

## Technical Documentation

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Functional expansion 2003

**TLCxxx, TLD13x**

Operating system:

Order no.: -

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## Conventions and symbols

*Instructions for use* Introduction to the following steps

- ▶ This the 1st work step
- ◀ This is the response to the 1st work step
- ▶ This is the 2nd work step
- ◀ This is the response to the 2nd work step

Operating instructions consist of an introduction and the actual operational steps.

Unless otherwise specified, the individual operational steps must be executed in the specified sequence.

If there is a significant response to an operational step, this response will be described after the operational step. This enables the correct execution of the operational step to be checked.

*List symbol* Note on the content of the list

- 1st list item
- 2nd list item
  - 1st list subitem
  - 2nd list subitem
- 3rd list item

The actual list, which can consist of one or two levels, follows a note on the content of the list.

The list items are sorted alphanumerically or by priority.

*User notes* The user notes contain general information, not safety instructions.



*This contains additional information on the current subject.*

See the Safety chapter for an explanation of the safety instructions.

*Parameter* Parameter are shown as follows:

Group.Name Index:Subindex



# 1 Introduction



*This document is a supplement to the controller documentation and must only be used as part of it.*

As part of the continuing development of the Twin Line products, the functions of the TLCxxx and TLD13x units have been extended. The following functions have been added during the extension process:

<b>Function</b>	<b>Function available</b>	<b>See page</b>
Commutation monitoring	TLD13x, TLCx3x	Chap. 3-1
Setting parameters of ESIM resolution	TLD13x, TLCxxx	Chap. 3-3
REF_OK status info over output	TLC4xx	Chap. 3-5
Disabling position control at M1	TLCx3x	Chap. 3-5
Reference movement to index pulse during M1 position control	TLCx3x	Chap. 3-6
Flag access over PDO channel	TLC6xx	Chap. 3-8
StopMotion	TLCxxx	Chap. 3-9



## 2 Safety

### 2.1 Qualifications of personnel

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

The technicians must also have the technical training, knowledge and experience to be able to assess the work assigned to them.

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

### 2.2 Intended use

Berger Lahr drive systems are products intended for general use that conform to the state of the art in technology and are designed to eliminate dangers as much as possible. However, drives and drive controllers that are not specifically designed for safety engineering functions are general engineering equipment that is not approved for applications in which the drive functions could endanger persons. Unexpected or unbraked movements can never be completely excluded without additional safety equipment. For this reason no person should be in the danger zone of the drives unless additional suitable safety equipment is installed to prevent danger to persons. This is applicable for the machine in production operation and for all repairs and maintenance work on drives and machine. The machine must be designed to ensure personal safety. Suitable precautions must also be taken to prevent property damage.

In the system configuration described the drive systems must only be installed in an industrial environment with a fixed connection.

The applicable safety regulations and the specified operating conditions, such as environmental conditions and specifications, must be observed.

The drive systems may be commissioned and operated only after installation in accordance with EMC requirements and the product-specific specifications.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications to the drive systems are not permitted and will render all warranties and liability null and void.

The drive system must be operated only with the specified cables and approved accessories. Use original spare parts whenever possible.

Operation of the drive systems outside the described and specified limit values is not designated use.

## 2.3 Hazard categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions affixed to the product that warn of possible hazards and help to operate the product safely.

Depending on the seriousness of the hazard, the messages are divided into three hazard categories.



### **DANGER!**

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.



### **WARNING!**

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.



### **CAUTION!**

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

## 2.4 Safety instructions



### **WARNING!**

**Danger of injury and damage to system components by loss of control!**

- The system manufacturer must consider the possible errors that could occur with the signals and in particular the critical functions to ensure a safe status during and after errors. Critical functions include emergency stop and limiting end positions. Observe the accident prevention regulations
- Consideration of possible errors must include unexpected delay and failure of signals or functions
- Separate redundant controller paths must be provided for critical functions.

**DANGER!****Electric shock, fire or explosion**

- 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.
- Before working on the drive system:
  - Switch off power to all terminals.
  - Place a sign "DO NOT SWITCH ON" on the switch and lock to prevent switching on.
  - **Wait 6 minutes** (discharge of DC bus capacitors).
  - Measure voltage between DC+ and DC- and check for <48V. (The DC bus LED is not a safe indication for absence of the DC bus voltage).
- Do not short-circuit DC bus or touch unshielded components or screws of the terminals under voltage.
- Install all covers and close the housing doors before applying power.
- The motor generates voltage when the shaft is rotated. Lock the shaft of the motor to prevent rotation before starting work on the drive system.
- The system manufacturer is responsible for compliance with all applicable regulations relevant to earthing the drive system.
- Do not reach into the drive system (e.g. no pointed objects).



## 3 Extended functions

### 3.1 Commutation Monitoring

*Availability* This extended function is available in the TLD13x and TLCx3x units from:

- TLD13x from software version 1.020
- TLC43x from software version 1.006
- TLC53x from software version 1.205
- TLC63x from software version 1.102

*Functional principle* Twin Line servo units in position and speed control mode continuously check the plausibility of motor acceleration and effective motor torque to detect and if necessary prevent uncontrolled motor movements. The monitoring function is referred to as commutation monitoring.

If the motor accelerates over a period of over 5 to 10 ms although the TL drive controller is decelerating the servo motor with the maximum specified current, the commutation monitoring detects an uncontrolled motor movement.

In this case the drive controller reacts to this error with an error reaction in accordance with error class 4. The 7-segment display shows a flashing "c".

*Causes of error* Uncontrolled motor movements result from the following causes:

- Motor phases U, V, W have been incorrectly connected to the TL unit by being offset by 120°, i.e. motor phase U is connected to TL terminal V, motor phase V to TL terminal W and motor phase W to TL terminal U.
- Defective or faulty capture of the rotor position as a result of a defective position sensor on the motor, faulty sensor signals or defective position capture in the TL unit

The TL drive controller can also detect a commutation error in the following cases, because the plausibility conditions described above may also occur:

- The motor receives an external torque that is greater than the specified maximum torque. The external force causes it to accelerate.
- The motor is rotated manually against the motor torque with drive control active.
- The motor is moved to a mechanical stop.
- Speed or position control loop is set with extreme instability.

*Parameter setting***WARNING!**

**Danger of injury and damage to system components by unexpected movement!**

Disabling monitoring functions increases the risk of an unexpected movement.

- Use the monitoring functions.

For exceptional circumstances commutation monitoring can be switched off with the parameter `Setting.CommutChk 28:28=1`. Use the commutation monitoring whenever possible.

### 3.2 Setting parameters of the ESIM resolution

<i>Availability</i>	This extended function is available in the TLD13x and TLCx3x units from: <ul style="list-style-type: none"> <li>• TLD13x from software version 1.020</li> <li>• TLC41x and TLC43 from software version 1.006</li> <li>• TLC51x from software version 1.106</li> <li>• TLC53x from software version 1.205</li> <li>• TLC61x and TLC63x from software version 1.102</li> </ul>
<i>Revision status of ESIM module</i>	Setting the resolution via a parameter is only available if the revision status of the ESIM module is greater than or equal to RS03.
<i>Reference to controller documentation</i>	Case 1: TLD13x units: For complete information on these units see the controller documentation in Chapter 4.4.13, "Connection to the ESIM1-C and ESIM2-C modules".  Case 2: TLCxxx units: For complete information on these units see the controller documentation in Chapter 4.4.13, "Connection to the ESIM3-C module".
<i>Reading out the revision status</i>	The revision status of an ESIM module can be read with TLCT using the function "Twin Line - Diagnostics - Unit hardware - Installed modules". In the TLD13x units the identification is found under module slot M4, and in the TLCxxx units under module slot M3.  The following table describes the connection between the parameterised resolution and the output increments per motor revolution with quadruple evaluation of the A/B signal depending on the motor type in use.
<i>Resolution of stepper motor and servo motor</i>	The resolution can only be set in connection with servo motors from serial number 11.....

Parameter value	Stepper motor TLCx1x	Servo motor TLD13x, TLCx3x
0 (default)	4000	4096
1	2000	2048
2	1000	1024
3	500	512
4	250	256
5	125	128

### 3.2.1 Setting parameters in TLD13x units

Settings with ESIM-1 or ESIM-2 module (slot M4)

The parameter is only available if an ESIM module has been installed in this module slot.

Parameter		Meaning and unit []	Value range	Default	R/W	
Name	Idx:Sidx	TL-HMI		Value	rem.	
M4.EsimResol	24:44	-	Encoder simulation: setting resolution [Inc/rev]	UINT16 0...5 resolution setting: 0: 4096 (default) 1: 2048 2: 1024 3: 512 4: 256 5: 128	0	R/W rem.

### 3.2.2 Parameter setting with TLC units

Settings with the ESIM-3 module (TLCxxx, slot M4)

The parameter is only available if an ESIM module of the required revision status has been installed in this module slot.

Parameter		Meaning and unit []	Value range	Default	R/W	
Name	Idx:Sidx	TL-HMI		Value	rem.	
M4.EsimResol	23:22		Encoder simulation: setting resolution [Inc/rev]	UINT16 0...5 resolution setting: Stepper motor / AC servo 0: 4000 / 4096 (default) 1: 2000 / 2048 2: 1000 / 1024 3: 500 / 512 4: 250 / 256 5: 125 / 128	0	R/W rem.

### 3.3 REF\_OK status info via output

<i>Availability</i>	The function extension in the TLC41x and TLC43x units is available from software version 1.006
<i>Reference to the controller documentation</i>	For detailed information see the controller documentation in Chapter 7, section "Meaning of inputs and outputs".  The output assignment depends on the IO mode and can be found there in the table at IO-Mode=2.
<i>Function</i>	The status information REF_OK is output over an output in addition to the output in the status.  During control via the inputs/outputs (IO_Mode=2) in error-free status (NO_AXIS_ERR =1) an indication of whether the controller has a valid reference or not is output via the Q4:DETAIL_3 output.  The output status REF_OK corresponds in the status word Status.driveStat to the "drive referenced (ref_ok)" status reported via bit 22.

### 3.4 Disabling position control at M1

<i>Availability</i>	This extended function is available in the TLCx3x units: <ul style="list-style-type: none"> <li>• TLC43x from software version 1.006</li> <li>• TLC53x from software version 1.205</li> <li>• TLC63x from software version 1.205</li> </ul>
<i>Reference to controller documentation</i>	For detailed information on these units see the controller documentation in Chapter 7, section "Position control with additional incremental encoder at M1".
<i>Function</i>	With position control at M1 a continuous comparison is made between the motor position (sensor module, slot M2) and the measured direct position (sensor module, slot M1), which is used for position control. With a mechanical coupling between the sensors of the two position values this check represents a safety function, for example against failure of a RS422 sensor track connected to M1.  If the user consciously disconnects the mechanical coupling with the power amplifier active and a movement is run at only one sensor unit, this movement causes a monitoring error.  After switching the power amplifier to inactive status the monitoring is switched off. When the power amplifier is activated again, a position comparison is run between the two sensors and the monitoring is re-activated.

### 3.5 Reference movement to index pulse with external position control at M1

*Availability* This extended function is available in the TLCx3x units:

- TLC43x from software version 1.006
- TLC53x from software version 1.205
- TLC63x from software version 1.205

*Reference to controller documentation* For detailed information see the controller documentation in Chapter 6, section "Referencing".

*Functions* The processing sequence is run in the same way as the reference movement to index pulse with the stepper motor.

First, the defined reference switch is approached and finally a search movement is made to the nearest physical index pulse.

#### 3.5.1 Start of referencing mode

The reference movements are enabled via the existing selection in the action object `Home.startHome 40.1=1` or in TLCT via selection of the reference movement in the "Referencing" dialog.

If the position control at M1 is activated, the index pulse reference movement is made to the physical index pulse of the position encoder at M1, in the other case to the virtual index pulse with reference to the motor position encoder at M2.

Parameter	Meaning and unit []	Value range	Default-Value	R/W
Name	Idx:Sidx TL-HMI		Value	rem.
Home.startHome 40:1	Start of referencing mode Action object: A write access triggers a referencing	UINT16 1...8 1: LIMP 2: LIMN 3: REFZ neg. direction of rotation 4: REFZ pos. direction of rotation 5: LIMP with index pulse 6: LIMN with index pulse 7: REFZ neg. direction of rotation with index pulse 8: REFZ pos. direction of rotation with index pulse		R/W

#### 3.5.2 Search range for index pulse at position sensor M1

The search range between reference switch edge and index pulse signal can be set with a new user parameter. The default setting is a search range of +2147483647 increments. After leaving the reference or limit switch at which the reference movement was triggered, it waits for an index pulse within the configured range. If it does not occur, the reference movement is interrupted with an error.

The parameter is available only if slot M1 has an RS422 module and the external position control is activated at M1.

The description applies for position control at M1.

Parameter		Meaning and unit []	Value range	Default	R/W
Name	Idx:Sidx TL-HMI			Value	rem.
Home.p_SrchIdx	40.12	Index pulse search range with position control at M1 Only used with referencing at index pulse if the position control is installed at M1. Unit: Inc	INT32 1...2147483647	2147483647	R/W

Note: The nearest index pulse is always approached after leaving the limit or reference switch.

An absolute position is not calculated on the basis of a distance evaluation on measuring systems with multiple reference flags at slightly different distances.

### 3.6 Flag access via PDO channel

<i>Availability</i>	The function extension is available in the TLC6xx units <ul style="list-style-type: none"><li>• TLC61x from software version 1.102</li><li>• TLC63x from software version 1.102</li></ul> with control via CANopen (CAN-C module).
<i>Reference to controller documentation</i>	For detailed information see the CANopen documentation, Chapter 3, "CANopen communication".
<i>Function</i>	<p>The flag words available for CoDeSys can now also be accessed over the PDO channel. They can be accessed in the input direction only (RPDO), in the output direction only (TPDO) and also in both directions.</p> <p>The internal controller flag words 1 to 255, all 32 bits long, can be mapped to the PDO as 8, 16 or 32-bit values. The lowest-value bits are used for the 8 to 16-bit data type settings.</p> <p>The existing EDS file has been extended for the accesses to the flag ranges. When configuring with the EDS file only flag words 100...109 are available as RPDO or flag words 100...119 as TPDO. The data type of the individual entries is set to 32 bits.</p>

### 3.7 StopMotion

*Availability* This extended function is available in the TLCxxx units:

- TLC41x and TLC43x are available from software version 1.006
- TLC51x from software version 1.106
- TLC53x from software version 1.205
- TLC61x and TLC63x from software version 1.102

*Reference to controller documentation* For detailed information see the controller documentation in Chapter 8, section "Operating displays and transitions".

*Function* The user can interrupt a running movement with `StopMotion`. The movement is interrupted without interpretation of an error in the controller, i.e. there is no error reaction instead of as with , e.g., an interruption using "Stop (QuickStop)" in the control word `Commands.driveCtrl`.

The following requirements identify the special process:

- It is controlled via bit 5=1 in the control word `Commands.driveCtrl`
- There is no error entry in the error memory
- The status remains at "Operation Enable"
- The standstill is reported in `Status.driveStat` via bit14:`x_end` is equal to 1. The same reaction as that to a normal movement end is received. Via Bit13 (`x_add_info: "setpoint position reached"`) in `Status.driveStat` can e.g. be detected in PTP mode whether the setpoint position of the profile generator has been reached or not. The reaction in the various operating modes can be found in the table below.
- The deceleration always runs via the normal ramp (TLCx1x) or the torque ramp (TLCx3x) using the setting of the "default current" in `CtrlBlock1.I_max` or `CtrlBlock2.I_max`.
- The axis mode is retained.
- A new operating mode can only be enabled after standstill.

After interruption of a manual or reference movement with `StopMotion` the operating mode cannot be continued at a random interruption point. Only the processing of the movement sequence can be restarted from scratch.

### 3.7.1 Control word for state change

Parameter		Meaning and unit []	Value range	Default	R/W	
Name	Idx:Sidx	TL-HMI		Value	rem.	
Commands.driveCtrl	28.11		Control word for status change Write access triggers processing of the status machine	UINT 16 0...15 Bit 0: Disable power amplifier Bit 1: Enable power amplifier Bit 2: Stop (QuickStop) Bit 3: FaultReset Bit 4: QuickstopRelease (TLC units only, internal accesses only) Bit 5: StopMotion (TLC units only) Bit 6...15: not assigned	0	R/W

### 3.7.2 Reactions on movement interruption by StopMotion

The information in the table below applies for achieved standstill.

Operating mode	x-add-info	Remarks
PTP	0	Special case: if the movement interruption only occurs in the normal deceleration phase, "setpoint position reached" is set on drive standstill.
VEL	0	
data set processing	0	Special case for PTP data set: if the movement interruption only occurs in the normal deceleration phase, "setpoint position reached" is set on drive standstill.
Current control	1	curr_ctrl_nact_zero indicates that the drive is at standstill/ corresponds to the reaction on processing without "StopMotion".
Oscillator mode	0	
Electric gear <sup>1)</sup>	-	On offset positioning the bit "Offset setpoint position reached" is not set.
Reference movement <sup>1)</sup>	-	Identifier "ref_ok" is not set
Manual movement <sup>1)</sup>	-	
CAM <sup>1)</sup>	-	

<sup>1)</sup> In these operating modes x\_add\_info has no meaning, 0 is always output as value.