RAVEN

AutoBoom XRT Calibration and Operation Manual

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Powered by RAVEN

 GA8701234

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CHAPTER 1 IMPORTANT INFORMATION

SAFETY

NOTICE

Follow the operation and safety instructions included with the implement and/or controller and read this manual carefully before installing or operating this Raven system.

- Follow all safety information presented within this manual. Review implement operation with your local dealer.
- Contact a local Raven dealer for assistance with any portion of the installation, service, or operation of Raven equipment.
- Follow all safety labels affixed to system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. Contact a local Raven dealer to obtain replacements for safety labels.

Observe the following safety measures when operating the implement after installing this Raven system:

- Do not operate this Raven system or any agricultural equipment while under the influence of alcohol or an illegal substance.
- Be alert and aware of surroundings and remain in the operator seat at all times when operating this Raven system.
    - Do not operate the implement on any public road with this Raven system enabled.
    - Disable this Raven system before exiting the operator seat.
    - Determine and remain a safe working distance from obstacles and bystanders. The operator is responsible for disabling the system when a safe working distance has diminished.
    - Disable this Raven system prior to starting any maintenance work on the implement or components of this Raven system.
- Do not attempt to modify or lengthen any of the system control cables. Extension cables are available from a local Raven dealer.

DISPLAYS AND CONTROL CONSOLES

- If the display will not be used for an extended period, it is best to remove the display from the machine and store it in a climate controlled environment. This may help to extend the service life of electronic components.
- To prevent theft, secure the display and GPS antenna when leaving the machine unattended.

⚠ WARNING

HYDRAULIC SAFETY

When installing or servicing a hydraulic system or hydraulic components, be aware that hydraulic fluid may be extremely hot and under high pressure. Caution must be exercised.

- Always wear appropriate personal protective equipment when installing or servicing hydraulic systems.
- Never attempt to open or work on a hydraulic system with the implement running.
- Any work performed on the hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- Care should always be taken when servicing or opening a system that has been pressurized.
- The implement or machine must remain stationary and switched off with booms or implement sections unfolded and supported during installation or maintenance.
- Take precautions to prevent foreign material or contaminants from being introduced into the implement hydraulic system. Contaminants that are able to bypass the hydraulic filtration system will reduce performance and may damage hydraulic components.
- Stand clear of the implement when starting the system for the first time after installing or servicing hydraulic components in case a hose has not been properly connected or tightened.

⚠ CAUTION

ELECTRICAL SAFETY

- Always verify that power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the Raven system or other components.
- To prevent personal injury or fire, replace defective or blown fuses with only fuses of the same type and amperage.
- Do not connect the power leads to the battery until all system components are mounted and all electrical connections are completed.
- Always start the machine before initializing this Raven system to prevent power surges or peak voltage.
- To avoid tripping and entanglement hazards, route cables and harnesses away from walkways, steps, grab bars, and other areas used by the operator or service personnel when operating or servicing the equipment.

TOUCH SCREEN

- Only touch the touch-screen with your finger or by using a special touch-screen stylus/pen. Operating the touch-screen with sharp objects may cause permanent damage to the screen.
- Only clean the screen using a damp cloth. Never use caustic or other aggressive substances.

RECOMMENDATIONS AND BEST PRACTICES

HOSE ROUTING

The word “hose” is used to describe any flexible, fluid carrying components. Use the following guidelines and recommendations when connecting and routing hoses while installing or maintaining this Raven system:

- Leave protective caps/covers over hose ends until connecting the end into the hydraulic system to help prevent contaminants from entering the system.
- Follow existing hose runs already routed on the implement as much as possible. Proper hose routing should:
    - Secure hoses and prevent hoses from hanging below the implement.
    - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
    - Protect hoses from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).
    - Protect hoses from sharp bends, twisting, or flexing over short distances and normal implement operation.
    - Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp hoses securely to force controlled movement of the hose.
    - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
    - Avoid areas where the operator or service personnel might step or use as a grab bar.
- Do not connect, affix, or allow hoses to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of hose components.
    - Hoses should be protected or shielded if routing requires the hose to be exposed to conditions beyond hose component specifications.
- Avoid routing hoses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).

CHAPTER 2 INTRODUCTION

Raven's latest advancement in boom controls is AutoBoom® XRT. Industry-leading radar sensor technology uses simultaneous ground and canopy detection to maintain optimal spray height for maximum product efficacy. Pressure-based control allow for smooth movement and quicker reaction time while center rack stability technology with optional dampers gives the operator complete control, maximizing boom life.

INSTALLATION

⚠ WARNING

Carefully read and follow all safety requirements and precautions contained in this manual and the machine-specific Installation Manual. Failure to follow safety instructions may lead to equipment damage, personal injury, or death.

RECOMMENDATIONS

Before installing the AutoBoom XRT system, park the machine where the ground is level, clean, and dry. Bleed pressure from the hydraulic system and leave the machine turned off for the duration of the installation process.

During the installation process, follow good safety practices. Be sure to carefully read the instructions in this manual as you complete the installation process.

Raven Industries recommends the following best practices when installing or operating the XRT system for the first time, at the start of the season, or when moving the AutoBoom XRT system to another machine:

- Verify that the machine's hydraulic system is using fresh oil and that the filters have been recently changed
- Ensure there are no issues with the machine's hydraulic system (e.g., pump issues, faulty hydraulic motors, fine metal deposits in the hydraulic hoses, etc.).

POINT OF REFERENCE

The instructions in this manual assume that you are standing behind the machine, looking toward the cab.

UPDATES

Software and manual updates are available on the Raven Applied Technology website.

https://portal.ravenprecision.com/

Sign up for email alerts, and you will be automatically notified when updates for your Raven products are available on the website!

At Raven Industries, we strive to make your experience with our products as rewarding as possible. One way to improve this experience is to provide us with feedback on this manual.

Your feedback will help shape the future of our product documentation and the overall service we provide. We appreciate the opportunity to see ourselves as our customers see us and are eager to gather ideas on how we have been helping or how we can do better.

To serve you best, please send an email with the following information to

techwriting@ravenind.com

-AutoBoom XRT Calibration & Operation Manual
-016-0235-001 Rev. E
-Any comments or feedback (include chapter or page numbers if applicable).
-Let us know how long have you been using this or other Raven products.

We will not share your email or any information you provide with anyone else. Your feedback is valued and extremely important to us.

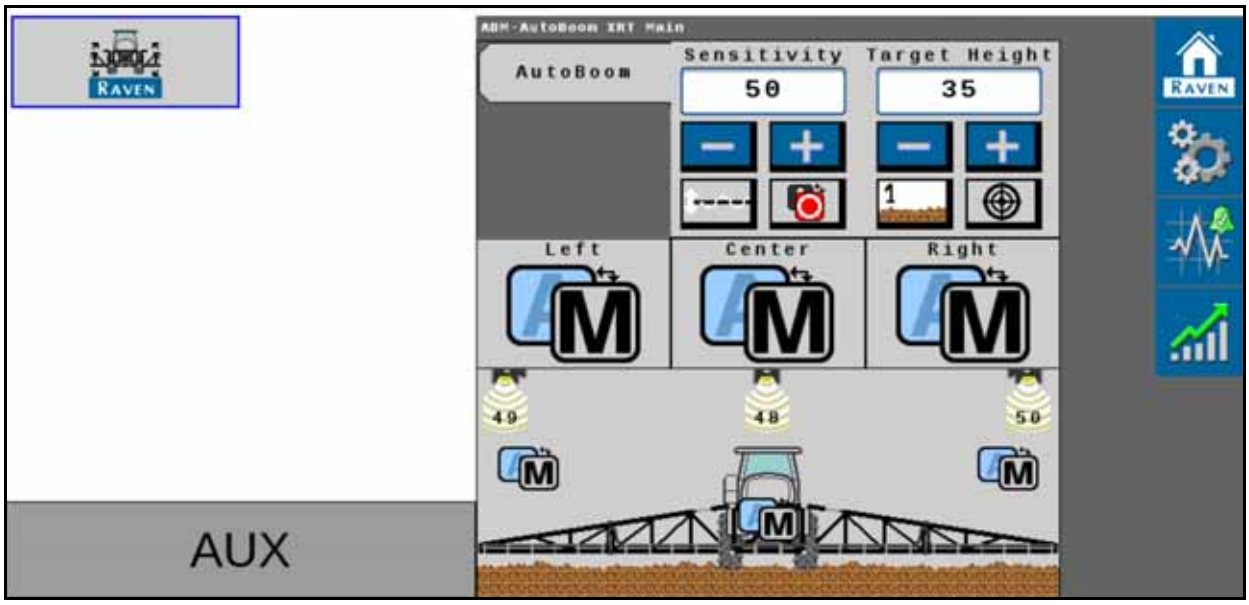
Thank you for your time.

CHAPTER 3 AUTOBOOM XRT HOME SCREEN AND OPERATION

UT OPERATION

Pressing the UT widget on the run screen will open the UT interface. From this screen it is possible to adjust machine settings, view diagnostic information, and adjust Sensitivity and Target Height.

FIGURE 1. UT Run Screen Interface

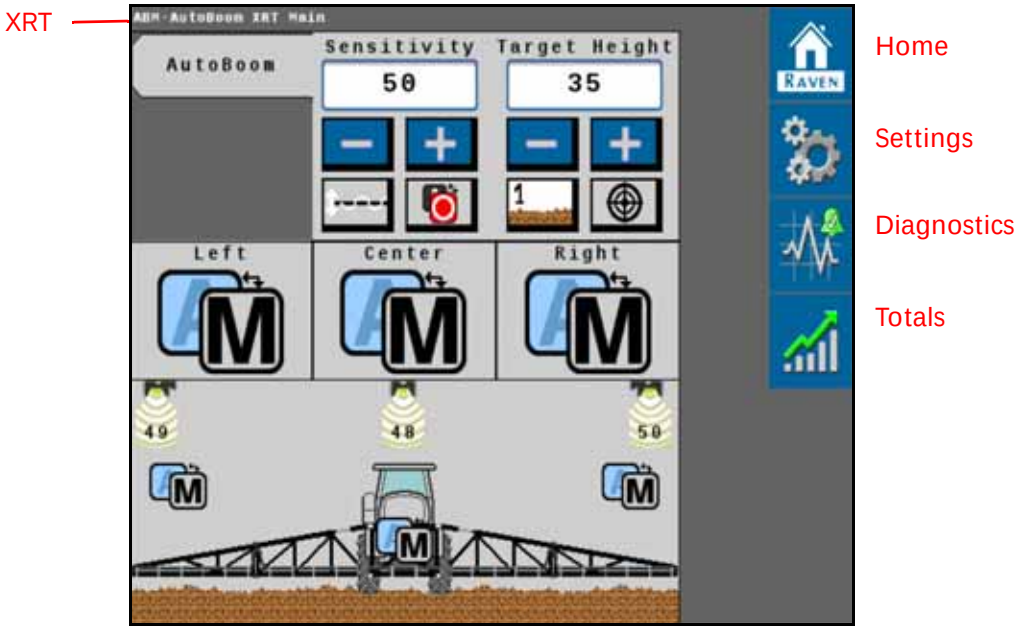


HOME SCREEN

AutoBoom XRT is a UT based application. To access AutoBoom XRT screens:

1. Press the UT icon.

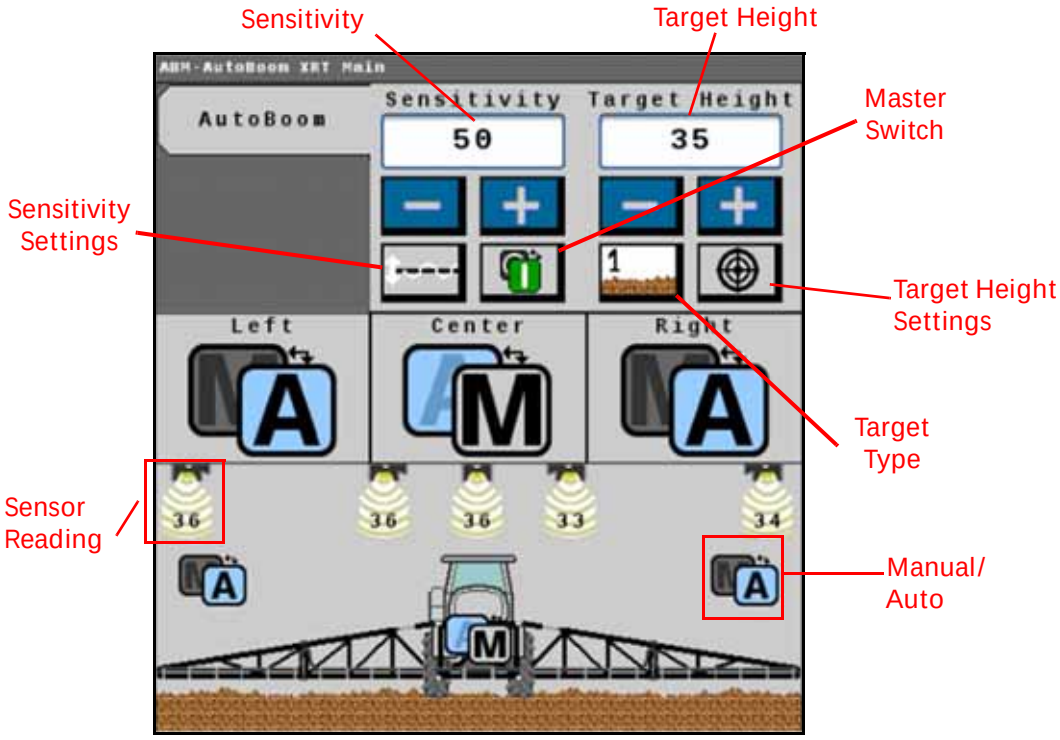
FIGURE 2. Home Screen



2. Select the XRTworking set  icon.

XRT HOME SCREEN OPERATION

FIGURE 3. XRT Home Screen



MASTER SWITCH

Press the Master Switch  to toggle between enabled and disabled states. If enabled, the system is ready to transition to auto mode. If disabled, auto mode is locked out.

NOTE: The Master Switch status will automatically toggle On after completing an AutoFold Out cycle to the spray position. The status will automatically toggle to Off when AutoFold begins to fold booms to the transport position. Without AutoFold, the status will automatically toggle to Off when the booms are near the folded position.

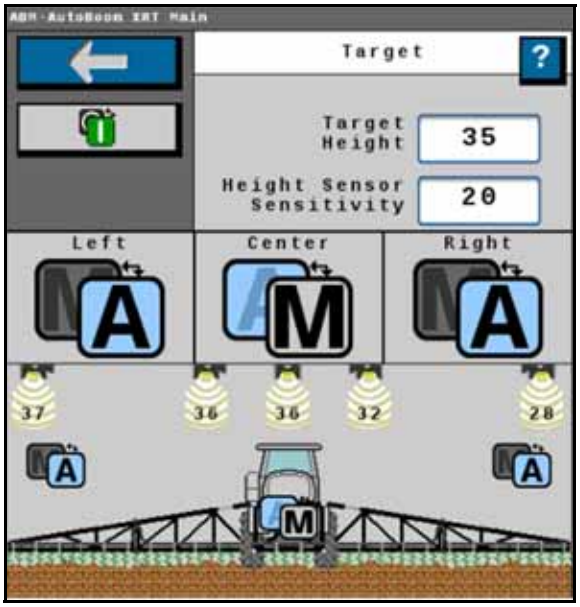
SENSITIVITY SETTINGS

Use the Sensitivity Settings  buttons to increase or decrease the system sensitivity. Increasing the sensitivity will increase how quickly the boom responds to the sensor target. Increasing the sensitivity too high may result in unnecessary or excessive movement. Decreasing the sensitivity will result in less boom movement but will make the booms slower to respond to an error in boom height.

TARGET HEIGHT SETTINGS

Press the Target Height  button to set the distance from the boom to the target. This screen also allows the user to select the Height Sensor Sensitivity. This information can also be changed on the *XRT Home* screen using the +/- buttons or typing the value into the Target Height field.

FIGURE 4. Target Height



HEIGHT SENSORY SENSITIVITY

Height Sensor Sensitivity can be adjusted by typing the value into the Height Sensory Sensitivity field. This value affects the ability of the radar sensor to distinguish between spray, crop, and ground.

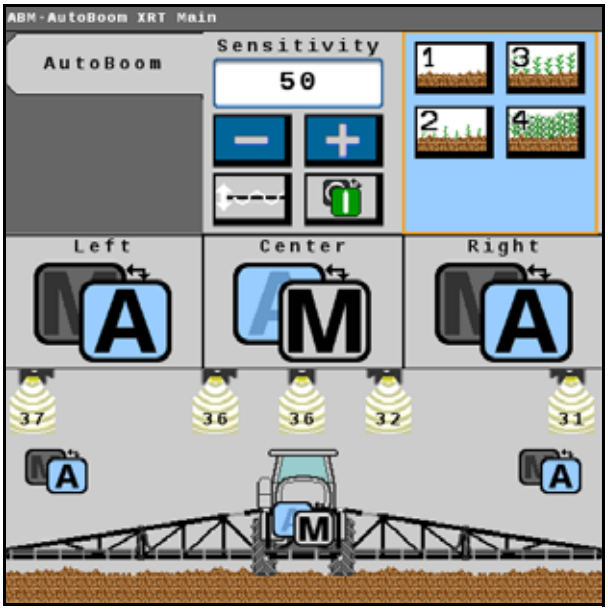
NOTE: A Height Sensory Sensitivity range of 1-20 is ideal for reduced canopy detection or high spray drift suppression.

A Height Sensory Sensitivity range of 20-100 allows the sensor to be more sensitive in detecting a canopy, however, as the Height Sensory Sensitivity value increases, drift suppression decreases.

The Height Sensory Sensitivity value is set to 45 by default.

TARGET TYPE

FIGURE 5. Target Type



Press the Target Type to select betweenthe desired measurement target:

- Ground  : This target type will use the ground signal as the primary target, but will use the canopy signal if it has a higher confidence level.
- Ground Locked  : This target type will only use the ground signal as a target.
- Canopy  : This target type will use the canopy signal as the primary target, but will use the ground signal if it has a higher confidence level.
- Canopy Locked  : This target type will only use the canopy signal as a target.

MANUAL/AUTO

Depending on the machine configuration, there can be up to three Manual/Auto toggle buttons. Each Manual/Auto toggle button controls a boom (left/right) or the center rack. If the center rack only displays a Manual button, center rack control is not enabled. Pressing this button will still transition the left and right booms into Auto mode. When in Auto  mode, the XRT system will continually move the boom position to reach the target position. When in Manual  mode with the Master Switch on, the system is ready to engage. Another way to switch from Manual/Auto is to press on the desired boom section.

SENSOR READING

Sensor Height displays the height for each of the sensors. The number of sensors displayed will match the number of sensors on the machine. The table below describes the Sensor Height reading in more detail.

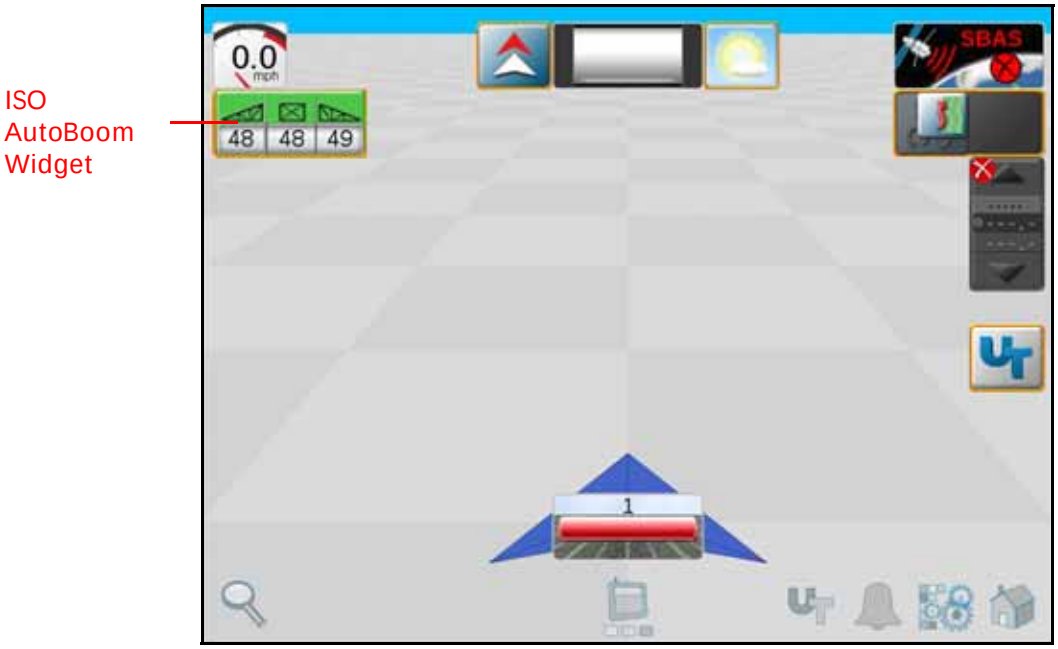
TABLE 1. Sensor Reading States

Image	Status	Description
	Sensor Working/Reading	Indicates the sensor is functioning properly and reading the desired target.
	Sensor Not Reading/ Malfunctioning	If there is an X through the sensor, the sensor is not reading a target or is malfunctioning.
	Sensor Offline/Disabled	If there isn't a number below the sensor location, the sensor may be offline or was disabled by the user.

AUTOBOOM XRT OPERATION ON RAVEN OPERATING SOFTWARE (ROS)

RUN SCREEN OPERATION

FIGURE 6. Run Screen



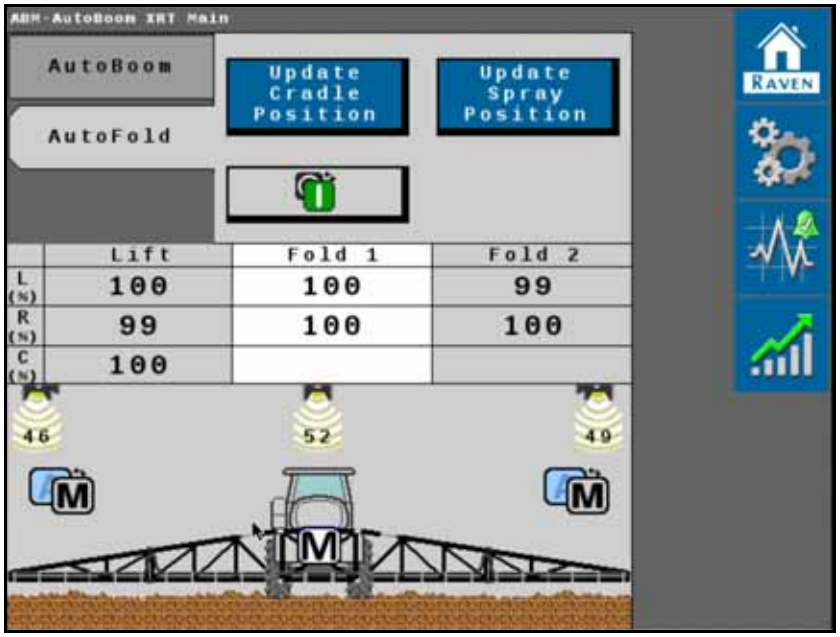
1. Press the desired boom on the XRT widget to enable or disable AutoBoom XRT.
2. Press and hold the desired widget to open additional boom information. Pressing and holding also allows the user to turn on or off the master switch.

FIGURE 7. XRT Widget Long Hold

AUTOFOLD OPERATION

NOTE: Initiating the AutoFold operation varies from machine manufacturers. Refer to the OEM machine operating manual for instructions in initiating AutoFold.

FIGURE 8. AutoFold Operation Main Screen



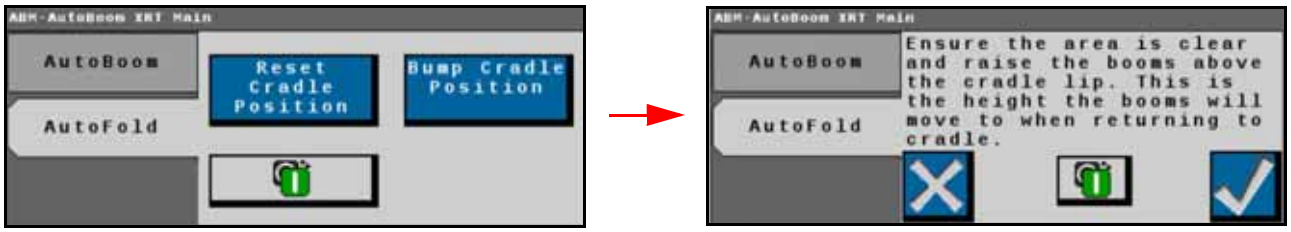
NOTE: It is not necessary to view the *AutoFold Operation Main* screen to perform automatic folding or unfolding functions.

Update Boom Height Limit. Adjusts the boom height limit above the cradle to prevent contacting the mirrors.

Update Spray Position. Saves the current boom tilt position as the new target for folding OUT operation. This setting affects tilt only. The target positions for inner/outer fold joints and the center rack position are not updated.

Update Cradle Position. Saves the current boom tilt position as the new target for folding IN operation. This only affects tilt. The target positions for inner/outer fold joints and the center rack position are not updated.

FIGURE 9. Set Cradle Position



CHAPTER 4 CALIBRATION

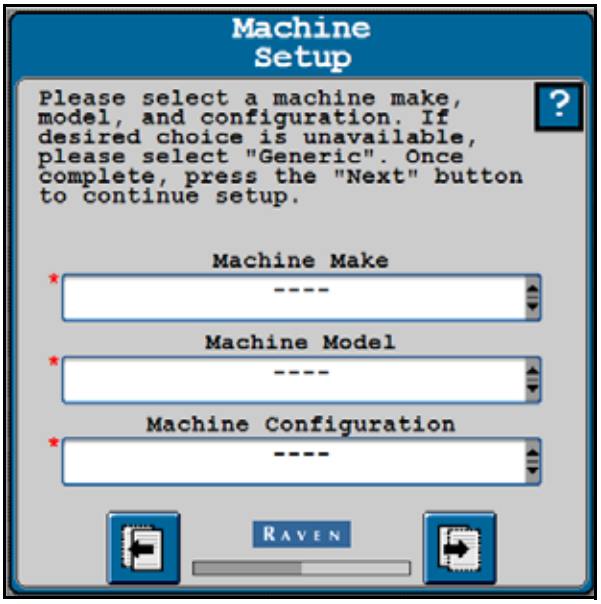
FIRST TIME CONFIGURATION

NOTE: Depending upon configuration settings and installed unlocks, the following steps may vary.

After installing the XRT system:

1. Park the machine on a level surface.
2. Select the Machine Make, Machine Model, and Machine Configuration.

FIGURE 1. Machine Selection

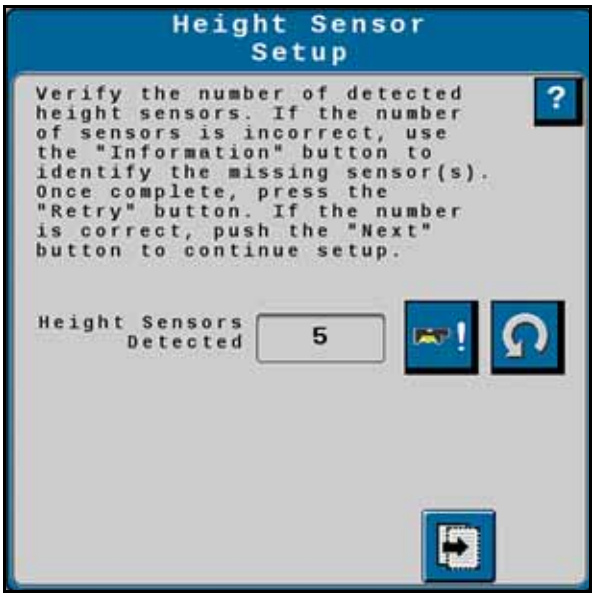


3. Press Next.

4. Verify the number of height sensors installed on the booms and center rack. This will be three, five, or seven sensors depending upon the number of sensors installed.

   If there are no Height Sensors Detected, press  to re-detect the number of sensors.

FIGURE 2. Height Sensors Detected



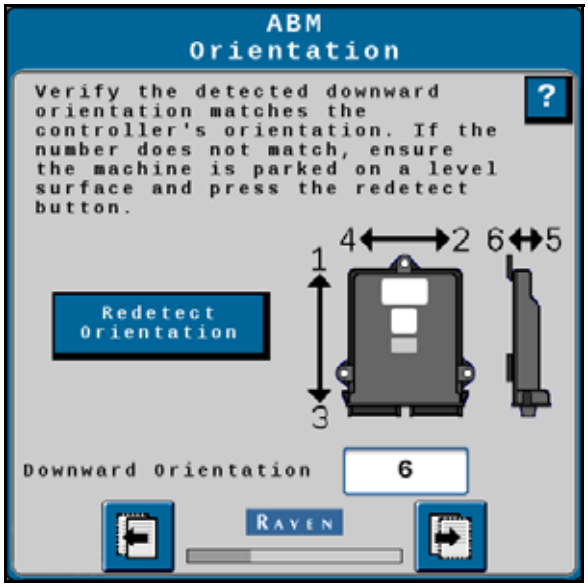
5. Press Next.

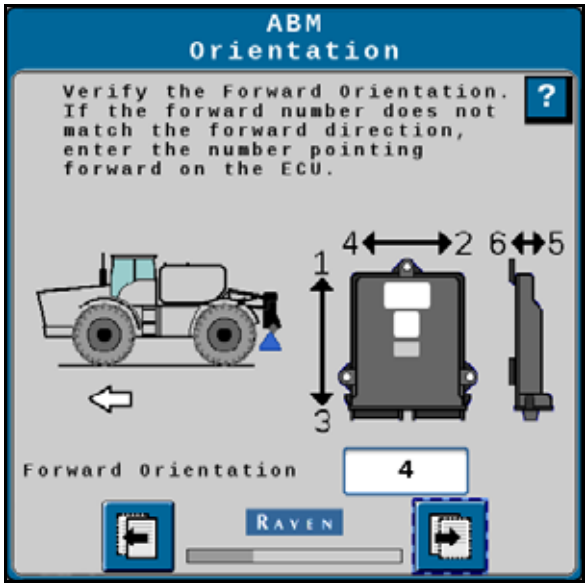
NOTE: If the AutoFold feature is unlocked, AutoFold will be calibrated at this time. Refer to the *AutoFold Calibration* section on page 40 for assistance with calibrating the AutoFold system. Once the AutoFold calibration is complete, proceed with step 6 to continue the AutoBoom XRT calibration.

6. Verify the orientation of the ABM (ECU) on the machine matches the downward/forward orientation of the controller on the *ABM Orientation* page.

NOTE: Many of the next screens will populate with default settings based on the machine configuration selected earlier. The settings will need to be changed if the actual installation deviated from the directions in the machine-specific installation manual.

FIGURE 3. ABM Orientation



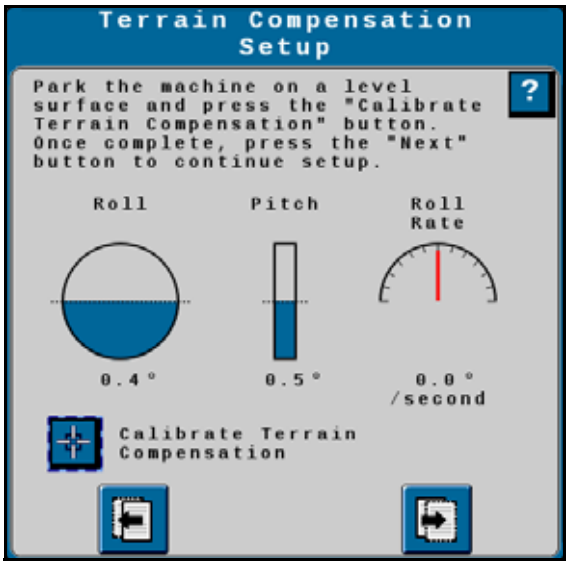


7. If required, press the Redetect Orientation button to redetect the orientation of the ABM on the *Downward Orientation* page.

NOTE: The downward and forward orientations can be entered in the appropriate fields.

8. Press Next.
9. Verify the machine is parked on a level surface.

FIGURE 4. Terrain Compensation Setup



10. Press Calibrate Terrain Compensation.
11. After terrain calibration compensation is complete, press Next.

NOTE: If the AutoFold feature is unlocked and calibrated, the following steps will have been completed during the AutoFold calibration. Skip to step 22 to continue the calibration process.

12. Fold the boom in so the booms are stored in the transport position.
13. Touch the Next button to continue fold calibration.
14. If AutoFold is unlocked, raise the booms above the cradle lip and inward to contact vertical stops. Booms will control to the set point when cradling.

FIGURE 5. AutoBoom Fold Setup - Raise Above Cradle

NOTE: Most machines will skip to step 19. If your screen does not match that shown in Figure 6 on page 18, proceed to step 19.

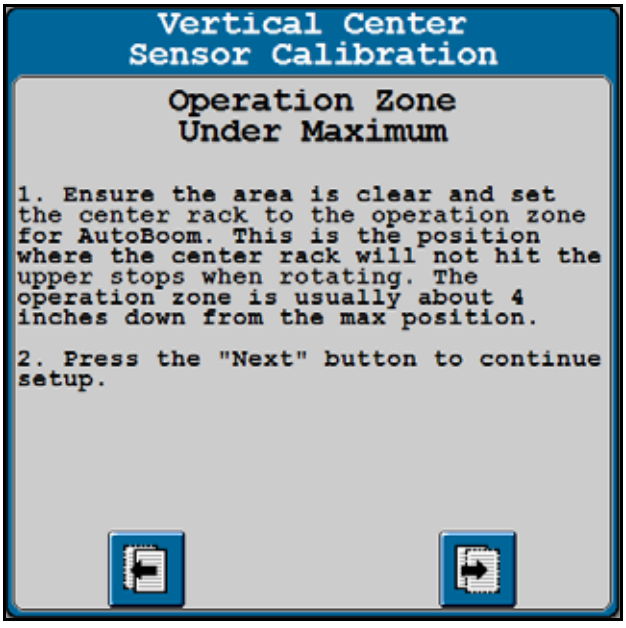
15. Raise the center rack to the maximum height.
16. Touch the Next button to continue the fold calibration.

FIGURE 6. Vertical Center Sensor Calibration - Maximum Height

17. Unfold the inner booms and lower the center rack to the operating position if required.

NOTE: For AGCO RoGator machines, this is low enough that the center rack is able to rotate freely without hitting the travel stops. This is typically about 4 in. [10 cm] below the maximum center rack height.

FIGURE 7. Vertical Center Sensor Calibration - Operation Zone



18. Touch the Next button to continue the fold calibration.

19. Move the booms to a typical spray position. The center rack should be well below the travel stops and the inner booms unfolded.
20. Touch the Next button to continue the fold calibration.

NOTE: Most machines will skip to step 22.

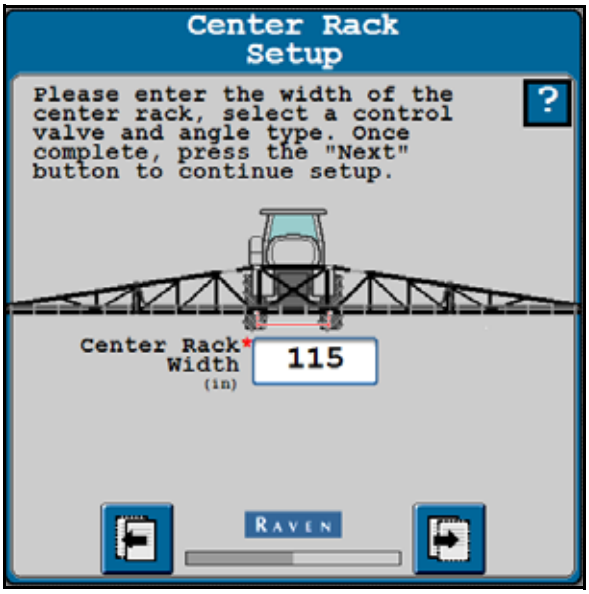
FIGURE 8. Vertical Center Sensor Calibration - Set to Spray Position

21. Lower the center rack to the lowest position. Touch the Next button to continue the calibration.

FIGURE 9. Vertical Center Sensor Calibration - Minimum Height

22. Enter the Center Rack Width. The center rack width is measured from the left boom pivot point to the right boom pivot point. The pivot point is where the boom rotates as it is raised/lowered. The pivot point is generally a horizontal steel pin.

FIGURE 10. Center Rack Setup

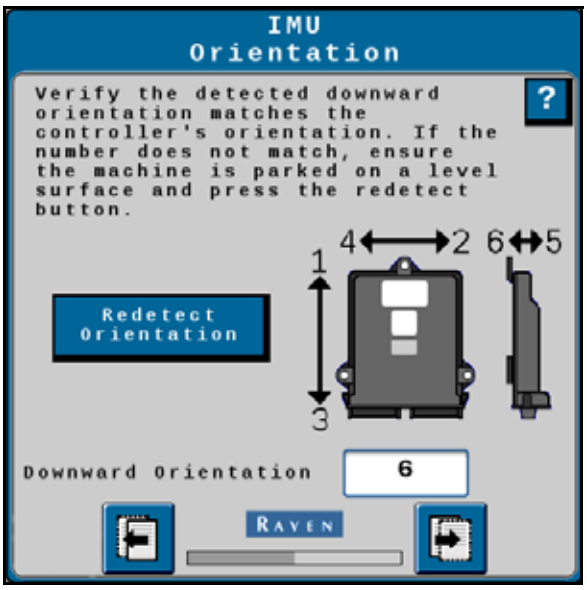


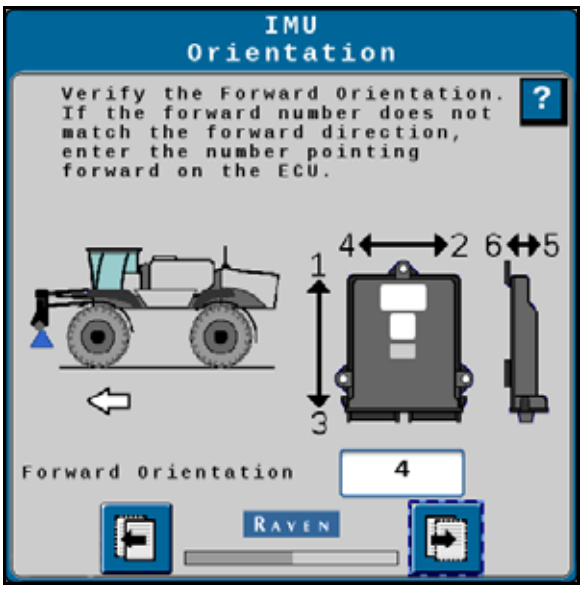
23. Press Next.

NOTE: Machines that use an IMU (Inertial Measurement Unit) for Center Rotation Measurement will perform step 24 through step 29. Machines that use a rotary position sensor will skip to step 30.

24. Verify the IMU orientation on the machine matches the image on the *IMU Orientation* page. If needed, press the rotate buttons on the right side of the tab to adjust the orientation.

FIGURE 11. IMU Orientation





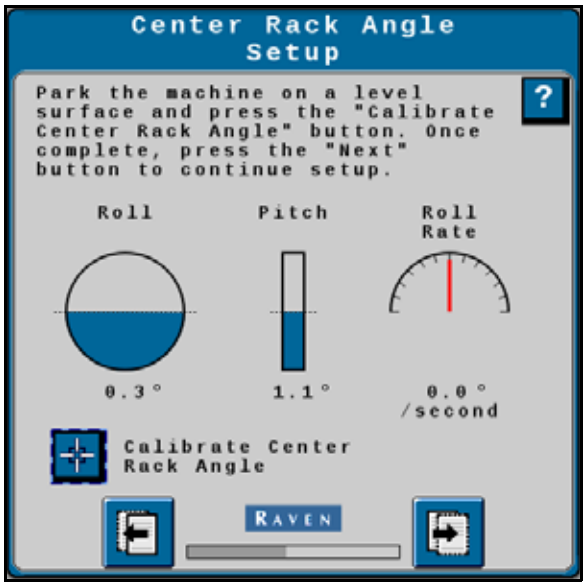
25. If required, press the Redetect Orientation button to redetect the orientation of the IMU on the *Downward Orientation* page.

NOTE: The downward and forward orientations can be entered in the appropriate fields.

26. Press Next.

27. Verify the machine is parked on a level surface

FIGURE 12. Center Rack Angle Setup



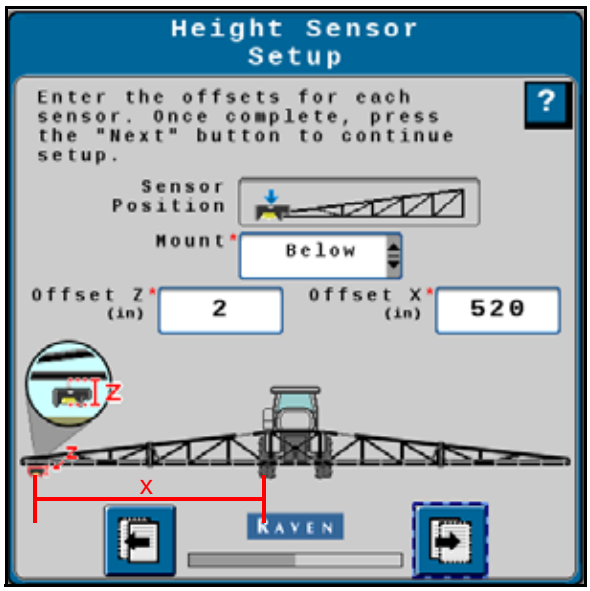
28. Press Calibrate Center Rack Angle.

29. After center rack angle calibration is complete, press Next.

30. Enter the Z offset from the bottom of the spray tips to the bottom of the sensor lens for the identified sensor into the Offset Z field.

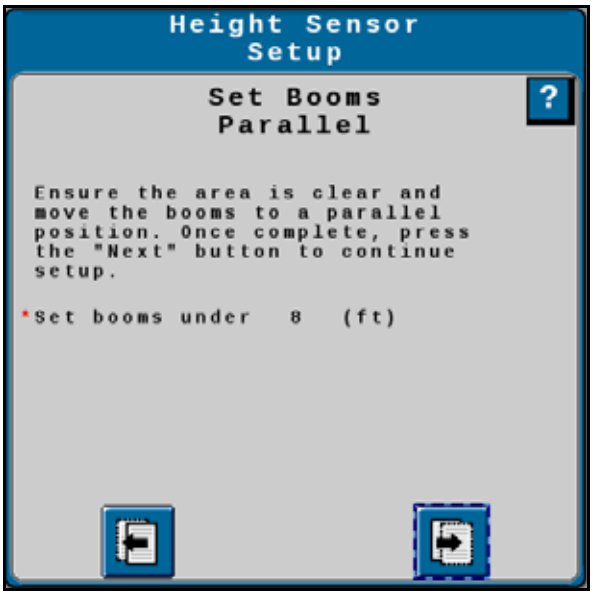
31. Enter the X offset from the boom pivot point (not the machine center line) to the sensor mounting location into the Offset X field.

FIGURE 13. Height Sensor Setup



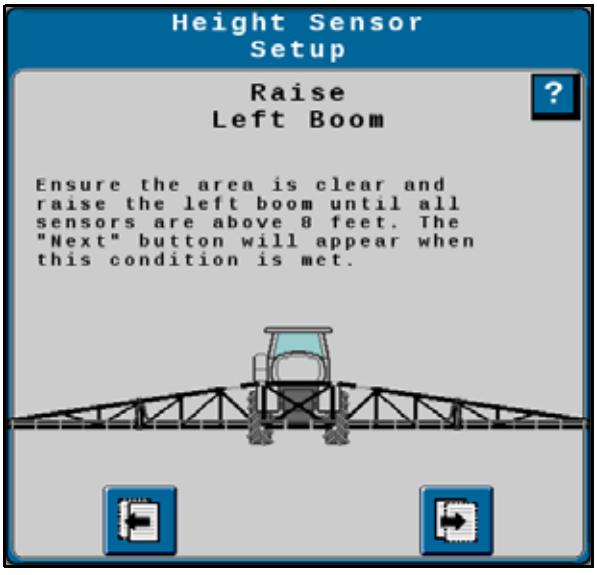
32. Press Next.
33. Repeat step 30 and step 32 for the remaining sensors.
34. Set the booms parallel and under 8 ft. [2.4 m] from the ground.
35. Press Next.

FIGURE 14. Height Sensor Setup - Set Booms Parallel



36. Raise the left boom until there is at least a 40 in. [101.6 cm] change in height.
37. Press Next.

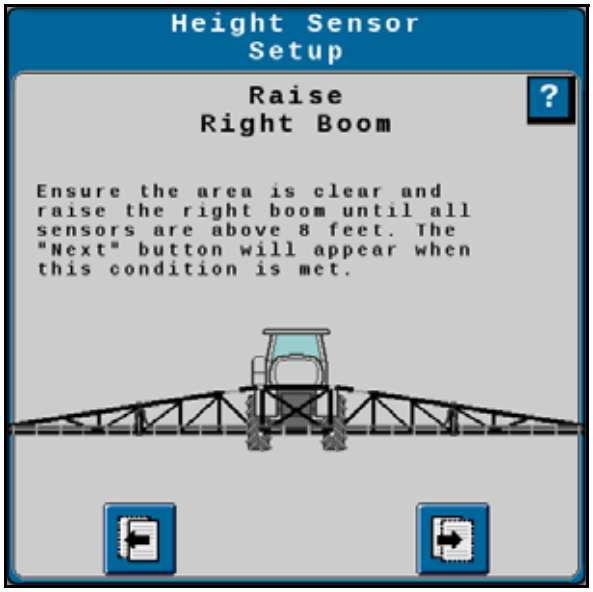
FIGURE 15. Height Sensor Setup - Raise Left Boom



38. Raise the right boom until there is at least a 40 in. [101.6 cm] change in height.

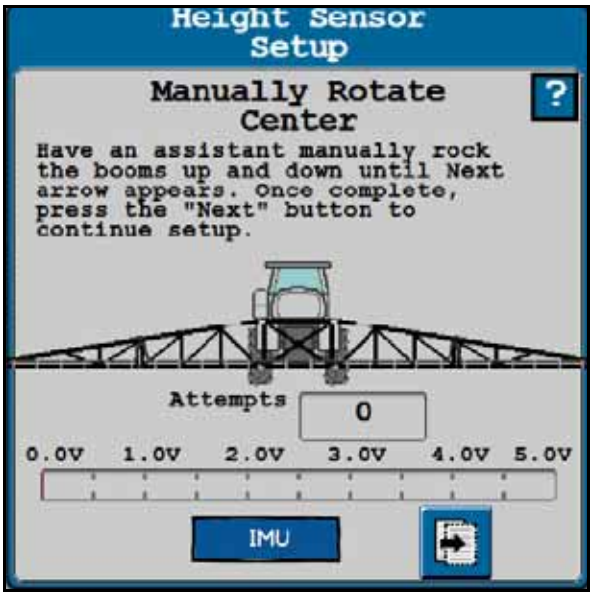
39. Press Next.

FIGURE 16. Height Sensor Setup - Raise Right Boom



40. If an IMU (Inertial Measurement Unit) is installed on the machine, skip to step 44.
41. Lower and level the booms.
42. Have an assistant manually rock the boom up and down until the Next arrow appears. The Next arrow will only appear when the voltage is more than 0.25 V apart.

FIGURE 17. Center Rack Rotation



43. Press Next.

44. Raise the center rack and set the booms level.

NOTE: The boom will move on its own for the next few steps. Verify nobody is standing near the booms.

FIGURE 18. Base Control Effort Calibration

45. Press Next. The system will perform an automatic calibration sequence to determine the duty cycle required to keep the boom stationary.
46. If prompted, manually raise or lower booms and press Next to continue calibration.
47. Review the information on the *Height Sensor Setup* page.
48. Press Next.
49. Review the information on the *System Summary* page.
50. Press Next.
51. The *XRT Home* screen will be displayed.

NOTE: If features are not visible on the *XRT Home* screen, it means those features are locked. To unlock these features, follow the directions in Chapter 6, *Feature Unlock Codes*.

CHAPTER 5 SETTINGS

MACHINE SETTINGS

FIGURE 1. Machine Settings

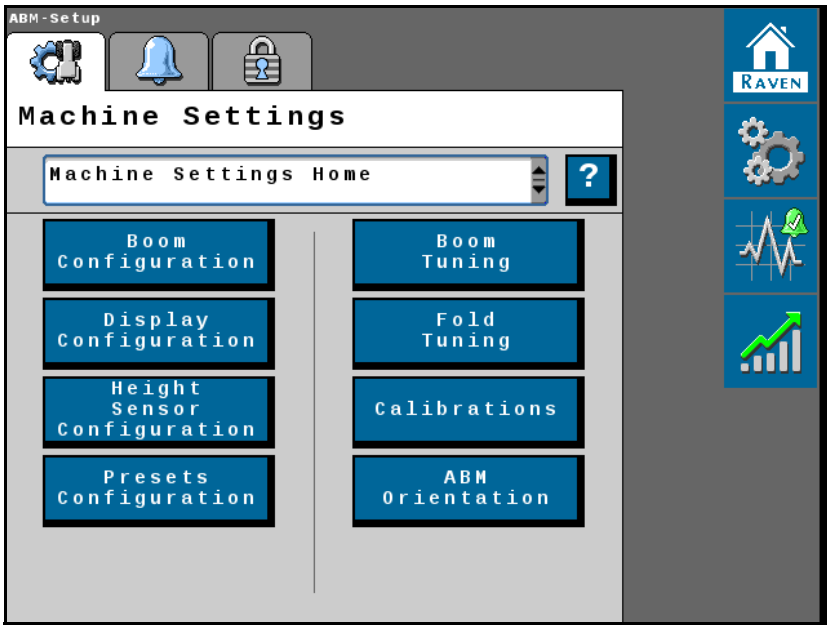
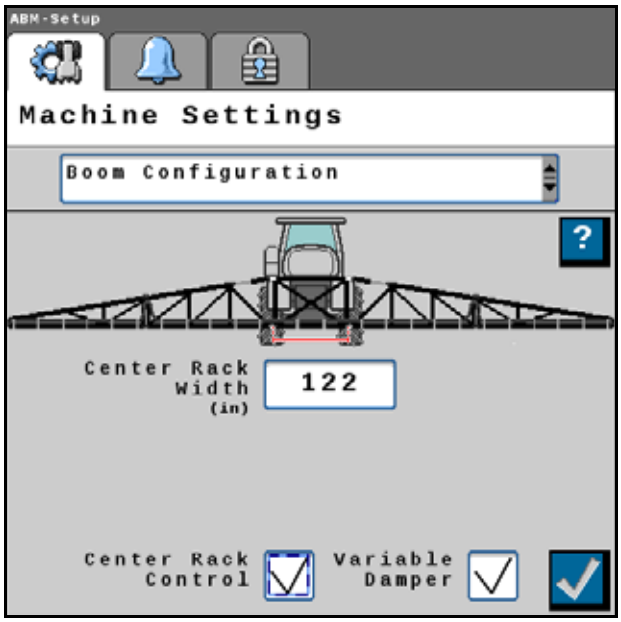


FIGURE 2. Machine Settings Drop-down Menu

BOOM CONFIGURATIONS

The *Boom Configuration* window allows the user to adjust the Center Rack Width, enable or disable Center Rack Control, and enable or disable the variable damper system. If the Center Rack Control checkbox is blank, the system will not automatically raise or lower the center rack based upon height sensor readings.

FIGURE 3. Boom Configuration

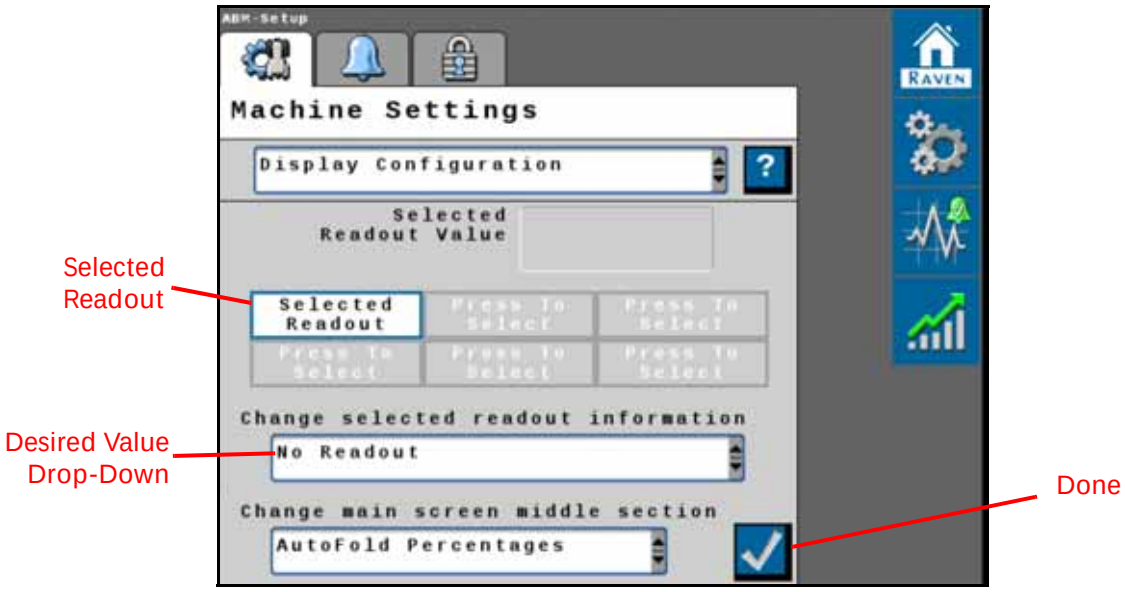


DISPLAY CONFIGURATION

The *Display Configuration* window allows the user to create a customized view of the AutoBoom XRT home screen. This may be useful for diagnostics and troubleshooting. To configure the display:

1. Select Display Configuration from the Machine Settings tab. A window will open that represents the editable sections of the *AutoBoom XRT Home* screen.

FIGURE 4. Display Configuration



2. Select the desired value for that location from the drop-down at the bottom of the page.
3. Select the Readout drop-down window and select Advanced Options

NOTE: These options can also be edited from the Home page by selecting the readout box to be updated.

4. Press Selected Readout in the desired area.
5. Select the AutoFold Percentages option at the bottom of the page to view the current joint fold positions instead of the AutoBoom sensor readouts on the *AutoBoom XRT Main* screen.

FIGURE 5. AutoFold Percentage Position Display

	Lift	Fold 1	Fold 2
L (%)	75	98	99
R (%)	69	99	98
C (%)	50		

6. Select the Enable/Disable Readout option at the bottom of the page to replace sensor readings on the *AutoBoom XRT Main* screen with large Auto/Manual toggle buttons. This can help the operator more easily confirm whether a boom fold section is engaged or not during AutoBoom operation.

FIGURE 6. Toggle Auto/Manual

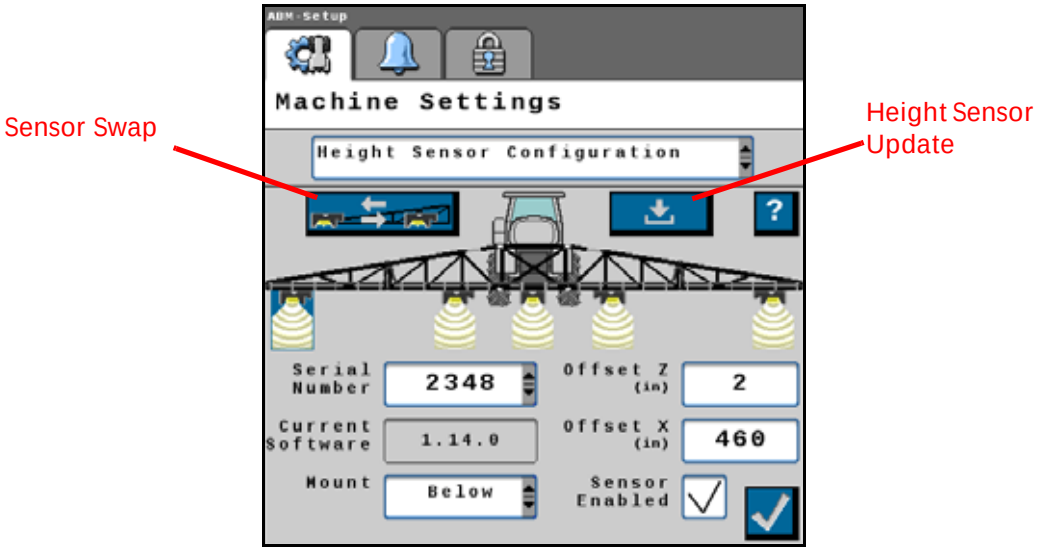
7. After all the Selected Readouts are configured, press Done.

HEIGHT SENSOR CONFIGURATION

The *Height Sensor Configuration* window allows the user to change the sensor Offset, review software information, or select Sensor Enable. This page also allows the user to swap the sensors by pressing the Swap Sensors button and update sensor software by touching the Height Sensor Update button.

Offset X is the horizontal distance from the pivot point of that boom (near the Left or Right Shoulder). Offset Z is the vertical distance between the spray tip and the lens of the height sensor. If the sensor is below the spray tip, the Mount field should be set to 'Below.'

FIGURE 7. Height Sensor Configuration

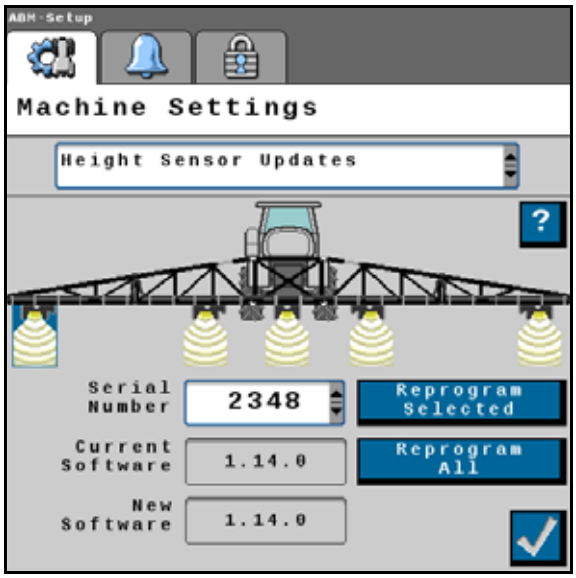


Select the different sensors shown on the sprayer boom to modify that sensors configuration.

HEIGHT SENSOR UPDATES

The *Height Sensor Updates* window allows the user to update software on the height sensors. The sensors may be updated individually by selecting each sensor and pressing Reprogram Selected. Alternatively, all sensors my be programmed by pressing Reprogram All. Height sensor software is bundled with the XRT ABM software. No external file is needed for updating height sensor software.

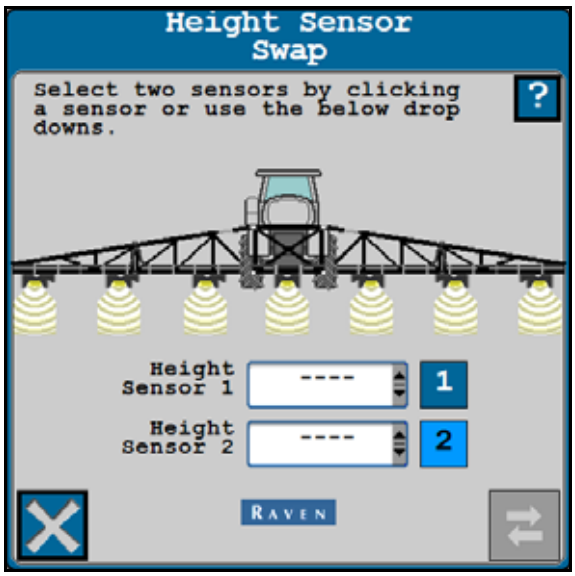
FIGURE 8. Height Sensor Updates



SWAP SENSORS

Press Swap Sensors to open the *Height Sensor Swap* window. After physically swapping sensors on the machine, select the two sensors that were swapped. Once both are selected, touch the Swap button.

FIGURE 9. Swap Sensors

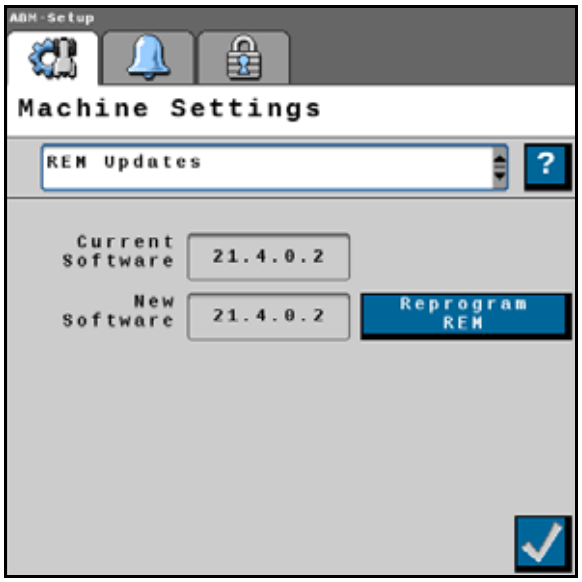


Swap

REM UPDATES

The REM software is included with the ABM software and updated through the object pool. REM Updates window allows the user to update software. If an update is available, select reprogram. No external file is needed for updating REM.

FIGURE 10. REM Update



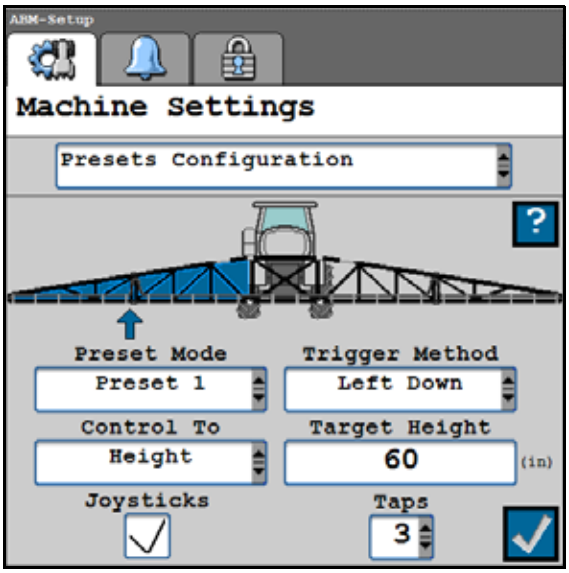
PRESETS CONFIGURATIONS

The *Presets Configuration* window allows the user to select the desired Preset Mode, select the number of Taps to enable the mode, and select the Joysticks checkbox if using the joystick will enable the mode.

Boom control switches can be configured to perform certain functions depending on the number of joystick presses. For example, the user can configure the system to raise the boom to a higher position (e.g. for end of row turnaround) when the switch on the joystick is quickly tapped up three times. To configure presets:

1. Select Preset Configuration from the Machine Settings tab.
2. Select the desired boom. Each boom will have its own settings from each preset selected.

FIGURE 11. Preset Configuration



3. Select the desired Preset Mode.
   a. Spray Mode - Standard XRT operation mode
   b. Preset 1 - User customizable mode
   c. Preset 2 - User customizable mode
4. Select the Trigger Method.
   a. There is one trigger method per Preset mode.
5. Select the Control To option.
   a. Height - The preset will control to a user selected height.
   b. Angle - The preset will control to a user selected angle.
   c. Spray Height - The preset will control to the height in the Spray mode.
   d. Transport - The preset will control to a max height and disable the wing when it reaches the height.
6. If desired, select the Joysticks checkbox. Selecting Joystick enables or disables joystick shortcuts for mode changing.
7. To activate the preset, press the joystick button in the direction selected as the trigger type and press it the number of times selected as number of taps.

BOOM TUNING

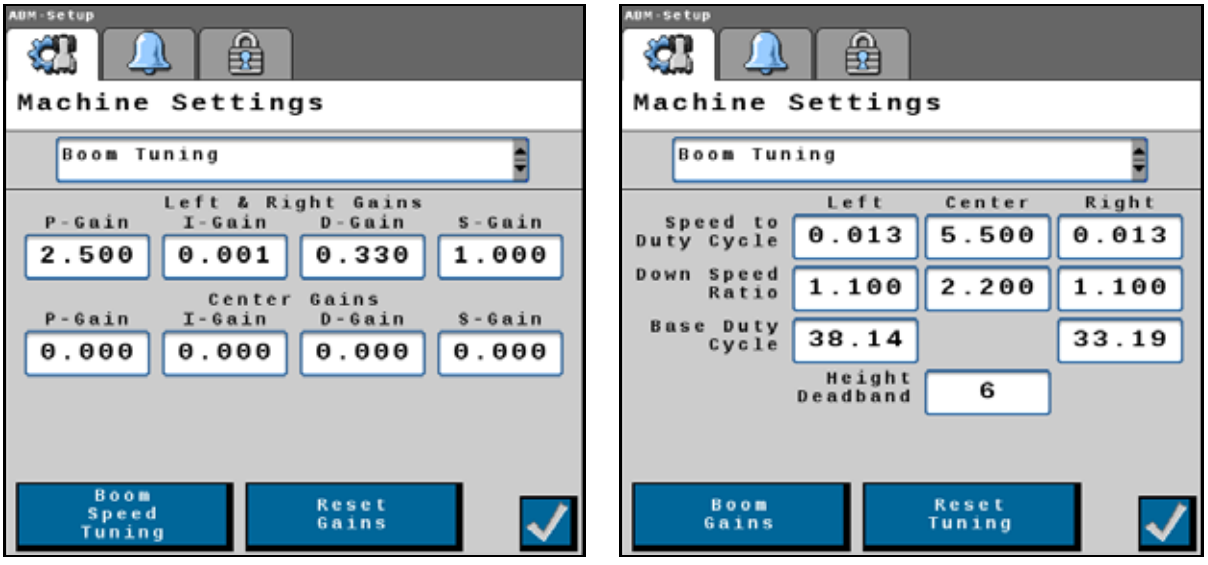
Boom tuning displays boom settings based on machine configuration (Make, Model, Boom Width) options selected during initial calibration. If needed, the user can adjust Speed to Duty Cycle, Down Speed Ratio, Base Duty Cycle, Height Deadband, and PID gain settings. Use the Boom Gains and Boom Speed Tuning buttons to toggle between the two screens.

NOTE: Pressing the Reset Tuning or Reset Gains buttons only reset the values displayed on that page. The values are reset to defaults specific to your machine Make, Model, and Boom Width.

Refer to Chapter 6, *AutoBoom XRT Advanced Tuning* for additional information on these settings.

NOTE: If the Machine Make is set to RoGator, there is an additional value displayed on the *Boom Tuning* window. This value called Operation Zone prevents AutoBoom from being switched to Auto mode if the center rack is too high and center rack control is disabled. This is necessary due to the unique configuration on these machines that prevents the center rack from rotating when the center mast is raised against the transport stops. This feature may be disabled by entering a 0 in this field. The Operation Zone can be recalibrated by performing an AutoBoom Fold Calibration. Refer to the *AutoBoom Fold Calibration* section on page 37 for assistance with completing this calibration.

FIGURE 12. Boom Tuning Screens



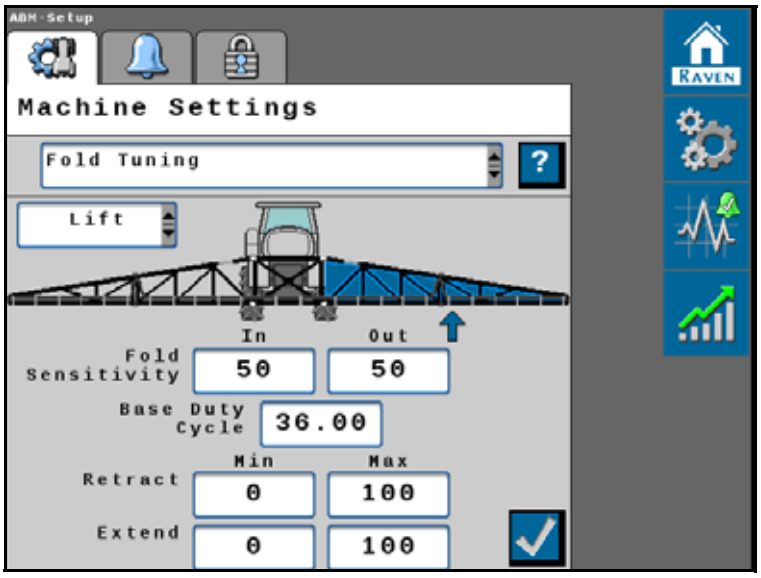
FOLD TUNING

Fold Tuning displays fold settings based on machine configuration (Make, Model, Boom Width) options selected during initial calibration. If needed, the user can adjust Sensitivity, Base Duty Cycle, and the Min/Max values.

1. Sensitivity can be set independently for Up/In and Down/Out. Higher sensitivities correspond to faster movements during manual boom movement.
2. Base Duty Cycle (Lift Only) is the Duty Cycle required to hold the booms level/stationary. Changing this value does not effect the equivalent value for AutoBoom.
3. Min and Max values set the maximum and minimum duty cycle that will be applied to the specified joint when the system is AutoFolding In or Out. The Min/Max values do not affect manual folding operations.

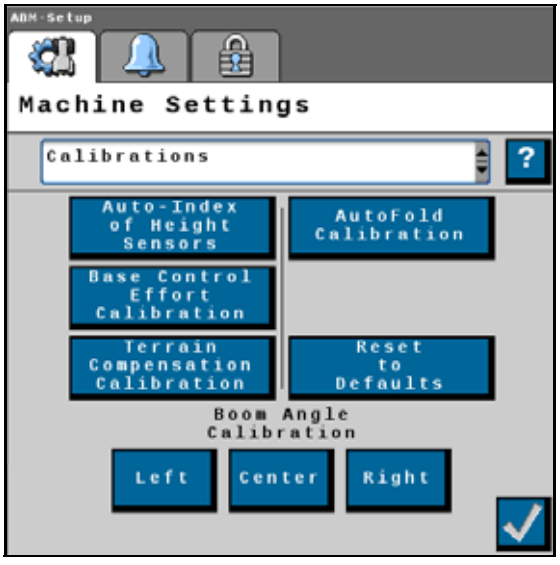
NOTE: These settings are only available for boom joints that have proportional hydraulic cartridges.

FIGURE 13. Preset Configuration



CALIBRATIONS

FIGURE 14. Calibrations

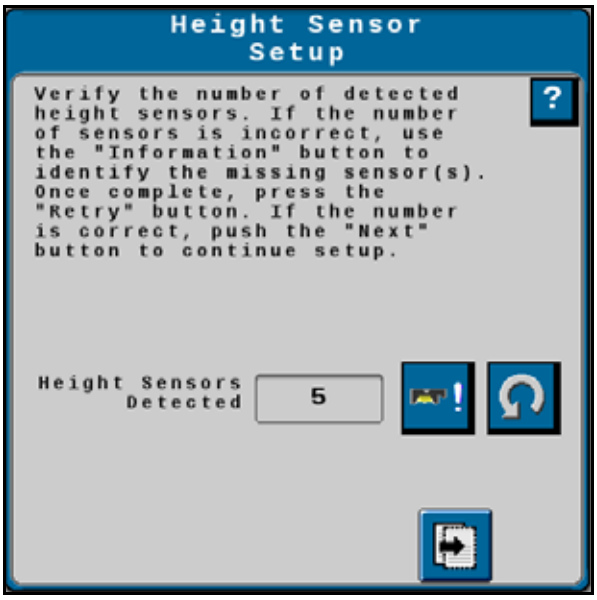


AUTO-INDEX OF HEIGHT SENSORS

The Auto-Index of Height Sensors calibration allows the user to verify the number of height sensors and update the location of the sensors. The user will be prompted to raise the left and right booms. By observing which sensors had the greatest increase in height at each step, the system learns which sensor is at each location on the boom.

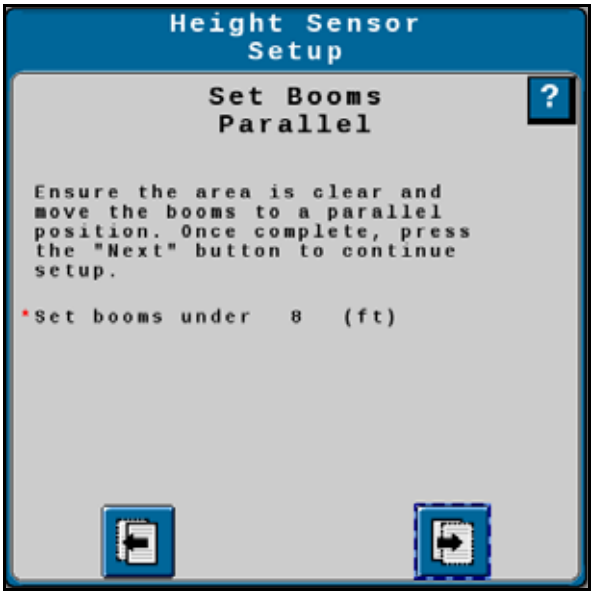
1. Verify the number of height sensors detected matches the number installed on the machine.
2. If all sensors are detected, touch the Next button to continue.

FIGURE 15. Height Sensor Setup - Sensor Indexing



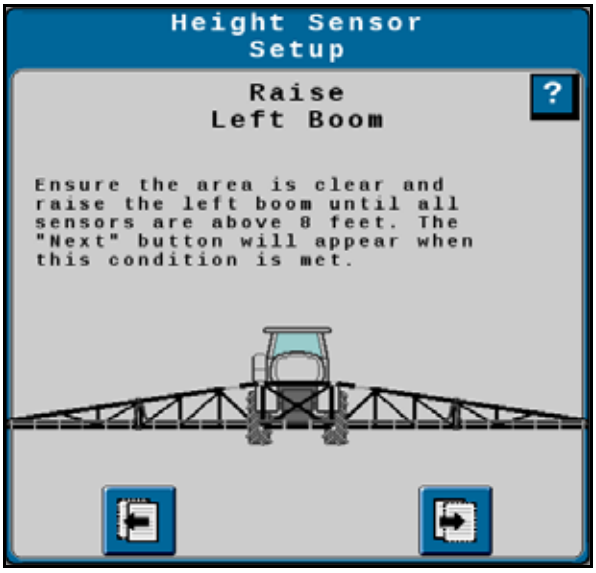
3. Unfold the boom and set the booms to level and less than 8 ft. [2.4 m] above ground.
4. When both booms are unfolded and level, touch the Next button to continue.

FIGURE 16. Height Sensor Setup - Set Booms Parallel



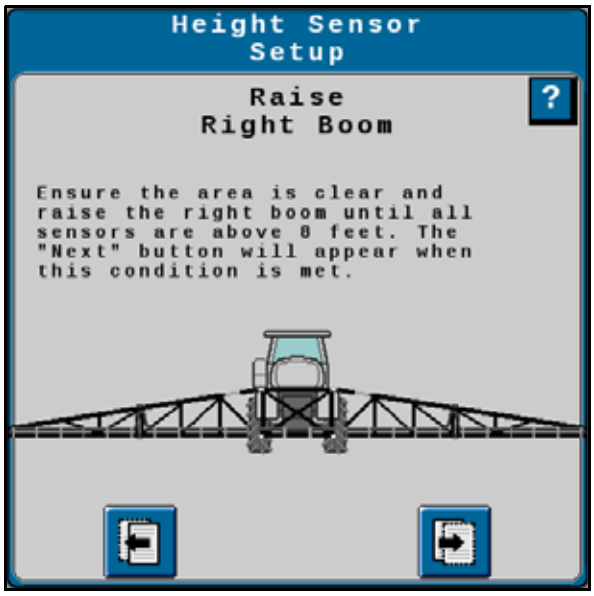
5. Raise the left boom.
6. When all sensors on the left boom have been raised above 8 ft. [2.4 m], the Next button will be displayed. Touch the Next button to continue.

FIGURE 17. Height Sensor Setup - Raise Left Boom



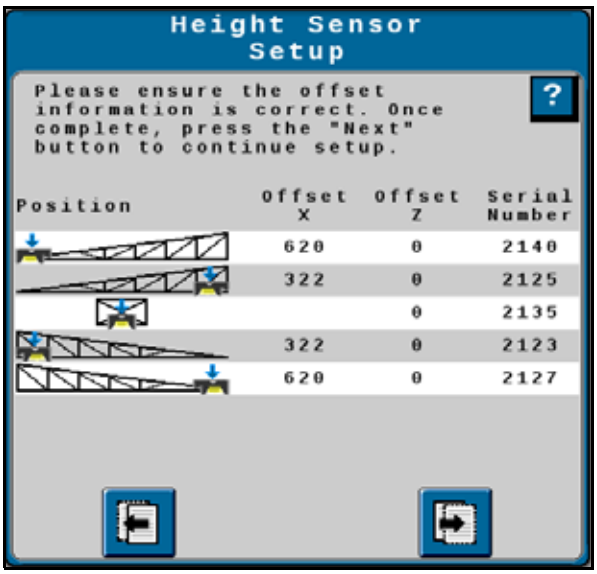
7. Raise the right boom.
8. When all sensors on the right boom have been raised above 8 ft. [2.4 m], the Next button will be displayed. Touch the Next button to continue.

FIGURE 18. Height Sensor Setup - Raise Right Boom



9. The location and offsets for each sensor are displayed on a summary page. This completes the calibration.

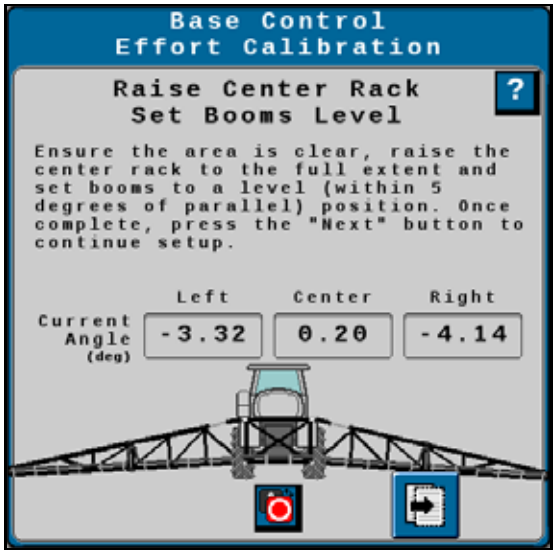
FIGURE 19. Height Sensor Setup - Summary Page Display



BASE CONTROL EFFORT CALIBRATION

Press the Base Control Effort Calibration button to recalibrate the pressure required to hold the booms level and stationary. This will update the Duty Cycle required to keep the booms level.

FIGURE 20. Base Control Effort Calibration



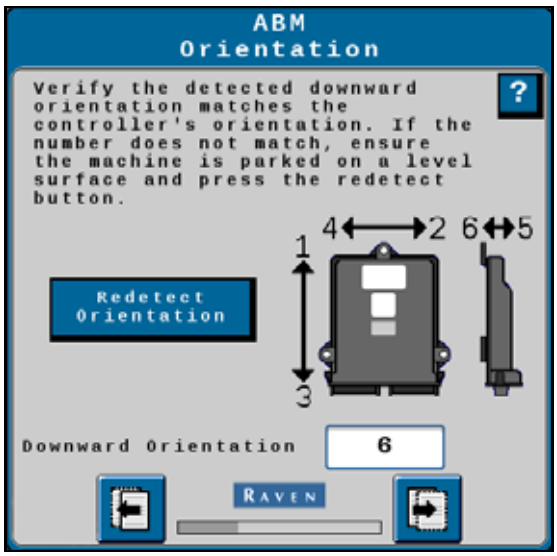
1. Ensure the area around the machine is clear of bystanders and obstacles. The booms will move up and down during this procedure.
2. Unfold the booms fully and set the left and right booms level. The booms must be within 5° of level to proceed with calibration.
3. Toggle the master switch to the on position.
4. Touch the Next button. Note that the booms will begin raising and lowering while this calibration is performed.
5. When calibration is complete, the new values will be displayed.

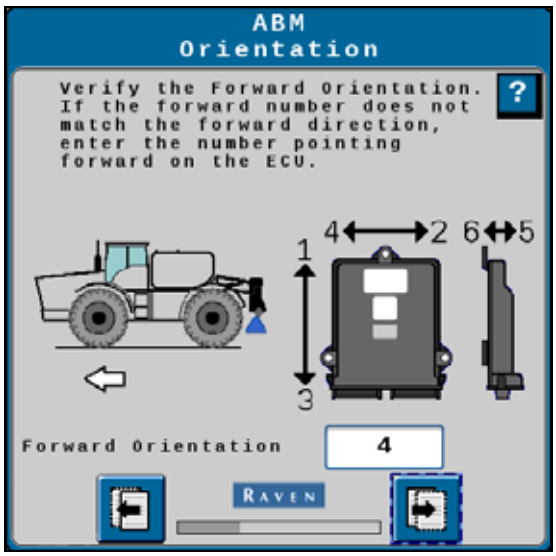
TERRAIN COMPENSATION CALIBRATION

The Terrain Compensation Calibration button allows the user to verify or update the ECU orientation and recalibrate the ABM inertial sensors.

The machine needs to be parked on a level surface prior to performing this calibration.

FIGURE 21. AutoBoom Node Orientation



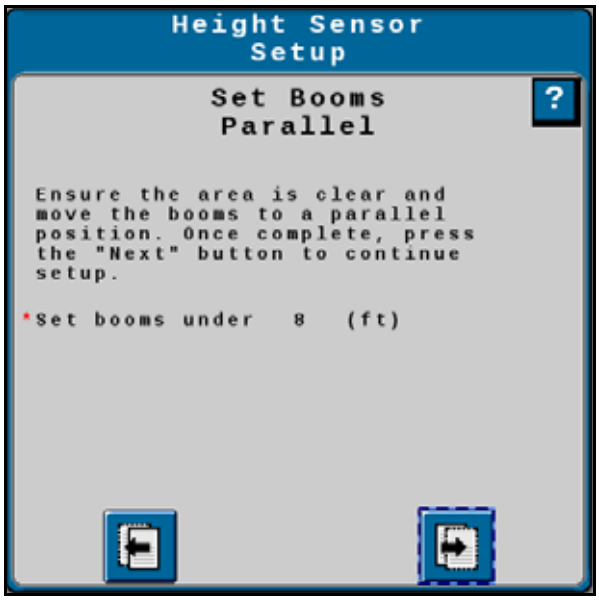


BOOM ANGLE CALIBRATION (LEFT AND RIGHT)

The Boom Angle Calibration button allows the user to recalibrate the boom tilt sensors. This correlates the tilt sensor measurement to an angular boom position.

1. Set the booms parallel and under 8 ft. [2.4 m] from the ground.
2. Press Next.

FIGURE 22. Height Sensor Setup - Set Booms Parallel

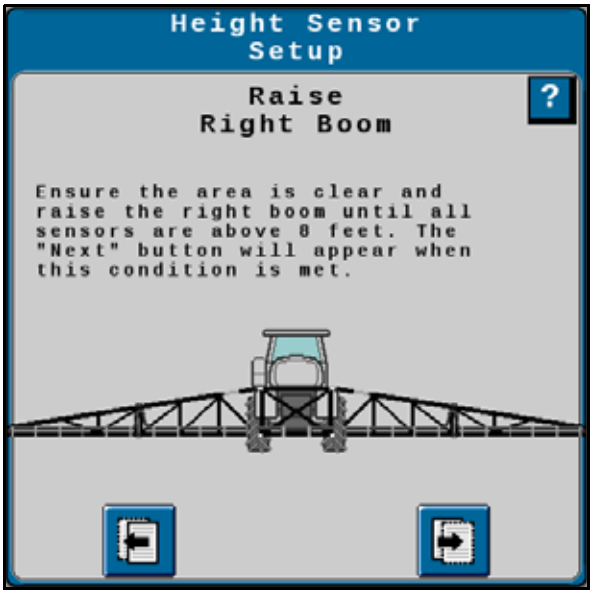


3. Raise the left boom until there is at least a 40 in. [101.6 cm] change in height.
4. Press Next.

FIGURE 23. Height Sensor Setup - Raise Left Boom

5. Raise the right boom until there is at least a 40 in. [101.6 cm] change in height.
6. Press Next.

FIGURE 24. Height Sensor Setup - Raise Right Boom

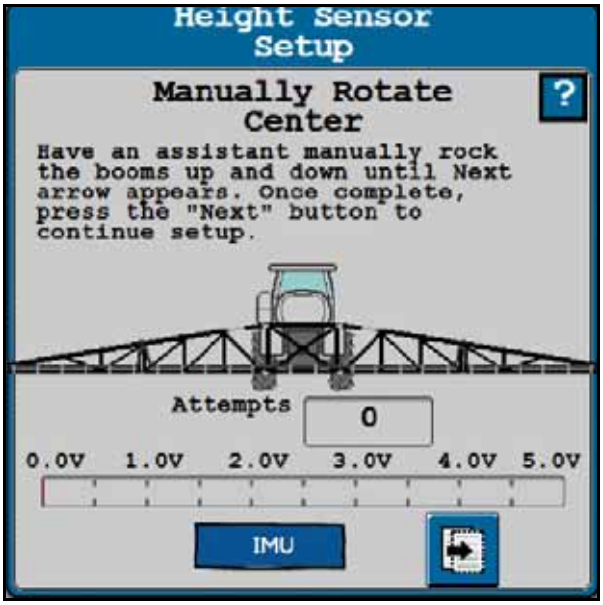


7. Lower and level the booms.

8. Have an assistant manually rock the boom up and down until the Next arrow appears. The Next arrow will only appear when the voltage is more than 0.25 V apart.

NOTE: If an IMU is present, the center angle icon will be used to calibrate the IMU.

FIGURE 25. Center Rack Rotation



AUTOBOOM FOLD CALIBRATION

The AutoBoom Fold Calibration allows the user to update the primary boom fold (Yaw) sensor calibration. These sensors are used to prevent the Master Switch from being turned on if the booms are not unfolded.

1. Fold the boom in so the booms are stored in the transport position.
2. Touch the Next button to continue fold calibration.

FIGURE 26. AutoBoom Fold Setup- Fold Boom In

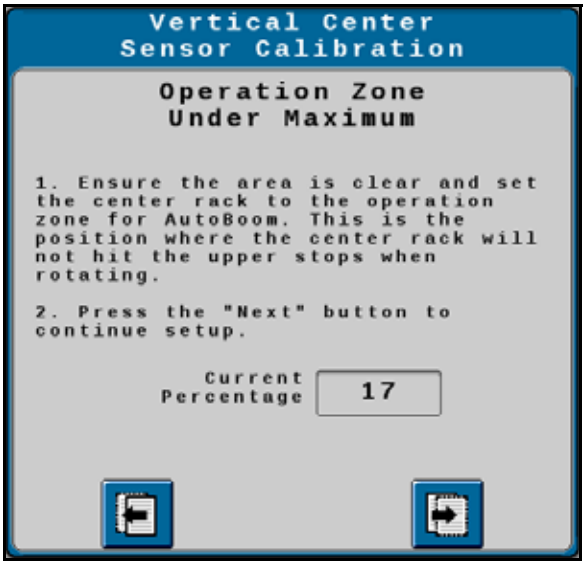
NOTE: Most machines will skip to step 7. If your screen does not match that shown in Figure 30 on page 39, proceed to step 7.

3. Raise the center rack to the maximum height.
4. Touch the Next button to continue the fold calibration.

FIGURE 27. Vertical Center Sensor Calibration - Maximum Height

5. Lower the center rack to the maximum operating position.

FIGURE 28. Vertical Center Sensor Calibration - Operation Zone



NOTE: For AGCO RoGator machines, this is low enough that the center rack is able to rotate freely without hitting the travel stops. This is typically about 4 in. [10 cm] below the maximum center rack height.

6. Touch the Next button to continue the fold calibration.

7. Lower the center rack to a typical operating position and unfold the booms.
8. Touch the Next button to complete the fold calibration.

FIGURE 29. Vertical Center Sensor Calibration - Set to Spray Position

9. Unfold the booms and lower the center rack.
10. Touch the Next button to continue the fold calibration.

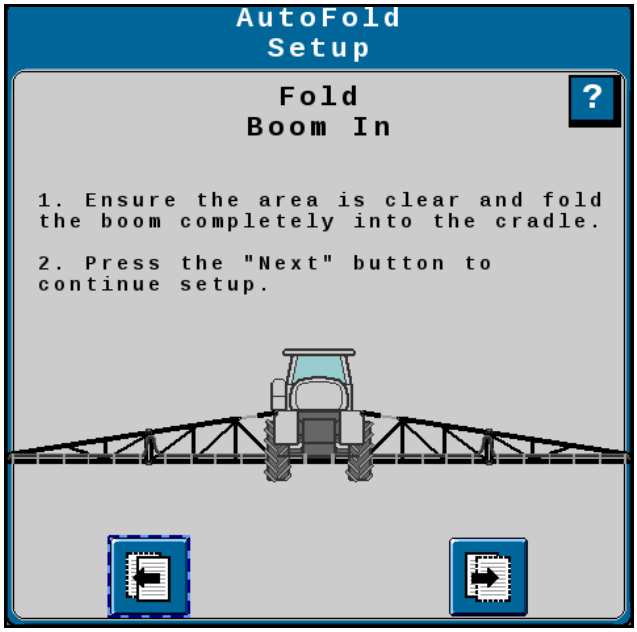
FIGURE 30. Vertical Center Sensor Calibration - Minimum Height

AUTOFOLD CALIBRATION

AutoFold Calibration recalibrates the sensors used for performing automatic folding and fore/aft operations. This should be performed if sensors have been adjusted/replaced, or if AutoFold is not completing an AutoFold IN or AutoFold OUT sequence.

1. Fold the boom and lower the booms completely into the cradle.

FIGURE 31. Set Folded Position

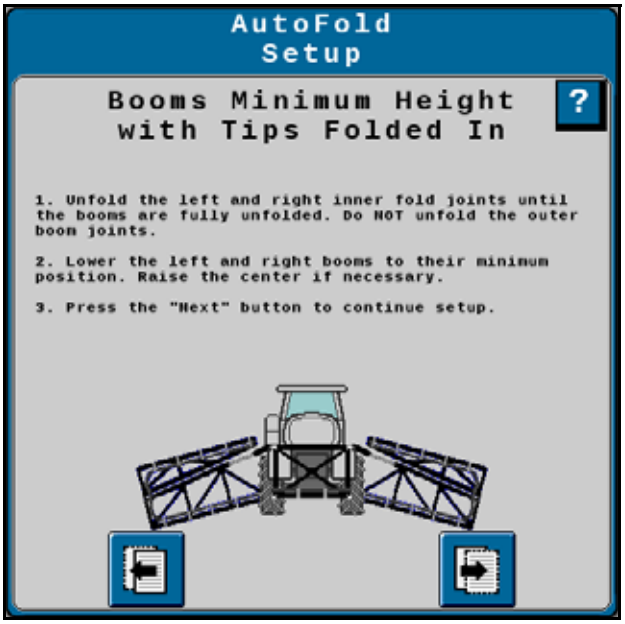


2. Raise the booms above the cradle. This should be mid-way between the height that clears the cradle lip and the maximum allowed height when the booms return to the cradle. This is the height the boom will move to when returning to the cradle.

FIGURE 32. Raise Above Cradle

3. Unfold the left and right *inner* joints fully. Leave the outer joints folded. Tilt the booms down to the fullest travel extent.

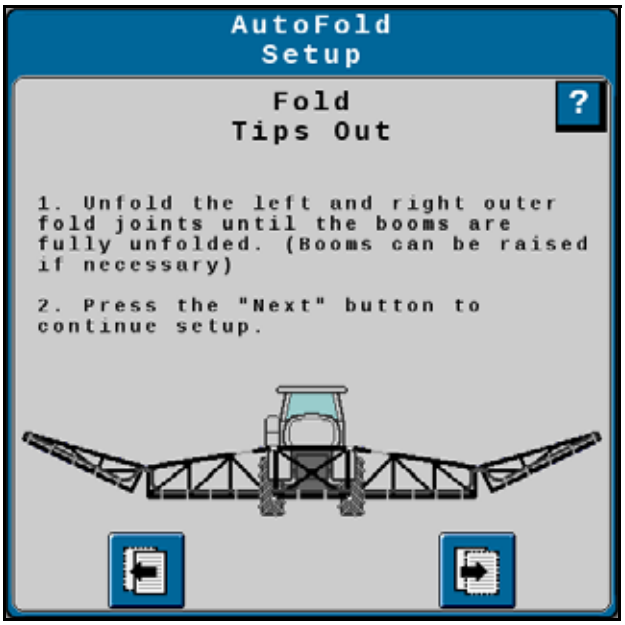
FIGURE 33. Minimum Height



4. Unfold the left and right *outer* joints fully. For three jointed booms, also unfold the middle joints.

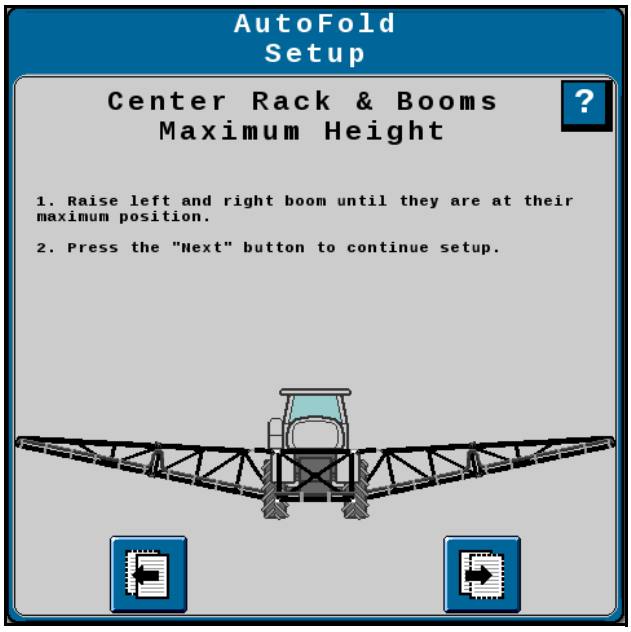
NOTE: The booms may be raised up to complete this step.

FIGURE 34. Fold Tips Out



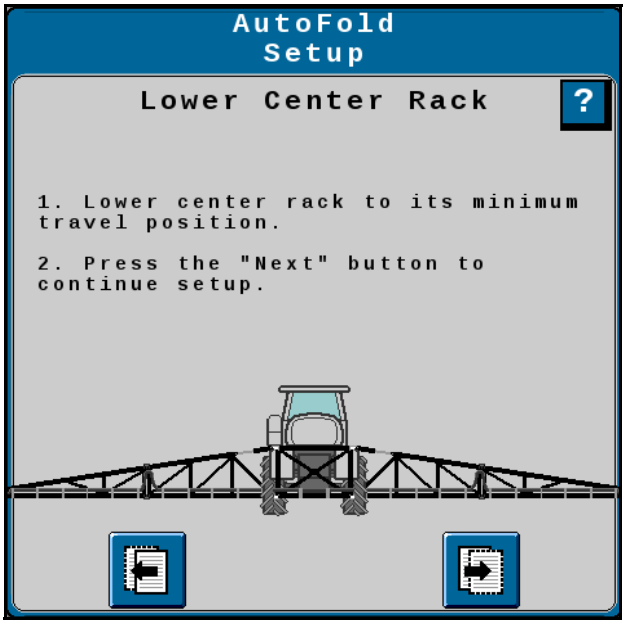
5. Raise the center rack to the maximum height and tilt the booms up to the full travel extent.

FIGURE 35. Raise Center Rack and Booms



6. Lower the center rack to its minimum position. Booms may be tilted down to horizontal.

FIGURE 36. Lower Center Rack



7. Move the booms and center rack to the desired spray position. This is the position the boom will move to when AutoFolding out. Note that the center rack height will be relearned each time an AutoFold in operation is performed. Left and Right tilt will not be relearned.

FIGURE 37. Set Booms and Center Rack to Spray Position

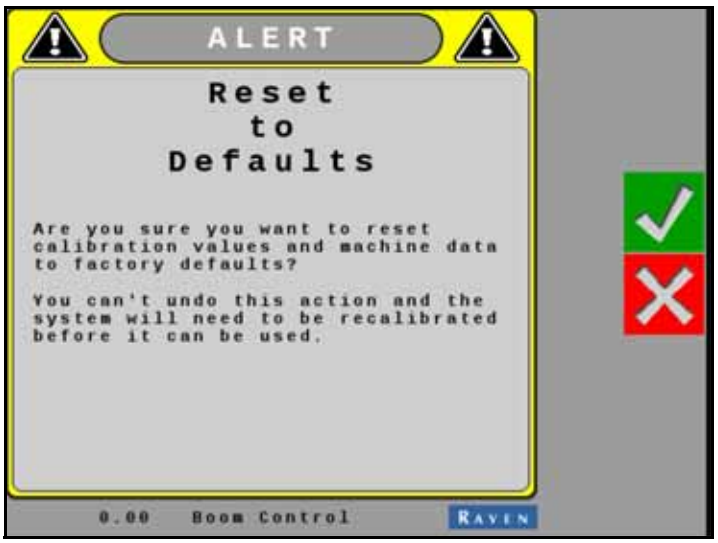
RESET TO DEFAULTS

Selecting Reset to Defaults allows the user to reset AutoBoom XRT to factory default settings.

To reset defaults:

1. Press the Reset to Defaults button in the *Calibrations* screen.

FIGURE 38. Reset to Defaults

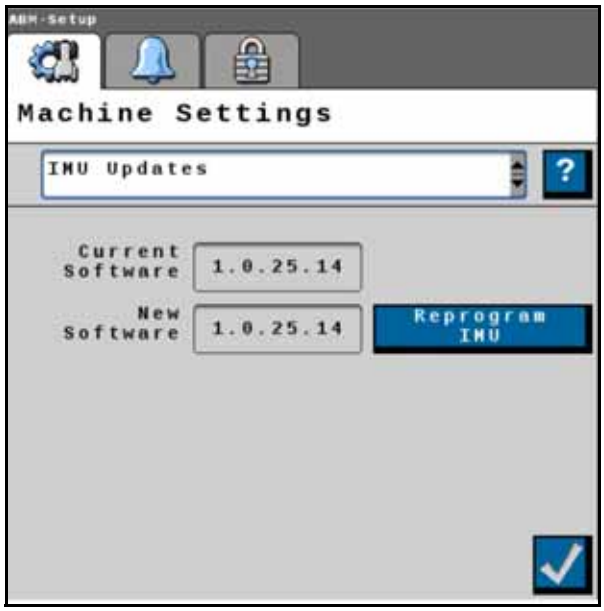


NOTE: Unlocks will not be erased during the reset.

IMU UPDATE

The *IMU Updates* page displays the current software information and any possible new software information. To update the IMU software, select Reprogram IMU.

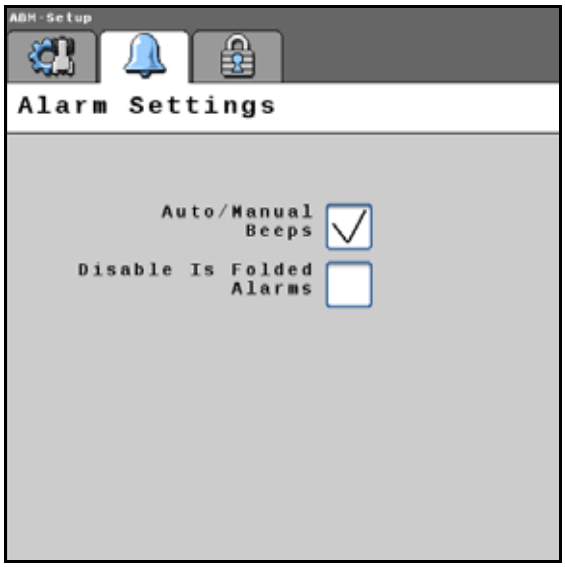
FIGURE 39. IMU Updates



ALARM SETTINGS

The Alarm Settings tab provides the option to sound audible beeps from the display when AutoBoom transitions from Auto mode to Manual and Manual mode to Auto.

FIGURE 40. Alarm Settings

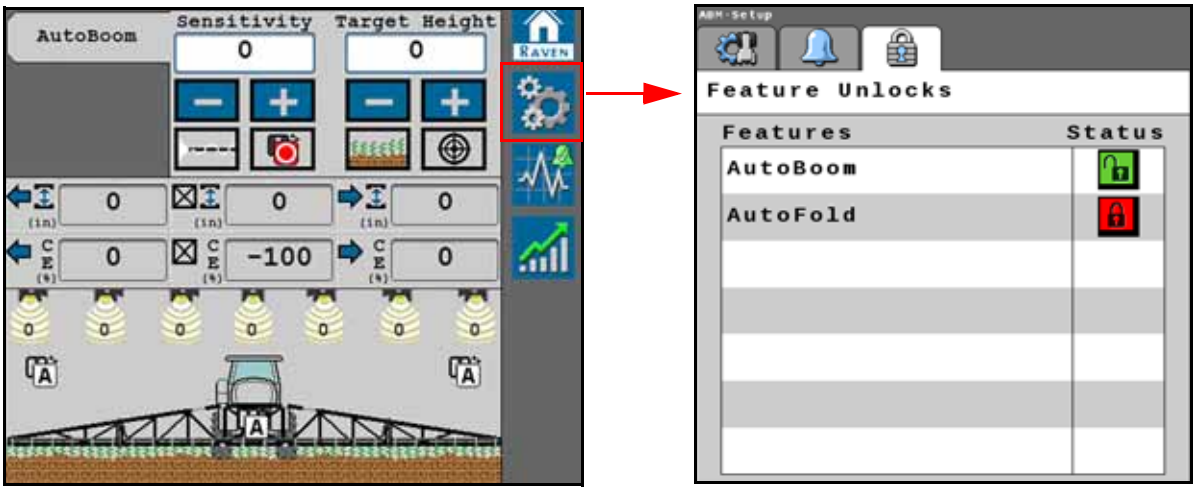


FEATURE UNLOCK CODES

The Unlocks tab displays a green padlock next to features that are already unlocked. A red padlock is displayed next to features that are not unlocked.

A feature unlock code is required to activate additional AutoBoom XRT features. Contact your local Raven dealer to purchase feature unlock codes.

FIGURE 41. Feature Unlock Screen



To enter a feature unlock code and enable a feature:

1. Select Settings on the XRT home screen.
2. Select the Unlocks tab.
3. Select the padlock icon next to the feature to be unlocked.
4. Enter the feature unlock code.

NOTE: Dashes may be omitted, letters may be entered in either upper or lower case.

5. Touch the checkbox to submit the entered code.

NOTE: A message will display indicating whether or not the unlock code that was entered is valid. If the code is valid, the padlock icon next to the feature will turn green and indicate that it is unlocked as shown in Figure 41 on page 45.

After unlocking a feature, a calibration is required before any XRT function can be used.

CHAPTER 6 AUTOBOOM XRT ADVANCED TUNING

PREPARATION

SENSOR DIMENSIONS

Verify the system dimensions are entered correctly for height sensor offsets and center rack width.

BOOM ANGLE SENSOR

Ensure the automated calibration sequence is performed over flat ground. If the sensor dimensions were updated, re-perform the boom angle sensor calibration.

HYDRAULIC OIL

For best results, perform tuning with the hydraulic oil at normal operating temperature.

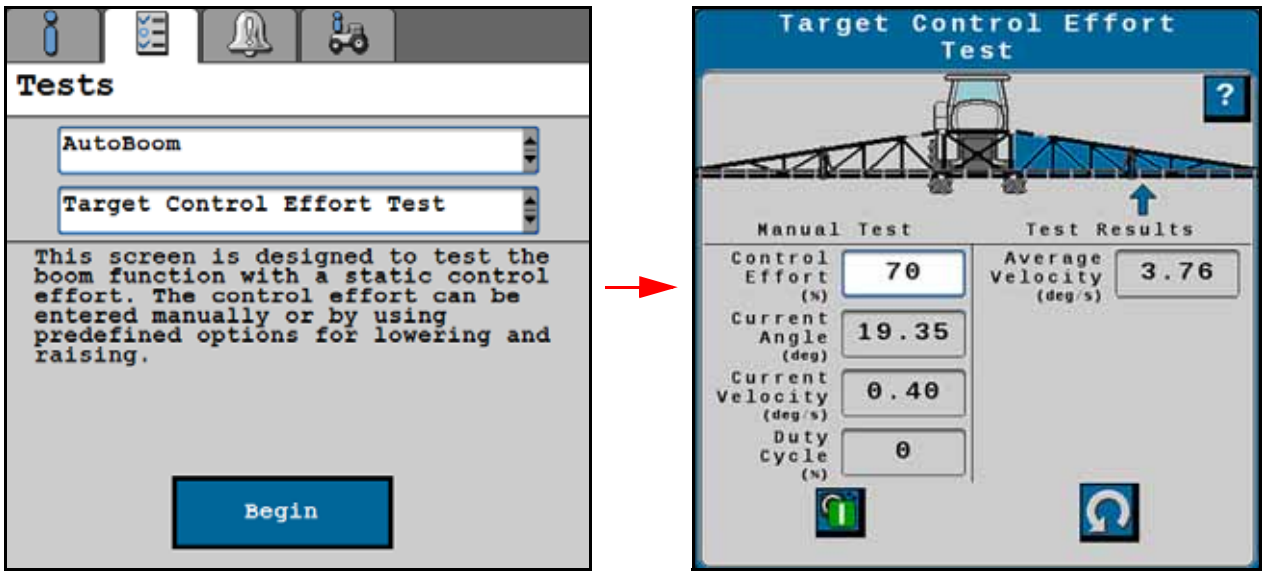
BASE CONTROL EFFORT CALIBRATION

Accurate base control effort values are necessary for successful advanced tuning. Only perform a Base Control Effort Calibration after warming the hydraulic oil. If possible, engage AutoBoom and drive slowly for two minutes prior to performing Base Control Effort calibration. This will ensure the Solenoid coils are at operating temperature and will give the most accurate Base Control Effort.

TARGET CONTROL EFFORT TEST

1. Select Diagnostics.
2. Select Tests.
3. Select Target Control Effort Test.

FIGURE 1. Target Control Effort Test



4. Press Begin Test.
5. If the boom moves up or down, Adjust Control Effort accordingly to result in no or very slow boom movement.
6. Repeat step 1 through step 5 until the desired results are achieved.

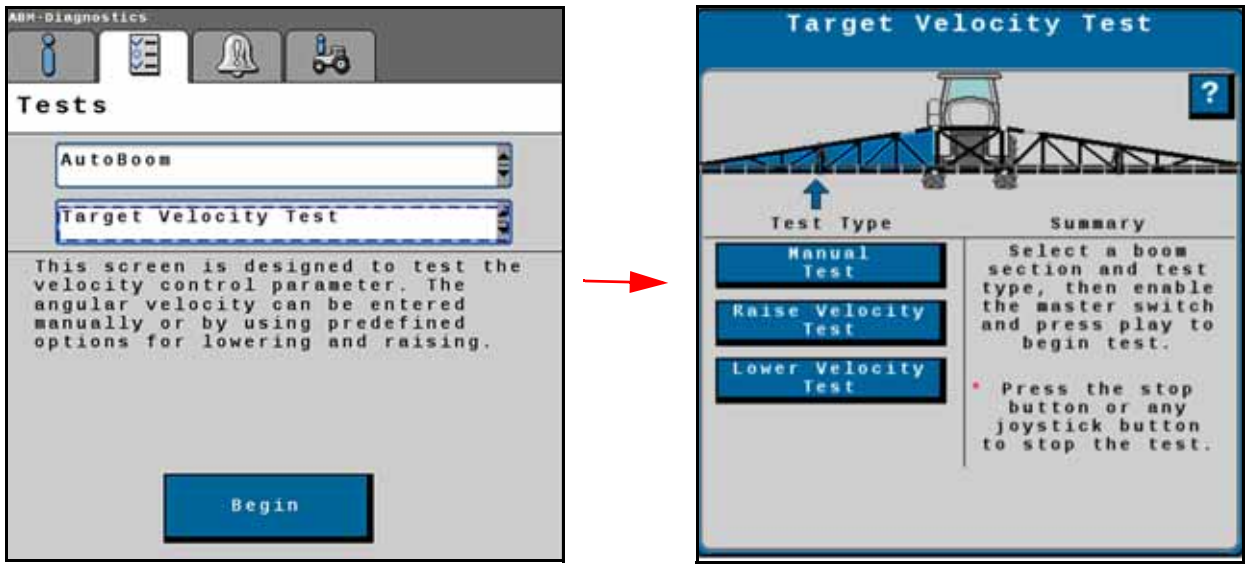
NOTE: Control effort must be performed on each side of the boom by selecting or highlighting each boom on screen.

BOOM SPEED TO CONTROL EFFORT SCALE

The boom speed to control effort scale value correlates the required PWM duty cycle to the hydraulic valve to create the desired boom speed. To determine the boom speed to control effort scale:

1. Select Diagnostics.
2. Select Tests.
3. Select Target Velocity Test.

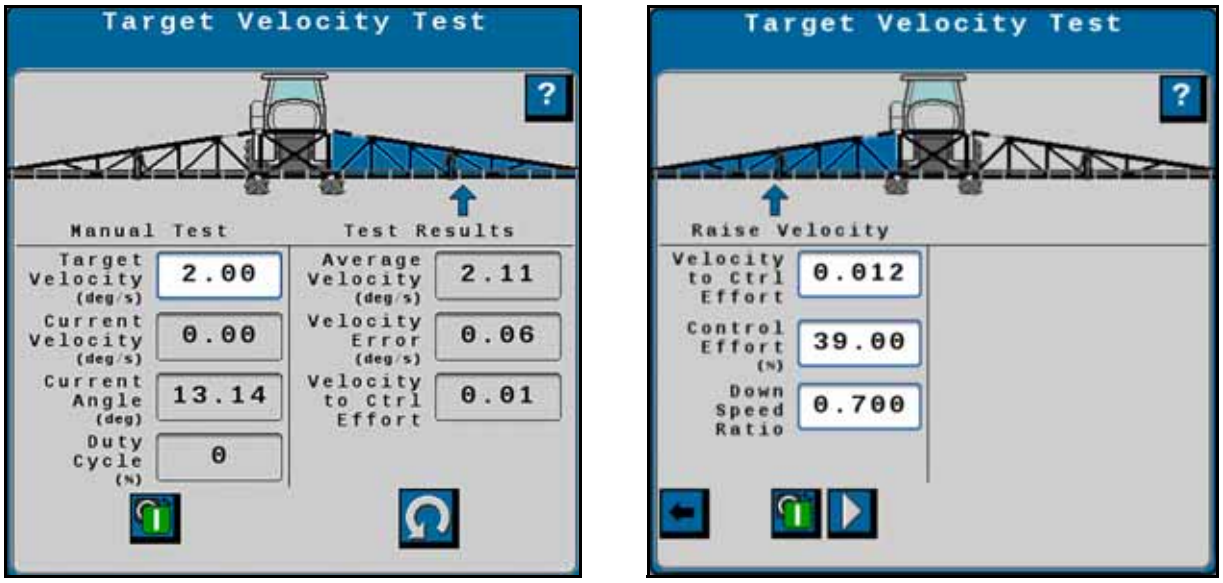
FIGURE 2. Target Velocity Test



4. Press Begin Test.
5. Set the Target Velocity to 2° per second.
6. Raise the center rack with one boom lowered near the ground (but at least 24” above the ground).
7. Press Start Test. The boom should raise. When the test is complete, the average velocity will display.
8. Press the Settings (small gear) on the tab.

9. If the boom moved faster than the desired 2° per second, decrease the Boom Speed to control effort value. If the boom moved slower than the desired 2° per second, increase the Boom Speed to control effort value.

FIGURE 3. Target Velocity Test Results



10. Repeat step 3 through step 9 until the speed matches the target velocity (+/- 20%).
11. Repeat step 3 through step 10 for the other boom.

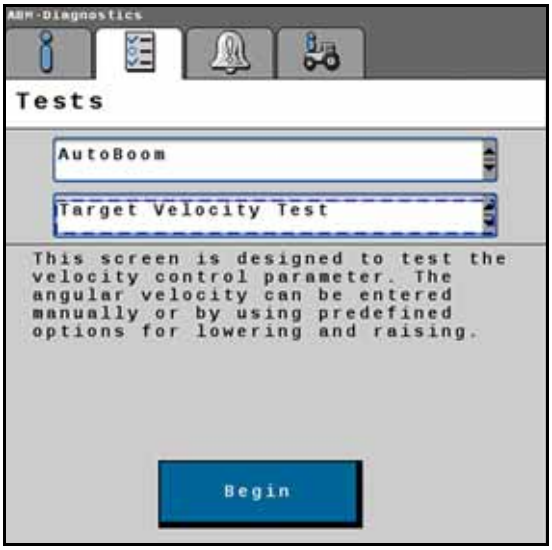
NOTE: Test results are affected by solenoid coil temperature. Perform the tests three or more times in rapid succession for best results.

DOWN SPEED RATIO

Because of different flow restrictions and the affect of gravity, booms generally lower faster than the raise for the same change in control effort. Down speed ratio accounts for this difference.

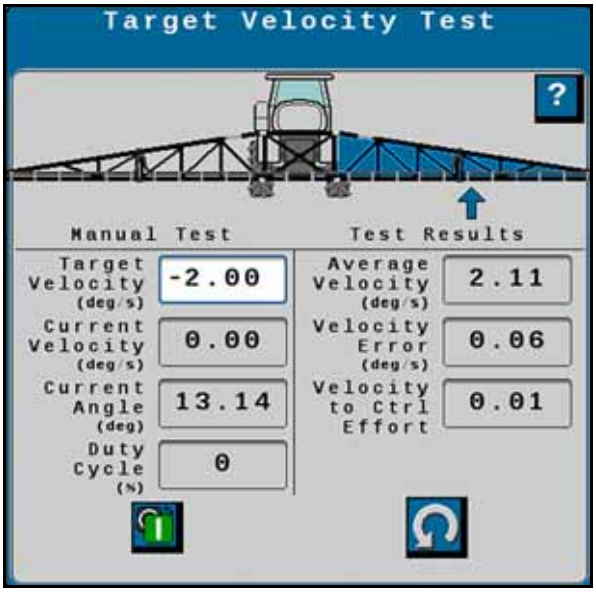
1. Select Diagnostics.
2. Select Tests.
3. Select Target Velocity Test.

FIGURE 4. Target Velocity Test



4. Press Begin Test.
5. Set the Target Velocity to -2° per second.
6. Raise the center rack and tilt one boom so the boom is approximately 5° above horizontal.
7. Press Start Test. The boom should lower. When the test is complete, the average velocity will display.
8. Press the Settings (small gear) on the tab.
9. If the boom moved faster than the desired 2° per second, decrease the Down Speed Ratio. If the boom moved slower than the desired 2° per second, increase the Down Speed Ratio value.

FIGURE 5. Down Speed Ratio Test Results



10. Repeat step 3 through step 9 until the speed matches the target velocity (+/- 20%).
11. Repeat step 3 through step 10 for the other boom.

NOTE: Test results are affected by coil temperature. Perform the tests three or more times in rapid succession for best results.

At this point most machines should be performing optimally. If further tuning is necessary, continue through these additional steps. Test the machine performance in the field before adjusting Boom Gains.

BOOM GAINS

After verifying all of the previous configuration steps and Boom Speed tuning is complete, the following values may be adjusted by going to Machine Settings and then Boom Tuning.

PROPORTIONAL GAIN

Larger proportional gain (P-Gain) values result in higher velocity for the same error in height. Typical values are 1.0 - 1.8. Too high of value will make the boom twitchy or unstable. Too low of a value and the boom will not move quickly enough to changes in ground/crop height.

INTEGRAL GAIN

Integral Gain (I-Gain) compensates for changes in Base control effort over time. This could be caused by oil temperature, valve coil temperature, boom weight, or other system changes. This is generally set between 0.001 and 0.003. To disable this feature, set the value to 0.000.

DERIVATIVE GAIN

Derivative Gain (D-Gain) prevents overshoot when moving the boom from one target position to another. If D-Gain is too low the boom will overshoot the target position. A D-Gain that is too high may cause a ratcheting (stop and go) effect until the target position is reached.

SYSTEM GAIN

System Gain (S-Gain) makes the complete system more or less responsive. This is equivalent to the Sensitivity value on the *XRT Home* screen.

CHAPTER 7 DIAGNOSTICS AND TROUBLESHOOTING

SYSTEM INFORMATION

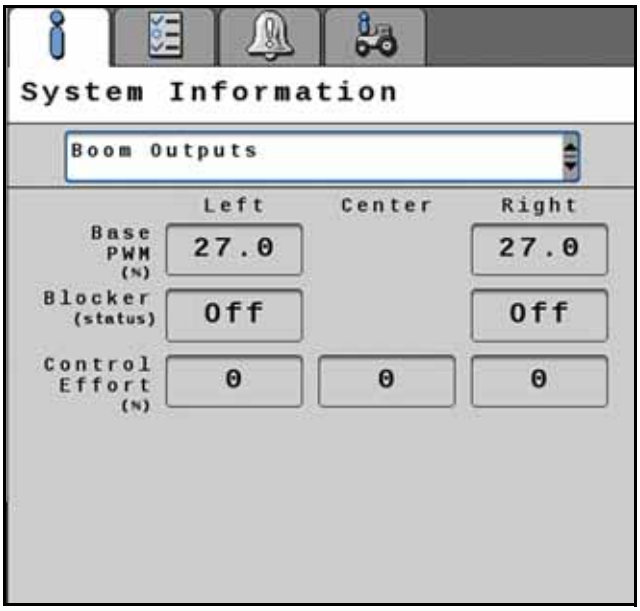
To access the *System Information* window:

1. Select the Diagnostics  icon.
2. Select the System Information tab.

BOOM OUTPUTS

The *Boom Outputs* window displays the Base PWM (%), Blocker (status), and Control Effort (%).

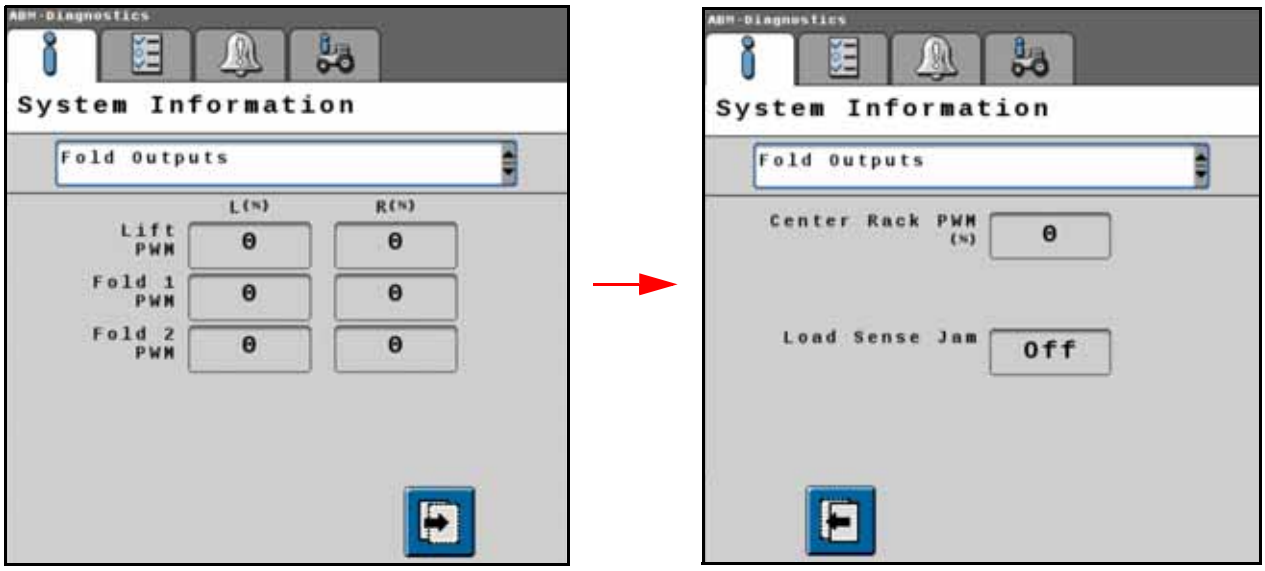
FIGURE 1. Boom Outputs



FOLD OUTPUTS

The *Fold Outputs* window displays Control Effort (%) for each joint on the boom.

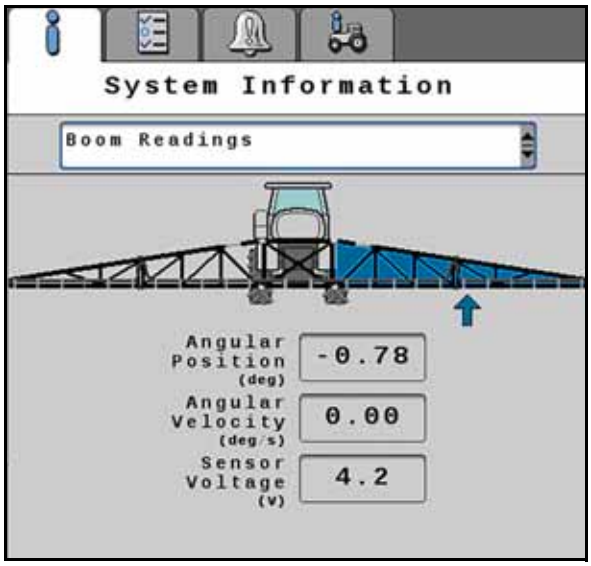
FIGURE 2. Fold Outputs



BOOM READINGS

The *Boom Readings* window displays the boom position, velocity, and the Sensor Voltage of the selected boom. Press the desired boom or center rack boom to view the information for that section. Voltage and angular position should change smoothly through the range of movement. Angular Position should be close to zero when the boom section is horizontal.

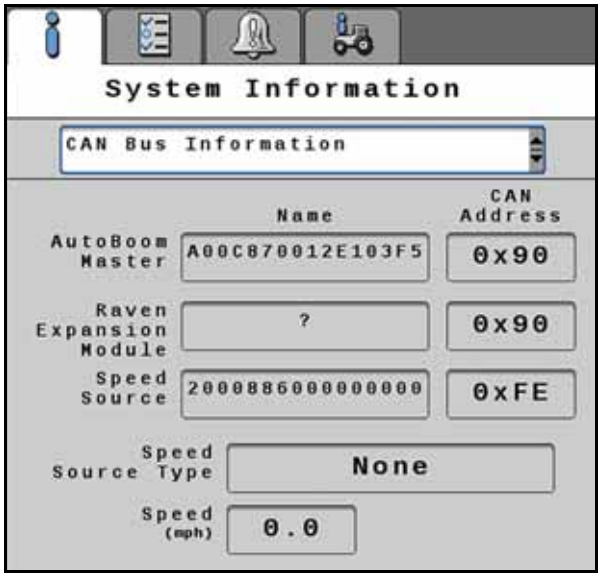
FIGURE 3. Boom Readings



CAN BUS INFORMATION

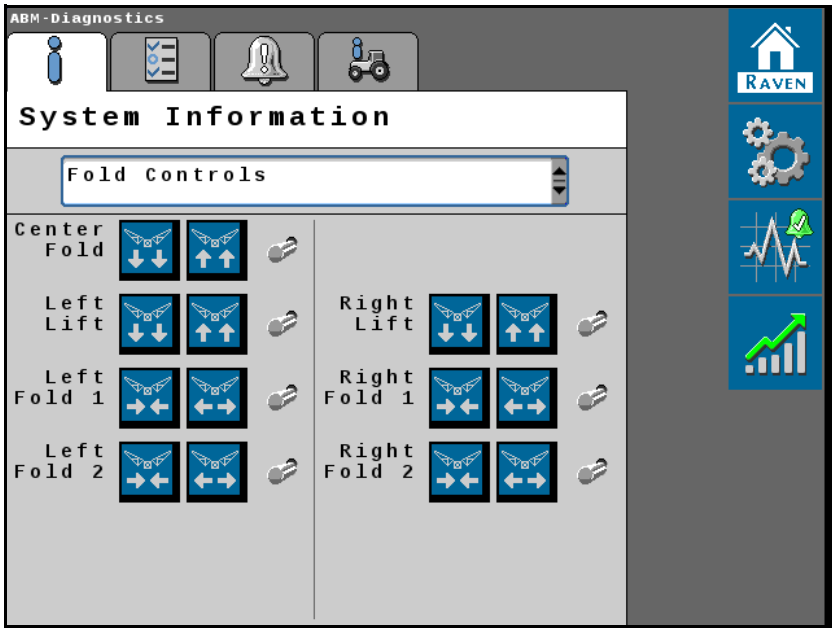
The *CAN Bus Information* window displays information about CAN system.

FIGURE 4. CAN Bus Information



FOLD CONTROLS

FIGURE 5. Fold Controls



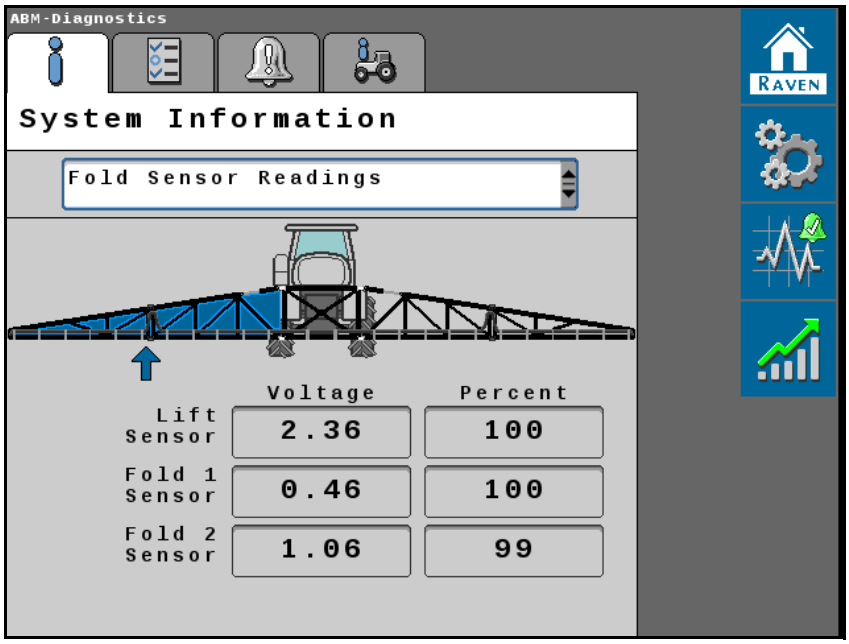
Manually control each section of the boom.

NOTE: Depending upon your machine's configuration, not all sections may be available to control on this page and some displayed sections may not be controlled via the displayed buttons.

FOLD SENSOR READINGS

Displays the voltage reading for each fold joint. If AutoFold is unlocked a percent position is also displayed. 0% is fully folded and 100% is fully unfolded.

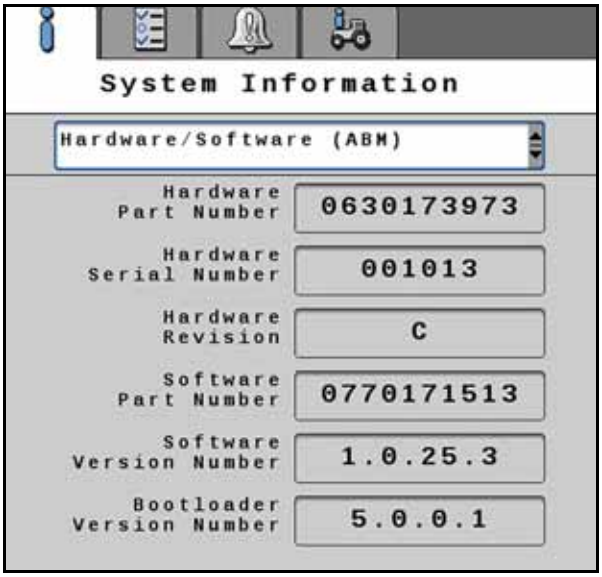
FIGURE 6. Fold Sensor Readings



HARDWARE/SOFTWARE (ABM)

The *Hardware/Software (ABM)* window displays the AutoBoom hardware and software number and versions.

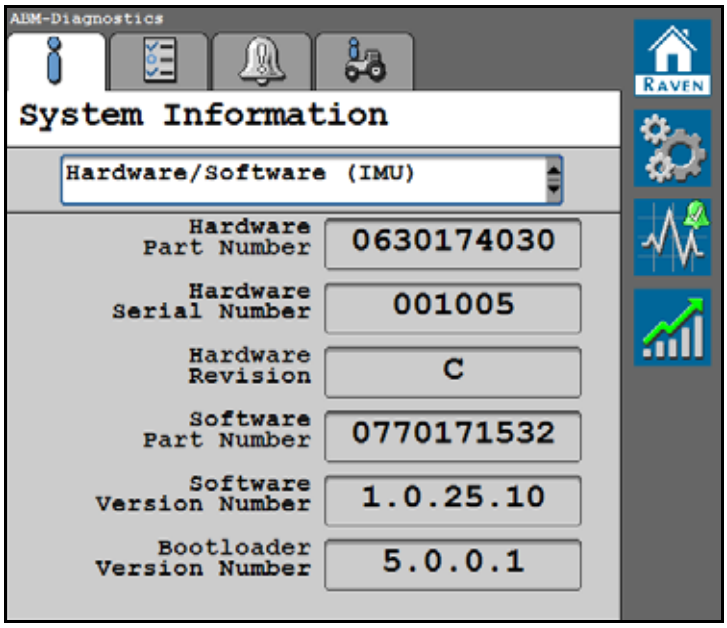
FIGURE 7. Hardware/Software (ABM)



HARDWARE/SOFTWARE (IMU)

The *Hardware/Software (IMU)* window displays the IMU hardware and software number and versions.

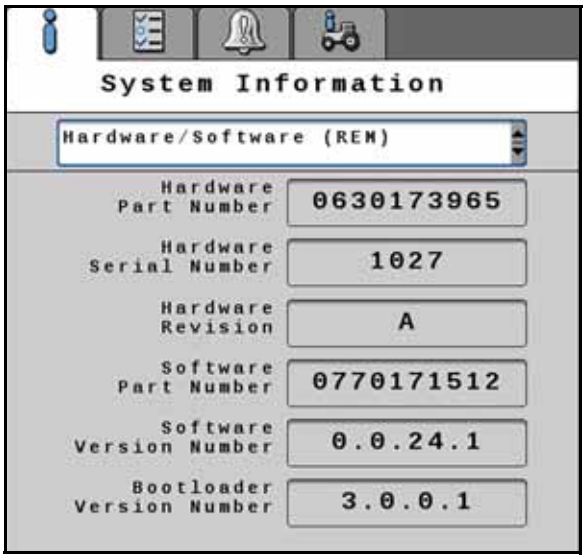
FIGURE 8. Hardware/Software (IMU)



HARDWARE/SOFTWARE (REM)

The *Hardware/Software (REM)* window displays the hardware and software number and version for the Raven Expansion Module (REM).

FIGURE 9. Hardware/Software (REM)

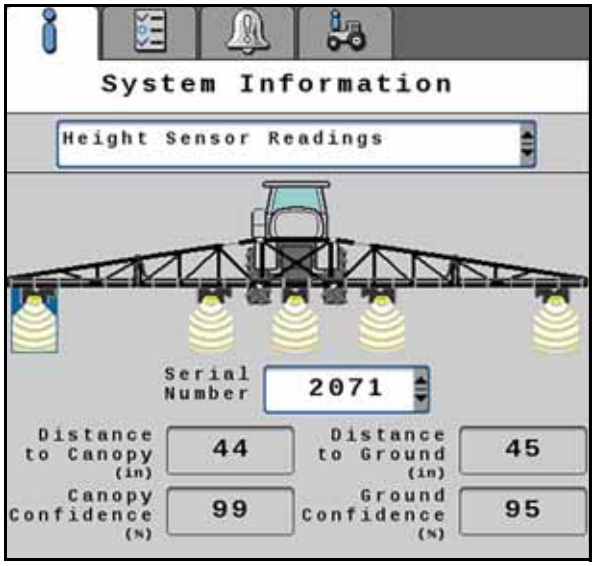


7

HEIGHT SENSOR READINGS

The *Height Sensor Reading* window displays the sensor Serial Number, Distance to Canopy, Distance to Ground, Canopy Confidence, and Ground Confidence percentages for the selected sensor.

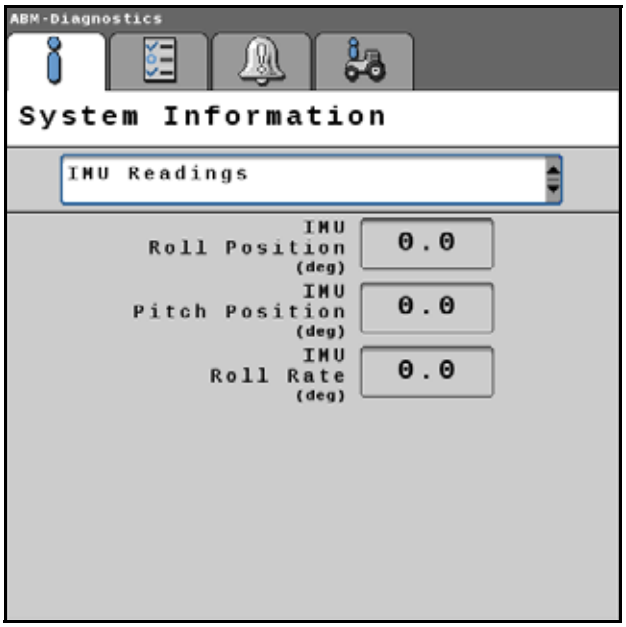
FIGURE 10. Height Sensor Reading



IMU READINGS

The *IMU Readings* window displays the IMU Roll Position, IMU Pitch Position, and IMU Roll Rate.

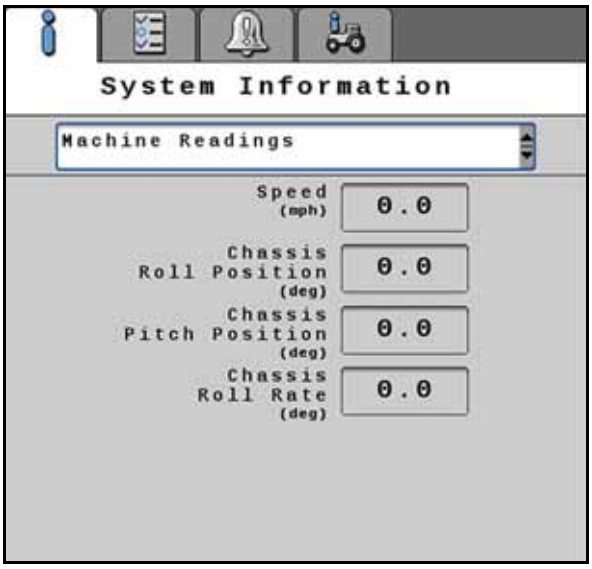
FIGURE 11. IMU Readings



MACHINE READINGS

The *Machine Readings* window displays the current machine Speed, Chassis Roll Position, Chassis Pitch Position, and Chassis Roll Rate.

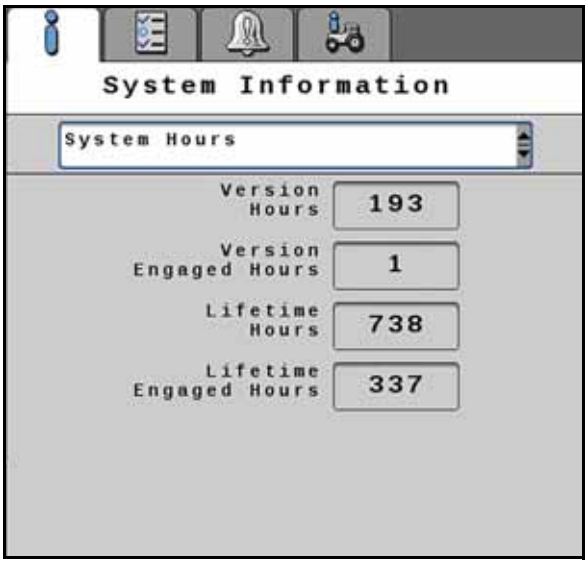
FIGURE 12. Machine Readings



SYSTEM HOURS

The *System Hours* window displays the current Version Hours, Version Engaged Hours, Lifetime Hours, Lifetime Engaged Hours.

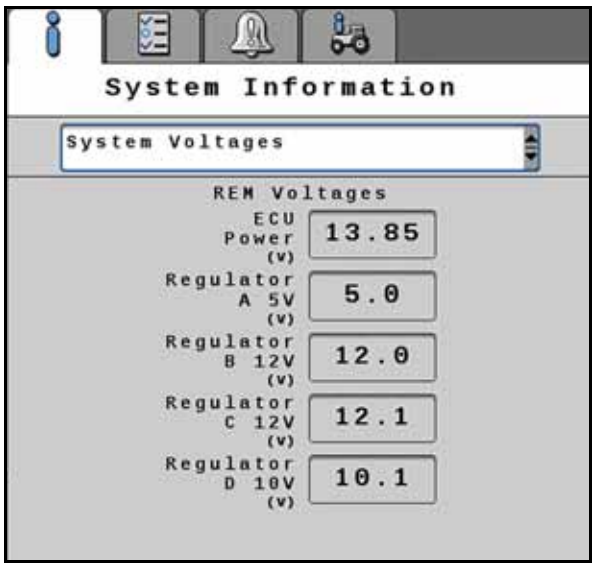
FIGURE 13. System Hours



SYSTEM VOLTAGES

The *System Voltages* window displays the ECU Power and the Regulator voltages.

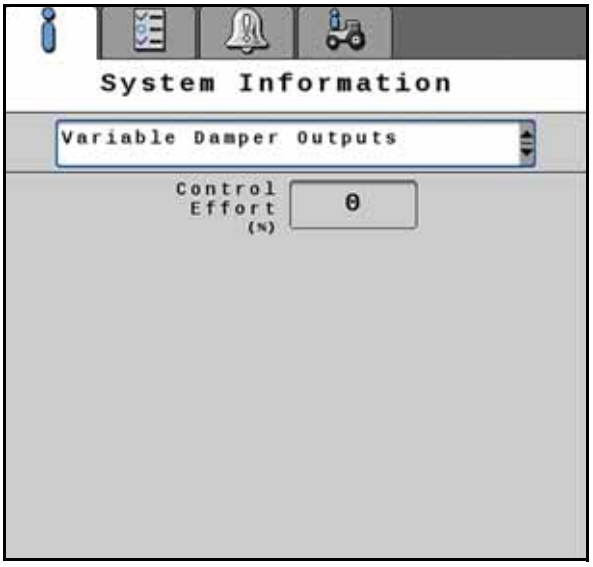
FIGURE 14. System Voltages



VARIABLE DAMPER OUTPUTS

The *Variable Damper Outputs* window displays the Control Effort for the variable damper.

FIGURE 15. Variable Damper Outputs

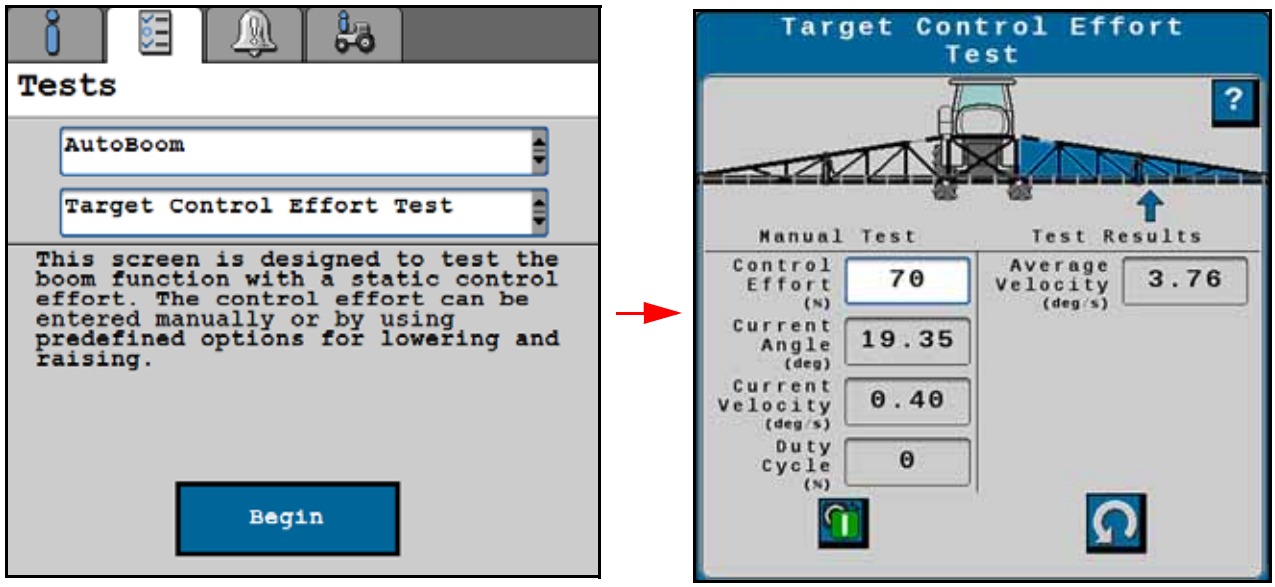


TESTS

TARGET CONTROL EFFORT TEST

The Target Control Effort Test tests boom function with a static control effort. Entering a Control Effort value equal to the Base Duty Cycle should result in no, or very slow boom movement. Higher values will cause the boom to raise and lower values will cause the boom to go down.

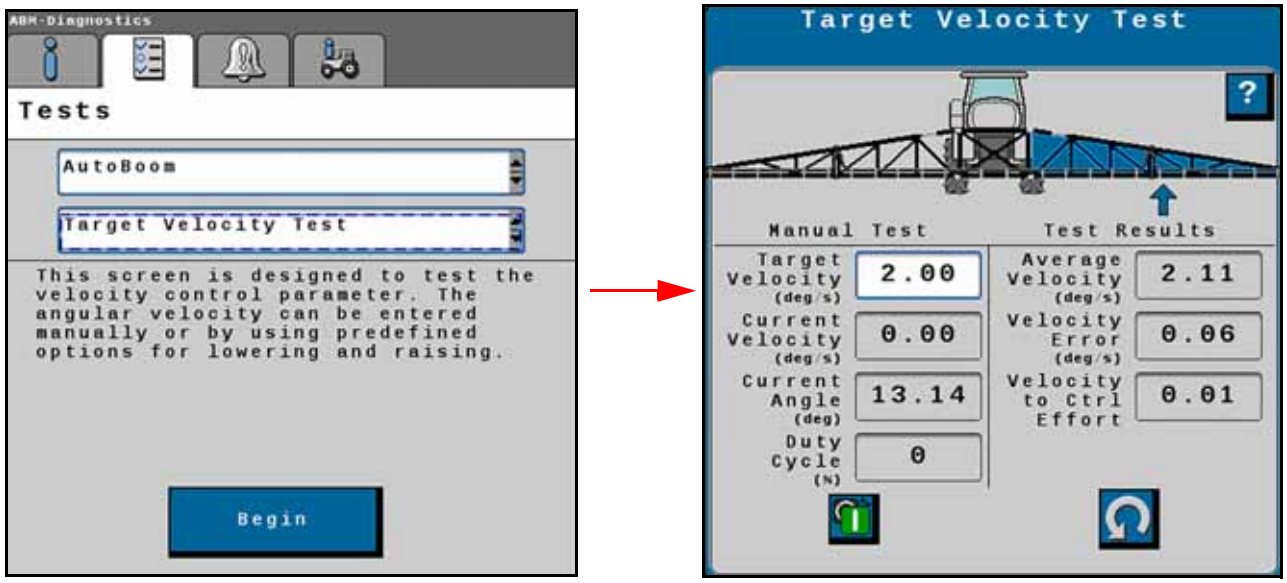
FIGURE 16. Target Control Effort Test



TARGET VELOCITY TEST

The Target Velocity Test tests the velocity control parameter by either manually entering the angular velocity or by using predefined options. Tests are generally performed at +/-2° per second. Before starting the test, manually move the boom to a position where it can travel up (or down) for five seconds. After running the tests an Average Velocity will display. This should be within 20% of the Target Velocity. If additional adjustments are required, refer to “AutoBoom XRT Advanced Tuning” on page 47.

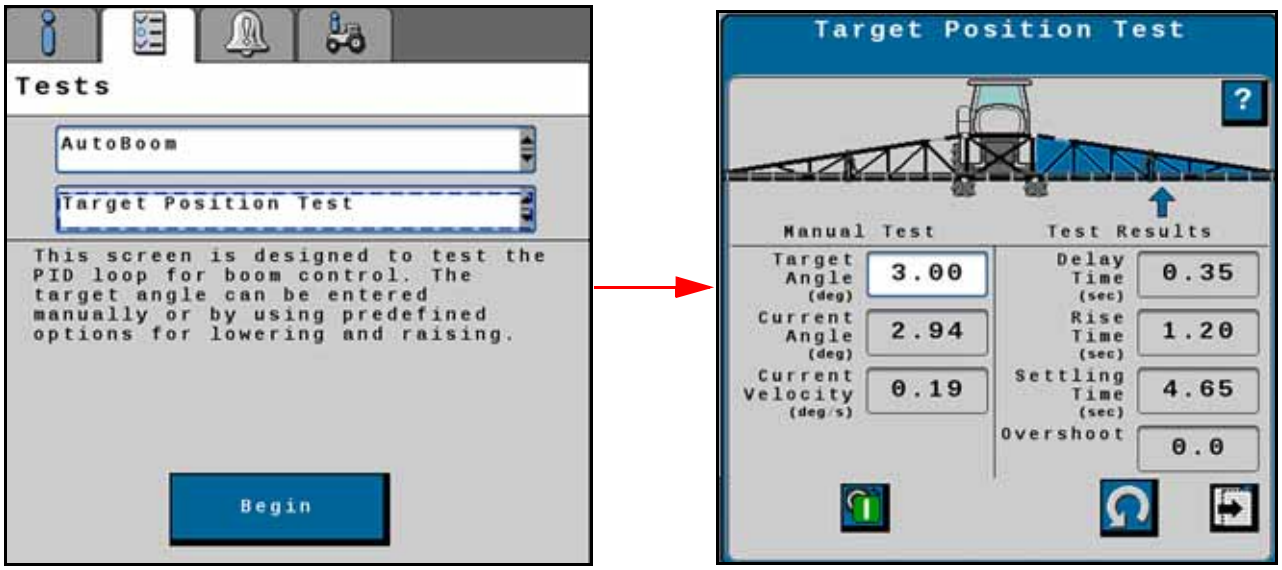
FIGURE 17. Target Velocity Test



TARGET POSITION TEST

This test is designed to test the boom control PID loop. Enter a target position several degrees away from the current position in the Target Angle field. After running the test, various values will be reported. These values represent how quickly the boom moved to the target position. Ideally, the Delay, Rise, Settling, and Overshoot values are low.

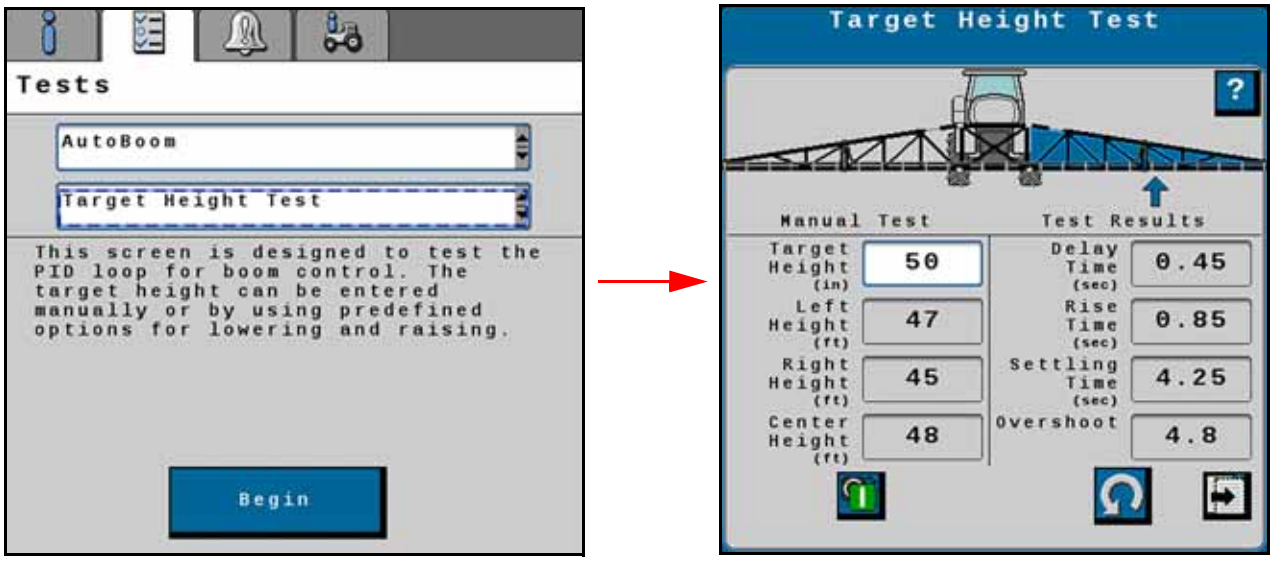
FIGURE 18. Target Position Test



TARGET HEIGHT TEST

This test is similar to the Target Position Test but incorporates all of the sensors on the machine to control the ground height.

FIGURE 19. Target Height Test



TERRAIN COMPENSATION TEST

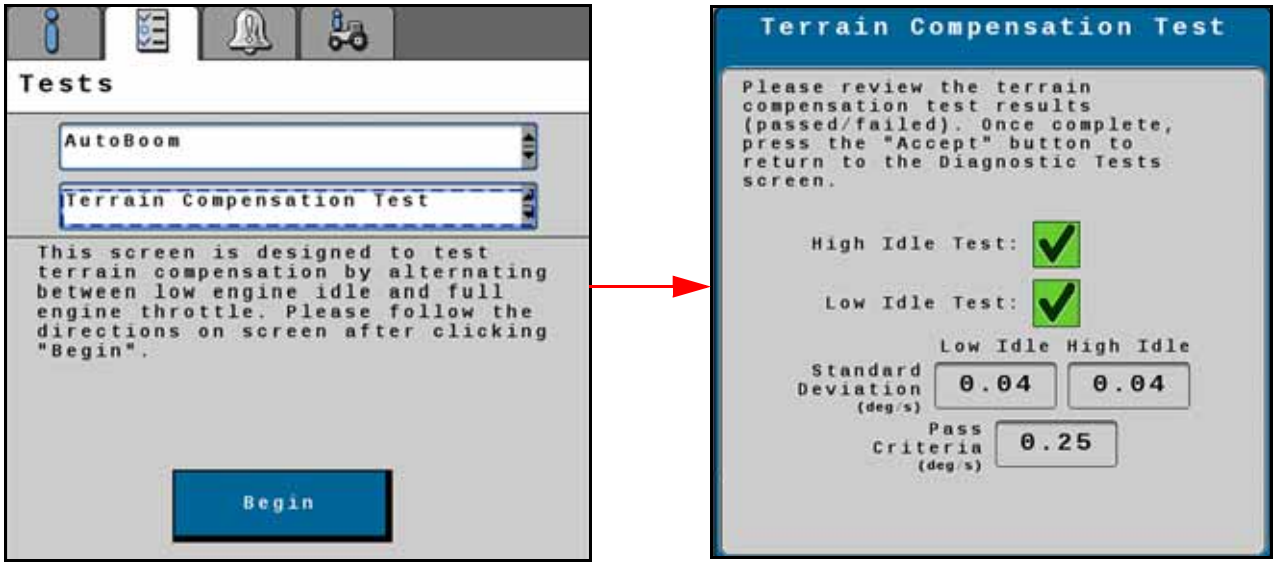
The Terrain Compensation Test analyzes data from the inertial sensors in the XRT ABM ECU.

At the start of the test, the user is asked to have the engine idling at low speed. Next the user is asked to run the engine at typical operating RPM. The test reports a pass or fail for each engine speed. If the test fails, engine vibrations may be having a negative impact on system performance.

NOTE: If the test fails, check the node installation. Verify the node is mounted securely and has not come lose during operation. Also confirm that the node is mounted as instructed in the AutoBoom XRT machine specific installation manual.

The AutoBoom XRT system will still operate if the test fails, however, terrain compensation features may not offer optimal boom height adjustments for all terrain features.

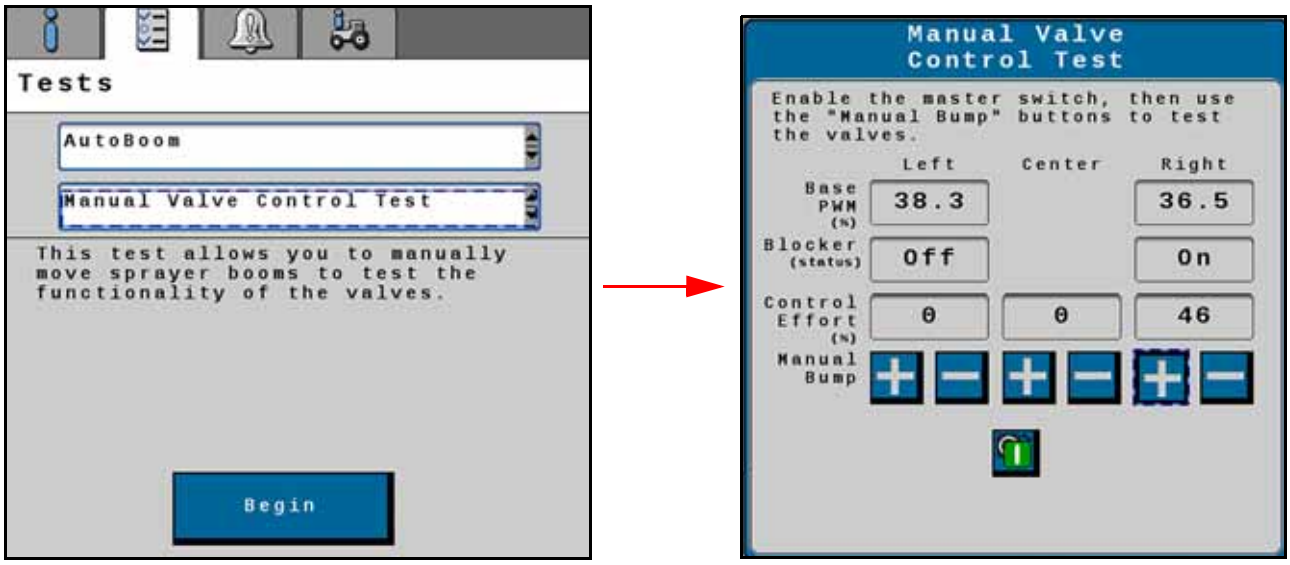
FIGURE 20. Terrain Compensation Test



MANUAL VALVE CONTROL TEST

The Manual Valve Control test allows the user to manually move the sprayer booms to validate hydraulic valve function.

FIGURE 21. Manual Valve Control Test



VARIABLE DAMPER TEST

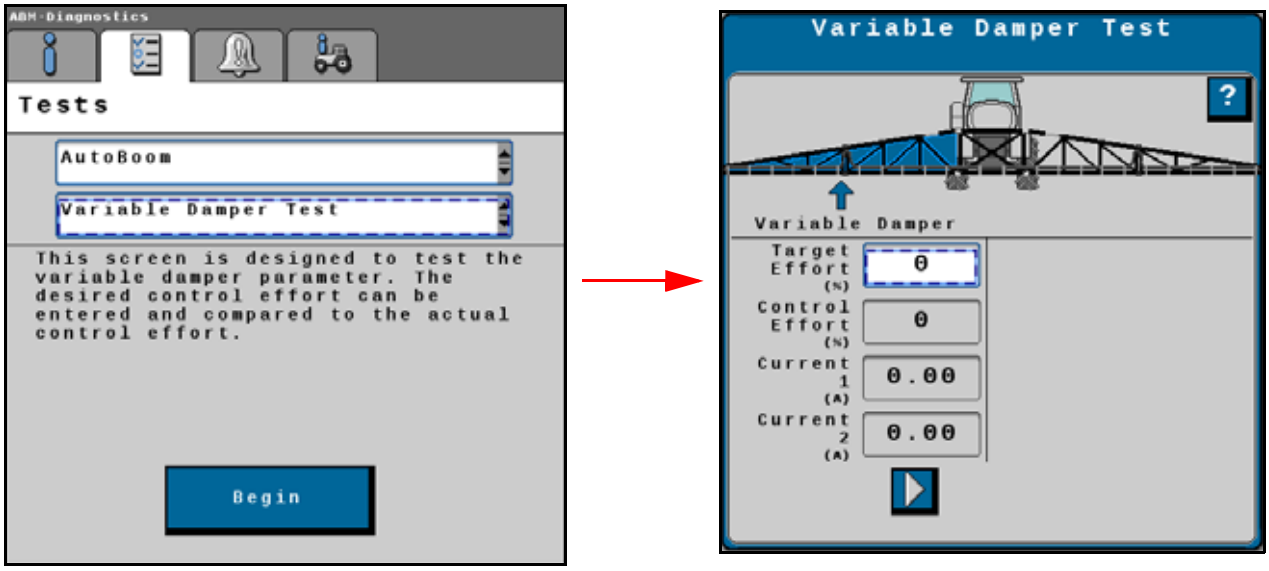
The Variable Damper test allows the user to manually apply a control effort to the variable damper system.

1. Select Connectivity Test.
2. Enter a Target Effort Percentage.
3. Touch the Start button.

NOTE: Variable Dampers are optional. Test is only valid if equipped.

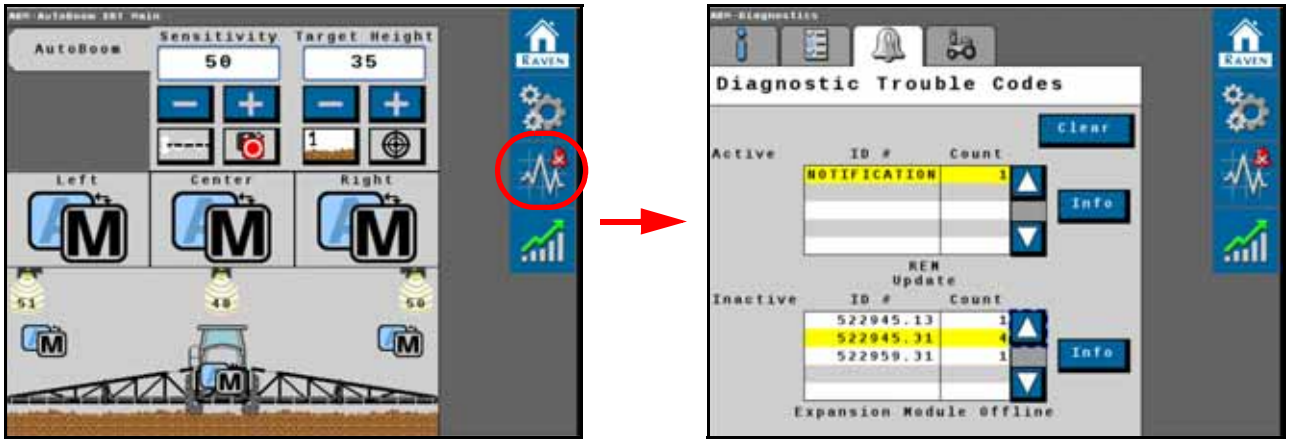
Each damper should draw between 2.0 and 2.8 amps when tested at 100%.

FIGURE 22. Variable Damper Test



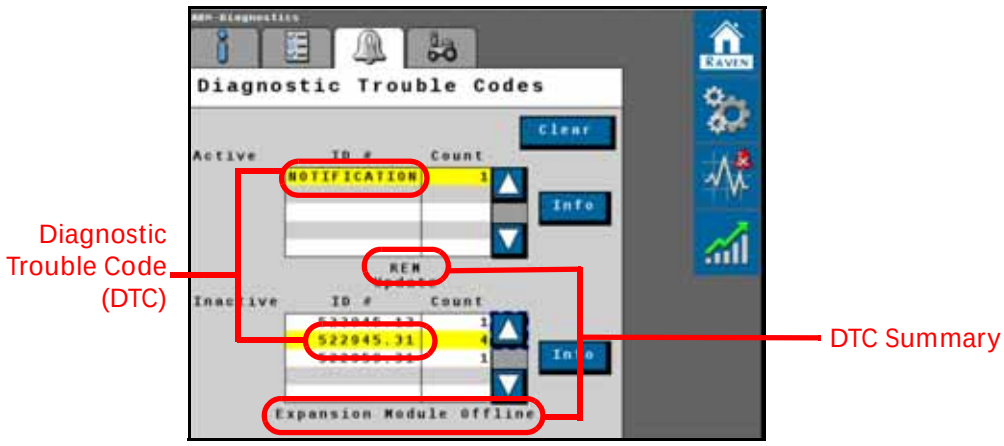
DIAGNOSTIC TROUBLE CODES (DTCS)

FIGURE 23. Diagnostic Trouble Codes Screen



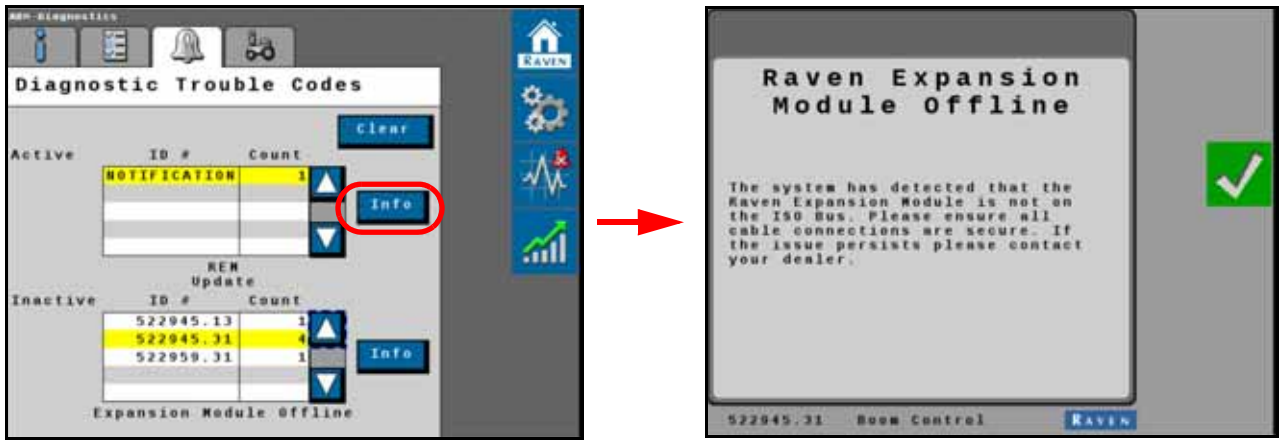
The Diagnostic Trouble Code screen displays active and previous diagnostic trouble codes (DTCs) that occur during XRT system operation. Active DTCs must be fixed before the XRT system can be enabled for operation. Once a DTC has been corrected, the code moves to the inactive DTC code list.

FIGURE 24. Diagnostic Trouble Codes Screen



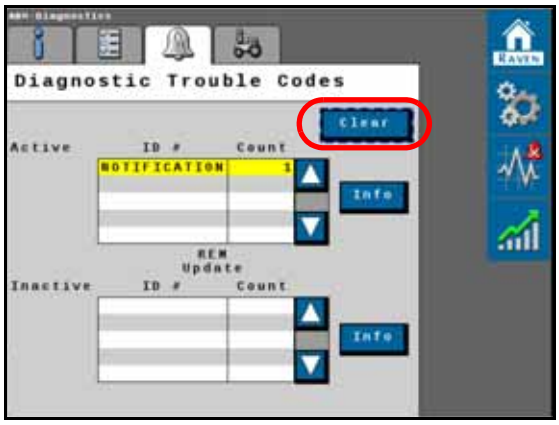
NOTE: In Figure 24 on page 65 above, the active DTC is “Notification” and the DTC summary is “REM Update.” The inactive DTC is 522945.31 and the DTC summary is “Expansion Module Offline.”

FIGURE 25. Info Screen



Pressing the Info button displays the complete description of the highlighted active DTC.

FIGURE 26. Inactive DTCs Cleared from Error Log



Pressing Clear deletes the inactive DTCs from the Inactive DTC error log.

DTC LIST

TABLE 1. Trouble Code Reference Table

Error	Error Code
REM OFFLINE ABM SUBNET BUS	522945.0
REM INVALID POOL	522945.13
REM COMMUNICATING ON ISO BUS	522945.15
REM OFFLINE ISO BUS	522945.16
LEFT LIFT POSITION VOLTAGE LOW	522946.4
LEFT LIFT POSITION VOLTAGE HIGH	522946.3
LEFT FOLD 1 POSITION VOLTAGE LOW	522947.4
LEFT FOLD 1 POSITION VOLTAGE HIGH	522947.3
LEFT FOLD 2 POSITION VOLTAGE LOW	522948.4
LEFT FOLD 2 POSITION VOLTAGE HIGH	522948.3
LEFT FOLD 3 POSITION VOLTAGE LOW	522949.4
LEFT FOLD 3 POSITION VOLTAGE HIGH	522949.3
RIGHT LIFT POSITION VOLTAGE LOW	522950.4

Error	Error Code
ABM ECU POWER VOLTAGE HIGH	520192.3
ABM ECU POWER VOLTAGE LOW	520192.4
ABM HIGH CURRENT POWER VOLTAGE HIGH	520194.3
ABM HIGH CURRENT POWER VOLTAGE LOW	520194.4
ABM LOSS OF COMMUNICATION ON ABM XRT CANBUS	520457.31
ABM LOSS OF COMMUNICATION WITH REM	522945.31
LEFT FOLD 3 IN SOLENOID CURRENT LOW	522922.5
RIGHT FOLD 3 IN SOLENOID CURRENT LOW	522923.5
LEFT FOLD 2 IN SOLENOID CURRENT LOW	522924.5
RIGHT FOLD 2 IN SOLENOID CURRENT LOW	522925.5
LEFT FOLD 1 IN SOLENOID CURRENT LOW	522926.5
RIGHT FOLD 1 IN SOLENOID CURRENT LOW	522927.5
LEFT FOLD 3 OUT SOLENOID CURRENT LOW	522928.5

TABLE 1. Trouble Code Reference Table

Error	Error Code
RIGHT LIFT POSITION VOLTAGE HIGH	522950.3
RIGHT FOLD 1 POSITION VOLTAGE LOW	522951.4
RIGHT FOLD 1 POSITION VOLTAGE HIGH	522951.3
RIGHT FOLD 2 POSITION VOLTAGE LOW	522952.4
RIGHT FOLD 2 POSITION VOLTAGE HIGH	522952.3
RIGHT FOLD 3 POSITION VOLTAGE HIGH	522953.4
RIGHT FOLD 3 POSITION VOLTAGE LOW	522953.3
CENTER ANGULAR POSITION VOLTAGE LOW	522954.4
CENTER ANGULAR POSITION VOLTAGE HIGH	522954.3
CENTER LIFT POSITION VOLTAGE LOW	522955.4
CENTER LIFT POSITION VOLTAGE HIGH	522955.3
LEFT OUTER HEIGHT SENSOR OFFLINE	522956.31
LEFT OUTER HEIGHT SENSOR NEEDS UPDATE	522956.1
LEFT INNER HEIGHT SENSOR OFFLINE	522957.31
LEFT INNER HEIGHT SENSOR NEEDS UPDATE	522957.1
LEFT MID HEIGHT SENSOR OFFLINE	522958.31
LEFT MID HEIGHT SENSOR NEEDS UPDATE	522958.1
CENTER HEIGHT SENSOR OFFLINE	522959.31
CENTER HEIGHT SENSOR NEEDS UPDATE	522959.1
RIGHT OUTER HEIGHT SENSOR OFFLINE	522960.31
RIGHT OUTER HEIGHT SENSOR NEEDS UPDATE	522960.1
RIGHT INNER HEIGHT SENSOR OFFLINE	522961.31

Error	Error Code
RIGHT FOLD 3 OUT SOLENOID CURRENT LOW	522929.5
LEFT FOLD 2 OUT SOLENOID CURRENT LOW	522930.5
RIGHT FOLD 2 OUT SOLENOID CURRENT LOW	522931.5
LEFT FOLD 1 OUT SOLENOID CURRENT LOW	522932.5
RIGHT FOLD 1 OUT SOLENOID CURRENT LOW	522933.5
LEFT BLOCKER SOLENOID CURRENT LOW	522934.5
LEFT PROPORTIONAL SOLENOID CURRENT LOW	522935.5
RIGHT BLOCKER SOLENOID CURRENT LOW	522936.5
RIGHT POPORTIONAL SOLENOID CURRENT LOW	522937.5
BOOM CRADLE LOCK SOLENOID CURRENT LOW	522938.5
CENTER RACK RAISE SOLENOID CURRENT LOW	522939.5
CENTER RACK LOWER SOLENOID CURRENT LOW	522940.5
DAMPER 1 DRIVER CURRENT LOW	520168.5
DAMPER 2 DRIVER CURRENT LOW	520169.5
LEFT STABILIZING SOLENOID CURRENT LOW	520303.5
RIGHT STABILIZING SOLENOID CURRENT LOW	520302.5
LEFT LIFT UP SOLENOID CURRENT LOW	522918.5
RIGHT LIFT UP SOLENOID CURRENT LOW	522919.5
LEFT LIFT DOWN SOLENOID CURRENT LOW	522920.5
RIGHT LIFT DOWN SOLENOID CURRENT LOW	522921.5
LEFT FOLD 3 IN SOLENOID CURRENT HIGH	522922.6
RIGHT FOLD 3 IN SOLENOID CURRENT HIGH	522923.6

TABLE 1. Trouble Code Reference Table

Error	Error Code
RIGHT INNER HEIGHT SENSOR NEEDS UPDATE	522961.1
RIGHT MID HEIGHT SENSOR OFFLINE	522962.31
RIGHT MID HEIGHT SENSOR NEEDS UPDATE	522962.1
INERTIAL MEASUREMENT UNIT OFFLINE	522963.0
INERTIAL MEASUREMENT UNIT NOT RATE TABLE CALIBRATED	52963.1
INVALID ABM ORIENTATION	522964.0
INVALID IMU ORIENTATION	522965.0
ERROR NOT RATE TABLE CALIBRATED	0.0
BOOM OFFLINE	0.0
LEFT LIFT UP DOWN PRESSED	0.0
LEFT FOLD 1 IN OUT PRESSED	0.0
LEFT FOLD 2 IN OUT PRESSED	0.0
LEFT FOLD 3 IN OUT PRESSED	0.0
RIGHT LIFT UP DOWN PRESSED	0.0
RIGHT FOLD 1 IN OUT PRESSED	0.0
RIGHT FOLD 2 IN OUT PRESSED	0.0
RIGHT FOLD 3 IN OUT PRESSED	0.0
CENTER UP DOWN PRESSED	0.0
AUTOFOLD IN OUT PRESSED	0.0
NO SPEED	0.0
IS RIGID CENTER RACK TOO HIGH	0.0
ISO AUTOFOLD NEEDS UPDATE	0.0
BOOMS ARE FOLDED	0.0

Error	Error Code
LEFT FOLD 2 IN SOLENOID CURRENT HIGH	522924.6
RIGHT FOLD 2 IN SOLENOID CURRENT HIGH	522925.6
LEFT FOLD 1 IN SOLENOID CURRENT HIGH	522926.6
RIGHT FOLD 1 IN SOLENOID CURRENT HIGH	522927.6
LEFT FOLD 3 OUT SOLENOID CURRENT HIGH	522928.6
RIGHT FOLD 3 OUT SOLENOID CURRENT HIGH	522929.6
LEFT FOLD 2 OUT SOLENOID CURRENT HIGH	522930.6
RIGHT FOLD 2 OUT SOLENOID CURRENT HIGH	522931.6
LEFT FOLD 1 OUT SOLENOID CURRENT HIGH	522932.6
RIGHT FOLD 1 OUT SOLENOID CURRENT HIGH	522933.6
LEFT BLOCKER SOLENOID CURRENT HIGH	522934.6
LEFT PROPORTIONAL SOLENOID CURRENT HIGH	522935.6
RIGHT BLOCKER SOLENOID CURRENT HIGH	522936.6
RIGHT PROPORTIONAL SOLENOID CURRENT HIGH	522937.6
BOOM CRADLE LOCK SOLENOID CURRENT HIGH	522938.6
CENTER RACK RAISE SOLENOID CURRENT HIGH	522939.6
CENTER RACK LOWER SOLENOID CURRENT HIGH	522940.6
DAMPER 1 DRIVER CURRENT HIGH	520168.6
DAMPER 2 DRIVER CURRENT HIGH	520169.6
LEFT STABILIZING SOLENOID CURRENT HIGH	520303.6
RIGHT STABILIZING SOLENOID CURRENT HIGH	520302.6
LEFT LIFT UP SOLENOID CURRENT HIGH	522918.6
RIGHT LIFT UP SOLENOID CURRENT HIGH	522919.6

TABLE 1. Trouble Code Reference Table

Error	Error Code
HEIGHT SENSOR ZERO OFFSET	0.0
IMU NOT CALIBRATED	522963.13
ABM LOSS OF COMMUNICATION WITH IMU	522963.31
INVALID ABM ORIENTATION DETECTED	522964.31

Error	Error Code
LEFT LIFT DOWN SOLENOID CURRENT HIGH	522920.6
RIGHT LIFT DOWN SOLENOID CURRENT HIGH	522921.6
IMU INVALID ORIENTATION DETECTED	522965.31
ABM LOSS OF COMMUNICATION WITH UT	524082.31

RADAR LED CODES

FIGURE 27. Raven Height Sensor LED

TABLE 2. Radar LED Colors

LED Status	LED Color
Sensor is in bootloader mode	Flashing Red at 10 Hz
Sensor is reprogramming	Flashing Red at 1 Hz
No CAN Communication	Flashing Yellow at 10 Hz
CAN Communication but no ABM detected	Flashing Yellow at 1 Hz
ABM detected, but not indexed	Flashing Pink at 1 Hz
Sensor has been indexed	Flashing Green at 1 Hz
Boom with sensor is enabled	Flashing Blue at 1 Hz

REM LED CODES

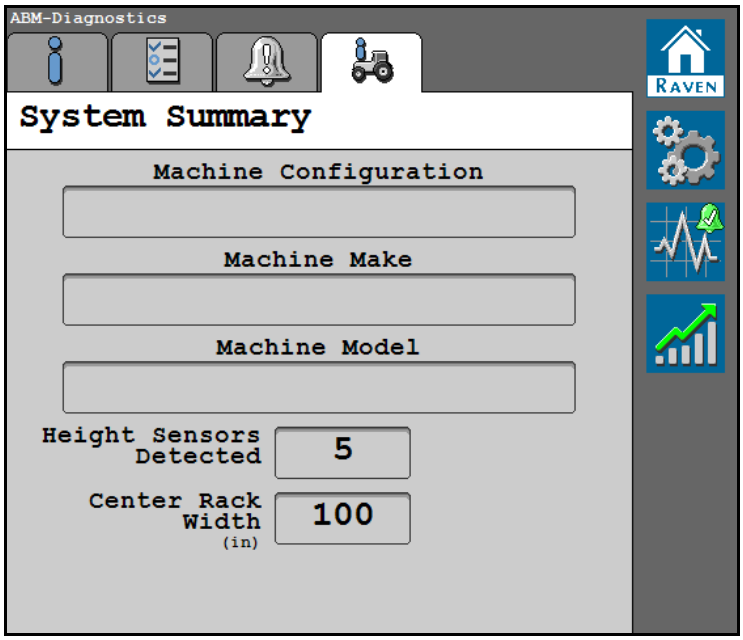
TABLE 3. REM Node LED Status

LED	Color	Hz	Status Name	Description
Power	Green	Solid	ECU Powered	Active when ECU has high current power.
A	Off	Solid	Microprocessor Off	Active when the microprocessor is not powered.
A	Red	1	ISOBUS Offline	Active if the ISOBUS is offline.
A	White	1	ISOBUS Online	Active if the ISOBUS is online.
A	Green	1	Systems Normal	Active when linked with VT and system is normal.
B	Red	1	ECU Power Loss	System has lost Logic power, but not high current power.
B	Off	Solid	ECU Has Power	System has logic power and high current power.
C	Red	Solid	FPGA Not Running	PCB subsystem not running (FPGA).
C	Green	Solid	LED C Functional - No Error	LED C is functional and there are no other LED C states to report.

SYSTEM SUMMARY

The *System Summary* window displays the machine configuration information.

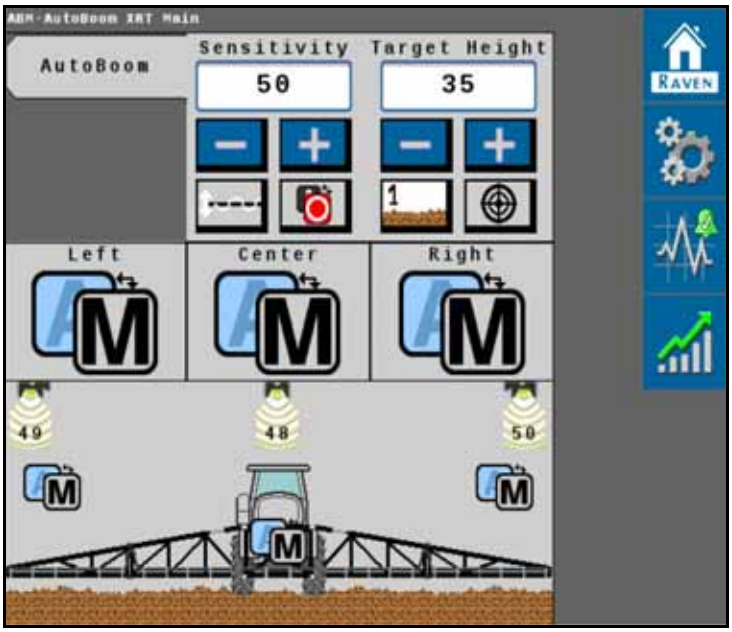
FIGURE 28. System Summary



TOTALS

The Totals icon on the right side of the run screen allows the user to view short-term performance.

FIGURE 29. Home Screen



The *Short-Term Performance* window displays Deviation of Heights, Average Terrain, Average Error, and Average Speed.

FIGURE 30. ABM Performance

The *Resettable Performance* window shows the same information as the short-term performance tab but allows the user to reset the information.

NOTE: Press the Report Issue button to send out diagnostic information on the ISOBus. You may be asked to do this if working with Tech Support.

We Solve Great Challenges.

LIMITED WARRANTY

WHAT DOES THIS WARRANTY COVER?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

HOW LONG IS THE COVERAGE PERIOD?

Raven Applied Technology products are covered by this warranty for 12 months from the date of retail sale. In no case will the Limited Warranty period exceed 24 months from the date the product was issued by Raven Industries Applied Technology Division. This warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries.

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the warranty claim, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THIS WARRANTY?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

We Solve Great Challenges.

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

DO I NEED TO REGISTER MY PRODUCT TO QUALIFY FOR THE EXTENDED WARRANTY?

Yes. Products/systems must be registered within 30 days of retail sale to receive coverage under the Extended Warranty. If the component does not have a serial tag, the kit it came in must be registered instead.

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

To register, go online to www.ravenhelp.com and select Product Registration.

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

Raven Applied Technology products that have been registered online are covered for an additional 12 months beyond the Limited Warranty for a total coverage period of 24 months from the date of retail sale. In no case will the Extended Warranty period exceed 36 months from the date the product was issued by Raven Industries Applied Technology division. This Extended Warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries. In addition, the words "Extended Warranty" must appear on the box and all documentation if the failure is between 12 and 24 months from the retail sale.

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the product's registration for the Extended Warranty and the claim itself, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. Cables, hoses, software enhancements, and remanufactured items are not covered by this Extended Warranty. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

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