

Raven SC1™/TC1™ Plough Steering Calibration and Operation Manual

016-4020-003 Rev. A

3/2022

E40379



DISCLAIMER

While every effort has been made to ensure the accuracy of this document, Raven Industries assumes no responsibility for omissions and errors. Nor is any liability assumed for damages resulting from the use of information contained herein.

Raven Industries shall not be responsible or liable for incidental or consequential damages or a loss of anticipated benefits or profits, work stoppage or loss, or impairment of data arising out of the use, or inability to use, this system or any of its components. Raven Industries shall not be held responsible for any modifications or repairs made outside our facilities, nor damages resulting from inadequate maintenance of this system.

As with all wireless and satellite signals, several factors may affect the availability and accuracy of wireless and satellite navigation and correction services (e.g. GPS, GNSS, SBAS, etc.). Therefore, Raven Industries cannot guarantee the accuracy, integrity, continuity, or availability of these services and cannot guarantee the ability to use Raven systems, or products used as components of systems, which rely upon the reception of these signals or availability of these services. Raven Industries accepts no responsibility for the use of any of these signals or services for other than the stated purpose.

Table of Contents

Chapter 1	Important Information.....	1
Safety		1
Displays and Control Consoles		1
Hydraulic Safety		2
Electrical Safety		2
Touch Screen		2
Recommendations and Best Practices		3
Hose Routing		3
Harness Routing		3
Chapter 2	Introduction.....	5
System Specifications		5
SC1/TC1 Electrical Rating		5
Installation		6
Recommendations		6
Updates		6
Chapter 3	Initial Implement Calibration	7
Calibration Overview		8
Preparation and Best Practices		8
Adjust the Plough Implement		8
Initial Implement Calibration		10
Implement Steering Machine Selection		10
Guidance Setup		11
GPS Setup		12
Terrain Compensation Calibration		15
Select the Next button.		17
Calibration Wizard summary		22
Chapter 4	Routine Implement Operation.....	25
Starting Jobs		25
Operator Liability		25
Home Screen		26
Steering Status Indicator		26
Off-Line Indicator		26
GPS Status Indicator		27
Steering Status Screen		27
Status Displays		28
GPS Status Screen		30
CRX Features and Operation		31
CRX Widget Definitions		31
Engaging SC1/TC1		31
Chapter 5	Implement Settings and Tuning	33
Implement Settings Tab		33
Change Profile		33

Table of Contents

Machine Configuration	34
Antenna Offsets Settings	35
Implement Settings	35
Node Orientation Information	36
Aux Input	36
Steering Setup Tab	37
Advanced Tuning	37
Hydraulic Control Settings	39
Width Correction Calibration	40
Reset Calibrated Gains	41
Implement Mins Calibration	41
Width Sensor	42
Disengage/Engage Settings	42
Guidance Setup Menu	43
Chapter 6 GPS Settings.....	45
GPS Receiver Configuration	45
Configure GPS in the SC1/TC1	45
Position accuracy Setup	46
Terrain Compensation Setup	46
GPS Receiver Setup	47
Differential Configuration Screen	47
GPS Information	48
Chapter 7 Feature Unlock Codes.....	51
Chapter 8 Diagnostics and Troubleshooting.....	53
Diagnostic Trouble Codes (DTC)	53
DTC Codes	55
System Health Tests	63
Step Response Test	63
System Information	65
Performance Monitor	68

SAFETY

NOTICE

Follow the operation and safety instructions included with the implement and/or controller and read this manual carefully before installing or operating this Raven system.

- Follow all safety information presented within this manual. Review implement operation with your local dealer.
- Contact a local Raven dealer for assistance with any portion of the installation, service, or operation of Raven equipment.
- Follow all safety labels affixed to system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. Contact a local Raven dealer to obtain replacements for safety labels.

Observe the following safety measures when operating the implement after installing this Raven system:

- Do not operate this Raven system or any agricultural equipment while under the influence of alcohol or an illegal substance.
- Be alert and aware of surroundings and remain in the operator seat at all times when operating this Raven system.
 - Do not operate the implement on any public road with this Raven system enabled.
 - Disable this Raven system before exiting the operator seat.
 - Determine and remain a safe working distance from obstacles and bystanders. The operator is responsible for disabling the system when a safe working distance has diminished.
 - Disable this Raven system prior to starting any maintenance work on the implement or components of this Raven system.
- Do not attempt to modify or lengthen any of the system control cables. Extension cables are available from a local Raven dealer.

DISPLAYS AND CONTROL CONSOLES

- If the display will not be used for an extended period, it is best to remove the display from the machine and store it in a climate controlled environment. This may help to extend the service life of electronic components.
- To prevent theft, secure the display and GPS antenna when leaving the machine unattended.

WARNING

HYDRAULIC SAFETY

When installing or servicing a hydraulic system or hydraulic components, be aware that hydraulic fluid may be extremely hot and under high pressure. Caution must be exercised.

- Always wear appropriate personal protective equipment when installing or servicing hydraulic systems.
- Never attempt to open or work on a hydraulic system with the implement running.
- Any work performed on the hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- Care should always be taken when servicing or opening a system that has been pressurized.
- The implement or machine must remain stationary and switched off with booms or implement sections unfolded and supported during installation or maintenance.
- Take precautions to prevent foreign material or contaminants from being introduced into the implement hydraulic system. Contaminants that are able to bypass the hydraulic filtration system will reduce performance and may damage hydraulic components.
- Stand clear of the implement when starting the system for the first time after installing or servicing hydraulic components in case a hose has not been properly connected or tightened.

CAUTION

ELECTRICAL SAFETY

- Always verify that power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the Raven system or other components.
- To prevent personal injury or fire, replace defective or blown fuses with only fuses of the same type and amperage.
- Do not connect the power leads to the battery until all system components are mounted and all electrical connections are completed.
- Always start the machine before initializing this Raven system to prevent power surges or peak voltage.
- To avoid tripping and entanglement hazards, route cables and harnesses away from walkways, steps, grab bars, and other areas used by the operator or service personnel when operating or servicing the equipment.

TOUCH SCREEN

- Only touch the touch-screen with your finger or by using a special touch-screen stylus/pen. Operating the touch-screen with sharp objects may cause permanent damage to the screen.
- Only clean the screen using a damp cloth. Never use caustic or other aggressive substances.

RECOMMENDATIONS AND BEST PRACTICES

HOSE ROUTING

The word “hose” is used to describe any flexible, fluid carrying components. Use the following guidelines and recommendations when connecting and routing hoses while installing or maintaining this Raven system:

- Leave protective caps/covers over hose ends until connecting the end into the hydraulic system to help prevent contaminants from entering the system.
- Follow existing hose runs already routed on the implement as much as possible. Proper hose routing should:
 - Secure hoses and prevent hoses from hanging below the implement.
 - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
 - Protect hoses from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).
 - Protect hoses from sharp bends, twisting, or flexing over short distances and normal implement operation.
 - Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp hoses securely to force controlled movement of the hose.
 - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
 - Avoid areas where the operator or service personnel might step or use as a grab bar.
- Do not connect, affix, or allow hoses to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of hose components.
 - Hoses should be protected or shielded if routing requires the hose to be exposed to conditions beyond hose component specifications.
- Avoid routing hoses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).

HARNESSE ROUTING

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

- Leave protective caps/covers over harness connectors until needed to avoid dirt and moisture from contaminating electrical circuits.
- Secure the harness to the frame or solid structural members at least every 12 in [30 cm].
- Follow existing harness runs already routed on the implement as much as possible. Proper harness routing should:
 - Secure harnessing and prevent the harness from hanging below the implement.
 - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
 - Protect harnessing from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).

- Protect harnessing from sharp bends, twisting, or flexing over short distances and normal implement operation.
- Connectors and splices should not be located at bending points or in harness sections that move.
- Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp harnessing securely to force controlled movement of the harness.
- Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
- Do not connect, affix, or allow harnessing to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of harness components.
 - Harnessing should be protected or shielded if routing requires the hose to be exposed to conditions beyond harnessing component specifications.
- Avoid routing harnesses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).
- Avoid routing harnesses in areas where the operator or service personnel might step or use as a grab bar.

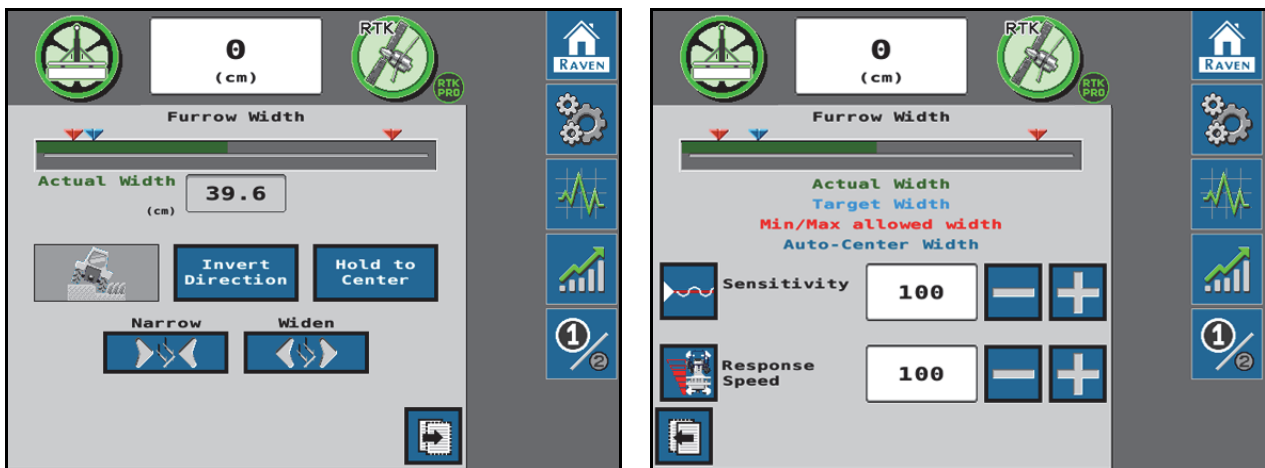
IMPORTANT: Avoid applying direct spray or pressure washing of electrical components and connections. High pressure streams and sprays can penetrate seals, cause corrosion, or otherwise damage electrical components.
When performing maintenance:

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

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 plough 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

	<p>WARNING</p> <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>
---	---

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.
- 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.

ADJUST THE PLOUGH IMPLEMENT

Prior to using the RS1™ or SC1™ plough steering system, make sure that the plough is correctly mounted to the tractor and configured for proper operation. The plough steering system will not be able to adequately steer the implement if the implement is not correctly mounted and configured. When adjusting the tractor and plough, keep the following points in mind:

NOTE: The following points outline the basic requirement to properly calibrate the plough implement. Please refer to the implement manufacturer's manual or a local dealer for further assistance with setting up the plough.

- Make sure the inner distance between the tires is the same for the front and rear wheels.
- Make sure the tire pressure is the same on both sides.
- Make sure that both lift arms of the 3-point hitch are the same length.
- Make sure that the plough is level in each direction.
 - a. Make sure the bottom of your plough furrow is smooth and not bumpy.
 - b. Make sure the side of the furrow is perpendicular (90°) to the bottom of the furrow. Refer to Figure 1 on page 9.

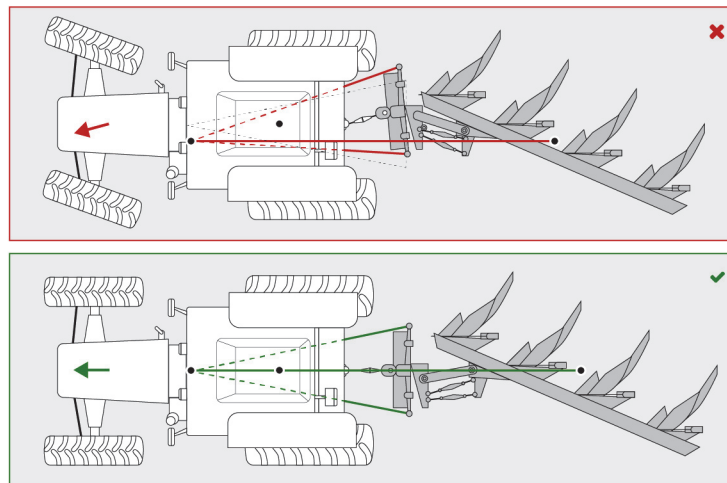
FIGURE 1. Proper Plough Leveling



NOTE: Refer to the *Width Correction Calibration* section on page 40 if the first body of the plough requires a wider working width calibration due to exceeding the width of the wheels compared to the furrow.

- Make sure that each body of the plough has the same working width.
- Make sure that the working line or pull line of the plough is centered and the lateral pull is minimal. Refer to Figure 2 on page 9.

FIGURE 2. Optimal Working or Pull Line



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 25 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.

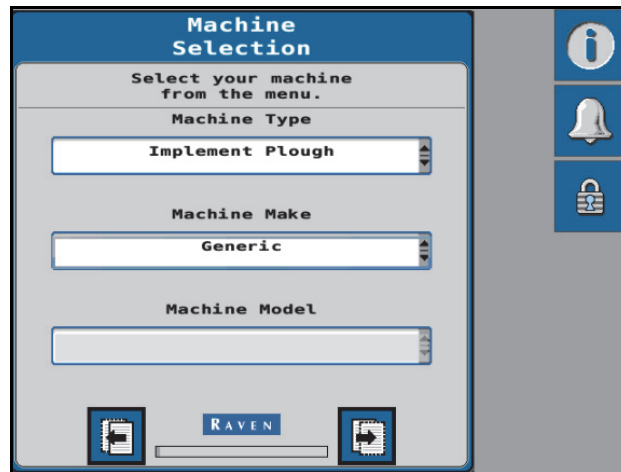
It is recommended to disconnect the tractor (machine) SC1/TC1 or RS1 upon initial install to avoid confusion when resetting the ECU. Refer to the *Reset Calibrated Gains* section on page 41 for additional information about resetting the SC1/TC1 system.

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.

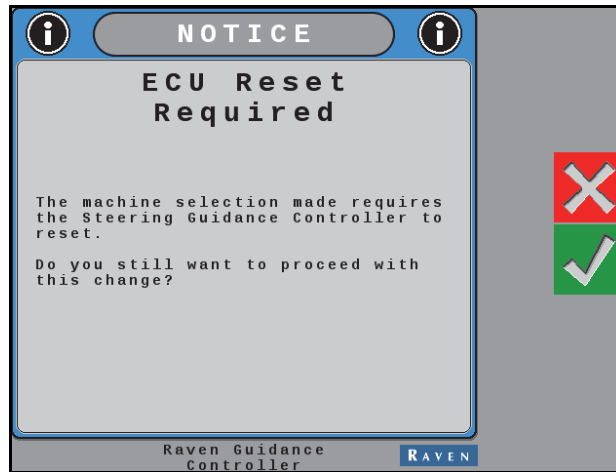
4. Use the drop-down options to select one of the following types for implement steering:

FIGURE 3. Machine Selection



- Implement Plough - select this option when steering a mounted plough implement.
5. Select **Generic** for the Machine Make field.
 6. Select the **Next** button.

FIGURE 4. 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** button.

GUIDANCE SETUP

1. Using the drop-down menu, select the desired guidance partner.

FIGURE 5. Guidance Setup Menu



NOTE: For additional information on the Guidance Setup Menu, refer to "Guidance Setup Menu" on page 43.

2. 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 65
- *Diagnostic Trouble Codes (DTC)* section on page 53



Information

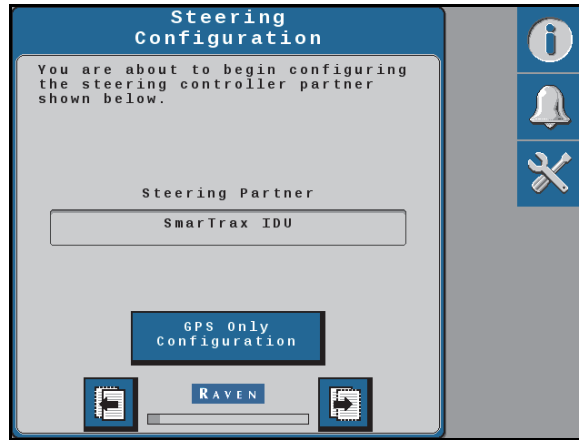


Alarms



Machine Test

FIGURE 6. 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.

NOTE: When configuring a system which uses an RS1, the receiver selection page may not display.

FIGURE 7. Receiver Selection



3. Select the **Next** button.

FIGURE 8. Antenna Fore/Aft Screen

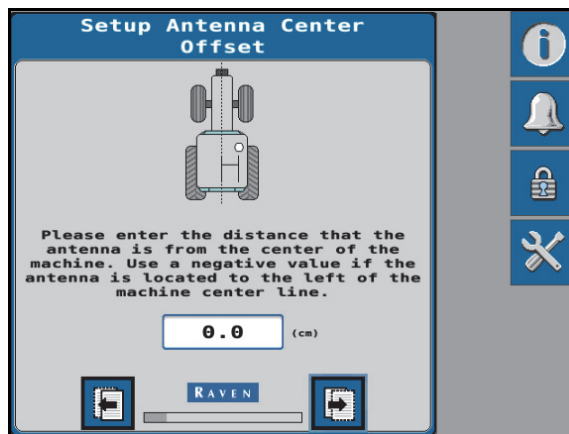


4. Select the value box to enter the Antenna Fore/Aft position.

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

5. Select the **Next** button.

FIGURE 9. 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 tractor 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** button.

FIGURE 10. Antenna Height Screen

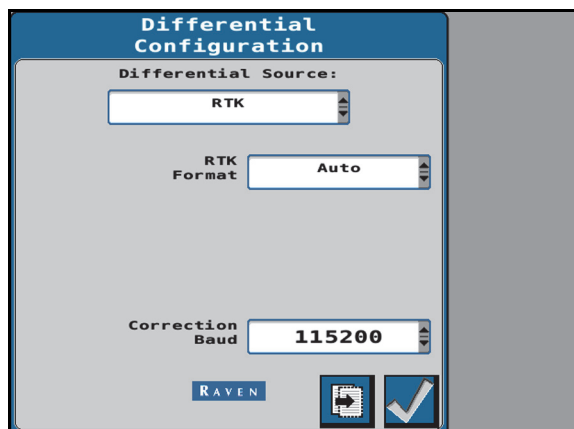


8. Select the value box to enter the Antenna Height.

NOTE: The Antenna Height is measured from the ground to the center of the GPS antenna.

9. Select the **Next** button.

FIGURE 11. 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 7, *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** button.

FIGURE 12. 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.

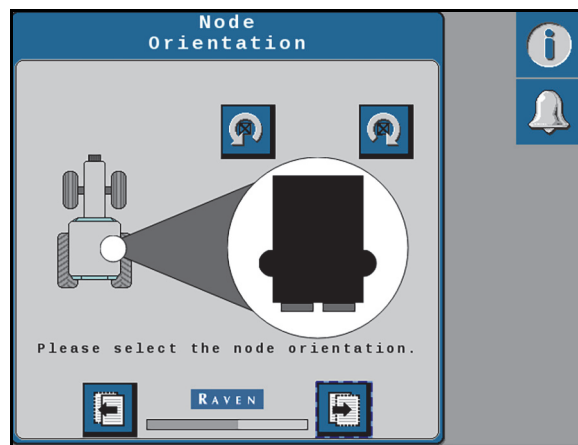
13. Select the **Next** button.

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 13. SC1/TC1 ECU Orientation



2. Select the **Next** button.

FIGURE 14. Terrain Compensation Calibration

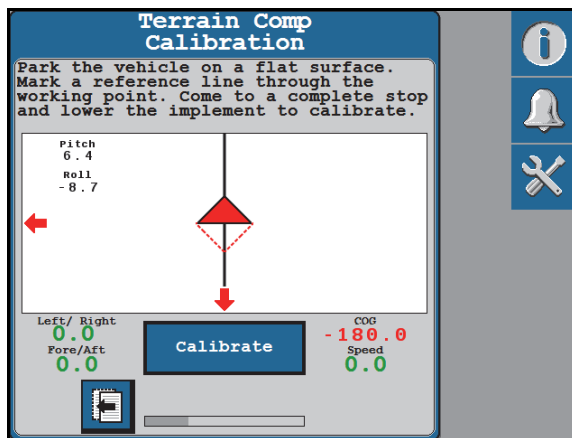


1. Drive the machine forward at least 33 feet [10 m] and park on a flat surface.

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 the outside of each wheel of the fixed axle of the machine.
 - Rear axle - Front boom sprayers, rear boom sprayers, and front-steered machines
4. Select the **Next** button and follow the on-screen instructions to begin the terrain compensation calibration.

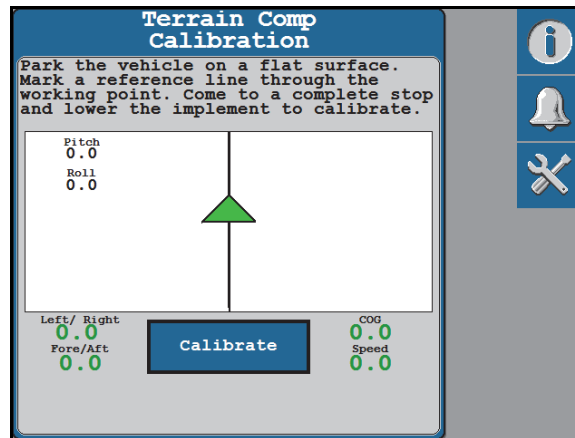
FIGURE 15. Terrain Compensation Calibration



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 machine.
6. Drive forward and turn the implement around (180°). Park the machine, between the markers facing in the opposite direction as when the **Calibrate** button was first selected. Make sure the markers are aligned with the fixed axle 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 16. Terrain Comp Calibration Screen



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

VALVE SELECTION

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

FIGURE 17. Valve Type Selection

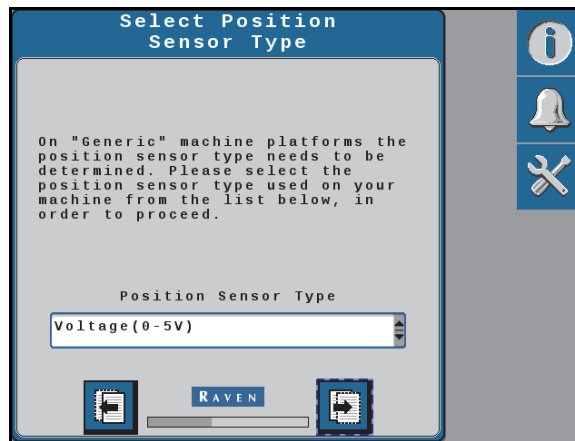


Select the **Next** button.

POSITION SENSOR TYPE SELECTION

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

FIGURE 18. Position Sensor Type Selection



Select the **Next** button.

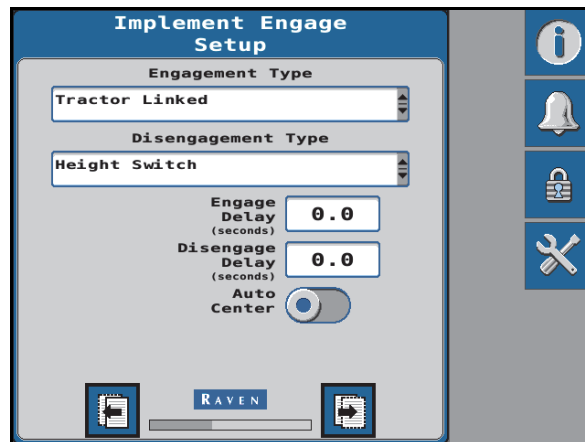
SELECT THE TYPE OF ENGAGEMENT

1. Use the drop down list to select how the implement steering system should be engaged during operation. Select:

- 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 42 for additional information on implement engage setup options.

FIGURE 19. Engage Type Selection



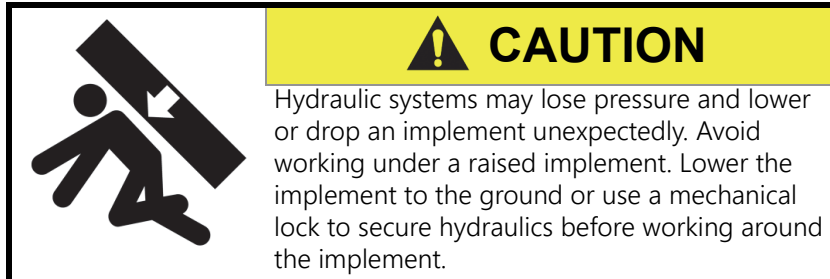
2. Use the drop down list to select how the implement steering system should be disengaged during operation.
 - Height Switch
 - Turn Detection
3. Select the **Next** button.

FURROW CALIBRATION

1. Raise the implement and use the **Narrow** button to adjust the implement to narrowest furrow width.

NOTE: Use the Reverse Hydraulics option as needed to switch the direction which the implement moves when the button is selected.

2. Measure the width between plough bodies.

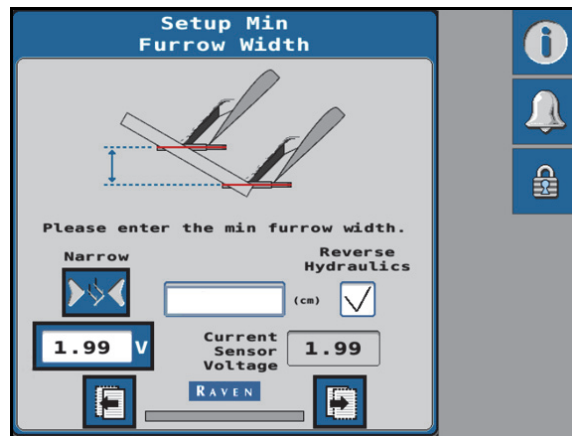


NOTE: Do not enter the overall width of the plough. The width between bodies must be measured perpendicular to the direction of forward travel.

For best results, measure the width of multiple plough bodies and enter the average measurement.


3. Select the voltage button to update the voltage for the minimum furrow width.

FIGURE 20. Minimum Furrow Width Page



4. Select the **Next** button.
5. Raise the implement and use the **Widen** button to adjust the implement to widest furrow width.

6. Measure the width between plough bodies.



CAUTION

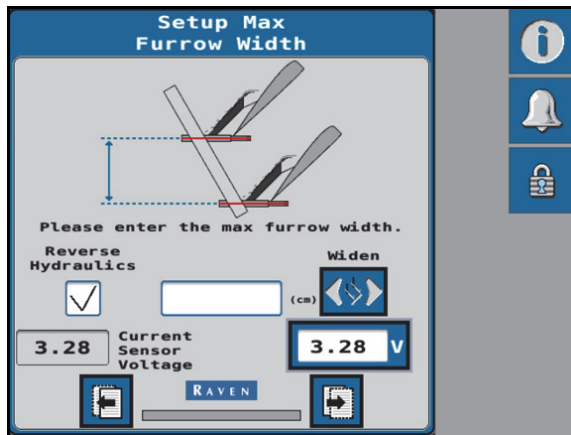
Hydraulic systems may lose pressure and lower or drop an implement unexpectedly. Avoid working under a raised implement. Lower the implement to the ground or use a mechanical lock to secure hydraulics before working around the implement.

NOTE: Do not enter the overall width of the plough. The width between bodies must be measured perpendicular to the direction of forward travel.

For best results, measure the width of multiple plough bodies and enter the average measurement.

7. Select the voltage button to update the voltage for the maximum furrow width.

FIGURE 21. Maximum Furrow Width Page




8. Select the **Next** button.

9. Raise the plough and use the control buttons to set the implement to the desired working width.

NOTE: The ideal furrow working width is 1.5 times the working depth.

10. Measure the physical furrow width between plough bodies as shown in the figure on the screen.



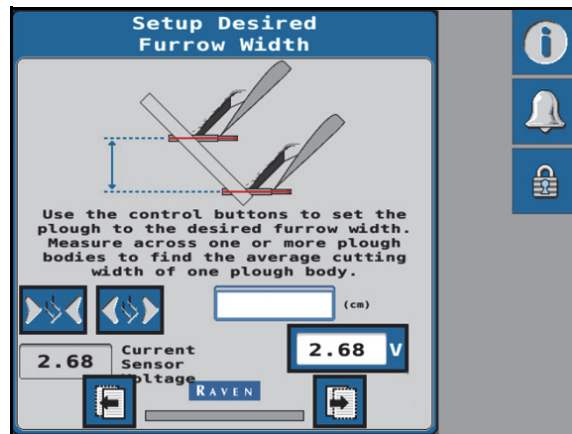
CAUTION

Hydraulic systems may lose pressure and lower or drop an implement unexpectedly. Avoid working under a raised implement. Lower the implement to the ground or use a mechanical lock to secure hydraulics before working around the implement.

NOTE: Do not enter the overall width of the plough. For best results, measure more than one furrow width and enter the average measurement.

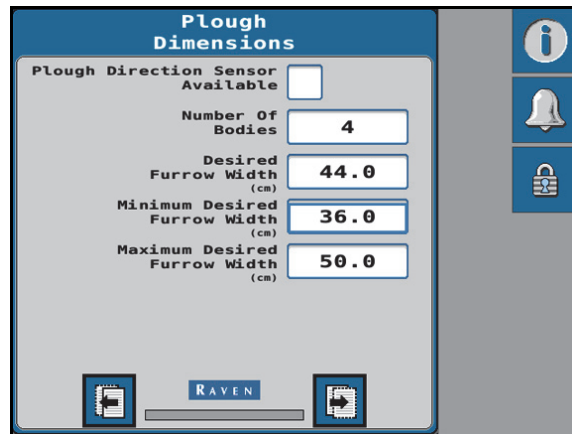
11. Select the voltage button to update the voltage for the maximum furrow width.

FIGURE 22. Desired Furrow Width Page



12. Select the **Next** button.

FIGURE 23. Desired Furrow Width Page



13. Enable the **Plough Direction Sensor** option to allow the system to detect and use the plough direction for future references.
14. Enter the number of plough bodies in the **Number of Bodies** field.

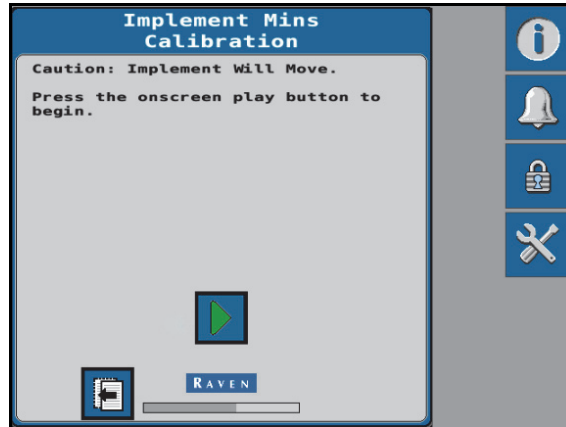
NOTE: The system will use the entered furrow widths and this value to calculate the overall guidance width of the plough.

15. Use the **Desired Furrow Width** field to set the desired position for the plough bodies during operation. This sets the position which the system will attempt to maintain while operating the plough steering system during guidance operation.
16. Use the **Minimum Desired Furrow Width** to set the lowest or narrowest physical furrow position which the system will allow during operation.
17. Use the **Maximum Desired Furrow Width** to set the highest or widest physical furrow position which the system will allow during operation.
18. Confirm the settings shown on this page and select the **Next** button.
19. Raise the implement.

20. Touch the Start button to begin the automatic calibration of the hydraulic valve.

NOTE: During the calibration, the plough bodies will move fully through the range of calibrated settings. It is important that the plough not be in contact with the ground during the calibration process.

FIGURE 24. Implement Mins Calibration

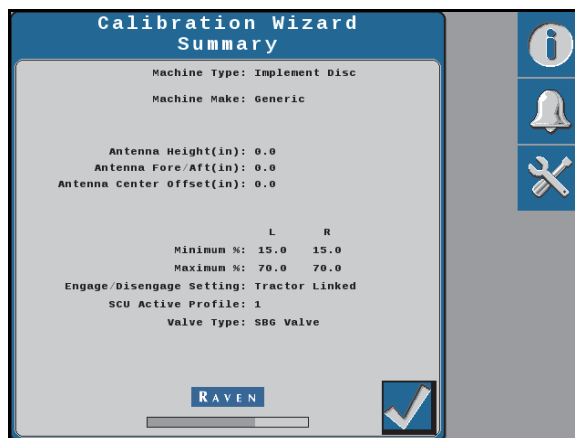


21. Once the calibration is complete, select the **Next** button.

CALIBRATION WIZARD SUMMARY

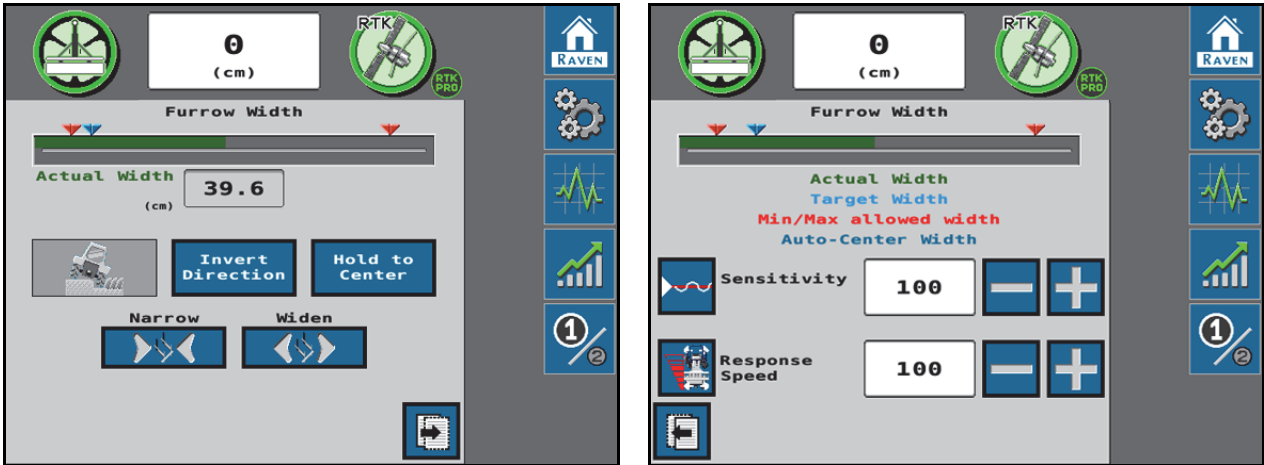
1. Review the Calibration Wizard Summary screen displayed.

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



STARTING JOBS

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.

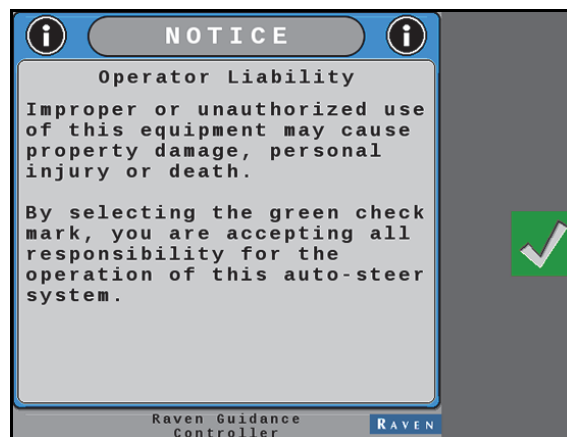
Make sure to properly configure the guidance width of the UT and/or Raven field computer for any changes to the physical width of the plough before starting a job. Review the Raven field computer operation at

<https://ravenindustries.mcoutput.com/fieldcomp/en-us/Content/Home.htm>

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.

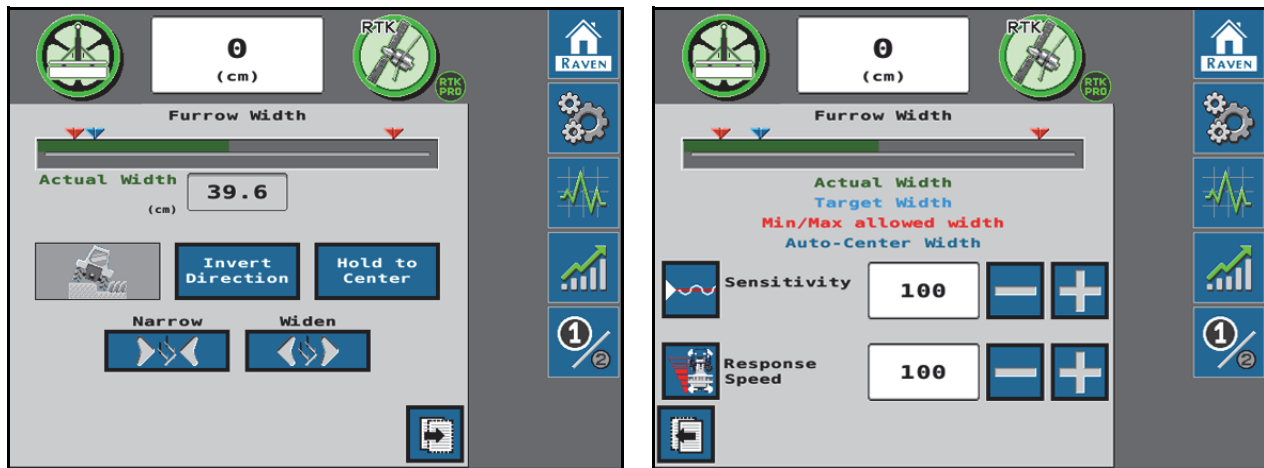
FIGURE 1. Operator Liability Prompt



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 8, <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 30 for additional assistance with the information available on this screen.

STEERING STATUS SCREEN

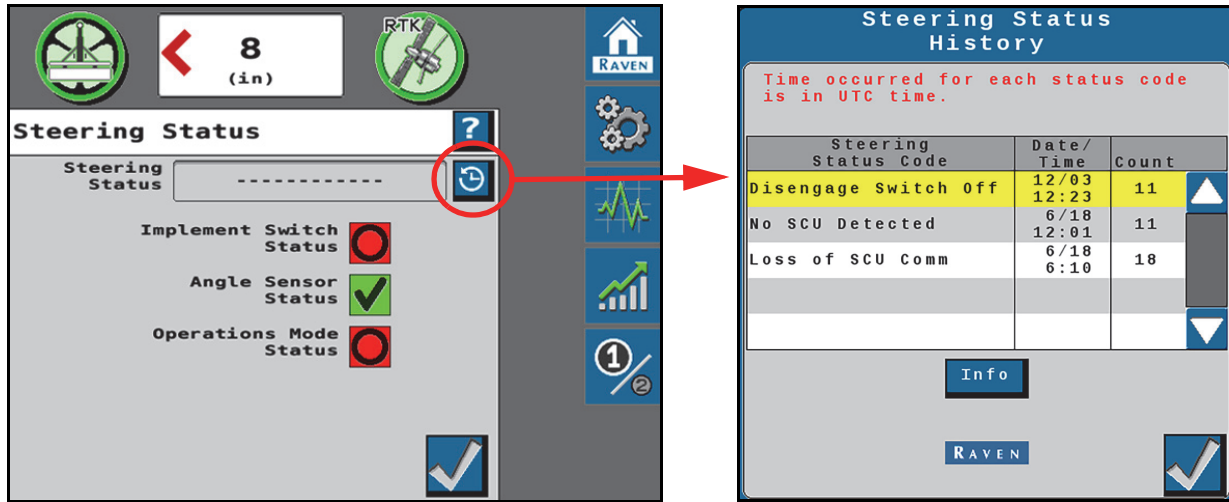
Select the steering wheel icon to display the Steering Status screen. The Steering Status field displays the last exit code and the reason why steering was disabled.

FIGURE 3. Steering Status Screen



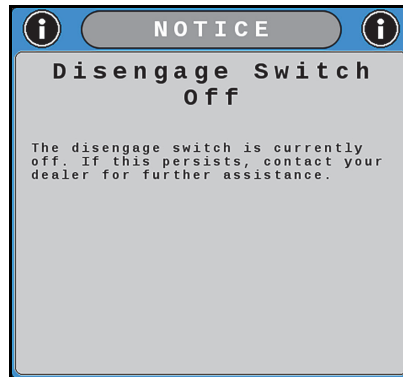
Select the Steering Status History icon next to the Steering Status field to view the history including the times the system disengaged and why it disengaged.

FIGURE 4. Steering Status History



Selecting 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.

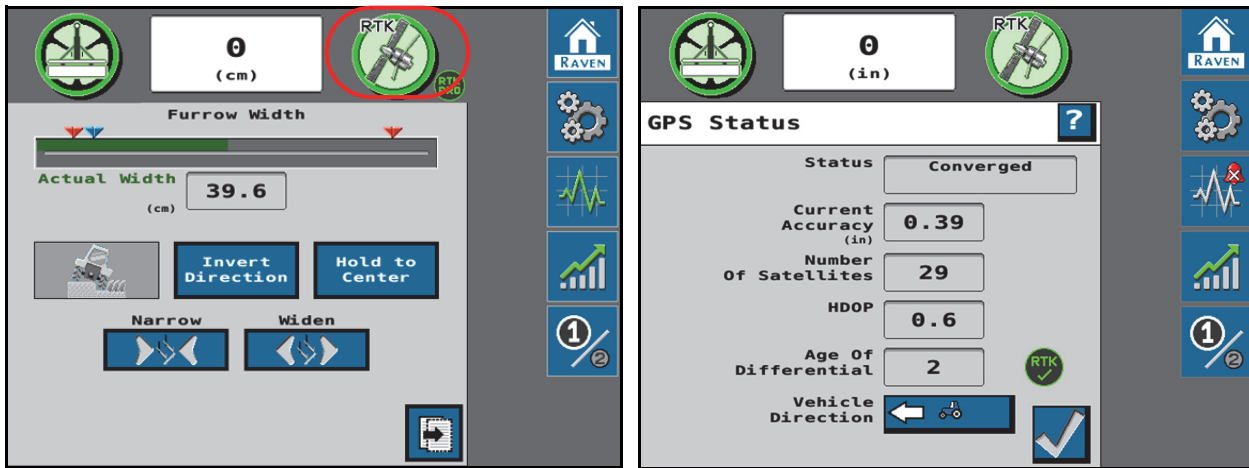
OPERATION MODE

Displays the operational status of the implement if present. Refer to *Implement Settings Tab* 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









Select 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.
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 53 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.

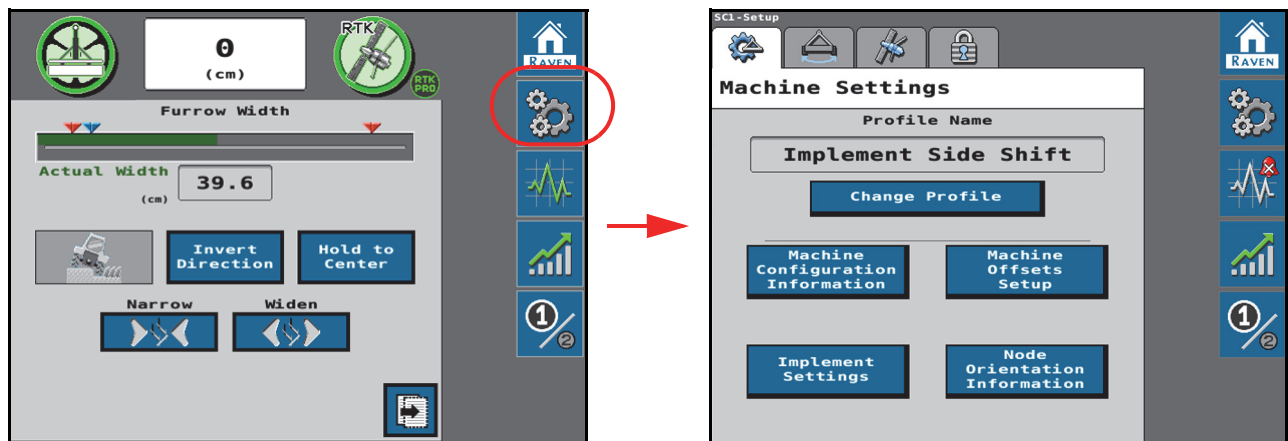
ENGAGING SC1/TC1

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.
- Select the SC1/TC1 on-screen status widget to engage the SC1/TC1 during field operation.

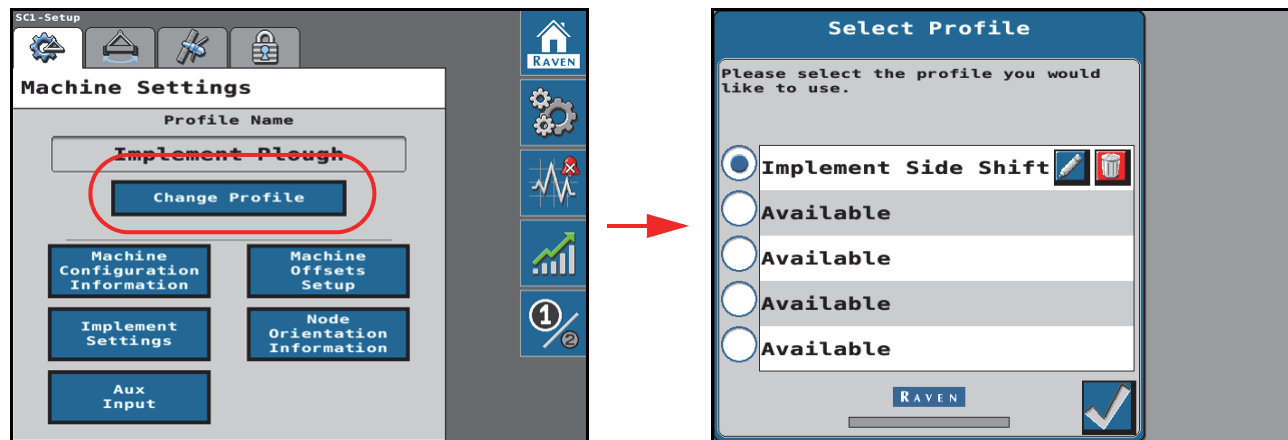
IMPLEMENT SETTINGS TAB

FIGURE 1. Implement Settings Screen



CHANGE PROFILE

FIGURE 2. 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 Tools 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.



IMPLEMENT SETTINGS

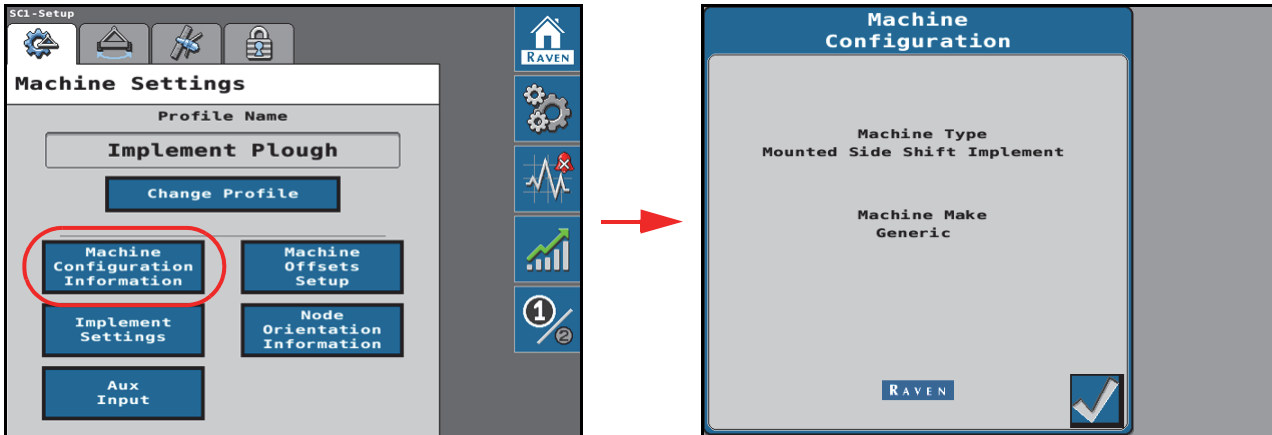
Toggle the Operation Mode feature on or off. When enabled, the SC1/TC1 steering system will allow the field computer to record coverage during a field operation when the system detects the appropriate input. Refer to the field computer manual for additional information and assistance with using the Operation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

MACHINE CONFIGURATION

FIGURE 3. Implement Configuration Screen

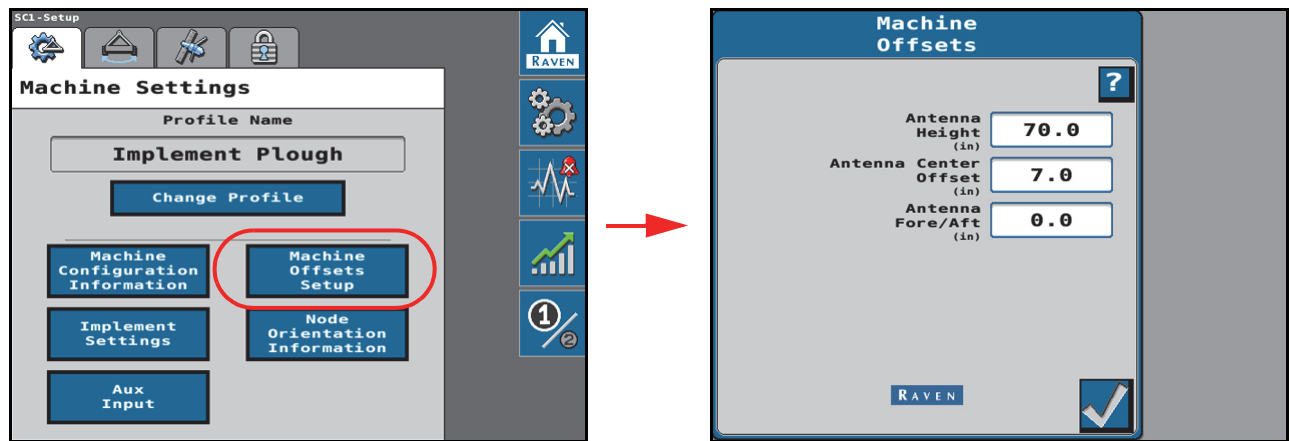


To view the current machine configuration:

1. From the SC1/TC1 Home screen, select the Tools 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 4. Machine Offsets Setup Screen



To adjust the antenna offset measurements:

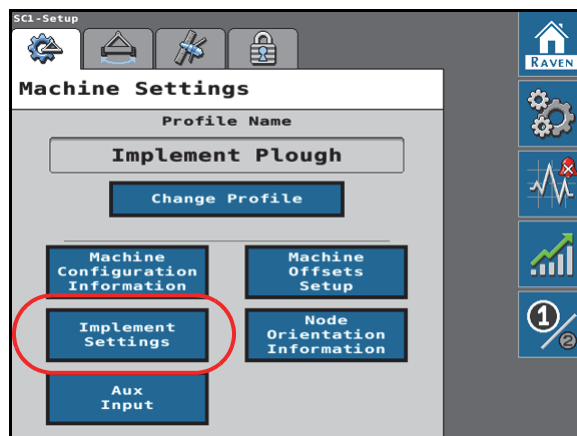
1. From the SC1/TC1 Home screen, select the Tools Menu button.
2. On the Machine Settings tab, select the Machine Offsets Setup button.
3. The Machine Offsets screen displays the machine-specific measurements that were entered during the system calibration:

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.

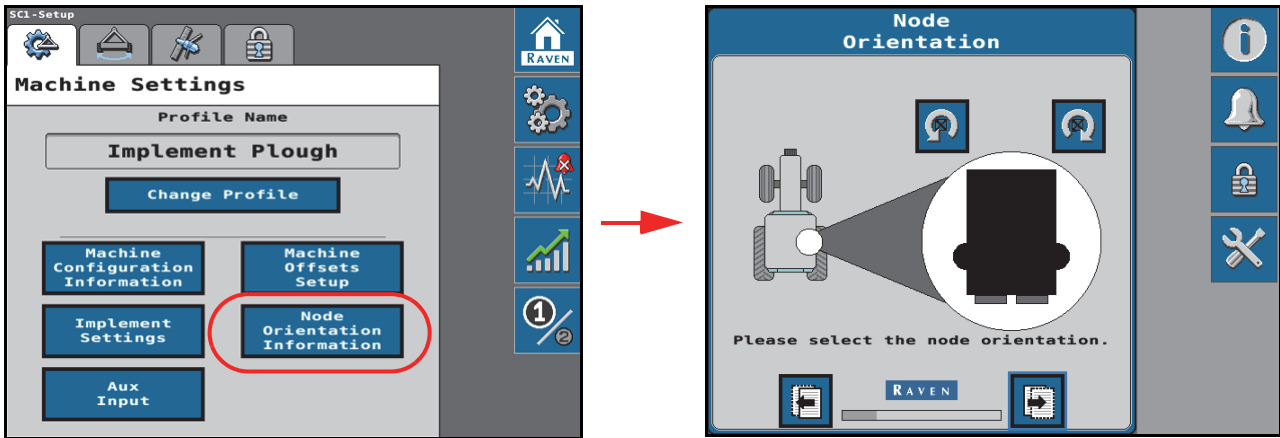
IMPLEMENT SETTINGS

FIGURE 5. Implement Settings Screen



NODE ORIENTATION INFORMATION

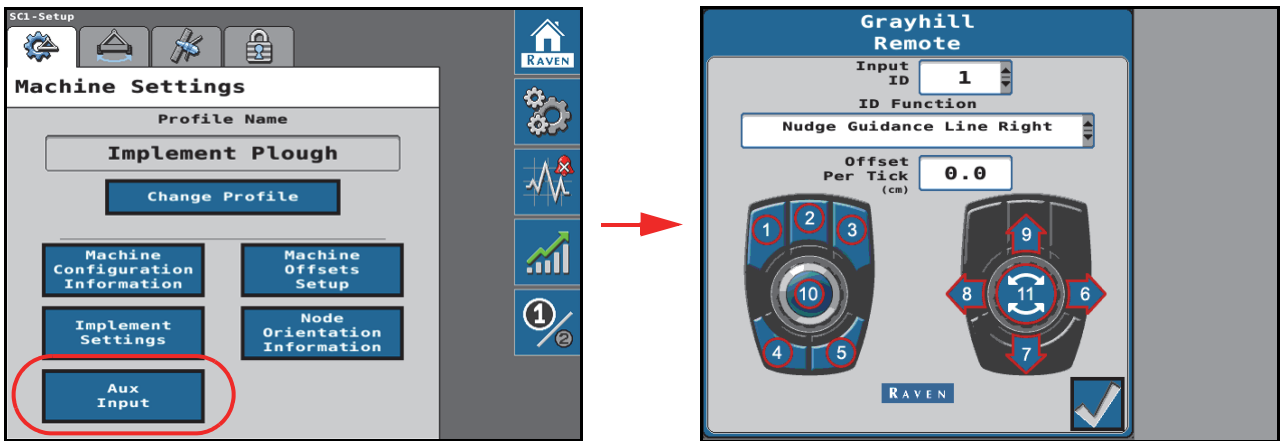
FIGURE 6. Node Orientation Information Screen



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.

AUX INPUT

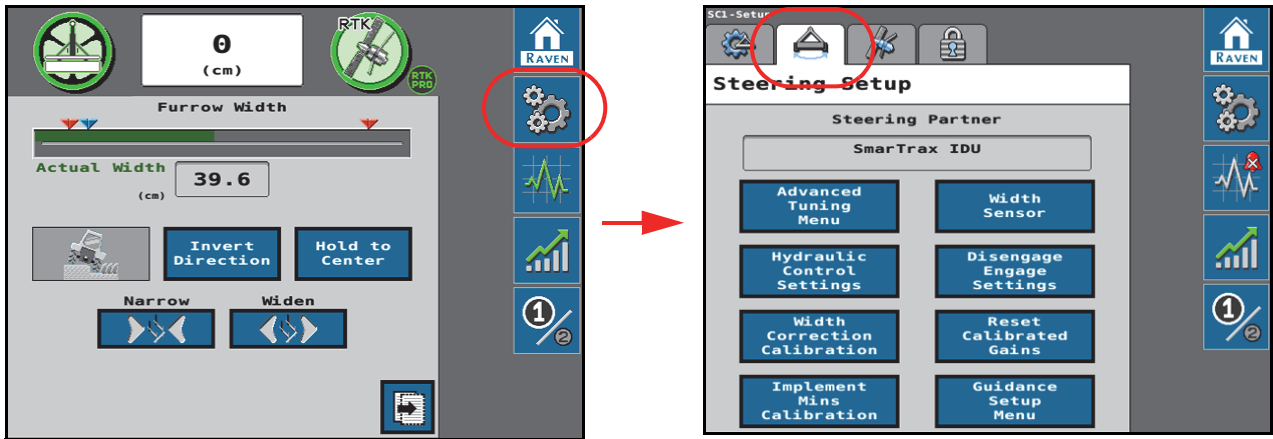
FIGURE 7. Aux Input Screen



The Auxiliary Input provides settings and options for an auxiliary device such as the Grayhill Remote. Refer to the auxiliary device manual for additional assistance with device configuration, features, and options.

STEERING SETUP TAB

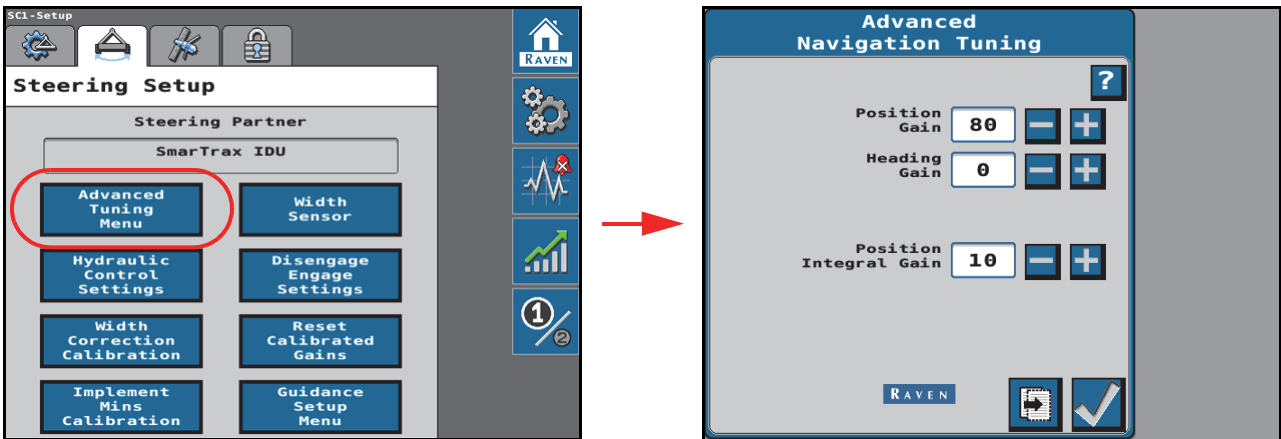
FIGURE 8. Steering Setup Screen



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 9. Advanced Tuning Menu



To access advanced auto-steering tuning options and settings:

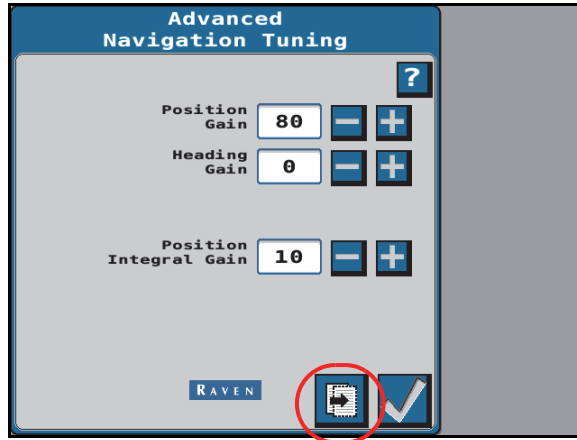
1. From the SC1/TC1 Home screen, select the Tools Menu button.
2. Select the Steering Setup tab and the Advanced Tuning Menu button.

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.

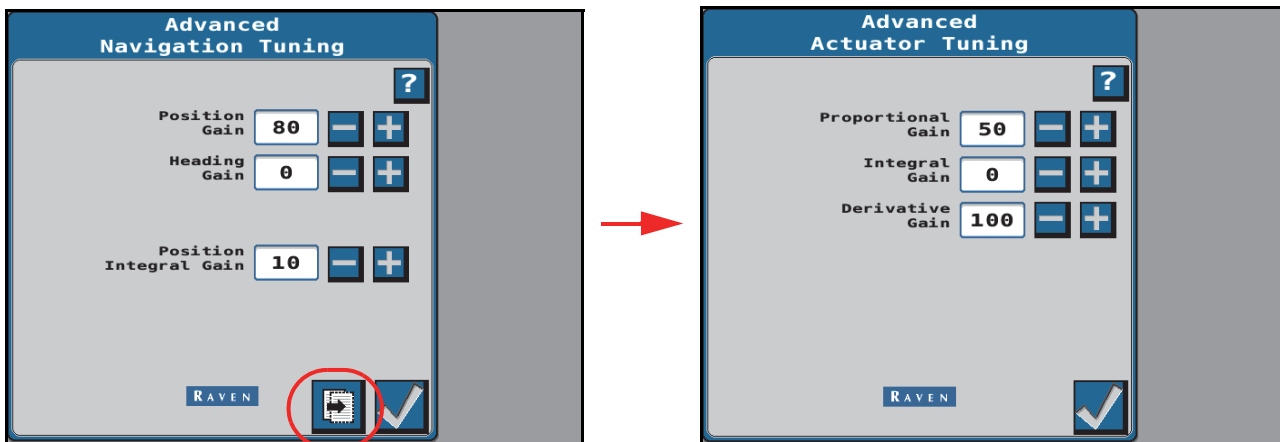
- **Position Integral Gain** - This value corrects long-term errors in the actuator control. If the system is not achieving the desired actuator position during operation, the system will re-direct the position to the desired set point. This value is generally at or near 0.

FIGURE 10. Advanced Tuning Page 2



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

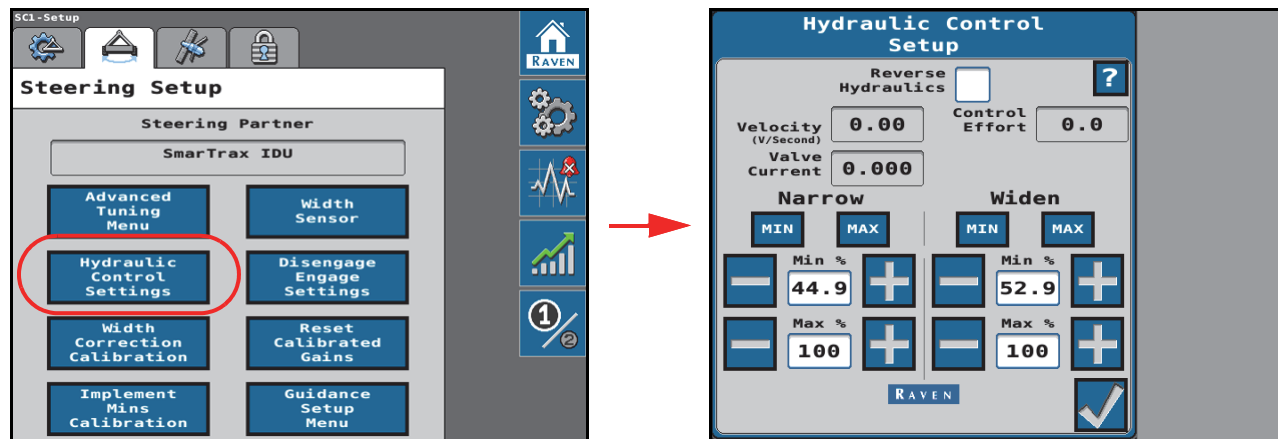
FIGURE 11. Advanced Actuator Tuning Screen



- **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.

HYDRAULIC CONTROL SETTINGS

FIGURE 12. Hydraulic Control Setup Screen



To access implement control settings:

1. From the SC1/TC1 Home screen, select the Tools 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.

WIDTH CORRECTION CALIBRATION

Ideally, the correction for the first body should be the same on both the right and the left side. When the system is still not accurate enough, the automatic calibration may be used to correct for errors.

NOTE: The following steps must be performed in actual field conditions. During performance monitoring, the tractor should be in the furrow. Complete a pass driving manually in both directions before starting the automatic calibration.

Complete the following steps for best results with the automatic width calibration:

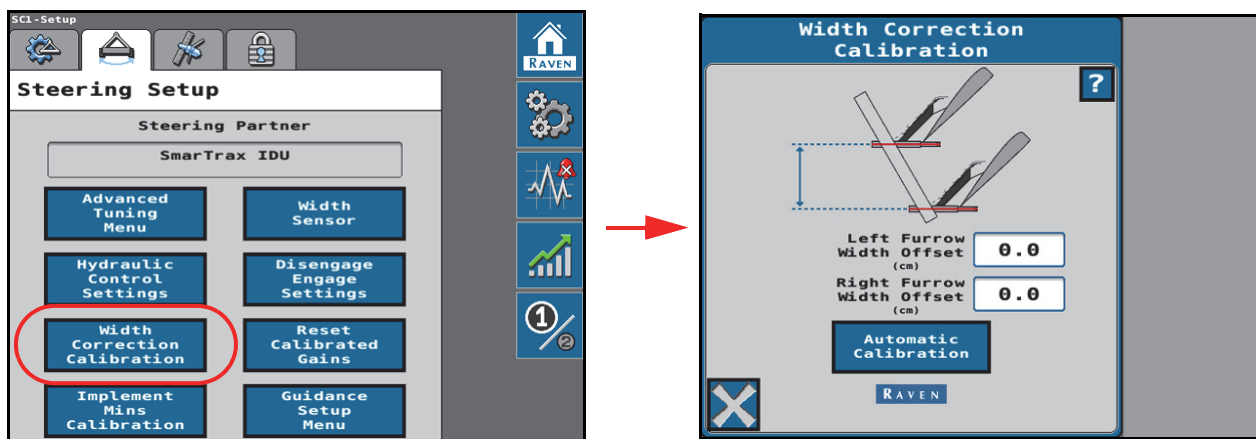
1. Reset the Online and Line-Acquire Performance statistics. Refer to the *Performance Monitor* section on page 68 for assistance with resetting the performance statistics.

NOTE: It is important to clear previous performance data to ensure previous steering characteristics do not negatively influence the auto calibration.

For best results, use the longest swaths available in the field for calibration and tuning of the plough steering system.

2. Create a straight (A-B) guidance line.
3. While steering manually, begin ploughing the first 20 m [65 ft] of the swath.
4. Engage the steering system on the guidance line and allow the system to steer until approximately 20 m [65 ft] from the end of the swath.
5. Disengage the steering system and manually steer to the end of the swath.
6. Repeat step 3 through step 5 until the steering system has been engaged through approximately 500 m [1640 ft] with the plough in the ground and at least one pass in each direction.
7. After approximately 500 m of active plough steering, select the Tools Menu button followed by the Steering Setup tab and the Width Correction Calibration button.

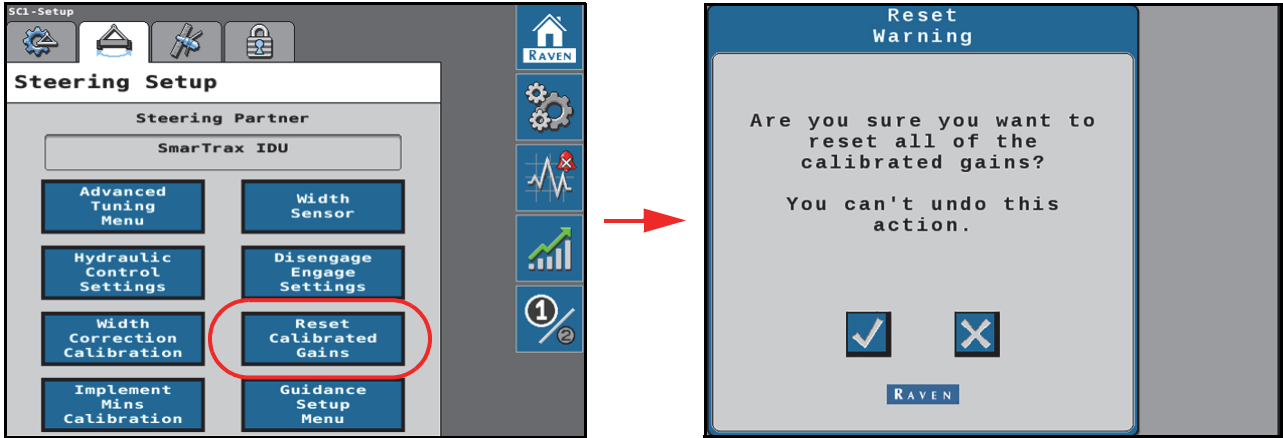
FIGURE 13. Width Correction Calibration Setup Screen



8. Select the Automatic Calibration button. The system will use the recorded performance statistics to calculate the offset values.

RESET CALIBRATED GAINS

FIGURE 14. Reset Calibrated Gains Screen

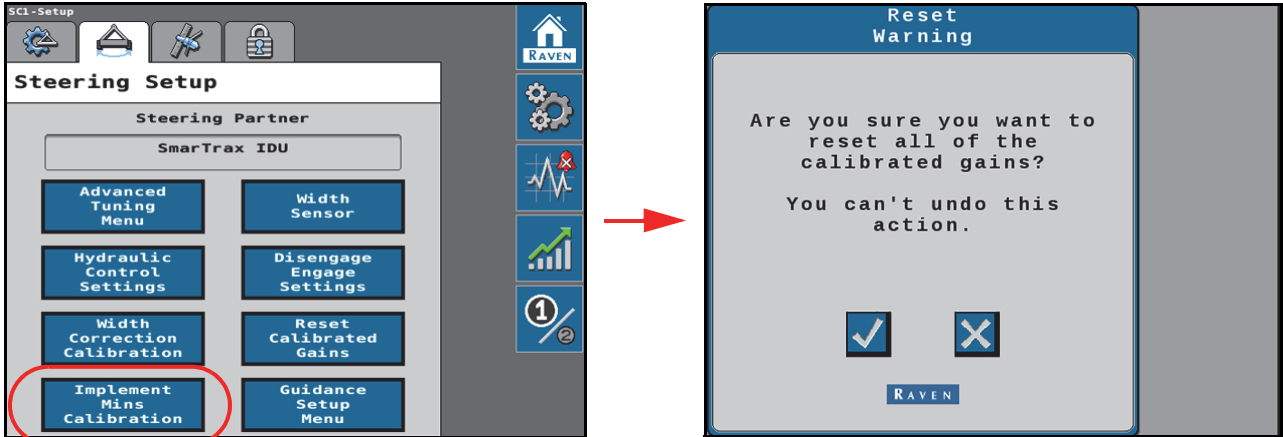


To reset the SC1/TC1 system to factory defaults:

- 1. From the SC1/TC1 Home screen, select the Tools 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.

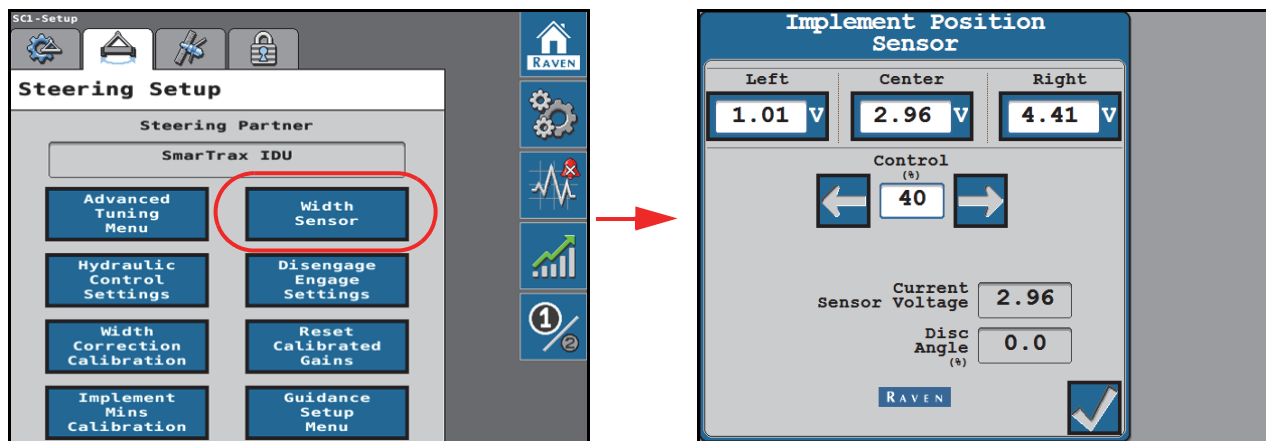
IMPLEMENT MINS CALIBRATION

FIGURE 15. Reset Calibrated Gains Screen



WIDTH SENSOR

FIGURE 16. Plough Width Sensor Screen

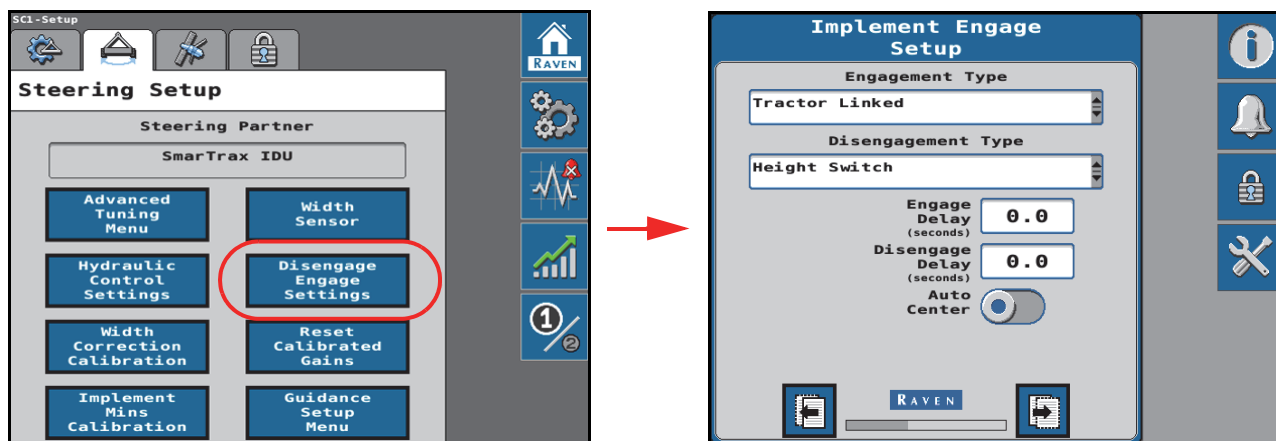


To set the Implement Position sensor calibration values:

1. From the SC1/TC1 Home screen, select the Tools 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 selecting 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 17. Steering Engage/Disengage Settings Screen



To access disengage switch settings:

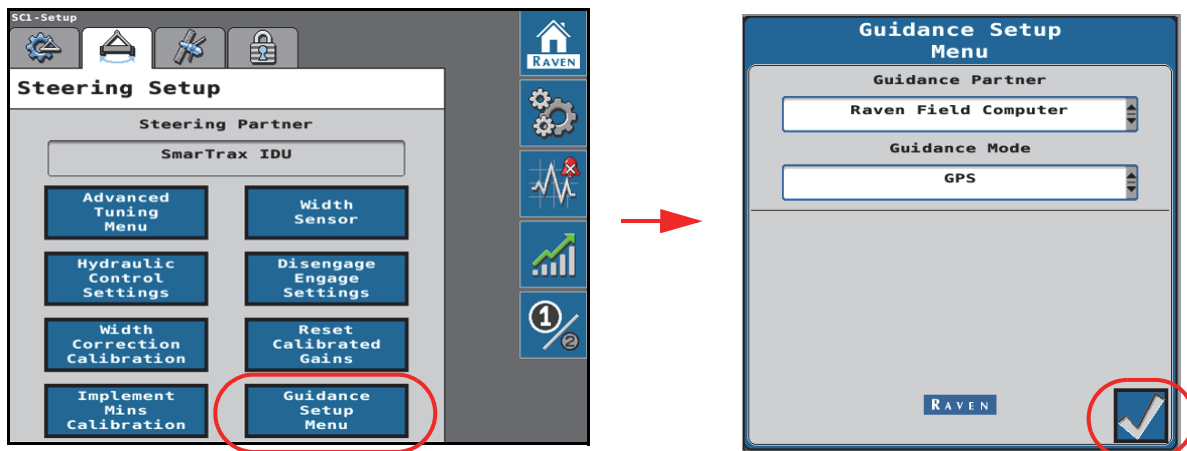
1. From the SC1/TC1 Home screen, select the Tools Menu button.

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.

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 18. Guidance Setup Menu



To access Guidance Setup settings:

1. From the SC1/TC1 Home screen, select the Tools 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
 - Guidance Mode - Use the drop-down list to select the desired Guidance Mode:
 - GPS - Guidance is performed via GPS guidance points only
3. Select the **Accept** button to complete the guidance setup.

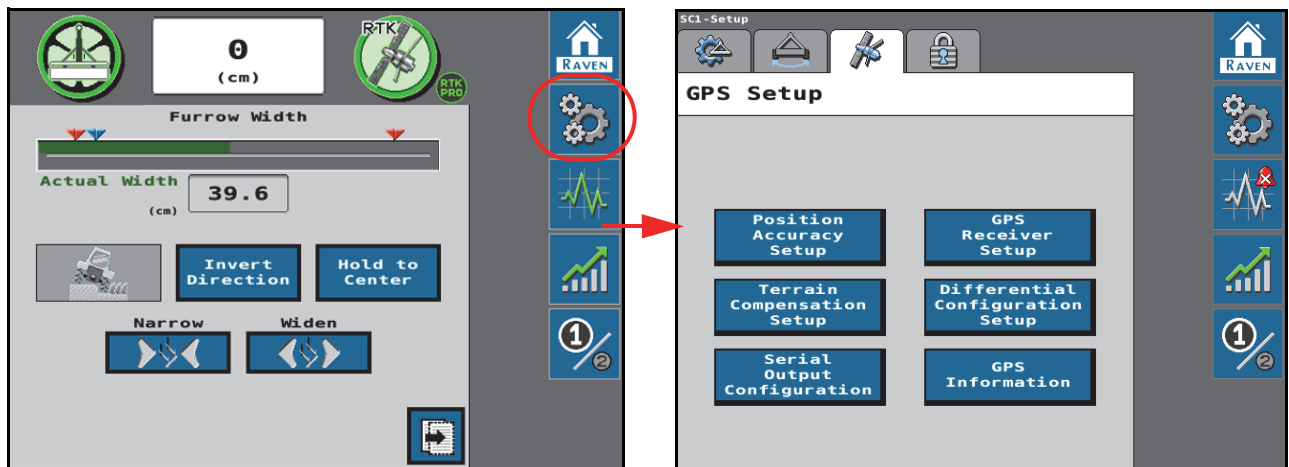
GPS RECEIVER CONFIGURATION

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

- Raven 700S™

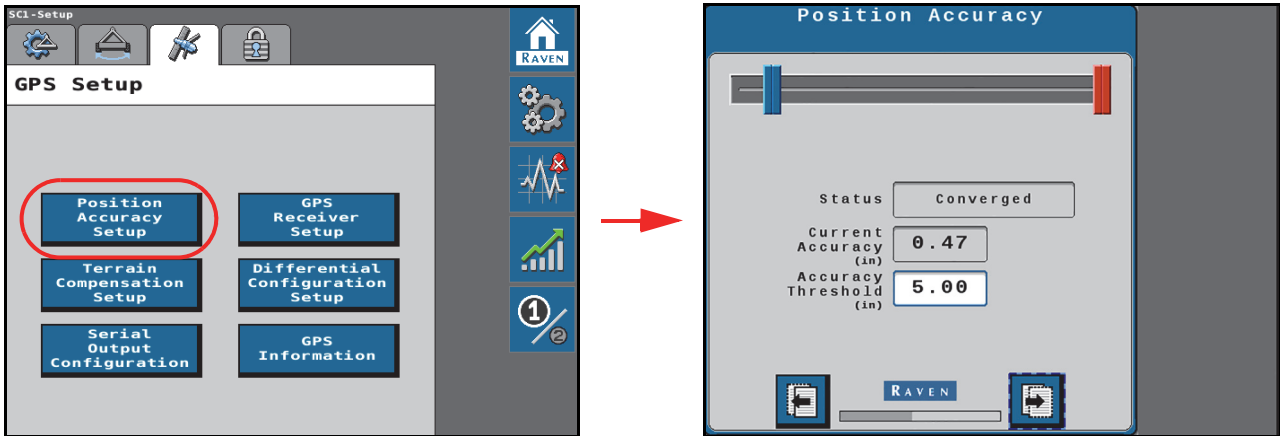
CONFIGURE GPS IN THE SC1/TC1

FIGURE 1. GPS Setup Screen



POSITION ACCURACY SETUP

FIGURE 2. Position Accuracy Setup Screen

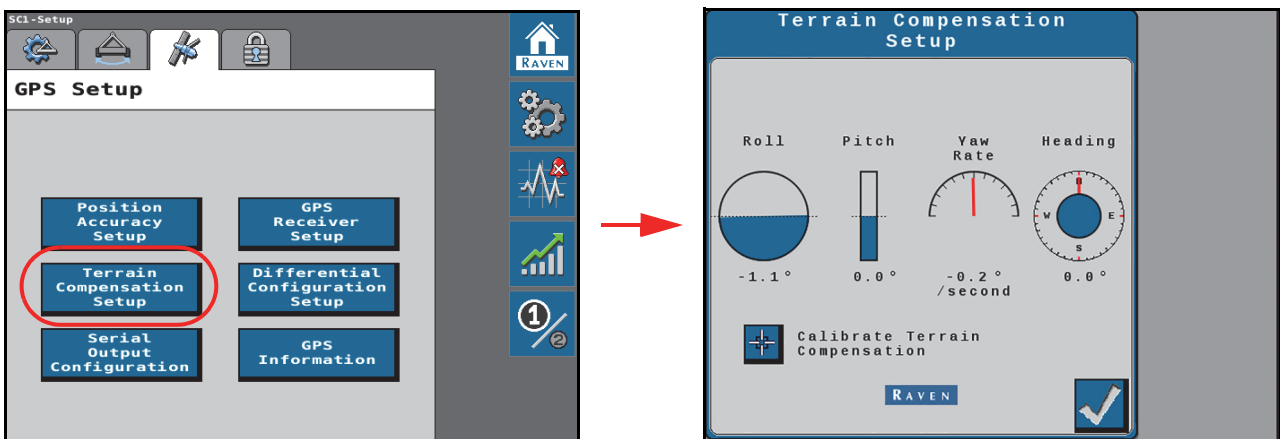


- **Status** - Displays the absolute status of the GPS accuracy. Statuses that may be displayed in this area include:
 - No Signal
 - Error
 - Converging
 - Converged
- **Current Accuracy** - A value representing the reported horizontal accuracy of the current solution as detected by the receiver.
-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

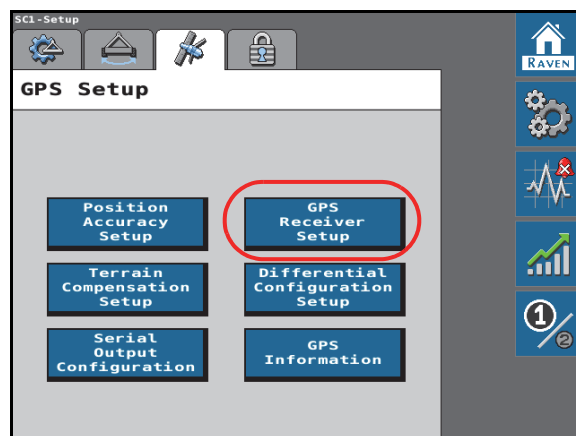
Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

GPS RECEIVER SETUP

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

1. From the SC1/TC1 Home screen, select the Tools 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



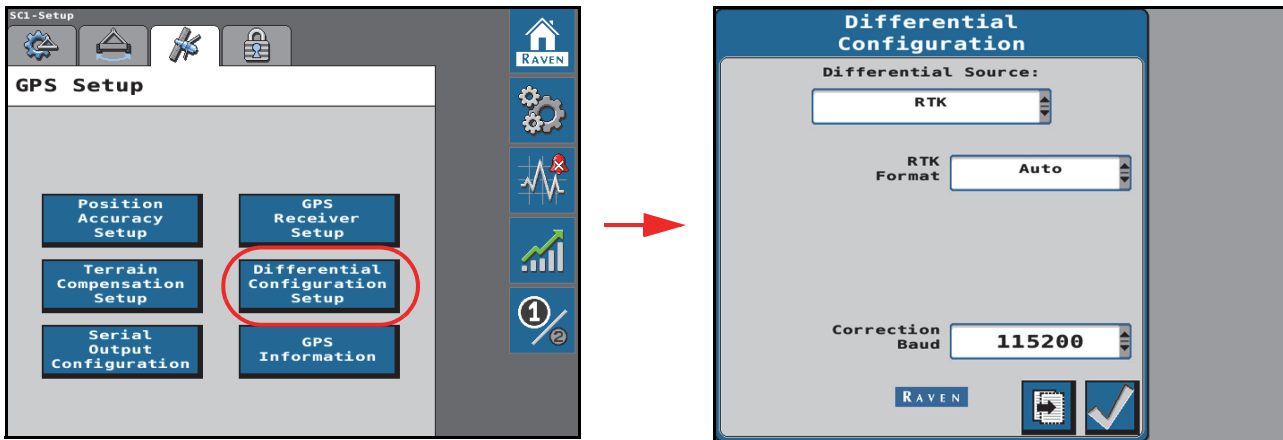
4. Select the Accept button in the lower, right corner of the screen to return to the GPS Setup tab.

DIFFERENTIAL CONFIGURATION SCREEN

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

1. From the SC1/TC1 Home screen, select the Tools 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



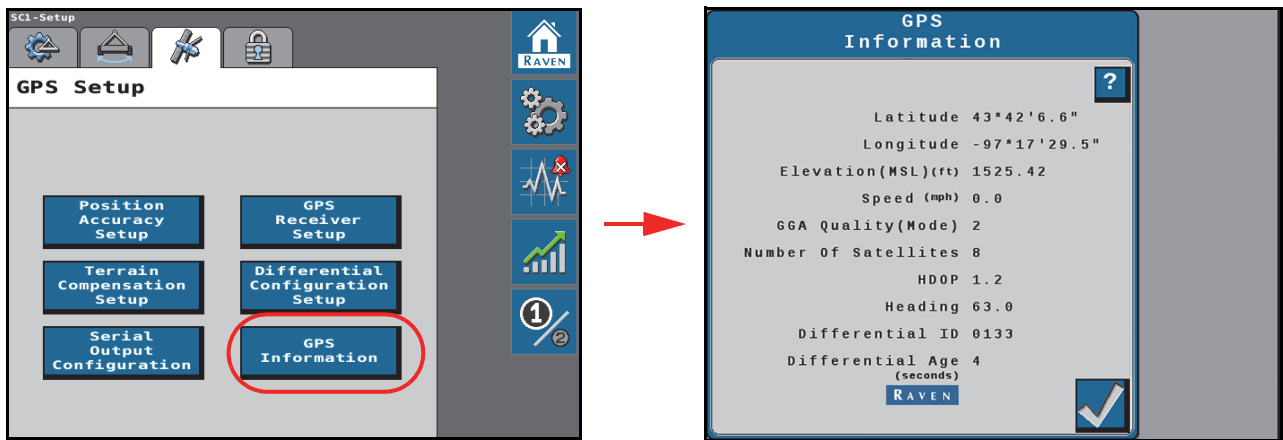
NOTE: Refer to Chapter 7, *Feature Unlock Codes*, for additional assistance with activating additional differential sources.

GPS INFORMATION

To view detailed GPS information:

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

FIGURE 6. GPS Information Screen



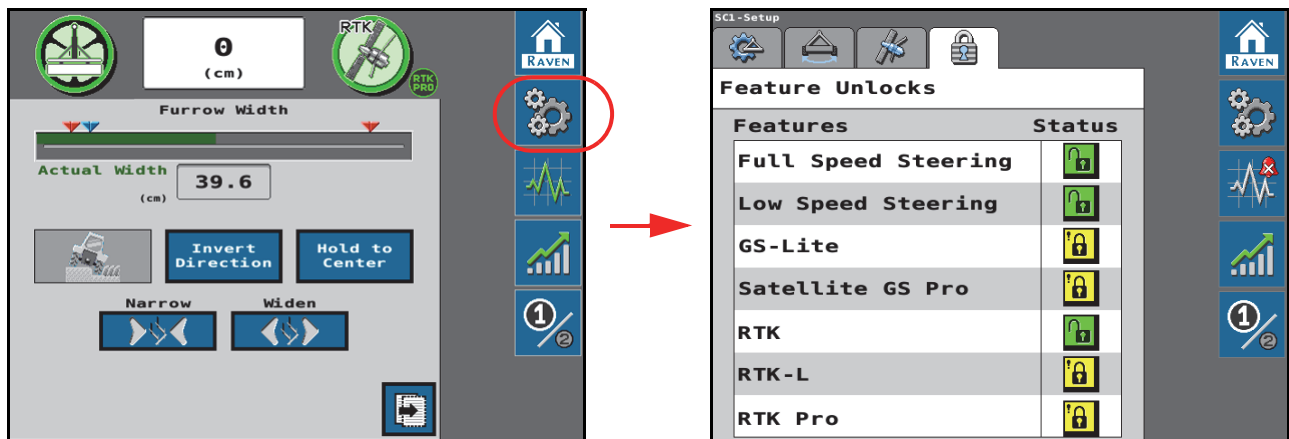
- **Latitude** - The angular distance of a place north or south of the earth’s equator.
- **Longitude** - The angular distance of a place east or west of the meridian at Greenwich, England.
- **Elevation (MSL)** - The height of the antenna in reference to sea level.
- **Speed** - Current speed based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

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.

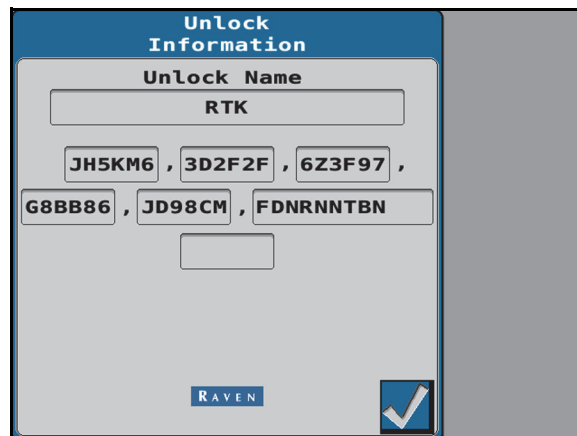
FIGURE 1. Feature Unlock Screen



To activate features of the SC1/TC1 steering system:

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

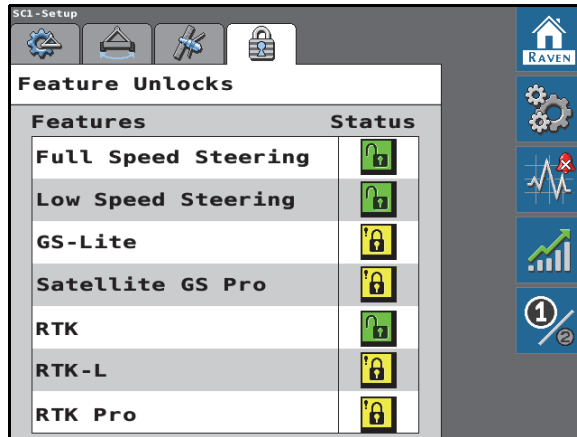
FIGURE 2. Feature Unlock Information Screen



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

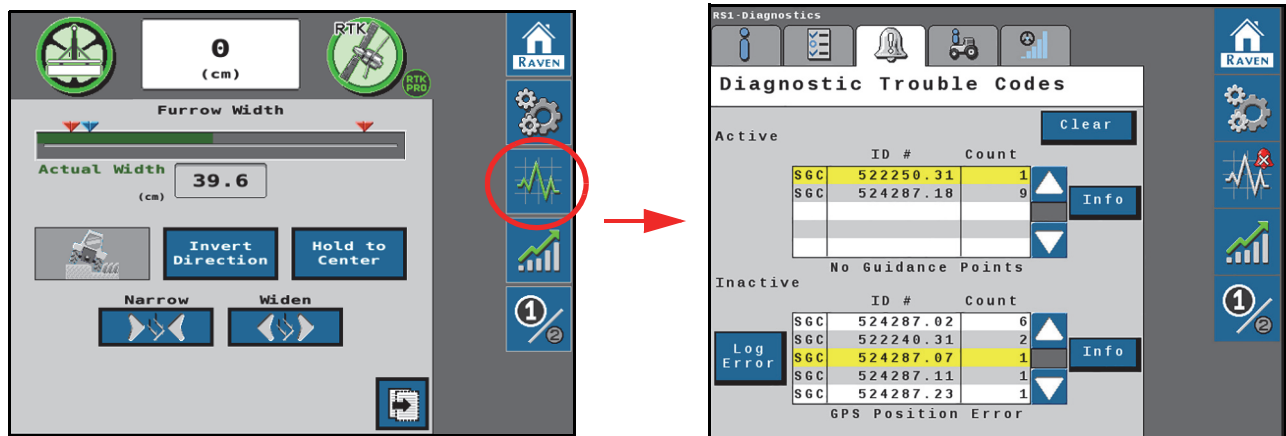


NOTE: RTK unlocks can only be applied for the following GPS Receivers:

- Raven 700S™

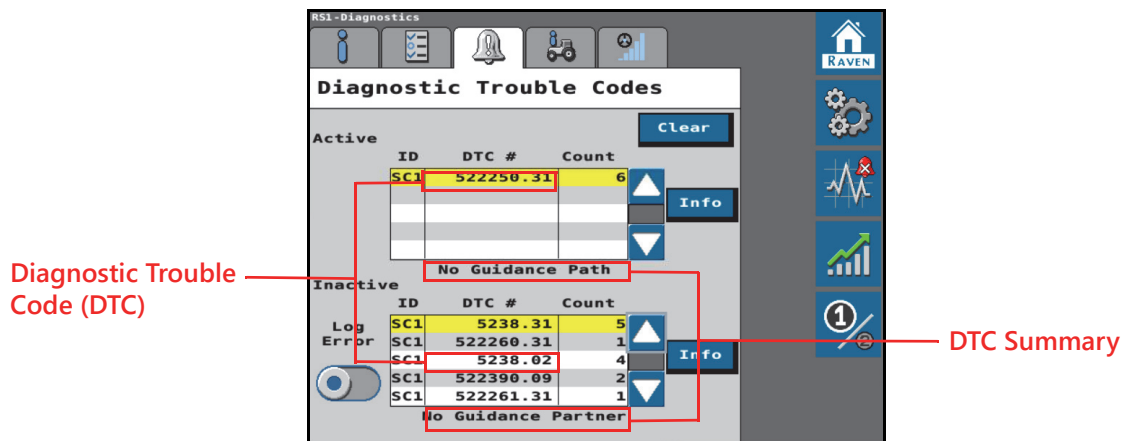
DIAGNOSTIC TROUBLE CODES (DTC)

FIGURE 1. Diagnostic Trouble Codes Screen



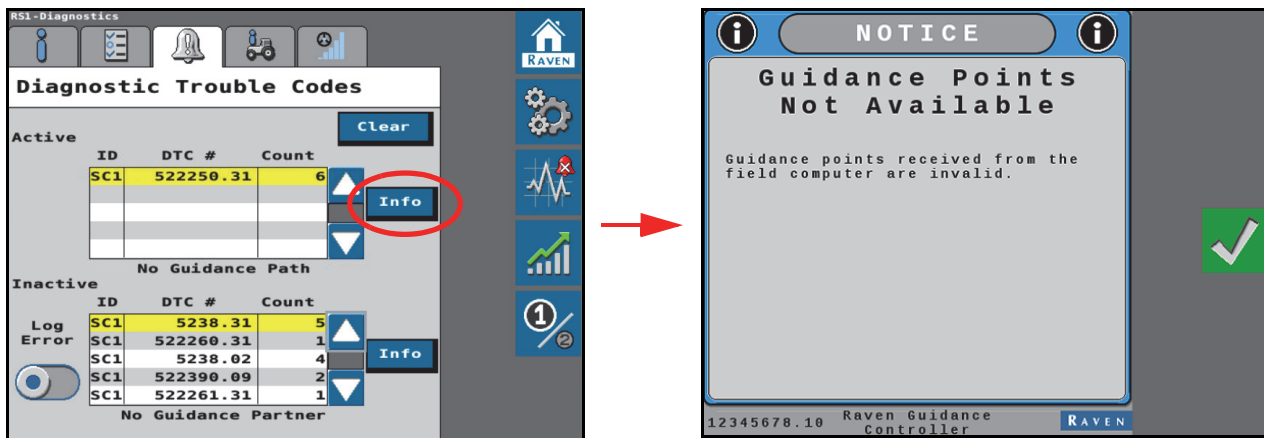
The Diagnostic Trouble Code screen displays active and previous diagnostic trouble codes (DTCs) that occur during SC1/TC1 system operation. Active DTCs must be fixed before the SC1/TC1 system can be enabled for guidance and steering operation. Once a DTC has been corrected, the code moves to the inactive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

FIGURE 2. Diagnostic Trouble Codes Screen



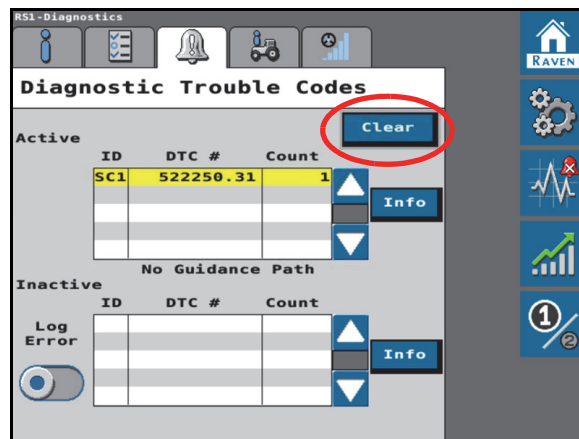
NOTE: In Figure 3 above, the active DTC is 522250.31 and the DTC summary is “No Guidance Points.” The inactive DTC is 522261.31 and the DTC summary is “No SCU Detected.”

FIGURE 3. Info Screen



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

FIGURE 4. Inactive DTCs Cleared from Error Log



Selecting **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 18 mph.
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 than 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	Oprator 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 Vlve Not Cnnected	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/

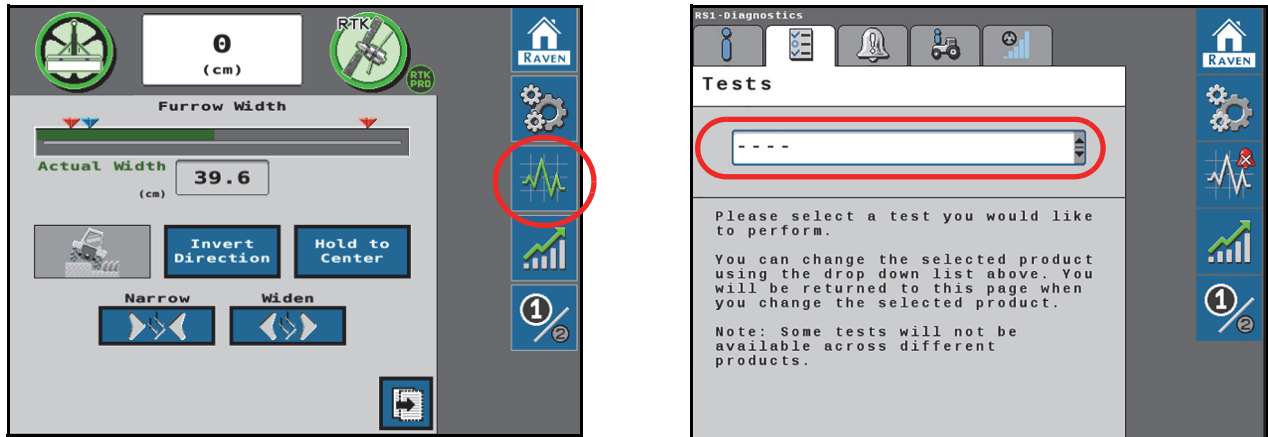
SYSTEM HEALTH TESTS



! WARNING

The machine will steer automatically while system health 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



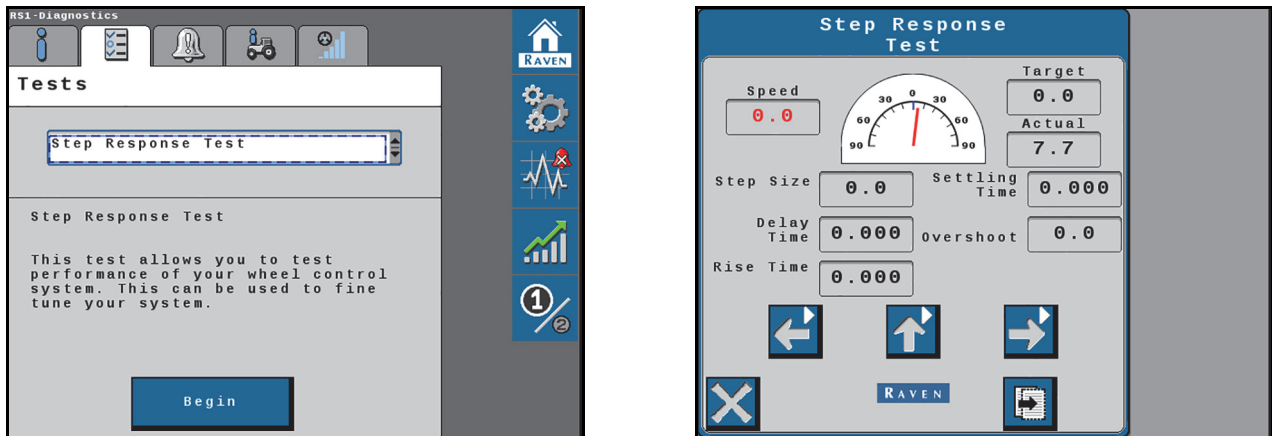
System health tests are performed to diagnose and correct machine and SC1/TC1 calibration issues. The following system health tests can be performed via the SC1/TC1 system:

- Step Response Test
- Machine Test

STEP RESPONSE TEST

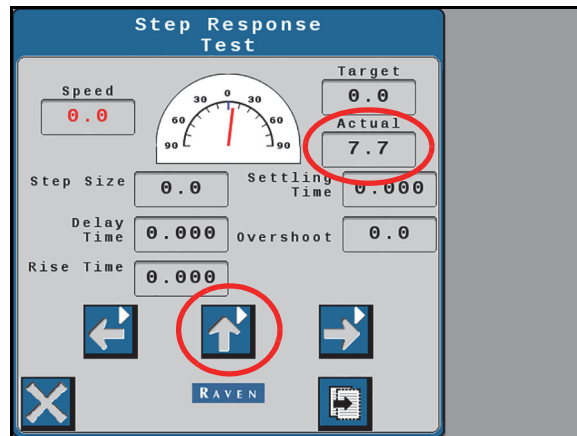
The Step Response Test is used to determine the responsiveness of the implement steering system.

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

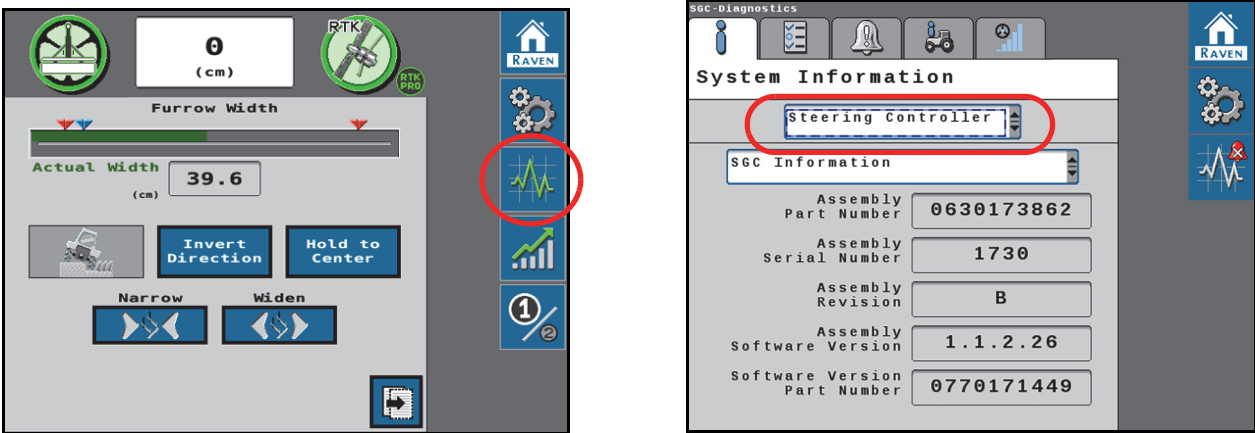


2. Select the center up arrow. Wait for the actuator to reach the center position.
3. Select the left arrow.
4. Wait for the following fields to populate and record the data:
 - a. Step Size
 - b. Delay Time
 - c. Rise Time
 - d. Settling Time
 - e. Overshoot
5. Drive forward 1 - 4 mph with the engine RPM set at 3/4 throttle.
6. Select the center up arrow. Wait for the actuator to reach the center position.
7. Select 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 step 1 through step 8.

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

SYSTEM INFORMATION

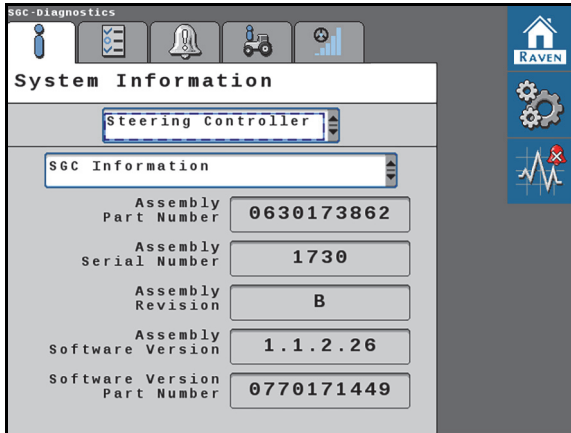
FIGURE 8. System Information Screen



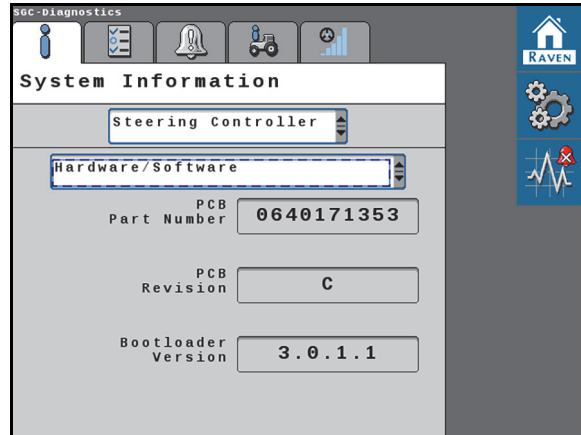
1. Select the desired device from the drop-down menu.
2. Select the desired system component from the second drop-down menu.

FIGURE 9. System Information Screens

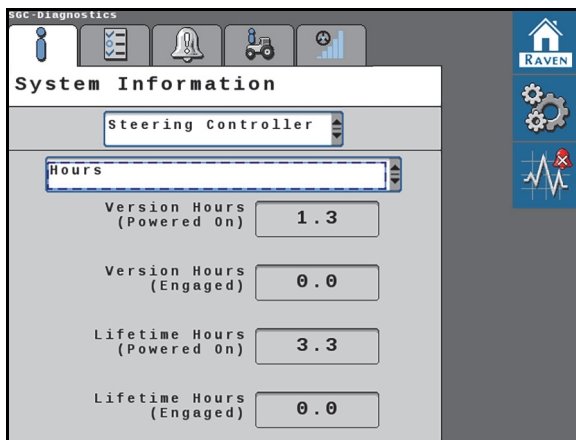
SC1/TC1 Information



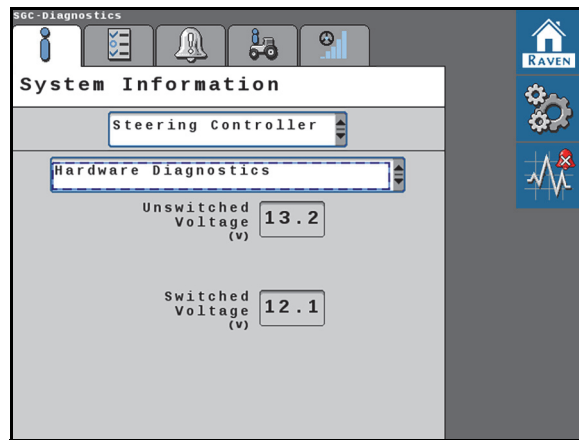
Hardware/Software Information



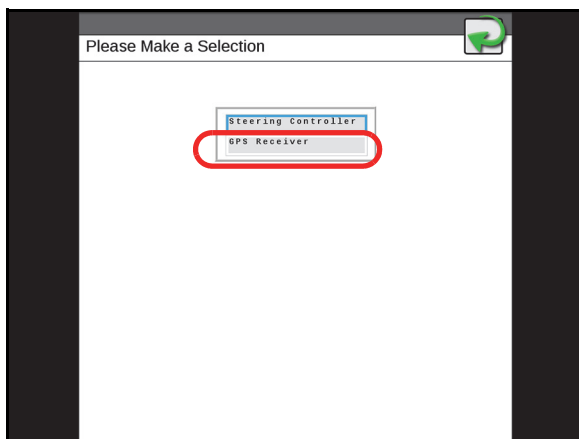
SC1/TC1 Unit Hours



SC1/TC1 Hardware Diagnostics



GPS Receiver Information



GPS Receiver

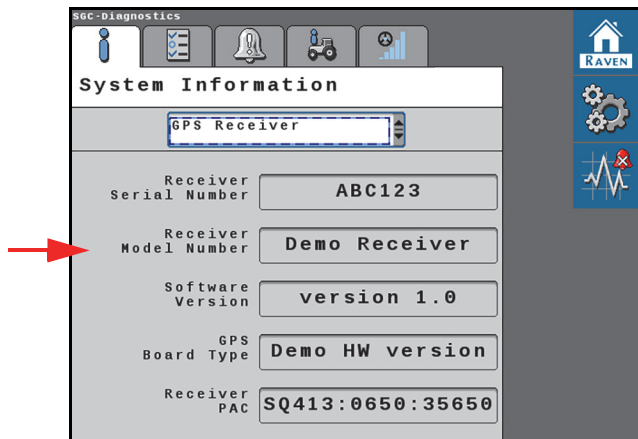
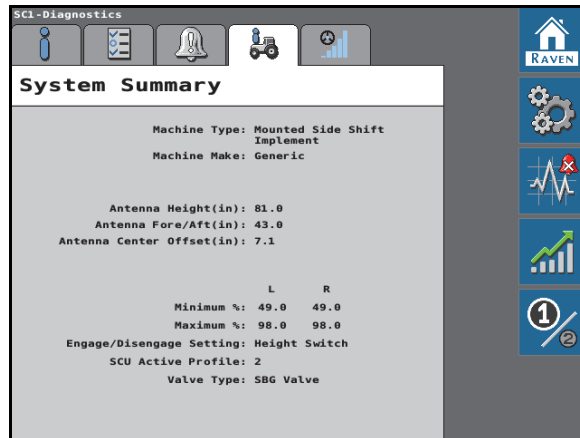
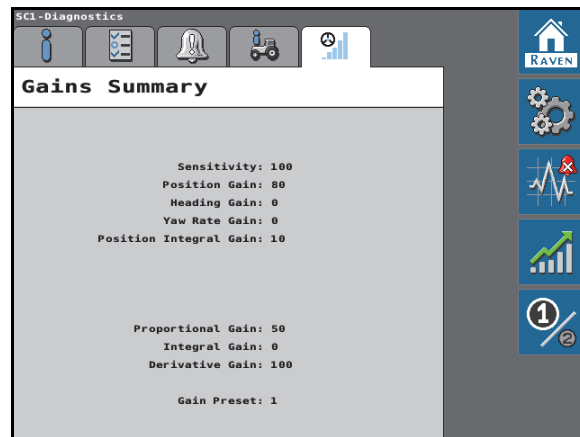


FIGURE 10. System Summary Screen



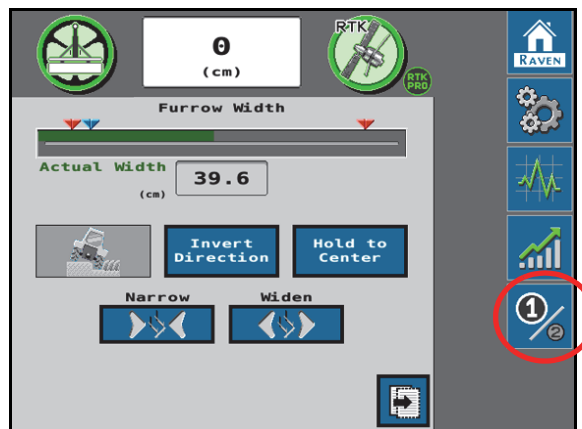
The System Summary screen displays the machine settings and calibrated steering settings for the SC1/TC1 system.

FIGURE 11. Gains Summary Screen



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

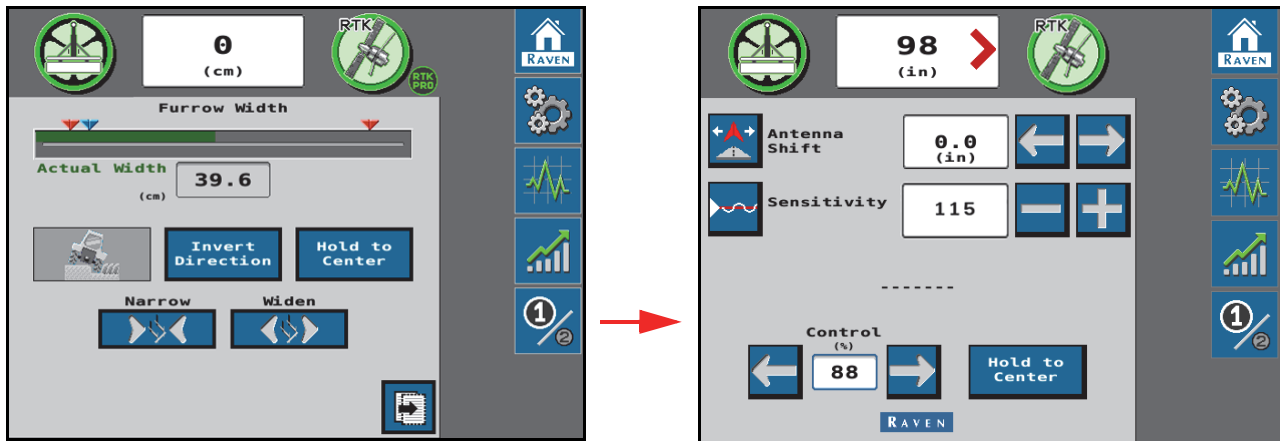
FIGURE 12. Preset Steering Gains



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:

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

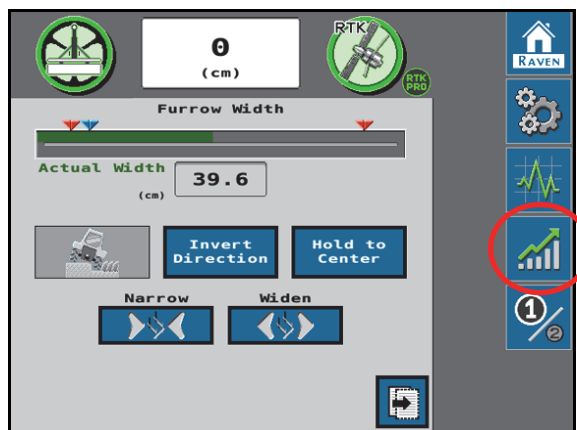
FIGURE 13. Preset Gains Settings



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

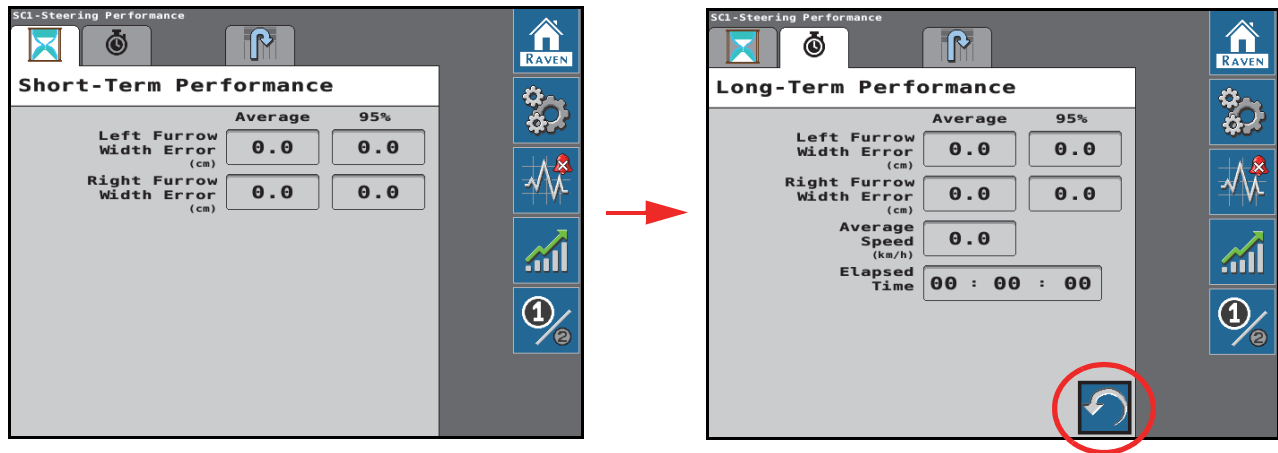
PERFORMANCE MONITOR

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 **Reset** icon to reset the values.

D

Diagnostics and Troubleshooting 53

- Button Definitions
 - Angle Sensor 29
 - Implement Switch 28
 - Operator Presence Switch 29
 - Steering Status 26
- Diagnostic Trouble Codes 53
- GPS Status 30
- Performance Monitor 68
- System Health Tests 63
 - Min PWM Sweep Test 65
 - Step Response Test 63
- System Information 65

F

Feature Unlock Codes 51

I

Implement Settings 33

Introduction 5

- Installation 6
 - Recommendations 6
- Updates 6

R

Routine Operation

- CRX Widget Definitions 31
- Implement 25

S

Steering Setup

- Advanced Tuning 37
- Disengage/Engage Settings 42
- Resetting Calibrated Gains 41

Steering Setup Tab 37

U

Updating the Node 6

LIMITED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

HOW LONG IS THE COVERAGE PERIOD?

Raven Applied Technology products are covered by this warranty for 12 months from the date of retail sale. In no case will the Limited Warranty period exceed 36 months from the date the product was issued by Raven Industries Applied Technology Division. This warranty coverage applies only to the original owner and is non-transferable.

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the warranty claim, Raven Industries will (at our discretion) repair or replace this product or any component of the product found to be defective during the warranty period. Replacement will be made with a new or remanufactured product or component. Standard return freight will be paid, regardless of inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THIS WARRANTY?

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

- Damages caused by normal wear and tear, misuse, abuse, neglect, accident, improper installation and maintenance are not covered by this warranty.
- Worn/Chafed hoses and cables.
- Items in contact with fluids and chemicals including seals and O-rings.
- Software downloads and updates.
- Tamper-Evident label broken or customer disassembly.
- Any customer modification to the original product outside normal calibration and adjustments, without written approval.
- Intentional modification to cables.
- Failures due to lack of cleaning or preventive maintenance, and any condition, malfunction or damage not resulting from defects in material or workmanship.
- Items in contact with fluids or chemicals, returned without proper cleaning, decontamination and documentation.

EXTENDED WARRANTY

WHAT DOES THIS WARRANTY COVER?

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

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

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

WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

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

HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

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

HOW CAN I GET SERVICE?

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

WHAT WILL RAVEN INDUSTRIES DO?

Upon confirmation of the warranty claim, Raven Industries will (at our discretion) repair or replace this product or any component of the product found to be defective during the warranty period. Replacement will be made with a new or remanufactured product or component. Standard return freight will be paid, regardless of inbound shipping method. Expedited freight is available at the customer's expense.

WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

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

- Damages caused by normal wear and tear, misuse, abuse, neglect, accident, improper installation and maintenance are not covered by this warranty.
- Worn/Chafed hoses and cables.
- Items in contact with fluids and chemicals including seals and O-rings.
- Software downloads and updates.
- Tamper-Evident label broken or customer disassembly.
- Any customer modification to the original product outside normal calibration and adjustments, without written approval.
- Intentional modification to cables.
- Failures due to lack of cleaning or preventive maintenance, and any condition, malfunction or damage not resulting from defects in material or workmanship.
- Items in contact with fluids or chemicals, returned without proper cleaning, decontamination and documentation.