

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

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. F
- Any comments or feedback (include chapter or page numbers if applicable).
- Let us know how long have you been using this or other Raven products.

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

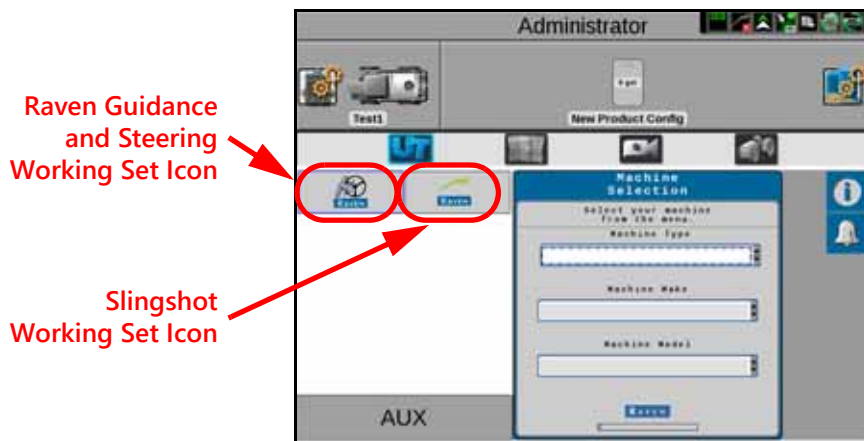
Thank you for your time.

CHAPTER 3

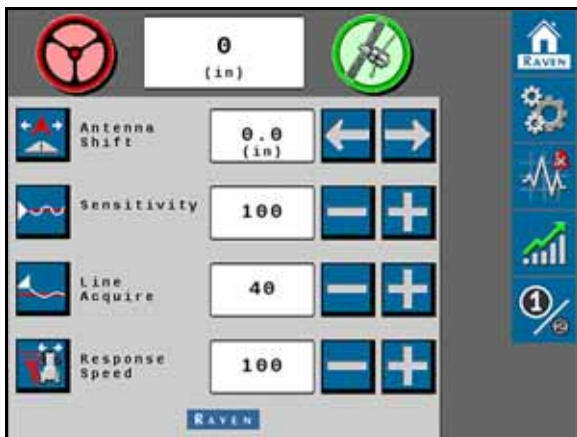
CALIBRATION - HDU-SPECIFIC, MD, AND STEERING-READY

INTRODUCTION

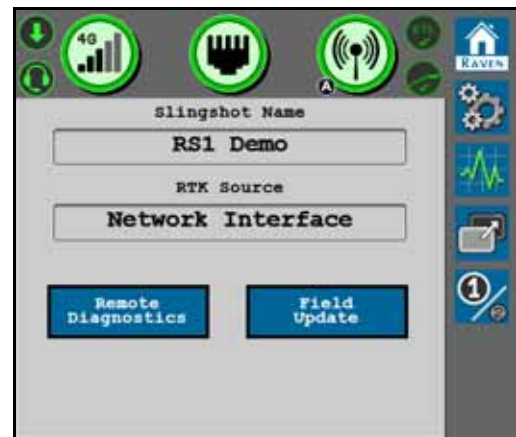
FIGURE 1. Home Screen



Guidance and Steering
Software Home Screen



Slingshot Software
Home Screen



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 Screen



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 screen will appear each time a steering partner is registered with the RS1.

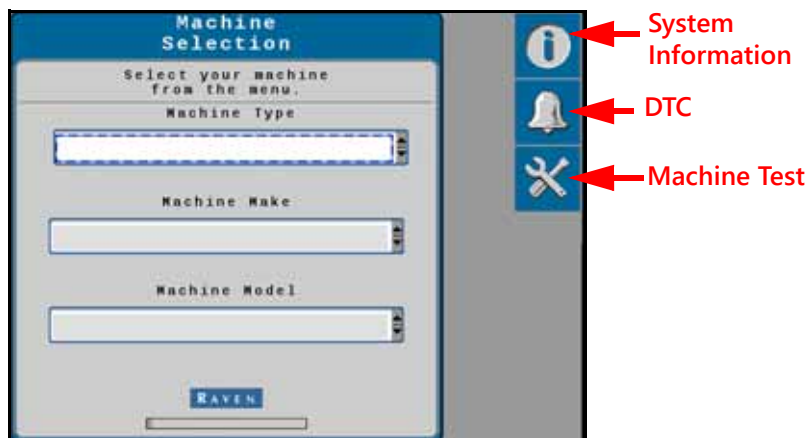
GPS AND STEERING CALIBRATION

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

- "System Information" on page 67
- "Diagnostic Trouble Codes (DTC)" on page 62
- "System Information" on page 67

GPS CALIBRATION

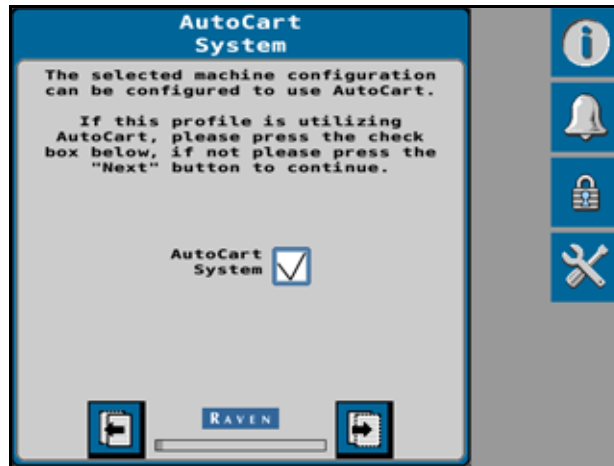
FIGURE 3. Machine Selection Screen



1. Select the Machine Type, Machine Make, and Machine Model from the Machine Selection drop-down boxes.

2. Enable the AutoCart System feature to allow an RS Lite device to connect to an AutoCart system.

FIGURE 4. AutoCart System Enable Screen



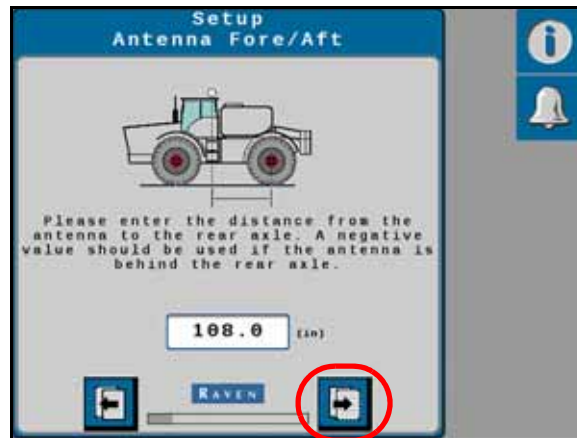
NOTE: The AutoCart System page will only display when calibrating an RS Lite with a compatible tractor or any combine machine type.

FIGURE 5. Steering Configuration Screen



3. 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
4. Select the **Next** arrow.

FIGURE 6. Antenna Fore/Aft Screen



5. 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.

6. Select the **Next** arrow.

FIGURE 7. Antenna Center Offset Screen

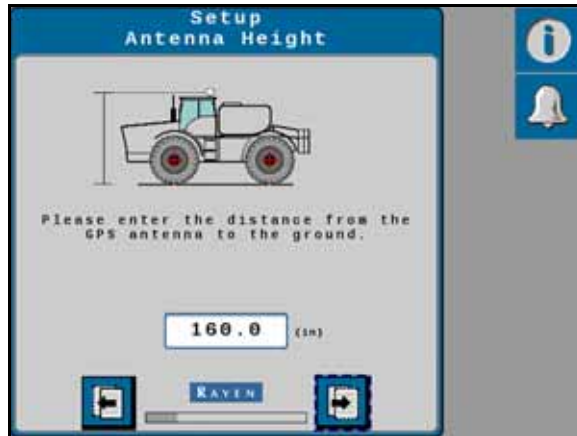


7. Select the value box to enter the Antenna Center Offset position.

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.

8. Select the **Next** arrow.

FIGURE 8. Antenna Height Screen



9. 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.

10. Select the **Next** arrow.

FIGURE 9. Wheel Base Screen



11. 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.

12. Select the **Next** arrow.

FIGURE 10. GPS Differential Configuration Screen



13. 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.

14. Select the **Next** arrow.

FIGURE 11. Position Accuracy Screen



15. Select the **Next** arrow.

TERRAIN COMPENSATION CALIBRATION

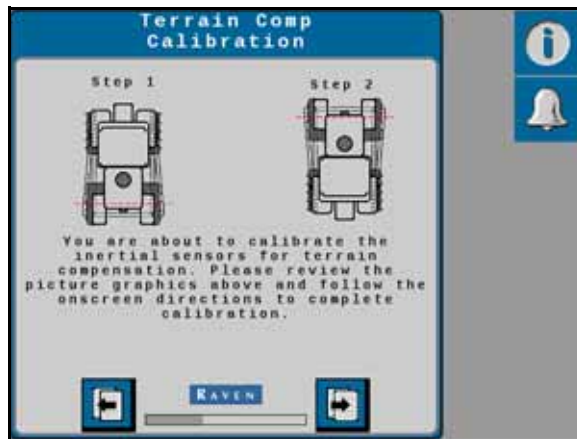
FIGURE 12. Terrain Compensation Calibration Wizard



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

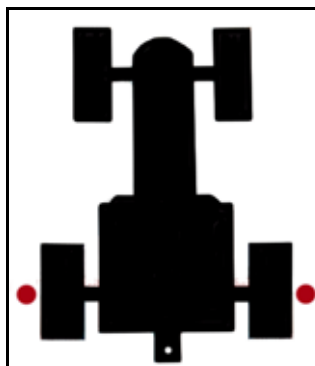
NOTE: The system must detect a converged GPS status with a green shield and a forward motion prior to calibration to determine which direction is forward.

FIGURE 13. Terrain Compensation Calibration Wizard



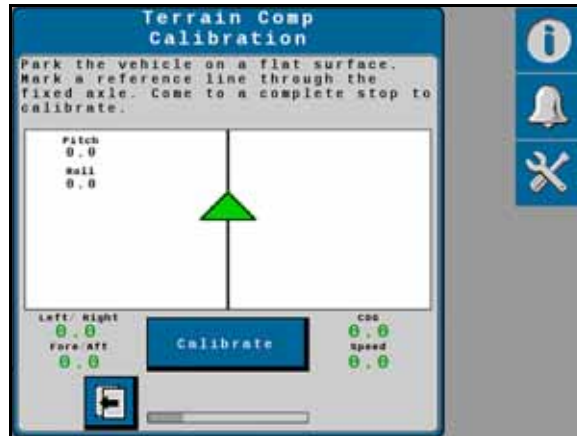
2. Follow the on-screen instructions to begin the calibration process.

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 Screen



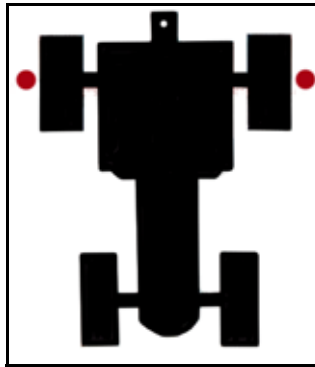
4. Select **Calibrate** to begin the calibration process. The following screen will appear:

FIGURE 16. Terrain Comp Calibration Screen



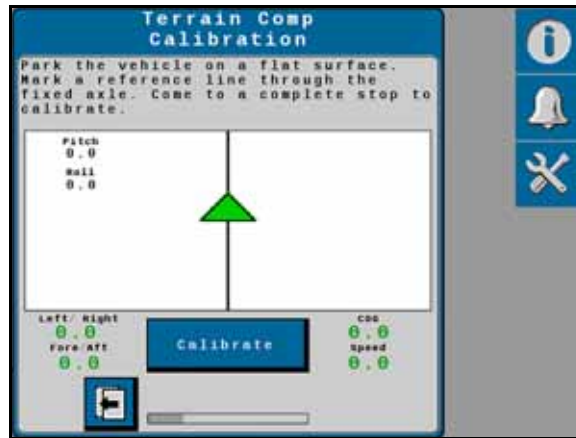
5. Wait for the calibration process to be completed before moving the vehicle.

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 Screen



7. Select **Calibrate**. Once the calibration is complete the following screen will appear.

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

RESUME/DISENGAGE CALIBRATION

FIGURE 20. Resume Switch Verification Screen



1. Press the resume switch.

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

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

FIGURE 21. Disengage Calibration Screen



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

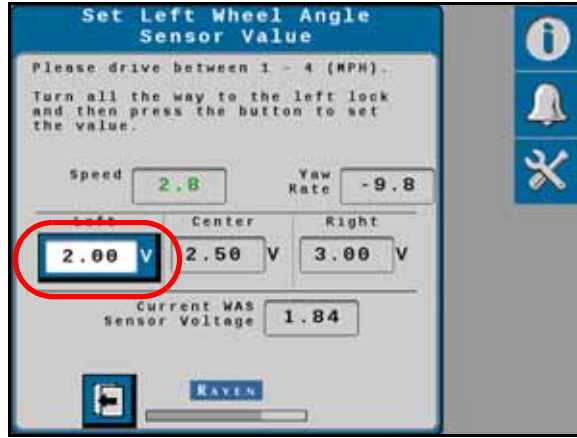
NOTE: The Disengage Status indicator will turn red while the steering wheel is being turned and will advance to the next screen once calibration is complete.

NOTE: If a pressure transducer or encoder is being used, a screen 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.

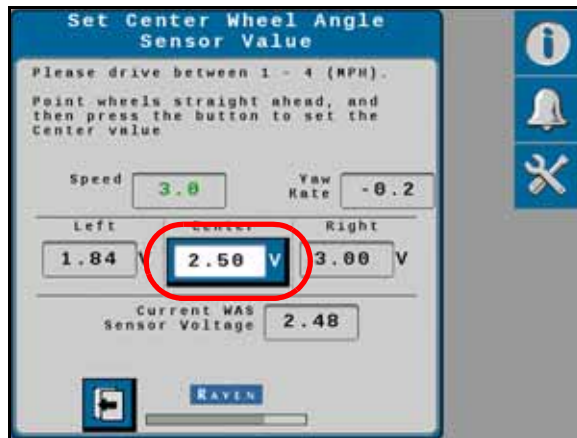
FIGURE 22. Left Wheel Angle Sensor Calibration (WAS) Screen



1. Drive forward between 1 - 4 mph [1.6 - 6.4 km/h].
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 screen advances to the Center WAS setting.

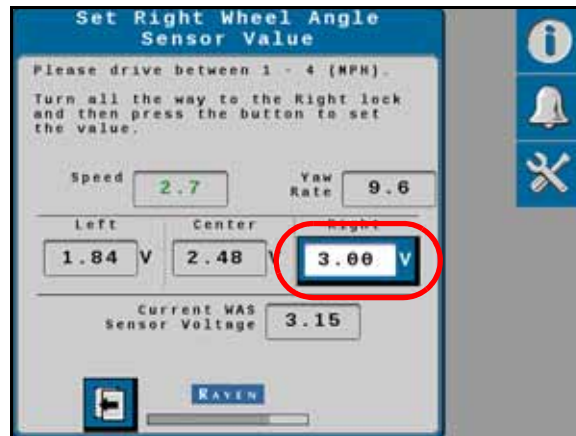
FIGURE 23. Center WAS Calibration Screen



4. Drive forward between 1 - 4 mph [1.6 - 6.4 km/h] 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 screen advances to the Right WAS setting.

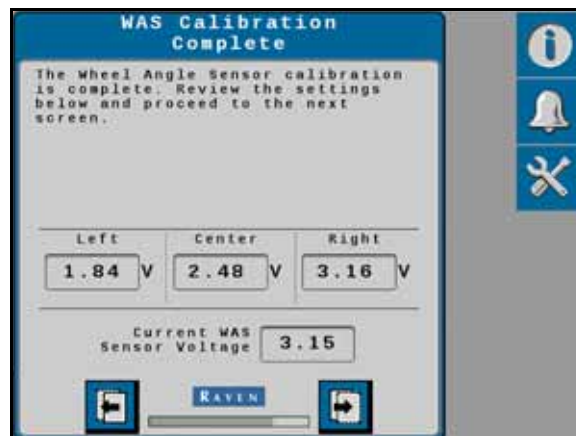
FIGURE 24. Right WAS Calibration Screen



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

FIGURE 25. Calibration Complete Screen



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
	<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

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.

If the ground or surface is slippery, muddy, or freshly tilled, the RS1 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 system.

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 62 for possible causes and corrective action steps to be taken.

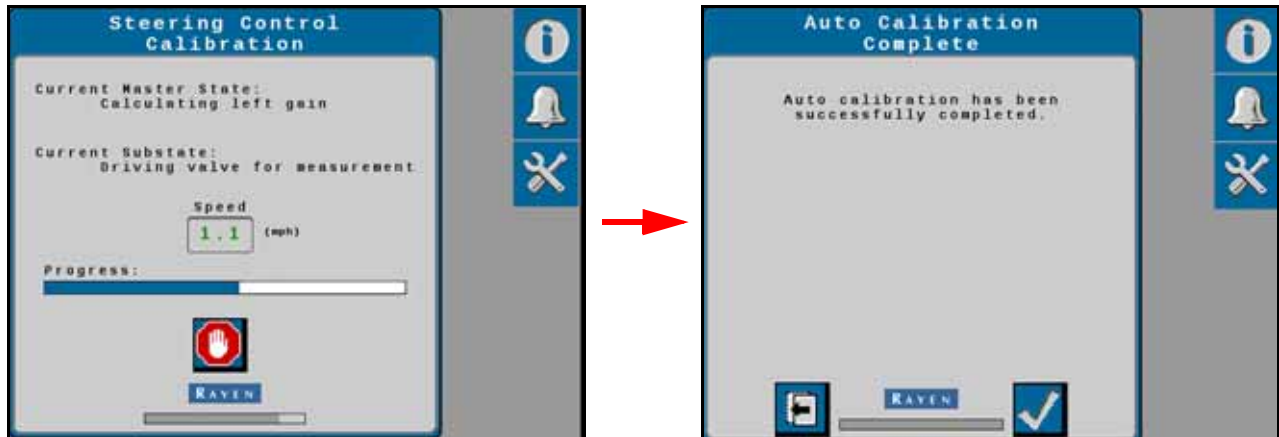
1. Park the machine on a level surface with several acres of smooth ground available.

FIGURE 26. Steering Control Calibration Screen



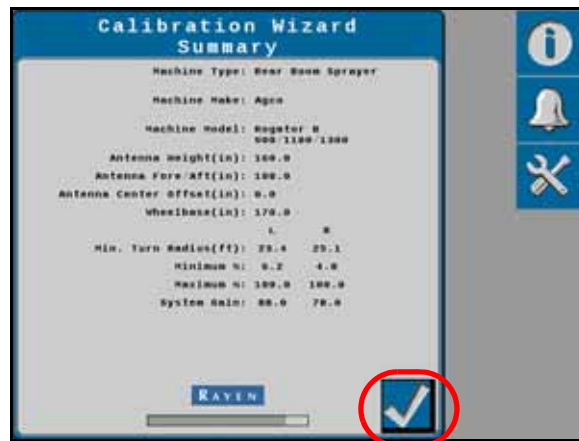
2. Drive forward at 1 - 4 mph [1.6 - 6.4 km/h].
3. Press the resume switch or use the on-screen arrow to begin calibration. The following screens will be displayed during the process:

FIGURE 27. Calibration in Process Screens



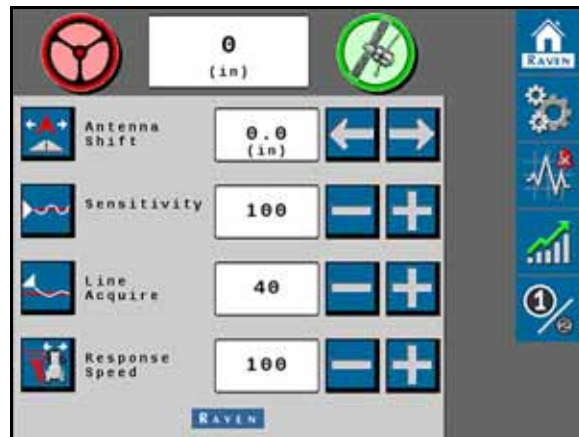
- Once the calibration process is complete, press the **Next** arrow.

FIGURE 28. Calibration Complete Screen



- Review the Calibration Wizard Summary.
- Press **Accept**.

FIGURE 1. Home Screen



- **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.

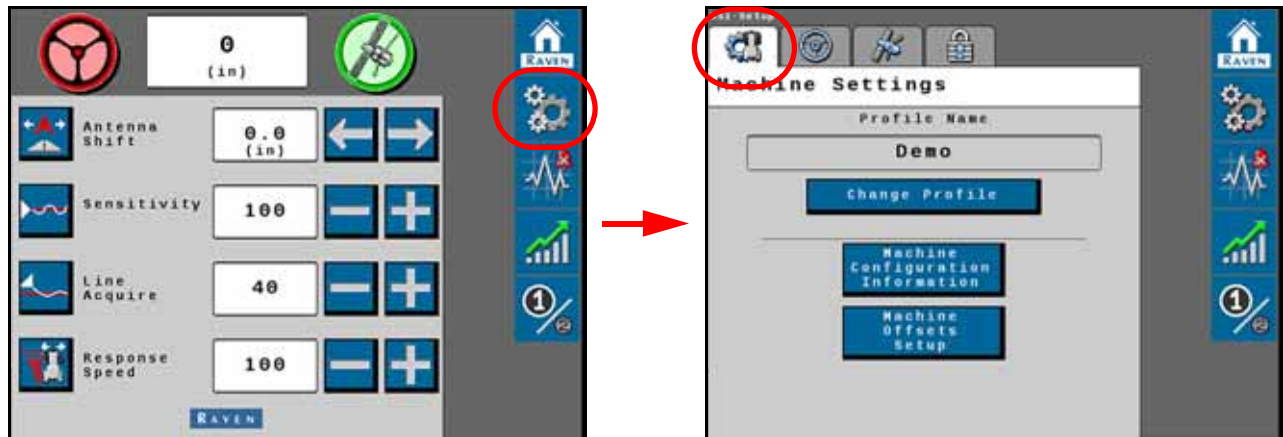
NOTE: If steering becomes jittery, lower the Response Speed value in increments of 10. If steering does not become jittery, the Response Speed value may be increased in increments of 10 until the desired Response Speed is reached.

- **Last Pass Sensitivity** - 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.

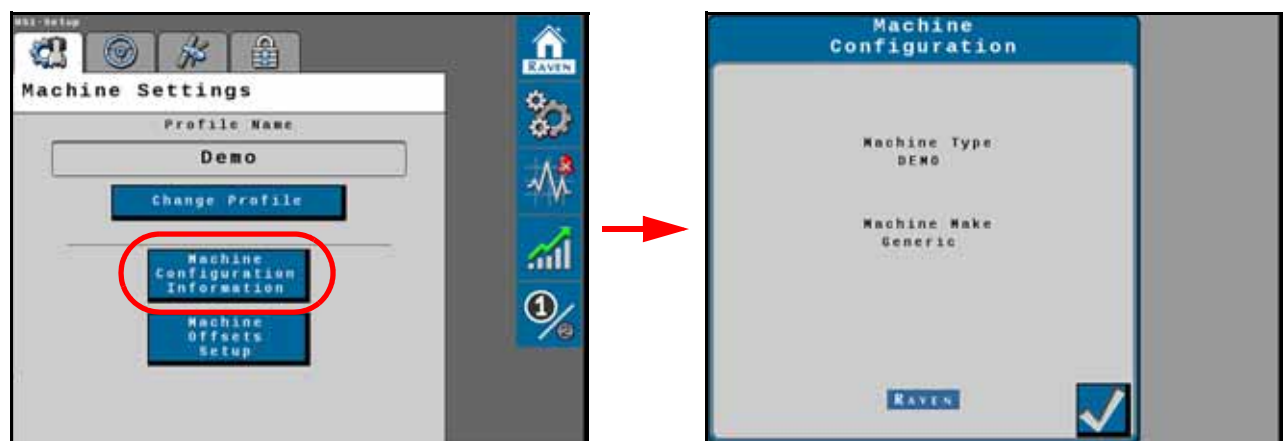
Adjusting the Last Pass Sensitivity value will not affect pivot performance. To adjust pivot performance, adjust the Response Speed and Sensitivity values.

FIGURE 1. Machine Settings Screen



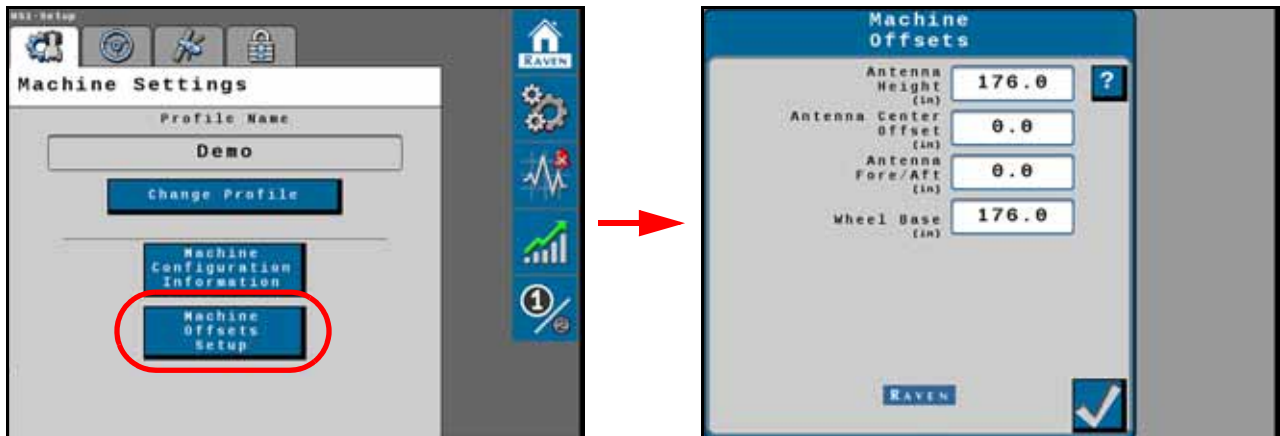
The Machine Settings screen displays the machine-specific measurements that were entered during the system calibration.

FIGURE 2. Machine Configuration Screen



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

FIGURE 3. Machine Offsets Setup Screen



- **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.


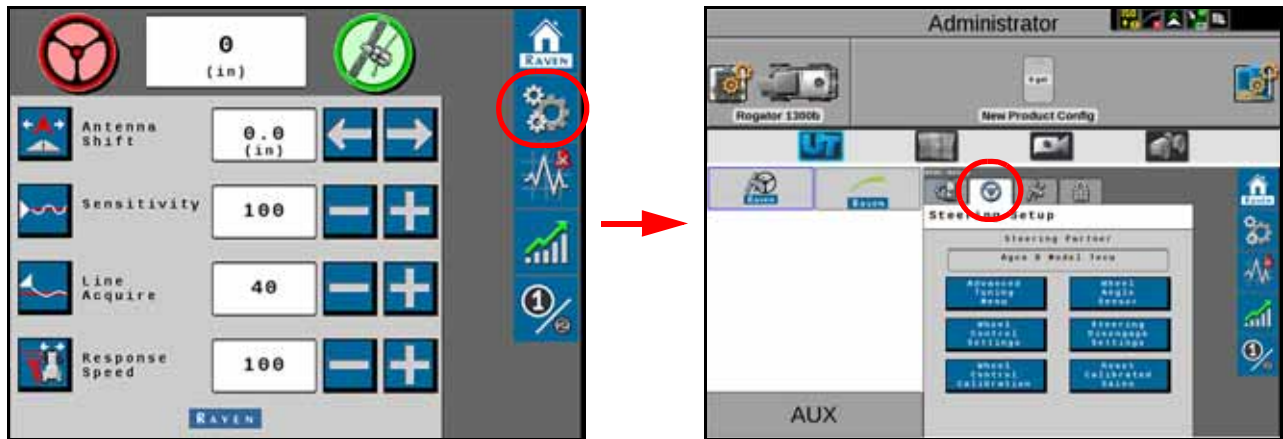
- **Help Menu Icon**  - Pressing the Help Menu icon displays the Help Menu. The Help Menu contains additional information about the settings contained within that screen.

FIGURE 1. Steering Setup Screen

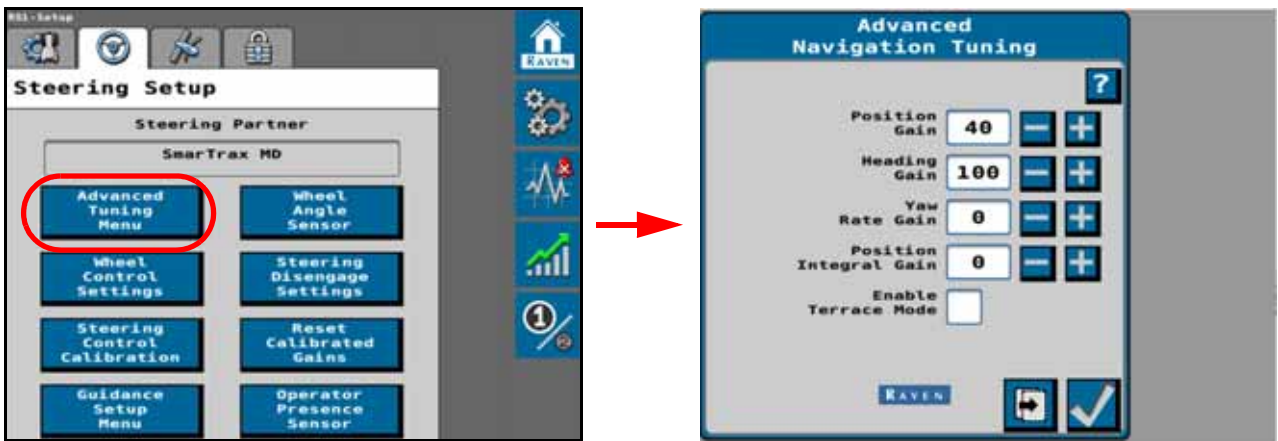


The Steering Setup screen displays the steering partner that the RS1 unit communicates with during steering operation. The Steering Setup screen contains the functions that allow the operator to fine-tune the steering system.

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

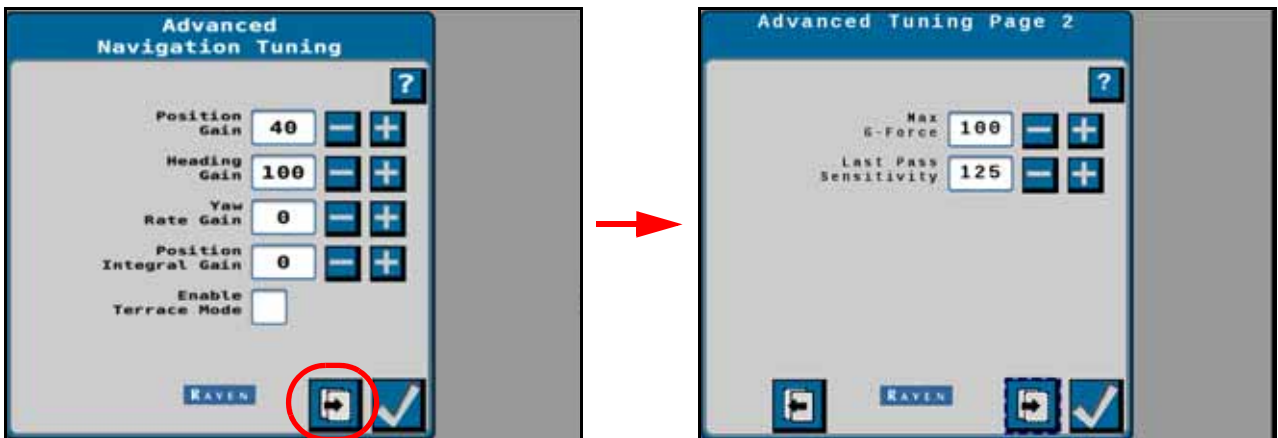
ADVANCED TUNING

FIGURE 2. Advanced Tuning Menu



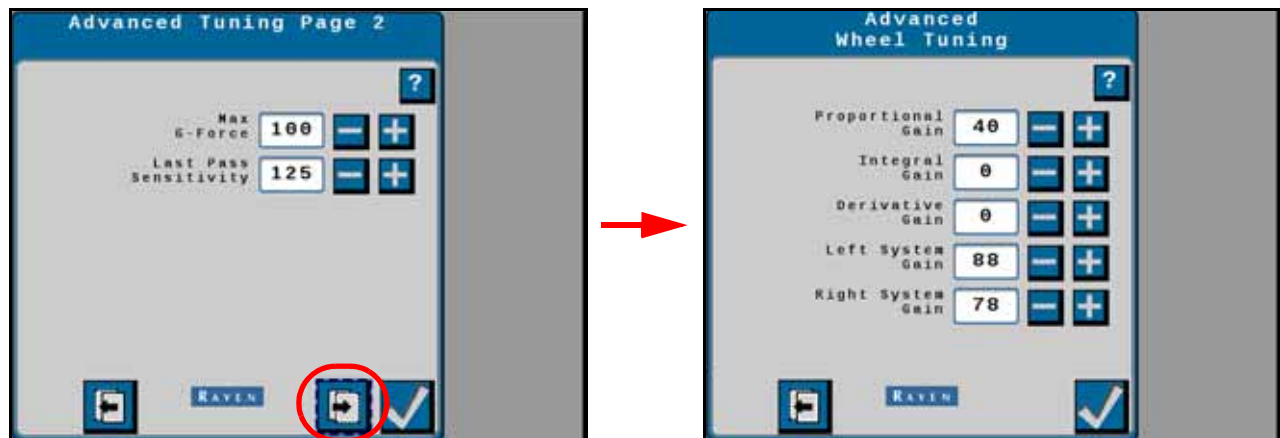
- **Position Gain** - Determines how aggressively the RS1 system responds to an off-track error. A higher Position Gain value results in a more aggressive response to an off-track error, while a lower value indicates a less aggressive response.
- **Heading Gain** - Determines how aggressively the RS1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

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.

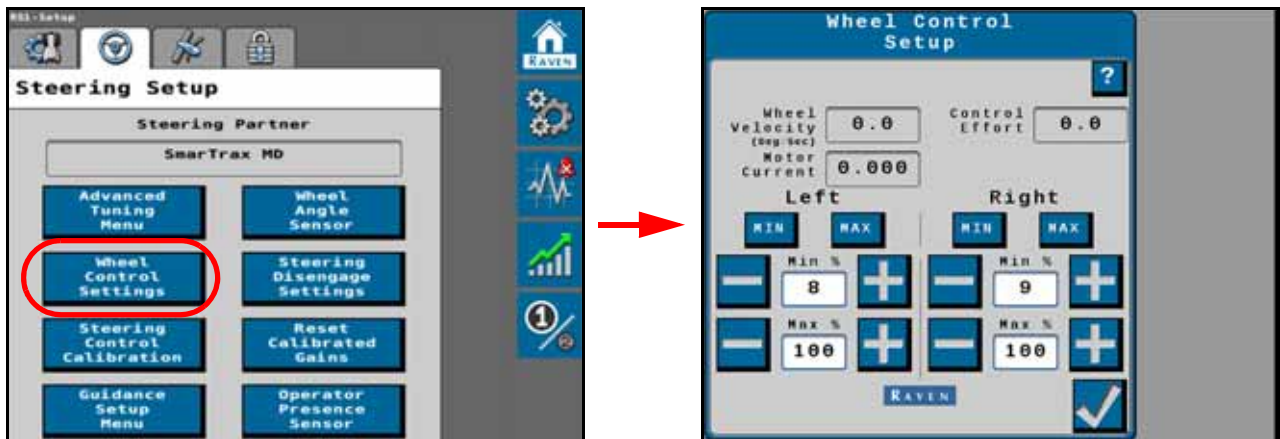
FIGURE 4. Advanced Wheel Tuning Screen



- **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 CONTROL SETTINGS

FIGURE 5. Wheel Control Setup Screen



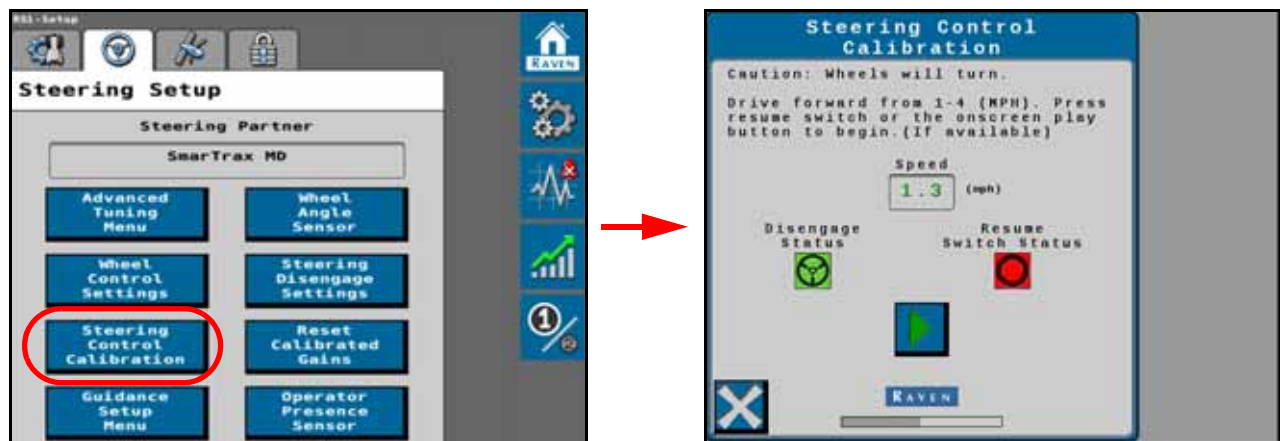
- **Wheel Velocity** - The speed at which the wheels are moving, measured in degrees per second.
- **Control Effort** - The amount of effort the RS1 system is using to drive the wheels.
- **Left/Right Min** - The minimum Control Effort that the machine valve must use to turn the wheels. Values range 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 screen.

WHEEL CONTROL CALIBRATION

FIGURE 6. Wheel Control Calibration Screen




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

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.



NOTICE

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.

If the ground or surface is slippery, muddy, or freshly tilled, the RS1 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 system.

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 11, *Diagnostics and Troubleshooting* on page 57 for possible causes and corrective action steps to be taken.

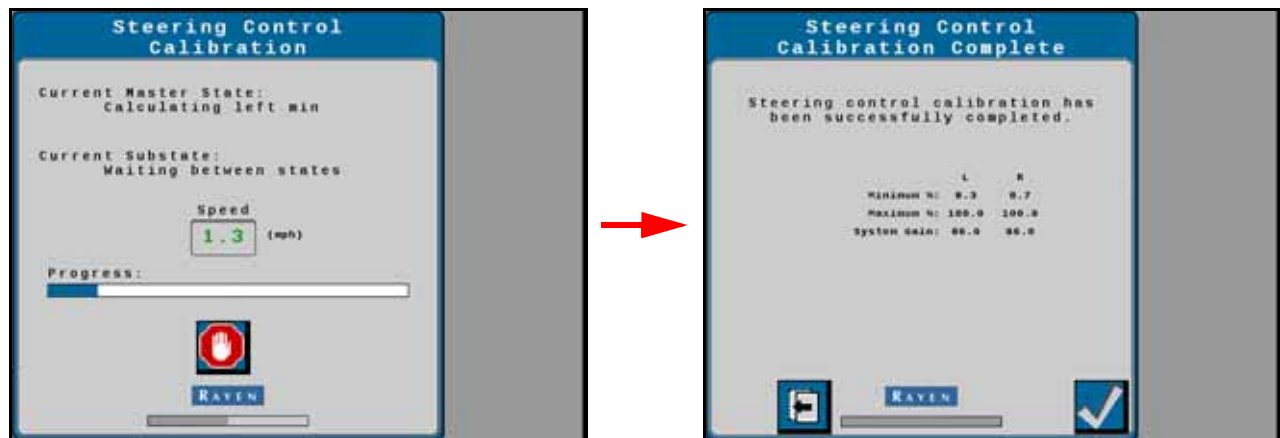
1. Park the machine on a level surface with several acres of smooth ground available.

FIGURE 7. Steering Control Calibration Screen



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

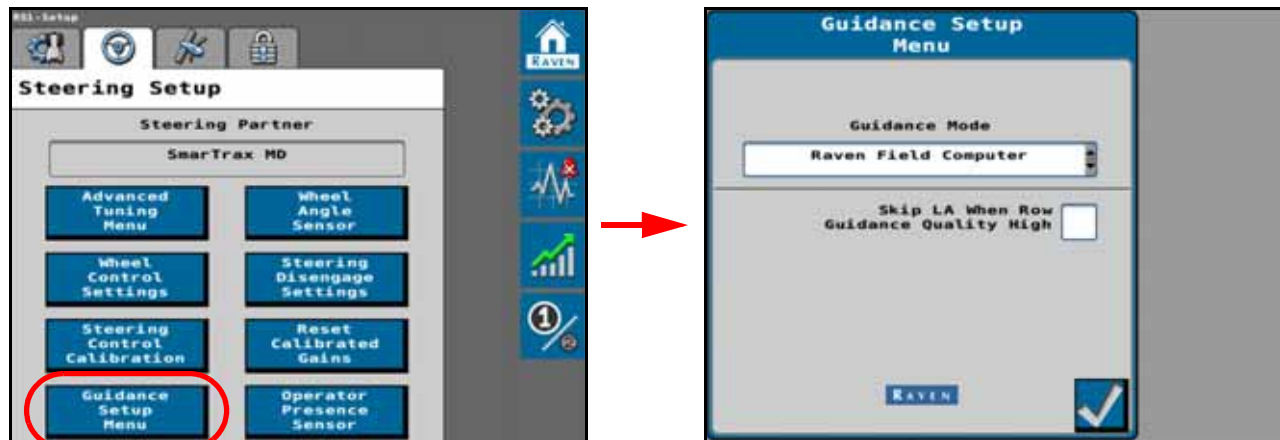
FIGURE 8. Calibration in Process Screens



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

GUIDANCE SETUP SETTINGS

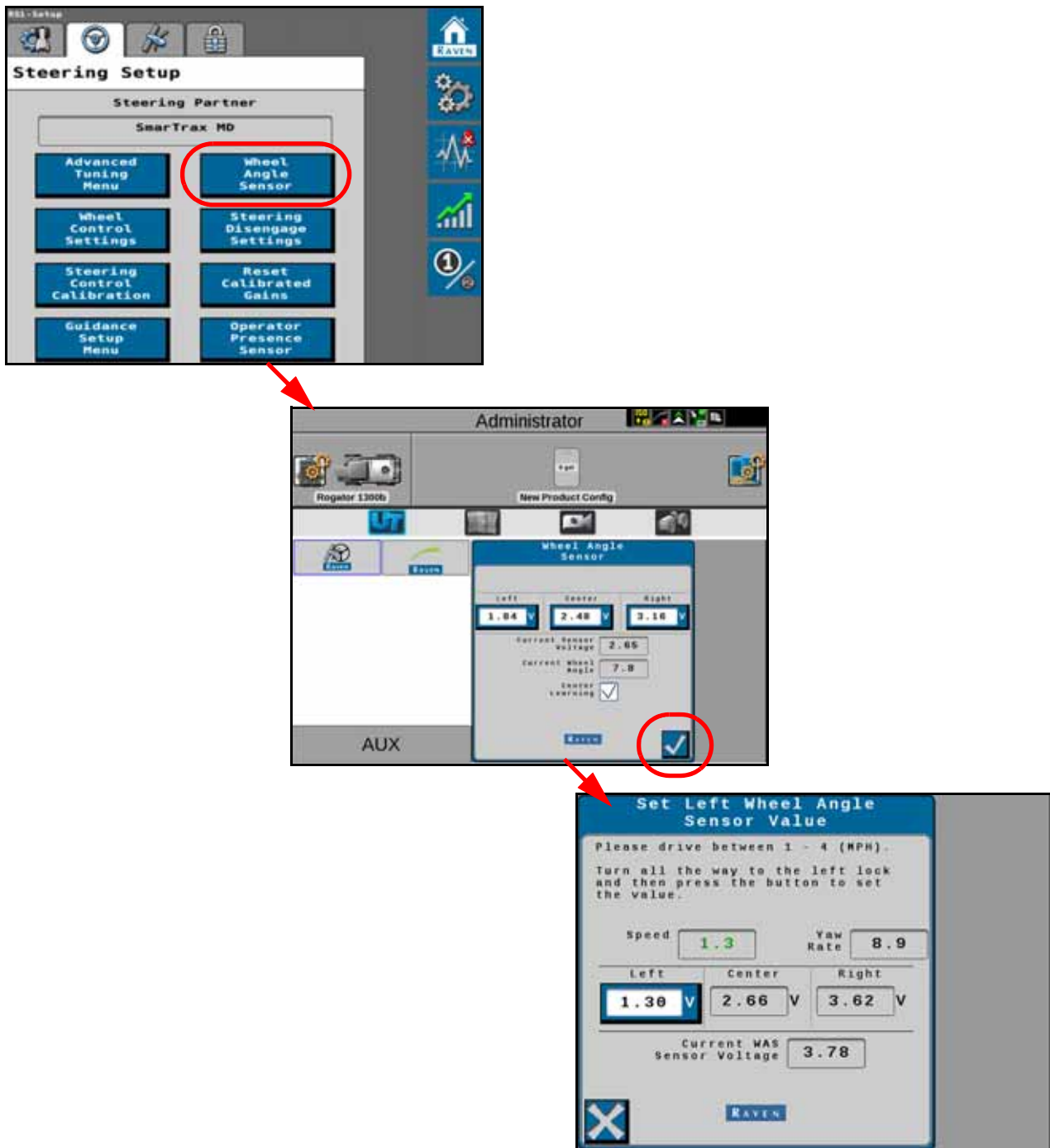
FIGURE 9. Guidance Setup Screen



- **Guidance Mode** - Displays the guidance modes:
 - Raven Field Computer - Guidance is performed via GPS guidance points only.
 - Vision - Guidance is performed via the VSN camera only. GPS corrections are neither utilized for guidance nor available as a fall-back solution. Line acquire must be performed manually. When the solution quality falls below the minimum threshold the steering system will disengage.
 - Vision+ - Guidance is performed via a combination of GPS and the VSN camera. This mode can be utilized for line acquire via GPS with the system switching to the VSN camera when the machine is aligned and near the guidance line. This mode will also fall back to GPS guidance if the solution quality falls below the minimum threshold. The system will then return to VSN guidance automatically when the solution quality is above the minimum threshold.
- **Skip LA When Row Guidance Quality High** - When enabled, the system will not attempt to line-acquire when the quality from VSN is above the threshold set on VSN.

WHEEL ANGLE SENSOR SETTINGS

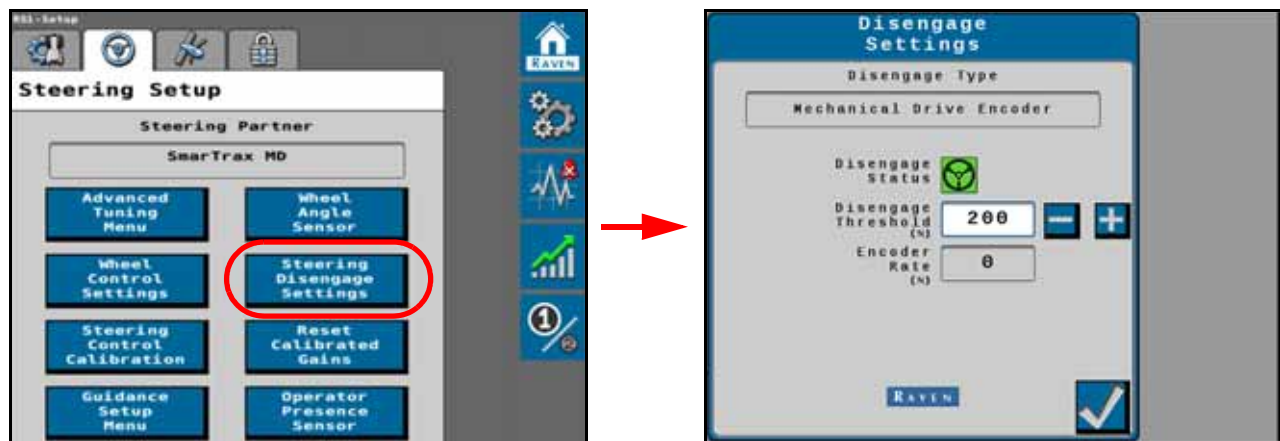
FIGURE 10. Wheel Angle Sensor Calibration Screen



- **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

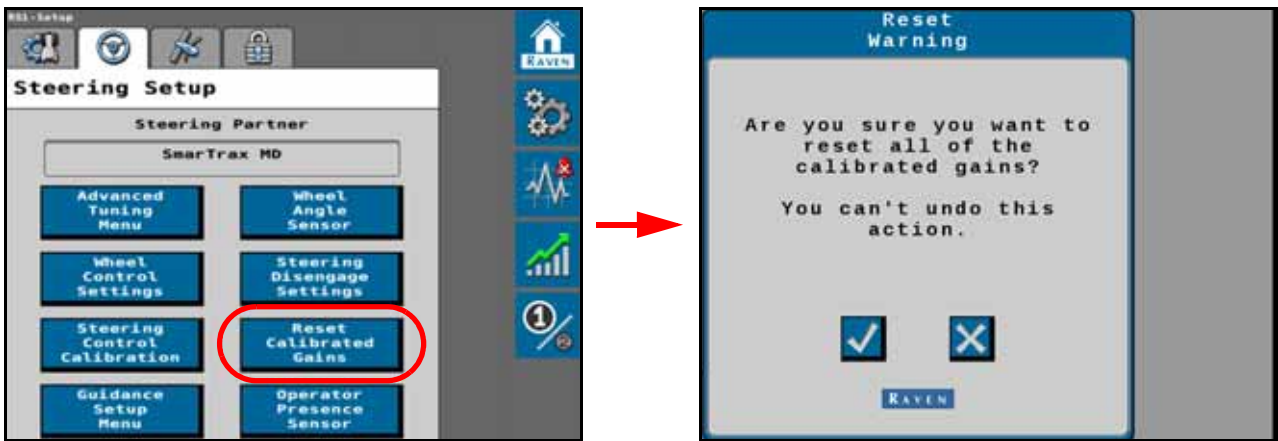
FIGURE 11. Steering Disengage Settings Screen



- **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

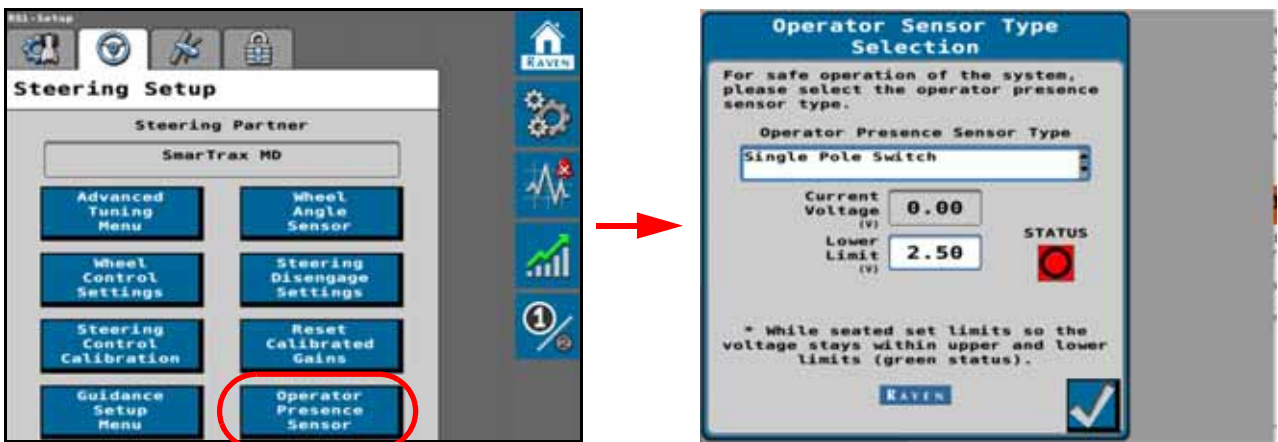
FIGURE 12. Reset Calibrated Gains Screen



- **Reset Calibrated Gains** - Resets the machine calibration settings back to factory defaults. 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 13. Operator Sensor Type Selection Screen



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.

- 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

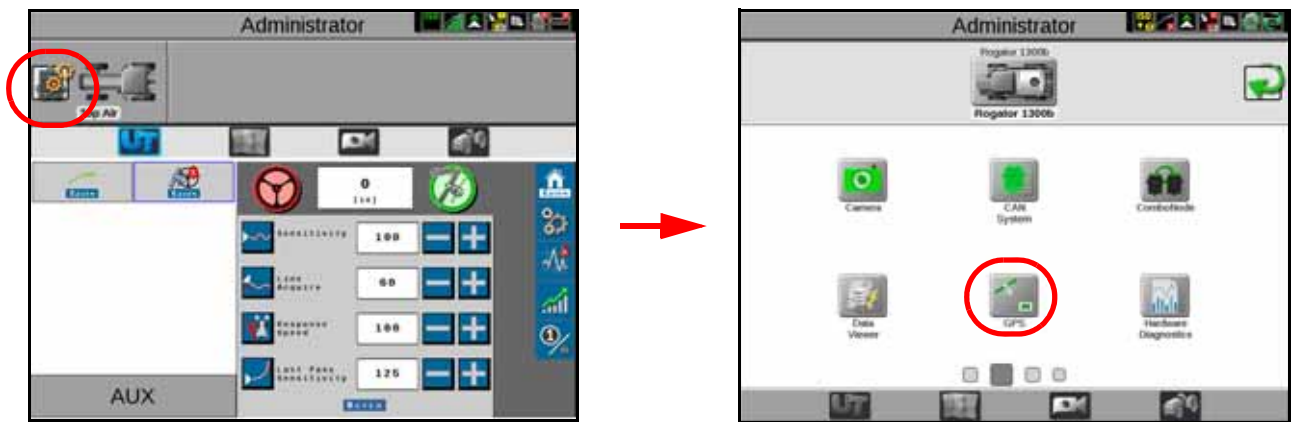
Displays the operator presence switch status. Toggle the presence switch (e.g. stand or sit in the operator seat) and confirm that the status indicates the switch is on when the operator is seated.

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

NOTE: Review Chapter 11, *Diagnostics and Troubleshooting* for information on the status displayed in this area.

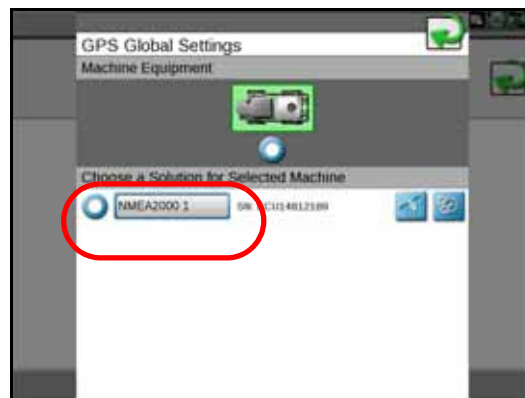
RS1 ON-BOARD GPS VIA THE VIPER 4/VIPER 4+

FIGURE 1. GPS Setup



1. Select **Edit**.
2. Select **GPS**.

FIGURE 2. GPS Setup Screen



3. Select **NMEA2000**.

NOTE: The ROS device will automatically select NMEA 2000. If there are multiple devices outputting NMEA messages, be sure that the correct device to allow the RS1 to ensure proper operation of the RS1 system.

IMPORTANT: If the RS1 is replacing a steering system, the old steering ECU must be unplugged and a Serial Redetection performed before continuing.

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

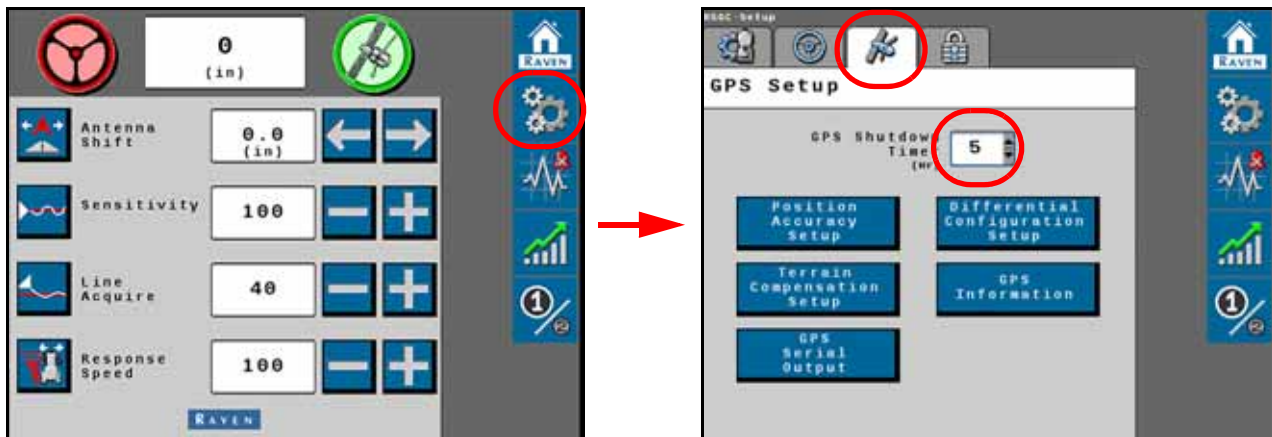
If a different receiver is being used, configure the receiver output to the settings below before performing calibration.

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

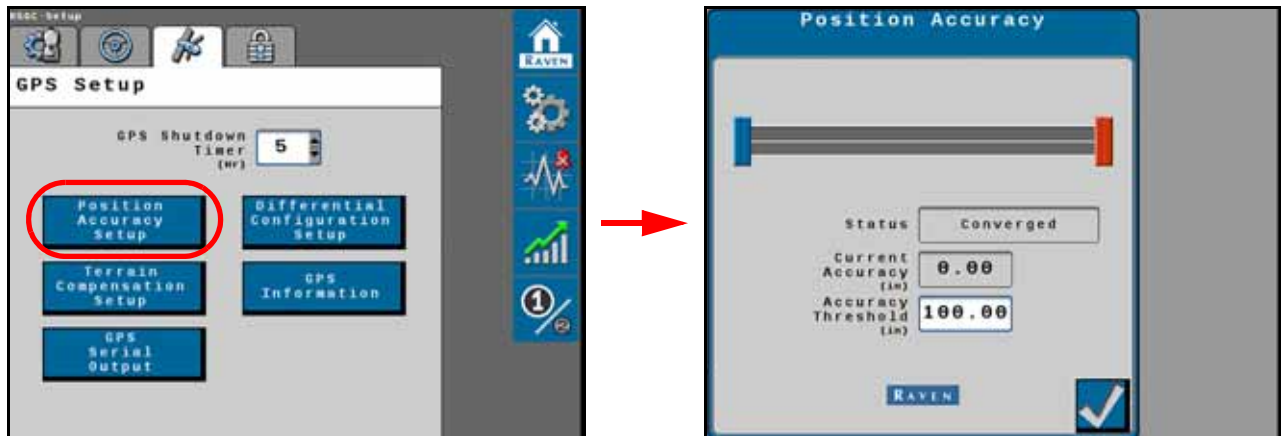
FIGURE 3. GPS Setup Screen



- **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.

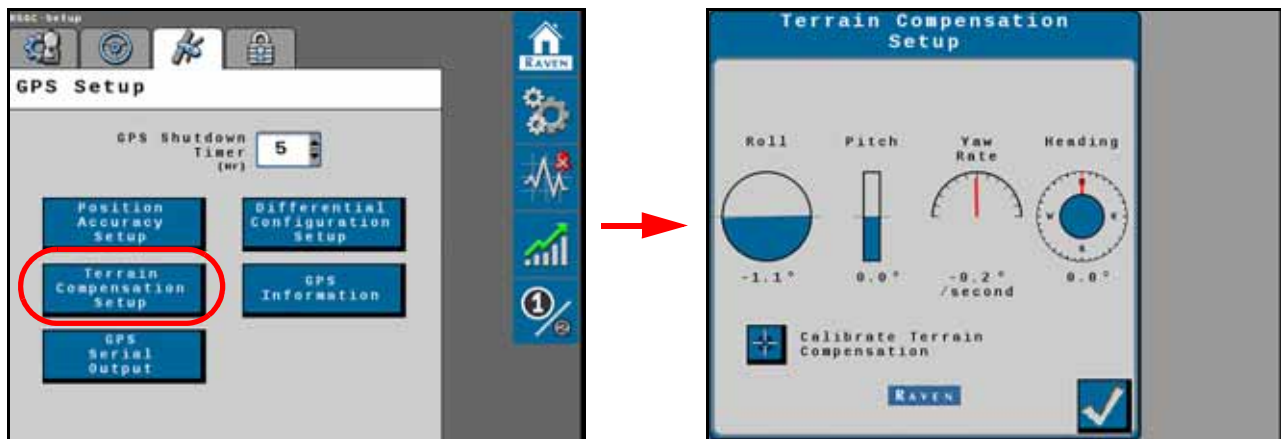
NOTE: The default value for the shutdown timer is 1 hour. This option requires that RS1 is installed properly with both switched and constant power.

FIGURE 4. GPS Status Information Setup Screen



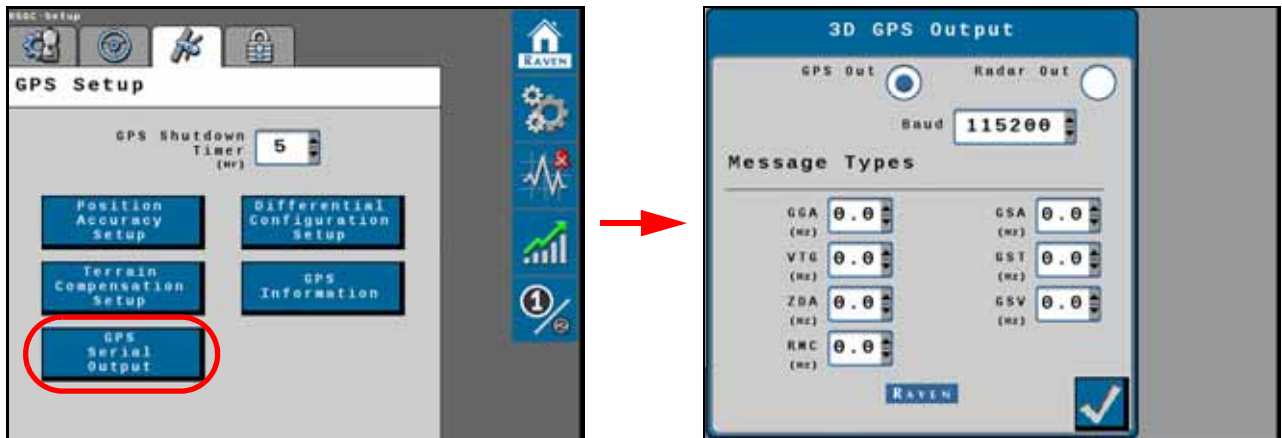
- **Status** - Displays the status of the GPS solution. Statuses that may be displayed in this area include:
 - No Signal
 - Error
 - Converging
 - Converged
- **Current Accuracy** - Value displayed is the horizontal standard deviation reported by the GPS receiver.
- **Accuracy Threshold** - This value 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 screen. The Accuracy Threshold will be populated with a default value.

FIGURE 5. Terrain Compensation Setup Screen



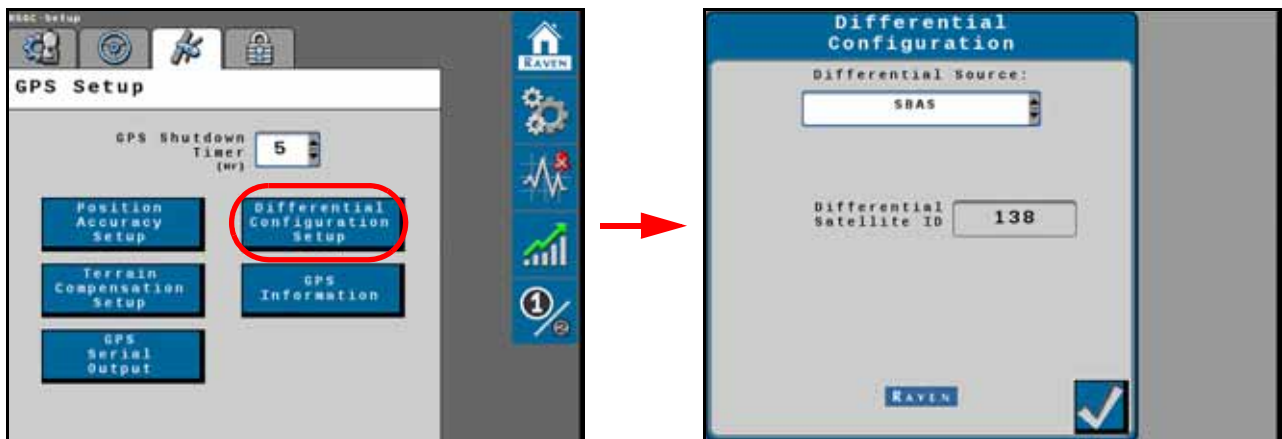
- **Roll, Pitch, Yaw Rate, and Heading** - Real-time measurement data used by the 3D terrain compensation feature.
- **Calibrate Terrain Compensation** - Begins the terrain compensation process.

FIGURE 6. 3D GPS Output/Radar Setup Screen



- **3D GPS Output/Radar** - Allows the RS1 system to toggle between a serial 3D compensated GPS position output or a simulated radar output. The baud rate and message types are not used in radar outputs.

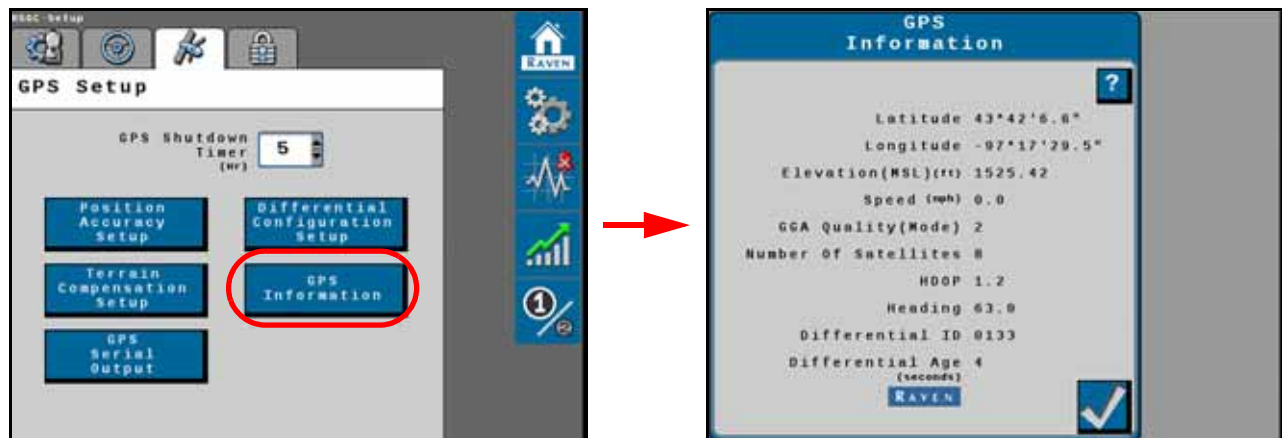
FIGURE 7. Differential Configuration Screen



4. Displays the GPS Differential Configuration options in 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. Contact your local Raven dealer to purchase additional unlock codes.

FIGURE 8. GPS Information Screen



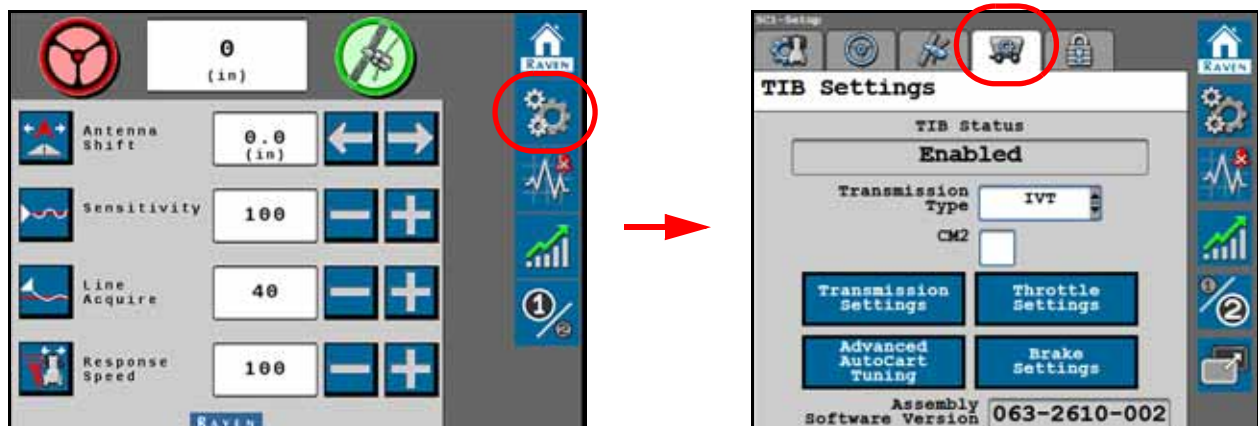
- **Latitude** - The angular distance of a place north or south of the earth equator.
- **Longitude** - The angular distance of a place east or west of the meridian at Greenwich, England.
- **Elevation (MSL)** - The height of the antenna in reference to sea level.
- **Speed** - Current speed based on 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 "- - -".

CHAPTER 8 TIB SETTINGS

8

NOTE: The TIB Settings tab is only available with the AutoCart unlock.

FIGURE 1. TIB Settings Page



The Tractor Interface Board (TIB) Settings screen displays the settings for autonomous machine operation.

TIB Status. The current status of the Tractor Interface Board is displayed at the top of the page.

- Active - machine is actively operating in autonomous mode.
- Ready to Enable - autonomous button not active, machine is in manual operation mode.
- Disabled - System status good (TIB and RS Lite communicating), but the Autonomous Switch in the tractor cab is toggled off. Autonomous operation is disabled.
- E-Stop Active - One of the system E-Stops is activated.
- Fault - A system fault prohibits the system from engaging autonomous mode.
- TIB Offline - No communication between RS Lite and TIB.

TABLE 1. TIB Status and Autonomous States

TIB Status	E-Stop(s) Activated	Good TIB Communication	Tractor Armrest Switch Enabled	Autonomous Switch	Autonomous State
Disabled		√			Disabled
Ready to Enable		√	√		Ready
Active		√	√	√	Active
E-Stop Active	√	√	√	√	Disabled
Fault					Disabled
TIB Offline					Disabled

Transmission Type. Toggle the tractor transmission type.

CM2 Option. Enable this option if the tractor has a CommandView 2 armrest and display.

Transmission Settings. Select this button to review the current transmission calibration values or to manually set or calibrate the tractor transmission. Refer to the Additional information may be found in the AutoCart online user assistance.

Throttle Settings. Select this button to review the current throttle calibration values or to manually set or calibrate the throttle.

Advanced AutoCart Tuning. Select this button to display the following AutoCart tuning settings.

Brake Settings. Review current calibration values or manually calibrate the AutoCart brake actuators.

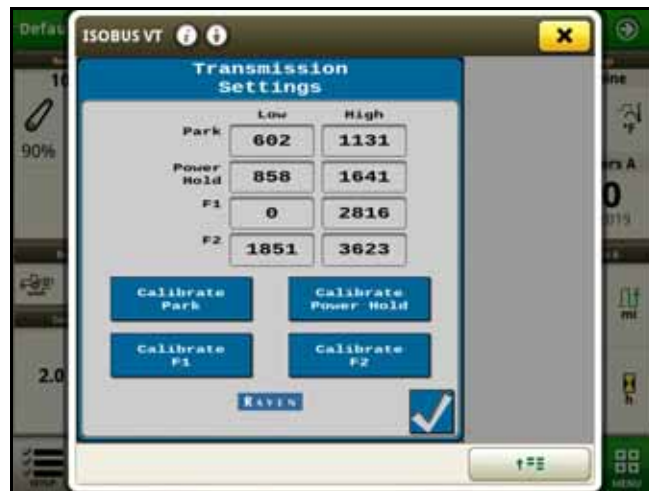
Assembly Software Version. The part number of the software installed on the tractor interface board (TIB) is displayed at the bottom of the TIB Settings tab.

TRANSMISSION SETTINGS

Depending upon the type of transmission selected during the initial calibration wizard, one of the following screens will be displayed.

IVT TRANSMISSIONS

FIGURE 2. Transmission Settings Page for IVT Transmissions



The current calibration values for Park, Power Hold, F1, and F2 are displayed at the top of the Transmission Settings page. These values may be useful for tuning or diagnostics of the system.

To recalibrate transmission, select the calibrate button for the desired setting and follow the on-screen instructions to properly complete the calibration.

NOTE: To properly calibrate the IVT power hold position, be sure the control lever to the power hold position (detent just above the park position).

FIGURE 3. Power Hold Control Lever Position



PST TRANSMISSIONS

FIGURE 4. Transmission Settings Page for PST Transmissions



The current calibration values for Clutch pressed and released positions are displayed at the top of the Transmission Settings page. These values may be useful for tuning or diagnostics of the system.

To recalibrate the clutch, select the calibrate button for the desired setting and follow the on-screen instructions to properly complete the calibration.

USER RPM

Set the engine RPM range which the tractor will maintain during autonomous operations. The typical RPM range is 900 to 2300, however the operator may want to adjust this range based upon field conditions or operational concerns.

FOR EXAMPLE: Limiting the maximum RPM may allow smoother shifting while maintaining better power with a loaded grain cart.

THROTTLE SETTINGS

FIGURE 5. Throttle Settings Page



Enable the check box option at the top of the page if a physical foot throttle is present in the cab of the tractor.

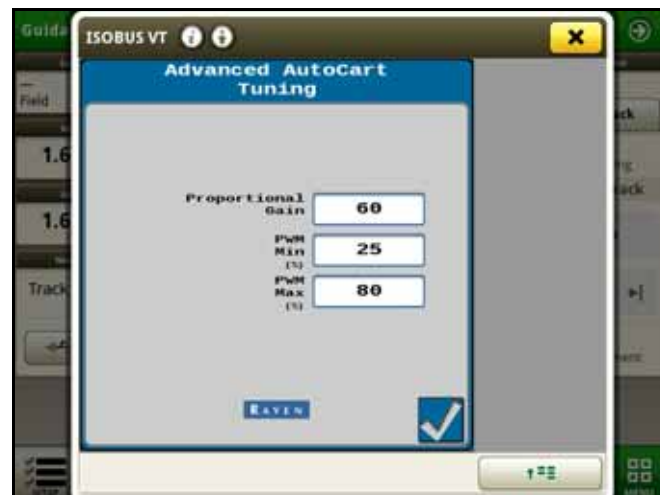
NOTE: AutoCart currently requires the presence of a physical foot throttle when operating on tractor equipped with a PST. If this option is enabled, use the physical foot throttle while completing the following calibration procedures.

1. Release the foot throttle to lower the engine RPM to the minimum position and select the Calibrate Minimum button.
2. Depress the foot throttle to raise the engine RPM to the maximum position and select the Calibrate Maximum button.

NOTE: The minimum throttle values must be lower than the maximum throttle values.

ADVANCED AUTOCART TUNING

FIGURE 6. Advanced AutoCart Tuning Page



PROPORTIONAL GAIN

The proportional gain value is an indicator of how reactive the tractor steering is. This value is the ratio of steering effort to the current wheel angle detected.

PWM MIN

The minimum pulse width required for controlling the steering valve. A higher value may allow the steering system to respond more rapidly to changes. A value that is too high may cause the machine to steer too aggressively and will be jittery while trying to maintain a straight line.

PWM MAX

The maximum pulse width which provides control response during operation. A value too low may limit the speed which the system allows the machine to steer. A higher value may allow more rapid movement of the machine steering while a value too high may create additional heat or advanced wear in the hydraulic system.

BRAKE SETTINGS

FIGURE 7. Brake Settings Page

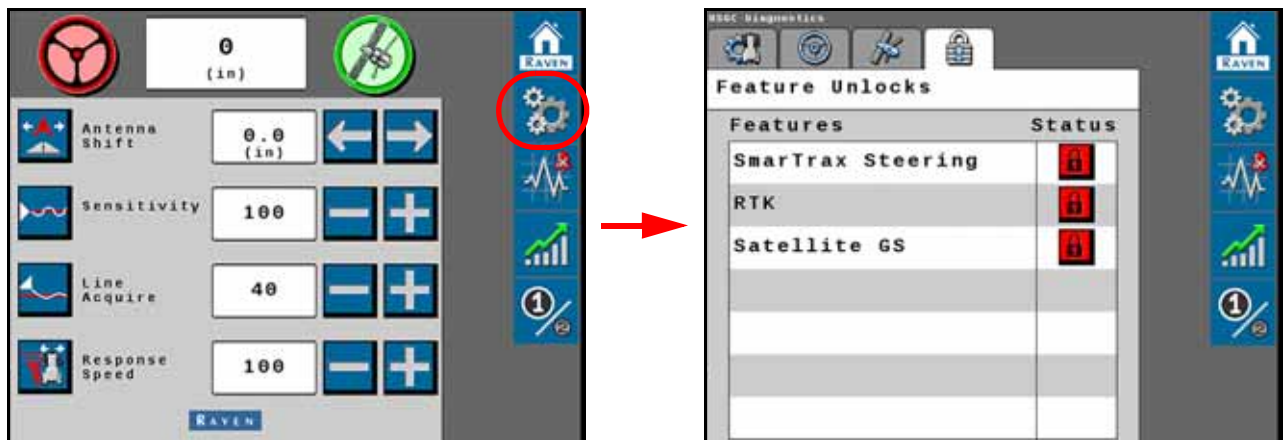


The current calibration values for the brake actuators are displayed at the top of the Brake Settings page. These values may be useful for tuning or diagnostics of the system.

Touch the Calibrate Brakes button to manually initiate a brake actuator calibration. When this button is selected, the brake actuators will automatically extend and retract. New values will be recorded and displayed at the top of this page.

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 Screen



1. Select the **Gears** icon on the home screen.
2. Select the **Padlock** tab.
3. Select the **Padlock** icon next to the feature to be unlocked.

FIGURE 2. Feature Unlock Information Screen



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 52.

FIGURE 3. Feature Unlocked

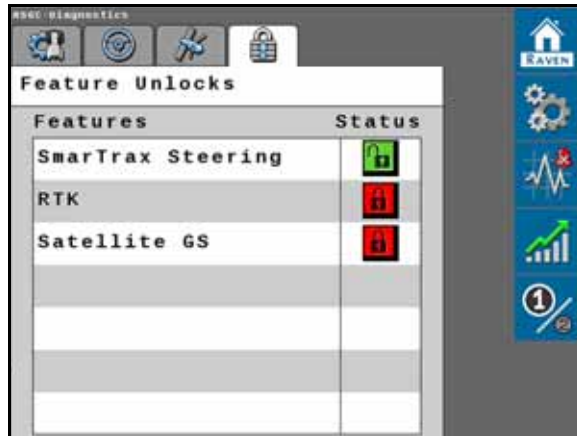












TABLE 1. Unlock Status

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 62 for additional status conditions which may be displayed in the RS1 or RS Lite on-screen widget.

UT NAVIGATION BUTTONS

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

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.

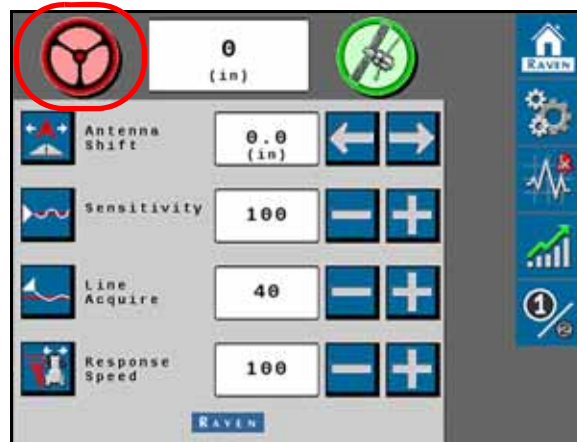
UPDATING RS1

Refer to the *Field Updates* section on page 78 or the field computer manual for instructions on updating the RS1 software.

BUTTON DEFINITIONS

STEERING STATUS

FIGURE 1. Home Screen



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 Screen



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


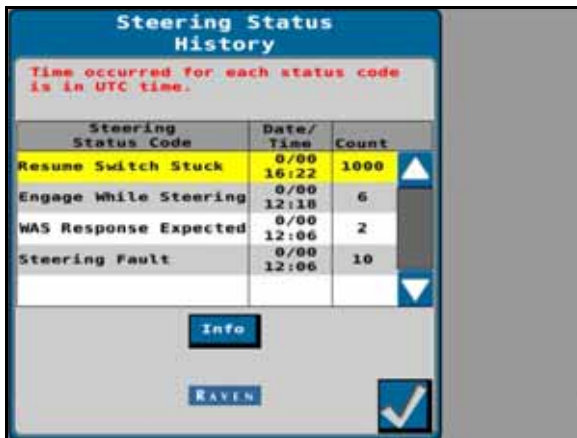


The Steering Status History button  shows a table for the reason steering disengaged, including a time stamp and the number of occurrences.

FIGURE 3. Steering Status History Screen





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.



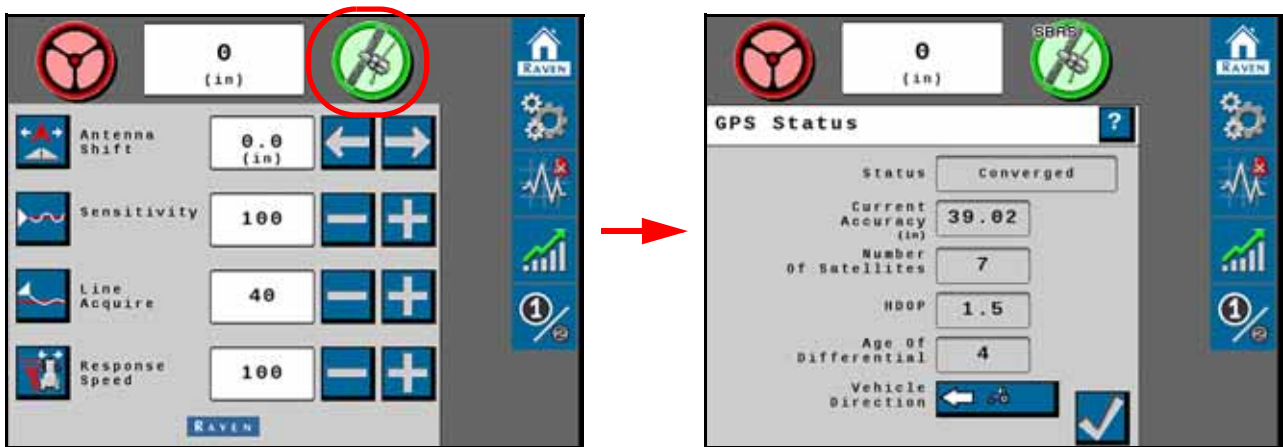
OPERATOR PRESENCE SWITCH

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.



GPS STATUS

FIGURE 4. Home Screen



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.

	<p>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.</p>
	<p>GPS RTK-L or RTK Pro solutions are converged and actively being used.</p>

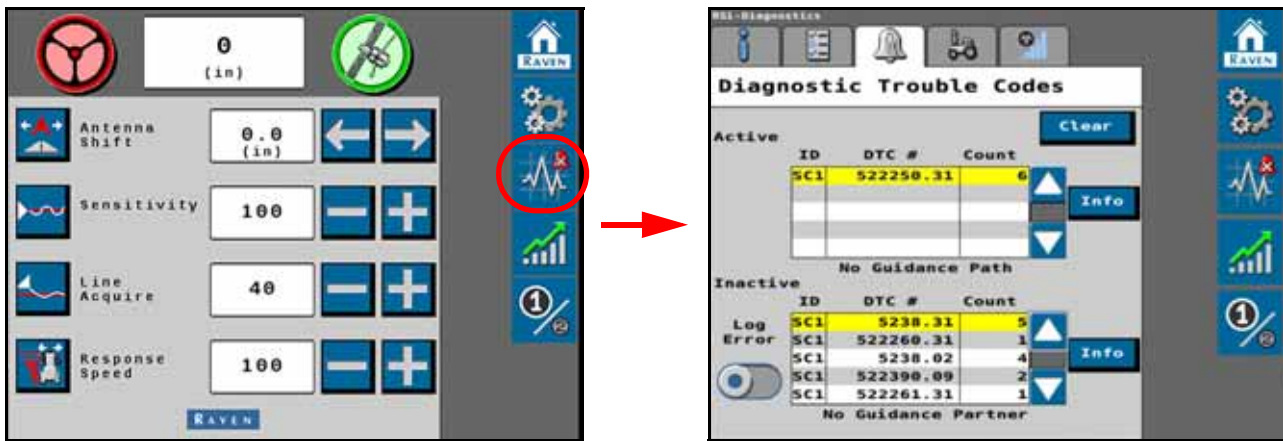
Press the GPS icon to display the GPS Status screen.

Display	Message
Status	<p>Displays the selected GPS convergence status.</p> <ul style="list-style-type: none"> • Error • No Signal • Converging • Converged
Current Accuracy	<p>Value displayed is the horizontal standard deviation reported by the GPS receiver.</p>
Number of Satellites	<p>The number of satellites currently in view by the GPS receiver.</p>
HDOP	<p>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.</p>
Age of Differential	<p>Time (in seconds) since the last differential correction was received. If a differential source is not currently tracked this entry will be "- - -".</p>



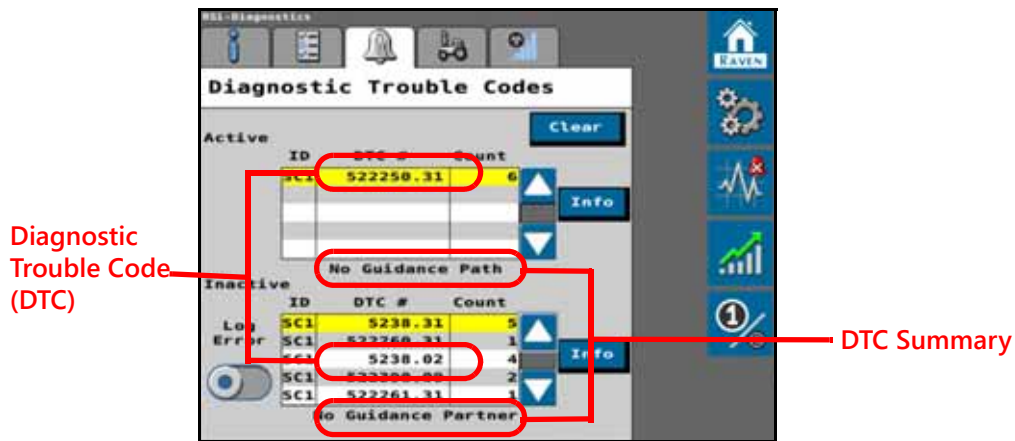
DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 5. Diagnostic Trouble Codes Screen



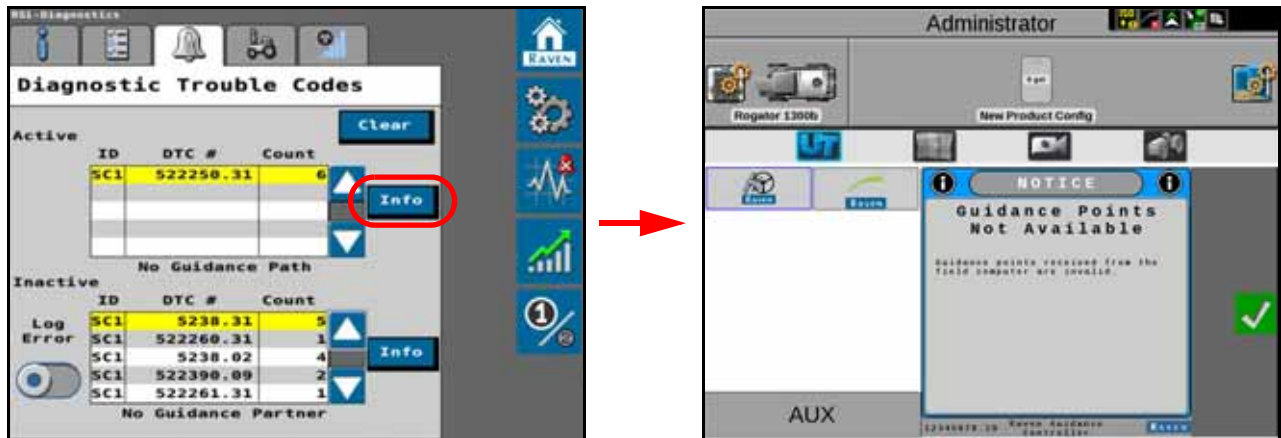
The Diagnostic Trouble Code screen displays active and previous diagnostic trouble codes (DTCs) that occur during RS1 system operation. Active DTCs must be fixed before the RS1 system can be enabled for guidance and steering operation. Once a DTC has been corrected, the code moves to the inactive DTC code list. Refer to Figure 5 on page 62 for an example of DTCs and DTC summaries.

FIGURE 6. Diagnostic Trouble Codes Screen



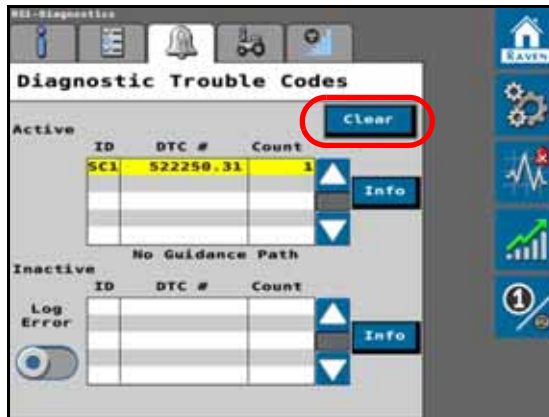
NOTE: In Figure 5 on page 62 above, the active DTC is 522250.31 and the DTC summary is “No Guidance Points.” The inactive DTC is 522261.31 and the DTC summary is “No SCU Detected.”

FIGURE 7. Info Screen



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

FIGURE 8. Inactive DTCs Cleared from Error Log

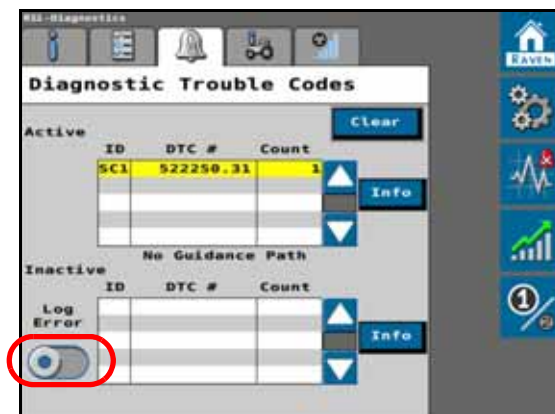


Pressing **Clear** deletes the inactive DTCs from the Inactive DTC error log. For a complete list of the RS1 DTCs, please visit:

http://ravenprecision.force.com/knowledgebase/articles/Tech_Tip/RS1-Lights-and-Diagnostic-Codes/

Press **Log Error** to record a random failure condition.


FIGURE 9. Create Error Log



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

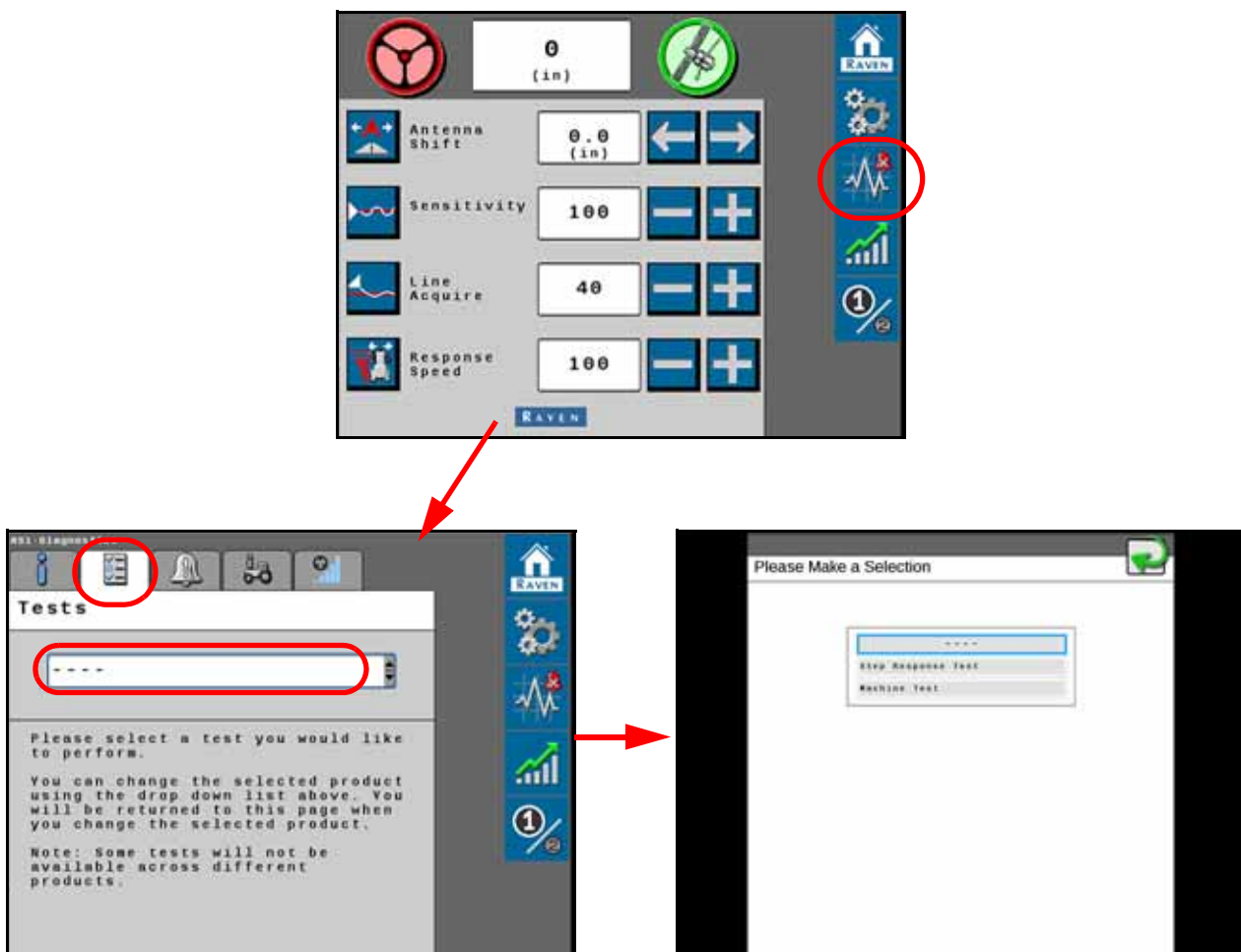


⚠ WARNING

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.

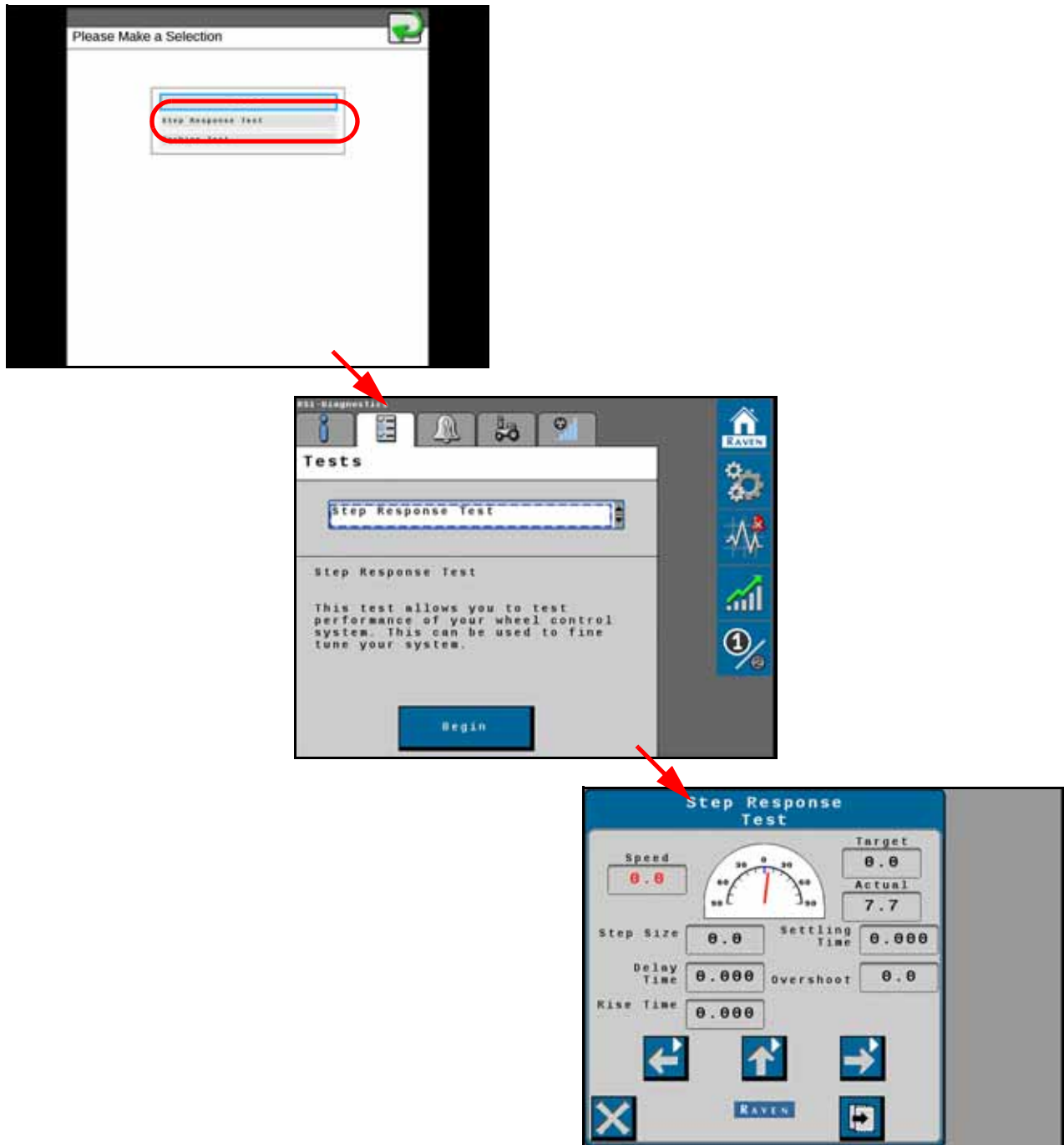
FIGURE 10. Test Selection Screen



STEP RESPONSE TEST

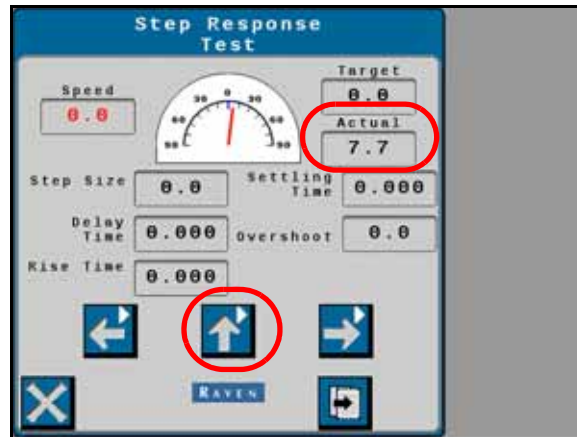
The Step Response Test is used to determine the responsiveness of the machine steering system.

FIGURE 11. Step Response Test Screen



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 Screen

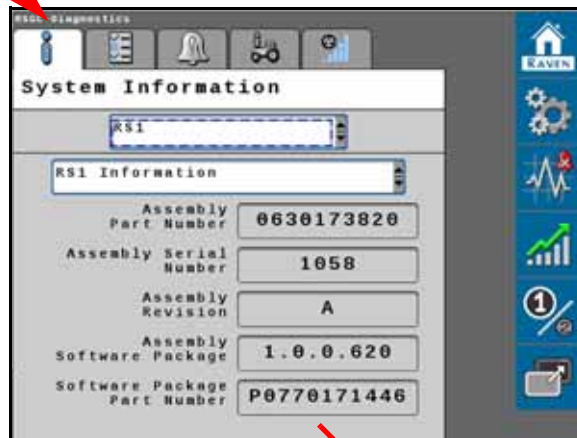
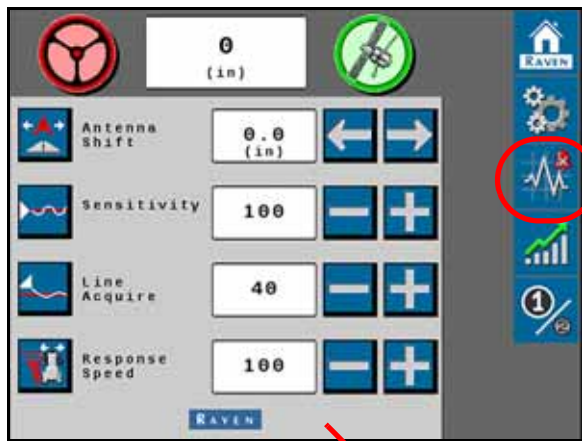


2. Turn the steering wheel to the right so that the Actual reading displays 20.0 degrees.
3. Press the center up arrow.
4. Wait for the following fields to populate and record the data:
 - Step Size
 - Delay Time
 - Rise Time
 - Settling Time
 - Overshoot
5. Drive forward 1 - 4 mph [1.6 - 6.4 km/h] with 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.

SYSTEM INFORMATION

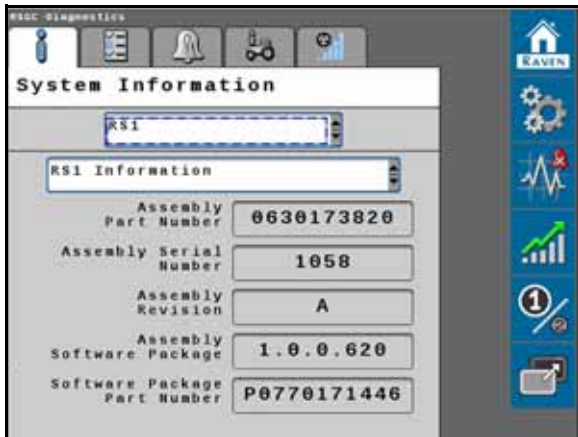
FIGURE 13. System Information Screen



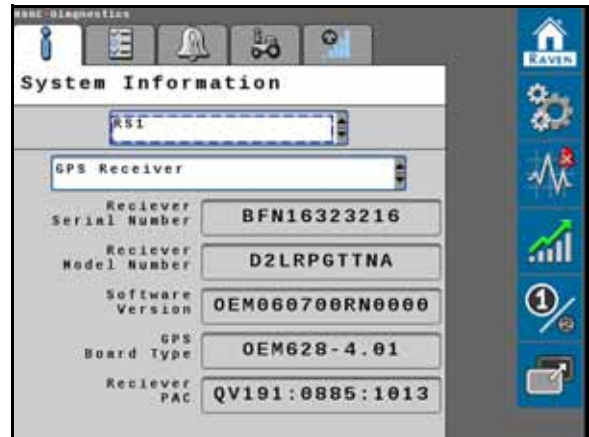
1. Select the steering control device from the drop-down menu.
2. Select the desired system component from the second drop-down menu.

FIGURE 14. System Information Screens

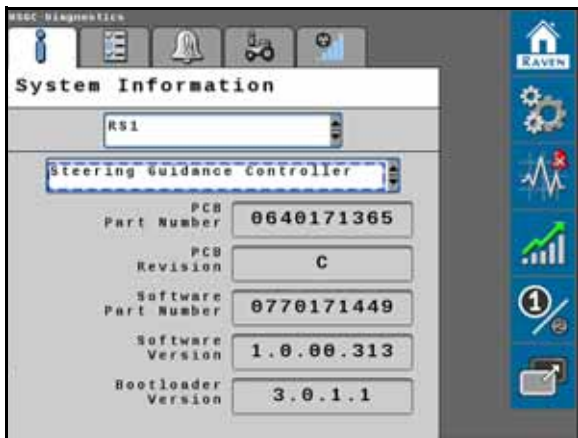
RS1 Information



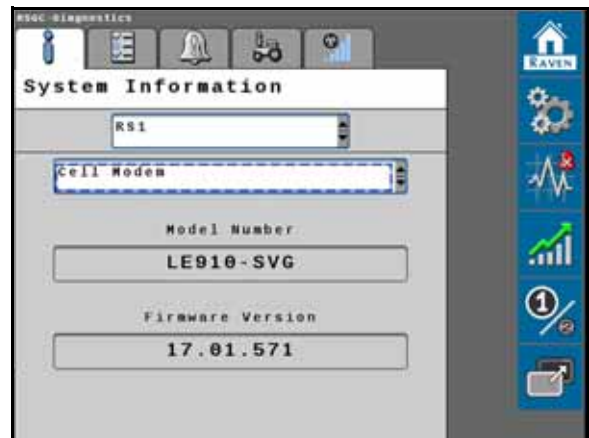
GPS Receiver Information



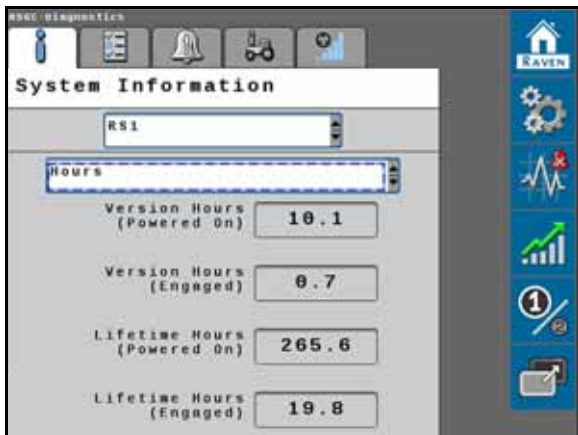
Steering Guidance Controller Information



Cell Modem Information



RS1 Unit Hours



RS1 Hardware Diagnostics

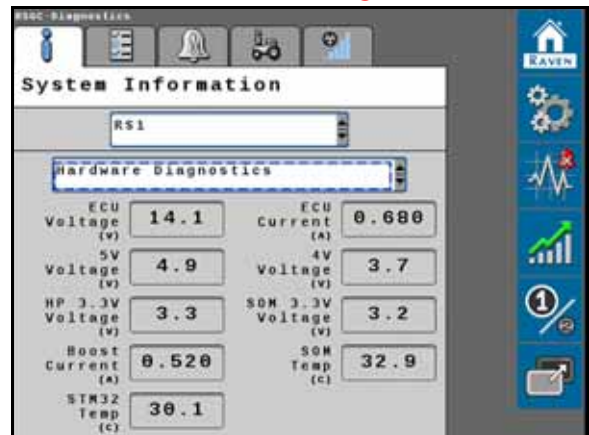
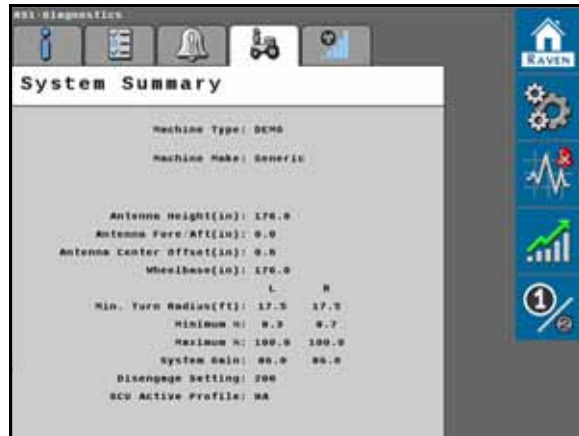
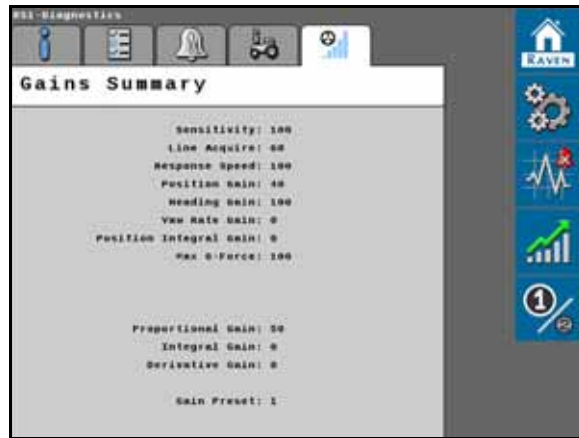


FIGURE 15. System Summary Screen



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

FIGURE 16. Gains Summary Screen



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

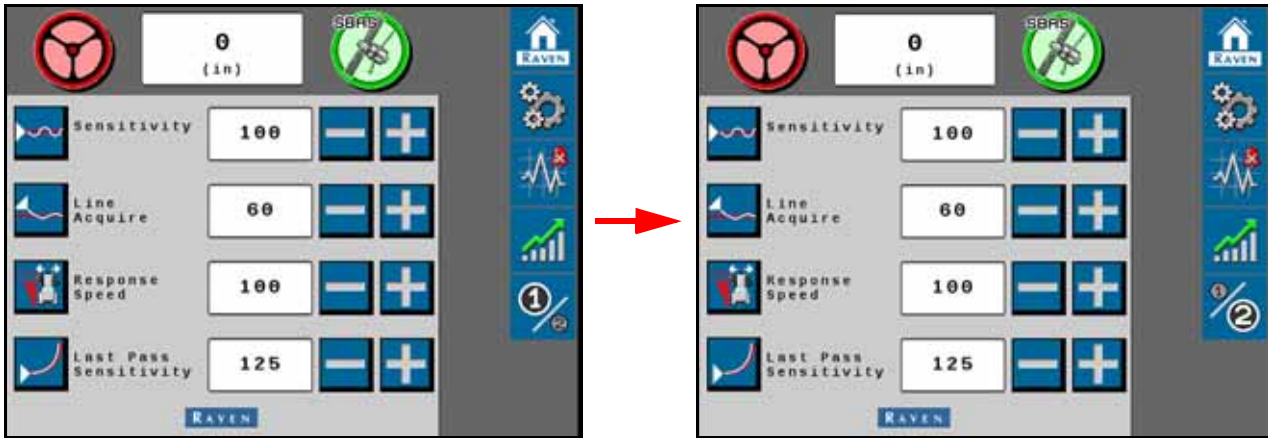
FIGURE 17. Preset Steering Gains



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)

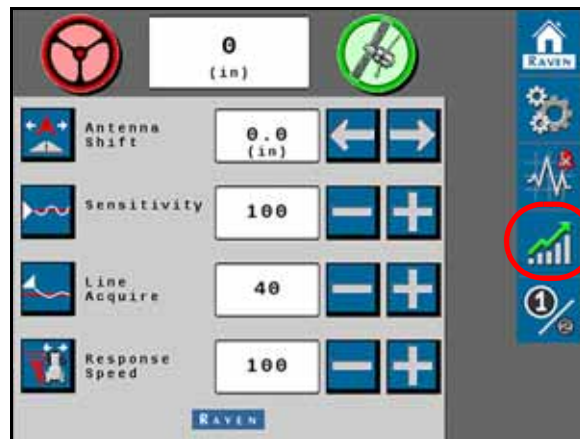
FIGURE 18. Preset Gains Settings



To toggle between the settings, press the  button.

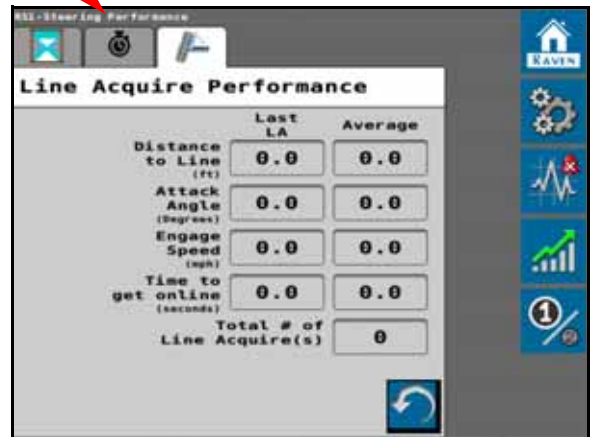
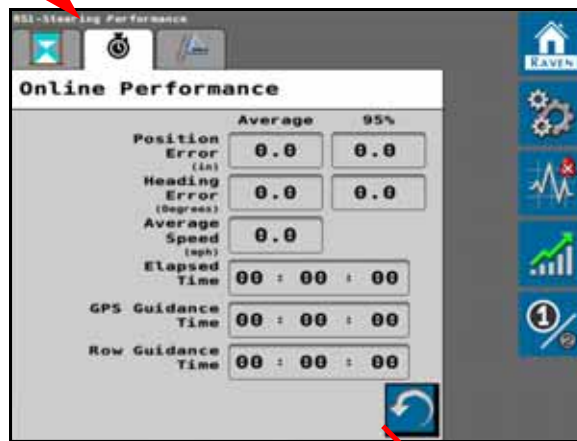
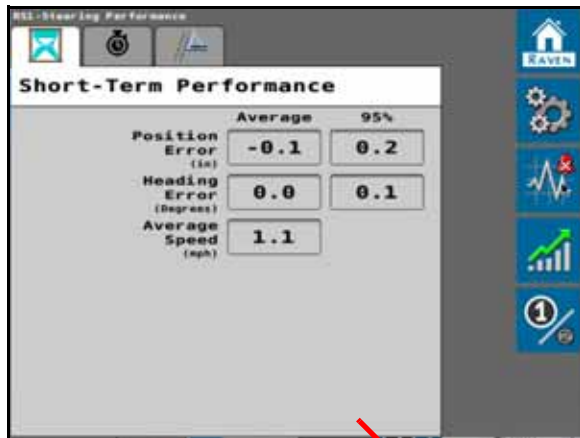
PERFORMANCE MONITOR

FIGURE 19. RS1 Home Screen



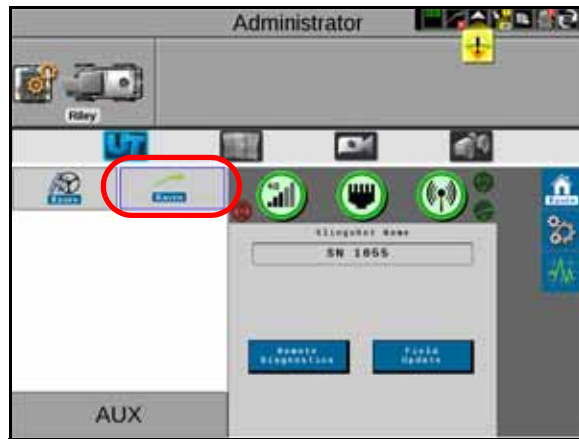
1. Select the **Performance** icon on the right side of the Machine Settings screen to view the short-term system performance.

FIGURE 20. Short-Term and Resettable Performance Screen



- NOTE:** The Short-Term Performance screen 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 Screen



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

BUTTON DEFINITIONS

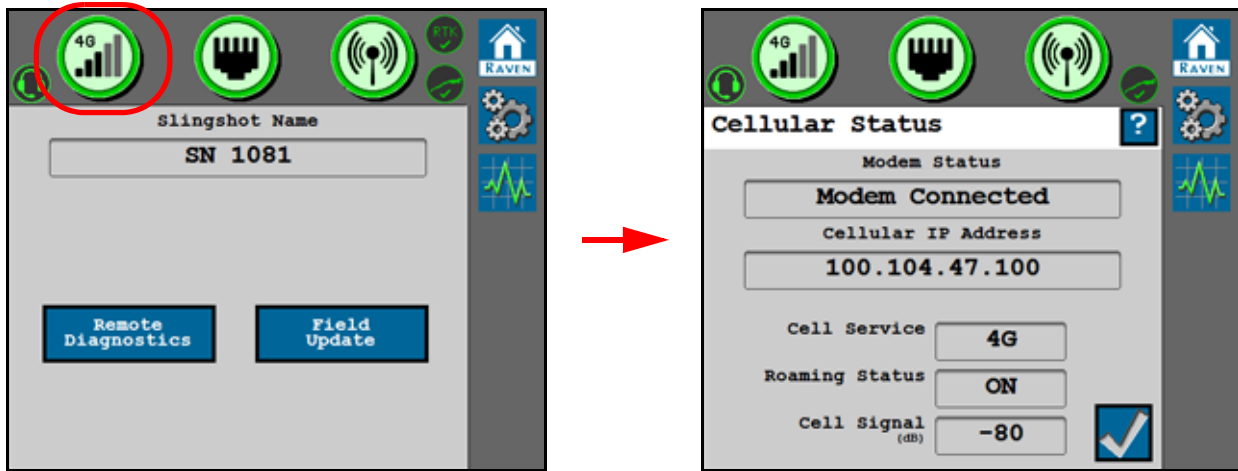
The following are common status or mode messages which may occur.

TABLE 1. UT Navigation Buttons

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

CELLULAR MODEM

FIGURE 2. Cellular Status Screen



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.
	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.

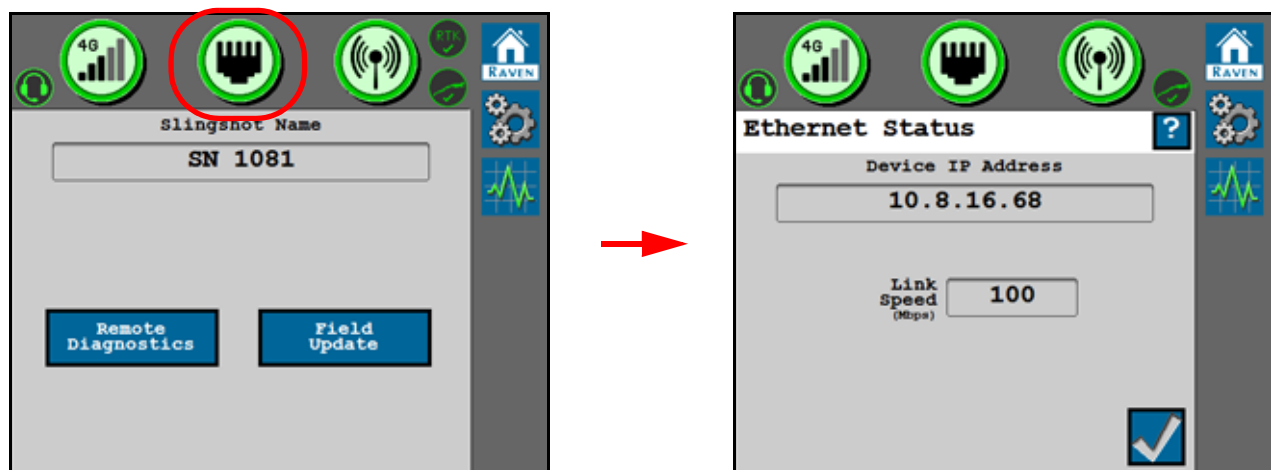
CELLULAR STATUS



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 Screen

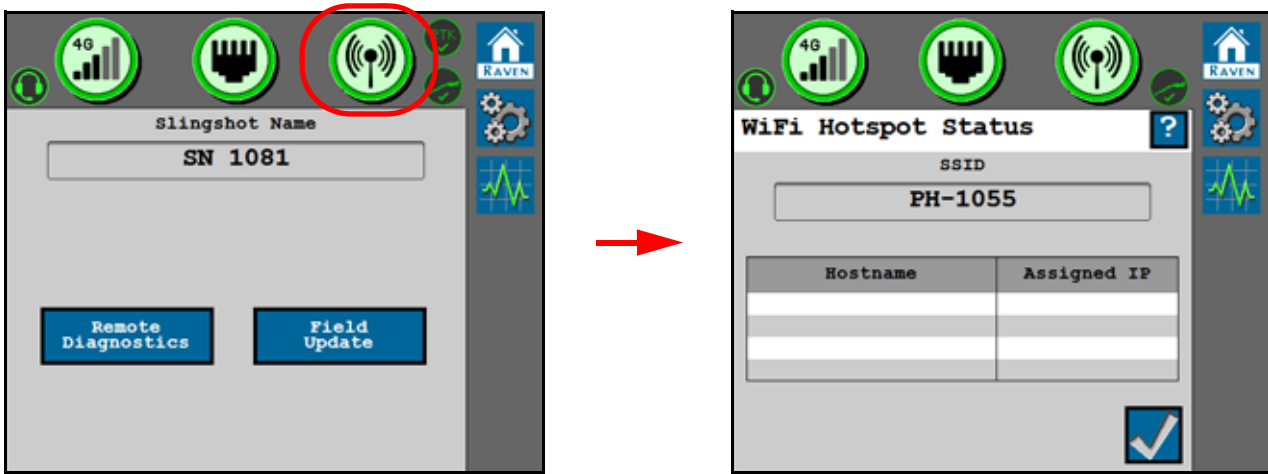





Display	Message
	Indicates that a valid connection has been established between the RS1 and a field computer or field hub.
	No Ethernet connection has been made or the RS1 does not recognize that an Ethernet has been made.



Display	Message
	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 Screen



Display	Message
	The WiFi Hotspot is active and functioning properly.
	WiFi Hotspot is not functioning properly.
	WiFi client is active and has connection.

Display	Message
	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.

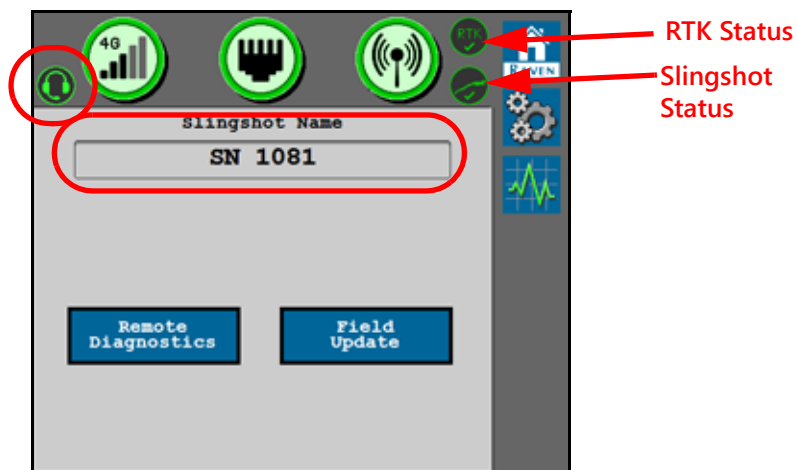
Hostname. The Hostname is the name of any device that is connected to the RS1.




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 82 for additional information regarding Hotspot and WiFi configurations.

SLINGSHOT AND RTK STATUS

FIGURE 5. Home Screen

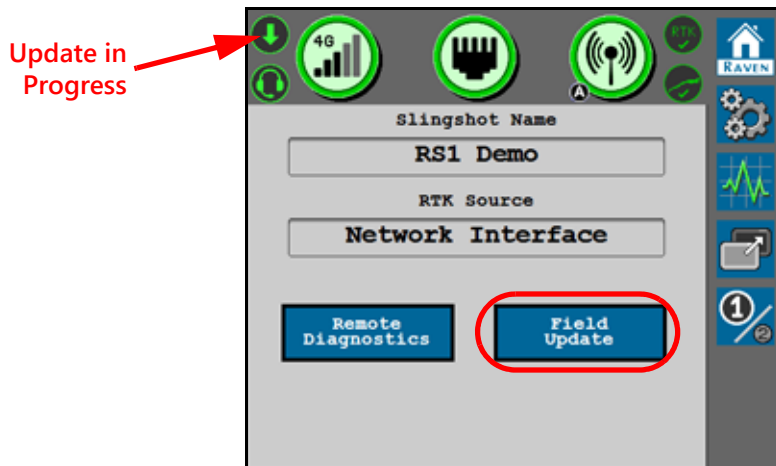


Display	Message
	RS1 is connected to the Slingshot portal.
	RS1 is not connected to the Slingshot portal.
	RS1 is receiving RTK corrections. NOTE: This icon is hidden if RTK corrections have not been unlocked in the RS1 unit.

Display	Message
	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.

FIELD UPDATES

FIGURE 6. Slingshot Home Screen



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

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

FIGURE 7. Software Download Screen



2. Select **Check for Server Updates**.

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

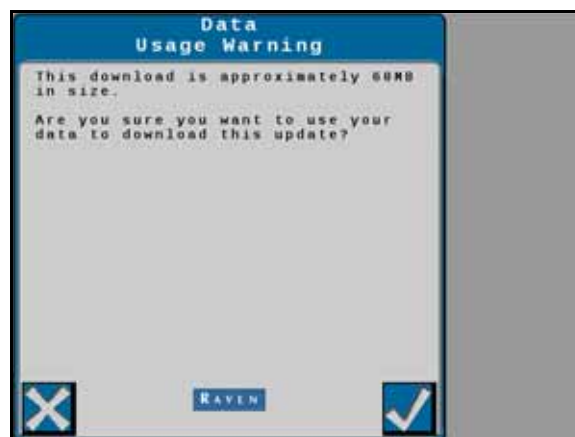
3. Select the desired software update from the list.

4. Select **Accept**.

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

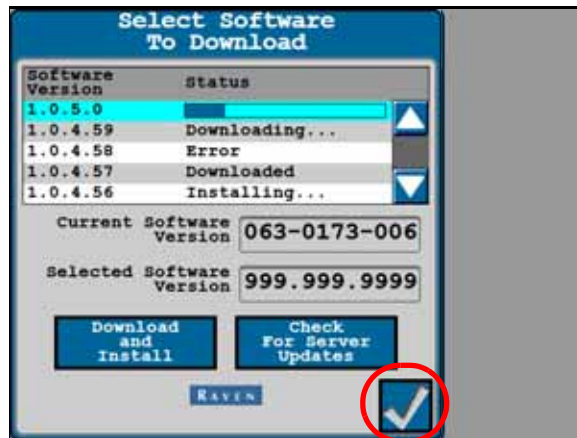
NOTE: When the button is pressed, the following warning screen appears notifying the user that cellular data will be used to download the software and asks if the user would like to proceed with the download.

FIGURE 8. Data Usage Warning Screen



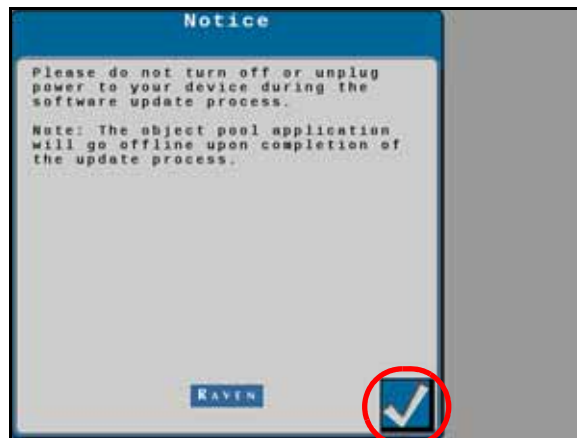
NOTE: Select Cancel to exit the field update without performing a software update.

FIGURE 9. Software Update Notice



5. Press **Accept** to begin the software download.
6. Wait for the software download to be completed.

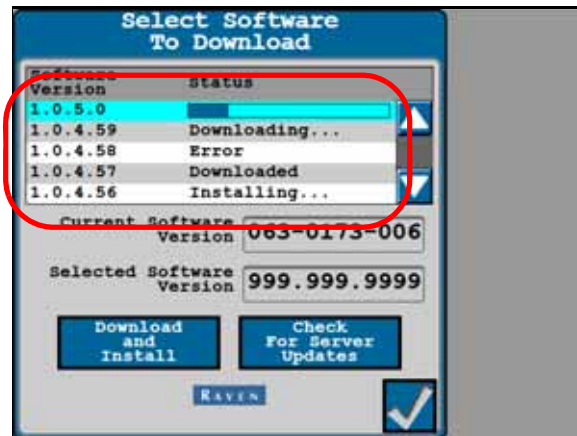
FIGURE 10. Software Update Notice



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

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

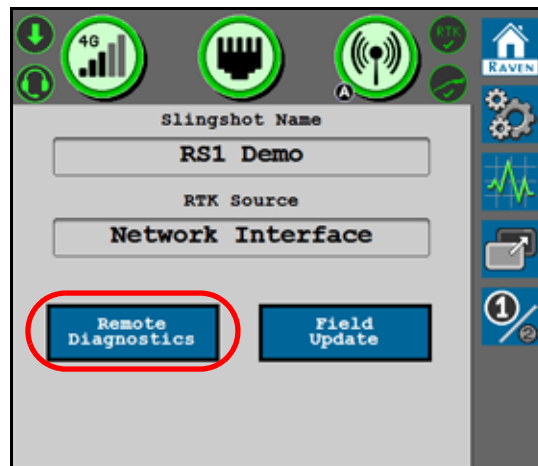
FIGURE 11. Software Installation in Progress



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 12. Slingshot Home Screen



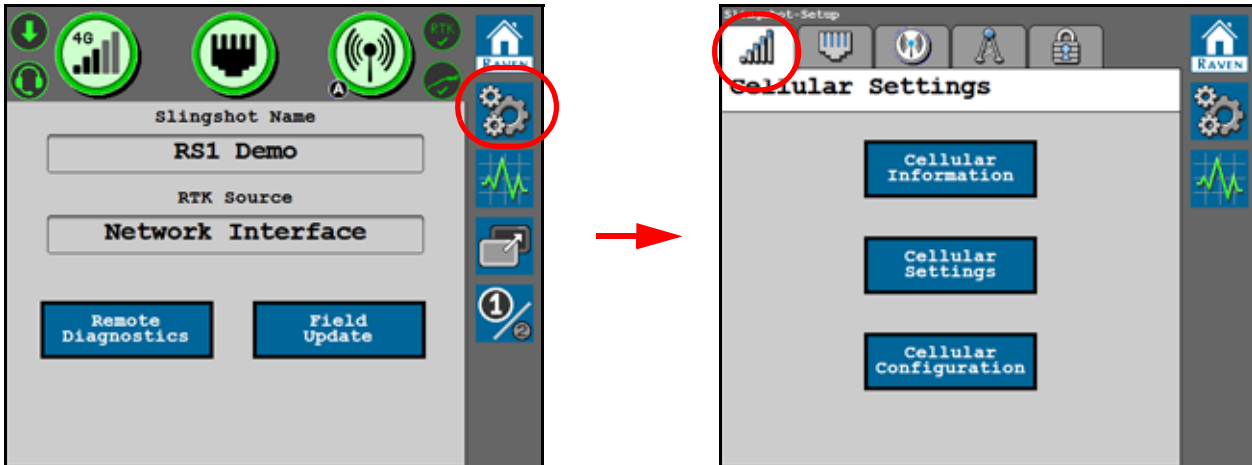
The EULA must be pressed after every power cycle. To accept the EULA so it does not need to be pressed until the next time the EULA is revised, accept the EULA on the Slingshot Portal.

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

SYSTEM SETTINGS

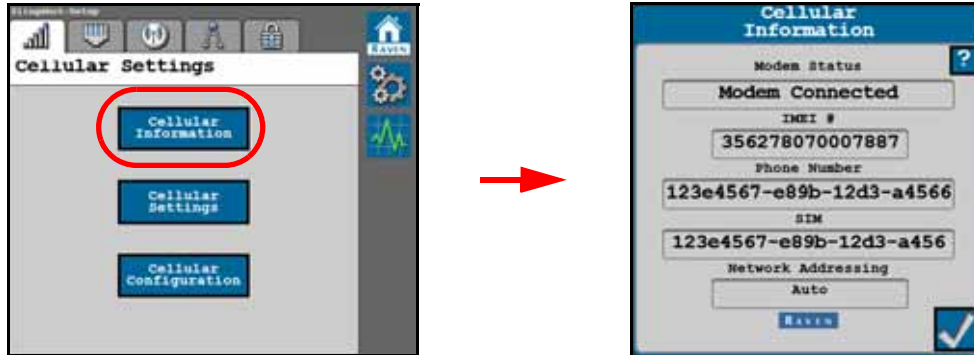
CELLULAR SETTINGS

FIGURE 13. Slingshot Home Screen



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

FIGURE 14. Cellular Information Screen

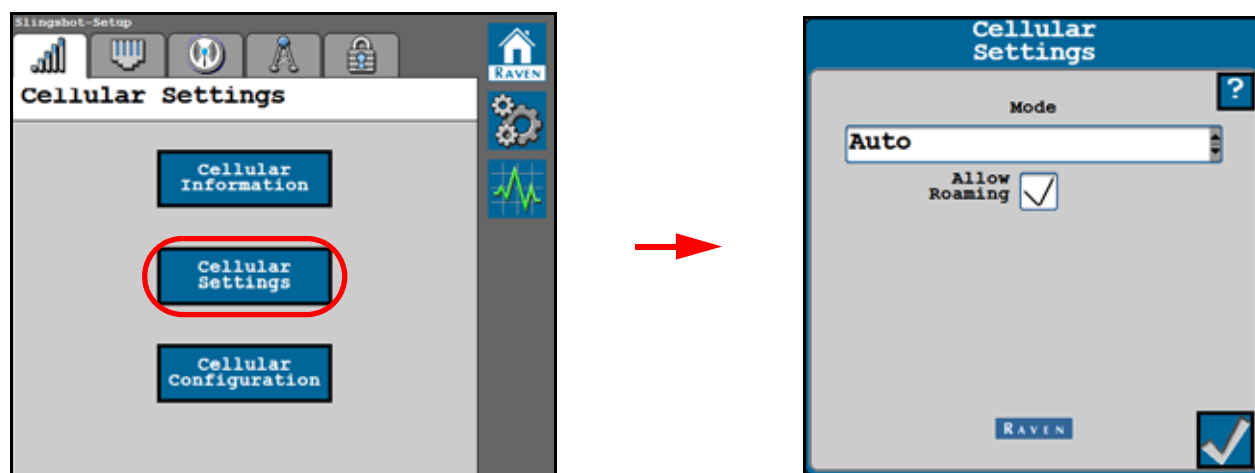


- **IMEI #** - Displays the International Mobile Equipment Identity number (IMEI#) with the modem installed in the RS1 unit.
- **Phone Number** - Displays the phone number assigned to the SIM card in the RS1 modem when an valid data plan is active.
- **SIM** - Displays the identification number associated 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 74 for additional information on cellular settings.

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

FIGURE 15. Cellular Settings Screen



- **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.

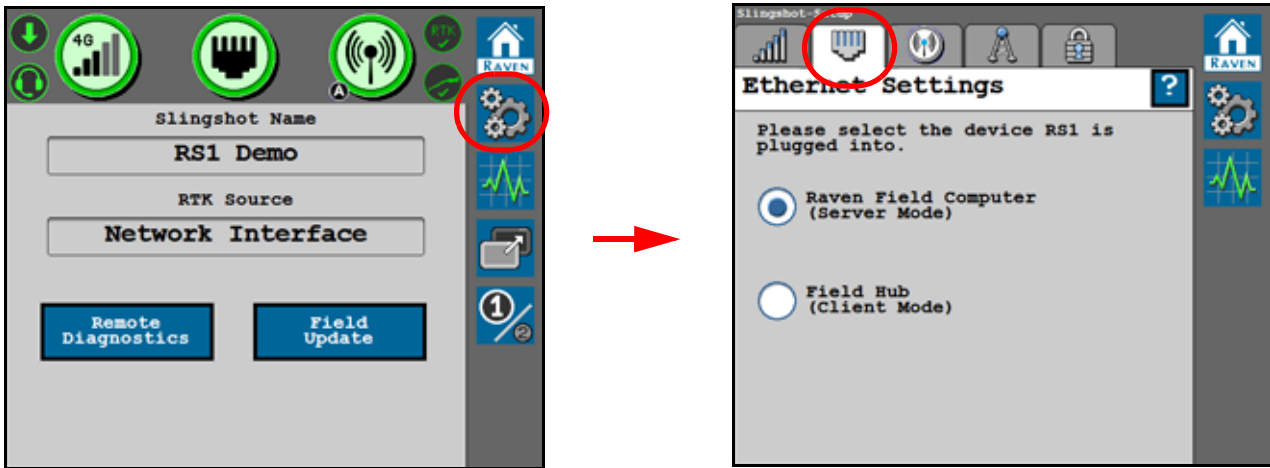
FIGURE 16. Cellular Configuration Screens



- **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 17. Ethernet Settings Screen

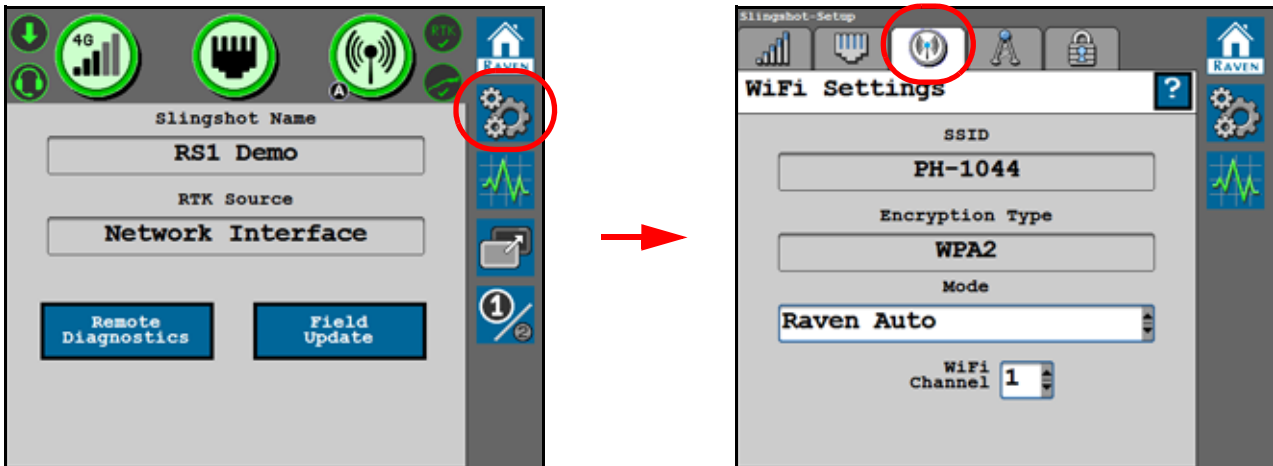


There are two selectable modes for the Ethernet connection in the RS1 unit.

- **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.

WiFi SETTINGS

FIGURE 18. WiFi Hotspot Settings Screen



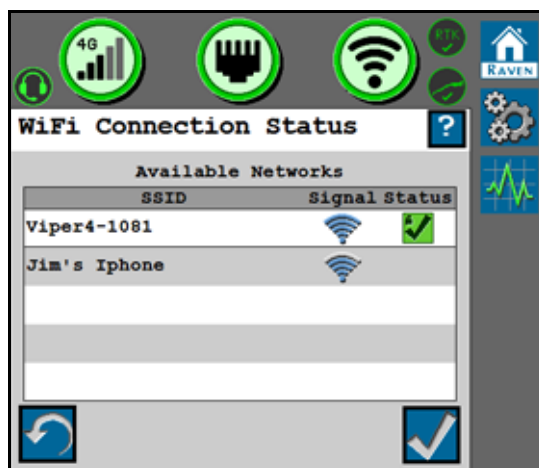
- **SSID** - Displays the WiFi SSID (network name). This setting cannot be modified by the operator.
- **Encryption Type** - Displays the encryption mode being used on the RS1 WiFi hot spot. This setting cannot be modified by the operator.
- **Mode** - Select the mode for WiFi or Hotspot operation.
 - 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 19. 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 screen.

MANUAL HOTSPOT

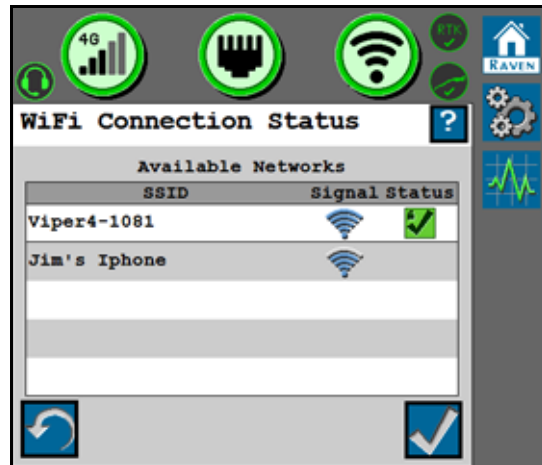
Select Manual Hotspot to broadcast a hotspot for local WiFi devices.

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.

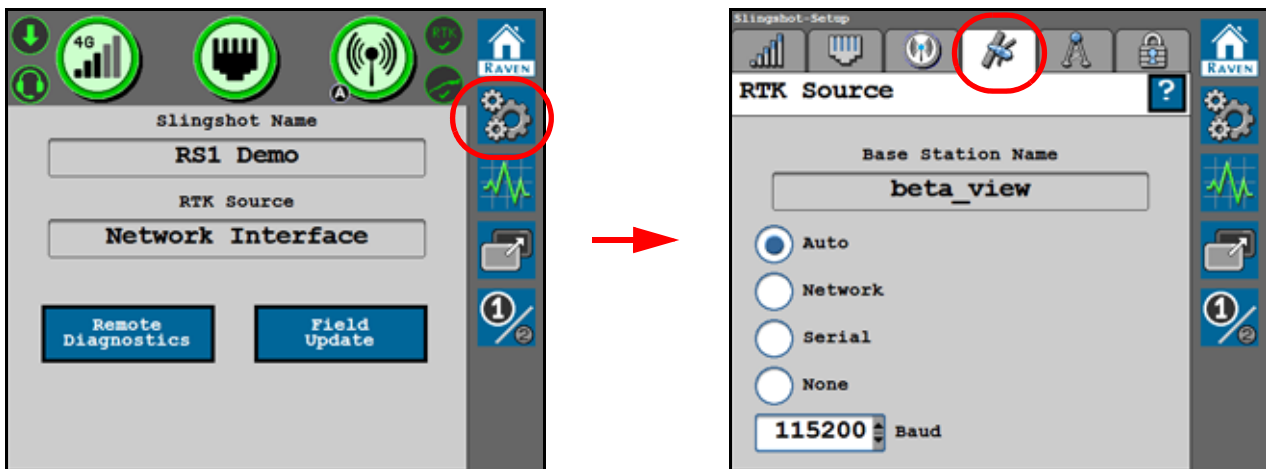
NOTE: When set to Raven Auto, a small "A" indicator will be displayed to indicate Raven is controlling the Hotspot and WiFi settings for the system.

FIGURE 20. WiFi Connection Status



RTK SOURCE SETTINGS

FIGURE 21. RTK Source Screen



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

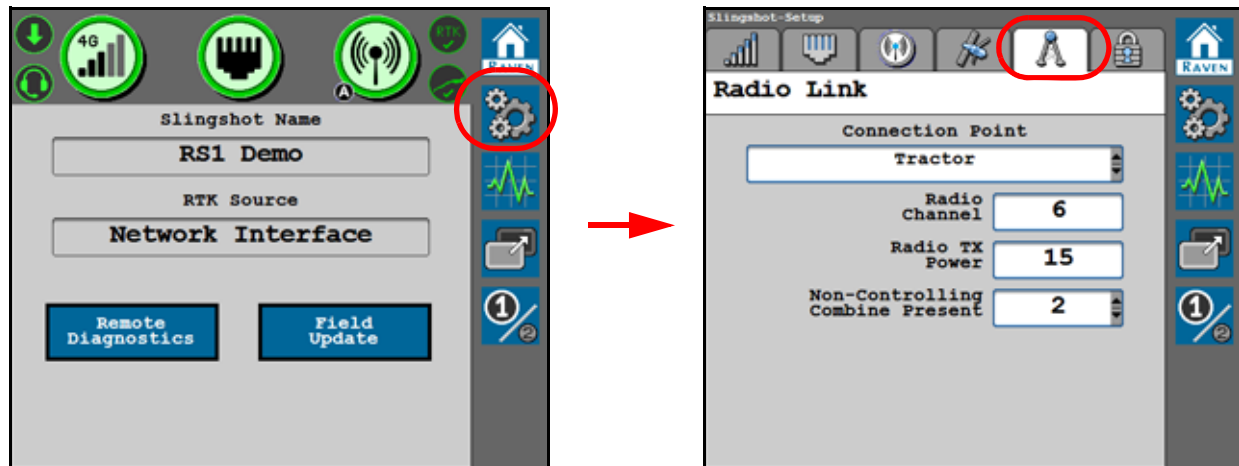
NOTE: Generally, the RTK Source setting should be set to “Auto”. However, this setting may be locked to a “Serial” setting if the RTK is provided via a non-Raven source or Slingshot Field Hub connected serially. This setting may be switched based on location or customer.

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

FIGURE 22. Radio Link Screen



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

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.

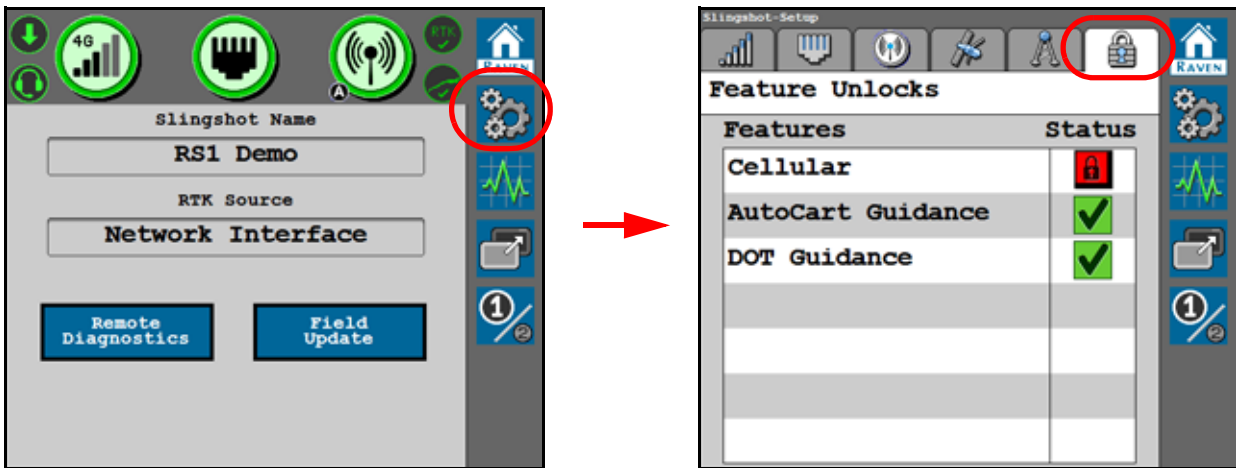
Lower values typically offer better results for near proximity (e.g. syncing with the combine, smaller fields, etc.). Higher values may be required to transmit across larger fields or through tree lines, but may cause more interference when machines are operating close together.

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 AutoCart system (e.g. the tractor, the controlling combine, and each non-controlling combine).

FEATURE UNLOCKS

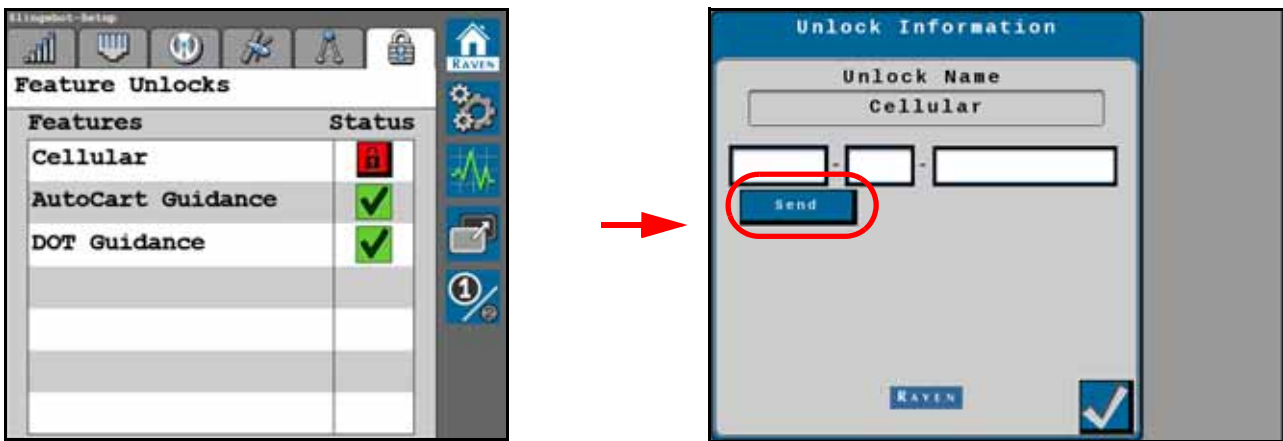
FIGURE 23. Feature Unlock Screen



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

1. Select the Padlock tab.
2. Select the Padlock icon in the Status column.

FIGURE 24. Unlock Information Screen

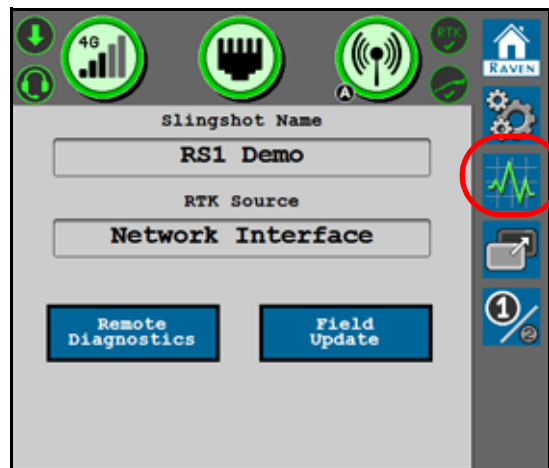


3. Enter the feature unlock code.
4. Select **Send**.

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 25. System Information Screen



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

FIGURE 26. System Information Screens

RS1 Information

Slingshot-Diagnostics

System Information

RS1 Information

Assembly Part Number	0630173820
Assembly Serial Number	1044
Assembly Revision	A
Assembly Software Version	1.5.0.0
Software Version Part Number	P0779000021

GPS Receiver Information

Slingshot-Diagnostics

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

Slingshot-Diagnostics

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

Slingshot-Diagnostics

System Information

Cell Modem

Model Number	LE910-SVG
Firmware Version	17.01.571

RS1 Unit Hours

Slingshot-Diagnostics

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

Slingshot-Diagnostics

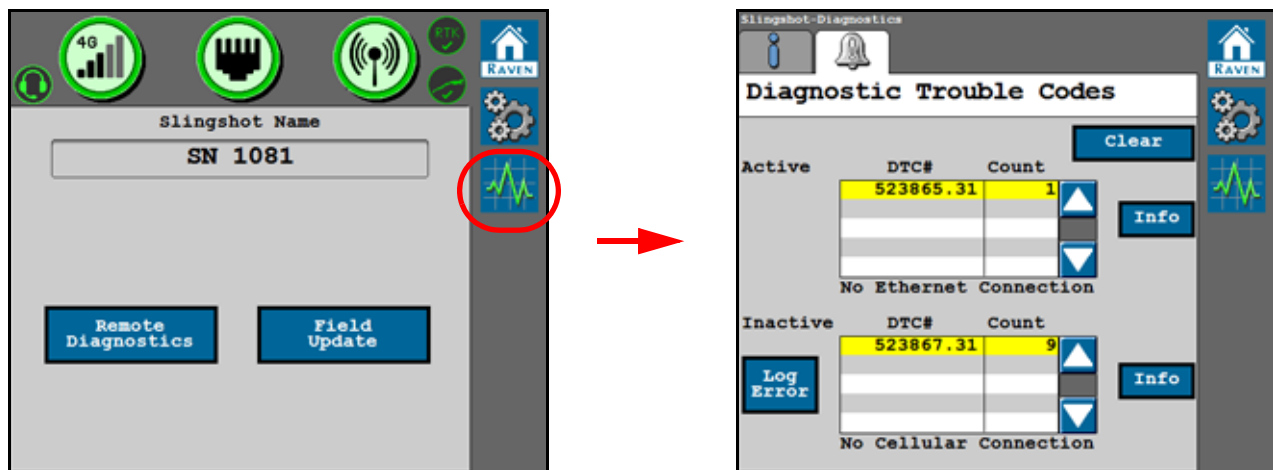
System Information

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		

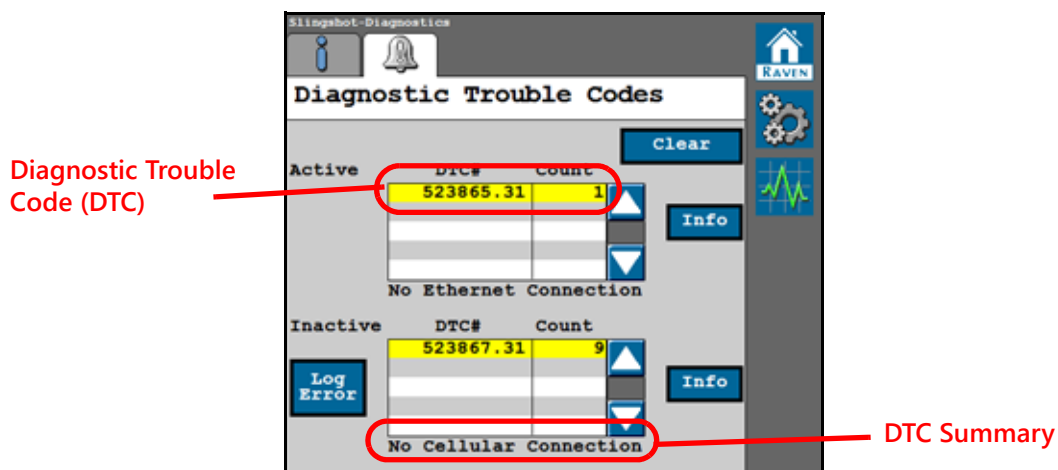
DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 27. Diagnostic Trouble Codes Screen



The Diagnostic Trouble Code screen 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 28. Diagnostic Trouble Codes Screen



NOTE: In Figure 28 on page 91 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)

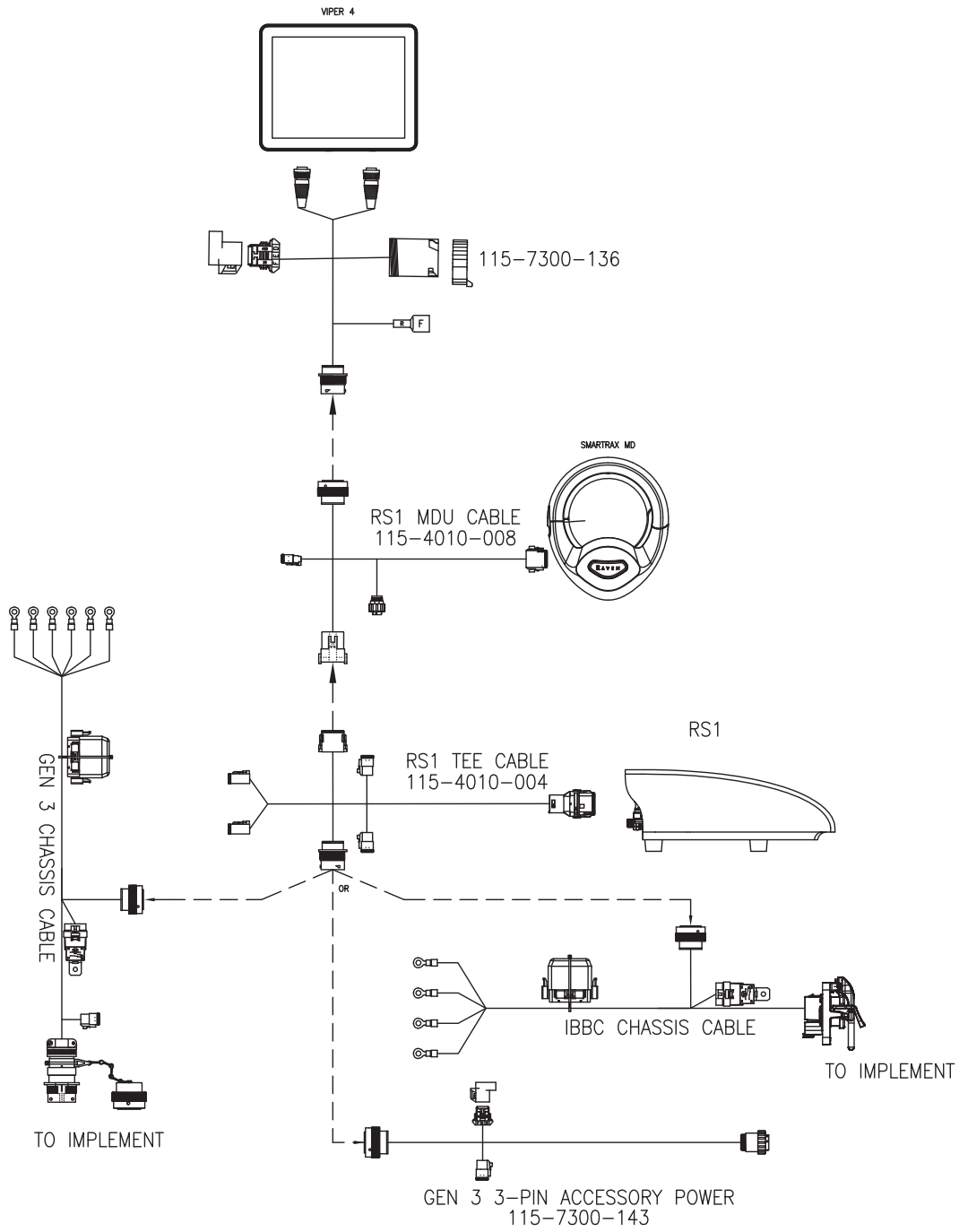
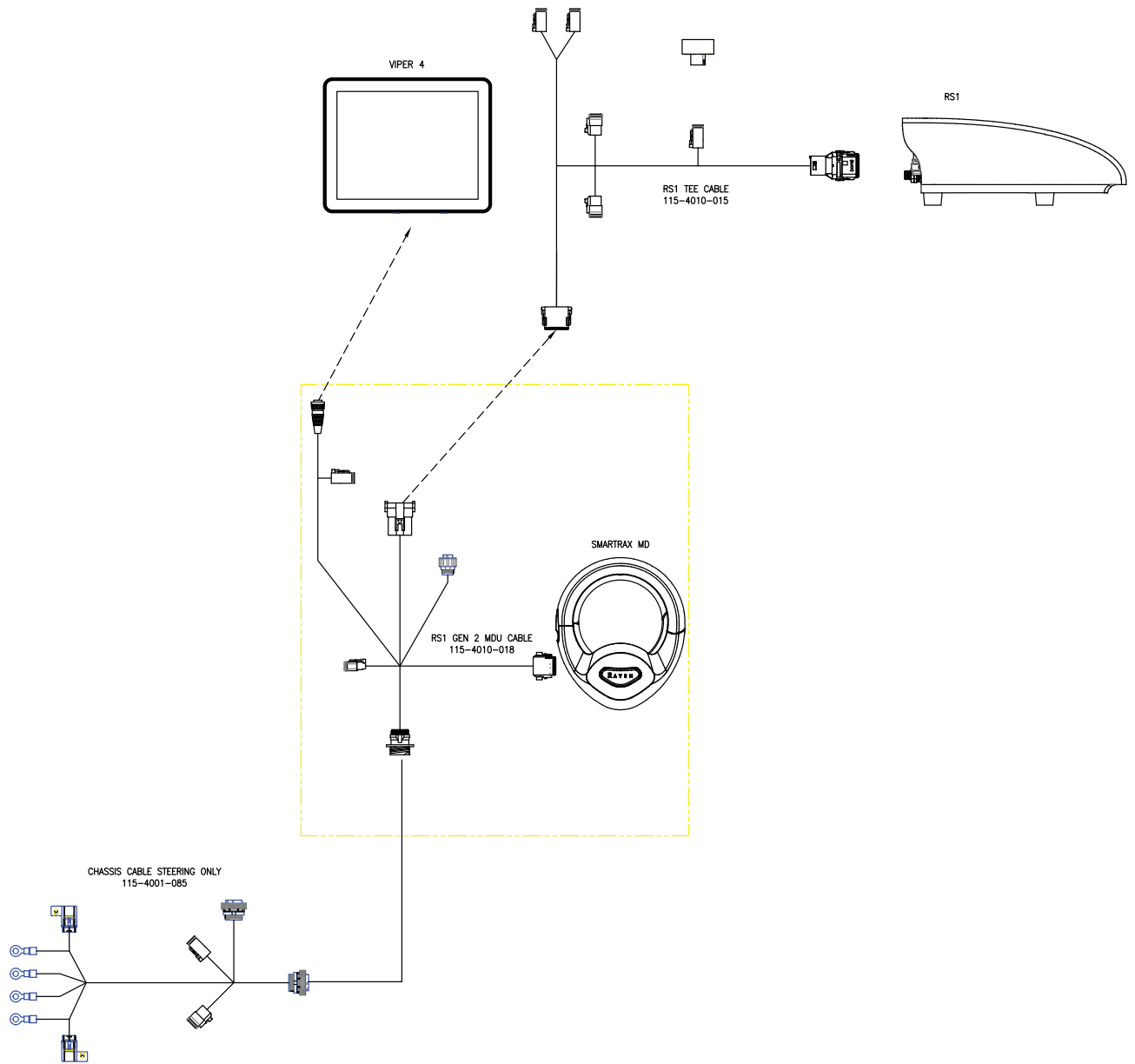


FIGURE 2. RS1 with Gen II Cabling and MDU



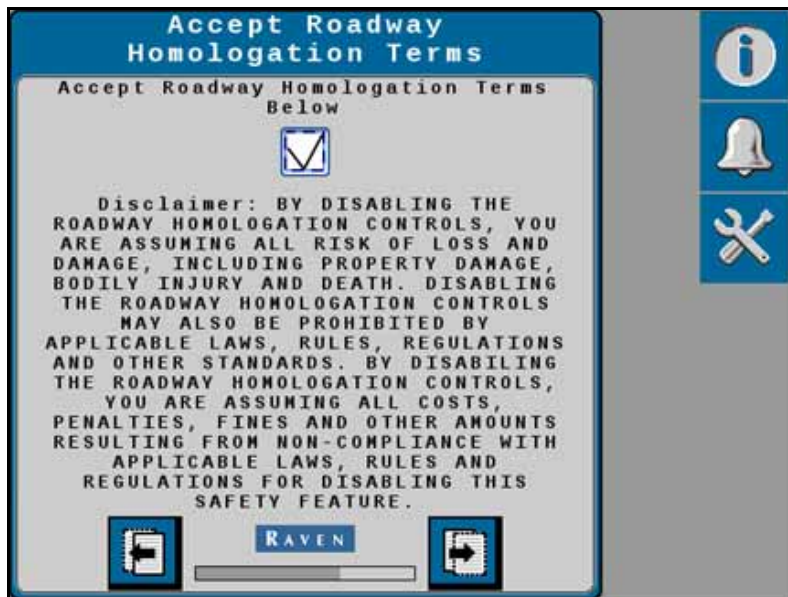
ROADWAY HOMOLOGATION

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 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 19 mph [30.5 km/h].
- Auto-steering will disengage above 21 mph [33.8 km/h].

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.


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DIN EN ISO/IEC 17025 and / DIN EN ISO/IEC 17020 und
Registration number / Registrier-Nr.
KBA-P 00077-09

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Dokument:
Rev. 04

Page / Seite:
16 of / von 16

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 24 months from the date the product was issued by Raven Industries Applied Technology Division. This warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THIS WARRANTY?

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

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

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

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

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

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

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

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

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

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