VSN® Operation Manual

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RAVEN

CHAPTER   IMPORTANT INFORMATION

1

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.

⚠ 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

HARNESS ROUTING

The word "harness" is used to describe any electrical cables and leads, both bundled and unbundled. Use the following guidelines and recommendations when connecting and routing harnesses while installing or maintaining this Raven system:

- Leave protective caps/covers over harness connectors until needed to avoid dirt and moisture from contaminating electrical circuits.
- Secure the harness to the frame or solid structural members at least every 30 cm [12 in].
- Follow existing harness runs already routed on the implement as much as possible. Proper harness routing should:
    - Secure harnessing and prevent the harness 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 harnessing 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 harnessing from sharp bends, twisting, or flexing over short distances and normal implement operation.
    - Connectors and splices should not be located at bending points or in harness sections that move.
    - 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 harnessing securely to force controlled movement of the harness.
    - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
- Do not connect, affix, or allow harnessing to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of harness components.
    - Harnessing should be protected or shielded if routing requires the hose to be exposed to conditions beyond harnessing component specifications.
- Avoid routing harnesses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).
- Avoid routing harnesses in areas where the operator or service personnel might step or use as a grab bar.

IMPORTANT: Avoid applying direct spray or pressure washing of electrical components and connections. High pressure streams and sprays can penetrate seals, cause corrosion, or otherwise damage electrical components. When performing maintenance:

- Inspect electrical components and connectors for corrosion, damaged pins or housings, etc. Repair or replace components or harnessing as necessary.
- Ensure connectors are kept clean and dry. Apply dielectric grease to the sealing surfaces of all connections exposed to moisture, dirt, debris, and other contaminates. Repair or replace harnessing as necessary.
- Clean electrical components with pressurized air, aerosol electrical cleaning agent, or low pressure rinse.
- Remove visible surface water from electrical components and connections using pressurized air or an aerosol cleaning agent. Allow components to dry thoroughly before reconnecting cables.

CHAPTER INTRODUCTION

2

When coupled with a Raven field computer and RS1/SC1, VSN® is designed to provide a visual row guidance solution for post-emergence operations on agricultural sprayers and cultivator implements.

NOTE: Implement steering is only supported with a CR12 and an SC1 steering system.

The chapters in this manual are intended to assist with the proper calibration and operation of the VSN system.

FIGURE 1. VSN® Home Page
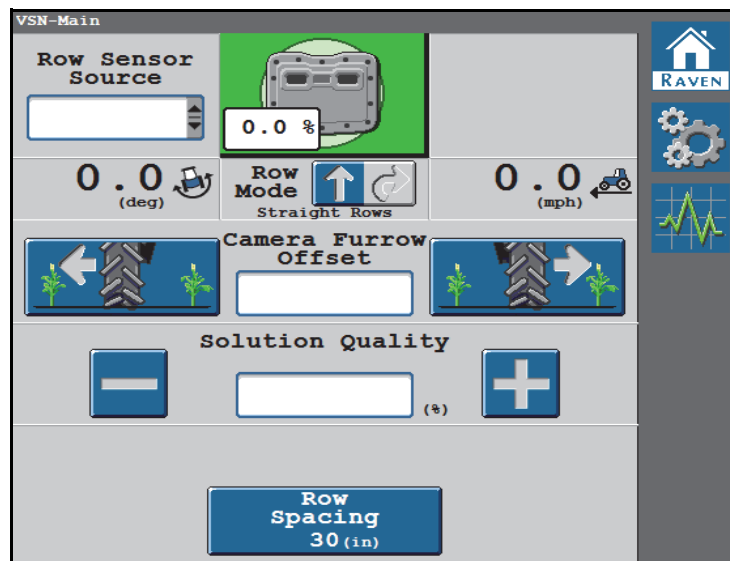
SYSTEM SPECIFICATIONS

TABLE 1. **VSN® Technical Specifications**

		Metric	**U.S.**
Dimensions	Height	19.66 cm	7.74 in.
	Width	25.25 cm	9.94 in.
	Depth	8.53 cm	3.36 in.
	Weight	approx. 3.9 kg	approx. 8.75 lbs.
Power	Operating Voltage	9 to 16 V DC nominal (reverse polarity protected)	
Environmental	Operating Conditions	-40° to 85° C	-40° to 185° F
	Storage Conditions	-40° to 85° C	-40° to 185° F

OPERATING SPECIFICATIONS
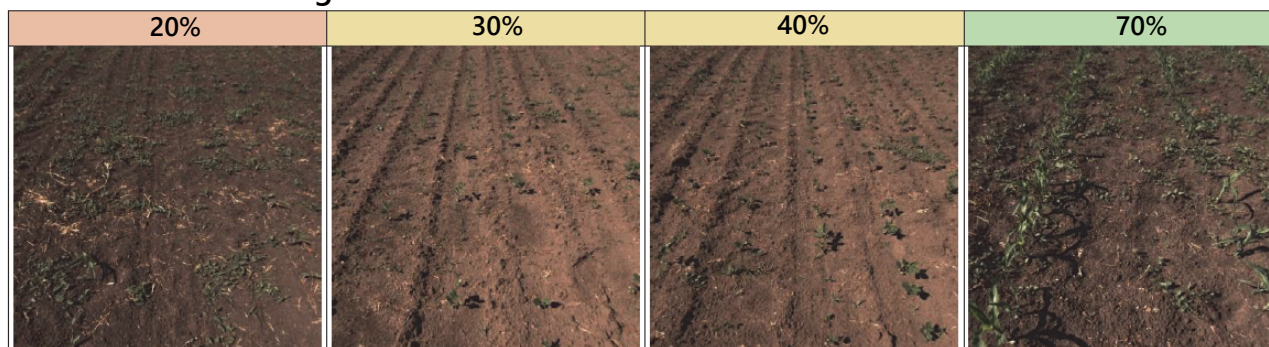
TABLE 2. VSN® Specifications

	VSN®	VSN® Full Canopy	VSN® Implement		
Machine Type	Self-propelled Sprayers	Self-propelled Sprayers	Cultivating Implements		
Row Type	Contour, Straight	Straight	Straight		
Crop Type	Soybeans, Cotton, Corn, Sorghum, Sunflower	Corn, Sorghum, Sunflower	Green Crops[1]	Sugar Beets, Onions,Celeriac, Corn, Lettuce	Wheat, Beans, Corn, Poppy Crop, Cabbage
Crop Height[2]	10 cm [4 in] to 90% canopy	90 to 100% canopy	~5 cm [~2 in]		
Row Spacing	38 cm - 1 m [15 - 40 in]		12 -75 cm [5 - 30 in]		
Plant Spacing (in row)	-		≤ 25 cm [10 in]		
Operating Speed[3]					
Sprayer, Rear Boom	Up to 32 km/h [20 mph]		-		
Sprayer, Front Boom	Up to 24 km/h [15 mph]		-		
VSN® Implement	-		Up to 19.2 km/h [12 mph]		
Steering Accuracy	-		±0.787 in [±2 cm]		

1. The crop type list provided is created based on experience in beta testing. This does not exclude crops not on this list.
2. Crop height depending on diameter and leaf size.
3. Row spacing less than 50.8 cm [20 in] impacts maximum speed.

WEED COVERAGE

Plant rows need to be clearly distinguishable from the weeds by eye. When plant rows are difficult to distinguish from the weeds, the VSN® camera can have issues recognizing rows. When weeds grow in rows, the VSN® camera can confuse the weed rows with the actual plant rows. The image below shows row recognition quality as an example.

TABLE 3. **Weed Recognition**

20%	30%	40%	70%

INSTALLATION

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

RECOMMENDATIONS

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

• Verify that the hydraulic system is using fresh oil and that the filters have been recently changed.

• Ensure there are no issues with the hydraulic system (e.g. pump issues, faulty hydraulic motors, fine metal deposits in the hydraulic hoses, etc.).

• Ensure there are no issues with the steering system (worn bushings, faulty tie rod ends, improperly adjusted steer components, etc.).

CAMERA MOUNTING RECOMMENDATIONS

The settings for camera angle and camera height may affect the accuracy of the camera measurement and the row recognition quality.

The settings in the following table are recommended minimum and maximum camera mounting heights. Minimum heights mean the lowest possible camera height required to cover at least three rows in the field of view.

For row spacings between 12.5 cm [4.92 in] to 100 cm [39.37 in], which are not given in the table below, the camera height can be interpolated.

TABLE 4. **Camera Mounting Height**

Row Spacing	Camera Height (min-max)
12.5 cm [4.92 in]	50 cm [19.69 in] - 100 cm [39.37 in]
15 cm [5.91 in]	50 cm [19.69 in] - 100 cm [39.37 in]
20 cm [7.87 in]	50 cm [19.69 in] - 100 cm [39.37 in]
25 cm [9.84 in]	60 cm [23.62 in] - 100 cm [39.37 in]
30 cm [11.81 in]	60 cm [23.62 in] - 100 cm [39.37 in]
33 cm [12.99 in]	70 cm [27.56 in] - 100 cm [39.37 in]
37.5 cm [14.76 in]	80 cm [31.5 in] - 112.5 cm [44.3 in]
50 cm [19.69 in]	100 cm [39.37 in] - 150 cm [59.1 in]
75 cm [29.53 in]	150 cm [59.1 in] - 225 cm [88.59 in]
100 cm [39.37 in]	180 cm [70.87 in] - 300 cm [118.11 in]
	*Based on 45° Mounting Angle

CARE AND MAINTENANCE

GLASS CARE AND CLEANING

• Avoid pressure washing the camera lens.
• Use any glass cleaning products with a soft cloth. Avoid any abrasive products that could scratch or damage the glass.

RADAR SENSORS

• If the system does not allow the operator to engage while using radar sensors, use a rag or cloth to clean the radar sensors and allow for better solution quality.

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

-VSN® Operation Manual
-016-2020-001 Rev. F
-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.

SOFTWARE AND FIRMWARE UPDATES

Please review the *Software Update* section on page 43 for assistance with updating the VSN system or radar sensors.

CHAPTER

CALIBRATION WIZARD

3

The following sections offer assistance with the VSN system calibration wizard.

NOTE: For best results, take all measurements in operating conditions. To reset or adjust the Machine Calibration, the VSN system must be reset to factory defaults.

CAMERA AND EQUIPMENT CALIBRATION

Refer to the following sections to get started with the VSN calibration for the specific application:

REAR BOOM SPRAYERS

1. Use the Machine Type drop down list to select the Rear Boom Sprayer option.
2. Use the Machine Make and Model drop down lists to select your machine.

NOTE: If your machine make or model is not listed, select the Generic option.

3. Measure the height of the camera lens to the ground.
4. Use the on-screen keypad to enter the camera height.

FIGURE 1. VSN Camera Height
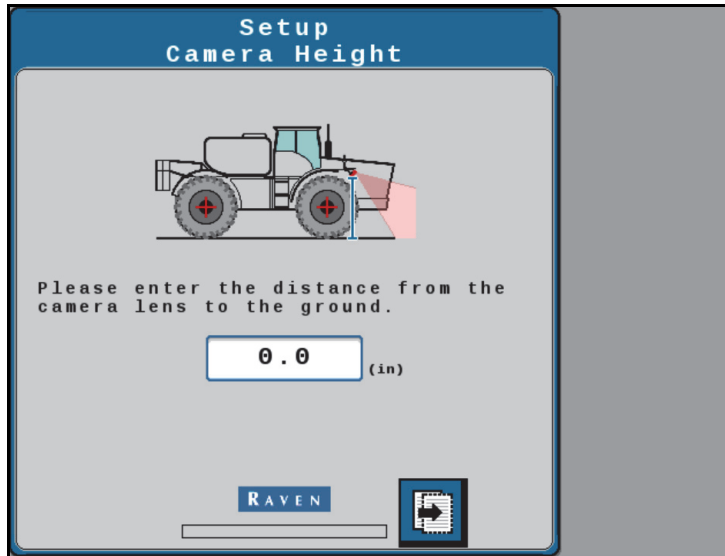
5. Select the Next button.
6. Next, measure and enter the distance from the rear axle of the vehicle to the camera lens.

NOTE: A positive value means the camera is located in front of the rear axle.

FIGURE 2. VSN Camera Fore/Aft Position
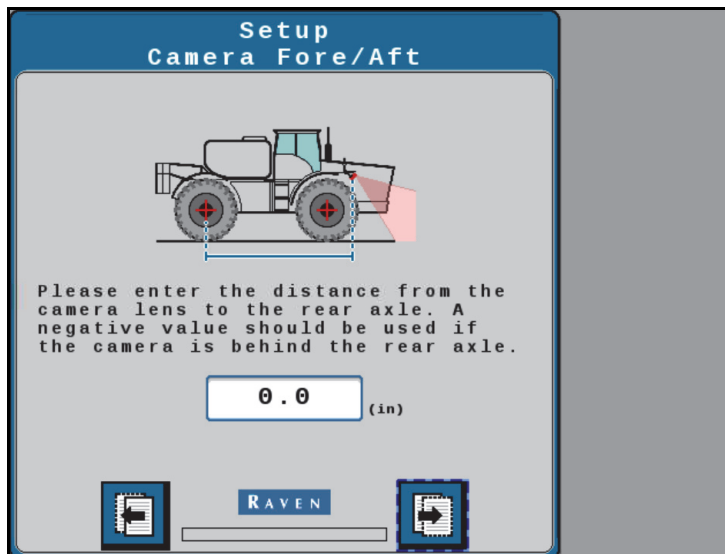
7. Select the Next button.
8. Enter the pitch (tilt) of the camera from horizontal.

FIGURE 3. VSN Camera Tilt
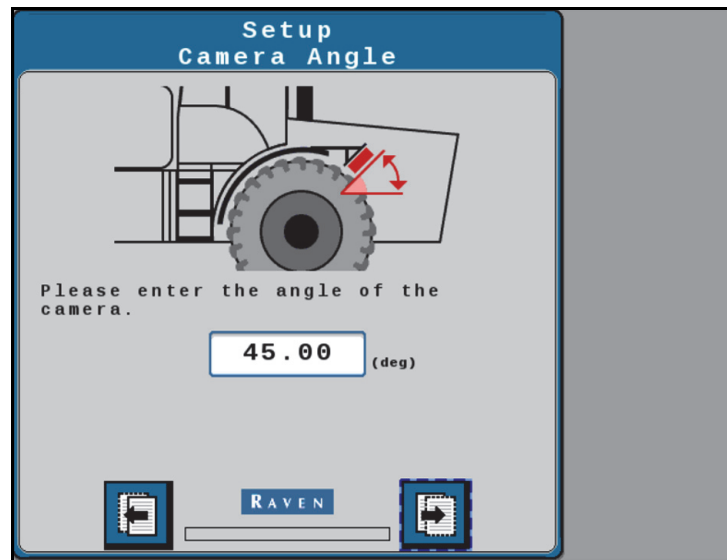
9. Select the Next button.
10. Measure the distance between the front and rear axles of the machine and enter the measurement as the Wheel Base
11. Select the Next button.

Proceed to the *Image Exclusion* section on page 17 to proceed with calibration wizard.

FRONT BOOM MACHINES

1. Use the Machine Type drop down list to select the Front Boom Sprayer option.
2. Use the Machine Make and Model drop down lists to select your machine.

NOTE: If your machine make or model is not listed, select the Generic option.

3. Lower the center rack to the down position.
4. Measure the height of the camera lens to the ground.
5. Use the on-screen keypad to enter the camera height. VSN will calculate the camera to sensor offset and display the value on the page.

NOTE: If an AutoBoom XRT system is detected, VSN will utilize the center rack height sensor for dynamic VSN camera height monitoring. If not, a stand-alone height sensor may be installed for dynamic VSN height detection.

If no height sensor is installed, the operator must manually enter the camera height during guidance operations.
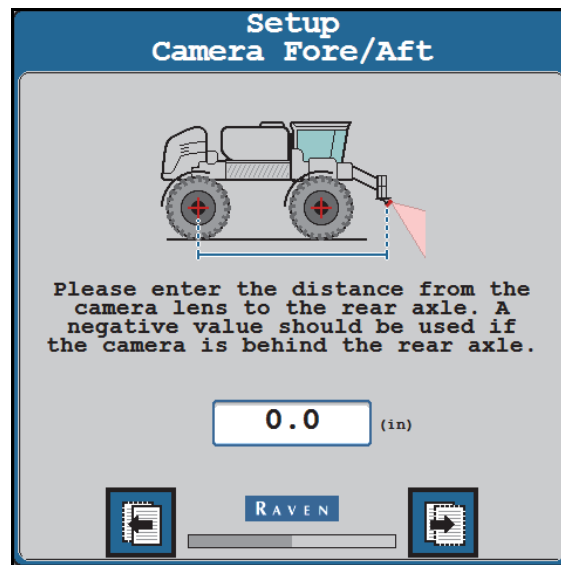
FIGURE 4. VSN Camera Height
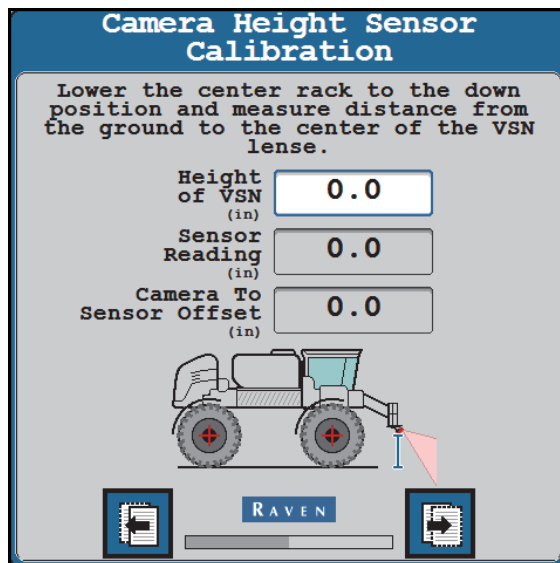
6. Select the Next button.
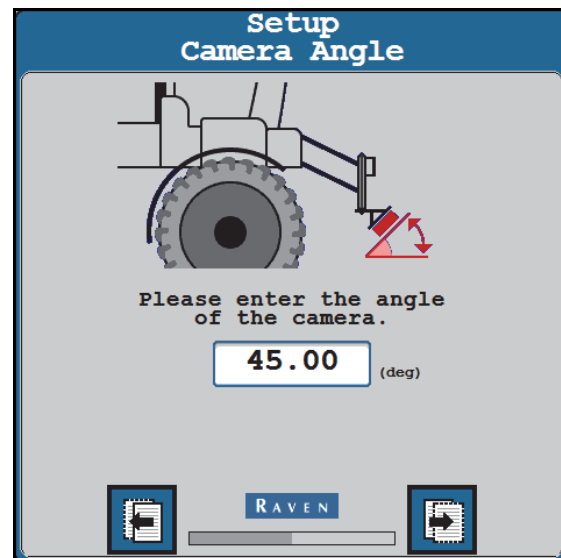7. Next, measure and enter the distance from the rear axle of the vehicle to the camera lens.

NOTE: A positive value means the camera is located in front of the rear axle.

FIGURE 5. VSN Camera Fore/Aft Position

8. Select the Next button.
9. Enter the pitch (tilt) of the camera from horizontal.

FIGURE 6. VSN Camera Tilt

10. Select the Next button.
11. Measure the distance between the front and rear axles of the machine and enter the measurement as the Wheel Base.
12. Select the Next button.

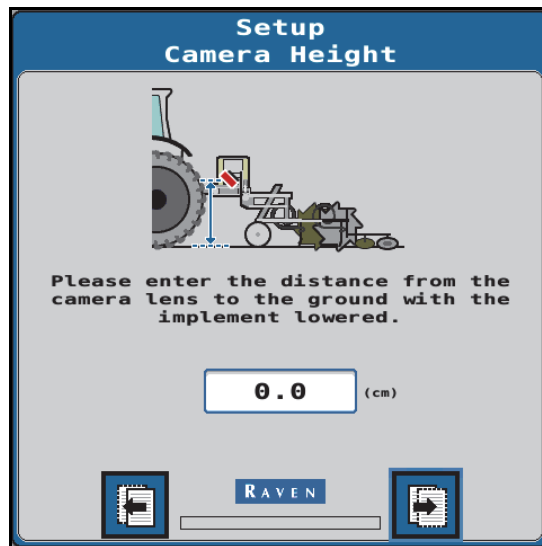Proceed to the *Image Exclusion* section on page 17 to proceed with calibration wizard.

IMPLEMENT

1. Use the Machine Type drop down list to select the Implement option.
2. Use the Machine Make and Model drop down lists to select your machine.

NOTE: If your machine make or model is not listed, select the Generic option.

3. Lower the implement to the working height.
4. Measure the height of the camera lens to the bottom of the furrow.
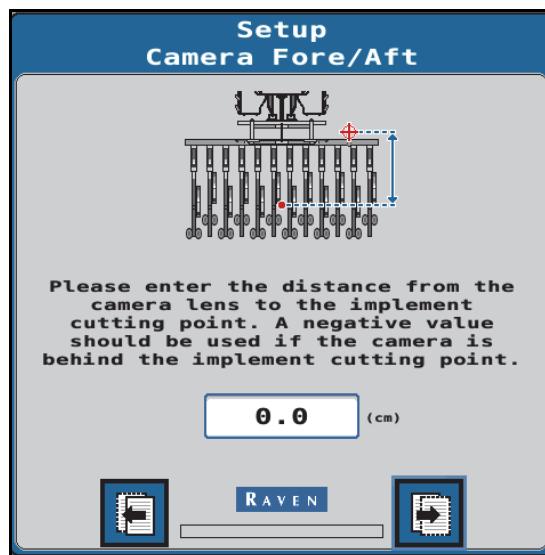5. Use the on-screen keypad to enter the camera height.

FIGURE 7. VSN Camera Height

6. Select the Next button.
7. Next, measure and enter the distance from the working point of the implement to the camera lens.

NOTE: A positive value means the camera is located in front of the working point.

FIGURE 8. VSN Camera Fore/Aft Position

8. Select the Next button.
9. Enter the pitch (tilt) of the camera from horizontal.

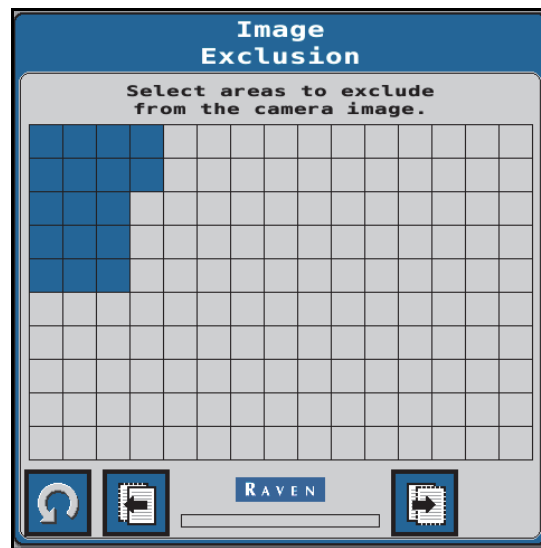**FIGURE 9. VSN Camera Tilt**

10. Select the Next button.

Proceed to the *Image Exclusion* section on page 17 to proceed with calibration wizard.

IMAGE EXCLUSION

1. Select areas to exclude from the camera image. For example, if part of the machine is in sight of the camera, exclude this area to avoid issues with row guidance.
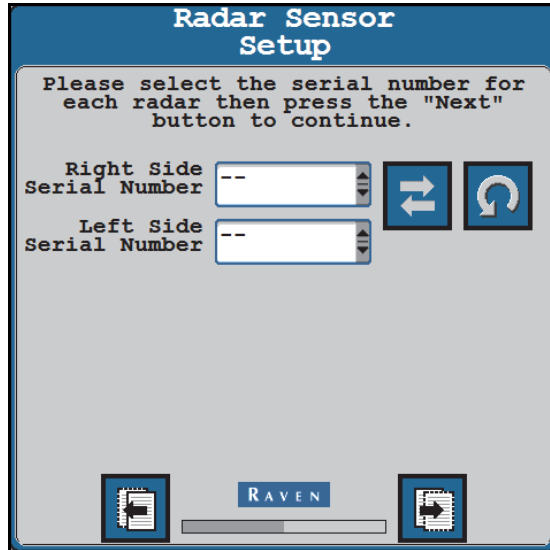
FIGURE 10. Image Exclusion Page

2. Select the Next button and proceed to the *Radar Sensors* section on page 18 to proceed with calibration wizard.

RADAR SENSORS

1. Use the Left and Right Side drop down lists to select the serial number of the radar sensor mounted on the left and right wheel.

FIGURE 11. Left/Right Radar Sensor Setup Page

NOTE: Touch the Flip Left/Right button to flip the entered values for the left and right radar sensors. Touch the Refresh button to redetect the radar sensors connected to the system.

2. Select the Next button.
3. Measure the angle of the radar sensors. This angle is measured using the direction of forward vehicle travel as 0°.
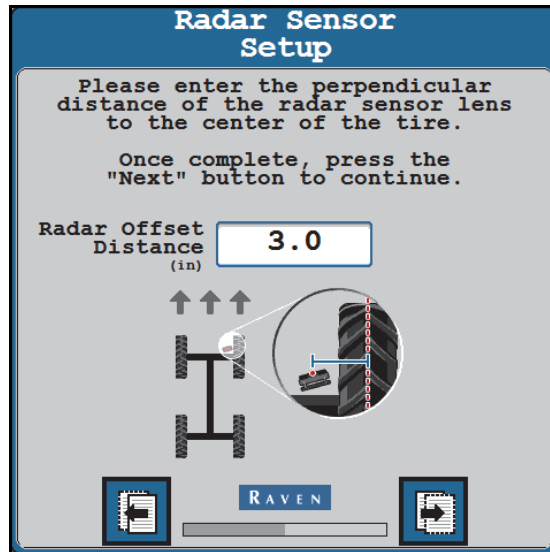
FIGURE 12. Radar Sensor Angle Page
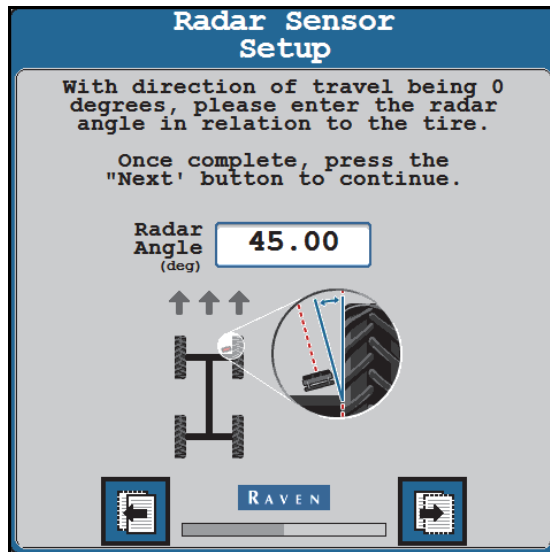
NOTE: The factory radar brackets are designed to mount the radar sensors at a 45° angle with the forward course over ground. Enter the radar sensor angle as a positive value.

4. Enter the offset from the center of the tire to the radar sensor lens.

FIGURE 13. Radar Sensor Offset Page

5. Select the Next button.

CALIBRATION SUMMARY

1. The Calibration Summary page will be displayed after all camera and machine settings have been entered.

FIGURE 14. VSN Machine Calibration Summary

2. To complete the Machine Calibration and save the displayed settings, select the check mark button.
3. Proceed to the *Row Spacing Preset Calibration* section on page 20 to continue with the calibration wizard.

ROW SPACING PRESET CALIBRATION

Complete the following steps to calibrate a row spacing preset on the VSN system.

IMPORTANT: VSN will only steer as well as the RS1/SC1 is paired. It is recommended that the RS1/SC1 has a properly calibrated and tuned profile before calibrating the VSN. If you experience poor GPS steering you will experience poor VSN steering.

NOTE: Up to 5 row spacing presets may be saved with the VSN system.

1. Select the Row Spacing button to proceed with the calibration process.

NOTE: If radar sensors are available, VSN may be run in a radar only mode. If no radar sensors are installed, a row spacing calibration will need to be completed before the VSN camera may be used for row guidance.

FIGURE 15. VSN Row Spacing Preset Selection
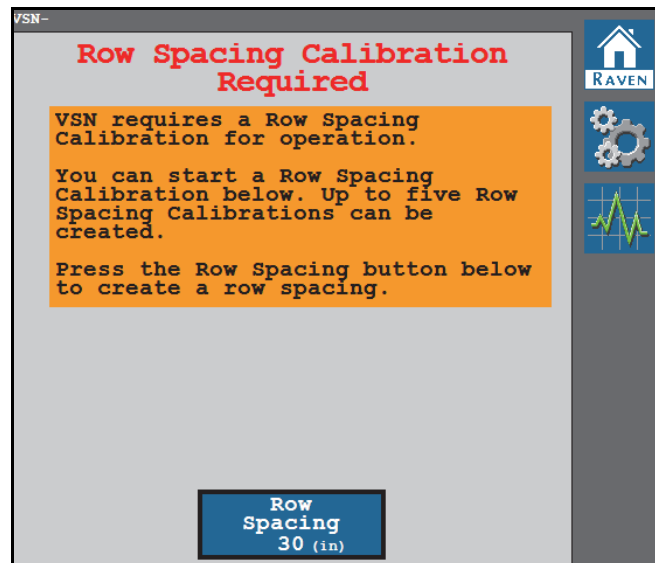
2. Enter the row spacing of the crop (in cm [inches]) in which the VSN steering system will be used.
3. Enable the Radar Only option to bypass the Row Spacing Calibration.

NOTE: If the Radar Only option is enabled, the system will skip the following calibration steps and the row sensor source will be locked to radar sensors. This option may be useful when completing the calibration in full canopy or late season crops where the VSN system may encounter lower visual solution qualities.
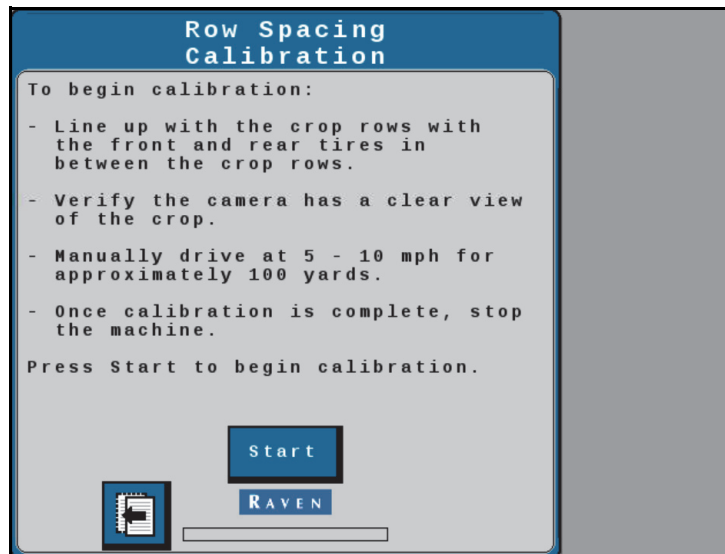
Proceed to Chapter 4, *Operation*, for assistance with VSN operation in the Radar Only mode.

FIGURE 16. VSN Row Spacing
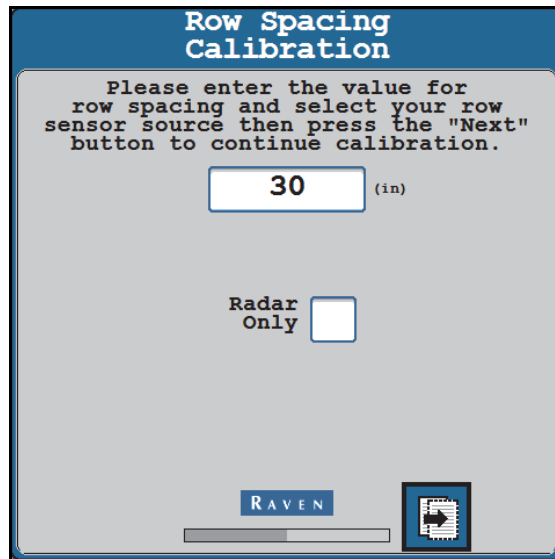
4. Select the Next button.
5. Review the calibration instructions on-screen before selecting the Start button to begin the calibration.

FIGURE 17. Begin VSN Camera Calibration

6. Drive down the row while steering the machine manually. Drive at a speed of 8 to 16 km/h [5 to 10 mph]. After approximately 91 m [100 yards], the calibration process will be complete.

NOTE: The VSN camera needs to be calibrated in a flat field with straight rows. A good calibration is extremely important to good steering performance.

A better calibration may be achieved at 13 to 16 km/h [8 to 10 mph] than at 8 to 9.5 km/h [5 to 6 mph].

FIGURE 18. Calibration In Progress

NOTE: Values displayed in red during the calibration process indicate an issue with the calibration parameters and may cause the calibration to stop or require the calibration to be restarted.

To successfully complete calibration, the following values will be required:

- Yaw rate must remain below 2.5° per second
- Roll must be less than 2°
- Quality must be above 50

7. Bring the machine to a complete stop.

8. Review the Camera Calibration Results page. To complete the calibration and save the displayed values, select the check mark button.

FIGURE 19. VSN Camera Calibration Summary

CHAPTER

OPERATION

4
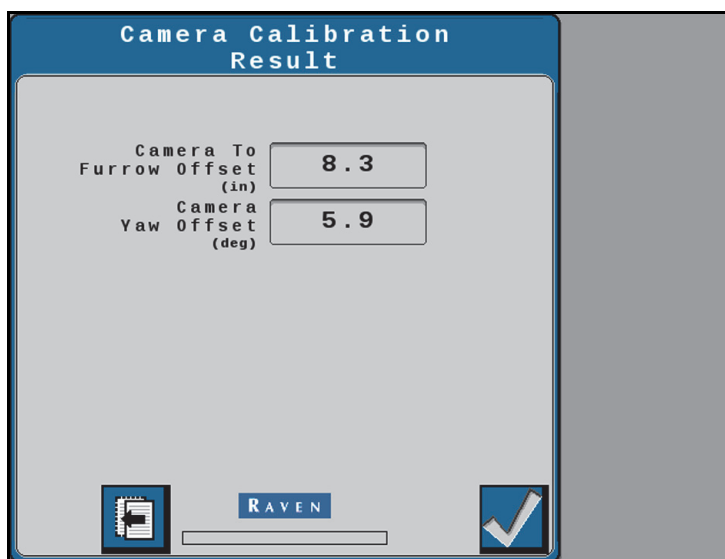
NOTICE
Do not use abrasive cleaning materials or sharp objects on the VSN camera lens. Check the lens periodically during field operations. Wipe lens with a soft cloth using glass cleaner if needed.

Refer to the ROS (Raven Operating System) Basic Operation Manual (P/N 016-0171-539) or CRX Operation Guide (P/N 016-0171-664) for instructions on starting a job and setting guidance lines.

HOME PAGE

The following sections provide information about the system status and settings shown on the VSN System Home page.
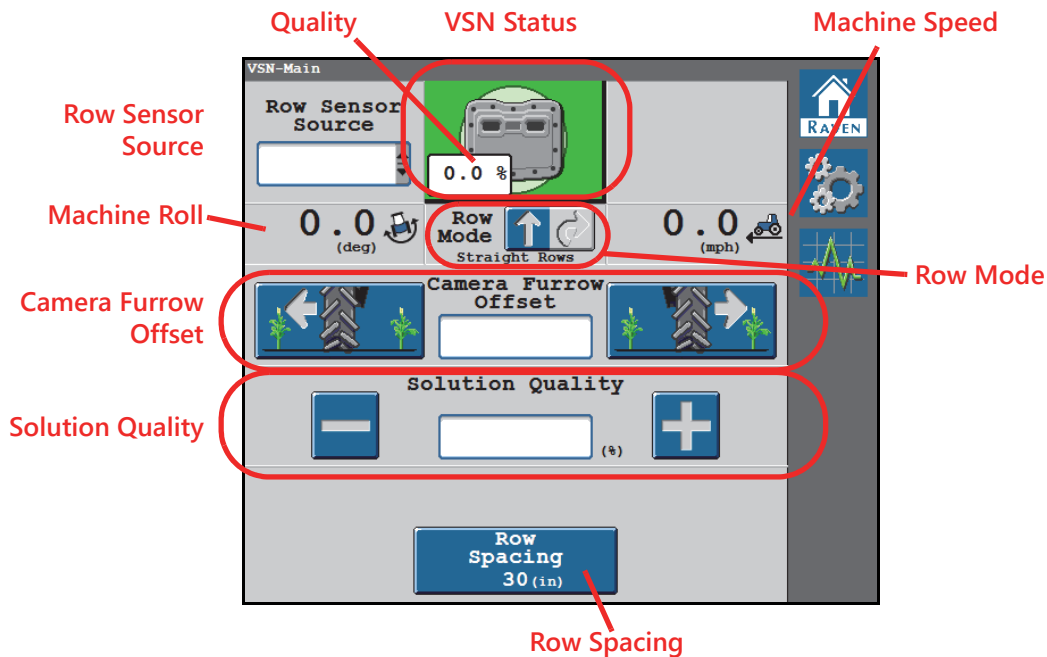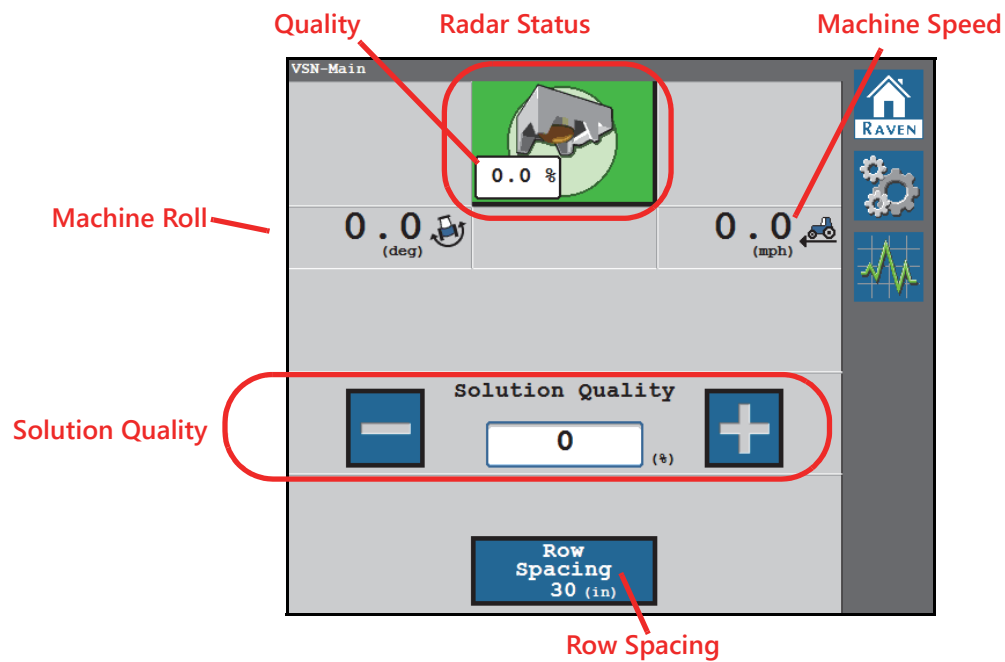
FIGURE 1. VSN Main Page - Calibrated Row Spacing

FIGURE 2. VSN Main Page - Radar Only

VSN® STATUS ICON

TABLE 1. VSN System Status Icon Displays

Status Icon	Description
Green	System is ready for row steering operation. No active Diagnostic Trouble Codes (DTC).
Yellow	Solution quality is low. No active DTCs. System may be operated with caution.
Red	Active DTCs are preventing the system from operating.

QUALITY

The percentage displayed indicates the current steering solution quality.

ROW SENSOR SOURCE

Select one of the following as the source of VSN row detection for field guidance:

NOTE: The row sensor source option is not available when operating in radar only mode.

Camera. Use the VSN camera for visual row guidance in the Vision or Vision+ operation modes.

Radar. Use the radar sensors to detect the crop stalks below the canopy.

MACHINE ROLL

The left/right tilt angle of the vehicle.

ROW MODE

Select the type of rows in which VSN is operating.

Straight Rows. Optimized guidance for straight rows or rows with minor curves. This mode is set by default.

Curve Rows. For guidance in center pivot, contours, and other curved rows, select this mode to provide optimal machine position and minimize crop damage.

MACHINE SPEED

Current GPS speed of the machine.

CAMERA FURROW OFFSET

NOTE: The camera furrow offset is not available when operating in radar only mode.

Distance from the camera to the center of the nearest furrow bottom.

• A positive value means the camera is to the right of the furrow.
• A negative value means the camera is to the left of the furrow.

The offset value may be edited after the VSN camera has been calibrated to fine tune the tire-to-furrow position and help to center the tire in the furrow. Select the left button to nudge the tire to the left, and the right button to nudge the tire to the right. Using these buttons will nudge the tire in ±1 inch increments.

ROW DETECTION SOLUTION QUALITY

Set the minimum quality value that must be met to engage VSN. This value is the camera ability to detect the crop rows versus the furrows. This value is editable.

A value of 50% is recommended. In Vision Only mode, VSN will disengage if the solution quality goes below the set percentage. In Vision Plus mode, VSN will revert back to GPS guidance.

ROW SPACING PRESET

Displays the current row spacing entered for the current row spacing preset. Select the button to select a currently calibrated row spacing preset or calibrate a new row spacing preset.

NOTE: Up to 5 row spacing presets may be saved.

VSN® OPERATION WIDGETS

The following widgets are available for use with the VSN system to quickly change modes, monitor system operations, and engage the system from the Raven field computer running the Raven Operating System (ROS) or CRX operating system during field operations.

OPERATION MODE WIDGETS

The Operation Mode widget must be added to the field computer guidance screen to allow the operator to change modes during a field operation.

TABLE 2. VSN Operation Modes

ROS Widget	Description
	GPS Mode. Guidance is performed via GPS guidance points only.
	Vision. Guidance is performed via the VSN camera or radar sensors only. GPS corrections are neither utilized for guidance nor available as a fall-back solution. Line acquire must be performed manually. When the solution quality falls below the minimum threshold the steering system will disengage.
	Vision+. Guidance is performed via a combination of GPS and the VSN camera or radar sensors. This mode can be utilized for line acquire via GPS with the system switching to the VSN camera when the machine is aligned and near the guidance line. This mode will also fall back to GPS guidance if the solution quality falls below the minimum threshold. The system will then return to VSN guidance automatically when the solution quality is above the minimum threshold. **NOTE:** It is recommended to use Last Pass when using Vision+ mode.

STATUS AND ENGAGE WIDGET

The following widget may be used with Raven steering systems to engage steering from the field computer screen and view the current status of the steering system.

NOTE: The VSN steering system may be engaged using the machine engage switch. Refer to the RS1 or SC1/TC1 manual for additional information on using the machine engage switch.

TABLE 3. Field Computer Widget Status

ROS Widget	CRX Widget	Description
		System disabled and cannot be engaged. Check for active DTCs and VSN solution quality.
		VSN solution quality is nearing minimum thresholds. System may be engaged, but system performance may be impacted.
		System ready for steering.
		System engaged in GPS mode or using GPS fall back corrections in Vision+ mode.
		System engaged and using Vision or radar sensors for steering solution.

ANALOG VIDEO DISPLAY WIDGET

The Analog Video Display widget can be helpful when troubleshooting the visual guidance system.

FIGURE 3. Analog Video Widgets

ROS Camera Widget

CRX Camera Widget
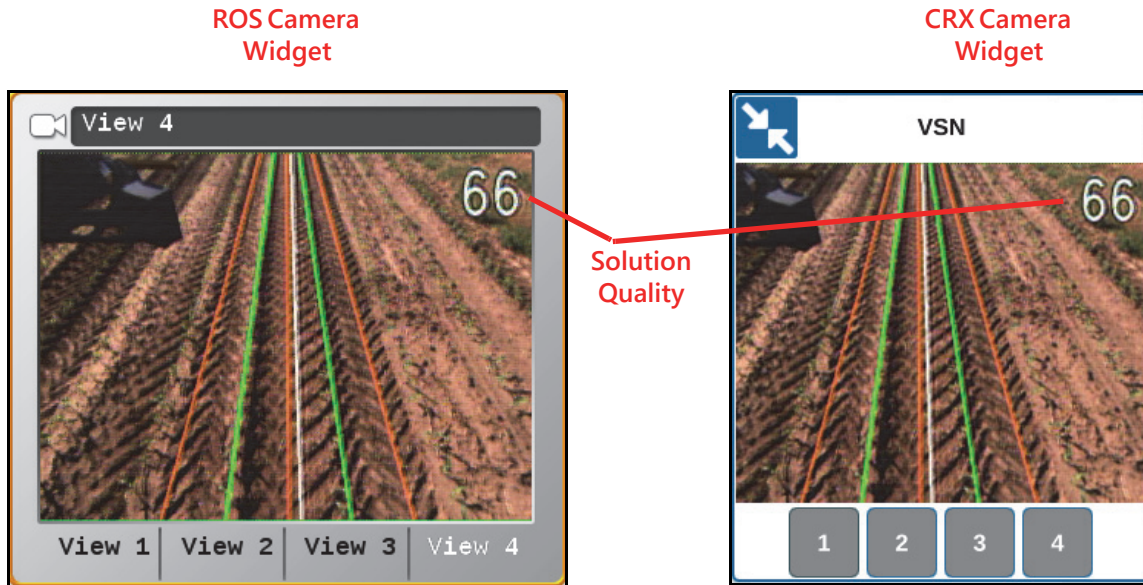
Solution Quality

NOTE: Refer to the Viper/Viper 4+ Installation and Operation manual (P/N 016-0171-539) or CRX Operation Guide (P/N 016-0171-664) for information on adding widgets.

Solution Quality Display. The solution quality is displayed on the analog video display from the VSN camera.

Vehicle Heading. The current vehicle heading is displayed on the VSN analog video as a white line.

Rows. The green lines shown on the analog video display should correspond with crop rows shown in the video image.

Furrows. The brown lines displayed in the analog video should correspond to the furrow bottoms.

VSN® STATUS WIDGET

The VSN Status widget allows the operator to quickly check the current status of the VSN system during operation.

ROS Widget		Description
Vision	Radar	
		VSN requires calibration.
		No A-B path or guidance line has been set, solution quality is below minimum threshold, or an active DTC is preventing the VSN system from engaging.
		VSN is detected and ready.
		VSN solution quality is nearing minimums. While in a caution state, the system may be engaged, but system performance may be impacted.

NOTE: Machine roll is displayed on the VSN Status widget.

Refer to *Diagnostic Trouble Codes Tab* section on page 47 for additional status conditions which may be displayed in the VSN on-screen widget.

VSN® SYSTEM SETTINGS AND TUNING

The following buttons will be used to navigate the settings and option pages in the following sections and will be referenced while offering assistance with the settings menus and options available for tuning the VSN system.

TABLE 1. UT Navigation Buttons

	✓	**Accept** - Saves the changes made to the VSN system at the end of the setup process and returns the to the Tools Menu.
		Next - Saves the changes made to the VSN system and proceeds to the next step in the setup process.
		Previous - Returns the UT display to the previous screen in the setup process.

MACHINE SETTINGS TAB

FIGURE 1. Machine Settings Tab
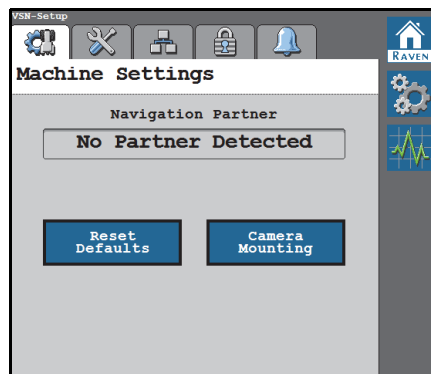
NAVIGATION PARTNER

Displays the Navigation Controller to which the VSN system is communicating.

RESET DEFAULTS

To restore system default settings:
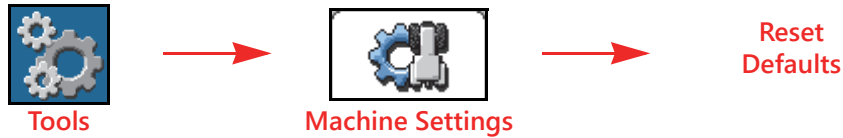
Tools → **Machine Settings** → **Reset Defaults**

1. From the VSN home page, select the Tools button.
2. Select the Machine Settings tab.
3. Select the Reset Defaults button to clear stored row spacing presets and recalibrate the system. Accepting the confirmation will restore the VSN back to factory default settings.

NOTE: Review Chapter 3, *Calibration Wizard*, for additional assistance with calibrating the VSN system and completing the calibration wizard after resetting the system defaults.

CAMERA MOUNTING

To adjust camera mounting settings and measurements:

Tools → **Machine Settings** → **Camera Mounting**

1. From the VSN home page, select the Tools button.
2. Select the Machine Settings tab.
3. Select the Camera Mounting button. The following settings and options will be displayed.

FIGURE 2. Camera Mounting Settings Page

NOTE: A factory reset will be required to change or adjust the values displayed on the Camera Mounting Settings page.

Camera Fore/Aft. Distance from the VSN camera lens to the rear axle. A positive value indicates the camera is positioned in front of the rear axle.

Camera Height. Distance from the VSN camera lens to the bottom of the furrow.

Camera Angle. Pitch of the camera from horizontal.

Wheel Base. Measurement between the front and rear axle.

SYSTEM SETTINGS TAB

FIGURE 3. System Settings Tab
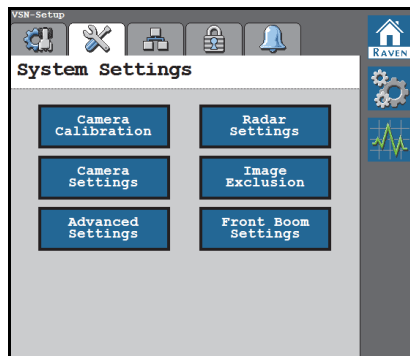
CAMERA CALIBRATION

To tune the camera calibration settings:

Tools   **System Settings**   **Camera Calibration**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Camera Calibration button. Use the following settings and options to tune the VSN cameras for operation.

FIGURE 4. Camera Calibration Page
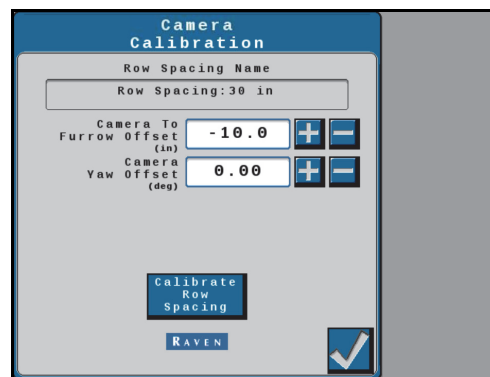
Row Spacing Name. Displays the name of the selected Row Spacing tuneset.

Camera to Furrow Offset. Displays the distance from the right camera lens to the center of the nearest furrow bottom. This distance value is calculated during the row spacing preset calibration procedure. Use the + and - buttons to fine tune the tire-to-furrow position to center the tire in the furrow.

Camera Yaw Offset. Displays the calibrated camera Yaw offset value. This value can be tuned to help account for any camera left or right heading alignment errors.

Row Spacing Calibration. Touch the Calibrate Row Spacing button to recalibrate the row spacing preset outside of the preset calibration wizard.

CAMERA SETTINGS

To tune the camera exposure settings or capture a still image through the VSN camera:

Tools   **System Settings**   **Camera Settings**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Camera Settings button. The following settings and options will be displayed.

FIGURE 5. Camera Settings Page
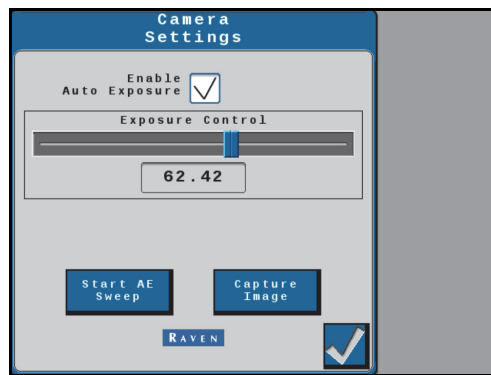
Enable Auto Exposure. Automatically determines the correct exposure for video without any user input. Disable this option to manually adjust camera exposure.

NOTE: Auto Exposure is enabled by default and it is recommended to allow the VSN system to automatically adjust exposure during operation.

Exposure Control. Determines how much light is allowed to reach the VSN sensor and adjusts how light or dark the image appears. The correct exposure allows optimal contrast for system performance.

NOTE: It is not recommended to manually adjust the Exposure Control value.

Capture Image. Touch the Capture Image button to save a still image of the current VSN camera view. The image will be saved on the VSN system and may be used by the Raven Service Team to help troubleshoot potential field issues.

Start AE Sweep. Start the auto-exposure sweep test. The camera will test the full camera spectrum to set the appropriate exposure.

ADVANCED SETTINGS

To access advanced VSN system settings:

Tools → **System Settings** → **Advanced Settings**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Advanced Settings button. The following settings and options will be displayed.

FIGURE 6. Advanced Settings Page
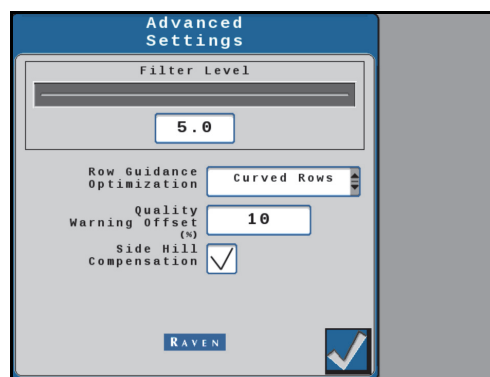
Filter Level. This setting controls the noise level in the guidance errors sent onto the CANbus from VSN. A lower setting has less filtering and lower latency. A higher setting has more filtering and more latency.

NOTE: The default value for the Filter Level is 2. It is only recommended to adjust this setting with the support of a technician.

Row Guidance Optimization. Select either curved or straight for optimal steering performance in the typical rows in your fields.

Quality Warning Offset. The threshold above the Row Detection Quality (shown on Home page) at which the operator will be notified that the solution quality from the VSN system has dropped to into a caution state. This value is editable.

For example, if the Row Detection Quality is set to 50 and the Quality Warning Offset is set to 10, the VSN icon will be in a caution (yellow) state when the Row Detection Quality is between 50 and 60.

Side Hill Compensation. Provides additional compensation to adjust for guidance errors due to machine roll in camera and full canopy (radar) operations.

NOTE: The Side Hill Compensation feature is enabled by default and is recommended for most machine operations.

RADAR SETTINGS

NOTE: Review the *Operating Specifications* section on page 6 for crop type information. Radar sensors are not intended for use in some crops.

To tune the radar row sensor settings:

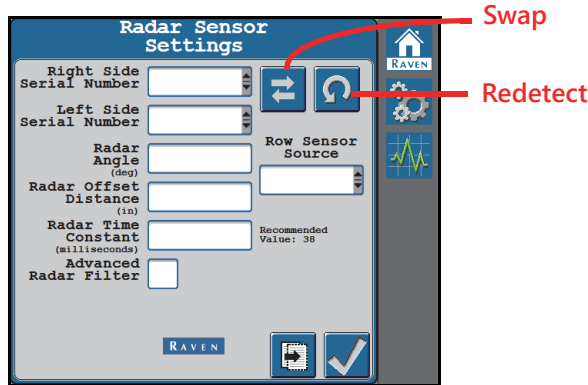**Tools** → **System Settings** → **Radar Settings**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Radar Settings button. The following settings and options will be available.

FIGURE 7. **Radar Sensor Settings**

Right/Left Side Serial Number. Use the drop down options to set the orientation of the radar sensors on the machine.

Swap. Select the Swap button to switch the left and right side radar sensor assignments.

Redetect. Use the Redetect button to have the system scan for new sensors connected to the system. Use this feature if a sensor is replaced or is not currently displayed as an option for available radar sensors.

Radar Angle. Set the horizontal angle of the radar sensors. This angle is measured using the direction of forward vehicle travel as 0°.

NOTE: The factory radar brackets are designed to mount the radar sensors at a 45° angle with the forward course over ground. Enter the radar sensor angle as a positive value.

Row Sensor Source. Select camera or radar as the source of VSN row detection for field guidance. Review the *Row Sensor Source* section on page 24 for additional assistance.

NOTE: The row sensor source option is not available when operating in radar only mode.

Radar Offset Distance. The offset distance from the centerline of the tire to the radar sensor lens.

Radar Time Constant. This value allows the system to avoid processing of certain types of radar targets.

NOTE: The default radar time constant value is 38 milliseconds. It is not recommended to adjust this value unless instructed by Raven Technical Service.

Advanced Radar Filter. Enable this feature to improve steering performance only while using radar guidance under dense, drooping sunflower foliage.

NOTE: This feature is not intended for use in other crop types.

IMAGE EXCLUSION

To adjust the camera view options:

Tools → **System Settings** → **Image Exclusion**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Image Exclusion button. The following settings and options will be displayed.

FIGURE 8. Image Exclusion Settings
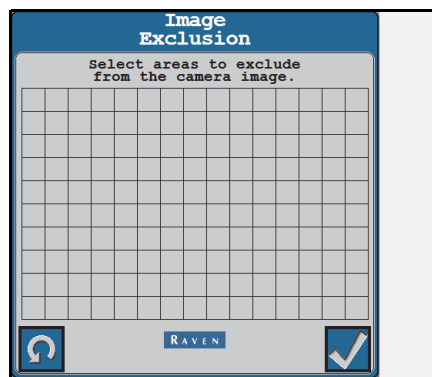
Select areas of the camera image where components of the machine are visible. These areas will be omitted from VSN steering corrections.

FRONT BOOM SETTINGS

To adjust the VSN camera mounting settings for front boom configurations:

Tools → **System Settings** → **Front Boom Settings**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the Front Boom Settings button. The following settings and options will be displayed.

FIGURE 9. Height Sensor Page
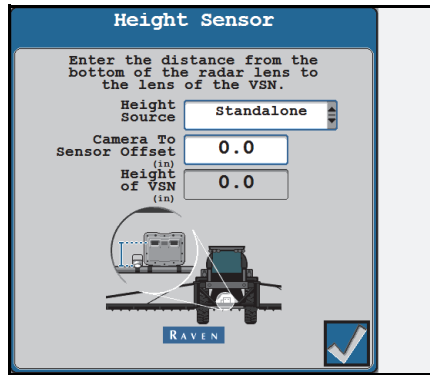
Height Source. The height sensor source used with the front boom mounted VSN. This option may be set to utilize the XRT center rack height sensor or a standalone height sensor.

Camera to Sensor Offset. The offset is the difference between the VSN camera lens and the height radar sensor. Enter a positive offset value if the VSN camera is above the radar height sensor.

Height of VSN. The calculated height of the VSN camera. The value displayed in this field utilizes the height sensor source and camera to sensor offset to calculate the current height of the VSN camera.

NETWORK SETTINGS TAB

FIGURE 10. Network Settings Tab
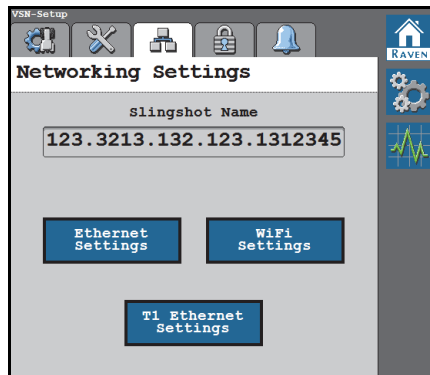
SLINGSHOT NAME DISPLAY

Displays the registered name of the VSN unit found on the Raven Slingshot® Portal.

ETHERNET SETTINGS

Touch the Ethernet Settings button to review the IP address assigned to the VSN system and the current link speed.

FIGURE 11. Ethernet Settings Page
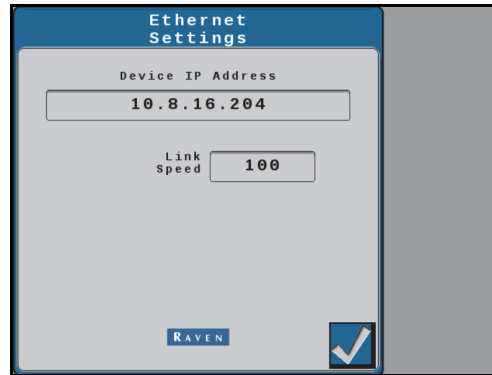
WIFI SETTINGS

To change WiFi or wireless communication settings:
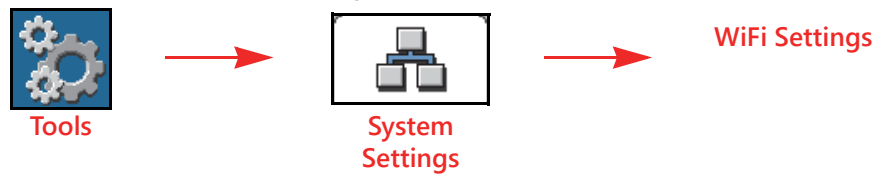
Tools　　　　　**System Settings**　　　　　**WiFi Settings**

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the WiFi Settings button to review all WiFi Networks available to the VSN system. The network to which VSN is currently connected will be displayed with a green check mark next to the name.

Mode. Use the Mode drop-down option to select Raven Auto or Manual. Raven Auto will allow VSN to automatically connect with a compatible Raven device.

If a compatible Raven device is not available, select Manual from the Mode drop down list to display a list of available WiFi networks. The network to which VSN is currently connected will be displayed with a green check mark next to the name.

FIGURE 12. WiFi Settings Page

T1 ETHERNET SETTINGS

To review or change the T1 Ethernet settings:
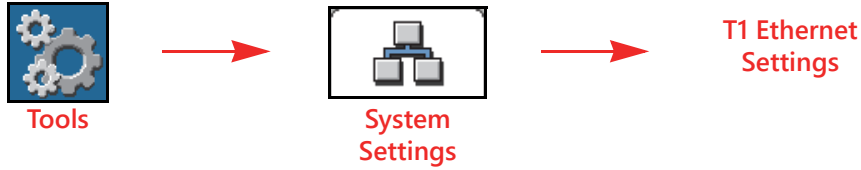
Tools → System Settings → T1 Ethernet Settings

1. From the VSN home page, select the Tools button.
2. Select the System Settings tab.
3. Select the T1 Ethernet Settings button. The following settings and options will be displayed.

FIGURE 13. T1 Server and Client Mode Pages
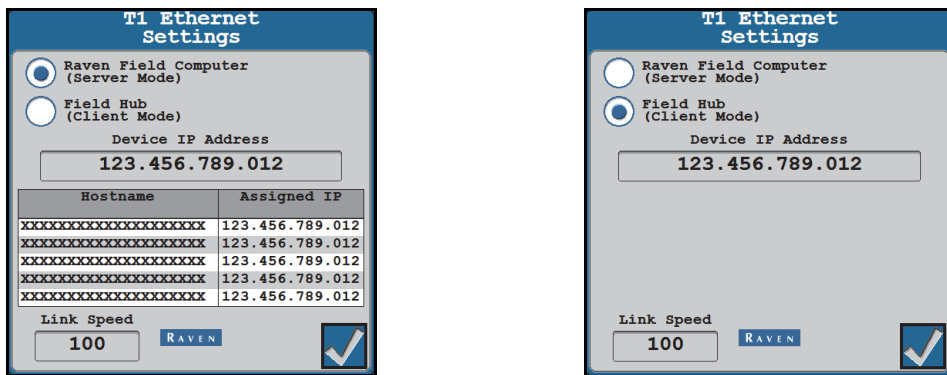
Raven Field Computer (Server Mode). Allows other devices to connect to the VSN.

Field Hub (Client Mode). Allows the VSN to connect to another device via wireless Internet.

Device IP Address. Displays the IP address the VSN has received (via Field Hub) or the IP address of the VSN broadcast (via Server Mode).

Link Speed. Displays the fastest data rate for all devices connected via Ethernet cable. The value is measured in megabits per second (MB/s).

CHAPTER   DIAGNOSTICS

6

The following buttons will be used to navigate the diagnostics menus and pages described in the following sections.

TABLE 1. **UT Navigation Buttons**

✓	**Accept** - Saves the changes made to the VSN system at the end of the setup process and returns the to the Tools Menu.
▣→	**Next** - Saves the changes made to the VSN system and proceeds to the next step in the setup process.
←▣	**Previous** - Returns the UT display to the previous page in the setup process.

SYSTEM INFORMATION

FIGURE 1. System Information Tab
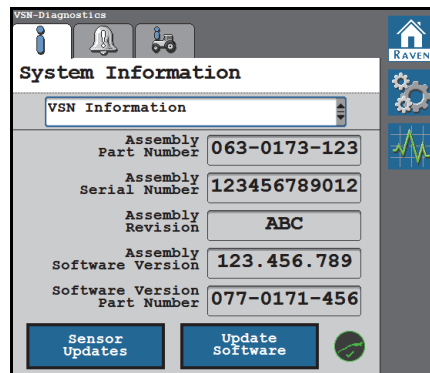
The System Information tab displays the following information associated with the VSN system:

- Hardware Version
- Software Version
- Inertial Data
- System Hours
- System Voltages

SLINGSHOT STATUS ICON

- Green - Denotes a VSN connection to Slingshot.
- Red - Denotes that the VSN is NOT connected to Slingshot.

UPDATE SENSOR

To update radar sensors used with the VSN system:

Diagnostics → System Settings → Sensor Updates

1. From the VSN home screen, select the **Diagnostics** button along the right side of the page.
2. Select the **System Information** tab.
3. Select the **Sensor Updates** button in the lower, left corner of the page.

NOTE: VSN radar sensor software updates are downloaded as part of the VSN software.

FIGURE 2. Sensor Updates Page
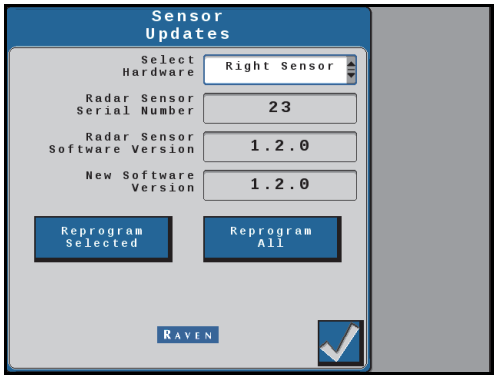
4. To update the VSN radar sensors

- Select the **Reprogram All** button to update all radar sensors connected to the VSN guidance system.
- Select the **Reprogram Selected** button to update the radar sensor which is shown in the Select Hardware field at the top of the page.

SOFTWARE UPDATE

Select the Update Software button at the bottom of the page to update the software version on the VSN system.

FIGURE 3. Software Download Page
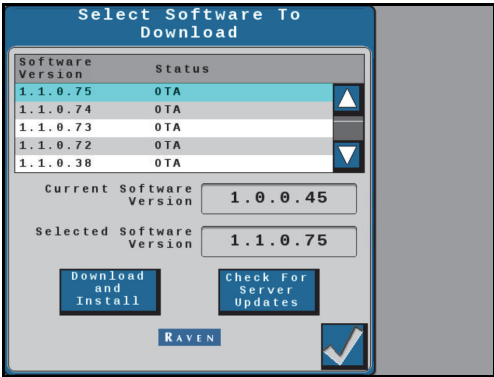
The current software version installed on the VSN system is displayed along with any available OTA (Over the Air) updates.

NOTE: VSN may be updated with a USB drive via the field computer or UT. An OTA update may be completed with an Internet connection either via WiFi or Ethernet.

Refer to the CAN Node Update process in the field computer manual and ensure WiFi is enabled on the field computer.

TO UPDATE SOFTWARE

FIGURE 4. Software Download Page
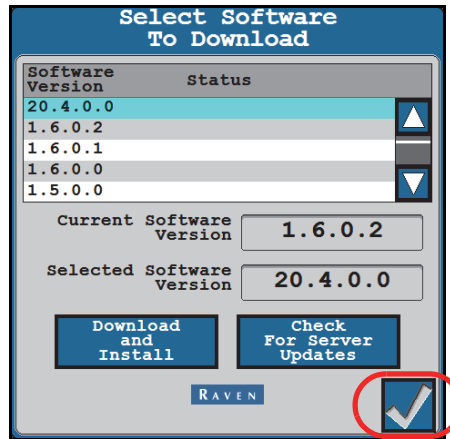
5. Select the **Check for Server Updates** button to search for available updates.

6. Select the desired software update from the list.

7. Select the **Accept** button.

NOTE: The software will download, but will not be installed until later in the procedure. Before proceeding, accept the Data Usage Warning to allow the system to use cellular data to download the updates.

FIGURE 5. Data Usage Warning Page
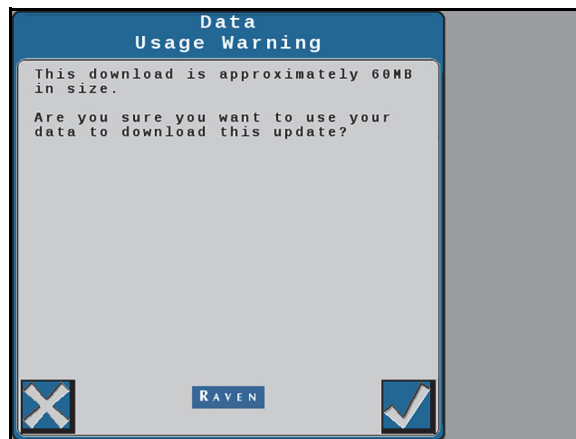
NOTE: Select Cancel to exit without downloading the software update.

FIGURE 6. Software Download Page
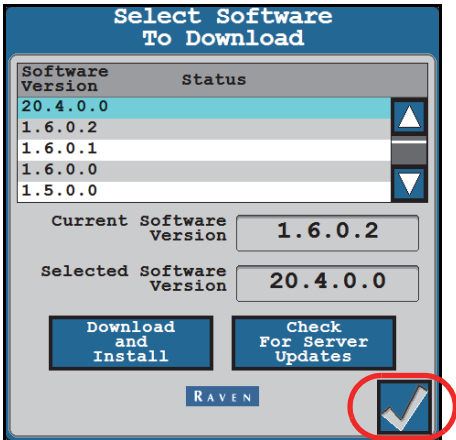
8. Select **Accept** to begin the software download.
9. Wait for the software download to be completed.

FIGURE 7. Software Update Notice
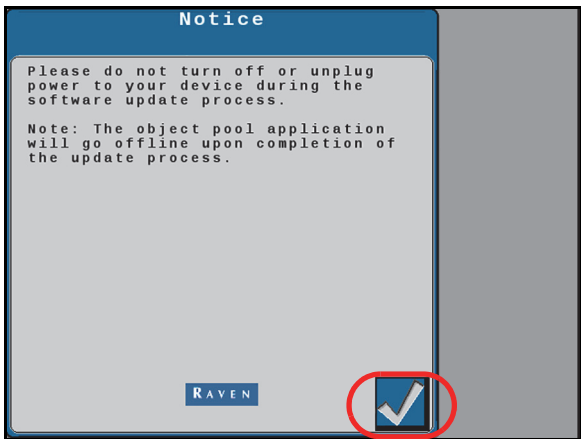
10. Select **Accept** to install the software.

NOTE: Do not shutdown the system or field computer during the software update.

FIGURE 8. Software Installation in Progress
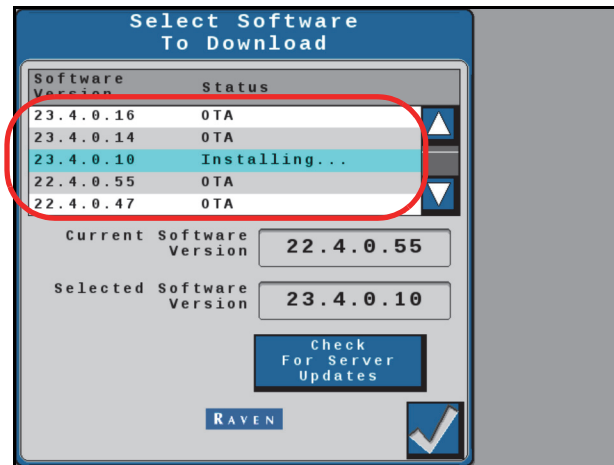
DIAGNOSTIC TROUBLE CODES (DTCS)

The Diagnostic Trouble Code tab displays lists of both active and previous (inactive) diagnostic trouble codes (DTCs) that occur during VSN system operation. Active DTCs must be fixed before the VSN system can be enabled for guidance and steering operation. Once a DTC has been corrected, the code moves to the inactive DTC code list. Refer to Figure 9 on page 47 for an example of DTCs and DTC summaries.

FIGURE 9. Diagnostic Trouble Codes Tab
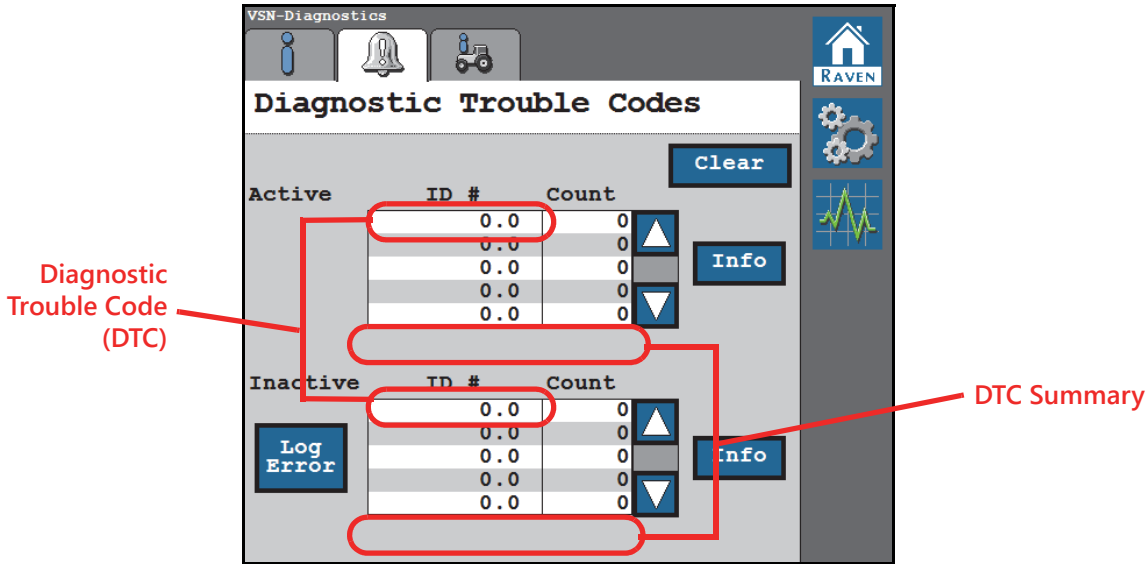
Selecting Clear deletes the inactive DTCs from the Inactive DTC error log.Select the Log Error button to record diagnostic CAN data.

VSN® DIAGNOSTIC LED STATES

TABLE 2. VSN Diagnostic LED Displays

LED Color	Frequency	Description
Green	1 Hz	VSN system is calibrated and detecting rows.
Yellow	10 Hz	No CAN communication.
	1 Hz	CAN communication present.
Red	-	VSN has power and is starting up.
Red / Purple	-	VSN requires reprogramming.

RADAR SENSOR STATUS LEDS

TABLE 3. VSN Steering Radar LEDs

LED Color	Frequency	Left/Right Radar	Height Radar
Red	10 Hz	Reprogramming sensors or error.	
Yellow	1 Hz	Sensors not configured.	
Green	1 Hz	N/A	Sensors are configured.
Blue	1 Hz	Sensors are configured.	N/A
Magenta	1 Hz	Acquiring data from the sensor.	

DIAGNOSTIC TROUBLE CODES (DTC)

TABLE 4. Diagnostic Trouble Codes

Code ID		Description	Recommended Actions
523865	.31	No ethernet connection.	Check network settings. Check ethernet connection and cabling.
523872	.31	SC1 ECU out of date.	Update the SC1 ECU.
523929	.31	Row guidance failed.	Cycle power to the VSN system.
523930	.31	Video control failed.	Cycle power to the VSN system.
523931	.13	Bad calibration file.	Rerun row spacing calibration.
523932	.13	Radar sensors not configured.	Configure the radar sensors from the setup page. Refer to the *Radar Settings* section on page 36.
523933	.31	Left radar sensor offline.	Check cabling. Cycle power to the VSN system and update VSN firmware.
523934	.31	Right radar sensor offline.	Check cabling. Cycle power to the VSN system and update VSN firmware.
523935	.31	Stand-alone height sensor out of date.	Update the height sensor.
523936	.31	ABM ECU version out of date.	Update the ABM ECU.
523937	.13	ABM ECU not calibrated.	Calibrate or unlock AutoBoom XRT ECU.
523938	.31	Dynamic height sensor offline.	Check cabling. Cycle power to the ABM ECU and update ABM firmware.
		Both radar sensors offline.	Check cabling. Cycle power to the ABM ECU and update ABM firmware.

Code ID		Description	Recommended Actions
523939	.31	Invalid AutoBoom XRT sensor detected.	Invalid configuration. Ensure that the tuneset is configured as a front boom and the AutoBoom XRT system is not present on the ISOBUS.
523940	.31	Left side sensor update.	Update the radar sensor firmware.
523941	.31	Right side sensor update.	Update the radar sensor firmware.
523942	.31	Left or Right sensor radar chip failure.	Replace the radar sensor.
524194	.31	Left sensor programming failure.	Retry programming the radar sensor. Review the *Update Sensor* section on page 42.
524195	.31	Right sensor programming failure.	Retry programming the radar sensor. Review the *Update Sensor* section on page 42.
524196	.31	Height sensor programming failure.	Retry programming the radar sensor. Review the *Update Sensor* section on page 42.

SYSTEM SUMMARY

The System Summary tab provides an overview of the current VSN settings and may be useful to verify that the system is configured properly for the machine or implement with which the system is operating.

FIGURE 10. System Summary Tab
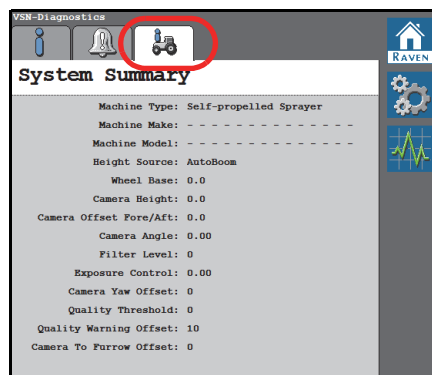
LIMITED WARRANTY

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 36 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 completed RMA form, Certificate of Decontamination, and retail 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 this product or any component of the product found to be defective during the warranty period. Replacement will be made with a new or remanufactured product or component. Standard return freight will be paid, regardless of 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 outside our facility 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, improper installation and maintenance are not covered by this warranty.
- Worn/Chafed hoses and cables.
- Items in contact with fluids and chemicals including seals and O-rings.
- Software downloads and updates.
- Tamper-Evident label broken or customer disassembly.
- Any customer modification to the original product outside normal calibration and adjustments, without written approval.
- Intentional modification to cables.
- Failures due to lack of cleaning or preventive maintenance, and any condition, malfunction or damage not resulting from defects in material or workmanship.
- Items in contact with fluids or chemicals, returned without proper cleaning, decontamination and documentation.

RAVEN

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 https://portal.ravenprecision.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 completed RMA form, Certificate of Decontamination, and Extended Warranty Registration Number) 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 warranty claim, Raven Industries will (at our discretion) repair or replace this product or any component of the product found to be defective during the warranty period. Replacement will be made with a new or remanufactured product or component. Standard return freight will be paid, regardless of inbound shipping method. Expedited freight is available at the customer's expense.

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WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

Raven Industries will not assume any expense or liability for repairs outside our facility 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, improper installation and maintenance are not covered by this warranty.
- Worn/Chafed hoses and cables.
- Items in contact with fluids and chemicals including seals and O-rings.
- Software downloads and updates.
- Tamper-Evident label broken or customer disassembly.
- Any customer modification to the original product outside normal calibration and adjustments, without written approval.
- Intentional modification to cables.
- Failures due to lack of cleaning or preventive maintenance, and any condition, malfunction or damage not resulting from defects in material or workmanship.
- Items in contact with fluids or chemicals, returned without proper cleaning, decontamination and documentation.

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