

Technical Documentation

Product manual

Commissioning tool

BLCT

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Writing conventions and symbols

Work steps If work steps must be carried out in sequence, they are shown as follows:

- Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Important response to this work step
- ▶ Step 2

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
 - Subpoint to 2
 - Subpoint to 2
- Point 3

Making work easier Information on making work easier can be found at this symbol:



*This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.*

Menu paths "⇒" Action steps within the menu are described with complete menu path and the "⇒" symbol,
e.g. "⇒ File ⇒ Save As...".

1 Introduction

1.1 General features

The BLCT commissioning software is a PC program for commissioning and diagnostics for many Berger Lahr products.

The functions of the commissioning software automatically adapt to the products. Some functions may not be available. For details see the product manual.

Functions of the commissioning software

The functions of the commissioning software include:

- Display and input of device parameters
- Archiving and duplication of device parameters
- Manual positioning of motor
- Testing input and output signals
- Recording, evaluating and archiving courses of travel
- Diagnosis of operating faults
- Optimisation of control behaviour

Supported devices

The product manual of the specific device specifies whether the commissioning software can be operated with the device.



You should be familiar with the operation of Windows to work with the commissioning software.

2 Safety

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by parameterisation, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, provisions and accident prevention regulations that must be observed when working on the drive system.

2.2 General safety instructions

▲ WARNING!

Risk of injury and damage to system components by loss of control!

Malfunctions on the PC or in the software may cause loss of control over the system (no stop, unexpected reactions).

- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for the motion before connecting the system to the PC.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▲ WARNING!

Unexpected motion may cause injury and damage to the system

When the drive is operated for the first time there is a high risk of unexpected motion because of possible wiring faults or unsuitable parameters.

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure that the system is free and ready for the motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

3 Installation

Reference source The commissioning software can be downloaded from the internet.
<http://www.berger-lahr.com/download>

3.1 Requirements for the PC

System requirements The minimum hardware requirements for installation and operation of the software are:

- IBM-compatible PC with Pentium processor
- approx. 30 MB of space on the hard disk
- 128 MB RAM
- graphics board and monitor with a resolution of at least 1024x768 pixels
- free serial port (RS232) or free USB port
- Windows 2000 or Windows XP Professional operating system

Required accessories • RS232 to RS485 converter or USB to RS485 converter

3.2 Installation procedure

We recommend backing up important data regularly and always before installing new software.

- ▶ Check the requirements on the PC.
- ▶ Start the installation from the file "BLCT-EN.MSI".
- ▶ Follow the prompts of the installation routine.

The program is installed in the folder C:\Programme\Berger Lahr\BLCT.

A program link is created in the Windows start menu for starting the commissioning software.



An advantage for working with the commissioning software is to set up a link on the desktop.

4 Operation

The commissioning software can be started with the program link in the Windows start menu.

4.1 The user interface

The following figure shows the user interface of the commissioning software.

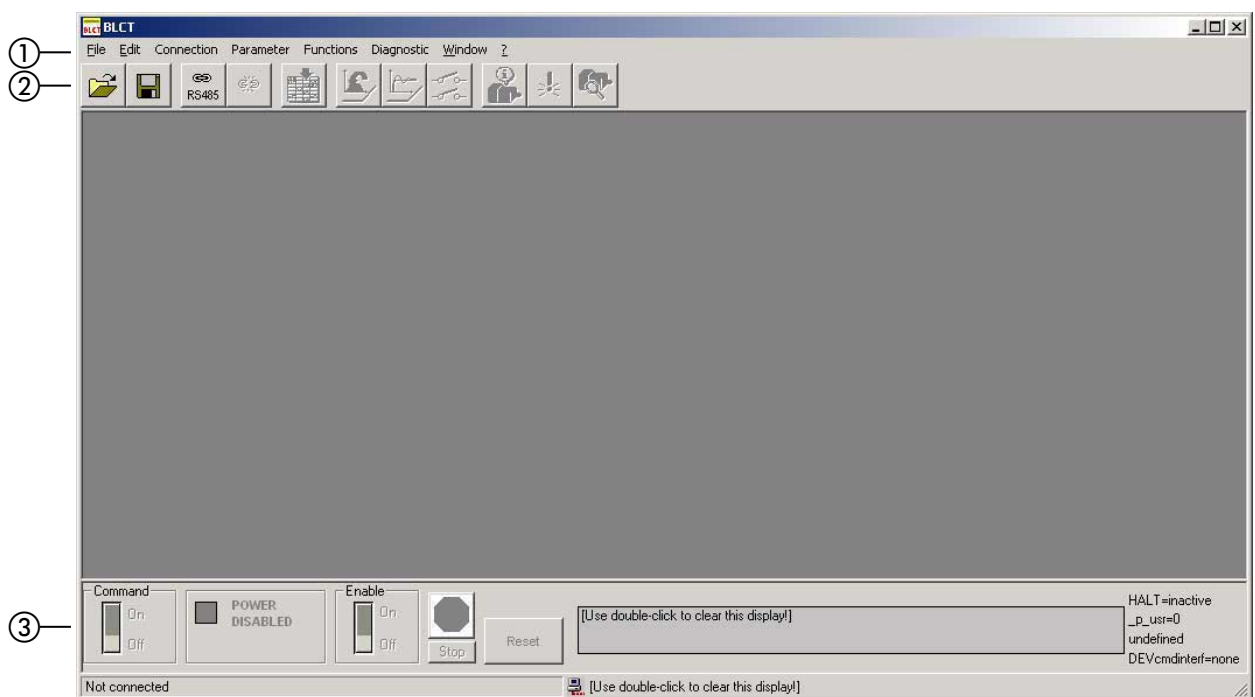


Figure 4.1 The components of the active window

- (1) Menu bar
- (2) Tool bar
- (3) Control and status bar

The functions of the commissioning software can be executed from the menu bar, the tool bar and the control and status bar.

4.1.1 The menu bar

The menu bar adapts itself to the current task. It only shows the functions required and possible for operation.

For example, if there is no connection to the device, the "⇒ Diagnostics ⇒ Device info..." function also cannot be run.

4.1.2 The tool bar

The tool bar allows frequently used functions from the menu bar to be started with one click.

The buttons represent the following functions of the menu bar:

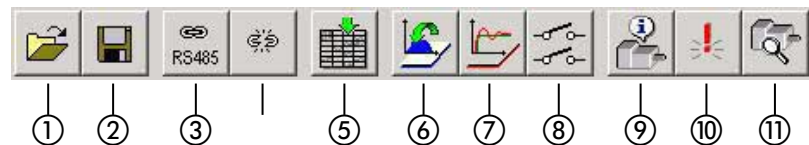


Figure 4.2 Tool bar

- (1) ⇒ File ⇒ Open...
- (2) ⇒ File ⇒ Save
- (3) ⇒ Connection ⇒ RS485 connection...
- (4) ⇒ Connection ⇒ Disconnect
- (5) ⇒ Parameter ⇒ Open parameter window...
- (6) ⇒ Functions ⇒ Operating modes...
- (7) ⇒ Functions ⇒ Record/Optimize...
- (8) ⇒ Functions ⇒ Inputs+outputs...
- (9) ⇒ Diagnostics ⇒ Device info...
- (10) ⇒ Diagnostics ⇒ Error memory...
- (11) ⇒ Diagnostics ⇒ Object monitoring...



If the mouse pointer is above a button "Tooltip" shows a short description of the assigned function.

4.1.3 The control and status bar

The control and status bar is for access to the device. It can be used to activate the power amplifier and shows various status information.

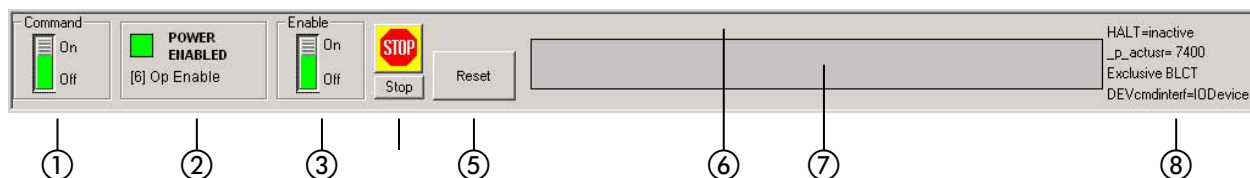


Figure 4.3 Toolbar

- (1) Access control
- (2) Operating status
- (3) Enable
- (4) Stop
- (5) Reset
- (6) Current breakdown
- (7) Communication error
- (8) Status information

Access control The commissioning software receives access control to the device with the "Access" switch. For more information on the access control see the product manual of the device.

Operating status The commissioning software shows the current operating status of the connected device. For more information on the operating status see the product manual of the device.

Enable The power amplifier of the device can be enabled or disabled with the "Enable" switch. For more information on enabling or disabling the power amplifier see the product manual of the device.

Stop Press the "Stop" button to stop the motor with "Quick Stop". For more information on "Quick Stop" see the product manual of the device.

Reset Press the "Reset" button to acknowledge an error message. For more information on acknowledging error messages see the product manual of the device.

Current breakdown The field shows the current pending breakdown of the device (asynchronous errors).

Communication error The field shows current communication errors (synchronous errors) in chronological order.

Status information This information consists of:

- line 1 shows whether the "Halt" function is active
- line 2 shows the current motor position
- line 3 shows the status of the access control
- line 4 shows the control mode

5 Work with the commissioning software

5.1 First steps

5.1.1 Important terms

Data interface The connection for data exchange is a RS485 interface. It is the standard commissioning interface and is installed on every device.

Device data Device data are all parameter values of a device. They are saved in the EEPROM memory of the device to prevent loss in case of power failure.

Transferring device data Device data can be transferred between the device and the PC only if there is a connection. The parameters of the device can be transferred in full or in groups (Simply Start, configuration, settings, motion, communication and data sheet).

The commissioning software transfers modified parameter in the first step to the RAM memory of the device. They remain there until the controller supply voltage is switched off. Note that the device data must be backed up separately in the EEPROM memory to save them permanently in the product.

Parameter file The device data can be saved and loaded to the PC.

On the PC all device data are saved in one file, the parameter file. The commissioning software always saves the complete parameter set in the file.

There must not be a connection between the PC and the device in order to process the parameter file.

5.1.2 The first connection

The device must be connected to the PC via a data interface.

A data link to the device is established with the menu item "⇒ Connection ⇒ RS485 connection...". The "Connection" window is opened.

The figure below shows an example.

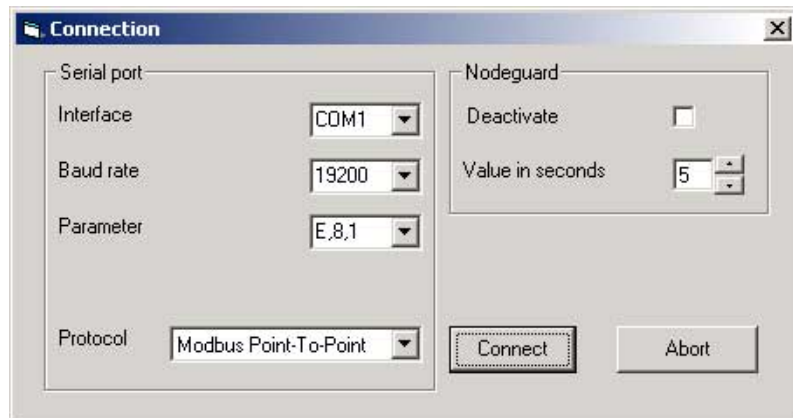


Figure 5.1 Selection of the connection data

Settings The "Modbus Point-to-Point" protocol must be used when the device is directly connected to the PC.

The "Modbus Multidrop" protocol must be used if the device is in a network in which multiple devices are connected together. The corresponding Modbus address must be set.

The setting of the Modbus address and the rate of transmission are described in the product manual of the device.

Connection The device data are transferred to the PC when connecting. After transfer the commissioning software is connected online to the device.

Start-up message The commissioning software shows a start-up message depending on the device. For example, in the case of new devices or device that must be reset to the factory setting the commissioning software shows the following information.



Figure 5.2 Start-up message

5.2 Parameter file

Parameter files have the extension ".blx". Even if it is not connected to the device a device file can be opened and edited by the PC. The file contains the parameter values and also the contents of the error memory, all actual values and the recorded data.

5.2.1 Save file

Device data on the PC can be backed up to a parameter file, for example, to archive it for maintenance and service purposes. It can be used to commission additional devices of the same device version quickly.

A parameter file can be backed up on the PC with the menu item "⇒ File ⇒ Save..." and "⇒ File ⇒ Save As.....".



After commissioning a device we recommend backing up the device data as a parameter file on the PC. This means that the device can be put back into operation immediately after a repair.

5.2.2 Open file

A parameter file can be opened on the PC with the menu item "⇒ File ⇒ Open...".

If there is a connection to the device, the commissioning software checks that the parameter file is compatible with the device.

If the parameter file is compatible with the device, the saved parameter values of the parameter file are compared with the parameter values of the device. Differences are highlighted in colour.

If the parameter file is not compatible with the device, the loading process is stopped and an error message is output.

5.2.3 Export parameter

All writable device parameters can be saved as a .csv file for further processing. This function can be run from the menu item "⇒ File ⇒ Export parameter...".

The file is saved with the extension ".csv". This file can be opened with Microsoft Excel and edited.

5.2.4 Print parameter

The device data can be output to a printer with the menu item "⇒ File ⇒ Print parameter...". The file is output in the following groups:

- Simply Start
- Configuration
- Settings
- Motion
- Communication
- Data sheet

In addition, the device type, serial number and information on the software can be output.

5.3 Configuration

The data of a device can be edited in the "Parameter" window. A data link is not required. The parameter values of a file can be modified in off-line operation and sent to the device at a later time.

5.3.1 Open parameter window

The parameter window is opened with the menu item "⇒ Parameter ⇒ Open parameter window...".

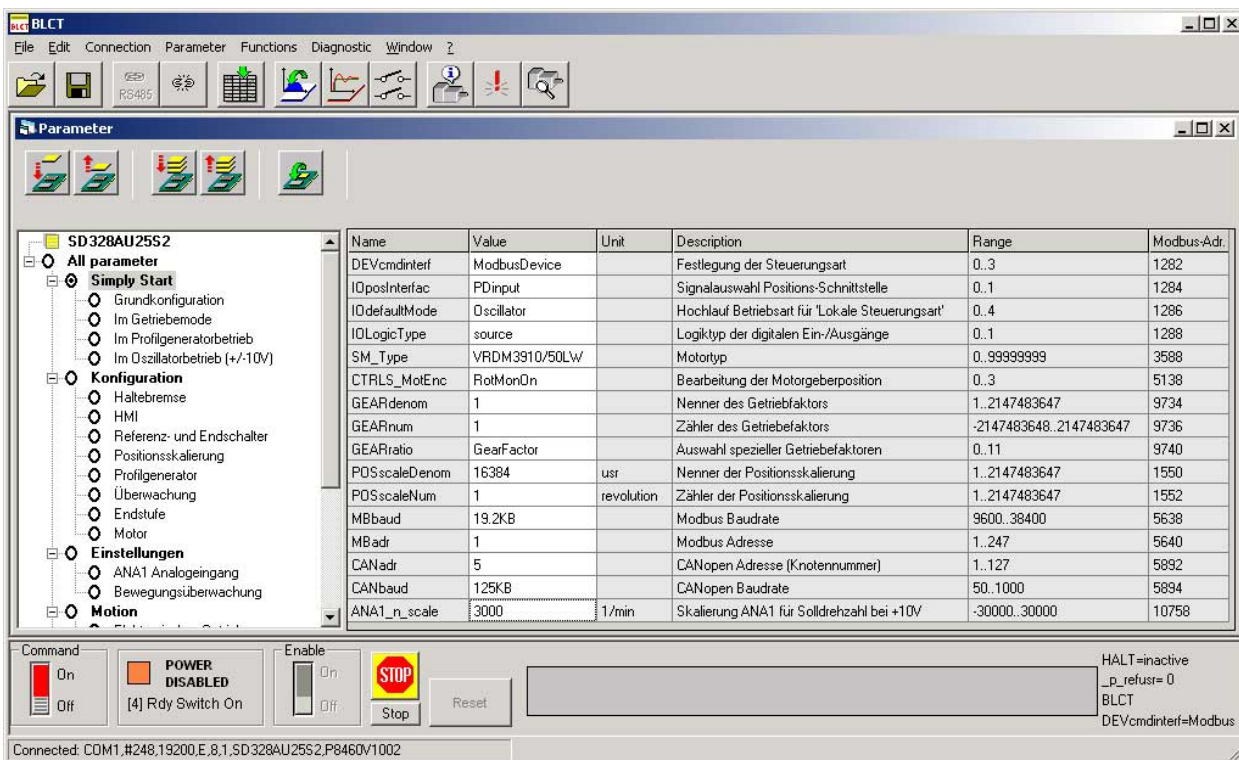


Figure 5.3 Parameter window

The figure shows the parameter groups in the left section and the associated parameters in the right section.

Parameter groups The displayed parameter groups depend on the actual device version.

The following parameter groups are present in all device versions:

- Simply Start
- Configuration

The following parameter groups depend on the device version.

- Settings
- Motion
- Communication
- Data sheet

<i>Parameters of a group</i>	The parameter window shows the parameters associated with the selected parameter group. The list shows the names, values, unit, a description, the range and the Modbus address.
<i>Change parameter values</i>	<p>The value of a parameter is changed in the "Value" column. Values with grey background are read-only and cannot be modified.</p> <p>Modified values that have not been transferred to the device are highlighted in colour. At the same time the parameter group belonging to the parameter is highlighted by a red exclamation mark. When the values are transferred to the device the highlight is reset.</p> <p>A change to a parameter value may be input directly or selected from a list.</p>
<i>Checking the value range</i>	The commissioning software checks whether the input parameter values in the permissible value range. If the input value is not in the valid range, the value is not accepted.

5.3.2 Transfer parameter values

After switching on the controller supply voltage to the device the device data are automatically copied from the EEPROM memory to the RAM. The devices only operate with the data of the RAM.

The data exchange between the device and the PC is controlled by the following menu items and buttons.

Menu items Parameter values are sent from the PC to the device with the menu item "⇒ Parameter ⇒ Send parameter group to drive" and "⇒ Parameter ⇒ Send all parameters to drive".

Parameter groups are sent from the device to the PC with the menu item "⇒ Parameter ⇒ Load parameter group from drive" and "⇒ Parameter ⇒ Load all parameters from drive".

Buttons The buttons represent the following functions of the menu bar:



Figure 5.4 Buttons for data transmission

- (1) ⇒ Parameter ⇒ Send parameter group to drive
- (2) ⇒ Parameter ⇒ Load parameter group from drive
- (3) ⇒ Parameter ⇒ Send all parameters to drive
- (4) ⇒ Parameter ⇒ Load all parameters from drive
- (5) ⇒ Parameter ⇒ Save device parameters in EEPROM



Not all parameters can be transferred in operating status "Operation Enable". Parameter values that cannot be transferred remained highlighted in colour.

5.3.3 Reset factory setting

All device parameters can be reset to the factory setting with the menu item "⇒ Parameter ⇒ Reset to factory settings".



Figure 5.5 Reset to factory settings

After validation with "OK" all device parameters are reset to the factory setting.

5.3.4 Reset user parameters

All user parameters can be reset to the values saved in the EEPROM with the menu item "⇒ Parameter ⇒ Reset user parameters to factory settings".



Figure 5.6 Reset user parameters

After validation with "OK" all user parameters are reset.

5.4 Functions

The menu item "Functions" includes the basic tasks:

- Operating modes
- Recording and optimising
- Inputs and outputs



The following illustrations may contain different functions or functions that are not available because of different functions of the devices.

5.4.1 Changing the operating status

To be able to control the device with the commissioning software it must be accessed exclusively. This is done with the "Access" switch in the control and tool bar. When the device is accessed a warning is shown. It must be validated with a key combination. For more information on the access control see the product manual of the device.

▲ WARNING!

Unexpected motion may cause injury and damage to the system

When the drive is operated for the first time there is a high risk of unexpected motion because of possible wiring faults or unsuitable parameters.

- If possible, run the first test movement without coupled loads.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Also anticipate a movement in the incorrect direction or oscillation of the drive.
- Make sure that the system is free and ready for the motion before starting the function.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Now the device can be set to operating status 6 "Operation Enable" with the commissioning software. In this operating status the power amplifier of the device is active. This is done with the "Enable" switch. For more information on enabling or disabling the power amplifier see the product manual of the device.

Operating status 6 "Operation Enable" is the prerequisite for running the functions of the commissioning software.

5.4.2 Operating modes

Use menu item "⇒ Functions ⇒ Operating modes..." to call the "Operating modes" function.

The various operating modes can be selected from the tabs in the operating modes window.

The window has two sections:

- tab for the selected operating mode and for setting specific parameters (top section)
- display of some status information (bottom section)

The user can switch between the tabs in the operating modes window without interfering with a currently active operating mode.

Device monitoring

During movement mode the data link to the device is periodically monitored. If the connection between the PC and device is cut, the motor stops within the cycle time.

The commissioning software can also not be exited during the movement mode.



All operating modes are described in detail in the product manuals. Therefore this documentation does not describe the details of the operating modes.

Profile position

In profile position operating mode a movement with an adjustable travel profile is run from a start position to a target position. The value of the target position can be given as either a relative or an absolute position.

A movement profile can be set with values for acceleration and deceleration ramps and final speed.

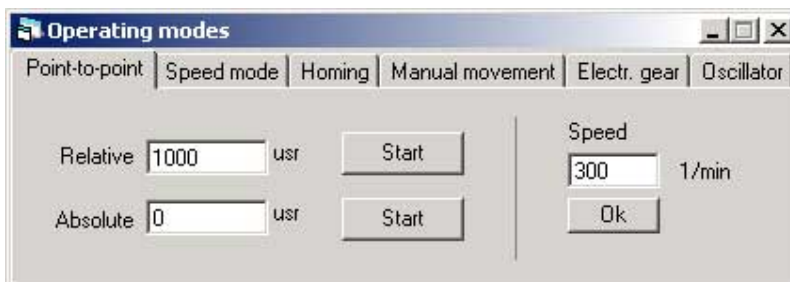


Figure 5.7 Profile position operating mode

Profile velocity In the profile velocity operating mode it is accelerated to an adjustable setpoint speed. A movement profile can be set with values for acceleration and deceleration.

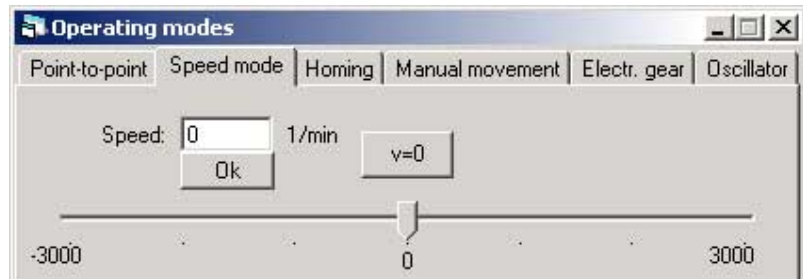


Figure 5.8 Profile velocity operating mode

Homing In homing mode, an absolute scale reference of the motor position at a defined axis position is established. Homing can be carried out by a reference movement or by dimension setting.

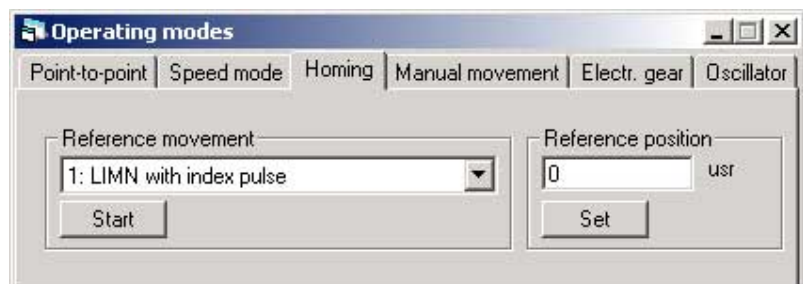


Figure 5.9 Homing tab

Jog The motor is switched between slow or fast manual speed with the buttons. The movement continues only while the button is enabled. When the button is released the motor is braked to standstill.

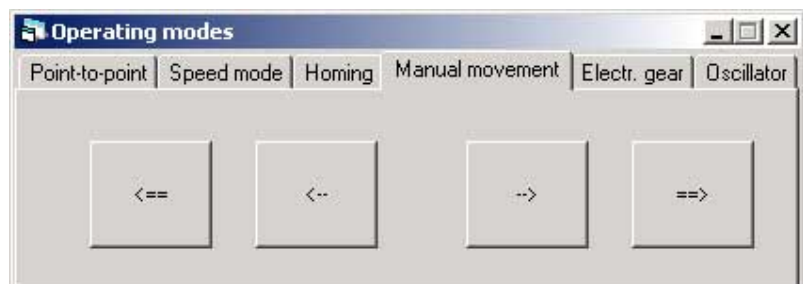


Figure 5.10 Jog operating mode

Electronic gear In the electronic gear operating mode reference signals are fed in as A/B signals or as pulse/direction signals. They are offset to a new position reference value with an adjustable gear ratio.

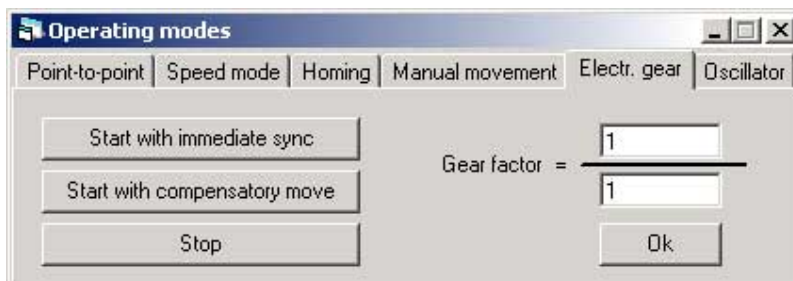


Figure 5.11 Electronic gearbox operating mode

Oscillator

⚠ WARNING!

Unexpected movement may cause injury and damage to the system.

In the operating mode an unknown voltage value at the analogue input may cause an unexpectedly high speed of rotation of the motor.

- When starting the operating mode note the voltage value at the analogue input.

Failure to follow these instructions can result in death, serious injury or equipment damage.

In the oscillator operating mode the motor is moved corresponding to a voltage-dependent speed default. There are two options:

- selection of the value directly in the window by input or the slide regulator
- selection via the analogue input ANA1. The voltage value can also be set the "inputs and outputs" window for this option.

The actual movement is started and stopped with the "Start" and "Stop" buttons.

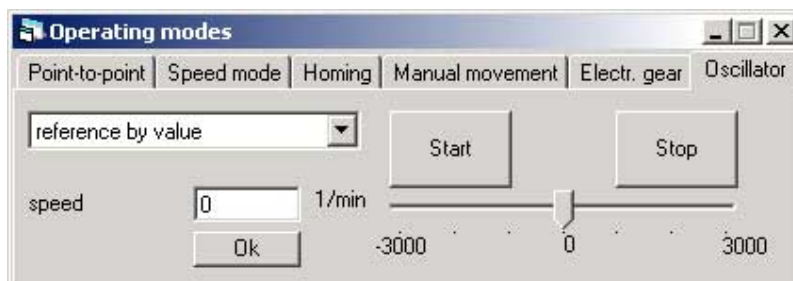


Figure 5.12 Oscillator operating mode

5.4.3 Recording and optimising

Introduction The commissioning software provides the "recording/optimising" function for visualising internal device data during movement mode. The connected device reads the travel data to an internal memory during a defined recording period and then sends it to the PC. In the PC the data are graphically processed and can be displayed as a graph or a table.

A recording can be saved on the PC, see Chapter 5.2.1 "Save file" and can be archived or printed for documentation.

Use the menu item "⇒ Functions ⇒ Record/Optimize..." to call the "recording" function.

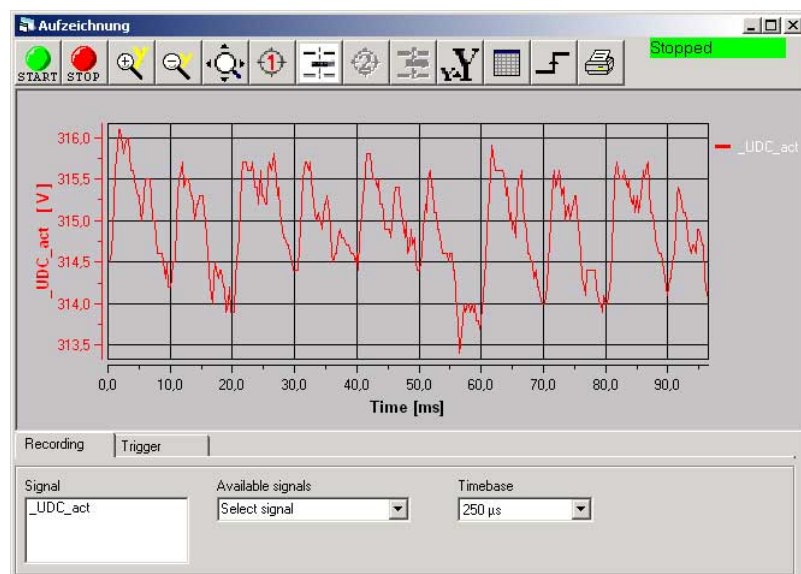


Figure 5.13 Recording

The recording window displays from top to bottom

- Buttons
- Graph with the recorded data
- Tabs for recording and trigger

Diagram A diagram is only shown if at least one signal was selected.

Each of the selected signals is shown in a distinct colour.

Buttons

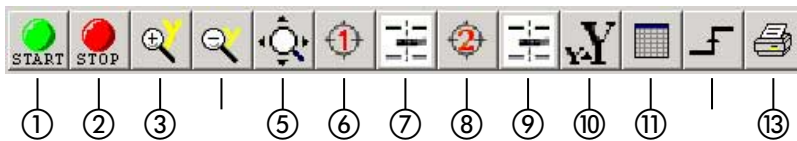


Figure 5.14 Buttons

- (1) Start recording
- (2) Stop recording
- (3) Magnify y-axis zoom
- (4) Reduce y-axis zoom
- (5) Infinite zoom of x-axis and y-axis
- (6) 1. Show values for a specific time
- (7) Switch value display for first display(x-value and y-value, x-value, y-value, period, peak/peak value)
- (8) 2. Show values for a specific time
- (9) Switch value display for second display(x-value and y-value, x-value, y-value, period, peak/peak value)
- (10) Reset zoom
- (11) Display recorded values as table
- (12) Hide or show configuration
- (13) Print recording

"Recording" tab The desired recording is configured in the "Recording" tab.



Figure 5.15 Recording tab

The desired signal is selected in the "Available Signals" input field. A maximum of 4 signals can be selected. If a signal is no longer required, it can be deselected by a double-click on the name of the signal.

The desired recording increment is select in the "Time base" input field.

"Trigger" tab The desired triggering for the recording is configured in the "Trigger" tab.

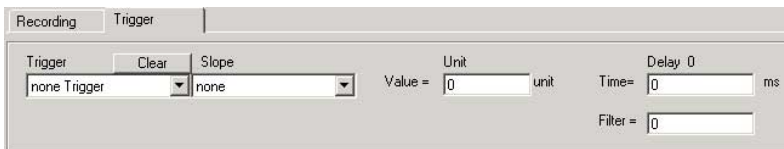


Figure 5.16 Trigger tab

Start recording The desired recording is started with the "Recording" button.

After recording the data are sent to the PC. Then they are graphically processed.

5.4.4 Inputs and outputs

⚠ WARNING!

Risk of injury and damage to system components!

Changing the settings may cause unpredictable motor movements.

- Only changes settings if the motor can be operated without danger.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The "inputs and outputs" function is used for monitoring and display of the analogue and digital inputs and the digital outputs.

Use menu item "⇒ Functions ⇒ Inputs+outputs..." to access the "inputs and outputs" function.

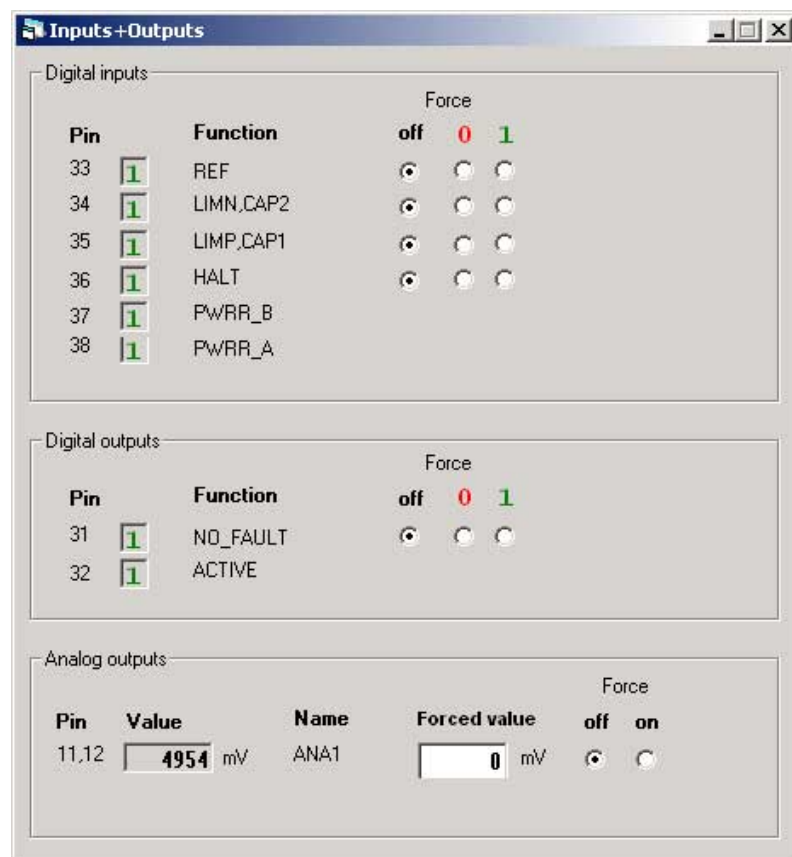


Figure 5.17 Inputs and outputs

Forcing The "Forcing" function offers the option of setting specific digital inputs, specific digital outputs and the voltage at the analogue inputs directly. The actual pending signal is disabled during this process. For example, this option can be used to apply the specified voltage via the analogue input in "Oscillator" mode.

5.5 Diagnostics

BLCT places diagnostic functions and information on error detection and error evaluation in various windows.

5.5.1 Device information

Information on the device is displayed with the menu item "⇒ Diagnostics ⇒ Device info...".

Important data for diagnostics and service, such as device type or serial number, can be found in this information.

5.5.2 Error memory

The error memory is opened with the menu item "⇒ Diagnostics ⇒ Error memory...".

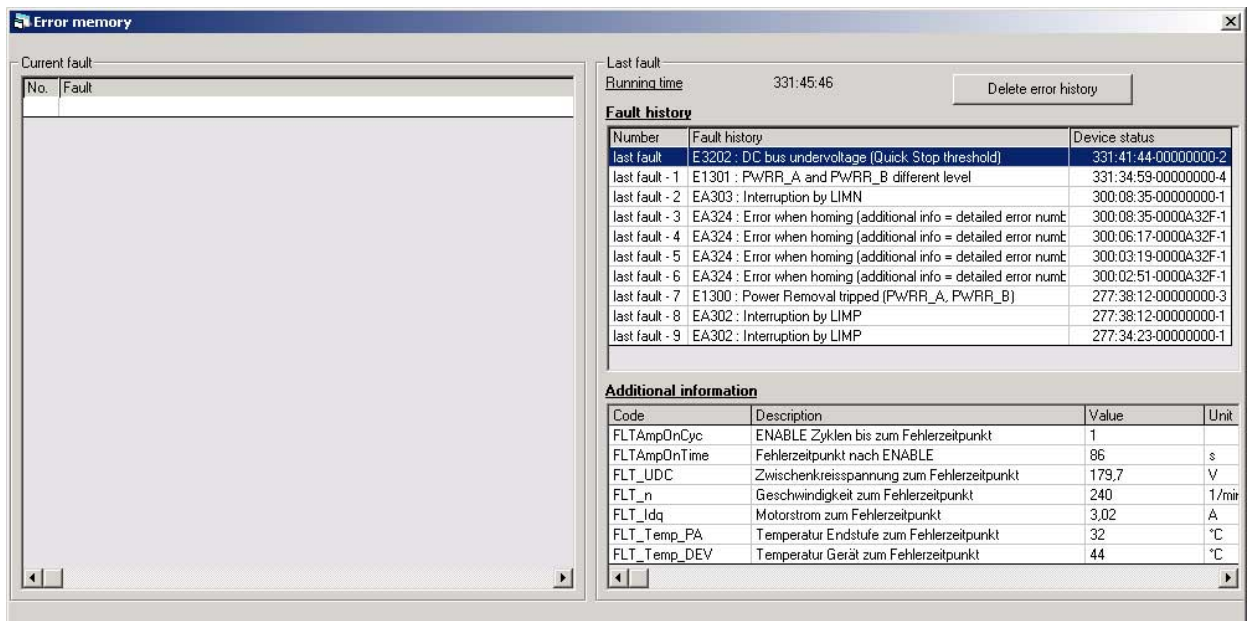


Figure 5.18 Output of error memory

Current error The current error, e.g. limit switch (LIMP/LIMN/REF), is output in the left section.

Last error The current hour meter and the error messages are output in the right section.

The "error history" list shows the error messages in chronological order. The "device status" column consists of:
(error time)-(detailed error number)-(error class)

The "additional information" list shows additional information on the error for every error message.

Erase error memory Use the menu item "⇒ Diagnostics ⇒ Delete error memory..." and the button "Delete error memory" to delete the "error history" list.

5.5.3 Observe parameter

Selected parameters of the device can be observed with the menu item "⇒ Diagnostics ⇒ Object monitoring...".

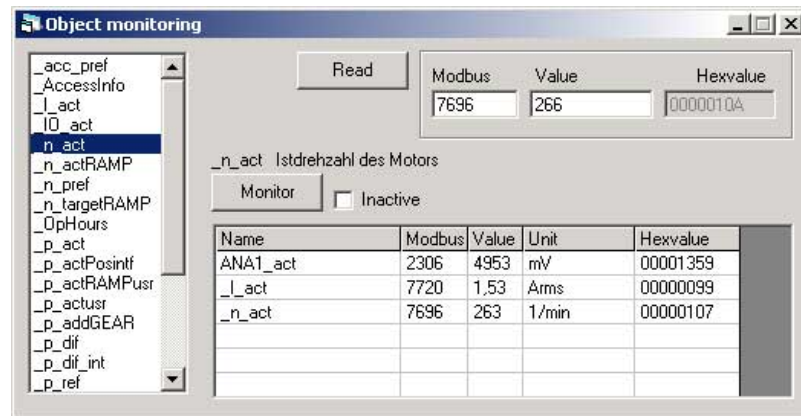


Figure 5.19 Observe parameter

The parameter for observation is selected in the list. The selected parameter is added to the table with the "Monitor" button. Multiple parameters can be added to the table and observed.

A parameter can also be observed by input of the Modbus address. The momentary value is output directly in the value field.

6 Diagnostics and troubleshooting

6.1 Error display

Overview The commissioning software shows diagnostic functions and information on error detection in various windows or parts of windows:

- Diagnostic functions for the device
⇒ Diagnostics ⇒ Device info (see 5.5.1 "Device information")
- Error message for the device
⇒ Diagnostics ⇒ Error memory (see 5.5.2 "Error memory")
- Monitoring parameters
⇒ Diagnostics ⇒ Object monitoring (see 5.5.3 "Observe parameter")
- Error message in the toolbar which is permanently displayed in the active window.

Error display The cause of a breakdown is displayed:

- On the device with the device-specific equipment, e.g. LED or segment displays
- By the error response of the device
- In the commissioning software as an error message in the toolbar and the last error message in the error memory

The error messages in the toolbar are output with the specific error number with additional information in the grey field below.

Resetting error messages The additional information can be deleted by double-click, but will remain available in the error history.

The error status can be reset with the "Reset" button after the cause of the error has been corrected.

7 Glossary

7.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 metres [m] to yards [yd]
 $5 \text{ m} / 0.9144 = 5.468 \text{ yd}$

7.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

7.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559 \cdot 10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559 \cdot 10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

7.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807 \cdot 10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100 \cdot 10^3$
N	/ 4.448222	/ 0.27801	/ $9.807 \cdot 10^{-3}$	* $100 \cdot 10^3$	-

7.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

7.1.5 Rotation

	1/min (RPM)	rad/s	deg./s
1/min (RPM) -		$* \pi / 30$	$* 6$
rad/s	$* 30 / \pi$	-	$* 57.295$
deg./s	/ 6	/ 57.295	-

7.1.6 Torque

	lb-in	lb-ft	oz-in	Nm	kp-m	kp-cm	dyne-cm
lb-in	-	/ 12	$* 16$	$* 0.112985$	$* 0.011521$	$* 1.1521$	$* 1.129*10^6$
lb-ft	$* 12$	-	$* 192$	$* 1.355822$	$* 0.138255$	$* 13.8255$	$* 13.558*10^6$
oz-in	/ 16	/ 192	-	$* 7.0616*10^{-3}$	$* 720.07*10^{-6}$	$* 72.007*10^{-3}$	$* 70615.5$
Nm	/ 0.112985	/ 1.355822	/ 7.0616*10 ⁻³	-	$* 0.101972$	$* 10.1972$	$* 10*10^6$
kp-m	/ 0.011521	/ 0.138255	/ 720.07*10 ⁻⁶	/ 0.101972	-	$* 100$	$* 98.066*10^6$
kp-cm	/ 1.1521	/ 13.8255	/ 72.007*10 ⁻³	/ 10.1972	/ 100	-	$* 0.9806*10^6$
dyne-cm	/ 1.129*10 ⁶	/ 13.558*10 ⁶	/ 70615.5	/ 10*10 ⁶	/ 98.066*10 ⁶	/ 0.9806*10 ⁶	-

7.1.7 Moment of inertia

	lb-in ²	lb-ft ²	kg-m ²	kg-cm ²	kp-cm-s ²	oz-in ²
lb-in ²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	$* 16$
lb-ft ²	$* 144$	-	$* 0.04214$	$* 421.4$	$* 0.429711$	$* 2304$
kg-m ²	$* 3417.16$	/ 0.04214	-	$* 10*10^3$	$* 10.1972$	$* 54674$
kg-cm ²	$* 0.341716$	/ 421.4	/ 10*10 ³	-	/ 980.665	$* 5.46$
kp-cm-s ²	$* 335.109$	/ 0.429711	/ 10.1972	$* 980.665$	-	$* 5361.74$
oz-in ²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

7.1.8 Temperature

	°F	°C	K
°F	-	$(°F - 32) * 5/9$	$(°F - 32) * 5/9 + 273.15$
°C	$°C * 9/5 + 32$	-	$°C + 273$
K	$(K - 273.15) * 9/5 + 32$	$K - 273.15$	-

7.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm ²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

7.2 Terms and Abbreviations

<i>Asynchronous error</i>	Error detected and reported by the internal controller monitoring equipment.
<i>Default value</i>	Factory settings.
<i>Direction of rotation</i>	Rotation of the motor shaft in a positive or negative direction of rotation. A positive direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.
<i>DOM</i>	(Date of manufacturing) , the nameplate of the device shows the date of manufacture in the format DD.MM.YY, e.g. 31.12.06 (31. December 2006).
<i>LED</i>	Light-Emitting Diode
<i>Limit switch</i>	Switch that signals an overrun of the permissible travel range.
<i>Node Guarding</i>	Monitoring function with slave at an interface for cyclic communication.
<i>Parameter</i>	Device functions and values that can be set and called by the user.
<i>Power amplifier</i>	A device that generates current for controlling the motor in accordance with the positioning signals from the controller.
<i>RS485</i>	Fieldbus interface compliant with EIA-485, which enables serial data transmission with multiple devices.
<i>Synchronous errors</i>	Error reported by the controller if it is unable to execute a command sent by the master.

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