

STEER X

Operating instructions

Forced steering - SteerX



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**Read these operating instructions prior to first-time start-up and observe them at all times!
Retain for future reference!**

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1. System description

The electronic forced steering SteerX is an electro-hydraulic steering system for towed trailers. It is compatible with tandem and tridem assemblies with one or two non-driven self-steering axle(s) and one rigid guide axle. The aim of the system is to enable low-wear cornering without shear forces. This reduces tyre wear, minimises the forces acting on the axles and increases vehicle manoeuvrability.

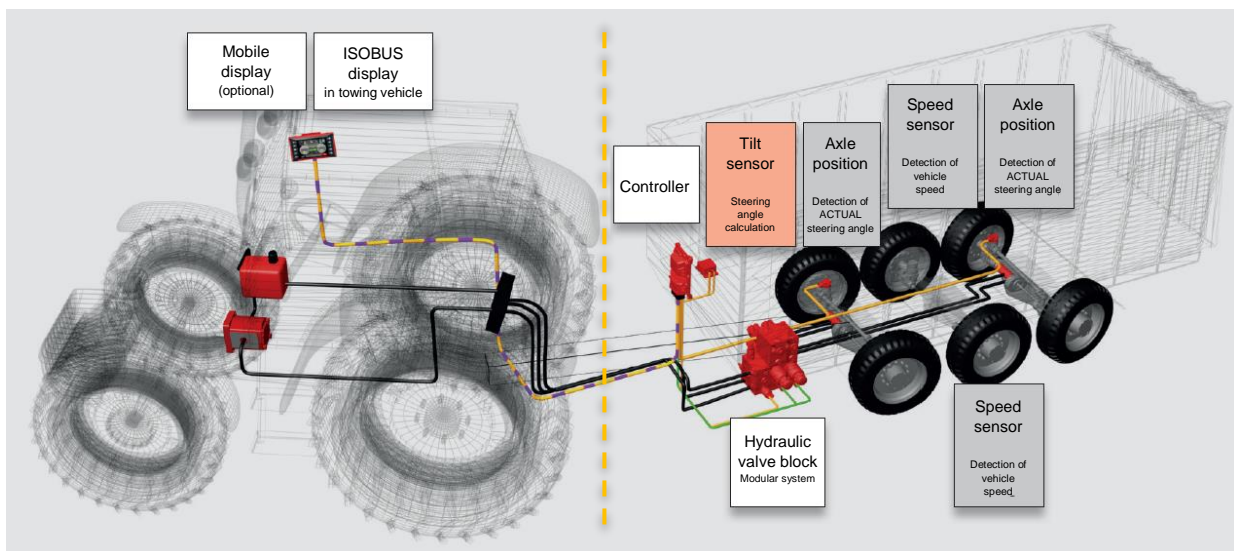
Due to the contactless and wear-free target angle calculation based on the yaw rate and travel speed, the system does not require complex external coupling constructions for the sensors or special drawbar eyes.

It therefore eliminates maintenance work and the time-consuming adjustment of the mechanical components, thus ensuring significant cost savings.

Moreover, the contactless yaw rate measurement means there are no restrictions with regard to the drawbar hitch, and the user benefits from maximum steering angles, ground clearance and PTO clearance.

1.1 Overview

1.1.1 Component layout



Required and optional components for forced steering system

Component	Required	Optional
Controller	<input checked="" type="checkbox"/>	
Hydraulic control block incl. pressure transducer	<input checked="" type="checkbox"/>	
Target angle sensors	<input checked="" type="checkbox"/>	
Speed sensors	<input checked="" type="checkbox"/>	
Steering angle sensors	<input checked="" type="checkbox"/>	
Display/control unit	<input checked="" type="checkbox"/>	
Error indicator		<input checked="" type="checkbox"/>
Coding pin connection (via wiring harness)		<input checked="" type="checkbox"/>

1.1.2 Components

The steering system requires the following components:

- Controller for controlling the system (incl. application software)
- Modular hydraulic control block for actuating the steering cylinders.
- Tilt sensor for measuring the yaw rate and calculating the target steering angle.
- Two speed sensors for redundant measurement of the vehicle speed.
- A sensor is installed on each side of the vehicle, either on the rigid axle or on the steering axle.
- Steering angle sensor or integrated position sensor system on the steering axles to determine the current steering angle.
- Display/control unit

The following optional components are also available for the steering system:

- Error indicator: In addition to the display/control unit, an error indicator (e.g. visual or acoustic) can be used to signal a potential error state.
- A digital output is provided for this purpose.
- Coding pin connection: The steering controller features three coding pins, which allow the software configuration to be checked via the wiring harness.
- Up to 8 different configurations are possible.

1.2 Technical requirements

Electrical	Power supply	12 V or 24 V
Hydraulic	Oil temperature	-20°C to +80°C
	Filtration	ISO 4406 cleanliness code 19/17/14 or higher
	Operating fluid	According to DIN 51524 part 1 and 2
	Supply pressure P	Max. 250 bar
	Tank pressure	Max. 20 bar
	Control pressure difference	Min. 20 bar
Environmental conditions	Ambient temperature	-20°C to +60°C

1.3 Main functions / travel functions

1.3.1 Start-up check

Function

During the start-up check, the functionality of the dump valves for the safe state of the system is checked. The test is carried out when the engine is started.

1.3.2 Neutral

Function

In "**Neutral**" mode, the auxiliary steering axles are disconnected. This means that the dump valves and steering valves are de-energised. The chambers of the steering cylinders are connected with each other and with the tank.

1.3.3 Automatic

Function

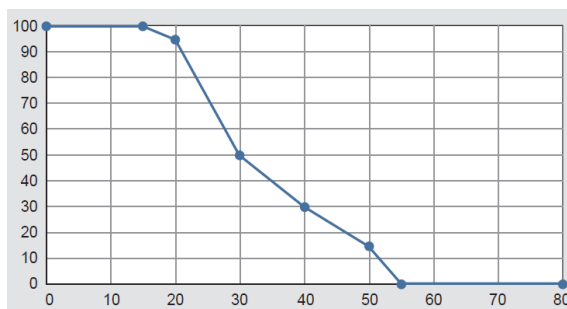
The electro-hydraulic auxiliary steering turns the steering axles around the rigid axle without producing shear forces. No steering takes place below a speed of 0.5 km/h.

Regardless of the configuration, the target angle is always limited to a speed-dependent maximum.

An example of this restriction is shown in the following configurable table:

Speed [km/h]	Max. steering angle, relative [%]
0	100
15	100
20	95
30	50
40	30
50	15
55	0
80	0

Max. steering angle, relative [%]



1.3.4 Target value calculation with tilt sensor

Function

The target angle is calculated on the basis of the measured yaw rate of the trailer, the travel speed at vehicle centre and the distance between the steering axle and the rigid axle.

The following geometric vehicle data is therefore required to calculate the target steering angle:

- Distance between wheel centre and centre point of vehicle.
- Distance between rigid axle and rear axle.
- Distance between rigid axle and front axle (on tridem models).

1.3.5 Manual mode

Function

In manual mode, the operator can manually enter a fixed target angle. This is done using the "**left**" and "**right**" arrow keys. The target angle for the rear axle is set in all cases. When manual mode is activated, the system always uses the current value of the last axle as the target value.

In the case of a tridem chassis, the steering angle for the front axle is derived from the steering angle for the rear axle and applied in the opposite direction. At speeds *greater than 8 km/h*, the system automatically switches from "**Manuell (Manual)**" to "**Automatik (Automatic)**" mode.

1.3.6 Crab steering mode

Function

In "**Hundegang (Crab steering)**" mode, the operator can manually enter a fixed target angle.

This is done using the "**left**" and "**right**" arrow keys. Both axles are always set to the defined target value. When crab steering mode is activated, the system always uses the current actual value of the last axle as the target value. In the case of a tridem chassis, the steering angle for the front axle is derived from the steering angle for the rear axle and applied in the same direction.

At speeds *greater than 8 km/h*, the system automatically switches from "**Hundegang (Crab steering)**" mode to "**Automatik (Automatic)**" mode.

1.3.7 Steering axle calibration mode

Function

In calibration mode, the mechanical end stops and the centre position of the steering axle are set and calibrated. The calibration mode guides the user through a predefined calibration procedure.

The values must be calibrated in the following cases:

- First-time start-up
- Changes to or replacement of the steering angle sensor.
- Changes to geometric parameters, e.g. transfer of steering angles to the angle sensor and limitation of the maximum mechanical steering angle.

1.3.8 Steering valve calibration

Function

In the steering valve calibration, the opening point of the steering valve is determined for each axle and direction by means of an automated routine.

1.4 Error handling

In the event of an error, e.g. a component error, the auxiliary steering axles are disconnected and an error message is displayed.

For specific dump valve errors, a corresponding error message is issued and the steering axle is set to centre position during the start-up check and in automatic mode.

The errors are only reset when the engine is turned off or the controller is restarted.

2. Optional equipment for different vehicle types

The electronic forced steering is available as an option for the following Fliegl vehicle types:

 <p>ASW push-off trailer</p>	 <p>KDS chain manure spreader</p>
 <p>vHKL hook lift roll-off tipper</p>	 <p>TMK tandem/tridem tipper</p>
 <p>VFW vacuum tanker</p>	 <p>PFW pump tanker</p>
 <p>HFW high-pressure tanker</p>	 <p>TFW transport tanker</p>

3. Safety instructions



No persons permitted in danger zone during operation:

No persons must enter the danger zone (wheel proximity) when the hydraulic and electrical supply is active since steering operations can take place at any time. Before activating the hydraulic and electrical supply, the driver must ensure that there are no persons in the danger zone. Persons must also be aware that the vehicle could be set in motion at any time.



No consumers other than valve coils / sensors permitted in wiring harness:

There must be no consumers other than the necessary valve coils / sensors in the wiring harness since these could influence the error detection of the steering system.



Ensure correct qualification of machine operators:

The operator or user of the vehicle must have received the necessary training.



Software:

The system must be used only with application software that has been defined and approved by Fliegl Agrartechnik GmbH.



System must be used only in designated vehicle types:

The auxiliary steering system is suitable only for use in towed trailers. This requires a tandem or tridem chassis with one or two non-driven self-steering axle(s), combined with a rigid guide axle around which the vehicle turns.



System must be used only with designated components:

Only components defined by Fliegl Agrartechnik GmbH must be used.



Ensure correct handling, usage conditions and installation of system components:

The correct handling and usage conditions of the system components are defined in these operating instructions.

4. Start-up

4.1 Prerequisites

Note the following points before start-up:

- System start-up must be performed only by trained personnel.
- The hydraulic system must be bled.
- The complete hydraulic system must be checked for leaks.
- There must be no persons within the danger zone of the vehicle when the electric and/or hydraulic supply to the system is active.

4.2 Execution

4.2.1 Checking the system version

The first step during start-up is to check the system version:

Vehicle-specific parameters are set by the vehicle manufacturer in the factory.



Parameter check and adjustment by vehicle manufacturer:

The check and adjustment of the parameters for the relevant vehicle is performed by the manufacturer prior to delivery from the factory. The operational safety of the vehicle is therefore assured.

4.2.2 Error-free system



Steering system must be without errors:

It must be ensured that the auxiliary steering system is free from errors, meaning that no errors must be reported by the system. In this case, a non-calibrated system is not an error, but merely constitutes a warning.

4.2.3 Calibrating the steering valves and angle sensors

The calibration must be performed carefully.



Only specialist personnel with the requisite training is permitted to perform the calibration.

4.2.4 Function check following installation

Following the installation and successful calibration of the steering system, suitable measures must be taken to ensure that the system functions correctly.

5. Use and operation



Read carefully. If there is anything you do not understand, contact customer service to exclude the possibility of operating errors.



Regular system power cycle required:

The steering system must be restarted every 8 hours so that the start-up check can take place and to allow the system to run self-diagnostics for the control loop of the axle centring function.



No persons permitted in danger zone during operation:

No persons must enter the danger zone (wheel proximity) when the hydraulic and electrical supply is active since steering operations can take place at any time. Before activating the hydraulic and electrical supply, the driver must ensure that there are no persons in the danger zone. Persons must also be aware that the vehicle could be set in motion at any time.

5.1 Control block

No adjustments or changes need to be made to the control block during operation.

The control block must be used only within the permitted operating range (e.g. pressure, flow rate, temperature, environmental conditions), as per the values specified in the technical data.

5.2 Error behaviour

If a system error occurs, the steering cannot be used.

The steering switches to safe state and is generally disconnected.



Handling system errors:

The relevant error is displayed to the user. The individual errors are listed in section 8. Errors need to be rectified by a workshop in a timely manner. Errors must be rectified only by specialist personnel. There must be no persons in the danger zone while the engine is running. In the event of an error, the trailer must be moved at a reduced speed so that safe, permanent control is possible.



Safe state in the event of an error:

The auxiliary steering is (usually) disconnected while in safe state. It is up to the vehicle manufacturer to determine whether this safe state is safe for the intended vehicle.



Reversing with an active error:

The steered axles with tracking properties will deflect in an uncontrolled manner in the following situations:

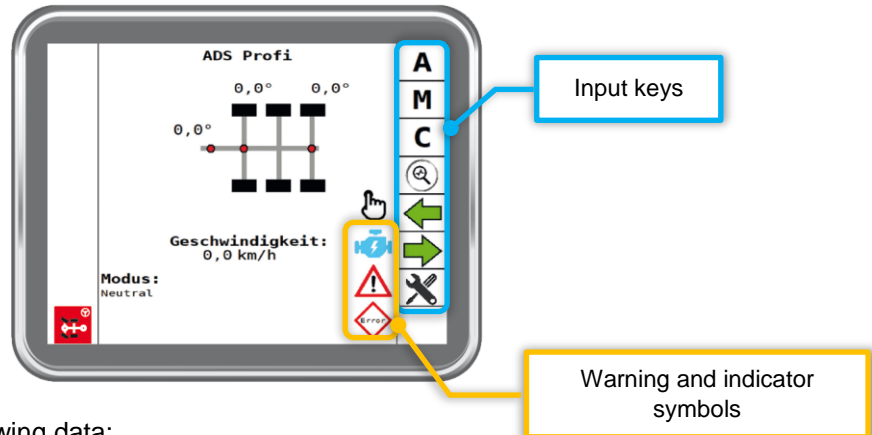
- If no energy is supplied to the steering system
- In the event of an error

6. Control










All figures show the presentation on an ISOBUS display.
The exact presentation may vary depending on the display type.




6.1 Main menu



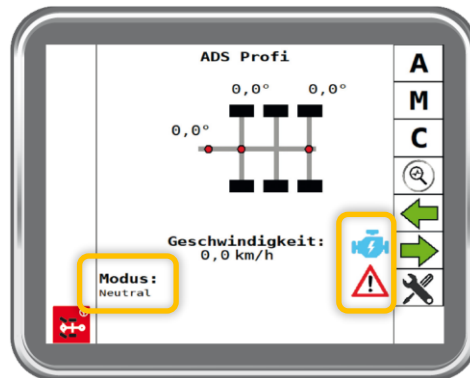
The main page shows the following data:



- Currently measured yaw rate
- Current steering angle of the steering axle(s)
- Calculated travel speed of the trailer
- Current steering mode


Input keys	
Mode selection key	
	Automatic
	Manual
	Crab steering mode
Submenus	
	Diagnostic menu
	Service menu
Arrow keys	
	Right
	Left


Warning and indicator symbols	
	Engine off
	Steering not ready
	Steering error


6.2 Behaviour upon vehicle start






When the ignition is switched on, "Neutral" mode is displayed and the  "engine off" and  "steering not ready" symbols appear on the display.

Once the engine has been started or hydraulic pressure is applied, the  "engine off" symbol disappears.

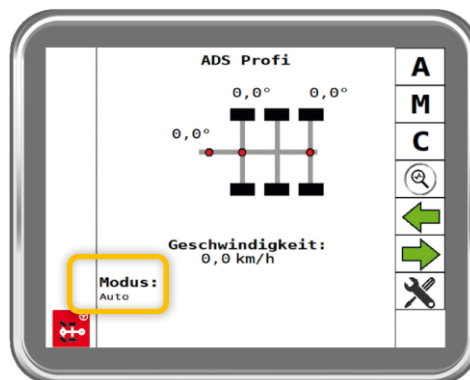
The system then carries out a self-test. Following successful completion of the self-test, the  "steering not ready" symbol disappears. The steering is operational and "Neutral" is displayed as the current mode.

When the travel speed is $> 0.5 \text{ km/h}$, the steering automatically switches to "Automatik (Automatic)" mode. Pressing the  key also activates "Automatik (Automatic)" mode.

6.3 Selecting the operating mode

The three different operating modes are activated via the ,  and  keys in the main menu. The selected mode is displayed in the "Modus (Mode)" field.


6.3.1 Automatic mode "A"



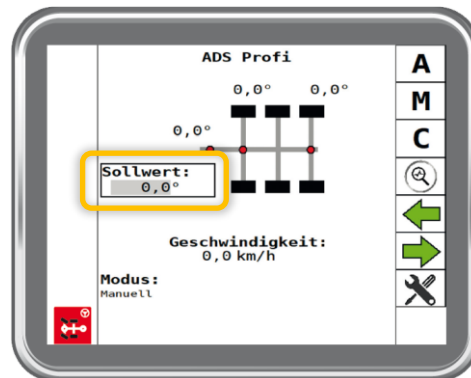
Function:

The electro-hydraulic auxiliary steering turns the trailer's steering axle(s) around the rigid axle without producing shear forces.

Activation:

- Press the  key
- In "Neutral" mode → speed $> 0.5 \text{ km/h}$
- In "Manuell (Manual)" or "Hundegang (Crab steering)" mode → speed $\geq 8 \text{ km/h}$

6.3.2 Manual mode "M"



Function:

Manual entry of a fixed steering angle for the rear steering axle.

On a tridem chassis, the front axle is steered in the *opposite* direction according to the axle geometry.




"**Manuell (Manual)**" mode is restricted via the travel speed.

Switching to "**Manuell (Manual)**" mode is only possible at a speed < 6 km/h.

If the speed is > 6 km/h in "**Manuell (Manual)**" mode, a warning is issued in form of a short buzzer signal.

At a speed > 8 km/h, the system automatically switches from "**Manuell (Manual)**" to "**Automatik (Automatic)**" mode.

Activation:



Press the  key and then press the  or  key within 3 seconds.

Following activation, the "**Sollwert (Target value)**" field appears.

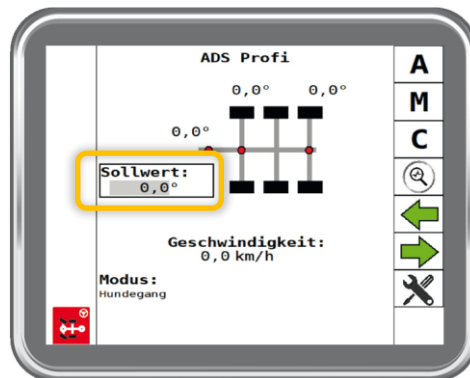
By default, the target value is set to the currently measured steering angle of the rear axle.

This value is displayed in the "**Sollwert (Target value)**" field.

Note:

Using the  and  arrow keys, the value displayed in the "**Sollwert (Target value)**" field is set in ° *steering angle*. A short press makes a small change to the steering angle (0.1°), while pressing the key for more than 2 seconds will make more rapid changes.

6.3.3 Crab steering mode "C"



Function:

Manual entry of a fixed steering angle on the rear steering axle.

On a tridem chassis, the front axle is steered in the *same* direction.




"**Hundegang (Crab steering)**" mode is limited by the travel speed.

Switching to "**Hundegang (Crab steering)**" mode is only possible at a speed < 6 km/h.

If the speed is > 6 km/h in "**Hundegang (Crab steering)**" mode, a warning is issued in form of a short buzzer signal.

At speeds > 8 km/h, the system automatically switches from "**Hundegang (Crab steering)**" mode to "**Automatik (Automatic)**" mode.

Activation:

Press the  key and then press the  or  key within 3 seconds.

Following activation, the "**Sollwert (Target value)**" field appears.

By default, the target value is set to the current steering angle of the rear axle.

This value is displayed in the "**Sollwert (Target value)**" field.

Note:

Using the arrow keys, the value displayed in the "**Sollwert (Target value)**" field is set in ° *steering angle*.

A short press makes a small change to the steering angle (0.1°), while pressing the key for more than 2 seconds will make more rapid changes.

6.4 System maintenance

6.4.1 Calibrating the yaw rate sensor

Yaw rate sensors are subject to long-term drift. If this drift exceeds a specific tolerance, the sensor needs to be calibrated. The system checks automatically whether calibration is necessary and notifies the user accordingly. The user simply follows the instructions provided. The following page opens on the display:



Input keys:

Pressing the  key switches back to the main menu.

Pressing the  key confirms an entry or operating step.

Pressing the  key activates or restarts the calibration.

Preparation and calibration:

MESSAGE on display: **"Bedingungen nicht erfüllt (Conditions not met)":**



This message appears on the display when the calibration conditions are not met.

The following conditions must be fulfilled:

- Engine off
- Vehicle stationary
- Yaw rate sensor ready and error-free

Performing the calibration:

The process for calibrating the steering axles comprises two steps.

1. **Starting the calibration:** The message **"Bitte Bestätigen, wenn sich der Anhänger in Ruhe befindet (Confirm when the trailer is at rest)"** appears on the display. If this condition is met, the calibration process can be started with the  key.
2. **Automatic calibration:** The calibration is performed automatically. The message **"Kalibrierung läuft (Calibration running)"** appears on the display. Once the calibration is complete, the message **"Kalibrierung erfolgreich (Calibration successful)"** is displayed. The  key can then be used to return to the main menu.

Note:

This system test is performed whenever the ignition is switched on, no hydraulic power is supplied and the vehicle is at a standstill.

If the system detects a yaw rate sensor drift, this calibration step must be completed.

The calibration should be performed without delay in this case. If the request is persistently ignored, the system will switch to error state.

6.5 Error mode

6.5.1 System behaviour

If an error is detected by the system, the following actions take place depending on the type of the error:

- The steering axle(s) is/are switched to floating position.
The steering then behaves as with a self-steering axle.
- The steering axle(s) is/are set to centre position during travel.



ATTENTION: The speed must be reduced to a permanently controllable level without delay. A suitable location to stop the vehicle must be found as soon as possible.


6.5.2 Error display

If the steering detects an error, this is immediately indicated on the display by means of: "**Fehler: XXX (Error: XXX)**".

The display's integrated buzzer sounds (if fitted) and the following appears on the display:

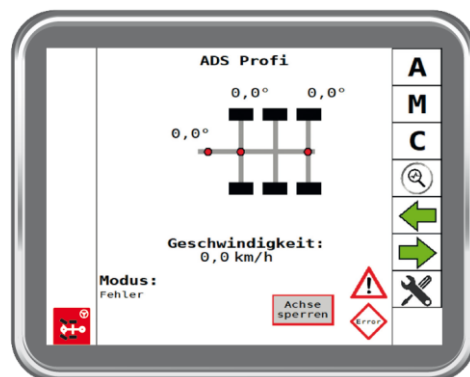


The error list can be found in the appendix to these operating instructions (see section 8).

The user can acknowledge the error message via the  key.

The warning sound then stops.

The main page of the steering system shows the following:



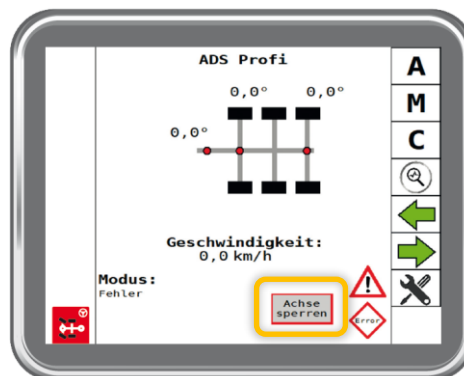
6.5.3 Basic rules during troubleshooting

Errors must be rectified only by specialist personnel.

- There must be no persons in the danger zone while the engine is running.
- In the event of an error, the trailer must be moved at a reduced speed so that safe, permanent control is possible.

Once troubleshooting has been completed, the steering system is reset by switching the ignition (supply voltage) back on.

6.5.4 Reversing in the event of an error



Since the steered trailing axle(s) move(s) in an uncontrolled manner when reversing, the system allows the user to override the floating position during reverse travel and thus keep the axle(s) in the current position.

For this purpose, the axle(s) must be locked in centre position. To set the axle(s) to centre position, the tractor/trailer combination must be driven straight ahead until the axles assume centre position.

The axles must then be locked in this position using the **Achse sperren** key.


The lock is only active while the key is pressed.

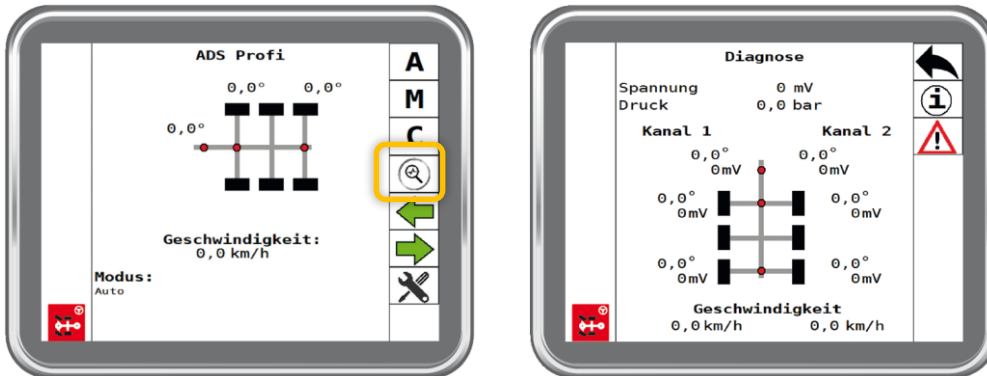
The following conditions must be met to hold the current position of the steering axle:

- The dump valve(s) is/are functioning correctly.
- Both speed sensors are functioning correctly.
- The proportional valve(s) of the steering is/are in neutral position.
- The system has detected reverse travel.
- The **Achse sperren** key is pressed.


When the axle is locked, the visual appearance of the "**Achse sperren (Lock axle)**" key changes to indicate this.

6.6 Diagnostic menu


Pressing the  key in the main menu opens the diagnostic menu:

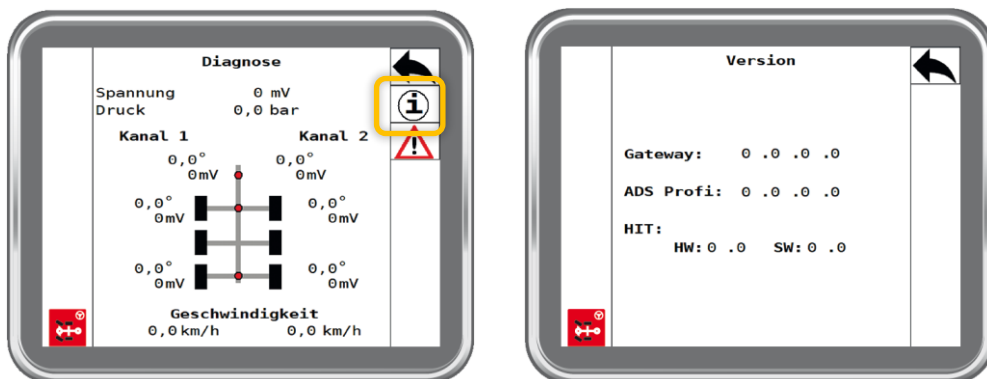


The diagnostic menu shows the sensor values, raw sensor values and supply voltage.

Pressing the  key switches back to the main screen.

6.6.1 Displaying the version numbers

Pressing the  key in the diagnostic menu opens the following page:




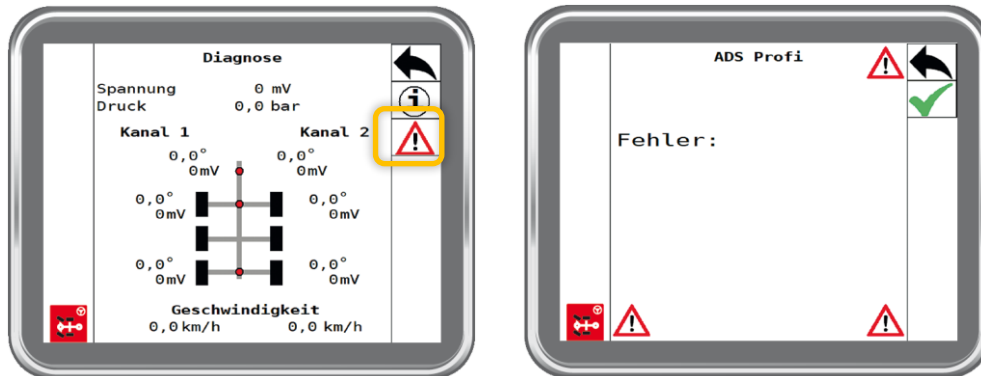
The following are displayed:

- Software version of the ISOBUS gateway "**Gateway**"
- Software version of the steering controller "**ADS-Profi**"
- Hardware and software version of the sensor


Pressing the  key switches back to the main screen.

6.6.2 Displaying active errors


Pressing the  key in the diagnostic menu opens the following page:

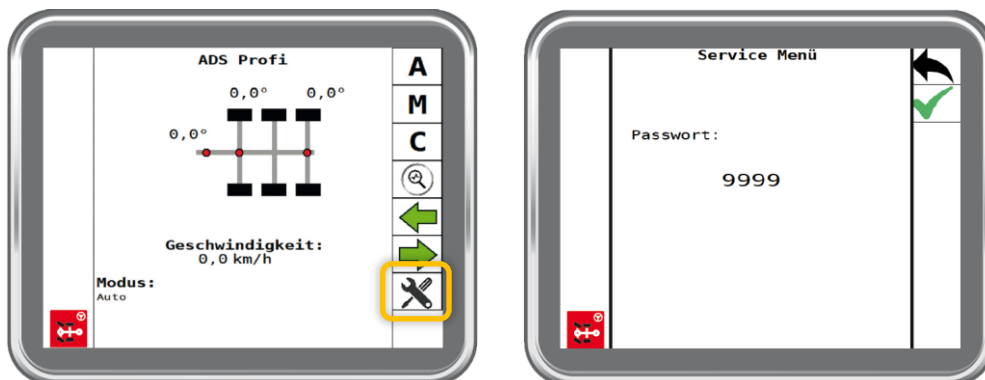


The active error is displayed here. The error list can be found in the appendix to these operating instructions (see section 8).

Pressing the  key switches back to the main screen.

6.7 Service menu

Pressing the  key on the main screen opens the selection page for the machine settings:



The authorisation page opens, and a password must be entered here.
As of this step, access is available only to specialist workshops.

7. Maintenance



Relevant personnel qualification required for maintenance work:

Maintenance and repair work must be performed only by trained personnel.



Maintenance permitted only in de-energised state:

Maintenance and repair work must be performed only when the engine and voltage supply are switched off.

The auxiliary steering system must always be fully depressurised before performing service work on the system hydraulics.



Calibration required after work on angle sensors:

Calibration must always take place after replacing the angle sensors or altering the mechanical connection to the steering axle.

7.1 Maintenance intervals

7.1.1 Steering system

The following maintenance activities must be performed at regular intervals to ensure long, trouble-free operation of the steering system:

Activity	Interval
Cleaning	As needed
Check connections for secure attachment and possible leaks	Daily
Check fittings and safety devices for correct condition	Weekly
Check fastening elements	Monthly
Hydraulic fluid	As specified by vehicle manufacturer

7.1.2 Maintenance of the control block

The control block requires minimal maintenance when used as intended.

The service life of the control block greatly depends on the quality of the hydraulic fluid.

Activity	Interval
Cleaning	As needed
Check control block for external leaks and unusual noises	Daily
Check operating temperature	Weekly
Check that fastening elements are secure in depressurised, de-energised and cooled state	Monthly
Hydraulic fluid	As specified by vehicle manufacturer

7.2 Configuration of truck-specific parameters during servicing

Customer parameter check required:

Throughout the entire system life cycle, the parameters that can be adjusted by the vehicle manufacturer's customer service via the ISOBUS display must be checked on all vehicles to ensure that they are correct.

7.3 Hydraulic system

Hydraulic oil fill level on vehicle:

A fill level indicator on the vehicle allows the vehicle operator to detect and take the necessary action to pre-empt a potential failure of the steering system attributable to a leak that results in a critical hydraulic oil fill level. In the case of a critical hydraulic oil level, a loss of steering function is to be expected.

Hydraulic oil contamination indicator on vehicle:

A filter contamination indicator on the vehicle allows the vehicle operator to detect and take the necessary action to pre-empt a potential failure of the steering system attributable to contamination of the hydraulic fluid. In the case of contaminated hydraulic fluid, a loss of steering function is to be expected.

7.4 Faults

7.4.1 Faults on the control block

The following points must be observed during troubleshooting:

- Define and cordon off the safety zone.
- Operate the machine at significantly reduced speed/pressure.
- Troubleshooting must be performed only with all safety devices activated.
- A qualified electrician must be involved when working on electrohydraulic machines.
- Exclude possible hazards from adjacent machines or risks to persons at adjacent machines.
- The work steps performed must be documented along with all set values and any changes made to these values. All changes to the machine must be recorded in a traceable manner, e.g. in the machine documentation and, if necessary, in the service logbook.
- All installed parts must be selected according to the applicable operating pressures and hydraulic fluids.

The following points in particular must be observed once troubleshooting has been completed:

- Check all connections.
- Check that all screw joints, cable connections and electrical couplings are securely fastened.
- Once maintenance has been completed, ensure that any previously closed tank lines are opened again.
- Deactivate all previously activated safety devices.
- Fill and vent all hydraulic components.
- Perform a function check; start with a low pressure and gradually increase it.

8. Error code

Error code gateway	Error cause	Action
001	Software configured/parametrised incorrectly	Check configuration/parametrisation Replace controller
002	Wiring harness or software not suitable	Check wiring harness and software
003	Configuration not released Configuration was reset (EEPROM error)	Check configuration Replace controller
004	Parametrisation not released Parametrisation was reset (EEPROM error)	Check parametrisation Replace controller
005	Incorrect software – tandem software on tridem system	Use controller with correct software
006	Project ID not set in configuration list Project ID was reset (EEPROM error)	Check configuration Replace controller
007	Material number not set in configuration list Material number was reset (EEPROM error)	Check configuration Replace controller
009	Power supply too high Power supply (12/24 V) set incorrectly in configuration	Check power supply Check configuration
010	Power supply too low Power supply (12/24 V) set incorrectly in configuration	Check power supply Check configuration
011	Sensor supply – short circuit to high potential	Check wiring / pin H3
012	Sensor supply – short circuit to low potential Consumer current too high	Check wiring / pin H3 Check load of connected consumers
013	Supply pressure significantly too high – pressure supply faulty	Check supply pressure
014	ECU temperature above 90°C Controller faulty	Ambient temperature too high Replace controller
015	ECU temperature below -40°C Controller faulty	Ambient temperature too low Replace controller
017	Non-fatal input board error	Check power supply Replace controller
018	Fatal input board error	Replace controller
019	Input pin error	Check controller Check environmental conditions
020	Output pin error • Y03/FSV – high side – wire break / short circuit to supply/ground • Y04/FSV – high side – wire break / short circuit to supply/ground	Check wiring Y03/FSV1 (pin D1 and B1) Check wiring Y04/FSV2 (pin C1 and A1) Check magnetic coil(s)
021	ECU error	Replace controller
022	Memory error	Replace controller
023	Watchdog error	Check power supply (ECU_PWR and PWR synchronous) Replace controller
024	Output pin error • Y03/FSV – low side – short circuit to supply • Y04/FSV – low side – short circuit to supply	Check wiring Y03/FSV1 (pin B1) Check wiring Y04/FSV2 (pin A1)
028	Output pin error • Y03/FSV – low side – short circuit to ground • Y04/FSV – low side – short circuit to ground	Check wiring Y03/FSV1 (pin B1) Check wiring Y04/FSV2 (pin A1)
029	Undefined error	Replace controller
033	Controller EEPROM error	Restart controller
034	Controller EEPROM error	Restart controller
035	Controller EEPROM error	Restart controller

Error code gateway	Error cause	Action
036	Controller EEPROM error	Restart controller
041	Y03/FSV1 – wire break or short circuit to supply voltage	Check wiring Y03/FSV1 (pin D1 and B1) Check magnetic coil
042	Y03/FSV1 – internal short circuit	Replace controller
043	Y03/FSV1 – short circuit to ground	Check wiring Y03/FSV1 (pin D1 and B1)
044	Y03/FSV1 – internal driver error	Replace controller
049	Y04/FSV2 – wire break or short circuit to supply voltage	Check wiring Y04/FSV2 (pin C1 and A1) Check magnetic coil
050	Y04/FSV2 – internal short circuit	Replace controller
051	Y04/FSV2 – short circuit to ground	Check wiring Y04/FSV2 (pin C1 and A1)
052	Y04/FSV2 – internal driver error	Replace controller
057	KF01/ErrInd – wire break	Check wiring KF01/ErrInd (pin K1) Check magnetic coil
058	KF01/ErrInd – short circuit to supply voltage	Check wiring KF01/ErrInd (pin K1)
059	KF01/ErrInd – short circuit to ground	Check wiring KF01/ErrInd (pin K1)
060	KF01/ErrInd – internal driver error	Replace controller
065	Y01.1 – wire break	Check wiring Y01.1 (pin H1) Check magnetic coil
066	Y01.1 – short circuit to supply voltage	Check wiring Y01.1 (pin H1)
067	Y01.1 – short circuit to ground	Check wiring Y01.1 (pin H1)
068	Y01.1 – current deviation	Check coil resistance Y01.1
069	Y01.1 – internal error	Replace controller
073	Y01.2 – wire break	Check wiring Y01.2 (pin G1) Check magnetic coil
074	Y01.2 – short circuit to supply voltage	Check wiring Y01.2 (pin G1)
075	Y01.2 – short circuit to ground	Check wiring Y01.2 (pin G1)
076	Y01.2 – current deviation	Check coil resistance Y01.2
077	Y01.2 – internal error	Replace controller
081	Y02.1 – wire break	Check wiring Y02.1 (pin F1) Check magnetic coil
082	Y02.1 – short circuit to supply voltage	Check wiring Y02.1 (pin F1)
083	Y02.1 – short circuit to ground	Check wiring Y02.1 (pin F1)
084	Y02.1 – current deviation	Check coil resistance Y02.1
085	Y02.1 – internal error	Replace controller
089	Y02.2 – wire break	Check wiring Y02.2 (pin E1) Check magnetic coil
090	Y02.2 – short circuit to supply voltage	Check wiring Y02.2 (pin E1)
091	Y02.2 – short circuit to ground	Check wiring Y02.2 (pin E1)
092	Y02.2 – current deviation	Check coil resistance Y02.2
093	Y02.2 – internal error	Replace controller
097	BG01 – drawbar angle sensor – channel 1 – wire break or short circuit to low potential	Check wiring BG01 (pin E4) Check sensor
098	BG01 – drawbar angle sensor – channel 1 – short circuit to high potential	Check wiring BG01 (pin E4) Check sensor
099	BG01 – drawbar angle sensor – channel 2 – wire break or short circuit to low potential	Check wiring BG01 (pin D4) Check sensor

Error code gateway	Error cause	Action
100	BG01 – drawbar angle sensor – channel 2 – short circuit to high potential	Check wiring BG01 (pin D4) Check sensor
101	BG01 – drawbar angle sensor – channel 1 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
102	BG01 – drawbar angle sensor – channel 2 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
103	BG01 – error in cross comparison between both channels	Check sensor Check for faults to sensor ground Repeat calibration Replace sensor
105	BG02 – rear axle angle sensor – channel 1 – wire break or short circuit to low potential	Check wiring BG02 (pin C4) Check sensor
106	BG02 – rear axle angle sensor – channel 1 – short circuit to high potential	Check wiring BG02 (pin C4) Check sensor
107	BG02 – rear axle angle sensor – channel 2 – wire break or short circuit to low potential	Check wiring BG02 (pin B4) Check sensor
108	BG02 – rear axle angle sensor – channel 2 – short circuit to high potential	Check wiring BG02 (pin B4) Check sensor
109	BG02 – rear axle angle sensor – channel 1 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
110	BG02 – rear axle angle sensor – channel 2 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
111	BG02 – error in cross comparison between both channels	Check sensor Check for faults to sensor ground Repeat calibration Replace sensor
113	BG03 – rear axle angle sensor – channel 1 – wire break or short circuit to low potential	Check wiring BG03 (pin A4) Check sensor
114	BG03 – rear axle angle sensor – channel 1 – short circuit to high potential	Check wiring BG03 (pin A4) Check sensor
115	BG03 – rear axle angle sensor – channel 2 – wire break or short circuit to low potential	Check wiring BG03 (pin A3) Check sensor
116	BG03 – rear axle angle sensor – channel 2 – short circuit to high potential	Check wiring BG03 (pin A3) Check sensor
117	BG03 – rear axle angle sensor – channel 1 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
118	BG03 – rear axle angle sensor – channel 2 – sensor values outside calibrated range	Check mechanism/attachment of linkage and recalibrate Check sensor
119	BG03 – error in cross comparison between both channels	Check sensor Check for faults to sensor ground Repeat calibration Replace sensor
121	BP01 – wire break or short circuit to low potential	Check wiring BP01 (pin J4) Check sensor
122	Speed sensor cross-comparison error • BS01 – wire break / cross-connections • BS02 – wire break / cross-connections	Check wiring BS01 (pin E3 / pin D3) Check wiring BS02 (pin C3 / pin F4) Check sensor Check installation position Check parametrisation (forward direction)
159	Vehicle in motion without pressure supply	Check pressure supply
167	Yaw rate error in cross-comparison	Invalid frequencies on vehicle Replace sensor
168	HIT temperature compensation inactive	Check/replace HIT
169	HIT sensor error	Check/replace HIT

Error code gateway	Error cause	Action
170	HIT yaw rate error	Check/replace HIT
175	CAN bus failure (CAN1) BG04/HIT failure	Check CAN bus Check BG04/HIT
176	HIT communication/software problem	Check CAN bus Check BG04/HIT
177	HIT with incorrect hardware/Software/material number fitted	Replace BG04/HIT
178	HIT incorrectly configured	Replace BG04/HIT
179	HIT communication/software problem	Check CAN bus Check BG04/HIT
183	– Deviation of target/actual steering angle on rear axle at standstill – • Insufficient hydraulic supply • Steering valve PLV1 faulty • Dump valve FSV1 faulty • Mechanical problems with angle sensor / axle connection	Check hydraulic supply/pressure Check steering valve PLV1 Check dump valve Check mechanics
184	– Deviation of target/actual steering angle on rear axle during motion – • Insufficient hydraulic supply • Steering valve PLV1 faulty • Dump valve FSV1 faulty • Mechanical problems with angle sensor / axle connection	Check hydraulic supply/pressure Check steering valve PLV1 Check dump valve Check mechanics
185	– Deviation of target/actual steering angle on front axle at standstill – • Insufficient hydraulic supply • Steering valve PLV2 faulty • Dump valve FSV2 faulty • Mechanical problems with angle sensor / axle connection	Check hydraulic supply/pressure Check steering valve PLV2 Check dump valve Check mechanics
186	– Deviation of target/actual steering angle on front axle during motion – • Insufficient hydraulic supply • Steering valve PLV2 faulty • Dump valve FSV2 faulty • Mechanical problems with angle sensor / axle connection	Check hydraulic supply/pressure Check steering valve PLV2 Check dump valve Check mechanics
191	FSV1 jamming in switched state	Check/replace FSV1
192	FSV2 jamming in switched state	Check/replace FSV2
193	PLV jamming in neutral state Insufficient hydraulic supply	Check/replace PLV Check hydraulic supply/pressure
207	CAN bus failure (CAN0) Command message failed	Check CAN bus Check display/ISOBUS gateway
208	Invalid commando messages	Check display/ISOBUS gateway
215	Pressure supply to low	Check pressure supply
216	Pressure supply during steering operation too low	Check pressure supply
223	CAN bus failure (CAN1) Failure of yaw rate message 1 (primary)	Check CAN bus Check HIT supply
224	Invalid yaw rate messages on bus	Check HIT
225	Inverse message invalid	Check HIT
227	Receipt of inverse message outside time definition	Check HIT
228	CAN bus failure (CAN1) Failure of yaw rate message 2 (secondary)	Check CAN bus Check HIT supply
229	Invalid yaw rate messages on bus	Check HIT
230	Inverse message invalid	Check HIT
232	Receipt of inverse message outside time definition	Check HIT
241	BS01 – single-channel wire break / cross-connection	Check wiring (BS02 / pin E3 or pin D3) Check sensor / sensor installation
242	BS02 – loose contact of direction pin	Check wiring (BS01 / pin F4) Check sensor / sensor installation
250	Yaw rate offset error – offset deviation too high	Recalibrate yaw rate



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