

**Unverferth NutriMax™ Applicator  
ISO Steerable Hitch Installation &  
Operation Manual**

*P/N 016-4001-133 Rev. B*

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*E28236*

## ***Disclaimer***

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# CHAPTER

# 1

# IMPORTANT SAFETY INFORMATION

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## NOTICE

Read this manual and the operation and safety instructions included with your implement and/or controller carefully before installing the Steerable Hitch system.

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

When operating the machine after installing the Steerable Hitch system, observe the following safety measures:

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

## WARNING

- Before starting the hydraulic installation, bleed the pressure from the hydraulic system.
- When starting the machine for the first time after installing the Steerable Hitch system, be sure that all persons stand clear in case a hose has not been properly tightened.
- When operating the system, ensure people and obstacles are clear of the hitch pivot points and unfolded boom components.

## CAUTION

## INSTRUCTIONS FOR HOSE ROUTING

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The word "hose" is used to mean all flexible fluid carrying components. Follow existing hoses as much as possible and use these guidelines:

Hoses should not contact or be attached to:

- Components with high vibration forces
- Components carrying hot fluids beyond component specifications

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

- Sheared or flame cut edges
- Edges of machined surfaces
- Fastener threads or cap screw heads
- Ends of adjustable hose clamps

Routing should not allow hoses to:

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

Hoses should not have sharp bends

Allow sufficient clearance from machine component operational zones such as:

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

For hose sections that move during machine operation:

- Allow sufficient length for free movement without interference to prevent: pulling, pinching, catching or rubbing, especially in articulation and pivot points
- Clamp hoses securely to force controlled movement to occur in the desired hose section
- Avoid sharp twisting or flexing of hoses in short distances

Protect hoses from:

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

- High pressure wash

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## INSTRUCTIONS FOR WIRE ROUTING

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

Harness should not contact or be attached to:

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

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

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

Routing should not allow harnesses to:

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

Harnessing should not have sharp bends

Allow sufficient clearance from machine component operational zones such as:

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

For harness sections that move during machine operation:

- Allow sufficient length for free movement without interference to prevent: pulling, pinching, catching or rubbing, especially in articulation and pivot points
- Clamp harnesses securely to force controlled movement to occur in the desired harness section

- Avoid sharp twisting or flexing of harnesses in short distances
- Connectors and splices should not be located in harness sections that move

Protect harnesses from:

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

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

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



Congratulations on your purchase of the Steerable Hitch system! The Steerable Hitch system is designed to actively steer the implement's hitch in response to various driving conditions such as speed, turning rate, and field terrain.

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### PREPARING FOR INSTALLATION

Before installing the Steerable Hitch system, park the machine where the ground is level, clean, and dry. Bleed pressure from the hydraulic system and leave the machine turned off for the duration of the installation process.

During the installation process, follow good safety practices. Be sure to carefully read the instructions in this manual as you complete the installation process.

### RECOMMENDATIONS

Raven Industries recommends the following best practices when installing or operating the Steerable Hitch system for the first time, at the start of the season, or when moving the Steerable Hitch system to another machine:

- Ensure the machine's hydraulic filters have been recently changed and there are no issues with the machine's hydraulic system (e.g., pump issues, faulty hydraulic motors, fine metal deposits in the hydraulic hoses, etc.).
- Ensure the machine's hydraulic valve is using fresh oil and debris is flushed from the hydraulic hoses, valves, and filters.

Raven Industries recommends the following best practices when installing the Steerable Hitch system:

- Use part numbers to identify the parts.
- Do not remove the plastic wrap from a part until it is necessary for installation.
- Do not remove plastic caps from a part until it is necessary for installation.

### POINT OF REFERENCE

The instructions in this manual assume that you are standing behind the machine, looking toward the cab.

### TOOLS NEEDED

The following tools are recommended for installation of the Steerable Hitch system:

- SAE standard-sized wrenches
- Cable ties
- Side cutters

## HYDRAULIC FITTINGS

This manual may reference the following types of hydraulic fittings:

- SAE O-ring fittings
- ORFS (O-Ring Face Seal) fittings
- JIC fittings

**SAE O-ring fitting**



**ORFS fitting**



**JIC fitting (M)**



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## UPDATES

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

<http://www.ravenhelp.com>

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Your feedback will help shape the future of our product documentation and the overall service we provide. We appreciate the opportunity to see ourselves as our customers see us and are eager to gather ideas on how we have been helping or how we can do better.

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

[techwriting@ravenind.com](mailto:techwriting@ravenind.com)

-Unverferth NutriMax™ Applicator ISO Steerable Hitch Installation & Operation Manual

-P/N 016-4001-133 Rev. B

-Any comments or feedback (include chapter or page numbers if applicable).

-Let us know how long have you been using this or other Raven products.

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

Thank you for your time.

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## KIT CONTENTS

This section contains a list of the components that are included in the Steerable Hitch kit. Before beginning the system installation, compare the items in the Steerable Hitch kit with the components on this list.

## GEN III INSTALLATION KIT

**NOTE:** The ISO node (P/N 063-0173-445) is included in the Unverferth Steerable Hitch installation kit. Contact your local Unverferth dealer for ordering information.

**TABLE 1. Gen III Installation Kit (P/N 117-4001-133, UM 9007473)**

Picture	Item Description	Part Number	Qty.	UM #
Not Pictured	Manual - Steerable Hitch Installation & Operation	016-4001-133	1	N/A
	Valve - Open Center Hydraulic	063-0131-130	1	9005925
	Cable -Unverferth Steerable Hitch Applicator	115-7302-017	1	9007426
	Assembly - Non-Contact Rotary Sensor	063-0181-026	1	9006222
	Sensor - Inductive Proximity	412-6000-007	1	9005932

## UNVERFERTH INSTALLATION KIT

TABLE 2. Unverferth Installation Kit (P/N 412003BFS)

Item Description	Part Number	Qty.
Bracket - Sensor Mounting	410905	1
Bracket - Steerable Hitch Valve Mounting	410916	1
Bracket - Proximity Switch Mounting	410920	1
Bracket - Node Mounting	410927	1
Bracket - Cylinder Lock	411149	2
Tie - Cable	9000107	10
Hydraulic Hose - 3/4" JIC (F) to 3/4" JIC (F) - 15"	9001228	1
Hydraulic Hose - 9/16" JIC (F) to 9/16" JIC (F) - 43-1/2"	9003061	1
Hydraulic Hose - 9/16" JIC (F) to 9/16" JIC (F) - 31"	9003113	1
Hydraulic Hose - 3/4" JIC (F) to 3/4" SAE O-Ring (M) - 186"	9007545	2
Clamp - Poly Double	9004367	3
U-Bolt	9004454	2
Filter - 120 Micron Hydraulic	9005403	1
Cylinder - 3-1/2" x 12	9005673	2
Marker - Hose	9005870	1
Marker - Hose	9005871	1
Screw - Flanged	9006040	2
Fitting - 9/16" JIC (M) to 9/16" SAE O-Ring 90° Elbow	9006171	2
Fitting - 9/16" JIC (M) to 3/4" SAE O-Ring 90° Elbow	9006173	2

TABLE 2. Unverferth Installation Kit (P/N 412003BFS)

Item Description	Part Number	Qty.
Fitting - 3/4" JIC (M) x 3/4" JIC (M) x 7/8" SAE O-Ring (M) Tee Adapter	9006174	1
Fitting - 3/4" JIC (M) x 7/8" SAE O-Ring (M) 90° Elbow	9006175	1
Fitting - 3/4" JIC (M) X 7/8" SAE O-Ring (M) Straight Adapter	9006176	1
Fitting - 3/4"-16 SAE O-Ring Union	98508	1
Node - ISO Steerable Hitch	9006470	1
Cable - John Deere ISO to Raven ISO Adapter	9007794	1
Cable - Raven ISO to ISO Terminator	9006744	1
Kit - ISO Steerable Hitch Applicator	9007473	1
Screw - 5/16"-18 x 3/4"	91256	6
Nut - 5/16"-18 Flanged	91257	2
Screw - 3/8" Flanged	91262	2
Coupling - 3/4"-16 Male Tip	91383	2
Bolt - 5/16" x 3" UNC Grade 5 Hex	9390-038	3
Bolt - 3/8" x 1-1/4" UNC Grade 5 Hex	9390-056	3
Nut - Elastic Lock	9398-012	3
Valve - Check	94909	1
Pin - Snap	95937	2
Nut - 1/4"-20 UNC Hex	97189	4
Top Plate	9003814	3
Hydraulic Hose - 9/16" JIC (F) to 9/16" JIC (F) 54"	9004442	2



TABLE 2. Unverferth Installation Kit (P/N 412003BFS)

Item Description	Part Number	Qty.
Nut - #8-32 Serrated Flange	9006041	2
Screw - #8-32	9006042	2
Fitting - Tee, 9/16" JIC (M) x 9/16" JIC (M) x 3/4" SAE O-Ring (M)	9006168	2
Console - Steerable Hitch Switch Box	9007594	1
Cable, Switch Box Signals	9007607	1
Cable, Switch Box Power	9007608	1
Washer - 5/16" Lock	9404019	3

INSTALL THE HYDRAULIC SYSTEM

FIGURE 1. Hydraulic Valve Installed



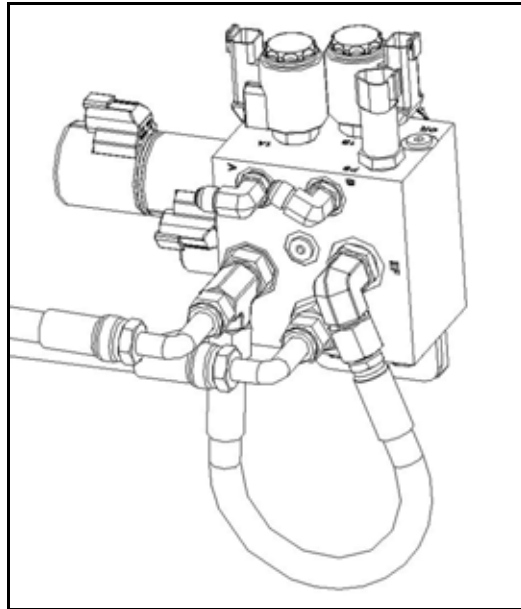
1. Install the hydraulic valve mounting bracket to the Steerable Hitch tongue using the supplied hardware.
2. Mount the Steerable Hitch hydraulic valve (P/N 063-0131-130) on the valve mounting bracket using the supplied hardware.

FIGURE 2. Machine's Selective Control Valve



3. Install a hydraulic hose in the pressure port of the machine's selective control valve.
4. Route a new pressure hose from the machine's selective control valve and connect it to Port P of the Steerable Hitch valve.
5. Install a hydraulic hose in the tank port of the machine's selective control valve.

FIGURE 3. Tank Hose Installed



6. Install a tee fitting in Port T of the Steerable Hitch valve.
7. Connect the new tank hose to one end of the installed tee fitting.
8. Install a hydraulic hose on the remaining end of the tee fitting.
9. Connect the other end of the installed hydraulic hose to Port EF of the Steerable Hitch valve.

FIGURE 4. Left and Right Steering Hoses Installed

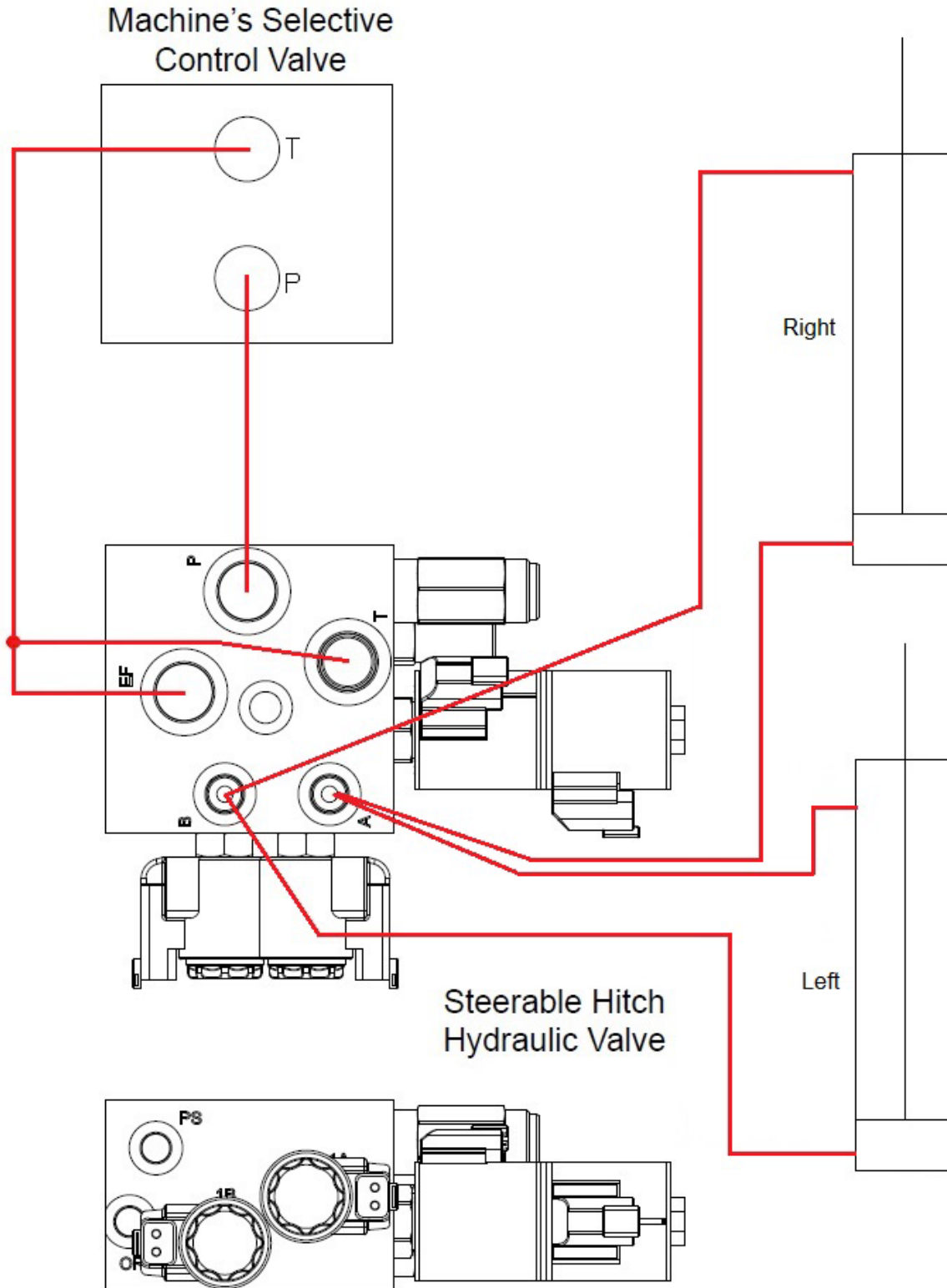


10. Install a 9/16" JIC tee fitting in the base-end of each hitch cylinder.
11. Install a hydraulic hose on the base-end of the machine's left hitch cylinder.
12. Connect the other end of the installed hydraulic hose to Port B of the Steerable Hitch valve.
13. Install a hydraulic hose on the remaining end of the tee fitting at the base-end of the machine's left hitch cylinder.
14. Connect the other end of the installed hydraulic hose to the rod-end of the machine's right hitch cylinder.
15. Install a hydraulic hose on the base-end of the machine's right hitch cylinder.
16. Connect the other end of the hose to Port A of the Steerable Hitch valve.



17. Install a hydraulic hose on the remaining end of the tee fitting at the base-end of the machine's right hitch cylinder.
18. Connect the other end of the hose to the rod-end of the machine's left hitch cylinder.

FIGURE 5. Hydraulic Schematic



## INSTALL THE STEERABLE HITCH NODE

1. Install the Steerable Hitch node (P/N 063-0173-445) on the node mounting bracket (UM410927B) using the supplied hardware.

FIGURE 6. Node Mounting Location



2. Locate the square crossbar under the front of the tank.
3. Position the node mounting bracket so that arrow #2 on the node is pointing forward and arrow #5 is pointing down.
4. Secure the node mounting bracket to the square crossbar using the supplied U-bolts.

## INSTALL THE ROTARY SENSOR

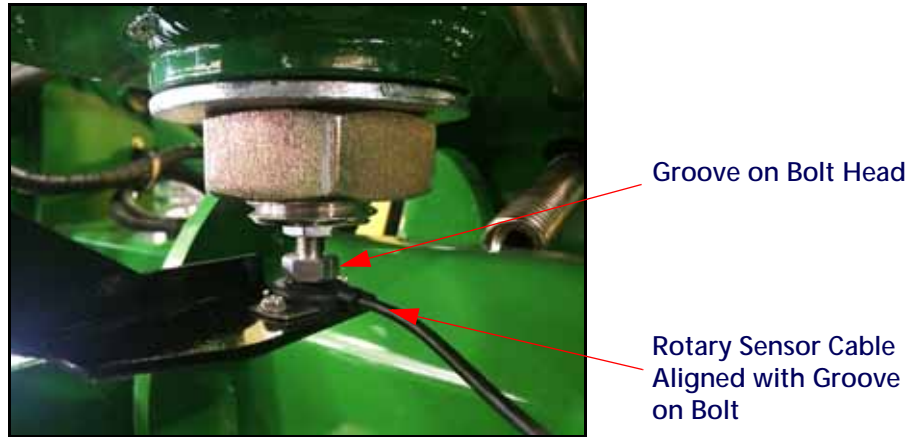
FIGURE 7. Rotary Sensor Installed



1. Position the hitch so that it is in the straight position.
2. Install the cylinder locking plate on each cylinder.
3. Thread the M10 jam nut included in the rotary sensor installation kit onto the magnetic bolt of the rotary sensor (P/N 063-0181-026).
4. Screw the magnetic bolt into the machine's pivot pin on the bottom side of the tongue.
5. Mount the rotary sensor assembly on the sensor bracket using the supplied hardware.

6. Mount the sensor bracket on the machine's tongue using the supplied hardware.

FIGURE 8. Rotary Sensor Alignment



7. Align the groove on the bolt head with the cable coming out of the sensor.

**IMPORTANT:** The sensor must be aligned so that the output is near zero when the hitch is centered. This is critical to keep the left and right movable range the same.

8. Position the rotary sensor assembly components so that the gap between the sensor and the magnetic bolt is approximately 1/16".
9. Using the plastic tool that was included in the sensor installation kit, verify that the sensor is centered above the bolt head.
10. Tighten the nuts to ensure the sensor is mounted securely.

## INSTALL THE PROXIMITY SWITCH

FIGURE 9. Proximity Switch Installed (Near Right Wing Folding Joint on Center Section)



1. Install the proximity switch (P/N 412-6000-007) on the switch mounting bracket using the supplied hardware.
2. Mount the switch mounting bracket on the machine's top crossbar near the right side folding joint.
3. Position the proximity switch so that it is located within 1/4" of metal when the machine's toolbar is unfolded and no metal is near the sensor surface when the toolbar is folded.

## INSTALL THE STEERABLE HITCH WIRING

**NOTE:** In addition to the steps below, refer to the system drawings at the end of this chapter for further details.

### CONNECT STEERABLE HITCH TO A RAVEN ISO PRODUCT CONTROL SYSTEM (IF APPLICABLE)

1. Locate and disconnect the machine's main power harness and the Raven ISO product control cable connection.

**NOTE:** The main power harness (P/N 115-7302-018) and Raven ISO product control cable (P/N 115-7302-016) should already be installed on the applicator and are not included in the Steerable Hitch kit.

2. Install the Steerable Hitch harness (P/N 115-7302-017) between the main power harness and product control cable connection.

### CONNECT STEERABLE HITCH TO JOHN DEERE RATE CONTROLLER (IF APPLICABLE)

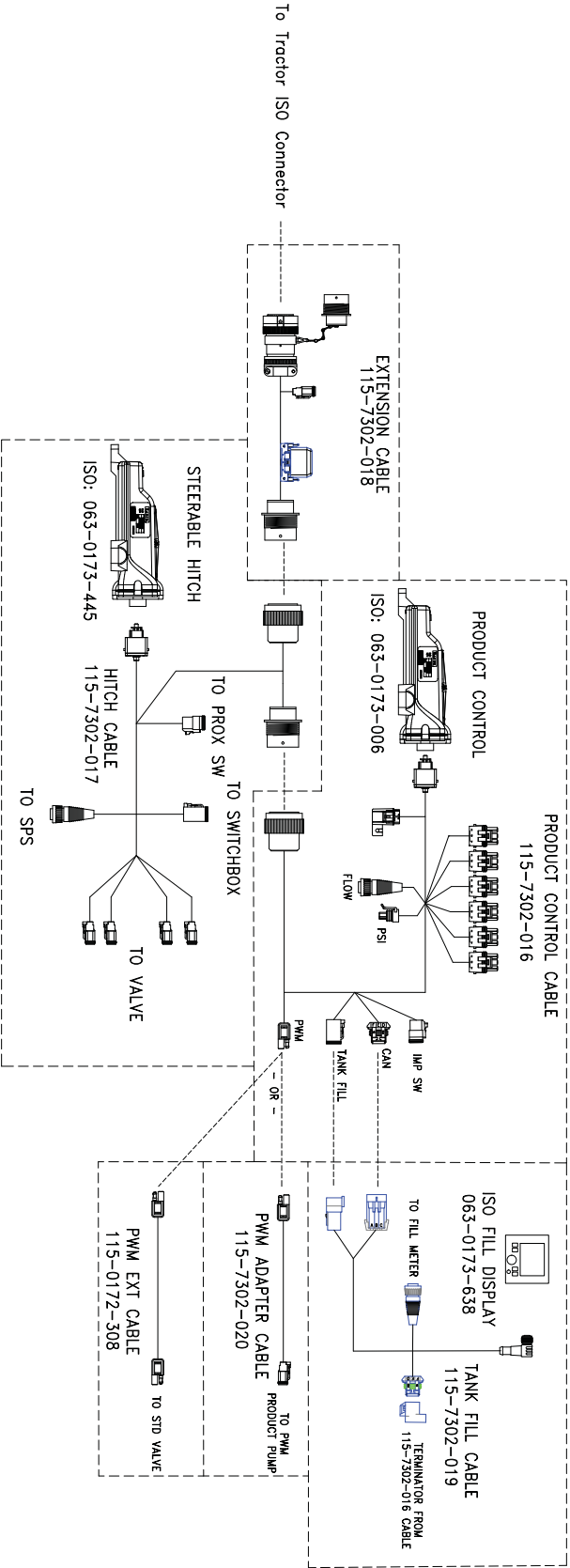
1. Locate and remove the existing ISO terminator from the John Deere rate control cable's 2-pin and 12-pin connectors.
2. Install the John Deere ISO to Raven ISO adapter cable (P/N 115-7300-066) on the rate control cable.
3. Connect the Steerable Hitch harness (P/N 115-7302-017) to the John Deere ISO to Raven ISO adapter cable.
4. Install a Raven ISO terminator cable (P/N 115-7300-044) on the remaining end of the Steerable Hitch harness.

### CONNECT THE STEERABLE HITCH HARNESS TO THE VALVE AND SENSORS

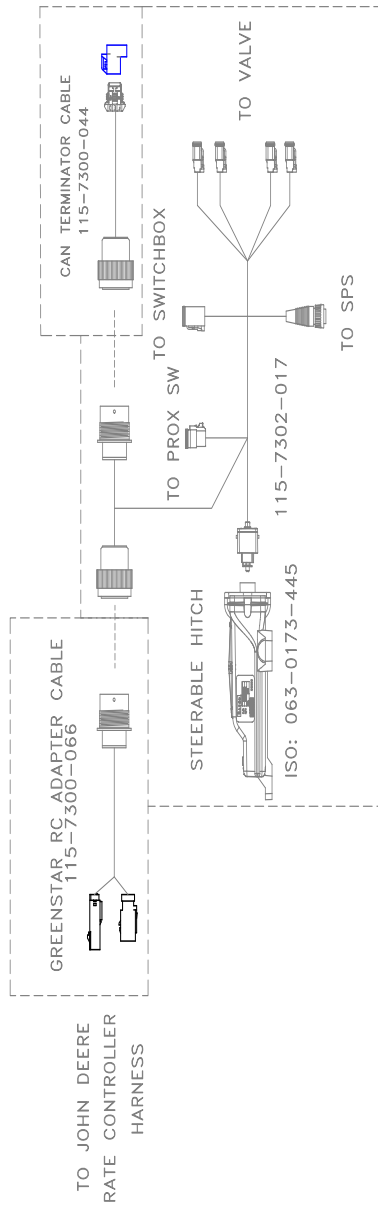
1. Connect the large, rectangular connectors of the Steerable Hitch harness into the correct ports of the Steerable Hitch node (P/N 063-0173-445), tightening the bolts to secure the connections.
2. Connect the 6-pin connection on the Steerable Hitch harness to the mating connector on the applicator's switchbox cable.
3. Connect the SPS connector on the Steerable Hitch harness cable to the rotary sensor on the king pin.
4. Route the valve connections toward the Steerable Hitch valve.
5. Connect the LEFT/OUTER connection of the Steerable Hitch harness cable to the top coil of the stack on the Steerable Hitch valve.
6. Connect the RIGHT/INNER connection to the bottom coil of the stack on the Steerable Hitch valve.
7. Connect the remaining unlabeled cable connections to Port 1A and 1B of the Steerable Hitch valve.
8. Route the ENABLE connector to the right side folding joint and connect it to the installed proximity switch.

SYSTEM DIAGRAMS

Unverferth NutriMax Liquid Fertilizer Applicator – ISO System Diagram



RAVEN ISO STEERABLE HITCH WITH JOHN DEERE PRODUCT CONTROL – UNVERFERTH NUTRIMAX



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CHAPTER

4

ISO CALIBRATION &  
OPERATION

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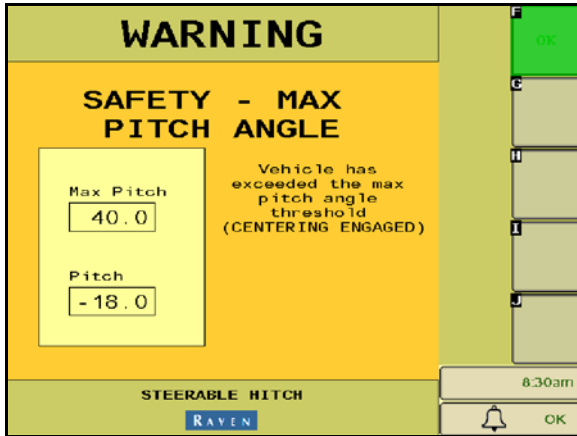
ISO SCREENS

Refer to the ISO screen layout on the following pages for assistance during calibration and operation of the ISO Steerable Hitch system.

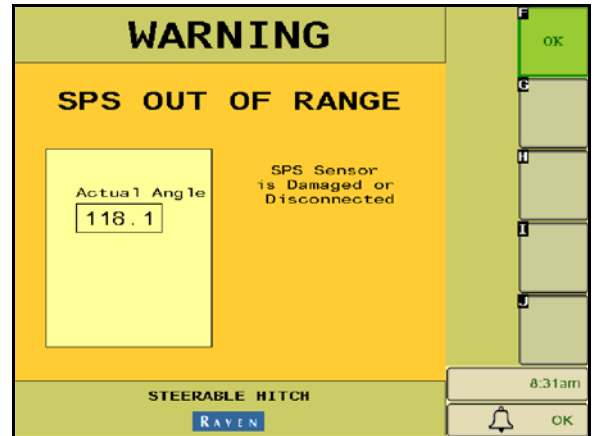




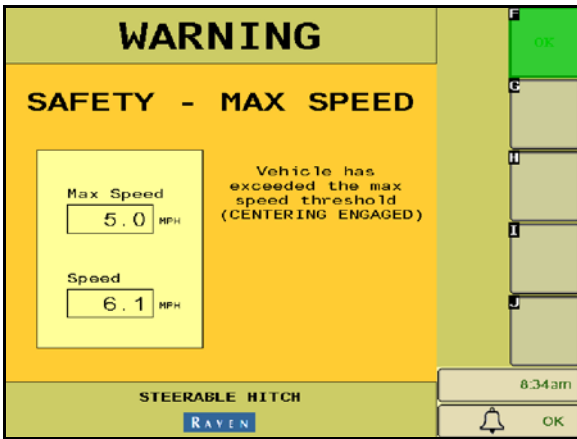
Max Pitch Angle Alarm



SPS Out of Range Alarm



Max Speed Alarm



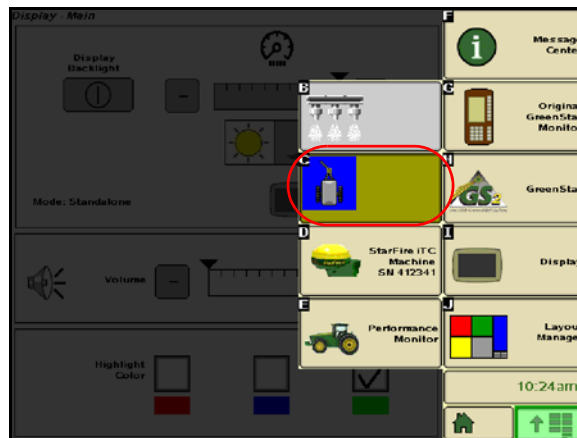
Max Roll Rate Alarm



## CALIBRATING THE STEERABLE HITCH SYSTEM

Once the Steerable Hitch system has been installed it must be calibrated to provide optimal steering performance. To begin the calibration process, locate the Steerable Hitch Main Menu by pressing the Steerable Hitch icon on the ISO Menu.

FIGURE 1. Steerable Hitch Icon



PROGRAM THE MACHINE SETTINGS

FIGURE 2. Main Menu



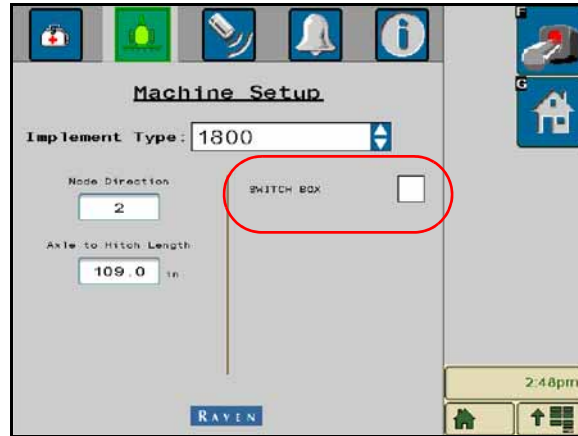
1. Navigate to the Machine Settings Screen by selecting the Tools icon and then the Implement icon.
2. Press the drop-down arrow and select the vehicle model (e.g., TA 1800 or TA 2600).
3. Measure the distance from the tractor axle to the hitch pin.

**NOTE:** For articulated tractors, measure from the tractor’s front axle.

4. Enter the distance value in the Axle To Hitch Length field.

## PROGRAM SWITCH BOX STATUS

FIGURE 3. Machine Settings Screen



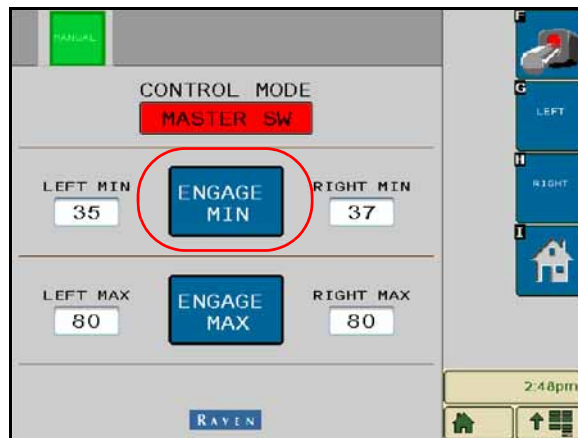
1. Navigate to the Machine Settings Screen.
2. Select the desired Switch Box status to enable switch box control of the Steerable Hitch system, depending on if the switch box has Steerable Hitch functionality.

**NOTE:** The Switch Box status is usually enabled.

## PROGRAM THE LEFT AND RIGHT MIN STEER SETTINGS

1. Navigate to the Manual Control Screen by selecting the Manual button along the right side of the Home screen.

FIGURE 4. Manual Control Screen



2. Turn the master switch On. If no switchbox is installed, toggle the master switch icon in the top right corner of the screen.

**NOTE:** The toolbar must be unfolded.

3. From the Manual Control Screen, select Engage Min (located between the Left and Right values).

4. Manually drive the hitch to the left at the minimum pulse width by holding the Left button located at the right edge of the screen or by holding the Left switch on the switchbox.

**NOTE:** If the hitch does not move, raise the Left Min value until the cylinder just starts to move. If the hitch moves easily, lower the Left Min value until the cylinder just starts to move when the button is engaged.

5. Manually drive the hitch to the right at the minimum pulse width by holding the Right button located at the right edge of the screen or by holding the Right switch on the switchbox.

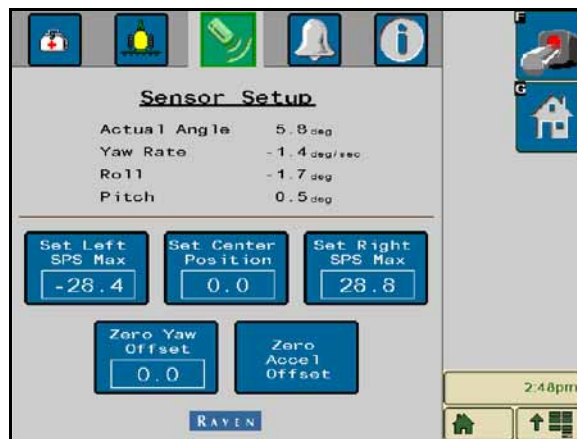
**NOTE:** If the hitch does not move, raise the Right Min value until the cylinder just starts to move. If the hitch moves easily, lower the Right Min value until the cylinder just starts to move when the button is engaged.

6. Press the Home button to accept the values and return to the Home Screen.

## PROGRAM THE STEERING POSITION SENSOR (SPS) SETTINGS

**NOTE:** If the calibration values are set incorrectly, they can be reset at the SPS Calibration Screen.

FIGURE 5. Sensor Setup Screen



1. Set the center SPS position.
  - a. Navigate to the Manual Control Screen.
  - b. Enable manual steering at the minimum value.
  - c. Steer the machine left or right at the minimum values until the cylinder locking brackets fit onto both cylinders.
  - d. Navigate to the Sensor Setup Screen.
  - e. Select Set Center Position to accept the new center position.

**NOTE:** The system is now programmed to recognize the center hitch position.

2. Set the left SPS position.
  - a. Navigate to the Manual Control Screen and enable manual steering at the maximum value.
  - b. Steer the machine left at the maximum value until the hitch reaches its maximum left position.
  - c. Navigate back to the Sensor Setup Screen.
  - d. Select Set Left SPS Max to accept the new left position.

**NOTE:** The system is now programmed to recognize the maximum left hitch position.

3. Set the right SPS position.
  - a. Steer the machine right at the maximum value until the hitch reaches its maximum right position.
  - b. Select Set Right SPS Max to accept the new right position.

**NOTE:** The system is now programmed to recognize the maximum right hitch position.

## ZERO THE YAW SENSOR AND ACCELEROMETER

Complete the following steps to clear the yaw sensor value, which measures the turning speed of the vehicle (degrees/second).

1. Navigate to the Sensor Setup Screen.
2. Stop the vehicle on flat, level ground.
3. Press the Zero Yaw Offset button and confirm the displayed yaw offset value.

**NOTE:** The yaw rate should now display 0.

4. Press the Zero Accel Offset button.
5. Confirm the roll and pitch values are zero.

## OPERATING THE STEERABLE HITCH SYSTEM

There are five modes of operating the Steerable Hitch control node: Auto, Center, Bump, Min, and Max. The method for engaging these modes depends on whether or not a switchbox is installed on the system.

**IMPORTANT:** The toolbar must be unfolded to activate the proximity sensor. None of the control modes are available unless the toolbar is unfolded for field use.

### SWITCHBOX INSTALLED

FIGURE 6. Unverferth Switchbox



**NOTE:** If the modes do not engage as described below, a condition may have occurred that requires the master switch to be toggled.

- **AUTO MODE-** When the Steerable Hitch node is in AUTO MODE, the implement will compensate for turns made by the tractor to maintain track alignment between the tractor and the implement. Once AUTO mode is enabled, the system will default to it when the master switch is toggled. To enable AUTO MODE:

1. Toggle the master switch ON.
2. Push the AUTO/TRANSPORT switch on the switchbox to AUTO.

- **CENTER MODE-** When the Steerable Hitch node is in CENTER MODE, the implement will align itself as closely as possible to the calibrated zero position. To enable CENTER MODE:

1. Toggle the master switch ON.
2. Push the AUTO/TRANSPORT switch on the switchbox to TRANSPORT.

**IMPORTANT:** Once CENTER mode is used to shift the tongue, the steerable hitch system will maintain that tongue position. To resume AUTO mode, toggle the master switch OFF and then On again.

- **BUMP MODE-** When the Steerable Hitch node is in BUMP mode, the implement will move a fixed number of degrees. The bump value is set in the Home Screen under Bump Rate. To enable BUMP MODE:

1. Toggle the master switch ON.
2. Push the LEFT/RIGHT switch on the switchbox to the desired direction.

**NOTE:** A single tap will result in a shift at that selected bump rate. Press the switch multiple times to repeat the bump.

**IMPORTANT:** Once BUMP mode is used to shift the tongue, the steerable hitch system will maintain the tongue position. To resume, AUTO mode, toggle the master switch OFF and then ON again or select AUTO mode.

- **MIN MODE-** When the Steerable Hitch node is in MIN MODE, the implement is manually driven to the left or the right at the preset minimum pulse width (refer to the Manual Control Screen). To enable MIN MODE:

1. Navigate to the Manual Control Screen.
2. Select Engage Min.
3. Manually drive the implement to the left or right by pushing the LEFT/RIGHT switch on the switchbox in the desired direction (L or R).

**NOTE:** The system will continue to drive the coils at the minimum pulse width while the LEFT/RIGHT switch is held.

- **MAX MODE-** When the Steerable Hitch node is in MAX MODE, the implement is manually driven to the left or the right at the preset maximum pulse width (refer to the Manual Control Screen). To enable MAX MODE:

1. Toggle the master switch ON.
2. Navigate to the Manual Control Screen.
3. Select Engage Max.
4. Manually drive the implement to the left or right by pushing the LEFT/RIGHT switch on the switchbox in the desired direction (L or R).

**NOTE:** The system will continue to drive the coils at the maximum pulse width while the LEFT/RIGHT switch is held.

### NO SWITCHBOX INSTALLED

- **AUTO MODE -** When the Steerable Hitch node is in AUTO MODE, the implement will compensate for turns made by the tractor to maintain track alignment between the tractor and the implement. When AUTO mode is enabled, the system will default to it when the master switch is toggled. To enable AUTO MODE:

1. From the Home Screen, ensure the master switch is activated under CONTROL MODE. If not, verify that the toolbar is unfolded and the proximity sensor is detecting metal.

FIGURE 7. Home Screen

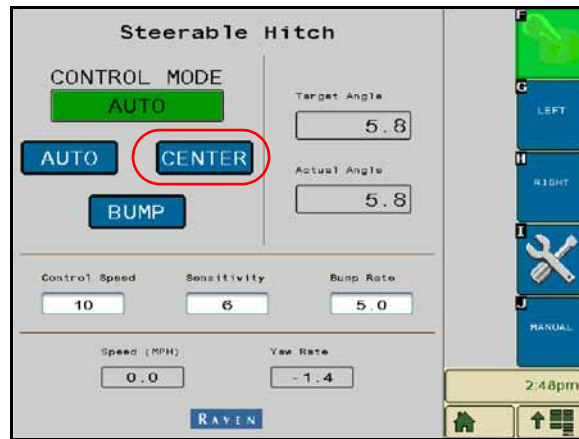


2. Toggle the master switch ON and verify that the control mode changes to AUTO.

**NOTE:** To return to AUTO mode from another mode, either press the AUTO button or cycle the master switch OFF and then ON again.

- CENTER MODE - When the Steerable Hitch node is in CENTER MODE, the implement will align itself as closely as possible to the calibrated zero position. To enable CENTER MODE:

FIGURE 8. Home Screen

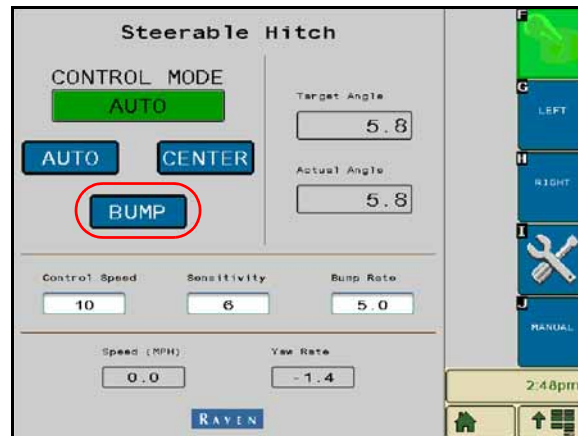


1. From the Home Screen, ensure the master switch is activated under CONTROL MODE.
2. Toggle the master switch ON.
3. Select CENTER.

**IMPORTANT:** Once CENTER mod is used to shift the tongue, the steerable hitch system will maintain that tongue position. To resume AUTO mode, toggle the master switch OFF and then ON again.

- BUMP MODE- When the Steerable Hitch node is in BUMP mode, the implement will move a fixed number of degrees. The bump value is set in the Home Screen under Bump Rate. To enable BUMP MODE:

FIGURE 9. Main Menu



1. From the Home screen, ensure the master switch is activated under CONTROL MODE.
2. Toggle the master switch ON.
3. Select BUMP.
4. Use the LEFT or RIGHT buttons at the side of the screen.

**NOTE:** A single button press will result in a shift at the selected bump rate. Press the button multiple times to repeat the bump. Ex. For a five degree bump rate, two button presses in the same direction will result in a ten degree bump.

**IMPORTANT:** Once BUMP mode is used to shift the tongue, the steerable hitch system will maintain that tongue position. To resume AUTO mode, toggle the master switch OFF and then ON again or select AUTO mode.

- MIN MODE- When the Steerable Hitch node is in MIN MODE, the implement is manually driven to the left or the right at the preset minimum pulse width (refer to the Manual Control Screen). To enable MIN MODE:
  1. Ensure the master switch is activated under CONTROL MODE.
  2. Toggle the master switch ON.
  3. Navigate to the Manual Control Screen.
  4. Select Engage Min.
  5. Manually drive the implement to the left or right by holding the LEFT or RIGHT button on the right edge of the screen.

**NOTE:** The system will continue to drive the coils at the minimum pulse width while the LEFT or RIGHT button is held.

- MAX MODE- When the Steerable Hitch node is in MAX MODE, the implement is manually driven to the left or the right at the preset maximum pulse width (refer to the Manual Control Screen). To enable MAX MODE:
  1. Ensure the master switch is activated under CONTROL MODE.
  2. Toggle the master switch ON.
  3. Navigate to the Manual Control Screen.
  4. Select Engage Max.
  5. Manually drive the implement to the left or right by holding the LEFT or RIGHT button on the right edge of the screen.

**NOTE:** The system will continue to drive the coils at the maximum pulse width while the LEFT or RIGHT button is held.



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# CHAPTER

# SYSTEM FEATURES

## 5

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### FEATURE DESCRIPTIONS

Field	Description
CONTROL MODE	This feature displays the current steering mode (Auto/Manual/Min/Max/Center).
AUTO	When the master switch is on, this feature automatically turns the hitch to align with the tractor wheels.
CENTER	When the master switch is on, this feature automatically turns the hitch to a centered position. Once the hitch is centered, the master switch must be toggled to re-engage steering.
BUMP	When the master switch is on, this feature bumps the hitch out to a fixed angular amount on each left/right key toggle. It continues to steer to that position until another position is set.
SWITCH BOX	This feature toggles between present and removed to indicate to the node whether a switchbox is installed on the system. The default setting is blank.
CONTROL SPEED	This feature is used to set the aggressiveness of the control response. If the system is turning too aggressively, lower the value. If the system appears sluggish, increase the value. The default setting is 10.
SENSITIVITY	Used to set the system's responsiveness in changing the target angle to compensate for changes in the vehicle's direction. By increasing this value, the system will be more responsive to changes in vehicle direction. By decreasing this value, the system will be less responsive to changes in vehicle direction. The default setting is 10.
BUMP RATE	Displays the degrees the hitch will change when the steering mode is set to bump and the left or right toggle is engaged. The default setting is 5.0.
IMPLEMENT TYPE	Toggles between machine model numbers. This number should be set to the corresponding sprayer model. The default setting is 1600.
AXLE TO HITCH	Length from the center of the hitch pin to the center of the tractor axle (inches or centimeters). The default setting is 45.0.
LEFT MIN	Sets the minimum pulse-width to drive the left steering valve. The default setting is 35.
RIGHT MIN	Sets the minimum pulse-width to drive the right steering valve. The default setting is 35.
ENGAGE MIN	Once engaged, this feature allows manual steering of the hitch in either the left or right direction at the current minimum pulse-width setting.
LEFT MAX	Sets the maximum pulse-width to drive the left steering valve. The default setting is 80.
RIGHT MAX	Sets the maximum pulse-width to drive the right steering valve. The default setting is 80.
ENGAGE MAX	Once engaged, this feature allows manual steering of the hitch in either the left or right direction at the current maximum pulse-width setting.

Field	Description
SET LEFT SPS MAX	Sets and displays the left-most hitch angle the system will control before stopping. The default setting is -35.0.
SET RIGHT SPS MAX	Sets and displays the right-most hitch angle the system will control before stopping. The default setting is 35.0.
SET CENTER POSITION	Sets and displays the current offset value from the expected zero position. When set, the value will define the actual center position of the hitch. The default setting is 0. <b>NOTE:</b> The value determines the position to which the hitch is centered. It is important to set this value correctly as it determines how straight the sprayer drives in relation to the tractor.
ZERO YAW OFFSET	This feature displays the current yaw offset value in degrees/seconds. If selected, the operator can manually set the zero position of the yaw sensor. The default setting is 0.0. <b>NOTE:</b> The vehicle must be stopped and the hitch stationary before adjusting this value.
MAX SPEED	This feature sets the maximum speed the vehicle can travel before steering disengages and centers. The default setting is 14.0 mph (22.5 kph).
MAX PITCH ANGLE	The maximum downward slope the vehicle can be driven before steering disengages and centers. The default setting is 40.0.
MAX ROLL RATE	The maximum change in the vehicle's tilt angle per second that is allowed before the steering disengages. The default setting is 20.0.
NODE DIRECTION	This feature identifies the correct directions for measurement of pitch and roll. The default setting is 2. <b>NOTE:</b> There are six arrows engraved into the node enclosure. The number entered into the Node Orient field should be the number of the arrow pointing forward, toward the tractor.
ZERO ACCEL OFFSET	This feature manually sets the zero position for the roll and pitch sensor measurements. This procedure should be performed on level ground.
SERVICE MENU	This is an advanced feature for product support diagnostics.
TARGET ANGLE	The current angle the hitch is targeting.
ACTUAL ANGLE	The current angle of the hitch.
SPEED	The current speed of the vehicle.
PWM	The current pulse-width being driven to the steering coils. A negative number indicates this value is for the left coil. A positive number indicates the value is for the right coil.
YAW RATE	The current yaw rate measurement on the node.
ROLL RATE	The current roll rate measurement on the node.
ROLL	The current roll angle of the node.
PITCH	The current pitch angle of the node.
TARGET CURRENT	The coil current the hitch is targeting.
ACTUAL CURRENT	The actual current at which the coil is being driven. A negative number indicates this value is for the left coil. A positive number indicates this value is for the right coil.
3D%	Percentage of time in the last 15 minutes the hitch angle has been within +/- three degrees of the target angle. This value is calculated only when the system is active and is zeroed out when the system is powered down.

Field	Description
6D%	Percentage of time in the last 15 minutes the hitch angle has been within +/- six degrees of the target angle. This value is calculated only when the system is active and is zeroed out when the system is powered down.
ENGAGED HOURS	Amount of time the node has been engaged during the life of the node.
SOFTWARE HOURS	Amount of time the node has been engaged while running the current software version.
HC VOLTAGE	The high current voltage of the node.
SOFTWARE PART NUMBER	The part number of the software specification.
SOFTWARE VERSION	The current node program version.
NODE REVISION	The current node hardware version.
NODE SERIAL NUMBER	The serial number of the node.
BOOTLOADER VERSION	The bootloader version in the node.
NODE PART NUMBER	The enclosure assembly number of the node.

## SAFETY FEATURES

The Steerable Hitch system comes with three safety settings that can be modified through the console when maneuvering challenging terrain: max speed (default 14 mph), max pitch angle (default 40 degrees), and max roll (default 20 degrees/second). These features cannot be increased from the default setting, but can be decreased to reduce risk. When the max speed and max pitch angle conditions are met, the hitch will begin steering to a centered position and then shut off all control to ensure the hitch is in a safe position during transport and when turning on steep terrain. When the max roll rate condition is met, the hitch will stop controlling all together to prevent compensation for a false yaw measurement when the implement drops into a hole in the field. After any of the three of these conditions are met, a master switch toggle is required to re-engage steering.



## TROUBLESHOOTING

## NODE

The CAN control node features several green light-emitting diodes (LEDs) which may be used to diagnose issues within the Steerable Hitch system.

**NOTE:** If the LEDs are not displayed as outlined in the figure below or are all on continuously, check the CAN connections and the control cable connections on the node. If the issue persists, contact your local Raven dealer for additional technical support.

FIGURE 1. CAN Control Node LEDs



## SYSTEM ALARMS

Alarm	Cause
Proximity Sw Off	The user attempted to engage Auto/Manual mode with the proximity switch turned off.
Invalid Hardware	The node hardware is not compatible with the current software version.
Bad Yaw Sensor	The yaw sensor in the node is damaged.
Bad Accelerometer	The accelerometer in the node is damaged.
SPS Out of Range	The SPS sensor is damaged or the SPS was not properly calibrated and the actual tongue position exceeded the expected maximum position..
Safety-Max Speed	A max speed condition has been detected.
Safety-Max Roll Rate	A max roll rate condition has been detected.
Safety-Max Pitch Ang	A max pitch angle condition has been detected.
Current Comp Bad Pwr	The system voltage is out of range for the node.
Hitch Not Responding	There is a problem with the hydraulics, cabling, or node that is not allowing steering to engage.
SH HC Pwr Disconnect	The node does not have high current power connected.

## SYSTEM ISSUES

To obtain satisfactory hitch steering, all of the sensors must be fully operational. Verify the following sensors are operational: speed sensor, position sensor, proximity switch, and node sensors (yaw, roll, pitch). If the system is not operating satisfactorily after verifying sensor operation, refer to the following table to improve hitch steering performance.

Symptom	Possible Cause	Solution
System too aggressive upon initial startup	Hydraulics not up to operating temperature	Allow system hydraulics to warm up before enabling Steerable Hitch
	Speed parameter is set too high	Decrease Speed parameter Enable Current Compensation
System too sluggish or too aggressive during routine operation	Speed parameter is set too low (sluggish)	Increase Speed parameter
	Speed parameter is set too high (aggressive)	Decrease Speed parameter
	System hydraulics set too low (sluggish)	Increase tractor hydraulic flow
	System hydraulics set too high (aggressive)	Decrease the tractor hydraulic flow
	System PWM mins set too low (sluggish)	Increase PWM mins on Right and Left by one until achieving satisfactory performance
System PWM mins set too high (aggressive)	Decrease PWM mins on Right and Left by one until achieving satisfactory performance	

Symptom	Possible Cause	Solution
System does not return to the center of the tow vehicle track when driving straight ahead	Sensitivity parameter too high	Lower Sensitivity parameter
	Yaw sensor is offset too far	<ol style="list-style-type: none"> <li>1. Stop the vehicle</li> <li>2. Inspect YR value on diagnostics Screen</li> <li>3. Re-zero on Setup Screen if greater than 1 or less than -1</li> </ol>
	Hitch center position offset	Re-center hitch, lock center locking mechanism, and reset SPS center position on Setup Screen
Hitch does not respond to controls	Switchbox not detected, but connected to system	<ol style="list-style-type: none"> <li>1. Inspect cabling</li> <li>2. Ensure "Switchbox Present" is selected</li> </ol>
	Hydraulics not engaged	Engage hydraulics (verify the SCV is engaged in the correct direction to pressurize the valve).
	Booms not unfolded (proximity switch)	Unfold booms
	Hitch locking mechanism in place	Remove hitch locking mechanism
	Insufficient high current power	Inspect node high current lights and check fuses
	Master switch not toggled	Toggle the master switch off and on
	No speed input to system	Check speed on Diagnostics Screen and check speed source connections and functionality

Hydraulic Flow Limitations – If there are additional features using hydraulic fluid on the machine (example: boom leveling), there may be conditions where the hitch steering valve will require significant amounts of hydraulic fluid (e.g., while turning). During these conditions, there may be limited hydraulic flow to other components, which can result in reduced performance.

Still Having Problems? Contact your local distributor for more information.





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# LIMITED WARRANTY

## WHAT DOES THIS WARRANTY COVER?

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

## HOW LONG IS THE COVERAGE PERIOD?

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

## HOW CAN I GET SERVICE?

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

## WHAT WILL RAVEN INDUSTRIES DO?

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

## WHAT IS NOT COVERED BY THIS WARRANTY?

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

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

# EXTENDED WARRANTY

## WHAT DOES THIS WARRANTY COVER?

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

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

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

## WHERE CAN I REGISTER MY PRODUCT FOR THE EXTENDED WARRANTY?

To register, go online to [www.ravenhelp.com](http://www.ravenhelp.com) and select Product Registration.

## HOW LONG IS THE EXTENDED WARRANTY COVERAGE PERIOD?

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

## HOW CAN I GET SERVICE?

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

## WHAT WILL RAVEN INDUSTRIES DO?

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

## WHAT IS NOT COVERED BY THE EXTENDED WARRANTY?

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

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