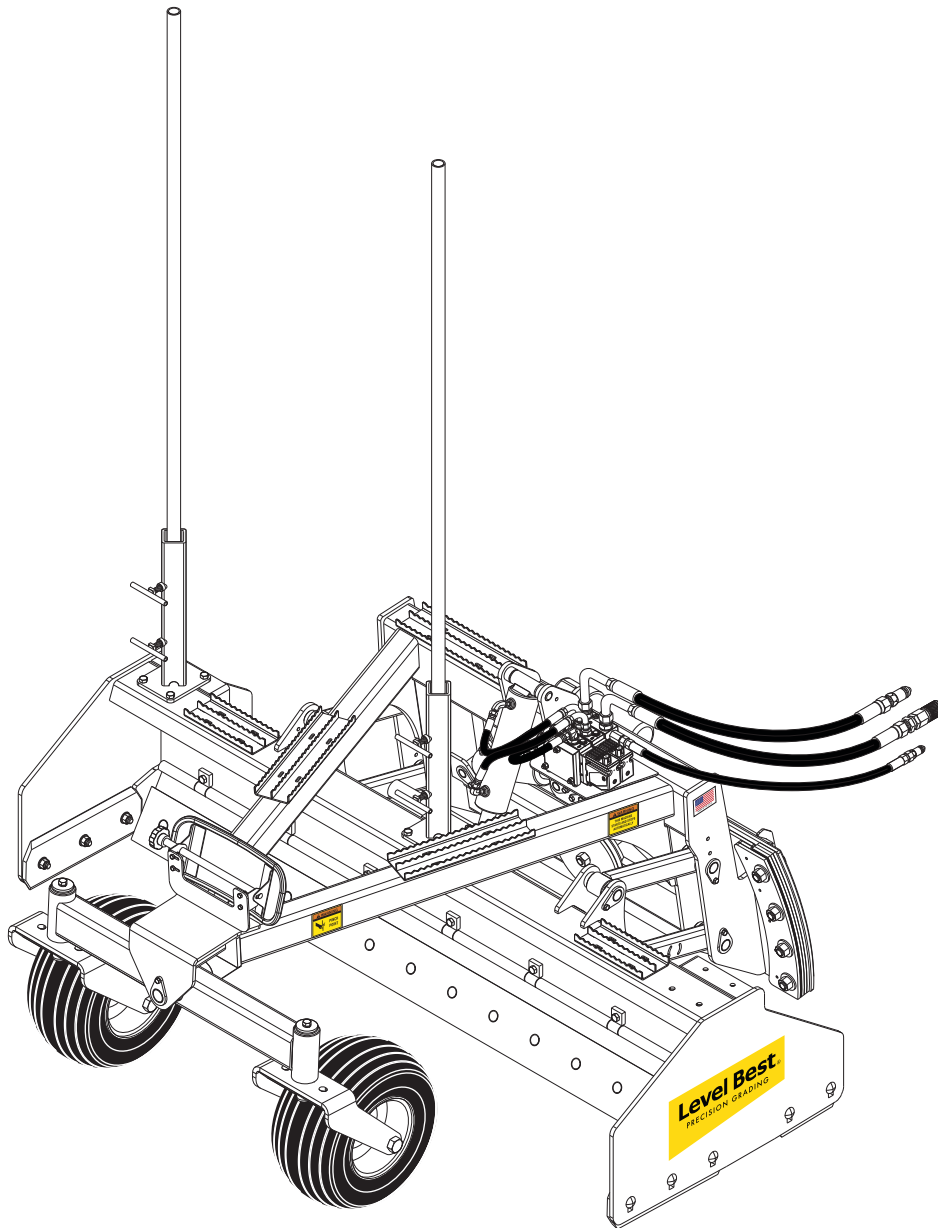


OPERATORS MANUAL

PD - SERIES PARA-LEVEL DUAL ASN3516



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DISCLAIMER

THE INFORMATION IN THIS MANUAL IS PROVIDED TO PROMOTE THE SAFE USE OF, AND ASSIST THE OPERATOR IN ACHIEVING THE BEST PERFORMANCE FROM, PARA-LEVEL GRADING BOX DESCRIBED HEREIN, FOR THEIR INTENDED APPLICATIONS.

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TABLE OF CONTENTS

DISCLAIMER	i
USING THIS DOCUMENT	i
TABLE OF CONTENTS	ii
LIST OF ILLUSTRATIONS	iii
SAFETY INFORMATION	v
Safety Precaution Definitions	v
WARRANTY	vi
SYSTEMS FEATURES AND BASIC OPERATION	1
Purpose	1
Components	1
Product Overview	2
Product Description and Features	2
Control Panel	2
Cradle	3
Getting Started	3
Operation	5
Select the Grade/Slope Sensor Input Source	5
Setting a Reference Height	5
Using the Laser Receiver	6
3D Sensors	8
Setting the Value for Gain and Deadband	8
Gain	9
Rotating Laser	9
Equipment Setup	17
Hydraulics	19
Danfoss PVG-32 Hydraulic Valve	19
Hydraulic Hose Connection	19
Job Site Set-Up	20
Set-Up for Level Grading	20
Set-Up for Sloped Grading	20
Benching And Operating	22
Benching	22
Benching with a Rod Eye	23
Operation	24

TABLE OF CONTENTS

TROUBLESHOOTING.....	25
SPECIFICATIONS AND MAINTENANCE	28
Specifications.....	28
Dimensions	28
Technical Data	28
PowerGrade Technical Data	28
Junction Box.....	29
Maintenance.....	30
Storage and Transport.....	30
Cleaning.....	30
Cables and Hoses.....	30
Machine	30
Calibration	30
Service	30
Hub Greasing Instructions	31
NOTES.....	32
INDEX	33

LIST OF ILLUSTRATIONS

Figure 1. Plane of Laser Light with Components of the Automatic Control System.....	1
Figure 2. Control Panel, Front View.....	2
Figure 3. Special keys.	3
Figure 4. Display.	3
Figure 5. Cradle.....	3
Figure 6. Snap control panel onto cradle.....	4
Figure 7. Turn on the control panel.....	4
Figure 8. Remove control panel from Cradle.....	4
Figure 9. Sensor setup keys.....	4
Figure 10. Sensor selection.	5
Figure 11. Sensor not connected.	5
Figure 12. Selecting sensor.....	5
Figure 13. Seek Mode.	6
Figure 14. Laser Receiver.....	6
Figure 15. Link Mode when using two power mast.....	7
Figure 16. 3D Sensors.	8
Figure 17. Rotating Laser.....	9
Figure 18. Power Cable Detail.	11

LIST OF ILLUSTRATIONS

Figure 19. Receiver Cable Detail.	11
Figure 20. Solenoid Cable Detail.	11
Figure 21. Remote Switch with Cradle Detail.	12
Figure 22. Remote Switch Detail.	12
Figure 23. Pigtail to 14 Pin Connector.	12
Figure 24. Bobcat Joystick Functions.	13
Figure 25. Cat D-Series Joystick Functions.	13
Figure 26. Kubota SSV65 & 75 Joystick Functions.	14
Figure 27. Kubota SVL 95 S6699 Multifunction Controller.	14
Figure 28. Case Joystick Functions.	15
Figure 29. New Holland Joystick Functions.	15
Figure 30. Takeuchi TL12/TL250 Joystick Functions.	16
Figure 31. JCB/Volvo Joystick Functions.	16
Figure 32. John Deere G-Series Joystick Functions.	17
Figure 33. Control Panel Mounting.	18
Figure 34. Components of the Automatic Control System on a Skid Steer.	19
Figure 35. Hydraulic Valve (Danfoss PVG-32).	19
Figure 36. Hydraulic Hose Connections to Skid Steer.	19
Figure 37. Method One: Align Rotating Laser with Grade Stakes.	20
Figure 38. Sight Over Rotating Laser.	20
Figure 39. Grade Stake with Elevation Mark.	21
Figure 40. Method Two: Align Rotating Laser with Grade Stakes.	22
Figure 41. Benching the Para-Level LGB with a Level Plane.	22
Figure 42. Lube and Maintenance.	31

SAFETY INFORMATION

This manual is furnished to you, the owner/operator, as a guide to get the greatest benefit from your Grading Box. ATI Corporation wants you to be able to get the most use out of your Grading Box through safe and efficient operation.

Before attempting to operate the Grading Box, carefully read all sections of this manual. Be sure that you thoroughly understand all of the safety information and operating procedures.

SAFETY PRECAUTION DEFINITIONS

Dangers, Warnings, Cautions, and Notes are strategically placed throughout this manual to further emphasize the importance of personal safety, qualifications of operating personnel, and proper use of the grading box in its intended application. These precautions supplement and/or complement the safety information decals affixed to the unit and include headings that are defined as follows:

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation or practice which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation or practice which, if not avoided, will result in damage to equipment and/or minor injury.

NOTE: Indicates an operating procedure, practice, etc., or portion thereof, which is essential to highlight.

- Always use caution and safe operating practices when operating this equipment.
- Always set the Automatic/Manual Switch on the Control Panel to MANUAL before leaving the operator's seat or whenever the machine is not moving.

- Always allow for clearance under the cutting edge of the machine when tuning the system or when switching to automatic control. Insufficient clearance could cause the machine to lift itself off the ground as its cutting edge attempts to achieve the programmed slope.
- Never adjust the position of the Laser Receiver when the system is in automatic control.
- Never perform service work on your machine or the Automatic Control System when the system is in automatic control.
- Install all safety panels and guards before operating your equipment.
- Stay clear of all moving parts when the machine is in operation.
- Keep all people clear of the machine when it is running.
- Keep feet and other body parts from under the cutting edges of the machine at all times.
- Read and comply with all safety recommendations of your Tractor/Skid Steer manufacturer, as outlined in its operator and service manuals.

NOTE: References made to left, right, front, and rear are those directions viewed from behind the power unit and grading box.

NOTE: Some equipment depicted in illustrations may not reflect exact production model configurations.

NOTE: All safety, operating, and servicing information reflects current production models at the time of publication of this manual.

NOTE: ATI Corporation reserves the right to discontinue models at any time, change specifications, and improve design without notice and without incurring obligation on goods previously purchased and to discontinue supplying any part listed, when the demand does not warrant production.

WARRANTY

This Level-Best Grading System is designed and manufactured to high standards. ATI Corporation, therefore, guarantees this Level-Best product to be free from defect in workmanship and materials for three (3) years from purchase date. If the machine is to be used for rental purposes the warranty is limited to ninety (90) days.

Components supplied by outside vendors (e.g. cylinders, hydraulic valves and components, electronic modules, and machine control technology systems) are warranted separately by their respective manufacturers. The warranty periods of these components are generally one (1) year from date of purchase.

Neither Level-Best nor hydraulic component manufacturers will cover normal wear or failure due to hydraulic oil contamination from the power source. ALWAYS start with clean oil and filters prior to installation and operation.

Misuse, abuse, misapplication, and unauthorized alterations will void this warranty.

All warranty work must be performed by an authorized Level-Best dealer and authorized by ATI Corporation. All Level-Best parts suspected of failure must be returned to ATI Corporation for warranty analysis prior to any credit being issued.

SYSTEMS FEATURES AND BASIC OPERATION

PURPOSE

The Level Best Laser Grading Box (LGB) is a cost-efficient method for fine grading. Various capacities sized to fit the skid steer or tractor with a choice of automatic control systems are available. This manual is for skid steer systems equipped with an Leica Geosystems Automatic Control System.

Laser-guided depth control provides unmatched measurement of plane from a single reference point. Grade information from a rotating laser is processed and automatically directs the grading box's hydraulics to maintain the elevation of the cutting edge.

The Grade Position LEDs on the Laser Receiver indicate the location of the box's cutting edge relative to the required finished grade (The Control Panel has a set of LEDs that mimic the Laser Receiver's LEDs).

- In manual control, the operator watches the Grade Position LEDs and uses the controls to keep the center LEDs lit, thereby keeping the box "On Grade".
- In automatic control, the Automatic Control System controls the box's hydraulic cylinder to keep the center LEDs lit, thereby keeping the box "On Grade".
- The control system uses two laser Receivers. One laser Receiver provides grade information for the center elevation of the LGB, the second laser Receiver ensures the proper tilt angle is maintained by measuring the elevation at one end of the LGB.

COMPONENTS

The control system consists of 4 components:

Rotating Laser – Provides a reference Plane of Laser Light over the job site (refer to Figure 1). The light plane may be level or set at an angle to match the slope of the ground.

Laser Receivers – Mounted at a specific height on a mast on the Laser Grading Box, it determines the difference in depth based on the Plane of Laser Light.

Control Panel – Mounted on the Grading Box, the Control Panel processes data received from the Laser Receivers and from the operator. LEDs indicate the location of the box's cutting edge relative to the desired finish grade. When set to Automatic, it provides signals to the Valve Assembly to either extend or retract the cylinders on the Laser Grading Box.

Valve Assembly – Wired to the Control Panel, the valve meters hydraulic oil to the hydraulic cylinders for elevation and tilt control.

In addition, wires and cables to connect the components are included with the unit. Two remote switches provide control from within the skid steer loader's operator station while maintaining visible contact of the Control Panel screen mounted on the LGB.

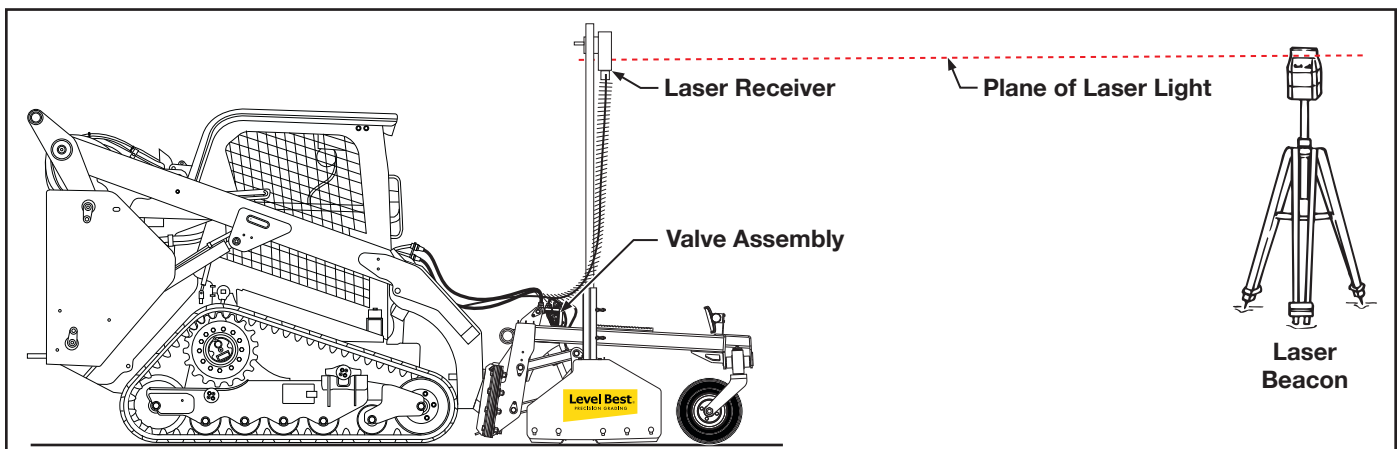


Figure 1. Plane of Laser Light with Components of the Automatic Control System.

SYSTEMS FEATURES AND BASIC OPERATION

PRODUCT OVERVIEW

Product Description and Features

General

The control panel has keys surrounding the screen for user input. The 3.5" color display, incorporates a state of the art LCD color screen, making it easy to use, even in bright, sunny conditions.

The rugged IP56 enclosure is designed for harsh environments.

Power supply, communication

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

Control Panel

The Control Panel is essentially a computer with built-in logic for the inputs and outputs connected to it. The Control Panel provides many adjustments to allow compatibility with different machinery and application requirements.

The settable functions on the Control Panel can be categorized as Operation or Installation. Installation functions configure communication with the Laser Receiver and valve and other items which, once configured, never require modification. Operation functions are typically adjusted often, either on a job site basis or during operation.

Functions which are typically changed during operation are accessible on the face of the Control Panel while other switches which do not require frequent adjustment are under an access cover.

The following identifies the indicators, switches and type of switch on the Control Panel.

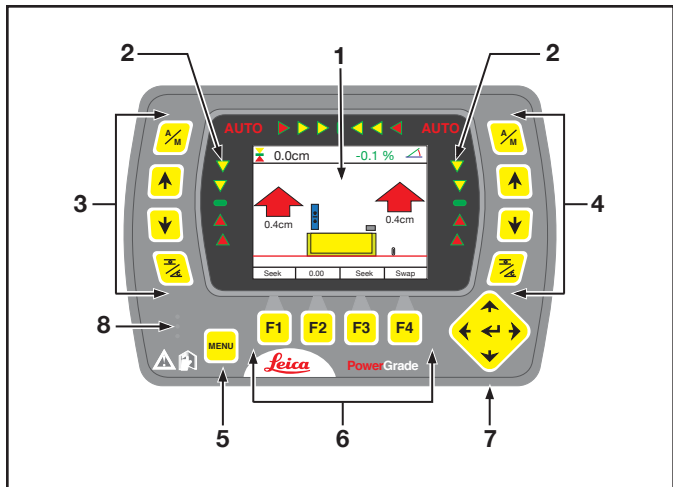


Figure 2. Control Panel, Front View.

1. Graphical display
2. Grade indication led's
3. Left side sensor setup
4. Right side sensor setup
5. Menu key
6. Function keys
7. Enter key
8. Speaker

WARNING

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

WARNING

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

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

SYSTEMS FEATURES AND BASIC OPERATION

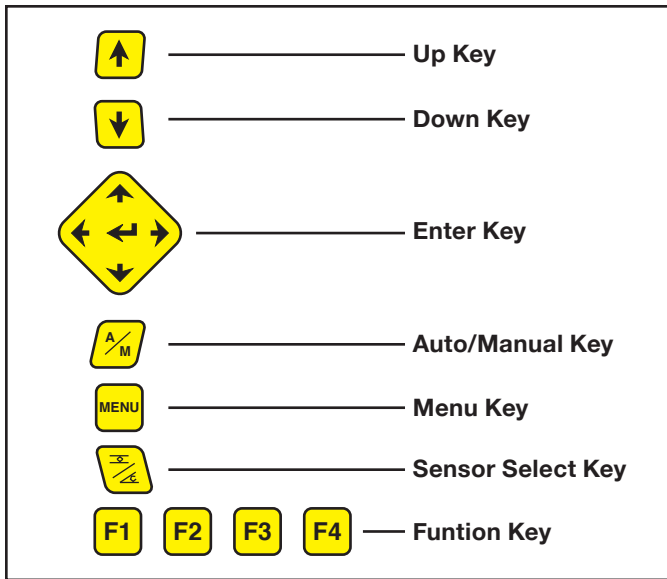


Figure 3. Special keys.

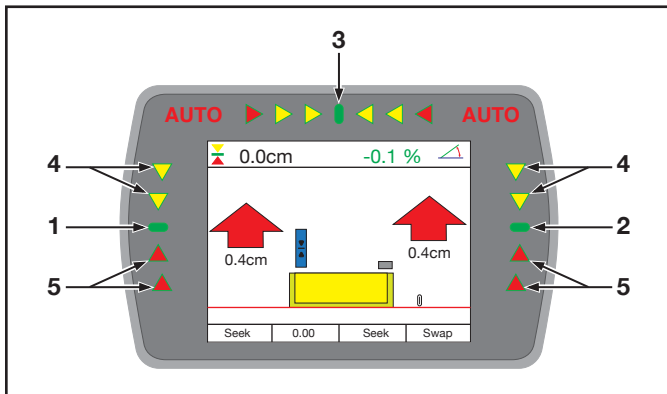


Figure 4. Display.

1. Left on-grade indication
2. Right on-grade indication
3. Side shift alignment indication
4. Above grade
5. Below grade

Cradle

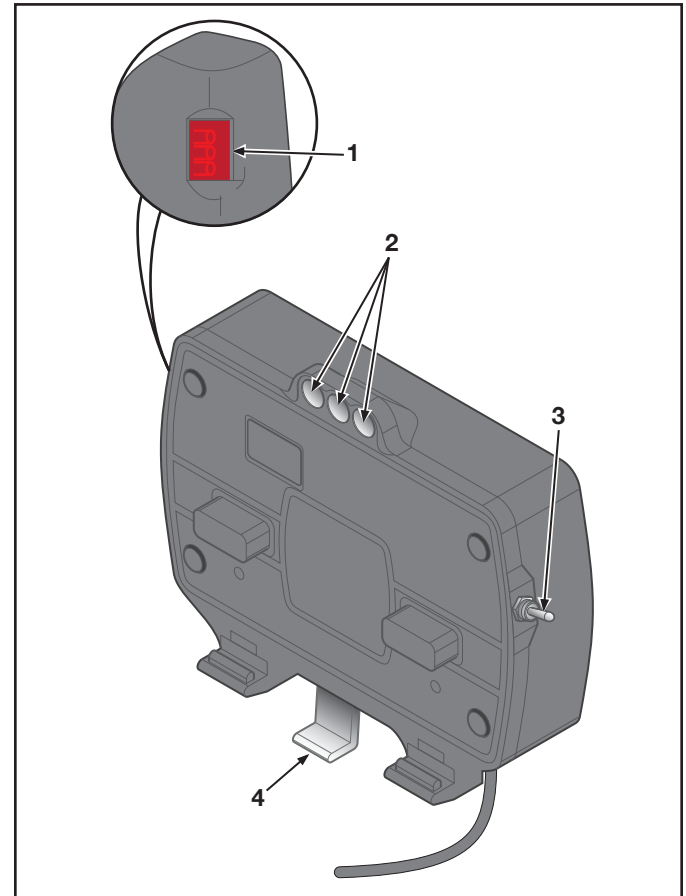


Figure 5. Cradle.

1. Power and data transfer LED indicators
2. Holding magnets
3. On/off switch
4. Release key for control panel

Getting Started

System start

To get the system started complete the following steps:

SYSTEMS FEATURES AND BASIC OPERATION

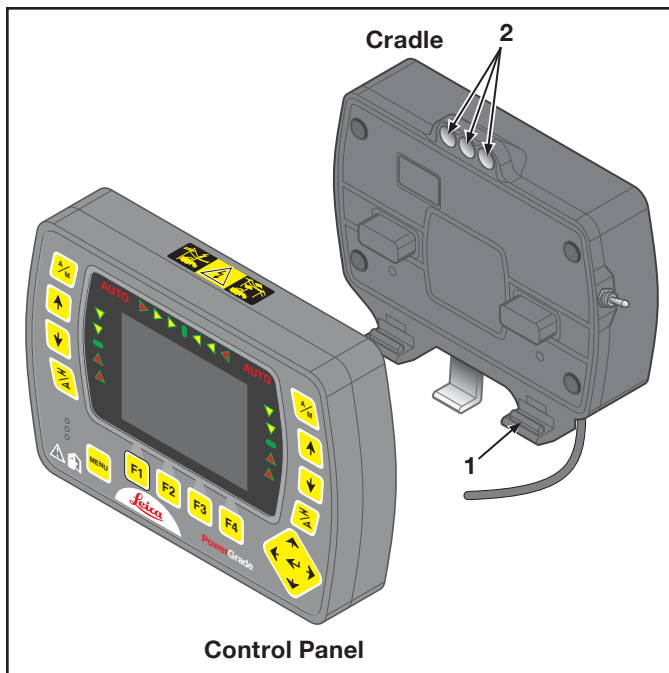


Figure 6. Snap control panel onto cradle.

To connect the control panel to the cradle:

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

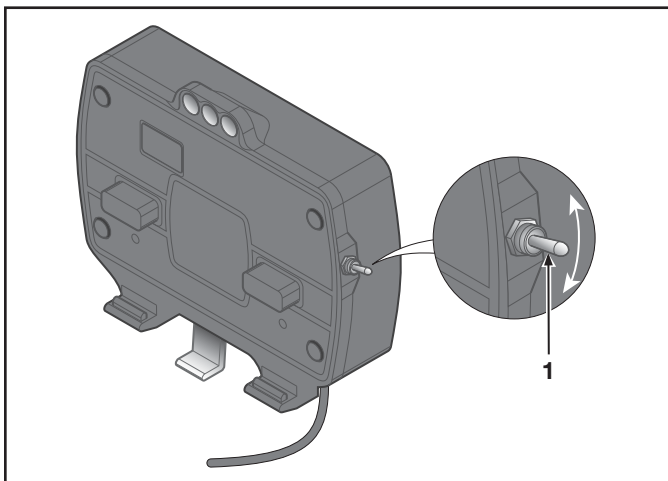


Figure 7. Turn on the control panel.

To turn the system on and off, use the power switch 1 on the right side of the cradle. This is the master switch for the entire system.

NOTE: Removing the panel will also turn off the power.

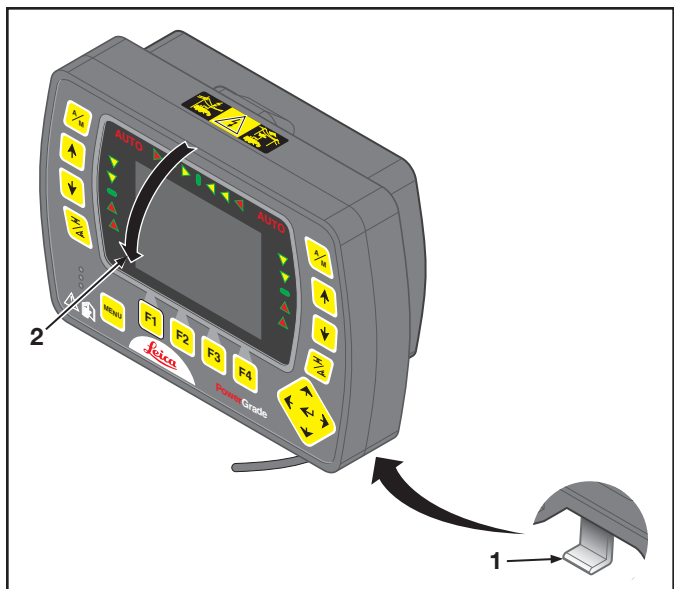


Figure 8. Remove control panel from Cradle.

To release the control panel simply press the Release Key 1 at the bottom of the cradle, pull the Control Panel towards you 2 and then lift it away from the Cradle.

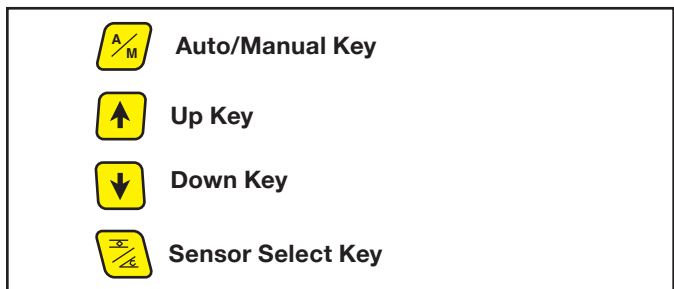


Figure 9. Sensor setup keys.

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

SYSTEMS FEATURES AND BASIC OPERATION

OPERATION

Select the Grade/Slope Sensor Input Source

Sensor selection

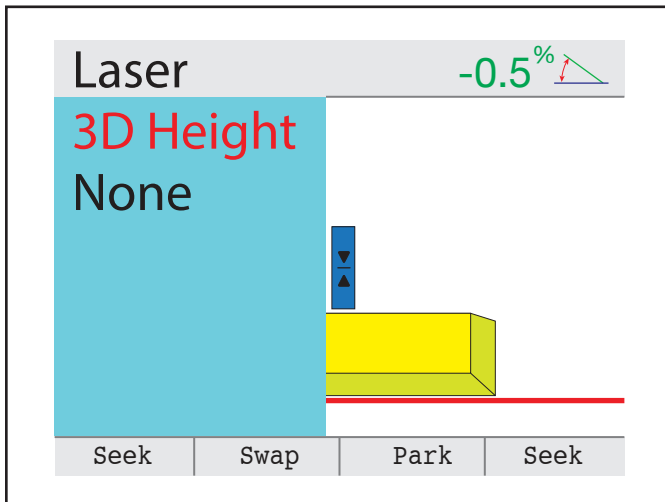





Figure 10. Sensor selection.

1. Push the left or right  key to open the sensor selection menu. Following screen appears:
2. Use the  /  keys to scroll through the available sensors.
 - a) If the sensor is connected and active it will show up in black.
 - b) If it's not connected or inactive, it will be hidden and cannot be selected when in User Mode.

If a selected sensor gets disconnected, an error message **Sensor not connected** will be displayed.

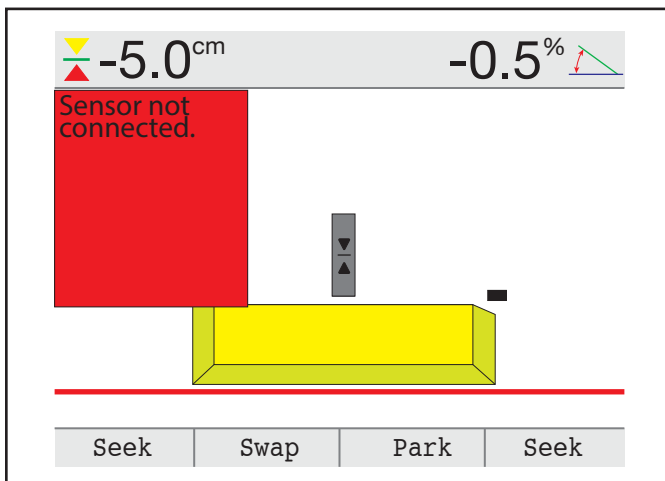




Figure 11. Sensor not connected.

3. Highlight the sensor that is going to be used and exit the sensor selection menu by pressing  or .
4. The chosen sensor is indicated by a small icon in the upper corner of the display, and by an icon shown on the blade in relation to the actual placement of the sensor.

Example:

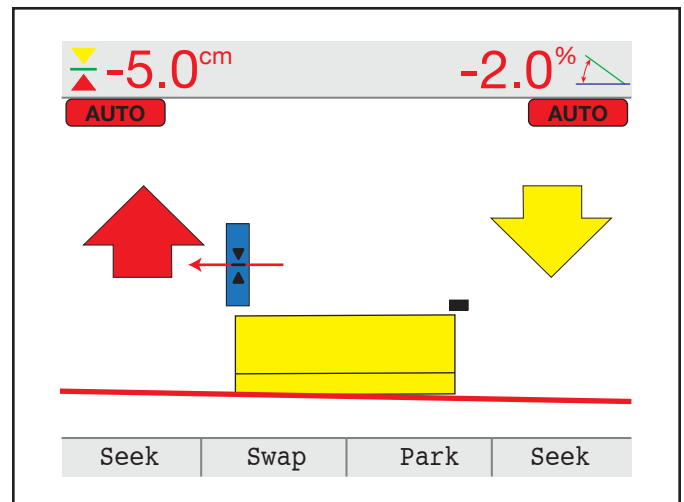


Figure 12. Selecting sensor.

A cross slope is selected on the right channel and on the left side a Laser Receiver is selected.

Setting a Reference Height



Inspection

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



There are two ways to change the reference:

- Manual mode
- Seek mode

Manual mode

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

Seek mode

Press the  and  keys simultaneously to enter the seek mode. In seek mode the screen shows the current sensor value of the selected sensor.

Pressing both keys simultaneously again exits the seek mode.

SYSTEMS FEATURES AND BASIC OPERATION

Or press **F1** for seek mode.

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

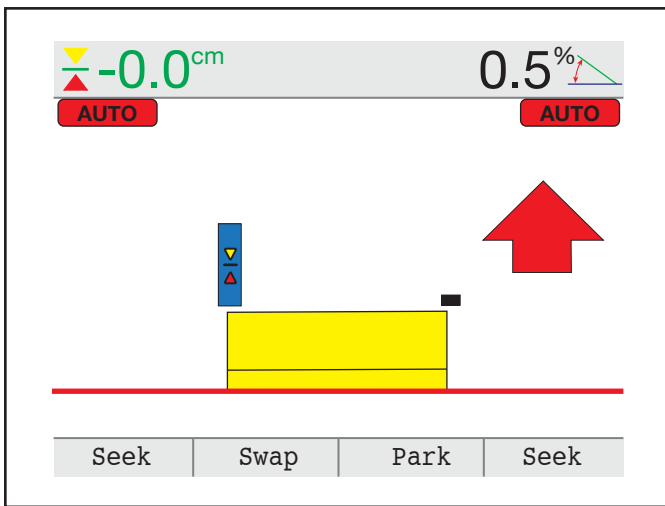


Figure 13. Seek Mode.

NOTE: If both keys are pressed, and held for more than three seconds, the control panel will take the current sensor value and store as the new reference height.

Absolute height

Press and hold the Seek function key. At the same time, adjust the offset using the **↑** and **↓** keys. Once the desired offset has been reached, release the Seek function key and the offset number will be saved.

Automatic detection of the laser beam

For systems with a PowerMast, entering seek mode will start an automatic search for the laser beam.

If the Laser Receiver is out of beam the operator can select in which direction the mast should start moving to look for the laser beam using the **↑** and **↓** keys. The mast will move in that direction until the Laser Receiver has the beam centered.

If the mast, during a seek reaches its top or bottom limit it will automatically reverse direction, and continue to seek for the laser beam until it is found or it hits the next end point.

The mast will automatically exit seek mode when the laser beam is found.

USING THE LASER RECEIVER

Laser Receiver

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

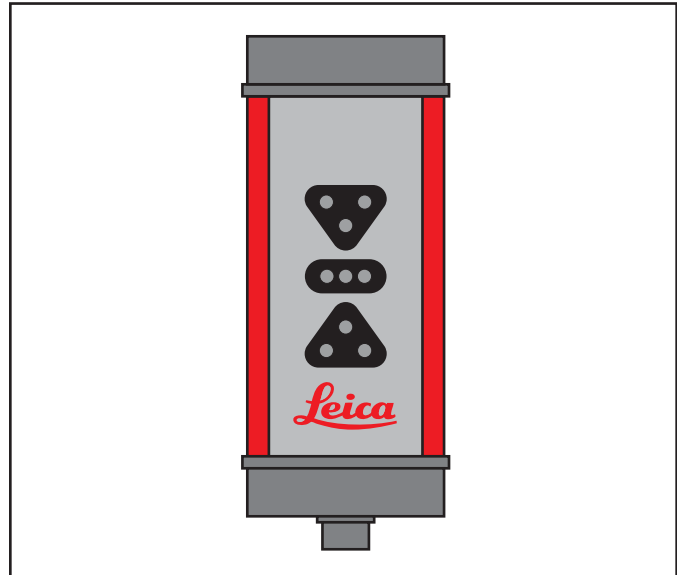


Figure 14. Laser Receiver.

When the Laser Receiver detects a laser beam this is indicated on the display by a red line through the laser icon.

If at some point the laser beam is lost while the control panel is set in auto mode, it will give a beep and a text message saying No laser beam will appear.


NOTE: Never adjust the Laser Receiver height while the panel is in automatic mode.

Laser Receiver and manual mast

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






1. Select the Laser Receiver on one of the sides.
2. Place the cutting edge of the blade at the desired height.
3. Move the mast up or down until the Laser Receiver detects the laser beam. Continue to move the mast until the indication LEDs on the Laser Receiver show a green line.

SYSTEMS FEATURES AND BASIC OPERATION

4. Press the  key to set the machine in Auto-Mode.
5. When the control panel is in Auto-Mode the machine will start to move the raise/lower hydraulic cylinders so that the laser beam always is in the center of the Laser Receiver.

Laser Receiver and power mast

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

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

Zero the Set-Point

Press and hold for only two seconds the **Seek** function key. The set-point and offset values will be reset to 0.00.



Offset the Set-Point

Press and hold the Seek function key. At the same time, adjust the offset using the and keys. Once the desired offset has been reached, release the Seek function key and the offset number will be saved.

NOTE: While in Link mode (see below), both set-points will be adjusted.

Link mode when using two power masts and laser receivers

This feature will link together two Laser Receivers on power masts so that their control will match a laser reference with a predefined cross-slope.

To enable this mode, select Laser on both the right and left side and press the Link function key. The masts will retract to their lowest position and then return to their original location. Adjusting offset height with either left or right set of  and  keys will change the height of both power masts. While in Link mode, the display will have a black line marked linked between the laser receivers.

While in Link mode, pressing the **Seek** function key will initiate a laser search on the left power mast. Once the laser beam has been located, the right power mast will move to the correct height.

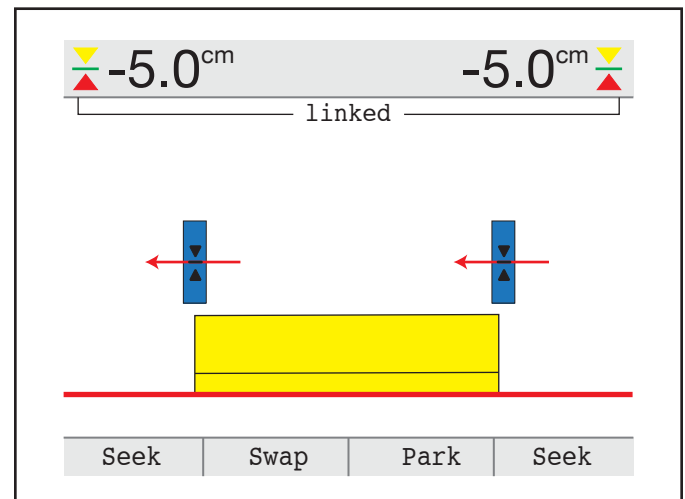


Figure 15. Link Mode when using two power mast.

Reset feature for the laser receiver

When using a laser receiver it is possible to relocate the laser strike set-point to the centre of the laser receiver using the **Reset** function key. The key will appear only if an MLS700 is connected.

Park feature for power masts

This feature allows for easier access to remove the laser receivers at the end of the working shift. It also affords extra protection for the masts when the machine is left unattended overnight, or during transport to another job site.

Pressing the Park function key will return the respective power mast to its lowest position.

SYSTEMS FEATURES AND BASIC OPERATION

While linked, both masts will lower and synchronization will be disabled.

3D Sensors

How to set 3D sensors

To select 3D Height, press the **left or right (sensor) key** once, and then press the Adjust function key to enter the adjust menu.

NOTE: That only the currently selected sensor in either left or right side will be adjusted.

If the 3D system is configured to indicate which sensor is currently in use, select **AUTO**.

If not, then select either **TRACKER** or **GPS** from the menu.

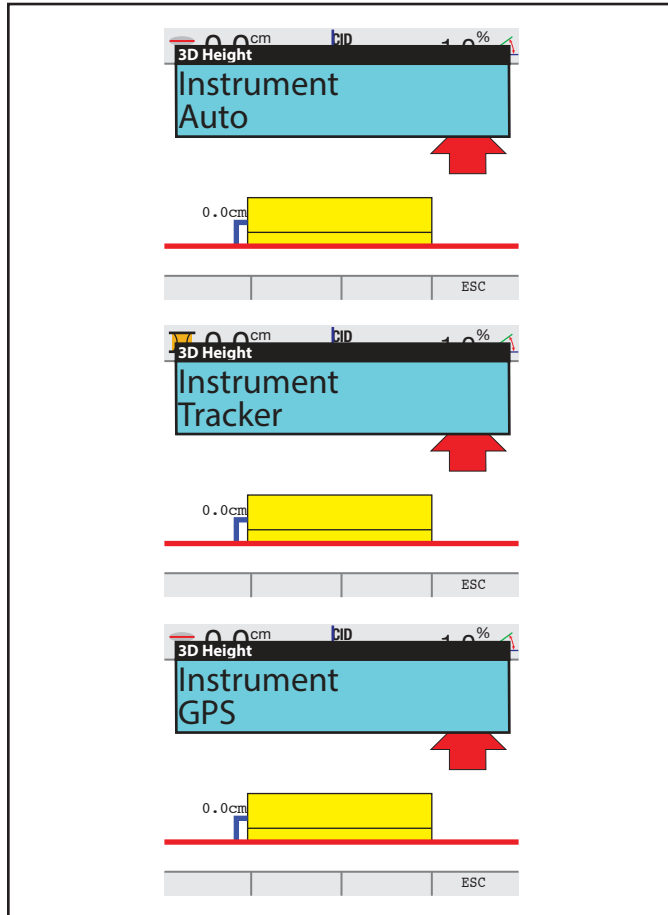


Figure 16. 3D Sensors.

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

Tracker and GPS 3D control modes typically give different hydraulic response/behaviour.

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

Use the right arrow key to enter the gains settings.

Refer to chapter “2.6 Setting the Value for Gain and Deadband” for configuring Gains.


To select 3D Slope, press the **left or right (sensor) key** once, and then press the **Adjust** function key to enter the adjust menu.

NOTE: That only the currently selected sensor in either left or right side will be adjusted.





Setting the Value for Gain and Deadband

Adjust the gain and deadband

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

1. Press the left or right  key once, and then press the **Adjust** function key to enter the adjust menu.

NOTE: That only the currently selected sensor in either left or right side will be adjusted.

2. Use the  or left  key to scroll through the settings.
3. Use the  or  key to change the value.
4. To exit the adjust menu press the menu key.

Deadband

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

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

Below are the default values. Consult technical support prior to adjusting.

SYSTEMS FEATURES AND BASIC OPERATION

SENSOR	DOZER	GRADER
GPS	1.0 cm	1.0 cm
Laser	0.7 cm	0.7 cm
Cross slope	0.6 %	0.3 %
Tracker	0.5 cm	0.5 cm
Sideshift	---	2.0 cm

Gain

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

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

Adjust the gain of the hydraulic system for each sensor. This is done by pressing the **2s** button in the adjust menu for each sensor. This will control the hydraulics upwards for two seconds. Revert if necessary using the **Revert** function key.

NOTE: Please follow the on-screen instructions!

Elevation

Press the **2s** button to adjust the value so that it corresponds to the below distances. A simple tape-measure or ruler can be used to gauge the actual blade movement (taking great care around the machine). For example, after pressing the **2s** button, the blade should move approximately 15 cm for GPS.

SENSOR	DOZER	GRADER
Laser/Sonics/Tri-Sonics/GPS	15 cm	13 cm
Tracker	8 cm	7 cm

Second laser for cross slope on dozer:

This should be measured 1.5 meters from the centre of the blade. Press the **2s** button to adjust the value so that it corresponds to 8 cm for a laser sensor controlling tilt on a dozer.

2D and 3D cross slope sensor:

This should be measured 1.5 meters from the centre of the blade. Press the **2s** button to adjust the value so that it corresponds to the below distances. For example, the blade should move 7 cm for 3D cross-slope.

SENSOR	DOZER	GRADER
2D and 3D cross-slope	7cm	14cm

ROTATING LASER

The Automatic Control System can operate with many models of Rotating Lasers. The laser must have a 360° rotating head with invisible or red beam and a speed of 8-40 RPS (revolutions per second). The faster the laser's speed the more optimally the system will perform.

The Rotating Laser is mounted on a tripod, which is located on the job site near where the box is operating. The Rotating Laser is the unit that creates the plane of laser light detected by the Laser Receiver.



Figure 17. Rotating Laser.

The Rotating Laser transmits a focused plane of laser light approximately 1000 feet (300 meters), optimal range for most Rotating Lasers, as it rotates.

Rotating Lasers are available in single grade, dual grade, and steep slope versions. They can be quickly and easily aligned to job site requirements without complicated calculation of angles.

A dual slope Rotating Laser can be configured for level, single slope, or dual slope applications. Simply enter the required percent of grade and align the Rotating Laser to the axis (direction) to be graded.

SYSTEMS FEATURES AND BASIC OPERATION

- Percent of Grade. The change in elevation for every 100 feet (30 meters) graded.
- Slope. The change in elevation per foot (meter).

WARNING

Never look directly into a laser light or serious injury to the eye may occur. In general, incidental exposure of the laser to the eye will not do damage. However, avoid looking into the beam whenever possible. Use a target for viewing the laser spot.

WARNING

Use of any laser on a worksite is controlled by OSHA regulations found at 29 CFR 1926.54. Be familiar with these regulations before using any laser beacon used in conjunction with this system. Review and understand all literature provided with the Laser System before operating.

WARNING

Laser protection devices must be provided to all workers in the area if the laser system exceeds five (5) milliwatts. Refer to the literature provided with the system to determine the power output. If unsure of the strength of the laser system, anti-laser eye protection should be provided to all workers.

CABLES

The cables are provided to connect the various components together into a system. Each connector uses a unique number of pins to prevent the components from being connected incorrectly. At the Control Panel, each cable uses a press-and-twist style of connector. After the cable is pressed into the socket, twist the ring clockwise until tight to secure it.

CAUTION

Never force a connector into a socket.

CAUTION

All cables must be secured with adequate cable length to avoid pinching, stretching and tight bending. Do not clamp cables to pipes or hoses that may generate high heat.

Cable Configurations

Power Cable - supplies power to the system.

NOTE: The Control Panel supports both 12 and 24-volt machine systems. However, the valve is 12 volts only. Contact ATI Corporation for additional information when using a 24-volt system.

Receiver Cables (2) - power the Receiver and communicate grade information between each Laser Receiver and the Control Panel. The connector attaches to the junction block end of the receiver cable and the straight end to the Laser Receiver(s).

These are coiled cables that can hang freely between the Junction Box and Laser Receiver mounted on the mast.

Solenoid Cable - communicates grade information between the Junction Box and the hydraulic valve. There is one connector for the Junction Box and two connectors for the valve. One connector goes to each valve solenoid. Labels located on the cable identify the solenoid to connect to.

Remote Switches Cable - connects to the Cradle allows operation of the Raise/Lower and Auto/Manual functions remotely (within 10 ft.) from the skid steer operator station. The cable includes two switches that mimic the two joysticks on the Control Panel. The switches should be mounted with the cable down so the direction of movement is the same as the joystick movement.

NOTE: Contact your local Leica Dealer for any questions about pin locations or configurations.

SYSTEMS FEATURES AND BASIC OPERATION

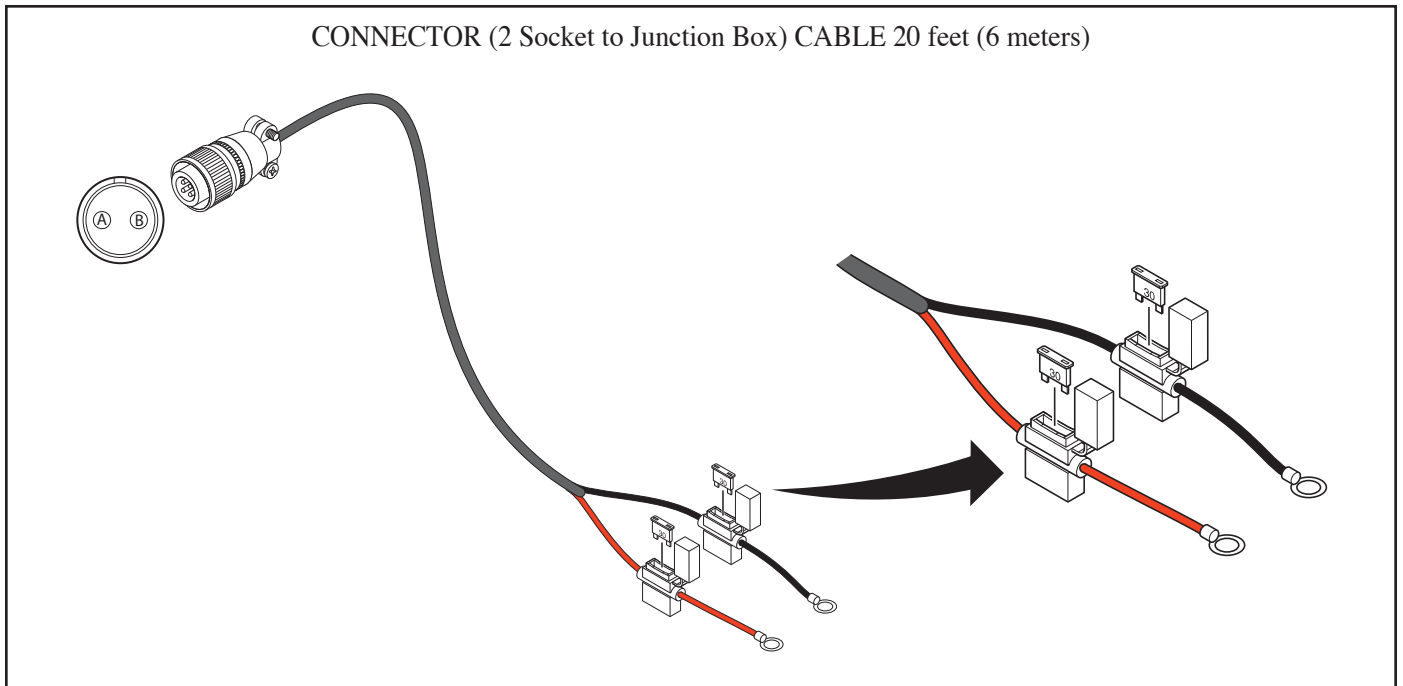


Figure 18. Power Cable Detail.

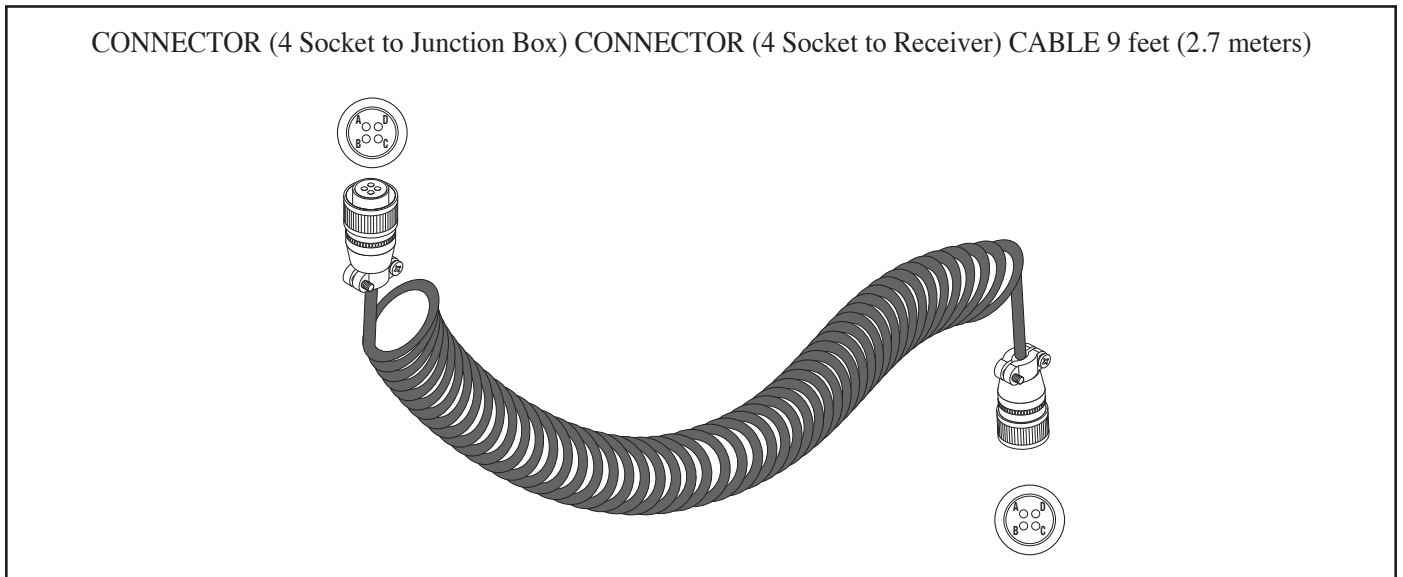


Figure 19. Receiver Cable Detail.

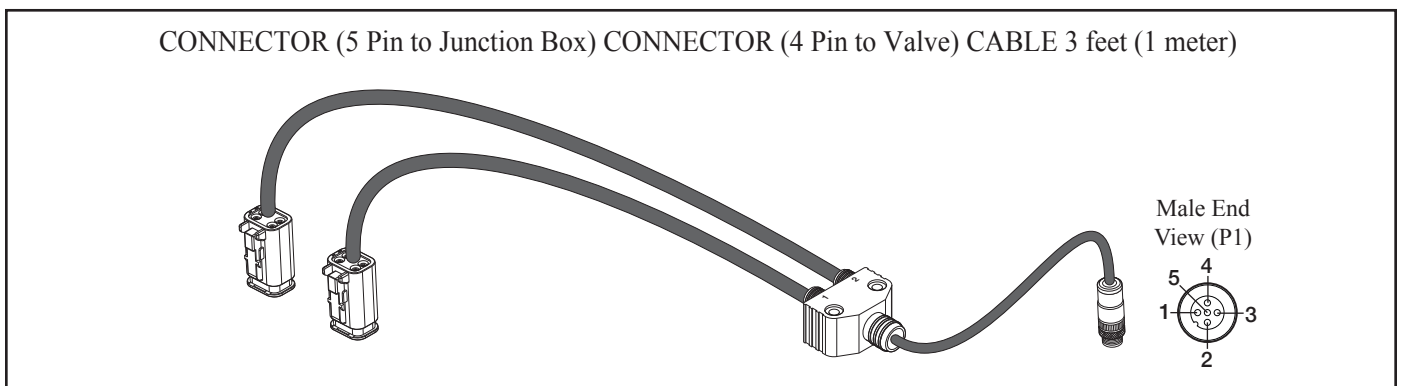


Figure 20. Solenoid Cable Detail.

SYSTEMS FEATURES AND BASIC OPERATION

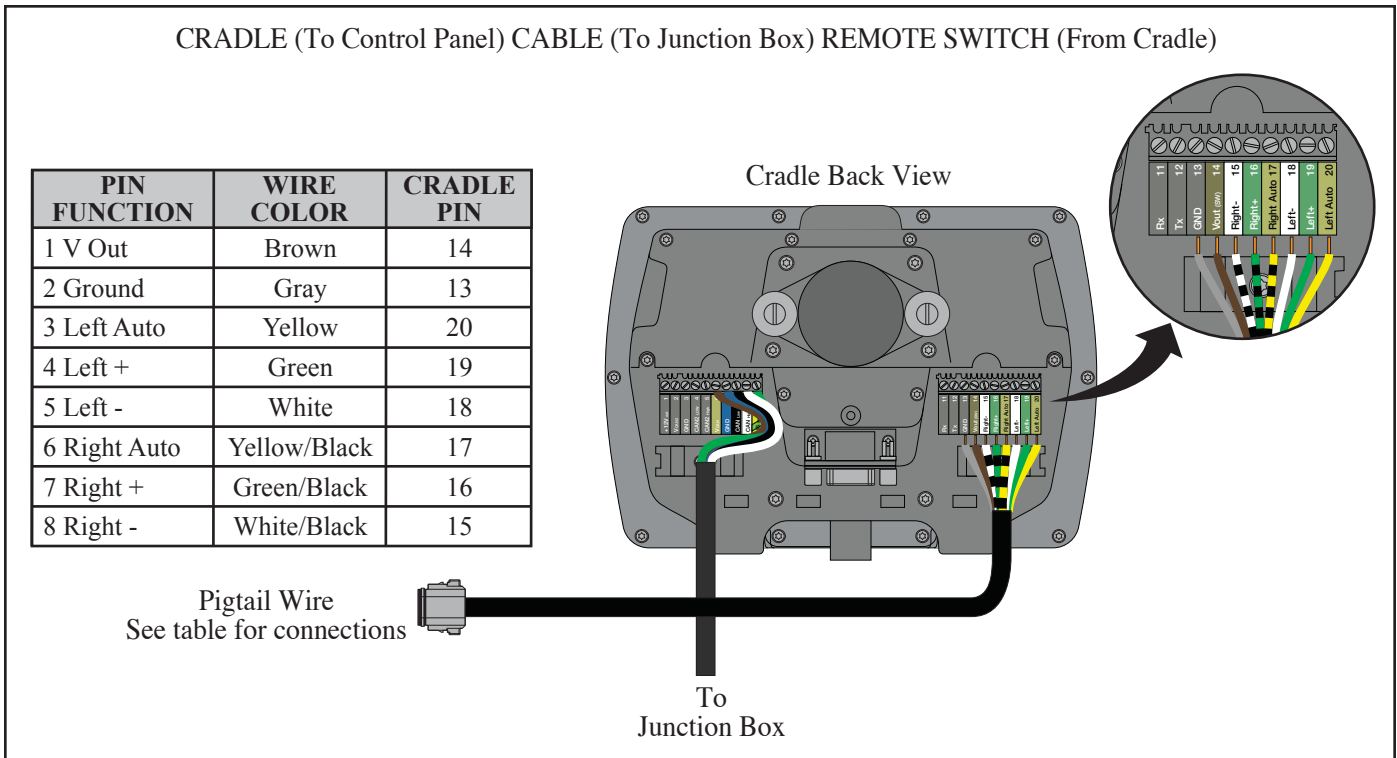


Figure 21. Remote Switch with Cradle Detail.

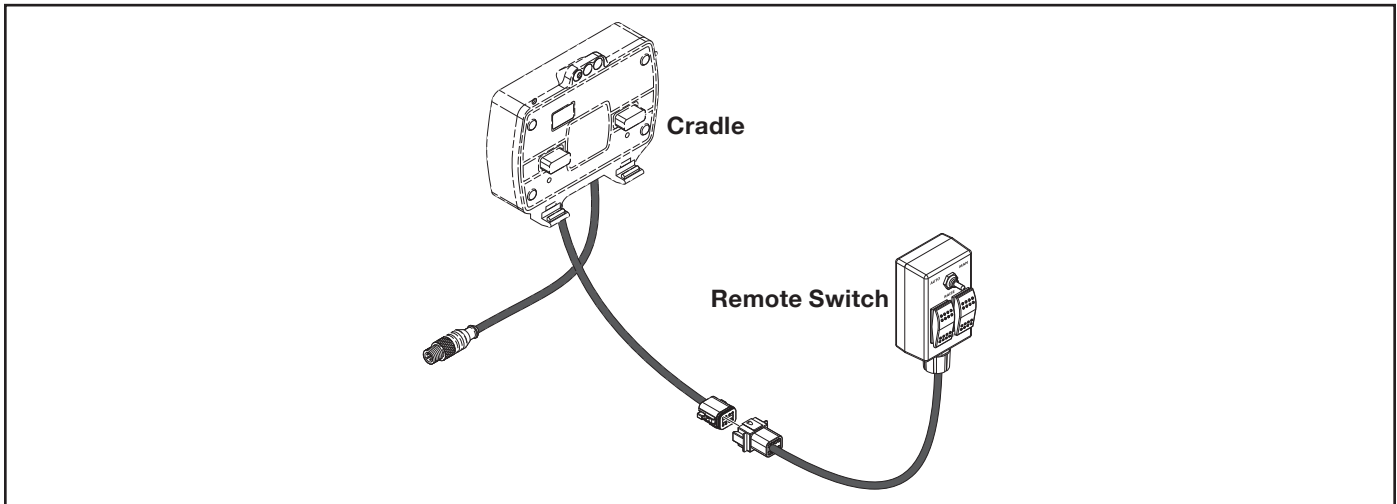


Figure 22. Remote Switch Detail.

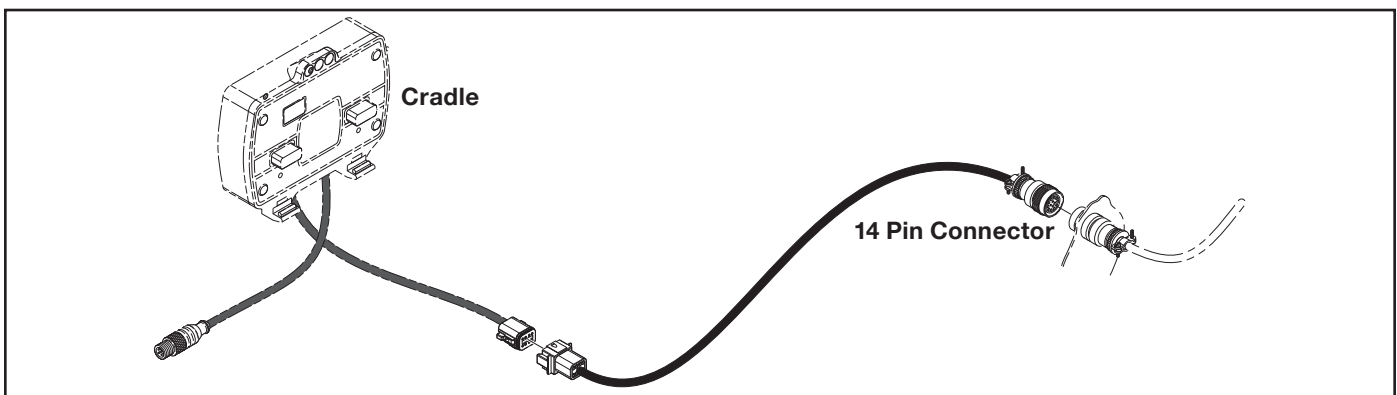


Figure 23. Pigtail to 14 Pin Connector

SYSTEMS FEATURES AND BASIC OPERATION

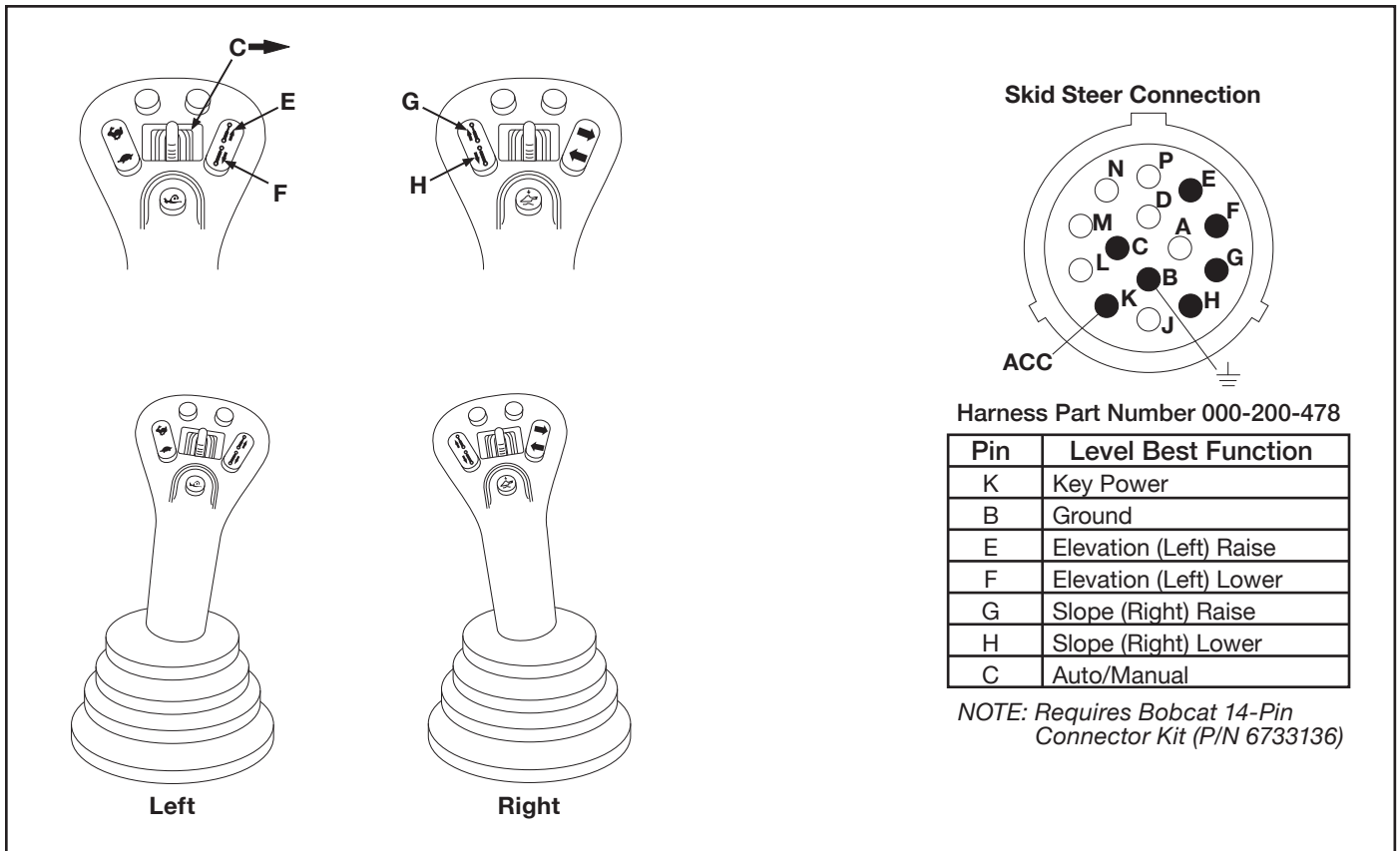


Figure 24. Bobcat Joystick Functions

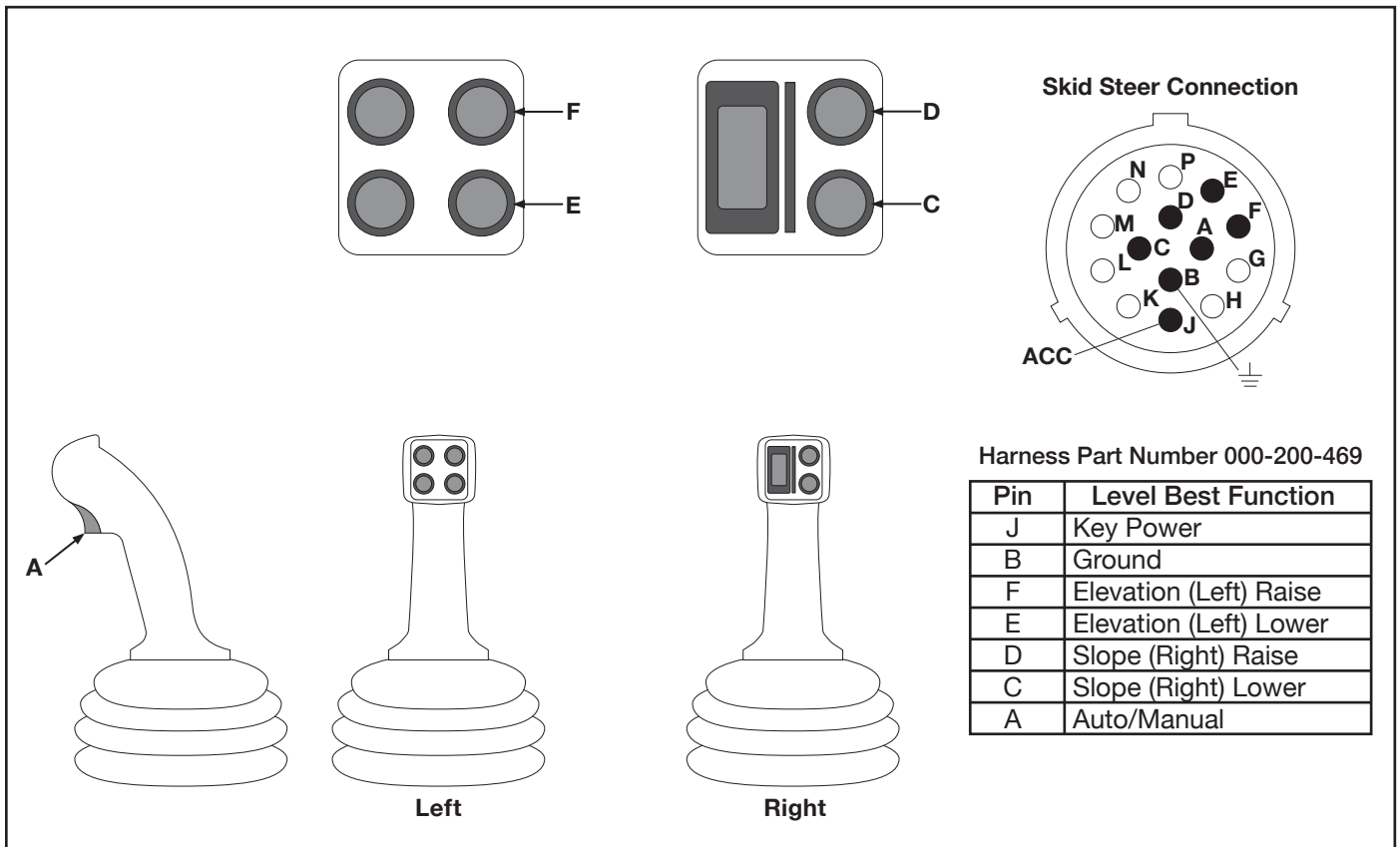


Figure 25. Cat D-Series Joystick Functions

SYSTEMS FEATURES AND BASIC OPERATION

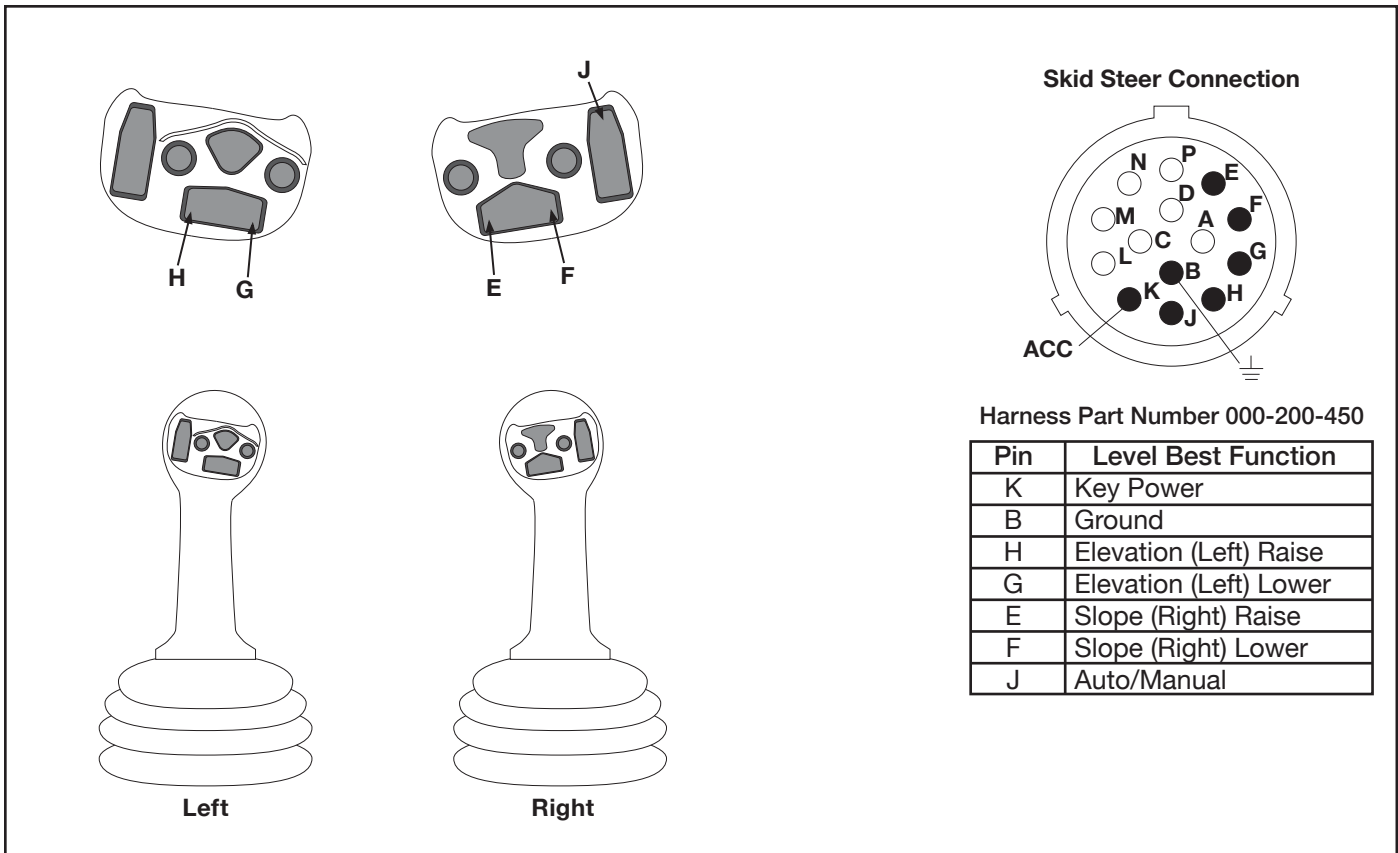


Figure 26. Kubota SSV65 & 75 Joystick Functions

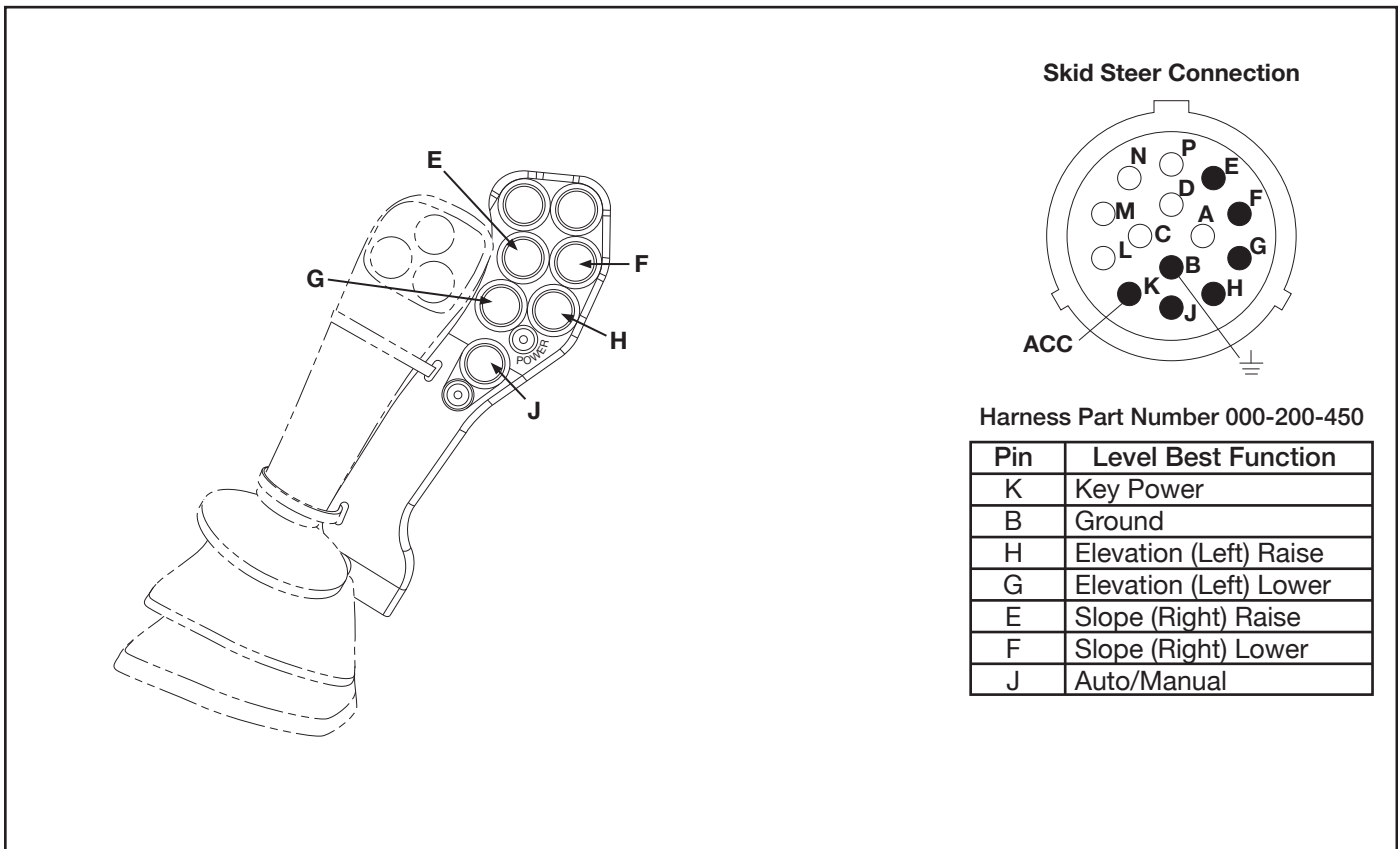


Figure 27. Kubota SVL 95 S6699 Multifunction Controller

SYSTEMS FEATURES AND BASIC OPERATION

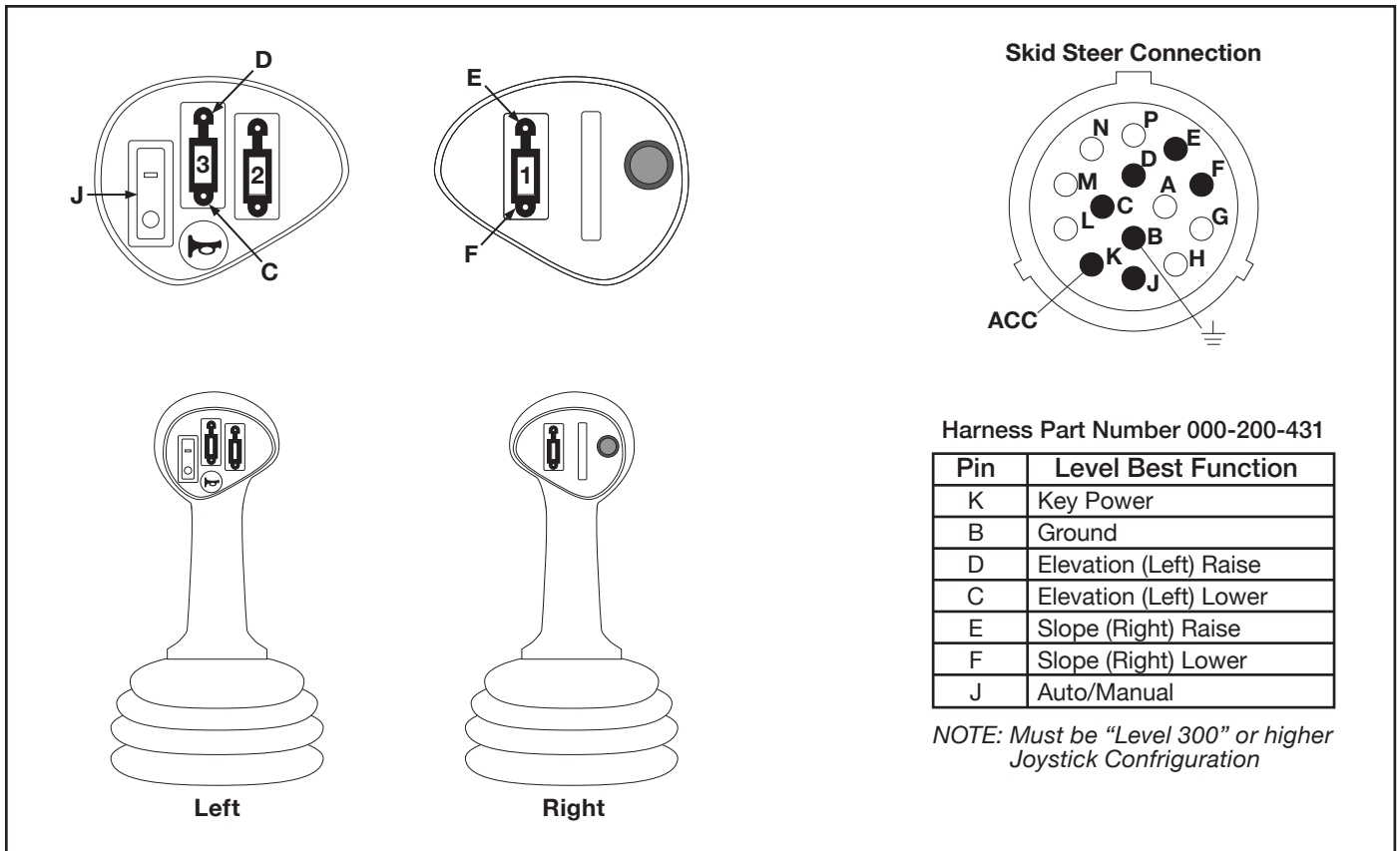


Figure 28. Case Joystick Functions

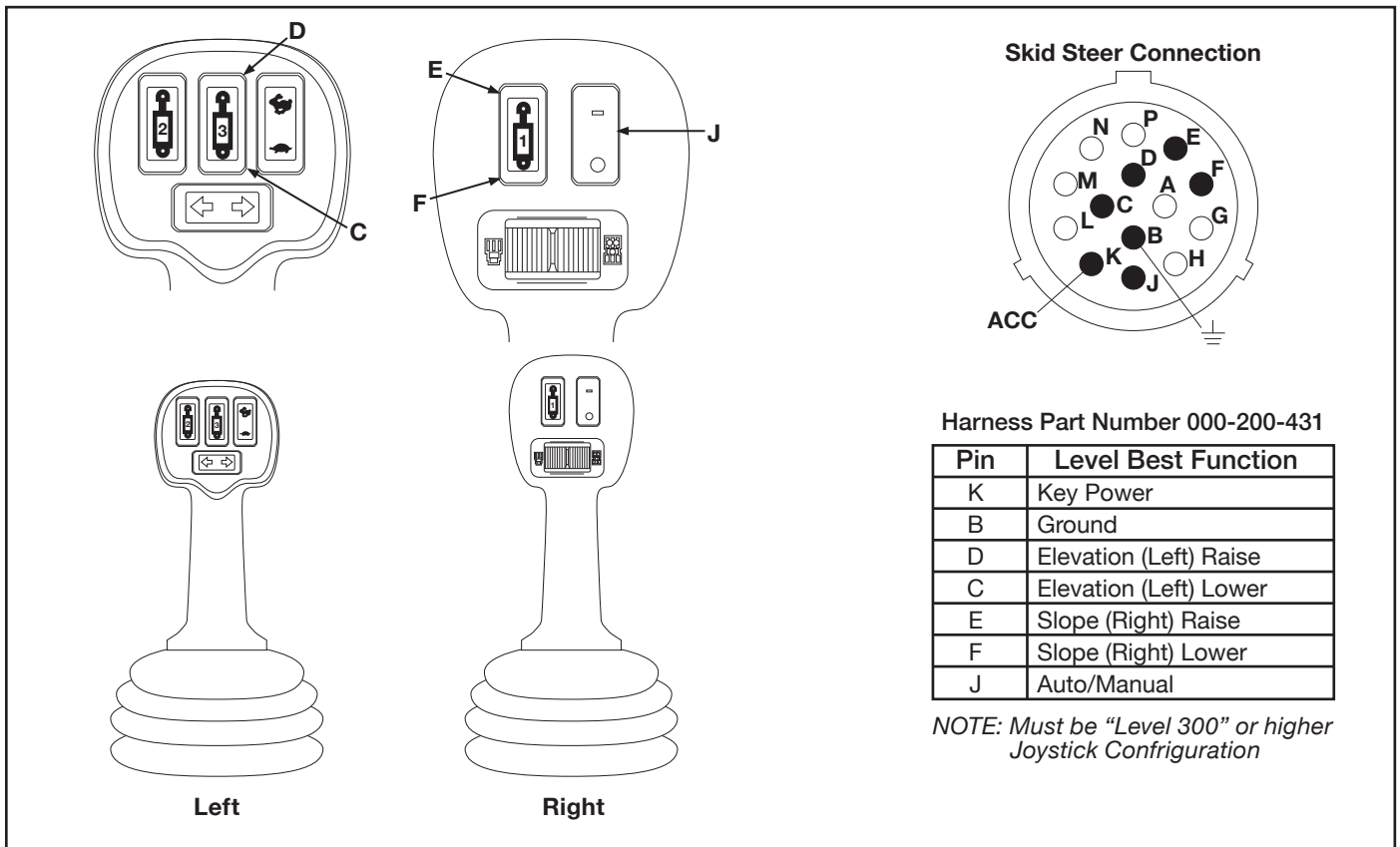


Figure 29. New Holland Joystick Functions

SYSTEMS FEATURES AND BASIC OPERATION

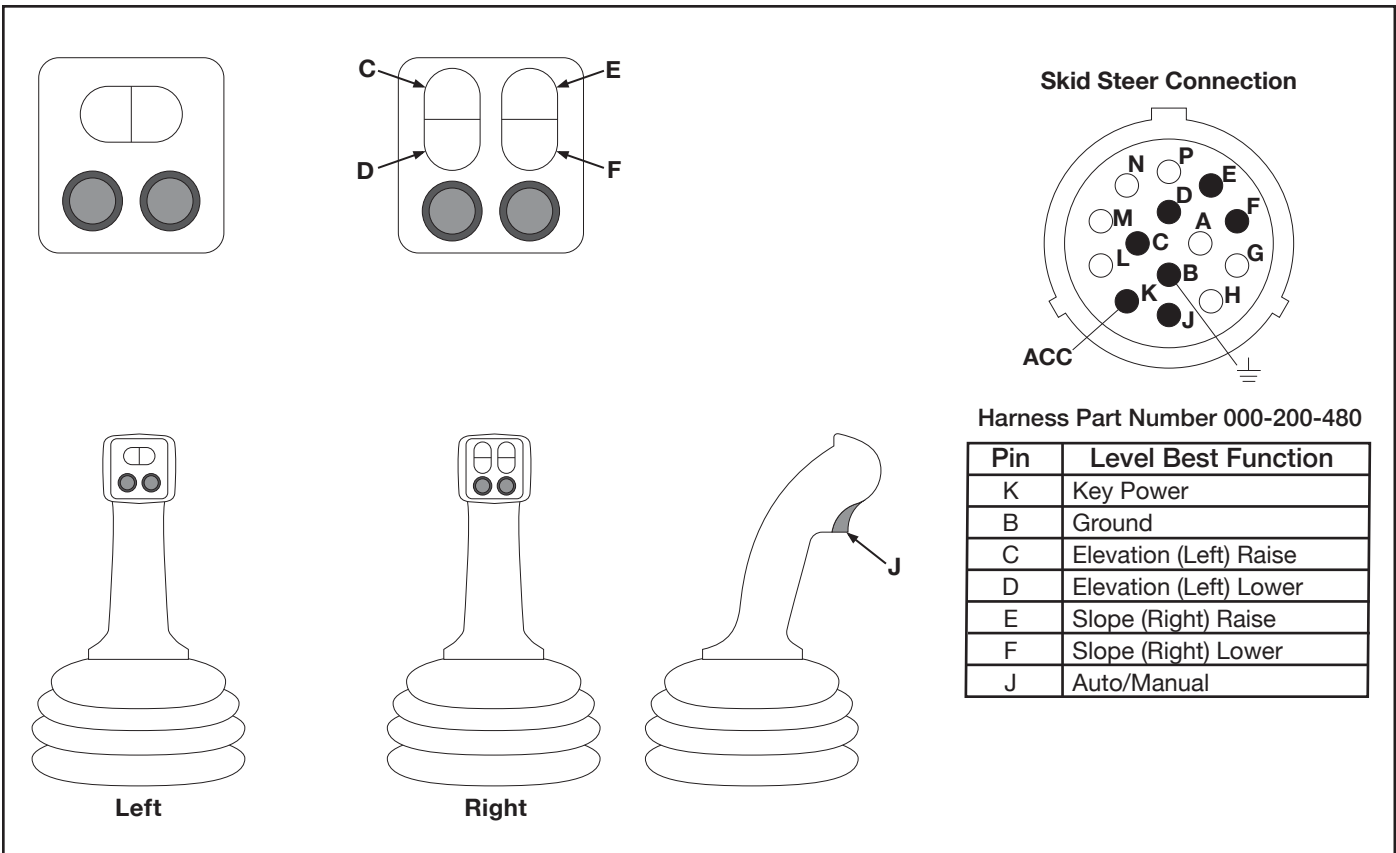


Figure 30. Takeuchi TL12/TL250 Joystick Functions

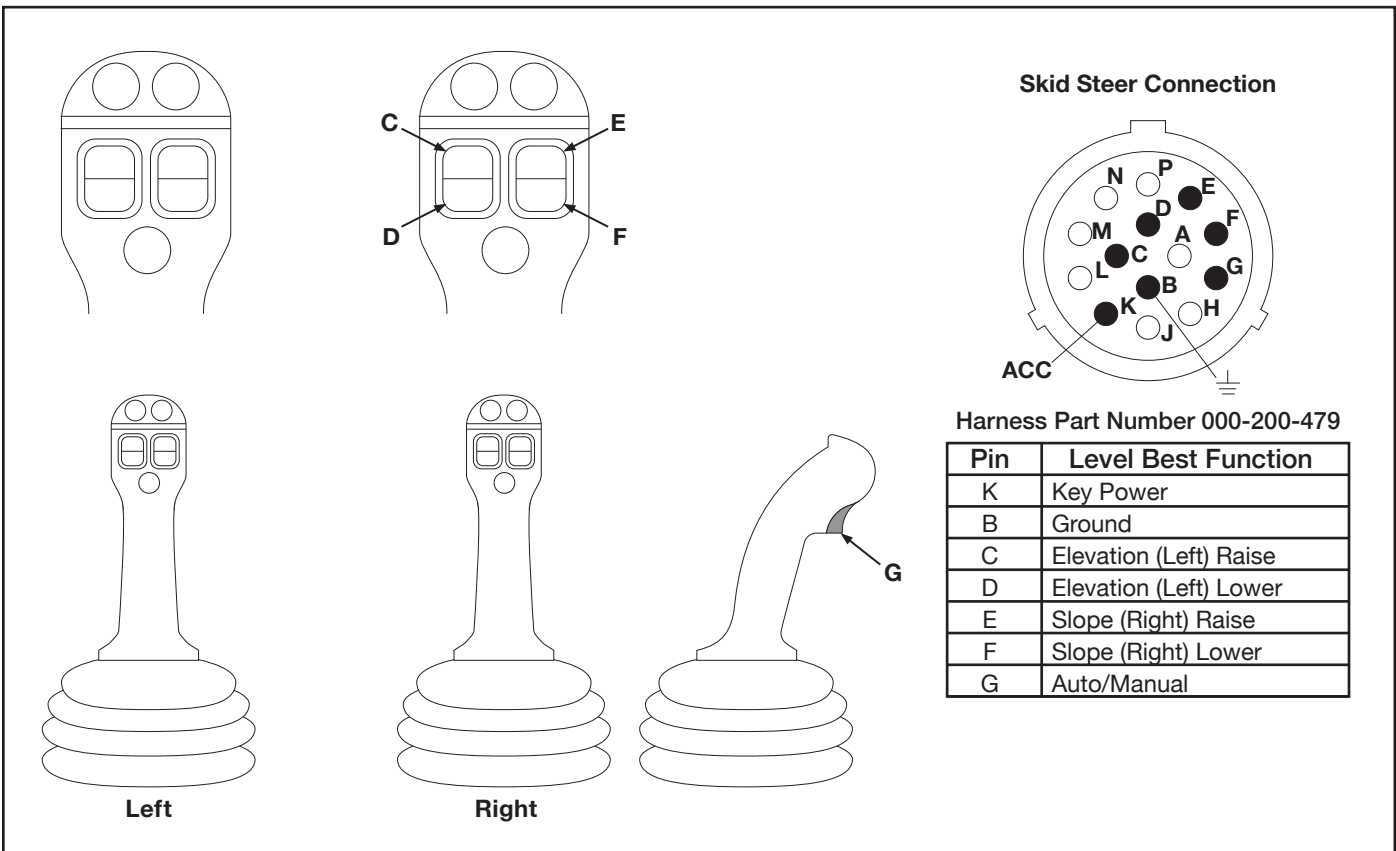


Figure 31. JCB/Volvo Joystick Functions

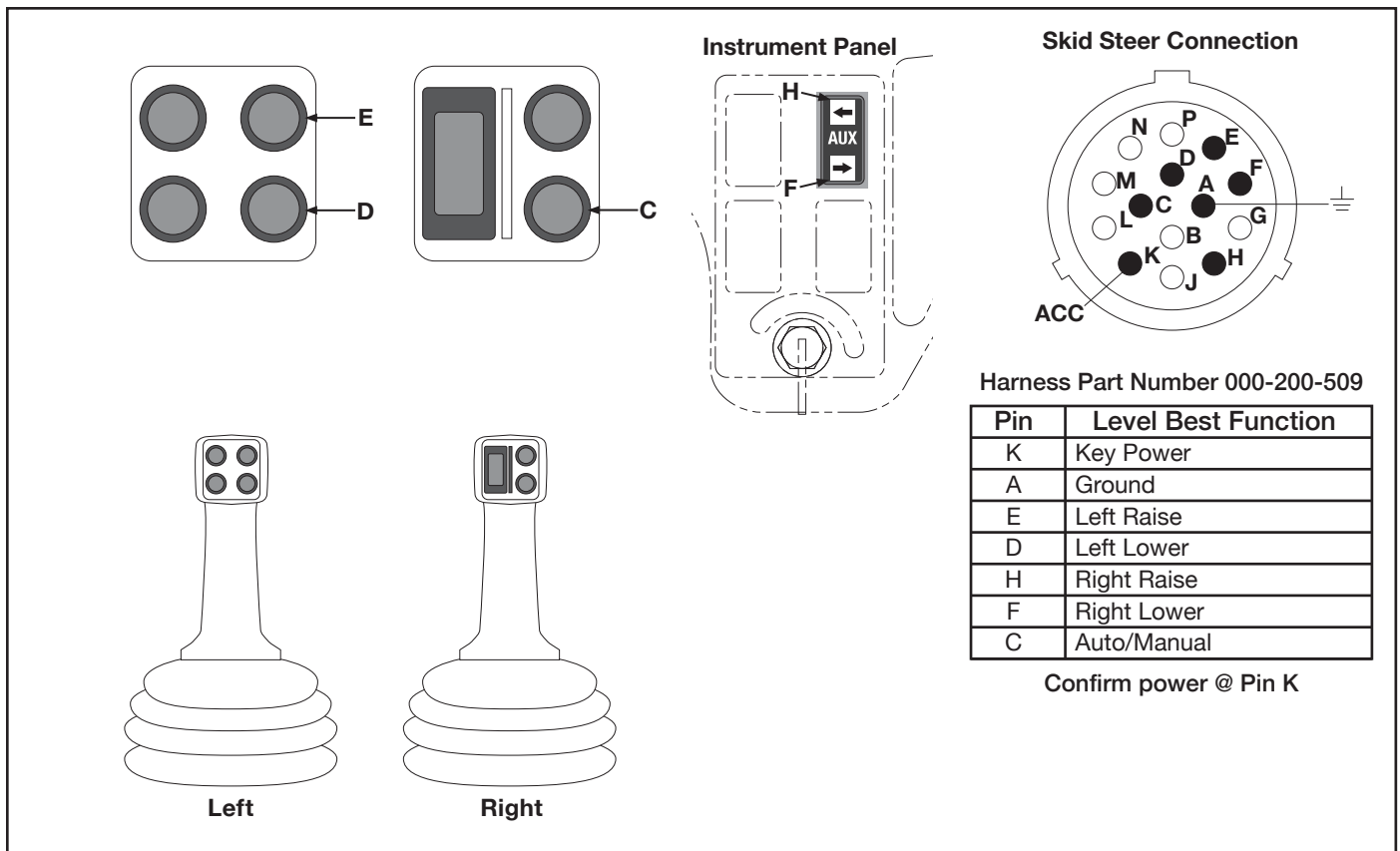


Figure 32. John Deere G-Series Joystick Functions

EQUIPMENT SETUP

Some of the following setup procedures may already be completed. However, it is recommended that the operator be familiar with the various system components and how they interconnect.

1. Connect the Power Cable to the battery power supply. Place connector end of cable near the Control Panel bracket for later connection to the Control Panel.

NOTE: Red wire is positive and black is negative.

2. The Laser Grading Box should be positioned on a level area for attaching to the skid steer. Start the skid steer, drive up to the attachment plate and secure per the skid steer manufacturer's directions. The Level Best quick-attach plate is designed to be universal.

NOTE: If the skid steer's pins do not fit securely into the rectangular holes at the base of the attachment plate, these holes can be notched larger to accept the pins.

3. After installation, ensure that the Grading Box is level. The loader arms must be completely lowered and the bucket cylinders set so the tires of the Laser Grading Box are on the ground.

Verify that the Laser Grading Box is level by observing that the main frame is horizontal to the ground. Turn the skid steer engine OFF when connected.

4. Attach the Control Panel to the Cradle, mount that Ram Ball attach it to the Mounting Bracket.

SYSTEMS FEATURES AND BASIC OPERATION

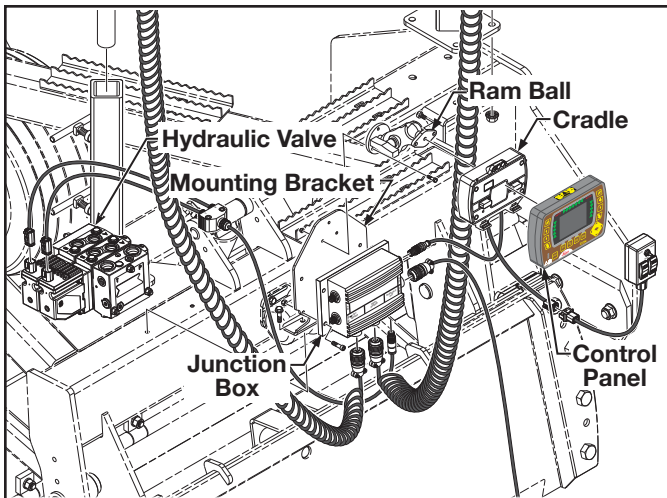


Figure 33. Control Panel Mounting.

NOTE: Most skid steer's have the ability to reverse the hydraulic flow to the quick couplers. Care must be taken that the flow is always engaged the correct direction. (Refer to [Figure 36.](#))

5. Connect the Laser Grading Box's hydraulic hoses with quick couplers to the auxiliary hydraulic ports of the skid steer. The Laser Grading Box's hydraulic manifold is marked "P" and "T" where the pressure and return (tank) hoses connect.

NOTE: "P" means pressure (supply) and "T" means tank (return). Refer to the skid steer Owner's Manual for identifying the "P" and "T" Auxiliary Hydraulic Ports.

6. Insert the two Mast Poles in the holders, one in the center and one on the right side, until they rest at the bottom of the tube. Tighten the tee handles to secure the masts. Clamp a Laser Receiver near the top of each mast so it is higher than any local obstructions including the skid steer cab or fall protection devices. (Refer to [Figure 34.](#))

CAUTION

Cables must be securely fastened and pinch/rubpoints eliminated. Do not fasten to hydraulic lines which may operate at high temperatures. Ensure sufficient cable length to allow movement of the machine.

7. Attach the switch end of the Remote Switch Cable at a convenient location for the operator. Connect the 7-pin remote switch connector to the 7-socket connector on the Junction Box.
8. Connect Receiver Cable to the base of the Laser Receiver and the other end to the Junction Box. All cables only attach to the proper connectors.
9. Connect the Solenoid Cable to the directional valve and the other end to the Junction Box. (Refer to [Figure 20.](#))
10. Repeat step 9 for the other cable and Laser Receiver mounted on the right-side mast, connecting it to the Junction Block labeled R.
11. Connect end of the Valve cable to the back of the Junction Box. Connect the straight end (molded) of the Valve cable labeled SLOPE to the forward valve solenoid and the other straight end connector (not labeled) to the rearward valve solenoid
12. Connect the Power Cable to the side of the Junction Box. The terminal end was previously wired to the battery

SYSTEMS FEATURES AND BASIC OPERATION

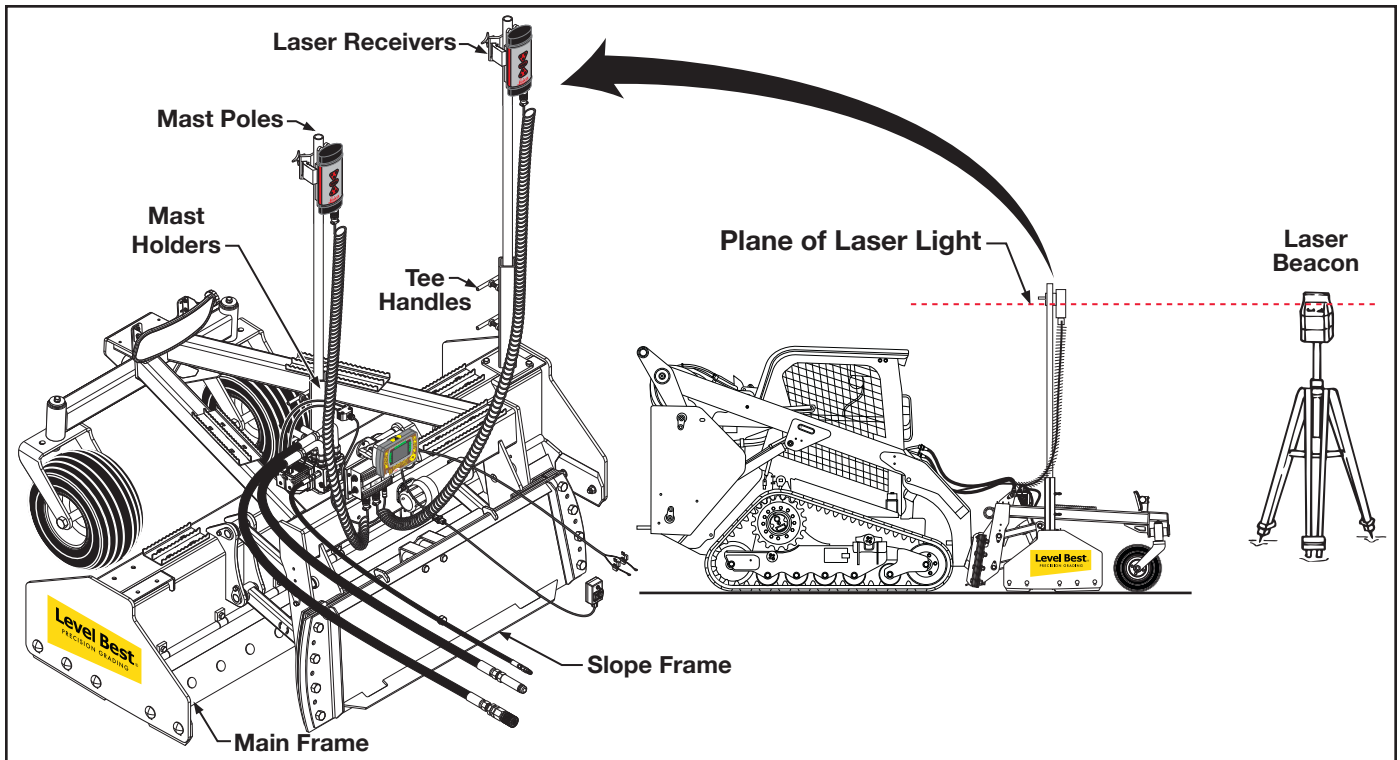


Figure 34. Components of the Automatic Control System on a Skid Steer.

HYDRAULICS

Danfoss PVG-32 Hydraulic Valve

The hydraulic valve is setup at the factory and should not need any adjustments. If there are any changes required, they should be done by an authorized factory technician.

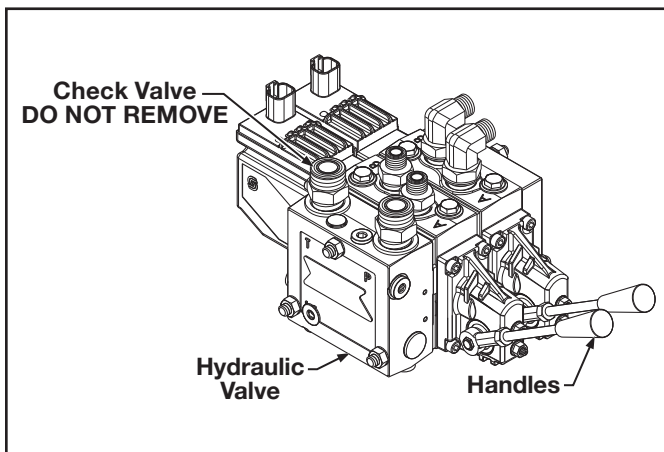


Figure 35. Hydraulic Valve (Danfoss PVG-32).

NOTE: Do not remove the check valve. Removal will void the warranty.

The handles are for manual actuation of the valve.

Hydraulic Hose Connection

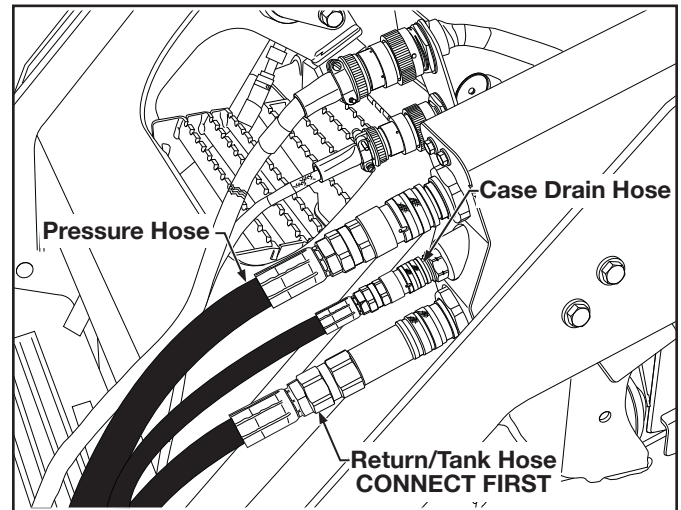


Figure 36. Hydraulic Hose Connections to Skid Steer

⚠ CAUTION

The return line must be connected before the pressure line. Pressurizing the valve without an outlet will damage the valve and void the valve warranty.

SYSTEMS FEATURES AND BASIC OPERATION

NOTE: Check the manufacture of your skid steer for the correct hose connections.

JOB SITE SET-UP

The following are guidelines for setting up the Rotating Laser for both level job sites and sloped job sites:

- Choose a location for the Rotating Laser where obstructions, such as trees and buildings, can not block the plane of laser light. The Laser Receiver needs to be able to sense the plane of laser light at all times.
- Whenever possible, set up the Rotating Laser and the Laser Receiver at a height above the machine's cab. This prevents the cab or rollover structure from blocking the plane of laser light as the machine moves around the job sites.
- The recommended head speed for the Automatic Control System is 20 RPS (Revolutions per Second). At 20 RPS, the Rotating Laser updates the Laser Receiver 20 times per second.

Set-Up for Level Grading

If the job site is to be level, the set-up of the Rotating Laser is simple. Since no slope is required in either axis, the Rotating Laser does not need to be aligned. The Rotating Laser will provide a level plane of laser light in all directions.

1. Locate the Rotating Laser following the guidelines above.
2. Apply power to the Rotating Laser. Level the Rotating Laser (some Rotating Lasers will automatically level, others will need manual adjustment).
3. Set the counters for both axis at 0.000% (If needed, see the Rotating Laser Operation Manual).
4. Bench the machine. See the "Benching and Operating" procedure in this section.

Set-Up for Sloped Grading

If the job site is to be graded for a single or dual slope, the Rotating Laser requires its axis to be aligned for the job site. The Rotating Laser will then provide a plane of laser light at the required slope(s).

The following procedures are for two typical examples of job sites requiring sloped grades. Remember, each job site is unique, so consider the following methods as guidelines and not as the only methods possible.

Method One:

1. Set a minimum of two grade stakes exactly in line with one of the axis to be graded.
2. Place the Rotating Laser in line with the two grade stakes.

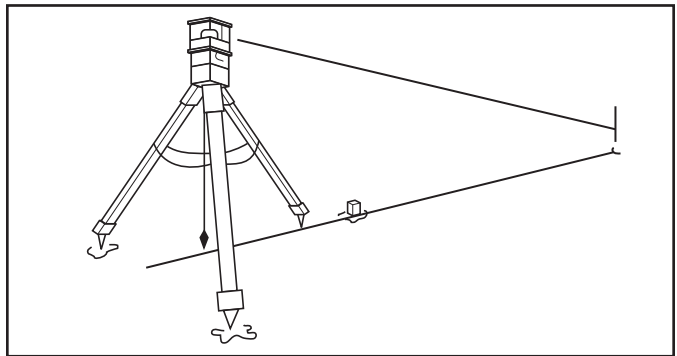


Figure 37. Method One: Align Rotating Laser with Grade Stakes.

3. Switch on the Rotating Laser. Level the Rotating Laser (some Rotating Lasers will automatically level, others will need manual adjustment).
4. Set the counter on the Rotating Laser for both axis to 0.0000% (If needed, see the Rotating Laser Operation Manual).

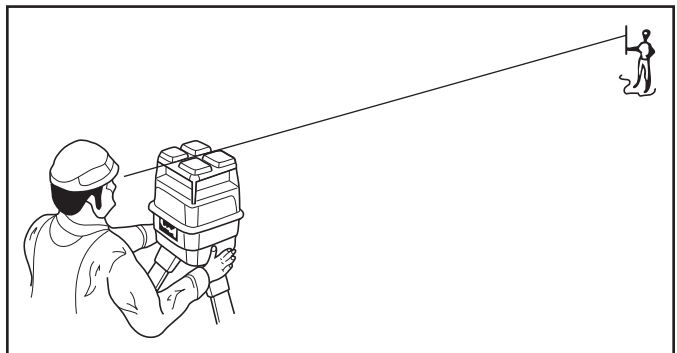


Figure 38. Sight Over Rotating Laser.

SYSTEMS FEATURES AND BASIC OPERATION

5. Roughly align one of the axis to the grade stakes by sighting over the top of the Rotating Laser (Refer to [Figure 36](#).)
6. Align the plane of laser light.
 - a. Set a grade rod with Rod Eye Receiver on the far grade stake and adjust the rod until the Rod Eye Receiver indicates “On Grade.”
 - b. On the axis not aligned with the stakes, enter on the Rotating Laser: 5.000%. Allow the Rotating Laser to level itself to this new position, if needed.
 - c. Check the Rod Eye Receiver again.
 - If the Rod Eye Receiver indicates “On Grade”, the plane of laser light is aligned correctly.
 - If the Rod Eye Receiver indicates the plane of laser light is too high or too low, have a second person rotate the Rotating Laser on the tripod in small steps until the Rod Eye Receiver indicates “On Grade.”
7. Enter on the Rotating Laser the required percent of grade for each axis and allow the Rotating Laser to level itself again.
8. Bench the machine. See the “Benching and Operating Your Machine” procedure in this section.

Method Two:

NOTE: This procedure requires that the elevations of the grade stakes are correct and aligned to the slope or percent of grade required.

1. Set a minimum of two surveyed grade stakes. The stakes must have elevation information.

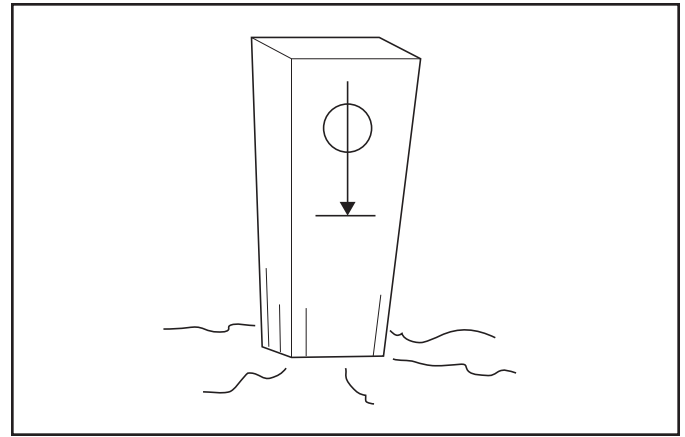


Figure 39. Grade Stake with Elevation Mark.

2. Place the Rotating Laser a few feet (meters) behind the first grade stake and in line with one of the far grade stakes (it is not critical to align the Rotating Laser exactly). (Refer to [Figure 40](#).)

NOTE: Follow the guidelines at the beginning of this section when placing the Rotating Laser.

3. Switch on the Rotating Laser. Level the Rotating Laser.
4. Roughly align one of the axis to the grade stakes by sighting over the top of the Rotating Laser (Refer to [Figure 38](#)).
5. Set both the counters on the Rotating Laser to the required percent of grade (If needed, see the Rotating Laser Operation Manual).

NOTE: The Grade Rod must be held plumb for each of the readings taken in the following steps.

6. Establish the H.I. (height of the instrument) for the plane of laser light.
 - a. Align the bottom of the Grade Rod to the mark on the near grade stake.
 - b. Adjust the Rod Eye Receiver up and down until it indicates “On Grade.”
 - c. Adjust the Rod Eye Receiver for any cut or fill amount indicated by the grade stake.
 - If the grade stake shows a cut, extend the Grade Rod and Rod Eye by the amount shown as a cut.

SYSTEMS FEATURES AND BASIC OPERATION

- If the grade stake shows a fill, lower the Rod Eye by the amount shown as fill.

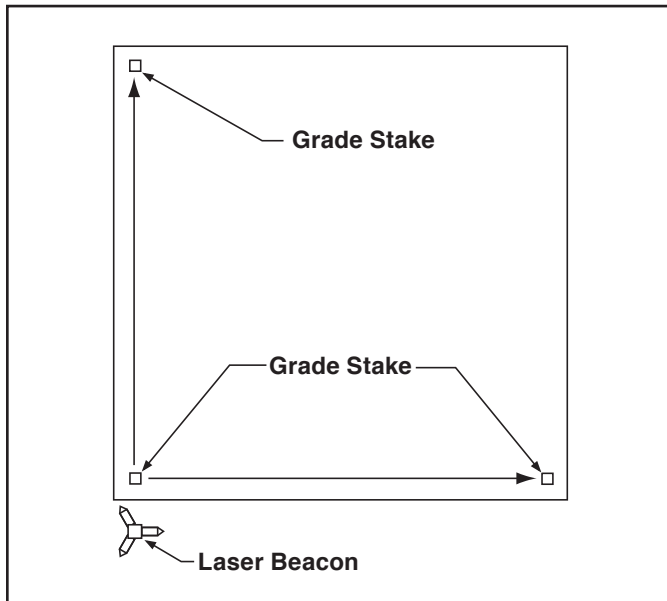


Figure 40. Method Two: Align Rotating Laser with Grade Stakes.

7. Align the plane of laser light.
 - a. Align the bottom of a Grade Rod to the mark on the far grade stake.
 - b. Check the Rod Eye Receiver.
 - If the Rod Eye Receiver indicates “On Grade,” the plane of laser light is aligned at the correct slope.
 - If the Rod Eye Receiver indicates the plane of laser light is too high or too low, have a second person rotate the Rotating Laser on the tripod in small steps until the Rod Eye Receiver indicates “On Grade.”

NOTE: If it was necessary to rotate the Rotating Laser a significant amount at the far stake, then the original reading at the near stake may be out of tolerance. Check the setting again and make minor adjustments as required.

8. Bench the machine.

NOTE: If needed, check the elevations on both the plane of laser light and the grade stake elevations by setting the bottom of the Grade Rod at any stake’s grade mark and checking the Rod Eye Receiver for the “On Grade” indication.

BENCHING AND OPERATING

Before benching, the plane of laser light must be set at its proper slope. Benchening is the process of setting the relationship between the Laser Receiver and the Rotating Laser or benchmark. Failure to properly bench the system before grading will result in an unacceptable grade.

The goal is to have the Laser Grading Box approximately 1/2 full during operation. If, during rough grading, a lot of material needs to be removed from a site, the elevation offset feature can be used to rough-in the grade. As material is removed, the elevation offset can be reduced and the site regraded. This may need to be repeated several times until finished grade is achieved.

Benching

NOTE: Finish grade can be checked several times during the grade process to “zero” in on final grade.

1. Turn the system on using the Power switch.
2. Ensure the system is in manual control and dual elevation mode (default).
3. Turn the Rotating Laser ON and set to 0.0% slope.

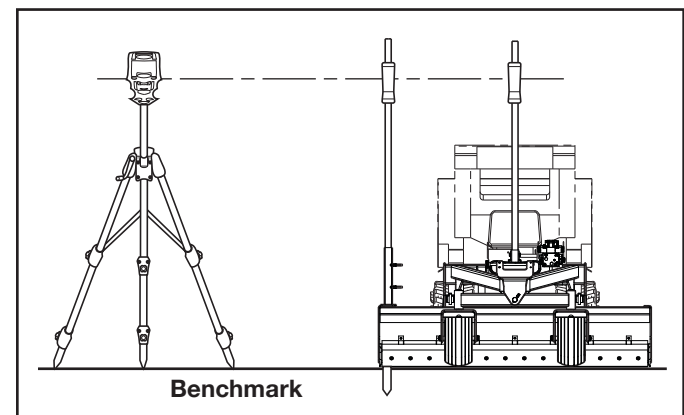


Figure 41. Benchening the Para-Level LGB with a Level Plane.

SYSTEMS FEATURES AND BASIC OPERATION

4. Move the machine to an area to be graded. Using the system controls, lower the cutting edge to finished grade. This is normally done close to the Rotating Laser.

NOTE: If necessary, a small area may need to be manually graded to obtain sufficient space for benching.

5. Use a bubble level to level the LGB. Re-check the cutting edge to ensure it remains at the finished grade.
6. Raise the Power switch and hold in the I position for 1 second to access the User Setup menu.
7. From the User Setup screen on the Control Panel, highlight the Deadband (Accuracy) icon and press the joystick.
8. Select an appropriate deadband for the job and conditions.
9. Press the joystick twice to exit the deadband setup.
10. Adjust the height of each Laser Receiver until the appropriate center Grade Position LED cluster is lit, indicating it is “on grade.” Tighten the mounting knobs on each Laser Receiver securely after adjustment.

For grading to level, skip to step 14. For grading on a slope, continue from step 11.

11. For sloped grades, the Rotating Beacon can now be adjusted to the proper slope.
12. With the LGB remaining at finished grade, raise or lower the Rotating Beacon on the tripod until the Laser Receiver on the center mast indicates the Elevation is “on grade.”

WARNING

Always have system in Manual setting when not operating the skid steer.

13. Using all applicable safety precautions, set the Control Panel to automatic control. Drive the skid steer a short distance to allow the control system to adjust the LGB to the grade.

14. Both elevations should now indicate 0.0. Slope offset and other adjustments for rough grading can be made and grading can begin.
15. After grading a small area, check the grade using a grade rod. If required, adjust the LGB using this procedure.

NOTE: Most materials graded must later be compacted. To compensate for the compacting distance, raise the Rotating Beacon. This raises the cutting edge by the same distance. The distance the Rotating Beacon is raised depends on the material.

Benching with a Rod Eye

To bench the Laser Receiver follow the process listed below:

1. Turn on the Rotating Beacon. Attach a Rod Eye to a measuring pole and turn on. Set the base of the measuring pole on the benchmark and adjust the measuring pole so the Rod Eye emits a solid “On Grade” tone (compensate for slab thickness and compaction if needed).
2. Find an area to be graded that is close to specified grade. Making sure the control system is in manual mode, start the skid steer, engage the auxiliary hydraulics and move the unit to that location. Manually raise or lower the Laser Grading Box’s cutting edge until it is even with the bottom of the measuring pole when the Rod Eye is emitting the “On Grade” tone or resting on the ground if already at grade.

NOTE: The elevation measurement must be made as close to the Laser Receiver as possible, i.e., in the middle or on the right-side.

3. With the control system deadband set as required for the job, move the Laser Receiver to a height on the mast pole where it indicates the beam in the “On Grade” position and is unobstructed by any object.

NOTE: Operator may prefer to turn the face of the Laser Receiver towards the operator for easy viewing.

SYSTEMS FEATURES AND BASIC OPERATION

4. Move the Rod Eye to the right side of the blade. Using the tilt function (right-side joystick), manually raise or lower the Laser Grading Box's cutting edge until it is even with the bottom of the measuring pole while the Rod Eye is emitting the "On Grade" tone or resting on the ground if already on grade. Repeat step 3.

Operation

After the Laser Grading Box is connected and the Automatic Control System is calibrated, operation can begin.

The operational goal is to drive over the area to be graded with the box 1/2 full of material and the green LEDs on the grade indicators always illuminated.

1. When seated in the Operator's seat, start the skid steer. Turn the control system on and set the system to automatic control. For initial or rough-cut situations, use a higher deadband setting.

NOTE: Most materials graded must later be compacted. To compensate for the compacting distance, raise the Rotating Beacon. This raises the cutting edge by the same distance. The distance the Rotating Beacon is raised depends on the material.

2. Drive the machine forward or reverse (the Para-Level Laser Grading Box has front and rear cutting edges). The Automatic Control System constantly senses the plane of laser light to maintain the cutting edge of the box at the required elevation.

NOTE: The following during operation:

- *In some situations, the Automatic Control System may require a cut deeper than the machine can handle. The machine may lose traction, stall the engine, or the wheel frame will be lifted off the ground to the maximum stroke of the cylinder as the cutting edge tries to reach finished grade. If this occurs, set the system to manual control and use the joysticks to raise the cutting edge until the machine can move*

the material. Make multiple passes to cut the area closer to finished grade and then go back to automatic control. This allows the high spots to be gradually removed.

- *If one of the Control Panel or Laser Receiver grade lights are blinking, it indicates the direction of the last elevation prior to passing out of the laser beam. If necessary, do the rough grading and then bench the Laser Grading Box again.*

NOTE: In rough grading situations, use the Automatic Control System as an "Indicate Only" system and operate the machine under manual control. After the area has been rough graded, switch to automatic control.

WARNING

Always have system in Manual setting when not operating the skid steer.

4. After several passes with the Laser Grading Box, stop and turn off the skid steer. Place the base of the measuring pole on the graded area and check grade elevation.
5. After a rough grade is achieved, the Deadband (Accuracy) may be changed to a narrower setting as required to meet the job tolerance requirements. With a tighter deadband, the speed of the skid steer needs to be decreased for optimum finish.

TROUBLESHOOTING

SYMPTOM	POTENTIAL CAUSE	REMEDY
Control Panel lamps do not light.	<p>Control Panel not turned on.</p> <p>Power Cable not connected to Control Panel.</p> <p>Power Cable not providing power to the Control Panel.</p> <p>Fuse blown.</p> <p>Electrical short.</p>	<p>Push the Power ON/OFF Switch.</p> <p>Connect power cable to Control Panel.</p> <p>Check that the Power Cable is connected to the battery. The red wire connects to the positive (+) post and the black wire connects to the negative (-) post.</p> <p>Remove the Power Cable from the Control Panel and, using a volt meter, check for a minimum of 11 volts DC.</p> <p>Check the fuse.</p> <p>Disconnect all cables except the Power Cable. If the lamps still do not cycle when the Control Panel is turned on, contact the local Apache Technologies dealer.</p>
Laser Receiver does not display grade.	<p>No Rotating Laser in range.</p> <p>Laser beam blocked.</p> <p>Electrical short.</p>	<p>Ensure Laser Receiver is within operating range of Rotating Laser.</p> <p>Ensure beam is striking middle of the Laser Receiver</p> <p>Check and clean glass covering the Laser Receiver's photo cells.</p> <p>Check for obstructions keeping Laser Receiver from seeing the Rotating Laser.</p> <p>If LEDs do not cycle when Control Panel is turned On, contact the local Apache Technologies dealer.</p>
Laser Receiver does not display grade (cont'd)	<p>Laser Receiver not receiving power.</p>	<p>Check Fuse in the Control Panel.</p> <p>Check Receiver Cable for damage. Use an Ohm meter to check continuity.</p> <p>Disconnect and reconnect the Laser Receiver Cable making sure the connectors on the ends are seated into the Laser Receiver and Junction Block/ Receiver Cable correctly.</p> <p>Check that the Control Panel is communicating with the Laser Receiver, indicated by the Control Source Indicator icon on the LCD.</p>

TROUBLESHOOTING

SYMPTOM	POTENTIAL CAUSE	REMEDY
Box has trouble staying on grade.	Rotating Laser out of range.	Ensure Laser Receiver is within specified operating range of Rotating Laser.
	Laser beam being reflected.	Ensure Rotating Laser's light is not reflecting off other surfaces (windows, windshields, mirrors, etc.) causing multiple readings by the Laser Receiver.
	Multiple laser beams.	Ensure that there are no other lasers operating on the job site or nearby.
	Laser deadband set too narrow.	Ensure the Deadband (Accuracy) setting is appropriate for rough grading. Slow down.
	Travel speed is too fast for grade tolerance.	Decrease the Valve Speed setting.
	Hydraulic response too quick.	Confirm the pressure is going in the "P" port.
	Hydraulic flow reversed.	Push the Power switch.
Laser Grading Box does not raise or lower.	Control Panel not turned on.	Ensure hydraulic control handle of skid steer is in correct position.
	No hydraulic flow to Laser Grading Box.	Ensure auxiliary hydraulics are ON or in continuous flow mode.
	Cables not connected correctly.	Check Valve cable, valve and valve solenoids for visible damage. Move directional valve spool manually using the overrides on the end of the directional valve. (Refer to Figure 35.)

 WARNING

Be sure to stay clear of any moving parts of the Laser Grading Box.

If the Laser Grading Box moves, refer to Electrical problems. If the Laser Grading Box does not move, refer to Hydraulic problems.

TROUBLESHOOTING

SYMPTOM	POTENTIAL CAUSE	REMEDY
	Electrical Problems	Check Valve cable, valve and valve solenoids for visible damage. Use an Ohm meter to check cable for continuity.
	Hydraulic Problems	Confirm hydraulic flow through the manifold and returning to the power source through the "T" hose. Contact ATI Corporation for help troubleshooting the hydraulic manifold.
Laser Grading Box moves in opposite direction.	Hydraulic flow reversed.	Confirm the pressure is going in the "P" port. Verify control handle is moving in desired direction.

SPECIFICATIONS AND MAINTENANCE

SPECIFICATIONS

Dimensions

Model	PD-72	PD-84	PD-96
Box Width	72 in. (183 cm)	84 in. (213 cm)	96 in. (244 cm)
Overall Width	75.25 in. (191 cm)	87.25 in. (222 cm)	99.25 in. (252 cm)
Total Length	71.25 in. (181 cm)		
Box Capacity, Front	11.5 ft ³ (0.33 m ³)	13.4 ft ³ (0.38 m ³)	15.3 ft ³ (0.43 m ³)
Box Capacity, Rear	7.0 ft ³ (0.20 m ³)	8.0 ft ³ (0.23 m ³)	9.0 ft ³ (0.25 m ³)
Weight	1885 lbs. (855 kg)	1935 lbs. (878 kg)	1985 lbs. (900 kg)

TECHNICAL DATA

PowerGrade Technical Data

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

System accuracy

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

Control Panel

Parameter	Specification
Voltage range Power consumption	24 V DC Nominal Voltage, Range 10 V-30 V < 0.25 A
Dimensions	15.3 x 8.7 x 3.9 cm
Weight	0.855 kg
Accuracy cross slope	±0.1 % slope at ±25°
Working range	190 mm
Operating range	±80°
Interfaces	CAN MIL

Cradle

Parameter	Specification
Voltage range Power consumption	24 V DC Nominal Voltage, Range 10 V-30 V < 2.5 A with control panel connected and no load at 12 V
Dimensions	12.4 x 15.2 x 4.4 cm
Weight	0.320 kg
Communication (Infrared)	1 Mbit
Output	2x RS232, RX, TX, 12V/2Amp, GND, 2 x MikroCAN and J1939

SPECIFICATIONS AND MAINTENANCE

Junction Box

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

MPM700 PowerMast

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

Manual Mast

Parameter	Specification
Height (extended)	3.257 m
Height (retracted)	1.857 m
Travel	1.4 m
Scale	Metric/Inch
Weight	14 kg

MLS700 Laser Receiver

Parameter	Specification
Voltage range Power consumption	24 V DC Nominal Voltage, Range 11 V-30 V < 500 mA
Dimensions	28 x 12 x 7.2 cm (without mounting bracket)
Weight	2.5 kg (incl. clamp)
Detection angle	360°
Linear detection height	190 mm
Operating range	300 m radius
Sensor pick-up range	18.5 cm
Laser requirement	All Rotating Lasers (HeNe or Infrared Laser diodes visible and invisible)
Pulsed display	5 pulses per second

SPECIFICATIONS AND MAINTENANCE

MAINTENANCE

The rugged and durable Automatic Control System is built to last, but as with all equipment, a few minutes of routine care, maintenance, and cleaning can extend the life of the system.

Storage and Transport

Most often the Laser Grading Box and its hydraulic controls remain on the machine. However, the Control Panel, Laser Receiver, Coiled Receiver Cable and Solenoid Cable should be stored in a safe, protected place when not in use. Protect the cable connections by installing the covers supplied.

Cleaning

The Laser Receiver is completely sealed and purged with dry nitrogen. It requires no maintenance other than periodic checking to be sure its mounting structure is tight and secure.

The Control Panel is water-resistant. It can be cleaned with mild soap, water, and a damp, soft cloth. Do not submerge the Control Panel or direct high pressure spray at it. Do not use a dry cloth to wipe the Laser Receiver or Control Panel as scratching may occur.

Cables and Hoses

Check all cables and hoses regularly for signs of wear and damage. Keep cable connections clean and free from dirt and corrosion. If a cable has been damaged, do not attempt to repair. Incorrect or poor connections can cause damage to your Automatic Control System.

When applicable, check the hydraulic hoses. Look for areas where the hoses could rub against each other or another object as they expand and contract under pressure. Check the hydraulic fittings for tightness.

Machine

Check areas that affect the Automatic Control system function and accuracy, such as looseness or play in the cylinders or wear on the box's cutting edge. Looseness in the connection to the tractor/skid steer, such as in the adaptor plate/3-point hitch, will cause inaccurate depth positioning.

Also check the tractor/skid steer routinely for wear to its components, such as loader pins and 3-point linkage, ensuring it is operating properly.

Calibration

Perform periodic calibration checks of the Rotating Laser System as outlined in its Operation Manual to ensure accurate performance.

SERVICE

If the Automatic Control System is not functioning properly, the first step is to determine the problem component. Use the Troubleshooting Chart to determine possible causes and remedies. The following test equipment is needed:

- Voltage/Ohm Meter
- Rotating Laser or Laser Simulator

Cable Wiring Diagrams and troubleshoot electrical problems contact your local Leica Dealer.

The Control Panel provides diagnostic codes to aid in troubleshooting and diagnostics. If a 5-digit code appears, contact ATI Corporation for assistance in diagnosing the code.

If the code 1505 appears, it indicates communication with the laser receiver(s) has been lost. Check the cable connections.

CAUTION

To prevent serious damage to the Automatic Control System, never replace a fuse with a fuse that has a higher amperage value.

CAUTION

The Automatic Control System is a highly sophisticated electronic system. Do not attempt repairs to the components. Contact Leica Geosystems or your local dealer if you have any problems.

SPECIFICATIONS AND MAINTENANCE

HUB GREASING INSTRUCTIONS

The hub bearings on Level-Best products are pre-greased from factory for a long service life. However, it is strongly suggested that the axle and hub assembly be removed and disassembled annually to repack with grease and inspect the bearings for wear or damage.

The hubs now have an option to add grease through a zerk during routine maintenance. When greasing the hubs with this method please adhere to the following guidelines:

1. **DO NOT OVER GREASE** the bearings. One or two shots of grease every 100 operating hours is sufficient to keep the bearings lubricated. Forcing excessive amounts of grease into the hub will push the seals off their seats and expose the bearings to external dirt, use a Multi-Purpose grease.

Adding external grease is no replacement for proper maintenance practices. Annual tear-down and repacking of the bearings is still required to ensure a long life of the machine and minimal downtime.

NOTE: Check Hydraulic System Components for wear and/or leaks.

Check and tighten all bolts and nuts for scraper blade and end blades, weekly.

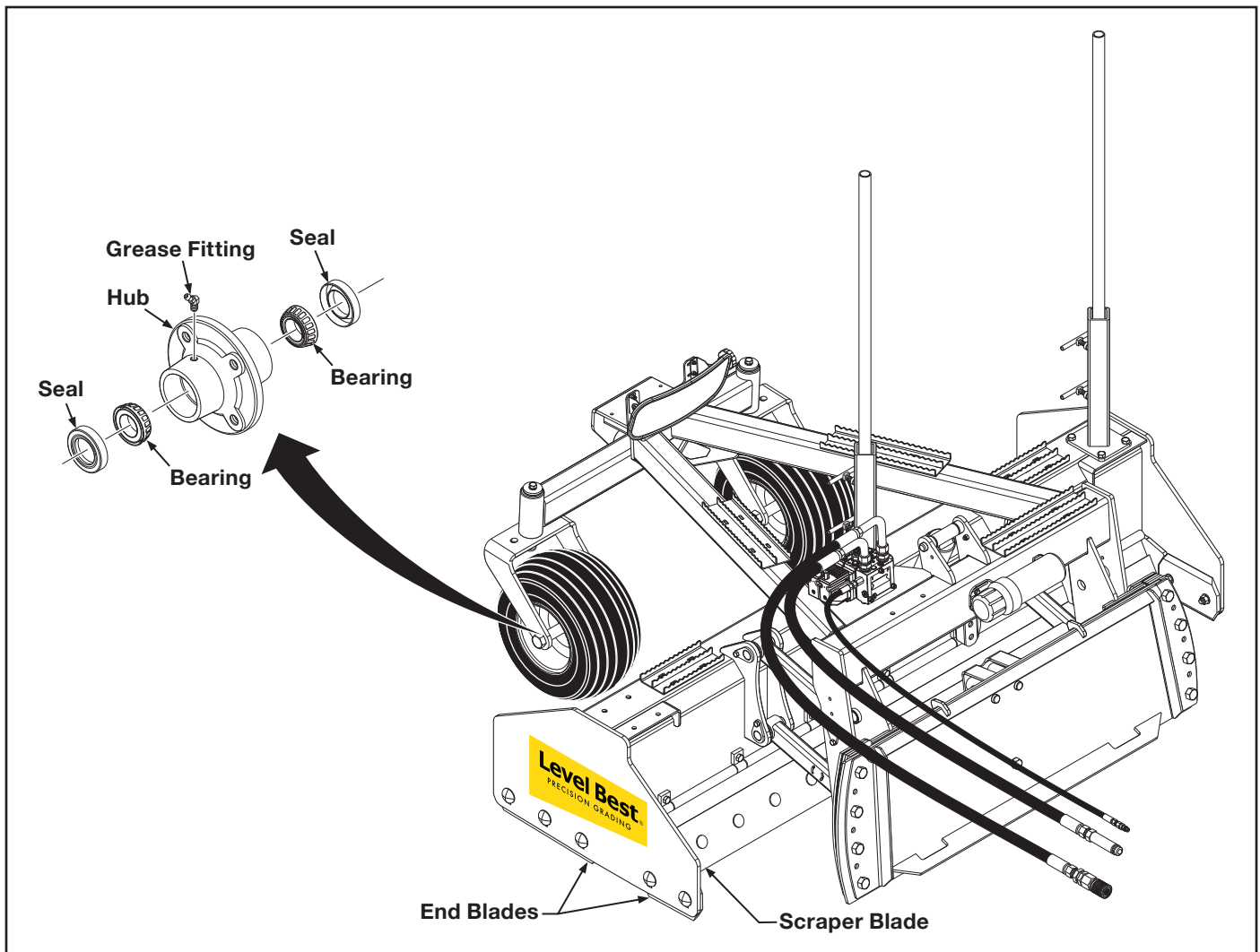


Figure 42. Lube and Maintenance.

INDEX

B

Benching.....	22
Benching And Operating.....	22
Benching with a Rod Eye.....	23
Bobcat Joystick Functions.....	13

C

Cables.....	10
Cables and Hoses.....	30
Calibration.....	30
Case Joystick Functions.....	15
Cat D-Series Joystick Functions.....	13
Cleaning.....	30
Components.....	1
Control Panel.....	2
Control Panel - Specification.....	28
Cradle.....	3
Cradle - Specification.....	28

D

Danfoss PVG-32 Hydraulic Valve.....	19
Disclaimer.....	i

E

Elevation.....	9
Equipment Setup.....	17

G

Gain.....	9
Getting Started.....	3

H

Hub Greasing Instructions.....	31
Hydraulic Hose Connection.....	19
Hydraulic Hose Connections to Skid Steer.....	19
Hydraulics.....	19

I

Index.....	33
------------	----

J

JCB/Volvo Joystick Functions.....	16
Job Site Set-Up.....	20
John Deere G-Series Joystick Functions.....	17
Junction Box - Specification.....	29

K

Kubota SSV65 & 75 Joystick Functions.....	14
Kubota SVL 95 S6699 Multifunction Controller Kit.....	14

L

List of Illustrations.....	iii
Lube and Maintenance Chart.....	31

M

Machine Maintenance.....	30
Maintenance.....	30
Manual Mast - Specification.....	29
MLS700 Laser Receiver - Specification.....	29
MPM700 PowerMast - Specification.....	29

N

New Holland Joystick Functions.....	15
-------------------------------------	----

O

Operation.....	5
----------------	---

P

Pigtail to 14 Pin Connector.....	12
Power Cable.....	10
PowerGrade Technical Data.....	28
Product Description and Features.....	2
Product Overview.....	2
Purpose.....	1

R

Receiver Cables.....	10
Remote Switch Detail.....	12
Remote Switches Cable.....	10
Rotating Laser.....	9

S

Safety Information.....	v
Safety Precaution Definitions.....	v
Select the Grade/Slope Sensor Input Source.....	5
Sensors 3D.....	8
Service.....	30
Setting a Reference Height.....	5
Setting the Value for Gain and Deadband.....	8
Set-Up for Level Grading.....	20
Set-Up for Sloped Grading.....	20
Solenoid Cable.....	10
Specifications.....	28
Specifications and Maintenance.....	28
Storage and Transport.....	30
Systems Features and Basic Operation.....	1

T

Table of Contents.....	ii
Takeuchi TL12/TL250 Joystick Functions.....	16
Technical Data.....	28
Troubleshooting.....	25

U

Using the Laser Receiver.....	6
Using this document.....	i

W

Warranty.....	vi
---------------	----



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