

Raven RS1™ and RS Lite™ Calibration and Operation Manual

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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.

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.
- When starting the machine for the first time after installing RS1, be sure that all persons stand clear in case a hose has not been properly tightened.
- The machine must remain stationary and switched off during RS1 installation or maintenance.

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

AERIALS AND SIGNAL INTERFERENCE

Due to the relatively low broadcast power from satellites, all GNSS receivers and aerials tend to be susceptible to sources of signal noise and interference as compared to terrestrial signals (i.e. radio or cellular).

NOTE: Poor GNSS signal reception may cause other systems which rely on GNSS solutions (e.g. auto-steer systems, rate control systems, etc.) to disengage or may cause undesired operation or results.

The following recommendations are intended to provide an optimal environment for GNSS systems and provide the best up-time results, even as sources of interference may spike throughout the day.

- Mount GNSS antennas with a clear, unobstructed view of the sky.
 - A minimum clearance of 1 m [39 in] is recommended around the GNSS antenna to help avoid common issues with signal interference. Do not mount cellular, radio, or other GNSS antennas within this area.
 - Mount the GNSS antenna to the tallest point of the machine. Avoid mounting the antenna in a location where obstructions (e.g. bins/hoppers, cab roof lines, equipment frame or structural elements, etc.) may rise into the antenna view.

NOTE: The antenna view typically starts 5° to 10° above horizontal from the base of the antenna and extends over the skyward face of the receiver/antenna.

- GNSS is a line-of-sight system. A clear path must exist between the satellite and the GNSS antenna.
 - Obstructions such as buildings, tree branches and limbs, as well as components of the vehicle such as a fiberglass or metal roof, and etc. may cause signal multi-path or completely block the GNSS receiver.
- Electrical and magnetic fields can interfere with GNSS or L-Band signals.
 - Avoid mounting GNSS receivers or antennas near components such as radio or cellular antennas, electrical motors, generators, alternators, strobe lights, radio transmitters, radio or cellular antennas, etc.
 - Over-head power lines, microwave dishes, radar, other active antennas, etc. can interfere with GNSS signal.
- Mount the Field Hub cellular and diversity antennas at least 1 m [39 in] apart. Avoid mounting other cellular, radio, or GNSS aerials within this area.

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.).

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 12 in [30 cm].
- 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 contaminants. 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

Thank you for purchasing the RS1™ system.

The instructions in this manual are designed to assist in the proper calibration and operation of the RS1 system when used with the Viper 4 or CR7 series field computers.

NOTE: Installation of the RS1 system must be completed before calibrating the system. Refer to the machine-specific RS1 Installation Manual for assistance with installation of the RS1 system.

The Raven field computer must be calibrated specifically for the equipment before being used to operate the RS1 system. Refer to the Operation Manual for the field computer used to operate the RS1 system.

Installation and Operation Manuals for Raven systems can be downloaded from the Raven website:

<https://portal.ravenprecision.com/>

SYSTEM SPECIFICATIONS

RS1 ELECTRICAL RATING

The specifications below are specific to the RS1 system:

Current Rating	Voltage Range
6 Amps	8 - 24 Volts

INSTALLATION BEST PRACTICES



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 RS1 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 RS1 system for the first time, at the start of the season, or when moving the RS1 system to another machine:

- Verify that the machine hydraulic system is using fresh oil and that the filters have been recently changed
- Ensure there are no issues with the machine 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

- Raven RS1™ and RS Lite™ Calibration and Operation Manual
- 016-4010-001 Rev. J
- 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.



WARNING

The machine will steer automatically. While calibrating or operating the RS1 steering system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

To disengage auto-steering at any time, turn the steering wheel or select the on-screen Stop button.



WARNING

During the auto-steering calibration, the machine will make several hard left and right turns. Adjust the vehicle speed and location as necessary.



NOTICE

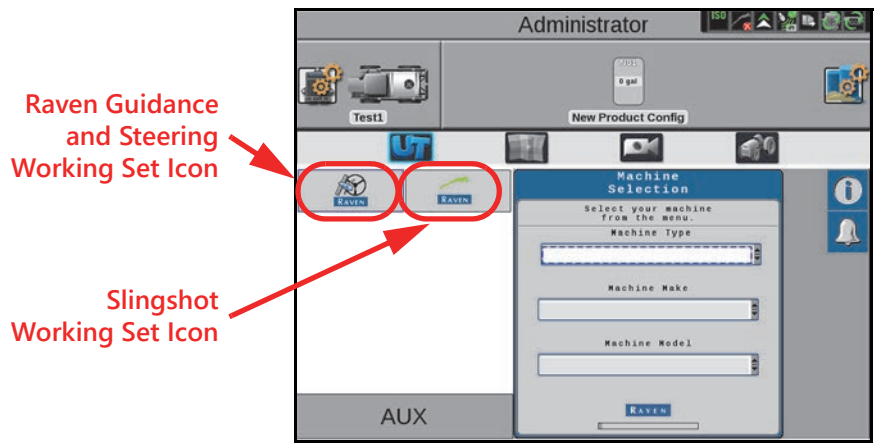
Calibration of the machine steering system should be performed in a field or other large, open space and with conditions similar to normal vehicle operation.

If the ground or surface is slippery, muddy, or freshly tilled, the RS1 steering system may learn incorrect steering responses for normal operating conditions.

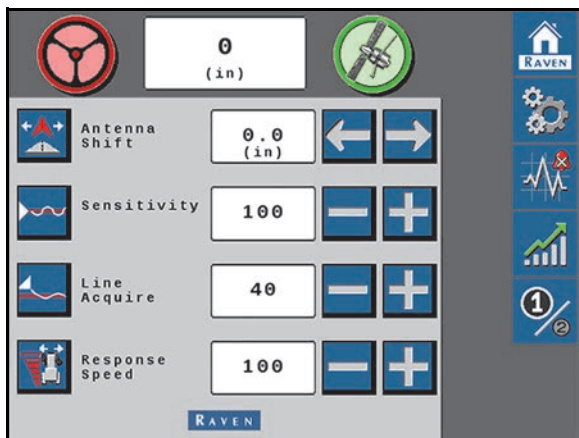
Ensure the machine hydraulics are operating properly and there are no other mechanical issues that may affect the performance of the RS1 steering system.

INTRODUCTION

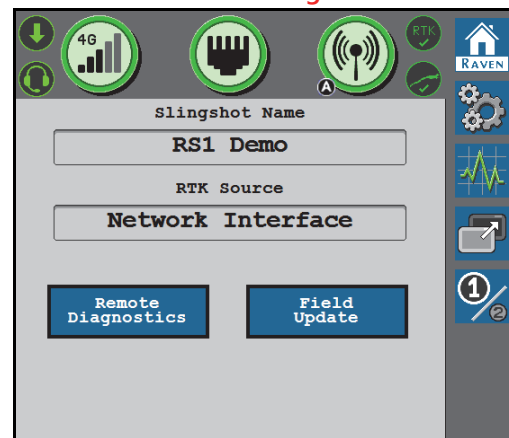
FIGURE 1. Home Page



Guidance and Steering Software Home Page



Slingshot Software Home Page

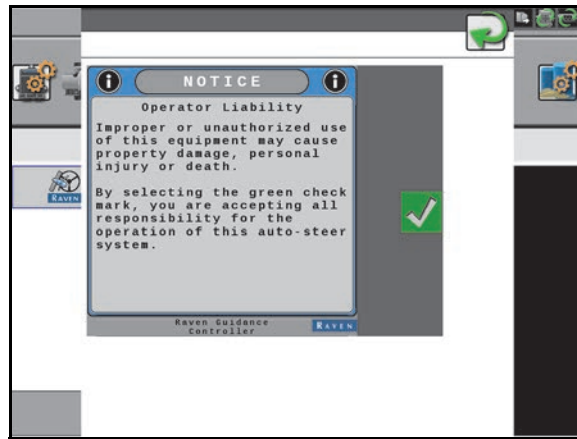


The RS1 unit contains two sets of software loaded into the Universal Terminal on the display or field computer.

- **Guidance and Steering** - Allows the steering and GPS settings within the RS1 unit to be calibrated and modified.
- **Slingshot** - Allows the cellular, Ethernet, and WiFi settings within the RS1 unit to be modified.

RS1 TERMS OF USE

FIGURE 2. Operator Liability Page



Read and accept the Operator Liability Warning. If the operator does not accept liability, the RS1 system will disable and cannot be reengaged until the liability warning is accepted. The Operator Liability Warning prompt will display each time a steering partner is registered with the RS1.

GPS AND STEERING CALIBRATION

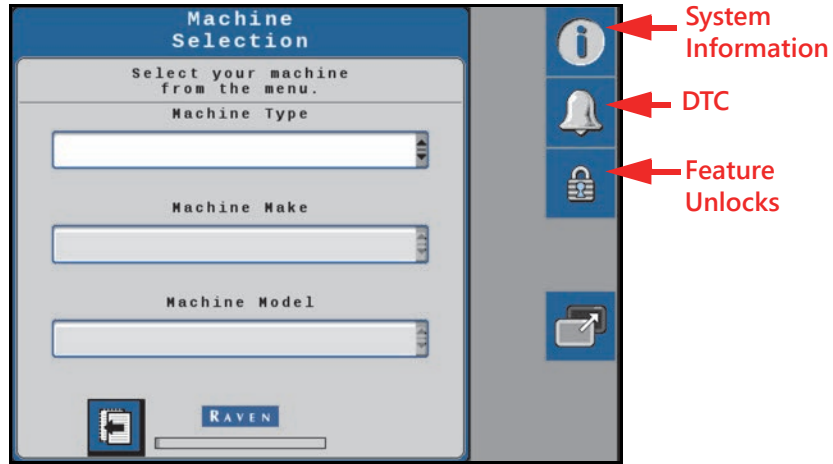
NOTE: The System Information, diagnostic trouble codes (DTCs), Feature Unlock, and Machine Test pages may be viewed during calibration. For further information on these settings, refer to the following sections of this manual:

- *System Information* section on page 76
- *Diagnostic Trouble Codes (DTC)* section on page 58
- *Feature Unlock Codes* section on page 49
- Machine Test

NOTE: The machine test pages provide additional diagnostics capabilities and allow the operator to test function of various machine controls and sensors.

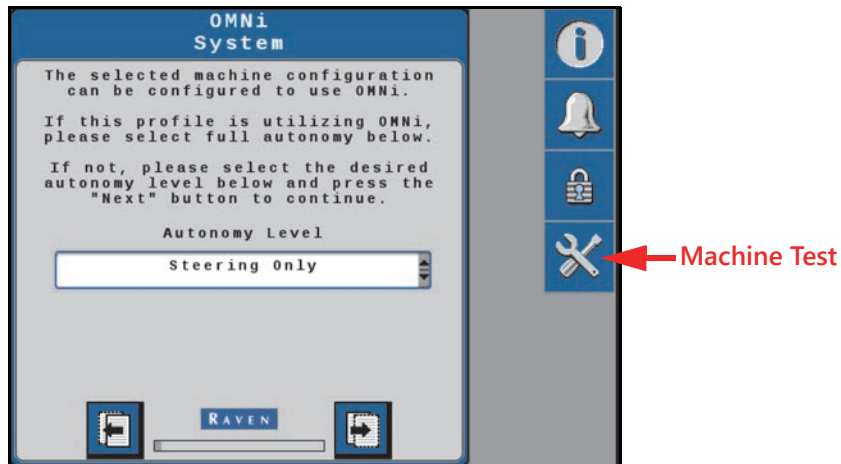
GPS CALIBRATION

FIGURE 3. Machine Selection Page



1. Select the Machine Type, Machine Make, and Machine Model from the Machine Selection drop-down boxes.
2. Select the **Next** arrow.
3. Use the drop-down list to select one of the following options for devices installed on a OMNi system.

FIGURE 4. OMNi System Enable Page



NOTE: The OMNiDRIVE™ System page will only display when calibrating an RS Lite with a compatible tractor or any combine machine type.

GPS Only. Stream GNSS correction information only. Select this option for guidance only applications or to stream corrections to a separate automated steering system.

Steering Only. Use the guidance and automated steering features of the device. Select this option for automated tractor or sprayer steering applications.

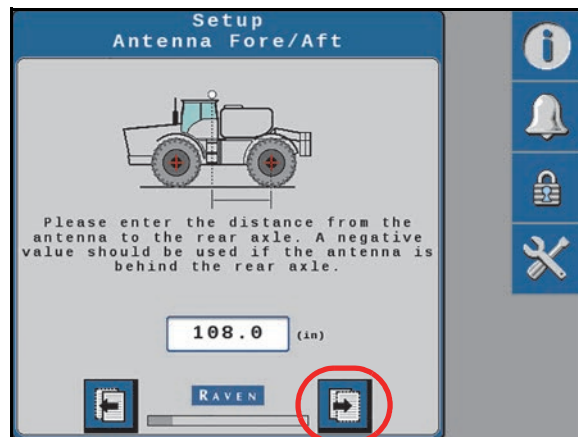
Autonomy Driverless. Select this option to enable features for autonomous systems such as OMNiDRIVE.

FIGURE 5. Steering Configuration Page



4. Verify that the correct steering controller partner has been identified:
 - OEM TECU (tractor electronic control unit)
 - Sauer Danfoss CL/CLS Valve
 - SmarTrax MD
 - SmarTrax HD Analog
 - SmarTraxHDPWM
5. Select the **Next** arrow.

FIGURE 6. Antenna Fore/Aft Page

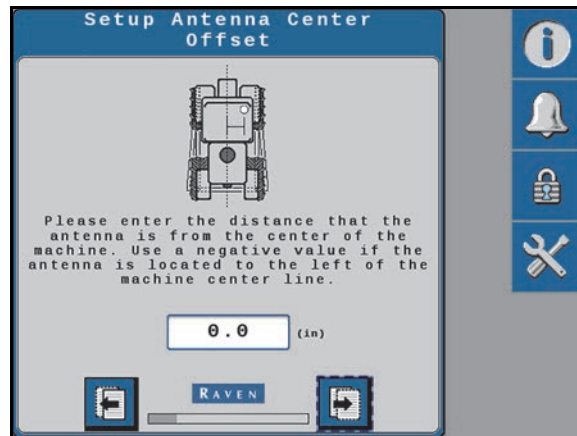


6. Select the value box to enter the Antenna Fore/Aft position.

NOTE: The Antenna Fore/Aft position is calculated by measuring from the rear axle of the machine to the middle of the RS1 unit. Enter a negative value if the RS1 unit is located behind the rear axle.

7. Select the **Next** arrow.

FIGURE 7. Antenna Center Offset Page

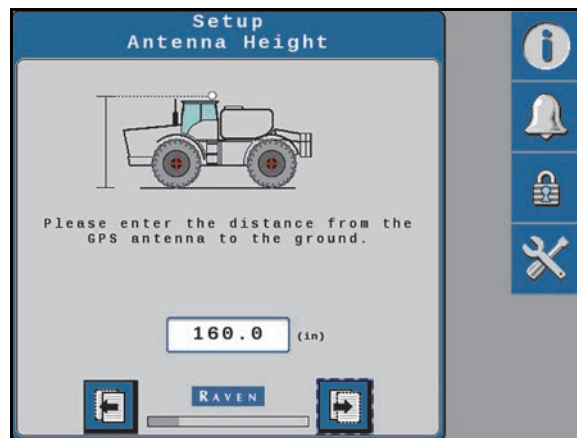


8. Select the value box to enter the Antenna Center Offset position.

NOTE: The Antenna Center Offset position is calculated by measuring from the center of the machine to the center of the RS1 unit. Enter a negative value if the RS1 unit is located to the left of the machine center line.

9. Select the **Next** arrow.

FIGURE 8. Antenna Height Page

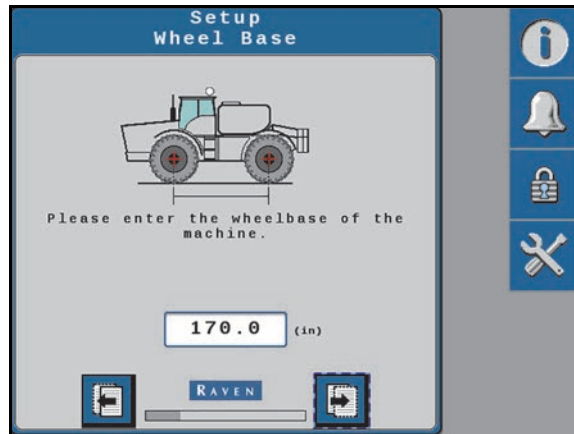


10. Select the value box to enter the Antenna Height.

NOTE: The Antenna Height is calculated by measuring from the ground to the center of the RS1 unit.

11. Select the **Next** arrow.

FIGURE 9. Wheel Base Page

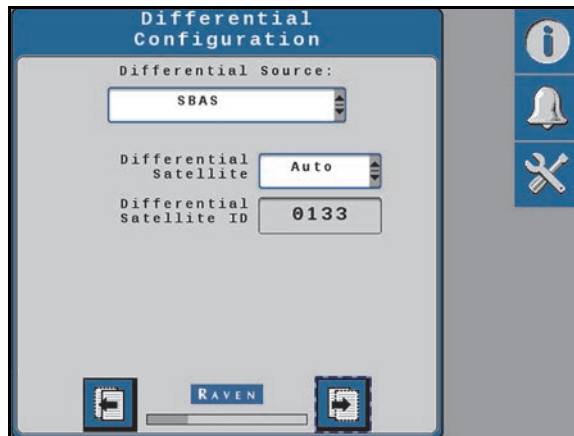


12. Select the value box to enter the Wheel Base.

NOTE: The Wheel Base is calculated by measuring from the center of the front tire to the center of the rear tire on both sides of the machine. Add these measurements together and then divide by two to get the average Wheel Base value.

13. Select the **Next** arrow.

FIGURE 10. GPS Differential Configuration Page



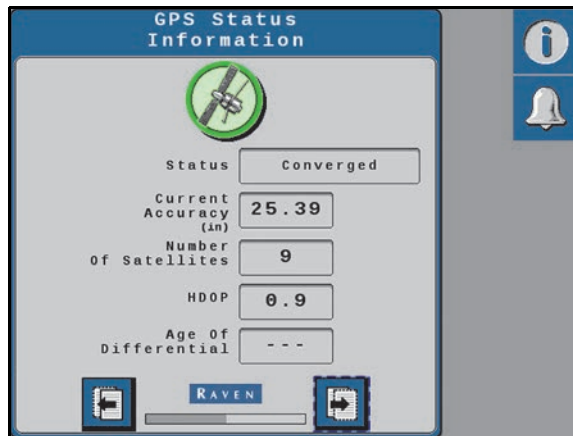
14. Select the appropriate GPS Differential Source from the drop-down box:

- GL1DE®
- SBAS
- Satellite GS
- RTK

NOTE: Depending on the number of feature unlocks purchased, all options may not be available for selection in the drop-down box. Contact your local Raven dealer to purchase additional unlock codes.

15. Select the **Next** arrow.

FIGURE 11. Position Accuracy Page



16. Select the **Next** arrow.

TERRAIN COMPENSATION CALIBRATION

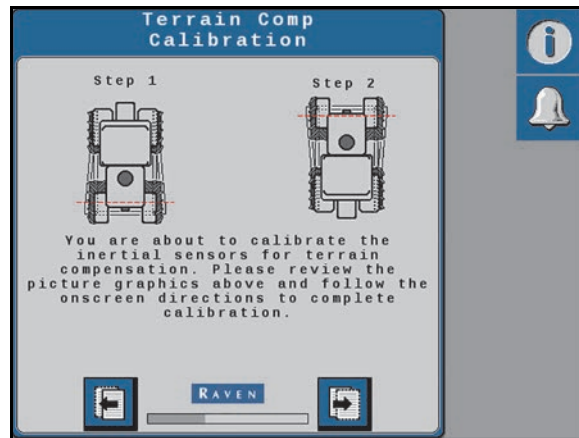
FIGURE 12. Terrain Compensation Calibration Wizard



1. Drive the machine forward 33 feet [10.1 m] and park on a flat surface.

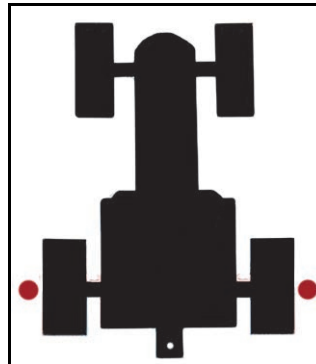
NOTE: The system must detect a converged GPS status with a green shield and a forward motion prior to calibration to determine which direction is forward.

FIGURE 13. Terrain Compensation Calibration Wizard



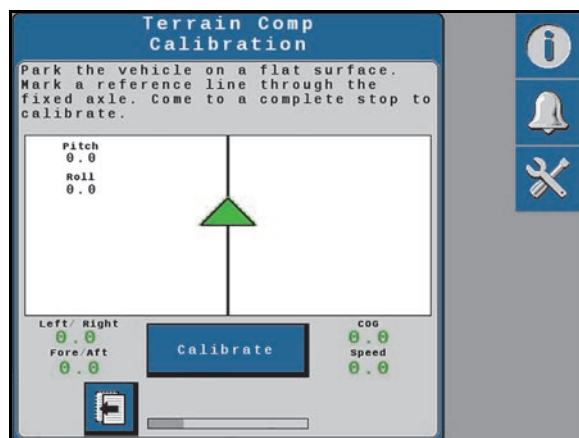
2. Follow the on-screen instructions to begin the calibration process.

FIGURE 14. Machine Rear Axle Marked Before Terrain Comp Calibration



3. Place flags or markers on the outside of each wheel of the fixed axle of the machine.
 - Rear axle - Front boom sprayers, rear boom sprayers, and front-steered machines
 - Front axle - Articulated tractors, rear-steered machines, and wind rowers
 - Center of track - Tracks

FIGURE 15. Terrain Comp Calibration Page



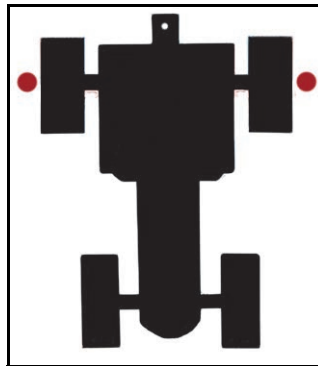
4. Select **Calibrate** to begin the calibration process. The following page will display:

FIGURE 16. Terrain Comp Calibration Page



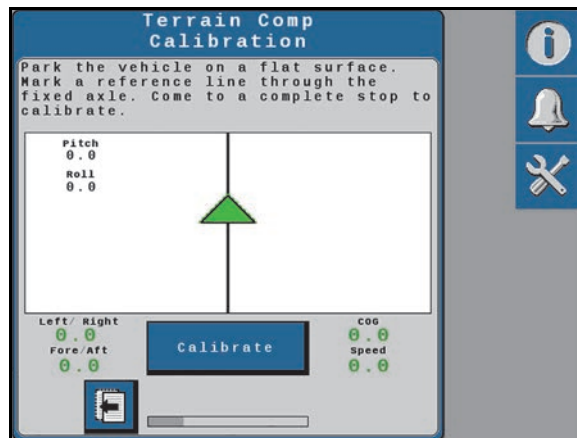
5. Wait for the calibration process to be completed before moving the vehicle.

FIGURE 17. Machine Orientation After Terrain Comp Calibration



6. Turn the machine around 180° and park with the machine facing the opposite direction and the fixed axle in between the flags or markers.

FIGURE 18. Terrain Comp Calibration Page



7. Select **Calibrate**. Once the calibration is complete the following page will display.

FIGURE 19. Finish Calibration



8. Select the **Next** arrow.

NOTE: If performing a GPS Only calibration, the wizard is complete and a summary page will open.

STEERING CALIBRATION

HOMOLOGATION

Some machine tunesets and operational regions may require that the operator accept the roadway homologation terms. Refer to Chapter 13, *Certification and Compliance*, for additional details and certification information.

RESUME/DISENGAGE CALIBRATION

FIGURE 20. Resume Switch Verification Page



1. Press the resume switch.

NOTE: The page should automatically advance to the next page if the resume switch is detected.

NOTE: If the On-Screen Engage widget is going to be used, select **Use On-Screen Engage**. The page should automatically advance to the next page.

FIGURE 21. Disengage Calibration Page



2. Calibrate the disengage sensor by turning the steering wheel.

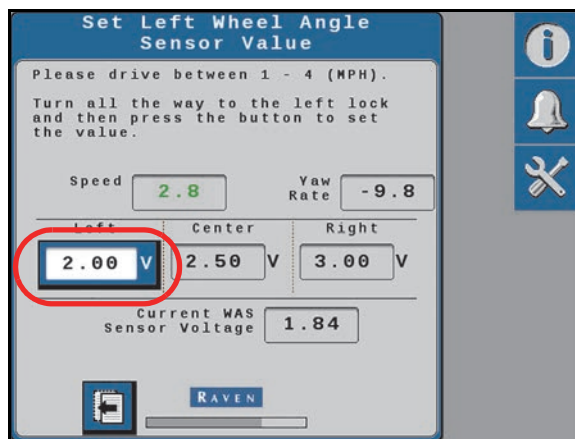
NOTE: The Disengage Status indicator will turn red while the steering wheel is being turned and will advance to the next page once calibration is complete.

NOTE: If a pressure transducer or encoder is being used, a page displaying the calibrated disengage value will be displayed. This value is editable.

CALIBRATE THE WHEEL ANGLE SENSOR (WAS)

NOTE: The machine must remain moving during the WAS calibration.

FIGURE 22. Left Wheel Angle Sensor Calibration (WAS) Page

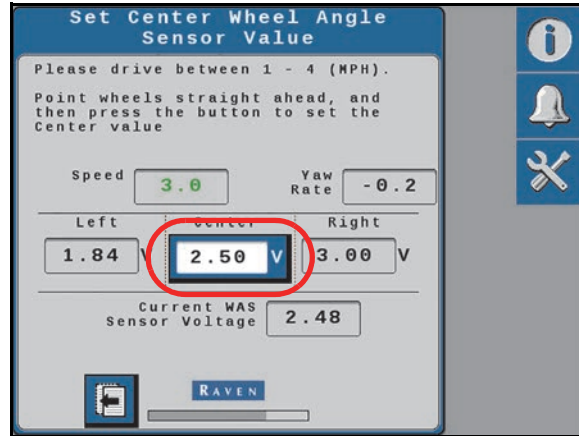


1. Drive forward between 1.6 - 6.4 km/h [1 - 4 mph].
2. Turn the steering wheel all the way to the left steering lock.

3. Press the **Left** button to set the left WAS value.

NOTE: Do not turn the steering wheel until the WAS page advances to the Center WAS setting.

FIGURE 23. Center WAS Calibration Page

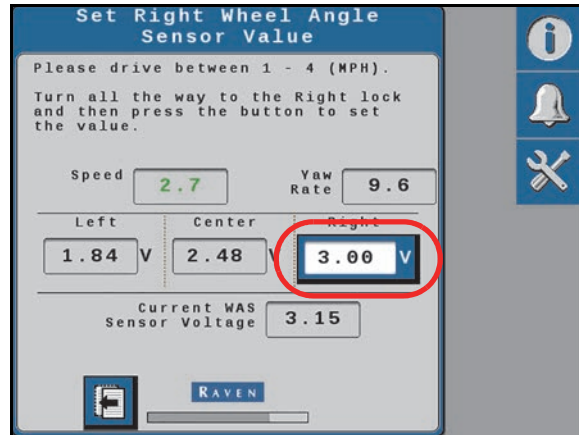


4. Drive forward between 1.6 - 6.4 km/h [1 - 4 mph] with the machine wheels pointing straight ahead.

5. Press the **Center** button to set the center WAS value.

NOTE: Do not turn the steering wheel until the WAS page advances to the Right WAS setting.

FIGURE 24. Right WAS Calibration Page



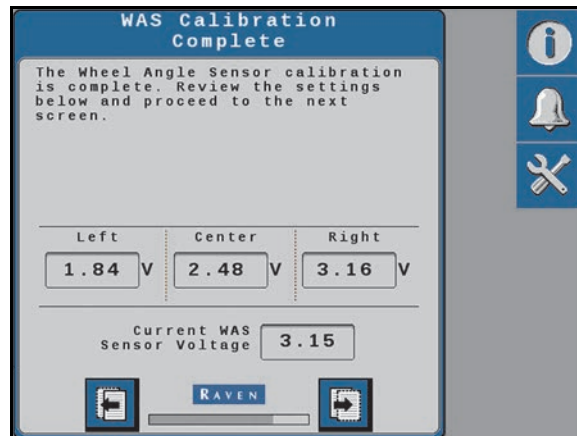
6. Drive forward between 1.6 - 6.4 km/h [1 - 4 mph].

7. Turn the steering wheel all the way to the right steering lock.

8. Press the **Right** button to set the right WAS value.

NOTE: Do not turn the steering wheel until the following Calibration Complete page is displayed.

FIGURE 25. Calibration Complete Page



9. Review the WAS calibration information.
10. Press the **Next** arrow.


CALIBRATE THE MACHINE STEERING SYSTEM

NOTE: Although the RS1 steering and guidance system should be automatically calibrated to ensure optimal system performance, the automatic calibration of the system can be bypassed by selecting the **Use Quick Calibration** option. This causes the system to load default gains for the machine selected during the calibration process.

The steering control calibration process allows the RS1 to learn the hydraulic capabilities of the machine for optimal steering performance in the field.

Before beginning the machine steering system calibration, ensure that the following conditions are met:

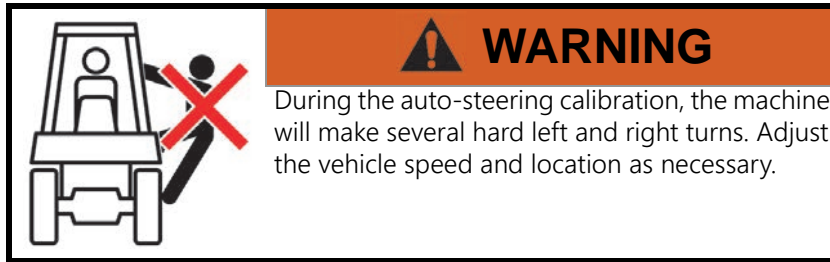
- The booms are racked on self-propelled units.
- There are no implements connected to the hitch.
- The machine engine is running at the normal operating RPM.
- The machine measurements are correctly entered into the Viper 4.
- The machine hydraulic fluid is at the normal operating temperature.



WARNING

The machine will steer automatically. While calibrating or operating the RS1 steering system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

To disengage auto-steering at any time, turn the steering wheel or select the on-screen Stop button.



NOTE: To ensure the calibration is successful, the number of starts and stops during the calibration process should be limited. If it is necessary to pause the calibration process, turn the steering wheel or press the Stop button on the field computer. Tap the foot/enable switch again to resume calibration.

NOTE: During calibration, the machine will make several hard left and right turns. Adjust the vehicle speed and location as necessary.

NOTE: If an error message is displayed during calibration, refer to *Diagnostic Trouble Codes (DTC)* section on page 58 for possible causes and corrective action steps to be taken.

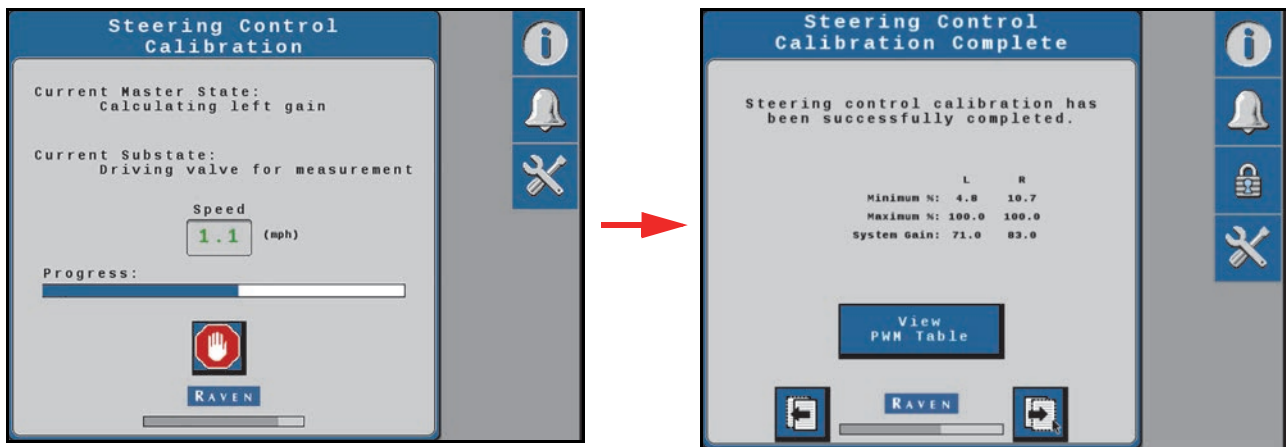
1. Park the machine on a level surface with several acres of smooth ground available.

FIGURE 26. Steering Control Calibration Page



2. Drive forward at 1.6 - 6.4 km/h [1 - 4 mph].
3. Press the resume switch or use the on-screen arrow to begin calibration. The following pages will be displayed during the process:

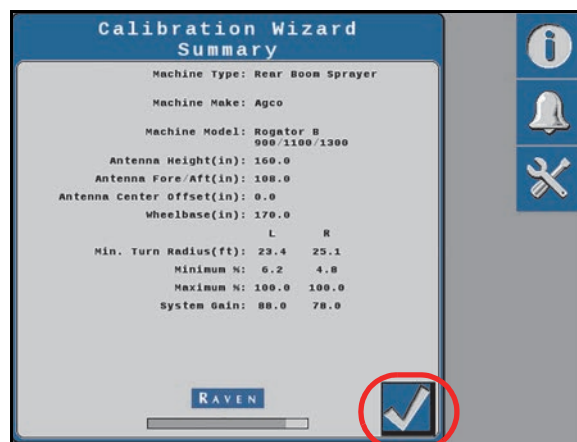
FIGURE 27. Calibration in Process Pages



4. Review the steering effort information shown on the page. Select the **Next** arrow when ready to proceed.

NOTE: For additional calibration information, select the View PWM Table button. A chart of the calibration just completed will be displayed.

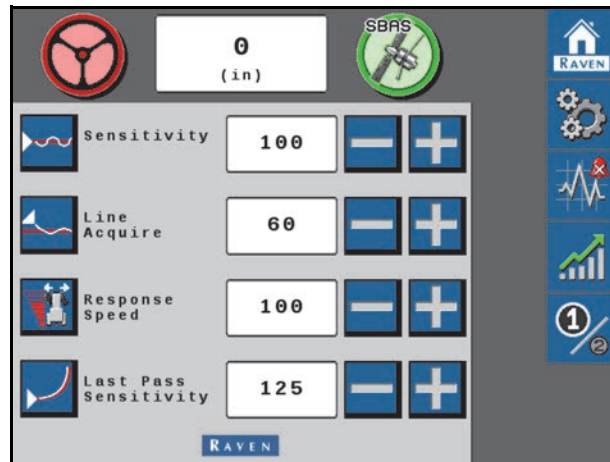
FIGURE 28. Calibration Complete Page



5. Review the Calibration Wizard Summary.

6. Press **Accept**.

FIGURE 1. Home Page



NOTE: Tap any of the steering settings icons along the left for information about each setting.

Antenna Shift (Tractors Only). The Antenna Shift settings allows the user to shift the center point of the antenna relative to the machine center point. Negative values indicate that the antenna is located to the left of the machine center point.

NOTE: The Antenna Shift value can be verified by marking the hitch pin of the tractor with a flag, setting a guidance line, turning the machine around 180° degrees, and stopping on the guidance line with the hitch pin in the same location. If the hitch pin does not line up with the flag, divide the number of inches [cm] by two and enter that value into the Antenna Shift field. If the hitch pin falls to the right of the flag, enter a positive Antenna Shift value. If the hitch pin falls to the left of the flag, enter a negative value.

Sensitivity. The Sensitivity value determines how aggressively the machine will attempt to remain on the guidance line. The Sensitivity value is used to fine-tune the RS1 system. Values range between 50 - 200.

NOTE: If the machine is slow to react after a steering adjustment, increase the Sensitivity setting in increments of 10. If the machine makes an adjustment too quickly, decrease the Sensitivity value.

Line Acquire. The Line Acquire value determines the distance away from the set guidance line at which the machine will make adjustments to come closer to the guidance line. If a low value is entered, the machine will make an adjustment at a greater distance as it drifts away from the guidance line. If a high value is entered, the machine is quicker to adjust the steering while it is still close to the guidance line. Values range between 1 - 200.

NOTE: A low value will minimize the risk of over-correction, but it could take longer to acquire the guidance line. A high value increases the risk of over-correction, but the machine is quicker to re-acquire the guidance line. If the machine takes too long to acquire the guidance line, increase the Line Acquire value in increments of 10. If the machine over-shoots the guidance line, decrease the value in increments of 10.

Response Speed. The Response Speed determines how quickly the machine will steer when prompted. If the Response Speed is too high, the wheel movement may become jittery. If the Response Speed is too low, the wheel movement may wander lazily. Values range between 1 - 255.

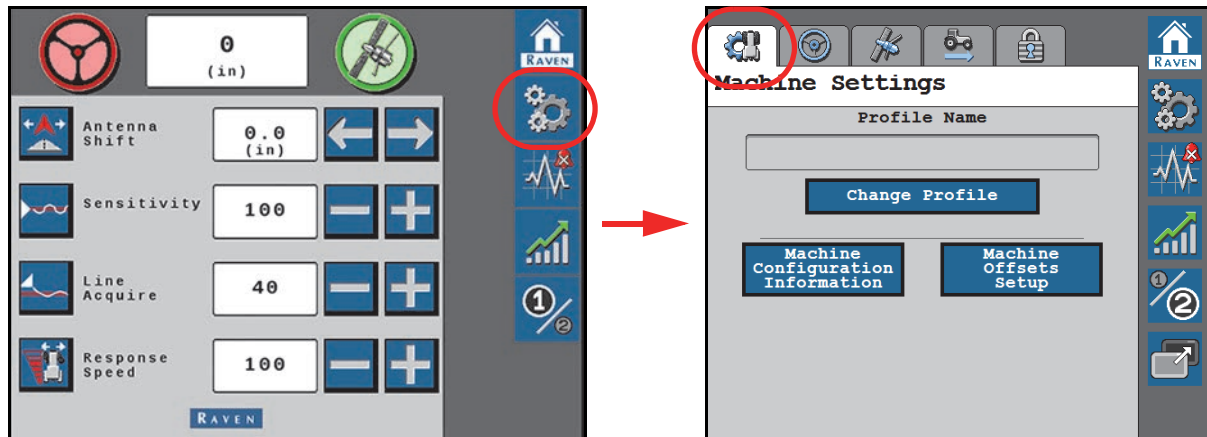
NOTE: If steering becomes jittery, lower the Response Speed value in increments of 10. If steering does not become jittery, the Response Speed value may be increased in increments of 10 until the desired Response Speed is reached.

Last Pass Sensitivity (Non-Tractor Tunesets). The Last Pass Sensitivity determines how tightly the machine tries to steer on a curved path. If the setting is too high, the machine will steer to the inside of a curve. If the setting is too low, the machine will steer to the outside of a curve. The Last Pass Sensitivity value ranges from 1 - 500.

NOTE: The Last Pass Sensitivity value only adjusts the system performance on Last Pass and A-B Curve lines.

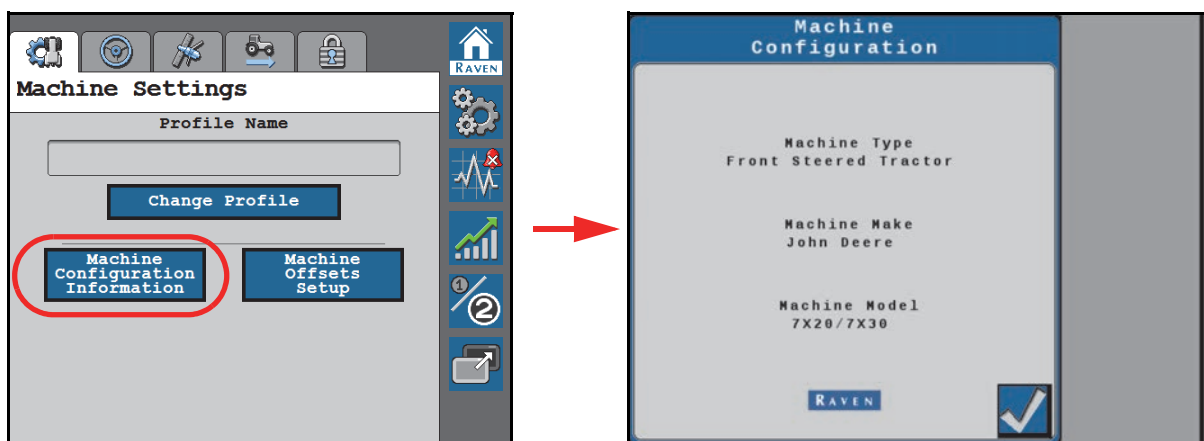
Adjusting the Last Pass Sensitivity value will not affect pivot performance. To adjust pivot performance, adjust the Response Speed and Sensitivity values.

FIGURE 1. Machine Settings Page



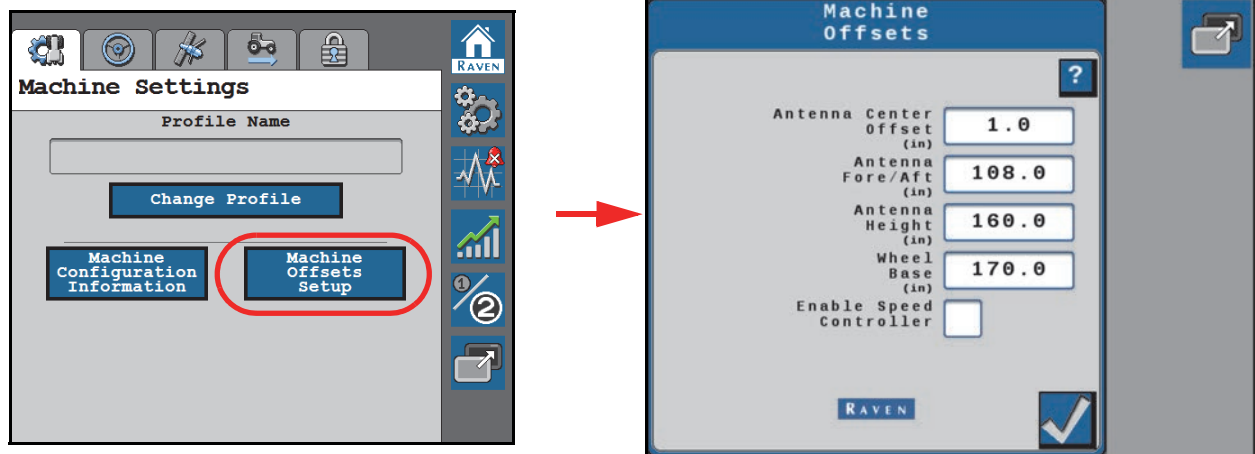
The Machine Settings page provides access to the machine tunesets and configurations which were entered during the initial system calibration.

FIGURE 2. Machine Configuration Page



- The Change Profile button allows the user to select an existing tuneset or create a new machine tuneset.
- The Machine Configuration Information button allows the operator to view the profile which was entered during the calibration process. Settings cannot be changed unless the RS1 system is recalibrated. Press the Accept button in the lower-right corner of the page to return to the Machine Settings page.
- The Machine Offsets Setup button allows the user to view and adjust the following:

FIGURE 3. Machine Offsets Setup Page



- **Antenna Height** - The Antenna Height is calculated by measuring from the ground to the center of the RS1 unit.
- **Antenna Center Offset** - The Antenna Center Offset position is calculated by measuring from the center of the machine to the center of the RS1 unit. Enter a negative value if the RS1 unit is located to the left of the machine center line.
- **Antenna Fore/Aft** - The Antenna Fore/Aft position is calculated by measuring from the rear axle of the machine to the middle of the RS1 unit. Enter a negative value if the RS1 unit is located behind the rear axle.
- **Wheel Base** - The Wheel Base is calculated by measuring from the center of the front tire to the center of the rear tire.

NOTE: The Wheel Base is calculated by measuring from the center of the front tire to the center of the rear tire on both sides of the machine. Add these measurements together and then divide by two to get the average Wheel Base value.


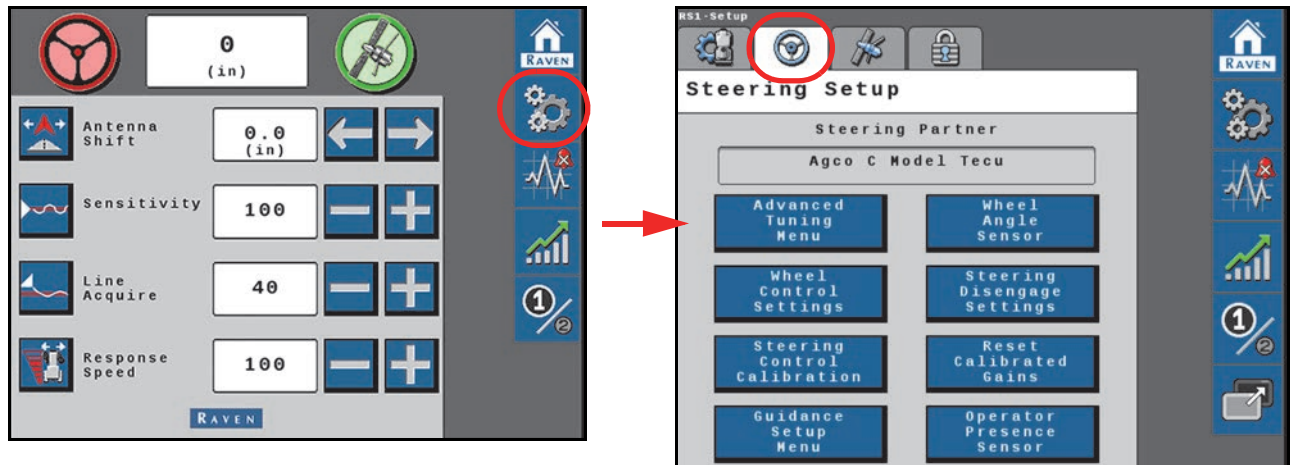
- **Help Menu Icon**  - Pressing the Help Menu icon displays the Help Menu. The Help Menu contains additional information about the settings contained within that page.

FIGURE 1. Steering Setup Page

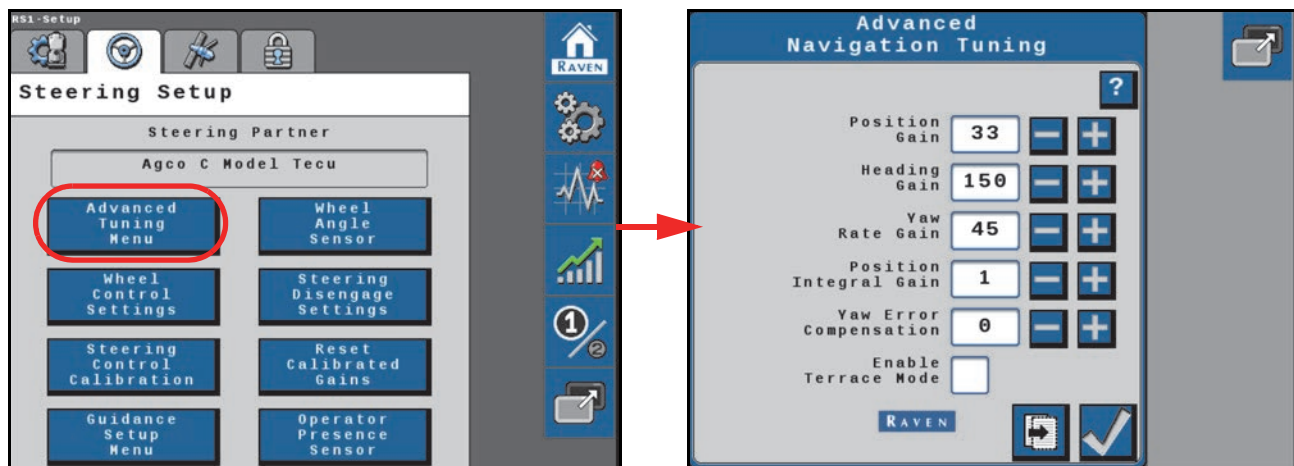


The Steering Setup page displays the steering partner that the RS1 unit communicates with during steering operation. The Steering Setup page contains the functions that allow the operator to fine-tune the steering system.

NOTE: The Steering Setup tab is hidden from view if "GPS Only" was selected during the RS1 system calibration.

ADVANCED TUNING

FIGURE 2. Advanced Tuning Menu



Position Gain. Determines how aggressively the RS1 system responds to an off-track error. A higher Position Gain value results in a more aggressive response to an off-track error, while a lower value indicates a less aggressive response.

Heading Gain. Determines how aggressively the RS1 system responds to a heading error. A higher Heading Gain value results in a more aggressive response to a heading error, while a lower value indicates a less aggressive response.

Yaw Rate Gain. Determines the impact of the yaw rate on tracking performance. A higher Yaw Rate Gain value results in a more aggressive response to yaw rate, while a lower value results in a less aggressive response.

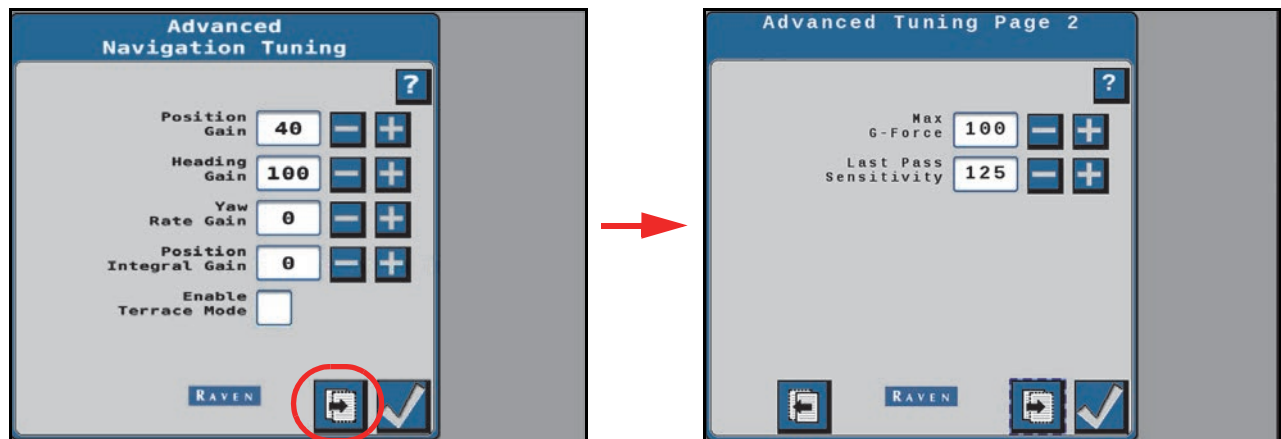
Integral Gain. This value corrects long-term errors in the wheel control. If the system is not achieving the desired wheel angle during operation, the system will re-direct the wheels to the desired set point. This value is generally at or near zero.

Yaw Error Compensation. Increase the yaw error compensation value to allow the machine steer more aggressively on curves.

Terrace Mode. Select the terrace mode check box to enable Terrace Mode. This mode temporarily adjusts some configuration settings to increase performance on terraced fields.

ADVANCED TUNING (CONT.)

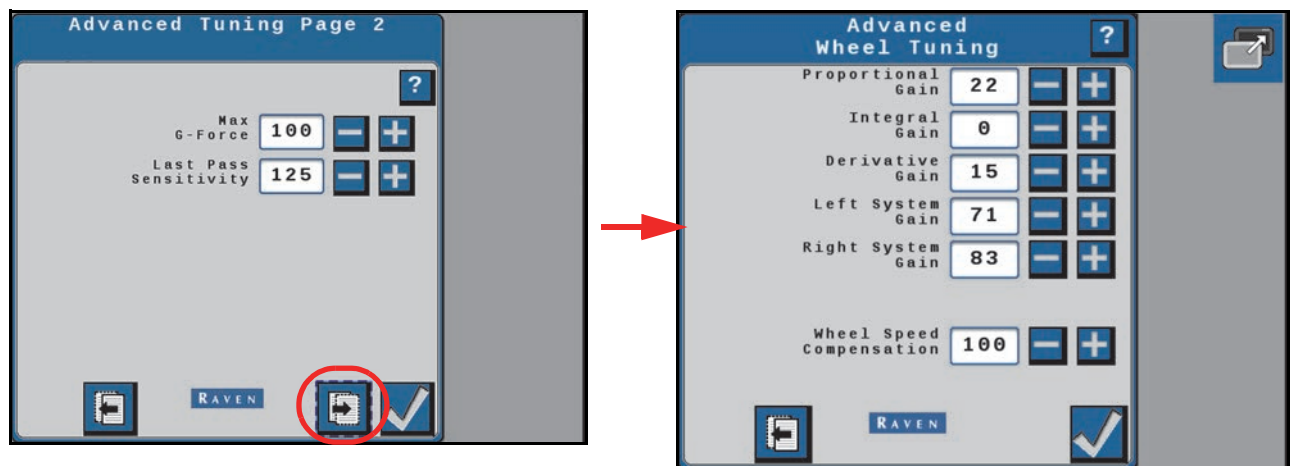
FIGURE 3. Advanced Tuning Page 2



Max G-Force. Limits the centripetal force experienced by the operator during a turn. A higher value allows to the machine to perform sharper turns, while a lower value limits the machine turning radius.

Last Pass Sensitivity. The Last Pass Sensitivity determines how tightly the machine tries to steer on a curved path. If the setting is too high, the machine will steer to the inside of a curve. If the setting is too low, the machine will steer to the outside of a curve. The Last Pass Sensitivity value ranges from 1 - 500.

FIGURE 4. Advanced Wheel Tuning Page



Proportional Gain. Determines the rate of the wheel response. Increasing the Proportional Gain value causes the wheel response to be faster, but can result in the machine overshooting the target wheel angle position or can cause the wheels to take a longer time to stabilize.

Integral Gain. This value corrects long-term errors in the steering control loop. This setting should be adjusted by qualified technicians only.

Derivative Gain. The Derivative Gain value limits the wheel response time. A larger Derivative Gain value will reduce the tendency to overshoot the target wheel angle position, but will limit the wheel speed.

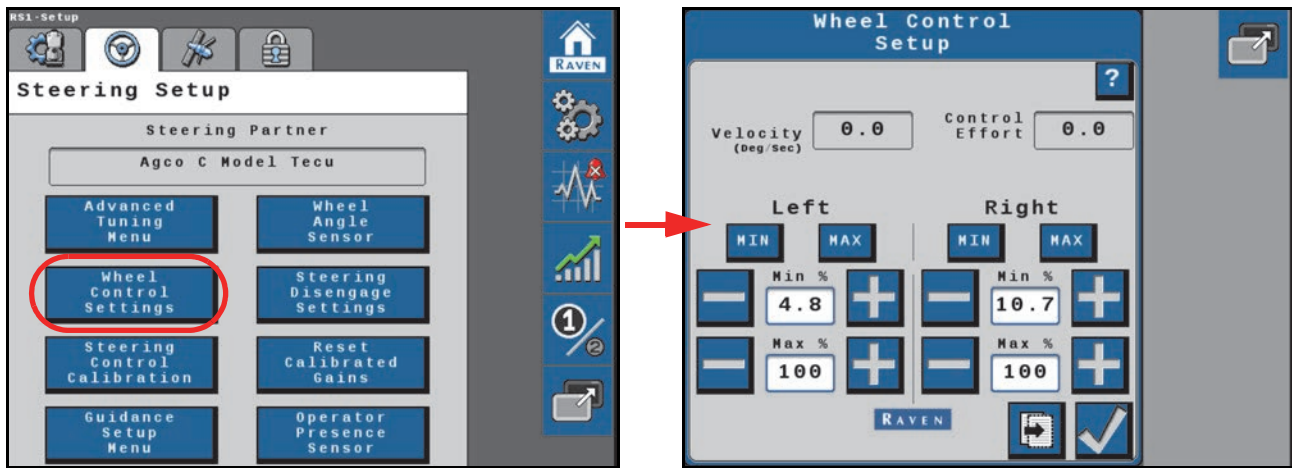
Left System Gain. Compensates for any bias or non-linearity in the steering valve while the machine is turning to the left.

Right System Gain. Compensates for any bias or non-linearity in the steering valve while the machine is turning to the right.

Wheel Speed Compensation. This value allows the system to steer the machine more rapidly while steering on curves. A higher value will allow the system to steer more aggressively, but may cause the machine steering to be unstable. Lower the value to improve stability of the system on curved guidance lines.

WHEEL CONTROL SETTINGS

FIGURE 5. Wheel Control Setup Page




Wheel Velocity. The speed at which the wheels are moving, measured in degrees per second.

Control Effort. The amount of effort the RS1 system is using to drive the wheels.

Left/Right Min. The minimum Control Effort that the machine valve must use to turn the wheels. Values range from 0 - 99.

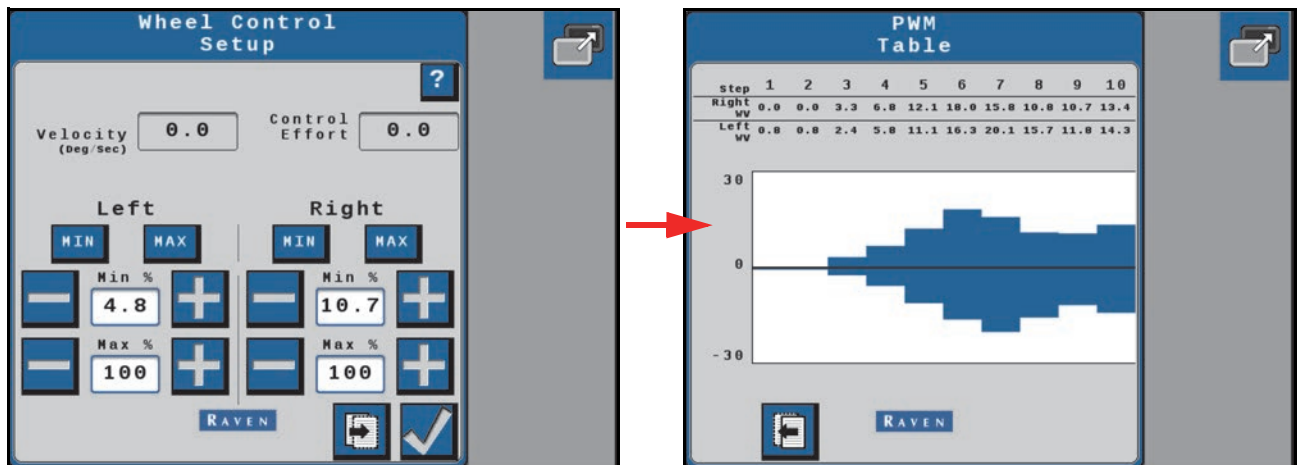
NOTE: The Min values cannot exceed the Max values.

Left/Right Max. The maximum Control Effort that the machine valve may use to turn the wheels. Values range from 1 - 100.

Help Menu Icon . Pressing the Help Menu icon displays the Help Menu. The Help Menu contains additional information about the settings contained within that page.

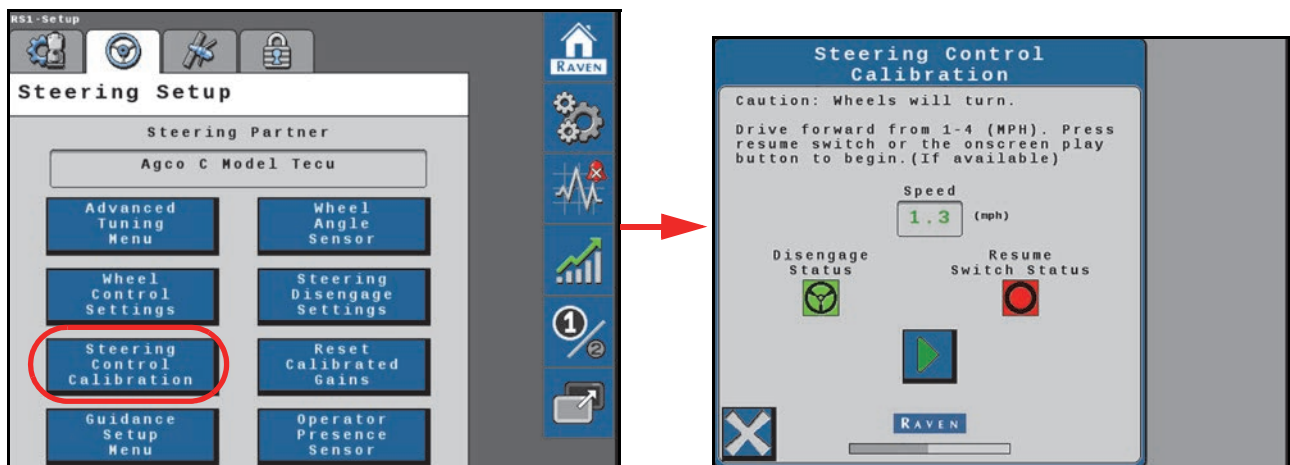
Select the Next button to view the PWM table for the last performed calibration.

FIGURE 6. PWM Table Page



WHEEL CONTROL CALIBRATION

FIGURE 7. Wheel Control Calibration Page





NOTE: The Wheel Control Calibration allows the machine hydraulic system to be calibrated separately from the complete RS1 system calibration.


The steering control calibration process allows the RS1 to learn the hydraulic capabilities of the machine for optimal steering performance in the field.

Before beginning the machine steering system calibration, ensure that the following conditions are met:

- The booms are racked on self-propelled units.
- There are no implements connected to the hitch.
- The machine engine is running at the normal operating RPM.
- The machine measurements are correctly entered into the field computer.

- The machine hydraulic fluid is at the normal operating temperature.

	 WARNING
	<p>The machine will steer automatically. While calibrating or operating the RS1 system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.</p> <p>To disengage auto-steering at any time, turn the steering wheel or select the on-screen Stop button.</p>

	NOTICE
	<p>The calibration of the machine steering system should be performed in a field or other large, open space and during conditions similar to normal vehicle operation.</p> <p>If the ground or surface is slippery, muddy, or freshly tilled, the RS1 system may learn incorrect steering responses for normal operating conditions.</p> <p>Ensure the machine hydraulics are operating properly and there are no other mechanical issues that may affect the performance of the RS1 system.</p>

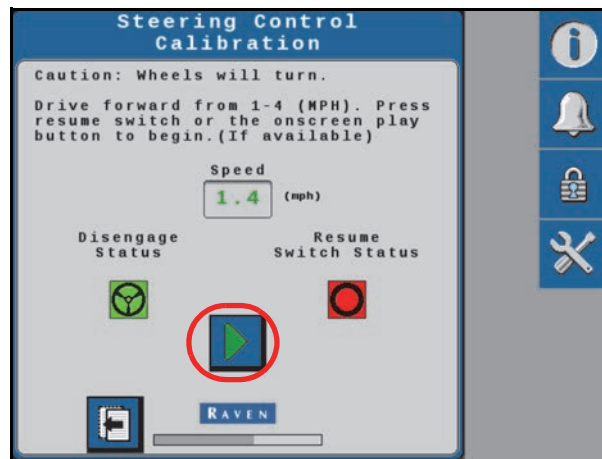
NOTE: To ensure the calibration is successful, the number of starts and stops during the calibration process should be limited. If it is necessary to pause the calibration process, turn the steering wheel or press the **Stop** button on the field computer. Tap the foot/enable switch again to resume calibration.

NOTE: During calibration, the machine will make several hard left and right turns. Adjust the vehicle speed and location as necessary.

NOTE: If an error message is displayed during calibration, refer to Chapter 10, *Diagnostics and Troubleshooting* on page 53 for possible causes and corrective action steps to be taken.

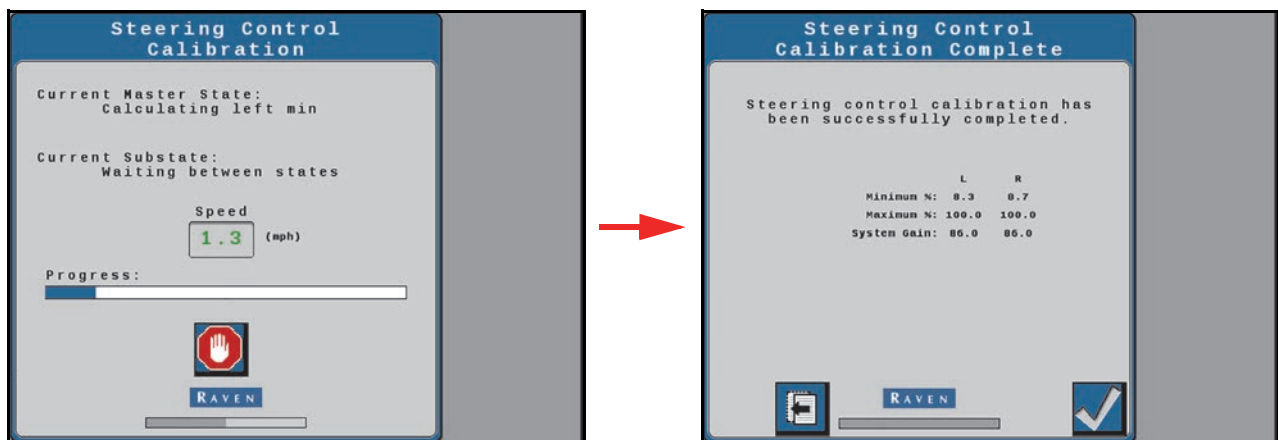
1. Park the machine on a level surface with several acres of smooth ground available.

FIGURE 8. Steering Control Calibration Page



2. Drive forward at 1.6 - 6.4 km/h [1 - 4 mph].
3. Press the resume switch or use the on-screen arrow to begin calibration. The following pages will be displayed during the process:

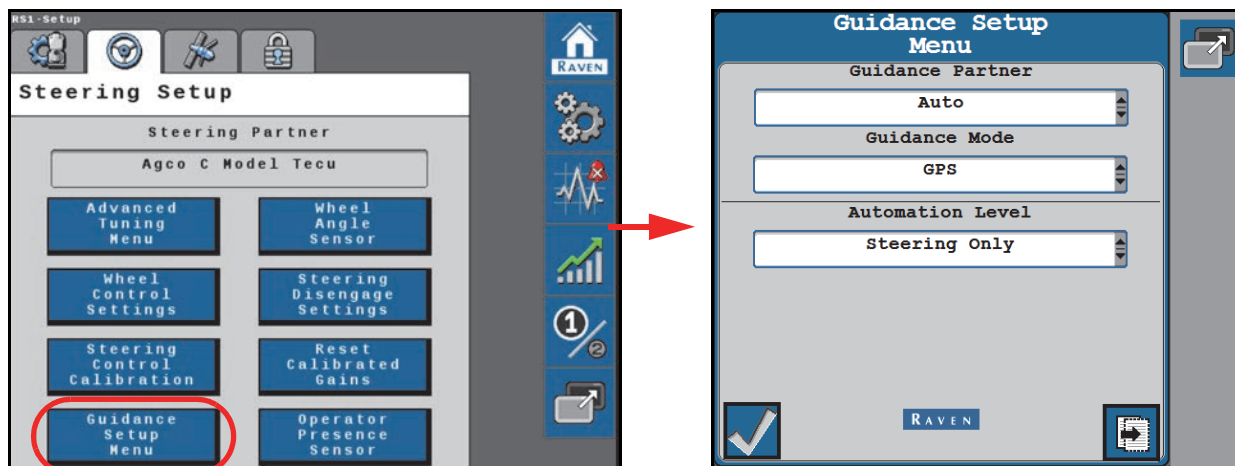
FIGURE 9. Calibration in Process Pages



4. Press **Accept** to complete the calibration.

GUIDANCE SETUP SETTINGS

FIGURE 10. Guidance Setup Page



Guidance Partner. Use the drop down to select the desired guidance partner.

Guidance Mode. Use the drop down list to select one of the following modes for guidance operations.

- GPS - Guidance is performed via GNSS guidance points only.
- Vision - Guidance is performed via the VSN camera only. GNSS 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 GNSS and the VSN camera. This mode can be utilized for line acquire via GNSS 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 GNSS 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.

Automation Level. Set the mode for devices installed on an OMNi system:

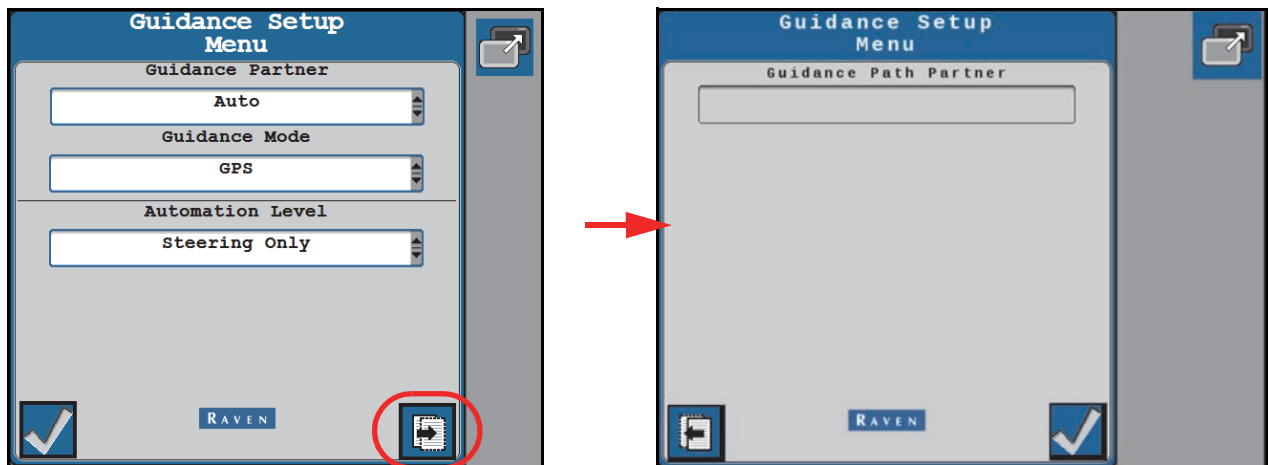
GPS Only. Stream GNSS correction information only. Select this option for guidance only applications or to stream corrections to a separate automated steering system.

Steering Only. Use the guidance and automated steering features of the device. Select this option for automated tractor or sprayer steering applications.

Autonomy Driveless. Select this option to enable features for autonomous systems such as OMNiDRIVE.

Select the Next arrow from the Guidance Setup Menu page for additional settings.

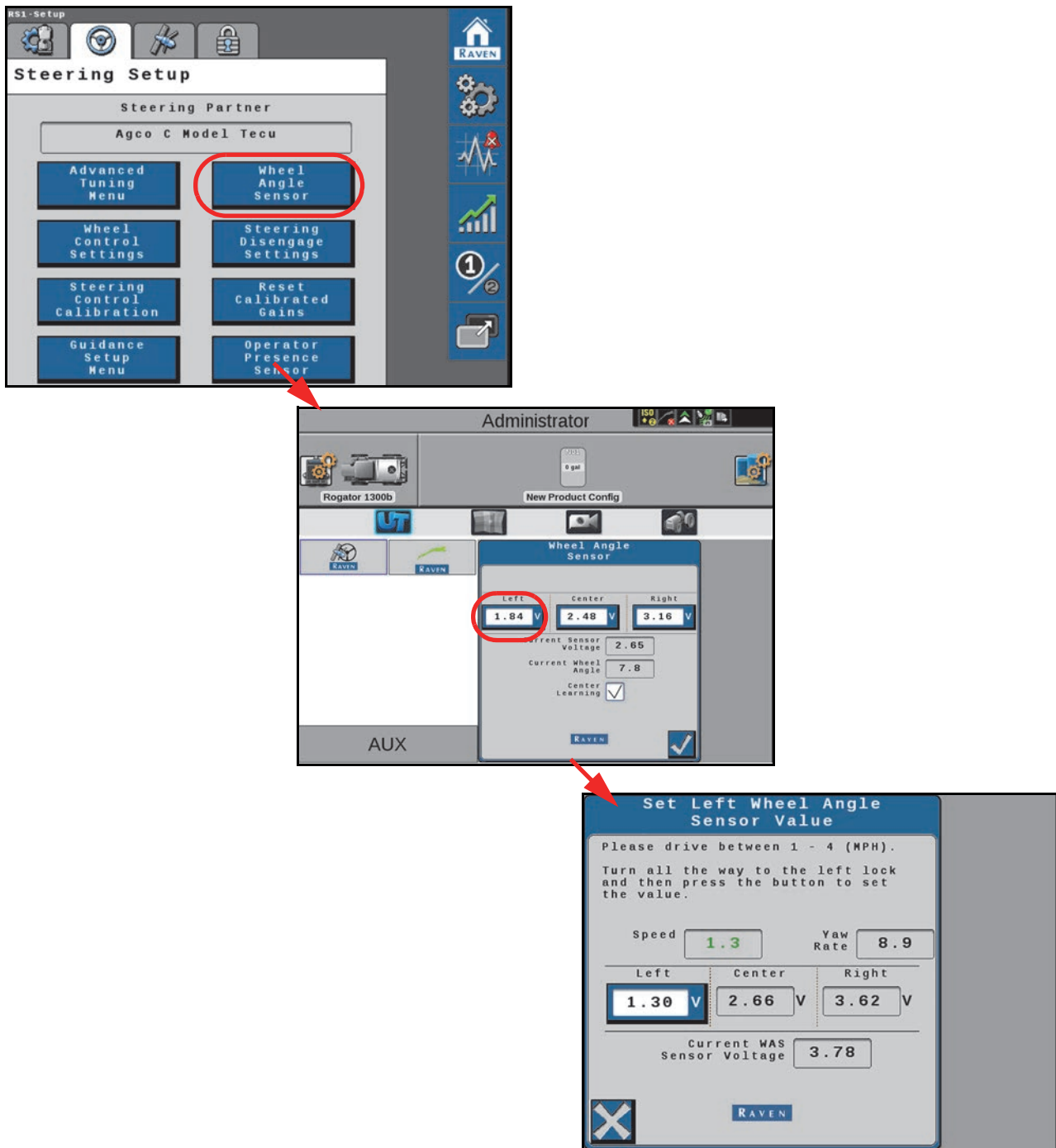
FIGURE 11. Guidance Setup Page



Guidance Path Partner. Displays the recognized device which provides a guidance path for the automated steering system.

WHEEL ANGLE SENSOR SETTINGS

FIGURE 12. Wheel Angle Sensor Calibration Page



Left/Center/Right. Displays the current calibration values. These values can be modified by selecting the desired WAS value to be changed, moving the wheels to the correct position, and pressing the Accept button.

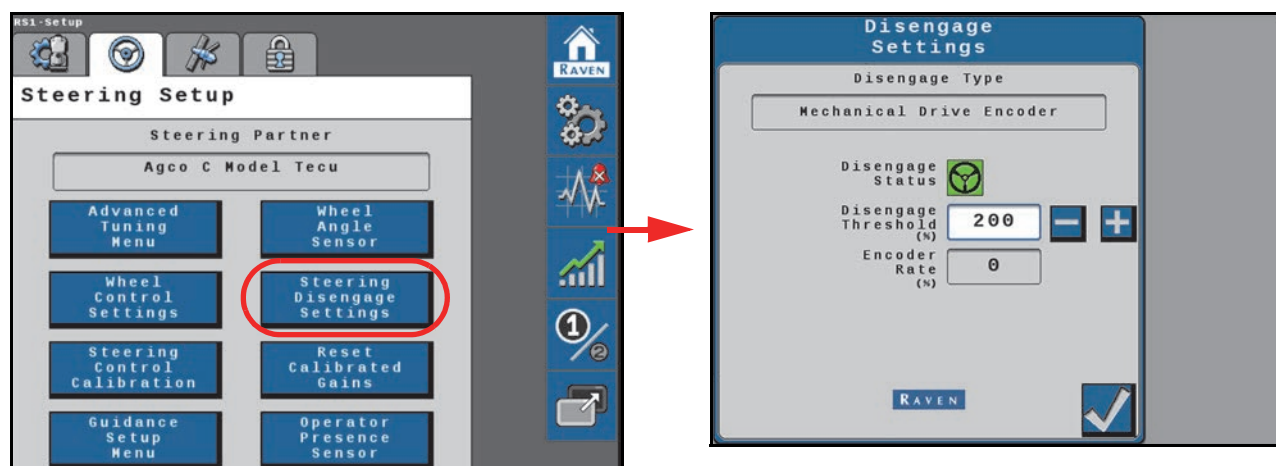
Current Sensor Voltage. Displays the sensor voltage detected during calibration.

Current Wheel Angle. Displays the WAS angle detected during calibration.

Center Learning. When selected, the Center Learning option the system will continuously correct its calibrated center position while the machine is steering straight ahead.

DISENGAGE SETTINGS

FIGURE 13. Steering Disengage Settings Page



Disengage Type. Displays the type of disengage switch being used in the system. Disengage switch types that may be displayed in this area include:

- CAN Switch
- Pressure Transducer
- Encoder
- Flow Switch

Disengage Status. Indicates the status of the disengage switch. Disengage switch status types displayed in this field include:

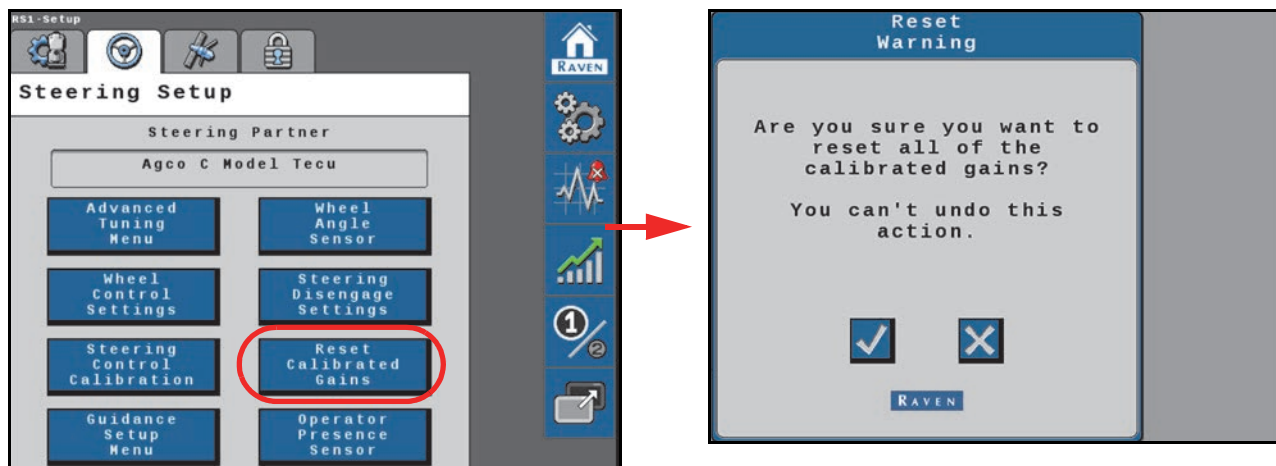
- Green - The disengage switch is detected and the steering wheel is not moving. The RS1 system may be engaged when this status is displayed.
- Red - The disengage switch is detected and the steering wheel is moving. The RS1 system may not be engaged when this status is displayed.
- Yellow - No disengage switch is detected in the system. Turn the steering wheel to activate the disengage switch. If the disengage switch is not activated, check cabling for loose or missing connections.

Disengage Threshold. The minimum value that the disengage sensor must meet for steering to disengage when the steering wheel is turned manually.

Encoder Rate. Displays the speed at which the steering wheel is being turned.

RESETTING CALIBRATED GAINS

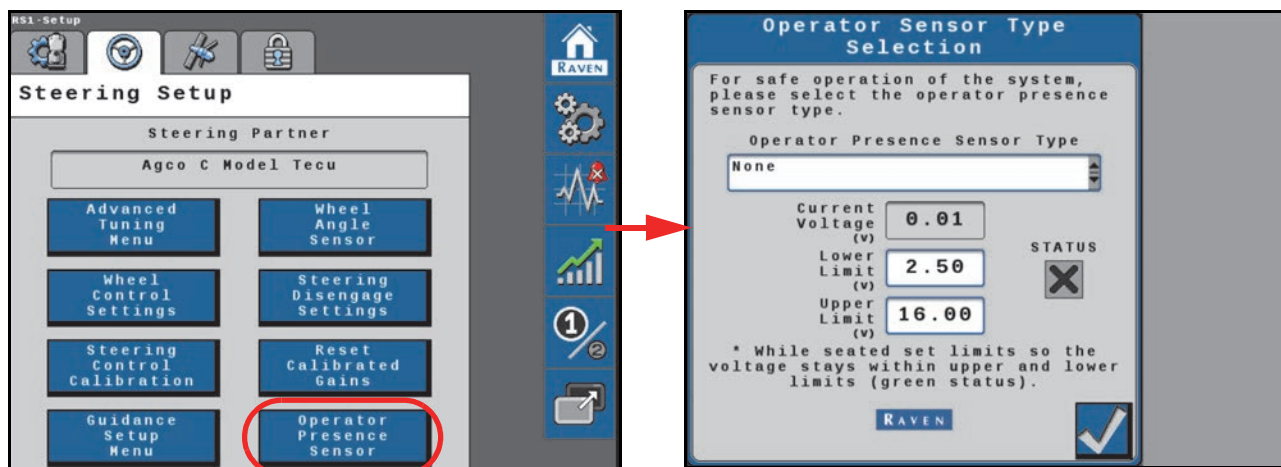
FIGURE 14. Reset Calibrated Gains Page



Select the check button to reset the machine steering settings back to factory default, or select the X button keep the current steering settings.

OPERATOR PRESENCE SENSOR

FIGURE 15. Operator Sensor Type Selection Page



Operator Presence Sensor Type. Use the drop down list to select the type of switch used to detect the presence of the operator while the system is engaged.

- None
- Single Pole
- Double Pole
- CAN Switch
- Touch Screen (Activity Monitor)

If the operator switch is in a non-functional state, the operator may opt to use the touch screen activity monitor. The activity monitor uses input on the field computer touch screen to reset a 7 minute timer. If the timer does expire, the system will disable automated steering until the operator touches the screen and reengages the steering system.

Current Voltage. Displays the current switch voltage. This display may be useful to adjust the upper and lower voltage limits if necessary.

Lower Limit. Use this setting to set the lower voltage limit. This is the voltage at which the switch will toggle when the operator is seated or the Activity Monitor is enabled.

Upper Limit (Double Pole Switch Only). Use this setting to adjust the upper voltage limit. Set the upper limit so that the current voltage reading remains below the upper limit while the operator is seated. If the presence switch voltage exceeds the upper limit, the presence switch will disengage steering.

Status. Displays the operator presence switch status. Toggle the presence switch (e.g. stand or sit in the operator seat) and confirm that the status indicates the switch is on when the operator is seated.

If the status does not change, but the current voltage changes, adjust the upper and lower limit settings as necessary.

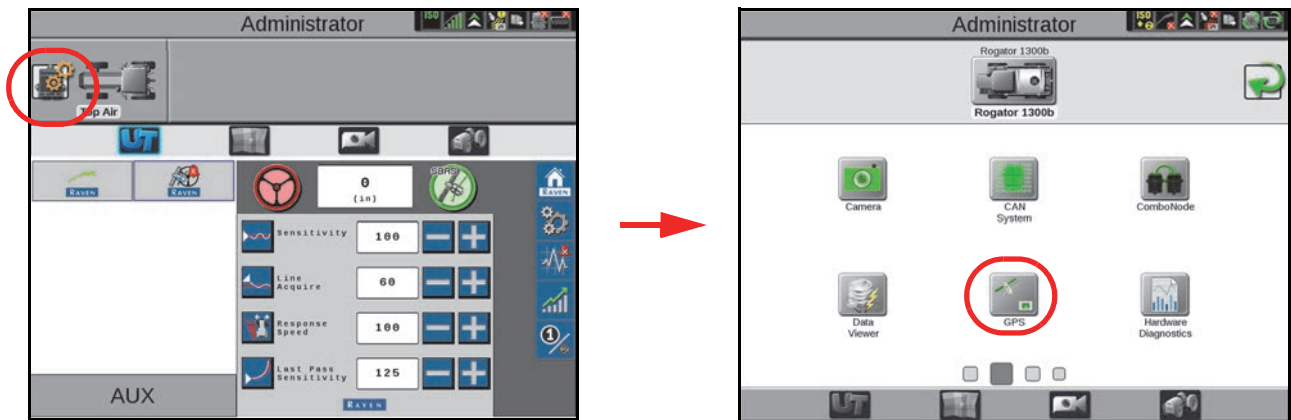
NOTE: Review Chapter 10, *Diagnostics and Troubleshooting*, for information on the status displayed in this area.

CONFIGURE RS1 VIA THE VIPER 4

To configure the RS1 GNSS receiver via the Viper 4:

1. From the ROS main page, select the **Edit** button.
2. Select the **GPS** menu.

FIGURE 1. GPS Setup

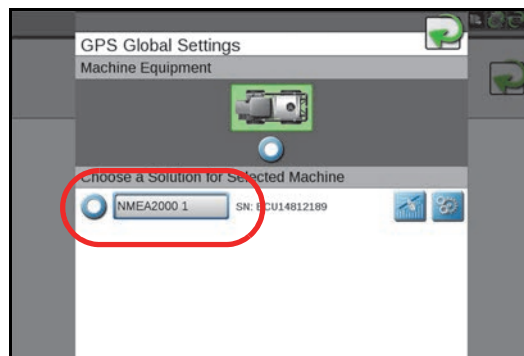


3. Select the **NMEA2000** option.

NOTE: NMEA2000 is the default option for the ROS device. If the RS1 is replacing a steering system, ensure that the old steering ECU is disconnected from the ISOBUS. Perform a serial redetect before proceeding.

If multiple devices are configured to output NMEA messages over the ISOBUS, be sure to select the correct device to ensure proper operation of the RS1.

FIGURE 2. GPS Setup Page



EXTERNAL GPS FOR RS LITE™

RS Lite will automatically configure the following Raven receivers to output the correct messages and message rates:

- Raven 600S™
- Raven 700S™
- Viper 4/4+
- Viper 4/4+ Twin

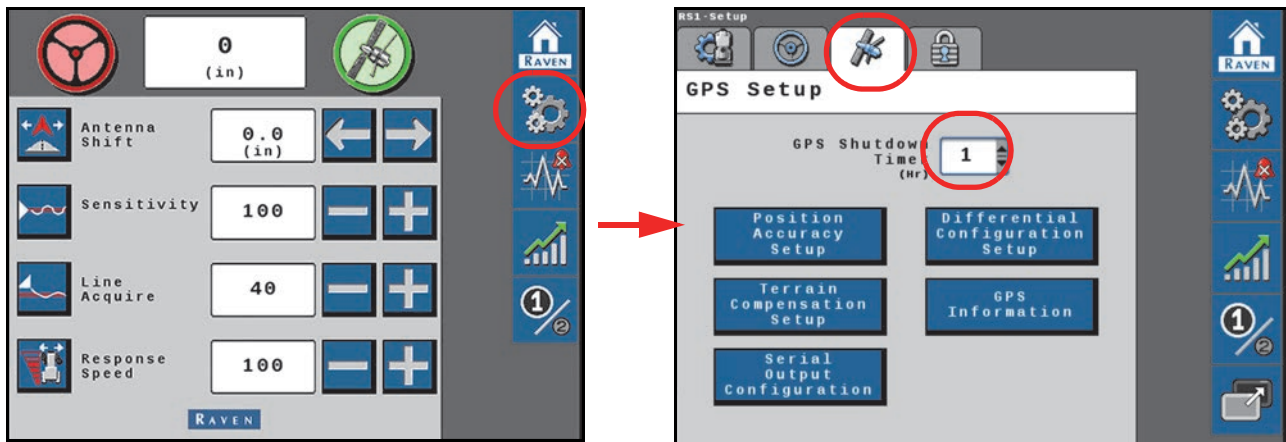
If a different receiver is being used, configure the receiver output to the settings below before performing calibration.

TABLE 1. GPS Receiver Message Settings

Baud Rate	Message Type	Frequency
115200	GGA	10 Hz
	VTG	0.1 Hz
	GSV	0.1 Hz
	ZDA	0.1 Hz
	GSA	0.1 Hz
	GST	1 Hz
	GRS	0.1 Hz

CONFIGURE GPS

FIGURE 3. GPS Setup Page



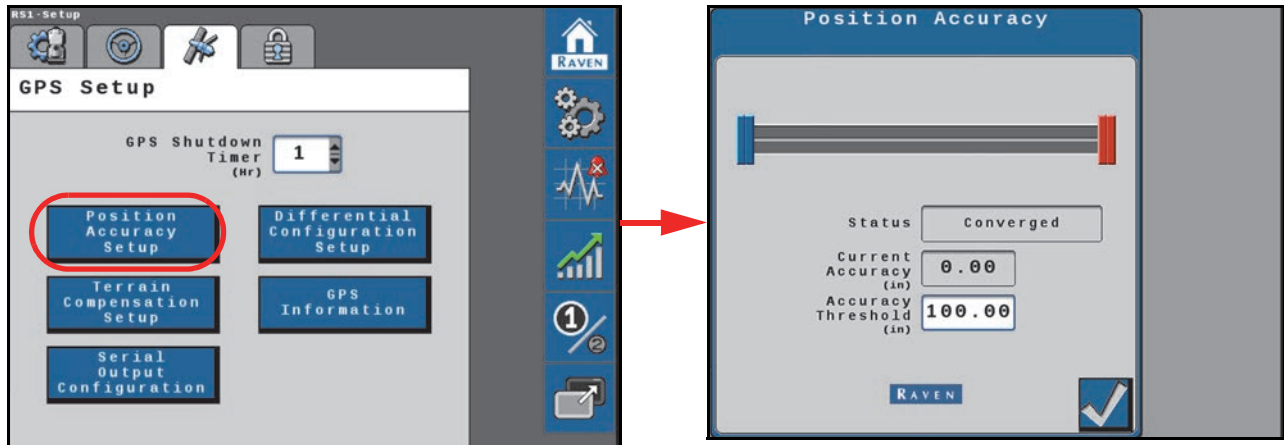
GPS SHUTDOWN TIMER

The GPS Shutdown Timer value determines the length of time the RS1 unit remains powered after the machine switched power is turned off. The GPS remains converged for the length of time selected.

NOTE: The default value for the shutdown timer is 1 hour. This option requires that RS1 is installed properly with both switched and constant power.

POSITION ACCURACY SETUP

FIGURE 4. GPS Status Information Setup Page



Status. Displays the status of the GNSS solution. Statuses that may be displayed in this area include:

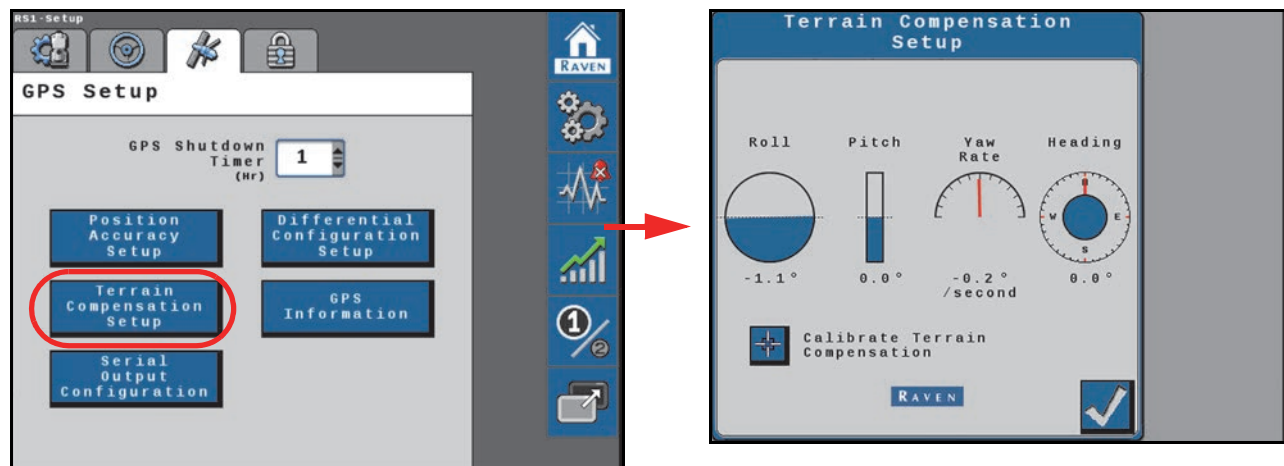
- No Signal
- Error
- Converging
- Converged

Current Accuracy. Value displayed is the horizontal standard deviation reported by the GPS receiver.

Accuracy Threshold. This value dictates the distance from which the machine GPS position may deviate from the Current Accuracy position. If the GPS solution falls outside the set Accuracy Threshold, a DTC entry will be displayed into the Diagnostic Trouble Code page. The Accuracy Threshold will be populated with a default value.

TERRAIN COMPENSATION SETUP

FIGURE 5. Terrain Compensation Setup Page

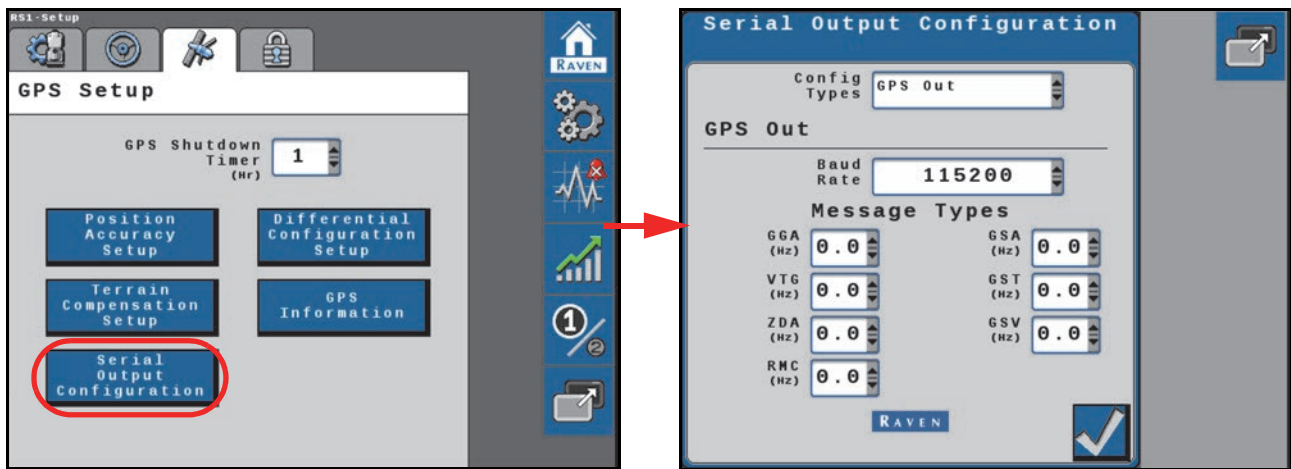


Roll, Pitch, Yaw Rate, and Heading. Real-time measurement data used by the 3D terrain compensation feature.

Calibrate Terrain Compensation. Begins the terrain compensation process.

SERIAL OUTPUT CONFIGURATION

FIGURE 6. Serial Output Configuration Page



Config Types. Allows the RS1 system to toggle between a serial 3D compensated GNSS position output or a simulated radar output.

NOTE: The baud rate and message types are not used in radar outputs.

GPS OUT

Baud Rate. The rate for messages transmitted over the serial port. This rate must be set to match the devices on the system which are intended to receive messages from the RS1 or RS Lite.

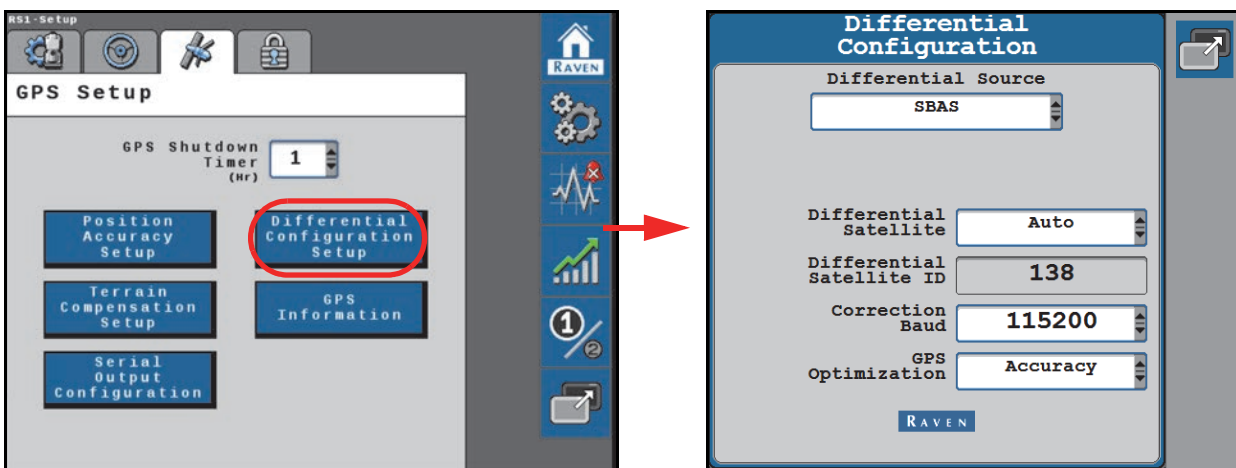
NOTE: The default baud rate setting is 115200 and is recommended for all steering systems.

Message Types. Set the frequency for each required NMEA message.

NOTE: Changing message types and rates may cause poor system performance. It is not recommended to change message rates unless instructed by documentation or Raven technical service.

DIFFERENTIAL CONFIGURATION SETUP

FIGURE 7. Differential Configuration Page



Differential Source. Use the drop-down option to select the desired differential correction source.

NOTE: Depending upon the feature unlocks activated, some correction sources may not be available. Contact your local Raven dealer to purchase unlock codes for additional correction types.

Differential Satellite. Select the desired differential satellite. The default setting is Auto and is recommended to allow the RS1 to automatically set the differential satellite with the best signal strength for the current area of operation. Auto also allows the RS1 to automatically adjust when differential satellites are decommissioned.

Differential Satellite ID. The PRN (pseudo-random number) for the satellite currently used for differential corrections.

Correction Baud. The rate for NMEA correction messages output from the RS1. The default baud is 115200.

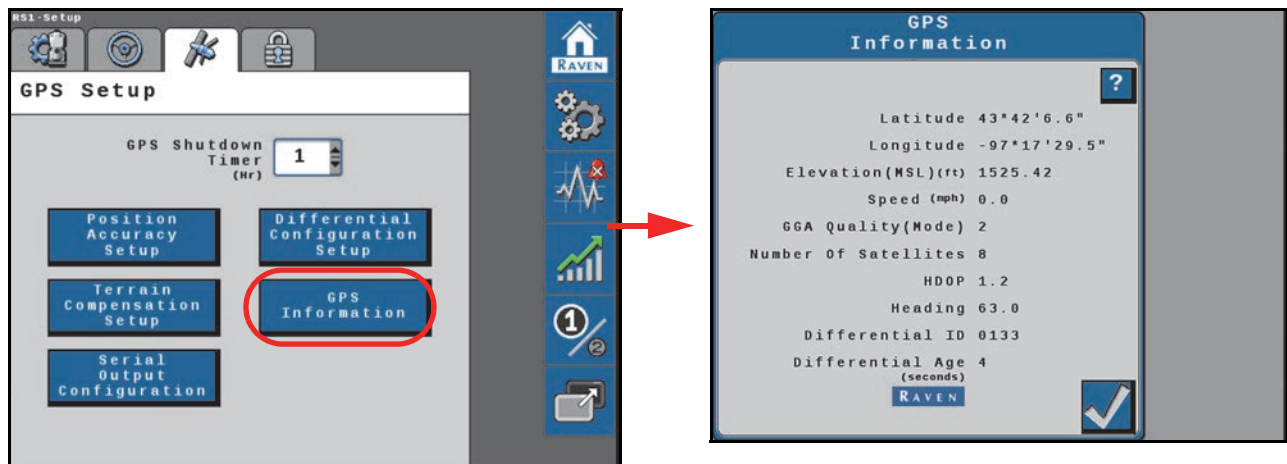
GPS Optimization. Use the drop-down option to select the preferred type of optimization to apply to GNSS corrections. Select one of the following options:

NOTE: This option will only display when a compatible receiver is detected.

- Accuracy - Ensure the most accurate GNSS correction for the selected correction type.
- Reliability - Optimize for areas with poor GNSS coverage to mitigate drop-outs and steering disengage events.

GPS INFORMATION

FIGURE 8. GPS Information Page



Latitude. The angular distance of a place north or south of the earth equator.

Longitude. The angular distance of a place east or west of the meridian at Greenwich, England.

Elevation (MSL). The height of the antenna in reference to sea level.

Speed. Current speed based on GPS measurements.

GGA Quality (Mode). The current convergence state of the GPS receiver.

- 0 = No data received.
- 1 = Single solution, no differential corrections being received.
- 2 = When the receiver has locked onto a differential source and formed a solution (SBAS or GS-Lite fixed solution or converging with Satellite GS).

- 4 = RTK fixed mode.
- 5 = Fixed solution for Satellite GS or OmniSTAR differential sources or RTK Float.

Number of Satellites. The number of satellites currently in view by the GPS receiver.

HDOP. Horizontal Dilution of Precision. If all of the satellites in view are from the same direction, the number will be higher and the accuracy will be reduced.

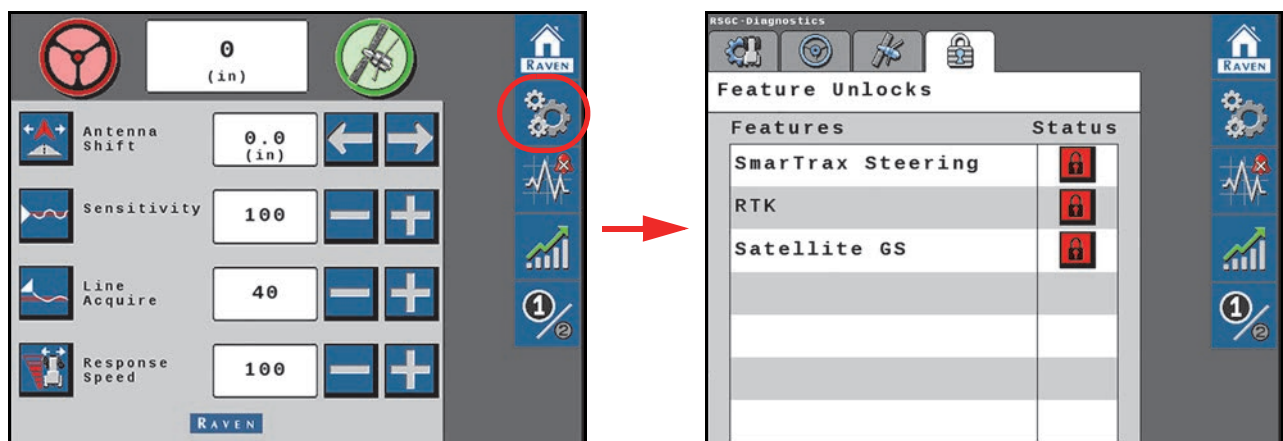
Heading. The machine direction of travel.

Differential ID. The ID of the differential source used to obtain the solution.

Age of Differential. Time (in seconds) since the last differential correction was received. If a differential source is not currently tracked this entry will be "- - -".

The RS1 unit is capable of working with SmarTrax™, Real-Time Kinematic (RTK), and Satellite GS differential corrections. In order to activate any of these products, a feature unlock code is required. Contact your local Raven dealer to purchase feature unlock codes.

FIGURE 1. Feature Unlock Page



1. Select the **Tools** icon on the home page.
2. Select the **Feature Unlocks** tab.
3. Select the **Padlock** icon next to the feature to be unlocked.

FIGURE 2. Feature Unlock Information Page



4. Enter the feature unlock code and press **Send**.

NOTE: A message will appear 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 3 on page 50.

FIGURE 3. Feature Unlocked

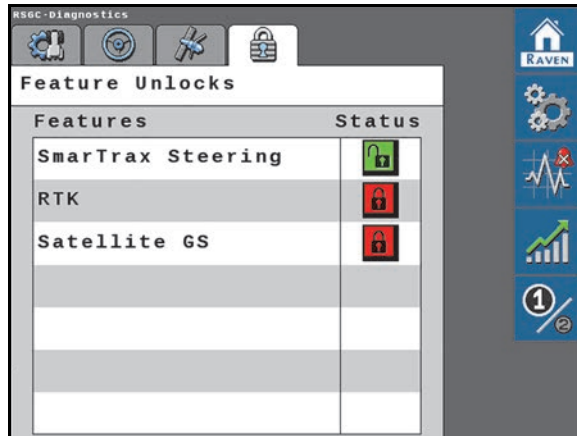












TABLE 1. Unlock Status

Color	Status
Red	Locked
Yellow	Unlocked. A subscription is required to activate and use the feature.
Green	Unlocked. If a subscription is required, an active subscription is detected.




WIDGET DEFINITIONS

The following are common status or mode information which may be displayed in the RS1 system while in a job:

ROS	CRX	Message
		The RS1 is detected, but the operator must accept responsibility for the operation of the RS1 system.
		No A-B path or guidance line has been set or an active DTC is preventing the RS1 system from engaging.
		RS1 is detected, turned on, and calibrated.
		RS1 is detected and in operation.
		Vehicle speed is too fast or too slow for RS1 operation and the system will disengage.

NOTE: Refer to *Diagnostic Trouble Codes (DTC)* section on page 58 for additional status conditions which may be displayed in the RS1 or RS Lite on-screen widget.

UT NAVIGATION BUTTONS

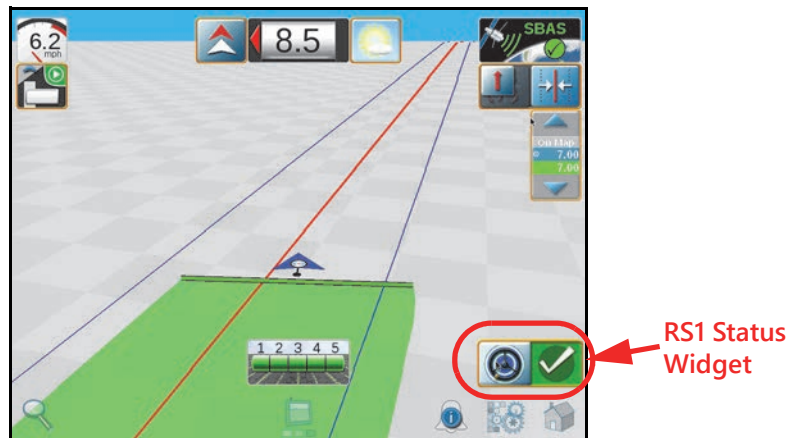
	Accept - Saves the changes made to the system at the end of the setup process and returns the to the Tools Menu.
	Next - Saves the changes made to the system and proceeds to the next step in the setup process.
	Previous - Returns to the previous page in the setup process.

STARTING A JOB

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

ENGAGE STEERING

FIGURE 1. RS1 Status Widget on ROS



NOTE: If the steering widget does not appear on the screen, refer to the Viper/Viper 4+ Installation and Operation manual (P/N 016-0171-539) for further information on adding widgets.

NOTE: The operator liability waiver must be accepted before the RS1 system can be enabled for operation.

The RS1 steering may also be engaged using the following methods:

- Tap the foot switch or rocker switch to engage RS1 features during field operation.
- Press the RS1 on-screen status widget to engage the RS1 during field operation.

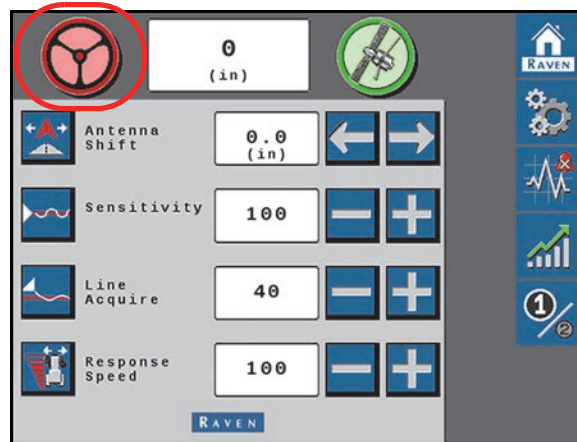
UPDATING RS1

Refer to the *Field Updates* section on page 101 or the field computer manual for instructions on updating the RS1 software.

BUTTON DEFINITIONS

STEERING STATUS

FIGURE 1. Home Page



The following are common steering status or mode messages which may occur while the RS1 system is engaged:

Display	Message
	Active diagnostic and troubleshooting codes are present. The RS1 system cannot be engaged in this state.
	Active diagnostic and troubleshooting codes are present. The RS1 system can be engaged in this state, but performance quality may be degraded.
	No active diagnostic or troubleshooting codes are present. The RS1 system is ready to be engaged. NOTE: Both the steering wheel and GPS icons must be green in order to engage the RS1 system.
	Steering is engaged, with no active diagnostic or troubleshooting codes present in the RS1 system.

FIGURE 2. Steering Status Page



Select the steering wheel icon to display the Steering Status page. The Steering Status field displays the last exit code and the reason why steering was disabled.


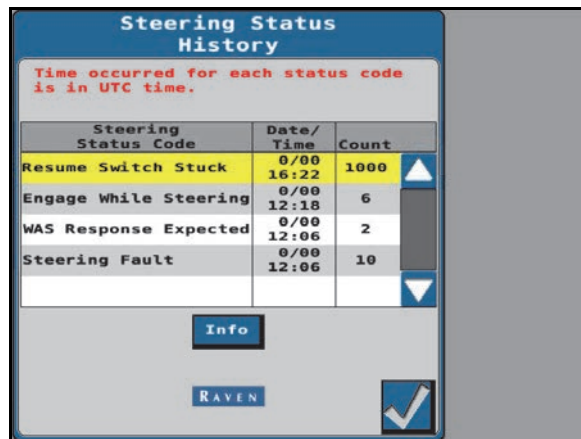


The Steering Status History button  shows a table for the reason steering disengaged, including a time stamp and the number of occurrences.

FIGURE 3. Steering Status History Page





MASTER SWITCH

Display	Message
	The master switch is set to "road mode." The SC1/TC1 system cannot be enabled until the master switch is toggled to "field mode."
	The master switch is set to "field mode" and the SC1/TC1 system can be enabled.




RESUME SWITCH

The status of the enable switch (e.g. foot switch) used to engage the steering system.

Display	Message
	The resume switch is set in the OFF position.
	The resume switch is in the ON position.




DISENGAGE SENSOR

Status of the pressure sensor used to disable steering when the steering wheel is turned.

Display	Message
	The SC1/TC1 disengage sensor is active. The SC1/TC1 system cannot be enabled.
	The SC1/TC1 disengage sensor is out of range or disconnected.
	The SC1/TC1 disengage sensor is inactive. The SC1/TC1 system can be enabled.





WHEEL ANGLE SENSOR

Displays the status of the position sensor.

Display	Message
	The wheel angle sensor (WAS) is out of range or disconnected.
	Wheel angle sensor (WAS) is not calibrated.
	The wheel angle sensor (WAS) is calibrated and ready to operate.




OPERATOR PRESENCE SWITCH

Displays the status or presence of the operator presence switch.

Display	Message
	The presence switch is not available or not used with the selected machine profile.
	The operator is not present in the seat.
	The operator presence switch is disconnected.
	The operator presence switch detects the operator. The SC1/TC1 system can be operated.

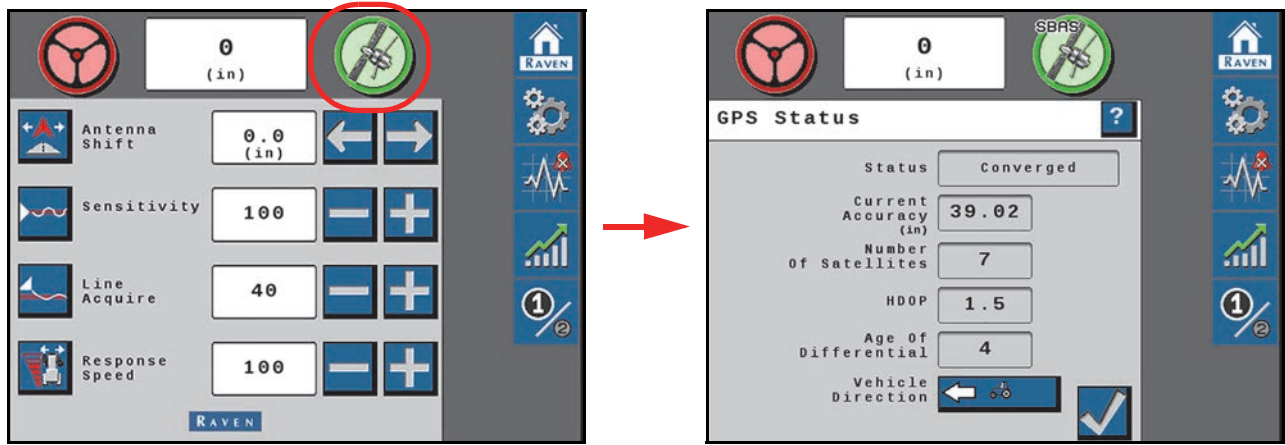
STEERING MODE

Displays the current steering mode.

Display	Message
	Not available
	Front wheel steering
	Four-wheel steering

GPS STATUS

FIGURE 4. Home Page



The following are common GPS status or mode information which may occur while the RS1 system is engaged

	No GPS information is being detected in the RS1 system.
	GPS signals are not converged or GPS is converged and a warning DTC is present.
	GPS signals are converged and no warning DTCs are active. NOTE: Both the steering wheel and GPS icons must be green in order to engage the RS1 system.
	GPS RTK-L or RTK Pro solutions are converged and actively being used.

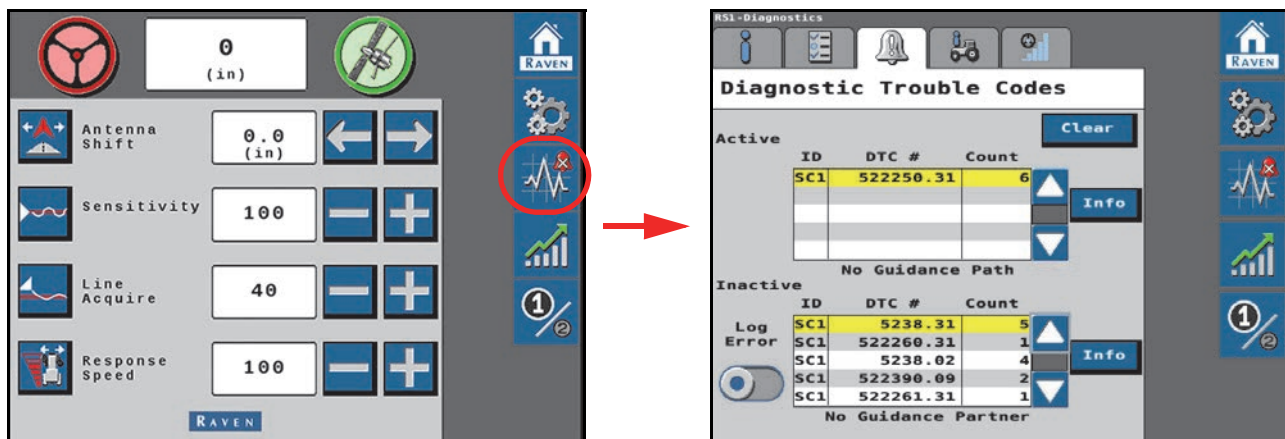
Press the GPS icon to display the GPS Status page.

Display	Message
Status	Displays the selected GPS convergence status. <ul style="list-style-type: none"> • Error • No Signal • Converging • Converged
Current Accuracy	Value displayed is the horizontal standard deviation reported by the GPS receiver.

Display	Message
Number of Satellites	The number of satellites currently in view by the GPS receiver.
HDOP	Horizontal Dilution of Precision. If all of the satellites in view are from the same direction, the number will be higher and the accuracy will be reduced.
Age of Differential	Time (in seconds) since the last differential correction was received. If a differential source is not currently tracked this entry will be " - - - -".

DIAGNOSTIC TROUBLE CODES (DTC)

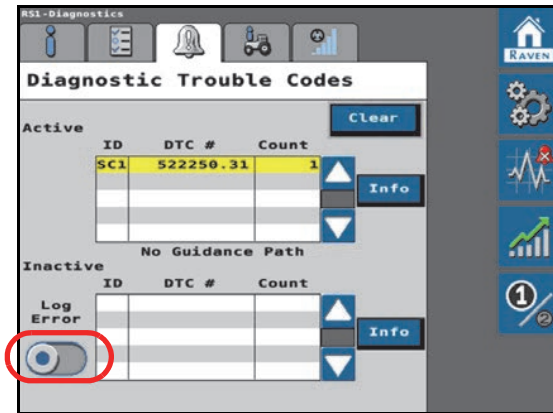
FIGURE 5. Diagnostic Trouble Codes Page



The Diagnostic Trouble Code page displays active and previous diagnostic trouble codes (DTCs) that occur during RS1 system operation. Active DTCs must be fixed before the RS1 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 5 on page 58 for an example of DTCs and DTC summaries.

Press **Clear** to delete the inactive DTCs from the Inactive DTC error log. Press **Log Error** to record a random failure condition.

FIGURE 9. Create Error Log



DIAGNOSTIC TROUBLE CODE (DTC) LIST

TABLE 1. Diagnostic Trouble Codes

Code ID		Description	Recommended Actions
74	.0	Maximum engage speed shutdown.	<p>Machine speed exceeds maximum auto-steer speed. Auto-steering is disengaged.</p> <p>Reduce machine speed below maximum engage speed and re-engage auto-steering. RS1 maximum auto-steer operating speed is:</p> <ul style="list-style-type: none"> • 19.3 km/h [12 mph] for machines operating in Europe with homologation terms accepted. • 32.1 km/h [20 mph] for tracked machines and swathers. • 46.7 km/h [29 mph] for units capable of high-speed steering and not subject to homologation terms. <p>NOTE: Contact a local Raven dealer for additional assistance with high-speed steering unlocks.</p>
	.16	Maximum engage speed warning.	<p>Machine speed is approaching the maximum auto-steer speed. To maintain auto-steer operation, do not exceed the maximum auto-steering speed (refer to 74.0 above).</p> <p>RS1 maximum steering warning DTC is triggered at:</p> <ul style="list-style-type: none"> • 16.1 km/h [10 mph] for machines operating in Europe with homologation terms accepted. • 29 km/h [18 mph] for tracked machines and swathers. • 43.5 km/h [27 mph] for units capable of high-speed steering and not subject to homologation terms. <p>NOTE: Contact a local Raven dealer for additional assistance with high-speed steering unlocks.</p>
87	.0	Maximum speed engage.	<p>Reduce machine speed below maximum engage speed to engage auto-steering.</p> <p>RS1 maximum engage speed is:</p> <ul style="list-style-type: none"> • 16.1 km/h [10 mph] for machines operating in Europe with homologation terms accepted. • 19.3 km/h [12 mph] for tracked machines and swathers. • 29 km/h [18 mph] for units capable of high-speed steering and not subject to homologation terms. <p>NOTE: Contact a local Raven dealer for additional assistance with high-speed steering unlocks.</p>
		Maximum engage speed engage warning.	
88	.1	Too slow to engage.	<p>Increase machine speed above 0.5 km/h [0.3 mph] (RTK - 0.1 km/h [0.1 mph]) to engage auto-steering.</p>

Code ID		Description	Recommended Actions
168	.3	High voltage.	Check battery voltage.
	.4	Low voltage.	
621	.11	GPS receiver error: LNA failure.	Cycle power to the RS1.
	.31	GPS receiver error: Antenna power.	
	.4	GPS receiver error: Antenna shorted.	
	.5	GPS receiver error: Antenna open.	
628	.13	Memory error.	<ol style="list-style-type: none"> 1. Cycle power to the RS1. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
630	.13	System not calibrated.	Complete the initial calibration wizard to use RS1. Review Chapter 3, <i>Calibration - HDU-Specific, MD, and Steering-Ready</i> , for additional assistance.
	.31	Steering calibration recommended.	Complete a steering control calibration. Review the <i>Steering Calibration</i> section on page 19 for additional assistance.
701	.3	Resume switch stuck on.	<ol style="list-style-type: none"> 1. Check the resume switch functionality in the RS1 UT. 2. Check the resume switch cabling and connections.
841	.0	GPS not converged.	<ol style="list-style-type: none"> 1. Wait for GNSS to converge (up to 30 minutes). 2. Cycle power to the RS1.
	.11	GPS error.	<ol style="list-style-type: none"> 1. Ensure the RS1 is calibrated and the desired differential source is unlocked. 2. Wait for GNSS to converge (up to 10 minutes). 3. Ensure that NMEA 2000 is selected. Review the Chapter 7, <i>GPS Configuration</i>.
	.15	Poor GPS position accuracy.	<ol style="list-style-type: none"> 1. If using Satellite GS or RTK corrections, ensure that the GNSS quality is as expected for those correction sources. Review the <i>GPS Status</i> section on page 57. 2. Adjust the position accuracy to allow greater tolerance for the current GNSS position accuracy.
1504	.2	Operator not present.	<ol style="list-style-type: none"> 1. Check presence switch cabling and connections. 2. Confirm presence switch functionality in the RS1 UT. 3. Choose activity monitor.
2901	.2	Incompatible hardware.	A machine specific tuneset has not been developed for combination of machine type and valve type. Select a generic machine type and recalibrate the RS1.
3045	.31	Authorization denied.	Check the steering control unit (SCU) cabling is properly connected. Check connections for pins which are not making proper connection (e.g. bent or pushed in).

Code ID		Description	Recommended Actions
5238	.2	Invalid curvature.	<ol style="list-style-type: none"> 1. Check cabling and connections to the steering partner (steering valve). 2. Cycle power to the steering valve. 3. Update the steering partner/valve software.
	.31	Loss of SCU communication.	<p>The RS1 previously registered a steering partner but is not currently communicating with the expected partner.</p> <ol style="list-style-type: none"> 1. Check cabling and connections to the steering partner (steering valve). 2. Cycle power to the steering valve. 3. Check the software version of the steering partner/valve and confirm compatibility with the RS1 software.
5241	.31	Disengage switch is in the off position.	<ol style="list-style-type: none"> 1. Check the disengage switch status in the RS1 UT. Switch should only be active (red status indicator) when the steering wheel is moving. 2. If the disengage switch is showing activity (red) while the steering wheel is stationary, increase the disengage value. Review the <i>Resume/Disengage Calibration</i> section on page 19. For best results, set the value as low as possible. 3. Check the disengage switch cabling and connections. 4. Check the sensor voltage (5 V) and current (4-20 mA). Review the <i>Disengage Settings</i> section on page 39 for assistance with the disengage switch settings.
5243	.2	Master switch is in the off position.	<ol style="list-style-type: none"> 1. Toggle the master switch ON or to field mode. 2. Toggle the hydraulic lock switch to the unlocked state. 3. Check CAN communication to the steering valve.
5613	.11	Field terrain compensation not calibrated.	Perform the terrain compensation calibration. Refer to the <i>Terrain Compensation Setup</i> section on page 45.
	.13	Terrain compensation not calibrated.	Perform a terrain compensation calibration. Refer to the <i>Terrain Compensation Setup</i> section on page 45.
	.2	Inertial navigation system (INS) data invalid.	<ol style="list-style-type: none"> 1. Perform a terrain compensation calibration. Refer to the <i>Terrain Compensation Setup</i> section on page 45. 2. Verify inertial sensor functionality in the RS1 UT.
	.31	GPS receiver error: INS reset.	Cycle power to the RS1.
516118	.14	Toggle autonomy switch to the OFF position.	Toggle the autonomy switch to the OFF position.
	.17	Autonomy switch in the OFF position.	<ol style="list-style-type: none"> 1. Toggle the autonomy switch to the ON position. 2. Check switch cabling and connections.
	.2	Machine not configured for automation.	Complete a calibration with autonomous features enabled. Complete provisioning procedures for autonomous machine operations.

Code ID		Description	Recommended Actions
516119	.2	Lockout switch invalid.	Check cabling and connections.
	.31	Lockout switch pressed.	Toggle the lockout switch off. If DTC does not clear, check lockout switch cabling.
522240	.16	GGA rate high.	Cycle power to the RS1.
	.18	GGA rate low.	Cycle power to the RS1.
	.31	No GPS comm	1. Leave RS1 powered on for 10 minutes. 2. Cycle power to the RS1.
522242	.16	ZDA rate high.	Cycle power to the RS1.
	.18	ZDA rate low.	Cycle power to the RS1.
522250	.0	End of line error.	Contact Raven technical service.
	.15	Maximum point space error.	Contact Raven technical service.
	.16	Segment angle error.	Contact Raven technical service.
	.17	Minimum point space error.	Contact Raven technical service.
522250	.2	Curvature invalid.	1. Reset or update the field computer. 2. Contact your local Raven dealer.
	.31	No guidance path.	1. Cycle power to the Raven field computer. 2. Ensure the Raven field computer is used for guidance. 3. Start a job and create an A-B guidance line.
	.7	Maximum cross-track error (XTE) exceeded.	1. Recalibrate the RS1 steering system, including the hydraulic calibration. 2. Check hydraulic steering performance. Refer to the <i>Wheel Control Settings</i> section on page 32 for additional assistance.
	.8	Lookahead too large.	Contact Raven technical service.
522260	.31	No guidance partner.	Field computer is not registered as a guidance partner. 1. Cycle power to the field computer. 2. Update the field computer software.
522261	.31	No steering control unit (SCU) detected.	1. Check cabling and connections to the steering valve. 2. Cycle power to the steering system. 3. Update the steering valve software. 4. Check for CAN communication errors between the steering valve and the RS1. Check CAN terminators and wiring.
522268	.31	No field computer.	Check cabling and connections between the field computer and the RS1.
522390	.9	Engage switch error.	1. Check the resume switch status in the UT. Ensure the status changes when the engage switch is pressed. 2. Check cabling and connections to the resume switch.

Code ID		Description	Recommended Actions
522550	.13	FNRP not in park.	Move FNRP lever to "Park" position.
	.2	TCU fault.	Check the TCU disconnect DTC (522825.19) and follow troubleshooting steps if active. If not active, cycle power to the machine.
522810	.14	Vision mode invalid partner.	VSN not supported by MDU steering. Switch to GPS guidance or contact your local Raven dealer for assistance with upgrading to HDU steering.
522811	.14	Roadway homologation terms.	Homologation terms not accepted by the operator. Accept the terms of the Roadway Homologation.
522812	.16	Heading out of range.	This DTC is expected upon turning around. If this DTC activates on a straight A-B path, check the RS1/SC1 mounting
522813	.14	Profile orientation mismatch.	OMNiPOWER orientation does not match the configured tuneset. Convert the OMNiPOWER frame to Wide or Narrow mode appropriate for
522814	.14	Guidance width required.	A guidance width or working width must be programmed into the field computer or UT.
522815	.13	No four wheel support.	Selected machine tuneset does not support four-wheel steering. Contact a local Raven dealer or Raven technical service for additional assistance.
522818	.13	Brake connection failed.	<ol style="list-style-type: none"> 1. Check hydraulic connections. 2. Check pressure sensor cabling and connections. 3. Validate brake function by attempting to enter automation.
522819	.2	Brake validation fail.	<ol style="list-style-type: none"> 1. Toggle the autonomous switch OFF and back ON to recalibrate brakes. 2. Check brake connections. DTC typically encountered when the brake is disconnected or hydraulic pressure is low.
522820	.18	System pressure low.	Check pressure sensor connection and check hydraulic lines and fluid level.
522821	.16	Maximum propulsion speed.	Raise maximum speed if desired.
522822	.31	E-Stop pressed.	<ol style="list-style-type: none"> 1. Check the RCU UT. 2. Cycle power to the RCU.
522823	.13	MCM voltage fault.	<ol style="list-style-type: none"> 1. Cycle power to the MCM. 2. Contact a local Raven dealer if issue persists.
	.19	MCM disconnected.	Cycle power to the MCM.
522823	.8	MCM not ready.	<ol style="list-style-type: none"> 1. Use MCM object pool to determine the cause. 2. Contact a local Raven dealer if issue persists.
522823	.9	MCM communication fault.	Machine Control Module (MCM) detected a CAN communication fault. Toggle the autonomy switch to the OFF position and check the MCM hardware connections before proceeding.
522824	.19	RCU disconnected.	Cycle power to the RCU.

Code ID		Description	Recommended Actions
522825	.19	TCU disconnected.	<ol style="list-style-type: none"> 1. Check cabling and connections. 2. Check machine TECU version and OMNiDRIVE unlock. 3. Create a new RS1 profile.
522826	.16	Invalid pitch.	<p>A pitch greater than 15° has been detected for an extended period of time. Confirm that the RS1 is mounted securely to a flat surface. Confirm that any sunroofs are closed.</p> <p>If the issue persists, re-calibrate the terrain compensation. Review the <i>Terrain Compensation Setup</i> section on page 45 for additional assistance.</p>
523766	.31	Steering control partner serial number mismatch.	Select the correct steering profile or connect to the correct machine and steering control unit.
523827	.0	Reverse steer not supported.	Reverse steering is not supported on this machine. If the machine is moving forward when this DTC activates, select the direction toggle icon on the field computer or the RS1 UT.
523830	.31	Steering not unlocked.	Enter a steering unlock code. An unlock code is not necessary if using a SmarTrax MD unit.
523832	.0	GPS mode not unlocked.	Contact a local Raven dealer for a GNSS unlock or select a different GNSS correction type.
523839	.31	Selected tuneset not released.	<ol style="list-style-type: none"> 1. Update the RS1 software for the latest list of released tunesets. 2. Recalibrate RS1 using a generic tuneset.
523842	.31	Liability acceptance.	Accept the RS1 liability.
523843	.0	Lost internal communication.	<ol style="list-style-type: none"> 1. Cycle power to the RS1. 2. Ensure proper CAN termination. 3. Check cabling and connections.


Code ID		Description	Recommended Actions
523844	.11	GPS receiver error.	Cycle power to the RS1.
523845	.16	GPS receiver error: temperature.	
523846	.16	GPS receiver error: voltage.	
523847	.31	GPS receiver error: CPU overload.	
523848	.2	GPS receiver error: COM1 buffer overrun.	
523849	.2	GPS receiver error: COM2 buffer overrun.	
523850	.2	GPS receiver error: COM3 buffer overrun.	
523851	.2	GPS receiver error: link overrun.	
523852	.31	GPS receiver: auxiliary transmit overrun.	
523853	.3	GPS receiver error: AGC out of range.	
523854	.11	GPS receiver error: almanac.	
523855	.31	GPS receiver error: position solution.	
523856	.31	GPS receiver error: position fixed.	
523857	.31	GPS receiver error: clock steering	
523858	.31	GPS receiver error: clock model.	
523859	.31	GPS receiver error: external oscillator locked.	
523860	.31	GPS receiver error: software resource.	
523861	.31	GPS receiver error: Auxiliary 3 event.	
523862	.31	GPS receiver error: Auxiliary 2 event.	
523863	.31	GPS receiver error: Auxiliary 1 event.	
523864	.31	GPS source mismatch.	Machine and implement steering systems are using different correction type. Ensure that the machine and the implement are setup for the same correction type.
523868	.31	G-force limit active.	The maximum G-force has been reached during line acquire or curvature steering operation. Contact Raven technical service.

Code ID		Description	Recommended Actions
523874	.13	Memory communication error.	Power cycle the RS1. If the issue persists, contact Raven technical service.
523875	.13	SCU software out of date.	Update the RS1 software.
523875	.7	MCM software compatibility.	Update Machine Control Module (MCM) software version.
523898	.31	OEM engage error.	Field computer on-screen engage switch not supported. Use the machine engage switch to initiate autosteer.
523913	.31	GPS invalid authorization.	Some correction types require an unlock code. Either the code was not entered correctly or an existing code has expired. Review Chapter 8, <i>Feature Unlock Codes</i> for additional information on entering unlock codes. Contact a local Raven dealer or Raven technical service for additional support.
523916	.13	SC1 software out of date.	Update the SC1 ECU software version.
	.14	RS Lite software out of date.	Update the RS Lite software version.
523918	.2	GPS receiver error: input overrun.	Power cycle the RS1.
523919	.31	GPS receiver error: jammer detected.	
523920	.2	GPS receiver error: IMU communication failure.	
523921	.31	GPS receiver error: tracking mode.	
523922	.31	GPS receiver error: digital filter enabled.	
523923	.0	VSN data invalid warning.	VSN is unable to provide valid row guidance. Check the camera feed and solution quality from the VSN object pool Home page.
523924	.0	VSN data invalid error.	VSN guidance vectors not valid. Restart the VSN.
523925	.2	No row camera communication.	VSN times out after 10 seconds. Check cabling and connections.
523926	.31	No user activity.	Check operator switch settings and operator switch cabling and connections if present.
523927	.31	VSN only needs TC.	VSN requires a task controller. Open a job on a field computer to use VSN guidance.
523928	.13	Invalid factory calibration	1. Restart the RS1. 2. Contact your local Raven dealer.
573927	.31	VSN only job required.	Start a job on the field computer or UT to function.

SYSTEM HEALTH TESTS

System health tests are performed to diagnose and correct machine and RS1 calibration issues. The following system health test can be performed via the RS1 system:

- Step Response Test
- Machine Test

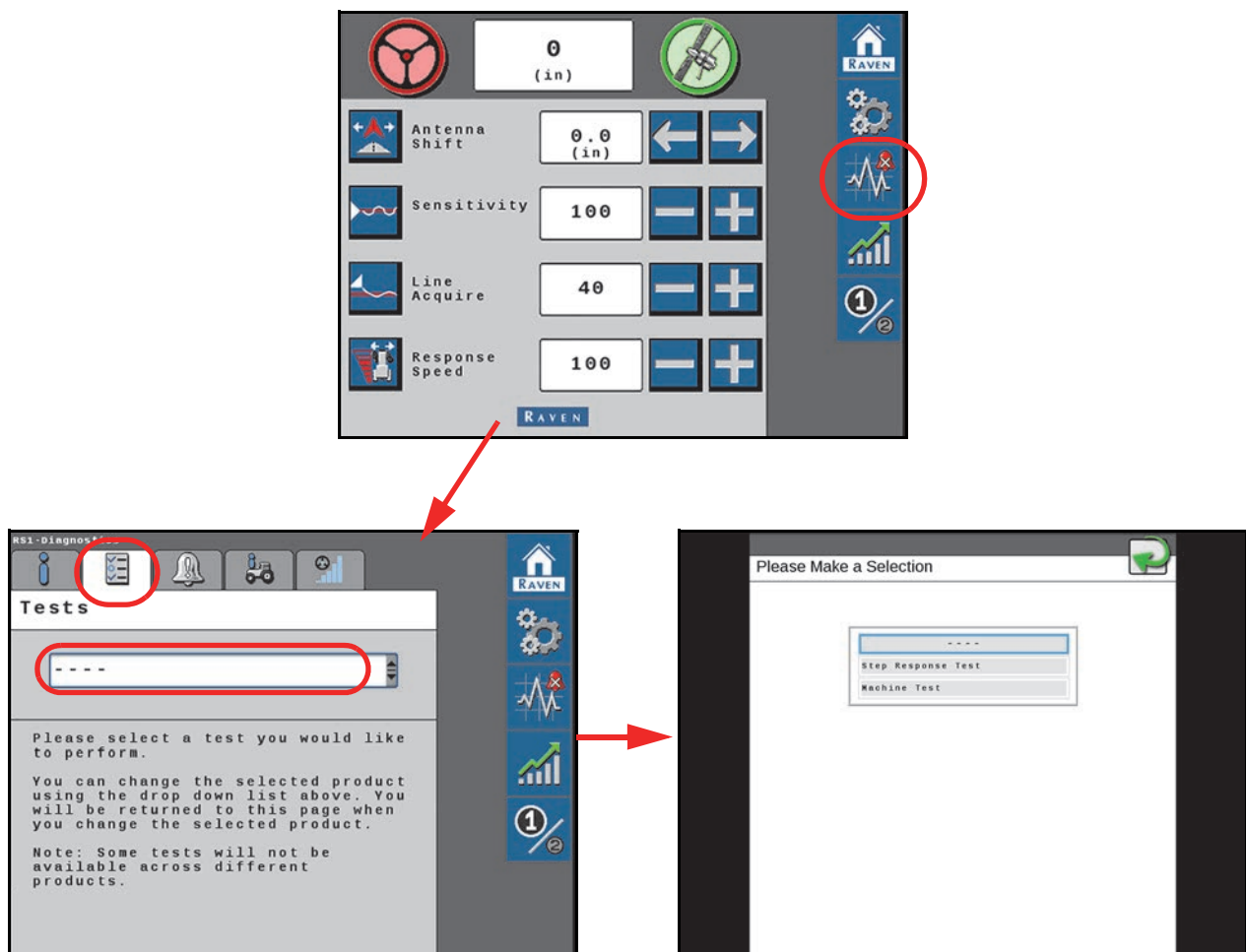


WARNING

The machine will steer automatically. While calibrating or operating the RS1 system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

To disengage auto-steering at any time, turn the steering wheel or select the on-screen Stop button.

FIGURE 10. Test Selection Page

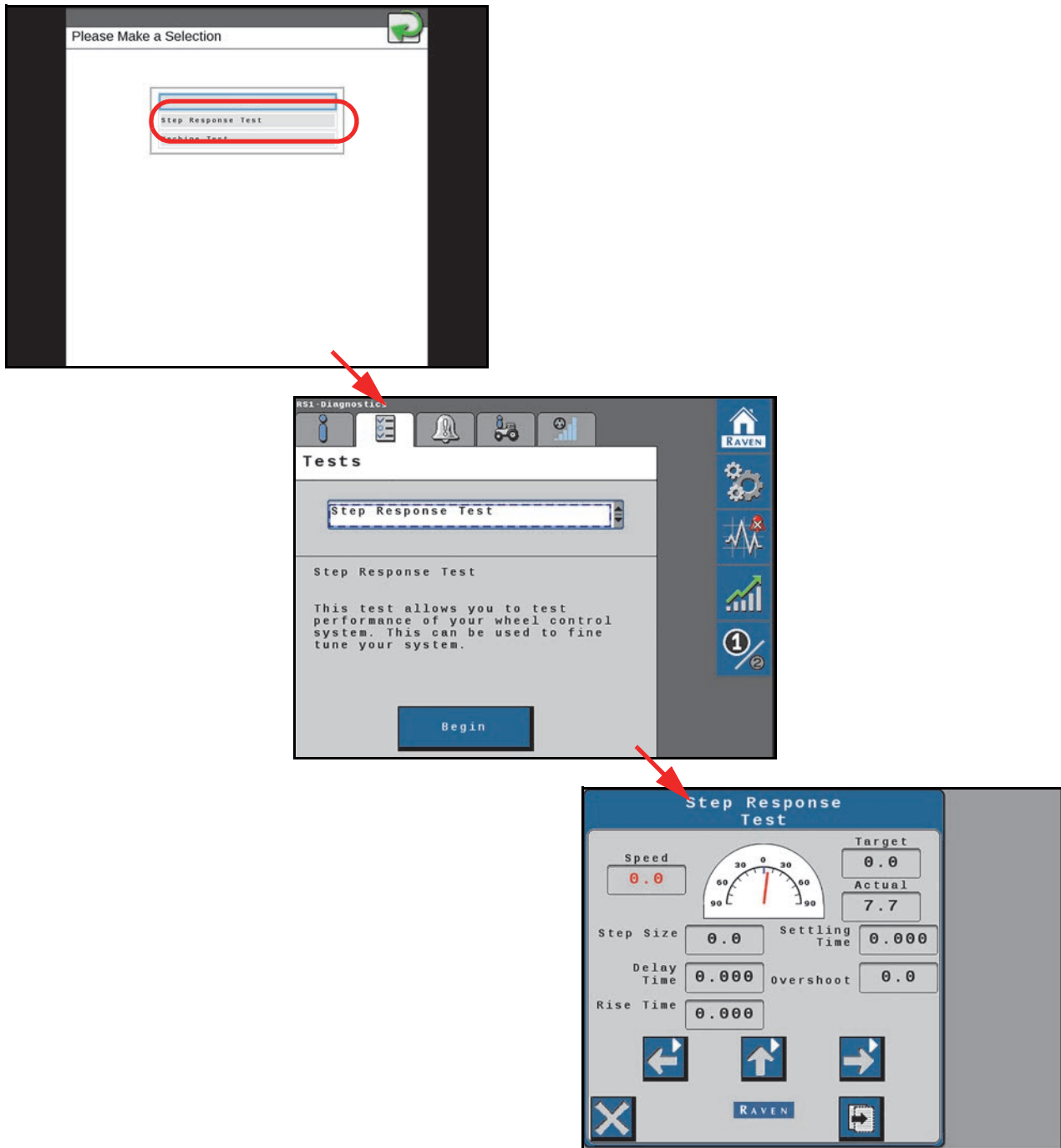


The figure illustrates the navigation process for selecting system health tests. It starts with the main control screen, where a test icon is highlighted. This leads to the 'Tests' selection page, which features a dropdown menu and instructions. Finally, a selection dialog box appears, allowing the user to choose between 'Step Response Test' and 'Machine Test'.

STEP RESPONSE TEST

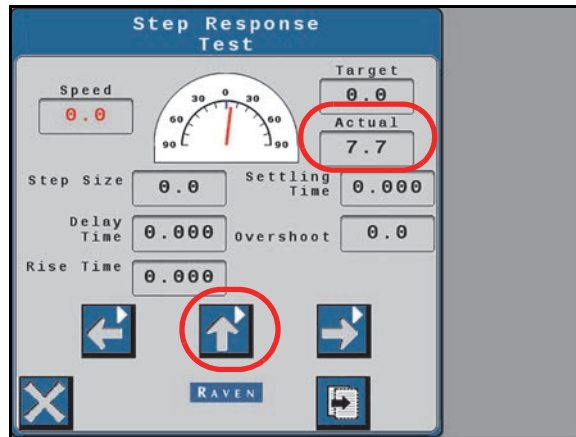
The Step Response Test is used to determine the responsiveness of the machine steering system.

FIGURE 11. Step Response Test Page



1. Drive forward 1 - 4 mph [1.6 - 6.4 km/h] with the engine RPM set at 3/4 throttle.

FIGURE 12. Step Response Test Page



2. Turn the steering wheel to the right so that the Actual reading displays 20.0 degrees.
3. Press the center up arrow.
4. Wait for the following fields to populate and record the data:
 - Step Size
 - Delay Time
 - Rise Time
 - Settling Time
 - Overshoot
5. Drive forward 1.6 - 6.4 km/h [1 - 4 mph] with the engine RPM set at 3/4 throttle.
6. Turn the steering wheel to the left so that the Actual reading displays -20.0 degrees.
7. Press the center up arrow.
8. Wait for the following fields to populate and record the data:
 - Step Size
 - Delay Time
 - Rise Time
 - Settling Time
 - Overshoot
9. Repeat step 1 through step 8.

NOTE: Once the Step Response Test has been completed, the machine performance reading should fall within the recommended system settings. Provide the collected data to a Raven Service Technician to verify machine performance falls within the recommended settings.

MACHINE TEST

The Machine Test is used to determine the responsiveness of the machine steering system.

FIGURE 13. Step Response Test Page



Use the drop-down list options to select the following machine test pages:

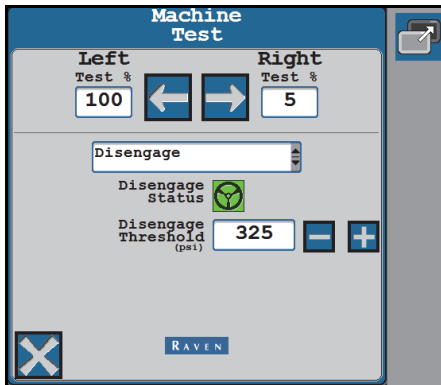
- Disengage
- Machine Info
- Readouts
- Switches

MACHINE CONTROL EFFORT STEERING TEST

The top of the Machine Test page allows the operator to test the steering system and valve control effort.

1. Enter the test control effort percent in the left or right field.

FIGURE 14. Disengage Switch Test Page

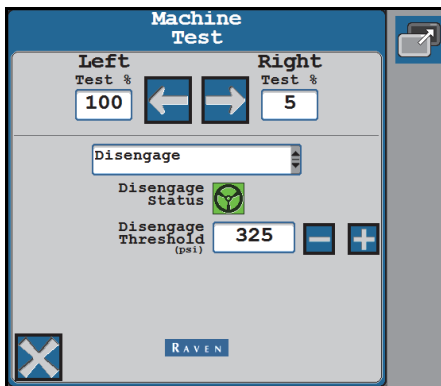


2. Use the blue arrow buttons to manually steer the wheels left or right.
3. Select the 'X' in the lower, left corner to return to the Tests tab.

DISENGAGE

Review the disengage switch settings and confirm switch operation and status.

FIGURE 15. Disengage Switch Test Page

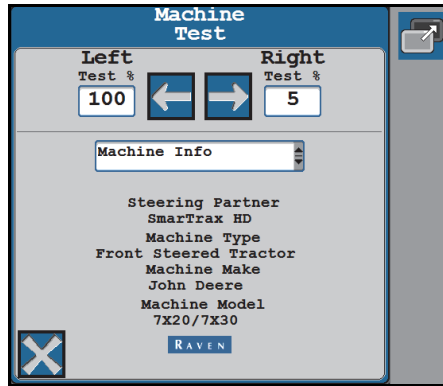


NOTE: Adjust the Disengage Threshold value to test the disengage status based upon steering wheel inputs.

MACHINE INFO

Review basic tune-set profile information.

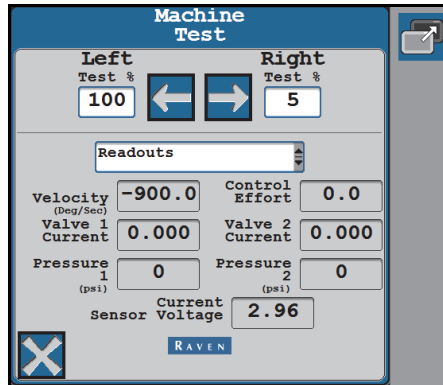
FIGURE 16. Machine Information Machine Test Page



READOUTS

Page offers information such as velocity (wheel speed), control effort for the steering valve, the amperage per valve, current pressure at each transducer (if applicable), and the WAS voltage.

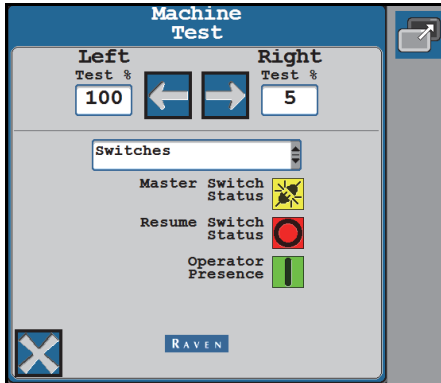
FIGURE 17. Machine Test Readouts Page



SWITCHES

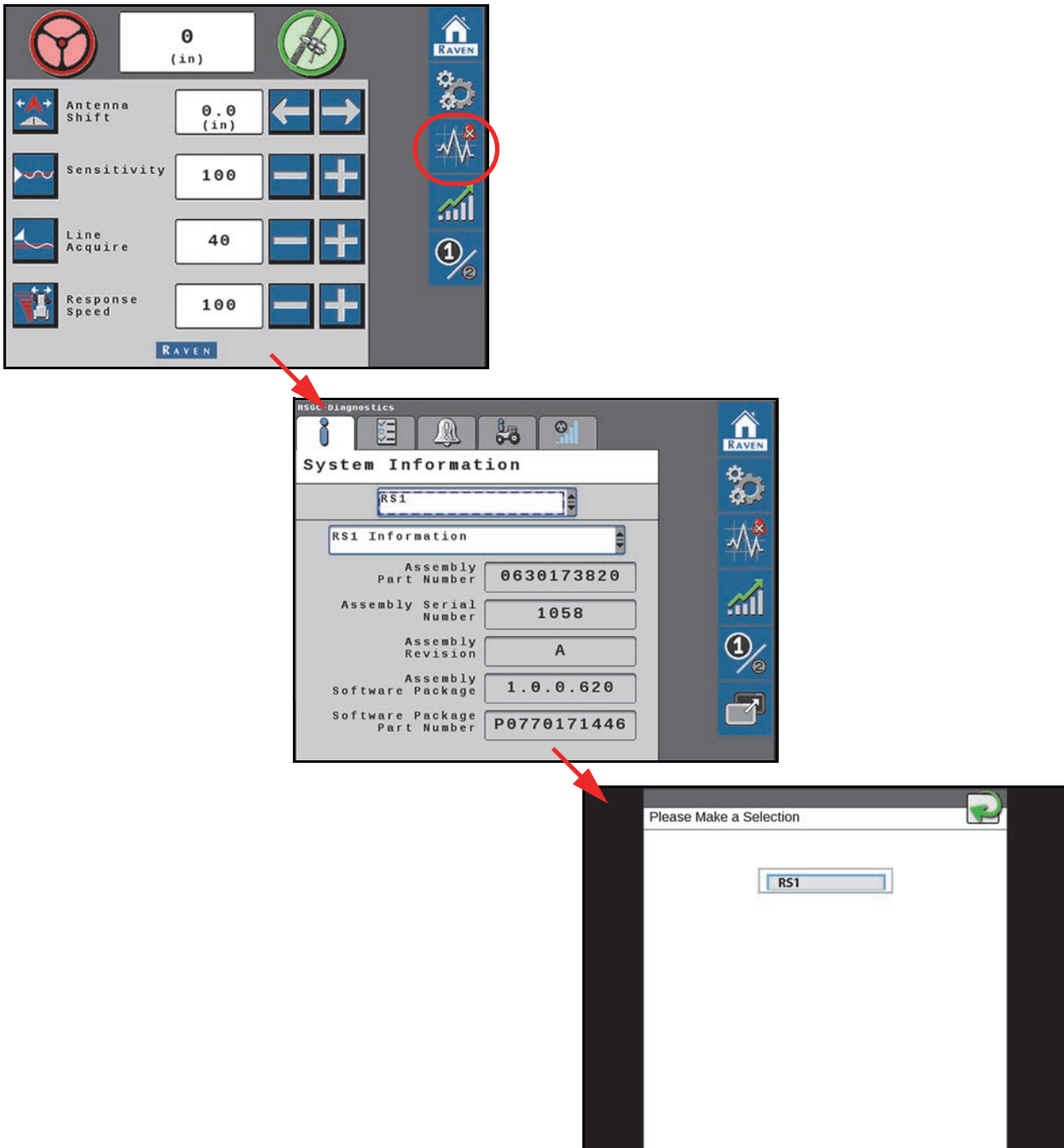
The switches page allows the operator to troubleshoot the machine steering master switch, resume switch, and operator presence switch. The icons shown on this page should change when the switch status changes.

FIGURE 18. Machine Test Switches Page



SYSTEM INFORMATION

FIGURE 19. System Information Page



1. Select the steering control device from the drop-down menu.
2. Select the desired system component from the second drop-down menu.

FIGURE 20. System Information Pages

RS1 Information

System Information

RS1

RS1 Information

Assembly Part Number	0630173820
Assembly Serial Number	1058
Assembly Revision	A
Assembly Software Package	1.0.0.620
Software Package Part Number	P0770171446

GPS Receiver Information

System Information

RS1

GPS Receiver

Receiver Serial Number	BFN16323216
Receiver Model Number	D2LRPGTTNA
Software Version	OEM060700RN0000
GPS Board Type	OEM628-4.01
Receiver PAC	QV191:0885:1013

Steering Guidance Controller Information

System Information

RS1

Steering Guidance Controller

PCB Part Number	0640171365
PCB Revision	6
Software Part Number	0770171449
Software Version	22.3.1.19
Bootloader Version	5.0.0.12
Controls Software Version	22.1.0.2

Cell Modem Information

System Information

RS1

Cell Modem

Model Number	LE910-SVG
Firmware Version	17.01.571

RS1 Unit and Powered-On Hours

System Information

Steering Controller

Hours

Engaged

Version Hours (Engaged)	3.7
Lifetime Hours (Engaged)	11.7
Radar Lifetime Hours (Engaged)	1.7
VSN Lifetime Hours (Engaged)	11.3

RS1 Hardware Diagnostics

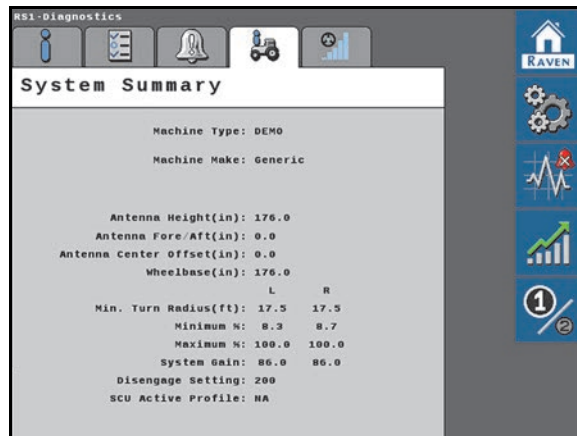
System Information

RS1

Hardware Diagnostics

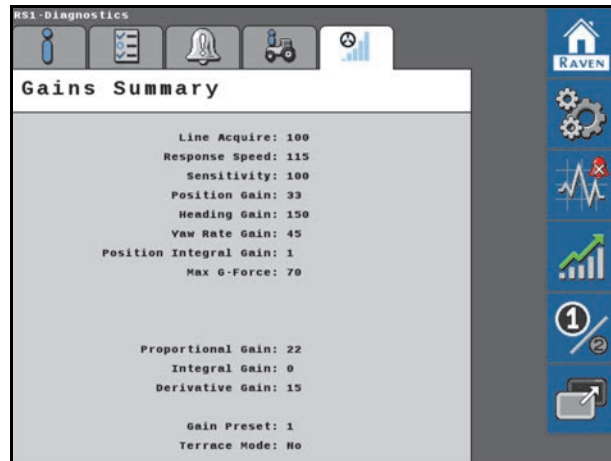
ECU Voltage (v)	14.1	ECU Current (A)	0.680
5V Voltage (v)	4.9	4V Voltage (v)	3.7
HP 3.3V Voltage (v)	3.3	SOM 3.3V Voltage (v)	3.2
Boost Current (A)	0.520	SOM Temp (c)	32.9
STM32 Temp (c)	30.1		

FIGURE 21. System Summary Page



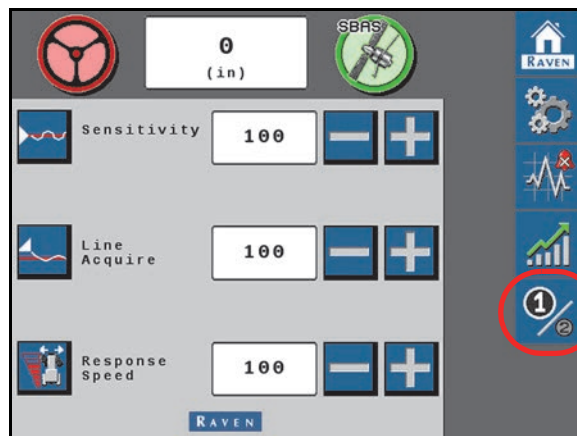
The System Summary page displays the machine settings and calibrated steering settings for the RS1 system.

FIGURE 22. Gains Summary Page



The Gains Summary page displays all of the advanced steering settings used to steer the machine.

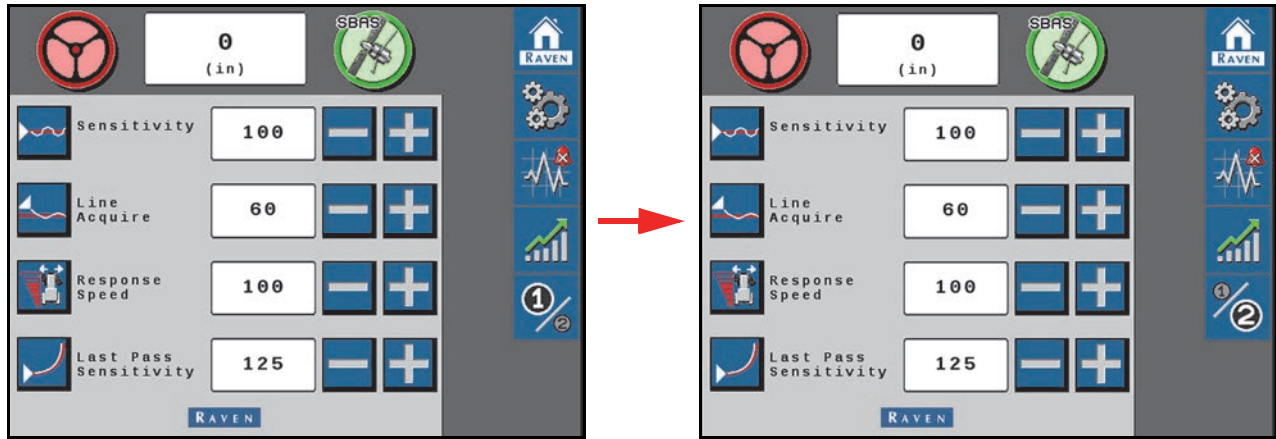
FIGURE 23. Preset Steering Gains



The Preset Gains option allows the operator to switch back and forth between two sets of steering gain settings. Different sets of settings may be useful when:

- The machine uses two tire configurations (floater vs. row crop tires)
- Different soil types
- Different speeds (planting vs. spraying)

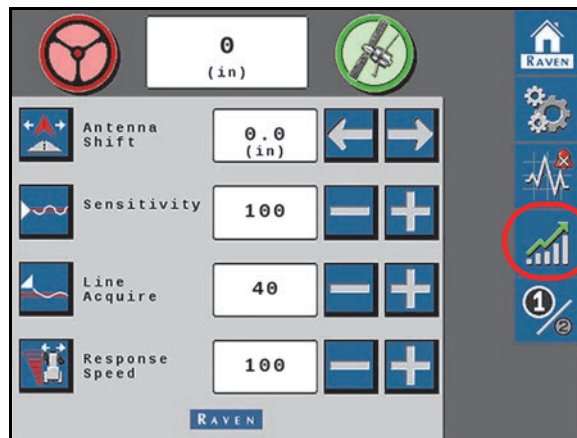
FIGURE 24. Preset Gains Settings



To toggle between the settings, press the  button.

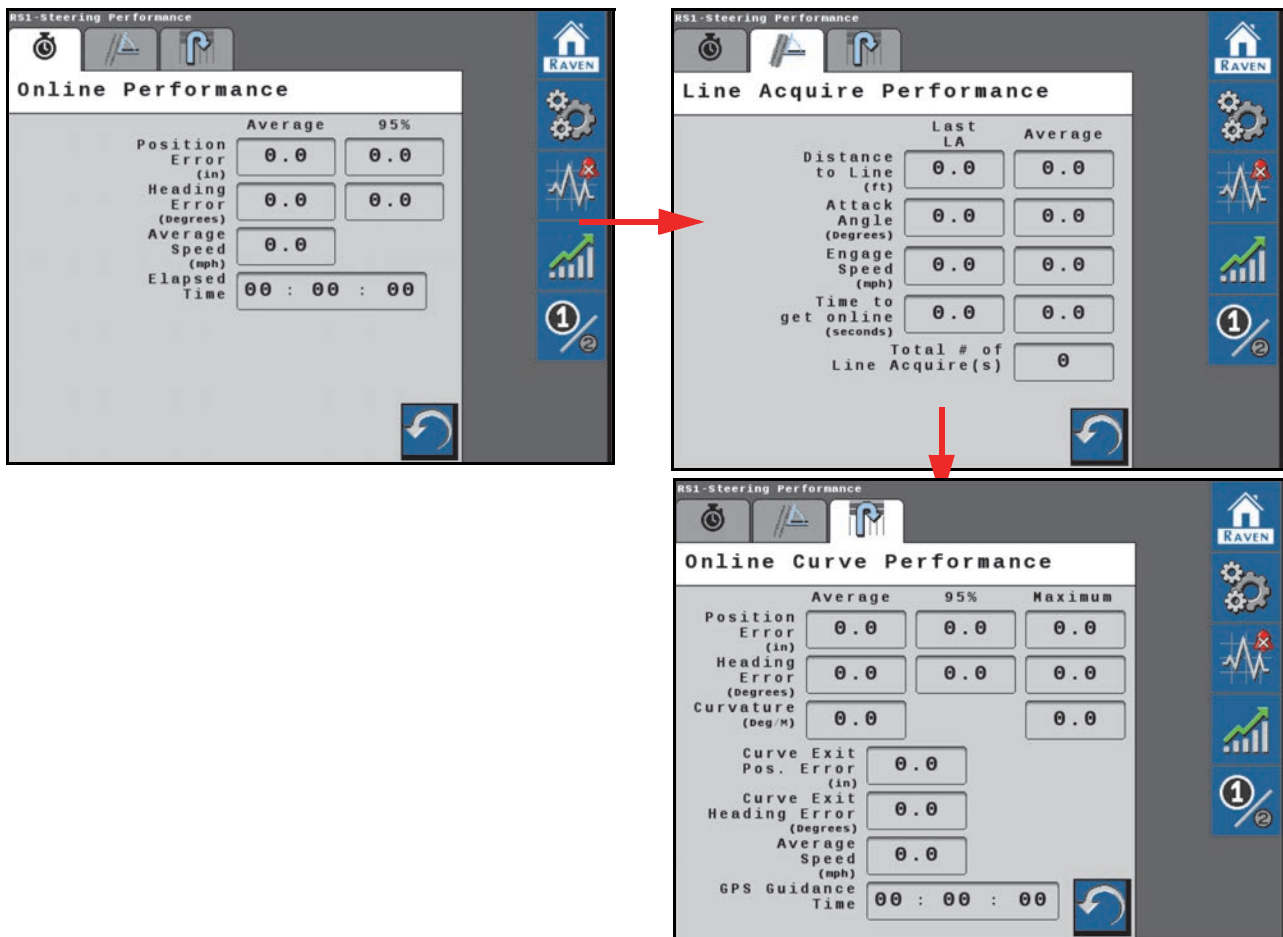
PERFORMANCE MONITOR

FIGURE 25. RS1 Home Page



1. Select the **Performance** icon on the right side of the Machine Settings page to view the short-term system performance.

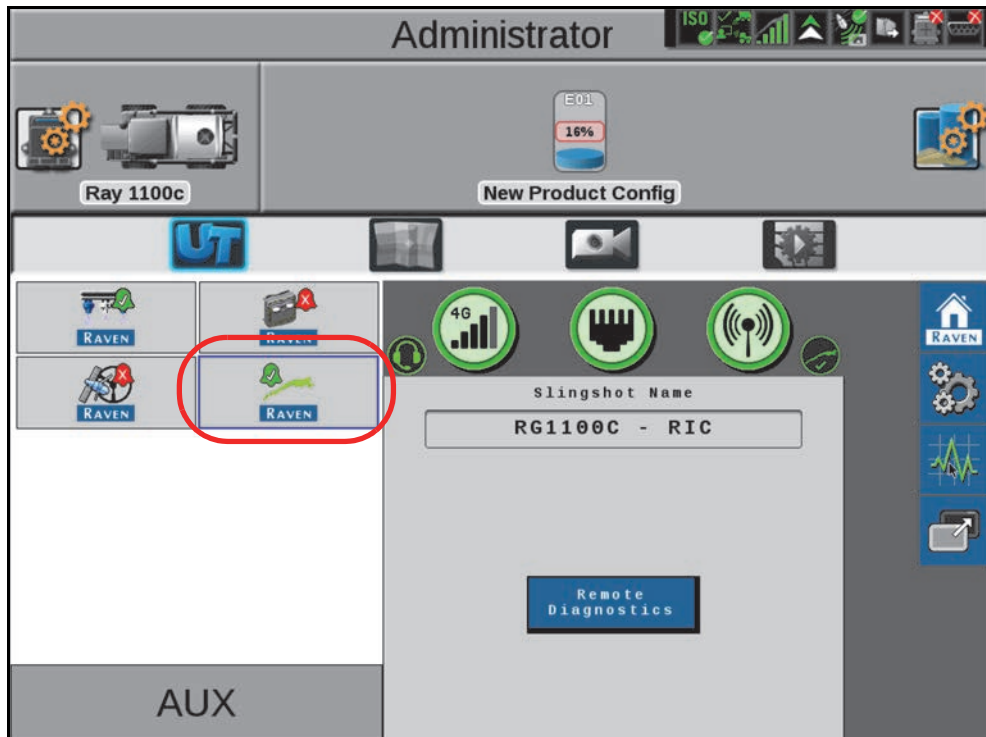
FIGURE 26. Short-Term and Resettable Performance Page



NOTE: The Short-Term Performance page displays the averages and 95% performance values.

2. Select the tab with the watch icon to view the Resettable Performance values.
3. Select the **Reset** icon to reset the values.

FIGURE 1. Main Page






To access the Slingshot home page, select the Slingshot icon from the UT menu.

BUTTON DEFINITIONS

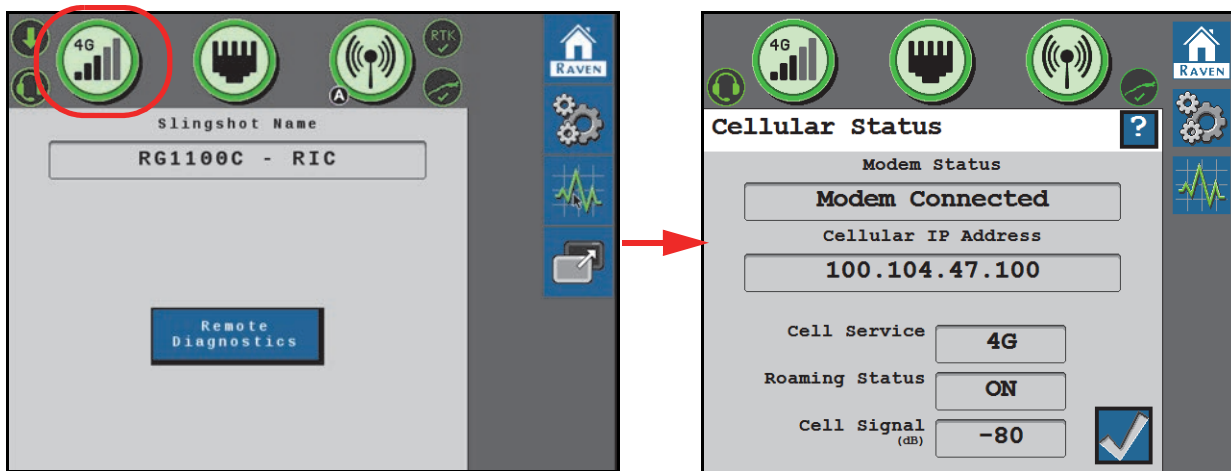
The following are common status or mode messages which may occur.




TABLE 1. UT Navigation Buttons



	Accept - Saves changes made to the RS1 system and returns the user to the previous Status page (or returns the user to the Tools Menu during the initial setup process).
	Next - Press to proceed to the next page.
	Previous - Returns the field computer display to the previous page in the setup process.

CELLULAR MODEM

FIGURE 2. Cellular Status Page



Display	Message
	RS1 is connected to the network via the cellular modem.
	The cellular modem is functional, but is not connected to the network.
	The cellular modem is not functional and RS1 is not connected to the network.

Display	Message
	The RS1 unit is equipped with a cellular modem, but the feature has not been unlocked. Contact your local Raven dealer to purchase feature unlock codes.
	The RS1 unit is not equipped with a cellular modem.

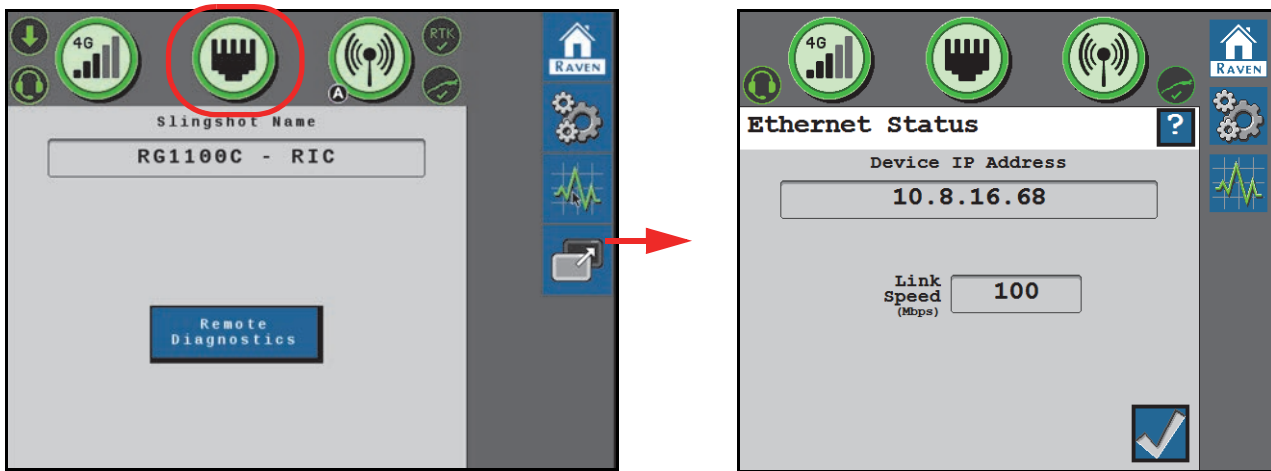
CELLULAR STATUS

The table below defines some of the terms used as cellular status:

Status	Definition
Cellular APN	Displays the current APN used by the cell mode. If Not Available is displayed, either no cellular connection was established or the user didn't enter an APN.
WAN	Displays the Wide Area Network (WAN) IP address the cell modem is receiving from the network.
Cell Signal	Displays the current RSSI (signal strength) of the cell modem.
Cell Service	Displays the current cell service connection type.
Roaming Status	Displays if the cell modem is roaming.

ETHERNET STATUS

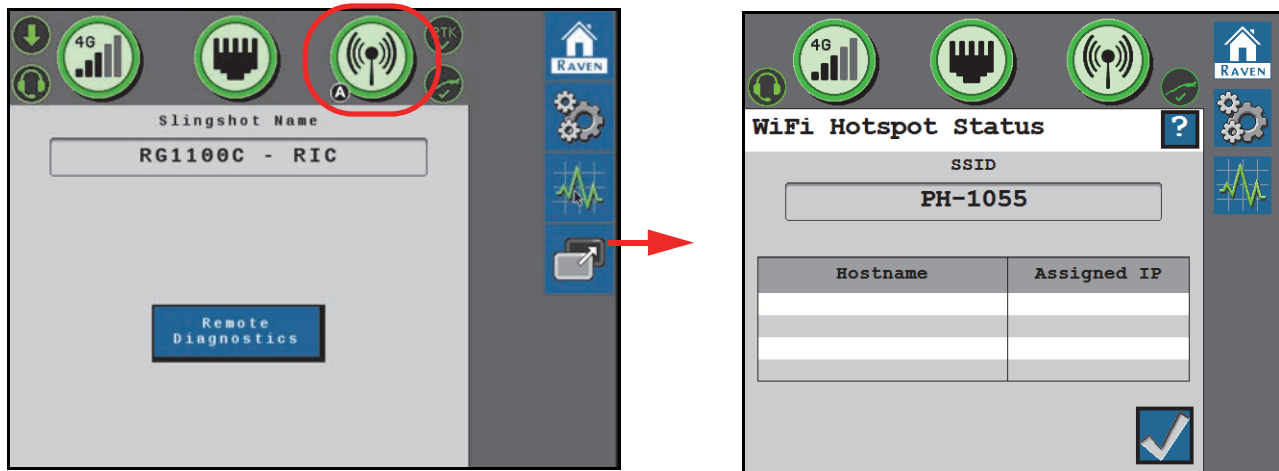
FIGURE 3. Ethernet Status Page



Display	Message
	Indicates that a valid connection has been established between the RS1 and a field computer or field hub.
	No Ethernet connection has been made or the RS1 does not recognize that an Ethernet has been made.
	Ethernet device failure. Contact Raven for support.
Device IP Address	Displays the IP Address the RS1 will broadcast to a connected device.
Link Speed	The speed data can pass from the RS1 to the devices it is connected to.

WiFi STATUS

FIGURE 4. WiFi Status Page



Display	Message
	The WiFi Hotspot is active and functioning properly.
	WiFi Hotspot is not functioning properly.
	WiFi client is active and has connection.
	WiFi client is active, but does not have a valid connection to a WiFi network.
	WiFi hardware is not functioning properly.

SSID. The Service Set Identifier (SSID) is a wireless network identifier name that connects to via a WiFi network.

Hostname. The Hostname is the name of any device that is connected to the RS1.

Assigned IP. The Assigned IP is the IP address that is given to the device when it connects to the RS1.

NOTE: Refer to “Cellular Settings” on page 87 for additional information regarding Hotspot and WiFi configurations.

SLINGSHOT AND RTK STATUS

FIGURE 5. Home Page

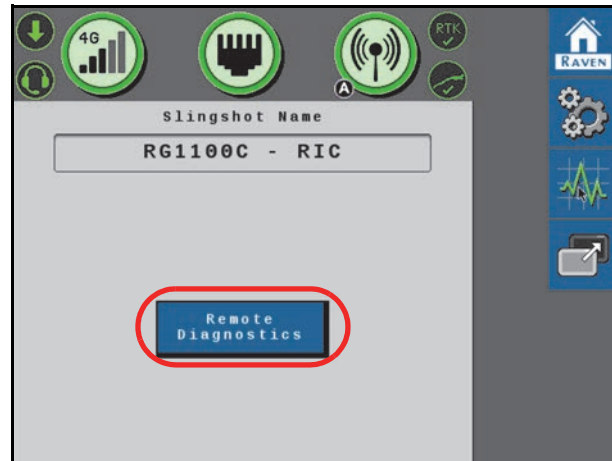


Display	Message
	RS1 is connected to the Slingshot portal.
	RS1 is not connected to the Slingshot portal.
	RS1 is receiving RTK corrections. NOTE: This icon is hidden if RTK corrections have not been unlocked in the RS1 unit.
	RS1 is not receiving RTK connections. NOTE: This icon is hidden if RTK has not been unlocked in the RS1 unit or an RTK correction profile has not been setup on the Slingshot website.
	RS1 Remote Diagnostics are being sent to the Slingshot portal.
	RS1 Remote Diagnostics are not being sent to the Slingshot portal.
Slingshot Name	Displays the default System name given to the RS1 in the Slingshot portal when the device was registered.

REMOTE DIAGNOSTICS

The remote diagnostics button enables the RS1 to send usage logs to the Slingshot server for use by Raven to monitor RS1 performance. Press the Remote Diagnostics and accept the End User License Agreement (EULA).

FIGURE 6. Slingshot Home Page



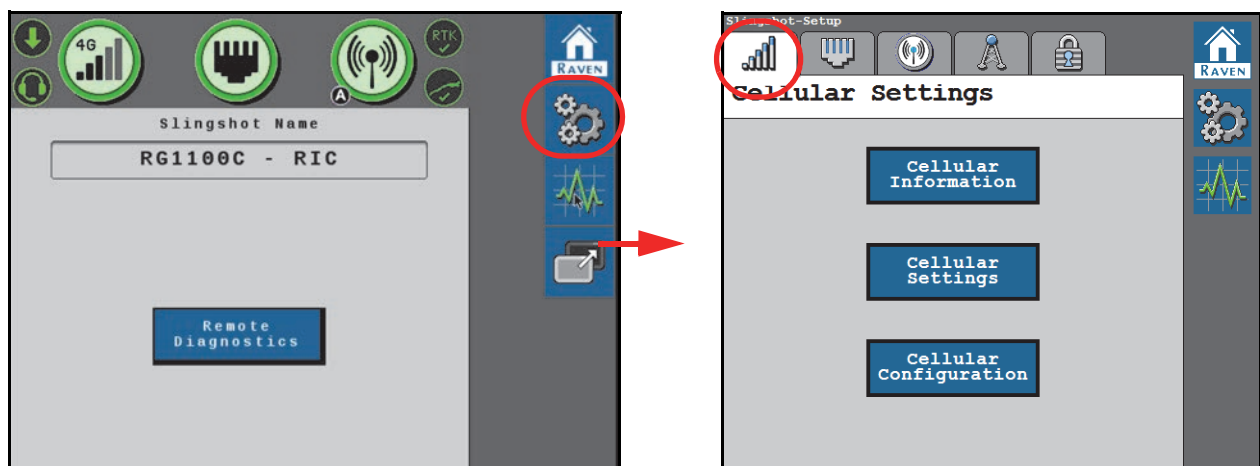
The EULA must be pressed after every power cycle. To accept the EULA so it does not need to be pressed until the next time the EULA is revised, accept the EULA on the Slingshot Portal.

<https://portal.ravenslingshot.com/index.php?r=site/login>

SYSTEM SETTINGS

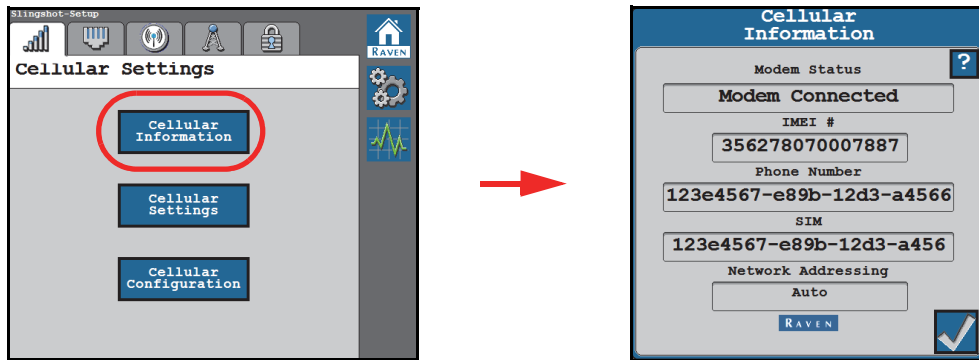
CELLULAR SETTINGS

FIGURE 7. Slingshot Home Page



The Cellular Settings page allows the operator to access the Cellular Information and Cellular Settings used in the RS1 system.

FIGURE 8. Cellular Information Page



IMEI #. Displays the International Mobile Equipment Identity number (IMEI#) with the modem installed in the RS1 unit.

Phone Number. Displays the phone number assigned to the SIM card in the RS1 modem when a valid data plan is active.

SIM. Displays the identification number associated with the SIM card currently in use in the RS1 system.

Network. Displays the cellular network the Slingshot is utilizing.

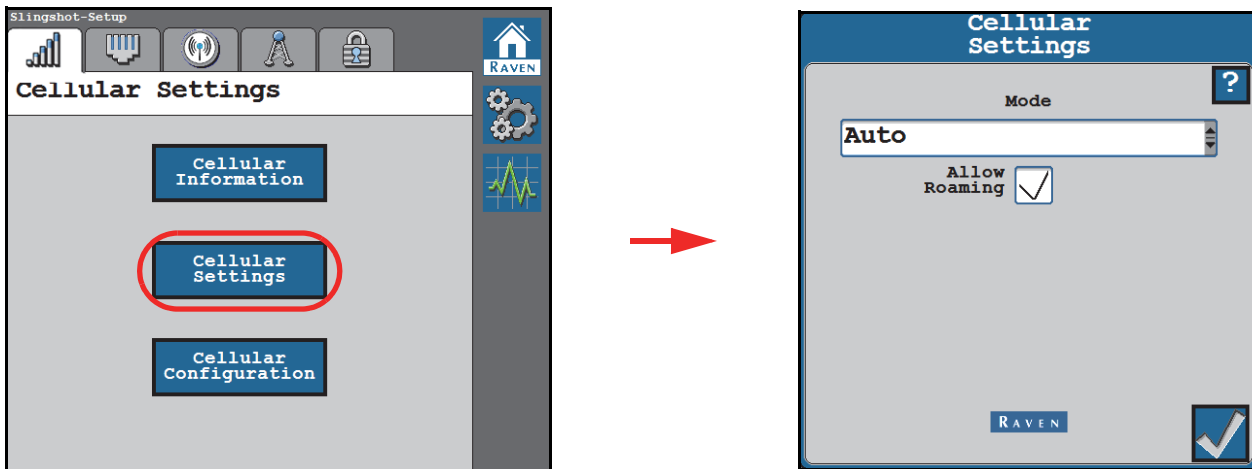
Country. Displays the country that the cellular network provides is in.

Network Provider. •Displays the cellular network used by the SIM card that is in the modem in the RS1.

NOTE: Refer to the “Cellular Modem” on page 82 for additional information on cellular settings.

APN Password. •Dictated by the cellular provider. This is not applicable for all networks.

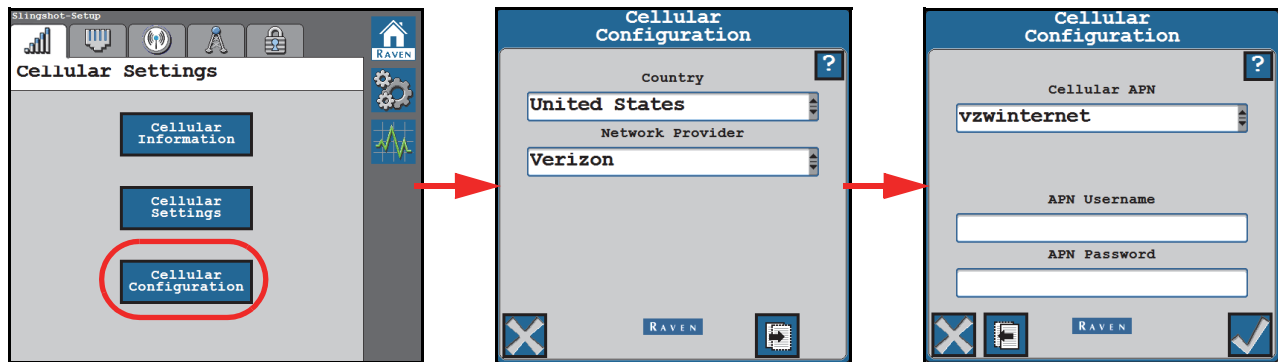
FIGURE 9. Cellular Settings Page



Mode. Indicates the cellular network mode in which the RS1 receiver is operating.

Roam. Allows the user to restrict or allow cellular data usage when the system is not in its home network. This is not available on all cellular networks.

FIGURE 10. Cellular Configuration Pages



Country. Displays the country, chosen by the user, of the cellular provider. Can be changed by the user.

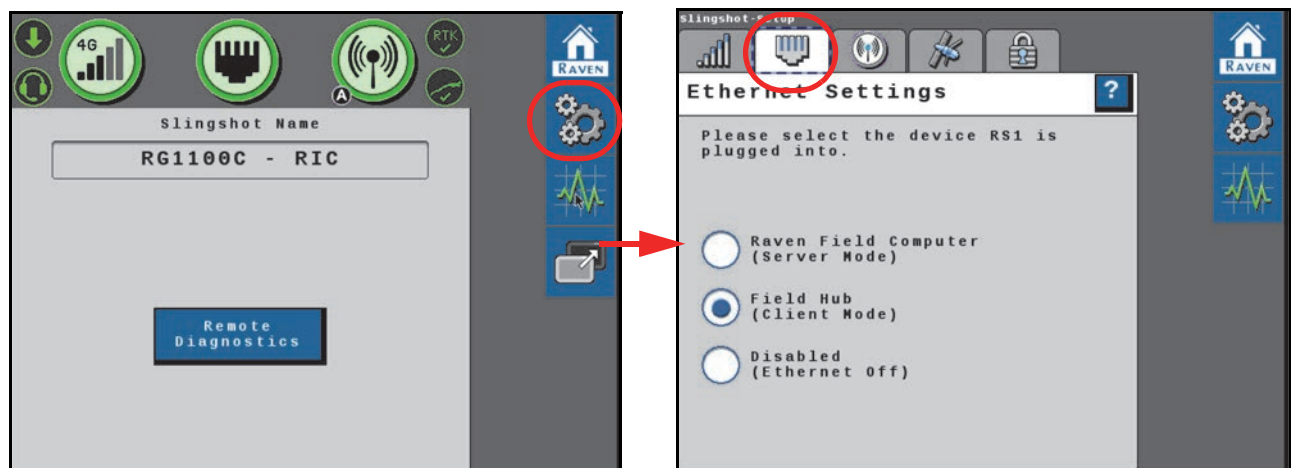
Network Provider. Displays the cellular network provider, chosen by the user. The setting can be changed on this page.

Cellular APN. Displays the cellular APN in use. The network can be selected from the drop down or defined by the user.

APN Username and Password. Displays the APN Username and Password, when applicable. This is only used by some providers and must be given by such providers.

ETHERNET SETTINGS

FIGURE 11. Ethernet Settings Page



There are two selectable modes for the Ethernet connection in the RS1 unit.

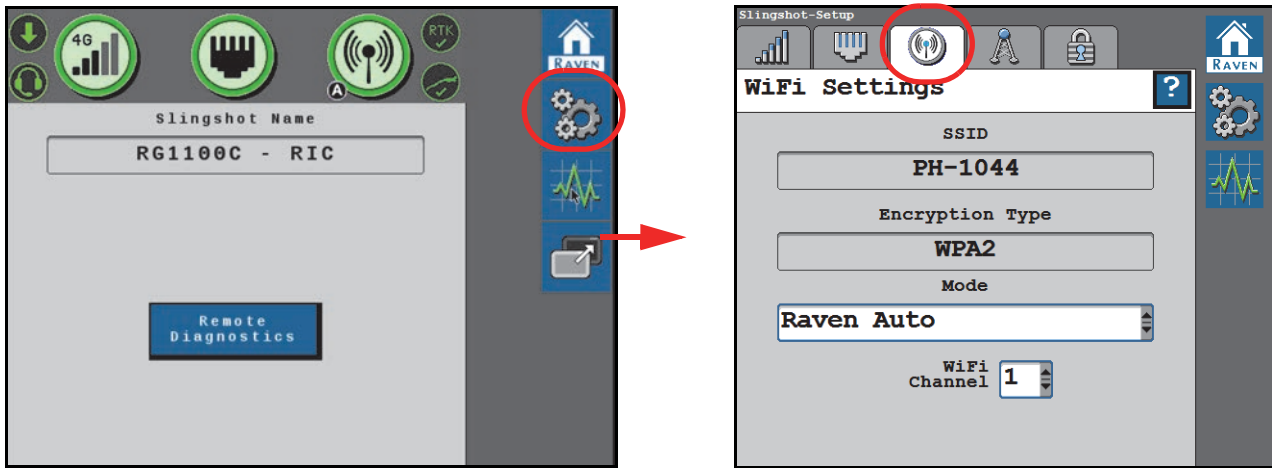
Raven Field Computer (Server Mode). Select this mode when the RS1 unit is directly connected to the field computer via an Ethernet cable.

Field Hub (Client Mode). Select this mode when the RS1 unit is directly connected to the field hub via an Ethernet cable.

Disabled. Select this option to disable Ethernet.

WiFi SETTINGS

FIGURE 12. WiFi Hotspot Settings Page



SSID. Displays the WiFi SSID (network name). This setting cannot be modified by the operator.

Encryption Type. Displays the encryption mode being used on the RS1 WiFi hot spot. This setting cannot be modified by the operator.

Mode. Select the mode for WiFi or Hotspot operation.

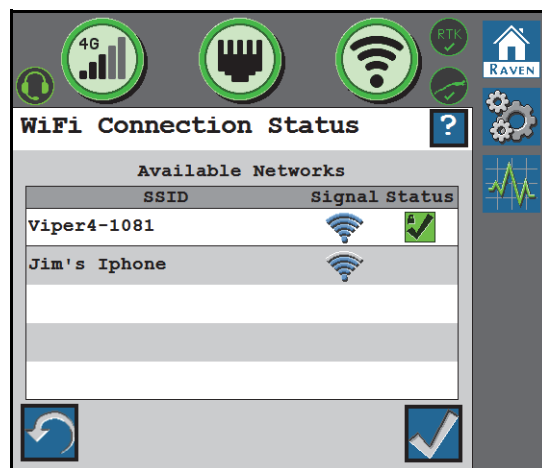
- Manual Client
- Manual Hotspot
- Raven Auto

WiFi Channel. Displays the channel the WiFi hot spot is currently using. If the operator is experiencing a issues with connectivity or staying connected, adjusting these settings may improve connectivity issues. This setting can be modified by the operator. The WiFi password can only be modified through the Slingshot website.

MANUAL CLIENT

Select Manual Client to manually connect to available WiFi networks.

FIGURE 13. WiFi Connection Status



- Touch the refresh button in the lower, left corner to update the list of available WiFi networks.
- Select an available network to enter the WiFi password and connect to the selected network. The network to which the system is currently connected will display with a green check mark on the WiFi Connection Status page.

MANUAL HOTSPOT

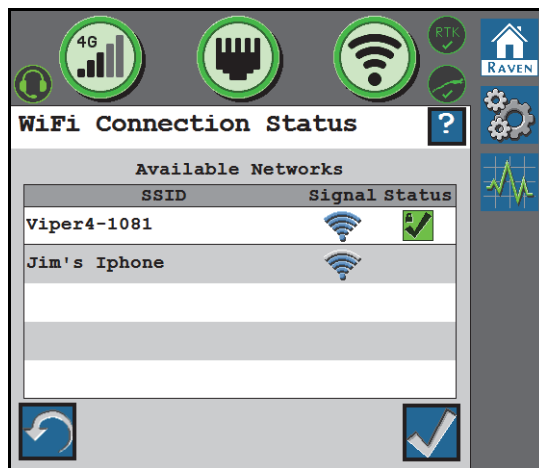
Select Manual Hotspot to broadcast a hotspot for local WiFi devices.

RAVEN AUTO

Select Raven Auto to allow the system to automatically select the best WiFi network connection. To change which WiFi network the system is connected to, select the Manual Client mode.

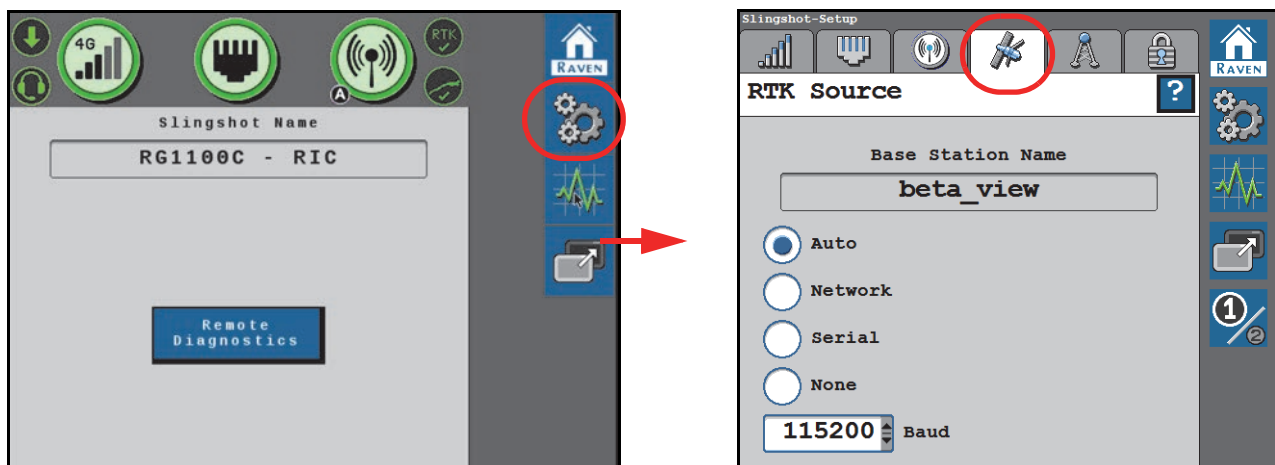
NOTE: When set to Raven Auto, a small "A" indicator will be displayed to indicate Raven is controlling the Hotspot and WiFi settings for the system.

FIGURE 14. WiFi Connection Status



RTK SOURCE SETTINGS

FIGURE 15. RTK Source Page



The RTK Source page displays the base station information (if applicable) and allows the operator to choose the RTK source.

NOTE: Generally, the RTK Source setting should be set to "Auto". However, this setting may be locked to a "Serial" setting if the RTK is provided via a non-Raven source or Slingshot Field Hub connected serially. This setting may be switched based on location or customer.

NOTE: If RTK has not been unlocked in the RS1 unit, this tab will display "RTK Is Not Unlocked" and this feature will not be available until an unlock code for RTK is entered into the system.

- **Network** - Select if the source is provided via the Slingshot server, either through Ethernet or cellular receiver.
- **Serial** - Select if the source is provided via serial input to the RS1 unit.
- **None** - Use this setting to turn off a source if there are multiple RTK over CAN devices on the system.

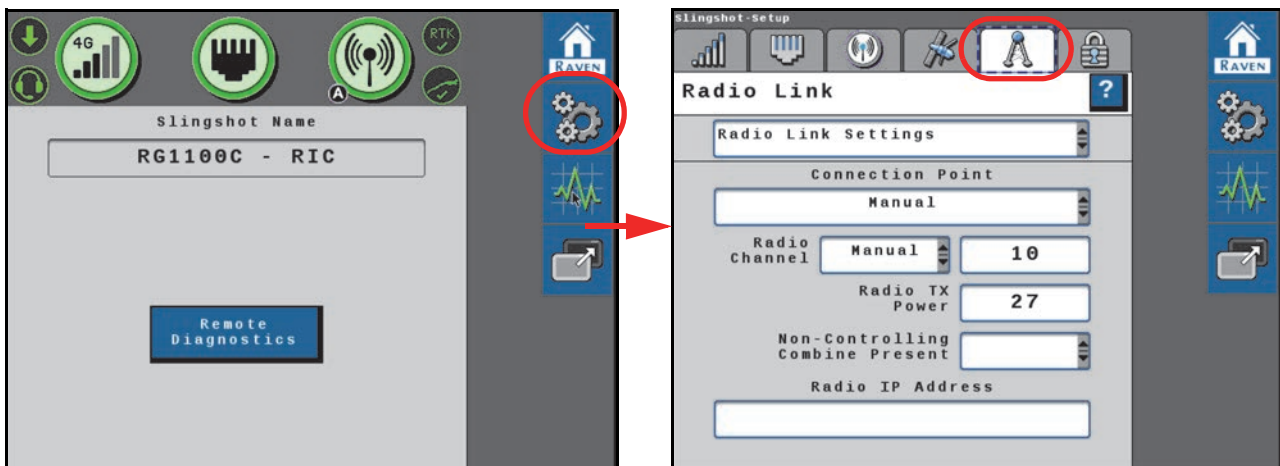
RADIO CONFIGURATION

Use the drop-down option at the top of the Radio Configuration tab to toggle the page between the following settings pages:

- *Radio Link Settings* section on page 92
- *Radio Link Status* section on page 94
- *Signal Information* section on page 95

RADIO LINK SETTINGS

FIGURE 16. Radio Link Settings Page



Connection Point. Calibrates the RS Lite for the types of radio data to transmit and receive during autonomous operation.

Radio Channel Mode. Use the drop-down options to set the mode for manual to assign a specific channel ID or set the mode to HOP to allow the radio link to automatically find the best radio channel on system startup.

NOTE: When the Radio Channel is set to HOP, the channel ID shows AUTO. A channel cannot be set manually as the radio channel is read only.

Radio Channel. Set the radio channel for autonomous vehicle operations. The radio channel may be set between 1 and 18 and must be set to the same value for each vehicle operating as part of the autonomous system.

Interference on channels will vary by location and other radio communication in the area. If too much interference is present, the system may encounter frequent communication or link errors. If this occurs, change the radio channel for each radio in the system to find a channel with less interference.

Radio Tx (Transmit) Power. The radio signal power to transmit to other radios in the autonomous system. The value must be between 10 and 30.

Lower values typically offer better results for near proximity (e.g. syncing with the combine, smaller fields, etc.). Higher values may be required to transmit across larger fields or through tree lines, but may cause more interference when machines are operating close together.

Non-Controlling Combine Present. Use the drop down list to set the number of non-controlling combines present during field operations.

NOTE: The value set for the number of non-controlling combines present must be set on the Radio Link tab on each machine in the OMNiDRIVE™ system (e.g. the tractor, the controlling combine, and each non-controlling combine).

Radio IP Address. If the connection point is set to Manual, the Radio IP Address field may be used to enter the IP address desired for the RS1.

NOTE: A reboot is required each time the IP address is changed. This field is only displayed when set to Manual.

FIGURE 17. Radio Link Status Page

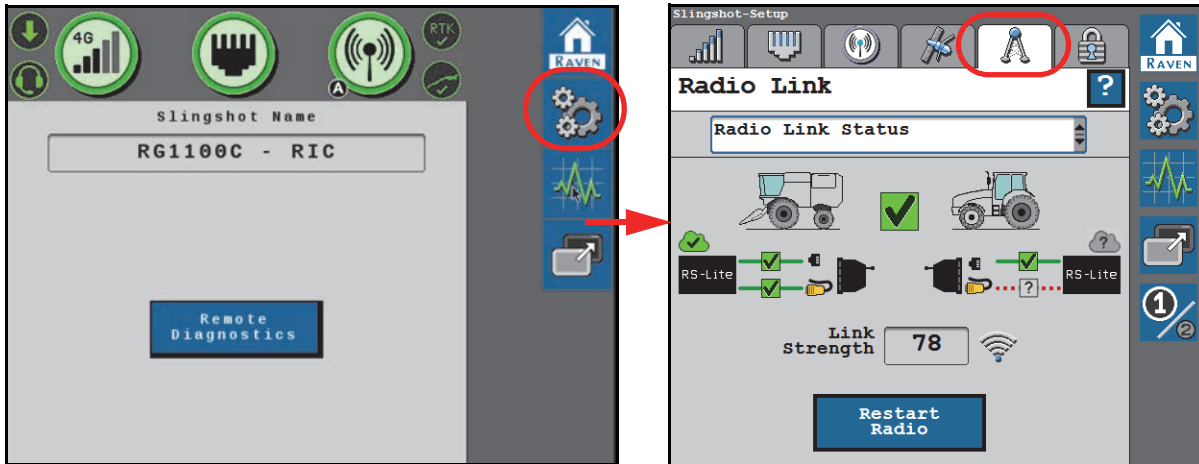
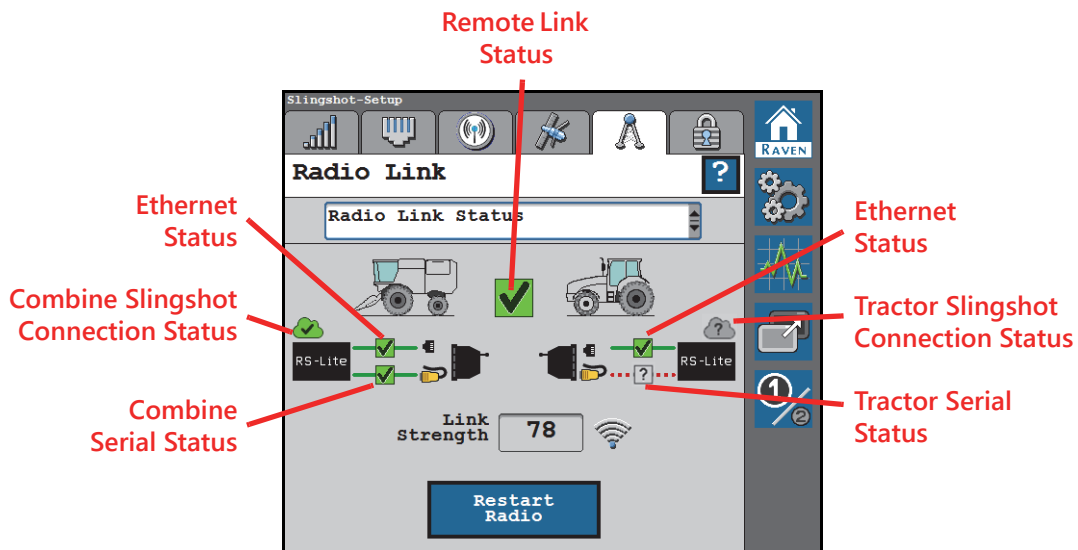


FIGURE 18. Link Status Page



Remote Link Status. The status of remote radio communication.

- Green - Communication between OMNi machines is good with an acceptable network delay.
- Red - Unable to communicate between OMNi machines or with an unacceptable network delay.

Combine and Tractor Slingshot Connection Status. The connection status of RS Lite to the Slingshot servers. The status of the Slingshot connection is displayed for each machine in the OMNi system.

- Green - Active connection.
- Red - No active connection.
- Gray - Cannot be determined.

NOTE: The Slingshot connection status may only display the correct status on the respective machine. The connection status may not display properly when viewing this page from the object pool on the synced machine.

Combine and Tractor Ethernet Status. The local and remote Ethernet status connections. Displays the connection between the RS Lite and radio on each OMNi machine.

- Green - RS Lite is connected with the local radio.
- Red - RS Lite cannot establish connection with the local radio.

Combine and Tractor Serial Line Status. The status of serial communication between the radio and RS Lite on the combine and the tractor.

- Green - communication good.
- Red - not receiving data or data period out-of-date.
- Gray - communication status cannot be determined.

NOTE: The serial line connection status may only display the correct status on the respective machine. The connection status may not display properly when viewing this page from the object pool on the synced machine.

Link Strength. The radio signal strength between OMNi machines. A value above 60 is recommended to continue OMNi operations.

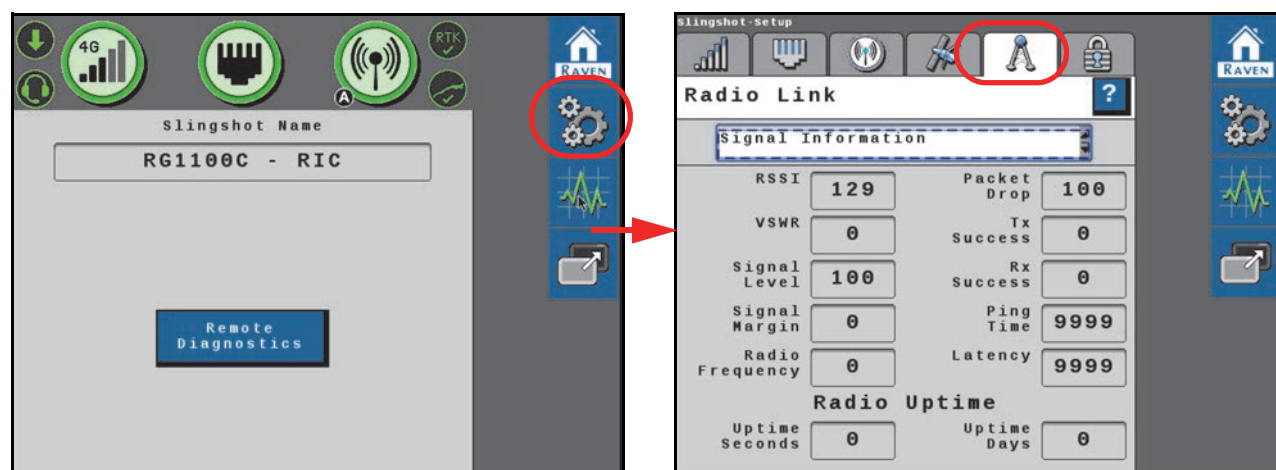
TABLE 2. Link Strength Values

Link Value	Description
≤ 30	Bad - OMNi system is non-functional.
30 to 60	Poor - OMNi may establish a connection, but system operation is very likely to be impacted.
$60 \geq$	Good - OMNi system connection is good and signal strength should not impact inter-machine operations.

Restart Radio. Select the Restart Radio button to re-initiate the radio connection between the OMNi machines.

SIGNAL INFORMATION

FIGURE 19. Signal Information Page



RSSI (Received Signal Strength Indicator). Displays the status of radio data.

- 129 - Data not present.

- 128 - Data cannot be parsed.
- Any other value indicates signal from the radio. Values closer to zero (0) indicate better signal strength.

Packet Drop. Count of instances when transmission was limited due to poor connection on the RF channel.

VSWR (Voltage Standing Wave Ratio). A voltage ratio measured from the last packet sent from the radio.

- ≥ 100 indicates a poor radio connection.
- 99 to 11 indicates a moderate radio connection.
- ≤ 10 indicates a good radio connection.

Tx (Transmit) Success. Percent of packets which were transmitted successfully.

Signal Level. Displays the decibel-milliwatts (dBm) of the last packet received via the radio.

NOTE: A value of 128 indicates that no packet has been received since statistics were cleared.

Rx (Receive) Success. Percent of packets successfully received.

Signal Margin. A value between 0 (zero) and 100 which indicates the difference between signal level and either the receive sensitivity or the noise level, whichever is higher. Higher values indicate a better margin.

Ping Time. Time, in milliseconds, to test the connection between the RS Lite and the local radio.

Radio Frequency. The radio operating frequency in MHz (mega-hertz).

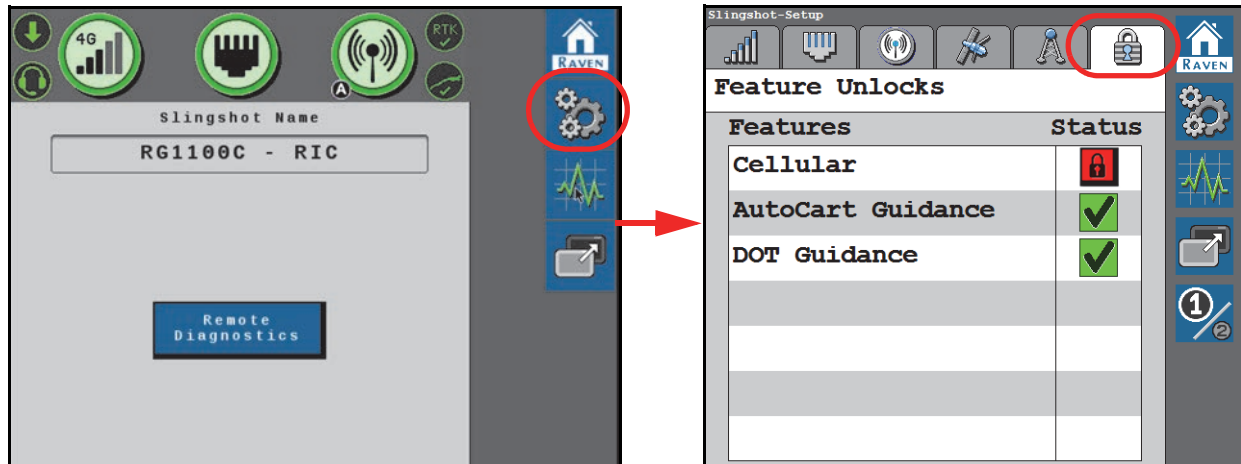
Latency. Time, in seconds, required to send a command and receive a response from the local radio.

Uptime Seconds. The number of seconds since the radio restarted minus the uptime days field.

Uptime Days. The number of days since the radio restarted.

FEATURE UNLOCKS

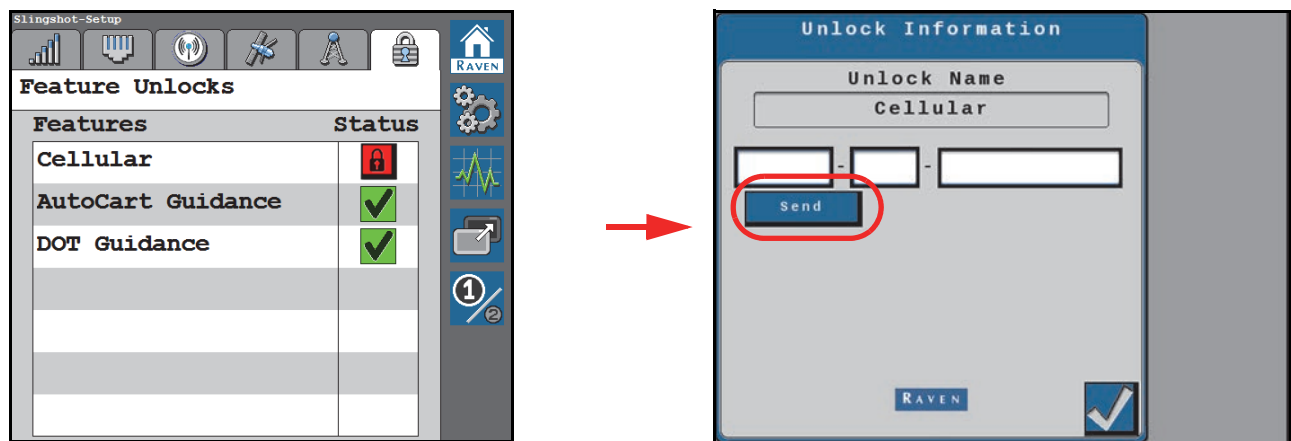
FIGURE 20. Feature Unlock Page



The integrated Slingshot modem is unlocked via the Feature Unlocks page. To unlock the Slingshot modem:

1. Select the **Feature Unlocks** tab.
2. Select the **Padlock** icon in the Status column.

FIGURE 21. Unlock Information Page

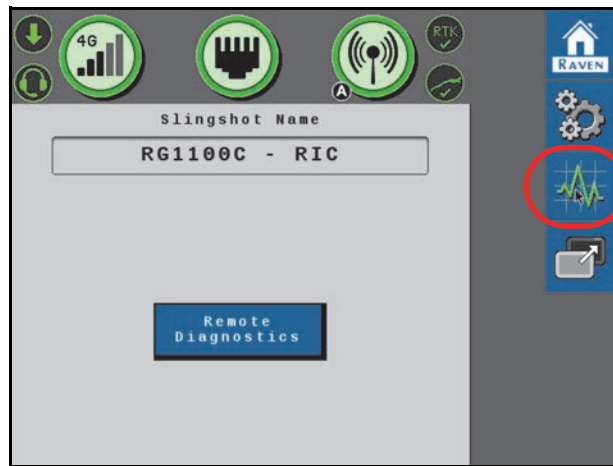


3. Enter the feature unlock code.
4. Select **Send**.

NOTE: Once the Slingshot modem is successfully unlocked, the icon next to the feature will turn green. If the code is invalid, a message will appear below the unlock code field.

SYSTEM INFORMATION

FIGURE 22. System Information Page



Select the desired system component from the second drop-down menu.

FIGURE 23. System Information Pages

RS1 Information

System Information

RS1 Information

Assembly Part Number	0630173820
Assembly Serial Number	23038
Assembly Revision	E
Assembly Software Version	22.3.1.19
Software Version Part Number	P0779000021

ECU Updates Field Update

GPS Receiver Information

System Information

GPS Receiver

Receiver Serial Number	BFN17103755
Receiver Model Number	D2LRPGTTNA
Software Version	OEM060700RN0000
GPS Board Type	OEM628-4.01
Receiver PAC	QV697:3351:4400

Steering Guidance Controller Information

System Information

Steering Guidance Controller

PCB Part Number	0640171365
PCB Revision	C
Software Part Number	0770171449
Software Version	1.1.0.001
Bootloader Version	3.0.1.1

Cell Modem Information

System Information

Cell Modem

Model Number	LE910-SVG
Firmware Version	17.01.571

RS1 Unit Hours

System Information

Hours

Version Hours (Powered On)	0.1
Version Hours (Engaged)	0.0
Lifetime Hours (Powered On)	1250.0
Lifetime Hours (Engaged)	3.3

RS1 Hardware Diagnostics

System Information

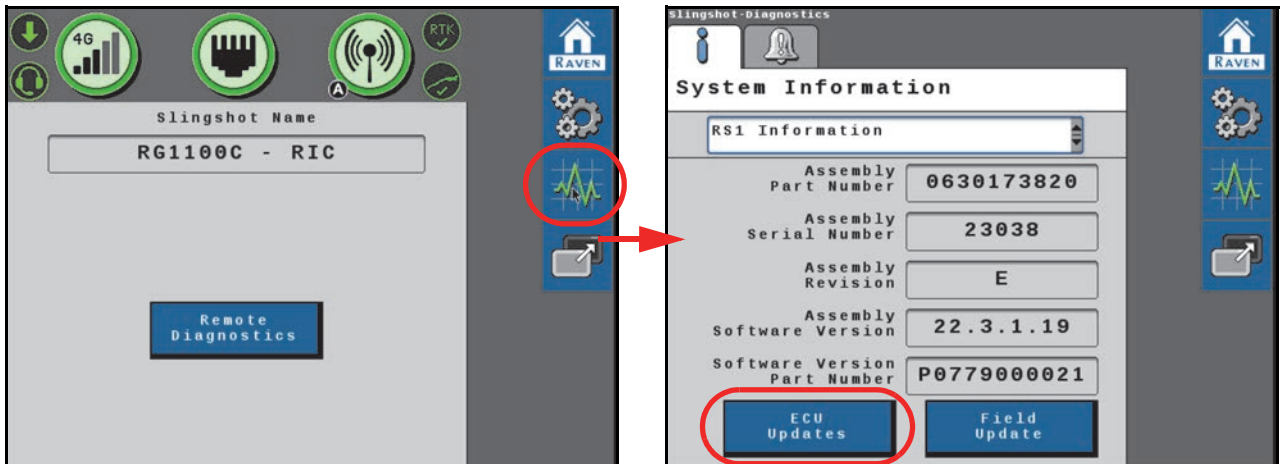
Hardware Diagnostics

ECU Voltage (V)	14.0	ECU Current (A)	0.670
5V Voltage (V)	4.9	4V Voltage (V)	3.7
HP 3.3V Voltage (V)	3.3	SOM 3.3V Voltage (V)	3.2
Boost Current (A)	0.610	SOM Temp (C)	31.0
STM32 Temp (C)	39.0		

ECU UPDATES

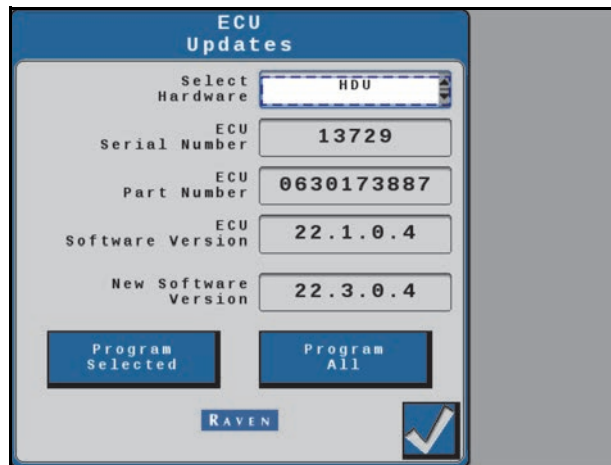
1. From the Slingshot working set home page, select the **Diagnostics** button.
2. On the System Information tab, select the RS1 Information option in the drop-down.
3. Select the **ECU Updates** button at the bottom of the page.

FIGURE 24. System Information Page



4. If any updates are available for ECUs connected to the ISOBUS, use the drop-down list at the top of the page to review version information for each device as desired.

FIGURE 25. ECU Updates Page

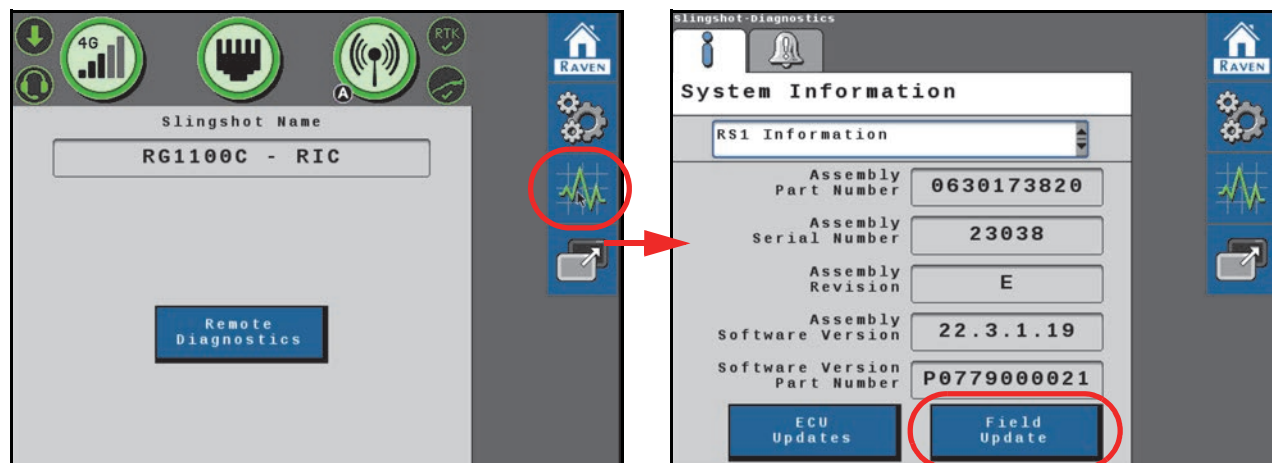


5. Select the **Program Selected** button at the bottom of the page to program the specific ECU displayed on the page. Select the **Program All** button to begin the update process for all ECUs which have updates available.

FIELD UPDATES

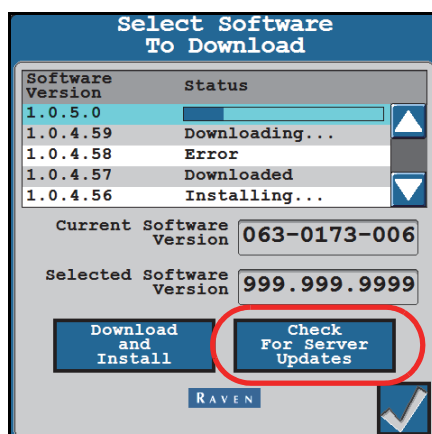
1. From the Slingshot working set home page, select the **Diagnostics** button.
2. On the System Information tab, select the RS1 Information option in the drop-down.
3. Select the **Field Update** button at the bottom of the page.

FIGURE 26. System Information Page



4. Select the **Field Update** button to view the latest software updates for the RS1 unit.

FIGURE 27. Software Download Page



5. Select **Check for Server Updates**.

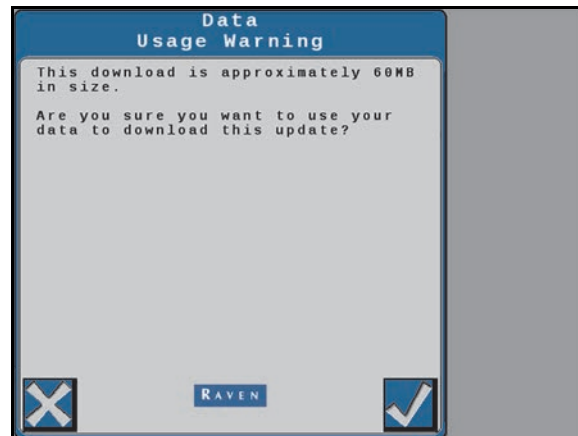
NOTE: This will search the RS1 system for the latest software updates.

6. Select the desired software update from the list.
7. Select **Accept**.

NOTE: The software is downloaded to the RS1 unit, but is not installed in the system until later in the procedure.

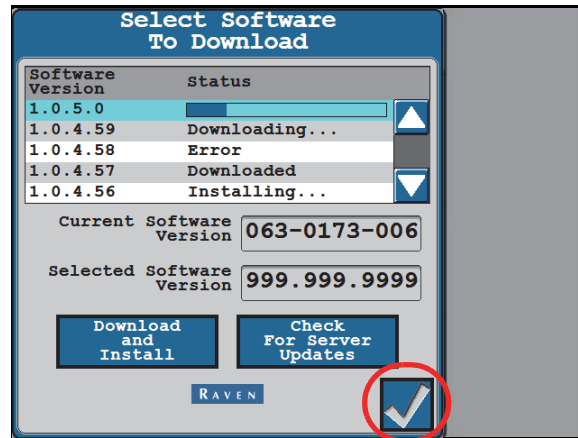
NOTE: When the button is pressed, the following warning prompt is displayed notifying the user that cellular data will be used to download the software and asks if the user would like to proceed with the download.

FIGURE 28. Data Usage Warning Page



NOTE: Select Cancel to exit the field update without performing a software update.

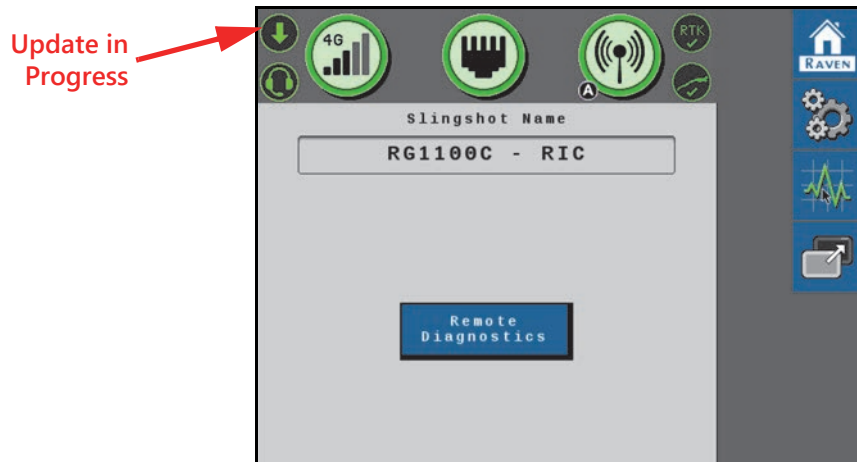
FIGURE 29. Software Update Notice



8. Press **Accept** to begin the software download.

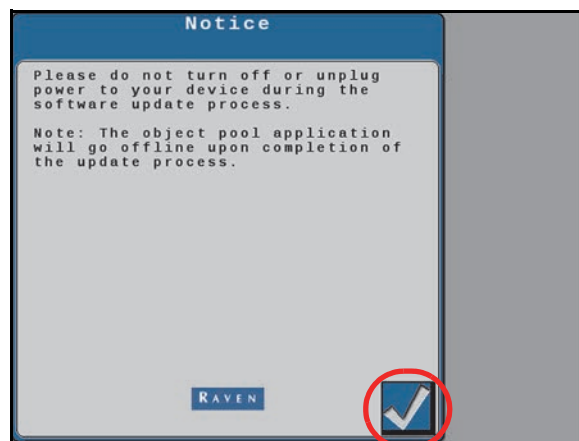
NOTE: A status icon will be displayed on the Slingshot home page when an update is in progress.

FIGURE 30. Slingshot Home Page



9. Wait for the software download to be completed.

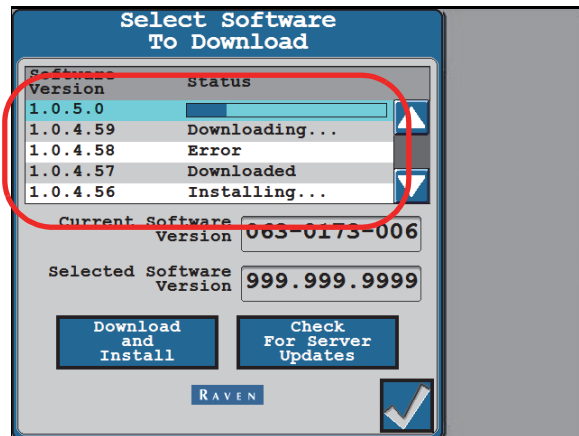
FIGURE 31. Software Update Notice



10. Press **Accept** to install the software.

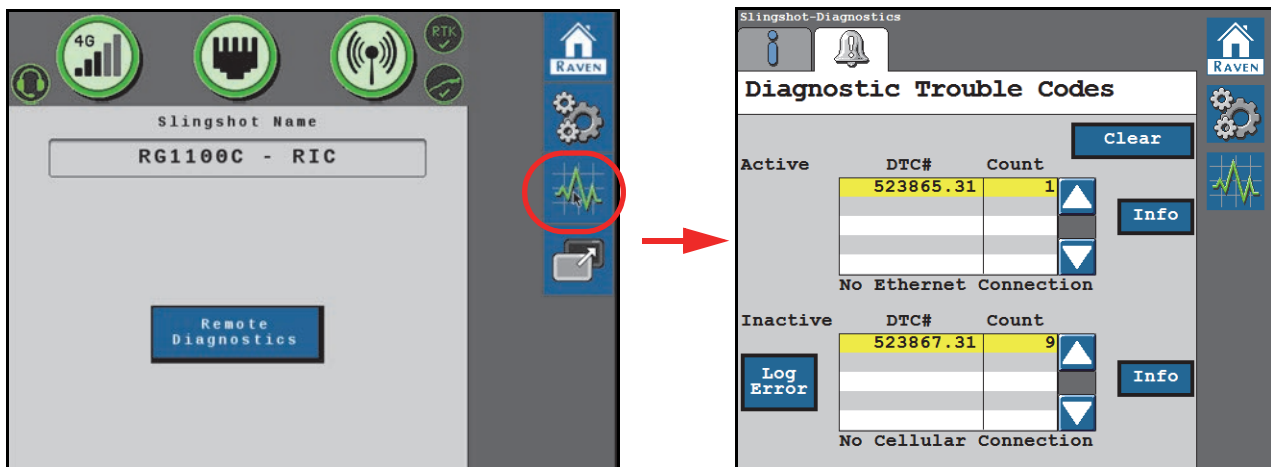
NOTE: Do not power off the RS1 or field computer during the software update.

FIGURE 32. Software Installation in Progress



DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 33. Diagnostic Trouble Codes Page



The Diagnostic Trouble Code page displays active and past diagnostic trouble codes (DTCs) that occur during RS1 system operation. Active DTCs must be fixed before the RS1 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 3 for an example of DTCs and DTC summaries.

FIGURE 34. Diagnostic Trouble Codes Page

Diagnostic Trouble Codes Page

Active

DTC#	Count
523865.31	1

No Ethernet Connection

Inactive

DTC#	Count
523867.31	9

No Cellular Connection

Diagnostic Trouble Code (DTC)

DTC Summary

NOTE: In Figure 34 on page 105 above, inactive DTC is 2.01 and the DTC summary is "No Ethernet Connection."

- Pressing the **Info** button displays the complete description of the highlighted active DTC.
- Pressing **Clear** deletes the inactive DTCs from the Inactive DTC error log.

The diagrams contained in this chapter may be helpful when installing or troubleshooting the RS1 system. Some of the diagrams may show optional features or components not required for RS1 operation and may not necessarily apply to the system installed on the machine.

NOTE: Contact your local Raven dealer for ordering information on any optional features or components.

Additional system diagrams are available on the Raven Industries web site:

<https://portal.ravenprecision.com/>

FIGURE 1. RS1 with Viper 4 and MDU Gen 3 Cabling (D/N 054-5030-200)

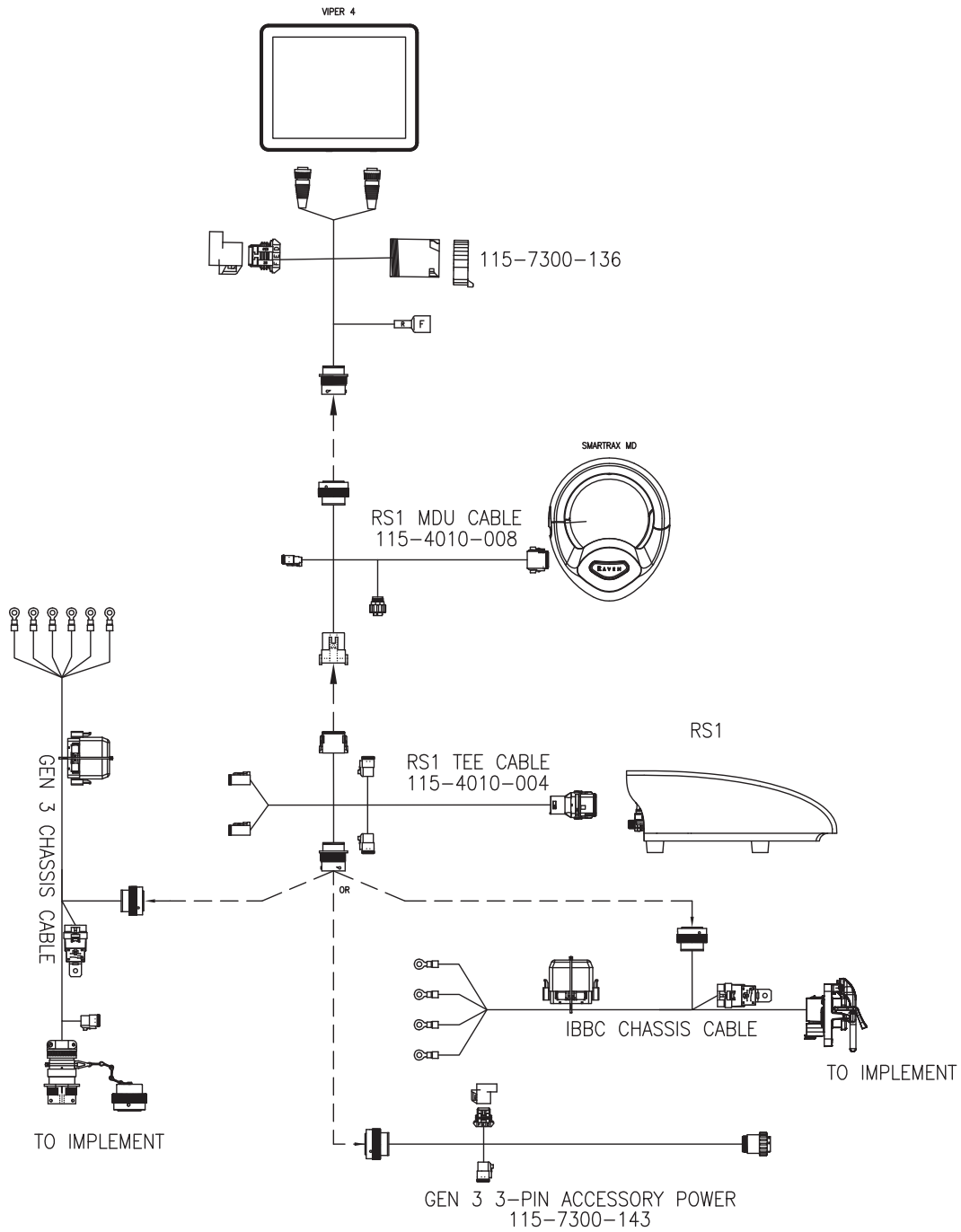
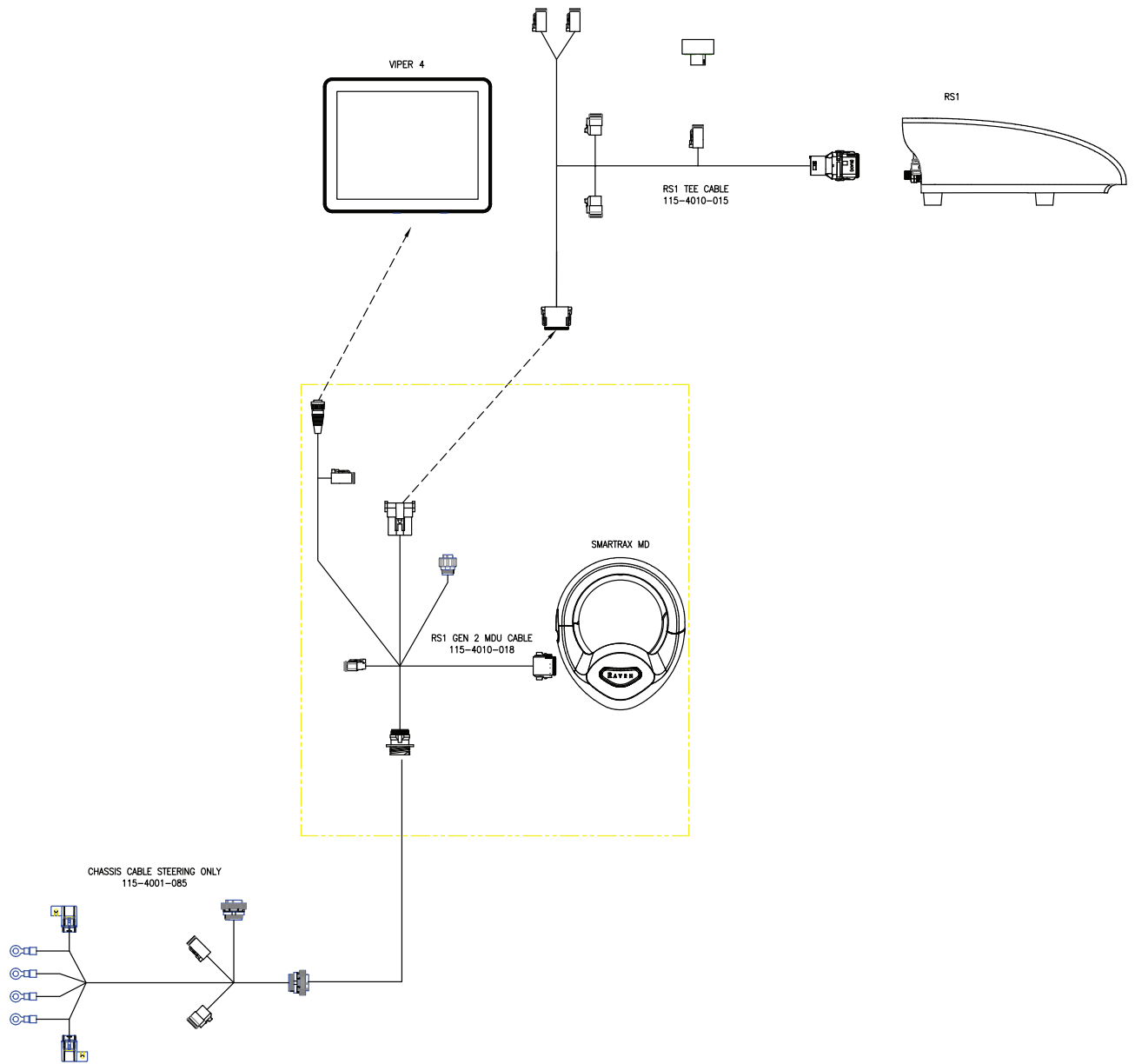


FIGURE 2. RS1 with Gen II Cabling and MDU



CHAPTER 13

CERTIFICATION AND COMPLIANCE

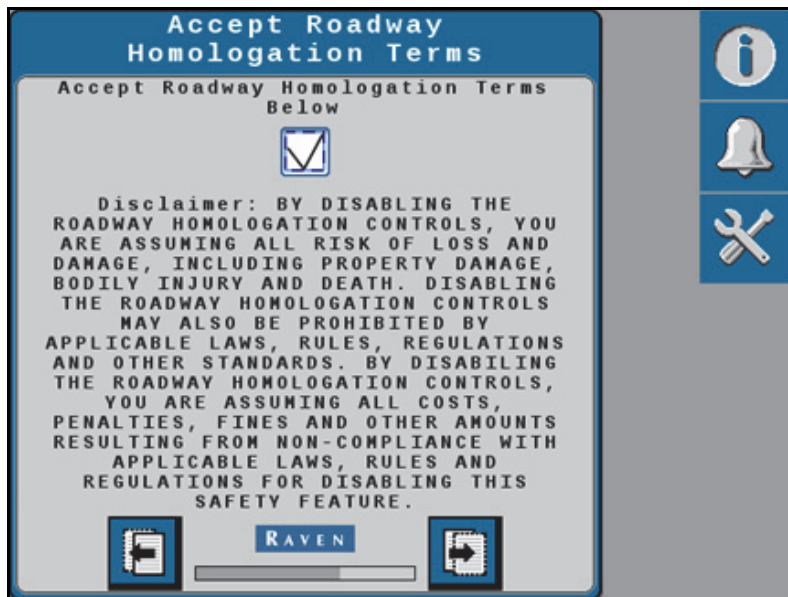
ROADWAY HOMOLOGATION

The Accept Roadway Homologation Terms page will be displayed during the initial calibration of the RS1 system in either of the following conditions:

- Operating with a generic tune-set
- Operating on the European continent

Carefully review the on-screen disclaimer before proceeding.

FIGURE 1. Roadway Homologation



When roadway homologation is accepted (checkbox enabled), the following parameters will be applied to RS1 operation:

- An operator presence method will be required while operating with the RS1 auto-steering system enabled.
- Auto-steering cannot be enabled above 16.1 km/h [10 mph].
- Auto-steering will disengage above 19.3 km/h [12 mph].


NOTE: To engage and operate with autosteering higher than the limits above, review the disclaimer on the page and do not accept the homologation terms.

CERTIFICATIONS

NOTE: The Raven RS1/SC1 system is an approved steering system per the requirements of 2009/66/EC, § 38 StVZO (EU) 2015/208 IV and V incl. all amendments up to (EU) 2015/208. By GTÜ No. GTÜ 2015/208/V-19002.00.

A copy of the full report may be requested by contacting Raven Europe.

FIGURE 2. Certification Test Report

Test Report / Prüfbericht		
No. / Nr. : GTÜ 2015/208/V-19002.00		
Type / Typ	: RS1/SC1	
Manufacturer / Hersteller	: Raven Europe	

9. Certification / Schlussbescheinigung

The system as mentioned under no. 1. and 2. is in compliance with the test specification mentioned above. /

Das unter Nr. 1. und 2. beschriebene System - entspricht - der o. a. Prüfspezifikation.

With regard to the required level of performance to be achieved, the tested items were representative for the type to be validated.

Die verwendeten Prüfmuster waren im Hinblick auf das erforderliche Leistungsniveau für den zu beurteilenden Typ repräsentativ.

This Test Report comprises pages 1 to 16 and attachments. The Test Report shall be reproduced and published in full only and by the client only. It shall be reproduced partially with the written permission of the Test Laboratory only.


Dieser Prüfbericht umfasst Blatt 1 bis 16 sowie die Anlagen. Dieser Prüfbericht darf nur vom Auftraggeber und nur in vollem Wortlaut vervielfältigt und weitergegeben werden. Eine auszugsweise Vervielfältigung und Veröffentlichung des Prüfberichtes ist nur nach schriftlicher Genehmigung des Prüflaboratoriums zulässig.

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Bundesrepublik Deutschland.*

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Registration number / Registrier-Nr.
KBA-P 00077-09

Document / Page / Seite:
Dokument: 16 of / von 16
Rev. 04

SAFETY NOTES

- The system "RS1/SC1" can be installed by authorized dealers / workshops only.
- Before driving on public roads:
 - the "RS1/SC1" has to be switched off by the master switch.
 - the monitor must be mounted outside of the required visibility of the driver.

ANATEL COMPLIANCE STATEMENT

NOTE: RS1 units with part number 063-0173-922 include the following compliant modules.

Este produto contém a placa CC IMX6 código de homologação Anatel 02268-19-01209.

Este produto contém a placa Skywire código de homologação Anatel 00014-16-10218.

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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.

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.

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.