

Auto Steering Tuning Guide



Auto Steering Tuning Guide

Part Number: 1004089-01

Rev Number: 1.1

For use with Software Versions:

- X14: 3.22
- X30: 3.23
- X25/X35: 4.0
- ISO UT: 4.1K12p2

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Preface

This manual provides information about operating and maintaining this Topcon Precision Agriculture product. Correct use and servicing is important for safe and reliable operation of the product.

It is very important that you take the time to read this manual before using the product.

Information in this manual is current at the time of publication. A system may vary slightly. The manufacturer reserves the right to redesign and change the system as necessary without notification.

Terms and Conditions

Note: Please read these Terms and Conditions carefully.

General

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ELECTRONIC AND MECHANICAL COMPONENTS -TPA warrants that the electronic components manufactured by TPA shall be free of defects in materials and workmanship for a period of one year from the original date of shipment to the dealer. TPA warrants that all valves, hoses, cables and mechanical parts manufactured by TPA shall be free of defects in materials and workmanship for a period of 90 days from the date of purchase.

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- (v) use of the product in combination with other products not supplied or specified by TPA.

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- the laws of the State of California if the product is sold and supplied to you outside of Australia
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Service Information

Service assistance can be provided by contacting your local TPA Authorized Dealer.

Communications Regulation Information

FCC Compliance Statement (USA)

This equipment has been tested and found to comply with the limits for a Class ‘A’ digital device, pursuant to Part 15 of the FCC Rules. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's expense.



FCC Compliance Statement (Canada)

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulation.



CE EMC Statement (European Community)

Warning: This is a class ‘A’ product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.



‘C’ Tick EMC Statement (Australia & New Zealand)

This product meets the applicable requirements of the Australia and New Zealand EMC Framework.

Type Approval and Safety Regulations

Type approval may be required in some countries to license the use of transmitters on certain band frequencies. Check with local authorities and your dealer. Unauthorized

modification of the equipment may void that approval, the warranty and the license to use the equipment.

The receiver contains an internal radio-modem. This can potentially send signals. Regulations vary between countries, so check with the dealer and local regulators for information on licensed and unlicensed frequencies. Some may involve subscriptions.

Radio and Television Interference

This computer equipment generates, uses, and can radiate radio-frequency energy. If it is not installed and used correctly in strict accordance with TOPCON Precision Agriculture instructions, it may cause interference with radio communication.

You can check if interference is being caused by this equipment by turning the Topcon equipment off to see if the interference stops. If the equipment is causing interference to a radio or other electronic device, try:

- Turning the radio antenna until the interference stops
- Moving the equipment to either side of the radio or other electronic device
- Moving the equipment farther away from the radio or other electronic device
- Connecting the equipment to another circuit that is not linked to the radio.

To reduce potential interference operate the equipment at the lowest gain level that will allow successful communication.

If necessary contact your nearest Topcon Precision Agriculture dealer for assistance.

Note: Changes or modifications to this product not authorized by TOPCON Precision Agriculture could void the EMC compliance and negate authority to operate the product.

This product was tested for EMC compliance using Topcon Precision Agriculture peripheral devices, shielded cables and connectors. It is important to use Topcon Precision Agriculture devices between system components to reduce the possibility of interference with other devices

General Safety



DANGER: It is essential that the following information and the product specific safety information is read and understood.

Most incidents arising during operation, maintenance and repair are caused by a failure to observe basic safety rules or precautions. Always be alert to potential hazards and hazardous situations.

Always follow the instructions that accompany a Warning or Caution. The information these provide aims to minimize risk of injury and/or damage to property.

In particular follow instructions presented as Safety Messages.

Safety Messages and Warnings

The safety symbol is used with the relevant word: DANGER, WARNING or CAUTION.

Messages marked in this way recommend safety precautions and practices. LEARN and apply them.



DANGER: Indicates an imminently hazardous situation that, if not avoided, could result in DEATH OR VERY SERIOUS INJURY.



WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in DEATH OR SERIOUS INJURY.



CAUTION: Indicates a potentially hazardous situation that, if not avoided, may result in MINOR INJURY.

Safety Signs



WARNING: DO NOT remove or obscure safety signs. Replace any safety signs that are not readable or are missing. Replacement signs are available from your dealer in the event of loss or damage.

If a used vehicle has been purchased, make sure all safety signs are in the correct location and can be read. Replace any safety signs that cannot be read or are missing. Replacement safety signs are available from your dealer.

Operator Safety



WARNING: It is YOUR responsibility to read and understand the safety sections in this book before operating this vehicle. Remember that YOU are the key to safety.

Good safety practices not only protect you, but also the people around you. Study this manual as part of your safety program. This safety information only relates to Topcon equipment and does not replace other usual safe work practices.



WARNING: In some of the illustrations or photos used in this manual, panels or guards may have been removed for demonstration purposes. Never operate the vehicle with any panels or guards removed. If the removal of panels or guards is necessary to make a repair, these MUST be replaced before operation.



WARNING: Always check that any suspended vehicle attachments are lowered to the ground before beginning repair or maintenance work on a vehicle.



WARNING: Vehicle and implement parts can become hot during operation and may be under pressure. Refer to vehicle manuals.



WARNING: Wear appropriate protective clothing for the task being undertaken and conditions.



WARNING: Do not operate equipment around explosive equipment or supplies.



WARNING: Topcon is committed to good environmental performance and minimizes the use of any potentially harmful substances in its products. However, it is always advisable not to handle damaged electronic equipment.

This Topcon product may contain a sealed lithium battery.

Always dispose of any electronic equipment thoughtfully and responsibly.

Exposure to Radio Frequency

Exposure to energy from radio frequencies is an important safety issue. Keep a distance of at least 20 cm (7.8 inches) between people and any radiating antenna. Keep a distance of at least 20 cm between transmitting antennas.



WARNING: Products using cellular modem or an RTK base station can transmit radio frequency energy. Check with your dealer.

This device is designed to operate with TPA approved antennas. Discuss with your dealer.

Preparation for Operation

- Read and understand this manual and learn all of the controls before you use the equipment.
- Keep the manual with the equipment.
- If the equipment is moved to another vehicle, move the manual as well.
- Read the manual for the vehicle with which the equipment will be used and check that the vehicle has the correct equipment required by local regulations.
- Make sure you understand the speed, brakes, steering, stability, and load characteristics of the vehicle before you start.
- Check all controls in an area clear of people and obstacles before starting work.
- Identify possible hazards.



WARNING: Topcon equipment must not be used by an operator affected by alcohol or drugs. Seek medical advice if using prescription or over-the-counter medication.

Disclaimer

Topcon accepts no responsibility or liability for damages to property, personal injuries, or death resulting from the misuse or abuse of any of its products.

Further, Topcon accepts no responsibility for the use of Topcon equipment or the GNSS signal for any purpose other than the intended purpose.

Topcon cannot guarantee the accuracy, integrity, continuity, or availability of the GNSS signal.

The operator must ensure that the equipment is correctly turned off when not in use.

Before operating any vehicle equipped with Topcon products, read and understand the following product specific safety precautions.

Important Safety Information

Operator Alertness and Responsibility

The console helps the operator to steer the vehicle, but the operator remains in charge and must be alert and in complete control of the vehicle at all times. The operator is ultimately responsible for safe operation of this equipment.

It is essential that safety requirements are met when operating the console and any of its components. All operators and other relevant personnel must be advised of safety requirements.

Electrical Safety



WARNING: Incorrectly connected power can cause severe injury and damage to people or the equipment.

When working with electrical components, you must do the following:

- Make sure the negative terminal of the battery is disconnected before doing any welding on the vehicle.
- Check that all power cables to system components are connected to the correct polarity as marked. Please refer to the vehicle manual for safety information.
- Check that equipment is grounded in accordance with installation instructions.

Operation and Risk of Obstacles

The following list is not exhaustive or limited. To use the console for assisted steering along a defined wayline, the operator must ensure that it is used:

- Away from people and obstacles
- Away from high voltage power lines or other overhead obstructions (identify any clearance problems before activating the console)
- On private property without public access
- Within cleared fields
- Off public roads or access ways.

Note that:

- The operator needs to know the vehicle's position and the field conditions at all times.
- The operator will need to respond if the GNSS satellite or differential correction signal is lost momentarily.
- The console cannot detect obstacles (people, livestock or other).
- Only use the console in areas that are clear of obstacles and keep a proper distance.
- Steering needs to be disengaged for manual control if an obstacle appears in the path or the vehicle moves away from the wayline.

On/Off and Manual Control



WARNING: Ensure the steering switch is Off to prevent unintentional engagement of the assisted steering. When repairing or maintaining the vehicle/implement, ensure the vehicle CANNOT be moved.

Disengage steering, apply brakes and remove keys.

The operator must ensure that the steering switch is Off (*all* LED indicators are off) when assisted steering is not being used.

The operator must disengage assisted steering and use manual control if an obstacle is in the line of travel or moves into the line of travel, or if the vehicle steers away from the desired wayline.

To disengage assisted steering:

- Turn the steering wheel a few degrees OR
- Select the Disengage Auto Steering button on the console AND/OR
- If using an external steering switch, disengage using the switch if the above actions do not disengage assisted steering.

Vehicle Shut Down Safety

Before leaving the vehicle, disengage assisted steering, disengage external steering switch if this is being used, and remove the key from the key switch.

Using a Reference (Base) Station



WARNING: Do not move a reference station while in operation. Moving an operating reference station can interfere with the controlled steering of a system using the reference station. This could result in personal injury or damage to property.

Operators and other affected personnel must be advised of the following safety precautions.

- Do not erect the reference station under or within the vicinity of high voltage power lines.
- When using the portable reference station, make sure that the tripod is securely mounted.

To Get the Best Out of the Product

Back up data regularly. The console has large, but limited storage capacity. Use the Diagnostics Mini-view to view capacity available. A warning screen displays if storage is reaching its limit.

Be aware of file format compatibility. Discuss compatible formats with the dealer. Topcon Agricultural Products are hardy and designed to work in tough conditions. However, if equipment is unused for a length of time, store away from water and direct heat sources.

Alert Symbols

In this manual two alert symbols are used:

Note: This offers additional information.



WARNING: A warning signal appears on safety signs and in this manual to show that this information is very important to your safety. LEARN these and APPLY them.

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Chapter 1 – Introduction

Correct auto steering tuning is required to ensure the vehicle approaches and follows guidelines in a smooth and consistent manner.

Tuning should only be carried out if auto steering performance is unsatisfactory.

Note: Tuning should be carried out in a clear area away from high voltage power lines and large metal objects. Allow enough space to drive in a straight line for a minimum of 100 meters and enough room to drive in complete circles. Tuning should be carried out at a speed matching the speed of the operations planned.

The following factors can affect the performance of the steering system:

- Tyre size and number
- Implement size, shape and loading
- Vehicle speed
- Terrain and soil condition

Tuning the vehicle is a real world application that is best performed in actual working conditions. For example:

- On soft ground with the implement fitted and engaged in work.
- Hydraulic fans running if it is a seeder.
- For self-propelled sprayers; have boom folded out with half a tank of water.
- For windrower, combines etc, have the front fitted and machine running.

All these factors can severely affect steering performance and tuning ability.

Note: The steering response of each vehicle will behave in a slightly different manner. Two vehicles of the same make and type may require different settings for optimal performance.

The X14, X25, X30, X35 and ISO UT consoles are included in this guide.

Note: All information provided for the X30 console is also applicable for the X25 and X35 consoles.

Note: If using an X14 console, follow the instructions supplied for the X30 console if X14 instructions are not supplied separately.

Note: If you are using an ISO UT console, the advanced tuning settings are not accessible. The AES-25 wheel angle sensor is not supported for ISO UT. Contact Topcon technical support for assistance.

Chapter 2 – Console Navigation

This section describes how to access the required tuning settings for each console.

2.1. X14 console

2.1.1. Setup and operation screens

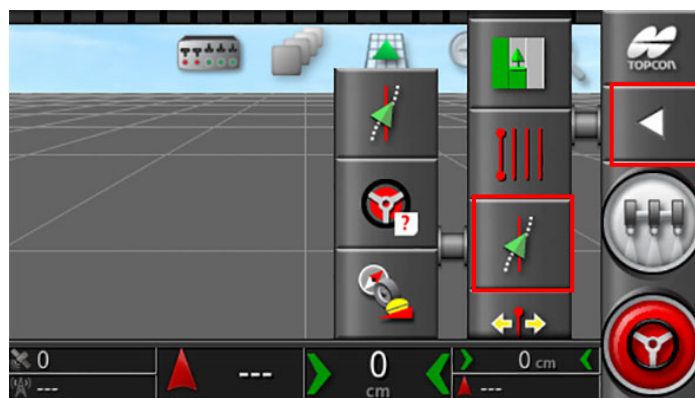
The X14 console has two main screens that are used during tuning; the Operation screen and the Setup screen.



Use the highlighted buttons to switch between the screens.

2.1.2. Steering options menu

The steering tuning settings are accessed using the steering options menu.



2.2. X30 console

2.2.1. Setup and operation screens

The X30 console has two main screens that are used during tuning; the Operation screen and the Setup screen.



Use the highlighted buttons to switch between the screens.

2.2.2. Steering options menu

The steering tuning settings are accessed using the highlighted steering options menu.

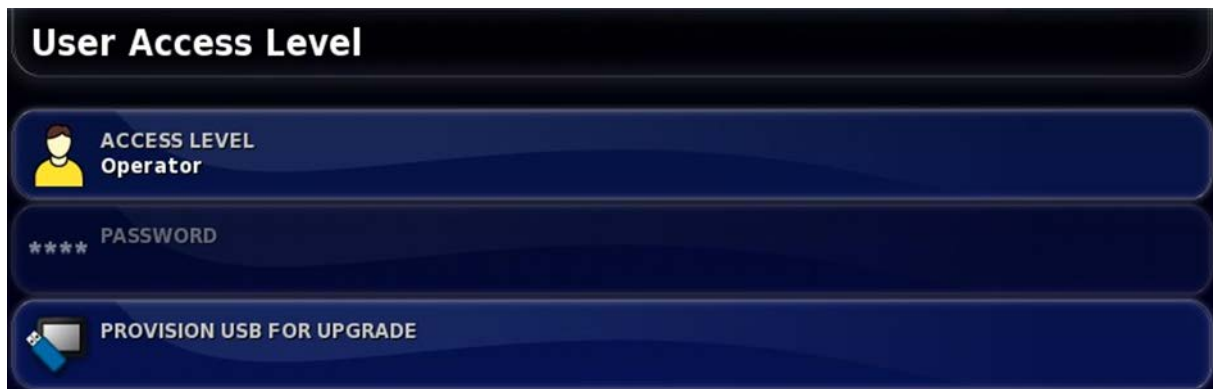


2.3. Enabling dealer mode

The tuning process uses advanced tuning settings. These settings may only be accessed when the X14/X30 console is set to dealer mode.

To set the console to dealer mode:

1. Select **User / Access Level**.
2. Select **ACCESS LEVEL** and select **Dealer**.
3. Select **PASSWORD** and enter the dealer password, then confirm.



Note: When the console is set to dealer mode, the number of tuning options displayed on the steering options menu will change. The number of options displayed will vary, depending on the type of steering controller and its configuration.


2.4. Universal terminal (UT)

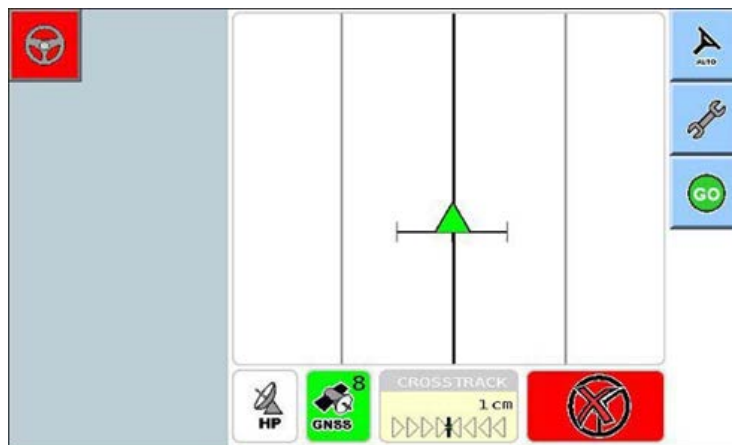
2.4.1. Setting UT to advanced mode

The ISO UT allows you to operate in basic or advanced mode.

The ISO UT is usually set to the basic guidance mode by default. To access the settings required for vehicle tuning, the ISO UT terminal must be switched to advanced mode. The settings required for tuning are selected from the advanced set-up menu.

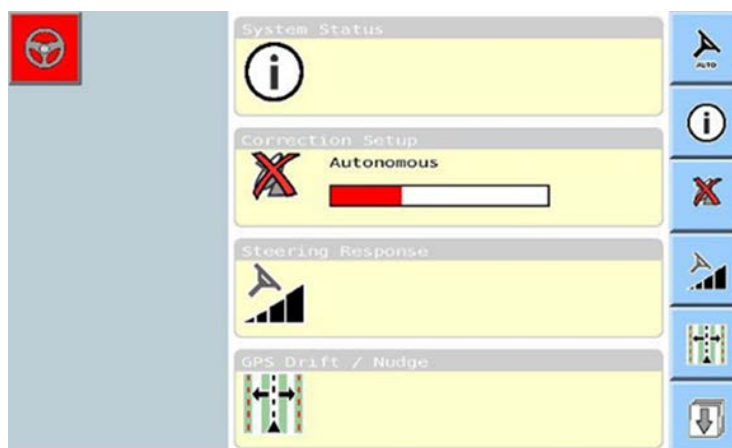
Complete the steps below to switch to advanced mode and the advanced set-up menu.


1. Select  from the basic guidance mode.



The first screen of the basic setup menu is displayed.

2. Select  to display the next menu of the basic setup screen.

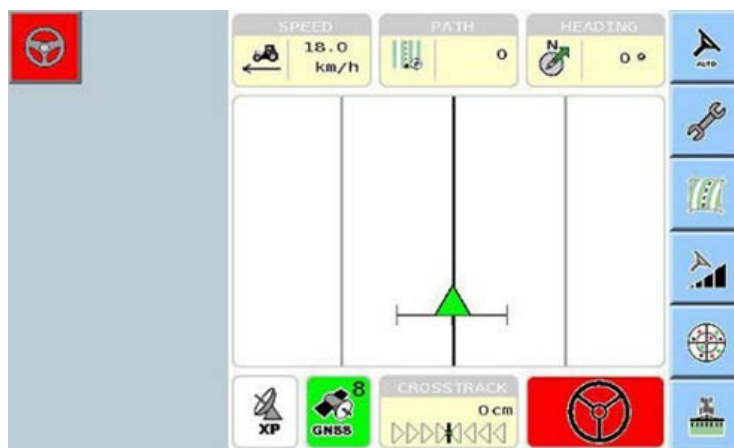


3. Select  when prompted to confirm change of user mode to advanced.

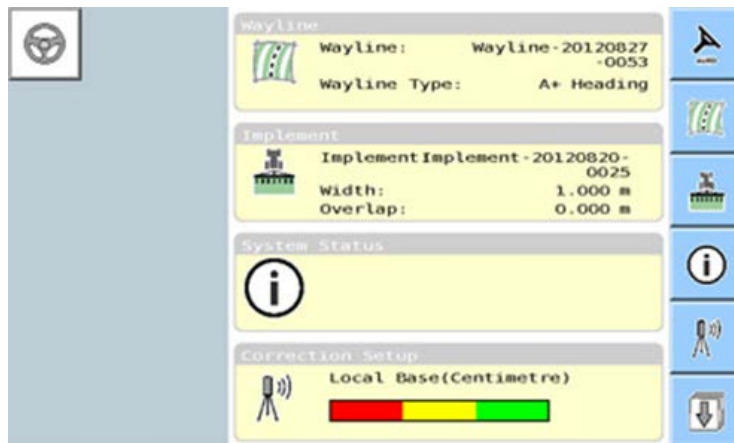


The advanced guidance menu is displayed.

4. Select .



The advanced set-up menu is displayed.



2.4 Universal terminal (UT)

Chapter 3 – Tuning Preparation

Perform the following steps before adjusting any steering settings.

1. Set **GPS Correction** to **Autonomous**. See Select GPS correction source, page 10.

Selecting Autonomous mode when starting tuning avoids difficulties that can occur when trying to perform mounting bias calibration on an un-tuned system.

2. Select the vehicle profile. See Select the vehicle profile, page 12.
3. Set the vehicle geometry. See Set the vehicle geometry, page 14.
4. Select the steering controller. See Select the steering controller, page 16.
5. Perform a compass calibration. See Compass calibration, page 20.
6. Perform a wheel angle sensor calibration, if a wheel angle sensor is fitted. See Wheel angle sensor calibration (with AES-25 and Fendt FSC), page 20 or Wheel angle sensor calibration (without AES-25), page 22.
7. Perform a hydraulic calibration (if ACU-1 is fitted). See Hydraulic system calibration, page 23.
8. Perform a mounting bias calibration. See Mounting bias calibration, page 25.

3.1. Select GPS correction source


X30 console

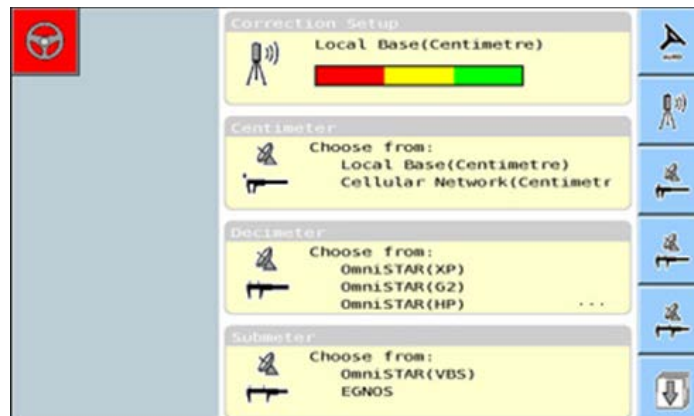
1. Select **System / GPS / Correction.**





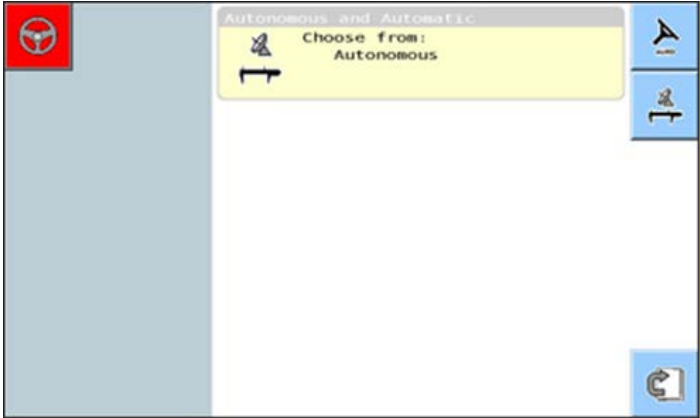
2. Select **CORRECTION SOURCE** and select **Autonomous.**

Universal terminal

1. Select  from the advanced setup menu.



2. Select the correction source that will be used for operation in the field.
3. If Autonomous is required, select  to display the Autonomous and Automatic screen.
4. Select  to enable **Autonomous** as the correction source.



3.2. Select the vehicle profile


X30 console

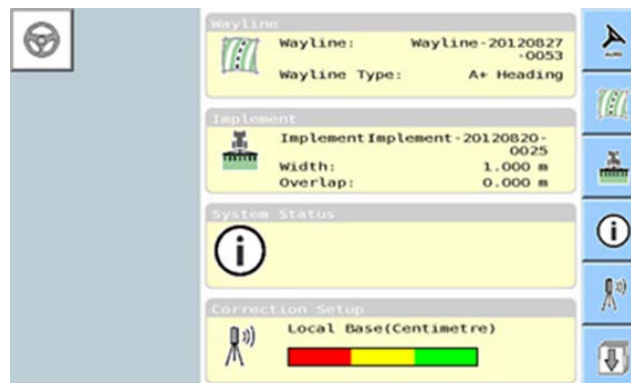
1. Select **Vehicle / Select**. The current vehicle profile is displayed with a green tick next to it.



2. If the incorrect profile is displayed, select another profile from the list or select **Vehicle / New** to create a new profile.

Universal terminal

Select  from the advanced set-up menu. Refer to Setting UT to advanced mode, page 6.




1. Select .



The vehicle profile name is displayed.



2. If the incorrect profile is displayed, select  to load a previously loaded profile or to create a new profile.

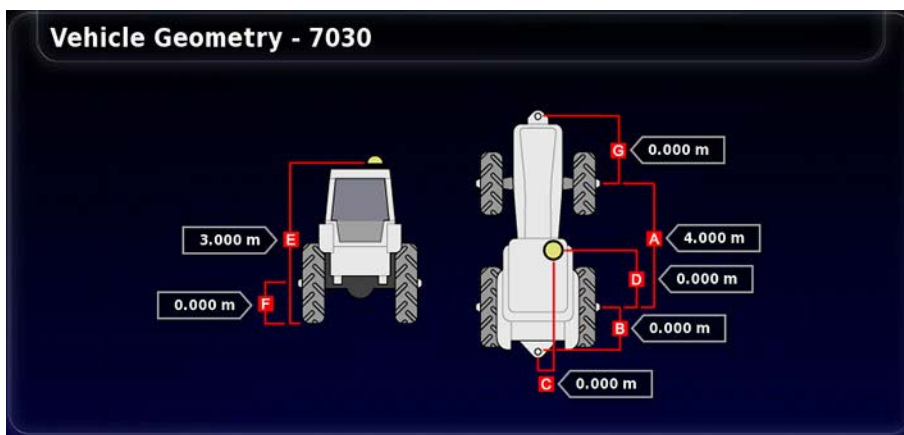
3.3. Set the vehicle geometry

Note: Vehicle dimensions must be accurately measured. Ideally measurements should be within one cm / 0.5 inch. The tolerance must be within +/- 5 cm or 2 inches.

Note: Ensure the correct dimensions identified by the red lines are measured and entered. Incorrect data will affect system performance.


X30 console

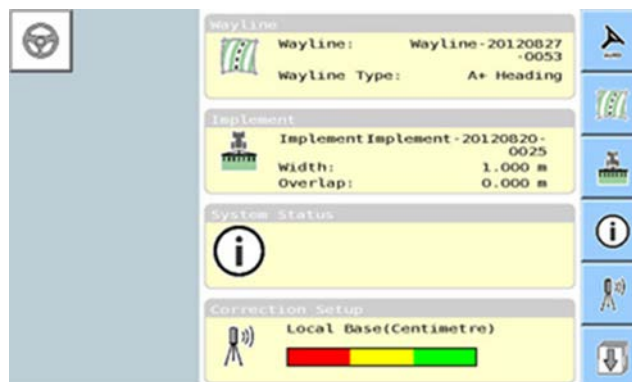
1. Select **Vehicle / Geometry**.



2. Select a vehicle dimension.
3. Add or adjust dimensions where required and confirm.

Universal terminal

Select  from the advanced set-up menu. Refer to Setting UT to advanced mode, page 6.



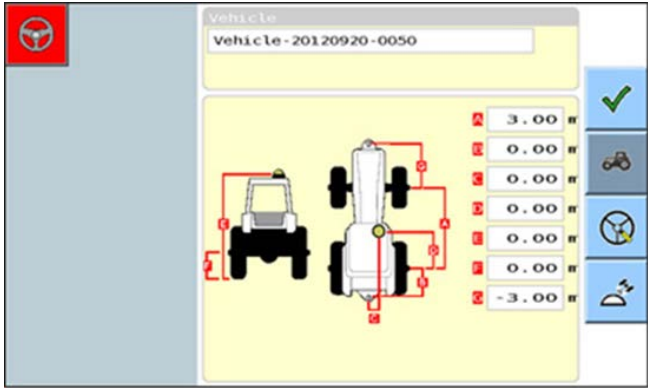
1. Select .



2. Select .



The vehicle geometry settings are displayed.



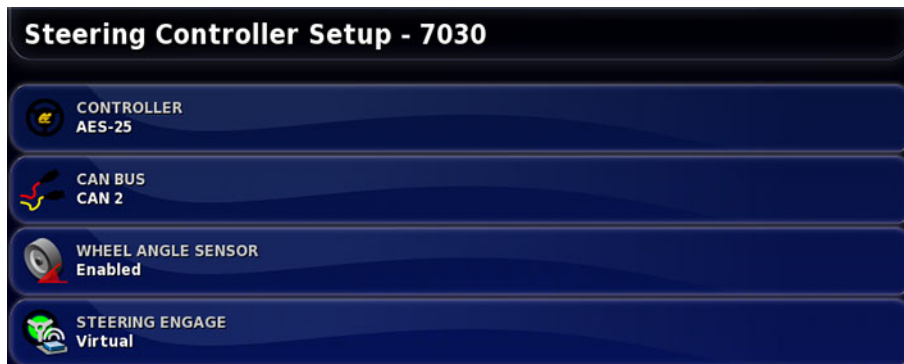
3. To add or adjust a vehicle dimension, select a dimension.

3.4. Select the steering controller

This section describes how to ensure that the correct steering controller has been configured.

X30 console

1. Select **Vehicle / Steering**.




2. Select **CONTROLLER** and select the required controller.

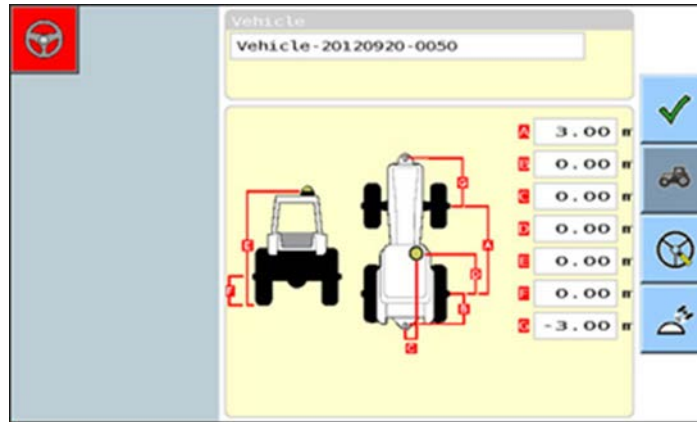
Note: It is important to select the specific steering controller, if it is listed, so that auto steering settings match the vehicle profile. (If the system is factory Fendt, then FSC must be selected. If AES-25 is fitted then AES-25 must be selected.) If the required controller is not listed, select **Other**.

Note that if the steering controller is changed later, it may be necessary to return to the vehicle geometry to confirm the dimensions (refresh them).

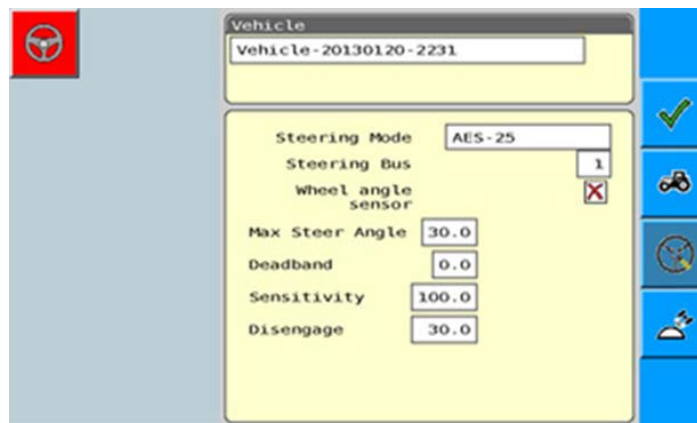
3. Select **WHEEL ANGLE SENSOR** and enable if a wheel angle sensor is installed.

Universal terminal

1. Select  from the vehicle geometry menu.



2. Select **Steering Mode**. Select the required controller.
3. Select **Wheel Angle Sensor**, if installed. Uncheck the box to enable.



3.5. Steering calibrations

The console uses the satellite data it receives, through the receiver attached to the top of the vehicle, to identify the precise coordinates of the vehicle. Using this and other data, the system is able to calculate the vehicle's position and control the vehicle's steering system.

For this to work properly the system needs to be calibrated for the individual vehicle.

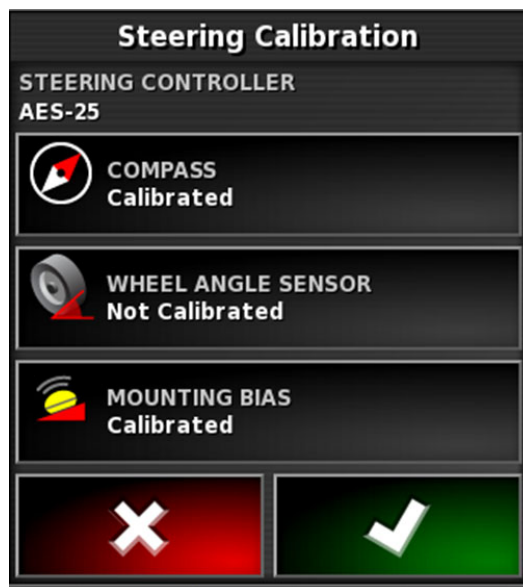
The steering calibrations must be carried out before the tuning process is commenced. This should be done every time tuning is carried out, regardless of the calibration state.

3.5.1. Accessing the calibration screen

X30 console

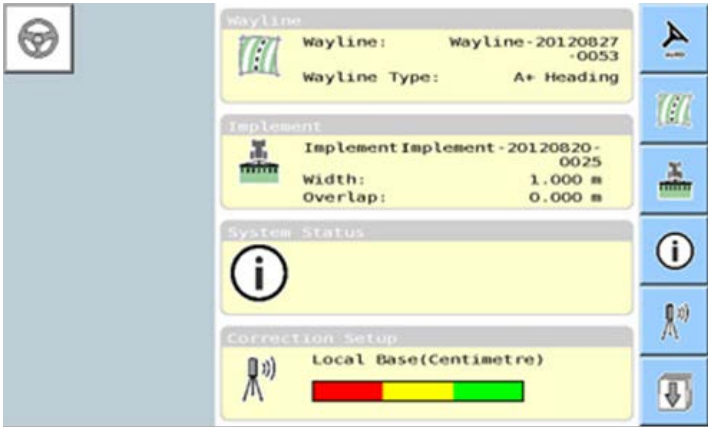
1. Select **Steering Options Menu**  / **Auto Steer Calibration** .

The Steering Calibration screen displays.




Universal terminal

- 1. Select . The first screen of the set-up menu is displayed.



- 2. Select  twice. The calibration sub-menu is displayed.



- 3. Select  from the calibration sub-menu. The calibration menu is displayed.



3.5.2. Compass calibration

Drive to a place that will not interfere with the calibration before beginning. This should be away from high voltage power lines and large metal objects, with space to drive in complete circles.

1. From the calibration screen, select the compass calibration option:

- X30: COMPASS 
- Universal terminal: 

If the compass reports as calibrated, still complete the calibration procedure.

2. Read the screen and find an appropriate flat place away from high voltage power lines and large metal objects. Then select next.
3. Drive the vehicle in a circle at approximately 75% of full lock, the direction does not matter. Once 1 and ½ turns have been completed, stop and select next.
4. Drive the vehicle straight ahead for approximately 100 m / 100 yards then STOP the vehicle. Select next.
5. The system will begin to save calibration data. Wait until the screen states that the calibration is completed successfully and then confirm.

3.5.3. Wheel angle sensor calibration (with AES-25 and Fendt FSC)

Note: This procedure is the same for calibrating AES-25 wheel angle sensor and Fendt Steering Controller (FSC), but the hydraulics actuate instead of the steering wheel moving for the FSC.

Note: Wheel angle sensor calibration should be performed once every 6-12 months.



WARNING: Ensure there is sufficient space for the tractor to complete the full maneuver before selecting next. The calibration will take up to 60 seconds in each of these full lock modes.

The AES-25 electric steering wheel will slowly turn the steering to full lock left and then, when next is pressed, to full lock right.

It is recommended to remove the implement if it is a trailed, pivoted type implement to avoid possible damage to the implement or vehicle.

1. From the calibration screen, select the wheel angle sensor calibration option:

- X30: WHEEL ANGLE SENSOR



- Universal terminal:



2. Drive the vehicle forward to start the procedure. The wheel angle sensor calibration should be completed at approximately 2 kph or 1.2 mph. Select next.

The AES-25 motor will move full lock to the left and hold the wheels in the full lock left position until the vehicle has moved just over a quarter of a turn. When the left side value has been calibrated, the console will emit a beep and the AES-25 motor will stop.

3. Select next.

Note: If the wheel sensor is in the reversed state (wheel angle sensor value high 622 or above when wheels are left), a box will appear indicating that the wheel angle sensor is in the reversed state and the procedure will repeat.

The AES-25 motor will move full lock to the right and hold the wheels in the full lock right position until the vehicle has moved just over a quarter of a turn. When the right side value has been

calibrated, the console will emit a beep and the AES-25 motor will stop.

4. Turn the tractor to face in a direction in which you can travel at least 200 meters/200 yards in a straight line. When the tractor is moving straight ahead, select next.

The AES-25 electric steering wheel will try to find the exact straight ahead position. Once this has been found and the vehicle has driven about 50 meters/yards in this true straight line, the calibration will complete.

5. The system will begin to save calibration data. Wait until the screen states that the calibration is completed successfully and then confirm.

3.5.4. Wheel angle sensor calibration (without AES-25)

Note: This procedure applies to other steering controllers (not the AES-25) with wheel angle sensor support.



WARNING: Ensure there is sufficient space for the tractor to drive forward in the center position before proceeding.


Ensure there is sufficient space for the tractor to complete the full maneuver before selecting next. The calibration will take up to 60 seconds in each of these locked modes.

It is recommended to remove the implement if it is a trailed, pivoted type implement to avoid possible damage to the implement or vehicle.

Note: Wheel angle sensor calibration should be performed once every 6-12 months.

1. From the calibration screen, select the wheel angle sensor calibration option:

- X30: WHEEL ANGLE SENSOR 

- Universal terminal: 
2. Drive the vehicle forward to start the procedure. The wheel angle sensor calibration should be completed at approximately 2 kph (1.2 mph).
 3. Turn the steering wheel full lock to the left and select next. The console will beep and move to the next step once calibrated.
 4. Turn the steering wheel full lock to the right and select next. The console will beep and move to the next step once calibrated.
 5. Ensure the vehicle is still moving at 2 kph (1.2 mph). Turn the steering wheel as close as possible to the center position
Note: Finding the center position and driving in a straight line, before selecting Next, is crucial for system performance.
 6. Select next.
 7. The system will begin to save calibration data. Wait until the screen states that the calibration is completed successfully and then confirm.

3.5.5. Hydraulic system calibration

Note: This is only applicable to ACU-1 installations.



WARNING: During hydraulic calibration, the vehicle will automatically move the front axle wheels progressively to the left position and then progressively to the right when Next is selected. The calibration can take up to 60 seconds in this mode.

Ensure there is sufficient space for the tractor to complete a progressive turn to the left, right and to move straight ahead before selecting Next.

It is recommended to remove the implement if it is a trailed, pivoted type implement to avoid possible damage to the implement or vehicle.

1. When ready and confident that your pathways left, right and ahead are clear, select Next to continue.

3.5 Steering calibrations

Note: In the following two steps, the vehicle steering begins without moving and then progressively speeds up as the valve position increases to the minimum hydraulic threshold set in the vehicle profile.

The system will begin calibrating the hydraulic system for the left steering valve.

Once complete, the system will begin calibrating the hydraulic system for the right steering valve.

Once complete, a message displays stating that steering hydraulics are calibrated successfully. The left and right steering valve minimum Pulse Width Modulation (PWM) percentage is displayed.

3.5.6. Mounting bias calibration

Mounting bias refers to the offset from horizontal at which the GPS receiver is mounted on the roof of the vehicle. The following things can affect and change the mounting bias:

- Tire pressure
- Track tension
- Dual tires
- Tire sizing
- Cabin suspension
- Cabin repairs (suspension and mounts)
- Removing and refitting the receiver
- Mounting location has moved

Note: Mounting bias calibration should be performed if any of the above change or at a minimum once every 6-12 months.



Note: It is advisable to still perform a mounting bias calibration when using **Autonomous** as the **Correction Source (System / GPS / Correction)**, even though the console reports that it is not required.

Mounting bias calibration is performed in a clear, flat area well away from obstacles. If the mounting of the receiver is not quite level, this calibration will adjust for the actual position.




WARNING: Ensure the vehicle has sufficient space to travel in a straight line for at least 70 m/230 ft and then turn at each end of the wayline.

1. From the calibration screen, select the mounting bias calibration option:

- X30: MOUNTING BIAS 
- Universal terminal: 

Note: To calibrate for mounting bias, ‘A’ and ‘B’ wayline points are plotted over 70 m/230 ft, driving the vehicle at 2 kph or

1.2 mph along the wayline. The operator turns the vehicle around at the end of the pass and repeats the procedure. It is important that the vehicle meets the 'A' and 'B' waypoints within approximately 30 cm, to initiate the next step in the calibration procedure.

2. Reposition the vehicle to an open area. When ready to start the procedure, select  to mark the 'A' waypoint.
3. Drive forward in a straight line. The 'B' waypoint is created automatically when the **Distance to A** indicates 70 m/230 ft.
4. Turn the vehicle around and steer to the wayline just plotted, this track number should read '0'.
5. Select **Auto Steer Engage** on the operation screen to auto-steer on the wayline. The icon will turn green, an audible tone will sound and an 'engage message' will flash on screen to indicate the auto steering has engaged.

If steering does not engage when **Auto Steer Engage** is selected, the steering status box will appear.

6. Address any of the issues with red indicators before proceeding with the mounting bias calibration procedure.
7. Drive the vehicle over the 'B' point previously created during the calibration procedure.
8. Set the vehicle speed to 2 kph or 1.2 mph.
9. Auto-steer along the wayline back to the 'A' point previously created.

When the **Distance to A** indicates 50 m the blue line on the Calibration Progress bar will start to move and the percentage will increase.

When the Calibration Progress bar reaches 50% the calibration bar will stop and the percentage will remain at 50%.

This indicates the system has enough data for the first stage of the calibration and the mounting bias calibration will be paused at this point.

10. Proceed to cross the 'A' waypoint.
11. When the 'A' waypoint has been crossed, turn the vehicle around.
12. Acquire the track '0' and engage the auto steering again.
13. Cross over the 'A' waypoint again travelling in the opposite direction.
14. Set the vehicle speed to 2 kph or 1.2 mph.
15. Steer along the wayline back to the 'B' waypoint previously created.

When the **Distance To B** is less than 50 m, the blue line on the Calibration Progress bar will move from 50% and the percentage and the percentage will increase.

When the Calibration Progress bar reaches 100% this indicates the system has enough data for the second stage of the calibration and the mounting bias calibration is paused at this point.

16. Proceed to cross the 'B' waypoint and wait until the screen reports saving calibration and calibration successful before steering off course.
17. Stop the vehicle. Mounting bias has been successfully calibrated.
18. Confirm to return to the calibration screen.

Note: If the mounting bias calibration will not complete after several attempts due to excessive steering movement, set the tuning values to the default settings defined in the next section and repeat the mounting bias calibration procedure.

Note: If using **Autonomous** as the **Correction Source (System / GPS / Correction)** the screen will still report not required, and not calibrated once the calibration is complete.

3.5 Steering calibrations

Chapter 4 – Default Tuning Values

Note: The values listed here are only a starting point for the tuning process. The optimal values will vary for every machine.

4.1. AES-25 with WAS

| | Vehicle Type | | | |
|-----------------------------------|--------------|-------------|-----------|---------|
| | Articulated | Front steer | Harvester | Sprayer |
| Steering Tuning | | | | |
| Online Aggressiveness | 40 | 70 | 40 | 50 |
| Approach Aggressiveness | 30 | 30 | 30 | 10 |
| Max Steering Angle | 30 | 30 | 25 | 25 |
| Smoothing Radius for Curved Lines | 7 | 7 | 7 | 7 |
| Sensitivity Adjustment | 100 | 100 | 100 | 100 |
| Deadband Adjustment | 20 | 20 | 20 | 20 |
| Disengage Threshold | 15 | 15 | 15 | 15 |
| Advanced Steering Tuning | | | | |
| pTime | 0.95 | 0.75 | 0.85 | 0.90 |
| pTime off | 1.15 | 0.95 | 1.05 | 1.10 |
| DGain | N/A | N/A | N/A | N/A |
| PGain | N/A | N/A | N/A | N/A |
| Wheel Angle Sensor Tuning | | | | |
| Low Speed Differential Gain | 2 | 2 | 2 | 2 |
| High Speed Differential Gain | 4 | 4 | 4 | 4 |
| Low Speed Proportional Gain | 2 | 2 | 2 | 2 |
| High Speed Proportional Gain | 4 | 4 | 4 | 4 |
| Max RPM | 100 | 100 | 100 | 80 |

4.2 AES-25 without WAS

| | | | | |
|------------------|-----|-----|-----|-----|
| Deadband Speed | 8 | 8 | 8 | 8 |
| Steering Booster | Off | Off | Off | Off |

4.2. AES-25 without WAS

| Steering Tuning | Vehicle Type | | | | | |
|-----------------------------------|--------------|-------------|-------------|-----------|---------|---------|
| | Tracked | Articulated | Front steer | Harvester | Sprayer | Swather |
| Online Aggressiveness | 60 | 40 | 70 | 40 | 50 | 40 |
| Approach Aggressiveness | 20 | 30 | 30 | 30 | 10 | 10 |
| Max Steering Angle | 30 | 30 | 30 | 25 | 25 | 25 |
| Smoothing Radius for Curved Lines | 7 | 7 | 7 | 7 | 7 | 7 |
| Sensitivity Adjustment | 100 | 100 | 100 | 100 | 100 | 100 |
| Deadband Adjustment | 10 | 20 | 20 | 20 | 20 | 20 |
| Disengage Threshold | 15 | 15 | 15 | 15 | 15 | 15 |
| Advanced Steering Tuning | | | | | | |
| pTime | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| pTime off | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| DGain | N/A | N/A | N/A | N/A | N/A | 0.7 |
| PGain | N/A | N/A | N/A | N/A | N/A | 0.21 |

4.3. ACU-1 steering ECU

| Steering Tuning | Vehicle Type | | | | | |
|-----------------------------------|------------------|-------------|-------------|-----------|---------|---------|
| | Tracked | Articulated | Front steer | Harvester | Sprayer | Swather |
| Online Aggressiveness | 60 | 40 | 70 | 40 | 50 | 40 |
| Approach Aggressiveness | 20 | 30 | 30 | 30 | 10 | 10 |
| Max Steering Angle | 30 | 30 | 30 | 25 | 25 | 25 |
| Smoothing Radius for Curved Lines | 7 | 7 | 7 | 7 | 7 | 7 |
| Advanced Steering Tuning | | | | | | |
| pTime | 0.9 | 1 | 0.85 | 1 | 1 | 0.95 |
| pTime off | 1.1 | 1.2 | 0.95 | 1.1 | 1.1 | 1.05 |
| Max PWM | N/A | 70 | 70 | 70 | 60 | N/A |
| WAS Gain | N/A | 70 | 100 | 100 | 120 | N/A |
| Wheel Angle Sensor Tuning | | | | | | |
| Left min | Auto Calibration | | | | | |
| Right min | Auto Calibration | | | | | |

Note: Low speed figures refer to 3-4 km/h and high speed to 34 km/h.

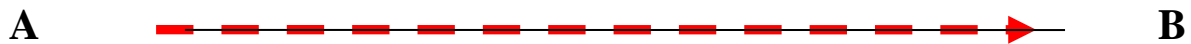
Note: Excluding AES-25 and ACU-1, all other steering controllers have tuning values set by default. Only pTime and Aggressiveness values are available for adjustment. The default settings for the available values should be the same as those supplied in the tables above.

4.3 ACU-1 steering ECU

Chapter 5 – Tuning Procedure

The vehicle tuning procedure is carried out by driving the vehicle along a set AB line (guideline). When the mounting bias calibration is carried out, an AB line is created. This line may be used while tuning the vehicle, or one more suited to high speed driving may be chosen. Ensure the selected AB line is sufficiently long if a high speed vehicle is in use.

When properly tuned, the vehicle should approach and follow the AB line without excessive deviation, as shown below:



Small deviations from the line are normal, but large deviations should be prevented by correct tuning.

1. Set the tuning settings to the default settings listed in the previous chapter before tuning is attempted.
2. Analyze the steering behavior and adjust the appropriate settings (described in this chapter). Each vehicle will behave differently and must be tuned accordingly.

Note: The settings available depend on the steering controller installed.

3. Drive along the chosen AB line and adjust steering settings until the vehicle steering is satisfactorily tuned.


5.1. Steering tuning settings

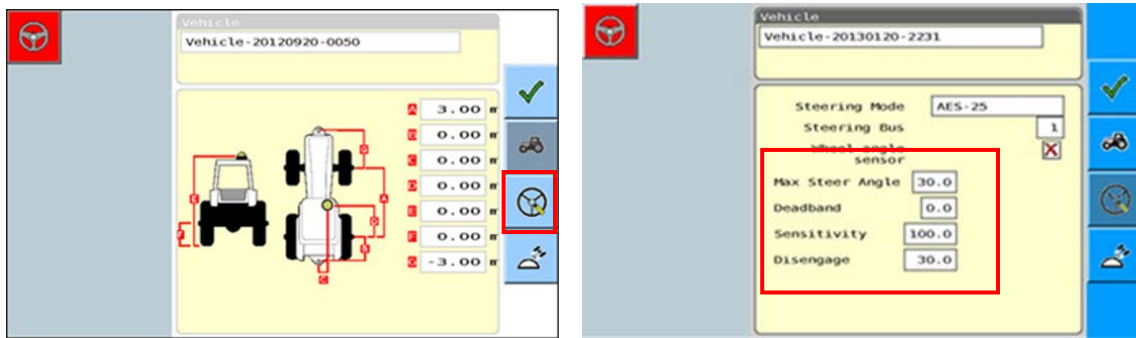
X30 console

1. Select **Steering Options Menu**  / **Auto Steer Tuning Parameters** .

Universal terminal



Steering controller

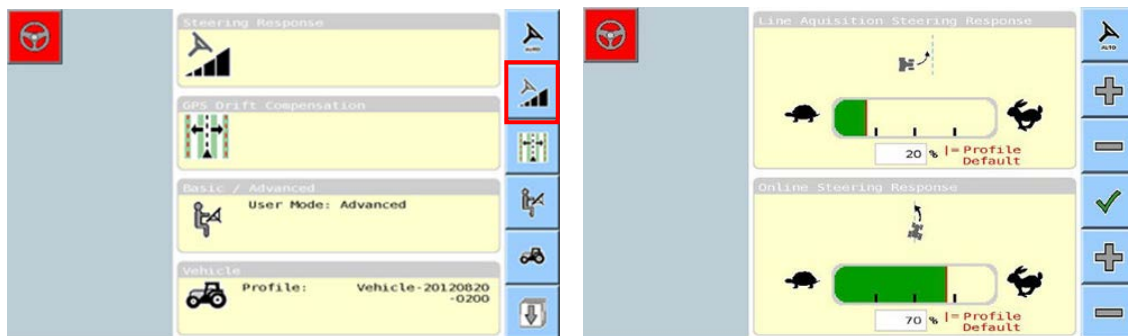
1. Select  from the vehicle geometry screen.










The Steering tuning settings are displayed on the steering control settings page.

Steering response

2. Select  from the advanced setup screen. The vehicle sub menu will be displayed.
3. Select  to display the Line Acquisition Steering Response and Online Steering Response settings.



| Icon | Steering tuning settings |
|---|--|
|  | <p>Online aggressiveness (online steering response)</p> <p>Sets how aggressively the steering will try to follow the guideline. Set high when you require your vehicle to follow a very precise path, such as when performing between row seeding.</p> |
|  | <p>Approach aggressiveness (line acquisition steering response)</p> <p>Sets how aggressively the steering will approach (turn the vehicle onto) the guideline. If too high, the vehicle may respond too fast and become unstable.</p> |
|  | <p>Maximum steering angle</p> <p>Limits the angle of turn to stay within the limits of the vehicle's safe capability.</p> |
|  | <p>Smoothing radius for curved waylines</p> <p>Sets how tight or loose the auto steering will adhere to curved waylines.</p> |
|  | <p>AES-25 sensitivity adjustment</p> <p>Adjusts the responsiveness of the AES-25 when following the AB line.</p> |
|  | <p>AES-25 deadband adjustment</p> <p>Allows you to adjust the minimum wheel reaction speed to adjust for steering freeplay.</p> <p>The AES-25 electric steering wheel is said to be in steering freeplay when it is not reacting to maintain the vehicle's position along a given path.</p> |
|  | <p>AES-25 disengage threshold</p> <p>Adjusts the amount of effort required to disengage the steering wheel.</p> |

5.2. Advanced steering tuning

Note: These settings are not available on the Universal Terminal. Contact Topcon technical support for assistance.

To access advanced steering tuning:

1. Select steering **Options Menu**  / **Advanced Steering Tuning** .

Note: **DGain** and **PGain** settings are only available if the vehicle type is a swather/windrower.

| Steering tuning settings |
|---|
| <p>Ptime</p> <p>Sets the prediction time (look ahead) of the steering controller. The prediction time sets how far along the guideline the vehicle will focus to stay on the guideline. It is used when the vehicle's cross track error is within 25 cm and 5 deg heading. A small adjustment to this value makes a big difference. The Ptime value is in seconds.</p> |
| <p>Ptime off</p> <p>Sets the prediction time (look ahead) of the steering controller. The prediction time sets how far ahead the vehicle will focus when it is not on the guideline. It is used when the vehicle's cross track error is more than 50 cm and 10 deg heading. A small adjustment to this value makes a big difference.</p> |
| <p>DGain</p> <p>Only available if the vehicle has been configured as a swather/windrower. This setting provides the torque or effort used to adjust the steering. The correct setting should ensure the system responds quickly to rapidly changing steering demands while avoiding overshoot.</p> |
| <p>PGain</p> <p>Only available if the vehicle has been configured as a swather/windrower. This setting determines how quickly the steering will react to a required change in direction.</p> |

Steering tuning settings

Max PWM

The maximum speed at which the system will operate the hydraulic valve.

WAS Gain

Adjusts the influence of the wheel angle sensor response.

5.3. Tuning wheel angle sensor system

Note: These settings are not available on the Universal Terminal. Contact Topcon technical support for assistance.

1. Select **Steering Options Menu**  / **Wheel Angle Sensor Tuning** .

| Steering tuning settings |
|--|
| <p>Differential gain</p> <p>This setting provides the torque or effort used to adjust the steering. The bigger the error, the more effort the system will put into the AES-25 to resolve the error.</p> |
| <p>Proportional gain</p> <p>This setting provides the speed applied to adjust the steering. The bigger the error, the faster the AES-25 will respond to reduce the error.</p> |
| <p>Max RPM</p> <p>Determines the maximum speed at which the AES-25 can rotate when the steering is engaged. This figure is a limiter. Having this value too high can allow rapid changes in the vehicle direction resulting in equipment damage. Setting this value too low can make the vehicle too slow to respond and cause the vehicle to overshoot the line.</p> |
| <p>Deadband speed limit</p> <p>Limits the operating speed range of the dynamic deadband controller. (Should not be changed from default value.)</p> |
| <p>Steering booster</p> <p>Increases the steering ability of the dynamic steering controller. (Should not be changed from default value.)</p> |
| <p>Left min</p> <p>The minimum value required to obtain movement from the wheels via the hydraulic system.</p> |

Steering tuning settings**Right min**

The minimum value required to obtain movement from the wheels via the hydraulic system.

Note: Low speed settings relate to a speed of 3-4 km/h and high speed settings relate to the speed that matches the highest speed planned (approximately 34km/h), however the vehicle does not need to be driven at these speeds to adjust the settings.

The actual gain figures used by the system vary with the speed at which the vehicle is travelling.

5.4. Tuning completion

Once the auto steering is performing as required:

1. Set the GPS correction source to the correction source that will be used for operation in the field. Refer to Select GPS correction source, page 10.
2. Repeat the mounting bias calibration.
3. Ensure the machine operates and steers at the required operational speed, in the desired conditions, with the desired results.

Note: Tune an AES-25 system to a reasonable operation first before turning on the WAS and retuning with the advanced features.

The advanced tuning will only improve a system that is steering correctly in the first place and will not fix any initial setup or tuning issues. In a lot of cases if the base tuning is not correct, then enabling the WAS will actually make the system more difficult to tune.

Chapter 6 – Troubleshooting Guide

| Symptom | Causes | Solutions |
|---|--|---|
| <p>Excessive wheel motion.</p> <p>Overall steering performance is acceptable, but the operator is concerned about how quickly the wheels are twitching back and forth.</p> | AES-25 Deadband Adjustment set too high. | Reduce AES-25 Deadband Adjustment . |
| | AES-25 Sensitivity Adjustment set too high. | Reduce AES-25 Sensitivity Adjustment (only if no WAS fitted). |
| | pTime setting too low. | Increase pTime setting. |
| | Incorrect vehicle profile being used. | Load correct vehicle profile. |
| | Incorrect vehicle type being used, example: swather set-up using harvester vehicle type. | Load correct vehicle type. |
| | Worn or loose steering components. | Inspect steering system for worn or loose steering components, replace or repair. |
| | GPS receiver has a loose fitting or is fitted incorrectly. | Check receiver mounting is secure and correctly fitted. |
| <p>Aggressive snaking motion.</p> <p>The vehicle appears to be continually moving back and forth when looking over the front nose of the vehicle. Although a lot of motion is observed, the cross track error displayed is relatively small.</p> | Online Aggressiveness setting too high. | Reduce Online Aggressiveness setting. |
| | pTime too low. | Increase pTime setting. |
| | Compass calibration corrupted. | Re-calibrate compass. |
| | Vehicle geometry GPS receiver to center axle incorrect. | Check measurements of vehicle geometry are correct. |
| | GPS receiver has a loose fitting or is fitted incorrectly. | Check receiver mounting is secure and correctly fitted. |

5.4 Tuning completion

| Symptom | Causes | Solutions |
|---|--|---|
| Lazy snaking motion. Performance of the steering system seems very sluggish when trying to stay on the line and slowly wanders from side to side. | Online Aggressiveness too low. | Increase Online Aggressiveness setting. |
| | AES-25 Sensitivity Adjustment too low. | Increase AES-25 Sensitivity Adjustment . |
| | pTime setting too high. | Decrease pTime setting. |
| Lazy line acquisition. Steering appears sluggish during line acquisition and the tractor remains off to one side of the line for a long time before getting lined up. | Approach Aggressiveness setting too low. | Increase Approach Aggressiveness setting. |
| | pTime Off setting too low. | Increase pTime Off setting. |
| | GPS receiver has a loose fitting or is fitted incorrectly. | Check receiver mounting is secure and correctly fitted. |
| | Wheel angle sensor calibration corrupted. | Re-calibrate wheel angle sensor. |
| Aggressive line acquisition. The autosteering overshoots the line, and continues to overcompensate during acquisition. Results in high frequency, tight snaking pattern during acquisition. | Approach Aggressiveness setting too high. | Reduce Approach Aggressiveness setting. |
| | pTime Off setting too high. | Decrease pTime Off setting. |
| | GPS receiver has a loose fitting or is fitted incorrectly. | Check receiver mounting is secure and correctly fitted. |
| | Wheel angle sensor calibration is corrupted. | Re-calibrate wheel angle sensor. |

| Symptom | Causes | Solutions |
|---|---|--|
| <p>Unable to tune swather / windrower. After carrying out the complete tuning process on a swather/ windrower, the steering is still very erratic.</p> | Incorrect vehicle type, example: swather set-up using harvester vehicle type. | Load correct vehicle type. |
| | DGain setting not used when tuning. | Adjust DGain setting. |
| | PGain not used during tuning. | Adjust PGain setting. |
| <p>Auto steering keeps disengaging. The auto steering keeps disengaging and all system settings appear ok.</p> | AES-25 Disengage Threshold setting too low. | Increase AES-25 Disengage Threshold setting. |
| | Binding or worn steering components. | Inspect steering system for binding or loose steering components, replace or repair. |



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