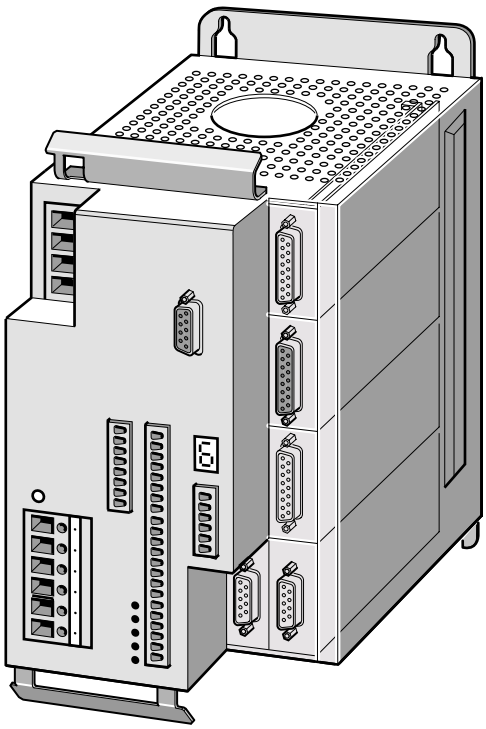
BERGER LAHR

Technical documentation



Twin Line Controller 51x

Positioning controller for stepper motors

TLC51x

Operating system: 1.1xx

Order no.: 9844 1113 117

Edition: f107, 09.02

Twin Line

CAUTION!
See the “Supplement” chapter at the end of the documentation for important information.

9844 1113 117, f107, 09.02

Table of Contents

9844 1113 117, f107, 09.02

4 Installation

5 Commissioning

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

Glossaries

Abbreviations

Abbreviation	Meaning
AC	Alternating current
ASCII	American Standard Code for Information Interchange
DC	Direct current
DC link	DC link
DP	Decentralized Periphery
EC	European Community
EMC	Electromagnetic compatibility
EU	European Union
HMI	Human-Machine Interface, plug-in hand-held operating unit
I	Incremental encoder
I/O	Inputs/Outputs
Inc	Increment
IT system	I: isolated T: terre System without potential to ground, not grounded
LED	Light-Emitting Diode
M	motor
PC	Personal Computer
PELV	Protective Extra-Low Voltage
PLC	Programmable Logic Controller
RC	Residual current
SM	Stepping motor

Product name

Abbreviation	Product designation	Term used
TL CT	Twin Line Control Tool	Operating software
TL HBC	Twin Line Holding Brake Controller	Holding brake controller
TL HMI	Twin Line HMI	HMI hand-held operating unit
TLC51x	Twin Line Controller 51x Standard unit	Positioning controller
TLC51xP	Twin Line Controller 51x Version P	Positioning controller protection class IP54, category 2

9844 1113 117, f107, 09.02

Technical Terms

Actual position of the drive system	The actual position of the drive system gives the absolute or relative positions of moving components in the system.
Actual position of the motor	See Angular position of the motor
Angular position of the motor	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.
CAN-C	Field bus module which couples the positioning controller to a CAN field bus. The selection of a field bus profile defines whether the device works with the CAN bus, CANOpen or DeviceNet protocol.
DC link	The DC link generates the necessary direct current for operating the motor and provides the amplifier with the necessary energy. The DC link acts as a buffer for energy fed back by the motor.
Default values	Preset values for the parameters of the Twin Line unit before initial commissioning, factory settings
Direction of rotation	Rotation of the motor shaft in a clockwise or anticlockwise direction. A clockwise direction of rotation is defined as the motor shaft rotating clockwise as the observer faces the end of the protruding shaft.
Drive solution	The drive solution comprises the drive system with the Twin Line Unit and motor with the system mechanics forming an integral part of the chain of motion.
Drive system	The drive system consists of the Twin Line Unit and the motor.
Electronic gear	An input speed is recalculated by the Twin Line unit using the values of an adjustable gear ratio to derive a new output speed for the motor movement.
Encoder	Sensor for recording the angular position of a rotating element. The encoder is mounted on the motor and signals the angular position of the rotor.
Error class	Response of the Twin Line unit to an operational malfunction corresponding to one of five error classes
ESIM3-C	Simulation module for output of positioning data as A/B signal to the external controller or the second TL module.
Forcing	To change signal states regardless of the hardware switching status in the unit; with the control tool, for example. The hardware signals remain unchanged.
High/open	Signal status of an input or output signal; when no signal is present, signal voltage is high (high level).
HMI	Hand-held operating unit which can be plugged into the Twin Line unit. HMI: Human Machine Interface. HMI: Human-machine interface
IBS-C	Field bus module which couples the positioning controller to an Interbus field bus.
Incremental encoder	See encoder
Incremental signals	Angular steps of an encoder in the form of square-wave pulse sequences. The pulses signal changes in position.
Index pulse	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.

9844 1113 117, f107, 09.02

Input device	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.
Internal units	Resolution of the power amplifier with which the motor is directed to the new setpoint. Internal units are given in increments
IOM-C	Analog module for sending analog and digital signals and for detecting external analog and digital voltage signals.
IT system	Power system with no ground potential reference, since it is not grounded. I: Isolation T: terre
I^2t monitoring	Predictive temperature monitoring. The expected temperature rise of unit components is calculated in advance on the basis of the motor current If a limit value is exceeded, the Twin Line unit reduces the unit current.
Limit switch	Switches that signal an overrun of the permissible travel range.
Low/open	Signal status of an input or output signal; when no signal is present, signal voltage is low (low level)
Module code	Internal electronic code (8 bit) which describes the hardware and the functionality of modules. This code is stored in an EEPROM in every module.
Node guarding	Monitoring function at the RS232 interface or the field bus interface
Optically isolated	Electrical transmission of signals with electrical isolation
Parameter	Device data and values that can be set by the user
PBDP-C	Field bus module with which the positioning controller can be integrated into a Profibus-DP network
Power controller	See Power amplifier
Power amplifier	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.
Pulse direction signals	Digital signals with variable pulse frequencies which signal changes in position and rotation direction via separate signal wires.
Quick-Stop	This function is used in the event of faults, the stop command or for fast braking of the motor in an emergency.
RS232 interface	The RS232 port is the communications interface of the Twin Line unit for connecting a PC or the HMI hand-held operating unit
RS422-C	RS422 rotary transducer module, module for connecting a rotary transducer for recording external encoder signals at RS422 level for motor positioning.
RS422 level	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-C	Field bus module which enables the field bus to be used over 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.
RS485 level	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.

9844 1113 117, f107, 09.02

Sense regulation 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.

SMART Operating system software of the positioning controller

User-defined units A user-defined unit corresponds to the maximum precision at which a distance, speed or acceleration value can be input.

Watchdog Device in the unit which detects internal faults. If a fault occurs, the Twin Line unit switches off the amplifier and outputs immediately.

Conventions and 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 results in a noticeable response from the unit, this will be described after the description of the action to be carried out. This will give you 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 "File" menu; 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 preceded by this symbol may have to be discussed in more detail with the local customer service.

9844 1113 117, f107, 09.02

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 for an update or repair.

Scope of supply positioning controller standard unit

The scope of supply of the TLC51x positioning controller includes:

Item	Qty.	Designation	Order no.
1	1	TLC511, TLC512	type code
2	1	Hood for front cover	-
3	1 or 2	SK 14 shielding terminal for motor connection (two shielding terminals in units without internal line filters)	6250 1101 400
4	1	Connector caps for the terminal strips	-
5	1	Documentation on the TLC51x on CD-ROM, multilingual	9844 1113 138

Modules

Option module configurations for the positioning controller:

Item	Qty.	Designation	Order no.
6	1	RS422-C encoder module or PULSE-C pulse/direction module or IOM-C analog module	type code
6	1	RM-C speed monitoring	type code
6	1	ESIM3-C module for encoder simulation	type code
6	1	PBDP-C, CAN-C, RS485-C or IBS-C field bus module	type code

Fig. 1-1 on page 1-2

9844 1113 117, f107, 09.02

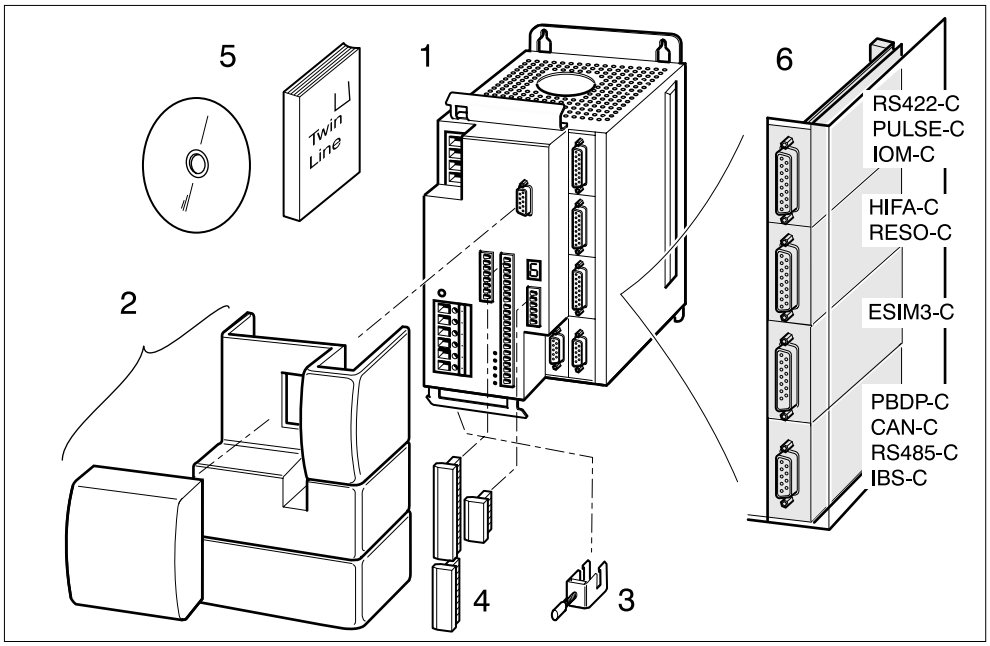


Fig. 1.1 TLC51x and modules

9844 1113 117, f107, 09.02

Scope of supply of positioning controller version P

The scope of supply of the TLC51xP positioning controller includes:

Item	Qty.	Designation	Order no.
1	1	TLC511P, TLC512P	type code
2	1	Power plug (round plug, 4-pin)	-
3	1	SK14 shielding terminal for motor connection	6250 1101 400
4	1	Sub-D cover for RS232 interface	-
5	1	Documentation on the TLC51x on CD-ROM, multilingual	9844 1113 138
-	1	integrated HBC holding brake controller (optional)	type code

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

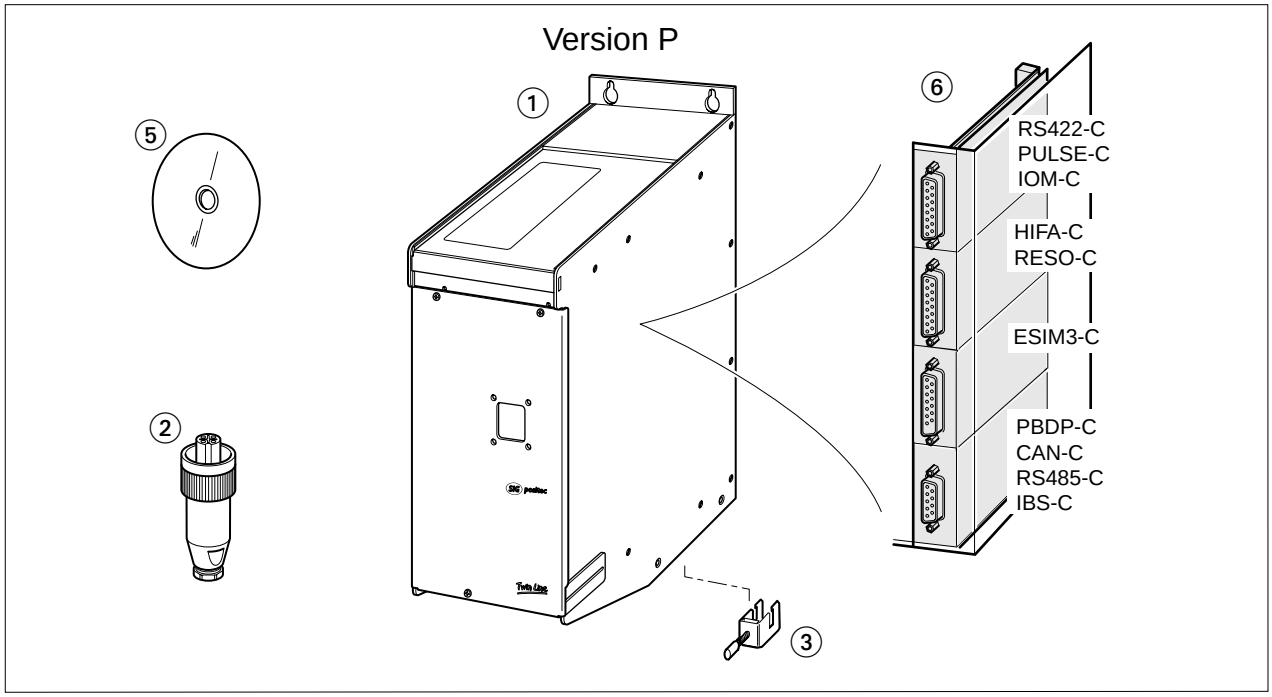


Fig. 1.2 TLC51xP and modules

9844 1113 117, f107, 09.02

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

Item	Qty.	Designation	Standard unit/ Version P (S/P)	Order no.
1	1	operating software with online documentation on data medium, multilingual	S/P	6250 1101 803
2	1	HMI hand-held operating unit 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 cables for RM-C module	S/P	6250 1440 xxx [1]
6	1	pulse direction cable for PULSE-C module encoder cables for RS422-C module, open at one end only cables for IOM-C module	S/P	6250 1447 yyy [2] 6250 1449 yyy [2] 6250 1452 xxx [1]
7	1	encoder cables for RS422-C module, plug at each end encoder cables for ESIM3-C module	S/P	6250 1448 yyy [2] 6250 1448 yyy [2]
8		field bus cables for modules CAN-C IBS-C RS485	S/P	 6250 1446 yyy [2] 6250 1451 yyy [2] 6250 1455 xxx [1]
-	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	TL HBC holding brake controller	S	6250 1101 606
11	1	External line filter for units without internal filters 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 Phoenix Contact type MBK terminals	P	6250 1102 200
13	1	set of 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, greater 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.

Fig. 1.3 and 1.4 on page 1-5.

9844 1113 117, f107, 09.02

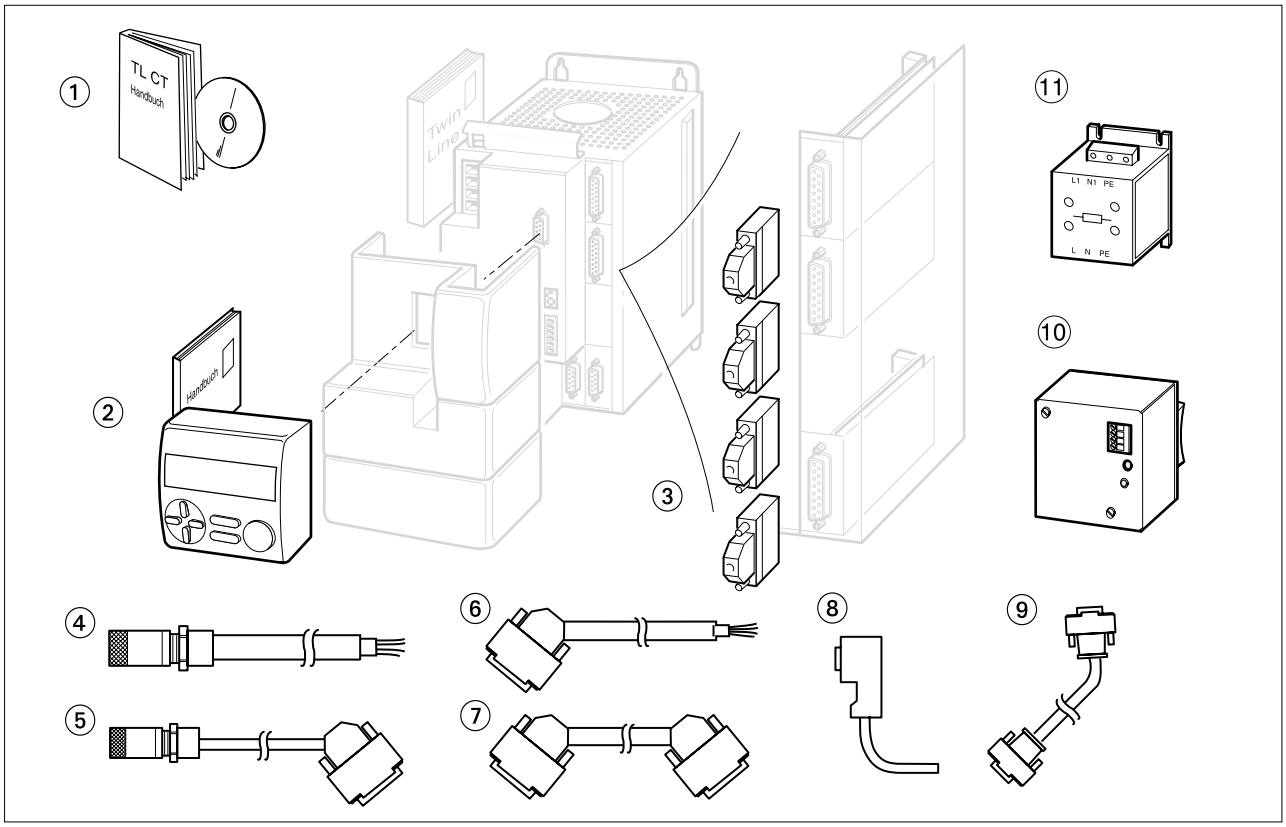


Fig. 1.3 Accessories for the TLC51x

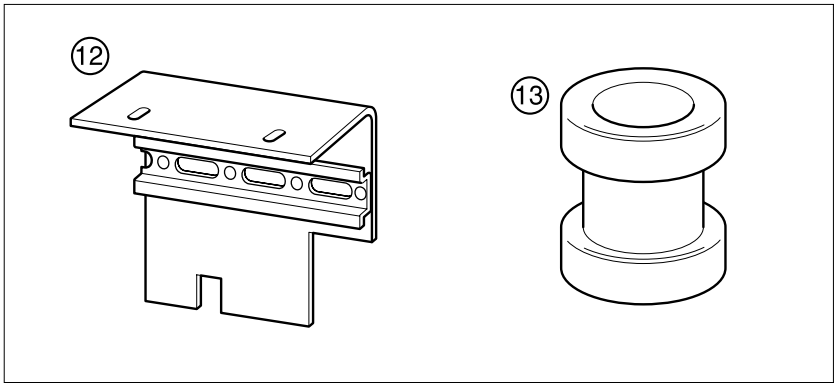


Fig. 1.4 Special accessories for the TLC51xP

9844 1113 117, f107, 09.02

1.2 Documentation and literature

Manuals for the positioning controller

Twin Line HMI, manual for the Human-Machine Interface HMI, English
Order no.: 9844 1113 091

Twin Line Control Tool, manual for the operating software, English
Order no.: 9844 1113 095

EMC

Installation notes and help for EMC-compliant installation of BERGER LAHR motor drives, order no.: 9844 1113 075

9844 1113 117, f107, 09.02

1.3 Unit series

The positioning controller TLC51x forms part of the 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 control positioning on a stepper motor and carry out positioning operations on its own.

The positioning controller is available with two power ratings in 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, as IP20, for use in a control cabinet
- version P, TLC51xP, with protection grade IP54, category 2 for use outside the control cabinet adjacent to the motor

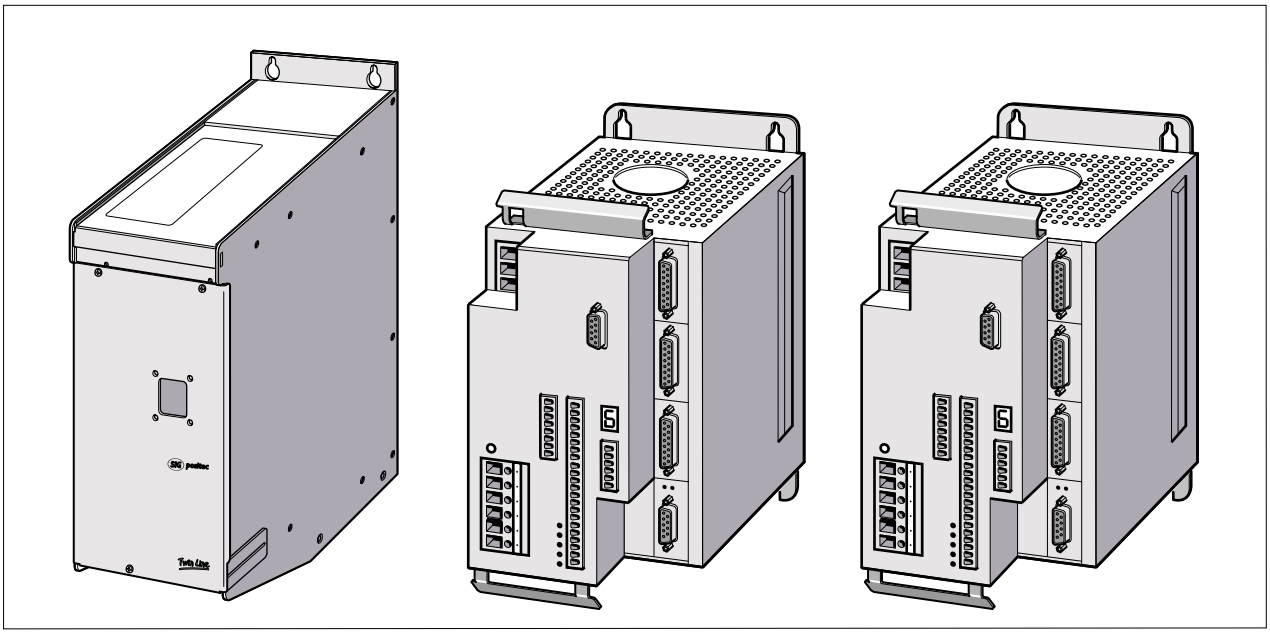


Fig. 1.5 Positioning controller TLC511P, TLC511 and TLC512

Type code There are two different name plates for the "standard unit" and "version P" versions.

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

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

9844 1113 117, f107, 09.02

Standard unit

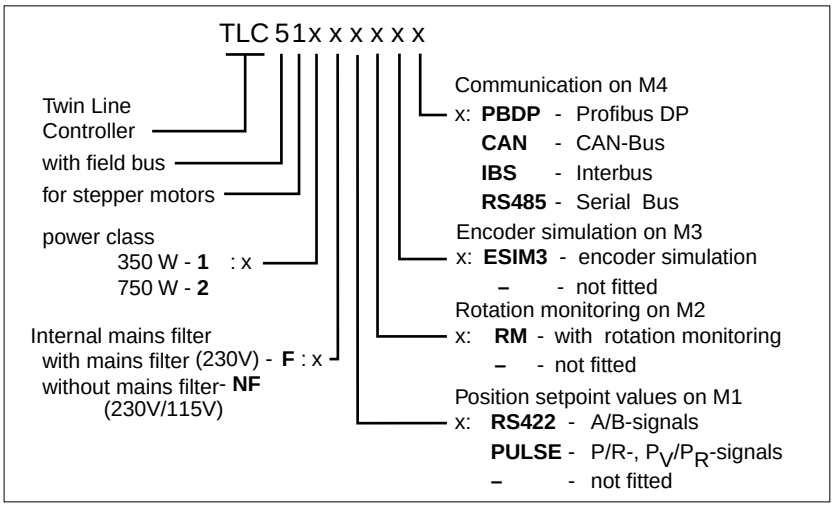


Fig. 1.6 Type code for the standard unit of the positioning controller TLC51x

The ESIM3-C encoder simulation module is only possible in connection with RM-C.

Version P

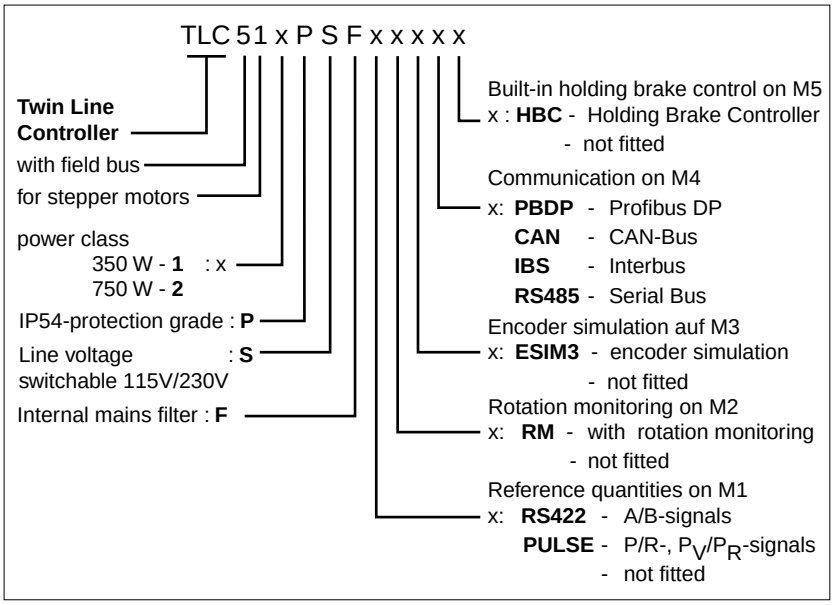


Fig. 1.7 Type code for version P of the positioning controller TLC51x

The ESIM3-C encoder simulation module is only possible in connection with RM-C.

The positioning controller is optionally available with built-in holding brake control.

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

9844 1113 117, f107, 09.02

1.4 Unit overview

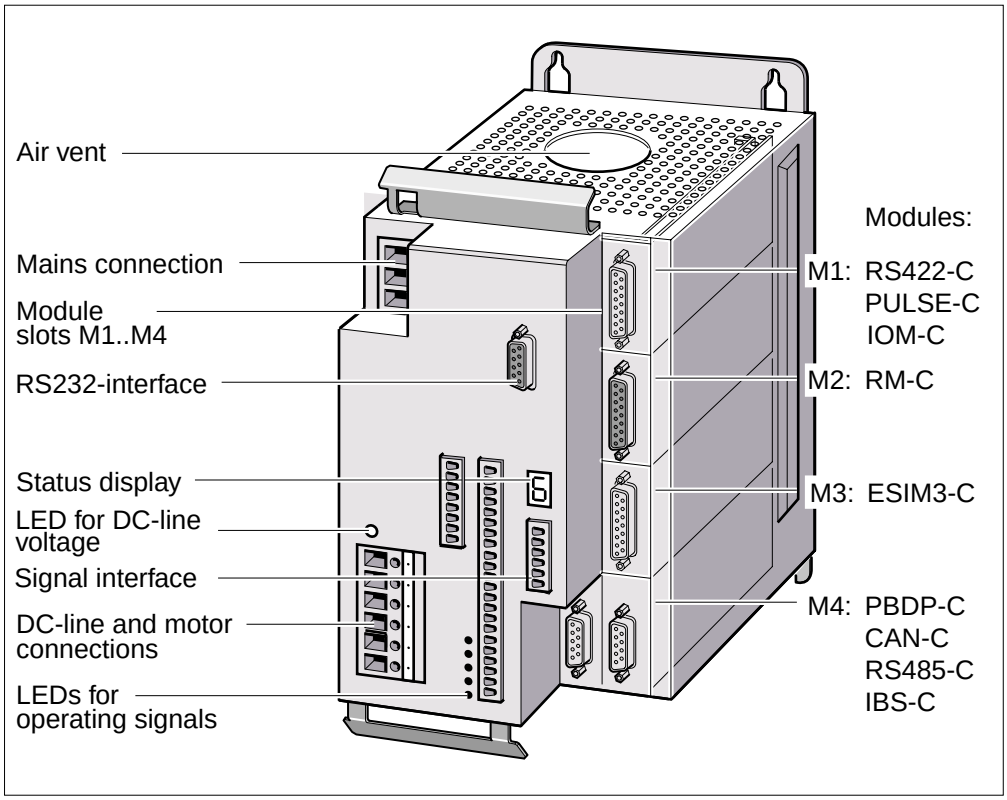


Fig. 1.8 Positioning controller TLC51x

Power connection The power supply for the amplifier is connected to the line power output: A position controller with a built-in line power filter can be operated without any further noise suppression on the supply side.

The power for control loops and for controlling the fan must be supplied by an external 24 V_{DC} power supply.

Motor connection The positioning controller supplies the power for a permanent-field AC synchronous servomotor over the three-phase connection. The motor connection is short-circuit protected and is checked for ground faults when the amplifier is enabled.

DC link connection The DC link voltage for the unit is taken from the intermediate circuit terminal. The capacity of the built-in DC-link capacitors at the DC-link connection can be increased with external capacitors for short-trm absorption of excess braking energy.

Status display A 7-segment display shows information about the operating status of the positioning controller. If there is an operating malfunction the display will flash and display an error code.

9844 1113 117, f107, 09.02

LED for DC link voltage The LED comes on when there is voltage in the DC link.

LEDs for operating signals Five LEDs display the signal states of these adjacent inputs: Positive and negative limit switches, motor stop signal, power amplifier enable and automatic operation.

Voltage selector switch The unit can be connected to 115 V or 230 V power with the voltage selector switch. The voltage selector switch is only available with units without line filters (NF option).

The voltage selector switch is always supplied with version P units.

Signal interfaces The input and output signals are routed via the signal interface and an external 24 V_{DC} supply voltage is fed 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 feeds cool air into the unit from below to cool the power amplifier and ballast resistor. It discharges the warmed air through the upper air 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 customized for your particular area of application. The minimum configuration required to drive an stepper motor is a module in slot M1. The other module slots offer additional functions for the positioning controller.

Configuration variants Several module variants can be selected at slots M1, M2 and M4. This allows the positioning controller to be set to a desired system configuration.

Slot	Functions when module fitted	Possible modules
M1	External setpoint signals for moving and positioning the motor Initializing and recording analog voltage signals	PULSE-C or RS422-C and IOM-C
M2	Actual position of an encoder for speed monitoring of the motor	RM-C
M3	Output of the change in the motor position as incremental signals, e. g. to control a slave drive	ESIM3-C
M4	Field bus module for integration 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

9844 1113 117, f107, 09.02

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, with the HMI hand-held operating unit or over the field bus.

Motor data set The motor data set is read in automatically at the start of commissioning and after a change of motors or is selected with the operating software.

Controller parameters The two controller parameter sets contain two independent controller settings. You can switch between sets via the signal interface or with a manual control unit. The parameter values of both sets are preset and can be optimized for operation in the system.

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.

9844 1113 117, f107, 09.02

1.5 Modules of the positioning controller

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

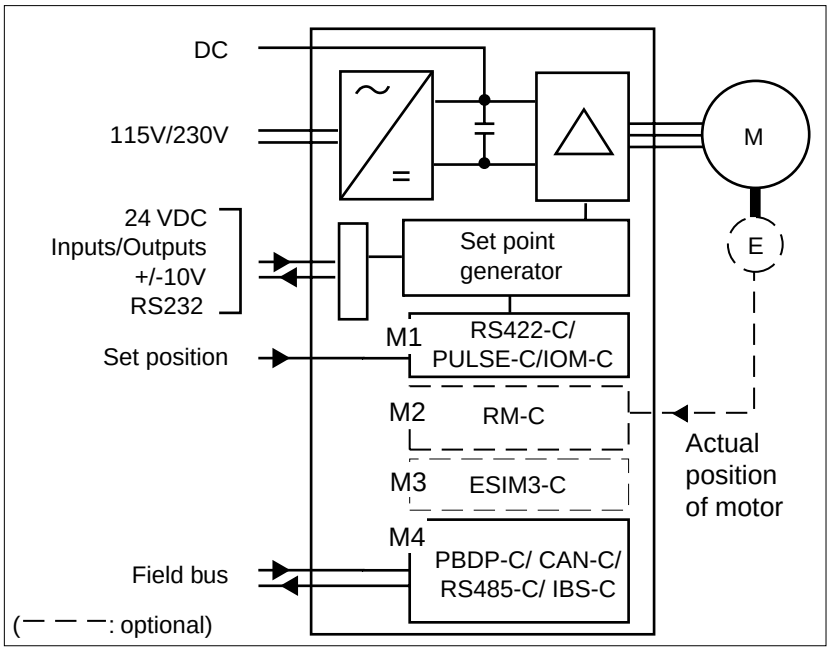


Fig. 1.9 Block diagram with modules and interface signals

PULSE-C module The PULSE-C pulse-direction module sends externally fed 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.

RS422-C module The RS422-C encoder module evaluates externally fed encoder signals as reference signals for positioning. The signals take the form of A/B signals from an encoder, from a higher-order controller or from the encoder simulation of a master positioning controller.

IOM-C module The analog module records and generates analog and digital voltage values.

RM-C module The positioning controller receives A/B signals for position monitoring of the stepper motor and a signal that checks the motor tempterature over the RM-C speed monitoring module. The encoder electronics in the motor receives the required operating power from the speed monitoring connection.

Speed monitoring is built into the system as an option.

ESIM3-C module The ESIM3-C encoder simulation module outputs the position data of the stepper motor as an A/B signal.

PBDP-C module The PBDP-C field bus module serves to integrate the positioning controller into the Profibus-DP field bus. The positioning controller operates as a command receiver or slave. It executes the control and work commands received from a higher-order controller.

9844 1113 117, f107, 09.02

CAN-C module The CAN-C field bus module couples the positioning controller to a CAN-C, CANOpen or DeviceNet field bus system.

IBS-C module The IBS-C field bus module allows the positioning controller to be used as a slave device in an Interbus network. The field bus module is optional. The module is designed to Interbus specification version 1.

RS485-C module 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, f107, 09.02

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
- oscillator mode

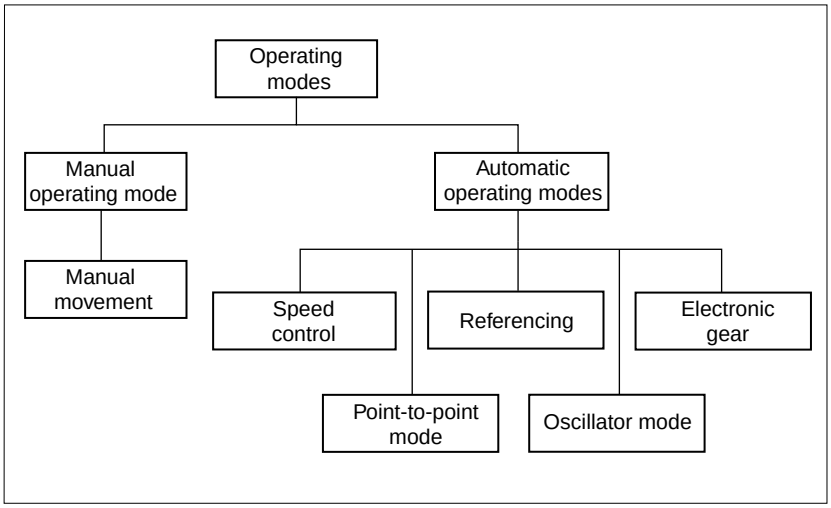


Fig. 1.10 Operating modes of the positioning controller TLC51x

The following table shows the modules required for each operating mode and possible configurations for additional functions.

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

9844 1113 117, f107, 09.02

Manual movement with position reference

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

Speed mode

In speed mode a setpoint speed is specified for the motor, and movement is initiated with no defined finishing point. 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 a positioning command. The positioning distance is given in absolute terms with reference to the zero point of the axis or in relative terms with reference to the current axis position.

Referencing

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

In a referencing movement a defined position on the axis, the zero or reference point, is targeted to establish the absolute scale reference of the motor position to the axis. The reference point is used as the point of reference for all subsequent absolute positioning operations.

Dimension setting allows the current motor position to be defined as the new axis reference point to which all subsequent position data relate.

Oscillator mode

In oscillator mode the motor is speed-controlled. The speed is set via the ±10V-input of the signal -interface.

Electronic gear

The electronic gear operating mode is used when one or more stepper motors are to follow the reference signal of a higher-order controller or an encoder and are run under position control.

The reference signals are fed in via the RS422-C encoder module or the PULSE-C pulse-direction module. A new position setpoint value is calculated from these signals with an adjustable gear factor.

Field bus mode

The positioning controller is principally operated in field bus mode with a module in slot M4. There are four modules available for field bus mode:

- 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 on a field bus in the relevant manuals.

9844 1113 117, f107, 09.02

List control

While the positioning controller is carrying out a movement command, the direction of movement is monitored in the background by list control. When a list position is reached, the positioning controllerresponds with the relevant event 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.

Entries can be made in the list with the HMI hand-held operating unit, the operating software or via the field bus.

Teach-in

The positioning controller offers Teach-In processing for entering the position values: Depending of the reference point, list positions are approached in succession and transferred to the parameter memory with a value for the trigger output or the speed.

9844 1113 117, f107, 09.02

1.7 Directives and standards

1.7.1 Declaration of conformity and CE mark

The EC directives 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 directives describe the main requirements for a product. The technical details are laid down in the harmonized standards, which are published in Germany as 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 mark

With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC-directives. The unit can be used anywhere in the world.

Machine Directive

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

Provided the rest of the machine complies with the machine directive and it has been set up in accordance with the EMC testing code of the manufacturer, conformity with the machine directive can be certified.

EMC Directive

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

The Twin Line unit’s compliance with the EMC Directive cannot be assessed until it has been installed into a machine or installation. The instructions provided in "Installation" must be complied with to guarantee that the Twin Line unit is EMC-compliant when fitted in the machine or installation and before use of the unit is permitted.

Low Voltage Directive

The EC Low-Voltage Directive (73/23/EEC) specifies safety requirements for "electrical apparatus" to reduce the risks that can originate in such devices and can arise in response to external influences.

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

- protection class 1
- contamination degree 2 (standard unit only)

Declaration of conformity

The declaration of conformity certifies that the device satisfies the requirements of the EC directive cited. A declaration of conformity in accordance with the EC low-voltage directive has been issued for the Twin Line unit.

9844 1113 117, f107, 09.02

EC Declaration of Conformity 2001

BERGER LAHR

BERGER LAHR GmbH & Co.KG
Breslauer Str. 7
D-77933 Lahr

☐ Machine Directive 98/37/EEC, Appendix IIA
☒ EMC Directive 89/336/EEC
☒ Low Voltage Directive 73/23/EEC
the above directives have been amended by the CE Marking Directive 93/68/EEC

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.

Designation:	3-phase motor amplifiers with/without electronic control and accessories
Type:	TLDx1x, TLCx1x, TLDx3x, TLCx3x, TLCx1xP, TLCx3xP, TLBRC, TLHBC
Product number:	634xxxxxxxx, 635xxxxxxxx, 62501101706, 62501101606,
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 test conditions 200.47-01 EN
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/Signature:	27.04.2001
Name/Department:	W. Brandstätter / MOM-E

Fig. 1.11 Conformity to the EC low-voltage directive

9844 1113 117, f107, 09.02

1.7.2 Regulations and standards

Standards concerning safe operation of the Twin Line units	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
Standards regarding compliance with EMC limiting values	EN 61000-4-1 (IEC 1000-4-1: 1992): Testing and measurement procedures, Section 1: Overview of noise suppression test procedures
	EN 61800-3: 1996 and prA11: 1999: Variable-speed electric drives

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

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.

Danger symbols are divided into three danger categories classified by how serious a danger is.. The symbols shown emphasize the danger situation to which the warning applies.

DANGER!
This indicates 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 notes

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 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-link terminals DC+ and DC-. The residual voltage must not exceed 48 V_{DC} before you start work on the connections. If additional DC-link capacitors are connected, the discharge period is increased to 10 minutes. Wait for this period and then measure the residual voltage.

9844 1113 117, f107, 09.02

2.3 Use for the purpose intended

2.3.1 Ambient conditions

	Transport 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
	(directions: X,Y,Z per pos. and neg. direction, total 6000)	
	Peak acceleration:	150m/s^2
TLC51x	Protection grade	IP20
	Ambient temperature	0°C to +50°C
	Relative humidity	15% to 85%
		(no condensation permissible)
TLC51xP	Protection grade	IP54, category 2
	Protection grade of internal cooling air duct	IP24 Ambient
	Ambient temperature	0°C to +45°C
	Relative humidity 15% to 85% (from serial number 1010020048 with protection against short-term condensation)	

Version P can be operated outside the switch cabinet, but not outside and not in environments with serious contamination (clogging of the fan).

9844 1113 117, f107, 09.02

2.3.2 Intended use

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

Only an AC stepper motor may be operated with the positioning controller. The motor must be approved by your local representative for operation with the unit.

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

Multiple units must not be connected in parallel over the DC-link output.

The positioning controller may be used for industrial applications in the system configuration described with a fixed connection only.

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 can be operated outside the switch cabinet, but not outside and not in environments with serious contamination (clogging of the fan).

The positioning controller may only be set up and operated after correct EMC installation. It may only be used with the cables and accessories specified by your local representative.

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.

9844 1113 117, f107, 09.02

2.4 Qualification of the personnel

Only personnel qualified as electrical technicians and controller technicians in accordance with IEV 826-09-01 (modified) and who are familiar with the contents of this manual are permitted to set parameters, commission and operate the TL unit. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

Qualified personnel can use their technical training, knowledge and experience to assess the work to be done and to recognize and avoid possible dangers or non-qualified personnel can have the same knowledge as qualified personnel after several years of work in the same area.

Qualified personnel must be familiar with the current standards, regulations and accident prevention regulations which have to 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	Task and protective functions
Limit switch signals	Monitoring the permissible ranges of movement to protect personnel and the system
Stop switch signal	Stops the drive with maximum braking energy and when it is stopped holds the motor stationary 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 functions
Short-circuit	Monitor the motor wiring for short circuit between the motor phases Functional safety and device protection
Overvoltage and undervoltage	Monitor DC link for overvoltage and undervoltage, functional safety and device protection
Temperature	Monitor motor and power amplifier [1)] with sensors for excess temperature, device protection
Speed error	With units with speed monitoring following error limit value if position deviation is too great, functional safety
Motor speed	Speed threshold for maximum permitted speed, device protection
Data connection with an operating unit	Functioning of connection when motor controlled via operating unit, functional safety

1) Motor monitoring only with devices with optional speed monitoring

9844 1113 117, f107, 09.02

3 Technical data

3.1 Mechanical data

3.1.1 Positioning controller TLC51x

Weight TLC511, TLC512 with 3 modules 2.7 kg

Device protection Protection grade to 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

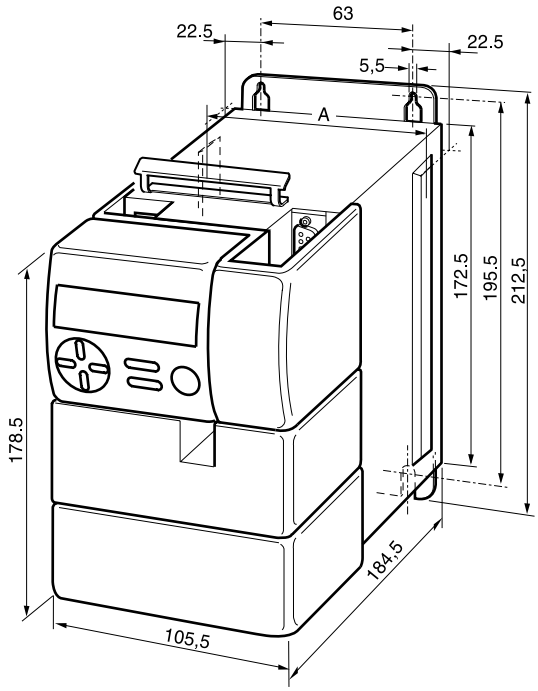


Fig. 3.1 Dimensions TLC511 and TLC512,
the HMI manual operating unit illustrated is optional.

9844 1113 117, f107, 09.02

3.1.2 Positioning controller TLC51xP

Weight	TLC511P SF with 3 modules	8 kg
	TLC512P SF with 3 modules	8 kg
Device protection	Protection grade to DIN EN 60529: 1991	IP 54, category 2

Dimensions

	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

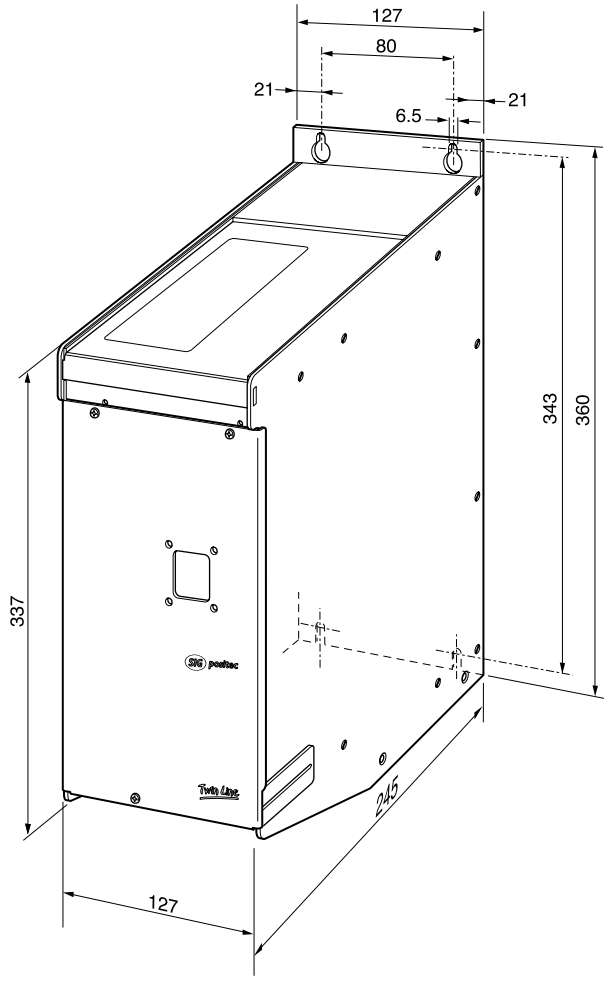


Fig. 3.2 Dimensions TLC51xP

9844 1113 117, f107, 09.02

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

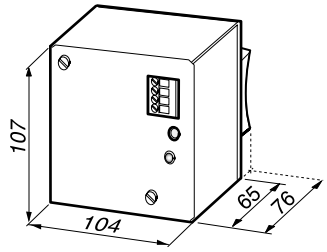


Fig. 3.3 Holding brake controller

9844 1113 117, f107, 09.02

3.2 Electronic data

3.2.1 Positioning controller

Line connection

	TLC511/TLC511P	TLC512/TLC512P
Line voltage [V_{AC}] only with TLC51xNF:	1 x 230 -20%/+15% 1 x 115 -20%/+15%	1 x 230 -20%/+15% 1 x 115 -20%/+15%
Line 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 cosφ	> 0.6	> 0.6
Power loss [W]	≤ 40	≤ 60
Line buffering [ms]	< 5	< 5
Overvoltage strength (DIN EN 61800-3)	Between phases: 1 kV, phases to ground: 1 kV	
Leakage current [1] [mA]	< 30	< 30
Fuse, external [A] / characteristics at 230 V at 115 V	 10 C, K or similar 10 C, K or similar	 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. Notes on using ground 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]	3	7
Max. speed [rpm]	3000	3000
Cable length [2] [m]	20	20
Cable cross-section [mm^2]	1.5	1.5

1) Max. electrical effective power of the unit at rated current and 115 V_{AC} or 230 V_{AC} line voltage
2) Longer cables on request

9844 1113 117, f107, 09.02

24 V_{DC} supply	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
Signal interface	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-proof
	DC voltage	≤ 30 V
	Switching current	≤ 400 mA
	Voltage drop at 400 mA	≤ 1 V
	Analog signal input	
	Voltage range	+10 V to -10 V
	Input resistance	5 kΩ
UL 508C certification	You will find the thresholds for UL 508C certification in the chapter entitled "UL 508C certification" from page 3-8.	

9844 1113 117, f107, 09.02

3.2.2 Modules

Note: You will find more detailed data on individual modules in the chapter entitled "Electrical installation" from page 4-10.

RS422-C encoder module	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
PULSE-C pulse/ direction module	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) motor current controller (PWM)	≤ 200 kHz 6 kHz to 25 kHz
	Step count	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
IOM-C analog module	Digital signal inputs	reverse-polarity-protected no electrical isolation debounced, debounce interval 0.7 ms 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 (50 mH) short-circuit-proof reverse-polarity-protected
	DC voltage	12 V to 30 V
	Blocking current	≤ 100 µA
	Voltage drop at 50 mA	≤ 2 V
	Analog signal inputs	
	Voltage range	+10 V to -10 V
	Input resistance	50 kΩ
	Analog signal outputs	
		short-circuit-proof reverse-polarity-protected
	Voltage range	+10 V to -10 V
	Output current	max. 5 mA
	Resolution	≥ 3800 steps
Encoder simulation module ESIM3-C	Signal outputs (A, B)	RS422-voltage-compatible Connected electrically to 24GND

9844 1113 117, f107, 09.02

RM-C speed monitoring	Signal inputs (A, B, I)	RS422-level connected electrically to 24VGND
	Input frequencies:	≤ 400 kHz 1.600 Inc/s
	Encoder pitch	1000 lines
	Output Encoder power supply (SENSE)	5 V ± 5%, ≤ 300 mA sense-controlled short-circuit and overload-proof
RS485-C module	Signal inputs/outputs	in accordance with the RS485 standard electrically isolated 4-wire interface
	Transmission rates	1200, 2400, 4800, 9600 19200, 38400 baud
PBDP-C module	Signal inputs/outputs	in accordance with the RS485 standard electrically isolated
	Transmission rate	≤ 12 Mbaud
CAN-C module	Signal inputs/outputs	level to ISO 11898 electrically isolated
	Transmission rate	≤ 1 Mbaud
IBS-C module	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.	
Version P *option holding brake controller*	Supply voltage, input Input current	20 V to 30 V input current = 0.5 A + brake current
	Output, brake Current atv24 V for 100 ms DC voltage	not short-circuit-proof max. 2.5 A 20 V to 30 V
	With voltage drop Continuous current DC voltage	 max. 1.25 A 9.5 V to 15 V

9844 1113 117, f107, 09.02

3.2.3 UL 508C certification

The positioning controller TLC51x is certified to UL 508C with the following data.

Line connection

Unit	Line voltage [V]	Line 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

TL HBC holding brake controller

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
Current 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

9844 1113 117, f107, 09.02

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 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 galvanized or chrome-plated mounting plates, make large contact surface connections for metal parts, remove paint from contact surfaces	Good conductivity due to two-dimensional contacts
Ground the control cabinet, door and mounting plate with metal tapes or cables with a cross section area 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
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

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 of 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 - Power and motor cables - Line filter input and output cables	Reduction of mutual interference, reduction of emissions, increasing resistance to interference
Connect large surface areas of cable shields, use cable clamps 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	Preventing interference on control cables, reduction of emissions
Shield analog signal lines at one end only at the power controller, at the other end via capacitor, e.g. 10 nF/100V MKT	Preventing ripple loops due to low-frequency interference

9844 1113 117, f107, 09.02

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. Use motor and encoder cables recommended by your local representative.	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

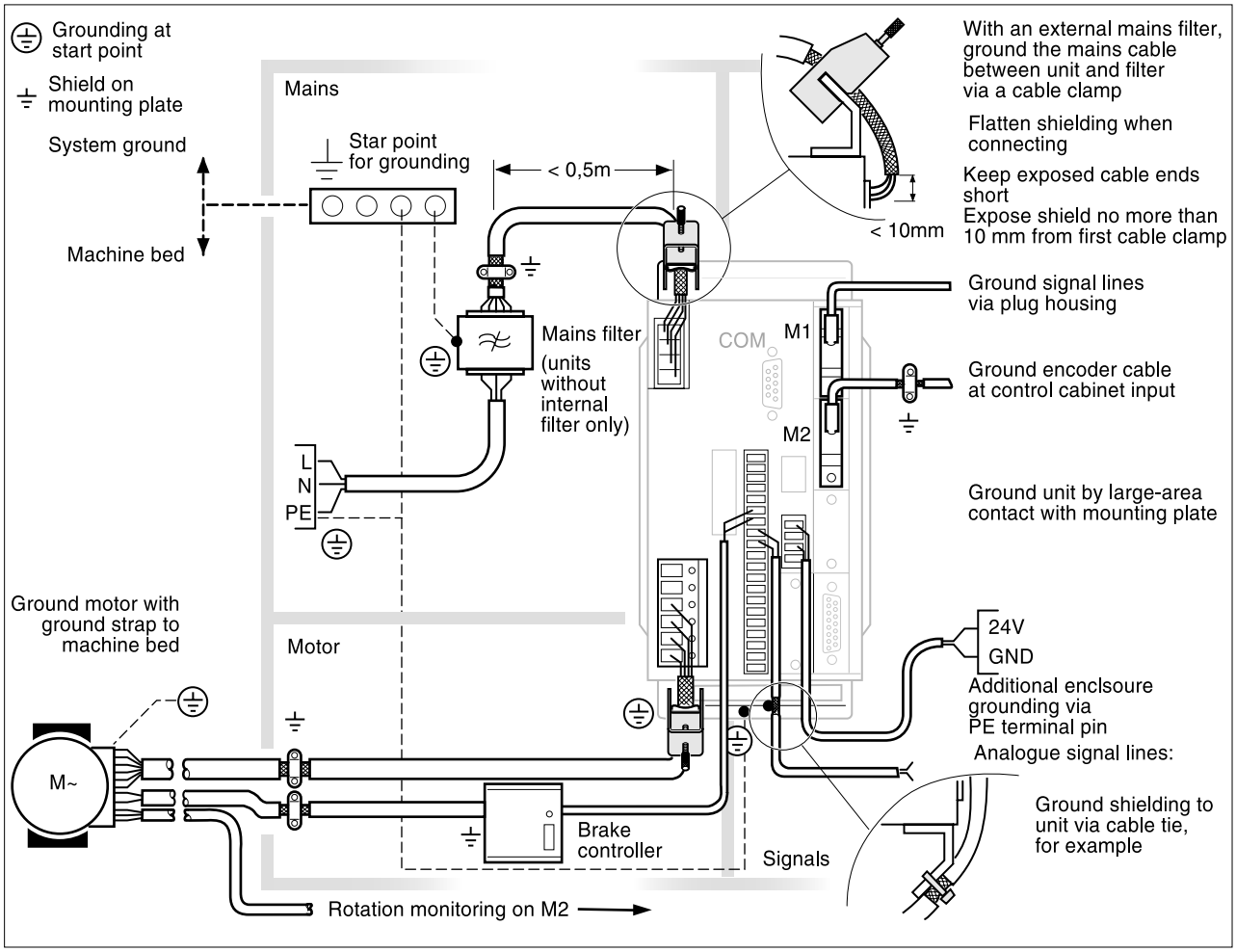


Fig. 4.1 EMC measures and subdivisions of the control cabinet

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.

9844 1113 117, f107, 09.02

Motor leads and encoder cables are especially critical signal circuits. Use the cables recommended by your local agent. They are tested for EMC safety. These cables can also be used as trailing cables.

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

9844 1113 117, f107, 09.02

4.2 System components

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

- three-phase stepper motor
- motor cable
- signal cable to fit device version:

  RS422-C module: encoder cable for RS422-C
  PULSE-C module: pulse direction cable for PULSE-C
  IOM-C module: cables for IOM-C
  RM-C module (optional): encoder cable for RM-C
  ESIM3-C module encoder cable for ESIM3-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 connection plug
- line cable and line fuses
- external power supply, 24 V_{DC} with safe separation - PELV
- external line filter for units with no built-in line filter
- additional filters and chokes for line 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 the operating software

9844 1113 117, f107, 09.02

4.3 Mechanical installation

Before installation...

▶ Check the unit for external 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
During installation ensure 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 damage the unit through short-circuits.

4.3.1 Installing the positioning controller TLC51x

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 through the switch cabinet ventilation.

Installation clearances

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 neighboring units or walls.

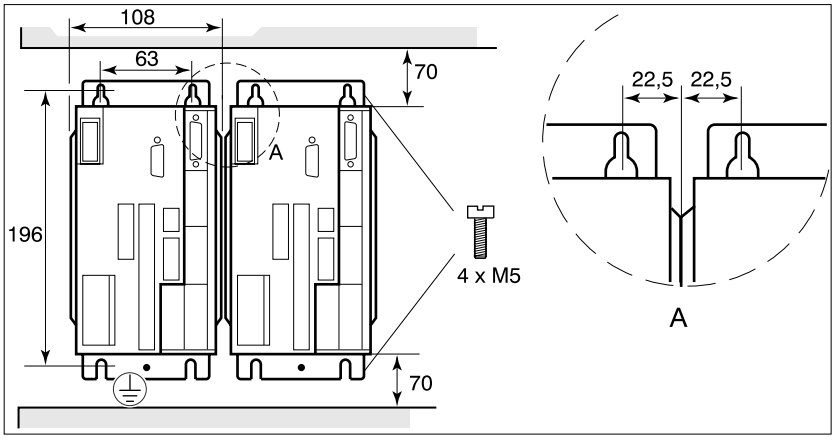


Fig. 4.2 Installation clearances, dimensions in mm

▶ 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 power connection at the top.

▶ Fasten the unit to a galvanized metal plate. The back wall of the unit must have good contact with the metal plate across its whole surface area.

9844 1113 117, f107, 09.02

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 Installing the positioning controller TLC51xP

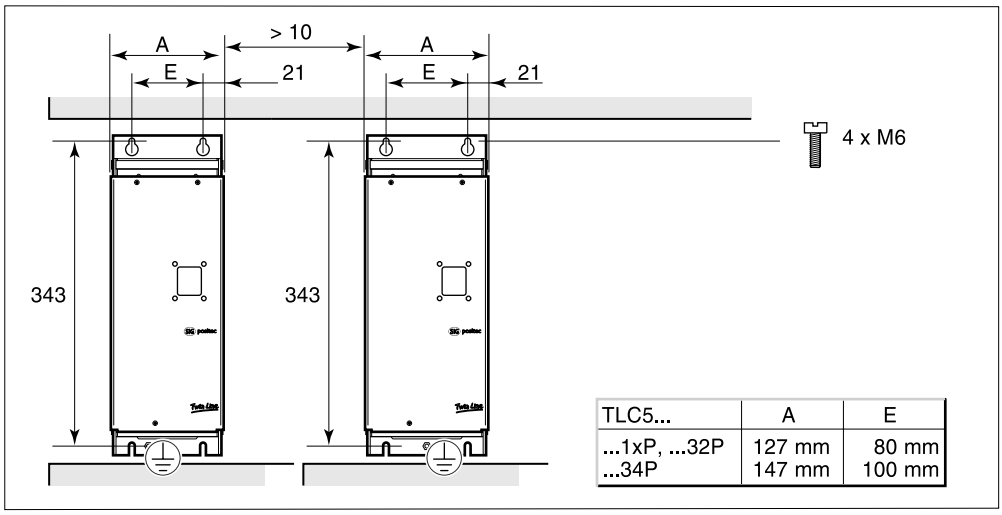
Installation clearances

Version P units must be installed at a minimum distance of 10 mm from neighboring devices.

Positioning controller connections are routed from the bottom of the housing. There must be 20 centimeters of space under the unit 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 to maintain its water protection grade.



TLC5...	A	E
...1xP, ...32P	127 mm	80 mm
...34P	147 mm	100 mm

Fig. 4.3 Installation clearances, dimensions in mm

9844 1113 117, f107, 09.02

4.3.3 Fitting the unit label

The unit label provides 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 for copying is provided in section "Unit label", page 11-1.

TLC51x

▶ Attach the unit label inside the hood of the Twin Line unit on the side where the signal plugs are connected.

▶ After the electrical installation has been completed and the unit hood installed, the cables for connection to power 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.

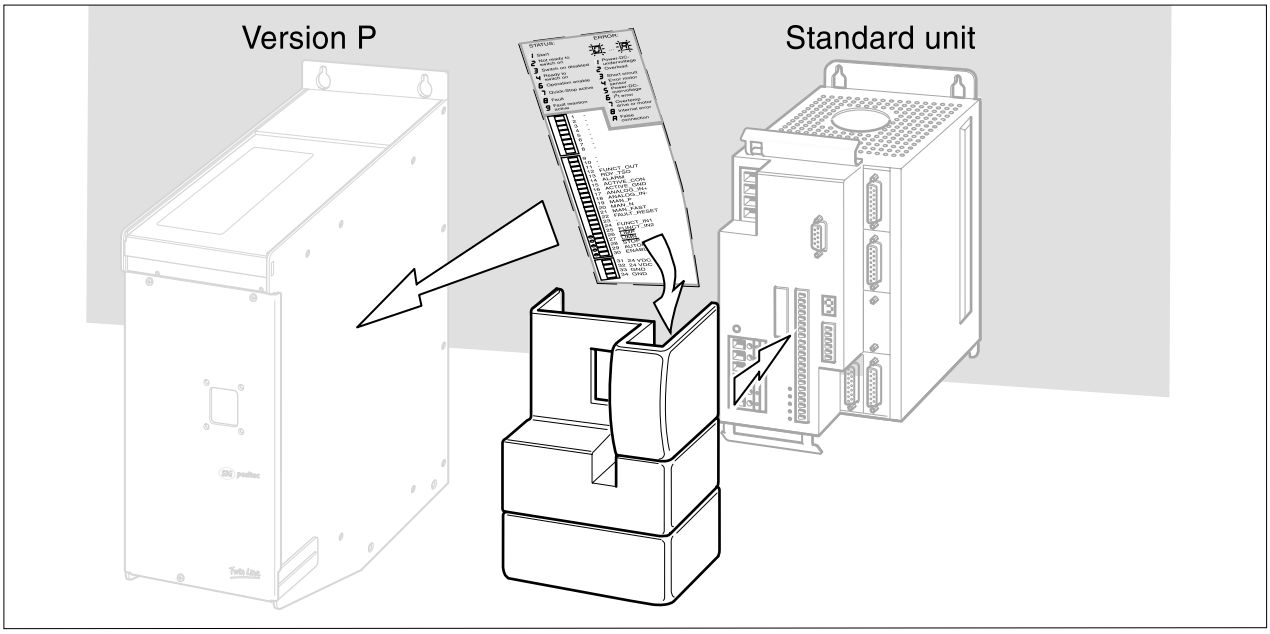


Fig. 4.4 Stick the unit label in the side of the hood or to the side of the Twin Line unit

9844 1113 117, f107, 09.02

4.3.4 Installing accessories to the standard unit

Line filter

The position controller is supplied with a built-in line filter as standard. A special version of the unit can also be ordered without a line filter.

An external line filter is required for a standard unit without a built-in line filter. The user must ensure that the EMC directives are observed in this case.

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

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

- "F": with line filter, e.g. TLC51x F
- "NF": without line filter, e.g. TLC51x NF

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

▶ Fit the line filter near the mains connection and on the same mounting plate. The length of the cable to the positioning controller must not exceed 50 cm. **The cable must be shielded and the shield must be grounded at both ends.**

9844 1113 117, f107, 09.02

4.3.5 Installing version P accessories

Terminal angle Version P offers a terminal angle as an accessory 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.

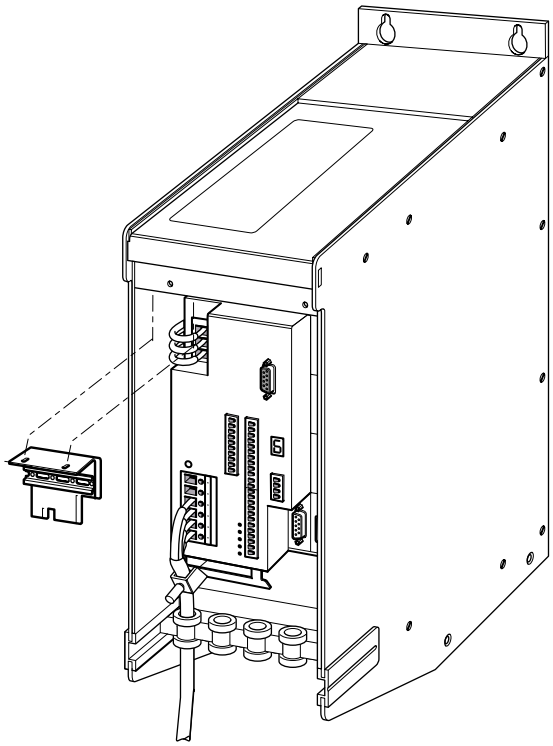


Fig. 4.5 Connection of terminal angle

9844 1113 117, f107, 09.02

4.4 Electrical installation

WARNING!
Malfunctions and danger of injury arising from interference with other units!
Connect the unit correctly to meet EMC requirements. 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 neighboring 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.

Only qualified electrical technicians may install the positioning controller and other components and connect them to the power supply.

9844 1113 117, f107, 09.02

4.4.1 Electrical installation TLC51xP

Most of the electrical connections for TLC51xP units 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
- power connection via circular power plug

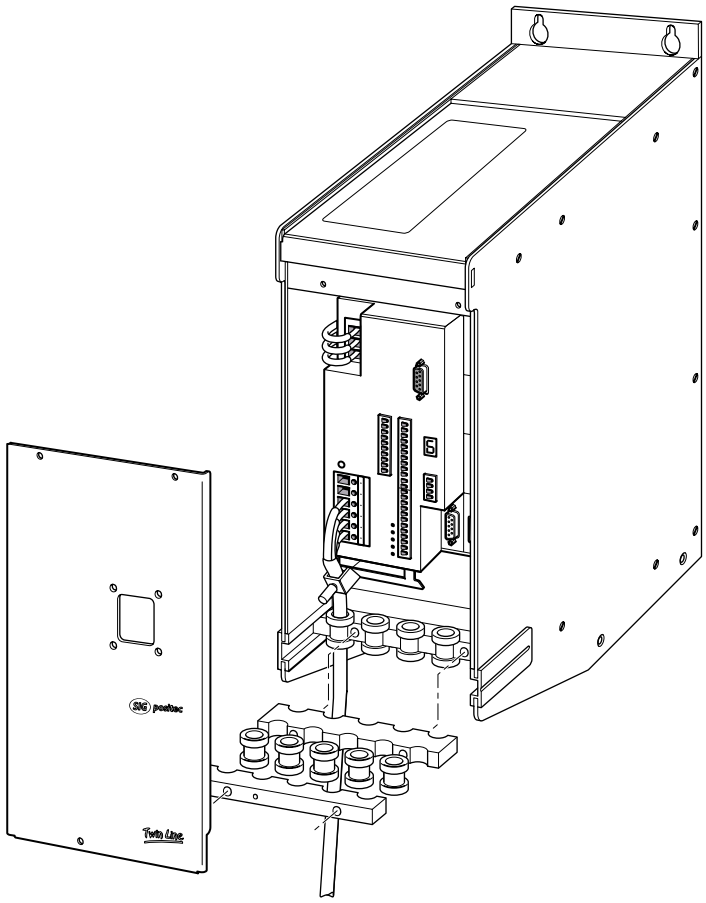


Fig. 4.6 Connection example for the TLC51xP unit

▶ 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

9844 1113 117, f107, 09.02

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 to ensure that they are sealed and not subject to tension.
- ▶ Mount the grommets as shown in Fig. 4.6.
- ▶ Ground the unit at the grounding point at the back of the unit near the bottom. Connect them to the system ground 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.

9844 1113 117, f107, 09.02

4.4.2 Line connection

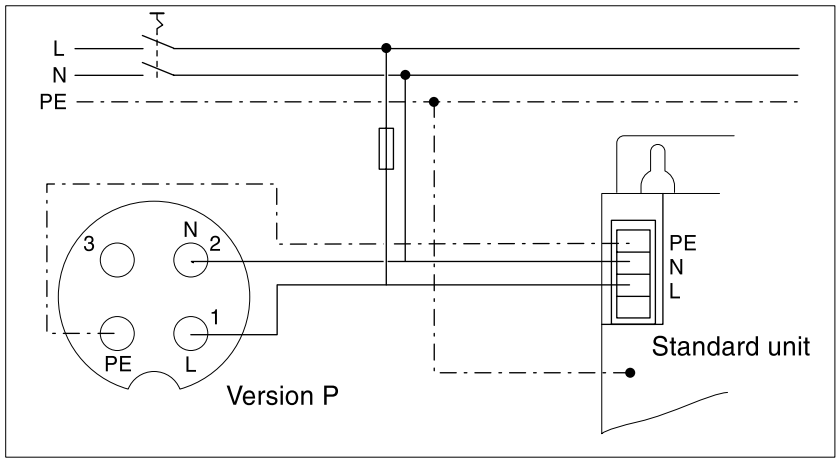


Fig. 4.7 Line connection for single-phase units

Standard unit

▶ In the case of the single-phase unit, connect the power cables to screw terminals PE, N and L

- The correct torque for the terminal screws is 0.4 Nm - 0.5 Nm.
- For units without a line filter, any power cable over 20 cm in length must be shielded between the filter and the unit terminals and grounded at both ends.
- For units with a hood, the cable must be led upwards from the point of connection.

Version P

▶ Connect the power cable to the power plug using terminals 1, 2 and PE.

▶ Do not use a plug for a three-phase unit instead of one for single-phase units. The unit can be permanently damaged.

Both versions

- The connection cross-section for the power cables is 1.5 to 2.5 mm^2.
- Fit a fuse in the power phase: for a 230 V connection: 10 A (C, K characteristic or similar).
- The additional PE terminal must be connected to the housing because of the high leakage currents.

Wire end ferrules

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

- Do not use end ferrules with a plastic collar on wires with a cable cross-section of 2.5 mm^2.
- Only use square end ferrules to ensure that they do not work loose.
- Strip the insulation from the cable to a length of 10 mm.

Ground leakage circuit-breaker

If a fault occurs, fault currents with DC component may occur. For single-phase units, an e.l.c.b. for fault currents with a pulsating DC component can be fitted.

9844 1113 117, f107, 09.02

4.4.3 Motor connection TLC51x

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. During installation ensure that the motor cannot be driven by another device.

Connecting motor wires

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

Terminal	Connection	Color
U	Motor cable	brown (bn)
V	Motor cable	blue (bl)
W	Motor cable	black (bk)
PE	protective conductor (shield tracer wire)	-

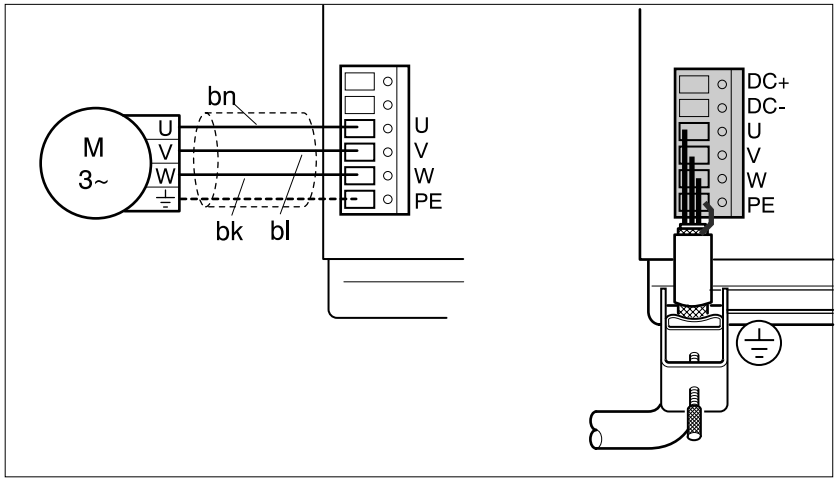


Fig. 4.8 Connection of the motor cable at the motor, plug on motor as seen from outside

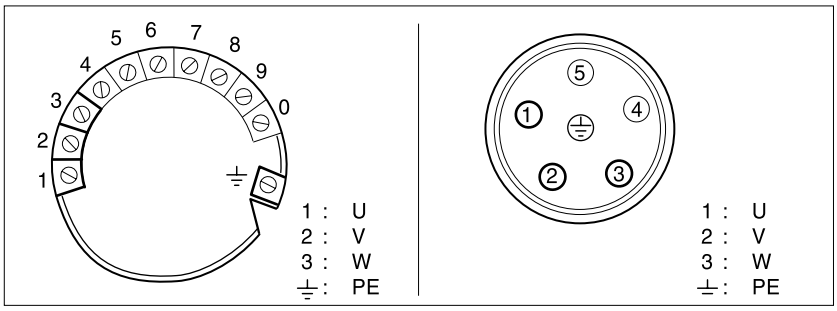


Fig. 4.9 Connection of the motor cable at the motor, plug on motor as seen from outside

9844 1113 117, f107, 09.02

- cable cross-section: 1.5 mm^2
- maximum cable length: 20 m
- The correct 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 led downwards from the point of connection.
- For the PE connection you must use the shield filler wire.

Preparing the motor cable Standard unit

Note the dimensions shown when preparing the motor cable for connection to the standard unit.

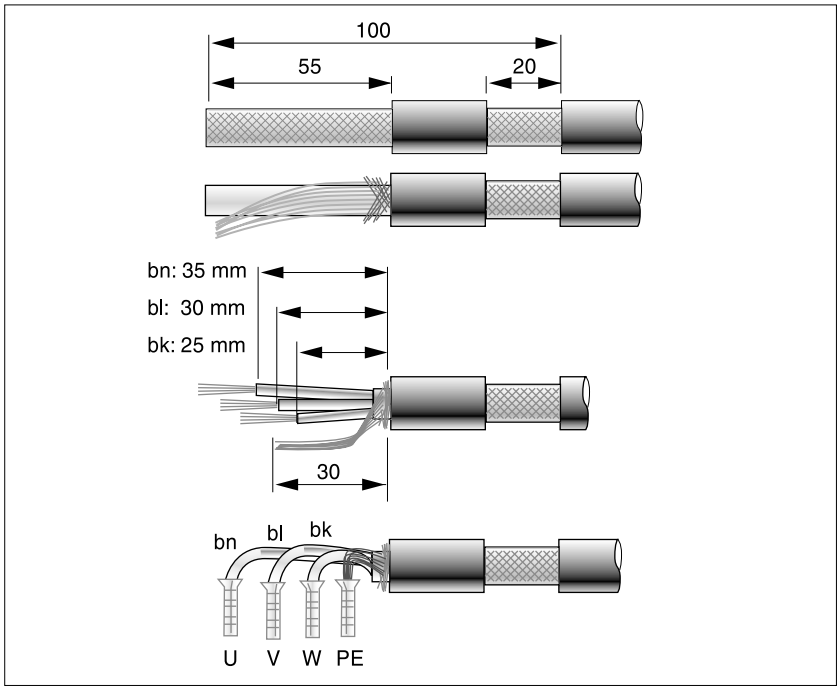


Fig. 4.10 Preparing the motor cable for the standard version.

For more information see section "Connecting accessories to the standard unit" at page 4-47.

9844 1113 117, f107, 09.02

Preparing the motor cable Version P with holding brake

Note the dimensions shown when preparing the motor cable for connection to version P with integrated holding brake control. If no holding brake is integrated use the dimensions for the standard unit.

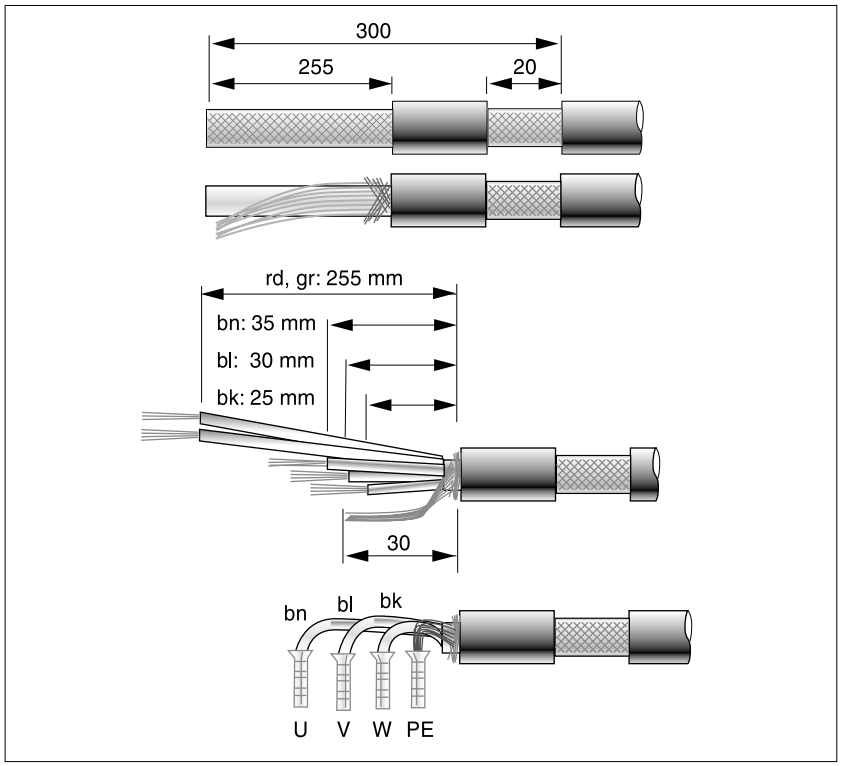


Fig. 4.11 Preparing the motor cable for version P with integrated holding brake

Wire end ferrules

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

- Only use square end ferrules to ensure that they do not work loose.
- Do not use end ferrules with a plastic collar on wires with a cable cross-section of 2.5 mm^2.
- 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.
- Where possible motor cables and signal wiring must laid at least 20 cm apart; if they are laid closer together, motor cables and signal wiring must be shielded with grounded plates.

9844 1113 117, f107, 09.02

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. During installation ensure 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.

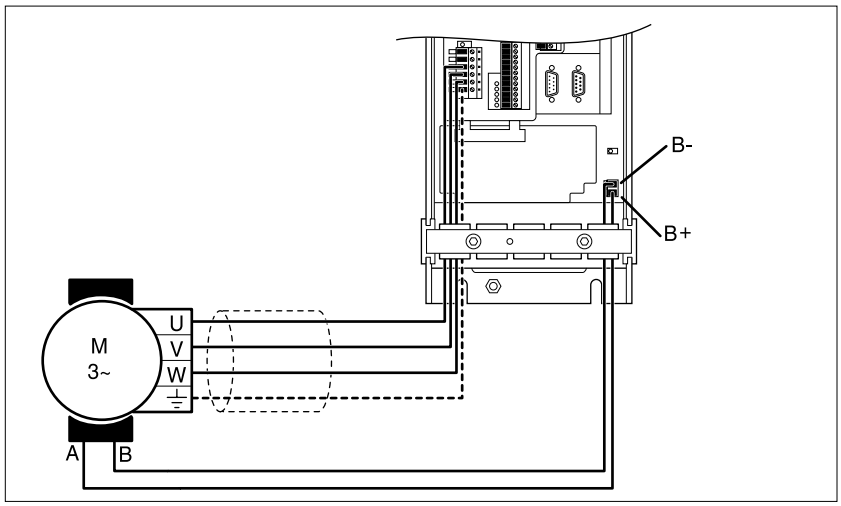


Fig. 4.12 Connecting the motor cable and holding brake controls to the unit

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 4-14.

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

▶ Connect the control connections to the holding brake terminals B+ and B-.

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]

The voltage reduction function is described in the chapter entitled "Braking function with TL HBC" from page 7-32.

9844 1113 117, f107, 09.02

4.4.5 Connecting the 24 V supply voltage

▶ Route the 24 V wires to the unit over a grounded 24 V_{DC} transformer (PELV).

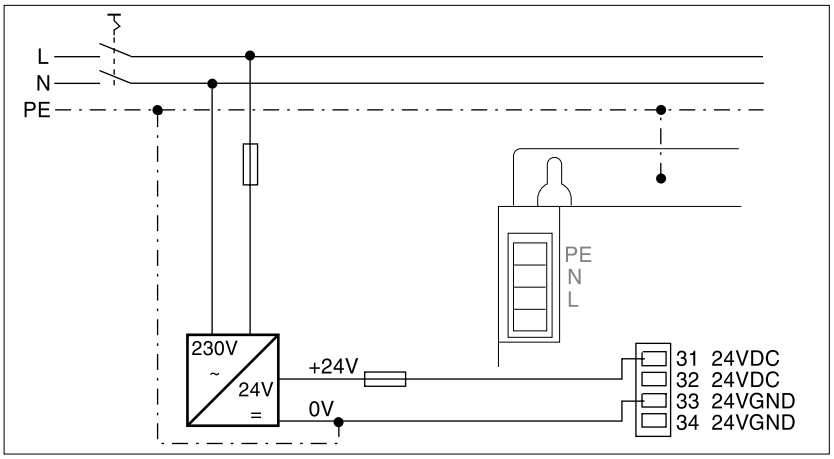


Fig. 4.13 24 V connection

Pin	Signal	Active	Meaning	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 for 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 motor retains its position when the power is off, the external 24 V power supply must remain on and no external torque may be applied to the motor.
- Lay the 24 V supply line at a distance of at least 20 cm from other lines to ensure EMC protection. For wiring longer than 2 m, make a twisted pair of the 0 V and 24 V supply wires.
- The torque for terminal screws 1-34 is 0.22 Nm to 0.25 Nm.

Version P

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

9844 1113 117, f107, 09.02

4.4.6 Connection to the signal interface

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

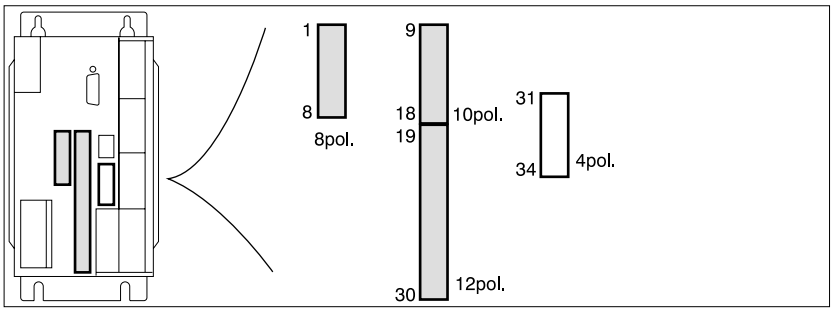


Fig. 4.14 Signal interface: 1-30: inputs/outputs, 31-34: 24 V connection

Connection

▶ The connections of the signal interface should be wired up as required by the selected operating mode. See also the wiring examples starting on page 4-49.

▶ 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

Disable "Settings.SignEnabl", see page 7-13.

The terminal blocks of the signal interface may 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.

- "IO_mode" = "0": Input signals are used to set address and baud rate in field bus mode.
  This is the preset for 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 and output signals are permanently assigned.

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

9844 1113 117, f107, 09.02

Pin	Signal at IO_mode=0/1	Signal at IO_mode=2	Active	Meaning	I/O
1	ADR_1/I_8	DATA_1	high	ADR_1: Bit0 for network address DATA_1: Bit0 for selecting a list number	I
2	ADR_2 / I_9	DATA_2	high	ADR_2: Bit1 for network address DATA_2: Bit1 for selecting a list number	I
3	ADR_4/I_10	DATA_4	high	ADR_4: Bit2 for network address DATA_4: Bit2 for selecting a list number	I
4	ADR_8/I_11	DATA_8	high	ADR_8: Bit3 for network address DATA_8: Bit3 for selecting a list number	I
5	ADR_16/I_12	DATA_16	high	ADR_16: Bit4 for network address DATA_16: Bit4 for selecting a list number	I
6	ADR_32/I_13	DATA_32	high	ADR_32: Bit5 for network address DATA_32: Bit5 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: Acknowledgement signal at AUTOM signal	O
10	Q_1 / Q_1	AXIS_ADD_INFO	high	AXIS_ADD_INFO: Supplementary info on current movement job	O
11	Q_2 / Q_2	AXIS_END	high	AXIS_END: End of processing of a movement job, drive at standstill	O
12	Q_3 / Q_3	AXIS_ERR	high	AXIS_ERR: Error detection during a movement job	O
13	Q_4 / Q_4	RDY_TSO/Q4	high	RDY_TSO: Ready for operation, active in operating status 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 on 24VGND [1)]	O
17	⇒	ANALOG_IN+	-	Analog control input ±10 V	I
18	⇒	ANALOG_IN-	-	Analog control input 0 V, reference potential to pin 17 ANALOG_IN+	I
19	BAUD_1/I_0	MAN_P	high	BAUD_1: Bit0 for setting the baud rate MAN_P: manual movement clockwise motor rotation	I
20	BAUD_2/I_1	MAN_N	high	BAUD_2: Bit1 for setting the baud rate MAN_N: manual movement anticlockwise motor rotation	I
21	BAUD_4/I_2	MAN_FAST	high	BAUD_4: Bit2 for setting the baud rate MAN_FAST: Manual selection slow or fast	I
22	CAPTURE1 or I_5	FAULT_RESET	high	CAPTURE1: Fast input for exact capture of current position data FAULT_RESET: Resetting error messages	I
23	⇒	CAPTURE2 or I_6	high	CAPTURE2: Fast input for exact capture of current position data	I
24	ADR_64/I_7	TEACH_IN	high	ADR_64: Bit6 for the network addressTEACH_IN: Trigger signal for saving the current setpoint position in the list data memory	I
25	⇒	$\overline{\text{REF}}$	low [2)]	reference switch signal	I
26	⇒	$\overline{\text{LIMP}}$	low [2)]	limit switch signal clockwise motor rotation	I
27	⇒	$\overline{\text{LIMN}}$	low [2)]	limit switch signal anticlockwise motor rotation	I
28	⇒	$\overline{\text{STOP}}$	low [2)]	stop motor	I

9844 1113 117, f107, 09.02

Pin	Signal at IO_mode=0/1	Signal at IO_mode=2	Active	Meaning	I/O
29	MODE_2/I_4	AUTOM	high	MODE_2: Bit1 for setting the field bus profileAUTOM: Automatic mode (high) or manual mode (low), acknowledged by AUTOM_ACK	I
30	MODE_1/I_3	ENABLE	high	MODE_1: Bit0 for setting field bus profile ENABLE: Enable (high) or lock (low) power amplifier	I

1) Version P: Holding brake connection hard wired.
2) Signal level for default setting of 'Settings.SignEnabl' and 'Settings.SignLevel' parameters

Minimum interface assignment

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 mm^2, max. cross-section 1.5 mm^2
- maximum length with minimum cross-section 15 m

Function

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

The signal interface is primarily designed for field bus mode. Signal inputs such as MAN_N, MAN_P or AUTOM and outputs such as AXIS_ERR, AXIS_END or AUTOM_ACK are not required here. In field bus mode these signals are changed and evaluated using receive and send data.

The signal interface can operate in three pin assignment modes:

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

Pin assignment can be changed with the parameter "Settings.IO_mode", see "Changing the operating mode", page 6-1.

9844 1113 117, f107, 09.02

Setting address and baud rate in field bus mode

Condition: Parameter "Settings.IO_mode"=0:

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

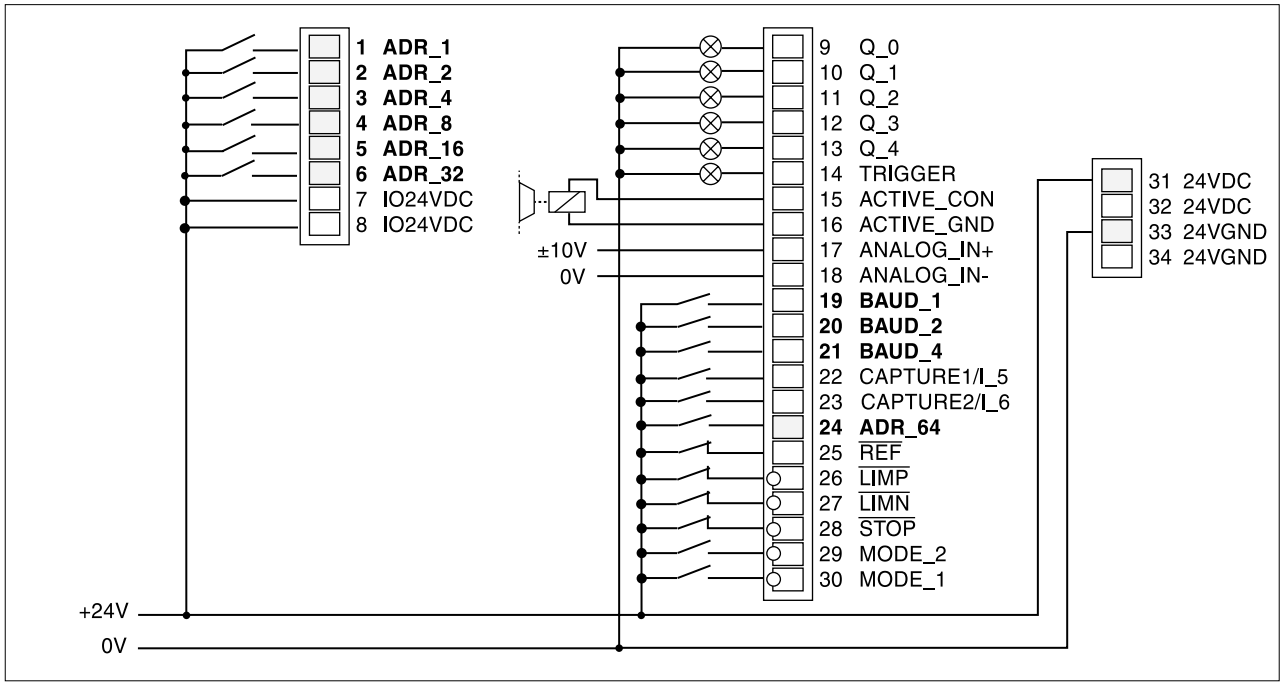


Fig. 4.15 Signal interface inputs for field bus addressing

9844 1113 117, f107, 09.02

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

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-C 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 profile	0	1
DeviceNet profile	1	0

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

9844 1113 117, f107, 09.02

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 field bus commands.

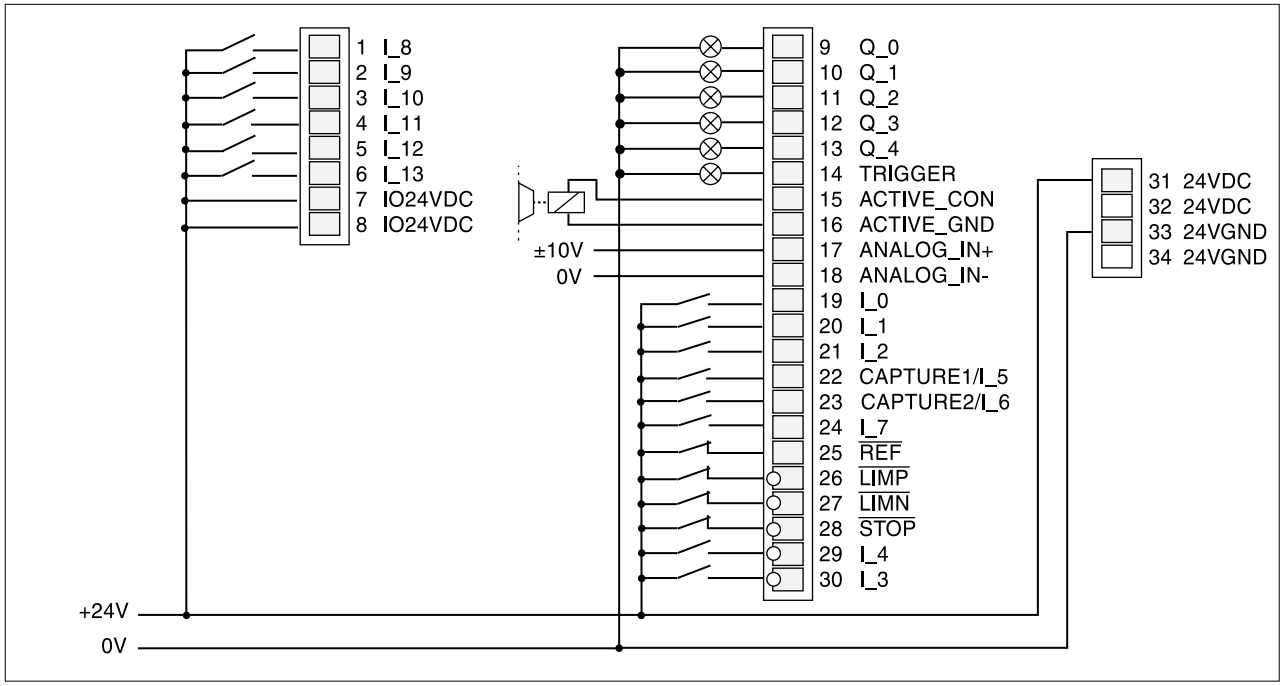


Fig. 4.16 Signal interface inputs and outputs for free assignment

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

- read input signals with the "I/O.IW1_act" parameter
- write output signals with the "I/O.QW0_act" parameter

For more detailed information see "Testing inputs and outputs" on page 5-17.

9844 1113 117, f107, 09.02

Fixed assignment of interface

Parameter "Settings.IO_mode"=2:

With fixed assignments control and switching signals for manual mode and teach-in are available on the signal interface.

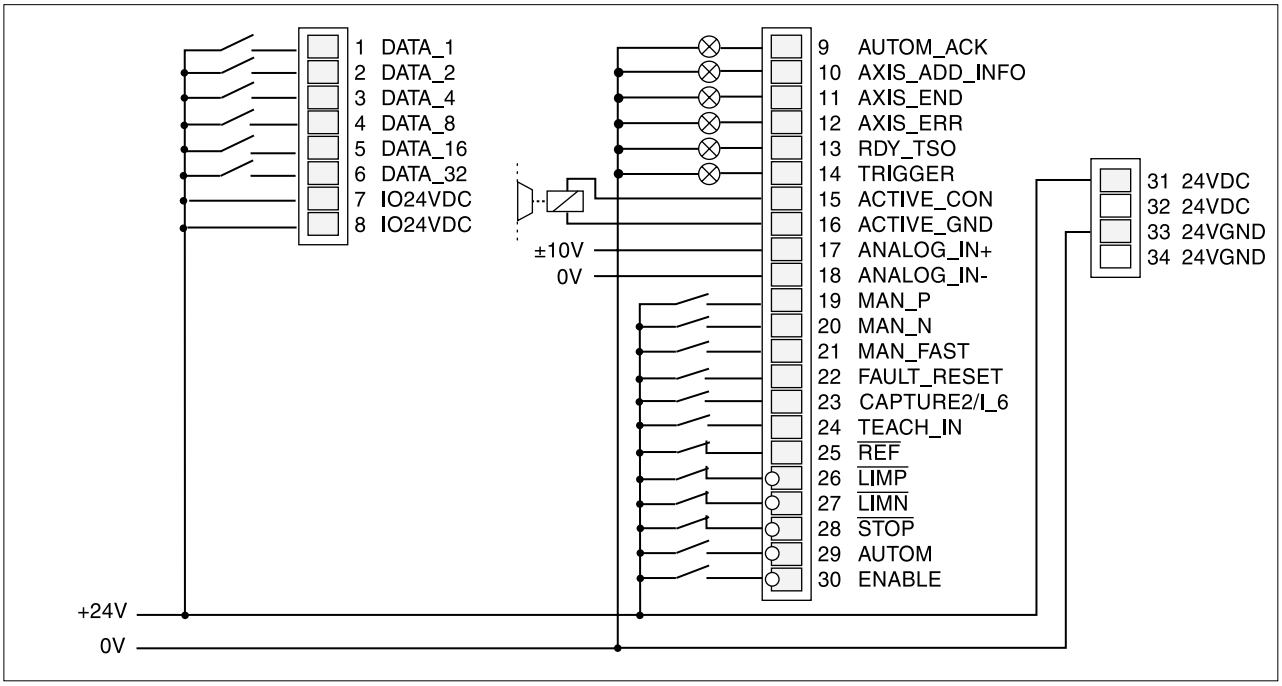


Fig. 4.17 Signal interface inputs and outputs with fixed assignment

Manual mode is described on page 6-10 in "Manual movement" and teach-in mode on page 7-8 in "Teach-in processing".

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 $\overline{\text{LIMP}}$, LIMN or $\overline{\text{STOP}}$ becomes active.

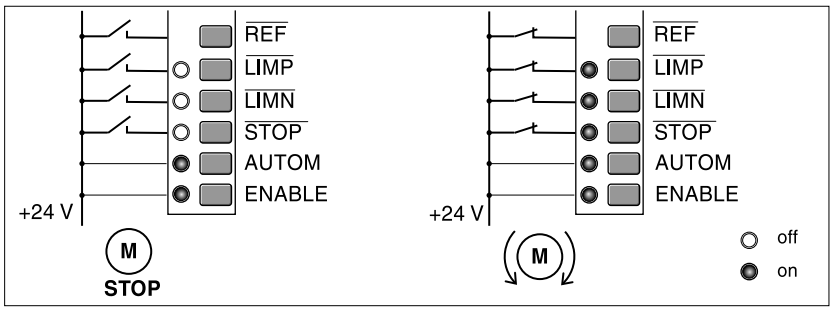


Fig. 4.18 LED display of signal interface

Enabling of the input signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$", $\overline{\text{REF}}$ and $\overline{\text{STOP}}$ and evaluation as active low or high can be changed via the parameters Changing "Settings.SignEnabl" and "Settings.SignLevel". See page 7-25.

Output signals remain unchanged for at least 0.5 ms.

9844 1113 117, f107, 09.02

4.4.7 Connection to the RS232 interface

Connection The RS232 interface with a 9-pole Sub-D socket with M3-threaded connection is wired up 1:1 with the PC or with the Twin Line HMI. The positioning controller supplies the Twin Line HMI with the operating voltage via pin 9.

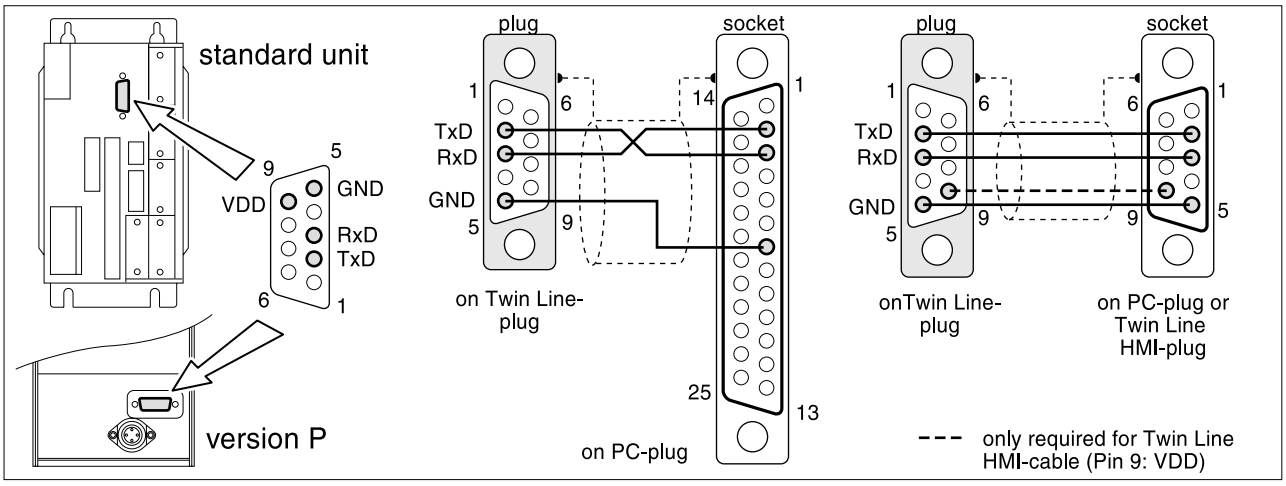


Fig. 4.19 Cables for the RS232 interface at the PC or Twin Line HMI View: Solder side of cable connectors

Pin	Signal	Color [1)]	Pair	Meaning	I/O
1	-	-	-	not assigned	-
2	TxD	brown	-	Transmitted data to input device	O
3	RxD	white	-	Data received from input device	I
4	-	-	-	not assigned	-
5	GND	green	-	ground	-
6	-	-	-	not assigned	-
7	-	-	-	not assigned	-
8	-	-	-	not assigned	-
9	VDD	yellow	-	10 V_{DC} supply for the TL HMI	O

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

Cable specification

- shielded cable
- cable length maximum 15 m
- minimum cross-section of the signal conductors 0.25 mm^2, for supply voltage and ground line 0.5 mm^2
- shield grounded at both ends

9844 1113 117, f107, 09.02

Function The positioning controller is started up and operated via the serial RS232 interface. Connect the HMI hand-held unit or a computer to the Twin Line Control Tool operating software.

You can plug the Twin Line HMI directly into the unit or connect it by cable to the unit. It is powered by the unit.

Multiple units cannot be networked via the RS232 interface.

9844 1113 117, f107, 09.02

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.

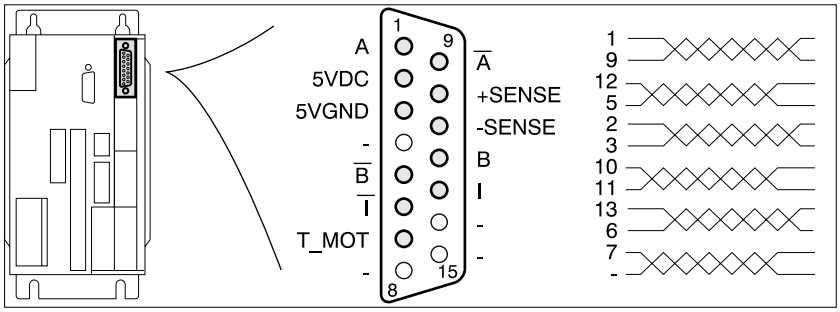


Fig. 4.20 Interface of the encoder module

Pin	Signal	Color [1]	Pair	Meaning	I/O
1	O	white	1	Encoder signal channel A	I
9	$\overline{O}$	brown	1	Channel A, negated	I
12	B	green	2	Encoder signal channel B	I
5	$\overline{B}$	yellow	2	Channel B, negated	I
2 [2]	5VDC	red	3	Encoder supply, 5 V, max. 300 mA	O
3	5VGND	blue	3	Encoder supply, ground	O
10	+SENSE	purple	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	gray	5	Channel index pulse	I
6	$\overline{I}$	pink	5	Channel index pulse, negated	I
7 [2]	T_MOT (5VDC)	pink/pink	6	Line monitoring, connect signal at encoder to pin 2: Connect 5VDC	I
4	-	red/blue	6	not assigned	-
8	-		-	not assigned	-
14	-		-	not assigned	-
15	-		-	not assigned	-

1) Color details refer to the cable available as an accessory.
2) Connect signals 2 (5VDC) and 7 (T_MOT) for line monitoring in the encoder plug
3) Sense line must be connected for activating the 5VDC.

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

Cable specification

- shielded cable
- minimum cross-section of signal wires 0.25 mm^2, 5VDC and 5VGND 0.5 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum cable length 100 m

9844 1113 117, f107, 09.02

CAUTION!
Permanent damage to external encoder!
Only connect cable when power supply is switched off.
Otherwise the encoder may be permanently damaged.

Function

Setpoints are specified via externally injected A/B signals and index pulse in electronic gear 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.

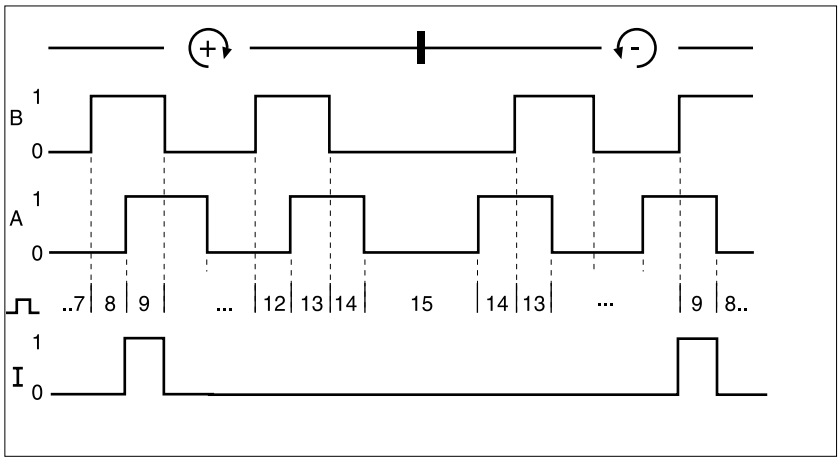


Fig. 4.21 Timing diagram with A, B and index pulse signal, counting forwards and backwards

Monitoring

The T_MOD signal displays wire break at low signal.

Position data transmission errors with excessive voltage drop: the difference of the ground potential of 24 VGND to other connected devices must be less than 1 volt.
Otherwise use larger cross-section cable for 24 VGND.

9844 1113 117, f107, 09.02

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.

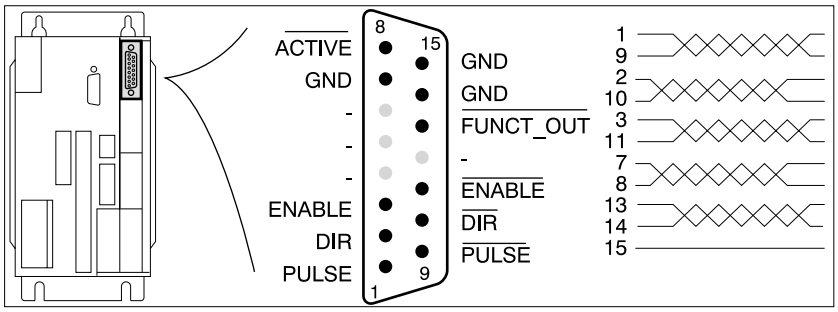


Fig. 4.22 Interface of the pulse/direction module

Pin	Signal	Color [1)]	Pair	Meaning	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	Direction of rotation "Dir" or motor step backwards "PR"	I
10	$\overline{\text{DIR}}$ ($\overline{\text{PR}}$)	yellow	2	Direction of rotation "Dir" or motor step backwards "PR", inverted	I
3	ENABLE	gray	3	Enable signal	I
11	$\overline{\text{ENABLE}}$	pink	3	Enable signal, inverted	I
7	GND	pink/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) Color details refer to the cable 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 cross-section of signal wires 0.14 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum length:
  100 m with RS422 connection
  up to 10 m with Open Collector connection

9844 1113 117, f107, 09.02

Function

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

Reference signals for step-by-step positioning of the motor and a control signal for enabling the power amplifier are transmitted via the pulse direction interface. The unit simultaneously 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 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.

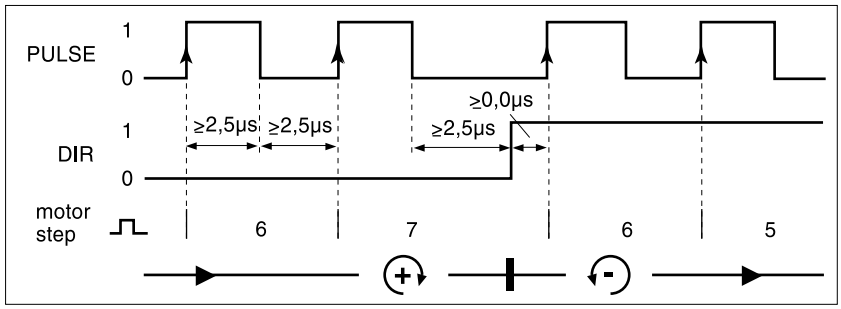


Fig. 4.23 Pulse direction signal

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

Operating mode
$Pulse_{forward}$ - $Pulse_{backward}$

The PV (PULSE) signal is used to move the motor in a clockwise direction, and the PR (DIR) signal moves it in an anticlockwise direction.

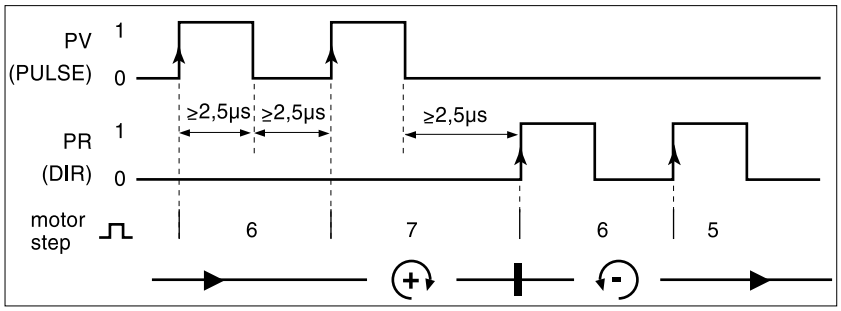


Fig. 4.24 $Pulse_{forward}$ - $Pulse_{backward}$ signal

9844 1113 117, f107, 09.02

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

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

ENABLE The ENABLE signal enables the power amplifier so 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 that the positioning controller is ready for operation.

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.

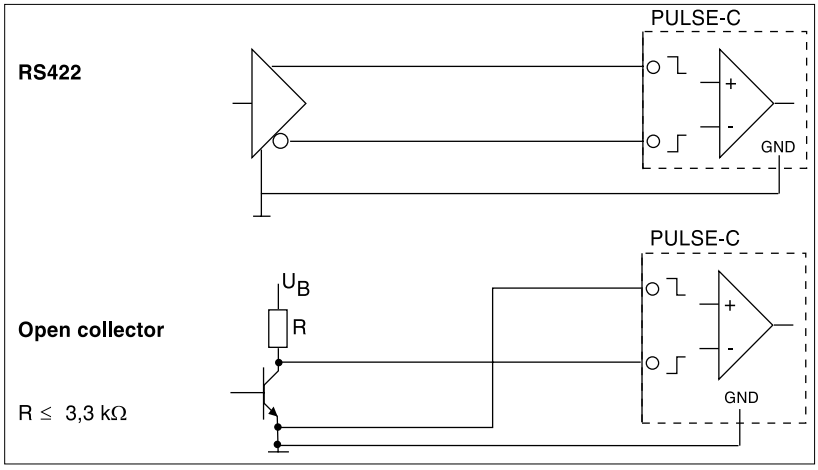


Fig. 4.25 Circuit of the signal inputs, L: Cable length

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

9844 1113 117, f107, 09.02

4.4.10 Connection to the IOM-C module

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

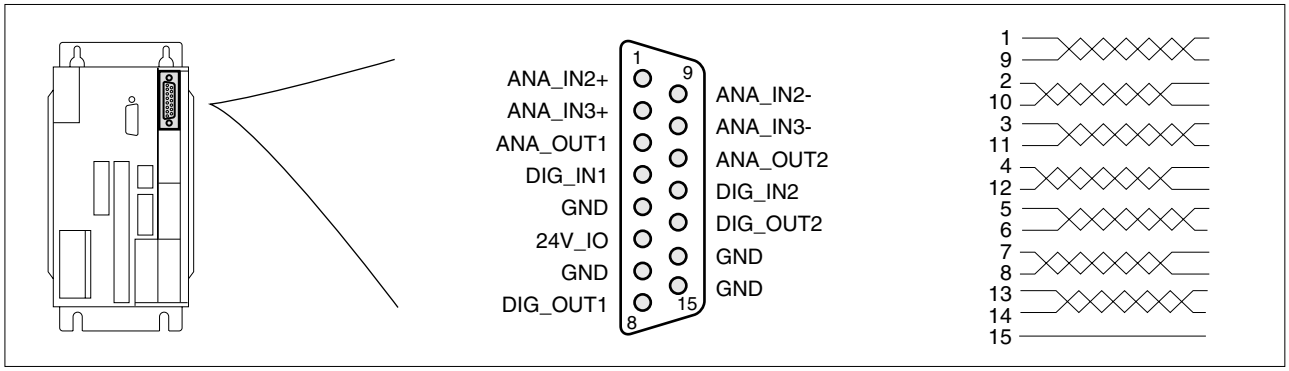


Fig. 4.26 Interface of the analog module

Pin	Signal	Color [1)]	Pair	Meaning	I/O
1	ANA_IN2+	white	1	Analog control input ±10 V	I
2	ANA_IN3+	green	2	Analog control input ±10 V	I
3	ANA_OUT1	gray	3	Analog control output ±10 V	O
4	DIG_IN1	blue	4	Digital control input 1	I
5	GND	black	5	ground	I
6	+24V_IO	purple	5	Power supply, 24 V, for digital control outputs	I
7	GND	pink/pink	6	ground	I
8	DIG_OUT1	red/blue	6	Digital control output 1	O
9	ANA_IN2-	brown	1	Analog control input 0 V, reference potential for pin 1 ANA_IN2+	I
10	ANA_IN3-	yellow	2	Analog control input 0V, reference potential for pin 2 ANA_IN3+	I
11	ANA_OUT2	pink	3	Analog control output ±10 V	O
12	DIG_IN2	red	4	Digital control input 2	I
13	DIG_OUT2	white/green	7	Digital control output 2	O
14	GND	brown/ green	7	ground	I
15	GND	white/ yellow	8	ground	I

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

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

Cable specification

- shield analog signal lines at one end only at the power controller, shield the other end via capacitor, e.g. 10nF/100V MKT
- minimum cross-section of signal wires 0.14 mm^2
- twisted-pair wires
- maximum length 5 m

9844 1113 117, f107, 09.02

Function The IOM-C analog module enhances the user interface:

- Two analog inputs for measuring analog voltages between +/- 10 V; parameter values of analog inputs/outputs belong to parameter group M1.
- Two analog outputs for providing analog voltages in the +/- 10 V range; parameter values of analog inputs/outputs belong to parameter group M1.
- Two digital signal inputs for recording 24 V signals; diagram of the digital inputs/outputs in the I/O parameter group.
- Two digital signal outputs for output of 24 V signals; diagram of the digital inputs/outputs in the I/O parameter group.

Pin 6 must be connected to 24 V_{DC} for the digital signal outputs to function.

After switching on the power supply or after resetting the power electronics the analog output is at +10 V while the controller is starting up.

DANGER!
Risk of injury and permanent damage to system components due to unexpected system movements!
If analog outputs are used as setpoints for a downstream drive and they are not switched on in sequence, the downstream drive may move unexpectedly.
Do not enable the downstream drive power amplifier until all units in the system have started.

9844 1113 117, f107, 09.02

4.4.11 Connection to the ESIM3-C module

Module interface

The ESIM3-C module is equipped with a Sub-D socket, 15-pin with an M3 threaded connection.

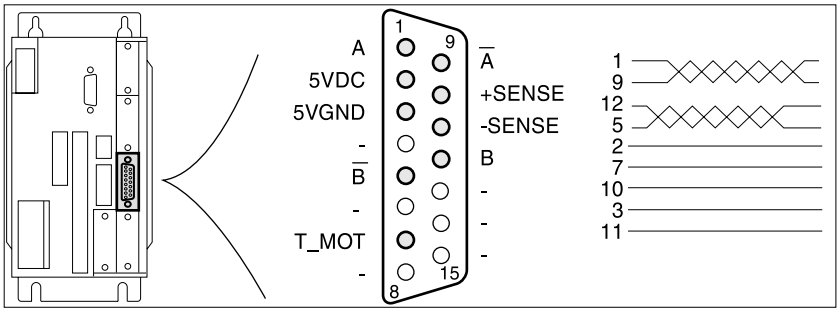


Fig. 4.27 Module interface connection for encoder simulation

Pin	Signal	Color [1]	Pair	Meaning	I/O
1	O	white	1	Channel A	O
9	$\overline{O}$	brown	1	Channel A, negated	O
12	B	green	2	Channel B	O
5	$\overline{B}$	yellow	2	Channel B, negated	O
2	5VDC	red	3	Internal bridge to Pin 10 to activate +SENSE Internal bridge to Pin 7 to activate T_MOT [2]	I
3	5VGND	blue	3	Internal bridge to Pin 11 to activate -SENSE [2]	I
10	+SENSE	purple	4	Internal bridge to Pin 2 to activate -SENSE [2]	O
11	-SENSE	black	4	Internal bridge to Pin 3 to activate -SENSE [2]	O
13	-	-	-	not assigned	O
6	-	-	-	not assigned	O
7	T_MOT	pink/pink	6	Internal bridge to Pin 2 to activate T_MOT [2]	O
4	-	red/blue	6	not assigned	-
8	-	-	-	not assigned	-
14	-	-	-	not assigned	-
15	-	-	-	not assigned	-

1) Color details refer to the cable available as an accessory.
2) Only required for connection to RS422-C

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

Cable specification

- shielded cable
- minimum cross-section of signal wires 0.14 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum length 100 m

9844 1113 117, f107, 09.02

Function Signals for indicating the actual position are output at the incremental encoder connection. They are two out-of-phase signals A and B. The A/B signals are generated and sent by the motor-encoder module.

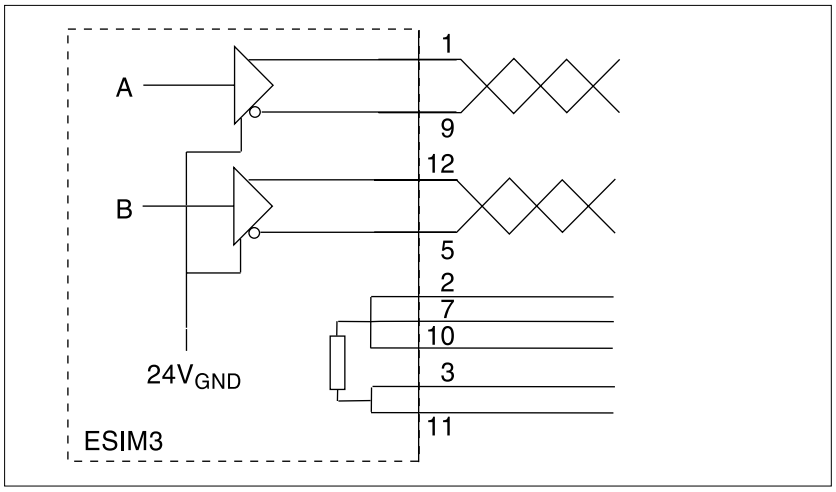


Fig. 4.28 Circuit for ESIM3C

Resolution Resolutions of the encoder simulation:

Encoder with 1000 lines: 4000 Inc/rev.

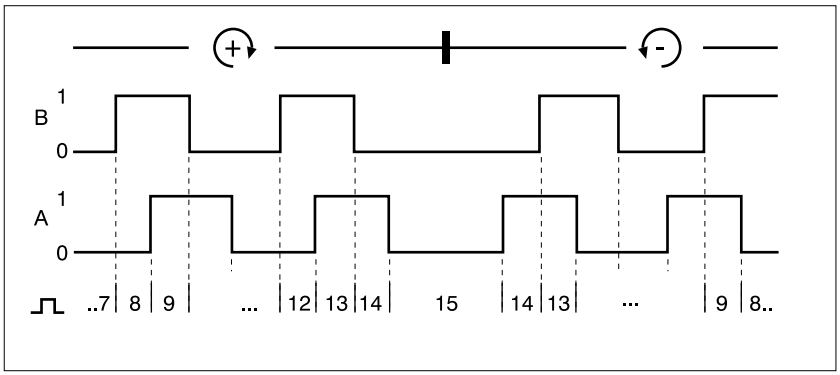


Fig. 4.29 Timing diagram with A and B signal, counting forwards and backwards

Incorrect transmission of position data when voltage drop excessive.
The difference in the ground potential of 24VGND between two units connected via ESIM3-C or RS422-C must be less than 1 volt. Otherwise use cable of larger cross-section for 24VGND.

The pin assignments for the signals of the ESIM3-C and RS422-C modules are identical. A 1:1 cable can be used for a connection.

9844 1113 117, f107, 09.02

4.4.12 Connection to the RM-C module

The optional encoder interface is only built-in in units with speed monitoring.

Module interface

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

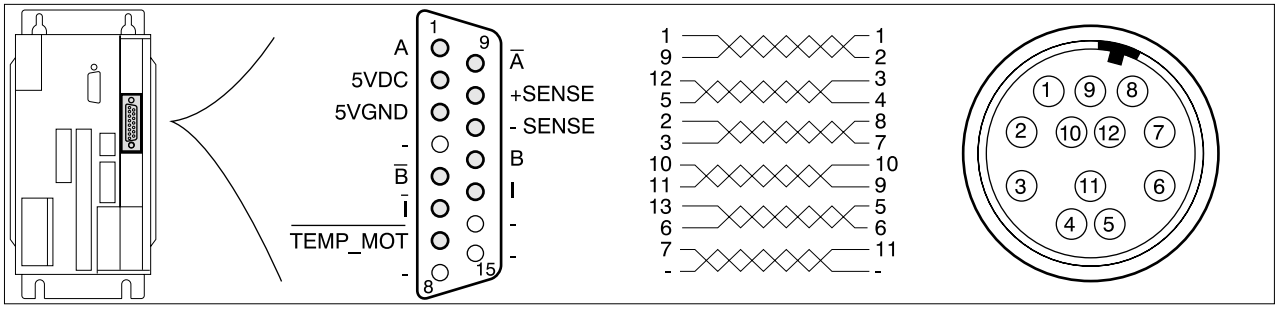


Fig. 4.30 Interface for speed monitoring, motor plug view: Solder side

Pin	Signal	Color [1]	Pair	Meaning	I/O
1	O	white	1	Encoder signal channel A	I
9	$\overline{O}$	brown	1	Channel A, negated	I
12	B	green	2	Channel B	I
5	$\overline{B}$	yellow	2	Channel B, negated	I
2	5VDC	red	3	Encoder supply, 5V, max. 300mA	O
3	5VGND	blue	3	Encoder supply, ground	O
10	+SENSE	purple	4	Sense line positive [2]	I
11	-SENSE	black	4	Sense line negative [2]	I
13	I	gray	5	Channel index pulse	I
6	$\overline{I}$	pink	5	Channel index pulse, negated	I
7	$\overline{TEMP\_MOT}$	pink/pink	6	Temperature error, inverted	I
4	-	red/blue	6	not assigned	-
8	-	-	-	not assigned	-
14	-	-	-	not assigned	-
15	-	-	-	not assigned	-

1) Color 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 from the point of connection.

Cable specification

- shielded cable
- minimum cross-section of signal wires 0.25 mm^2, 5VDC and 5VGND 0.5 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum cable length 100 m

9844 1113 117, f107, 09.02

CAUTION!
Permanent damage to external encoder!
Only connect cable when power supply is switched off.
Otherwise the encoder may be permanently damaged.

Function

The angular position of the motor is transferred incrementally over the connection with A/B rectangular signals. The unit detects stepper errors by comprison with the setpoint position and reports a following error if the limit value of 6.4° is exceeded. The monitoring can be disabled with the "Settings.monitorM" parameter, see chapter "Setting phase current and device parameters" from page 5-9.

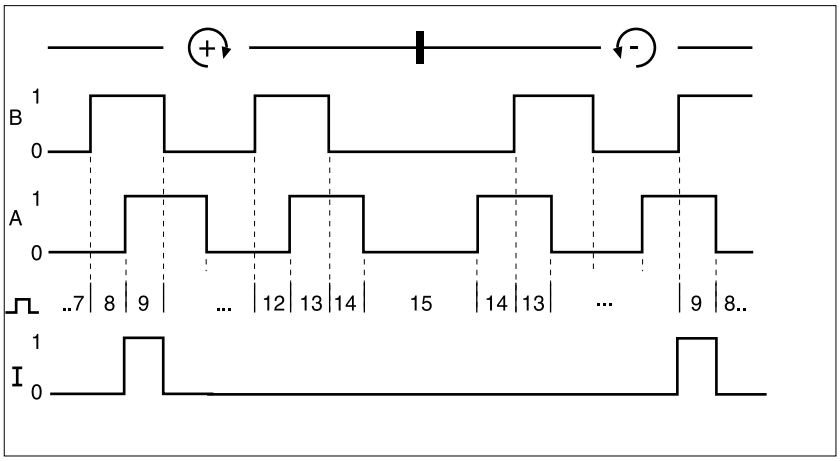


Fig. 4.31 Timing diagram with A, B and index pulse signal, counting forwards and backwards

Monitoring

The motor winding temperature is monitored with the TEMP-MOT signal. The signal also indicates whether the encoder is connected.

Pin	Signal	Function	Value
7	TEMP_MOT	Temperature range OK Overheating of motor or break in cable	high low

Encoder type

An encoder with 1000 lines must be connected to use the speed monitoring.

9844 1113 117, f107, 09.02

4.4.13 Connection to the PBDP-C module

Module interface

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

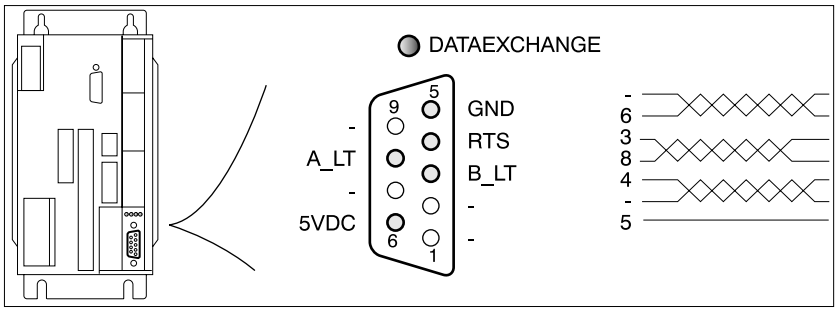


Fig. 4.32 Field bus module interface connection

Pin	Signal	Color	Pair	Meaning	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 wire, negated	I/O
8	A_LT	-	2	Data wire	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 in accordance with the minimum wiring requirement.

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

Cable specification for connection to a bus terminal

- shielded cable
- minimum cross-section of signal wires: 0.14 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum length 100 m

To protect against interference, the shield for digital cables is connected at both ends. Differences in potential can lead to excessive current in the shield, and these have to be prevented with bonding conductors.
Cable cross-section for lengths up to 200 m: 16 mm^2, for lengths over 200 m: 20 mm^2.

9844 1113 117, f107, 09.02

Function

The positioning controller can be connected to a Profibus-DP network as a slave device with the PBDP-C field bus module.

The positioning controller receives data and commands from a higher-order device on the bus, a master device. The controller sends status information such as device status and processing status back to the master device as acknowledgement. Data exchange is with a special communications protocol.

Data are exchanged cyclically between master and slave devices. Every device in the network is identified by a unique address which can be set as desired.

Setting the address

The address can be set with the "M4.addrPbd" parameter or inputs ADR_1 to ADR_64 of the signal interface, see page 4-23.

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 manual in the chapter on installation and set-up.

9844 1113 117, f107, 09.02

4.4.14 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.

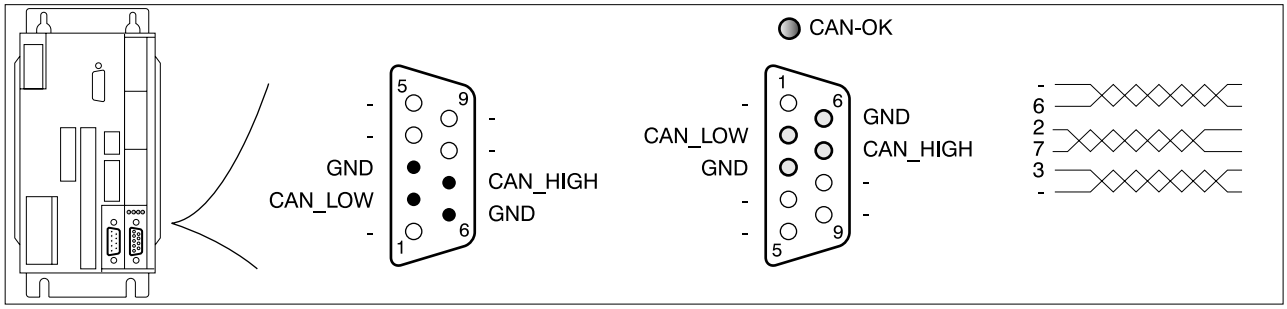


Fig. 4.33 Interface connections of the field bus module with plug and socket

Pin	Signal	Color [1)]	Pair	Meaning	I/O
1	-	-	1	not assigned	-
6	GND	green	1	ground	-
2	CAN_LOW	white	2	Data wire, negated	I/O
7	CAN_HIGH	brown	2	Data wire	I/O
3	GND	gray	3	ground	-
8	-	pink	3	not assigned	-
4	-	-	-	not assigned	-
9	-	-	-	not assigned	-
5	-	-	-	not assigned	-

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

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

Cable specification

- shielded cable
- minimum cross-section of signal wires: 0.14 mm^2
- twisted-pair wires
- shield grounded at both ends
- Maximum length depends on the number of devices, the baud rate and signal times. The higher the baud rates, the shorter the bus cable has to be. Recommended values: 40 m at 1 Mbit/s, 500 m at 100 kbit/s Recommended values for DeviceNet: 100 m at 500 kbit/s, 500 m at 125 kbit/s.

To protect against interference, the shield for digital cables is connected at both ends. Differences in potential can lead to excessive current in the shield, and these have to be prevented by bonding conductors. Cable cross-section for lengths up to 200 m: 16 mm^2, for lengths over 200 m: 20 mm^2.

9844 1113 117, f107, 09.02

Function

The positioning controller can be connected with the CAN-C field bus module on the following networks:

- CAN-Bus
- CANOpen
- DeviceNet

The positioning controller receives data and commands from a higher-order device on the bus, a master device. The controller sends status information such as device status and processing status back to the master device as acknowledgement. Data exchange is with a special communications protocol.

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

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 when there is a connection to the device. 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 with the "M4.addrCAN" parameter (see page 12-18) or inputs ADR_1 to ADR_64 of the signal interface (see page 4-23).

Baud rate

The baud rate can be set with the "M4.baudCan" parameter (see page 12-18) or via the BAUD_1 to BAUD_4 inputs of the signal interface (see page 4-23).

Field bus profile

The field bus profile can be set with the "M4.profileCan" parameter (see page 12-18) or with the MODE_1 and MODE_2 inputs (see page 4-23).

Terminating resistors

A terminating resistor of 120 Ω must be connected at both ends. You will find an appropriate terminator plug in the "Accessories and spare parts" chapter.

Field bus manual

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

9844 1113 117, f107, 09.02

4.4.15 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-pin with M3 thread. Pin assignment is identical for both interface connections.

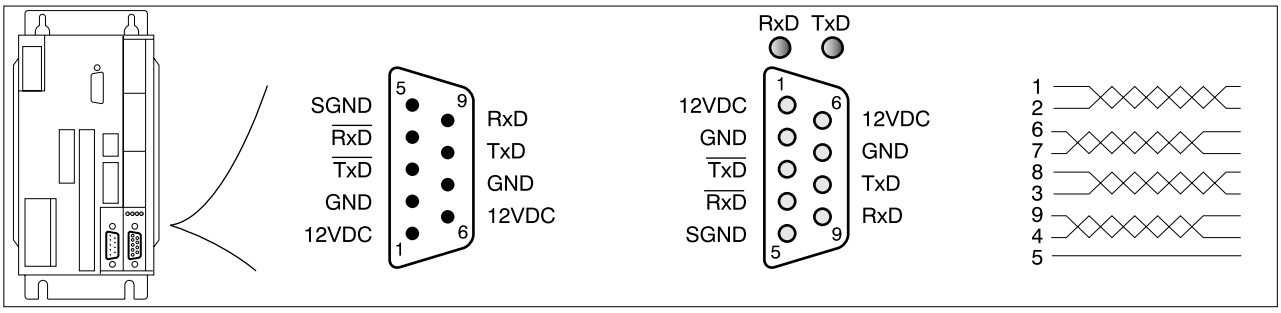


Fig. 4.34 Field bus module interface connection

Pin	Signal	Color	Pair	Meaning	I/O
1	12VDC	white	1	power supply	O
2	GND	brown	1	Ground for 12VDC power supply	O
6	12VDC	green	2	power supply	O
7	GND	yellow	2	Ground for 12VDC power supply	O
8	TxD	pink	3	transmitted data	O
3	$\overline{\text{TxD}}$	gray	3	transmitted data, negated	O
9	RxD	red	4	received data	I
4	$\overline{\text{RxD}}$	blue	4	received data, negated	I
5	SGND	black	-	ground	-

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

Cable specification

- shielded cable
- minimum cross-section of signal wires: 0.14 mm^2
- twisted-pair wires
- shield 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 shield for digital cables is connected at both ends. Differences in potential can lead to excessive current in the shield, and these have to be prevented with bonding conductors.
Cable cross-section for lengths up to 200 m: 16 mm^2, for lengths over 200 m: 20 mm^2.

9844 1113 117, f107, 09.02

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-order device on the bus, a master device. The controller sends status information such as device status and processing status back to the master device as achnowledgement. Data exchange is with a special communications protocol.

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

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 4-23.

Baud rate The baud rate can be set via the "M4.baudSer" parameter or 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 in the chapter on installation and set-up.

9844 1113 117, f107, 09.02

4.4.16 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-pin with UNC thread.

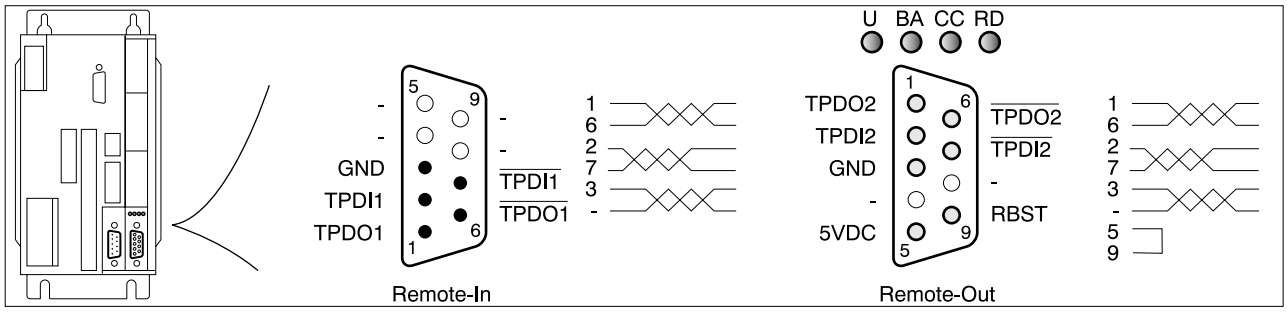


Fig. 4.35 Field bus module interface connection

Pin	Signal Remote-In	Signal Remote-Out	Color [1)]	Pair	Meaning	I/O
1	TPDO1	TPDO2	white	1	received data	I
6	$\overline{\text{TPDO1}}$	$\overline{\text{TPDO2}}$	brown	1	received data, negated	I
2	TPDI1	TPDI2	green	2	transmitted data	O
7	$\overline{\text{TPDI1}}$	$\overline{\text{TPDI2}}$	yellow	2	transmitted data, negated	O
3	GND	GND	blue	3	ground	-
8	-	-	red	3	not assigned	-
4	-	-	gray	-	not assigned	-
9	-	RBST	pink	-	only for Remote-Out: Signal inputs for additional board In cable connector with Pin5: Connect 5VDC	I
5	-	5VDC	black	-	only for Remote-Out: 5 V power In cable connector with Pin9: Connect RBST	O

1) Color 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

- shielded cable
- minimum cross-section of signal wires: 0.14 mm^2
- twisted-pair wires
- shield grounded at both ends
- maximum length 400 m

To protect against interference, the shield 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 bonding conductors.
Cable cross-section for lengths up to 200 m: 16 mm^2, for lengths over 200 m: 20 mm^2.

9844 1113 117, f107, 09.02

Function

The positioning controller can be connected to an Interbus network as a slave device with the IBS-C field bus module. The Interbus is a standardized 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 topology. Connection to the neighboring 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	Color	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 500 kbit/s.

Field bus manual

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

9844 1113 117, f107, 09.02

4.4.17 Connecting accessories to the standard unit

TL HBC holding brake controller

In motors with holding brakes the brake can be connected directly or via the TL HBC holding brake controller.

The ACTIVE-CON control signal is amplified with the holding brake controller to ensure that the brake switches quickly and generates as little heat as possible.

Motor connection

Terminal	Connection	Color
U	Motor cable	brown (bn)
V	Motor cable	blue (bl)
W	Motor cable	black (bk)
PE	protective conductor (shield tracer wire)	-
O	Brake wire	red (rd)
B	Brake wire	gray (gr)

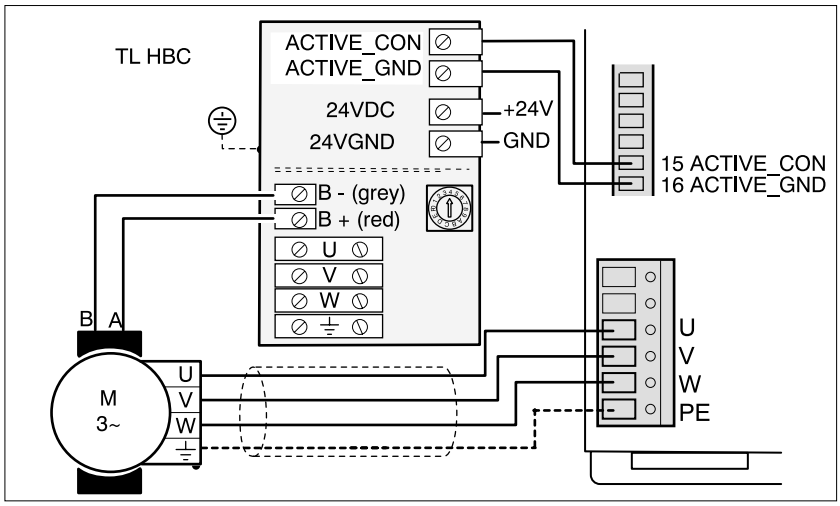


Fig. 4.36 Connection of the TL HBC holding brake controller

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

9844 1113 117, f107, 09.02

Only use cables with the following specifications:

	TLC511	TLC512
cable cross-section [mm^2]	1.5	1.5
Max. cable length [1] [m]	20	20

1) longer cables 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 switch for voltage reduction to "1".

The voltage reduction function is described in chapter "Braking function with TL HBC" on page 7-32.

External capacitors

The power control can store superfluous braking energy on an external electrolytic capcitor viaq the DC link connection. This enables any increase in the DC link voltage to be reduced in the event of frequent braking.

Only use cables with the following specifications:

	TLC511	TLC512
dielectric strength	≥ 450 V	≥ 450 V
external capacity	< 500 µF	< 1000 µF

Cable specification

- shielded cable
- shield grounded at both ends
- maximum cable length 3 m
- minimum cross-section: 1.5 mm^2

Connection

Conenct the cable from the DC link connection to the capacitor connections. Observe correct polarity: DC+ to + and DC- to -. Otherwise the unit and capacitor can be destroyed.

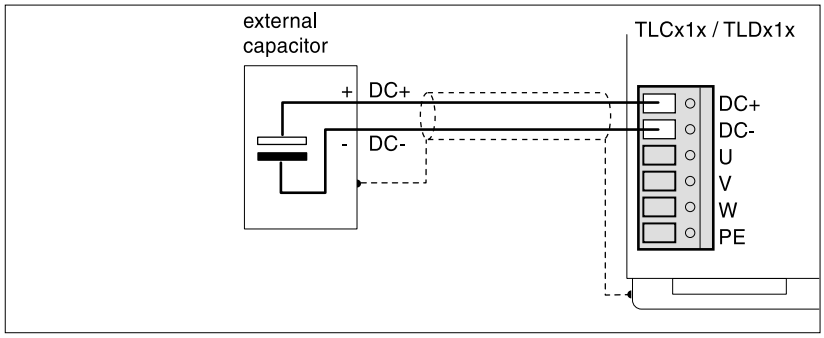


Fig. 4.37 Connection of an external capacitor

9844 1113 117, f107, 09.02

4.5 Wiring examples

4.5.1 Manual setup and operation via field bus

Functions Manual setup with teach-in function, manual movement via I/O, operation over field bus with fixed I/O pin assignments

Presets Parameter setting: "Settings.IO_mode"=2, see chapter"Operating modes of the positioning controller", from page6-1.

Manual movement vian I/O and teach-in: AUTOM=0
field bus mode: AUTOM=1.

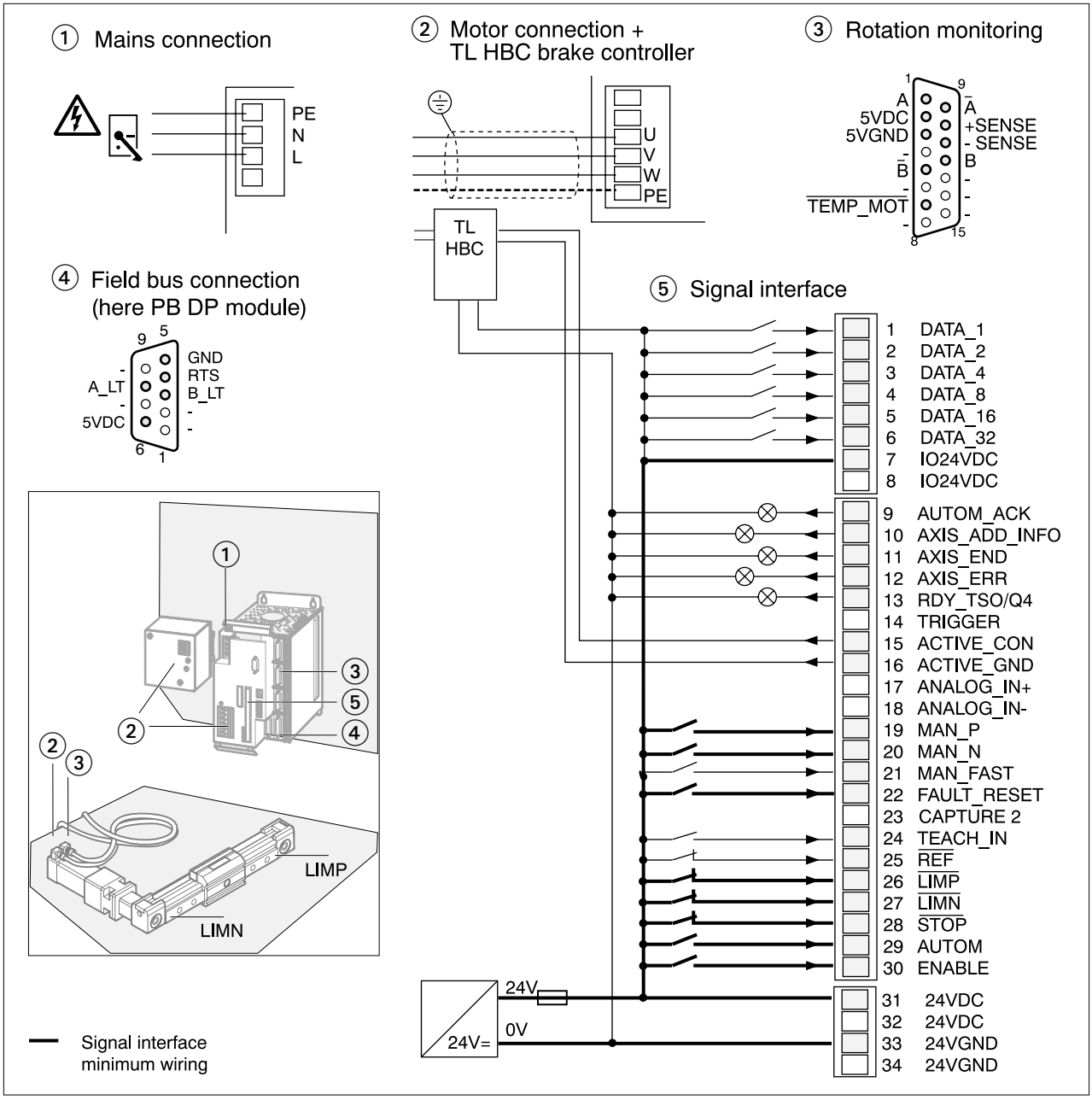


Fig. 4.38 Wiring for manual mode via inputs and outputs

9844 1113 117, f107, 09.02

Connection

▶ Wiring up the line connection (1):

- For single-phase units see page 4-13.
- 24 V connection wiring, see page 4-18.

▶ Wiring motor connection (2) and holding brake controller in motors with holding brakes:

- Motor connection see page 4-14.
- Holding brake controller see page 4-47.

▶ Installing motor speed monitoring (3), see page 4-37.

▶ Wiring up the field bus connection (4):

- Profibus DP see page 4-39.
- CAN-Bus see page 4-41.
- Serial bus see page 4-43.
- Interbus-S see page 4-45.

▶ Wiring signal interface for manual operation (5):

- The complete signal interface assignments are described from 4-19.
- See the table below for the minimum assignment for Manual Mode.

Pin	Signal	Active	Meaning	I/O
1	DATA_1	high	Bit0 for selecting a list number	I
2	DATA_2	high	Bit1 for selecting a list number	I
3	DATA_4	high	Bit2 for selecting a list number	I
4	DATA_8	high	Bit3 for selecting a list number	I
5	DATA_16	high	Bit4 for selecting a list number	I
6	DATA_32	high	Bit5 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 at AUTOM signal	O
10	AXIS_ADD_INFO	high	Supplementary information on current movement job	O
11	AXIS_END	high	End of processing of a movement job, drive at standstill	O
12	AXIS_ERR	high	Error detection during processing of a movement job	O
13	RDY_TSO:	high	Ready for operation, output max. 400 mA	O
15	ACTIVE_CON	high	Motor under power, 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 clockwise motor rotation	I
20	MAN_N [1)]	high	manual movement anticlockwise motor rotation	I
21	MAN_FAST	high	Manual selection slow (low) or fast (high)	I
22	FAULT_RESET [1)]	high	Resetting error messages	I

9844 1113 117, f107, 09.02

Pin	Signal	Active	Meaning	I/O
24	TEACH_IN	high	Trigger signal for saving the current setpoint position in the list data memory	I
25	$\overline{\text{REF}}$	low	reference switch signal	I
26	$\overline{\text{LIMP}}$ 1)	low	limit switch signal clockwise motor rotation	I
27	$\overline{\text{LIMN}}$ 1)	low	limit switch signal anticlockwise motor rotation	I
28	$\overline{\text{STOP}}$ 1)	low	stop motor	I
29	AUTOM 1)	high	Automatic mode via field bus (high), manual mode (low)	I
30	ENABLE 1)	high	Enable (high) or lock (low) power amplifier	I
31, 32	24 VDC 1)	–	24 VDC power supply	I
33, 34	GND 1)	–	GND for 24 VDC voltage	I

1) minimum pin assignment of signal interface for commissioning
2) Version P: Holding brake connection hard wired.

9844 1113 117, f107, 09.02

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

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

Presets Parameter setting: "Settings.IO_mode"=1, see chapter "Operating modes of the positioning controller", from page6-1.

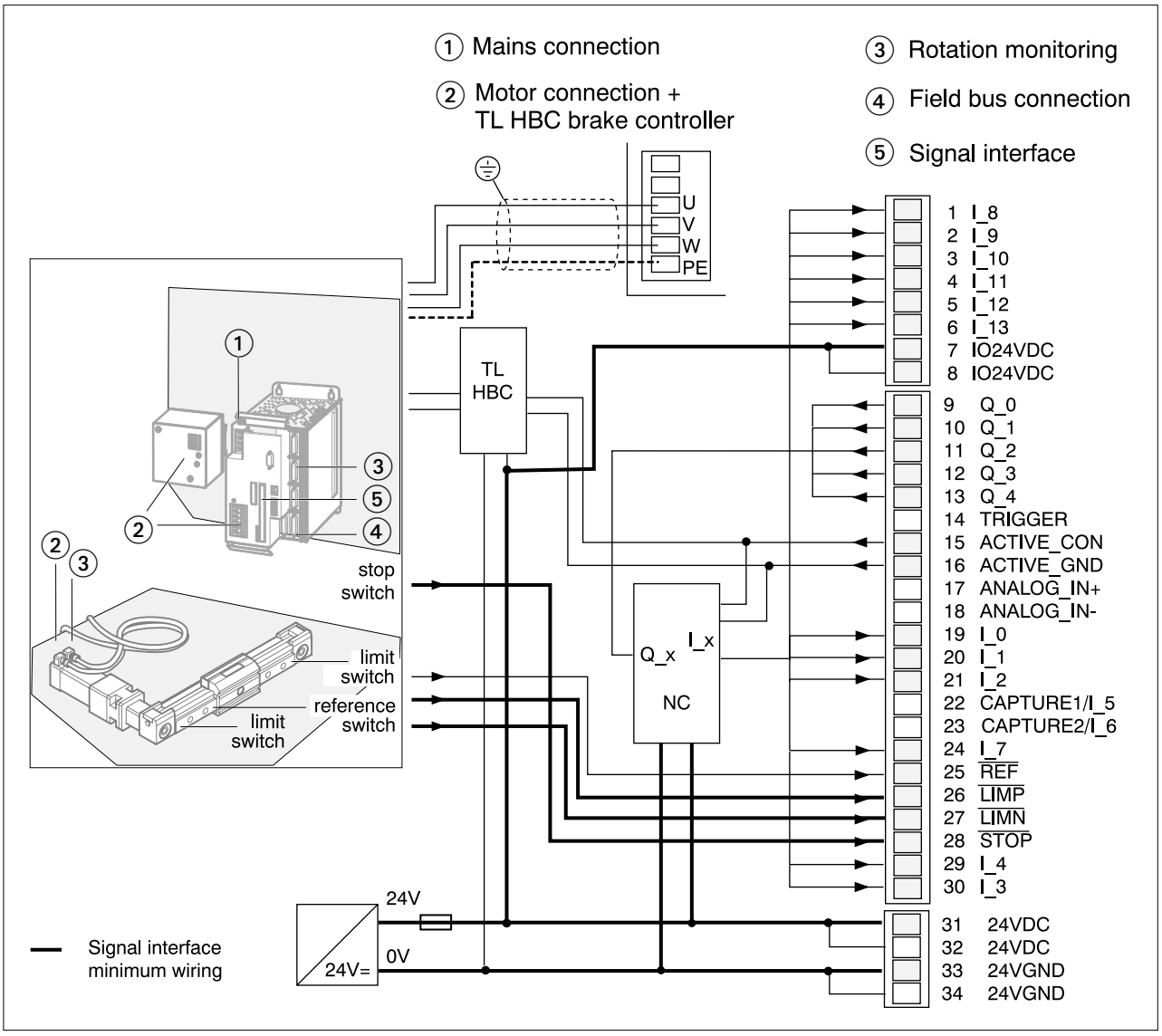


Fig. 4.39 Wiring for automated operation on field bus

9844 1113 117, f107, 09.02

Pin	Signal	Active	Meaning	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 TL HBC, 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 clockwise motor rotation	I
27	$\overline{\text{LIMN}}$ [1]	low	limit switch signal anticlockwise 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	24VDC [1]	–	24 VDC power supply	I
33, 34	GND [1]	–	GND for 24 VDC voltage	I

1) minimum pin assignment of signal interface for commissioning
2) Version P: Holding brake connection hard wired.

9844 1113 117, f107, 09.02

4.5.3 Operation by field bus, field bus configuration via inputs

Functions Operation only by field bus master device, field bus settings via signal interface inputs. Field bus address 7 is set on switching on the Twin Line unit. 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 page6-1.

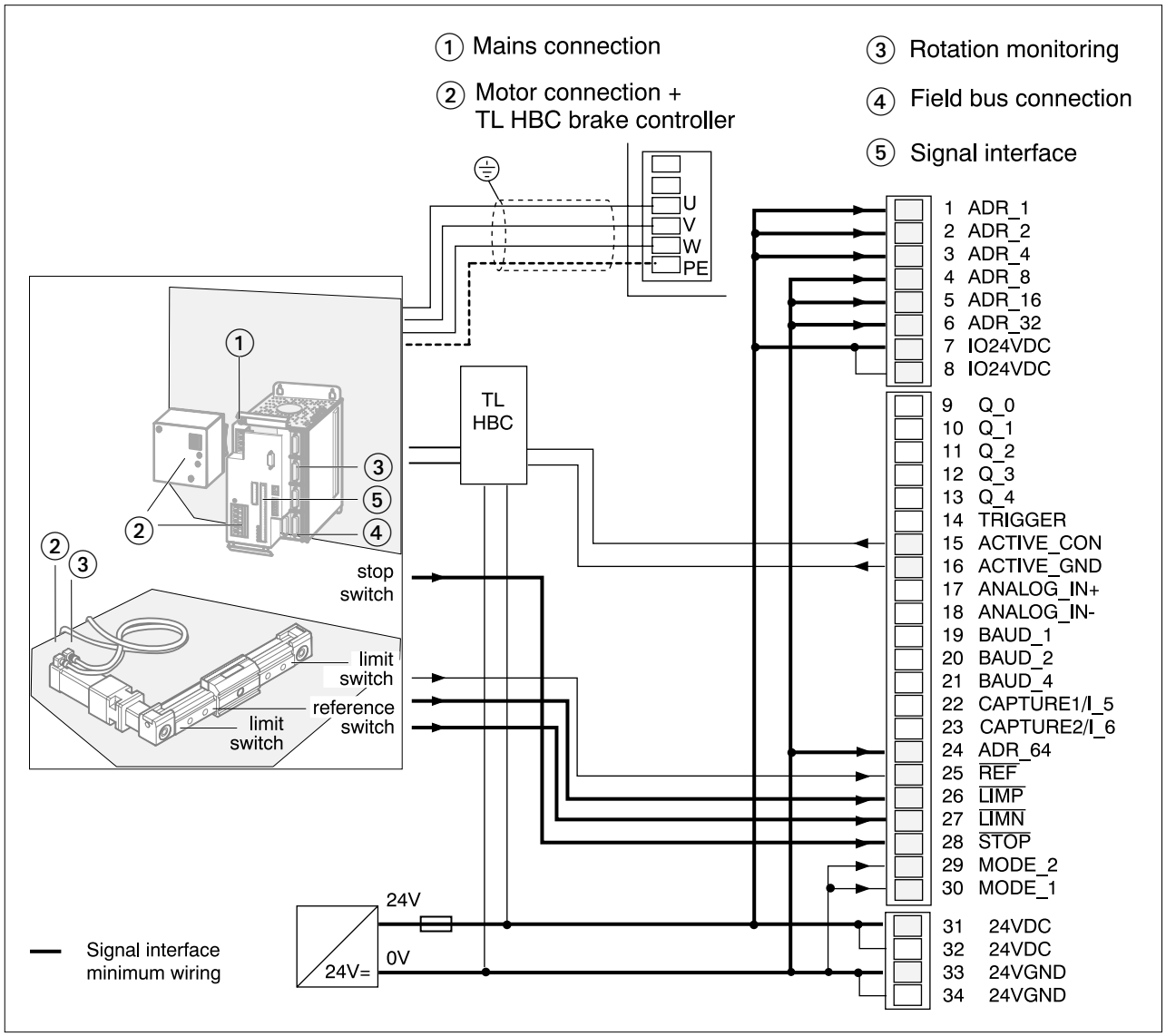


Fig. 4.40 Wiring for automatic operation only on field bus

9844 1113 117, f107, 09.02

Pin	Signal	Active	Meaning	I/O
1	ADR_1	high	Bit0 for network address	I
2	ADR_2	high	Bit1 for network address	I
3	ADR_4	high	Bit2 for network address	I
4	ADR_8	high	Bit3 for network address	I
5	ADR_16	high	Bit4 for network address	I
6	ADR_32	high	Bit5 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	Bit0 for setting the baud rate	I
20	BAUD_2	high	Bit1 for setting the baud rate	I
21	BAUD_4	high	Bit2 for setting the baud rate	I
24	ADR_64 [1)]	high	Bit6 for network address	I
25	$\overline{\text{REF}}$	low	reference switch signal	I
26	$\overline{\text{LIMP}}$ [1)]	low	limit switch signal clockwise motor rotation	I
27	$\overline{\text{LIMN}}$ [1)]	low	limit switch signal anticlockwise 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
	24VDC [1)]	–	24 VDC power supply	I
	GND [1)]	–	GND for 24 VDC voltage	I

1) minimum pin assignment of signal interface for commissioning
2) Version P: Holding brake connection hard wired.

9844 1113 117, f107, 09.02

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 commissionung the engine should be run decoupled from the system. This means that the motor and system will not be damaged 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 during commissioning; 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

▶ Set the ENABLE input of the signal interface to Low if you have assigned the signal input.

WARNING
Destruction of motor!
The motor must only be operated with the correct phase current. Controlling the motor with excessively high phase current will destroy the motor immediately.

System check and initialization

▶ Switch on the 24 V power supply.

▶ Switch on the primary power supply.

Unit OK

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

The unit runs a self-test and checks the internal operating data, the parameters, the internal monitoring devices and the connected sensing equipment.

The DC link is loaded. The DC link LED D2 lights.

▶ Switch off the power supply again.

9844 1113 117, f107, 09.02

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-minute discharge time. Then measure the residual voltage at the DC link terminals DC+ and DC-. The residual voltage must not exceed 48 V before you start work on the connections.
If additional DC-link capacitors are connected, the discharge period is increased to 10 minutes. Wait for this period and then measure the residual voltage.

If additional DC-link capacitors are connected, the discharge period is increased to 10 minutes. Wait for this period and then measure the residual voltage.

Operational status indicator "2" — If the positioning controller hangs in the switching-on state "2", this indicates an internal fault in the unit which can only be identified and corrected by your local representative.

Operational status indicator "3" — If the display does not change from "3" to "4", check whether the line voltage is switched on and the line voltage connections are correctly wired.

Operational status indicator flashing — The unit has detected a fault. In "Diagnosis and troubleshooting" from page 8-1 you will find a list of the causes of faults.

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

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

The following commissioning steps are also required if you are using a configured unit under changed operating conditions. Incorrectly set values could cause permanent damage to the positioning controller, motor and system parts.

What you need to do...	Info
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 "Wiring examples" on page 4-49.	"Installation" from page 4-1
Make sure the limit switches work if these are installed.	page 5-13
Check the functioning of the holding brake controller if you are using motors with holding brake	page 5-14
Setting phase current and device parameters.	page 5-9
Check direction of rotation and conduct test run.	page 5-15
Optimizing movement behavior.	page 5-22

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.

9844 1113 117, f107, 09.02

5.2 Safety notes

Only qualified electrical technicians may commission the system.

WARNING!
Incorrectly set parameters can cause the motor to start unexpectedly with risk of crushing and damage to the system!
Close off the danger area and start up the motor when it is disconnected mechanically from the system and not under load.

WARNING!
Danger of injury and permanent damage to system parts by 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!
Permanent damage to the power controller!
Only change the settings for the phase current when the power supply has been switched off.

WARNING!
Incorrectly set parameters can cause the motor to start unexpectedly with risk of crushing and damage to the system!
Close off the danger area and start up the motor when it is disconnected mechanically from the system and not under load.

9844 1113 117, f107, 09.02

5.3 Commissioning tools

5.3.1 Overview

Two input routes are at your disposal for commissioning, setting parameters and 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

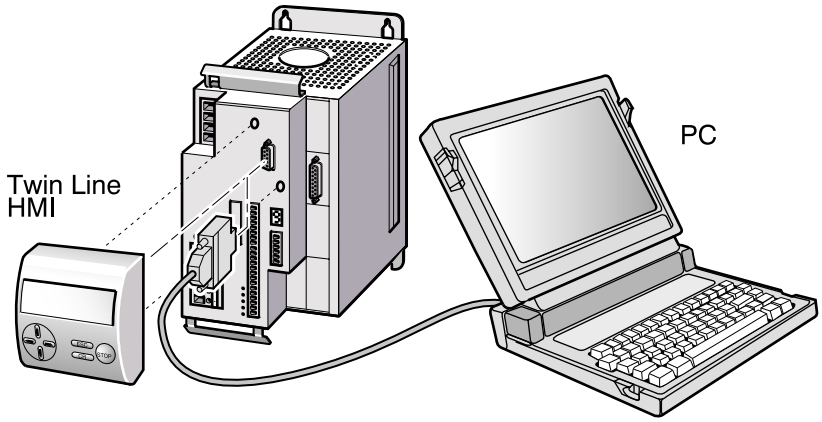


Fig. 5.1 Commissioning with the hand-held operating unit or the PC

9844 1113 117, f107, 09.02

5.3.2 The Twin Line HMI hand-held operating unit

HMI hand-held operating unit

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

The operation of a Twin Line unit with the HMI unit is described in the Twin Line HMI manual.

Menu structures for the TLC51x

The Twin Line HMI is menu-controlled. When the positioning controller is switched on, the menu structures and parameter values displayed are automatically adapted to the device type connected. The following menu items are available on the first and second levels for the positioning controller TLC51x:

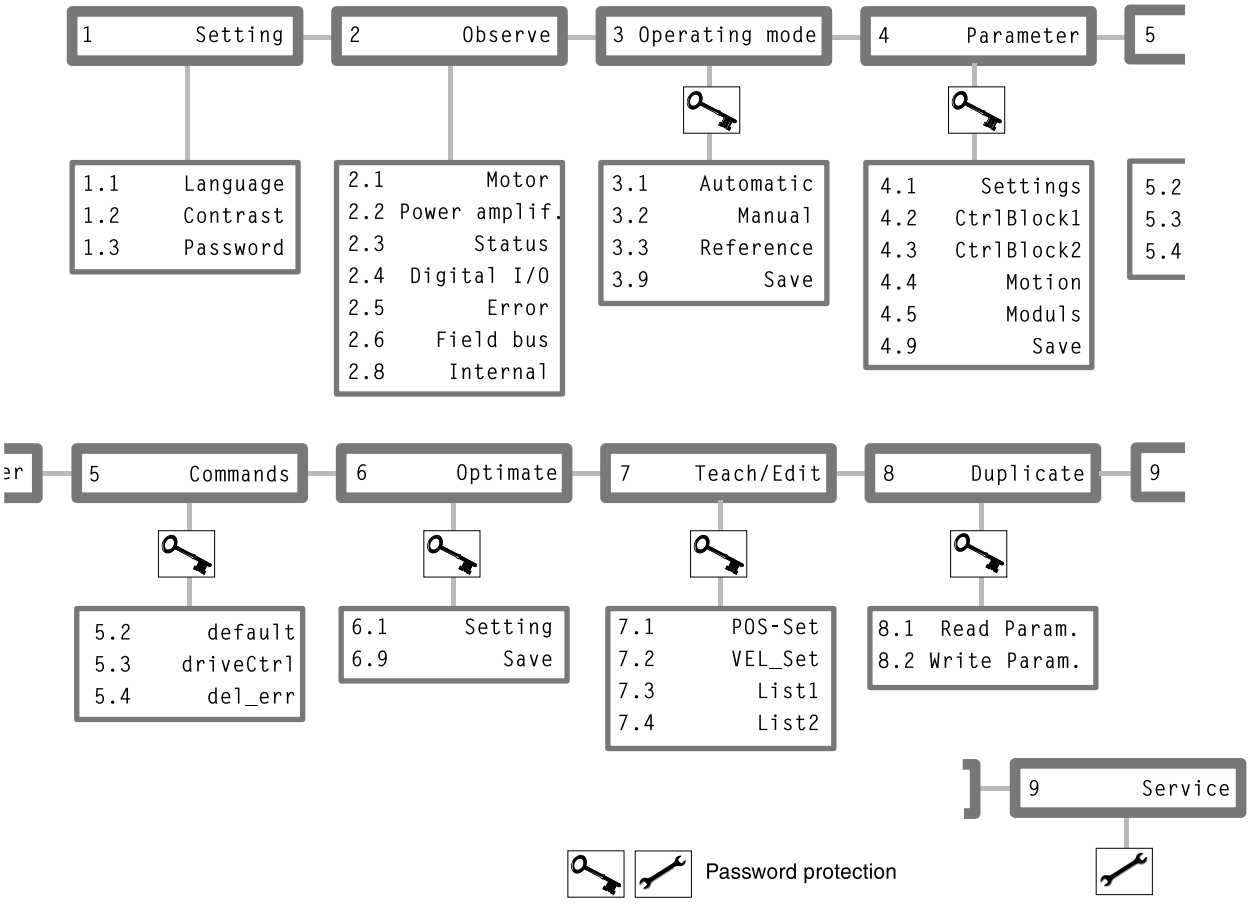


Fig. 5.2 First and second menu levels of the Twin Line HMI with TLC51x

9844 1113 117, f107, 09.02

First menu level	Meaning
1 Settings	Settings specific to the Twin Line HMI
2 Observe	Device and movement data with error displays
3 Operating mode	Selection and launch of the operating mode and settings for the operating mode
4 Parameters	Phase currents, movement parameters and settings for the modules
5 Commands	Default values, setting operating status, deleting error memory
6 Optimize	Settings for reference values
7 Teach/edit	Process data for list control with the positioning controller
8 Duplicate	Copy parameter sets to other Twin Line units
9 Service	Password-protected, for servicing purposes only

So that you can easily find all 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 Write Param.".

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

9844 1113 117, f107, 09.02

5.3.3 Twin Line Control Tool operating software

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 behavior.

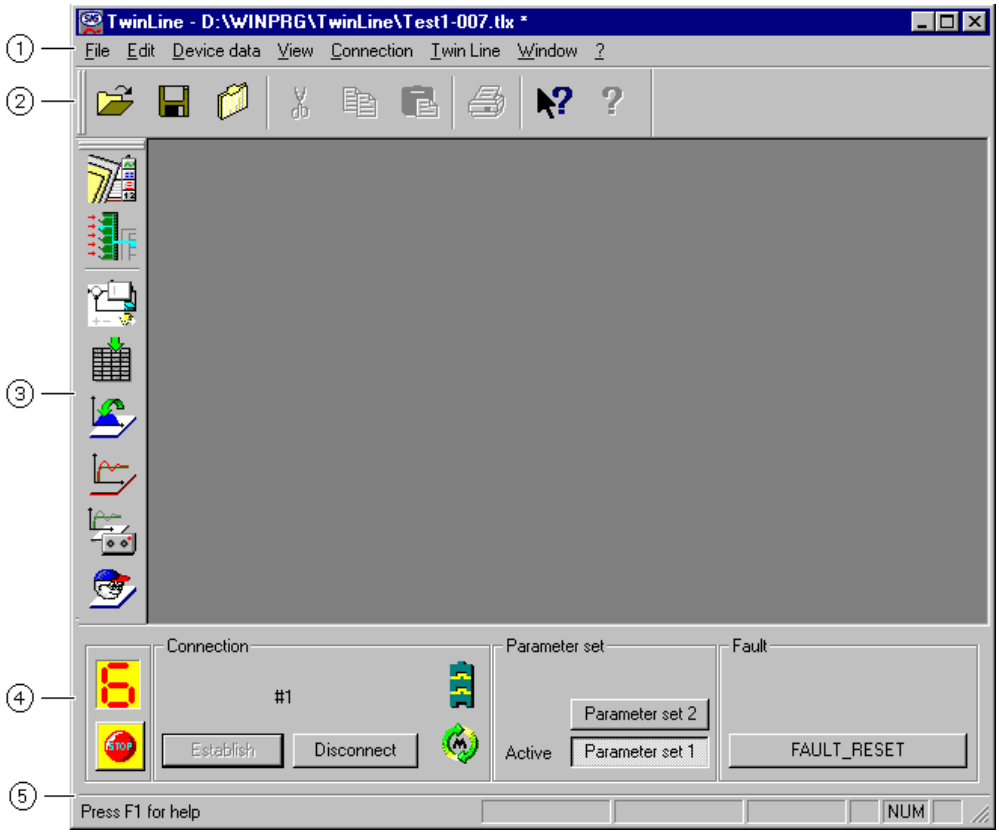


Fig. 5.3 Twin Line Control Tool operating software

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

Operation of a Twin Line unit 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 Tool

A PC or laptop with a free serial port and running Windows NT, Windows 95 or Windows 98 is required to work with the Twin Line Control Tool.

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

9844 1113 117, f107, 09.02

Menu structure All operating software commands can be executed with the menu items and the program buttons.

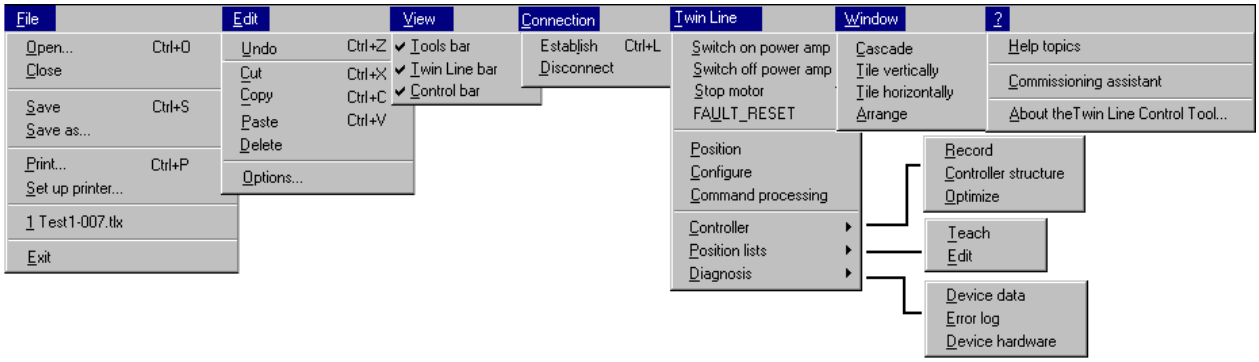


Fig. 5.4 The menu structure of the Twin Line Control Tool

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.

9844 1113 117, f107, 09.02

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.
- Testing and setting the phase current.
- Check the motor's direction of rotation and manual movement.
- Optimizing the movement behavior.

WARNING!
Danger of injury from uncontrolled operation of connected devices!
Check inputs via the input device, especially limit values for current, speed and motor type.

WARNING!
Danger of injury if braking function fails!
Secure the danger zone before starting up.

9844 1113 117, f107, 09.02

5.4.2 Setting phase current and device parameters

Setting device parameters

The corresponding parameter view must be selected to set the device parameters.

The parameter display contains information required to enable programs such as the TL CT operating software or the HMI handleld unit to identify a parameter. The parameter display can also provide information on setting options, presets and parameter properties. Note that the parameters of the Twin Line unit are grouped into functionally similar blocks, referred to as parameter groups. A parameter display has the following features:

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
VEL.velocity	36:1	3.1.2.1	Start of a speed change with transfer of setpoint speed [usr]	INT32 -2147483648..2147483647	–	R/W –

where:

- **Group.Name:** parameter designation made up of a combination of the name of the parameter group (="group") and the name of that specific parameter (="name").
- **Idx:Sidx:** index (="Idx") and subindex (="Sidx") for identification of a parameter, input options with the TL CT operating software in the "Monitor" window, selection of the parameter in field mode.
- **TL-HMI:** menu item of the three-level menu structure in the HMI that corresponds to a parameter; for more information see the chapter on "The Twin Line HMI hand-held operating unit" on page 5-4.
- **Explanation and unit [ ]:** detailed explanation of the parameter and its unit.
- **Range of values:** includes the data type, the variable numerical range for the parameter and the bit assignment of the parameter. The data type is significant for operation via field bus.
- **Default value:** value set by the manufacturer.
- **R/W:** Note on reading and writing the values (R:= read and W:= write).
  "R/-" – values can be read only,
  "R/W" – values can be read and written.
- **rem.:** The value is retentive; it is retained in the memory even after the unit is switched off.
  To ensure that the value is retained, the user must save the data to the non-volatile memory before shutting down the unit.
  This procedure can be run in TL CT by selecting "Save in EEPROM".
  "rem." - values are non-volatile,
  "-" - values are not non-volatile.

Instructions on input of values:

The "max. current" and "max. speed" values under "Range of values" correspond to the lower maximum values of power amplifier and motor. The unit limits automatically to the lower value.

Temperatures in Kelvin [K] = temperature in degrees Celsius [°C] + 273: e.g. 385 K = 85 °C

9844 1113 117, f107, 09.02

Use the specifications relevant for controlling the unit through the particular access channel.

Access channel	Specifications
field bus	Idx:Sidx
TL HMI	menu items under "TL-HMI"
TL CT	"Group Name", e.g. "Settings.SignEnabl"

Phase current

The positioning controller controls the motor torque with the phase current. A high phase current generates a high motor torque. To prevent damage to the motor, the maximum permissible phase current at the unit must be limited.

WARNING!
Phase current that is set too high can damage or destroy the motor!
The phase current at the unit must not be set higher than the rated phase current of the motor.

The values for the maximum allowable rated phase current are shown on the motor nameplate.

▶ Test the phase current setting for the following three parameters and reduce the values to maximum allowable rated phase current of the motor.

TL CT: Setting phase current

▶ Open the parameters window with "Twin Line → Configuring" and enter the limit values for current and speed in the "Settings" parameter group.

TL HMI: Setting phase current

▶ Input the limit values under the menu items which are shown in the table.

9844 1113 117, f107, 09.02

Enabling and disabling speed monitoring

The "Settings.monitorM" parameter checks the encoder connection and the motor temperature. If no encoder is connected during commissioning, the unit reports a line fault.

Disable the "Settings.monitorM" parameter during commissioning if an encoder is not connected yet.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Settings.I_0	14:10	4.1.30	Phase current standstill (100=1Arms)	UINT16 0..1000	90	R/W rem.
Settings.I_acc	14:11	4.1.31	Phase current acceleration/ deceleration (100=1Arms)	UINT16 0..1000	90	R/W rem.
Settings.I_const	14:12	4.1.32	Phase current constant movement (100=1Arms)	UINT16 0..1000	90	R/W rem.
Settings.monitorM	14:18	4.1.35	Motor monitoring, with module in M2 only 0: deactivated 1: activated	UINT16 0..3 Bit0: Speed monitoring Bit1: Temperature monitoring	3	R/W rem.
Motion.invertDir	28:6	4.4.27	Inversion of sense of rotation	UINT16 0..1 0: no inversion 1: sense 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 thresholds

▶ Set the thresholds for the following current and speed parameters before you operate the motor in the system. Suitable thresholds must be calculated from the system configuration and motor characteristics.

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

9844 1113 117, f107, 09.02

5.4.3 Starting the positioning controller

Requirements Either a computer with the Twin Line Control Tool operating software installed or the HMI hand-held unit must be connected to the positioning controller.

The power amplifier must be switched off so the motor is not controlled.

▶ If the access to the input/output signals is enabled with the "Settings.IO_mode" parameter, switch the "ENABLE" signal to low level.
Information on "Settings.IO_mode" can be found on page 6-2.

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

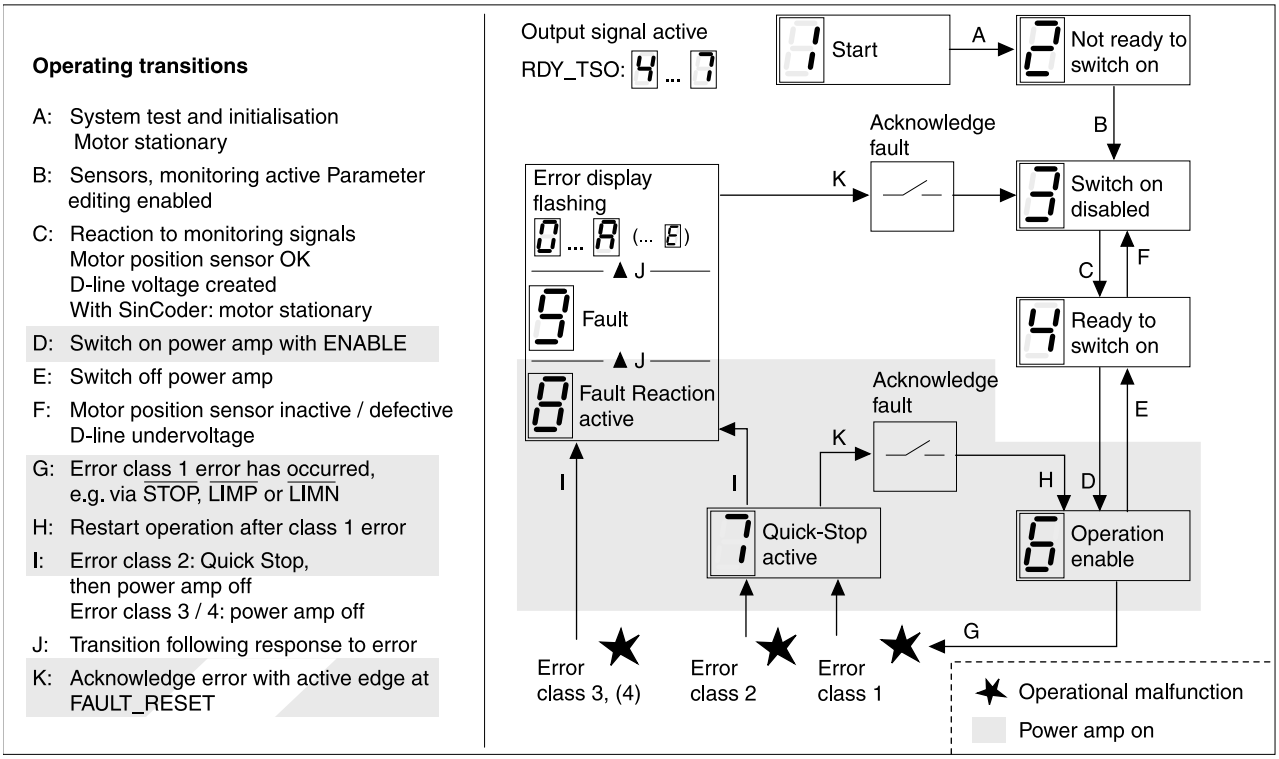


Fig. 5.5 Operating states and transitions of the positioning controller

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 in the section entitled "Diagnosis and troubleshooting" from page 8-1.

9844 1113 117, f107, 09.02

5.4.4 Checking the limit switches

▶ Trip the limit switches manually while observing the LEDs for the positive limit switch signal $\overline{\text{LIMP}}$ and the negative limit switch signal $\overline{\text{LIMN}}$. The LEDs remain on unless the limit switches have been tripped.

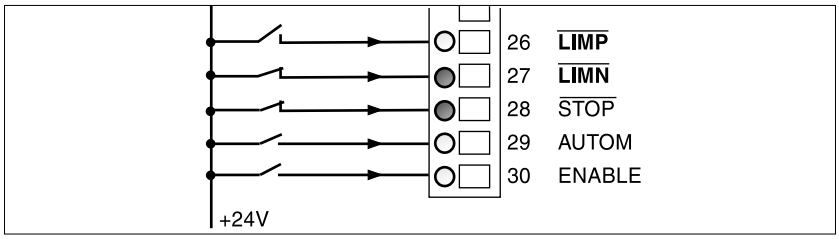


Fig. 5.6 Positive limit switch tripped

Enabling 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 Changing "Settings.SignEnabl" and "Settings.SignLevel". See page 7-25.

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 $\overline{\text{LIMN}}$.

9844 1113 117, f107, 09.02

5.4.5 Checking the holding brake

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

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

Standard unit

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 to alternately release and re-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 the brake is not applied, but not when the brake is applied.

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 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 the brake is not applied, but not when the brake is applied.

9844 1113 117, f107, 09.02

5.4.6 Test mode of motor with manual movement

WARNING!
Danger of injury and damage to system parts resulting from unexpected motor acceleration!
Run the first test run with no coupled load.
If the motor is already installed in the plant, ensure that any unexpected motor movements will not cause any damage.

The positioning controller is supplied with a controller preset so its smooth operation can be tested with a manual movement.

Operating options

Test mode with manual movement can be run with the TL CT operating software, the HIM hand-held unit or via the signal interface.

If you wish to run the Twin Line unit with the fixed preset signal interface assignment, run the test movement via the signal interface. To do this, set the "Settings.IO_mode" parameter to 2.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Settings.IO_mode	29:31	4.1.4	Significance of I/O signal assignment	UINT16 0..2 0: Setting the field bus parameters via inputs 1: I/O freely available 2: I/O assigned with function	0	R/W rem.

If the end switches or stop switches are not connected, the signals $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ or $\overline{\text{STOP}}$ mst be set to +24 V.

Manual movement with TL HMI

- ▶ Start the manual movement with the HMI hand-held unit with "3.2.11 Start" in the menu. The direction of movement is set with the cursor keys.
- ▶ Check the direction of rotation: The motor shaft must rotate clockwise when the right-hand button is pressed.

For details on manual movement with the HMI hand-held unit see the TL HMI manual.

Manual movement with TL CT

- ▶ Enable the power amplifier with "Twin Line → Switch on power amplifier".
- ▶ Open the "Positioning" dialog box with "Twin Line → Positionieren" and start the manual movement from the "Manual" tab.
- ▶ Check the direction of rotation: The motor shaft must rotate clockwise when one of the "Motor clockwise rotating" buttons is pressed.

For details on manual movement with the operating software see the TL HMI manual.

9844 1113 117, f107, 09.02

Manual movement via the signal interface

The "Settings.IO_mode" parameterr must be set to 2 for manual movement via the signal interface. The following signals must be switched.

I/O signal	Function	Value
MAN_N	stop motor Movement in counterclockwise direction	low/open high
MAN_P	stop motor Movement in clockwise direction	low/open high
$\overline{\text{STOP}}$ 1)	Stop motor with Quick-Stop Mode release	low high/open
AUTOM	Manual mode Automatic mode	low/open high
ENABLE	Power amplifier switched off Power amplifier released	low/open high

1) Signal level for default setting of "Settings.SignEnabl" and "Settings.SignEnabl"

- ▶ Switch on manual mode: Deactivate AUTOM input signal.
- ▶ Switch on power amplifier: Enable ENABLE input signal.
- ▶ Rotate motor shaft clockwise: Enable MAN_P input signal.

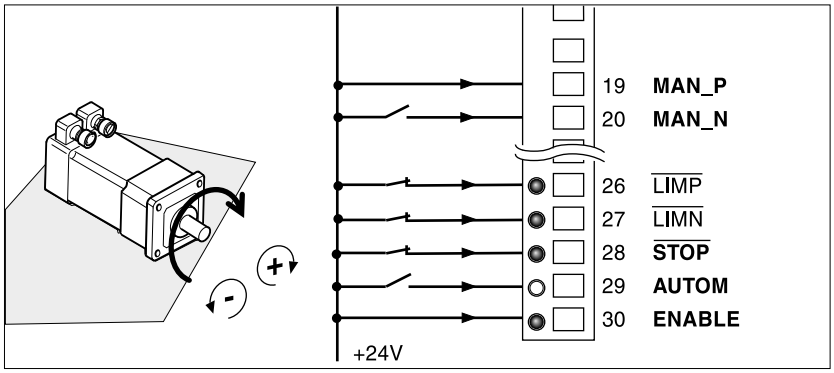


Fig. 5.7 Check direction of rotation

If the MAN_FAST signal is connected, you can switch between fast and slow movement mode.

For manual movement the preset movement parameters for slow and fast motor speed ad for maximum motor current can be changed; see page 6-10.

9844 1113 117, f107, 09.02

5.4.7 Setting and checking signal interface 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 HMI hand-held unit. The signal states of the inputs and outputs can also be changed with the operating software - independently of the hardware signals 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" and for the outputs in the parameters "I/O.QW0_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.

	Inputs			Outputs	
Bit	**I/O.IW0_act**	**I/O.IW1_act fixed assignment**	**I/O.IW1_act freely assignable**	**I/O.QW0_act fixed assignment**	**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	-	DIG_IN1 [1)]	DIG_IN1 [1)]	DIG_OUT1 [1)]	DIG_OUT1 [1)]
15	-	DIG_IN2 [1)]	DIG_IN2 [1)]	DIG_OUT2 [1)]	DIG_OUT1 [1)]

1) Assigned only if the unit is fitted with the IOM-C analog module

TL CT: Displaying signal states

▶ Select "Twin Line → Diagnostics → Device hardware" and click on the "Inputs/outputs" tab.

9844 1113 117, f107, 09.02

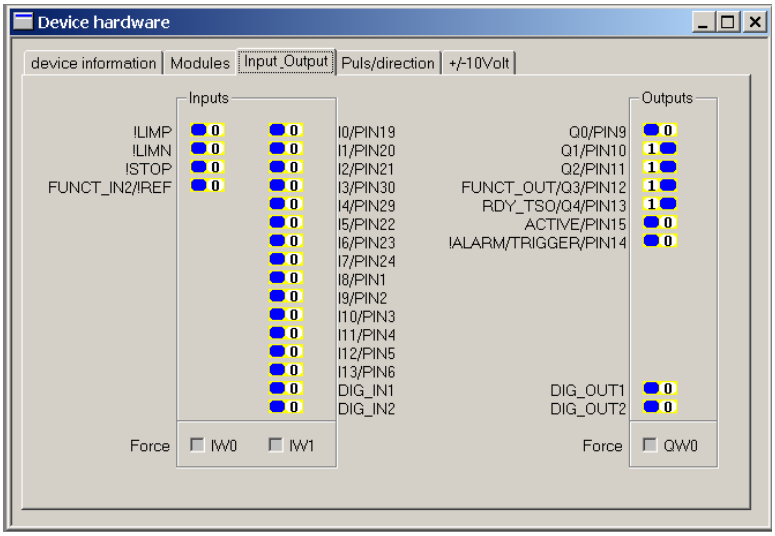


Fig. 5.8 Switching the inputs/outputs of the signal interface with the operating software

"DIG_IN 1/2" and "DIG_OUT 1/2" are only shown if an analog module is installed at M1.

▶ 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. "Electronic gear" mode must be activated for this.

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

9844 1113 117, f107, 09.02

TL HMI: Displaying signal states

▶ Change to "2.4.1 IW0_act", "2.4.2 IW1_act" or "2.4.10 QW0_act".

"IW0_act" and "IW1_act" show the inputs in bit-coded form, "QW0_act" the outputs.

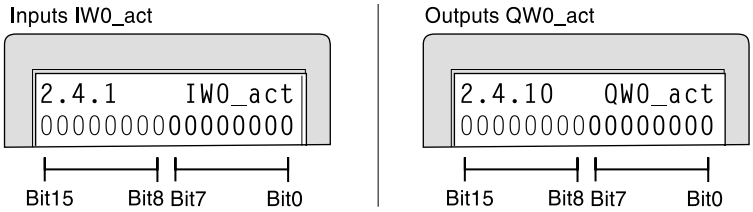


Fig. 5.9 Observing inputs/outputs of the signal interface with the HMI hand-held unit

The switching states of input and output signals cannot be changed with the HMI hand-held unit.

For detailed information on displaying signals with the HMI hand-held unit see the Twin Line HMI manual.

Displaying analog inputs

The value at the analog input, pins 17 and 18 of the signal interface, can be displayed by:

- TL HMI
- TL CT
- field bus

9844 1113 117, f107, 09.02

TL CT: Displaying analog input

▶ Open the diagnostics window with "Twin Line → Diagnosis → device data" and the "+/-10Volt" tab.

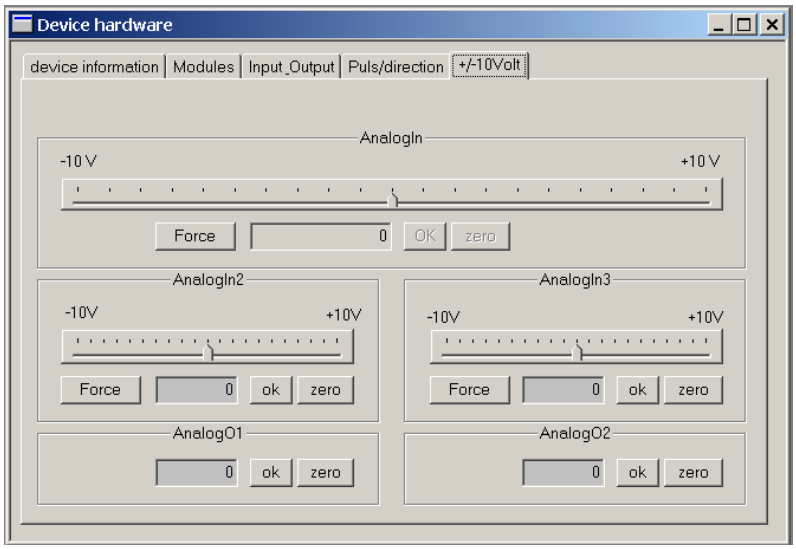


Fig. 5.10 Displaying and setting the analog input with the operating software

Operating elements for AnalogIn2/3 and AnalogO1/2 are visible only if the IOM-C analog module is installed at M1.

▶ Switch on the "Force" field to change the voltage of the analog input.
To change analog 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.

9844 1113 117, f107, 09.02

Field bus: Displaying analog input

▶ The analog input is read and set using the "Status.AnalogIn" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Status.AnalogIn	20:8	2.3.3.1	analog input at input ANALOG_IN [mV]	INT16 -10000... +10000	0	R/- -
M1.AnalogIn2 1)	21:14	2.3.3.5	voltage value analog input 2 ANA_IN2 [mV]	INT16 -10000... +10000	-	R/- -
M1.AnalogIn3 1)	21:19	2.3.3.6	voltage value analog input 3 ANA_IN3 [mV]	INT16 -10000... +10000	-	R/- -
M1.AnalogO1 1)	21:24	2.3.3.7	analog output 1 ANA_OUT1 [mV] (1000=1V)	INT16 -10000... +10000	0	R/W -
M1.AnalogO2 1)	21:27	2.3.3.8	analog output 2 ANA_OUT2 [mV] (1000=1V)	INT16 -10000... +10000	0	R/W -

1) Assigned only if the unit is fitted with the IOM-C analog module

9844 1113 117, f107, 09.02

5.4.8 Optimizing the movement behavior of the motor

The positioning controller provides as default a ramp function with linear acceleration and deceleration ramps. In addition, the ramp shape can be further optimized by values of the torque characteristic of the motor.

Setting the linear ramp function

The linear ramp is optimized in three steps.

- Estimating the slope for the acceleration and deceleration.
- Setting start-stop speed.
- Selecting setpoint speed.

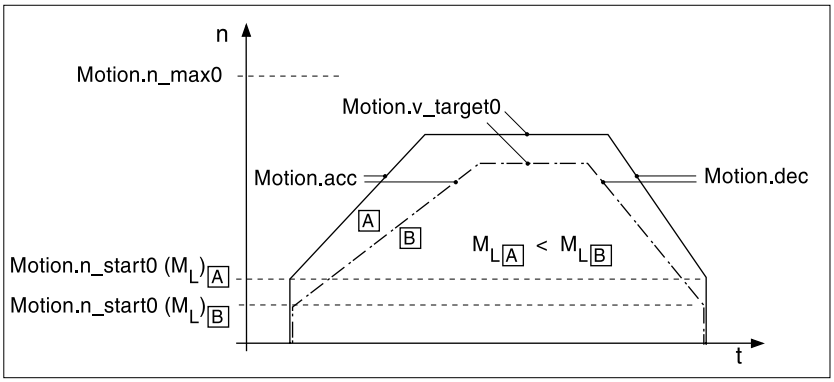


Fig. 5.11 Lineare ramp settings with variable load M_L

Setting the slope of the ramps

The slopes of the ramp function are entered in the "Motion.acc" and "Motion.dec" parameters. The values can be estimated with the following formulas.

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

Characteristic value	Meaning	Unit
M_M	Available motor torque	Nm
M_M	External load torque	Nm
J_{Ges}	External moment of inertia	kgm^2
α	Angular acceleration	rad/sec^2
Motion.acc	Acceleration parameters	[rev/(min*s)]
Motion.dec	Deceleration parameters	[rev/(min*s)]

9844 1113 117, f107, 09.02

Start-stop speed

A special property of stepper motors is the extremely fast acceleration from standstill, which can be set as start-stop speed with the "Motionn_start0" parameter.

The start-stop speed can be set at up to 60 rpm depending on external load, but should be at least 12 rpm. A lower speed value set too low may cause mechanical resonances in the stepper motor at low, external damping.

Too high a value for the start-stop speed can be recognized by the fact that only reduced ramp values for acceleration and deceleration can be set.

Setpoint speed

The motor setpoint speed depends on the application requirements. It is set with 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 stepper motor, apart from its size and the type of electrical control, primarily depends on the speed The interdependence of speed and torque is shown as a typical characteristic of a stepper motor in motor data sheets.

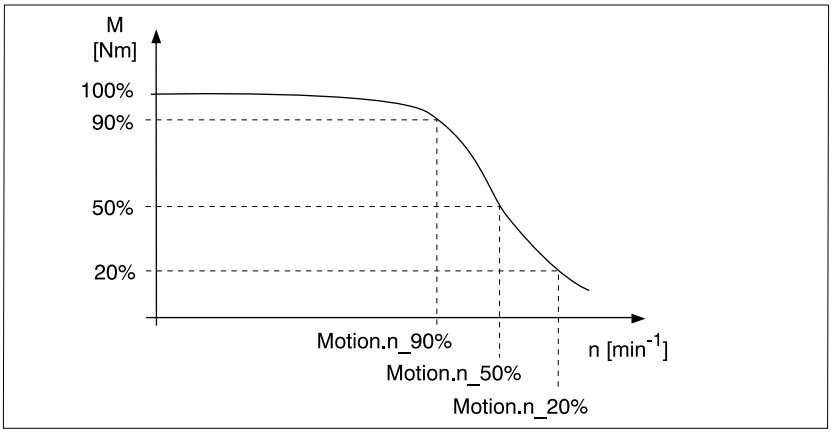


Fig. 5.12 Typical torque characteristic of a stepper motor

In the higher speed range the available torque decreases greatly with increasing speed. The available acceleration is also correspondingly reduced. In addition to the acceleration values of the ramp, there are three interpolation points for optimized operation.

9844 1113 117, f107, 09.02

Entering 90%, 50%, 20% interpolation points

Take the speed values at which 90%, 50% and 20% of the maximum torque are avialble from the table depending on the motor type and enter the values at the parameters "Motion.n_90%", "Motion.n_50%" and "Motion.n_20%". The speed settings can only be made in operating modes 1 to 4 and 8 to 9.

	VRDM368	VRDM397	VRDM3910	VRDM3913	VRDM31117	VRDM31122
Motion.n_90%	420	660	600	480	360	360
Motion.n_50%	1260	1620	1260	1020	720	690
Motion.n_20%	2580	2940	2400	1860	1800	1380

The default values of motor type VRDM31122 are used below.

Parameter Name	**Idx:Sidx**	**TL-HMI**	**Explanation and unit [ ]**	**Range of values**	**Default Value**	**R/W rem.**
Motion.n_90%	14:15	4.4.30	Motor speed with 90% of standstill torque [rpm]	UINT16 1..3000	360	R/W rem.
Motion.n_50%	14:16	4.4.31	Motor speed with 50% of standstill torque [rpm]	UINT16 1..3000	690	R/W rem.
Motion.n_20%	14:27	4.4.32	Motor speed with 20% of standstill torque [rpm]	UINT16 1..3000	1380	R/W rem.
Motion.n_max0	29:21	4.4.28	Speed limit for travel profile [rpm]	UINT32 1..3000	3000	R/W rem.
Motion.n_start0	29:22	4.4.10	Start-stop speed [rpm]	UINT32 1..n_max0 0..3000	12	R/W rem.
Motion.v_target0	29:23	4.4.11	Setpoint speed [usr]	UINT32 1..n_max0 1..2147483647	60	R/W rem.
Motion.acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1..2 1: linear 2: Exponential	1	R/W rem.
Motion.acc	29:26	4.4.14	Acceleration [usr]	UINT32 1.. 2 147 483 647	600	R/W rem.
Motion.dec	29:27	4.4.15	Deceleration [usr]	UINT32 1.. 2 147 483 647	600	R/W rem.

9844 1113 117, f107, 09.02

6 Operating modes of the positioning controller

6.1 Changing the operating mode

Operating modes

The positioning controller functions in the following operating modes:

- manual movement mode
- automatic speed mode
- automatic point-to-point mode
- automatic referencing mode
- automatic electronic gear mode, when RS422-C or PULSE-C modules are installed in slot M1
- automatic oscillator mode

6.1.1 Access channels

Local and remote access

Data exchange and control of Twin Line units is possible over various access channels:

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

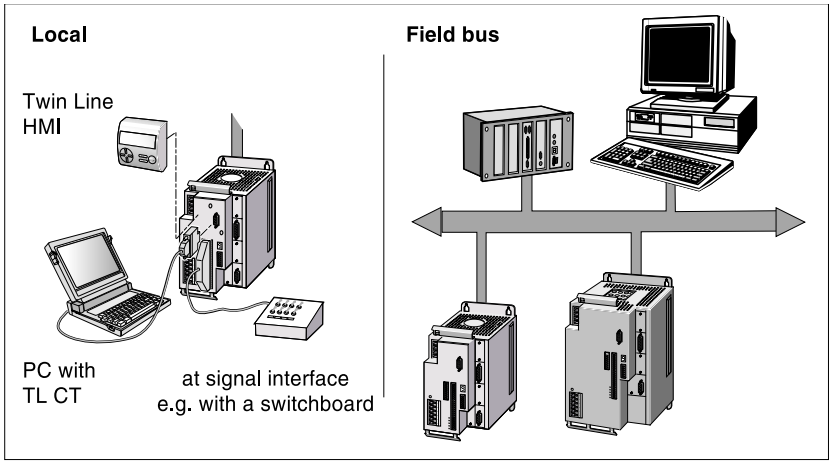


Fig. 6.1 Local and remote access to Twin Line units

Automatic access security

If an operating mode is initiated through an access channel, the operating mode can only be changed with this access channel during processing. A different operating mode can be selected with other access channels only after 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 new operating mode.

9844 1113 117, f107, 09.02

Access for local operating devices to the Twin Line unit can be disabled and enabled with the "Commands.OnlAuto" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Commands.OnlAuto	29:30	-	Access to the mode setting	UINT16 0..65535 0: access via all channels 1: access only via the channel that has set this parameter	1	R/W -

The local channels are available again when the field bus master enables them again with these parameters or when field bus mode is interrupted.

6.1.2 Access control for selecting operating mode or function

Access channels are enabled and operating mode selection options are set with the "Settings.IO_mode" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Settings.IO_mode	29:31	4.1.4	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 with function	0	R/W rem.

IO_mode=0 or 1 Signal interface inputs and outputs for free assignment with "Settings.IO_mode"= 0 for the field bus configuration or with "Settings.IO_mode"= 1. In both cases operating modes can be started with equal access with the HMI hand-held unit TL CT operating software or the field bus.

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

1) •: access possible, –: no access

9844 1113 117, f107, 09.02

IO_mode=2 If the parameter is "Settings.IO_mode"=2, the signal interface inputs and outputs have a fixed assignment. Operating modes and functions can be started locally depending on the AUTOM input signal or via the field bus.

- AUTOM=0, low level: locally with the HMI hand-held unit, TL CT operating software or signal interface
- AUTOM=1, high level: via field bus

The following table shows the operating modes and functions available depending on the status of the AUTOM signal.

	Access channels			
Operating modes and functions [1)]	**TL HMI**	**TL CT**	**I/O of signal interface**	**Field bus**
manual mode	0	0	0	1
point-to-point mode	0	0	–	1
speed mode	0	0	–	1
electronic gear	0	0	–	1
referencing	0	0	–	1
oscillator mode	–	0	–	1

1) •: access possible, –: no access

If the AUTOM signal changes, the new operating mode is activated after completion of the current process. The controller confirms the change with 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 enabled Operation via field bus enabled	low high

9844 1113 117, f107, 09.02

6.1.3 Selecting the operating mode

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

Operation can be switched between manual mode and automatic mode, which can be set via parameters, via the signal interface. This requires fixed assignment of the signal interface.

The current operating mode can be monitored with the bits in the "Status.xMode_act" parameter.

Example of PTP mode

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

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	Idx:Sidx	TL-HMI			Value	rem.
PTP.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 –

PTP operating mode can be initiated with the HMI hand-held unit by selecting "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: 01 00 23h: 44h:	sf=0, write access Subindex 1: Index 35 324 mm
acknowledgement 00 23 00 06. 00 00 00 00h	23h: 00 06h:	ref_ok=1, PTP mode motion_end=0, amplifier on

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

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

9844 1113 117, f107, 09.02

6.1.4 Monitoring the set operating mode

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

Status Parameter

The positioning controller has a global and a mode-specific status parameter for monitoring operations.

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

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Status.driveStat	28:2	2.3.5.1	Status word for the operating status	UINT32 0..429496795 Bit0..3: Current 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 message Bit8..11: not assigned Bit12..15: Mode-specific coding of the processing status Bit13: x_add_info Bit14: x_end Bit15: x_err Bit16-20: current operating mode (Bit0-4: Status.xmode_act) 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) 6: Electronic gear speed controlled 7: Data set mode 8: function generator (current controller) 9: function generator (speed controller) 10: function generator (position controller) 11..15: cannot be set 16: Function generator in disabled status 17: Current regulation 18: Oscillator mode 19..30: reserved 31: not used Bit21: drive is referenced (ref_ok) Bit22: control deviation in position window (SM not assigned)	–	R/– –

9844 1113 117, f107, 09.02

Global status bits

The status bits (bit13 - bit15) in the status parameter are taken unchanged from the status bits of operating mode specific status parameters: The global status bits have the same significance as the status bits of the individual mode:

Status bit	Function	Value
Bit13: x_add_info	Additional information depending on operating mode	low/high
Bit14: x_end	Process running Process finished, motor stopped	low high
Bit15: x_err	Fault-free operation Fault has occurred	low high

Mode-specific status parameters

Every operating mode has its own status parameter, which contains information on the processing status in bits13 to 15.

For example, the following applies for PTP operation:

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
PTP.statePTP	35:2	3.2.14	Acknowledgement: PTP positioning	UINT16 0..65535 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: Set position reached Bit14: motion_end Bit15: motion_err	–	R/– –

Status via I/O signals

The operating states via the signal interface can be evaluated if the interface assignment is fixed.

I/O signal	Function	Value
AXIS_ADD_INFO	Additional information depending on operating mode	low/high
AXIS_END	Process running Process 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 process initiated, bit14 changes to "0". When the process is finished, bit14 changes back to "1" thereby indicating that further process steps can now be executed. Corresponding to status monitoring or AXIS_END at low level.

Bit14's signal change to "1" is suppressed if one process is followed immediately by a new process in a different operating mode.

If bit15 shows "1", a fault has occurred and must be corrected before processing continues. The positioning controller reacts according to one of the fault categories depending on the seriousness of the fault, see chapter "Diagnosis and troubleshooting", page 8-1.

9844 1113 117, f107, 09.02

6.1.5 Status monitoring in movement mode

Status parameters

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

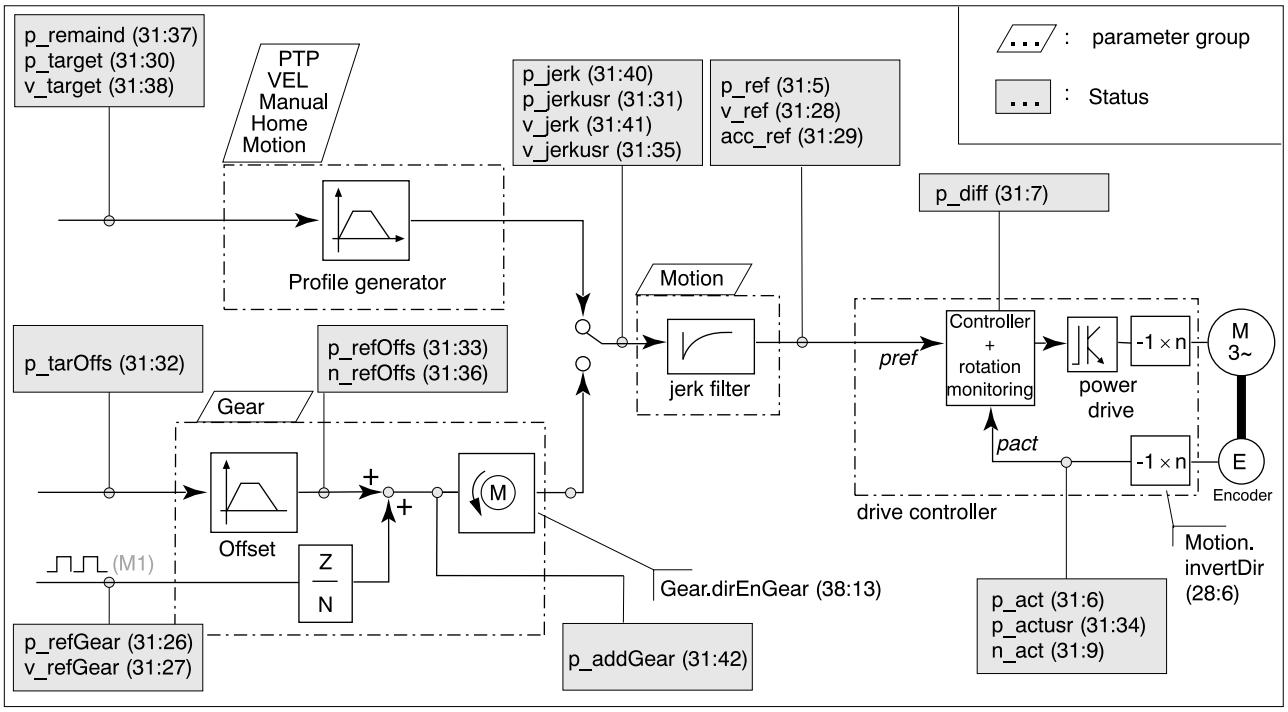


Fig. 6.2 Monitoring movement mode with status parameters

Current control and Oscillator modes are not shown in the diagram for the sake of clarity. For more information see chapter "Oscillator mode".

Parameter sets

Operating modes are set via parameters in parameter groups specific to that mode:

- PTP group: settings for Point-to-Point mode
- VEL group: settings for speed mode
- Gear group: settings for electronic gear mode with superimposed offset
- Motion group: parameter settings for all modes: jerk filter, direction of rotation, software limit switches, standardization and ramp settings

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

9844 1113 117, f107, 09.02

Profile generator

Target position and final speed are input values to be entered by the user. The profile generator uses these values to calculate a motion profile dependent on the selected operating mode. 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 chapter "Ramp function" from page 7-19.

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.

9844 1113 117, f107, 09.02

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 start signals. In the "classic manual movement" mode, the motor changes to continuous motion if the start signal is persistent.

Manual mode can be executed by

- HMI hand-held operating unit
- operating software
- field bus
- signal interface inputs when the signal interface is permanently assigned

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating mode with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

Starting manual mode

The starting conditions for a manual movement depend on the settings of the signal interface assignments. The setting is changed with the "Settings.IO_mode" parameter, see page 6-2.

- Free assignment, parameter value "Settings.IO_mode"=0 or 1: The positioning controller switches to manual movement as soon as the movement is initiated by a control unit or the "Manual.startMan" parameter over the field bus. A manual movement via the signal interface is not possible with free assignment of the interface.
- Fixed assignment, parameter value "Settings.IO_mode"=2:
  With input signal AUTOM = 0 manual mode can be started via the interface inputs or with an operating unit as soon as the AUTOM_ACK output changes to Low level. If the input signal displays AUTOM = 1, the manual movement can be started with the parameter "Manual.startMan" over the field bus as soon as AUTOM_ACK references high level.

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

Manual movement is initiated by the "Manual.startMan" parameter. The current axis position is the start position for 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

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

9844 1113 117, f107, 09.02

The "Manual.statusMan" parameter shows information on the status of the process.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Manual.startMan	41:1	3.2.1	Start of manual movement with transfer of control bits	UINT16 0..7 Bit2: 0: slow 1: fast Bit1: neg. sense of rotation Bit0: pos. sense of rotation	–	R/W –
Manual.statusMan	41:2	–	Acknowledgement: manual movement	UINT16 0..65535 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/– –

Manual movement enabled and started via the interface signals:

I/O signal	Function	Value
I: AUTOM	Switching to Manual operating mode Switching to Automatic operating mode	low/open high
O: AUTOM_ACK	Manual mode possible Manual mode not possible	low/open high
I: MAN_N	Traverse in anticlockwise direction of rotation	high
I: MAN_P	Traverse in clockwise direction 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 processing modes:

- classical manual movement
- united inching

The processing modes can be changed by the "Manual.typeMan" parameter.

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

9844 1113 117, f107, 09.02

Classical manual movement

On receiving the start signal for manual movement, the motor first moves along a defined distance, "Manual.step_Man". If the start signal is still persistent after a specific delay period "Manual.time_Man", the positioning controller changes to continuous movement until the start signal is canceled.

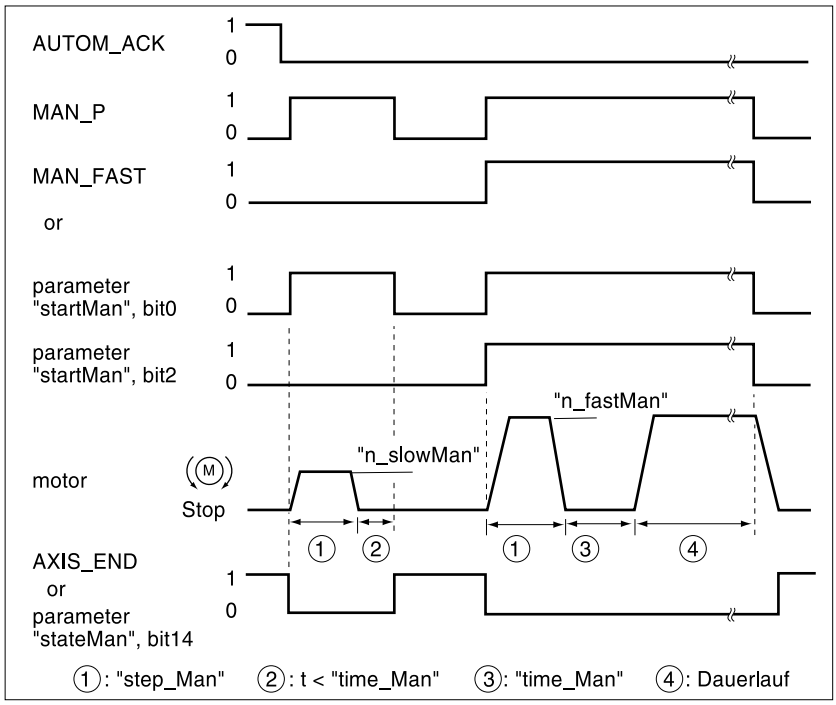


Fig. 6.3 Classical manual movement, slow and fast

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

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

9844 1113 117, f107, 09.02

United inching

The motor moves a defined distance at every start signal for manual movement. If the start signal is canceled before the destination has been reached, the positioning controller will stop the motor immediately.

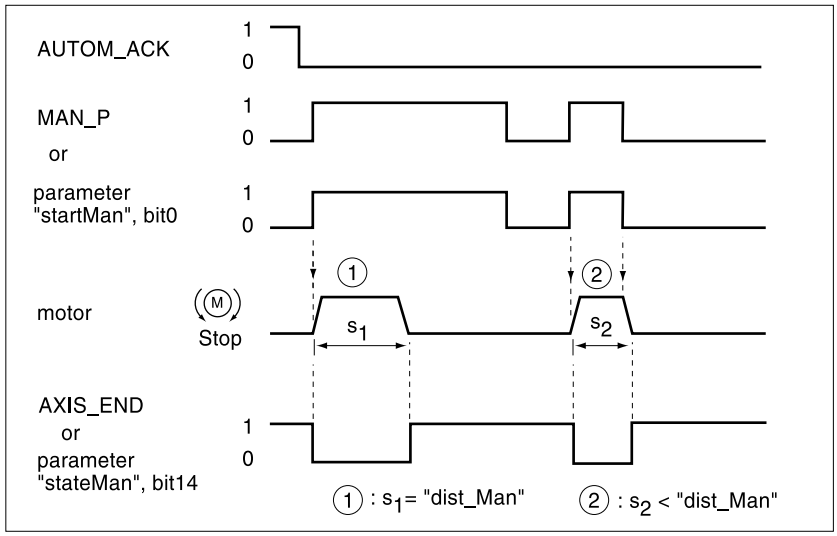


Fig. 6.4 Manual movement with united inching

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

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

Setting options

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

- Changing acceleration and delay behavior using "ramp function", jerk filter" and "quick stop function".
- Making position-dependent speed or signal changes with "list control and list data processing".
- Creating list data with the "teach-in processing".
- Adapting user-defined units and internal units with the "calibration" function.
- Setting unit and movement monitoring with "monitoring functions".

9844 1113 117, f107, 09.02

Example A simple, partially automated movement mode can be set up by controlling the signals for manual movement with a manually operated switch and cam switches.

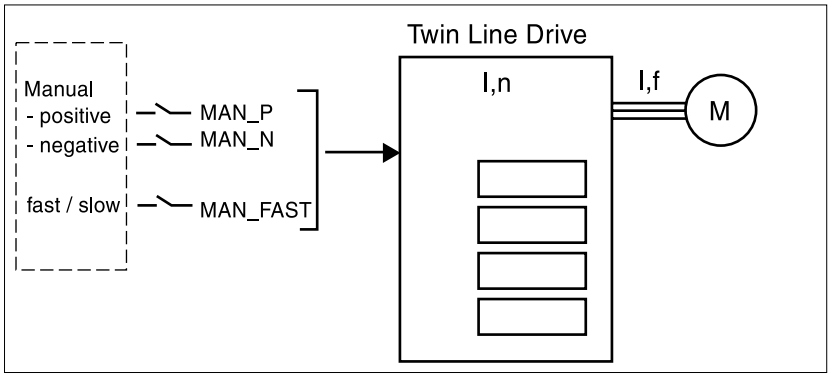


Fig. 6.5 Manual mode using input and output signals

9844 1113 117, f107, 09.02

6.3 Speed mode

In speed mode a setpoint speed is specified for the motor, 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 terminated.

Speed mode can be carried out by:

- HMI hand-held operating unit
- operating software
- field bus

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating mode with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

Starting speed mode

As soon as a speed value is sent to the positioning controller with 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" shows information on the processing status.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
VEL.velocity	36:1	3.1.2.1	Start of speed change with transfer of setpoint speed [usr]	INT32 -2147483648..2147483647	–	R/W –
VEL.stateVEL	36:2	–	Acknowledgement: Speed profile mode	UINT16 0..65535 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 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 range limits.

New ramp settings are transmitted when a speed value is sent with the "VEL.velocity" parameter.

9844 1113 117, f107, 09.02

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

- Changing acceleration and delay behavior using "ramp function", "jerk filter" and "quick stop function".
- Making position-dependent speed or signal changes with "list control and list data processing".
- Creating list data with the "teach-in processing".
- Adapting user-defined units and internal units with the "calibration" fnction.
- Setting unit and movement monitoring with "monitoring functions".

9844 1113 117, f107, 09.02

6.4 Point-to-point mode

Point-to-point mode (PTP mode, PTP: Point to Point) positions the motor from a point A to a point B with a positioning command. The positioning distance is given in absolute terms with reference to the zero point of the axis or in relative terms with reference to the current axis position.

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

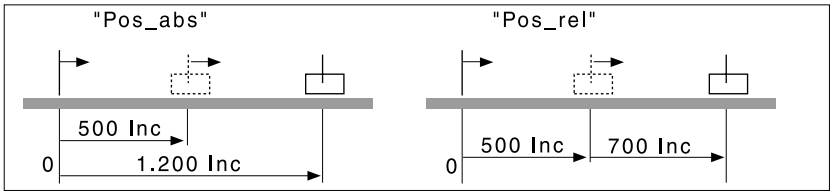


Fig. 6.6 Point-to-point positioning, absolute and relative

PTP mode can be executed by:

- HMI hand-held operating unit
- operating software
- field bus

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating mode with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

Starting 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 mode and starts the positioning process at the set speed 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 shows information on the status of the process.

If a mode other than PTP mode is active, relative positioning may only be initiated when the motor is at standstill.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
PTP.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 –
PTP.statePTP	35:2	3.2.14	Acknowledgement: PTP positioning	UINT16 0..65535 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: Set position reached Bit14: motion_end Bit15: motion_err	–	R/– –

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
PTP.p_relPTP	35:3	3.1.1.2	Start of relative positioning with transfer of the value for the distance [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 0..65535 value is not relevant for positioning	–	R/W –
PTP.v_tarPTP	35:5	3.1.1.5	Setpoint speed of PTP positioning [usr]	INT32 1....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 analyzed.

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 predefined position.

You will find further settings and functions for PTP operation in:

- Changing acceleration and delay behavior using "ramp function", "jerk filter" and "quick stop function".
- Making position-dependent speed or signal changes with "list control and list data processing".
- Creating list data with the "teach-in processing".
- Adapting user-defined units and internal units with the "calibration" function.
- Setting unit and movement monitoring with "monitoring functions".

9844 1113 117, f107, 09.02

6.5 Electronic gear

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

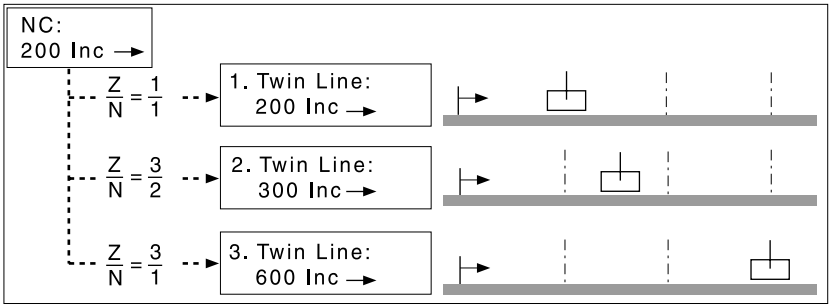


Fig. 6.7 Electronic gear with three Twin Line units, gear ratio adjustable via gear factor (Z, N)

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

To work in electronic gear mode, the RS422-C encoder module or the PULSE-C pulse/direction module must be inserted in slot M1. Different types of signal can be fed depending on the module:

- A/B signals with four-way evaluation of sensor signals with the RS422-C module
- Pulse/direction signal or $pulse_{forward}$/$pulse_{backward}$ signals with the PULSE-C module.

Electronic gear mode can be executed by:

- HMI hand-held operating unit
- operating software
- field bus

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating mode with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

9844 1113 117, f107, 09.02

Starting electronic gear

This mode is activated with the "Gear.startGear" parameter. If reference pulses are fed in, the positioning controller offsets them against the gear factor and positions the motor at the new setpoint.

Position values are given in internal increments. The positioning controller reacts to any change in the values immediately. Electronic gear mode is not limited by the positioning area boundaries.

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

Synchronization

In electronic gear 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, it loses synchronization with the other drives. When gear processing is restarted, the drive has two ways of re-establishing synchronization.

- Immediate synchronization: the positioning controller follows reference pulses from the moment when gear processing is activated. Reference pulses, offset entries and position changes that have occurred before the mode started are not taken into consideration.
- Synchronization 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 synchronization with compensatory movement. For more information on this subject see "Synchronization with compensatory movement", page 6-25.

The type of synchronization required is set by the "Gear.startGear" parameter, which also initiates the mode.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Gear.startGear	38:1	3.1.3.1	Starting an electronic gear process with selection of the processing mode	UINT16 0..2 0: deactivated 1: immediate synchronization 2: synchronization with compensatory movement	–	R/W –
Gear.stateGear	38:2	–	Acknowledgement: gear processing	UINT16 0..65535 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/– –

9844 1113 117, f107, 09.02

6.5.1 Gear settings

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

- gear factor
- maximum acceleration
- maximum speed
- offset value for PTP offset positioning
- parameter for the reference encoder speed filter
- enabling sense of rotation

Gear factor The gear factor is the ratio between motor increments and externally fed reference increments for motor movement. The gear factor is defined with the parameters for numerators and denominators. A negative numerator value reverses the motor's direction of rotation. The gear ratio is preset to 1:1.

$$\text{Gear factor} = \frac{\text{Motor increments}}{\text{Reference increments}} = \frac{\text{Gear factor numerator}}{\text{Gear factor denominator}}$$

At a setting of 1000 reference increments the motor should rotate 2000 motor increments. This yields a gear ratio of 2:1 or a gear factor of 2.

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	Gear factor numerator	INT32 -2147483648..2147483647	1	R/W –
Gear.denGear	38:8	–	Gear factor denominator	INT32 1..2147483647	1	R/W –

The resulting positioning path depends on the current motor resolution; this is 19200 pulses per revolution with stepper motor units.

9844 1113 117, f107, 09.02

Acceleration/ deceleration

The maximum values for acceleration and deceleration are set with "Gear.a_maxGear". In the case of active gear the drive always decelerates with this value with a Quick-Stop and with errors of arror class 1 or 2. The settings in "Settings.SignQstop" do not influence the deceleration behavior with active gear.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Gear.a_maxGear	38:6	3.1.3.20	Maximum acceleration [rpm*s] Note: Acceleration calibration is not considered	UINT32 120.. 120000	600	R/W rem.

Movement speeds

The maximum speed in electronic gear mode is set with "Gear.n_maxGear". A speed calibration is not considered.

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

Following errors

If the pulse frequency at the setpoint input changes quickly, the drive will not be able to follow a positioning setpoint directly. A temporary following error results. This following error can have any values.

Direction enabling

Direction enabling prevents any movement opposed to the desired direction of travel, which could occur with compensatory or offset movements. Direction enabling is set by the "Gear.dirEnGear" parameter.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Gear.dirEnGear	38:13	-	Release of movement direction, If the direction is inverted, the release of movement direction is reversed	INT16 1..3 1: positive direction 2: negative direction 3: both directions	3	R/W rem.

Current settings

If the drive is in "electronic gear" mode, the standstill current is phase current with inactive gear.
"Settings.I_O" effective.
With active gear the phase current for acceleration and deceleration "Settings.I_acc" is always effective, regardless of whether and how the motor is rotating.

9844 1113 117, f107, 09.02

Filter for reference encoder speed

The reference encoder speed is smoothed by a filter to ensure smooth synchronization at constant reference speed, even with stepper motor units. The filter parameters "Gear.Flt_nGear" and "Gear.Flt_rGear" must be set accordingly.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**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 –
Gear.Flt_rGear	38:14	3.1.3.22	Tripping threshold for speed filter.	UINT16 1..100 Speed change from which the filtering of the reference speed is disabled [Inc / ms^2]	15	R/W rem.

The higher the value "Gear.Flt_nGear" for the speed filter is set, the stronger the filtering.

Reference encoder speed filtering can be switched off with the "Gear.Flt_rGear" parameter (speed change). The higher the gear factor the higher the value should be set.
Rule of thumb: Value = 2 * numerator/denominator.
To reach an improved synchronization, it is recommended that a higher value be selected; in contrast a lower value yields improved dynamics.

9844 1113 117, f107, 09.02

Gear processing example

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

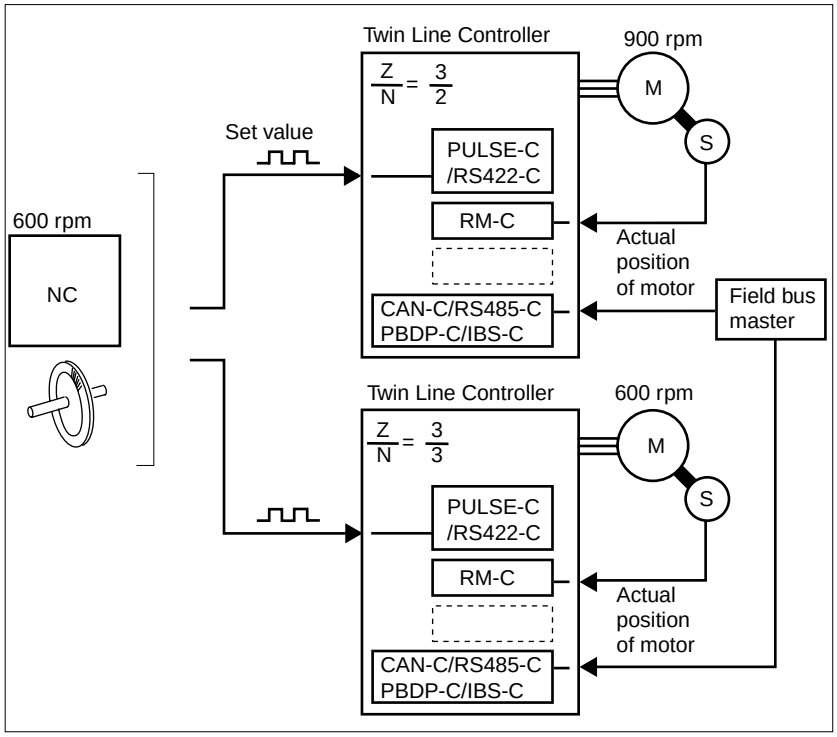


Fig. 6.8 Electronic gear with setpoint preset via NC controller or encoder

9844 1113 117, f107, 09.02

6.5.2 Synchronization with compensatory movement

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

Conditions for a compensatory movement

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

- Switching off the mode with "Gear.startGear"=0.
- Starting a different 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

Electronic gear mode with compensatory movement is started with the "Gear.startGear"=2 parameter.

The positioning controller attempts to catch up reference pulses that have accumulated before the operating mode was activated as quickly as possible. They are limited in this 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 the parameters "Status.p_addGear" and "Status.p_ref".

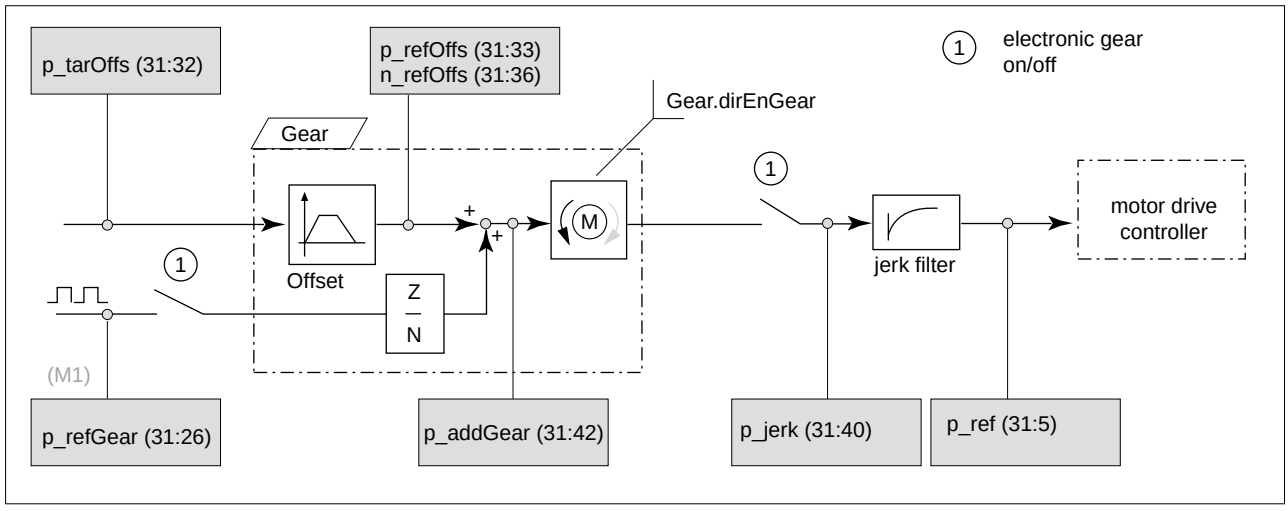


Fig. 6.9 Parameters for establishing a positional deviation

Direction preset

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

9844 1113 117, f107, 09.02

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.

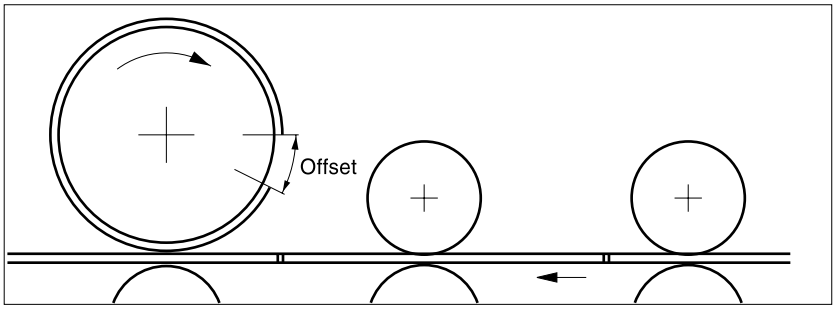


Fig. 6.10 Offset for bridging an empty area when printing

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 therefore depend on the type of encoder used.

The "Gear.StateOffs" parameter shows information on the status of the operation.

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

9844 1113 117, f107, 09.02

Settings The offset movement is added to the reference pulses of a running gear processing operation. PTP positioning can be set to be executed by ramp or jump. The following information assumes a ramp setting.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Gear.ModeOffs	39:9	3.1.3.12	Processing mode of an absolute or relative positioning	UINT16 0..1 0: Jump 1: Ramp	0	R/W rem.

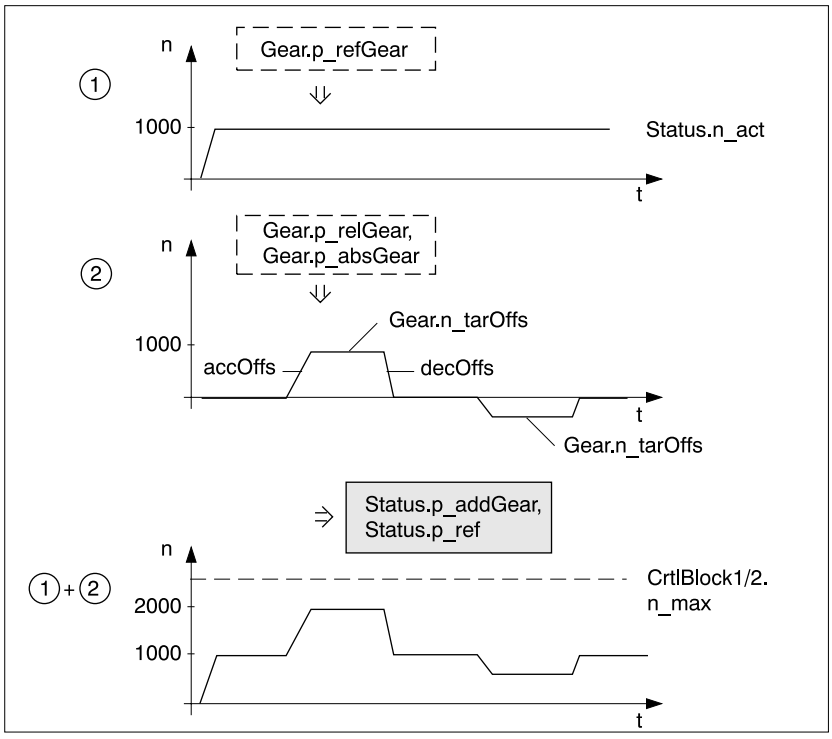


Fig. 6.11 Constant movement with superimposed offset positioning

If gear processing has been deactivated, the offset value is immediately set off against the reference pulses with no limitation from offset ramp values. For example, a setpoint position can be corrected for synchronization with compensatory movement.

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 with the offset parameter "Gear.phomeOffs". This does not cause the motor to move.

9844 1113 117, f107, 09.02

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 with "Status.p_refOffs" and "Status.n_refOffs".

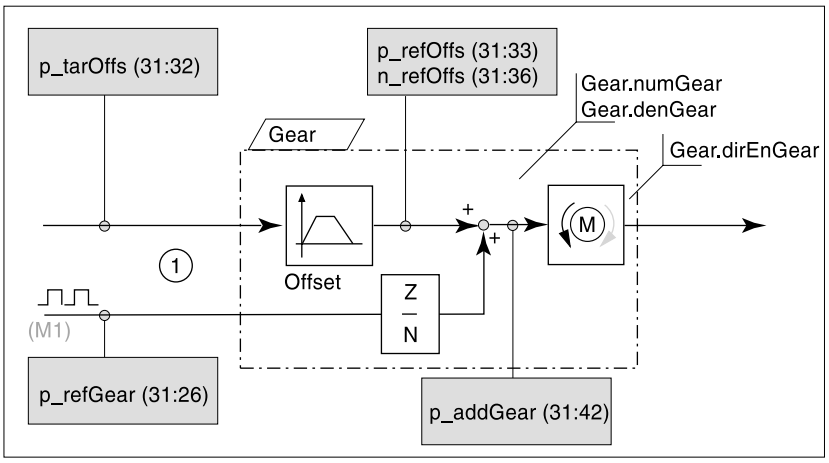


Fig. 6.12 Supervision of offset positioning

Parameter Group.Name	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 value [Inc]	INT32 -2147483648..2147483647	0	R/W –
Gear.stateOffs	39:2	–	Acknowledgement: Offset positioning	UINT16 0..65535 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/– –
Gear.p_relOffs	39:3	3.1.3.7	Start of relative offset positioning with transfer of distance value [Inc]	INT32 -2147483648..2147483647	0	R/W –
Gear.phomeOffs	39:6	3.1.3.9	Dimension setting in offset positioning [Inc]	INT32 -2147483648...2147483647	0	R/W –
Gear.n_tarOffs	39:5	3.1.3.8	Setpoint speed of offset positioning [rpm]	INT32 1..3000	60	R/W –
Gear.accOffs	39:7	3.1.3.10	Acceleration ramp for offset positioning [rev/(min*s)]	INT32 60..2000000	300	R/W –
Gear.decOffs	39:8	3.1.3.11	Deceleration ramp for offset positioning [rev./(min*s)]	INT32 60..2000000	300	R/W –

9844 1113 117, f107, 09.02

6.6 Referencing

Overview

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

- reference movement or
- dimension setting

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

Dimension setting offers the option of defining a point on the axis as the reference point to which all following position data refer.

Referencing mode can be run with:

- HMI hand-held operating unit
- operating software
- field bus

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating mode with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

Referencing with parameters

Referencing mode can be started with the field bus via two parameters:

- reference movement with "Home.startHome"
- dimension setting with "Home.startSetP"

The "Home.StateHome" parameter shows information on the state of the operation.

Successful referencing is indicated by bit5, "ref_ok"= 1 in the "Status.xMode_act" parameter. You can find the complete assignments of the "Status.xMode_act" parameter on page 12-22.

9844 1113 117, f107, 09.02

6.6.1 Reference movement

The positioning controller offers a choice of four standard reference movements.

- 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 signal inputs required for the reference movement, $\overline{\text{LIMN}}$, $\overline{\text{LIMP}}$ and $\overline{\text{REF}}$, must be wired up. Unused monitoring signals must be deactivated or connected to 24 V.

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 modes, a reference movement must be completed before the operating mode can be changed.

The reference movement can be executed with or without an index pulse.

Search and clearance speeds and also safety gap and withdrawal path can all be set in user-defined units for the reference movement without index pulse.

Search and clearance speeds can also be set for reference movement with index pulse. However, clearance from the switching range is with an index pulse. This means that a movement of 1.1 revolutions in the requested direction is initiated with simultaneous activation of the capture processing. The drive is stopped as soon as the index pulse is overrun. Then it is positioned at the calculated index pulse position.

The REF switch does not have to be enabled for the reference movement.

The level of the $\overline{\text{REF}}$ reference switch can be inverted with Bit3 in the "Settings.SignLevel" parameter.

Additional setting options

The following additional parameters can be set in referencing mode:

- Home.DefPosTyp
- Home.RefAppPos

If the speed or ramp setting is changed for withdrawal from the switching area, the end position of the reference movement may be changed. The "Home.DefPosTyp" parameter can be used to save the motor position at the time of the signal change at the limit and reference switch. The precision of the position record is approximately equal to the position distance covered in 1 ms.

9844 1113 117, f107, 09.02

The "Home.RefAppPos" parameter can be used to set the user position (= zero point of application) to the reference point (= machine zero point) after completion of a reference movement. The negative position difference between reference position and user position is derived and the calculated value is set in the "Home.RefAppPos" parameter.

6.6.2 Reference movement without index pulse

The table below shows the parameters with which the reference movement without index pulse can be started, executed and acknowledged at the end or reference switch.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W 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 referencing mode	UINT16 1..8 **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 –
Home.stateHome	40:2	–	Acknowledgement: referencing	UINT16 0..65535 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, Bit0..4: List of possible operating modes for your TL unit will be found in the "Operating modes" chapter	UINT16 0..65535 Bit0..4: Current mode (unit-specific) [For the exact coding see "Parameter Group Status" on page 12-28 List of possible operating modes for your TL unit will be found in the "Operating modes of the positioning controller" chapter on page 6-1] Bit5: Drive is referenced ("ref_OK") Bit6: Control deviation in position window (SM not assigned) Bit7: reserved Bit8..15: not assigned	–	R/– –
Home.v_Home	40:4	3.3.3	Speed for search of reference switch [usr]	INT32 -2147483648..2147483647	60	R/W rem.

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Home.v_outHome	40:5	3.3.4	Speed for processing withdrawal path and safety distance [usr]	INT32 -2147483648..2147483647	6	R/W rem.
Home.p_outHome	40:6	3.3.5	Max. withdrawal path with activated reference switch [usr]	UINT32 0..2147483647 0: Withdrawal disabled >0: Withdrawal path [usr]	0	R/W rem.
Home.p_disHome	**40:7**	**3.3.6**	**Safety distance from switching edge to reference point [usr]**	**UINT32 0..2147483647**	**200**	**R/W rem.**
Home.DefPosTyp	40:10	–	Reference position for processing safety distance and index pulse search	UINT16 0.. 1 0: Setpoint position at standstill after deceleration because of signal change at limit or reference switch 1: Save current motor position on signal change at limit or reference switch	0	R/W rem.
Home.RefAppPos	40:11	–	Application position at reference point [usr]	INT32 -2146483648.. 2146483647	0	R/W rem.
Home.RefSwMod	40:9	3.3.10	Processing sequence with reference movement to REF	UINT16 0..3 Bit0: Rotation reversal at REF 0: permissible (standard operation) 1: not permissible Bit1: Movement direction safety distance 0: away from switch 1: into switch area	0	R/W rem.

9844 1113 117, f107, 09.02

Reference movement towards limit switch without index pulse

A reference movement to the negative limit switch with additional safety distance is shown below: The reference point is "R-".

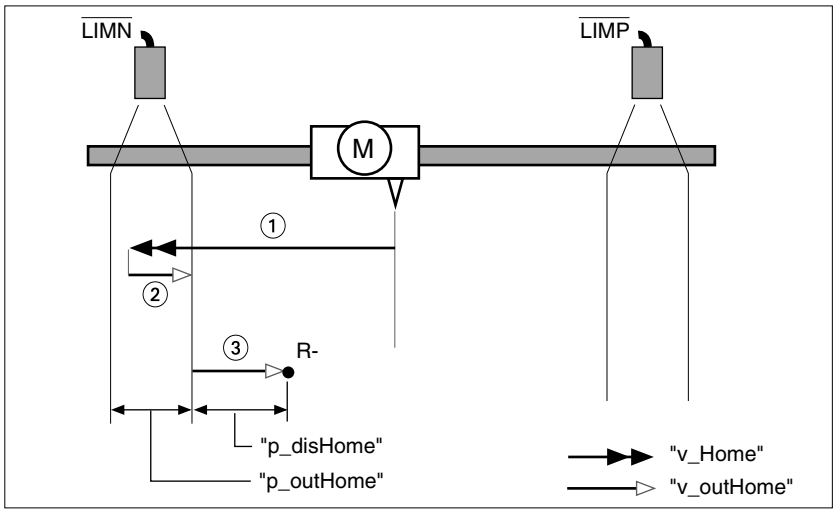


Fig. 6.13 Reference movements to limit switch with movement to safety distance

① movement at search speed "Home.v_Home"
② movement to switching edge at clearance speed "Home.v_outHome"
③ movement to distance "Home.p_disHome" at clearance speed.

9844 1113 117, f107, 09.02

Reference movement to limit switch without index pulse

- movement to the reference switch with the first movement in negative direction, $\overline{\text{REF}}$ switch first in front of (A1, A2) then behind the starting point (B1, B2), reference point is "R-"
- additional movements when traveling through switching window (A2, B2).

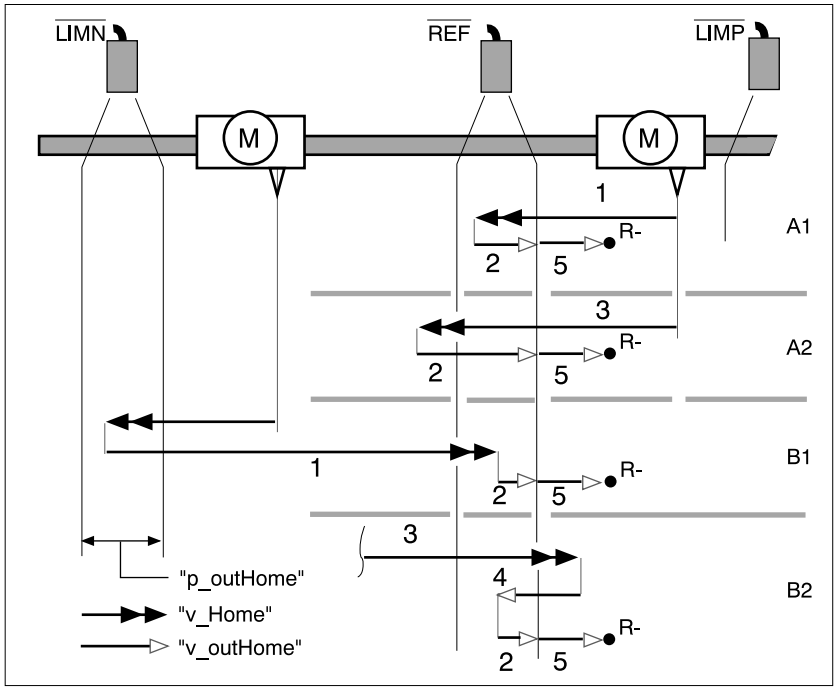


Fig. 6.14 Reference movement to reference switch with first movement in negative sense of rotation

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 movement at clearance speed in switch area
⑤ movement to distance "Home.p_disHome" at clearance speed.

9844 1113 117, f107, 09.02

Special setting options with reference movement to REF

During reference movement to REF "Home.RefSwMod" can be used to set whether a reversal of direction is permissible and whether a movement should be executed in the safety area.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Home.RefSwMod	40:9	3.3.10	Processing sequence with reference movement to REF	UINT16 0..3 Bit0: Rotation reversal at REF 0: permissible (standard operation) 1: not permissible Bit1: Movement direction safety distance 0: away from switch 1: into switch area	0	R/W rem.

This yields the following four cases:

- Case A: Bit0 = 0 and Bit1 = 0 [standard/default setting],
  i.e. direction reversal at REF is permissible and the safety distance movement is executed away from the switch.
- Case B: Bit0 = 1 and Bit1 = 0,
  i.e. direction reversal at REF is not permissible and the safety distance movement is executed away from the switch.
- Case C: Bit0 = 0 and Bit1 = 1,
  i.e. direction reversal at REF is permissible and the safety distance movement is executed into the switch area.
- Case D: Bit0 = 1 and Bit1 = 1,
  i.e. direction reversal at REF is actually not permissible and the safety distance movement is executed into the switch area. However, an automatic direction reversal takes place when processing the safety distance because of this setting.

9844 1113 117, f107, 09.02

The following diagram shows the special setting options offered by "Home.RefSwMod".
Example: Reference movement to REF in negative rotation direction without index pulse

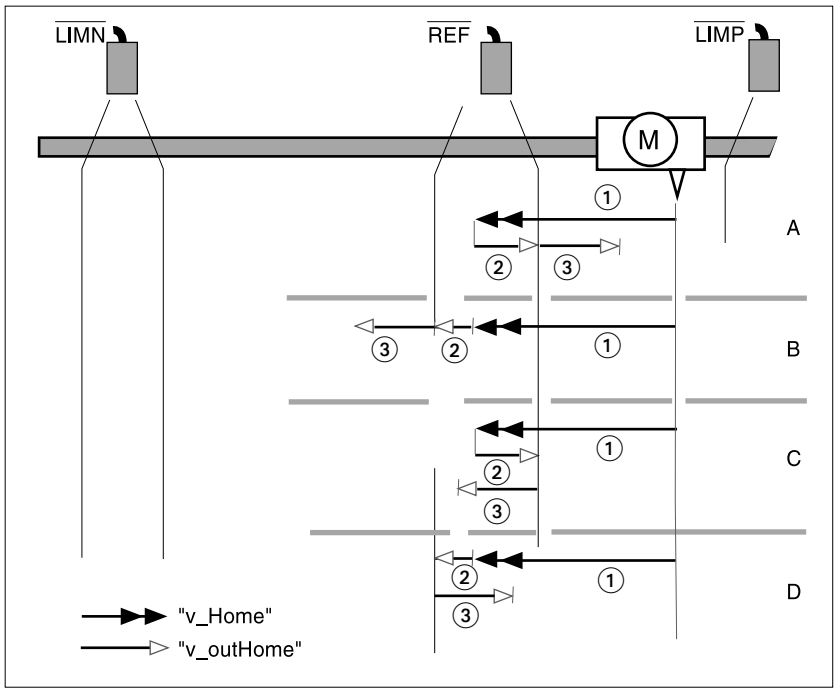


Fig. 6.15 Settings of "Home.RefSwMod"

Options for reference movement to reference switch depending on the setting of "Home.RefSwMod" with initial movement in negative rotation direction:

① movement to switch at search speed "Home.v_Home"
② movement to switching edge at clearance speed "Home.v_outHome"
③ movement safety distance

9844 1113 117, f107, 09.02

6.6.3 Reference movement with index pulse

Requirements and general information

If a capture process is active, a reference movement with index pulse is not initiated.

The system resource "fast positioning control" is assigned during processing of a reference movement. This means that the write accesses of the capture parameters are blocked. After the reference movement with index pulse, a new setting of the capture parameters is required.

Because the end position is set by the index pulse, by reading the value of pactmodulo after the first processing you receive a value suitable for control of reproducibility.

The table below shows the parameters with which the reference movement with index pulse can be started, executed and acknowledged at the limit or reference switch.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W 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 referencing mode	UINT16 1..8 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 –
Home.stateHome	40:2	–	Acknowledgement: referencing	UINT16 0..65535 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, Bit0..4: List of possible operating modes for your TL unit will be found in the "Operating modes" chapter	UINT16 0..65535 Bit0..4: Current mode (unit-specific) [For the exact coding see "Parameter Group Status" on page 12-28 List of possible operating modes for your TL unit will be found in the "Operating modes of the positioning controller" chapter on page 6-1] Bit5: Drive is referenced ("ref_OK") Bit6: Control deviation in position window (SM not assigned) Bit7: reserved Bit8..15: not assigned	–	R/– –

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
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 withdrawal path and safety distance [usr]	INT32 -2147483648..2147483647	6	R/W rem.
Home.p_outHome	40:6	3.3.5	Max. withdrawal path with activated reference switch [usr]	UINT32 0..2147483647 0: Withdrawal disabled >0: Withdrawal path [usr]	0	R/W rem.
Status.p_diffind	**31:48**	**–**	**Distance between switch and index pulse after reference movement [Inc]**	**INT32 -2147483648.. 2147483647**	**–**	**R/– –**
Home.DefPosTyp	40:10	–	Reference position for processing safety distance and index pulse search	UINT16 0.. 1 0: Setpoint position at standstill after deceleration because of signal change at limit or reference switch 1: Save current motor position on signal change at limit or reference switch	0	R/W rem.
Home.RefAppPos	40:11	–	Application position at reference point [usr]	INT32 -2146483648.. 2146483647	0	R/W rem.
Home.RefSwMod	40:9	3.3.10	Processing sequence with reference movement to REF	UINT16 Bit0: Rotation reversal at REF 0: permissible (standard operation) 1: not permissible	0	R/W rem.

9844 1113 117, f107, 09.02

Reference movement towards limit switch with index pulse

A reference movement to the positive limit switch with additional safety distance is shown below: The reference point is "R+".

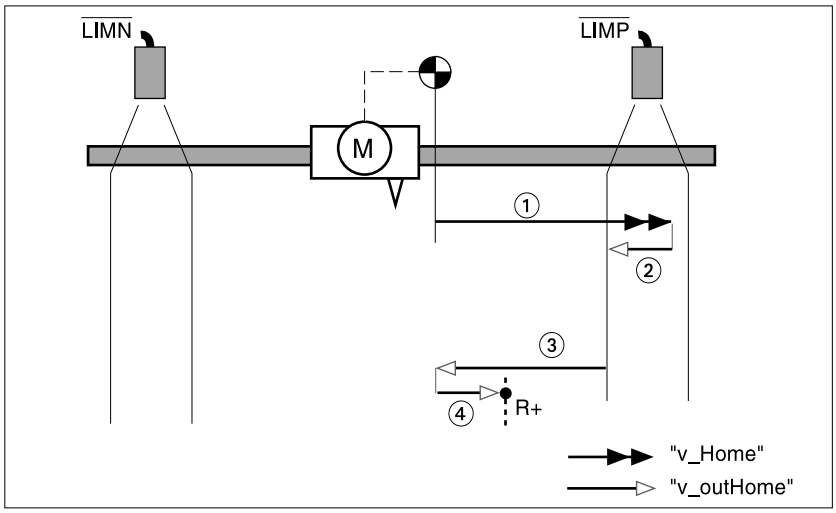


Fig. 6.16 Reference movement towards limit switch

① movement at search speed "Home.v_Home" to LIMP limit switch
② movement to switching edge at clearance speed "Home.v_outHome"
③ Search movement index pulse at clearance speed.
④ movement to index pulse at clearance speed

9844 1113 117, f107, 09.02

Reference movement to limit switch with index pulse

- movement to the reference switch with the first movement in a negative direction, $\overline{\text{REF}}$ switch first in front of (A1, A2) then behind the starting point (B1, B2)
- additional movements when traveling through switching window (A2, B2)

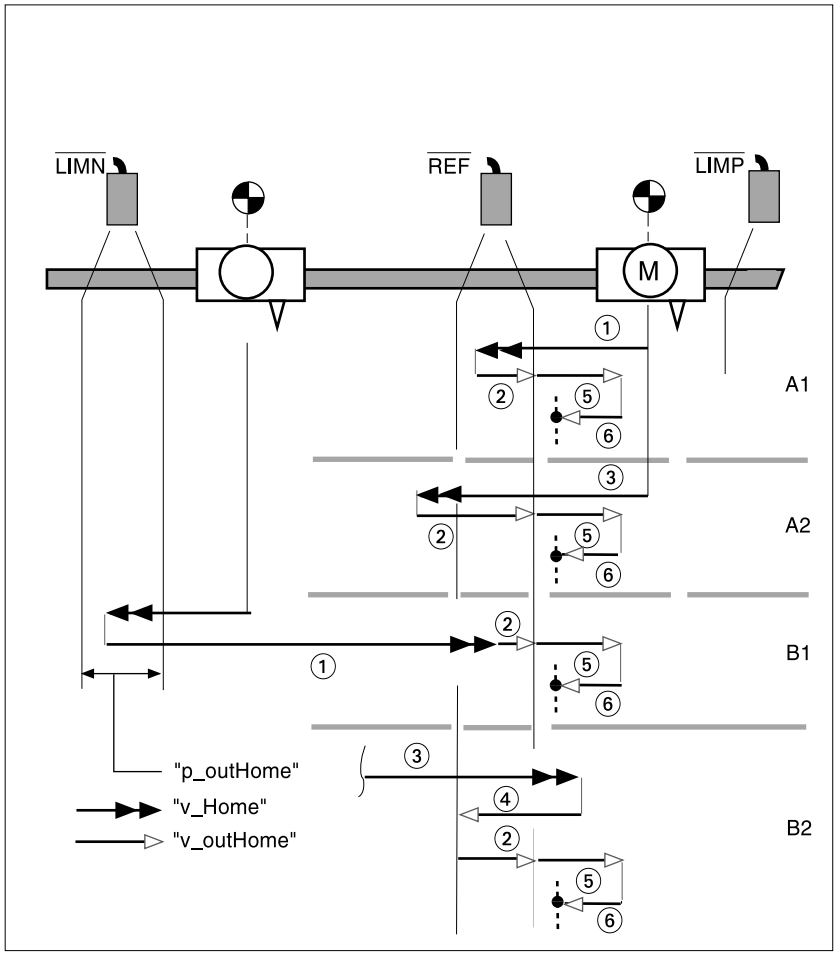


Fig. 6.17 Reference movement to reference switch with first movement in negative sense of rotation

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 movement at clearance speed in switch area
⑤ Search movement index pulse at clearance speed.
⑥ movement to index pulse at clearance speed

9844 1113 117, f107, 09.02

Special setting options with reference movement to REF

During reference movement to REF "Home.RefSwMod" can be set to determine whether a rotation reversal is permissible.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Home.RefSwMod	40:9	3.3.10	Processing sequence with reference movement to REF	UINT16 Bit0: Rotation reversal at REF 0: permissible (standard operation) 1: not permissible	0	R/W rem.

This yields the following cases:

- Case A: Bit0 = 0 [standard/default setting],
  i.e. rotation reversal at REF is permissible.
- Case B: Bit0 = 1,
  i.e. direction reversal at REF is not permissible and the safety distance movement is executed away from the switch.

The following diagram shows the special setting options offered by "Home.RefSwMod". Example: Reference movement to REF in negative rotation direction with index pulse

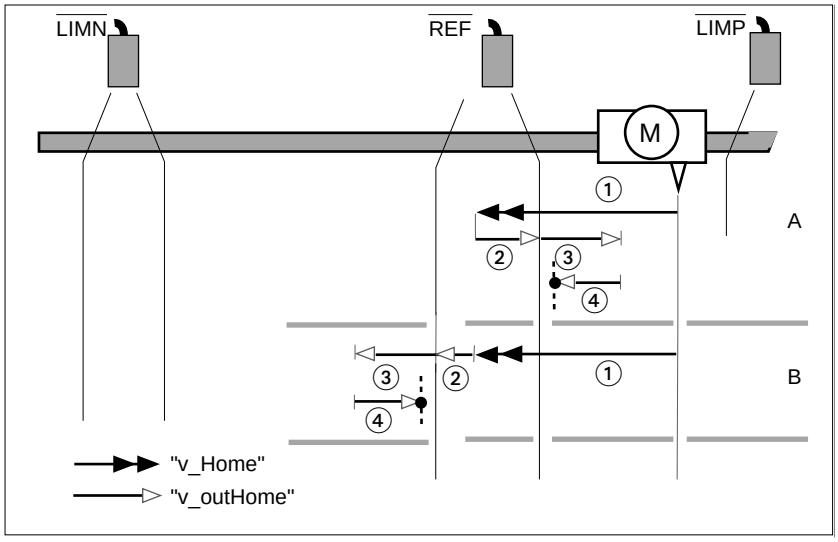


Fig. 6.18 Settings of "Home.RefSwMod"

Options for reference movement to reference switch depending on the setting of "Home.RefSwMod" with initial movement in negative rotation direction:

① movement to switch at search speed "Home.v_Home"
② movement to switching edge at clearance speed "Home.v_outHome"
③ Search movement index pulse at clearance speed.
④ movement to index pulse at clearance speed

9844 1113 117, f107, 09.02

6.6.4 Referencing by dimension setting

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

Referencing by 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	–	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 Bit13: – Bit14: ref_end Bit15: ref_err	–	R/– –
Status.xMode_act	28:3	2.3.5.5	Current axis mode with additional information	UINT16 0..65535 Bit0..4: Current mode (unit-specific) [List of optional modes for your TL unit can be found in "Operating modes of the positioning controller" See "Parameter group Status" for the exact coding] Bit5: Drive is referenced ("ref_OK") Bit6: Control deviation in position window (SM not assigned) Bit7: reserved Bit8..15: not assigned	–	R/– –

9844 1113 117, f107, 09.02

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

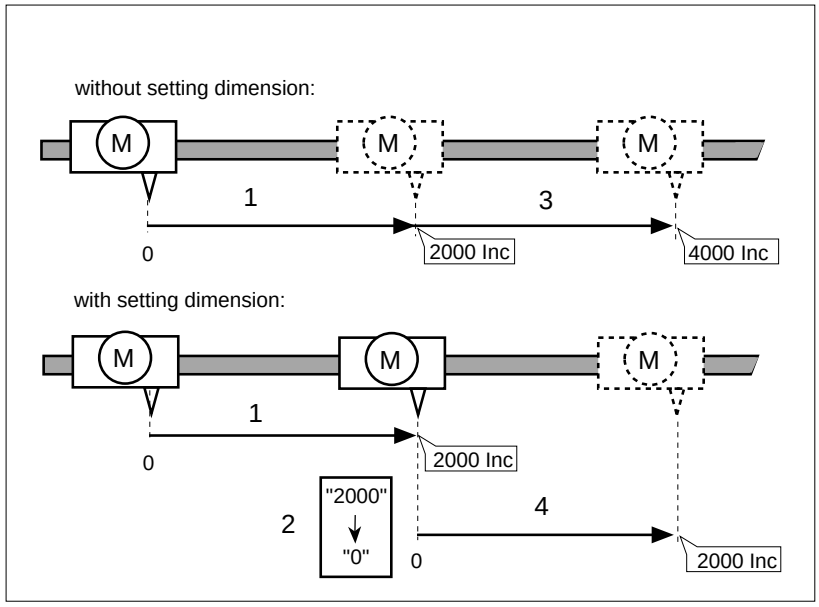


Fig. 6.19 Positioning by 4000 increments with and without dimension setting

① The motor positions 2000 increments with the start on the reference point.

② By calling up referencing by dimension setting, the current position is set to the scale position in user-defined units.

③ After triggering a new movement order at 2000 increments the new target position without dimension setting is 4000 increments.

④ After triggering a new movement order at 2000 increments the new target position with dimension setting is 2000 increments.

This method avoids crossing absolute position limits during a positioning operation because the zero point is continuously tracked.

9844 1113 117, f107, 09.02

6.7 Oscillator mode

In oscillator mode the motor is moved in accordance with a voltage-dependent speed preset over the ±10 V input.

If the input voltage changes, the drive will accelerate or decelerate to the new setpoint speed with the acceleration and deceleration values set by "Motion.acc" and "Motion.dec".

Oscillator mode can be executed by:

- operating software
- field bus

Operation with the operating software

The operating software supports oscillator mode with special dialog boxes and menu items. You will find details on this in the manual for the TL CT operating software.

Overview

The following structural view shows the effects of the parameters on the setpoint speed which can be set in oscillator mode.

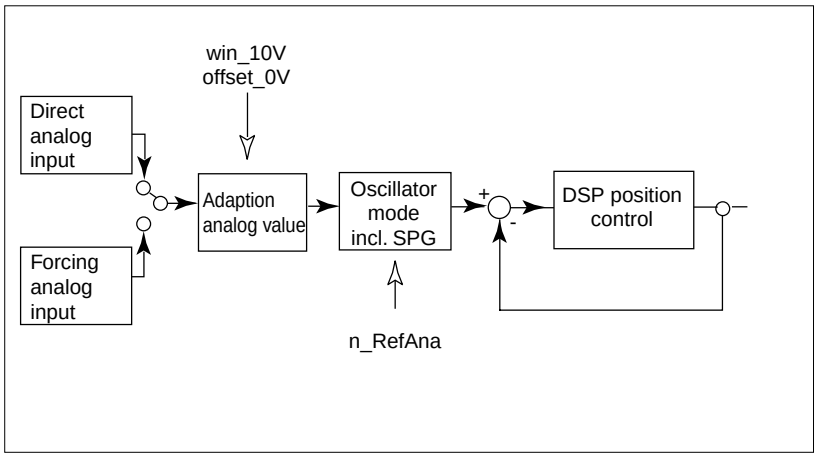


Fig. 6.20 Overview of how the variable parameters in oscillator mode operate

Starting oscillator mode

Oscillator mode is set with the "Oscillator.startOszi" parameter.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Oscillator.startOszi	51:1	3.1.9.1	Starting oscillator mode	UINT16 0..1 0: deactivated (setpoint=0) 1: Setpoint via +/-10 V interface	–	R/W –

9844 1113 117, f107, 09.02

Acknowledging oscillator mode

The "Oscillator.state Oszi" parameter shows information on the processing status in oscillator mode. Processing in oscillator mode is stopped when the mode has been "disabled" and the drive is stationary or if the motor speed has the value 0 as the result of an error.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Oscillator.stateOszi	51:2	–	Acknowledgement: oscillator mode	UINT16 0..65535 Bit0: error LIMP Bit1:error LIMN Bit2: error HW_STOP Bit3: error REF Bit4: not assigned Bit5: error SW_LIMP Bit6: error SW_LIMN Bit7: error SW_STOP Bit8-Bit12: not assigned Bit13: setpoint speed reached 0: actual speed <> set speed 1: actual speed = set speed Bit14: oscillator_end 0: Priocess active1: process inactive Bit15: oscillator_err 0: no error 1: error	–	R/– –

Options for speed control

The curve of the setpoint speed can be changed depending on the ±10 V analog input value with:

- Setting the setpoint speed at 10 V.
- Preprocessing the analog value using an offset or a voltage window.

Setpoint speed at 10 V input signal

The "Oscillator. n_RefAna" parameter can be used to specify the setpoint speed for a 10 V input signal.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Oscillator. n_RefAna	51:3	3.1.9.2	Setpoint speed at 10 V input signal [rpm]	INT16 0.. 13200 (Note: max. motor speed must not be exceeded)	3000	R/W rem.

9844 1113 117, f107, 09.02

Analog value offset The "Settings.offset_0V" parameter can be used to vary the offset for the ±10V input, whereby the interconnection between input voltage and speed changes.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	Idx:Sidx	TL-HMI			Value	rem.
Settings.offset_0V	20:58	4.1.38	Offset to shift of the 0V input voltage [mV]	UNIT 16 -5000..+5000	0	R/W rem.

Small deviations in the zero area can be compensated with the user offset.

The diagram below shows this more clearly:

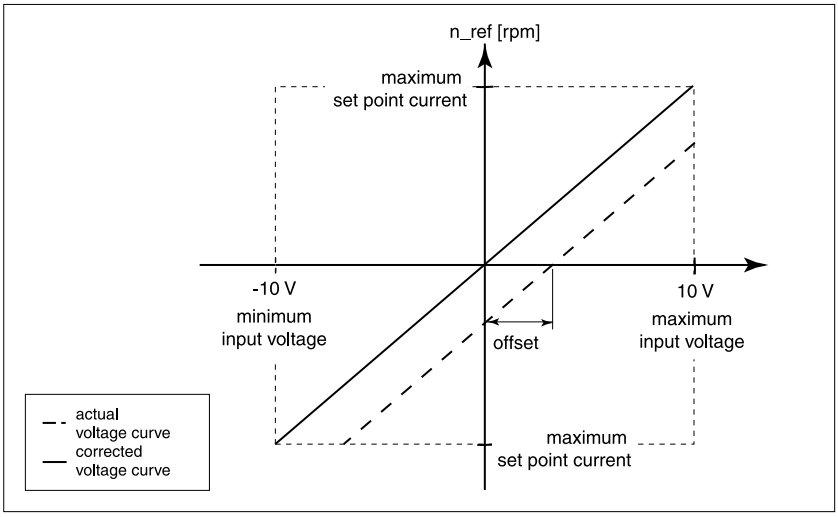


Fig. 6.21 User value offset for the ±10 V input

9844 1113 117, f107, 09.02

Analog value voltage window

An analog value voltage window can be set with "Settings.win_10V" for the ±10 V input. The setpoint speed takes the value 0 here.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Settings.win_10V	20:59	4.1.39	Voltage window within which its analog value is equal to 0 [mV] Example: set value of 20 mV means the range - 20 mV to + 20 mV will be interpreted as 0 mV	UINT16 0..1000	0	R/W rem.

Once the analog value voltage window range is left, a setpoint value ≠ 0 is generated.

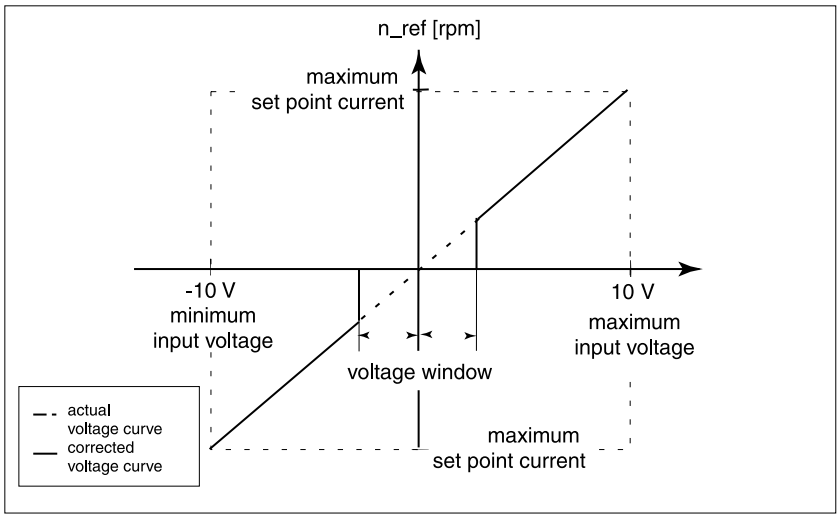


Fig. 6.22 Analog value voltage window around the value 0 V for the ±10 V input

Information on additional settings

List data for a position/speed list cannot be processed oscillator mode.

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

7 Functions of the positioning controller

7.1 List control and list processing

Overview

List-controlled operation runs in the background while a movement command is being processed. If the motor overruns an axis position stored in the list, an interface signal is changed or a new speed value 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 list:
  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 switched by 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 7-6.

Starting list-controlled operation

List-controlled operation can be used with various modes depending on the list type.

Position/speed list

- point-to-point mode
- speed mode

The comparison value is the parameter "Status.p_jerkusr". This value is compared with the position value in the list and the corresponding response is executed internally in the controller.

Position/signal list type

- point-to-point mode
- speed mode
- manual movement mode
- electronic gear mode
- oscillator mode

The comparison value is the parameter "Status.p_jerkusr". This value is compared with the position value in the list and the corresponding response is executed internally in the controller.

List-controlled operation can be started with

- HMI hand-held operating unit
- operating software
- field bus

9844 1113 117, f107, 09.02

List-controlled operation is started 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. List processing can be interrupted at any point in the positioning process by deactivating the current list.

When the specified finishing number is reached, list-controlled 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.

Monitoring list-controlled operation

The processing status of the list-controlled mode can be evaluated via two parameters. Bit14, "list_quit" of the "List.stateList" parameter gives global information on the status of the function:

- 0: list-controlled mode active
- 1: list-controlled mode completed

The parameter "List.actList" gives detailed information on the processing status. It displays the last activated list position.

- -1: no list entry activated yet
- 0... 63: last activated entry

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
List.startList	44:1	3.1.5.1 3.1.5.2 3.1.6.1 3.1.6.2	Activate new list control	UINT16 0..2 0: no list active 1: list 1 2: list 2	0	R/W –
List.stateList	44:2	–	Acknowledgment and status: List control	UINT16 0..65535 Bit15: list_err Bit14: list_quit 0: list-controlled operation active 1: list-controlled operation completed Bit0.1: - 0: no list active - 1: list 1 active - 2: list 2 active	–	R/– –
List.actList	44:18	–	List: activated processing number	INT16 -1..63 -1: no list entry activated yet 0..63: last activated list entry Range preset by start and end number of the list control	-1	R/– –
List.cntList1	44:4	–	List 1: number of available list entries	UINT16 0..64	64	R/– –
List.bgnList1	44:6	–	List 1: Starting number of the list control finishing number > = starting number	UINT16 0...63	0	R/W rem.

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
List.endList1	44:7	–	List 1: Finishing number of the list control finishing number > = starting number	UINT16 0...63	63	R/W rem.
List.cntList2	44:12	–	List 2: number of available list entries	UINT16 0..64	64	R/– –
List.bgnList2	44:14	–	List 2: Starting number of the list control finishing number > = starting number	UINT16 0...63	0	R/W rem
List.endList2	44:15	–	List 2: Finishing number of the list control finishing number > = starting number	UINT16 0...63	63	R/W rem.

Processing list entries

List entries of the non-active list can be changed manually before and during list-controlled operation with TL HMI, TL CT or field bus or with teach-in processing. For details on teach-in processing see this chapter from page 7-8.

When changing list values, please note the following:

- The positioning controller stores position and speed values in user-defined units. This makes the lists independent of the resolution of a connected motor.
- List entries are selected via list numbers and evaluated in ascending order. Position entries must correspondingly be entered in ascending or descending order.
- The assigned list type applies for the whole list. The list type cannot be changed within a list.
- The end number of 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 Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
L1Data0.typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1..2 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 [usr]	INT32 -2147483648..2147483647	0	R/W rem.
L1Data0.signList1	1100:3	7.3.2.3	List 1: signal state	UINT16 0, 1	0	R/W rem.

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
L1Data0.velList1	1100:4	7.3.2.4	List 1: setpoint speed [usr]	INT32 -2147483648..2147483647 -"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 (1201:x...1263:x)	UINT16 1..2 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 [usr]	INT32 -2147483648..2147483647	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 [usr]	INT32 -2147483648..2147483647 -"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.

9844 1113 117, f107, 09.02

Example of position/signal list

List-controlled operation begins with point-to-point positioning from the reference point to the position 510 mm at a speed of 100 rpm. Position calibration is set for 1 user-defined unit to equal 1mm.

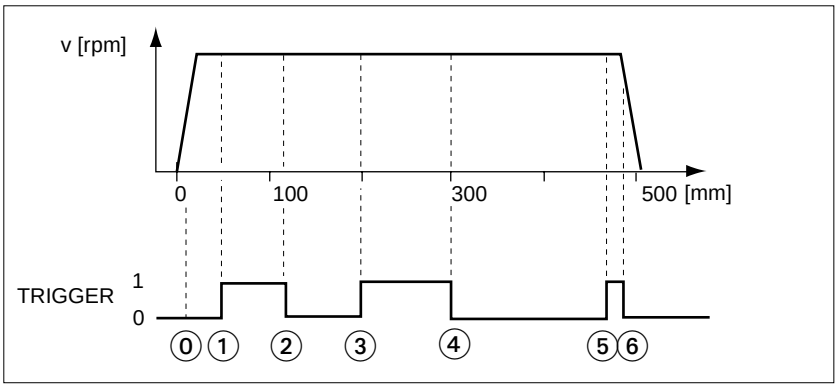


Fig. 7.1 Positioning with position/signal list

- ▶ Activate position/speed list with "L2Data0.typeList2"= 1,
- ▶ Entering position values manually in list 1 for list processing between the starting and finishing positions with TL HMI, TL CT or field bus or with teach-in list 1.

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

The speed' column has no significance for list control with the position/ signal list.

- ▶ Starting position list number 0 with "List.bgnList1"= 0 (Lst.No.1100.x)
- ▶ Finishing position list number 6 with "List.endList1"= 6 (Lst.No.1106.x)
- ▶ Activate list 1 with "List.startList"=1
- ▶ Start positioning.

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

9844 1113 117, f107, 09.02

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 influenced by hardware and software-dependent factors.

- determined by hardware causes such as temperature, power supply or output load:
  jitter: max. +/-20 µs
- determined by software causes: jitter: max. +/-30 µs, 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 µs later
- braking: triggering 12 µs 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 control or after list control has been interrupted.

The parameter can only be changed if no list control is active. It is locked during list-controlled operation.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
I/O.OutTrig	34:9	–	Setting trigger output when signal list inactive	UINT16 0..1 0: Low level 1: High level	0	R/W –

Example of position/speed list

List-controlled operation is carried out with absolute positioning from the reference point to the 6000 Inc position. The starting speed is 100 rpm.

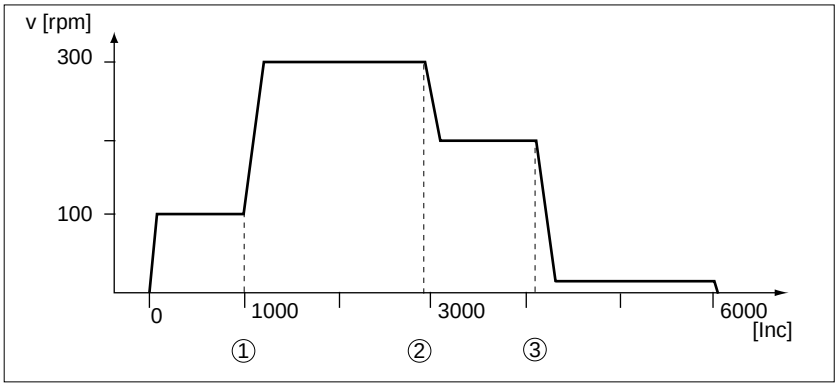


Fig. 7.2 Positioning with position/speed list

9844 1113 117, f107, 09.02

- ▶ Activate position/speed list with "L2Data0.typeList2"= 2,
- ▶ Entering position values of the list manually between the starting and finishing positions with TL HMI, TL CT or field bus or by 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

The trigger signal column has no significance for list control with the position/speed list.

- ▶ 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
- ▶ Start positioning.

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

The processing status of the list control can be monitored with the parameters "List.stateList" and "list_quit".

Triggering time

The positioning controller checks at intervals of 1 ms whether a setpoint that triggers a new speed value has been reached.

The trigger times must be at least 1 ms apart. Otherwise triggering of the next speed change is delayed by 1 ms.

9844 1113 117, f107, 09.02

7.2 Teach-in processing

Overview

Teach-in processing offers the option of recording current position values by traversing the motor and transferring them to a previously specified memory range. The size of the available memory depends on the size of the free list memory. Up to 64 position entires can be saved if a list is empty. Teach-in processing can be run with the following:

- HMI hand-held operating unit
- operating software
- field bus
- signal interface inputs

The data are stored in a position/signal list or a position/speed list. List values for speed or signal status are supplemented as follows:

- HMI hand-held operating unit
- operating software
- field bus

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

Operation with operating software or the HMI hand-held operating unit

The operating software and the HMI hand-held operating unit support this operating function with special dialog boxes and menu items. You will find details on this in the manuals for the operating software and the HMI hand-held operating unit.

Starting teach-in processing

The following are required to start teach-in processing:

- axis position defined by referencing or compensation of the encoder position during initialization
- power amplifier switched on and ready for operation
- motor in positioning range
- motor stationary
- for teach-in via the signal interface: "Settings.IO_mode"=2

The list type must be set and the list selected before a teach-in process.

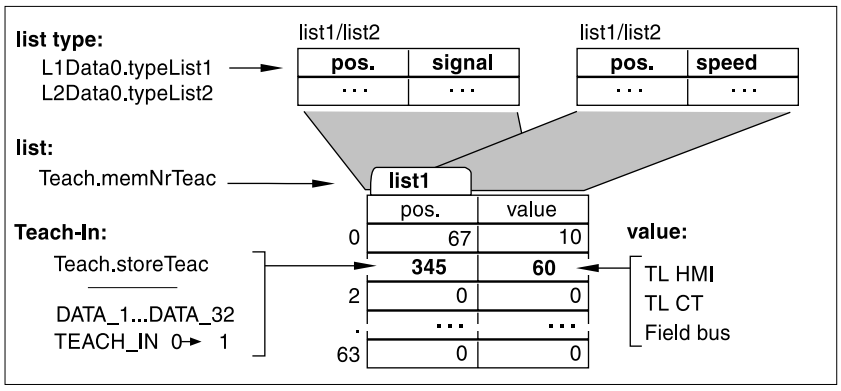


Fig. 7.3 List setting

The teach-in process can only be controlled via the signal interface if the parameter "Settings.IO_mode"= 2 and the AUTOM input signal runs low level.

9844 1113 117, f107, 09.02

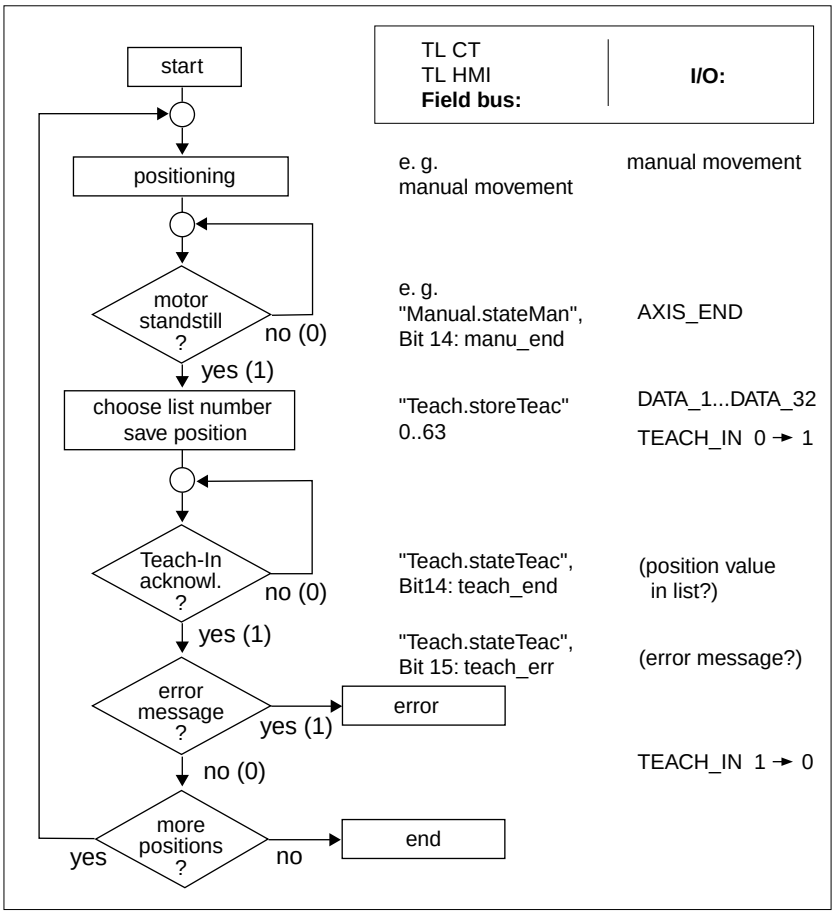


Fig. 7.4 Teach-in process

After every positioning the list data can be directly changed with a connected input device.

9844 1113 117, f107, 09.02

Example for teach-in over field bus

The positioning is executed with field bus commands; the selection of list, list type and list number can be set with parameters.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Teach.storeTeac	43:1	–	Teach-in processing Selecting memory List number for storing a position value (0...63) Example: 000010: List number 2	UINT16 0..65535 Bit0.5: List number	0	R/W –
Teach.stateTeac	43:2	–	Acknowledgement: Teach-in processing	UINT16 0..65535 Bit15: teach_err Bit14: teach_end	–	R/– –
Teach.memNrTeac	43:3	–	Data storage for teach-in processing	UINT16 1..2 1: List data list 1 2: List data list 2	1	R/W –
Teach.p_actTeac	43:4	–	Motor position stored during teach-in processing [usr]	INT32 -2147483648..2147483647	–	R/– –
L1Data0.typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1..2 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 (1201:x...1263:x)	UINT16 1..2 1: pos./signal 2: pos./speed	1	R/W rem.

Example for teach-in over signal interface

For example, the motor is positioned with the manual movement signals. List and list type must be set with parameters or an operating 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 DATA_2 DATA_4 DATA_8 DATA_16 DATA_32	Selecting a list set, bit-coded Examples: List number 5=000101: DATA_4=1, DATA_1=1 List number 35=100011: DATA_32=1, DATA_2=1, DATA_1=1 Inputs that are not entered are zero	low/open

9844 1113 117, f107, 09.02

7.3 Calibration

Overview

Calibration 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. The positioning controller then applies its own calibration factor to each value.

This makes it unnecessary to recalculate and re-enter position or speed values if the motor is changed and the new motor has a different resolution.

The calibration of the motor position encoder cannot be changed by the user.

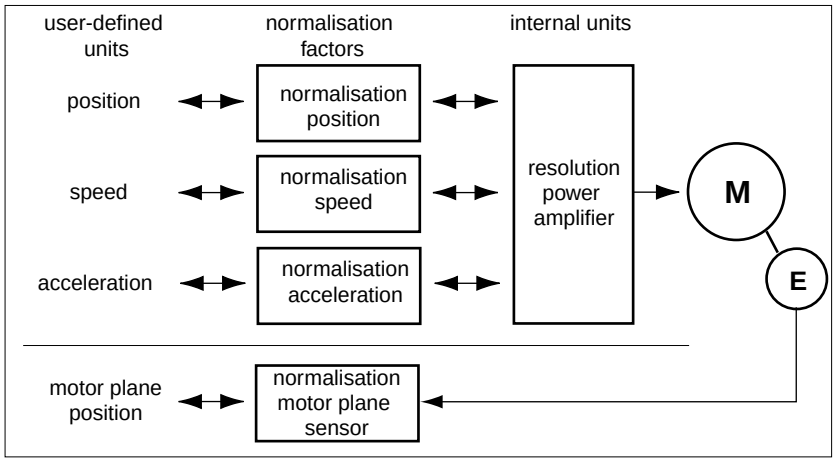


Fig. 7.5 Calibration

9844 1113 117, f107, 09.02

7.3.1 Calibration factor, controller value and user value

The calibration factor is described by the ratio of "controller value" to "user value".

$$\text{Calibration factor} = \frac{\text{Controller value}}{\text{User value}}$$

Fig. 7.6 The calibration factor

The units for calibration factor and "controller value" depend on the type of calibration. The "user value" must be given in user units [usr] for all calibration factors.

Calibration factor	User value	Controller value
Position calibration [rev/usr]	Position [usr]	Motor revolution [rev]
Speed calibration [rev/(min*usr)]	Speed [usr]	Motor speed [rpm]
Acceleration calibration [rev./(min*s)]	Acceleration/ deceleration [usr]	Motor speed [rev/(min*s)]

Calibration factors are set with parameters. A new factor is activated when the numerator value is transferred.

When entering calibration factors note that the ratio can be shown as a complete break.

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

The values of the calibration factor can only be changed when the power amplifier is inactive. Values entered in user units are converted into internal controller values when the power amplifier is activated. The range of values is checked at the same time.

Parameter			**Explanation and unit [ ]**	**Range of values**	**Default**	**R/W**
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
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.

9844 1113 117, f107, 09.02

After the calibration factors have been changed, the relevant usr values must also be changed accordingly to ensure the same motor behavior. This applies to the system's non-volatile parameters and user-defined values.

7.3.2 Setting calibration factors

Calibration factor, positioning

The positioning calibration factor set the relationship of the number of motor revolutions required for the number of user-defined units.

It is described by the "controller value" to "user value" ratio and given in rev/usr.

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

Fig. 7.7 Calibration factor for positioning

The minimum user resolution is the value at which a change of 1 usr effects a change in the motor position – depending on the motor type.

Motor type	Motor resolution	Min. user resolution
Stepper motor with incremental encoder	19200 Inc/rev.	1/19200

The following observations refer to a motor resolution of 1 motor revolution = 19200 Inc.

Three situations can be distinguished when setting user-defined units:

- User-defined resolution corresponds to motor resolution, e.g.
  1 motor revolution ≡ 19200 user-defined units.

  Any motor position can be approached.

- User-defined resolution is higher than motor resolution, e.g.
  1 motor revolution ≡ 19200 increments
  1 revolution ≡ 38400 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 ≡ 19200 increments
  1 revolution ≡ 4800 user-defined units.

  Every fourth motor position can be approached.

9844 1113 117, f107, 09.02

To achieve the same positioning movement from the motor after the positioning calibration factor has been changed, the following retentive 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".

For example, if the reference parameters are not adjusted, en error may occur during the reference movement. The safety distance may be insufficient for leaving the switch area of the limit or reference switch in this case.

If an existing controller is replaced by this controller and the same positioning jobs as before will be used, the calibration must be set to correspond to the former controller.

Example 1 Control of an older stepper motor unit at 1000 inc/rev, i.e. a positioning at 1000 usr should correspond to one motor revolution.

User value = 1000 usr

Controller value = 1 rev

$$\text{Position calibration} = \frac{1\ \text{rev}}{1000\ \text{usr}}$$

Example 2 Positioning of 1111 user-defined units is to correspond to 3 motor revolutions. This gives:

User value = 1111 usr

Controller value = 3 rev

$$\text{Position calibration} = \frac{3\ \text{rev}}{1111\ \text{usr}}$$

If you carry out a relative positioning operation of 900 user-defined units now, the motor will move 900 usr * 3/1111 rev/usr = 2 4302 revolutions.

Example 3 Calculation of a calibration factor for positioning in units of length: 1 motor revolution corresponds to a path of 100 mm. Every user unit [usr] should correspond to one 0.01 mm step.

This gives: 1 usr ≡ 0.01 mm * 1 rev/100 mm = 1/10000 rev.

$$\text{Position calibration} = \frac{1\ \text{rev}}{10000\ \text{usr}}$$

Example 4 Setting positioning in 1/1000 rad, 1rad = 1 rev/(2*π), π = 3.1416 (rounded)

9844 1113 117, f107, 09.02

User value = 1 usr

Controller value = 1/(2*π*1000) rev

$$\text{Position calibration} = \frac{1\ \text{rev}}{2*3{,}1416*1000\ \text{usr}} = \frac{1\ \text{rev}}{6283{,}2\ \text{usr}} = \frac{10\ \text{rev}}{62832\ \text{usr}}$$

Calibration factor, Speed

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

It is described by the "controller value" to "user value" ratio and given in rpm per usr.

$$\text{normalisation factor for speed} = \frac{\text{revolutions [rev]}}{\text{unit of time [min]}} * \frac{1}{\text{user-defined unit [usr]}}$$

Fig. 7.8 Calibration factor for speed

The minimum user resolution is the value at which a change of 1 usr effects a change in the motor speed.

Motor type	Motor resolution	Min. user resolution
Stepper motor with incremental encoder	19200 Inc/rev.	1 / 81.92

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

User value = 1 usr

Controller value = 60/1000 rpm

$$\text{Speed calibration} = \frac{60\ \text{rev}}{1000\ \text{min} * 1\ \text{usr}} = \frac{3\ \text{rev}}{50\ \text{min*usr}}$$

Example 2 Setting the speed in steps of 1/10 rpm:

User value = 10 usr

Controller value = 1 rpm

$$\text{Speed calibration} = \frac{1\ \text{rev}}{1\ \text{min} * 10\ \text{usr}} = \frac{1\ \text{rev}}{10\ \text{min*usr}}$$

9844 1113 117, f107, 09.02

Example 3 Linear axis moves by 100 mm in one motor revolution; values should be entered in steps of 1 mm/s.

This gives: 1 usr ≡ 0.01 rev/s = 60/100 rpm

User value = 1 usr

Controller value = 60/100 rpm

$$\text{Speed calibration} = \frac{60\ \text{rev}}{100\ \text{min} * 1\ \text{usr}} = \frac{3\ \text{rev}}{5\ \text{min*usr}}$$

Example 4 Setting the speed in 1/10 rad/s, 1rad = 1 rev/(2*π), π = 3.14 (rounded)

User value = 1 usr

Controller value = 60/(2*π*10) rpm

$$\text{Speed calibration} = \frac{60\ \text{rev}}{100\ \text{min} * 1\ \text{usr}} = \frac{600\ \text{rev}}{628\ \text{min*usr}} = \frac{150\ \text{rev}}{157\ \text{min*usr}}$$

Calibration factor, Acceleration The acceleration calibration factor is used to define the smallest unit for the acceleration setting

The calibration factor for acceleration is described by the "controller value" to "user value" ratio and given in rev/(min*s) per usr.

$$\text{normalisation factor for acceleration} = \frac{\text{speed [rpm]}}{\text{unit of time [s]}}$$

Fig. 7.9 Acceleration calibration factor

The minimum user resolution is the value at which a change of 1 usr effects a change in the motor acceleration – depending on the motor type.

Motor type	Motor resolution	Min. user resolution
Stepper motor with incremental encoder	19200 Inc/rev.	12.21 / 1

Example 1 Setting corresponding to stepping motor resolution of 1000 Inc/rev. The acceleration resolution is to be 1 Hz/ms:
1/1000 rev /(s*ms) or 60 rev /(min*s) is:

User value = 1 usr

Controller value = 60 rev/(min*s)

$$\text{Speed calibration} = \frac{60\ \text{rev}}{1\ \text{min*s} * 1\ \text{usr}} = \frac{60\ \text{rev}}{1\ \text{min*s*usr}}$$

9844 1113 117, f107, 09.02

Example 2 Setting acceleration in steps of 1/10 rev/(min*s):

User value = 1 usr

Controller value = 10 rev/(min*s)

$$\text{Speed calibration} = \frac{10\ \text{rev}}{1\ \text{min*s} * 1\ \text{usr}} = \frac{10\ \text{rev}}{1\ \text{min*s*usr}}$$

Example 3 Linear axis moves 100 mm at one motor revolution; values should be entered in steps of 10 mm/s^2.

User value = 1 usr

Controller value = 0.1 rev/s^2 = 60/10 rev/(min*s)

$$\text{Acceleration calibration} = \frac{60\ \text{rev}}{10\ \text{min*s} * 1\ \text{usr}} = \frac{6\ \text{rev}}{1\ \text{min*s*usr}}$$

Example 4 Setting in rad/s^2, 1 rad= 1 rev/(2*π)
1 user-defined unit ≡ 1 rad/s^2 = 1 rev/(2*π *s^2) = 60/(2*π) rev/(min*s)
π = 3.14 (rounded)

User value = 1usr

Controller value = 60/(2*π) rev/(min*s)

$$\text{Acceleration calibration} = \frac{60\ \text{rev}}{2*3{,}14\ \text{min*s} * 1\ \text{usr}} = \frac{6000\ \text{rev}}{628\ \text{min*s*usr}} = \frac{1500\ \text{rev}}{157\ \text{min*s*usr}}$$

9844 1113 117, f107, 09.02

7.3.3 Residual value in user-defined calibration

If the movement data are given in user-defined units, the positioning controller calculates in internal units corresponding to the resolution 19200 Inc/rev and moves to the nearest internal position corresponding 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. Use the parameter "Status.p_remaind" to read out the differential value.

Parameter Group.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 -2147483648..2147483647	–	R/– –

During teach-in the residual value = 0 displays that the current motor position can be calculated exactly from the stored user position. If the residual value is not equal to zero, the closest user position is stored.

Example of residual value

Motor resolution is 19200 Inc/rev.

Resolution of user-defined unit [usr]: 1200 Inc/rev. => 1 usr = 16 Inc

The motor reacts to 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.

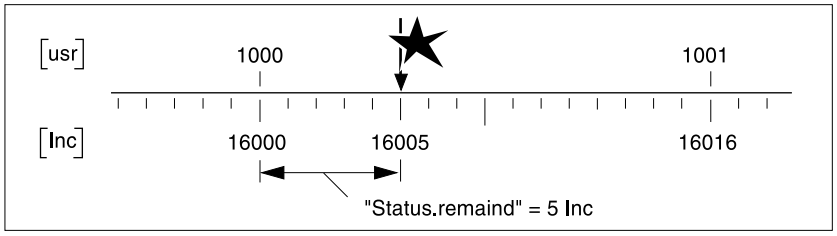


Fig. 7.10 Residual value after interruption to movement at 16005 Inc

9844 1113 117, f107, 09.02

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 with the "Motion.acc" and "Motion.dec" parameters.

The positioning controller absorbs excess braking energy during deceleration. If the DC link voltage exceeds a permissible threshold in this process, the positioning controller switches off the power amplifier and displays error 5 "DC link overvoltage". The motor then runs 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.

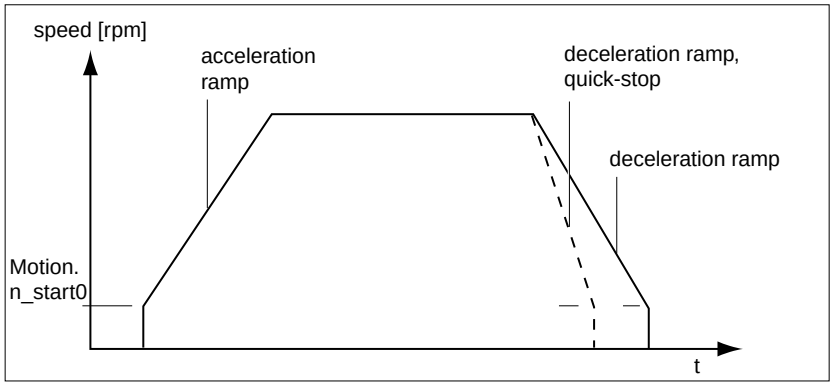


Fig. 7.11 Acceleration and deceleration ramps

Settings for the ramp gradient are given in user-defined units. For the steps to optimize the ramp function see "Optimizing the movement behavior of the motor" on page 5-22.

Ramp shape

The positioning controller can use a linear ramp as the ramp shape for the acceleration and deceleration phases.

The linear ramp is always used as the ramp shape for a quick stop ramp.

The motor-optimized ramp is used to compensate for the typical stepper motor torque reduction at increasing speed by reducing the acceleration.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Motion.n_max0	29:21	4.4.28	Speed limit for travel profile [rpm]	UINT32 1..3000	3000	R/W rem.
Motion.n_start0	29:22	4.4.10	Start-stop speed [rpm]	UINT32 0..3000 1..n_max0	12	R/W rem.
Motion.acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1..2 1: linear 2: Exponential	1	R/W rem.

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Motion.acc	29:26	4.4.14	Acceleration [usr]	UINT32 1...2147483647	600	R/W rem.
Motion.dec	29:27	4.4.15	Deceleration [usr]	UINT32 1...2147483647	600	R/W rem.

Jerk filter

The jerk filter is used to smooth sudden changes in speed to produce smooth, non-jerky changes in speed.

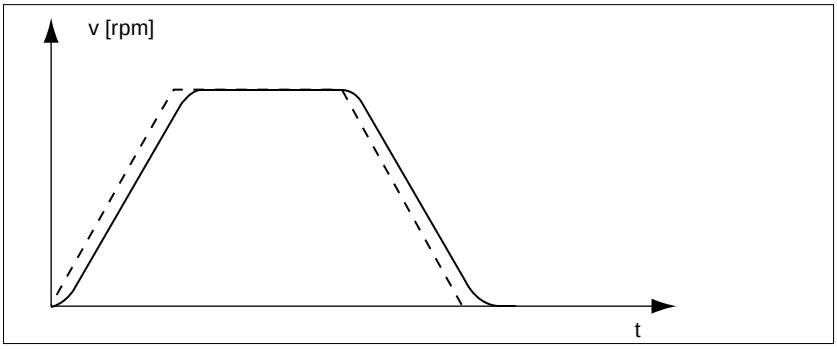


Fig. 7.12 Acceleration ramp with and without (dotted line) jerk filter

The jerk filter can be switched off by the "Motion.Flt_jerk" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Motion.Filt_jerk	28:5	4.4.26	Jerk filter	UINT16 0..30 0: off 3..30: filter setting value	0	R/W rem.

9844 1113 117, f107, 09.02

7.5 Quick-Stop function

Quick-Stop is an emergency stop function which stops the motor if required, e.g in the event of a malfunction. Quick-Stop can be triggered:

- by 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 that requires an emergency stop

Quick-Stop remains active until the motor has come to a complete stop. In the event of a fault category 1 fault response, the power amplifier remains on.

Quick-Stop via deceleration or Quick-Stop ramp

The following can be set for the signals that trigger Quick-Stop: "Settings.SignQstop" s´defines whether the motor is stopped by the Quick-Stop ramp or the deceleration ramp. The deceleration ramp is set under "Motion.Dec". The deceleration for the Quick-Stop ramp is set with the "Settings.dec_Stop" parameter.

This does not apply for electronic gear mode. The deceleration for the Quick-Stop ramp is always set with the "Gear.a_maxGear" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Settings.SignQstop	28:20	4.1.26	Control signals that trigger a Quick-Stop: 0: Deceleration ramp 1: Quick-Stop ramp	UINT16 0..255 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit4..6: - Bit7: SW_STOP	0	R/W rem.
Settings.dec_Stop	28:21	–	Deceleration ramp for Quick-Stop [rev./(min*s)]	UINT32 1.. 2147483647	6000	R/W rem.

Settings for Quick-Stop ramp

The positioning controller absorbs excess braking energy during a Quick-Stop. If the DC link voltage exceeds a permissible threshold, the positioning controller switches off the power amplifier and displays error 5 "DC link 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 with error 5 "DC link overvoltage", the maximum braking current must be reduced or an external load resistor fitted.

9844 1113 117, f107, 09.02

Acknowledging Quick-Stop

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

I/O signal	Function	Value
FAULT_RESET	Resetting an error message	Low -> High

If the motor has been stopped by Stop, the $\overline{\text{STOP}}$ signal must first be reset.

If Quick-Stop has been triggered by the limit switch signals $\overline{\text{LIMN}}$ or $\overline{\text{LIMP}}$, the drive must be moved back into the area of movement in manual mode; see "Moving the drive out of the limit switch area" on page 7-27.

7.6 Reversal of direction of rotation

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

▶ Reverse the direction of rotation with the parameter "Motion.invertDir".

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 $\overline{\text{LIMN}}$.

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

9844 1113 117, f107, 09.02

7.7 Fast position capture

Position values can be recorded via two channels whose parameters can be adjusted. The capture inputs have an input delay period of 100 µs. This delay period has a maximum spread of +/-10 µs. At constant drive speed the jitter is a maximum of +/-5 µs.

The parameter "Capture.TrigSign" defines the signal source of a position value capture. The CAPTURE1 and CAPTURE2 inputs of the signal interface or the index pulse of a position encoder in slot M1.

A capture can be triggered by a rising or falling signal slope. The slope change is set with the "Capture.TrigLevl" parameter. Changes to the parameter "Capture.TrigLevl" are only activated when the positioning detection is restarted by writing to the "Capture.TrigStart" parameter.

Starting position capture

The "Capture.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 positíoning controller calculates the position values from the elapsed trime and the speed at the setpoint and actual position. The position values can be interrogated via "Capture.TrigPact1/2".

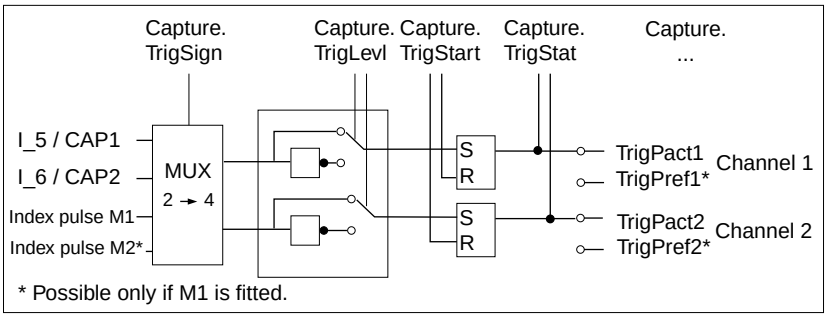


Fig. 7.13 Fast position capture, signal pattern and parameter

Continuous position capture

Position capture can be executed once or continuously. It can be set in bit15 in "Capture.TrigStart":

- Bit15=0: the position value after the first triggering is stored. Further values are ignored until the process is restarted.
- Bit15=1: every triggering updates the position value.

9844 1113 117, f107, 09.02

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Capture.TrigSign	20:13	–	Selection of trigger signals for position storage Bit3..2: Signal - channel 2 (K2) Bit1.0.0: Signal - channel 1 (K1) Examples: 4: binary 01 00 => CAPTURE2 (K2), CAPTURE1 (K1) 9: 01 00 => CAPTURE2 (K2), index pos. setpoint pos. (K1)	UINT16 0..15 bits0..1/bits2..3 (K1/K2): - 00: CAPTURE1 - 01: CAPTURE2 - 10: index pulse setpoint encoder (with module on M1) - 11: index pulse actual position encoder (for SM with module on M2)	4	R/W –
Capture.TrigType	20:14	–	Position source for position storage	UINT16 0..1 0: actual position encoder 1: setpoint position encoder	1	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 0..3 Bit0: set trigger level on channel 1 Bit1: set trigger level on channel 2	3	R/W –
Capture.TrigStart	20:16	–	start triggering (bits0..1): 0: no change 1: reset triggering and repeat cancel triggering (Bit14=1) repeat triggering (bit15) 0: trigger once 1: trigger continuously	UINT16 0..3 Bit0: trig. on channel 1 Bit1: trig. on channel 2 Bit14: cancel trig. Bit15: Trig. repeat	0	R/W –
Capture.TrigStat	20:17	–	Status, triggering executed	UINT16 0..3 Bit0: triggering on channel 1 Bit1: triggering on channel 2	–	R/– –
Capture.TrigPact1	20:18	–	Actual position of motor on triggering on channel 1 [Inc]	INT32 -214748364..2147483647	–	R/– –
Capture.TrigPact2	20:19	–	Actual position of motor on triggering on channel 2 [Inc]	INT32 -214748364..2147483647	–	R/– –
Capture.TrigPref1	20:20	–	Setpoint of elect. gear on triggering on channel 1 [Inc]	INT32 -214748364..2147483647	–	R/– –
Capture.TrigPref2	20:21	–	Setpoint of elect. gear on triggering on channel 2 [Inc]	INT32 -214748364..2147483647	–	R/– –

9844 1113 117, f107, 09.02

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.

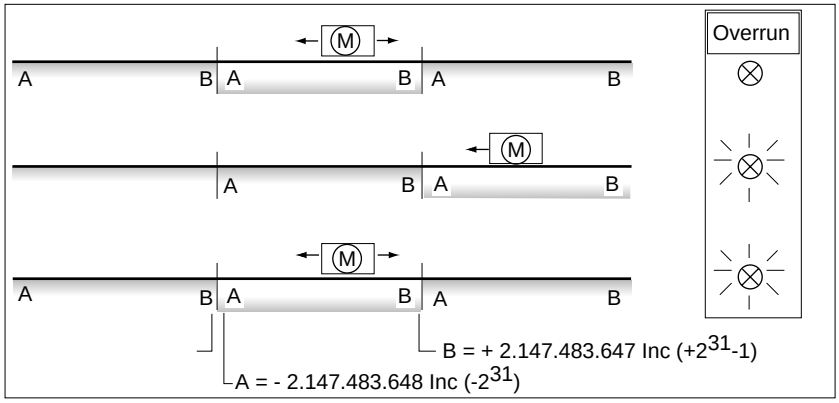


Fig. 7.14 Positioning range and range overrun

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.

Positioning limits can be crossed 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.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Status.IntSigSr	29:34	2.3.4.2	Monitoring signals in positioning controller 0: not active, 1: activated	UINT32 0..4294967295 Bit0..1: reserved Bit2: position overflow Bit3..4: reserved Bit5: SW limit switch, pos. sense of rotation (SW_LIMP) Bit6: SW limit switch, neg. sense of rotation (SW_LIMN) Bit7: stop via control word (SWSTOP) Bit8..14: reserved Bit15: amplifier not active Bit16..31: reserved	-	R/– –

9844 1113 117, f107, 09.02

Software limit switches

The software limit switch position is set the "Motion.SW_LimP" and "Motion.SW_LimN" parameters and activated with "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. Bits5 and 6 of the "Status.IntSigSr" parameter signal that the limit switch position has been crossed.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	**Idx:Sidx**	**TL-HMI**			**Value**	**rem.**
Motion.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.
Motion.SW_LimN	29:5	4.4.6	Software limit switch for neg. position limit LIMN condition: SW_LimN > SW_LimP [usr]	INT32 -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) Bit6: SW limit switch, neg. sense of rotation (SW_LIMN)	–	R/– –

Limit switch signal and $\overline{STOP}$ signal

During motion, both limit switches are monitored by 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 Quick-Stop. Further processing is possible if:

- the STOP signal is canceled and
- Quick-Stop has been acknowledged and
- a new movement command is activated

9844 1113 117, f107, 09.02

Enabling the input signals $\overline{\text{REF}}$, $\overline{\text{LIMP}}$, $\overline{\text{LIMN}}$ and $\overline{\text{STOP}}$ and evaluation as active low or high can be changed with the parameters Changing "Settings.SignEnabl" and "Settings.SignLevel":

Parameter Group.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: blocked 1: released	UINT16 0..15 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF	7	R/W rem.
Settings.SignLevel	28:14	4.1.11	Signal level for monitoring inputs 0: reaction at 0-level 1: reaction at 1-level	UINT16 0..15 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: 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 (exception: reference movement to REF).

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 the drive does not move back into the travel area, check whether manual mode has been activated and the correct manual movement signal held.

9844 1113 117, f107, 09.02

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 in "Safety devices" on page 2-4.

The positioning controller displays error messages and warnings by causing the 7-segment display to flash. In addition a connected control panel displays an error text.

Temperature monitoring

Sensors monitor the temperature of motor, power amplifier and load resistor. If the temperature of one of these components approaches its permitted limit, the positioning controller will display a warning. If the temperature exceeds the limit for more than five seconds, the positioning controller switches off the amplifier and the control loop to protect them from overheating, and signals a temperature fault.

If the motor is fitted with a temperature switch instead of a sensor, only the upper temperature limit can be monitored with no prior warning. All temperature limits are permanently set.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	Idx:Sidx	TL-HMI			Value	rem.
PA.T_warnPA	16:10	2.2.15	Temperature warning threshold of the current amplifier [K]	UINT16	–	R/– rem.
PA.T_maxPA	16:11	2.2.16	Max. permitted temperature of the current amplifier [K]	UINT16	–	R/– rem.

I^2t monitoring

If the positioning controller is working with high peak currents, temperature monitoring with sensors may be too slow. With I^2t monitoring the closed-loop control anticipates a rise in temperature in time and if the I^2t threshold is exceeded, it reduces the motor, amplifier or load resistor current to their rated value.

If the temperature drops below the threshold again, the component can once again be operated at the limit of its performance.

Parameter			Explanation and unit [ ]	Range of values	Default	R/W
Group.Name	Idx:Sidx	TL-HMI			Value	rem.
PA.I2tPA	16:13	2.2.10	Max. permitted time for max. current at high speed [ms]	UINT16 1..32767	3000	R/W rem.
PA.I2t_warnB	16:14	2.2.12	Warning threshold for make time of an internal ballast resistor [ms]	UINT16 1..32767	10	R/W rem.
PA.I2tB	16:15	2.2.11	Max. permitted make time of internal ballast resistor [ms]	UINT16 1..32767	11	R/– rem.
PA.I2t_n0PA	16:47	2.2.13	Max. permitted time for max. current at low speed [ms]	UINT16 1..32767	4100	R/W rem.

9844 1113 117, f107, 09.02

Following error monitoring

Following error monitoring checks for positional discrepancies between the actual position of the motor and its setpoint. If the difference exceeds a following error threshold, the positioning controller reports a fault.

In addition, the error class for a following error can be changed; see below in "Monitoring parameters".

Monitoring parameters

The parameters listed in the "Status" set can be used to monitor unit status and operating status with parameters. They include

- "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 in "Diagnosis and troubleshooting" on page 8-1.

9844 1113 117, f107, 09.02

7.8.3 Monitoring communications with field bus

The following diagnostic values are available to monitor field bus communications.

- content of controller transmission data
- content of controller receive data
- bus statistics for determining the frequency of communications errors

The diagnostic values can be read as follows:

- TL HMI
- TL CT
- field bus

TL CT: Displaying objects

▶ Open the diagnostics window with "Twin Line → Diagnosis → device data".

▶ Enter index and subindex of the desired diagnostic value in the "device data" window.

Sending and receiving data

The current content of the sending and receiving data can be determined with the following diagnostic values. See the field bus manuals for the byte assignments.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
M4.busTxD	24:33	2.6.2	Sending data Online command processing (Byte 1... 4)	UINT32 0...4294967295	0	R/– –
M4.busTxD5_8	24:34	2.6.2	Sending data Online command processing (Byte 5... 8)	UINT32 0...4294967295	0	R/– –
M4.busRxD	24:28	2.6.1	Receiving data Online command processing (Byte 1... 4)	UINT32 0...4294967295	0	R/– –
M4.busRxD5_8	24:29	2.6.1	Receiving data Online command processing (Byte 5... 8)	UINT32 0...4294967295	0	R/– –

9844 1113 117, f107, 09.02

Bus statistics The bus statistics can be used to find information on the number of timeout errors and bus cycles. The total of all errors that resulted in breaking a connection can be determined. The following diagnostic values are available:

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
M4.busTout	24:31	2.6.6	Bus statistics timeout: Total number of broken connections caused by timeout (node guarding)	UINT16 0...65535	0	R/ W–
M4.busError	24:32	2.6.7	Bus statistics Transmission error Total of all errors that resulted in a connection break	UINT16 0...65535	0	R/ W–
M4.busCycle	24:35	2.6.6	Bus statistic Bus cycles Total number of all processed bus cycles	UINT32 0...4294967295	0	R/ W–

9844 1113 117, f107, 09.02

7.9 Braking function with TL HBC

In 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 with the holding brake controller, which is available as an accessory.

Holding brake controller

The holding brake controller 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 is not separated from the signal connections of the positioning controller in the event of insulation failures.

Standard unit

The holding brake can be released with the push-button switch fitted to the holding brake controller for commissioning and function tests.

Version P

The holding brake can be controlled with the TL CT operating software or the TL HMI for commissioning and function tests.

Braking signals

ACTIVE_CON switches to "high" and opens the brake as soon as the power amplifier is enabled and the motor has holding torque.

I/O signal	Function	Value
ACTIVE_CON	Brake will be opened or is open	high
ACTIVE_CON	Brake will be applied or is applied	low

Voltage reduction

The control voltage of the holding brake controller is variable when the voltage drop is activated. The voltage is then 24 V for approx.. ms and afterwards falls back to its holding voltage of 12 V.

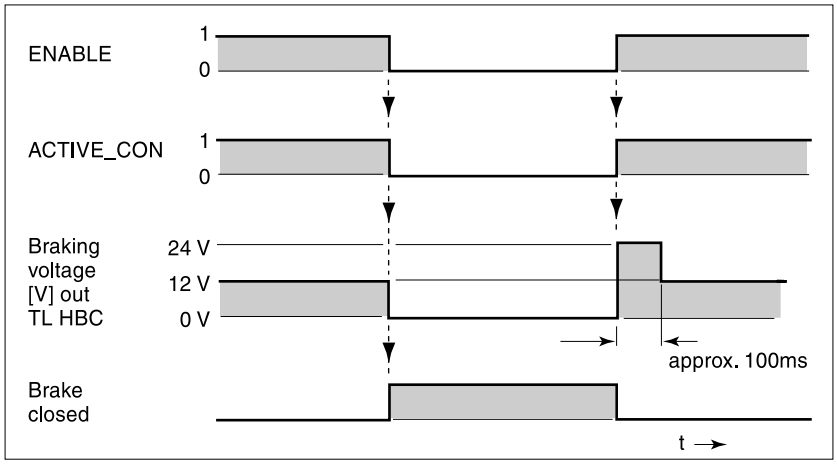


Fig. 7.15 Time diagram, brake function with voltage reduction on

When the power is switched on, the holding brake control system and the button function are reset. No voltage is present on the control terminals of the brake, and the control system LED is off.

9844 1113 117, f107, 09.02

8 Diagnosis and troubleshooting

8.1 Operational status indicators and transitions

Status display in the unit

The D2 LED on the motor plug lights when there is power in the DC link.

The 7-segment display shows 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 unit is working in the selected mode
7	A Quick-Stop is being executed
8, 9	An error has been detected and the error response activated
0 - A flashing	Indicates an error value

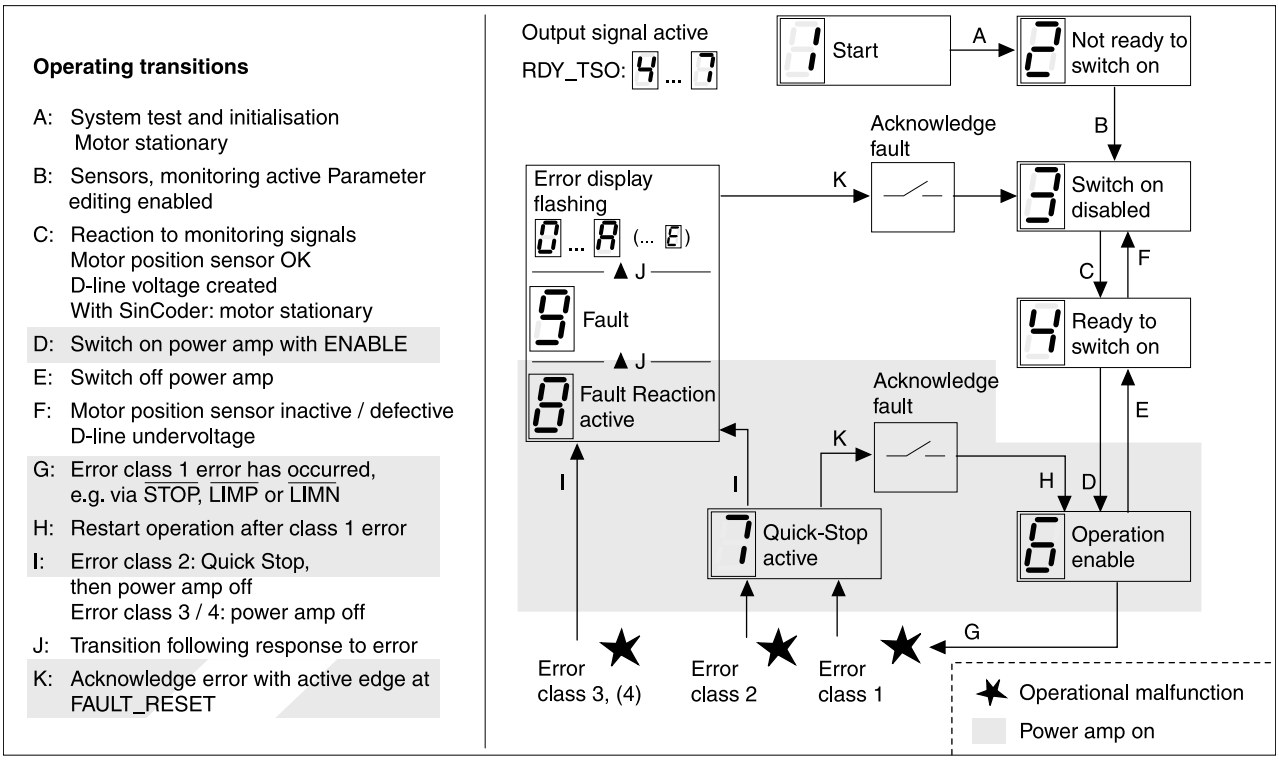


Fig. 8.1 Operating states and transitions of the positioning controller

9844 1113 117, f107, 09.02

Operating transitions

The conditions for changing between the operating states displayed and the response of the positioning controller to an error follow a fixed sequence.

Changing the operating status is controlled by the "Commands.driveCtrl" parameter.

Parameter Group.Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.
Commands. driveCtrl	28:1	-	Control word for state change, default Bit0..3="0", Write access automatically triggers slope change 0->1.	UINT16 0..15 Bit0: disable amplifier Bit1: enable amplifier Bit2: stop (Quick-Stop) Bit3: FaultReset Bit4: QuickstopRelease (TLC units only, internal accesses only) Bit5..15: not assigned	0	R/W –

8.2 Error display and troubleshooting

Error display

The cause of an 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 HMI hand-held unit 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 responds to a fault with 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 recorded in the error memory and can be accessed via the HMI hand-held unit or the operating software.

Resetting error messages

Once the error has been corrected, the message can be reset

- by setting the FAULT_RESET input signal
- by the operating software with the Reset button
- by switching off the power supply to the positioning controller

9844 1113 117, f107, 09.02

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	Response	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 shut-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 can only be reactivated after the error has been corrected.
4	Uncontrolled operation	The power amplifier and controller switch off. The error response can only be reset by switching off the unit.

Troubleshooting

Display	Error	Error class	Cause	Troubleshooting
dark	display dark	-	no power supply	check power supply and fuses
	display dark	-	power supply wrongly connected	connect properly
1	Undervoltage	3	DC link voltage below threshold value for switching off the drive	check line voltage and check connections to unit
2	Following error	3	drive blocked; start-stop frequency too high; movement frequency or acceleration too high	reduce load or motor torque check settings for motor current set start-stop frequency lower; reduce movement frequency or acceleration
	reference encoder at M1	1	cable fault to RS422 or sensor defective	Check encoder cable and encoder, replace cable
	Maximum motor speed	3	maximum motor speed exceeded	reduce pulse frequency
3	Motor cable	3	Short circuit or ground fault in motor cable	Check connections, replace motor cable
4	position sensor	3	only with TLC51x with speed monitoring: encoder or encoder cable defective	Check encoder cable and encoder, replace cable
5	Overvoltage	3	DC link overvoltage	Use external capacitor
7	power amplifier overtemperature	3	The power amplifier is overheating	Reduce load, use current drop to reduce power
	motor overtemperature	3	The motor is overheating Temperature sensor is not connected	Allow motor to cool Reduce load, use a motor with a higher rated power, use current drop to reduce power, check or replace motor encoder cable
8	Watchdog	4	Internal system error	Switch unit off and on, replace unit
	Control system error	4	System error, e.g. division by 0 or time-out checks, insufficient EMC	Comply with EMC protective measures, switch unit off and on, contact your local service representative
O	Error at outputs		Short circuit in digital outputs, No 24 V for signal interface IO 24 VDC	Check connections and wiring supply pin 7 and 8 with 24 V_{DC}

9844 1113 117, f107, 09.02

Display	Error	Error class	Cause	Troubleshooting
I	Positioning controller system error	3	Cause of error corresponding to error number in error memory	Correction dependent on error number
	Positioning controller system error	4	Cause of error corresponding to error number in error memory	Correction dependent on error number
None [1)]	Limit switch	1	Limit switch is or was activated, wire interrupted	traverse drive to movement range, match positioning data to axis range special report in error memory
	Stop	1	Stop signal activated, line interrupted	Check line for the $\overline{\text{STOP}}$ terminals signal
	Node guarding	1	Connection monitoring for the manual control unit activated	Check RS232 connection at controller
	Timeout	1	error in communication protocol	Timeout exceeded during exchange of data with manual control unit, restart transmission

1) No error display, operating status continues to be displayed.

Version P The following error can occur in version P.

Display	Cause	Troubleshooting
dark	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.

9844 1113 117, f107, 09.02

TL CT: Error display

▶ Select "Twin Line → Diagnosis → Error memory". A dialog box which displays the error messages appears.

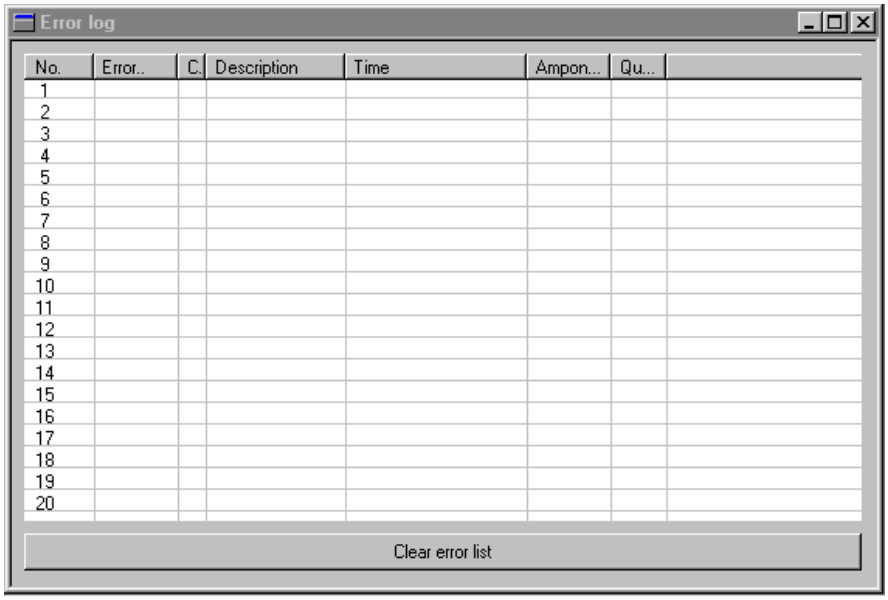


Fig. 8.2 Error messages

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 initialization error in parameter IxSix -> Qualifier" the Qualifier identifies the index/subindex of the parameter for which the error has been detected. You will find the parameter in the list of parameters in chapter 12.

As 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 while processing manual movement -> Qualifier"
- 181Fh: "error while processing reference movement -> Qualifier"
- 181Dh: "error in changing user mode -> Qualifier"

You will find more detailed information in the Qualifier; e.g. 00001846h, this is error message No. E1846 in the error list.

9844 1113 117, f107, 09.02

▶ Acknowledge the current error message with the "Reset" button on the command bar of the program.

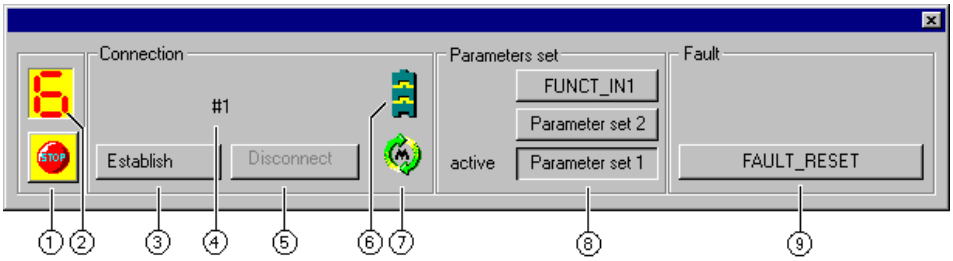


Fig. 8.3 Reset button, 9

TL HMI: Error display

▶ Use menu item "2.4 Error" to change to the menu items for displaying error messages.

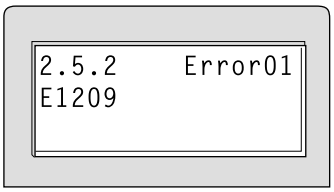


Fig. 8.4 Displaying an error value

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	1. error entry, oldest report
2.5.3 Error02	2. error entry, later report, if present
...	...

The meaning of the error values with cause and troubleshooting information is given in the HMI hand-held unit 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 recognized by the status word "fb_statusword". Signal status "1" indicates an error or warning message. Details on the cause of the error can be determined via parameters.

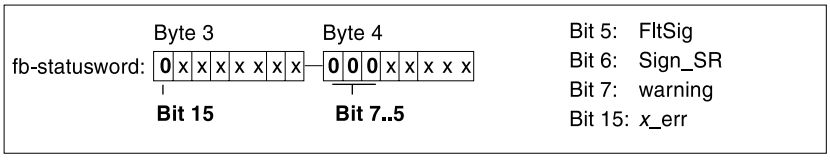


Fig. 8.5 Error evaluation for asynchronous error

9844 1113 117, f107, 09.02

- Bit5, "FltSig": Message from internal monitoring signal e. g. overtemperature power amplifier. Details of parameters "Status.FltSig_SR" and "Status.IntSigSR"
- Bit6, "Sign_SR": Message from external monitoring signal e. g. movement interruption by STOP input. Details of "Status.Sign_SR" parameter
- Bit7, "warning": Controller warning message e. g. I^2T error power amplifier. Details of parameters "Status.FltSig_SR" and "Status.IntSigSR"

Besides asynchronous errors, synchronous errors are also reported in field bus operation, triggered by a communication error, e.g. by unauthorized 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 subindex values:

Index	Meaning
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,...	20. error entry. if present, the latest error value is found here

Further information on each fault report can be obtained from the subindex.

Additional information can be found on 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 1..65535	–	R/– –
ErrMem0.ErrNum	900:1	2.5.2	Coded error number	UINT16 0..65535	–	R/– –
ErrMem0.Class	900:2	–	Error class	UINT16 0..65535	–	R/– –
ErrMem0.Time	900:3	–	Error time since power amplifier switched on [s]	UINT32 0..4294967295	–	R/– –
ErrMem0. AmpOnCnt	900:4	–	Number of switch-on cycles of power amplifier	UINT32 0..4294967295	–	R/– –
ErrMem0.ErrQual	900:5	–	Additional information for assessing error	UINT32 0..4294967295	–	R/– –
Commands.del_err	32:2	5.4	Deletion of all entries in the error memory	UINT16 0..1	0	R/W –

The error cause for each error message is saved in coded form as an error number under "Status.ErrNum". The table on page 8-9 ff. shows error numbers and their explanation.

9844 1113 117, f107, 09.02

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 cable	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

9844 1113 117, f107, 09.02

8.4 Table of error numbers

Error number	Error class	Meaning
E1001	0	Parameter does not exist
E1002	0	Parameter does not exist
E1003	0	Parameter does not exist
E1004	0	Parameter does not exist
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	Prior command not yet fully processed
E100C	0	Command not allowed while drive is active
E100D	0	Successive table entries must be different
E100E	0	System error: non-volatile memory too small
E100F	0	non-volatile memory defective
E1010	0	non-volatile memory booted
E1011	0	non-volatile memory read error
E1012	0	non-volatile memory write error
E1013	0	no valid parameter set
E1014	0	no data exists, upload not possible
E1015	0	function not allowed
E1016	0	write-protected against current user level
E1017	0	maximum permissible current is exceeded
E1018	0	input value outside allowed speed range
E1019	0	mode dies not exist
E101A	0	Communication protocol: service not supported
E101B	0	password not correct
E1021	0	program checksum not correct
E1022	0	bootstrap address error
E1023	0	wrong or missing module
E1024	0	movement interruption by LIMP
E1025	0	movement interruption by LIMN
E1026	0	movement interruption by STOP
E1027	0	power amplifier not found
E1028	0	power amplifier not factory-adjusted
E1029	0	power-amplifier changed
E102A	0	motor not factory-adjusted
E102B	0	motor parameters missing

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
E102C	0	non-volatile memory reinitialized
E102D	0	HIPERFACE module not adjusted or incorrectly adjusted
E102E	0	flashing not possible while drive is active
E102F	0	no valid operating system
E1031	0	command not allowed while drive is waiting for reference pulse from SinCoder
E1032	0	flash delete error (timeout)
E1033	0	motor moves during unit startup process
E1034	0	drive not active
E1035	0	non-volatile checksum error
E1036	0	created new Hiperface encoder non-volatile memory
E1037	0	Hiperface non-volatile memory not correctly defined
E1038	0	analog input +-10V not adjusted
E1039	0	reference encoder module not available
E103A	0	non-volatile memory block length incorrect
E103B	0	activation of amplifier not permitted
E103C	0	incorrect amplifier type
E103D	0	parameter write error with active gear mode
E103E	4	No connection to SAM
E103F	4	transmission timeout to SAM
E1040	3	transmission error to SAM
E1041	4	SAM module not supported by obsolete CPU module
E1200	0	Communication protocol: last service not processed
E1201	0	receive 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	trace data upload active
E120A	0	trace active
E120B	0	trace buffer too small for configured trace
E120C	0	parameter out of table range
E120D	0	function not implemented
E120E	0	error during access to Sincoder
E120F	0	HIPERFACE: data in non-volatile memory of sensor incorrect
E1210	0	no feedback module found
E1211	0	Warning: feedback module exchanged
E1212	0	unknown sensor connected with HIPERFACE module

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
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	DC link undervoltage limit value 1 reached: Quick-Stop
E1402	3	DC link undervoltage limit value 1 reached: drive error
E1403	3	motor ground fault detected
E1404	3	motor short circuit or motor overcurrent detected
E1405	3	DC link overvoltage
E1406	3	ballast resistor overtemperature
E1407	3	motor overtemperature
E1408	3	power amplifier overtemperature
E1409	0	I^2t monitoring error power amplifier
E140A	0	I^2t monitoring dummy
E140B	0	I^2t monitoring error motor
E140C	0	I^2t monitoring error ballast resistor
E140D	3	motor phase not connected
E140E	3	line phase not connected
E140F	4	system watchdog
E1410	4	DSP internal system fault
E1411	3	safe stop
E1412	0	Serial interface: transmission error
E1413	3	speed limit exceeded
E1414	3	Slot M1: reference quantity signal not correctly connected
E1415	3	Slot M2: position sensor for current motor position not correctly connected
E1416	3	following error limit reached
E1417	4	24 V line failure
E1418	0	position following error
E1419	2	I/O error
E141A	1	limit switch incorrectly wired
E141B	0	warning motor overtemperature
E141C	0	warning power amplifier overtemperature
E141D	0	unit overtemperature
E141E	0	SAM warning
E141F	0	Node guarding
E1800	0	parameter does not exist
E1801	0	no write access for parameter
E1802	0	incorrect password for commissioning or service
E1803	0	serial interface: initialization parameter not correct

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
E1804	4	serial interface: no send/receive buffer
E1805	2	serial interface: not initialized
E1806	0	precondition not met
E1807	0	parameter does not exist
E1808	2	send buffer too small
E1809	2	send string not converted
E180A	2	receive buffer too small
E180B	0	serial interface: overrun error
E180C	0	serial interface: framing error
E180D	0	serial interface: parity error
E180E	0	serial interface: receive error
E180F	0	serial interface: error in communication protocol
E1810	0	serial interface: transmission error
E1811	0	read/write allowed only during active axis mode
E1812	4	access to non-configured object (this = NIC)
E1813	0	DSP clock missed once
E1814	4	DSP clock total failure
E1815	0	trace object invalid
E1816	1	resource or function not ready
E1817	0	parameter value incorrect
E1818	0	non-calculable value
E1819	0	function only allowed at standstill
E181A	0	position overflow occurred
E181B	0	error while processing manual movement -> Qualifier
E181C	0	current position not yet defined
E181D	0	mode with external reference signals is active
E181E	0	drive is interrupted or blocked
E181F	0	error while processing reference movement -> Qualifier
E1820	1	error in processing position list
E1821	0	function not available with this unit version
E1822	0	reference movement is active
E1823	0	Can Master: invalid object number
E1824	0	Can Master: invalid CAN-ID
E1825	0	processing not allowed in actual operating mode
E1826	0	SWLIM causes error
E1827	0	trace position of HW limit switch not def.
E1828	0	limit switch not enabled
E1829	0	reference movement error at /LIMP
E182A	0	reference movement at /LIMN
E182B	0	Can Master: invalid object attribute

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
E182C	0	Can Master: Defined object reports error
E182D	0	Can Master: initialization reports error
E1832	4	hardware initialization indicates error
E1833	4	System: insufficient system memory
E1834	0	field bus module: FIFO debug message
E1835	4	field bus module: FIFO timeout
E1836	4	field bus module: error during boot procedure
E1837	4	field bus module: error during initialization
E1838	4	field bus module: incorrect communication parameter
E1839	4	field bus module: indicates error
E183A	4	field bus module: does not indicate
E183B	4	field bus module: unknown FIFO object received
E183C	4	field bus module: state machine indicates error
E183D	4	System: internal communication, write request to DSP with error
E183E	4	service request read object to DSP with error
E183F	0	-
E1840	4	data interface type mismatch (size)
E1841	0	change to new user mode still active
E1842	4	acceleration distance too large
E1843	0	LIMP causes interruption or Quick-Stop
E1844	0	LIMN causes interruption to Quick-Stop
E1845	0	REF causes interruption or Quick-Stop
E1846	0	STOP causes interruption or Quick-Stop
E1847	0	external monitoring signal LIMP causes quick-stop during negative movement
E1848	0	external monitoring signal LIMN causes during positive movement
E1849	0	internal position range exceeded
E184A	4	DSP bootstrap loader timeout
E184B	4	DSP indicates wrong program version
E184C	3	non-volatile memory contains invalid data
E184D	4	internal overflow
E184E	0	command or parameter write is locked by other interface
E184F	0	reference movement error by HWSTOP
E1850	0	reference movement error at/by REF
E1851	3	error during gear calculation
E1852	3	DSP timeout
E1853	3	dear mode: change of reference signal too large
E1854	0	command not allowed during processing (xxxx_end=0)
E1855	2	initialization error with parameter IxSix
E1856	0	access only possible with PowerDisabled
E1857	0	access possible only with PowerEnabled

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
E1858	0	Quick-stop active status activated
E1859	0	FaultReaction status or fault active
E185A	0	processing only possible in gear mode
E185B	0	input AUTOM or automatic processing active
E185C	0	input AUTOM inactive or manual processing active
E185D	0	login still unsuccessful
E185E	0	PSOS task not found
E185F	0	System: setpoint position generation interrupted
E1860	0	interruption or QuickStopActive by SWLIM
E1861	0	interruption or QuickStop Active by SWSTOP
E1862	0	interruption or QuickStopActive by internal SWSTOP
E1863	0	access only possible in OperationEnable status
E1864	0	reference encoder module not available
E1865	0	more then one HWLIM/REF signal active
E1866	0	call with direction bits=0 before new manual movement required
E1867	0	list processing: last number set lower than first number
E1868	0	list processing: position values not in correct ascending or descending order
E1869	0	list processing: current position behind position of last selected list entry
E186A	0	list processing: signal list is active
E186B	0	deactivation of current list-controlled operation due to change of operating mode
E186C	2	Timeout: drive has not reached standstill window
E186D	1	error in changing mode ->Qualifier
E186E	4	unit 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
E1872	0	external memory FRAM error
E1873	0	internal position adaptation to 0 because of range overrun
E1874	0	external memory FLASH error
E1875	0	external memory RAM error
E1876	1	unable to process synchronous start signal
E1877	0	reference switch /REF not found between /LIMP and /LIMN
E1878	0	reference movement on /REF without reversal of rotation, invalid limit switch /LIM actuated
E1879	0	reference movement on /REF without reversal of rotation, overtravel / LIM or /REF illegal
E187A	0	processing not possible: invalid or missing actual position encoder
E187B	0	processing not possible during reference movement to index pulse
E187C	0	processing not possible: fast position detection is active
E187D	1	index pulse not found
E187E	1	reproducibility of the index run not assured, index pulse too close to switch
E2000	0	FIRST_TLCT_FEHLER

9844 1113 117, f107, 09.02

Error number	Error class	Meaning
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	addressing error
E2016	0	Timeout when polling the unit
E2017	0	LOGIN has failed
E2018	0	TIMEOUT during LOGIN
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

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9 Service, Maintenance and Warranty

9.1 Service address

Contact your local dealer with any questions or problems. Your dealer will be happy to give you the name of a customer service outlet in your area.

Maintenance

The Twin Line unit requires no maintenance

▶ Check the filter in the switch cabinet ventilator regularly. Inspection intervals depend on the ambient conditions on site.

Have repairs to the unit carried out only by your local service representative to ensure that the unit continues to operate reliably.

Warranty

If the unit is opened the warranty is canceled.

9844 1113 117, f107, 09.02

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!
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-link terminals DC+ and DC-. The residual voltage must not exceed 48 V_{DC} before you start work on the connections. If additional DC-link capacitors are connected, the discharge period is increased to 10 minutes. Wait for this period and then measure the residual voltage.

Removal

▶ Save the parameter settings of the unit:

With the operating software select "File → Save" to save all values on the PC data storage medium.

With the HMI hand-held unit select menu "8.1 Read Param." to copy a parameter set into the HMI hand-held unit's 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 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, separate 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 applicable environmental protection laws. Send these parts for special waste disposal.

9844 1113 117, f107, 09.02

10 Accessories and spare parts

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 no.
1	TL CT operating software with online documentation on data medium, 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 cables 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 cables for RS422-C module, plug at each end encoder cables for RS422-C module, open at one end only	S/P	6250 1448 yyy [2] 6250 1449 yyy [2]
1	cables for IOM-C module	S/P	6250 1452 xxx [1]
1	encoder cables for ESIM3-C module	S/P	6250 1448 yyy [2]
1	field bus cable for module CAN-C IBS-C RS485-C	S/P	 6250 1446 yyy [2] 6250 1451 yyy [2] 6250 1455 xxx [1]
1	CAN terminator, 9-pin socket CAN terminator, 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 TLHBC	S	6250 1101 606
1	Terminal angle with top-hat rail TS 15, e.g for Phoenix Contact type MBK terminals	P	6250 1102 200
1	Set of grommets type KDT/Z [3](Murrplastic GmbH, see chap. 10.3, suppliers)	P	6250 1102 202
1	External line filter for units without internal filters 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, greater 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.

9844 1113 117, f107, 09.02

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	-
1	Documentation on the TLC51x on CD-ROM, multilingual	9844 1113 138

10.3 Suppliers

Grommets:

Murrplastic GmbH

D-71567 Oppenweier

Tel.: +49 (0) 7191 / 482-0

Fax.: +49 (0) 7191 /482-280

9844 1113 117, f107, 09.02

11 Unit label

11.1 Illustration of the unit label

▶ Copy the unit label and stick it on the inside of the Twin Line unit's hood.

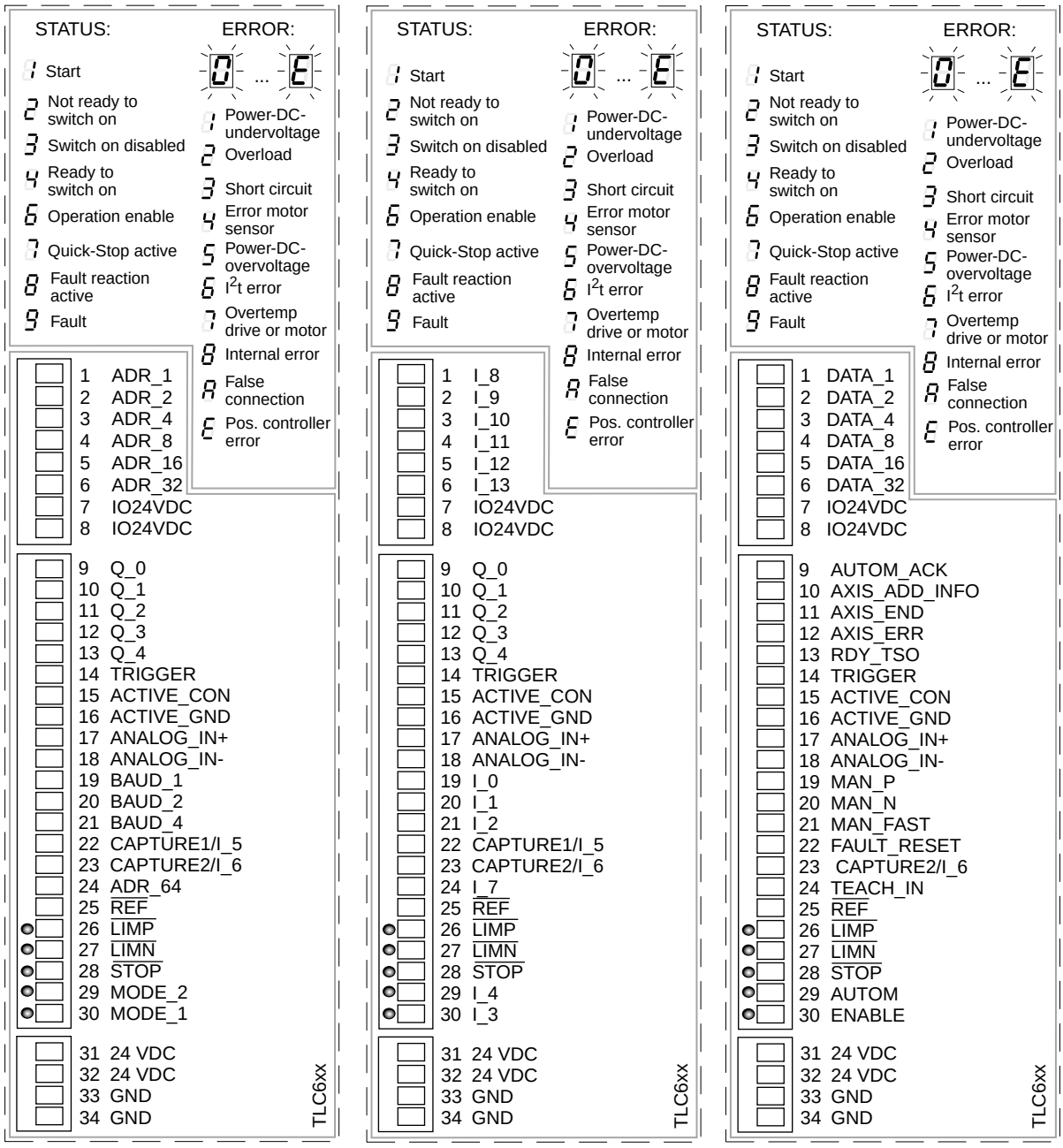


Fig. 11.1 Unit label

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

12 Parameters

12.1 Overview

Parameter groups The parameters of the Twin Line unit are grouped in functional blocks.

- Settings, page 12-3:
  Behavior of the input and output signals of the signal interface, modifying error responses, gear factors, parameters for the ±10 V interface and general control system settings
- Commands, page 12-4:
  Transmission of parameter sets, system settings for power amplifier, controller
- PA, page 12-5:
  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, standardization and ramp settings.
- Manual, page 12-7:
  Parameter settings for manual mode
- VEL, page 12-8:
  Settings for speed mode
- PTP, page 12-8:
  Settings for point-to-point mode
- Gear, page 12-9:
  Settings for electronic gear mode with offset superimposition
- Home, page 12-10:
  Settings for referencing mode
- Oscillator, page 12-11:
  Settings for oscillator mode
- Teach, page 12-12:
  Settings for the teach-in function mode
- List, page 12-13:
  Settings for the list-controlled operation function mode
- List1Data0..List1Data63, page 12-14:
  List data input data
- List2Data0..List2Data63, page 12-15:
  List data input data
- Capture, page 12-15:
  Settings for the operating function for capturing position data
- I/O, Page 12-16:
  Switching states of inputs and outputs of the signal interface
- M1, page 12-18:
  Settings for modules in slot M1
- M3, page 12-18:
  Settings for modules in slot M3
- M4, page 12-18:
  Settings for modules in slot M4

9844 1113 117, f107, 09.02

- Status, page 12-20:
  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 12-26:
  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 lower value.

Temperature in Kelvin [K] = temperature in degree Celsius [°C] + 273, for example: 358K=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 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"

9844 1113 117, f107, 09.02

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.	Info Page
name1	11:1	–	User device name 1	UINT32 0..4294967295	538976288	R/W rem.	–
name2	11:2	–	User device name 2	UINT32 0..4294967295	538976288	R/W rem.	–
Password	11:3	1.3	Password for configuring with a hand-held operating unit	UINT16 0..9999 0: No password protection	0	R/W rem.	–
I_0	14:10	4.1.30	Phase current standstill (100=1Arms)	UINT16 0..1000	90	R/W rem.	5-11
I_acc	14:11	4.1.31	Phase current acceleration/ deceleration (100=1Arms)	UINT16 0..1000	90	R/W rem.	5-11
I_const	14:12	4.1.32	Phase current constant movement (100=1Arms)	UINT16 0..1000	90	R/W rem.	5-11
SM_toggle	14:17	4.1.33	Short maximum motor motion when power amplifier switched on	UINT16 0: disabled 1: activated	1	R/W rem.	–
monitorM	14:18	4.1.35	Motor monitoring, with module in M2 only 0: deactivated 1: activated	UINT16 0..3 Bit0: Speed monitoring Bit1: Temperature monitoring	3	R/W rem.	5-11
offset_0V	20:58	4.1.38	Offset for linear shift of the 0V input voltage [mV]	INT16 –5000.. +5000	0	R/W rem.	6-46
win_10V	20:59	4.1.39	Voltage window within which its analog value is equal to 0 [mV] Example: set value of 20 mV means the range - 20 mV to + 20 mV will be interpreted as 0 mV	UINT16 0..1000	0	R/W rem.	6-47
SignEnabl	28:13	4.1.10	Signal enable for monitoring inputs 0: blocked 1: released	UINT16 0..15 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF	7	R/W rem.	7-27
SignLevel	28:14	4.1.11	Signal level for monitoring inputs 0: reaction at 0-level 1: reaction at 1-level	UINT16 0..15 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF	0	R/W rem.	7-27
SignQstop	28:20	4.1.26	Control signals that trigger a Quick-Stop: 0: Deceleration ramp 1: Quick-Stop ramp	UINT16 0..255 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit4..6: – Bit7: SW_STOP	0	R/W rem.	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
dec_Stop	28:21	–	Deceleration ramp for Quick-Stop [rev./(min*s)]	UINT32 1.. 2147483647	6000	R/W rem.	7-21
IO_mode	29:31	4.1.4	Significance of I/O signal assignment	UINT16 0..2 0: Setting the field bus parameters via inputs 1: I/O freely available 2: I/O assigned with function	0	R/W rem.	5-15

12.2.2 Parameter group Commands

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
eeprSave	11:6	3.9 4.9 6.9	Save parameter values in EEPROM memory 1: Save the range	UINT16 0..31 Ranges to be saved: Bit0: Parameter Bit1: Set data Bit2: List data List1 Bit3: List data List2 Bit4: User-def. data	–	R/W –	–
stateSave	11:7	–	Processing state of "Commands.eeprSave"	UINT16 0: Saving 1: Saving completed	–	R/– –	–
default	11:8	5.2 9.1	Factory setting	UINT16 2: Run factory setting	–	R/W –	–
stateDef	11:9	–	Processing state param. "Commands.default"	UINT16 0: Initializing 1: Initialization completed	–	R/– –	–
driveCtrl	28:1	–	Control word for state change, default Bit0..3="0", Write access automatically triggers slope change 0->1.	UINT16 0..15 Bit0: disable amplifier Bit1: enable amplifier Bit2: stop (Quick-Stop) Bit3: FaultReset Bit4: QuickstopRelease (TLC units only, internal accesses only) Bit5..15: not assigned	0	R/W –	8-2

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL-HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
OnlAuto	29:30	–	Access to the mode setting	UINT16 0..65535 0: access via all channels 1: access only via the channel that has set this parameter	1	R/W –	6-2
del_err	32:2	5.4	Deletion of all entries in error memory	UINT16 0..1	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.	Info Page
Serial	16:2	–	Module serial number	UINT32 0..4294967295	–	R/W rem.	–
I_maxPA	16:8	2.2.1	Peak current of the unit [100=1Arms]	UINT16 1..32767	1000	R/W rem.	–
U_maxDC	16:12	2.2.17	Max. permitted DC link voltage on the DC-bus [10=1V]	UINT16 1..20000	4000	R/W rem.	–
U_minDC	16:21	2.2.19	DC link undervoltage for switching off the drive	UINT16 1..20000	1500	R/W rem.	–
I_maxPA	16:58	2.2.22	Maximum current of the unit [Arms] (100 = 1 Arms)	UINT16 1..32767	1000	R/– –	–

12.2.4 Parameter group Motion

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
n_90%	14:15	4.4.30	Motor speed with 90% of standstill torque [rpm]	UINT16 1..3000	360	R/W rem.	5-24
n_50%	14:16	4.4.31	Motor speed with 50% of standstill torque [rpm]	UINT16 1..3000	690	R/W rem.	5-24
n_20%	14:27	4.4.32	Motor speed with 20% of standstill torque [rpm]	UINT16 1..3000	1380	R/W rem.	5-24
Filt_jerk	28:5	4.4.26	Jerk filter	UINT16 0..30 0: off 3..30: filter setting value	0	R/W rem.	7-20
invertDir	28:6	4.4.27	Inversion of sense of rotation	UINT16 0..1 0: no inversion 1: sense of rotation inverted	0	R/W rem.	7-22
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.	7-26

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
SW_LimN	29:5	4.4.6	Software limit switch for pos. position limit LIMN condition: SW_LimN > SW_LimP [usr]	INT32 - 2147483648..2147483647	–2147483647	R/W rem.	7-26
SW_Enabl	29:6	4.4.7	Set monitoring of software limit switches 0: deactivated 1: activated	UINT16 0..96 Bit5: SW_LIMP Bit6: SW_LIMN	0	R/W rem.	7-26
pNormNum	29:7	4.4.20	Position calibration numerator	INT32 - 2147483648..2147483647	1	R/W rem.	7-12
pNormDen	29:8	–	Position calibration denominator	INT32 - 2147483648..2147483647	19200	R/W rem.	7-12
vNormNum	29:9	4.4.21	Speed calibration numerator	INT32 1..2147483647	1	R/W rem.	7-12
vNormDen	29:10	–	Speed calibration denominator	INT32 1..2147483647	1	R/W rem.	7-12
aNormNum	29:11	4.4.22	Acceleration calibration numerator	INT32 1..2147483647	1	R/W rem.	7-12
aNormDen	29:12	–	Acceleration calibration denominator	INT32 1..2147483647	1	R/W rem.	7-12
n_max0	29:21	4.4.28	Speed limit for travel profile [rpm]	UINT32 1..3000	3000	R/W rem.	5-24
n_start0	29:22	4.4.10	Start-stop speed [rpm]	UINT32 1..n_max0 0..3000	12	R/W rem.	5-24
v_target0	29:23	4.4.11	Setpoint speed [usr]	UINT32 1..n_max0 1..2147483647	60	R/W rem.	5-24
acc_type	29:25	4.4.13	Shape of acceleration curve	UINT16 1..2 1: linear 2: Exponential	1	R/W rem.	5-24
acc	29:26	4.4.14	Acceleration [usr]	UINT32 1.. 2 147 483 647	600	R/W rem.	5-24
dec	29:27	4.4.15	Deceleration [usr]	UINT32 1.. 2 147 483 647	600	R/W rem.	5-24

9844 1113 117, f107, 09.02

12.2.5 Parameter group Manual

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
startMan	41:1	3.2.1	Start of manual movement with transfer of control bits	UINT16 0..7 Bit2: 0: slow 1: fast Bit1: neg. sense of rotation Bit0: pos. sense of rotation	–	R/W –	6-11
statusMan	41:2	–	Acknowledgement: manual movement	UINT16 0..65535 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/– –	6-11
typeMan	41:3	3.2.2	Type of manual movement	UINT16 0..1 0.: Classical inching 1: United inching	0	R/W rem.	6-11
n_slowMan	41:4	3.2.3	Speed for slow manual movement [usr]	UINT32 1..2147483647	60	R/W rem.	6-13
n_fastMan	41:5	3.2.4	Speed for fast manual movement [usr]	UINT32 1..2147483647	180	R/W rem.	6-13
dist_Man	41:6	3.2.5	Inch travel, defined travel per jog cycle with united inching [usr]	UINT16 1..65535	20	R/W rem.	6-13
step_Man	41:7	3.2.6	Inch travel, defined travel on manual movement start [usr] [usr]	UINT16 0..65535 0: Continuous operation	20	R/W rem.	6-12
time_Man	41:8	3.2.7	Classical waiting time [ms]	UINT16 1..30000	500	R/W rem.	6-12

9844 1113 117, f107, 09.02

12.2.6 Parameter group VEL

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
velocity	36:1	3.1.2.1	Start of speed change with transfer of setpoint speed [usr]	INT32 –2147483648..2147483647	–	R/W –	6-15
stateVEL	36:2	–	Acknowledgement: Speed profile mode	UINT16 0..65535 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 speed reached Bit14: vel_end Bit15: vel_err	–	R/– –	6-15

12.2.7 Parameter group PTP

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info 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, 6-17
statePTP	35:2	3.2.14	Acknowledgement: PTP positioning	UINT16 0..65535 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: Set position reached Bit14: motion_end Bit15: motion_err	–	R/– –	6-4, 6-17
p_relPTP	35:3	3.1.1.2	Start of relative positioning with transfer of the value for the distance [usr]	INT32 -2147483648..2147483647	0	R/W –	6-17
continue	35:4	3.1.1.3	Continuation of interrupted positioning with transfer of any value	UINT16 0..65535 value is not relevant for positioning	–	R/W –	6-17
v_tarPTP	35:5	3.1.1.5	Setpoint speed of PTP positioning [usr]	INT32 1..2147483647	Motion.v_target0	R/W –	6-18

9844 1113 117, f107, 09.02

12.2.8 Parameter group Gear

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
startGear	38:1	3.1.3.1	Starting an electronic gear process with selection of the processing mode	UINT16 0..2 0: deactivated 1: Immediate synchronization: 2: synchronization with compensatory movement	–	R/W –	–
stateGear	38:2	–	Acknowledgement: gear processing	UINT16 0..65535 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/– –	–
n_maxGear	38:5	3.1.3.3	maximum speed [rpm]	INT32 1..3000	3000	R/W rem.	–
a_maxGear	38:6	3.1.3.20	Maximum acceleration [rpm*s)] Note: Acceleration calibration is not considered	UINT32 120..120000	600	R/W rem.	–
numGear	38:7	3.1.3.2	Gear factor numerator	INT32 –2147483648..2147483647	1	R/W –	–
denGear	38:8	–	Gear factor denominator	INT32 1..2147483647	1	R/W –	–
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 –	–
DirEnGear	38:13	–	Release of movement direction, If the direction is inverted, the release of movement direction is reversed	INT16 1..3 1: positive direction 2: negative direction 3: both directions	3	R/W rem.	–
Flt_rGear	38:14	3.1.3.22	Tripping threshold for speed filter.	UINT16 1..100 Speed change from which the filtering of the reference speed is disabled [Inc/ms2]The higher the gear factor the higher the value should be set. Rule of thumb: Value = 2 * numerator/denominator. Select a higher value for better synchronism, select lower value for better dynamics.	15	R/W rem.	–
p_absOffs	39:1	3.1.3.6	Start of absolute offset positioning with transfer of position	INT32 –2147483648..2147483647	0	R/W –	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
stateOffs	39:2	–	Acknowledgement: Offset positioning	UINT16 0..65535 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/– –	6-28
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 –	6-28
n_tarOffs	39:5	3.1.3.8	Setpoint speed of offset positioning [rpm]	INT32 1..12000	60	R/W –	6-28
phomeOffs	39:6	3.1.3.9	Dimension setting in offset positioning [Inc]	INT32 –2147483648..2147483647	0	R/W –	6-28
accOffs	39:7	3.1.3.10	Acceleration ramp for offset positioning [rev/(min*s)]	INT32 60..2000000	300	R/W –	6-28
decOffs	39:8	3.1.3.11	Deceleration ramp for offset positioning [rev./(min*s)]	INT32 60..2000000	300	R/W –	6-28
ModeOffs	39:9	3.1.3.12	Processing mode of an absolute or relative positioning	UINT16 0..1 0: Jump 1: profile	0	R/W rem.	–

12.2.9 Parameter group Home

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info 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 referencing mode	UINT16 1..8 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 –	6-31

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
stateHome	40:2	–	Acknowledgement: referencing	UINT16 0..65535 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/– –	6-31, 6-42
startSetp	40:3	3.3.2	Sizing on sizing position (set absolute position) [usr]	INT32 –2147483648..2147483647	–	R/W –	6-42
v_Home	40:4	3.3.3	Speed for search of reference switch [usr]	INT32 –2147483648..2147483647	60	R/W rem.	6-31, 6-42
v_outHome	40:5	3.3.4	Speed for processing withdrawal path and safety distance [usr]	INT32 –2147483648..2147483647	6	R/W rem.	6-32
p_outHome	40:6	3.3.5	Max. withdrawal path with activated reference switch [usr]	UINT32 0..2147483647 0: Withdrawal disabled >0: Withdrawal path [usr]	0	R/W rem.	6-32
p_disHome	40:7	3.3.6	Safety distance from switching edge to reference point [usr]	UINT32 0..2147483647	200	R/W rem.	6-32
RefSwMod	40:9	3.3.10	Processing sequence with reference movement to REF	UINT16 0..3 Bit0: Rotation reversal at REF 0: permissible (standard operation) 1: not permissible Bit1: Movement direction safety distance 0: away from switch 1: into switch area	0	R/W rem.	6-32
DefPosTyp	40:10	–	Reference position for processing safety distance and index pulse search	UINT16 0.. 1 0: Setpoint position at standstill after deceleration because of signal change at limit or reference switch 1: Save current motor position on signal change at limit or reference switch	0	R/W rem.	6-32
RefAppPos	40:11	–	Application position at reference point [usr]	INT32 –2146483648.. +2146483647	0	R/W rem.	6-32

12.2.10 Oscillator mode

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
startOszi	51:1	3.1.9.1	Starting oscillator mode	UINT16 0..2 0: deactivated (setpoint=0) 1: Setpoint via +/-10 V interface	0	R/W –	6-44

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
stateOszi	51:2	–	Acknowledgement: oscillator mode	UINT16 0..65535 Bit0: error LIMP Bit1: error LIMN Bit2: error HW_STOP Bit3: error REF Bit4: not assigned Bit5: error SW_LIMP Bit6: error SW_LIMN Bit7: error SW_STOP Bit8-Bit12: not assigned Bit13: setpoint speed reached 0: Actual speed <> setpoint speed 1:actual speed = setpoint speed Bit14: oscillator_end 0: Priocess active1: Process inactive Bit15: oscillator_err 0: no error 1: Error	–	R/– –	6-45
n_RefAna	51:3	3.1.9.2	Setpoint speed at +10 V input signal [rpm]	INT16 0.. 13200 (Note: max. motor speed must not be exceeded)	3000	R/W rem.	6-45

12.2.11 Parameter group Teach

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
storeTeac	43:1	–	Teach-in processing Selecting memory List number for storing a position value (0...63) Example: 000010: List number 2	UINT16 0..65535 Bit0.5: List number	0	R/W –	7-10
stateTeac	43:2	–	Acknowledgement: Teach-in processing	UINT16 0..65535 Bit15: teach_err Bit14: teach_end	–	R/– –	7-10

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
memNrTeac	43:3	–	Data storage for teach-in processing	UINT16 1..2 1: List data list 1 2: List data list 2	1	R/W –	7-10
p_actTeac	43:4	–	Motor position stored during teach-in processing [usr]	INT32 –2147483648..2147483647	–	R/– –	7-10

12.2.12 Parameter group List

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
startList	44:1	3.1.5.1 3.1.5.2 3.1.6.1 3.1.6.2	Activate new list control	UINT16 0..2 0: no list active 1: list 1 2: list 2	0	R/W –	7-2
stateList	44:2	–	Acknowledgment and status: List control	UINT16 0..65535 Bit15: list_err Bit14: list_quit 0: list-controlled operation active 1: list-controlled operation completed Bit0.1: – 0: no list active – 1: list 1 active – 2: list 2 active	–	R/– –	7-2
typeList1	44:3	–	List 1: List type	UINT16 1: pos./signal 2: pos./speed	1	R/– –	7-10
cntList1	44:4	–	List 1: number of available list entries	UINT16 0..64	64	R/– –	7-2
bgnList1	44:6	–	List 1: Starting number of the list control starting number <= finishing number	UINT16 0..63	0	R/W rem.	7-2
endList1	44:7	–	List 1: Finishing number of the list control finishing number >= starting number	UINT16 0..63	63	R/W rem.	7-3
chgList1	44:9	–	List1: Change by other interfaces	UINT16 0..65535 0: no change <>0: change	0	R/W –	–
typeList2	44:11	–	List 2: List type	UINT16 1: Pos./signal 2: Pos./speed	1	R/– –	7-10
cntList2	44:12	–	List 2: number of available list entries	UINT16 0..64	64	R/– –	7-3
bgnList2	44:14	–	List 2: Starting number of the list control starting number <= finishing number	UINT16 0..63	0	R/W rem.	7-3

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
endList2	44:15	–	List 2: Finishing number of the list control finishing number > = starting number	UINT16 0..63	63	R/W rem.	7-3
actList	44:18	–	List: activated processing number	INT16 –1..63 –1: no list entry activated yet 0..63: last activated list entry Range preset by start and end number of the list control	–1	R/– –	7-3

12.2.13 Parameter group List1Data0..List1Data63

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.	Info Page
typeList1	1100:1	7.3.1.1	List 1: list type for ALL following list entries (1101:x...1163:x)	UINT16 1..2 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 [usr]	INT32 –2147483648..2147483647	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 –2147483648..2147483647 -"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.	7-4

9844 1113 117, f107, 09.02

12.2.14 Parameter group List2Data0..List2Data63

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.	Info Page
typeList2	1200:1	7.4.1.1	List 2: list type for all following list entries (1201:x...1263:x)	UINT16 1..2 1: pos./signal 2: pos./speed	1	R/W rem.	7-4, 7-10
posList2	1200:2	7.4.2.1 7.4.2.2	List 2: Position [usr]	INT32 -2147483648..2147483647	0	R/W rem.	7-4
signList2	1200:3	7.4.2.3	List 2: signal state	UINT16 0..1	0	R/W rem.	7-4
velList2	1200:4	7.4.2.4	List 2: setpoint speed [usr]	INT32 –2147483648..2147483647 -"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.	7-4

12.2.15 Parameter group Capture

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
TrigSign	20:13	–	Selection of trigger signals for position storage Bit3..2: Signal - channel 2 (K2) Bit1.0.0: Signal - channel 1 (K1) Examples: 4: binary 01 00 => CAPTURE2 (K2), CAPTURE1 (K1) 9: 01 00 => CAPTURE2 (K2), index pos. setpoint pos. (K1)	UINT16 0..15 bits0..1/bits2..3 (K1/K2): – 00: CAPTURE1 – 01: CAPTURE2 – 10: index pulse setpoint pos. encoder (with module at M1) – 11: index pulse actual pos. encoder (at SM with module at M2)	4	R/W –	7-24
TrigType	20:14	–	Position source for position storage	UINT16 0..1 0: actual position encoder 1: setpoint position encoder	1	R/W –	–
TrigLevl	20:15	–	Signal level for trigger channels bit state: 0: triggering at 1->0 change 1: triggering at 0->1 change	UINT16 0..3 Bit0: set trigger level on channel 1 Bit1: set trigger level on channel 2	3	R/W –	7-24

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
TrigStart	20:16	–	start triggering (bits0..1): 0: no change 1: reset triggering and repeat cancel triggering (Bit14=1) repeat triggering (bit15) 0: trigger once 1: trigger continuously	UINT16 0..3 Bit0: trig. on channel 1 Bit1: trig. on channel 2 Bit14: cancel trig. Bit15: Trig. repeat	0	R/W –	7-24
TrigStat	20:17	–	Status, triggering executed	UINT16 0..3 Bit0: triggering on channel 1 Bit1: triggering on channel 2	0	R/– –	7-24
TrigPact1	20:18	–	Actual position of motor on triggering on channel 1 [Inc]	INT32 –214748364..2147483647	–	R/– –	7-24
TrigPact2	20:19	–	Actual position of motor on triggering on channel 2 [Inc]	INT32 –214748364..2147483647	–	R/– –	7-24
TrigPref1	20:20	–	Setpoint of elect. gear on triggering on channel 1 [Inc]	INT32 –214748364..2147483647	–	R/– –	7-24
TrigPref2	20:21	–	Setpoint of elect. gear on triggering on channel 2 [Inc]	INT32 –214748364..2147483647	–	R/– –	7-24

12.2.16 Parameter group I/O

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
IW0_act	33:1	2.4.1	Input word 0 With "forcing" (e.g. with TL CT): read access shows force state	UINT16 0..65535 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF Bit12: – Bit13: – Additional bits (independent from IO_ mode assignment) if IOM-C analog module is fitted Bit14: DIG_IN1 Bit15: DIG_IN2	–	R/–	– –

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
IW1_act	33:4	2.4.2	Input word 1 Assignment depends on parameters "Settings.IO_mode": With "forcing" (e.g. with TL CT): read access shows force state	UINT16 0..65535 "Settings.IO_mode"=0/1/2: – Bit0: BAUD_1/I_0/MAN_P – Bit1: BAUD_2/I_1/MAN_N – Bit2: BAUD_4/I_2/ MAN_FAST – Bit3: MODE_1/I_3/ENABLE – Bit4: MODE_2/I_4/AUTOM – Bit5: I_5/I_5/FAULT_RESET additional: CAPTURE1 – Bit6: I_6/I_6/I_6 additional: CAPTURE2 – Bit7: ADR_64/I_7/ TEACH_IN – Bit8: ADR_1/I_8/DATA_1 – Bit9 ADR_2/I_9/DATA_2 – Bit10: ADR_4/I_10/DATA_4 – Bit11: ADR_8/I_11/DATA_8 – Bit12: ADR_16/I_12/ DATA_16 – Bit13: ADR_32/I_13/ DATA_32 Additional bits if IOM-C analog module is fitted: – Bit14: DIG_IN1/DIG_IN1/ DIG_IN1 – Bit15: DIG_IN2/DIG_IN2/ DIG_IN2	–	R/– –	–
QW0	34:1	2.4.10	Output word 0 With "forcing" (e.g. with TL CT): read access shows force state	UINT16 0..65535 "Settings.IO_mode"=0/1/2: – Bit0: Q_0/Q_0/ AUTOM_ACK – Bit1: Q_1/Q_1/ AXIS_ADD_INFO – Bit2: Q_2/Q_2/AXIS_END – Bit3: Q_3/Q_3/AXIS_ERR – Bit4: Q_4/Q_4/RDY_TSO – Bit5: ACTIVE_CON/ ACTIVE_CON/ACTIVE_CON – Bit6: TRIGGER/TRIGGER/ TRIGGER – Bit7..Bit13: not assigned Additional bits if IOM-C analog module is fitted: – Bit14: DIG_OUT1/ DIG_OUT1/DIG_OUT1 – Bit15: DIG_OUT2/ DIG_OUT2/DIG_OUT2	–	R/W –	–
OutTrig	34:9	–	Setting trigger output when signal list inactive	UINT16 0..1 0: Low level 1: High level	0	R/W –	7-6

9844 1113 117, f107, 09.02

12.2.17 Parameter group M1

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
PULSE–C	21:10	4.5.1	Setting position encoder PULSE–C	0..10 UINT16 Bit2: Max. frequency 0: 200 kHz, 1: 25 kHz Bit3: Signal form: 0: PULSE–DIR 1: PV–PR	0	R/W rem.	–
AnalogIn2	21:14	2.3.3.5	voltage value analog input 2 ANA_IN2 [mV]	INT16 -10000.. +10000	–	R/– –	5-21
AnalogIn3	21:19	2.3.3.6	voltage value analog input 3 ANA_IN3 [mV]	INT16 -10000.. +10000	–	R/– –	5-21
AnalogO1	21:24	2.3.3.7	analog output 1 ANA_OUT1 [mV] (1000=1V)	INT16 -10000... +10000	0	R/W –	5-21
AnalogO2	21:27	2.3.3.8	analog output 2 ANA_OUT2 [mV] (1000=1V)	INT16 -10000.. +10000	0	R/W –	5-21

12.2.18 Parameter group M3

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
p_indESIM	23:9	4.5.4	End coder simulation: Position of index pulse [Inc]	UINT16 0..16383 Actual position value is based on "Status.p_abs" at which the index pulse is output	1000	R/W rem.	–

12.2.19 Parameter group M4

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
profilSer	24:11	4.5.10	RS485-interface, processing mode incl. profile selection only readable via field bus	UINT32 0..4294967295	0	R/W rem.	–
baudSer	24:12	4.5.11	RS485-interface, baud rate [baud] only readable via field bus	UINT32 0..38400 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..31	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 –	–
profilIbs	24:16	4.5.15	Interbus-S, processing mode incl. profile selection only readable via field bus	UINT32 0..4294967295	0	R/W rem.	–

9844 1113 117, f107, 09.02

Parameter			Explanation and unit [ ]	Range of values	Default	R/W	Info
Name	Idx:Sidx	TL HMI			Value	rem.	Page
baudIbs	24:17	4.5.16	Interbus-S, baud rate (kbaud) only readable via field bus	UINT32 500000..2000000	500000	R/W rem.	–
toutIbs	24:18	4.5.17	Interbus-S, timeout time [ms] only readable via field bus	UINT16 0..640 0: monitoring inactive	640	R/W rem.	–
profilPbd	24:20	4.5.20	Profibus-DP, processing mode incl. profile selection only readable via field bus	UINT32 0..429496795	0	R/W rem.	–
addrPbd	24:21	4.5.21	Profibus-DP, address only readable via field bus	UINT16 0..126	126	R/W rem.	–
profilCan	24:23	4.5.25	CAN-C, processing mode incl. profile selection only readable via field bus	UINT32 0..2 0: CAN–Bus 1: CanOpen 2: DeviceNet	0	R/W rem.	–
addrCan	24:24	4.5.26	CAN-C, address only readable via field bus	UINT16 0..127	127	R/W rem.	–
baudCan	24:25	4.5.27	CAN-C, baud rate [baud] only readable via field bus	UINT32 20000..1000000	125k	R/W rem.	–
toutCan	24:26	4.5.28	CAN-C, timeout time [ms]	UINT16 0..65535 0: monitoring inactive	0	R/W rem.	–
busRxD	24:28	2.6.1	Receiving data Online command processing (Byte 1...4)	UINT32 0.. 4294967295	0	R/– –	–
busRxD5_8	24:29	2.6.1	Receiving data Online command processing (Byte 5... 8)	UINT32 0.. 4294967295	0	R/– –	–
busDiag	24:30	2.6.5	Bus diagnosis for DeviceNet (DNSTATE)	UINT16 0..65535 0: OFFLINE 1: ONLINE 2: LINK_OK 3: FAILURE 4: TIMED_OUT 5: IDLE 0..65535	–	R/– –	–
busTout	24:31	2.6.6	Bus statistics timeout: Total number of broken connections caused by timeout (node guarding)	UINT16 0.. 65535	0	R/W –	7-31
busError	24:32	2.6.7	Bus statistics Transmission error Total of all errors that resulted in a connection break	UINT16 0.. 65535	0	R/W –	7-31
busTxD	24:33	2.6.2	Sending data Online command processing (Byte 1... 4)	UINT32 0.. 4294967295	0	R/– –	7-30
busTxD5_8	24:34	2.6.2	Sending data Online command processing (Byte 5... 8)	UINT32 0.. 4294967295	0	R/– –	7-30
busCycle	24:35	2.6.6	Bus statistic Bus cycles Total number of all processed bus cycles	UINT32 0.. 4294967295	0	R/W –	7-31

9844 1113 117, f107, 09.02

12.2.20 Parameter group Status

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
serial_no	1:20	2.8.5	Device serial number, max. 9 digits	UINT32 0..4294967295	0	R/W rem.	–
p_DifPeak	12:16	2.3.1.9	Max. following error reached [Inc] write access resets value	UINT32 0..131072	0	R/W –	–
AnalogIn	20:8	2.3.3.1	analog input at input ANALOG_IN [mV]	INT16 –10000..+10000	0	R/– –	5-21

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
driveStat	28:2	2.3.5.1	Status word for the operating status	UINT32 0..429496795 Bit0..3: Current 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 message Bit8..11: not assigned Bit12..15: Mode-specific coding of the processing status Bit13: x_add_info Bit14: x_end Bit15: x_err Bit16–20: current operating mode (corresponds to Bit0–4: Status.xmode_act) 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) 6: Electronic gear speed controlled 7: Data set mode 8: function generator (current controller) 9: function generator (speed controller) 10: function generator (position controller) 11..15: cannot be set 16: Function generator in disabled status 17: Current regulation 18: Oscillator mode 19..30: reserved 31: not used Bit21: drive is referenced (ref_ok) Bit22: control deviation in position window (SM not assigned)	–	R/– –	6-6

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
xMode_act	28:3	2.3.5.5	Current axis operating mode with additional information, Bit0..4: List of possible operating modes for your TL unit will be found in the "Operating modes" chapter	UINT16 0..65535 Bit0..4: Current mode (unit-specific) [List of optional modes for your TL unit can be found in "Operating modes"] 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) 6: Electronic gear speed controlled 7: Data set mode 8: function generator (current controller) 9: function generator (speed controller) 10: function generator (position controller) 11..15: cannot be set 16: Function generator in disabled status 17: Current regulation 18: Oscillator mode 19..30: reserved 31: not used Bit5: Drive is referenced ("ref_OK") Bit6: Control deviation in position window (SM: not assigned) Bit7: reserved Bit8..15: not assigned	–	R/– –	6-31
Sign_SR	28:15	2.3.4.1	Saved signal states of external monitoring signals 0: not active, 1: activated	UINT16 0..15 Bit0: LIMP Bit1: LIMN Bit2: STOP Bit3: REF	–	R/– –	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
FltSig	28:17	2.3.4.3	Monitoring signals 0: not active, 1: activated	0..429496795 UINT32 Bit0: Power up error Bit1: DC link undervoltage Lim1 Bit2: DC link undervoltage Lim2 Bit3: Motor line ground fault Bit4: Motor line short circuit Bit5: DC link overvoltage Bit6: Overtemperature ballast Bit7: Overtemperature motor Bit8: Overtemperature Power amplifier Bit9: I^2t power amplifier Bit10: reserved Bit11: I^2t motor Bit12: I^2t ballast Bit13: Phase monitoring motor Bit14: Phase monitoring line Bit15: Watchdog Bit16: Internal system error Bit17: pulse block/SAM error Bit18: Protocol error HMI Bit19: Max. speed exceeded Bit20: Cable break reference encoder Bit21: Cable break actual position encoder Bit22: Position deviation error Bit23: Line failure 24 V Bit24: Following error Bit25: Short circuit in the digital outputs Bit26: Incorrect limit switch Bit27: Prewarning temperature motor Bit28: Prewarning temperature power amplifier Bit29: Bit30: SAM warning Bit31: not assigned	–	R/– –	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
FltSig_SR	28:18	2.3.4.4	Saved monitoring signals	UINT32 0..419496795 Bit0: Power up error Bit1: DC link undervoltage Lim1 Bit2: DC link undervoltage Lim2 Bit3: Motor line ground fault Bit4: Motor line short circuit Bit5: DC link overvoltage Bit6: Overtemperature ballast Bit7: Overtemperature motor Bit8: Overtemperature Power amplifier Bit9: I^2t power amplifier Bit10: reserved Bit11: I^2t motor Bit12: I^2t ballast Bit13: Phase monitoring motor Bit14: – Bit15: Watchdog Bit16: Internal system error Bit17: Pulse disable Bit18: Protocol error HMI Bit19: Max. speed exceeded Bit20: Cable break reference encoder Bit21: Cable break actual position encoder Bit22: Position deviation error Bit23: Line failure 24 V Bit24: Following error Bit25: Short circuit in the digital outputs Bit26: 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 0..65535 Bit0: Error class 0 Bit1: Error class 1 Bit2: Error class 2 Bit3: Error class 3 Bit4: Error class 4 Bit5: reserved Bit6: Actual speed = 0 Bit7: Clockwise rotation drive Bit8: Anticlockwise rotation drive Bit9: Current limit active Bit10: Speed limit active Bit11: Reference = 0 Bit12: Drive time-delayed Bit13: Drive accelerated Bit14: Drive operates constant	1	R/– –	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
IntSigSr	29:34	2.3.4.2	Monitoring signals in positioning controller 0: not active, 1: activated	UINT32 0..4294967295 Bit0..1: reserved Bit2: position overflow Bit3..4: reserved Bit5: SW limit switch, pos. sense of rotation (SW_LIMP) Bit6: SW limit switch, neg. sense of rotation (SW_LIMN) Bit7: stop via control word (SWSTOP) Bit8..14: reserved Bit15: amplifier not active Bit16..31: reserved	–	R/– –	7-25
p_ref	31:5	2.3.1.2	Setpoint position of rotor [inc]	INT32 –2147483648..+2147483647	–	R/– –	–
n_act	31:9	2.3.2.1	Actual speed [rpm]	INT16 –32768..32767	–	R/– –	–
p_abs	31:16	2.3.1.11	Absolute position per motor revolution (modulo value) [inc]	UINT16 0..32767 RESO-C: 0..4095 HIFA-C: 0..16383	–	R/– –	–
UDC_act	31:20	2.3.3.2	DC link voltage [10=1V]	INT16 0..32767	–	R/– –	–
Iu_act	31:21	–	Motor phase current phase U [100=1A]	INT16 –32768..32767	–	R/– –	–
Iv_act	31:22	–	Motor phase current phase V [100=1A]	INT16 –32768..32767	–	R/– –	–
v_ref	31:28	–	Speed of the rotor position setpoint value p_ref [inc/s]	INT32 –2147483648..2147483647	–	R/– –	–
p_target	31:30	2.3.1.5	Target position of travel profile generator [usr]	INT32 –2147483648..2147483647	–	R/– –	–
p_jerkusr	31:31	2.3.1.4	Actual position of movement profile generator [usr]	INT32 –2147483648..2147483647	–	R/– –	–
p_actusr	31:34	2.3.1.3	Actual position of motor in user-defined units [usr]	INT32 –2147483648..2147483647	–	R/– –	–
v_jerkusr	31:35	2.3.2.3	Actual speed of movement profile generator [usr]	INT32 –2147483648..2147483647	–	R/– –	–
p_remaind	31:37	–	Residual value of position calibration of position setpoint p_ref [Inc]	INT32 –2147483648..2147483647	–	R/– –	7-18
v_target	31:38	2.3.2.4	Target speed of movement profile generator	INT32 –2147483648..2147483647	–	R/– –	–
p_jerk	31:40	–	Setpoint position at jerk filter input [Inc]	INT32 –2147483648..2147483647	–	R/– –	–
v_jerk	31:41	–	Setpoint speed at jerk filer input [Inc]	INT32 –2147483648..2147483647	–	R/– –	–
v_refM1	31:43	2.3.2.5	Speed from input value increments counted on module on M1 [Inc/s]	INT32 –2147483648..2147483647	–	R/– –	–
p_refusr	31:44	–	Setpoint position of rotor position [usr]	INT32 –2147483648..2147483647	–	R/– –	–

9844 1113 117, f107, 09.02

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
v_refusr	31:45	–	Speed of rotor position setpoint p_ref [usr]	INT32 –2147483648..2147483647	–	R/– –	–
p_diffind	31:48	–	Distance between switch and index pulse after reference movement [Inc]	INT32 –2147483648.. 2147483647	–	R/– –	–
StopFault	32:7	2.5.1	Cause of last interruption, error number	UINT16 1..65535	–	R/– –	8-7

12.2.21 Parameter group ErrMem0..ErrMem19

ErrMem0: Index 900
ErrMem1 to ErrMem19 via index 901 to 919

Parameter Name	Idx:Sidx	TL HMI	Explanation and unit [ ]	Range of values	Default Value	R/W rem.	Info Page
ErrNum	900:1	2.5.2	Coded error number	UINT16 0..65535	–	R/– –	8-7
Class	900:2	–	Error class	UINT16 0..65535	–	R/– –	8-7
Time	900:3	–	Error time since power amplifier switched on [s]	UINT32 0..4294967295	–	R/– –	8-7
AmpOnCnt	900:4	–	Number of switch-on cycles of power amplifier	UINT32 0..4294967295	–	R/– –	8-7
ErrQual	900:5	–	Additional information for assessing error	UINT32 0..4294967295	–	R/– –	8-7

9844 1113 117, f107, 09.02

Index

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

9844 1113 117, f107, 09.02

Supplement

Safety note

Twin Line units are drives designed for general use. They are state of the art and are designed to be as safe as possible. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of Twin Line drives unless additional suitable safety equipment prevents any personal danger. This applies for operating the machine during production and also for all service and maintenance work on drives and the machine.

The machine design must ensure personal safety.

Suitable measures for prevention of property damage are also required.

The following constraints must be observed for applications conforming to UL508C

- Input mains overvoltage category III (UL840): The Twin Line product range has been designed in accordance with standard UL840. A UL Recognized Transient Voltage Surge Suppressor, conforming to UL 1449, with a maximum clamping voltage of 4kV, shall be provided in all phases of the line side of the drive in the end installation. Use Square D SDSA3650 surge arrester or equivalent.
- Branch circuit fuse class CC 600V according to UL248 required
- Max. surrounding air temperature 50 °C

New in the product range: the Modbus ASCII function

Please see the MODBUS ASCII documentation
(No. 009844 1113 181).

9844 1113 154, f107, 09.02

9844 1113 154, f107, 09.02