Raven SC1™/TC1™ (software version 1.5) Calibration & Operation Manual for Tractors and Sprayers

016-4010-005 Rev. F *2/2020* *E34442*

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CHAPTER 1 IMPORTANT SAFETY INFORMATION

NOTICE

Read this manual and the operation and safety instructions included with your implement and/or controller carefully before installing the Raven SC1/TC1™ guidance and steering system.

- Follow all safety information presented within this manual.
- If you require assistance with any portion of the installation or service of your Raven equipment, contact your local Raven dealer for support.
- Follow all safety labels affixed to the SC1/TC1 system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. To obtain replacements for missing or damaged safety labels, contact your local Raven dealer.

When operating the machine after installing SC1/TC1, observe the following safety measures:

- Be alert and aware of surroundings.
- Do not operate SC1/TC1 or any agricultural equipment while under the influence of alcohol or an illegal substance.
- Remain in the operator's position in the machine at all times when SC1/TC1 is engaged.
- Disable SC1/TC1 when exiting the operator's seat and machine.
- Do not drive the machine with SC1/TC1 enabled on any public road.
- Determine and remain a safe working distance from other individuals. The operator is responsible for disabling SC1/TC1 when the safe working distance has diminished.
- Ensure SC1/TC1 is disabled prior to starting any maintenance work on the system or the machine.

⚠ 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.
- The machine must remain stationary and switched off during SC1/TC1 installation or maintenance.

⚠ CAUTION

INSTRUCTIONS FOR WIRE ROUTING

The word “harness” is used to mean all electrical leads and cables, bundled and unbundled. When installing harness, secure it at least every 30 cm (12in) to the frame. Follow existing harness as much as possible and use these guidelines:

Harness should not contact or be attached to:

- Lines and hoses with high vibration forces or pressure spikes
- Lines and hoses carrying hot fluids beyond harness component specifications

Avoid contact with any sharp edge or abrading surfaces such as, but not limited to:

- Sheared or flame cut edges
- Edges of machined surfaces
- Fastener threads or cap screw heads
- Ends of adjustable hose clamps
- Wire exiting conduit without protection, either ends or side of conduit
- Hose and tube fittings

Routing should not allow harnesses to:

- Hang below the unit
- Have the potential to become damaged due to exposure to the exterior environment. (i.e. tree limbs, debris, attachments)
- Be placed in areas of or in contact with machine components which develop temperatures higher than the temperature rating of harness components
- Wiring should be protected or shielded if it needs to route near hot temperatures beyond harness component specifications

Harnessing should not have sharp bends

Allow sufficient clearance from machine component operational zones such as:

- Drive shafts, universal joints and hitches (i.e. 3-point hitch)
- Pulleys, gears, sprockets
- Deflection and backlash of belts and chains
- Adjustment zones of adjustable brackets
- Changes of position in steering and suspension systems
- Moving linkages, cylinders, articulation joints, attachments
- Ground engaging components

For harness sections that move during machine operation:

- Allow sufficient length for free movement without interference to prevent: pulling, pinching, catching or rubbing, especially in articulation and pivot points

- Clamp harnesses securely to force controlled movement to occur in the desired harness section
- Avoid sharp twisting or flexing of harnesses in short distances
- Connectors and splices should not be located in harness sections that move

Protect harnesses from:

- Foreign objects such as rocks that may fall or be thrown by the unit
- Buildup of dirt, mud, snow, ice, submersion in water and oil
- Tree limbs, brush and debris
- Damage where service personnel or operators might step or use as a grab bar
- Damage when passing through metal structures

IMPORTANT: Avoid directly spraying electrical components and connections with high pressure water. High pressure water sprays can penetrate seals and cause electrical components to corrode or otherwise become damaged. When performing maintenance:

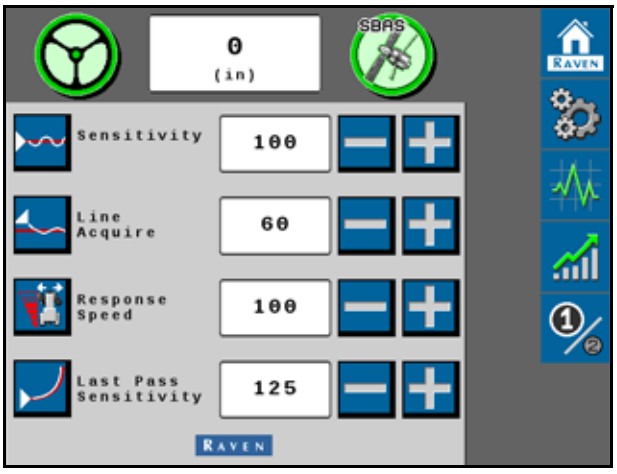
- Inspect all electrical components and connections for damage or corrosion. Repair or replace components, connections, or cable as necessary.
- Ensure connections are clean, dry, and not damaged. Repair or replace components, connections, or cable as necessary.
- Clean components or connections using low pressure water, pressurized air, or an aerosol electrical component cleaning agent.
- Remove visible surface water from components, connections, or seals using pressurized air or an aerosol electrical component cleaning agent. allow components to dry completely before reconnecting cables.

CHAPTER 2 INTRODUCTION

When coupled with a Raven field computer and a GPS solution of your choice, SC1/TC1™ is designed to offer hands-free steering of agricultural equipment including sprayers, spreaders, and tractors. When coupled with an implement steering system, SC1/TC1 is capable of keeping both your tractor and a towed implement on track.

The chapters in this manual are intended to assist with the proper calibration and operation of the SC1/TC1 system.

FIGURE 1. SC1/TC1 Home Screen



SYSTEM SPECIFICATIONS

SC1/TC1 ELECTRICAL RATING

The specifications below are specific to the SC1/TC1 system:

Current Rating	Voltage Range
60 mA	8 - 36 Volts

INSTALLATION

⚠ WARNING

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

RECOMMENDATIONS

Raven Industries recommends the following best practices when installing or operating the SC1/TC1 system for the first time, at the start of the season, or when moving the SC1/TC1 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.).

UPDATES

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

https://portal.ravenprecision.com/

Refer to the Viper 4 Installation & Operation Manual (P/N 016-0171-539) or CRX Operation Manual (P/N 016-0171-664) for instructions on updating the SC1/TC1 node software.

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 SC1™/TC1™ (software version 1.5) Calibration & Operation Manual for Tractors and Sprayers
-016-4010-005 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 INITIAL MACHINE CALIBRATION

⚠ WARNING

The machine will steer automatically. While calibrating or operating the SC1/TC1 system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

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

⚠ WARNING

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

NOTICE

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

If the ground or surface is slippery, muddy, or freshly tilled, the SC1/TC1 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 SC1/TC1 system.

CALIBRATION OVERVIEW

IMPORTANT: Installation of the SC1/TC1 system must be completed before calibrating the system. Refer to the machine-specific SC1/TC1 installation manual or contact your local Raven dealer for assistance with installing the SC1/TC1 system.

PREPARATION AND BEST PRACTICES

- For best performance, the SC1/TC1 guidance and steering system must be calibrated specifically for each machine configuration (e.g. tractor and implement combination).
- Start the calibration process with the machine parked on a level surface with several acres of smooth ground available.
- Ensure that the engine and hydraulic systems are at normal operating temperature and perform all calibration procedures at typical operating RPM.
- It is recommended to calibrate in conditions as close to actual field operations as possible. Before starting the calibration process:
    - Fold and rack booms on self-propelled applicators.
    - Disconnect any implements from the tractor hitch. Best results are obtained by completing the machine calibration without any towed implements. Refer to Chapter 3, *Initial Implement Calibration*, for assistance with calibrating the SC1/TC1 implement guidance features.
    - Verify machine measurements are correctly entered into the UT.
- During the auto-steering calibration, the machine will make several hard left and right turns. Adjust the vehicle speed and location as necessary.
    - To pause the calibration at any time, turn the steering wheel or press the **Stop** button on the UT. Tap the foot/resume switch to resume the calibration process.
    - To ensure successful auto-steering calibration, try to minimize the number of pauses.
    - If an error message is displayed during calibration, refer to Chapter 8, *Diagnostics and Troubleshooting* on page 65 for possible causes and corrective action steps to be taken.

INITIAL MACHINE CALIBRATION

Initial calibration of the SC1/TC1 system consists of the following component setup calibrations:

- *GPS Setup*
- *Terrain Compensation Calibration*
- *Auto-Steering Calibration*

NOTE: The SC1/TC1 system can be used for GPS only or for GPS and auto-steering. The following sections walk through the calibration procedures for both GPS only as well as GPS guidance and auto-steering. If using the system for GPS only, the steering calibration steps will not be completed.

1. When prompted, accept Operator Liability. Refer to the *Operator Liability* section on page 27 for additional information.

NOTE: The calibration wizard will be displayed the first time the SC1/TC1 module is accessed after installation or any time the Reset SC1/TC1 option is selected. Refer to *Resetting Calibrated Gains* section on page 113 for additional information about resetting the SC1/TC1 system.

2. Select the **Guidance and Steering** terminal from the UT menu. The Machine Selection page will be displayed.

GPS SETUP

NOTE: System Information, Diagnostic Trouble Codes (DTCs), and Machine Test screens may be viewed during the calibration process. For additional assistance with the settings available on these screens, please refer to the:

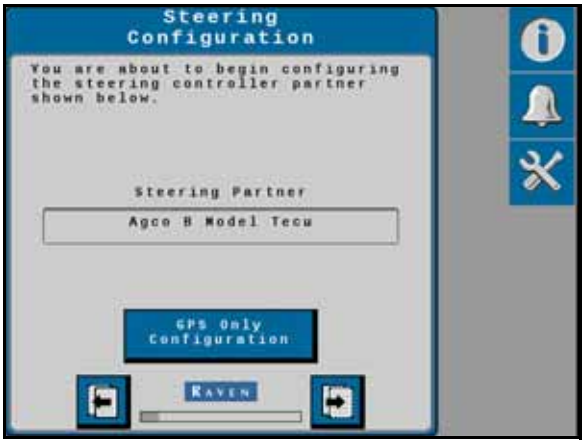
- *System Information* section on page 69
- *Diagnostic Trouble Codes (DTC)* section on page 65
- *Wheel Angle Sensor Settings* section on page 46.

NOTE: The Machine Test icon will only be displayed if a Steering Partner is detected.

3. Use the drop-down options to select the Machine Type, Machine Make, and Machine Model most closely matching the equipment used for the current machine configuration.
4. When all options have been set, select the Next button. One of the two following screens will be displayed.

- Steering Partner Not Found
- Steering Configuration

FIGURE 1. Steering Partner and Configuration



5. Select the **GPS Only Configuration** button to set up and use only the GPS features of the SC1/TC1 system. Proceed to step 6 to continue the GPS Only Configuration.

   To calibrate both the GPS and auto-steering features of the SC1/TC1 system, confirm that the Steering Configuration screen displays the correct Steering Partner and touch the **Next** button.
6. Use the drop-down to select the appropriate GPS receiver.

FIGURE 2. Receiver Selection

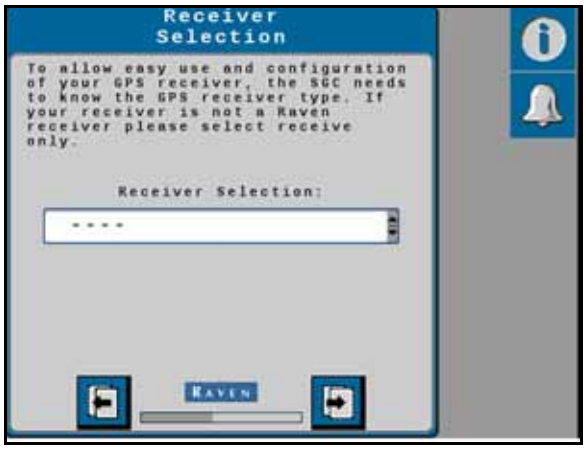
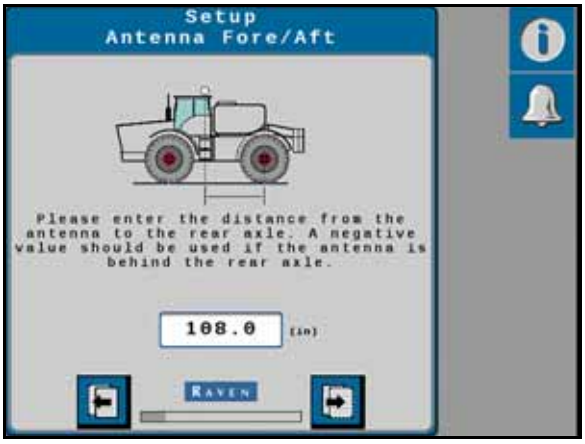


FIGURE 3. Antenna Fore/Aft Screen

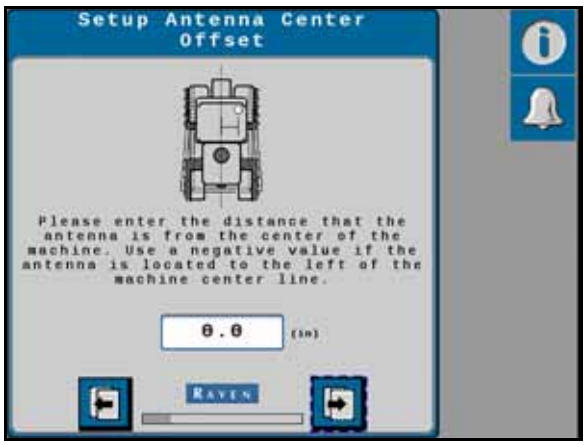


7. Select the value box to enter the Antenna Fore/Aft position.

NOTE: The Antenna Fore/Aft Offset is measured from the rear axle of the machine to the center of the GPS antenna. A negative value should be entered if the GPS antenna is located behind the rear axle.

8. Select the **Next** arrow.

FIGURE 4. Antenna Center Offset Screen

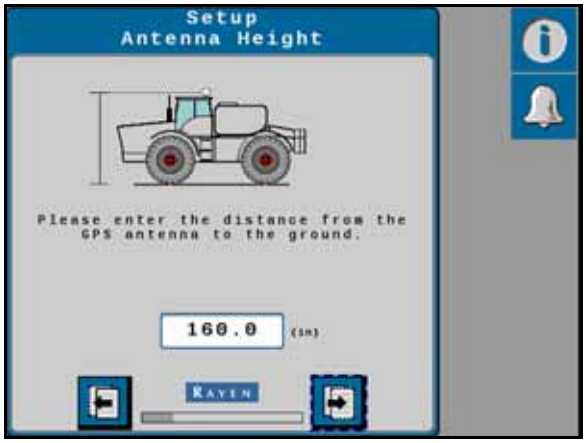


9. Select the value box to enter the Antenna Center Offset position.

NOTE: The Antenna Center Offset position is measured from the centerline of the machine to the center of the GPS antenna. A negative value should be entered if the GPS antenna is located to the left of the centerline.

10. Select the **Next** arrow.

FIGURE 5. Antenna Height Screen

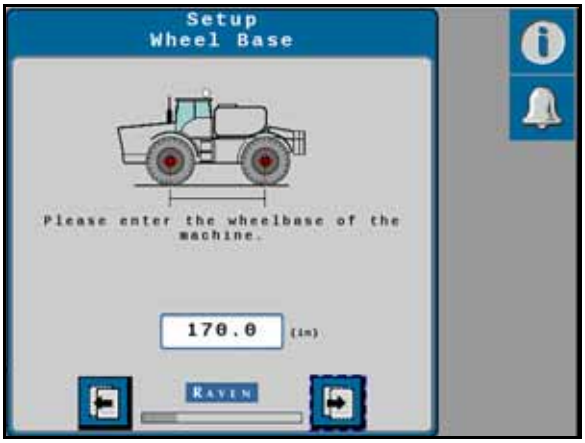


11. Select the value box to enter the Antenna Height.

NOTE: The Antenna Height is measured from the ground to the mid-point of the GPS antenna.

12. Select the **Next** arrow.

FIGURE 6. Wheel Base Screen

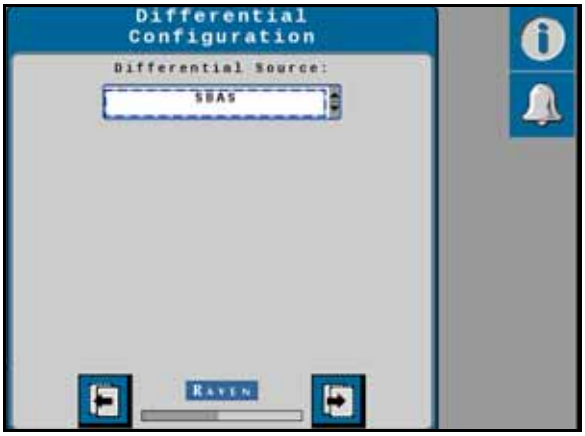


13. Select the value box to enter the Wheel Base.

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 2 to get the average Wheel Base value.

14. Select the **Next** arrow.

FIGURE 7. GPS Differential Configuration Screen

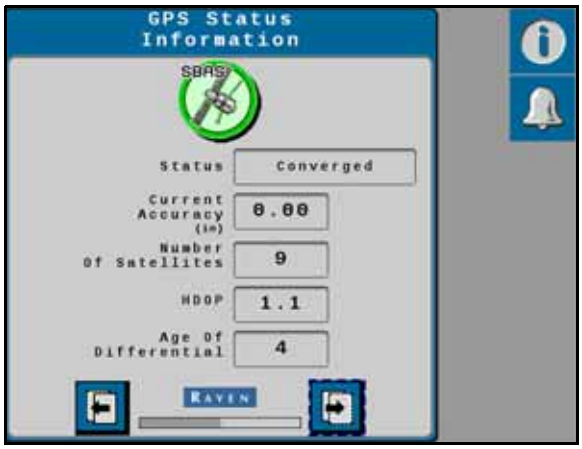


15. Select the appropriate GPS Differential Configuration from the drop-down box:

NOTE: Some differential sources may require a feature unlock. Refer to Chapter 7, *Feature Unlock Codes*, for additional assistance with entering feature unlocks. Contact your local Raven dealer for assistance with purchasing feature unlocks.

16. Select the **Next** arrow.

FIGURE 8. Position Accuracy Screen

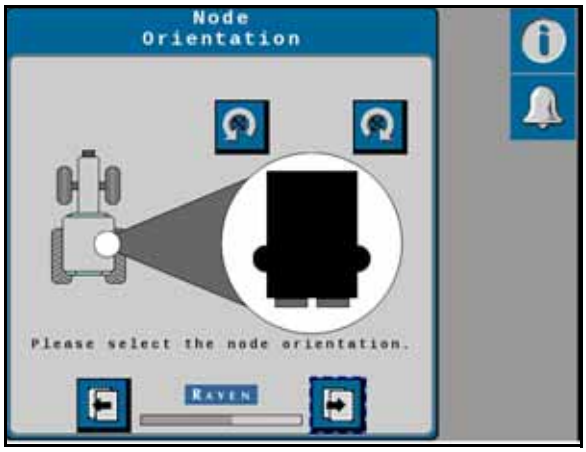


17. Review the GPS Status Information displayed and select the Next button to proceed with the calibration process.

NOTE: The GPS solution must be converged to calibrate and proceed with the initial system calibration.

18. Select the **Next** arrow.
19. Use the rotation buttons until the on-screen display matches the orientation of the SC1/TC1 ECU.

FIGURE 9. SC1/TC1 ECU Orientation



20. Select the **Next** arrow.

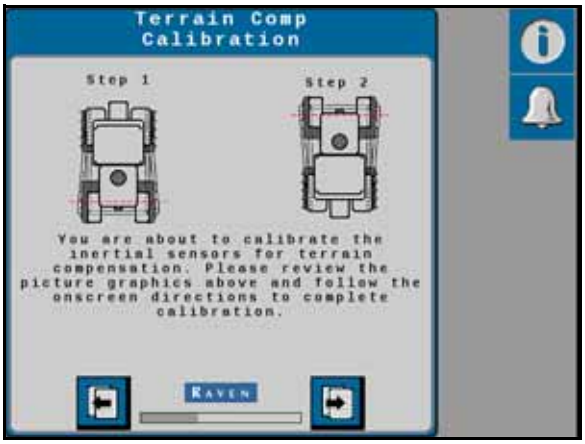
TERRAIN COMPENSATION CALIBRATION

FIGURE 10. Terrain Compensation Calibration (page 1)

1. Drive the machine forward 33 feet [10 m] and park on a flat surface.

NOTE: The SC1/TC1 system must detect the direction of forward travel to properly calibrate the terrain compensation features.

FIGURE 11. Terrain Compensation Calibration (page 2)



2. Stop the machine on a level surface.
3. Place flags or markers to mark rear tire position on each side of the machine.
4. Select the **Next** button and follow the on-screen instructions to begin the terrain compensation calibration.

FIGURE 12. Step 1 - Marking the Pivot Point Before Calibration

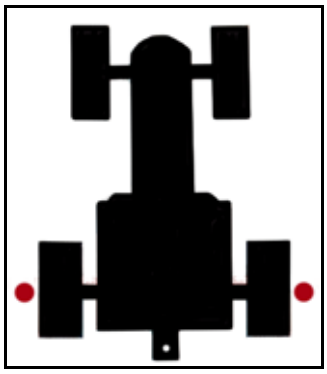
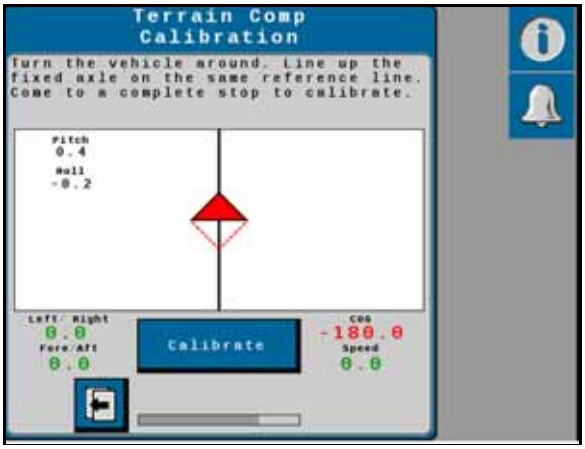
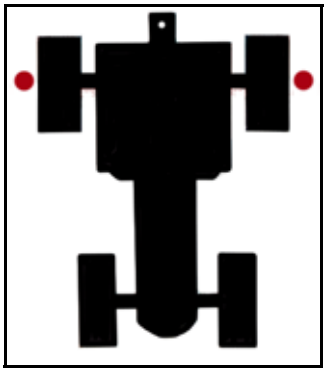


FIGURE 13. Terrain Compensation Calibration



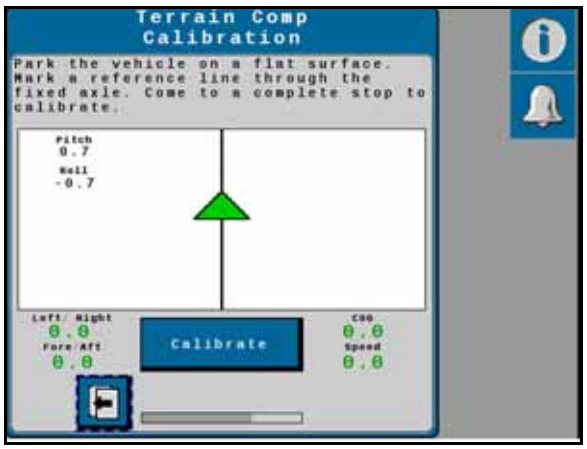
5. Select the **Calibrate** button to begin the calibration process.
6. The progress of the terrain compensation calibration will be displayed on the screen. Wait for the calibration process to be completed before moving the vehicle.
7. Drive forward and turn the machine around (180°). Park the vehicle between the markers facing in the opposite direction as when the Calibrate button was first selected. Make sure the markers are aligned with the pivot point of the machine on opposite sides of the machine.

FIGURE 14. Step 2 - Machine Orientation to Complete Calibration



NOTE: The two triangles on the display should line up on top of each other when the machine is in the correct position.

FIGURE 15. Terrain Comp Calibration Screen



8. Select the **Calibrate** button again to complete the Terrain Compensation Calibration.
9. Select the **Next** arrow.

NOTE: If calibrating the SC1/TC1 system for GPS only operation, the Calibration Wizard Summary will be displayed. Touch the Accept button to go to the GPS Only Home screen. Refer to Chapter 4, *Routine Machine Operation*, for assistance with operating the SC1/TC1 system in GPS only mode.

If calibrating the auto-steering features, continue to the next section to continue the SC1/TC1 system calibration.

FIGURE 16. Calibration Summary

AUTO-STEERING CALIBRATION

The Auto-Steering calibration consists of the following component setup calibrations:

- *Resume and Disengage Switch Calibration*
- *Wheel Angle Sensor (WAS) Calibration*

RESUME AND DISENGAGE SWITCH CALIBRATION

FIGURE 17. Resume Switch Verification Screen

1. Press the foot/resume switch. The switch status icon will change if the switch input is detected and the calibration will automatically proceed to the next screen.

NOTE: Select the **Use On-Screen Engage** option to use an on-screen engage widget to start and stop auto-steering during SC1/TC1 operation.

FIGURE 18. Disengage Switch Calibration Screen

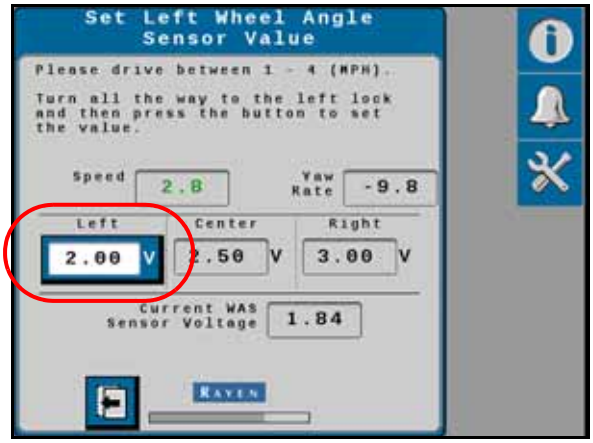
2. Turn the steering wheel to calibrate the disengage sensor. The status icon will change if the input is detected and the calibration with automatically proceed to the next screen.

NOTE: In a SmarTrax MD/HD system, a screen displaying the calibrated disengage value will be displayed. This value is editable.

WHEEL ANGLE SENSOR (WAS) CALIBRATION

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

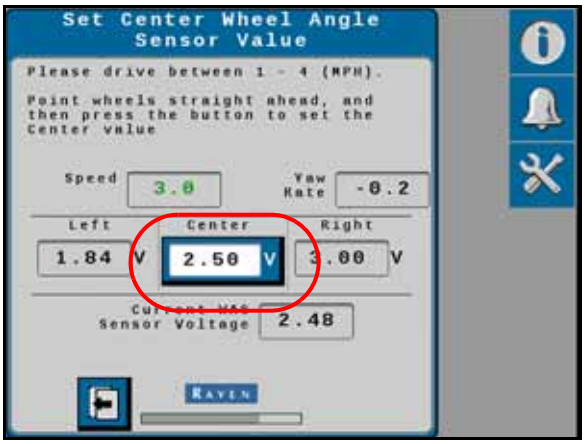
FIGURE 19. Left WAS Calibration Screen



1. Drive forward between 1 - 4 mph [2 - 6 km/h].
2. Turn the steering wheel all the way to the left steering lock.
3. Select the **Left** button to set the left WAS value.

NOTE: Do not move the steering wheel until the calibration screen advances to the Center WAS setting.

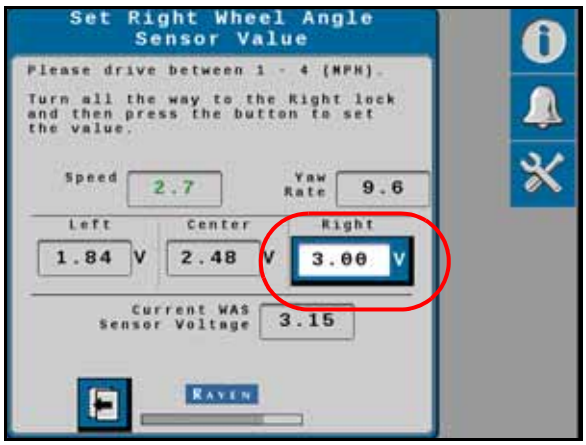
FIGURE 20. Center WAS Calibration Screen



4. While driving forward between 1 - 4 mph [2 - 6 km/h], recenter the steering wheel to drive straight ahead.
5. Select the **Center** button to set the center WAS value.

NOTE: Do not move the steering wheel until the calibration screen advances to the Right WAS setting.

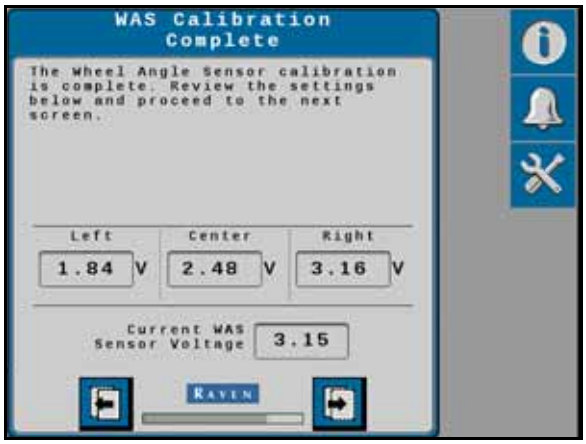
FIGURE 21. Right WAS Calibration Screen



6. Continue driving forward between 1 - 4 mph [2 - 6 km/h].
7. Turn the steering wheel all the way to the right steering lock.
8. Select the **Right** button to set the right WAS value.

NOTE: Do not move the steering wheel until the Calibration Complete screen is displayed.

FIGURE 22. WAS Calibration Complete Screen



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

HYDRAULIC SYSTEM CALIBRATION

The steering control calibration process allows the SC1/TC1 system to learn the hydraulic capabilities of the machine for optimal steering performance in the field.

NOTE: Review the *Preparation and Best Practices* section on page 10 for tips on completing the auto-steering calibration successfully.

It is recommended to complete the SC1/TC1 Steering Control Calibration for optimal system performance. However, the automatic calibration may be bypassed by selecting the **Use Quick**

Calibration option. The system will load default gains for the machine selected during the calibration process.

The Quick Calibration option will not be available if a “Generic” machine make was selected during the GPS calibration process.

NOTE: If an error message is displayed during calibration, refer to Chapter 8, *Diagnostics and Troubleshooting* on page 65 for possible causes and corrective action steps to be taken.

NOTICE

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

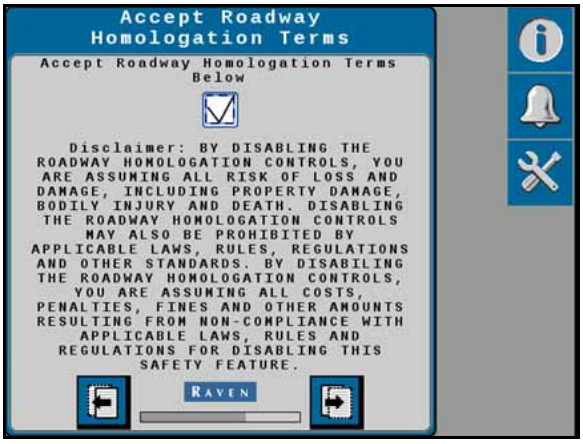
If the ground or surface is slippery, muddy, or freshly tilled, the SC1/TC1 system may learn incorrect steering responses for normal operating conditions.

Ensure the hydraulic systems are operating properly and there are no other mechanical issues that may affect the performance of the SC1/TC1 system.

To complete the Steering Control Calibration:

1. Accept the Roadway Homologation terms. Carefully review the on-screen disclaimer and select the check box option.

FIGURE 23. Roadway Homologation



NOTE: Refer to the Chapter 10, *Roadway Homologation*, for additional information about the SC1/TC1 homologation terms and certifications.

2. Select the **Next** arrow.

3. Drive forward between 1 - 4 mph [2 - 6 kph].

WARNING

The machine will steer automatically. While calibrating or operating the SC1/TC1 system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

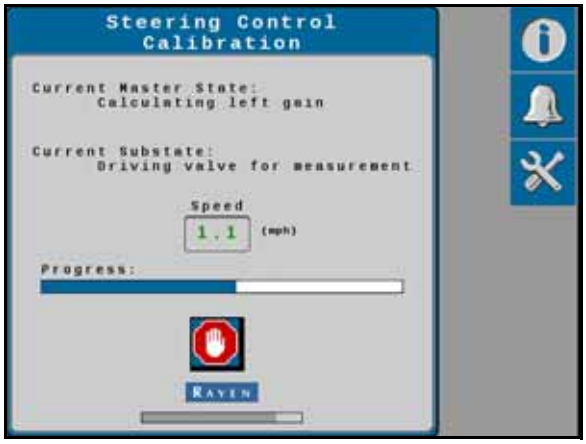
To disengage auto-steering at any time, turn the steering wheel or select the on-screen Stop button.

WARNING

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

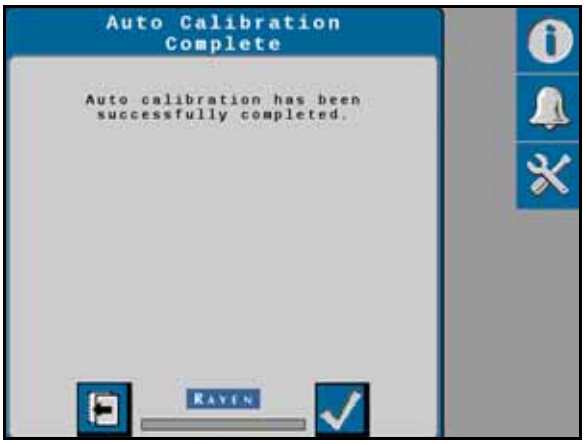
4. Press the foot/resume switch or use the on-screen arrow to begin calibration.
5. The display will show progress of the auto-steering calibration.

FIGURE 24. Calibration in Process Screen



6. Once the calibration process is complete, select the **Accept** button.

FIGURE 25. Auto Calibration Complete



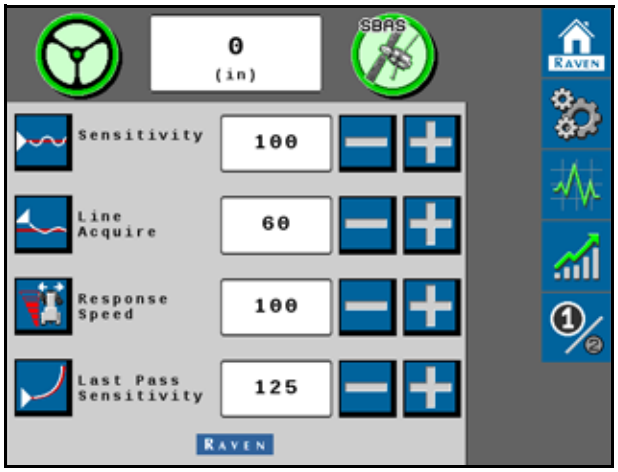
CALIBRATION SUMMARY

1. Review the Calibration Wizard Summary information.

FIGURE 26. Calibration Wizard Summary

2. Select the **Accept** button to complete the calibration process. Refer to Chapter 4, *Routine Machine Operation*, for assistance with operation of the SC1/TC1 guidance and steering system.

FIGURE 27. SC1/TC1 Home Screen



CHAPTER 4 ROUTINE MACHINE OPERATION

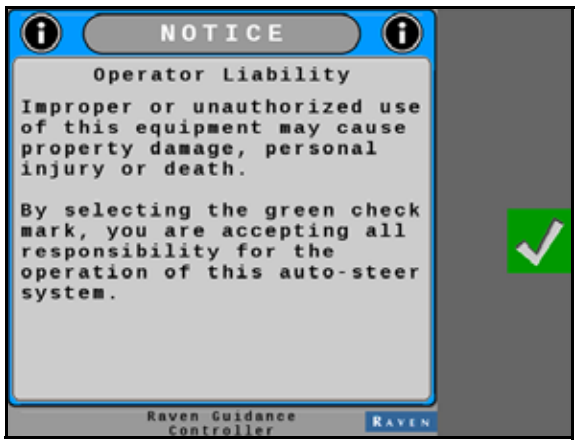
NOTE: The ISO UT must be calibrated specifically for the vehicle before being used to operate the SC1/TC1 system. Refer to the UT operation manual for additional assistance with using your UT display.

Refer to the UT display or Raven field computer operation manual for assistance with setting up and starting a job, setting guidance lines, and other guidance settings during in-field operations.

OPERATOR LIABILITY

The Operator Liability Warning is displayed each time the SC1/TC1 system is powered on. If the operator does not accept liability, the SC1/TC1 system will be disabled and cannot be reengaged until the liability warning is accepted.

FIGURE 1. Operator Liability Prompt

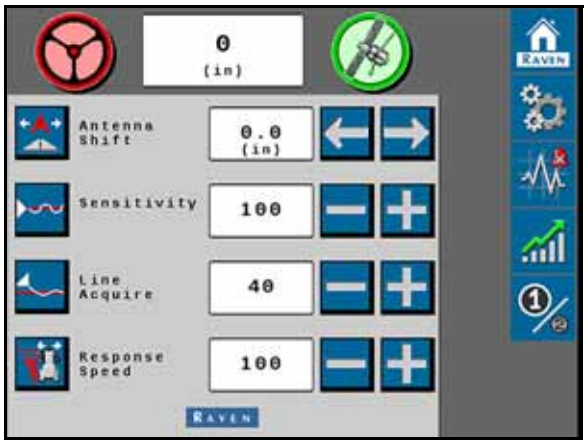


To proceed with normal operation of the SC1/TC1 GPS and auto-steering features, read and accept the Operator Liability Warning.

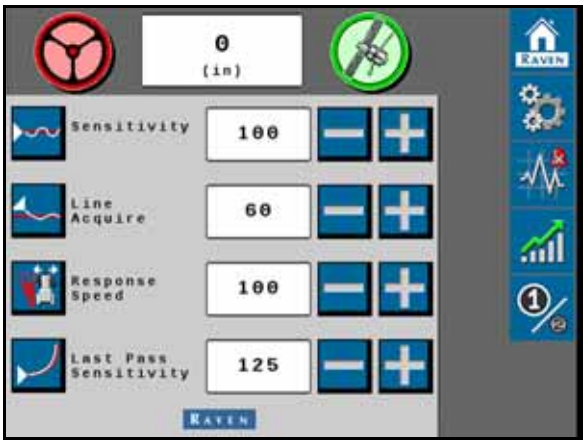
HOME SCREEN

FIGURE 2. Home Screen Examples

Tractor



All Other Machines



NOTE: The Home screen will display settings and options based upon the machine type and the features selected during the machine configuration calibration.

When operating in GPS Only mode, the Home screen is replaced with the GPS Status information. See the *GPS Status Screen* section on page 33 for information displayed on this screen.

STEERING STATUS INDICATOR

The following are common steering status or mode messages which may occur while the SC1/TC1 system is on the ISOBUS:

Display	Message
	System critical DTCs are present. The SC1/TC1 system cannot be engaged in this state. Refer to Chapter 8, *Diagnostics and Troubleshooting*, for assistance with resolving active DTCs and troubleshooting the system..
	Warning DTCs are present. The SC1/TC1 system may be engaged in this state, but system performance may be impacted.
	No active DTCs are present. The SC1/TC1 system is ready to be engaged.
	Steering is engaged, with no active diagnostic or troubleshooting codes present in the SC1/TC1 system.

Select the steering wheel icon to display the Steering Status screen. Refer to the *Steering Status Screen* section on page 30 for additional assistance with the information available on this screen.

OFF-LINE INDICATOR

Shown in the top, center of the Home screen, the off-line indicator displays the distance and direction to the current guidance line.

GPS STATUS INDICATOR

The following are common GPS status or mode information which may occur while the SC1/TC1 system is engaged:

	No GPS information is detected by the SC1/TC1 system.
	GPS solution is not converged or an active DTC has been detected.
	GPS solution is converged and no active DTCs are detected. **NOTE:** Both the steering wheel and GPS icons must be green in order to engage the SC1/TC1 system.
	GPS RTK-L or RTK Pro solutions are being used for field guidance. DTCs may be present.

Select the satellite icon to display the GPS Status screen. Refer to the *GPS Status Screen* section on page 33 for additional assistance with the information available on this screen.

TUNING SETTINGS

The following settings and adjustments are displayed on the SC1/TC1 Home screen and may be used during normal operation to adjust or tune the system:

- **Antenna Shift (Tractors Only)** - The Antenna Shift settings allows the user to shift the center point of the antenna relative to the center point of the machine. Negative values indicate that the antenna is located to the left of the 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 SC1/TC1 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 steering may become jittery. If the Response Speed is too low, the machine may wander lazily. Values range between 1 - 255.

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

- **Last Pass Sensitivity (non-Tractors Only)** - The Last Pass Sensitivity determines how tightly the machine tries to steer on a curved path. Too high of a value will cause the machine to steer to the inside of a curve. Too low of a value will cause the machine to steer to the outside of a curve. Values range from 1 - 500.

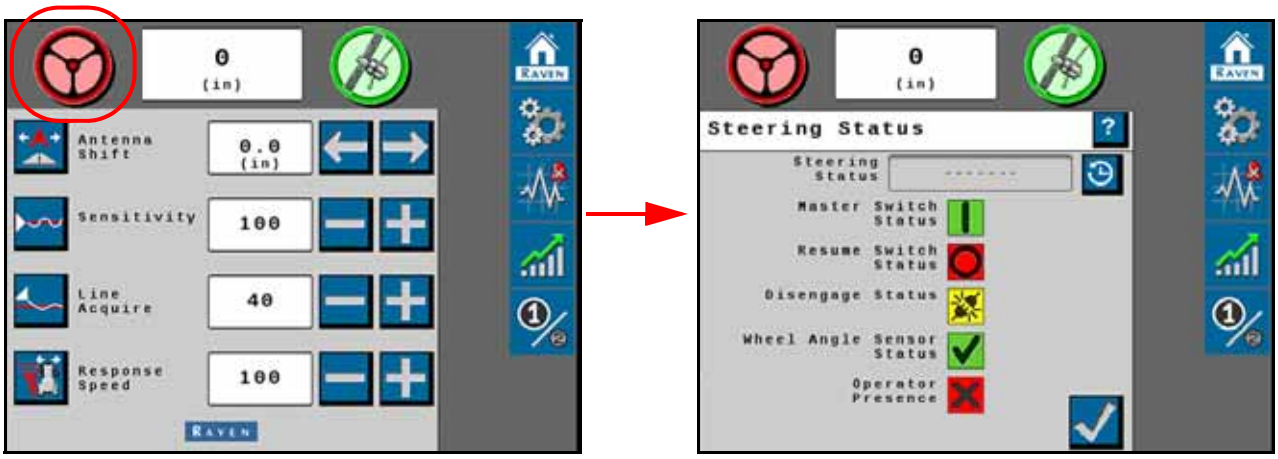
NOTE: Refer to the *Advanced Tuning* section on page 40 for assistance with the Last Pass Sensitivity setting when operating on conventional tractors. Last Pass Sensitivity only adjusts the system performance on Last Pass and A-B Curve lines.

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

STEERING STATUS SCREEN

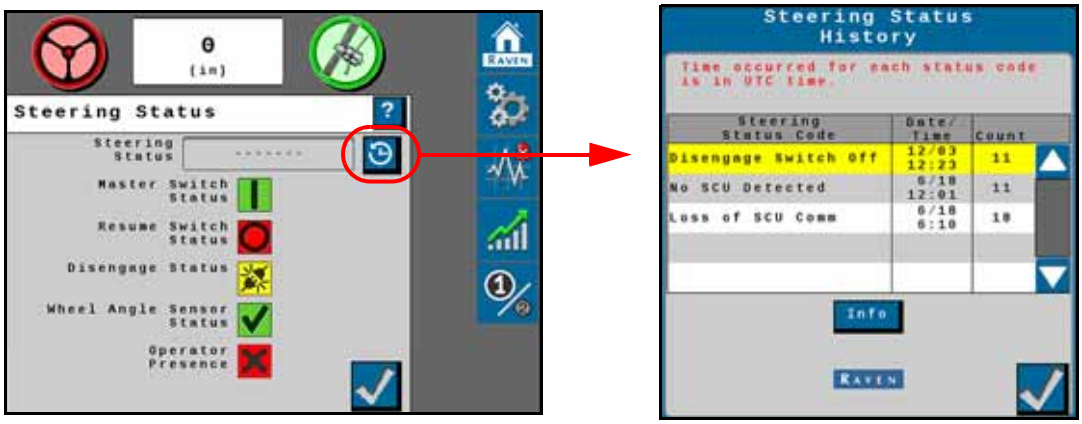
Select the steering wheel icon to display the Steering Status screen. The Steering Status field displays the last exit code and the reason why steering was disabled.

FIGURE 3. Steering Status Screen



Select the Steering Status History icon next to the Steering Status field to view the history including the times the system disengaged and why it disengaged.

FIGURE 4. Steering Status History



Select the **Info** button on the bottom of the Steering Status History page to display a description of the disengagement code.

FIGURE 5. Info Button Information

STATUS DISPLAYS

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.

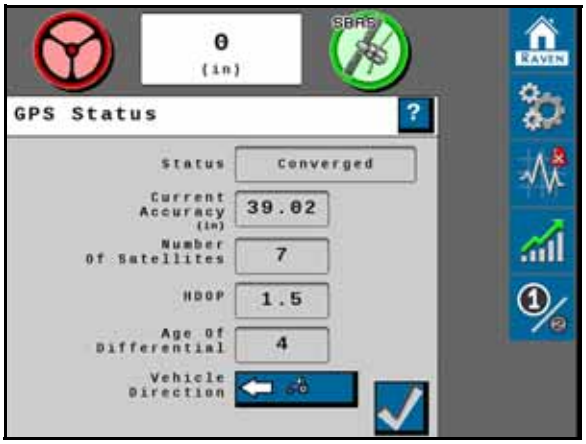
OPERATOR PRESENCE SWITCH

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 SCREEN

FIGURE 6. GPS Status Screen



Select the GPS icon to display the GPS Status screen.

Display	Message
Status	Displays the selected GPS convergence status. • Error • No Signal • Converging • Converged
Current Accuracy	A value representing the reported horizontal accuracy of the current GNSS solution as detected by the receiver.
Number of Satellites	The number of satellites currently in view by the GPS receiver.
HDOP	Horizontal Dilution of Precision. A higher value indicates that the satellites currently used for the machine position are grouped closer together and accuracy may be reduced. If the satellites are too close, the system may record a High HDOP DTC.
Age of Differential	Time (in seconds) since the last differential correction was received. This field will not display a value if a differential source is not currently tracked.
Vehicle Direction	Select the Vehicle Direction button to manually override the displayed direction of travel.

CRX FEATURES AND OPERATION

CRX WIDGET DEFINITIONS

The following are common status or mode information which may be displayed on a ROS device while operating the SC1/TC1 system while in a job:

Display	Message
	The SC1/TC1 node is detected, but the operator must accept responsibility for the operation of the SC1/TC1 system.
	No A-B path or guidance line has been set or an active DTC is preventing the SC1/TC1 system from engaging.

Display	Message
	SC1/TC1 is detected, turned on, and calibrated. A non-critical DTC is present.
	SC1/TC1 is detected, on, and calibrated.
	SC1/TC1 is detected and in operation.
	SC1/TC1 is detected and in operation. A non-critical DTC is present.

NOTE: Refer to *Diagnostic Trouble Codes (DTC)* section on page 65 for additional status conditions which may be displayed in the SC1/TC1 on-screen widget.

ENGAGING SC1/TC1

FIGURE 7. SC1/TC1 Status Widget

NOTE: If the SC1/TC1 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 SC1/TC1 system can be enabled for operation.

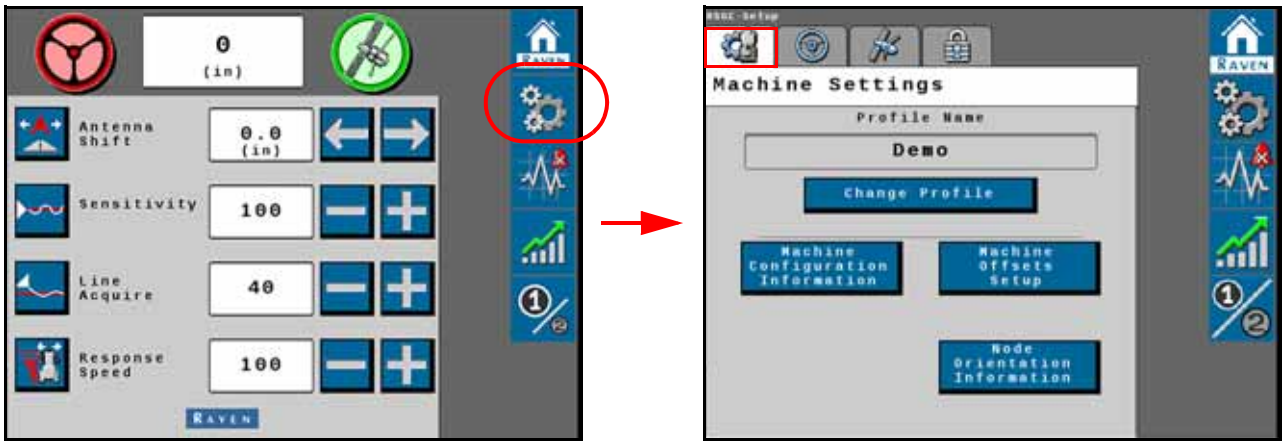
The SC1/TC1 steering may also be engaged using the following methods:

- Tap the foot switch or rocker switch to engage SC1/TC1 features during field operation.
- Press the SC1/TC1 on-screen status widget to engage the SC1/TC1 during field operation.

CHAPTER 5 MACHINE SETTINGS AND TUNING

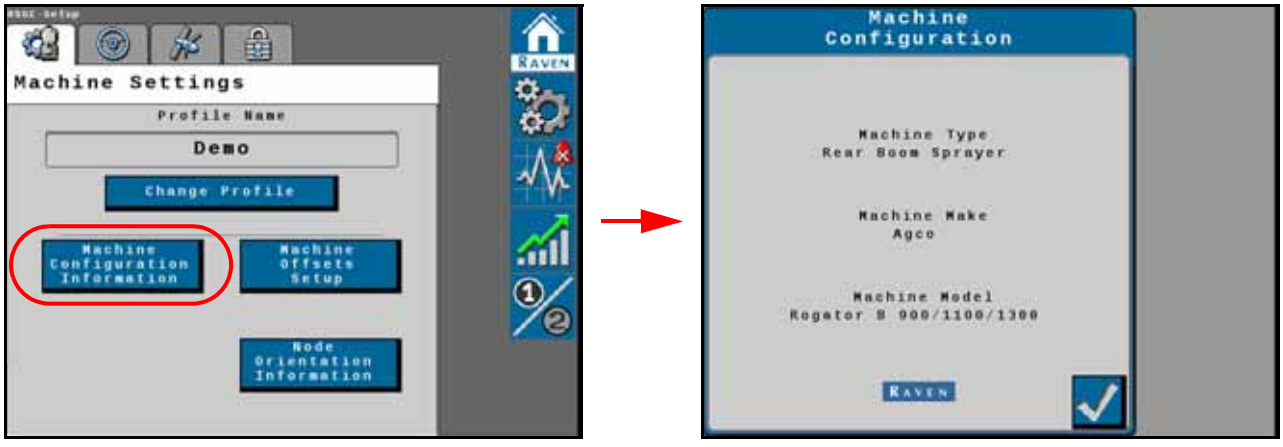
MACHINE SETTINGS TAB

FIGURE 1. Machine Settings Screen



MACHINE CONFIGURATION

FIGURE 2. Machine Configuration Screen



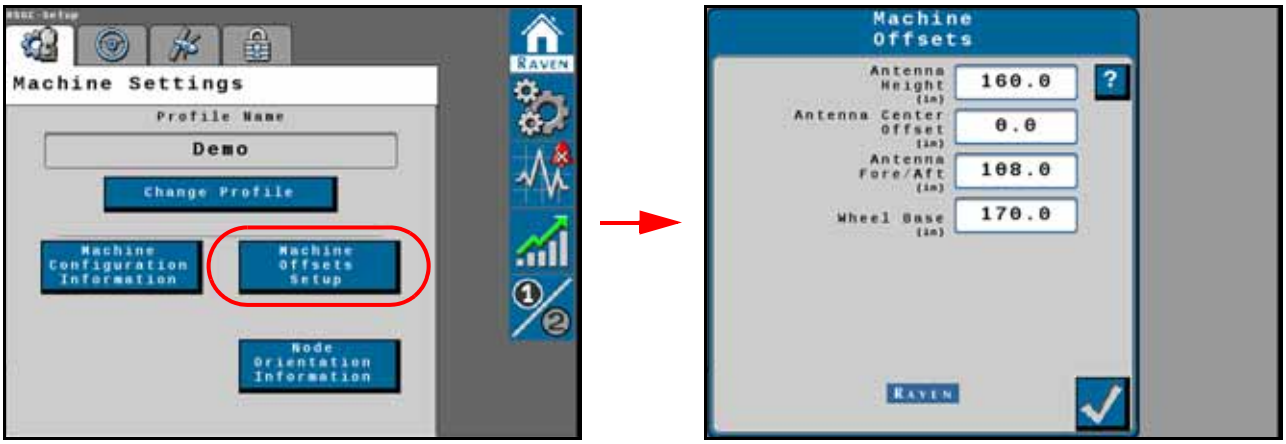
To view the current machine configuration:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. On the Machine Settings tab, select the Machine Configuration Information button.
3. The current machine type, make, and model information that was entered during the calibration process. The Machine Configuration settings cannot be changed unless the SC1/TC1 system is recalibrated.

4. Select the Accept button in the lower, right corner of the screen to return to the Machine Settings tab.

ANTENNA OFFSETS SETTINGS

FIGURE 3. Machine Offsets Setup Screen



To adjust the antenna offset measurements:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. On the Machine Settings tab, select the Machine Offsets Setup button.
3. The Machine Offsets screen displays the machine-specific measurements that were entered during the system calibration:

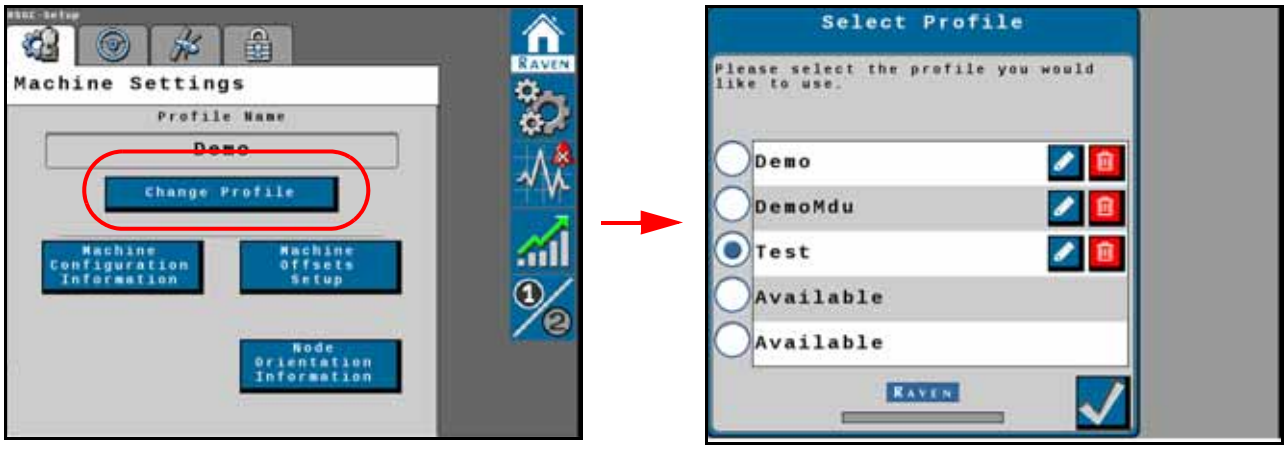
NOTE: Select the **Help** ? icon for more information about the settings shown on the screen.

- **Antenna Height** - The Antenna Height is measured from the ground to the middle of the GPS antenna.
- **Antenna Center Offset** - The Antenna Center Offset position measured from the centerline of the machine to the center of the GPS antenna. A negative value should be entered if the GPS antenna is located to the left of the center line.
- **Antenna Fore/Aft** - The Antenna Fore/Aft position is measured from the rear axle of the machine to the center of the GPS antenna. A negative value should be entered if the GPS antenna 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.

4. Select the Accept button in the lower, right corner of the screen to return to the Machine Settings tab.

CHANGE PROFILE

FIGURE 4. Change Profile



To select a different profile, create a new profile, or recalibrate the current profile:

1. From the SC1/TC1 Home screen, select the Settings Menu button.

NOTE: The name of the current profile selected is displayed at the top of the Machine Settings tab.

2. Select the Change Profile button.

NOTE: Up to 5 machine profiles may be saved for the SC1/TC1 system.

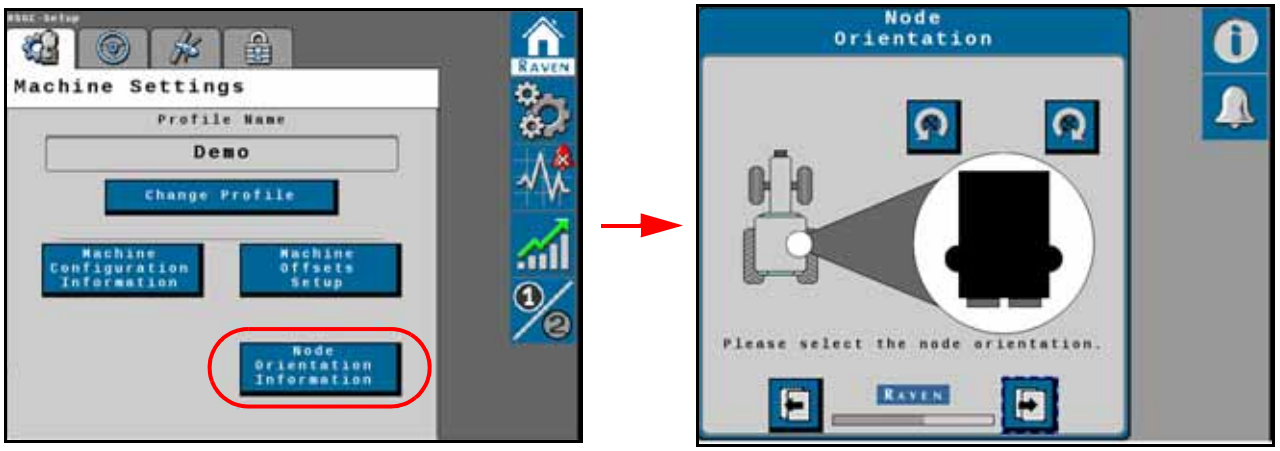
3. Use the radio buttons to select a different profile.

   Selecting an “Available” profile will require the operator to complete the Initial Machine Configuration process.

4. Select the Edit button to rename the selected profile or the Delete button to remove profile settings from the SC1/TC1 system. The profile will need to be recalibrated.
5. Select the Accept button in the lower, right corner of the screen to return to the Machine Settings tab.

NODE ORIENTATION

FIGURE 5. Node Orientation



To adjust the node orientation:

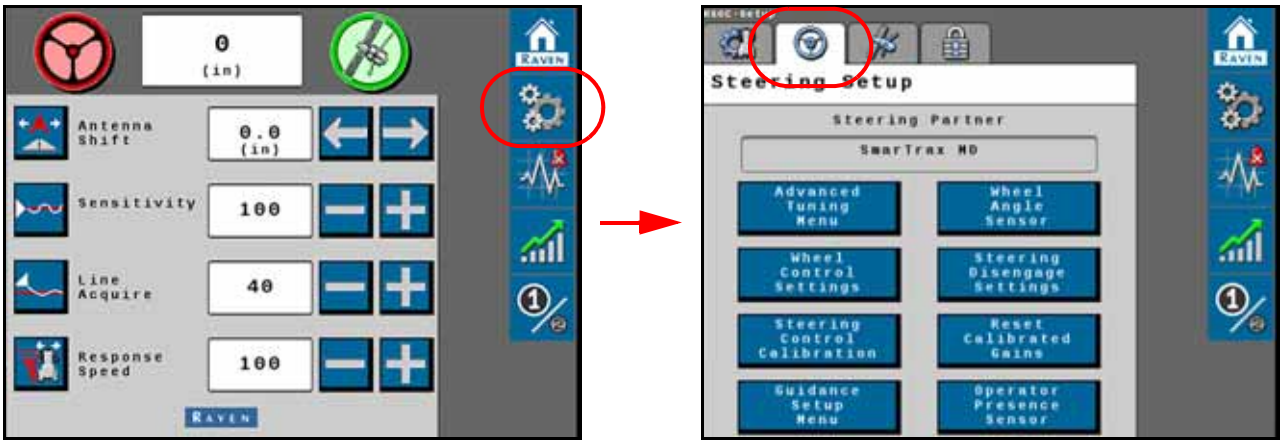
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. On the Machine Settings tab, select the Node Orientation button.
3. Use the rotation buttons to rotate the node image in 90° increments. The node image shown on the screen should match the orientation of the ECU in the machine cab.

NOTE: The SC1/TC1 ECU must be mounted in a horizontal orientation. Vertical orientations are not supported.

4. Select the Accept button in the lower, right corner of the screen to return to the Machine Settings tab.

STEERING SETUP TAB

FIGURE 6. Steering Setup Screen

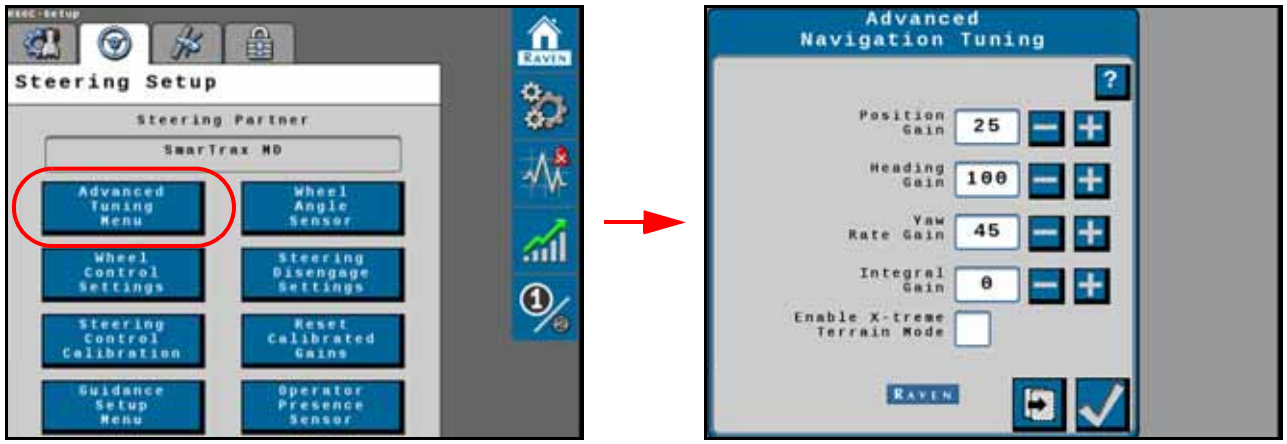


The Steering Setup tab displays the steering partner with which SC1/TC1 works during auto-steering operation. The Steering Setup tab offers settings and options which allow the operator to fine-tune the steering system.

NOTE: The Steering Setup tab will not be available if the SC1/TC1 system is calibrated for the GPS Only mode.

ADVANCED TUNING

FIGURE 7. Advanced Tuning Menu



To access advanced auto-steering tuning options and settings:

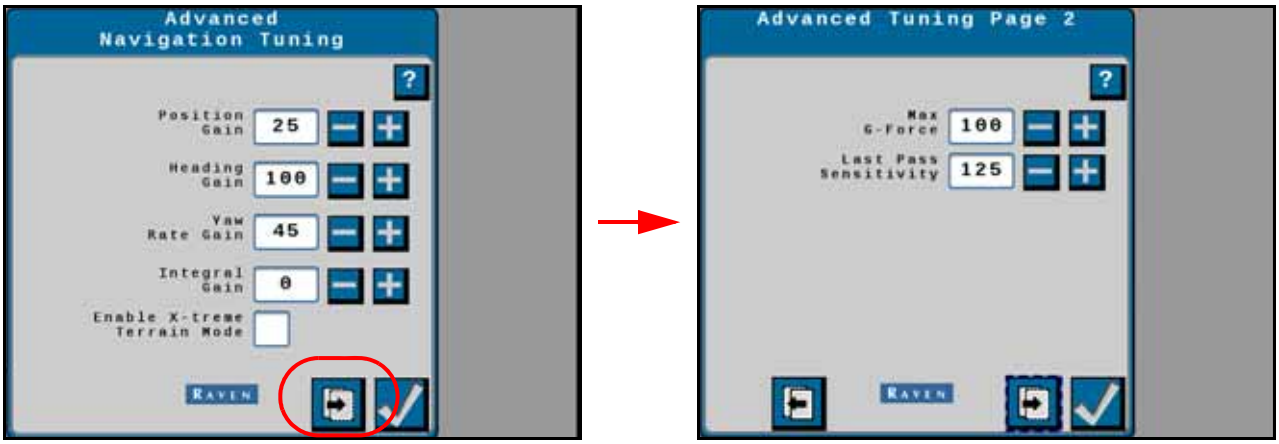
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Advanced Tuning Menu button.

   The following settings and options are displayed on the Advanced Navigation Tuning page:

- **Position Gain** - Determines how aggressively the SC1/TC1 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 SC1/TC1 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 0.
- **Enable X-Treme Terrain Mode** - This setting allows adjustment for steering performance on terraces.

3. Select the Next button to display the Advanced Tuning Page 2. The following settings and options are displayed:

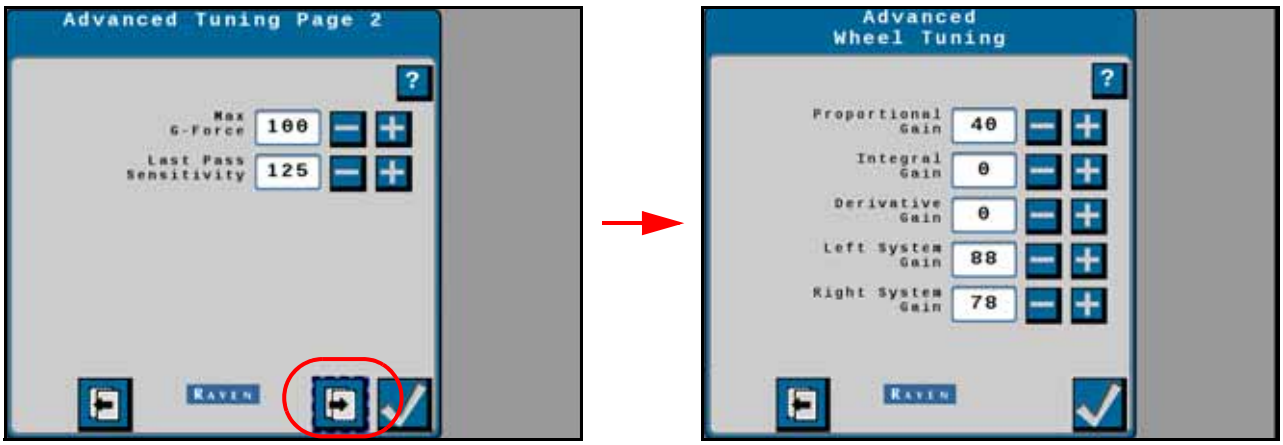
FIGURE 8. Advanced Tuning Page 2



- **Max G-Force** - Limits the centripetal force experienced by the operator during a turn. A higher value allows to the machine to perform sharper turns, while a lower value limits the machine turning radius.
- **Last Pass Sensitivity** - The Last Pass Sensitivity determines how tightly the machine tries to steer on a curved path. Too high of a value will cause the machine to steer to the inside of a curve. Too low of a value will cause the machine to steer to the outside of a curve. Values range from 1 - 500.

4. Select the Next button to display the Advanced Wheel Tuning page. The following settings and options are displayed:

FIGURE 9. Advanced Wheel Tuning Screen

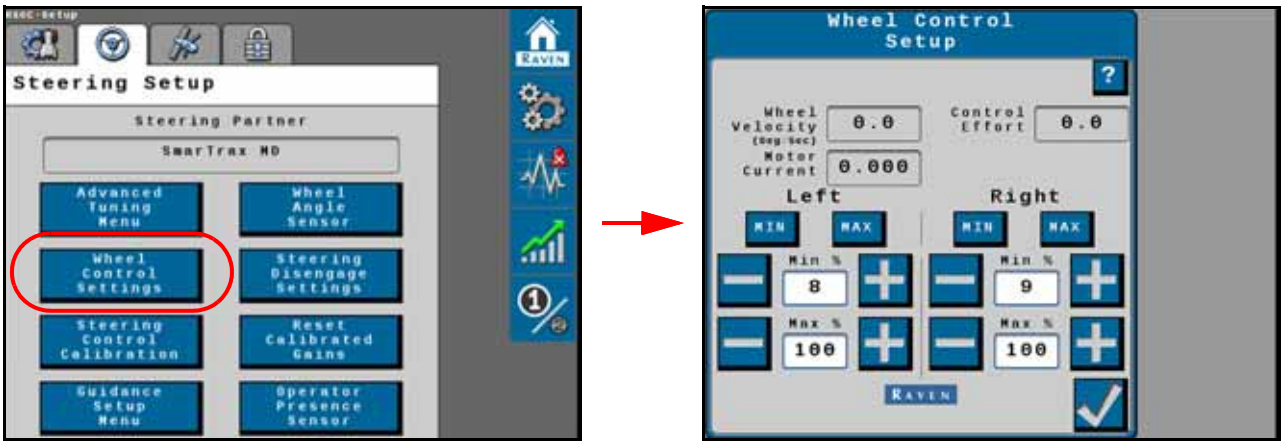


- **Proportional Gain** - Determines the rate of the wheel response. Increasing the Proportional Gain value causes the wheel response to be faster, but can result in the machine overshooting the target wheel angle position or can cause the wheels to take a longer time to stabilize.
- **Integral Gain** - This value corrects long-term errors in the steering control loop. This setting should be adjusted by qualified technicians only. Raven Industries does not recommend that anyone other than a qualified technician make changes to this setting.
- **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.

5. Select the Accept button in the lower, right corner of the screen to save the displayed selections and values and return to the Steering Setup tab.

WHEEL CONTROL SETTINGS

FIGURE 10. Wheel Control Setup Screen



To access wheel control settings:

1. From the SC1/TC1 Home screen, select the Settings Menu button.

2. Select the Steering Setup tab and the Wheel Control Settings button. The following information and settings are displayed on the page:

NOTE: Select the **Help** icon for more information about the settings shown on the screen.

- **Wheel Velocity** - The speed at which the wheels are moving, measured in degrees per second.
- **Control Effort** - The amount of effort the SC1/TC1 system is using to drive the wheels.
- **Valve/Motor Current** - Displays the current draw of the steering valve/steering motor.
- **Left/Right MIN/MAX** - Touch and hold the MIN or MAX button to test the steering system response using the set minimum and maximum values. For example, touching the Left MIN button will steer the machine to the left using the minimum control effort.
- **Left/Right Min %** - The minimum Control Effort that the control 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 valve may use to turn the wheels. Values range from 1 - 100.

3. Select the Accept button in the lower, right corner of the screen to save the displayed settings and return to the Steering Setup tab.

WHEEL CONTROL CALIBRATION

The Wheel Control Calibration process allows SC1/TC1 to learn the hydraulic capabilities of the machine hydraulic system for optimal steering performance in the field. Complete the following steps to calibrate SC1/TC1 to the machine hydraulic system without completing the full SC1/TC1 system calibration.

NOTE: Review the *Preparation and Best Practices* section on page 10 for tips on preparing for and completing the calibration process.

WARNING

The machine will steer automatically. While calibrating or operating the SC1/TC1 system, be sure the area around the vehicle is clear of people and obstacles before engaging the steering system.

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

WARNING

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

FIGURE 11. Wheel Control Calibration Screen

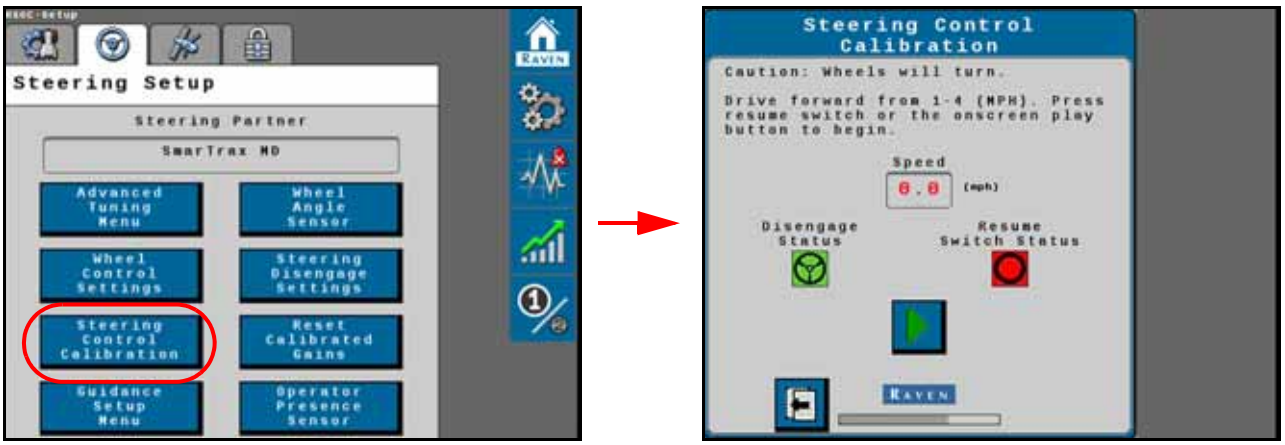
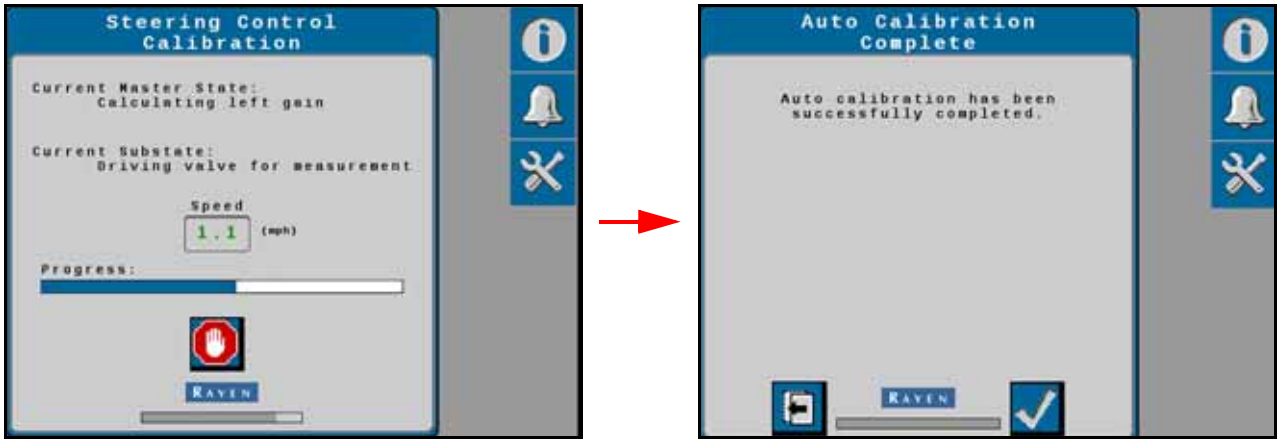


FIGURE 12. Calibration in Process Screens



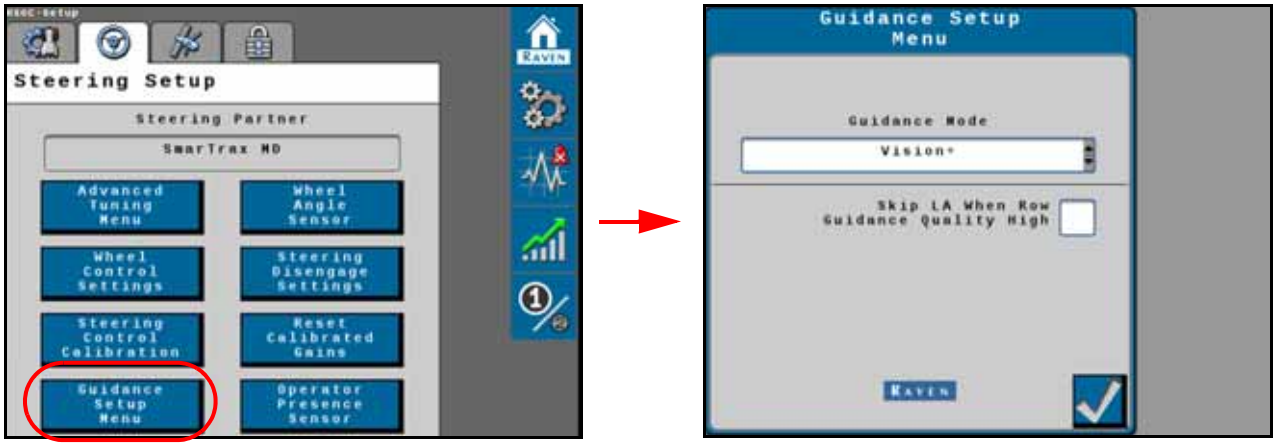
To perform a wheel calibration:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Wheel Control Calibration button.
3. Drive the machine forward at 1 - 4 mph [2 - 6 km/h].
4. Press the resume switch or use the on-screen Start button to begin calibration. SC1/TC1 will display the progress of the calibration.
5. When the calibration is complete, select the Accept button in the lower, right corner of the screen to return to the Steering Setup tab.

GUIDANCE SETUP MENU

If a Raven VSN™ visual guidance system is connected, the Guidance Setup Menu allows the operator to set the mode and row guidance

FIGURE 13. Wheel Control Calibration Screen



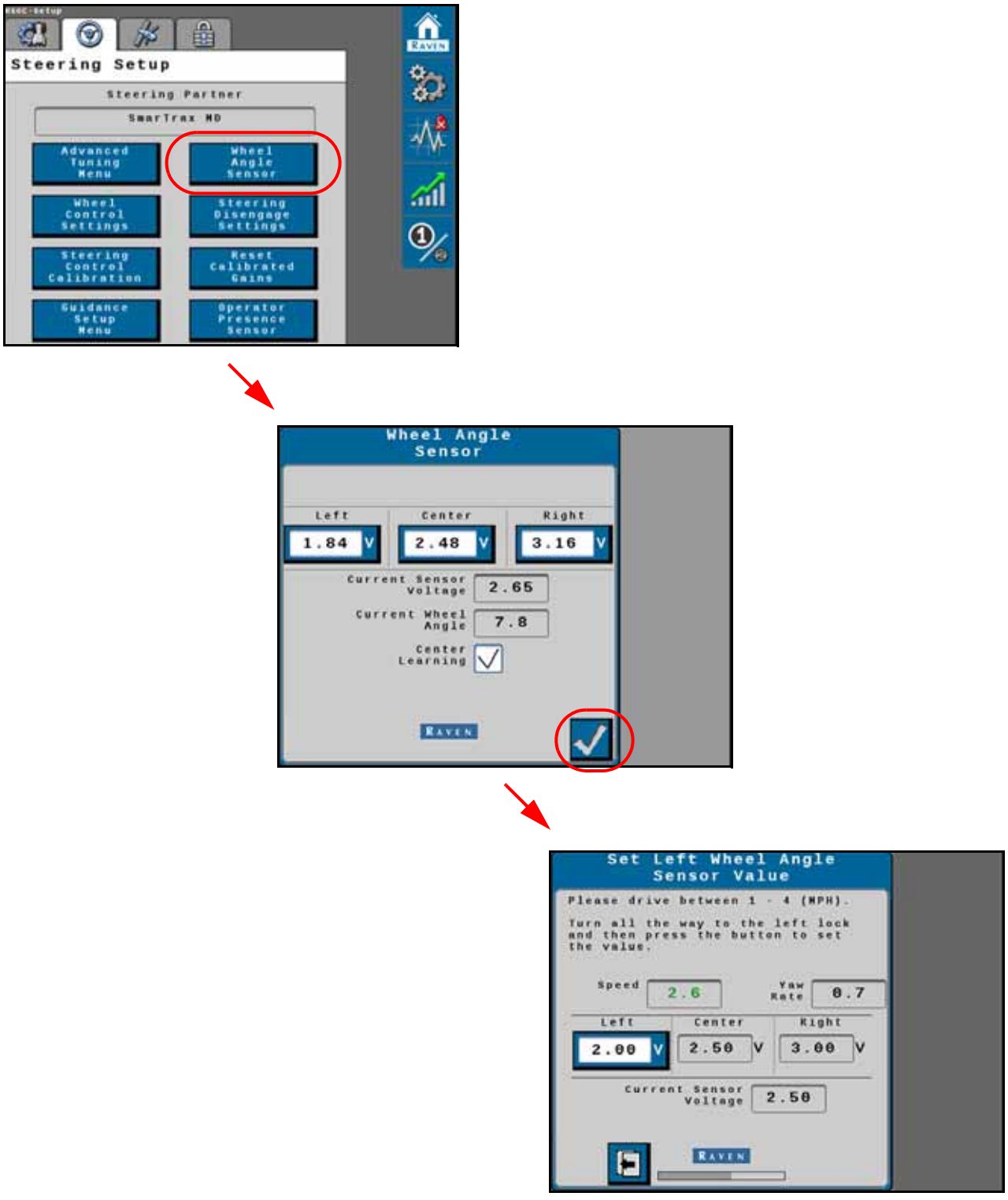
GUIDANCE MODE

- **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

To set the wheel angle sensor calibration values:

FIGURE 14. Wheel Angle Sensor Calibration Screen



1. From the SC1/TC1 Home screen, select the Settings Menu button.

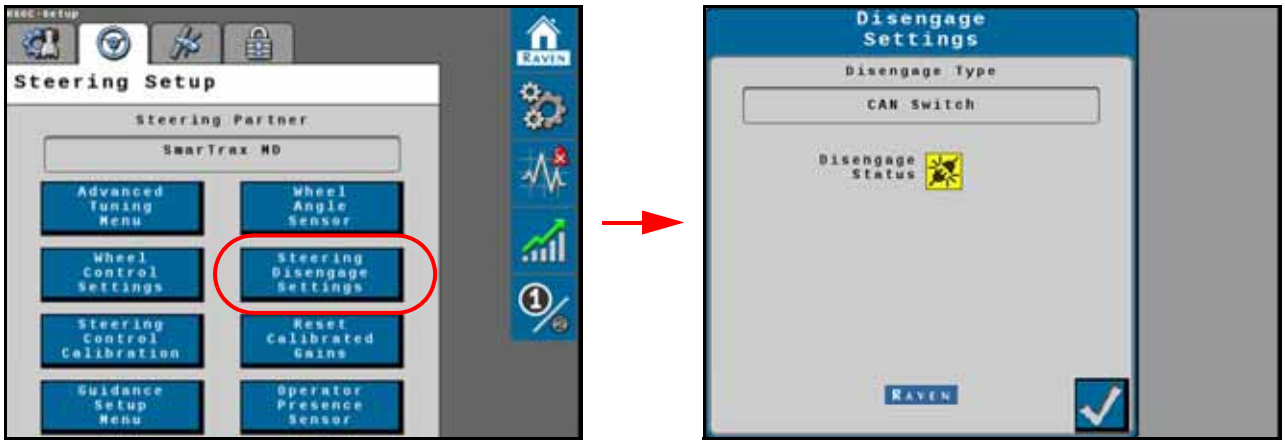
2. Select the Steering Setup tab and the Wheel Angle Sensor button. The following values and options are displayed on the Wheel Angle Sensor page:

- **Left/Center/Right** - Displays the current calibration values. Complete the following steps to adjust or tune the wheel angle sensor (WAS).
- **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.

3. Drive the machine forward at 1 - 4 mph [2 - 6 km/h].
4. Manually turn the steering wheel to the left steering lock, right steering lock, or center position to drive straight ahead.
5. Select the Left, Center, or Right value as appropriate to the steering wheel position.
6. Select the Accept button to save the new value.
7. When the calibration is complete, select the Accept button in the lower, right corner of the screen to return to the Steering Setup tab.

RESUME/DISENGAGE SETTINGS

FIGURE 15. Steering Disengage Settings Screen



To access disengage switch settings:

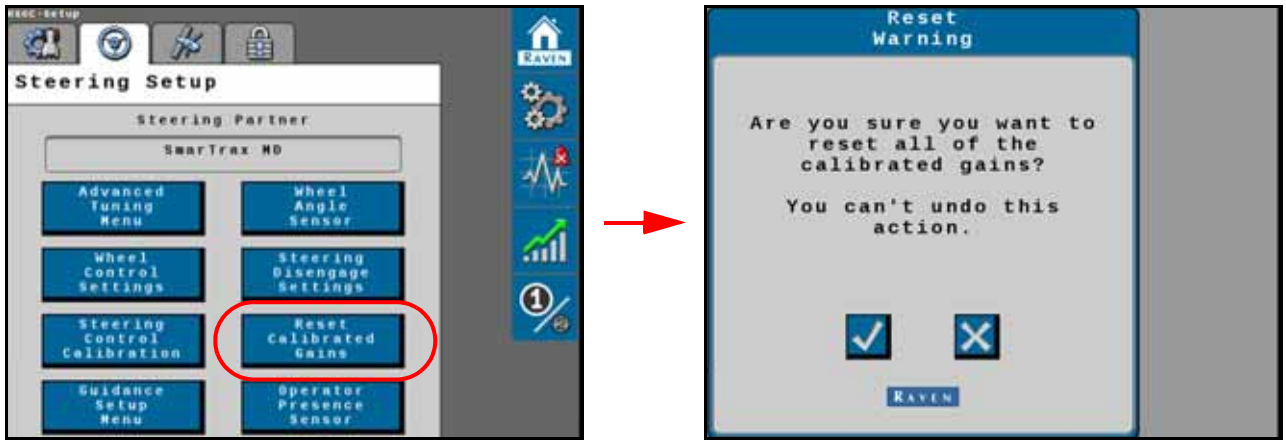
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Steering Disengage Settings button. The following information is displayed on the page:

- **Disengage Type** - Displays the type of disengage switch calibrated with the auto-steering system.
- **Disengage Status** - Indicates the status of the disengage switch. The disengage status will display:
    - Green - The disengage switch is detected and the steering wheel is not moving. The SC1/TC1 system may be engaged when this status is displayed.
    - Red - The disengage switch is detected and the steering wheel is moving. The SC1/TC1 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.

3. Select the Accept button in the lower, right corner of the screen to return to the Steering Setup tab.

RESET CALIBRATED GAINS

FIGURE 16. Reset Calibrated Gains Screen

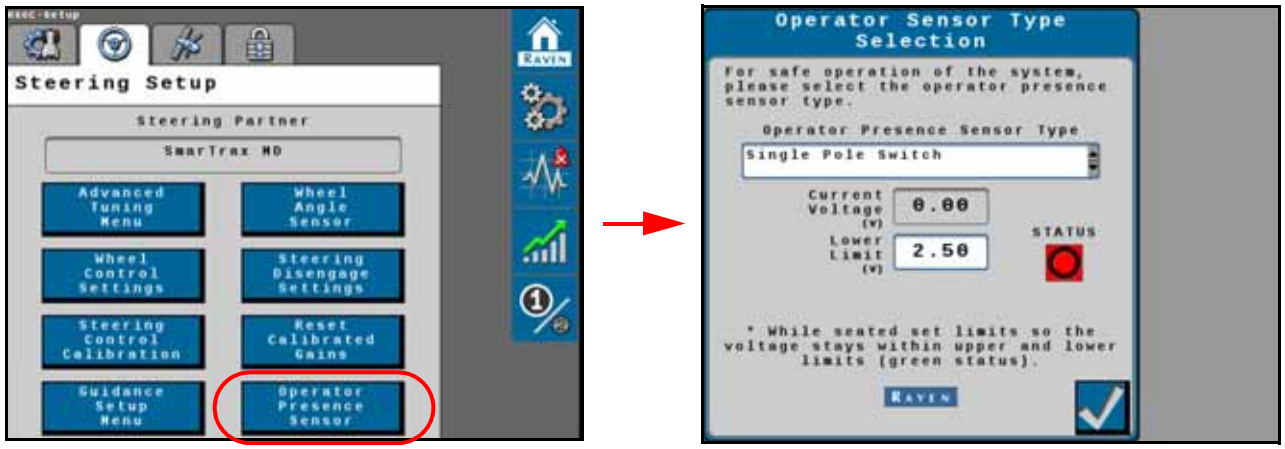


To reset the SC1/TC1 system to factory defaults:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Reset Calibrated Gains button.
3. Review the warning prompt and select the Accept button to reset the SC1/TC1 to a factory condition. Select the Cancel button to keep the current system configuration and return to the Steering Setup tab.

OPERATOR PRESENCE SENSOR

FIGURE 17. Steering Disengage Settings Screen



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.

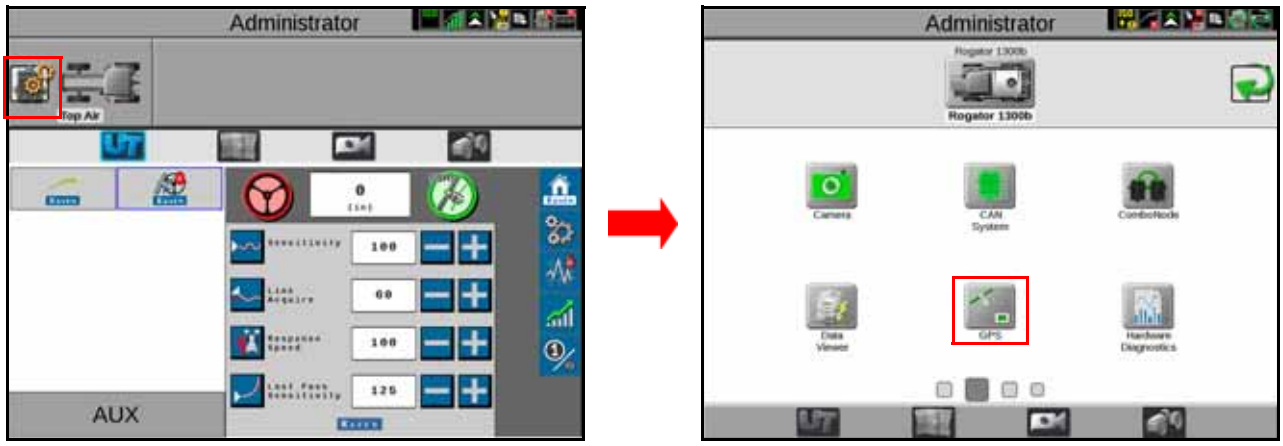
If the status does not change, but the current voltage changes, adjust the upper and lower limit settings as necessary.

NOTE: Review the *Operator Presence Switch* section on page 33 for information on the status displayed in this area.

CHAPTER 6 GPS SETTINGS

CONFIGURE GPS IN 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 SC1 system.

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

GPS RECEIVER CONFIGURATION

SC1/TC1 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.

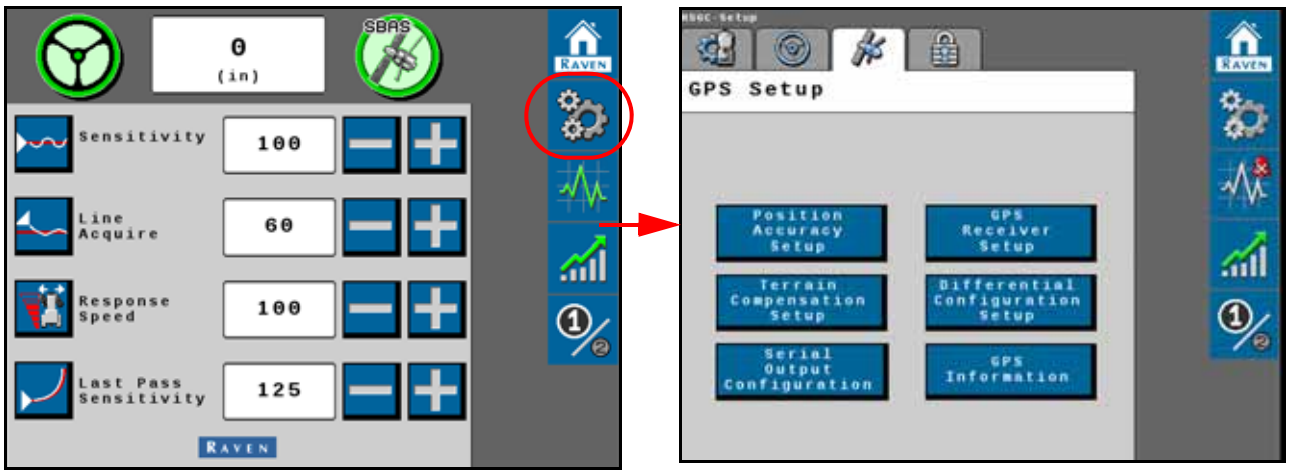
TABLE 1. GPS Receiver Message Settings

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

NOTE: Refer to Appendix 9, *Trimble 372 Configuration using AgRemote*, for assistance with these settings when using a Trimble receiver.

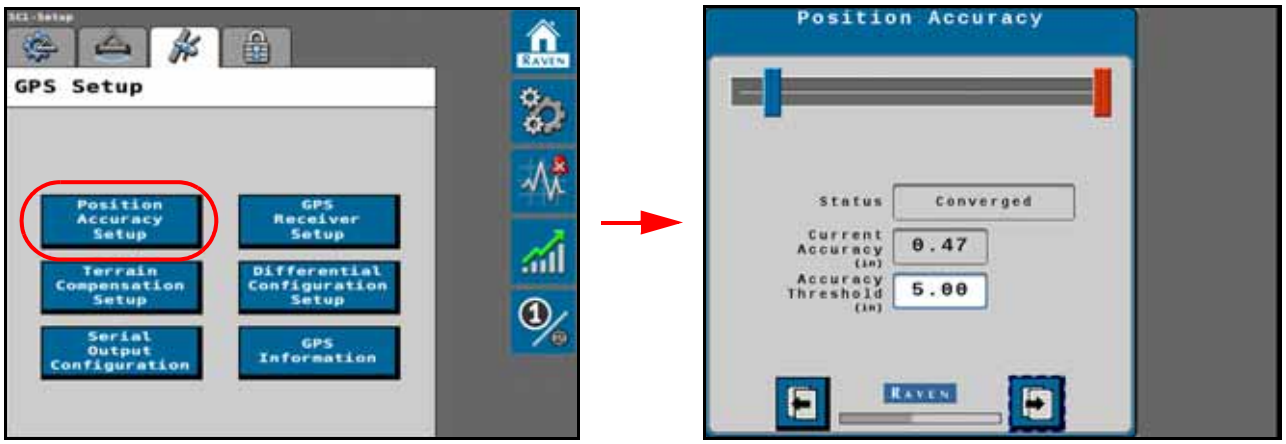
CONFIGURE GPS IN THE SC1/TC1

FIGURE 3. GPS Setup Screen



POSITION ACCURACY SETUP

FIGURE 4. Position Accuracy Setup Screen

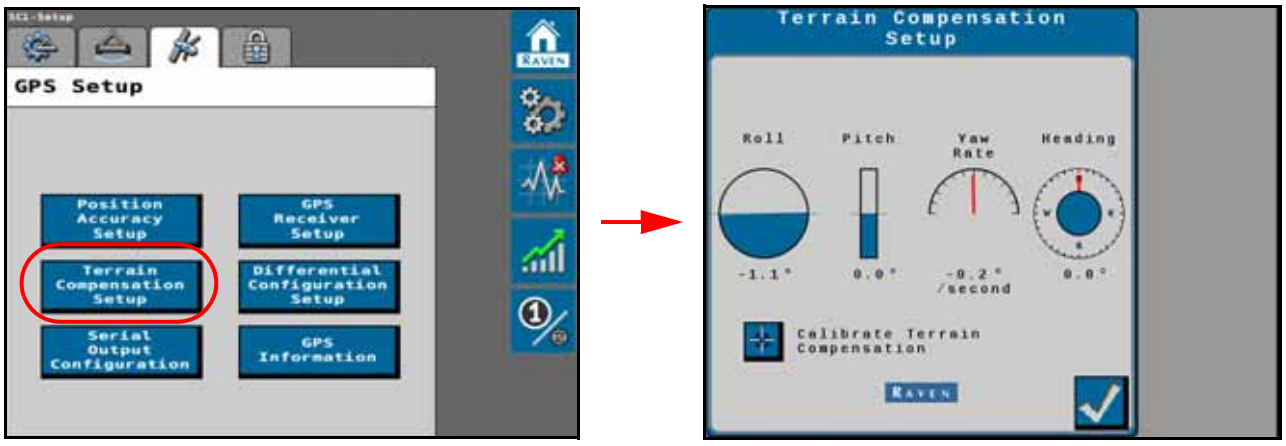


- **Status** - Displays the absolute status of the GPS accuracy. Statuses that may be displayed in this area include:
  - No Signal
  - Error
  - Converging
  - Converged
- **Current Accuracy** - A value representing the reported horizontal accuracy of the current solution as detected by the receiver.
- **Accuracy Threshold** - Set the maximum distance allowed for the Current Accuracy value. If the Current Accuracy value is greater than the set Accuracy Threshold, a DTC entry will be recorded on the Diagnostic Trouble Code screen.

Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

TERRAIN COMPENSATION SETUP

FIGURE 5. Terrain Compensation Setup Screen



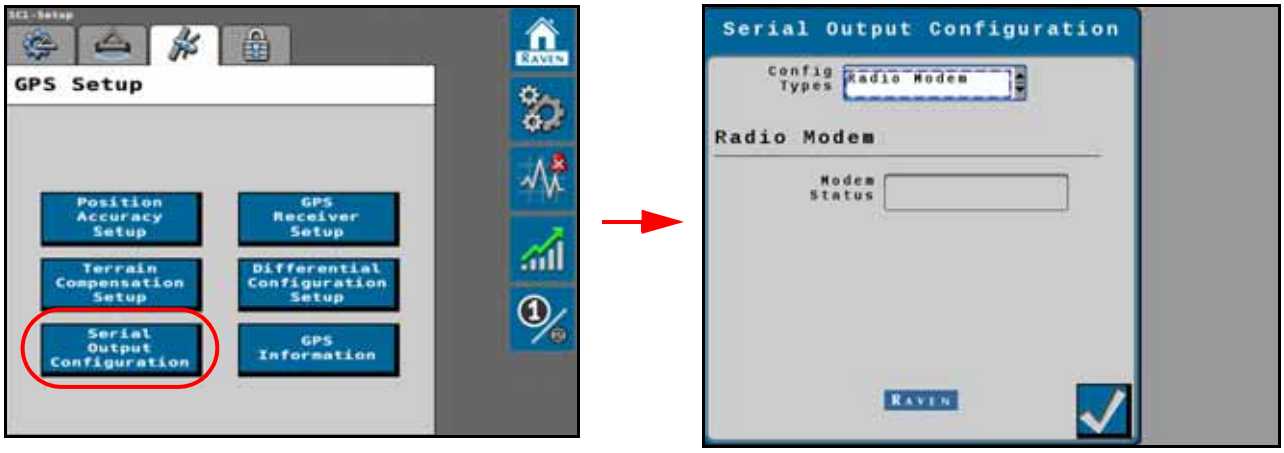
- **Roll, Pitch, Yaw Rate, and Heading** - Real-time measurement data used by the 3D terrain compensation feature.

- **Calibrate Terrain Compensation** - Begins the terrain compensation process. Refer to *Terrain Compensation Calibration* section on page 16 for additional information on completing the Terrain Compensation Calibration.

Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

SERIAL OUTPUT CONFIGURATION

FIGURE 6. GPS Serial Output/Serial Output Configuration

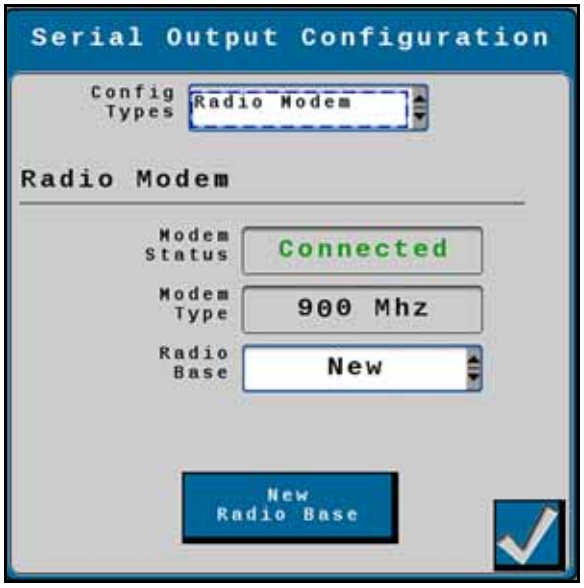


- **GPS Output** - Allows the SC1/TC1 system to output NMEA 0183 messages at configurable rates. See the *GPS Serial Output Configuration* section on page 57 for details.
- **Radio Modem** - Select Radio Modem to configure the radio modem. See the *Radio Modem Configuration* section on page 55 for information on configuring the Radio Modem.
- **RTK Out** - Allows the SC1/TC1 system to Output RTK corrections to another ECU.See the *RTK Out* section on page 58 for information on configuring the Radio Modem.

Select the Accept button in the lower, right corner of the screen to accept the current output settings displayed and return to the GPS Setup tab.

RADIO MODEM CONFIGURATION

FIGURE 7. Modem Type



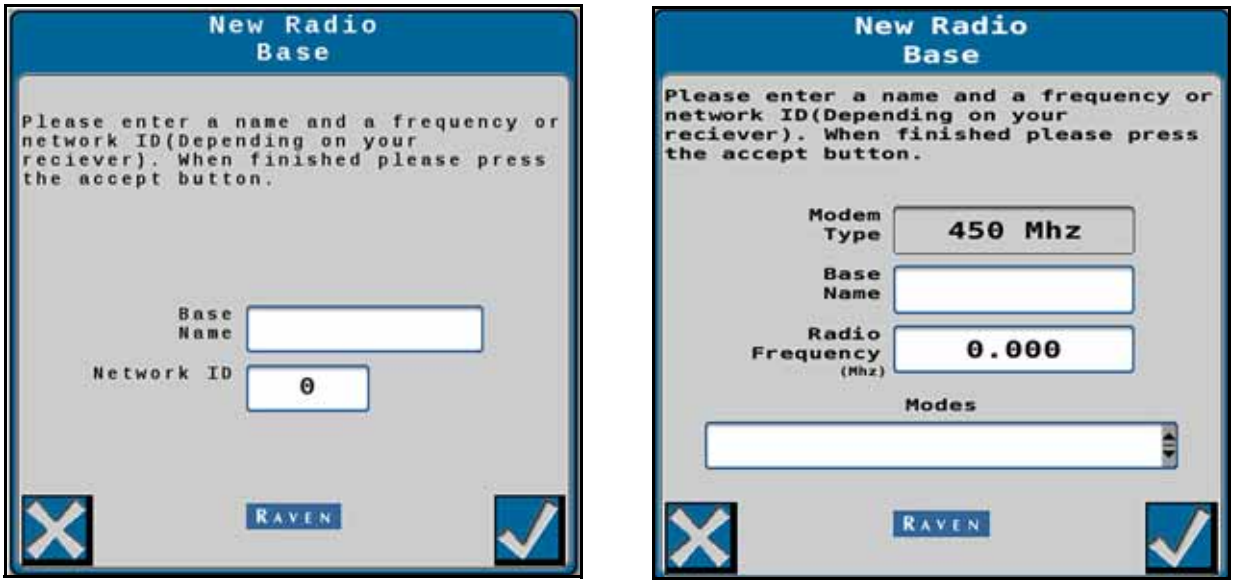
- **Modem Status** - Displays if a modem is detected. The status can be:
    - No Comm: No modem detected.
    - Configuring: Modem is detected.
    - Connected: Modem is connected to the SC1/TC1.
- **Modem Type** - The detected radio modem type will display here. Modem type options are:
    - 450 MHz
    - 900 MHz
- **Radio Base** - Allows the user to toggle between stored radio bases.

4. Select **New** in the Radio Base drop-down list to setup a new radio base station.

NOTE: If a base station has already been configured, use the Base Name drop-down field to select the stored base station for SC1/TC1 operation. Select the Accept button in the lower, right corner of the screen to save the selection and return to the GPS Setup tab.

5. Enter a name for the new base station.

FIGURE 8. New Base



6. When configuring a 900 MHz radio modem, set the Network ID.
   When configuring a 450 MHz radio modem, enter the radio frequency and select the proper Mode from the drop-down.

FIGURE 9. 450 MHz Modem Modes

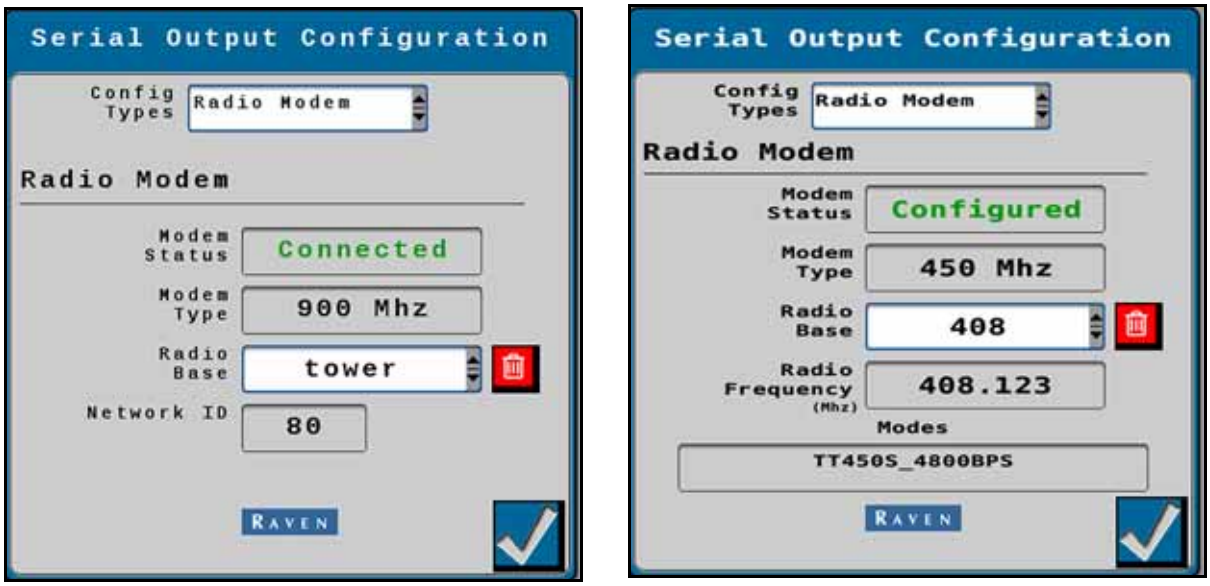
7. Select the Accept button in the lower, right corner of the screen to save the displayed radio modem settings and return to the Serial Output Configuration page.
8. Select the Accept button again to return to the Machine Settings tab.

DELETE A RADIO MODEM

To remove a configured a radio modem:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the Serial Output Configuration button.
3. Select the Radio Modem from the Config Types drop-down.
4. Select the stored radio modem in the Radio Base drop-down list.
5. Select the Delete button.
6. Select the Accept button to confirm removing the stored base and return to the Serial Output Configuration page.

FIGURE 10. Configured Radio Base



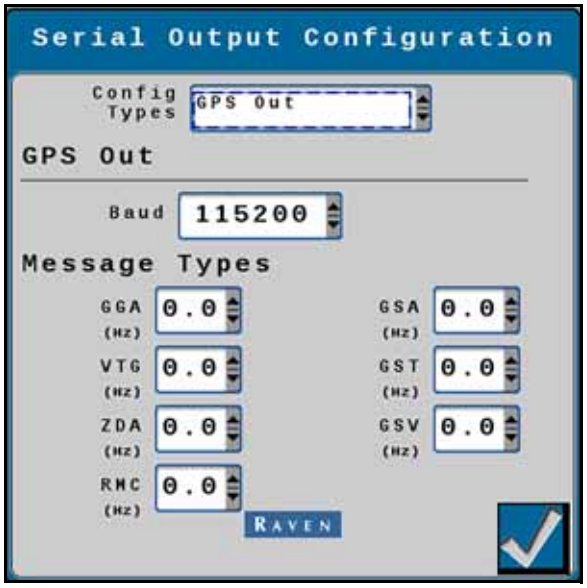
7. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

GPS SERIAL OUTPUT CONFIGURATION

To configure GPS message output from or passed through the SC1/TC1 system:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the Serial Output Configuration button.
3. Select GPS Out from the Config Types drop-down to output 3D compensated GPS to another ECU.
4. Select the Baud rate and frequencies for specific message types.
5. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

FIGURE 11. GPS Configuration

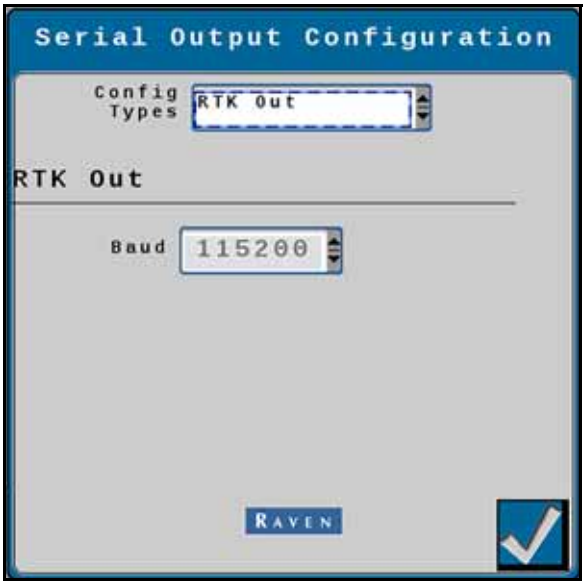


RTK OUT

To configure RTK corrections output from or passed through the SC1/TC1 system:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the Serial Output Configuration button.
3. Select RTK Out from the Config Types drop-down to output 3D compensated RTK to another ECU.
4. Select the Baud rate for corrections.
5. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

FIGURE 12. RTK Out



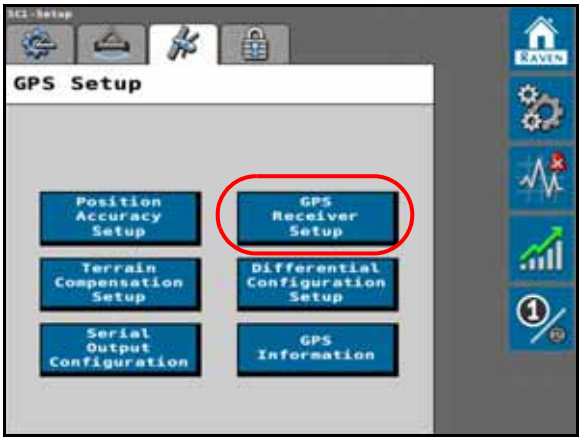
GPS RECEIVER SETUP

To configure the type of receiver connected to the SC1/TC1 system:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the GPS Receiver Setup button.
3. Select the receiver supplying GPS to the SC1/TC1 system:
    - Raven 500S™
    - Raven 600S™
    - Raven 700S™
    - Viper 4/4+ Twin
    - Viper 4/4+
    - Receive Only

NOTE: Receive Only can be used with any GPS Receiver that is outputting GPS into the serial port of the SC1/TC1 system. The GPS Receiver may need to be configured to output the correct messages if the Receive Only option is selected. Refer to the *Configure GPS in the Viper 4/Viper 4+* section on page 51 for additional information on required GPS receiver outputs for SC1/TC1.

FIGURE 13. GPS Setup Screen



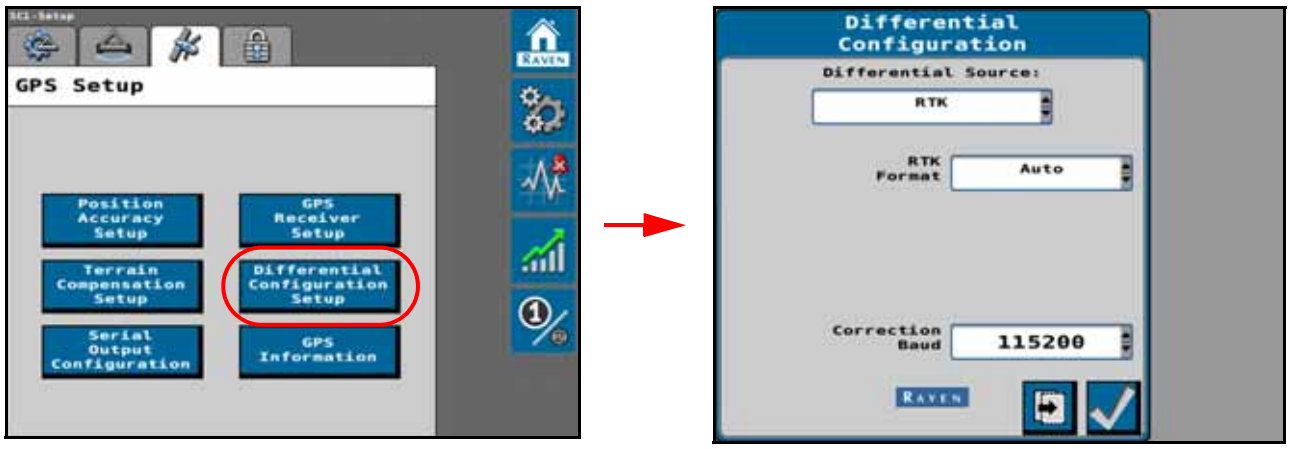
4. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

DIFFERENTIAL CONFIGURATION SCREEN

To set the differential solution used with the SC1/TC1 system:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the Differential Configuration Setup button.
3. Select source of differential position corrections provided to the SC1/TC1 system.
4. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

FIGURE 14. Differential Configuration Screen



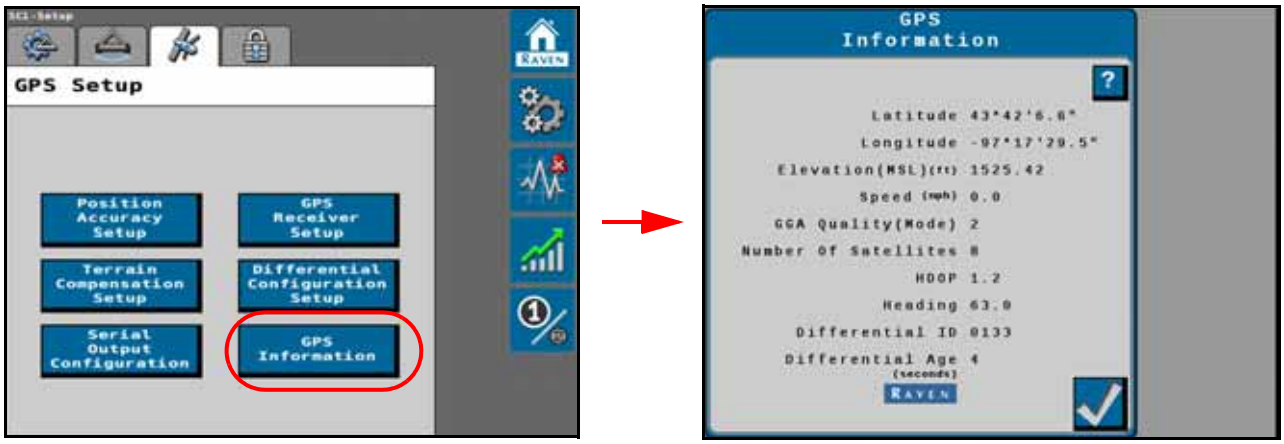
NOTE: Refer to Chapter 7, *Feature Unlock Codes*, for additional assistance with activating additional differential sources.

GPS INFORMATION

To view detailed GPS information:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the GPS Setup tab and the GPS Information button. The following information will be displayed:

FIGURE 15. GPS Information Screen



- **Latitude** - The angular distance of a place north or south of the earth's 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 state of the GPS receiver.
  - 0 = No Signal
  - 1 = Single solution
  - 2 = SBAS converged, GL1DE®, GS-Lite converged, Satellite GS converging
  - 3 = N/A

  - 4 = RTK converged, Satellite GS (500S) converged
  - 5 = RTK Float, Satellite GS converged
  - 6 = Dead reckoning
- **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 current direction of travel.
- **Differential ID** - The ID of the satellite used for differential corrections.
- **Age of Differential** - Time (in seconds) since the last differential correction was received. When using the GL1DE corrections, or if a differential source is not currently tracked, this entry will be “- - - -”.

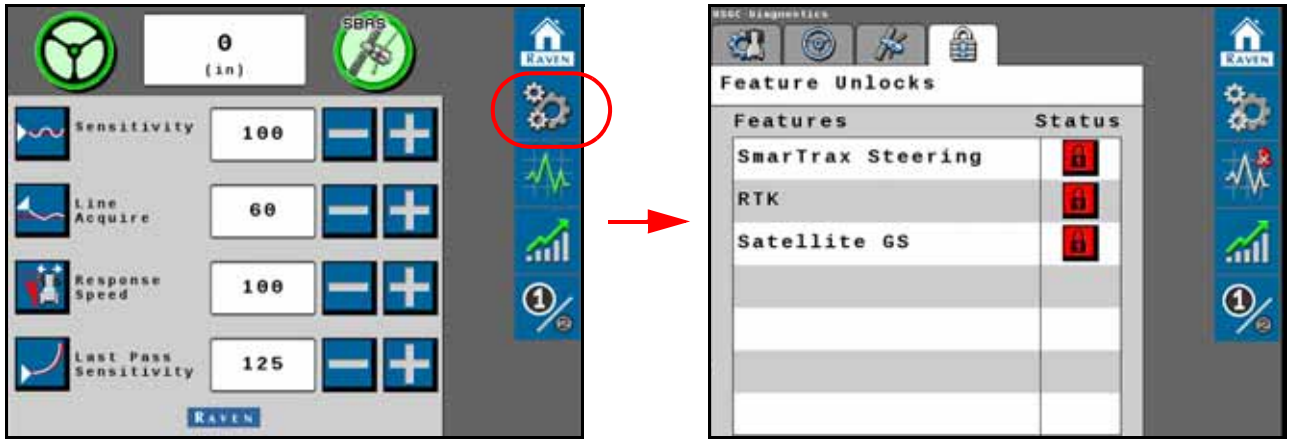
3. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

CHAPTER 7 FEATURE UNLOCK CODES

In order to activate desired features, a feature unlock code is required. Contact your local Raven dealer to purchase feature unlock codes.

NOTE: Contact your local Raven dealer for additional information and assistance with purchasing activation and feature unlock codes.

FIGURE 1. Feature Unlock Screen



To activate features of the SC1/TC1 steering system:

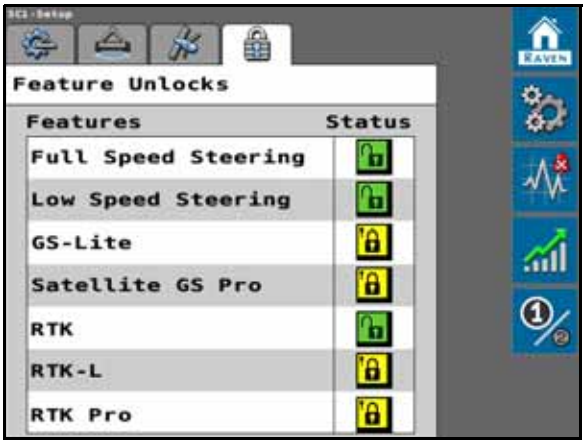
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Feature Unlocks tab.
3. Select the Lock icon next to the feature to be activated.

FIGURE 2. Feature Unlock Information Screen

4. In the code field, enter the feature activation code obtained from your Raven dealer.
5. Select the Accept button.

NOTE: SC1/TC1 will display a message indicating whether the unlock code is valid. If the code is accepted, the padlock will turn green and indicate that the feature is ready for use.

FIGURE 3. Feature Unlocked



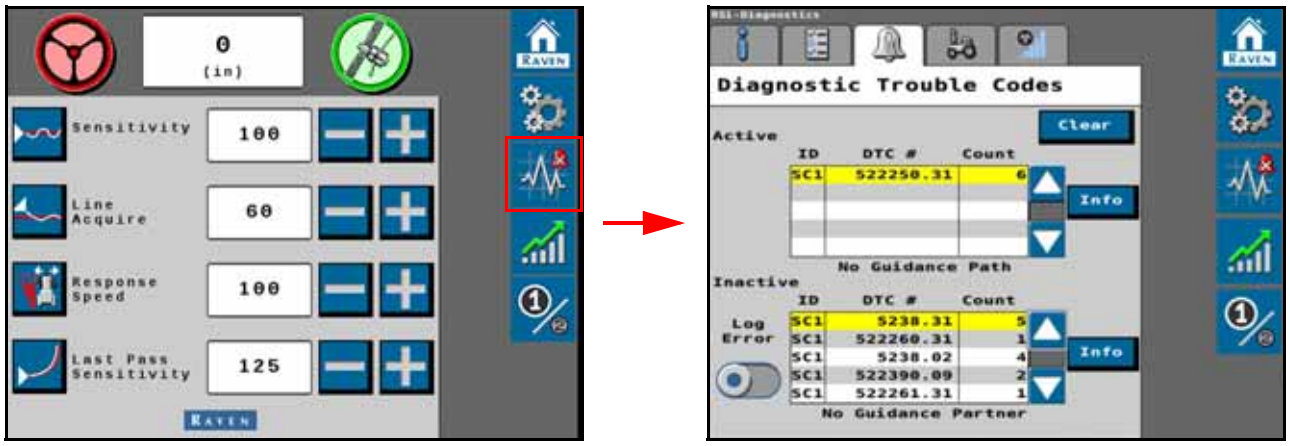
NOTE: GS-Lite, Satellite GS, and RTK unlocks can only be applied for the following GPS Receivers:

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

CHAPTER 8 DIAGNOSTICS AND TROUBLESHOOTING

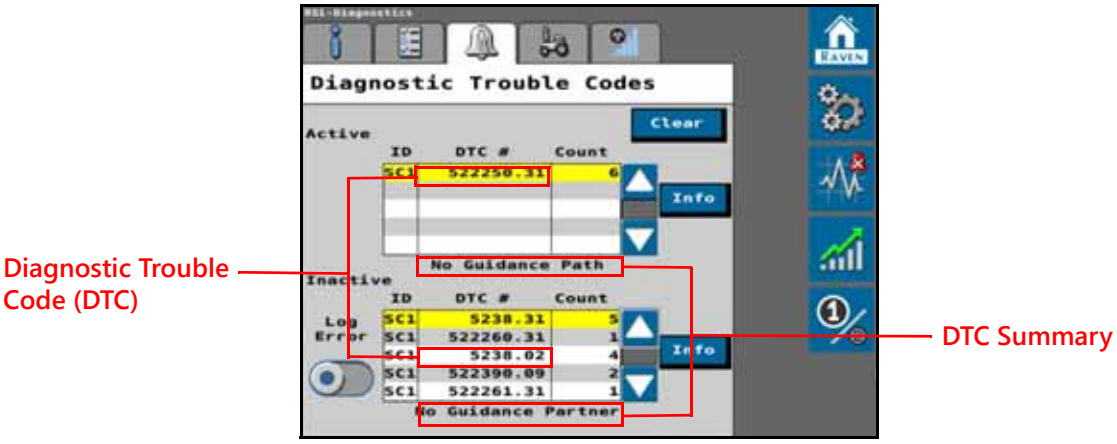
DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 1. Diagnostic Trouble Codes Screen



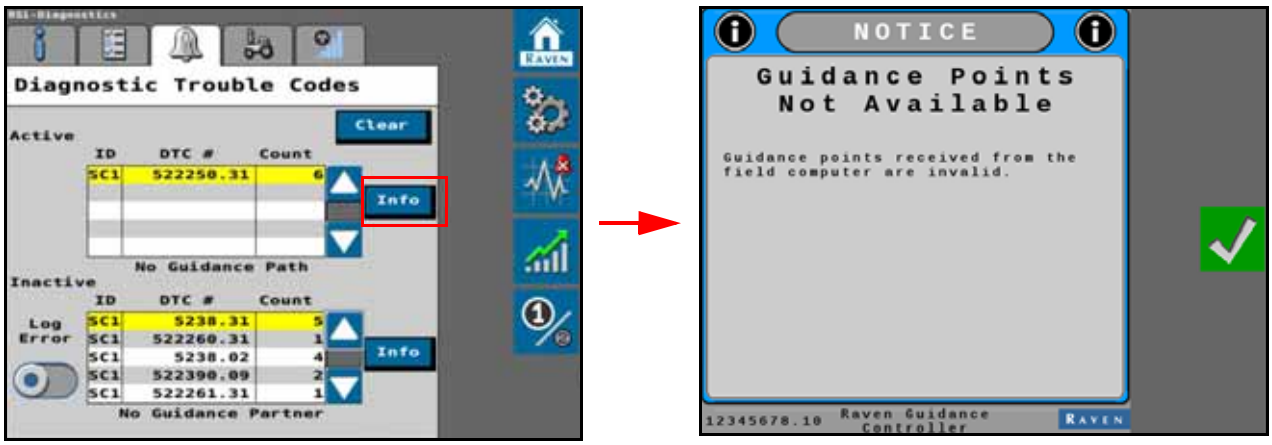
The Diagnostic Trouble Code screen displays active and previous diagnostic trouble codes (DTCs) that occur during SC1/TC1 system operation. Active DTCs must be fixed before the SC1/TC1 system can be enabled for guidance and steering operation. Once a DTC has been corrected, the code moves to the inactive DTC code list. Refer to Figure 3 for an example of DTCs and DTC summaries.

FIGURE 2. Diagnostic Trouble Codes Screen



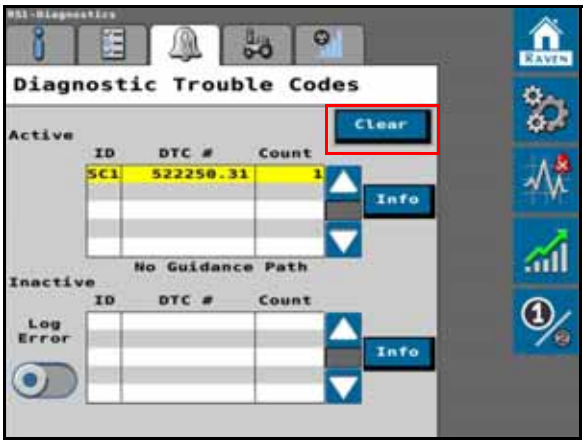
NOTE: In Figure 3 above, the active DTC is 522250.31 and the DTC summary is “No Guidance Points.” The inactive DTC is 522261.31 and the DTC summary is “No SCU Detected.”

FIGURE 3. Info Screen



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

FIGURE 4. Inactive DTCs Cleared from Error Log



Pressing **Clear** deletes the inactive DTCs from the Inactive DTC error log. For a complete list of the SC1/TC1 DTCs, please visit:

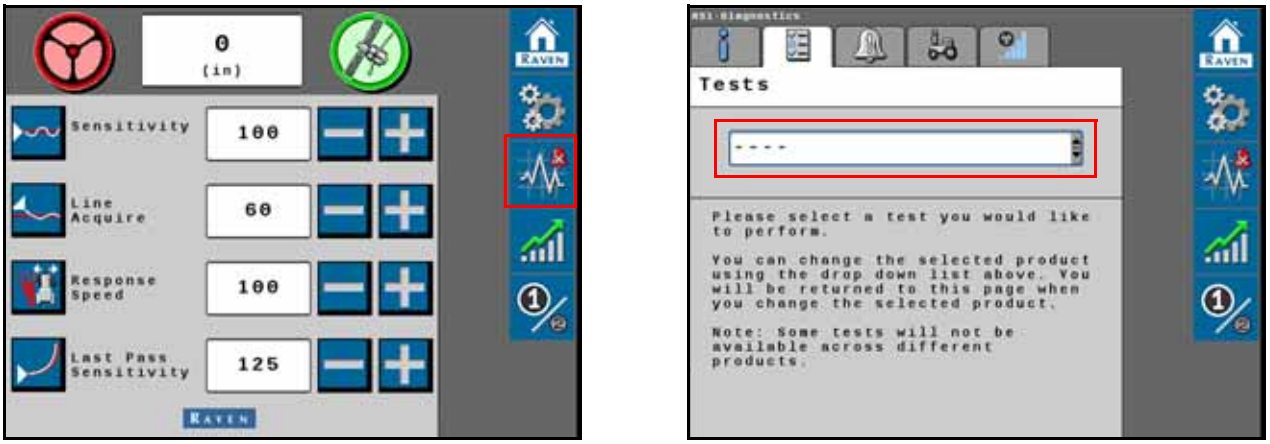
http://ravenprecision.force.com/knowledgebase/articles/Tech_Tip/SC1-Lights-and-Diagnostic-Codes/

SYSTEM HEALTH TESTS

WARNING

The machine will steer automatically while system heath tests are being performed. Be sure the area around the vehicle is clear of people and equipment before engaging the SC1/TC1 system.

FIGURE 5. Test Selection Screen



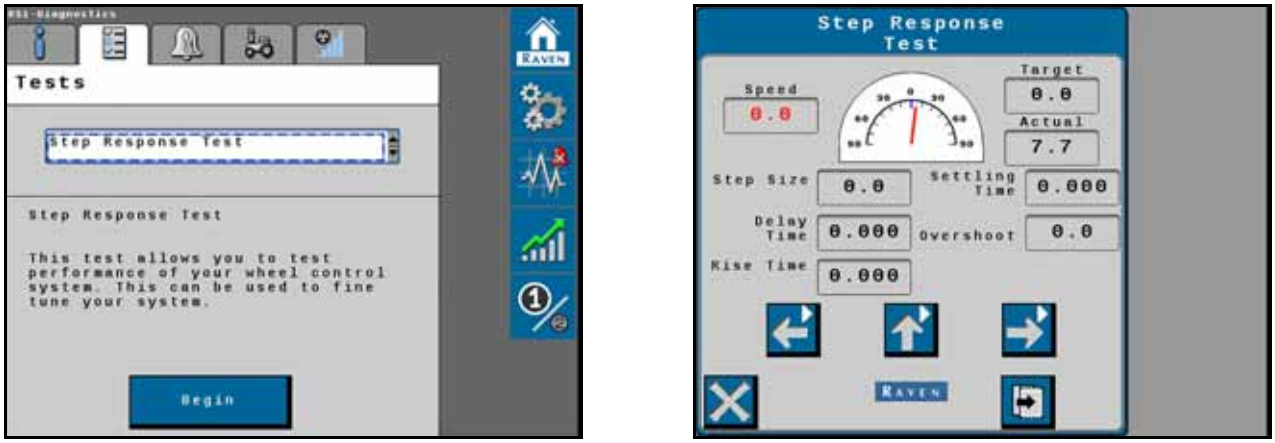
System health tests are performed to diagnose and correct machine and SC1/TC1 calibration issues. The following system health tests can be performed via the SC1/TC1 system:

- Step Response Test
- Machine Test

STEP RESPONSE TEST

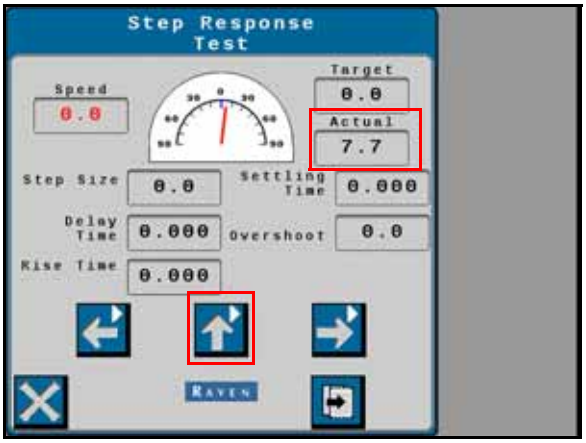
The Step Response Test is used to determine the responsiveness of the implement steering system.

FIGURE 6. Step Response Test Screen



1. Drive forward 1 - 4 mph with the engine RPM set at 3/4 throttle.

FIGURE 7. Step Response Test Screen

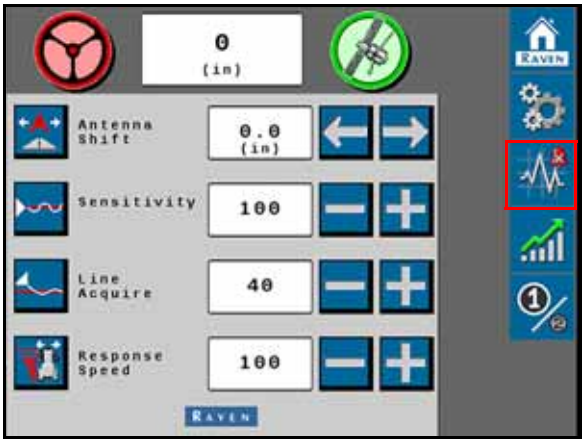


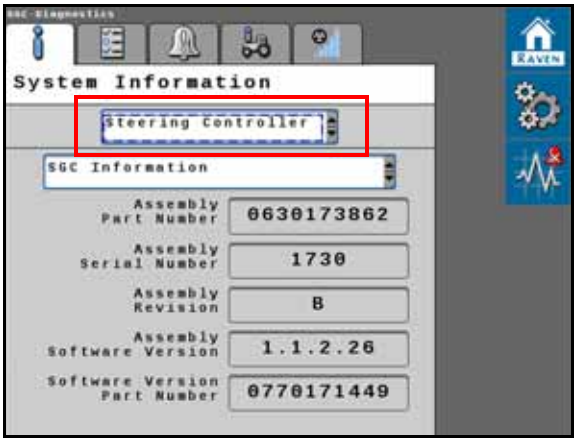
2. Press the center up arrow. Wait for the actuator to reach the center position.
3. Press the left arrow.
4. Wait for the following fields to populate and record the data:
   a. Step Size
   b. Delay Time
   c. Rise Time
   d. Settling Time
   e. Overshoot
5. Drive forward 1 - 4 mph with the engine RPM set at 3/4 throttle.
6. Press the center up arrow. Wait for the actuator to reach the center position.
7. Press the right arrow.
8. Wait for the following fields to populate and record the data:
   a. Step Size
   b. Delay Time
   c. Rise Time
   d. Settling Time
   e. Overshoot
9. To test consistency, repeat steps 1 - 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 8. System Information Screen

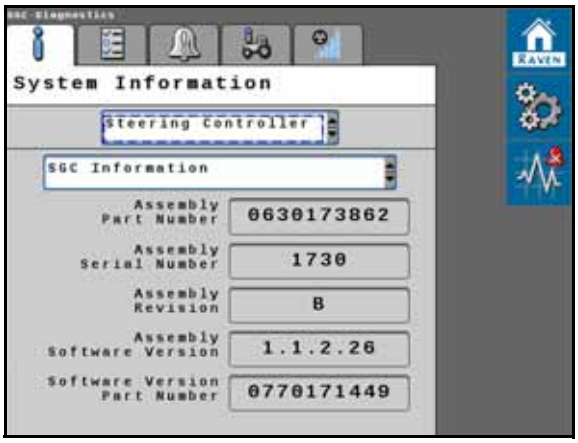




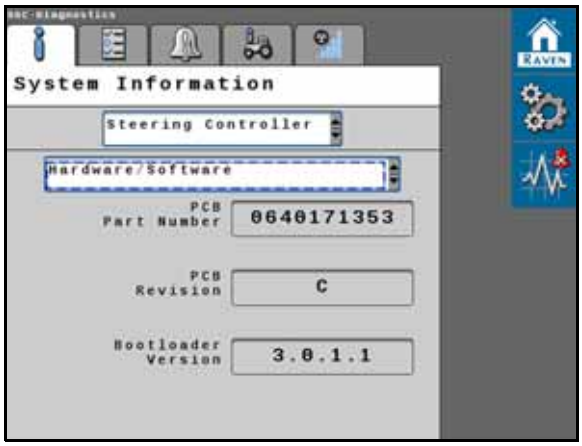
1. Select the desired device from the drop-down menu.
2. Select the desired system component from the second drop-down menu.

FIGURE 9. System Information Screens

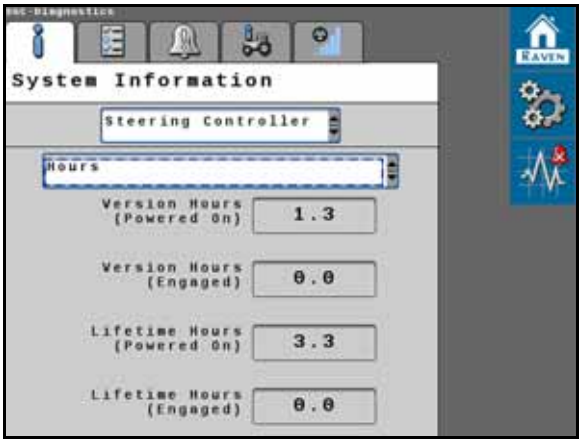
SC1/TC1 Information



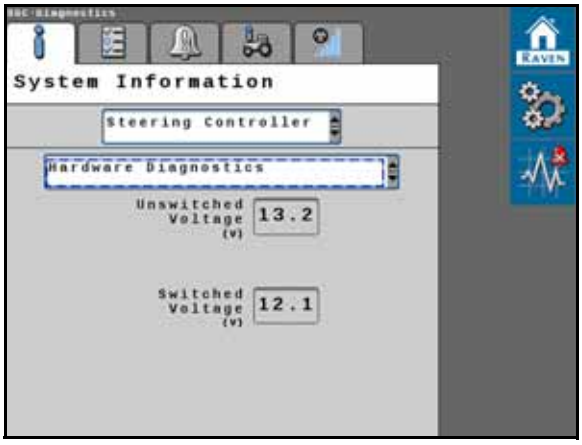
Hardware/Software Information



SC1/TC1 Unit Hours



SC1/TC1 Hardware Diagnostics



GPS Receiver Information

GPS Receiver

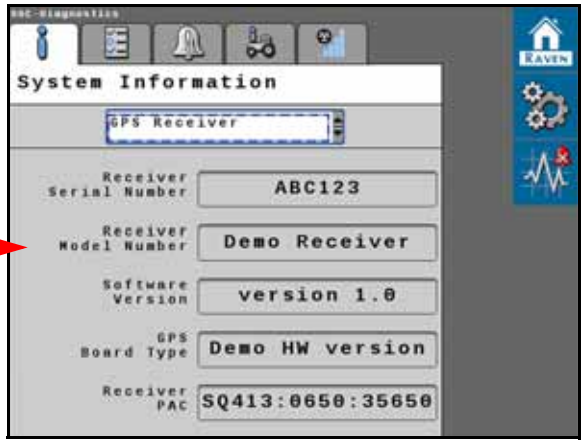
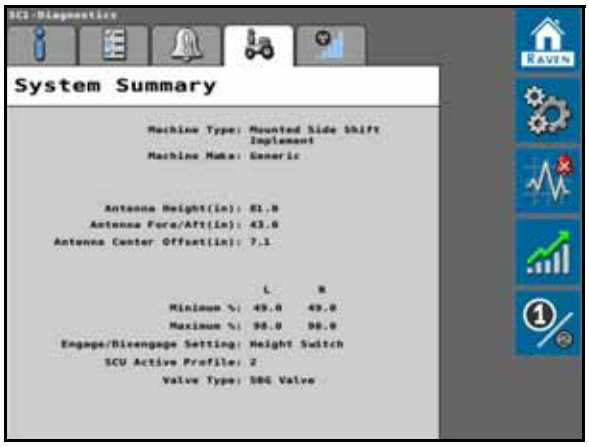
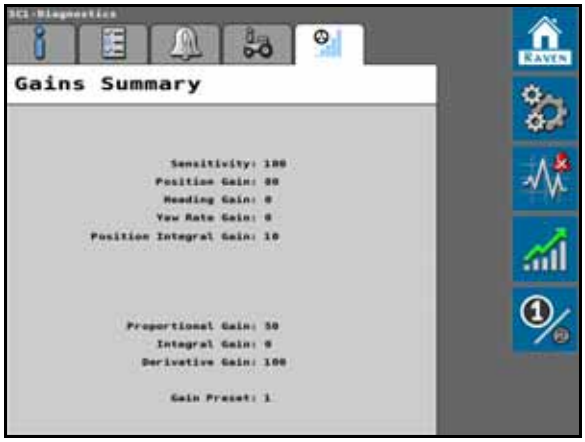


FIGURE 10. System Summary Screen



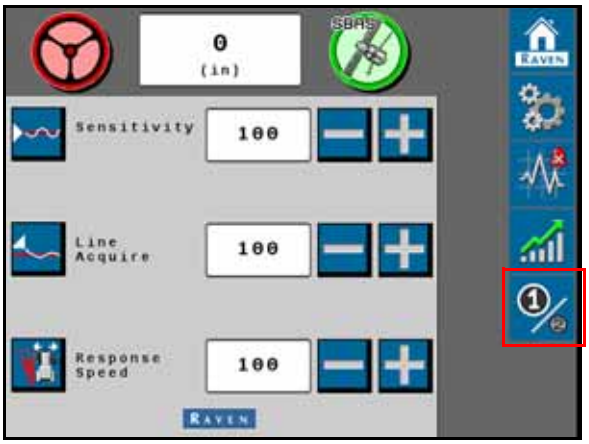
The System Summary screen displays the machine settings and calibrated steering settings for the SC1/TC1 system.

FIGURE 11. Gains Summary Screen



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

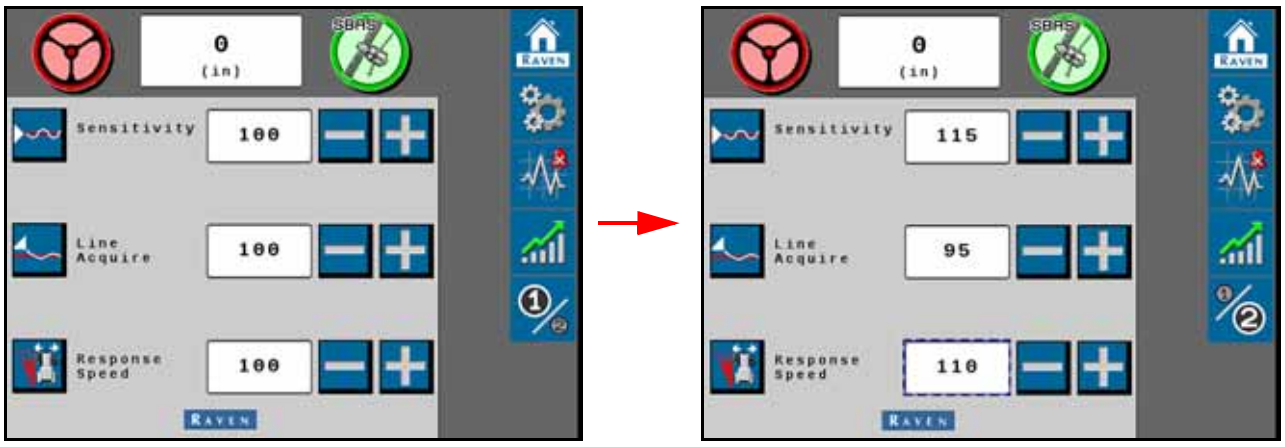
FIGURE 12. Preset Steering Gains



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 terrain conditions
- Different soil types
- Different speeds (planting vs. spraying)

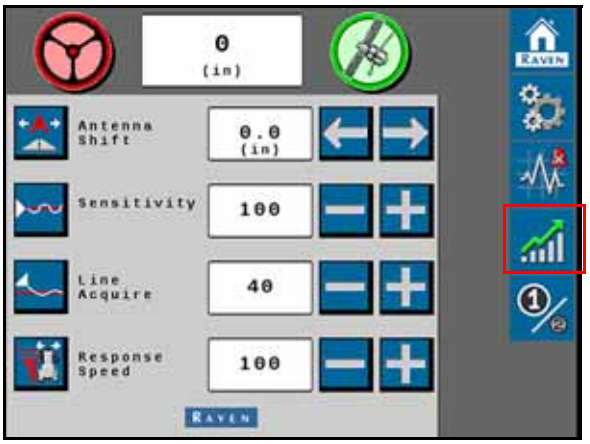
FIGURE 13. Preset Gains Settings



Press the button to toggle between the two sets of steering gains.

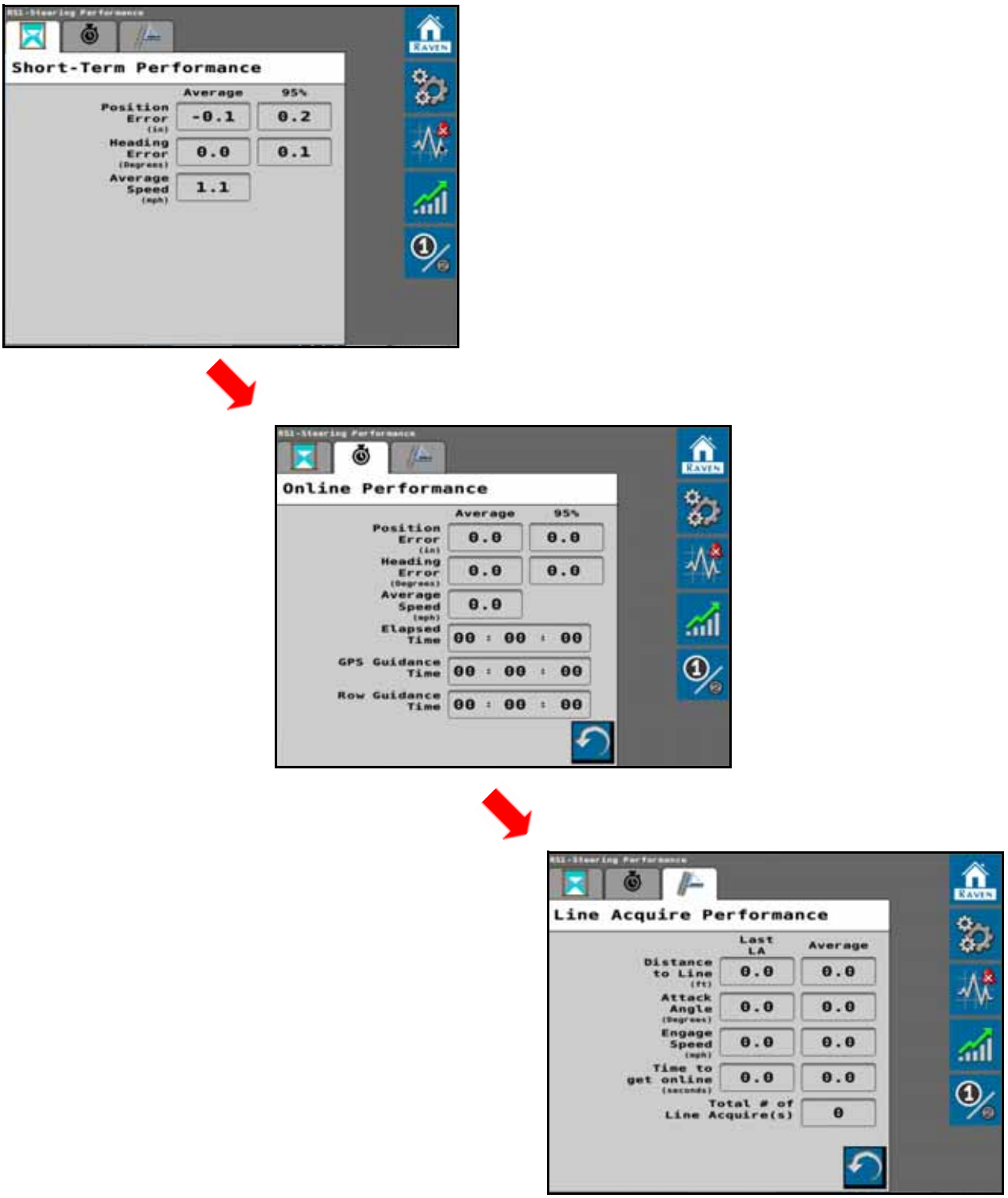
PERFORMANCE MONITOR

FIGURE 14. SC1/TC1 Home Screen



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

FIGURE 15. Short-Term and Resettable Performance Screen

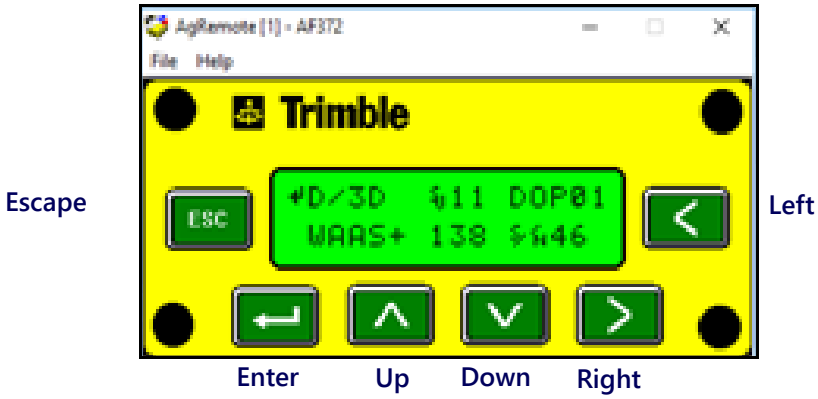


NOTE: The Short-Term Performance screen displays the averages and 95% performance values.

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

APPENDIX 9 TRIMBLE 372 CONFIGURATION USING AGREMOTE

FIGURE 1. AgRemote Interface



Connect the 372 to the AgRemote via Port B.

GPS CONFIGURATION

1. Press the Right button until “Configuration” displays on the screen.
2. Press the Down button to select “Configuration”.
3. Press the Right button until “GPS Config” displays.
4. Press the Down button until “Position Rate” displays.
5. Press Right to set the “Position Rate” to 10Hz.

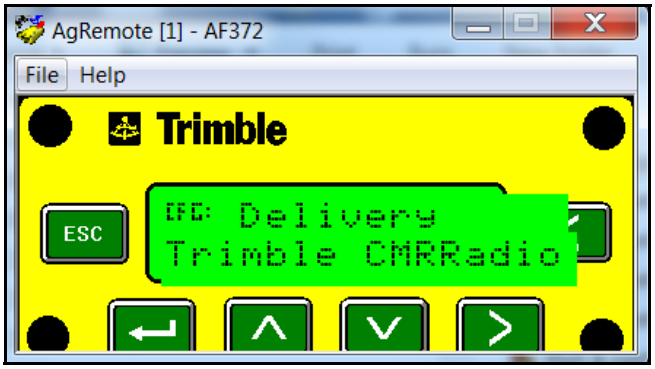
FIGURE 2. Position Rate Setting

6. Press Enter to save the settings.

RADIO MODE CONFIGURATION

1. Press the Right button until “Configuration” displays on the screen.
2. Press the Down button to select “Configuration”.
3. Press the Right button until “RTK Config” displays.
4. Press the Down button to select “RTK Config” displays.
5. Press the Down button until “Delivery” displays.
6. Select the Right button to set “Delivery” to Trimble CMRRadio.

FIGURE 3. Delivery Setting



7. Select Enter to save the settings.

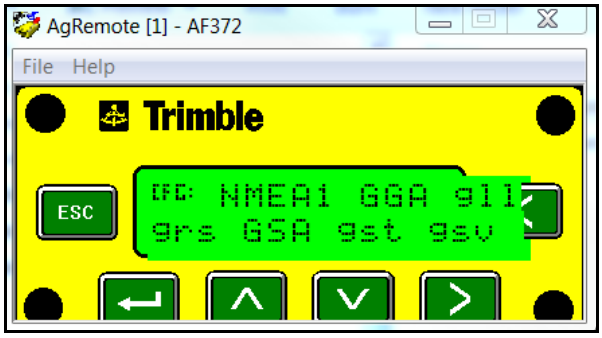
PORT A CONFIGURATION

1. Press the Right button until “Configuration” displays on the screen.
2. Press the Down button to select “Configuration”.
3. Press the Right button until “Port A Config” displays.
4. Press the Down button to select “Port A Config”.
5. Ensure the Input (I) messages are set to None and the baud rate is set to 115K.
6. Verify the Output (O) messages are set to 8N1 and that the NEMA and baud rates are set to 115K.

FIGURE 4. Port A Configuration

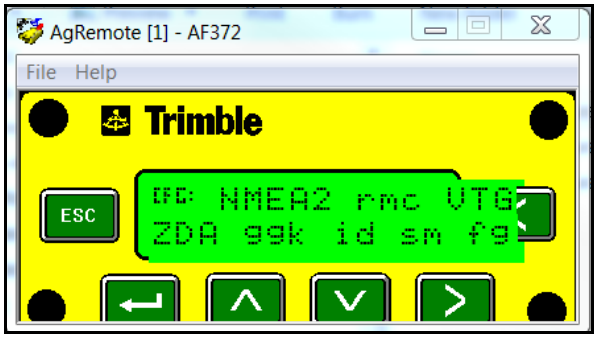
7. Press Enter to save the settings.
8. Press the Down button until “NEMA1” displays.
9. Verify GGA and GSA are capitalized so they are on.

FIGURE 5. Port A NEMA1 Configuration



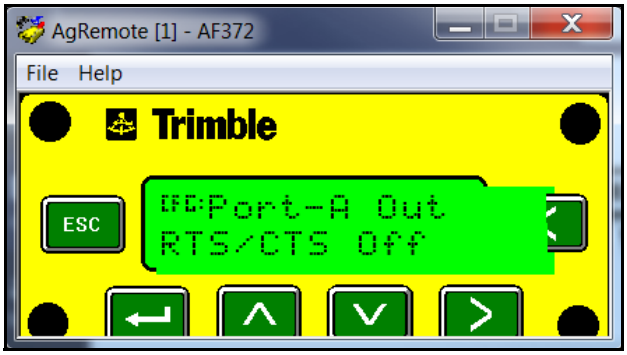
10. Press Enter to save the settings.
11. Press the Down button until “NEMA2” displays.
12. Verify that VTG and ZDA are capitalized so they are turned on.

FIGURE 6. NEMA 2 Configuration



13. Press the Down button to continue configuring Port A.
14. Press the Down button until “CFG: Port A Out RTS_CTS” displays.
15. Verify “CFG: Port A Out RTS_CTS” is off.

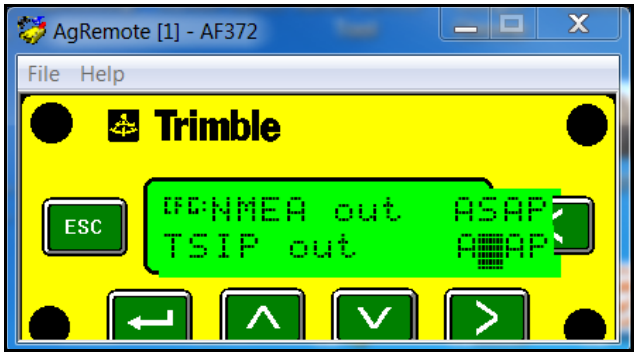
FIGURE 7. Port A RTS/CTS Configuration



16. Press Enter to save the settings.
17. Press the Down button to continue configuring Port A.

18. Press Enter to save the settings.
19. Press the Down button until “NMEA” out displays.
20. Ensure that “NEMA” out and TSIP out are set to ASAP.

FIGURE 8. NEMA Configuration



21. Press Enter to save the settings.
22. Press the Down button until “CFG: NEMA QUALITY” displays.
23. Verify the setting is Report True Mode.

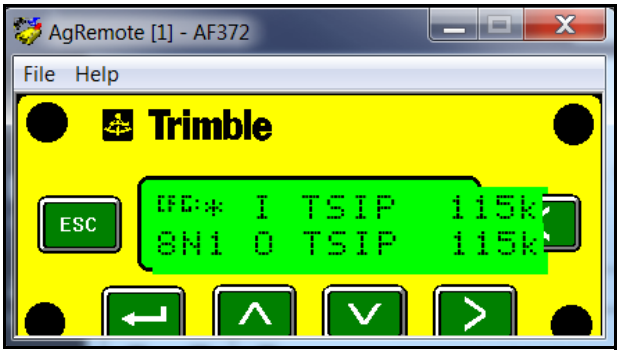
FIGURE 9. Port A NEMA Quality

24. Press Enter to save the settings.

PORT B CONFIGURATION

1. Press the Right button until “Configuration” displays.
2. Press the Down button to select “Configuration”.
3. Press the Right button until “Port B Config” displays.
4. Press the Down button to select Port B Config.
5. Verify the Input (I) messages are set to TSIP and the baud rate is set to 115K.
6. Ensure the Output (O) messages are set to 8N1 and the TSIP and baud rate are set to 115K.

FIGURE 10. Port B Configuration



7. Press Enter to save the settings.

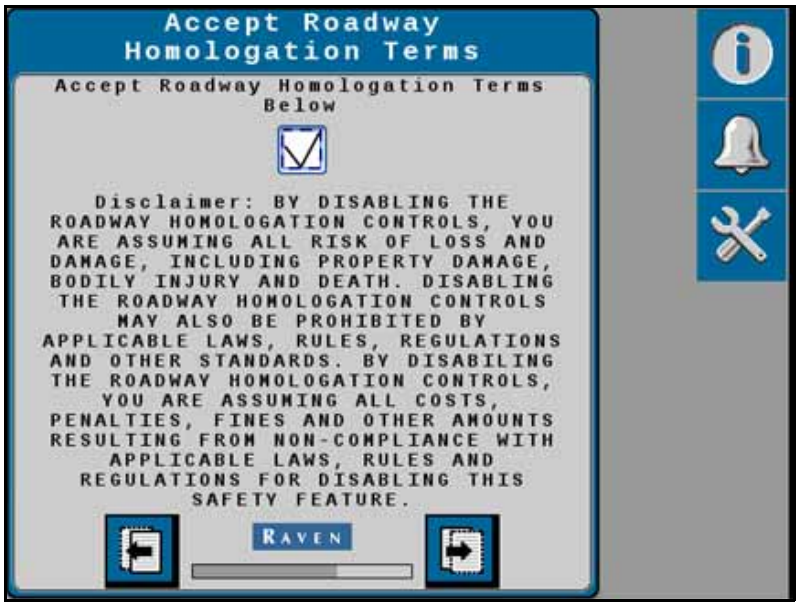
CHAPTER 10 ROADWAY HOMOLOGATION

The Accept Roadway Homologation Terms page will be displayed during the initial calibration of the SC1/TC1 system in either of the following conditions:

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

Carefully review the on-screen disclaimer before proceeding.

FIGURE 1. Roadway Homologation



When roadway homologation is accepted, the following parameters will be applied to SC1/TC1 operation:

- An operator presence method will be required while operating with the SC1/TC1 auto-steering system enabled.
- Auto-steering cannot be enabled above 10 mph (16.1 km/h).
- Auto-steering will disengage above 12 mph (19.3 km/h).

CERTIFICATION

NOTE: The Raven RS1/SC1/TC1 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 - i n c o m p l i a n c e - with the test specification mentioned above. /

Das unter Nr. 1. und 2. beschriebene System - e n t s p r i c h t - 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 compromises pages 1 to 16 and attachments.
The Test Report shall be reproduced and published in full only and by the client only. It shall be reproduced partially with the written permission of the Test Laboratory only.

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

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benannt von der Benennungsstelle des Kraftfahrt-Bundesamtes, Bundesrepublik Deutschland.

Stuttgart, 16.06.2019

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DE-70567 Stuttgart

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

Document / *Dokument:* Rev. 04

Page / *Seite:* 16 of / *von* 16

SAFETY NOTES

- The system “RS1/SC1/TC1” can be installed by authorized dealers / workshops only.
- Before driving on public roads:
    - the “RS1/SC1/TC1” has to be switched off by the master switch.
    - the monitor must be mounted outside of the required visibility of the driver.

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We Solve Great Challenges.

LIMITED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

HOW LONG IS THE COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THIS WARRANTY?

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

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

We Solve Great Challenges.

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

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

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

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

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

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

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

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

RAVEN