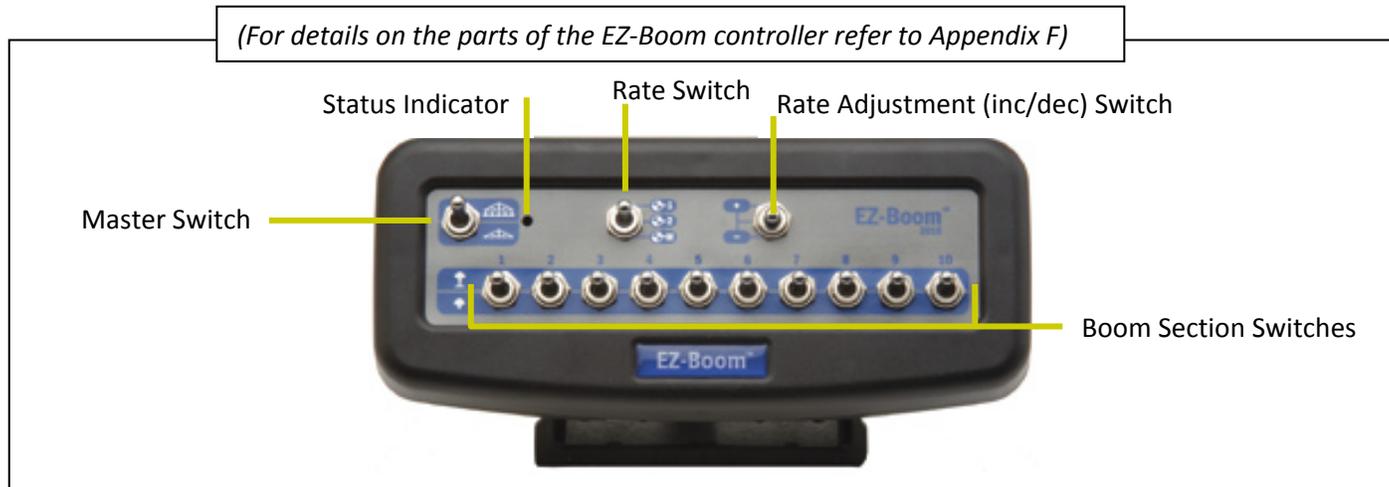


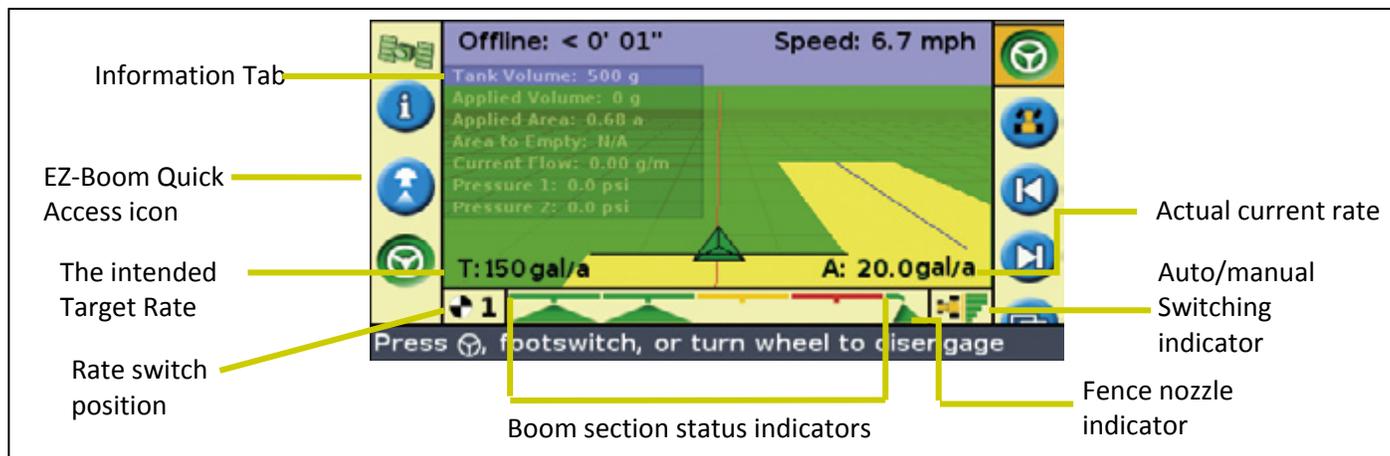
EZ-Boom 2010 System for the EZ-Guide 500 Lightbar

Triangle Ag-Services Users Guide

Parts of the Controller



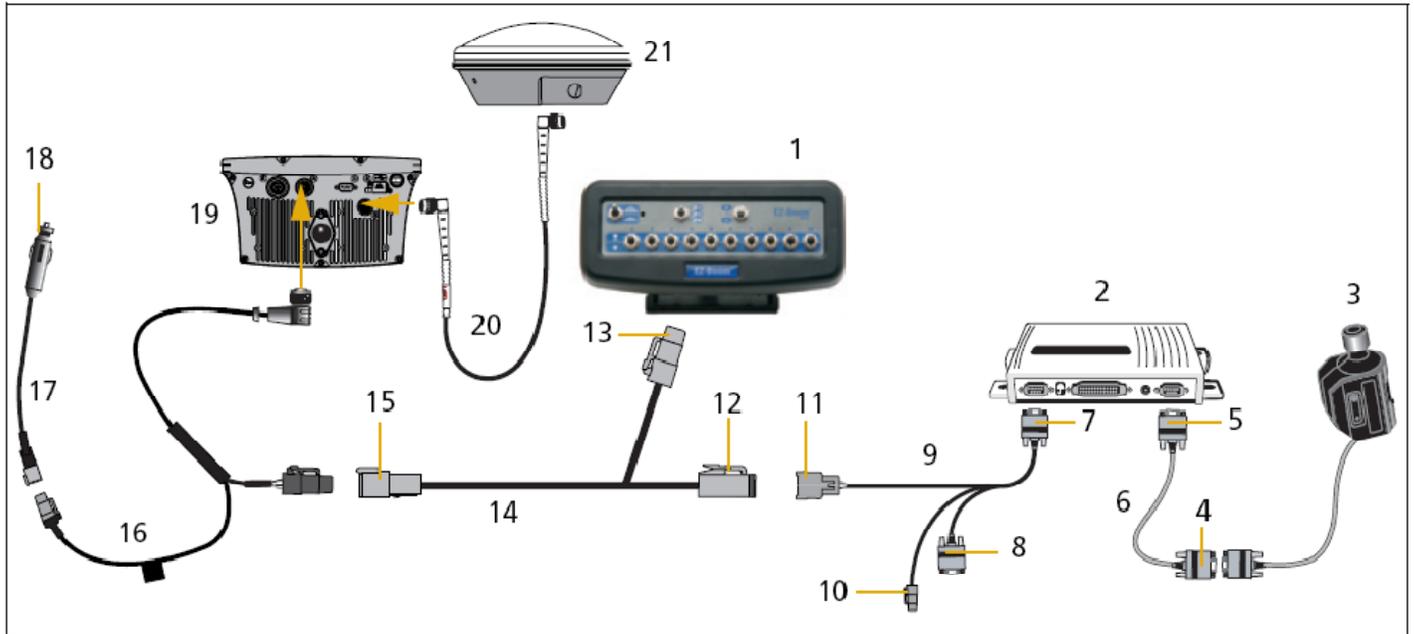
When the EZ-Boom 2010 system is connected to the EZ-Guide 500 lightbar, the EZ-Boom Quick Access icon  appears among the fast keys on the left of the lightbar display. The EZ-Boom quick settings icon provides quick-access to some of the most common EZ-Boom system settings. The sprayer bar at the base of the screen indicates the state of the boom sections. (For details refer to Appendix G)



Setup Steps

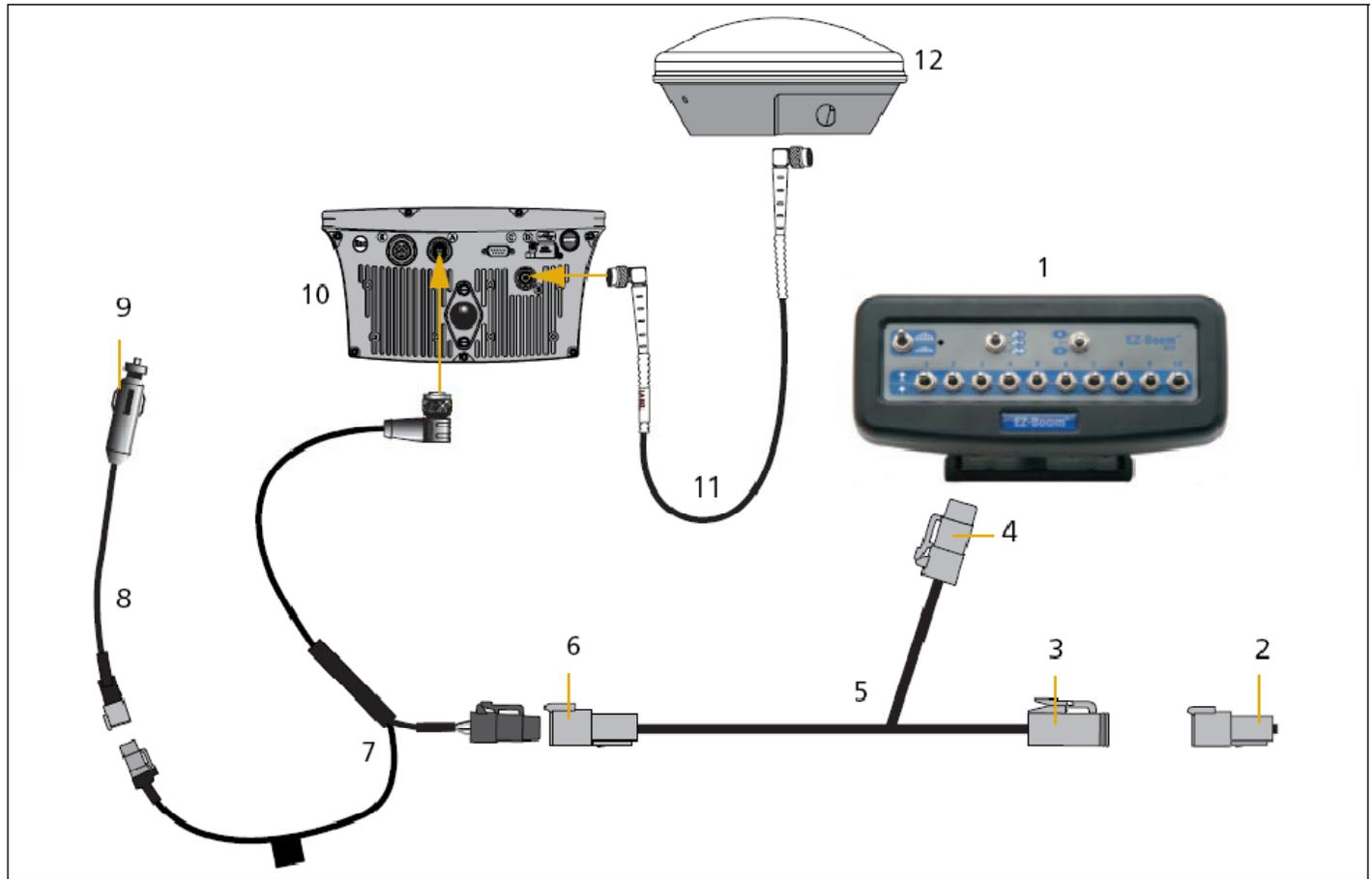
1. Install and connect the hardware
2. Set the lightbar to Advanced Mode
3. In the Implement Setup enter Implement Width, Forward/Back Offset and Implement Mount Type
4. Configure the Boom Setup
5. Configure Swath Setup (automatic boom switching)
6. Configure Application Setup
7. Configure Control Valve Setup
8. Configure Tank Setup
9. Calibrate the pressure sensor (if fitted)
10. Enter the flow meter calibration if known or calibrate flow meter

EZ-Guide 500 and EZ-Boom with EZ-Steer (new cables, since about 2008):



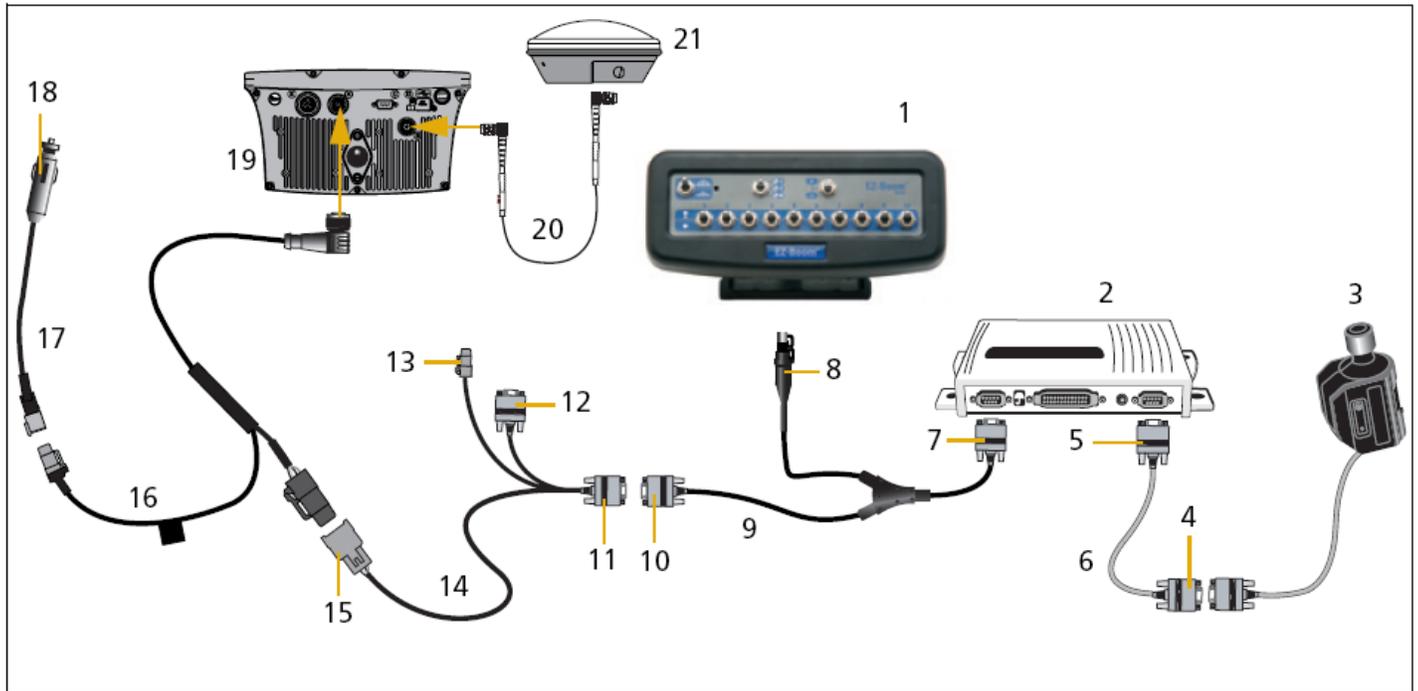
Item	Description	Part Number
1	EZ-Boom Controller	-
2	EZ-Steer Controller	-
3	EZ-Steer Motor	-
4	"P2" connector	connector
5	"P1" connector	connector
6	EZ-Steer Motor Cable	PN 52764
7	"R2" connector	connector
8	"R4" connector (computer connection for firmware upgrades)	connector
9	EZ-Guide 250/500 to EZ-Steer Cable	PN 62974
10	"P3" Alternative power connector	connector
11	"S1" connector	connector
12	"P3" connector	connector
13	"P1" connector	connector
14	EZ-Boom Cable	PN 61437
15	"S3" connector	connector
16	EZ-Guide 500 power cable	PN 62817
17	Power Cable (recommended direct to battery)	PN 63193
18	To power	-
19	EZ-Guide 500 Lightbar	-
20	GPS Coax antenna cable	-
21	GPS antenna	-

EZ-Guide 500 and EZ-Boom without EZ-Steer (new cables, since about 2008):



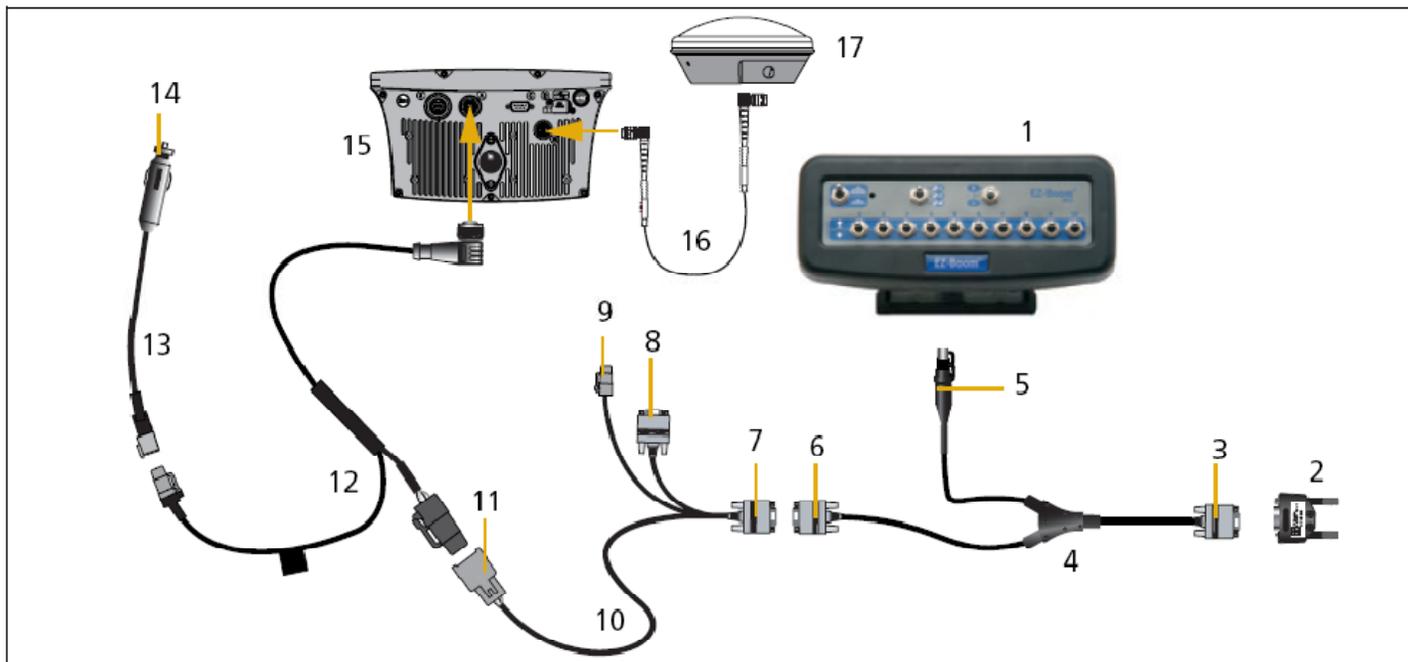
Item	Description	Part Number
1	EZ-Boom Controller	-
2	CAN terminator (required if there is not EZ-Steer installed)	PN 59783
3	"P3" connector	connector
4	"P1" connector	connector
5	EZ-Boom Cable	PN 61437
6	"S3" connector	connector
7	EZ-Guide 500 power cable	PN 62817
8	Power Cable (recommended direct to battery)	PN 63193
9	To power	-
10	EZ-Guide 500 Lightbar	-
11	GPS Coax antenna cable	-
12	GPS antenna	-

EZ-Guide 500 and EZ-Boom with EZ-Steer (old cables, before about 2008):



Item	Description	Part Number
1	EZ-Boom Controller	-
2	EZ-Steer Controller	-
3	EZ-Steer Motor	-
4	"P2" connector	connector
5	EZ-Steer Motor Cable	PN 52764
6	"P1" connector	connector
7	"To SCM" connector	connector
8	"To EZ-BOOM" connector	connector
9	EZ-Boom "Y" Cable	PN 58377
10	"To Power" connector	connector
11	"R2" connector	connector
12	"R4" connector (computer connection for firmware upgrades)	connector
13	"P3" Alternative power connector	connector
14	EZ-Guide 250/500 to EZ-Steer Cable	PN 62974
15	"S1" connector	connector
16	EZ-Guide 500 power cable	PN 62817
17	Power Cable (recommended direct to battery)	PN 63193
18	To power	-
19	EZ-Guide 500 Lightbar	-
20	GPS Coax antenna cable	-
21	GPS antenna	-

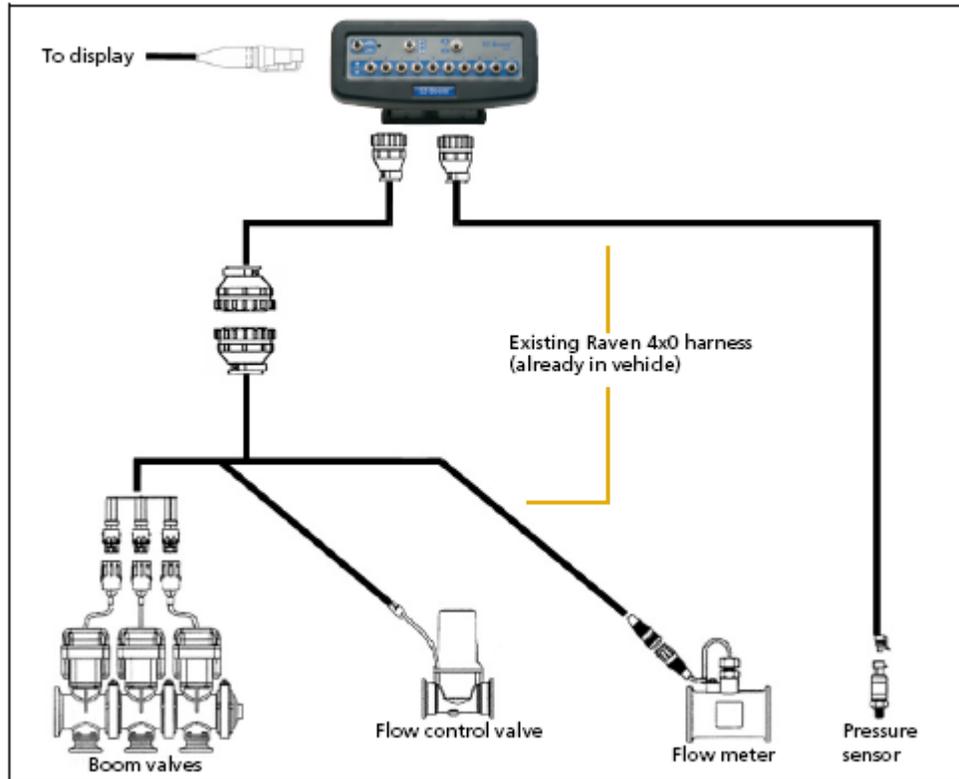
EZ-Guide 500 and EZ-Boom without EZ-Steer (old cables, before about 2008):



Item	Description	Part Number
1	EZ-Boom Controller	-
2	Serial terminator (required if there is not EZ-Steer installed)	PN 58378
3	"TO SCM" connector	connector
4	EZ-Boom "Y" Cable	PN 58377
5	"To EZ-Boom" connector	connector
6	"To POWER" connector	connector
7	"R2" connector	connector
8	"R4" connector (computer connection for firmware upgrades)	connector
9	"P3" Alternative power connector	connector
10	EZ-Guide 250/500 to EZ-Steer Cable	PN 62974
11	"S1" connector	connector
12	EZ-Guide 500 power cable	PN 62817
13	Power Cable (recommended direct to battery)	PN 63193
14	To power	-
15	EZ-Guide 500 Lightbar	-
16	GPS Coax antenna cable	-
17	GPS antenna	-

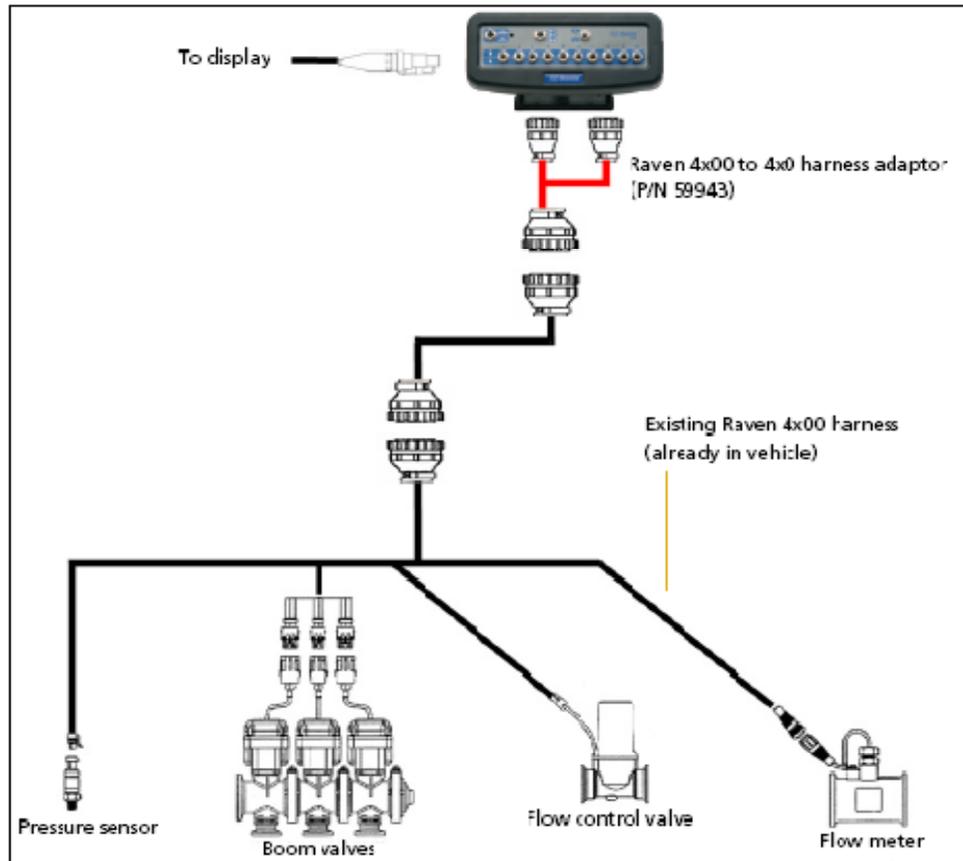
Connecting to the Raven 4X0 Harness

(take out the Raven 4X0 console; EZ-Boom will control rate and boom switching):



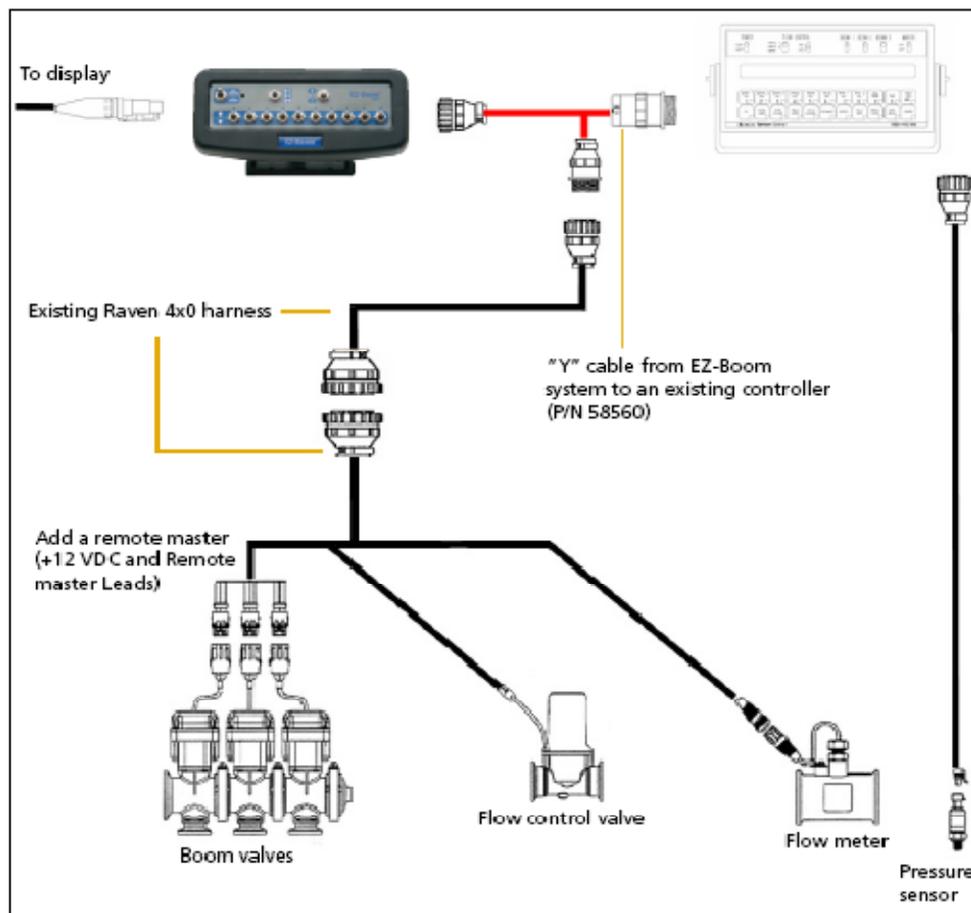
Connecting to the Raven 4X00 Harness

(take out the Raven 4X00 console; EZ-Boom will control rate and boom switching):



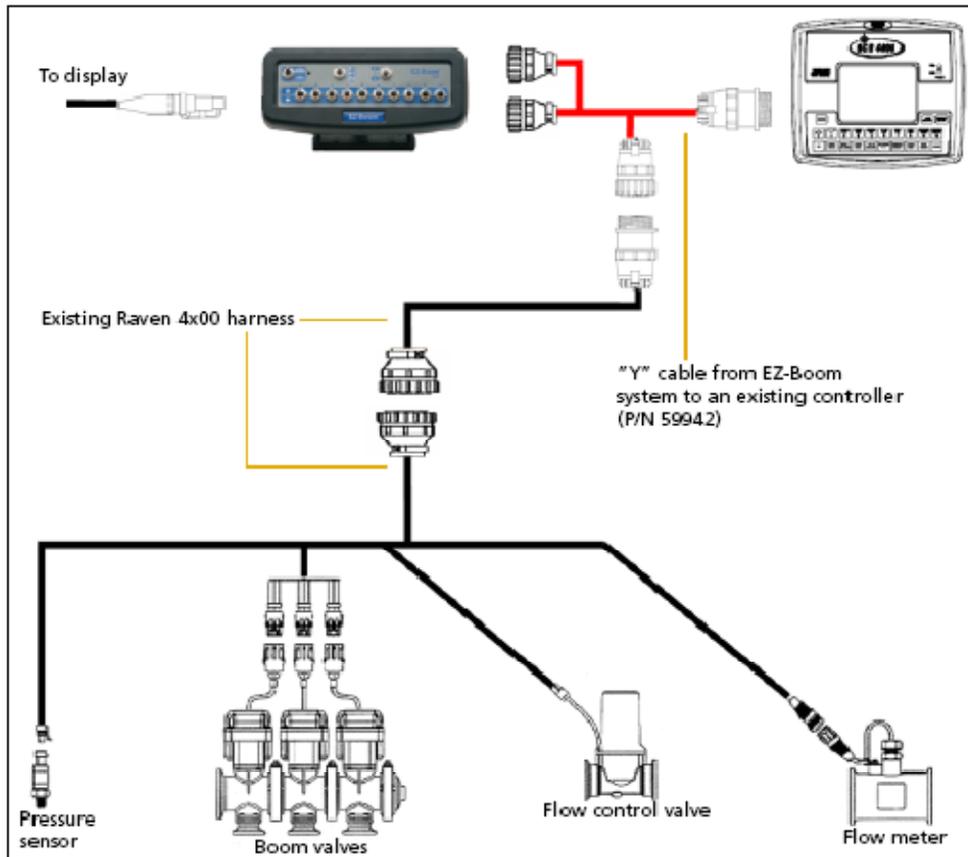
Connecting to the Raven 4X0 Harness

(Leave in the Raven 4X0 console; Raven 4X0 console will control rate, EZ-Boom will control boom switching only):



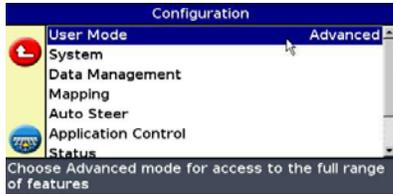
Connecting to the Raven 4X00 Harness

(Leave in the Raven 4X00 console; Raven 4XX0 console will control rate, EZ-Boom will control boom switching only):



Step 2: Make sure the EZ-Guide 500 is in Advanced Mode

- From the main guidance screen press  or  until the  is selected and then press . The *Configuration Screen* appears. Check that User Mode is Advanced, change to Advanced if it's in Easy.



Step 3: In the Implement Setup enter Implement Width, Forward/Back Offset and Implement Mount Type

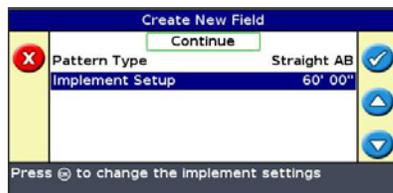
- After the system is in advanced mode, select the Reset guidance and start new field icon.



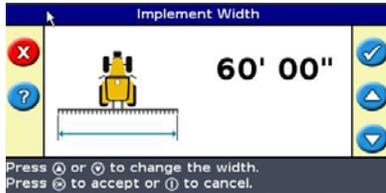
- Create New Field



- Select Implement Setup



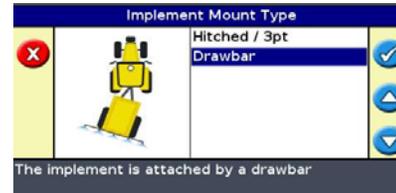
- Set Implement Width. The easiest way is to count the number of nozzles and multiply by the nozzle spacing. (You'll need to the number of nozzles in each section for the boom setup later.) Enter the Implement Width in inches. (ex. 42 nozzles X 20" nozzle spacing = 840" or 70' implement width) (To create an overlap enter the amount of overlap you want in the Overlap/Skip setup. With the sprayer in field position measure from end nozzle to end nozzle and be sure to have enough overlap to ensure coverage.)



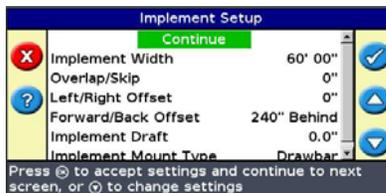
- Set the Forward/Back Offset. Measure the distance from your antenna to your boom. Then enter that distance in inches. Behind indicates your boom is behind your antenna, Forward specifies that the boom is in front of your antenna.



- Set the Implement Mount Type



- Continue through the New Field Setup by selecting Continue and press OK until the screen is back to the map view to save these settings. If you press  you will lose these settings.



Step 4: Configuring the boom

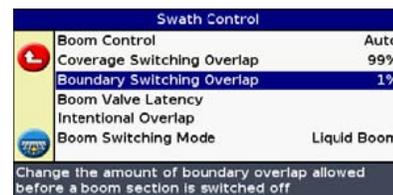
1. From the main guidance screen press  or  until  is selected and then press . The *Configuration Screen* appears.
2. Select *Application Control* and then press . The *Application Control* screen appears.
3. Select *Boom Setup* and then press . The *Boom Setup* screen appears.
4. The *Implement Width* should already be correct; you set that width in the Implement Setup in step 3.

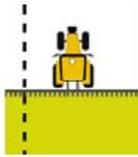
Item	Option
Fence Nozzles	Fence nozzles are spray sections at the far end of the boom that point out to the sides to cover any fence lines. On the EZ-Boom controller, Switch 1 controls the left fence nozzle and the first switch after boom section switches controls the right nozzle. Fence nozzles are always manually controlled. They must be activated with the corresponding switch. With two fence nozzles the system supports up to eight boom sections. You can disable both fence nozzles, enable either the left or the right fence nozzle, or enable both. <i>Note: Triangle Ag recommends that users wire and operate the fence nozzles separate from the EZ-Boom.</i>
Number of Sections	Enter the number of boom sections on your spray boom (not including fence nozzles). You can select up to 10 boom sections, or up to eight if you have both fence nozzles enabled.
Section Widths	Set each section width. The system starts with default widths. Adjust each section width in order. As you adjust each section width, the later section widths adjust so the specified implement width is maintained. Section 1 is the section that is the furthest to the left when you stand behind the vehicle. On the EZ-Boom controller, the switch section switch that is furthest to the left controls section 1. <i>Note: Triangle Ag has had users that have the wiring on their boom valves wrong. If you find that switching the boom switch controls a different section than it should then check the wiring on the boom valves.</i>

5. Press  to exit the Boom Setup Screen.

Step 5: Configuring the Swath Setup (Automatic Boom Switching)

- From the *Application Control* screen, select *Swath Control* and then press . The *Swath Control* screen appears.



Item	Description	Options
Boom Control *		Manual: User controls the spray boom sections with the switches on the EZ-Boom Controller Auto: EZ-Boom controller switches the boom sections on and off.
Coverage Switching Overlap	This setting controls how the sprayer performs when it reaches previously sprayed areas.	The slider controls allows the user to set the allowable overlap to a percentage. If you set the slider to 99%, the EZ-Boom system will overlap coverage, to ensure that there are no gaps in coverage. <i>Use this for Roundup</i> If you set the slider to 50%, the EZ-Boom system will partially overlap and partially skip the covered area, to blend the coverage. If you set the slider to 1%, the EZ-Boom system will not overlap coverage, to avoid spray double-up. 
Boundary Switching Overlap	This setting controls boom switching when the boom moves outside the boundary of the field or inside an exclusion zone you have recorded.	You can set the amount of overlap allowed by each boom section before it is switched off. The Boundary Switching Overlap setting is only effective when you are travelling parallel to the boundary edge or exclusion zone. When travelling perpendicular to the boundary, this setting has little effect on boom switching. 
Boom Valve Latency	This is the delay between the time when the EZ-Boom controller sends the command to the sprayer to begin or end spraying and the time when that action actually occurs. This happens because the solution takes time to flow through the spray hoses.	Valve On Latency: The time that it takes for the system to begin spraying after you turn it on. Valve Off Latency: The time that it takes for the system to stop spraying after you turn it off. <i>Note: If Boom Valve Latency is hard to measure on your sprayer, Triangle Ag recommends setting Boom Valve Latency at 0 and then spray past flags to get an accurate Overlap Distance.</i>
Intentional Overlap	This setting allows the user to double-spray a set distance to ensure complete coverage.	On Overlap Distance: The buffer that you would like to create before you reach the unsprayed area. Spraying will begin this distance before the area to be sprayed has been reached. Off Overlap Distance: The buffer that you would like to create after you leave the unsprayed area. Spraying will stop this distance outside the area to be sprayed.
Boom Switching Mode		Liquid Boom

- Press  to exit the Swath Setup Screen.

*There are two ways to disable the Automatic Boom Switching (When Automatic Boom Switching is disabled the little tractor and sprayer icon on your main navigation page will be in black and white instead of color)

- Go into the menus and set Boom Control to manual. This will leave the rate control on and the boom control in manual mode.
- With the EZ-Guide 500 screen on the main guidance page, stop the vehicle. On the EZ-Boom, turn the master switch off and switch from Rate 1 (or Rate 2) to manual. Flip the master back on to spray. You can now control rate by speed and by pressing the Rate Adjustment (inc/dec) switch. The boom control and the rate control will be in manual mode. This is easiest for small areas that need more spray.

Step 6: Configuring the Application Setup



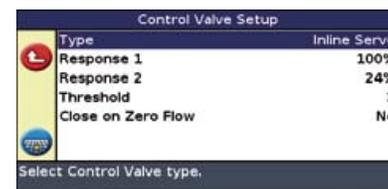
- From the *Application Control* screen, select *Application Setup* and then press **OK**. The *Application Setup* screen appears. (For details on *Application Setup* see Appendix A)

	Item	Option
	Rate Control	Off: The EZ-Boom will not control rate but can control Boom Switching On: The EZ-Boom controls rate
Off	Off When Stopped	If the vehicle is a clutch-operated planter, select No. Otherwise select Yes.
Rate Control On	Rate 1	This is the volume that the sprayer supplies when the Rate switch is set to 1.
	Rate 2	This is the volume that the sprayer supplies when the Rate switch is set to 2.
	Allowable Error	This is the percentage of acceptable Rate 1 or Rate 2 error before the flow control valve adjusts. The default setting is 2%.
	Rate Increment	When the Rate switch is in the Rate 1 or Rate 2 position, the current application rate increases or decreases by this amount each time you press the Rate adjustment (inc/dec) switch. When the Rate switch is in Manual position, Rate Increment does not apply. In Manual the Rate adjustment (inc/dec) switch directly activates the valve, hold the switch up to open the valve (increasing pressure) or down to close the valve (decrease pressure).
	Flow Control Delay	Adjust the control valve, if it is very slow or very fast in reaching the target rate.

- Press **EXIT** to exit the Application Setup Screen.

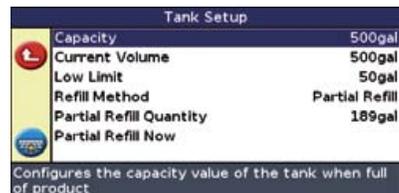
Step 7: Configuring the Control Valve Setup

- From the *Application Control* screen, select *Control Valve Setup* and then press **OK**. The *Control Valve Setup* screen appears. (For details on *Valve Setup* see Appendix B)



	Item	Option
Inline/Bypass/Pump	Type	Identify the control valve type that is on the sprayer being used.
	Response 1	The desired adjustment speed of the valve when the application rate is outside the threshold. (see Appendix B for common valve settings)
	Response 2	The desired adjustment speed of the valve when the application rate is within the threshold.
	Threshold	The point at which the application rate is close enough to the target rate for the application speed of the valve to switch from Response 1 to Response 2. (see Appendix B for common valve settings)
All	Close on Zero Flow	How the valve responds when there is no flow, set at No.
PWM	Frequency	The valve's operating frequency.
	Gain	The adjustment speed of the valve.
	Zero Flow Offset	The shut-off point of the PWM valve.

- Press **EXIT** to exit the Control Valve Setup Screen.



Step 8: Configuring the Tank

- From the *Application Control* screen, select *Tank Setup* and then press . The *Tank Setup* screen appears. (For details on *Tank Setup* go to Appendix C)

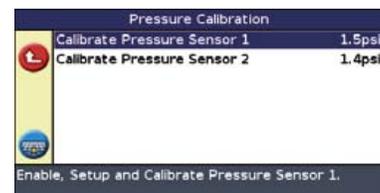
Item	Option
Capacity	The capacity of the tank when full.
Current Volume	The amount currently in the spray tank. This amount decreases as you use the spray solution.
Low Limit	When the volume reaches this level, a warning appears (visual warning on the screen not audible)
Tank Refill Method	The method that you will use to fill the tank: Partial Refill=if you add a specific amount of solution to the tank. (if you select <i>Partial Refill</i> the <i>Partial Refill Quantity</i> option appears) Refill=If you fill the tank to capacity (Resets the <i>Current Volume</i> value to the <i>Capacity</i> volume.)
Partial Refill Quantity	The amount that you add when you partially fill the tank. The <i>Current Volume</i> value will be increased by this amount when you use <i>Partial Refill</i> .

- Press  to exit the *Tank Setup* Screen.

Step 9: Configuring the Pressure

If your sprayer has a pressure transducer fitted, you can use it to display pressure information on the EZ-Boom information tab. To calibrate pressure, ensure that the transducer is connected to the correct input on the EZ-Boom system and then follow the steps below. If you want pressure information to appear on the EZ-Boom information tab and there is not already a pressure transducer on the sprayer, install one. *Note: The system operates correctly without a pressure transducer. Triangle Ag-Services strongly recommends an inline manual gauge that the operator can see easily, whether you have a transducer or not.*

- From the *Application Control* screen, select *Pressure Calibration* and then press . The *Pressure Calibration* screen appears.
- Select *Calibrate Pressure Sensor 1* and then press . The *Calibration Wizard: Pressure Sensor 1* warning screen appears.
- Press  as you read through the screen and then press . The *Pressure Sensor State* screen appears.
- Configure the following settings:



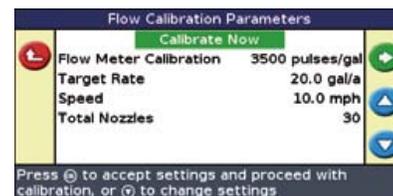
Item	Option
Pressure Sensor State	Off = There is not a pressure sensor – go to Step 8. On = There is a pressure sensor.
Slope	The relationship between pressure and the output of the sensor. Slope is measured in mV/KPa or MB/psi. The standard Raven pressure sensor has a slope of 16.0mV/psi.
Set Point	The actual pressure at the time of calibration. This is usually read from your sprayer's inline manual gauge.

- Select *Calibrate Now* and then press . The *Pressure Sensor 1 Calibration Status* screen appears.
- Press  as you read through the screen and then press . The *Slope* and *Set Point* values are sent to the EZ-Boom controller. The *Pressure Calibration* screen reappears. The first pressure sensor is calibrated. If the sprayer has a second pressure transducer, select *Calibrate Pressure Sensor 2* and then repeat steps 3 through 5 above.
- After calibrating, ensure that the pressure values are correct on the EZ-Boom information tab. If the sprayer has a manual pressure gauge fitted, use it to verify that the calibration is correct. If the pressure is not correct repeat steps 1 through 6 and check again.
- Press  to exit the *Pressure Calibration* screen.

Step 9: Calibrating the Flow Meter

(For details on Flow Meter Calibration refer to Appendix E)

Note: Many Triangle Ag-Customers don't go through the entire calibration process, especially if they have used this flow meter before. Take the calibration number that you have been using or that is on the flow meter tag and enter it without actually measuring the amount. If you use this method, make sure you're using about the right amount of product from your tank for the distance you're covering in the field. Trimble recommends that you run the calibration



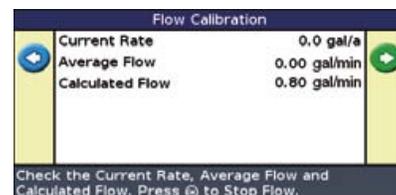
1. From the *Application Control* screen, select *Flow Calibration Wizard* and press **OK**.
2. The *Flow Calibration Parameters* screen appears.
3. Select *Flow Meter Calibration* and then press **OK**. The *Flow Meter Calibration* screen appears.
4. Enter the flow meter calibration number. You can find the number on the flow meter, or by contacting the flow meter manufacturer. The number you enter will be pulses per gallon.
For a Raven flow meter, enter the calibration number as it is written on the tag. For other brands of flow meters, add a 0 to the number when you enter it (for example, if the number is 75, enter 750).
5. Do one of the following:
To exit the screen and use the flow meter calibration number you have entered, press **OK**. The system is now configured.

To fine tune the calibration, adjust the following settings:

Item	Option
Target Rate	Set the expected application rate
Speed	Set the expected vehicle speed
Total Nozzles	Specify the number of boom nozzles that will be turned on during the calibration. Do not count the fence nozzles. Remember that if you have some nozzles that are worn then the individual nozzles will measure different amounts.

Note: Turn on all the boom nozzles (but not the fence nozzles), and make sure that they are operational.

6. Select *Calibrate Now* and then press **OK**. The *Flow Calibration* screen appears.
7. Read the information and then press **OK**. The flow begins.
8. Perform the calibration:
 - a. Measure the total volume from at least 3 nozzles for a total of 1 minute for each nozzle.
 - b. Press **OK** to stop the flow.
 - c. Calculate the volume per minute per nozzles of your sprayer. To do this, divide the total volume measured by the number of nozzles that you took measurements from.
 - d. In the *Measured Flow* field, set the actual volume that you calculated in Step 9c. The system calculates the difference between the measured flow/nozzle and the averaged flow/nozzle. The *Calibration Complete* screen appears. The flow meter calibration number is adjusted.
 - e. Press **OK**. The *Application Control* screen reappears.
9. Press **OK** to exit. The system is now configured.



Caution: EZ-Guide 500 firmware version 4.00 contains a flaw in the calculations for the Flow Calibration which could result in over or under application of product. Please consider this if your calculated Flow Meter Calibration number is significantly different from the manufacture's number. Always make sure you have the newest firmware or call your dealer for more information.

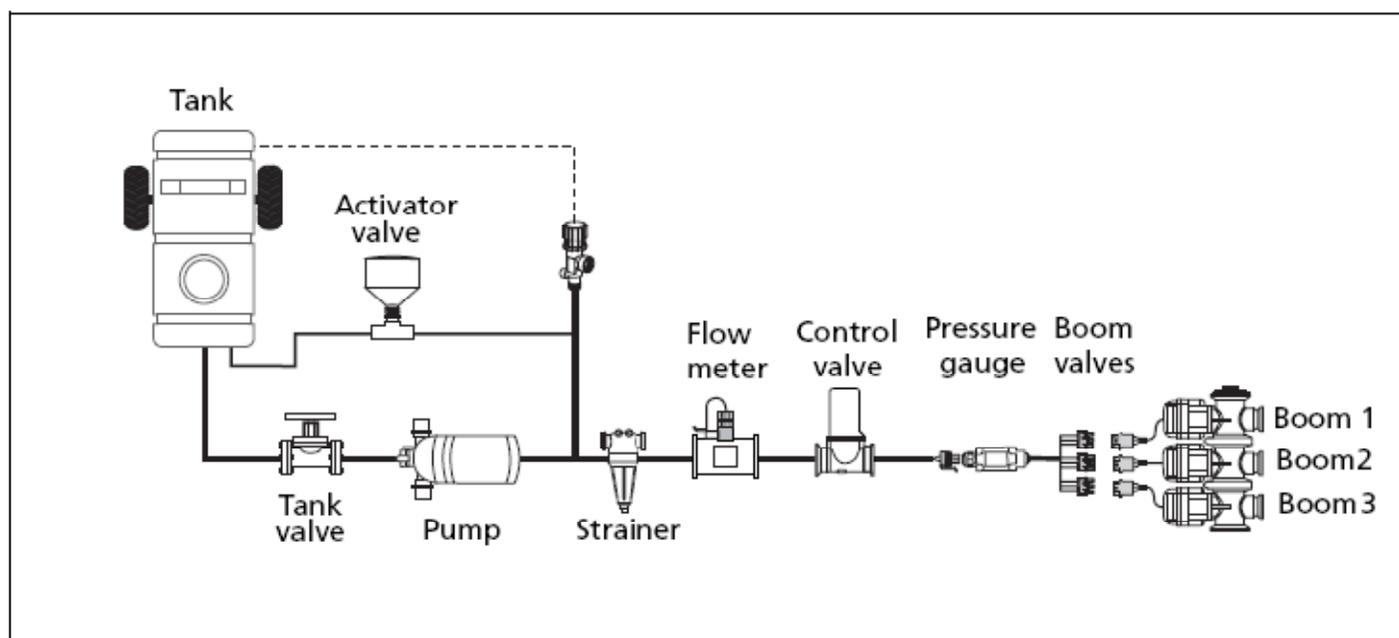
Appendix A Application Setup Details

Setting	Definition	How to use the setting
Rate Control	Enables or disables rate control.	<p>Set the Rate Control to:</p> <p>On. This enables the EZ-Boom system to control the rate response and boom switching. When you select On, the cable is removed from the third-party console and all signals are sent directly to the EZ-Boom system. The EZ-Boom system controls the boom valves, flow meter, and control valve. You can also view readouts from two sets of pressure sensors.</p> <p>Off. This allows the EZ-Boom system to control the boom switching but not the rate response. When you select Off, you must connect a T-harness or other special cabling to a third-party console to the EZ-Boom system. The EZ-Boom system controls only the signal line leading to the boom valves. The third-party display controls the flow meter and control valve.</p>
Target Rate 1 Target Rate 2	Pre-selected spray rates	<p>Define two Target Rates and change between these rates when working, without having to manually increment the rate</p> <p>Example Set Target Rate 1 to 5 gallons/acre and use this for normal spraying conditions. Set Target Rate 2 to 7 gallons/acre and use this for areas with a little heavier weed population.</p>
Allowable Error	The percentage of allowable Rate 1 or Rate 2 error before the flow control valve readjusts to the Target Rate.	<p>To achieve a lower error percentage, change the value to a lower number. If you set a value that is much lower, the valve will work harder to achieve the required rate and this could cause oscillations. To reduce the oscillations, increase the allowable error, or adjust the servo/pump settings in the control valve setup menu.</p> <p>See also Control Valve setup in the next appendix.</p>
Minimum Flow	The minimum flow setting. When this setting is reached, the flow control valve will not reduce the application rate any further.	<p>When you apply a given target rate, the EZ-Boom system controls the rate as you change your speed. When you reach the flow set in the Minimum Flow Setting, the EZ-Boom will maintain that smallest flow so that spray will continue to flow out the nozzles.</p> <p><i>Note-Minimum Flow is used as a safety feature. All sprayers currently on the market need a minimum quantity of flow to maintain the flow from the nozzles. When that flow is not met, the check valves in the nozzle body locks and stops fluid from coming out of the nozzle. To ensure that this does not occur, add a Minimum Flow value to the setup.</i></p>

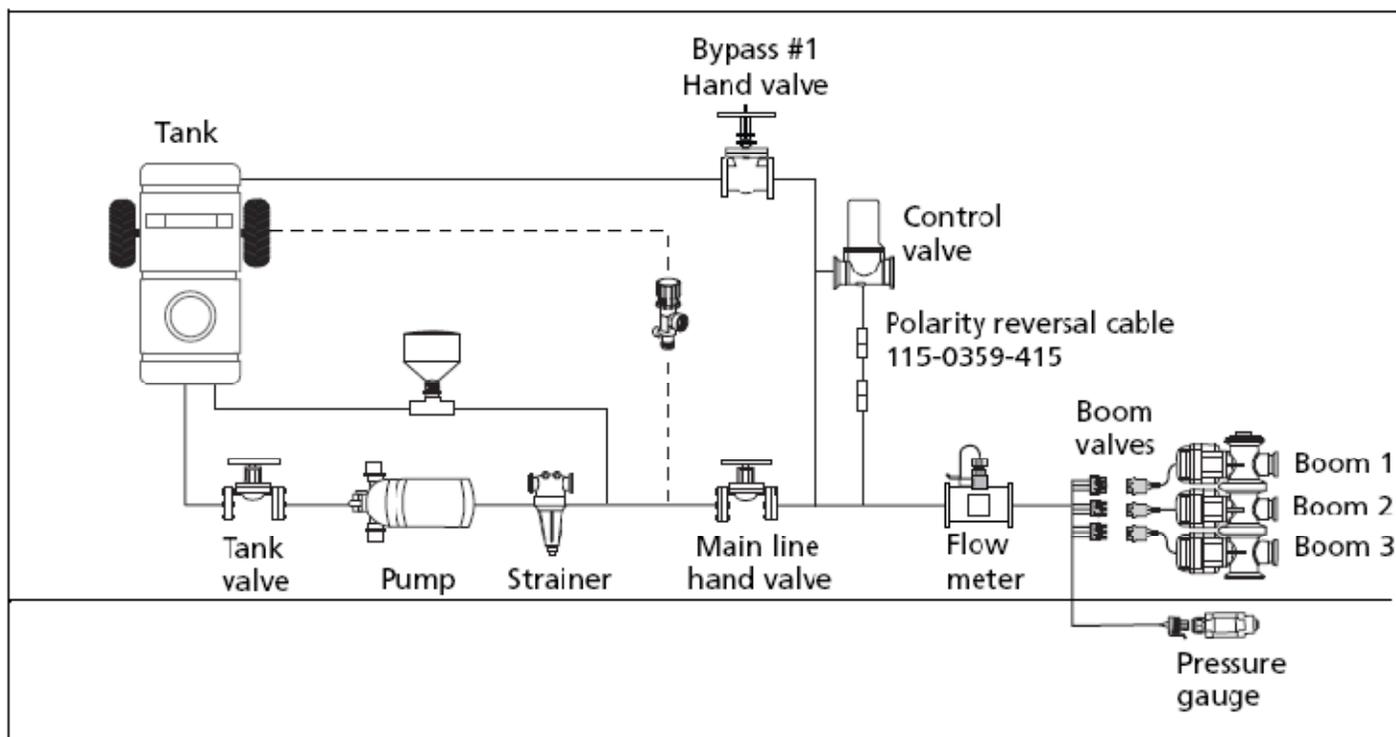
Rate Increment	The amount by which the current application rate (Rate 1 or Rate 2) increases or decreases each time you press toggle the Rate Adjustment (inc/dec) switch	<p>If you want to adjust the rate volume, toggle the switch up (increase) or down (decrease).</p> <p>Example: When Rate 1 or Rate 2 is selected If Rate 1 = 5 gpa and the Rate Increment = 1 gpa Press the switch up once to increase Rate 1 = 6 gpa, continue to press up again to increment.</p> <p>Example: When Manual Rate is selected: In this case the Rate Increment does not apply. Press and hold the switch up to open the control valve, or down to close.</p>
Flow Control Delay	Adjust the control valve, if it very slow or very fast in reaching the target rate.	If the system is either very slow or very fast in reaching its target rate, you can adjust the Flow Control Delay (higher or lower in seconds) to keep the flow control valve constant until the system stabilizes. This may prevent a situation where the flow rate starts oscillating due to premature adjustments on initial startup.
Off When Stopped	Control whether the EZ-Boom system continues spraying when the vehicle is no longer moving.	<p>This setting is active when the rate is turned on or off. However, when the rate control is turned on, the Off When Stopped setting is not visible – to change this setting, turn the rate control back to Off, make the changes and then turn the rate control back to On. The setting will not return to the default.</p> <p>Yes. Have the sprayer stop spraying when the vehicle is stopped, this is the most common.</p> <p>No. Continue spraying when the receiver no longer detects movement. This is used when the vehicle is a clutch-operated planter, so you can continue planting when stopped.</p>

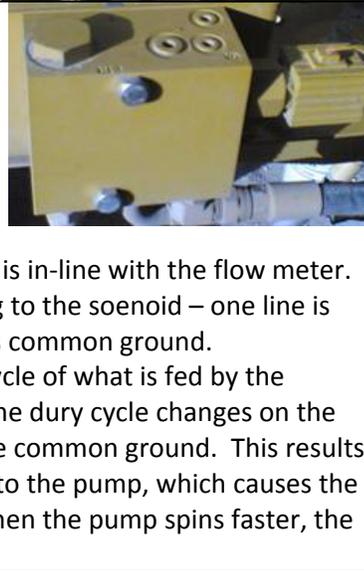
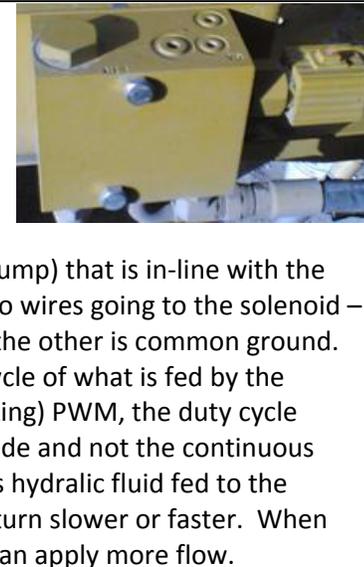
Appendix B Control Valve Setup

Setting	Definition	How to use the setting
None	If Rate Control is Off, the EZ-Boom system sends commands only to the boom control; it does not look for a rate response from the flow meter, or send signal out to the control valve.	Use this function if the customer wants to use the EZ-Boom system for boom control only. This allows the third-party controller to control the flow rate but not the boom control
Inline Servo	Used to achieve rate control. If selected, the EZ-Boom system actuates a butterfly or ball valve in the solution hose that controls the product flow to the booms. When the valve opens, the flow increases. When the valve closes, the flow decreases.	Find the control valve and verify that it is located on the same line that the flow meter is on. If the control valve and flow meter are on the same line, you have an inline servo setup. This is very common on the majority of pull-type sprayers.

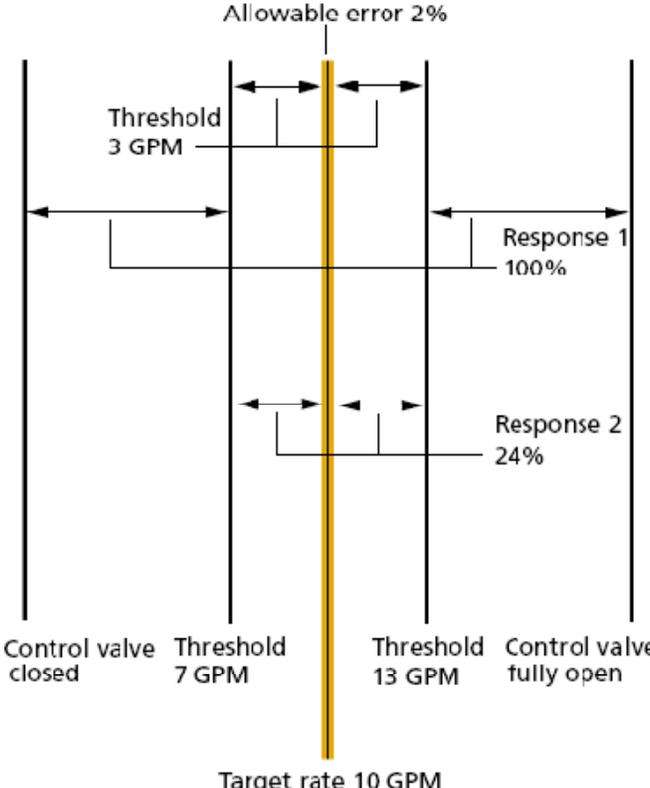


Setting	Definition	How to use the setting
Bypass Servo	<p>Used to achieve rate control. If selected, the EZ-Boom system actuates a butterfly or ball valve in the return line to the solution tank.</p> <p>When the valve opens, the flow to the boom valves decreases and this increases the flow through the return line back to the solution tank.</p> <p>When the valve closes, the flow to the boom valves increases and this decreases the return to the solution tank.</p>	<p>Find the control valve and verify that it is located on a return line going back to the solution tank. The control valve and flow meter will not be in line with each other; each will be on a separate line. The control valve goes to the solution tank and the flow meter goes to the boom sections.</p>



Setting	Definition	How to use the setting
Pump Servo	Used to achieve rate control. If selected, the EZ-Boom system sends changes to the solution pump to adjust product rate. The Pump Servo setting controls an electric motor which actuates a hydraulic valve. As the valve actuates, it adjusts the hydraulic flow to the pump. This valve adjusts the application rate indirectly.	<p>Find a valve that has an electric motor on top of a hydraulic manifold. The hydraulic manifold has lines coming into it from the priority pump on the sprayer. The output lines are connected to a pump (for example, a centrifugal pump) that is in-line with the flow meter.</p> 
PWM (standard)	Used to achieve rate control. The EZ-Boom system sends speed changes to the solution pump. The PWM pump setting controls an electric solenoid valve which adjusts the hydraulic flow to the pump. This valve adjusts the application rate indirectly. PWM standard only changes the duty cycle of the signal line through the continuous power and leaves the common ground alone.	<p>Find a valve that has a single electric solenoid attached to a hydraulic manifold. The hydraulic manifold has lines coming into it from the priority pump on the sprayer. The output lines are connected to a pump (for example, a centrifugal pump) that is in-line with the flow meter. PWM pumps have two wires going to the solenoid – one line is continuous power and the other is common ground. The solenoid moves by the duty cycle of what is fed by the controller. On a standard PWM, the duty cycle changes on the continuous power side and not the common ground. This results in more or less hydraulic fluid fed to the pump, which causes the pump to turn slower or faster. When the pump spins faster, the boom can apply more flow.</p> 
PWM (grounded)	Used to achieve rate control. The EZ-Boom system sends speed changes to the solution pump. The PWM pump setting controls an electric solenoid valve which adjusts the hydraulic flow to the pump. This valve adjusts the application rate indirectly. PWM grounded only changes the duty cycle of the common ground leaves the continuous power alone.	<p>Find a valve that has a single electric solenoid attached to a hydraulic manifold. The hydraulic manifold has lines coming into it from the priority pump on the sprayer. The output lines are connected to a pump (for example a centrifugal pump) that is in-line with the flow meter. PWM pumps have two wires going to the solenoid – one line is continuous power and the other is common ground. The solenoid moves by the duty cycle of what is fed by the controller. On a grounded (or sinking) PWM, the duty cycle changes on the common ground side and not the continuous power. This results in more or less hydraulic fluid fed to the pump, which causes the pump to turn slower or faster. When the pump spins faster, the boom can apply more flow.</p> 

Inline servo, bypass servo, pump servo setup

Setting	Definition	Process description
Valve Response 1	Controls the response time of the valve when the actual rate is outside the response threshold. A larger number makes the valve respond more quickly; a lower number makes the valve respond less quickly.	<p>If you select a target rate of 10 gpa and a threshold setting of 3, which shows an indication of a (+) or (-) point on each side of the target rate, you have a boundary at 7 gpa and at 13 gpa in relation to the target rate.</p> <p>Response 2 drives the control valve at 100% speed from either closed or full open. Response 1 will run like this until it reaches the threshold: Once it is within the 3 (+) or (-) of the target rate, Response 1 drops off and Response 2 becomes active. Response 2 then runs at 24% of its speed capacity until it reaches the actual rate of 10 gpa (the target rate).</p> <p>Once the valve is within the 2% allowable margin of error, it stops moving. When the flow ventures out of the 2% allowable margin of error, the valve then uses Response 2 at 24% to responds directly back to the target rate (10gpa). The control valve will work like this until there is no longer a rate response from the flow meter.</p> <p>The following diagram shows how the servo settings works:</p> 
Valve Response 2	Controls the response time of the valve when the actual rate is inside the response threshold. A larger number makes the valve respond more quickly, while a lower number makes the valve respond less quickly. To reduce the likelihood of an overshoot when adjusting flow rate, lower the Response 2 value.	
Valve Threshold	The point at which the EZ-Boom system changes between using Valve Response 1 and Valve Response 2.	
Close on Zero Flow	Command the control valve to close if there is no flow response detected by the EZ-Boom system.	

Note: Bypass and Inline values are similar and setups help control the flow. Inline usually works with a smaller application and can control that better than a Bypass as this would be erratic over a small application. However, Inline may not be suitable to control a higher flow and a Bypass would be more useful for servo control.

Default Settings

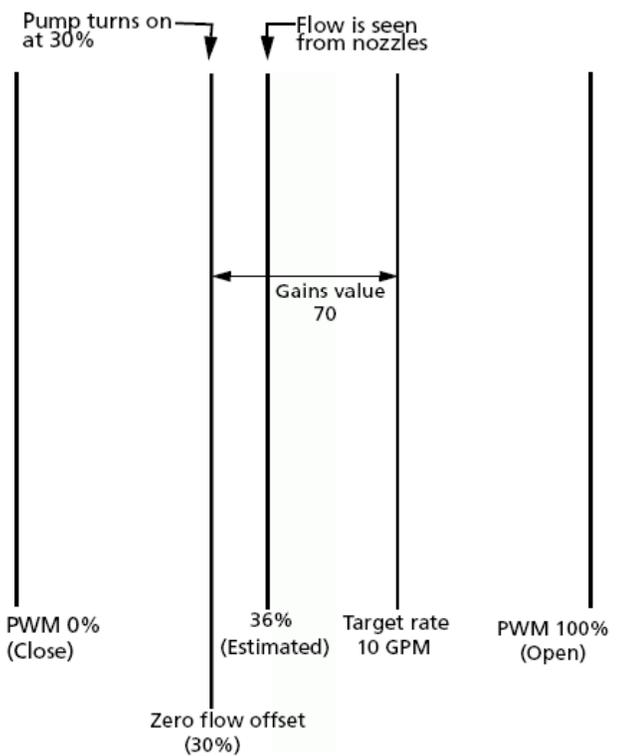
Servo Valve Control Settings

Flow control valve	Control valve	Valve resp. 1	Valve resp. 2	Response threshold
Raven Accu-Flow - 20 gpm - Single valve system (FAST VALVE)	In-line servo	40%	10%	5
Raven Accu-Flow - 20 gpm - Two valve system (STANDARD VALVE)	In-line servo	100%	24%	5
Raven Accu-Flow - 30 gpm - Single valve system (FAST VALVE)	In-line servo	40%	10%	5
Raven Accu-Flow - 30 gpm - Two valve system (STANDARD VALVE)	In-line servo	100%	24%	5
Raven flow control valve - 3/4 In (STANDARD)	In-line or bypass	100%	24%	1
Raven flow control valve - 3/4 In (FAST)	In-line or bypass	40%	10%	5
Raven flow control valve - 1 In (STANDARD)	In-line or bypass	100%	24%	2
Raven flow control valve - 1 In (FAST)	In-line or bypass	40%	10%	5
Raven flow control valve - 1-1/2 In (STANDARD)	In-line or bypass	100%	24%	3
Raven flow control valve - 2 In (STANDARD)	In-line or bypass	100%	24%	8
Raven flow control valve - 2 In (FAST)	In-line or bypass	40%	10%	15
Raven flow control valve - 3 In (STANDARD)	In-line or bypass	100%	24%	15
Mid-Tech - 3/4" in	In-line or bypass	40%	10%	5
Mid-Tech - 1 in	In-line or bypass	40%	10%	8
Mid-Tech - 1 1/2" in	In-line or bypass	40%	10%	11
Mid-Tech - 2 in	In-line or bypass	40%	10%	15
Dickey-John NH3 heat exchanger	In-line Servo	40%	10%	8

Servo Valve Control Settings (self-propelled sprayers)

Flow control valve or sprayer model	Control valve	Valve resp. 1	Valve resp. 2	Response threshold
Case IH SPX 3200 without AIM (KZKCO valve)	By-pass servo	40%	10%	5
Case IH SPX 4260 without AIM (KZKCO valve)	By-pass servo	40%	10%	5
Case IH SPX 4260 without AIM (STANDARD Raven butterfly valve)	Inline servo	100%	24%	3
Case IH SPX 3150 without AIM (STANDARD Raven butterfly valve)	Inline servo	100%	24%	3
Case IH SPX 3185 without AIM (STANDARD Raven butterfly valve)	Inline servo	100%	24%	3
Case IH SPX 3200 with AIM	Inline servo	100%	24%	3
Case IH SPX 4260 with AIM	Inline servo	100%	24%	3
Case IH SPX 3150 with AIM	Inline servo	100%	24%	3
Case IH SPX 3185 with AIM	Inline servo	100%	24%	3
Case IH SPX 3310 with AIM	Inline servo	100%	24%	3
Case IH SPX 4410 with AIM	Inline servo	100%	24%	3
Tyler Patriot with Raven Controller (STANDARD Raven butterfly valve)	Inline or by-pass	100%	24%	3
Tyler Patriot II with Raven Controller (STANDARD Raven butterfly valve)	Inline or by-pass	100%	24%	3
Tyler Patriot XL with Raven Controller (STANDARD Raven butterfly valve)	Inline or by-pass	100%	24%	3
Tyler Patriot 150 (XL) with Raven Controller (STANDARD Raven butterfly valve)	Inline or by-pass	100%	24%	3
Tyler Patriot WT with Raven Controller (STANDARD Raven butterfly valve)	Inline or by-pass	100%	24%	3
Nitro N1 (all 2200 models) (STANDARD Raven hydraulic servo valve), N2	Pump servo	100%	24%	20
Hagle STS 10/12 Model year 2005 Raven 30 gpm hydraulic valve (STANDARD)	Pump servo	100%	24%	
Hagle 2100, 2101, DTS 10 - Raven 16 gpm hydraulic valve (STANDARD)	Pump servo	100%	24%	
Hagle 284, 284xp, DTS 8- Raven Butterfly valve (STANDARD)	Pump servo	100%	24%	3

PWM (Pulse Width Modulation) pump, PWM grounded setup

Setting	Definition	How to use the setting
Close on Zero Flow	Command that closes the control valve if there is no flow response detected by the EZ-Boom System.	<p>Select a target rate (for example, 10 gpa) and set the frequency for the PWM valve (for example, 122 Hz-the frequency required for reading the signal for the control by a Raven PWM).</p> <p>When you turn the pump on, the valve starts to react to the rate that it needs to achieve (10 gpa). Because the zero flow offset was set to 30%, the valve automatically starts to increase to 35% instead of 0%. When it reaches 36%, flow is seen from the nozzles.</p> <p><i>Note – 36% is not a set value and will be different on every sprayer model.</i></p> <p>This enables you to increase the Zero Flow Offset to obtain a more direct response without requiring a delay in the PWM valve. The Gain value used to speed up or slow down the responsiveness of the PWM in order to reach the target rate of 10 gpa.</p> <p>The following diagram shows how the PWM settings work:</p> 
Frequency	The frequency of the signal that controls the pulse width modulation valve. This is usually set and read by the valve.	
Gain	Controls the responsiveness of the PWM valve. The large the PWM gain value, the more responsive the valve will be. The smaller the PWM gain value, the less responsive the valve is to reaching target.	
Zero Flow Offset	The shut-off point of the PWM valve.	

Note: When you select Zero Flow Offset, a certain speed or flow is required to achieve the required rate. For example, if the sprayer backs into a corner and cannot achieve the required rate from here because there is either no speed or no flow, the user must switch the rate to manual and turn off the boom switches. This places pressure against the boom valves so that when the user drives away from the corner, the applicator will turn on the boom switches, opening the valves. This can be applied from a given stop. After the applicator has gained some speed, the user can then switch from manual to Rate 1 or Rate 2.

Flow control valve	Control valve	PWM frequency	PWM gain	Zero flow offset
Raven	PWM	122 Hz	100	30
Other	PWM	100 Hz	100	30

Appendix C

Tank Setup Detail

Setting	Definition	How to use the setting
Capacity	The amount the spray tank holds when full	Adjust this setting before you adjust any other setting in the group. As the remaining settings are based on this setting, it must be accurate to ensure manageable values in the field.
Current Volume	The amount currently in the spray tank. As you continue to spray, the Current Volume decreases.	Use this setting to : Adjust current volume in the tank. Check how much fluid is still in the system. When you are spraying, the value decreases. The volume is based on the flow meter and how much fluid is going through the meter at a given time.
Low Limit	Warns the user that the current volume has reached the low limit value.	This setting alerts you when the tank is nearly empty. Make sure that you set the value high enough so that the system does not lose pressure or cause an intermittent flow issue. It is important to have good pressures while running the sprayer. If the lower limit is set too low, you may have erratic applications to the field. You must also consider whether the product foams – if the product foams, it will have less volume than shown on the screen.
Refill Method	Enables you to either refill or partially refill the volume in the tank.	Select one of the following refill methods: Refill – if you fill the tank to maximum capacity. Partial Refill – if you add a specific amount to the tank, but don't fill it to maximum capacity. The current volume is increased by the <i>Partial Refill Quantity</i> . <i>Note: If you select Partial Refill, the Partial Refill Quantity field appears on the Tank Setup Screen.</i>
Partial Refill Quantity	Changes the amount of the volume that you want to add back into the tank each time you do a Partial Refill Now.	Select a <i>Partial Refill Quantity</i> (ranging from 1 gallon upward). The quantity in the tank increase by this quantity every time that you select <i>Partial Refill Now</i> . Example: If you set <i>Partial Refill Quantity</i> of 100 gallons, the <i>Current Volume</i> will increase by 100 gallons if you press <i>Partial Refill Now</i> . If you have 225 gallons in the tank and then press Partial Refill Now twice, the tank volume increases from 225 gallons to 425 gallons.
Partial Refill Now	Adjusts the Current Volume by the amount in the Partial Refill Quantity value.	When you spray a field and then refill to less than maximum capacity, use Partial Refill Now. See example above.
Refill Tank Now	Changes the amount of the Current Volume back to the Capacity amount set.	Example: The tank capacity is 1000 gallons and you spray until you have only 50 gallons remaining, and then refill the tank completely. Press Refill Tank Now and this will change the 50 gallons showing on the screen to 1000 gallons.

Appendix D

Pressure Sensor Calibration Detail

Setting	Definition	How to use the setting																
Calibrate Pressure Sensor 1 Calibrate Pressure Sensor 2	Enables or disables a pressure sensor reading on the main guidance screen.	<p>If the user has a pressure transducer installed and wants to have pressure displayed on the information tab, do the following:</p> <ol style="list-style-type: none"> 1. Enable Pressure Sensor 1 or Pressure Sensor 2. 2. Set the correct Slope value, see the pressure sensor owner's manual. The slope for a standard Raven pressure transducer is 16mV/psi. 3. Check an in-line pressure gauge and then set the Set Point value. Install an in-line gauge if there isn't one. 4. Select Calibrate Now. 5. Return to the Pressure Calibration menu. If the pressure reading is not correct on the manual pressure gauge, re-run the wizard to change values as required. <p>If the user doesn't have a pressure transducer one can be installed.</p>																
		<p>Pressure sensor pin outs for the EZ-Boom controller</p> <p>Pressure Sensor 1: Power is a +12 V source</p> <table border="1"> <tr> <td colspan="2">Secondary connector (14-pin connector)</td> </tr> <tr> <td>Ground</td> <td>9</td> </tr> <tr> <td>Power</td> <td>8</td> </tr> <tr> <td>Signal</td> <td>10</td> </tr> </table> <p>Pressure Sensor 2: Power is a +12 V source</p> <table border="1"> <tr> <td colspan="2">Secondary connector (14 – pin connector)</td> </tr> <tr> <td>Ground</td> <td>5</td> </tr> <tr> <td>Power</td> <td>4</td> </tr> <tr> <td>Signal</td> <td>6</td> </tr> </table>	Secondary connector (14-pin connector)		Ground	9	Power	8	Signal	10	Secondary connector (14 – pin connector)		Ground	5	Power	4	Signal	6
Secondary connector (14-pin connector)																		
Ground	9																	
Power	8																	
Signal	10																	
Secondary connector (14 – pin connector)																		
Ground	5																	
Power	4																	
Signal	6																	
<p><i>Note: To receive or enable Pressure Sensor 1 and 2 to work simultaneously, you must have firmware version 1.01 or later installed on the EZ-Boom controller. Pressure Sensor 1 may be installed at boom/pump pressure. Pressure Sensor 2 was added for spare/return pressure.</i></p>																		
Slope	The relationship between pressure and the output of the sensor, measured in Mv/psi or Mv/kPa	This is a set value determined by the manufacturer of the pressure sensor. If the value is not correct, the pressure readout will either be inaccurate or not give a dynamic readout																
Set Point	The actual pressure at the time of calibration.	If your sprayer has a manual pressure gauge fitted, use it to determine the Set Point. If the sprayer does not have a pressure gauge, add an In-line manual pressure gauge.																

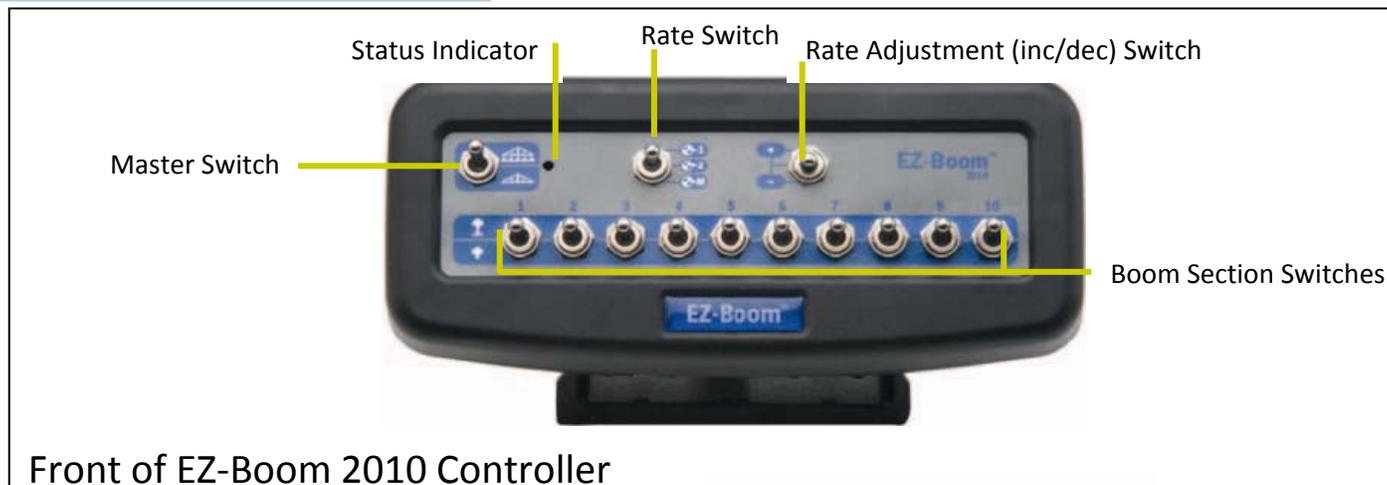
Appendix E

Flow Calibration Setup Detail

Setting	Definition	How to use the setting
Flow Meter Calibration	The calibration number from the flowmeter measured in pluses/gallon or pulses/liter.	You must enter the Flow Meter Calibration value when you set up the EZ-Boom system to work with flow control. It is not required if you are only using boom control. The number is on the flow meter. If you cannot see the number, contact the manufacturer of the meter. Note – If you are using a Raven flow meter, enter the calibration number exactly as it is written on the tag. For other flow meter brands, add a zero to the number when you enter it, for example, if the number is 75, enter it as 750.
Target Rate	The target application rate to be used for the flow calibration sequence.	You can use the default setting to make sure that the unit works correctly. However, Trimble recommends that you change the value to the targeted rate. If you do this, the rate will stabilize and perform slightly better by reaching the target rate.
Speed	The target ground speed to be used for the flow control calibration. For example, 12 mph.	You can use the default setting to make sure that the unit works correctly. However, Trimble recommends that you set the value to the speed that the user will be traveling while applying the expected rate. If you do this, the rate will stabilize and perform slightly better while traveling at the expected speed (miles per hour).
Total Nozzles	The total number of nozzles on the spray boom, excluding the fence row section nozzles.	Advise the user to select the correct number of boom section nozzles used for spraying. Make sure that they do not include the fence row nozzles.
Calibration Steps	A flow calibration improves the performance when using the EZ-Boom 2010 controller.	Trimble recommends this procedure. <ol style="list-style-type: none"> 1. Make sure that the EZ-Boom system is configured and that the spray rig is connected. 2. Enter the Flow Meter Calibration shown on the flow meter. 3. Enter the Target Rate (the expected application rate) 4. Enter the Speed (the expected driving speed). 5. Enter the Total Nozzles—include the boom section nozzles only. 6. Select Calibrate Now. 7. Turn the pump on and open the boom valves. 8. Check that the system is at normal operating pressure and that all nozzles are functioning correctly—nozzles and screens should not be plugged or defective. 9. Take a timed sample from at least three nozzles—check that they are distributing the correct gal/min or oz/min during this time. 10. Average the timed samples that you recorded—for example, if you have three samples, add the gal/min or oz/min readings and then divide the total by 3. 11. Check that the current rate is reaching the target rate that you are trying to achieve. 12. Check that the calculated flow is consistent with the average flow, see Step 10.

Appendix F

EZ-Boom Controller components



Front of EZ-Boom 2010 Controller

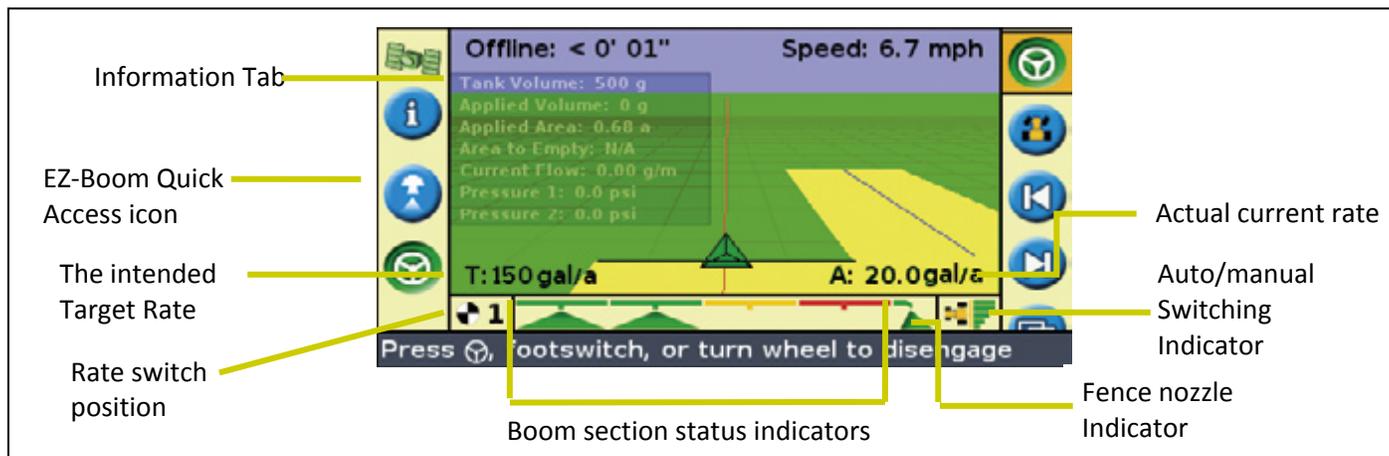


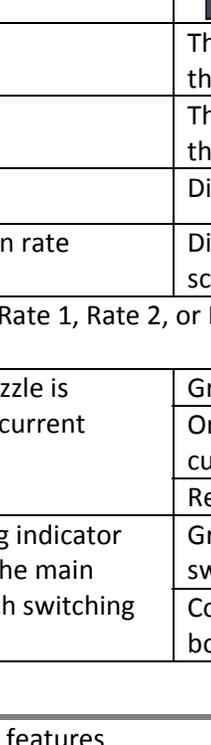
Back of EZ-Boom 2010 Controller

Item	Option	
Master Switch	Enables/disables the EZ-Boom controller	
Status Indicator	Off	No power
	Steady green	Normal operation
	Flashing 1 Hz yellow	CAN bus errors detected (error active/passive state)
	Steady yellow	CAN bus off
	Steady red	Hardware or initialization failure
	Flashing 1 Hz red	Firmware download in progress
	Flashing fast red	Firmware download error
Rate switch	Selects the preset Rate 1 or Rate 2 or selects Manual rate	
Rate Adjustment (Inc/Dec) switch	Increases or decrease the spray rate Note: When the Rate switch is set to Rate 1 or Rate 2, the Rate Adjustment switch adjusts the rate by the increment in the setup. When the Rate switch is set to Manual, the Rate Adjustment switch manually adjusts the flow.	
Boom section switches	Ten switches that can be used to individually turn on or off up to ten boom sections and manually control fence nozzles.	
Main connector	Connects to the sprayer flow control harness, including boom sections 1 to 7.	
Secondary connector	Connects to a pressure sensor and boom sections from 8 to 10	
Power connector	CAN power cable socket	

Appendix G

Onscreen EZ-Boom system features



Item	Description	Details
Information Tab	An additional information tab lists sprayer-specific information. To view the information tab from the main guidance screen, press  until the spray information appears on screen. Continue pressing  to remove information tabs from the screen.	
EZ-Boom Quick Access Icon	The icon  enables you to access the most common EZ-Boom settings more quickly.	 <p>EZ-Boom Quick Access</p> <ul style="list-style-type: none"> Boom Setup Swath Control Application Setup Tank Setup Flush Control Boundaries Enabled <p>Configure the spray boom</p>
When the rate switch is on Rate 1 or Rate 2	T = Target Rate	The intended Target application rate, displayed on the bottom left of the guidance screen.
	A = Actual Current Rate	The actual current application rate, displayed on the bottom right of the guidance screen.
When the Rate Switch is on M (Manual)	F = The current flow rate	Displayed on the bottom left of the guidance screen
	A = The actual current application rate	Displayed on the bottom right of the guidance screen
Rate Switch Position Indicator	The position of the Rate switch: Rate 1, Rate 2, or Manual	
Boom Section Indicators	Each boom section and fence nozzle is depicted in a color indicating its current operational status.	Green = The boom section is enabled and spraying
		Orange = The boom section is enabled but not currently spraying
		Red = The boom section is off (the switch is off)
Switching Indicator	The Automatic/Manual switching indicator appears on the bottom right of the main guidance screen and shows which switching mode the controller is in.	Gray indicator = The controller is in manual boom switching mode
		Color indicator = The controller is in automatic boom switching mode