

Raven SC1™/TC1™ Calibration & Operation Manual for Towed Implements

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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.



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.

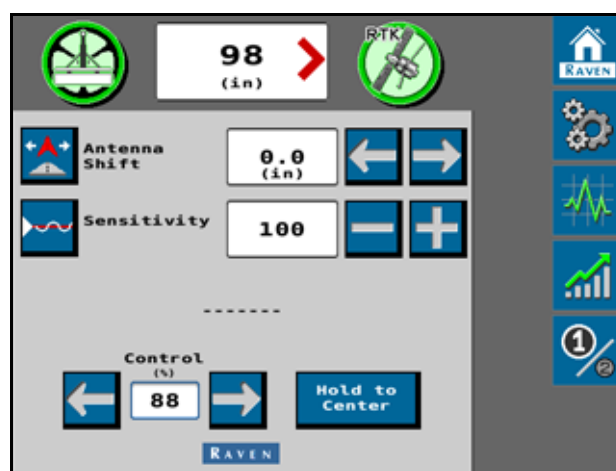
CHAPTER INTRODUCTION

2

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 for implement steering.

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

	<div data-bbox="760 247 1073 310"> WARNING</div> <p>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.</p>
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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 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™ Calibration & Operation Manual for Towed Implements
- 016-4010-008 Rev. C
- Any comments or feedback (include chapter or page numbers if applicable).
- Let us know how long have you been using this or other Raven products.

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

Thank you for your time.

**WARNING**

The machine will steer automatically. While calibrating or operating the 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 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.
- Before selecting Implement Steering as a machine type, make sure that the tractor is disconnected or already calibrated.
- It is recommended to calibrate in conditions as close to actual field operations as possible. Before starting the calibration process:
 - Verify machine measurements are correctly entered into the UT.
 - Confirm that the

INITIAL IMPLEMENT CALIBRATION

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

- *Implement Steering Machine Selection*
- *GPS Setup*
- *Terrain Compensation Calibration*

IMPLEMENT STEERING MACHINE SELECTION

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.

It is recommended to disconnect the tractor (machine) SC1/TC1 or RS1 upon initial install to avoid confusion when resetting the ECU. Refer to the *Reset Calibrated Gains* section on page 39 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.
3. Confirm that the correct ECU will be reset by touching the Information icon in the upper, right corner and matching the Hardware Serial Number to the ECU serial number mounted to the implement.

NOTE: If the Machine Home page displays, the ECU for that terminal has been calibrated. Check other terminals for an ECU that has not been calibrated.

4. Use the drop-down options to select one of the following types for implement steering:

FIGURE 1. Machine Selection

Side Shift



Disc

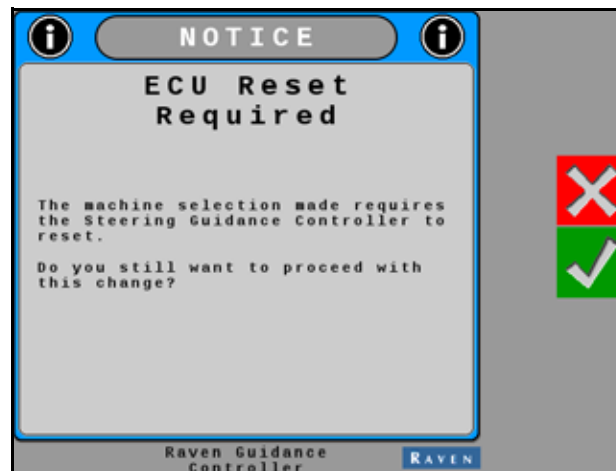


- Mounted Side Shift Implement - select this option if a side-shift adapter frame will be used to steer the implement.
- Implement Disc - select this option if a steering disc has been mounted to the implement.

5. Select **Generic** for the Machine Make field.

6. Select the **Next** arrow.

FIGURE 2. ECU Reset Required



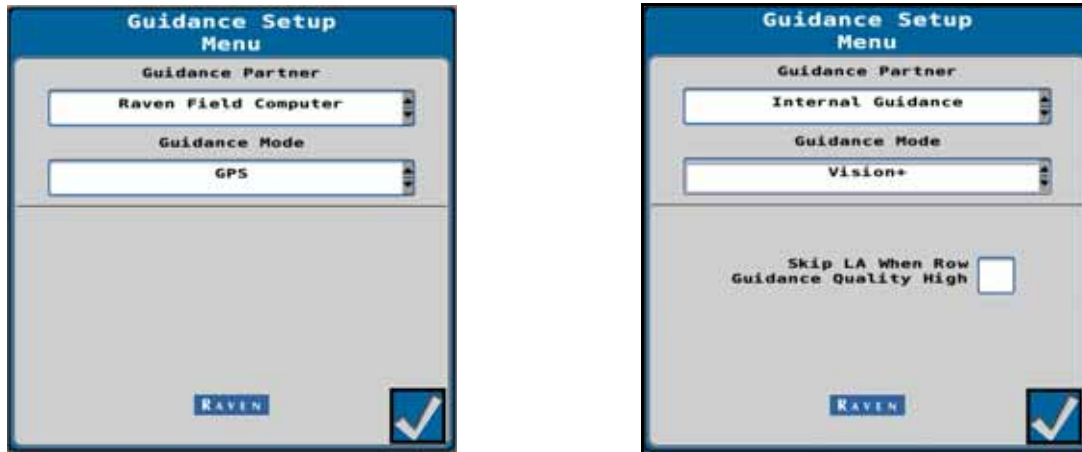
NOTE: The SC1/TC1 ECU is configured to steer tractors and sprayers from the factory. The ECU will need to be reset for implement steering operations and restarted before the initial calibration wizard can be completed. Complete the following steps to reset the ECU.

7. Touch the **Accept** button.
8. Allow the node to restart.
9. When the ECU restarts, select the **Implement Guidance and Steering** terminal from the UT menu.
10. After the ECU restarts, select the Type and Make from the Machine Selection Page.
11. Select the **Next** arrow.

GUIDANCE SETUP

1. Using the drop-down menu, select the desired guidance partner. If a Raven VSN™ visual guidance system is connected, the guidance mode may be set for row guidance.

FIGURE 3. Guidance Setup Menu



NOTE: For additional information on the Guidance Setup Menu, refer to “Guidance Setup Menu” on page 40.

2. Using the drop-down menu, select the desired guidance mode.
3. If desired, enable the Skip LA When Row Guidance Quality High option by pressing the check-box. When enabled, the system will not attempt to line-acquire when the quality from the VSN is above the set threshold.
4. For internal guidance systems, input the working width.
5. Select the **Accept** button to complete the guidance setup.

GPS SETUP

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

- *System Information* section on page 61
- *Diagnostic Trouble Codes (DTC)* section on page 57
- *Implement Position Sensor Calibration* section on page 36. The Machine Test icon will only be displayed if a Steering Partner is detected.



Information



Alarms



Machine
Test

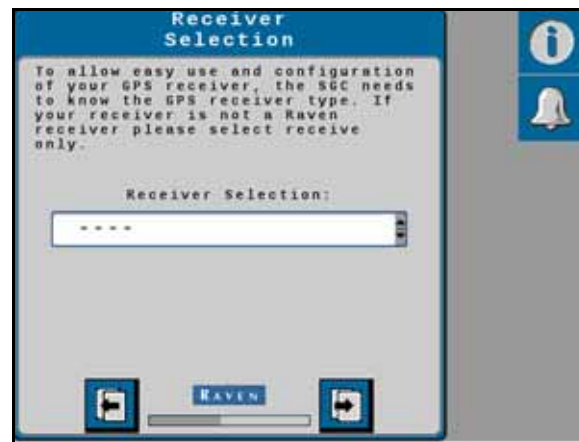
FIGURE 4. Steering Partner and Configuration



NOTE: GPS Only Configuration should not be used with implement steering systems.

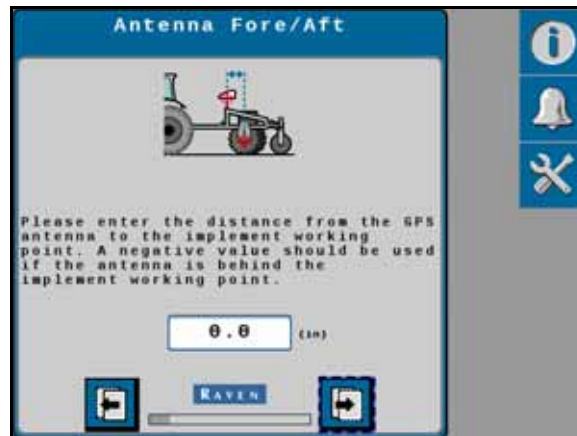
1. To calibrate both the GPS and auto-steering features of the SC1/TC1 system, confirm that the Steering Configuration screen displays the correct Steering Partner and touch the **Next** button.
2. Use the drop-down to select the appropriate GPS receiver.

FIGURE 5. Receiver Selection



3. Select the **Next** arrow.

FIGURE 6. Antenna Fore/Aft Screen



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

NOTE: The Antenna Fore/Aft Offset is measured from the working point of the implement to the center of the implement GPS antenna. A negative value should be entered if the GPS antenna is located behind the operation point.

5. Select the **Next** arrow.

FIGURE 7. Antenna Shift Screen

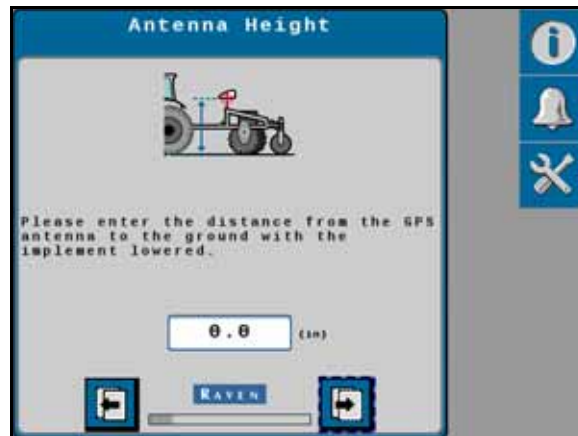


6. Select the value box to enter the Antenna Center Offset position.

NOTE: The Antenna Center Offset is measured from the centerline of the implement 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.

7. Select the **Next** arrow.

FIGURE 8. Antenna Height Screen

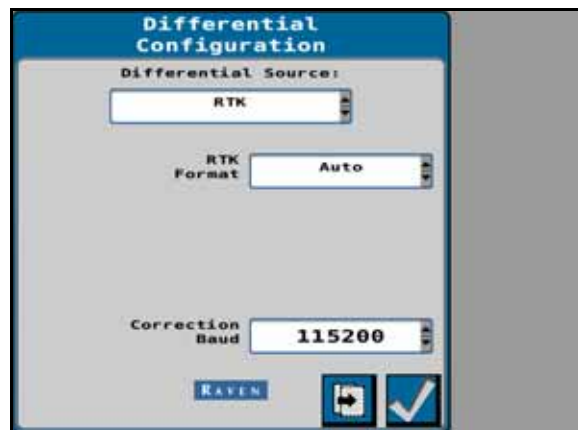


8. Select the value box to enter the Antenna Height.

NOTE: The Antenna Height is measured from the ground to the center of the GPS antenna with the implement lowered to working position.

9. Select the **Next** arrow.

FIGURE 9. GPS Differential Configuration Screen



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

NOTE: Some differential sources may require a feature unlock. Refer to Chapter 8, *Feature Unlock Codes*, for additional assistance with entering feature unlocks. Contact your local Raven dealer for assistance with purchasing feature unlocks.

11. Select the **Next** arrow.

FIGURE 10. Position Accuracy Screen



12. 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.

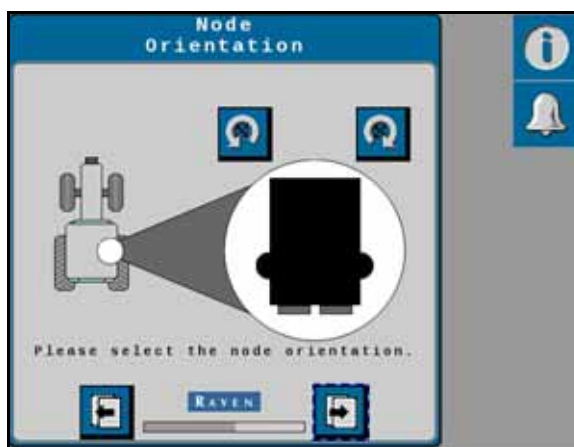
13. Select the **Next** arrow.

TERRAIN COMPENSATION CALIBRATION

1. Use the rotation buttons until the on-screen display matches the orientation of the SC1/TC1 ECU.

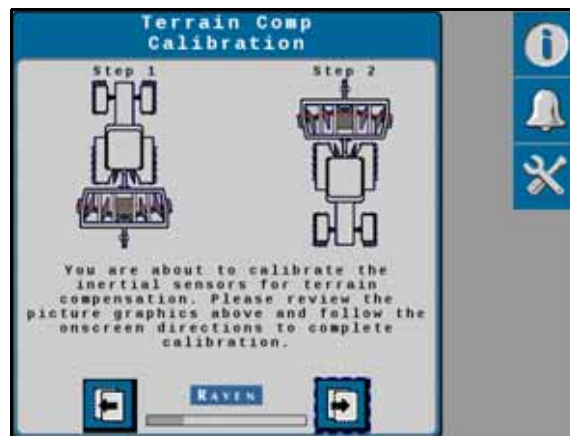
NOTE: The SC1/TC1 ECU must be mounted in a horizontal orientation (Mounting surface parallel to the ground).

FIGURE 11. SC1/TC1 ECU Orientation



2. Select the **Next** arrow.

FIGURE 12. Terrain Compensation Calibration

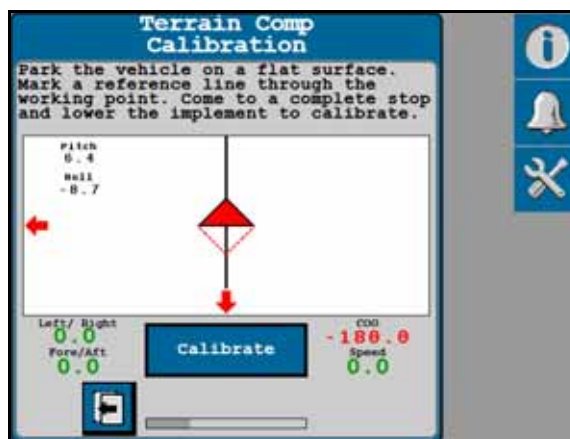


1. Drive the machine forward at least 33 feet [10 m] and park on a flat surface.

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

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

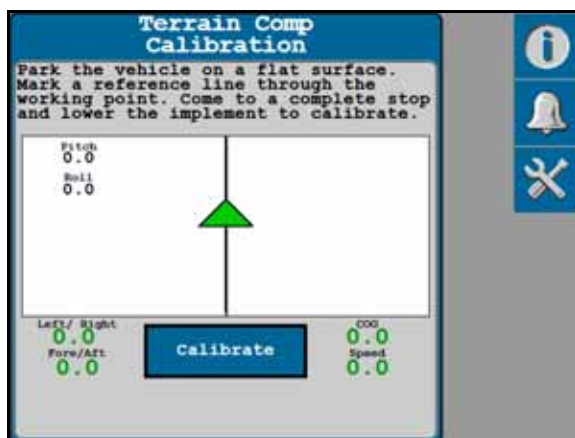
FIGURE 13. Terrain Compensation Calibration



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

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

FIGURE 14. Terrain Comp Calibration Screen



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

VALVE SELECTION

1. Use the drop down list to select the type of valve used to steer the implement.

FIGURE 15. Valve Type Selection

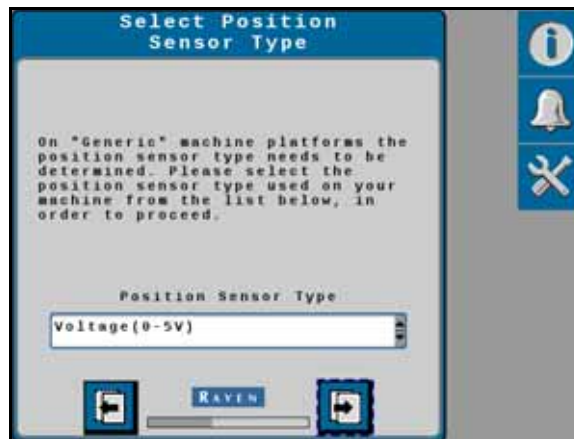


Select the **Next** arrow.

POSITION SENSOR TYPE SELECTION

1. Use the drop down list to select the type of sensor used to detect the implement position.

FIGURE 16. Position Sensor Type Selection



Select the **Next** arrow.

SELECT THE TYPE OF ENGAGEMENT

1. Use the drop down list to select how the implement steering system should be engaged during operation.
Select:
 - Tractor Linked - implement follows tractor engage status (not compatible with standalone steering)
 - Height Switch - implement engages when implement is lowered
 - Field Computer Only - implement engages via the UT independent from machine engage status

NOTE: Refer to the *Disengage/Engage Settings* section on page 38 for additional information on implement engage setup options.

FIGURE 17. Engage Type Selection

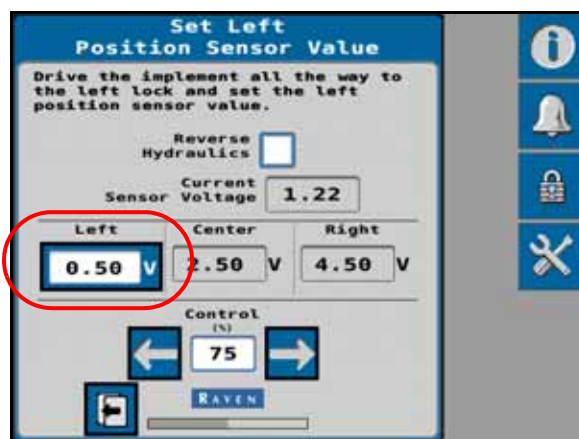


2. Select the **Next** arrow.

ANGLE SENSOR CALIBRATION

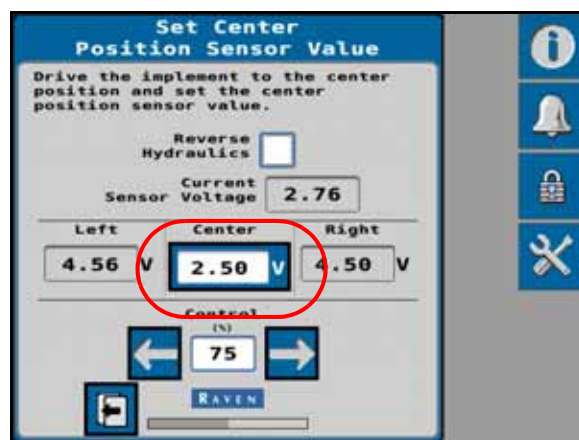
NOTE: The implement must be towed and moving during the angle sensor calibration.

FIGURE 18. Left Position Calibration Screen



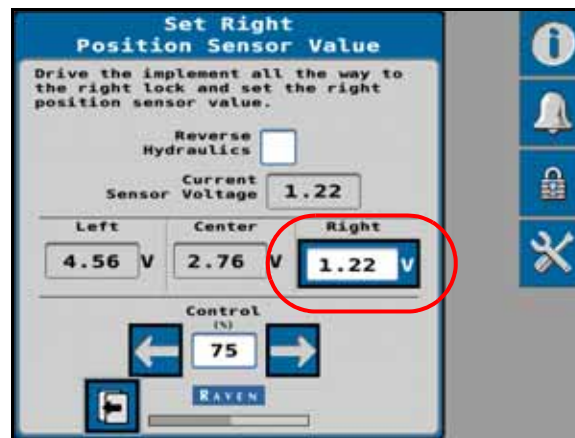
1. Use the left and right arrow keys to confirm that the implement shift hydraulic system is working properly.
2. If left and right controls are switched, check the Reverse Hydraulics box.
3. Adjust the actuator all the way to the maximum left position.
4. Select the **Left** button to set the left angle sensor value.

FIGURE 19. Center Position Calibration Screen



5. Center the implement using the right arrow button.
6. Select the **Center** button to set the center angle sensor value.

FIGURE 20. Right Position Calibration Screen



7. Adjust the actuator all the way to the maximum right position.
8. Select the **Right** button to set the right angle sensor value.

FIGURE 21. Position Sensor Calibration Complete Screen



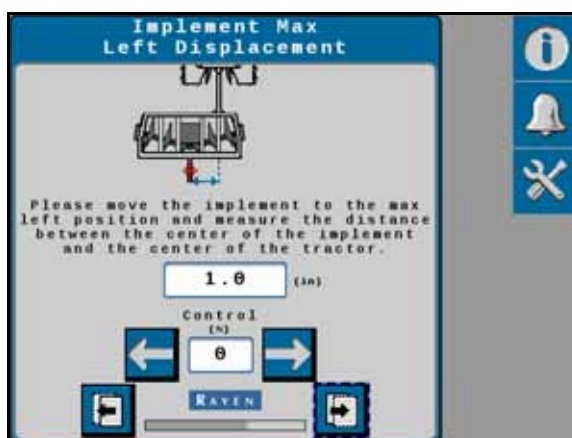
9. Review the position sensor calibration details.
10. Press the **Next** arrow.

IMPLEMENT CONTROL SETTINGS

NOTE: Complete the following steps when calibrating a side shift implement steering system. When calibrating a disc system, skip to step 9.

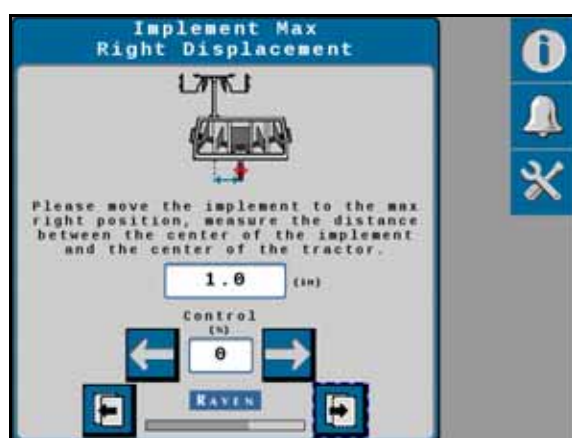
1. Use the on screen arrows to move the implement to the maximum left position.

FIGURE 22. Maximum Left Displacement



2. When the implement has reached the furthest left position, measure the displacement from the center position.
3. Enter the measured distance and select the **Next** arrow.
4. Use the on screen arrows to move the implement to the maximum right position.

FIGURE 23. Maximum Right Displacement



5. When the implement has reached the furthest right position, measure the displacement from the center position.
6. Enter the measured distance and select the **Next** arrow.
7. Set the Min % to the minimum value required to move the implement steering actuator.
8. The Max % can be used to limit the maximum speed of the implement steering actuator, if desired.
9. Use the Implement Control Setup screen to confirm implement steer actuator operation. Review the *Implement Steer Control Settings* section on page 36 for additional information on using this screen.

FIGURE 24. Implement Control Setup

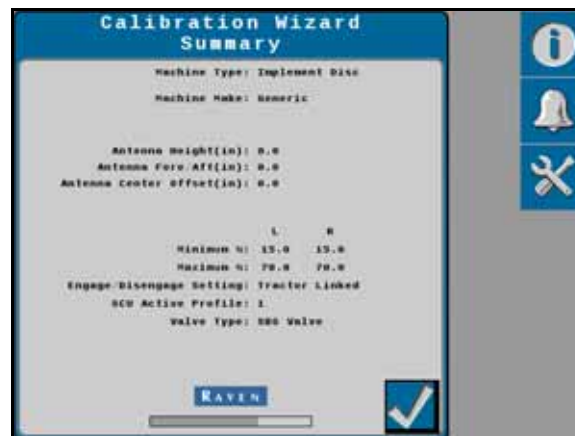


10. Select the **Next** arrow.

CALIBRATION WIZARD SUMMARY

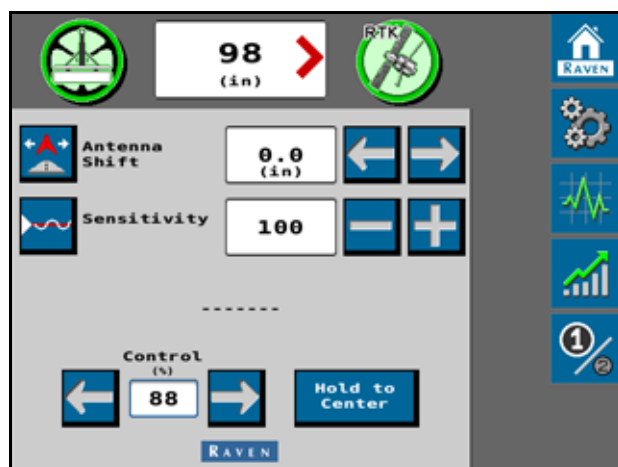
1. Review the Calibration Wizard Summary screen displayed.

FIGURE 25. Calibration Wizard Summary



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

FIGURE 26. Implement Home Screen



CHAPTER 4

ROUTINE IMPLEMENT OPERATION

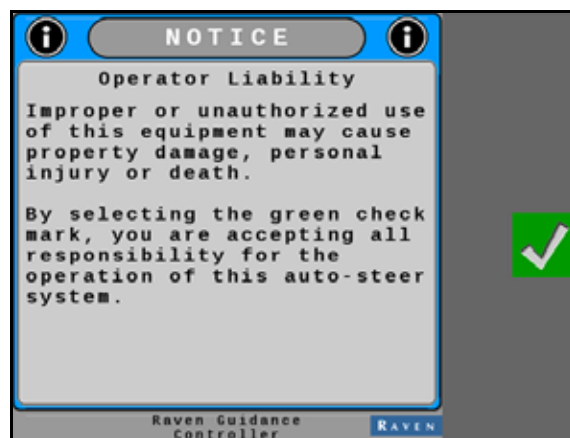
NOTE: The ISO UT must be selected specifically for the implement before being used to operate the SC1/TC1 system. Refer to the UT operation manual for additional assistance with using your UT display.

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.

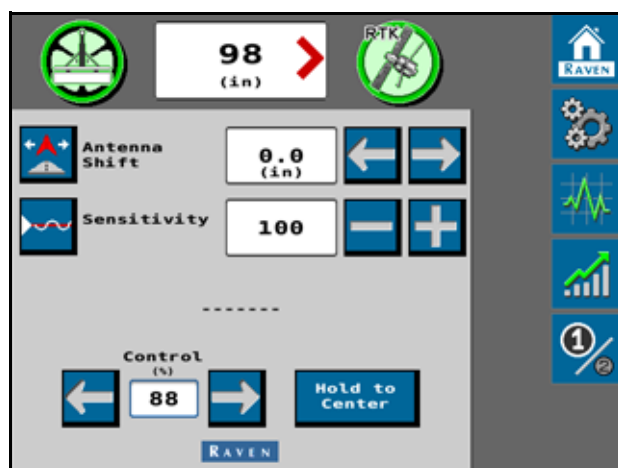
FIGURE 1. Operator Liability Prompt



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. SC1/TC1 Home 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 9, <i>Diagnostics and Troubleshooting</i> , for assistance with resolving active DTCs and troubleshooting the system.
	Active diagnostic and troubleshooting codes are present. The SC1/TC1 system may be engaged in this state, but system performance may be impacted.
	No active diagnostic or troubleshooting codes 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.





NOTE: Both the steering wheel and GPS icons must be green in order to engage the SC1/TC1 system.

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 is not converged or GPS is converged and a warning DTC is present.
	GPS is converged and no active DTCs are present.
	GPS RTK-L solutions are being used for field guidance. DTCs may be present.

NOTE: Both the steering wheel and GPS icons must be green in order to engage the SC1/TC1 system.

Select the satellite icon to display the GPS Status screen. Refer to the *GPS Status Screen* section on page 28 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** - The Antenna Shift settings allows the user to shift the center point of the antenna relative to the center point of the implement. Negative values indicate that the antenna is located to the left of the implement center point.
- **Sensitivity** - The Sensitivity value determines how aggressively the implement 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.

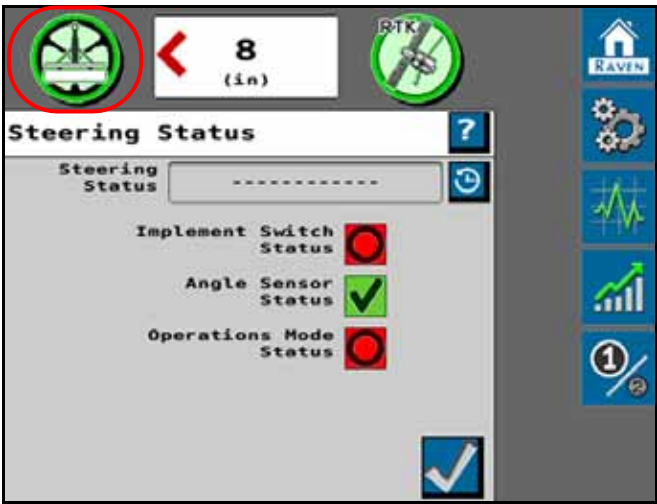
NOTE: If the implement is slow to react after a steering adjustment, increase the Sensitivity setting in increments of 10. If the implement makes an adjustment too quickly, decrease the Sensitivity value.

- **Hold to Center** - Return the implement to the calibrated center position.

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



Pressing the **Info** button on the bottom of the Steering Status History page provides a description of the disengagement code.



FIGURE 5. Info Button Information



STATUS DISPLAYS



IMPLEMENT SWITCH

The implement switch status displays the current status of the engage mechanism selected.

Display	Message
	Implement switch is in the off position (e.g. implement is raised or tractor is not engaged).
	Implement switch is on (e.g. implement is lowered or tractor is engaged).



ANGLE SENSOR

Displays the status of the position sensor used to detect the actuator position.

Display	Message
	Position sensor is out of range or the sensor is disconnected.
	Position sensor is ready.

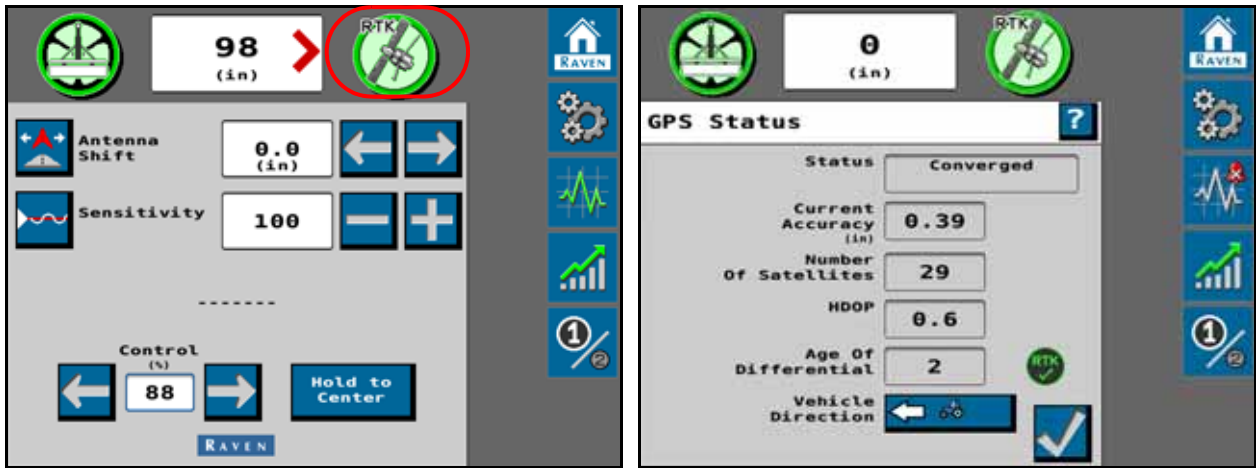
OPERATION MODE

Displays the operational status of the implement if present. Refer to *Implement Settings* section on page 33 for more information and to enable this feature.

Display	Message
	Operation Mode input is not active.
	Operation Mode input is active.

GPS STATUS SCREEN

FIGURE 6. Home Screen



Press the GPS icon to display the GPS Status screen.







Display	Message
Status	Displays the selected GPS convergence status. <ul style="list-style-type: none">• Error• No Signal• Converging• Converged
Current Accuracy	If the machine is positioned in exactly the same spot day after day, the position reading should be within the distance displayed.
Number of Satellites	The number of satellites currently in view by the GPS receiver.

Display	Message
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. If a differential source is not currently tracked this entry will be "- - - -".

CRX FEATURES AND OPERATION

CRX WIDGET DEFINITIONS

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

Display	Message
	The SC1/TC1 node is detected, but the operator must accept the operator liability waiver before the system can be enabled.
	No A-B path or guidance line has been set or an active DTC is preventing the SC1/TC1 system from engaging.
	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 57 for additional status conditions which may be displayed in the SC1/TC1 on-screen widget.

If the SC1/TC1 steering widget does not appear on the screen, refer to the field computer operation manual for further information on adding widgets.

ENGAGING SC1/TC1

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

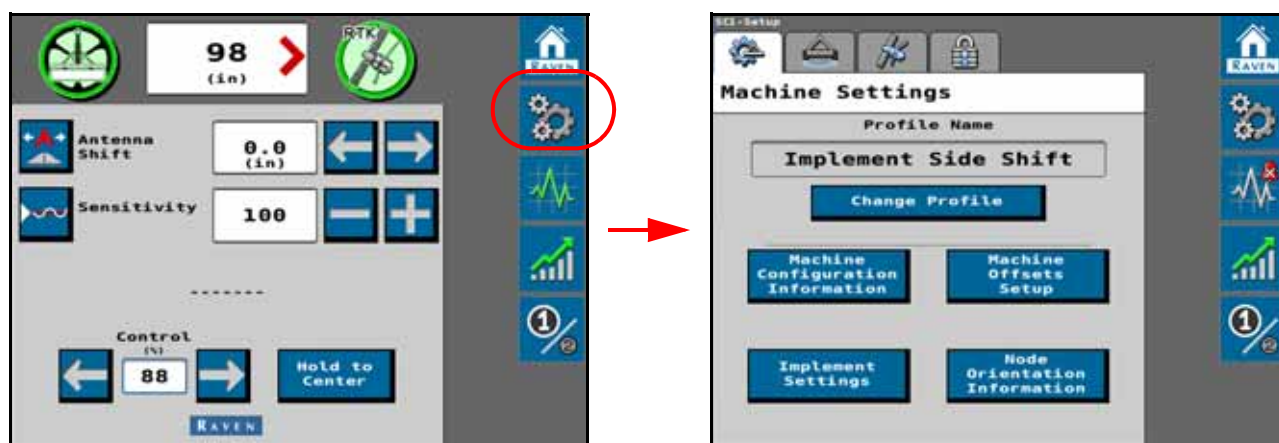
- Tap the foot switch or rocker switch to engage SC1/TC1 features during field operation.
- Press the SC1/TC1 on-screen status widget to engage the SC1/TC1 during field operation.

CHAPTER 5

IMPLEMENT SETTINGS AND TUNING

IMPLEMENT SETTINGS TAB

FIGURE 1. Implement Settings Screen



MACHINE CONFIGURATION

FIGURE 2. Implement Configuration Screen



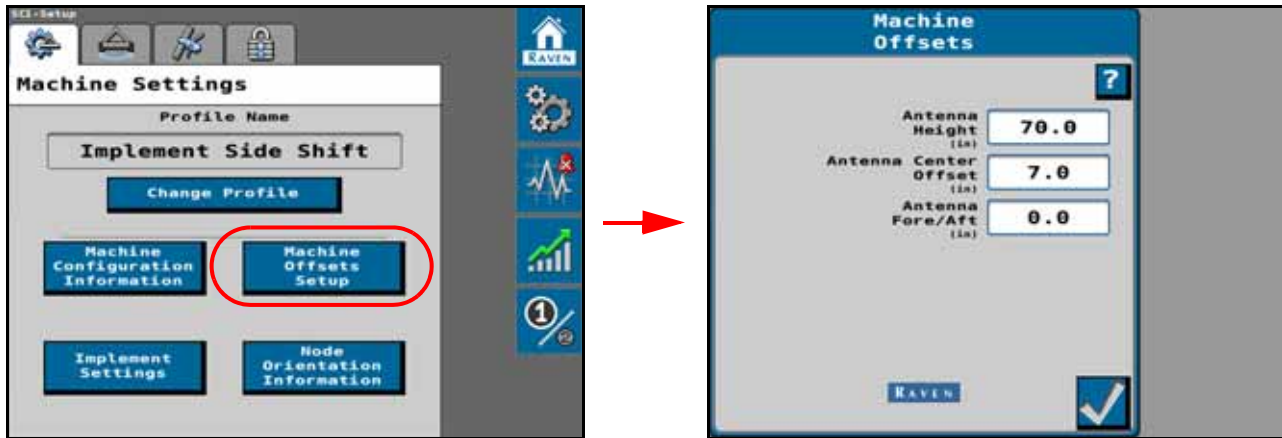
To view the current machine configuration:

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. Implement Offsets Setup Screen



To adjust the antenna offset measurements:

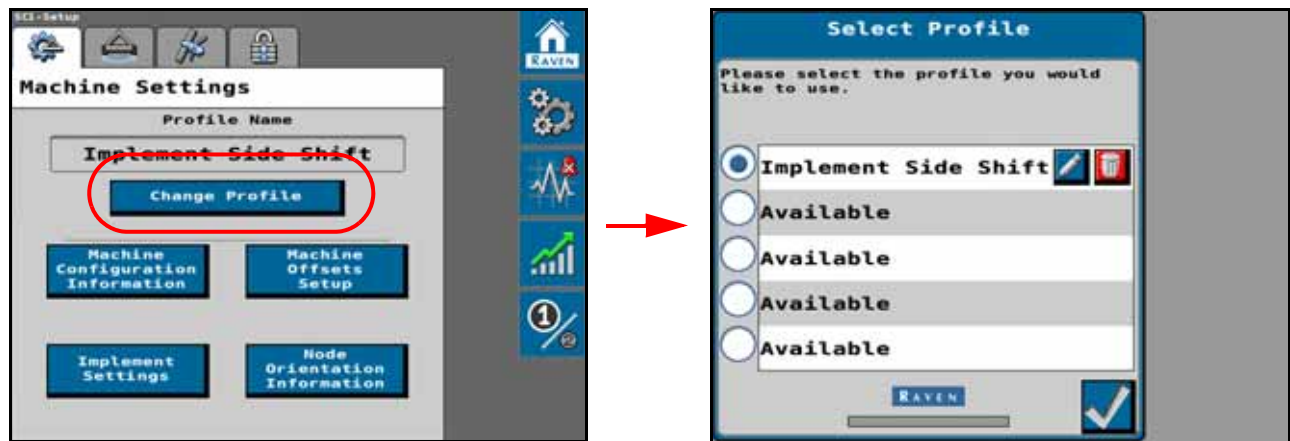
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. On the Machine Settings tab, select the Machine Offsets Setup button.
3. The Machine Offsets screen displays the machine-specific measurements that were entered during the system calibration:

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 implement 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 working point of the implement to the center of the GPS antenna. A negative value should be entered if the GPS antenna is located behind the rear axle.
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.



Edit



Delete

IMPLEMENT SETTINGS

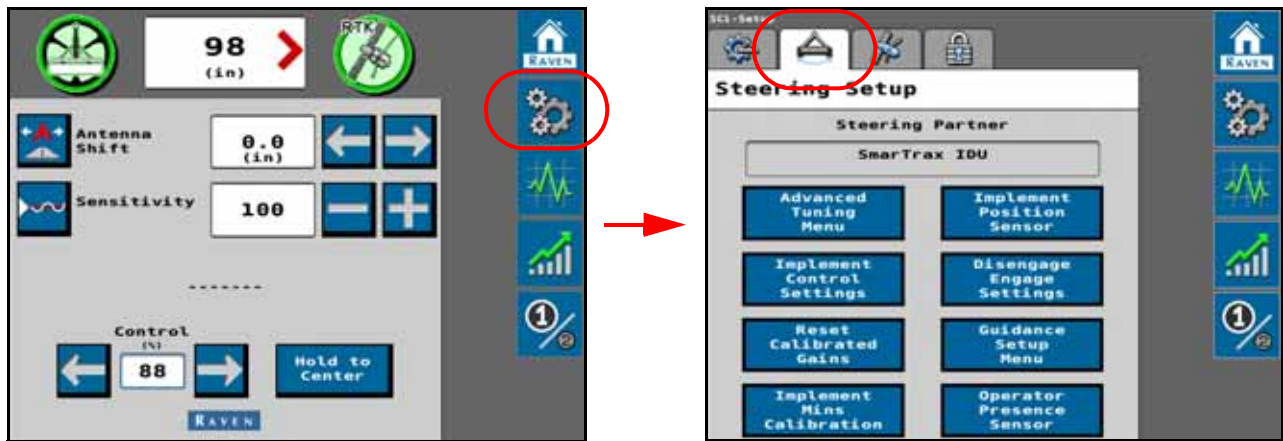
Toggle the Operation Mode feature on or off. When enabled, the SC1/TC1 steering system will allow the field computer to record coverage during a field operation when the system detects the appropriate input. Refer to the field computer manual for additional information and assistance with using the Operation Mode feature.

NODE ORIENTATION INFORMATION

Use the Node Orientation screen to verify the physical orientation of the SC1/TC1 ECU on the implement. If the Node Orientation display does not match the actual ECU orientation, the implement profile will need to be recalibrated to ensure the system properly steers the implement during field operation.

STEERING SETUP TAB

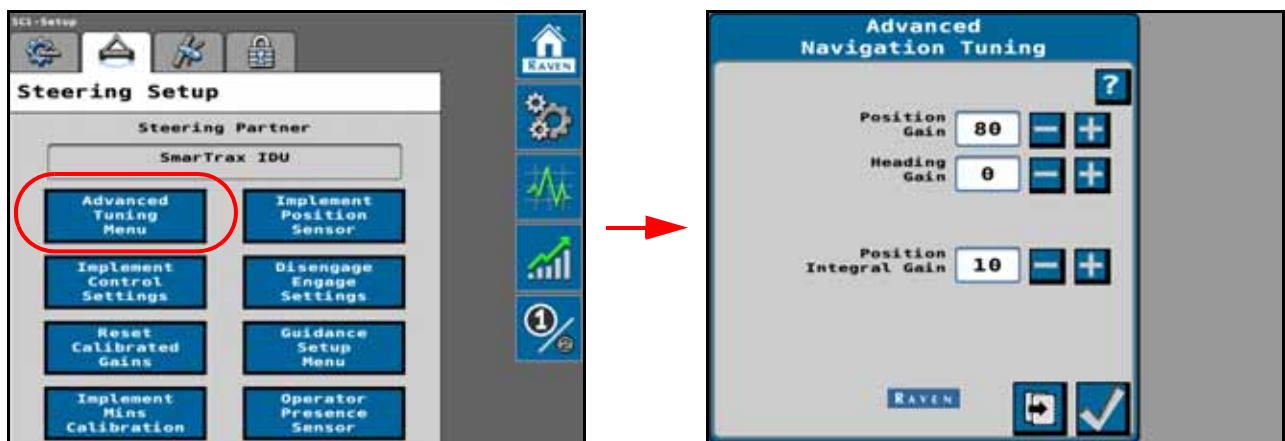
FIGURE 5. Steering Setup Screen



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.

ADVANCED TUNING

FIGURE 6. Advanced Tuning Menu



To access advanced auto-steering tuning options and settings:

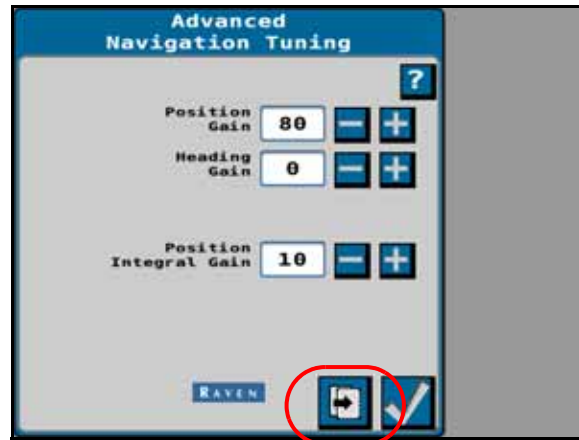
1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Advanced Tuning Menu button.

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.

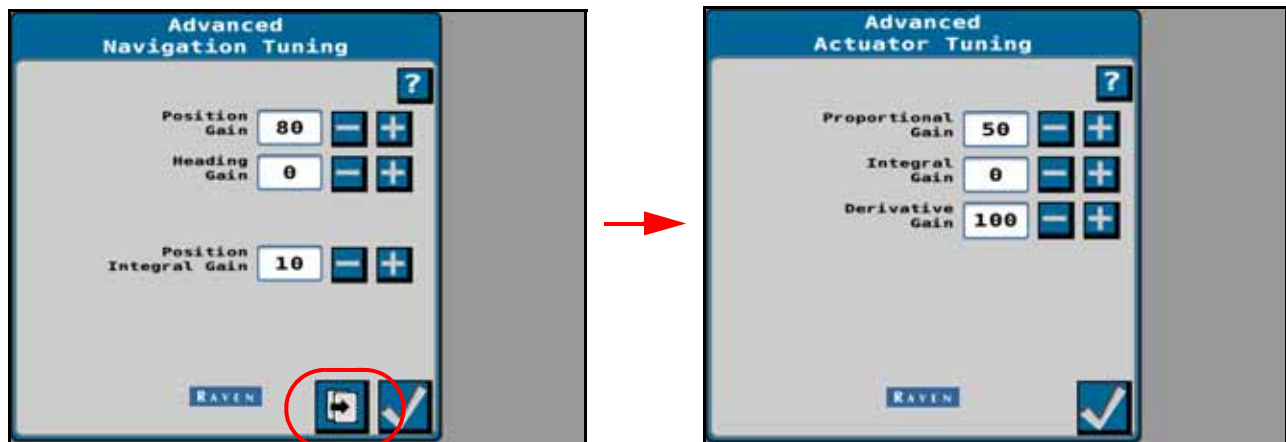
- **Position Integral Gain** - This value corrects long-term errors in the actuator control. If the system is not achieving the desired actuator position during operation, the system will re-direct the position to the desired set point. This value is generally at or near 0.

FIGURE 7. Advanced Tuning Page 2



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

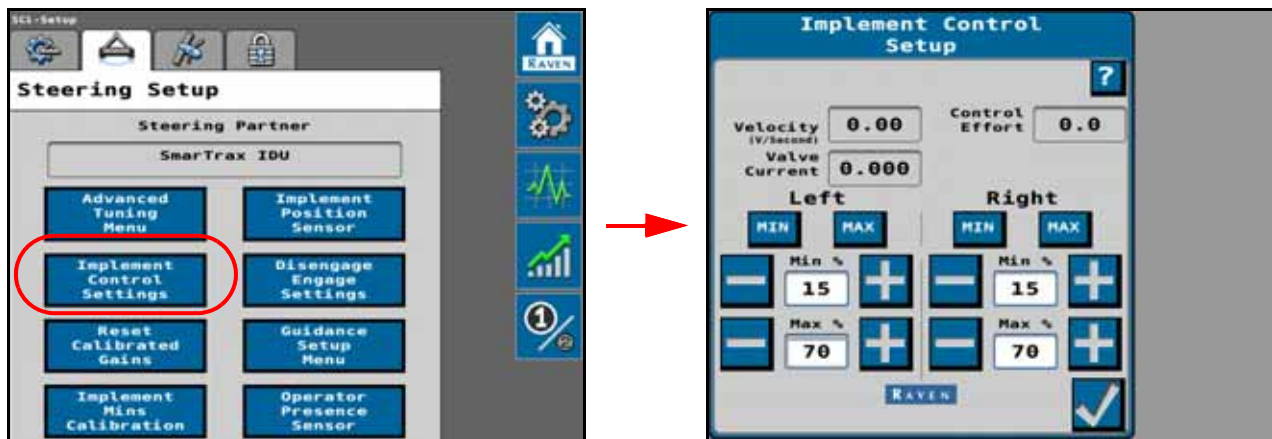
FIGURE 8. Advanced Actuator Tuning Screen



- **Proportional Gain** - Determines the rate of the implement steering actuator response. Increasing the Proportional Gain value causes the implement steering actuator response to be faster, but can result in the machine overshooting the target position or can cause the actuator 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 implement steering actuator response time. A larger Derivative Gain value will reduce the tendency to overshoot the target position, but will limit the implement speed.
4. 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.

IMPLEMENT STEER CONTROL SETTINGS

FIGURE 9. Implement Control Setup Screen



To access implement control settings:

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

- **Velocity** - The speed at which the implement steering actuator is moving, measured in voltage per second.
- **Control Effort** - The amount of effort the SC1/TC1 system is using to drive the implement steering actuator.
- **Valve/Motor Current** - Displays the current draw of the steering valve.
- **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 %** - Set the Min % to the minimum value required to move the implement steering actuator.

NOTE: The Min values cannot exceed the Max values.

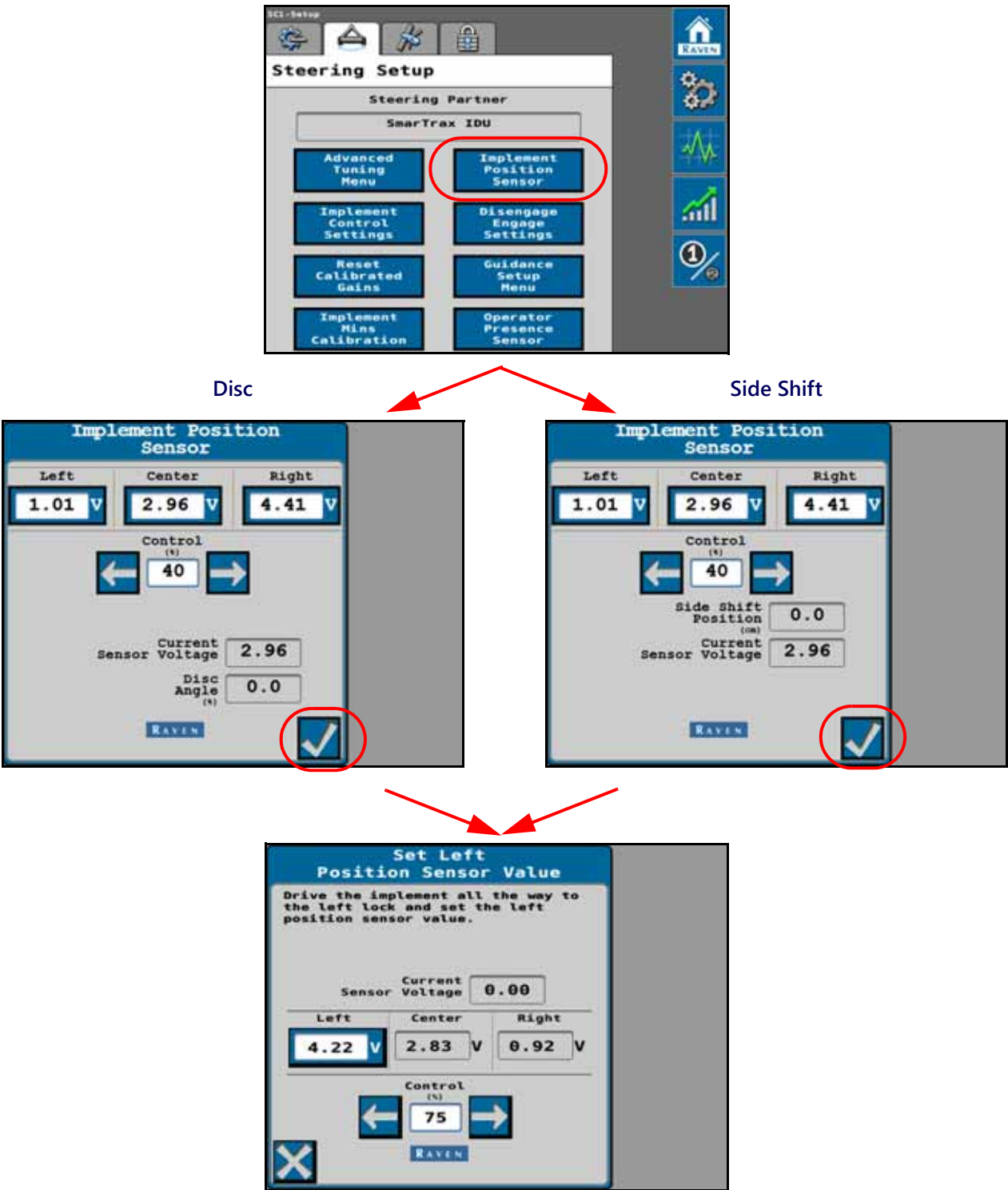
- **Left/Right Max %** - The Max% value can be used to limit the maximum speed of the implement steering actuator, if desired.
3. Select the Accept button in the lower, right corner of the screen to save the displayed settings and return to the Steering Setup tab.

IMPLEMENT POSITION SENSOR CALIBRATION

The position sensor calibration process allows SC1/TC1 to set right, left, and center points of the implement position

IMPLEMENT POSITION SENSOR SETTINGS

FIGURE 10. Implement Position Sensor Calibration Screen

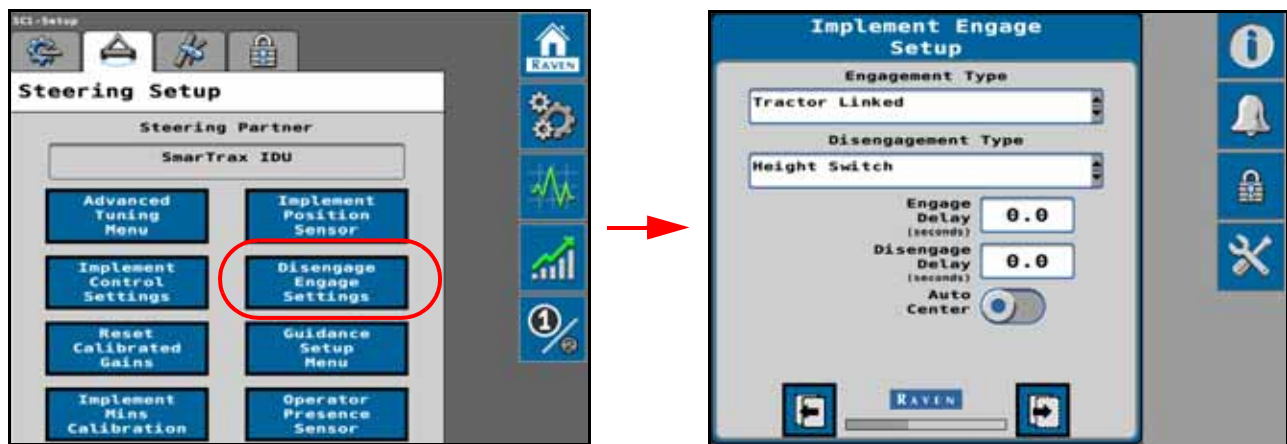


To set the Implement Position sensor calibration values:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Implement Position Sensor button. The following values and options are displayed on the Implement Position Sensor page:
 - **Left/Center/Right** - Displays the current calibration values. Complete the following steps to adjust or tune the Implement Position Sensor.
 - **Control %** - Control effort applied to the actuator when pressing the left or right buttons.
 - **Side Shift Position** - Current offset distance from the center of the implement.
 - **Current Sensor Voltage** - Current voltage as detected by the position sensor.
 - **Disc Angle** - Current disc angle percentage with respect to the calibrated center (straight forward) position.

DISENGAGE/ENGAGE SETTINGS

FIGURE 11. Steering Engage/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 Disengage Engage Settings button. The following information is displayed on the page:
 - **Engagement Type** - Use the drop down list to select how the implement steering system should be engaged during operation. Select:
 - Tractor Linked - implement follows tractor engage status
 - Height Switch - implement engages when implement is lowered
 - Field Computer Only - implement engages via the UT independent from machine engage status
 - **Auto Center** - Determine if the implement will return to center after disengage.
 - **Engage Delay** - Defines how long before the implement will start steering after engage status change.
3. Select the Accept button in the lower, right corner of the screen to return to the Steering Setup tab.

RESET CALIBRATED GAINS

FIGURE 12. Reset Calibrated Gains Screen



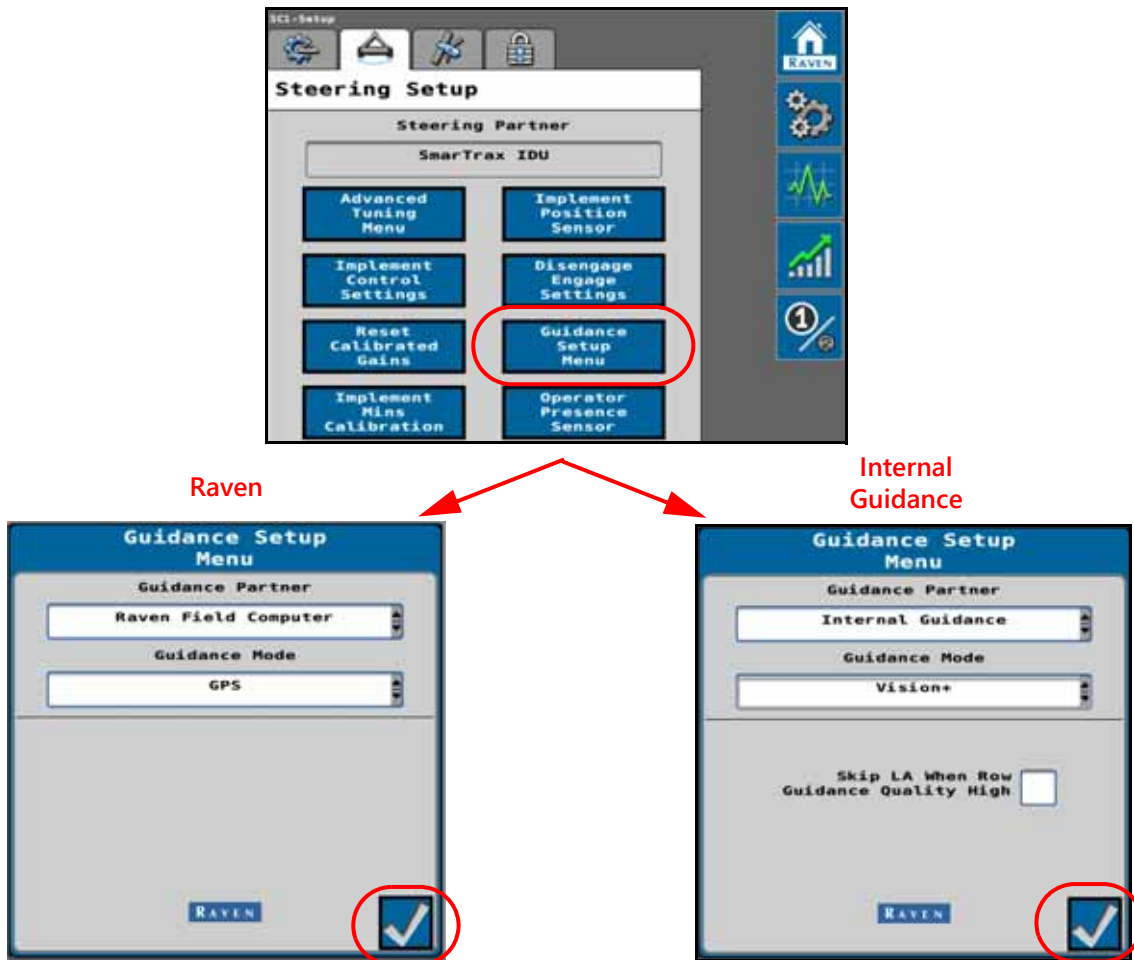
To reset the SC1/TC1 system to factory defaults:

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.

GUIDANCE SETUP MENU

This menu allows the operator to switch guidance partners. If a Raven VSN™ visual guidance system is connected, the Guidance Setup menu will set the guidance mode and row guidance.

FIGURE 13. Guidance Setup Menu



To access Guidance Setup settings:

1. From the SC1/TC1 Home screen, select the Settings Menu button.
2. Select the Steering Setup tab and the Guidance Setup button. The following information is displayed on the page:
 - Guidance Partner - Use the drop-down list to select the Guidance Partner. Select:
 - Raven Field Computer - SC1 is receiving the guidance line from a CR7 or CR12 field computer
 - Internal Guidance - SC1 implement is used for standalone steering and does not receive a guidance line from a field computer
 - Guidance Mode - Use the drop-down list to select the desired Guidance Mode:
 - GPS - 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.
3. If desired, enable the Skip LA When Row Guidance Quality High option by pressing the check-box. When enabled, the system will not attempt to line-acquire when the quality from the VSN is above the set threshold.
 4. For internal guidance systems, input the working width.
 5. Select the **Accept** button to complete the guidance setup.

OPERATOR PRESENCE SENSOR

It is not recommended to use the operator presence sensor settings in the SC1/TC1 implement steering working set. Refer to the SC1/TC1 Operation Manual for Sprayers and Tractors (P/N 016-4010-005) for additional information.

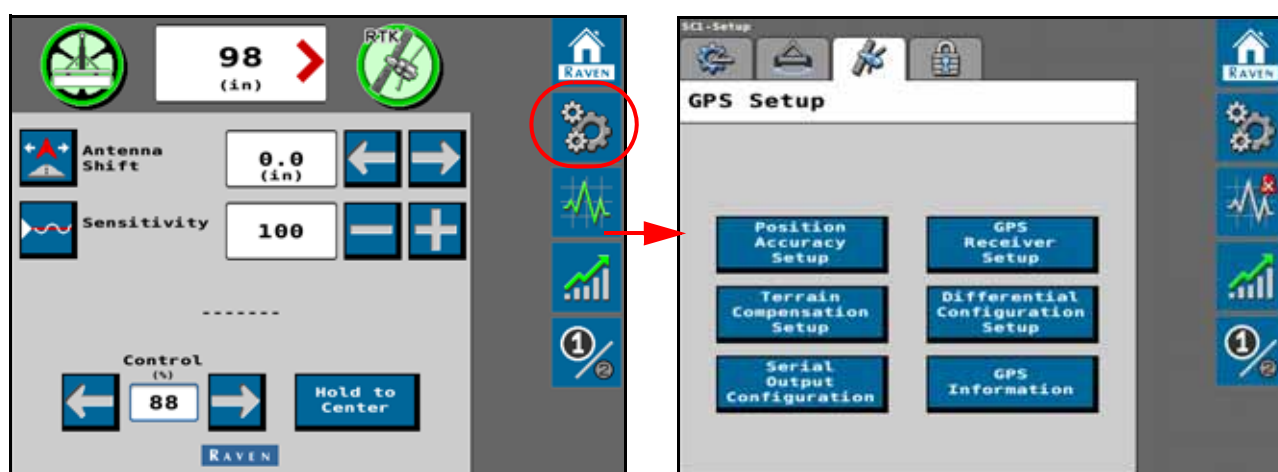
GPS RECEIVER CONFIGURATION

SC1/TC1 will automatically configure the following Raven receivers to output the correct messages and message rates:

- Raven 700S™

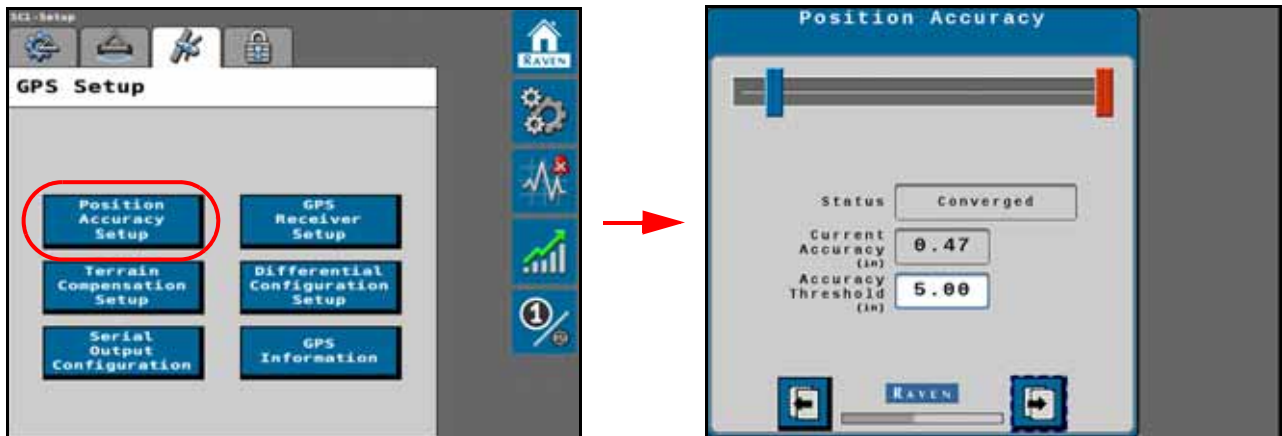
CONFIGURE GPS IN THE SC1/TC1

FIGURE 1. GPS Setup Screen



POSITION ACCURACY SETUP

FIGURE 2. Position Accuracy Setup Screen

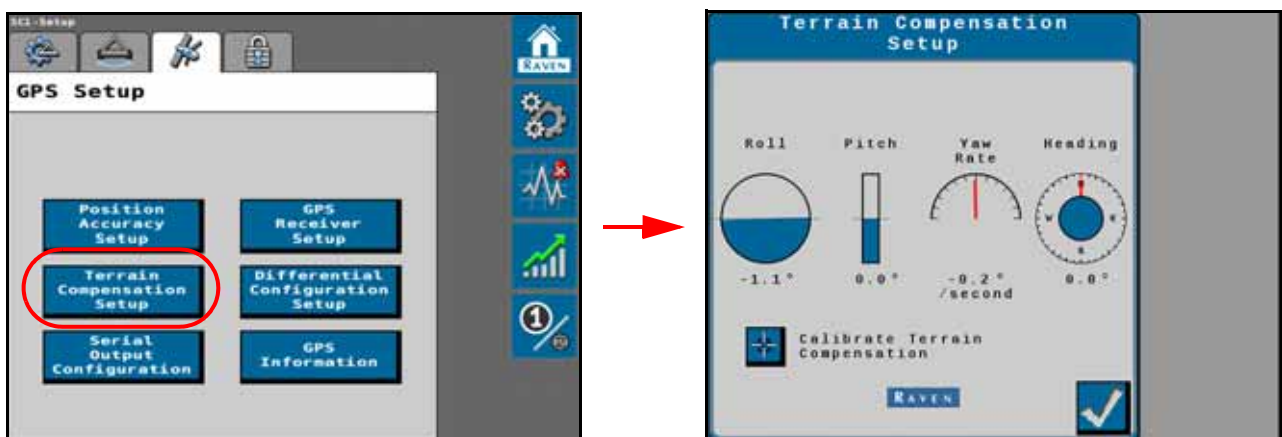


- **Status** - Displays the absolute status of the GPS accuracy. Statuses that may be displayed in this area include:
 - No Signal
 - Error
 - Converging
 - Converged
- **Current Accuracy** - A value representing the reported horizontal accuracy of the current solution as detected by the receiver.
- **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 3. 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.

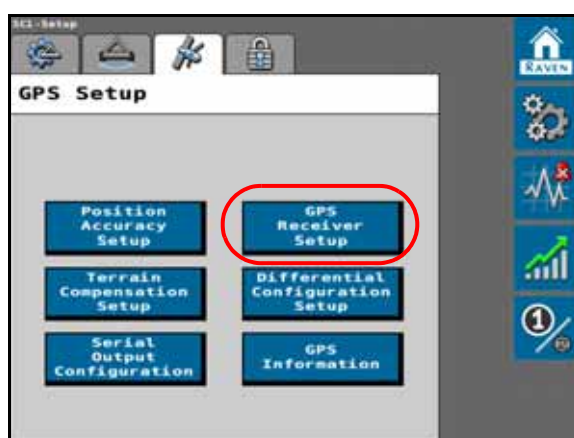
Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

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 700S™

FIGURE 4. GPS Setup Screen



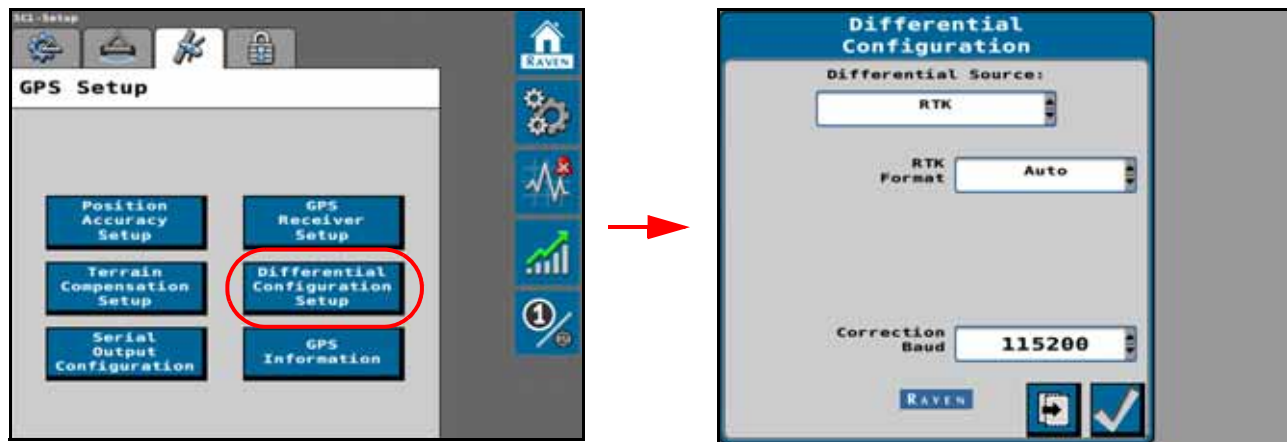
4. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

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 5. Differential Configuration Screen



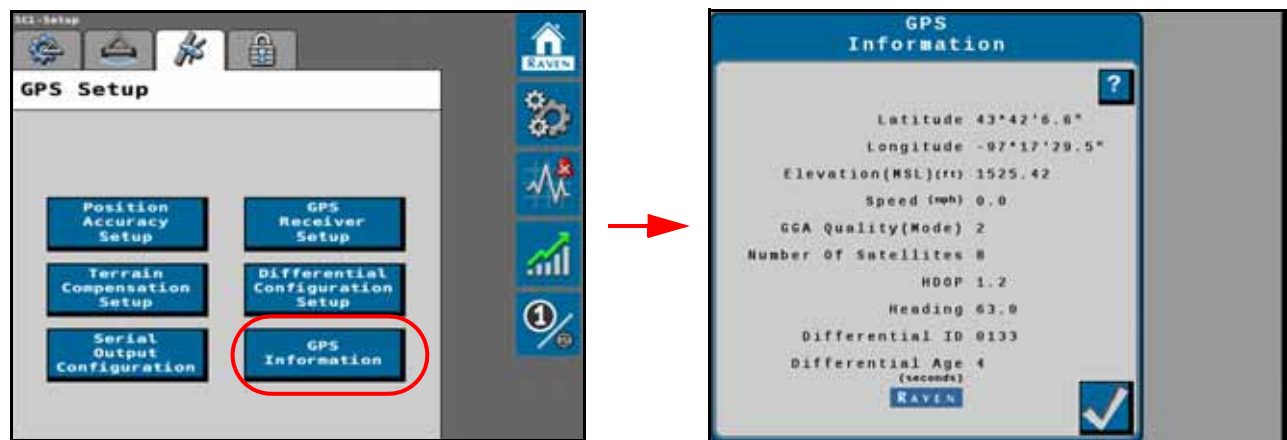
NOTE: Refer to Chapter 8, *Feature Unlock Codes*, for additional assistance with activating additional differential sources.

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 6. 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.

This chapter is intended to assist with the proper operation of the standalone steering feature of the SC1™/TC1™ system for implement steering.

RUN SCREEN OVERVIEW

The image below is an example of a run screen. This section provides basic information on the run screen layout.

FIGURE 1. Standalone Steering Run Screen

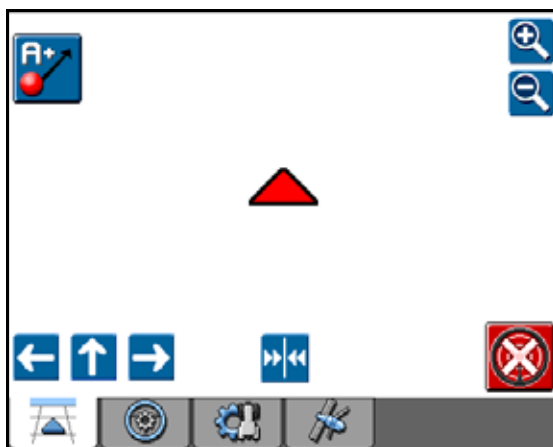





TABLE 1. Status Bar Icons

Icon	Name	Description
	Manual Control	Steers the implement manually. The upwards arrow button controls the actuator to its center position. The control speed can be adjusted by changing the control percentage in the Standalone Steering Tuning Settings screen.
	Nudge to Position	This will move the guidance line to be centered under the current antenna position.
	Steering Status	Shows the current steering status. See "Engaging SC1™/TC1™" on page 52 for more information.
	Zoom In/Out	Press the plus to zoom in on the run screen and press the minus to zoom out on the run screen.
	Run Screen Tab	This section provides basic information during normal operation.

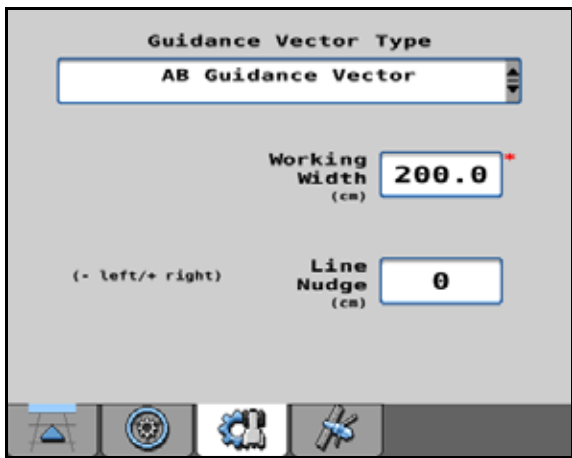
	Standalone Steering Tuning Settings Tab	This menu allows the user to adjust or tune the system during normal operations.
	Standalone Steering Settings Tab	This menu allows the operator to switch between guidance vector type and allows the operator to nudge the guidance line.
	Guidance Mode Tab	If a Raven VSN™ visual guidance system is connected, the guidance mode icon allows the operator to quickly set the guidance mode. See “Switch Guidance Modes” on page 53.

STANDALONE GUIDANCE LINES

CREATE GUIDANCE LINE



NOTE: When rebooting the system, the last created guidance line will reload.

FIGURE 2. Standalone Steering Settings Screen



To access Standalone Steering Settings:

1. Select the Standalone Steering Settings icon on the run screen. From the drop-down list, select AB Guidance Vector.
2. Select the desired guidance vector type:


Icon	Name	Description
	Straight AB	Create a straight guidance line using a starting point (A) and an ending point (B).
	A+	Create a straight guidance line using a starting point (A) and a compass heading (direction).

3. Select the **Accept** button to create the guidance line and return to the Run Screen.

STRAIGHT AB GUIDANCE LINE

To create a Straight AB guidance line:

1. Once the machine is on the desired starting point and in the proper orientation, select the guidance line

starting point .

2. Drive forward to start recording.

NOTE: Drive forward for at least 65 ft. [20 m] to record an AB guidance line. When recording, the record widget will display a flashing red light.


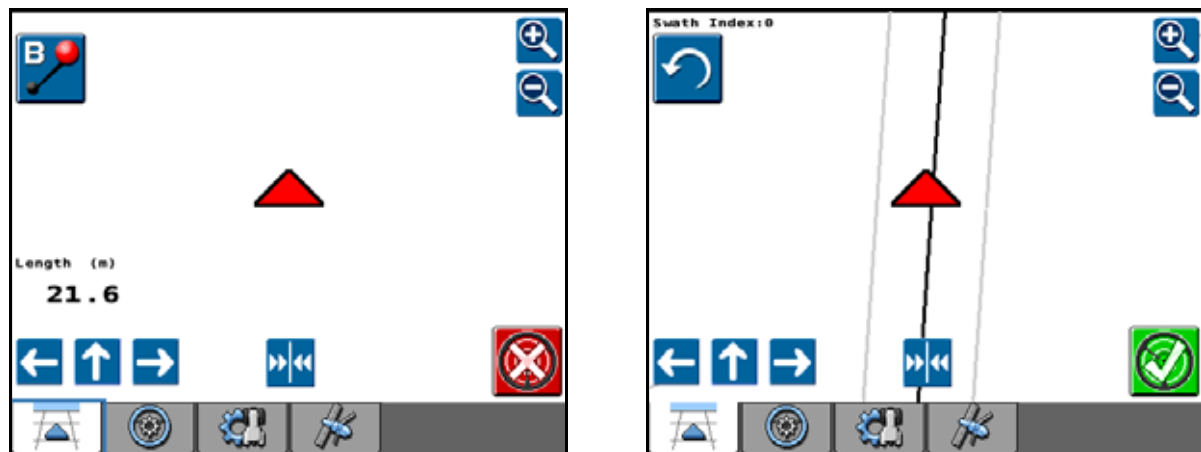

3. When done recording, press the end point (B) . A guidance line will appear between the starting point (A) and ending point (B).

FIGURE 3. AB Guidance Line




4. To erase the current guidance line and start a new line, press the reset button .

A+ GUIDANCE LINE

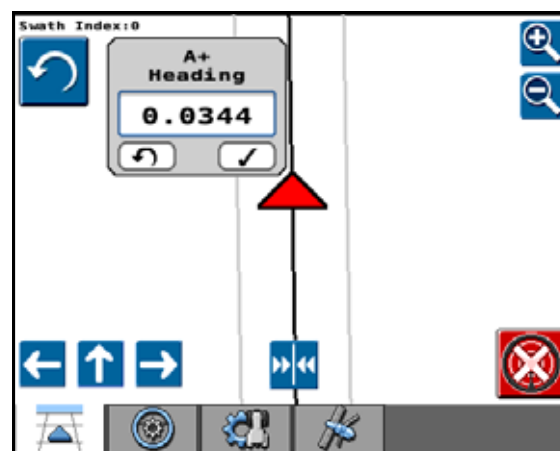
To create a A+ guidance line:

1. Once the machine is on the desired starting point and in the proper orientation, select the guidance line

starting point .

2. Fill out the desired compass heading and press the checkmark to set the guidance line.

FIGURE 4. A+ Guidance Line

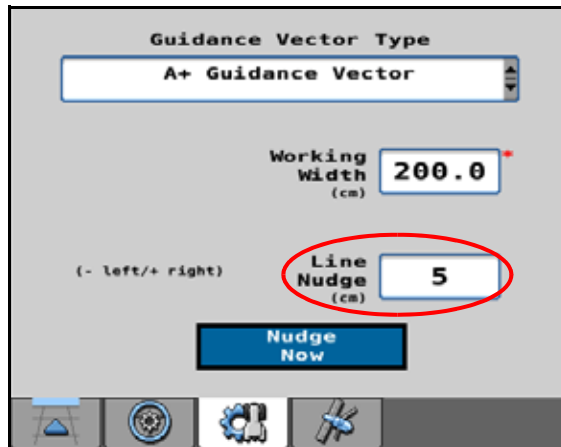


NUDGE GUIDANCE LINE

To adjust the guidance line to the left or right by a specified distance:

1. Select the Standalone Steering Settings icon on the run screen.
2. Enter the desired length for the guidance line to be moved. A negative value will move the line to the left, and a positive value will move the line to the right.

FIGURE 5. Nudge Guidance Line



3. Select the **Nudge Now** to move the guidance line the specified distance.

IMPORTANT: To center the guidance line underneath the current antenna position, press the nudge to position button



ENGAGING SC1™/TC1™

The steering status icon indicates the current steering status. The steering status icon will also function as the engage/disengage button for steering.

FIGURE 6. Steering Status Icon

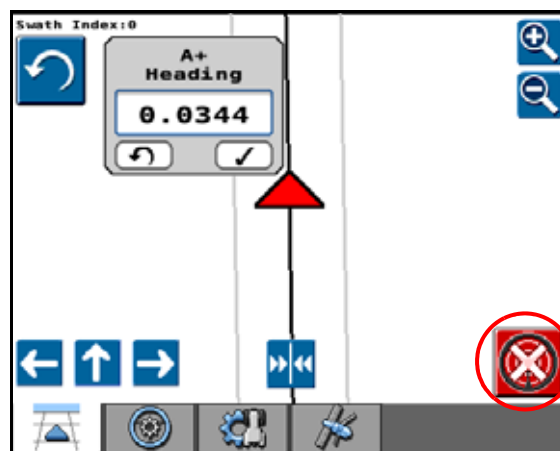





TABLE 2. Steering Status Icons

Icon	Description
	No AB path or guidance line has been set.
	SC1 is on and calibrated. Ready to engaging steering. Press to engage steering.
	SC1 is in operation. Press to disengage steering.

SWITCH GUIDANCE MODES




If a Raven VSN™ visual guidance system is connected, the guidance mode icon allows the operator to quickly set or change the guidance mode.

FIGURE 7. Guidance Mode Icon



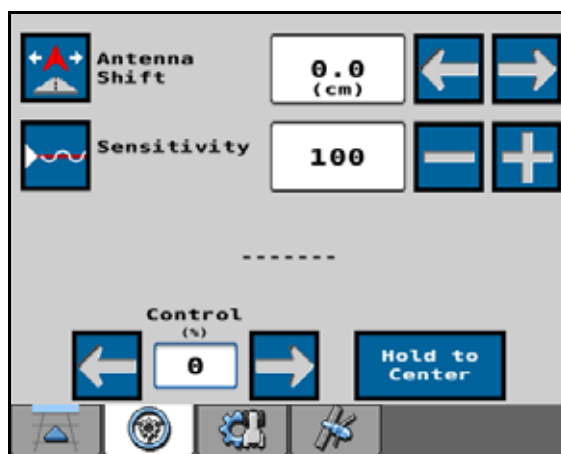
To switch the guidance mode:

1. Select the guidance mode tab.
2. Select the desired guidance vector:

Icon	Name	Description
	GPS	Guidance is preformed 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.

TUNE STANDALONE STEERING SETTINGS

FIGURE 8. Standalone Steering Tuning Settings



The following settings and adjustments are displayed on the Standalone Steering Settings menu and may be used during normal operation to adjust or tune the system:

- **Antenna Shift** - 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, turn 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 or centimeters by two and enter the result into the antenna shift field. 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 in increments of 10.

- **Manual Control** - Steers the implement manually. The percentage can be used to control the speed of the implement steering actuator.
- **Hold to Center** - Controls the steering actuators to its center position when pressing the button.

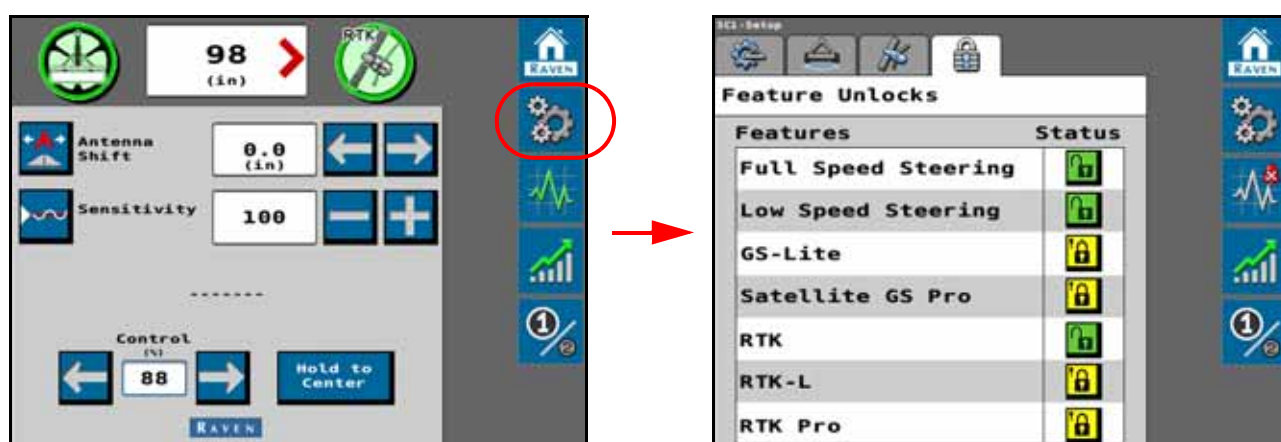
CHAPTER 8 FEATURE UNLOCK CODES

8

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.

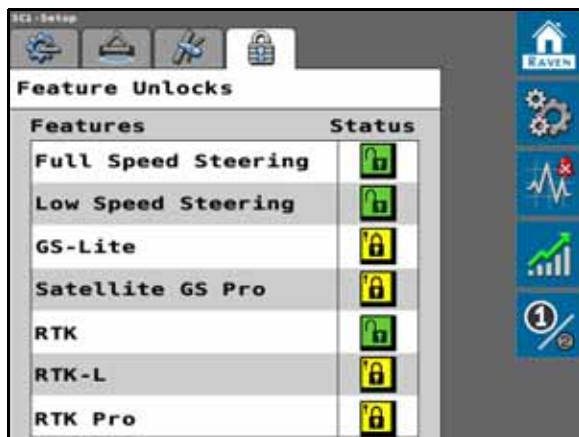
FIGURE 2. Feature Unlock Information Screen



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: RTK unlocks can only be applied for the following GPS Receivers:

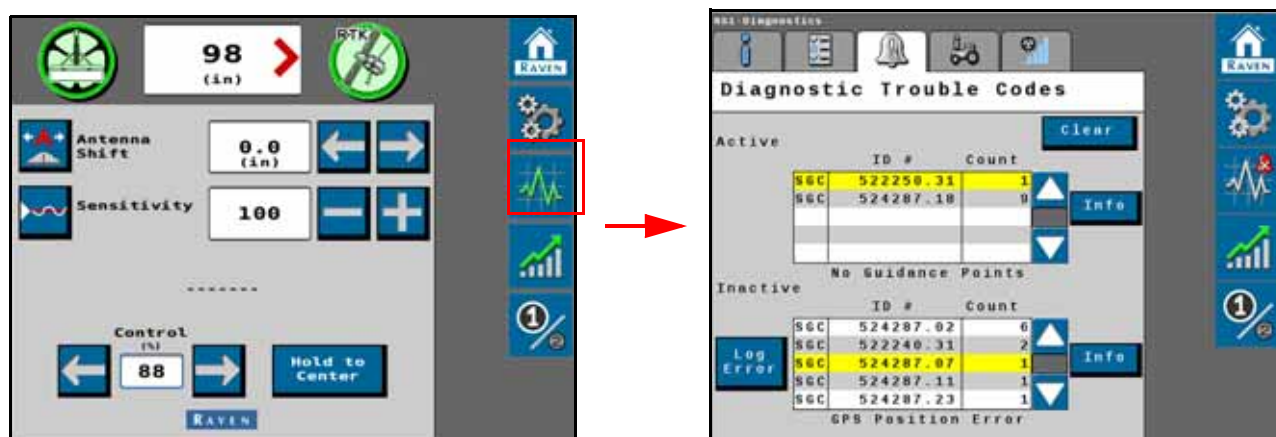
- Raven 700S™

CHAPTER 9

DIAGNOSTICS AND TROUBLESHOOTING

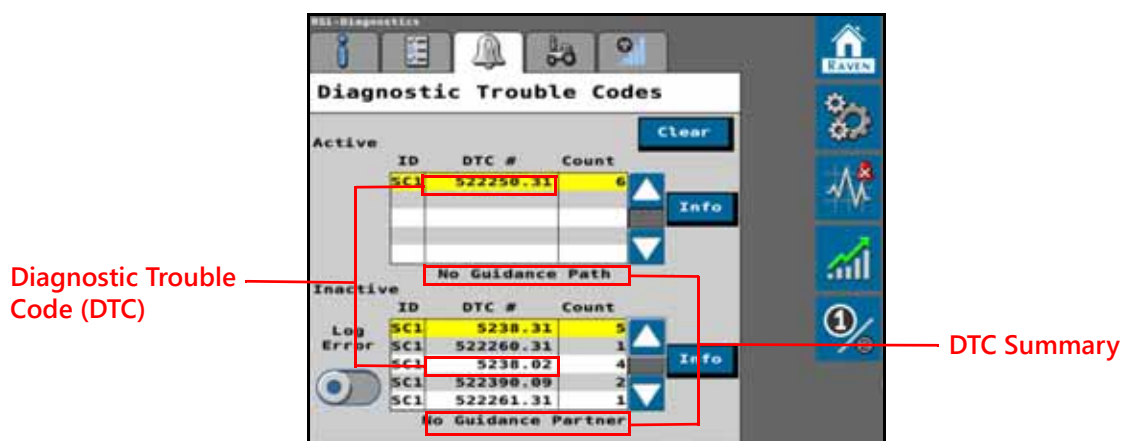
DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 1.



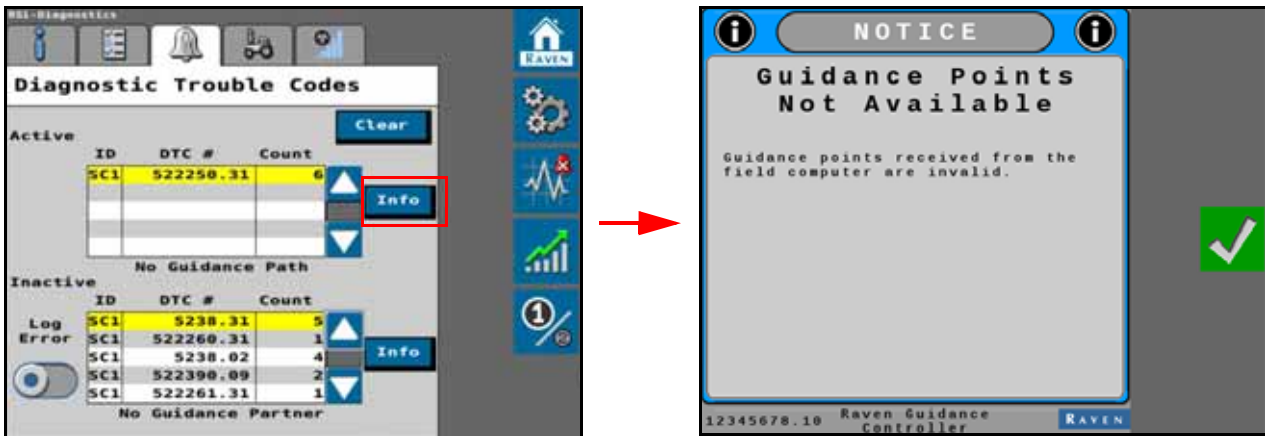
The Diagnostic Trouble Code screen displays active and previous diagnostic trouble codes (DTCs) that occur during SC1/TC1 system operation. Active DTCs must be fixed before the SC1/TC1 system can be enabled for guidance and steering operation. Once a DTC has been corrected, the code moves to the inactive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

FIGURE 2. Diagnostic Trouble Codes Screen



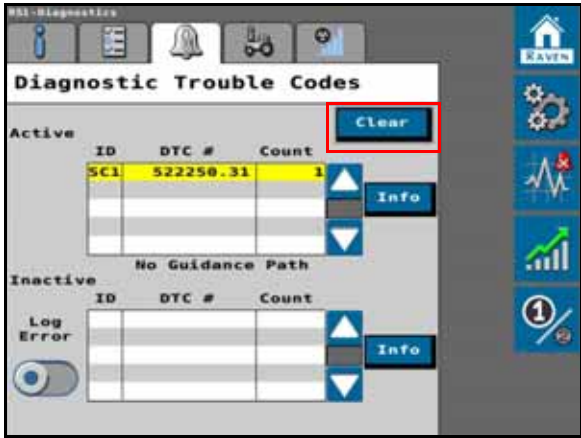
NOTE: In Figure 3 above, the active DTC is 522250.31 and the DTC summary is "No Guidance Points." The inactive DTC is 522261.31 and the DTC summary is "No SCU Detected."

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.

DTC CODES

TABLE 1. RS1/SC1/TC1 DTC Codes

Code ID		Display Name	Description
630	.13	Steering No Cal	System is not fully calibrated.
2901	.2	Incompatible HW	This hardware platform isn't supported by the current software loaded onto it.
168	.4	HC Low Voltage	The supply voltage is less than nine 9V. Check battery voltage.
	.3	HC High Voltage	The supply voltage is greater than 32V. Check battery voltage.
5238	.31	Loss of SCU Comm	Steering Control Unit was detected, but communication has stopped. Please check cabling.
3045	.31	SCU Denied Steering	Steering Control Unit is preventing system operation. Please check steering control unit.
522260	.31	No Guidance Partner	Field Computer has not been detected during the current power cycle. Please check cabling.
5238	.2	Invalid Curvature	The estimated curvature from the Steering Control Unit is invalid.
522390	.9	Engage SW Error	An engage switch is currently in a failed state. Please check engage switch.
522261	.31	No SCU Detected	Steering Control Unit has not been detected during the current power cycle. Please check cabling.
522240	.31	No GPS Comm	System is unable to communicate with the GPS receiver.
	.18	GGA Rate Low	Communication to the receiver is active, but the GGA string is being received at < 5Hz.
	.16	GGA Rate High	Communication to the receiver is active, but the GGA string is being received at > 20Hz.
522242	.18	ZDA Rate Low	Communication to the receiver is active, but the ZDA string is being received at < 0.1Hz.
	.16	ZDA Rate High	Communication to the receiver is active, but the ZDA string is being received at > 1Hz.
522250	.7	Max XT ERR Exceeded	Machine exceeded max error from the guidance line.
	.31	No Guidance Path	Guidance points received from field computer are invalid.
	.2	Curvature Invalid	Reset/update field computer. Contact dealer.
	.17	Min Point Space ERR	
	.15	Max Point Space ERR	
	.16	Segment Angle ERR	
	.0	End of Line ERR	
	.3	NoPts Behind Start	
	.4	NoPts Ahead Start	
	.5	Curve No Pts Behind	
	.6	Curve No Pts Ahead	
	.8	Lookahead too Large	

Code ID		Display Name	Description
1504	.2	Operator Not Present	Operator presence switch indicates that the operator is not present.
5243	.2	Master Switch Off	Master Switch is turned off.
74	.16	Max Speed Warning	Vehicle speed has exceeded the warning threshold for the calibrated platform.
	.0	Max Speed Shutdown	Vehicle speed has exceeded the warning threshold for the calibrated platform and has shutdown.
87	.0	Max Speed Engage	RS1 cannot be engaged over 18mph.
841	.11	GPS Position Error	GPS position is currently invalid.
523832	.0	GPS Mode Not Unlocked	The differential correction mode requested is not unlocked.
5613	.2	INS Data Invalid	System is unable to measure data from inertial sensors.
523842	.31	Liability Acceptance	RS1/SC1/TC1 Liability has not been accepted.
841	.15	Poor GPS Pos Accuracy	The user set position accuracy has been reached or passed. Performance may not be as desired.
523827	.0	Rev Steer No Support	Reverse steering is not supported for this machine.
701	.3	Resume Switch Stuck	The resume switch has been in the on position for too long. If this problem persists, contact dealer.
5241	.31	Disengage Switch Off	The disengage switch is currently off. If this persists, contact dealer.
523839	.31	Tuneset Not Released.	The selected tuneset has not been released yet. Contact dealer for updates on this tuneset.
523830	.31	Steering Not Unlocked.	Steering has not been unlocked. To use the steering feature, contact dealer for an unlock code.
5613	.13	3D Not Calibrated	Terrain Compensation has not been factory calibrated. If this problem persists, contact dealer.
5613	.11	No Field 3D Cal.	Recalibrate terrain compensation.
841	.0	GPS Not Converged.	GPS has not converged. This can take up to 30 minutes. If this problem persists, contact dealer.
523843	.0	Lost Internal Comm.	There is no communication between the SOM and the SGC. This could affect RTK streams and file management. If this problem persists, contact dealer.
522250	.2	SWATH JUMP.	A swath jump has been detected.

Code ID		Display Name	Description
523844	.11	GPS RCVR: Error.	The GPS receiver has encountered an error. If this problem persists, contact dealer.
523845	.16	GPS RCVR: Temp.	
523846	.16	GPS RCVR: Voltage.	
621	.31	GPS RCVR: Antenna P.	
	.11	GPS RCVR: LNA Fail.	
	.5	GPS RCVR: Antenna O.	
	.4	GPS RCVR: Antenna S.	
523847	.31	GPS RCVR: CPU Max.	
523848	.2	GPS RCVR: COM1 OVR.	
523849	.2	GPS RCVR: COM2 OVR.	
523850	.2	GPS RCVR: COM3 OVR.	
523851	.2	GPS RCVR: Link OVR.	
523918	.2	GPS RCVR: Input OVR.	
523852	.31	GPS RCVR: Aux Tx OR.	
523853	.3	GPS RCVR: AGC Error.	
523919	.31	GPS RCVR: Jammer Det.	
5613	.31	GPS RCVR: INS Reset.	
523920	.2	GPS RCVR:IMU Comm Er.	
523854	.11	GPS RCVR: Almanac Er.	
523855	.31	GPS RCVR: Position S.	
523856	.31	GPS RCVR: Position F.	
523857	.31	GPS RCVR:Clock Steer.	
523858	.31	GPS RCVR:Clock Model.	
523859	.31	GPS RCVR: Oscillator.	
523860	.31	GPS RCVR:Software Re.	
523921	.31	GPS RCVR:Tracking Mo.	
523922	.31	GPS RCVR: Dig Filter.	
523861	.31	GPS RCVR:Aux 3 Event.	
523864	.31	GPS Source Mismatch	Implement and tractor are using different correction sources.
3509	.31	Curvature Msmtch WRN.	Machine heading and wheel direction does not match. Check wheel angle sensor and/or reset system.
	.7	Curvature Msmtch FLT.	The wheel angle sensor measurement is not aligned with the yaw rate sensor measurement.
88	.1	Speed Too Low.	Vehicle Speed is not above the required speed to engage. Please drive above .5 kph or .3 mph.
523868	.31	G-Force Limit Active.	The maximum G force has been limited. This can happen when the SGC limits the amount the machine turns when performing operations such as line acquire and curve steering.
628	.13	Memory Error.	Memory failure
523874	.13	Memory Comm Error.	

Code ID		Display Name	Description
523875	.13	SCU SW Out of Date.	The MDU/HDU needs to be higher than this version for support
523898	.31	OEM Engage Error.	Tried to engage using field computer when system only supports machine engage switch to engage
523913	.31	GPS Invalid Auth.	The GPS receiver has lost the unlock code.
523923	.0	VSN Data Invalid Wrn.	SC1 software is older then what is supported by the steering control unit.
523924	.0	VSN Data Invalid Err.	VSN guidance vectors not valid. Restart VSN.
523925	.2	No Row Cam Comm.	VSN communication timeout. Restart the system.
523916	.13	SC1 SW Out of Date.	SC1 version does not support current SCU version. Update SC1 software.
523926	.31	No User Activity.	No user activity detected. Check operator switch settings and operator switch harness (if present).
523927	.31	Vision Only Needs TC.	System requires a field computer to function. Start a job.
523916	.13	RS1 SW Out of Date.	RS1 version does not support current SCU version. Update RS1 software.
523928	.13	Invalid Factory Cal.	Restart RS1. If problem persists, contact dealer.
522550	.16	FNRP Not in Park.	FNRP Lever is not seated in the park position. If this problem persists, contact your dealer.
	.18	TCU Fault.	Machine cannot enter automation.

TABLE 2. HDU/MDU/IDU DTC Codes

Code ID		Display Name	Description
630	.13	SCU Not Calibrated	SCU is not on a calibrated profile
2901	.2	Incompatible HW SCU	The current software is incompatible with this hardware.
3509	.3	WAS Supply High	Wheel angle sensor power out is above its expected tolerance.
	.4	WAS Supply Low	Wheel angle sensor power out is below its expected tolerance.
	.31	WAS Alignment Fault	Machine heading and wheel direction does not match. Check wheel angle sensor and/or reset system.
	.7	Curvature Mismatch	The wheel angle sensor measurement is not aligned with the yaw rate sensor measurement.
	.5	SID 1 Signal High	The disengage sensor signal (#1) is above the upper limit.
	.6	SID 1 Signal Low	The disengage sensor signal (#1) is below the low limit.
523899	.7	Small WAS Range	Their isn't sufficient range between the wheel angle sensor setpoints.
	.3	WAS 1 Sig High	The wheel angle sensor signal (#1) is above the upper limit.
	.4	WAS 1 Sig Low	The wheel angle sensor signal (#1)
	.10	WAS 1 Sig Rate	Wheel angle sensor measurement out of spec. Check sensor mounting and harness.
523900	.3	WAS 2 Sig High	The wheel angle sensor signal (#2) is above the upper limit.
	.4	WAS 2 Sig Low	The wheel angle sensor signal (#2).
	.10	WAS 2 Sig Rate	Wheel angle sensor measurement out of spec. Check sensor mounting and harness.
523902	.5	SID 2 Signal High	The disengage sensor signal (#2) is above the upper limit.
	.6	SID 2 Signal Low	The disengage sensor signal (#2) is below the low limit.
1504	.14	OP Active	Operator out of seat.
	.31	Operator Presence Wrn	The operator is out of the seat and the system is about to disengage
702	.1	Master Off	The master switch sensor is currently off.
701	.2	Auto Resume Error	The resume switch is stuck on.
523907	.5	EH Vlv Not Connected	No current draw detected when commanding the valve (HDU) or motor (MDU).
168	.4	HC Low Voltage SCU	The input voltage to the system is below the low limit.
	.3	HC High Voltage SCU	The input voltage to the system is above the upper limit.

Code ID		Display Name	Description
5237	.2	Invalid Command	The commanded curvature for steering is invalid.
	.31	Loss SC1 Comm	The steering control unit is not receiving in the commanded curvature message from the navigation controller.
4985	.9	No Yaw Rate	The steering control unit is not receiving the yaw rate CAN message.
523908	.31	No SC1 Detected	No navigation partner detected
628	.31	FRAM Error SCU	Memory issues
	.2	Memory Warning SCU	Memory issues
523877	.13	FLASH Error SCU	Memory issues
523878	.0	Logic SW Power Error	The power supplied to the internal electronics is out of range. If this problem persists contact your dealer.
523879	.0	Logic LDO Pwer Error	The power supplied to the internal electronics is out of range. If this problem persists contact your dealer.
523880	.0	CAN Power Error	The voltage on the 3.3V CAN power rail is outside the tolerance of the system.
523881	.0	Internal Vref Error	The internal 3.3V micro reference voltage is outside the tolerance of the system.
523882	.0	Vbatt Voltage Error	The voltage on the 3.3V logic power rail is outside the tolerance of the system.
1385	.11	Node Temp Error	The temperature inside of the ECU is outside the tolerance of the system.
523910	.2	Current Out Of Sync	The current measured by the high side driver and proportional control driver differ significantly.
523912	.0	Over Torque	The SmarTrax MD system has exceeded the allowable current draw for the system.
87	.0	Too Fast To Engage	The vehicle speed has exceeded the limit for steering engagement.
5241	.31	Disengage Switch Off	The disengage switch is currently off. If this persists, contact your dealer for further assistance.
523883	.13	Jumper Pin Invalid	The actuator type doesn't match the jumper selection. Check cabling to the valve.
523884	.11	Valve Fault	The valve has indicated a fault. Check cabling to the valve and power cycle the system. If this problem persists contact your dealer.
523885	.6	PWM PWR Current High	The current that is powering both the left and right solenoids is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
	.5	PWM PWR Current Low	The current that is powering both the left and right solenoids is too low. Please check for cuts in the wiring and make sure cabling is properly connected.

Code ID		Display Name	Description
523886	.6	PWM PWR Crrnt Fail	Unexpected current is being detected on the wiring powering both the left and right solenoids while steering was not active. Please check for shorts in the wiring and make sure cabling is properly connected.
523887	.6	PWM LGND Crrnt High	The current for the left solenoid ground is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
	.5	PWM LGND Crrnt Low	The current for the left solenoid is too low. Please check for cuts in the wiring and make sure cabling is properly connected.
523888	.6	PWM LGND Crrnt Fail	Unexpected current from the left solenoid ground while steering was not active. Please check for shorts in the wiring and make sure cabling is properly connected.
523889	.6	PWM RGND Crrnt High	The current for the right solenoid ground is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
	.5	PWM RGND Crrnt Low	The current for the right solenoid is too low. Please check for cuts in the wiring and make sure cabling is properly connected.
523890	.6	PWM RGND Crrnt Fail	Unexpected current from the right solenoid ground while steering was not active. Please check for shorts in the wiring and make sure cabling is properly connected.
523885	.31	PWM Out != PWM In	Left/Right PWM Valve return current does not match supply current. Check cabling.
523891	.6	DB PWR Current High	The current powering the double-blocker solenoid is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
	.5	DB PWR Current Low	The current powering the double-blocker solenoid is too low. Please check for cuts in the wiring and make sure cabling is properly connected.
523892	.6	DB PWR Current Fail	Unexpected current is being detected on the wiring powering the double-blocker solenoid while steering was not active. Please check for shorts in the wiring and make sure cabling is properly connected.
523893	.6	DB GND Current High	The current for the double-blocker solenoid ground is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
	.5	DB GND Current Low	The current for the double-blocker solenoid ground is too low. Please check for cuts in the wiring and make sure cabling is properly connected.

Code ID		Display Name	Description
523894	.6	DB GND Current Fail	Unexpected current is being detected on the wiring used to ground the double-blocker solenoid while steering was not active. Please check for shorts in the wiring and make sure cabling is properly connected.
523891	.31	DB Out != DB In	Double blocker return current does not match supply current. Check cabling
523895	.6	SEN PWR Current High	The current for the sensor output (i.e wheel angle sensor, or disengage sensor) is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
523896	.6	SEN GND Current High	The current for the sensor output ground (i.e wheel angle sensor, or disengage sensor) is too high. Please check for shorts in the wiring and make sure cabling is properly connected.
523903	.10	Wheels Trning,No SID	No wheel angle sensor change detected while commanding the valve (HDU) or motor (MDU).
523904	.7	WAS Response Expcted	The system is commanding the actuator but didn't see a response from the actuator
523897	.0	Sfety Micro Comm Err	Communication to the safety micro has stopped
523868	.31	G-Force Limit Active	Max g limit reached
523915	.15	Dseng. Sens Mismatch	The difference between the two disengage encoders is greater than 25 Hz.

For an online list of the DTCs, please visit:

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

SYSTEM HEALTH TESTS

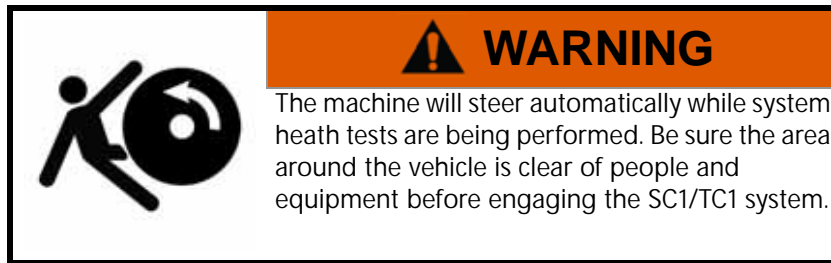
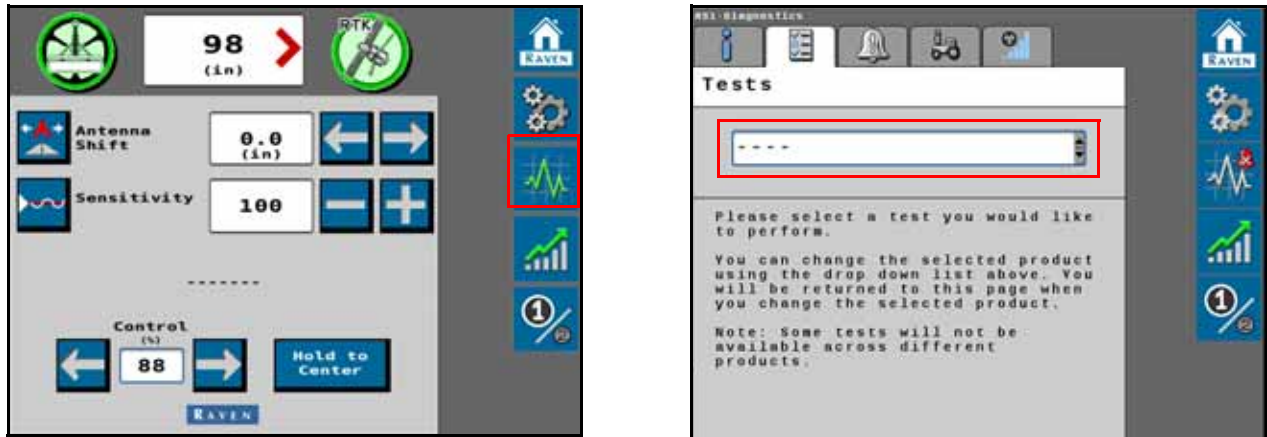


FIGURE 5. Test Selection Screen



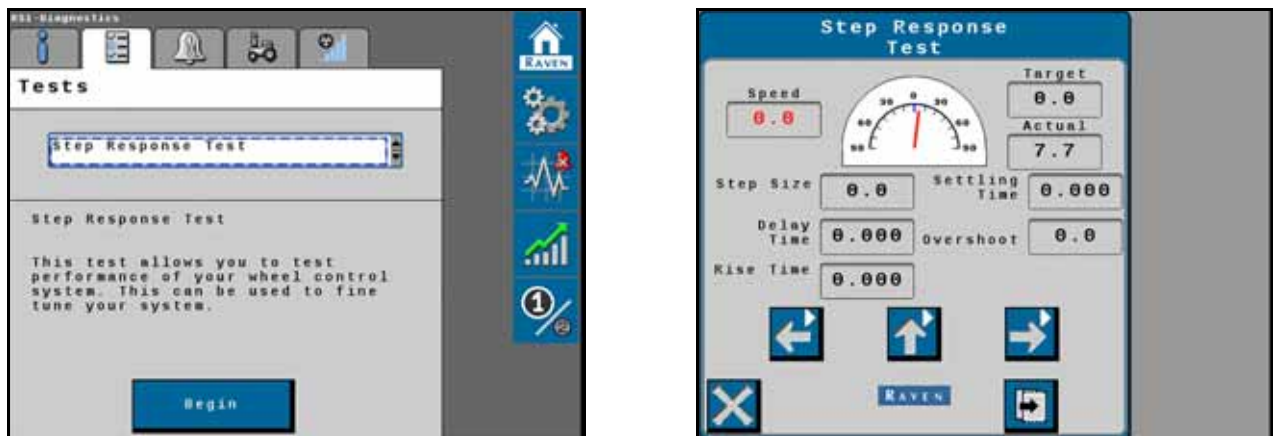
System health tests are performed to diagnose and correct machine and SC1/TC1 calibration issues. The following system health tests can be performed via the SC1/TC1 system:

- Step Response Test
- Machine Test

STEP RESPONSE TEST

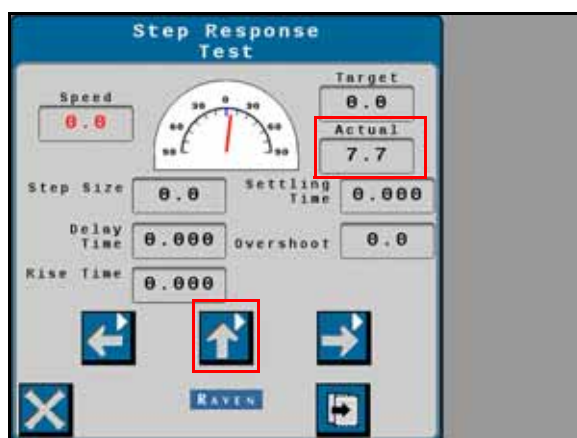
The Step Response Test is used to determine the responsiveness of the implement steering system.

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

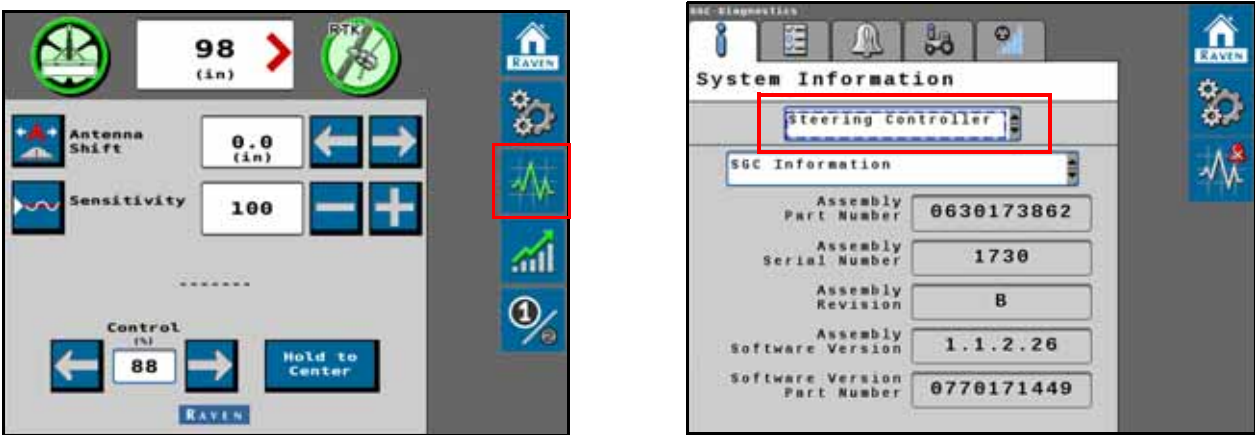


2. Press the center up arrow. Wait for the actuator to reach the center position.
3. Press the left arrow.
4. Wait for the following fields to populate and record the data:
 - a. Step Size
 - b. Delay Time
 - c. Rise Time
 - d. Settling Time
 - e. Overshoot
5. Drive forward 1 - 4 mph with the engine 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

System Information

Steering Controller

SGC Information

Assembly Part Number 0630173862

Assembly Serial Number 1730

Assembly Revision 8

Assembly Software Version 1.1.2.26

Software Version Part Number 0770171449

Hardware/Software Information

System Information

Steering Controller

Hardware/Software

PCB Part Number 0640171353

PCB Revision C

Bootloader Version 3.0.1.1

SC1/TC1 Unit Hours

System Information

Steering Controller

Hours

Version Hours (Powered On) 1.3

Version Hours (Engaged) 0.0

Lifetime Hours (Powered On) 3.3

Lifetime Hours (Engaged) 0.0

SC1/TC1 Hardware Diagnostics

System Information

Steering Controller

Hardware Diagnostics

Unswitched Voltage (v) 13.2

Switched Voltage (v) 12.1

GPS Receiver Information

Please Make a Selection

Steering Controller

GPS Receiver

GPS Receiver

System Information

GPS Receiver

Receiver Serial Number ABC123

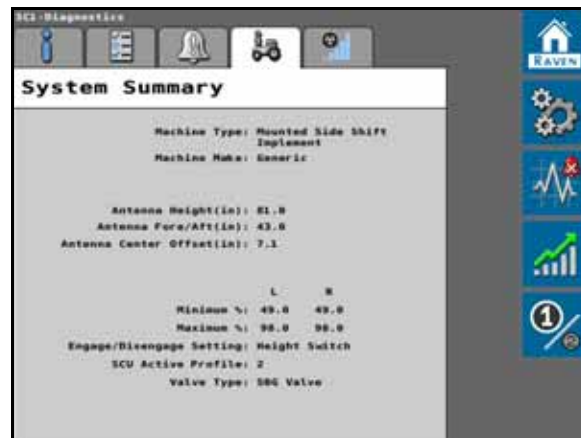
Receiver Model Number Demo Receiver

Software Version version 1.0

GPS Board Type Demo HW version

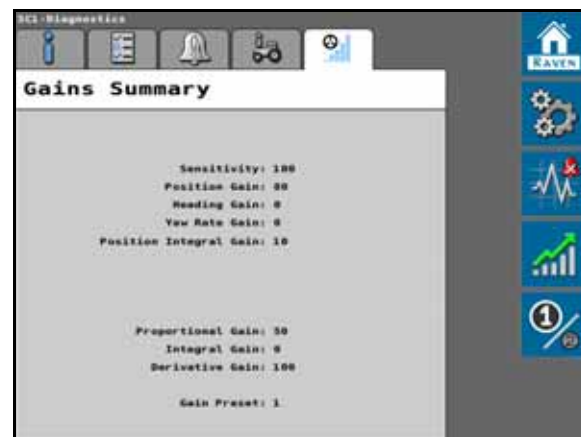
Receiver PAC SQ413:0650:35650

FIGURE 10. System Summary Screen



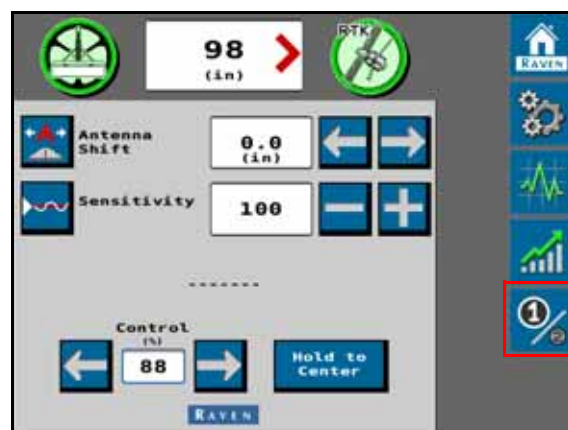
The System Summary screen displays the machine settings and calibrated steering settings for the SC1/TC1 system.

FIGURE 11. Gains Summary Screen



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

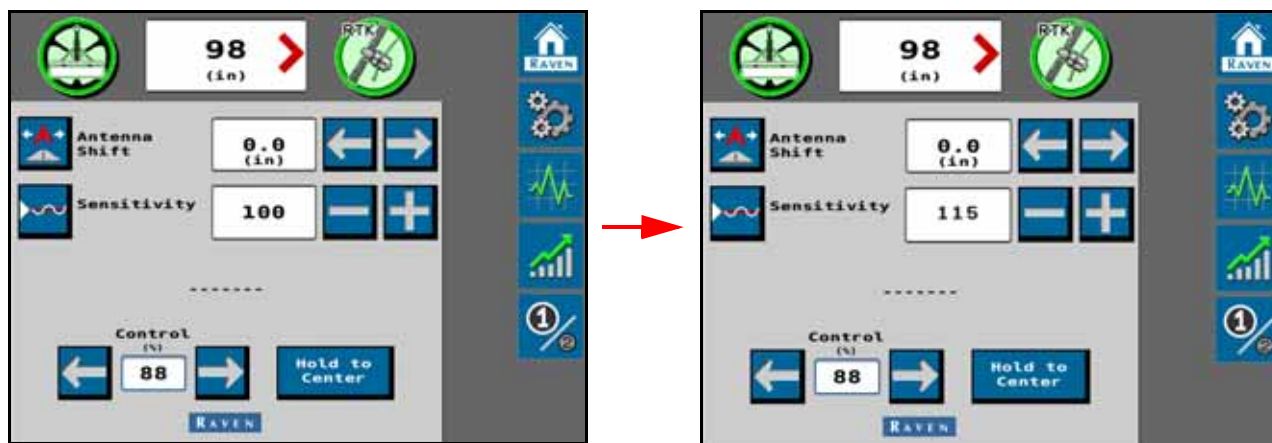
FIGURE 12. Preset Steering Gains



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:

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

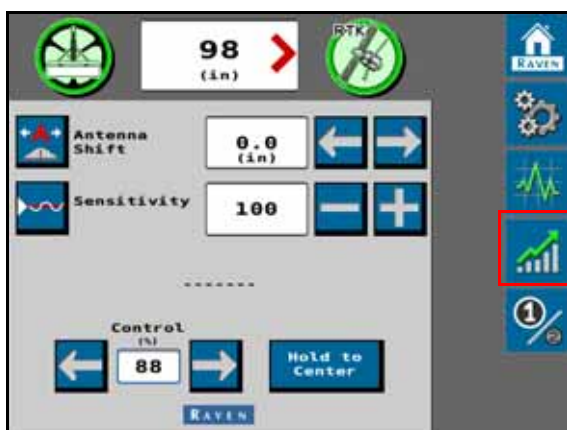
FIGURE 13. Preset Gains Settings



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

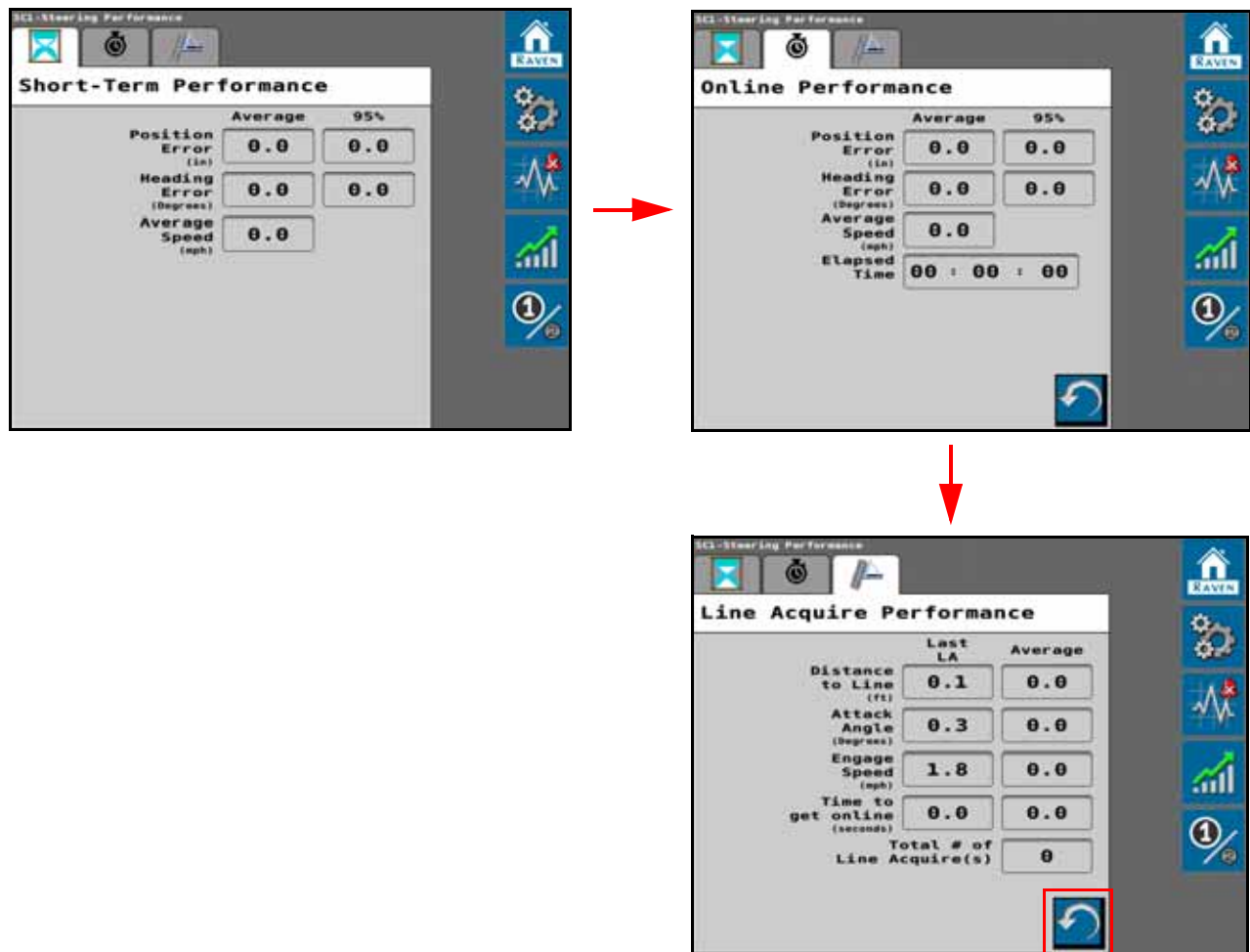
PERFORMANCE MONITOR

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, Online, and Line-Acquire Performance Screen



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

2. Select the Online and Line-Acquire tabs to view the operation statistics.
3. Select the **Reset** icon to reset the values.

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LIMITED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

HOW LONG IS THE COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THIS WARRANTY?

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

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

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

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

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

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

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

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

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

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

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

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