

DirecSteer Calibration and Operation Manual



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Table of Contents

Disclaimer	ii
Table of Contents	iii
Important Safety Information	1
Field Computers, Displays, and Control Consoles	2
Hydraulic Safety	2
Electrical Safety	3
Machine Safety Systems	4
Touch Screen	4
Recommendations and Best Practices	4
Point of Reference	4
Preparing for Install	4
Aerials and Signal Interference	4
Hose Routing	5
Harness Routing	6
Introduction	9
Device Specifications	10
Dimensions	10
Power	10
Environmental	10
Connectivity and GNSS Signals	11
Approvals and Certifications	12
Dimensions	12
Power	12
Environmental	13
Connectivity	13
Updates	13

Machine Calibration	15
Preparation and Best Practices	16
Guidance and GNSS Calibration	19
Terrain Compensation Calibration	29
Auto-Steer Calibration	33
Roadway Homologation Terms	33
Resume/Disengage Calibration	34
Calibrate the Wheel Angle Sensor (WAS)	35
Steering Control Calibration	41
Auto-Steer Calibration	41
External Device Settings	45
Viper® 4 and Viper® 4+	45
External GNSS Settings	46
Message Types and Frequencies	47
Configure the TrimbleAG-372 with AgRemote	47
GNSS Configuration	47
Radio Mode Configuration	48
Port A Configuration	48
Port B Configuration	51
Operation	53
Starting Jobs	53
Operator Liability	53
Steering Status	54
Steering Status Indicators	54
Critical DTCs	55
Active DTCs	55
No DTCs	55
No DTCs - Steering Engaged	55

Steering Status Page	55
Master Switch	56
Resume Switch	57
Disengage Sensor	57
Wheel Angle Sensor	57
Operator Presence Switch	58
Engage Steering	58
Feature Unlocks Tab	59
Red	60
Yellow	60
Green	60
Widget Definitions	62
Not Engaged - Liability Not Accepted	63
Not Engaged - No Guidance Path or Active DTC	63
Detected Turned On and Calibrated	63
Detected and In Operation	63
Detected - Non-Critical Active DTC	64
Detected and Calibrated - Non-Critical Active DTC	64
System Settings	65
Machine Settings Tab	65
Steering Setup Tab	65
GPS (GNSS) Setup Tab	65
Feature Unlocks Tab	65
UT Navigation	66
Accept	66
Next	66
Previous	66
Machine Settings Tab	66

Change the Machine Profile	67
Review the Machine Configuration	70
Machine Offset Setup	71
Help Menu Icon	73
Antenna Height	73
Antenna Center Offset	73
Antenna Fore/Aft	73
Wheel Base (Machine Steering Only)	74
Steering Setup Tab	74
Advanced Tuning	75
Position Gain	77
Heading Gain	77
Yaw Rate Gain	78
Position Integral Gain	78
Yaw Error Compensation	78
Proportional Gain	78
Integral Gain	78
Derivative Gain	78
Left System Gain	79
Right System Gain	79
Steering Backlash (DirecSteer Only)	79
Wheel Speed Compensation	79
Wheel Control Settings	79
Informational Readouts	81
Velocity or Wheel Velocity	81
Control Effort	82
Motor or Valve Current	82
Reverse Hydraulics	82

Min and Max Buttons	82
Minimum Percent	82
Maximum Percent	82
PWM Table	82
Steering Control Calibration	83
Preparation	83
Perform a Calibration	84
Guidance Setup Menu	85
Guidance Partner	87
Guidance Mode	87
Automation Level	88
Guidance Path Partner	88
Wheel Angle and Implement Position Sensor Settings	88
Informational Readouts	89
Wheel Angle Sensor Applications	90
Left, Center, and Right Values	90
Current Sensor Voltage	90
Current Wheel Angle	90
Calibrate the Sensor Positions	90
Steering Disengage Settings	91
Informational Readouts	92
Disengage Type	92
Disengage Status	92
Pressure 1	93
Pressure 2	93
Disengage Differential	93
Measured Rotation Rate	93
Measured PWM Encoder Change Rate	93

Encoder Rate	93
Disengage Threshold	93
Reset Calibrated Gains	93
Operator Presence Sensor	95
Informational Readouts	97
Current Voltage	97
Status	97
Operator Presence Sensor Type	97
Lower Limit	98
Upper Limit	98
GPS (GNSS) Setup Tab	98
GPS Shutdown Timer (if equipped)	100
Position Accuracy Setup	100
Status	102
Current Accuracy	102
Accuracy Threshold	102
GNSS Terrain Compensation	103
Roll, Pitch, Yaw Rate, and Heading	104
Calibrate Terrain Compensation	104
GPS Serial Output	104
Baud Rate	107
Message Types	107
Modem Status	108
Modem Type	108
Differential Configuration Setup	109
GPS Information Page	111
Latitude	113
Longitude	113

Elevation (MSL)	113
Speed	113
GGA Quality (Mode)	113
Number of Satellites	114
HDOP	114
Heading	114
Differential ID	114
Age of Differential	114
Slingshot® Universal Terminal Overview	115
Slingshot® Home Page Overview	116
Slingshot® Name	116
Remote Diagnostics	116
Field Update	116
Connectivity Status	117
Cellular Modem Status	117
Ethernet Status	118
Wi-Fi® Status	119
Hotspot	119
Client	119
Slingshot® Feature Status	120
Update In Progress	120
Slingshot® Remote Diagnostics	120
Slingshot® Portal Connection	120
Slingshot® RTK	120
Ethernet Status Page	120
Device IP Address	121
Link Speed	121
Wi-Fi® Connection and Hotspot Status Page	121

Connection Status	122
Service Set Identifier (SSID)	122
Signal	122
Status	122
Hotspot Status	122
Service Set Identifier (SSID)	122
Hostname	122
Assigned IP	122
RS1™ Field Update	123
Slingshot® System Settings	125
Cellular Information	126
Modem Status	128
IMEI	129
Phone Number	129
SIM	129
Ethernet Settings Tab	129
Raven Field Computer (Server Mode)	130
Field Hub (Client Mode)	131
Wi-Fi® Settings	131
SSID	132
Encryption Type	132
Mode	132
Wi-Fi® Channel	133
RTK Source Settings	133
Base Station Name	135
RTK Source Toggle Option	135
Network	135
Serial	135

None	135
Baud	135
Radio Link Settings	136
Connection Point	137
Radio Channel	137
Radio Tx (Transmit) Power	137
Non-Controlling Combine Present	138
Feature Unlocks	138
Slingshot® Diagnostic System Information	140
RS1™ Information	142
GPS Receiver	142
Steering Guidance Controller	143
Cell Modem	143
Hours	144
Hardware Diagnostics	144
Diagnostics and Troubleshooting	145
Diagnostic Trouble Codes (DTCs)	145
DTC List for RS1™ and SC1™/TC1™	147
DTC List for DirecSteer, HDU, MDU, and IDU	161
Performance Monitor	172
Online Performance	172
Line Acquire Performance	173
Online Curve Performance	174
System Tests	174
Step Response Test	175
Machine Test	181
Control Effort Test	182
Disengage Test	183

Machine Info	184
Readouts	184
Switches Test	185
Control Effort Test	187
Disengage Test	188
Machine Info	188
Readouts	189
Switches Test	189
Control Effort Test	191
Disengage Test	192
Machine Info	193
Readouts	193
Switches Test	194
SGC System Information	194
SGC Information	196
Hardware/Software	196
Cell Modem	196
Hours	197
Hardware Diagnostics	197
GPS Receiver	197
Update DirecSteer Unit	198
Performance Monitor	200
Online Performance	200
Line Acquire Performance	201
Online Curve Performance	202
Certification and Compliance	203
Roadway Homologation	203
Certifications	204

Safety Notes	204
ANATEL Compliance Statement	204

Important Safety Information

NOTICE

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

- Park the machine where the ground is level, clean, and dry.
- Bleed pressure from the hydraulic system and leave the machine turned off for the duration of the installation or maintenance process.

Follow the operation and safety instructions included with the implement and/or controller. Before installing or operating this Raven system, review and understand the information presented on this site.

- Failure to follow safety instructions may lead to equipment damage, personal injury, or death.
- Review equipment operation with your local dealer and follow all safety information presented on this site.
- 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 while operating this Raven system.
 - 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.
 - Do not operate the implement on any public road with this Raven system enabled.
 - Maintain control of the vehicle at all times during operation. For example,
 - Remain in the operator seat while the system is enabled and disable automated Raven controls before exiting the operator seat.
 - Maintain control of safety devices such as E-Stops at all times during operation.
 - 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.

Field Computers, 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 GNSS 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.
- Always take care 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.
- Any work performed on the hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- Before installing hydraulic components, ensure there are no issues with the machine hydraulic system (e.g. pump issues, faulty hydraulic motors, fine metal deposits in the hydraulic lines, etc.).
- 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.
 - Verify that the hydraulic system is using fresh oil and the filters have been changed.
- 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 system power cable to the vehicle ignition or 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.

Machine Safety Systems

- Use all provided safety systems on the machine when operating the machine with the Raven system.
- Seat belts and restraints must be used when an operator is in the cab.
- Do not disable any machine-provided safety systems, including but not limited to audible alarms, alarm lights, etc.

Touch Screen

- Only touch the touch-screen with your finger or by using a special touch-screen stylus or 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

Point of Reference

Instructions provided generally assume you are standing behind the machine facing toward the cab. More specific orientation may be provided as necessary to complete procedures.

Preparing for Install

- 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.).
- 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 steering system (e.g., worn bushings, faulty tie rod ends, improperly adjusted steering components, etc.)

Aerials and Signal Interference

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

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

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

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

Note: The antenna view typically starts 5° to 10° above horizontal from the base of the antenna and extends over the skyward face of the receiver/antenna.
- GNSS is a line-of-sight system. A clear path must exist between the satellite and the GNSS antenna.
 - Obstructions such as buildings, tree branches and limbs, as well as components of the vehicle such as a fiberglass or metal roof, and etc. may cause signal multi-path or completely block the GNSS receiver.
- Electrical and magnetic fields can interfere with GNSS or L-Band signals.
 - Avoid mounting GNSS receivers or antennas near components such as radio or cellular antennas, electrical motors, generators, alternators, strobe lights, radio transmitters, radio or cellular antennas, etc.
 - Over-head power lines, microwave dishes, radar, other active antennas, etc. can interfere with GNSS signal.
- Mount the Field Hub cellular and diversity antennas at least 1 m [39 in] apart. Avoid mounting other cellular, radio, or GNSS aerials within this area.

Hose Routing

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

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

Harness Routing

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

- Leave protective caps/covers over harness connectors until needed to avoid dirt and moisture from contaminating electrical circuits.
- Secure the harness to the frame or solid structural members at least every 12 in [30 cm].
- Follow existing harness runs already routed on the implement as much as possible. Proper harness routing should:
 - Secure harnessing and prevent the harness from hanging below the implement.
 - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
 - Protect harnessing from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).
 - Protect harnessing from sharp bends, twisting, or flexing over short distances and normal implement operation.
 - Connectors and splices should not be located at bending points or in harness sections that move.
 - Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp harnessing securely to force controlled movement of the harness.
 - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
- Do not connect, affix, or allow harnessing to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of harness components.
 - Harnessing should be protected or shielded if routing requires the hose to be exposed to conditions beyond harnessing component specifications.
- Avoid routing harnesses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).

- Avoid routing harnesses in areas where the operator or service personnel might step or use as a grab bar.

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

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

Chapter 2:

Introduction

The instructions in this manual are designed to assist in the proper calibration and operation of the DirecSteer system when connected with a Raven SGC (e.g. RS1™, SC1™, or TC1™).

Note: *Installation of the DirecSteer and SGC must be completed before calibrating the system. Refer to the machine-specific Installation Manual for assistance with installation of DirecSteer and the SGC.*

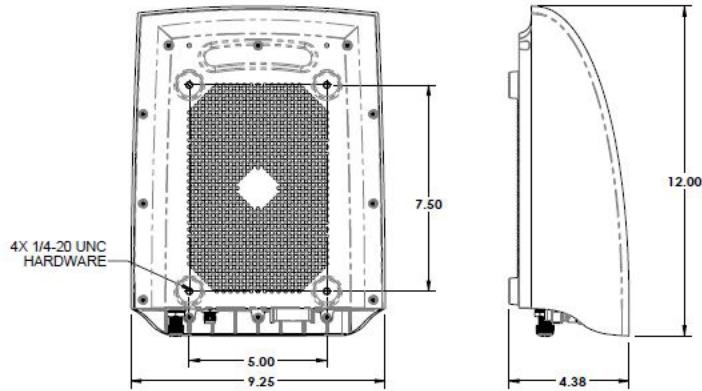
Installation and Operation Manuals for Raven systems can be downloaded from the Raven website: <https://portal.ravenprecision.com>.

Note: *The universal terminal or Raven field computer must be calibrated specifically for equipment before starting auto-steering operations. Refer to the Operation Manual for the universal terminal or Raven field computer connected to the auto-steer components.*

Device Specifications

RS1™

Dimensions



Overall (LxWxH):

- 30.48 x 23.5 x 11.13 cm
- 12 x 9.25 x 4.38 in.

Mounting (LxW):

- 19.05 x 12.7 cm
- 7.5 in. x 5 in.

Power

Operating Voltage (DC): 7 - 28 Volts

Max. Current (7 VDC): 6 Amps

Nom. Current (12 VDC): 1.5 Amps

Environmental

Operating Temperature: -40° to 70° C [-40° to 158° F]

Storage Temperature: -40° to 70° C [-40° to 158° F]

Humidity (relative): 10% - 95%

Environmental Rating: IP67

Connectivity and GNSS Signals

Communication: 2x RS232, 2x CANbus, Cellular, Wi-Fi, Bluetooth®, Ethernet

Method	Band	Transmitted Power (Avg.)	Antenna Gain	Data Rate	How Used
Cellular	LTE B4 (1700)	23 dBm	-3 dB	10 MB Down 5 MB Up	Slingshot® connectivity for RTK, file transfer, OTA updates, and diagnostics.
	LTE B13 (700C)	23 dBm	-3 dB		
Wi-Fi	2.4 GHz	10.5 dBm	4 dB	54 MB/sec.	Communication to field computer for Slingshot® connectivity/reprogramming, and external user diagnostics.
Ethernet	-	-	-	10/100/1000 MB/sec.	

GNSS Signals:

- GPS L1, L2, L2C, L5
- Glonass L1, L2
- Galileo E1, E5A, E5B
- Beidou B1, B2
- L-Band
- SBAS

Position Accuracy:

- Single Point L1: 1.5 m
- Single Point L1/L2: 1.2 m
- SBAS: 0.6 m
- Satellite GS 4 cm
- RTK: <2.56 cm

Approvals and Certifications

- CE
- E-Mark - E8 10R-05 9484
- FCC 47 CRF Part 15 Subpart B
- ISED Canada ICES-003 Issue 6

DirecSteer



Dimensions

Motor (WxH):

- Ø16.5 cm [6.5 in.] (outer) x Ø 4.05 cm [1.5 in.] (inner) x 8.05 cm [3.2 in.]
- Weight: 5.5 kg [12.1 lbs.]

Steering wheel:

- Ø42 cm [16.5 in.]

Power

- Operating Voltage (DC): 9 - 32 V

Environmental

- Operating Temperature: -20° to 60° C [-4° to 140° F]
- Storage Temperature: -40° to 85° C [-40° to 185° F]
- Environmental Rating: IP65

Connectivity

Communication: RS485, CAN

Updates

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

<https://portal.ravenprecision.com>

Sign up for email alerts and you will be automatically notified when updates for Raven products are available.

At Raven Industries, we strive to make your experience with our Applied Technology products as rewarding as possible. One way to help us improve your experience is to provide your feedback.

Your feedback will help shape the future of our product documentation and the overall service we provide. We want to see ourselves as our customers see us and are eager to learn how we have been helping you or how we could do better.

To serve you best, please send an email with the following information to

techwriting@ravenind.com

- P/N 016-0171-729-B
- DirecSteer Calibration and Operation Manual
- Any comments or feedback (please include URLs, chapter, or page numbers as applicable).
- Let us know how long have you been using this or other Raven products.

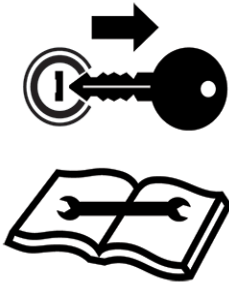
We will not share your email or any information you provide with anyone else. Your feedback is valued and extremely important to us.

We thank you for your time.

Chapter 3:

Machine Calibration

NOTICE



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

A profile wizard starts automatically and must be completed the first time which the steering module is accessed after installation or any time the ECU is reset.

Refer to "Reset Calibrated Gains" on page 93 for additional information about resetting the steering system.

Note: *System Information, Diagnostic Trouble Codes (DTCs), and Machine Test screens may be viewed during the initial calibration process. Refer to the following topics for additional assistance with the settings available during the initial calibration wizard.*



- "SGC System Information" on page 194
- "Diagnostic Trouble Codes (DTCs)" on page 145

- "Wheel Angle and Implement Position Sensor Settings" on page 88

Note: *The Machine Test icon will only be displayed if a steering partner is detected.*

Preparation and Best Practices

- For best performance, the steering system must be calibrated specifically for each machine configuration (e.g. tractor and implement combination).
- Start the calibration process with the machine parked on a level surface with several acres of smooth ground available.
- Ensure that the engine and hydraulic systems are at normal operating temperature and perform all calibration procedures at typical operating RPM.
- It is recommended to calibrate in conditions as close to actual field operations as possible. Before starting the calibration process:
 - Fold and rack booms on self-propelled applicators.
 - Disconnect any implements from the tractor hitch. Best results are obtained by completing the machine calibration without any towed implements.
 - Verify machine measurements are correctly entered into the UT.
- During the auto-steering calibration, the machine will make several hard left and right turns. Adjust the vehicle speed and location as necessary.
 - To pause the calibration at any time, turn the steering wheel or press the **Stop** button on the UT. Tap the foot/resume switch to resume the calibration process.
 - To ensure successful auto-steering calibration, try to minimize the number of pauses.
 - If an error message is displayed during calibration, refer to "Diagnostic Trouble Codes (DTCs)" on page 145 for possible causes and corrective action steps to be taken.

**WARNING**

The machine will steer automatically. Be sure the area around the vehicle is clear of people and obstacles before engaging the auto-steer 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 auto-steering system may learn incorrect steering responses for normal operating conditions.

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

Initial calibration of the RS1™ or SC1™/TC1™ system consists of the following component setup calibrations:

- "Guidance and GNSS Calibration" on page 19
- "Terrain Compensation Calibration" on page 29
- "Auto-Steer Calibration" on page 33
- "Steering Control Calibration" on page 41


Note: *The SC1™/TC1™ system can be used for GPS only or for GPS and auto-steering. The following sections walk through the calibration procedures for both GPS only as well as GPS guidance and auto-steering.*

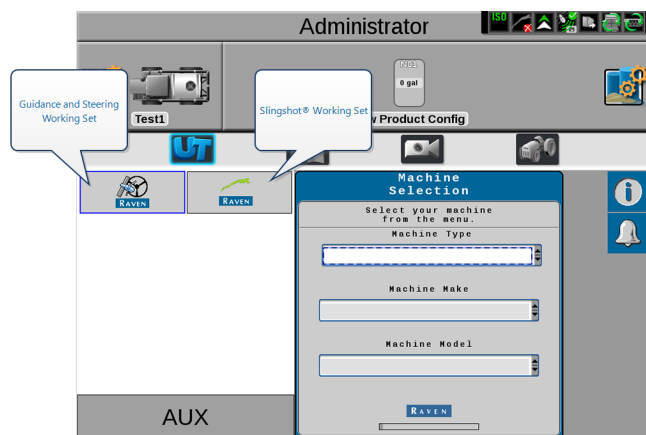
Guidance and GNSS Calibration

Note: The following steps are intended to outline the calibration procedure. Some options shown will be dependent upon settings and options selected.

1. Open the UT menu of the display or field computer.
2. During the initial start-up of system, the operator will be presented with the Operator Liability prompt.

Note: Refer to the "Operator Liability" on page 53 topic for more information.

3. Select the guidance and steering working set icon .

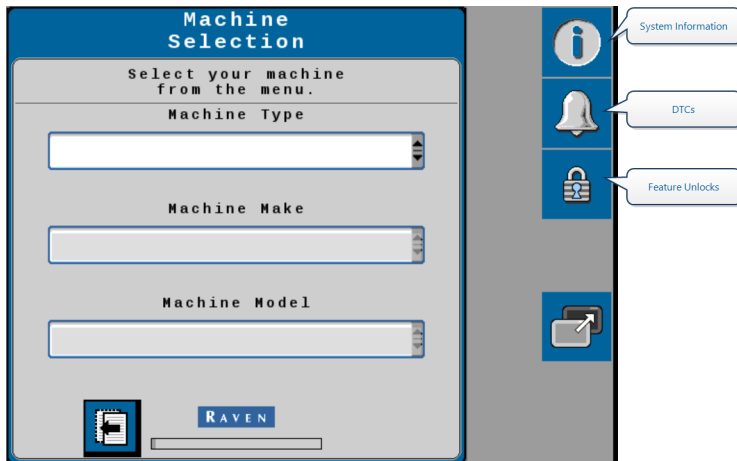


Note: The Slingshot® working set icon only displays with an RS1™.

4. Confirm that the correct ECU will be programmed by selecting the Information icon in the upper, right corner and matching the Hardware Serial Number to the ECU serial number mounted to the machine or implement.

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

5. The Machine Selection page will be displayed.



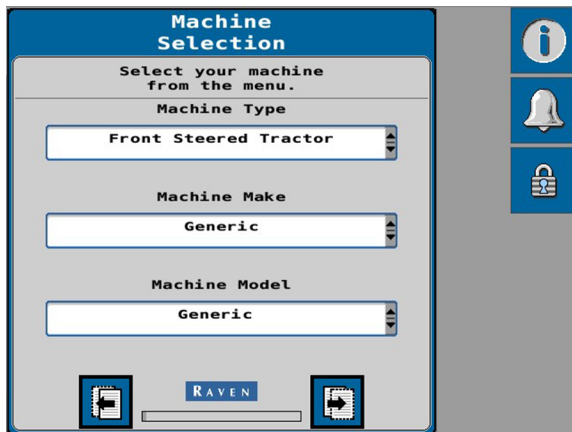
Note: System information, DTCs, and system test pages may be viewed during the initial calibration. For further information on these settings, review the following topics:

- "SGC System Information" on page 194
- "Diagnostic Trouble Codes (DTCs)" on page 145
- "Feature Unlocks" on page 138

Note: The system health test pages provide additional diagnostic capabilities and allow the operator to test function of various machine controls and sensors.

- "Step Response Test" on page 175

- Use the drop-down options to set the **Machine Type**.

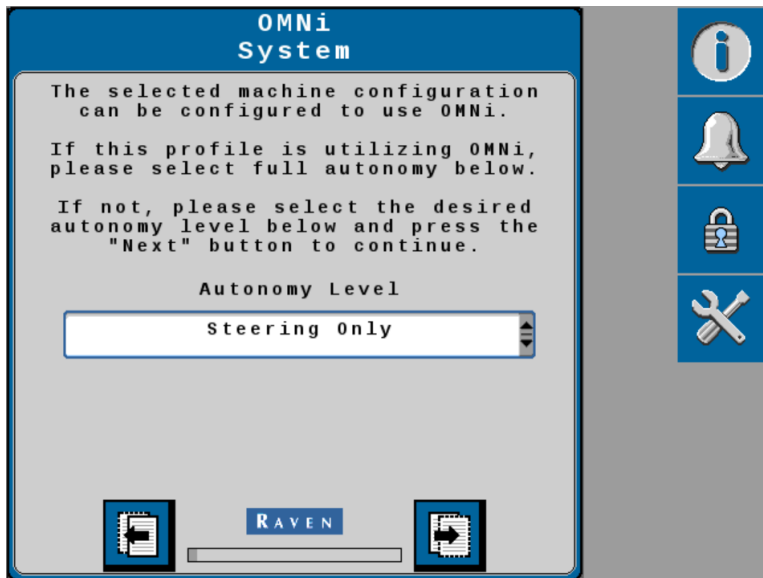


- DirecSteer - Select "Front Steered Tractor" for the Machine Type when steering the machine using a DirecSteer unit. The Make and Model options must be set to "Generic" when auto-steering with the DirecSteer electric drive unit.

Note: CR7™ must be using version 23.2.0.68 for use with DirecSteer. Refer to [Field Computer Updates](#) for assistance with checking and updating the Raven field computer or Universal Terminal.

- Once the Machine options are set, select the **Next** page button to proceed with the initial calibration.

8. On the next page, use the drop-down to select one of the following options for the **Autonomy Level** drop-down.



GPS Only

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

Steering Only

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

9. Select the **Next** page button to proceed.

Note: The following prompt is displayed if the SCU software is not compatible with the SGC.



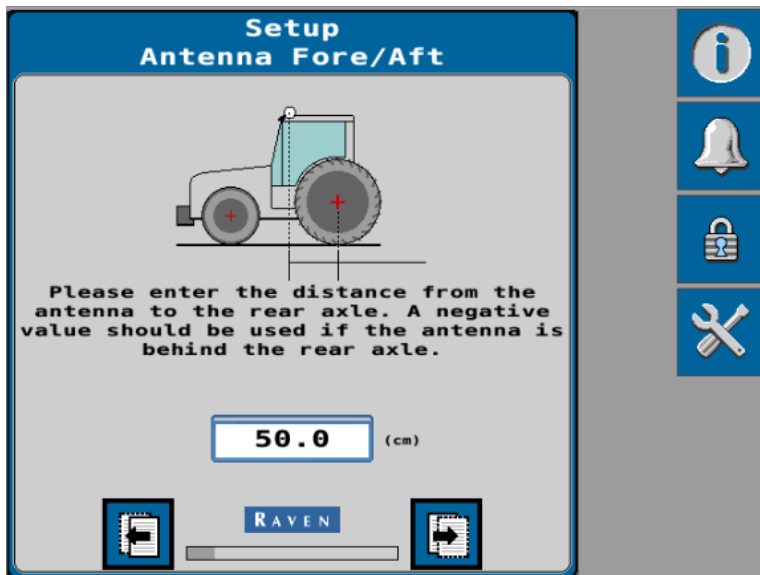
Select the **Install** button to update to the indicated software version. The SCU update must be completed to proceed with the calibration process. Once the update is complete, the system will attempt to detect the steering partner and allow the operator to proceed with the initial calibration process.

10. The system will attempt to detect a steering partner.



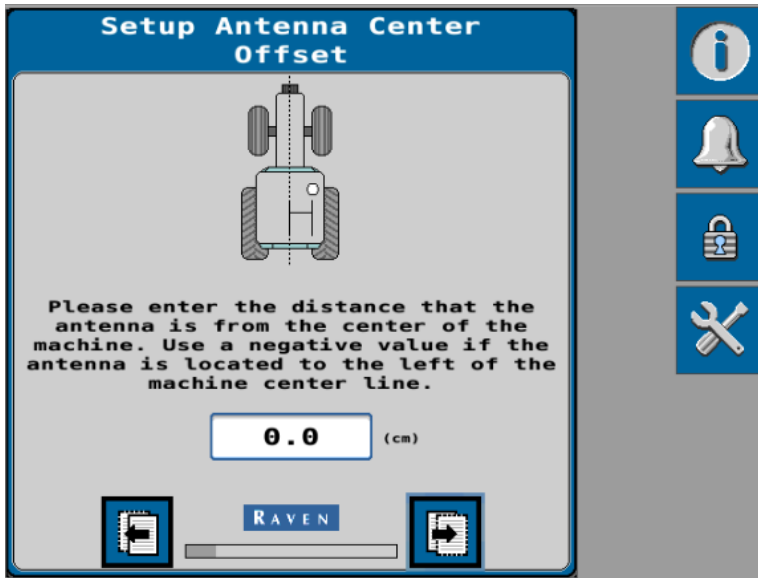
- If no steering partner is detected, or if steering will not be used in the current application, select the **GPS Only Configuration** button. In this configuration, auto-steer features will not be available.
- If a steering partner is detected, select the **Next** button to calibrate both the GNSS and auto-steering features of the system. Recognized steering partners include:
 - DirecSteer

11. Enter the Antenna Fore/Aft measurement in the units displayed on the page.

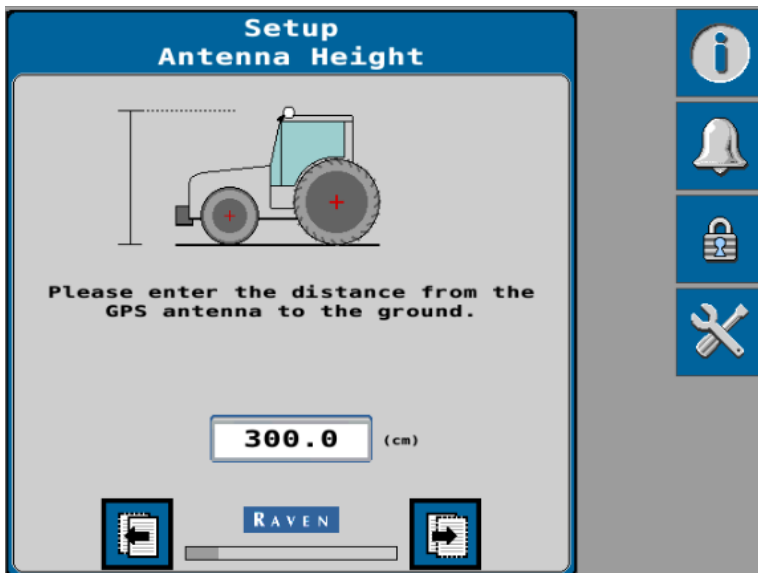


12. Select the **Next** page button.

13. Enter the Antenna Center offset measurement in the units displayed on the page.



14. Select the **Next** page button.
15. Enter the Antenna Height measurement in the units displayed on the page.



16. Select the **Next** page button to proceed.

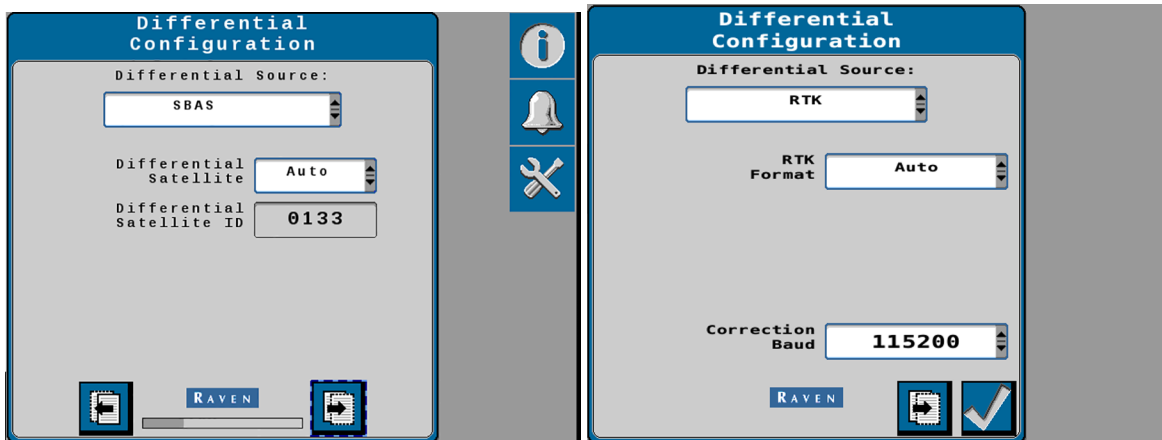
17. Enter the wheel base measurement in the units displayed on the page.



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

18. Select the **Next** page button.

19. Select the appropriate GNSS Differential Source from the drop-down options list. Available options may include:
- GLIDE®
 - SBAS
 - GS-Lite
 - Satellite GS or Satellite GS Pro
 - RTK



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

20. Select the **Next** page button.

21. Review the GPS Status Information page.

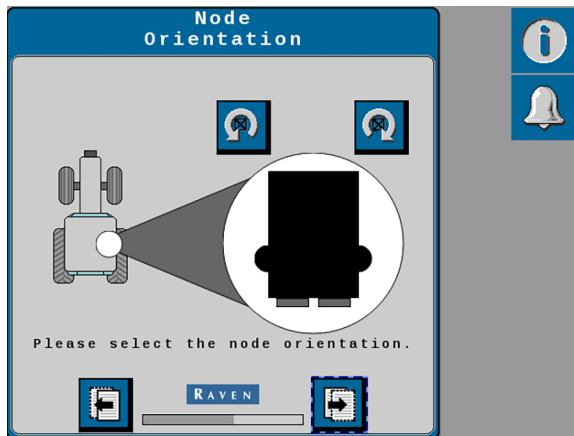


Note: The system must detect a converged GNSS status and display a green shield to successfully complete the terrain compensation calibration procedure.

22. Select the **Next** arrow to proceed to the "Terrain Compensation Calibration" on the facing page procedure.

Terrain Compensation Calibration

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



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

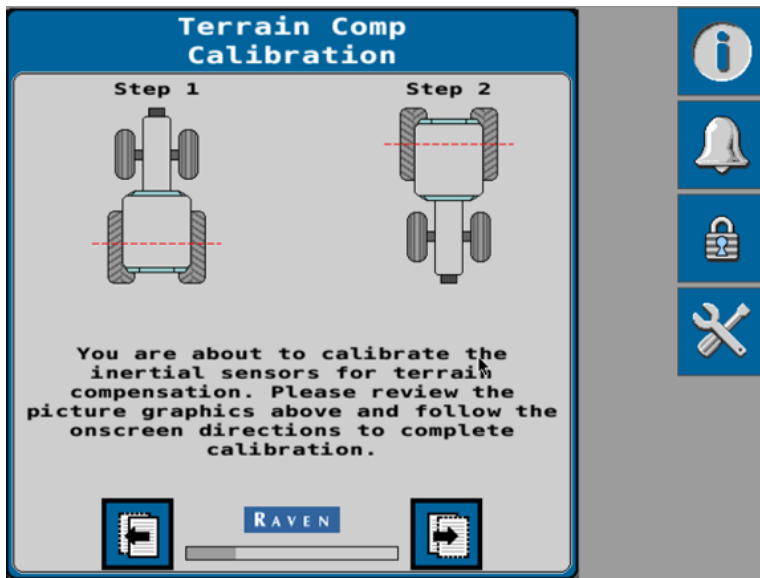
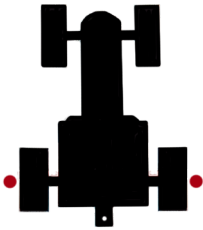
Note: The RS1™ orientation is fixed. This page will not display when calibrating a system with RS1™.

2. Select the **Next** button.
3. Drive the machine forward at least 10 m [33 feet] and park on a flat surface.

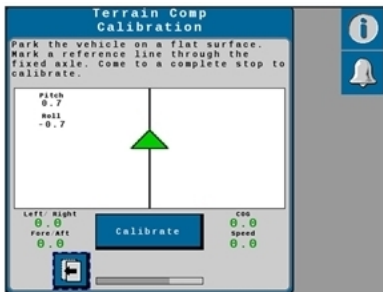


Note: The system must detect a converged GNSS status and the direction of forward travel to properly calibrate the terrain compensation features.

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



5. Select the **Next** button and follow the on-screen instructions to begin the terrain compensation calibration.

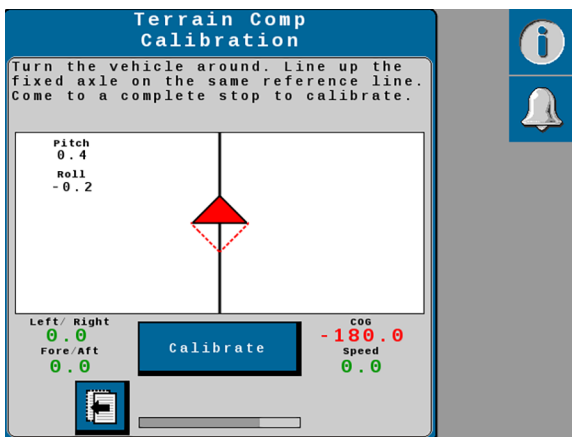
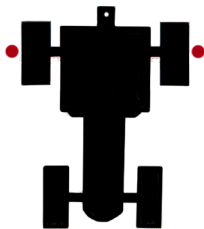


6. Select the **Calibrate** button and wait for the gyro calibration to complete.



Note: Do not move the machine or implement during the calibration. Wait for the calibration process to complete before moving the machine.

7. After the gyro calibration is complete, drive forward and turn the machine around (180°). Park the machine between the markers facing in the opposite direction from the first calibration. 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 machine or implement is in the correct position.

8. Select the **Calibrate** button again and allow the gyro calibration to complete.
9. Select the **Next** arrow.
10. Begin driving forward at approximately 8 km/h [5 mph]. Turn and hold the steering wheel at a constant steer rate and select the **Calibrate** button.



11. Continue driving at a constant speed and while holding the steering wheel at the same steer rate until the compass calibration process is finished.
12. Stop the machine and select the **Next** arrow.
13. Proceed to the "Auto-Steer Calibration" on the facing page procedure.

Auto-Steer Calibration

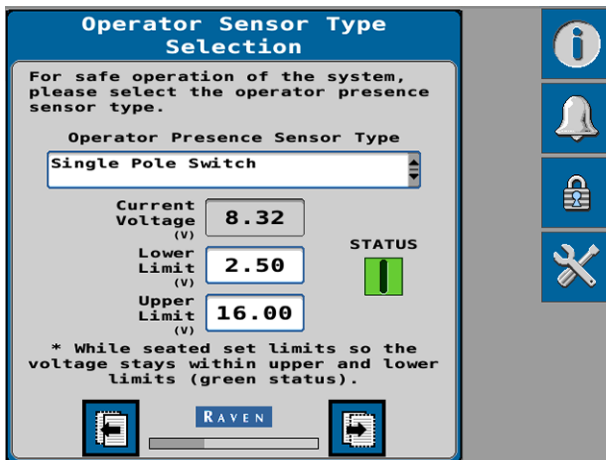
Roadway Homologation Terms

1. If prompted to review and accept roadway homologation terms, review the on-screen text and toggle the check-box option.






Note: Some machine tunesets and operational regions may require that the operator accept the roadway homologation terms. Refer to "Certification and Compliance" on page 203 for additional details and certification information.

2. Select the **Next** page button to proceed.
3. When the homologation terms check box is enabled on the previous page, the Operator Sensor Type Selection page is displayed.



4. Use the Sensor Type drop-down to select the type of operator presence sensor connected to the auto-steer system.

5. The Status icon displays the current state of the sensor.

-  Presence sensor is disconnected. Connect the sensor to the system before proceeding.
-  Presence sensor does not detect an operator.
-  Presence sensor detects that the operator is present.

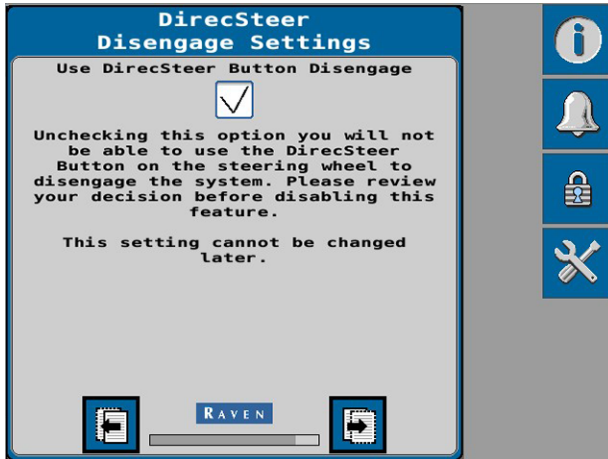
Resume/Disengage Calibration

1. Test the resume button or foot switch.



- a. Press and release the resume or foot switch. The switch status icon on the page will change if the switch input is detected and the calibration will automatically proceed to the next page.
 - b. If a foot switch is not available, or if the on-screen widget will be used, select the **Use On-Screen Engage** button. The calibration will automatically advance to the next page.
2. Select the **Next** page button to proceed.

3. Select the **Use DirecSteer Button Disengage** option to allow the operator to disable the auto-steer using the physical button on DirecSteer.



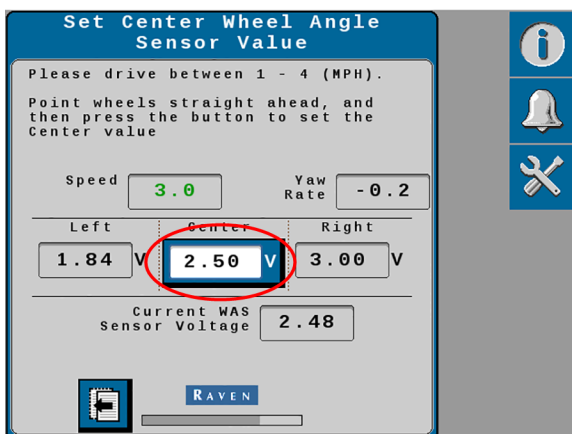
Note: This option cannot be enabled after the calibration wizard is complete. To enable this feature, restart the initial calibration wizard.

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

Calibrate the Wheel Angle Sensor (WAS)

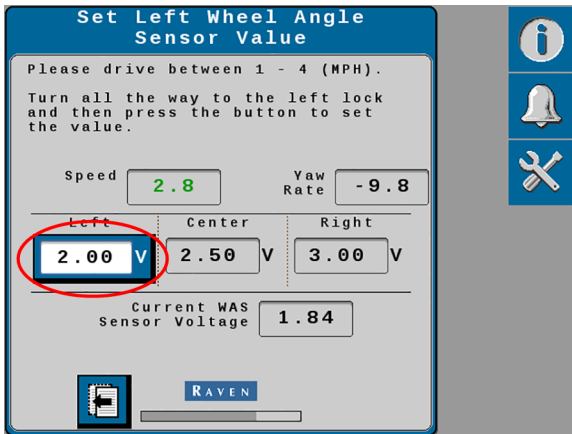
Note: The machine must remain moving during the WAS calibration.

1. Begin driving forward at a speed between 1.6 and 6.4 km/h [1 and 4 mph].
2. Turn the steering wheel to the center and drive straight forward.
3. Select the **Center** voltage button to set the center WAS value.



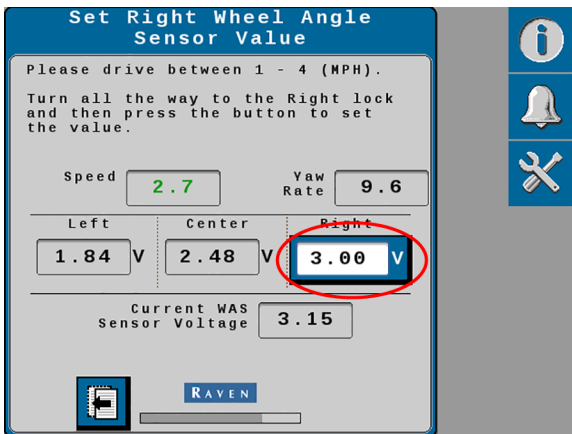
Note: Do not turn the steering wheel until the WAS page advances to the Left WAS setting.

4. Turn the steering wheel all the way to the left steering lock.
5. Select the **Left** voltage button to set the left WAS value.



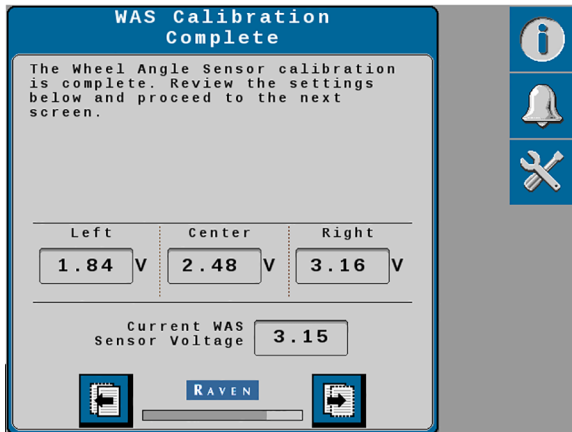
Note: Do not turn the steering wheel until the WAS page advances to the Right WAS setting.

6. Turn the steering wheel all the way to the right steering lock.
7. Select the **Right** voltage button to set the right sensor value.



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

- Review the calibration values shown on the Sensor Calibration Complete page.




While driving, turn the steering wheel and use the Current WAS Sensor Voltage value to confirm left and right steering lock and center positions.

- Select the **Next** page button.

10. Continue driving forward at a speed between 1.6 - 6.4 km/h [1 and 4 mph].

⚠ WARNING



Steering wheel will not disengage for resistance. Do not grasp or try to impede the steering wheel during the disengage switch calibration.



11. Select the **Start/Play** button to begin the disengage switch calibration process. The steering wheel will:
- i. move to the left steering lock.
 - ii. move to the right steering lock.
 - iii. return to the left steering lock.
 - iv. return to the center position.

Note: A value between 2000 and 2500 is expected for the Disengaged Threshold value.

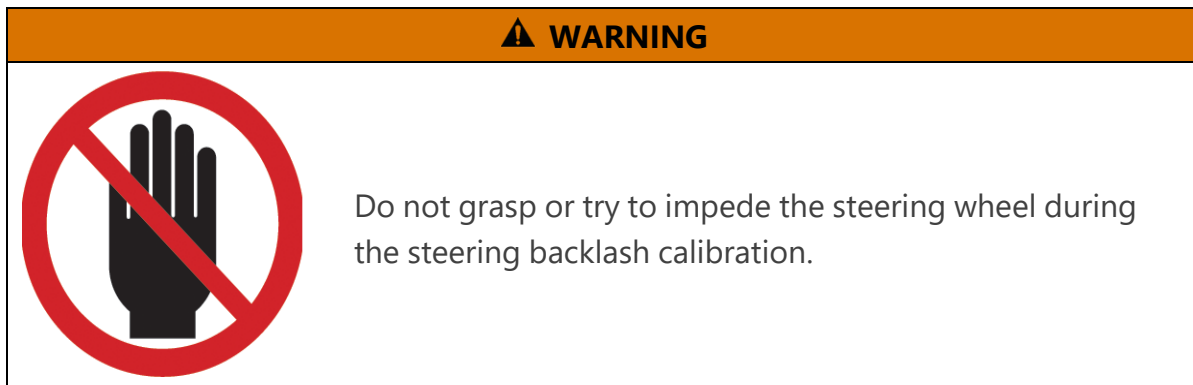
12. Select the **Next** button to proceed with the calibration.

13. Select the **Start/Play** button.



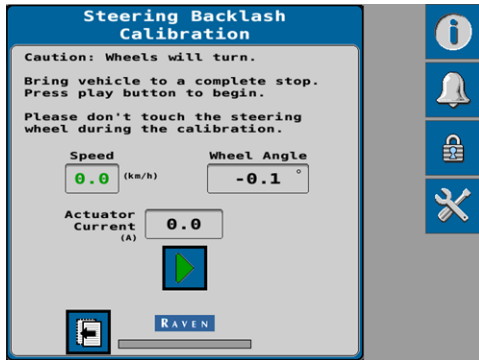
Note: Select the **Back** arrow to return to the previous page to manually adjust the Disengage Threshold value if necessary.

14. Turn the steering wheel to check the calibrated value. The status icon will change if the input is detected and the calibration will automatically proceed to the next page.
15. Select the **Next** page button.
16. Bring the vehicle to a complete stop.



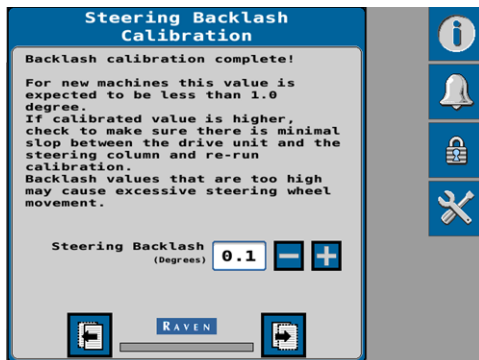
Note: The backlash calibration will not start if the machine is moving.

17. Select the **Start/Play** button on the Steering Backlash Calibration page to begin the backlash calibration.



DirecSteer will begin turning the steering wheel until the system detects the minimum effort required to move the steering wheel.

18. The calibrated backlash value will display on the page when the calibration is complete.



Note: It is not recommended to adjust this value during the initial calibration process. The backlash value may be adjusted via the Settings menu later. Refer to "Advanced Tuning" on page 75 for additional assistance.

19. Select the **Next** page button to proceed to the "Steering Control Calibration" on the facing page.

Steering Control Calibration

The steering control calibration process allows the auto-steering system to learn the hydraulic or mechanical capabilities of the machine for optimal steering performance in the field.

Note: *When operating with a generic tuneset, the steering control calibration must be performed to tune the auto-steer system to the machine. The Quick Calibration option is not available when the machine make and model selections were set to the "Generic" option at the beginning of the calibration wizard.*

Auto-Steer Calibration

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

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

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



WARNING



The machine will steer automatically. Be sure the area around the vehicle is clear of people and obstacles before engaging the auto-steer system.

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

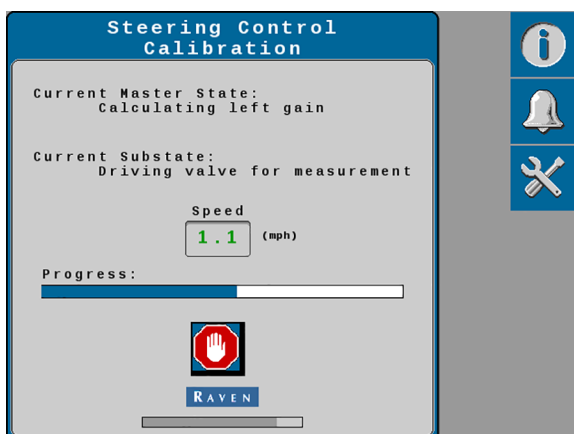

WARNING


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

1. Begin driving forward at a speed between 1.6 and 6.4 km/h [1 and 4 mph].
2. Press the resume switch or use the on-screen arrow to begin calibration.



3. The following information is displayed during the calibration process:

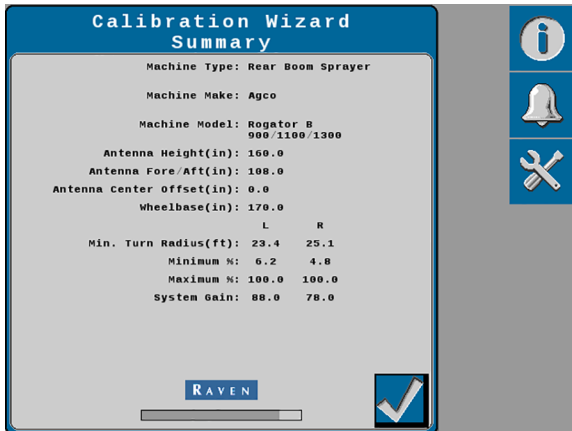


4. Allow the auto-steer calibration to complete. Once complete, select the **Next** page button to proceed.

5. Review the steering effort information shown on the page. Select the **Next** page button to proceed.



6. Review the information presented on the Calibration Wizard Summary page.



7. Select the **Accept** button to confirm the calibration and proceed to the Home page.

Chapter 4:

External Device Settings

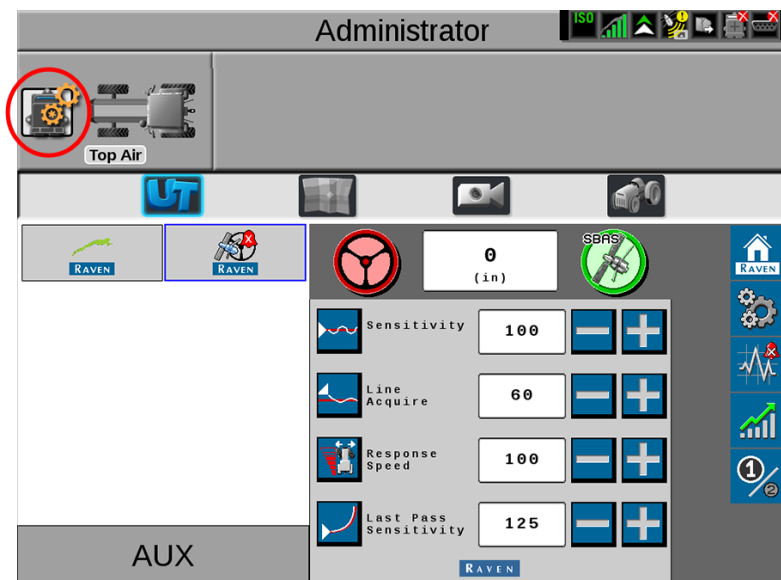
The following sections offer information on setting up external devices or displays to utilize GNSS messages from the auto-steer system.

Viper® 4 and Viper® 4+

To configure Viper® 4 or Viper® 4+ to use GNSS messages from the auto-steer system:

Note: If RS1™ is replacing a steering system, the old steering ECU must be unplugged and a Serial Redetection performed before continuing. Refer to the [Serial Device Detection](#) topic for assistance.

1. From the ROS home screen, select the **Edit Machine** icon.



- Next, select the **GPS Menu** button.



- On the GPS Global Settings page, select the **NMEA2000** option.



Note: The ROS device will automatically select NMEA 2000. If there are multiple devices outputting NMEA messages, be sure to select the correct device to ensure proper operation of the auto-steer system.

External GNSS Settings

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

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

If a different receiver is being used, configure the receiver output a baud rate of 115200 and the following message types and frequencies before performing calibration.

Message Types and Frequencies

- GGA at 10 Hz
- VTG at 0.1 Hz
- GSV at 0.1 Hz
- ZDA at 0.1 Hz
- GSA at 0.1 Hz
- GST at 1.0 Hz
- GRS at 0.1 Hz

Note: Refer to "Configure the TrimbleAG-372 with AgRemote" below for assistance with these settings when using a Trimble receiver.

Configure the TrimbleAG-372 with AgRemote

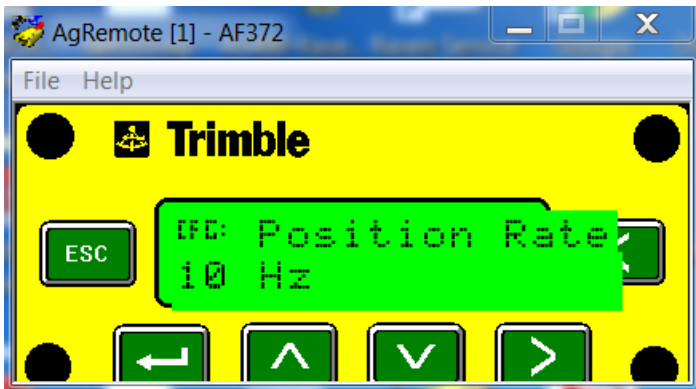
This procedure is only necessary when using a Trimble AG-372 receiver with the Raven auto-steering system.

Note: Connect AgRemote to Port B on the AG-372 receiver.

GNSS Configuration

1. Press the **Right** button until "Configuration" displays on the screen.
2. Press the **Down** button to select "Configuration."
3. Press the **Right** button until "GPS Config" displays.
4. Press the **Down** button until "Position Rate" displays.

5. Press the **Right** button to set the "Position Rate" to 10 Hz.



6. Press the **Enter** button to save the settings.

Radio Mode Configuration

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

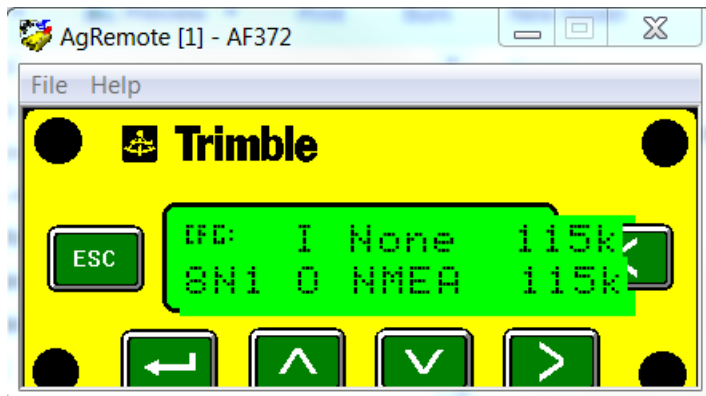


7. Press the **Enter** button to save the settings.

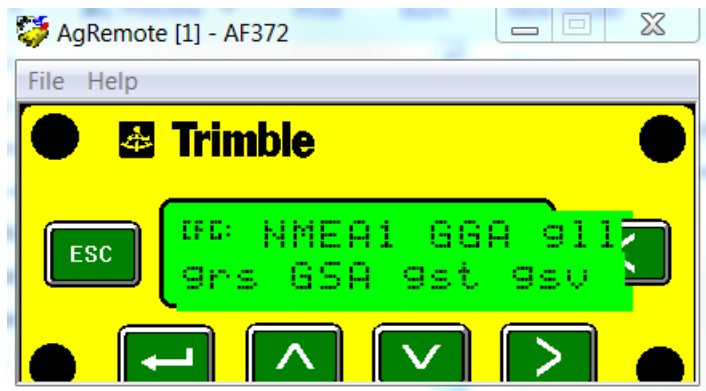
Port A Configuration

1. Press the **Right** button until "Configuration" displays on the screen.
2. Press the **Down** button to select "Configuration."

3. Press the **Right** button until "Port A Config" displays.
4. Press the **Down** button to select "Port A Config."
5. Verify the Input (I) messages are set to None and the baud rate is set to 115k.
6. Verify the Output (O) messages are set to 8N1 and that the NEMA and baud rates are set to 115k.

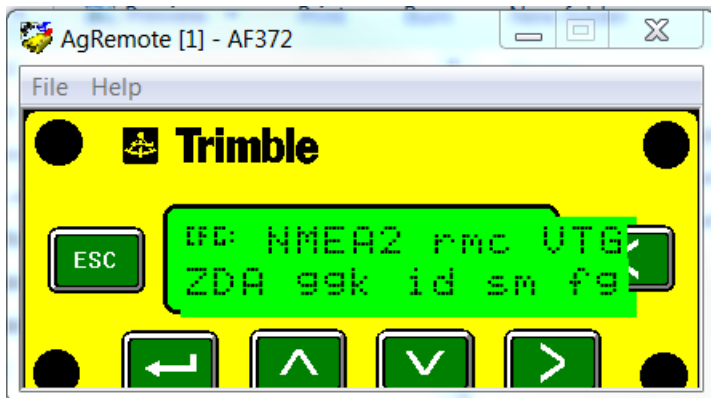


7. Press the **Enter** button to save the settings.
8. Press the **Down** button until "NEMA1" displays.
9. Verify GGA and GSA are capitalized so they are on.

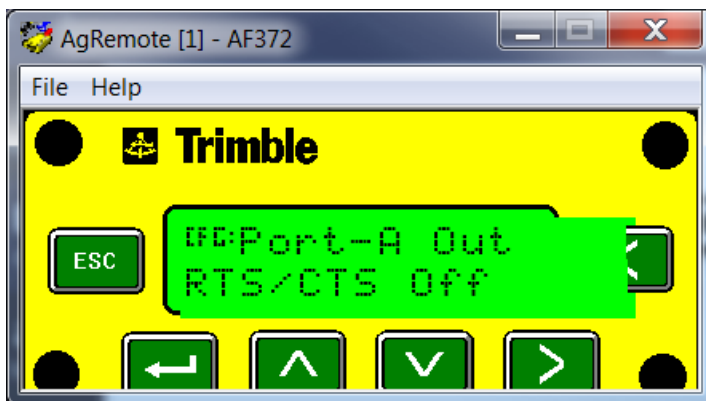


10. Press the **Enter** button to save the settings.
11. Press the **Down** button until "NEMA2" displays.

12. Verify that VTG and ZDA are capitalized so they are turned on.

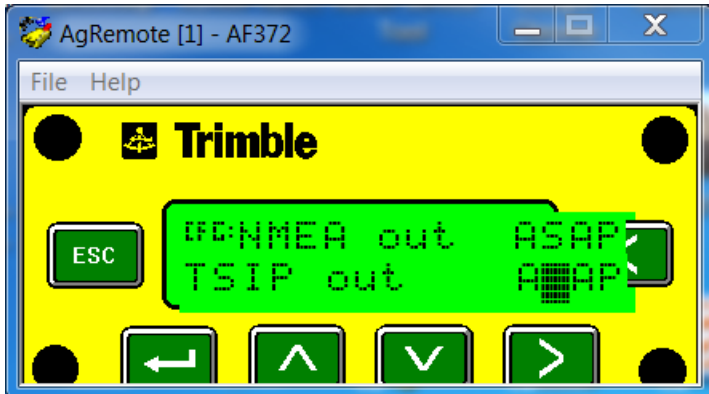


13. Press the **Down** button to continue configuring Port A.
14. Press the **Down** button until "CFG: Port A Out RTS_CTS" displays.
15. Verify "CFG: Port A Out RTS_CTS" is off.

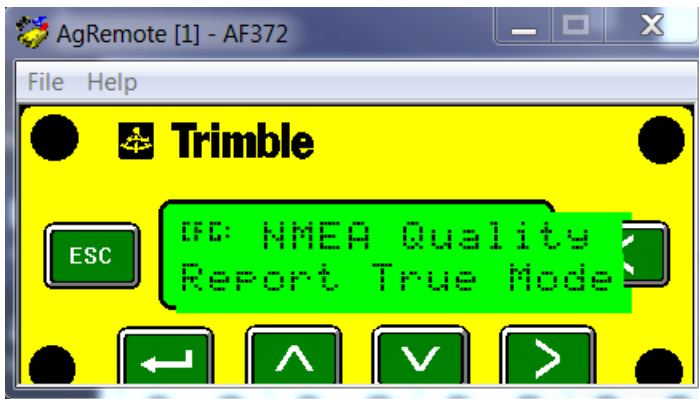


16. Press the **Enter** button to save the settings.
17. Press the **Down** button to continue configuring Port A.
18. Press the **Enter** button to save the settings.
19. Press the **Down** button until "NMEA" out displays.

20. Verify that "NEMA" out and TSIP out are set to ASAP.



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

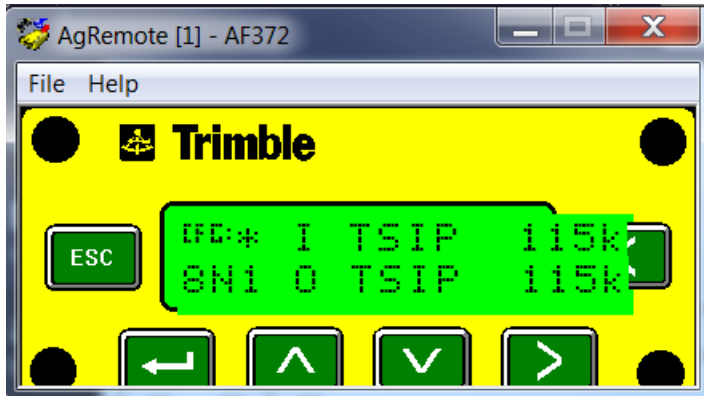


24. Press the **Enter** button to save the settings.

Port B Configuration

1. Press the **Right** button until "Configuration" displays.
2. Press the **Down** button to select "Configuration".
3. Press the **Right** button until "Port B Config" displays.
4. Press the **Down** button to select Port B Config.
5. Verify the Input (I) messages are set to TSIP and the baud rate is set to 115K.

6. Verify the Output (O) messages are set to 8N1 and the TSIP and baud rate are set to 115K.



7. Press the **Enter** button to save the settings.

Chapter 5:

Operation

Starting Jobs

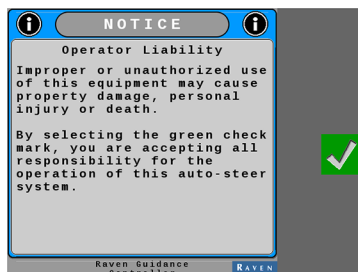
The ISO UT must be calibrated specifically for the machine and implement before being used to operate the steering system (RS1™, SC1™, or TC1™). Refer to the UT display or Raven field computer operation manual for assistance with setting up and starting a job, setting guidance lines, and other guidance 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 implement before starting a job. Review the Raven field computer operation at

<https://ravenindustries.mcoutput.com/fieldcomp/Default.htm>.

Operator Liability

The Operator Liability Warning is displayed each time the RS1™ or SC1™/TC1™ system is powered on. If the operator does not accept liability, the steering system will be disabled and cannot be reengaged until the liability warning is accepted.

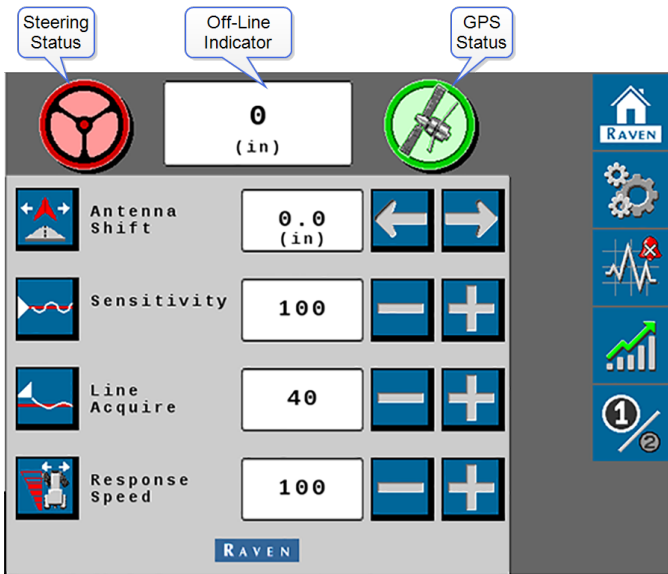


To proceed with normal operation of the GNSS and auto-steering features, read and accept the Operator Liability Warning.

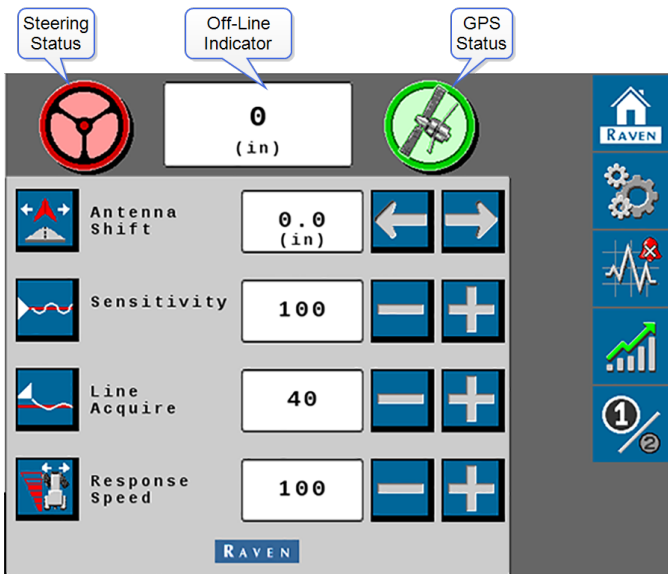
Steering Status

Machine Steering

The color of the steering wheel icon in the upper left-hand corner indicates the status of the steering system.



Steering Status Indicators



The color of the steering wheel icon in the upper left-hand corner indicates the status of the steering system:

Note: Tap the steering wheel icon to display additional details about the auto-steer system and functionality. Refer to the Steering Status page for additional information.

Critical DTCs

Active diagnostic and troubleshooting codes are present. The steering system cannot be engaged in this state.

Active DTCs

Active diagnostic and troubleshooting codes are present. The steering system can be engaged in this state, but performance quality may be degraded.

No DTCs

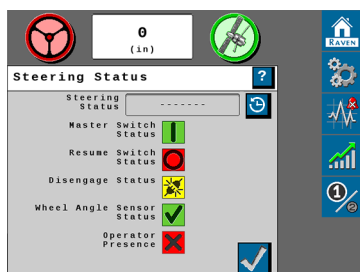
No active diagnostic or troubleshooting codes are present. The steering system is ready to be engaged. Both the steering wheel icon and the GPS icon must be green in order to engage the steering system.


No DTCs - Steering Engaged

Steering is engaged, with no active diagnostic or troubleshooting codes present in the steering system.

Steering Status Page

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



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

Steering Status History		
Time occurred for each status code is in UTC time.		
Steering Status Code	Date/Time	Count
Disengage Switch Off	12/03 12:23	11
No SCU Detected	6/18 12:01	11
Loss of SCU Comm	6/18 6:10	18

Info

RAVEN

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

i NOTICE i

Disengage Switch Off

The disengage switch is currently off. If this persists, contact your dealer for further assistance.

Master Switch

The master switch is set to "road mode". The steering system cannot be enabled until the master switch is toggled to "field mode".

The master switch is set to "field mode" and the steering system can be enabled.



Resume Switch

The status of the enable switch used to engage the steering system.



The resume switch is set in the OFF position.

The resume switch is set in the ON position.

Disengage Sensor

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



The steering disengage sensor is active. The steering system cannot be enabled.



The steering disengage sensor is out of range or disconnected.



The steering disengage sensor is inactive. The steering system can be enabled.

Wheel Angle Sensor

Displays the status of the position sensor.



The wheel angle sensor (WAS) is out of range or disconnected.



Wheel angle sensor (WAS) is not calibrated.



The wheel angle sensor (WAS) is calibrated and ready to operate.

Operator Presence Switch

Displays the status or presence of the operator presence switch.



The presence switch is not available or not used with the selected machine profile.



The operator is not present in the seat.



The operator presence switch is disconnected.



The operator presence switch detects the operator. The steering system can be operated.

Engage Steering

The steering system can be engaged using the following methods:

- Tap the foot switch or rocker switch to engage steering during field operations.
- Press the on-screen steering status widget to engage steering during field operations.



Note: Refer to the "Widget Definitions" on page 62 topic for status or mode information which may be displayed in the steering system while in a job.

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

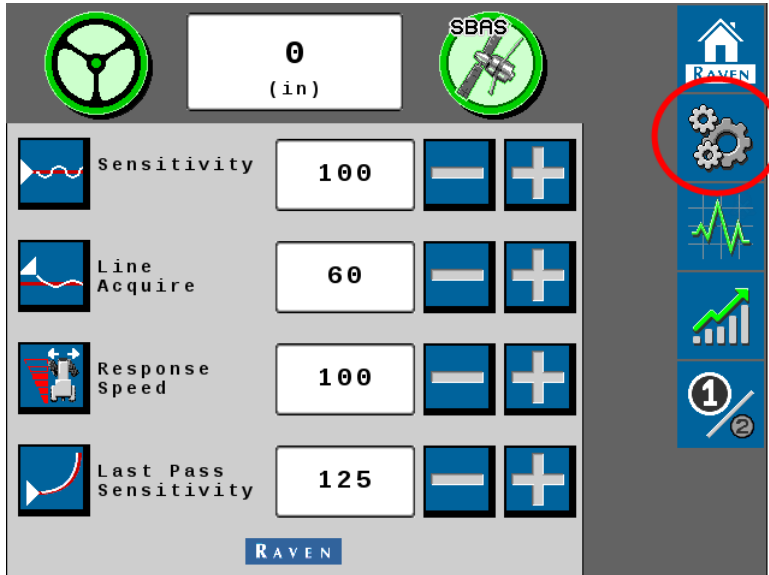
Feature Unlocks Tab


The steering system offers additional capabilities for optional features and services which are not enabled from the factory. These features require an unlock code to enable or activate these features or services. Contact a local Raven dealer for additional information on available unlock codes.

Note: Some pages and options may differ based upon how the machine or implement is configured.

To review or enter unlock codes for optional features:

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Feature Unlocks**  tab.
3. Select the Padlock icon to the right of the desired feature to unlock.

Unlock Status

Red

Feature is locked. An unlock code is required to allow the feature to operate on the system.

Note: A subscription may also be required for some types of features or services.

Yellow

Feature is unlocked but requires a subscription to activate and use the feature during in-field operations.

Green

Feature is unlocked and an active subscription, if required, is detected.

4. Confirm the unlock information and enter the code received from a local Raven dealer.

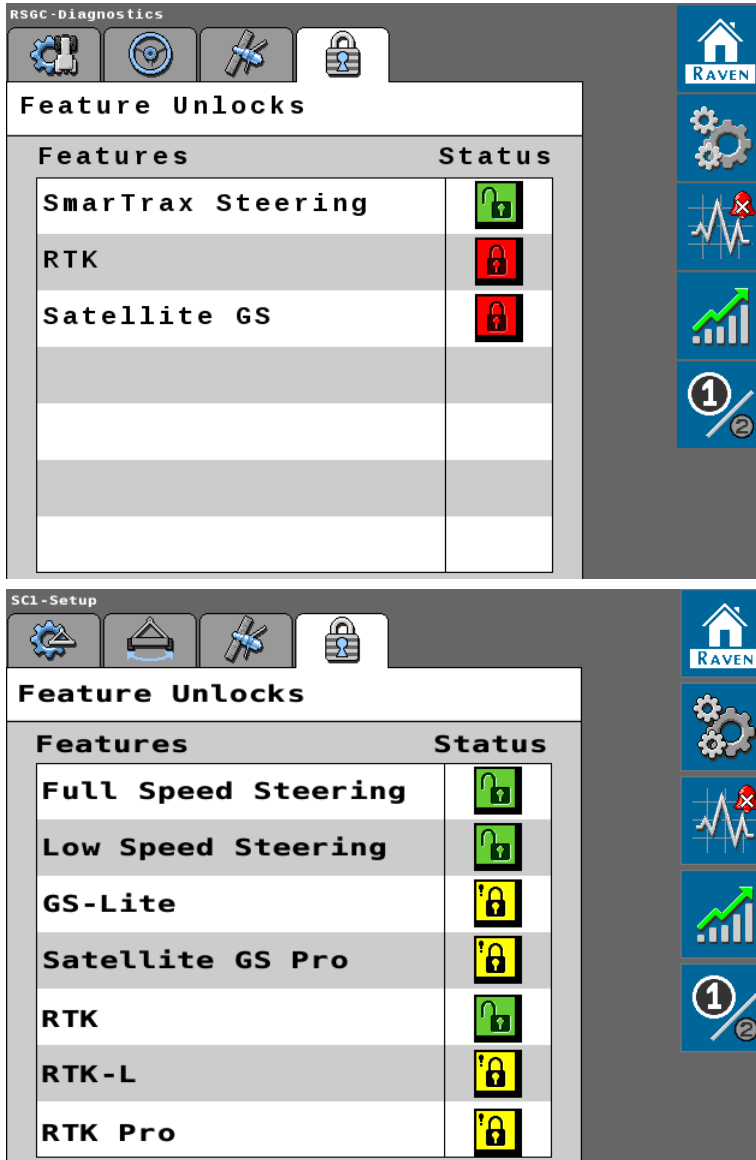
5. Select either the **Send** or **Accept** button depending upon the system.

The screenshot shows a software interface titled "Unlock Information". Under the heading "Unlock Name", the text "SmarTrax Steering" is displayed in a text box. Below this, three alphanumeric codes are shown in separate boxes: "26963", "0001", and "40A7930132FA", separated by hyphens. A "Send" button is located below the first code. To the right of the codes, the text "Code is Valid." is displayed in green. At the bottom of the screen, there is a "RAVEN" logo and a blue checkmark icon.

The screenshot shows a software interface titled "Unlock Information". Under the heading "Unlock Name", the text "RTK" is displayed in a text box. Below this, several alphanumeric codes are shown in separate boxes, separated by commas: "JH5KM6", "3D2F2F", "6Z3F97", "G8BB86", "JD98CM", and "FDNRNNTBN". There is an empty text box below the codes. At the bottom of the screen, there is a "RAVEN" logo and a blue checkmark icon.

A message is displayed indicating whether or not the unlock code that was entered is valid.

6. Select the **Check** button. If the code is valid, the status icon on the Feature Unlocks tab will update and indicate that the feature is unlocked. The image displayed may be different based on the system installed.



Note: Review the [GNSS Correction Options](#) for additional information on available correction types for your Raven GNSS equipment. Contact a local Raven dealer for additional assistance.

Widget Definitions

The following are common status or mode information which may be displayed in the RS1™ or SC1™/TC1™ system while in a job:

Not Engaged - Liability Not Accepted

 - ROS Steering System

 - CRX Steering System

 - CRX Implement Steering System

The steering system node is detected, but the operator must accept the operator liability waiver before the system can be enabled.

Not Engaged - No Guidance Path or Active DTC

 - ROS Steering System

 - CRX Steering System

 - CRX Implement Steering System

No A-B path or guidance line has been set or an active DTC is preventing the steering system from engaging.

Detected Turned On and Calibrated

 - ROS Steering System

 - CRX Steering System

 - CRX Implement Steering System

Steering system is detected, turned on, and calibrated.

Detected and In Operation

 - ROS Steering System

 - CRX Steering System

 - CRX Implement Steering System

Steering system is detected and in operation.

Detected - Non-Critical Active DTC

 - ROS Steering System

 - CRX Steering System

 - CRX Implement Steering System

Steering system is detected and in operation. A non-critical DTC is present.

Detected and Calibrated - Non-Critical Active DTC

 - CRX Steering System

 - CRX Implement Steering System

Steering system is detected, turned on and calibrated. A non-critical DTC is present.

Note: Refer to "Diagnostic Trouble Codes (DTCs)" on page 145 section for additional status conditions which may be displayed in the on-screen widget.

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

Note: Refer to the "Engage Steering" on page 58 procedure for more information on how to engage the steering system.

Chapter 6:

System Settings

The following sections provide a brief orientation and description of the settings found in the guidance and steering UT.

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

Machine Settings Tab

The Machine Settings tab provides access to machine tuneset profile settings and options and antenna offset values. Additionally, options for implement steering will be available when the ECU is configured for implement steering applications. To access the Machine Settings tab:

Steering Setup Tab

The Steering Setup tab displays the current steering partner detected for auto-steering operations. This tab also provides access to the settings which allow the operator to fine-tune the auto-steering system. To access the Steering Setup tab:

Note: *The Steering Setup tab is not available if the 'GNSS Only Calibration' option was selected during the tuneset calibration wizard.*

GPS (GNSS) Setup Tab

The GPS Setup tab provides access to GNSS options and features such as differential correction types and terrain compensation for auto-steering operation. To access the GPS Setup tab:

Feature Unlocks Tab

The Raven auto-steering system may offer optional features which are not enabled from the factory. These features require an unlock code to enable or activate these features or services. To review or enter unlock codes for optional features:

Note: *Contact a local Raven dealer for additional information on available unlock codes.*

UT Navigation

The following buttons are common navigational buttons when navigating the UT.

Accept



Saves the changes made to the system at the end of the setup process and returns to the Tools Menu.

Next



Saves the changes made to the system and proceeds to the next step in the setup process.

Previous

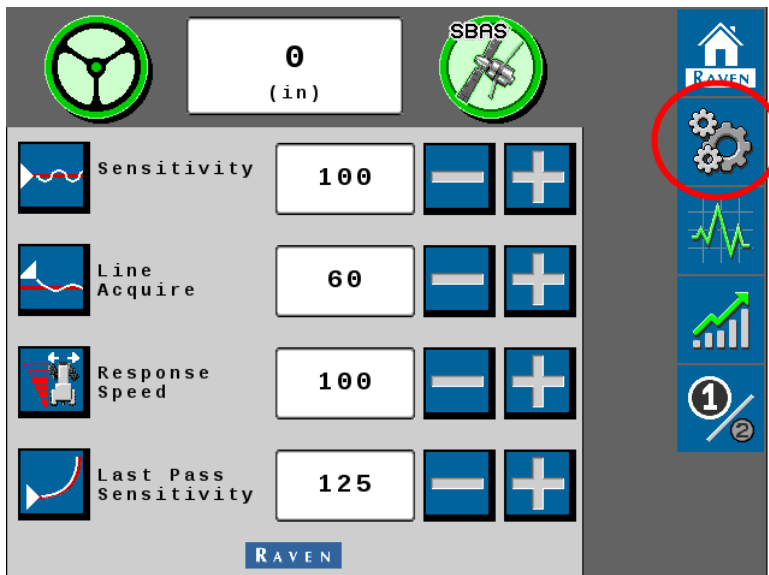


Returns to the previous screen in the setup process.

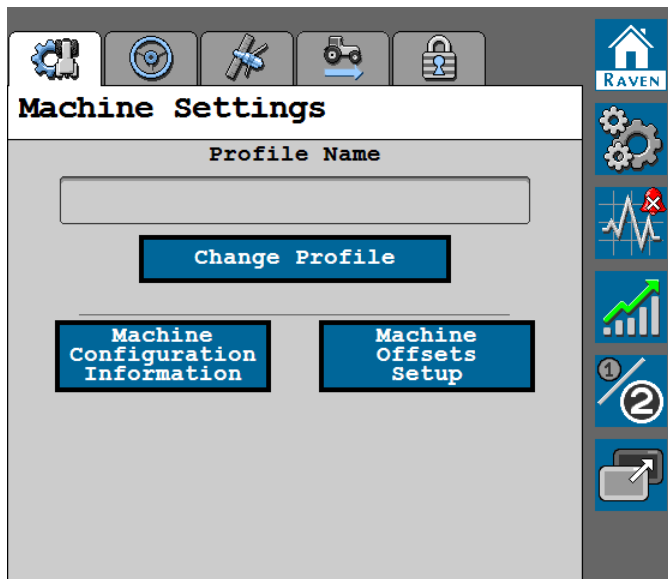
Machine Settings Tab

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.




2. Select the **Machine Settings**  tab.

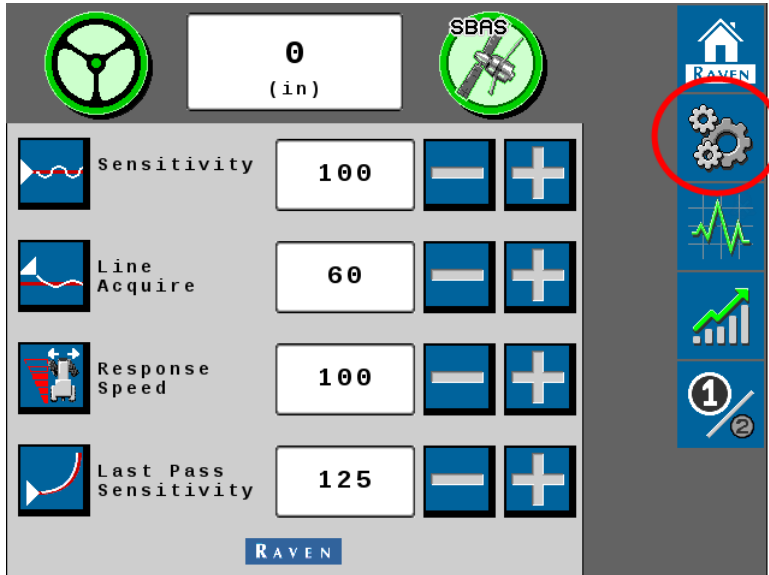


The Machine Settings page displays the machine-specific measurements which were entered during the initial system calibration and provides access to machine tuneset and configurations.

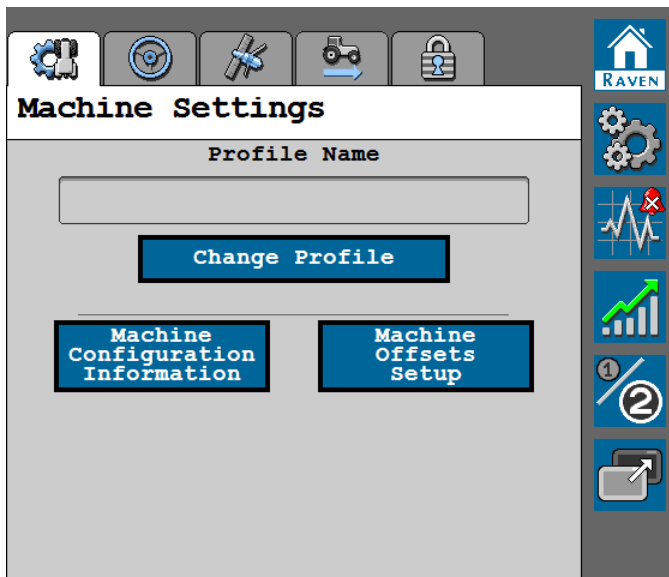
Change the Machine Profile

Note: Some pages and options may differ based upon how the machine or implement is configured.

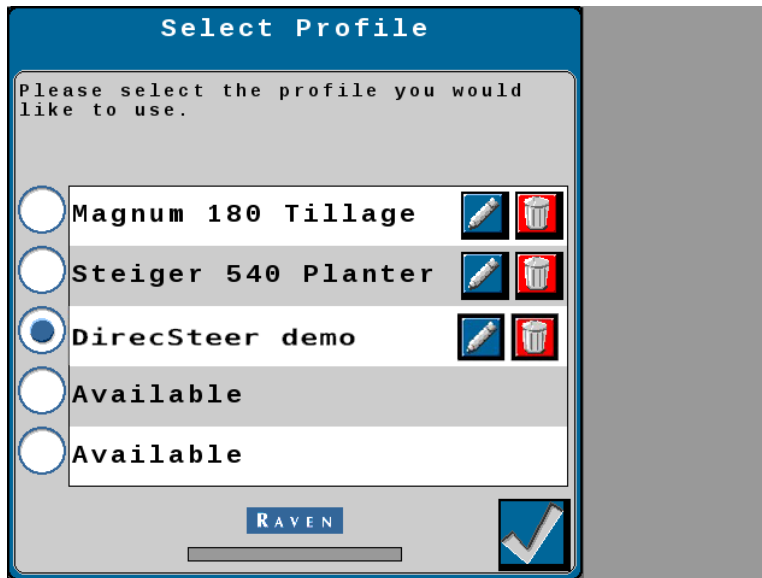
1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Machine Settings**  tab.



3. Select the **Change Profile** button.



The Select Profile page allows the operator to perform the following changes to the tuneset profiles:

To calibrate a tuneset profile

- a. Select a profile labeled Available.
- b. Select the **Accept** button in the lower, right corner of the page.

The tuneset calibration wizard will begin. Review the Initial Tuneset Calibration processes and follow the on-screen instructions to complete the tuneset calibration.

To select a different tuneset profile

- a. Touch the radio option for the desired tuneset configuration.

Note: Selecting a tuneset labeled "Available" will require the operator to complete the Initial Tuneset Configuration.
- b. Select the **Accept** button in the lower, right corner of the page to load the tuneset and return to the Machine Settings tab.

To rename a tuneset profile

- a. Select the **Edit** button.
- b. Use the UT keyboard to enter the desired tuneset name.

- c. Select the **Accept** button in the lower, right corner of the page to load the selected tuneset and return to the Machine Settings tab.

To delete a tuneset profile

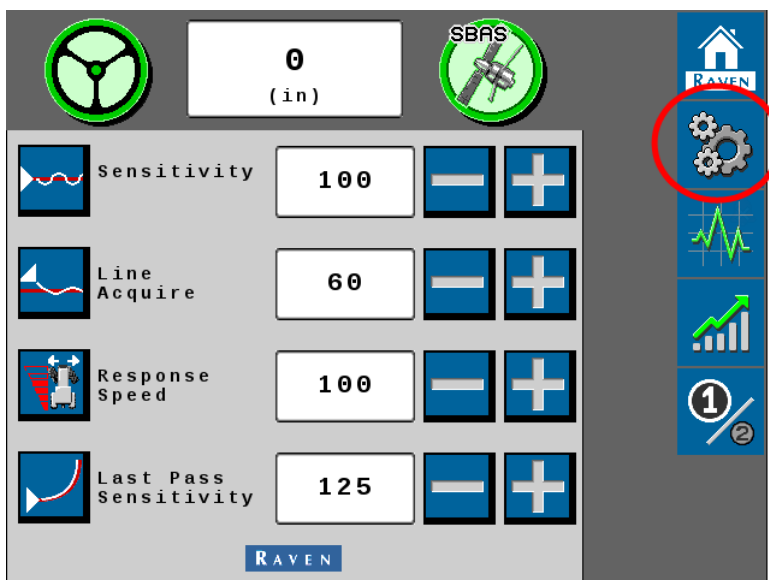
- a. Select the **Delete** button and confirm that the profile should be removed.
- b. To resume normal operation, either select an existing tuneset or select an "Available" tuneset and complete the tuneset calibration wizard.

Review the Machine Configuration

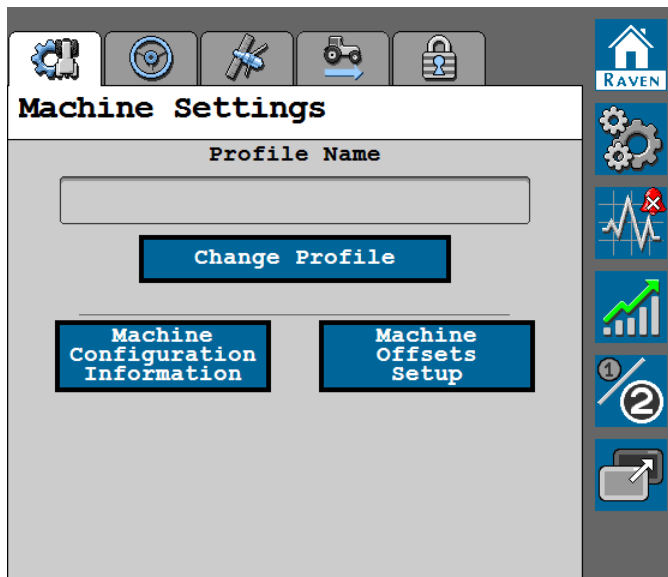
The Machine Configuration Information page provides a very brief overview of the tuneset profile shown in the Profile Name field at the top of Machine Settings tab.

Note: Some pages and options may differ based upon how the machine or implement is configured.

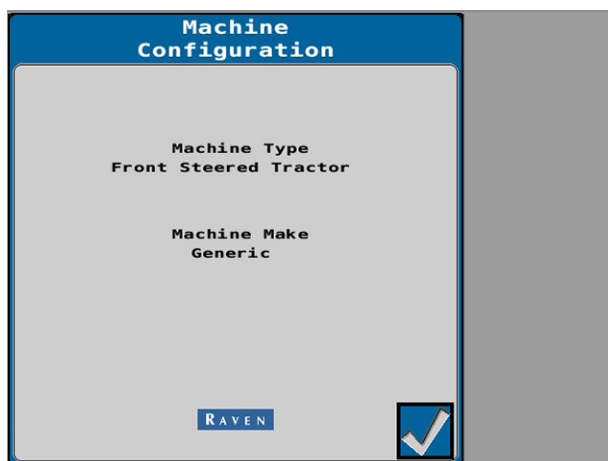
- 1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Machine Settings**  tab.



3. Select the **Machine Configuration Information** button.



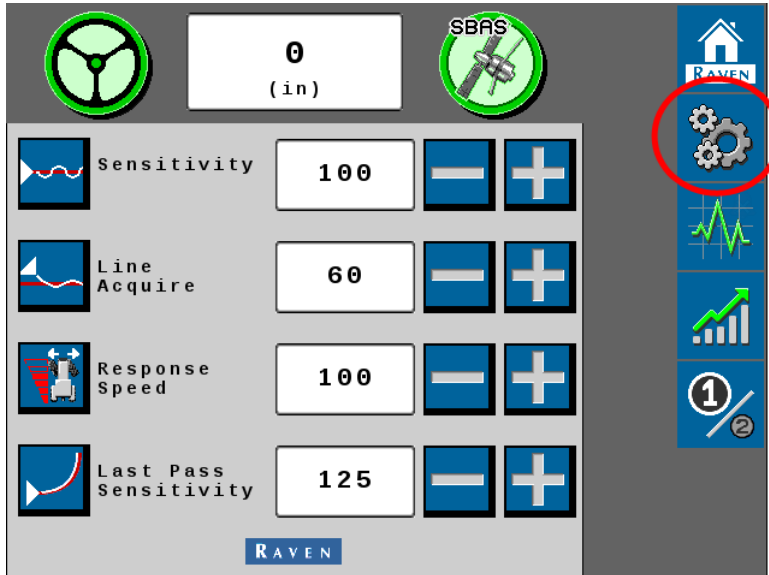
This page displays the current machine type, make, and model information which was entered during the tuneset calibration process. Review "Change the Machine Profile" on page 67 for assistance with editing or changing the tuneset profile.

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

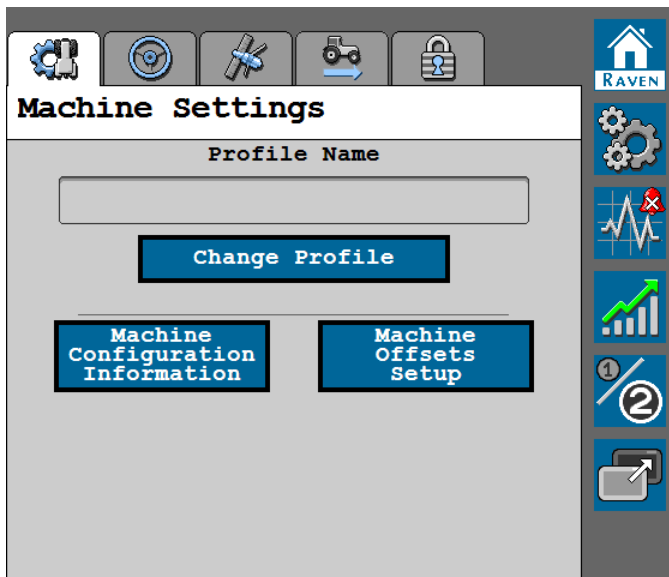
Machine Offset Setup

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.




2. Select the **Machine Settings**  tab.



3. Select the **Machine Offsets Setup** button.

Machine Offsets	
Antenna Height (in)	176.0
Antenna Center Offset (in)	0.0
Antenna Fore/Aft (in)	0.0
Wheel Base (in)	176.0

Help Menu Icon 

Note: Select the Help Menu  icon to access the Help Menu. The Help Menu may contain additional information about the features and options displayed on the page.

Antenna Height

The Antenna Height is calculated by measuring from the ground to the center of the GNSS antenna.

Antenna Center Offset

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

Antenna Fore/Aft

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

Wheel Base (Machine Steering Only)

The Wheel Base is calculated by measuring from the center of the front tire to the center of the rear tire.

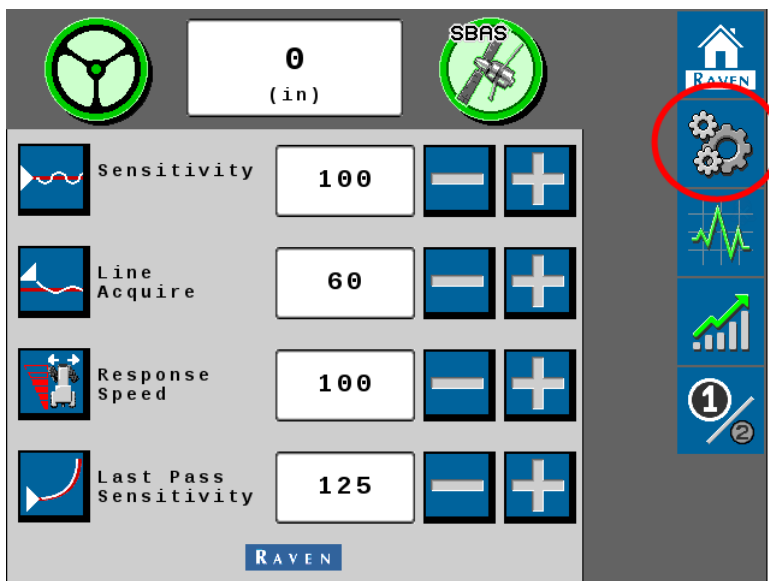
Note: The Wheel Base is calculated by measuring from the center of the front tire to the center of the rear tire on both sides of the machine. Add these measurements together and then divide by two to get the average Wheel Base value.

Steering Setup Tab

Note: Some pages and options may differ based upon how the machine or implement is configured.

Access the Steering Setup tab to adjust or tune the auto-steer system after the initial setup and calibration. This tab offers the operator access to settings and options to help adjust how the system responds to various steering inputs. To access the Steering Setup options, settings, and features:

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



The Steering Setup tab displays the steering partner with which the auto-steer system communicates during steering operations.

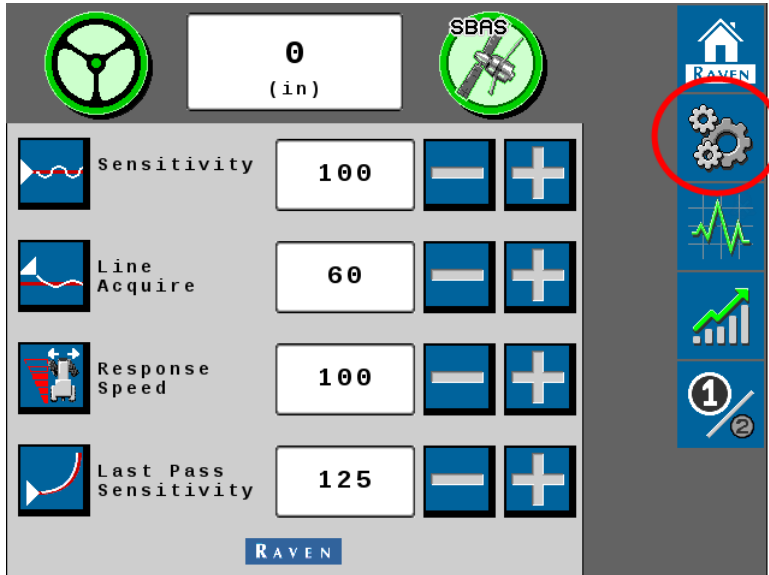
Note: The Steering Setup tab is hidden from view if the 'GNSS Only Calibration' option was selected during the profile setup.

Advanced Tuning

The Advanced Tuning settings allows the operator to fine-tune how the machine or implement will respond to auto-steer inputs. To access the advanced tuning settings for the current tuneset profile:

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Advanced Tuning Menu** button.

Review the following sections for additional information regarding the available tune settings and options for the auto-steering application.

Note: Use the next and previous page buttons at the bottom of the page as necessary to access additional settings.

The following values and options are available for tuning the auto-steering response:

Note: Use the next and previous page buttons at the bottom of the page as necessary to access additional settings.

The image displays two screenshots of the 'Advanced Navigation Tuning' settings page. The top screenshot shows the settings with a 'RAVEN' button and a checkmark icon. The bottom screenshot shows the same settings but without the 'RAVEN' button and checkmark icon.

Setting	Value	Minus	Plus
Position Gain	33	-	+
Heading Gain	150	-	+
Yaw Rate Gain	45	-	+
Position Integral Gain	1	-	+
Yaw Error Compensation	0	-	+
Enable Terrace Mode	<input type="checkbox"/>		

Position Gain

Determines how aggressively auto-steer 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 auto-steer responds to a heading error. A higher Heading Gain value results in a more aggressive response to a heading error, while a lower value indicates

a less aggressive response.

Yaw Rate Gain

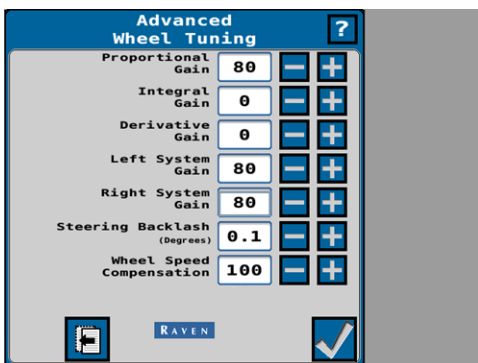
Determines the impact of the yaw rate on tracking performance. A higher Yaw Rate Gain value results in a more aggressive response to yaw rate, while a lower value results in a less aggressive response.

Position Integral Gain

This value corrects long-term errors in the wheel control. If the system is not achieving the desired wheel angle during operation, the system will re-direct the wheels to the desired set point. This value is generally at or near 0.

Yaw Error Compensation

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



Proportional Gain

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

Integral Gain

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

Derivative Gain

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

Left System Gain

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

Right System Gain

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

Steering Backlash (DirecSteer Only)

The steering backlash value is used to tune auto-steering response for the free play between mechanical linkages in the vehicle steering system. In general, this value helps to account for the distance which a driver would turn the steering wheel before the steered axle begins to move.

If the backlash value is too high, DirecSteer will constantly chatter while engaged. If the backlash value is too low, the machine will weave across the desired guidance path.

Note: *The typical backlash value for newer machines with tight mechanical steering linkage is less than 1.0. Older machines with more operating hours may have higher values.*

Use the \pm buttons to increase or decrease the backlash value until DirecSteer steers online without undesired characteristics.

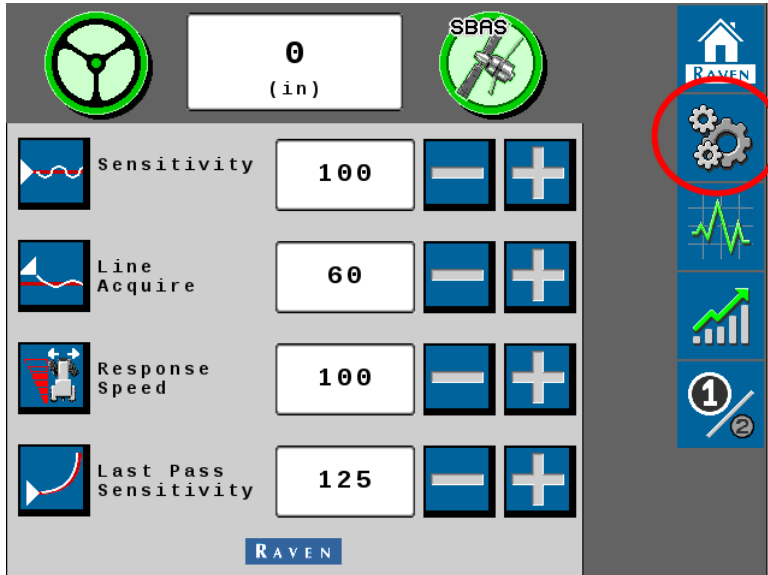
Wheel Speed Compensation

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

Wheel Control Settings

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.




3. Select the **Wheel Control Settings** button.

The image displays two screenshots of the "Wheel Control Setup" interface. The top screenshot shows the initial state with "Velocity (Deg/Sec)" at 0.0 and "Control Effort" at 0.0. The bottom screenshot shows the same interface with "Reverse Hydraulics" checked, "Velocity (Deg/Sec)" at 0.0, "Valve Current" at 0.000, and updated "Min %" and "Max %" values for the Left and Right wheels.

Parameter	Value
Velocity (Deg/Sec)	0.0
Control Effort	0.0
Reverse Hydraulics	<input checked="" type="checkbox"/>
Valve Current	0.000
Left Min %	4.8
Left Max %	100
Right Min %	10.7
Right Max %	100
Left Min % (Bottom)	26.9
Left Max % (Bottom)	93
Right Min % (Bottom)	25.3
Right Max % (Bottom)	98

Informational Readouts

The Wheel Control Setup page displays the following information:

Note: Select the Help Menu  icon to access the Help Menu. The Help Menu may contain additional information about the features and options displayed on the page.

Velocity or Wheel Velocity

The speed at which the wheels are moving, measured in degrees per second. The speed at which the implement steering actuator is moving, measured in voltage per second.

Control Effort

The amount of effort the system is using to drive the wheels. The amount of effort the SC1™/TC1™ system is using to drive the implement steering actuator.

Motor or Valve Current

Displays the current (amps) draw of the steering valve or motor.

Reverse Hydraulics

Enable this option if control inputs have the opposite effect on the steering axle or implement actuator. For example, when turning the steering wheel to the left moves the wheels right.

Min and Max Buttons

Touch and hold the MIN or MAX button to test the steering system response. The auto-steer system will use the set minimum and maximum percent values to drive the steering axle or actuators to the left or right (narrow or widen for plough applications).

For example, hold the Left MIN button to steer the machine to the left using the minimum control effort percent.

Minimum Percent

Set the Min % to the minimum value required to move the steering axle or implement steering actuator. Values range from 0 - 99.

Note: *Left and right values may be set independently. The Min values cannot exceed the Max values.*

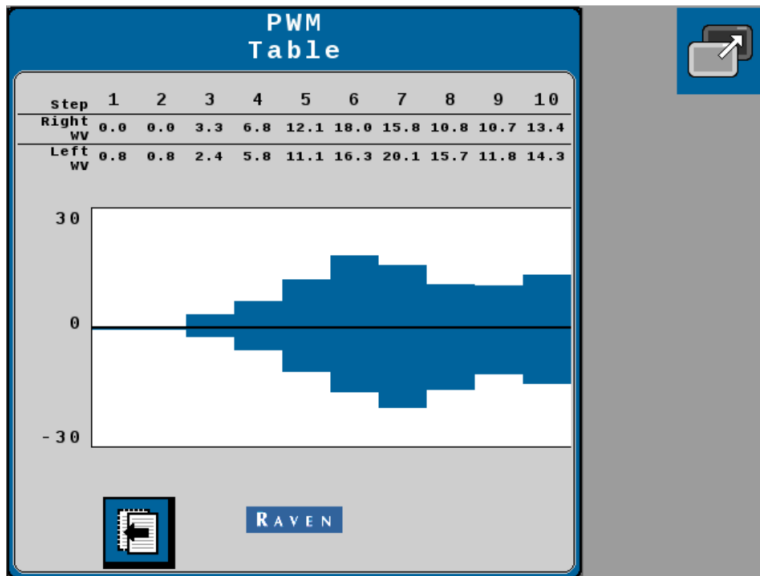
Maximum Percent

The Max % value may be used to limit the control effort which auto-steer system may use to steer the axle or implement steering actuator. Values range from 1 - 100.

Note: *Left and right values may be set independently.*

PWM Table

From the Wheel Control Setup page, select the **Next** button to review the PWM Table page for the last completed calibration. The PWM table displays the control effort for various target angles.



Steering Control Calibration

The steering control calibration process allows the auto-steering system to learn the hydraulic or mechanical capabilities of the machine for optimal steering performance in the field.

Note: When operating with a generic tuneset, the steering control calibration must be performed to tune the auto-steer system to the machine. The Quick Calibration option is not available when the machine make and model selections were set to the "Generic" option at the beginning of the calibration wizard.

Note: When operating with a specific make and model tuneset, the steering control calibration is recommended to tune the auto-steer system to the specific machine. However, when a make and model tuneset set selected at the beginning of the calibration wizard, the control calibration process can be bypassed with the **Use Quick Calibration** option. This allows the system to load the predefined gains for the selected machine profile.

Preparation

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

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

- The machine measurements are correctly entered into the UT or field computer.
- The machine hydraulic fluid is at the normal operating temperature.

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.

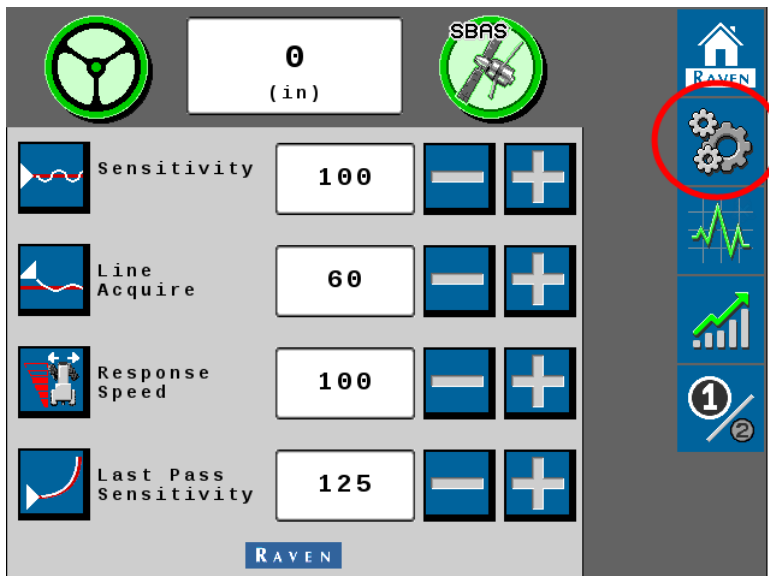
If the ground or surface is slippery, muddy, or freshly tilled, the auto-steering system may learn incorrect steering responses for normal operating conditions.

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

Perform a Calibration

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. Park the machine on a level surface with several acres of smooth ground available.
2. From the auto-steer Home page, select the **Tools**  button.



3. Select the **Steering Setup**  tab.



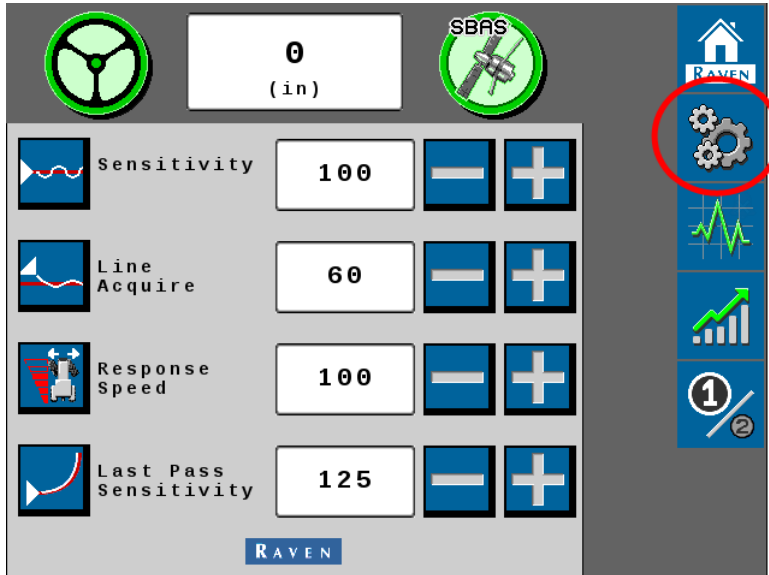
4. Select the **Steering Control Calibration** button. Follow the on-screen instructions and review "Steering Control Calibration" on page 41 for additional assistance with completing the calibration.

Guidance Setup Menu

The Guidance Setup Menu to configure auto-steering options for in-field guidance.

Note: Some pages and options may differ based upon how the machine or implement is configured.

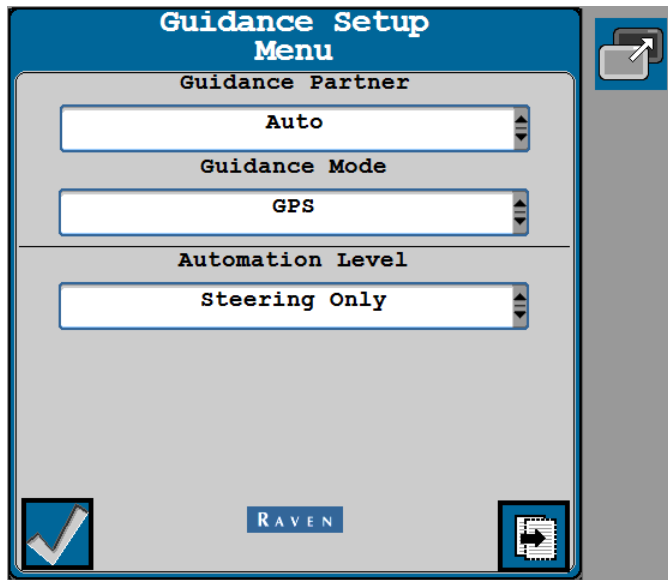
1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Guidance Setup Menu** button.



Review the following sections for assistance with selecting the appropriate guidance options for your application.

Guidance Partner

Use the drop-down list to select the desired guidance partner.

Guidance Mode

Select one of the following modes for guidance operations:

- **GPS** - Guidance is performed via GNSS guidance points only.
- **Vision** - Guidance is performed via the VSN[®] camera only. GNSS corrections are neither utilized for guidance nor available as a fall-back solution. Line acquire must be performed manually. When the solution quality falls below the minimum threshold, the steering system will disengage.
- **Vision+** - Guidance is performed via a combination of GNSS and the VSN[®] camera. This mode may be utilized for line acquire via GNSS with the system switching to the VSN[®] camera when the machine is aligned and near the guidance line. This mode will also fall back to GNSS guidance if the solution quality falls below the minimum threshold. The system will then return to VSN[®] guidance automatically when the solution quality is above the minimum threshold.

Automation Level

Set the mode for devices installed in an OMNiDRIVE™ or OMNiPOWER™ system:

- **GPS Only** - Stream GNSS correction information only. Select this option for guidance only applications or to stream corrections to a separate automated steering system.
- **Steering Only** - Use the guidance and auto-steering features of the device. Select this option for automated tractor or sprayer steering applications.
- **Autonomy Driverless** - Select this option to enable features for autonomous systems such as OMNiDRIVE™.

Note: DirecSteer does not support Autonomous operations.

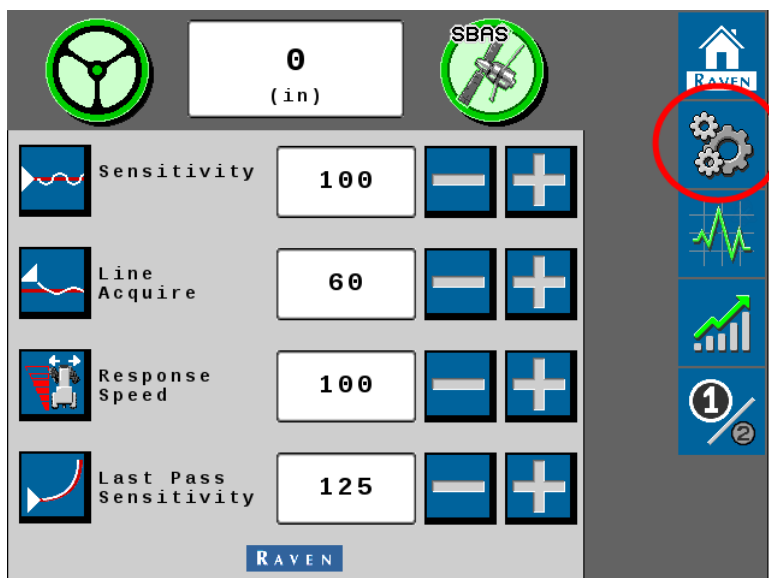
Guidance Path Partner

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

Wheel Angle and Implement Position Sensor Settings

Note: Some pages and options may differ based upon how the machine or implement is configured.

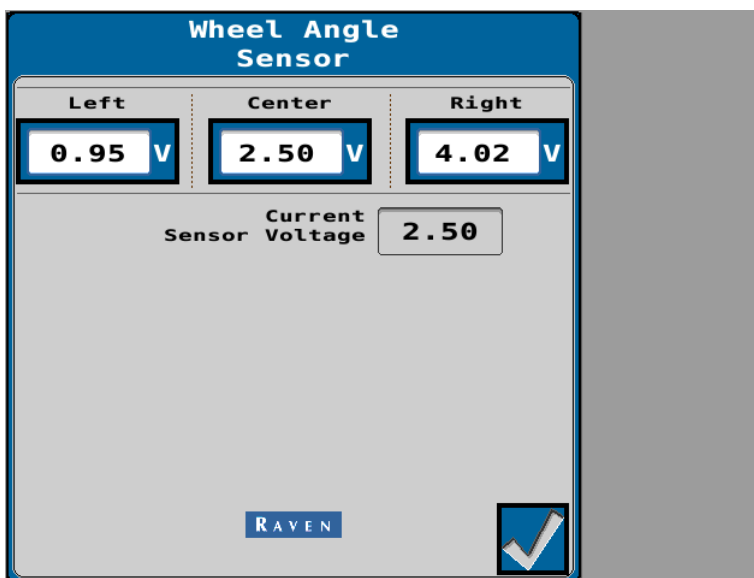
1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Wheel Angle Sensor** button.



Informational Readouts

The Wheel Angle Sensor or Implement Position Sensor page displays the following information:

Wheel Angle Sensor Applications

Left, Center, and Right Values

Displays the current sensor voltage set point value for each sensor position.

Current Sensor Voltage

Displays the current voltage of the wheel angle or implement position sensor.

When the operator turns the steering wheel, this value will increase or decrease, depending upon which way the wheel is turned, through the sensor range.

Current Wheel Angle

Displays the current angle of the steer axle.

While driving straight forward, this value should be zero. If the machine is steered to the left, this value will display negative and when steered to the right, this value will display positive.

Calibrate the Sensor Positions

To Calibrate the Left Position

1. Drive the machine forward at 2 - 6 km/h [1 - 4 mph].
2. Select the Left position button.
3. Manually turn the steering wheel to the full left lock.
4. Select the Left position button again to save the new Left position value.

To Calibrate the Center Position

1. Drive the machine forward at 2 - 6 km/h [1 - 4 mph].
2. Select the Center position button.
3. Manually center the steering wheel to drive straight ahead.
4. Select the Center position button again to save the new Center position value.

To Calibrate the Right Position

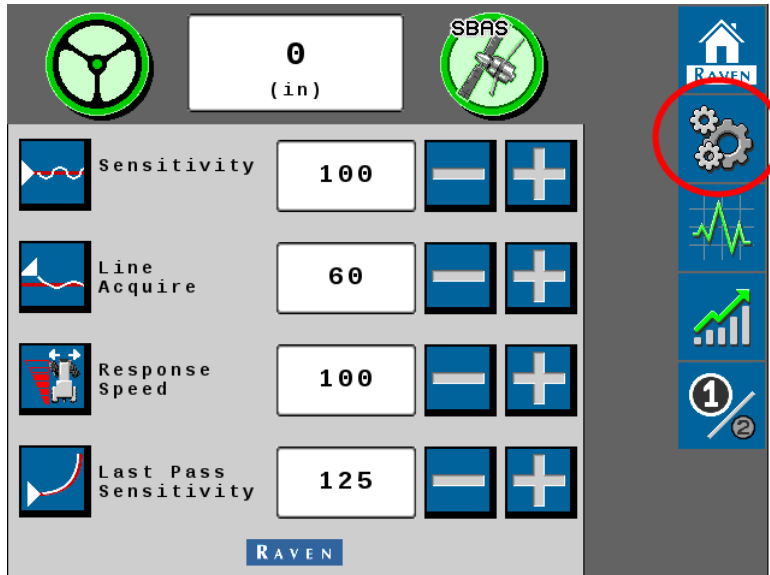
1. Drive the machine forward at 2 - 6 km/h [1 - 4 mph].
2. Select the Right position button.
3. Manually turn the steering wheel to the full right lock.

4. Select the Right position button again to save the new Right position value.

Steering Disengage Settings

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Steering Disengage Settings** button.



Informational Readouts

The Disengage Settings, Disengage Engage Settings, or Implement Engage Setup page displays the following information:

Disengage Type

Displays the type of disengage switch used in the auto-steer system.

- Encoder

Disengage Status

Indicates the status of the disengage switch. The following statuses may be displayed:

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

Note: DirecSteer does not support testing the disengage sensor from the Disengage Settings page.

Pressure 1

For single and dual pressure disengage types, the pressure monitored by the first pressure transducer is shown.

Pressure 2

For dual pressure disengage types, the pressure monitored by the second pressure transducer is shown.

Disengage Differential

For dual pressure disengage types, this field displays the differential between the two transducers.

Measured Rotation Rate

This rate displays for steering wheel encoder disengage types and displays the rate of steering in degrees per second.

When connected with a DirecSteer unit, this display provides a calculated, non-dimensional rotation rate through the DirecSteer unit.

Measured PWM Encoder Change Rate

This rate displays for steering wheel encoder disengage types. This field displays the change in steering position in percent per second.

Encoder Rate

Displays the speed at which the steering wheel is turning.

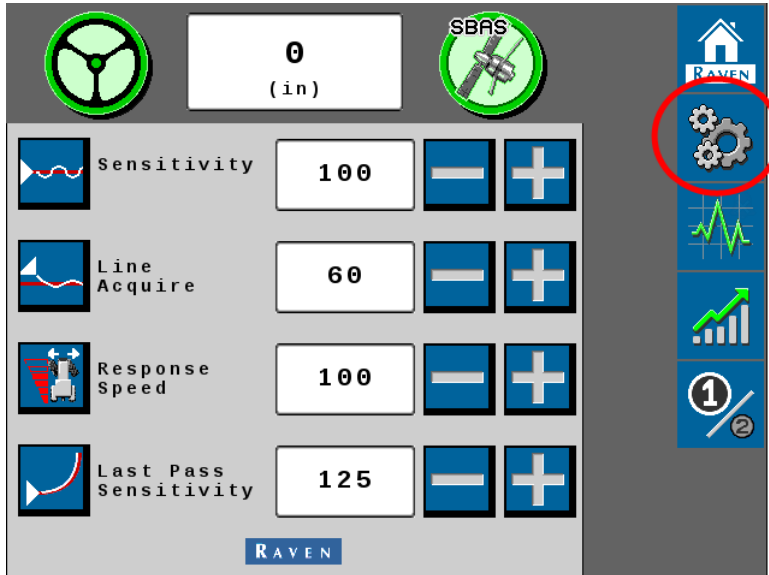
Disengage Threshold

Set the minimum value which the sensor must detect to disengage auto-steering as the steering wheel is turned manually. Adjust the value so that the disengage status changes to red when the steering when the steering disengage switch is engaged. When the steering input stops, this status should return to green, which indicates that auto-steer may be engaged. Adjust the threshold to minimize the delay between detecting steering input and the status toggling between red and green.

Reset Calibrated Gains

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

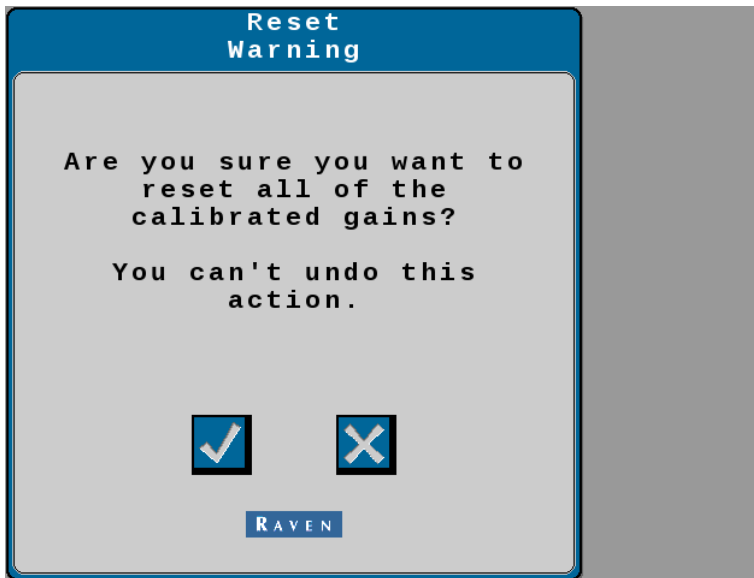
1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Reset Calibrated Gains** button.

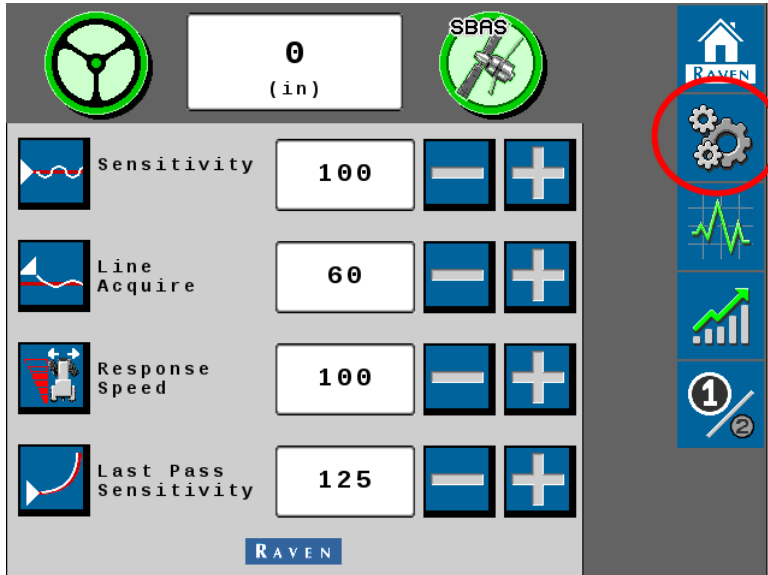


- Select the **Check** button to reset the auto-steer settings back to a factory default condition.
- Select the **X** button to keep the current system configuration and return to the Steering Setup tab.

Operator Presence Sensor

Note: Some pages and options may differ based upon how the machine or implement is configured.

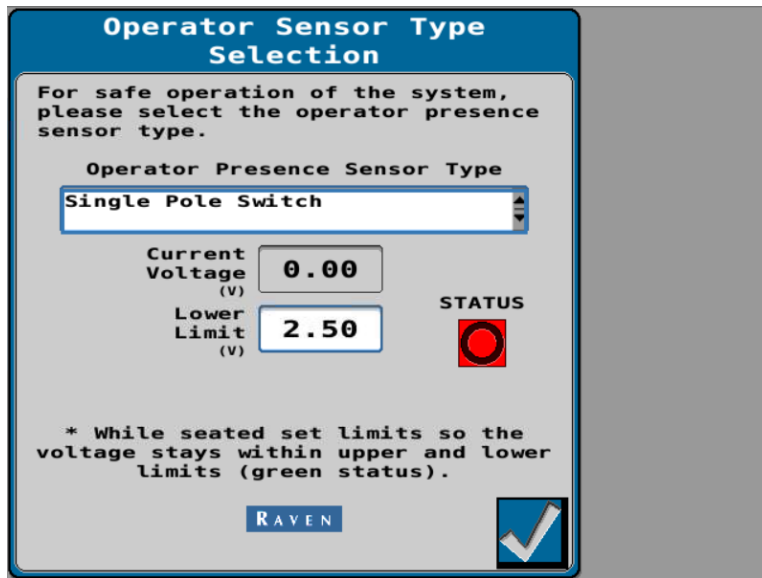
1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **Steering Setup**  tab.



3. Select the **Operator Presence Sensor** button.



Informational Readouts

The Operator Sensor Type Selection page displays the following information:

Current Voltage

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

Status

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

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

Note: Review "Diagnostics and Troubleshooting" on page 145 for information on the status displayed in this area.

Operator Presence Sensor Type

Use the drop-down list to select the type of switch used to detect the presence of the operator while the auto-steer system is engaged.

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

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

Lower Limit

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

Upper Limit

Note: *The upper limit field is only used with the double pole switch type.*

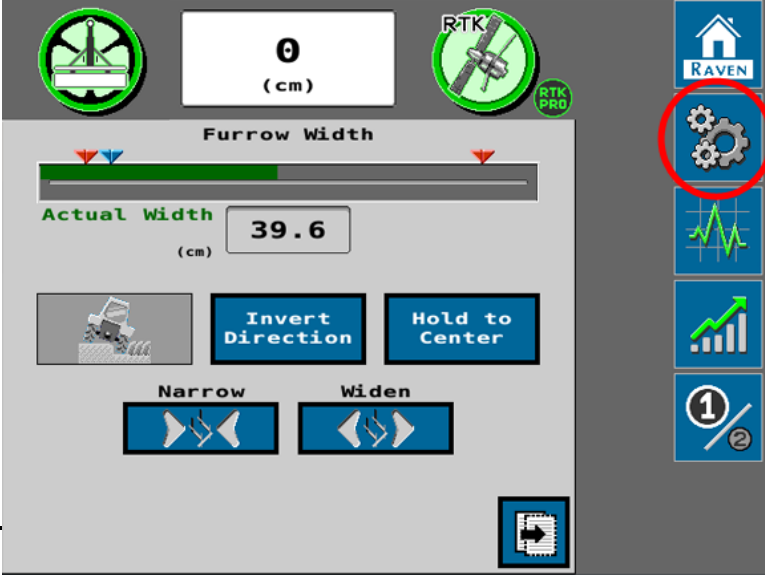
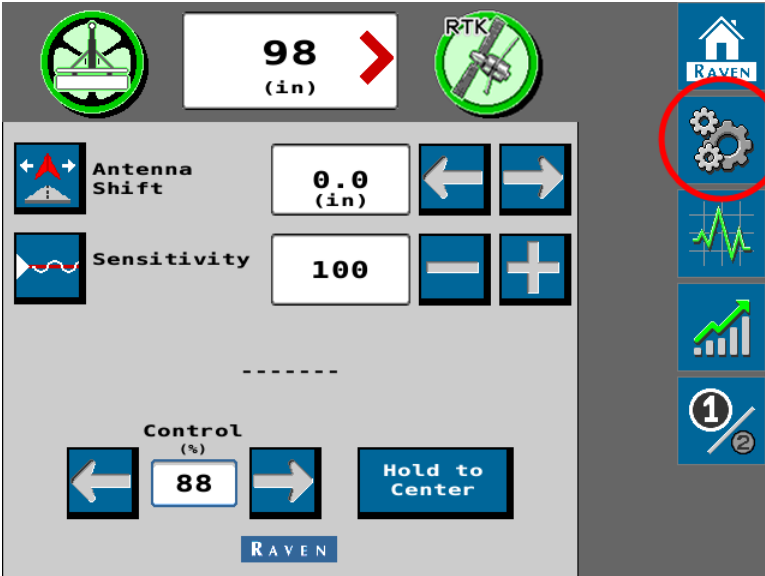
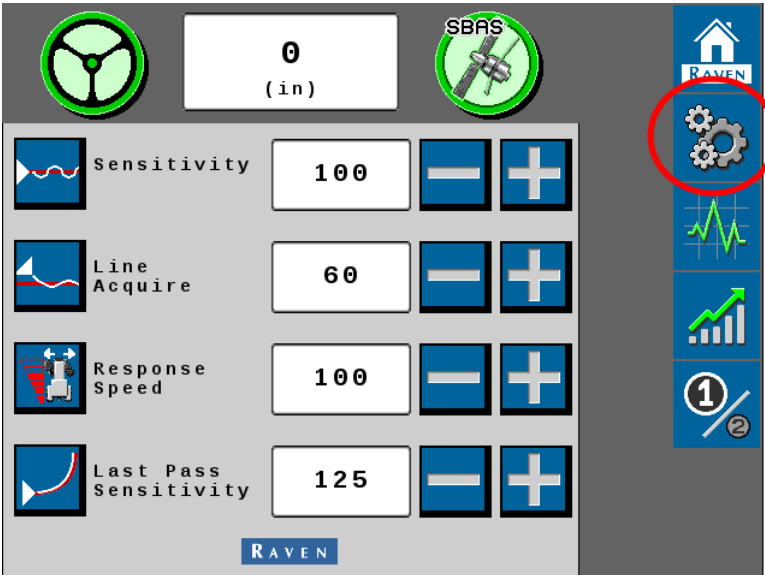
Use this setting to adjust the upper voltage limit. Set the upper limit so that the current voltage reading remains below the upper limit while the operator is seated. If the presence switch voltage exceeds the upper limit, the presence switch will disengage steering.

GPS (GNSS) Setup Tab

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

To access the GNSS correction settings and options available for Raven auto-steer applications.

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **GPS Setup**  tab.

GPS Shutdown Timer (if equipped)

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

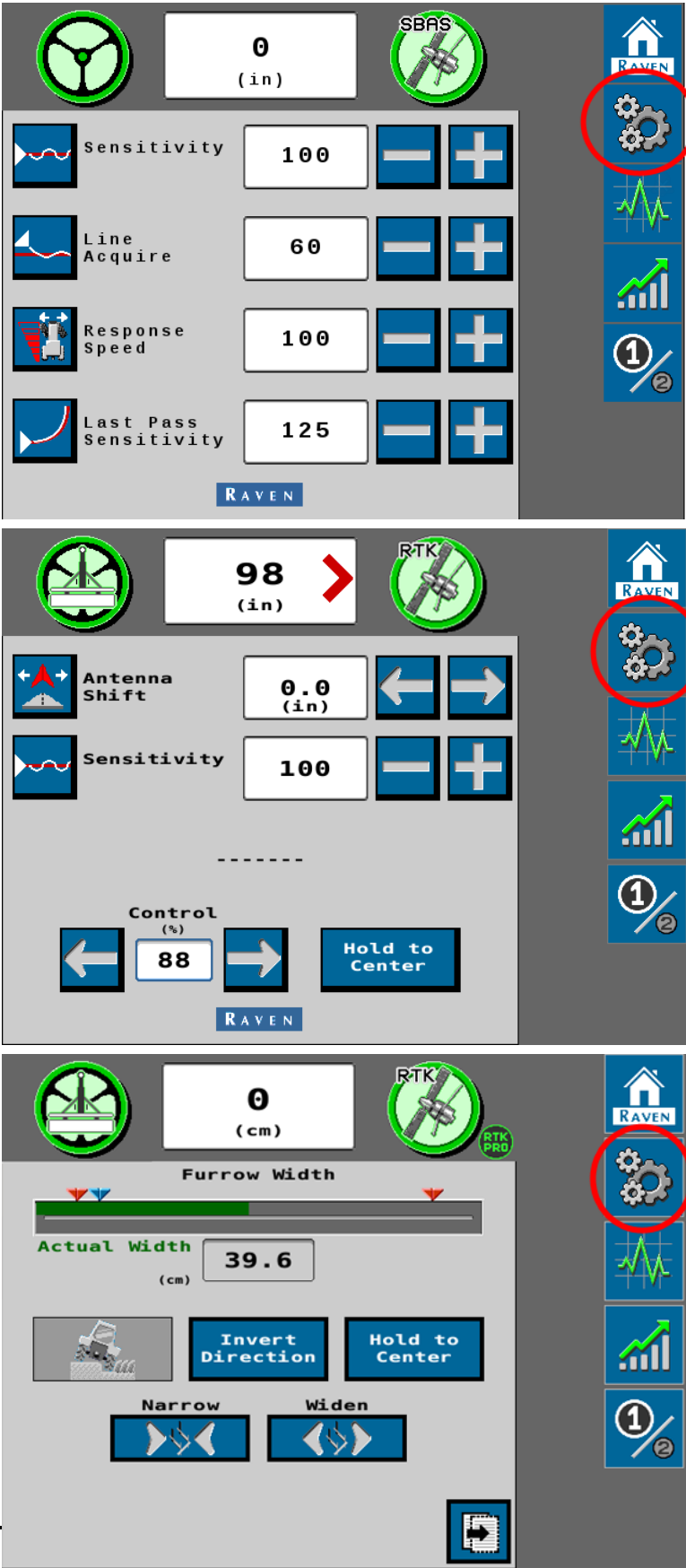
Note: *The default value for the shutdown timer is 1 hour. This option requires that RS1™ is installed properly with both switched and constant power.*

The following provide additional assistance with features and options in the GPS Setup menu:

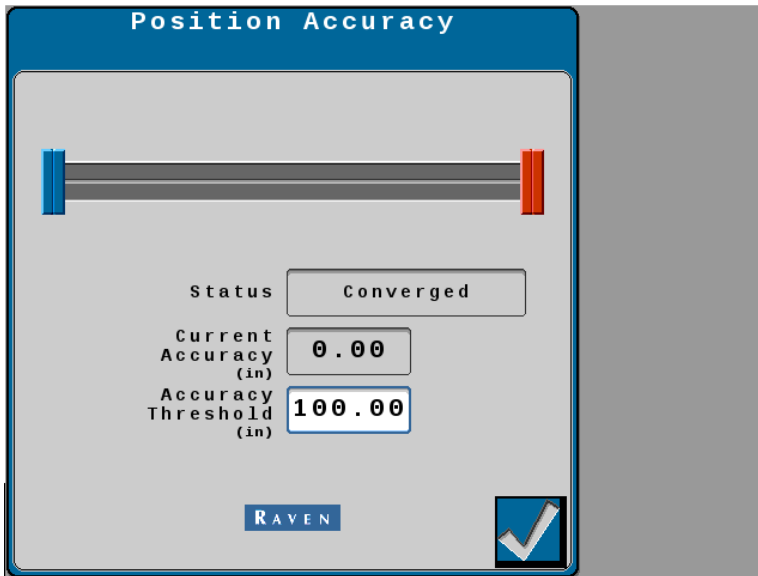
Position Accuracy Setup

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **GPS Setup**  tab.
3. Select the **Position Accuracy Setup** button.



The Position Accuracy page displays the following information:

Status

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

- No Signal
- Error
- Converging
- Converged

Current Accuracy

Value displayed is the horizontal standard deviation reported by the GPS/GNSS receiver.

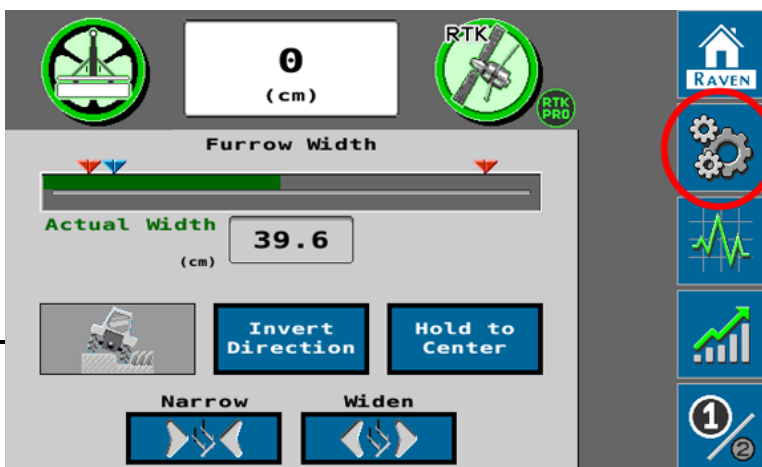
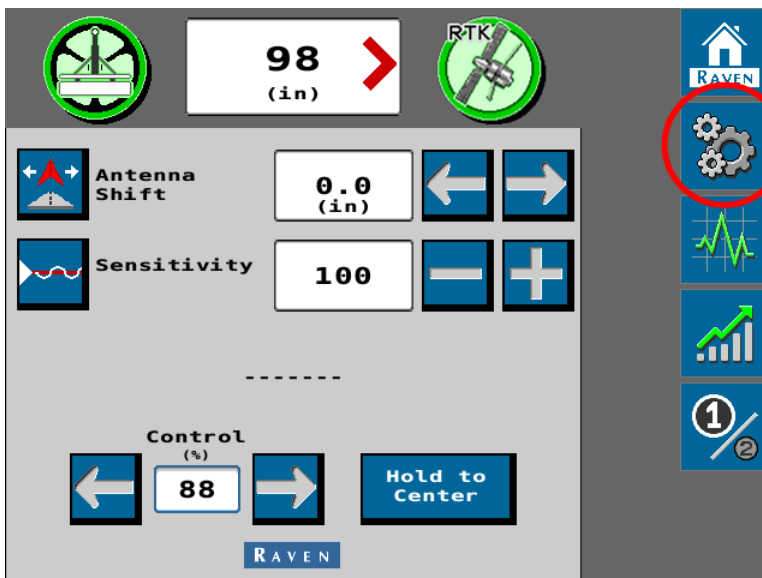
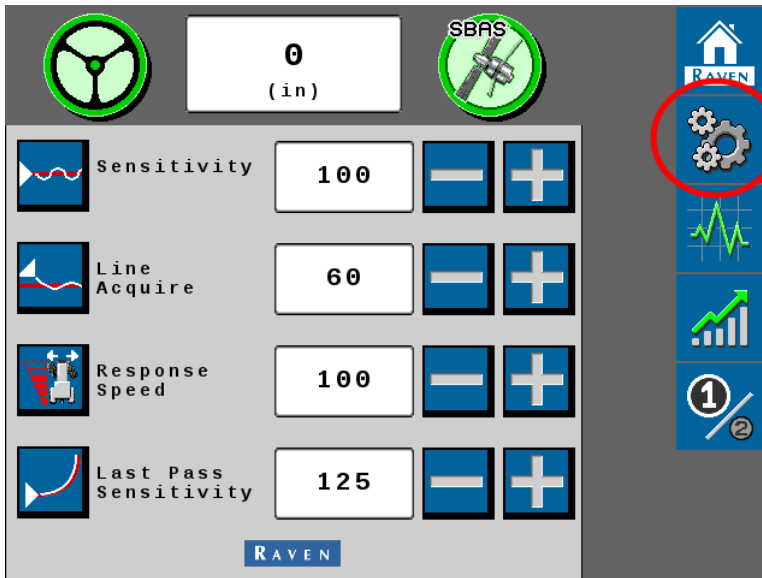
Accuracy Threshold


This user-defined value sets the allowable deviation from current machine GPS position. If the GPS solution falls outside the set threshold, a DTC will be triggered. The default Accuracy Threshold value is 254 cm [100 in].

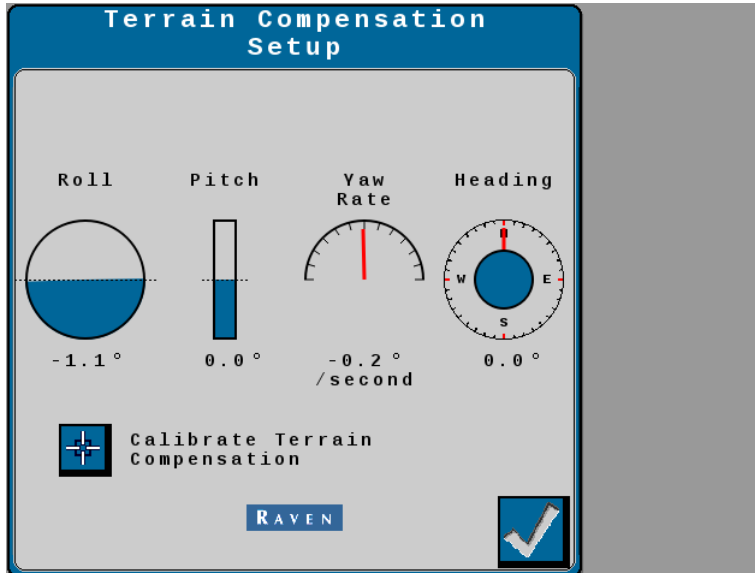
GNSS Terrain Compensation

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **GPS Setup**  tab.
3. Select the **Terrain Compensation Setup** button. The following terrain compensation diagnostic information is displayed.



4. When finished reviewing the displays, or after completing a calibration, select the **Accept** button in the lower, right corner of the page to return to the GPS Setup tab.

Roll, Pitch, Yaw Rate, and Heading

Real-time measurement data used by the 3D terrain compensation feature.

Calibrate Terrain Compensation

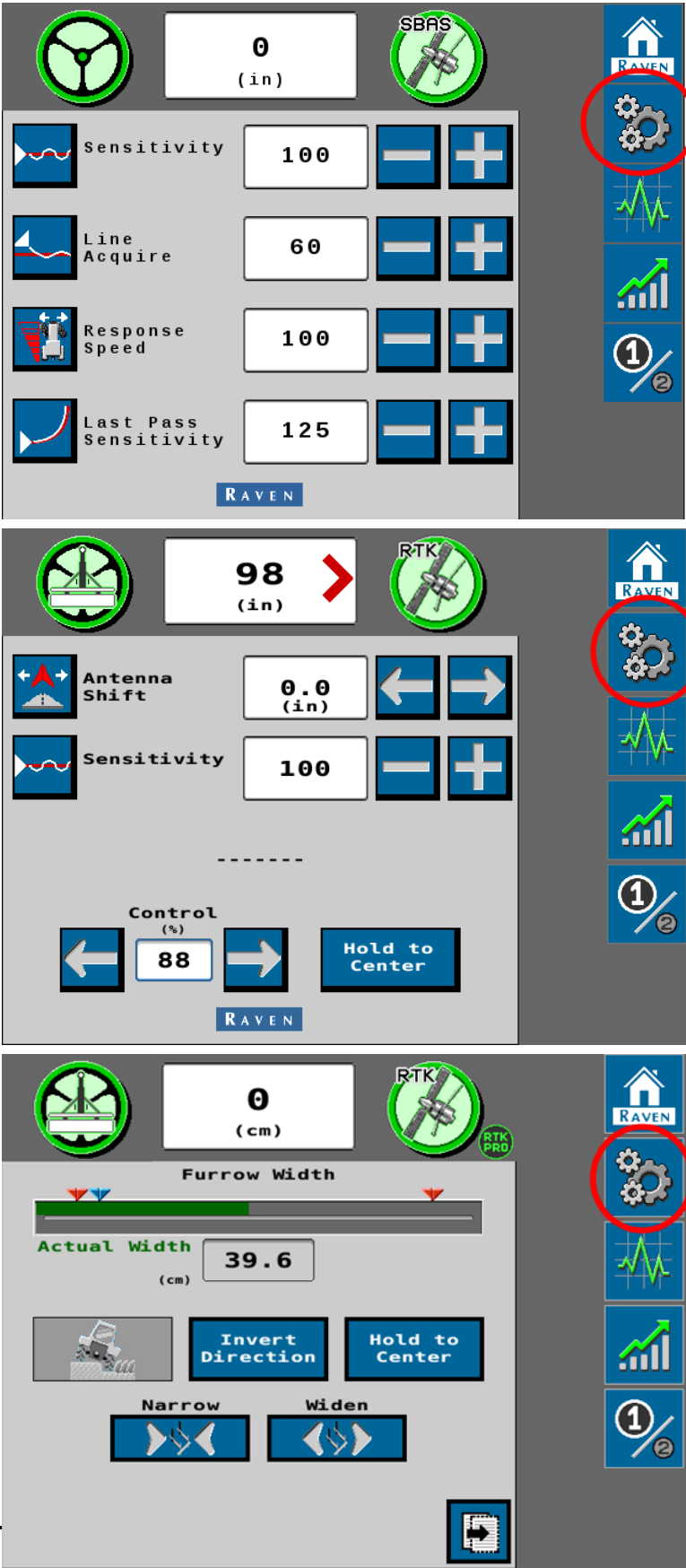
Begins the terrain compensation process. Review the "Terrain Compensation Calibration" on page 29 procedure for assistance with completing the terrain compensation calibration process.


Note: Calibration of the terrain compensation system should be performed in a field or other large, open space.

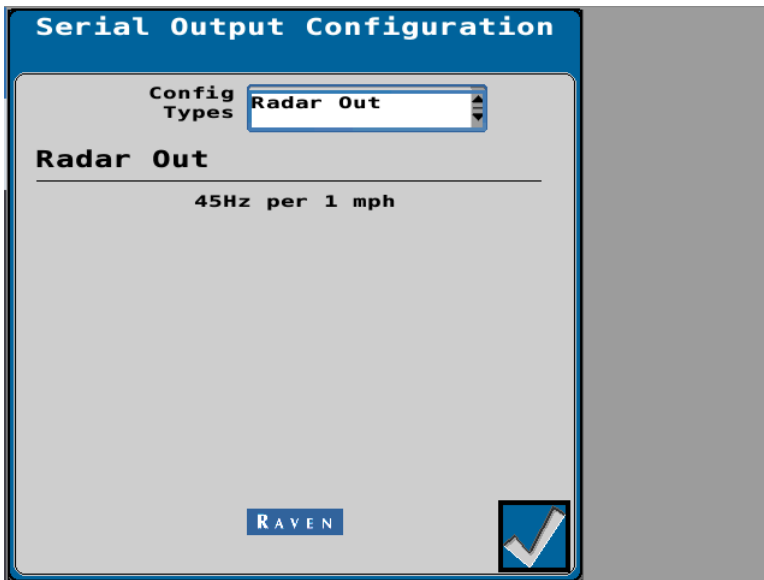
GPS Serial Output

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.



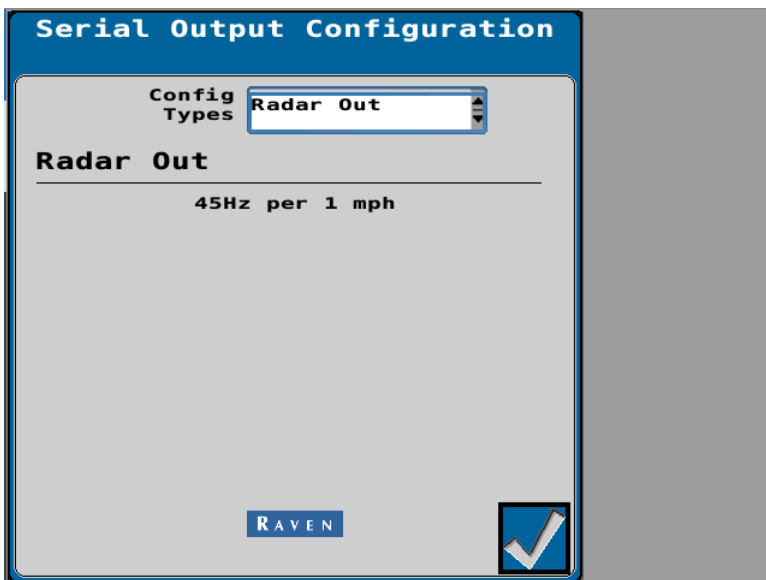
2. Select the **GPS Setup**  tab.
3. Select the **GPS Serial Output** or **Serial Output Configuration** button.



4. Use the **Config Types** drop-down to toggle between the following options:

Radar Out

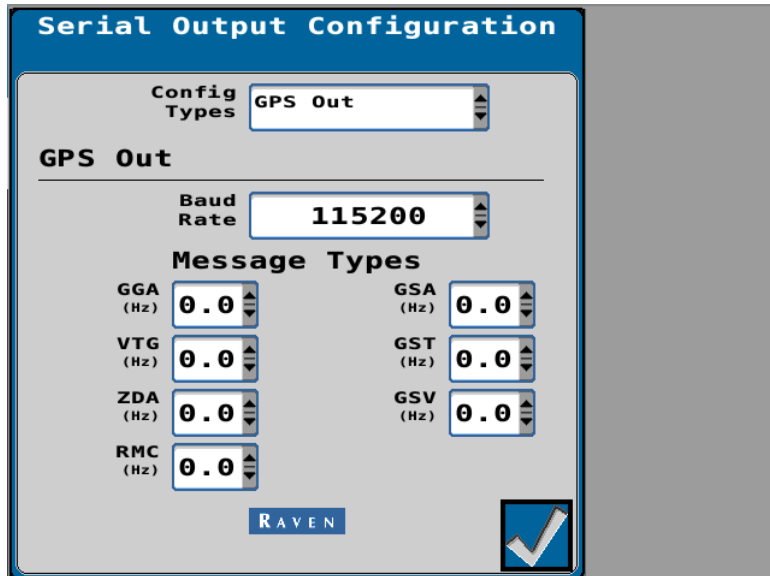
Output a simulated radar speed.



This mode outputs a fixed frequency and there are no further user settings to tune this output.

GPS Out

Provides 3D compensated GNSS position messages in a NMEA 0183 format through the serial output.



Baud Rate

The rate at which messages are transmitted over the serial port. This rate must be set to match the devices on the system which are intended to receive serial output messages.

Note: The default baud rate setting is 115200 and is recommended for auto-steering systems.

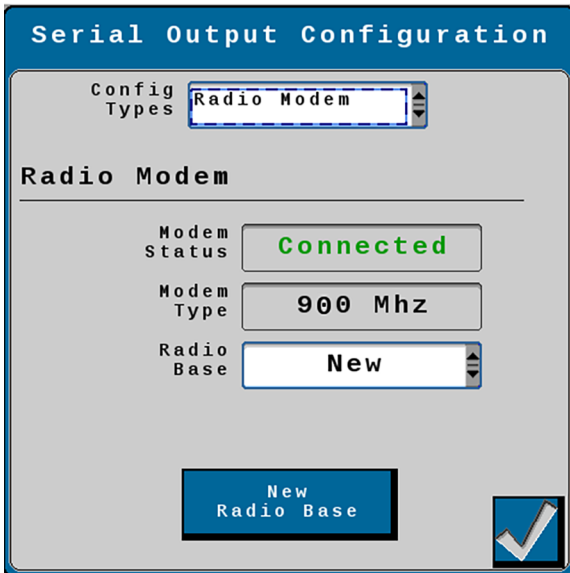
Message Types

Allows the operator to configure required and desired NMEA message types and frequency.

Note: Changing message types and rates may cause poor system performance. It is not recommended to change message rates unless instructed by documentation or the Raven Technical Service team.

Radio Modem

Configure a radio modem for serial output.



Modem Status

The modem status may display as:

- No Comm: No modem detected.
- Configuring: Modem is detected.
- Connected: Modem is connected to the steering guidance controller (SGC).

Modem Type

The detected radio modem type will display here. Modem type options are:

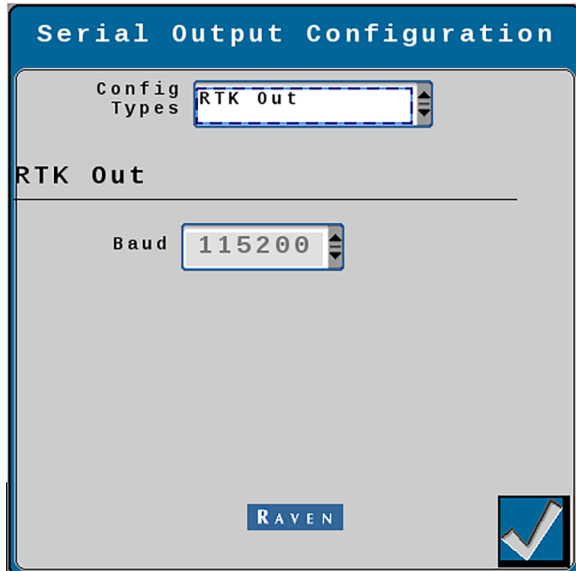
- 450 MHz
- 900 MHz

Radio Base

Select a base station from the drop-down list to select a stored radio base or select New to create a new radio base. Refer to Add or Delete Radio Modem for assistance with managing or creating radio modems.

RTK Out

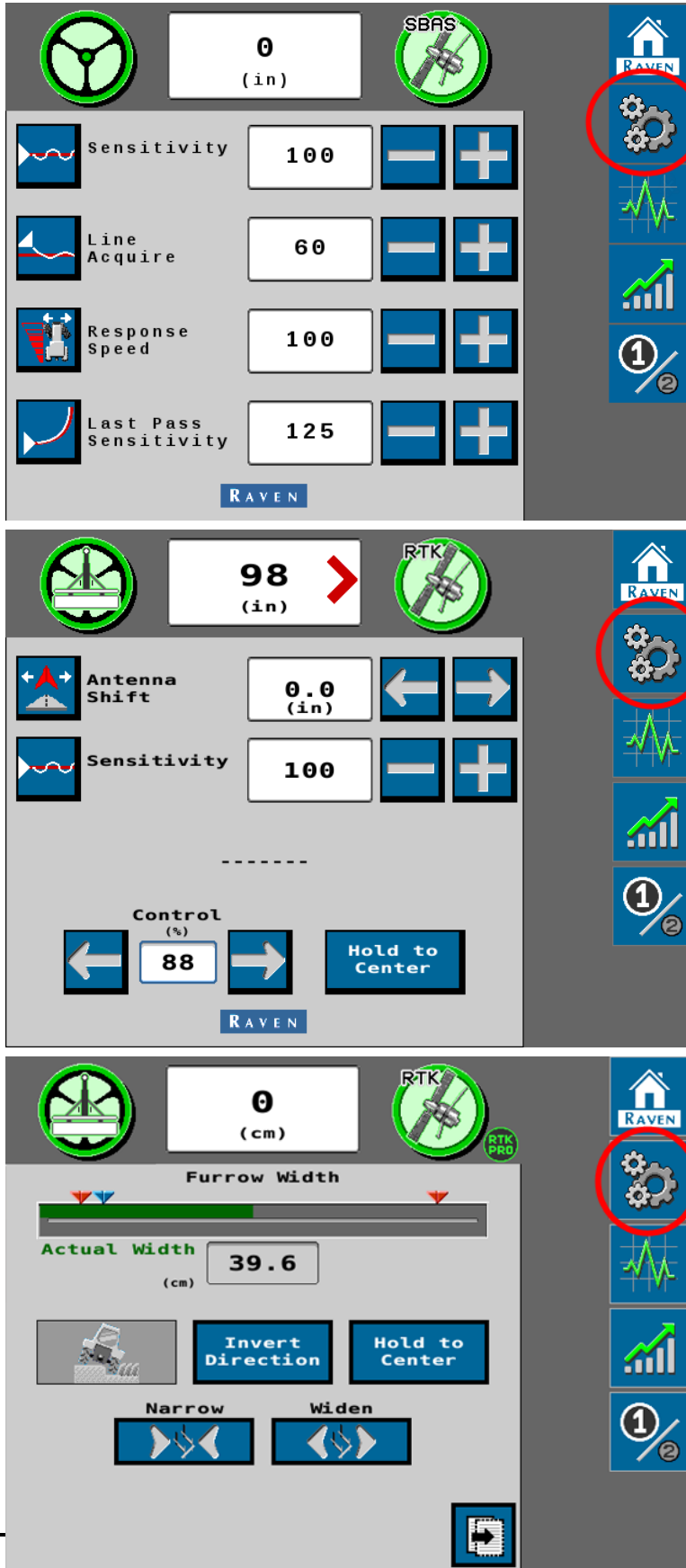
Select RTK Out to output 3D compensated RTK to another ECU. The operator may set the baud rate for the serial output.



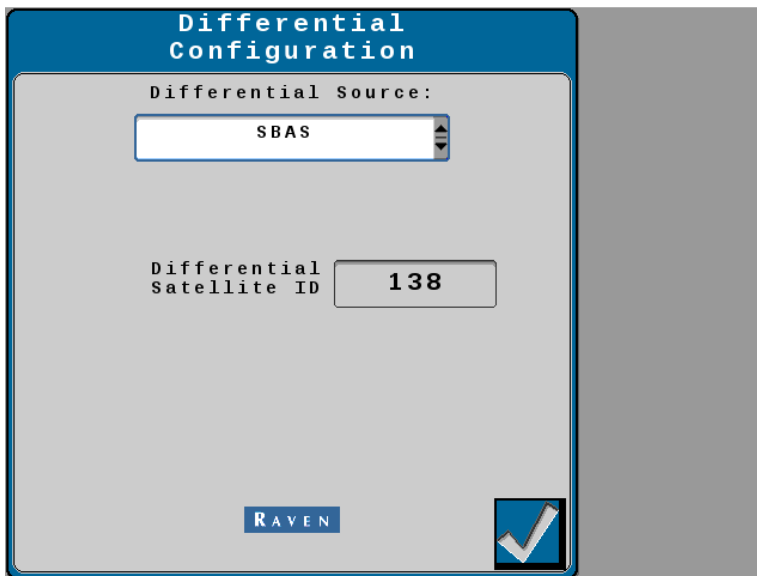
Differential Configuration Setup

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **GPS Setup**  tab.
3. Select the **Differential Configuration Setup** button.



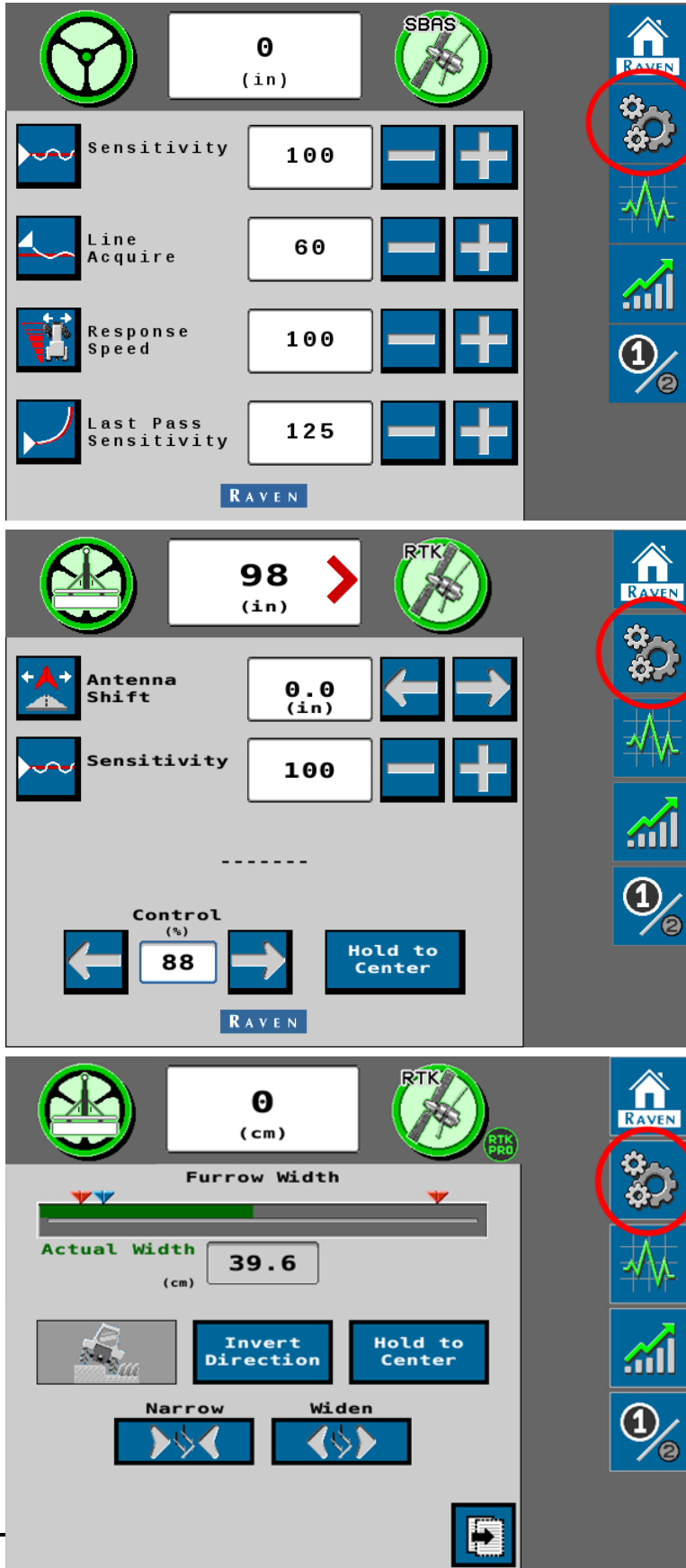
Note: *Differential Source options will vary depending upon the GNSS receiver connected, authorized or unlocked correction sources or subscriptions, and etc. Contact a local Raven dealer for additional assistance with feature unlock codes and activation.*


GPS Information Page

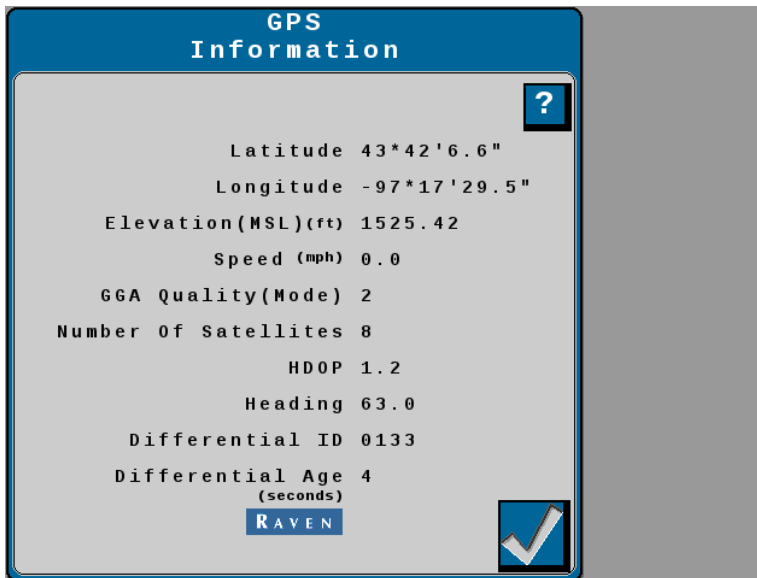
The steering guidance controller (SGC) provides some general GNSS diagnostic data from the GNSS receiver. To review GNSS data from the connected receiver:

Note: *Some pages and options may differ based upon how the machine or implement is configured.*

1. From the auto-steer Home page, select the **Tools**  button.



2. Select the **GPS Setup**  tab.
3. Select the **GPS Information** button. The following diagnostic information is displayed:



The GPS Information page displays the following data:

Latitude

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

Longitude

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

Elevation (MSL)

The height of the GNSS antenna in reference to sea level.

Speed

Current speed based on GNSS measurements.

GGA Quality (Mode)

The current convergence state of the GNSS receiver.

- 0 = No data received.
- 1 = Single solution, no differential corrections being received.

- 2 = SBAS converged, GLIDE®, 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 GNSS receiver.

HDOP

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

Heading

The machine direction of travel.

Differential ID

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

Age of Differential

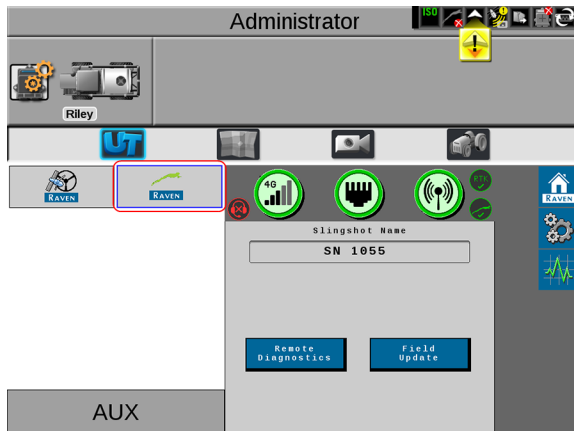
Time (in seconds) since the last differential correction was received. If a differential source is not currently tracked this entry will be "- - - -".

Chapter 7:

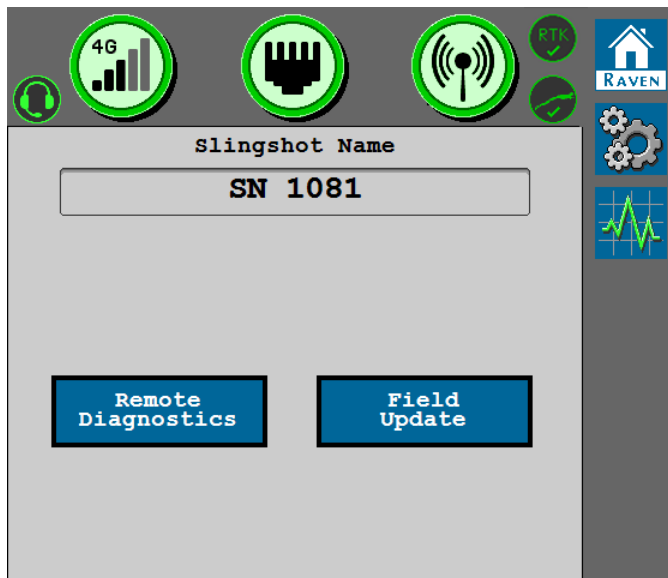
Slingshot® Universal Terminal Overview

The Slingshot® universal terminal provides an interface for the Field Hub module built into the RS1™ unit. To access the Slingshot® UT:

1. Select the **Slingshot®**  button from the UT menu.



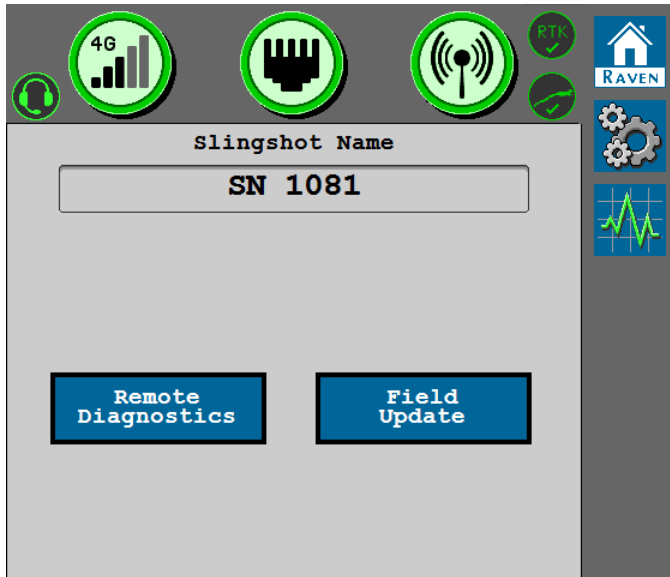
2. The Slingshot® home screen displays.



Refer to the following sections for additional information about the features, settings, and options available through the Slingshot® UT.

Slingshot® Home Page Overview

The Slingshot® Home page displays status icons and general information about connectivity to the Slingshot® systems.



The following features and information are displayed on the Slingshot® home page.

Slingshot® Name

Displays the default system name assigned to the RS1™ unit in the Slingshot® portal when the device was registered.

Remote Diagnostics

Select the Remote Diagnostics button and accept the End User License Agreement (EULA) to allow RS1™ to send usage logs to Raven. Statistics shared through Slingshot® will be used by Raven to monitor RS1™ performance.

Note: The EULA must be accepted each time the RS1™ powers on. Accept the EULA on the Slingshot® portal at the link below to allow diagnostics until the EULA terms are revised.

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

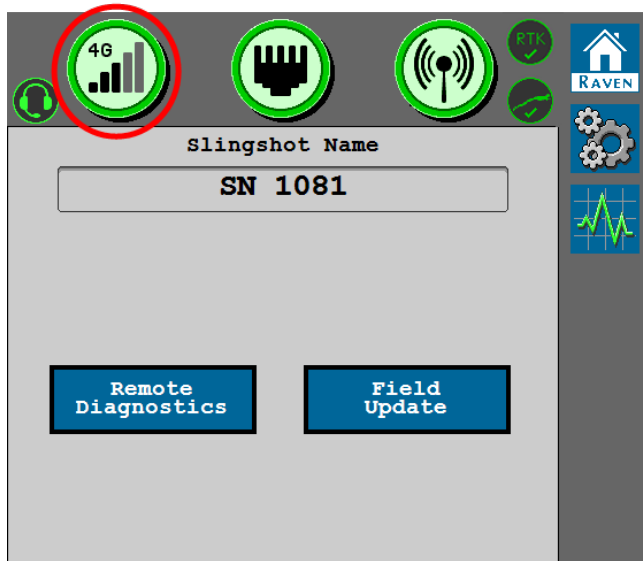
Field Update

Refer to "RS1™ Field Update" on page 123 for assistance with updating the RS1™ via a cellular network connection to the Slingshot® server.






Connectivity Status

Cellular Modem Status

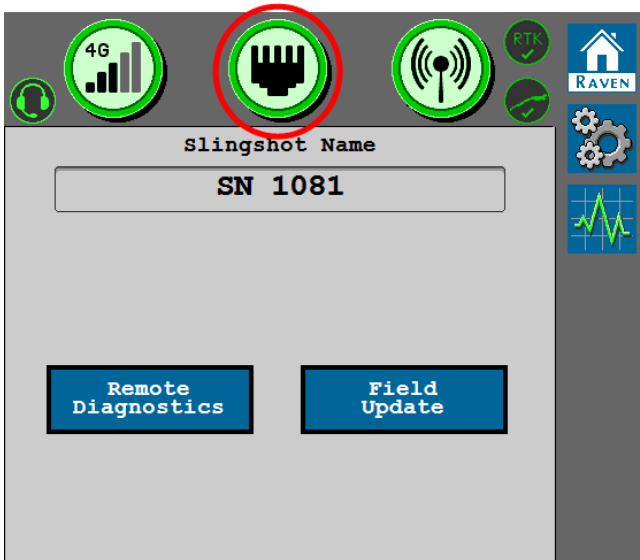
The Cellular Status icon displays cell signal and modem status.






Note: Select the modem status icon to access the Cellular Status page with additional modem information. Refer to the Cellular Status Page for additional details on the information shown on this status page.

-  RS1™ is connected to the network via the cellular modem.
-  The cellular modem is functional, but is not connected to the cell network.
-  The cellular modem is not functional and RS1™ is not connected to the cell network.
-  The RS1™ unit is equipped with a cellular modem, but the feature has not been unlocked. Contact a local Raven dealer for additional assistance with feature unlock codes and activation.
-  The RS1™ unit is not equipped with a cellular modem.

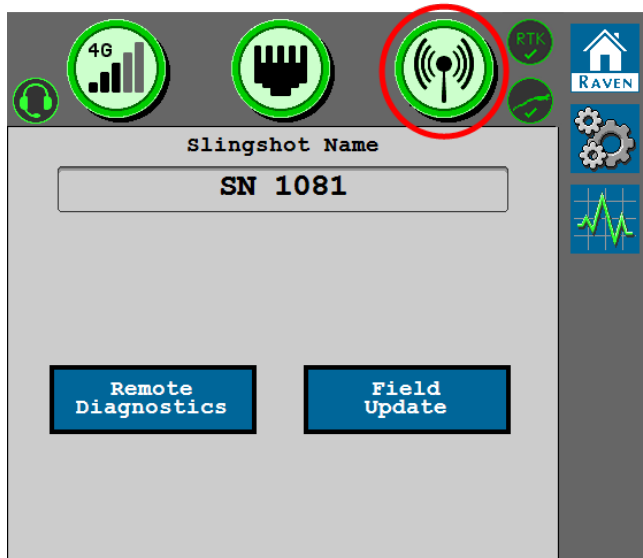
Ethernet Status



Note: Select the Ethernet status icon to access the Ethernet Status page. Refer to the "Ethernet Status Page" on page 120 for additional details on the information shown on this status page.

-  Indicates that a valid connection has been established between the RS1™ and a field computer or Field Hub.
-  No Ethernet connection has been made or the RS1™ does not recognize that an Ethernet has been made.
-  Ethernet device failure. Contact the Raven Technical Service team for support.



Wi-Fi® Status



Note: Select the Wi-Fi® status icon to access the Wi-Fi® Status page. Refer to the "Wi-Fi® Connection and Hotspot Status Page" on page 121 for additional details on the information shown on this status page.




Hotspot

Note: The following status icons are displayed when RS1™ is broadcasting a Wi-Fi® hotspot for other devices.

-  The Wi-Fi® Hotspot is active and functioning properly.
-  Wi-Fi® Hotspot is not functioning properly.

Client

Note: The following status icons are displayed when RS1™ is configured to connect to a Wi-Fi® network broadcast from a separate device.



-  Wi-Fi® client is active and is connected.
-  Wi-Fi® client is active, but does not have a valid connection to a Wi-Fi® network.
-  Wi-Fi® hardware is not functioning properly.

Slingshot® Feature Status



Update In Progress

-  An update is in progress.

Slingshot® Remote Diagnostics



-  RS1™ Remote Diagnostics are being sent to the Slingshot® portal.
-  RS1™ Remote Diagnostics are not being sent to the Slingshot® portal.

Slingshot® Portal Connection

-  RS1™ is connected to the Slingshot® portal.
-  RS1™ is not connected to the Slingshot® portal.

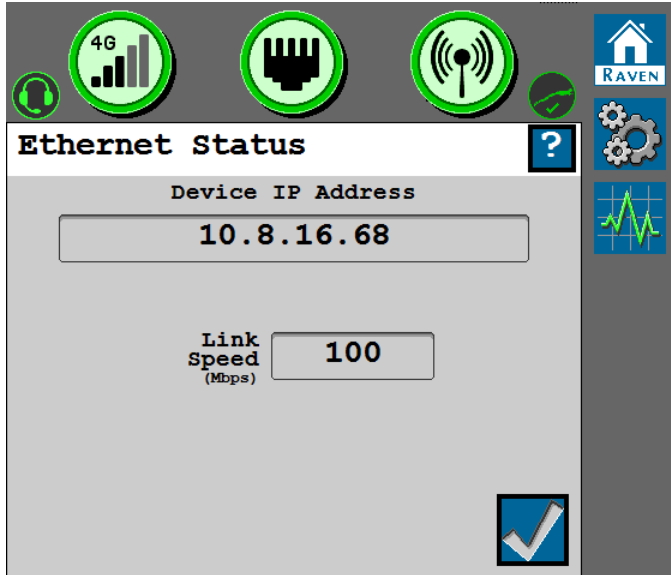
Slingshot® RTK

Note: RTK corrections must be unlocked for the RS1™ to display this status icon. Contact a local Raven dealer for additional assistance with feature unlock codes and activation.

-  RS1™ is receiving RTK corrections.
-  RS1™ is not receiving RTK connections.

Ethernet Status Page

Select the Ethernet Status icon on the Slingshot® Home page to view the Ethernet Status page.



Device IP Address

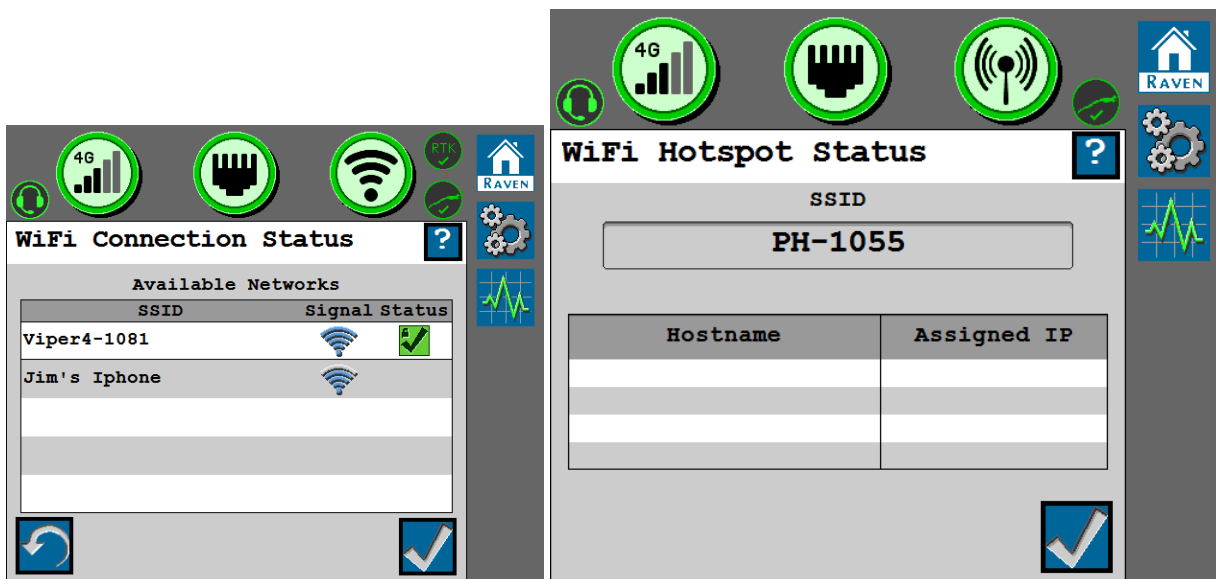
Displays the IP address which the RS1™ will broadcast to connected devices.

Link Speed

The speed data can pass from the RS1™ to connected devices.

Wi-Fi® Connection and Hotspot Status Page

Select the Wi-Fi® Status icon to view either the Wi-Fi® Connection or Hotspot Status pages.



Connection Status

Note: The Wi-Fi® Connection Status page is displayed when the RS1™ is configured as a Wi-Fi® client device and will connect to available Wi-Fi® networks.

Service Set Identifier (SSID)

The name of any available Wi-Fi® networks detected by the RS1™.

Signal

Signal strength of each network detected by the RS1™.

Status

The status column displays a green check mark icon if the RS1™ is connected to one of the detected Wi-Fi® networks.

Hotspot Status

Note: The Wi-Fi® Hotspot Status page is displayed when the RS1™ is configured to broadcast a Wi-Fi® signal to which Wi-Fi® enabled devices may connect.

Service Set Identifier (SSID)

The Service Set Identifier (SSID) is a wireless network identifier name that connects to via a Wi-Fi® network.

Hostname

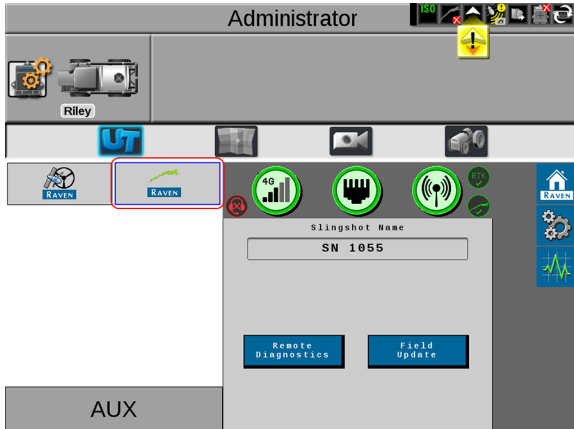
The hostname is the name of any device that is connected to the RS1™.

Assigned IP

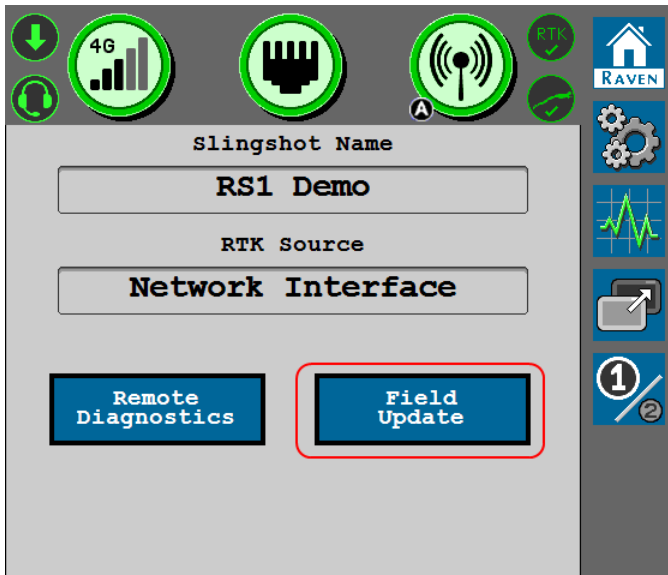
The IP address given to the device when it connects to the RS1™.


RS1™ Field Update

1. Select the **Slingshot®**  button from the UT menu.

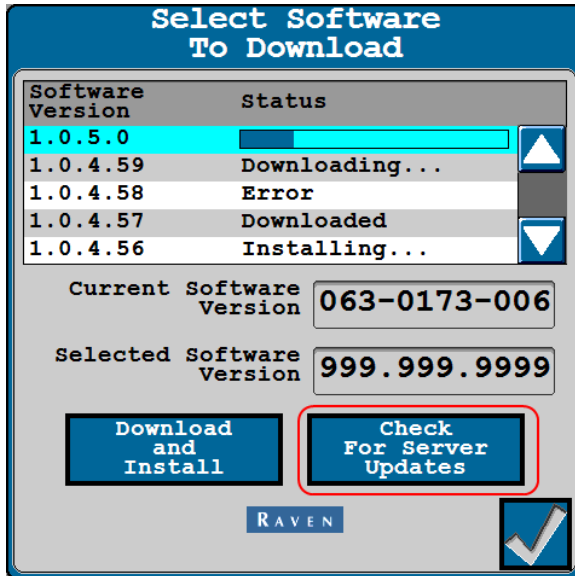



2. On the Slingshot® home page, select the **Field Update** button.

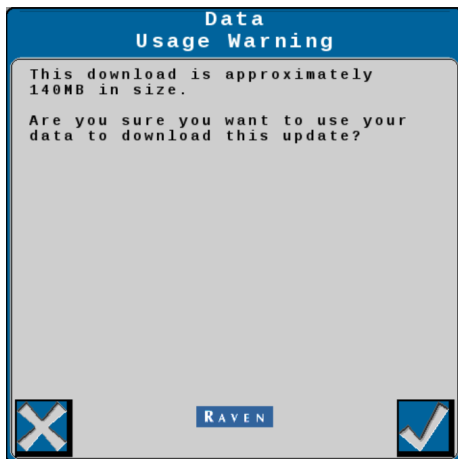


Note: A status icon  will display in the upper, left corner of the Slingshot® home page when an update is in progress.

3. Select the **Check for Server Updates** button to view the latest software updates available for the RS1™ unit.

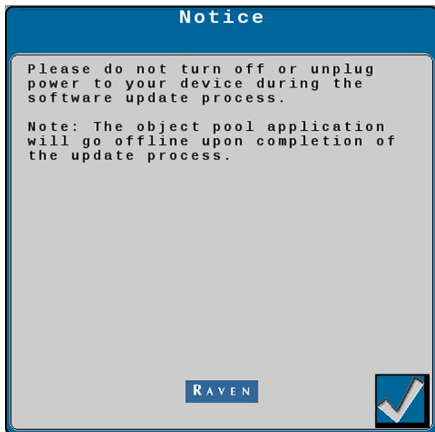


4. Use the scrolling list to select the desired software version to apply to the RS1™.
5. Select the **Download and Install** button.
6. A warning prompt is displayed with information about cellular data usage. To proceed with the download, select the **Accept**  button.



7. Allow the system to download the selected software version.

8. Select the **Accept**  to install the software version.

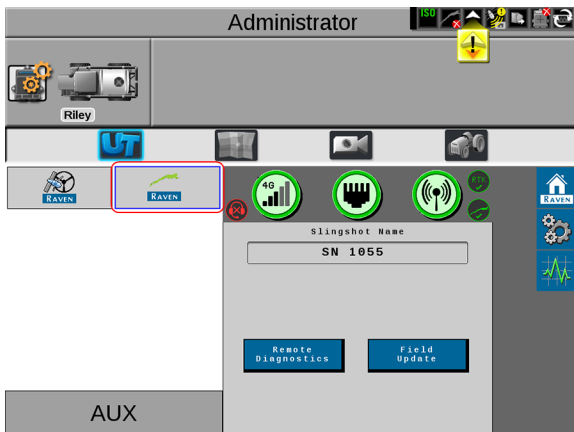


Note: Do not power off the RS1™ or field computer during the software update.

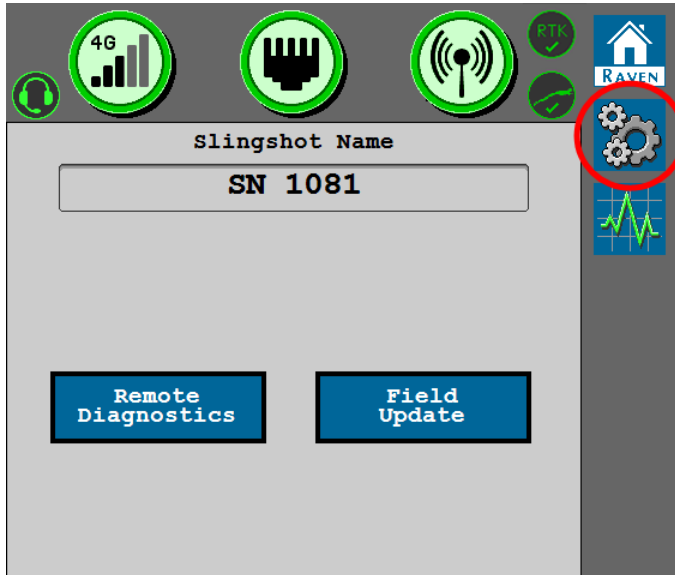
Slingshot® System Settings

Open the Tools menu to review or adjust current Slingshot® communication options and settings and RTK correction information. To review Slingshot® system options:

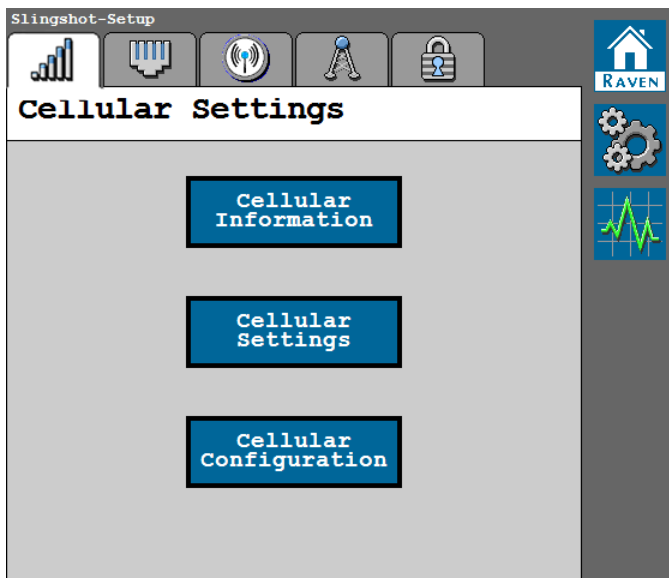
1. Select the **Slingshot®**  button from the UT menu.



- From the Slingshot® Home page, select the **Tools**  button.



- The Tools menu page displays with the various tabs. Review the following sections for additional assistance with the available settings, features, and options.

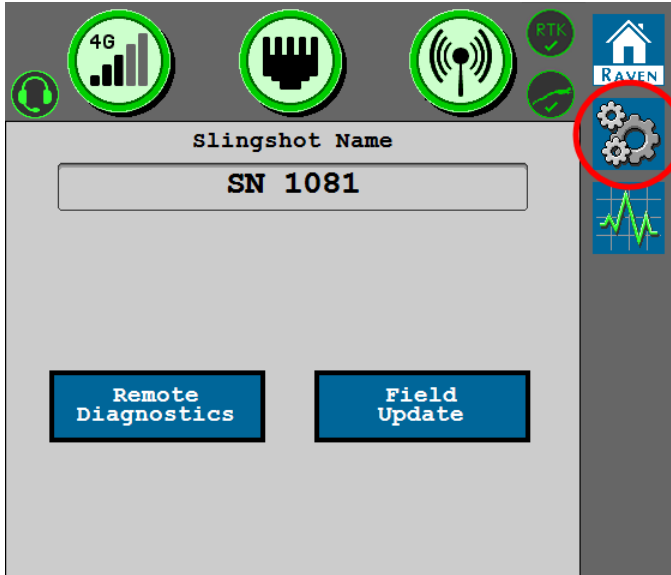


Cellular Information

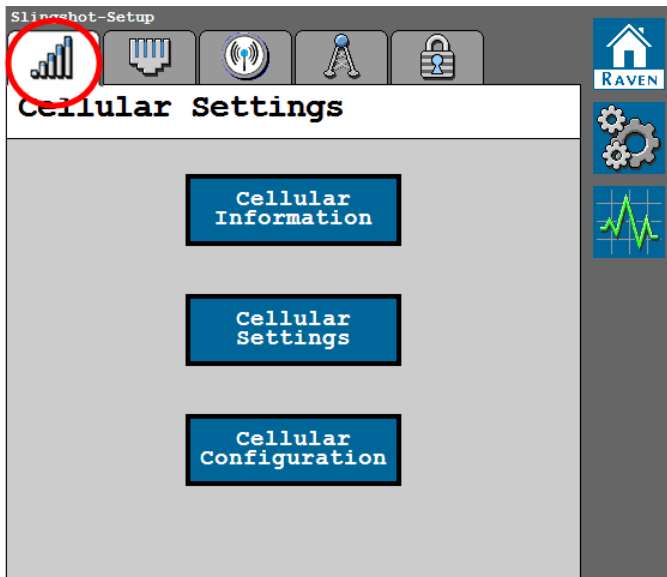
The Cellular Information page provides cellular features, options, and configuration of the RS1™ cellular modem.

Note: Refer to Slingshot® Cellular Settings and Cellular Settings for additional assistance with available modem configuration and settings.

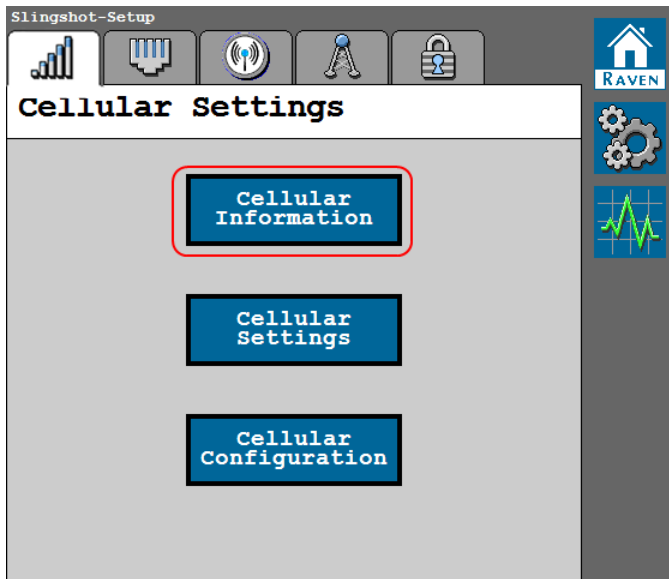
1. From the Slingshot® Home page, select the **Tools**  button.



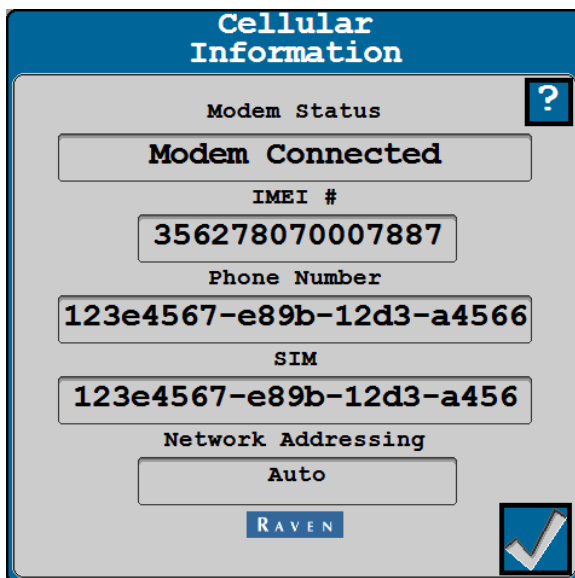
2. Select the **Cellular Settings**  tab.



3. Select the **Cellular Information** button.



4. The Cellular Information page displays the following modem configuration details.



Modem Status

Review the following for a description of the possible modem status messages.

- Cellular APN - The current APN used by the cell modem. If "Not Available" is displayed, either no cellular connection is established or the user did not enter an APN.
- WAN - Displays the Wide Area Network (WAN) IP address from which the cell modem is receiving.

- Cell Signal - Displays the current RSSI (signal strength) of the cell modem.
- Cell Service - Displays the current cell service connection type.
- Roaming Status - Cell modem is roaming.

IMEI

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

Phone Number

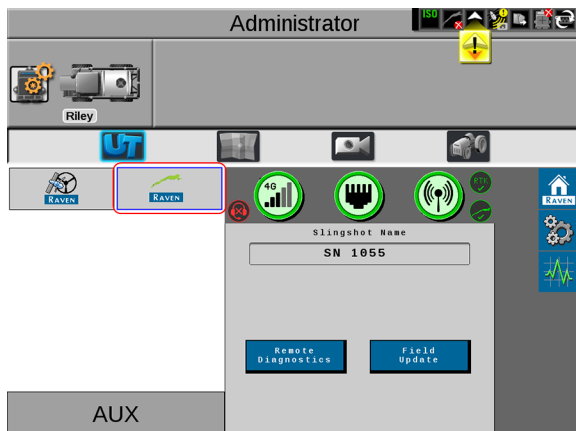
Displays the phone number assigned to the SIM card in the RS1™ modem when an valid data plan is active.

SIM

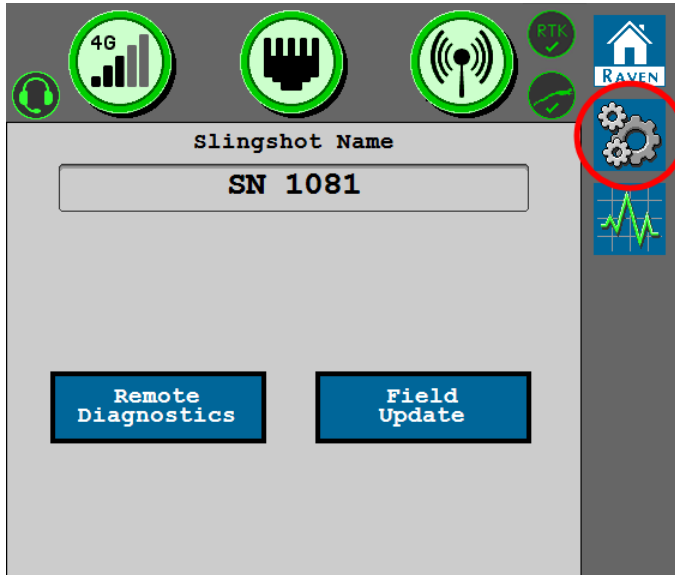
Displays the identification number associated with the SIM card currently in use in the RS1™ system.

Ethernet Settings Tab

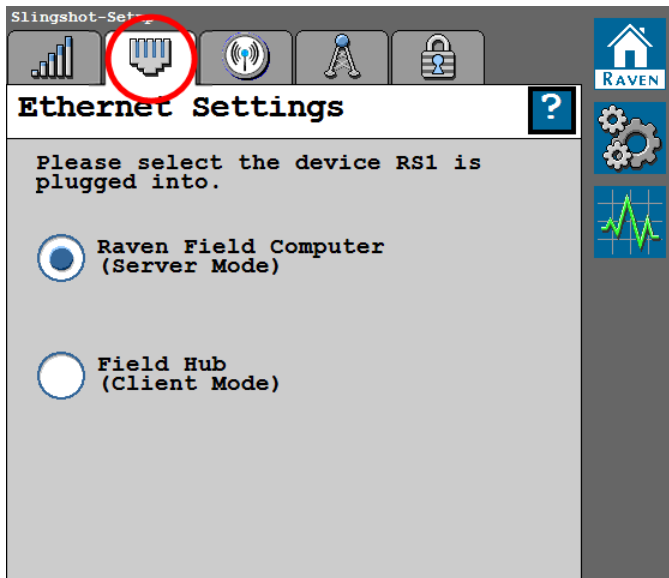
1. Select the **Slingshot®**  button from the UT menu.



- From the Slingshot® Home page, select the **Tools**  button.



- Select the **Ethernet Settings** tab.



- Use the toggle option to set the modes for the Ethernet connection in the RS1™ unit.

Raven Field Computer (Server Mode)

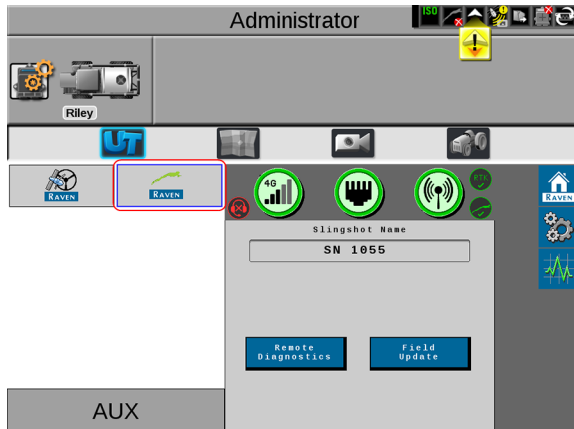
Select this mode when the RS1™ unit is directly connected to the field computer via an Ethernet cable.

Field Hub (Client Mode)

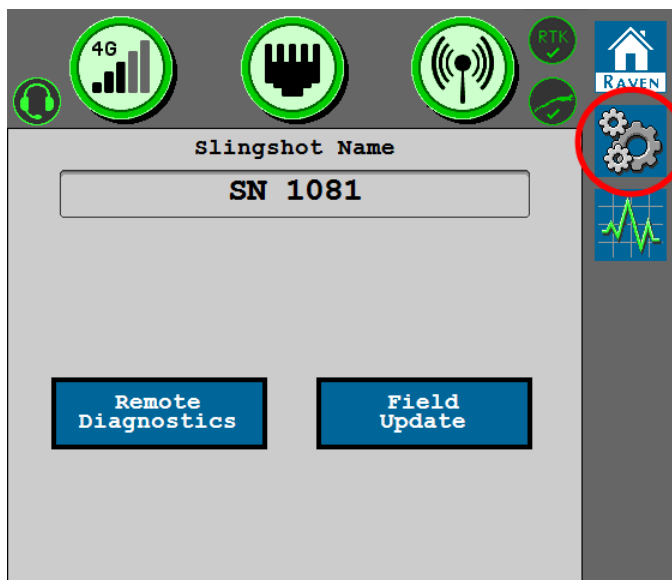
Select this mode when the RS1™ unit is directly connected to the field hub via an Ethernet cable.

Wi-Fi® Settings

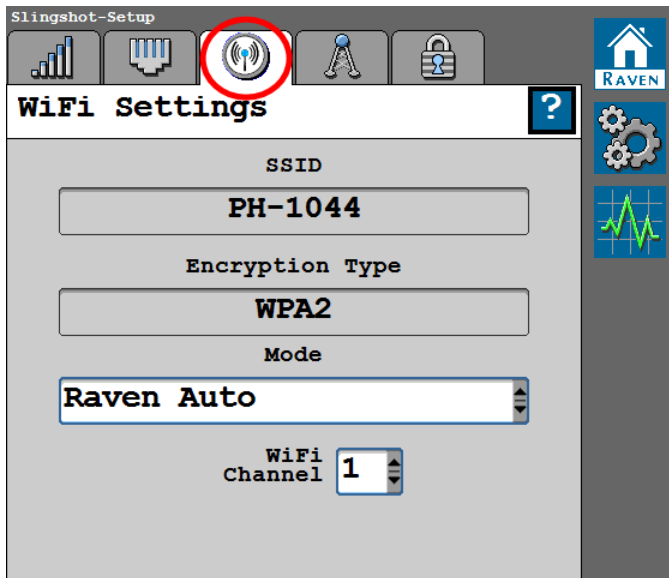
1. Select the **Slingshot®**  button from the UT menu.



2. From the Slingshot® Home page, select the **Tools**  button.



3. Select the Wi-Fi® Settings tab. The following information and options are presented for the operator.



SSID

Displays the Wi-Fi® SSID (network name).

Note: The SSID cannot be modified by the operator.

Encryption Type

Displays the encryption mode applied to the RS1™ Wi-Fi® hot spot.

Note: Encryption settings cannot be modified by the operator.

Mode

Select the mode for Wi-Fi® or Hotspot operation.

Manual Client

Select **Manual Client** to manually connect to available Wi-Fi® networks.

Manual Hotspot

Select **Manual Hotspot** to broadcast a hotspot for local Wi-Fi® devices.

Raven Auto

Select **Raven Auto** to allow the system to automatically select the best Wi-Fi® network connection. To change which Wi-Fi® network the system is connected to, select the Manual

Client mode.

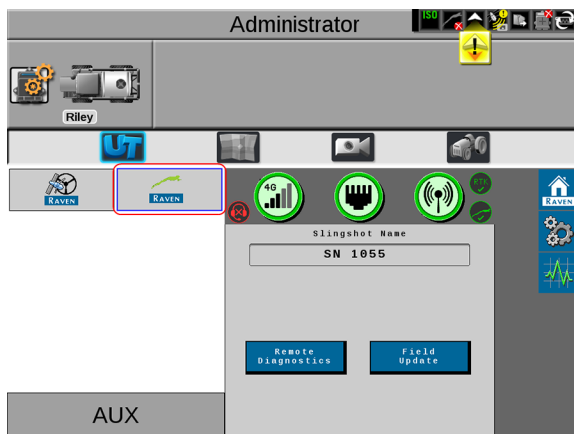
Note: When set to Raven Auto, a small “A” indicator will be displayed to indicate Raven is controlling the Hotspot and Wi-Fi® settings for the system.

Wi-Fi® Channel

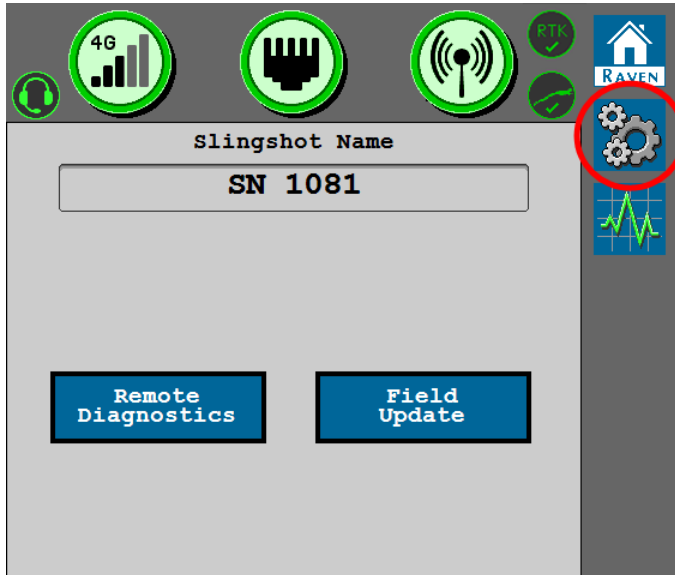
Displays the channel the Wi-Fi® hot spot is currently using. If the operator is experiencing a issues with connectivity or staying connected, adjusting these settings may improve connectivity issues. This setting can be modified by the operator. The Wi-Fi® password can only be modified through the Slingshot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

RTK Source Settings

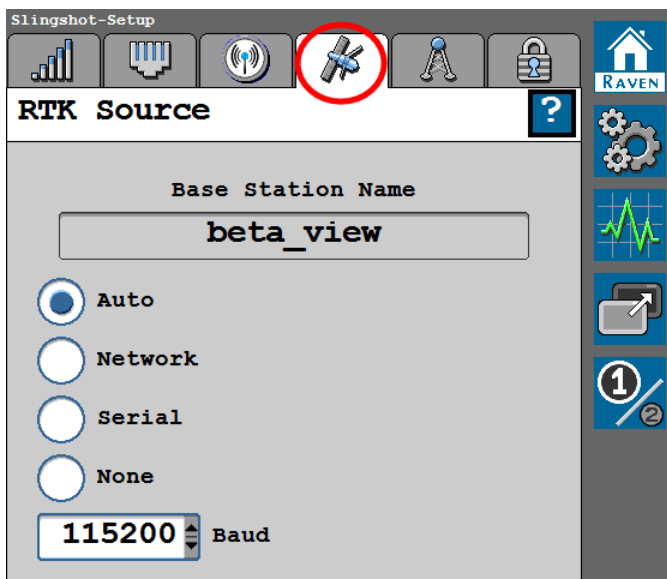
1. Select the **Slingshot®**  button from the UT menu.



- From the Slingshot® Home page, select the **Tools**  button.



- Select the **RTK Source**  tab.



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

Note: RTK must be unlocked to display the settings and information below. Contact a local Raven dealer for additional assistance with feature unlock codes and activation. Review "Feature Unlocks" on page 138 for assistance with entering an unlock code if this tab displays the "RTK Is Not Unlocked" message.

Base Station Name

The ID of the base station from which RTK corrections are received.

RTK Source Toggle Option

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

Network

Select if the source is provided via the Slingshot® server, either through Ethernet or cellular receiver.

Serial

Select if the source is provided via serial input to the RS1™ unit.

None

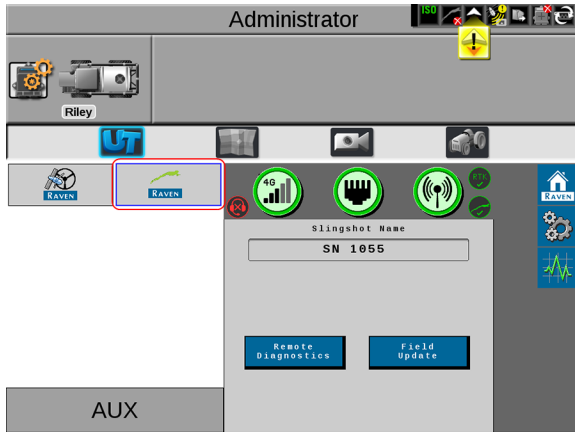
Use this setting to turn off a source if there are multiple RTK over CAN devices on the system.

Baud

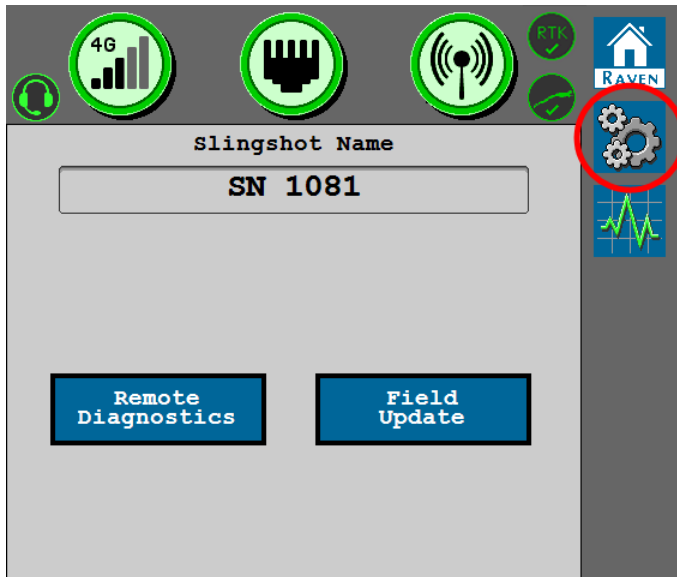
Use the drop-down option to set the baud rate for correction information from the base station.

Radio Link Settings

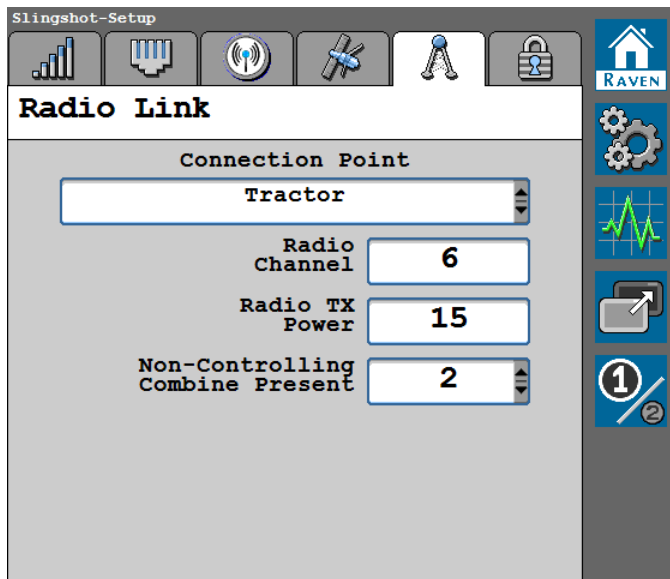
1. Select the **Slingshot®**  button from the UT menu.



2. From the Slingshot® Home page, select the **Tools**  button.



3. Select the **Radio Link**  tab. The following options and settings are presented.



Connection Point

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

Radio Channel

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

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

Radio Tx (Transmit) Power

The radio signal power to transmit to other radios in the autonomous system. The value must be between 10 and 30.

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

Non-Controlling Combine Present

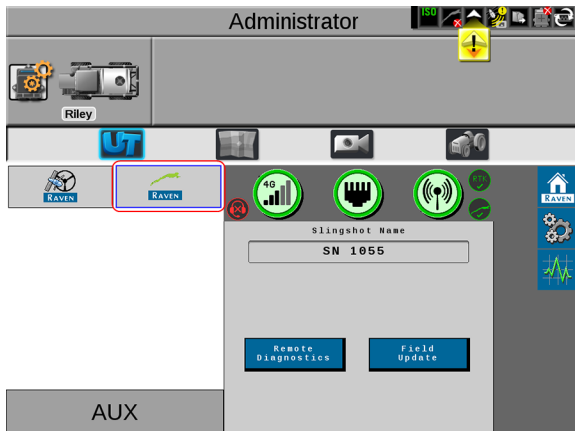
Use the drop down list to set the number of non-controlling combines present during field operations.

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

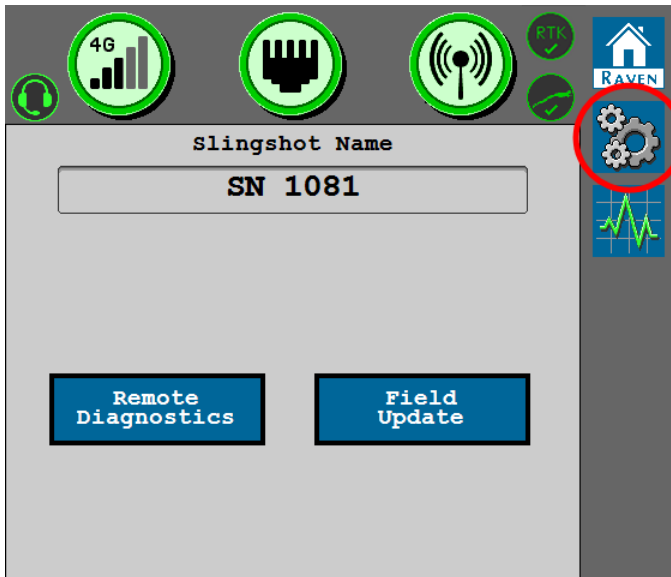
Feature Unlocks

To unlock and activate features on the RS1™ Slingshot® modem:

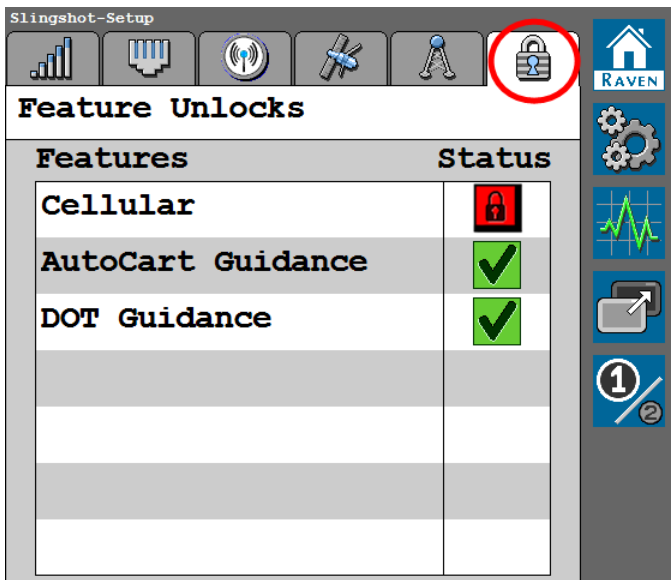
1. Select the **Slingshot®**  button from the UT menu.



- From the Slingshot® Home page, select the **Tools**  button.

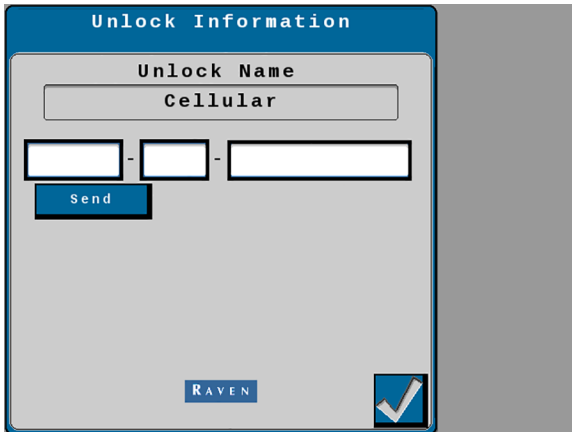


- Select the **Feature Unlocks**  tab.



- To unlock an available feature, select the red **Padlock** icon in the Status column.

5. Enter the feature unlock code.



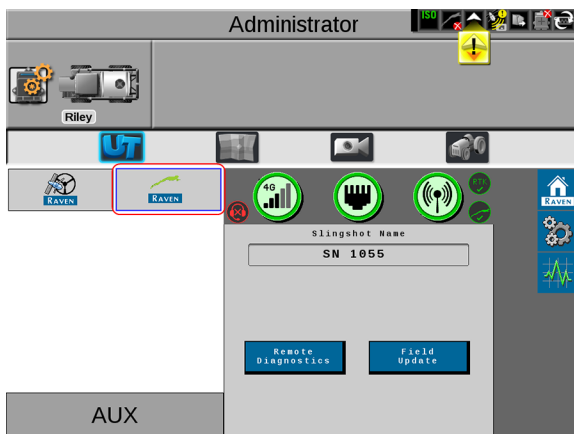
6. Select the **Send** button


Note: If the code is invalid, a message is displayed below the unlock code field.

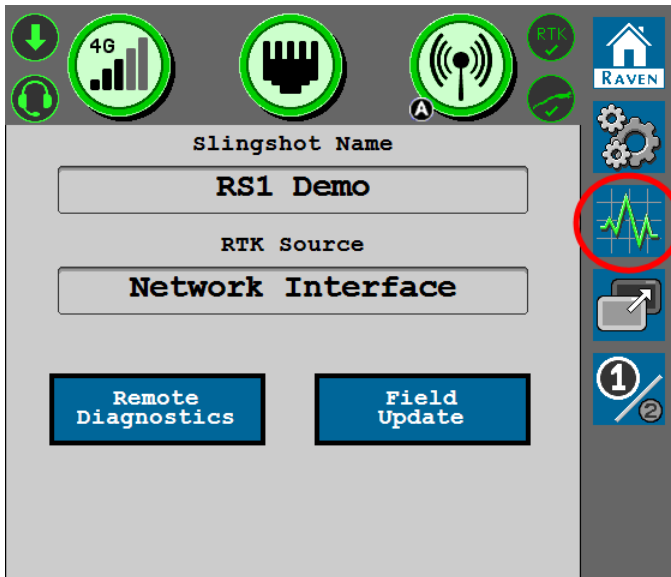
7. Select the **Accept** button to return to the Feature Unlocks page. Once the feature is successfully unlocked, the icon next to the feature will turn green.


Slingshot® Diagnostic System Information

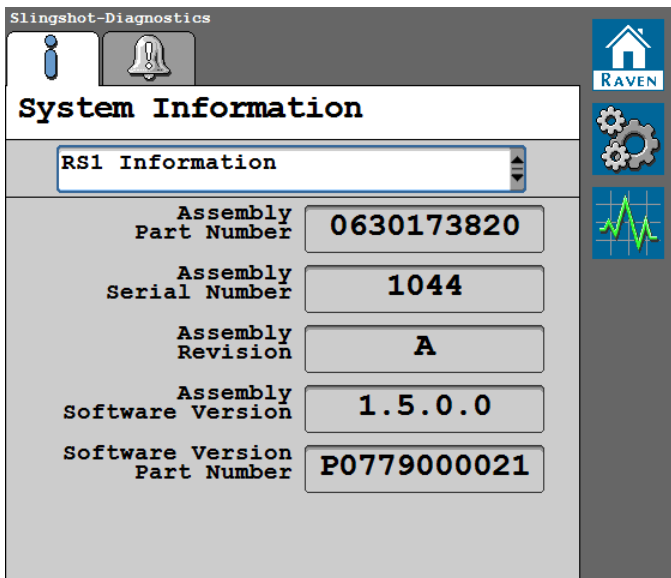
1. Select the **Slingshot®**  button from the UT menu.



- From the auto-steer home page Home page, select the **Diagnostic**  button.



- Select the **System Information**  tab. Use the drop-down list at the top of the page to select the desired system information for display and review.



RS1™ Information



Slingshot-Diagnostics

System Information

RS1 Information

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

RAVEN



GPS Receiver



Slingshot-Diagnostics

System Information

GPS Receiver

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

RAVEN



Steering Guidance Controller

The screenshot shows the 'Slingshot-Diagnostics' application window. At the top left, there are icons for information and notifications. The title bar reads 'Slingshot-Diagnostics'. Below the title bar, there are three icons: a house icon labeled 'RAVEN', a gear icon, and a waveform icon. The main content area is titled 'System Information' and features a dropdown menu currently set to 'Steering Guidance Controller'. Below the dropdown, there are five rows of information, each with a label and a corresponding value in a text box:

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

Cell Modem

The screenshot shows the 'Slingshot-Diagnostics' application window. At the top left, there are icons for information and notifications. The title bar reads 'Slingshot-Diagnostics'. Below the title bar, there are three icons: a house icon labeled 'RAVEN', a gear icon, and a waveform icon. The main content area is titled 'System Information' and features a dropdown menu currently set to 'Cell Modem'. Below the dropdown, there are two rows of information, each with a label and a corresponding value in a text box:

Model Number	LE910-SVG
Firmware Version	17.01.571

Hours

The screenshot shows the 'System Information' page in the Slingshot-Diagnostics application. A dropdown menu is set to 'Hours'. The page displays four data points in a grid format:

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

On the right side of the interface, there is a vertical toolbar with icons for Home (RAVEN), Settings (gears), and a waveform graph.

Hardware Diagnostics

The screenshot shows the 'System Information' page in the Slingshot-Diagnostics application. A dropdown menu is set to 'Hardware Diagnostics'. The page displays various hardware metrics in a grid format:

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


On the right side of the interface, there is a vertical toolbar with icons for Home (RAVEN), Settings (gears), and a waveform graph.

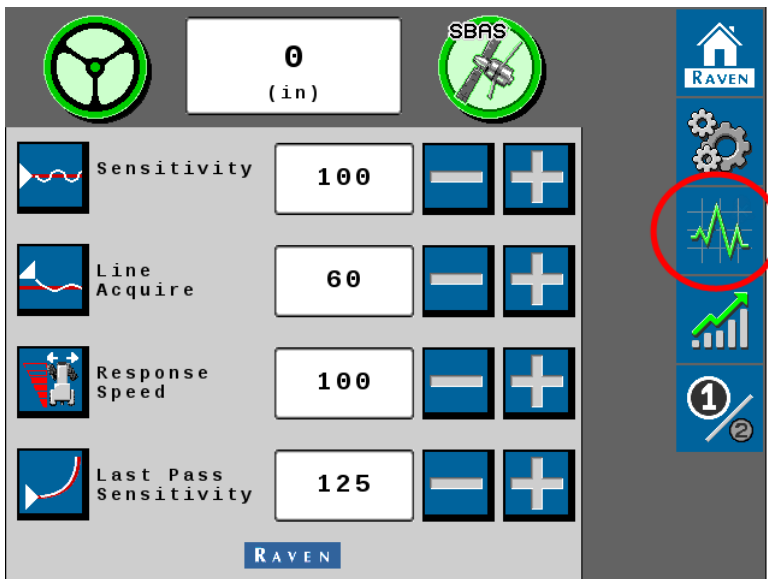
Diagnostics and Troubleshooting

Diagnostic Trouble Codes (DTCs)	145
Performance Monitor	172
System Tests	174
SGC System Information	194

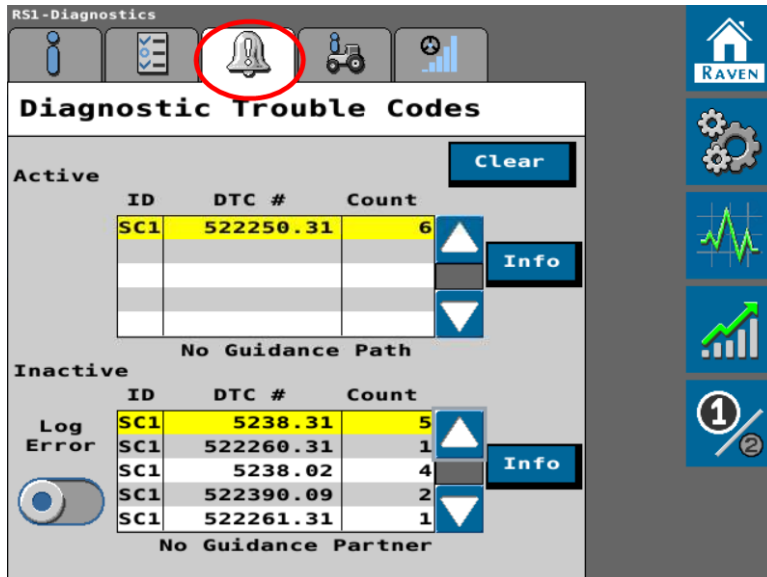
Diagnostic Trouble Codes (DTCs)

Note: Refer to "DTC List for RS1™ and SC1™/TC1™" on page 147 or "DTC List for DirecSteer, HDU, MDU, and IDU " on page 161 for a complete list of DTCs.

1. From the auto-steer home page Home page, select the **Diagnostic**  button.

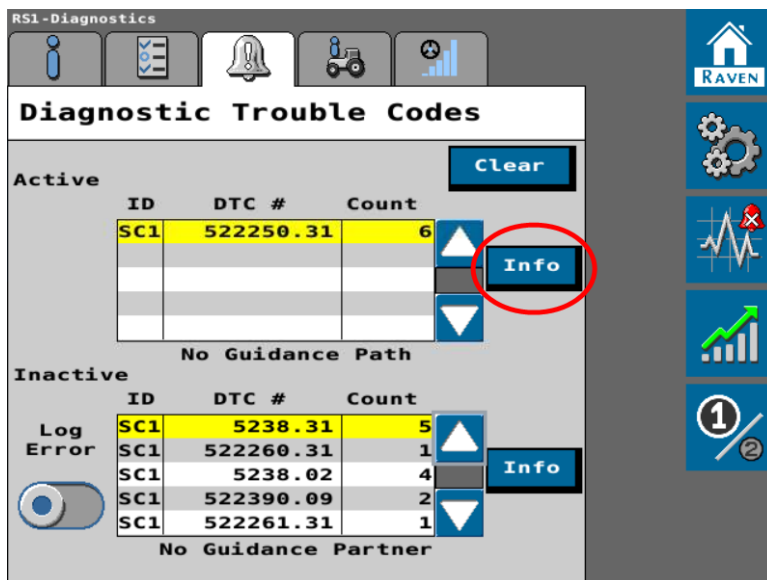


2. Select the **Diagnostic Trouble Codes**  tab to view active and inactive DTCs.

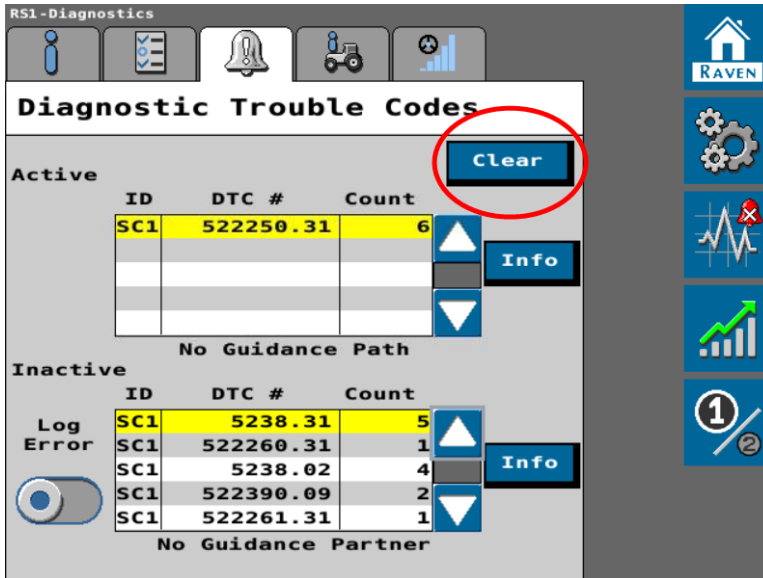


Note: Active DTCs are conditions currently detected by the system. Inactive DTCs are conditions which have been detected, but are not currently active during steering system operations. Active DTCs may require attention before the auto-steering operations can be enabled. Once an active DTC has been corrected, the code moves to the inactive DTC list.

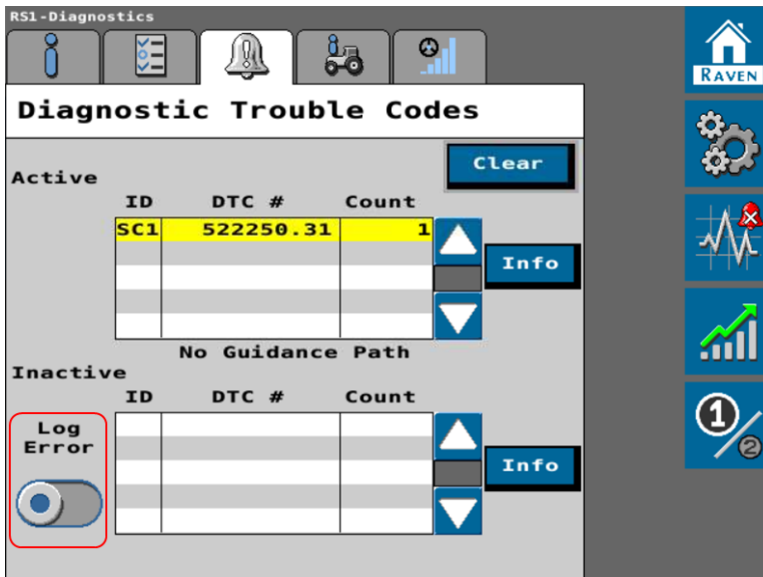
3. Select the **Info** button to display the complete description of the highlighted active or inactive DTC.



4. Select the **Clear** button to delete the DTCs from the Inactive DTC error log.



5. Select the **Log Error** toggle to record a random failure condition.



DTC List for RS1™ and SC1™/TC1™

An operator may encounter the following Diagnostic Trouble Codes (DTCs) when using the Steering Guidance Controller (SGC) during auto-steering operations.

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

Code ID		Description	Recommended Actions
		Maximum engage speed engage warning.	<ul style="list-style-type: none"> • 16.1 km/h [10 mph] for machines operating in Europe with homologation terms accepted. • 29 km/h [18 mph] for tracked machines and swathers. • 43.5 km/h [27 mph] for units capable of high-speed steering and not subject to homologation terms. <p>Note: Contact a local Raven dealer for additional assistance with high-speed steering unlocks.</p>
88	.1	Too slow to engage.	Increase machine speed above 0.5 km/h [0.3 mph] (or 0.1 km/h [0.1 mph] when using RTK corrections) to engage auto-steering.
168	.3	High voltage.	Check battery voltage.
	.4	Low voltage.	
621	.11	GPS receiver error: LNA failure.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.31	GPS receiver error: antenna power.	
	.4	GPS receiver error: antenna shorted.	
	.5	GPS receiver error: antenna open.	
628	.13	Memory error.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
630	.13	System not calibrated.	Complete the initial calibration to engage the Steering Guidance Controller (SGC). Review the appropriate section of the Initial Tuneset Calibration for assistance with the calibration process.

Code ID		Description	Recommended Actions
	.31	Steering calibration recommended.	Complete a steering control calibration. Review the "Steering Control Calibration" on page 83 for additional assistance.
701	.3	Resume switch stuck on.	<ol style="list-style-type: none"> 1. Check the resume switch cabling and connections. 2. Confirm the resume switch functionality in the universal terminal (UT).
841	.0	GPS not converged.	<ol style="list-style-type: none"> 1. Wait for GNSS to converge (up to 30 minutes). Review the GNSS Correction Options chart for expected convergence times for various correction sources. 2. Cycle power to the machine.
	.11	GPS error.	<ol style="list-style-type: none"> 1. Ensure the SGC is calibrated and the desired differential source is unlocked. 2. Wait for GNSS to converge (up to 30 minutes). Review the GNSS Correction Options chart for expected convergence times for various correction sources. 3. Ensure that NMEA 2000 is selected. Review the "Guidance and GNSS Calibration" on page 19 for additional information.
	.15	Poor GPS position accuracy.	<ol style="list-style-type: none"> 1. Ensure that the GNSS quality is as expected for the correction source. Review GNSS Status for additional information. 2. Adjust the position accuracy to allow greater tolerance for the current GNSS position accuracy.
1504	.2	Operator not present.	<ol style="list-style-type: none"> 1. Check presence switch cabling and connections. 2. Confirm presence switch functionality in the universal terminal (UT).
2901	.2	Incompatible hardware.	A machine specific tuneset has not been developed for the combination of machine type and valve type. Select a generic machine type and recalibrate the auto-steer system.

Code ID		Description	Recommended Actions
3045	.31	Authorization denied.	<ol style="list-style-type: none"> 1. Check the steering guidance controller (SGC) cabling is properly connected. 2. Check connectors for bent or pins pushed in and not making proper connection.
5238	.2	Invalid curvature.	<ol style="list-style-type: none"> 1. Check cabling and connections to the steering partner (steering valve). 2. Cycle power to the steering valve. 3. Update the steering partner/valve software.
	.31	Loss of SCU communication.	<p>The steering guidance controller (SGC) previously registered a steering partner but is not currently communicating with the expected partner.</p> <ol style="list-style-type: none"> 1. Check cabling and connections to the steering partner (steering valve). 2. Cycle power to the machine. 3. Check the software version of the steering partner (steering valve) and confirm compatibility with the steering guidance controller (SGC) software.
5241	.31	Disengage switch is in the off position.	<ol style="list-style-type: none"> 1. Check the disengage switch status in the universal terminal (UT). Status in the UT should only be active (red status indicator) when the steering wheel is moving. 2. If the disengage switch status is red (activity detected) while the steering wheel is stationary, increase the disengage threshold. Review the "Steering Disengage Settings" on page 91 for assistance. <p>Note: For best results, set the disengage value to the minimum value necessary to disengage auto-steering.</p> 3. Check the disengage switch cabling and connections.

Code ID		Description	Recommended Actions
			4. Check the sensor voltage (5 V) and current (4 - 20 mA). Review the "Steering Disengage Settings" on page 91 for assistance with disengage switch settings.
5243	.2	Master switch is in the off position.	<ol style="list-style-type: none"> 1. Toggle the master switch ON or to field mode. 2. Toggle the hydraulic lock switch to the unlocked state. 3. Check CAN communication to the steering partner (steering valve).
5613	.11	Field terrain compensation not calibrated.	Perform the terrain compensation calibration. Refer to "GNSS Terrain Compensation" on page 103.
	.13	Terrain compensation not calibrated.	Perform the terrain compensation calibration. Refer to "GNSS Terrain Compensation" on page 103.
	.2	Inertial navigation system (INS) data invalid.	<ol style="list-style-type: none"> 1. Perform the terrain compensation calibration. Refer to "GNSS Terrain Compensation" on page 103. 2. Verify inertial sensor functionality in the universal terminal.
	.31	GPS receiver error: INS reset.	Cycle power to the machine.
516118	.14	Toggle autonomy switch to the OFF position.	Toggle the autonomy switch to the OFF position.
	.17	Autonomy switch in the OFF position.	<ol style="list-style-type: none"> 1. Toggle the autonomy switch to the ON position. 2. Check switch cabling and connections.
	.2	Machine not configured for automation.	Complete a calibration with autonomous features enabled. Complete provisioning procedures for autonomous machine operations.
516119	.2	Lockout switch	Check cabling and connections.

Code ID		Description	Recommended Actions
		invalid.	
	.31	Lockout switch pressed.	Toggle the lockout switch OFF. If the issue persists, check the lockout switch cabling and connections.
522240	.16	GGA rate high.	Cycle power to the machine.
	.18	GGA rate low.	
	.31	No GPS comm.	<ol style="list-style-type: none"> 1. Leave the SGC powered on for 10 minutes. 2. Cycle power to the machine.
522242	.16	ZDA rate high.	Cycle power to the machine.
	.18	ZDA rate low.	
522250	.0	End of line error.	Contact the Raven Technical Service team for additional assistance.
	.15	Maximum point space error.	
	.16	Segment angle error.	
	.17	Minimum point space error.	
	.2	Curvature invalid.	<ol style="list-style-type: none"> 1. Reset or update the field computer. 2. Contact a local Raven dealer for additional assistance.
	.31	No guidance path.	<ol style="list-style-type: none"> 1. Cycle power to the Raven field computer or UT display. 2. Ensure the Raven field computer is used for guidance. 3. Start a job and create an A-B guidance path.
	.7	Maximum cross-track error (XTE) exceeded.	<ol style="list-style-type: none"> 1. Recalibrate the auto-steer system, including the hydraulic calibration. 2. Check hydraulic steering performance. Refer to the "Wheel Control Settings" on page 79 for assistance.
	.8	Look-ahead too large.	Contact the Raven Technical Service team for additional assistance.

Code ID		Description	Recommended Actions
522260	.31	No guidance partner.	<p>Field computer is not registered as a guidance partner.</p> <ol style="list-style-type: none"> 1. Cycle power to the Raven field computer or UT display. 2. Update the field computer software version.
522261	.31	No steering control unit (SCU) detected.	<ol style="list-style-type: none"> 1. Check cabling and connections to the steering partner (steering valve). 2. Cycle power to the machine. 3. Update the steering partner (steering valve) firmware. 4. Check for CAN communication errors between the steering valve and the steering guidance controller (SGC) including CAN terminators and wiring.
522262	.11	DirecSteer overload error.	<p>DirecSteer is unable to move for too long. For example, holding the steering wheel when the unit is trying to steer.</p> <ol style="list-style-type: none"> 1. DirecSteer steering effort is too high. <ol style="list-style-type: none"> i. Ensure that the machine speed is at least 1.6 km/h [1 mph]. ii. Check for obstructions to steering wheel movement. 2. Check power and ground connections. 3. Check cabling for shorts or loose connections. 4. Check the machine battery voltage.
	.12	DirecSteer high temperature error.	<p>Internal temperature of the unit is too high.</p> <ol style="list-style-type: none"> 1. Disable or shutdown DirecSteer and allow unit to cool down. 2. Check power and ground connections. 3. Check steering wheel for binding or increased steering effort.

Code ID		Description	Recommended Actions
	.19	DirecSteer hall error.	Hardware failure. 1. Contact a local Raven dealer for additional assistance.
	.3	DirecSteer over-volt error.	DirecSteer supply voltage is too high. 1. Check the power and ground connections. 2. Check cabling for shorts or loose connections. 3. Check the machine battery voltage.
	.4	DirecSteer under-volt error.	DirecSteer supply voltage is too low. 1. Check power and ground connections. 2. Check cabling for broken or frayed wiring.
	.6	DirecSteer over-current error.	DirecSteer current draw is too high. 1. Check power and ground connections.
	.8	DirecSteer phase error.	Hardware failure. 1. Contact a local Raven dealer for additional assistance.
522268	.31	No field computer.	Check cabling and connections between the field computer and the steering guidance controller (SGC).
522390	.9	Engage switch error.	1. Check the resume switch status in the universal terminal (UT). Ensure that the status changes when the engage switch is pressed. 2. Check cabling and connections to the resume switch.
522810	.14	Vision mode invalid partner.	VSN® is not supported by MDU steering systems. Switch to GPS guidance or contact a local Raven dealer for assistance with upgrading to HDU steering.
522811	.14	Roadway homologation terms.	Homologation terms not accepted by the operator. Accept the terms of the roadway homologation. Review "Roadway Homologation" on page 203.
522812	.16	Heading out of range.	This DTC is expected when turning around such as on end rows. If this DTC triggers during straight A-B path

Code ID		Description	Recommended Actions
			guidance, check the steering guidance controller (SGC) mounting.
522814	.14	Guidance width required.	A guidance width or working width must be programmed into the field computer or universal terminal (UT).
522815	.13	No four wheel support.	Selected machine tuneset does not support four-wheel steering. Contact a local Raven dealer for additional assistance.
522818	.13	Brake connection failed.	<ol style="list-style-type: none"> 1. Check hydraulic connections. 2. Check pressure sensor cabling and connections. 3. Validate brake function by attempting to enter automation.
522820	.18	System pressure low.	Check pressure sensor connection and check hydraulic lines and fluid level.
522821	.16	Maximum propulsion speed.	Raise the maximum speed, if desired.
522826	.16	Invalid pitch.	<p>A pitch greater than 15° has been detected for an extended period of time.</p> <ol style="list-style-type: none"> 1. Confirm that the steering guidance controller (SGC) is mounted securely to a flat surface. 2. Confirm that any sunroof is closed. <p>If the issue persists, recalibrate the terrain compensation. Review "GNSS Terrain Compensation" on page 103.</p>
523766	.31	Steering control partner serial number mismatch.	Select the correct steering profile or connect the correct machine and steering guidance controller (SGC).
523827	.0	Reverse steer not supported.	Reverse steering is not supported on this machine. If the machine is moving forward when this DTC is triggered, select the direction toggle icon in the field computer or universal terminal (UT).

Code ID		Description	Recommended Actions
523830	.31	Steering not unlocked.	Enter a steering unlock code. An unlock code is not necessary if using a SmarTrax™ MD unit.
523832	.0	GPS mode not unlocked.	Select a different GNSS correction type or Contact a local Raven dealer for additional assistance with feature unlock codes and activation.
523832	.0	GPS mode not unlocked.	Select a different GNSS correction type or Contact a local Raven dealer for additional assistance with feature unlock codes and activation.
523839	.31	Selected tuneset not released.	<ol style="list-style-type: none"> 1. Update the steering guidance controller (SGC) software for the latest list of released tunesets. 2. Recalibrate the steering guidance controller (SGC) using a generic tuneset.
523842	.31	Liability acceptance.	Accept the steering guidance controller (SGC) liability.
523843	.0	Lost internal communication.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Ensure proper CANbus termination. 3. Check cabling and that cable connections are properly seated.
523844	.11	GPS receiver error.	Cycle power to the machine.
523845	.16	GPS receiver error: temperature.	
523846	.16	GPS receiver error: voltage.	
523847	.31	GPS receiver error: CPU overload.	
523848	.2	GPS receiver error: COM1 buffer overrun.	
523849	.2	GPS receiver	

Code ID		Description	Recommended Actions
		error: COM2 buffer overrun.	
523850	.2	GPS receiver error: COM3 buffer overrun.	
523851	.2	GPS receiver error: link overrun.	
523852	.31	GPS receiver error: auxiliary transmit overrun.	
523853	.3	GPS receiver error: AGC out of range.	
523854	.11	GPS receiver error: almanac.	
523855	.31	GPS receiver error: position solution.	
523856	.31	GPS receiver error: position fixed.	
523857	.31	GPS receiver error: clock steering.	
523858	.31	GPS receiver error: clock model.	
523859	.31	GPS receiver error: external oscillator locked.	
523860	.31	GPS receiver error: software	

Code ID		Description	Recommended Actions
		resource.	
523861	.31	GPS receiver error: auxiliary 3 event.	
523862	.31	GPS receiver error: auxiliary 2 event.	
523863	.31	GPS receiver error: auxiliary 1 event.	
523864	.31	GPS source mismatch	Machine and implement steering systems are using different correction types. Ensure that both the machine and the implement are configured for the same correction type.
523868	.31	G-force limit active.	The maximum G-force has been reached during line acquire or curvature steering operation. Contact the Raven Technical Service team for additional assistance.
523874	.13	Memory communication error.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
523875	.13	SCU software out of date.	Update the steering guidance controller (SGC) or steering controller unit (SCU) software.
523898	.31	OEM engage error.	Field computer on-screen engage switch not supported. Use the machine engage switch to initiate auto-steer.
523913	.31	GPS invalid authorization.	<p>Some correction types require an unlock code. Either the code was not entered correctly or an existing code has expired.</p> <p>Review "Feature Unlocks Tab" on page 59 for information on entering unlock codes. Contact a local Raven dealer for additional assistance with feature unlock codes and activation.</p>

Code ID		Description	Recommended Actions
523916	.13	SC1™ software out of date.	Update the steering guidance controller (SGC) software version.
523918	.2	GPS receiver error: input over-run.	Cycle power to the machine.
523919	.31	GPS receiver error: jammer detected.	
523920	.2	GPS receiver error: IMU communication failure.	
523921	.31	GPS receiver error: tracking mode.	
523922	.31	GPS receiver error: digital filter enabled.	
523923	.0	VSN® data invalid warning.	
523924	.0	VSN® data invalid error.	VSN® guidance vectors not valid. Restart the VSN®.
523925	.2	No row camera communication.	VSN® times out after 10 seconds. Check cabling and that cable connections are properly seated.
523926	.31	No user activity.	Check operator switch settings and operator switch cabling and connections if present.

Code ID		Description	Recommended Actions
523927	.31	VSN® only needs task controller (TC)	VSN® requires a task controller. Open a job on a Raven field computer or universal terminal (UT) to use VSN® guidance.
523928	.13	Invalid factory calibration.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Contact a local Raven dealer for additional assistance.
573927	.31	VSN® only job required.	Start a job on the Raven field computer or universal terminal (UT) to use VSN® guidance.

DTC List for DirecSteer, HDU, MDU, and IDU

An operator may encounter the following Diagnostic Trouble Codes (DTCs) with a Steering Controller Unit (SCU) in auto-steering systems.

Code ID		Description	Recommended Actions
87	.0	Too fast to engage.	<p>Reduce machine speed below maximum engage speed to engage auto-steering. Maximum auto-steer engage speeds are as follows:</p> <ul style="list-style-type: none"> • 16.1 km/h [10 mph] for machines operating in Europe with homologation terms accepted. • 19 km/h [12 mph] for tracked machines and swathers. • 29 km/h [18 mph] for units capable of high-speed steering and not subject to homologation terms. <p>Note: Contact a local Raven dealer for additional assistance with high-speed steering unlocks.</p>
168	.3	HC (high current) high voltage.	<p>Input voltage is above the upper limit (32 V). Optimal system voltage should be 12 V.</p> <ol style="list-style-type: none"> 1. Check cabling for shorts or loose connections. 2. Check the machine battery voltage.
	.4	HC (high current) low	Input voltage is below the lower limit (9 V).

Code ID		Description	Recommended Actions
		voltage.	<ol style="list-style-type: none"> 1. Check cabling for broken or frayed wiring. 2. Check the machine battery voltage.
628	.2	NVM (non-volatile memory) warning.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.31	NVM (non-volatile memory) error.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
630	.13	SCU (steering controller unit) not calibrated.	Complete the tuneset calibration wizard to calibrated the SCU, HDU, or IDU. Refer to Initial Tuneset Calibration for assistance with completing the profile calibration wizard.
701	.2	Auto resume error.	<p>Resume switch is stuck ON.</p> <ol style="list-style-type: none"> 1. Check the resume switch and test functionality in the universal terminal (UT). Review the "Step Response Test" on page 175 for assistance with testing the switch. 2. Check resume switch cabling and that cable connections are properly seated.
702	.1	Master OFF.	Toggle the master switch to the ON position.
1385	.11	Node temperature error.	Temperature within the ECU exceeds the operational temperature range. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
1504	.14	OP (operator presence) active.	The operator override sensor is currently OFF and does not detect an operator in the operator seat. Review the "Step Response Test" on page 175 for assistance with testing the operator presence sensor.
	.31	Operator presence warning.	The operator override sensor is OFF. The steering system is about to disengage. Review the "Step Response Test" on page 175 for assistance with testing the operator presence sensor.

Code ID		Description	Recommended Actions
2901	.2	Incompatible hardware.	Update the steering guidance controller (SGC) software version. Refer to the Raven field computer operation manual for assistance with ECU updates.
3509	.13	Wheel Angle Calibration Incomplete	<p>Wheel angle sensor (WAS) center position calibration is incomplete. To complete the calibration:</p> <ol style="list-style-type: none"> Center the steering wheel and continue to drive at a speed above 2 km/h [1.2 mph] with the steering wheel in the center position for at least 5 seconds. Review "Wheel Angle and Implement Position Sensor Settings" on page 88 for additional assistance with calibrating the WAS position sensor. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.3	WAS supply high.	<p>Wheel angle sensor (WAS) signal voltage is above the expected range.</p> <ol style="list-style-type: none"> Recalibrate the WAS. Review the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with completing this procedure. Check mounting of the WAS or for damage to the WAS. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.31	WAS alignment fault.	<p>The wheel angle sensor (WAS) measurement is not aligned with the yaw rate sensor measurement.</p> <ol style="list-style-type: none"> Cycle power to the machine. Recalibrate the WAS. Review the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with completing this procedure.

Code ID	Description	Recommended Actions
		<ol style="list-style-type: none"> 3. Ensure cable connections are properly seated. 4. Check mounting of the WAS or for damage to the WAS.
	.4 WAS supply low.	<p>Wheel angle sensor (WAS) signal voltage is below the expected range.</p> <ol style="list-style-type: none"> 1. Recalibrate the WAS. Review the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with completing this procedure. 2. Check mounting of the WAS or for damage to the WAS. 3. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.5 SID 1 signal high.	<p>The disengage sensor signal (#1) is above the upper limit.</p> <ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Ensure cable connections are properly seated. 3. Contact a local Raven dealer for additional assistance.
	.6 SID 1 signal low.	<p>The disengage sensor signal (#1) is below the lower limit.</p> <ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Ensure cable connections are properly seated. 3. Contact a local Raven dealer for additional assistance.
4985	.9 No yaw rate.	<p>The steering control unit (SCU) is not receiving the yaw rate CAN message.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Inspect for damage to cables or cable connections including bent or pushed in pins.

Code ID		Description	Recommended Actions
			<ol style="list-style-type: none"> 3. Contact a local Raven dealer for additional assistance.
5237	.2	Invalid command.	<p>The input guidance line or path for auto-steering is not valid.</p> <ol style="list-style-type: none"> 1. Check that GNSS corrections are converged. 2. Close the active job or task. 3. Cycle power to the Raven field computer or UT display. 4. Resume the previous job or task. 5. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
	.31	Loss SC1™ comm.	<p>The steering control unit (HDU, MDU, or IDU) is not receiving the input line or path message from the navigation controller.</p>
5241	.31	Disengage switch off.	<ol style="list-style-type: none"> 1. Check the disengage switch status in the object pool. Review "Steering Disengage Settings" on page 91 for assistance with disengage switch status. The switch should only be active when the steering wheel is moving. 2. Adjust the disengage threshold value if the system disengages without the operator manipulating the steering wheel. Review "Steering Disengage Settings" on page 91 for assistance with disengage switch status. 3. Check the switch cabling and the sensor voltage/current. 4. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
253875	.13	SCU software compatibility.	<p>The current steering control unit (SCU) software is incompatible with the steering guidance controller (SGC). Update the MDU/HDU software to a supported version.</p>

Code ID		Description	Recommended Actions
523877	.13	SPI (serial peripheral interface) error.	<p>A memory error has occurred while trying to use the interface.</p> <ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
523878	.0	Logic SW power error.	<p>Logic power input to the HDU is out of range. If the error persists, contact your local Raven dealer or the Raven Technical Service team.</p>
523880	.0	CAN power error.	<p>The voltage of the 3.3 V CAN power rail is outside the tolerance of the system.</p>
523881	.0	Internal Vref error.	<p>Reference voltage of 3.3 V is not present (either high or low).</p> <ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Contact a local Raven dealer for additional assistance.
523882	.0	Vbatt voltage error.	<p>Battery voltage.</p> <ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Check the machine electrical system for issues. 3. Contact a local Raven dealer for additional assistance.
523883	.13	Jumper pin invalid.	<p>The actuator type does not match the jumper selection.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Inspect the connectors near the SC1/HDU for a jumper wire and check connection of the wire. 3. Contact a local Raven dealer for additional assistance.
523884	.11	Valve fault.	<p>The machine steering valve has indicated a fault.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Cycle power to the machine.

Code ID		Description	Recommended Actions
			3. Contact a local Raven dealer for additional assistance.
523885	.31	PWM Out ! = PWM in.	Amperage supplied to the left or right PWM valve does not match return. 1. Ensure cable connections are properly seated. 2. Contact a local Raven dealer for additional assistance.
	.5	PWM pwr current (mA) low.	Amperage supplied to the left and right solenoids is too low. 1. Ensure cable connections are properly seated. 2. Check cabling for broken or frayed wiring.
	.6	PWM pwr current (mA) high.	Amperage supplied to the left and right solenoids is too high. 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523886	.6	PWM pwr current (mA) fail.	Unexpected amperage supplied to the left and right solenoids while auto-steering is not active. 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523887	.5	PWM Ignd (left ground) current (mA) low.	Amperage supplied to left solenoid is too low. 1. Ensure cable connections are properly seated. 2. Check cabling for broken or frayed wiring.
	.6	PWM Ignd (left ground) current (mA) high.	Amperage supplied to left solenoid is too high. 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523888	.6	PWM Ignd (left ground) current fail.	Unexpected amperage supplied to the left solenoid while auto-steering is not active. 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.

Code ID		Description	Recommended Actions
523889	.5	PWM rgnd (right ground) current (mA) low.	Amperage supplied to right solenoid is too low. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for broken or frayed wiring.
	.6	PWM rgnd (right ground) current (mA) high.	Amperage supplied to right solenoid is too high. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523890	.6	PWM rgnd (right ground) current (mA) fail.	Unexpected amperage supplied to the right solenoid while auto-steering is not active. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523891	.31	DB Out ! = DB in.	Amperage supplied to double blocker solenoid does not match amperage return. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check for supply voltage on the connections to the machine steering valve. 3. Contact a local Raven dealer for additional assistance.
	.5	DB pwr (power) current (mA) low.	Amperage supplied to double blocker solenoid too low. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for broken or frayed wiring. 3. Check for supply voltage on the connections to the machine steering valve.
	.6	DB pwr (power) current (mA) high.	Amperage supplied to double blocker solenoid is too high. <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections. 3. Check for supply voltage on the connections to the machine steering valve.

Code ID		Description	Recommended Actions
523892	.6	DB pwr (power) current fail.	<p>Unexpected amperage supplied to the double blocker solenoid while auto-steering is not active.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections. 3. Check for supply voltage on the connections to the machine steering valve.
523893	.5	DB gnd (ground) current (mA) low.	<p>Amperage supplied to double blocker solenoid too low.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for broken or frayed wiring. 3. Check for supply voltage on the connections to the machine steering valve.
	.6	DB gnd (ground) current (mA) high.	<p>Amperage supplied to double blocker solenoid is too high.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523894	.6	DB gnd (ground) current fail.	<p>Unexpected amperage supplied to the double blocker solenoid while auto-steering is not active.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523895	.6	Sen pwr (sensor power) current (mA) high.	<p>Amperage output from sensor (e.g. wheel angle sensor, disengage sensor, etc.) is too high.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523896	.6	Sen gnd (sensor ground) current (mA) high.	<p>Amperage output from sensor (e.g. wheel angle sensor, disengage sensor, etc.) is too high.</p> <ol style="list-style-type: none"> 1. Ensure cable connections are properly seated. 2. Check cabling for shorts or loose connections.
523897	.0	Safety micro-	No communication to the safety micro.


Code ID		Description	Recommended Actions
		comm err.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. If the error persists, contact your local Raven dealer or the Raven Technical Service team.
523899	.3	WAS 1 signal high.	<ol style="list-style-type: none"> 1. Check the wheel angle sensor (WAS) and sensor mounting for damage. 2. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor.
	.4	WAS 1 signal low.	<ol style="list-style-type: none"> 1. Check the wheel angle sensor (WAS) and sensor mounting for damage. 2. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor.
	.7	Small WAS range.	A narrow range between the minimum and maximum wheel angle set points may cause unstable or undesired steering performance.
523900	.3	WAS 2 signal high.	<ol style="list-style-type: none"> 1. Check the wheel angle sensor (WAS) and sensor mounting for damage. 2. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor.
	.4	WAS 2 signal low.	<ol style="list-style-type: none"> 1. Check the wheel angle sensor (WAS) and sensor mounting for damage. 2. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor.
523902	.5	SID 2 signal low.	<ol style="list-style-type: none"> 1. Check the disengage sensor and sensor mounting for damage.

Code ID		Description	Recommended Actions
			<ol style="list-style-type: none"> Recalibrate the disengage sensor. Refer to the "Steering Disengage Settings" on page 91 for assistance with calibrating the sensor.
	.6	SID 2 signal high.	<ol style="list-style-type: none"> Check the disengage sensor and sensor mounting for damage. Recalibrate the disengage sensor. Refer to the "Steering Disengage Settings" on page 91 for assistance with calibrating the sensor.
523903	.1	Wheels turning no SID.	<p>Wheel angle movement detected without operator disengage detected or auto-steer control active.</p> <ol style="list-style-type: none"> Ensure cable connections are properly seated. Contact a local Raven dealer for additional assistance.
523904	.7	WAS response expected.	<p>No wheel angle sensor (WAS) change detected while commanding the valve (HDU) or motor (MDU).</p> <ol style="list-style-type: none"> Ensure cable connections are properly seated. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor. Check for software compatibility DTC messages (253875.13 or 523916.13). If these DTCs are also present, update the SGC and SCU software as appropriate.
523907	.5	EH valve not connected.	<p>No current draw detected when commanding the valve (HDU) or motor (MDU).</p> <ol style="list-style-type: none"> Ensure cable connections are properly seated. Recalibrate the WAS. Refer to the "Wheel Angle and Implement Position Sensor Settings" on page 88 for assistance with calibrating the sensor.

Code ID		Description	Recommended Actions
			3. If the machine steering valve offers LED status lights, review the machine operator manual for additional troubleshooting procedures.
523908	.31	No SGC (steering guidance controller) detected.	The steering control unit (SCU) does not detect a navigation controller on the CANbus. 1. Ensure cable connections are properly seated. 2. Inspect for damage to cables or cable connections including bent or pushed in pins. 3. Check CANbus communication.
523916	.13	SGC (steering guidance controller) software compatibility.	The current steering guidance controller (SGC) software is out of date. Update the SGC and HDU software.
583879	.0	Logic LDO (linear and low drop out) power error.	The logic power supplied to the ECU is out of range. If the error persists, contact your local Raven dealer or the Raven Technical Service team.

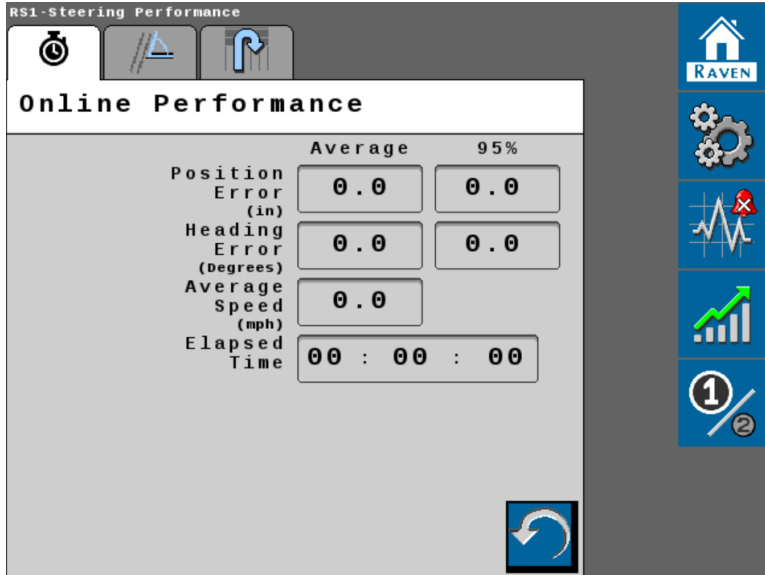
Performance Monitor

The steering guidance controller (SGC) offers auto-steering performance metrics.

1. From the auto-steer Home page, select the **Performance**  button.
2. Each Performance page offers system metrics. These pages allow the operator to reset data collection for diagnostic purposes or to collect metrics for a specific period of time.

Online Performance

The Online Performance page provides average and 95% metrics for auto-steer system performance.

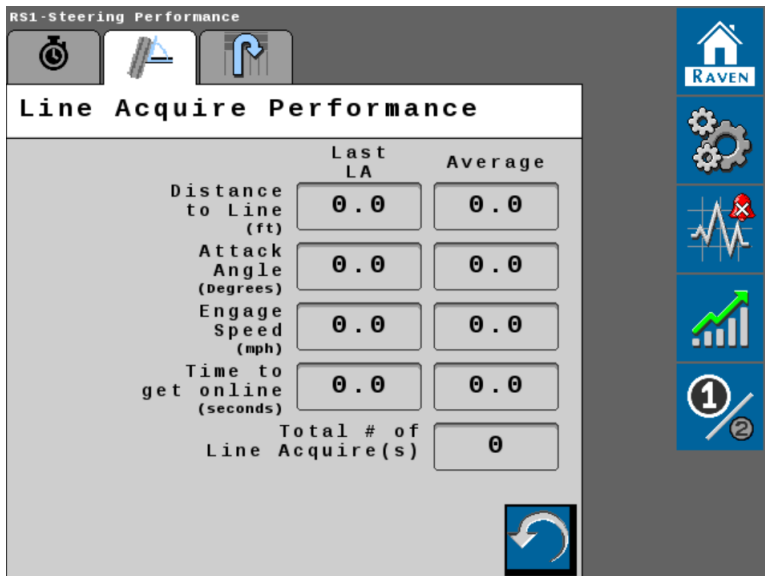


The column labeled 95% may be read as 95% of the elapsed time, the error distance or degrees is less than the value shown.

Note: Select the Reset icon to reset the online performance metrics.

Line Acquire Performance

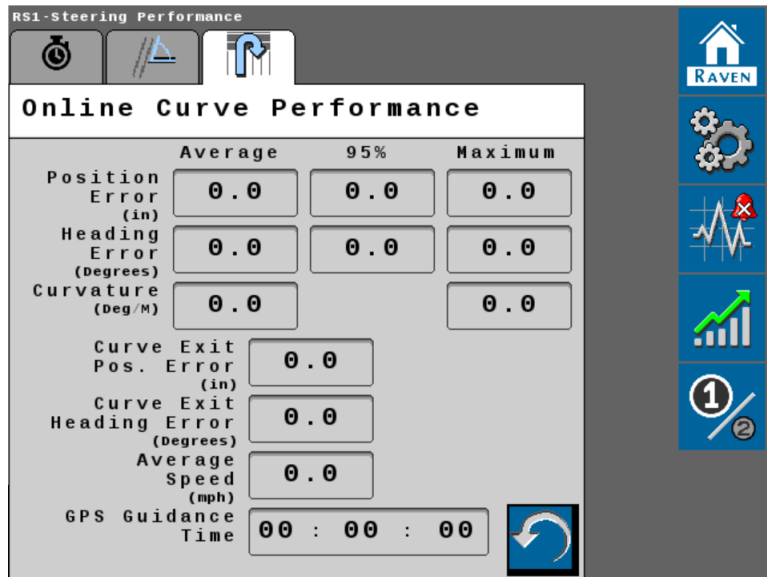
Line Acquire Performance offers metrics for the last line acquisition performed by the auto-steer system as well as average metrics for line acquisition.



Note: Select the Reset icon to reset collected line acquisition metrics.

Online Curve Performance

Online Curve Performance metrics depict the average, maximum, and 95% metrics for auto-steer system performance.




The column labeled 95% may be read as 95% of the elapsed time, the error distance or degrees is less than the value shown.


Note: Select the Reset icon to reset the online curve performance metrics.

System Tests

System tests may be used to help diagnose and correct poor machine and steering calibration issues. The Raven auto-steer systems offer the operator and technicians the following system tests.

Step Response Test

 **WARNING**




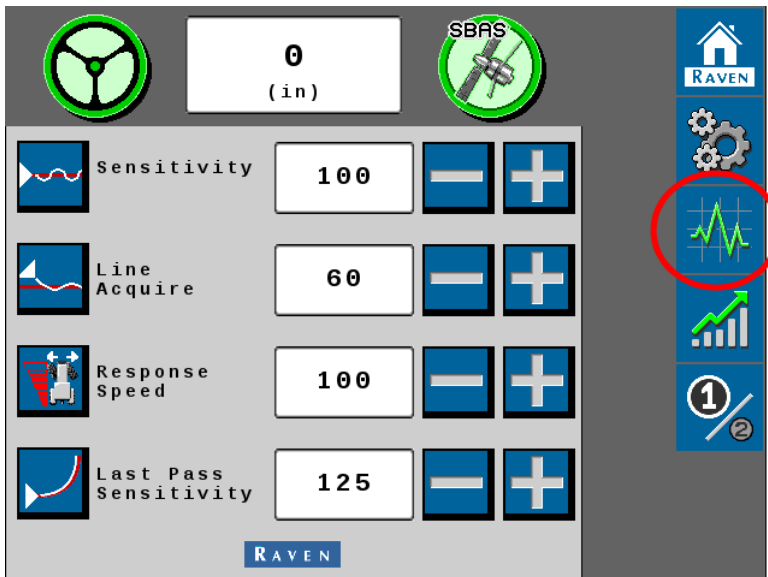
The machine will steer automatically. Be sure the area around the vehicle is clear of people and obstacles before engaging the auto-steer system.

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

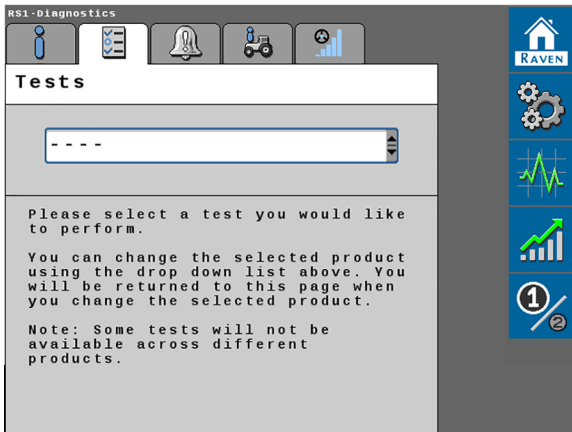
Note: Some screens and options may differ based on how the machine is equipped.

Machine Steering

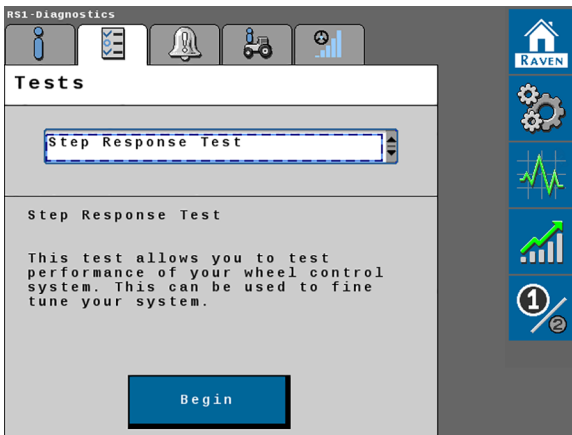
1. From the auto-steer home page Home page select the **Diagnostic**  icon.



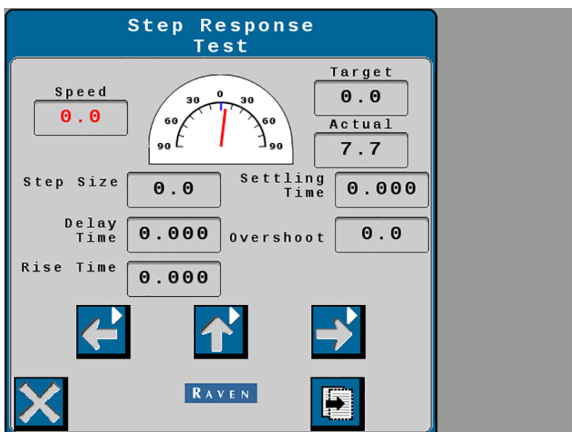
2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.
4. Select the **Begin** button.




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

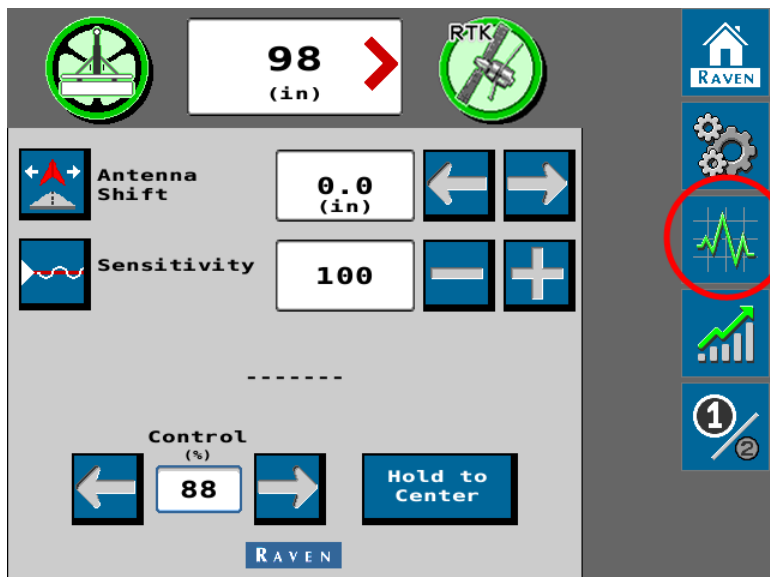


6. Turn the steering wheel to the right so that the Actual reading displays 20.0°.
7. Select the center **Up** arrow button. Wait for the wheels on the steering axle to reach the center position and for information to populate each field displayed on the page.
8. Continue to drive forward at a speed between 1.6 - 6.4 km/h [1 - 4 mph] with the engine RPM set at approximately 3/4 throttle.
9. Turn the steering wheel to the left so that the Actual reading displays -20.0°.
10. Select the center **Up** arrow button. Wait for the wheels on the steering axle to reach the center position and for information to populate each field displayed on the page.
11. To test consistency of the auto-steer system, repeat the procedure and check values against previous test results.

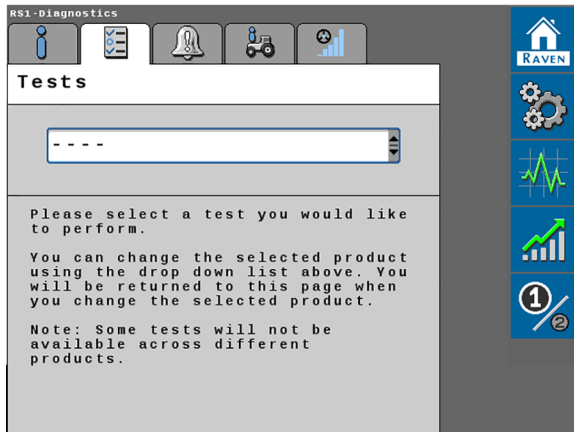
Note: Once the Step Response Test has been completed, the machine performance reading should fall within the recommended system settings. Provide the collected data to a Raven Technical Service team to verify that machine performance falls within the recommended settings.

Implement Steering

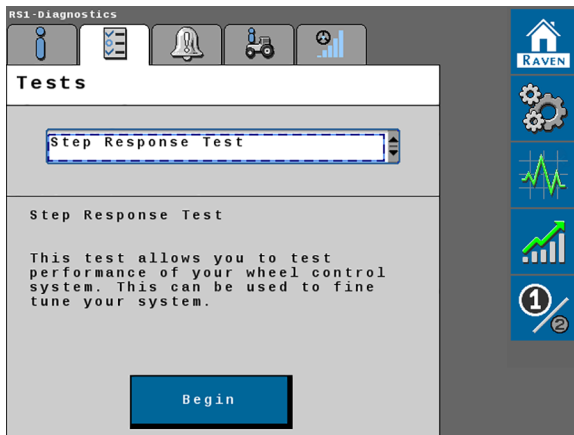
1. From the auto-steer home page Home page select the **Diagnostic**  icon.



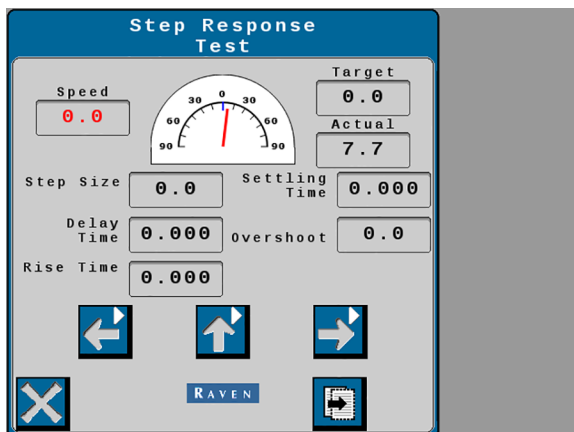
2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.
4. Select the **Begin** button.




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

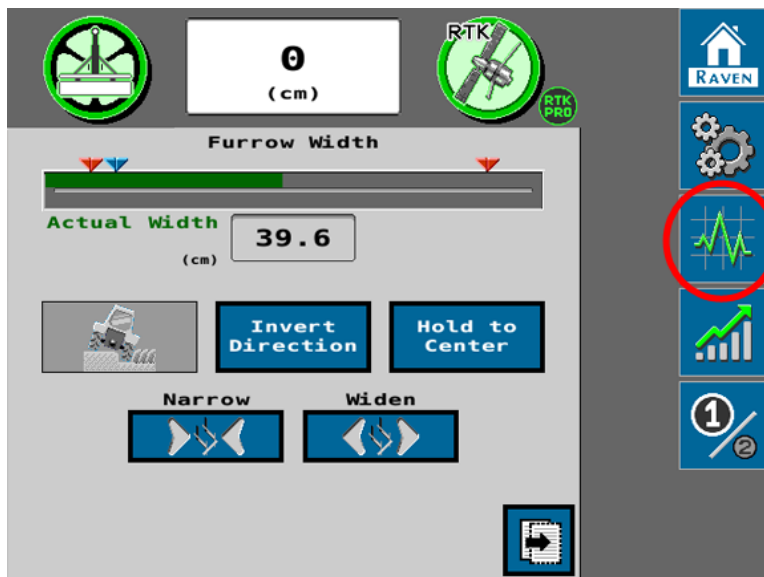


6. Select the center **Up** arrow button. Wait for the actuator to reach the center position.
7. Select the **Left** arrow button. Wait for the actuator to reach the left position and for information to populate each field displayed on the page.
8. Continue to drive forward at a speed between 1.6 - 6.4 km/h [1 - 4 mph] with the engine RPM set at approximately 3/4 throttle.
9. Select the center **Up** arrow button. Wait for the actuator to reach the center position.
10. Select the **Right** arrow button. Wait for the actuator to reach the right position and for information to populate each field displayed on the page.
11. To test consistency of the auto-steer system, repeat the procedure and check values against previous test results.

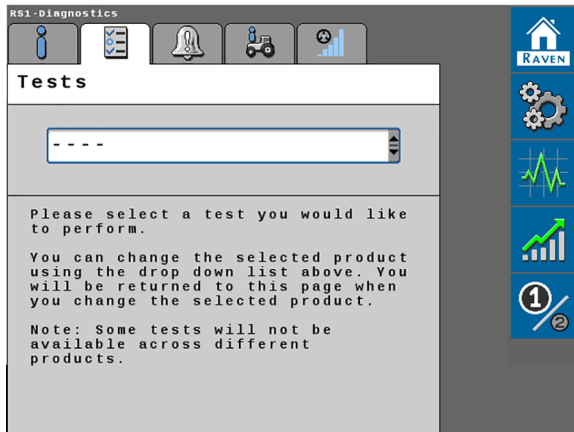
Note: Once the Step Response Test has been completed, the machine performance reading should fall within the recommended system settings. Provide the collected data to a Raven Technical Service team to verify that machine performance falls within the recommended settings.

Plough Steering

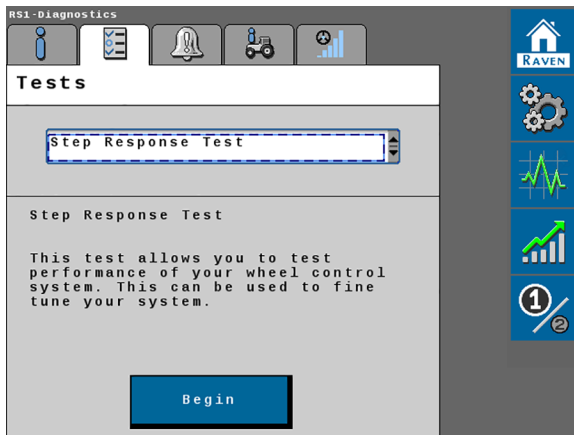
1. From the auto-steer home page Home page select the **Diagnostic**  icon.



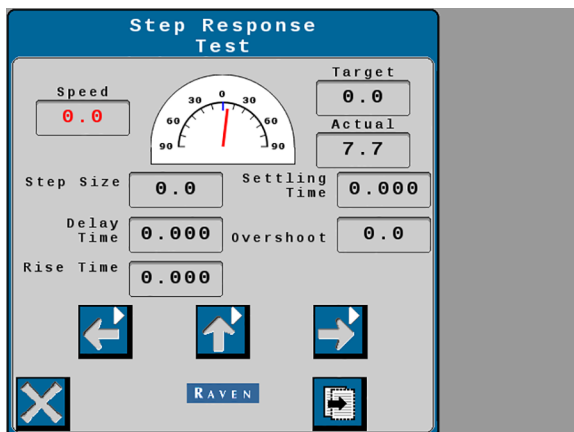
2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.
4. Select the **Begin** button.



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




6. Select the center **Up** arrow button. Wait for the actuator to reach the center position.
7. Select the **Left** arrow button. Wait for the actuator to reach the left position and for information to populate each field displayed on the page.
8. Continue to drive forward at a speed between 1.6 - 6.4 km/h [1 - 4 mph] with the engine RPM set at approximately 3/4 throttle.
9. Select the center **Up** arrow button. Wait for the actuator to reach the center position.
10. Select the **Right** arrow button. Wait for the actuator to reach the right position and for information to populate each field displayed on the page.
11. To test consistency of the auto-steer system, repeat the procedure and check values against previous test results.

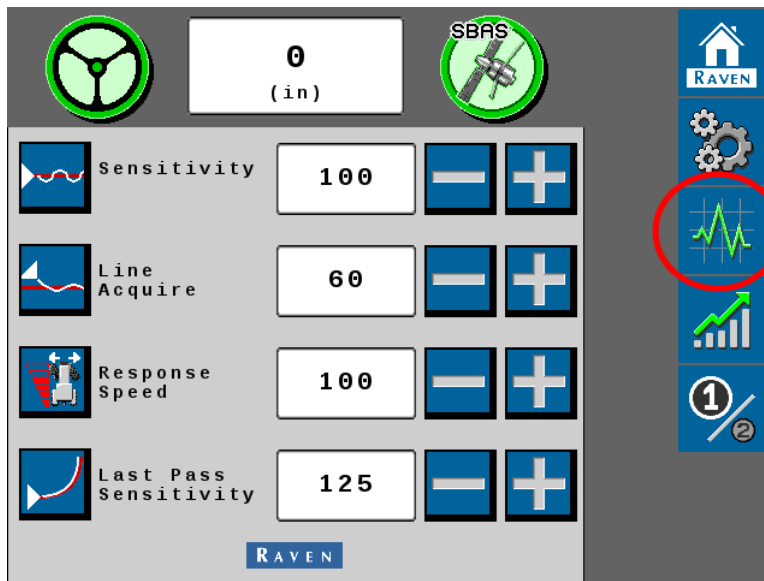
Note: Once the Step Response Test has been completed, the machine performance reading should fall within the recommended system settings. Provide the collected data to a Raven Technical Service team to verify that machine performance falls within the recommended settings.

Machine Test

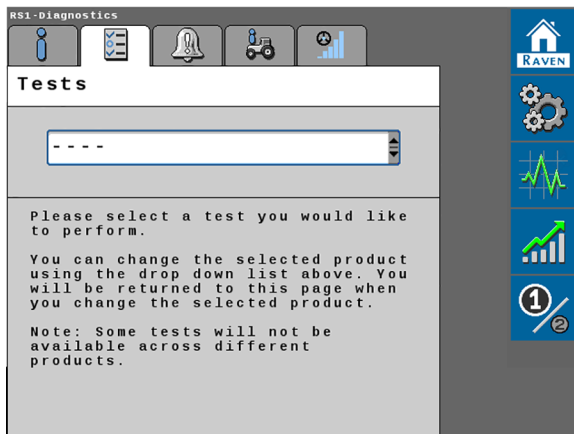
Note: Some pages and options may differ based upon how the machine or implement is configured.

Machine Steering

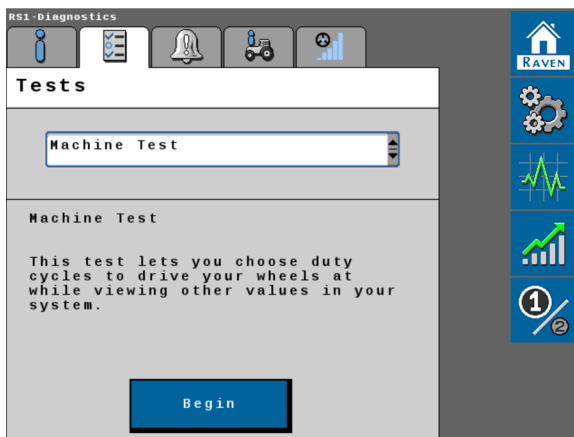
1. From the auto-steer home page Home page select the **Diagnostic**  icon.



2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.
4. Select the **Begin** button.

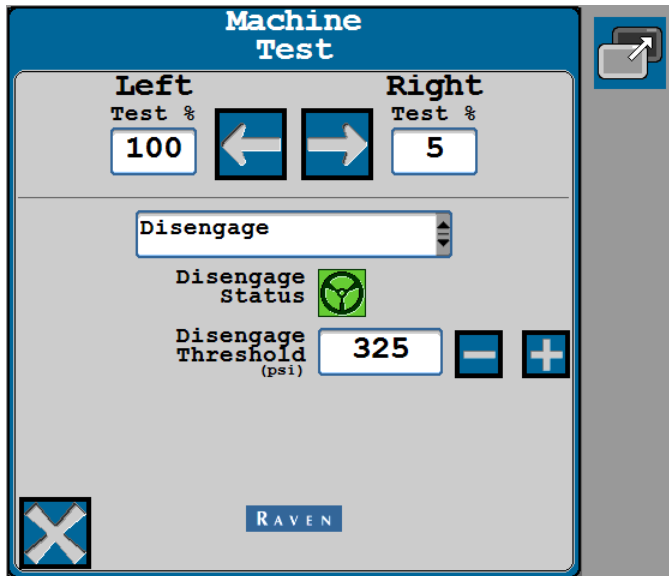


5. The Machine Test page displays with the **Control Effort** test at the top of the page. Use the drop-down list to select the **Disengage**, **Machine Info**, **Readouts**, or **Switches** test pages.

Note: Review the following sections for assistance with each test page.

Control Effort Test

The control effort test is displayed at the top of the Machine Test page.



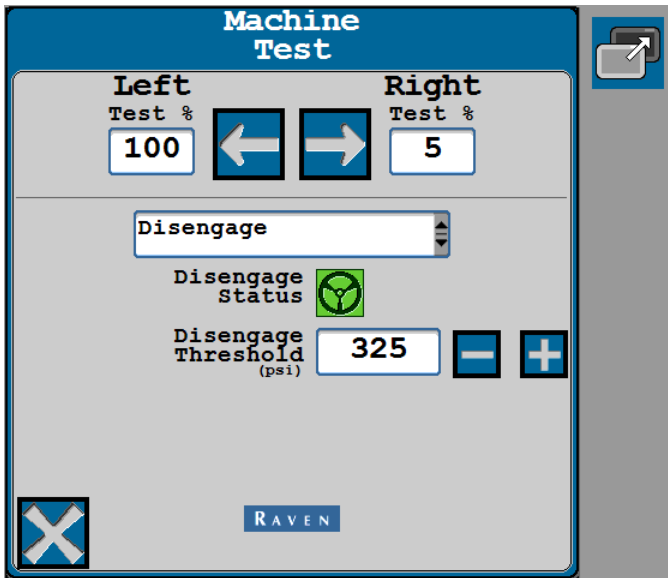
To test control effort:

1. Enter a test value for the control effort in the left and right test percent fields.
2. Use the **Left** and **Right** arrow buttons to manually steering the wheels left or right using the set control effort value.
3. Select the **X** button in the lower, left corner when done to return to the Tests page.

At the top of the Machine Test page, enter the test control valve effort percent for the left and right steer solenoids.

Disengage Test

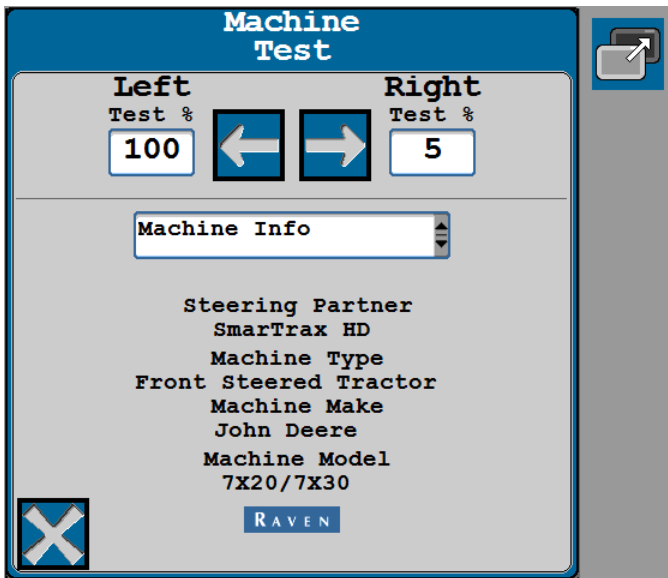
Review the disengage switch threshold and confirm that the switch status changes as the steering wheel is turned. Adjust the threshold value to test the disengage status based upon steering wheel inputs.



Note: Refer to the "Steering Disengage Settings" on page 91 for assistance with changing the Disengage Threshold.

Machine Info

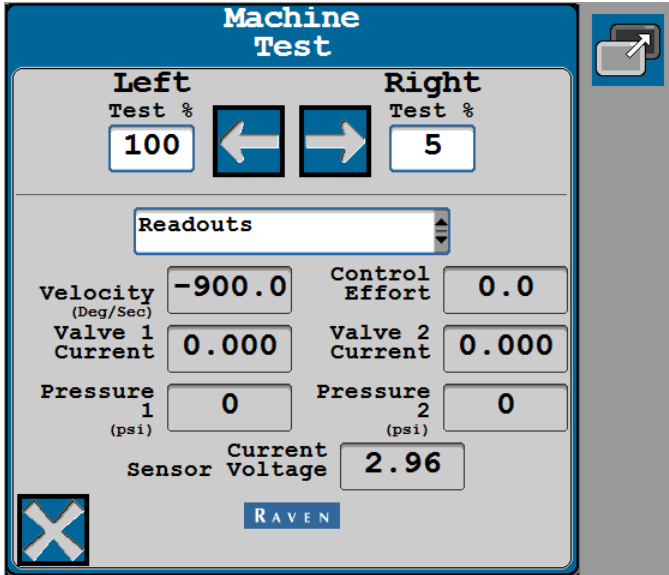
Select the Machine Info test page to review basic tune-set profile information.



Note: To change tune-set selections, refer to the Initial Tuneset Calibration and restart the tune-set calibration wizard.

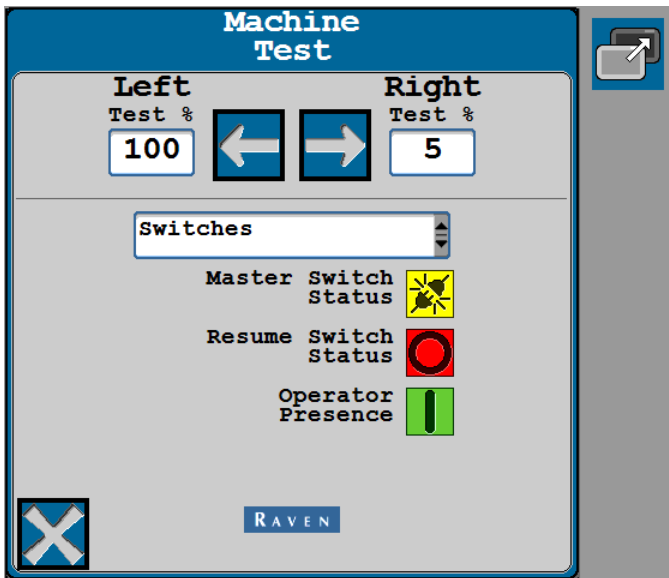
Readouts

Select the Readouts page to review the following display information:




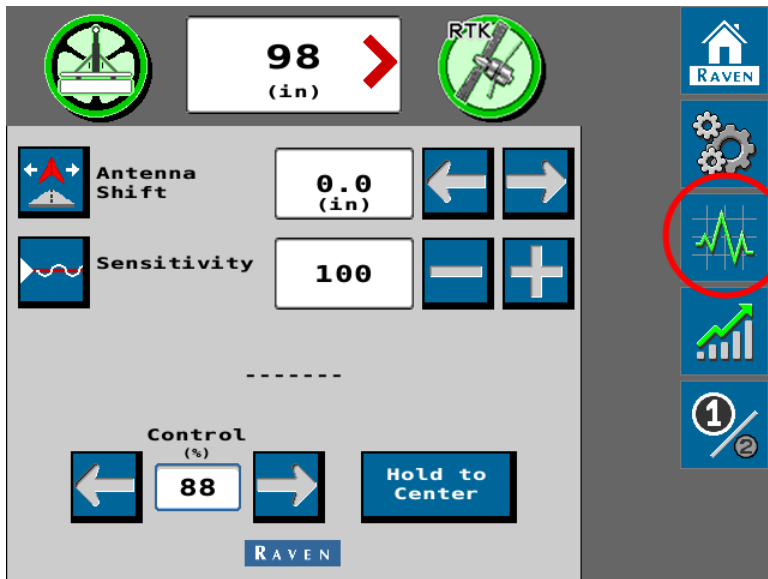
Switches Test

The switches page allows the operator to test the steering master switch, the resume foot switch, and the operator presence switch. Toggle the switch and monitor the status icons. The switch status icon should change when the switch is toggled.

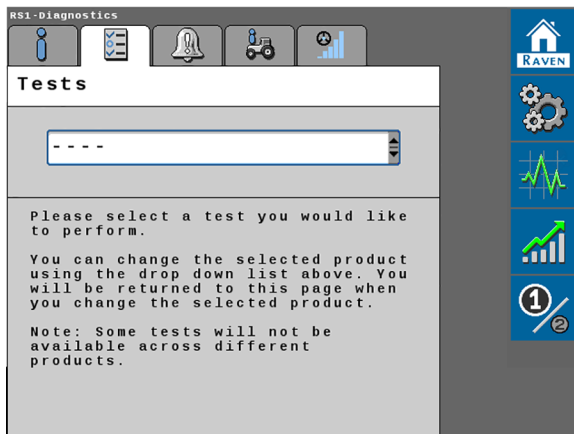


Implement Steering

1. From the auto-steer home page Home page select the **Diagnostic**  icon.

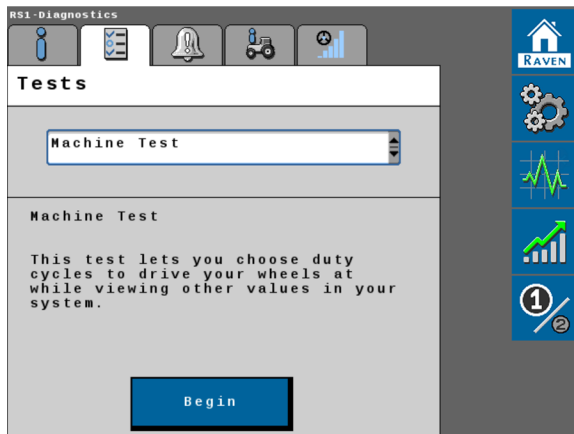


2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.

4. Select the **Begin** button.

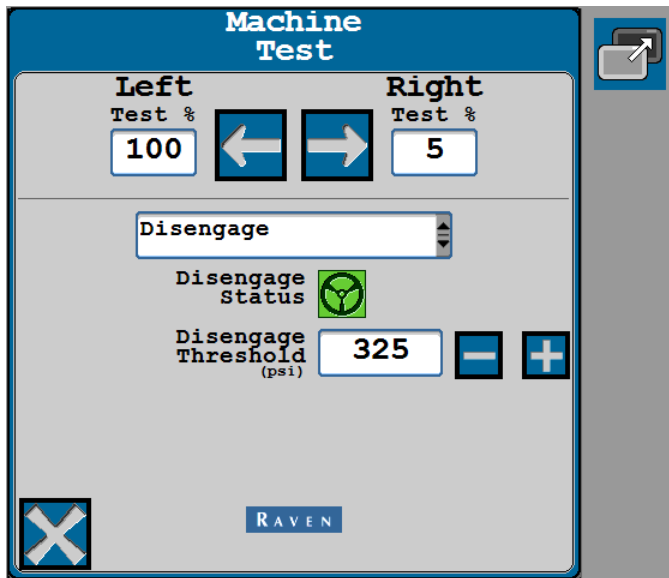


5. The Machine Test page displays with the **Control Effort** test at the top of the page. Use the drop-down list to select the **Disengage**, **Machine Info**, **Readouts**, or **Switches** test pages.

Note: Review the following sections for assistance with each test page.

Control Effort Test

The control effort test is displayed at the top of the Machine Test page.



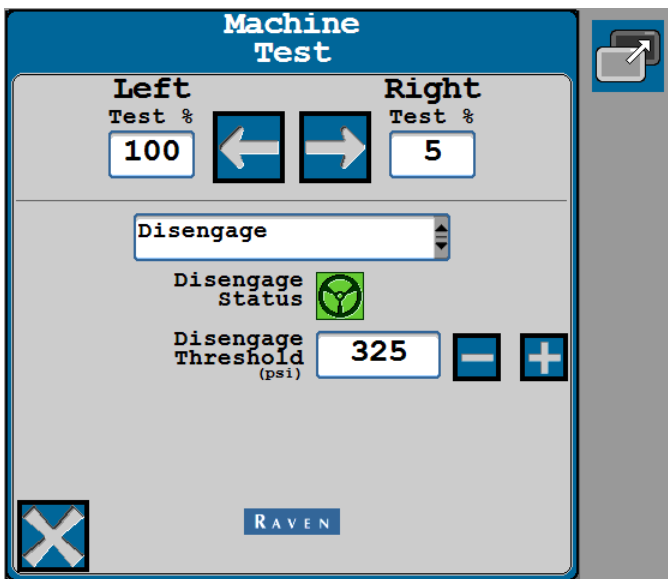
To test control effort:

1. Enter a test value for the control effort in the left and right test percent fields.
2. Use the **Left** and **Right** arrow buttons to manually steering the wheels left or right using the set control effort value.
3. Select the **X** button in the lower, left corner when done to return to the Tests page.

At the top of the Machine Test page, enter the test control valve effort percent for the left and right steer solenoids.

Disengage Test

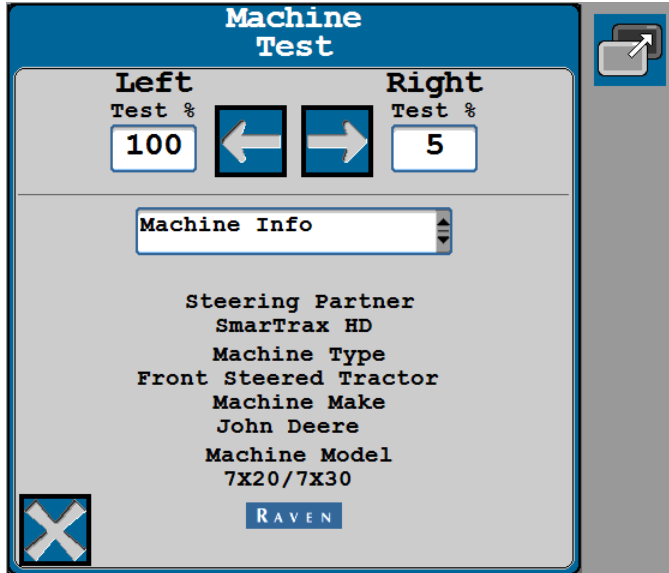
Review the disengage switch threshold and confirm that the switch status changes as the steering wheel is turned. Adjust the threshold value to test the disengage status based upon steering wheel inputs.



Note: Refer to the "Steering Disengage Settings" on page 91 for assistance with changing the Disengage Threshold.

Machine Info

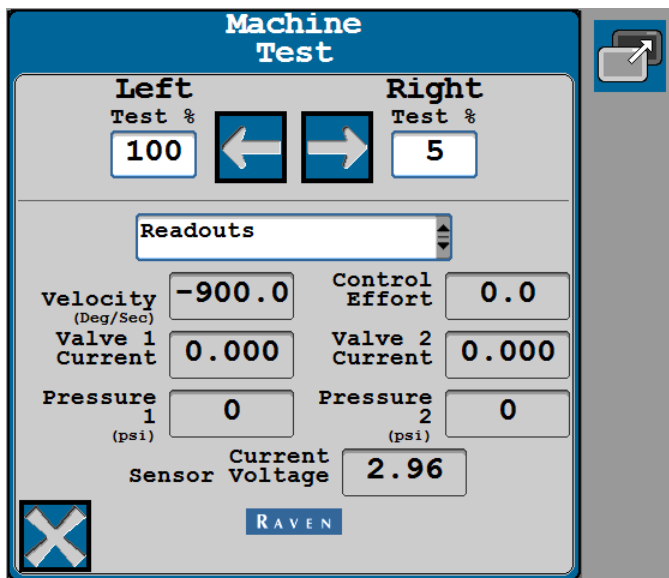
Select the Machine Info test page to review basic tune-set profile information.



Note: To change tune-set selections, refer to the Initial Tuneset Calibration and restart the tune-set calibration wizard.

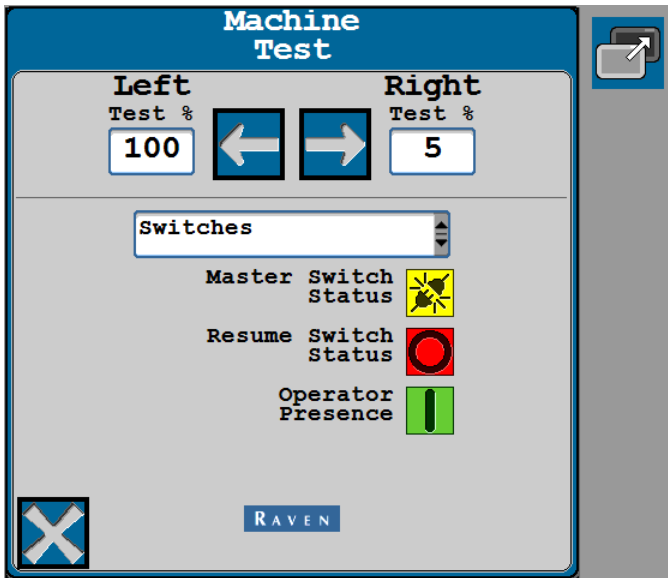
Readouts

Select the Readouts page to review the following display information:




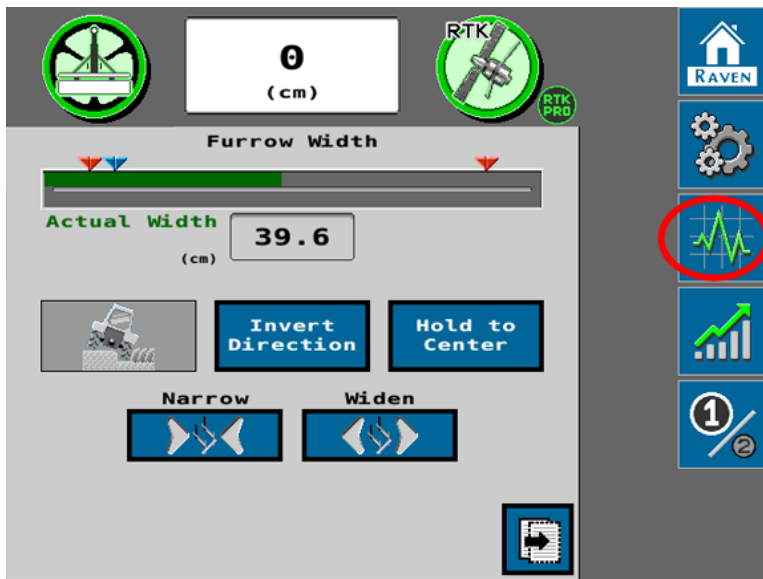
Switches Test

The switches page allows the operator to test the steering master switch, the resume foot switch, and the operator presence switch. Toggle the switch and monitor the status icons. The switch status icon should change when the switch is toggled.

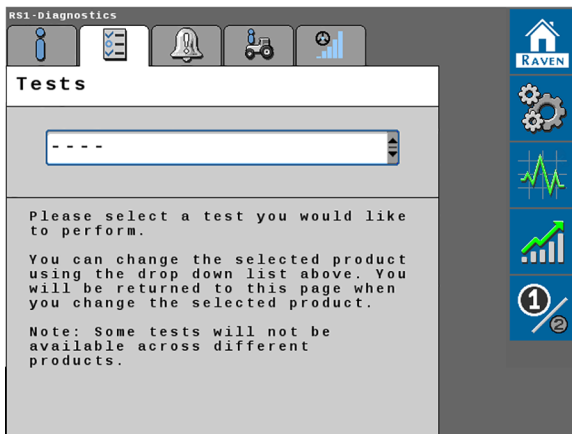


Plough Steering

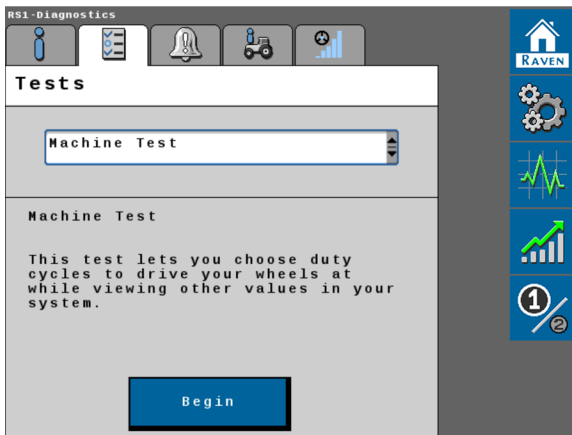
1. From the auto-steer home page Home page select the **Diagnostic**  icon.



2. Select the **Tests** tab along the top of the page.



3. Select the **Machine Test** from the drop-down options on the Tests page.
4. Select the **Begin** button.

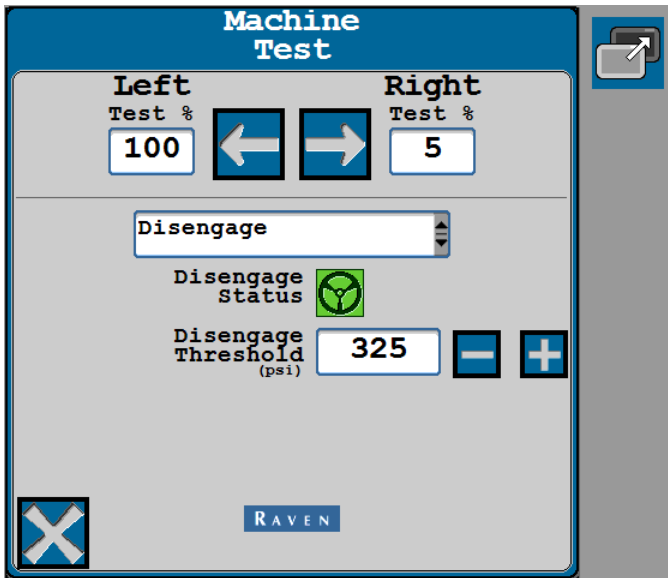


5. The Machine Test page displays with the **Control Effort** test at the top of the page. Use the drop-down list to select the **Disengage**, **Machine Info**, **Readouts**, or **Switches** test pages.

Note: Review the following sections for assistance with each test page.

Control Effort Test

The control effort test is displayed at the top of the Machine Test page.



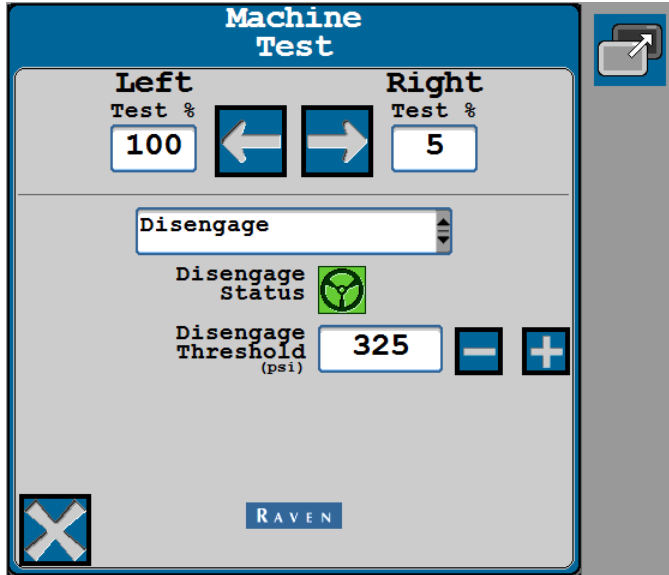
To test control effort:

1. Enter a test value for the control effort in the left and right test percent fields.
2. Use the **Left** and **Right** arrow buttons to manually steering the wheels left or right using the set control effort value.
3. Select the **X** button in the lower, left corner when done to return to the Tests page.

At the top of the Machine Test page, enter the test control valve effort percent for the left and right steer solenoids.

Disengage Test

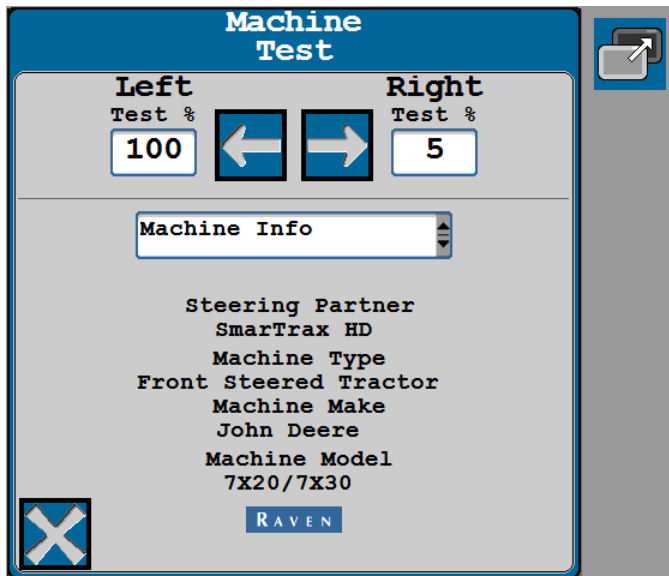
Review the disengage switch threshold and confirm that the switch status changes as the steering wheel is turned. Adjust the threshold value to test the disengage status based upon steering wheel inputs.



Note: Refer to the "Steering Disengage Settings" on page 91 for assistance with changing the Disengage Threshold.

Machine Info

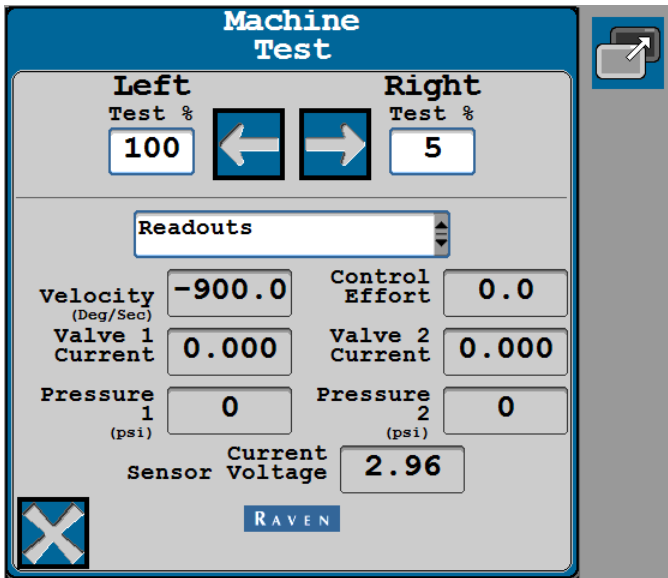
Select the Machine Info test page to review basic tune-set profile information.



Note: To change tune-set selections, refer to the Initial Tuneset Calibration and restart the tune-set calibration wizard.

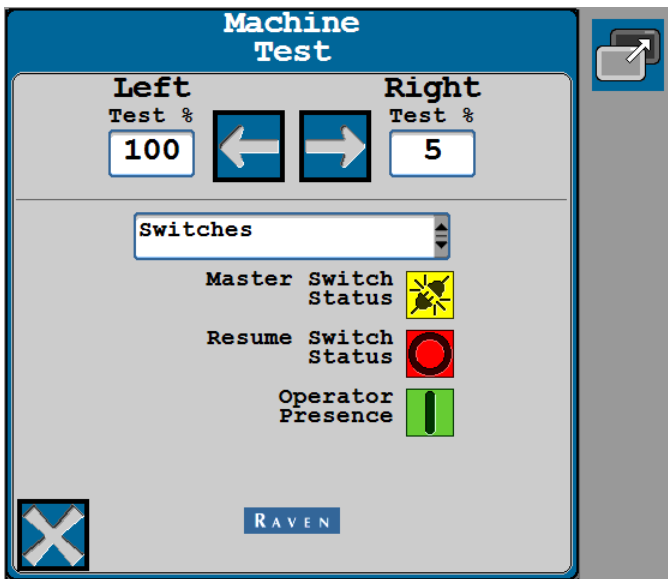
Readouts

Select the Readouts page to review the following display information:




Switches Test

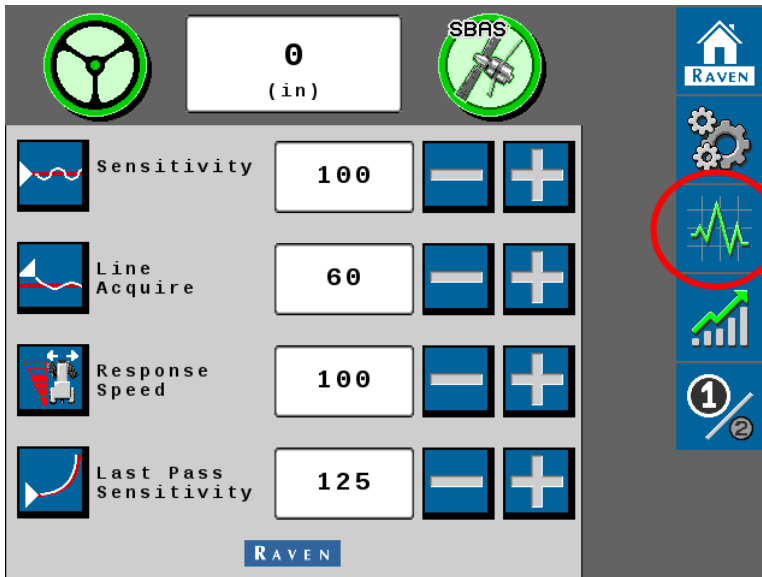
The switches page allows the operator to test the steering master switch, the resume foot switch, and the operator presence switch. Toggle the switch and monitor the status icons. The switch status icon should change when the switch is toggled.



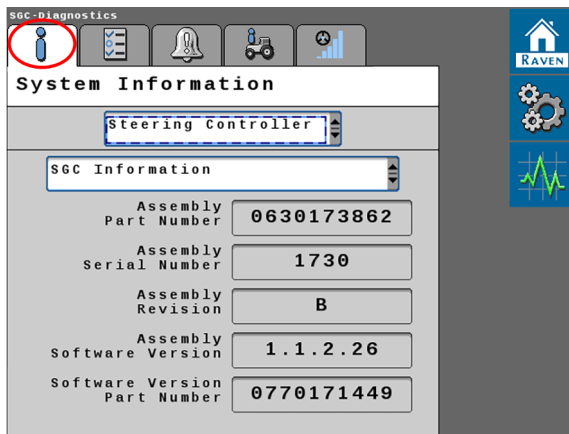
SGC System Information

Note: Some pages and options may differ based upon how the machine or implement is configured.

1. From the auto-steer home page Home page, select the **Diagnostic**  button.



2. Select the **System Information**  tab.



3. Use the drop-down list at the top of the page to select the **Steering Controller** option.
4. Use the second drop-down list to review the available system information pages.

SGC Information

The screenshot shows the 'System Information' screen for 'Steering Controller'. The 'SGC Information' section is selected, displaying the following details:

Assembly Part Number	0630173862
Assembly Serial Number	1730
Assembly Revision	B
Assembly Software Version	1.1.2.26
Software Version Part Number	0770171449

Hardware/Software

The screenshot shows the 'System Information' screen for 'Steering Controller'. The 'Hardware/Software' section is selected, displaying the following details:

PCB Part Number	0640171353
PCB Revision	C
Bootloader Version	3.0.1.1

Cell Modem

The screenshot shows the 'System Information' screen for 'RS1'. The 'Cell Modem' section is selected, displaying the following details:

Model Number	LE910-SVG
Firmware Version	17.01.571

Hours

The screenshot shows the 'Hours' section of the 'System Information' page. The 'Steering Controller' is selected. The 'Hours' dropdown menu is open, showing 'Hours' as the selected option. Below the dropdown, there are four data fields:

Version Hours (Powered On)	1.3
Version Hours (Engaged)	0.0
Lifetime Hours (Powered On)	3.3
Lifetime Hours (Engaged)	0.0

Hardware Diagnostics

The screenshot shows the 'Hardware Diagnostics' section of the 'System Information' page. The 'Steering Controller' is selected. The 'Hardware Diagnostics' dropdown menu is open, showing 'Hardware Diagnostics' as the selected option. Below the dropdown, there are two data fields:

Unswitched Voltage (v)	13.2
Switched Voltage (v)	12.1

GPS Receiver


The screenshot shows the 'GPS Receiver' section of the 'System Information' page. The 'Steering Controller' is selected. The 'GPS Receiver' dropdown menu is open, showing 'GPS Receiver' as the selected option. Below the dropdown, there are five data fields:

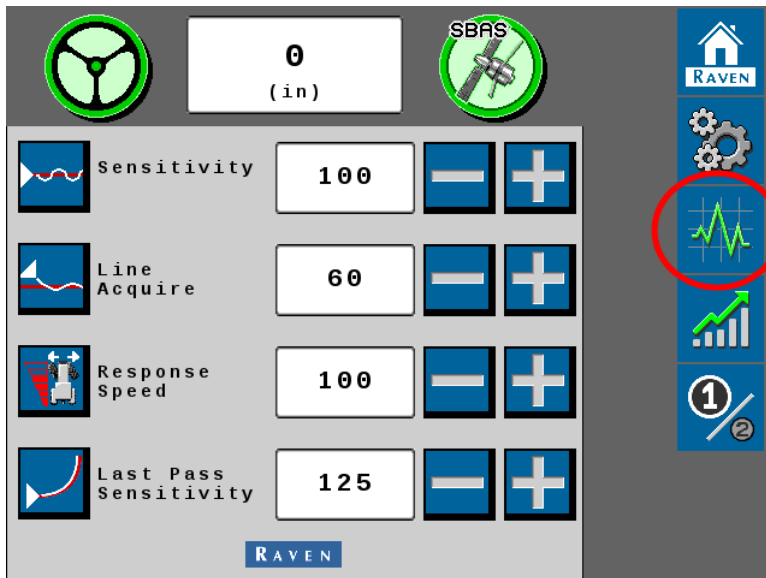
Receiver Serial Number	ABC123
Receiver Model Number	Demo Receiver
Software Version	version 1.0
GPS Board Type	Demo HW version
Receiver PAC	SQ413:0650:35650

Update DirecSteer Unit

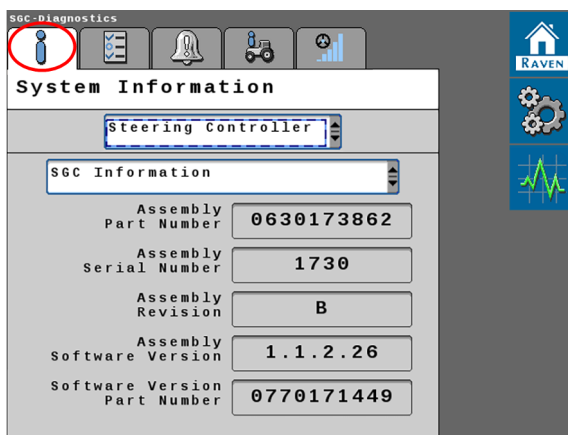
Note: Some pages and options may differ based upon how the machine or implement is configured.

To update the firmware of the DirecSteer electric drive unit:

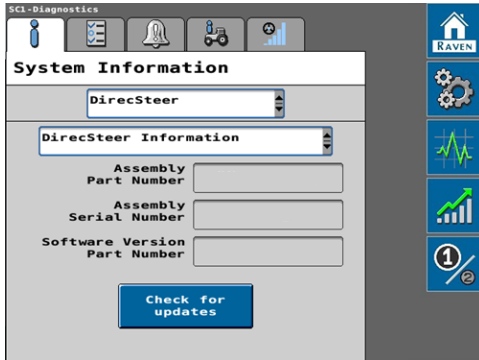
1. From the auto-steer home page Home page, select the **Diagnostic**  button.



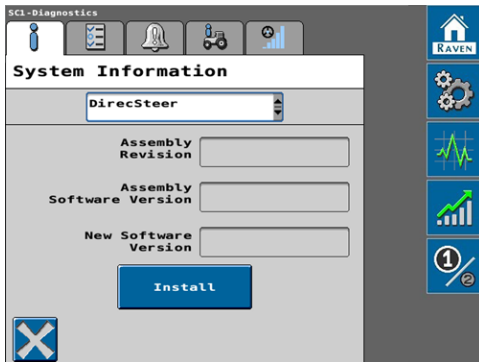
2. Select the **System Information**  tab.



- Use the drop-down list at the top of the page to select the **DirecSteer** option and use the second drop-down list to select **DirecSteer Information**.



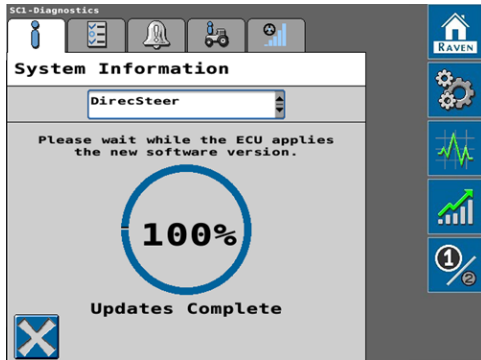
- Select the **Check for Updates** button at the bottom of the page.
- Review the current and available software information.



- Select the **Install** button to accept the available software update and install the software on the DirecSteer unit.

Note: Select the **X** in the lower, left corner to cancel the update and return to the DirecSteer Information page.


7. Once the software update is complete, select the **X** in the lower, left corner of the page to return to the DirecSteer Information page.



Note: Select the Check for Updates button again to confirm that the DirecSteer unit has been updated.

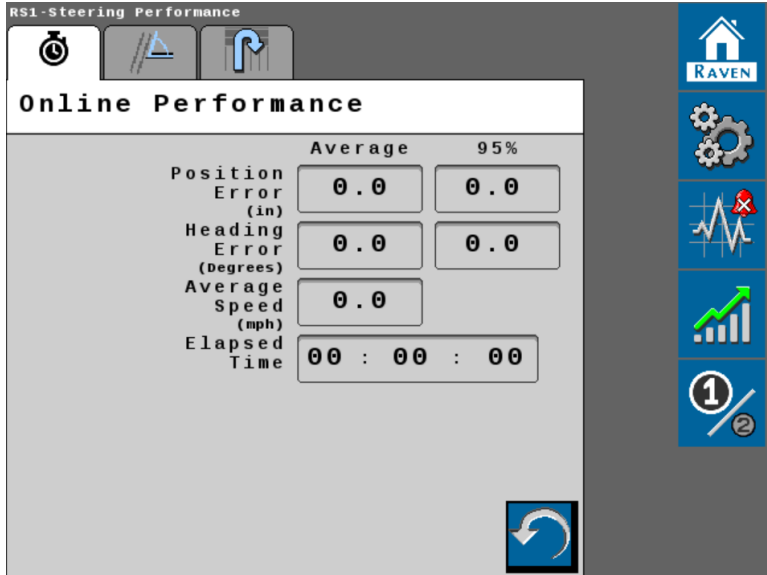
Performance Monitor

The steering guidance controller (SGC) offers auto-steering performance metrics.

1. From the auto-steer Home page, select the **Performance**  button.
2. Each Performance page offers system metrics. These pages allow the operator to reset data collection for diagnostic purposes or to collect metrics for a specific period of time.

Online Performance

The Online Performance page provides average and 95% metrics for auto-steer system performance.

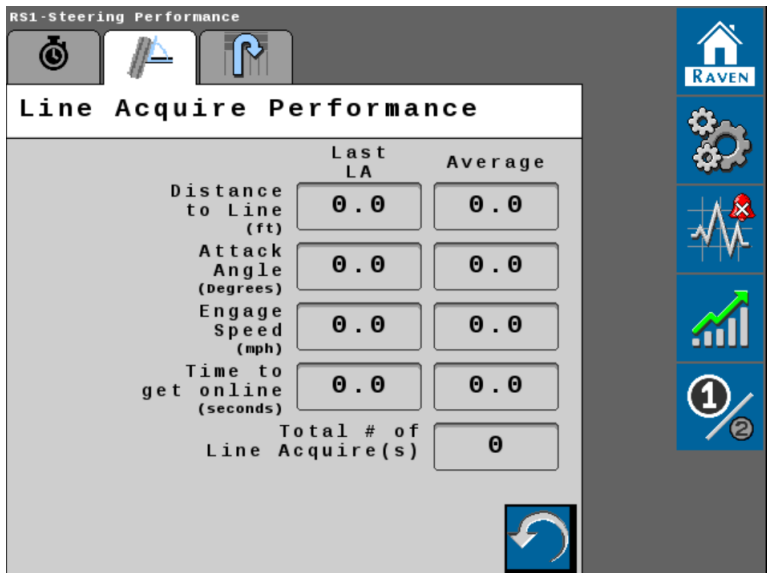


The column labeled 95% may be read as 95% of the elapsed time, the error distance or degrees is less than the value shown.

Note: Select the Reset icon to reset the online performance metrics.

Line Acquire Performance

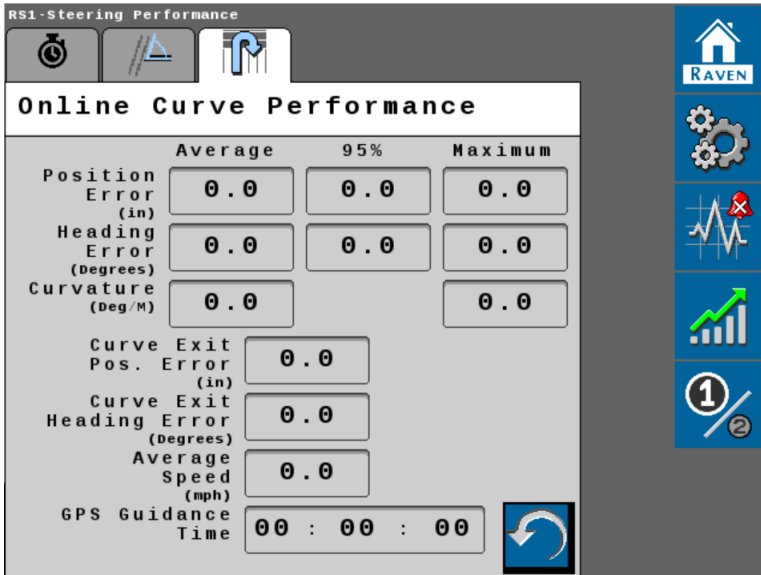
Line Acquire Performance offers metrics for the last line acquisition performed by the auto-steer system as well as average metrics for line acquisition.



Note: Select the Reset icon to reset collected line acquisition metrics.

Online Curve Performance

Online Curve Performance metrics depict the average, maximum, and 95% metrics for auto-steer system performance.



The column labeled 95% may be read as 95% of the elapsed time, the error distance or degrees is less than the value shown.

Note: Select the Reset icon to reset the online curve performance metrics.

Chapter 8:

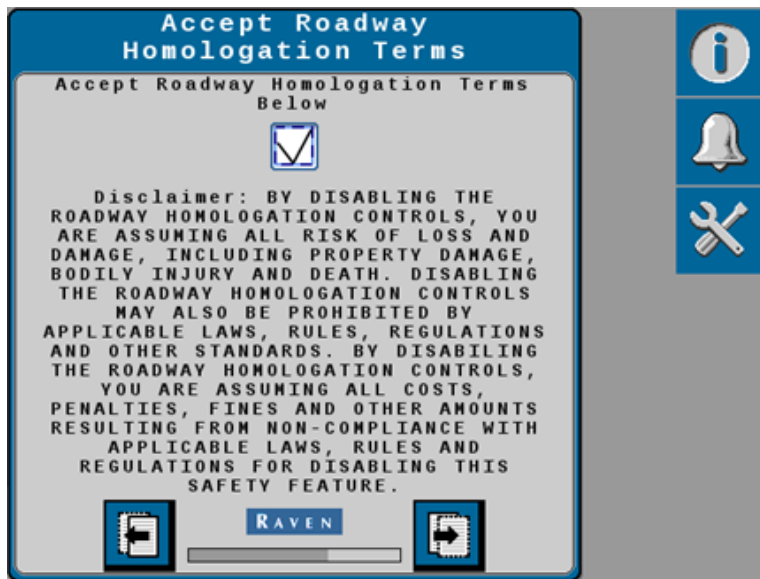
Certification and Compliance

Roadway Homologation

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

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

Carefully review the on-screen disclaimer before proceeding.



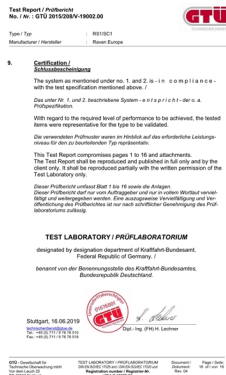
When roadway homologation is enabled, the following parameters will be applied to RS1™ operation:

- An operator presence method will be required while operating with the RS1™ auto-steering system enabled.
- Auto-steering cannot be enabled above 19 mph [30.5 km/h].
- Auto-steering will disengage above 21 mph [33.8 km/h].

Certifications

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

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



Safety Notes

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

ANATEL Compliance Statement

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

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

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