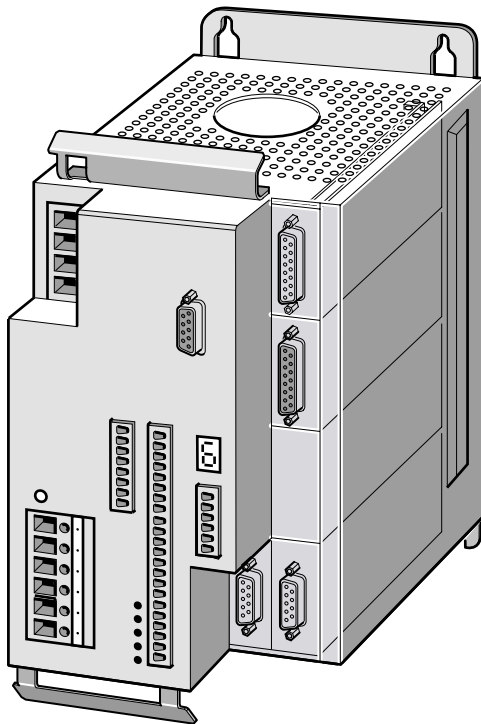


Technical documentation



Twin Line Controller 51x

Positioning controller for stepper motors

TLC51x

Operating system 1.1xx

Order No.: 9844 1113 117

Edition: c325, 11.00

A product from:

SIG Positec BERGERLAHR
GmbH & Co. KG

Breslauer Str. 7
D-77933 Lahr

Tel. +49 (0) 7821 946 01
Fax +49 (0) 7821 946 313

<http://www.sig-berger.de>

Twin Line

Advice, Service and Sales:

SIG Positec Automation GmbH

Breslauer Str. 7
D-77933 Lahr

Tel. +49 (0) 7821 946 02
Fax +49 (0) 7821 946 220

<http://www.sig-positec.de>

Table of Content

Glossaries	V-5
Abbreviations	V-5
Product name	V-5
Technical Terms	V-6
Written conventions and note symbols	V-8
1 The positioning controller	1-1
1.1 Scope of supply	1-1
1.2 Documentation and literature	1-5
1.3 Unit series	1-6
1.4 Unit overview	1-8
1.5 Modules of the positioning controller	1-10
1.6 Module configuration, operating modes and functions	1-11
1.7 Guidelines and standards	1-13
1.7.1 Declaration of conformity and CE labelling	1-13
1.7.2 Regulations and standards	1-15
2 Safety	2-1
2.1 Danger categories	2-1
2.2 Safety instructions	2-1
2.3 Use for the purpose intended	2-2
2.3.1 Ambient conditions	2-2
2.3.2 Intended use	2-2
2.4 Qualification of the personnel	2-3
2.5 Safety devices	2-3
3 Technical data	3-1
3.1 Mechanical data	3-1
3.1.1 Positioning controller TLC51x	3-1
3.1.2 positioning controller TLC51xP	3-2
3.1.3 Accessories for standard unit	3-3
3.2 Electronic data	3-4
3.2.1 Positioning controller	3-4
3.2.2 Modules	3-6
3.2.3 UL 508C certification	3-8
3.2.4 Accessories for standard unit	3-8

4	Installation	4-1
4.1	Electromagnetic compatibility, EMC	4-1
4.2	System components	4-4
4.3	Mechanical installation	4-5
4.3.1	Positioning controller TLC51x mounting	4-6
4.3.2	Mounting the positioning controller TLC51xP	4-7
4.3.3	Fitting the unit label	4-8
4.3.4	Installing accessories to the standard unit	4-9
4.3.5	Mounting version P accessories	4-10
4.4	Electrical installation	4-11
4.4.1	Electrical installation TLC51xP	4-12
4.4.2	Mains connection	4-14
4.4.3	Motor connection TLC51x	4-15
4.4.4	Motor connection with holding brake to TLC51xP	4-17
4.4.5	Connecting the 24 V supply voltage	4-18
4.4.6	Connection to the signal interface	4-19
4.4.7	Connection to the RS232 interface	4-26
4.4.8	Connection to the RS422-C module	4-27
4.4.9	Connection to the PULSE-C module	4-29
4.4.10	Connection to the RM-C module	4-32
4.4.11	Connection to the PBDP-C module	4-34
4.4.12	Connection to the CAN-C module	4-36
4.4.13	Connection to the RS485-C module	4-38
4.4.14	Connection to the IBS-C module	4-40
4.4.15	Connection of accessories to the standard unit	4-42
4.5	Wiring examples	4-44
4.5.1	Manual set-up and operation on the field bus	4-44
4.5.2	Operation via field bus, configuration via TL HMI or TL CT	4-47
4.5.3	Operation via field bus, field bus configuration via inputs	4-49
4.6	Function test	4-51
4.7	Installation troubleshooting	4-52
5	Commissioning	5-1
5.1	Commissioning procedure	5-1
5.2	Safety instructions	5-2
5.3	Commissioning tools	5-3
5.3.1	Overview	5-3
5.3.2	The Twin Line HMI hand-held operating unit	5-3
5.3.3	Operating software Twin Line Control Tool	5-5
5.4	Commissioning the positioning controller	5-7
5.4.1	Commissioning stages	5-7
5.4.2	Setting phase current and device parameters	5-7
5.4.3	Starting the positioning controller	5-8
5.4.4	Checking the limit switches	5-9
5.4.5	Checking the holding brake	5-9
5.4.6	Testing the motor under manual movement	5-10
5.4.7	Checking inputs and outputs	5-12
5.4.8	Optimizing the performance of the motor	5-15

6	Operating modes of the positioning controller	6-1
6.1	Changing the operating mode	6-1
6.1.1	Access channels	6-1
6.1.2	Access control for selecting operating mode or function	6-3
6.1.3	Selecting the operating mode	6-4
6.1.4	Monitoring the set operating mode	6-5
6.1.5	Status monitoring in movement mode	6-7
6.2	Manual movement	6-9
6.3	Speed mode	6-14
6.4	Point-to-point mode	6-15
6.5	Electronic gear	6-17
6.5.1	Gear settings	6-19
6.5.2	Synchronisation with compensatory movement	6-22
6.5.3	Offset positioning	6-23
6.6	Referencing	6-26
6.6.1	Reference movement	6-26
6.6.2	Dimension setting	6-30
7	Functions of the positioning controller	7-1
7.1	List control and list processing	7-1
7.2	Teach-in processing	7-7
7.3	Normalisation	7-10
7.3.1	User-defined units and normalisation factors	7-10
7.3.2	Setting normalisation factors	7-11
7.3.3	Residual value in user-defined normalisation	7-15
7.4	Ramp function	7-16
7.5	Quick-Stop function	7-18
7.6	Reversal of direction of rotation	7-19
7.7	Fast position capture	7-20
7.8	Monitoring functions	7-22
7.8.1	Monitoring of axis signals	7-22
7.8.2	Monitoring internal signals	7-25
7.9	Braking function with TL HBC	7-26
8	Diagnosis and error rectification	8-1
8.1	Operational status indicators and transitions	8-1
8.2	Error display and rectification	8-2
8.3	Malfunctions in movement mode	8-8
8.4	Table of error numbers	8-9
9	Service, Maintenance and Warranty	9-1
9.1	Service address	9-1
9.2	Shipping, storage and disposal	9-2

10 Accessories and spare part. 10-1

 10.1 List of accessories 10-1

 10.2 List of spare parts 10-2

 10.3 Suppliers 10-2

11 Unit label 11-1

 11.1 Illustration of the unit label 11-1

12 Parameters 12-1

 12.1 Overview 12-1

 12.2 Parameter groups 12-3

 12.2.1 Parameter group Settings 12-3

 12.2.2 Parameter group Commands 12-4

 12.2.3 Parameter group PA 12-4

 12.2.4 Parameter group Motion 12-5

 12.2.5 Parameter group Manual 12-6

 12.2.6 Parameter group VEL 12-6

 12.2.7 Parameter group PTP 12-7

 12.2.8 Parameter group Gear 12-7

 12.2.9 Parameter group Home 12-9

 12.2.10 Parameter group Teach 12-9

 12.2.11 Parameter group List 12-10

 12.2.12 Parameter group L1Data0..L1Data63 12-11

 12.2.13 Parameter group L2Data0..L2Data63 12-11

 12.2.14 Parameter group Capture 12-12

 12.2.15 Parameter group I/O 12-13

 12.2.16 Parameter group M1 12-14

 12.2.17 Parameter group M4 12-14

 12.2.18 Parameter group Status 12-15

 12.2.19 Parameter group ErrMem0..ErrMem19 12-20

Index A-1

Glossaries

Abbreviations

Abbreviation	Meaning
AC	Alternating current
ASCII	American Standard Code for Information Interchange
COS	Controller Operating System
DC	Direct current
E	Encoder
I/O	Inputs / output
EMV	Electromagnetic compatibility
EG	European Community
EU	European Union
RC	Residual current
HMI	Human-Machine Interface, plug-in hand-held operating unit
Inc	Increment
IT system	I: isolated; T: terre (Fr.), ground. System without potential to ground, not earthed
LED	Light-Emitting Diode
M	Motor
PC	Personal Computer
PELV	Protected Extra-Low Voltage
PLC	Programmable logic controller

Product name

Abbreviation	Product designation	Term used
TLC51x	Twin Line Controller 51xstandard unit	Positioning controller
TLC51xP	Twin Line Controller 51x version P	Positioning controller Protection grade IP54, second category industrial environment
TL HMI	Twin Line HMI	Human Machine Interface HMI
TL CT	Twin Line Control Tool	Operating Software
TL HBC	Twin Line Holding Brake Controller	Holding Brake Controller

Technical Terms

<i>Actual position of the drive system</i>	The actual position of the drive system gives the absolute or relative positions of moved components in the system.
<i>Actual position of the motor</i>	See Angular position of the motor
<i>Angular position of the motor</i>	The angular position of the motor corresponds to the angular position of the rotor in the motor housing, and refers to the zero point or index point of the position sensor.
<i>CAN-C</i>	Field bus module which connects the positioning controller to a CAN field bus. The selection of a field bus profile defines whether the device works with CAN bus, CANOpen or DeviceNet protocol.
<i>DC-line</i>	The DC-line generates the necessary direct current for operating the motor and provides the amplifier with the necessary energy. The DC-line acts as a buffer to energy fed back by the motor.
<i>Default values</i>	Preset values for the parameters of the Twin Line Unit before the first commissioning, factory settings
<i>Direction of rotation</i>	Rotation of the motor shaft in a clockwise or anticlockwise direction. A clockwise direction of rotation is given when the motor shaft rotates clockwise as the observer faces the end of the protruding shaft.
<i>Drive solution</i>	The drive solution comprises the drive system with its Twin Line Unit and motor, as well as the system mechanics forming an integral part of the chain of motion.
<i>Drive system</i>	The drive system consists of the Twin Line Unit and the motor.
<i>Electronic gear</i>	An input speed is recalculated by the Twin Line Unit using the values of an adjustable gear ratio to produce a new output speed for the motor movement.
<i>Encoder</i>	Sensor for recording the angular position of a rotating element. Mounted on the motor, the encoder signals the angular position of the rotor.
<i>Error class</i>	Reaction of the Twin Line Unit to an operational malfunction corresponding to one of five error classes
<i>Forcing</i>	To change signal states irrespective of the hardware switching status in the unit; with the control tool, for example. The hardware signals remain unchanged.
<i>High/open</i>	Signal status of an input or output signal; when no signal is present, signal voltage is high (high level).
<i>HMI</i>	Hand-held operating unit which can be plugged into the Twin Line Unit. HMI: Human-machine interface.
<i>I²t monitoring</i>	Predictive temperature monitoring. On the basis of the motor current, the expecting heating of unit components is calculated in advance. Should a limit value be exceeded, the Twin Line Unit reduces the unit current.
<i>IBS-C</i>	Field bus module which couples the positioning controller to an interbus field bus.
<i>Index-impuls</i>	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.
<i>Incremental signals</i>	Angular steps of an encoder in the form of square-wave pulse sequences. The pulses signal changes in position.
<i>Input device</i>	Input device is the device which can be connected to the RS232 interface for the purpose of commissioning; it is either the HMI hand-held operating unit or a PC with the Operating Software.

<i>Internal unit</i>	The actual position of the drive system gives the absolute or relative positions of moved components in the system.
<i>IT system</i>	Mains with no ground potential reference, since it is not grounded I: iso-lation ; T: terre (French): ground
<i>Limit switch</i>	Switches which signal any overrun on the permissible travel.
<i>Low/open</i>	Signal status of an input or output signal; when no signal is present, signal voltage is low (low level)
<i>Module code</i>	Internal electronic code (8 bit) which describes the hardware and the functionality of modules. This code is held in an EEPROM in every module.
<i>Node guarding</i>	Monitoring function at the RS232 interface
<i>Optically isolated</i>	Electrical transmission of signals with electrical isolation
<i>Parameter</i>	Device data and values which can be set by the user
<i>PBDP-C</i>	Field bus module with which the positioning controller can be integrated into a Profibus-DP network
<i>Power amplifier</i>	This is the unit that controls the motor. The power amplifier generates currents for controlling the motor in accordance with the positioning signals from the control unit.
<i>Power controller</i>	See Power amplifier
<i>Pulse direction signals</i>	Digital signals with variable pulse frequencies which signal changes in position and rotation direction via separate signal wires.
<i>Quick-stop</i>	This function is used in the event of faults, the stop command or in an emergency for rapidly braking a motor.
<i>RS232 interface</i>	Communications interface of the Twin Line unit for the connection of a PC or the HMI hand-held operating unit
<i>RS422-C</i>	The signal status is calculated from the differential voltage of one positive and one inverted negative signal. Two signal wires must therefore be connected for one signal.
<i>RS422 level</i>	The signal status is calculated from the differential voltage of one positive and one inverted negative signal. Two signal wires must therefore be connected for one signal.
<i>RS485-C</i>	Field bus module which enables the field bus to be used via a multipoint connection with serial data transmission. A multipoint connection - in contrast to a point-to-point connection - can swap data with several devices on the bus.
<i>RS485 level</i>	The signal status is calculated from the differential voltage of one positive and one inverted negative signal. Two signal wires must therefore be connected for one signal. RS485 signal transmission is bidirectional.
<i>Sense regulation</i>	The voltage drop on the supply lines is compensated in such a way that the output voltage at the sense terminals has the correct value. The output voltage is only activated once the sense lines have been connected.
<i>SMART</i>	Operating system software
<i>User units</i>	A user unit corresponds to the maximum precision at which a distance, speed or acceleration value can be input. User units can be set for all normalizable parameters.
<i>Watchdog</i>	Device in the unit which detects internal faults. If a fault occurs, the amplifier is switched off immediately.

Written conventions and note symbols

Action symbols „▶“ This action symbol is used for step-by-step instructions which can be carried out as they are described. If one of the instructions leads to a noticeable response from the unit, this will be given after the description of the action to be carried out. In this way you will receive direct confirmation that a particular step has been correctly carried out.

Enumeration symbol „•“ The enumeration symbol is used for listing individual points in a given information group in summary form. If the result of steps or sequences is described, the step to be carried out is described first.

Menu paths „→“ In the Twin Line Control Tool operating software an action is launched via 'Menu → Menu item → ...'. For example, 'File → Save' in the menu 'File'; under the menu item 'Save' saves data to the data storage medium.



This symbol is used for general notes which give additional information about the unit.



Passages which are preceded by this symbol may have to be discussed in more detail with SIG Positec's customer service. You will find contact addresses for SIG Positec under 'Service address', page 9-1.

1 The positioning controller

1.1 Scope of supply

- ▶ Check the parts supplied to make sure they are complete.

Keep the original packaging in case the unit has to be returned to the manufacturer to be added to or repaired.

Scope of supply of positioning controller standard unit

The scope of supply of the TLC51x positioning controller includes:

No.	Qty.	Designation	Order no.
1	1	TLC511, TLC512	type code
2	1	Hood for front cover	-
3	1 or 2	Shielding terminal SK 14 for motor connection (two shielding terminals in case of units without internal mains filter)	6250 1101 400
4	1	Connector mountings for the terminal strips	-
5	1	Documentation for the TLC51x	9844 1113 117

Modules Option module configurations for the positioning controller:

No.	Qty.	Designation	Order no.
6	1	Encoder module RS422-C or Pulse-/direction module PULSE-C	type code
6	1	Rotation monitoring RM-C	type code
6	1	Field bus module PBDP-C, CAN-C, RS485-C or IBS-C	type code

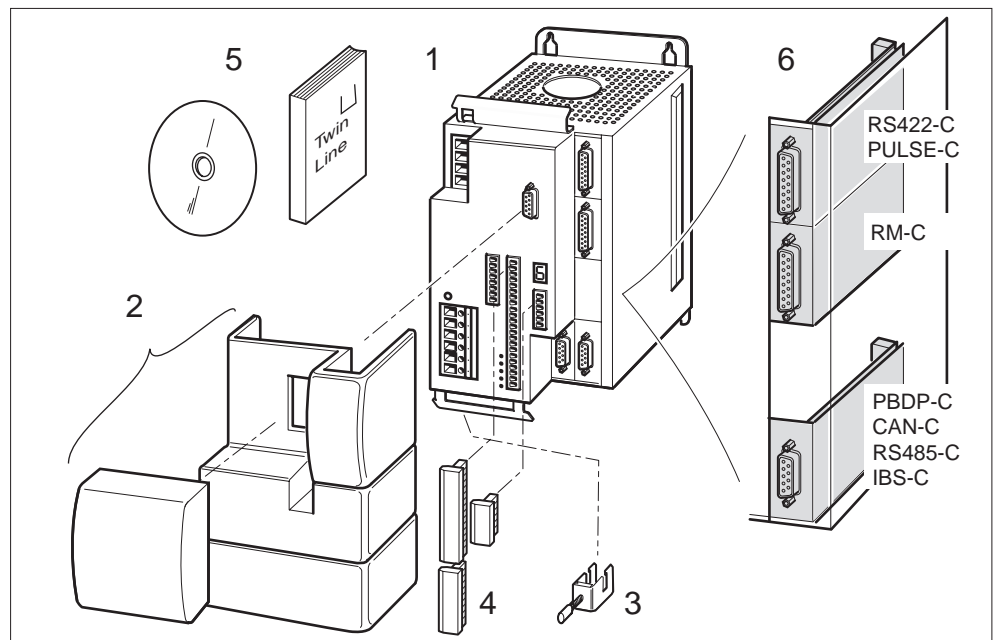


Fig. 1.1 TLC51x and modules

Scope of supply of positioning controller version P

The scope of supply of the TLC51xP positioning controller includes:

Item	Qty	Designation	Order Number
1	1	TLC511P, TLC512P	Type code
2	1	mains plug (round plug, 4-pin)	-
3	1	shielding terminal SK14 for motor connection	6250 1101 400
4	1	Sub-D cover for RS232 interface	-
5	1	Documentation on the &device type; on CD-ROM, multilingual	9844 1113 138
-	1	Built in holding brake controller HBC (optional)	type code

Modules Optional modules are identical with those of the standard unit.

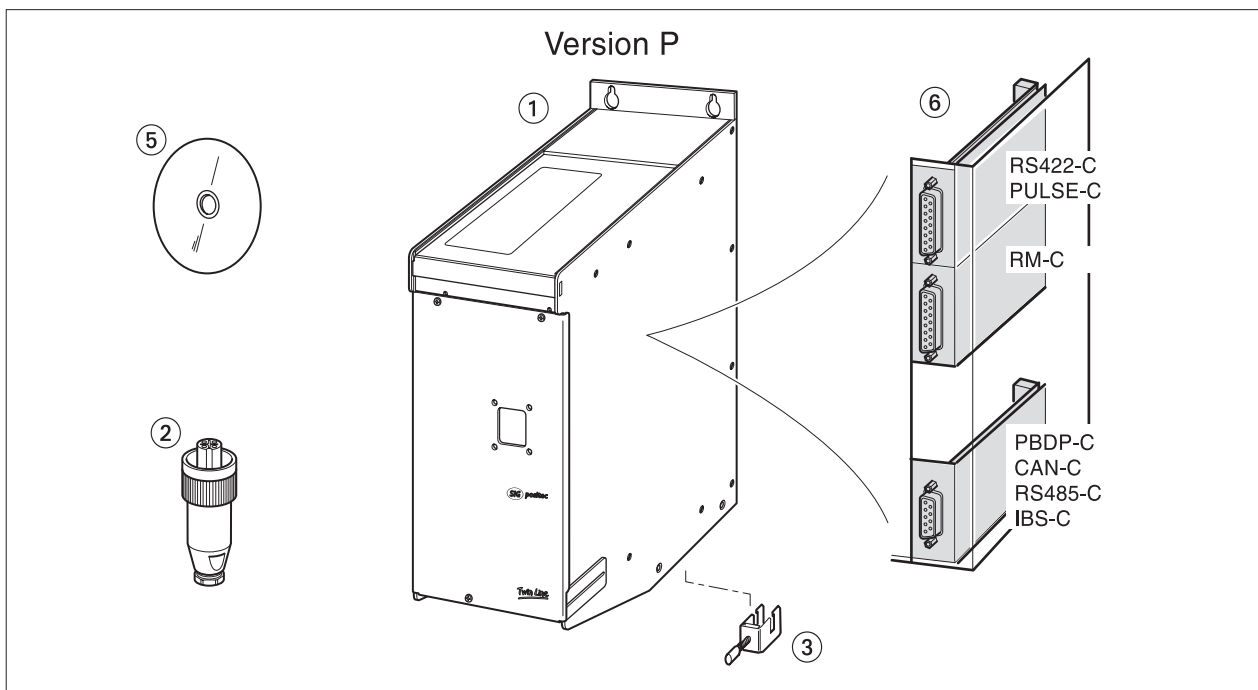


Fig. 1.2 TLC51xP and Modules

Accessories Accessories for the standard unit and for version P are:

Item	Qty	Designation	Standard unit/ version P (S/P)	Order Number
1	1	operating software with online documentation on data carrier, multilingual	S/P	6250 1101 803
2	1	hand-held operating unit HMI with manual	S/P	6250 1101 503
3	1	connector set for complete assembly	S/P	6250 1519 002
4	1	motor cable 1.5 mm ²	S/P	6250 1317 xxx ¹⁾
5	1	encoder cable for module RM-C	S/P	6250 1440 xxx ¹⁾
6	1	pulse direction cable for module PULSE-C	S/P	6250 1447 yyy ²⁾
7	1	encoder cable for module RS422-C	S/P	6250 1448 yyy ²⁾
8		field bus cable for module CAN-C IBS-C	S/P	6250 1446 yyy ²⁾ 6250 1451 yyy ²⁾
-	1	CAN terminator, 9-pin socket CAN terminator, 9-pin plug	S/P	6250 1518 002 6250 1518 003
9	1	RS232 programming cable 5 m RS232 programming cable 10 m	S/P	6250 1441 050 6250 1441 100
-	1	TL HMI cable	S/P	6250 1442 yyy ²⁾
10	1	holding brake controller TL HBC	S	6250 1101 606
11	1	external mains filter for units with no internal filter for TLC511 NF, 4A for TLC512 NF, 10A	S	5905 1100 200 6250 1101 900
12	1	terminal angle with top-hat rail TS 15, e.g. for terminal Messrs. Phoenix Contact Typ MBK	P	6250 1102 200
13	1	set grommets, type KDT/Z ³⁾ (Murrplastic GmbH, see chap. 10.3, Suppliers)	P	6250 1102 202

1) cable length xxx: 003, 005, 010, 020: 3 m, 5 m, 10 m, 20 m, longer cable lengths on request.

2) cable length yyy: 005, 015, 030, 050: 0.5 m, 1.5 m, 3 m, 5 m.

3) The inside diameter of the grommets must match the diameter of the cables used.

Figures. 1.3 and 1.4 on page 1-4.

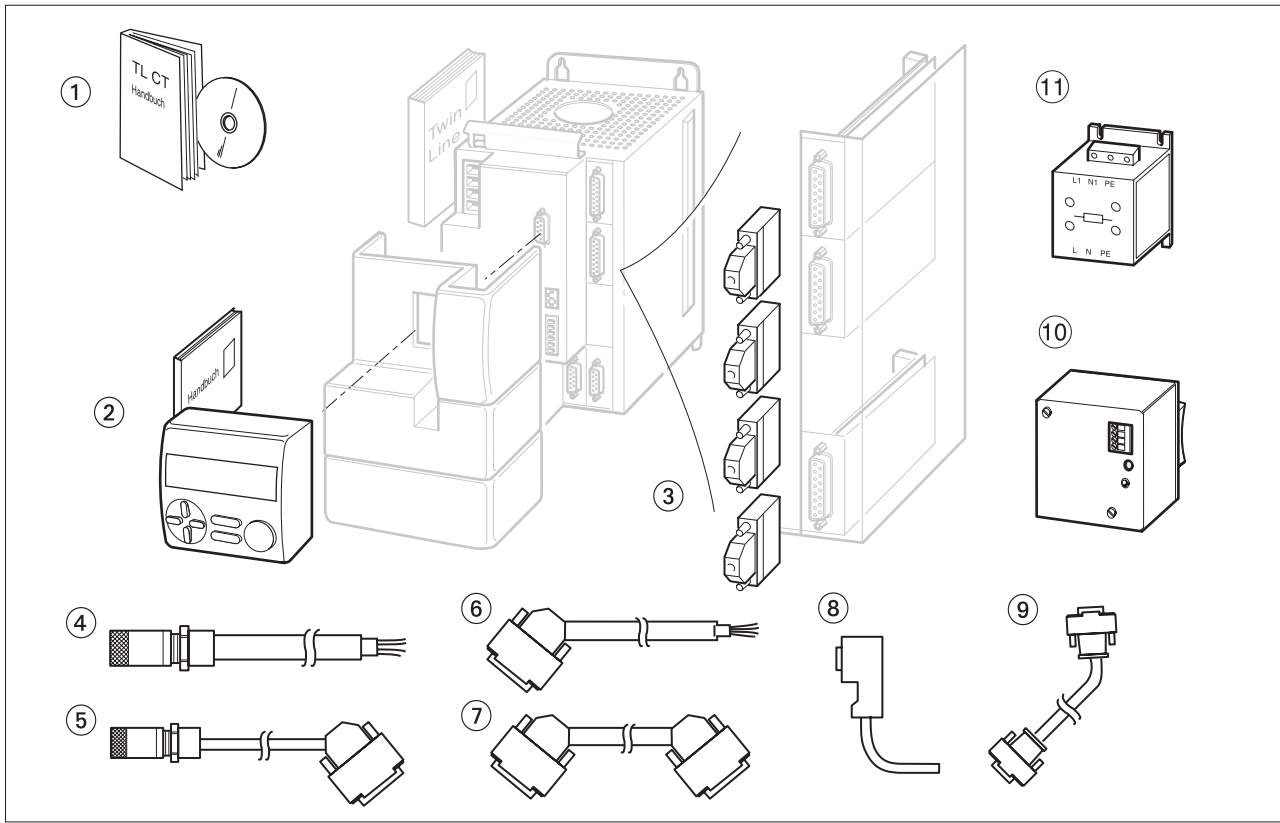


Fig. 1.3 Accessories for the TLC51x

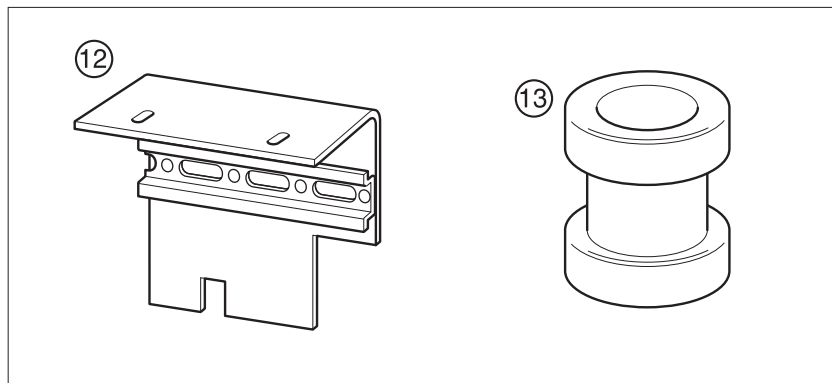


Fig. 1.4 Special accessories for the TLC51xP

1.2 Documentation and literature

Manuals for the positioning controller Twin Line HMI, Manual for the Human-Machine Interface HMI, Order no.: 9844 1113 091
Twin Line Control Tool, Manual for the operating software, English Order no.: 9844 1113 096

1.3 Unit series

The positioning controller TLC51x forms part of SIG Positec's Twin Line device series for controlling stepper motors and AC servomotors. The positioning controller with built-in control electronics and power amplifier works as a stand-alone amplifier or as part of a field bus configuration. It can operate position control on an AC synchronous servomotor and carry out positioning operations on its own.

The positioning controller is available with two power amplifiers with a similar housing design. Electrical connections and functional scope are identical for both units.

The positioning controller comes in two versions with identical functions:

- standard unit, TLC51x, for use in a control cabinet
- version P, TLC51xP, with protection grade IP54, category 2 for use outside the control cabinet close to the motor.

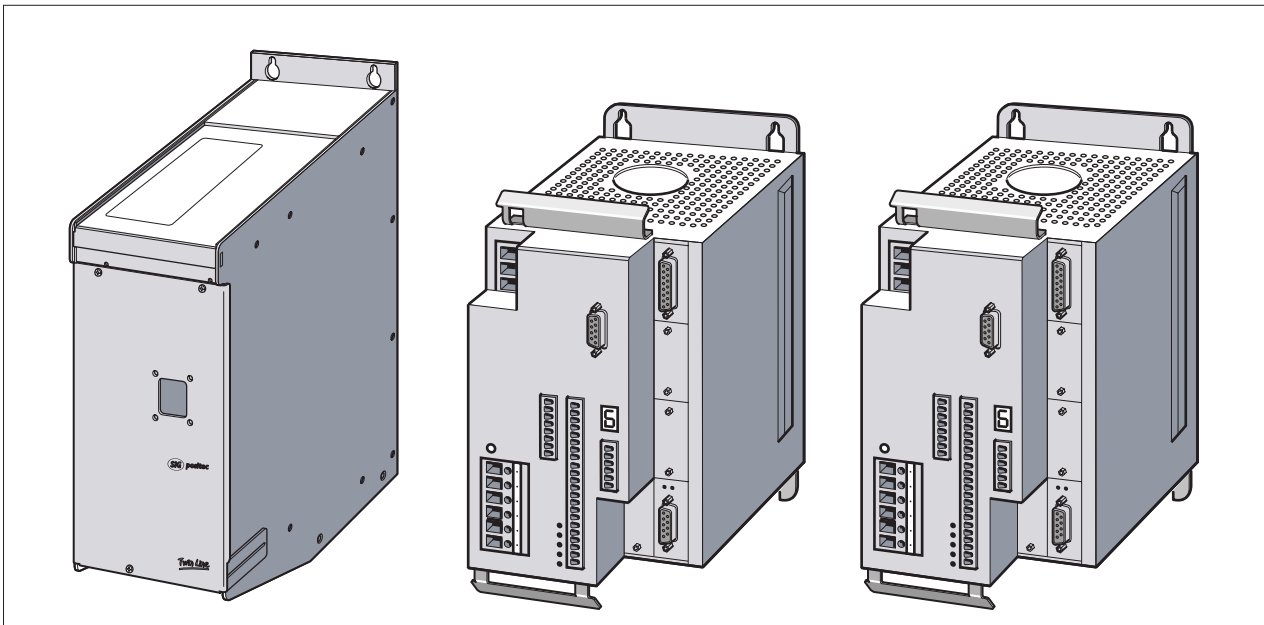


Fig. 1.5 Positioning controller 11P, TLC511 and TLC512

Type code The power class of the positioning controller is indicated by the last digit in the device name 'TLC51x' of the type code.

version Version P with IP54 protection is designated by an additional "P" for "protected" in the type code device name.

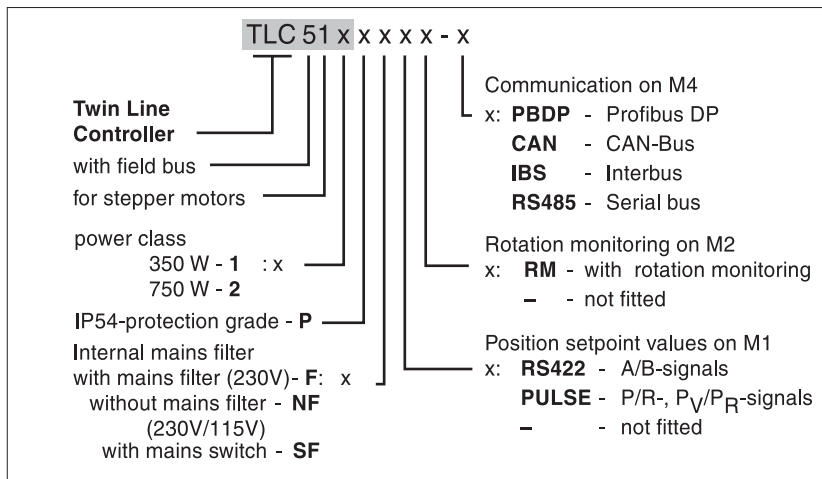


Fig. 1.6 Type code of the positioning controller TLC51x

Version P There is an option to supply the positioning controller with built-in holding brake control.

Accessories TL HBC and TL BRC are not suitable for version P, as they only have IP20 protection.

1.4 Unit overview

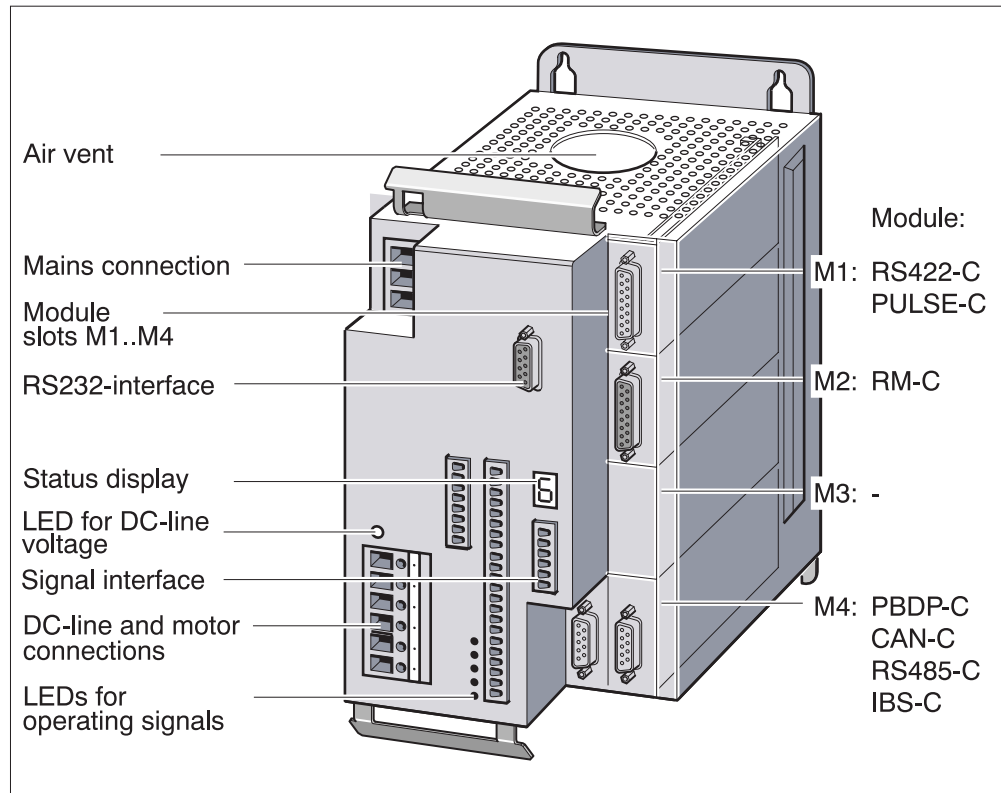


Fig. 1.7 Positioning controller TLC51x

- Mains connection* The power supply for the amplifier is connected to the mains. A positioning controller with a built-in mains filter can be operated without any further noise suppression on the supply side.

The power supply for control loops and for controlling the fan must be provided by an external 24 V_{DC} power supply.
- Motor connection* The positioning controller supplies the power for a permanent-field AC synchronous servomotor via the three-phase connection. The motor connection is short-circuit protected and is checked for ground faults when the amplifier is enabled.
- DC-line connection* The device's DC-line voltage is available at the DC-line terminals. DC-line capacitors can be supported by external capacitors in order to absorb sudden, excess braking energy.
- Status display* A seven-segment display provides information about the operating status of the positioning controller. If there is an operating malfunction the display will flash and display an error code.
- LED for DC-line voltage* The LED comes on when there is voltage in the DC-line.
- LEDs for operating signals* Five LEDs display the signal states of these adjacent inputs: positive and negative limit switches, motor stop signal, power amplifier enablement and automatic operation.

Voltage selector switch The voltage selector switch can be used to run the unit off a mains voltage of 115 V or 230 V. The voltage selector switch is only available for units with no mains filter (NF option).

Version P units are always fitted with voltage selection.

Signal interfaces The input and output signals are routed via the signal interface and an external 24 V_{DC} supply voltage injected for the closed-loop control unit.

RS232 interface The RS232 connection is the communications interface of the unit and is used for connecting a PC or the HMI hand-held operating unit.

Air outlet and fan A built-in fan sucks cold air into the unit from below to cool the power amplifier and ballast resistor. It discharges the warmed air through the upper air outlet vents. Temperature sensors on the power amplifier's heat sink protect the unit from overheating.

Module slots Four module slots allow the positioning controller to be matched flexibly to your particular area of application. The minimum configuration required to drive an AC servomotor is a module in slot M2. The other slot modules expand the scope of functions of the positioning controller.

Configuration variants You can choose between several module variants in slots M1, M2 and M4 and thereby configure the positioning controller for a particular arrangement of installations.

Slot	Functions when module fitted	Possible modules fitted
M1	External setpoint signals for moving and positioning the motor	PULSE-C or RS422-C
M2	Actual position of an encoder for monitoring rotation of motor	RM-C
M4	Field bus module for integrating into the following field bus systems: Profibus-DP, CAN-Bus, CANOpen, DeviceNet, serial online connection or Interbus-S	PBDP-C, CAN-C, RS485-C or IBS-C

Slot M3 remains free for later extensions.

Parameter memory All settings of the positioning controller are administered in a motor data record, two records for control parameters and one for movement parameters. The parameters are stored in the unit, protected against power outages, and can be displayed and changed via the RS232 interface on the PC, via the HMI hand-held operating unit or over the field bus.

Movement parameters The set of movement parameters contains specific data for the various operating modes of the positioning controller. Should the operating mode change, the controller will switch over to the appropriate set of movement parameters.

1.5 Modules of the positioning controller

The block diagram shows the modules and interface signals of the positioning controller.

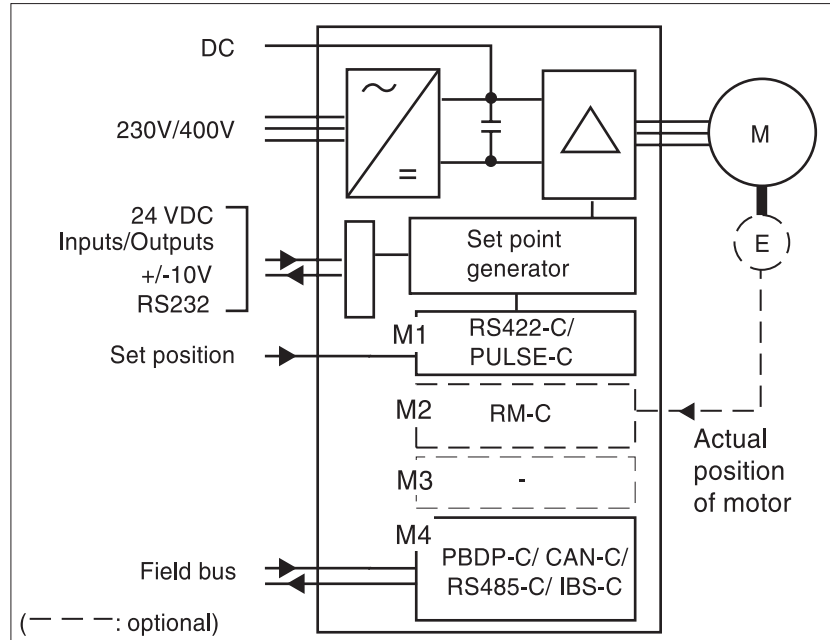


Fig. 1.8 Block diagram with modules and interface signals

- Module PULSE-C* The PULSE-C pulse-direction module passes on externally injected frequency signals to the controller as reference signals for positioning. The module registers the position data as pulse-direction signal or as pulse_{forward} / pulse_{back} signal.
- Module RS422-C* The RS422-C encoder module evaluates externally injected encoder signals as reference signals for positioning. The signals take the form of A/B signals from an encoder, from a higher-ranking controller or from the encoder simulation of a first positioning controller.
- Module RM-C* The positioning controller receives A/B signals from the RM-C rotation monitoring module in order to monitor the position of the stepping motor, and also a signal for checking the temperature of the motor. The encoder electronics in the motor receive their power via the rotation monitoring terminals.

The rotation monitoring is optional.
- Module PBDP-C* The PBDP-C field bus module serves to integrate the positioning controller into the Profibus-DP field bus. The positioning controller works as a command receiver or as a slave device. It executes the control and work commands from a higher-ranking controller.
- Module CAN-C* The CAN-C field bus module couples the positioning controller to a CAN-Bus, CANOpen or DeviceNet field bus
- Module IBS-C* The IBS-C field bus module allows the positioning controller to be used as a slave device in an Interbus network. The module is designed to Interbus specification version 1.
- Module RS485-C* The RS485-C field bus module permits field bus applications via a multipoint connection with serial data transmission. A multipoint connection - in contrast to a point-to-point connection - is able to swap data with several devices.

9844 1113 117, c325, 11.00

1.6 Module configuration, operating modes and functions

Overview Depending on the module configuration, the positioning controller functions in one manual and several automatic modes, which can be swapped during travel.

- Manual movement with positioning
- Speed mode
- Point-to-point mode
- Electronic gear
- Referencing

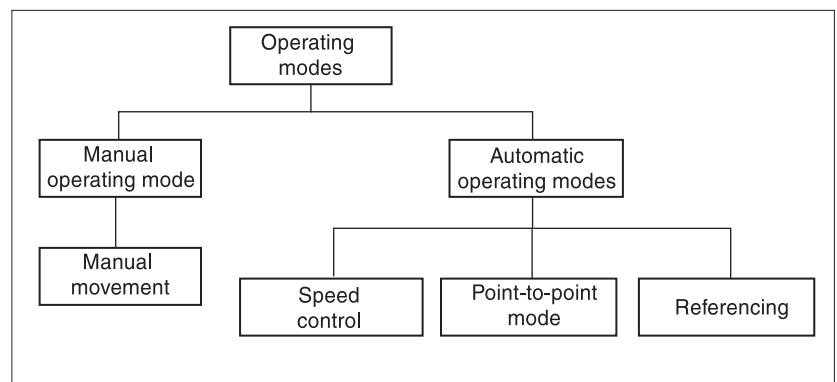


Fig. 1.9 Operating modes of the positioning controller TLC51x

The following table shows the modules that require to be fitted for each operating mode, and possible configurations for additional functions.

Operating mode	Minimum module configuration in slot			
	M1	M2	M3	M4
Manual mode, Speed mode, Point-to-point mode, Referencing movement	optional	optional	-	PBDP-C, CAN-C, IBS-C oder RS485-C
Register reference pulses Electronic gear mode	PULSE-C or RS422-C	optional	-	PBDP-C, CAN-C, IBS-C oder RS485-C
Operation with rotation monitoring	optional	RM-C	-	PBDP-C, CAN-C, IBS-C oder RS485-C

Manual movement with positional reference

In manual movement mode the positioning controller moves the motor a defined distance or in continuous motion at a constant speed. Distance, speed steps and the time for changing from united inching to continuous motion can be set.

Speed mode

In speed mode, the motor is given a set speed and a movement is started with no defined target position. The motor continues to move at this speed until a new speed is set or the mode is terminated.

- Point-to-point mode* In point-to-point mode (also PTP mode), the motor is moved from a point A to a point B by means of a positioning command. The positioning distance is given either in absolute terms with reference to the axis zero point or in relative terms with reference to the current axis position.
- Referencing* In referencing mode, an absolute dimension reference is created between the position of the motor and a defined axis position. Referencing can be carried out by a referencing movement or by dimension setting.
- In a referencing movement, the motor is moved to a defined position, the zero or reference point, on the axis in order to create an absolute dimension reference between the position of the motor and the axis. The reference point is used as the point of reference for all following absolute positioning operations.
- Dimension setting offers the chance to define the current motor position as the new axis reference point to which all following position data relate.
- Field bus mode* The primary area of application of the positioning controller is in field bus operation via a module in slot M4. There are four modules available for field bus operation:
- Profibus-DP with the PBDP-C module
 - CAN-Bus, CANOpen or DeviceNet with the CAN-C module
 - serial RS485 bus with the RS485-C module
 - Interbus-S with the IBS-C module
- You will find information on connecting, programming and operating the positioning controller in a field bus in the relevant field bus manuals from SIG Positec.
- List control* While the positioning controller is carrying out a movement command, the direction of movement is monitored in the background by means of list control. When a list position is reached, the positioning controller responds with the relevant reaction depending on the list type.
- List type for position values and signal values: when the motor reaches a list position, the output signal 'TRIGGER' is set or reset depending on the list entry.
 - List type for position values and speed values: when the motor reaches a position value, the positioning controller switches to the new speed value in the list, and moves the motor at this speed.
- Teach-In* Entries can be made in the list with the HMI hand-held operating unit, the operating software or via the field bus. For entering the position values, the positioning controller offers teach-in processing: the motor is moved to successive list positions with respect to the reference point, and these positions are then committed to the parameter memory together with a value for trigger output or speed.

1.7 Guidelines and standards

1.7.1 Declaration of conformity and CE labelling

The EG guidelines define the minimum requirements - particularly safety requirements - applicable to a product and must be complied with by all manufacturers and dealers marketing the product in the member states of the European Union (EU).

The EC guidelines describe the main requirements made of a product. The technical details are laid down in the harmonized standards, which for Germany take the form of the DIN EN standards. If there is not yet any EC standard applicable to a particular product area, existing technical standards and regulations will apply.

CE labelling With the declaration of conformity and the CE labelling of the product the manufacturer certifies that his product complies with all relevant requirements of the EC guidelines. He is permitted to sell and use the product throughout the EC.

Machine guideline The Twin Line unit is not a machine in the sense of the machines EC guideline (89/392/EEC). It has no function-associated moving parts. The unit may however be a component part of a machine or installation.

Provided the rest of the machine complies with the machines guideline and it has been set up in accordance with the EMC testing code of SIG Positec, conformity with the machines guidelines can be certificated.

EMC guideline The EC guidelines on electromagnetic compatibility (89/336/EEC) applies to units which can cause electromagnetic interference or whose operation can be impaired by such interference.

Compliance with the EMC guideline cannot be checked for the Twin Line unit until it has been installed into a machine or installation. The instructions provided under 'Installation' must be complied with to guarantee the Twin Line unit is EMC-safe when fitted in the machine or installation and before use of the unit is permitted.

Low voltage guideline The EC guideline on low voltages (73/23/EEC) lays down safety requirements for 'electrical apparatus' as protection against the risks which can originate in such devices and which can be created in response to external influences.

As specified by the low voltage guidelines the Twin Line unit conforms to EN 50178 and to the following peripheral conditions:

- Protection class 1
- Contamination degree 2 (only standard unit)

Declaration of conformity The declaration of conformity certifies that the device satisfies the requirements of the EC guideline cited. For the Twin Line unit a declaration of conformity in accordance with the EC low voltages guideline has been issued.




<h1>EC Declaration of Conformity 2000</h1>		 
<p>in accordance with EC Low-Voltage Equipment Directive 73/23/EWG, modified by EC Certification Directive 93/68/EWG</p>		<p>SIG Positec BERGERLAHR GmbH & Co. KG Breslauer Str. 7, D-77933 Lahr</p>
<p>We hereby declare that the products designated below correspond, in their design and construction as well as in the version marketed by us, to the requirements of the listed EC directives. This declaration loses its validity if changes are made to the products which have not been agreed with us.</p>		
Designation:	3-phase motor amplifiers with / without electronic control and accessories	
Type:	TLDx1x, TLCx1x, TLDx3x, TLCx3x, TLCx1xP, TLCx3xP, TLBRC, TLHBC	
Product number:	634xxxxxxx, 62501101706, 62501101606	
Applicable EC Directives:	(NSR) 73/23/EWG, (EMV) 89/336/EWG	
harmonised norms applied especially:	EN 50178 Classification VDE 0160: 1998.04 EN 61800-3 Classification VDE 0160: 1997.08, category 2 according to BERGER LAHR test conditions	
national norms and technical specifications applied, especially:	UL 508C BERGER LAHR EMC testing conditions 200.47-01 EN	
Company stamp	<p style="text-align: center;"> SIG Positec BERGERLAHR GmbH & Co. KG Breslauer Straße 7 77933 Lahr/Schwarzwald </p>	
Date/Signature	20.04.2000	i.v. 
Name/Department	W. Brandstätter / GME	

Fig. 1.10 Conformity as per the EC low voltages guideline

9844 1113 117, c325, 11.00

1.7.2 Regulations and standards

<i>Standards concerning safe operation of the Twin Line units</i>	EN 60204 - (VDE 0113 Part 1: 1998): Electrical equipment of machines, General requirements DIN VDE 0100, Regulations regarding the installation of high-voltage systems with voltages up to 1000 V DIN VDE 0106-100, 1983, Protection against electrical shock; Location of actuation elements in the vicinity of operating resources liable to accidental contact DIN VDE 0470-1,1992, IP protection types EN 954-1: Safety of machines, Safety of components of control devices, Part 1: General design principles
<i>Standards regarding compliance with EMC limit values</i>	EN 61000-4-1 (IEC 1000-4-1: 1992): Testing and measurement procedures, Section 1: Overview of noise immunity testing procedures EN 618500-3:1996 and prA11:1999: Speed variable electrical driving units.

2 Safety

2.1 Danger categories

Safety notes and general information are indicated by special symbols in the manual. In addition you will find symbols and instructions affixed to your Twin Line unit which warn you of possible dangers and help you to operate the unit safely.

Depending on the seriousness of the danger, danger symbols are divided into three danger categories. The symbols shown emphasize the danger situation to which the warning applies.



DANGER!

This is an indication of direct personal danger. Can lead to serious injuries with fatal consequences if not observed.



WARNING!

Indication of a recognizable danger. If the warning is ignored, the danger can lead to serious injury with fatal consequences, and to the unit or system parts being permanently damaged.



CAUTION!

Indication of a danger. If this is ignored, minor personal injury and light damage to the unit or system may be the result.

2.2 Safety instructions



DANGER!

*Electric shock from high voltage!
Follow safety rules when working on electrical systems:*

- Switch off the power to the unit
- Make sure the unit cannot be switched on again inadvertently
- Confirm that no voltage is present
- Cover or shield neighboring system parts which are live.



DANGER!

*Electric shock from high voltage!
Before starting work on the connections of the power unit or on the motor terminals, wait for the 4 minutes discharge time and then measure the residual voltage on the DC-line terminals "DC+" and "DC-". The residual voltage must not be higher than 48 V_{DC} before you work on the connections. If additional DC-line capacitors are fitted, the discharge time increases to up to 10 minutes. Wait for this length of time, and then measure the residual voltage.*

2.3 Use for the purpose intended

2.3.1 Ambient conditions

	Transportation and storage temperature	-40 °C to +70 °C
	Installation height, operation with no reduction in performance	h <1000 m above m.s.l.
	Vibration stress during operation to DIN IEC 68-2-6	
	Number of cycles:	10
	frequency range:	10Hz to 500Hz
	acceleration:	20m/s ²
	Continuous shocks to DIN IEC 68-2-29	
	Number of shocks:	1000/direction (X,Y,Z for each clockwise, anticlockwise direction, total 6000)
	Peak acceleration:	150m/s ²
<i>TLC51x</i>	Protection type	IP20
	Ambient temperature	0 °C to +50 °C
	Relative humidity	15% to 85% (no condensation permissible)
<i>TLC51xP</i>	Protection type	IP54, category 2
	Protection grade of internal cooling air duct	IP34
	Ambient temperature	0 °C to +45 °C

Version P is not suitable for use in the open air or in sticky environments (danger of fan glueing up).

2.3.2 Intended use

The positioning controller is an electrical device for controlling a variable-speed drive with a stepping motor.

Only 3-phase stepping motors may be operated with the positioning controller. The motor must be approved by SIG Positec for operation with the device.

The motor connections of multiple units may not be connected to each other.

Units may not be connected in parallel to the DC-line output.

The positioning controller may be used for industrial applications in the system configuration described.

The positioning controller must be installed and operated in an environment which meets at least protection grade IP54. The standard unit must therefore be installed and properly mounted in a control cabinet. Version P may be operated outside a control cabinet.

The positioning controller may only be set up and operated after correct EMC installation has taken place. It may only be used with the cables and accessories specified by SIG Positec.

The positioning controller may not be used in IT networks, as they have no ground potential. Interference suppression filters for correct EMC installation will only work properly with a ground potential connection.

2.4 Qualification of the personnel

Work on and with the positioning controller may only be carried out by qualified personnel.

Qualified personnel can use their technical training, knowledge and experience to assess the work to be done and to recognize and avoid possible dangers.

Qualified personnel will be aware of the current standards, regulations and accident prevention regulations which must be observed when working on the unit.

2.5 Safety devices

The positioning controller unit monitors a range of signals from system and installation components.

Safety devices coupled with the unit protect the system and operating personnel.

Safety devices	Tasks and protective functions
Limit switch signals	Monitoring the permissible ranges of movement in order to protect personnel and the system
Stop switch signal	Stops the drive with maximum braking energy and at standstill hold the motor still under positional control. Protection of persons and system in the event of unexpected movements due to the motor being switched off.

The following components and limit values are monitored internally:

Monitoring	Task and protective function
Short-circuit	Motor line monitored for short circuit between the motor phases functional safety and device protection
Over- and undervoltage	Monitoring DC line for overvoltage and undervoltage functional safety and device protection
Temperature	Monitor motor ¹⁾ and power amplifier with sensors for excess temperature device protection
Rotation monitoring error	For units with rotation monitoring, contouring error threshold value when positional deviation too large functional safety
Motor speed	Speed limit at maximum permitted motor speed, device protection
Data connection with a hand-held operating unit	Functioning of the connection during motor control via the hand-held operating unit, functional safety

1) Motor monitoring only for units with optional rotation monitoring

3 Technical data

3.1 Mechanical data

3.1.1 Positioning controller TLC51x

<i>Weight</i>	TLC511, TLC512 with 3 modules	2,7 kg
<i>Device protection</i>	Protection type as per DIN EN 60529: 1991	IP 20

Dimensions

	TLC511	TLC512
Width [mm]	108	108
Height [mm]	212,5	212,5
Depth [mm]	184,5	184,5
Front width [mm]	105,5	105,5
Connection dimension [mm]	63	63

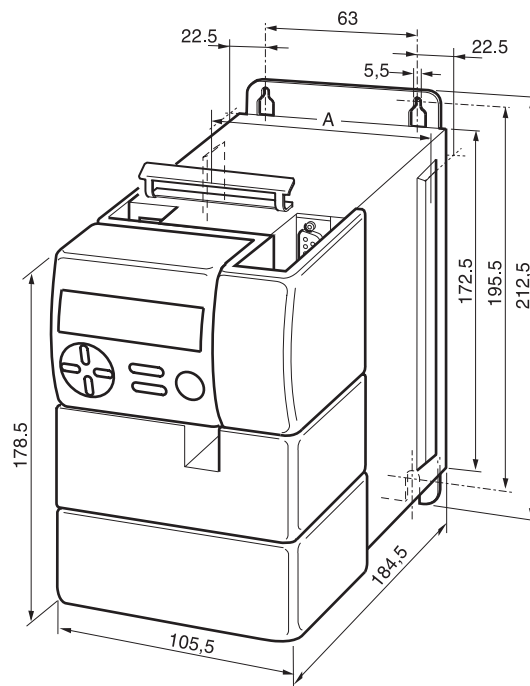


Fig. 3.1 Dimensions TLC511 and TLC512. The Twin Line HMI shown in the drawing is an option.

3.1.2 positioning controller TLC51xP

<i>Weight</i>	TLC511P SF with 3 modules	8 kg
	TLC512P SF with 3 modules	8 kg
<i>Device protection</i>	Protection type as per DIN EN 60529: 1991	IP 54, Category 2

<i>Dimensions</i>	TLC511P	TLC512P
Width A [mm]	127	127
Height B [mm]	360	360
Depth C [mm]	245	245
Front width D [mm]	127	127
Connection dimension E [mm]	80	80

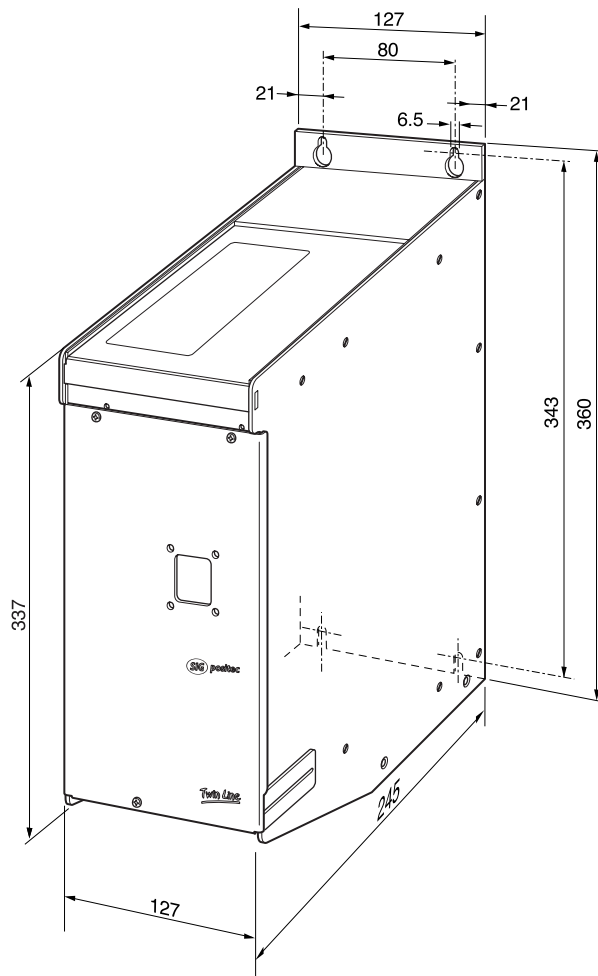


Fig. 3.2 Dimensions TLC51xP

3.1.3 Accessories for standard unit

*Holding brake controller
TL HBC*

Dimensions (H x W x D)

107 mm x 104 mm x 76 mm

Installation on top-hat rail

55 mm

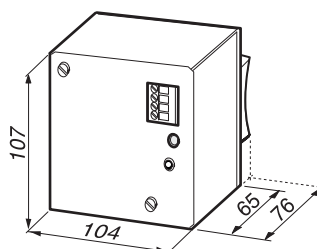


Fig. 3.3 Holding brake controller

3.2 Electronic data

3.2.1 Positioning controller

Mains connection

	TLC511/TLC511P	TLC512/TLC512P
Mains voltage [V_{AC}]	1 x 230 -20%/+15%	1 x 230 -20%/+15%
only for TLC51xNF:	1 x 115 -20%/+15%	1 x 115 -20%/+15%
Mains frequency [Hz]	47 - 63	47 - 63
Current consumption [A]	2 (230 V) 4 (115 V)	5 (230 V) 10 (115 V)
Starting current [A]	< 60	< 60
Power factor $\cos\phi$	> 0.6	> 0.6
Power loss [W]	\leq 40	\leq 60
Mains buffering [ms]	< 5	< 5
Overvoltage strength (DIN EN 61800-3)	between phases: 1 kV, phases to earth: 1 kV	
Leakage current ¹⁾ [mA]	< 30	< 30
Fuse, external [A] / characteristic		
for 230 V	10 C, K or similar	10 C, K or similar
for 115 V	10 C, K or similar	10 C, K or similar

1) Leakage currents are measured with an RC circuit in accordance with IEC60990. The value can be higher if measured directly. Advice on using earth leakage circuit-breakers on request.

Motor connection

	TLC511/TLC511P	TLC512/TLC512P
Power class ¹⁾ [kW]	0.35	0.75
Switching frequency [kHz]	16	16
Rated current [Arms], r.m.s. value ³		7
Maximum speed [r.p.m.]	3000	3000
Cable length ²⁾ [m]	20	20
Cable diameter [mm ²]	1.5	1.5

1) Max. effective electrical power of the unit for nominal current and 115 V_{AC} or 230 V_{AC} mains voltage
 2) longer cable lengths on request

<i>24 V_{DC} supply</i>	PELV, DIN 19240, reverse-polarity-protected	
	Input	
	Voltage range	20 V to 30 V
	Ripple	< 2 V _{SS}
	Input current (without loading of the outputs)	< 2.5 A
<i>Signal interface</i>	Digital signal inputs	Reverse-polarity-protected No electrical isolation Debounced, debounce interval 0.7 to 1.5 ms
	DC-voltage U _{high}	12 V to 30 V (I ≥ 3 mA)
	DC-voltage U _{low}	≤ 5V (I ≤ 0,5 mA)
	Current at 24 V	≤ 7 mA
	Digital signal outputs	Inductive loadability (150 mH / 11 W) Short-circuit protected
	DC-voltage	≤ 30 V
	Switching current	≤ 400 mA
	Voltage drop at 400 mA	≤ 1 V
	Analogue signal input	
	Voltage range	+10 V to -10 V
	Input resistance	5 kΩ
<i>UL 508C certification</i>	You will find the thresholds for UL 508C certification in the chapter entitled 'UL 508C certification' from page 3-8.	

3.2.2 Modules

Note: You will find more detailed data on individual modules in the chapter entitled 'Electrical installation' from page 4-11.

<i>RS422-C encoder module</i>	Signal inputs (A, B, I)	RS422-compatible Connected electrically to 24VGND
	Input frequency	≤ 400 kHz 1 600 000 Inc/s
	Output Encoder supply (SENSE)	5 V ± 5%, max. 300 mA Sense-controlled Short-circuit- and overload-proof
<i>PULSE-C pulse direction module</i>	Signal inputs	
	Symmetrical	Compatible with RS422-voltage
	Asymmetrical	4.5 V to 30 V Connected electrically to 24VGND
	Input resistance	5 kΩ
	Input frequencies: Stepping frequency (PULSE/PV, DIR/PR)	≤ 200 kHz
	Motor current control (PWM)	6 kHz to 25 kHz
	Number of steps	200, 400, 500, 1000, 2000, 4000, 5000, 10000
	Signal outputs ($\overline{\text{ACTIVE}}$, $\overline{\text{FUNCT_OUT}}$)	Open collector outputs Short-circuit-proof
Output voltage	≤ 30 V	
Output current, maximum	≤ 50 mA	
<i>Rotation monitoring RM-C</i>	Signal inputs (A, B)RS422 level	electrically connected to 24VGND
	Input frequencies:	≤ 400 kHz 1 600 00 Inc/s
	Encoder resolution	1000 lines
	Encoder power supply output (SENSE)	5 V ± 5%, ≤ 300 mA sense controlled short-circuit and overload protected
<i>RS485-C module</i>	Signal inputs / outputs	in accordance with RS485 norm electrically isolated 4-wire interface
	Transmission rates	1200, 2400, 4800, 9600 19200, 38400 Baud
<i>PBDP-C module</i>	Signal inputs / outputs	in accordance with RS485 norm electrically isolated
	Transmission rate	≤ 12 MBaud
<i>CAN-C module</i>	Signal inputs / outputs	level to ISO 11898 electrically isolated
	Transmission rate	≤ 1 MBaud

9844 1113 117, c325, 11.00

<i>IBS-C module</i>	Signal inputs / outputs	in accordance with INTERBUS specification, category 1 Two-wire remote bus
	Transmission rate	500 kBaud
	For units with the IBS-C module, 24 VGND is internally connected to PE.	
<i>Version P optional holding brake controller</i>	Power supply input 20 V to 30 V input current	input current = 0.1 A + braking current
	output, brake not short-circuit protected current at 24 V for 100 ms	max. 2.5 A DC voltage 20 V to 30 V
	With voltage reduction continuous current max. 1.25 A DC voltage	9.5 V to 15 V

3.2.3 UL 508C certification

The Twin Line Twin Line Controller 51x is certified to UL 508C with the following data.

Mains connection

Unit	Mains voltage [V]	Mains frequency [Hz]	Current [A]	Phases
TLCX11	230 115	47-63	2 4	1
TLCX12	230 115	47-63	5 7.5	1

Motor data

Unit	Motor voltage [V]	Motor frequency [Hz]	Motor current [A]	Phases
TLCX11	0-230	0-2500	3	3
TLCX12	0-230	0-2500	7	3

Accessories

- Holding brake controller, TL HBC
Power supply 24 V

3.2.4 Accessories for standard unit

<i>TL HBC holding brake controller</i>	Supply voltage, input	20 V to 30 V
	Input current	Input current = 0.5 A + brake current
Output, brake	DC-voltage	20 V to 30 V
	Power at 24 V for 100 ms	0.5 A to 2.5 A
	Continuous current	0.5 A to 1.5 A
	DC-voltage with voltage drop	9.5 V to 15 V
	Current at 12 V	0.5 A to 2 A
Safe electrical isolation between 24 V input, control input and brake output		

4 Installation

4.1 Electromagnetic compatibility, EMC

Strong electromagnetic interference occurs in the power area of the positioning controller which can influence signals coming from control cables and system parts and which can endanger the operational reliability of the system if suitable protective measures are not taken.

The positioning controller meets the requirements of the EC directives on EMC noise resistance and on noise output as specified in EN-61800-3, as long as the following steps have been taken during installation.

Control cabinet setup

EMC measures	Effect
Use zinc or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from bearing surfaces	Good conductivity due to two-dimensional contacts
Ground the control cabinet, door and mounting plate by means of metal tapes or cables with a diameter greater than 10 mm ²	Reduction of EMC emissions
Mount power components and control components separately, minimum distance 25 cm, reduce interference injection from either component by using multiple-ground dividing plates	Reduction of mutual interference injection
Fit switching devices such as contactors, relays or solenoids with interference suppressors or spark suppressors (e.g. diodes, varistors, RC elements)	Reduction of mutual interference injection

Cabling

EMC measures	Effect
Keep cables as short as possible, no 'safety loops', short cables from the star point in the control cabinet to outlying ground connection	Avoidance of capacitive and inductive interference injection
Use cable clamps to connect a large surface area of the shield from all shielded cables to the mounting plate at the control cabinet entry.	Reduction of EMC emissions
Lay the cables spatially separated from each other: - Signal cables and power cables - Mains and motor cables - Mains filter input and output cables	Reduction of mutual interference injection, reduction of emissions, increasing resistance to interference
Connect large surface areas of cable shields, use cable sleeves and tapes	Low shielding effect if the connection is not made over large surface area, reduction of emissions
Ground a large surface area of the shields of digital signal cables at each end or via sub-D housing	Avoidance of interference on control cables, reduction of emissions
Screen analogue signal lines at one end only at the power drive, at the other end via capacitor, e.g. 10 nF / 100V MKT	Avoidance of ripple loops due to low-frequency interference

EMC measures	Effect
Use only shielded motor cables with copper braiding and at least 85% covering, ground a large surface area of the shield at each end. Only use motor and encoder cables recommended by SIG Positec.	Controlled discharge of interference currents, reduction of emissions
If the motor and machine are not conductively connected, for example by an insulated Flange or a non-flat connection, ground the motor with a grounding wire (> 10 mm ²) or ground strap.	Reduction of emissions, increase in resistance to interference
Ground unused cable wires from control circuits at both ends of the cable (does not apply to motor cable)	Additional shielding effect

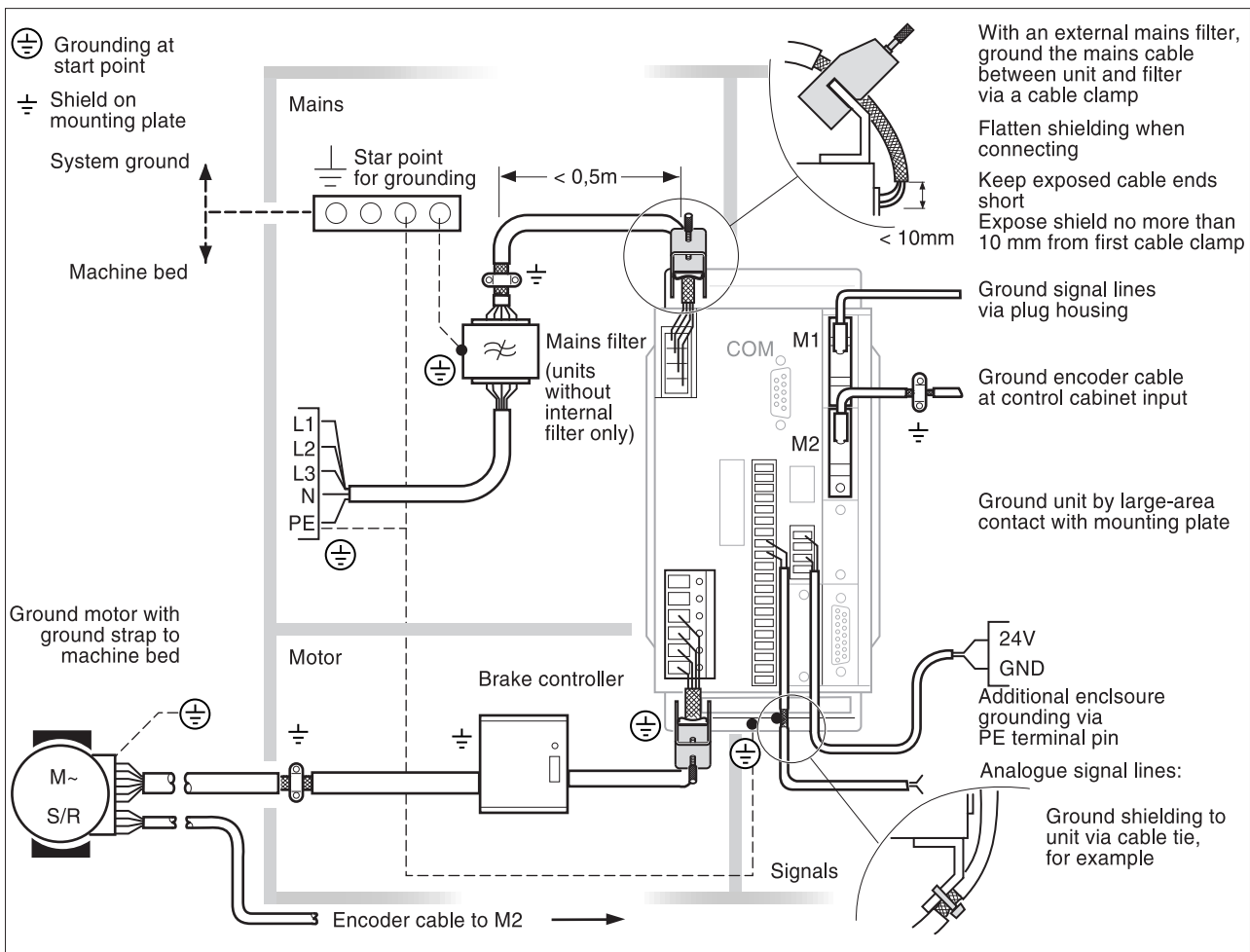


Fig. 4.1 EMC measures and subdivisions of the control cabinet

**WARNING!**

Malfunctions and risk of injury!

The EMC of cables must be guaranteed if the unit is to function reliably and free of faults. The use of unsuitable, non-EMC-secure cables can damage the unit and lead to malfunctions.

Motor leads and encoder cables are especially critical signal circuits. Use SIG Positec cables for them. SIG Positec motor and encoder cables have been tested for EMC stability. In addition these cables can be used as trailing cables.

You can find information on the cables in the section 'Accessories and spare part' on page 10-1.

4.2 System components

Besides the components included in the scope of delivery, further system components are required for connecting the positioning controller:

- Three phase stepping motor
- Motor cable
- Signal cable to fit device version:
 - RS422-C module: encoder cable for RS422-C
 - RM-C module (optional): encoder cable for RM-C
 - PULSE-C module: encoder cable for PULSE-C
 - PBDP-C module: bus cable for Profibus-DP
 - CAN-C module: bus cable for CAN-Bus, CANOpen and DeviceNet
 - RS485-C-module: bus cable for serial online bus
 - IBS-C module: bus cable for Interbus
- RS232 cable with PC connecting plug
- Mains cable and mains fuses
- External power supply unit, 24 V_{DC} with safe isolation - PELV
- External mains filter for units with no built-in mains filter
- Additional filters and chokes for mains connection and motor connection, depending on system configuration
- NC control or PLC for automatic operation
- PC or laptop with Windows 95, 98 or NT for commissioning with operating software.

4.3 Mechanical installation

- Before installation...* ► Check the unit for outwardly visible damage such as dents in the housing or broken connection terminals. Do not install damaged units.



DANGER!

Danger from high voltages, possibility of permanent damage to the unit's electronic circuitry

Make sure when installing that no loose parts such as pieces of wire or mounting parts fall into the unit. Loose, conductive parts inside the unit can endanger life by forming parasitic voltages and permanently damaging the unit through short-circuits.

4.3.1 Positioning controller TLC51x mounting

Control cabinet The control cabinet must be big enough to allow both unit and accessories such as ballast resistor controller and holding brake controller to be firmly mounted and connected in line with EMC requirements.

Operating heat from the unit and other components as well as the heat produced by the ballast resistors must be able to dissipate by means of the switch cabinet ventilation.

Mounting distances The unit is fitted with a built-in fan. Ventilation slots on and under the unit must be kept at least 70 mm away from neighbouring units or walls.

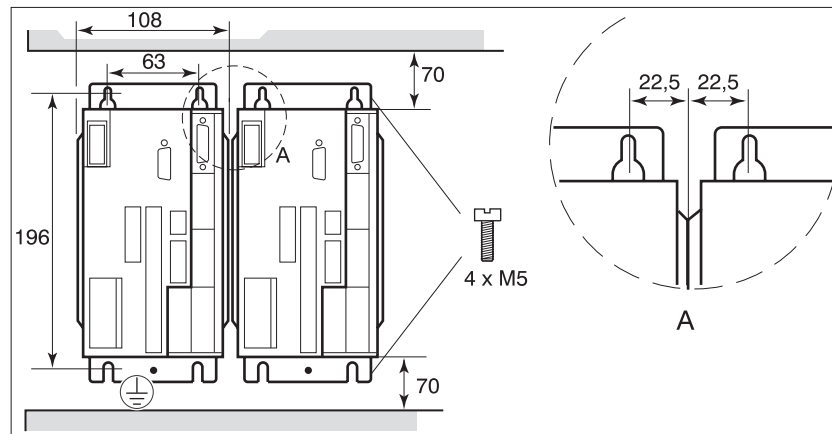


Fig. 4.2 Mounting distances, dimensions in mm

- ▶ Position the unit in the control cabinet such that the heated air flow from other units, for example from an external ballast resistor, does not result in undesired heating of the cooling air.
- ▶ Mount the unit vertically with the mains connection at the top.
- ▶ Mount the unit on a galvanized metal plate. The back wall of the unit must be in good contact with the metal plate across its whole surface area.



Painted surfaces have an insulating effect. Before fixing the unit to a painted mounting plate, scratch off the paint over a wide surface area in the places where the unit is to be mounted, to ensure that it has a good connection with the grounded plate.

4.3.2 Mounting the positioning controller TLC51xP

Mounting distances Version P units must be mounted at a minimum distance of 10 mm from neighbouring devices.

Positioning controller connections are routed out of the bottom of the housing. There must be 20 centimetres of space under the unit in order to ensure that connecting cables do not have to be bent.

There is a ventilation element on the bottom of the unit. Do not remove the protective cover!

The unit must be mounted vertically in order to maintain its water protection grade.

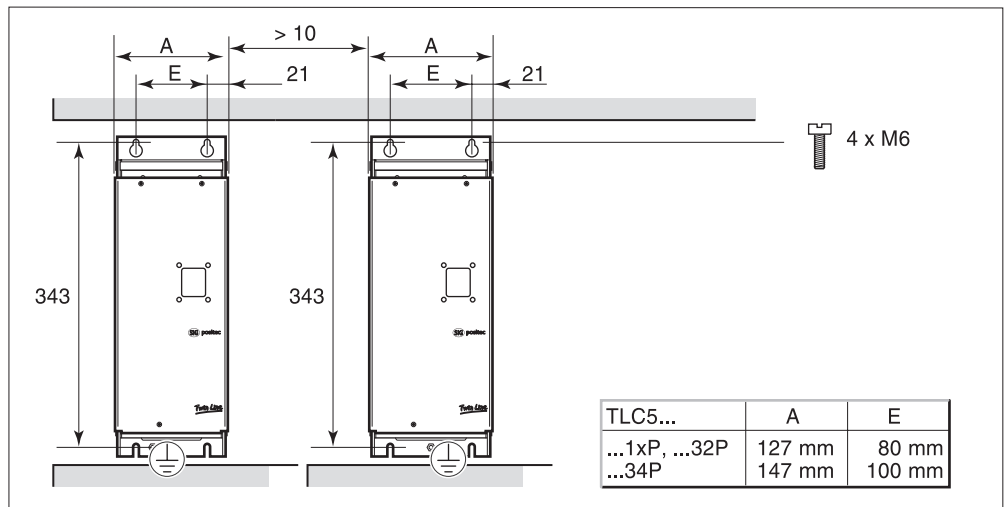


Fig. 4.3 Mounting distances, dimensions in mm

4.3.3 Fitting the unit label

The unit label supplies information on the meaning of all operating states displayed on the 7-segment display, and on signal interface assignment. An example of the unit label which you can copy is provided in section 'Unit label', Page 11-1.

- TLC51x* ▶ Stick the unit label on the inside of the hood on the side where the signal plugs are connected.
- ▶ After the electrical installation has been completed and the unit hood mounted, the cables for connection to the mains and the cables for both upper signal connections are led out through the top of the hood, while the motor cable and other signal cables are taken out through the bottom.
- TLC51xP* ▶ Stick the label to the side of the Twin Line Unit.

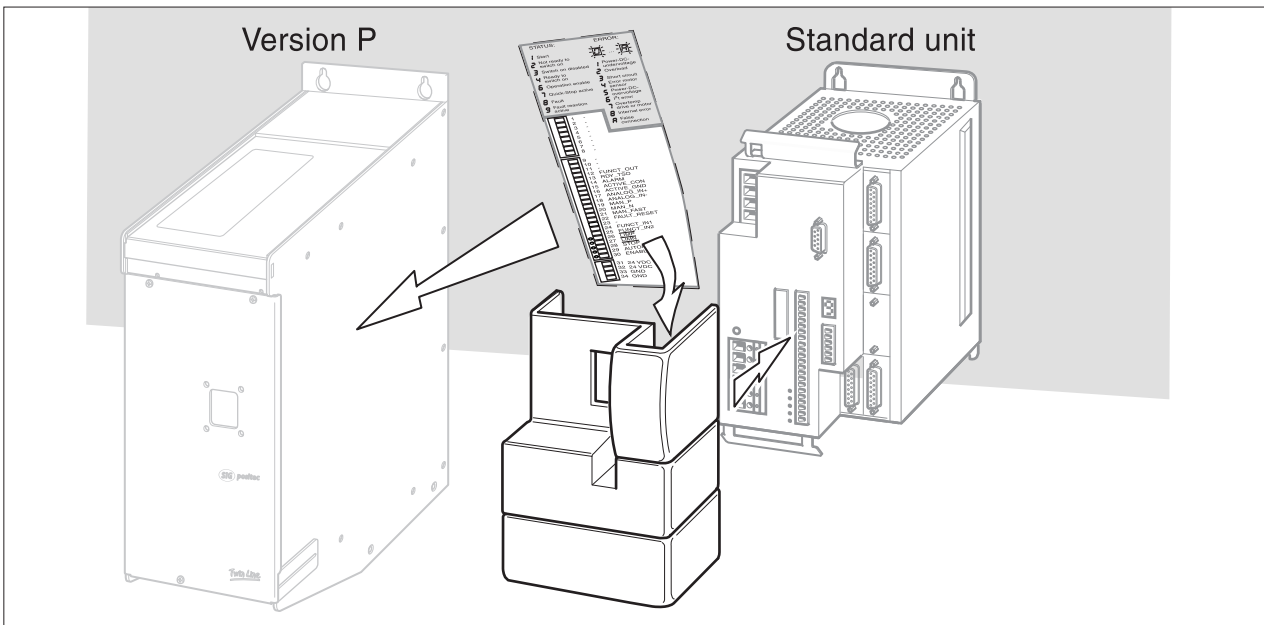


Fig. 4.4 Sticking the unit label in the side of the hood to the side of the Twin Line Unit

4.3.4 Installing accessories to the standard unit

Mains filter The positioning controller is supplied with a built-in mains filter as standard. A special version of the unit can also be ordered with no mains filter.

Do not use the units with external mains filters unless you can make test measurements at the unit of the functioning and the EMC of a selected mains filter.

The type plate on the front of the unit states whether a mains filter is built in or not:

- F: With mains filter, e.g. TLC51x F
- NF: Without mains filter, e.g. TLC51x NF

Select a two-stage mains filter, e.g. for a frequency converter. The size and selection of a suitable filter is for the system designer to decide.

- ▶ Fit the mains filter near the mains connection and on the same mounting plate. The length of cable to the positioning controller should not be longer than 50 cm. The cable must be shielded and grounded at both ends.

4.3.5 Mounting version P accessories

Terminal angle Version P offers a terminal angle as an accessory which is used for additional wiring.

- ▶ Open the front plate with the three mounting screws.
- ▶ Fix the terminal angle to the top left-hand side of the top of the housing, using two M3 screws.

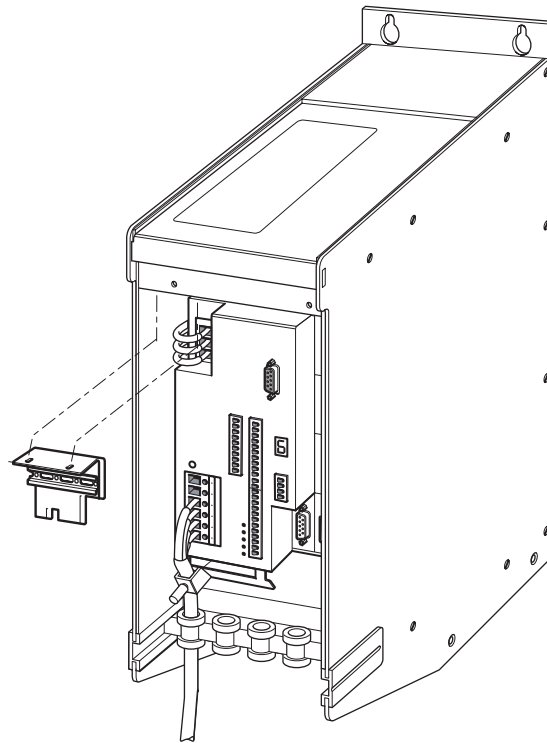


Fig. 4.5 Connection of terminal angle

4.4 Electrical installation

**WARNING!**

Malfunctions and danger of injury arising from interference with other units!

Connect the unit correctly with respect to EMC. Control signals suffering interference can generate unexpected signal states which can impair the functioning of the unit.

**DANGER!**

Electric shock from high voltage!

Follow safety rules when working on electrical systems:

- Switch off the power to the unit
- Make sure the unit cannot be switched on again inadvertently
- Confirm that no voltage is present
- Cover or shield any neighbouring system parts which are live.

**DANGER!**

Electric shock from high voltage!

Work on the power supply circuit may only be carried out when the power supply has been switched off.

Lock the main switch and lock access to it.

Installing the positioning controller and other components and connecting it to the power supply may only be carried out by qualified personnel.

4.4.1 Electrical installation TLC51xP

For TLC51xP units, most of the electrical connections are made inside the housing.

The following connections are made to the underside of the housing:

- connection for PC or HMI operating unit via 9-pin sub-D socket
- mains connections via circular power plug

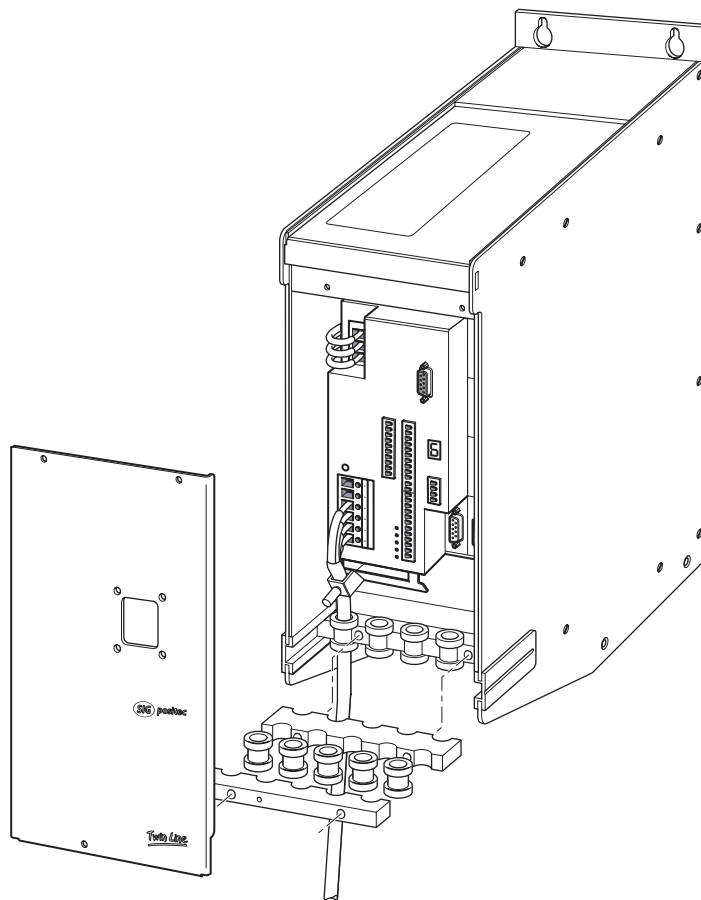


Fig. 4.6 Connection example for the TLC51xP unit

► Open the front plate via the three mounting screws.

► Make the necessary connections to:

- motor
- position response signal
- field bus
- signal interface for manual operation

You will find details on individual connections in the following sub-sections

- ▶ Place the grommets on the cables. Only use grommets whose inside diameter matches that of the cables.
- ▶ Mount the grommets as shown in Fig. 4.6.
- ▶ Earth the unit at the grounding point at the back of the unit near the bottom. Connect them to system earth and the machine bed.
- ▶ Close the front plate with the three screws.

The holding brake controller can be built into the unit as an optional extra.

The fan and the holding brake controller are already connected to pins 32 and 34.

4.4.2 Mains connection

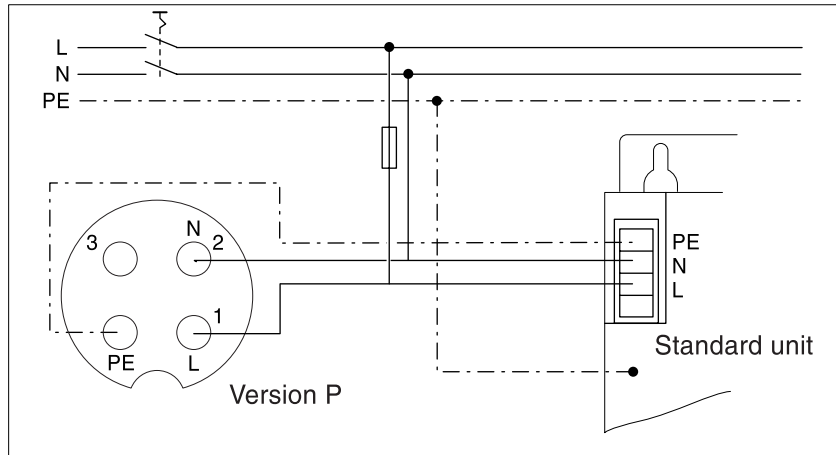


Fig. 4.7 Mains connection for single-phase units

- Standard unit**
- ▶ In the case of the single-phase unit, connect the mains cables to screw terminals PE, N and L
 - The correct torque for the terminal screws is 0.4 - 0.5 Nm.
 - For units without a mains filter, any mains cable over 20 cm in length must be shielded between the filter and the unit terminals and grounded at both ends.
 - The individual wires of the cable can be connected without wire end ferrules.
 - For units with a hood, the cable must be routed upwards from the point of connection.
- Version P**
- ▶ Connect the power cable to the mains plug using terminals 1, 2 and PE.
 - ▶ Do not use a plug in for a three-phase unit instead of one for single-phase units. The unit can be damaged.
- Both versions**
- The connection diameter for the mains cables is 1.5 to 2.5 mm².
 - Fit a fuse in the mains phase: for a 230 V connection: 10 A (C, K-characteristic or similar).
 - The additional PE terminal must be connected to the housing on account of the high leakage currents.
- Wire end ferrules**
- If you use wire end ferrules, pay attention to the following:
- Applies to TLC532 only: Do not use end ferrules with a plastic collar on wires with a cable diameter of 2.5 mm².
 - Only use square end ferrules to ensure that they cannot work loose after screws are tightened.
 - Strip the insulation from the cable to a length of 10 mm.
- Earth leakage circuit-breaker**
- If a fault occurs, fault currents with DC component may arise. For single-phase units, an e.l.c.b. for fault currents with a pulsating DC component can be fitted.

9844 1113 117, c325, 11.00

4.4.3 Motor connection TLC51x



DANGER!

*High voltage danger due to induced voltage!
Do not touch the wires or contacts of the motor cable when the motor is turning. Even when they are not connected to the positioning controller motors will create high induced voltages when the motor shaft rotates. Make sure that the motor is not driven by external sources while installation work is going on.*

Connecting motor wires

- ▶ Connect the motor wires and protective ground to terminals U, V, W and PE. The assignment of wires must be the same at the motor as at the unit.

Terminal	Connection	Colour
U	motor wire	brown (bn)
V	motor wire	blue (bl)
W	motor wire	black (bk)
PE	protective conductor (screen tracer wire) -	

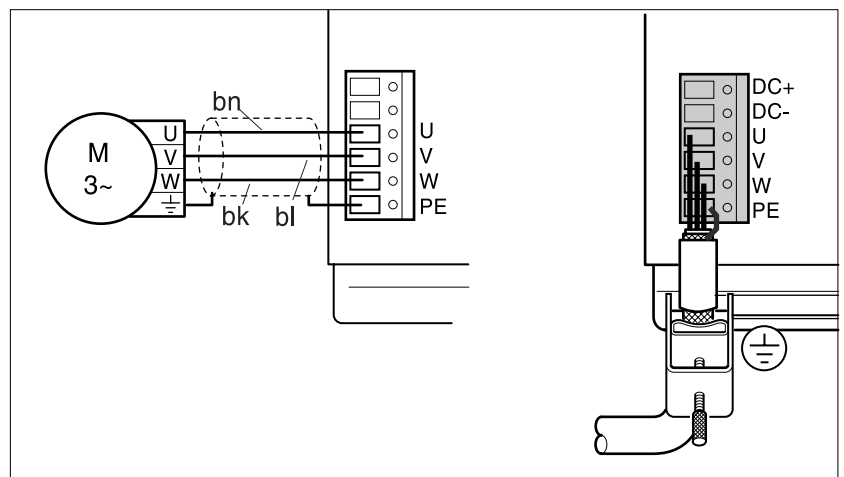


Fig. 4.8 Motor cable connection to unit

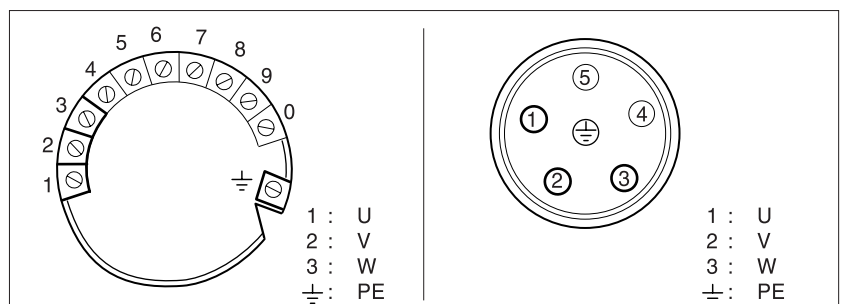


Fig. 4.9 Motor cable connection to motor, motor plug from the outside

- Cable cross-section: 1.5 mm²
- Maximum cable length: 20 m
- The tightening torque for the terminal screws is 0.4 Nm-0.5 Nm.
- The individual conductors of the cable can be connected without wire end ferrules.
- For units with a hood, the cable must be routed upwards from the point of connection.
- For the PE connection you must use the shield drain wires.

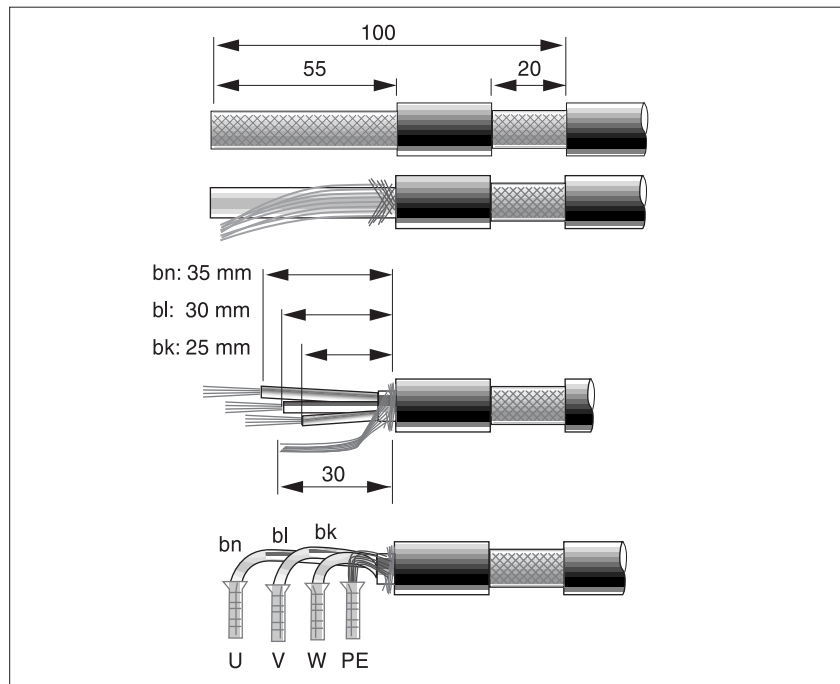


Fig. 4.10 Preparing the motor cable

Wire end ferrules

If you use wire end ferrules, pay attention to the following:

- Only use square end ferrules to ensure that they cannot work loose after screws are tightened.
- Do not use end ferrules with a plastic collar on wires with a cable diameter of 2.5 mm².
- The wire must fill the wire end ferrule over its whole length. Only then has the connection been safely carried out, ensuring maximum current carrying capacity and vibration resistance.

EMC measures

The motor cable is a source of interference and must be carefully laid:

- The shield braiding of the motor cable must be connected to the motor housing and to the unit housing as well as to the switch cabinet entry with a large surface area connection. Use the supplied shielded terminal for the connection to the housing.
- The motor cable and signal cables must be laid at a distance of at least 20 cm from each other. If the distance is less than this, the motor cable and signal cables must be separated by grounded screening plates.

4.4.4 Motor connection with holding brake to TLC51xP



DANGER!

*Danger of high voltages from inductance!
Do not touch motor cable wires and contacts while the motor is moving. Even when they are not connected to the positioning controller, motors will build up dangerous induced voltages if the motor shaft is turned. Make sure during installation that the motor cannot be driven by another device.*

Connecting the motor cable

- ▶ Connect motor wires and protective conductor to terminals U, V, W and PE. Wiring assignment for motor and unit must match.

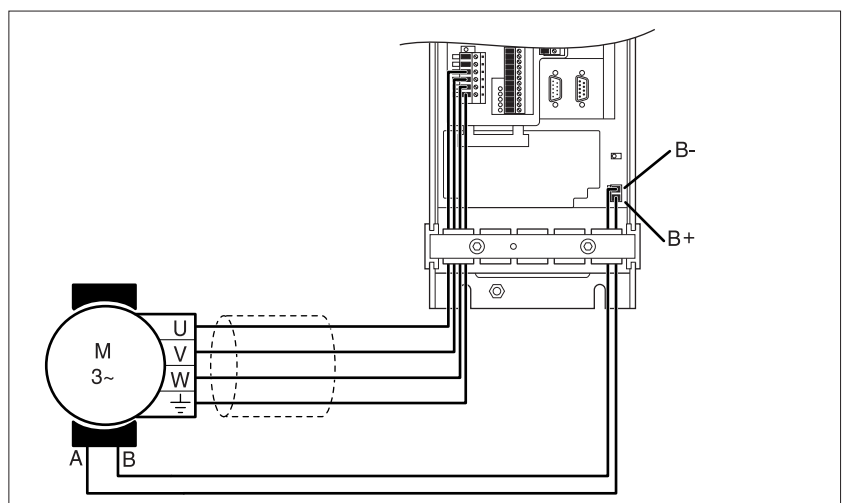


Fig. 4.11 Connection of motor cable and holding brake controls to the unit

You will find details on connecting the motor cable to the motor, the use of wire end ferrules and EMC measures in the chapter entitled 'Motor connection TLC51x' from page 4-15.

A holding brake connection can be built into the unit as an optional extra.

- ▶ Connect the holding brake control wires to terminals B+ und B-.

The power required by the holding break controller depends on the holding brake switching current:

holding brake controller input current [A]= 0.5 A + switching current [A]

The voltage reduction function is described in the chapter entitled 'Braking function with TL HBC' from page 7-26.

4.4.5 Connecting the 24 V supply voltage

- ▶ Route the 24 V supply lines to the unit via a grounded 24 V_{DC} transformer (PELV).

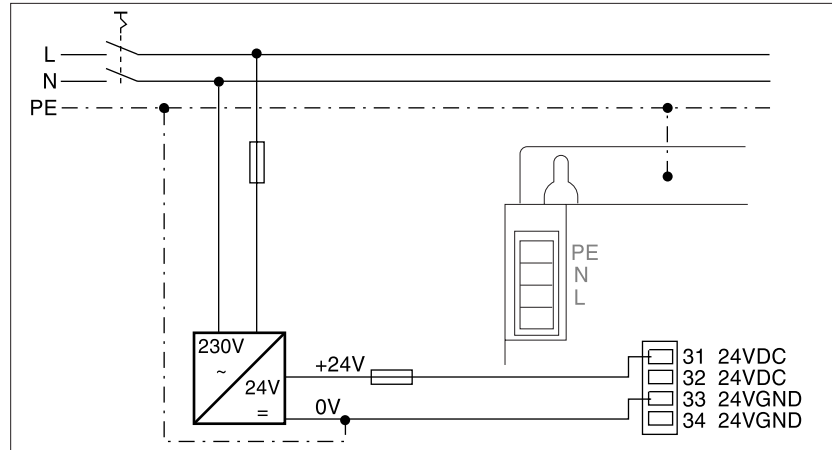


Fig. 4.12 24 V connection

Pin	Signal	Active	Explanation	I/O
31	24VDC	-	24 V _{DC} supply voltage, internally connected to pin 32	-
32	24VDC	-	24 V _{DC} supply voltage	-
33	24VGND	-	GND for 24 V _{DC} voltage, connected internally to pins 34 and 16 (ACTIVE_GND)	-
34	24VGND	-	GND für 24 V _{DC} voltage	-

- The second 24 V_{DC} and GND connection can be used as a 24 V output for further consumers or for cascading several Twin Line units; the maximum terminal current is 7.5 A.
- In selecting your 24 V power supply unit make sure you take into account any additional consumers, such as the holding brake and the holding brake controller.
- To ensure that the position of the motor is preserved when the supply voltage to the power unit is switched off, the external 24 V supply voltage must remain switched on, and no external torque may affect the motor.
- Lay the 24 V supply line at a distance of at least 20 cm from other lines to ensure EMC protection. For cable lengths of more than 2 m, make a twisted pair of the 0 V and 24 V supply wires.
- The tightening torque for the terminal screws 1-34 is 0.22 Nm-0.25 Nm.

Version P

- Fan and holding brake controller are already connected to pins 32 and 34.

4.4.6 Connection to the signal interface

The positioning controller can be controlled manually or automatically via the lines of the signal interface.

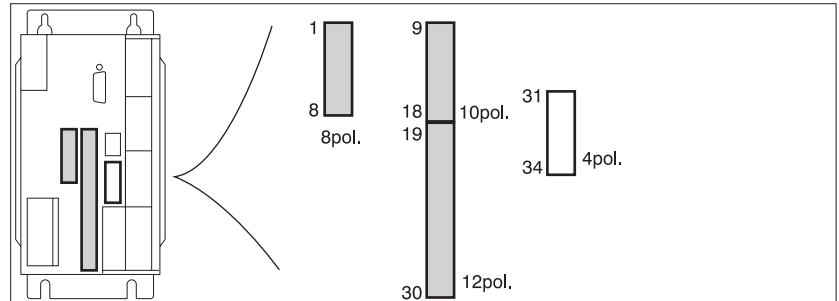


Fig. 4.13 Signal interface: 1-30: inputs / outputs, 31-34: 24 V connection

- Connection**
- ▶ The connections of the signal interface should be wired up as required by the operating mode selected. See also the wiring examples starting on page 4-44.
 - ▶ Connect inputs $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{STOP}}$ to the +24 V voltage if they are not being used or switch them out via the parameter 'Settings.SignEnabl'. See page 7-22.

The terminal blocks of the signal interface must only be wired up when the unit is in a de-energized state.

Variable interface connections

The assignment of signal interface connections depends on the switching status of the 'Settings.IO_mode' parameter, see page 6-3:

- 'IO_mode' = '0': input signals are used for setting addresses and baud rates in field bus operation. This is the preset on switching on the positioning controller.
- 'IO_mode' = '1': input signals I_0 to I_13 and output signals Q_0 to Q_4 can be freely set.
- 'IO_mode' = '2': input / output signals are fixed.

The following table shows the assignment of interface connections. Identical signals for all assignments are shown in the left-hand column by an arrow '⇒'.

Pin	Signal at IO_mode=0/1	Signal at IO_mode=2	active	Explanation	I/O
1	ADR_1 / I_8	DATA_1	high	ADR_1: Bit 0 for the network address DATA_1: Bit 0 for selecting a list number	I
2	ADR_2 / I_9	DATA_2	high	ADR_2: Bit 1 for the network address DATA_2: Bit 1 for selecting a list number	I
3	ADR_4 / I_10	DATA_4	high	ADR_4: Bit 2 for the network address DATA_4: Bit 2 for selecting a list number	I
4	ADR_8 / I_11	DATA_8	high	ADR_8: Bit 3 for the network address DATA_8: Bit 3 for selecting a list number	I
5	ADR_16 / I_12	DATA_16	high	ADR_16: Bit 4 for the network address DATA_16: Bit 4 for selecting a list number	I
6	ADR_32 / I_13	DATA_32	high	ADR_32: Bit 5 for the network address DATA_32: Bit 5 for selecting a list number	I
7	⇒	IO24VDC	-	Power supply for inputs / outputs	I
8	⇒	IO24VDC	-	Power supply for inputs / outputs	I
9	Q_0 / Q_0	AUTOM_ACK	high	AUTOM_ACK: acknowledgment signal to AUTOM signal	O
10	Q_1 / Q_1	AXIS_ADD_INF O	high	AXIS_ADD_INFO: additional information on current movement	O
11	Q_2 / Q_2	AXIS_END	high	AXIS_END: end of movement processing, drive at standstill	O
12	Q_3 / Q_3	AXIS_ERR	high	AXIS_ERR: fault detection during movement	O
13	Q_4 / Q_4	RDY_TSO/Q4	high	RDY_TSO: data set ready, active in operating states 4 to 7, max. 400 mA	O
14	⇒	TRIGGER	high	Trigger output, signal value is switched via position / signal list	O
15	⇒	ACTIVE_CON	high	Motor under power, control signal for brake controller TL HBC, output max. 400 mA ¹⁾	O
16	⇒	ACTIVE_GND	high	0 V signal for brake controller TL HBC, internally to 24VGND ¹⁾	O
17	⇒	ANALOG_IN+	-	analogue control input ±10 V	I
18	⇒	ANALOG_IN-	-	analogue control input 0 V, reference potential to pin 17 ANALOG_IN+	I
19	BAUD_1 / I_0	MAN_P	high	BAUD_1: Bit 0 for setting baud rate MAN_P: manual movement, positive motor rotation	I
20	BAUD_2 / I_1	MAN_N	high	BAUD_2: Bit 1 for setting baud rate MAN_N: manual movement, negative motor rotation	I
21	BAUD_4 / I_2	MAN_FAST	high	BAUD_4: Bit 2 for setting baud rate MAN_FAST: manual selection slow or fast	I
22	CAPTURE1 or I_5	FAULT_RESET	high	CAPTURE1: quick input for exact capture of current position data FAULT_RESET: reset fault signal	I
23	⇒	CAPTURE2 or I_6	high	CAPTURE2: quick input for exact capture of current position data	I
24	ADR_64 / I_7	TEACH_IN	high	ADR_64: Bit 6 for the network address TEACH_IN: trigger signal for storing current setpoint in list data memory	I
25	⇒	$\overline{\text{REF}}$	low ²⁾	Reference switch signal	I

Pin	Signal at IO_mode=0/1	Signal at IO_mode=2	active	Explanation	I/O
26	⇒	$\overline{\text{LIMP}}$	low ²⁾	limit switch signal positive motor rotation	I
27	⇒	$\overline{\text{LIMN}}$	low ²⁾	limit switch signal negative motor rotation	I
28	⇒	$\overline{\text{STOP}}$	low ²⁾	Quick-Stop	I
29	MODE_2 / I_4	AUTOM	high	MODE_2: bit1 for setting field bus profile AUTOM: automatic mode (high) or manual mode (low), acknowledgement via AUTOM_ACK	I
30	MODE_1 / I_3	ENABLE	high	MODE_1: bit0 for setting field bus profile ENABLE: enable (high) or disable (low) power amplifier	I

1) Version P: Holding brake fix connected

2) Signal level for default setting of 'Settings.SignEnabl' and 'Settings.SignLevel' parameters

Minimum interface connections The following signal interface connections must be made:

- Pin 26: $\overline{\text{LIMP}}$
- Pin 27: $\overline{\text{LIMN}}$
- Pin 28: $\overline{\text{STOP}}$
- Pin 31 and Pin 33: 24 V GND
- Pin 7 and Pin 8 must be connected even if the signal interface is not used.

Cable specification Cables for digital signals:

- Minimum cross-section 0.14 mm², max. cross-section 1.5 mm²
- Maximum length of the minimum cross-section 15 m.

Function The signal interface can be used to control the positioning controller manually or in automated mode, to report operating states and to control peripheral devices.

The signal interface is principally designed for field bus operation. Signal inputs such as MAN_N, MAN_P or AUTOM, and outputs such as AXIS_ERR, AXIS_END or AUTOM_ACK are not required for it. In field bus operation these signals are changed and evaluated via transmitted and received data.

The signal interface can operate in three pin assignment modes:

- Settings for address, baud rate and field bus profile in field bus operation
- free assignment of interface
- fixed assignment of interface

Pin assignment can be changed by means of the 'Settings.IO_mode' parameter, for this see 'Operating modes of the positioning controller', page 6-1.

Setting address and baud rate in field bus operation

Condition: parameter 'Settings.IO_mode' = 0:

After switching on the positioning controller, device address and baud rate can be specified via input signals.

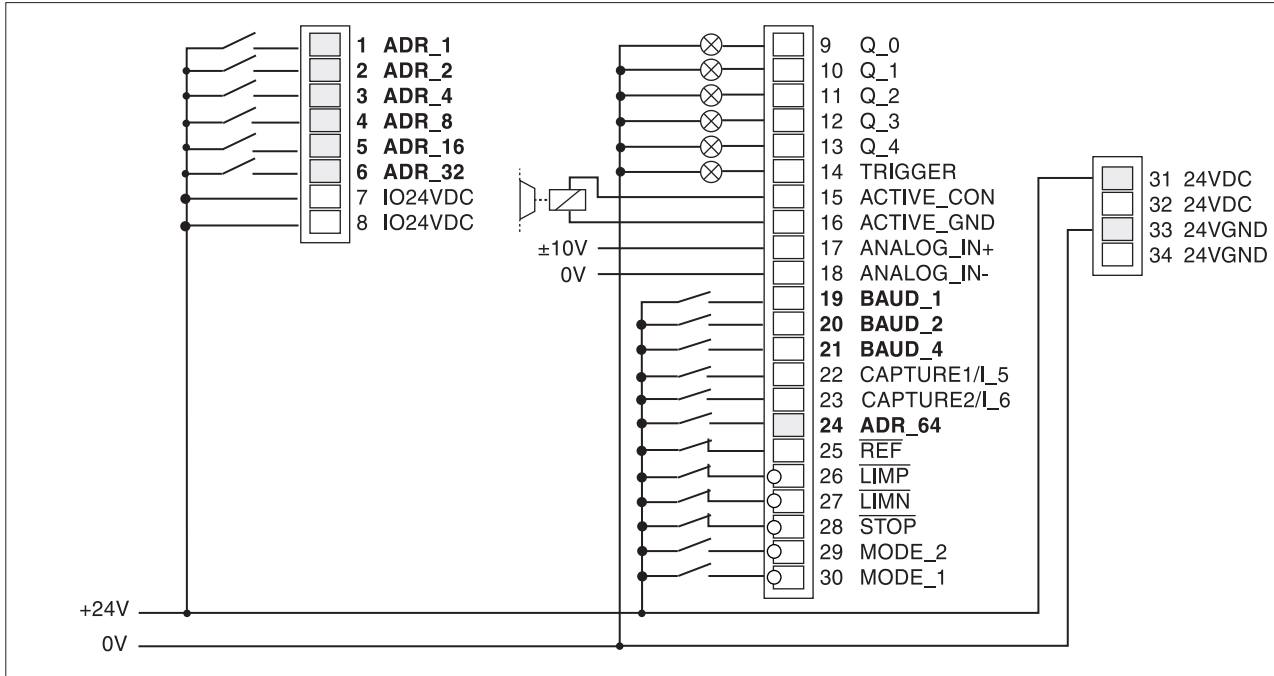


Fig. 4.14 Signal interface inputs for field bus addressing

Network address

The network address is bit-coded via inputs ADR_1 to ADR_64. ADR_1 is the lowest value bit.

Network address:	0	1	2	3	4	5	6	...	125	126	127
Pin: input											
1: ADR_1 ¹⁾	0	1	0	1	0	1	0	...	1	0	1
2: ADR_2 ¹⁾	0	0	1	1	0	0	1	...	0	1	1
3: ADR_4 ¹⁾	0	0	0	0	1	1	1	...	1	1	1
4: ADR_8 ¹⁾	0	0	0	0	0	0	0	...	1	1	1
5: ADR_16 ¹⁾	0	0	0	0	0	0	0	...	1	1	1
6: ADR_32 ¹⁾	0	0	0	0	0	0	0	...	1	1	1
24: ADR_64	0	0	0	0	0	0	0	...	1	1	1

1) Required for DeviceNet

Example: for address 17, inputs ADR_16 and ADR_1 must carry 24 V. The remaining inputs remain open.

Baud rate For field bus modules CAN-C and RS485-C, the baud rate can be specified bit-coded at inputs BAUD_1 to BAUD_4 when the unit is started up. BAUD_1 is the lowest value bit.

Baud rate CAN-C	Baud rate RS485-C	BAUD_4	BAUD_2	BAUD_1
20 kBaud	1200 Baud	0	0	0
125 kBaud ¹⁾	9600 Baud	0	0	1
250 kBaud ¹⁾	19,2 kBaud	0	1	0
500 kBaud ¹⁾	38,4 kBaud	0	1	1
800 kBaud	reserved	1	0	0
1 MBaud	reserved	1	0	1
reserved	reserved	1	1	0
reserved	reserved	1	1	1

1) Can be set in DeviceNet

If an illegal baud rate is set, field bus processing cannot be activated. The Twin Line unit issues an error message on a connected operating unit. A network branch can only be run on one baud rate which must be set on all devices.

Profile setting For the CAN-field bus module, the field bus profile can be set in bit-coded form via inputs MODE_1 and MODE_2 when the unit is started up.

Profile	MODE_2	MODE_1
CAN-Bus	0	0
CANOpen-Profil	0	1
DeviceNet-Profil	1	0

A network branch can only be run on one network profile which must be set on all devices.

Free assignment of interface Parameter 'Settings.IO_mode' = 1:

With free interface assignment, inputs I_0 to I_13 and outputs Q_0 to Q_4 can be assigned additional functions by means of field bus commands.

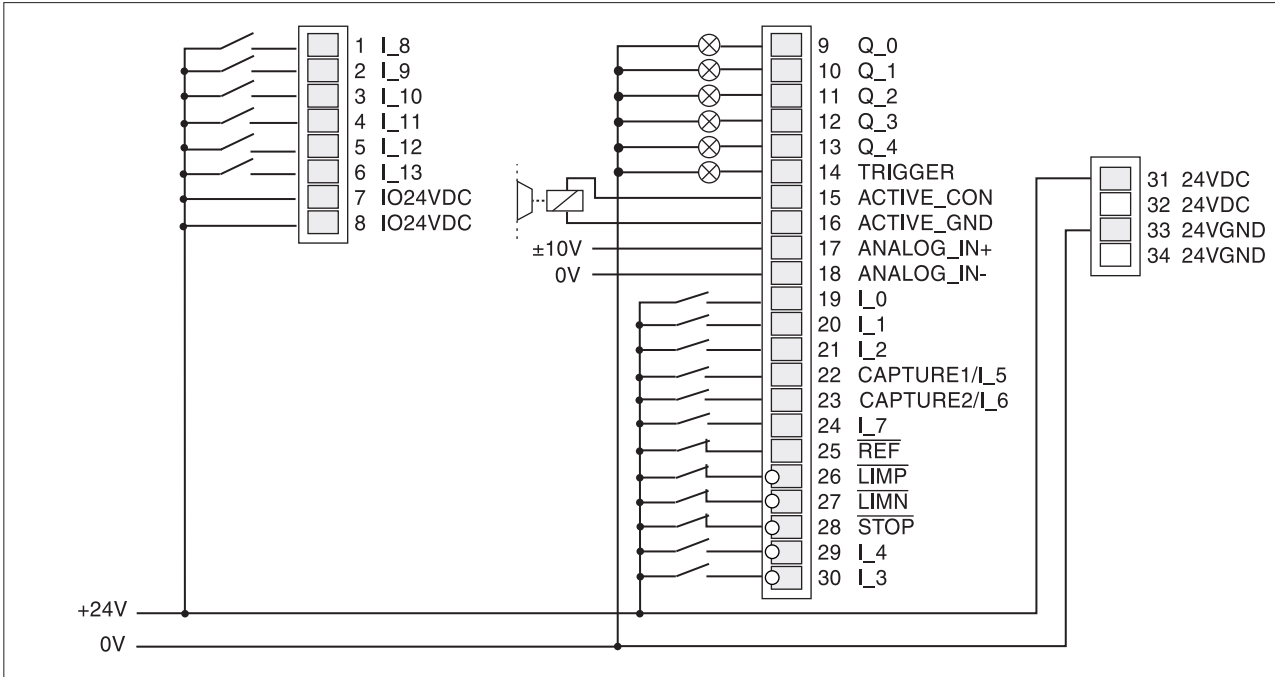


Fig. 4.15 Signal interface inputs and outputs for free assignment

Input and output signal states can be read and changed via parameters.:

- Read input signals via the 'I/O.IW1_act' parameter“
- write output signals via the 'I/O.QW0_act' parameter.

You will find details on this in 'Checking inputs and outputs' on page 5-12.

Fixed interface assignment Parameter 'Settings.IO_mode' = 2:

With fixed assignment, control signals and switching signals for manual mode and for teach-in are available at the signal interface.

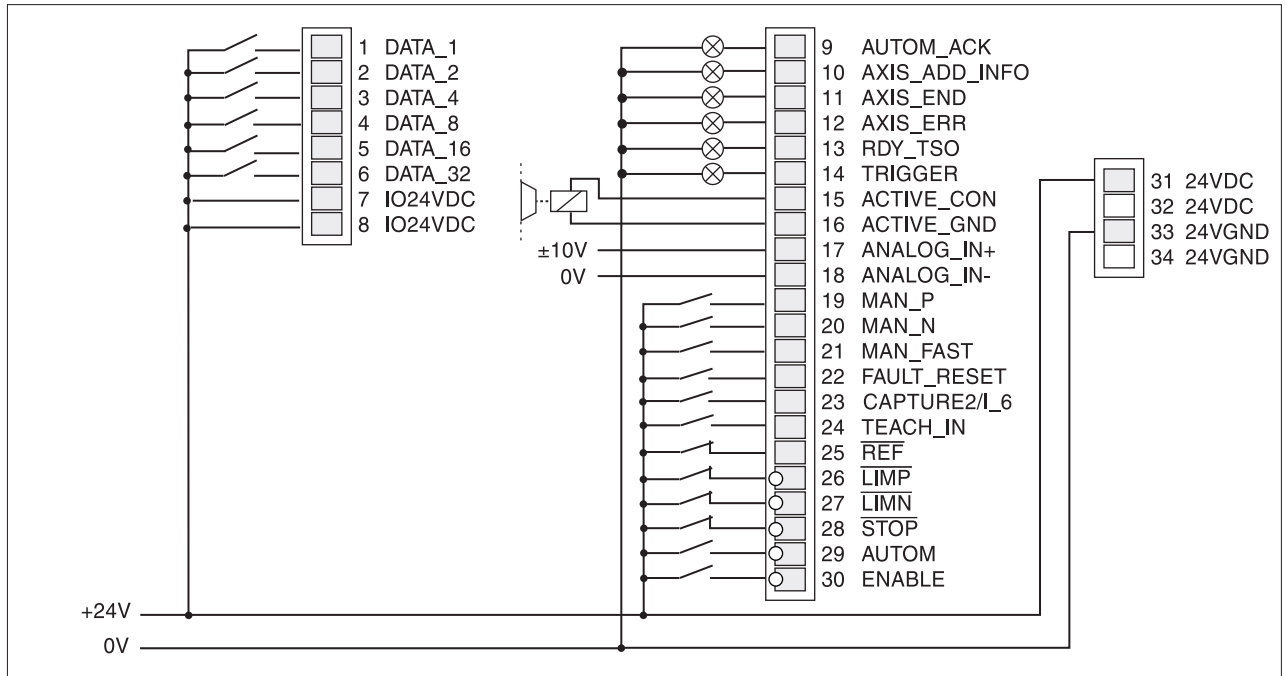


Fig. 4.16 Signal interface inputs and outputs for fixed assignment

Manual operation is described on page 6-9 in the chapter 'Operating modes of the positioning controller' and teach-in mode on page 7-7 in the chapter 'Functions of the positioning controller'.

Signal interface LEDs

Five LEDs at the signal interface show when current is flowing through signal inputs.

The positioning controller will abort movement as soon as one of the signal inputs LIMP, LIMN or STOP becomes active.

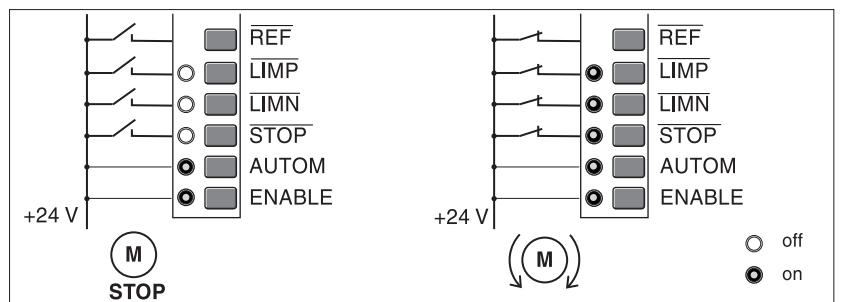


Fig. 4.17 LED display of signal interface

Enabling of the input signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{STOP}}$ and evaluation as active low or high can be changed via the parameters 'Settings.SignEnabl' and 'Settings.SignLevel'. See page 7-22.

Output signals remain unchanged for at least 0.5 ms.

4.4.7 Connection to the RS232 interface

Connection The RS232 interface, equipped with a 9-pole Sub-D socket with UNC thread is wired up 1:1 with the PC or with the Twin Line HMI. The positioning controller supplies the Twin Line HMI with the operational voltage via pin 9.

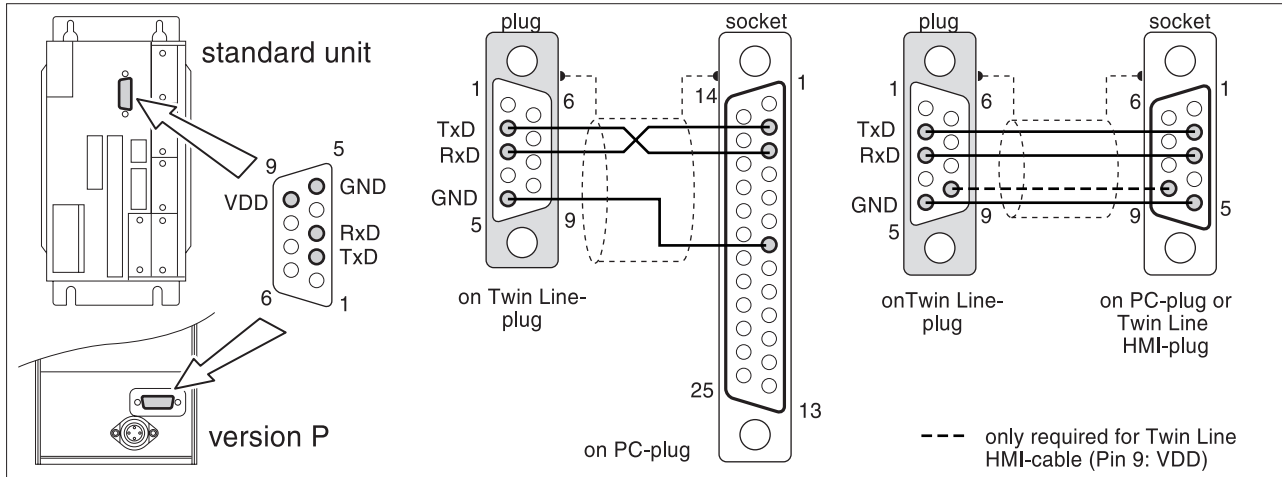


Fig. 4.18 Cables for the RS232 interface at the PC or Twin Line HMI View: Solder side of cable connectors

Pin	Signal	Colour ¹⁾	Pair	Explanation	I/O
1	-	-	-	Not assigned	-
2	TxD	brown	-	Send data to the input device	O
3	RxD	white	-	Data received from the input device	I
4	-	-	-	Not assigned	-
5	GND	green	-	Ground line	-
6	-	-	-	Not assigned	-
7	-	-	-	Not assigned	-
8	-	-	-	Not assigned	-
9	VDD	yellow	-	10 V _{DC} supply for the TL HMI	O

1) Colour details refer to the cable which is available as an accessory.

- Cable specification**
- Screened cable
 - Cable length maximum 15 m
 - Minimum cross-section of the signal conductors 0.25 mm², for supply voltage and ground line 0.5 mm²
 - Shield grounded at both ends

Function The positioning controller is started up and operated via the serial RS232 interface. Use the Twin Line Control Tool operating software here to connect up the Twin Line HMI hand-held operating unit or a PC. You can plug the Twin Line HMI directly into the unit or connect it by cable to the unit. It is supplied with voltage by the unit. Networking of additional units via the RS232 interface is not possible.

4.4.8 Connection to the RS422-C module

Module interface The RS422-C module is equipped with a Sub-D socket, 15-pin with an M3 threaded connection.

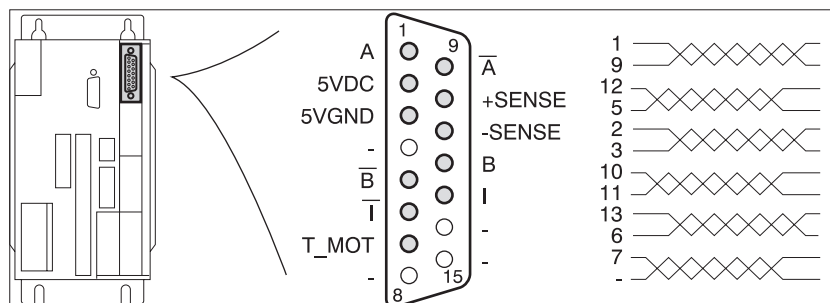


Fig. 4.19 Interface of the encoder module

Pin	Signal	Colour ¹⁾	Pair	Explanation	I/O
1	A	white	1	Encoder signal channel A	I
9	\bar{A}	brown	1	Channel A, negated	I
12	B	green	2	Encoder signal channel B	I
5	\bar{B}	yellow	2	Channel B, negated	I
2 ²⁾	5VDC	rot	3	Encoder supply, 5 V, max. 300 mA	O
3	5VGND	blue	3	Encoder supply, ground	O
10	+SENSE	violet	4	Sense line positive, connect on encoder side to 5V _{DC} ³⁾	I
11	-SENSE	black	4	Sense line negative, connect on encoder side to 5V _{GND} ³⁾	I
13	I	grey	5	Channel index pulse	I
6	\bar{I}	pink	5	Channel index pulse, negated	I
7 ²⁾	T_MOT (5VDC)	grey / pink	6	Line monitoring, connect signal at encoder to pin 2: 5VDC	I
4	-	red / blue	6	Not assigned	-
8	-	-	-	Not assigned	-
14	-	-	-	Not assigned	-
15	-	-	-	Not assigned	-

1) Colour details refer to the cable which is available as an accessory.

2) Connect together signals 2 (5VDC) and 7 (T_MOT) for line monitoring in the encoder plug

3) Sense line must be connected for activating the 5VDC.

In the case of units with a hood the cable must be routed downwards from the connection.

Cable specification

- Shielded cable
- Minimum diameter of signal wires 0.25 mm², 5VDC and 5VGND 0.5 mm²
- Twisted-pair wires
- Shield grounded at each end
- Maximum cable length 100 m



CAUTION!

*Destruction of external encoder!
Only connect cable when power supply is switched off.
Otherwise the encoder can be destroyed.*

Function

Setpoints are specified via externally injected A/B signals and index pulse under electronic gear operating mode

The RS422-C module receives the A/B encoder signals and index pulse as a position setpoint for the positioning controller. The maximum input frequency is 400 kHz.

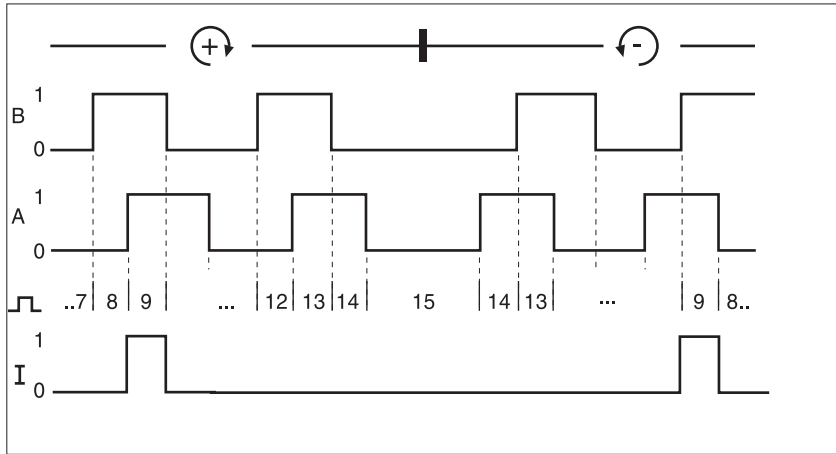


Fig. 4.20 Time diagram with A-, B and index pulse signal, counting forwards and backwards

Monitoring

The T_MOD signal displays wire break at low signal.



Incorrect transmission of position data when voltage drop excessive. The difference in the ground potential of 24VGND between two units connected via ESIM1-C/ ESIM2-C or RS422-C must be less than 1 volt. Otherwise use cable of larger cross-section for 24VGND.

4.4.9 Connection to the PULSE-C module

Module interface The PULSE-C module is fitted with a 15-pole sub-D plug with an M3 thread.

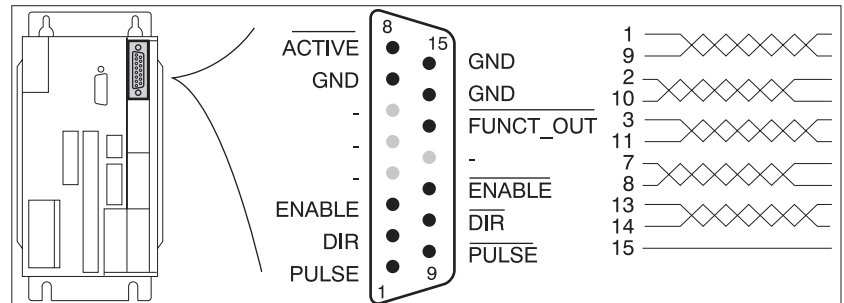


Fig. 4.21 Interface of the pulse direction module

Pin	Signal	Colour ¹⁾	Pair	Explanation	I/O
1	PULSE (PV)	white	1	motor step „Pulse“ or motor step forwards „PV“	I
9	$\overline{\text{PULSE}}$ ($\overline{\text{PV}}$)	brown	1	motor step „Pulse“ or motor step forwards „PV“, inverted	I
2	DIR (PR)	green	2	sense of rotation „Dir“ or motor step backwards „PR“	I
10	$\overline{\text{DIR}}$ ($\overline{\text{PR}}$)	yellow	2	sense of rotation „Dir“ or motor step backwards „PR“, inverted	I
3	ENABLE	grey	3	enable signal	I
11	$\overline{\text{ENABLE}}$	pink	3	enable signal, inverted	I
7	GND	grey/pink	4	ground, internally via resistor to 24 VGND	I
8	$\overline{\text{ACTIVE}}$	red/blue	4	drive ready	O
13	$\overline{\text{FUNCT_OUT}}$	white/green	5	reserved, internally to Low level	O
14	GND	brown/green	5	ground, internally via resistor to 24 VGND	I
15	GND	white/yellow	6	ground, internally via resistor to 24 VGND	I
4	-	blue	-	not assigned	-
12	-	red	-	not assigned	-
5	-	black	-	not assigned	-
6	-	purple	-	not assigned	-

1) Colour specifications relate to the cable which is available as an accessory.

For units with a hood, the cable must be led upwards from the point of connection.

Cable specification

- Shielded cable
- Minimum diameter of signal wires 0.14 mm²
- Twisted-pair wires
- Grounding of screen at both ends
- Maximum length at RS422 connection 100 m with open collector connection up to 10 m

Function

Setpoints are specified via externally injected pulse direction signals under electronic gear operating mode

Reference signals for step-by-step positioning of the motor and control signals for the motor current, angular resolution and for enabling the power amplifier are transmitted via the pulse direction interface. At the same time the unit signals operational readiness of the drive or a possible malfunction via the interface.

PULSE (PV), DIR (PR) The square-wave signals PULSE (PV) and DIR (PR) can be combined for two operating modes. The operating mode is set with the parameter 'M1.PULSE-C'.

- PULSE/DIR: Pulse direction signal

PV/PR: Pulse_{forward} - Pulse_{backward} signal

Pulse direction operating mode

The motor executes an angular step with the leading edge of the PULSE signal. The direction of rotation is controlled by the DIR signal.

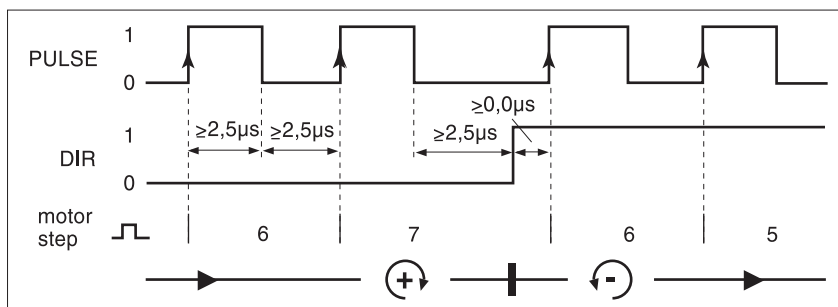


Fig. 4.22 Pulse direction signal

Pin	Signal	Function	Value
1, 9	PULSE	Motor step	low -> high
2, 10	DIR	Clockwise direction of rotation Anticlockwise direction of rotation	low / open high

Pulse_{forward} - pulse_{backward} operating mode

The PV (PULSE) signal is used to execute a movement of the motor in a clockwise direction, and the PR (DIR) signal a movement in an anticlockwise direction.

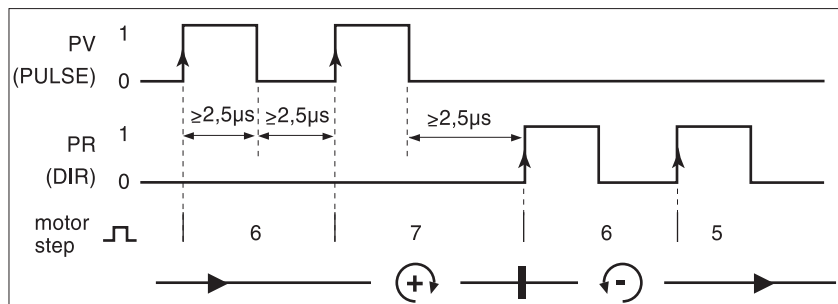


Fig. 4.23 Pulse_{forward}/Pulse_{backward} signal

Pin	Signal	Function	Value
1, 9	PULSE (PV)	PV: Step in a clockward direction of rotation	low -> high
2, 10	DIR (PR)	PR: Step in anticlockwise direction of rotation	low -> high

The maximum permissible frequency of PULSE (PV) and DIR (PR) is 200 kHz.

ENABLE The ENABLE signal enables the power amplifier so that the motor can be controlled.

Pin	Signal	Function	Value
3, 11	ENABLE	Disable power amplifier Enable power amplifier	low / open high

If there is no operating fault, the $\overline{\text{ACTIVE}}$ output displays operational readiness for approx 100 ms after the power amplifier is enabled.

$\overline{\text{ACTIVE}}$ The output shows the operational readiness of the positioning controller.

Pin	Signal	Function	Value
8	$\overline{\text{ACTIVE}}$	Power amplifier is disabled Power amplifier is enabled	high low

$\overline{\text{ACTIVE}}$ is an open collector output to GND. The logically negated signal function is available at the ACTIVE_CON output of the signal interface.

Circuit of the signal inputs

It is recommended that signal inputs be switched via the RS422 interface.

The diagram shows the circuitry of the signal inputs PULSE (PV), DIR (PR) and ENABLE. Up to 10 inputs of the PULSE-C module can be connected to an RS422-C transmitter.

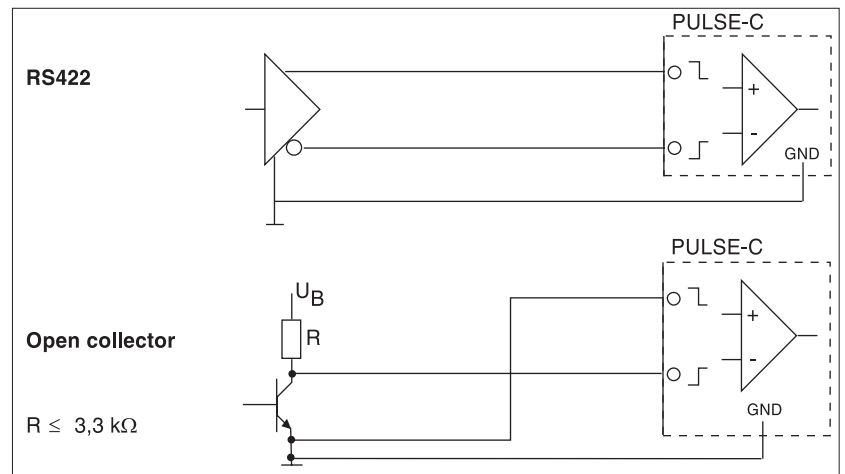


Fig. 4.24 Circuit of the signal inputs, L: Cable length

For cable lengths ≤10 m and frequencies ≤50 kHz, Open Collector outputs can be used if interference resistance requirements are low.

4.4.10 Connection to the RM-C module

The optional encoder interface is only included in units with rotation monitoring.

Module interface The interface is fitted with a 15-pole, M3 threaded Sub-D socket.

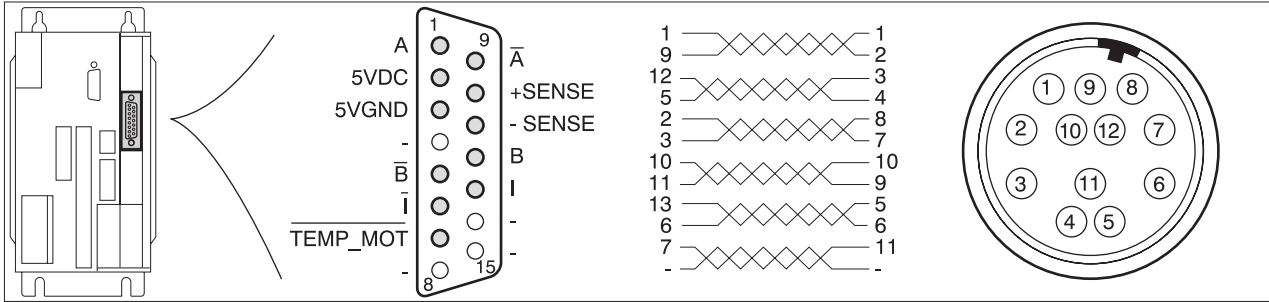


Fig. 4.25 Interface for rotation monitoring, view of motor plug:soldering side

Pin	Signal	Colour ¹⁾	Pair	Explanation	I/O
1	A	white	1	encoder signal channel A	I
9	\bar{A}	brown	1	channel A, inverted	I
12	B	green	2	channel B	I
5	\bar{B}	yellow	2	channel B, inverted	I
2	5VDC	red	3	Encoder power supply, 5 V, max. 300 mA	O
3	5VGND	blue	3	Encoder power supply, ground	O
10	+SENSE	purple	4	Sense wire positive ²⁾	I
11	-SENSE	black	4	Sense wire negative ²⁾	I
13	I	grey	5	Index pulse channel	I
6	\bar{I}	pink	5	Index pulse channel, inverted	I
7	$\overline{\text{TEMP_MOT}}$	grey/pink	6	temperature error, inverted	I
4	-	red/blue	6	not assigned	-
8	-	-	-	not assigned	-
14	-	-	-	not assigned	-
15	-	-	-	not assigned	-

1) Colour details refer to the cable available as an accessory.

2) Sense line must be connected for activating the 5VDC.

For units with a hood, the cable must be led upwards away from the terminals.

Cable specification

- Shielded cable
- Minimum cross-section of signal wires 0.25 mm², 5VDC and 5VGND 0.5 mm²
- Twisted-pair wires
- Screen earthed on both sides
- Maximum cable length 100 m



Function

ATTENTION!

*Destruction of external encoder!
Only connect cable when power supply is switched off.
Otherwise the encoder can be destroyed.*

The connection is used to convey the angular position of the motor incrementally by means of A/B square-wave signals. The unit detects stepping errors by making comparisons with the setpoint and reports a contouring error if the threshold value of 6.4° is exceeded. Monitoring can be switched off via the "Settings.monitorM" parameter, see Chapter entitled 'Setting phase current and device parameters' from page 5-7.

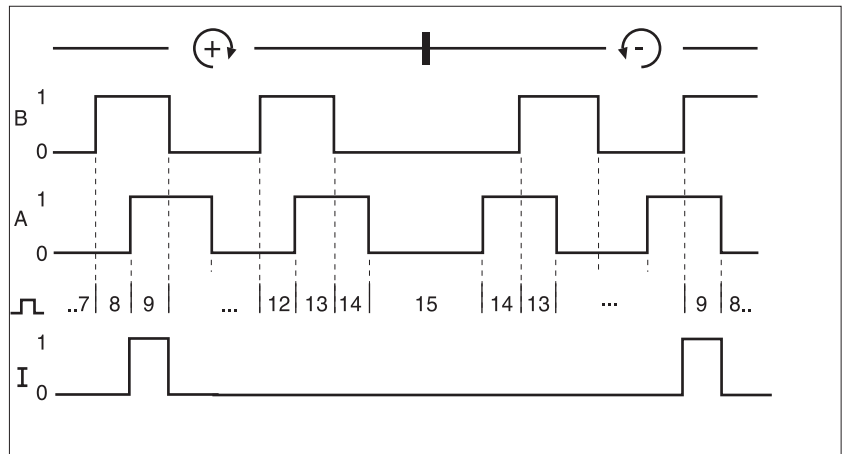


Fig. 4.26 Time diagram with A, B and index pulse signals, counting forwards and backwards

Monitoring

The winding temperature of the motor is monitored via the TEMP_MOT signal. The signal also shows whether the encoder is connected.

Pin	Signal	Function	Value
7	TEMP_MOT	Temperature range OK	high
		Motor overheating or cable break	low

Encoder type

In order to use the monitoring function, an encoder with 1000 lines must be fitted.

4.4.11 Connection to the PBDP-C module

Module interface The PBDP-C module is fitted with a 9-pole, SUB-D socket, with UNC thread.

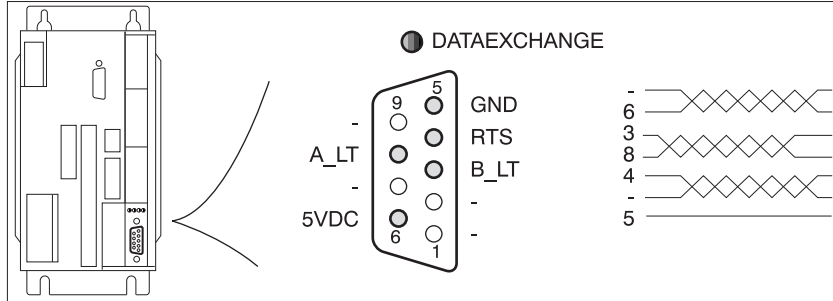


Fig. 4.27 Field bus module interface connection

Pin	Signal	Colour	Pair	Explanation	I/O
1	-	-	1	not assigned	-
6	5VDC	-	1	power supply, max. 10 mA for terminator	O
2	-	-	-	not assigned	-
7	-	-	-	not assigned	-
3	B_LT	-	2	data line, inverted	I/O
8	A_LT	-	2	data line	I/O
4	RTS	-	3	transmission request	O
9	-	-	3	not assigned	-
5	GND	-	-	ground	-

A bus terminal forms the docking station to the Profibus. Data lines between module and bus terminal are wired up 1:1.

Terminals A_LT and B_LT must be connected to wires A and B in the network by way of the minimum wiring requirement.

For units with a hood, the cable must led downwards from the point of connection.

Cable specification for connection to a bus terminal

- Screened cable
- Minimum cross-section of signal wires: 0.14 mm²
- Twisted-pair wires
- Screen grounded at both ends
- Maximum length 100 m



To protect against interference, the screen for digital cables is connected at both ends. Differences in potential can lead to excessive current in the screen, and these have to be prevented by means of bonding lines. Cable cross-section for lengths up to 200: 16 mm², for lengths over 200 m: 20 mm².

- Function* Using the PBDP-C field bus module, the positioning controller can be connected as a slave device to a Profibus-DP network.
- The positioning controller receives data and commands from a higher-ranking device on the bus, or master. By way of acknowledgement the controller sends status information such as device status and processing status back to the master device. The exchange of data is carried out using a special communications protocol.
- Data are exchanged cyclically between master and slave devices. Each device in the network is identified by means of a unique device address which can be set.
- Setting the address* The address can be set via the 'M4.addrPbd' parameter or via inputs ADR_1 to ADR_64 of the signal interface, see page 4-22.
- Baud rate* The baud rate is determined by the transmission speed of the master device.
- Display* The DATAEXCHANGE LED displays signal connection to the Profibus master device.
- Field bus manual* The integration of a Twin Line unit into the field bus is described in the relevant field bus manuals from SIG Positec in the chapters on installation and set-up.

4.4.12 Connection to the CAN-C module

Module interface The CAN-C module is fitted with a SUB-D plug and a SUB-D socket, both 9-pole with UNC thread. Pin assignment is identical for both interface connections.

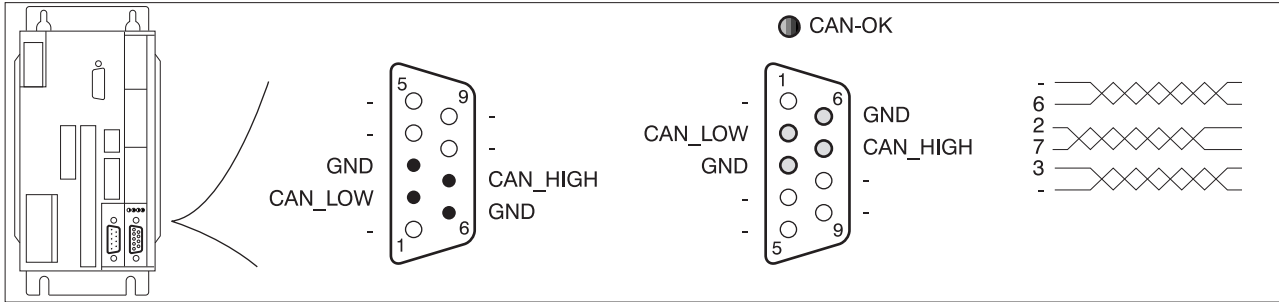


Fig. 4.28 Interface connections of the field bus module with plug and socket

Pin	Signal	Colour ¹⁾	Pair	Explanation	I/O
1	-	-	1	not assigned	-
6	GND	green	1	ground	-
2	CAN_LOW	white	2	Data wire, inverted	I/O
7	CAN_HIGH	brown	2	Data wire	I/O
3	GND	grey	3	ground	-
8	-	pink	3	not assigned	-
4	-	-	-	not assigned	-
9	-	-	-	not assigned	-
5	-	-	-	not assigned	-

1) Colour details refer to the cable available as an accessory – the colours used match the CAN guidelines. ! Remember that the colours do not match the DeviceNet specification.

For units with a hood, the cable must be led downwards from the point of connection.

Cable specification

- Screened cable
- Minimum cross-section of signal wires: 0.14 mm²
- Twisted-pair lines
- Screen grounded at both ends
- Maximum length dependent on the number of devices, the baud rate and signal times. The higher the baud rates, the shorter the bus cable has to be. Guide values: 40 m at 1 Mbit/s, 500 m at 100 kbit/s
guide values for DeviceNet: 100 m at 500 kbit/s, 500 m at 125 kbit/s



To protect against interference, the screen for digital cables is connected at both ends. Differences in potential can lead to excessive current in the screen, and these have to be prevented by means of bonding lines. Cable cross-section for lengths up to 200: 16 mm², for lengths over 200 m: 20 mm².

Function With the CAN-C field bus module, the positioning controller can be connected as a slave to the following networks:

- CAN-Bus
- CANOpen
- DeviceNet.

The positioning controller receives data and commands from a higher-ranking device on the bus, or master. By way of acknowledgement the controller sends status information such as device status and processing status back to the master device. The exchange of data is carried out using a special communications protocol.

Every device in the network is identified by means of a unique address which can be set.

CAN bus display The „CAN-OK“ LED on the CAN-C module lights for approx. two seconds when the field bus data have been correctly received.

CANOpen display The „CAN-OK“ LED on the CAN-C module lights up when a connection to the device exists. If the connection is broken, the LED flashes: 0.5 sec on / 0.5 sec off.

DeviceNet display The „CAN-OK“ LED on the CAN-C module displays the status of the DeviceNet node:

DeviceNet status	Display
OFFLINE	flashes (0.2 sec on / 0.8 sec off)
ONLINE (Duplicate MAC ID Check)	flashes (0.8 sec on / 0.2 sec off)
LINK_OK	on
TIMEOUT/FAILURE	flashes (0.2 sec on / 0.2 sec off)

Setting the address The address can be set via the 'M4.addrCan' parameter (see page 12-14) or via inputs ADR_1 to ADR_64 of the signal interface (see page 4-22).

Baud rate The baud rate can be set with the 'M4.baudCan' parameter (see page 12-14) or via inputs BAUD_1 to BAUD_4 of the signal interface (see page 4-23).

Field bus profile The field bus profile can be set with the „M4.profilCAN“ parameter (see page 12-14) or via inputs MODE_1 and MODE_2 of the signal interface (see page 4-23).

Terminating resistors A terminating resistor of 120 Ω must therefore be connected at both ends. You will find an appropriate terminator plug in the chapter entitled „Accessories and spare parts“.

Field bus manual The integration of a Twin Line unit into the field bus is described in the relevant field bus manual from SIG Positec in the chapter on installation and set-up.

4.4.13 Connection to the RS485-C module

Module interface The RS485-C module is fitted with a SUB-D socket and a SUB-D plug, both 9-pole with UNC thread. Pin assignment is identical for both interface connections.

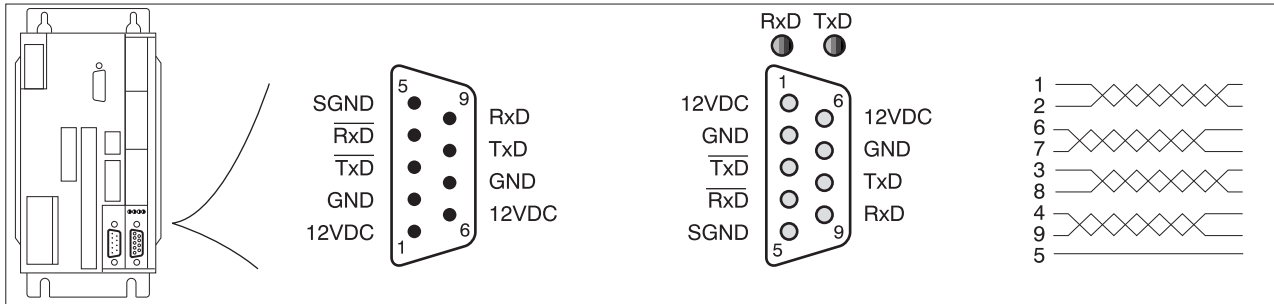


Fig. 4.29 Field bus module interface connection

Pin	Signal	Colour	Pair	Explanation	I/O
1	12VDC	-	1	power supply	O
6	12VDC	-	1	power supply	O
2	GND	-	2	ground for 12VDC power supply	O
7	GND	-	2	ground for 12VDC power supply	O
3	TxD	-	3	Transmitted data	O
8	TxD̄	-	3	Transmitted data, inverted	O
4	RxD	-	4	Received data	I
9	RxD̄	-	4	Received data, inverted	I
5	SGND	-	-	ground	-

Only one 12VDC output of the two Sub-D connections may be loaded with a current of max. 150 mA.

Cable specification

- Screened cable
- Minimum cross-section of signal wires: 0.14 mm²
- Twisted-pair wires
- Screen grounded at both ends
- Maximum length 400 m

For units with a hood, the cable must be led downwards from the point of connection.



To protect against interference, the screen for digital cables is connected at both ends. Differences in potential can lead to excessive current in the screen, and these have to be prevented by means of bonding lines. Cable cross-section for lengths up to 200: 16 m², for lengths over 200 m: 20 mm².

- Function* Using the RS485-C field bus module, the positioning controller can be connected to a serial bus as a slave device.
- The positioning controller receives data and commands from a higher-ranking device on the bus, a master device. By way of acknowledgement the controller sends status information such as device status and processing status back to the master device. The exchange of data is carried out using a special communications protocol.
- Every device in the network is identified by means of a unique address which can be set.
- Display* Two LEDs on the RS485-C module show the transfer of transmitted and received data.
- Setting the address* The address can be set via the 'M4.addrSer' parameter or via inputs ADR_1 to ADR_16 of the signal interface. See page 4-22.
- Baud rate* The baud rate can be set via the 'M4.baudSer' parameter or via inputs BAUD_1 to BAUD_4 of the signal interface, see page 4-23.
- Field bus manual* The integration of a Twin Line unit into the field bus is described in the relevant field bus manual from SIG Positec in the chapter on installation and set-up.

4.4.14 Connection to the IBS-C module

Module interface The IBS-C module is fitted with a Sub-D plug for remote-in and a Sub-D socket for Remote-out, both 9-pole with UNC thread.

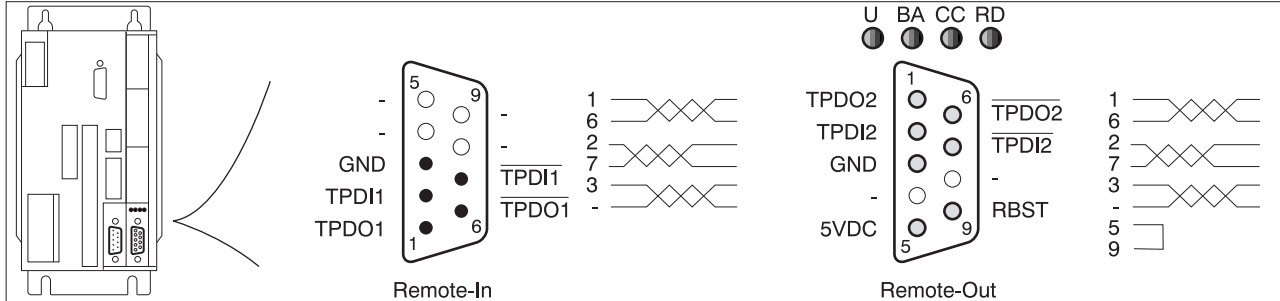


Fig. 4.30 Field bus module interface connection

Pin	Signal Remote-In	Signal Remote-Out	Colour ¹⁾	Pair	Explanation	I/O
1	TPDO1	TPDO2	white	1	received data	I
6	$\overline{\text{TPDO1}}$	$\overline{\text{TPDO2}}$	brown	1	received data, inverted	I
2	TPDI1	TPDI2	green	2	transmitted data	O
7	$\overline{\text{TPDI1}}$	$\overline{\text{TPDI2}}$	yellow	2	transmitted data, inverted	O
3	GND	GND	blue	3	ground	-
8	-	-	red	3	not assigned	-
4	-	-	grey	-	not assigned	-
9	-	RBST	pink	-	only for Remote-Out: signal input for further card connect to pin 5 in the cable plug: 5VDC	I
5	-	5VDC	black	-	only for Remote-Out: 5 V, connect to pin 9 in the cable plug: RBST	O

1) Colour details refer to the cable available as an accessory.

For units with a hood, the cable must be led downwards from the point of connection.

Cable specification

- Screened cable
- Minimum cross-section of signal wires: 0.14 mm²
- Twisted-pair wires
- Screen grounded at both ends
- Maximum length 400 mm



To protect against interference, the screen for digital cables is connected at both ends. Differences in potential can lead to excessive current in the screen, and these have to be prevented by means of bonding lines. Cable cross-section for lengths up to 200: 16 mm², for lengths over 200 m: 20 mm².

Function Using the IBS-C field bus module, the positioning controller can be connected to an Interbus network as a slave device. The Interbus is a standardised field bus for data exchange for sensors and actuators.

During processing, the positioning controller swaps process data with the master device, e.g. a PLC or PC with Interbus master interface. The master device controls and monitors all connected slave devices.

Devices on the Interbus are networked in a ring formation. Connection to the next-door device is made in each case via Remote-In and Remote-Out.

Display The field bus module signals status and diagnostic information through four LEDs:

LED designation	Colour	Explanation, if active
U	green	power supply OK
BA	green	remote bus connection OK
CC	green	remote bus OK
RD	red	remote bus to the next slave device switched off

Setting the address The address is derived from the position of the Twin Line unit in the network ring.

Baud rate The baud rate is permanently set to 500kBit/s.

Field bus manual The integration of a Twin Line unit into the field bus is described in the relevant field bus manual from SIG Positec in the chapter on set-up.

4.4.15 Connection of accessories to the standard unit

TL HBC holding brake controller The brake on motors with a holding brake can be connected directly or via the TL HBC holding brake controller.

With the holding brake controller the control signal ACTIVE_CON of the positioning controller is amplified with the result that the brake responds quickly, generating as little heat as possible.

Connection

terminal	connection	colour
U	motor cable	brown (bn)
V	motor cable	blue (bl)
W	motor cable	black (bk)
PE	protective conductor (screen tracer wire) -	

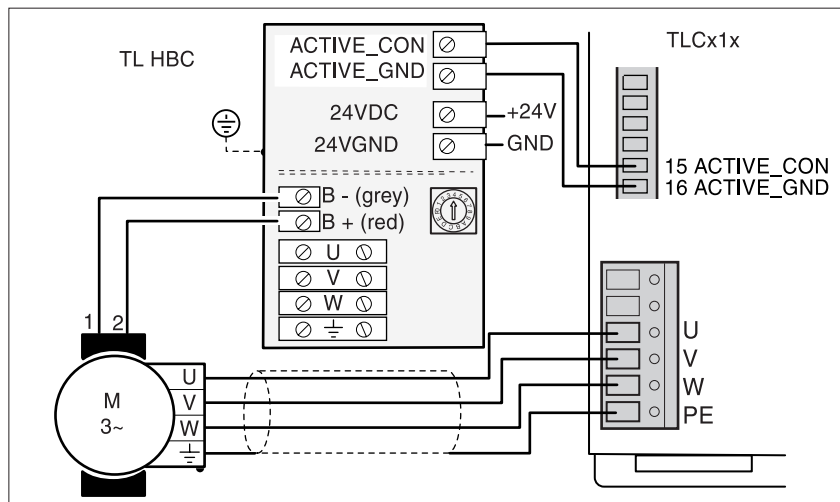


Fig. 4.31 Connection of the TL HBC holding brake controller

- ▶ Only use square end ferrules to ensure that they do not work loose.
- ▶ Connect control terminals B+ and B- of the holding brake.
- ▶ Connect together the control terminals ACTIVE_CON and ACTIVE_GND of the brake controller and signal interface.
- ▶ Connect the 24 V_{DC} power supply to the holding brake controller.

Only use cables with the following specifications:

	TLC511	TLC512
Cable diameter [mm ²]	1.5	1.5
max. cable length ¹⁾ [m]	20	20

1) longer cable lengths on request

The holding brake controller's power requirement depends on the switching current for the holding brake:

Brake controller input current [A] = 0.5 A + switching current [A]

- ▶ Set the voltage reduction switch to “1”.

The voltage reduction function is described in chapter 'Braking function with TL HBC' on page 7-26.

External capacitors

The power drive can store excess braking energy via the DC-line connection in an external electrolytic capacitor. This allows the increase in the DC-line voltage to be reduced on frequent braking.

Only use capacitors with the following specification:

	TLC511	TLC512
Voltage stability	> 450 V	> 450 V
external capacitance	<500 µF	<1000 µF

Cable specification

- Screened cable
- Screen earthed on both sides
- Maximum cable length 3 m
- Minimum cross-section: 1.5 mm²

Connection

Connect the wires from the DC-line terminals to the capacitor terminals. Pay attention to correct polarity: DC+ to „+“ and DC- to „-“. Otherwise device and capacitor can be destroyed.

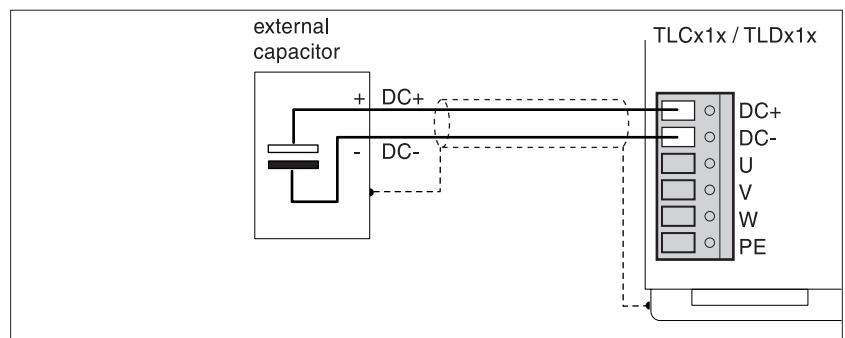


Fig. 4.32 Connection of external capacitor

4.5 Wiring examples

4.5.1 Manual set-up and operation on the field bus

Functions Manual set-up using the teach-in function, manual movement via I/O, operation via field bus with fixed I/O assignment

Presets Parameter settings: 'Settings.IO_mode' = 2, see chapter 'Operating modes of the positioning controller', from page 6-1.

Manual movement via I/O and teach-in: AUTOM=0
 Field bus operation: AUTOM=1.

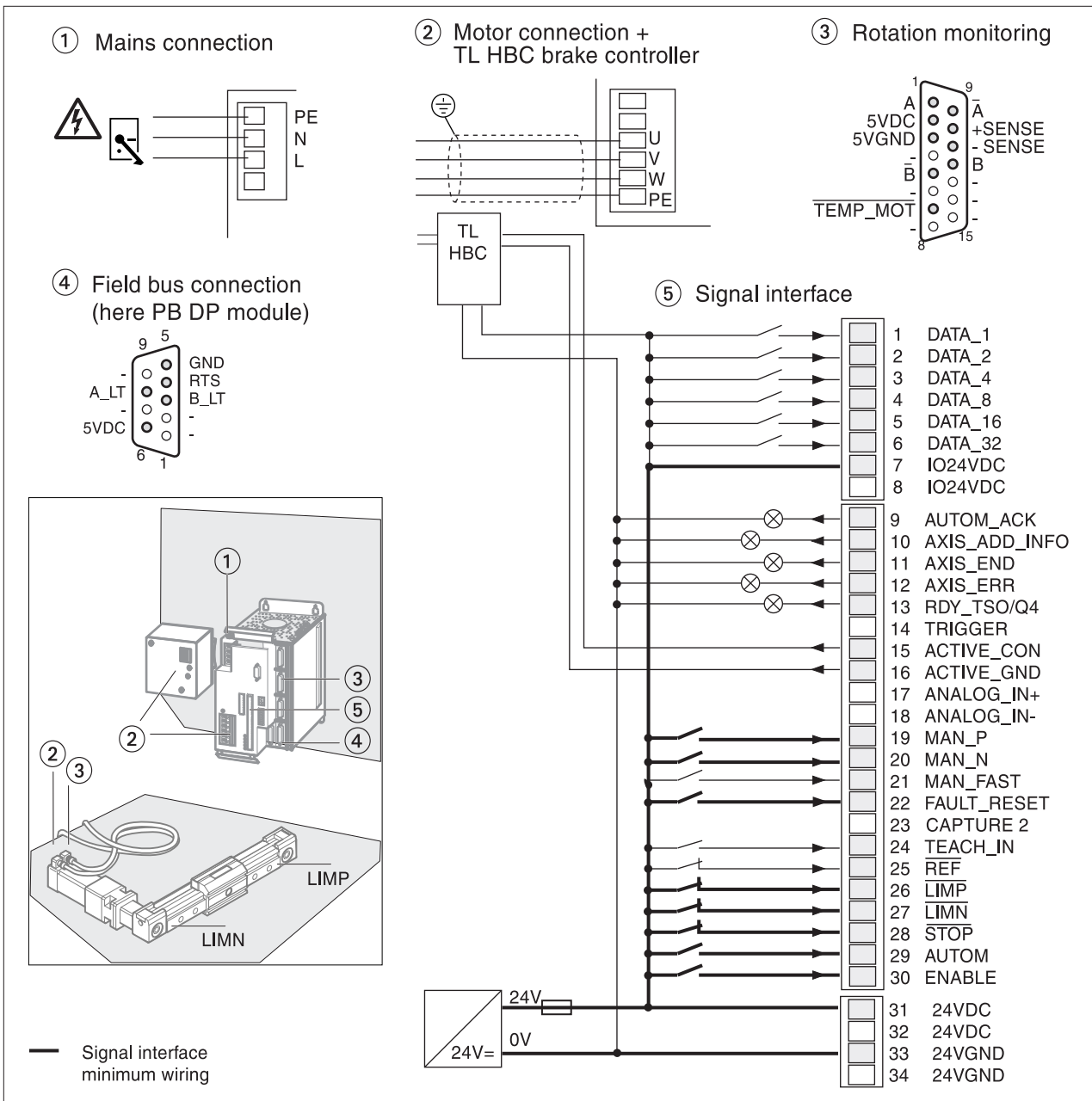


Fig. 4.33 Wiring for manual operation via inputs and outputs

9844 1113 117, c325, 11.00

- Connection*
- ▶ Wiring up the mains connection (1):
 - For single-phase Twin Line units see page 4-14.
 - Wiring up a 24 V connection, see page 4-18
 - ▶ Wiring up the motor connection (2) and the brake controller (for motors with holding brake)
 - For the motor connection see page 4-15
 - For the brake controller see page 4-42.
 - ▶ Installing rotation monitoring (3) on the motor, see page 4-32
 - ▶ Wiring field bus connection (4)
 - Profibus DP see page 4-34
 - CAN-Bus see page 4-36
 - serial bus see page 4-38
 - Interbus-S see page 4-40.
 - ▶ Wiring signal interface for manual operation (5)
 - The complete pin assignment of the signal interface is described from 4-19.
 - You can find the minimum pin assignment for manual operation in the following table.

Pin	Signal	active	Explanation	I/O
1	DATA_1	high	Bit 0 for selecting a list number	I
2	DATA_2	high	Bit 1 for selecting a list number	I
3	DATA_4	high	Bit 2 for selecting a list number	I
4	DATA_8	high	Bit 3 for selecting a list number	I
5	DATA_16	high	Bit 4 for selecting a list number	I
6	DATA_32	high	Bit 5 for selecting a list number	I
7	IO24VDC ¹⁾	–	power supply for inputs / outputs	I
8	IO24VDC	–	power supply for inputs / outputs	I
9	AUTOM_ACK	high	acknowledgement signal to AUTOM signal	O
10	AXIS_ADD_INFO	high	additional information on current movement	O
11	AXIS_END	high	end to movement processing, drive at standstill	O
12	AXIS_ERR	high	fault detection when processing movement command	O
13	RDY_TSO	high	operational readiness, output max. 400 mA	O
15	ACTIVE_CON	high	motor under current, control signal for brake controller TL HBC, max. 400 mA ²⁾	O
16	ACTIVE_GND	high	0 V signal for brake controller, internally on 24VGND ²⁾	I
19	MAN_P ¹⁾	high	manual movement, positive motor rotation	I
20	MAN_N ¹⁾	high	manual movement, negative motor rotation	I
21	MAN_FAST	high	manual selection slow (low) or fast (high)	I
22	FAULT_RESET ¹⁾	high	reset fault signal	I

Pin	Signal	active	Explanation	I/O
24	TEACH_IN	high	trigger signal for storing current setpoint in the list data memory	I
25	$\overline{\text{REF}}$	low	reference switch signal	I
26	$\overline{\text{LIMP}}^1)$	low	limit switch signal, positive motor rotation	I
27	$\overline{\text{LIMN}}^1)$	low	limit switch signal, negative motor rotation	I
28	$\overline{\text{STOP}}^1)$	low	stop motor	I
29	AUTOM ¹⁾	high	automatic mode via field bus (high), manual operation (low)	I
30	ENABLE ¹⁾	high	enable power amplifier (high) or disable (low)	I
31, 32	24 VDC ¹⁾	–	24 VDC power supply	I
33, 34	GND ¹⁾	–	GND for 24 VDC	I

1) minimum pin assignment of signal interface for start-up

2) Version P: Holding brake fix connected

4.5.2 Operation via field bus, configuration via TL HMI or TL CT

Functions Operation via field bus or local operating units TL HMI or TL CT with signal interface with free pin assignment, field bus settings through local operating units.

Presets Parameter setting: 'Settings.IO_mode' = 1, see chapter 'Operating modes of the positioning controller', from page 6-1.

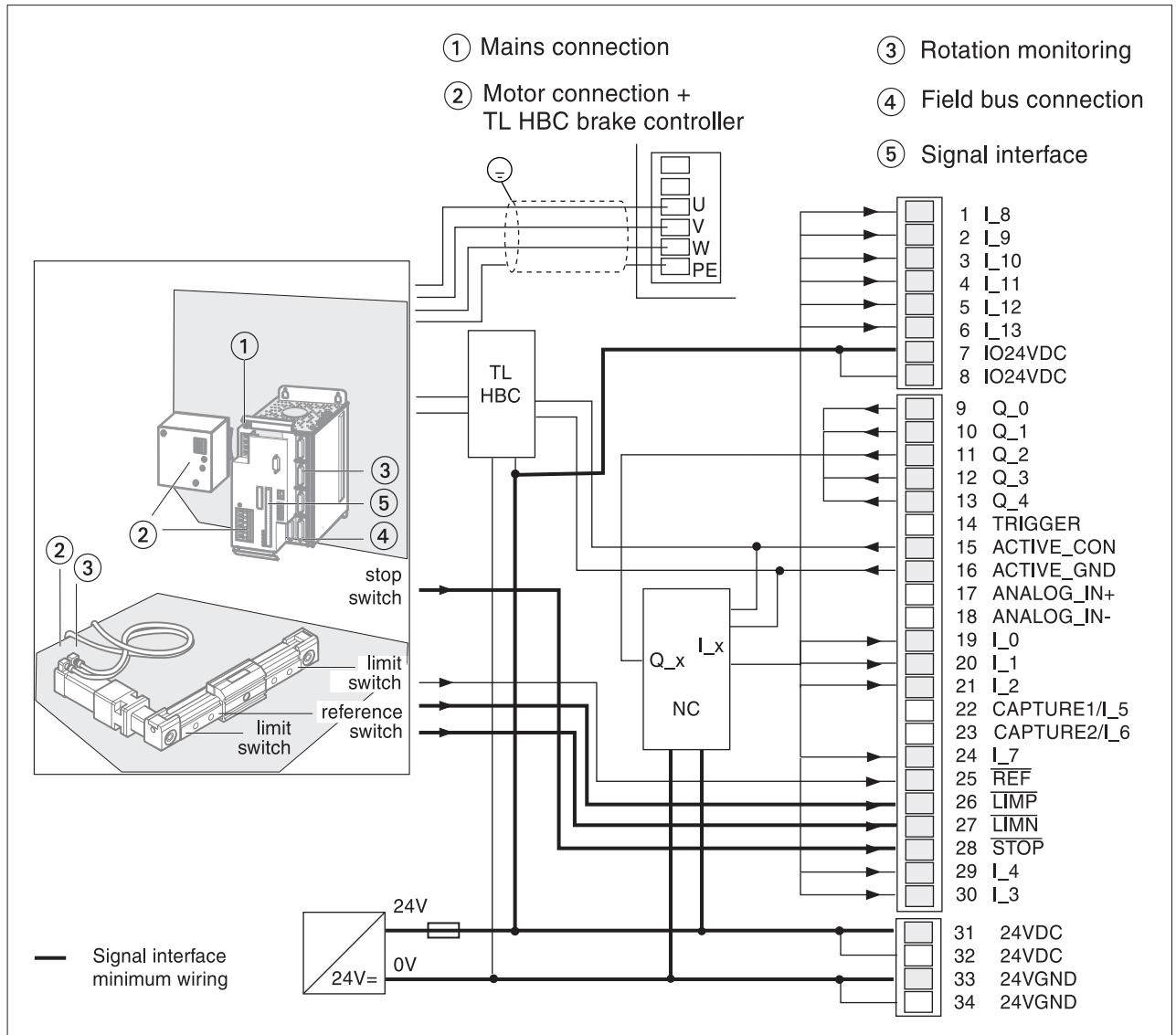


Fig. 4.34 Wiring for automated operation on field bus

Pin	Signal	active	Explanation	I/O
1	I_8	high	freely assignable input	I
2	I_9	high	freely assignable input	I
3	I_10	high	freely assignable input	I
4	I_11	high	freely assignable input	I
5	I_12	high	freely assignable input	I
6	I_13	high	freely assignable input	I
7	IO24VDC ¹⁾	–	power supply for inputs / outputs	I
8	IO24VDC	–	power supply for inputs / outputs	I
9	Q_0	high	freely assignable output	O
10	Q_1	high	freely assignable output	O
11	Q_2	high	freely assignable output	O
12	Q_3	high	freely assignable output	O
13	Q_4	high	freely assignable output	O
15	ACTIVE_CON	high	motor under current, control signal for brake controller TL HBC, max. 400mA ²⁾	O
16	ACTIVE_GND	high	0 V signal for brake controller, internally on 24VGND ²⁾	I
19	I_0	high	freely assignable input	I
20	I_1	high	freely assignable input	I
21	I_2	high	freely assignable input	I
24	I_7	high	freely assignable input	I
25	$\overline{\text{REF}}$	low	reference switch signal	I
26	$\overline{\text{LIMP}}$ ¹⁾	low	limit switch signal, positive motor rotation	I
27	$\overline{\text{LIMN}}$ ¹⁾	low	limit switch signal, negative motor rotation	I
28	$\overline{\text{STOP}}$ ¹⁾	low	stop motor	I
29	I_4	high	freely assignable input	I
30	I_3	high	freely assignable input	I
31, 32	24 VDC ¹⁾	–	24 VDC power supply	I
33, 34	GND ¹⁾	–	GND for 24 VDC	I

1) minimum pin assignment of signal interface for start-up

2) Version P: Holding brake fix connected

4.5.3 Operation via field bus, field bus configuration via inputs

Functions Operation only via field bus master device, field bus settings via signal interface inputs. On switching on the Twin Line unit, field bus address 7 is set. Baud rate and processing profile are not set here and are at 24VGND.

Inputs I_5 and I_6 are available as freely assignable inputs, outputs Q_0 to Q_4 as freely assignable outputs.

Presets Parameter setting: 'Settings.IO_mode' = 0, see chapter 'Operating modes of the positioning controller', from page 6-1.

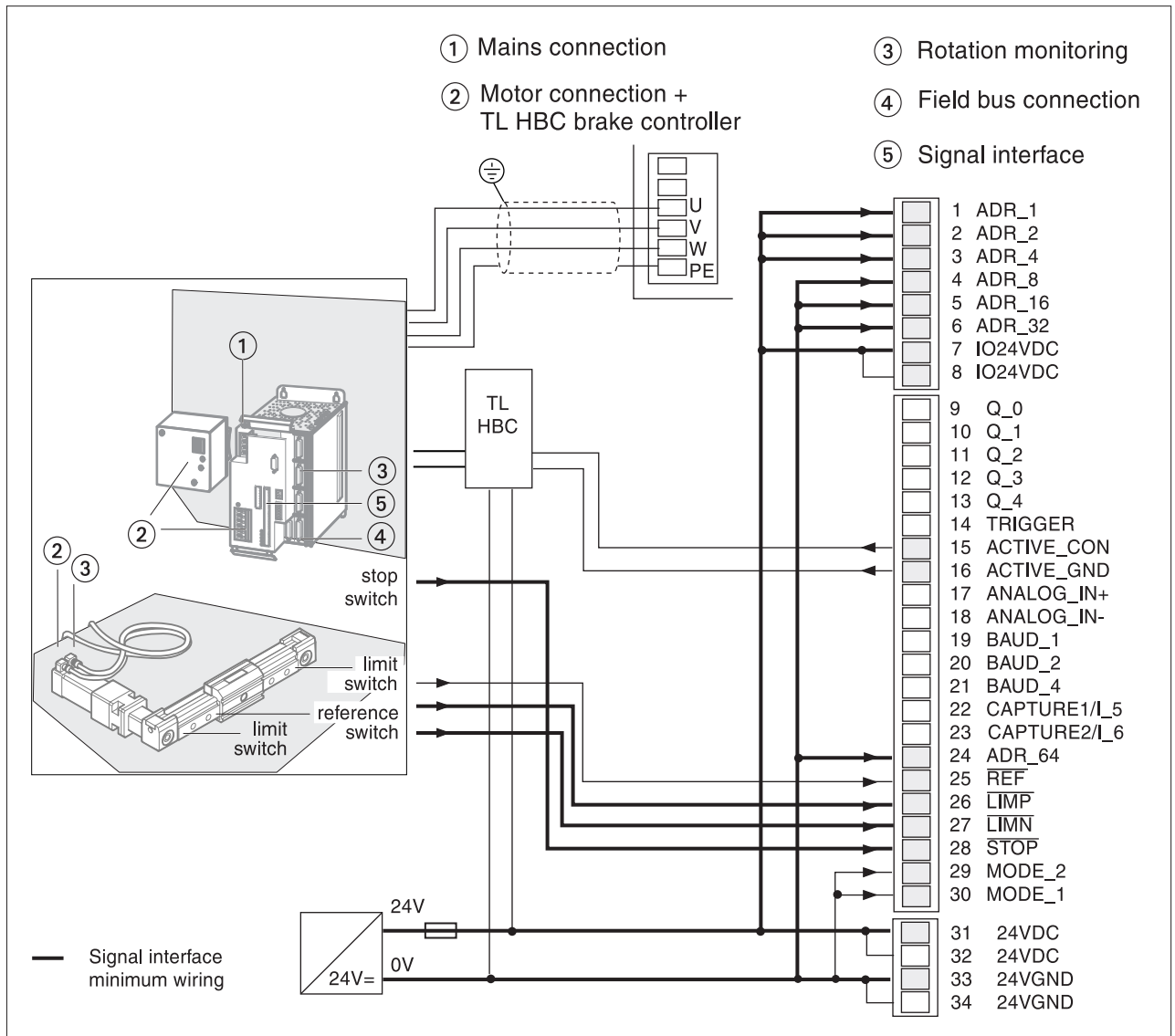


Fig. 4.35 Wiring for automated operation only on field bus

Pin	Signal	active	Explanation	I/O
1	ADR_1	high	Bit 0 for network address	I
2	ADR_2	high	Bit 1 for network address	I
3	ADR_4	high	Bit 2 for network address	I
4	ADR_8	high	Bit 3 for network address	I
5	ADR_16	high	Bit 4 for network address	I
6	ADR_32	high	Bit 5 for network address	I
7	IO24VDC ¹⁾	–	power supply for inputs / outputs	I
8	IO24VDC	–	power supply for inputs / outputs	I
15	ACTIVE_CON	high	motor under current, control signal for brake controller TL HBC, max. 400mA ²⁾	O
16	ACTIVE_GND	high	0 V signal for brake controller, internally on 24VGND ²⁾	O
19	BAUD_1	high	Bit 0 for setting the baud rate	I
20	BAUD_2	high	Bit 1 for setting the baud rate	I
21	BAUD_4	high	Bit 2 for setting the baud rate	I
24	ADR_64 ¹⁾	high	Bit 6 for network address	I
25	$\overline{\text{REF}}$	low	reference switch signal	I
26	$\overline{\text{LIMP}}$ ¹⁾	low	limit switch signal positive motor rotation	I
27	$\overline{\text{LIMN}}$ ¹⁾	low	limit switch signal negative motor rotation	I
28	$\overline{\text{STOP}}$ ¹⁾	low	stop motor	I
29	MODE_2	high	Bit1 for setting field bus profile	I
30	MODE_1	high	Bit0 for setting field bus profile	I
	24 VDC ¹⁾	–	24 VDC power supply	I
	GND ¹⁾	–	GND for 24 VDC	I

1) minimum pin assignment of signal interface for start-up

2) Version P: Holding brake fix connected

4.6 Function test

► Carry out these checks:

- Are all cables and connectors safely installed and connected?
- Are any live cable ends exposed?
- Are the control lines connected correctly?

For this test and the first stages of start-up the engine should be run decoupled from the system. This means that the motor and system will suffer no damage if the motor starts up unexpectedly.



Certain unit parameters must be tested and adjusted before control signals may be sent to the motor. Parameters will be set in the next chapter 'Set-up'; the following function test must therefore be conducted when the power amplifier is switched off.

- Disconnect the plugs from the 'unit's field bus interface to ensure that the power amplifier cannot be switched on through the field bus
- Switch the signal interface ENABLE input to Low after connecting the signal input.



WARNING!

Destruction of the motor!

The motor may only be operated when the phase current has been correctly set. Driving the motor with the phase current too high will destroy it immediately.

System check and initialisation

- Switch on the 24 V power supply.
- Switch on the primary power supply.

Device OK

The status display changes first from „1“ to „2“, then to „3“ and „4“.

The unit carries out a self-test and checks the internal operating data, the parameters, the internal monitoring devices and the connected sensing equipment and also reads in the motor data from the Sincoder.

The DC-line is charged. The D2 DC-line LED lights.

- Switch off the power supplies again.

4.7 Installation troubleshooting

**DANGER!**

Electric shock from high voltage!

Before starting work on the connections of the power unit or on the motor terminals, wait for the 4 minutes discharge time (TLC538: 6 minutes) and then measure the residual voltage at the DC-line terminals DC+ and DC-. The residual voltage must not be higher than 48 V_{DC} before you start work on the connections.

Operational status indicator '2'

If the controller hangs in the switching-on state '2', this indicates an internal fault in the unit which can only be identified and corrected by SIG-Positec.

Operational status indicator '3'

If the display does not change from „3“ to „4“, check whether the mains voltage is switched on and the mains connections correctly wired up.

Operational status indicator flashing

The unit has detected a fault. In the section 'Diagnosis and error rectification' on page 8-1 you will find a listing which includes the causes of faults.

5 Commissioning

5.1 Commissioning procedure

Where can I find information on...	TLC51x controller manual	TL HMI manual	TL CT software manual	TL CT help
Commissioning step by step	•	–	–	•
Settings and parameter list	•	–	–	–
Commissioning procedure	•	–	–	•
Detailed information on operation using...	–	TL HMI	TL CT	TL CT



Carry out the following start-up steps even if you are using an already configured unit under changed operating conditions. Incorrectly set values could cause permanent damage to the positioning controller and the motor.

What you need to do...	Info's
Make sure the Twin Line unit is correctly installed and wired up. When carrying out this check, use the wiring diagrams of the system configuration or the wiring examples in section 'Wiring examples', page 4-44.	In the section 'Installation', page 4-1
Make sure the limit switches work if these are installed.	Page 5-9
Check the functioning of the holding brake controller if you are using motors with holding brake	Page 5-9
Set phase current and device parameters	Page 5-7
Check the direction of rotation and carry out a test run	Page 5-10
Optimize travel behaviour	Page 5-15

Next steps... After commissioning is completed the unit can be tested in its various operating modes.

- For information on these operating modes see page 6-1.
- The signals, parameters and conditions for changing operating modes are described on page 6-1.

5.2 Safety instructions

Commissioning may only be carried out by qualified personnel with a knowledge of automatic control engineering.



WARNING!

Incorrectly set parameters can cause the motor to start unexpectedly leading to a risk of crushing and of damage to the system!

Close off the danger area and start up the motor when it is disconnected mechanically from the system and is not under load.



WARNING!

Danger of injury and destruction of system parts from runaway motor!

In error class 3 or 4, or if the unit fails, the motor will no longer be actively braked and it will run at high speed against a mechanical stop.



WARNING!

Destruction of the power drive!

Only change the settings for the phase current when the power supply has been switched off.

5.3 Commissioning tools

5.3.1 Overview

Two input routes are at your disposal for commissioning and configuring tasks as also for diagnostics:

- The Twin Line HMI hand-held operating unit (HMI stands for 'human-machine interface')
- The Twin Line Control Tool operating software in conjunction with a PC or laptop running Windows NT, Windows 95 or Windows 98.

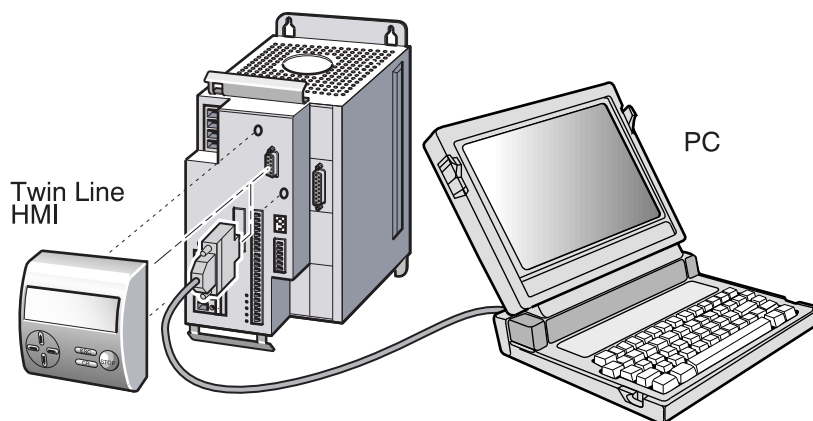


Fig. 5.1 Commissioning with the hand-held operating unit or the PC

5.3.2 The Twin Line HMI hand-held operating unit

Human-Machine Interface HMI The Twin Line HMI is a plug-in hand-held operating unit with an LCD display of 3 x 16 characters. It is plugged directly into the RS-232 interface but can also be connected to the RS-232 interface via a serial cable.

Twin Line HMI manual Operation of a Twin Line units with the Human-Machine Interface HMI is described in the Twin Line HMI manual.

Menu structures for the TLC51x The Twin Line HMI operates under menu guidance. When the positioning controller is switched on, the menu structures and parameter values displayed adapt themselves automatically to the device type connected. For the TLC51x positioning controller the following menu items are available on the first and second levels:

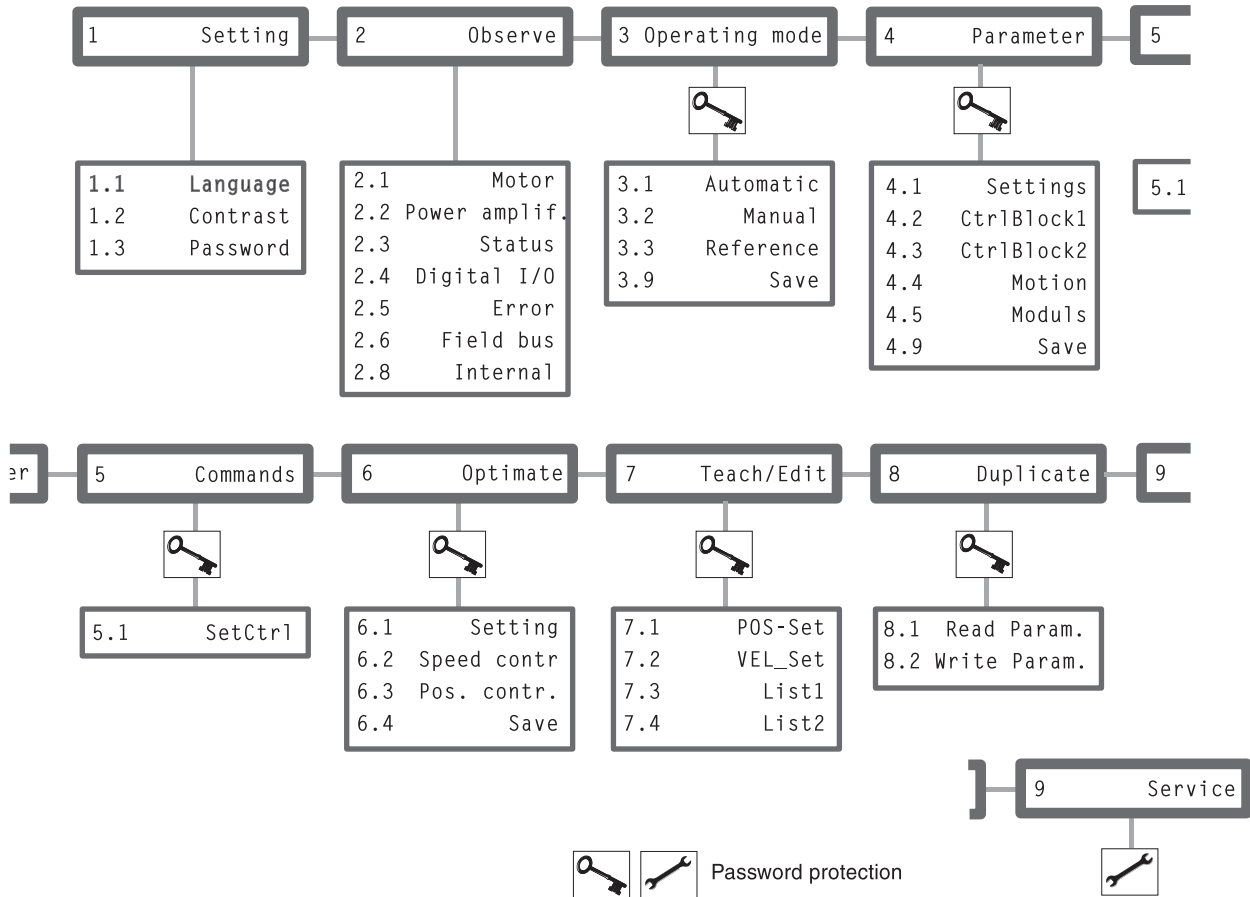


Fig. 5.2 First and second menu levels of the Twin Line HMI with TLC51x

First menu level	Meaning
1 Settings	Settings specific to the Twin Line HMI
2 Observe	Device, motor and movement data as well as error displays
3 Operating mode	Selection and launch of the operating mode and settings for the operating mode
4 Parameters	Controller and movement parameters with settings for the controller and the modules
5 Commands	Selection of the control parameters set
6 Optimize	Optimization of the control loops
7 Teach / edit	Process data for list control
8 Duplicate	Copy parameter sets to other Twin Line units
9 Service	Password-protected, for servicing purposes only

So that you can find readily all of the parameters with the Twin Line HMI the menu paths for each parameter are provided in the manual. For example HMI menu '8.2' means: On the first menu level select item '8 Duplicate'; next, on the second level, select the menu item '8.2 ParamSchr'.

For information on operating the Twin Line HMI please refer to the Twin Line HMI manual.

5.3.3 Operating software Twin Line Control Tool

Twin Line Control Tool The Twin Line Control Tool operating software provides a graphical user interface as well as a way of loading and saving control parameters and motor data. With the software you can test the input and output signals of the positioning controller, trace signal paths on the screen and interactively optimize controller behaviour.

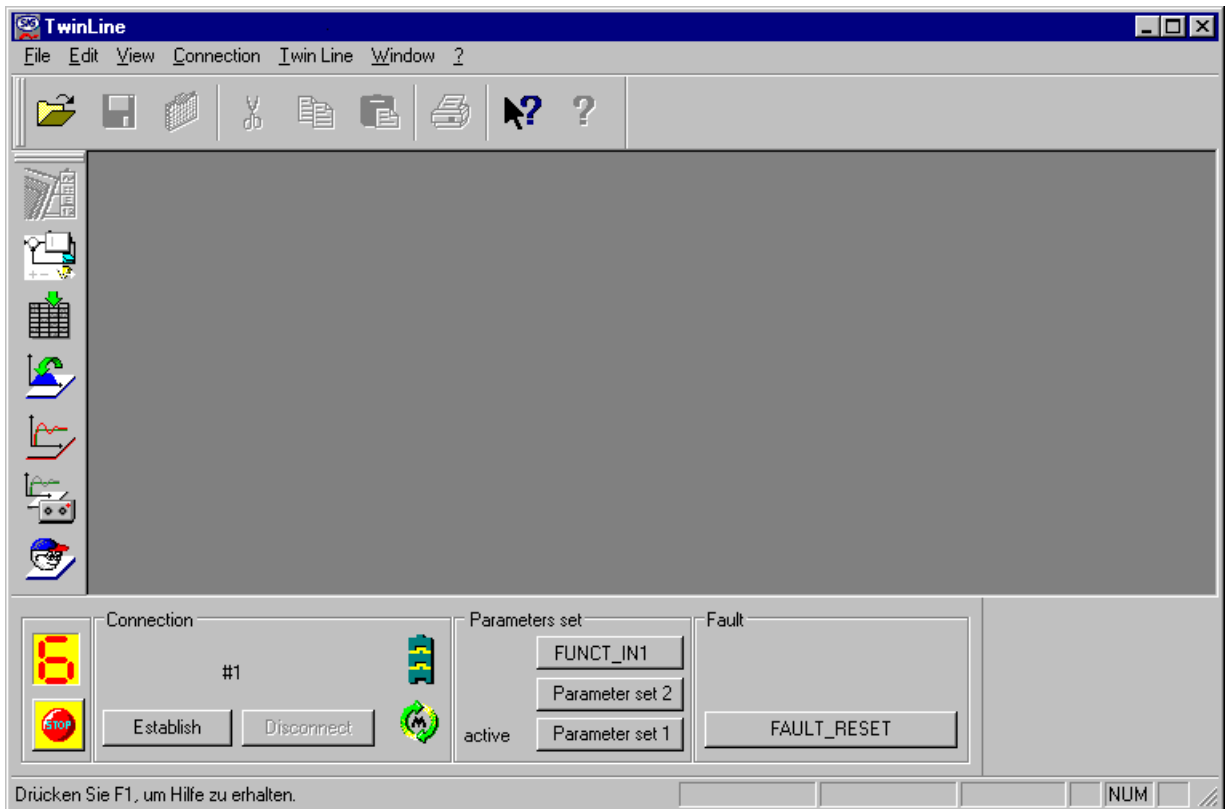


Fig. 5.3 Twin Line Control Tool operating software

The software provides more extensive features than the Twin Line HMI, such as:

- Extensive diagnostic tools for optimization and maintenance
- Archiving all device settings and recordings with export functions for data processing.

TL CT manual Operating a Twin Line units with the Twin Line Control Tool is described in the TL CT manual. The manual is included in the software package as a printable pdf file which can be displayed on the screen.

Requirements for the use of the Twin Line Control Too Before you can work with the Twin Line Control Tool a PC or laptop must have a free serial interface and be running Windows NT, Windows 95 or Windows 98.

The PC and the Twin Line unit must be linked by the RS232 cable.

Menu structure All of the commands of the operating software can be activated via the menu items and the program's buttons.

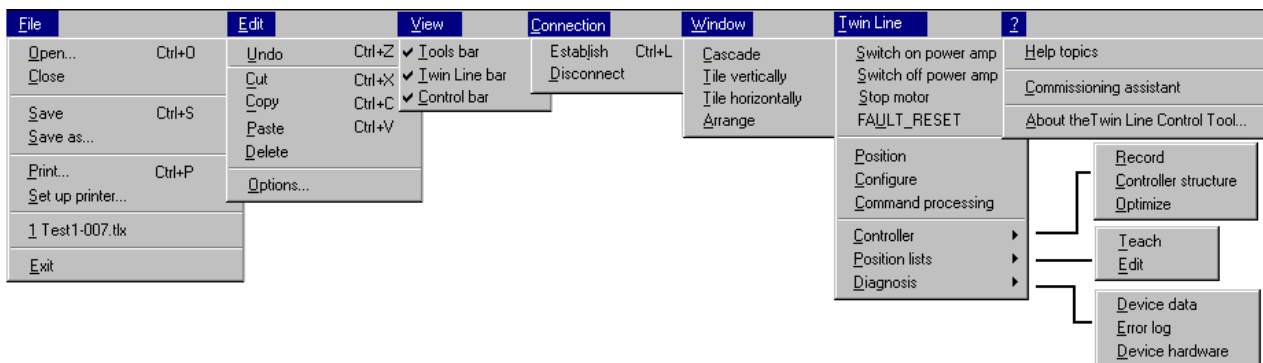


Fig. 5.4 The menu structure of the Twin Line Control Tool

Throughout this manual all references to a menu item quote the complete menu path; for example, 'Twin Line → Positioning'.

Software help

The Twin Line Control Tool provides detailed help functions which you can access within the program via '? → Help topics' or the F1 key.

5.4 Commissioning the positioning controller

5.4.1 Commissioning stages

Before putting the unit into operation make sure that all cables and system components have been wired up and connected correctly.

Check whether the internal fan is running.

Commissioning should be done in the following sequence:

- Make sure the limit switches and holding brake controller are working
- Check and set phase current
- Make a manual run with the motor
- Optimize travel behaviour



WARNING!

Danger of injury from connected devices not operating under control!

Check inputs via the input device, especially limit values for current, speed and motor type.



WARNING!

Danger of injury if the brake function fails!

Secure the danger zone before starting up.

5.4.2 Setting phase current and device parameters

Phase current

The positioning controller uses the phase current to control motor torque. A large phase current produces high motor torque. The maximum permissible phase current on the unit must be limited to ensure that the motor is not damaged.



WARNING!

Damage to or destruction of the motor caused by phase current being set too high!

The phase current on the unit may not be set to a higher value than the nominal phase current of the motor.

Values for the maximum permissible nominal phase current are given on the type plate on the motor.

- ▶ Check the phase current settings for the following three parameters, and reduce the values to the maximum permissible nominal phase current of the motor.

TL CT: Setting the phase current

- ▶ Open the parameters window via 'Twin Line → Setting parameters' and enter the limit values for current and speed in the 'Settings' parameter group.

TL HMI: Setting the phase current

- ▶ Enter the limit values in the menu items shown in the table.

Switching rotation monitoring on and off

The "Settings.monitorM" parameter checks the temperature of the motor and whether the encoder has been connected. If no encoder has been connected during set-up, the unit reports a cable fault.

Deactivate the "Settings.monitorM" during set-up if no encoder has been fitted.

Parameter	Explanation and units []		Value range	Default	R/W
Gruppe.Name	Idx:Sidx	TL-HMI		value	rem.
Settings.I_0	14:10	4.1.30	Max. phase current at standstill [Arms]	0...10 A	0.9 A R/W rem.
Settings.I_acc	14:11	4.1.31	Phase current during acceleration/deceleration [Arms]	0...10 A	0.9 A R/W rem.
Settings.I_const	14:12	4.1.32	Max. phase current during travel at constant speed [Arms]	0...10 A	0.9 A R/W rem.
Settings.monitorM	14:18	4.1.35	motor monitoring, only with module in M2 0: deactivated 1: activated	UINT16 Bit 0: rotation monitoring Bit 1: temperature monitoring 0...3	3 R/W rem.
Motion.invertDir	28:6	4.4.27	Inversion of direction of rotation	UINT16 0: no inversion 1: direction of rotation inverted	0 R/W rem.



WARNING!

*Damage to system components!
If the motor is being operated within the system, the default settings for current and speed can result in system components being permanently damaged.*

Setting limit values

- ▶ Set the limit values for the following current and speed parameters before you run the motor in the system. You will need to work out suitable limit value from your system configuration and the motor characteristics.

As long as you are running the motor outside the system you will not need to change the default settings.

5.4.3 Starting the positioning controller

Requirements Either a computer with the Twin Line Control Tool operating software installed or the Human-Machine Interface HMI must be connected to the positioning controller.

The power amplifier must be switched off so that the motor will not be activated.

- ▶ If access to the input/output signals is activated via the „Settings.IO_mode“ = „2“ parameter, switch the „ENABLE“ signal to Low. You will find information on 'Access control for selecting operating mode or function' on page 6-3.

Switch on the external 24 V_{DC} supply voltage and then the mains voltage for the power amplifier supply.

The status display of the positioning controller changes from 1 to 3 or 4.

If the display flashes, this indicates a fault. You will find information on rectifying faults on page 8-1 in the section entitled 'Diagnosis and error rectification'.

5.4.4 Checking the limit switches

- ▶ Trip the limit switches manually while keeping an eye on the LEDs for the positive limit switch signal $\overline{\text{LIMP}}$ and for the negative limit switch signal $\overline{\text{LIMN}}$. The LEDs are on provided the limit switches have not been tripped.

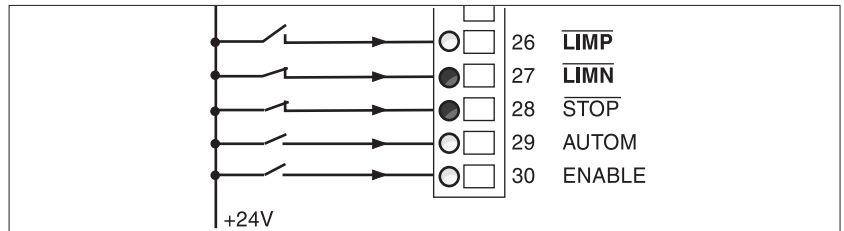


Fig. 5.5 Positive limit switch tripped

Enabling of the input signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{STOP}}$ and their evaluation to active low or high can be changed via the parameters 'Settings.SignEnabl' and 'Settings.SignLevel'. See page7-22.

The limit switch, which limits the work area during clockwise rotation, must be connected to $\overline{\text{LIMP}}$. The limit switch, which limits the work area during anti-clockwise rotation, must be connected to $\overline{\text{LIMN}}$.

5.4.5 Checking the holding brake

Carry out this test when you are using a motor with a holding brake.



Standard unit

WARNING!

*Danger of injury if the brake function fails!
Protect the danger zone before starting up, and carry out function test at no load.*

Check the brake function with the push-button switch on the holding brake controller.

If the holding brake controller is to enable the button, the controller must not be switched by the positioning controller:

- Disconnect the ACTIVE_CON control cable at the positioning controller or switch off the 24 V supply to the positioning controller.
- Press the button on the holding brake controller several times in order to alternately release and re-apply the brake. The LED on the controller lights up when the brake is activated and thus released.
- Test the effectiveness of the brake: when the brake is released the shaft can be moved by hand, when the brake is on, this is not possible.

Version P

Check the brake function with the TL CT or the TL HMI.

TL CT: Open the „Twin Line → Diagnosis →device data → Input_Output“ window.

- Select „Force QWO“. Switch the "ACTIVE/PIN15" output several times in order to successively release and apply the brake. The LED on the controller will light up when the brake has been activated and thereby released.
- Check the brake function: The shaft can be moved by hand when not under braking, but not when the brake is applied.

5.4.6 Testing the motor under manual movement



WARNING!

Danger of injury and damage to system parts from unexpected acceleration of the motor. Carry out the first test run with no connected loads. If the motor has already been installed in the system, make sure that unexpected movements of the motor do not cause any damage.

The positioning controller is supplied with a default setting which allows smooth operation to be tried out with a manual run.

Operating facilities

The test operation with a manual movement can be carried out using the TL CT operating software, the HMI hand-held operating unit or via the signal interface.



If you want to use the Twin Line unit with the preset signal interface pin assignment, carry out the test run via the signal interface. Set the 'Settings.IO_mode' parameter to 2.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Settings.IO_mode	29:31	4.1.4	Significance of I/O signal assignment	UINT16 0: setting field bus parameter via I/O assignment 1: I/O freely available 2: I/O assigned functions	0 R/W rem.

If stop switch or limit switches are not connected, the switch signals LIMP, LIMN or STOP must be applied to +24 V.

Manual movement with TL HMI

- ▶ With the Human-Machine Interface HMI start manual movement by selecting menu item '3.2.11 Start'. Use the cursor keys to specify the direction of movement.
- ▶ Test the direction of rotation: If the right cursor key is pressed, the motor shaft must rotate clockwise.

You will find detailed information on manual movement using the Human-Machine Interface HMI in the manual TL HMI.

Manual movement with TL CT

- ▶ In the operating software select „Twin Line → Switch on power amp“ to activate the power amplifier.
- ▶ Select 'Twin Line → Positioning' to open the 'Positioning' dialog box. Select 'Manual' to start manual movement.
- ▶ Test the direction of rotation: Press one of the two right buttons in the dialog box for rotating the motor shaft clockwise.

You will find detailed information on manual movement using the operating software in the manual TL CT.

Manual movement via the signal interface

For manual movement via the signal interface, the „Settings.IO_mode“ parameter must be on 2. The following signals must be switched.

I/O signal	Function	Value
MAN_N	Stop the motor Move anticlockwise	low / open high
MAN_P	Stop motor Move clockwise	low / open high
$\overline{\text{STOP}}$ ¹⁾	Stop motor with quick stop Operation enablement	low high / open
AUTOM	Manual movement A utomatic operation	low / open high
ENABLE	Power amplifier switched off Power amplifier enabled	low / open high

1) Signal level with default setting of the parameters 'Settings.SignEnabl' and 'Settings.SignLevel'

- ▶ Activate manual movement: deactivate the AUTOM input signal.
- ▶ Switch on the power amplifier: activate the ENABLE input signal.
- ▶ Turn motor shaft in clockwise direction: activate input signal MAN_P.

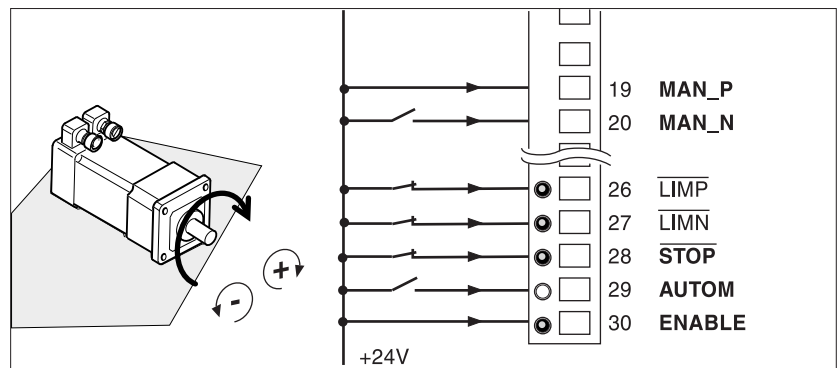


Fig. 5.6 Checking the motor's direction of rotation

When the MAN_FAST signal is connected, you can choose between fast and slow movement.

For manual movement the preset movement parameters for slow and fast motor speed and for maximum motor current can be changed - see page 6-9.

5.4.7 Checking inputs and outputs

The switching states of the inputs and outputs of the signal interface can be monitored with the operating software or with the Human-Machine Interface HMI. In addition the signal states of the inputs and outputs can be changed with the operating software - independently of the hardware signals which are routed through the connections.



WARNING!

Danger of injury and damage to system parts! Activating and deactivating inputs and outputs can result in unexpected switching states and motor movements. Do not change the signals unless the motor can be run without danger.

Parameters for inputs and outputs

The current switching states are displayed in bit-coded form - for the inputs in the parameters 'I/O.IW0_act' and 'I/O.IW1_act' for the outputs in the parameters 'I/O.QW0_act' and 'I/O.QW1_act'. The values 1 and 0 indicate whether an input or output is active.

0: The input or output carries 0 V.

1: The input or output carries 24 V.

Inputs and outputs can be configured with fixed or free signal interface pin assignment. The parameter 'Settings.IO_mode' allows you to switch between settings, see page 6-1.

Bit	Inputs			Outputs	
	I/O.IW0_act	I/O.IW1_act permanently assigned	I/O.IW1_act freely assignable	I/O.QW0_act permanently assigned	I/O.QW0_act freely assignable
0	$\overline{\text{LIMP}}$	MAN_P	I_0	AUTOM_ACK	Q_0
1	$\overline{\text{LIMN}}$	MAN_N	I_1	AXIS_ADD_INFO	Q_1
2	$\overline{\text{STOP}}$	MAN_FAST	I_2	AXIS_END	Q_2
3	$\overline{\text{REF}}$	ENABLE	I_3	AXIS_ERR	Q_3
4	-	AUTOM	I_4	RDY_TSO	Q_4
5	-	FAULT_RESET	I_5	ACTIVE_CON	ACTIVE_CON
6	-	CAPTURE2	I_6	TRIGGER	TRIGGER
7	-	TEACH_IN	I_7	-	-
8	-	DATA_1	I_8	-	-
9	-	DATA_2	I_9	-	-
10	-	DATA_4	I_10	-	-
11	-	DATA_8	I_11	-	-
12	-	DATA_16	I_12	-	-
13	-	DATA_32	I_13	-	-
14	-	-	-	-	-
15	-	-	-	-	-

- Displaying signal states with TL CT ▶ Select the menu item 'Twin Line → Diagnosis → Device data' and click on the 'Inputs / outputs' tab.

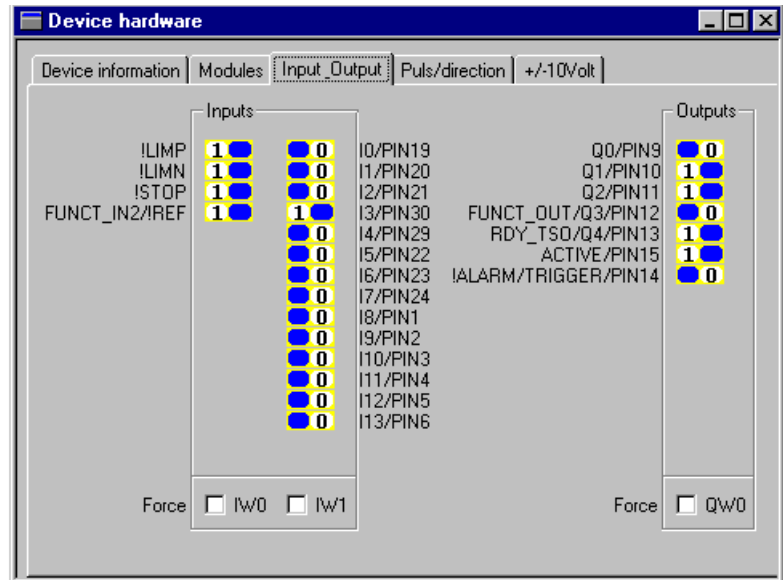


Fig. 5.7 Switching the inputs / outputs of the signal interface with the operating software

- ▶ Activate the 'Force' check box to modify inputs and outputs.



If the positioning controller has the PULSE-C module installed, under the 'Pulse / direction' tab you can observe and change the frequency of the reference values for setpoint positioning. For this the operational function 'Electronic gear' must be activated.

For detailed information on displaying and modifying signals with the operating software see the section on diagnostics in the Twin Line Control Tool manual.

Displaying signal states with TL HMI

- ▶ Change to the menu item '2.4.1 IW0_act' or '2.4.10 QW0_act'.

'IW0_act' and 'IW1_act' shows the inputs in bit-coded form, 'QW0_act' and 'QW0_act' the outputs.

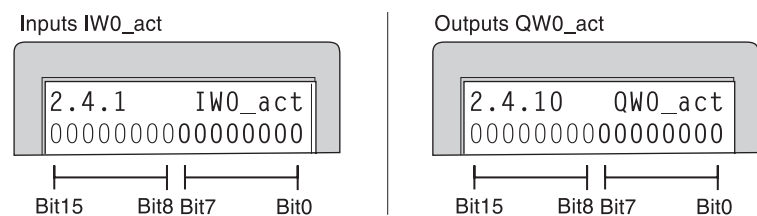


Fig. 5.8 Observing inputs / outputs of the signal interface with Human-Machine Interface HMI

The switching states of input and output signals cannot be changed with the Human-Machine Interface HMI.

For detailed information on displaying signals with the Human-Machine Interface HMI see the Twin Line HMI manual.

Displaying analogue inputs The value at the analogue input, pins 17 and 18 of the signal interface, can be displayed via:

- TL HMI
- TL CT
- Fieldbus

TL CT: Displaying analogue input ► Open the diagnostics window via menu item „Twin Line → Diagnosis → device data“ and the „+/-10Volt“ tab.

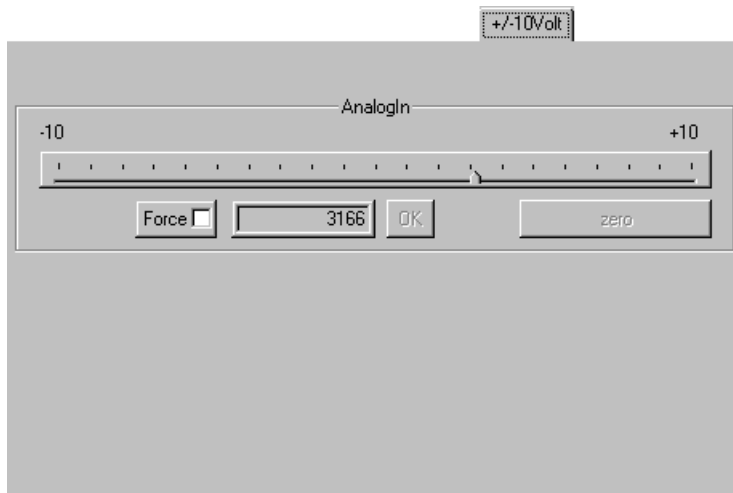


Fig. 5.9 Displaying and setting the analogue input with the operating software

► Switch on the „Force“ field in order to change the voltage of the analogue input.

You will find details on displaying and changing signals with the operating software in the „TL CT“ manual in the chapter on diagnostic functions.

Field bus: Displaying analogue input ► The analogue input is read and set using the "Status.AnalogIn" parameter.

Parameters	Explanation and units []		Value range	Default value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Status.AnalogIn	20:8	2.3.3.1 analogue input at input ANALOG_IN [mV]	INT16	0	R/W rem.

5.4.8 Optimizing the performance of the motor

The positioning controller provides a ramp function with linear acceleration and deceleration ramps as the standard setting. Beyond this, the shape of the ramp can be further optimized with values from the motor's torque characteristic.

Setting the linear ramp function

The linear ramp is optimized in three steps:

- Estimate acceleration and deceleration gradients
- Set start/stop speed
- Select set speed.

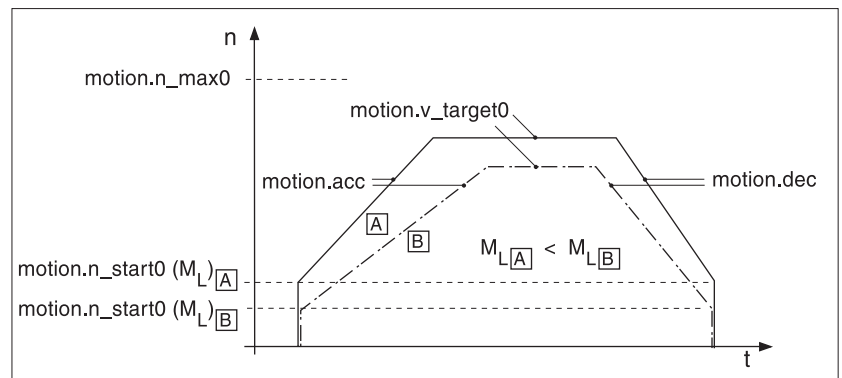


Fig. 5.10 Linear ramp settings under variable load M_L

Setting ramp gradients

The ramp function gradients are entered in parameters Motion.acc and Motion.dec. Their values can be estimated using the following formulae.

- $\alpha = (M_M - M_L) / J_{Ges}$
- $Motion.acc \leq 30 * \alpha / \pi$
- $Motion.dec \leq 30 * \alpha / \pi$

Characteristic Value	Explanation	Units
M_M	Available motor torque	Nm
M_L	External load torque	Nm
J_{Ges}	External mass moment of inertia	kgm ²
α	Angular acceleration	rad/sec ²
Motion.acc	Acceleration parameter	r.p.(min*sec)
Motion.dec	Deceleration parameter	r.p.(min*sec)

Start/Stop speed

One of the special qualities of stepping motors is their very fast acceleration from a standing start, and this can be set as the start/stop speed via the 'Motion.n_start0' parameter.

The start/stop speed can be set to as high as 60 r.p.m. depending on the external load, but it should be at least 12 r.p.m. If the lower value is too small, this can cause mechanical resonance in the motor at low external attenuation.

You can recognize too high a value for the start/stop speed when only limited ramp values can be set for acceleration and deceleration.

Set speed The set speed of the motor depends on the requirements of the application. It is set by means of the 'Motion.v_target0' parameter and is limited by the maximum speed of the motor 'Motion.n_max0'.

Torque characteristic of the motor The available torque of the stepping motor depends not only on its size and the kind of electrical control it uses, but also on its speed. The relationship between speed and torque is shown in motor specifications as the typical characteristic of a stepping motor.

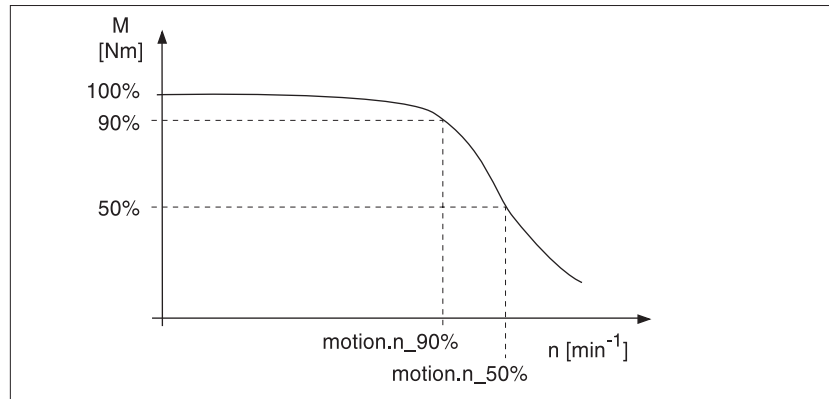


Fig. 5.11 Typical torque characteristic of a stepping motor

In the upper speed range, the available torque decreases rapidly as the speed increases. The acceleration achievable is also correspondingly reduced. For optimal performance, two reference values can be specified in addition to the acceleration values of the ramp.

90%-, 50%-reference values Take the speeds at which 90% and 50% of maximum motor torque are still available, from the stepping motor's data sheet, and enter these values in the two parameters 'Motion.n_90%' and 'Motion.n_50%'.

Parameter	Explanation and unit []		Range of values	Default-value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI			
Motion.n_90%	14:15	4.4.30	Motor speed with 90% of the standstill momentum [r.p.m.]	UINT 32 1..3000	– R/W rem.
Motion.n_50%	14:16	4.4.31	Motor speed with 50% of the standstill momentum [r.p.m.]	UINT32 1..3000	– R/W rem.
Motion.n_max0	29:21	4.4.28	Speed limit for travel profile [r.p.m.]	UINT32 1...3000	3000 R/W rem.
Motion.n_start0	29:22	4.4.10	Start-stop speed [usr]	UINT32 1...n_max0	12 R/W rem.
Motion.v_target0	29:23	4.4.11	Setpoint speed [usr]	UINT32 1..n_max0	60 R/W rem.
Motion.acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1: linear 2: exponential	1 R/W rem.
Motion.acc	29:26	4.4.14	Acceleration [usr]	UINT326 0...2000000	600 R/W rem.
Motion.dec	29:27	4.4.15	Deceleration [usr]	UINT32 60...2000000	600 R/W rem.

6 Operating modes of the positioning controller

6.1 Changing the operating mode

Operating modes The positioning controller functions in five operating modes:

- manual movement mode
- automatic speed mode
- automatic point-to-point mode
- automatic referencing mode
- Automatic operating mode, Electronic Gear, if module fitted to slot M1

6.1.1 Access channels

Local and remote access Data exchange and control of Twin Line devices can be carried out through various access channels:

- locally via the RS232 interface with the HMI hand-held control unit or the TL CT operating software or via the signal interface
- remotely via field bus commands.

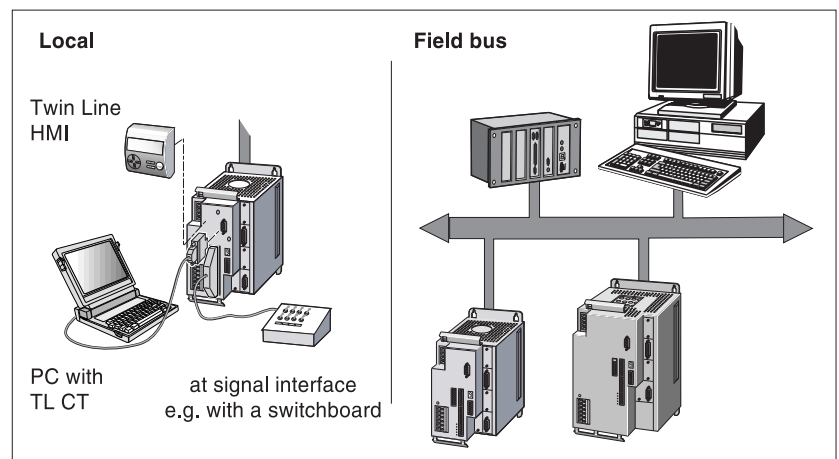


Fig. 6.1 local and remote access to Twin Line devices

Automatic access security

If an operating mode is initiated through an access channel, the operating mode can only be changed using this access channel while operation is in progress. A different operating mode can only be selected using other access channels once the current operation is finished.

When the operating mode is changed, the motor stops briefly and activates the drive parameters and specific settings for the operating mode selected.

Access for local control units to the Twin Line device can be disabled and enabled using the 'Commands.OnlAuto' parameter.

Parameter		Explanation and unit []	Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Commands.OnlAuto	29:30		UINT16 0: access via local control units or field bus 1: access via field bus only	0	R/W -

Local channels are available again when the field bus master enables them via this parameter or when field bus operation is interrupted.

6.1.2 Access control for selecting operating mode or function

Access channels are enabled and operating modes selected using the 'Settings.IO_mode' parameter.

Parameter	Explanation and unit []		Range of values	Default- R/W	
Group.name	Idx:Sidx	TL-HMI		Value rem.	
Settings.IO_mode	29:31	4.4.25	Significance of I/O signal assignment	UINT16 0: setting for the field bus parameter via I/O assignment 1: I/O freely available 2: I/O assigned functions	0 R/W rem.

IO_mode=0 or 1 Signal interface inputs and outputs can be assigned for field bus configuration on 'Settings.IO_mode'= 0, and are freely available on 'Settings.IO_mode'= 1. In both cases the HMI hand-held control unit, the TL CT operating software and the field bus have equal priority in initiating operating modes.

Operating modes and functions ¹⁾	Access channels		
	TL HMI, TL CT	I/O of signal interface	Field bus
manual mode	•	–	•
point-to-point mode	•	–	•
speed mode	•	–	•
electronic gear	•	–	•
referencing	•	–	•
controller setup	•	–	–

1) •: access possible, –: no access

IO_mode=2 When the 'Settings.IO_mode' parameter = 2, signal interface inputs and outputs are assigned. Operating modes and functions can be initiated locally via the AUTOM input signal or via the field bus.

- AUTOM=0, Low level: locally via HMI hand-held control unit, TL CT operating software or signal interface
- AUTOM=1, High level: via field bus.

The following table shows the possible operating modes depending on the status of the AUTOM signal.

Operating modes and functions ¹⁾	Access channels		
	TL HMI, TL CT	I/O signal interface	field bus
manual mode	0	0	1
point-to-point mode	0	–	1
speed mode	0	–	1
electronic gear	0	–	1
referencing	0	–	1
controller setup	0	–	-

1) „0“: AUTOM=0, „1“: AUTOM=1

If the AUTOM signal changes, the new operating mode will be selected when the current operation has been completed. The controller confirms that the change has taken place via the AUTOM_ACK output signal.

I/O signal	Function	Value
AUTOM	local operating mode selection on operation via field bus on	low/open high
AUTOM_ACK	local operating mode selection activated operation via field bus activated	low high

6.1.3 Selecting the operating mode

Operatating modes in the Twin Line unit are set by means of action commands. The HMI hand-held operating unit and the operating software offer these action commands as menu items and dialogue boxes. In field bus operation, the action commands are given via parameters.

You can use the signal interface to switch between manual mode and the automatic mode which is set via parameters. To do so, the signal interface inputs and outputs must be permanently assigned.

The current operating mode can be monitored by means of the bits in the 'Status.xMode_act' parameter.

Example of PTP operation

The parameter for initiating the PTP operating mode with absolute positioning is:

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
PTPp_absPTP	35:1	3.1.1.1	Start of absolute positioning with transfer of absolute target position value [usr]	INT32 -2147483648...2147483647	0 R/W -

The PTP operating mode can be initiated using the HMI hand-held control unit by selecting the menu option '3.1.1.1 p_absPTP'.

In field bus mode, index and subindex are used for starting the operating mode. The command for PTP positioning with the 324 mm position value is:

Sending/receiving data	comments
command 04 01 00 23. 00 00 01 44h	04: sf=0, recording access 01 00 23h: Subindex 1: Index 35 01 44h: 324 mm
acknowledgement 00 23 00 06 . 00 00 00 00h	23h: ref_ok=1, PTP operation 00 06h: motion_end=0, amplifier on

Status information is sent back by way of acknowledgement, thereby enabling the change of operating mode to be monitored.

In the operating software, the 'Position' dialogue box is opened via Twin Line Position'. Settings can be entered, and the operating mode initiated in the 'PTP' register.

6.1.4 Monitoring the set operating mode

The set operating mode can be monitored by means of status parameters or via signal interface outputs.

Status-Parameter The positioning controller has a global and an operating mode specific status parameter for monitoring the operation.

The status parameter "Status.driveStat" supplies global information on the unit's operating status and the processing status.

Parameters	Explanation and units []		Value range	Default	R/W	
Group.name	Idx:Sidx	TL-HMI		value	rem.	
Status.driveStat	28:2	2.3.5.1	Status word for the operating status	UINT32 Bit0..3: Akt. Operating status: - 1: Start - 2: Not Ready to switch on - 3: Switch on disabled - 4: Ready to switch on - 5: Switched on - 6: Operation enable - 7: Quick-Stop active - 8: Fault reaction active - 9: Fault Bit4: reserved Bit5=1: internal monitoring fault (FltSig) Bit6=1: external monitoring fault (FltSig_SR) Bit7=1: warning Bit13: x_add_info Bit14: x_end Bit15: x_err Bit16-20: current mode (Bit0-4: Status.xMode_act) Bit21: drive is referenced (ref_ok) Bit22: drive in standstill window (p_win)	–	R/– –

Global status bits The status bits (bit 13 - bit 15) in the status parameter are taken unchanged from the status bits of operating mode specific status parameters. They have the following significance:

Status bit	Function	Value
Bit 13: x_add_info	Additional information depending on operating mode	Low/High
Bit 14: x_end	Operation running Operation finished, motor stopped	Low High
Bit 15: x_err	Fault-free operation Fault has occurred	Low High

Operating mode specific status parameters Every operating mode has its own status parameter which contains information on the processing status in bits 13 to 15.
For example, for PTP operation it is as follows:

Parameter	Explanation and unit []	Range of values	Default- R/W	
Group.name	Idx:Sidx TL-HMI		Value rem.	
PTP.StatePTP	35:2 3.2.14	Acknowledgement: PTP positioning	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit 5: Error SW_LIMP Bit 6: Error SW_LIMN Bit 7: Error SW_STOP Bit13: Setpoint reached Bit14: motion_end Bit15: motion_err	- R/- -

status via I/O signals Evaluation of the operating status via the signal interface can be used when fixed interface assignment has been set.

I/O signal	Function	Value
AXIS_ADD_INFO	Additional information depending on operating mode	Low/High
AXIS_END	Operation running Operation finished, motor stopped	Low High
AXIS_ERR	Fault-free operation Fault has occurred	Low High

As soon as an operating mode has been set and the operation initiated, bit 14 changes to '0'. When the operation is finished, bit 14 changes back to '1' thereby indicating that further operations can now be performed. Corresponding to status monitoring or AXIS_END at low.

Bit 14's signal change to '1' is suppressed, when one operation is followed immediately by another operation in a different operating mode.

If bit 15 is showing '1', a fault has occurred which must be corrected before operation continues. The positioning controller reacts in accordance with one of the fault categories depending on the seriousness of the fault, see Chapter 'Diagnosis and error rectification', page 8-1.

6.1.5 Status monitoring in movement mode

Status parameters In movement mode the positioning controller can be monitored by means of the parameters in the Status parameter set. The parameters are read only.

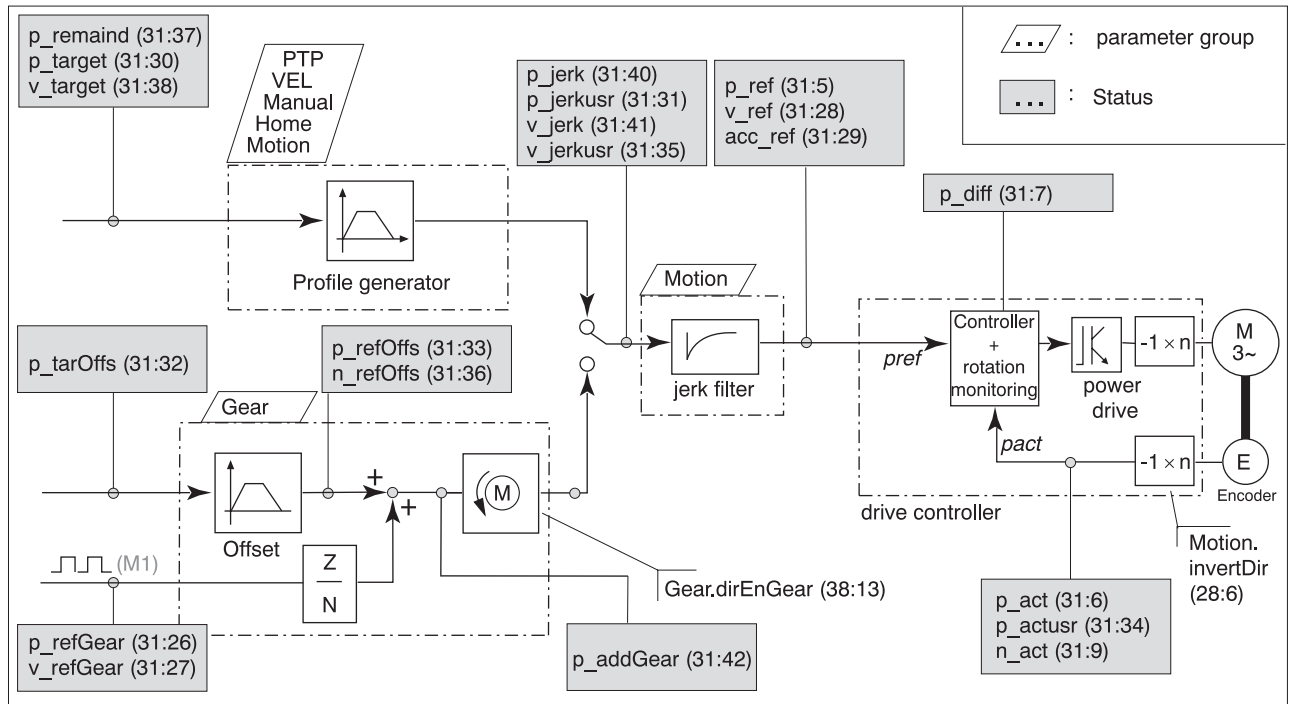


Fig. 6.2 Monitoring movement operations with status parameters

Parameter sets Operating modes are set via parameters in parameter sets belonging to the specific operating mode:

- PTP group: Settings for point-to-point mode
- VEL group: Settings for speed mode
- Gear set: Settings for the electronic gear operating mode with superimposed offset
- Motion group: parameter settings for all operating modes: jerk filter, direction of rotation, software limit switches, normalisation and ramp settings

Setting options for manual mode are in the „Manual“ parameter group, for homing in the „Home“ group. You will find a list of all parameter groups in the chapter entitled 'Parameters', page 12-1.

Profile generator Target position and final speed are input values which are entered by the user. The profile generator uses these values to work out a motion profile in conjunction with the operating mode selected. The output values from the profile generator and an upstream jerk filter are converted into motor movements by the drive controller. You will find information on the jerk filter in the chapter 'Ramp function' from page 7-16. In the electronic gear operating mode, positioning values are calculated from the input pulses fed in via a module in the M1 slot. An additional positioning offset can be superimposed by entering an offset position. The offset position is processed via the profile generator.

In the electronic gear operating mode, positioning values are calculated from the input pulses fed in via a module in the M1 slot. An additional positioning offset can be superimposed by entering an offset position. The offset position is processed via the profile generator.

6.2 Manual movement

Overview Manual movement is carried out as 'classic manual movement' or as 'united inching'. In both operating modes the motor is moved over a prescribed distance by means of start signals. In the 'classic manual movement' mode, the motor changes to continuous movement if the start signal is maintained for longer.

Manual operation can be carried out via

- HMI hand-held control unit
- Operating software
- Field bus
- Signal interface inputs when signal interface assignment is fixed.

Operation by means of operating software or HMI hand-held control unit

The operating software and the HMI hand-held control unit support this operating mode by means of special dialogue boxes and menu options. You can find further details on these in the operating software and HMI control unit manuals.

Starting manual operation

The starting conditions for manual movement depend on the setting of the signal interface assignment. The setting can be changed using the 'Settings.IO_mode' parameter, see page 6-3.

- Free assignment, parameter value 'Settings.IO_mode' = 0 or 1:
The positioning controller switches to manual movement as soon as the movement is initiated via a control unit or by means of the 'Manual.startMan' parameter via the field bus. Manual movement can not be initiated via the signal interface if the interface assignment is free.
- Fixed assignment, parameter value 'Settings.IO_mode' = 2:
If the input signal AUTOM = 0, manual operation can be initiated via the interface inputs or via a control unit as soon as the AUTOM_ACK output changes to low. If the input signal AUTOM = 1, manual movement can be initiated with the 'Manual.startMan' parameter via the field bus as soon as AUTOM_ACK goes high.

The motor can only be moved in both directions at two speeds via the input signals MAN_P, MAN_N and MAN_FAST, when assignment is fixed.

Manual movement is initiated by means of the 'Manual.startMan' parameter. The current axis position is the start position for the manual movement. The values for position and speed for which parameters can be set, are entered in user-defined units.

Manual movement is finished when the motor has stopped and

- on classical manual movement, the direction signal is inactive
- on united inching, the inching distance has been covered,
- the operating mode has been interrupted by a fault response.

The 'Manual.statusMan' parameter gives information on the status of the operation.

Parameter	Explanation and unit []		Range of values	Default- R/W
Group.name	Idx:Sidx	TL-HMI		Value rem.
Manual.startMan	41:1	3.2.1	Start of manual travel with transfer of control bits UINT16 Bit0: pos. sense of rotation Bit1: neg. sense of rotation Bit2: 0:slow 1:fast	0 R/W -
Manual.statusMan	41:2	-	Acknowledgement: manual travel UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit14: manu_end Bit15: manu_err	- R/W -

Enabling and starting manual movement via interface signals:

I/O Signal	Function	Value
I: AUTOM	Switch to manual mode Switch to automatic mode	low/open high
O: AUTOM_ACK	Manual mode possible M anual mode not possible	low/open high
I: MAN_N	Movement in negative sense of rotation	high
I: MAN_P	Movement in positive sense of rotation	high
I: MAN_FAST	Slow speed Fast speed	low/open high

Selecting manual movement mode

Manual movement can be carried out in two operating modes:

- Classical manual movement
- United inching

The operating modes can be changed by means of the 'Manual.type-Man' parameter.

Parameter	Explanation and unit []		Range of values	Default- R/W
Group.name	Idx:Sidx	TL-HMI		Value rem.
Manual.typeMan	41:3	3.2.2	Type of manual travel UINT16 0.: Classical inching 1: Unified inching	0 R/W rem.

Classical manual movement On receiving the start signal for manual movement, the motor first travels along a defined path, „Manual.step_Man“. If the start signal is still present after a certain delay, „Manual.time_Man“, the positioning controller changes to continuous movement until the start signal is cancelled.

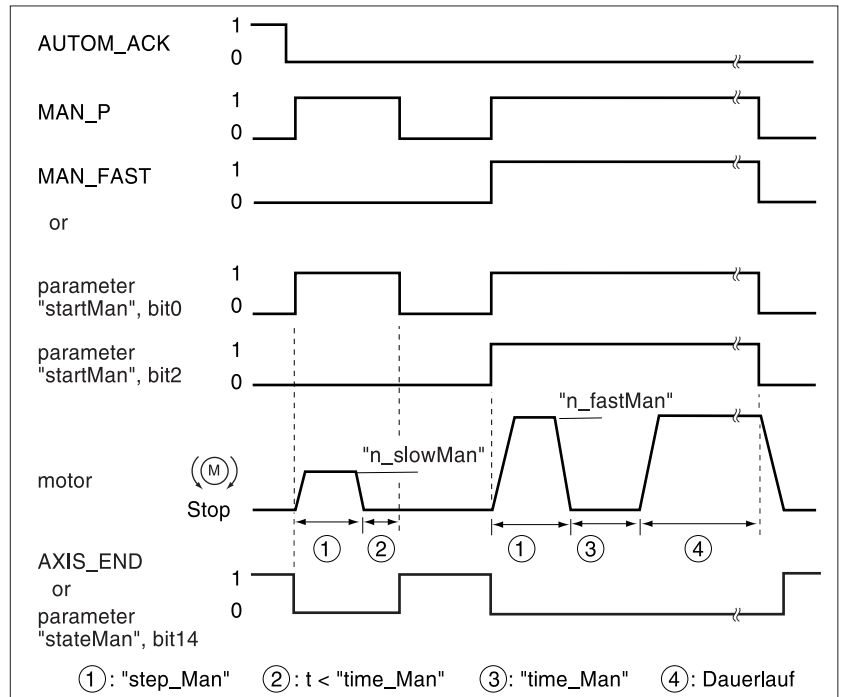


Fig. 6.3 Classical manual movement, slow and fast

The inching distance, delay and manual movement speed can be set. If the inching distance is zero, manual movement starts directly with continuous movement irrespective of the delay.

Parameter	Explanation and unit []		Range of values	Default-Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Manual.n_slowMan	41:4	3.2.3	Speed for slow manual travel [usr]	UINT32 1...2147483647	60 R/W rem
Manual.n_fastMan	41:5	3.2.4	Speed for fast manual travel [usr]	UINT32 1...2147483647	180 R/W rem
Manual.step_Man	41:7	3.2.6	Inch travel, defined travel on manual travel start [usr]	UINT16 0..65535	20 R/W rem.
Manual.time_Man	41:8	3.2.7	Classical waiting time [ms]	UINT16 1..30000	500 R/W rem

United inching With every start signal for manual movement, the motor moves a defined distance. If the start signal is removed before the destination has been reached, the positioning controller will stop the motor immediately.

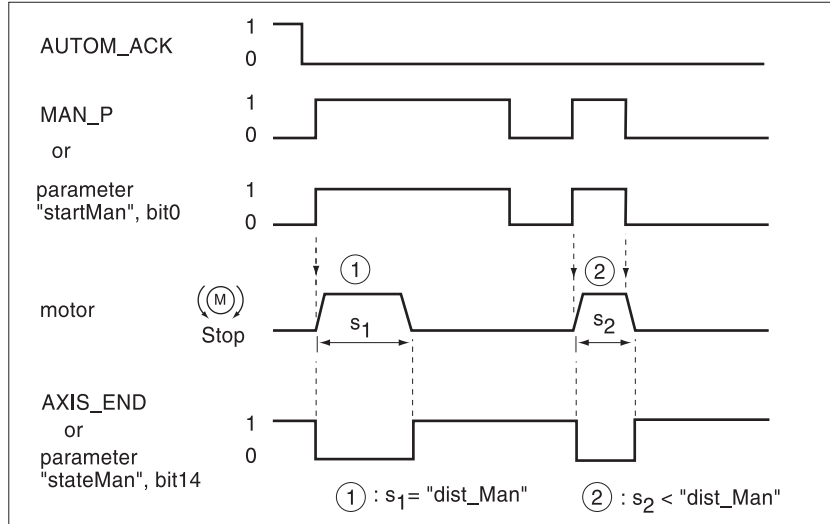


Fig. 6.4 Manual movement with united inching

The distance to be covered and manual movement speeds can be set.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Manual.n_slowMan	41:4	3.2.3	Speed for slow manual travel [usr]	UINT32 1...2147483647	60 R/W rem
Manual.n_fastMan	41:5	3.2.4	Speed for fast manual travel [usr]	UINT32 1...2147483647	180 R/W rem
Manual.dist_Man	41:6	3.2.5	Inch travel, defined travel per jog cycle on travel-limited inching [usr]	UINT16 1..65535	20 R/W rem.

Settings You will find further possible settings and functions for manual operation in:

- Changing acceleration and delay behaviour using 'ramp function' and 'quick stop function'
- Carrying out position-dependent speed and signal changes via list control and processing'
- Producing list data with 'teach-in processing'
- Adapting user-defined units and internal units with 'normalising'
- Setting unit and movement supervision with 'monitoring functions'
- Setting current limitation for manual operation via 'Manual.I_MaxMan' parameter

Example Simple, partially automated travel can be achieved by controlling signals for manual movement by hand-operated switches and cam switches.

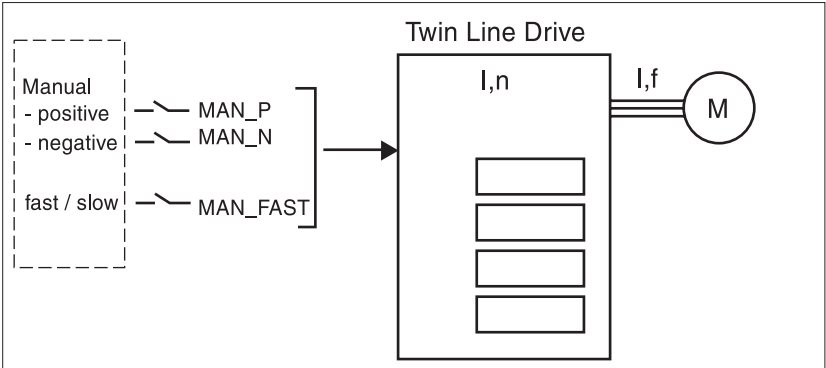


Fig. 6.5 Manual operation via input and output signals

6.3 Speed mode

In speed mode the motor is given a set speed, and movement is initiated with no defined finishing point. The motor moves at this speed until a different speed is set or the operating mode is finished.

Speed mode can be carried out via

- the HMI hand-held control unit
- the operating software
- field bus.

Operation via operating software or HMI hand-held control unit

The operating software and the HMI hand-held control unit support this operating mode through special dialogue boxes and menu options. You will find more details on them in the operating software and control unit manuals.

Starting speed mode

As soon as a speed value is communicated to the positioning controller via the 'VEL.velocity' parameter, the unit changes to speed mode and accelerates up to the set speed.

Processing in speed mode is completed when the set speed and actual speed are zero or when the operating mode is interrupted by a fault response. The parameter „VEL.stateVEL“ gives information on the processing status.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
VEL.velocity	36:1	3.1.2.1	Start of speed change with transfer of setpoint speed [usr]	INT32	0 R/W –
VEL.StateVEL	36:2	–	Acknowledgement: speed profile mode	UINT16 Bit0: errorr LIMP Bit1: error LIMN Bit2: error HW_STOP Bit3: error REF Bit 5: error SW_LIMP Bit 6: error SW_LIMN Bit 7: error SW_STOP Bit13: sepoint speed reached Bit14: vel_end Bit15: vel_err	R/– –

Settings

The set speed is transmitted in user-defined units and can be changed while the motor is in motion. Speed mode is not limited by the positioning area limits.

New ramp settings are transmitted when a speed value is communicated using the 'VEL.velocity' parameter.

You will find further possible settings and functions for speed mode in:

- Changing acceleration and delay behaviour using 'ramp function', 'jerk filter' and 'quick stop function'
- Carrying out position-dependent speed or signal changes via „list control and list data processing“
- Producing list data with 'teach-in processing'
- Adapting user-defined units and internal units with 'normalising'
- Setting unit and movement supervision with 'monitoring functions' and 'standstill window'

6.4 Point-to-point mode

In point-to-point mode (PTP), the motor is moved from a point A to a point B by means of a positioning command. The positioning distance is given in absolute terms with respect to the zero point of the axis or in relative terms with respect to the current axis position.

Before absolute positioning can be carried out, the reference point must be defined by means of a referencing process.

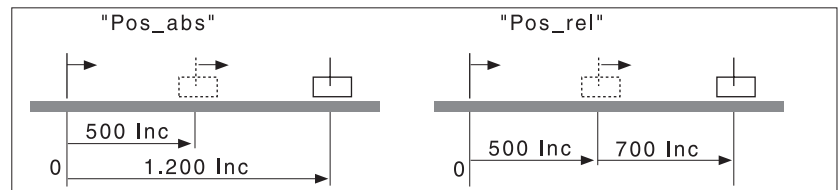


Fig. 6.6 Point-to-point positioning, absolute and relative

PTP mode can be executed via:

- the HMI hand-held control unit
- the operating software
- field bus.

*Operation with operating software
or HMI hand-held control unit*

The operating software and the HMI hand-held control unit support this operating mode through special dialogue boxes and menu options. You will find more details on them in the operating software and control unit manuals.

Initiating PTP mode

As soon as the positioning value is transmitted in the 'PTP.p_absPTP' or 'PTP.p_relPTP' parameters, the positioning controller changes to PTP operation, and starts the positioning process at the set speed which is stored in the 'PTP.v_target' parameter.

The positioning process is finished when the target position has been reached and the motor has stopped, or when the operating mode is interrupted by a fault response. The 'PTP.StatePTP' parameter gives information on the state of the operation.

If a different operating mode to PTP mode is active, relative positioning may only be initiated when the motor is at standstill.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
PTP.p_absPTP	35:1	3.1.1.1	Start of absolute positioning with transfer of absolute target position value [usr]	INT32 -2147483648...2147483647	0 R/W -
PTP.StatePTP	35:2		Acknowledgement: PTP positioning	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit13: Setpoint reached Bit14: motion_end Bit15: motion_err	- R/- -
PTP.p_relPTP	35:3	3.1.1.2	Start of relative positioning with value transfer for travel [usr]	INT32 -2147483648...2147483647	0 R/W -
PTP.continue	35:4	3.1.1.3	Continuation of interrupted positioning with transfer of any value	UINT16 value is not relevant for positioning	- R/W -
PTP.v_tarPTP	35:5	3.1.1.5	Setpoint speed of PTP positioning [usr]	INT32 -2147483648...2147483647	Motion. v_target 0 R/W -

- Continuing PTP operation* If a positioning process is interrupted, e.g. by an external stop signal, processing can be continued and completed by writing to the 'PTP.continue' parameter. The cause of the interruption must first be deactivated.
- The value transmitted via 'PTP.continue' is not analysed.
- Settings for PTP operation* Position and speed values are given in user units. If one of the values changes, the positioning controller responds immediately.
- New ramp settings are accepted when the motor starts with a new target position.
- You will find further settings and functions for PTP operation under:
- Changing acceleration and delay behaviour using 'ramp function', 'jerk filter' and 'quick stop function'
 - Carrying out position-dependent speed or signal changes via „list control and list data processing“
 - Producing list data with 'teach-in processing'
 - Adapting user-defined units and internal units with 'normalising'.
 - Setting unit and movement supervision with 'monitoring functions' and 'standstill window'.

6.5 Electronic gear

In the electronic gear operating mode, the positioning controller calculates a new position setpoint for the motor to move to, from a predefined position and an adjustable gear ratio. This operating mode is used when one or several motors is to follow the reference signal from a NC control unit or an encoder.

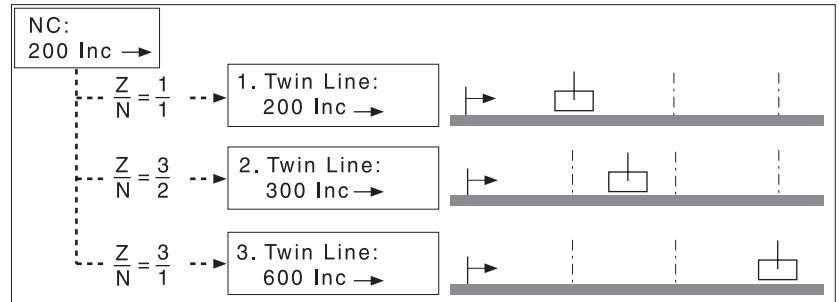


Fig. 6.7 Electronic gear with three Twin Line units, speed ratio adjustable via gear ratio (Z, N)

A PTP offset movement can be superimposed on the positioning process, and this can be used to alter the position setpoint.

In order to work in electronic gear mode, the encoder module RS422-C or the pulse-direction module PULSE-C must be inserted in slot M1. Depending on the module, different types of signal can be supplied:

- A/B signals with four-way evaluation of sensor signals with the RS422-C module
- Pulse-direction or pulse forward/pulse backward signals with the PULSE-C module.

The electronic gear operating mode can be carried out via:

- HMI hand-held control unit
- Operating software
- Field bus.

*Operation with operating software
or HMI hand-held control unit*

The operating software and the HMI hand-held control unit support this operating mode with special dialogue boxes and menu options. You will find details on these in the operating software and HMI control unit manuals.

Initiating electronic gear

This operating mode is switched on via the 'Gear.startGear' parameter. If reference pulses are supplied, the positioning controller offsets them against the gear ratio and directs the motor to the new setpoint.

Position values are given in internal increments. The positioning controller follows any change in the values immediately. The electronic gear operating mode is not limited by the positioning area boundaries.

The process is finished when gear processing has been deactivated and the motor has come to a halt, or when the operating mode has been interrupted. If the positioning controller switches from the operating status '6 Operation enable' to a different status, gear processing is automatically deactivated, e.g. when the motor is stopped by Quick Stop. The 'Gear.stateGear' parameter gives information on the processing status.

Synchronisation In the electronic gear operating mode, the positioning controller operates synchronously in a coupled gear arrangement, e.g. with other drives. If the positioning controller switches from gear processing for a short time, synchronisation with the other drives is lost. When gear processing is recommenced, the drive has two ways of re-establishing synchronisation.

- Immediate synchronisation: The positioning controller follows reference pulses from the moment when gear processing is activated. Reference pulses, offset entries and position changes which have occurred before the operating mode commenced, are not taken into consideration.
- Synchronisation with compensatory motion: when gear processing is activated, the drive makes a compensatory movement in an attempt to reach the position which it would have gone to if no interruption had taken place.

There are various conditions attached to synchronisation with compensatory movement, and you will find more on this subject in the section 'Synchronisation with compensatory movement', page 6-22.

The type of synchronisation required is set by means of the 'Gear.startGear' parameter which also initiates the operating mode.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.name	Idx:Sidx	TL-HMI			
Gear.startGear	38:1	3.1.1.1	Start of electronic gearbox processing with selection of processing mode	UINT16 0: deactivated; 1: gearbox with position referencing activated	0 R/W -
Gear.stateGear	38:2	-	Acknowledgement: gearbox processing	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit13: gear_sync_window Bit14: gear_end Bit15: gear_err	- R/- -

An NC control unit sends a position setpoint to two positioning controllers. The motors execute different, proportional positioning movements in accordance with the gear ratios.

6.5.1 Gear settings

Overview Setting values for electronic gear, regardless of the type of synchronisation, are

- gear ratio
- Maximum acceleration
- Maximum speed
- offset value for PTP offset
- positioning enabling of sense of rotation.
- Parameters for reference speed filter

Gear ratio The gear ratio is the relationship between externally supplied reference pulses and output pulses for motor movement. The gear ratio is defined by means of the parameters for numerators and denominators. A negative numerator value reverses the motor's sense of rotation. The gear ratio is preset to 1:1.



A new gear ratio is activated when the numerator value is supplied.

Parameter	Group.name		Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.numGear	38:7	3.1.3.2			Gearbox factor numerator	INT32 -2147483648...2147483647	1	R/W -
Gear.denGear	38:8	-			Gearbox factor denominator	INT32 1...2147483647	1	R/W -

The resulting positioning motion is dependent on the current motor resolution, e.-g.

Current limitation The maximum values for acceleration and deceleration are derived from the limitation in current. They are not limited by ramp functions as in PTP mode, for example. To protect the drive system, current limitation must be set, using the following parameters, to match the system which has been constructed:

Parameter	Group.name		Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.a_maxGear	38:6	3.1.3.20			Maximum values for acceleration and deceleration in [r.p.m.*s], normalisation of acceleration not taken into account	UINT32 120.. 120000	600	R/W -

Speeds The maximum speed in electronic gear is set by means of 'Gear.n_maxGear'. Speed normalising is not taken into account.

Parameter	Group.name		Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.n_maxGear	38:5	3.1.3.3			Maximum speed	INT32 1..3000	3000	R/W rem.

- Contouring errors* If the pulse frequency at the setpoint input changes quickly, the drive will not be able to follow a positioning target directly. A temporary lag occurs. This lag can be of any size.
- Direction enabling* Direction enabling prevents any movement opposed to the desired direction of travel which could for example occur with compensatory or offset movements. Direction enabling is set by means of the 'Gear.dirEnGear' parameter.

Parameter	Group.name		Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.dirEnGear	38:13	-			Release of movement direction, Reversing the sense of rotation inverts the movement direction	INT16 1: positiv direction 2: negativ direction 3: both directions	3	R/W -

Electricity settings If the drive is in the "Electronic Gear" operating mode, the standstill current, „Settings.l_O“ is the effective phase current when the gear is inactive. When the gear is active, the phase current for acceleration / deceleration, „Settings.l_acc“ always applies regardless of whether or how the motor is turning.

Filter for reference sensor speed In order to achieve smooth speeds even for stepping motors when the reference speed remains constant, the reference sensor speed is smoothed by a filter. For this, the correct filter parameters , „Gear.Flt_nGear“ and „Gear.Flt_rGear“ must be set.

Parameter	Group.name		Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.Flt_nGear	38:9	3.1.3.21			Parameters for speed filter. 0 = filter deactivated 1..8 = filter activated	UINT16 0..8	4	R/W rem.
Gear.Flt_rGear	38:14	3.1.3.22			Switch-off threshold for speed filter. [motor increments / ms ²	UINT16 1..100	15	R/W rem.

The higher the value „Gear.Flt_nGear“ is set for the speed filter, the stronger the effect of the filter.

Filtering of the reference sensor speed can be switched off by means of the „Gear.Flt_rGear“ parameter (change of speed). The higher the gear ratio, the higher the value that has to be set.

Rule of thumb: Value = 2 * numerator / denominator.

In order to achieve smoother speeds, it is advisable to choose a higher value; on the other hand, a lower value will give better dynamic performance.

Example gear processing An NC control unit sends a position setpoint to two positioning controllers. The motors execute different, proportional positioning movements in accordance with the gear ratios.

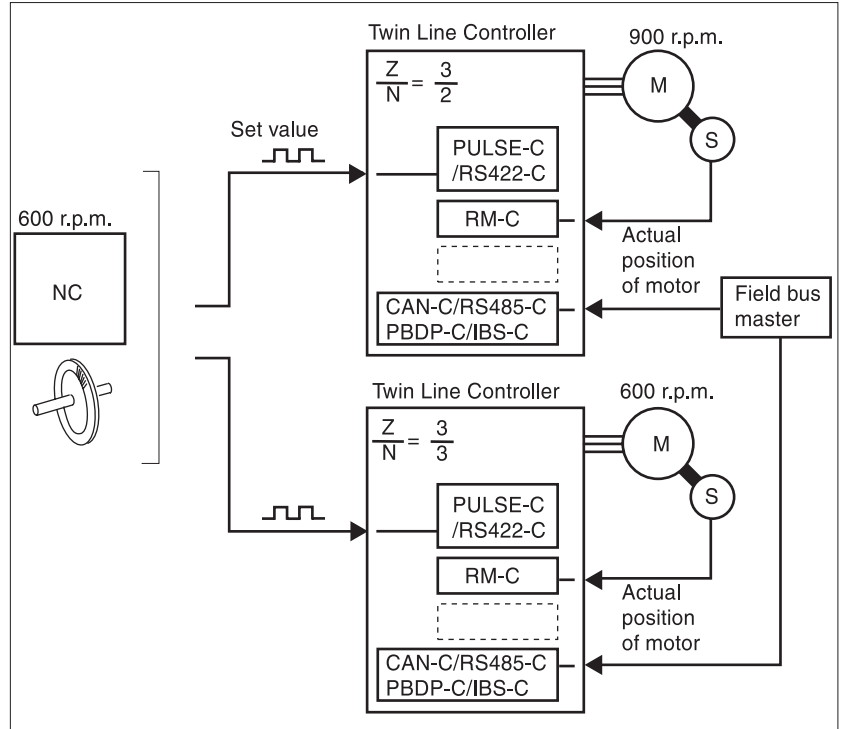


Fig. 6.8 Electronic gear with setpoint preset via NC control unit or encoder

6.5.2 Synchronisation with compensatory movement

Synchronisation with compensatory movement can be used to uncouple and recouple the positioning controller for a short time in a coupled gear system, without losing synchronisation with the other gears. In making its compensatory movement, the positioning controller takes into consideration all reference pulses, position changes and offset entries which have occurred during the interruption, and attempts to move to the exact position which it would have reached without the interruption.

Conditions for a compensatory movement

The positioning controller can be uncoupled from synchronous operation by means of the following actions:

- Switching off the operating mode by means of 'Gear.startGear' = 0
- Initiating a different operating mode
- Quick Stop

The power amplifier must remain switched on. If it is switched off, all stored reference pulses will be lost when it is switched on again.

Starting a compensatory movement

The electronic gear operating mode with compensatory movement is initiated by means of the 'Gear.startGear' = 2 parameter.

The positioning controller attempts to catch up as quickly as possible with reference pulses which have accumulated before the operating mode was activated. It is restricted in doing so by the maximum acceleration „Gear.a_maxGear“ and the maximum speed „Gear.n_maxGear“.

Establishing positional deviation

A positional deviation during gear processing can be established by comparing parameters 'Status.p_addGear' and ' Status.p_ref'.

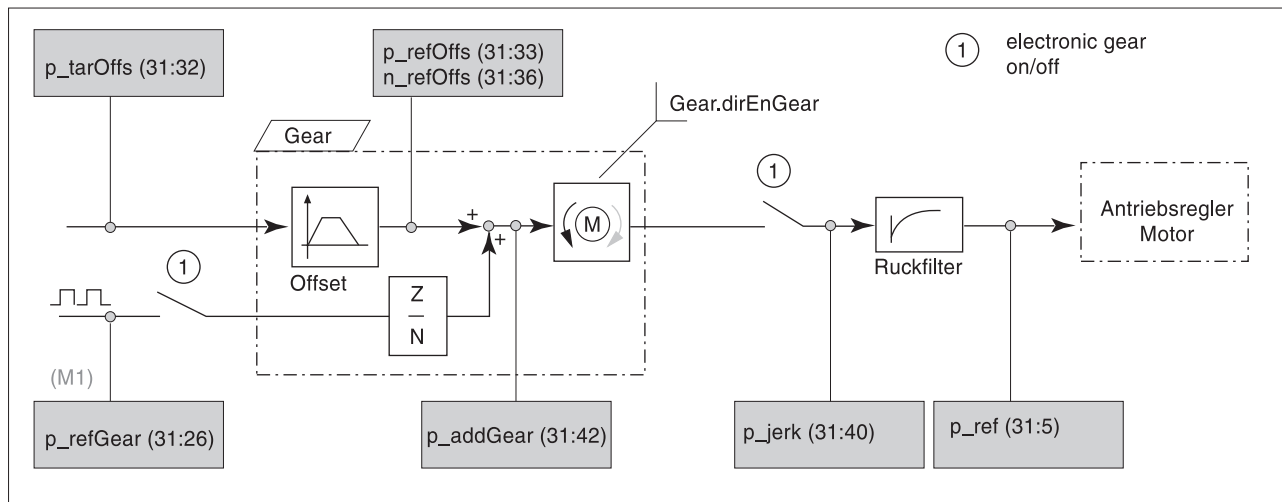


Fig. 6.9 Parameters for establishing positional deviation

If electronic gear has been deactivated, parameter 'Status.p_addGear' is no longer updated. Any positional deviation can then be established by means of the positional value 'Gear.p_refGear' at the gear input, taking into consideration the gear ratio.

Direction presets

Before gear processing is activated, the direction of any compensatory movement can be preset by means of the 'Gear.dirEnGear' parameter. To ensure that the direction is correctly enabled, the direction inversion function must be taken into consideration which can be established via the 'Motion.invertDir' parameter.

6.5.3 Offset positioning

A point-to-point offset positioning operation can be superimposed on a positioning operation in electronic gear mode. This is used to alter the position setpoint of the position controller by adding the offset value. For example, it can be used to trigger a position offset in continuous processing.

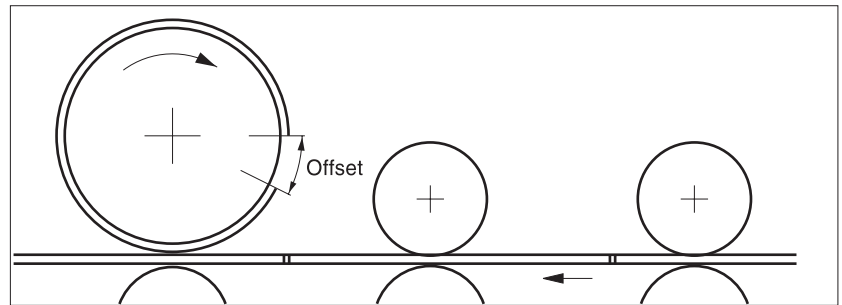


Fig. 6.10 Offset for bridging an empty area when printing

Offset displacement is initiated as soon as the 'Gear.p_absOffs' or 'Gear.p_relOffs' parameter is transmitted. Offset values are given in internal incremental units as relative or absolute values. They are therefore subject to the type of encoder used.

The 'State' parameter gives information on the state of the operation.

If the operating mode changes from electronic gear to a different mode, any running offset positioning operation is immediately interrupted, and the current positioning operation is finished.

Settings In a similar fashion to PTP positioning, offset movements are defined by means of a linear ramp profile with acceleration and deceleration ramps as well as final speed. The offset movement is added to the reference pulses of a running gear processing operation.

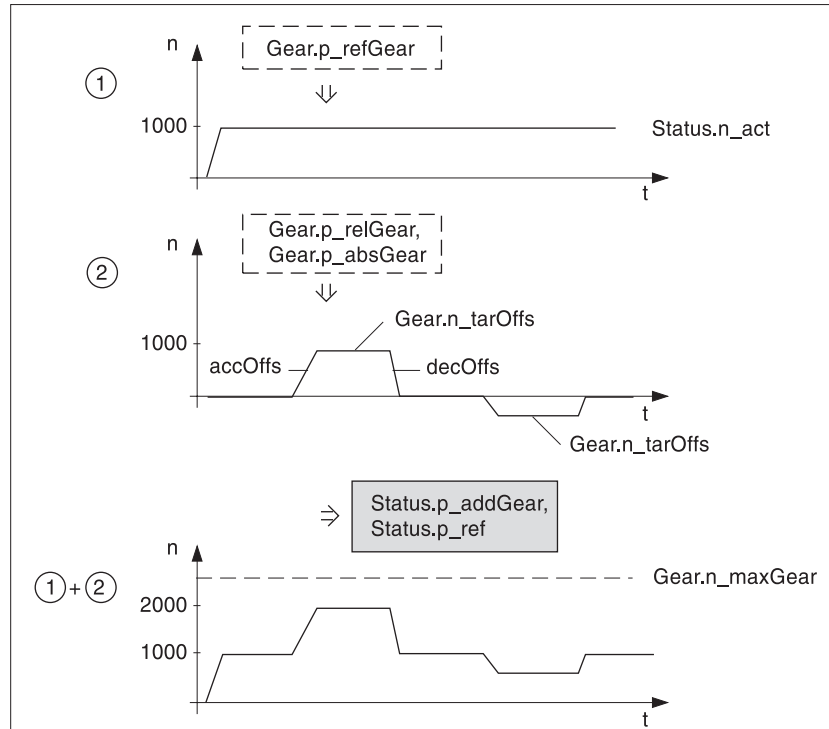


Fig. 6.11 Constant movement with superimposed offset positioning

If gear processing has been deactivated, the offset value is immediately set off against the reference pulses with no limitation from offset ramp values. This means that when operating synchronisation with compensatory movements, it is possible to adjust the position of the motor immediately to match any movement caused by a sudden PTP positioning process.

Dimension setting The operator is free to switch freely between absolute and relative movement. The positioning area of an absolute value can be set to a defined value by means of the offset parameter 'Gear.p_homeOffs'. This does not cause the motor to move.

Monitoring The position preset is given as an absolute value in increments in the 'Status.p_tarOffs' parameter. The current position value and speed can be determined via 'Status.p_refOffs' and 'Status.n_refOffs'.

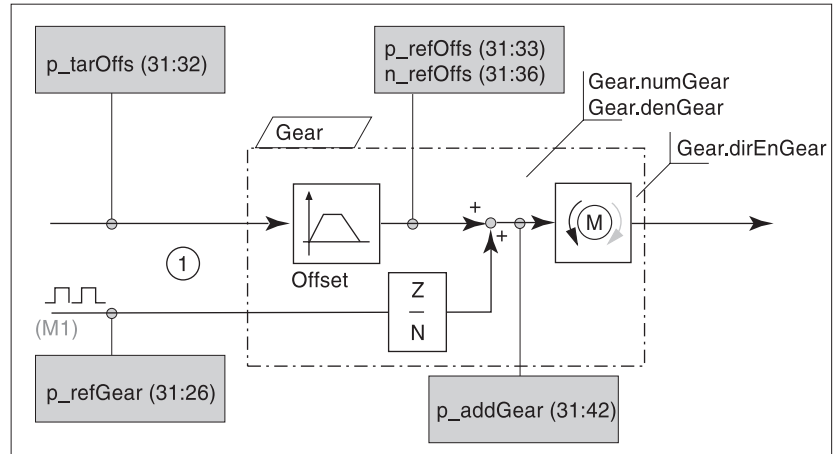


Fig. 6.12 Supervision of offset positioning

Parameter	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Gear.p_absOffs	39:1	3.1.3.6	Start of absolute offset positioning with transfer of position	INT32 -2147483648...2147483647	0	R/W -
Gear.stateOffs	39:2	-	Acknowledgement: offset positioning	UINT16 Bit0: Errorr LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit13: offset set position reached Bit14: offset_motion_end Bit15: offset_motion_err	-	R/- -
Gear.p_relOffs	39:3	3.1.3.7	Start of relative offset positioning with transfer of travel value [Inc]	INT32 -2147483648...2147483647	0	R/W -
Gear.n_tarOffs	39:5	3.1.3.8	Setpoint speed of offset positioning [Inc]	INT32 -12000..12000	60	R/W -
Gear.phomeOffs	39:6	3.1.3.9	Sizing in offset positioning [Inc]	INT32 -2147483648...2147483647	0	R/W -
Gear.accOffs	39:7	-	Acceleration ramp for offset positioning [r.p.m/s]	INT32 60..2.000.000	600	R/W -
Gear.decOffs	39:8	-	Deceleration ramp for offset positioning [r.p.m/s]	INT32 60..2.000.000	600	R/W -

6.6 Referencing

Overview In the referencing operating mode, an absolute scale reference of the motor position to a defined axis position is established. Referencing is possible by means of:

- reference movement or
- dimension setting.

In a reference movement, a defined position on the axis, the zero or reference point is targeted in order to establish the absolute scale reference of the motor position to the axis.

Dimension setting offers the chance of defining a point on the axis as the reference point, to which all following position data are referred.

The referencing operating mode can be carried out via

- HMI hand-held control unit,
- operating software
- field bus.

Operation with operating software or HMI control unit The operating software and the HMI control unit support this operating mode with special dialogue boxes and menu options. You will find details on these in the operating software and HMI control unit manuals

Referencing with parameters The referencing operating mode can be initiated using the field bus via two parameters:

- reference movement via 'Home.startHome'
- dimension setting via 'Home.startSetP'

The 'Home.StateHome' parameter gives information on the state of the operation.

Successful referencing is indicated by bit 5, 'ref_ok'= 1 in the 'Status.xMode_act' parameter.

6.6.1 Reference movement

The positioning controller offers a choice of four standard reference movements. In addition for each of these reference movements, a reference movement can be executed on the index pulse of the motor.

- movement to negative limit switch $\overline{\text{LIMN}}$
- movement to positive limit switch $\overline{\text{LIMP}}$
- movement to reference switch $\overline{\text{REF}}$ with first movement in negative sense of rotation
- movement to reference switch $\overline{\text{REF}}$ with first movement in positive sense of rotation

The corresponding signal inputs $\overline{\text{LIMN}}$, $\overline{\text{LIMP}}$ and $\overline{\text{REF}}$ must be wired up. Search and clearance speeds, as well as safety gap and clearance distance are all adjustable in user-defined units for the reference movement.

The REF switch does not have to be enabled for reference travel. If the REF switch is enabled, it takes on the function of an additional STOP switch.

The level of the $\overline{\text{REF}}$ reference switch can be inverted via bit 3 in the "Settings.SignLevel" parameter.

Parameter	Explanation and unit []		Range of values	Default-	R/W	
Group.name	Idx:Sidx	TL-HMI		Value	rem.	
Home.startHome	40:1	3.3.1.1 3.3.1.2 3.3.1.3 3.3.1.4 3.3.1.5 3.3.1.6 3.3.1.7 3.3.1.8	Start of operating mode refer- encing	UINT16 1 : LIMP 2 : LIMN 3 : REFZ neg. sense of rotation 4 : REFZ pos. sense of rotation 5 : LIMP with index pulse 6 : LIMN with index pulse 7 : REFZ neg. sense of rotation with index pulse 8 : REFZ pos. sense of rotaion with index pulse	–	R/W –
Home.stateHome	40:2	–	Acknowledgement: referencing	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit14: ref_end Bit15: ref_err	–	R/– –
Home.v_Home	40:4	3.3.3	Speed for search of reference switch [usr]	INT32 -2147483648...2147483647	60	R/W rem.
Home.v_outHome	40:5	3.3.4	Speed for processing run-out travel and safety distance [usr]	INT32 -2147483648...2147483647	6	R/W rem.
Home.p_outHome	40:6	3.3.5	Run-out distance, is automati- cally approached when reference is found [usr]	UINT32 0: Run-out disabled >0: Run-out distance [usr]	0	R/W rem.
Home.p_disHome	40:7	3.3.6	Safety distance of switching edge to reference point	UINT32 0...2147483647	200	R/W rem.

A reference movement must be completed for the new reference point to be valid. If the movement is interrupted, it must be restarted. In contrast to the other operating modes, a reference movement must be completed before the operating mode may be changed.

You will find further settings and functions for this operating mode under:

- Adapting user-defined units and internal units with 'normalising'.

Example 1 Reference movement towards limit switch

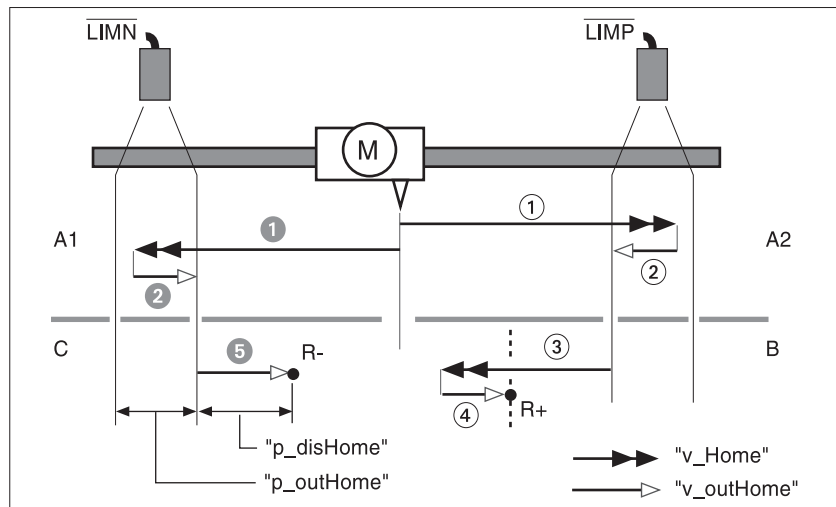


Fig. 6.13 Reference movements to limit switch with movement to index pulse and to safety gap

- Movement to the positive limit switch (A2) with index pulse (B), reference point is 'R+'

1: Fahrt mit Suchgeschwindigkeit „Home.v_Home“ auf LIMP-Endschalter

2: movement to the switching edge at clearance speed 'Home.v_outHome'

3: movement to the index pulse at search speed

4: movement to the index pulse at clearance speed

- Movement to negative limit switch (A1) with additional safety gap (C), reference point is 'R-'

1: movement at search speed 'Home.v_Home'

2: movement to switching edge at clearance speed 'Home.v_outHome'

5: movement to distance 'Home.p_disHome' at clearance speed.

Example 2 Reference movement to reference switch

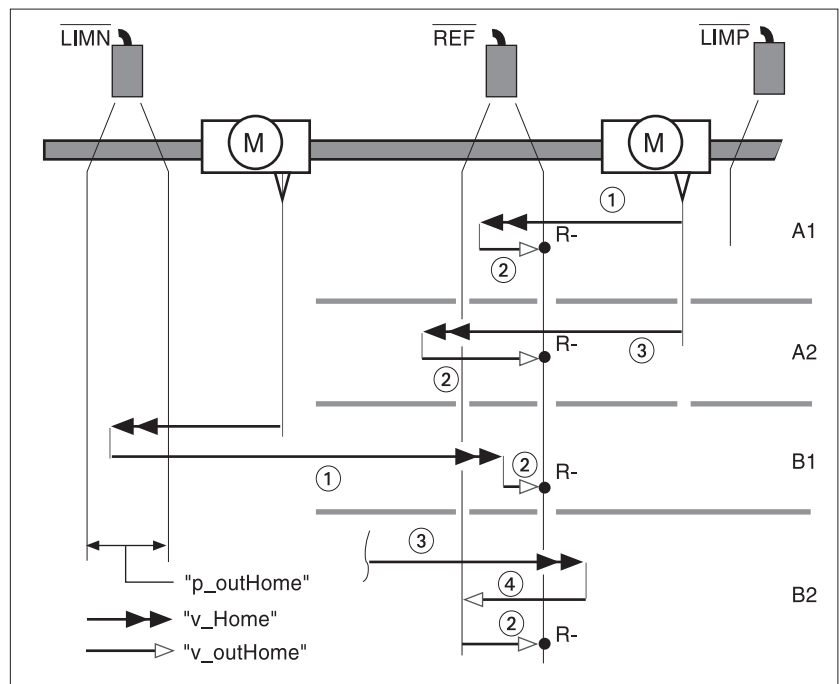


Fig. 6.14 Reference movement to reference switch with first movement in negative sense of rotation

- Movement to the reference switch with the first movement in a negative direction, REF switch first in front of (A1, A2) then behind the starting point (B1, B2), reference point is 'R-'
- Additional movements when travelling through switching window (A2, B2).

- 1: movement to reference switch at search speed 'Home.v_Home'
- 2: movement to switching edge at clearance speed 'Home.v_outHome'
- 3: over-rapid movement to reference switch at search speed
- 4: return to first switching edge at clearance speed

6.6.2 Dimension setting

Referencing by dimension setting moves the reference point for set-points to the new scale position. The position is transmitted in user-defined units in the 'Home.startSetp' parameter.

Dimension setting can only be carried out when the motor is at a standstill. Any active position deviation is retained and can still be compensated by the position controller after dimension setting has taken place.

Parameter	Explanation and unit []	Range of values	Default- R/W
Group.name	Idx:Sidx TL-HMI	Value	rem.
Home.startSetp	40:3 3.3.2	Sizing on sizing position (set absolute position) [usr]	INT32 -2147483648...2147483647 0 R/W -
Home.stateHome	40:2 -	Acknowledgement: referencing	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit14: ref_end Bit15: ref_err - R/- -
Status.xMode_act	28:3 2.3.5.5	Current axis operating mode with additional information	UINT16 Bit0..4: Actual operation mode Bit5=1: Drive is referenced ('ref_OK') - R/- -

Example Dimension setting can be used to carry out a continuous motor movement without exceeding positioning limits.

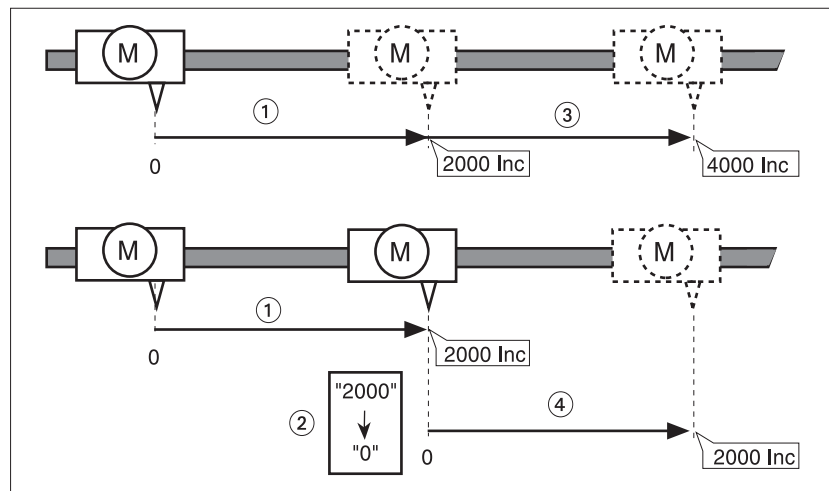


Fig. 6.15 Positioning by 4000 increments with and without dimension setting

- The motor positions 2000 incs (1) with the start on the reference point.
- By calling up referencing by dimension setting, the current position is set to the scale position in user-defined units (2).
- New movement command by 2000 incs is triggered
 - new target position without dimension setting (3): 4000 incs
 - new target position with dimension setting (4): 2000 incs.

By this method, crossing absolute position limits during a positioning operation is avoided, as the zero point is continuously tracked.

7 Functions of the positioning controller

7.1 List control and list processing

Overview List-driven operation runs in the background while a movement command is being carried out, and can be used in conjunction with all operating modes. If the motor travels over an axis position which is stored in the list, an interface signal is changed or a new speed setting is activated.

The positioning controller can store two separate lists with 64 list fields each for position entries. A list type must be assigned before inputting values in a list.

- Position / speed list A separate speed is stored in this list for every position entry.
- Position / signal lists They store a signal level for every position entry to which the interface output TRIGGER is set.

I/O signal	Function	Value
TRIGGER	Output signal which is switched by means of a position / signal list	Low/open

The accuracy of the time at which the positioning controller sets the output signal depends on various hardware and software related factors. See „Triggering accuracy“ on page 7-5.

initiating list-driven operation

List-driven operation can be initiated via

- the HMI hand-held control unit
- operating software
- field bus.

List-driven operation is initiated by selecting the list and a starting number in the range between the first and last number. If an operating mode is switched on, the positioning controller changes the TRIGGER output or the speed setting when list and axis position match.

The list can be changed during a running operation by selecting the inactive list. By deactivating the current list, list processing can be interrupted at any point in the positioning process.

When the specified finishing number is reached, list-driven operation is stopped. To restart it, only the list needs to be selected as the starting and finishing positions as well as all list entries remain set.

Parameter	Explanation and units []		Range of values	Default-	R/W
Gruppe.Name	Idx:Sidx	TL-HMI		value	rem.
List.startList	44:1	3.1.5.1 3.1.5.2 3.1.6.1 3.1.6.2	Activate new list-driven operation, current list-driven operation is first deactivated.	UINT16 0 : no list active 1 : list 1 2 : list 2	0 R/W -
List.stateList	44:2	-	Acknowledgement and status: list data processing	UINT16 Bit15: list_err Bit14: list_quit 0: list-driven operation active 1: list-driven operation completed bit 0,1: - 0 : no list active - 1 : list 1 active - 2 : list 2 active	- R/- -
List.cntList1	44:4	-	List 1: number of available list entries	UINT16	64 R/- -
List.bgnList1	44:6	-	List 1: starting number, first entry for list data processing finishing number < finishing number	UINT16 0...63	0 R/- -
List.endList1	44:7	-	List 1: finishing number, last entry for list data processing finishing number > finishing number	UINT16 0...63	63 R/W rem.
List.actList	44:18	-	Last activated list number starting number =< active proc.No. =< fin.No.	INT16 -1: no list entry activated 0..63: last activated list entry	0 R/W rem.
List.cntList2	44:12	-	List 2: number of available list entries	UINT16	64 R/- -
List.bgnList2	44:14	-	List 2: starting number, first entry for list data processing starting number < finishing number	UINT16 0...63	0 R/W -
List.endList2	44:15	-	List 2: finishing number, last entry for list data processing finishing number > starting number	UINT16 0...63	63 R/W rem.

Processing list data

List entries in the non-active list can be changed before and during list-driven operation either manually or with the teach-in function. You will find details on teach-in processing further on in this chapter from page 7-7.

When changing list values, please pay attention to the following:

- The positioning controller stores position values and speed values in user-defined units. This makes the lists independent of the resolution of the connected motor.
- List entries are selected via list numbers, and processed in ascending order. In the same way, position values must be entered consecutively in ascending or descending order.
- The list type assigned applies to the whole list. The list type can not be changed within one list.
- The finishing number in the list can be moved.

The entries in both lists can be accessed via parameter groups 'L1Data0' to 'L1Data63' for list 1 and 'L2Data0' to 'L2Data63' for list 2.

Parameter			Explanation and unit []	Range of values	Default- Value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI				
L1Data0.typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.
L1Data0.posList1	1100:2	7.3.2.1 7.3.2.2	List 1: position	INT32	0	R/W rem.
L1Data0.signList1	1100:3	7.3.2.3	List 1: signal state	UINT16 0, 1	0	R/W rem.
L1Data0.velList1	1100:4	7.3.2.4	List 1: setpoint speed	INT32 -'motion.n_max0' .. 'Motion.n_max0' setting dependent on operating mode PTP: 0: PTP.Vtarget; <>0: stored value VEL: <>0: VEL.velocity; 0: stored value	0	R/W rem.
L2Data0.typeList2	1200:1	7.4.1.1	List 2: list type for ALL following list entries (1202:x...1263:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.
L2Data0.posList2	1200:2	7.4.2.1 7.4.2.2	List 2: position	INT32	0	R/W rem.
L2Data0.signList2	1200:3	7.4.2.3	List 2: signal state	UINT16 0, 1	0	R/W rem.
L2Data0.velList2	1200:4	7.4.2.4	List 2: setpoint speed	INT32 -'motion.n_max0' .. 'Motion.n_max0' setting dependent on operating mode PTP: 0: PTP.Vtarget; <>0: stored value VEL: <>0: VEL.velocity; 0: stored value	0	R/W rem.

Example of position / signal list

List-driven operation begins with a point-to-point positioning process from the reference position to the 510 mm position at a speed of 100 r.p.m.

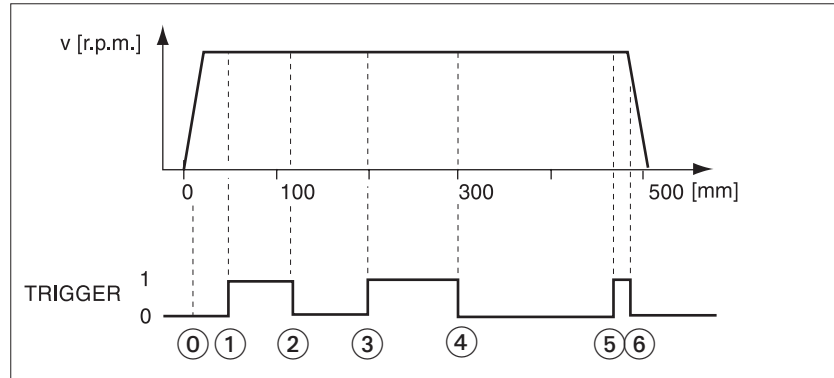


Fig. 7.1 Positioning with position / signal list

- ▶ Entering position values in list 1 for list processing between the starting and finishing positions manually or via teach-in.

Activated list excerpt for the example:

Graphics point	List number 1100:x...1163:x	List type 1xxx:1	Position 1xxx:2	Trigger signal 1xxx:3	Speed 1xxx:4
0	1100	1	10	0	0
1	1101	1	50	1	0
2	1102	1	120	0	0
3	1103	1	200	1	0
4	1104	1	300	0	0
5	1105	1	470	1	0
6	1106	1	490	0	0
-	...	...	...	0	0

- ▶ Starting position list number 0 with „List.bgnList1“= 0 (Lst.Nr.1100.x)
- ▶ finishing position list number 6 with „List.endList1“= 6 (Lst.Nr.1106.x)
- ▶ Activate list 1 with 'List.startList'=1
- ▶ Initiate positioning process.

The trigger signal is changed when the position from the list corresponds to the current position of the motor pick-up.

Triggering the trigger signal

Two successive trigger signals must be at least 3 ms apart. Smaller intervals are possible; the trigger signal can then be delayed for several milliseconds.

Triggering accuracy The point at which the trigger signal is switched varies by values which are influenced by hardware and software dependent factors.

- Determined by hardware causes such as temperature, power supply or output load: Jitter: max. +/-20 μ s.
- Determined by software causes: Jitter: max. +/-30 μ s, at low speeds +/- 25 Inc.

Trigger signals are shifted by an additional factor during an acceleration or deceleration phase by comparison with the trigger point during a constant speed phase.

Example at 10000 rev/(min*s):

- Acceleration: triggering 12 μ s later
- Braking: triggering 12 μ s earlier

Trigger level The level of the trigger signal is set via the "I/O.OutTrig" parameter. This is used to set the first trigger level after the start of list processing or after list processing has been interrupted.

Parameter		Explanation and units []	value range	Default	R/W
Gruppe.Name	Idx:Sidx TL-HMI			value	rem.
I/O.OutTrig	34:9 –	Setting trigger output when signal list inactive	UINT16 0: Low level 1: High level	0	R/W –

Example of position / speed list

List-driven operation is carried out with an absolute positioning process from the reference point to the 6,000 incs position. The starting speed is 100 r.p.m.

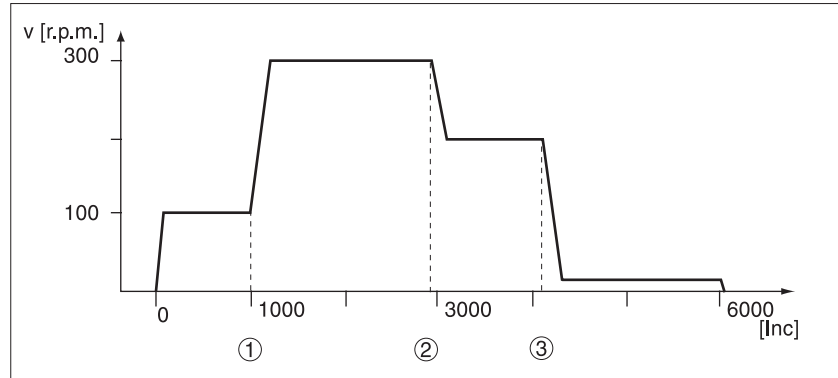


Fig. 7.2 Positioning with position / speed list

- ▶ Activate position / speed list with 'L2Data0.typeList2' = 2,
- ▶ Enter position values for list-driven operation between starting and finishing position manually or via teach-in.

Activated list excerpt for the example:

Graphics point	List number 1200:x...1263:x	List type 1xxx:1	Position 1xxx:2	Trigger signal 1xxx:3	Speed 1xxx:4
1	1205	2	1000	0	300
2	1206	2	2800	0	200
3	1207	2	4200	0	10
-	...	...	...	...	0

- ▶ Define starting position list number 5 with 'List.bgnList2'= 5 (Lst.Nr.1205.x)
- ▶ finishing position list number 7 with „List.endList2“=7 (Lst.Nr.1207.x)
- ▶ Activate list 2 with 'List.startList'=2
- ▶ Initiate positioning.

The change in speed is triggered when the position from the list matches the current set position.

7.2 Teach-in processing

Overview Teach-in processing offers the chance to register current position values by moving the motor, and to copy them to a previously assigned memory area. The size of the available memory depends on the extent of the free list memory. If the list is empty, up to 64 position entries can be stored. Teach-in processing can be carried out via:

- HMI hand-held control unit
- Operating software
- Field bus
- Signal interface inputs

Data are stored in a position / signal list or a position / speed list. List values for speed or signal status can be added to using:

- HMI hand-held control unit
- Operating software
- Field bus.

The positioning controller reads the position values as absolute values in user-defined units.

Operation controlled by operating software or HMI hand-held control unit

The operating software and the HMI unit support this operating function with special dialogue boxes and menu items. You will find details in the operating software and HMI manuals.

Initiating teach-In processing

The following are requirements for initiating teach-in processing:

- Axis position defined by referencing or encoder position recorded on initialization
- Output switched on and ready
- Motor in the positioning area
- Motor at standstill
- For teach-in via signal interface: 'Settings.IO_Mode'=2

Before commencing teach-in processing, the list type must be set and the list selected.

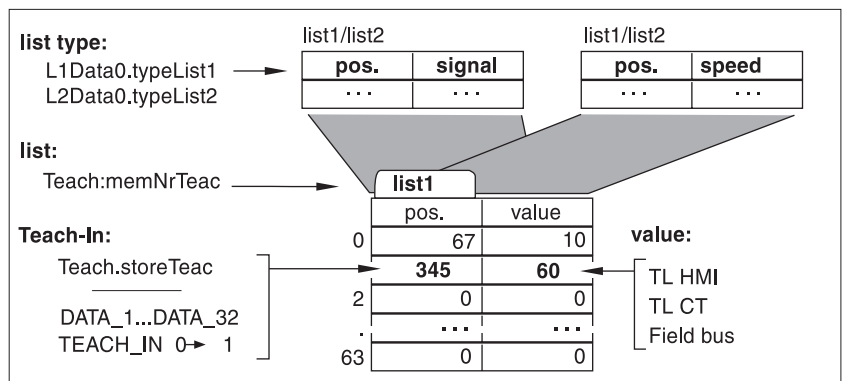


Fig. 7.3 List setting

Control of the teach-in process via the signal interface is only possible if the 'Settings.IO_mode' parameter = 2, and the AUTOM input signal is at low.

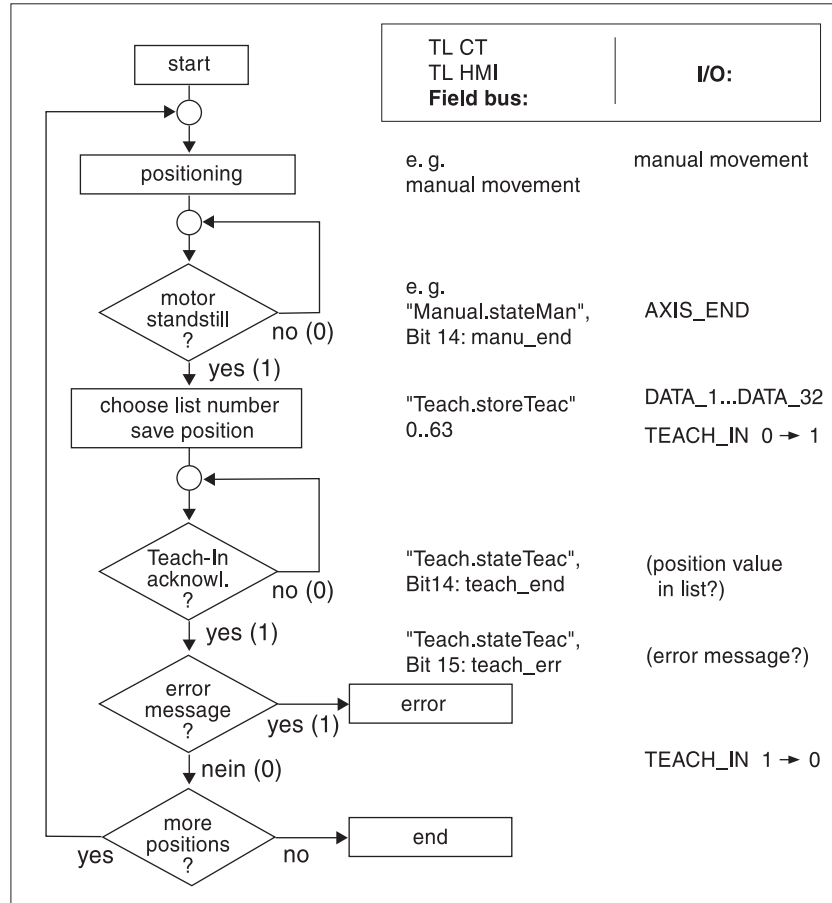


Fig. 7.4 Teach-In process

After each positioning process, the list data can be changed directly or via a connected input device.

Teach-In over field bus Positioning is carried out by means of field bus commands, and the selection of list, list type and list number can be set by means of parameters.

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Teach.storeTeac	43:1	–	Teach-In processing, select memory address, list number for storing position value Example: 000010: list number 2	UINT16 0...63 Bit 0..5: list number	0	R/W –
Teach.stateTeac	43:2	–	Acknowledgement: teach-in processing	UINT16 Bit15: teach_err Bit14: teach_end	–	R/– –
Teach.memNrTeac	43:3	–	List for teach-in processing	UINT16 1: List 1 of list processing 2: List 2 of list processing 3: set data	1	R/W –
Teach.p_actTeac	43:4	–	current motor position in teach-in processing [usr]	INT32	–	R/– –
L1Data0.typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.
L2Data0.typeList2	1200:1	7.4.1.1	List 2: list type for ALL following list entries (1202:x...1263:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.

Teach-In via signal interface The motor is positioned for example via manual movement signals. List and list type must be set by means of parameters or a control unit.

Before saving the position, the list number must be set via the DATA_1 to DATA_32 inputs.

I/O Signal	Function	Value
DATA_1	Selection of a list set, bit coded	low/open
DATA_2	Examples: List number 5=000101:	
DATA_4	DATA_4=1, DATA_1=1	
DATA_8	List number 35=100011:	
DATA_16	DATA_32=1, DATA_2=1,	
DATA_32	DATA_1=1	
	Inputs not given are zero.	

7.3 Normalisation

Overview Normalisation translates user-defined units into the positioning controller's internal units and vice versa. The positioning controller stores position, speed and acceleration values in user-defined units. It then applies its own normalisation factor to each value.

For this reason neither positional nor speed values need to be recalculated and re-entered if the motor is changed and the new motor has a different resolution.

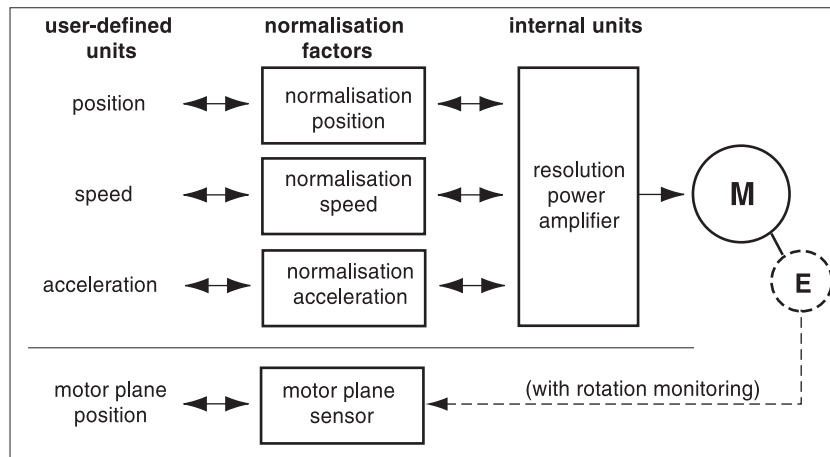


Fig. 7.5 Normalisation

7.3.1 User-defined units and normalisation factors

User-defined units A user-defined unit corresponds to the maximum resolution with which a position, speed or acceleration value can be entered.

User-defined units [usr] are specified during set-up at the following resolutions:

- Position values at the resolution of the motor encoder, for a Sincoder with 16384 incs/rev. \equiv 16384 usr
- Speed values as a multiple of an r.p.m., at 1 r.p.m. \equiv 1 usr
- Acceleration values as a multiple of the speed per second, 1 (r.p.m) / s \equiv 1 usr.

Normalisation factors You can change the resolution of a user-defined unit with respect to one motor revolution by means of the normalisation factors.

Normalisation factors are set by means of parameters. Each normalisation factor is given as a fraction with numerator and denominator. A new factor is set by specifying the numerator.

When entering normalisation factors with the operating software or the HMI hand-held control unit, the input field for the denominator is automatically displayed when numerator field is called up.

Parameter			Explanation and unit []	Range of values	Default-Value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI				
Motion.pNormNum	29:7	4.4.20	Position calibration numerator	INT32 - 2147483648..2147483647	1	R/W rem.
Motion.pNormDen	29:8	–	Position calibration denominator	INT32 - 2147483648..2147483647	19200	R/W rem.
Motion.vNormNum	29:9	4.4.21	Speed calibration numerator	INT32 1..2147483647	1	R/W rem.
Motion.vNormDen	29:10	–	Speed calibration denominator	INT32 1..2147483647	1	R/W rem.
Motion.aNormNum	29:11	4.4.22	Acceleration calibration numerator	INT32 1..2147483647	1	R/W rem.
Motion.aNormDen	29:12	–	Acceleration calibration denominator	INT32 1..2147483647	1	R/W rem.



After the normalisation factors have been changed, the associated *usr* values must be adapted to ensure that motor behaviour remains the same. This applies to the system's non-volatile parameters and user-defined values.

7.3.2 Setting normalisation factors

Normalisation factor, positioning

The positioning normalisation factor links the number of motor revolutions for an axis positioning operation to the number of user-defined units required for it.

$$\text{normalisation factor for positioning} = \frac{\text{revolutions [rev]}}{\text{user-defined unit [usr]}}$$

Fig. 7.6 Normalisation factor for positioning process

Differentiation can be made between three situations when setting user-defined units:

- User-defined resolution corresponds to motor resolution, e.g. 1 motor revolution \equiv 16384 user-defined units
Any motor position can be reached.
- User-defined resolution is higher than motor resolution, e.g. 1 motor revolution \equiv 16384 increments 1 revolution \equiv 32768 user-defined units
Motor will move only if user-defined units change by two.
- User-defined resolution is lower than motor resolution, e.g. 1 motor revolution \equiv 16384 increments 1 revolution \equiv 4096 user-defined units
Every fourth motor position can be reached.



In order to achieve the same positioning movement from the motor after the positioning normalisation factor has been changed, the following remanent parameters must be adjusted in addition to the user-defined values in the application: For manual movement: 'Manual.dist_Man' and 'Manual.step_Man', for referencing 'Home.p_disHome' and 'Home.p_outHome'.

If reference parameters are not adjusted, this can lead to an error in a referencing movement. The safety distance is then not sufficient to leave the switching area of the limit switch or reference switch.

Example 1 Positioning of 1111 user-defined units is to correspond to 3 motor revolutions. This gives:

- 1 Motor revolution \equiv 16384 Inc
- Normalisation factor = 3/1111 [rev./usr].

If you now carry out relative positioning by 900 user-defined units, the motor will move $900 \text{ usr} * 3/1111 \text{ rev/usr} = 2,4302$ revolutions, corresponding to an internal resolution of 46,661 increments.

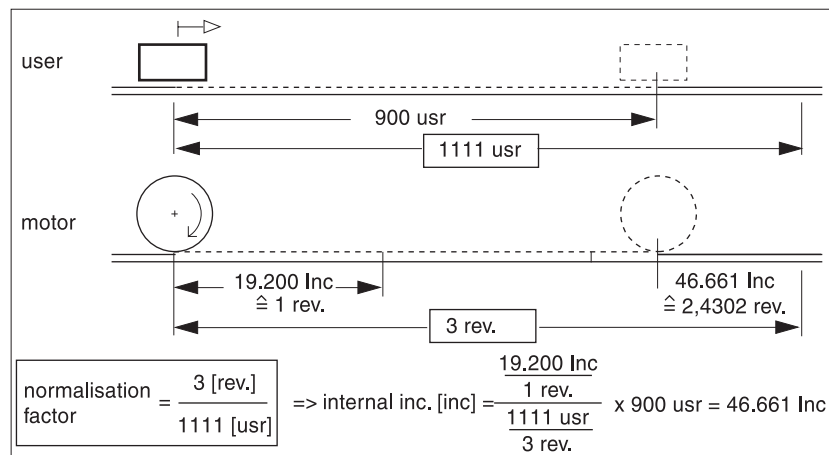


Fig. 7.7 Example: Positioning

Example 2 Replacing one stepping motor amplifier with another.

Change a stepping motor by a servo motor

- 1000 Inc/rev.: 1/1000 [rev./usr]
- Stepping motor resolution 19200 Inc/rev.: normalisation factor 1/19200 [rev./usr]

Example 3 Calculation of a normalisation factor for positioning in units of length: 3 motor revolutions correspond to a distance of 1000 µm. Each user-defined unit [usr] is to correspond to a 10 µm step.

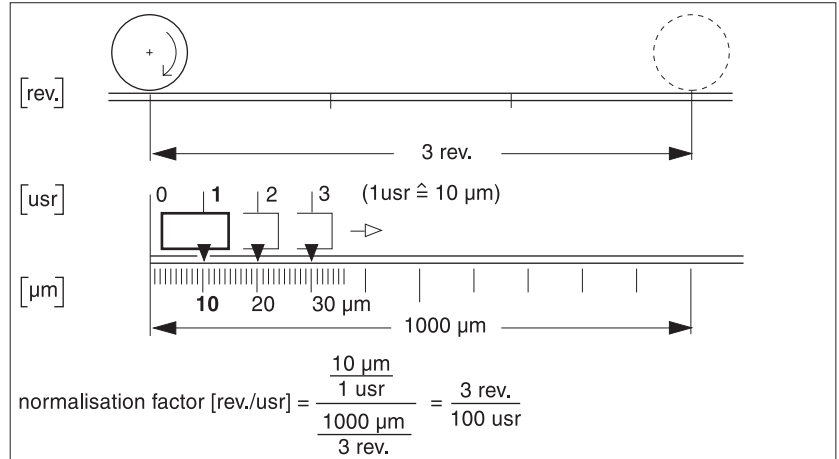


Fig. 7.8 Example: Positioning normalisation factor

One user-defined unit moves the motor 3/100 of a revolution.

Normalisation factor, speed

The speed normalisation factor describes the connection between the number of motor revolutions and the time required for them.

$$\text{normalisation factor for speed} = \frac{\text{revolutions [rev]}}{\text{unit of time [min]}}$$

Fig. 7.9 Normalisation factor for speed

Example 1 Setting user-defined speed in 1/10 rev./min:

- Normalisation factor = 1/10 rev./min
- 1 user-defined unit $\equiv 1/(10 * 60) * 19200 = 32 \text{ Inc/s}$

If you enter a user speed of 52, the motor will turn at 5.2 r.p.m. or 1664 Inc/s.

Example 2 Setting corresponding to stepping motor resolution of 1000 Inc/rev. The speed resolution is to be 1 Hz:

- 1 user-defined unit $\equiv 1\text{Hz} = 1 \text{ Inc/s} = 1/1000 \text{ rev./s} = 60/1000 \text{ rev./min}$
- Normalisation factor = 6/100 [rev./min].

Normalisation factor, acceleration

The acceleration normalisation factor is used to define the smallest unit for the acceleration setting

$$\text{normalisation factor for acceleration} = \frac{\text{speed [r.p.m.]}}{\text{unit of time [s]}}$$

Fig. 7.10 Acceleration normalisation factor

Example 1 Setting the acceleration in steps of 10 rev./(min*s), 1 motor revolution/
s² ≡ 19200 Inc/s²:

- Normalisation factor = 10 rev./(min*s)
- 1 user-defined unit ≡ 10/(1 * 60) * 16384 = 2731 Inc/s²:

Example 2 Setting corresponding to stepping motor resolution of 1000 Inc/rev.
The acceleration resolution is to be 1 Hz/ms:

- 1 user-defined unit ≡ 1 Hz/ms = 1 Inc/(s*ms) = 1000 rev/s² = 60 rev./(min*s)
- Normalisation factor = 60/1 [rev./(min*s)].

Example 3 Setting in rad/s², 1 rad= 1 rev/(2*π)
1 user-defined unit ≡ 1 rad/s² = 1 rev/(2*π *s²) = 60/(2*π) rev/(min*s)

Normalisation factor = 30/π [rev/(min*s)], (π = 3,141)

Setting e.g. 300.000 / 31416

7.3.3 Residual value in user-defined normalisation

With the exception of the electronic gear operating mode, movement data are given in user-defined units in all operating modes. The positioning controller works internally with the resolution of 19200 inc and heads for the nearest internal position in relation to the user-defined position.

Discrepancies can occur between the actual position of the motor and the nearest possible user-defined position due to an interruption to the movement or a change from an operating mode with internal resolution to one with user-defined resolution. The differential value can be interrogated via the 'Status.p_remaind' parameter.

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default- Value	R/W rem.
Status.p_remaind	31:37	-	Residual value of position calibration of position setpoint p_ref [Inc]	INT32	-	R/- -

In teach-in, residual value = 0 shows that the present position of the motor can be calculated exactly from the stored user-defined position. If the residual value does not equal zero, the nearest user-defined position is stored.

Example of residual value

Motor resolution is 16384 Inc/rev.

Resolution of user-defined unit [usr]: 1024 Inc./rev. => 1 usr = 16 Inc

The motor follows a change of one user-defined position by rotating 16 increments.

If the drive remains on 16005 Inc due to the movement being interrupted, 'Status.p_remaind' displays the value 5 as the distance to the nearest user-defined unit.

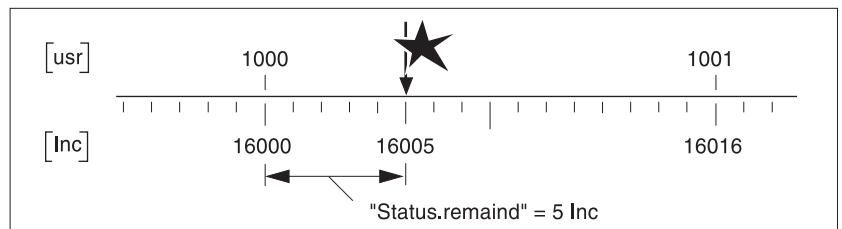


Fig. 7.11 Residual value after interruption to movement at 16005 Inc

7.4 Ramp function

The positioning controller uses the ramp functions to control the acceleration and deceleration behaviour of the motor. The gradient and shape of the ramp describe the ramp function. The ramp gradient shows the motor's change of speed, and the shape of the ramp the acceleration over time.

Ramp gradient The ramp gradient for the acceleration and deceleration ramps can be set on the positioning controller by means of the 'Motion.Acc' and 'Motion.Dec' parameters.

The positioning controller absorbs excess braking energy during deceleration. If the DC-line voltage exceeds the permissible threshold in this process, the positioning controller switches off the power output and displays error 5 'DC-line overvoltage'. The motor will then run down under no braking.

The gradient for the deceleration ramp should be set in such a way that the motor brakes as quickly as possible without causing the output to trip out due to overvoltage.

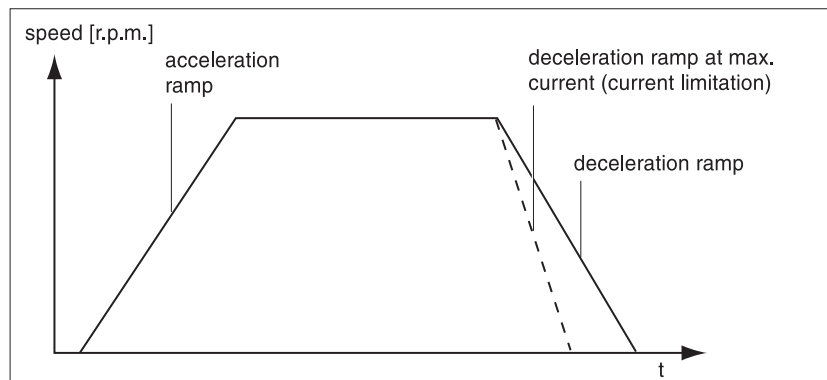


Fig. 7.12 Acceleration and deceleration ramps

Settings for ramp gradients are given in user-defined units. You will find steps for optimizing the ramp function under 'Optimizing the performance of the motor' on page 5-15.

Ramp shape The positioning controller can use a linear ramp and a motor-optimized ramp for the acceleration and deceleration phases.

Parameter	Explanation and unit []		Range of values	Default- Value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI			
Motion.n_max0	29:21	4.4.28	Speed limit for travel profile [r.p.m.]	UINT32 0..3000	3000 R/W rem.
Motion.n_start0	29:22	4.4.10	Start-stop speed [usr]	UINT32 1..n_max0	12 R/W rem.
Motion.acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1: inear 2: exponential	1 R/W rem.
Motion.acc	29:26	4.4.14	Acceleration [usr]	UINT32 60...2000000	600 R/W rem.
Motion.dec	29:27	4.4.15	Deceleration [usr]	UINT32 60...2000000	600 R/W rem.

9844 1113 117, c325, 11.00

Jerk filter The jerk filter is used to smoothe jerky changes in speed in order to produce a smooth, non-jerky change in speed.

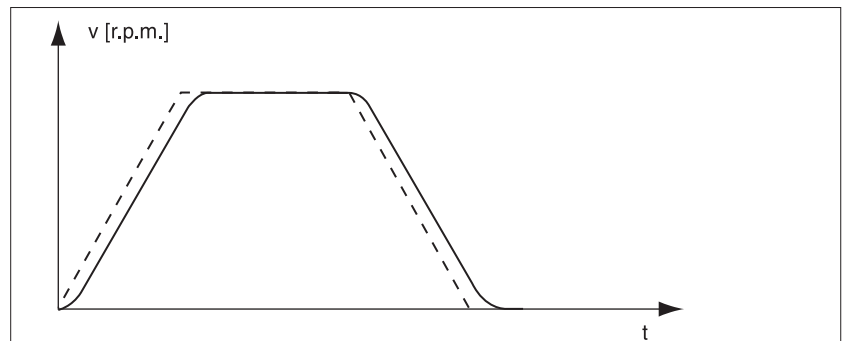


Fig. 7.13 Acceleration ramp with and without (dotted line) jerk filter

The jerk filter can be switched off by means of the 'Motion.Flt_jerk' parameter.

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default- Value	R/W rem.
Motion.Flt_jerk	28:5	4.4.26	Jerk filter	UINT16 0: off 1..65535: filter setting value	0	R/W rem.

7.5 Quick-Stop function

Quick-Stop is an emergency stop function which stops the motor in the event of a malfunction, for example. Quick-Stop can be triggered:

- via the $\overline{\text{STOP}}$ input signal
- by the stop command issued through a connected input device
- when limit switches are passed via the $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ input signals
- when the software limit switch areas SW_LIMP, SW_LIMN are passed
- by an operational malfunction which necessitates an emergency stop.

Quick-Stop remains active until the motor has come to a halt. In the event of a fault category 1 fault response, the output remains on.

Quick-Stop via Quick-Stop or deceleration ramp

For those signals which trigger Quick-Stop, the 'Settings.SignQstop' parameter can be used to define whether the motor is to be stopped by means of the quick-stop-ramp or the normal deceleration ramp. The deceleration ramp is set under 'Motion.Dec'. Deceleration for the quick-stop ramp is set via the 'Settings.dec_Stop' parameter.

This does not apply to the Electronic Gear operating mode. Here the delay for the Quick Stop ramp is always set by means of the „Gear.a_maxGear“ parameter.

Parameter	Explanation and unit []		Range of values	Default-Value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI			
Settings.SignQstop	28:20	4.1.26	Check signals which initiate quick stop 0: Deceleration ramp 1: Ramp for Quick stop	UINT16 Bit 0 : LIMP Bit 1 : LIMN Bit 2: STOP Bit 3: REF Bit 6: - Bit 7: SW_STOP	0 R/W rem.
Settings.dec_Stop	28:21	-	Deceleration ramp for quick stop [rev/(min*s)]	UINT32 60..2000000	6000 R/W rem.

Settings for Quick-Stop

The positioning controller absorbs excess braking energy during a Quick-Stop. If the DC-line voltage exceeds a permissible threshold, the positioning controller switches off the power amplifier and displays error 5 'DC-line overvoltage'. The motor then runs down under no braking.

The current for the deceleration torque should be set such that the positioning controller comes to a halt with maximum deceleration but without tripping out.

If the positioning controller trips out frequently during Quick-Stop displaying error 5 'DC-line overvoltage', the maximum braking current must be reduced or an external load resistor fitted.

Acknowledging Quick-Stop Quick-Stop must be acknowledged via the FAULT_RESET input signal or via the error confirmation function of an input device.

I/O signal	Function	Value
FAULT_RESET	Resets a fault message	low / open -> high

If the motor is brought to a halt by means of Stop, the $\overline{\text{STOP}}$ signal must first be reset.

If Quick-Stop has been triggered by limit switch signals $\overline{\text{LIMN}}$ or $\overline{\text{LIMP}}$, the drive must be moved back into the area of travel in manual mode, see 'Moving the drive out of the limit switch area' on page 7-24.

7.6 Reversal of direction of rotation

If the drive's direction of rotation must be reversed, the values of all parameter can be used unchanged.

► Reverse the drive's direction with the parameter „Motion.invertDir“.

The drive's direction of rotation can be reversed by means of the parameter 'Motion.invertDir'. At the same time the limit switch connections must be swapped round. The following applies when reversing the direction of rotation:

- Reverse the drive's direction with the parameter „Motion.invertDir“.
- Limit switch $\overline{\text{LIMP}}$ responds to negative rotation.

Parameter	Explanation and unit []		Range of values	Default- R/W
Name	Idx:Sidx	TL-HMI		Value rem.
Motion.invertDir	28:6	4.4.27	Inversion of sense of rotation UINT16 0: no inversion 1: sense of rotation inverted	0 R/W rem.

7.7 Fast position capture

Position values can be recorded via two channels whose parameters can be adjusted. The capture inputs show an input delay of 100µs. This delay fluctuates by max. +/-10 µs. If the drive speed is constant, the jitter is max. +/-5 µs.

Parameters 'Capture.TrigSign' define the signal source of a position value capture. The CAPTURE1 and CAPTURE2 inputs of the signal interface or the index pulse of a position sensor in slot M2.

A recording of the position can be triggered by the rising or falling edge of the signal; the edge change is set via the 'Capture.TrigLevl' parameter.

Initiating position capture

The 'Caputre.TrigStart' parameter activates a new recording procedure. Any stored position value is first deleted. As soon as a new position value has been recorded, the signal level of the 'Capture.TrigStat' parameter changes from '0' to '1'. The value remains stored until a new process is triggered for this channel.

The positioning controller calculates the position values from the time elapsed and the speed at set and actual positions. The position values can be interrogated via 'Capture.TrigPact1/2'.

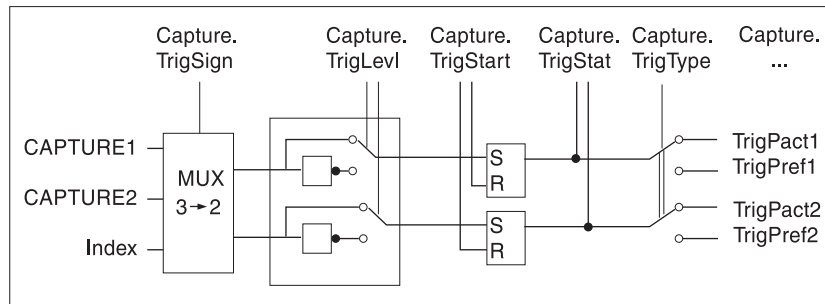


Fig. 7.14 Fast position capture, Signal pattern and parameter

Continuous position capture

Position capture can be carried out once or continuously, as set in bit 15 in 'Capture.TrigStart':

- Bit 15=0: The position value after the first triggering is stored. Further values are ignored until the process is re-initiated.
- Bit 15=1: Every triggering updates the position value.

Parameter			Explanation and unit []	Range of values	Default-Value	R/W rem.
Group.Name	Idx:Sidx	TL-HMI				
Capture.TrigSign	20:13	–	Selection of trigger signals for position storage Bit 3..2: Signal - channel 2 (K2) Bit 1..0: Signal - channel 1 (K1) Examples: 4: binary 01 00 => CAPTURE2 (K2), CAPTURE1 (K1) 9: 10 01 => CAPTURE2 (K2), Indexp. Sollpos. (K1)	UINT16 bits 0..1/ bits 2..3 (K1/K2): - 00: CAPTURE1 - 01: CAPTURE2 - 10: index pulse setpoint sensor (with module on M1) - 11: index pulse actual position sensor (fori SM with module on M2)	4	R/W –
Capture.TrigLevl	20:15	–	Signal level for trigger channels bit state: 0: triggering at 1->0 change 1: triggering at 0->1 change	UINT16 bit 0: set trigger level on channel 1 bit 1: set trigger level on channel 2	1	R/W –
Capture.TrigStart	20:16	–	start triggering (bits0..1): 0: no change 1: reset triggering and repeat cancel triggering (bit 14=1) repeat triggering (bit15) 0: trigger once 1: trigger continuously	UINT16 bit 0: trig. on channel 1 bit 1: trig. on channel 2 bit 14: cancel trig. bit 15: repeat trig.	0	R/W –
Capture.TrigStat	20:17	–	Status of trigger channels	UINT16 bit 0: triggering on channel 1 running bit 1: triggering on channel 2 running	0	R/– –
Capture.TrigPact1	20:18	–	Actual position of motor on triggering on channel 1 [Inc]	INT32	–	R/– –
Capture.TrigPact2	20:19	–	Actual position of motor on triggering on channel 2 [Inc]	INT32	–	R/– –
TrigPref1	20:20	–	Setpoint of electrical gearbox on triggering on channel 1 (inc)	INT32	-	R/– –
TrigPref2	20:21	–	Setpoint of electrical gearbox on triggering on channel 2 (inc)	INT32	-	R/– –

7.8 Monitoring functions

7.8.1 Monitoring of axis signals

Positioning limits The motor can be moved to any point on the axis within the axis positioning range by specifying an absolute positioning process. The axis travel range is specified in internal units in the range -2^{31} to $+2^{31}$ increments. The resolution of the motor encoder in increments is specified as the internal unit.

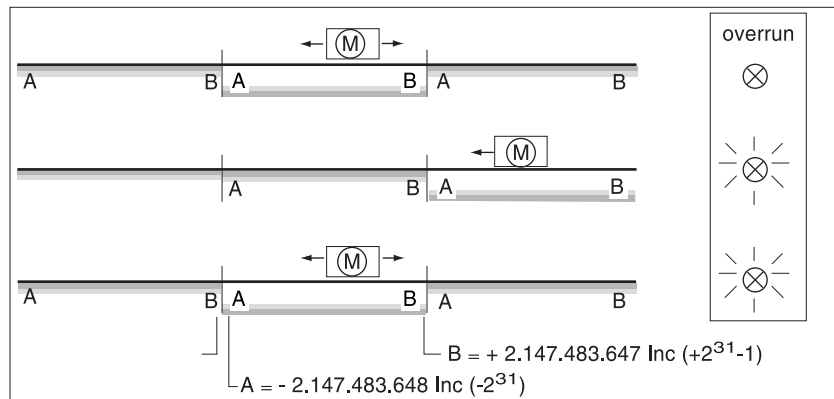


Fig. 7.15 Positioning range and range overrun

If the motor crosses the positioning limits, the internal monitoring signal for position overrun is set and the work area moved by 2^{32} units. The „Status.IntSigSr“ parameter displays a position overrun on bit 2.

The monitoring signal remains set when the motor moves back into the valid area. It is reset by a new referencing procedure or by switching the positioning controller off and on.

Crossing positioning limits is possible in speed mode, electronic gear mode, referencing and manual mode. In Point to Point positioning, after limits have been crossed, values are used in the new work area.

Teach-in processing is not possible after limits have been crossed as positions are no longer defined. Crossing range limits can be prevented by activating software limit switches.

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default- Value	R/W rem.
Status.IntSigSr	29:34	2.3.4	Monitoring signals 0: not active, 1: activated	UINT32 Bit2: position overflow	-	R/- -

Software limit switches The software limit switch position is set via parameters 'Motion.SW_LimP' and 'Motion.SW_LimN' and activated via 'Motion.SW_Enabl'. The determining factor for position monitoring of the software limit switch range is the setpoint of the position controller. Depending on the controller setting, therefore, the motor can stop before it reaches the limit switch position. Bits 5 and 6 of the 'Status.IntSigSr' parameter signal the crossing of the limit switch position.

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.
Motion.SW_LimP	29:4	4.4.5	Software limit switch for pos. Position limit LIMP condition: SW_LimP > SW_LimN [usr]	UINT32 -2147483648..2147483647	2147483647	R/W rem.
Motion.SW_LimN	29:5	4.4.6	Software limit switch for pos. Position limit LIMN condition: SW_LimN > SW_LimP [usr]	UINT32 -2147483648..2147483647	-2147483648	R/W rem.
Motion.SW_Enabl	29:6	4.4.7	Set monitoring of software limit switches 0: deactivated 1: activated	UINT16 Bit5: SW_LIMP Bit6: SW_LIMN	0	R/W rem.
Status.IntSigSr	29:34	2.3.4	Monitoring signals 0: not active, 1: activated	UINT32 Bit5: SW limit switch, pos. sense of rotation (SW_LIMP) Bit 6: SW limit switch, neg. sense of rotation (SW_LIMN)	–	R/– –

Limit switch signal and \overline{STOP} signal During motion, both limit switches are monitored via input signals \overline{LIMN} and \overline{LIMP} . If the drive reaches a limit switch, the positioning controller stops the motor. The triggering of the limit switch is signalled on the input device. Set up the limit switches in such a way that the drive cannot cross the switch restriction. For example, use longer actuator lugs.

The \overline{STOP} input signal stops the motor by means of Quick-Stop. Further processing is possible if:

- the STOP signal is cancelled and
- Quick-Stop has been acknowledged and
- a new movement command is activated.

The 'Settings.SignEnabl' and 'Settings.SignLevel' parameters are used to change the enabling of input signals $\overline{\text{REF}}$, $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{STOP}}$ and their evaluation at active low or high:

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default- Value	R/W rem.
Settings.SignEnabl	28:13	4.1.10	Signal enable for monitoring inputs 0: inactive 1: active	UINT16 Bit 0: LIMP Bit 1: LIMN Bit 2: STOP Bit 3: REF	7	R/W rem.
Settings.SignLevel	28:14	4.1.11	Signal level for monitoring inputs	UINT16 Bit 0: LIMP Bit 1: LIMN Bit 2: STOP Bit 3: REF	0	R/W rem.

The REF switch does not have to be enabled for the reference movement. If the REF switch is enabled, it takes on the function of an additional STOP switch.

Moving the drive out of the limit switch area

The drive must be moved out of the limit switch area and back into the valid travel area in manual mode.

- ▶ If 'Settings.IO_mode'=2, change to manual operation by means of input signal AUTOM.
- ▶ Activate and hold the manual movement signal in order to move the drive into the permitted area of travel: If limit switch signal $\overline{\text{LIMP}}$ has been triggered, signal MAN_N must be activated, and vice versa.

If the drive does not move back into the area of travel, check whether manual mode has been activated and the correct manual movement signal held.

7.8.2 Monitoring internal signals

Monitoring systems protect motor, power amplifier and load resistors from overheating, and ensure functional and operational safety. You will find a list of all safety devices under 'Safety devices' on page 2-3.

The positioning controller displays error messages and warnings by causing the 7-segment display to blink. In addition a connected operating device displays an error text.

Temperature monitoring

Sensors monitor the temperature of motor and power amplifier. If the temperature of one of these components exceeds the limit, the positioning controller switches off the amplifier and the control loop to protect them from overheating and signals a temperature fault. All temperature thresholds are pre-set and cannot be changed.

Monitoring parameters

The parameters listed in the 'Status' set can be used to monitor unit status and operating status by means of parameters. Among them are

- „Status.FltSig“ (28:17), „Status.FltSig_SR“ (28:18) and „Status.IntSigSr“ (29:34) for monitoring internal unit signals
- „Status.action_st“ (28:19) for monitoring the operating status
- „Status.StopFault“ (32:7), with which the cause of the last interruption can be determined.

You will find information on evaluating the monitoring facilities built into the unit over the field bus under 'Diagnosis and error rectification', page 8-1.

7.9 Braking function with TL HBC

For motors fitted with a holding brake, the brake prevents unintended movement of the motor when not under power. The positioning controller controls the holding brake via the holding brake control system which is available as an accessory.

Holding brake control system

The holding brake control system amplifies the ACTIVE_CON control signal from the signal interface, and controls the brake in such a way that it responds quickly whilst generating as little heat as possible. The brake connection which is in the same cable as the power connections to the motor, is safely separated from the positioning controller's signal connections in the event of insulation breaks occurring in the motor cable.

Standard unit

For set-up and function test, the holding brake can be released with the push-button switch fitted to the holding brake control system.

Version P

For set-up and function testing the holding brake can be controlled via the TL CT operating software or the TL HMI.

Brake signals

ACTIVE_CON switches to 'high' and releases the brake as soon as the amplifier is enabled and the motor has holding torque.

I/O signal	Function	Value
ACTIVE_CON	Brake disengaged, no braking torque Brake engaged, braking torque	high low / open
ACTIVE_GND	GND connection for ACTIVE_CON	low

Voltage reduction

The control voltage from the holding brake control system is variable if the voltage reduction function is switched on. The voltage is then 24 V for approx.. 100 ms and afterwards falls back to its holding voltage of 12 V.

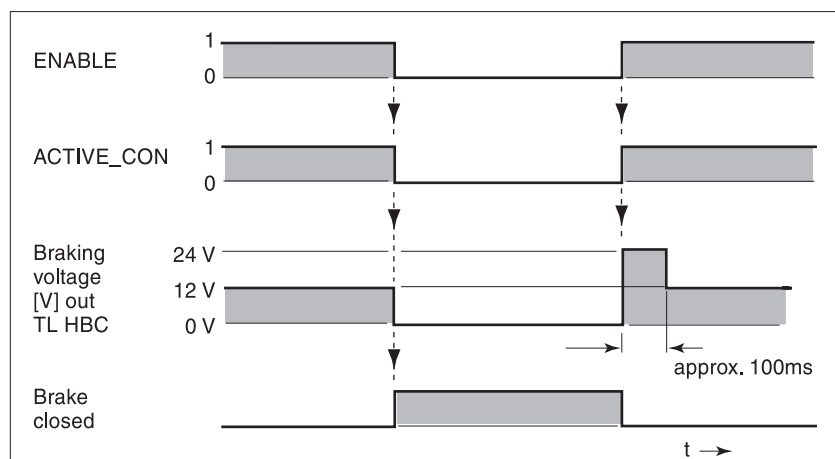


Fig. 7.16 Time diagram, brake function with voltage reduction on

When the supply voltage is switched on, the holding brake control system and the switch/Taster function are reset. No voltage is present on the control terminals of the brake, and the control system LED is off.

9844 1113 117, c325, 11.00

8 Diagnosis and error rectification

8.1 Operational status indicators and transitions

Status display in the unit The D2 LED on the motor plug lights, when voltage is present in the DC-line.

The 7-segment display represents the operating states of the positioning controller in coded form.

Display	Operating status
0	24 V switched on
1	Initialization of the unit electronics
2	The power amplifier is not ready to switch on
3	Switching on the power amplifier is disabled
4	The power amplifier is ready to switch on
6	The device is working in the operating mode selected
7	A quick stop is being executed
8, 9	An error has been detected and the error response activated
0 - A flashing	Indicates the error value

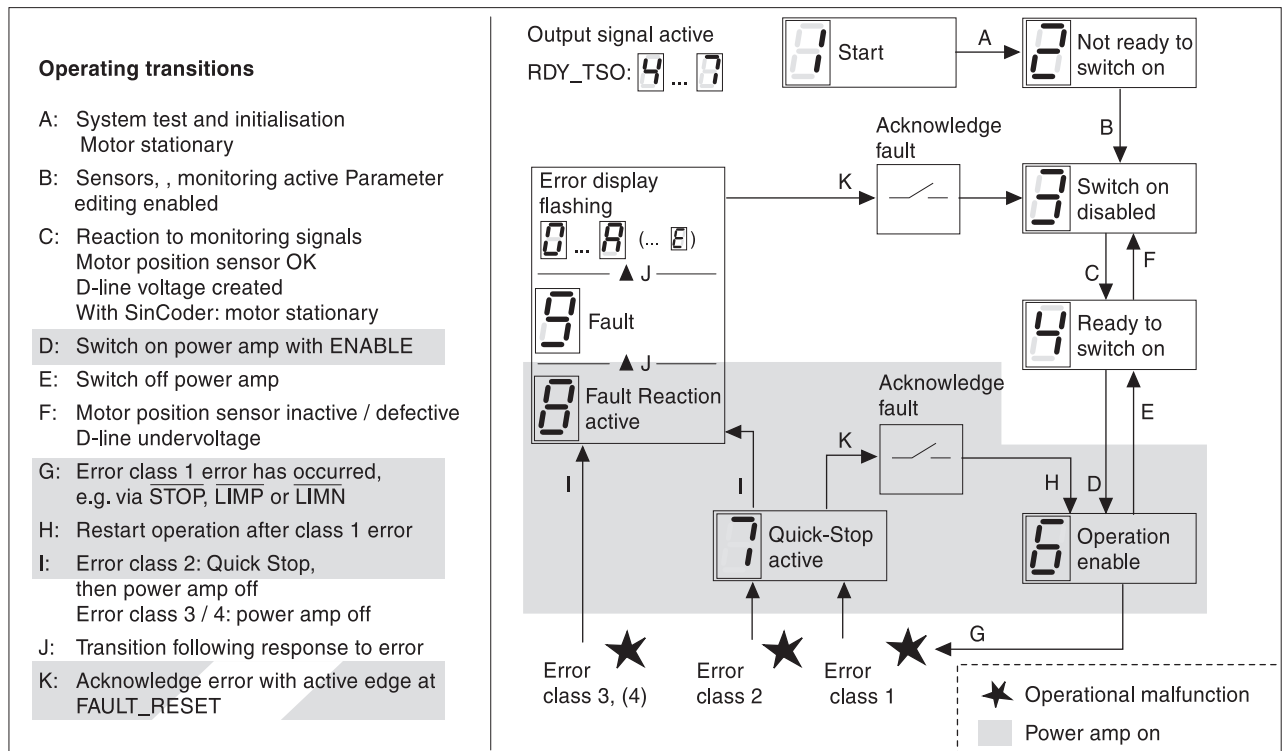


Fig. 8.1 Operating states and transitions of the positioning controller

Operating transitions The conditions for changing between the operating states displayed and the reactions of the positioning controller to an error follow a fixed sequence.

Changing the operating status is controlled via the "Commands.driveCtrl" parameter.

Parameter			Explanation and units []	Range of values	Default value	R/W rem.
Gruppe.Name	Idx:Sidx	TL-HMI				
Commands.driveCtrl	28:1	-	Control word for status change, default setting Bit0..3='0', write access automatically triggers edge change 0->1.	UINT16 Bit0: Disable power amplifier Bit1: Enable power amplifier Bit2: Stop (Quick-Stop) Bit3: FaultReset Bit4..15: not assigned	0	R/ - -

8.2 Error display and rectification

- Error display* The cause of a particular operating malfunction is displayed
- by a flashing number in the seven-segment display
 - by the error response of the positioning controller
 - in the operating software as an error message on the control bar and in the list of the error memory.
 - in the display of the Human-Machine Interface HMI as an error message and in the list of the error memory.
 - bit-coded in the parameters 'Status.FltSig', 'Status.FltSig_SR', 'Status.IntSigSR' and 'Status.Sign_SR'.

The positioning controller reacts to a fault via the the limit switch or STOP signal by initiating a quick stop without displaying an error message on the unit. The cause of the interruption is however recorded in the error memory and can be accessed via the Human-Machine Interface HMI or the operating software.

- Resetting error messages* Once the error has been corrected, the message can be reset
- by setting the input signal FAULT_RESET
 - via the operating software with the Reset button
 - by switching off the power supply to the positioning controller.

Error response The positioning controller triggers an error response when a malfunction occurs. Depending on the seriousness of the fault, the unit responds in accordance with one of the following error classes:

Error class	Reaction	Meaning
0	Warning	Message only, no interruption to movement operations
1	Quick stop	The motor stops with quick stop, the power amplifier and controller stay switched on, stop control is activated.
2	Quick stop with switch-off	The motor stops with quick stop, the power amplifier and controller switch off at standstill.
3	Fatal error	The power amplifier and controller switch off. The unit cannot be activated until the fault is corrected.
4	Uncontrolled operation	The power amplifier and controller switch off. The error response can only be reset by switching off the unit.

Error rectification

Display	Error	Error class	Cause	Error rectification
None	No LED display	-	Supply voltage missing	Check supply voltage and fuses
	No LED display	-	Supply voltage incorrectly connected	Connect correctly
1	Undervoltage	3	DC-line voltage below threshold value for switching off the drive	Check mains voltage / check connections to unit
2	Contouring error	3	Drive blocked, start-stop frequency too high, ramp frequency too high	Reduce load or motor torque, check rotary switch position for motor current, NC settings: set start-stop frequency lower, reduce acceleration frequency
	Maximum motor speed	3	Exceeding the maximum motor speed under shift operation	Reduce vertical loading
3	Motor line	3	Short circuit or earth fault in the motor line or in the motor	Check the encoder cable or encoder, replace the cable or motor
4	Position sensor	3	Only for TLC51x units with rotation monitoring: encoder or encoder cable faulty	Check the encoder cable or encoder, replace the cable or motor
5	Overvoltage	3	DC-line overvoltage	Use external capacitor
7	Overtemperature power amplifier	3	The power amplifier is overheating	Reduce load, use current reduction to reduce power
	Overtemperature motor	3	Only for TLC51x units with encoder connected: motor overheated, temperature sensor not connected or broken	Allow the motor to cool, use higher rated motor, use current reduction to reduce power, check/replace encoder cable
8	Watchdog	4	Internal system error	Switch the unit off and back on, replace the unit
	System error, control system	4	System error e.g. division by 0 or time-out checks, inadequate EMC	Comply with EMC protective measures, switch the unit off and back on, contact SIG Posittec
A	Short circuit I/O		Short circuit in the digital outputs No 24 V for signal interface	Check the connections and wiring Supply 24 VDC at pins 7 and 8

Display	Error	Error class	Cause	Error rectification
E	System error, positioning controller, fatal error	3	Cause of error corresponding to error number in error memory	rectification dependent on error number
	System error, positioning controller, uncontrolled operation	4	Cause of error corresponding to error number in error memory	rectification dependent on error number
None ¹⁾	Limit switch	1	Limit switch overshoot	Bring the drive into movement zone, match the positioning data to the axis range Special message in the error memory shows the limit switch which is connected incorrectly as regards direction.
	Stop	1	Stop signal activated, line interrupted	Check the line for the $\overline{\text{STOP}}$ terminals signal
	Node guarding	1	Connection monitoring for the manual control unit activated	Check the RS232 connection at the controller
	Time-out	1	Protocol error	Time-out exceeded during exchange of data with the manual control unit, start transmission again

1) No error display, operating status continues to be displayed.

Version P The following error can occur in version P.

Display	Cause	Correction
none	functions disabled due to condensation	allow unit to dry and reduce humidity

With the operating software TL CT and the TL HMI the current and the last 20 error messages are displayed.

TL CT: Error display ▶ Select 'Twin Line → Diagnosis → Error memory'. A dialog box which displays the error messages appears.

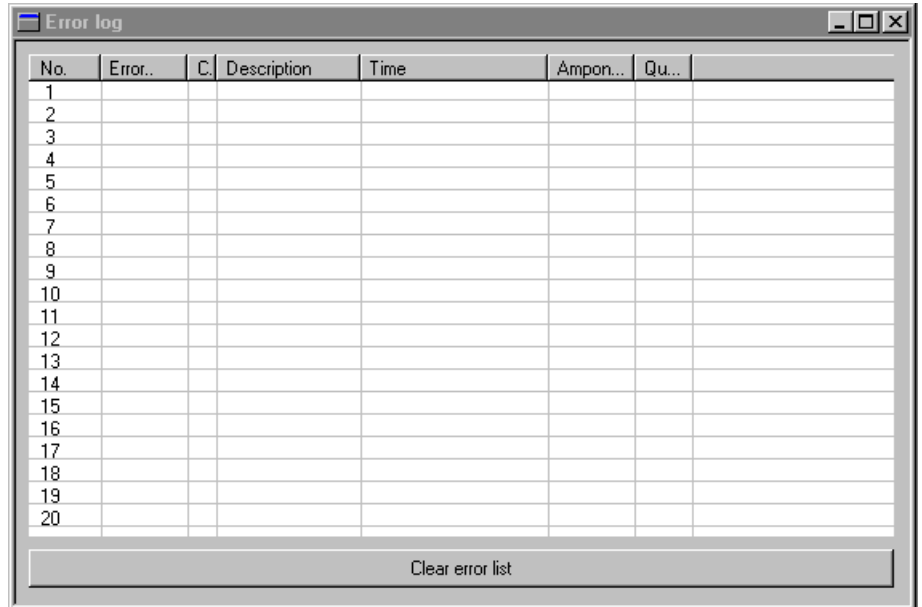


Fig. 8.2 Error messages

Error messages are displayed showing status, error class, time when error occurred and a short description. The error number is given as a hexadecimal value.

Additional information is given in column Qu..., Qualifier. At the error message „E1855 initialisation error in parameter lxSix -> Qualifier“ the Qualifier identifies the index/sub-index of the parameter, for which the error has been detected. You will find the parameter in the list of parameters in chapter 12.

By way of an example, Qualifier is showing 00290023h. This is parameter 29:23 „Motion.v_target0“.

A detailed error message is given in the following sumcheck error messages:

- 181Bh: „error in processing manual movement ->Qualifier“
- 181Fh: „error in processing reference movement ->Qualifier“
- 181Dh: „error in changing user operating mode ->Qualifier“

▶ Acknowledge the current error message with the 'Reset' button on the command bar of the program.

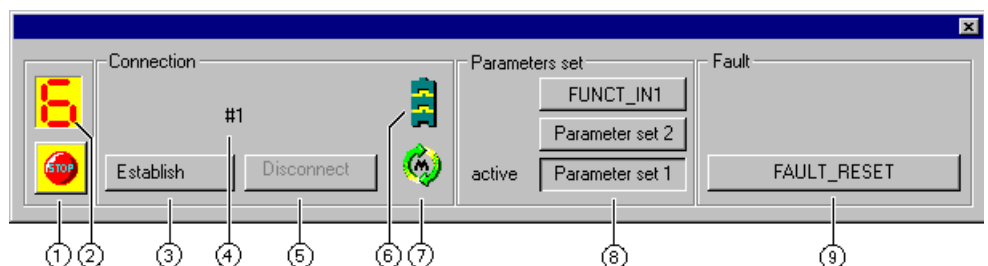


Fig. 8.3 Reset button, 9

TL HMI: Error display ▶ Via the menu item '2.4 Error' change to the menu items for displaying error messages.

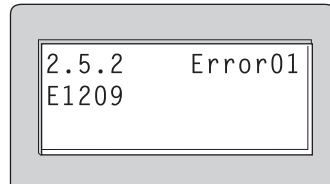


Fig. 8.4 Displaying an error value

You can use the cursor keys to scroll through the error entries:

Menu item	Meaning
2.5.1 StopFault	Cause of the last interruption
2.5.2 Error01	1st error entry, oldest message
2.5.3 Error02	2nd.error entry, more recent message, if present
...	...

The meaning of the error values is given in the Human-Machine Interface HMI manual.

Field bus: evaluating error messages

In field bus operation, device faults are reported as asynchronous errors by the controller's monitoring facility. An asynchronous error is recognised by the status word 'fb_statusword'. Signal status '1' indicates an error or warning message. Details on the cause of the fault can be determined via parameters.

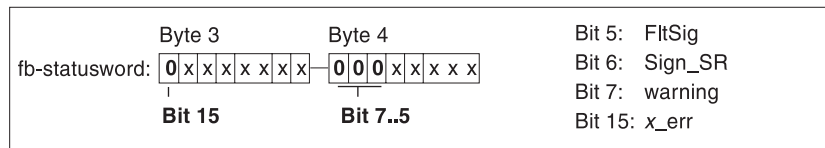


Fig. 8.5 Error evaluation for asynchronous error

- Bit 5, 'FltSig': report from internal monitoring signal, e.g. overtemperature in power amplifier. Details via parameters 'Status.FltSig_SR' and 'Status.IntSigSR'
- Bit 6, 'Sign_SR': report from external monitoring signal, e.g. interruption of movement through $\overline{\text{STOP}}$ input. Details via parameter 'Status.Sign_SR'
- Bit 7, 'warning': warning message from the controller, e.g. I^2T error in power amplifier. Details via parameters 'Status.FltSig_SR' and 'Status.IntSigSR'

Besides asynchronous errors, synchronous errors are also reported in field bus operation which are triggered by a communication error, e.g. by unauthorised access or an incorrect command. Both error types are described in the controller's field bus manual.

Error display over the field bus

The positioning controller saves the last 20 error messages in a separate error memory. In addition, the current error cause is saved in the 'Status.StopFault' parameter. The error messages are arranged in chronological order and can be read via index and sub-index values:

Index	Explanation
900:1, 900:2, 900:3, ...	1. error entry, oldest report
901:1, 901:2, 901:3, ...	2. error entry, later report, if present
...	
919:1, 919:2, 919:3, ...	20th error entry, if present, the latest error value is found here

Further information on each fault report can be obtained from the sub-index.

The additional informations can be read about the „ErrMem0.ErrQual“ parameter.

Parameter Group.name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default- Value	R/W rem.
Status.StopFault	32:7	2.5.1	Cause of last interruption, error number	UINT16	0	R/--
ErrMem0.ErrNum	900:1	–	Coded error number	UINT16 0...65535	–	R/--
ErrMem0.Class	900:2	–	Error class	UINT16 0...65535	–	R/--
ErrMem0.Time	900:3	–	Error moment since power amplifier switched on [ms]	UINT16 0...65535	–	R/--
ErrMem0.AmpOnCnt	900:4	–	Number of switch-on cycles of power amplifier	UINT16 –	–	R/--
ErrMem0.ErrQual	900:5	–	Additional information for assessing error	UINT16 –	0	R/--
Commands.del_err	32:2	5.4	Deletion of all entries in the error memory	UINT16 0	0	R/W –

The error cause for each error message is saved in coded form as an error number under 'Status.ErrNum'. The table from page 8-9 shows error numbers and their explanation.

8.3 Malfunctions in movement mode

Faults	Cause	Correction
The motor jerks briefly	The motor phases are swapped	Check the motor cable and connection: connect motor phases U, V and W in the same way on the motor and unit sides
No motor movement	The motor has seized	Release the motor brake
	Break in the motor line	Check the motor cable and connection. One or more motor phases are not connected.
	No torque	Set the parameters for max. current, max. speed to higher than zero
	Incorrect operating mode selected	Set the input signal and parameters for the operating mode you want

8.4 Table of error numbers

Error number	Error class	Meaning
E1000	0	First entry
E1001	0	parameter not existing
E1002	0	parameter not existing
E1003	0	parameter not existing
E1004	0	parameter not existing
E1005	0	Communication protocol: unknown service
E1006	0	Communication protocol: invalid service
E1007	0	Communication protocol: segment service not initialized
E1008	0	Parameter not writable
E1009	0	Parameter not readable
E100A	0	Parameter out of range
E100B	0	Communication protocol: parameter- or command processing not finished
E100C	0	Command not allowed while drive is active
E100D	0	Successive table entries have to be different
E100E	0	System: non-volatile memory too small
E100F	0	Non-volatile memory defective
E1010	0	Non-volatile memory booted
E1011	0	Non-volatile memory reading error
E1012	0	Non-volatile memory writing error
E1013	0	No valid parameter set
E1014	0	No data existing, upload not possible
E1015	0	Function not allowed
E1016	0	Write protected against actual user level
E1017	0	maximum allowed current is exceeded
E1018	0	Input value exceeds allowed speed
E1019	0	Operating mode not existing
E101A	0	Communication protocol: servicenot supprted
E101B	0	Password not correct
E101C	0	Download faulty segment
E101D	0	S3 set faulty
E101E	0	Write error flash
E101F	0	S-Record CRC Error
E1020	0	S-Record ID unknown
E1021	0	System: program checksum not correct
E1022	0	Bootstrap address error
E1023	0	Wrong or missing modul
E1024	0	Quick-stop caused by LIMP
E1025	0	Quick-stop caused by LIMN

Error number	Error class	Meaning
E1026	0	Quick-stop caused by STOP
E1027	0	No power amplifier found
E1028	0	Power amplifier not factory-adjusted
E1029	0	Power-amplifier changed, Power amplifier not factory-adjusted
E102A	0	Motor not factory-adjusted
E102B	0	Motor parameter are missing
E102C	0	Non-volatile memory initialized
E102D	0	HIPERFACE modul not adjusted
E102E	0	Flashing not possible while drive is active
E102F	0	No firmware stored in Flash
E1030	0	Absolute position deviation too large
E1031	0	Command not allowed while drive is waiting for reference pulse of SinCoder
E1032	0	Error while deleting Flash (Timeout)
E1033	0	During power-on, motor is rotating
E1034	0	Drive not active
E1035	0	Non-volatile checksum error
E1036	0	Feedback Non-volatile memory new defined
E1037	0	Feedback Non-volatile memory not righth defined
E1038	0	Analog input +-10V not adjusted
E1039	0	Reference position module not available
E103B	0	Activation of amplifier not permitted
E103C	0	Wrong amplifier type
E1200	0	Communication protocol: parameter- or command processing not finished
E1201	0	Serial interface: buffer overflow
E1202	0	Serial interface: transmission error
E1203	0	Serial interface: transmission error
E1204	0	Serial interface: transmission error
E1205	0	Serial interface: transmission error
E1206	0	Parameter for trace trigger not correct
E1207	0	Trace not completely configured
E1208	0	Parameter out of range
E1209	0	read/write not possible while trace data are being read
E120A	0	Read/write not possible while trace is active
E120B	0	trace buffer too small for confured trace
E120C	0	parameter out of range (table range)
E120D	0	Function not implemented
E120E	0	HIPERFACE serial interface: transmission error
E120F	0	HIPERFACE: data in non-volatile memory of sensor are not correct
E1210	0	No feedback modul found
E1211	0	Warning: feedback modul exchanged

Error number	Error class	Meaning
E1212	0	Unknown sensor connected with HIPERFACE module
E1213	0	HIPERFACE: non-volatile memory too small
E1214	0	HIPERFACE-Sensor not adjusted
E1215	0	System: watchdog
E1216	0	System: Illegal Address
E1400	2	power up error
E1401	2	undervoltage DC bus limit 1: quickstop
E1402	3	undervoltage DC bus limit 2: drive error
E1403	3	ground fault motor outputs
E1404	3	short motor outputs or overcurrent detected
E1405	3	DC bus overvoltage
E1406	3	overtemperature of ballast resistor
E1407	3	overtemperature of motor
E1408	3	overtemperature of power module
E1409	0	I ² t supervision error of power module
E140A	0	I ² t monitoring Dummy
E140B	0	I ² t supervision error of motor
E140C	0	I ² t supervision error of dynamic brake
E140D	3	phase error motor outputs
E140E	3	phase error line
E140F	4	system watch dog
E1410	4	internal system fault
E1411	3	Save-Standstill
E1412	0	serial interface transmission error
E1413	3	speed limit error
E1414	3	Slot M1: external setpoint signals not correctly connected
E1415	3	Slot M2: feedback position sensor not correctly connected
E1416	3	Position following error
E1417	4	Linefail 24V
E1418	0	Position following error
E1419	1	I/O error
E141A	1	limit switch not correct installed
E141B	0	Warning overtemperature motor
E141C	0	Warning overtemperature power amplifier
E141F	0	Nodeguarding
E1800	0	parameter not existing
E1801	0	Write protected against actual user level
E1802	0	Password not correct
E1803	0	Serial interface: initialization parameter not correct
E1804	4	Serial interface: no send/receive buffer

Error number	Error class	Meaning
E1805	2	Serial interface: initialization not completed
E1806	0	precondition not met
E1807	0	parameter not existing
E1808	2	Serial interface: send buffer too small
E1809	2	Serial interface: send string not convertible
E180A	2	Serial interface: receive buffer too small
E180B	0	Serial interface: transmission error
E180C	0	Serial interface: transmission error
E180D	0	Serial interface: transmission error
E180E	0	Serial interface: transmission error
E180F	0	Serial interface: error in communication protocol
E1810	0	Serial interface: transmission error
E1811	0	Parameter read/write allowed only during active axis mode
E1812	4	parameter not existing
E1813	0	system: DSP-clock missed once
E1814	4	system: DSP-clock missed totally
E1815	0	Parameter for trace channel not correct
E1816	1	system: function not ready
E1817	0	Parameter out of range
E1818	0	Error while calculating internal values
E1819	0	command- or parameter write, only allowed during motion standstill
E181A	0	Position overflow occurred
E181B	0	Error while operation mode manual -> Qualifier
E181C	0	Homing position not defined or homing procedure not finished
E181D	0	Operation mode with external reference signals it active -> Qualifier
E181E	0	Drive is blocked or broken
E181F	0	Error while operation mode reference motion -> Qualifier
E1820	1	Error in position list
E1821	0	Function not implemented
E1822	0	command- or parameter write not allowed while homing is active
E1823	4	-
E1824	0	-
E1825	0	command- or parameter write not allowed in actual operating mode
E1826	0	SWLIM causes error
E1827	0	Recording position of HW limit switch not def.
E1828	0	homeing error, limit switch not enabled
E1829	0	homeing error at /LIMP
E182A	0	homeing error at /LIMN
E182B	0	-
E182C	0	-

Error number	Error class	Meaning
E182D	0	-
E182E	0	-
E182F	0	-
E1830	0	-
E1831	0	-
E1832	4	Initializing hardware indicates error
E1833	4	System: too less system memory
E1835	4	Fieldbus module: FIFO timeout
E1836	4	Fieldbus module: error while boot procedure
E1837	4	Fieldbus module: error while initialization
E1838	4	Fieldbus module: communication parameter not correct
E1839	4	Fieldbus module: indicates error
E183A	4	Fieldbus module: timeout
E183B	4	Fieldbus module: unknown FIFO object
E183C	4	Fieldbus module: state machine indicates error
E183D	4	System: internal communication, write request to DSP with error
E183E	4	System: internal communication, read request to DSP with error
E183F	0	-
E1840	4	System: data interface type mismatch
E1841	0	Change of operation mode still active
E1842	4	accelation distance too large
E1843	0	LIMP causes quick-stop
E1844	0	LIMN causes quick-stop
E1845	0	REF causes quick-stop
E1846	0	STOP causes quick-stop
E1847	0	LIMP causes quick-stop, while negative movement
E1848	0	LIMN causes quick-stop, while positive movement
E1849	0	Internal position range exceeded
E184A	4	DSP Bootstraploader Timeout
E184B	4	DSP indicates wrong program version
E184C	3	Non-volatile with invalid data
E184D	4	Internal overflow
E184E	0	command or parameter write is locked from other interface
E184F	0	homeing error at /STOP
E1850	0	homeing error at /REF
E1851	3	Error while calculation electronic gear
E1852	3	DSP Timeout
E1853	3	Gear mode: Change of reference signal too large
E1854	0	Command not allowed while operation mode active(xxxx_end=0)
E1855	2	Initialization error with parameter lxSix -> qualifier

Error number	Error class	Meaning
E1856	0	Command or write parameter not allowed while active drive
E1857	0	Read- or write parameter only allowed while active drive
E1858	0	Quick-stop active
E1859	0	Fault reaction active or fault active
E185A	0	Command or write parameter only allowed in gear mode
E185B	0	Automatic operation active
E185C	0	Manual operation active
E185D	0	Login missing
E185E	0	System: PSOS-task not found
E185F	0	System: profil generation or gear mode brokeed
E1860	0	SWLIM causes quick-stop
E1861	0	SWSTOP causes quick-stop
E1862	0	Internal SWSTOP causes quick-stop
E1863	0	Read- or write parameter only allowed while active drive
E1864	0	Reference position module not available
E1865	0	More then one signal HWLIM/REF active
E1866	0	Call with direction bits=0 before new manual motion is required
E1867	0	List-driven operation: finising number set to value smaller than starting number
E1868	0	List-driven operation: position values not in correct ascending or descending order
E1869	0	List-driven operation: current position is behind position of last selected list entry
E186A	0	List-driven operation: signal list is active
E186B	0	Deactivation of current list-driven operation due to change of operating mode
E186C	2	Timeout: drive has not reached standstill window
E186D	1	Error in changing operating mode
E186E	4	device type not defined
E186F	1	Processing in current operating status of status machine not possible
E1870	0	External memory module not present
E1871	1	Illegal set number
E2000	0	FIRST_TLCT_FEHLER
E2001	0	Timeout
E2002	0	Incorrect data received
E2003	0	Incorrect frame received
E200A	0	SCAN-LOGIN has failed
E200C	0	TIMEOUT during SCAN-LOGIN
E200D	0	SCAN-LOGOUT has failed
E200E	0	TIMEOUT during SCAN-LOGOUT
E2015	0	Polling error
E2016	0	Timeout when polling the unit
E2017	0	LOGIN has failed
E2018	0	TIMEOUT during LOGIN

Error number	Error class	Meaning
E2019	0	Reading of object list has failed
E201A	0	TIMEOUT while reading object list
E201B	0	Reading control objects has failed
E201C	0	TIMEOUT while reading control objects

9 Service, Maintenance and Warranty

9.1 Service address

Please address questions or problems to your SIG Positec contact person or directly to SIG Positec. SIG Positec will be happy to give you the name of its customer service outlet in your area.

Hardware hotline

For questions concerning the unit, service or on-site commissioning

Telephone: +49 (07821) 946 257

Fax: +49 (07821) 946 430

Lotus Notes: Hotline, Hardware

Internet e-mail: hw.hotline@sig-positec.de

Software hotline

For questions concerning software or field bus

Telephone: +49 (07821) 946 360

Fax: +49 (07821) 946 430

Lotus Notes: Hotline, Software

Internet e-mail: sw.hotline@sig-positec.de

RED office

Repairs and spare parts service

Telephone: +49 (07821) 946 606

Fax: +49 (07821) 946 202

Lotus Notes: RED, Buero

Internet, e-mail: red@sig-positec.de

Maintenance

The Twin Line unit requires no maintenance

- ▶ Check the state of the filter in the switch cabinet ventilator regularly. Checking intervals depend on the ambient conditions on site.



Have repairs to the unit carried out only by SIG Positec to ensure that the unit continues to operate reliably.

Warranty

No warranty claims can be entertained if the unit has been opened.

9.2 Shipping, storage and disposal



DANGER!

*Electric shock from high voltage!
Switch off the power supply at the main switch before removing the unit.*



DANGER!

*Electric shock from high voltage!
Wait the 4 minutes discharge time (TLC538: 6 minutes) before working on the connections to the electronic power system or motor terminals. and then measure the residual voltage at the DC-line terminals DC+ and DC-. The residual voltage may not exceed 48 V_{DC}.*

Deinstallation

- ▶ Save the parameter settings of the unit:
With the operating software select 'File → Save' to save all values on the PC's data storage medium.
With the Human-Machine Interface HMI select menu '8.1 Read Param.' to copy a parameters set into the Human-Machine Interface HMI copy memory
- ▶ Switch the unit off.
- ▶ Disconnect the power supply.
- ▶ Mark all connections to the unit.
- ▶ Disconnect the motor cable.
- ▶ Pull out the interface connector.
- ▶ Remove the unit from the control cabinet.

Shipping

The unit must be protected against impact while in transit. Use the original packaging for this purpose.

Storage

Store the unit only under the given, permissible ambient conditions for room temperature and humidity.
Protect the unit from dust and dirt.

Disposal

The positioning controller is made from various materials which can be recycled or which must be separately disposed of.

For recycling purposes, split the unit into the following parts

- Housing, screws and terminals for ferrous metal recycling
- Cables for copper recycling
- Connectors, hood for plastics recycling

Circuit boards and electronic components must be disposed of separately in accordance with the relevant environmental protection laws. Send these parts for special waste disposal.

10 Accessories and spare part

10.1 List of accessories

Accessories The following accessories are available for standard units and for version P:

Qty	Designation	Standard unit/ version P (S/P)	Order Number
1	Operating software TL CT with on-line documentation on data carrier, multilingual	S/P	6250 1101 803
1	HMI hand-held operating unit with manual	S/P	6250 1101 503
1	Connector set for complete assembly	S/P	6250 1519 002
1	motor cable 1.5 mm ²	S/P	6250 1317 xxx ¹⁾
1	encoder cable for RM-C module	S/P	6250 1440 xxx ¹⁾
1	pulse direction cable for PULSE-C module	S/P	6250 1447 yyy ²⁾
1	Encoder cable for RS422-C	S/P	6250 1448 yyy ²⁾
1	field bus cable for module CAN-C, IBS-C	S/P	6250 1446 yyy ²⁾ 6250 1451 yyy ²⁾
1	CAN terminator, 9-pin CAN terminator socket, 9-pin plug	S/P	6250 1518 002 6250 1518 003
1	RS232 programming cable 5 m RS232 programming cable 10 m	S/P	6250 1441 050 6250 1441 100
1	TL HMI cable	S/P	6250 1442 yyy ²⁾
1	Holding brake controller TL HBC	S	6250 1101 606
1	terminal angle with top-hat rail TS 15, e.g. for terminal from Phonix Contact Typ MBK	P	6250 1102 200
1	set with grommets, type KDT/Z ³⁾ (Murrplastic GmbH, see chap. 10.3, Suppliers)	P	6250 1102 202
1	External mains filter for units with no internal filter for TLC511 NF, 4A for TLC512 NF, 10A	S	5905 1100 200 6250 1101 900

1) cable length xxx: 003, 005, 010, 020: 3 m, 5 m, 10 m, 20 m, longer lengths of cable on request;

2) cable length yyy: 005, 015, 030, 050: 0.5 m, 1.5 m, 3 m, 5 m

3) The inside diameter of the grommets must match the diameter of the cables used.

10.2 List of spare parts

Positioning controller

Qty.	Designation	Order no.
1	TLC511, TLC512	type code
1	SK14 shielding terminal	6250 1101 400
1	Connector caps for the terminal strips	6250 1519 002
1	Documentation on the TLC51x	9844 1113 117

10.3 Suppliers

Grommets:

Murrplastic GmbH

D-71567 Oppenweiler

Tel.: +49 (0) 7191 / 482-0

Fax.: +49 (0) 7191 /482-280

11 Unit label

11.1 Illustration of the unit label

- Copy the unit label and stick it to the inside of the Twin Line unit's hood.

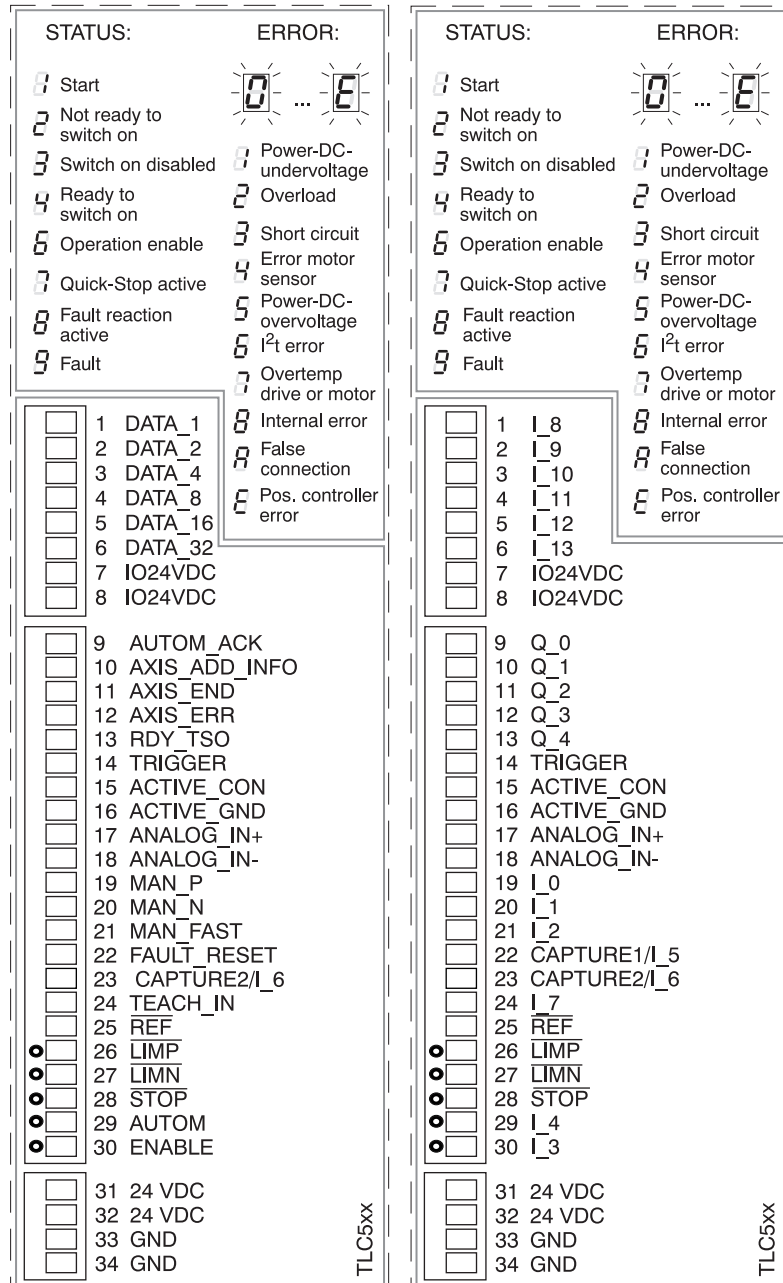


Fig. 11.1 Unit label

12 Parameters

12.1 Overview

Parameter groups The parameters of the Twin Line unit are grouped in functional blocks.

- Settings, Page 12-3: Behaviour of the input and output signals of the signal interface, modification of error responses, gear ratios, parameters for the ± 10 V interface and general control system settings
- Commands, Page 12-4: Transmission of parameter sets, system settings for power amplifier
- PPA, Page 12-4: Parameters of the power amplifier, system settings
- Motion, Page 12-5
Parameter settings for all operating modes: jerk filter, direction of rotation, software limit switches, normalisation and ramp settings
- Manual, Page 12-6 Parameter settings for manual mode
- VEL, Page 12-6
Settings for speed mode
- PTP, Page 12-7
Settings for point-to-point mode
- Gear, Page 12-7:
Settings for electronic gear mode with offset superimposition
- Home, Page 12-9
Settings for referencing mode
- Teach, Page 12-9
Settings for the teach-in operating function
- List, Page 12-10
Settings for the list-controlled operation function
- List1Data0..List1Data63, Page 12-11
List data input data
- List2Data0..List2Data63, Page 12-11
List data input data
- Capture, Page 12-12: Settings for the operating function for capturing position data
- I/O, Page 12-13: Switching states of the inputs and outputs of the signal interface
- M1, Page 12-14: Settings for modules in slot M1
- M4, Page 12-14 Settings for modules in slot M4
- Status, Page 12-15: System settings: Device-specific and current parameters such as temperature values of the power amplifier, motor and internal ballast resistor, control loop parameters and setpoint and actual values.
- ErrMem0...ErrMem19, Page 12-20: Storage of last 20 error messages. Older messages are shifted towards ErrMem0.

Instructions on inputting values The 'max. current' and 'max. speed' values under 'Range of values' correspond to the lesser maximum values of power amplifier and motor. The unit limits automatically to the lesser value.

Temperature in Kelvin [K] = temperature in degree Celsius [°C] + 273,
for example: 358 K = 85 °C

What does this mean? **Idx:Sidx:** Index and subindex for identifying a parameter, can be input with the operating software in the 'Monitor' window.

R/W: Value can be read or written. R/- means the value is read only.

rem: The value is retentive; it is retained in the memory even after the unit is switched off.

Info page: Further information on the parameter will be found on the page specified.

Use the specifications which are relevant for controlling the unit through the particular access channel.

Access channel	Specifications
field bus, signal interface	Idx:Sidx:
TL HMI	menu items under TL-HMI
TL CT	parameter group.individual parameters, e.g. „Settings.SignEnabl“

12.2 Parameter groups

12.2.1 Parameter group Settings

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
name1	11:1	–	User device name 1	UINT32 0..4294967295	538976288	R/W rem.	12-4
name2	11:2	–	User device name 2	UINT32 0..4294967295	538976288	R/W rem.	12-4
Password	11:3	1.3	Password for configuring with a hand-held operating unit	UINT16 0..9999 0: No password protection	0	R/– rem.	12-4
I_0	14:10	–	Phase current, standstill (100=1Arms)	–	90	R/W rem.	5-8
I_acc	14:11	4.1.31	Phase current, acceleration / deceleration (100=1Arms)	UINT16 0..1000	90	R/W rem.	5-8
I_const	14:12	4.1.32	Phase current, constant movement (100=1Arms)	UINT16 0..1000	90	R/W rem.	5-8
SM_toggle	14:17	4.1.33	Short minimal motor movement when switching on the amplifier	0: inactive 1: active	1	R/W rem.	12-3
monitorM	14:18	4.1.35	Motor monitoring, only with module in M2 0: deactivated 1: activated	UINT16 Bit 0: rotation monitoring Bit 1: temperature monitoring 0..3	3	R/W rem.	5-8
SignEnabl	28:13	4.1.10	Signal enable for monitoring inputs 0: inactive 1: active	UINT16 Bit 0 : LIMP Bit 1 : LIMN Bit 2 : STOP Bit 3 : REF	7	R/W rem.	7-24
SignLevel	28:14	4.1.11	Signal level for monitoring inputs 0: reaction at 0-level 1: reaction at 1-level	UINT16 Bit 0 : LIMP Bit 1 : LIMN Bit 2 : STOP Bit 3 : REF	0	R/W rem.	7-24
SignQstop	28:20	4.1.26	Check signals which initiate quick stop 0: Deceleraton ramp 1: Quick stop ramp	UINT16 Bit 0 : LIMP Bit 1 : LIMN Bit 2: STOP Bit 3: REF Bit 6: - Bit 7: SW_STOP	0	R/W rem.	7-18
dec_Stop	28:21	-	Deceleration ramp for quick stop [rev/(min*s)]	UINT32 60..2000000	6000	R/W rem.	7-18
Flt_pDiff	28:24	4.1.13	Error response to contour error	UINT16 1: Error class 1 2: Error class 2 3: Error class 3	3	R/W rem.	12-3
xMode	29:1	4.4.2	Axle operating mode to be set after power-on	UINT16 0: PTP-Mode 1: Gear-Mode	0	R/W rem.	12-3

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
IO_mode	29:31	4.1.4	Significance of I/O signal assignment	UINT16 0: setting field bus-parameter via I/O assignment 1: I/O freely available 2: I/O assigned functions	0	R/W rem.	5-10

12.2.2 Parameter group Commands

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
eeprSave	11:6	3.9 4.9 6.9	Save parameter values in EEPROM memory 1: Save the range	UINT16 Ranges to be saved: Bit0: Parameters Bit1: Set data Bit2: List data List1 Bit3: List data List2 Bit4: User-def. data	–	R/W –	12-4
stateSave	11:7	–	Processing state of 'Commands.eeprSave'	UINT16 0: Saving 1: Saving completed	–	R/– –	12-4
default	11:8	–	Initialize parameters with default values Factory setting	UINT16 1: Start initialization	–	R/W –	12-4
stateDef	11:9	–	Processing state param. 'Commands.default'	UINT16 0: Initializing 1: Initialization completed	–	R/– –	12-4
driveCtrl	28:1	–	Control word for change of state, presetting Bit 0..3='0', write access automatically triggers change of slope 0->1	UINT16 Bit0: disable amplifier Bit1: enable amplifier Bit2: stop (quick stop) Bit3: FaultReset Bits4..15: not assigned	0	R/W –	12-4
OnlAuto	29:30	–	Access to the mode setting	UINT16 0: access via local control units or field bus 1: access via field bus only	0	R/W –	6-2
del_err	32:2	5.4	Deletion of all entries in error memory	UINT16 0	0	R/W –	8-7

12.2.3 Parameter group PA

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
I_maxPA	16:8	2.2.1	Peak current of the unit [100=1Arms]	UINT16	1000	R/– rem.	12-4
U_maxDC	16:12	2.2.17	Max. permitted DC-line voltage on the DC-bus [10=1V]	UINT16	–	R/– rem.	12-4

12.2.4 Parameter group Motion

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
n_90%	14:15	-	Motor speed with 90% of the standstill momentum [r.p.m]	UINT32 1..3000	-	R/W rem.	5-16
n_50%	14:16	4.4.31	Motor speed with 50% of the standstill momentum [r.p.m]	UINT32 1..3000	-	R/W rem.	5-16
Filt_jerk	28:5	4.4.26	Jerk filter	UINT16 0: off 3..30: filter setting value	0	R/W rem.	7-17
invertDir	28:6	4.4.27	Inversion of sense of rotation	UINT16 0: no inversion 1: sense of rotation inverted	0	R/W rem.	5-8
SW_LimP	29:4	4.4.5	Software limit switch for pos. Position limit LIMP condition: SW_LimP > SW_LimN [usr]	INT32 -2147483648..2147483647	2147483647	R/W rem.	7-23
SW_LimN	29:5	4.4.6	Software limit switch for pos. Position limit LIMN condition: SW_LimN > SW_LimP [usr]	INT32 -2147483648..2147483647	-2147483648	R/W rem.	7-23
SW_Enabl	29:6	4.4.7	Set monitoring of software limit switches 0: deactivated 1: activated	UINT16 Bit5: SW_LIMP Bit6: SW_LIMN	0	R/W rem.	7-23
pNormNum	29:7	4.4.20	Position calibration numerator	INT32 -2147483648..2147483647	1	R/W rem.	7-11
pNormDen	29:8	-	Position calibration denominator	INT32 -2147483648..2147483647	19200	R/W rem.	7-11
vNormNum	29:9	4.4.21	Speed calibration numerator	INT32 1..2147483647	1	R/W rem.	7-11
vNormDen	29:10	-	Speed calibration denominator	INT32 1..2147483647	1	R/W rem.	7-11
aNormNum	29:11	4.4.22	Acceleration calibration numerator	INT32 1..2147483647	1	R/W rem.	7-11
aNormDen	29:12	-	Acceleration calibration denominator	INT32 1..2147483647	1	R/W rem.	7-11
n_max0	29:21	4.4.28	Speed limit for travel profile [r.p.m.]	UINT32 0 .. 3000	3000	R/W rem.	5-16
n_start0	29:22	4.4.10	Start-stop speed [Umin]	UINT32 1...n_max0	12	R/W rem.	5-16
v_target0	29:23	4.4.11	Setpoint speed [usr]	UINT32 1..n_max0	60	R/W rem.	5-16
acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1: linear 2 : exponential	1	R/W rem.	5-16
acc	29:26	4.4.14	Acceleration [usr]	UINT32 60...2000000	600	R/W rem.	5-16
dec	29:27	4.4.15	Deceleration [usr]	UINT32 60...2000000	600	R/W rem.	5-16

12.2.5 Parameter group Manual

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
startMan	41:1	3.2.1	Start of manual travel with transfer of control bits	UINT16 Bit2: 0:slow 1:fast Bit1: neg. sense of rotation Bit0: pos. sense of rotation	–	R/W –	6-10
statusMan	41:2	–	Acknowledgement: manual travel	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit14: manu_end Bit15: manu_err	–	R/– –	6-10
typeMan	41:3	3.2.2	Type of manual travel	UINT16 0.: Classical inching 1: Unified inching	0	R/W rem.	6-10
n_slowMan	41:4	3.2.3	Speed for slow manual travel [usr]	UINT32 1..2147483647	60	R/W rem.	6-12
n_fastMan	41:5	3.2.4	Speed for fast manual travel [usr]	UINT32 1..2147483647	180	R/W rem.	6-12
dist_Man	41:6	3.2.5	Inch travel, defined travel per jog cycle on travel-limited inching [usr]	UINT16 1..65535	20	R/W rem.	6-12
step_Man	41:7	3.2.6	Inch travel, defined travel on manual travel start [usr]	UINT16 0..65535 0: continuous travel	20	R/W rem.	6-11
time_Man	41:8	3.2.7	Classical waiting time [ms]	UINT16 1..30000	500	R/W rem.	6-11

12.2.6 Parameter group VEL

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
velocity	36:1	3.1.2.1	Start of speed change with transfer of setpoint speed [usr]	INT32	–	R/W –	6-14
stateVEL	36:2	–	Acknowledgement: speed profile mode	UINT16 Bit0: error LIMP Bit1: error LIMN Bit2: error HW_STOP Bit3: error REF Bit5: error SW_LIMP Bit6: error SW_LIMN Bit7: error SW_STOP Bit13: sepoint speed reached Bit14: vel_end Bit15: vel_err	–	R/– –	6-14

12.2.7 Parameter group PTP

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
p_absPTP	35:1	3.1.1.1	Start of absolute positioning with transfer of absolute target position value [usr]	INT32 -2147483648...2147483647	–	R/W –	6-4
statePTP	35:2	3.2.14	Acknowledgement: PTP positioning	UINT16 Bit0: error LIMP Bit1: error LIMN Bit2: error HW_STOP Bit3: error REF Bit5: error SW_LIMP Bit6: error SW_LIMN Bit7: error SW_STOP Bit13: Setposition reached Bit14: motion_end Bit15: motion_err	–	R/– –	6-6
p_reIPTP	35:3	3.1.1.2	Start of relative positioning with value transfer for travel [usr]	INT32 -2147483648...2147483647	–	R/W –	6-16
continue	35:4	3.1.1.3	Continuation of interrupted positioning with transfer of any value	UINT16 value is not relevant for positioning	–	R/W –	6-16
v_tarPTP	35:5	3.1.1.5	Setpoint speed of PTP positioning [usr]	INT32 1...2147483647	'Motion. v_target0	R/W –	6-16

12.2.8 Parameter group Gear

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
startGear	38:1	3.1.3.1	Start of electronic gearbox processing with selection of processing mode	UINT16 0: deactivated 1: immediate synchronisation 2: synchronisation with compensating movement	–	R/W –	6-18
stateGear	38:2	-	Acknowledgement: gearbox processing	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit13: - Bit14: gear_end Bit15: gear_err	–	R/– –	6-18
n_maxGear	38:5	3.1.3.3	Max. speed [rpm]	INT32 1..12000	3000	R/W rem.	6-19
a_maxGear	38:6	3.1.3.20	Maximum values for acceleration and deceleration in [r.p.m.*s], normalisation of acceleration not taken into account	UINT32 120.. 120000	600	R/W –	6-19
numGear	38:7	3.1.3.2	Gearbox factor numerator	INT32 -2147483648...2147483647	1	R/W –	6-19

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
denGear	38:8	–	Gearbox factor denominator	INT32 1...2147483647	1	R/W –	6-19
Flt_nGear	38:9	3.1.3.21	Parameters for speed filter. 0 = filter deactivated 1..8 = filter activated	UINT16 0..8	4	R/W rem	6-20
DirEnGear	38:13	–	Release of movement direction, Reversing the sense of rotation inverts the movement direction	INT16 1: positiv direction 2: negativ direction 3: both directions	3	R/W rem.	6-20
Flt_rGear	38:14	3.1.3.22	Switch-off threshold for speed filter. [motor increments / ms ²	UINT16 1..100	15	R/W rem	6-20
p_absOffs	39:1	3.1.3.6	Start of absolute offset positioning with transfer of position	INT32 -2147483648...2147483647	0	R/W –	6-25
stateOffs	39:2	–	Acknowledgement: offset positioning	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit13: offset set position reached Bit14: offset_motion_end Bit15: offset_motion_err	–	R/– –	6-25
p_relOffs	39:3	3.1.3.7	Start of relative offset positioning with transfer of travel value [inc]	INT32 -2147483648...2147483647	0	R/W –	6-25
n_tarOffs	39:5	3.1.3.8	Setpoint speed of offset positioning [inc/s]	INT32 -12000..12000	60	R/W –	6-25
phomeOffs	39:6	3.1.3.9	Sizing in offset positioning [inc]	INT32 -2147483648...2147483647	0	R/W –	6-25
accOffs	39:7	3.1.3.10	Acceleration ramp for offset positioning [r.p.m/s]	INT32 60..2.000.000	600	R/W –	6-25
decOffs	39:8	3.1.3.11	Deceleration ramp for offset positioning [r.p.m/s]	INT32 60..2.000.000	600	R/W –	6-25

12.2.9 Parameter group Home

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
startHome	40:1	3.3.1.1 3.3.1.2 3.3.1.3 3.3.1.4 3.3.1.5 3.3.1.6 3.3.1.7 3.3.1.8	Start of operating mode referencing	UINT16 1 : LIMP 2 : LIMN 3 : REFZ neg. sense of rotation 4 : REFZ pos. sense of rotation 5 : LIMP with index pulse 6 : LIMN with index pulse 7 : REFZ neg. sense of rotation with index pulse 8 : REFZ pos. sense of rotation with index pulse	–	R/W –	6-27
stateHome	40:2	–	Acknowledgement: referencing	UINT16 Bit0: Error LIMP Bit1: Error LIMN Bit2: Error HW_STOP Bit3: Error REF Bit5: Error SW_LIMP Bit6: Error SW_LIMN Bit7: Error SW_STOP Bit14: ref_end Bit15: ref_err	–	R/– –	6-27
startSetp	40:3	3.3.2	Sizing on sizing position (set absolute position) [usr]	INT32 -2147483648...2147483647	–	R/W –	6-30
v_Home	40:4	3.3.3	Speed for search of reference switch [usr]	INT32 -2147483648...2147483647	60	R/W rem.	6-27
v_outHome	40:5	3.3.4	Speed for processing run-out and safety distance [usr]	INT32 -2147483648...2147483647	6	R/W rem.	6-27
p_outHome	40:6	3.3.5	Run-out distance, is automatically approached when reference is found [usr]	UINT32 0: Run-out disabled > 0: Run-out distance [usr]	0	R/W rem.	6-27
p_disHome	40:7	3.3.6	Safety distance of switching edge to reference point	UINT32 0...2147483647	200	R/W rem.	6-27

12.2.10 Parameter group Teach

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
storeTeac	43:1	–	Teach-In processing, select memory address, list number for storing position value (0...63) Example: 000010: list number 2	UINT16 Bit 0..5: list number	0	R/W –	7-9
stateTeac	43:2	–	Acknowledgement: teach-in processing	UINT16 Bit15: teach_err Bit14: teach_end	–	R/– –	7-9
memNrTeac	43:3	–	Memory selection for teach-in processing	UINT16 1: List 1 of list processing 2: List 2 of list processing	1	R/W –	7-9
p_actTeac	43:4	–	current motor position in teach-in processing [usr]	INT32	–	R/– –	7-9

12.2.11 Parameter group List

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
startList	44:1	3.1.5.1 3.1.5.2 3.1.6.1 3.1.6.2	activate new list processing, current list-driven operation is first deactivated	UINT16 0 :deactivate list driven operation 1 : activate List 1 2 : activate List 2	0	R/W -	7-2
stateList	44:2	-	acknowledgement and status: list data processing	UINT16 Bit15: list_err Bit14: list_quit 0: list data processing active 1: lis data processing completed Bit 0,1: - 0 : No list active - 1 : List 1 active - 2 : List 2 active	-	R/- -	7-2
cntList1	44:4	-	List 1: number of available list entries	UINT16	64	R/- -	7-2
bgnList1	44:6	-	List 1: starting number, first entry for list data processing starting number < finishing number	UINT16 0...63	0	R/W rem.	7-2
endList1	44:7	-	List 1: finishing number, last entry for list data processing finishing number > starting number	UINT16 0...63	63	R/W rem.	7-2
cntList2	44:12	-	List 2: number of available list entries	UINT16	64	R/- -	7-2
bgnList2	44:14	-	list 2 starting number, first entry for list data processing starting number < finishing number	UINT16 0...63	0	R/W rem.	7-2
endList2	44:15	-	List 2: finishing number, last entry for list data processing finishing number > starting number	UINT16 0...63	63	R/W rem.	7-2
actList	44:18	-	Last activated list	INT16 -1: no list entries activated yet 0..63: last activated list entry	0	R/- -	7-2

12.2.12 Parameter group L1Data0..L1Data63

specified here: L1Data0: Index 1100
L1Data1 to L1Data63 with index :1101 to 1163

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.	7-3
posList1	1100:2	7.3.2.1 7.3.2.2	List 1: position	INT32	0	R/W rem.	7-3
signList1	1100:3	7.3.2.3	List 1: signal state	UINT16 0, 1	0	R/W rem.	7-3
velList1	1100:4	7.3.2.4	List 1: setpoint speed [usr]	INT32 -'motion.n_max0' .. 'Motion.n_max0' setting dependent on operating mode PTP: 0: PTP.Vtarget; <>0: stored value VEL: <>0: VEL.velocity; 0: stored value	0	R/W rem.	7-3

12.2.13 Parameter group L2Data0..L2Data63

specified here: L2Data0: Index 1200,
L2Data1 to L2Data63 via index 1201 to 1263

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
typeList2	1200:1	7.4.1.1	List 2: list type for ALL following list entries (1202:x...1263:x)	UINT16 1: pos./signal 2: pos./speed	1	R/W rem.	7-3
posList2	1200:2	7.4.2.1 7.4.2.2	List 2: position [usr]	INT32	0	R/W rem.	7-3
signList2	1200:3	7.4.2.3	List 2: signal state	UINT16 0, 1	0	R/W rem.	7-3
velList2	1200:4	7.4.2.4	List 2: setpoint speed [usr]	INT32 -'motion.n_max0' .. 'Motion.n_max0' setting dependent on operating mode PTP: 0: PTP.Vtarget; <>0: stored value VEL: <>0: VEL.velocity; 0: stored value	0	R/W rem.	7-3

12.2.14 Parameter group Capture

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
TrigSign	20:13	–	Selection of trigger signals for position storage Bit 3..2: Signal - channel 2 (K2) Bit 1..0: Signal - channel 1 (K1) Examples: 4: binary 01 00 => CAPTURE2 (K2), CAPTURE1 (K1) 9: 10 01 => CAPTURE2 (K2), Indexp. Sollpos. (K1)	UINT16 Bits 0..1/ Bits 2..3 (K1/K2): - 00: CAPTURE1 - 01: CAPTURE2 - 10: index pulse setpoint sensor (with module on M1) - 11: index pulse actual position sensor (fori SM with module on M2)	4	R/W –	7-21
TrigLevl	20:15	–	Signal level for trigger channels bit state: 0: triggering at 1->0 change 1: triggering at 0->1 change	UINT16 Bit 0: set trigger level on channel 1 Bit 1: set trigger level on channel 2	1	R/W –	7-21
TrigStart	20:16	–	start triggering (bits 0..1): 0: no change 1: reset triggering and repeat cancel triggering (bit 14=1) repeat triggering (bit15) 0: trigger once 1: trigger continuously	UINT16 Bit 0: trig. on channel 1 Bit 1: trig. on channel 2 Bit 14: cancel trig. Bit 15: repeat trig.	0	R/W –	7-21
TrigStat	20:17	–	Status of trigger channels	UINT16 Bit 0: triggering on channel 1 running Bit 1: triggering on channel 2 running	0	R/– –	7-21
TrigPact1	20:18	–	Actual position of motor on triggering on channel 1 (inc)	INT32	-	R/– –	7-21
TrigPact2	20:19	–	Actual position of motor on triggering on channel 2 (inc)	INT32	-	R/– –	7-21
TrigPref1	20:20	–	Setpoint of electrical gearbox on triggering on channel 1 (inc)	INT32	-	R/– –	7-21
TrigPref2	20:21	–	Setpoint of electrical gearbox on triggering on channel 2 (inc)	INT32	-	R/– –	7-21

12.2.15 Parameter group I/O

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
IW0_act	33:1	2.4.1	Input word 0, With 'forcing' (e.g. with TL CT): read access shows force state	UINT16 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit4: MAN_P Bit5: MAN_N Bit6: MAN_FAST Bit7: ENABLE Bit8: AUTOM Bit9: FAULT_RESET Bit10: CAPTURE1 Bit11: FUNCTION	–	R/– –	–
IW1_act	33:4	2.4.2	Input word 1, With 'forcing' (e.g. with TL CT): read access shows force state	UINT16 'Settings.IO_mode'=0/1: - Bit0...Bit15: I_0...I_15 'Settings.IO_mode'=2: - Bit0: MAN_P - Bit1: MAN_N - Bit2: MAN_FAST - Bit3: ENABLE - Bit4: AUTOM - Bit5: FAULT_RESET/ CAPTURE1 - Bit6: CAPTURE2 - Bit7: TEACH_IN - Bit8: DATA1 - Bit9: DATA2 - Bit10: DATA4 - Bit11: DATA8 - Bit12: DATA16 - Bit13: DATA32 - Bit14: - Bit15:	–	R/– –	–
QW0	34:1	2.4.10	Output word 0, With 'forcing' (e.g. with TL CT): read access shows force state	UINT16 'Settings.IO_mode'=0/1: - Bit0 ...Bit4: Q_0...Q_4 'Settings.IO_mode'=2: - Bit0: AUTOM_ACK - Bit1: AXIS_ADD_INFO - Bit2: AXIS_END - Bit3: AXIS_ERR - Bit4: RDY_TSO - Bit5: ACTIVE_CON - Bit6: TRIGGER	–	R/W –	–
OutTrig	34:9	–	Setting trigger output if signal list inactive	UINT16 0: Low level 1: High level	0	R/W –	7-5

12.2.16 Parameter group M1

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
PULSE-C	21:10	4.5.1	Setting position encoder PULSE-C	UINT16 Bit 2: Max. frequency 0: 200 kHz, 1: 25 kHz Bit 3: Signal shape: 0: PULSE-DIR 1: PV-PR	4	R/W rem.	-

12.2.17 Parameter group M4

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
profilSer	24:11	4.5.10	RS485-interface, processing mode incl. Profile selection only readable via field bus	UINT32	0	R/W rem.	-
baudSer	24:12	4.5.11	RS485-interface, baud rate [baud] only readable via field bus	UINT32 0 = Autobaud 9600 = 9600 Baud 19200 = 19200 Baud 38400 = 38400 Baud	9600	R/W rem.	-
addrSer	24:13	4.5.12	RS485-interface, address only readable via field bus	UINT16	1	R/W rem.	-
toutSer	24:14	4.5.13	RS485-interface, monitoring time for a timeout signal [ms] only readable via field bus	UINT16 0...65535 0: monitoring inactive	0	R/W -	-
profillbs	24:16	4.5.15	Interbus-S, processing mode incl. Profile selection only readable via field bus	UINT32	0	R/W rem.	-
baudlbs	24:17	4.5.16	Interbus-S, baud rate (kbaud) only readable via field bus	UINT32	500	R/W rem.	-
toutlbs	24:18	4.5.17	Interbus-S, timeout time [ms] only readable via field bus	UINT16 0...65535 0: monitoring inactive	0	R/W rem.	-
profilPbd	24:20	4.5.20	Profibus-DP, processing mode incl. Profile choice only readable via field bus	UINT32	0	R/W rem.	-
addrPbd	24:21	4.5.21	Process bus - DP, address only readable via field bus	UINT16 0..126	126	R/W rem.	-
profilCan	24:23	4.5.25	CAN, processing mode incl. Profile choice only readable via field bus	UINT32	0	R/W rem.	-
addrCan	24:24	4.5.26	CAN, address only readable via field bus	UINT16 0..127	127	R/W rem.	-
baudCan	24:25	4.5.27	CAN, baud rate [baud] only readable via field bus	UINT32	125k	R/W rem.	-
toutCan	24:26	4.5.28	CAN, timeout time [ms]	UINT16 0...65535 0: monitoring inactive	0	R/W rem.	-

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
busDiag	24:30	2.6.5	Bus diagnosis for DeviceNet (DNSTATE)	0: OFFLINE 1: ONLINE 2: LINK_OK 3: FAILURE 4: TIMED_OUT 5: IDLE	-	R/- -	-

12.2.18 Parameter group Status

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
serial_no	1:20	2.8.5	Device serial number, max. 9 digits	UINT32	-	R/- -	-
p_DifPeak	12:16	2.3.1.9	Max. contouring error reached [Inc] write access resets value	UINT32	0	R/W -	-
AnalogIn	20:8	2.3.3.1	Analogue input at input ANALOG_IN [mV]	INT16	0	R/- -	5-14
driveStat	28:2	2.3.5.1	Status word for the operational status of the device	UINT32 Bit0..3: act. operating status: - 1: Start - 2: Not Ready to switch on - 3: Switch on disabled - 4: Ready to switch on - 5: Switched on - 6: Operation enable - 7: Quick-Stop active - 8 Fault reaction active - 9: Fault Bit4: reserved Bit5=1: internal monitoring fault (FltSig) Bit6=1: external monitoring fault (FltSig_SR) Bit 7=1: warning Bit13: x_add_info Bit14: x_end Bit15: x_err Bits16-20: current operating mode (Bits0-4: Status.xmode_act) Bit21: drive is referenced (ref_ok) Bit22: 0	-	R/- -	6-5

Parameter			Explanation and unit []	Range of values	Default-	R/W	Infos
Name	Idx:Sidx	TL-HMI			Value	rem.	page
xMode_act	28:3	2.3.5.5	Current axis operating mode with additional information, bits 0 - 4: List of possible operating modes for your TL unit will be found in the section 'Operating modes'	UINT16 Bit0..4 device-specific: - 0: not used - 1: manual positioning mode - 2: referencing - 3: PTP positioning - 4: speed profile - 5: electronic gear with offset adjustment, position controlled (AC) or with position reference (SM) - 7: Data set mode - 16..31: reserved Bit5=1: drive is referenced ('ref_OK') Bit6:- Bit7: reserved Bit8..15: not assigned	-	R/- -	6-30
Sign_SR	28:15	2.3.4.1	Saved signal states of external monitoring signals 0: Not active, 1: Activated.	UINT16 Bit 0 : LIMP Bit 1 : LIMN Bit 2 : STOP Bit 3 : REF	-	R/- -	-

Parameter	Explanation and unit []		Range of values	Default-	R/W	Infos	
Name	Idx:Sidx	TL-HMI		Value	rem.	page	
FltSig	28:17	2.3.4.3	Saved monitoring signals 0: Not active, 1: Activated	UINT32 Bit 0: Fault, power up Bit 1: DC-line undervoltage Lim1 Bit 2: DC-line undervoltage Lim2 Bit 3: Motor line earth fault Bit 4: Motor line short circuit Bit 5: DC-line overvoltage Bit 6: Overtemperature ballast Bit 7: Overtemperature motor Bit 8: Overtemperature power amplifier Bit 9: I ² t power amplifier Bit 10: Reserved Bit 11: I ² t motor Bit 12: I ² t ballast Bit 13: Phase monitoring motor Bit 14: - Bit 15: Watchdog Bit 16: Internal system error Bit 17: Pulse disable Bit 18: Protocol error HMI Bit 19: Max. speed exceeded Bit 20: Cable break reference encoder Bit 21: Cable break actual position encoder Bit 22: Position deviation error Bit 23: Line failure 24 V Bit 24: Contour error Bit 25: Short circuit in the dig- ital outputs Bit 26: Incorrect limit switch Bit 27: Prewarning tempera- ture motor Bit 28: Prewarning Tempera- ture power amplifier Bit29: Bit30: Bit31:	-	R/- -	-

Parameter	Explanation and unit []		Range of values	Default-	R/W	Infos	
Name	Idx:Sidx	TL-HMI		Value	rem.	page	
FltSig_SR	28:18	2.3.4.4	Saved monitoring signals	UINT32 Bit 0: Fault, power up Bit 1: DC-line undervoltage Lim1 Bit 2: DC-line undervoltage Lim2 Bit 3: Motor line earth fault Bit 4: Motor line short circuit Bit 5: DC-line overvoltage Bit 6: Overtemperature ballast Bit 7: Overtemperature motor Bit 8: Overtemperature power amplifier Bit 9: I ² t power amplifier Bit 10: Reserved Bit 11: I ² t motor Bit 12: I ² t ballast Bit 13: Phase monitoring motor Bit 14: - Bit 15: Watchdog Bit 16: Internal system error Bit 17: Pulse disable Bit 18: Protocol error HCI Bit 19: Max. speed exceeded Bit 20: Cable break reference encoder Bit 21: Cable break actual position encoder Bit 22: Position deviation error Bit 23: Line failure 24 V Bit 24: Contour error Bit 25: Short circuit in the digital outputs Bit 26: Incorrect limit switch Bit27: Prewarning temperature motor Bit28: Prewarning temperature power amplifier Bit29: Bit30: Bit31:	-	R/-	-
action_st	28:19	2.3.4.8	Action word, Saved error class bits	UINT32 Bit 0: Error class 0 Bit 1: Error class 1 Bit 2: Error class 2 Bit 3: Error class 3 Bit 4: Error class 4 Bit 5: Reserved Bit 6: Actual speed = 0 Bit 7: Clockwise rotation drive Bit 8: Anticlockwise rotation drive Bit 9: Current limit active Bit 10: Speed limit active Bit 11: Reference = 0 Bit 12: Drive time-delayed Bit 13: Drive accelerated Bit 14: Drive operates constant	0	R/-	-

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit []	Range of values	Default-Value	R/W rem.	Infos page
IntSigSR	29:34	2.3.4.2	Monitoring signals in positioning controller 0: not active, 1: activated	UINT32 Bit0..1: reserved Bit2: position overrun Bit3..4: reserved Bit5: SW limit switch, clockwise sense of rotation (SW_LIMP) Bit6: SW limit switch, anticlockwise sense of rotation (SW_LIMN) Bit7: stop via control word (SWSTOP) Bit8..14: reserved Bit15: amplifier not active Bit16..31: reserved	–	R/– –	7-22
p_ref	31:5	2.3.1.2	Setpoint position of rotor [inc]	INT32	–	R/– –	–
n_act	31:9	2.3.2.1	Actual speed [rpm]	INT16	–	R/– –	–
UDC_act	31:20	2.3.3.2	DC-line voltage [10=1V]	INT16	–	R/– –	–
Iu_act	31:21	–	Motor phase current phase U [100=1A]	INT16	–	R/– –	–
Iv_act	31:22	–	Motor phase current phase V [100=1A]	INT16	–	R/– –	–
v_ref	31:28	–	Speed of the rotor position setpoint value p_ref [inc/s]	INT32	–	R/– –	–
p_target	31:30	2.3.1.5	Target position of travel profile generator [usr]	INT32	–	R/– –	–
p_jerkusr	31:31	2.3.1.4	Actual position of travel profile generator [usr]	INT32	–	R/– –	–
p_actusr	31:34	2.3.1.3	Actual position of motor in operator units [usr]	INT32	–	R/– –	–
v_jerkusr	31:35	2.3.2.3	Actual speed of travel profile generator [usr]	INT32	–	R/– –	–
p_remaind	31:37	–	Residual value of position calibration of position setpoint p_ref [inc]	INT32	–	R/– –	7-15
v_target	31:38	2.3.2.4	Target speed of travel profile generator	INT32	–	R/– –	–
p_jerk	31:40	–	Setpoint position at jerk filter input [Inc]	INT32	–	R/– –	–
v_refM1	31:43	2.3.2.5	Speed from input value increments counted on module on M1 [Inc/s]	INT32 -2147483648...2147483647	0	R/– –	–
StopFault	32:7	2.5.1	Cause of last interruption, error number	UINT16	–	R/– –	8-7

12.2.19 Parameter group ErrMem0..ErrMem19

ErrMem0: Index 900,
ErrMem1 to ErrMem19 via Index 901 to 919

Parameter		Explanation and unit []		Range of values	Default-	R/W	Infos
Name	Idx:Sidx TL-HMI				Value	rem.	page
ErrNum	900:1 –		Coded error number	UINT16 0...65535	–	R/– –	8-7
Class	900:2 –		Error class	UINT16 0...65535	–	R/– –	8-7
Time	900:3 –		Error moment since power amplifier switched on [ms]	UINT16 0...65535	–	R/– –	8-7
AmpOnCnt	900:4 –		Number of switch-on cycles of power amplifier	UINT16 –	–	R/– –	8-7
ErrQual	900:5 –		Additional information for assessing error	UINT16 –	0	R/– –	8-7

Index

Numerics

7-segment display, See Status display

A

Access channels to Twin Line devices 6-1

Accessories

Installation 4-9

Order nos. 10-1

Scope of supply 1-3

Technical data 3-8

Wiring 4-42

Ambient conditions 2-2

Analogue input 5-14

display 5-14

Display with TL CT 5-14

displaying via field bus 5-14

B

Brake controller, see Holding brake controller

Brake ramp see deceleration ramps

Braking function 7-26

C

Cascading, Max. terminal current for 4-18

CE labelling 1-13

Changing the operating mode 6-1

Classical manual movement 6-11

Commissioning software 5-5

Commissioning tools 5-3

Connecting the encoder 4-27

Connecting the interface for rotation monitoring 4-32

Connecting the pulse direction module 4-29

Contouring errors

Function 6-20

Control cabinet 4-6

Correcting operating errors 8-8

D

Danger categories 2-1

DC bus, See DC-line connection

deceleration ramps setting 7-16

Declaration of conformity 1-13

Deinstallation 9-2

Device series TL 1-6

Diagram

A/B signals 4-28, 4-33

Dimension setting 6-30

offset values 6-24

Disposal 9-2

E

- EC guidelines 1-13
- Electronic gear
 - Offset positioning 6-23
 - Settings 6-19
- EMC guideline 1-13
- ENABLE signal
 - Function 4-31
- Encoder
 - Function 4-33
 - Number of lines 4-33
- Error class
 - Meaning 8-3
- Error display and rectification 8-2, 8-3
- Error messages
 - Resetting 8-2

F

- Fan 1-9
- Field bus module
 - CAN-C 4-36
 - IBS-C 4-40
 - PBDP-C 4-34
 - RS485-C 4-38
- Fitting the unit label 4-8
- Forcing 5-13, 5-14

G

- Gear ratio 6-19
- Global Statusbits, Statusbits 6-5

H

- HMI hand-held operating unit
 - Displaying signal states of the signal interface 5-13
 - Error display 8-6
 - Manual 1-5
 - Manual movement 5-10
 - Overview 5-3
- Holding brake control system
 - function 7-26
- Holding brake controller
 - Dimensions 3-3
 - Technical data 3-8
 - Wiring 4-42
- Holding brake, Function check 5-9

I

- Intended use 2-2
- Interface signal
 - ACTIVE_CON 7-26
 - FAULT_RESET 7-19
 - STOP 7-23
 - TRIGGER 7-1
 - trigger output 7-1

- Interface signals
 - DATA_1..DATA_32 7-9
- IT networks, Use in 2-2
- J**
- Jerk filter 7-17
- L**
- Laying motor cables 4-15
- LED
 - for DC-line voltage 1-8
 - for operating signals 1-8
- Limit switch
 - Monitoring function 7-23
 - Moving drive out 7-24
- Limit switches
 - Function check 5-9
 - Software limit switches 7-23
- List control
 - Overview 7-1
 - Settings 7-1
- List of spare parts 10-2
- M**
- M1 - M4, See Module slots
- Mains connection
 - 24 V+ supply 4-18
 - Mains connection
 - Alternating current 4-14
- Mains filter, unit designations 4-9
- Maintenance 9-1
- Malfunctions in movement mode 8-8
- Manual movement
 - Movement parameter 6-9
 - Starting a test run 5-10
- Manual set-up and operation on the field bus 4-44
- Mode
 - Manual mode 6-9
 - Point-to-point mode 6-15
 - Referencing 6-26
 - Speed mode 6-14
- Module
 - CAN-C 1-10, 4-36
 - for electronic gear 6-17
 - IBS-C 1-10, 4-40
 - PBDP-C 1-10, 4-34
 - PULSE-C 1-10, 4-29
 - RM-C 1-10, 4-32
 - RS422-C 1-10, 4-27
 - RS485-C 1-10, 4-38
- Module slots 1-9

- Modules
 - Combinations 1-11
 - Overview 1-10
 - Scope of supply 1-1
 - Signal cables for 1-3
 - Technical Data 3-6
 - wiring 4-40
- Monitoring functions 7-22
- Monitoring parameters 7-25
- Motor connection 1-8
- Mounting distances 4-6
- mounting distances 4-7
- mounting, mechanical 4-6
- Movement mode
 - Status monitoring 6-7
- Movement parameters 1-9
- N**
- Normalisation factor
 - acceleration 7-13
 - positioning 7-11
 - speed 7-13
- normalisation, Residual value in 7-15
- O**
- Offset positioning 6-23
- Open collector circuit 4-31
- Operating modes
 - changing 6-1
 - Monitoring the status parameter 6-5
 - Overview 1-11
 - Selecting the mode 6-4
- Operating software
 - Displaying switching states of the signal interface 5-13
 - Error display 8-5
 - Manual movement 5-10
- Operating states and transitions 8-2
- Operation via field bus, field bus configuration via inputs 4-49
- Optimizing the performance 5-15
- P**
- Parameter groups 12-1
- Parameter memory 1-9
- Parameter sets 6-7
- Parameter values
 - Overview of groups 12-1
 - Values for electronic gear 6-19
- PC connection 4-26
- Performance of the motor, optimizing 5-15
- Position / signal list 7-4
- Position / speed list 7-6
- Position values recording 7-20
- Positioning limits 7-22
- Power connection 4-14

- Power electronic system 10-2
 - 24 V+ connection wiring 4-18
 - Connecting the signal interface 4-19
 - mechanical installation 4-9
 - Overview 1-8
 - Power classes 1-7
 - Scope of supply 1-1, 1-2
 - Type code 1-7
 - Wiring up the mains connection 4-14
- Profile generator 6-8
- Protection type 2-2
- Q**
- Qualification of the personnel 2-3
- Quick-Stop function 7-18
- R**
- Ramp gradient 7-16
- Ramp gradients, setting 5-15
- Ramp shape 7-16
- Reference movement
 - Overview 6-26
 - to reference switch, Example 6-29
 - towards limit switch, Example 6-28
- Referencing
 - adjusting normalisation factor 7-12
- Residual value 7-15
- Residual-current circuit-breakers 4-14
- Resolution
 - for calculating the gear ratio 6-19
- Reversal of direction of rotation 7-19
- RS232 interface 1-9, 4-26
- S**
- Safety devices 2-3
- Safety instructions 2-1
- Safety notes 2-1
- Sense of rotation, reversing 6-19
- Service address 9-1
- Shipping 9-2
- Signal inputs
 - Assignments 4-19
 - Circuit diagram 4-31
 - Wiring example 4-44
- Signal interface
 - Assignments 4-19
 - Checking inputs and outputs 5-12
 - Function 1-9
 - Wiring examples 4-44
- Slots, See module slots
- Software limit switches 7-23
- Start/Stop speed 5-15
- Start-up interface, See RS232 interface

- Status display 1-8, 8-1
- Stepping motor 2-2
- Storage 9-2
- T**
- Teach-In
 - Initiating processing 7-7
 - over field bus 7-9
 - Overview 7-7
 - residual value 7-15
 - via signal interface 7-9
- Temperature monitoring 7-25
- Time diagram
 - Brake function 7-26
 - Pulse direction signal 4-30
 - Pulse forward / backward signal 4-30
- TL CT
 - Setting the phase current 5-7
- TL HMI
 - Setting the phase current 5-7
- Torque characteristic of the motor 5-16
- Trigger channels 7-20
- Twin Line HMI, see HMI hand-held operating unit
- Twin Line Unit
 - Mounting 4-6
 - Mounting distances 4-7
- Type code 1-7
- U**
- Unit label
 - fitting 4-8
 - Specimen 11-1
- United inching 6-12
- User-defined units 7-10
- V**
- Voltage reduction 7-26
- W**
- Warranty 9-1
- Wiring examples 4-44
- X**
- x_end, x_err, x_add_info 6-5