Purpose: This document guides certified field technicians through an AutoFarm installation on John Deere 8000 Series tracked tractors.
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1 INSTALLATION OVERVIEW

This document will guide you through the installation, calibration and tuning of the AutoSteer™ system.

1.1 Safety Precautions

**IMPORTANT:** The following precautions must be read and understood to avoid damage to the hardware and possible harm to the installer.

⚠️ **WARNING:** Turn off the tractor engine and remove the starter key from the tractor before proceeding with the electrical installation. All accessories and implements must be turned off. Failure to observe this warning can result in personal injury or death.

⚠️ **WARNING:** Make sure nobody is in the area around tractor when steering tests are performed. Failure to observe this warning can result in personal injury and death.

The vehicle pictured in this manual is an 8520T. However AutoSteer installation is similar across all 8000 series tracked tractors.
1.2 Pre-Installation Check List

Before you begin installation, review the following checklist to ensure proper tractor operation.

Table 1 Pre-Install Check list

- **Proper Steering:**
  To ensure proper steering, both the left and right “Dead Band” range is checked. While the tractor is in neutral and running at 1500 rpm's let go of the steering wheel to allow the steering to self align. Grasp the steering wheel at the 12 o’clock position and turn right until the vehicle begins to respond. Note: the position of the steering wheel. Do the same for the left and again note the rotation distance. If the distance is the same the steering will pass. If the dead band distance is not equal it fails. Refer to your John Deere Operators manual for adjustment.

- **Rubber Track Tension:**
  Ensure that the rubber track tension is within specifications. Refer to John Deere Maintenance Manual.

- **Electronic Steering Calibration:**
  Calibrate the tractor electronic steering wheel sensor according to tractor manufacturer recommendations. Refer to the John Deere Maintenance Manual.

The AutoSteer System will not work properly unless the tractor’s steering system functions without problems and is undamaged.

1.3 Parts List

The table below lists the AutoFarm parts in installation kit PN: 180-0001-01.

Table 2 Kit Parts List

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>200-0008-01</td>
<td>Kit, Mounting Hardware JD 8000</td>
</tr>
<tr>
<td>2</td>
<td>200-0002-01</td>
<td>Cable Steering, Tracked JD</td>
</tr>
<tr>
<td>3</td>
<td>202-0002-02</td>
<td>Slider Plate Monitor Mtg</td>
</tr>
<tr>
<td>4</td>
<td>202-0004-01</td>
<td>Bracket JD 8000 Cab &amp; Monitor</td>
</tr>
<tr>
<td>5</td>
<td>202-0004-25</td>
<td>Cab Box Slider</td>
</tr>
</tbody>
</table>
### 1.4 Recommended Tools List

<table>
<thead>
<tr>
<th>Table 3  Recommended Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>24mm socket wrench</td>
</tr>
<tr>
<td>½” socket wrench</td>
</tr>
<tr>
<td>17mm wrench or socket wrench</td>
</tr>
<tr>
<td>8mm wrench</td>
</tr>
<tr>
<td>5mm Hex. Allen wrench</td>
</tr>
<tr>
<td>1/8” Hex Allen Wrench (supplied with AutoSteer kit)</td>
</tr>
<tr>
<td>Medium Phillips screwdriver</td>
</tr>
<tr>
<td>¼” or medium size screwdriver</td>
</tr>
</tbody>
</table>
2 INSTALLATION PROCEDURE

2.1 Install Antenna Roof Array

The three GPS antennas and the radio link antenna (whip antenna) are factory assembled and pre-wired. It will be installed to the cab-roof with the paired antennas on the left side of the cab.

**IMPORTANT: Be sure the associated rubber washer for the whip antenna is not lost during unpacking.**

2.2 Mount the Antenna Roof Array

**Step 1. Remove the Cab Roof Bolts**

Remove the two external bolts from cab roof using a 15/16” socket wrench exposing the threaded holes. They will be used to secure the antenna array to the roof.

- **Note:** Leave both rubber and metallic washers in original position on mounting bolt when mounting the array.

**Figure 2 External Bolts on Cab Roof**

**Step 2. Align Antenna Roof Array to Mounting Holes**

Align the mounting holes of the array’s cross-bar over the threaded holes so that the side with two antennas are on the left side facing towards the front of tractor.

**Important:** It is important that the antenna roof array is installed in this orientation so the system will work properly.

**Figure 3 Align Array with mounting holes**
Step 3. Fasten to Roof
Locate the two M16x25 bolts through the array cross-bar slots and fasten into the threaded holes.

Caution! Be very careful not to bind and damage the antenna cables running through the cross bar while securing the bolts into place. Cable damage will cause malfunction.

Figure 4 Fasten Array

Step 4. Install the Whip Antenna
Insert the rubber washer into the socket of the radio-link whip antenna.

Align the socket over the threaded post in the center of cross-bar and screw into place thumb tight.

Important: Tighten the whip antenna with your hand (do not use tools).

Figure 5 Whip Antenna installed

2.3 Route & Secure Array Cable

Step 5. Secure Cable to Roof
Using an 5/8” eye-clamp secure the antenna cables to the tractor roof using the existing screw.

Figure 6 Secure Array Cable to Roof
Step 6. Route Antenna Array Cable down left side of Cab

Route the cables down the rear left side of the cab and secure with tie wraps.

**Important:** It is very important to correctly secure all cables to avoid possible damage and abrasion to cables.

![Array Cable down left side of Cab](image7.png)

Step 7. Route Array Cable into Cab

Route the array cable into the tractor cab through the hole under the left side of the rear window.

![Array Cable into Cab](image8.png)

Step 8. Route Array Cable behind Cab Seat

Move the cab seat forward then remove the vent cover. This will allow you to route the cable properly along the floor under the vent cover. Once cable is routed, replace the vent cover.

![AC Panel removed](image9.png)
Step 9. Route Array Cable to Cab Box area
Route the cables along the right side of the cab to where the cab box will be mounted.

**Important:** Be sure not to route the cable too close to the seat track, window or door hinges, along the door entrance or other areas that may damage or pinch the cables.

2.4 Install Cab Box & Monitor
A bracket assembly is used to support the monitor and cab box. The bracket is designed to mount over the original John Deere mounting holes of the cab post, right side of cab.

2.4.1 Assemble Bracket

Step 10. Monitor Bracket Assembled
Position the monitor bracket over the main bracket and secure with the four ¼-20x ¾” screws and lock nuts.

- **Note:** The monitor bracket can also be mounted in the opposite direction to give the monitor a higher position if desired.

Step 11. Cab Box Bracket Assembled
Position the cab box sliding bracket over the main bracket in the position shown and secure with the four 10-32x3/4” screws.

Step 12. Remove Hole Covers
Unscrew and remove the two plastic hole covers of the cab post. These holes are used to mount the bracket assembly.
Step 13. **Mount Bracket Assembly**

Position the bracket assembly over the holes and secure with two M-10x25 screws using your 17mm wrench.

**Attention:** Do not attempt to use longer bolts or inch thread bolts because damage to the mounting studs might occur. Use only the correct metric bolts provided with your parts kit.

Figure 13  Bracket Assembly mounted in cab
2.5 Install Cab Box

The Cab Box has a reinforcement plate and sliding bracket that can be assembled four different ways giving you four installation options as the need arises for an increase in vertical position or an installation behind the driver seat. The following steps are for the most typical right side cab installation.

The sliding bracket allows you to remove and mount the cab box easily when swapping between tractors.

Step 1. Assemble Reinforcement Plate and Sliding Bracket to Cab Box

Position the reinforcement plate and sliding bracket as shown.

Step 2. Slide Cab Box onto Bracket

Slide cab box onto the fixed sliding bracket.

Step 3. Secure Cab Box to Bracket

Secure the cab box firmly to the cab bracket using the two ¼” philips screws. Check how secure the cab box is to the cab slider bracket by gently shifting it back and forth. Tighten as needed.

**Important:** The cab box must be snug to the cab bracket to avoid any unnecessary vibration.

This completes Cab Box install.
2.6 Install Monitor

Step 1. Mount Adjustable Arm to Monitor

Mount adjustable arm to monitor using three 3/16” nuts and washers.

Step 2. Remove Adjustment Bolt Caps

Remove adjustment bolt caps using a screwdriver to remove.

Step 3. Adjust Monitor Arm Tightness

Loosen or tighten the adjustment bolts using a ½” socket wrench to adjust the monitor’s position.
Step 4. Remove Travel Stop
Remove the top travel stop from the slider of the cab bracket using a Philips screwdriver.

Step 5. Install Monitor Arm onto the Cab Bracket
Slide the adjustable arm into the fixed bracket.

Step 6. Replace Travel Stop
Replace the top travel stop and secure into place.

Step 7. Replace Adjustment Bolt Caps
(Refer to Step 2, “Remove Adjustment Bolt Caps.”)
Step 8. Adjust Monitor Arm play on Cab Bracket
Tighten the two Allen screws with the supplied 1/8” Allen wrench. These two screws tighten the sliding joint to prevent unnecessary movement of the monitor.

![Figure 24 Monitor Arm play adjustment](image)

Step 9. Adjust Monitor Viewing Angle
Adjust monitor viewing angle to a desired position using the release lever located on the monitor arm behind the screen.

![Figure 25 Monitor Arm view adjustment](image)
2.7 Install Cables

Cables coming from the antenna array, monitor, power panel and steering need to be connected to the cab box. The steps that follow will walk you through this process.

Step 1. Connect Antenna Cables to Cab Box

During the installation of the roof array the cables were routed to reach the cab box. See section 2.3 “Route & Secure Array Cable”. There are three colored coded cables coming from the roof array that are connected to the cab box. Each cable connects to its corresponding cab box socket with a push and rotate motion.

Step 2. Connect Electro-Hydraulic Steering Cable to Cab Box

**WARNING:** Turn off the tractor engine and remove the starter key from the tractor before proceeding with the electrical installation. All hydraulic cylinders must be placed in their lowered position and all accessories and implements must be turned off.
**Step 3. Route the Steering Cable through Window**

Locate the cable exit hole below the rear window on the left side of the tractor. Open the rear window to allow access to the cable exit hole. Route the cable end with the two connectors through the hole and down under the tractor cab structure.

**Figure 29 Route steering cable**

**Step 4. Route Cable Under the Cab**

Continue routing the steering cable down under the cab structure. Follow existing harness and tie wrap tucked clear of possible damage.

The cable connectors must reach the area between the engine and the cab.

**Figure 30 Steering Cable routed under Cab**

**Figure 31 Steering Cable routed along frame**
Step 5. Raise Hood
Raise the hood giving you access to the guard plate.

- **Note:** Raising the hood applies to the John Deere 8520 only.

![Tractor hood opened](image)

Step 6. Remove Guard Plate
Remove the left side guard plate using a 5mm Allen wrench to loosen the two Allen screws.

![Guard Plate](image)

Step 7. Disconnect John Deere Steering Cable Connectors
Locate and disconnect the John Deere steering cable and make the connectors accessible and ready to receive the matching AutoFarm steering cable connectors.

![Guard Plate removed](image)
Step 8. Connect Cable to John Deere Steering Cable

Locate the AutoFarm steering cable connectors between the cab and engine compartment and connect to each of the corresponding John Deere connectors.

**Attention:** Connectors will fit in one position only. Do not force connectors to avoid possible pin damage.

Step 9. Tie Wrap Cables

Secure all loose cables with tie wraps and roll excess cable into a neat roll. Secure under the tractor cab using tie wraps.

**Caution:** Cables must be secured with tie wraps and kept away from any possible heat source or moving parts. Ensure cables are clear from the tracks and debris that may be generated during normal operation.

Step 10. Replace Guard Plate

Replace the guard plate and secure into place.

Step 11. Connect the AutoSteer Power Cable to Cab Box

The power cable connects the Cab box to the tractor’s 12 volt power system.

Connect the large connector to the Cab box at the connector labeled POWER. Rotate the connector in the clockwise direction to mate with socket.
Step 12. Route and Connect Power Cable to Tractor Panel

Connect the other end of the power cable to the 12 volt socket on the right side of the tractor panel. Secure and wrap all excess power cable with tie wraps after routing from the power socket to Cab box.

Step 13. Connect Monitor Cable to Monitor

Connect the monitor cable to the socket on the back side of the monitor. The connector will only fit in one position. Rotate the connector to find the proper position.

Step 14. Connect Monitor Cable to Cab Box

Connect the other end of the monitor cable to cab box.

Step 15. Tie Wrap Excess Cable

Wrap all excess wire inside the space between the Cab box and the bracket. Secure cables with tie wraps.
The calibration and tuning process described in this guide is for the first time installation. The following calibration and tuning procedures assume AutoFarm hardware has been properly installed, and a base station has been set up. Refer to the “Base Station” manual. Before moving on to the calibration and controller tuning process the following conditions must be met:

- A two acre field must be available for running the tractor during tuning process.
  - Note: The field must be disked over after this procedure. Parking lots are unacceptable.
- Tune using the most challenging implement (usually a lister), to calibrate properly.
- Ensure that all key persons are present for training after calibration, such as operations and maintenance personnel.
- All base station requirements are met including a fresh 12 Volt, deep cycle marine battery (TYPE 24 or 27). See Base Station Manual.

Calibration and tuning of the tractor is broken down into the following procedures:

- Initialize System
- Add a New Vehicle
- Calibration (Calibration “Wizard”)
- Controller Tuning
3.1 INITIALIZE SYSTEM

System initialization has two user levels, “Driver” and “Supervisor”. Driver’s are given limited access to the system. Calibration and tuning require “Supervisor” privileges.

Getting to the main Menu requires the steps outlined to the right.
3.1.1 Initialize to the Main Menu

Step 1. Start the tractor’s engine.

Step 2. Turn on the AutoFarm Cab Box

Step 3. Select Language
Choose a Language.

Step 4. Accept Safety Responsibility
Read and Accept.

Step 5. Select User Level
Choose Supervisor to calibrate and tune the vehicle.
Step 6. Enter Password

Key-in “YES” and enter.

Step 7. Base Station Survey

Select “Auto” in all cases to begin survey.

Attention: During the first time system survey you will be prompted to enter a name for the base station.

Step 8. Survey Progress

Screen 6, “Survey Progress” displays.

Important: Do not move the vehicle during the survey. Survey typically takes less than 5 minutes.
Step 9. Name New Base Station

Key-in a name for the new base station and enter.

Step 10. Accept New Base Station Parameters

Select “Accept” to confirm the information.

3.1.2 Main Menu

The “Main Menu”, screen 7 displays once the survey is done.

Initialization in now complete.

To continue setup select the green “Begin AutoSteer” button.
3.2 Add a New Vehicle

Adding a new vehicle is necessary for a first time installation. You will have to enter the “System Menu”, to set vehicle parameters and then restart the system to complete the process.

Step 11. Select “Change Settings”

Initialize to the Main Menu as a supervisor following the steps outlined in section 3.1.1. Access the “Choose Item to Change” menu by selecting the “Change Settings” button.

Step 12. Select “System Menu”

Select the “System Menu” button to display the system menu password screen.

Step 13. Enter Password

Key-in “BWP” and enter to display the “System Menu.”

**Important:** Access to this menu is restricted to protect the calibration and steering parameters from unauthorized changes or deletion.
**Step 14. Select “Special Commands”**
Select the “Special Commands” button from the system menu.

**Step 15. Select “Change Vehicle”**
Select the “Change Vehicle” button.

**Step 16. Select Add New Vehicle**
Select the “Add New Vehicle” button.
Step 17. Enter New Vehicle Name

Key-in a name for the new vehicle being added and press enter.

- Note: When naming a vehicle you should consider using the vehicle’s make and model for easy future reference.

Step 18. Enter Vehicle Type

Highlight DEERE_TRACK and select.

Important: Be sure to select the correct vehicle type to load the best default tuning parameters.

Step 19. Select Vehicle Color

Highlight the color of your vehicle and select. The color designates the tractor icon used throughout AutoSteer screens.
Step 20. Accept Vehicle Information
Review the entered data and accept. After accepting you will be asked to restart the system.

Step 21. Select “OK”
At the restart screen select “OK” to shut down the system.
3.3 Calibration Wizard

The Calibration Wizard will guide you through the calibration process. During the process you will be given directions to complete each step screen by screen.

Step 1. Initialize to Main Menu
To get to the Calibration Wizard, repeat section 3.1.1 until you reach the “Main Menu.”

Step 2. Select “Begin AutoSteer”
At the “Main Menu”, select the green “Begin Auto Steer” button.

This will bring up the Calibration Wizard’s welcome screen.

Step 3. Select Continue
Select “Continue” to start the Calibration Wizard.

The wizard is a series of five procedures (steps) each displaying informational screens. The five steps are:

3.3.1 System Test
First step is to ensure:
1. Manual steering outside of GPS system is correct.
2. Steering response through GPS system commands are acceptable.

3.3.2 Lever Arm Measurements
Second step is to orient the master GPS antenna to the vehicle. You will be asked to enter three values, the X, Y and Z. The X value is the distance between the master antenna and the control point of vehicle, or pivot point of the tractor. The “Y” value is the distance between the master antenna and the center of the vehicle. The “Z” value is the distance between the ground and the master antenna.

3.3.3 Attitude Survey
Third step is the attitude survey which allows the system to make precise pitch, roll, and yaw calculations. It takes exactly 30 minutes.

3.3.4 Deere Track Steering Wheel Calibration
The forth step is to determine the average values of each steering potentiometer in the three steering positions; center, hard left and hard right. The steering system uses three potentiometers to determine the position of the steering wheel. These values will be used by the system when AutoSteering the tractor.

3.3.5 Track Calibration
The fifth step calibrates the track movement with the AutoFarm GPS control system. It is important to read and understand each screen throughout the process.

When finished the Calibration Wizard takes you to the Main Menu. Controller tuning is next.
3.4 Controller Tuning

3.4.1 Overview
Controller tuning optimizes the tractor’s line-holding performance when obtaining and holding the desired row. The AutoFarm controller has three control loops, 1-steering, 2-heading and, 3-lateral-error. These three control loops mimic the actual driving of a tractor and controls the tractor during AutoSteer. Consider a tractor that is aligned parallel to the desired row but is positioned five feet away to the left. To get onto the desired row, the driver turns the steering wheel towards the row. As the tractor moves forward it begins to turn changing its heading, in turn causing lateral-error to become less and less. As the tractor approaches the desired row, the driver turns in the opposite direction going back parallel to the desired row. Heading and lateral-error become zero, the tractor in now heading down the desired row.

3.4.2 The Three Man Analogy
Before moving on to specific tuning instructions, the following analogy may be helpful: think of the controller as three men working together to steer the tractor. The inside man, the steering man can only see the steering wheel; he can move the steering wheel to a certain position for you, but he can't see outside, it's like he is driving in a cab with blackened windows. The second man, the heading man is also in the blackened cab, but he has a compass, which tells him the heading of the tractor relative to the desired line (0 degrees being the desired direction). The heading man's job is to tell the steering man how to turn the steering wheel so that tractor turns onto and follows a desired heading. Finally, the third man, the lateral-error man can see the perpendicular distance from the tractor to the desired line. He tells the heading man which direction to go, and then the heading man tells the steering man which way to turn the wheel. Together, these three men in the blackened cab have to steer the tractor onto the line and keep it there.

To get best performance, we want each man to do his job as quickly as possible, but there are limits. The steering man can only turn the wheel so fast, and it's no use for the heading man to try to rush him by updating his heading commands too quickly. Similarly, the heading man is limited by the speed of the steering man and the speed with which he can read his compass, so it is no use for the lateral error man to try to rush the heading man. Each has to request a change from his inside man and wait for the change to happen before requesting another change. The point is that sometimes, if you turn up the speed (control gain) of the outer controllers (men) you can destabilize the performance of the whole system, because the inner controllers (men) can't keep up. If the outer men change commands faster than the inner men can keep up, the three men end up working against each other instead of with each other.

There are three controller tuning screens described on pages 39-42. Each screen isolates a given controller. The idea is to work from the inside out (called successive loop closure), making each controller as fast as possible, given the limitations of its inner controllers.
3.4.3 Tuning Objective

The objective in tuning the controller is to optimize the communication between the three control loops, \textit{the three men}, and to do the job as quickly as possible within given limitations. Obtaining good line holding performance is done by having the controller quickly correct for heading, (the direction down the row) and lateral-error, (the offset distance from the row). It is also necessary for the steering loop to respond quicker than the heading loop and the heading loop must respond quicker than the lateral-error loop. The aggressiveness of each of the three control loops is most directly affected by the control gain of each loop. The controller screens allow you to change the gain of each loop. Increase the gain to increase the aggressiveness or speed of response. Gain increase is limited by the physical limitations of the vehicle. Going beyond these limitations will cause the controller to begin to oscillate and eventually destabilize. An optimally tuned control loop therefore gives the fastest response possible without causing unacceptable oscillations, giving you peak performance.
3.4.4 Controller Tuning Process

Controller tuning is done after the Calibration Wizard is complete (see section 3.3 for details. The process that follows is for a first time installation.

Step 1. Select “Change Settings”

Starting from the Main Menu access the “System Menu” by selecting the “Change Settings” button.

Step 2. Select “System Menu”

Select the “System Menu” button to display the system menu password screen.

Step 3. Enter Password

Key-in “BWP” and enter to display the “System Menu.”
Step 4. Select Controller Tuning

To begin the tuning process you will have to add a field and a job to the system. Selection of the “Controller Tuning” button takes you to the “Select a Field” screen.

3.4.5 Add a New Field

Step 5. Select “Add New Field”

Step 6. Key in New Field Name

Key-in the new field name and press enter.
Step 7. Field Boundary Screen
Select NO.

3.4.6 Add a New Job
Once a new field has been added, a job must be entered.

Step 1. Select Add new Job

Step 2. Enter Job Name
Key-in a job name and enter.
Controller Tuning

Step 3. Repeat Recorded Job
Select No.

Would you like to repeat an existing recorded job?

Repeat recorded job Screen

Step 4. Create special rows
Select No.

Would you like to create 'special' rows?

Special rows Screen

Step 5. Custom Nudge Distance
Select No.

Would you like to enter a custom 'nudge' distance?

Custom Nudge Screen
Step 6. Set Start Point
Define a row by selecting “Set Start Point.”

Step 7. Set Row Heading
During a first time calibration select “Set Row Heading” displaying the directional screen.

Step 8. Steer into Desired Direction
Turning the steering wheel causes the directional icon to indicate direction. The “Current” button will also display direction numerically.

Step 9. Select the Current Button
Select the “Current” button to accept the heading.
3.4.7 Controller Tuning Menu

The controller tuning screen displays once you have added a new job. In the controller tuning screen you have six buttons available. During initial calibration and tuning you will use all but the “Response Rate Slider” button.

The tuning process is done in the following order:

A. Steering Control
B. Heading Control
C. Lateral Error Control
D. Hardcore Controller Tuning (to check on three previous settings)
E. Line Acquisition
F. Hardcore Controller Tuning (final check on all settings)

The three tuning procedures, steering, heading and lateral-error have similar displays. The important elements are as follows:

“Auto Data” plot display: This display represents the holding performance and vehicle response to commands. A plot between the green lines is the only acceptable reading to ensure sub-inch accuracy.

Adjustable Parameters: During each tuning process (steering, heading and lateral-error) adjustments are made to the control gain value to optimize track response and the curve displayed on data plot. Selection of the change button allows you to make control gain changes.

**Important:** DO NOT increase control gain greater than increments of tenths (0.1) between changes. Dramatic changes may cause undesirable shaking of the tractor.

Command Buttons: These buttons are used to give the controller various commands during the tuning process. These buttons represent specific commands depending on which controller is being tuned. The process for tuning each controller; steering, heading and lateral-error, requires you to observe the tractor’s action and plotted data after a command has been selected. Increase or decrease to the control gain value, in increments of tenths, then give the same command to observe the adjustment in the Auto Data plot. The process continues through each command button beginning with the least aggressive command to the most aggressive (left to right). This series of steps are the same for every tuning process.

**Important:** It is important not to go from one extreme to the other when selecting commands for two reasons; possible damage to the tractor and misleading Auto Data plots. When selecting a command button start on the left of the screen and continue to the right.

Note: Pressing the Auto Data plot toggles the display on and off. When “Auto Data” is on, the data will plot continuously. With it off, the plot will update once after selecting a command button. Turn “Auto Data” on to examine the steady-state controller performance and off to examine step response transitions.
3.4.8 Steering Controller Tuning

The objective is to have the tractor turn in a commanded direction and hold its position at a given arc as efficiently as possible. If the response is too slow the displayed Auto Data plot will be similar to the “Slow Steering Gain” screen shown. The plot indicates a slow response thus the control gain is too low. If the response is too fast the tractor will be jerky, the tractor will have a difficult time holding the arc and the Auto Data plot will be similar to the “Fast Steering Gain” screen shown below. In this case the control gain is too high. Through the tuning process you will adjust the control gain value to obtain a Auto Data plot similar to the “Good Steering Gain” screen shown. Do the following to proceed with steering controller tuning.

**Step 1. Drive the tractor at about 3 mph**
Manually drive the tractor straight.

**Step 2. Select Command Button “0”**
Select “0” to establish the benchmark setting (beginning point) for AutoSteer.

**Step 3. Make Command Button Selections**
The constant curvature command buttons indicate a circle in meters right or left. Select the 40L button and evaluate tractor response and the Auto Data plot. In the Auto Data plot the purple line is the commanded response, while the blue line is the actual response of the system and the vertical gray lines represent time in seconds. A well-tuned steering controller will move smoothly from the start point to the commanded curvature within a half to a full second as shown in the “Good Steering Gain” screen above.

**Step 4. Change Control Gain**
Select the “Change” button to make control gain changes in increments of tenths (0.1) as needed. At this point you should feel free to test different values until you get a good sense of how the tractor is responding before accepting a value.

**Step 5. Select Accept Parameters**
When you are satisfied with the tractor response select the “Accept Parameters” button to accept the control gain changes made completing the Steering Controller tuning.
3.4.9 **Heading Controller Tuning**

The objective in tuning the heading controller is to have the tractor respond to a heading change in the most efficient manner. As in tuning the steering controller, you proceed through the process selecting the command buttons (constant heading commands). These commands change the direction of the tractor to a given degree left or right of the current row. For example, 5L commands the tractor to head off its present direction five degrees to the left. Tractor response and Auto Data plots will determine how the control gain will be changed. The Good Heading Gain screen shown gives you an idea of the results to obtain.

**Step 1. Drive the tractor at about 3mph**
Manually drive the tractor straight on.

**Step 2. Select Command Button “0”**
Select “0” to establish the benchmark setting (beginning point) for AutoSteer.

**Step 3. Make Command Button Selections**
The commands buttons cause the tractor to change its heading in degrees to the left and to the right. Go through each command and evaluate the results.

**Step 4. Change Control Gain**
Select the “Change” button to make control gain changes in increments of tenths (0.1) as needed. Continue with steps 3 and 4 for each control button.

**Step 5. Select Accept Parameters**
Select the “Accept Parameters” button to accept the control gain changes made completing the Heading Controller tuning process.
3.4.10 Lateral Error-Tuning

The objective to lateral-error tuning is to have the tractor acquire and maintain a constant lateral offset from the current row. This control loop is the outermost of the three control loops and is integral to steering and heading response.

The screen and tuning process is similar to steering and heading controller tuning. Do the following to proceed with lateral-error controller tuning.

Step 1. Select the “GO” button
Select the “GO” button to get to the row you have established when beginning the process.

Step 2. Drive the tractor at about 3 mph
The speed of the tractor should be at about 3 mph while on row during AutoSteer.

Step 3. Select Command Button “0”
Select “0” to establish the benchmark setting (beginning point) for AutoSteer.

Step 4. Make Command Button Selections
The commands tell the system to move the tractor in increments of a meter to the left and to the right positioning itself parallel to the row.

Step 5. Change Control Gain
Select the “Change” button to make control gain changes in increments of tenths (0.1) as needed. Continue with steps 4 and 5 for each control button.

Step 6. Select Accept Parameters
Select the “Accept Parameters” button to accept the control gain changes made completing the tuning process.
3.4.11 **Hardcore Controller Tuning**

The objective of hardcore tuning is to feel how the tractor responds after having tuned the three controller loops, (steering, heading and lateral-error). Hardcore controller tuning lets you determine how the system is working in a real working situation. Using the Auto Data plot and your observations of AutoSteer performance you can make fine adjustments to the controllers with the response rate slider. The “Toggle Slider” button is used to toggle between three response rate parameters:

1. Response
2. Reverse response
3. Line acquisition response

The response rate slider should be used for fine tuning once the controllers have been properly tuned. Making adjustments to each response rate directly affects the steering, heading and lateral-error controllers proportionately and extreme slider adjustments will require you to go back and make changes. Your objective is to obtain the best possible tractor performance while in AutoSteer and determine if the previous tuning procedures need further adjustment based on the Auto Data plot and your observations. The steps are:

**Step 1. Select the “GO” button**
Select the “Go” to begin AutoSteer.

**Step 2. Observe Auto Data plot and Tractor Response**
Observe the tractor’s response and the Auto Data plot to determine if any adjustments need to be made.

**Step 3. Adjust Response Rate Slider**
Using the “Toggle Slider” button toggle through each response rate and increase or decrease the value to adjust AutoSteer performance and to obtain the desired Auto Data plot. The screen shown above shows a plot that is optimal.
3.4.12  Line-Acquisition Tuning

AutoSteer has two controller modes: an aggressive, tight line-holding mode called TURBO mode and a less aggressive line-acquisition mode. `TURBO' mode provides aggressive line-holding performance once the tractor is on the desired row. Typically, the implement is in the ground while in `TURBO' mode, changing tractor dynamics and needing more aggressive control. In the “Line-Acquisition” mode, when “TURBO ON” is not displayed, the implement will typically be raised, and the tractor will be making turns to acquire the line. Typically this requires less aggressive smoother tractor control. Therefore two modes need to be tuned separately.

When acquiring a line, the system maps out a smooth curve, called a trajectory, from the time the GO button is pressed to where the tractor reaches the line. The tractor then drives along this trajectory to obtain the desired line.

The “Max. Curvature and `Min. Curvature” settings determine the maximum tightness of the turns which the system is allowed to map out when calculating its trajectory. Decreasing these parameters will force the system to map out longer, smoother curves; increasing them maps out shorter tighter curves. It is important to note that these are NOT controller tuning parameters: they do not affect the performance of the controller, only the shape of the trajectories that it maps out.

The controller attempts to drive the tractor along these trajectories, but it cannot do so perfectly.

Before doing the line-acquisition tuning the following must be true:

A. The vehicle must be properly calibrated
B. Steering heading and lateral-error tuning must be complete
C. The vehicle is in good running order when in turbo mode
D. Enough room on the field to drive the vehicle with a very wide implement
E. Create a test field in the system
F. Create a straight row A-B line job in the middle of the field

The process begins with the top tuning parameter, “Heading Gain Factor” and continues down the list to “Minimum Curvature.” To explain each tuning objective and procedure, select the corresponding help button.

General Rules to Follow:

• Jumpy near the line, can’t quite settle down; decrease “Min Curvature.”
• Doesn’t quite zero in near the line; increase “Min Curvature.”
• Takes too long to reach the line from far away; increase “Max Curvature.”
• When facing away from the line, slow to come around; increase “Max Delta Heading.”
• When facing away from the line, comes around too fast; increase “Max Delta Heading.”

3.4.13  Hardcore Controller Tuning (Final)
This final Hardcore Controller tuning process helps determine whether the cumulative tuner settings achieve optimal vehicle performance under actual working conditions. While using the most demanding implement available at the site, (for example a lister).

Toggle through each response rate, Response, Reverse response and Line acquisition response, and make incremental changes using the response rate slider as done previously.

Your objective is to make any performance adjustments while using the most difficult implement.

The procedure is as follows:

**Step 1. Hook up the Implement**
Make sure the customer hooks up the most difficult implement available if not already done so.

**Step 2. Select the “GO” button**
Select the “Go” to begin AutoSteer and to acquire the row.

**Step 3. Drop Implement**
Drop the implement into the ground after the row has been acquired.

**Step 4. Observe Auto Data plot and Tractor Response**
Observe the tractors response, how the implement is performing and the Auto Data plot to determine if any adjustments need to be made.

**Step 5. Adjust Response Rate Slider**
Using the “Toggle Slider” button toggle through each response rate and increase or decrease the value to adjust AutoSteer performance and to obtain the desired Auto Data plot. The screen shown above shows an optimal plot.
4.1 Using the Loop-Back Cable

The Cable Loop-Back is used when it is necessary to switch out the cab box to another tractor or when the tractor is to be serviced without AutoSteer.

**Important:** Disconnecting the steering cable from the cab box will disable tractor steering and cause unwanted system error codes and possible data loss. It is important to install the Loop-Back cable to maintain manual steering control when the AutoFarm box is removed.

**Step 1. Disconnect Cable**

Disconnect the steering cable from the Cab Box with a rotating motion.

**Step 2. Connect the Loop-Back Cable**

Align and rotate the connectors to connect.

**Step 3. Route the Cable**

Route the cable away from possible damage.

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*Figure 42 Loop Back Cable*
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