User’s guide

ECO
ECU
DISTANCE-Control

September 2004

Contents

1. Introduction

With the ECO ECU DISTANCE-Control, your machine is equipped with state-of-the-art technology. Over 10 years experience in the development of CAN-bus components has had considerable influence here.

This ECO System works with ECO-Terminal of Müller-Elektronik GmbH u. Co. KG.

2. Safety instructions

2.1. Disclaimer:

The ECO DISTANCE-Control is specified exclusively for agricultural use. The manufacturer takes no responsibility for any installation or application outwith this area.

The manufacturer does not accept liability for damage to persons or property resulting from unspecified use. In such cases all risks are the responsibility of the user.

Specified implementation also includes adhering to the operation and maintenance requirements stipulated by the manufacturer.

Relevant accident prevention regulations as well as other generally recognised safety, industrial health and road traffic rules are to be adhered to. In addition the manufacturer accepts no liability in cases where arbitrary modifications have been made to the device.

2.2. Safety measures

Warning!

Always pay attention to this symbol for references to important safety precautions.
It means attention! Become alert!
It is a question of your safety.

Read the user's guide before using the ECO DISTANCE-Control for the first time.

Observe the following recommended precautions and safety instructions:

⚠ Do not remove any safety mechanisms or labels.

⚠ Before using the device, read and understand this guide. It is of equal importance that others operating this device also read and understand the manual.

⚠ During maintenance or when using a battery charger, switch off the power supply (pull out the plug to the basic-equipment).

⚠ Never service or repair the device while the system is switched on.

⚠ When welding on the equipment or on an attached machine, interrupt the power supply (pull out the plug to the basic-equipment).

⚠ Keep children away from the equipment.

⚠ Do not expose the job computer and the sensors to the direct jet of a high pressure cleaner.

⚠ Operate the keys with your finger tips but avoid using fingernails.

⚠ Should any part of this guide remain incomprehensible after reading, contact the dealer or Mueller-Elektronik Service for further clarification before using the device.

⚠ Read carefully all safety instructions in the manual and the safety labels on the equipment. Safety labels must always be legible. Replace missing or damaged labels. Ensure that the current safety labels can be found on all new components. Your authorised dealer can supply you with spare labels.

⚠ Learn how to operate the machine and controls correctly. Nobody is to operate the machine without exact instructions.

⚠ Keep the machine and the spare parts in good condition. Unstipulated alterations can impair the function and/or safety and affect the life span of the machine.

3. Overview and initial operation

The job computer is not sufficient in itself to operate the sprayer boom. The DISTANCE-Control can only be operated once the job computer has been connected via the 20 pin connector to the basic equipment of the terminal on the tractor. Diagram 3-1 illustrates the basic overview of the equipment on the tractor and the field sprayer.

Diagram 3-1 System overview

4. Masks

Please refer to your ECO-Terminal user's guide for the basic structure of the monitor and the function keys.

4.1. Working masks

As soon as the job computer has been switched on and selected from the terminal, a working mask appears on the monitor. From here all of the job computer's functions can be navigated.

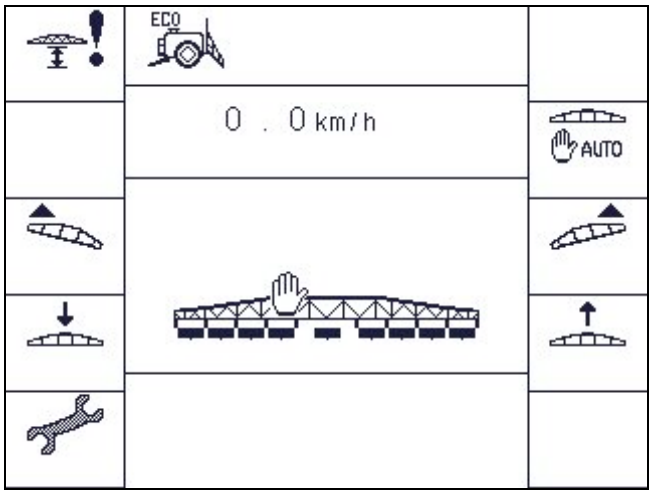
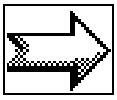
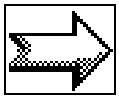
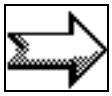


Diagram 4-1 Working mask 1

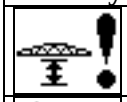
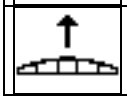
If the soft key  is pressed, the additional mask 1 appears. This has further functions.

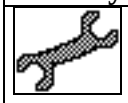
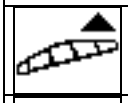
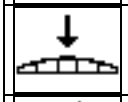
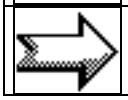
To return to the working mask, press  again.

If no multifunction grip is connected (emergency operation), further additional masks may appear which have its function. These can be accessed from the working mask by pressing the soft key  several times. The working mask is returned to after the last mask.

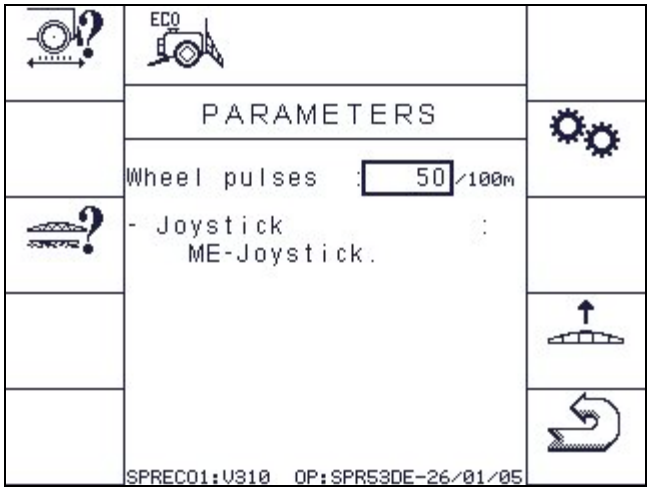
4.2. Soft keys in the working mask

Tab. 4-1 Soft keys in the working mask

Soft key	Description
	Calls up the DISTANCE-Control calibration mask (chap. 5 page 10)
	Raises boom on the left
	Raises boom

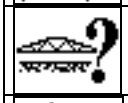
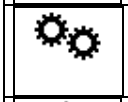
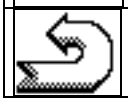
Soft key	Description
	Calls up the machine data mask (chap. 4.3 page 8). In the machine data masks all adjustable values can be seen and altered. From here further soft keys branch out to the individual calibration masks.
	Switches DISTANCE-Control manual/automatic When the symbol  is visible in the working mask, DISTANCE-Control is in manual mode.
	Raises boom on the right
	Lowers boom
	Switches to working mask 2 which has further soft keys for other functions.

4.3. Parameter mask



In the parameter mask it is possible to set the wheel pulses per 100 m and it can be selected if a multifunction grip (MFG) is available. The available soft keys call up different calibration masks. See the description in Tab. 4-2.

Tab. 4-2 Soft keys in the parameter mask

Soft key	Description
	Calls up the wheel sensor calibration mask
	Calls up the DISTANCE-Control calibration mask
	Calls up manufacturer configuration mask. This mask is password protected and only accessible for service staff.
	Returns to working mask

4.3.1. Calibration masks

Calibration of individual components serves the purpose of balancing out manufacturing variations and changes which have occurred in the course of time due to wear and tear etc. The individual calibration steps must be carried out as accurately as possible. Only then the best possible results can be achieved. It is recommended that all functions are examined for accuracy and if necessary calibrated again at the beginning of each season. A new calibration should be carried out immediately if inaccuracies occur during the season.

The following chapter describes the procedure for the various calibrations.

4.3.1.1 Wheel sensor

The calibration mask can be selected in the machine data mask. Some preparation is necessary before the calibration process can begin.

Attention! The calibration must be carried out accurately. The speed is affected by it.

1. Measure and mark a distance of 100 m on the field (tank half full).
2. Drive the tractor to the marked line.
3. To start the calibration process, press the  key. The key disappears. The OK and ESC keys appear.
4. Drive a hundred meters and stop. During the journey the current pulses measured are displayed.
5. To confirm the pulses measured, press the OK key at the end. The new value is now displayed in the machine data mask. The calibration process can be interrupted by pressing the ESC key instead of OK. The old values remain unchanged.

4.3.1.2 DISTANCE-Control

The DISTANCE-Control calibration is described in chapter 5 page 10.

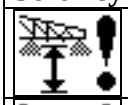
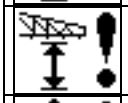
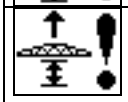
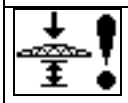
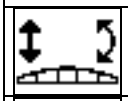
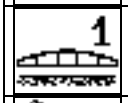
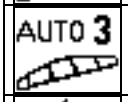
5. DISTANCE-Control

DISTANCE-Control automatically maintains the pre-set distance from the boom to the target surface. Two ultrasonic sensors installed near the ends of the boom constantly measure the current distance to the ground or plant surface. Further sensors provide information about deflection and inclination of the boom frame. By means of these values the job computer determines the current status and the necessary reaction to height and inclination deviations.

The current status of the DISTANCE-Control (manual / automatic) is shown in the working mask on the boom. In manual mode the symbol appears on the boom and disappears in automatic mode. The key on the MFG, or with emergency operation the soft key in the additional mask 1 is used for switching.

The DISTANCE-Control calibration mask can be reached from the main mask by pressing the key or from the parameters mask by pressing the key.

Tab. 5-1 Soft keys DISTANCE-Control calibration

Soft key	Description
	Sets the working height when DISTANCE-Control is in **manual** mode.
	Sets the excavation height when DISTANCE-Control is in **manual** mode.
	Increases the working or raised height when DISTANCE-Control is in **automatic** mode. When spraying is “OFF” the raised height is changed. The working height is changed when spraying is “ON”. See chapters 5.1 page 11 and 5.2 page 11 for detailed description
	Reduces the working or raised height when DISTANCE-Control is in **automatic** mode. When spraying is “OFF” the raised height is changed. The working height is changed when spraying is “ON”.
	Sets the control type (see chapter 5.3 page 12)
	Starts the 1st calibration process (see chapter 5.4 page 12)
	Starts the 2nd calibration process (see chapter 5.4 page 12)
	Starts the 3rd calibration process (see chapter 5.4 page 12)
	Returns to the working mask

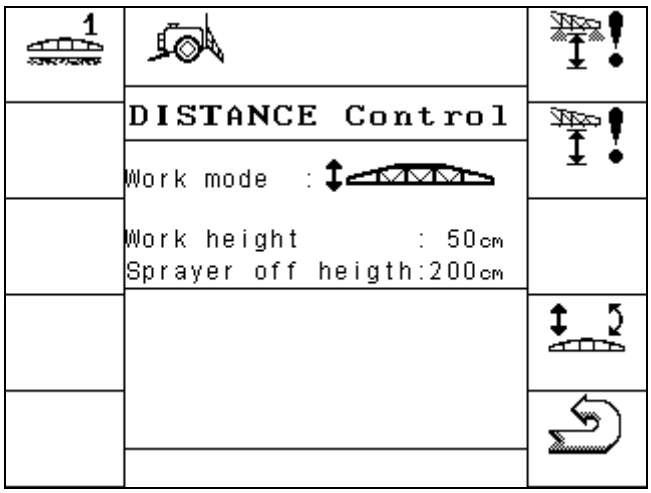


Diagram 5-1 DISTANCE-Control mask

Some information has to be entered before DISTANCE-Control can be used. Subsequently a calibration has to be carried out.

5.1. Setting the working height:

The working height is determined by DISTANCE-Control when the boom section main switch is on. In order to program this height the following steps have to be carried out:

1. Switch DISTANCE-Control to manual mode using the key on the MFG.
2. Set the boom to the required working height.
3. Press to store this information.

The working height is now stored and will be set automatically by DISTANCE-Control when it is in automatic mode and the boom section main switch is on.

The working height can also be set during operation. For this purpose the boom section switch must be on and the following steps carried out:

1. Call up DISTANCE-Control mask using the soft key in the working mask.
2. With the soft keys and set to the required height. Ready!

5.2. Setting the raised height:

The raised height is determined by DISTANCE-Control when the boom section main switch is off. In order to program this height the following steps have to be carried out:

3. Switch the DISTANCE-Control to manual mode using the key on the MFG.
4. Set the boom to the required working height.
5. Press to store this information.

The raised height is now stored and will be set automatically by DISTANCE-Control when it is in automatic mode and the boom section main switch is off.

If DISTANCE-Control is in automatic mode (boom section main switch off) the raised height can be set as follows:

1. Call up DISTANCE-Control mask using the soft key  in the working mask.
2. With the soft keys  and  set to the required height. Ready!

5.3. Selection of the control type

DISTANCE-Control operates normally with a combination of height and inclination control. The type of control in the DISTANCE-Control mask can be changed using the soft key  . Differentiation is made between height control (), inclination control () and a combination of both. Specific applications can be selected by repeatedly pressing the  key in the corresponding mode.

5.4. Calibration

Specific data for each boom type is determined once. These are stored as master data in the job computer and cannot be altered by the user. The user however is responsible for optimisation by carrying out calibration. All parameters which can vary due to production or can change during the life span of the machine are recorded here.

Important:

1. **The calibration must be carried out for each sprayer with DISTANCE-Control!**
2. **Calibration should be repeated at least once a year at the beginning of the season.**
3. **The sprayer must be positioned horizontally on ground which is even and has no slope. There should be no hollows under the ultrasonic sensors. The ground surface should not be too smooth (e.g. asphalt or concrete) otherwise the ultrasonic signals can get lost.**
4. **All mobile parts of the boom suspension must be free of paint and sufficiently lubricated.**
5. **The correct working width must be entered in the machine data.**

Correct functioning of DISTANCE-Control after the calibration process is only possible if all these points are adhered to. Regular maintenance of all mobile parts is absolutely essential to ensure long-lasting and correct functioning. Changes to the manoeuvrability of the boom suspension can cause grave impairment to control performance, which even a repeat calibration may not be able to rectify.

The calibration process is carried out in three consecutive stages. The individual stages are clearly separated but should be carried out successively during one process. The machine must be stationary during this process. If problems or operating errors occur, calibration will be automatically terminated and the original parameters restored. The process can be interrupted manually at any time by pressing the ESC soft key.

During calibration:
The functions of the multifunction grip remain active; boom adjustment to the defaults can therefore be carried out either via the multifunction grip.

Procedure:

1. Press the  soft key. The calibration process begins and the following text appears:

Horizontal calibration
Place boom in a horizontal position at a height of 2m
And press: OK

2. Now place the boom in a horizontal position at a height of 2m. In this position the boom must be able to tilt freely to the ground. If this is not the case select a lower height. To help with setting, the height of the boom on the left and right are displayed in the menu Depending on the position the following text appears:

Boom is now horizontal
or
Boom is not horizontal

3. When the boom is horizontal the setting is stored using the OK key. Now and again wind can cause the boom to move 2-3 cm back and forth so that the display "Boom is now horizontal" wavers on the monitor. In this case press the OK key several times until the input is accepted.

4. As soon as the first setting is completed the soft key  disappears and this key appears  .

5. To start the second calibration step press the Soft key  . This text appears :

Manual Calibration

Tilt the boom to the left for 5 seconds

6. Now press down the left side by hand (⚠ **Attention! <u>not</u>** via the slope adjustment) until the ultrasonic sensor is about 40 cm above the ground. As soon as the deflection is sufficient the following text appears:

Move back the boom to the horizontal position
and
Boom is now horizontal
or
Boom is not horizontal

7. Hold the boom in the deflected position for about 5 seconds and then let go. The boom should now move itself back into the horizontal position. If the display does not switch to "Move back the boom to the horizontal position" press down the boom once more, this time further than the first time.

   ⚠ The ground must not be touched.

8. Once the boom is horizontal this step can be concluded by pressing [OK]. The [2] key disappears and the [AUTO 3] key appears.
9. Press [AUTO 3] to start step 3. The following text appears:

Automatic calibration: please wait...

10. Now an automatic process is started. The boom will be raised first on the left and then on the right and subsequently returned to the horizontal position, during which it must not touch the ground. If, after this, the horizontal position is not set correctly this does <u>not</u> mean that the calibration has failed.
11. Observe the movement of the boom. If something is not correct, the process can be terminated by pressing [ESC] key. All three steps must then be carried out once again.
12. If this step has also been concluded successfully, the following text appears:

Calibration completed. Please press ok.

If the new calibration values are to taken over the [OK] key has to be pressed once more. With the [ESC] key the new calibration values can be rejected.

Once the calibration has been fully completed, DISTANCE-Control is ready for use and can be switched to automatic mode by pressing the [AUTO] key in the additional mask 1.

Safety functions:
Under specific safety-relevant conditions DISTANCE-Control is switched to manual mode.

- Maximum speed of 15 km/h is exceeded
- Error messages involving DISTANCE-Control
- Activation of another function involving DISTANCE-Control (folding etc.)
- Signal from other sensors e.g. locking, lift mast sensor etc.
- Start of calibration
- Short term loss of sensors

6. Appendix

6.1. Technical data

Tab. 6-1 Technical data

Connections:	- 16 pin connector for connecting the CAN-Bus cable - 1 x 42-pin plug (mating connector lockable and with single wire seals for the connection of actors, sensors etc.)
Power supply:	10 .. 16 V DC (incl. load-dump protection up to 80V)
Current consumption (IN):	400mA (at 14,4V without power output, without supply to external sensors)
Quiescent current (OUT):	70µA
Ambient temperature:	-20 .. +70 ºC (acc. to IEC68-2-14-Nb, IEC68-2-30 and IEC68-2-14Na)
Casing:	Anodised aluminium continuous casting casing, painted aluminium cover with EPDM seal, stainless steel screws
Safety class:	IP66K (dust proof and protection against jet water with increased pressure in acc. with DIN40050 part 9: 1993)
Environmental testing:	vibration and impact test in accordance with IEC68-2

6.2. Glossary

Tab. 6-2 Glossary

Term	Definition
Bus	Bus means that different devices (terminal, job computer etc.) are generally connected to one another by a network. Only data packets (messages) which can be accessed by all participants are sent here. Each message is labelled in such a way that each BUS participant can recognise if it is intended for him. In this case he evaluates it.
CAN-Bus	Principally a network existing of two cables. CAN means “Controller Area Network” and was developed by Bosch for use in industrial plants and the motorcar industry. This form of data bus is particularly suited to use in industrial plants as it has little susceptibility to faults.
Function keys	Function keys are keys on the terminal set up beside the monitor. The current key function (soft key) is displayed on the terminal.
Mask	Masks are where the various job computer functions are depicted on the terminal monitor. Within the mask information from the job computer and the assignment of the function keys are displayed.
Terminal	The terminal is the output and operating unit in the tractor cabin. It makes the connection between the driver and the machine. The data of the connected machines are displayed on the terminal. By means of function keys, all functions can be carried out.
Basic equipment	The basic equipment constitutes the link between the terminal and the tractor. By means of the basic equipment the voltage supply and the CAN-Bus are attached to the terminal. Depending upon the type of tractor and its equipment, the basic equipment also consists of the battery cable and the machine connector.
Soft key	The soft key is the current function of a function key. It is displayed on the monitor beside the function key.
Configuration	The configuration is a table of parameters, which communicates the

Term	Definition
	range of machine functions to the job computer.
Job computer	The job computer is the brain of the machine, being responsible for all functions. All control functions are carried out here and controlled. Sensor values are measured and sent for display to the terminal. Commands (e.g. raise or lower boom) which are entered on the terminal by the operator are converted here to switching signals and so controlled, e.g. hydraulic valves. The CAN-Bus cable connects the job computer to the tractor. The cables on the sensors and actuators are connected (if necessary by means of a cable harness or distributor) to the job computer.
Cursor	The cursor indicates the current position in a data input or selection menu. It marks the value which is being altered.
Resources	Resources are graphic objects made accessible by the job computer. Their purpose is to display the functions, input, output etc. on the terminal. The first time the terminal is connected to a new job computer, the resources are loaded and stored there. Due to storing, a reboot is not necessary. The resources remain stored on the terminal until they are deleted by the user.

6.3. Abbreviations

Tab. 6-3 Abbreviations

Abbreviation	Definition
MFG	Multifunction grip

6.4. List of diagrams

6.5. List of tables