

AG GCS300, AG GCS400 Grade Control System Operator's Manual



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Contents

1 Introduction

1.1	Introduction	2
1.2	Claim for Damage in Shipment	2
1.3	Technical Assistance	2
1.4	Your Comments	2
1.5	Warnings	3

2 Quick Start

2.1	Introduction	6
2.2	How the AG GCS Grade Control System Works	7
2.2.1	Laser receiver	7
2.2.2	Blade slope control	7
2.2.3	SR300 receiver mast	8
2.3	Before You Start	9
2.4	Power Up.	10
2.5	Benching a Laser Receiver or SR300 Receiver Mast	11
2.6	Setting the Reference Elevation	13
2.7	Setting the Desired Blade Slope	15
2.8	Leveling or Grading a Field	15
2.9	Turning Off the System	16

3 CB415 Dual Control Box and Remote Switches

3.1	Introduction	18
3.2	Features and Functions of the CB415	18
3.3	Remote Switch	24
3.3.1	Auto/Manual Switch.	26
3.3.2	Offset Switch.	26

3.3.3	Blade Raise/Lower.	27
3.3.4	Survey Sample.	27
3.3.5	Setups	27

4 System Operating Levels

4.1	Introduction	30
4.2	Level 1 / AG GCS300	30
4.3	Level 2 / AG GCS400	32

5 Guidance Mode

5.1	Introduction	36
5.2	Guidance Modes	36
5.2.1	Guidance mode screen.	36
5.2.2	Guidance source icons	38
5.3	Level 1/AG GCS300	39
5.3.1	Elevation display icon	40
5.3.2	Device status icons	41
5.4	Level 2/AG GCS400	44
5.5	Operating Modes	47
5.5.1	AG GCS300 operating modes	47
5.5.2	Blade slope operation	49
5.5.3	AG GCS400 operating modes	50

6 Configuration Mode

6.1	Introduction	62
6.2	Accessing Configuration Mode	62
6.2.1	Using Setup mode	63
6.3	Configuration Menu Items	65
6.3.1	Reference Elevation	65
6.3.2	Valve Speed	69

6.3.3	Customize	71
6.3.4	SR300 configuration	89
6.3.5	Linked Elevation Adjustment	91
6.3.6	Sensor Calibration	93
6.3.7	Diagnostics	98
6.3.8	Advanced Option	107

7 Field Methods When Using a Laser Receiver

7.1	Introduction	114
7.2	Setting Up the Laser Transmitter.	114
7.3	Benching a Level 1/AG GCS300 System	115
7.4	Benching the dual control Level 2/AG GCS400 System	117
7.4.1	Independent Elevation mode	117
7.4.2	Linked Elevation mode	118
7.5	SR300 Receiver Mast Operation	120

8 Field Methods When Using a Blade Slope Sensor

8.1	Introduction	124
8.2	Using the Blade-Slope Only System.	124
8.3	Using the Blade Slope with Elevation	125

A Troubleshooting

A.1	Introduction	128
A.2	Troubleshooting the CB415 Dual Control Box	128
A.3	Fault Messages	130
A.3.1	CB415 dual control box fault messages	132
A.3.2	VM410 valve module fault messages	138
A.3.3	VM415 valve module fault messages	141
A.3.4	VM420 valve module fault messages	143
A.3.5	Remote switch fault messages	146

- A.3.6 LR400 laser receiver fault messages 146
- A.3.7 LR410 laser receiver fault messages 147
- A.3.8 EM400 electric mast fault messages. 147
- A.3.9 AS400 blade slope sensor fault messages 149
- A.3.10 SR300 receiver mast fault messages. 149
- A.4 System Maintenance 150
- A.5 Machine Maintenance 151

B Setting Up a GL7xx Laser Transmitter

- B.1 Setup Rules for a Laser Transmitter 154
 - B.1.1 Laser transmitter placement and location rules 154
 - B.1.2 Tripod rules 155
 - B.1.3 Laser transmitter operation rules 156
- B.2 Level Laser Transmitter Setup and Operation 157
- B.3 Single- or Dual-Grade Laser Transmitter Setup and Operation . 158
- B.4 Precise Laser Transmitter Alignment 159
 - B.4.1 Do I need to align my laser transmitter precisely? . . . 159
 - B.4.2 Precise laser alignment instructions 161

C AG GCS Components

- C.1 Introduction 164
- C.2 System Components 164
 - C.2.1 CB415 dual control box 165
 - C.2.2 LR400 laser receiver 166
 - C.2.3 SA400 network adapter 168
 - C.2.4 LR410 laser receiver. 169
 - C.2.5 SR300 receiver mast. 170
 - C.2.6 EM400 electric mast 171
 - C.2.7 MM2X manual mast 173
 - C.2.8 VM410 valve drive module 174

C.2.9	VM415 valve drive module	175
C.2.10	VM420 valve drive module	176
C.2.11	PM400 power control module	177
C.2.12	Remote switch assembly	178
C.2.13	AS400 blade slope sensor	179
C.3	Component Specifications	181
C.3.1	CB415 dual control box	181
C.3.2	LR400 laser receiver	181
C.3.3	LR410 laser receiver	182
C.3.4	SR300 receiver mast	182
C.3.5	EM400 electric mast	183
C.3.6	PM400 power control module	183
C.3.7	VM410 valve drive module	183
C.3.8	VM415 valve drive module	184
C.3.9	VM420 valve drive module	184
C.3.10	AS400 slope sensor	184

Index

Contents

Introduction

In this chapter:

- Introduction
- Claim for Damage in Shipment
- Technical Assistance
- Your Comments
- Warnings

1.1 Introduction

Welcome to the *AG GCS300, AG GCS400 Grade Control System Operator's Manual*. This manual describes how to use the AG GCS300 and AG GCS400 Grade Control Systems. The systems are rugged and reliable machine control systems. Field-proven and versatile, these systems simplify grading processes, increase accuracy, save time, and reduce the amount of material moved.

1.2 Claim for Damage in Shipment

Inspect your purchase as soon as you receive your purchase.

The equipment has been packaged for safe delivery. However, in the unlikely event that damage has occurred, immediately file a claim with the carrier or, if insured separately, with the insurance company.

1.3 Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, contact your Trimble dealer.

1.4 Your Comments

Feedback about the documentation helps us to improve the documentation with each revision. To send feedback, e-mail your comments to ReaderFeedback@trimble.com.

1.5 Warnings



Warning – Do *not* operate this system unless you are fully trained on this equipment and end-use equipment.

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.

Never leave the system in automatic mode while unattended.

Always place the blade on the ground when not in use.



Equipment may extend beyond the extents of the blade. Maintain adequate clearance from people and objects when operating the equipment.



When calibrating the hydraulic valve of the machine with the GCS, make sure that you are away from the cutting edge of the machine.

Quick Start

- Introduction
- How the AG GCS Grade Control System Works
- Before You Start
- Power Up
- Benching a Laser Receiver or SR300 Receiver Mast
- Setting the Reference Elevation
- Setting the Desired Blade Slope
- Leveling or Grading a Field
- Turning Off the System

2.1 Introduction

This chapter gives you a brief overview of the system, and guides you through the system startup and shutdown sequences.

The system can be used in a number of different configurations. Each configuration depends on:

- the number of elevation sensors mounted on the machine
- the level of the upgradable firmware application

For information on using a single elevation or blade-slope system, see Chapter 7, Field Methods When Using a Laser Receiver.

For information on benching the cutting edge of the machine when you are using a sloping laser, see Section 7.4, Benching the dual control Level 2/AG GCS400 System, page 117.

For information on all AG GCS operating modes, see Chapter 4, System Operating Levels.

***Note** – The current chapter describes operating with Level 1 AG GCS300 software to control single elevation or single blade slope.*

2.2 How the AG GCS Grade Control System Works

The AG GCS300 Grade Control System uses either a single laser receiver and mast, or a blade slope sensor to provide elevation or cross-slope information. This information is used to drive the blade to a specified elevation and grade. The following elements of the system are discussed in this section:

- laser receiver
- blade-slope control
- survey mast

2.2.1 Laser receiver

The laser transmitter is mounted on a tripod or trailer. The laser transmitter emits a thin beam of light that rotates 360° at a fixed height above the design grade. The beam creates a grade reference over the work area.

The laser receiver, which is mounted on a mast above the cutting edge detects the elevation of the laser beam.

- If the laser beam strikes above the on-grade position of the laser receiver, the cutting edge is below finished grade
- If the laser beam strikes below the on-grade position of the laser receiver, the cutting edge is above the finished grade

The system sends correction signals to the hydraulic valves. The correction signals raise or lower the cutting edge of the blade to maintain the on-grade elevation.

2.2.2 Blade slope control

With a blade slope sensor installed, the required slope is entered into the CB415 control box, and when the system is put into Auto, the blade corrects to the entered slope. A blade slope sensor measures the actual slope of the cutting edge.

2.2.3 SR300 receiver mast

The SR300 receiver mast is mounted above the cutting edge of the machine and above any obstructions to the laser beam. The Survey receiver mast has the ability to differentiate between several different laser beams and filter strikes from multiple beams so that only the desired beam is used to control the implement. The operator can use any portion of the receiver to be on grade. For more information on techniques of using the SR300 Survey receiver mast, see Section 7.5, SR300 Receiver Mast Operation, page 120.

2.3 Before You Start

Before you start to use the AG GCS300 Grade Control System, make sure that:

- the hydraulic valves are calibrated. This is done when the system is installed or serviced. For more information about valve calibration refer to the *AG GCS300, AG GCS400 Grade Control System Reference Manual*, Section 3.5.2, Auto Valve Calibration.
- if a blade slope sensor installed, ensure the sensor is calibrated. This is done when the system is installed or serviced. For more information about blade slope calibration, see Blade Slope Calibration, page 93.

***Note** – If using a laser receiver, ensure the laser transmitter is correctly set up in a suitable location, and that the laser transmitter is turned on. For more information about using a laser transmitter, see Appendix B, Setting Up a GL7xx Laser Transmitter.*

2.4 Power Up

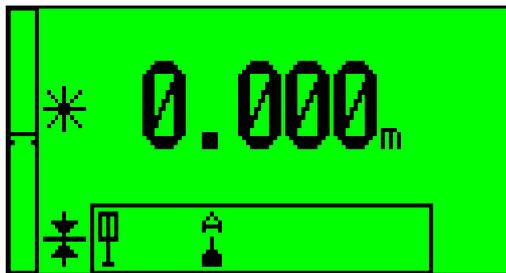
Toggle the power/setup switch on the CB415 dual control box to the I position.

Note – For more information about using the switches and buttons on the CB415, see Chapter 3, CB415 Dual Control Box and Remote Switches.

The following sequence occurs:

- The CB415 checks that all the system components are present and are responding correctly. If the CB415 finds a problem, the LCD screen indicates where the problem is. For more information, see Section 6.3.7, Diagnostics, page 98.
- The LED grade indicators on the CB415 sequence through the grade arrows. This shows that the LED grade indicators are functioning.
- With AG GCS300 firmware loaded and when the system checks are finished, the software version appears on the LCD.

A guidance screen similar to the following appears when you are in the AG GCS300 guidance mode:



For more information about the icons shown on this screen, see Section 5.2, Guidance Modes, page 36.

2.5 Benching a Laser Receiver or SR300 Receiver Mast

To make sure that the machine is grading to the correct elevation, the machine must be benched over a point with a known elevation relative to the reference grade provided by the laser beam. This point is known as a benchmark. You will have to bench the machine every time the laser transmitter is setup. The following sections discuss how to bench the AG GCS300 system and laser. For information on setting up and using the system in other applications see Chapter 7, Field Methods When Using a Laser Receiver.

To bench the system, complete the following steps:

1. For a split axle or center pivot scraper, level the cutting edge of the machine using a spirit level.
2. Place the center of the blade (the point on the blade under the laser receiver) on the benchmark, or an area of known accurate grade from a previous pass.

Make sure that you do not move the benchmark. If necessary, put the blade next to the benchmark. Often a lath with ribbons indicating the desired finish elevation will be used as a reference.

3. When the center of the blade is on the benchmark, press the  button on the CB415. The search for the laser beam stops when the laser receiver or SR300 receiver mast is on grade.

This process is called *auto benching*. The mast moves automatically until the laser receiver or SR300 receiver mast is aligned with the laser beam.



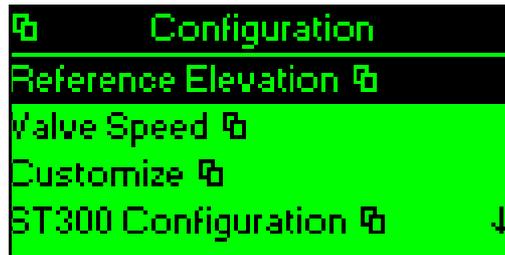
Figure 2.1 Benching in Dual Elevation mode using a level laser

2.6 Setting the Reference Elevation

Once the machine has been benched, the elevation of the benchmark is entered into the CB415. This elevation is known as the *reference elevation*. To enter the reference elevation, complete the following steps:

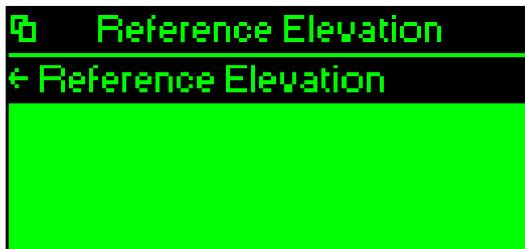
1. Turn the power/setup switch on the CB415 to the **i** (Information) position.

The following screen appears:



For more information on the buttons and switches on the CB415, see Chapter 3, CB415 Dual Control Box and Remote Switches.

2. Toggle either **↓** switch until *Reference Elevation* is highlighted.
3. Press **OK**. A screen similar to the following appears:



4. Press **OK** again. A screen similar to the following appears:



The current reference elevation value and the configured units appear on the LCD.

5. Edit the ← *Reference Elevation* value:
- To set the reference elevation to zero press **ESC** and **OK** simultaneously. The Reference Elevation will read 0.000.
 - Press the  button repeatedly to move the cursor to the right until the digit that you want to change is highlighted.
 - Toggle either  switch up or down to increase or decrease the value.
 - Toggle either  switch up or down to change from positive to negative. The cursor must be to the left of the entered number. To do this, press the  button.
6. Press **OK** to save the setting and return to the *Configuration* menu.
7. Turn the power/setup switch to the **I** position to return to Guidance mode.

2.7 Setting the Desired Blade Slope

1. Enter the desired slope by toggling the right  switch. Ensure that the slope angle is positioned correctly by using the Slope Direction switch (.
2. Toggle the auto manual remote switch into the Auto position. The auto / manual indicator will turn green.

2.8 Leveling or Grading a Field

Once the machine has been benched, the machine can be moved to the work area. To prepare for work:

1. Check the blade and the LED grade indicators. If the blade is at ground level and the LED grade indicators show a solid high light, enter an offset to the reference elevation until the LED grade indicators flash. This stops the blade from driving into the ground when automatics are used.

To enter an elevation offset, toggle the  switch or the Remote Elevation Offset switch.

Note – The system may have one or two offset switches that can be programmed to control the right or left of the scraper (if dual controlled scraper) or front or rear (if tandem scraper). You can configure the amount by which the reference elevation changes when the Elevation Offset switch is toggled. For more information, see Section 6.3.3, Customize, page 71.



Warning – Do not operate this system unless you are fully trained on this equipment and end-use equipment.

Never leave the system in automatic mode while unattended.



When using the system in automatic mode, make sure that you are away from the cutting edge of the machine.

2. Toggle the auto/manual remote switch to change from Manual to Auto. This causes the blade to automatically move to grade relative to the reference elevation. The green LEDs on the CB415 show when you are on grade.

The system is now ready to start work.

3. Increase or decrease the elevation offset to increase or decrease the amount of blade cut, as required.
4. Grade a small area and check that the blade is correctly cutting to grade. Use a grade rod and a laser detector to check the grade.
5. Continue to use the system until the following conditions are met:
 - there is no elevation offset applied to the reference elevation.
 - the green on-grade LEDs are showing on the CB415.
 - the blade is skimming the surface of the ground without moving any material.

Note – To turn off automatic control, toggle the Auto/Manual remote switch to change from Auto to Manual.

2.9 Turning Off the System

To turn off the CB415, turn the power/setup switch to the O position. The current settings automatically reload when you turn on the CB415 again.

CB415 Dual Control Box and Remote Switches

In this chapter:

- Introduction
- Features and Functions of the CB415
- Remote Switch

3.1 Introduction

The CB415 dual control box is the display and on-board computer for the AG GCS Grade Control System (“the system”). The CB415 is mounted in the cab of the machine.

The remote switch is optional and may be supplied by Trimble or custom made per the application and desires of the customer and dealer. The Trimble remote switch is an assembly that connects to the CB415 control box so that the system controls can be placed in a more convenient location.

This chapter discusses how to use the CB415 and the remote switch assembly.

3.2 Features and Functions of the CB415

The CB415 lets you set up and operate the system using the LCD, toggle switches, and buttons. Figure 3.1 shows the layout of the CB415.

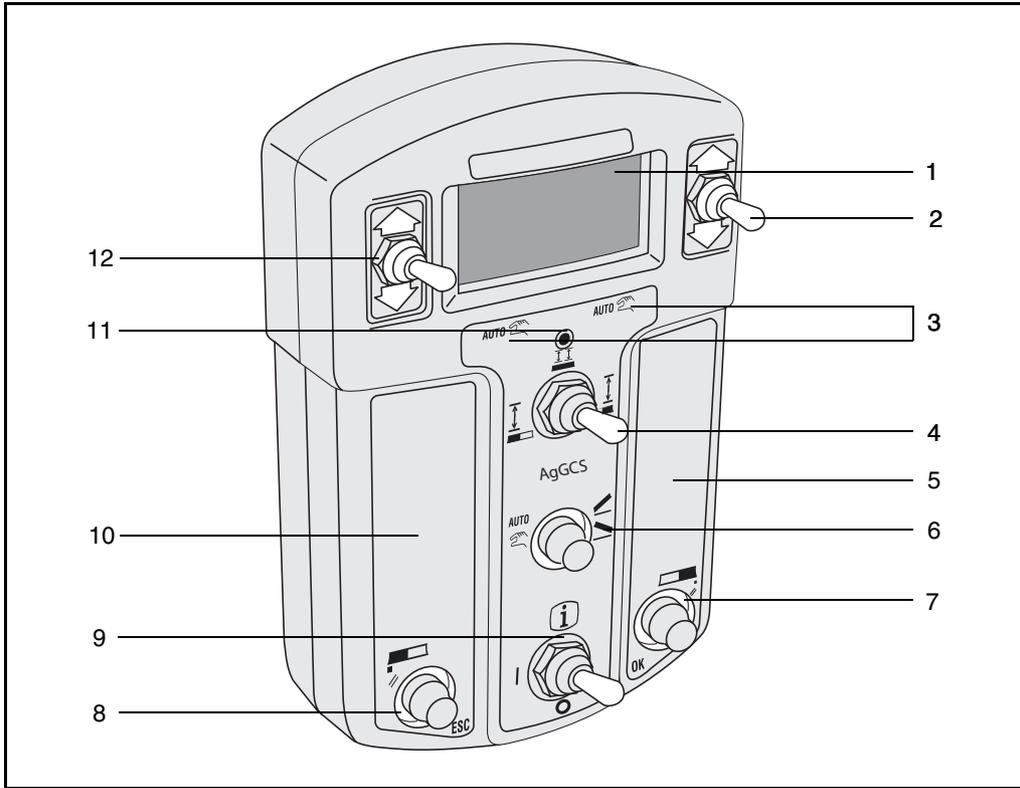


Figure 3.1 CB415 dual control box

Table 3.1 describes the features and functions of the CB415.

Table 3.1 CB415 features

Item	Feature	Function
1	Liquid Crystal Display (LCD)	Shows the guidance information. In Setup mode the selectable menus are shown.
2	Right Inc/Dec Blade Control -Menu scroll switch (↕)	Changes the target elevation or slope. Scroll through the menus.
3	Auto/Manual LEDs (visible when lit)	Shows if the system is operating under automatic (green) or manual (amber) control.

Table 3.1 CB415 features (continued)

Item	Feature	Function
4	Elevation Select switch 	Selects which sensor information is used to control the blade. This can be the left (front), right (rear), or both left (front) and right (rear) sensors. * Not functional in AG GCS300 software.
5	Right Grade LEDs	Right side display is active when <i>Right</i> is selected from menu and device is connected to right (rear) side. Colored arrows indicate when the cutting edge of the machine under the right (rear) elevation device is above or below grade. The arrows show the direction the cutting edge needs to move. A green line indicates that the cutting edge is on-grade under the right (rear) device.
6	Auto/Manual switch  Slope Direction switch 	This switch may be configured either as an Auto/Manual switch or as a Slope Direction switch for the AG GCS300. The AG GCS300 default is the auto/manual configuration. The Slope Direction switch changes the angle of the blade when the system is configured with a slope sensor. This switch also enables changes to be made to the numerical values in the setup menus.

Table 3.1 CB415 features (continued)

Item	Feature	Function
7	Right Reset button (OK and )	<ul style="list-style-type: none"> – Resets the blade's right (rear) bench elevation when <i>Right</i> is selected from the menu. – Enables the right (rear) laser receiver, when connected to an electric mast (EM400), to search for and lock onto the center of the laser beam. With the electric mast, the on-grade location is always at the center of the receiver. – Enables the right (rear) laser receiver, when connected to a manual mast, to be programmed as on-grade when any elevation is within ± 110 mm (4.33 inches) of the center of the receiver. – Reads the right (rear) slope when in slope control – Enables changes made from the <i>Configuration</i> menu to be accepted. – Enables you to step forward one level in the <i>Configuration</i> menu.

Table 3.1 CB415 features (continued)

Item	Feature	Function
8	Left Reset button (ESC and )	<ul style="list-style-type: none"> – Resets the blade's left (front) bench elevation when Left is selected from the menu. – Enables the left (front) laser receiver, when connected to an electric mast (EM400), to search for and lock onto the center of the laser beam. With the electric mast, the on-grade location is always at the center of the receiver. – Enables the left (front) laser receiver, when connected to a manual mast, to be programmed as on-grade when any elevation is within ± 110 mm (4.33 inches) of the center of the receiver. – Reads left (front) slope when in slope control. – Enables changes made from the <i>Configuration</i> menu to be rejected. – Enables you to step back one level in the <i>Configuration</i> menu.
9	Power/Setup switch (I, O, and )	<p>Switches the CB415 on or off.</p> <p>Accesses the <i>Configuration</i> menu when the switch is in the  position.</p>
10	Left Grade LEDs	<p>Left side display is active when <i>Left</i> is selected from the menu and device is connected to the left (front) side.</p> <p>Colored arrows indicate when the cutting edge of the machine under the left (front) elevation device is above or below grade. The arrows show the direction the cutting edge needs to move. A green line indicates that the cutting edge under the left (front) mast is on grade.</p>
11	Ambient light sensor	Measures the ambient light and automatically adjusts the brightness of the LEDs for optimal viewing.
12	Left Inc/Dec Blade Control / Menu scroll switch ()	Controls the left (front) blade height or slope. Scrolls through the menus.

Table 3.1 CB415 features (continued)

Item	Feature	Function
	On the back (not shown): – 6-pin CAN/power connector – 6-socket remote switch connector	Connects the CB415 to the rest of the system. Connects the CB415 to programmable remote switches.
	Audio alert	A single short tone is emitted when any switch is activated. A single long tone is emitted when a fault message is shown. Two tones are emitted when you are off-grade. These tones repeat every 5 seconds until the blade returns to on-grade. Three tones are emitted when the elevation reference is lost or missing. These tones repeat every 5 seconds until the beam is found.
	On the base (not shown): – Serial port	Use the serial port to: – Upgrade or change the firmware in the CB415 or any other connected component. – Plug in diagnostic equipment for troubleshooting.

3.3 Remote Switch

An optional remote switch can be plugged into the CB415 control box so that the system controls can be placed in a more convenient location. The switch is configured to perform the following operations:

- Switch between auto and manual
- Set the elevation offset
- Set the slope offset
- Set either Blade Raise/ Lower, Survey Sample or Setups



Tip – For information on how to configure any of the remote switches, refer to the *AG GCS300, AG GCS400 Grade Control System Reference Manual*, Section 3.4.4, Remote Switches.

The functions controlled by the switches are:

- Auto mode

When the Auto/Manual remote switch is set to Auto, control signals are sent to the hydraulic valves to change the elevation and/or slope of the blade automatically. When the system is in Automatic mode, the green LED is illuminated and the Amber LED is off.

Note – The CB415 can also be configured to utilize the Auto/Manual  panel switch if remote switches are not desired.

- Inactive-Auto mode

In the Inactive-Auto state, the automatic controls of the system are disabled and the system operates as if it is in Manual mode.

Controls enter the Inactive-Auto state if any of the following situations occur:

- a fault or error message requires you to acknowledge by pressing the **ESC** button

- a sensor, such as the laser receiver or slope sensor, is out of range
- any error that requires attention

When the error is cleared or the sensor brought back into range, the Auto/Manual remote switch will clear the Inactive- Auto Mode. When the system is in Inactive-Auto mode, the green LED is on and the amber LED is flashing on and off.

- Manual mode

When the Auto/Manual remote switch is set to Manual mode, automatic controls are not in use. When the system is in Manual mode, only the amber LED is illuminated.

Figure 3.2 shows the remote switch assembly:

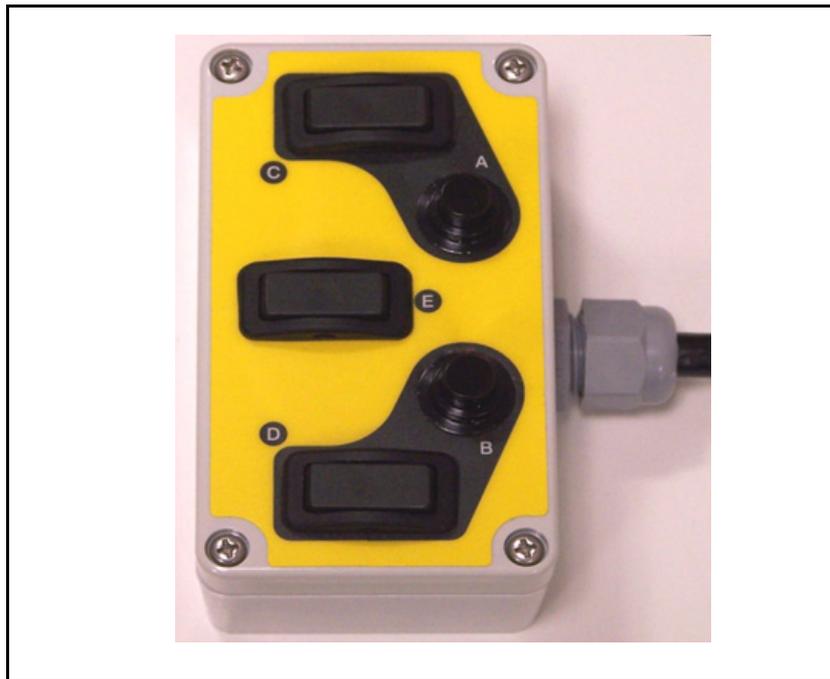


Figure 3.2 Remote switch assembly

Table 3.2 To use the remote switch assembly:

Remote Switch	AG GCS300	AG GCS400
Remote Switch: A	Auto/Manual left (front)	Auto/Manual left (front)
Remote Switch: B	Not used	Auto/Manual right (rear)
Remote Switch: C	Elevation Offset ¹	Offset left (front)
Remote Switch: D	Not used	Offset right (rear)
Remote Switch: E	Blade Raise/ Lower, Survey Sample or Setups	Blade Raise/ Lower, Survey Sample or Setups

¹Slope Offset if split axle or center pivot scraper

3.3.1 Auto/Manual Switch

Press the Auto/Manual remote switch to change the current state of automatic/manual blade movement.

For example, if the system is currently not automatically driving to grade, press the Auto/Manual button to provide automatic blade movement. The Auto/Manual LEDs on the CB415 change from amber to green.

Alternatively, if the blade is automatically driving to grade, press the Auto/Manual button to stop the system from providing automatic blade movement. The Auto/Manual LEDs on the CB415 change from green to amber.

3.3.2 Offset Switch

Toggle the offset switch on the remote switch assembly to increase or decrease the elevation or offset applied to the reference elevation.

The reference elevation shown on the CB415 screen changes when the remote elevation offset switch is toggled.

To configure the amount by which the remote elevation offset switch increments or decrements the reference elevation, use the *Offset* screen in Setup mode. For more information, see Offset, page 80.

3.3.3 Blade Raise/Lower

The Blade Raise/Lower switch is a manual switch used to raise or lower the blade of the scraper out of or into the reception range of the laser receiver. When the system is in automatic mode and the operator wants to pick the scraper blade up to transport material, activate the Blade Raise/Lower switch until the receiver is no longer receiving the laser beam. Release the switch.

To lower the cutting edge activate the switch to lower the scraper blade until the laser receiver receives the laser beam. Release the switch and the laser receiver will drive the blade back to the on grade elevation.

If you are using a John Deere and have the John Deere Auto Lower feature configured you can simply active the auto lower which will place the system back into automatic and lower the blade back to the on grade elevation. The raise function with the John Deere auto lower is a manual function as described above.

3.3.4 Survey Sample

When the Remote Switch E is configured as a Survey sample switch it will be used to collect an elevation at a point in the field selected by the operator. Each time the switch is closed the elevation of either the LR4xx or the SR300 receiver mast will be recorded to the CB415 when in survey mode.

3.3.5 Setups

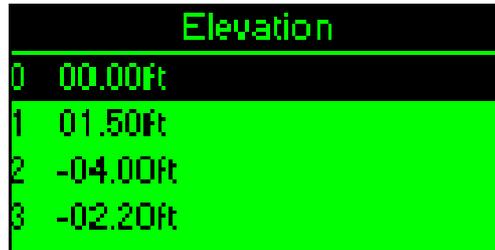
Remote Switch E can be configured so that up to three different elevations or slopes can be programmed into the CB415. This allows the operator, for example to be able to cut in one area of the field and move to a fill area of the field by simply highlighting the offset while moving between the two different field elevations.

Up to three different benches or offsets can be programmed relative to the reference elevation set into the CB415.

To configure these offsets, see Setups, page 72.

To select a setup, complete the following steps:

1. Toggle the Remote Switch E to bring up a set of choices. A screen similar to the following appears:



2. Toggle either \updownarrow switch until the required setup is highlighted.
3. You are returned to the Run-time screen, two seconds after the release of the \updownarrow switch.

System Operating Levels

In this chapter:

- Introduction
- Level 1 / AG GCS300
- Level 2 / AG GCS400

4.1 Introduction

The Grade Control System (the system) is an upgradable control system that allows increased flexibility from the base level system. The system has two software levels of operation. The software levels available depend on the devices connected to the system, and on the software options enabled. To learn more about enabling software options, refer to the *AG GCS300, AG GCS400 Grade Control Reference Manual*, Section 4.4, Applying Option Keys. The levels are as follows:

- Level 1 / AG GCS300
- Level 2 / AG GCS400

4.2 Level 1 / AG GCS300

The Level 1/AG GCS300 configuration provides either single-point blade elevation control or blade slope control. This is the basic level of shippable firmware.

Supported Level 1 sensors combinations are:

- single laser receiver
- single SR300 receiver mast
- single blade slope sensor

***Note** – Sonic Tracers, although not commonly used in Ag applications, can be added to the system, there is no special configuration required.*

The following diagram shows one of the most common Level 1 sensor combinations.

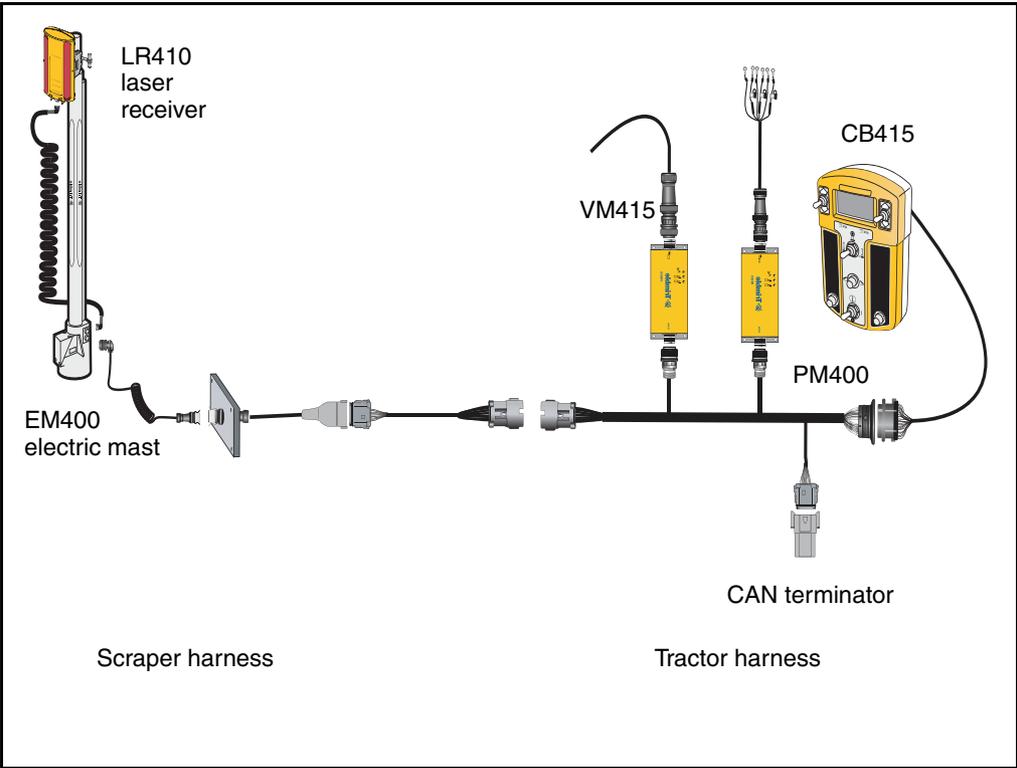


Figure 4.1 Level 1 operation:single laser receiver

4.3 Level 2 / AG GCS400

The Level 2/AG GCS400 configuration provides either two-point blade elevation control or single-point elevation plus blade-slope control.

Supported Level 2 sensor combinations are:

- dual laser receivers
- dual SR300 receiver masts
- single laser receiver with single blade slope sensor
- single SR300 receiver mast with single blade slope sensor

Note – Sonic Tracers, although not commonly used in Ag applications, can be added to the system, there is no special configuration required.

The following diagram shows one of the most common Level 2 sensor combinations.

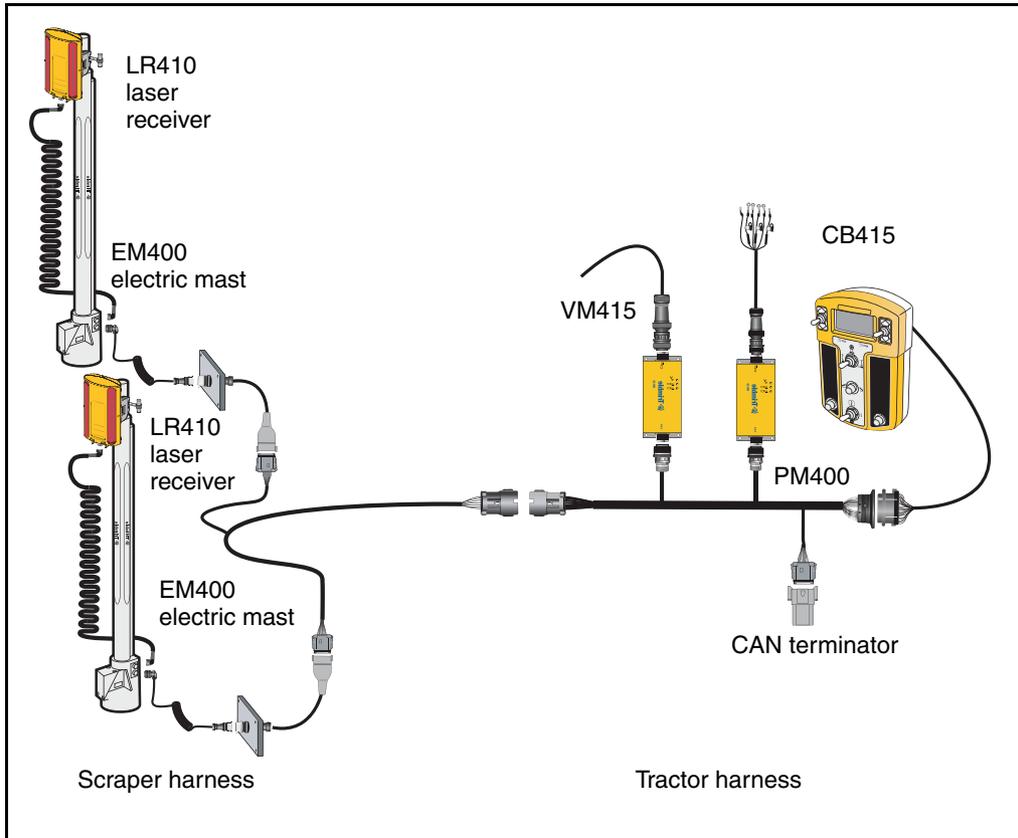


Figure 4.2 Level 2 operation: Dual laser receivers

Guidance Mode

In this chapter:

- Introduction
- Guidance Modes
- Level 1/AG GCS300
- Level 2/AG GCS400
- Operating Modes

5.1 Introduction

The CB415 dual control box has an LCD that shows specific information related to the current job. The LCD can be used in two modes:

- Guidance mode
- Configuration mode

This chapter discusses how to use the CB415 in Guidance mode.

The operating mode that is selected affects how the screen looks in Guidance mode.

For information about how to use the CB415 in Configuration mode, see Chapter 6, Configuration Mode.

5.2 Guidance Modes

Guidance mode lets you see what settings are configured and what devices are connected to the system. Guidance mode is the mode that you use most of the time when you are operating the system.

This chapter shows you how the guidance mode looks for the following operating levels:

- AG GCS300
- AG GCS400

5.2.1 Guidance mode screen

The following section outlines the various graphics shown on a typical guidance screen.

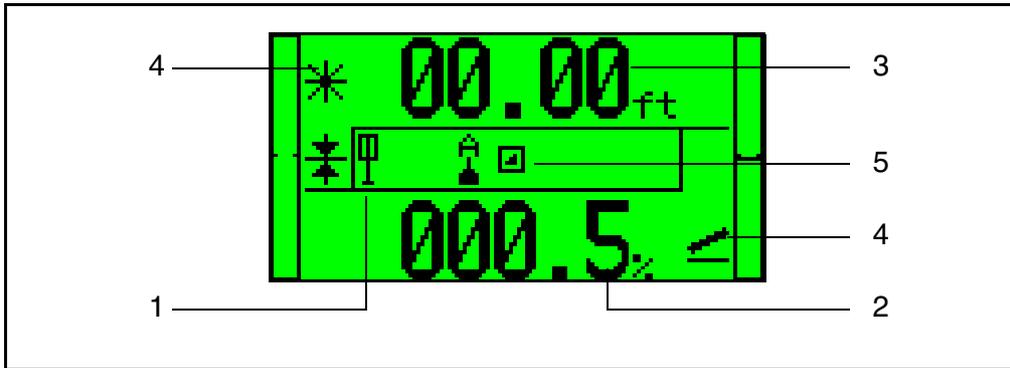


Figure 5.1 AG GCS400 Guidance Screen Graphics

Table 5.1 AG GCS400 Guidance Screen Graphics

Item	Feature	Function
1	Laser receiver icon	Represents the laser receiver when an EM400 electric mast or SR300 mast and laser receiver are connected to the system. Note: This icon represents the elevation device connected to the system.
2	Slope Reference Number	Displays the reference slope of the blade which is being controlled by the slope sensor.
3	Reference elevation	Indicates the reference elevation that is set. This is shown in the units set.
4	Guidance source icon	Indicates the guidance source used by the system. This icon can be a laser receiver or blade slope depending on what device is on the machine. See Section 5.2.2, Guidance source icons, page 38.
5	Blade slope sensor icon	Represents the blade slope sensor when an AS400 blade slope sensor is connected to the system.

5.2.2 Guidance source icons

The guidance source for the system depends on the level of software configured on the machine. The guidance source icon may be the laser receiver, sonic device, or a blade slope sensor. The icon that represents the guidance source is shown in Figure 5.1 and explained in Table 5.1. If no guidance source is detected when the system is powered up, then no guidance source icon is displayed on the LCD.

Table 5.2 Guidance source icons

Icon	Guidance Icons
	Laser; LR400/LR410 or SR300
	Blade slope (positive)
	Blade slope (negative)
	Blade slope (zero)

5.3 Level 1/AG GCS300

To start the CB415 in Guidance mode, turn the power/setup switch to the **I** position. When the system is configured as an AG GCS300, a screen similar to the one shown in Figure 5.2 appears.

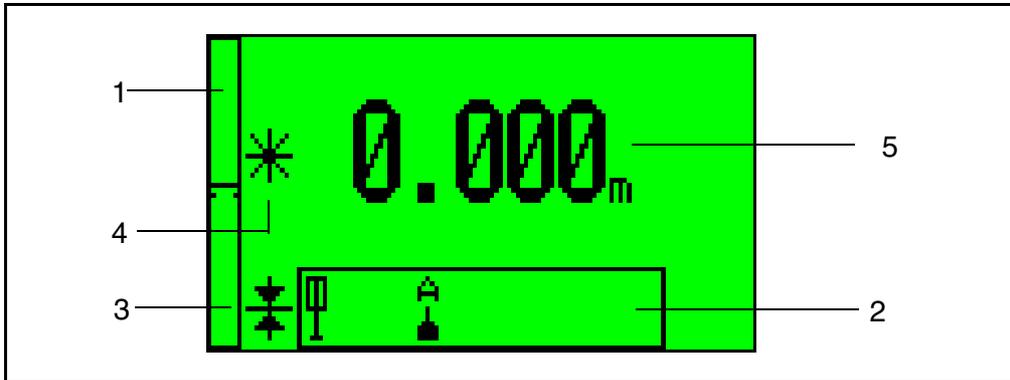


Figure 5.2 Guidance Mode screen – Level 1/AG GCS300

Table 5.3 Guidance Mode screen

Item	Feature	Function
1	Left (front) sensor position window	This window shows where the on-grade set point is and where the elevation sensor is relative to it.
2	Device status icons	Shows the status of the devices that are used by the AG GCS300 system.

Table 5.3 Guidance Mode screen (continued)

Item	Feature	Function
3	Elevation display icon	Represents the current display mode. See Section 5.3.1, Elevation display icon, page 40.
4	Guidance source icon	Indicates the guidance source used by the AG GCS300. This icon can be a laser receiver or slope device depending on what sensor is connected on the machine. The icon will not appear if the sensor is not detected. See Section 5.2.2, Guidance source icons, page 38.
5	Reference elevation	Indicates the reference elevation or slope that is set. This is shown in the units selected by the operator and appropriate for the sensor.

Most of the information shown on the LCD in Guidance mode is represented using icons. The following sections discuss these icons.

5.3.1 Elevation display icon

The elevation display icon indicates the type of elevation information that is shown in Guidance mode. Table 5.4 shows the icons used.

Table 5.4 Elevation display icons

The elevation display icon ...	is named ...	and shows ...
	Reference	the reference elevation
	Cut/Fill	the cut/fill to grade

The type of elevation displayed on the LCD depends on the operating mode that is configured. For more information, see Section 5.5, Operating Modes, page 47.

5.3.2 Device status icons

Device status icons indicate the status of every device in the system:

- Black icons indicate detected devices.
- Simulated gray icons indicate devices that have lost connection to the system.
- Missing icons indicate devices that are not detected when the system is powered up.

Note – The system will not give grade guidance if the device is not detected.

Table 5.5 to Table 5.8 describe the device status icons for the Level 1/ AG GCS300 system.

Table 5.5 Laser Receiver/Electric Mast icons

Icon	Status Laser receiver	Status Electric mast
	Connected	Connected
	Connected	Connection lost after system is powered up
	Connected	Not connected at system power up
	Connection lost after system is powered up	Connected
	Connection lost after system is powered up	Connection lost after system is powered up
	Not connected at system power up	Connected

Table 5.6 SR300 receiver mast status icons

Icon	Status
	Connected
	Connection lost after system is powered up

Table 5.7 Blade slope icons

Icon	Blade slope
	Connected
	Not connected

Table 5.8 Remote switch icons

Icon	Remote switches
	Auto/Manual connected
	Auto/Manual not connected

Table 5.15 to Table 5.16 describe the status icons for survey mode.

Table 5.9 Survey method icons

Icon	Survey method
	Timed survey mode
	Switch survey mode
	Streamed survey mode

Table 5.10 Row/field icons

Icon	Row/field
	Row
	Field

5.4 Level 2/AG GCS400

When the system is configured as an AG GCS400, a screen similar to the one shown in Figure 5.3 appears.

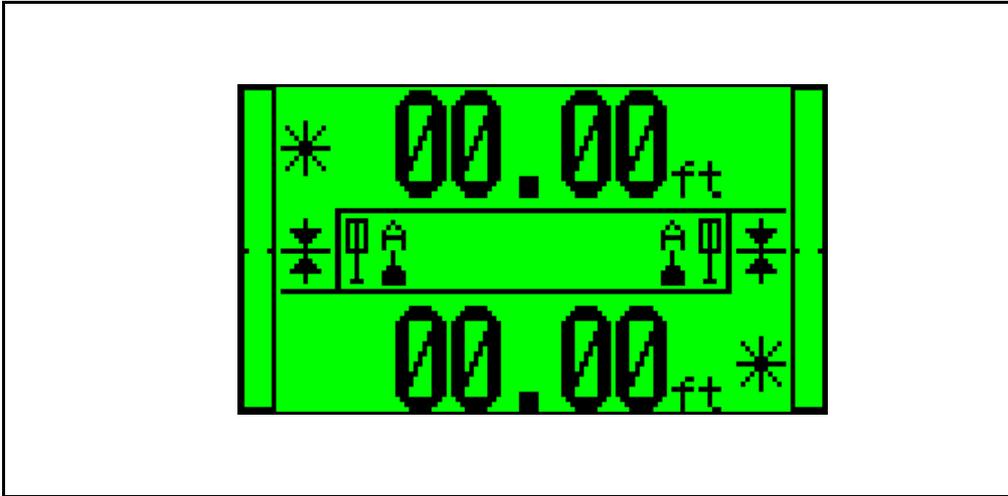


Figure 5.3 Guidance Mode screen – Level 2/AG GCS400

Table 5.11 to Table 5.14 describe the device status icons for AG GCS400 systems.

Table 5.11 Laser receiver\Electric mast icons

Icon	Status Laser receiver	Status Electric mast
	Connected	Connected
	Connected	Connection lost after system is powered up
	Connected	Not connected at system power up

Icon	Status Laser receiver	Status Electric mast
	Connection lost after system is powered up	Connected
	Connection lost after system is powered up	Connection lost after system is powered up
	Not connected at system power up	Connected

Table 5.12 SR300 receiver mast status icons

Icon	Status SR300 receiver mast
	Connected
	Connection lost after system is powered up

Table 5.13 Blade slope icons

Icon	Blade slope
	Connected
	Not connected

Table 5.14 Remote switch icons

Icon	Remote switches
	Auto/Manual connected
	Auto/Manual not connected

Table 5.15 to Table 5.16 describe the status icons for survey mode.

Table 5.15 Survey method icons

Icon	Survey method
	Timed survey mode
	Switch survey mode
	Streamed survey mode

Table 5.16 Row/field icons

Icon	Row/field
	Row
	Field

5.5 Operating Modes

The operating mode that is configured affects how the screen looks in Guidance mode. The operating mode also affects how the buttons and switches work on the CB415. The operating modes available depend on the operating level installed in the CB415.

5.5.1 AG GCS300 operating modes

For the single elevation system there are two operating modes:

- Reference Elevation
- Cut/Fill
- Survey

Reference Elevation mode

The following items describe how the single elevation system works in Reference Elevation mode:

- The guidance screen shows the reference elevation you are working to.
- Toggle either  switch to apply an offset to the reference elevation.
- If using an EM400 electric mast or SR300 receiver mast, press  to search for and to lock onto the laser beam. The search for the laser beam stops when the laser receiver is on grade. This fine tunes the on-grade position in the laser receiver.
- The Elevation Select switch () does not work in the single elevation system.

A Guidance mode screen similar to that shown in Figure 5.4 appears when you are in Reference Elevation mode.

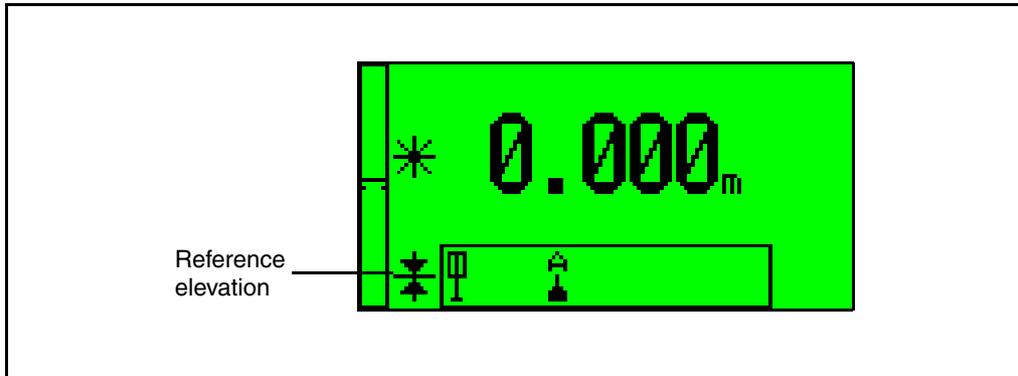


Figure 5.4 Reference Elevation mode

Cut/Fill mode

The following items outline how the AG GCS300 system works in Cut/Fill mode:

- The guidance screen shows the cut/fill required to reach the mast's reference elevation. A positive value means “cut” and a negative value means “fill”.
- Both  switches are disabled.
-  is disabled.
- The remote offset switch is disabled.
- The Elevation Select switch (///) does not work in the single elevation system.

A Guidance mode screen similar to that shown in Figure 5.5 appears when you are in Cut/Fill mode.

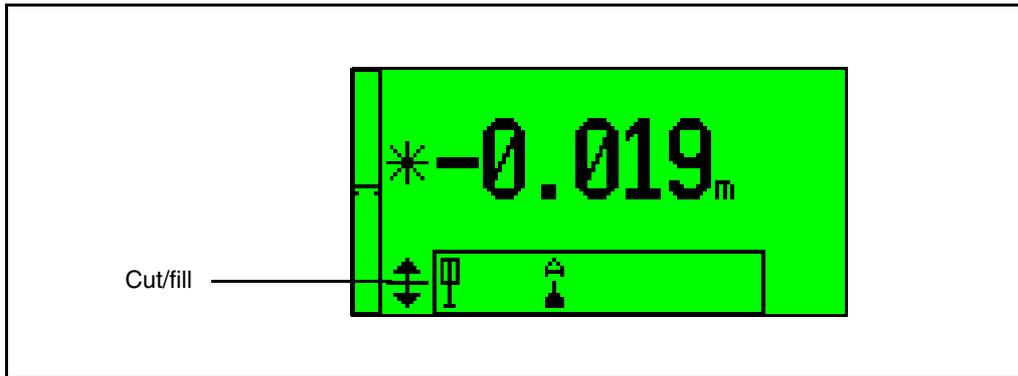


Figure 5.5 Cut/Fill mode

Survey mode

Survey mode functionality in an AG GCS300 system does not differ from that of an AG GCS400 system. For more information, see Survey mode, page 54.

5.5.2 Blade slope operation

The following items describe how the blade slope system works:

- Toggle either  switch to apply a required slope.
- Toggle the Elevation Select switch (//) to the side that will be manually controlled for elevation.
- Toggle the Slope Direction switch (/) to the required direction of slope.
- Toggle the remote switch from manual to auto.

A Guidance mode screen similar to that shown in Figure 5.6 appears when you are in Single Slope mode.

Note – The  switch does not allow the slope number to go through zero to achieve a negative slope. This action is obtained by reversing the direction of the Blade Slope Direction switch (). Using the remote offset switch to set the slope lets you go through zero to achieve negative slope.

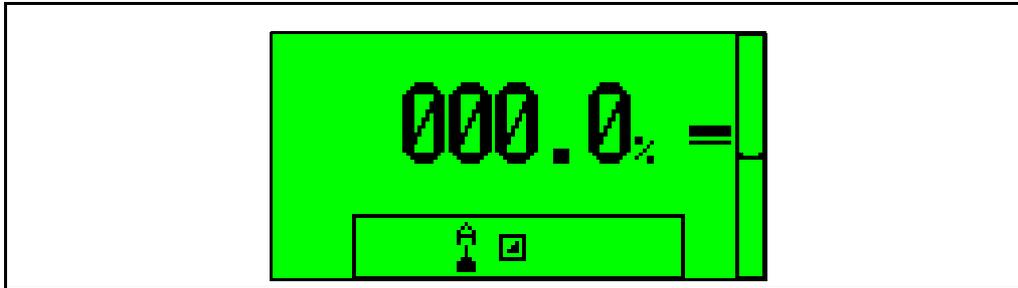


Figure 5.6 Blade Slope operation

5.5.3 AG GCS400 operating modes

For the dual control system there are four operating modes:

- Linked Elevation
- Independent Elevation
- Survey
- Dual Cut/Fill

To set the operating mode, see page 77.

Linked Elevation mode

Note – Linked Elevation mode does not work for tandem scrapers.

Linked Elevation mode requires that the two elevation devices be on EM400 electric masts or SR300 receiver masts. The following items describe how the AG GCS400 system works in Linked Elevation mode:

- Linked Elevation mode requires only one reference elevation. This means that the blade is benched over one point only.
- The Guidance screen shows the reference elevation that is being worked to.
- Toggle either  switch to apply the same elevation offset to both sides of the blade.
- If using EM400 electric masts or SR300 receiver masts, start a search for the laser beam, using one of the following actions:
 - If the left mast is over the benchmark, press . The search for the laser beam stops when the left laser receiver is on grade.
 - If the right mast is over the benchmark, press . The search for the laser beam stops when the right laser receiver is on grade.
- If using manual masts, do the following actions when laser strikes are detected by both laser receivers and you are ready to bench the cutting edge:
 - If the left mast is over the benchmark, press . This fine tunes the on-grade position in the laser receiver.
 - If the right mast is over the benchmark, press . This fine tunes the on-grade position in the laser receiver.

For more information on benching see Chapter 7, Field Methods When Using a Laser Receiver.

- The Elevation Select switch () is inactive in Linked Elevation mode. This means that both sides of the machine must use automatic or manual mode together.
- The *Linked Elevation Adjustment* option is available from the *Configuration* menu. For more information, see Section 6.3, Configuration Menu Items, page 65.

A Guidance mode screen similar to Figure 5.7 appears when you are in Linked Elevation mode.

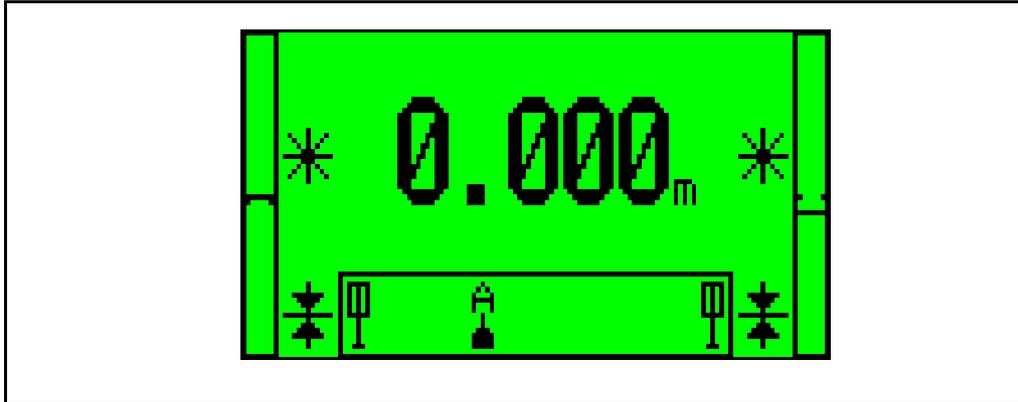


Figure 5.7 Dual elevation mode - Linked Elevation

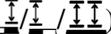
Independent Elevation mode

The following items describe how a AG GCS400 system works in Independent Elevation mode:

- Independent Elevation mode requires that the reference elevation for each elevation device be set independently. This means that the blade must be benched under the left (front) device and benched under the right (rear) device separately. For more information on how to bench the blade using Independent Elevation mode, see Section 7.4, Benching the dual control Level 2/AG GCS400 System, page 117.
- The guidance screen shows the two reference elevations that are being worked to.
- Toggle the left  switch to apply an elevation offset to the left (front) scraper blade.
- Toggle the right  switch to apply an elevation offset to the right (rear) scraper blade.

Note – When you use the switches on the CB415 the elevation being worked to changes. If you use the Remote offset switch, you apply an offset.

Note – Toggle the left remote offset switch to apply elevation offset to the left (front) mast. Toggle the right remote offset switch to apply elevation offset to the right (rear) mast.

- If using EM400 electric masts or SR300 receiver masts:
 - Press  to adjust to the center of the laser beam on the left laser receiver.
 - Press  to adjust to the center of the laser beam on the right laser receiver.
- If using manual masts, do the following actions when you are ready to bench the cutting edge:
 - If the left (front) mast is over the benchmark, press . This fine tunes the on-grade position in the left (front) laser receiver.
 - If the right (rear) mast is over the benchmark, press . This fine tunes the on-grade position in the right (rear) laser receiver.
- The Elevation Select switch () is active in Independent Elevation mode. When you toggle the Elevation Select switch to:
 - , left (front) elevation device selected, and left (front) blade hydraulics of the machine are under automatic or manual control.
 - , both left (front) and right (rear) elevation device is selected and left (front) and right (rear) blade hydraulics of the machine are under automatic or manual control.
 - , right (rear) elevation device selected, and right (rear) blade hydraulics are always under automatic or manual control.

- The *Linked Elevation Adjustment* option in the *Configuration* menu is *not* available.

A Guidance mode screen similar to that shown in Figure 5.8 appears when you are in Independent Elevation mode.

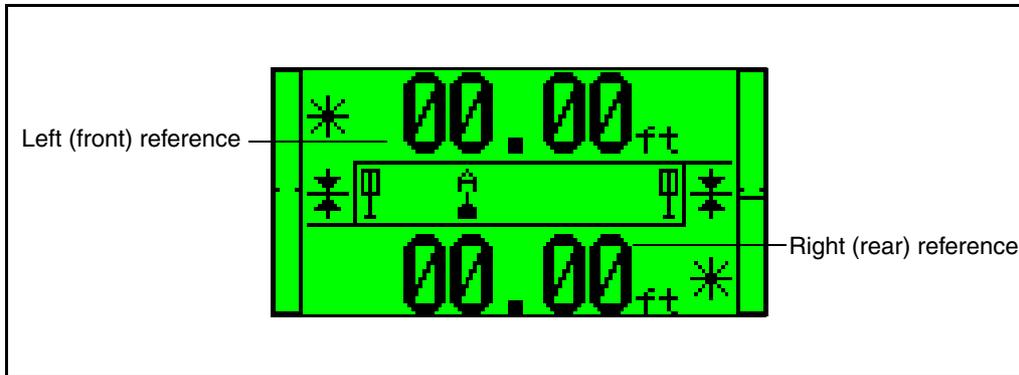


Figure 5.8 Independent Elevation mode

Survey mode

If the AG GCS300 and AG GCS400 systems are configured correctly, the CB415 will allow you to perform topographic surveys of a field. The system will perform surveys with either the EM400 and LR4xx or the SR300 receiver mast.

The CB415 control box can be configured to survey a field by taking a series of elevation readings. The machine traverses the field in rows or a random pattern and collects elevation data. Techniques include either raising the scraper blade above the grade and adjusting the elevations captured to that offset or placing the blade on the grade so that it is neither cutting nor filling and just skimming the grade of the field being surveyed.

As the machine travels across the field, row and field elevation averages are shown on the display.

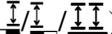
The system can output the survey data to a laptop computer using a serial connection and appropriate software to capture the survey data. Many land levelers use design software to capture and store the data and assist in the design of the field grades.

This information is used to create a topographic surface of the field and develop a cut/fill map to assist in moving the material.

To perform a field survey the system must be in automatic mode. When in automatic, the EM400 will move up and down to keep the LR4xx tracking the laser beam. The SR300 receiver must will record the elevation differences of the beam electronically.

Timed

The following items outline how an AG GCS400 system works in Survey mode, when it's configured method is Timed:

- The Guidance screen shows the row and field averages as the machine travels across the field. The rate at which the information is collected and displayed is configurable.
- Both  switches are disabled.
- Both  and  are disabled.
- The remote offset switch is disabled.
- The Elevation Select switch () is inactive.

A Guidance mode screen similar to that shown in Figure 5.9 appears when you are in Timed Survey mode.

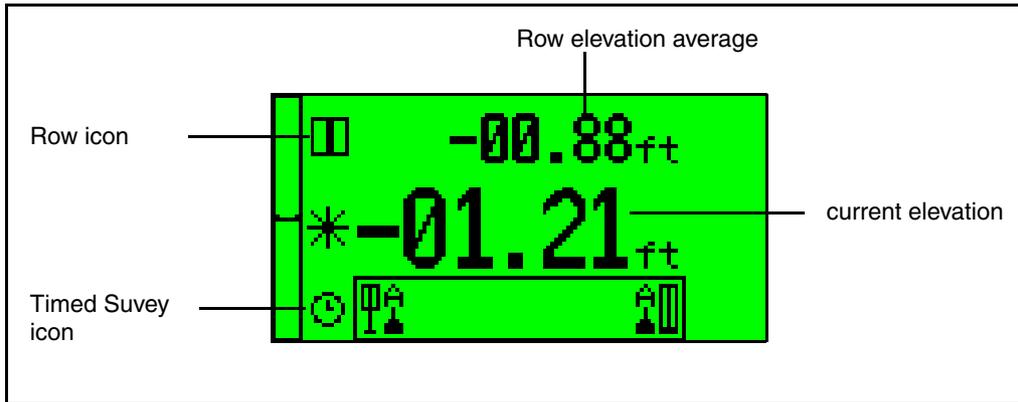


Figure 5.9 Timed Survey mode

Note – The system switches between displaying field and row data.

By Switch

The following items outline how an AG GCS400 system works in Survey mode, when it's configured method is By Switch:

- The Guidance screen shows the row and field averages when you toggle the survey sample switch.
- Both  switches are disabled.
- Both  and  are disabled.
- The remote offset switch E, if configured, can be toggled to provide a survey reading.



Tip – To configure Remote Switch E as a Survey Sample switch, refer to the *AG GCS300, AG GCS400 Grade Control System Reference Manual*, Section 3.4.4, Remote Switches.

- A floor mounted foot switch, if installed, acts like remote offset switch E and provides a survey reading.

- The Elevation Select switch ($\frac{\text{I}}{\text{I}}/\frac{\text{I}}{\text{I}}/\frac{\text{I}}{\text{I}}$) is inactive.

A Guidance mode screen similar to that shown in Figure 5.9 appears when you are in By Switch Survey mode.

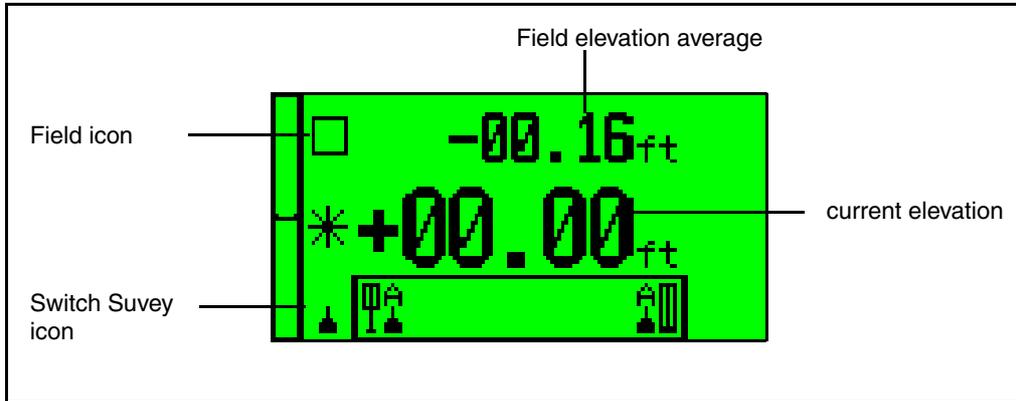


Figure 5.10 By Switch Survey mode

Note – The system switches between displaying field and row data.

Streaming

The following items outline how an AG GCS400 system works in Survey mode, when it's configured method is Streaming:

- The Guidance screen shows the row and field averages as the machine travels across the field. The data can also be output to a computer. For more information, see Streaming data output to a computer on page 58.
- Both \downarrow switches are disabled.
- Both \leftarrow and \rightarrow are disabled.
- The remote offset switch is inactive.
- The Elevation Select switch ($\frac{\text{I}}{\text{I}}/\frac{\text{I}}{\text{I}}/\frac{\text{I}}{\text{I}}$) is inactive.

A Guidance mode screen similar to that shown in Figure 5.9 appears when you are in Streaming Survey mode.

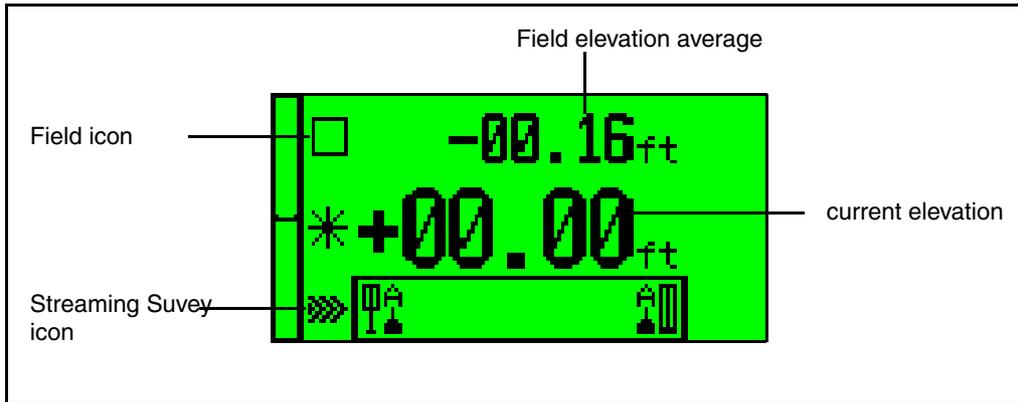


Figure 5.11 Streaming Survey mode

Streaming data output to a computer

Data can be saved to a computer using a program like HyperTerminal or ProComm.

The port settings for the computer collecting the data are: 57,600 baud, parity None, 8 data bits, 1 stop bit

To stream data output to a computer, complete the following steps:

1. Connect an RS-232 cable from the serial port on the base of the CB415 to a serial port on your computer.
2. Make sure that:
 - the CB415 is connected to the system cable harness.
 - power is connected to the system.
 - your computer has enough power to complete the download.
 - you have configured the machine for the streaming survey mode. For information on how to do this, see Survey Mode, page 78.

To begin data logging, press **ESC** on the CB415. The data is output as comma-delimited row data, terminated by a carriage return and line feed.

The minimum, maximum, and average for the row surveyed is output along with raw elevation data. Each row is terminated by a carriage return and line feed.

If you have used a program with the Trimble GCS21 system, the output from the AG GCS system is compatible with that previous format.

An example of the data output from the AG GCS system is shown in Figure 5.12. Each line shown in the file below depicts a row.

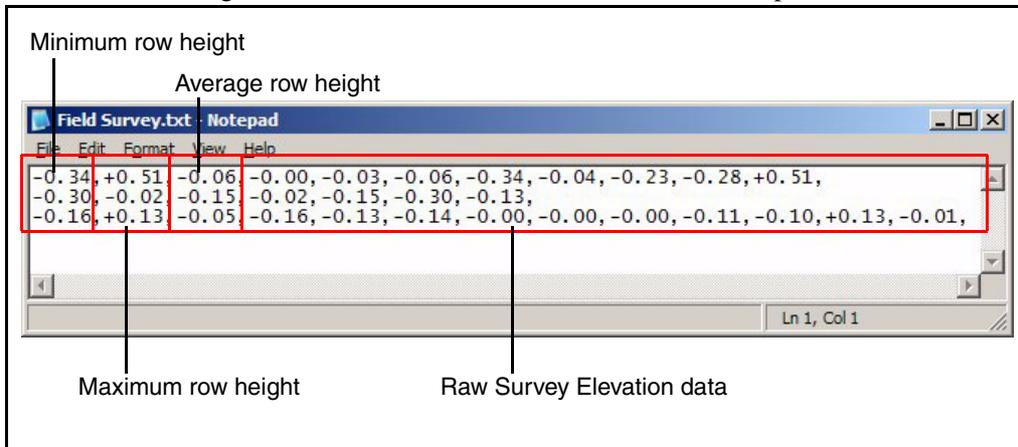


Figure 5.12 Survey data output format

Dual Cut/Fill mode

The following items outline how an AG GCS400 system works in Dual Cut/Fill mode:

- The Guidance screen shows the amount of cut or fill required to reach each mast's reference elevation. A positive value means "cut" and a negative value means "fill".
- Both **↓** switches are disabled.

- Both  and  are disabled.
- The remote offset switch is disabled.
- The Elevation Select switch (//) is active in Dual Cut/Fill mode. When you toggle the Elevation Select switch to:
 - , left (front) elevation device selected, and left (front) blade hydraulics of the machine are under automatic or manual control.
 - , both left (front) and right (rear) elevation device is selected and left (front) and right (rear) blade hydraulics of the machine are under either automatic or manual control.
 - , right (rear) elevation device selected, and right (rear) blade hydraulics of the machine are under either automatic or manual control.
- The *Linked Elevation Adjustment* option and the *Reference Elevation* option in the *Configuration* menu are **not** available.

A Guidance mode screen similar to that shown in Figure 5.13 appears when you are in Dual Cut/Fill mode.

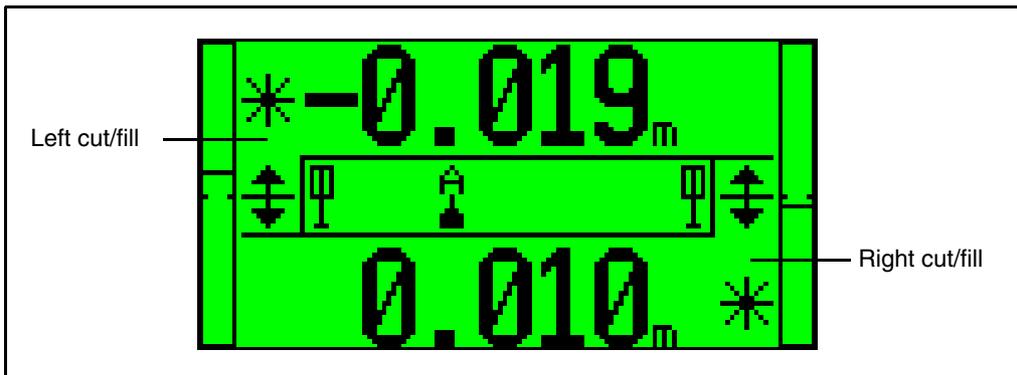


Figure 5.13 Dual Cut/Fill mode

Configuration Mode

In this chapter:

- Introduction
- Accessing Configuration Mode
- Configuration Menu Items

6.1 Introduction

The CB415 dual control box has an LCD screen that shows specific information related to the current job. The LCD can be used in two modes:

- Guidance mode
- Configuration Mode

The CB415 has menus that let you configure the system settings. These menus are accessed using Configuration mode.

6.2 Accessing Configuration Mode

To access Configuration mode, turn the power/setup switch to the **i** position. A screen similar to the one shown in Figure 6.1 appears.

For more information about the power/setup switch, see Figure 3.1 on page 19.

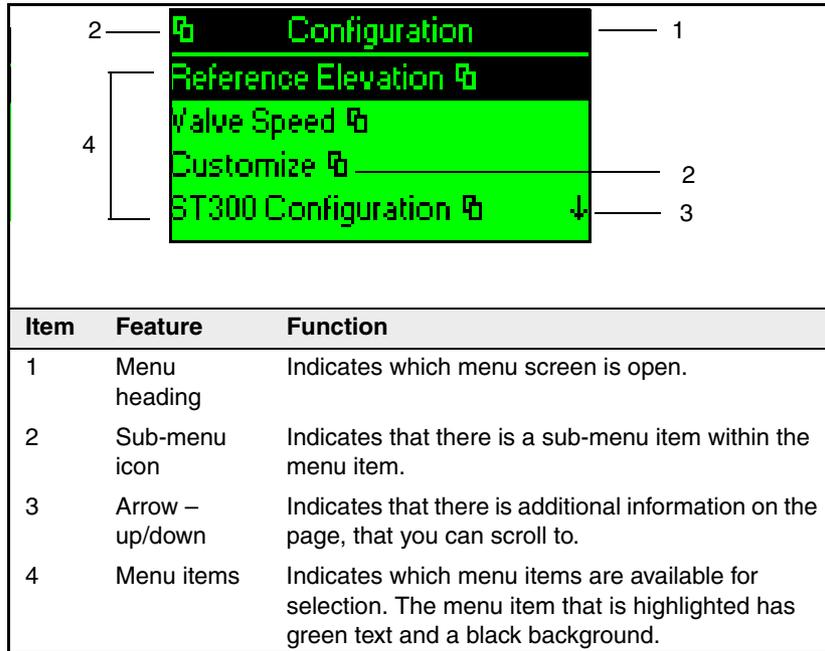


Figure 6.1 Configuration menu

6.2.1 Using Setup mode

Use the following steps to access the items from the *Configuration* menu:

1. Toggle either **↑** switch up or down to highlight the required menu item.
2. Press **OK** to select the highlighted menu item.
3. After you select a menu item, toggle either **↑** switch to scroll up or down through the sub-menus or to change the highlighted value.

Note – If you want to reset a value to the default setting, press **OK** and **ESC** simultaneously.

4. To exit from a menu item, do one of the following actions:
 - Press **OK** to accept any changes that you made and to exit the menu item.
 - Press **ESC** to abandon any changes that you made. Press **ESC** again to exit the menu item.
5. Press **ESC** to go back one level in the *Configuration* menu structure.
6. Turn the power/setup switch to **I** to exit from the *Configuration* menu.

6.3 Configuration Menu Items

The menu selections available from the *Configuration* menu are as follows:

This Menu Item...	is available with....	except....	For more information, see ...
Reference Elevation	all configurations	slope only configuration	page 65
Valve Speed	all configurations		page 69
Customize	all configurations		page 71
SR300 Configuration	all configurations Note – only appears if SR300 is detected.	slope only configurations	page 89
Linked Elevation Adjustment	all dual laser configurations		page 91
Sensor Calibration	all configurations	laser only configurations	page 93
Diagnostics	all configurations		page 98
Advanced Option	all configurations		page 107

6.3.1 Reference Elevation

Use the *Reference Elevation* option to set the reference elevation for the cutting edge.

The dual elevation system has the following options available from this screen:

- Left (front) and right (rear) reference elevation
- Left (front) reference elevation (Independent Elevation mode only)
- Right (rear) reference elevation (Independent Elevation mode only)

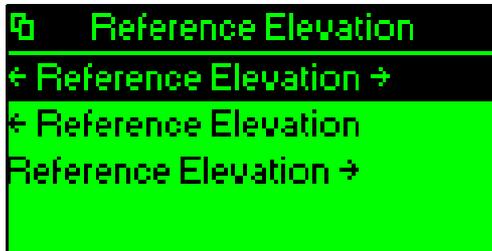
Note – The *Reference Elevation* menu option is not available in *Cut/Fill* mode.

The single elevation system has the following option available from this screen:

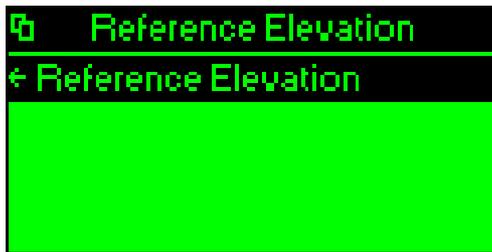
- Left (front) reference elevation

To open the *Reference Elevation* menu, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either **↓** switch until *Reference Elevation* is highlighted on the LCD.
3. Press **OK**. For a dual elevation sensor system a screen similar to the following appears:



For a single elevation sensor system, the following screen appears:



Left (front) and Right (rear) Reference Elevation

The \leftarrow *Reference Elevation* \rightarrow option allows you to set the same reference elevation for the right and left side of the blade or the front and rear blades on a tandem system, in the selected units.

1. From the *Reference Elevation* screen, toggle either \updownarrow switch until \leftarrow *Reference Elevation* \rightarrow is highlighted.
2. Press **OK**. The following screen appears:



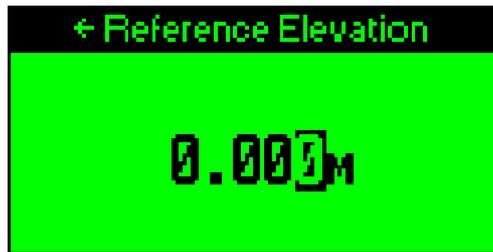
The current reference elevation value and unit appear.

3. To edit the reference elevation, complete the following steps:
 - a. Press **OK** and **ESC** simultaneously to reset the reference elevation to 0.000.
 - b. Press the **AUTO** button to move the cursor to the right and highlight the digit that you want to change.
 - c. Toggle either \updownarrow switch up or down to increase or decrease the value.
 - d. Toggle either \updownarrow switch up or down to change from positive to negative. The cursor must be to the left of the entered number.
4. Press **OK** to save the setting and return to the *Configuration* menu.
5. When you finish working in the *Configuration* menu, turn the power/setup switch to the **I** position to return to Guidance mode.

Left (Front) Reference Elevation

The ← *Reference Elevation* option allows you to set the reference elevation for the cutting edge under the left elevation device or the front scraper on a tandem system. You can set the elevation in the selected units.

1. From the *Reference Elevation* screen, toggle either ↓ switch until ← *Reference Elevation* is highlighted.
2. Press **OK**. The following screen appears:



The current reference elevation value and unit appear.

3. To enter the reference elevation, follow step 3 through step 5 on page 67.

Right (Rear) Reference Elevation

The *Reference Elevation* → option allows you to set the reference elevation for the cutting edge under the right elevation device or the rear scraper on a tandem system. You can set the elevation in the selected units.

1. From the *Reference Elevation* screen, toggle either ↓ switch until *Reference Elevation* → is highlighted.
2. Press **OK**. The following screen appears:



The current reference elevation value and unit appear.

3. To enter the reference elevation, follow step 3 through step 5 on page 67.

6.3.2 Valve Speed

Use the *Valve Speed* menu to change the speed of the valves that control the automatic blade movement.

Note – *Valve speed for elevation or slope may be adjusted while in automatic control. To perform this, toggle the selected Auto / Manual switch to automatic after the valve speed menu is accessed.*

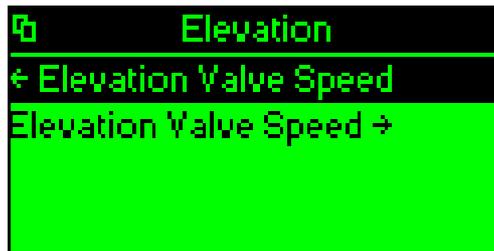
To customize the valve speed, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either ↓ switch until *Valve Speed* is highlighted.
3. Press **OK**.

For a system with slope and / or elevation sensors, the following screen appears:



4. From the *Valve Speed* screen, toggle either \leftarrow switch until *Elevation* or *Slope* is highlighted.
5. Press **OK** to confirm your selection. If you selected *Elevation*, a screen similar to the following appears:



6. From the *Elevation Valve Speed* screen, toggle either \leftarrow switch until your selection is highlighted.
7. Press **OK** to confirm your selection. A screen similar to the following appears:



The valve speed range is 1 to 200, where 1 is the slowest valve speed and 200 is the fastest valve speed. The number shown in the middle of the screen is the current valve speed setting (100 in the screen shown above).

8. To adjust the elevation valve speed, complete the following steps:
 - a. Toggle either  switch up to increase speed (the number increases and the bar graph length increases).
 - b. Toggle either  switch down to decrease speed (the number decreases and the bar graph length decreases).

*Note – Press **ESC** and **OK** simultaneously to reset the valve speed to the default of 100.*

9. Press **OK** to accept the value and exit to the *Valve Speed* menu.
10. To adjust the slope valve speed, complete the following steps:
 - a. From the *Valve Speed* screen, toggle either  switch until *Slope* is highlighted.
 - b. Repeat step 5 to step 9.

6.3.3 Customize

Use the *Customize* option to customize the following settings:

- Setups
- Operating mode
- Survey Mode (only available if Survey operating mode is configured)
- Survey Timer (only available if Survey operating mode and Timed survey method is configured)
- Offset (Elevation or Slope)
- On grade deadband (Elevation or Slope)
- Units of measure (Elevation or Slope)

- Audio

To change the settings under *Customize*, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either **↓** switch until *Customize* is highlighted. A screen similar to the following appears:



3. Press **OK** to enter the *Customize* screen.

Setups

Use the *Setups* option to set multiple benches when moving from one area of a job site to another. An example is a site which requires one area to be cut and another area to be filled. The *Setups* menu allows you to enter pre-programmed elevation and slope values (if an AS400 sensor is detected) so that you can switch between the desired elevation and/or grade for each working area, minimizing re-work caused by over-cutting or over-filling.

The setups wizard will store the setups in an array, which holds the offsets from the master bench position.

Note – Remote Switch E can be configured to make use of this operation. For more information, refer to the AG GCS300, AG GCS400 Grade Control System Reference Manual, Section 3.4.4, Remote Switches.

- **Elevation**

To customize the elevation setups, complete the following steps:

1. From the *Customize* menu, toggle either  switch until *Setups* is highlighted.
2. Press **OK**. The following screen appears:



3. Toggle either  switch until *Elevation* is highlighted.
4. Press **OK**. A screen similar to the following appears:



0 is the primary setup and cannot be edited. The elevation setup numbers 1, 2, 3 are offsets from the primary number. A maximum of 3 offsets per elevation are allowed. The current selection is highlighted.

The elevation is shown in the current units of measure. To change the measurement type, see Units of Measure, page 85.

5. Toggle either  switch until the required offset is highlighted.

6. Press **OK**. A screen similar to the following appears:



7. To edit the elevation value, complete the following steps:
- Press **AUTO** to move the cursor to the right and highlight the digit that you want to change.
 - Toggle either **↑** switch up to increase the highlighted value or toggle either **↓** switch down to decrease the highlighted value.
8. Press **OK**. A screen similar to the following appears:



Your first setup value will be displayed as well as a second setup value.

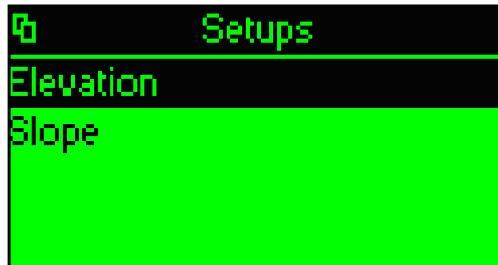
9. Repeat step 5 to step 8 to enter further setup values.
10. When the required elevation(s) are entered, press **OK** to return to the *Setups* menu and then **ESC** to return to the *Customize* menu.
11. Turn the power/setup switch to the **I** position to return to Guidance mode.

- *Slope*

If an AS400 sensor is detected, slope setups can be configured as a change to your original reference slope.

To customize the slope setups, complete the following steps:

1. From the *Customize* menu, toggle either \updownarrow switch until *Setups* is highlighted.
2. Press **OK**. The following screen appears:



3. Toggle either \updownarrow switch until *Slope* is highlighted.
4. Press **OK**. A screen similar to the following appears:



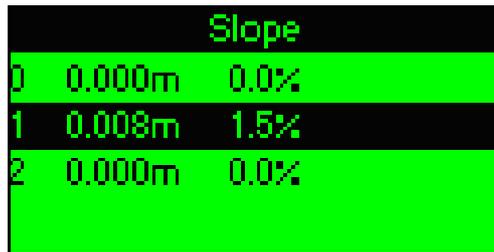
0 is the primary slope number and cannot be edited. It is the primary set point. The slope setup numbers 1, 2, 3 are the absolute set points. A maximum of 3 set points per slope are allowed. The current selection is highlighted.

The slope is shown in the current units of measure. To change the measurement type, see *Units of Measure*, page 85.

5. Toggle either \uparrow switch until the required slope is highlighted.
6. Press **OK**. A screen similar to the following appears:



7. To edit the slope value, complete the following steps:
 - a. Press **AUTO** \rightarrow to move the cursor to the right and highlight the digit that you want to change.
 - b. Toggle either \uparrow switch up to increase the highlighted value or toggle either \downarrow switch down to decrease the highlighted value.
8. Press **OK**. A screen similar to the following appears:



Your first setup value will be displayed as well as a second setup value.

9. Repeat step 5 to step 8 to enter further setup values.
10. When the required slope is entered, press **OK** to return to the *Setups* menu and then **ESC** to return to the *Customize* menu.
11. Turn the power/setup switch to the **I** position to return to Guidance mode.

Operating Mode

Use the *Operating Mode* option to select an operating mode.

An AG GCS300 system has the following modes available for selection:

- Reference Elevation
- Survey
- Cut/Fill

An AG GCS400 system has the following modes available for selection:

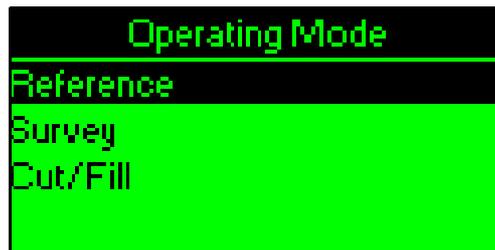
- Linked Elevation
- Independent Elevation
- Survey
- Cut/Fill

For more information, see Section 5.5, Operating Modes, page 47.

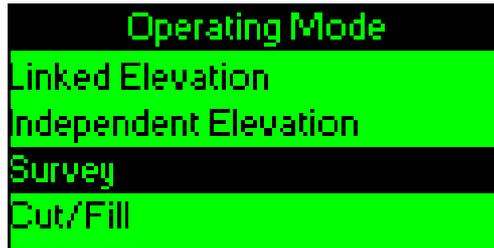
To select an operating mode, complete the following steps:

1. From the *Customize* menu, toggle either  switch until *Operating Mode* is highlighted.
2. Press **OK** to select *Operating Mode*.

For an AG GCS300 system, a screen similar to the following appears:



For an AG GCS400 system, a screen similar to the following appears:



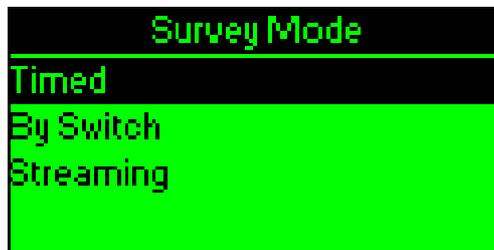
3. Toggle either **↑** switch until the operating mode that you require is highlighted.
4. Press **OK** to select and store the required operating mode. The *Customize* menu appears.
5. Turn the power/setup switch to the **I** position to return to Guidance mode.

Survey Mode

Note – This is only available if you have selected Survey as the operating mode. For information on how to do this, see Operating Mode, page 77.

To select a survey mode, complete the following steps:

1. From the *Customize* menu, toggle either **↑** switch until *Survey Mode* is highlighted.
2. Press **OK**. The following screen appears:



3. Toggle either **↓** switch until the survey mode that you require is highlighted.
 - *Timed* survey takes readings every ‘x’ seconds.
 - *By Switch* takes readings when the configured remote switch is pressed.



Tip – To configure Remote Switch E as a Survey Sample switch, refer to the *AG GCS300, AG GCS400 Grade Control System Reference Manual*, Section 3.4.4, Remote Switches.

- *Streaming* takes readings every second. You can collect the data using a PC or view it on the CB415.
4. Press **OK** to select and store the required survey mode. The *Customize* menu appears.
 5. Turn the power/setup switch to the **I** position to return to Guidance mode.

Survey Timer

Note – This is only available if you have selected Survey as the operating mode and Timed as the survey method.

To configure the time period between survey measurements, complete the following steps:

1. From the *Customize* menu, toggle either **↓** switch until *Survey Timer* is highlighted.
2. Press **OK**. A screen similar to the following appears:



3. Edit the survey timer time period:
 - a. Press the  button to move the cursor to the right and highlight the digit that you want to change.
 - b. Toggle either  switch up to increase the highlighted value or toggle either  switch down to decrease the highlighted value.

*Note – Press **ESC** and **OK** simultaneously to reset the survey timer to the default (01 sec).*

4. When the required time period is entered, press **OK** to return to the *Customize* menu.
5. Turn the power/setup switch to the **I** position to return to Guidance mode.

Offset

- **Elevation Offset**

Use the *Offset* option to set the amount each toggle of the Remote Offset switch increases or decreases the displayed reference elevation and the blade's elevation.

Note – Toggling a  switch on the CB415 when in Guidance mode always changes the elevation offset by 1 mm (0.1 feet or .01%). If Offsets are entered for both Elevation and Slope, both will be offset when the Remote Offset switch is used.



Tip – If the Remote Offset Switch does not appear to be functioning, check that an offset has been applied and that the Elevation Offset is not set to zero.

To customize the elevation offset increment, complete the following steps:

1. From the *Customize* menu, toggle either \uparrow switch until *Offset* is highlighted.
2. Press **OK**. The following screen appears:



3. From the *Offset* menu, toggle either \uparrow switch until *Elevation* is highlighted.
4. Press **OK**. The following screen appears:



5. Edit the elevation offset increment:
 - a. Press the **AUTO** button to move the cursor to the right and highlight the digit that you want to change.
 - b. Toggle either \uparrow switch up to increase the highlighted value or toggle either \downarrow switch down to decrease the highlighted value.

Note – Press **ESC** and **OK** simultaneously to reset the elevation offset to the default (0.030 m).

6. When the required elevation offset is entered, press **OK** to return to the *Customize* menu.
7. Turn the power/setup switch to the **I** position to return to Guidance mode.

Note – A fault condition will occur if the selected offset is larger than the range of travel on the laser receiver.

- **Slope Offset**

Use the *Slope Offset* option to set the amount each toggle of the Remote Offset switch increases or decreases the displayed reference slope.

Note – Toggling a  switch on the CB415 when in Guidance mode always changes the slope offset by 1 mm (0.1 feet or .01%). The remote offset switch allows the operator to change the blade angle from positive grade to negative grade, passing through zero. If Offsets are entered for both Elevation and Slope, both will be offset when the Remote Offset switch is used.



Tip – If the Remote Offset Switch does not appear to be functioning, check that an offset has been applied and that the Slope Offset is not set to zero.

To customize the slope offset increment, complete the following steps:

1. From the *Customize* menu, toggle either  switch until *Offset* is highlighted.
2. Press **OK**. The following screen appears:



3. From the *Offset* menu, toggle either \updownarrow switch until *Slope Offset* is highlighted.
4. Press **OK**. The following screen appears:



5. Edit the slope offset increment:
 - a. Press the **AUTO** button to move the cursor to the right and highlight the digit that you want to change.
 - b. Toggle either \updownarrow switch up to increase the highlighted value or toggle either \updownarrow switch down to decrease the highlighted value.

*Note – Press **ESC** and **OK** simultaneously to reset the slope offset to the default (0.1%).*

6. When the required slope offset is entered, press **OK** to return to the *Customize* menu.
7. Turn the power/setup switch to the **I** position to return to Guidance mode.

On Grade Deadband

Use the *On Grade Deadband* option to change the display deadband settings of elevation or slope, and the control valve deadband settings on the system.

Note – The Slope menu option only appears if a slope sensor is detected.

To customize the on grade deadband settings, complete the following steps:

1. From the *Customize* menu, toggle either  switch until *On Grade Deadband* is highlighted.
2. Press **OK**. A screen similar to the following appears:



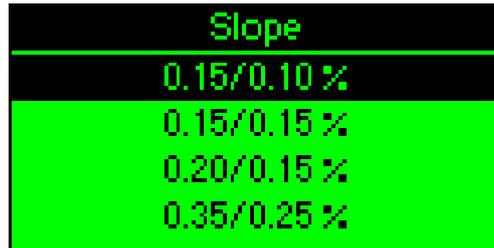
3. Select either elevation, or slope if a slope sensor is present. For elevation deadband, a screen similar to the following will appear:



4. The default setting is 5 / 3 mm which provides a 5 mm display deadband for the on-grade LED indicators and a 3 mm control deadband for the automatic hydraulic valve control. This setting suits most applications.

Note – Smaller elevation deadband values increase valve movement sensitivity. This can cause unstable system performance.

5. For slope deadband, a screen similar to the following will appear:



6. The default setting for slope deadband is 0.15/0.10%.
7. Toggle either \updownarrow switch until the required display and control deadband is highlighted.
8. Press **OK** to save the setting and return to the *Customize* menu.
9. Turn the power/setup switch to the **I** position to return to Guidance mode.

Units of Measure

Use the *Units of Measure* option to select either units of measure for elevation or slope. The following selections are available:

Note – *Slope units of measure will only appear if a slope sensor is detected.*

- Elevation

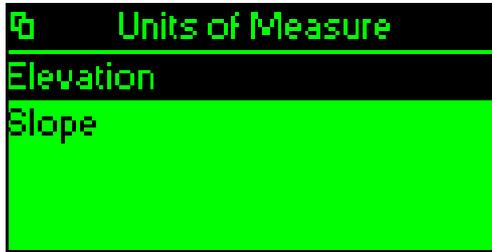
- Decimal Feet
- Meters
- Fractional Inches

- Slope

- Percentage of Slope
- Rise/Run
- Ratio

To select the units of measure, complete the following steps:

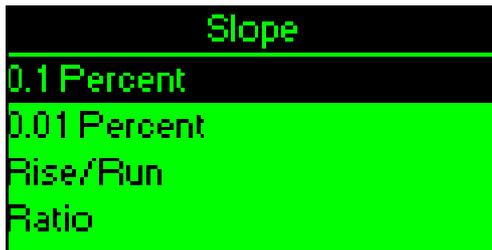
1. From the *Customize* menu, toggle either  switch until *Units of Measure* is highlighted.
2. Press **OK**. The following screen appears:



3. From the *Units of Measure* screen, toggle either  switch to highlight either *Elevation* or *Slope*.
4. Press **OK**. If you select *Elevation*, the following screen appears:.



If you select *Slope* the following screen appears:



5. Toggle either  switch to highlight the required units.

6. Press **OK** to store the selection and return to the *Customize* menu.
7. Turn the power/setup switch to the **I** position to return to the Guidance mode.

Audio

Use the *Audio* option to change the volume level of the audio alert. The audio alert sounds when a button or a switch is used or a system warning is given. Audio alerts can also be configured for elevation and slope.

If the elevation or slope alert is set, any deviation from grade longer than 3 seconds will produce a two beep alert until grade is reached. A lost reference will emit 3 beeps.

To customize the volume of the audio alert, complete the following steps:

1. From the *Customize* menu, toggle either **↓** switch until *Audio* is highlighted.
2. Press **OK**. A screen similar to the following appears:



3. From the *Audio* screen, toggle the **↓** switch until *Audio Volume* is highlighted on the LCD.

4. Press **OK**. A screen similar to the following appears:



5. The audio volume range is 0% to 100%, where 0% is the lowest volume and 100% is the highest volume. The number shown in the middle of the screen is the current audio volume setting (17 in the screen shown above).
6. Do one of the following actions:
- Toggle either **↑** switch up to increase the volume. The percentage and the bar graph length increases and a pulsed audible tone sounds.
 - Toggle either **↓** switch down to decrease the volume. The percentage and the bar graph length decreases and a pulsed audible tone sounds.
7. Press **OK** to store the audio volume level and return to the *Audio* menu.
8. Select either elevation or slope alert (if a slope sensor is present).

9. Press **OK**. If you select elevation alert the following screen appears:



If you select slope alert, the following screen appears:



10. To turn the alert on, highlight the *On* section and press **OK**, to store the selection and return to the *Audio* screen.
11. Turn the power/setup switch to the **I** position to return to Guidance mode.

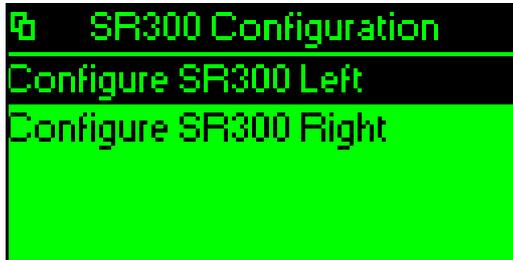
6.3.4 SR300 configuration

When the system is installed with SR300 receiver mast(s), the receiver mast must be configured.

Note – You can only configure one SR300 at a time. On an AG GCS400 dual control system, only the SR300 that is being configured should be connected, disconnect the other one.

To configure the SR300, complete the following steps:

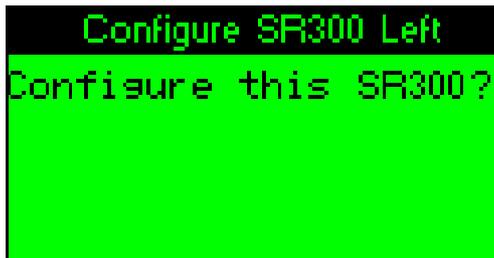
1. Turn the power/setup switch to the **i** position.
2. Toggle the **↓** switch until *SR300 Configuration* is highlighted.
3. Press **OK**. A screen similar to the following appears:



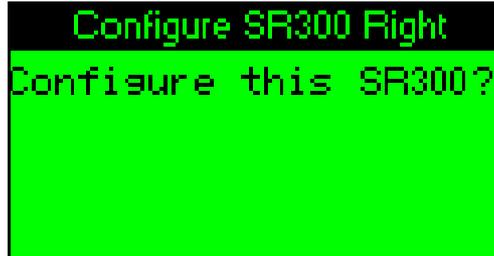
4. From the *SR300 Configuration* menu, toggle the **↓** switch to highlight the receiver mast to be configured.

For tandem scrapers:

- Select *Configure SR300 Left* for the SR300 on the front scraper. Verify that this is the only mast connected, disconnect the rear SR300.
 - Select *Configure SR300 Right* for the SR300 on the rear scraper. Verify that this is the only mast connected, disconnect the front SR300.
5. Press **OK**. If *Configure SR300 Left* was selected, the following screen appears:



If *Configure SR300 Right* is selected the following screen appears:



6. Press **OK** to store this selection and return to the *SR300 Configuration* menu.
7. Repeat steps 3-5 to configure a second receiver mast or turn the power/setup switch to the **I** position to return to the Guidance mode.

6.3.5 Linked Elevation Adjustment

Note – Linked Elevation Adjustment is not available on Tandem scrapers.

The *Linked Elevation Adjustment* option is only available with a split axle scraper or a center pivot scraper in *Linked Elevation* mode. Use the *Linked Elevation Adjustment* screen to fine tune the blade slope. That is, if an error exists on the surface due to incorrect blade slope, enter the amount of error into the *Linked Elevation Adjustment* screen to compensate. Uneven blade wear can cause a blade slope error.

Note – To detect blade slope error, cut a pass to grade, turn the machine around 180°, and check if the blade is still parallel to the grade.

*Note – The masts must be calibrated before a *Linked Elevation adjustment* is made. A *Linked Elevation calibration* is done when the masts are installed or serviced. For more information, refer to the *AG GCS300, AG GCS400 Grade Control System Reference Manual, Section 3.5.5, Linked Elevation Calibration.**

Note – this adjustment always adjusts the right side of the blade.

To enter the linked elevation adjustment, complete the following steps:

1. Turn the power/setup switch to the **I** position.
2. Toggle either **↓** switch until *Linked Elevation Adjustment* is highlighted.
3. Press **OK**. A screen similar to the following appears:



4. Enter a positive value to lift the right side of the blade or enter a negative value to lower the right side of the blade:
 - a. Press the **AUTO** button to move the cursor to the right and highlight the digit that you want to change.
 - b. Toggle either **↓** switch up or down to increase or decrease the value.
 - c. Toggle either **↓** switch up or down to change from positive to negative. The cursor must be to the left of the entered number.
5. Press **OK** to save the setting and return to the *Configuration* menu.
6. When you finish working in the *Configuration* menu, turn the power/setup switch to the **I** position to return to the Guidance mode.

6.3.6 Sensor Calibration

Note – Sensor Calibration is only available for split axle and centre pivot scrapers.

The *Sensor Calibration* menu is designed to calibrate the slope sensor on the machine to ensure accurate slope of the blade. *Sensor Calibration* will step the user through a process to calibrate the blade slope sensor. *Manual Sensor Calibration* lets you to specify which sensor is to be calibrated. It is recommended that you use *Blade Sensor Calibration* when calibrating the sensors.

Blade Slope Calibration

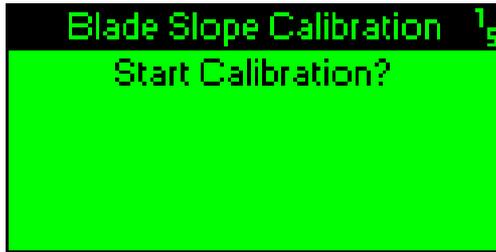
To calibrate the blade slope sensor, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either **↓** switch until *Sensor Calibration* is highlighted.
3. Press **OK**. A screen similar to the following appears:



4. Toggle either **↓** switch to select *Blade Slope Calibration*.

5. Press **OK**. A screen similar to the following appears:



6. Press **OK**. A screen similar to the following appears:



Note – If the machine is unstable, or the sensors are not reading near zero or level, the OK graphic appears as follows:



7. Press **OK**. A screen similar to the following appears:

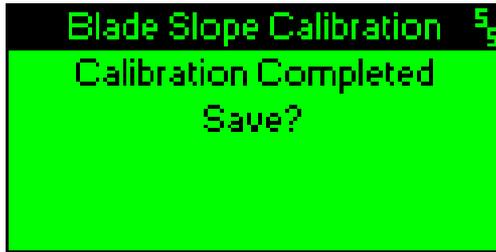


8. The following steps are illustrated on the *Blade Slope Calibration 1* screen. The machine should be parked on a solid, level material such as concrete or compacted soil.
- Lower the blade onto a hard surface and mark the position of the blade edges.
9. Press **OK**. A screen similar to the following appears:



10. Raise the blade, turn the machine 180 degrees, and position the blade on the marks made in the previous step. Again, place the blade firmly on the hard surface.

11. Press **OK**. A screen similar to the following appears:



12. Press **OK** to accept the calibration and return to the *Configuration* menu.
13. When you finish working in the *Configuration* menu, turn the power/setup switch to the **I** position to return to the Guidance mode.

Manual Sensor Calibration

To complete a manual blade sensor calibration, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either **↓** switch until *Sensor Calibration* is highlighted.
3. Press **OK**. A screen similar to the following appears:



4. Toggle either **↓** switch to highlight *Manual Sensor Calibration*.

5. Press **OK**. A screen similar to the following appears:



6. Press **OK**. A screen similar to the following appears:



7. The machine should be parked on a solid, level base such as concrete or compacted soil. Level the cutting edge of the blade using a spirit level.
8. The screen displays the sensor's current reading (as a percentage) and direction. The  icon indicates a negative value which means that the left blade tip is higher than the right blade tip. Similarly, the  icon indicates a positive value which means that the right blade tip is higher than the left blade tip.

- To see the amount of correction already being applied to the slope sensor, hold down **AUTO**. The correction value appears in the bottom right corner of the screen.



- To adjust the sensor reading, use the right **↑** switch. Hold the **↑** switch up to increase the correction amount which, in turn, will decrease the displayed sensor reading. Similarly, hold the **↓** switch down to decrease the correction amount which, in turn, will increase the displayed sensor reading.
- To accept the adjustment and exit the *Blade Slope* screen, press **OK**.
- To exit the *Blade Slope* screen without saving the adjustment, press **ESC**.
- When you finish working in the *Configuration* menu, turn the power/setup switch to the **I** position to return to the Guidance mode.

6.3.7 Diagnostics

This section describes the following system diagnostic items:

- Test valves
- Hour meter
- Software versions
- Sensor data
- Fault history

- Machine voltage
- Test control box

To access the *Diagnostics* screen, complete the following steps:

1. Turn the power/setup switch to the **i** position.
2. Toggle either **↓** switch until *Diagnostics* is highlighted.
3. Press **OK**. A screen similar to the following appears:



4. Toggle either **↓** switch to select the diagnostics item that you want to access.

Test Valves

Use the *Test Valves* option to test that the system is correctly driving the hydraulic valves.

To open the *Test Valves* screen, complete the following steps:

1. From the *Diagnostics* menu, toggle either **↓** switch until *Test Valves* is highlighted.

2. Press **OK** to select this item. A screen similar to the following appears:



Warning – Do *not* operate this system unless you are fully trained on this equipment and end-use equipment.



When using the system, make sure that you are away from the cutting edge of the machine.

3. Toggle the left  switch up to move the left valve or elevation up, or toggle the left  switch down to move the left valve or elevation down.
4. Toggle the right  switch up to move the right valve or tilt up, or toggle the right  switch down to move the right valve or tilt down.

Note – Press the  button to change the percentage of power that drives the valves.

Note – Toggling the right  switch only moves the blade if the right tilt valve is fitted to the machine.

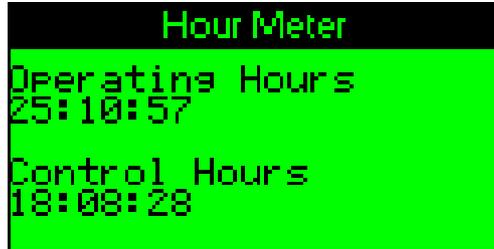
5. Press **OK** to return to the *Diagnostics* menu.
6. Turn the power/setup switch to the **I** position to return to Guidance mode.

Hour Meter

Use the *Hour Meter* option to view the length of time that the system has been operating. This is known as the *operating hours*. The *Hour Meter* screen also shows the length of time the automatic controls have been used with the system. This is known as the *control hours*.

To access the *Hour Meter* screen, complete the following steps:

1. From the *Diagnostics* menu, toggle either \updownarrow switch until *Hour Meter* is highlighted.
2. Press **OK** to select this item. A screen similar to the following appears:



3. Observe the *Operating Hours* and the *Control Hours* times.
4. Press **OK** to return to the *Diagnostics* menu.
5. Turn the power/setup switch to the **I** position to return to Guidance mode.

Software Versions

Use the *Software Versions* option to identify which system components are currently being used. The *Software Versions* screen also shows the versions of software that are loaded for each component. To access the *Software Versions* screen, complete the following steps:

1. From the *Diagnostics* menu, toggle either \updownarrow switch until *Software Versions* is highlighted.
2. Press **OK**.

For an AG GCS300 system, a screen similar to the following appears:

Software Versions					
CB415	Ø	U	2.50	L1.00	
VM415	←	U	1.00	L1.00	
SR300	←	U	2.32	L1.00	

For an AG GCS400 system, a screen similar to the following appears:

Software Versions					
CB415	Ø	U	2.50	L1.00	
VM415	←	U	1.00	L1.00	
VR410	→	U	1.00	L1.00	
SR300	←	U	2.32	L1.00	
TM400	→	U	1.05	L1.00	

Information shown in this screen includes the following items:

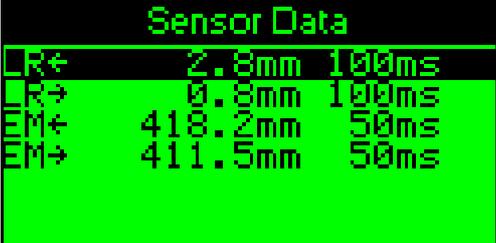
- The devices that are connected.
 - The arrow showing whether the device is the left or right device. A “number” means that the device is neither left nor right.
 - The version of application software for each device.
 - The version of loader software for each device.
3. Press **OK** to return to the *Diagnostics* menu.
 4. Turn the power/setup switch to the **I** position to return to Guidance mode.

Sensor Data

Use the *Sensor Data* option to view the current sensor data generated by the system. This is helpful in troubleshooting, and for judging the “health” of the installed sensors.

To view the Sensor data, complete the following steps:

1. From the *Diagnostics* menu, toggle either  switch until *Sensor Data* is highlighted.
2. Press **OK**. A screen similar to the following appears:



Sensor Data		
LR+	2.8mm	100ms
LR-	0.8mm	100ms
EM+	418.2mm	50ms
EM-	411.5mm	50ms

Table 6.1 describes the items that are displayed on the *Sensor Data* screen:

Table 6.1 Sensor Data information

Sensor	Left column	Right column
LR	Displays the deviation value from set-point, for a laser receiver.	Displays the rate at which the device reports it's information tot he system computer. For example, 100ms is 10 times.
EM	Displays an EM400 position	
BS	Displays an AS400 blade slope sensor calibrated reading	

Fault History

Use the *Fault History* option to view information about any faults with the system.

Note – The last five faults are stored and can be retrieved even if power to the system is lost.

To view the fault history, complete the following steps:

1. From the *Diagnostics* menu, toggle either **↑** switch until *Fault History* is highlighted.
2. Press **OK**. A screen similar to the following appears:



3. Toggle either **↑** switch to scroll through the list of recorded system faults.

*Note – To clear all the information in the fault history, simultaneously press **OK** and **ESC** while in the Fault History screen.*

4. Press **OK** to access extra information about the highlighted fault. A screen similar to the following appears:



This screen shows the following information:

- The device that caused the fault.
- The fault code.
- The fault count. The fault count is the number of instances that a fault has been received from a particular device.

- The time the fault occurred.
 - A description of the problem.
5. Press **ESC** to return to the previous screen.
 6. Press **ESC** again to return to the *Diagnostics* menu.
 7. Turn the power/setup switch to the **I** position to return to Guidance mode.

Machine Voltage

Use the *Machine Voltage* option to view the voltage that the system is receiving. To access the *Machine Voltage* screen, complete the following steps:

1. From the *Diagnostics* menu, toggle either **↓** switch until *Machine Voltage* is highlighted.
2. Press **OK** to select this item. A screen similar to the following appears:



3. Observe the measured machine voltage. The machine voltage is shown in volts.

Note – For the components in the system to run properly, machine voltage should be between 9 VDC – 32 VDC. For details on a component’s voltage requirements, see Appendix C.3, *Component Specifications*.

4. Press **OK** to return to the *Diagnostics* menu.

5. Turn the power/setup switch to the **I** position to return to Guidance mode.

Test Control Box

Use the *Test Control Box* option to test that the configured switches in the system work correctly, and to test that the LCD display works correctly.

The switches available for testing include the switches on the CB415 and the remote switches. All switches can be tested, except for the power/setup switch.

Note – Testing the **ESC** button or the **OK** button will return you to the *Diagnostics* menu.

To test the switches and the LCD, complete the following steps:

1. From the *Diagnostics* menu, toggle either **↓** switch until *Test Control Box* is highlighted on the LCD.
2. Press **OK** to select this item. A screen similar to the following appears:



When you enter the *Test Control Box* screen, the CB415 checks that all the LEDs are functioning properly.

3. Test each switch configured in the system. Remote switches are labeled A, B, C, D, and E. Panel switches are labeled P1, P2, P3, P4, P5, P6, and P7.

The arrow shown next to a remote switch identifier determines which switch is pressed and whether the switch is up or down:

A remote switch that ...	is represented by a flashing identifier and ...
has a short to power	the + symbol
has a short to ground	the – symbol
is not detected by the system	the ? symbol

4. Test that the complete LCD is working by completing the following steps:
 - a. Simultaneously toggle both  switches up to turn on all the LCD pixels. The display turns black.
 - b. Simultaneously toggle both  switches down to turn off all the LCD pixels. The display turns green.
5. Press **OK** to return to the *Diagnostics* menu.
6. Turn the power/setup switch to the **I** position to return to Guidance mode.

6.3.8 Advanced Option

Use the *Advanced Option* menu to view the serial number on the CB415, to enter a password to upgrade to a higher level of functionality, or to enter a password to extend software support.

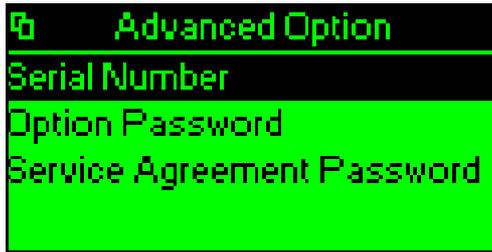
The following options are available from the *Advanced Option* menu:

- *Serial Number*
- *Option Password*
- *Service Agreement Password*

To access the *Advanced Option* screen, complete the following steps:

1. Turn the power/setup switch to the **I** position.
2. Toggle either  switch until *Advanced Option* is highlighted.

3. Press **OK**. A screen similar to the following appears:



Serial Number

The *Serial Number* option lets you view the serial number of the CB415, the software level, and the Service Agreement expiry date.

To access the *Serial Number* screen, complete the following steps:

1. From the *Advanced Option* screen, toggle either **↑** switch until *Serial Number* is highlighted.
2. Press **OK**. A screen similar to the following appears:

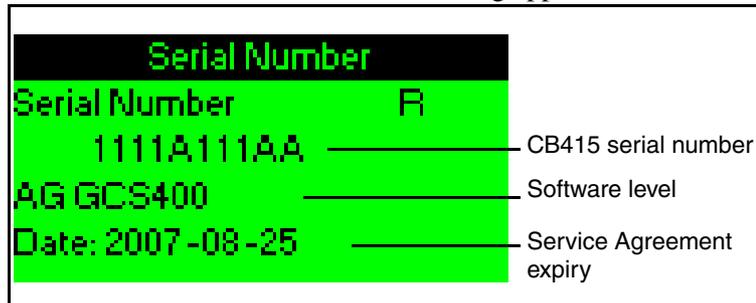


Figure 6.2 Serial Number screen

Note – You must provide the serial number when purchasing a software level upgrade or service agreement.

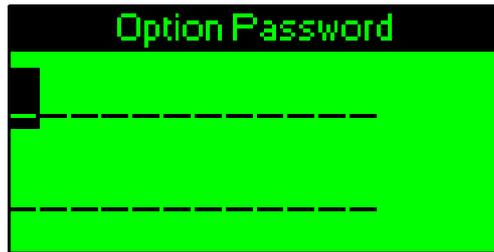
Option Password

The *Option Password* option allows you to enter a password to either upgrade or downgrade your system to a different level of functionality. For example, to upgrade from AG GCS300 to AG GCS400, or to downgrade from AG GCS400 to AG GCS300.

Note – *Option passwords can also be entered with a PC using the Trimble WinFlash utility. For information on using WinFlash to enter a password, refer to the AG GCS300, AG GCS400 Reference Manual.*

To access the *Option Password* screen, complete the following steps:

1. From the *Advanced Option* screen, toggle either  switch until *Option Password* is highlighted.
2. Press **OK**. A screen similar to the following appears:



3. Toggle either  switch to enter the first character in the password supplied by Trimble. When the correct character is displayed press  to advance to the next character.



Tip – If you make a mistake while entering the password, press **ESC** to return to the *Advanced Option* screen, press **OK** to go back into the *Option Password* screen, press  until the incorrect character is highlighted, and toggle either  switch to correct the mistake. Then continue to enter the rest of the password.

4. Once you have entered the 24 character password, press **OK**. If the password is accepted, the software will return to the *Advanced Option* screen.

If the password is not accepted, a message similar to the following appears:



To troubleshoot the problem, try the following solutions:

- Check the password, make sure you have entered it correctly.
- Check the serial number of the CB415. Make sure you have the correct password for that unit.
- If the two options outlined above do not work, contact your dealer or Trimble Support.

Service Agreement Password

The *Service Agreement Password* option lets you enter a password to extend your Service Agreement for this product. A Service Agreement lets you upgrade to newer versions of CB415 software or device firmware. If you try to upgrade a device that has a newer date than your service agreement expiry date, then that device will not be recognized. To fix this problem, try the following solutions:

- Purchase a service agreement and enter the *Service Agreement* password
- Downgrade the device with an older version of firmware

Note – *Service Agreement* passwords can also be entered with a PC using WinFlash. For information on using WinFlash to enter a password, refer to the AG GCS300, AG GCS400 Reference Manual.

To access the *Service Agreement Password* screen, complete the following steps:

1. From the *Advanced Option* screen, toggle either  switch until *Service Agreement Password* is highlighted.
2. Press **OK**. A screen similar to the following appears:



3. Toggle either  switch to enter the first character in the password supplied by Trimble. When the correct character is displayed press  to advance to the next character.



Tip – If you make a mistake while entering the password, press **ESC** to exit out to the *Advanced Option* screen, press **OK** to go back into the *Service Agreement Password* screen, press  until the incorrect character is highlighted and toggle either  switch to correct the mistake. Then continue entering the rest of the password.

4. Once you have entered the 24 character password, press **OK**. If the password is accepted, the software will return to the *Advanced Option* screen.

If the password is not accepted, a message similar to the following appears:



To troubleshoot the problem, try the following solutions:

- Check the password and make sure you have entered it correctly.
 - Check the serial number of the CB415. Make sure you have the correct password for that unit.
5. If the two options outlined above do not work, contact your dealer or Trimble Support.

Field Methods When Using a Laser Receiver

In this chapter:

- Introduction
- Setting Up the Laser Transmitter
- Benching a Level 1/AG GCS300 System
- Benching the dual control Level 2/AG GCS400 System
- SR300 Receiver Mast Operation

7.1 Introduction

This chapter explains some of the concepts and field procedures that you need to understand to use the system with laser receivers.

Dependent on what level software the system is using, single or dual elevation devices may be used. This chapter describes the different field methods of operation on each of these applications.

7.2 Setting Up the Laser Transmitter



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.

Before setting up the equipment, consider the size, shape, and elevation of the area to determine the number of laser setups you will need. For information on the maximum area covered by the transmitter, refer to the operation manual supplied with the laser transmitter.

Note – Generally, the closer you operate to the transmitter, the better the precision and the less impact you will have from environmental factors such as wind, dust, temperature, and curvature of the earth. For 360° operation, the elevation of the laser should be 0.5 m (20 inches) above the highest point on the machine to prevent the laser beam from being blocked. Mount the laser transmitter so that the laser receivers can detect the beam.

Align the grade axis of the laser and, if necessary, dial in slope(s) to match the job requirements. For information about setting up and using a Trimble GL720 laser transmitter, see Appendix B, Setting Up a GL7xx Laser Transmitter.

7.3 Benching a Level 1/AG GCS300 System

This section describes how to bench an AG GCS300 system, or a Level 1/AG GCS300 system operating in single control mode.

To make sure that the machine is grading to the correct elevation, the machine must be benched over a point with known elevation.

Follow these instructions to bench the system and to set the reference elevations.

1. Set up the laser transmitter to be in an operational mode for the site to be leveled. The laser must be oriented in the proper direction and the desired grade entered into the laser transmitter.
2. Place the scraper cutting edge on a point of known elevation.
3. Adjust the laser receiver vertically so that an on grade indication is shown on the CB415 control box.
4. If the point of known elevation is on grade, no further adjustments are needed.

If the point of known elevation is not on grade, adjust the reference elevation in the CB415 to indicate the cut or fill required to reach an on grade position. For more information about setting the reference elevation, see Section 6.3.1, Reference Elevation, page 65.

Figure 7.1 shows how the cutting edge of the machine must be positioned to successfully bench using a level laser.

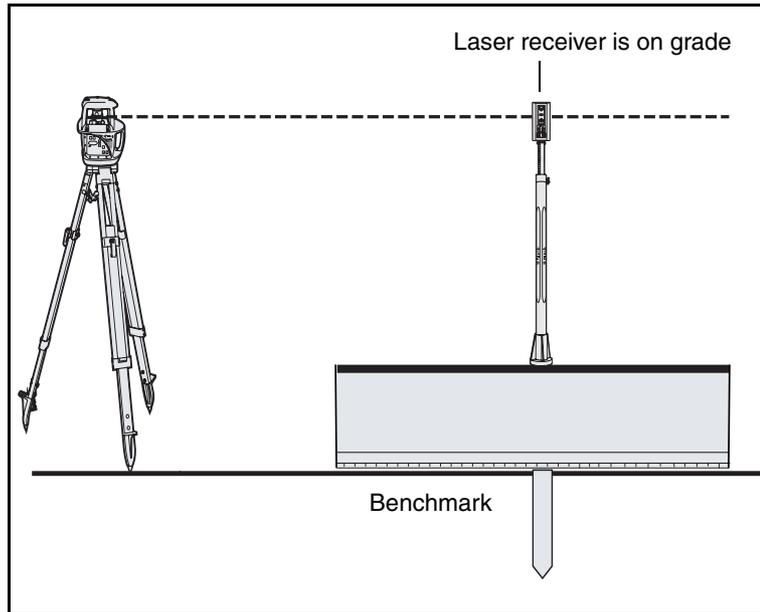


Figure 7.1 Benching a single control system using a level laser

Note – If you are benching a SR300 Receiver Mast, see Section 7.5, *SR300 Receiver Mast Operation*, page 120 for operation instructions.

7.4 Benching the dual control Level 2/AG GCS400 System

This section describes how to bench an AG GCS400 system, or a Level 2/AG GCS400 system operating in dual control mode.

To make sure that the machine is grading to the correct elevation, the machine must be benched over a point with a known elevation.

Note – If you are benching a SR300 Receiver Mast, see Section 7.5, SR300 Receiver Mast Operation, page 120 for operation instructions.

7.4.1 Independent Elevation mode

Split Axle and Center Pivot Scrapers

Follow these instructions to bench a split axle or center pivot scraper and to set the reference elevations in Independent Elevation mode.

1. Set up the laser transmitter to be in an operational mode for the site to be leveled. The laser must be oriented in the proper direction and the desired grade entered into the laser transmitter.
2. Level the cutting edge of the machine.
3. Place the scraper cutting edge over a point of known elevation.
4. If this point of known elevation is on grade, no further adjustments are needed.

If the point of known elevation is not on grade, adjust the reference elevation in the CB415 to indicate the cut or fill required to reach an on grade position.

5. Repeat Step 2 to Step 4 for the other side of the split axle or center pivot scraper.
6. Adjust the laser receiver vertically so that an on grade indication is shown on the CB415 control box.

Tandem Scrapers

Follow these instructions to bench a tandem scraper and to set the reference elevations in Independent Elevation mode.

1. Set up the laser transmitter to be in an operational mode for the site to be leveled. The laser must be oriented in the proper direction and the desired grade entered into the laser transmitter.
2. Place the cutting edge of the front scraper over a point of known elevation.
3. If this point of known elevation is on grade, no further adjustments are needed.

If the point of known elevation is not on grade, adjust the reference elevation in the CB415 to indicate the cut or fill required to reach an on grade position.

4. Place the cutting edge of the rear scraper over a point of known elevation.
5. If this point of known elevation is on grade, no further adjustments are needed.

If the point of known elevation is not on grade, adjust the reference elevation in the CB415 to indicate the cut or fill required to reach an on grade position.

7.4.2 Linked Elevation mode

Follow these instructions to bench the system and to set the reference elevations in Linked Elevation mode.

Note – Linked Elevation mode is only available for split axle and center pivot scrapers.

1. Set up the laser transmitter to be in an operational mode for the site to be leveled. The laser must be pointed in the proper direction and the desired grade entered into the laser transmitter.
2. Level the cutting edge of the machine. Place the right or left cutting edge of the scraper on a point of known elevation.

3. If this point of known elevation is on grade, no further adjustments are needed.

If the point of known elevation is not on grade, adjust the reference elevation in the CB415 to indicate the cut or fill required to reach an on grade position. For more information about setting the reference elevation, see Section 6.3.1, Reference Elevation, page 65.

Figure 7.2 shows how the cutting edge of the blade must be positioned to successfully bench a dual control system using a level laser.

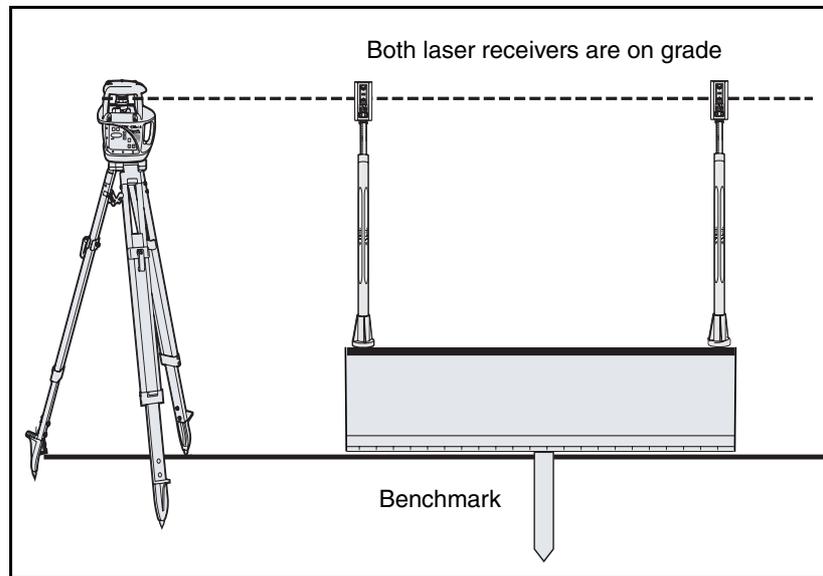


Figure 7.2 Benching a dual control system using a level laser in Linked Elevation mode

7.5 SR300 Receiver Mast Operation

The SR300 Receiver Mast is a machine mounted 360 degree solid state laser receiver. This control receiver basically has the same operation as a receiver-mast combination with an additional feature of multiple beam detection. This feature gives the operator the ability to select a desired beam from among several beams striking the receiver.

Multiple Beam Strikes

On a dual control system, the presence of multiple beams are depicted in the screen below:

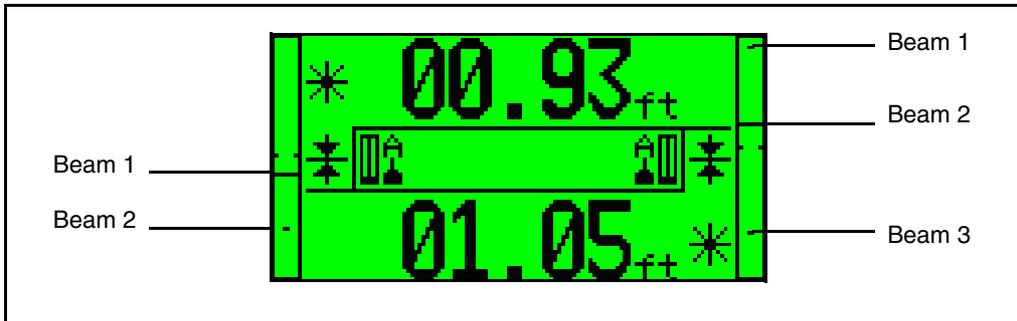


Figure 7.3 SR300 multiple beam strikes on a dual control system

The screen above, shows three beams striking the right SR300 and two striking the left SR300 receiver.

For a single control system, the presence of multiple beams are depicted in the screen below.

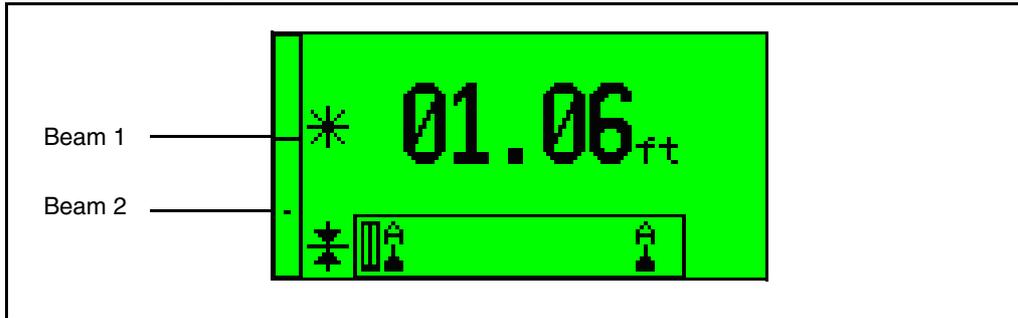


Figure 7.4 SR300 multiple beam strikes on a single control system

Beam 1 is the original beam and Beam 2 is the newly detected beam.

When the presence of multiple beams are detected, the following process will allow you to select the correct beam to control the AG GCS system.

1. Press either **ESC** or **OK**. A screen similar to the following appears:

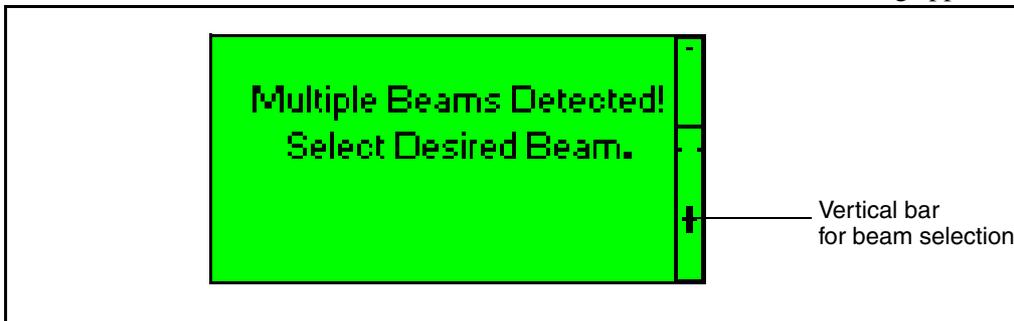


Figure 7.5 Select desired beam

Note – If there are no multiple beams, the screen will not be displayed.

The strike bar for the side being benched will be displayed. These bench buttons are only active when in Manual mode.

A vertical bar is used to indicate the selected beam.

2. Toggle either **↓** switch to select the desired beam. The vertical bar will move up or down. When the vertical bar is over the correct beam, press **OK** to bench the SR300 to the selected beam and return to the runtime screen.
3. Press the **ESC** button to bench that side to the originally selected beam and return to the runtime screen.

If multiple beams are detected on both receivers on a dual system, repeat Step 1 to Step 3 for the other receiver.

When an originally non-selected beam is selected via either **↓** switch, the width of that beam's strike bar widens so that it is more visible while being selected.

The selected beam will only change to full width after returning to the runtime screen.



Caution – The selected beam will not be restored after a power cycle. If different numbers or locations of beams are detected on a power cycle, or if the machine has moved, it may be impossible to determine which one is the valid beam. Once detected, the operation of selecting the correct beam should be performed immediately to avoid incorrect control and grade errors.

Returning to the Runtime Screen

On return to the runtime screen, the system will be benched to the selected beam. See below for an example of a dual runtime screen benched on the right side.



Field Methods When Using a Blade Slope Sensor

In this chapter:

- Introduction
- Using Blade Slope Only
- Using Blade Slope with Elevation

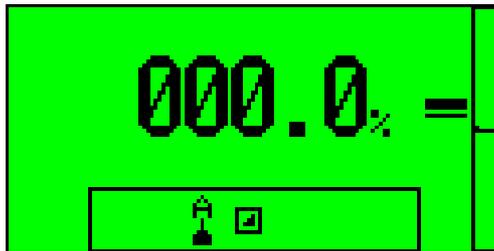
8.1 Introduction

This chapter explains some of the concepts and field procedures that you need to understand to use blade slope on the AG GCS300 and AG GCS400 systems.

8.2 Using the Blade-Slope Only System

Complete the following steps to operate a blade-slope only system:

1. Turn on the CB415. The system detects that only the blade slope sensor is connected to the machine. A screen similar to the following appears:

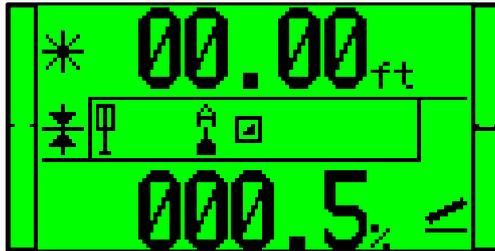


2. To enter the required blade slope, toggle the  switch up on the side that the slope will be controlling to increase the value, or toggle the  switch down to decrease the value.
3. If required, press  to swap the slope angle.
4. Position the elevation select switch to the elevation side that will be manually controlled.
5. Press the Auto/Manual remote button. The blade automatically moves to the entered slope.

8.3 Using the Blade Slope with Elevation

With a Level 2/AG GCS400 system, both blade slope and elevation can be controlled. To use both elevation and blade slope sensors, complete the following steps:

1. Turn on the CB415. The system detects which devices are connected to the machine. A screen similar to the following appears:



2. Make sure the Elevation Select switch ($\frac{\uparrow}{\downarrow} / \frac{\uparrow}{\downarrow}$) is switched to the side that the elevation sensor is mounted. Blade slope will be controlled on the opposite side.

For example, if a laser receiver is mounted on the left side of the blade, then the Elevation Select switch should be switched to the left ($\frac{\uparrow}{\downarrow}$) side and blade slope will be controlled on the right.

Note – When using a single laser receiver AG GCS400 system, the mast must always be mounted in the center of the blade and the Elevation Select switch should be on the left ($\frac{\uparrow}{\downarrow}$) side, as shown in the screen above.

3. To enter the required blade slope, toggle the \updownarrow switch up on the side that the slope will be controlling to increase the value, or toggle the \updownarrow switch down to decrease the value.
4. If required, press $\triangleleft \triangleright$ to swap the slope angle.
5. Position the elevation select switch to the elevation side that will be manually controlled.
6. Press the Auto/Manual remote button. The blade automatically moves to the entered slope.

Troubleshooting

In this appendix:

- Introduction
- Troubleshooting the CB415 Dual Control Box
- Fault Messages
- System Maintenance

A.1 Introduction

This appendix helps you to identify and solve common problems that may occur. Please read this appendix before contacting your Trimble dealer.

A.2 Troubleshooting the CB415 Dual Control Box

Good troubleshooting techniques can significantly reduce the time it takes to isolate a problem and, ultimately, the length of downtime.

Try to isolate the problem. Accumulate all relevant information. The more information you can provide for the support personnel, the less time it will take them to solve your problem.

Automatic control is unstable

- Make sure no other laser transmitter(s) is operating in the area. If another laser transmitter is operating, offset the elevation of the laser transmitter and/or flip down the beam attenuators, if applicable, on the other laser transmitter(s) to block the laser beam in your direction.
- Put the system in manual control and set the blade on the ground. If the grade LEDs are still erratic, check the stability or calibration of the laser transmitter.
- Check the tripod of the laser transmitter to make sure that all bolts and locking knobs are tight and that the tripod feet are firmly pushed into the ground.
- Adjust the valve speed. For more information, see Section 6.3.2, Valve Speed, page 69.
- If the problem persists call your Trimble dealer.

CB415 does not power up

- Check the cable and connections into the CB415. Tighten all connections and replace any cable that is cut or that has bare wires showing.
- Check the fuses.
- Check the cable and connections between the CB415 and the PM400 power module. Tighten all connections and replace any cable that is cut or has bare wires showing.
- Check the cable and connections between the PM400 and the battery. Tighten all connections and replace any cable that is cut or has bare wires showing.
- Toggle the power/setup switch between the **I** and **O** positions. If the CB415 still does not power up, call your Trimble dealer.

LCD shows a gray left/right laser receiver icon

- Check all the cables and connections from the CB415 to the EM400 electric mast and to the left/right laser receiver. Tighten all connections and replace any cable that is cut or has bare wires that are showing.
- If the laser receiver still does not operate and the icon is still gray, call your Trimble dealer.

LCD shows a gray left/right mast icon when an EM400 electric mast is being used on the machine

- Check all the cables and connections between the CB415 and the left/right EM400 electric mast. Tighten all connections and replace any cable that is cut or has bare wires that are showing.
- If the left/right mast still does not move and the icon is still gray, call your Trimble dealer.

LCD shows a gray left/right sonic tracer icon when a sonic tracer is being used on the machine

- Check all the cables and connections between the CB415 and the left/right sonic tracer. Tighten all connections and replace any cable that is cut or has bare wires that are showing.
- If the left/right sonic tracer still does not operate and the icon is still gray, call your Trimble dealer.

LCD shows gray slope sensor icon when blade slope is being used on the machine

- Check all the cables and connections between the blade slope sensor and the CB415 control box. Tighten all connections and replace any cable that is cut or has bare wires that are showing.
- If any of the rotation and slope sensors still does not operate and the icon is still gray, call your Trimble dealer.

Remote switch assemblies does not let the system into automatic, manual, or initiate an offset

- Check the affected remote switch assembly connection and make sure that the connection is tight and the icon is not grayed out.
- Check that the remote switch is properly configured.
- Check the remote switch operation by using the *Test Control Box* item in the *Diagnostics* menu. For more information, see *Test Control Box*, page 106.

A.3 Fault Messages

The CB415 provides fault codes and fault messages to help you troubleshoot any system problems.

When a fault is detected, a message appears on the LCD. There are two kinds of faults:

- A function has been initiated but the function cannot be carried out.
- A fatal error where something must be repaired or replaced.

The system stores the last five fault messages generated. For more information, see Sensor Data, page 103.

A.3.1 CB415 dual control box fault messages

Fault Number	Message	Cause	Solutions
6	Wrong Blade Motion, Check Valve	The hydraulics and/or the valve wiring is reversed.	<ul style="list-style-type: none"> • Replumb and/or rewire the valves and recalibrate the valves. • Service is required.
8	No Blade Movement, Check Valve	The CB415 requested valve movement but the valve took too long to get to the desired position.	<ul style="list-style-type: none"> • Check that the laser transmitter setup is stable. • Check that the valve is working correctly by using the <i>Test Valves</i> option in the <i>Diagnostics</i> menu.
10	Set Limits Fault, Restart	The blade has moved outside the upper or lower calibration limits during the valve calibration.	<ul style="list-style-type: none"> • Widen the upper and lower valve calibration limits. • Recalibrate the valves.
11	Low Voltage, Service	Low voltage has been observed. This often occurs on machine startup.	<ul style="list-style-type: none"> • Check the system is correctly connected to the power supply of the machine. • Check that the electrical system of the machine is functioning properly.
12	System Hours Lost, Continue	Frequent occurrence of this problem indicates that the CB415 is faulty.	<ul style="list-style-type: none"> • Replace the CB415. • Service is required.
15	Memory Fault, Service	The program in the flash memory has been corrupted due to the CB415 firmware being updated. Any other occurrence indicates that the CB415 is faulty.	<ul style="list-style-type: none"> • Replace the CB415 if the CB415 is faulty. • Service is required.
16	Linked Sensor Missing, Check Connections	A SR300, LR400 or an EM400 is not communicating with the CB415.	<ul style="list-style-type: none"> • Check that both laser receivers are connected to the system. • Check all cables and connections.

Fault Number	Message	Cause	Solutions
17	Network Fault, Service	There is a problem with the cables to the CB415.	<ul style="list-style-type: none"> • Check all cables and connections to the CB415. • Turn off the system at the power source, then turn on the system at the power source.
18	Network Fault, Service	There is a problem with the cable harness.	<ul style="list-style-type: none"> • Check cable termination. • Service is required.
19	Network Fault, Service	There is a problem with the cable harness.	<ul style="list-style-type: none"> • Check cable termination. • Service is required.
20	CAN Controller Hardware Error	There is a problem with the cable harness.	<ul style="list-style-type: none"> • Check cable termination. • Service is required.
21	Remote AM Switch Fault, Service	The remote switch's Auto/Manual button is not detected by the system.	<ul style="list-style-type: none"> • Check that the remote switch is connected to the system.
22	VM Missing, Service	The valve module is not detected by the system.	<ul style="list-style-type: none"> • Check that the valve module is connected to the system. • Check the valve module status LED is lit.
23	Unsupported Device, Cycle Power	<p>There is an internal failure in one of the devices in the system.</p> <p>There is an unknown device detected.</p>	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source.
24	Duplicate Left/Right Device, Service	Two devices connected to the system are considered to be the same. For example, two left EM400s are detected.	<ul style="list-style-type: none"> • Check that the correct devices are connected to the system. • Check the cable harness. • Service is required.

A Troubleshooting

Fault Number	Message	Cause	Solutions
25	←Elevation Limit, Check Bench	The left LR400 cannot work to the required offset. This can be due to the left EM400 being fully extended or fully retracted.	<ul style="list-style-type: none">• Reset the elevation offset.
26	Elevation Limit→, Check Bench	The right LR400 cannot work to the required offset. This can be due to the right EM400 being fully extended or fully retracted.	<ul style="list-style-type: none">• Reset the elevation offset.
27	Internal Fault. Cycle Power	Internal error in the CB415.	<ul style="list-style-type: none">• Turn off the system at the power source, then turn on the system at the power source.• Replace the unit if required.
28	Invalid Serial Number, Service	There is a fault with the CB415.	<ul style="list-style-type: none">• Replace the CB415.• Service is required.
29	VM Intermittent, Check Connection	The valve module was disconnected from the system and then reconnected. This could be due to a wiring fault.	<ul style="list-style-type: none">• Check that the Valve Module is connected correctly.• Check for a faulty power line.
30	Duplicate Serial Number, Service	More than one device in the system has the same serial number.	<ul style="list-style-type: none">• Service is required.
31	Recalibrate Linked Mode Elevation	The calibration for Linked Elevation mode has failed.	<ul style="list-style-type: none">• Recalibrate the Linked Elevation mode.
33	VM Fault, Service	The Valve Module is not communicating reliably with the CB415.	<ul style="list-style-type: none">• Check all cables and connections between the Valve Module and the CB415.• If the fault reoccurs, service is required.

Fault Number	Message	Cause	Solutions
34	VM Fault, Service	The Valve Module is not communicating reliably with the CB415.	<ul style="list-style-type: none"> • Check all cables and connections between the Valve Module and the CB415. • If the fault reoccurs, service is required.
35	VM Fault, Service	The Valve Module was detected when the AG GCS400 was turned on, but was then temporarily disconnected.	<ul style="list-style-type: none"> • Check all cables and connections between the Valve Module and the CB415. • If the fault reoccurs, service is required.
38	Angle Sensor Fault, Service	Blade slope sensor is providing erratic data	<ul style="list-style-type: none"> • Replace blade slope sensor. • Service required.
40	Laser Receiver Fault, Service	Laser receiver is providing erratic data.	<ul style="list-style-type: none"> • Laser receiver may be too close to laser transmitter. Make sure the transmitter is at least 20 m (60 ft) away. • Replace laser receiver.
41	Control Latency, Cycle Power	Large latency between the left elevation or blade slope sensor and the CDB420	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source.
42	Control Latency, Cycle Power	Large latency between the right elevation or blade slope sensor and the CDB420	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source.
43	Laser Interference, Check Setup	Laser receiver picking up interference from a secondary beam	<ul style="list-style-type: none"> • Check to see if there is a second laser transmitter or strobe lights operating in the vicinity.
44	Laser Interference, Check Setup	Laser receiver picking up interference from strobe lights	<ul style="list-style-type: none"> • Check to see if there is a second laser transmitter or strobe lights operating in the vicinity.

A Troubleshooting

Fault Number	Message	Cause	Solutions
46	Slope ratio out of limits	The current slope displayed on the CB415 is not within an acceptable range to be display by a ratio.	<ul style="list-style-type: none">• Enter a suitable slope into the CB415 (between 1:1 and 1:25).
47	Sensor Missing, Check Harness	A required sensor is either missing or not detected.	<ul style="list-style-type: none">• Check that all sensors are present.• Check cables and connections between all sensors and the CB415.
48	Invalid Password	Premium Option Password Invalid.	<ul style="list-style-type: none">• Try entering your password again.
49	Password Expired	The demo password has expired.	<ul style="list-style-type: none">• The demo password only lasts for 40 hrs.
50	Serial Number Fault, Service	CAN serial number is invalid.	<ul style="list-style-type: none">• Contact your Trimble dealer for service.
52	Sensor Not Supported, Reconfigure	Disallowed sensor is detected.	<ul style="list-style-type: none">• Remove disallowed sensor.
54	← Slope Limit, Continue	The left slope value is outside the allowable range.	<ul style="list-style-type: none">• Reboot CB415.• Adjust slope value on left side within range.
55	Slope Limit →, Continue	The right slope value is outside the allowable range.	<ul style="list-style-type: none">• Reboot CB415.• Adjust slope value on right side within range.
57	Password Expired	The service admin password has expired.	<ul style="list-style-type: none">• Contact your Trimble dealer for a new password.
58	Valve Interface Mismatch, Service	Valve type interface for left and right valves mismatch.	<ul style="list-style-type: none">• Replace one of the valves so that both the left and the right side match.
59	Calibration Fault, Check Setup	Blade control is not allowed by system.	<ul style="list-style-type: none">• Check system level in machine setup.

Fault Number	Message	Cause	Solutions
60	SR300 Not Found, Check Connection	An SR300 was not detected after configuration.	<ul style="list-style-type: none"> • Only one SR300 should be plugged in during SR300 configuration. • Plug only one SR300 in and cycle power. Try configuring again.
61	Service Agreement Expired	The service agreement has expired.	<ul style="list-style-type: none"> • Contact your Trimble dealer for a new password.
62	VM Fault, Service	Attempted to read a VM parameter edit and failed.	<ul style="list-style-type: none"> • Contact Trimble dealer support.
63	Calibration Fault, Check Setup	Time out of valve calibration state because the cylinder is at end of travel, or because of a faulty cable.	<ul style="list-style-type: none"> • Adjust laser height. • Check cables.

A.3.2 VM410 valve module fault messages

Fault Number	Message	Solutions
1	Memory Fault. Set Valve Type and Recalibrate	<ul style="list-style-type: none"> • Check that correct Valve Module is selected • Recalibrate the valves.
2	Memory Fault. Service	<ul style="list-style-type: none"> • Check that correct Valve Module is selected.
5	Internal Fault Service	<ul style="list-style-type: none"> • Replace the valve module component if problem persists. • Service is required.
7	Communication Fault, Service	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
8	Duplicate VM4xx Detected, Check Connection	<ul style="list-style-type: none"> • Check the cables to the valve modules for proper installation. • Check the function instance lines in the cable to verify there are no shorts or opens on these lines. The function instance must be different for each valve module on a CAN network.
10	←Valve Hardware Fault, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Check that the left valve is working correctly. • Service is required.
11	Valve Hardware Fault→, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Check that the right valve is working correctly. • Service is required.
12	Multiple VM4xx Detected, Service	<ul style="list-style-type: none"> • Check that there is only one valve module connected to the system. • Service is required.

Fault Number	Message	Solutions
13	Communication Fault, Service	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
14	Internal Failure, Service	<ul style="list-style-type: none"> • Replace the valve module component. • Service is required.
15	Too many devices in the network, Service	<ul style="list-style-type: none"> • Make sure the correct components are connected to the system. • Service is required.
16	Memory Fault, Cycle Power	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
17	Valve Drive Failure, Service	<ul style="list-style-type: none"> • Check that the valves are working properly. • Service is required.
18	Valve Drive Failure, Service	<ul style="list-style-type: none"> • Check the drive signal. • Service is required.
19	Valve Drive Failure, Service	<ul style="list-style-type: none"> • Replace Valve module. • Service is required.
20	Valve Drive Failure, Service	<ul style="list-style-type: none"> • Replace Valve module. • Service is required.
21	Function Instance Failure, Service	<ul style="list-style-type: none"> • Check function instance of Valve Module • Service is required.
22	Load Sense Shorted, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
23	Control Signal Shorted, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
24	Memory Fault, if persists Service	<ul style="list-style-type: none"> • If problem persists, replace Valve module. • Service is required.

A Troubleshooting

Fault Number	Message	Solutions
25	Valve Control Signal Failure, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
26	Overcurrent Lower →, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
27	←Overcurrent Raise, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
28	←Overcurrent Raise, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
29	Valve Return Fault→, Service	<ul style="list-style-type: none">• Service is required.
30	←Valve Return Fault, Service	<ul style="list-style-type: none">• Service is required.
31	Critical Fault, Service	<ul style="list-style-type: none">• Service is required.
32	Low Voltage, Service	<ul style="list-style-type: none">• Check that machine voltage is between 9 VDC and 32 VDC

A.3.3 VM415 valve module fault messages

Fault Number	Message	Solutions
1	Memory Fault. Set Valve Type and Recalibrate	<ul style="list-style-type: none"> • Check that correct Valve Module is selected • Recalibrate the valves.
5	Internal Fault Service	<ul style="list-style-type: none"> • Replace the valve module component if problem persists. • Service is required.
7	Communication Fault, Service	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
8	Duplicate VM4xx Detected, Check Connection	<ul style="list-style-type: none"> • Check the cables to the valve modules for proper installation. • Check the function instance lines in the cable to verify there are no shorts or opens on these lines. The function instance must be different for each valve module on a CAN network.
12	Multiple VM4xx Detected, Service	<ul style="list-style-type: none"> • Check that there is only one valve module connected to the system. • Service is required.
13	Communication Fault, Service	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
14	Internal Failure, Service	<ul style="list-style-type: none"> • Replace the valve module component. • Service is required.
15	Too many devices in the network, Service	<ul style="list-style-type: none"> • Make sure the correct components are connected to the system. • Service is required.

A Troubleshooting

Fault Number	Message	Solutions
16	Memory Fault, Cycle Power	<ul style="list-style-type: none">• Turn off the system at the power source, then turn on the system at the power source.• If this does not fix the problem service is required.
17	Valve Drive Fault, Service	<ul style="list-style-type: none">• Check that the valves are working properly.• Service is required.
18	Valve Drive Fault, Service	<ul style="list-style-type: none">• Check the drive signal.• Service is required.
19	Valve Drive Fault, Service	<ul style="list-style-type: none">• Replace Valve module.• Service is required.
20	Valve Drive Fault, Service	<ul style="list-style-type: none">• Replace Valve module.• Service is required.
21	Function Instance Fault, Service	<ul style="list-style-type: none">• Check function instance of Valve Module• Service is required.
23	Control Signal Shorted, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
24	Memory Fault, Cycle Power	<ul style="list-style-type: none">• If problem persists, replace Valve module.• Service is required.
26	Serial Number Fault, Service	<ul style="list-style-type: none">• Attempt to write the serial number again.
27	Serial Number Fault, Service	<ul style="list-style-type: none">• Replace Valve module.
28	Serial Number Fault, Service	<ul style="list-style-type: none">• Replace Valve module.

A.3.4 VM420 valve module fault messages

Fault Number	Message	Solutions
1	Memory Fault, Continue	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source.
2	Memory Fault. Service	<ul style="list-style-type: none"> • Check that correct Valve Module is selected.
5	Internal Failure, Service	<ul style="list-style-type: none"> • Replace the valve module component if problem persists. • Service is required.
7	Communication Fault, Service	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
8	Duplicate VM4xx Detected, Check Connection	<ul style="list-style-type: none"> • Check the cables to the valve modules for proper installation. • Check the function instance lines in the cable to verify there are no shorts or opens on these lines. The function instance must be different for each valve module on a CAN network.
10	←Valve Hardware Fault, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Check that the left valve is working correctly. • Service is required.
11	Valve Hardware Fault→, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Check that the right valve is working correctly. • Service is required.
12	Multiple VM4xx Detected, Service	<ul style="list-style-type: none"> • Check that there is only one valve module connected to the system. • Service is required.

A Troubleshooting

Fault Number	Message	Solutions
13	Communication Fault, Service	<ul style="list-style-type: none">• Turn off the system at the power source, then turn on the system at the power source.• If this does not fix the problem service is required.
14	Internal Failure, Service	<ul style="list-style-type: none">• Replace the valve module component.• Service is required.
15	Too many devices in the network, Service	<ul style="list-style-type: none">• Make sure the correct components are connected to the system.• Service is required.
16	Memory Fault, Cycle Power	<ul style="list-style-type: none">• Turn off the system at the power source, then turn on the system at the power source.• If this does not fix the problem service is required.
17	Valve Drive Failure, Service	<ul style="list-style-type: none">• Check that the valves are working properly.• Service is required.
18	Valve Drive Failure, Service	<ul style="list-style-type: none">• Check the drive signal.• Service is required.
19	Valve Drive Failure, Service	<ul style="list-style-type: none">• Replace Valve module.• Service is required.
20	Valve Drive Failure, Service	<ul style="list-style-type: none">• Replace Valve module.• Service is required.
21	Function Instance Fault, Service	<ul style="list-style-type: none">• Check function instance of Valve Module.• Service is required.
22	Load Sense Shorted, Service	<ul style="list-style-type: none">• Check for short circuits in VM cabling.• Service is required.
23	Control Signal Shorted, Service	<ul style="list-style-type: none">• Check the signal line from the VM400 to the valve. Look for a shorted condition.

Fault Number	Message	Solutions
24	Memory Fault, Cycle Power	<ul style="list-style-type: none"> • Turn off the system at the power source, then turn on the system at the power source. • If this does not fix the problem service is required.
25	Overcurrent Raise →, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
26	Overcurrent Lower →, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
27	←Overcurrent Raise, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
28	←Overcurrent Raise, Service	<ul style="list-style-type: none"> • Check for short circuits in VM cabling. • Service is required.
29	Valve Return Fault→, Service	<ul style="list-style-type: none"> • Service is required.
30	←Valve Return Fault, Service	<ul style="list-style-type: none"> • Service is required.
31	Critical Fault, Service	<ul style="list-style-type: none"> • Service is required.
32	Low Voltage, Service	<ul style="list-style-type: none"> • Check that machine voltage is between 9 VDC and 32 VDC

A.3.5 Remote switch fault messages

Fault Number	Message	Solution
1	Shorted to Ground	<ul style="list-style-type: none"> • Repair or replace cables. • Service is required.
2	Shorted to Power	<ul style="list-style-type: none"> • Repair or replace cables. • Service is required.
3	Lost Switch	<ul style="list-style-type: none"> • Diagnose using the <i>Test Control Box</i> screen. • Service is required.

A.3.6 LR400 laser receiver fault messages

Fault Number	Message	Cause	Solution
20	End of Travel	Attempted an elevation offset greater or less than the travel limits of the receiver.	<ul style="list-style-type: none"> • Adjust laser height.
21	Check connection	<ul style="list-style-type: none"> • The device is not connected to the system when the system is powered up • The connection to the device is faulty 	<ul style="list-style-type: none"> • Check the cables and the connection to the device

A.3.7 LR410 laser receiver fault messages

Fault Number	Message	Solution
0	Communication Fault, Service	<ul style="list-style-type: none"> • Check the harness • Service is required
1	Memory Fault, Continue	<ul style="list-style-type: none"> • If problem persists, replace laser receiver • Service is required
2	Memory Fault, Service	<ul style="list-style-type: none"> • If problem persists, replace laser receiver • Service is required
5	Serial Number Fault, Service	<ul style="list-style-type: none"> • Replace laser receiver • Service is required
6	Flash Program Fault, Retry	<ul style="list-style-type: none"> • Service is required
148	End of Travel	<ul style="list-style-type: none"> • Adjust laser height • Rebench laser receiver

A.3.8 EM400 electric mast fault messages

Fault Number	Message	Solution
1	Internal Fault, Service	Service is required.
2	Limit Switch Fault, Service	<ul style="list-style-type: none"> • Repair or replace cables. • Service is required.
15	Motor/Encoder Fault, Service	<ul style="list-style-type: none"> • Repair or replace cables. • Service is required.
21	Elevation Fault, Verify Bench	<ul style="list-style-type: none"> • Press Reset button.
23	Memory Fault, Service	<ul style="list-style-type: none"> • Service is required.
24	Memory Fault, Service	<ul style="list-style-type: none"> • Service is required.

A Troubleshooting

Fault Number	Message	Solution
25	Memory Fault, Service	<ul style="list-style-type: none">• Service is required.
26	Memory Fault, Service	<ul style="list-style-type: none">• Service is required.
29	Internal Fault, Service	<ul style="list-style-type: none">• Repair or replace cables.• Service is required.
30	Motor/Encoder Fault, Service	<ul style="list-style-type: none">• Service is required.
31	Memory Fault, Service	<ul style="list-style-type: none">• Service is required.
32	Check Connection	<ul style="list-style-type: none">• The device is connected to the system when the system is powered up.• The connection to the device is faulty.

A.3.9 AS400 blade slope sensor fault messages

Fault Number	Message	Solution
1	Memory Fault, Continue	• If problem persists, service is required.
2	Memory Fault, Service	• Service is required.
4	Serial Number Fault, Service	• Service is required.
5	Serial Number Fault, Service	• Service is required.
6	Flash Program Fault, Retry	• Service is required.

A.3.10 SR300 receiver mast fault messages

Fault Number	Message	Solution
20	End of Mast travel	• adjust laser height

A.4 System Maintenance

The system requires little maintenance. Occasionally, however, adjustments are necessary. These adjustments are straightforward and do not require technical training.

The common maintenance issues involved with the laser system are as follows:

- Routinely calibrate the laser transmitter to maintain accuracy. Calibration instructions are included with the unit.
- When maintenance of the hydraulic system on the machine is carried out, adjustment of the hydraulic valves may be required. Speed control for raising and lowering the cutting edge of the machine can be adjusted in the *Valve Speed* menu.
- Inspect the cables daily to make sure the cables are not cut or pulled during operation. Repair or replace the cables as required.
- Periodically inspect the drain holes for clogging. Both the CB415 and EM400 have built-in drain holes located on the side or bottom of the unit.
- Routinely check the machine sensor calibration to ensure accurate slope control. Calibration of the sensors can be found in the *Blade Slope Calibration* menu.

A.5 Machine Maintenance

Some of the machine maintenance problems that may affect control system accuracy are:

- blade wear
- blade curvature
- voltage problems

Always perform regularly scheduled maintenance to keep the machine tight and operating at peak performance.

Setting Up a GL7xx Laser Transmitter

In this appendix:

- Setup Rules for a Laser Transmitter
- Level Laser Transmitter Setup and Operation
- Single- or Dual-Grade Laser Transmitter Setup and Operation
- Precise Laser Transmitter Alignment

B.1 Setup Rules for a Laser Transmitter

This section describes the rules to follow when you set up a Trimble GL720 laser transmitter.



Tip – The GL710, GL722 and GL742 models can also be used, the rules for these models should be similar to that of the GL720.

***Note** – Trimble recommends that you read and follow the operator's manual supplied with your laser transmitter. The following rules are for a Trimble GL720 laser transmitter.*

B.1.1 Laser transmitter placement and location rules

Before you begin work, decide where to place the laser transmitter for optimum coverage of the job site.

1. Place the laser transmitter on the job site where the laser transmitter is out of the way of traffic and is not obstructed by other equipment.
2. Try to make the most efficient use of the operating radius of the laser transmitter. Typical machine control laser transmitters have an operating range of up to 460 m (1500 ft). To improve accuracy, try to minimize the distance from the laser transmitter to the machine by placing the laser in the center of the working area or offset to one side.
3. Set the height of the tripod and the laser transmitter so that the laser beam will strike the laser receiver when the laser receiver is positioned correctly on the machine. Set the laser transmitter high enough so that the cab of the machine will not stop the laser beam from being detected by the laser receiver.
4. Make sure the location of the tripod and the laser transmitter is stable. Ground vibration and extremely windy conditions can affect the operation of the laser transmitter.

5. If you are working in very dusty conditions, place the laser transmitter up-wind. Dirt and dust will be blown away from the laser transmitter. This reduces the interference between the laser transmitter and the laser receivers.

B.1.2 Tripod rules

All GL720 laser transmitters have a $\frac{5}{8}$ -11 tripod mount on the bottom of the laser so that you can attach the laser transmitter to a standard tripod, column-clamp, laser trailer or other mounting device. The laser transmitter can also be used without a tripod, but the laser must be mounted on a stable surface.

When setting up a laser tripod perform the following steps:

1. Always check your tripod before beginning work.
2. Make sure all screws, bolts, and nuts are tight.
3. The chains between the tripod legs should be slightly loose to allow for thermal expansion during the day.
4. On extremely windy days, secure the tripod using sand bags on each leg.
5. If you are using a tripod with a quick disconnect and adapter, point the control lever on the tripod top into the wind. This places the locking cam into the wind and provides better stability against the wind.
6. Set up the tripod up as level as possible.

B.1.3 Laser transmitter operation rules

The following is a list of rules that ensure reliable performance from your laser transmitter:

1. Check the laser transmitter calibration. As with any precision instrument, the laser transmitter calibration needs to be checked on a regular basis, such as the beginning of each job, or if the laser transmitter has been handled roughly.

If the laser transmitter is to be used in temperatures that are below freezing, be sure to check the laser transmitter calibration under those conditions.

Make sure you follow the laser transmitter calibration procedure outlined in the operator's manual that is supplied with the laser transmitter.

2. Check the rotation speed of the laser transmitter. For machine control operation, set the head rotation speed of the laser transmitter to 600 rpm or higher.
3. Make sure the laser transmitter has a sufficient charge to operate for the duration of the setup. For charging instructions, refer to your laser transmitter manual.
4. Make sure the laser transmitter is clean. For cleaning instructions, refer to your laser transmitter manual.

B.2 Level Laser Transmitter Setup and Operation

To set up a level laser, perform the following steps:

1. Set the height of the laser transmitter so that the laser beam will strike the laser receiver when the laser receiver is positioned correctly on the machine.
2. Press the power button to turn on the laser transmitter and allow the laser transmitter to self-level. The laser transmitter always powers up in the automatic self-leveling mode. When the head begins rotating, the laser is level.
3. Enter the percent of grade. Both the \angle (grade) and \blacktriangle (cross-slope) axes must have 0.000% entered into the LCD.

***Note** – Because no grade or cross-slope is entered into either axis of the laser transmitter, the axes of the laser transmitter do not need to be aligned. The laser transmitter will provide a flat and level laser reference in all directions (360°).*

B.3 Single- or Dual-Grade Laser Transmitter Setup and Operation

To set up a single- or dual-grade laser transmitter perform the following steps:

1. Set the height of the laser transmitter so that the laser beam will strike the receiver when the receiver is positioned correctly on the machine.
2. Press the power button to turn on the laser transmitter and allow the laser transmitter to self-level. The laser always powers up in the automatic self-leveling mode. When the head begins rotating, the laser is level.
3. Align the axes. Set up the laser directly over a reference point and use the sighting grooves on the top of the laser to align one axis (grade axis) to an alignment stake. See Figure B.1.

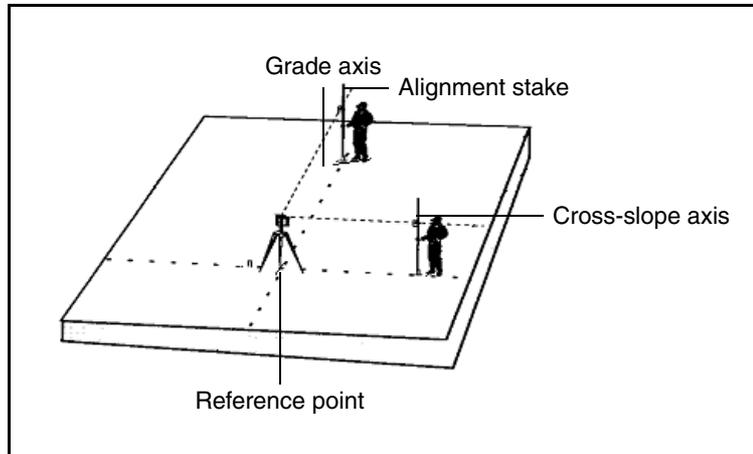


Figure B.1 Dual grade laser transmitter setup

Under most conditions, the sighting grooves on the top of the laser are adequate for alignment of the axes. However, for precise alignment use the precise alignment procedure outlined in Precise laser alignment instructions, page 161.

4. Enter the percent of grade required. One or both (\angle and \blacktriangle) axes of the laser transmitter must have a % grade entered into the LCD.

B.4 Precise Laser Transmitter Alignment

This section discusses precise laser transmitter alignment.

B.4.1 Do I need to align my laser transmitter precisely?

The laser transmitter requires precise alignment if you are:

1. using the laser transmitter on steeper slopes (1% or over)
2. working at long distances from the laser transmitter
3. requiring high accuracy for the job

If you need to precisely align the transmitter, see page 161.

The following scenario gives you some idea of the error that can be caused by misalignment of the laser.

Assume that a laser transmitter has a 1° misalignment to the left side of the true direction centerline and there is a 10 m distance between the direction centerline and cross axis point 2.

The grade in the direction axis is 0%. Figure B.2 shows this scenario.

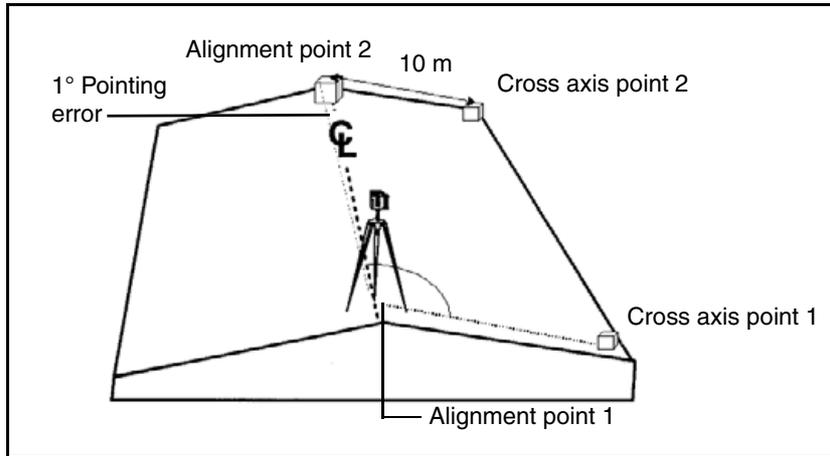


Figure B.2 Laser transmitter misalignment

The following table shows the errors that are associated with the misalignment:

Distance between Cross axis point 1 and point 2 (meters)	Cross Axis grade (%)	Elevation Error (meters)
10	2.5	0.004
30	2.5	0.013
100	2.5	0.131
10	10	0.017
30	10	0.052
100	10	0.523

B.4.2 Precise laser alignment instructions

If you need to align your laser transmitter precisely, follow the instructions set out below:

1. Set up the laser transmitter directly over a reference point. This is shown as Alignment point 1 in Figure B.3.
2. Press the power button to turn on the laser and allow the laser to self-level. The laser always powers up in the automatic self-leveling mode. When the head begins rotating, the laser is level.
3. Use the sighting grooves on the top of the laser transmitter to roughly align one axis to a second alignment stake. This is shown as Alignment point 2 in Figure B.3.
4. Enter a 0% grade into both axes (\angle and \blacktriangle).
5. Using a grade rod and laser receiver at point 2, adjust the laser receiver until you get an “on-grade” reading.
6. Enter a large value, for example +5.000%, into the cross-slope (\blacktriangle) axis. This means that the laser plane is raising to the right side of the laser transmitter. Figure B.3 shows these points.

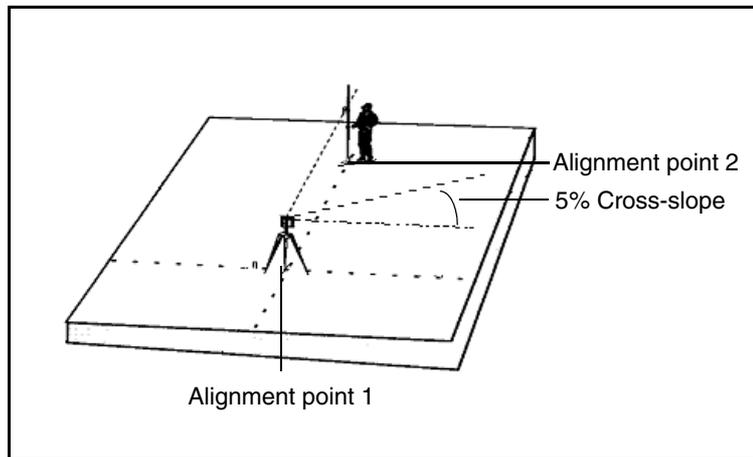


Figure B.3 Precise alignment of the laser transmitter

7. Take a second reading at Alignment point 2.

If the second reading is equal to the first reading, the axis is aligned correctly.

If the second reading is above “on-grade”, use the  button on the GL720 laser transmitter to internally rotate the axis **clockwise** until you get an “on-grade” reading again.

If the second reading is below “on-grade”, use the  button on the GL720 laser transmitter to internally rotate the axis **counter-clockwise** until you get an “on-grade” reading again.

8. The laser is now aligned, and you can enter the necessary percent of grade for the appropriate axes. For more information, see Step 4 on page 159.

***Note** – If you are using a Trimble GL722 laser transmitter equipped with a remote control, there is an automatic method of precise axis alignment available. Follow the instructions for automatic axis alignment in the GL720 Series Laser Transmitter Operator’s Manual.*

AG GCS Components

In this appendix:

- Introduction
- System Components
- Component Specifications

C.1 Introduction

This appendix outlines the system components and their specifications.

C.2 System Components

Depending on how the system is configured, the system can have the following on-board devices:

- a CB415 dual control box
- one or two LR400 or LR410 laser receivers
- a VM410, VM415 or VM420 valve drive module
- a PM400 power control module
- one or two masts
 - electric: EM400
 - electric: SR300
 - manual: MM2E or MM2M
- an AS400 blade slope sensor
- a remote-switch assembly
- a cable harness
- dual hydraulic control valve

Note – *Although not included with the system, if you are using laser receivers then a laser transmitter is required. Trimble offers a range of laser transmitters to suit many types of applications. For more information, contact your Trimble dealer.*

C.2.1 CB415 dual control box

The CB415 lets you set up and operate the system using the LCD, LED grade indicators, toggle switches, and buttons. For more information on the CB415, see Section 3.2, Features and Functions of the CB415, page 18.

C.2.2 LR400 laser receiver

The dual control system uses two LR400 laser receivers. The single-mast system uses one LR400 laser receiver. Use Figure C.1 to identify the LR400. The LR400 is a 360° omni-directional receiver that detects the laser beam and sends information about its elevation to the system. Each LR400 is mounted on an electric mast or a rigid manual mast.

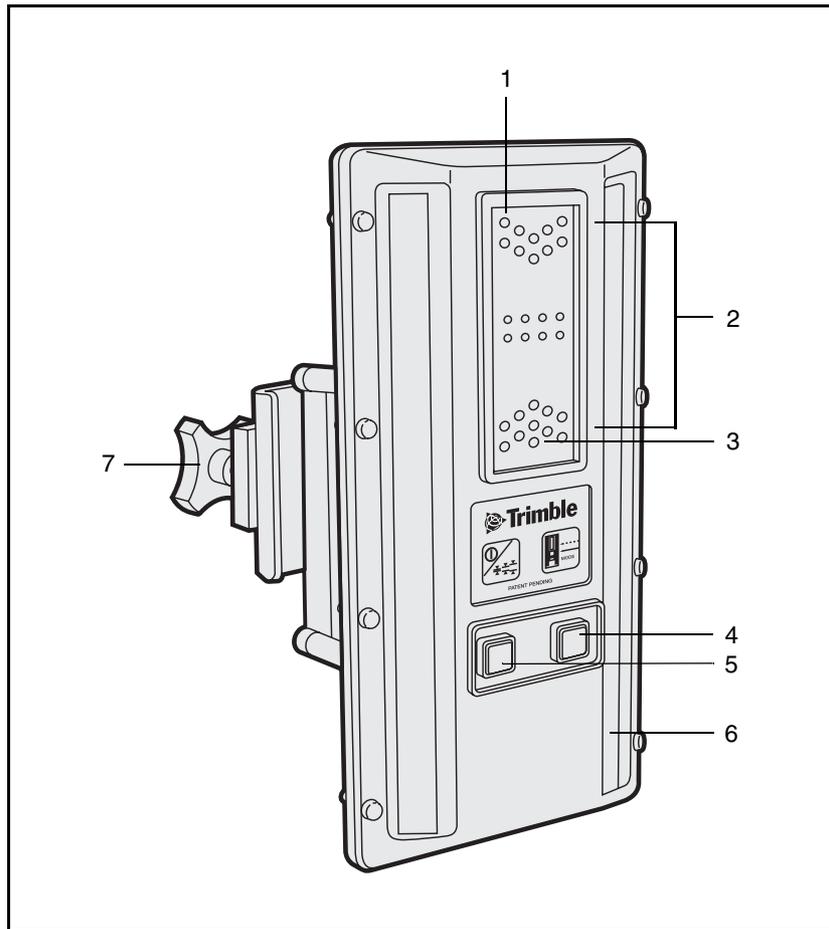


Figure C.1 LR400 laser receiver

Table C.1 outlines the features and functions of the LR400.

Table C.1 Features and functions of the LR400 Laser Receiver

Item	Feature	Function
1	Grade LEDs	Arrows indicate when the receiver is above or below grade. The arrows show the direction in which the receiver has to move to reach the correct elevation. A green line indicates that the receiver is on-grade. (The LEDs also show the distance from on-grade.)
2	Grade display	The display shows power status, on-grade band, mode selection, and grade information. The display also shows when the receiver has lost the laser beam, and the direction to move the receiver to find the beam.
3	Power LED	The LED shows whether the receiver is on or off. The LED is lit when the receiver is on and the Grade LEDs are off. The LED also flashes when the voltage to the LR400 is low.
4	Mode button	Use this button to select one of the receiver's three display modes. These modes are 5-Position, 7-Position, and Offset On-Grade. Note – When connected to a complete system, the mode button is inactive. The LR400 uses the 7-Position display mode and the error output is linear.
5	Power/On-Grade button	Use this button to turn the receiver on/off and change the sensitivity of the on-grade band (narrow, standard, and wide). Note – When connected to a complete system, the switches on the LR400 are not functional. Instead, all switches are controlled by the CB415. For more information about these functions, see the LR400 section of the <i>Display System Operator's Manual</i> .
6	Photo detectors	The detectors sense the laser beam when the laser beam hits the receiver.

Item	Feature	Function
7	Receiver clamp	The clamp attaches the receiver to multiple-sized mast poles, including sizes 38–50 mm (1½–2 inches) and 38–44 mm (1½–1¾ inches).
On the back (not shown)	Network adapter	This adapter connects the LR400 to the EM400 or machine power via cables. You can disconnect the LR400 from the adapter for storage.

C.2.3 SA400 network adapter

The SA400 network adapter connects the LR400 laser receiver to the system. Use Figure C.2 to identify the SA400.

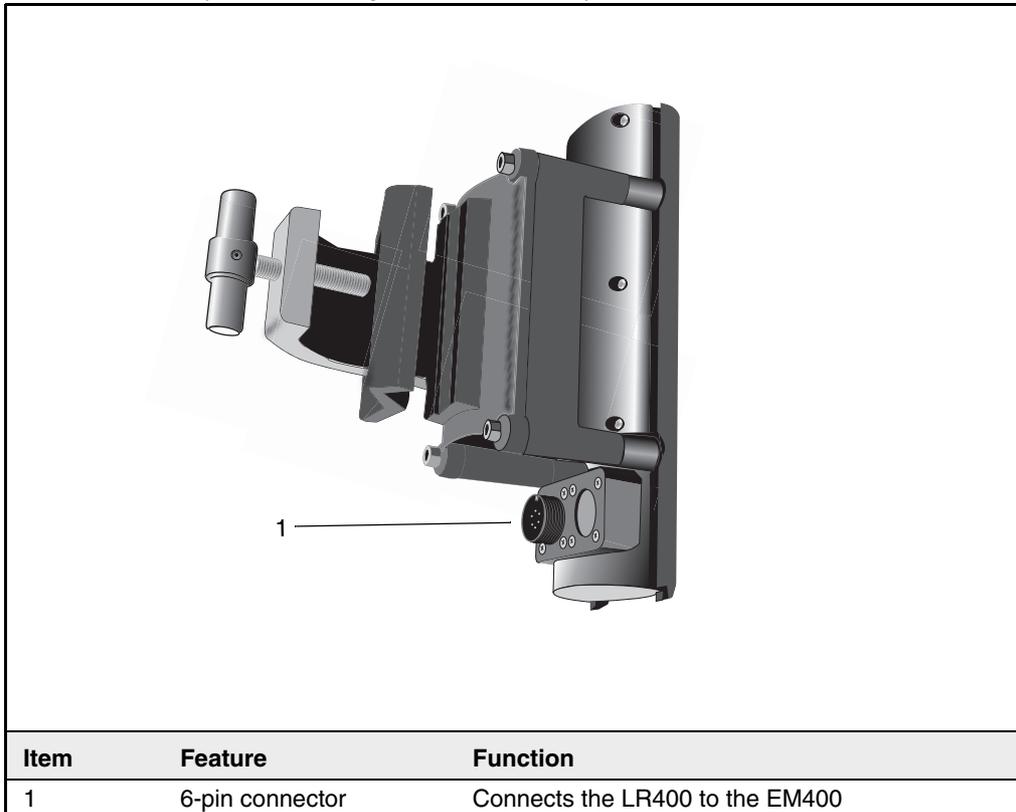


Figure C.2 SA400 network adapter

C.2.4 LR410 laser receiver

The dual control system uses two LR410 laser receivers. The single control system uses one LR410 laser receiver. Use Figure C.1 to identify the LR410. The LR410 is a 360° omni-directional receiver that detects the laser beam and sends information about its elevation to the system. Each LR410 is mounted on an electric mast or a rigid manual mast.

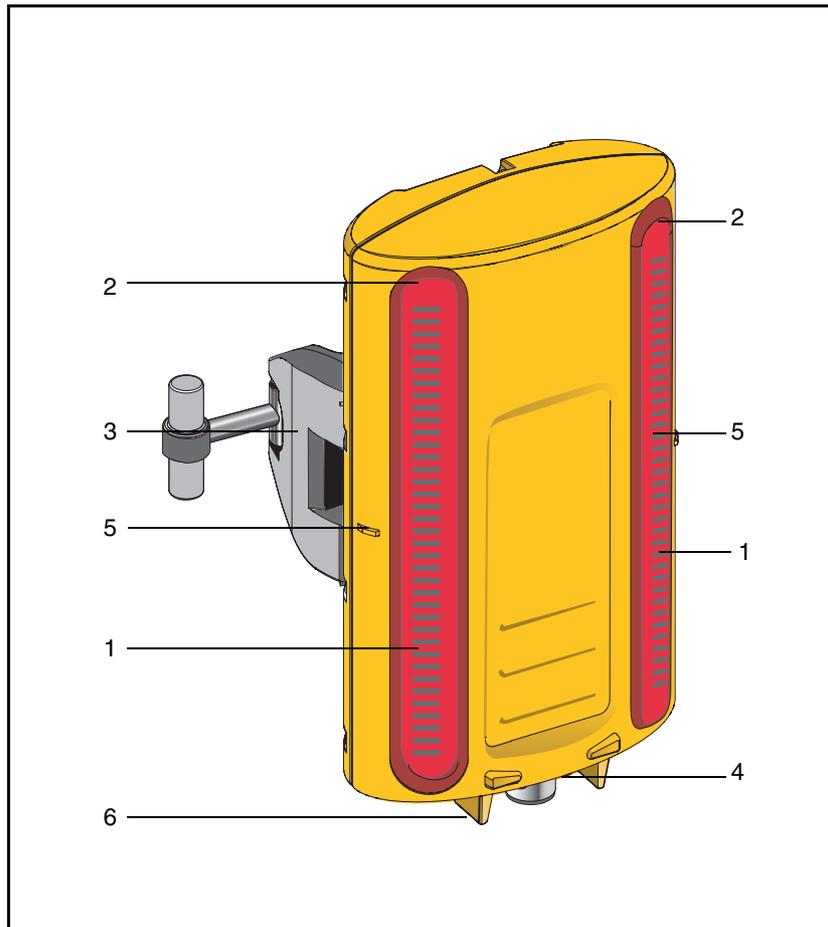


Figure C.3 LR410 laser receiver

Table C.1 outlines the features and functions of the LR410.

Table C.2 Features and functions of the LR410 Laser Receiver

Item	Feature	Function
1	Photo detectors	The detectors sense the laser beam when the laser beam hits the receiver. There are four photo detector windows (two on the front and two on the back) providing full 360° laser detection
2	Power LEDs	The LEDs show whether the receiver is on or off. The LEDs are lit when the receiver is on and the Grade LEDs are off. The LEDs also flash when the voltage to the LR410 is low.
3	Receiver clamp	The clamp attaches the receiver to multiple-sized mast poles, including sizes 38–50 mm (1½–2 inches) and 38–44 mm (1½–1¾ inches).
4	6-pin connector	Connects the LR410 to the EM400
5	Receiver center point notch	Marks the center of the photo detector window
6	Connector protection ribs	Helps protect the connector from damage.

C.2.5 SR300 receiver mast

The dual control system uses two SR300 receiver masts. The single control system uses one SR300 receiver mast. Use Figure C.4 to identify the SR300. The SR300 is a 360° omni-directional receiver that detects the laser beam and sends information about its elevation to the system.

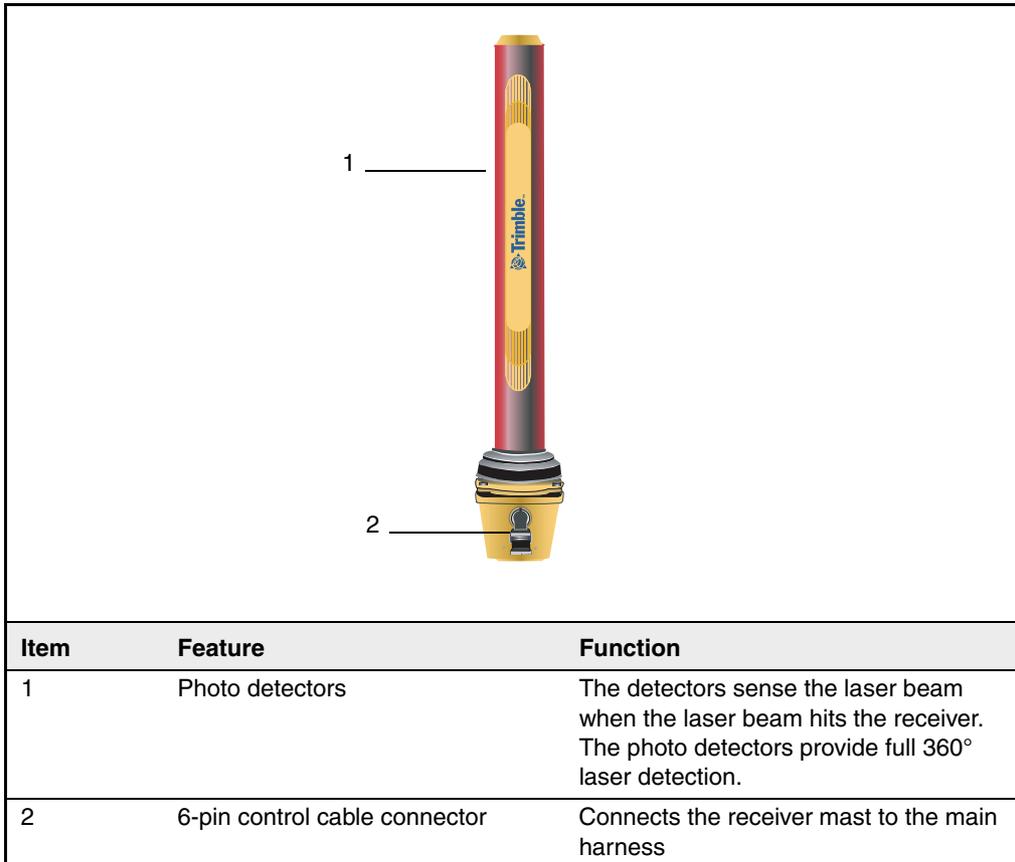


Figure C.4 SR300 receiver masts

C.2.6 EM400 electric mast

The dual control system uses two EM400 electric masts. The single-mast system uses one EM400 electric mast. The electric mast is a telescopic receiver mount that is driven by an electric motor. The mast raises and lowers the LR400 to locate the laser beam. Use Figure C.5 to identify the mast.

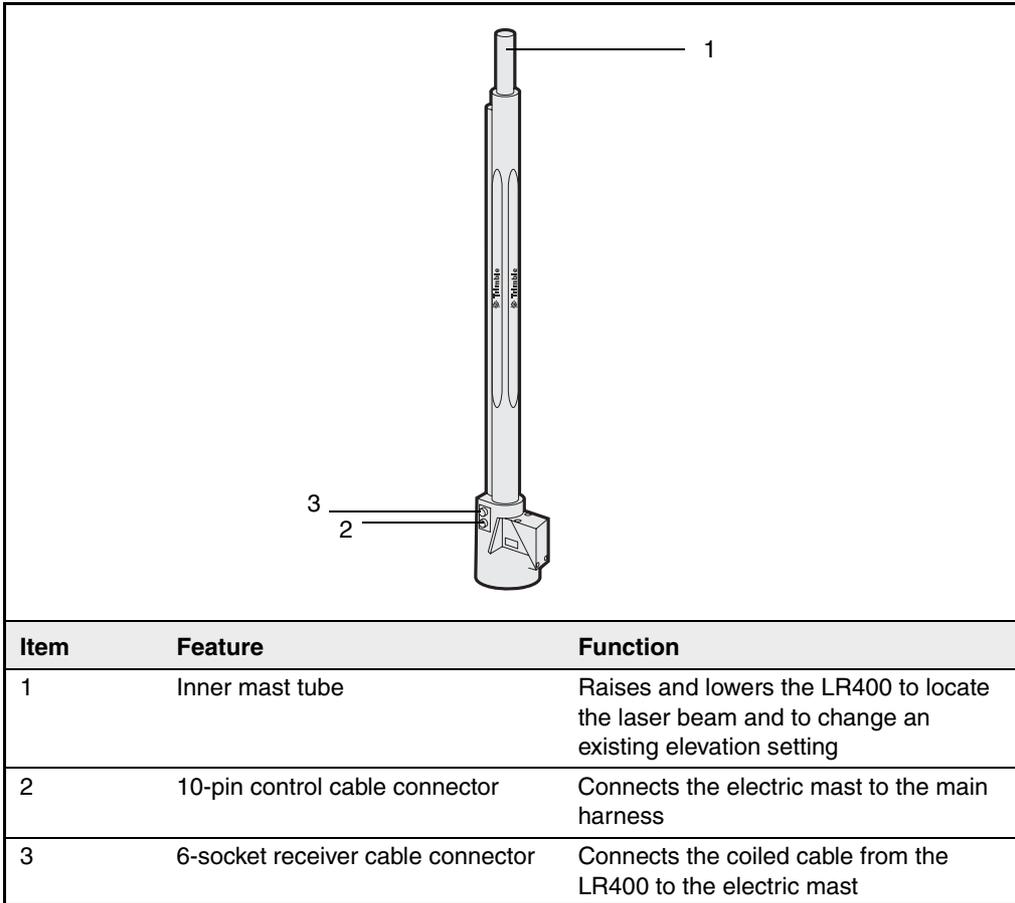


Figure C.5 EM400 electric mast

C.2.7 MM2X manual mast

The MM2E (English) and MM2M (metric) masts are telescoping receiver mounts that allow the LR400 to be manually raised and lowered. See Figure C.6.

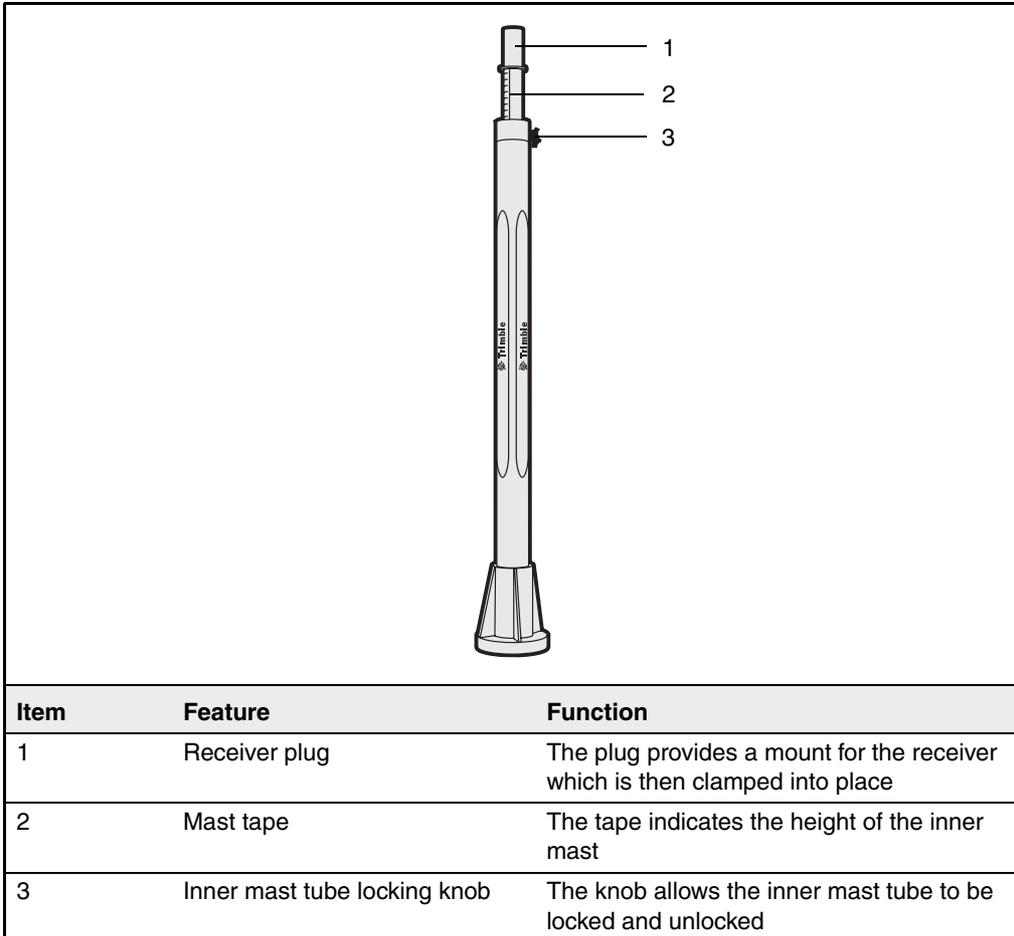


Figure C.6 MM2X manual mast

C.2.8 VM410 valve drive module

The VM410 valve drive module electrically controls the valves that position the cutting edge of the machine. Control signals are provided to proportional valves. If necessary, control signals are also provided to the load-sensing valve. Use Figure C.7 to identify the VM410.

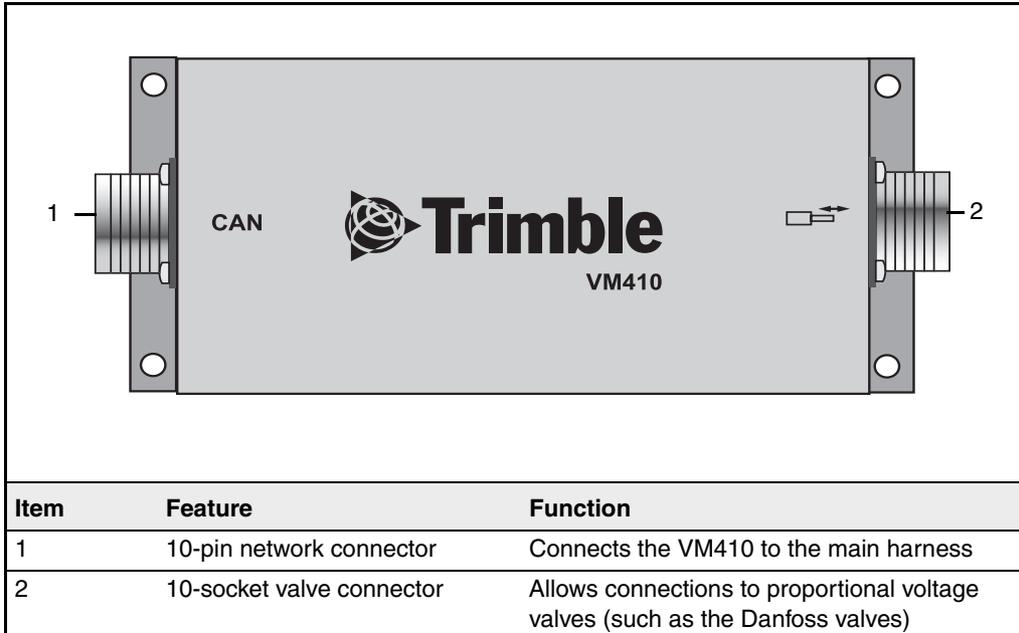


Figure C.7 VM410 valve drive module

C.2.9 VM415 valve drive module

The VM415 valve drive module electrically controls the valves that position the cutting edge of the machine. Control signals are provided to proportional valves. If necessary, control signals are also provided to the load-sensing valve. Use Figure C.8 to identify the VM415.

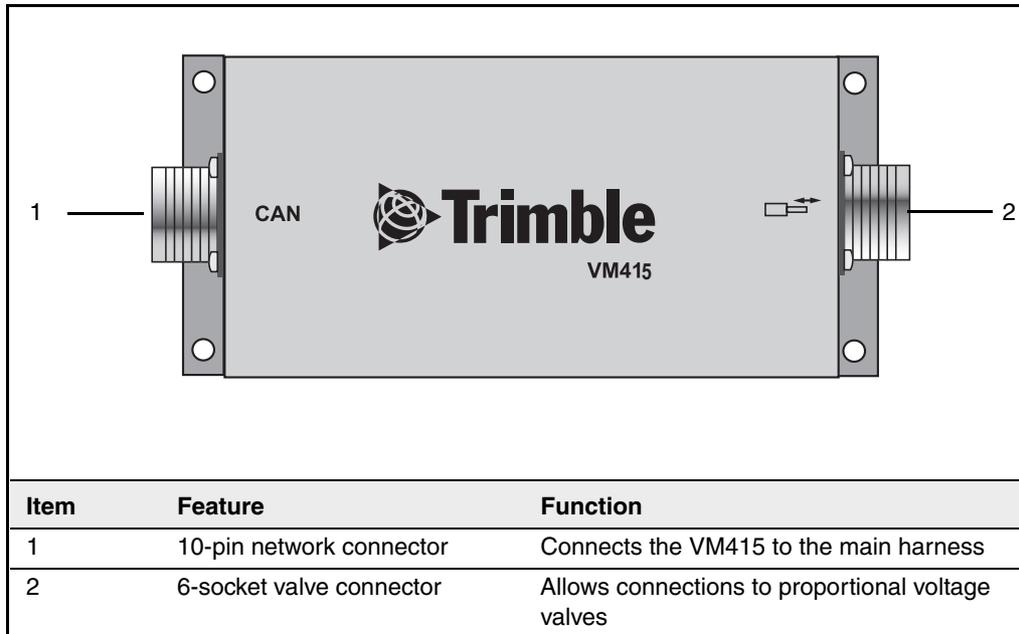


Figure C.8 VM415 valve drive module

C.2.10 VM420 valve drive module

The VM420 valve drive module electrically controls the valves that position the cutting edge of the machine. Control signals are provided to proportional valves. If necessary, control signals are also provided to the load-sensing valve. Use Figure C.7 to identify the VM420.

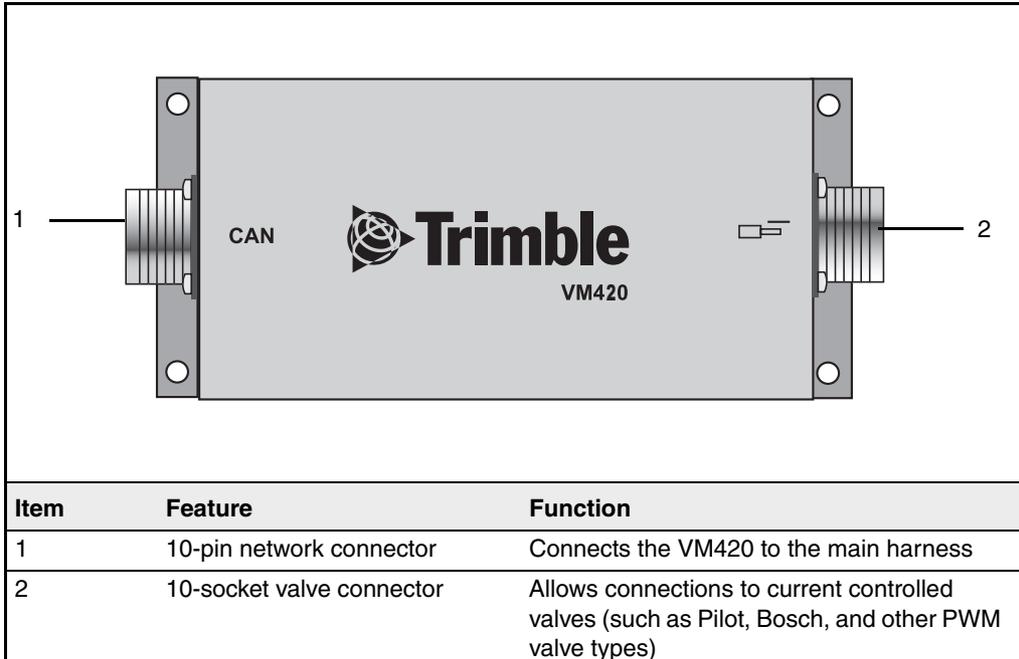


Figure C.9 VM420 valve drive module

C.2.11 PM400 power control module

The PM400 power control module supplies power to the CB415 dual control box, the EM400 electric masts, the LR400 laser receivers, and the VM410 valve drive module. The PM400 includes power conditioning and control circuits, as well as overcurrent and load dump protection. Use Figure C.10 to identify the PM400.

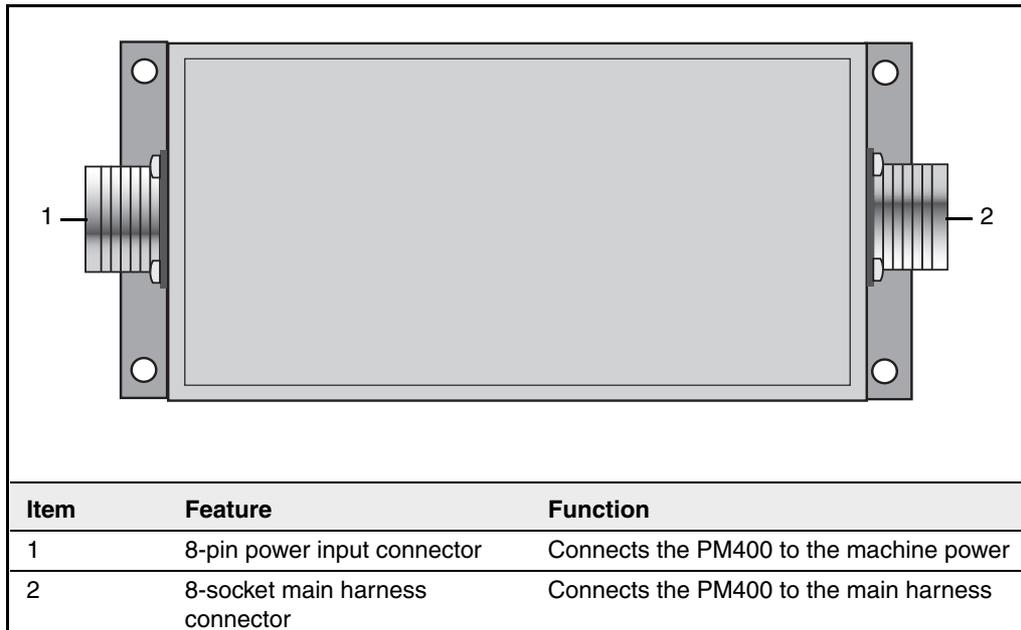


Figure C.10 PM400 power control module

C.2.12 Remote switch assembly

A remote switch plugs into the CB415 so that the system controls can be placed in a more convenient location. The switch is configured to perform the following operations:

- Switch between Auto and Manual
- Perform an elevation offset
- Set a slope offset
- Set either Blade Raise/ Lower, Survey Sample or Setups

Use Figure C.11 to identify the remote switch assembly.



Figure C.11 Remote switch assembly

Table 3.3 To use the remote switch assembly:

Remote Switch	AG GCS300	AG GCS400
Remote Switch: A	Auto/Manual left (front)	Auto/Manual left (front)
Remote Switch: B	Not used	Auto/Manual right (rear)
Remote Switch: C	Elevation Offset ¹	Offset left (front)
Remote Switch: D	Not used	Offset right (rear)
Remote Switch: E	Blade Raise/ Lower, Survey Sample or Setups	Blade Raise/ Lower, Survey Sample or Setups

¹Slope Offset if split axle or center pivot scraper

For more information on the remote switches, see Section 3.3, Remote Switch, page 24.

C.2.13 AS400 blade slope sensor

In a single slope system, the AS400 slope sensor is mounted to the rear of the blade and measures the actual slope of the blade. Use Figure C.12 to identify the AS400 sensor.

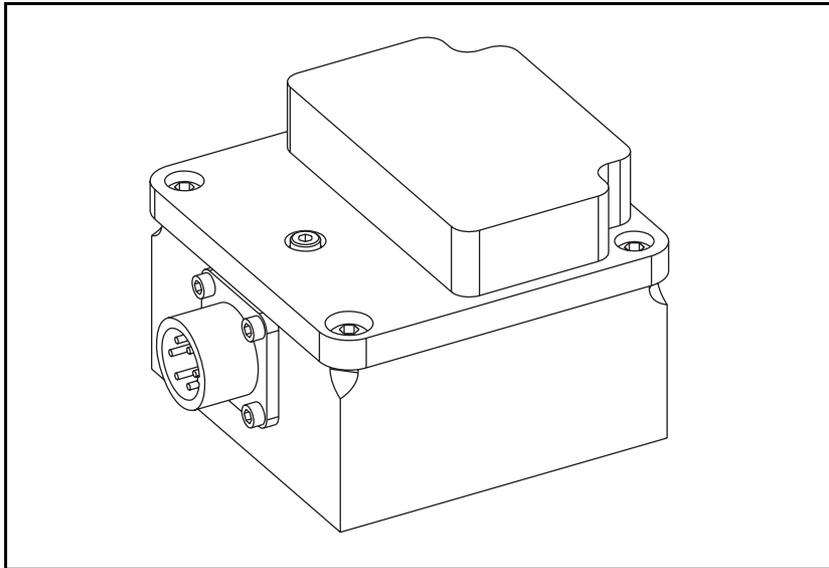


Figure C.12 AS400 Slope Sensor

C.3 Component Specifications

The following tables outline the specifications for each component.

C.3.1 CB415 dual control box

Item	Description
Size	20.3 cm (8 in) H x 12.7 cm (5 in) W x 10.2 cm (4 in) D
Weight	1.4 kg (3 lb)
Input Voltage	Machine power 9 VDC to 30 VDC
Operating temperature	-29° to +60° C (-20° to +140° F)
Storage temperature	-40° to +80° C (-40° to +176° F)
Network	CAN (Controller Area Network)

C.3.2 LR400 laser receiver

Item	Description
Size (without adapters)	30.5 cm (12 in) H x 15.2 cm (6 in) W x 6.0 cm (2.4 in) D
Weight with SA400	1.6 kg (3.5 lb)
Input Voltage	Machine power 9 VDC to 30 VDC
Battery Life Makita 9.6 VDC	Battery pack (BP21) Makita 9.6 VDC Over 10 hours of continuous operation at 25° C (77° F)
Operating temperature	-29° to +60° C (-20° to +140° F)
Storage temperature	-40° to +80° C (-40° to +176° F)
Housing	Die cast magnesium sealed and purged
Network capable	CAN (Controller Area Network)
Laser detection angle	360°
Laser detection height	26.7 cm (10.5 in)
Laser detection accuracy	1.5 mm
Grade display viewing angle	40°

C.3.3 LR410 laser receiver

Item	Description
Size	29.7 cm (11.7 in) H x 16.3 cm (6.41 in) W x 21.0 cm (8.25 in) D
Weight	2.9 kg (6.4 lb)
Input Voltage	Machine power 9 VDC to 32 VDC
Operating temperature	-40° to +71° C (-40° to +160° F)
Storage temperature	-55° to +85° C (-67° to +185° F)
Housing	Die cast magnesium sealed and purged
Network capable	CAN (Controller Area Network)
Laser detection angle	360°
Laser detection height	23.1 cm (9.1 in)
Laser detection accuracy	1.5 mm

C.3.4 SR300 receiver mast

Item	Description
Size	128.3 cm (50.5 in) H x 20.3 cm (8 in) W x 22.9 cm (9 in) D
Weight	19 kg (42 lb)
Input Voltage	Machine power 10 VDC to 30 VDC
Operating temperature	-29° to +60° C (-20° to +140° F)
Storage temperature	-40° to +80° C (-40° to +176° F)
Network capable	CAN (Controller Area Network)
Laser detection angle	360°
Laser detection range	460 m(1500 ft)

C.3.5 EM400 electric mast

Specification	EM400
Height retracted	1.64 m (64.5 in)
Height extended	2.90 m (113 in)
Weight	19 kg (42 lb)
Operating temperature	-29° to +71° C (-20° to +160° F)
Storage temperature	-40° to +80° C (-40° to +176° F)
Input voltage (Machine power)	9 VDC to 32 VDC
Network capable	CAN (Controller Area Network)

C.3.6 PM400 power control module

Item	Description
Size	17.3 cm (6.75 in) H x 10.3 cm (4.5 in) W x 5.7 cm (4 in) D
Weight	1.4 kg (3 lb)
Input voltage (Machine power)	10 VDC to 30 VDC
Operating temperature	-29° to +60° C (-20° to +140° F)
Storage temperature	-40° to +80° C (-40° to +176° F)

C.3.7 VM410 valve drive module

Item	Description
Size	17.3 cm (6.75 in) H x 10.3 cm (4.5 in) W x 5.7 cm (2.2 in) D
Weight	1.4 kg (3 lb)
Input voltage (Machine power)	9 VDC to 32 VDC
Operating temperature	-40° to +71° C (-40° to +160° F)
Storage temperature	-55° to +85° C (-67° to +185° F)

C.3.8 VM415 valve drive module

Item	Description
Size	21.6 cm (8.5 in) L x 9.7 cm (3.8 in) W x 6 cm (2.4 in) H
Weight	1.4 kg (3 lb)
Input voltage (Machine power)	9 VDC to 32 VDC
Operating temperature	-40° to +85° C (-40° to +185° F)
Storage temperature	-55° to +120° C (-67° to +248° F)

C.3.9 VM420 valve drive module

Item	Description
Size	17.3 cm (6.75 in) H x 10.3 cm (4.5 in) W x 5.7 cm (2.2 in) D
Weight	1.4 kg (3 lb)
Input voltage (Machine power)	9 VDC to 32 VDC
Operating temperature	-40° to +71° C (-40° to +160° F)
Storage temperature	-55° to +85° C (-67° to +185° F)

C.3.10 AS400 slope sensor

Item	Description
Size	17.3 cm (6.75 in) H x 10.3 cm (4.5 in) W x 5.7 cm (2.2 in) D
Weight	1.4 kg (3 lb)
Input voltage (Machine power)	9 VDC to 32 VDC
Operating temperature	-40° to +71° C (-40° to +160° F)
Storage temperature	-55° to +85° C (-67° to +185° F)

Index

A

Advance Option

- option password screen 109
- serial number screen 108
- service agreement password screen 110

Advanced Option screen 107

AG GCS

- Configuration mode 62

AG GCS system

- components 164
- Guidance mode 36
- introduction 2
- maintenance 150
- operating levels 30
- overview 7
- starting 10
- turning off 16

AG GCS300

- guidance mode 39
- operating modes 47

AG GCS300 Level 1 system 30

AG GCS400

- Dual laser receivers 33
- guidance mode 44

AG GCS400 Level 2 32

alignment, of laser transmitter 159

alignment, precise laser transmitter 161

AS400

- blade slope sensor calibration 96

- blade slope sensor component specifications 184

- blade slope sensor description 179

- blade slope sensor fault messages 147

AS400 Blade Slope sensor 7

Audio Alerts screen 87

Audio screen 87

Audio Volume screen 87

Auto/Manual remote button 15

Auto/Manual remote switch 24

automatic controls

- troubleshooting 128
- viewing length of time in use 101

axes, laser transmitter 158

axis

- cross-slope 158
- grade 158

B

benching

- AG GCS300 system 115

- AG GCS300 system using a level laser 10

- overview, dual mast 117

- overview, single mast 115

- single laser receiver 10

- using a SR300 receiver mast 120

benchmark

- entering elevation of 13

- Linked Elevation mode 51, 53

- definition of* 10
 - blade movement, controlling 69
 - Blade Slope 7
 - blade slope
 - setting 15, 124, 125
 - blade slope calibration 93
 - Blade slope sensor 37
 - blade slope sensor calibration 96
 - blade tilt
 - errors 91
 - fine tuning 91
 - buttons, CB415 dual control box 18
- C**
- CB415
 - component specifications 181
 - fault messages 131
 - features and functions 18
 - troubleshooting 128
 - turning off 15, 16
 - turning on 10
 - CB415 dual control box
 - buttons 19
 - LCD 19
 - LED grade indicators 19
 - switches 19
 - components 164
 - AS400 blade slope sensor 179
 - CB415 dual control box 165
 - EM400 electric mast 171
 - LR400 laser receiver 166
 - LR410 laser receiver 169
 - MM2X manual mast 173
 - PM400 power control module 177
 - remote switch assembly 178
 - SA400 network adapter 168
 - SR300 receiver mast 170
 - VM410 valve drive module 174
 - VM415 valve drive module 175
 - VM420 valve drive module 176
 - Configuration menu
 - accessing 62
 - figure 63
 - items 65
 - Configuration menu items 65
 - Configuration mode 62
 - Configuration mode, using 62
 - configuring AG GCS system 62
 - configuring the SR300 89
 - control box 18
 - control hours, viewing 101
 - control valve, deadband settings 83
 - cross-slope axis 158
 - Customize menu 71
 - Audio 87
 - Elevation Offset 80
 - On Grade Deadband 83
 - operating mode 77
 - Setups 72
 - Slope Offset 82
 - Slope setups 75
 - Survey Mode 78
 - Survey Timer 79
 - Units of Measure 85
 - cut, *definition of* 48, 59
 - cutting edge
 - setting reference elevation 67
 - setting reference elevation for 65
 - setting reference elevation for left mast 68
 - setting reference elevation for right mast 69
- D**
- deadband
 - elevation 83
 - slope 83
 - device status icons 37, 39, 44

- Diagnostics menu 132
 - Fault History 103
 - Hour Meter 101
 - Machine Voltage 105
 - Sensor Data 103
 - Software Versions 101
 - Test Control Box 106
 - Test Valves 99
 - Diagnostics screen 98
 - dual control box 18
 - Dual laser receivers 33
 - dual-grade laser transmitter, setup and operation 158
- E**
- elevation
 - audio alerts 87
 - measurement units 85
 - offset 80
 - offset setting 15
 - setups 73
 - valve speed 69
 - elevation display icons 40
 - cut/fill 40, 44
 - reference 40, 44
 - elevation offset
 - switches 19
 - elevation offset remote switch 24
 - Elevation Offset screen 80
 - elevation offset switch 15, 24
 - Cut/Fill mode 48
 - Dual Cut/Fill mode 59
 - Independent Elevation mode 52
 - Linked Elevation mode 51
 - Elevation Select switch
 - CB415 dual control box 19
 - Cut/Fill mode 48
 - elevation select switch
 - Linked Elevation mode 51
 - elevation, setting 13
 - EM400 electric mast
 - component specification 171
 - component specifications 183
 - description 171–172
 - fault messages 147
- F**
- Fault History, screen 103
 - fault messages
 - AS400 147
 - CB415 131
 - EM400 147
 - LR400 146
 - LR410 146
 - remote-switch 143
 - SR300 149
 - feedback 2
 - field
 - grading 15
 - leveling 15
 - fill, *definition of* 48, 59
- G**
- GL720 laser transmitter
 - setting up 114, 154
 - tripod rules 155
 - grade axis 158
 - AG Grade Control System, *see also* AG GCS
 - grading a field 15
 - Guidance mode 36
 - operating modes 36, 47
 - Guidance mode screen
 - AG GCS300 Level 1 39
 - AG GCS400 Level 2 44
 - device status icons 41, 44

- Dual Cut/Fill mode 47
- elevation display icon 40, 44
- guidance source icon 38
- Independent Elevation mode 44
- Reference Elevation mode 48
- Guidance source icon 37, 38, 40

H

- Hour Meter screen 101
- hydraulic valves, testing 99

I

- icons
 - cut/fill 40, 44
 - device status 37, 39, 41, 44
 - elevation display 40, 44
 - guidance source 37, 38, 40
 - guidance source display 38
 - operating modes 36, 47
 - reference 40, 44

- Independent Elevation mode 117

L

- laser receiver 7, 37
 - benching 10
 - LR400 component specifications 181
 - LR410 component specifications 182
 - strike window 39
- laser transmitter
 - aligning precisely 161
 - operation rules 156
 - placement and location rules 154
 - setup rules 154
 - tripod 154
 - tripod rules 155

LCD

- CB415 dual control box 18
- LR400 icon, troubleshooting 129
- mast icon, troubleshooting 129, 130

LEDs on CB415

- auto/manual indicators 19
- grade indicators 19

- Left Reference Elevation screen 68

- Level 1 AG GCS300 30

- Level 2 AG GCS400 32

- level laser transmitter, setup and operation 157

- leveling a field 15

- levels of operation 30

- Linked Elevation Adjustment screen 91

- Linked Elevation mode

- benching 118

- LR400 laser receiver 7

- description 166–168

- fault messages 146

- LR410 laser receiver 7

- description 169–170

- fault messages 146

M

- machine maintenance 151

- Machine Voltage screen 105

- machine, grading to correct elevation 10

- maintenance 150, 151

- manual sensor calibration 96

- mast button

- Cut/Fill mode 48

- Dual Cut/Fill mode 60

- Independent Elevation mode 53

- Linked Elevation mode 51, 53

- mast switches, CB415 dual control box 19

- measurement units

- elevation 85

- slope 85

menus

- accessing 62
- Configuration 63, 65
- Customize 71
- Diagnostics 132
- setup 65
- Valve Speed 69, 150

MM2X manual mast

- description 173

modes

- blade slope only 49
- Configuration 62
- Cut/Fill 48
- Dual Cut/Fill 59
- Guidance 36
- Independent Elevation 52
- operating 36, 47
- Reference Elevation 47
- Survey 54

O

offset

- elevation 80
- slope 82

offset, setting 15

On Grade Deadband screen 83

on/off switch, CB415 dual control box 19

operating hours, viewing 101

operating levels 30

Operating Mode screen 77

operating modes

- AG GCS300 47
- blade slope only 49
- Cut/Fill 48
- Dual Cut/Fill 59
- Independent Elevation 52
- Linked Elevation 50
- Reference Elevation 47

setting 77

status 36, 47

Survey 54

operating the remote switch 24

option password screen 109

P

password

invalid password 109, 110

option password 109

service agreement 110

PM400 power control module

component specifications 183

description 177

power up 10

troubleshooting 129

power/setup switch 10, 16, 19, 39, 44

precise laser transmitter alignment 159

errors due to misalignment 159

R

receiver mast 8

reference elevation 37, 40

setting 13, 65

Reference Elevation screen 65, 67

remote switch 24

auto/manual switch 24

operation 24

remote switch assembly 24, 178

remote switch assembly

description 178

remote-switch assembly

troubleshooting 130

remote-switch, fault messages 143

Right Reference Elevation screen 69

S

- SA400 network adapter
 - description 168
- screen, CB415 dual control box 18
- screens
 - Audio Volume 87
 - Configuration mode 62
 - Diagnostics 98
 - Elevation Alert 87
 - Elevation Offset 80
 - Fault History 103
 - Guidance mode 36
 - Hour Meter 101
 - Linked Elevation Adjustment 91
 - Machine Voltage 105
 - On Grade Deadband 83
 - Operating Mode 77
 - Reference Elevation 65
 - Sensor Data 103
 - Setups 72
 - Slope Alert 87
 - Software Versions 101
 - Survey Mode 78
 - Survey Timer 79
 - Test Control Box 106, 146
 - Test Valves 99
 - Units of Measure 85
- sensor calibration 9
 - blade slope calibration 93
 - manual sensor calibration 96
 - menu 93
- Sensor Data screen 103
- sensor data, viewing 103
- serial number screen 108
- service agreement password screen 110
- setting
 - audio alerts 87
 - control valve, deadband settings 83
 - deadband settings 83
 - elevation 13
 - measurement units 85
 - operating mode 77
 - reference elevation 65, 67, 80
 - reference elevation for left mast 68
 - reference elevation for right mast 69
 - setups elevation 73
 - survey mode 78
 - survey timer 79
 - valve speed 69
- setting the blade slope 15, 124, 125
- setting up, laser transmitter 114–122
- setup and operation
 - dual-grade laser transmitter 158
 - single-grade laser transmitter 158
- setups
 - elevation 73
 - slope 75
- Setups screen 72
- shipment damage claims 2
- sighting grooves 158
- single-grade laser transmitter, setup and operation 158
- slope
 - audio alerts 87
 - measurement units 85
 - offset 82
 - setups 75
 - valve speed 69
- software version information, viewing 101
- Software Versions screen 101
- SR300 receiver mast 8
 - component specification 170, 182
 - configuration 89
 - description 170
 - fault messages 149
- starting the AG GCS system 10
- streaming data output 58
- strike window 39
- Survey Mode
 - streaming data output 58

-
- Survey Mode screen 78
 - Survey Timer screen 79
 - switches
 - CB415 dual control box 18
 - power/setup 10, 16, 39, 44
 - testing 106
 - system
 - components 164
 - display 18
 - maintenance 150
 - shutdown 16
- T**
- technical assistance 2
 - Test Control Box screen 106, 146
 - Test Valves screen 99
 - tripod 154
 - tripod rules 155
 - troubleshooting
 - blade tilt errors 91
 - CB415 dual control box 128
 - fault history 103
 - turning off the AG GCS system 16
 - turning off the CB415 15, 16
 - turning on the CB415 10
- control hours 101
 - fault information 103
 - operating hours 101
 - sensor data 103
 - software version information 101
 - system voltage information 105
- VM410 valve drive module
 - component specifications 183
 - description 174
 - fault messages 132, 138
 - VM415 valve drive module
 - component specifications 184
 - description 175
 - VM420 valve drive module
 - component specifications 184
 - description 176
 - fault messages 141
 - voltage information, viewing 105
- U**
- Units of Measure screen 85
- V**
- valve calibration 9
 - Valve Speed menu 69, 150
 - valve speed, setting 69
 - version information, viewing 101
 - viewing

