Installation Manual
& Technical Information

Automatic Laser Control

Control Box
Model MCB1
Model MCB2

Software Version 4.00

ATI-010864 Rev D

Disclaimer

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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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Futtura Tools & Technologies, Inc.
100 N Rockwell Ste 96
Oklahoma City, OK 73127 USA

Phone: (877) 399-9900
Fax: (405) 470-1772

Website: www.futturaus.com
Email: sales@futturaus.com

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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 Futtura Tools & 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 Futtura Tools & Technologies service personnel only.

CAUTION: Ensure all equipment is properly installed, the MCR 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).

The following should be reviewed with the owner and/or operator prior to installation:

• Machines must be within the manufacturer's specification for fine grading. Loose linkage or "slop" between the blade and lifting cylinder will adversely affect grade performance.

• Similarly, uneven cutting edge wear will result in non-uniform grade surfaces.

• Existing wear or damage to the machine's hydraulic system including heat damage, oil contamination, existing leaks at fittings, hoses, valves, or cylinders and kinks or abrasion damage to hoses should be addressed.

• Maintenance program or rebuild/overhaul history if the machine is an older model.

GENERAL INSTALLATION

System Description - MCB2

Futtura Automatic Blade Control is used on construction grading machinery to automatically control the blade in earthmoving and grading applications. It is also used on agricultural drainage and land leveling machinery.

A single MCR laser receiver mounts above the cutting edge of the blade. The Model MCB2 control box mounts in the machine's cab. A hydraulic installation kit ties into the machine's hydraulic system. Grade information from a rotating laser is processed and automatically directs the machine's hydraulics to maintain the elevation of the blade.

The Model MCB2 control box will work with many types of hydraulic valves, from on/off (bang-bang) solenoid valves to fully proportional valves.

The system is designed to work with a single MCR machine control receiver. The system will accept MCR models 2, MC2E, or 3.

NOTE: If the MCR receiver was purchased prior to the purchase of the control box, check with the factory as updates to the receiver may be required. Please have the receiver model and serial number available. These updates are free of charge.

System Description - MCB1

The Model MCB1 control box is similar in configuration to the Model MCB2 control box, but there are some differences.

The Model MCB1 control box will work with only on/off (bang-bang) solenoid valves. It will not work with proportional current or proportional voltage valves.

The MCB1 is designed to work with a single MCR machine control receiver. The system will accept MCR models 1, 2, MC2E, or 3.

The valve drive selector switch (15) does not function with the MCB1. Refer to controls and configuration sections beginning on page 7.

When used with the MCR1, the on-grade deadband is limited to 1 inch (25 mm) total. The MCR1 has a total of 2 inches of proportional photocells which leaves a minimum of 1/2 inch for grade corrections on each side. When combining wide deadbands and low gain settings, the valve may not reach 100% valve on duty cycle on large corrections.

NOTE: The MCR1 is designed to work with the MCB1 control box only.

NOTE: If the MCR receiver was purchased prior to the purchase of the control box, check with the factory as updates to the receiver may be required. Please have the receiver model and serial number available. These updates are free of charge.

Components

Control Box

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.

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.

MCR Receivers

The MCR 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 MCR receivers is proprietary RS485 @ 62.5 kbaud.

Masts

The Model STM1 shock mounted manually telescoping mast allows the receiver to be positioned above the machinery for unobstructed laser reception. A mast mounting plate that is welded to the blade is also available.

Installation instructions are provided with the mast and are also in Appendix J.

Hydraulic Valve:

The MCB2 Control Box supports Proportional Time (PT), Proportional Current (PC), and Proportional Voltage (PV) hydraulic valves.

The MCB1 Control Box supports Proportional Time (PT) valves only

For specific information on these valves, please refer to Appendix B.

Hydraulic installation kits are available for several common machines. 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.

System Wiring

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

Plan the routing of all cables prior to actual installation.

All cables should be properly installed. 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.

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.

Connect the 6-pin receiver cable end to the 6-socket connector on the box. Route the cable to the receiver. Connect the 7-socket receiver cable end to the 7-pin connector on the bottom of the MCR receiver.

If a receiver cable with a junction block is used, follow the instructions provided with the cable.

Connect the 10-pin valve cable to the 10-socket connector on the box. Route the cable to the valve and connect the open-ended wires to the valve following the directions for the valve.

Cable diagrams and part numbers are in Appendix C.

Optional Remote Switch

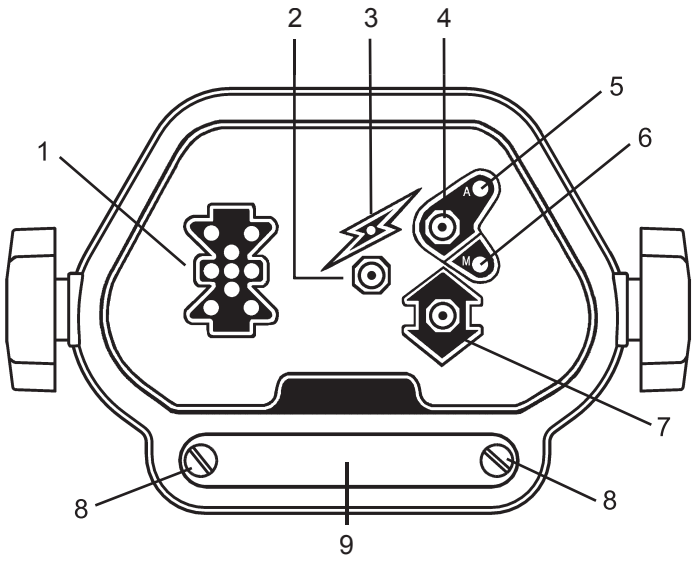
The remote switch assembly is designed to mount to lever shafts from 3/8 to 1-1/8 in. (10 to 28 mm)

The switch can be a single function of Auto / Manual selection or can be configured with the additional Raise / Lower function.

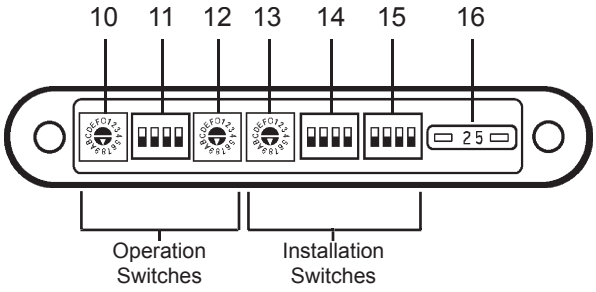
Cable diagrams and part numbers are in Appendix C.

Additional installation instructions are provided with the switch and are also in Appendix J.

Front View



1. LED grade display
2. Power ON / OFF push switch
3. Power ON indicator
4. Automatic / Manual toggle switch
5. Automatic ON indicator
6. Manual ON indicator
7. Raise / Lower toggle switch
8. Access panel thumbscrews
9. Access panel



Operation Switches:

10. Rotary switch - On-Grade Deadband selections
    (Default setting is "8".)
11. Dip Switch 4-way - Performance selections
    (Default setting is all in the OFF position.)
12. Rotary switch - Valve gain (speed)
    (Default setting is "8".)

Installation Switches:

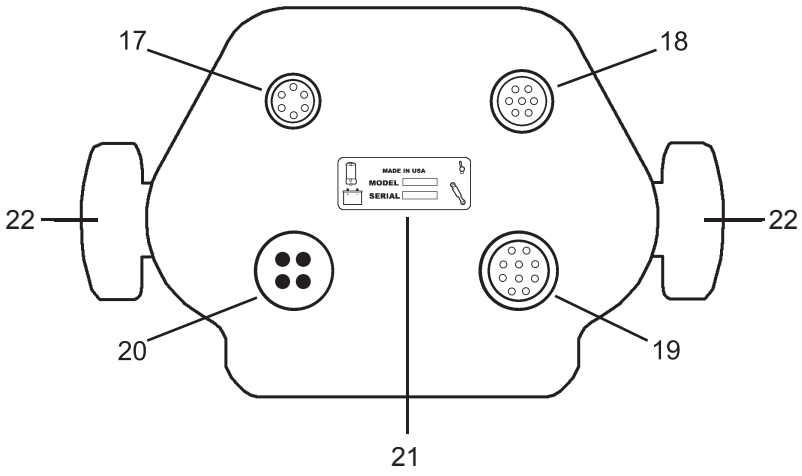
13. Rotary switch - Valve balance (raise/lower)
    (Default setting is "8".)
14. Dip Switch 4-way - Valve set-up
    (Default setting is all in the OFF position.)
15. Dip Switch 4-way - Valve drive selector
    (Default setting is all in the OFF position.)

16. Fuse, 25 amp

The 3 left side switches (10, 11, 12) are used by the operator to set operating functions.

The 3 right side switches (13, 14, 15) are used during installation for specific valves and machine settings. These should not be changed by the operator.

Rear View



17. 6-socket connector - laser receiver
18. 7-socket connector - optional remote switch
19. 10-socket connector - hydraulic valve outputs
20. 4-pin connector - machine power input
21. Identification / serial number label
22. Mounting knobs for bracket

Valve Selection (15)

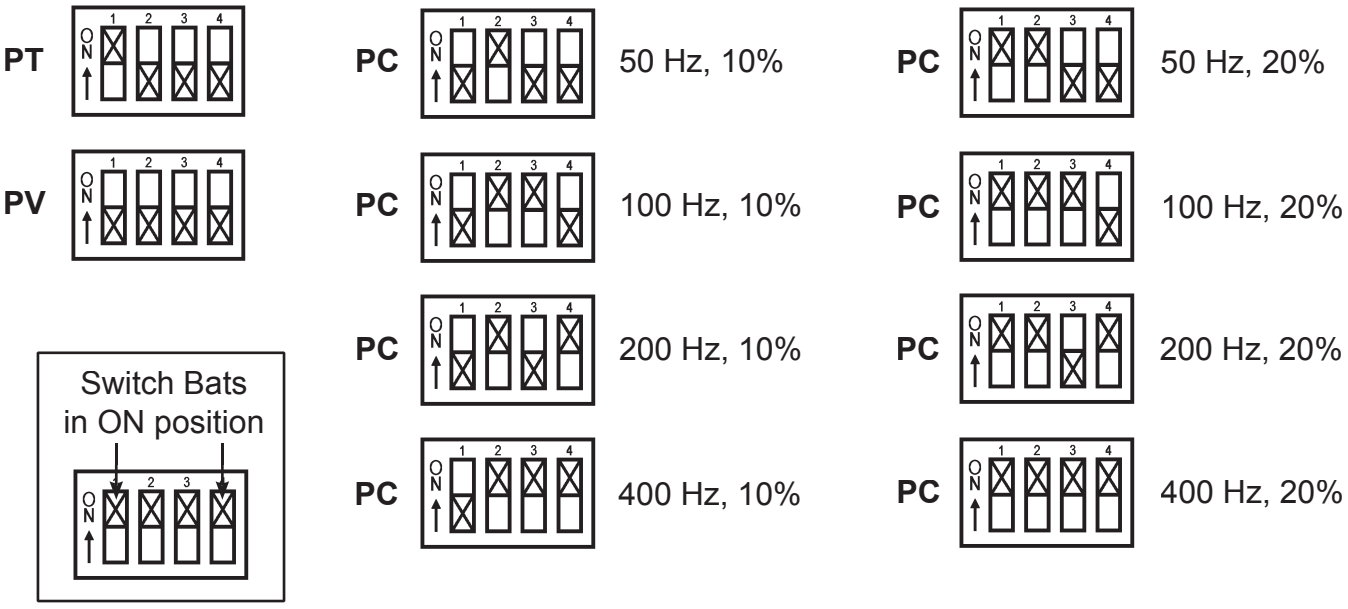
The Valve Drive Selector Dip Switch (15) is used to select the type of valve to be driven when used with the MCB2 Control Box. Following are the types of valves supported:

PT - Proportional Time	On/off (bang-bang) valve drive
PV - Proportional Voltage	Danfoss valve drive
PC - Proportional Current	Various dither frequencies (Hz) and dither amplitudes (% of maximum correction)

Additional information on the types of supported valves are in Appendix B.
Reference Appendix J for a list of common valve models and their Control Box settings.

NOTE: The MCB1 Control Box supports PT valves only. Switch settings are not functional.

MCB2 Settings are as follows



Proportional Current Valves: Dither is a signal which is constantly sent to the valve that causes the spool to vibrate and stay lubricated. This reduces hysteresis and stiction.

Choose a setting closest to the manufacturers recommendations.
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.

If the control box power was on during valve selection, cycle the box power before proceeding.

If auxiliary valve drivers and remote switches are desired, please consult the factory. Auxiliary valve drivers can be used via remote switches to drive other functions like scraper bowl eject, gate open and close, etc.

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.

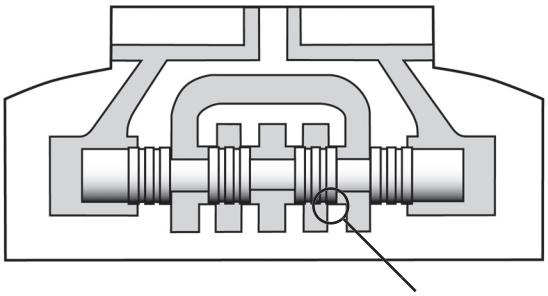
Check for proper hydraulic system operation. Ensure there are no leaks, excessive engine load or pressure relief valves continually opening. Check that all circuits function properly.

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.

Valve Set Up (14) - Set Valve Minimum Correction

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

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.



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

The VMC is adjusted by using the LED Counter Switch as described in Appendix D. Adjustment is made for both the raise minimum correction and the lower minimum correction.

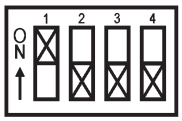
The VMC for PT valves is adjusted in increments of time. The VMC for PC or PV valves is a percentage of maximum valve correction.

Valve Type	VMC Increment	Adjustment Range
PT	10 ms	0 - 310 ms
PC, PV	2% of max.	0 - 62% of max.

Valve Set Up (14) - Set Valve Minimum Correction

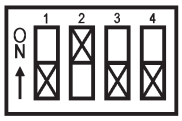
Set the machines throttle to normal operating RPM.
Place the blade approximately 1 foot (0.3 m) above the ground.
No laser is required.

RAISE Minimum Correction: (switch 1 in ON position)



1. Toggle raise/lower switch to raise and hold.
2. If no blade movement, release switch. If there is movement, skip to step 5.
3. Toggle automatic/manual switch once to auto to increase VMC one unit.
4. Return to step 1.
5. Observe blade speed. Goal is 0.5 inches (13 mm) per second.
6. If blade speed is too slow, continue increasing VMC and checking blade speed.
   If blade speed is too fast, toggle A/M switch towards manual to decrease VMC.
7. After proper VMC setting is obtained, note value.
8. Adjust DIP switch to OFF position.

LOWER Minimum Correction: (switch 2 in ON position)



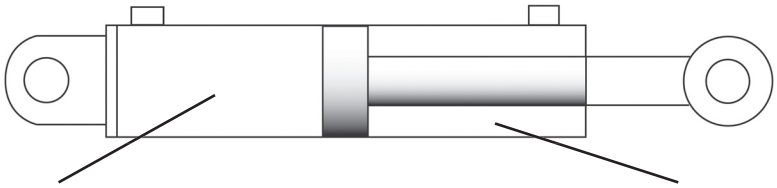
1. Toggle raise/lower switch to lower and hold.
2. If no blade movement, release switch. If there is movement, skip to step 5.
3. Toggle automatic/manual switch once to auto to increase VMC one unit.
4. Return to step 1.
5. Observe blade speed. Goal is 0.5 inches (13 mm) per second.
6. If blade speed is too slow, continue increasing VMC and checking blade speed.
   If blade speed is too fast, toggle A/M switch towards manual to decrease VMC.
7. After proper VMC setting is obtained, note value.
8. Adjust DIP switch to OFF position.

Note: It is advisable to log the various settings for each particular machine.

Set Valve Raise / Lower Balance (13)

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

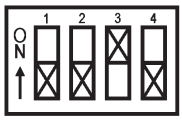
Most mobile equipment uses double-acting hydraulic cylinders. Double-acting cylinders are also called differential cylinders because the effective area, and therefore the volume, of each end of the cylinder is different. The rod end of the cylinder has less area and volume than the cap end by the nature 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.



Cap end of cylinder has greater volume and area than rod end.

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

Adjust the valve set-up DIP switch (14) to the dynamic balance set mode.



Set the valve balance rotary switch (13) to 8.

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. Adjust the rotary pot to minimize the drift.

Clockwise - toward position F - if blade is drifting down.
Counterclockwise - toward position 0 - if blade is drifting up.

NOTE: Ensure valve set-up switches are in run mode (all switches down) before proceeding

Set Performance Options and System Gain

Refer to the operator's manual for setting performance options that include laser beam strike averaging, receiver LED's on or off, and control box LED's bright or dim.

Generally, linear gain is selected for valves that have spools with an aggressive or exponential flow characteristics. Exponential gain is selected for valves that have spools with less aggressive or linear flow characteristics. Linear gain is the default position. Machine stability and hydraulic system reaction also influence the selection.

Presetting System Gain

Blade in Air Method:

Ensure valve set up switches are in run mode.

Set the machines throttle to normal operating RPM. Ensure the machine is on flat ground.

Place the blade approximately 1 foot (0.3 m) above the ground.

Set up the rotating laser at a typical working range. If a selectable rotation speed is available, set it to 600 RPM or faster.

Mount the receiver in its normal operating position to receive the laser.

Select an On-grade deadband (10) 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".

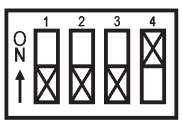
Select manual control (4). Raise the blade to position the receiver at the lower edge of its vertical reception range, but still receiving the beam. Select automatic control (4).

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 Gain switch (12) until there is one small overshoot for a full receiver length correction in either direction.

Clockwise rotation - towards F - corresponds to a faster, but less stable correction.

Counterclockwise rotation - towards 0 - corresponds to a slower, but more stable correction.

Set the Valve Set-up switch (14) to Run Mode after completion.



A 5 second timer is also available for checking blade velocities. When set in this mode, the raise or lower switch will activate the blade for 5 seconds when the switch is held in the raise or lower position. The cylinder stroke can then be measured. Ensure proper clearance when using the timer.

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 MCR receiver 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.

For example, if the jobsite tolerance is ± ½", set the On-Grade Deadband rotary switch (10) to 5. This is a deadband of ± ¼ inch or 0.50 inch total deadband.

Ensure other switches are set to "Run Mode" and the other desired options.

Fine tune the Valve Gain (12) while working in typical material and operating conditions.
If the system is over correcting or too jumpy, decrease the gain setting.
If the system is not correcting fast enough or is sluggish, increase the gain setting.

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, gain type, gain setting, valve balance, or valve minimum corrections can affect system performance. System operation should be rechecked after changing any of these parameters.

APPENDIX A

Control Box Operator's Manual

An operator's manual is included as part of this installation manual.

If missing, please request an additional copy.

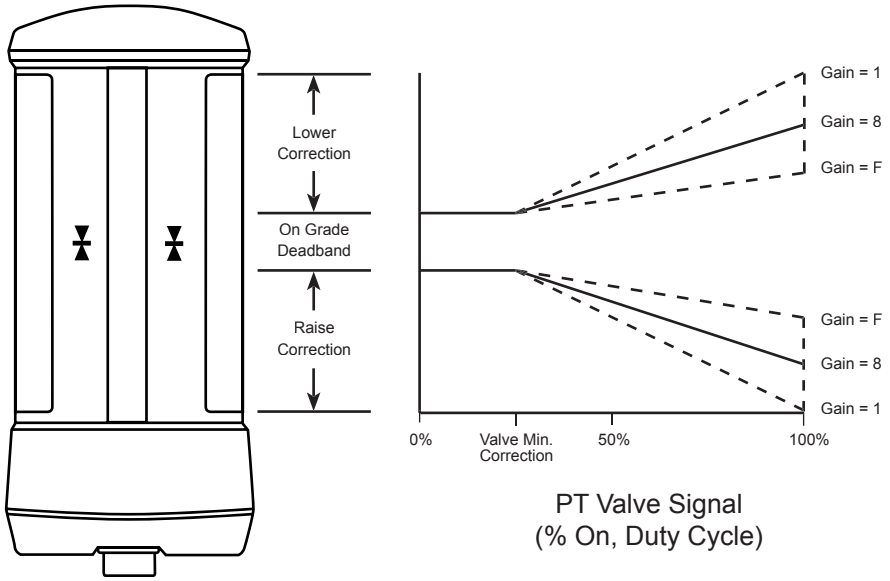
MCB2 Control Box Operator's Manual	Part No. ATI-026012 Rev E
MCB1 Control Box Operator's Manual	Part No. ATI-026023 Rev C

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.



PT Valve Signal
(% On, Duty Cycle)

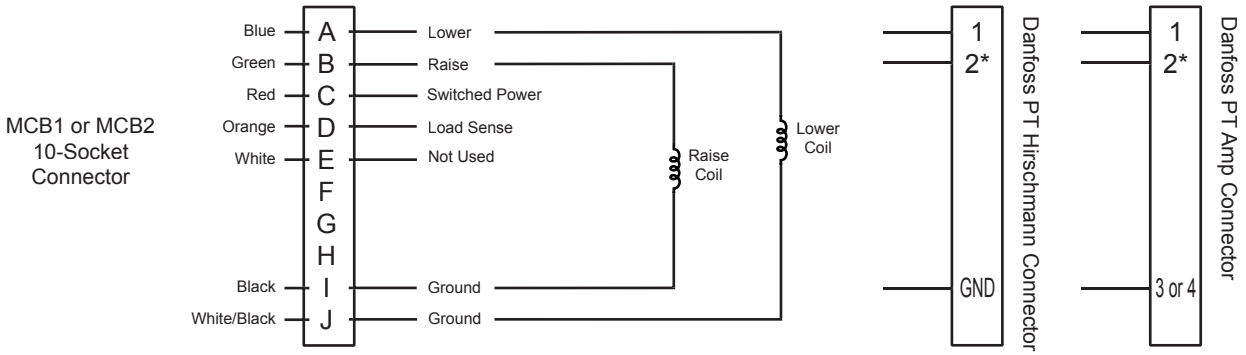
Full machine voltage is applied to the valve to turn it on.

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.

PT Valve Wiring: (P/N ATI-026040-XX)

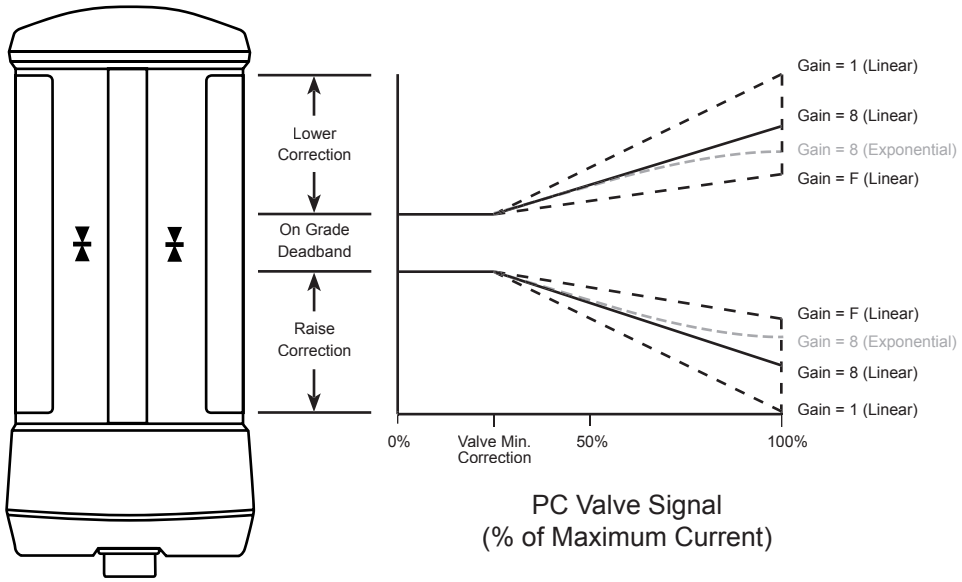


*Raise cylinder port is the port closest to black electronics module.

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.

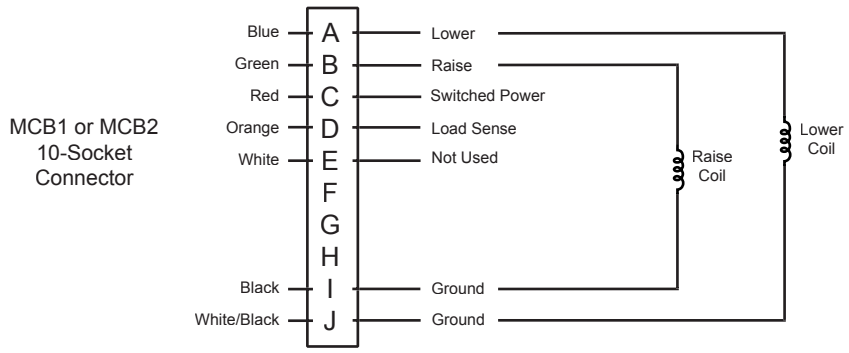
The PC signal energizes 1 coil at a time which slides the valve's spool back and forth changing the valve's orifice size which changes the oil flow rate.

If the valve's maximum current rating is less than the maximum supplied current, (machine voltage / coil resistance), use the PC valve current set mode (Appendix G) to lower the maximum supplied current to within the valve's maximum rated current. Reference Appendix J for PC valve identification and control box settings.

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.

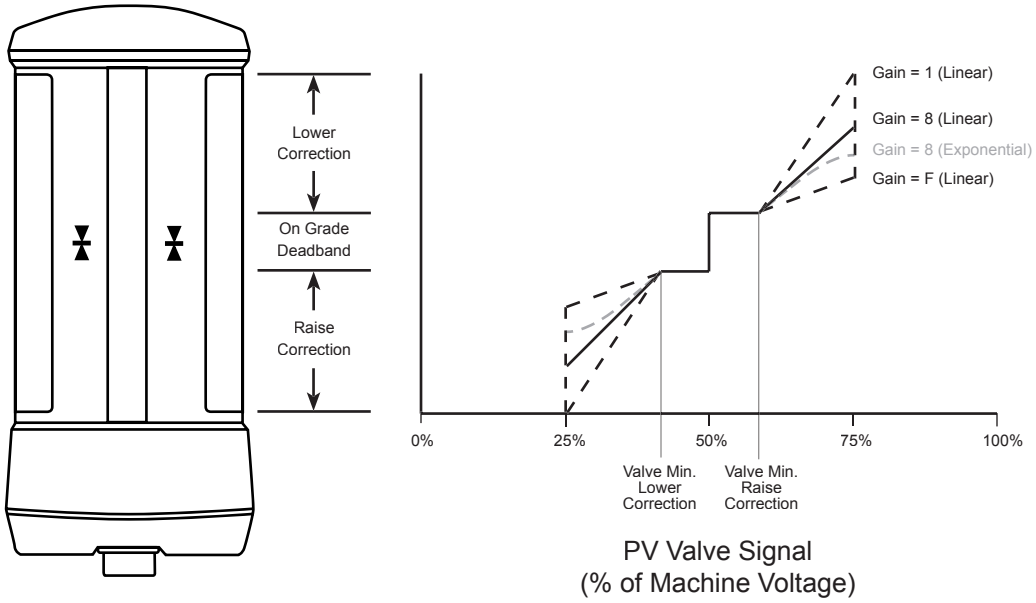
PC Valve Wiring: (P/N ATI-026040-XX)



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

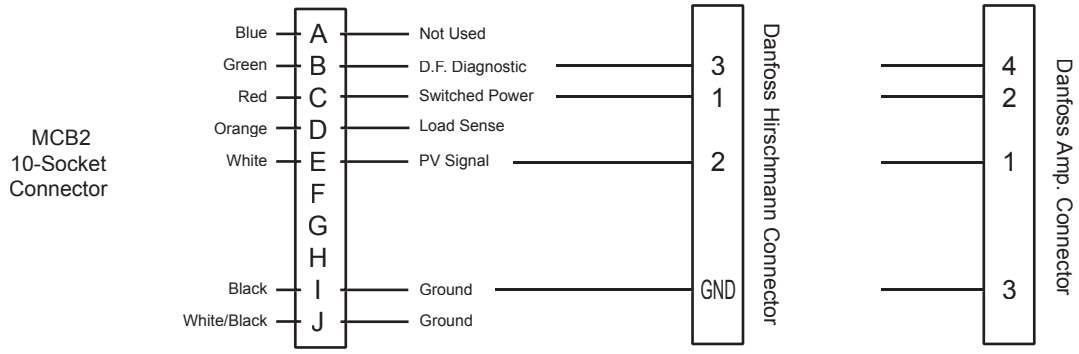
Danfoss diagnostics: Green LED on valve = OK
Red LED on valve = Fault

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.

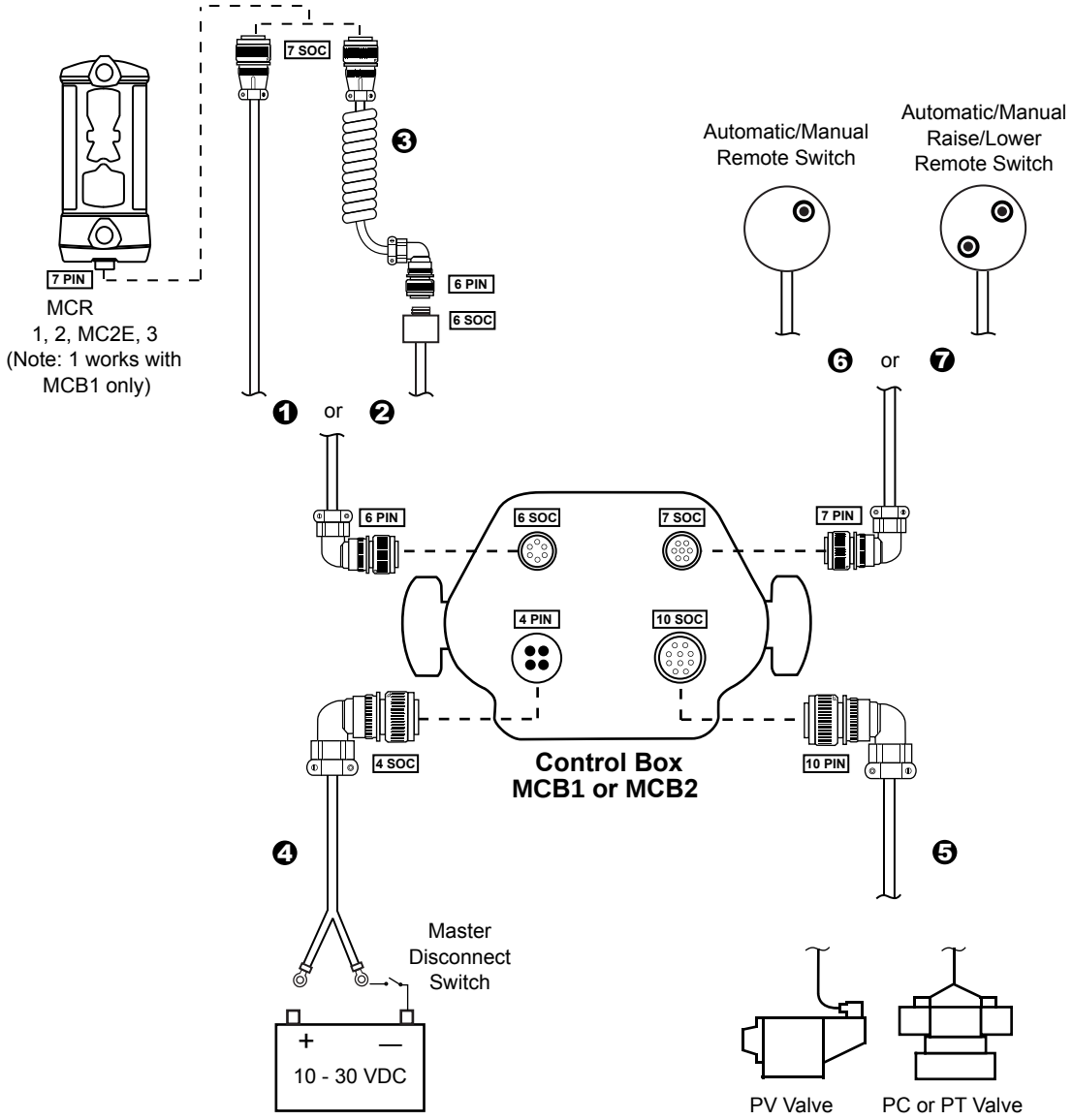
Raise cylinder port is the port closest to the black electronics module.

PV Valve Wiring: (ATI-026040-XX)



APPENDIX C

Cable Diagrams



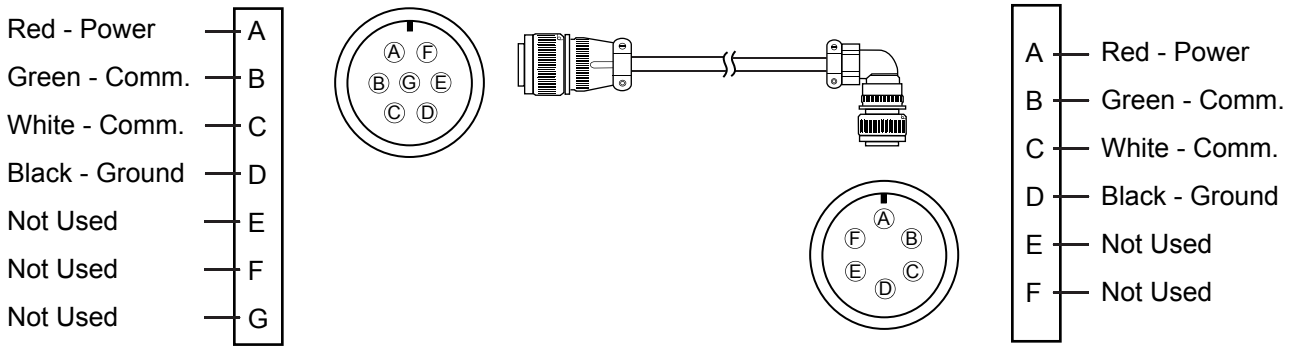
Number	Part Number	Description
1	ATI 024013-xx	Receiver cable
2	ATI 024019-xx	Receiver cable with mounting block for coil cord
3	ATI 024104	Coil cord
4	ATI 024012-xx	Power cable
5	ATI 026040-xx	Valve cable for PT / PC / PV valves
6	ATI 026017-xx	Remote switch cable - auto/manual
7	ATI 026016-xx	Remote switch cable - auto/manual and raise/lower

-xx reprsents cable length in feet.
Note: The MCB1 Control Box works with PT valves only

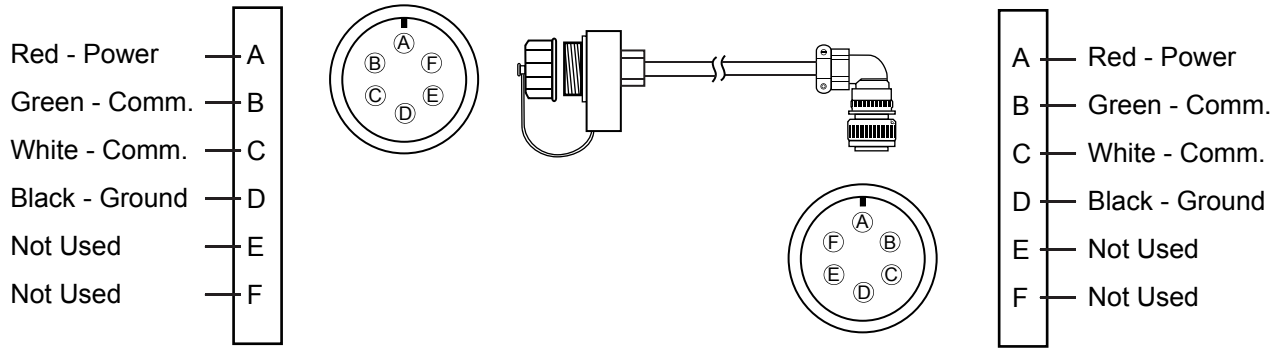
APPENDIX C

Cable Diagrams

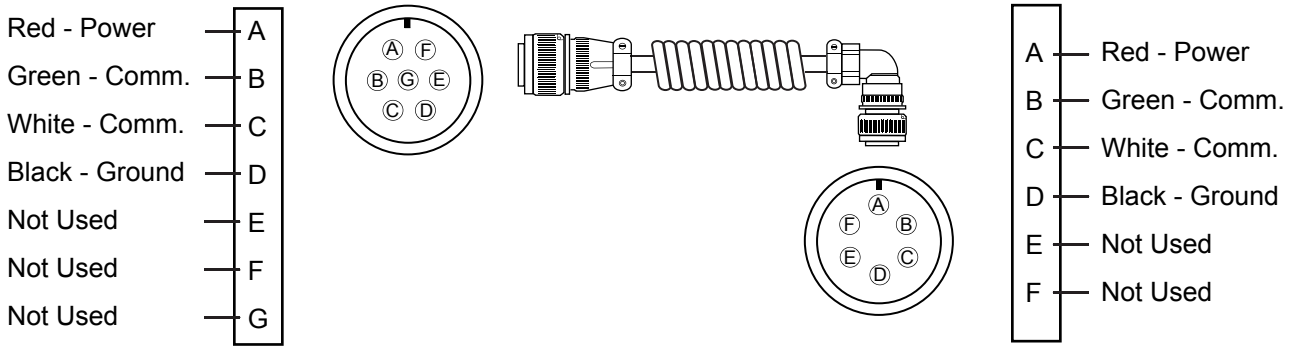
Receiver Cable ATI-0240013-xx (-xx represents cable length in feet)



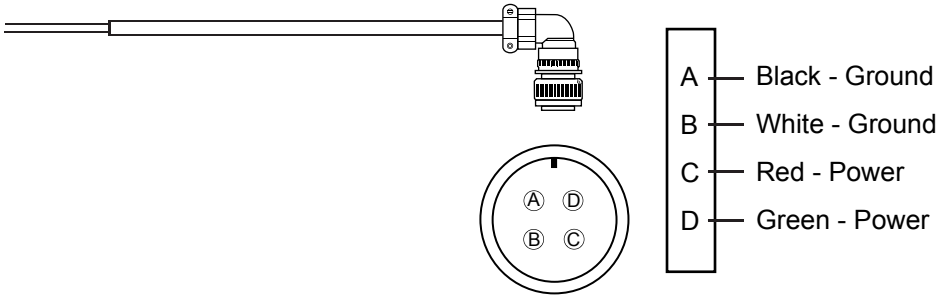
Receiver Cable with Mounting Block ATI-024019-xx



Coil Cable ATI-024104



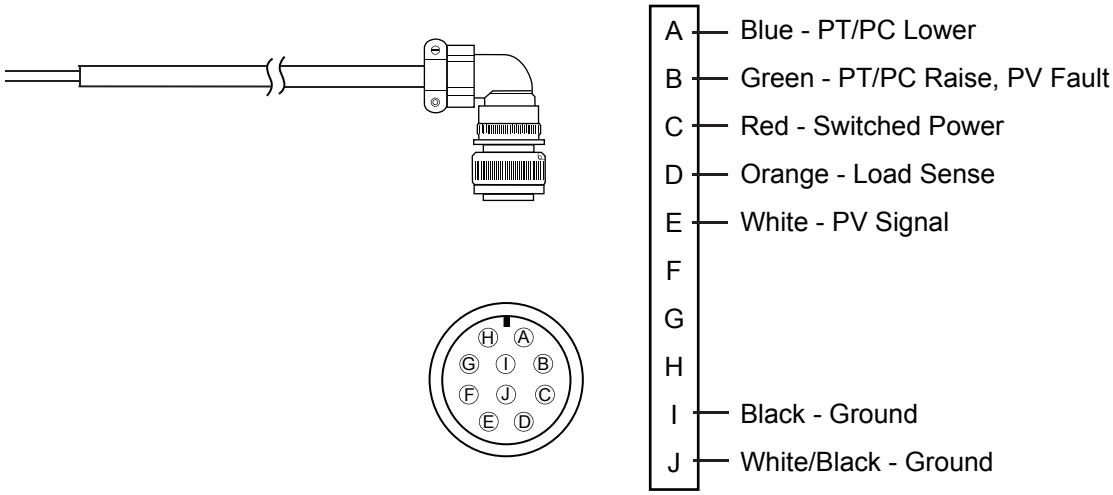
Power Cable ATI-024012-xx



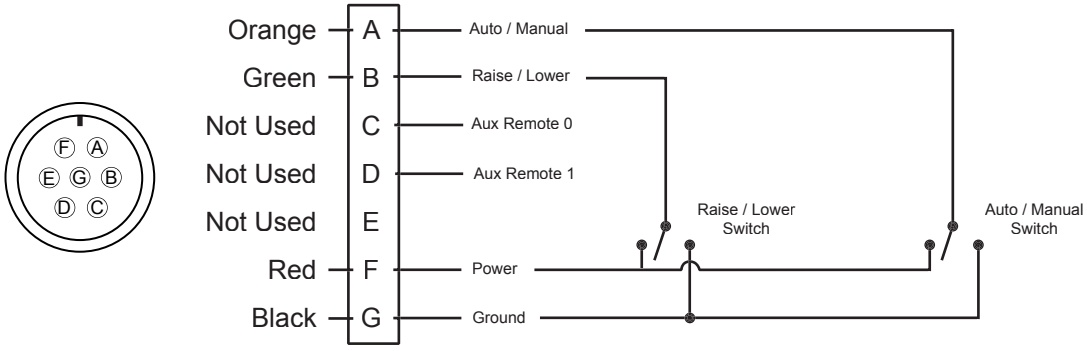
APPENDIX C

Cable Diagrams

Valve Cable ATI-026040-xx (-xx represents cable length in feet)



Remote Switch Cable
ATI-026016 (Auto/manual and raise/lower)
ATI-026017 (Auto/manual only)



Auto / Manual

Connecting Pin A to Ground toggles control to Manual.
Connecting Pin A to Power toggles to Automatic.

Raise / Lower

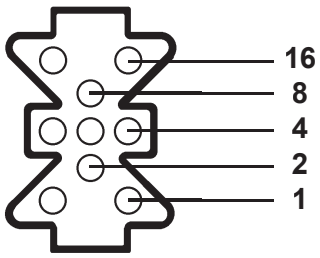
Connecting Pin B to Power creates a valve Raise signal (100%)
Connecting Pin B to Ground creates a valve Lower signal (100%)

LED Counter Switch

The control box uses a combination of switches and LED's to provide a counter for various set up operations. The Valve Minimum Correction uses this counter for adjustment of spool overlap correction during initial set up.

When the appropriate DIP switches are selected, the LED array and Auto / Manual switch on the front of the control box function together to form a binary counter.

Each row of LED's represent a specific number as follows:



An active LED row represents that specific number. Examples:

represents **2**

represents **16**

Multiple rows of LED's can be active. If multiple rows are active, the number that each row represents are added together. Examples

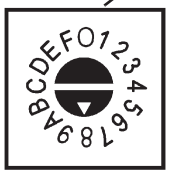
represents **18**
(2 + 16)

represents **11**
(1 + 2 + 8)

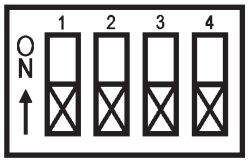
The combinations can represent numbers from 0 to 31.

The auto / manual switch is used to change the value of the LED Counter. The auto switch (up) increases the value. The manual switch (down) decreases the value.

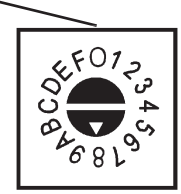
Operation Switches Reference Page



On-Grade Deadband (10)



Performance Options (11)



Valve Gain (12)

Pot	Deadband	
Value	in.	mm
0	0.0	0.0
1	0.1	2.5
2	0.2	5.1
3	0.3	7.6
4	0.4	10.2
5	0.5	12.7
6	0.6	15.2
7	0.7	17.8
8	0.8	20.3
9	0.9	22.9
A	1.0	25.4
B	1.1	27.9
C	1.2	30.5
D	1.3	33.0
E	1.4	35.6
F	1.5	38.1

Factory Default Setting = 8

1

2 Strike Averaging OFF

2 Strike Averaging ON

2

Receiver LED Disable OFF

Receiver LED Disable ON

3

Control Box LED's Bright

Control Box LED's Dim

4

Exponential Gain

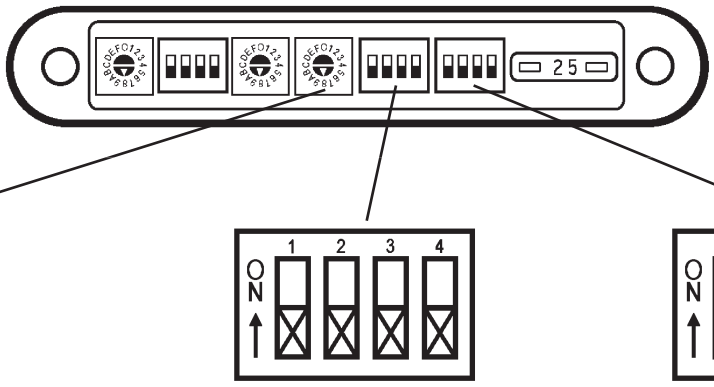
Linear Gain

Factory Default Setting = All OFF

	Distance from Deadband to Full Blade Speed	
Pot	Linear	Exponential
Value	mm	mm
0 (slow)	200	78
1	170	71
2	148	63
3	129	57
4	112	53
5	98	47
6	86	42
7	75	37
8	65	33
9	56	28
A	48	25
B	40	21
C	33	17
D	26	14
E	19	11
F (fast)	12	8

Factory Default Setting = 8

Installation Switches Reference Page



Valve Balance (13)

Pot		
Value		
0	Lower =	8.00 x Raise
1	Lower =	7.07 x Raise
2	Lower =	6.13 x Raise
3	Lower =	5.20 x Raise
4	Lower =	4.27 x Raise
5	Lower =	3.33 x Raise
6	Lower =	2.40 x Raise
7	Lower =	1.47 x Raise
8	Raise =	1.47 x Lower
9	Raise =	2.40 x Lower
A	Raise =	3.33 x Lower
B	Raise =	4.27 x Lower
C	Raise =	5.20 x Lower
D	Raise =	6.13 x Lower
E	Raise =	7.07 x Lower
F	Raise =	8.00 x Lower

Factory Default Setting = 8

Valve Set-up (14)

Run Mode

Raise Valve Minimum Correction Mode
Drives valve at VMC value with R switch
Factory Setting = 0

Lower Valve Minimum Correction Mode
Drives valve at VMC value with L switch
Factory Setting = 0

Dynamic Balance Set Mode
Use with Valve Balance Switch (13)
Oscillates blade with raise or lower switch

5 Sec. Timer
If sustained R or L, will time out after 5 sec.

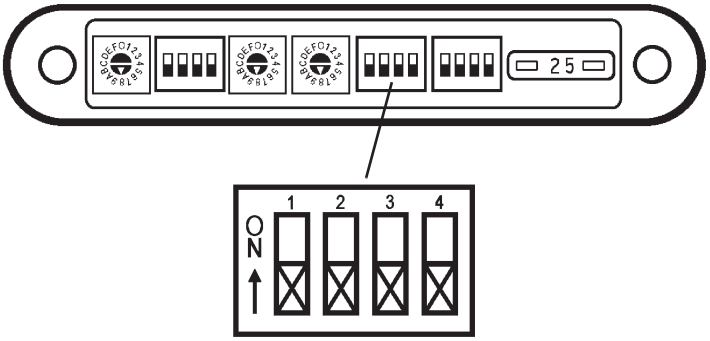
Factory Default Setting = All OFF

Valve Drive Selection (15) (MCB2 Only)

PT	
PV	Factory Default Setting
PC	50 Hz, 10%
PC	100 Hz, 10%
PC	200 Hz, 10%
PC	400 Hz, 10%
PC	50 Hz, 20%
PC	100 Hz, 20%
PC	200 Hz, 20%
PC	400 Hz, 20%

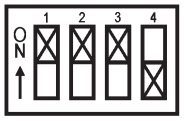
APPENDIX G

Advanced Installation Switches Reference Page

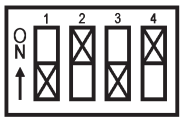


Valve Set-up (14)

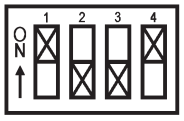
NOTE: The advanced installation switches are used for special applications and circumstances. In general, default settings for the functions below will suffice for most applications.
Value for the following functions are adjusted with the LED counter switch as described in Appendix D.



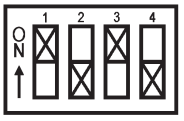
Load Sense Set Mode
0 = Load Sense OFF
1 = Load Sense ON
Factory setting = 0
(Software version 4.0 and later)



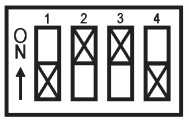
Switched Power Mode for PT / PC Valves. (Switched power is always on for PV valves.)
0 = Switched power OFF
1 = Switched power ON
Factory setting = 0
(Software version 4.0 and later)



Display Averaging Set Mode - Uses strike averaging to smooth LED display.
Takes into account laser RPM.
0 = Adaptive
1 = 1 strike
2 = 9 strike weighted average
3 = 13 strike weighted average
Factory setting = 0



Maximum Valve Current Set Mode
Limits pulse width modulation (PWM) which limits current sent to PC & PT valves at maximum correction.
0 = 100% maximum PWM = full current
1 – 25 = 96% – 0% of full current
Factory setting = 0
PC Valves: Included with S/N 0201 and higher (Software Version 3.0 and later).
PT Valves: Included with Software Version 4.0 and later

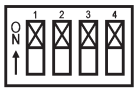


Control Deadband Set Mode - Determines if the corrections drive to the edges or inside the deadband.
0 = Corrections per on-grade deadband switch (10) setting.
1 = Inward corrections stop @1/2 on-grade deadband setting, outward corrections start @ on-grade deadband setting.
2 = Inward corrections start and outward corrections stop @ 1/2 on-grade deadband setting.
Factory setting = 0

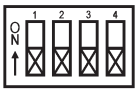
APPENDIX H

Internal Switches Reference Page

The main circuit board inside the control box has two additional 4-way dip switches.
Switch 101 functions are described below.
Switch 100 is used for auxiliary valve configurations and other test simulations.



SW101
(Factory Settings)



SW100
(Factory Settings)

1

Manual Raise/Lower Override in Auto OFF

Manual Raise/Lower Override in Auto ON

Default ON position allows the manual raise switch to send the raise signal to the valve even when in the automatic mode.

2

False Strike Rejection Disabled

False Strike Rejection Enabled

Default ON position filters out signals that are out of time with laser, strike multiple channels at the same time (strobes), or are at an unrealistic vertical distance from the previous strike.

3

Manual R/L Ramp OFF

Manual R/L Ramp ON

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

4

Test Mode

Operating Mode

APPENDIX I

Self Diagnosing Fault Codes

When the Control Box recognizes a fault, all receiver LED's will light solid and the Power, Auto and Manual LED's on the control box will alternately blink.

A specific fault information number will be displayed on the LED counter as described in Appendix D.

1. **Switched Power Driver**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – C
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

2. **Load Sense Driver**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – D
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

3. **Auxiliary Driver 2**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – F
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

4. **Auxiliary Driver 3**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – G
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

5. **Raise Proportional Current (PC) & Proportional Time (PT) Driver**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – B
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

6. **Lower Proportional Current (PC) & Proportional Time (PT) Driver**
   Description: Over current (>5A)
   Location: Connector – 10 socket **Pin** – A
   Notes: Driver will shut off for 250ms. It will then retry. If 3 failed tries in 2 seconds, driver stays off until power is cycled.
   Possible External Causes: Short in cable coil or connectors.

Self Diagnosing Fault Codes

7. Proportional Voltage Diagnostics
Description: Danfoss Passive or Active fault monitoring
Location: Connector – 10 socket **Pin** – B
Notes: Passive Danfoss - Fault will clear when fault removed.
Active Danfoss - Fault will clear when fault removed and power cycled.
Possible External Causes: PV signal exceeds 15% - 85% of supply, LVDT wires broken or shorted, Spool position exceeds command.

9. Proportional Voltage Driver
Description: Over current (>0.06 A)
Location: Connector – 10 socket **Pin** – E
Notes: Driver shuts off during fault. Fault will clear when fault removed
Possible External Causes: Short in coil cables or connectors.

15. Remote Switch Driver
Description: Over current
Location: Connector – 7 socket **Pin** – F
Notes: Fault will clear when fault removed
Possible External Causes: Short in cables or connectors.

16. Receiver Communication
Description: Loss of communication
Location: Connector – 6 socket **Pin** – A,B,C,D
Notes: Fault will clear when receiver communicates with the control box
Possible External Causes: Loss of power to receiver, loss of communication with receiver.

18. Machine Low Voltage
Description: Machine Power < 9.5V
Location: Connector – 4 pin **Pin** – A,B,C,D
Notes: Fault will clear when voltage returns to operating range.
Possible External Causes: Low battery, voltage regulator, poor connections, undersized / over length conductors.

19. Machine High Voltage
Description: Machine Power > 31.5V
Location: Connector – 4 pin **Pin** – A,B,C,D
Notes: Fault will clear when voltage returns to operating range. If sustained, fuse will blow.
Possible External Causes: Voltage regulator, alternator, power spikes.

20. Internal Problems
Description: Control Box Proc/Ram Check
Location: Connector – N/A **Pin** – N/A
Notes: Cycle control box power to clear fault. If fault doesn't clear, control box needs serviced.
Possible External Causes: Processor or RAM problems.

APPENDIX J

Valve Identification and Setting Recomendation

Valve Identification				CB26 Setting Recommendations			
Mfgr.	Model Number	Solenoid	Solenoid Description	Drive	Dither	Dither	Current
		ID		Type	Freq.	Ampl.	Limit
					(Hz.)	(%)	(LCS)
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%	0
Vickers/Eaton	KDG4-3S…..	HA	24VDC, 19.6 Ohms	PC	100	20%	0
Vickers/Eaton	KDG4-3S…..	G	12VDC, 1.8 Ohms	PC	100	20%	12
Vickers/Eaton	KDG4-3S…..	H	24VDC, 7.3 Ohms	PC	100	20%	12
Nachi	ESD……		24VDC, 20 Ohms	PC	100	20%	0
Parker	D1FW….	K	12VDC, 6 Ohms	PC	100	20%	0
Parker	D1FW….	J	24VDC, 24 Ohms	PC	100	20%	0
Parker	D3FW….	K	12VDC, 4 Ohms	PC	100	20%	0
Rexroth	4 WRAB6…..	G12	12VDC, 4.8 Ohms	PC	200	20%	0
Rexroth	4 WRAB6…..	G24	24VDC, 19.2 Ohms	PC	200	20%	0
Bosch	0811-404 ….		12VDC, 3.0 Ohms	PC	200	20%	9
Bosch	0811-404 ….		24VDC, 3.0 Ohms	PC	200	20%	17
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

Miscellaneous Installation Information

Remote Switch Installation Notes:

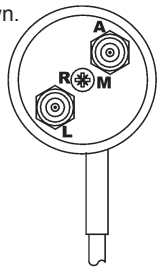
1. The Remote Switch Assembly is designed to mount to lever shafts from 3/8" to 1-1/8" in diameter by using the different screws provided.
2. Determine Remote Switch mounting location for easy access during operation. Cable should route downward from switch housing.
3. If mounted to a moving lever, ensure 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.

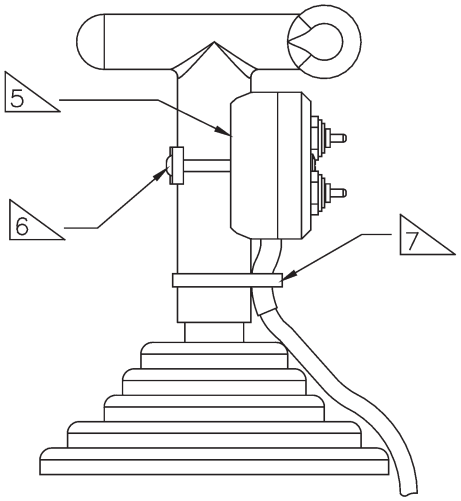
6 Select the correct length of screw for the shaft diameter and tighten clamping screws. Do not overtighten as this can distort housing and clamp.

7 Strain relief the cable by tie wrapping it to the lever as shown.

8. Check the function with the control box.

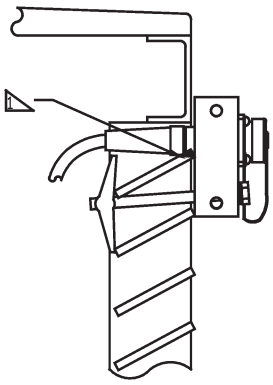


Switch Orientation View



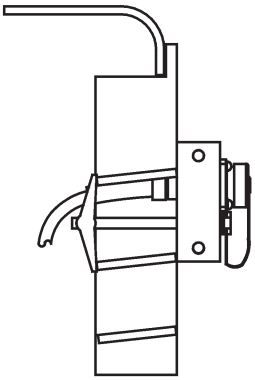
Receiver Cable with Mounting Block Installation Notes:

Mounting Options For ATI-024019-XX



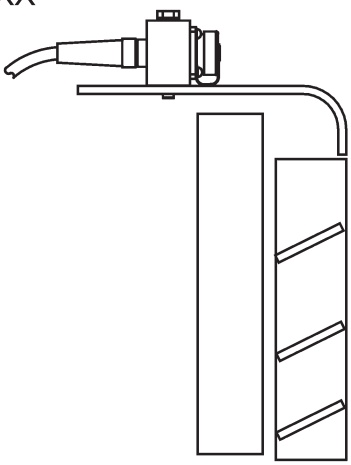
Grill Mounting
JD 450-650H Dozers

1 Notch top fin for strain relief clearance & mount to grill.
2. Leave service loop for opening grill.



Grill Mounting
CAT D3-D5G Dozers

- Loosen top radiator mounts to provide clearance for cable connector routing past radiator.

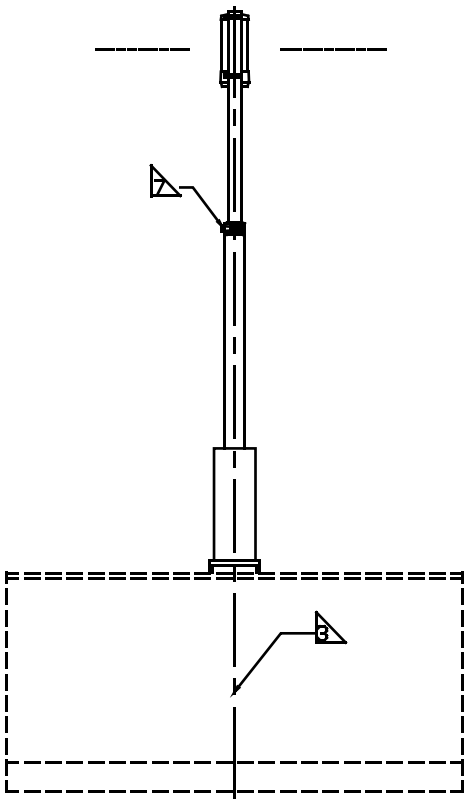


Hood Mounting

- If no access for cable around radiator, lay block on its side & mount to top of hood.

Miscellaneous Installation Information

STM1 Telescoping Manual Mast Installation Notes:

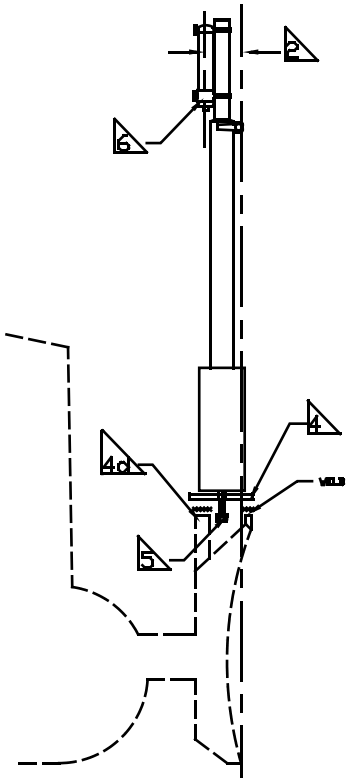


1. Observe all safety practices recommenced by the machinery manufacturer while installing and using the mast.
a) Turn off engine and engage parking brake.
b) Rest blade on the ground.
c) Take precautions to avoid lifting or falling injuries. Mast weight is 57 Lbs. (26 kg.)

2 To minimize elevation errors due to changing cut depths:
a) The mast should be positioned to place the laser receiver as close as possible vertically over the cutting edge of the blade.
b) The mast 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 on single laser receiver systems:
a) The mast should be mounted near the center of the blade.
b) The mast should be vertical "side-to-side" when the blade is in its normal operating position.

4 Weld the optional mast mounting plate (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 plate slightly above a dozer blade. These pieces are not included with the mounting plate.



5 Attach the mast to the mounting plate with provided (1) 3/4-10 x 2-1/2 inch long grade 8 screw and lockwasher. Torque to 265 ft-lbs. (37 mkg)

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

7 Loosen the mast clamp and extend the mast to the desired elevation to clear obstructions such as the machines cab. Tighten the mast clamp.
a) Pull out on the clamp handle to reposition the handle.