Operator's Manual

CONTROL BOX MODEL 24

FOR USE WITH BULLSEYE™
MACHINE MOUNTED LASER RECEIVERS

Apache Technologies, Inc.
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Thank you for purchasing an Apache Technologies, Inc. product. Your control box and laser receiver are premium quality tools that has been designed and manufactured to provide years of reliable performance. The control box, receiver and accessories have been specifically designed for use in harsh machine mounted construction environments.

This manual is an important part of your purchase as it will familiarize you with the system and explain the numerous features that have been designed into it. Please read this manual thoroughly before using your system.

Please contact your Apache dealer or the Apache factory should you have questions regarding specific applications or if you require additional information.

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Please record your product information below. This will assist you if there are any questions regarding warranty or service.

PRODUCT: _____

SERIAL NUMBER: _____

DATE OF PURCHASE: _____

PURCHASED FROM: _____

PHONE: _____

WARRANTY

Apache Technologies receivers and control boxes are warranted to be free of defects in material and workmanship for a period of two years. This warranty period is twenty-four months from the date the product is delivered from the dealer to the purchaser or is put into service by a dealer as a demonstration unit or rental unit. Electric cables and other allied equipment are warranted for a period of ninety days.

Please return the included warranty card as this will expedite any warranty service that may be required. Please retain your warranty information and proof of purchase. If a warranty card is not on file, proof of purchase must accompany your request for warranty repair.

Any evidence of abuse, misuse, alteration, accident or negligent use, or an attempt to repair products by unauthorized personnel or with parts other than those provided by Apache Technologies automatically voids the warranty.

The user of the product is expected to follow all operating instructions, periodically checking the instrument and the work as it progresses.

Apache Technologies liability under this warranty is limited to repairing or replacing any product returned to an authorized service center for that purpose. The foregoing states the entire liability of Apache Technologies regarding the purchase and use of its product and they shall not be held responsible for any consequential loss or damage of any kind.

This warranty is in lieu of all other warranties, expressed or implied, and constitutes all of Apache Technologies liability with respect to merchandise sold by it.

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.

Safety

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.

CAUTION: Ensure all equipment is properly installed, the BULLSEYE receiver is secured in its mounting position, and all cables connections are tight and secure.

CAUTION: The person responsible for the instrument must ensure that it is used in accordance with the instructions. This person is also accountable for the training of personnel who use the instruments and for the safety of the equipment when in use.

Environmental Limits: Suitable for use in an atmosphere appropriate for human habitation (no protection in an aggressive or explosive environment). Can be used in rain for short periods. Refer to specifications for temperature ranges.

Contents

CONTROL BOX MODEL 24

P/N ATI-024100 REV B

Laser Control Box Model 24

System Description

The Apache Model 24 Control Box is used in drainage, land leveling, and construction machine control applications to automatically control the digging depth or cutting edge of various machinery. The Control Box is used in conjunction with a BULLSEYE™ machine mounted laser receiver and a solenoid hydraulic valve.

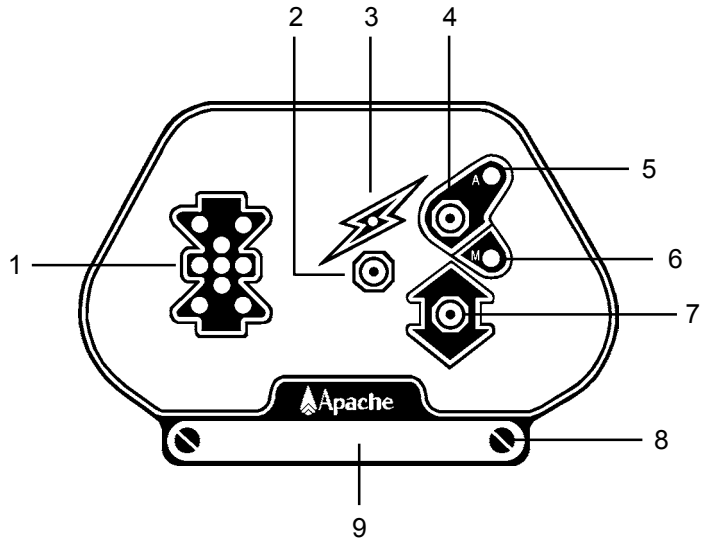
The control box is connected by cables to the BULLSEYE receiver, the solenoid valve, and to the machine's battery for power. The solenoid valve is tied into the raise and lower hydraulic circuit of the machine. When the system is in the AUTO ON mode and a laser signal is received by the BULLSEYE, the control box processes this signal and directs the solenoid valve to either raise, lower, or maintain the elevation of the machine's cutting edge to match the reference elevation of the laser.

The box can also be selected to operate in a MANUAL ON mode. This mode displays the relative grade information of the receiver but does not send the grade information to the solenoid valve.

The Control box has been designed to facilitate a wide range of applications with various machinery. A large selection of on-grade accuracies (deadbands) can be selected from approximately ± 1/8" to ± 1 ½" (± 2.5 mm to ± 37 mm). Configuration settings on the control box override settings made on the BULLSEYE laser receivers.

Controls and Displays

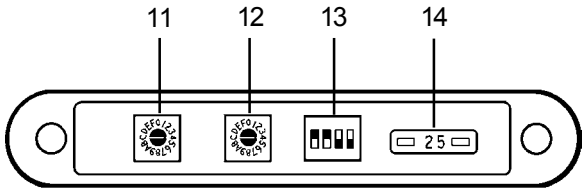
Front View



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

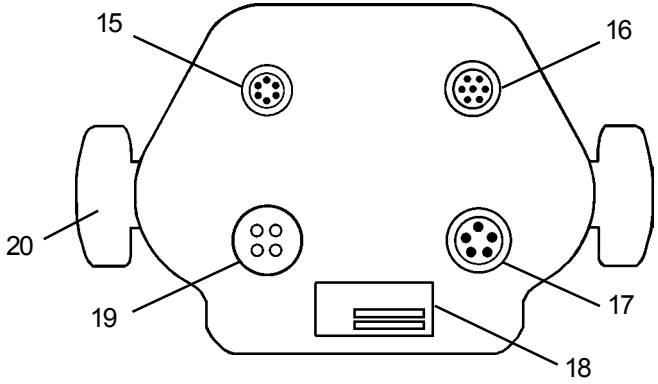
Controls and Displays

Switch Panel



11. Rotary switch pod for deadband selection
12. Rotary switch pod for gain selection
13. 4-way dip switch
14. Fuse, 25 amp

Rear View



15. 6-socket connector - BULLSEYE communication
16. 7-socket connector - optional remote switches
17. 5-socket connector - valve outputs
18. Control Box identification / serial number label
19. 4-pin connector - machine power input
20. Mounting knobs

Installation Guidelines

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

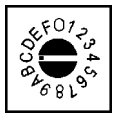
All cables should be properly installed. Cables should be attached to the machine a minimum of every 2 to 3 feet (.6 to 1.0 meter) or less to try to eliminate cable movement and possible abrasion damage. Special care should be taken at flex points to ensure the cable moves freely and does not rub on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

Connect the 6-pin receiver cable end to the 6-socket connector on the box and connect the 7-socket receiver cable end to the 7-pin connector on the bottom of the BULLSEYE receiver. Connect the 5-pin valve cable to the 5-socket connector on the box and connect the open-ended wires to the solenoid valve following the directions for the valve. Connect the 4-pin connector on the power cable to the 4-socket connector on the box and connect the terminal ends to the machine's 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.

Set up the laser and receiver as described in their operator's manuals.

Configuration

The control box has been designed to meet different machinery and application requirements. The system operation is a function of deadband setting, gain selection, laser RPM, machine speed, hydraulic pressure and flow, and general site or field conditions. The selectable factors of the control box are the deadband and gain settings. Two rotary switches are provided for selecting the deadband and the gain, while a third dip switch provides for 4 other selections. These switches are located behind the panel on the bottom front of the control box. To access them, turn the 2 thumbscrews counterclockwise and remove the panel from the box housing.



Deadband (Accuracy) Selection Switch:

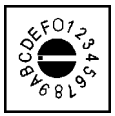
The deadband rotary switch (11) provides sixteen positions for deadband selection with "0" being the smallest and increasing clockwise to "F" which is the largest. The table below lists the corresponding on-grade deadband for each switch position. Each number or letter setting represents an increment of approximately plus or minus one-tenth inch (± 0.10 inch) or ± 2.5 mm.

	0	1	2	3	4	5	6	7
± in.	0	0.10	0.20	0.30	0.40	0.50	0.60	0.70
± mm	0	2.5	5	7.5	10	12.5	15	17.5

	8	9	A	B	C	D	E	F
± in.	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
± mm	20	22.5	25	27.5	30	32.5	35	37.5

Examples:
The deadband setting of '5' would correspond to ± ½ in. (± 12.5 mm).
The deadband setting of 'A' would correspond to ± 1.0 in. (± 25 mm).

Configuration

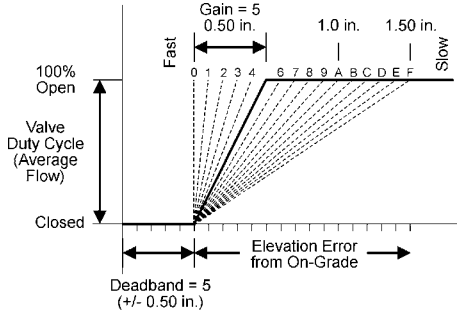


Gain Selection Switch:

The gain setting rotary switch (12) provides sixteen positions of gain selection with "0" being the fastest reacting and decreasing clockwise to "F" which is the slowest reacting. Each number or letter setting represents an increment of approximately plus or minus one-tenth inch (± 0.10 inch) or ± 2.5 mm.

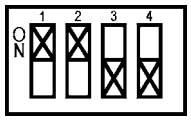
When the receiver is in the on-grade deadband, no correction signals are sent to the valve. Immediately after the receiver moves outside of the on-grade deadband, signals are sent to correct the elevation by pulsing the valve open. As the receiver moves further away from the on-grade deadband, the open signal duty cycle increases until the valve is in the 100% open state. The distance between this initial opening of the valve and the 100% open state is controlled by the gain.

Initially, set the deadband and gain equally to the largest acceptable setting based upon the site tolerance requirements and machine capabilities. The plus or minus job tolerance should equal the deadband plus the gain. The figure below shows graphically an example of the deadband and gain set to 5 for a job tolerance of ± 1.0 in. (± 25 mm). Field adjustments may be necessary due to the many other variables in the system operation.



If the system becomes unstable, overreacting between above grade and below grade, increase the deadband setting or the gain setting number or letter. Also, reducing the hydraulic flow through the valve may help smooth the operation of the system.

Configuration



Dip Switch Panel Settings:

The dip switch panel consists of 4 individual switches. The up position is ON and the down position is OFF. The function of the switches and their factory default settings are as follows:

Switch #	Function	Default Setting
1	Manual Override	ON
2	Receiver LED's	ON
3	Control Box LED's Dim	OFF
4	Test Mode	OFF

1. Manual Override - ON allows the raise / lower toggle switch to work even when the box is in the automatic mode. This is very useful when the depth of cut required to get to on grade is larger than the machine can handle in one pass. Manually raising the grade momentarily may allow the machine to make a pass without lugging the engine. When the manual raise / lower toggle switch is released, the system will resume normal automatic operation.

2. Receiver LED's - When ON, the receiver's grade LED's will be displayed. When OFF, there will be no display on the receiver LED's. Note: Some receiver models do not have LED's.

3. LED's Dim - The default and normal operating setting for the control box LED's are "bright", with the switch in the OFF position. The control box LED's can be set to dim by changing this switch to the ON position. This may be preferred by some operators in low light conditions.

4. Test Mode - The default and normal operating setting is OFF. Test mode ON allows qualified service technicians to check certain switch functions of the control box.

Configuration

Cable Configurations :

Receiver Cable - powers and communicates grade information between the BULLSEYE receiver and the control box.

Function	Control Box 6 Socket	Receiver 7 Socket	Wire Color
+8.5 V Out	A	A	Red
Xmit / Recv.	B	B	Green
Xmit / Recv.	C	C	White
Ground	D	D	Black
	N/C	E	N/C
	N/C	F	N/C
	N/C	G	N/C

Power Cable - supplies power to the system. The control box supports both 12 and 24 volt systems.

Function	Control Box 4 Pin	Wire Color
Machine Ground	A	Black
Machine Ground	B	Black
Machine Power	C	Red
Machine Power	D	Red

Configuration

Cable Configurations :

Valve Cable - communicates grade information between the control box and the solenoid valve. Also has provision for a load sensing valve for use with variable displacement pumps that have load sensing hydraulic circuits.

Function	Control Box 5 Socket	Wire Color
Raise Valve	A	Orange
Lower Valve	B	Brown
Load Sense	C	N/C
Switched Power	D	N/C
Ground	E	Black

Remote Switch Cable - optional accessory that extends the raise/lower and auto/manual switches via cable. It is used on machinery where the control box switches are not easily accessible by the operator.

Function	Control Box 7 Socket	Wire Color
	A	N/C
	B	N/C
	C	N/C
Raise	D	Red
Lower	E	Green
Automatic	F	White
Ground	G	Black

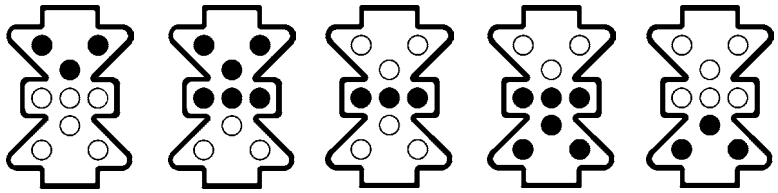
Operation

Power ON / OFF Switch:

Push the power switch once to turn the system on. All LED's on the box will turn on for a brief period. The red power on indicator LED will stay lit to indicate the power is on. Turning the box on will also turn the receiver on. Push the power switch again to turn the system off. If equipped with a toggle switch, the right position is on and the left position is off.

LED grade indication display: When a laser is striking the receiver, there are 5 positions of grade information indicated.

High Coarse - 3 top red LED's forming down arrow
High Fine - 3 top red LED's and 3 green on-grade LED's
On-Grade - 3 green LED's forming horizontal bar
Low Fine - 3 bottom red LED's and 3 green on-grade LED's
Low Coarse - 3 bottom red LED's forming up arrow



If the laser moves off the reception range of the receiver, an out-of-beam will be indicated on the LED's. If the last laser reception was on the bottom of the receiver, the top 3 LED's will flash indicating to move the receiver down. If the last laser reception was on the top, the bottom 3 LED's will flash indicating to move the receiver up. The out-of-beam indication will lasts for 2 minutes. After this time, the center LED flashes to show that the system is on.

Operation

Automatic / Manual Toggle Switch:

Automatic: Select the top switch position for automatic mode, which is indicated with an "A". The green LED will turn on confirming that the box is in the automatic mode. When the BULLSEYE receives a laser strike, the box will send the appropriate signals to the solenoid valve to either raise or lower the cylinder of the implement to obtain and maintain the desired on-grade.

Manual: Select the bottom switch position for manual mode, which is indicated with an "M". The amber LED will turn on confirming that the box is in the manual mode. When the BULLSEYE receives a laser strike, the box will display the grade information on the LED's but will not send signals to the valve. The operator may use the raise lower toggle switch or the machine lever to raise or lower the cylinder of the implement.

Raise / Lower Toggle Switch

This switch raises or lowers the implement. When in the manual mode, the switch acts just like the manual lever. To raise the implement, push the switch up. To lower the implement, push the switch down. When released, the switch will go back to the center neutral position.

When the system is in the automatic mode and the manual override dip switch is set to ON (default setting), the manual raise and lower switch will override the automatic setting when it is activated and raise and lower the implement. When it is released, the automatic mode will resume normal operation.

Operating Tips

Work as close as possible to the laser transmitter. Ensure the laser is on a stable tripod. On windy, gusty days it may be advisable to tie down or weigh down the tripod to reduce laser beam bounce and make it more stable.

If your laser has selectable rotation speeds, select the highest rotation speed up to 800 RPM for machine control applications.

Typical initial plus or minus job tolerance settings should be equal to the deadband plus the gain. For example, if jobsite tolerance is ± 1 inch, settings should be deadband of 5 and gain of 5. This should be the starting point to attain smooth operation. Field adjustments may be necessary due to the many variables in the system operation.

Maintenance and Care

The user of this product is expected to follow all operating and safety instructions of this manual and of the machinery operator's manual.

Do not wipe dust or dirt off the receiver or control box with a dry cloth as scratching could occur. Use only a good quality glass cleaner with a soft cloth on all external surfaces and windows.

Your laser receiver was shipped in a moisture resistant foam padded carrying case. If the instrument gets wet, allow it to dry before placing it in their case. Transport the instruments in their original cases.

Inspect cables daily to ensure there is no excessive wear, especially at pivot points. Check for crimps or cuts in the wire insulation.

Troubleshooting

Error Codes

The control box will detect certain errors when the system is not operating properly. When an error is detected, the LED's for the power on, automatic mode, and manual mode are toggled on and off. The grade indication LED's will provide additional information.

Grade Display LED's	Error
2 LED's at top toggled	Lower valve error
2 LED's at bottom toggled	Raise valve error
2 LED's at middle toggled	Load Sense valve error
Single LED's above & below middle	Switched Power valve error
Single LED at middle	Communication error

Other Symptoms

No Power LED's	Check cables. Check connections at battery. Check fuse.
Up or Down grade arrows flashing	Out of beam indication, receiver is not receiving laser beam. Move the receiver in the direction of arrows. Check laser transmitter.
Center only grade LED flashing	Receiver is not receiving laser beam. Move the receiver up or down until beam is received.
System Overcorrecting	Ensure stable laser set-up. Increase deadband or gain setting. Decrease hydraulic flow.

Specifications

Operating Voltage	10 to 30 Volts DC, Reverse polarity protected
Operating Temperature	-4° to +122° F (-20° to +50° C)
Weight	5 Lbs. (2.25 Kgs.)
Dimensions	7.0 x 5.25 x 4.75 inches (17.8 x 13.4 x 12.0 cm)
Laser RPM Compatibility	300 to 800 RPM
Valve Compatibility	12 or 24 volt solenoid, Maximum current 5 Amps per coil
Cable Requirements	Power cable: minimum 14 gauge, Maximum length 25 ft. (7.6 m) Valve cable: minimum 14 gauge, Maximum length 25 ft. (7.6 m) Receiver cable: minimum 16 gauge (consult factory if over 50 ft. (15 m))
Fuse	25 Amp, automotive type