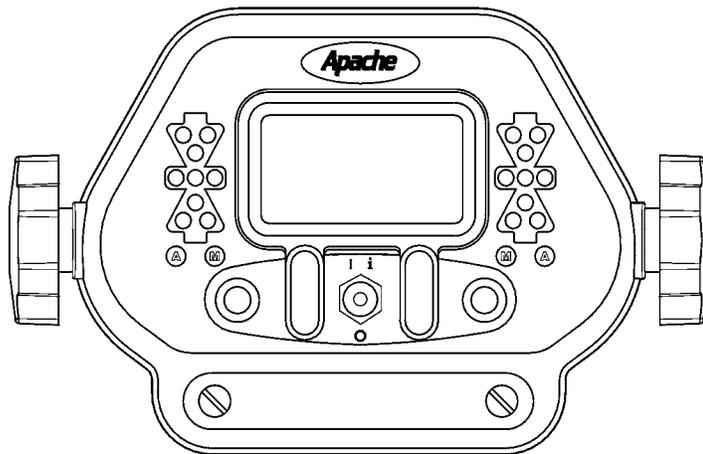


CB52 CONTROL BOX

Installation Manual Technical Information

Software Version 3.00



1.1 Amendments / Updates

All updated or amended information will be forwarded as it becomes available.
 The information contained below identifies pages or drawings that have been revised.

Section	Page, Software or Drawing Number	Description	Revision	Date
	S/W V2.00	Added: Italian, Spanish, French languages to operation text; Data Transfer function; mm & cm units; contrast limit; Revised Slope Reverse and Reference elevation icons.	B	June 2007
	S/W V3.00	Added Troubleshoot Menu; added laser strike requirements to LS Aux. valve function logic. Added single toggle remote switches with LH/RH mounting polarity.	C	Sept 2007

1.2 Contact Information

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1.4

Disclaimer

All documentation, data, dimensions, and drawings in this manual were compiled and checked with great care, however Apache Technologies, Inc. cannot assume responsibility for possible errors or omissions. We reserve the right to change designs and specifications without notice.

Apache Technologies, Inc. accepts no liability whatsoever for direct or indirect damage that may occur due to the unauthorized or improper use or interpretation of this document, and also shall not be held liable for direct or consequential damages resulting from improper service, application, maintenance or use of the product.

This document is strictly for the use of qualified service technicians with the requisite technical skills, training, and facilities. This manual should be read completely before installing the product.

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September 2007

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1.5

Meaning of Symbols

	WARNING: Indicates a potential hazardous situation, which could result in death or serious injury.
	CAUTION: Indicates a potentially hazardous situation, which could result in a minor or moderate injury and/or material, financial, or environmental damage.
	NOTE: Important information to enable the product to be used in a correct and efficient manner unrelated to safety.

- NOTE:** The installation technician should be a qualified person who is familiar with the installation, construction, and operation of the machine and laser equipment and the hazards involved.
- NOTE:** The user of this product is expected to follow all operating and safety instructions of this manual and of the machinery operator's manual. Perform periodic checks of the product's performance. The manufacturer or its representatives assume no responsibility for results of the use of this product including any direct, indirect, consequential damage, and loss of profits. Check your work frequently.
- WARNING:** High pressure fluid is present in operational hydraulic systems. Fluids under high pressure are dangerous and can cause serious injury or death. Do not make modifications, repairs or adjustments to any hydraulic system unless you are competent or working under competent supervision. If in doubt consult a qualified technician or engineer.
- WARNING:** When working near construction or agricultural machinery, follow all safety precautions as described in the machinery's user manual. Familiarize yourself with all basic functions of the machine before operating or beginning any work.
- WARNING:** Do not remove the back panel of the control box. The back panel is to be accessed by authorized Apache Technologies service personnel only.
- WARNING:** Be aware of all overhead obstructions and electrical power lines. The receiver and mast may be higher than the machinery. Remove when transporting.
- WARNING:** When excavating or trenching, follow all excavation and trench safety regulations and practices.
- CAUTION:** Do not disassemble any part of the receiver other than to replace batteries. The receiver is to be serviced by authorized Apache Technologies service personnel only.
- CAUTION:** Ensure all equipment is properly installed, the BULLSEYE receiver is secured in its mounting position, and all cables connections are tight and secure.
- NOTE:** Environmental Limits: Suitable for use in an atmosphere appropriate for human habitation (no protection in an aggressive or explosive environment).

2.1**System Description**

The Dual Automatic Blade Control System uses a CB52 Control Box, BULLSEYE laser receivers, cables, optional remote switches, and a hydraulic kit to automatically control construction grading machinery for earthmoving and grading applications.

Reference elevation from a rotating laser is received by the BULLSEYE receiver and sent to the control box. The information is processed and automatically directs the hydraulic valves to maintain the elevation of the blade when in automatic mode.

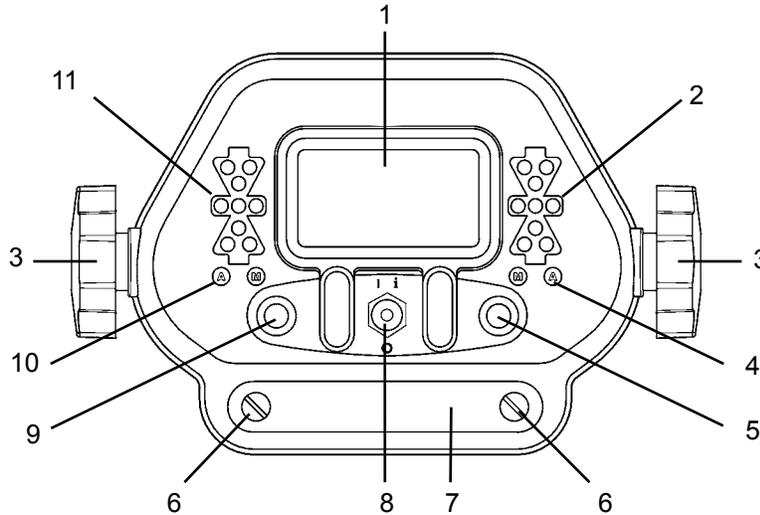
System configuration can be set for lift and tilt control - a typical bulldozer configuration.

Configuration can also be lift and lift - a typical motor grader configuration. In addition the system can be set to control the elevation of two independent implements with receivers, a typical tandem carry-all type scraper configuration

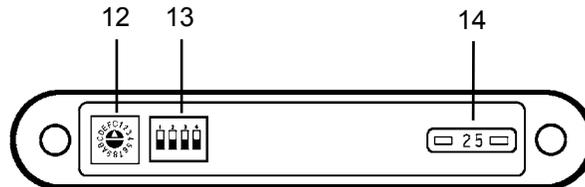
Elevation control may be used in conjunction with slope control with certain BULLSEYE receivers that contain internal slope sensors. These slope sensors control the slope of the blade relative to the machine. Slope lasers provide a slope relative to the laser transmitter.

2.2

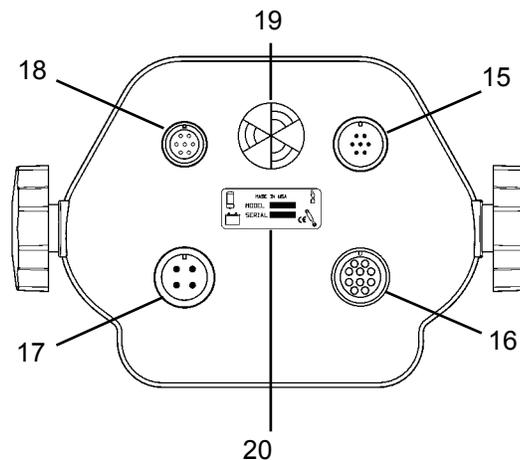
General Identification



1. Liquid Crystal Display (LCD) - indicates control modes, guidance information and system status. Menus are displayed during setup.
2. Right Grade LED's - green bar indicates on-grade, red arrows indicate direction to grade for right side. Blinking red arrows indicate lost beam and direction to move to find beam.
3. Mounting Knob - secures to control box bracket.
4. Right Auto/Manual LED's - green "A" indicates Automatic or amber "M" indicates Manual is selected on right side.
5. Right Multi-Switch - Left/right movement selects Auto/Manual control and up/down movement enables Raise/Lower implement. Rotation increases/decreases the control set point. Pressing in enables elevation or slope matching. Navigates User Setup menu.
6. Access panel thumbscrew.
7. Access panel cover plate - panel contains rotary switch, DIP switch and fuse. DIP switch used for installation.
8. Power / Setup Switch - turns power on and off. Toggle switch upward (I i) to turn power on. Toggle switch downward (o) to turn power off. Enables changing operating modes and entry into User Setup modes. Enables entry into Help screens.
9. Left Multi-Switch - Left/right movement selects Auto/Manual control and up/down movement enables Raise/Lower implement. Rotation increases/decreases elevation. Pressing in enables elevation or slope matching. Navigates User Setup menu.
10. Left Auto/Manual LED's - green "A" indicates Automatic or amber "M" indicates Manual is selected on left side.
11. Left Grade LED's - green bar indicates on grade, red arrows indicate direction to grade for left side. Blinking red arrows indicate lost beam and the direction to move to find beam.

2.2**General Identification**

- 12. Rotary Switch - used for factory tests. Default position is 0.
- 13. DIP Switch - used for installation. Default position is all switch bats down (off).
- 14. Fuse - 25 amp, auto style.



- 15. 7-pin connector - optional remote switch.
- 16. 10-socket connector - hydraulic valve output.
- 17. 4-pin connector - machine power input.
- 18. 7-socket connector - BULLSEYE receiver communication.
- 19. Beeper with adjustable volume control - rotate to increase or decrease volume. Single beep is activated when switch command is accepted. Double beep activated when switch command is not available, incorrect or not accepted.
- 20. Identification / serial number label / cable function symbols.

Refer to the control box operator's manual (P/N ATI-010884) for detailed operational information.

2.3

Specifications

CB 52 Dual Control Box

Grade Display	Green On-Grade LED's Red High / Low LED's
Display	LCD
Operating Voltage	10 to 30 Volts DC, reverse polarity protected
Maximum Current	5 Amps per driver
Electrical Connection	Standard military type
Valve Compatibility	PT, Proportional Time (On/Off), PC, Proportional Current, and PV, Proportional Voltage
Laser Receiver Deadband	0 - 2.0 inches (0.05 in increments) 0 - 0.16 ft (0.005 ft increments) 0 - 50 mm (1.0 mm increments)
BE3+	0 - 1.0 inches 0 - 0.08 ft 0 - 25 mm
Slope Set Point Range	+/- 23 degrees (+/- 44%)
Remote Switch Option	Raise/Lower, Auto/Manual Multi-Switch Single switch for lift & tilt Dual switches for dual lift
Weight	5 lbs. (2.25 kg)
Dimensions (without knobs)	7.7 x 5.5 x 5.5 in. (196 x 140 x 140 mm)
Operating Temperature	-4° F to 140° F (-20° C to +60° C)

**Specifications subject to change without notice*

3.1

Machine Architecture

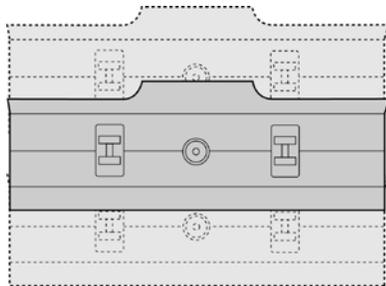


NOTE: The left and right sides of the machine are referenced while seated in the operator's seat, facing the normal direction of travel. Graphics are depicted from the operator's point of view.

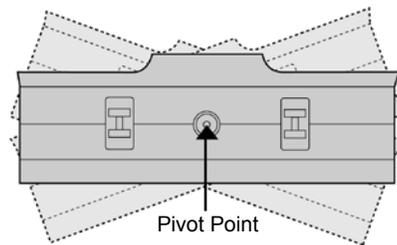
Machine architecture is referenced by what type of cylinder arrangement controls the blade - Lift & Tilt or Lift & Lift.

Left side and right side are defined as the operator would view the system when facing forward in the operators seat.

Lift & Tilt is a common dozer arrangement. Typically for a bulldozer, one set of cylinders are linked together for blade lift. A separate circuit controls blade tilt which pivots about a single pivot point. Lift & Tilt is not confined to bulldozers. Skid steer attachments and other tractor attachments may operate as a Lift & Tilt system. These systems may use a single lift cylinder.

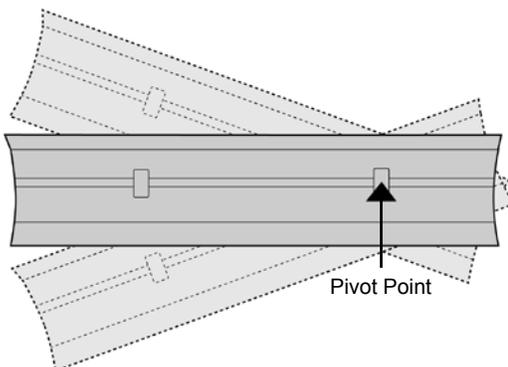


Blade Lift

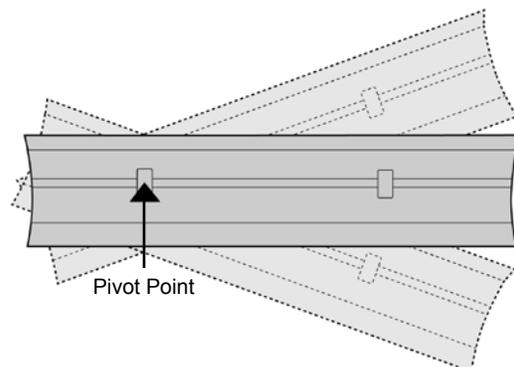


Blade Tilt

Lift & Lift is a common motorgrader arrangement. A separate cylinder controls each side for blade lift which pivots about a point on the opposite end of the blade. Lift & Lift is not confined to motorgraders. Tractor attachments such as drag boxes may operate as a Lift & Lift system. Additionally tandem pulled behind scrapers can operate as two independent lift systems.



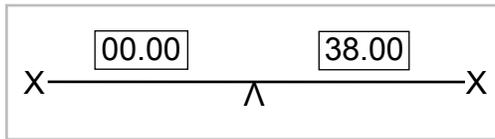
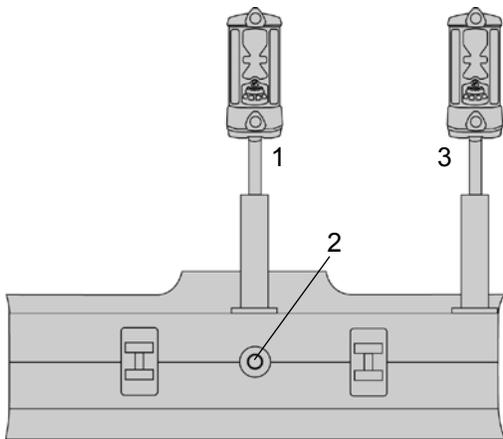
Left Hand Side Lift



Right Hand Side Lift

3.2 Mast Mounting Options

Mast mounting locations may differ depending on machine architecture, receiver model, type of machine, etc.



Cross Coupling Setup Example

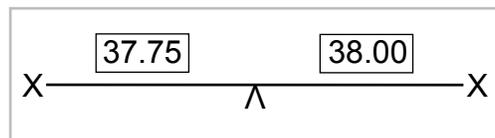
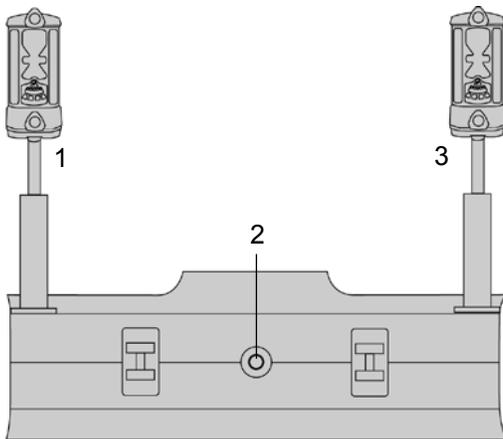
Lift & Tilt: Traditional mounting

The traditional method for mounting dual receivers is to mount the Lift mast and receiver (1) in the center of the blade above the blade pivot point (2) and the Tilt mast and receiver (3) on the end of the right hand side of the blade.

NOTE: Without cross-coupling, a Lift error will cause an unneeded Tilt correction which leads to instability (duck-walking). Traditional systems slow down the tilt blade speed to remain stable.

Turn on and set up the cross coupling to minimize the instability and improve performance. When the cross coupling is set, the Tilt can be ran as fast as the lift and remain stable.

Refer to the cross coupling menus in System Setup § 5.4.



Cross Coupling Setup Example

Lift & Tilt: Wide Stance mounting option

The grade accuracy at the end of the blade can be increased by moving the lift receiver (1) and the tilt receiver (3) to each end of the blade. Refer to the diagram on the following page for an illustration.

Cross coupling must be turned on. Refer to the cross coupling menus in System Setup § 5.4.

The wide stance also avoids mast mounting near blade king pin and linkage.

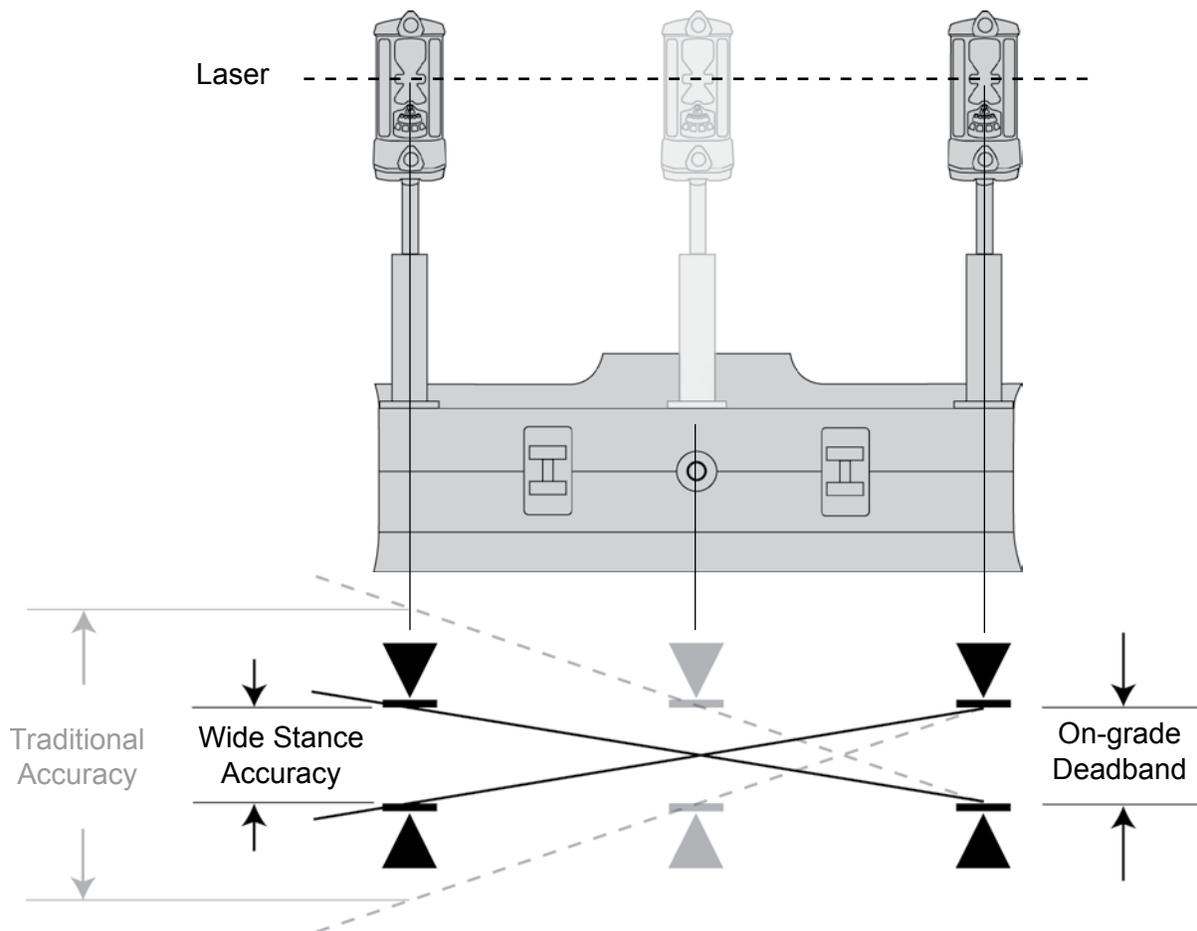
For low mounted receivers, it places the receiver grade display in better line of sight to the corners of the blade.

This arrangement is not recommended for single laser receiver or internal slope sensor systems.

3.2 Mast Mounting Options

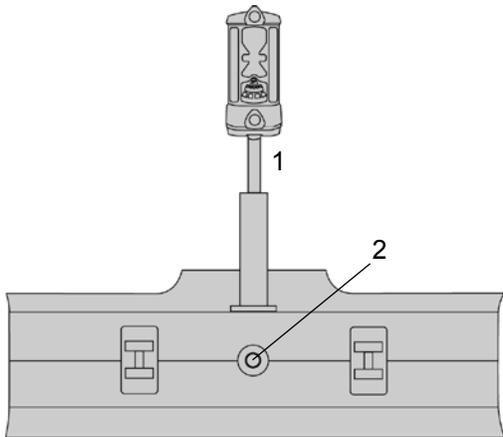
Lift & Tilt: Wide Stance option accuracy comparison.

Increasing the distance between the two receivers decreases the allowable movement within the deadbands before a correction takes place.



3.2 Mast Mounting Options

Lift & Tilt: Single Laser Receiver



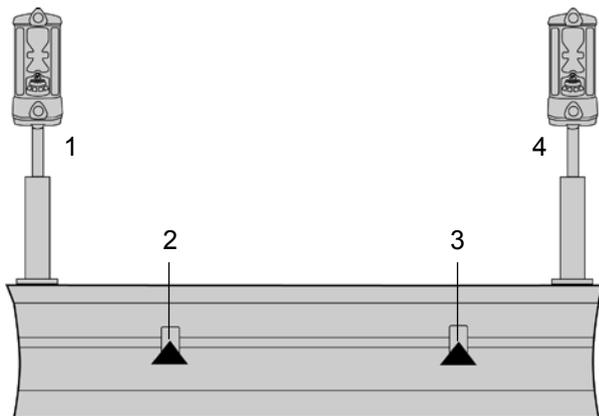
When a single laser receiver (1) is used, it is best to mount it above the blade's pivot point (2).

The internal slope sensor of a BULLSEYE 5+ or BULLSEYE 6 may be used to control the tilt of the blade.

A slope sensor driven tilt control will run slower than a laser receiver driven tilt control. See § 5.5.

Cross Coupling is not required.

Lift & Lift: Dual Laser Receivers



Mount the left hand receiver (1) near the left hand end of the blade.

Mount the right hand receiver (4) near the right hand end of the blade.

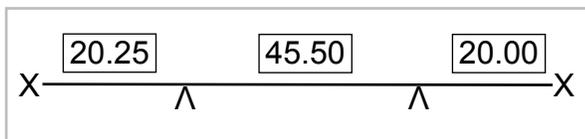
Cross coupling must be turned on and setup.

Mounting receivers near the end of the blade provides the best accuracy.

Mounting receivers near the blade pivot points (2 & 3) provides the best stability.

Mounting locations are usually dictated by the machine geometry.

If slope control is used, blade speeds must be lowered compared to laser control. See § 5.5.



Cross Coupling Setup Example

4.1**System Components****Control Box**

The control box mounts in the cab and is cable connected to machine power, the BULLSEYE receivers and the hydraulic valve. Optional remote switches may also be connected. The operator adjusts and selects various options using toggle switches or multi-switches that move left/right, up/down, rotate in both directions, and can be pushed in.

An LCD indicates system and configuration status. An LED display indicates grade information for each side. Automatic or manual modes are also indicated with LED's for each side.

Refer to the control box operator's manual (P/N ATI-010884) for detailed operational information.

The Control Box should be mounted in a location that is easily visible to the operator, is within easy reach of the operator's hands, and can be easily installed and removed. Insure that the location does not interfere with other machine controls or operator movements. Remote switches are available which allow the operator to adjust the system while keeping hands on the machine controls.

The Control Box has vented drain holes on the rear bottom of the unit that must face downward.

A control box mounting bracket (ATI-950054) is designed to accept the mounting knobs that are included with the control box.

**BULLSEYE Receivers**

All BULLSEYE receivers feature 360 degree laser reception and work with all common rotating lasers.

BULLSEYE models 3+, 5+, 5MC, and 6 are designed for automatic blade control and will work with the CB52. The model 3+ has limited proportional control capability and therefore limited on-grade offset and elevation matching capability.

Models 5+ and 6 incorporate internal slope sensors that can be used for blade slope control.

NOTE: These slope sensors must be calibrated to the machine before use.

Models 3+, 5+ and 6 can also be used as stand alone display receivers.

Please refer to the specific BULLSEYE operator's manuals for more detailed information.

The BULLSEYE receivers mount to round masts from sizes 1.66" to 2.00" O.D. (42 to 50 mm) and to 1-1/2" (38 mm) square tube.

The communication protocol for the BULLSEYE receivers is proprietary RS485 @ 62.5 kbaud.

4.1 System Components

Hydraulic Valves:

The Control Box supports Proportional Time (PT), Proportional Current (PC), and Proportional Voltage (PV) hydraulic valves.

Hydraulic installation kits are available for several common machines and depict valve mounting. Some kits contain the hydraulic valves, valve brackets, hydraulic hoses and fittings necessary for automatic control of a specific machine. Other valve kits require some additional components to be supplied. A separate installation guide is included with the hydraulic kit.

STM1 Mast:

The Model STM1 shock mounted manually telescoping mast allows the receiver to be positioned above the machinery for unobstructed laser reception.

STM1 Specifications

Height retracted:	75.5 in. (192 cm)
Extension Length	48.0 in. (122 cm)
Tape increments	1/16th in. and 1 mm
Weight	52 lbs. (23.6 kg)
Bolt size	3/4 in x 10 x 2-1/2 in Grade 8

4.2 System Components

STM1 Mast Installation:

The machine should be positioned on a flat level surface with the blade on the ground. Make sure that all mast-mounting bolts are accessible with the appropriate tools when the mounting assembly is complete.

Caution: Before welding turn the master disconnect off and disconnect any computer module.

1. Observe all safety practices recommended by the machinery manufacturer while installing and using the mast.

a) Turn off engine and engage parking brake.

b) Rest blade on the ground.

c) Take precautions to avoid lifting or falling injuries. Mast weight is 57 Lbs. (26 kg.)

2. To minimize elevation errors due to changing cut depths:

a) The masts should be positioned to place the laser receivers as close as possible vertically over the cutting edge of the blade.

b) The masts should be vertical "front-to-back" when the blade is in its normal operating position.

3. To minimize elevation errors due to changing blade tilt, the masts should be vertical "side-to-side" when the blade is in its normal operating position.

4. Weld the optional mast mounting plates (ATI-010766) to best meet the above recommendations, and:

a) Not interfere with blade movement or linkages.

b) Provide clearance for pin removal, or other service requirements.

c) Follow all machine manufacturer precautions for welding to the machine.

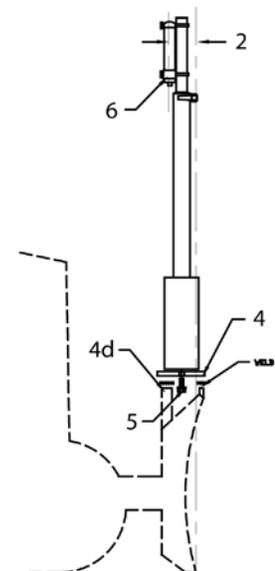
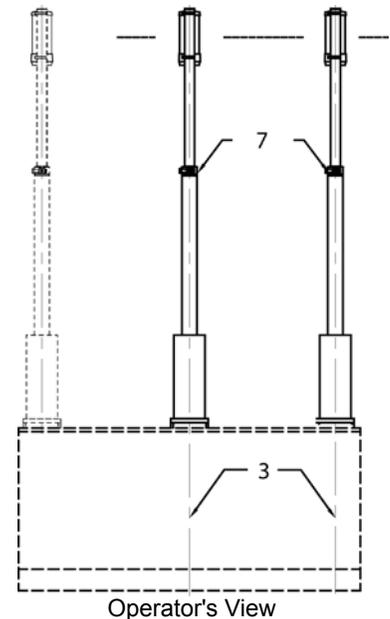
d) Several pieces of material are usually required to stand the plates slightly above a dozer blade. These pieces are not included with the mounting plate.

5. Attach the masts to the mounting plates with provided (1) 3/4-10 x 2-1/2 inch long grade 8 screws and lock washers. Torque to 265 ft-lbs. (37 mkg)

6. Attach the laser receivers to the masts as shown. Wrap the electrical cable around the masts to keep it out of harm from blade linkages or material near the blade. Attach the cables to the laser receivers.

7. Loosen the mast clamp and extend the mast to the desired elevation to clear laser obstructions such as the machine's cab. Tighten the mast clamp.

a) Pull out on the clamp handle to reposition the handle.



4.3 System Wiring

Cables are generally shipped at a predetermined length required for a particular machine. Connectors are installed at the factory.

Plan the routing of all cables prior to actual installation. Some machines may require cutting a hole in the sheet metal with a hole saw to route the cable. Be sure not to drill into harnesses or other components. Grind or file any sharp edges and add edge grommet or wire loom to protect the cables.

All cables should be attached to the machine at a minimum of every 2 to 3 feet (.6 to 1.0 meter) or less to try to eliminate cable movement and possible abrasion damage. Special care should be taken at flex points to ensure the cable moves freely and does not rub on other hoses, fittings, or the machine. Provide adequate cable length to avoid pinching, stretching, and tight bending. Also, cables should not be clamped to pipes or hoses that will cause the cable to be exposed to high temperatures.

Power Cable:

Connect the 4-socket connector on the power cable to the 4-pin connector on the box. Route the cable to the machine's battery and connect the terminal ends to the battery. The red terminal is for the positive post and the black is for ground. The box has reverse polarity protection in case the terminals are connected improperly.



NOTE: In order to utilize the machine's master disconnect, the ground wire must be connected to the machine frame.

Receiver Cable:

A dual receiver cable connects the control box with a dual connector junction block that supports two laser receivers. Two separate cables connect the junction block to the receivers.

The junction block can be mounted on the front of the machine with the provided 1/4 inch hardware. Once the junction block mounting is determined, route the cable through the machine to the control box. Connect the cable 7-pin connector to the 7-socket connector on the control box.

The junction block is marked "L" for left side and "R" for right side as the operator is looking forward in the direction of machine travel.

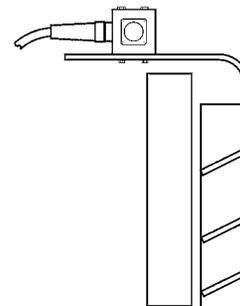
Connect the receiver straight cable or coil cord 7-pin connector to the 7-socket connector on the junction block for each side. Connect the cable's 7-socket connector to the 7-pin connector on the bottom of the BULLSEYE receiver for each side.

Attach dust caps to connectors when not in use.

Dual Receiver Cable - Hood Mounting

Lay block on its side with bolt holes vertical. Mount to top of hood with provided hardware.

Alternatively, the junction block may be mounted to the grill (possibly with minor grill modifications) and user provided hardware.



4.3 System Wiring

Valve Cable:

Connect the 10-pin valve cable to the 10-socket connector on the box. Route the cable to the valves. Connect the open-ended wires to the valve according to the cable diagrams in § 3.4.

Optional Remote Switch:

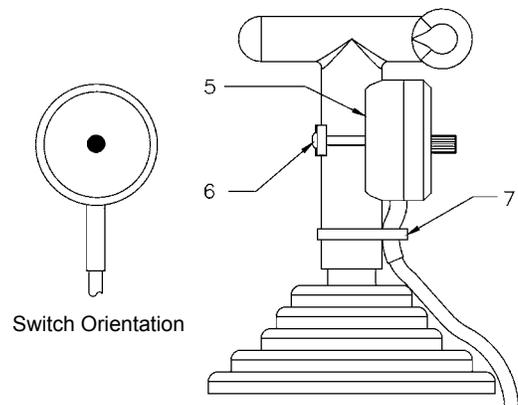
A single remote switch is used for Lift and Tilt applications. A dual remote switch is used for Dual Lift applications.

Multi-switch remote cables (P/N ATI-010904-XX and ATI-010938-XX) can be configured to operate similar to the multi-switches on the control box. Typically the remote switches are used to select automatic or manual control. Raise or lower implement may be selected, as well as elevation offset and grade matching functions. Refer to System Setup § 5.4

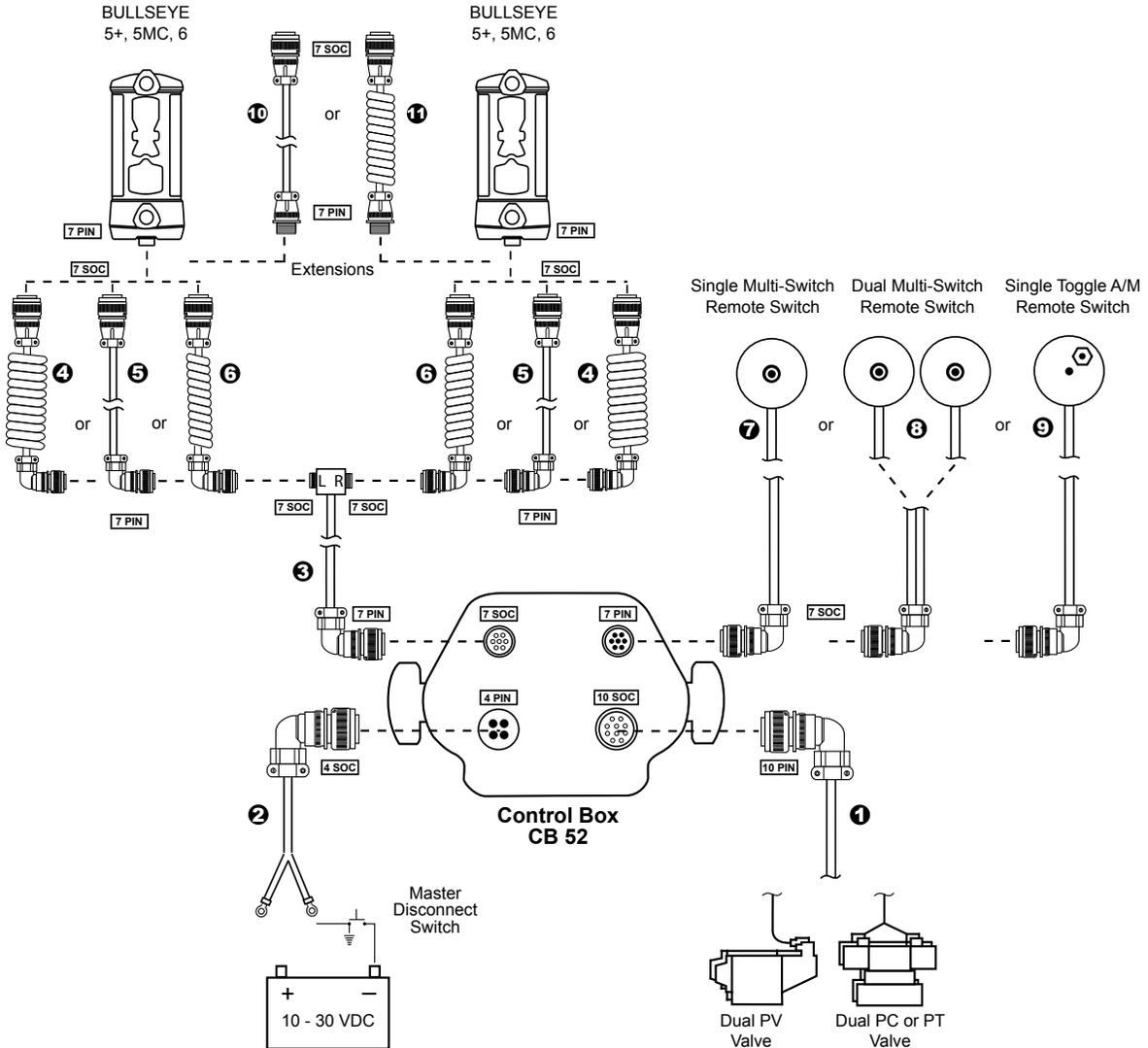
The multi-switch remotes are configured with the cable at the bottom when mounted and the switch facing inward so the thumb activates the switch. When mounted and configured properly, forward is Automatic, backward is Manual, up is Raise, and down is Lower.

Separate toggle switch remote cables are available and can be configured for automatic / manual (P/N ATI-011012-XX) and raise / lower.

1. The remote switch assembly is designed to mount to lever shafts from 3/8" to 1-1/8" in. (10 to 28 mm) diameter by using the different screws provided.
2. Determine remote switch mounting location for easy access during operation. Cable should route downward from switch housing.
3. If mounted to a moving lever, ensure there is enough cable to permit full lever travel.
4. Remove any dirt or oils from the area where the switch will mount with isopropyl alcohol or detergent cleaner.
5. Remove the adhesive liners on the double sticky tape and apply the switch.
6. Select the correct length of screw for the shaft diameter and tighten clamping screws. Do not overtighten as this can distort housing and clamp.
7. Strain relief the cable by tie wrapping it to the lever as shown.
8. Assign and check the functions with the control box.



4.4 System Wiring Diagram

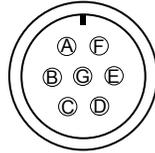


Item	Part No.	Description
1	ATI-026044-XX	Dual PT/PC/PV Valve Cable
2	ATI-024012-XX	Power Cable
3	ATI-010907-XX	Dual Receiver Cable w/ Junction Block
4	ATI-026047	Receiver Coil Cord, CB5X, 4-16 ft (1.2 - 4.9 m)
5	ATI-010980-XX	Straight Receiver Cable
6	ATI-026045	Receiver Coil Cord, CB5X, 3-12 ft (0.9 - 3.7 m)
7	ATI-010904-XX	Single Remote Multi-Switch Cable, CB5X
8	ATI-010938-XX	Dual Remote Multi-Switch Cable, CB5X
9	ATI-011012-XX	Single Remote A/M Toggle Switch, CB5X
10	ATI-026026-XX	Straight Cable Extension
11	ATI-010975	Coil Cord Extension 3-12 ft (0.9 - 3.7 m)

4.5

Cable Diagrams

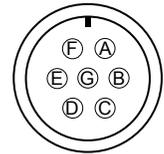
- A — Red - Power
- B — Green - Data -
- C — White - Data +
- D — Black - Ground
- E — Orange - N/U
- F — Blue - N/U
- G — N/C



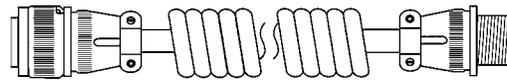
7-Socket



Receiver Coil Cord
ATI-026045

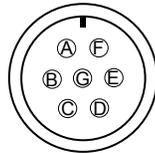


7-Pin

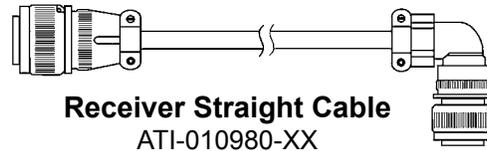


Receiver Coil Cord Extension
ATI-010975

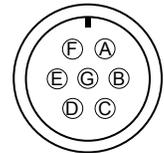
- A — Red - Power
- B — Green - Data -
- C — White - Data +
- D — Black - Ground
- E — N/C
- F — N/C
- G — N/C



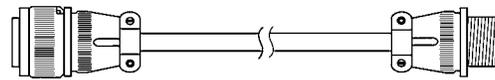
7-Socket



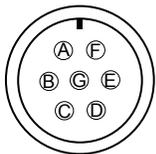
Receiver Straight Cable
ATI-010980-XX



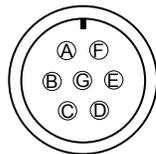
7-Pin



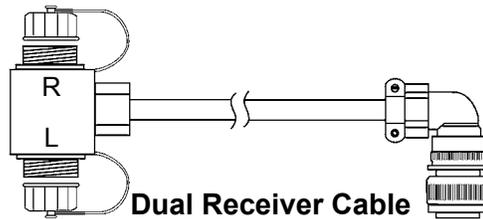
Straight Cable Extension
ATI-026026-XX



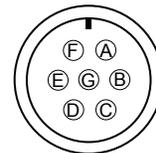
Right 7-Socket



Left 7-Socket



Dual Receiver Cable with Junction Block
ATI-010907



7-Pin

- A — Orange
- B — Green
- C — White
- D — Black
- E — N/C
- F — N/C
- G — N/C

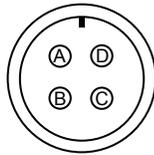
- A — Red
- B — Green
- C — White
- D — Black
- E — N/C
- F — N/C
- G — N/C

- A — Red - Left Power
- B — Green - Data -
- C — White - Data +
- D — Black - Ground
- E — N/C
- F — N/C
- G — Orange - Right Power

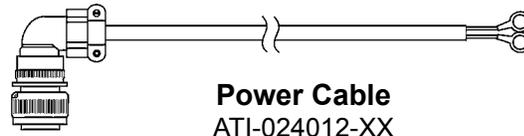
Note: -XX represents cable length in feet
N/C - Not Connected
N/U - Not Used

4.5 Cable Diagrams

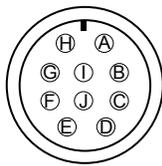
- A — Black - Ground
- B — White - Ground
- C — Red - Power
- D — Green - Power



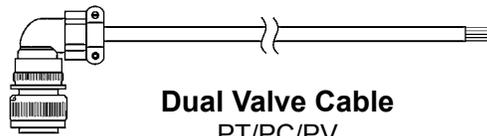
4-socket



Power Cable
ATI-024012-XX



10-Pin

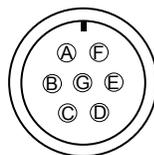


Dual Valve Cable
PT/PC/PV
ATI-026044-XX

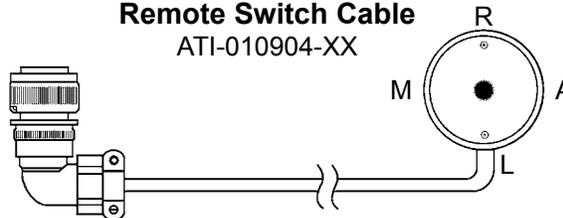
Connector 10 Pin	Wire Color	PT / PT or PC / PC Valve Function	PV / PV Valve Function	PV / PV Valve Hirschmann Pin
A	Blue	LH Lower	LH Fault	3
B	Green	LH Raise	RH Fault	3
C	Red	*Sw Power	*LH Sw Power	1
D	Orange	*Load Sense	*RH Sw Power	1
E	White	Not Used	LH Raise/Lower	2
F	Brown	RH Raise	Not Used	-
G	Yellow	RH Lower	Not Used	-
H	Violet	Not Used	RH Raise/Lower	2
I	Black	Ground	Ground	Ground
J	Gray	Ground	Ground	Ground

Note: *Function selected in Auxiliary Valve Driver Setup
Refer to Valve Setup § 5.5

Singe Multi-Switch Remote Switch Cable
ATI-010904-XX



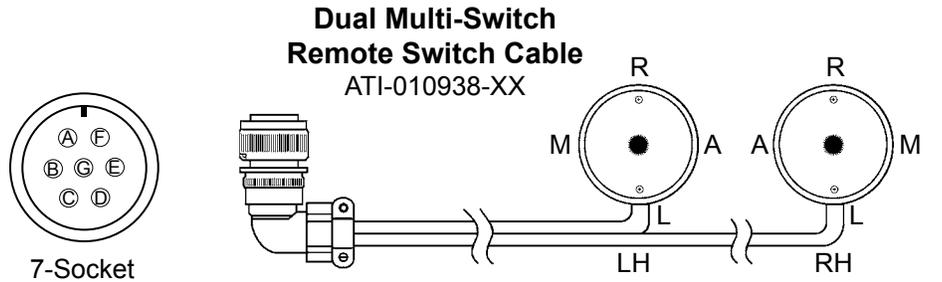
7-socket



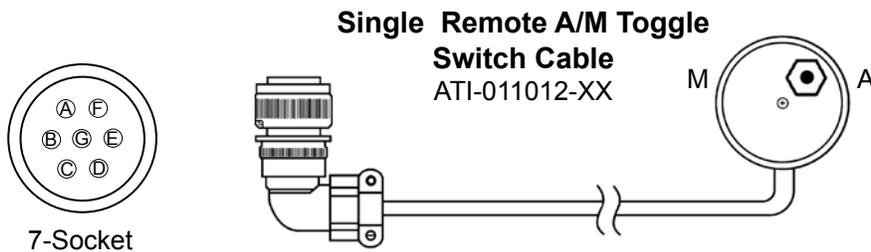
Connector 7 Pin	Wire Color	Function	LH Remote Switch PCB
A	Orange	LH Analog In	J2
B	N/C	RH Analog in	N/C
C	Black	LH Phase A	J3
D	White	LH Phase B	J4
E	N/C	RH Phase A	N/C
F	Red	Rem Sw Power	J1
G	N/C	RH Phase B	N/C

4.5

Cable Diagrams



Connector 7 Pin	Function	LH Cable Color	LH Remote Switch PCB	RH Cable Color	RH Remote Switch PCB
A	LH Analog In	Orange	J2	N/C	N/C
B	RH Analog in	N/C	N/C	Orange	J2
C	LH Phase A	Black	J3	N/C	N/C
D	LH Phase B	White	J4	N/C	N/C
E	RH Phase A	N/C	N/C	Blue	J3
F	Rem Sw Power	Red	J1	Red	J1
G	RH Phase B	N/C	N/C	Green	J4



Connector 7 Pin	Wire Color	Function	
A	Orange	LH Auto/Manual	
B	Green	LH Raise/Lower	N/C
C	Blue	RH Auto/Manual	N/C
D	White	RH Raise/Lower	N/C
E	N/C		
F	Red	Rem Sw Power	
G	Black	Rem Sw Ground	

NOTE: Remote Switches are configured with the cable routed downward from the switch housing. Automatic selection is multi-switch forward. Manual is multi-switch back.

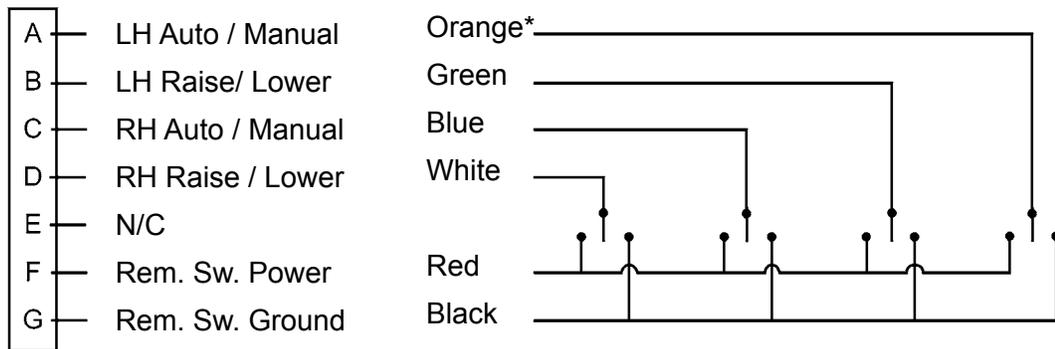
NOTE: -XX represents cable length in feet
N/C - Not Connected
N/U - Not Used

R - Raise
L - Lower
RH - Right Hand
LH - Left Hand

A - Automatic
M - Manual

4.6 Miscellaneous Cable Installation Notes

Toggle Remote Switch Wiring



Use momentary toggle switches.

Left Hand Auto / Manual

- Connecting Pin A to Ground toggles LH control to Manual
- Connecting Pin A to Power toggles LH control to Auto

Right Hand Auto / Manual

- Connecting Pin C to Ground toggles RH control to Manual
- Connecting Pin C to Power toggles RH control to Auto

LH Raise / Lower

- Connecting Pin B to Ground creates LH valve Lower signal
- Connecting Pin B to Power creates LH valve Raise signal

RH Raise / Lower

- Connecting Pin D to Ground creates RH valve to Lower signal
- Connecting Pin D to Power creates RH valve Raise signal

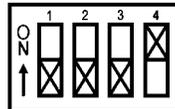
Single LH or RH Toggle switches should be wired as LH switches.
 LH or RH assignment will be selected with "Remote Config" function in the System Setup menu.

*A cable assembly with the connector wired per above schematic but with no toggle switches and housings attached is available as P/NATI-010998-XX.

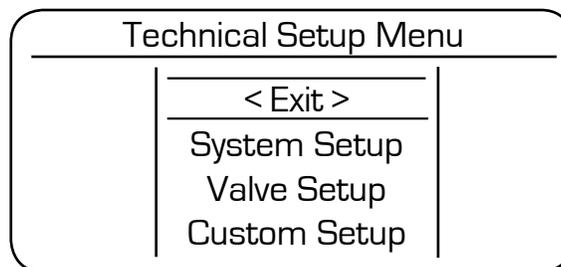
5.1 Technical Setup Menu

The Technical Setup Menu is used to configure the machine during initial installation. It is recommended that the operator not have access to this menu.

To access the Technical Setup Menu, remove the access panel thumb screws and plate. Move BAT 4 on the DIP switch into the ON position as shown.



The following screen appears:



The Technical Setup Menu consists of six sections:

- System Setup**
- Valve Setup**
- Custom Setup**
- Troubleshoot**
- Store / Recall**
- Data Transfer**

Each section has submenus. Menu availability and selection options will vary depending on valve type selected, machine architecture, and model of sensors attached.

The menus are organized so that moving from the top to the bottom through the menus and submenus provides the best order for system setup.

The menu is navigated by using the left or right multi-switch. Toggle the multi-switch down to highlight the item below the current selection and to scroll down. Toggle the multi-switch up to highlight the selection above the current selection and to scroll up. Press in the multi-switch to enter the highlighted selection.

Values or options are selected by rotating the multi-switch for the corresponding left or right side. An arrow and dotted box indicate the function must be entered to change values. For numeric values, clockwise rotation increases the value; counterclockwise rotation decreases the value.

Each section has an Exit function on the top and bottom level. To exit, scroll to the top or bottom of the menu to highlight <Exit> and press in the multi-switch.

Configuring the **System Setup** and **Valve Setup** are generally required for all systems.

Modifying the **Custom Setup** is generally not required for most systems.

5.2 Technical Setup Menu List and Brief Description

System Setup Menu

<Exit>	
Language	Select Language
Mach Arch	Select Machine Architecture
X-Couple Enable	Cross Coupling Enable
X-Couple Setup	Cross Coupling Compensation Setup
Slope	Slope Enable
Ctl%Dsp DB	Sets Control Deadband as a Percentage of Display Deadband
Remote Config	Remote Switch Configuration
Remote A/M	Remote Switch Auto / Manual Enable
Remote R/L	Remote Switch Raise / Lower Enable
Remote Offset	Remote Switch Elevation Offset Enable
Remote Match	Remote Switch Grade Match Enable
<Exit>	

Valve Setup Menu

<Exit>	
Aux Vlv Drives	Auxiliary Valve Driver Setup
	PT Valve Selected
PT Period ms	Sets update rate for PT Valves
	PC Valve Selected
Spool Profile	Exponential or Linear Valve Spool
Pk % Dither	Dither Amplitude for PC valves only
Dither Hz	Dither Frequency for PC valves
	PC or PV Valve Selected
Spool Profile	Exponential or Linear Valve Spool
	All Valves
Max % On	Limits amount of power sent to valves
Raise Min	Raise Valve Minimum Correction Calibration
Lower Min	Lower Valve Minimum Correction Calibration
R/L Balance	Dynamic Raise / Lower Balance
RH/LH Balance	Balance of Right hand / Left hand Blade Speeds
Valve Speed	Nominal Gain for Valves after applying Balance
Slope%Elev Spd	Slope speed as a percentage of elevation speed
<Exit>	

5.2 Technical Setup Menu List and Brief Description

Custom Setup Menu

<Exit>	
Out of Beam Alarm	Enable out of laser beam audible signal
Up/Down Switch	Selects Implement or Mast to Raise / Lower
Display Avg	Selects display performance options
Receiver LEDs	Receiver LED's On or Off
2 Strike Avg	Enables 2 strike laser averaging
R/L Override	Enables Raise / Lower switch to override in Auto control
R/L Ramp	Enables Raise / Lower switch to ramp up to full speed
Slope Axis	Slope Sensor X or Y Axis Select
Receiver Facing	Receiver Facing Orientation
<Exit>	

Troubleshoot Menu

<Exit>	
Machine Voltage	Displays Machine Voltage
Fault Log	Records History of Fault Occurrences
Clear Fault Log	Clears History of Faults
LCD/LED Test	Shows Functional LCD/LED's
Key/Switch Test	Shows Functional switches
Power Cycles	Displays Number of Power Cycles
On Time hrs	Displays On Time in Hours
Auto Time hrs	Displays Automatic Time in Hours
S/W Version	Displays Software Version
S/W Checksum	Displays Software Checksum
BL Checksum	Displays Bootloader Checksum
<Exit>	

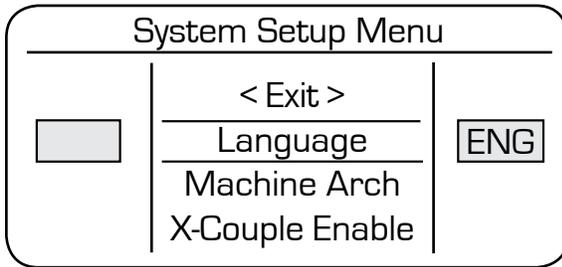
5.3 Installation Log

Customer:		Location:	Date:
Control Box Model:	S/N:	Machine Information:	Valve Type / ID:
<i>Left Side</i>	USER SETUP		<i>Right Side</i>
	On-grade Deadband		
	Valve Speed		
	Store / Recall		
	Lock / Unlock		
	SYSTEM SETUP		
	Machine Architecture		
	Cross Couple Enable		
	Cross Coupling Setup		
	Slope		
	Control % Display Deadband		
	Remote Configuration		
	Remote Auto / Manual		
	Remote Raise / lower		
	Remote Elev. Offset		
	Remote Grade Match		
	VALVE SETUP		
	Auxiliary Valve Drivers		
	Spool Profile		
	PT Period ms		
	Pk % Dither		
	Dither Hz		
	Max % On		
	Raise Minimum		
	Lower Minimum		
	R/L Balance		
	RH/LH Balance		
	Slope % Elev Speed		
	CUSTOM SETUP		
	Display Averaging		
	2-Strike Averaging		
	R/L Override		
	R/L Ramp		
	Receiver Facing		
	TROUBLESHOOT		
	Machine Voltage		
	Fault Log		
	Power Cycles		
	On Time hrs		
	Auto Time hrs		
	S/W Version		
	S/W Checksum		
	BL Checksum		

5.4 System Setup Menu

Highlight System Setup from the Technical Setup Menu and press in the multi-switch. Toggle the multi-switch up and down to navigate through the System Setup Menu.

Language - Select Language



Turn the right side multi-switch to select language used in operating modes.

- ENG - English
- GER - German
- FRE - French
- ITA - Italian
- SPA - Spanish

Technical menus remain in English

Mach Arch - Machine Architecture

Selections are Off, Lift, or Tilt for right side and Lift or Off for left side.

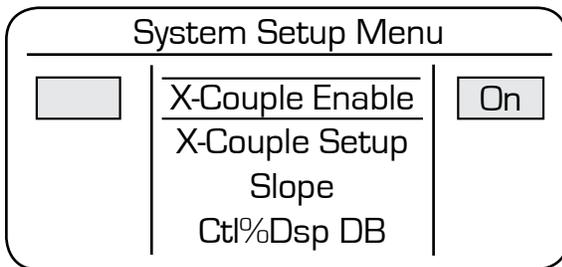
Lift & Tilt is used for a typical dozer configuration. Select Lift on left side for elevation side receiver; Tilt for the right side.

Lift & Lift is for independently controlled elevation sides, such as a motorgrader.

For single side operation, select Lift for one side and Off on the other side.

Refer to § 3.1 for additional machine architecture information.

X-Couple Enable - Cross Coupling Enable



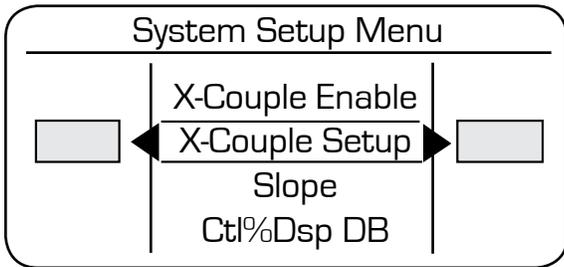
Cross coupling selection is On or Off. When On, it communicates corrections from one side to the other that stabilizes the blade's movement.

If On is selected, the Cross Couple Setup must be completed.

When On, cross coupling is only applied when both laser receivers are in the laser beam.

5.4 System Setup Menu

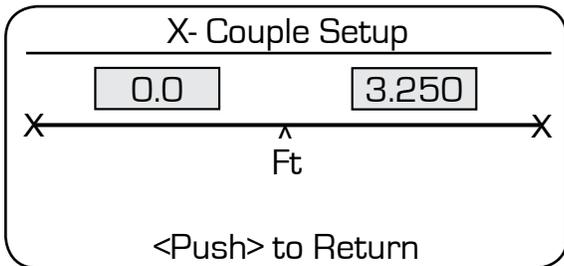
X-Couple Setup - Cross Coupling Setup



Setup enables entry of geometry for cross coupling calculations.

Geometry will be determined by machine architecture selection.

For measurement accuracy, ±.006 m, ±0.25 in., ±0.02 ft is sufficient. Ensure the units of measure are correct.

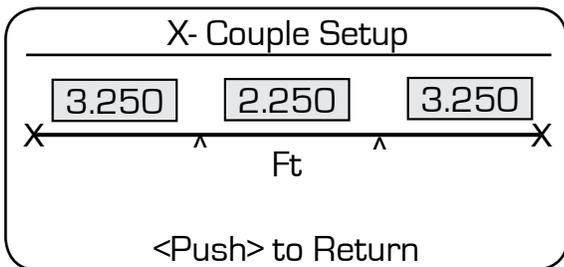


Lift and Tilt: Measure the horizontal distance between the left sensor and the center pivot point. Scroll the left multi-switch to enter the measurement.

Measure the horizontal distance between the right sensor and the center pivot point. Scroll the right multi-switch to enter the measurement.

On a traditional dozer configuration, the left receiver will control the lift and will be mounted over the pivot point on the blade. If so, the distance entered for the left side will be "0".

Push in the multi-switch to exit the setup screen.



Lift and Lift: Use the centered or operating blade side shift position prior to measurement. Measure the horizontal distance between the left sensor and the left side pivot point. Highlight the left number and scroll the left multi-switch to enter the measurement.

Measure the horizontal distance between the right sensor and the right side pivot point.

Highlight the right number and scroll the right multi-switch to enter the measurement.

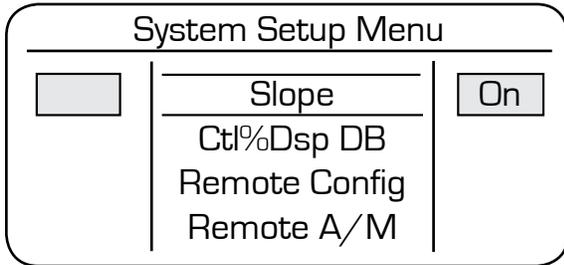
Measure the horizontal distance between the right side pivot point and the left side pivot point. Toggle either multi-switch sideways to highlight the center number. Use the same side switch to enter the measured value.

Push in the multi-switch to exit the setup screen.

5.4

System Setup Menu

Slope - Slope Enable



Slope selection is On or Off. When On, the slope sensors in the receivers, if equipped, are operational. Slope menu options are available. When Off, the slope sensors are not operational and slope menu options are not available. Rotate the right multi-switch to change the selection. When On - Calibrate the slope sensor. Ensure the receiver is properly oriented - the LED display is parallel to the blade.

Ctl%Dsp DB - Control Deadband as a Percentage of Display Deadband

The display deadband is set from the User Setup menu. The default setting is 100%. Consequently the display deadband and the control deadband are initially the same. To decrease the control deadband value, decrease the percentage value. For example, if the display deadband is 0.50 inches and the Ctl%Dsp DB is set to 50%, the control deadband would be 0.25 in.

Adjust each side of the system. Display is from 0 to 100 in increments of 1%.

NOTE: Smaller control deadband values increase valve movement sensitivity. This may cause unstable system performance. System performance should be checked after adjusting. See § 5.6.

Remote Config - Remote Switch Configuration

The remote switch configuration selects the type of remote switch (Multi-switch or Toggle), how many switches are used, and which side the switch is mounted. Multi-switches are not the same as Toggle switches. See cable diagrams for part numbers. Remote switches are installed with the switch facing inward and the cable routed downward. Once configured, this installation allows thumb activation for forward movement to Auto and back movement to Manual.

MULT - Multi-switch. All options for the multi-switch are available.
TOGL - Toggle switch. Auto/Manual and Raise/Lower switch options only.

For Dual Multi-switch, set both sides to MULT, and turn on or off the desired remote functions for each side in the next four menu items.

For Single remote switches, set the side the switch is mounted on to MULT or TOGL, and turn the other side to NONE. The single remote switch will activate both left hand and right hand remote functions. Turn Off or On the desired remote functions in the next four menu items. The Raise/Lower function for the Tilt side is not available.

Single remote switches are wired as left hand remotes and may be configured to operate the left hand, right hand, or both sides.

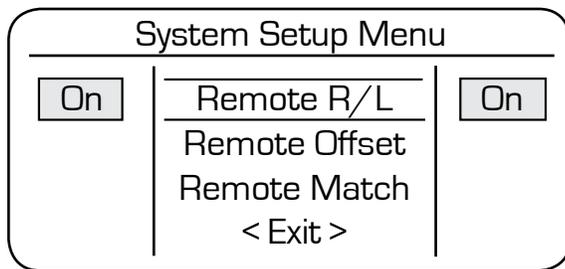
5.4 System Setup Menu

Remote A/M - Remote Switch Auto / Manual Enable

Selections are On and Off. On enables switching between Automatic and Manual with the remote switch.

Off disables switching between Automatic and Manual.

Remote R/L - Remote Switch Raise / Lower Enable



Selections are On and Off.

On enables the Raise and Lower command with the remote switch.

Off disables the Raise and Lower command.

Remote Offset - Remote Switch Elevation Offset Enable

Selections are On and Off.

On enables an elevation offset to be set at the remote switch by rotating the multi-switch. If slope is applicable, a slope change can be made at the switch.

Off disables the offset command.

Remote Match - Remote Switch Grade Match Enable

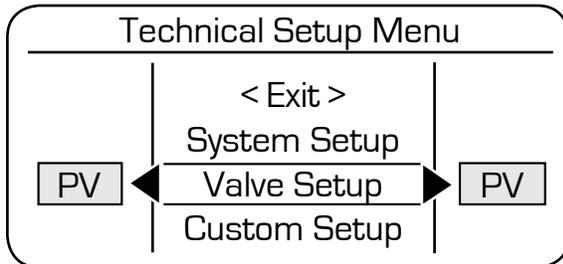
Selections are On and Off.

On enables an off-center laser strike to be set to on-grade with the remote switch by pressing in the multi-switch and holding for two seconds.

The on-grade position can be reset to the center of the receiver by pressing in the multi-switch and holding for five seconds.

Off disables the match command.

Highlight Exit and press in the multi-switch to return to the Technical Setup Menu.

5.5**Valve Setup Menu**

The type of valve used is selected from the initial Technical Setup Menu.

Selections are PC, PT, or PV.

PC - Proportional Current

PT - Proportional Time

PV - Proportional Voltage

Toggle the multi-switch to highlight Valve Setup. Rotate the left and right multi-switch to select PV, PC, or PT.

Each valve type has its individual characteristics.

The PT valve, sometimes referred to as on/off or "bang-bang" valve is not a true proportional valve. It can only be turned on or off. The proportionality is achieved by rapidly turning the valve on and off over time at varying duty rates.

The PC and PV valves are proportional spool valves and can take full advantage of the receivers proportional electronics.

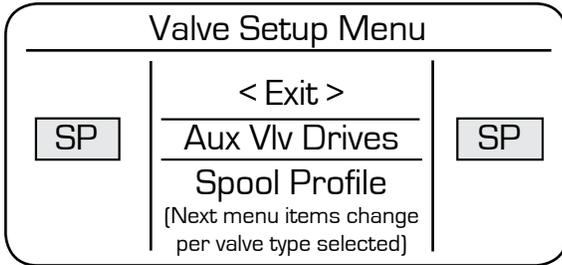
A common PV valve is the Danfoss PVG32, which is a pilot operated proportional valve.

Once the valve type is selected, press in the multi-switch to enter additional Valve Setup options.

Menu items will appear depending on the type of valve selected. If both sides have the same valve, menus specific to that valve will appear. If different valves are selected for each side, all menu items will appear.

5.5 Valve Setup Menu

Aux Vlv Drives - Auxiliary Valve Driver Setup



Selections enable setting of valve drivers for specific applications and types of valves.

- Selections are:
- OFF
 - SP (Switched Power)
 - LS (Load Sense)
 - LSA (Load Sense A)

SP supplies Machine Voltage anytime the control box is on.

NOTE: SP is required for PV valves.

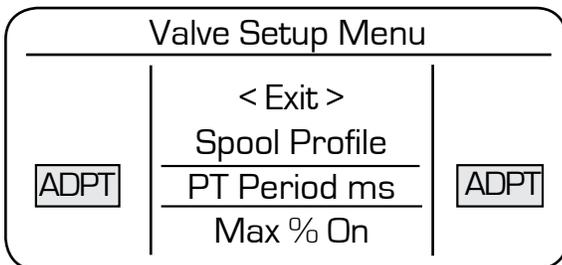
LS supplies Machine Voltage when either side of the control box is in AUTO mode and receiving laser strikes, or when raising or lowering.

LSA supplies Machine Voltage when either side of the control box is in AUTO mode or when raising or lowering.

If auxiliary valve drivers are not used, turn to OFF to avoid unused live wires.

PT Valve Selected

PT Period ms- Selects the update period for PT valves.

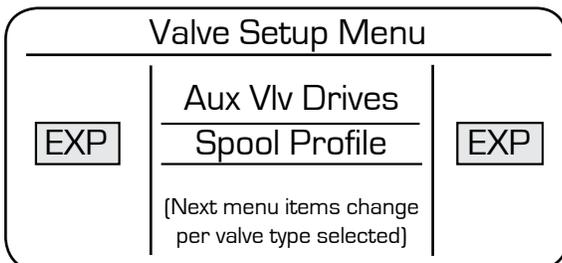


Adaptive optimizes the signal according to the laser RPM.

Other values can be set from 100 to 250 in increments of 10 ms.

PC or PV Valve Selected

Spool Profile



Spool profile selections are exponential (EXP) and linear (LIN).

Choose the same profile as the installed valve spool.

PC valves usually have exponential (EXP) spool profiles.

5.5

Valve Setup Menu

PC Valve Selected

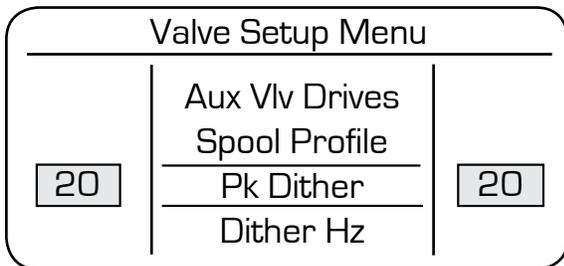
Dither is a signal which is constantly sent to the PC valve that causes the spool to vibrate and stay lubricated, reducing hysteresis and stiction.

Choose a setting closest to the manufacturers recommendations or use the Valve Identification and Setting Recommendation chart in Appendix A.

If cylinder lines or cylinder are vibrating from dither, select a higher frequency and/or lower the % amplitude.

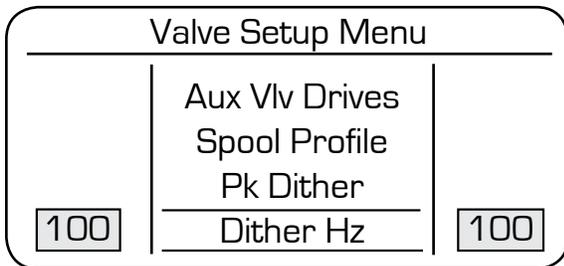
If the valve is sticking or sluggish, select a lower dither frequency and/or a higher % amplitude.

Pk Dither - Dither Current Amplitude for PC valves only



Select the dither amplitude according to the Valve Identification and Setting Recommendation chart in Appendix A. Select by rotating the right or left side multi-switch. Values are between 0 and 25 in increments of 1%.

Dither Hz - Dither Frequency for PC valves



Select the dither frequency according to the Valve Identification and Setting Recommendation chart in Appendix A. Rotate the right side multi-switch to select.

Values are 40 / 42.1 / 44.4 / 47.1 / 50 / 53.3 / 57.1 / 61.5 / 66.7 / 72.7 / 80 / 88.9 / 100 / 114.3 / 133.3 / 160 / 200 / 266.7 / 400.

Once the proper valve is selected, perform a system communication check. Turn the box on to confirm power. Check that the receiver is communicating properly. Check the raise/lower and auto/manual switches. Check the remote switch functions if installed.

Check for proper hydraulic system operation. Ensure there are no leaks, excessive engine load or pressure relief valves continually opening. Check that all circuits function properly.



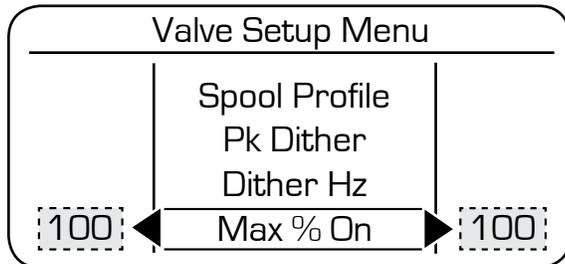
NOTE: Before proceeding, warm up the hydraulic system to operating temperature. Run the machine at operating RPM for approximately 15 minutes while cycling the blade lift cylinder.

5.5

Valve Setup Menu

All Valves

Max % On - Limits power sent to valves



Max % On adjusts Pulse Width Modulation (PWM) percentage to create a less than 100% proportional valve signal.

If the valve's maximum signal rating is less than the maximum supplied signal, lower the maximum supplied signal to within the valve's maximum rated signal.

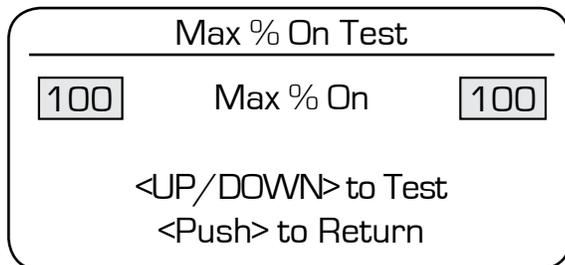
For PC or PT Valves:

The maximum current supplied to the solenoid is equal to machine voltage divided by coil resistance.

Reference Appendix A for PC valve solenoid descriptions for common valves.

Example: If a solenoid with a maximum rated current of 2.5 Amps (I) and resistance of 3 Ohms (Ω) is installed on a 12 Volt (V) machine, the maximum supplied current will be $I = V/R$; $12V/3\Omega = 4A$. Adjust the Max % On to $2.5A/4.0A = 63\%$ to stay within the solenoids maximum current rating.

Max % On Test



Push in the Multi-switch to change and test the system. A screen similar to the one depicted appears.

Rotate the left and right multi-switch to adjust the percentage.

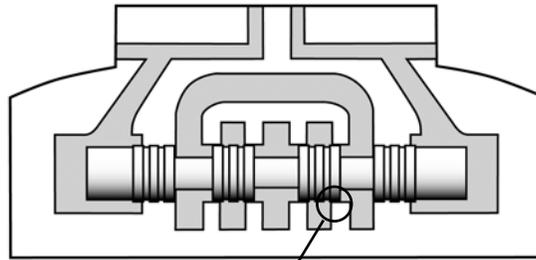
Toggle the multi-switch up and down and ensure the valve raises and lowers the implement.

5.5

Valve Setup Menu

Set Valve Minimum Correction

The Valve Minimum Correction (VMC) is set to provide output flow as soon as a correction signal is received.



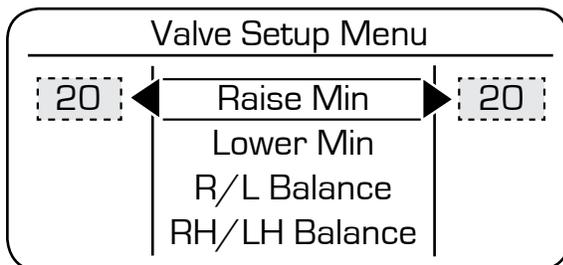
Spool Overlap - Minimum distance to move valve for flow to begin.

The edges of the valve spool have some degree of overlap with the corresponding edges of the valve body ports. This is required to prevent flow across the spool when it is in a neutral position. This spool overlap means that there will be a defined movement of the spool in the bore before flow begins to take place. This characteristic is sometimes referred to as valve “deadband”. In this text, adjusting the control box to account for this deadband and create a minimum blade velocity will be referred to as the Valve Minimum Correction (VMC) to avoid any confusion with laser system deadband or accuracy.

The minimum correction is set independently for both the raise and lower.

Set the machine throttle to normal operating RPM and place the blade approximately 1 foot (0.3 m) above the ground. No laser is required.

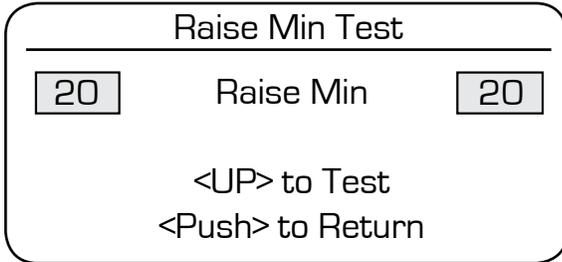
Select Raise Min from the Valve Setup Menu.



5.5

Valve Setup Menu

Raise Min - Raise VMC Calibration



Push in the multi-switch with the Raise Min selected from the Valve Setup Menu. A screen similar to the one depicted appears.

Toggle the left hand multi-switch to the raise position and hold.

If there is no movement, release the switch and increase the numeric value by one by rotating the

multi-switch. Repeat the switch raise until the blade speed is approximately 0.5 inches (13 mm) per second.

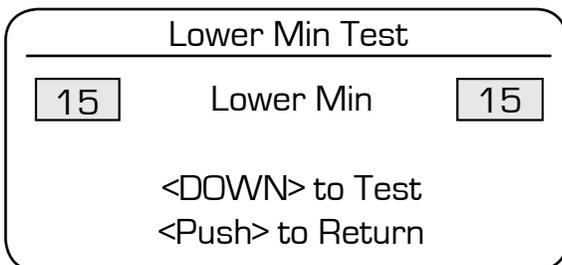
If the blade speed is too fast, decrease the numeric value until a speed of 0.5 inches (13 mm) per second is attained.

If the cylinders bottom out, the lower switch can be used to reposition the blade.

Repeat the process for the right hand valve.

Push in the multi-switch to return to the valve setup menu.

Lower Min - Raise VMC Calibration



Select Lower Min from the valve setup menu. A screen similar to the one depicted appears.

Toggle the left hand multi-switch to the lower position and hold.

If there is no movement, release the switch and increase the numeric value by one by rotating the multi-switch. Repeat the switch lower until the blade speed is approximately 0.5 inches (13 mm) per second.

If the blade speed is too fast, decrease the numeric value until a speed of 0.5 inches (13 mm) per second is attained.

If the cylinders bottom out, the raise switch can be used to reposition the blade.

Repeat the process for the right hand valve.

Push in the multi-switch to return to the valve setup menu.

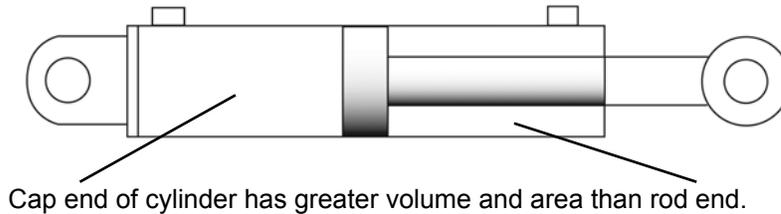
5.5

Valve Setup Menu

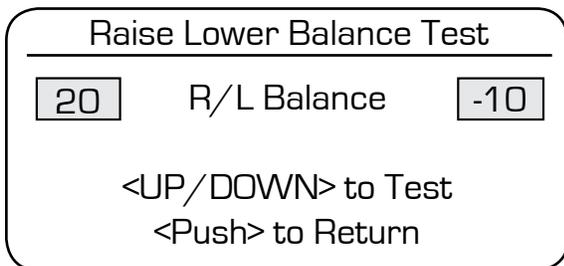
R/L Balance - Dynamic Raise / Lower Balance

The valve raise / lower balance set-up allows adjustment to compensate for different raise and lower blade velocities due to cylinder imbalance or for different hydraulic system responses to different loads.

Most mobile equipment uses double-acting hydraulic cylinders. Double-acting cylinders are also called differential cylinders because the effective area, and therefore the volume, of each end of the cylinder is different. The rod end of the cylinder has less area and volume than the cap end by the nature of the rod being present. This differential area and volume causes a different force and velocity during extension and retraction - or raising and lowering for a lift cylinder.



Set the machine throttle to normal operating RPM and place the blade approximately 1 foot (0.3 m) above the ground. No laser is required.



Select R/L Balance from the Valve Setup Menu. A screen similar to the one depicted appears.

Left side - Lift: Toggle the raise / lower switch to raise and hold. The blade will oscillate up and down. Observe the blade drifting up or down during oscillation.

If the blade is drifting upward, lower the left hand numeric value. If the blade is drifting downward, raise the left hand numeric value. Test the movement again and adjust until the blade is balanced.

Right side - Tilt (for Lift & Tilt): Toggle the raise / lower switch to raise and hold. The blade will oscillate about the tilt pivot point. Observe the blade drifting.

If the right side drifts downward, increase the right side numeric value. If the right side drifts upward, decrease the right side numeric value. Test the movement again and adjust until the blade is balanced about the pivot point.

Right side - Lift and Lift: Same procedure as the left side using the right side multi-switch.

5.5

Valve Setup Menu

RH/LH Balance - Balance Right Hand / Left Hand Blade Speeds

RH/LH Balance Test

RH/LH Balance

<UP/DOWN> to Test
<Push> to Return

Ideally, the right hand and left hand blade velocities should be the same. The Right Hand / Left Hand Balance Test and adjustment allow adjustment to compensate for different velocities of the right and left hand sides of the blade.

For Lift & Lift machines: Adjust RH/LH balance until oscillation amplitude of the blade during the test is nearly equal for right hand and left hand sides.

The RH/LH balance may be limited by unmatched valves or the mechanics of the machine.

For Lift & Tilt machines with the pivot point in the middle of the blade, adjust RH/LH balance until oscillation amplitude of the left hand end of the blade during the test is minimized.

For Lift & Tilt machines with pivot points not in the center of the blade, adjust the RH/LH balance so that the lift and tilt velocities are about the same when in operating modes. The Test is not required. Measure the tilt blade velocity at the end of the blade farthest from the pivot point.

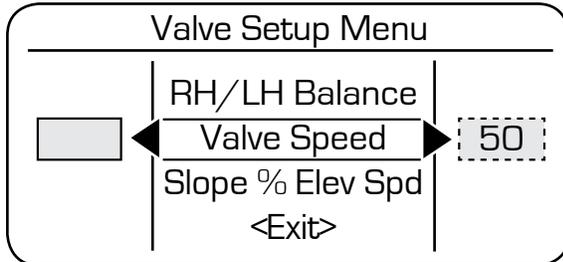
Clockwise adjustment of the right multi-switch (larger value) will increase the speed of the right side.

Counterclockwise adjustment of the right multi-switch (smaller value) will decrease the speed of the right side.

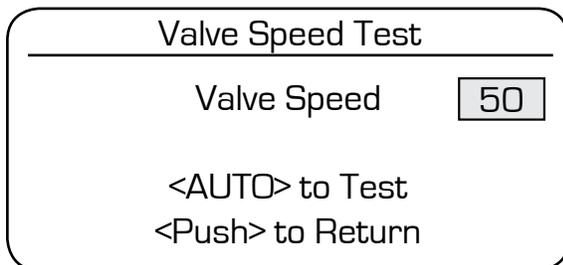
5.5

Valve Setup Menu

Valve Speed - Sets System Speed



Select Valve Speed from the Valve Setup Menu and enter.



Rotate the right multi-switch to change the valve speed. Values are selectable from 0 to 100.

The valve speed is applied to both valves.

The factory default setting is 50.

Presetting Valve Speed - Blade in Air Method:

1. Set up the rotating laser at a typical working range. If a selectable rotation speed is available, set it to 600 RPM or faster.
2. Mount the receiver in its normal operating position to receive the laser.
3. Select an On-grade deadband of approximately 1/2 of the jobsite tolerance. If working at ranges that exceed 500 feet (150 m), this may be increased to compensate for the rotating laser's beam "bounce".
4. Set the machines throttle to normal operating RPM. Ensure the machine is on flat ground.
5. Place the blade approximately 1 foot (0.3 m) above the ground.
6. Select Manual control. Raise the blade to position the receiver at the lower edge of its vertical reception range, but still receiving the beam. Select Automatic control.
7. The blade and receiver will move towards on-grade. Note any overshooting of On-grade. Repeat procedure for raise correction. Once again, note any overshooting of On-grade. Adjust the Valve Speed until there is none or one small overshoot for a full receiver length correction in either direction of both sensors.

Increasing Valve Speed corresponds to a faster, but less stable correction.

Decreasing Valve Speed corresponds to a slower, but more stable correction.

If one side seems more reactive than the other side, the RH/LH Balance may be used to correct this.

5.5

Valve Setup Menu

Slp%Elev Spd - Slope Speed as a Percentage of Elevation Speed

Slp%Elev Spd Test

Slp%Elev Spd

<Push> to Return

The slope sensors cannot operate as fast as the elevation sensors of the system. This adjustment sets the speed of the slope correction as a percentage of the elevation correction speed.

This lower speed is only applied to the slope sensor driven side.

To preset the Slope Speeds, select a slope operating mode from the main menu.

Presetting Slope%Elev Valve Speed - Blade in Air Method:

1. Mount the receiver in its normal operating position to receive the laser.
2. Select an On-grade deadband typically between 0.3% and 1.0% (0.2° and 0.6°) depending on the jobsite tolerance. Refer to Appendix D for more details.
3. Set the machines throttle to normal operating RPM. Ensure the machine is on flat ground.
4. Place the blade approximately 1 foot (0.3 m) above the ground.
5. Select Manual control. Tilt the blade to create a coarse (full arrow) lower correction. Select Automatic control.
7. The blade and receiver will move towards on-grade. Note any overshooting of On-grade. Repeat procedure for raise correction. Once again, note any overshooting of On-grade. Adjust the Valve Slope%Elev until there is none or one small overshoot for a coarse correction in either direction of both sensors.

Increasing Slope%Elev Speed corresponds to a faster, but less stable correction.

Decreasing Slope%Elev Speed corresponds to a slower, but more stable correction.



NOTE: After the Valve Setup is complete, it is recommended to name and save the settings for future reference. Refer to § 5.8.

5.6 Check System Performance

Set up the rotating laser at a typical working range. Select the RPM of the laser to 600 RPM or faster if available.

Mount the BULLSEYE receivers to the mast of the machine in a position to receive the beam.

Select an On-grade deadband less than the jobsite tolerance. Typically 1/2 the tolerance is the value used as a starting point.

Select the desired operating mode.

Fine tune the Valve Speed while working in typical material and operating conditions.

If the system is over correcting or too jumpy, decrease the valve speed setting.

If the system is not correcting fast enough or is sluggish, increase the valve speed setting.

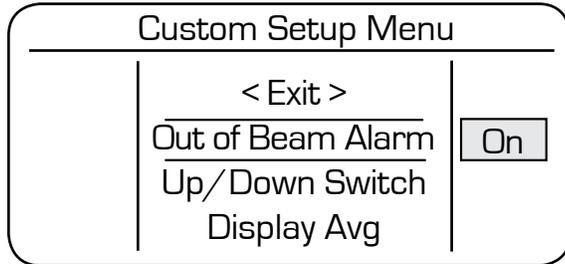
If one side seems more reactive than the other side, the RH/LH Balance may be used to correct this.

Environmental factors and laser set up can also affect system performance. Follow the set up procedures for your laser. Ensure proper tripods are used for stable laser operation.

Changing the laser RPM, laser strike averaging, deadband, spool profile, valve speed, valve balancing, or valve minimum corrections can affect system performance. System operation should be rechecked after changing any of these parameters.

5.7 Custom Setup Menu

Out of Beam Alarm - Enable out of laser beam audible signal



Select On to enable out of laser beam audible signal. One double beep is emitted when the receiver does not receive a laser beam strike for approximately one second.

Select Off to disable out of beam audible signal.

Up/Down Switch - Select Implement (Impl) or Mast (Mast) to Raise / Lower

Select Implement to raise / lower implement.

Select Mast to raise / lower mast (for use with electric mast; currently not available.)

(Depending on software release date, this function may not be available.)

Display Avg - Selects display performance options (Does not affect control)

- Selections include None - No averaging, each strike received is displayed.
- Adaptive (Adpt) - Adapts to laser RPM (recommended for most applications).
- Fast - Minor averaging function applied to display
- Stable (Stbl) - More averaging function applied to display.

Receiver LEDs - Turns Receiver LED's On or Off

Select On or Off. User preference for the receiver LED's.

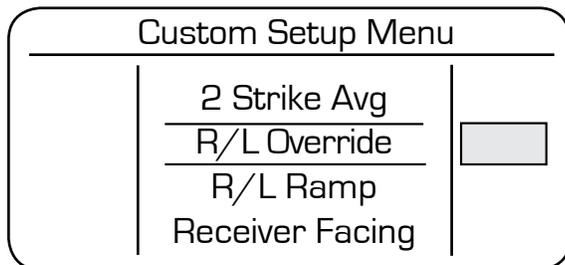
2 Strike Avg - Enables 2 strike laser averaging (Affects control)

Select On or Off.

On is used in environments that may cause unstable behavior such as very windy conditions and working long distances from the laser.

The 2 strike averaging will slow system response. Adjustments to the valve speed or on-grade deadband may be required to maintain stability.

R/L Override - Enables Raise / Lower switch to override in Auto control

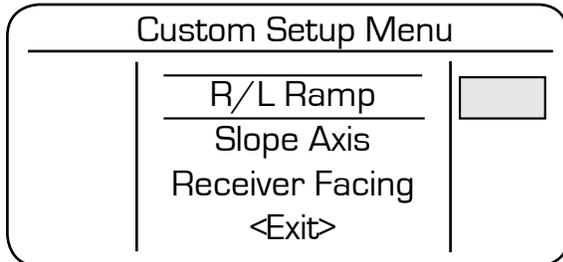


Select On or Off.

When On, the manual raise and lower switch will override the automatic control. When released, automatic control will resume.

5.7

Custom Setup Menu

**R/L Ramp - Enables Raise / Lower switch to ramp up to full speed**

Select On or Off.

On allows a progressive increase for the valve to get to the 100% open state in the first second.

Slope Axis - Selects X or Y Axis for receivers equipped with dual slope sensors.

Y is the default, tilt axis - "side to side" with respect to the receiver's grade display.

X is the plumb axis and would be set for a special application when the receiver would operate rotated 90 degrees about the vertical axis from its normal orientation - "front to back" with respect to the receiver's grade display.

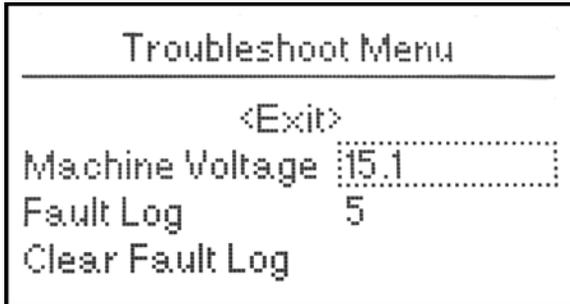
(Depending on software release date, this function may not be available)

Receiver Facing

Selection allows for consistent slope directions on the controls for either mounting option if internal slope sensors are used. Selects orientation of receiver. For receivers mounted on the front of the machine in front of the operator with LED's facing back toward the operator, select "Back". For receivers in the back of the machine behind the operator with LED's facing toward the front, select "Frnt" for front.

5.8 Troubleshoot Menu

Machine Voltage - Displays machine voltage.



Fault Log - Records history of fault occurrences.

Records relevant information regarding a fault including time of fault and fault code. Press in the multi-switch to enter the log. Rotate the multi-switch to view fault entries. Press the power switch up while viewing fault entries to display the fault description. Refer to Appendix B for specific fault code information.

Clear Fault Log - Clears all history in the fault log.

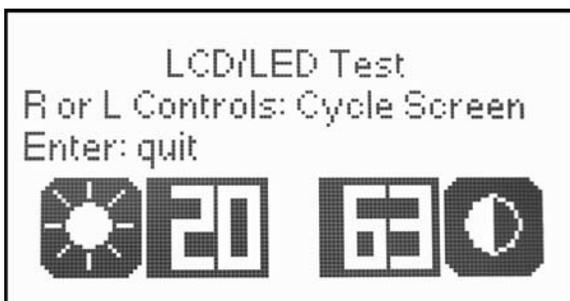
Press in the multi-switch to clear the fault log.

LCD/LED Test



Tests for LCD brightness, contrast, and light or dark pixels. Lights LED's in sequence.

Press in the multi-switch to enter the LCD/LED test.

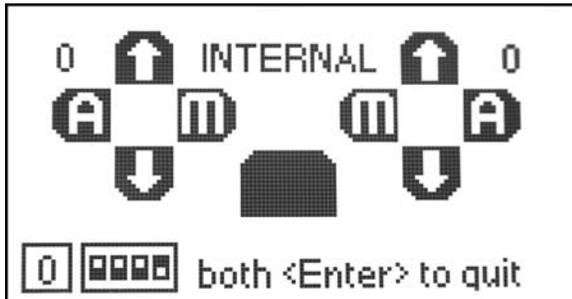


Rotate the left multi-switch to adjust the brightness.

Rotate the right multi-switch to adjust the contrast.

5.8 Troubleshoot Menu

Key/Switch Test - Graphically displays switch activations.



Press Power Switch up to switch between tests of Internal switches (Multi-, rotary, and dip switches), Remote Toggle switches, and remote Multi-switches.

Press in both multi-switches to quit the test mode.

Power Cycles - Counts the number of power cycles.

On Time hrs - Displays the number of hours the system is On.
Format is "hrs : min : sec".

Auto Time hrs - Displays the number of hours the system is in Automatic.
Format is "hrs : min : sec".

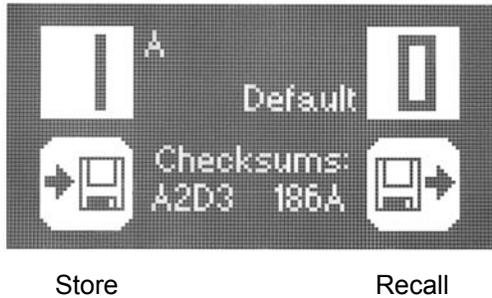
Troubleshoot Menu	
Auto Time hrs	10:06:54
S/W Version	3.00
S/W Checksum	DF29
BL Checksum	3155

S/W Version - Displays Installed Software Version

S/W Checksum - Displays Software Checksum

BL Checksum - Displays Bootloader Checksum

5.9



Store / Recall

The control box uses setups that are in "current" memory to operate.

The control box saves to current memory all setup values when exiting the Technical Setup Menu. It also saves to current memory every 30 seconds while in the operating mode.

The control box has one default memory slot for storing a factory setup. It also has four memory slots for saving installer or user customized setups.

The user or installer may copy a setup from current memory to 1 of 4 named memory slots with the Store function.

The user or installer may copy a stored setup from the 4 named or 1 default memory slot to the current memory using the Recall function.

The Store / Recall function in the Technical Setup Menu is the same Store / Recall function in the User Setup.

Store is on the left side. To store a current configuration, rotate the left multi-switch to the desired number 1 through 4. When selected, press in the multi-switch. A menu will ask if you would like to store. Select 'Yes' to store. Select 'No' to return to the previous menu.

If Yes is selected, a new name can be entered for the stored setting.

Rotate the multi-switch to scroll and stop on the desired character. Move the multi-switch to the right to allow selection of the next character. Continue until complete. Up to seven characters may be used. Once entered, the named setting will appear on the store and recall side for further use.

Recall is on the right side. To recall a stored configuration, rotate the right multi-switch to the desired number or name. Press in the right multi-switch. A screen will ask if you would like to recall. Select 'Yes' to recall and make the stored configuration the current configuration. Select 'No' to return to the previous menu.

Checksum values are displayed to check copied setups.

5.10

Data Transfer

The Data Transfer function along with the CB Center PC application software allows presets to be saved from a control box to a PC, and recalled from a PC to a control box via a serial cable.

Refer to the instructions that come with the CB Center software for further details.

Valve Identification and Setting Recommendation

Valve Identification				CB52 Setting Recommendations			
Mfgr.	Model Number	Solenoid	Solenoid Description	Drive	Dither	PkDither	Max %
		ID		Type	Freq.	Ampl.	On
					(Hz.)	(%)	(%)
Danfoss	PVG32 with PVEH elect. Module	157B4016	12VDC, Active Fault, Hrshmn conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4028	24VDC, Active Fault, Hrshmn conn	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4086	12VDC, Passive Fault, Hrshmn conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4088	24VDC, Passive Fault, Hrshmn conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4032	11-32VDC, Active Fault, Hrshmn conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4033	11-32VDC, Passive fault, Hrshmn conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4034	11-32VDC, passive Fault, Amp conn.	PV	N/A	N/A	N/A
Danfoss	PVG32 with PVEH elect. Module	157B4035	11-32VDC, Active Fault, Amp conn.	PV	N/A	N/A	N/A
Vickers/Eaton	KDG4-3S.....	GP	12VDC, 4.9 Ohms	PC	100	20%	100
Vickers/Eaton	KDG4-3S.....	HA	24VDC, 19.6 Ohms	PC	100	20%	100
Vickers/Eaton	KDG4-3S.....	G	12VDC, 1.8 Ohms	PC	100	20%	50
Vickers/Eaton	KDG4-3S.....	H	24VDC, 7.3 Ohms	PC	100	20%	50
Nachi	ESD.....		24VDC, 20 Ohms	PC	100	20%	100
Parker	D1FW....	K	12VDC, 6 Ohms	PC	100	20%	100
Parker	D1FW....	J	24VDC, 24 Ohms	PC	100	20%	100
Parker	D3FW....	K	12VDC, 4 Ohms	PC	100	20%	100
Rexroth	4 WRAB6.....	G12	12VDC, 4.8 Ohms	PC	200	20%	100
Rexroth	4 WRAB6.....	G24	24VDC, 19.2 Ohms	PC	200	20%	100
Bosch	0811-404		12VDC, 3.0 Ohms (2.5 A)	PC	200	20%	63
Bosch	0811-404		24VDC, 3.0 Ohms (2.5 A)	PC	200	20%	32
Danfoss	PVG32 with PVEO elect. module	157B4216	12VDC, Hrshmn conn.	PT	N/A	N/A	N/A
Danfoss	PVG32 with PVEO elect. module	157B4228	24VDC, Hrshmn conn.	PT	N/A	N/A	N/A
Danfoss	PVG32 with PVEO elect. module	157B4901	12VDC, Amp conn.	PT	N/A	N/A	N/A
Danfoss	PVG32 with PVEO elect. module	157B4902	24VDC, Amp conn.	PT	N/A	N/A	N/A
Vickers/Eaton	DG4V-3.....	GH	12VDC, 3.8 Ohms	PT	N/A	N/A	N/A
Vickers/Eaton	DG4V-3.....	HH	24VDC, 15.9 Ohms	PT	N/A	N/A	N/A
Nachi	SS-G0.....	D1	12VDC, 4.8 Ohms	PT	N/A	N/A	N/A
Nachi	SS-G0.....	D2	24VDC, 19.2 Ohms	PT	N/A	N/A	N/A
Parker	D3W....	K	12VDC, 4 Ohms	PT	N/A	N/A	N/A
Parker	D3W....	J	24VDC, 16 Ohms	PT	N/A	N/A	N/A
Parker	BV06.....	D012	12VDC, 5 Ohms	PT	N/A	N/A	N/A
Parker	BV06.....	D024	24VDC, 20Ohms	PT	N/A	N/A	N/A
Parker	D1VW.....	K 30 watt	12VDC, 4.3 Ohms	PT	N/A	N/A	N/A
Parker	D1VW.....	J 30 watt	24VDC, 17.3 Ohms	PT	N/A	N/A	N/A
Bosch/Rexroth	4WE6....., 4WE10....	G24	24VDC, 19.2 Ohms	PT	N/A	N/A	N/A
Bosch/Rexroth	4WE6....., 4WE10....	G12	12VDC, 4.8 Ohms	PT	N/A	N/A	N/A
Continental	VSD03M.....	42L, 70L	24VDC, 24 Ohms	PT	N/A	N/A	N/A
Continental	VSD03M.....	44L, 75L	12VDC, 6 Ohms	PT	N/A	N/A	N/A

Fault Codes

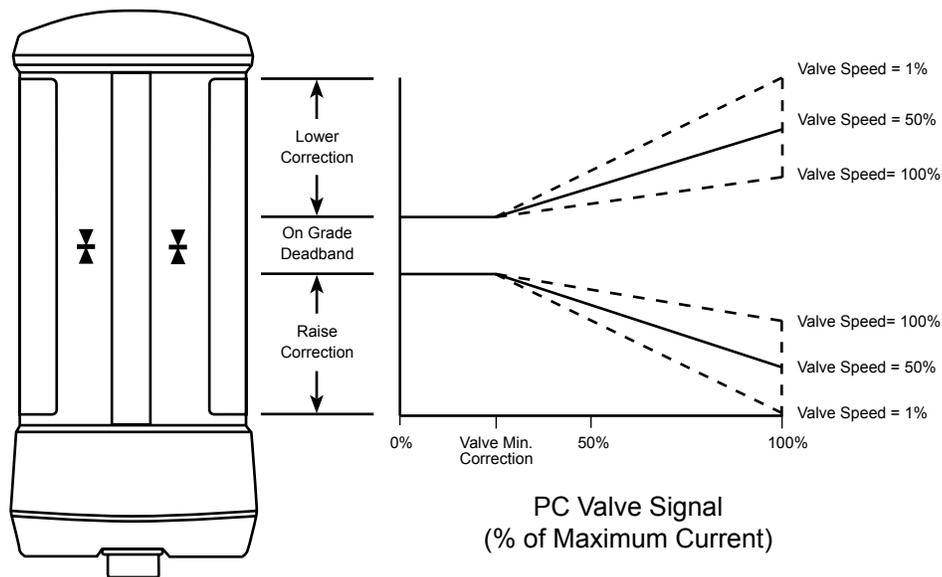
Fault code messages may be cleared by activating either multi-switch

<u>Code</u>	<u>Description</u>
10401	LH Raise Driver Overload. Valve Conn. Pin B If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., LH drivers stay off until power is cycled.
10402	LH Lower Driver Overload. Valve Conn. Pin A If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., LH drivers stay off until power is cycled.
10403	RH Raise Driver Overload. Valve Conn. Pin F If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., RH drivers stay off until power is cycled.
10404	RH Lower Driver Overload. Valve Conn. Pin G If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., RH drivers stay off until power is cycled.
10405	LH/AUX Driver Overload. Valve Conn. Pin C If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., driver stays off until power is cycled.
10406	RH/AUX Driver Overload. Valve Conn. Pin D If Current Exceeds 5 Amps driver turns off for 250ms. If 3 shut offs in 5.0 sec., driver stays off until power is cycled.
10407	LH PV Driver Overload. Valve Conn Pin E If Current Exceeds 6 mA driver turns off for 250ms. If 3 shut offs in 5.0 sec., driver stays off until power is cycled.
10408	RH PV Driver Overload. Valve Conn Pin H If Current Exceeds 6 mA driver turns off for 250ms. If 3 shut offs in 5.0 sec., driver stays off until power is cycled.
10409	LH Receiver Overload. Receiver Conn Pin A If Current Exceeds 6.5A driver turns off .
10410	RH Receiver Overload. Receiver Conn Pin G If Current Exceeds 6.5A driver turns off .
10510	LH PV Fault, Danfoss Valve; PV signal exceeds 15-85% of Mach Volt, LVDT wires Broken, Spool position exceeds command. Fault will clear when fault removed and power cycled.
10511	RH PV Fault, Danfoss Valve; PV signal exceeds 15-85% of Mach Volt, LVDT wires Broken, Spool position exceeds command. Fault will clear when fault removed and power cycled.
10604	Machine Volts High, Machine Voltage greater than 31.5 volts.
10605	Machine Volts Low, Machine Voltage less than 9.5 volts.
1505	Momentary lapse of communication with the laser receiver(s). Usually occurs due to low power during engine cranking. Cycling Power re-establishes communication.
10501	Default Values Loaded - Occurs when updating software (V1.00 to V2.00) due to parameter memory location changes.

Hydraulic Valve Guide

PC - Proportional Current Valve:

PC valves are proportional spool valves.



The maximum current supplied to the valve solenoid is equal to machine voltage divided by coil resistance.

Pulse Width Modulation (PWM) is used to create the < 100% proportional current signal.

The PC signal energizes 1 coil at a time which slides the valve's spool back and forth changing the valve's orifice size which changes the oil flow rate.

If the valve's maximum current rating is less than the maximum supplied current, (machine voltage / coil resistance), use the Max % On setting in the Valve Setup Menu § 5.5 to lower the maximum supplied current to within the valve's maximum rated current. Reference Appendix A for PC Valve Identification and Setting Recommendations.

Application Note: PC Valves are typically fast, but not always accurate.

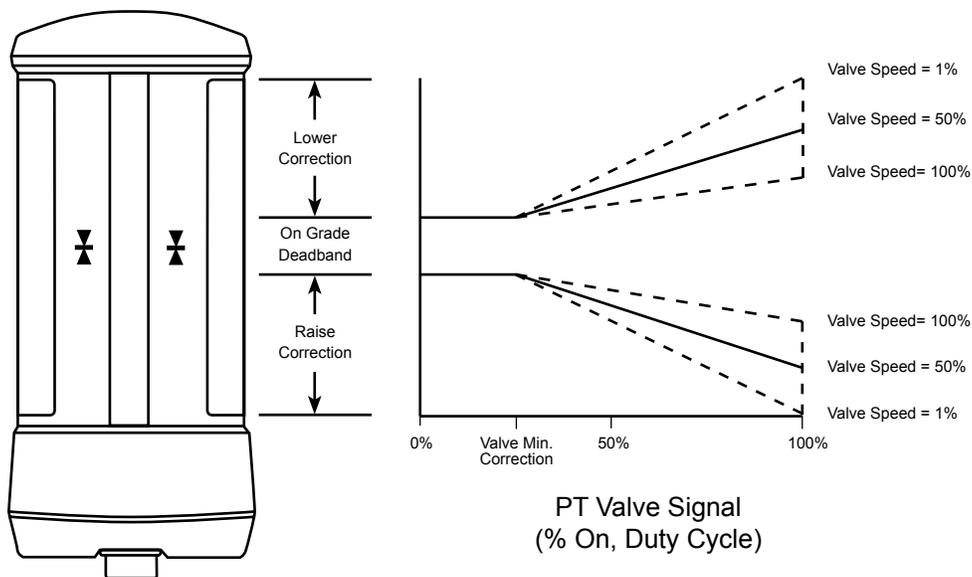
Direct operated solenoid PC Valves are limited in flow rates to about 8 GPM (30 l/m) due to the force capability of 12V solenoids.

Hydraulic Valve Guide

PT - Proportional Time Valve:

The PT valve, sometimes referred to as on/off or "bang-bang" valve is not a true proportional valve. It can only be turned on or off.

The proportionality is achieved by rapidly turning the valve on and off over time at varying duty rates as shown in the chart below.



Full machine voltage is applied to the valve to turn it on.

To achieve desired flow rates at "100% on" corrections, proper sizing of the valve or a flow control device is required.

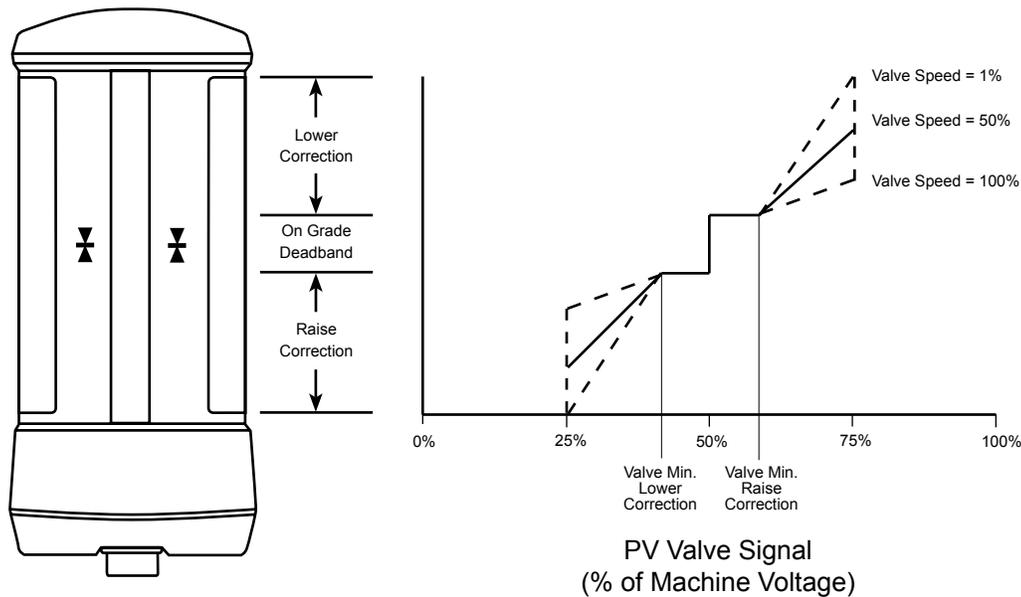
Application Note: These valves as a group are least expensive, but control performance is not as smooth as with the PC or PV valves.

Since this type of valve pops open or closed over time, the hoses can jump about and the rushing hydraulic fluid actually make a snapping sound, hence the name "bang bang" valve is often used.

Hydraulic Valve Guide

PV - Proportional Voltage Valve:

Namely, Danfoss PVG32, pilot operated proportional valves with "on-board" electronics, spool position and fault monitoring.



The PV valve signal is a low power ratiometric voltage signal that references the switched power output (machine voltage).

- I.e. 50% of machine voltage = No flow
- 25% of machine voltage = Full lower
- 75% of machine voltage = Full raise

Danfoss diagnostics: Green LED on valve = OK
 Red LED on valve = Fault

Application Notes: PV valves provide larger flows up to 32 GPM (120 l/m) and have more accurate flows. For best performance use PVEH actuation modules and linear spools.

Valves are easily converted to interface with open center, closed center, and load sensing hydraulic systems.

Raise cylinder port is the port closest to the black electronics module.

Vertical Elevation Error Caused by Slope On Grade Deadband about Horizontal

		+/- Elevation Error Caused by Slope On Grade Deadband (in)					
Slope On Grade Deadband		Distance from Laser Receiver to Furthest End of Blade (in)					
(%)	(Deg)	24	48	72	96	120	144
0.3	0.2	0.04	0.07	0.11	0.14	0.18	0.22
0.4	0.2	0.05	0.10	0.14	0.19	0.24	0.29
0.5	0.3	0.06	0.12	0.18	0.24	0.30	0.36
0.6	0.3	0.07	0.14	0.22	0.29	0.36	0.43
0.7	0.4	0.08	0.17	0.25	0.34	0.42	0.50
0.8	0.5	0.10	0.19	0.29	0.38	0.48	0.58
0.9	0.5	0.11	0.22	0.32	0.43	0.54	0.65
1	0.6	0.12	0.24	0.36	0.48	0.60	0.72
1.2	0.7	0.14	0.29	0.43	0.58	0.72	0.86
1.4	0.8	0.17	0.34	0.50	0.67	0.84	1.01
1.6	0.9	0.19	0.38	0.58	0.77	0.96	1.15

		+/- Elevation Error Caused by Slope On Grade Deadband (ft)					
Slope On Grade Deadband		Distance from Laser Receiver to Furthest End of Blade (ft)					
(%)	(Deg)	2	4	6	8	10	12
0.3	0.2	0.00	0.01	0.01	0.01	0.02	0.02
0.4	0.2	0.00	0.01	0.01	0.02	0.02	0.02
0.5	0.3	0.01	0.01	0.02	0.02	0.03	0.03
0.6	0.3	0.01	0.01	0.02	0.02	0.03	0.04
0.7	0.4	0.01	0.01	0.02	0.03	0.04	0.04
0.8	0.5	0.01	0.02	0.02	0.03	0.04	0.05
0.9	0.5	0.01	0.02	0.03	0.04	0.05	0.05
1	0.6	0.01	0.02	0.03	0.04	0.05	0.06
1.2	0.7	0.01	0.02	0.04	0.05	0.06	0.07
1.4	0.8	0.01	0.03	0.04	0.06	0.07	0.08
1.6	0.9	0.02	0.03	0.05	0.06	0.08	0.10

**Vertical Elevation Error Caused by
Slope On Grade Deadband about Horizontal**

		+/- Elevation Error Caused by Slope On Grade Deadband (cm)					
Slope On Grade Deadband (%) (Deg)	Distance from Laser Receiver to Furthest End of Blade (m)						
	1	1.5	2	2.5	3	3.5	
0.3 0.2	0.15	0.23	0.30	0.38	0.45	0.53	
0.4 0.2	0.20	0.30	0.40	0.50	0.60	0.70	
0.5 0.3	0.25	0.38	0.50	0.63	0.75	0.88	
0.6 0.3	0.30	0.45	0.60	0.75	0.90	1.05	
0.7 0.4	0.35	0.53	0.70	0.88	1.05	1.23	
0.8 0.5	0.40	0.60	0.80	1.00	1.20	1.40	
0.9 0.5	0.45	0.68	0.90	1.13	1.35	1.58	
1 0.6	0.50	0.75	1.00	1.25	1.50	1.75	
1.2 0.7	0.60	0.90	1.20	1.50	1.80	2.10	
1.4 0.8	0.70	1.05	1.40	1.75	2.10	2.45	
1.6 0.9	0.80	1.20	1.60	2.00	2.40	2.80	

Upgrading the CB52 Firmware

The Apache CB Center software is used to load new loader and application firmware to the CB52 control box.

Instructions are included with the upgrade package.



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