HIWIN®

Motion Control & Systems

Assembly and Commissioning Instructions

D2 Servo Drive Amplifier

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Contents

1. General Information

1.1 Information about the document

These assembly and commissioning instructions are intended for planners, developers and operators of machines and equipment in which HIWIN D2 servo drive amplifiers are already integrated or are to be used. They are also intended for people who perform the following work on or with the D2:

- Transport
- Assembly
- Electrical connection, including linking to a superordinate controller
- Integration in a safety system
- Conversion or upgrading
- Set-up
- Commissioning
- Operation
- Maintenance
- Troubleshooting
- Taking out of operation, dismantling and disposal

1.1.1 Version of this documentation

Table 1.1 **Version of this documentation**

Version	Date	Remark
02-1	September 2017	Update "Error codes and troubleshooting"
02-0	February 2017	Layout adaptation, complete update
01-1	June 2015	Update order code
01-0	May 2014	First edition

1.1.2 Requirements

It is assumed that operating staff are trained in safe operating practices and have read and understood these assembly and commissioning instructions in full.

1.1.3 Availability

These assembly and commissioning instructions must be available at all times to everyone working with or on the D2 servo drive amplifier.

1.1.4 Scope of validity for these assembly and commissioning instructions

These assembly and commissioning instructions apply to servo drive amplifiers from HIWIN with the following product designations:

- D2-01xx-x-xx
- D2-04xx-x-xx
- D2-10xx-x-xx
- D2T-01xx-x-xx
- D2T-04xx-x-xx
- D2T-10xx-x-xx
- D2T-20xx-x-xx

They also apply if two or more of the drive amplifiers listed above are combined.

1.2 Depictions used in these assembly instructions

1.2.1 Instructions

Instructions are indicated by triangular bullet points in the order in which they are to be carried out.
Results of the actions carried out are indicated by ticks.

Example:

- ▶ Produce appropriate mounting holes on the assembly surface if not already present.
- ▶ Clean assembly surface and position drive amplifiers on it.
- ▶ Screw in retaining bolts and tighten to a maximum torque of 3 Nm (when using type 8.8 screws)

- ✓ Drive amplifier is mounted.

1.2.2 Lists

Lists are indicated by bullet points.

Example:
D2 servo drive amplifiers must not be operated:

- Outdoors
- In potentially explosive atmospheres
- ...

1.2.3 Depiction of safety notices

Safety notices are always indicated using a signal word and sometimes also a symbol for the specific risk (see Section 1.2.4).
The following signal words and risk levels are used in these instructions:

⚠ DANGER!

Direct danger!
Non-compliance with the safety notices will result in serious injury or death!

⚠ WARNING!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of serious injury or death!

⚠ CAUTION!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of moderate to slight injury!

ATTENTION!

Potentially dangerous situation!
Non-compliance with the safety notices runs the risk of damage to property or environmental pollution!

1.2.4 Symbols used

The following symbols are used in these instructions:

Table 1.2 **Warning signs**

	Warning of dangerous, electrical voltage!
	Warning of magnetic fields!
	Warning of hot surfaces!
	Substance hazardous to the environment!
	Access denied!

Table 1.3 **Mandatory signs**

	Wear protective gloves!
	Isolate before work!

1.2.5 Information

NOTE Describes general information and recommendations.

1.3 Warranty and liability

The "General conditions of sale and delivery" of HIWIN GmbH apply.

1.4 Manufacturer's details

Table 1.4 **Manufacturer's details**

Address	HIWIN GmbH Brücklesbünd 2 D-77654 Offenburg
Telephone	+49 (0) 781 / 9 32 78 - 0
Technical customer service	+49 (0) 781 / 9 32 78 - 77
Fax	+49 (0) 781 / 9 32 78 - 90
Technical customer service fax	+49 (0) 781 / 9 32 78 - 97
E-mail	support@hiwin.de
Internet	www.hiwin.de

1.5 Copyright

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- Windows is a registered trademark of the Microsoft Corp.
- Beckhoff®, TwinCAT® and EtherCAT® are registered and licenced trade-marks of Beckhoff Automation GmbH.

1.6 Product monitoring

As the manufacturer of the D2 servo drive amplifier, please inform HIWIN about:

- Accidents
- Potential sources of risk
- Incomprehensibilities in these assembly and commissioning instructions

2. Basic safety notices

⚠ DANGER!

This chapter serves to ensure the safety of everyone working in the vicinity of the D2 servo drive amplifier and who fits, installs, connects, operates, maintains or disassembles it. Non-compliance with the following information results in danger of life.

2.1 Intended use

The servo drive amplifiers of the D2 range are suitable for operating brushless synchronous servo motors, as AC servo motors, in force and/or torque control and speed and/or position control.

Subsequent safety instructions must be observed:

- The rated voltage of the motors must be greater than or at least the same as the intermediate circuit voltage supplied by the drive amplifier.
- All drive amplifiers may only be used for the stated intended purpose.
- The drive amplifiers are fitted as components in electrical equipment or machines and may only be started up as integrated system components.
- The machine manufacturer is obligated to produce a risk assessment for the machine. This is used as the basis for determining appropriate measures to prevent injury and damage to property resulting from unforeseeable movements.
- The drive amplifiers of the D2 series can be connected directly to single-phase or three-phase, earthed industrial networks (110 – 230 V). They must not be operated in non-earthed networks or networks with unsymmetrical earthing with a voltage of more than 230 V.
- If the drive amplifiers are used in residential or commercial areas and small plants, the user must take additional EMC filter measures.
- The drive amplifiers may only be operated in a closed switch cabinet under the permissible ambient conditions. For details, see Table 3.2 "Technical data D2" on Page 14.
- Only use copper cables for wiring in the switch cabinet.
- The drive amplifiers of the D2 series must not be used in unprotected outdoor areas or areas at risk of explosion.
- The D2 servo drive amplifier can only be declared to be conforming if operated with the accessories supplied and the other HIWIN components required (motor, cables).

2.2 Disclaimer in the event of modification or improper use

Modifications not described in this assembly and commissioning instructions must not be undertaken on the drive amplifier. If a modified construction is needed, please contact HIWIN GmbH directly.
The manufacturer assumes no liability in the event of modifications or improper assembly, installation, commissioning, use, maintenance or repairs.
Only genuine parts from HIWIN are approved as spare parts and accessories. Spare parts and accessories not supplied by HIWIN are not checked for operation with HIWIN drive amplifiers and may restrict operational safety. HIWIN assumes no liability for damage caused through use of non-approved spare parts and accessories.

2.3 Qualified trained staff

The drive amplifiers may only be fitted, integrated in superordinate systems, started up, operated and maintained by qualified trained staff. Staffs are considered qualified and trained if:

- they have appropriate technical training and
- have been instructed by the machine operator in operation and the valid safety guidelines and
- can assess the anticipated risks and
- have read and understood these assembly and commissioning instructions in full and have access to them at all times.

2.4 General safety notices

The following safety notices must be observed. Non-compliance with safety notices may put life and limb at risk.

2.4.1 Safety notices regarding storing the drive amplifiers

ATTENTION!

Damage to the drive amplifier!

The drive amplifiers are delivered in packaging. If the drive amplifiers are to be put into storage, they must be kept in this packaging. They must be stored in a dry location with protection from impact.

2.4.2 Safety notices regarding transporting the drive amplifiers

ATTENTION!

Damage to the drive amplifier!

Drive amplifiers may only be transported by qualified staff in the original recyclable packaging. Severe impact should be avoided and the following ambient conditions should be observed:

- Permissible temperature during transport:
  –20 to +65 °C, max. 20 K/hour fluctuating
- Permissible air humidity during transport:
  relative humidity 20 % to 85 %, non-condensing

2.4.3 Safety notices regarding the handling of the drive amplifier!

ATTENTION!

Damage to the drive amplifier!

- Discharge your body before you touch the drive amplifier.
- Avoid contact with highly insulating materials (plastic fibres, plastic films etc.). Place the drive amplifier on a conductive surface. The drive amplifiers contain components at risk from electrostatic which may be damaged if handled incorrectly.

2.4.4 Safety notices regarding working with energised and live products

⚠ DANGER!

Danger from electrical voltage!

- The drive amplifiers should be de-energised before and during all assembly, disassembly or repair work. Ensure that no-one can reestablish the mains connection. Otherwise there is a risk of death and injury.
- Always ensure that the drive amplifiers are correctly earthed using the PE bar in the switch cabinet as reference potential. Safety is not guaranteed if there is no low-ohm earthing.
- Power connections may be live even if the motor is not moving. Never disconnect the electrical connections of motors and drive amplifiers when live. In the worst case scenario, electric arcs may form, causing personal injury and damage to contacts.
- After disconnecting the drive amplifiers from the supply voltages, wait at least five minutes before touching live parts (e.g. contacts, threaded bolts etc.) or breaking connections. For your own safety measure the voltage in the intermediate circuit and wait until it has fallen below 40 VDC.
- The drive amplifiers should always be operated in conjunction with appropriate safety equipment (zero contact protective equipment, mechanical protective equipment etc.). This protective equipment must be designed, installed and regularly checked in accordance with applicable national and international legislation and specifications.

2.4.5 Safety notices regarding working with hot surfaces!

⚠ WARNING!

Risk of burns!
The surface of the drive amplifier may reach temperatures in excess of 50 °C. There is therefore a risk of burns. The housing must not be touched during or shortly after operation.
- ▶ Leave the drive amplifier to cool for at least 15 minutes after switching off.

2.4.6 Danger due to uncontrolled movement!

⚠ WARNING!

Risk of serious injury or death due to uncontrolled movement of motors and machine parts!
Uncontrolled movement of motors and machine parts during installation and during operation can occur after a not defined period of time. Potential causes of uncontrolled movements may be:
- Damaged or defective components
- Incorrect parameterization of the drive
- Error in the software or firmware
- Incorrect handling of the software
- Wiring error
- Manipulation or modification of the wiring during operation
- Signal failure of encoders
- Exceeding the permissible payload of the motor

- ▶ Keep out of the dangerous zone of moving machine parts.
- ▶ Stop all motor movements safely before entering the dangerous zone.
- ▶ Protect the danger zone against unauthorised access.

⚠ WARNING!

Risk of serious injury or death due to incorrect wiring when using self-assembled cables for positioning measurement systems!
Self-assembled cables have the risk of incorrect wiring, which can lead to unpredictable movements of motors and machine parts.
- ▶ Read these assembly instructions carefully and if applicable contact the HIWIN technical support (see Section 2.5).

⚠ WARNING!

Risk of serious injury or death due to a damaged measuring scale of the positioning measurement system!
A damaged measuring scale can cause unpredictable movements of motors and machine parts.
- ▶ With optical positioning measurement systems make sure that the measuring scale is neither scratched or soiled.
- ▶ With magnetic positioning measurement systems make sure that the measuring scale is not subjected to any strong magnetic fields.

2.5 HIWIN technical support

If you have any questions, please contact the technical support team at HIWIN:

Phone: +49 (0) 781 / 9 32 78-77
Fax: +49 (0) 781 / 9 32 78-97
E-mail: support@hiwin.de

If you have any questions relating to documentation, any suggestions or improvements please send a fax to the above fax number.

2.6 Labels on D2 servo drive amplifier

2.6.1 Warning symbols

Table 2.1 **Warning symbols**

Pictogram	Type and source of danger	Protective measures
	Danger of electric shock!	Disconnect the power supply of the torque motor components before maintenance or repairs!
	Danger from hot surfaces!	Let hot surfaces cool down before touching them!

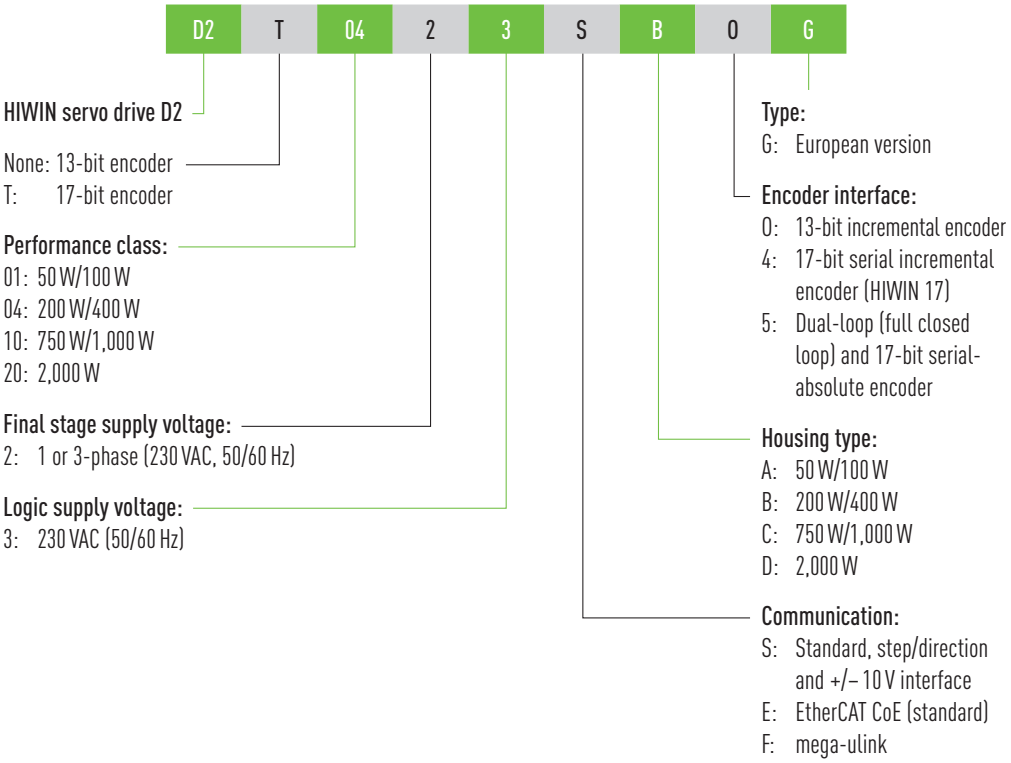
2.6.2 Type plate

See Section 3.2.

3. Product description

The D2 supports rotary AC servo motors from HIWIN with digital or absolute serial encoder interfaces.
The D2 servo drive amplifier supports the Ethernet-based EtherCAT field bus system. EtherCAT is an open technology which is regulated in international standards IEC 61158, IEC 61784 and ISO 15745-4. EtherCAT is a very fast industrial Ethernet system, also suited to use in time-critical motion control applications. The D2 supports the proprietary protocol "mega-ulink" under EtherCAT.

3.1 Order code



3.2 Type plate

The complete type plate is fitted on the right hand side of the device and contains all relevant information.

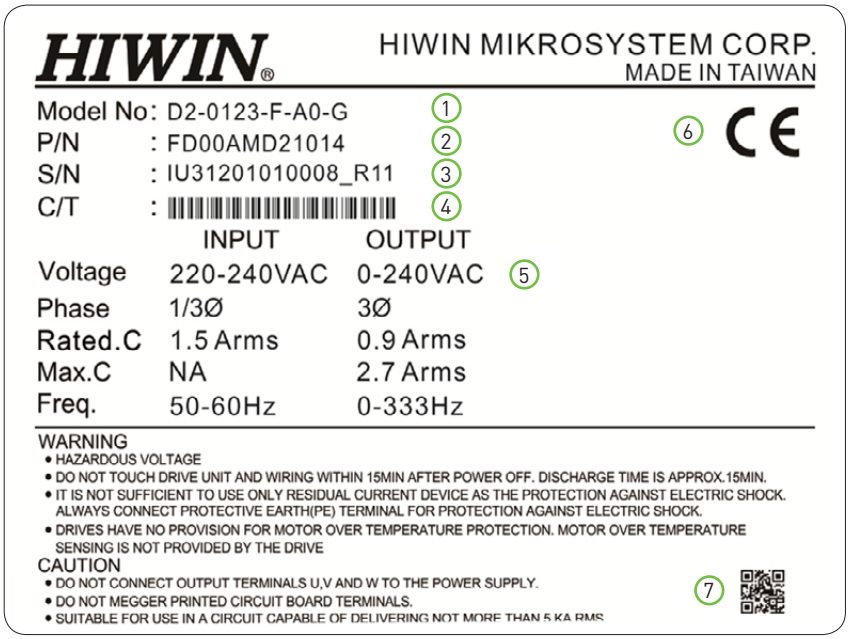


Fig. 3.1 **Type plate, right hand side of device**

Table 3.1 **Content of type plate**

Number	Description
1	Type designation of drive amplifier
2	HIWIN item number
3	Serial number of device
4	Barcode
5	Electrical properties of the device
6	CE compliant
7	QR-Code

3.3 Scope of supply

The scope of supply may vary depending on the configuration ordered. Before installation, please check whether all the ordered components have been supplied and whether the goods are damaged. If the goods are damaged, please contact the transport company immediately and document the damage.

Standard scope of delivery

- D2 in the performance class ordered
- Plug connectors for CN1, CN2 and CN6
- Printed Assembly and Commissioning Instructions
- The latest documentation, commissioning software "Lightening" and other valuable tools are free to download from www.hiwin.de.

Accessories

Please refer to Chapter 13 of this document or the current HIWIN catalogue "Drives and Servo Motors" for the extensive range of accessories. For more information, you can also visit www.hiwin.de.

3.4 Technical specification

Table 3.2 **Technical data D2**

HIWIN D2 servo drive amplifier				D2-0123	D2-0423	D2-1023
Power supply		**Final stage supply voltage and frequency**		200 to 240 VAC (± 10 %) / 50 to 60 Hz (± 5 %)		
		Number of phases		1 or 3		
		Power consumption of final stage		1.5 A_{eff}	4.1 A_{eff}	7.5 A_{eff}
		Logic supply voltage and frequency		200 to 240 VAC (± 10 %) / 50 to 60 Hz (± 5 %) 1-phase only		
		Power consumption of logic supply		0.5 A max.		
Output current		**Continuous current (effective)**		0.9 A	2.5 A	5.1 A
		Peak current (effective)		2.7 A	7.5 A	15.3 A
		Maximum duration of peak current		1 second		
Type of control				IGBT PWM vector control		
Controller sampling rate				Current, speed and position controllers: 15 kHz: standard and mega-ulink 16 kHz: EtherCAT (CoE)		
Motor types supported				AC servo motors		
Status LED				Red: Error; Green: Ready		
Operating modes	**Position control**	**Inputs/outputs**		Low-speed pulse inputs (CN6 pins: 3, 4, 5, 6) High-speed pulse inputs (CN6 pins: 44, 45, 46, 47)		
		Function		Step/direction; CW/CCW; AB signals (4 × evaluation)		
		Maximum input frequency		Low-speed (optocoupler): 500 kHz High-speed (different.): 4 MHz		
		Electric gear		Ratio: pulses/counts pulses: 1 – 2,147,483,647 counts: 1 – 2,147,483,647		
	Speed/torque control	**Analogue**	**Input resistance**	10 kΩ		
			Input voltage	±10 VDC		
			Resolution	12-bit		
		Digital	**PWM**	Via low-speed pulse inputs		
			Frequency	Min. 36.5 kHz; max. 100 kHz		
			Min. pulse duration	220 ns		
Encoder interface		**Operating voltage**		+ 5 VDC ± 5 % at 400 mA		
		Input	**Signal type**	A/A, B/B, Z/Z, differential signals		
			Bandwidth	After 4 × evaluation 5 million incr/s		
		Output	**Signal type**	A/A, B/B, Z/Z, differential signals		
			Resolution	After 4 × evaluation 8 million incr/s		
Encoder simulation output				Max. 18 million incr/s, RS422 differential; adjustable scaling		
Communication		**Interface**		USB 2.0		
Parameterisable I/O interface			**Digital inputs**	[I1 to I9], (single-end, optocoupler), 12–24 VDC		
			Digital outputs	[O1 to O4], (optocoupler), 24 VDC, 100 mA		
			Brake output	BRAKE [CN2_BRK], max. 1 ADC		

Table 3.2 **Technical data D2 (continuation)**

HIWIN D2 servo drive amplifier		D2-0123	D2-0423	D2-1023
Feedback	**Resistance**	External		
	Activation threshold	+ HV > 370 VDC		
	Deactivation threshold	+ HV < 360 VDC		
	Tolerance	± 5 %		
Monitoring functions		Short circuit, overvoltage (> 390 VDC ± 5 %), undervoltage (< 60 VDC); position error, encoder error, motor phase monitoring, overtemperature D2 (IGBT > 90 °C ± 1 °C), motor overtemperature		
Autotuning		With automatic mass inertia calculation		
Error mapping	**Method**	Compensation table for correcting position errors through linear interpolation		
	Table entries	Max. 5,000		
	Activation	Following successful referencing or via digital input signal		
VSF (vibration suppression)		0,1 Hz to 200 Hz		
Other functions		Friction compensation, gear play compensation		
External EtherCAT adapter (option)		EtherCAT with mega-ulink protocol		
Ambient conditions	**Operating temperature**	0 to 40 °C (above 55 °C only with air conditioning)		
	Storage temperature	–20 °C to +65 °C		
	Air humidity	20 to 85 % (non-condensing)		
	Operating altitude	< 1,000 m above sea level		
	Vibration	5.88 m/s² (10 to 60 Hz)		
	Protection class	IP20		

Table 3.3 **Technical data D2T**

HIWIN D2 servo drive amplifier				D2T-0123	D2T-0423	D2T-1023	D2T-2023
Power supply		**Final stage supply voltage and frequency**		200 to 240 VAC (± 10 %) / 50 to 60 Hz (± 5 %)			
		Number of phases		1 or 3			
		Power consumption of final stage		1.5 A_{eff}	4.1 A_{eff}	7.5 A_{eff}	8.75 A_{eff}
		Logic supply voltage and frequency		200 to 240 VAC (± 10 %) / 50 to 60 Hz (± 5 %) 1-phase only			
		Power consumption of logic supply		0.5 A max.			
Output current		**Continuous current (effective)**		0.9 A	2.5 A	5.1 A	11 A
		Peak current (effective)		2.7 A	7.5 A	15.3 A	33 A
		Maximum duration of peak current		1 second			
Type of control				IGBT PWM vector control			
Controller sampling rate				Current, speed and position controllers: 15 kHz: standard and mega-ulink 16 kHz: EtherCAT (CoE)			
Motor types supported				AC servo motors			
Status LED				Red: Error; Green: Ready			
Operating modes	**Position control**	**Inputs/outputs**		Low-speed pulse inputs (CN6 pins: 3, 4, 5, 6) High-speed pulse inputs (CN6 pins: 44, 45, 46, 47)			
		Function		Step/direction; CW/CCW; AB signals (4 × evaluation)			
		Maximum input frequency		Low-speed (optocoupler): 500 kHz High-speed (different.): 4 MHz			
		Electric gear		Ratio: pulses/counts pulses: 1 – 2,147,483,647 counts: 1 – 2,147,483,647			
	Speed/torque control	**Analogue**	**Input resistance**	10 kΩ			
			Input voltage	±10 VDC			
			Resolution	12-bit			
		Digital	**PWM**	Via low-speed pulse inputs			
			Frequency	Min. 36.5 kHz; max. 100 kHz			
			Min. pulse duration	220 ns			
Encoder interface		**Operating voltage**		+ 5 VDC ± 5 % at 400 mA			
		Input	**Signal type**	A/A, B/B, Z/Z, differential signals			
			Bandwidth	After 4 × evaluation 5 million incr/s			
			Option	Dual loop with rotatory 17-bit absolute encoder and AqB linear encoder (not for D2T-xxxx-E-)			
		Output	**Signal type**	A/A, B/B, Z/Z, differential TTL			
			Resolution	After 4 × evaluation 8 million incr/s			
Encoder simulation output				Max. 18 million incr/s, RS422 differential; adjustable scaling			
Communication	**Interface**			USB 2.0			
Parameterisable I/O interface		**Digital inputs**		[I1..I10], (single-end, optocoupler), 12–24 VDC			
		Digital outputs		[O1..O5], (optocoupler), 24 VDC, 100 mA			
		Analogue outputs		2 (1 × speed, 1 × torque)			
		Brake output		BRAKE [CN2_BRK], max. 1 ADC			

Table 3.3 **Technical data D2T (continuation)**

HIWIN D2 servo drive amplifier		D2T-0123	D2T-0423	D2T-1023	D2T-2023
Feedback	**Resistance**	External			Internal, 2.6 Ω ± 5 %, Rated power: 100 W, Max. power: 600 W Option: external
	Activation threshold	+ HV > 370 VDC			
	Deactivation threshold	+ HV < 360 VDC			
	Tolerance	± 5 %			
Monitoring functions		Short circuit, overvoltage (> 390 VDC ± 5 %), undervoltage (< 60 VDC); position error, encoder error, motor phase monitoring, overtemperature D2 (IGBT > 90 °C ± 1°C), motor overtemperature			
Autotuning		With automatic mass inertia calculation			
Error mapping	**Method**	Compensation table for correcting position errors through linear interpolation			
	Table entries	Max. 5.000			
	Activation	Following successful referencing or via digital input signal			
VSF (vibration suppression)		0,1 Hz to 200 Hz			
Other functions		Friction compensation, gear play compensation			
External EtherCAT adapter (option)		EtherCAT with mega-ulink protocol			
Ambient conditions	**Operating temperature**	0 to 40 °C (above 55 °C only with air conditioning)			
	Storage temperature	–20 °C to +65 °C			
	Air humidity	0 to 90 % (non-condensing and frost free)			
	Operating altitude	< 1,000 m above sea level			
	Vibration	10 m/s² (10 to 500 Hz)			
	Protection class	IP20			

Table 3.4 **Power dissipation**

Type	Efficiency [%]	Power dissipation [W]
D2/D2T-0123	88.50	13.1
D2/D2T-0423	93.60	25.6
D2/D2T-1023	94.10	59.0
D2T-2023	97.05	59.0

4. Assembly

⚠ WARNING!

Danger from electrical voltage!

- Before and during all assembly, disassembly and repair work, the drive amplifier must be de-energised. Ensure that no-one can re-establish the mains connection. Otherwise there is a serious risk of injury or death.

4.1 Assembling the drive amplifier

This drive amplifier has to be mounted using only the mounting holes provided. These are designed for size M4 screws. Refer to Section 4.2 onwards for the precise dimensions.

The screws must be secured with retaining rings to prevent them coming loose.

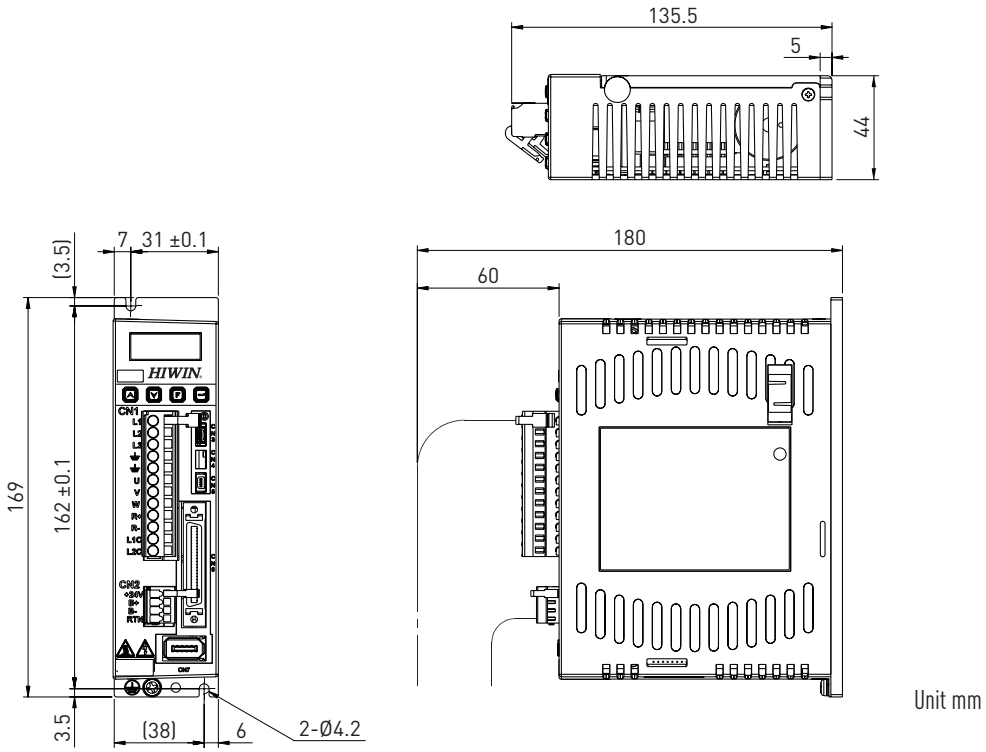
Assembly procedure:

- Produce appropriate mounting holes on the assembly surface if not already present.
- Clean assembly surface and position drive amplifiers on it.
- Screw in retaining bolts and tighten to a maximum torque of 3 Nm (when using type 8.8 screws).

✓ Drive amplifier is mounted.

4.2 Dimensions D2 – standard version

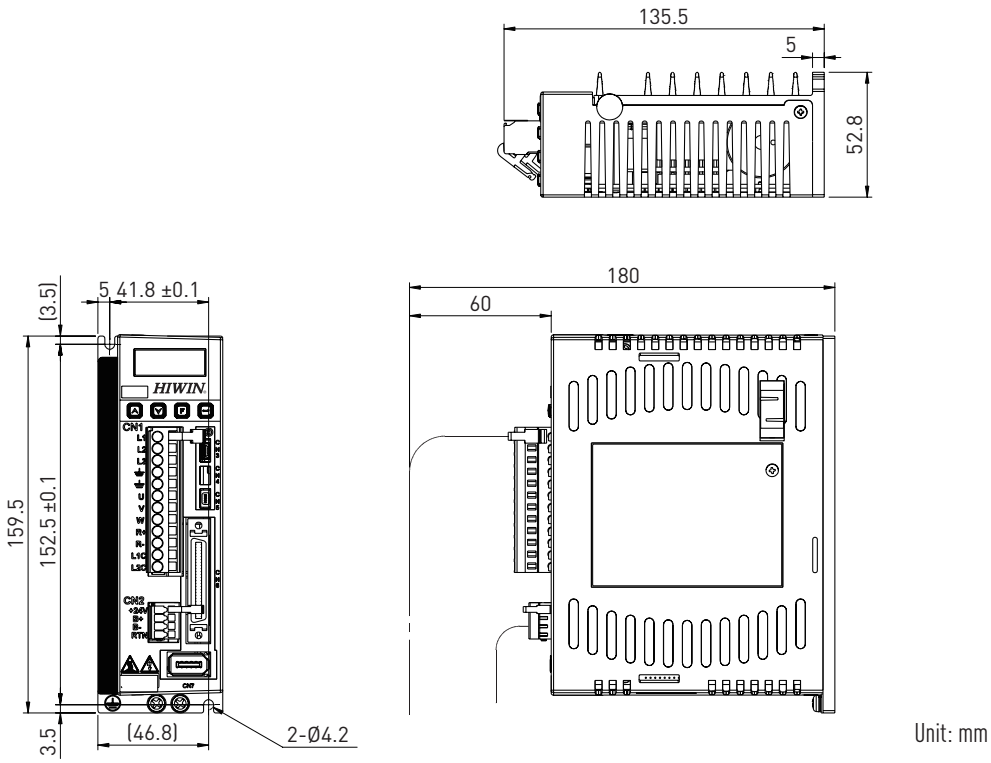
Housing type A



Unit mm

Fig. 4.1 **Dimensions D2-01xx-S-xx**

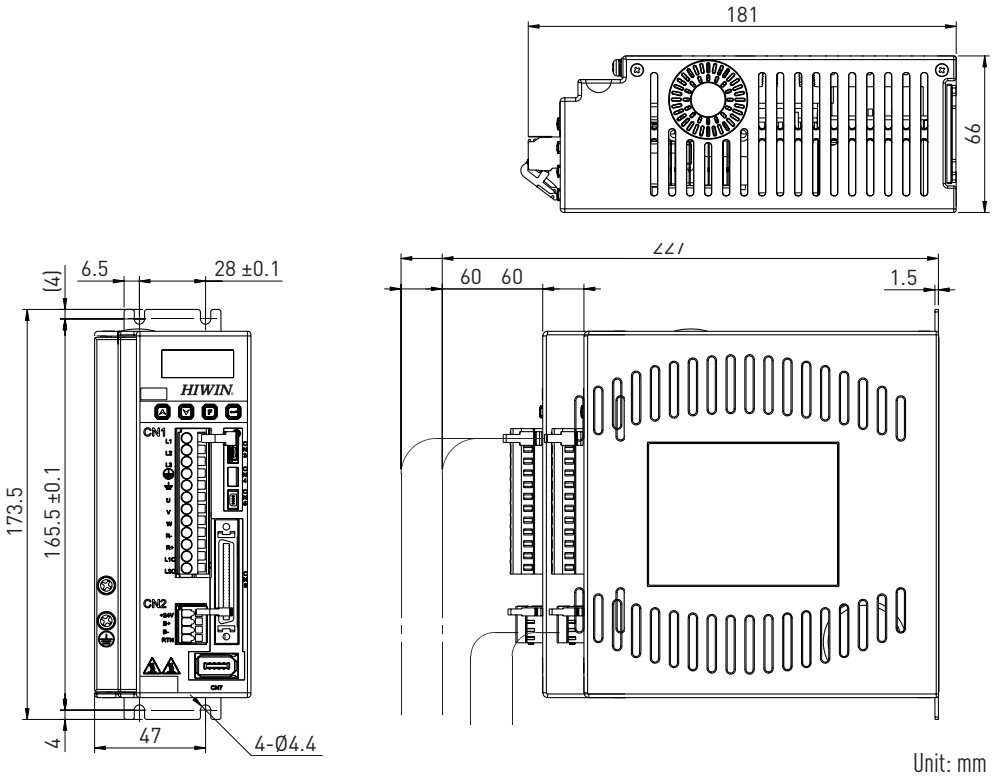
Housing type B



Unit: mm

Fig. 4.2 **Dimensions D2-04xx-S-xx**

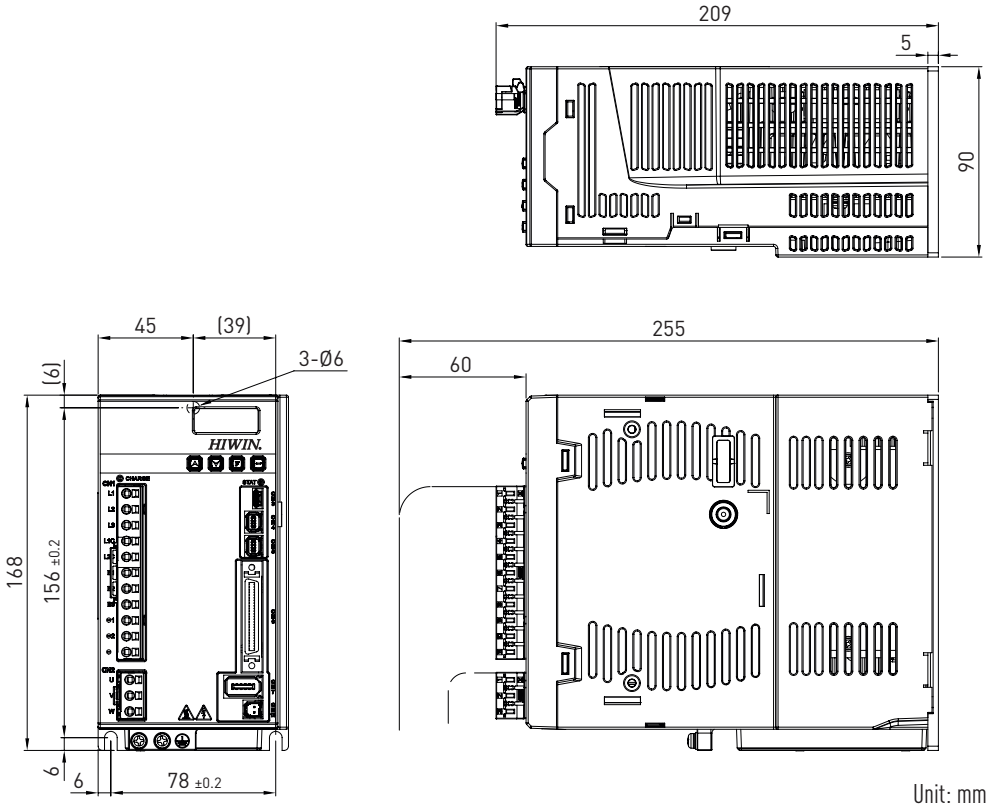
Housing type C



Unit: mm

Fig. 4.3 **Dimensions D2-10xx-S-xx**

Housing type D

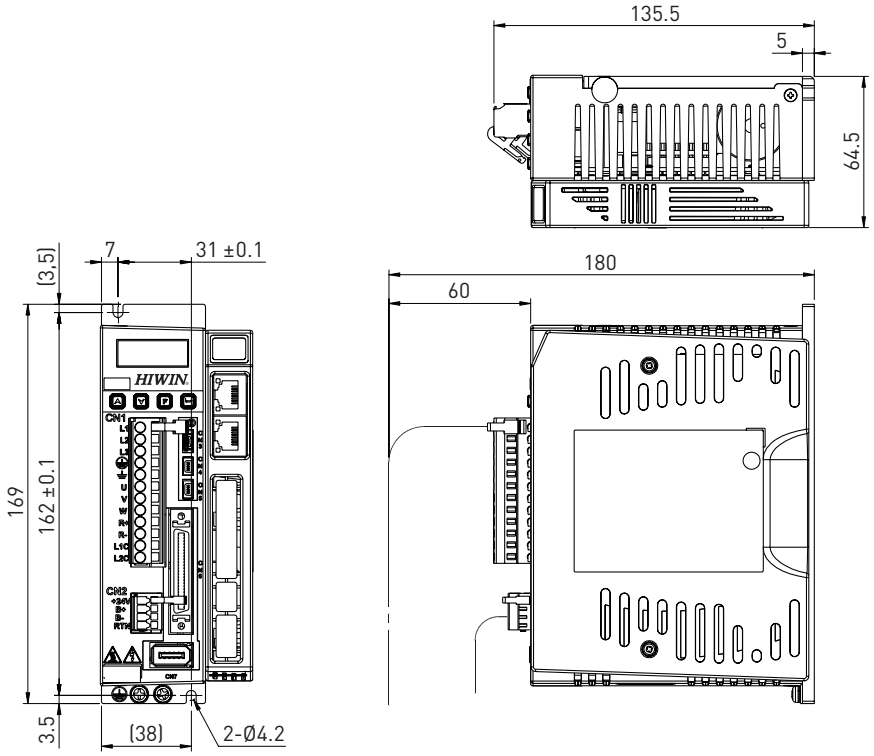


Unit: mm

Fig. 4.4 **Dimensions D2-20xx-S-xx**

4.3 Dimensions D2– mega-ulink version

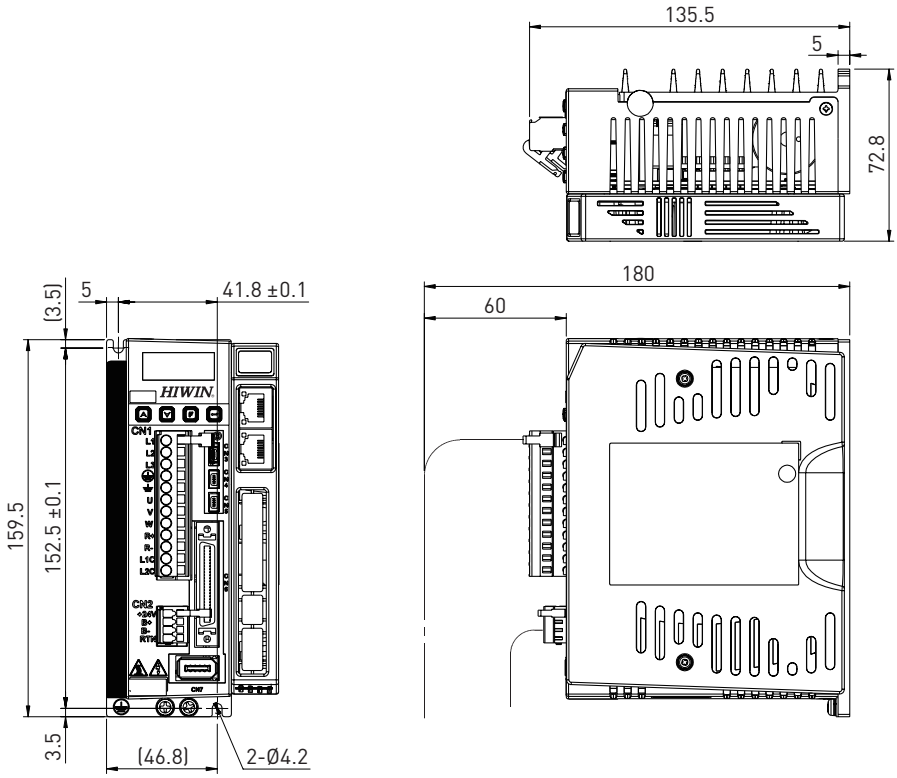
Housing type A



Unit: mm

Fig. 4.5 **Dimensions D2(T)-01xx-F-xx and D2(T)-01xx-E-xx**

Housing type B



Unit: mm

Fig. 4.6 **Dimensions D2(T)-04xx-F-xx and D2(T)-04xx-E-xx**

Housing type C

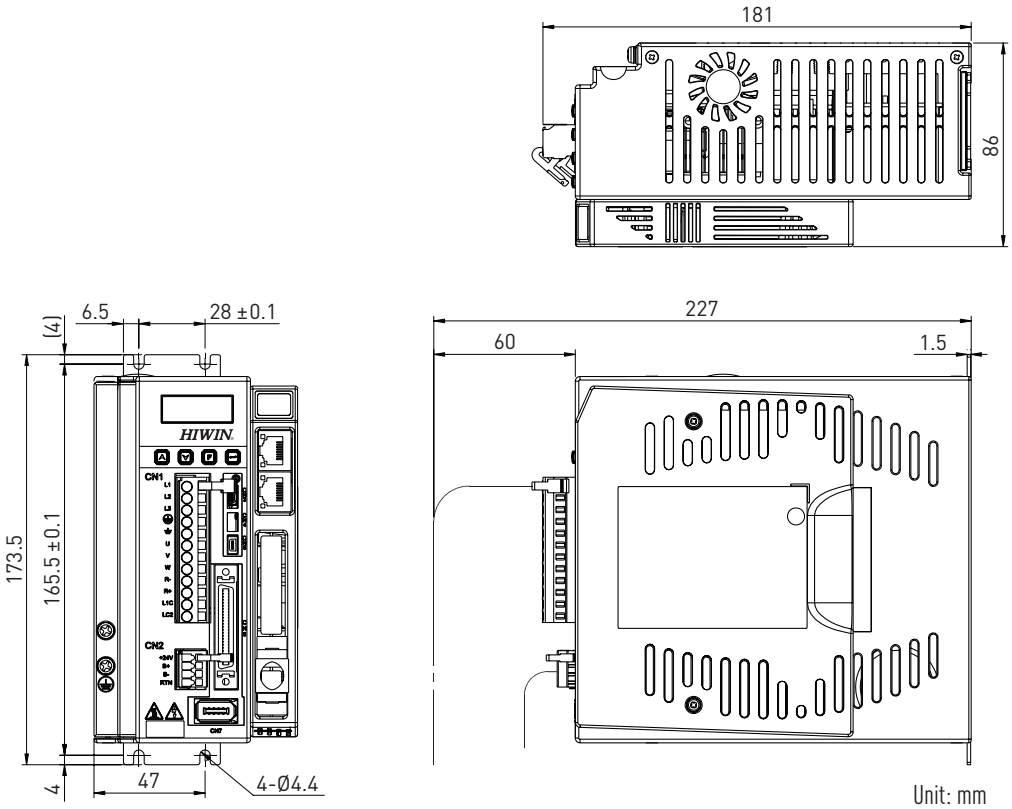


Fig. 4.7 **Dimensions D2(T)-10xx-F-xx and D2(T)-10xx-E-xx**

Housing type D

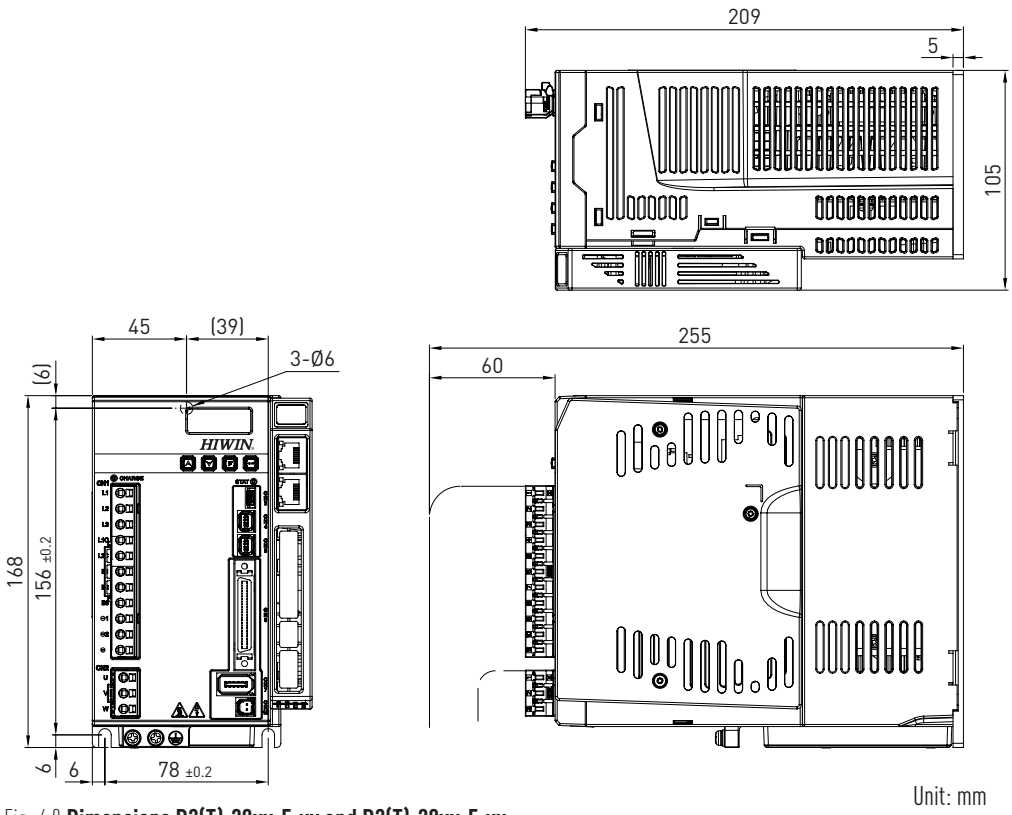


Fig. 4.8 **Dimensions D2(T)-20xx-F-xx and D2(T)-20xx-E-xx**

4.4 Switch cabinet assembly

⚠ WARNING!

Danger of electric shock due to insufficient earthing!

- During assembly, ensure sufficient earthing of the drive amplifier.
- Conductive screws should be used for this purpose.
- The assembly surface may have to be treated to produce a low-ohm electrical connection between the housing and assembly plate in the switch cabinet.

If you want to assemble several amplifiers in a line, ensure a minimum gap of 20 mm or more between the individual amplifiers and a gap of at least 50 mm from the switch cabinet panels.

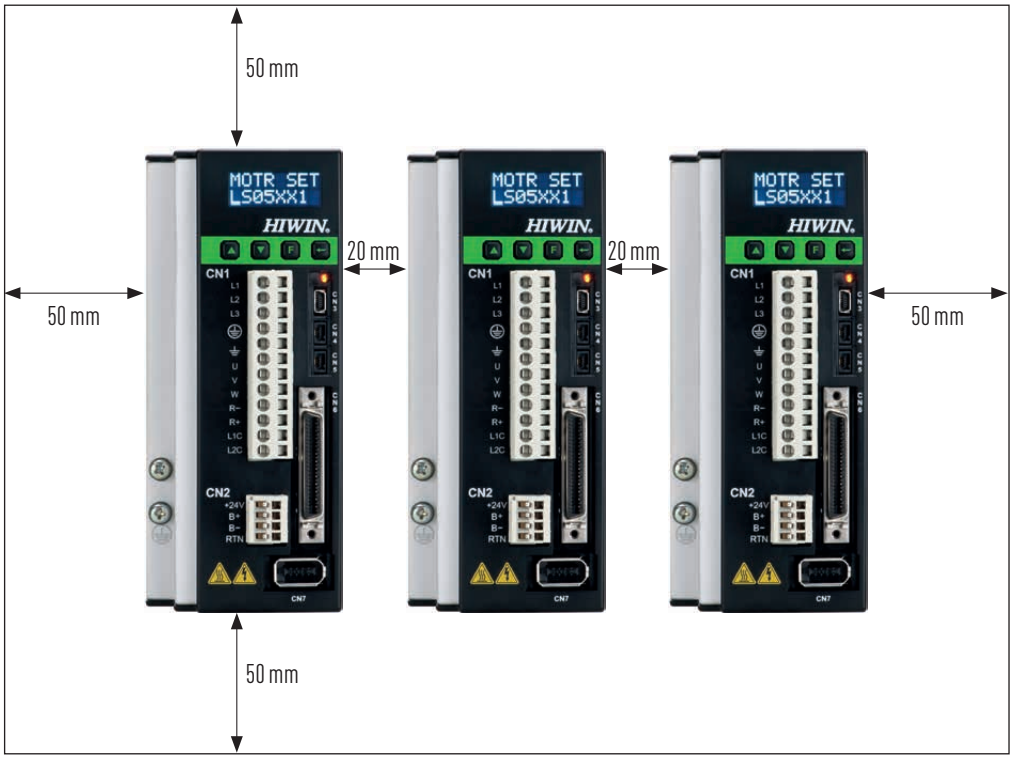


Fig. 4.9 **Minimum spacing in switch cabinet**

5. Electrical connection

⚠ DANGER!

Danger from electrical voltage!

- Always ensure that the drive amplifiers are correctly earthed using the PE bar in the switch cabinet as reference potential. Safety is not guaranteed if there is no low-ohm earthing.
- Power connections may be live even if the motor is not moving. Never disconnect the electrical connections of motors and drive amplifiers when live. In the worst case scenario, electric arcs may form, causing personal injury and damage to contacts.
- After disconnecting the drive amplifiers from the supply voltages, wait at least five minutes before touching live parts (e.g. contacts, threaded bolts etc.) or breaking connections. For your own safety measure the voltage in the intermediate circuit and wait until it has fallen below 40 VDC.

5.1 Overview of electrical connections

The parameters for the drive amplifiers are not set upon delivery. All the connections needed are established via five connectors on the drive amplifiers. The overview (Fig. 5.1) shows the basic structure:

Table 5.1 **Connection overview**

Number	Connection		Name
	Housing type A, B, C	**Housing type D**	**Housing type A, B, C, D**
1			Power switch
2			Mains filter
3			Motor power switch
4			Mains choke
5	CN1: L1, L2, L3, PE	CN1: L1, L2, L3	Main energy supply
6	CN1: U, V, W, PE	CN2: U, V, W	Motor current supply
7	CN1: REG+, REG–, PE	CN1: B1, B3	Brake resistor
8	CN1: L1C, L2C	CN1: L1C, L2C, B3	Logic supply
9	CN2	—	Brake
10	CN3	CN3	Mini USB communication connection (for setting parameters and configuring)
11	CN6	CN6	Control I/O and encoder output
12	CN7	CN7	Motor encoder input
	CN8	CN8	EtherCAT option

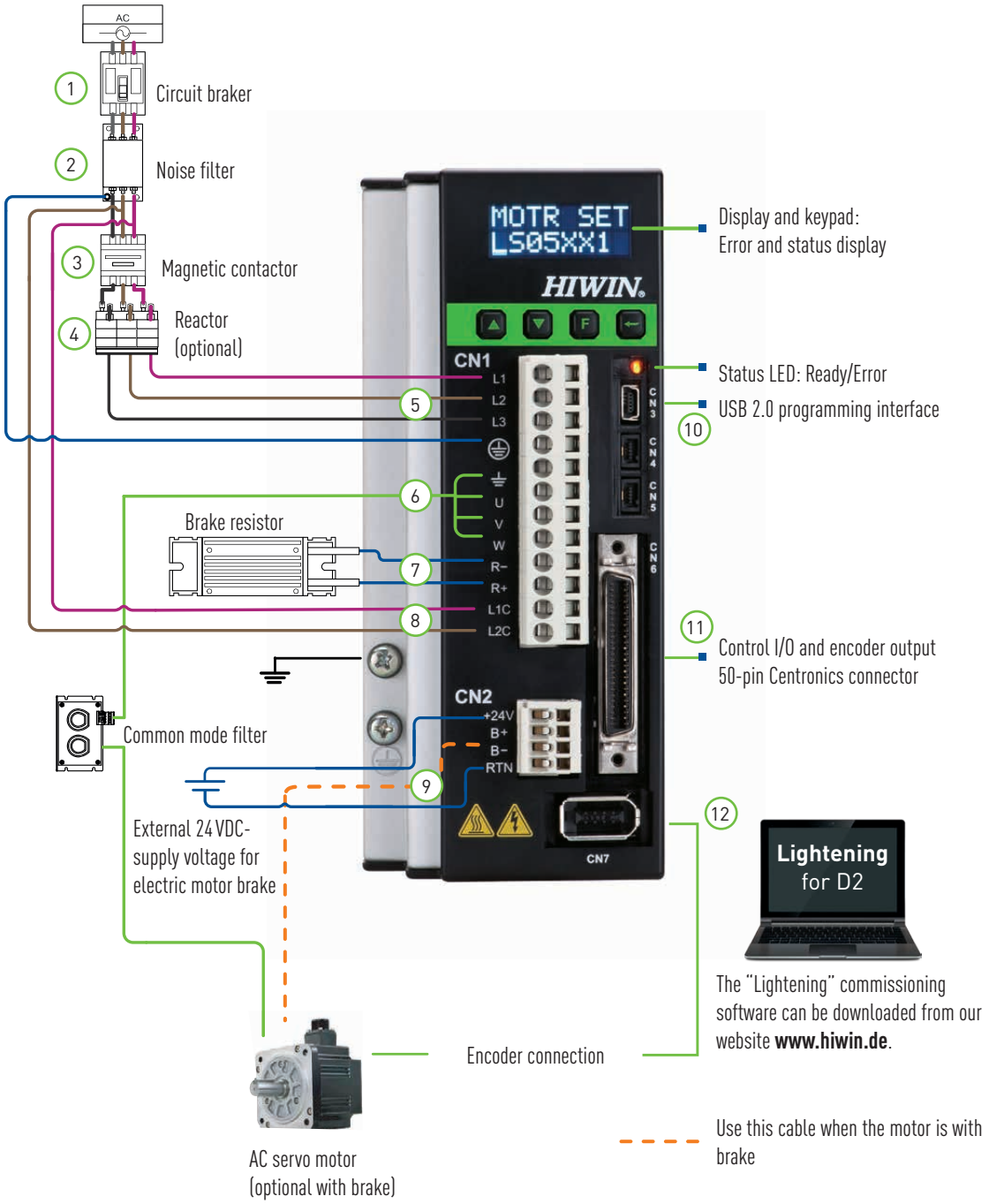


Fig. 5.1 **Schematic overview of electrical connections – housing type A, B, C**

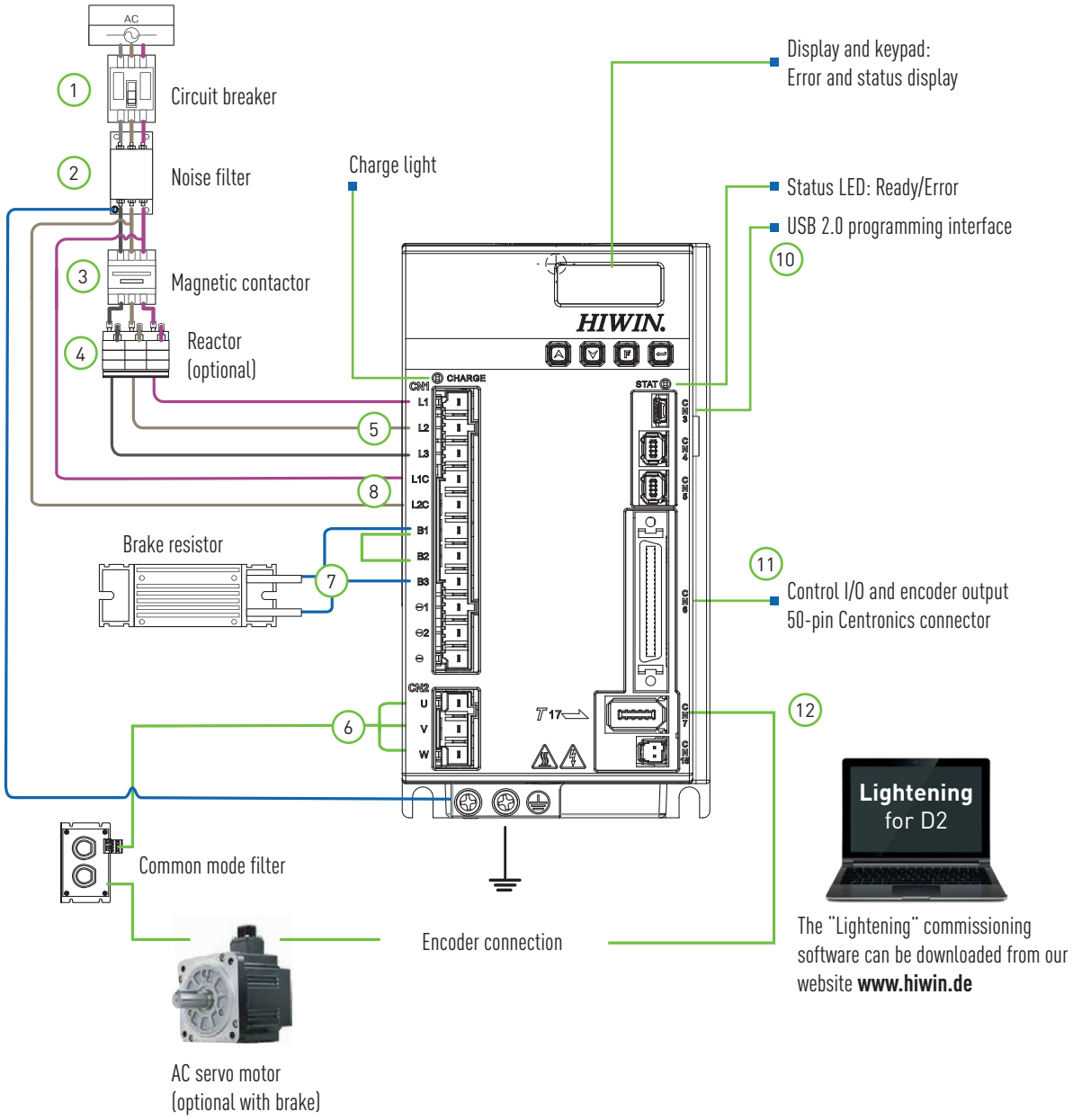


Fig. 5.2 **Schematic overview of electrical connections – housing type D**

5.2 CN1: Power plug

All power connections with the D2 are established here. The minimum cross-section of the mains connection cable depends on local requirements (see VDE 0100 Part 523, VDE 0298 Part 4), the ambient temperature and the rated current required of the drive amplifier.
Connector type: Wago 2092-1112 (bush)

Table 5.2 **Complete assignment of the CN1 power plug**

Pin	Designation	Description
1	L1	Mains connection for final stage (see Section 5.2.1 and 5.2.2)
2	L2	
3	L3	
4	PE	
5	Motor earth/shielding	Motor connection (see Section 5.2.3)
6	U	
7	V	
8	W	
9	REG–	Brake resistor connection (see Section 5.2.5)
10	REG+	
11	L1C	Logic supply voltage (see Section 5.2.1 and 5.2.2)
12	L2C	

5.2.1 Single-phase mains connection with mains filter

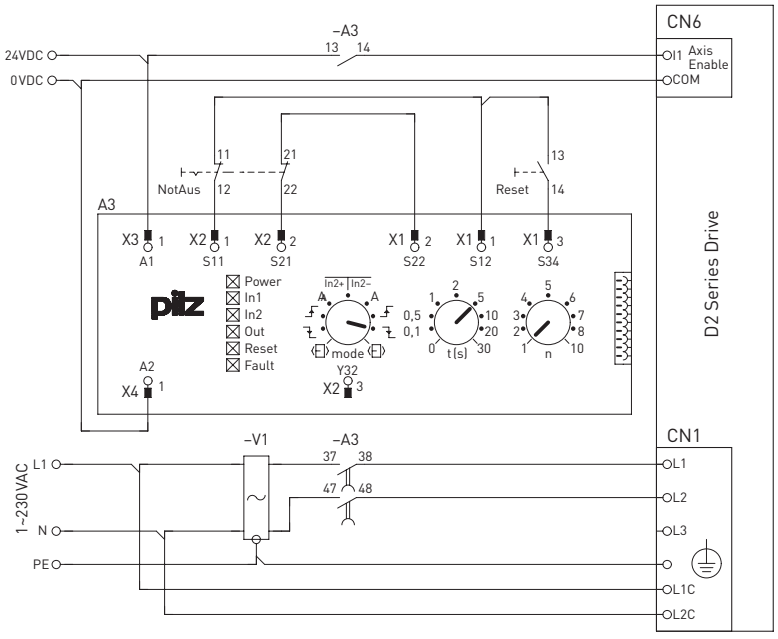


Fig. 5.3 **1-phase mains connection with filter**

Table 5.3 **Technical data of filter Schaffner FN2090-6-06**

Filter Schaffner FN2090-6-06 for 50 to 400 W power rating	
Maximum continuous voltage	250 VAC, 50/60 Hz
Operating frequency	DC to 400 Hz
Rated currents	6 A at 40 °C
Overvoltage protection	2 kV, IEC 61000-4-5
Filter Schaffner FN2090-6-06 for 750 to 1000 W power rating	
Maximum continuous voltage	250 VAC, 50/60 Hz
Operating frequency	DC to 400 Hz
Rated currents	10 A at 40 °C
Overvoltage protection	2 kV, IEC 61000-4-5

5.2.2 Three-phase mains connection with mains filter

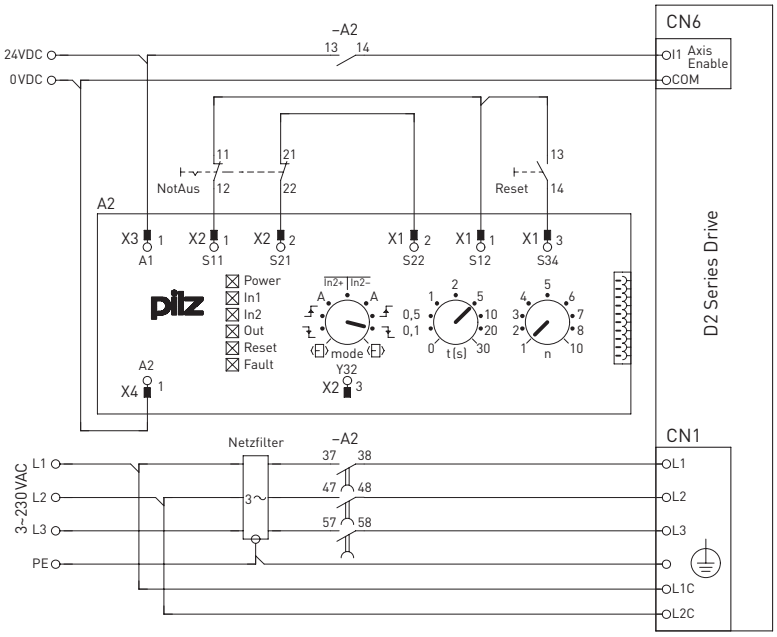


Fig. 5.4 **3-phase mains connection with filter**

Table 5.4 **Technical data of filter Schaffner FN3025-HL-20-71**

Filter Schaffner FN3025-HL-20-71 for 50 to 1000 W power rating	
Maximum continuous voltage	3 × 480/277 VAC (FN 3258)
Operating frequency	DC to 60 Hz
Rated currents	20 A at 50 °C
Rated power	4 kW
Leakage current at 400 VAC/50 Hz	0.4 mA
Overvoltage protection	2 kV, IEC 61000-4-5

Table 5.5 **Output filter**

Input		Output		Peak current for 1 s	Operating temperature [1]	Inductivity (Phase – Phase)
Max. current	**Rated current**	**Max. current**	**Rated current**			
373 VDC	11 A_{rms}	373 VDC	11 A_{rms}	33 A_{rms}	0 to 50 °C	1,100 µH

[1] If the temperature rises above the permissible limit of 50 °C, external cooling is recommended. A fan with a flow rate of 52 litres/minute is recommended.

The distance between the filter and drive amplifier should be max. 1 m.

NOTE

5.2.3 Motor connection

ATTENTION!

The motor cable without output filter must not exceed a length of 15 m. If longer cables are used, suitable filters must be fitted to effectively dampen any voltage peaks which arise.

When the drive amplifier is switched on, too high leakage currents can occur due to internal wiring. This effect is increased by earthing measures or can be summed up. The use of residual current devices must be considered during the design and the leakage currents must be taken into account. If further problems arise, please contact the manufacturer of the mains filter.

It is possible to use the filter for more than one drive. Please note the maximum permissible currents of the filter, which can occur due to the internal wiring.

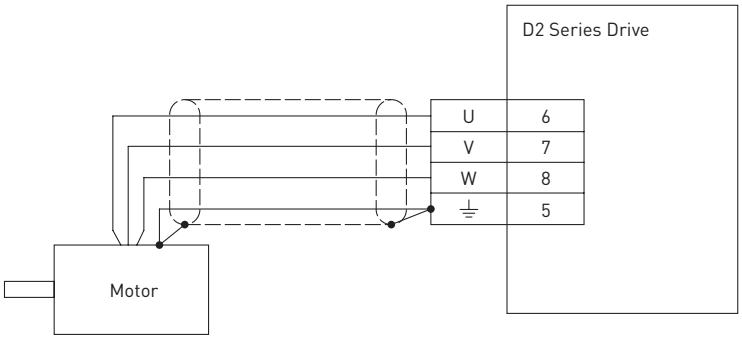


Fig. 5.5 **Motor connection**

Table 5.6 **Motor connection assignment**

Colour motor connection	Pin no.	Signal	Function	Colour motor cable (AC servo motor)
Black-1	6	U	Motor phase	Red
Black-2	7	V	Motor phase	White
Black-3	8	W	Motor phase	Black
Green/Yellow	5	–	GND	Green

5.2.4 EMC ferrite rings for minimising electromagnetic disturbances

For the EMC filter used by HIWIN, please note that ferrite rings should also be used to minimise electromagnetic disturbances. The following instructions show where and how the ferrite rings are to be installed and applies to HIWIN servo motors with 50 to 1,000 W power ratings

Fig. 5.6 **Ferrite ring type KCF-130-B**

- Position ferrite ring in the direct vicinity of the drive amplifier

NOTE

Only the U-V-W motor phases may be covered by the ferrite ring.

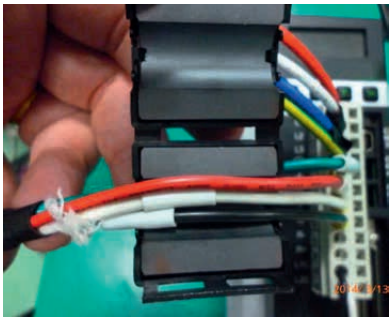


Fig. 5.7 **Ferrite ring type KCF-130-B, installation on the motor phases**

- Fold ferrite ring together, please ensure that clips engage.

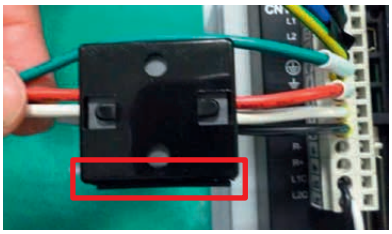


Fig. 5.8 **Ferrite ring type KCF-130-B, clips**

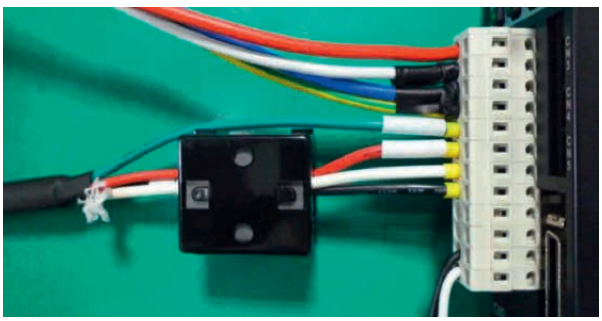


Fig. 5.9 **Ferrite ring type KCF-130-B, fully fitted**

5.2.5 Brake resistor connection

When an electric drive is braked, the kinetic energy is converted into electric energy and fed back to the drive amplifier's intermediate circuit. The energy fed back is absorbed by the internal capacitors provided they have sufficient capacity. If not, the excess energy must be dissipated via a brake resistor. Fig. 5.10 shows a diagram of the intermediate circuit in the D2.

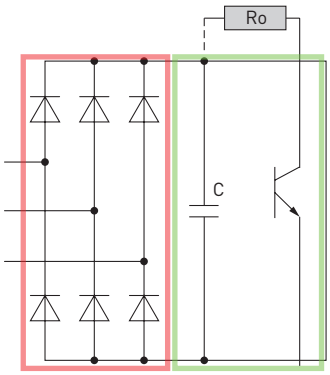


Fig. 5.10 **Intermediate circuit**

Permitted brake resistors can be found in section 13.8.

NOTE

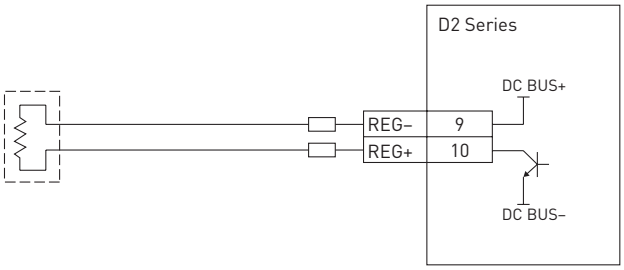


Fig. 5.11 **Connecting a brake resistor**

Using the total load bearing capacity of the driven load and the desired speed, the figures below show the point from which a brake resistor is to be used.

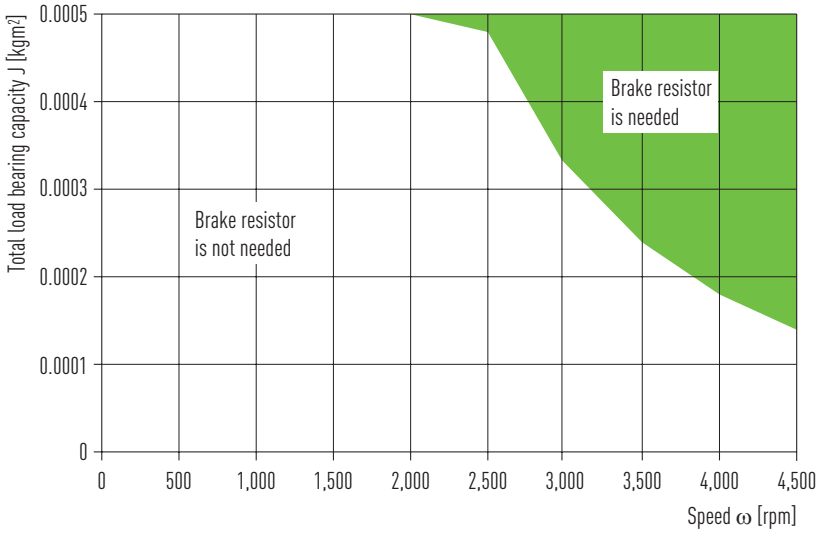


Fig. 5.12 **Use of the brake resistor with a 200 W HIWIN AC servo motor**

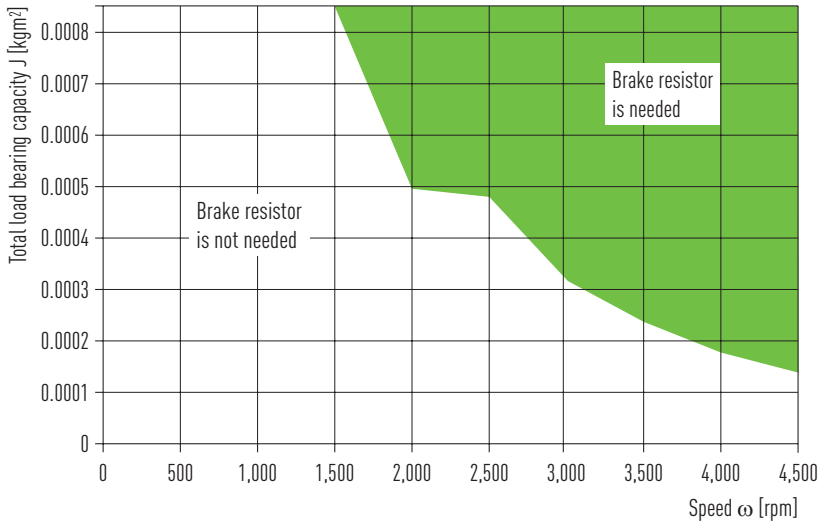


Fig. 5.13 **Use of the brake resistor with a 400 W HIWIN AC servo motor**

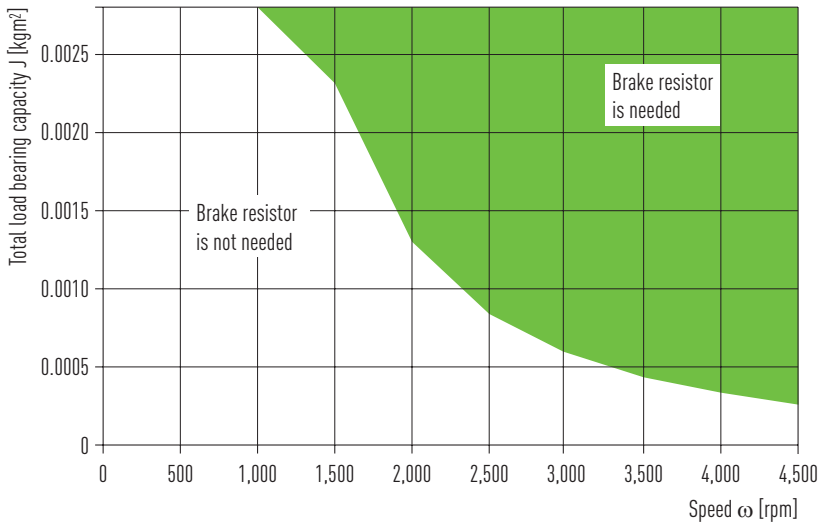


Fig. 5.14 **Use of the brake resistor with a 750 W HIWIN AC servo motor**

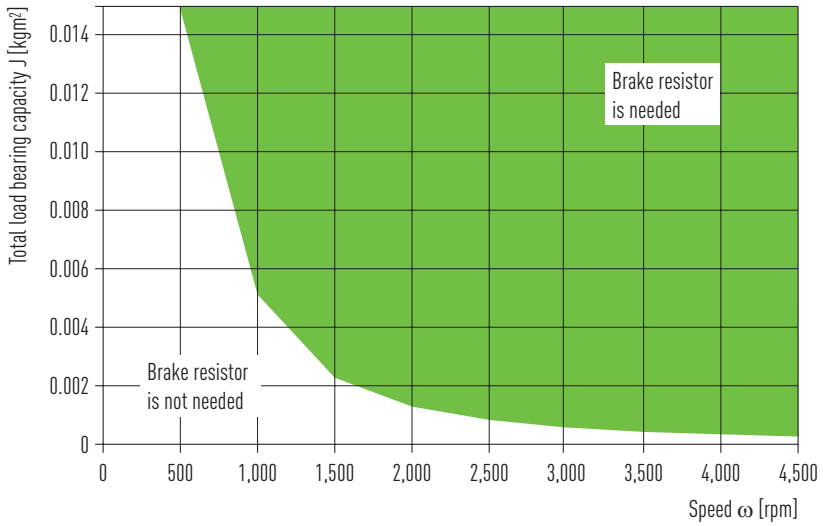


Fig. 5.15 **Use of the brake resistor with a 1 KW HIWIN AC servo motor**

5.3 CN2: Parking brake connection

The D2 allows you to activate an electric parking brake. The brake output supplies a voltage of 24 VDC and a current of up to 1 A. If your mechanical brake does not require a higher current, you can connect it directly (see Fig. 5.17). A relay circuit is recommended for brakes requiring different voltages or higher currents (see Fig. 5.18).

The brake output does not have a reverse polarity protection. Incorrect polarity of the supply voltage will destroy the internal polarity.

NOTE

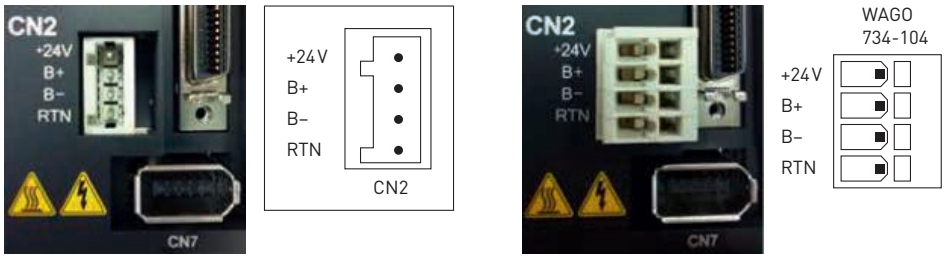


Fig. 5.16 **Connecting a parking brake**

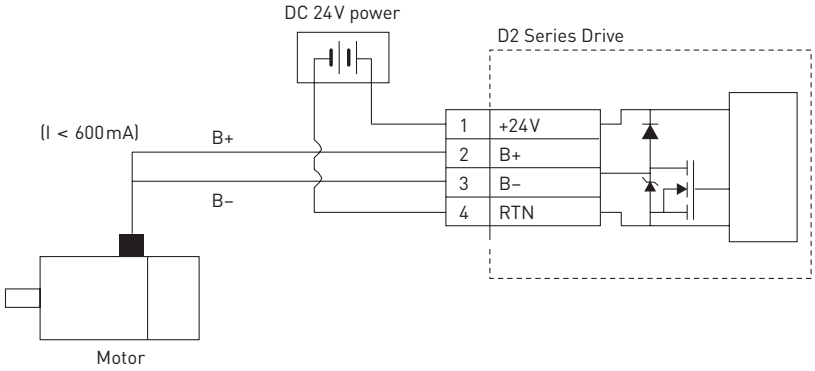


Fig. 5.17 **Wiring example for direct brake activation**

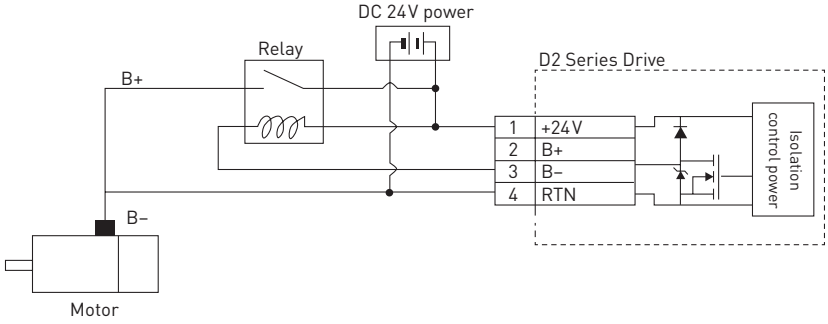


Fig. 5.18 **Wiring example for indirect brake activation via relay**

5.4 CN3: Mini USB parameterization interface

A standard USB 2.0 interface is provided to set parameters for and commission the drive amplifier. This is undertaken using a mini USB bush, type B (CN3).

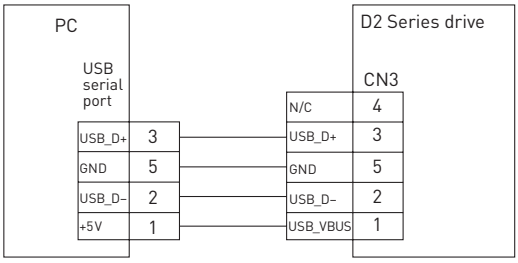


Fig. 5.19 **CN3 – mini USB interface**

5.5 CN6: Nominal value, I/O, analogue and encoder interface

ATTENTION!

Unexpected motor movements due to unshielded cables!

- Only use shielded cables for all cables carrying encoder signals. This minimises the effect of perturbation and avoids incorrect motor responses.

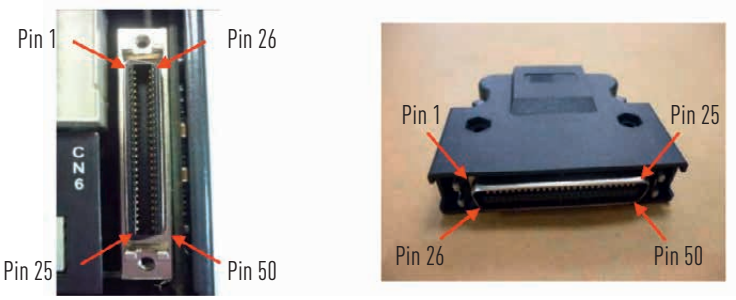


Fig. 5.20 **SCSI-50 pin: bush (left) and connector (right)**

The function of all CN6 pins is shown in Table 5.7.

Table 5.7 **Pin assignment CN6**

Pin	Assignment	Function	Pin	Assignment	Function
1	CWL	Low-speed (500 kHz) nominal value input Channel 1: Step, CW, track A	7	COM	Selection of switching characteristics of digital inputs; sink or source
3	CW+				
4	CW–		33	I1	Digital input 1
2	CCWL	Low-speed (500 kHz) nominal value input Channel 2: Direction, CCW, track B	30	I2	Digital inputs (parameters can be set)
5	CCW+		29	I3	**"Hardware Enable"** pre-assigned
6	CCW–		27	I4	Digital inputs (parameters can be set)
13	GND	Digital signal ground	28	I5	
21	A	Encoder output RS422 (buffered encoder or emulated encoder)	26	I6	
22	/A		32	I7	
48	B		31	I8	
49	/B		9	I9	
23	Z		8	NA	D2: Not assigned
24	/Z			I10	D2T

Table 5.7 **Pin assignment CN6 (continuation)**

Pin	Assignment	Function	Pin	Assignment	Function
25	GND	Digital signal ground	**35**	O1+	Digital outputs (parameters can be set)
19	CZ	Track Z output (open collector)	**34**	O1–	
14	ADC0+	Analogue nominal value input (±10 V)	**37**	O2+	
15	ADC0–		**36**	O2–	
16	ADC1+	Not assigned	**39**	O3+	
17	ADC1–		**38**	O3–	
18	ADC2+		**11**	O4+	
20	ADC2–		**10**	O4–	
43	DAC1	D2T: Analogue output (±10 V) for torque monitoring	**40**	NA	D2: not assigned
42	DAC2	D2T: Analogue output (±10 V) for speed monitoring		O5+	D2T
44	CWH+	High-speed (4 MHz) nominal value input Channel 1: Step, CW, track A	**12**	NA	D2: not assigned
45	CWH–			O5–	D2T
46	CCWH+	High-speed (4 MHz) nominal value input Channel 2: Direction, CCW, track B	**41**	GAND	Analogue signal ground
47	CCWH–		**50**	FG	Shielding

5.5.1 Wiring variants of nominal value inputs

The nominal value inputs on the D2 can process both differential signals and single-ended signals. The nominal value inputs must be wired on the CN6 connector according to the signal type. The following diagrams show the various possibilities.

The following wiring variants are possible for the **position control** operating mode:

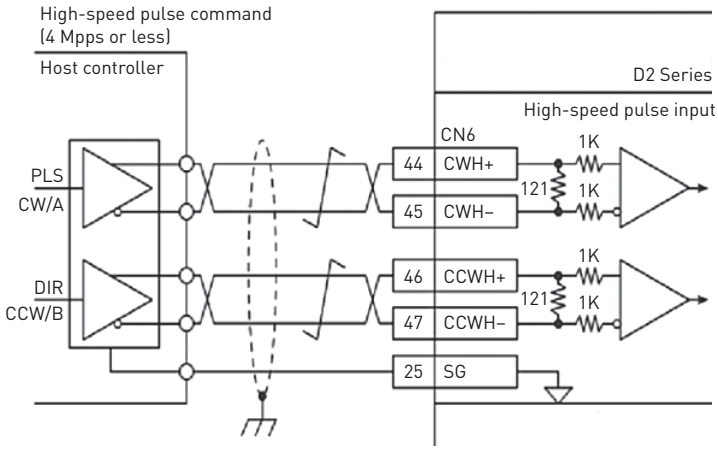
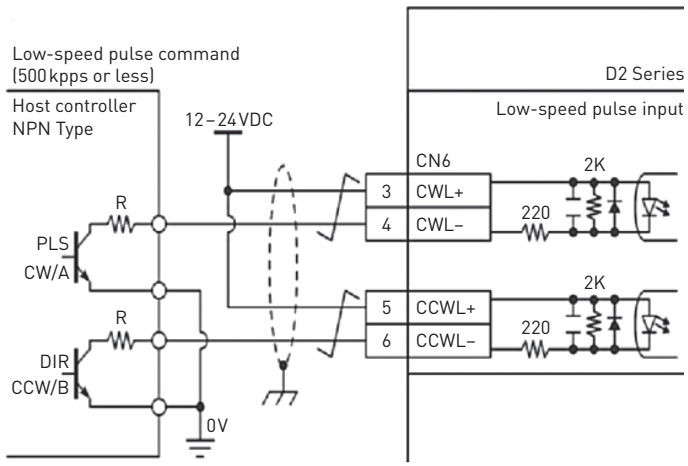


Fig. 5.21 **High-speed step/direction, differential**



Resistor (R):
12 VDC: 1 kΩ, 0,5 W
24 VDC: 2 kΩ, 0,5 W

Fig. 5.22 **Low-speed step/direction, "single-ended" sink (NPN) with external resistor in control**

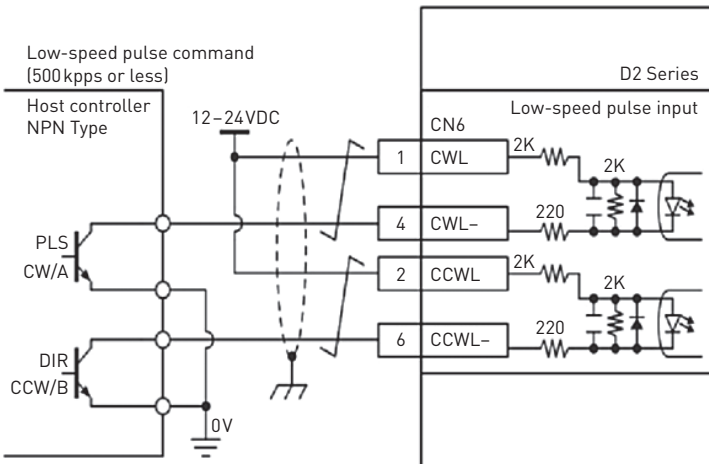
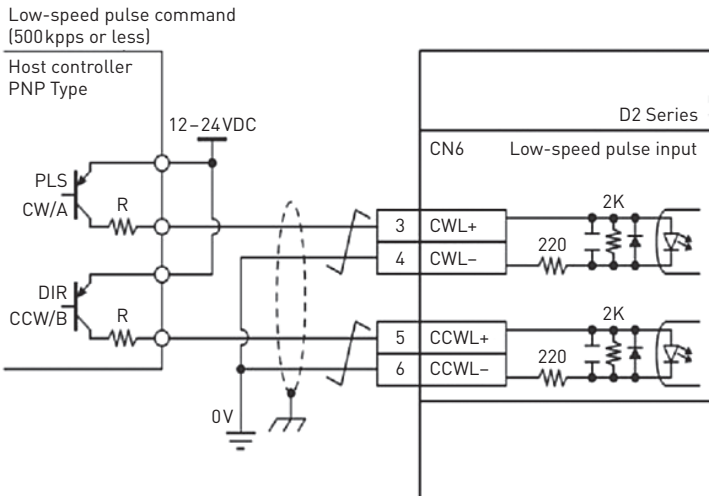


Fig. 5.23 **Low-speed step/direction, "single-ended" sink (NPN) with D2 internal resistor**



Resistor (R):
12 VDC: 1 kΩ, 0,5 W
24 VDC: 2 kΩ, 0,5 W

Fig. 5.24 **Low-speed step/direction, "single-ended" source (PNP) with external resistor in control**

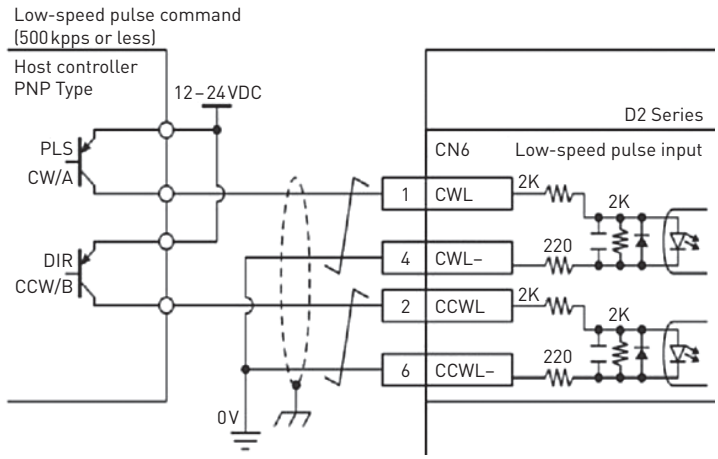


Fig. 5.25 **Low-speed step/direction, "single-ended" source (PNP) with D2 internal resistor**

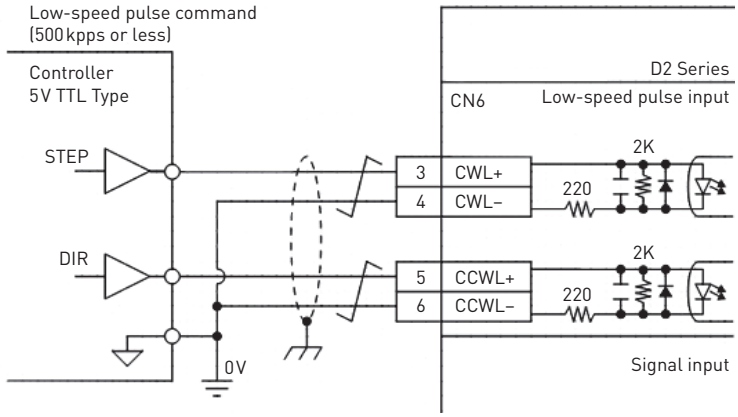


Fig. 5.26 **Low-speed step/direction, "single-ended" source (PNP) 5 V TTL**

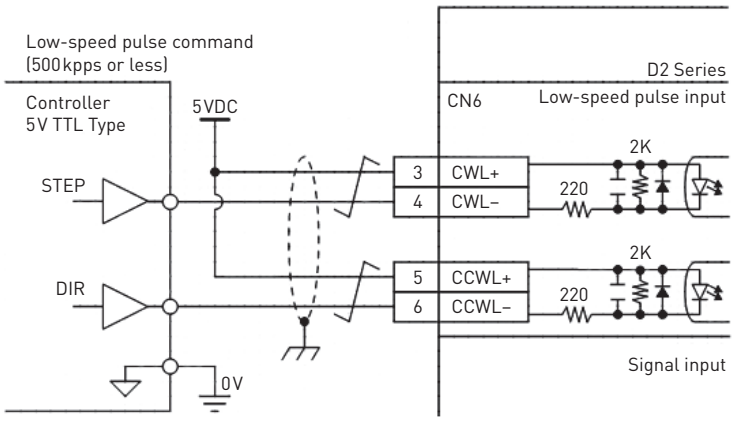


Fig. 5.27 **Low-speed step/direction, "single-ended" source (NPN) 5 V TTL**

The following wiring variants are possible for **speed and torque control**:

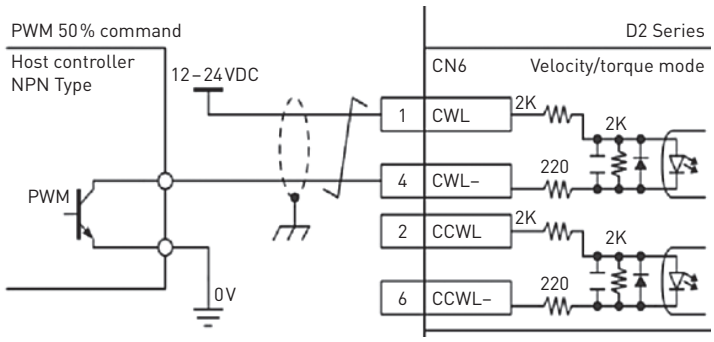


Fig. 5.28 **NPN wiring PWM activation in "PWM 50 %" mode**

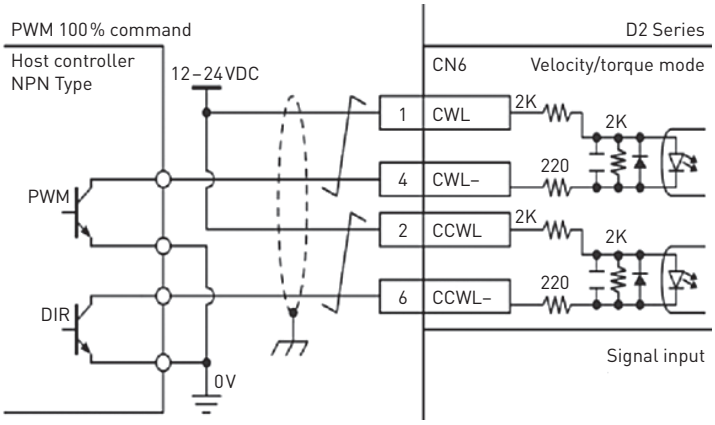


Fig. 5.29 **NPN wiring PWM activation in "PWM 100 %" mode**

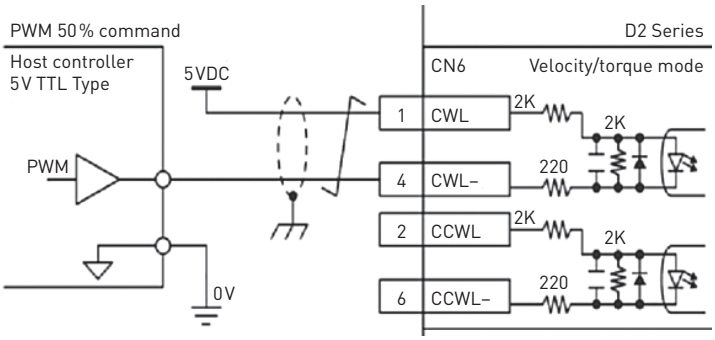


Fig. 5.30 **5 V TTL wiring PWM activation in "PWM 50 %" mode**

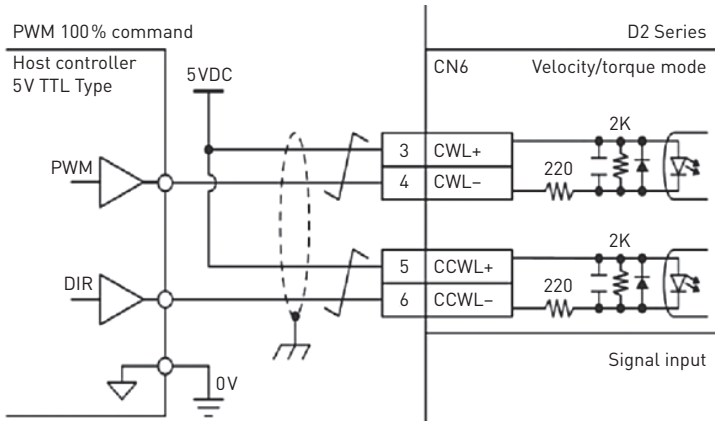


Fig. 5.31 **5 V TTL wiring PWM activation in "PWM 100 %" mode**

5.5.2 Wiring variants for digital inputs

The switching characteristics of the digital inputs can be defined by their wiring on the CN6 connector. Either the sink (NPN) or source (PNP) characteristics can be chosen. See the diagrams below.

Sink (NPN) input wiring:

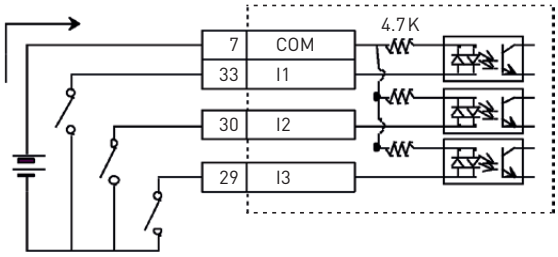


Fig. 5.32 **Sink input wiring via switch or relay**

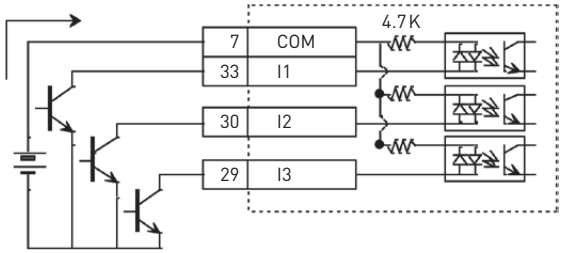


Fig. 5.33 **Sink input wiring via transistor**

Source (PNP) input wiring:

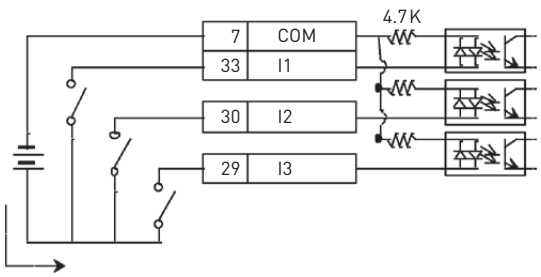


Fig. 5.34 **Source input wiring via switch or relay**

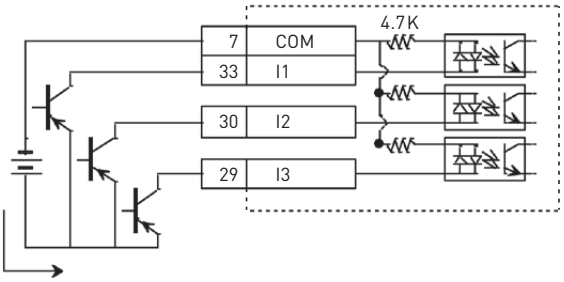


Fig. 5.35 **Source input wiring via transistor**

5.5.3 Wiring variants for digital outputs

The 4 digital outputs provide optocoupler outputs. The maximum output current is max. 100 mA.

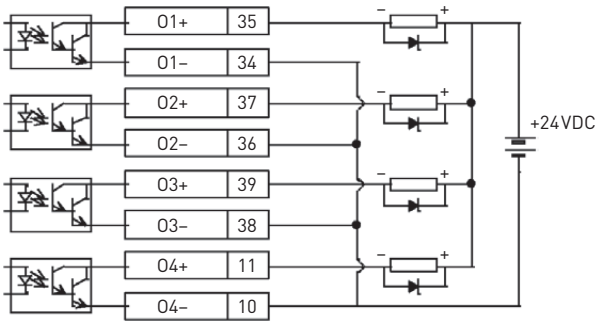


Fig. 5.36 **Output wiring via relay**

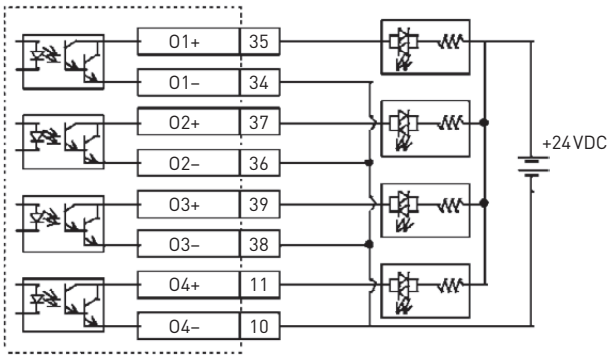


Fig. 5.37 **Output wiring via optocoupler**

5.5.4 Wiring of analogue nominal value input

The analogue input (±10 V) can be used as a nominal value input for the speed and torque control.

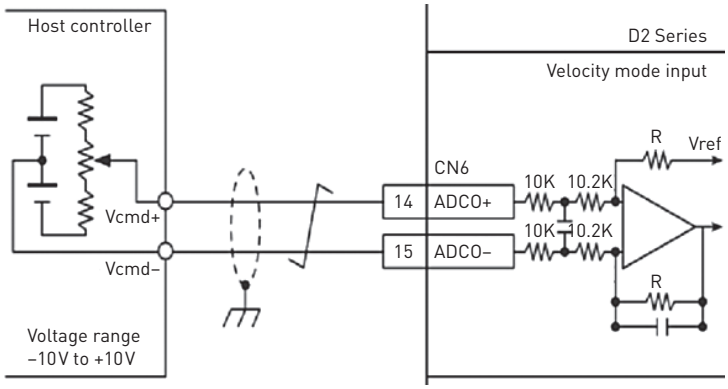


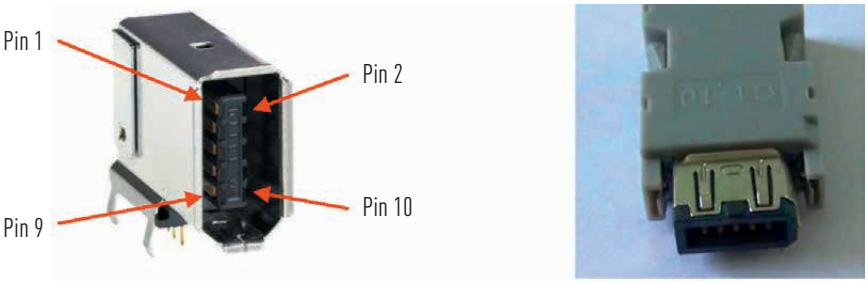
Fig. 5.38 **Wiring analogue nominal value specification from external control to D2**

5.6 CN7: Encoder connection

The encoder is connected to D2 via the CN7 interface.

ATTENTION!

Damage to the drive amplifier!
Never disconnect or loosen the encoder cable from the drive amplifier during operation. This could destroy highly sensitive electronic components in the encoder systems.
First shut down the power supply and control voltage before plugging or unplugging the connections on CN7.
The same applies to changes on the encoder system itself.



SCR connector 10-pin (male) SCR connector 10-pin (female)

Fig. 5.39 **Encoder interface**

Table 5.8 **Pin assignment of encoder connection**

Pin	Assignment	Function
1	+5 VDC	Output voltage of encoder
2	Signal GND	Signal ground
3	PS+	Serial encoder input
4	PS–	
5	A	Incremental digital encoder inputs
6	/A	
7	B	
8	/B	
9	Z	
10	/Z	

NOTE

In order to prevent EMC interference in the encoder signal, the encoder cable must be shielded and the shielding must be in full contact across the connectors.

5.7 CN8: EtherCAT connection (option)

Using the two RJ45 bushes at the optional module on CN8 slot, the D2 can be integrated in an EtherCAT network and communicate with an EtherCAT master.
You will find a detailed description of the EtherCAT function in Chapter 11.

Table 5.9 **EtherCAT interface**

Bush	Function
IN	Bush for incoming EtherCAT cable
OUT	Bush for forwarding EtherCAT cable

5.8 Wiring examples for the various operating modes

Below you can find selected wiring examples of the position control, speed and torque control operating modes for the D2. The wiring always depends on the superordinate control (host controller) used. More information can be found in Section 5.5.1 onwards.

5.8.1 Wiring example for position control operating mode

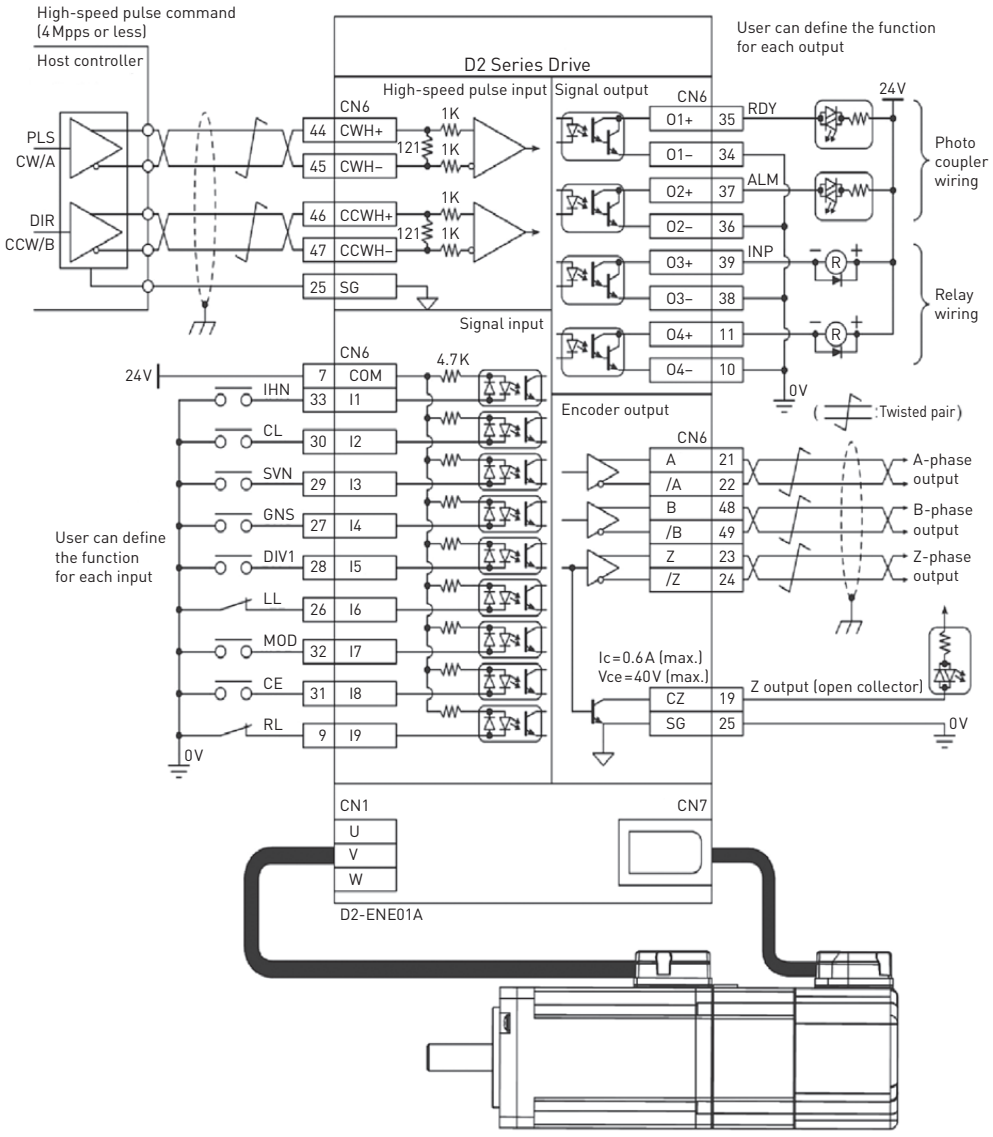


Fig. 5.40 **Wiring example for position control operating mode with high-speed differential nominal value signals**

5.8.2 Wiring example for speed control operating mode

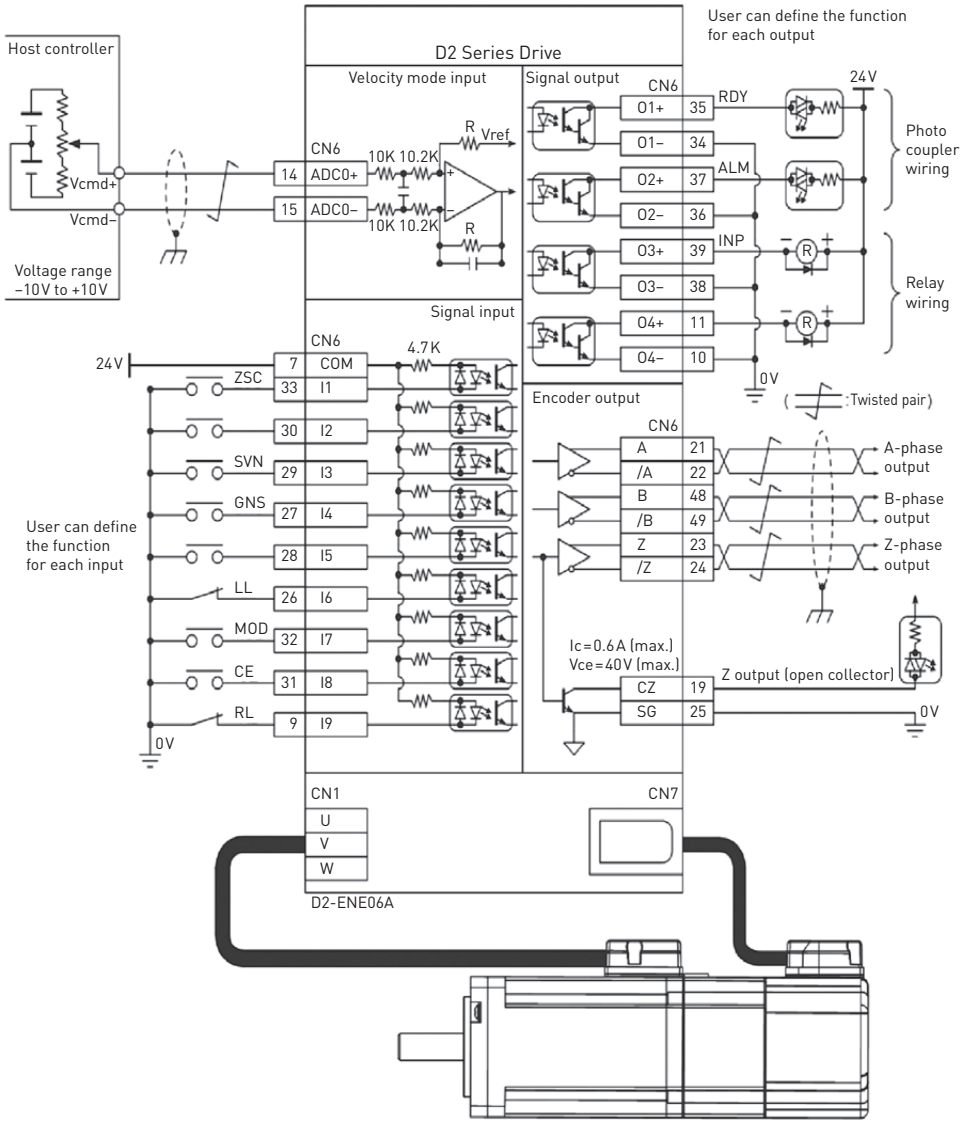


Fig. 5.41 **Wiring example for speed control operating mode via analogue ±10 V nominal value signal**

5.8.3 Wiring example for current control operating mode

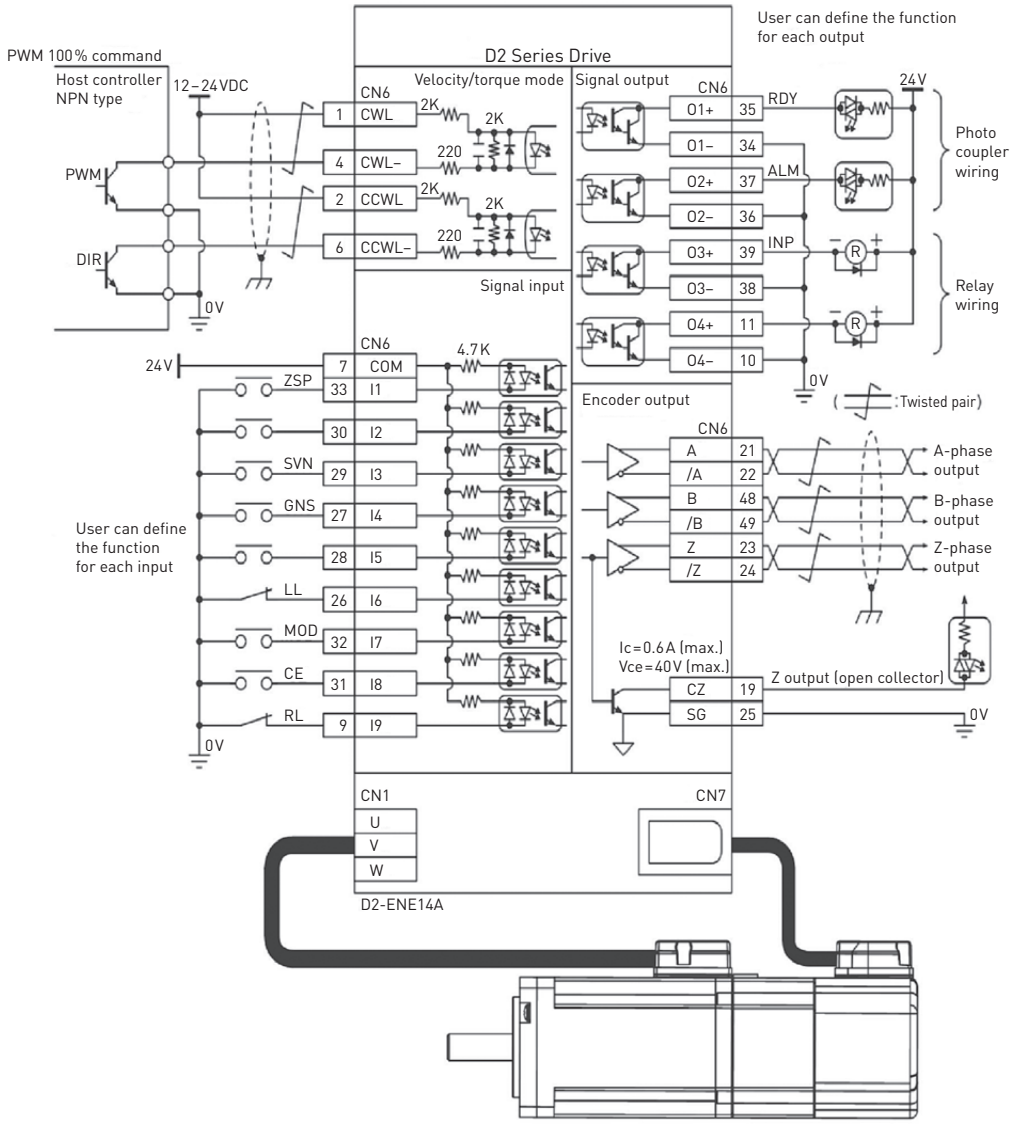


Fig. 5.42 **Wiring example for torque control operating mode via PWM nominal value signal**

6. "Lightening" commissioning software

The D2 drive amplifier is commissioned using the "Lightening" software. This permits parameter setting and diagnosis using a standard PC. During operation, any drive amplifier parameters can be recorded in real time. This greatly simplifies the setting of controller parameters.

Table 6.1 **PC requirements**

CPU	1.0 GHz or more
RAM	512 MB or more
Free hard disk memory	At least 50 MB
Connections	USB port
Operating system	Win 2000, Win XP, Win 7
Monitor resolution	At least 1024 ×768 pixels

6.1 Installation of the software

To install the "Lightening" commissioning software, run the **"Setup.exe"** file.
The desired installation location can be changed under **"Destination"** (standard: "C:\HIWIN\").
Press the **"Start"** button to start installation.

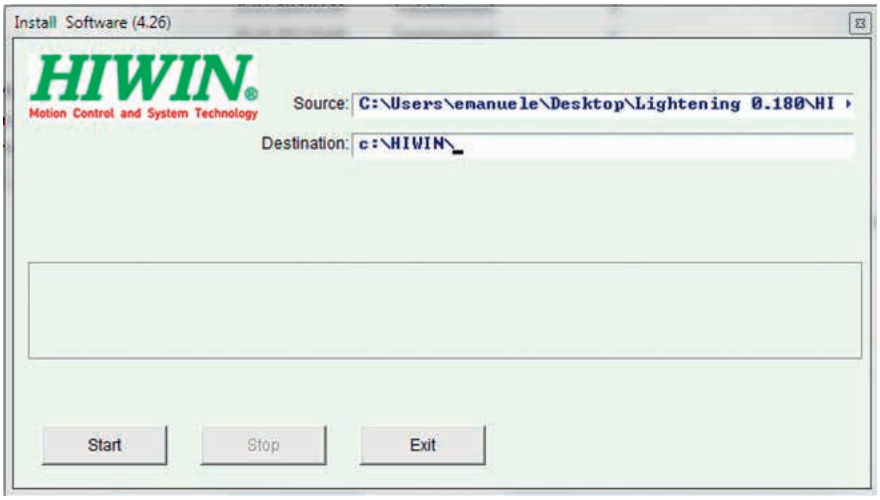


Fig. 6.1 **Installation software**

If Windows tells you during the installation that drivers without a signature need to be installed, confirm this message and install the driver. This is the driver for the USB interface of the D2 which is essential to operation.
Successful installation is confirmed by the following dialogue.

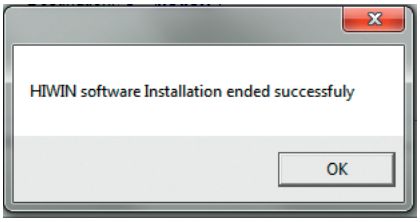


Fig. 6.2 **End of installation**

"Lightening" is now installed in full and can be launched via the following desktop icon.

Fig. 6.3 **"Lightening" desktop icon**

6.2 Initial launch of the "Lightening" software

6.2.1 Establishing connection with device

To establish communication between PC and D2, proceed as follows: Connect drive amplifier to PC. Windows will automatically detect the new device and select the previously installed driver. As soon as the driver installation is complete, "Lightening" can be started.

If "Lightening" was already open at the time of driver installation, the COM port may not be available. This problem can be remedied by restarting the software.

NOTE

Now open the **"Tools"** tab in the menu and select **"Communication setup"**.

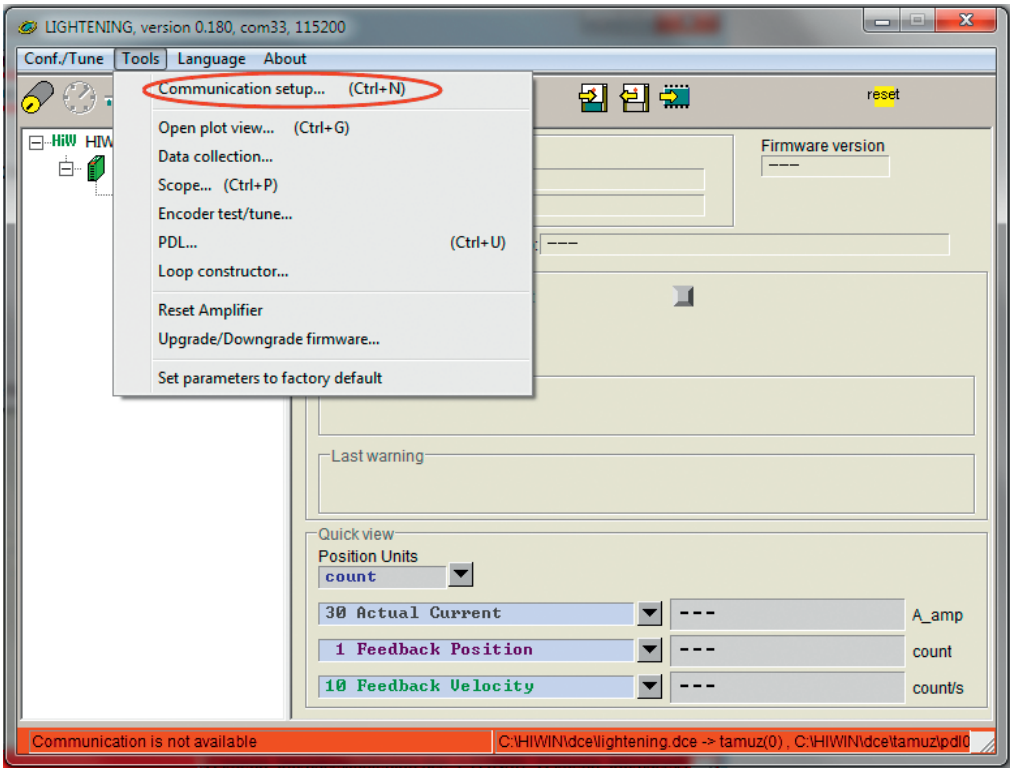


Fig. 6.4 **"Communication setup"**

Here you can define all the connection settings required between your PC and drive amplifier.
Select the COM port to which the drive amplifier is connected (Silicon Labs CP210x USB to UART Bridge (COMx)).

Only the COM ports available are displayed.

NOTE

The settings are permanently applied with the **"Apply"** button.
Exit the **"Communication setup"** with the **"Close"** button
Communication with the amplifier is now established automatically.
Please also check whether the set BPS matches the standard value.

BPS = 115200
Port = COMxx

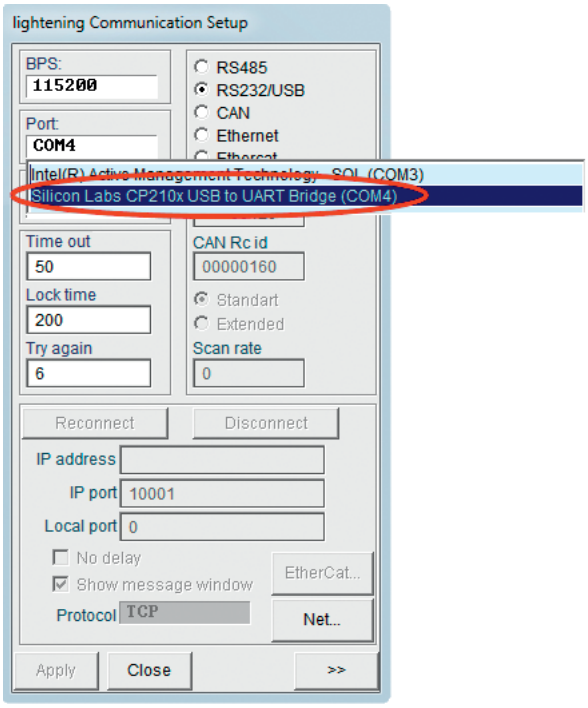


Fig. 6.5 **Setting the communication parameters**

Confirm your selection with **"Apply"** and **"Close"**. If the connection has been established successfully, it will look like this in the status bar.

Fig. 6.6 **Confirmation of connection in the status bar**

6.3 Operating interface

While the "Lightening" software is connected to the drive amplifier, the motor can be de-energised at any time with the F12 button. NOTE

Any change in value in a field must be confirmed with the "Enter" button, otherwise the change does not take effect. NOTE

Example:

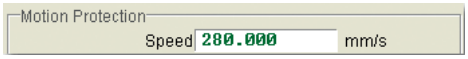


Fig. 6.7 **Original value**

Highlight field and enter new desired value

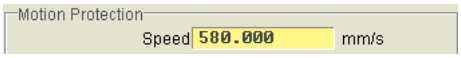


Fig. 6.8 **New value not confirmed**

Confirm value entered with the **"Enter"** button.

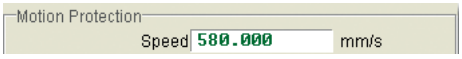


Fig. 6.9 **New value confirmed and active**

All changes are written to the RAM and are lost once the drive amplifier is reset (restarted). To permanently save changes, they must be transferred to the flash memory. This is done by pressing the "Save parameters to flash" button. NOTE

Fig. 6.10 **Permanently saving changes**

The following screenshot shows the main operating interface of the "Lightening" software..

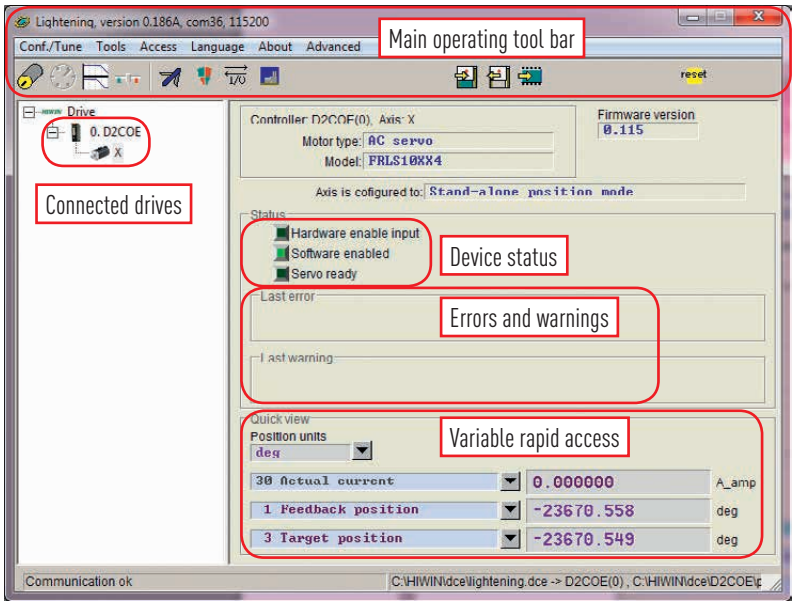


Fig. 6.11 **Main operating interface**

NOTE

Right-click on the connected drive amplifier and select "Properties" to display the characteristics of the connected device.

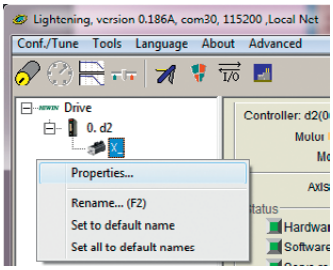


Fig. 6.12 **Selection menu of the slave**

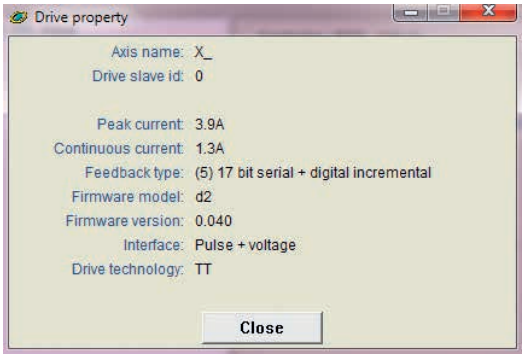


Fig. 6.13 **Overview of the characteristics of the connected drive amplifier**

6.3.1 The "Conf./Tune" menu

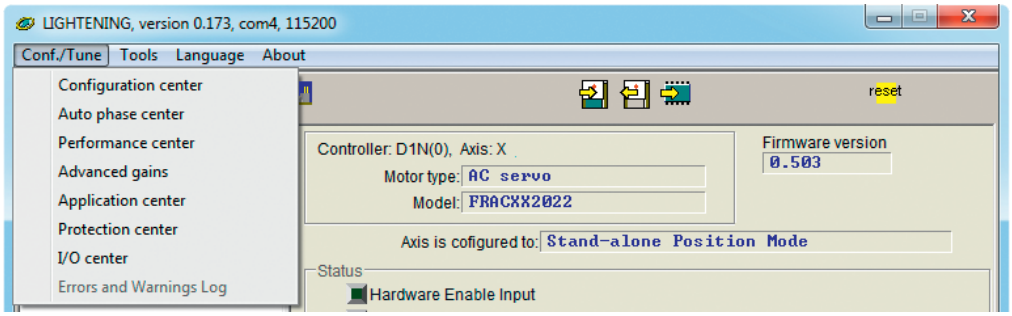


Fig. 6.14 **"Conf./Tune" menu**

This menu contains all the functions needed for commissioning. With the exception of **"Advanced gains"** and **"Errors and warnings log"**, these functions can also be found on the shortcut bar for quicker access.

Overview of functions:
- **"Configuration center"** – parameter settings for motor and encoder, and operation mode
- **"Auto tune center"** – motor commissioning with setup of commutation settings, and direction of counting
- **"Performance center"** – interface for drive procedure for commissioning and controller tuning
- **"Advanced gains"** – menu for setting the controller parameters, and setting filters
- **"Application center"** – settings for homing, backlash compensation, error mapping and resolver
- **"Protection center"** – limit value settings for position errors and traversing range as well as acceleration and speed. Setting of limit switch function and brake parameters
- **"I/O center"** – settings for digital inputs and outputs
- **"Errors and warnings log"** – call-up the error history

6.3.2 The "Tools" menu

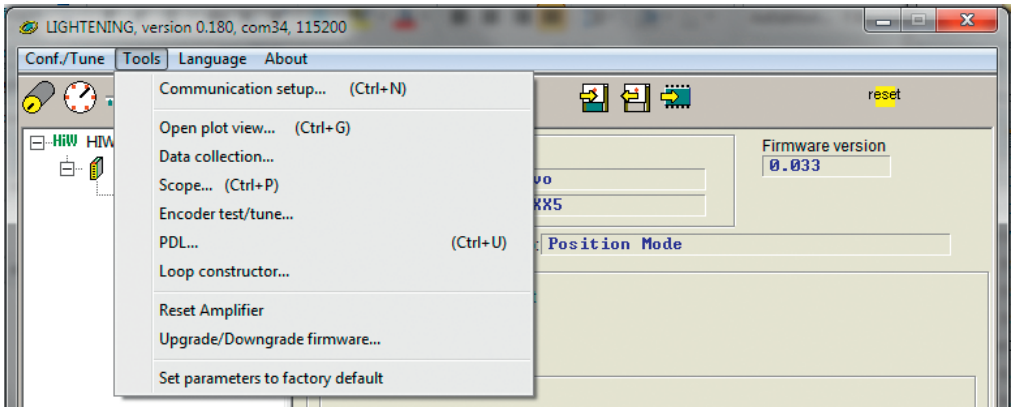


Fig. 6.15 **"Tools" menu**

This menu contains other useful functions relating to management of the drive amplifier. It also contains tools for checking the settings.

Overview of functions:
- **"Communication setup"** – setting connection parameters to device
- **"Open plot view"** – depiction and analysis of the recorded data
- **"Data collection"** – recording of parameter values in real time
- **"Scope"** – oscilloscope for evaluating travel behaviour and controller setting
- **"Encoder test/tune"** – testing encoder function at analogue sine-cosine encoders
- **"PDL"** – device's own programming language for simple processes
- **"Loop constructor"** – display and adaptation of control circuit structure

- **"Reset Amplifier"** – device restart
- **"Upgrade/downgrade firmware"** – loading of software updates
- **"Set parameters to factory default"** – reset drive amplifier to factory setting

The **"Language"** menu is used to select the language.
The **"About"** menu displays version info about the software installed.

6.3.3 The shortcut bar

⚠ CAUTION!

Danger of damage or injury due to uncontrolled movement!
If the **"Save parameters from amplifier RAM to flash"** button is pressed while the motor is energised/moving, the drive amplifier initiates a quick stop (Dec. Kill) and de-energises the motor.
▶ Deliberately stop the movement, before saving the parameters!

The shortcut bar makes it easier for the user to find commonly needed functions. The left area contains the functions from the menus.

Fig. 6.16 **Shortcut bar**

[1] Configuration center
[2] Auto tune center
[3] Performance center
[4] Application center
[5] Protection center
[6] I/O center
[7] PDL
[8] Save parameters to file
[9] Load parameters from file
[10] Save parameters to flash
[11] Reset amplifier

The main interface provides the **"Save parameters"** and **"Load parameters"** functions for loading parameter sets or saving on the PC.


Save current drive amplifier parameters to file.


Transfer parameters from file to drive amplifier.


Write parameters from drive amplifier RAM to drive amplifier flash
(save permanently in drive amplifier).

6.3.4 Reset

⚠ CAUTION!

Danger of damage or injury due to uncontrolled movement!
If you press the **"Reset amplifier"** button while the motor is energised/moving, the drive amplifier immediately de-energises the motor. The motor is NOT decelerated by the drive amplifier.
▶ Deliberately stop the movement, before using the reset function!

Clicking on the **"Reset"** symbol (yellow square) triggers a drive amplifier restart.

6.3.5 Status

The **"status"** field contains LEDs to evaluate the device status:

Active status

Inactive status

6.3.6 Errors and warnings

The last messages to be displayed are shown in the **"errors and warnings"** area.

6.3.7 Variable rapid access

The setting of user units can be adapted in this area using the **"Position Units"** drop-down list. Depending on the drive used, different units are provided for linear and rotary systems.
The other drop-down lists can be used to clearly view any drive parameters. The units for e.g. speed and position are adapted automatically depending on the selection made in the **"Position Units"** field.

6.4 "Configuration center"

The **"Configuration center"** is provided for parameterising the drive system and setting the operation mode. The **"Configuration center"** can be launched from the shortcut bar or the **"Conf./Tune"** menu in "Lightening". There are four tabs in the **"Configuration center"** for setting the motor type, motor encoder, any Hall sensors, and the operating mode.

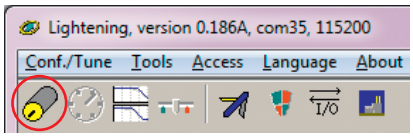


Fig. 6.17 **"Configuration center" symbol**

6.4.1 Motor selection

First parameters are set for the motor used. One motor type can be selected (AC servo). When using a HIWIN motor, the corresponding data record can be easily selected from the list. In the example shown, only the drive connection to the machine still needs setting. In the case of a ballscrew, the mass inertia for the spindle, moved mass, spindle lead and any gear factor used should be entered. The values entered affect the **"Linear Resolution"** in the **"Encoder"** tab. If your motor does not use a spindle, any value can be entered for **"Screw pitch"**. Do however be sure not to use a metre-based unit later on for the positioning tasks in "Lightening".

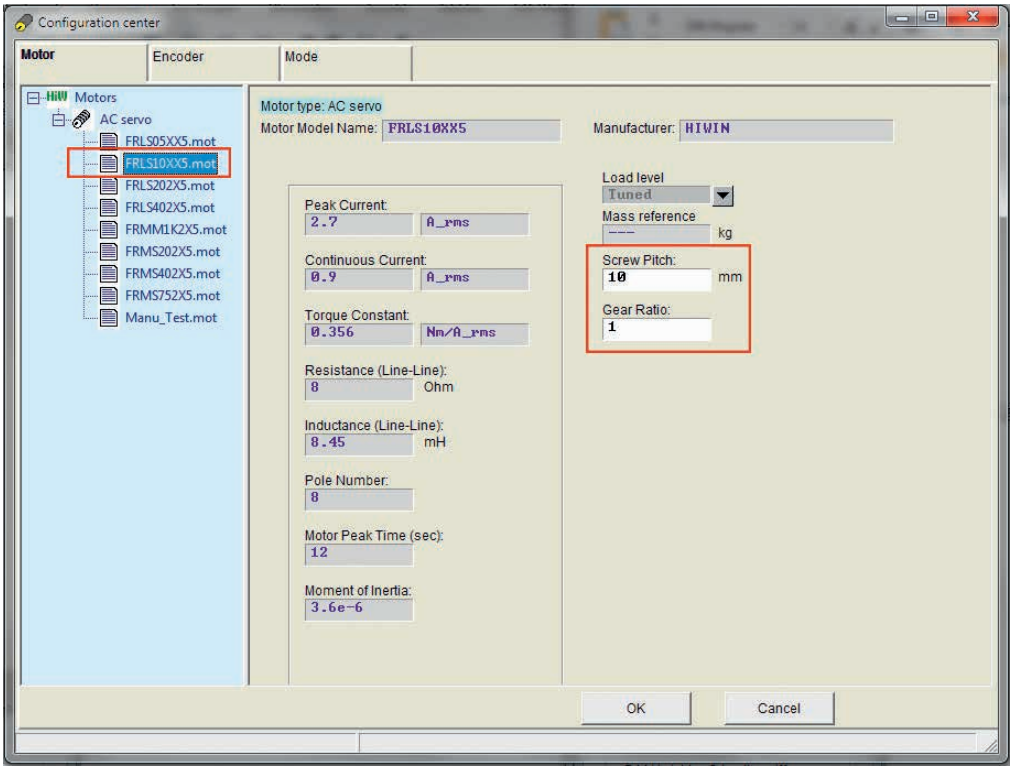


Fig. 6.18 **"Configuration center" – motor**

NOTE

When using a toothed belt axis, the spindle pitch corresponds to the circumference of the driving belt wheel (feed constant).

NOTE

If a HIWIN AC servo motor has been selected, the matching encoder is automatically selected.

NOTE

If using a non-HIWIN motor, all motor parameters must be taken from the motor manufacturer's manual and entered in the corresponding fields. The "Customized AC-Servo" with these parameter settings can be added to the motor database.

6.4.2 Encoder selection

The parameter settings for the encoder are entered in the same way as those for the motor. The encoder database contains all encoders which are sold in the direct context of the HIWIN drive components.
If using a non-HIWIN motor or special encoder, the corresponding data from the encoder manufacturer's manual must be entered.

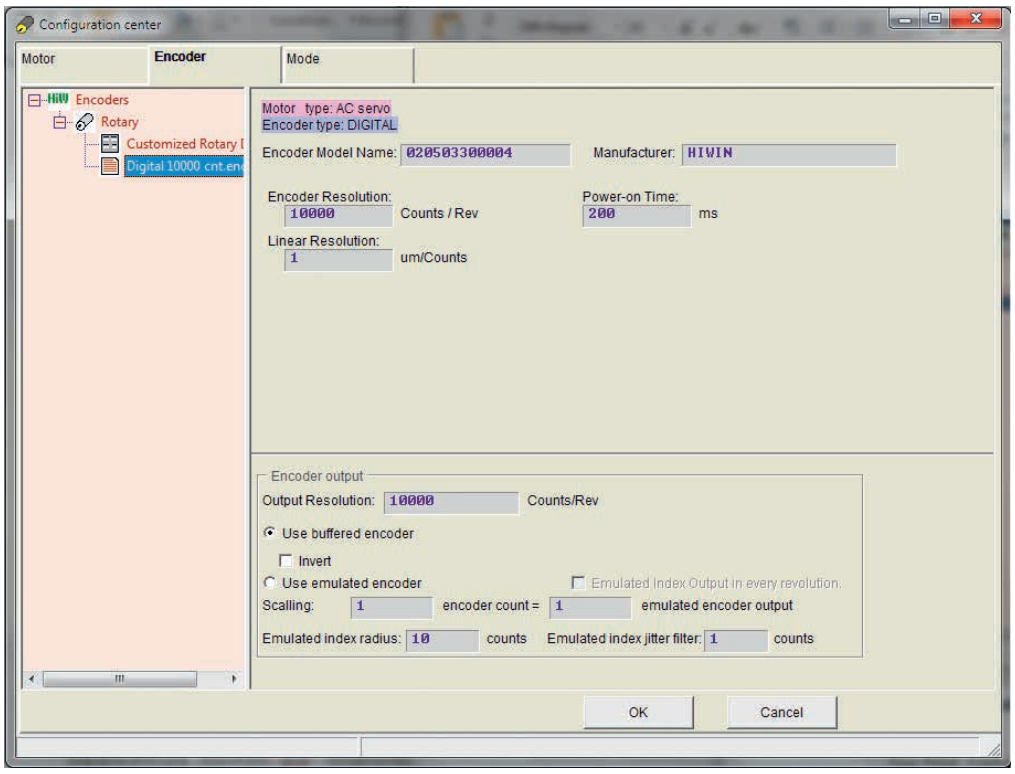


Fig. 6.19 **"Configuration center" – 13-bit encoder**

The "Linear Resolution" field shows the system resolution calculated from the motor and encoder data.

NOTE

The **"Encoder output"** area is only of importance if the drive amplifier creates an encoder signal for e.g. communicating the position to an external device such as a controller. A RS422 signal is produced.
The **"Buffered encoder"** renders the position of the drive amplifier as a digital signal.
With an **"Emulated encoder"** there is a signal processor which creates a new output signal from the interpolated encoder signal according to the defined specifications.
This signal has a delay of one sampling period (62.5 or 67.7 µs).

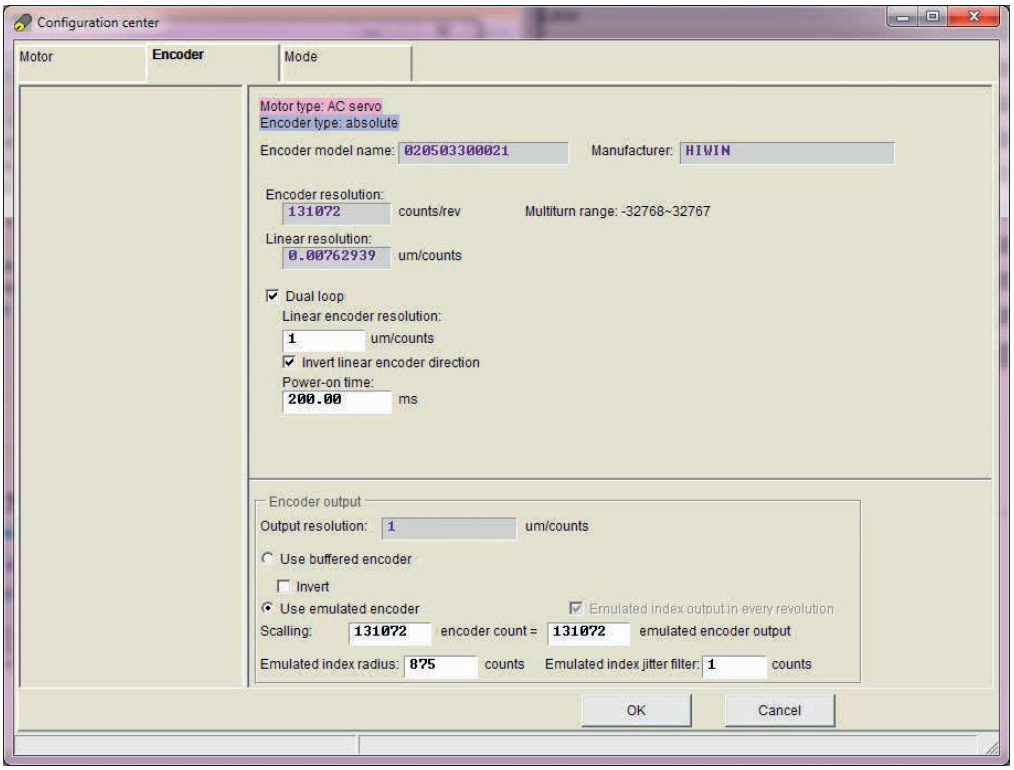


Fig. 6.20 **"Configuration center" – selecting an absolute encoder**

When using an absolute positioning measurement system, the rotary encoder in the motor is recognized automatically. In dual-loop mode, the encoder resolution for the linear, digital positioning measurement system is entered after selecting the dual loop.

6.4.3 Selecting the operation mode

The drive amplifier operation mode is defined in the **"Mode"** tab. The **"Stand-Alone Mode"** should be selected for commissioning without an external controller. Depending on the device type present, not all operation modes are available. Operation modes with I/O control are not available for devices with an EtherCAT interface. Vice versa, devices without an EtherCAT interface cannot be taken into EtherCAT operation mode.
In dual-loop operation only the **"Stand-Alone Mode"** and the **"Position Mode"** are available.

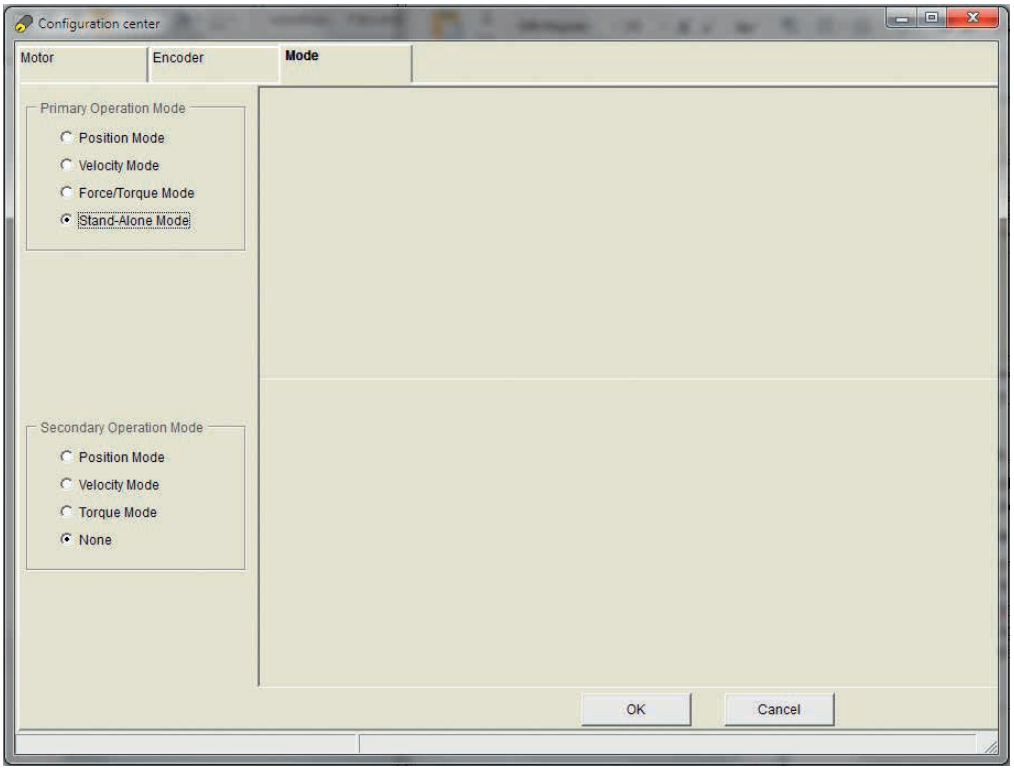


Fig. 6.21 **"Configuration center" – operation mode standard and mega-ulink**

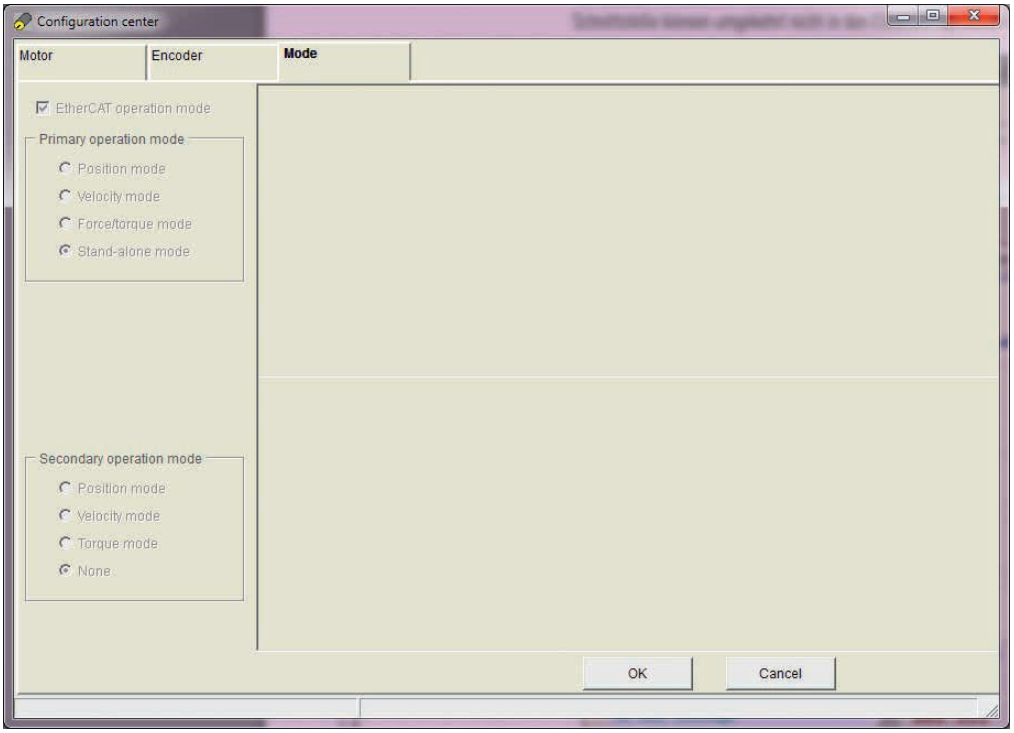


Fig. 6.22 **"Configuration center" – operation mode CoE version**

"Stand-Alone Mode":
The nominal values for speed, acceleration and position are generated in the drive amplifier.

"Position Mode":

ATTENTION!

Disturbing influences due to unshielded cables.

- To minimise the impact of disturbing influences and to avoid errors, please only use well shielded cables for all cables carrying encoder signals

The drive amplifier receives the nominal position value via I/O interface CN6. Different signal types, e.g. **"Pulse and Direction"**, **"Pulse Up/Pulse Down"** and **"Quadrature (AqB)"** can be selected here. **"Electronic gear"** signal scaling can also be undertaken. This reflects the ratio of motor increments (**"Output counts"**) to input pulses (at controller end). The position specification can be connected via **"High Speed Pulse Input"** or **"Low Speed Pulse Input"**. For the precise input specifications, refer to Section 3.4.

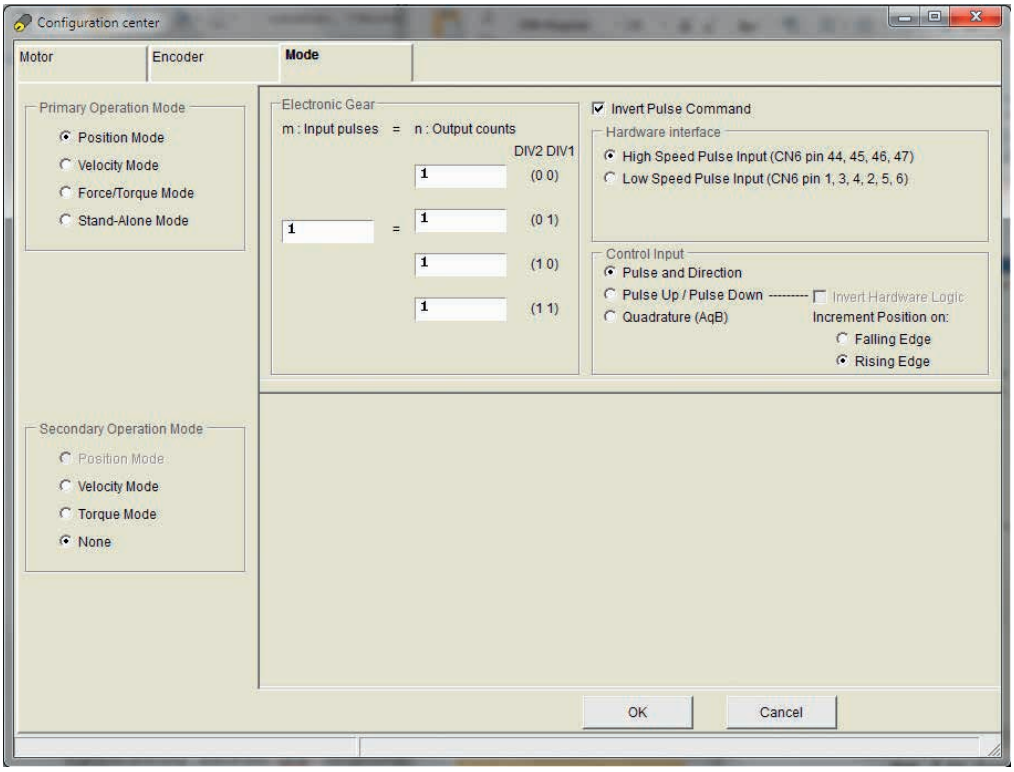


Fig. 6.23 **"Configuration center" – "Position Mode"**

"Velocity Mode":
The drive amplifier receives the nominal speed value via I/O interface CN6. Here the nominal value can be supplied via the analogue input or via a digital input using PWM.

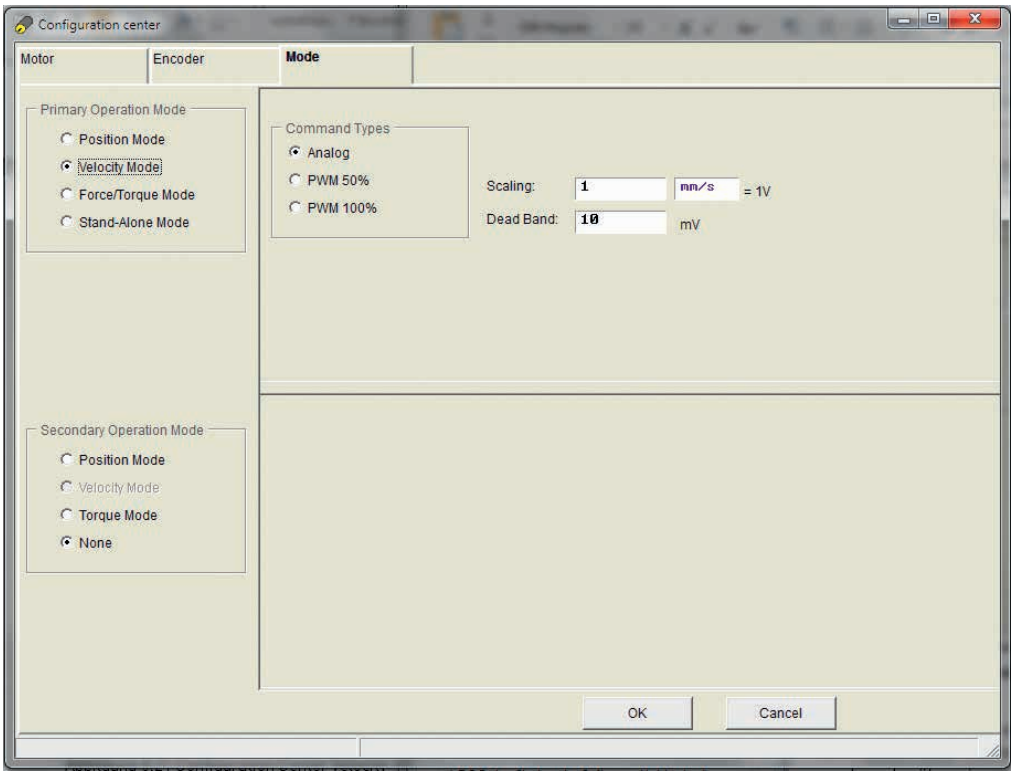


Fig. 6.24 **"Configuration center" – "Velocity Mode"**

The **"Dead Band"** is an area around the stationary point in which "small" signals in the mV range do not trigger movement in order to compensate for any zero point deviations.

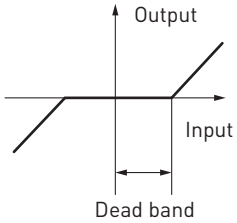


Fig. 6.25 **Definition of "Dead Band"**

"Force/Torque Mode":
The drive amplifier receives the nominal force/torque value via I/O interface CN6. Here the nominal value can be supplied via the analogue input or via a digital input using PWM. The setting is made in a similar way as in **"Velocity Mode"**.

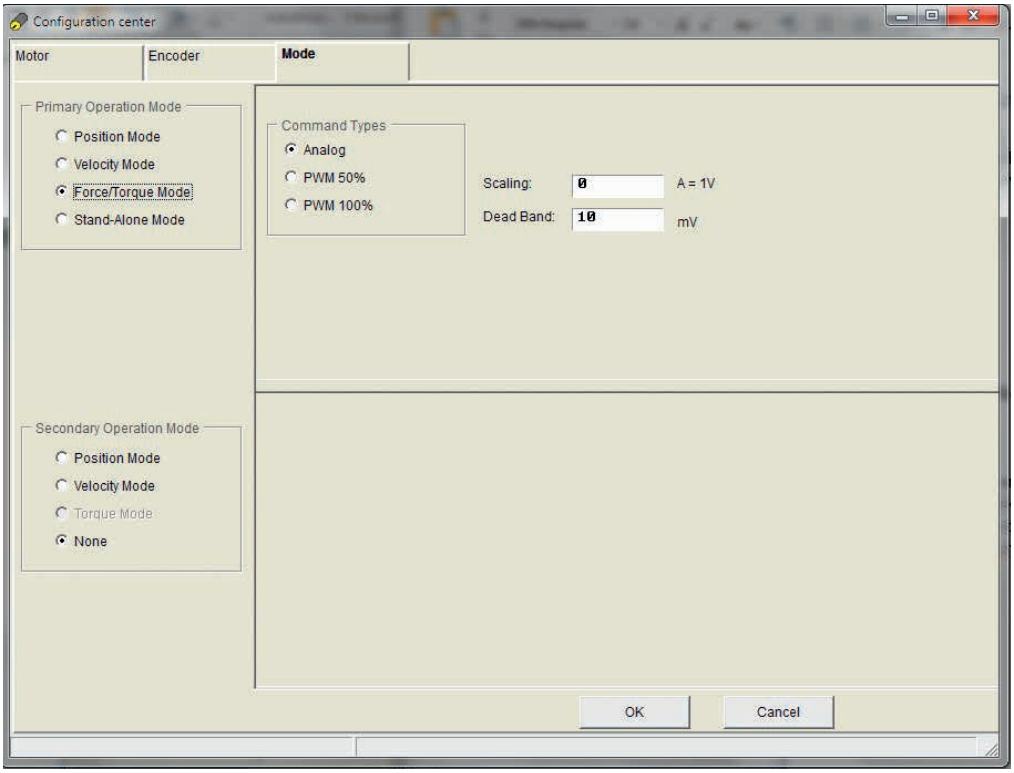


Fig. 6.26 **"Configuration center" – "Force/Torque Mode"**

6.4.4 End of configuration

Once all the parameters have been selected correctly, close the **"Configuration center"** with the **"OK"** button. The parameters are listed in a new window for checking purposes. Changes compared with the data from the drive amplifier's RAM are highlighted in red. To transfer the data, confirm with the **"Send to RAM"** button.

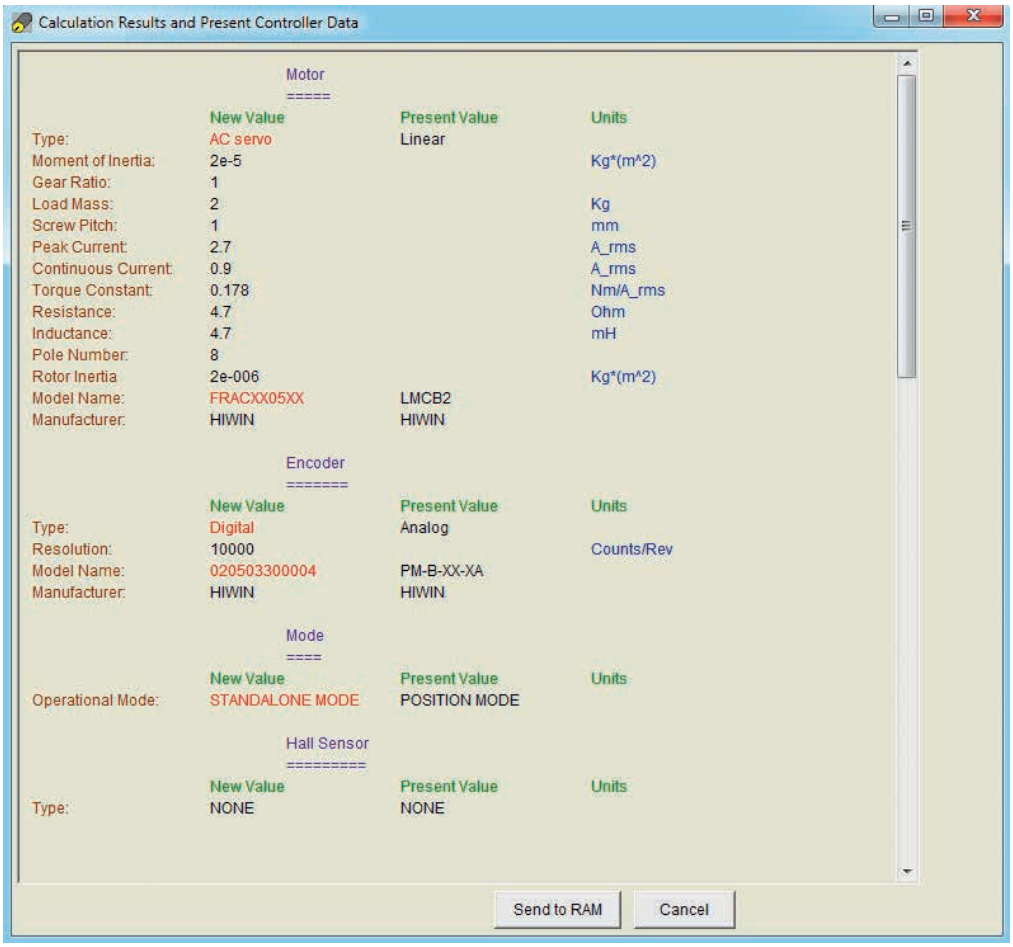


Fig. 6.27 **Parameter data set check**

The motor and encoder settings are now saved in the drive amplifier's RAM. For permanent storage, the changes still need to be transferred to the flash memory, otherwise all changes will be lost in the event of a restart (see Section 6.3.3).

NOTE

6.5 "Application center"

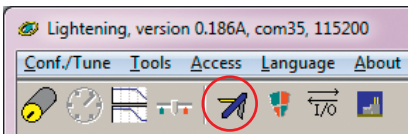


Fig. 6.28 **Accessing the "Application center"**

NOTE

The selection menu provided for "Position Units" can be used to define the desired unit for your input.

6.5.1 Homing (standard, mega-ulink)

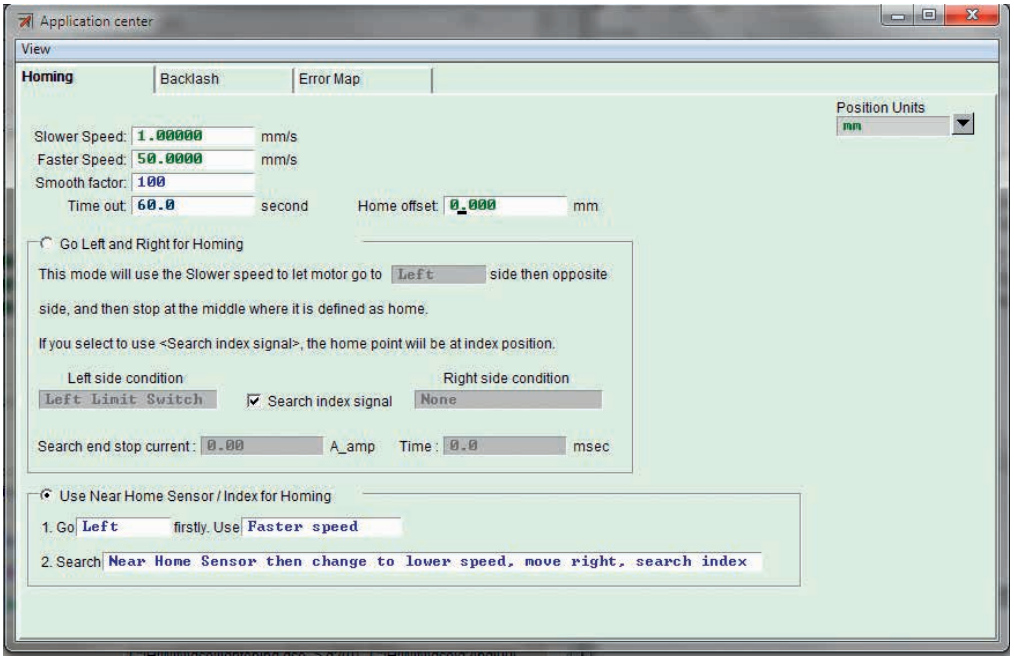


Fig. 6.29 **"Application center" – homing**

There are two different ways in which homing can be undertaken to record the absolute position of the drive.

"Go Left and Right for Homing"
This method can be used to place the reference point in the centre of the traversing range. In this example, the carriage is firstly moved to the left end of the axis. As soon as the limit switch has triggered, the carriage moves to the opposite end. The carriage is then positioned in the centre of the axis. Homing to the limit switch or the mechanical end block is possible. In the latter case, the threshold current value for the change in direction should be set correctly. If the motor encoder supplies an index pulse, this can be taken into account to enhance precision.

"Use Near Home Sensor/Index for Homing"
This method is used if there is a reference switch present. The carriage is homed to the switch and then back until the signal disappears. If the motor encoder supplies an index pulse, this can be taken into account to enhance precision.
Regardless of the method selected, before homing, the speed at which the switch is found (**"Faster Speed"**) and travels free (**"Slower Speed"**) should be defined before homing. The **"Smooth factor"** is used for jerk limitation and is set to 100 by default.
Should the axis be blocked during homing, a **"Time out"** can also be defined. Ensure that the time is sufficient for one movement over the entire traversing range of the axis. With rotary tables, this is one revolution.
Should the reference position determined by the drive not match the zero point of the traversing range, the desired offset can be entered in the **"Home offset"** field.

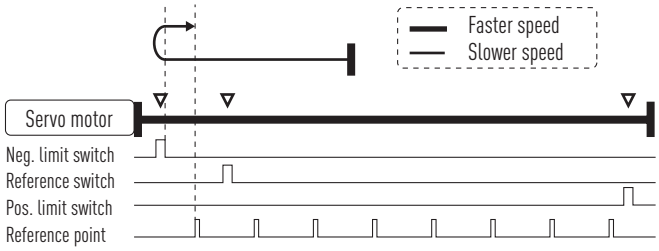


Fig. 6.30 **Homing to limit switch process**

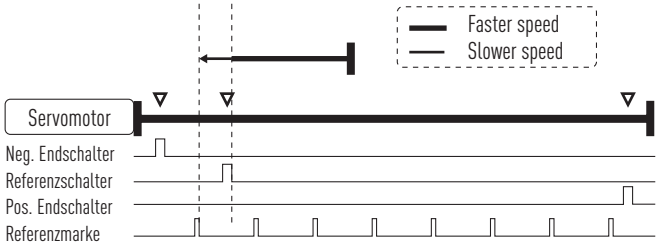


Fig. 6.31 **Homing to reference switch process**

6.5.2 Homing (D2/D2T CoE)

Regardless of the method selected, before homing, the speed (**"Faster Speed"** and **"Slower Speed"**) should be defined before homing. The **"Smooth factor"** is used for jerk limitation and is set to 100 by default.
Should the reference position determined by the drive not match the zero point of the traversing range, the desired offset can be entered in the **"Home offset"** field.

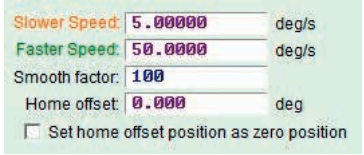


Fig. 6.32 **Setting moving parameters for homing**

There are different ways in which homing can be undertaken to record the absolute position:

Method –5:

The methods –4 or –5 are used for homing without limit switches or homing sensor.

- Move at **"Faster Speed"** in the negative direction
- Move up to the hard stop until **"End stop current"** is reached
- Keep **"End stop current"** pressed for the set **"Time"**
- Move in the positive direction until **"End stop offset"** has been reached

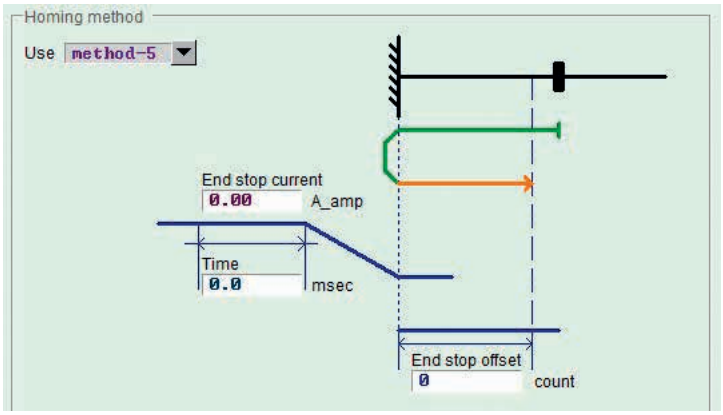


Fig. 6.33 **Homing method –5**

Method –4:

The methods –4 or –5 are used for homing without limit switches or homing sensor.

- Move at **"Faster Speed"** in the positive direction
- Move up to the hard stop until **"End stop current"** is reached
- Keep **"End stop current"** pressed for the set **"Time"**
- Move in the negative direction until **"End stop offset"** has been reached

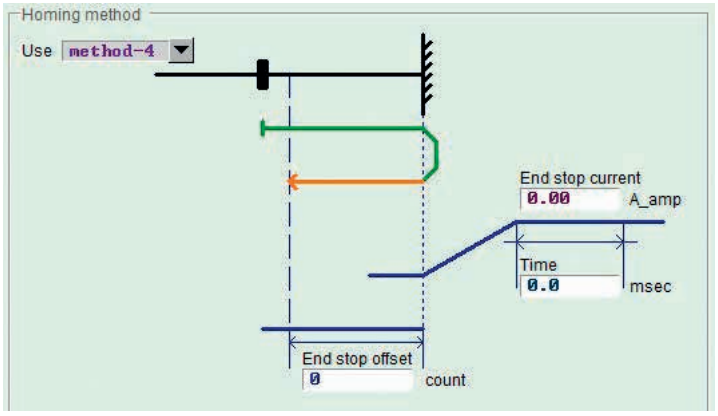


Fig. 6.34 **Homing method –4**

Method –2:

- Move at **"Faster Speed"** in the positive direction
- Move up to the hard stop until **"End stop current"** is reached
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the negative direction until the next index pulse is reached

"End stop current" defines the current limit when the drive moves to the end limit. **"Time"** defines the time during which the set **"End stop current"** is active.

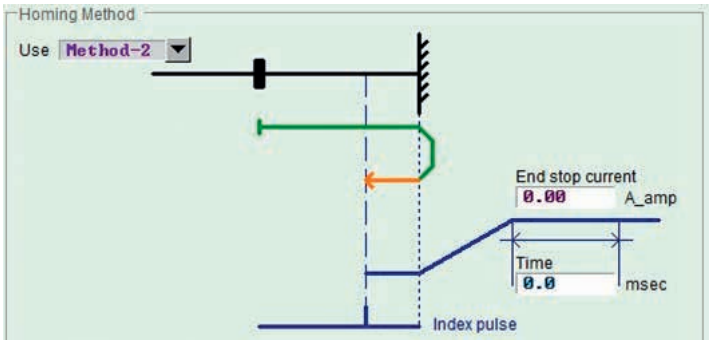


Fig. 6.35 **Homing method –2**

"End stop current" is given in peak, and not effective amperes! NOTE

Method –1:

- Move at **"Faster Speed"** in the negative direction
- Move up to the hard stop until **"End stop current"** is reached
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the positive direction until the next index pulse is reached

"End stop current" defines the current limit when the drive moves to the end limit. **"Time"** defines the time during which the set **"End stop current"** is active.

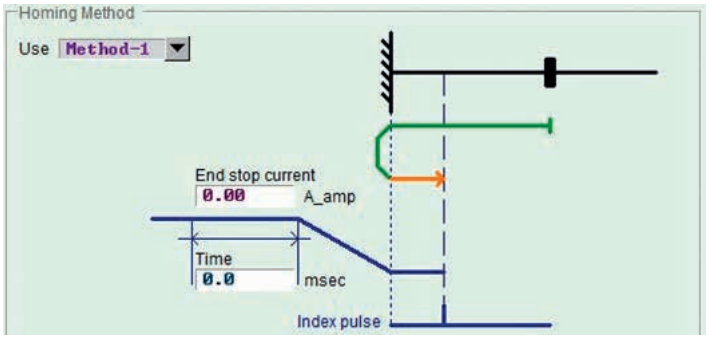


Fig. 6.36 **Homing method –1**

"End stop current" is given in peak, and not effective amperes! NOTE

Method 1:

- Move at **"Faster Speed"** in the negative direction
- Move until the negative hard switch outputs a rising edge
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the positive direction until the next index pulse

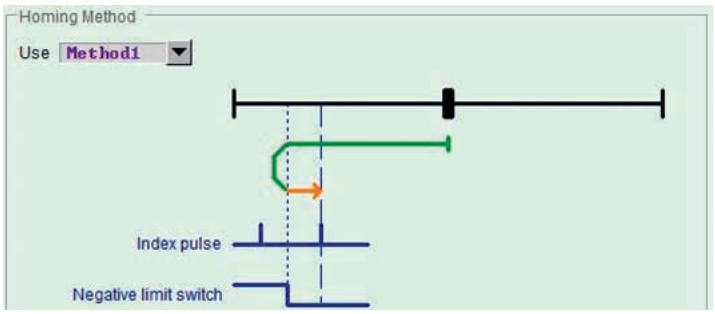


Fig. 6.37 **Homing method 1**

Method 2:

- Move at **"Faster Speed"** in the positive direction
- Move until the positive limit switch outputs a rising edge
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the negative direction until the next index pulse

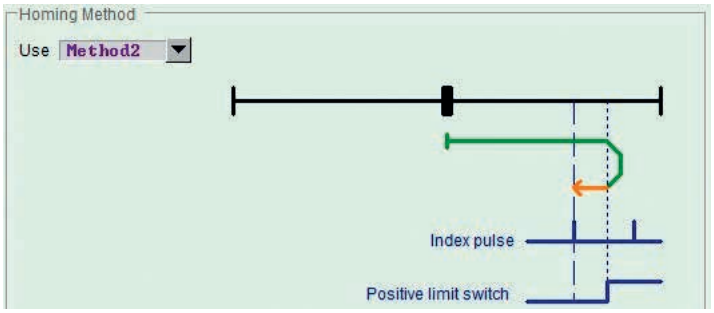


Fig. 6.38 **Homing method 2**

Method 7:

- Move at **"Faster Speed"** in the positive direction
- Until the home sensor outputs a rising edge
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the negative direction until the next index pulse

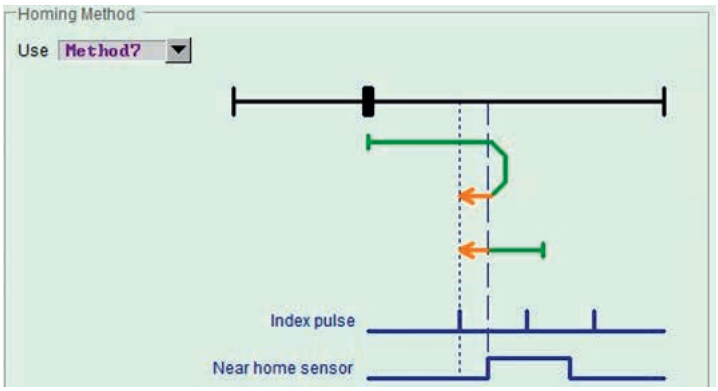


Fig. 6.39 **Homing method 7**

Method 8:

- Move at **"Faster Speed"** in the positive direction
- Until the home sensor outputs a rising edge
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the positive direction until the next index pulse

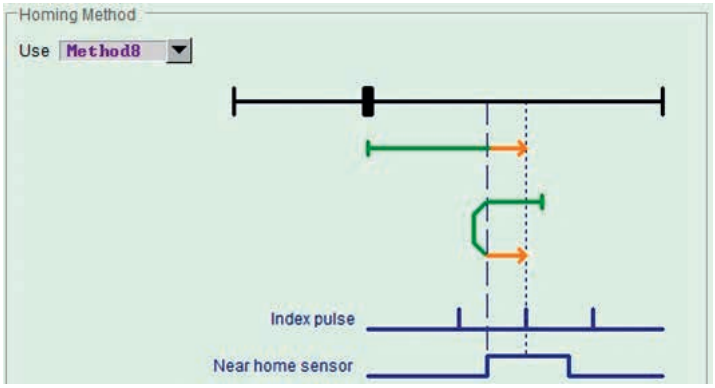


Fig. 6.40 **Homing method 8**

Method 9:

- Move at **"Faster Speed"** in the positive direction
- Until the home sensor outputs a falling edge
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the negative direction until the home sensor (logical 1) and the next index pulse is reached

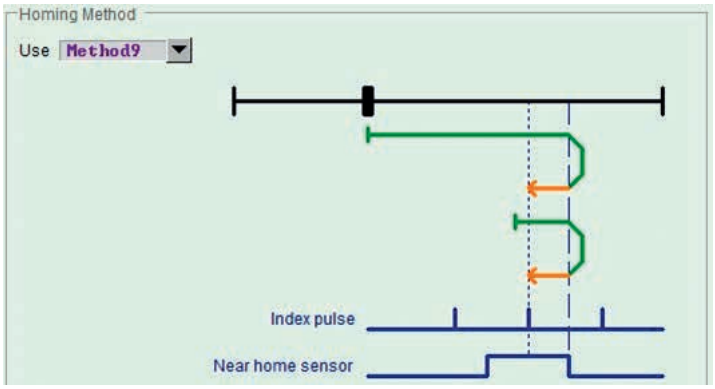


Fig. 6.41 **Homing method 9**

Method 10:

- Move at **"Faster Speed"** in the positive direction
- Until the home sensor outputs a falling edge
- On reaching this, move at **"Slower Speed"** in the positive direction until the next index pulse

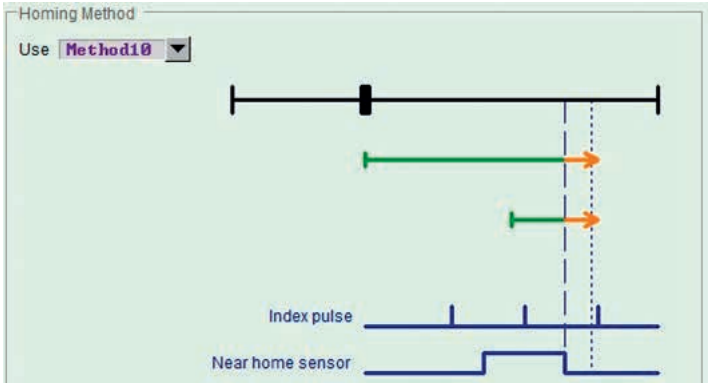


Fig. 6.42 **Homing method 10**

Method 11:

- Move at **"Faster Speed"** in the negative direction
- When the home sensor outputs a rising edge, decelerate and stop.
- Move at **"Slower Speed"** in the positive direction until the next index pulse is reached

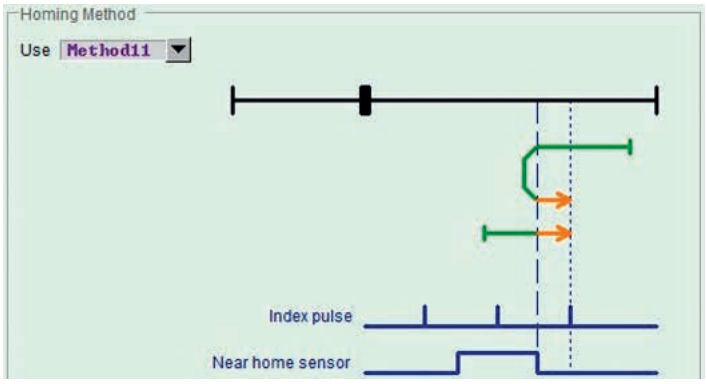


Fig. 6.43 **Homing method 11**

Method 12:

- Move at **"Faster Speed"** in the negative direction
- Until the home sensor outputs a falling edge
- On reaching this, move at **"Slower Speed"** in the negative direction until the home sensor (logical 1) and the next index pulse is reached

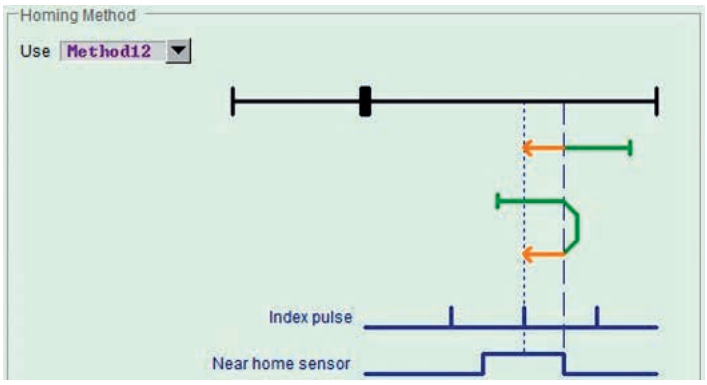


Fig. 6.44 **Homing method 12**

Method 13:

- Move at **"Faster Speed"** in the negative direction
- Until the home sensor outputs a falling edge and
- On reaching this, decelerate, stop, and move at **"Slower Speed"** in the positive direction until the home sensor (logical 1) and the next index pulse is reached

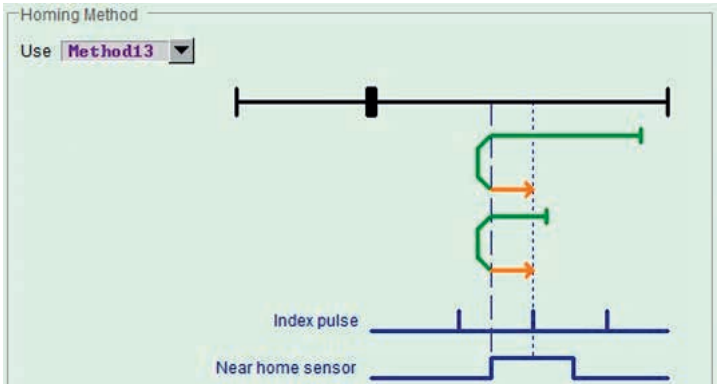


Fig. 6.45 **Homing method 13**

Method 14:

- Move at **"Faster Speed"** in the negative direction
- Until the home sensor outputs a falling edge
- Move at **"Slower Speed"** in the negative direction until the next index pulse is reached

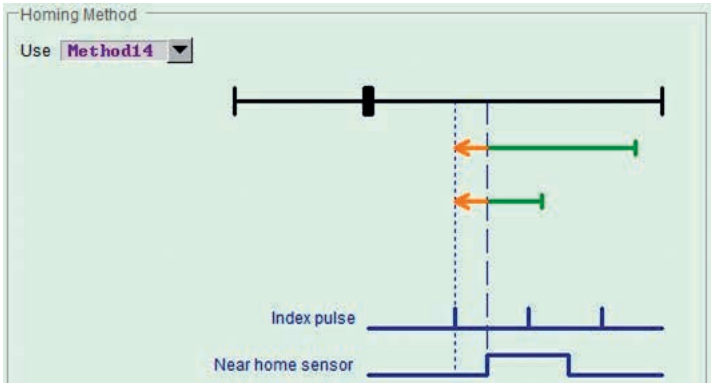


Fig. 6.46 **Homing method 14**

Method 33:

- Move at **"Slower Speed"** in the negative direction
- Until the index pulse is reached

This method is intended for positioning measurement systems that feature only one index mark (single index).

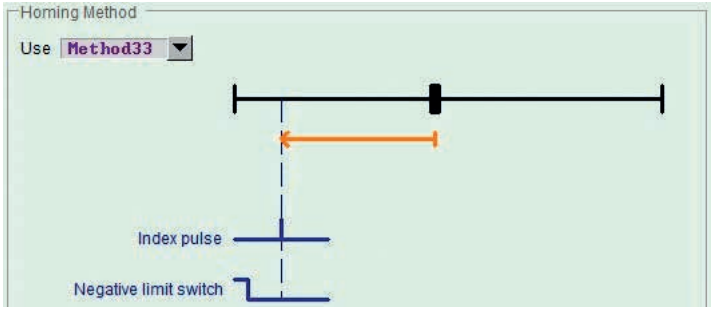


Fig. 6.47 **Homing method 33**

Method 34:

- Move at **"Slower Speed"** in the positive direction
- Until the index pulse is reached

This method is intended for positioning measurement systems that feature only one index mark (single index).

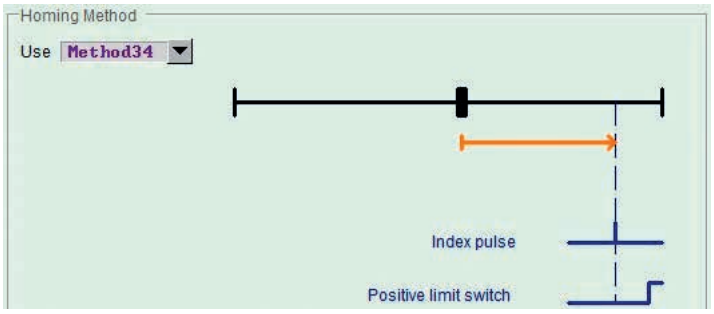


Fig. 6.48 **Homing method 34**

Method 37:

With this method, the current position becomes the zero position.

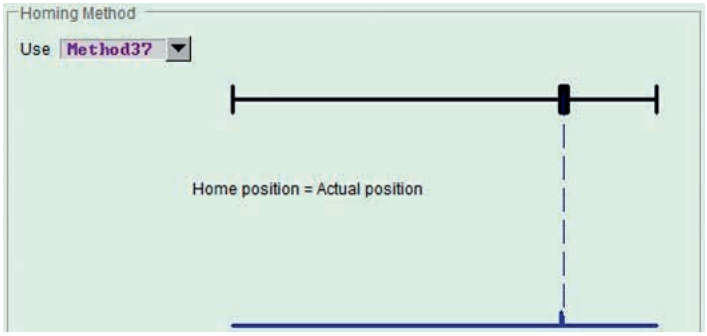


Fig. 6.49 **Homing method 37**

6.5.3 "Backlash"

The accuracy for axes with backlash can be increased by means of backlash compensation. The backlash simply needs to be known in advance.

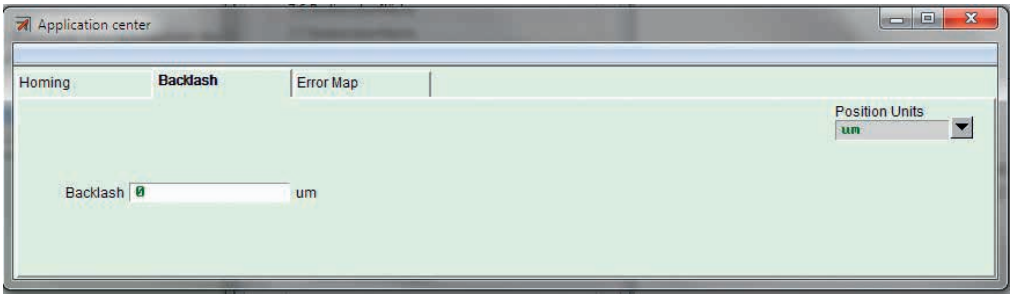


Fig. 6.50 **"Application center" – "Backlash"**

6.5.4 "Error map"

The D2 drive amplifier allows up to 5,000 position correction points to be stored directly in the drive amplifier. The raw data for the correction points can be captured with a glass scale or laser interferometer for example.

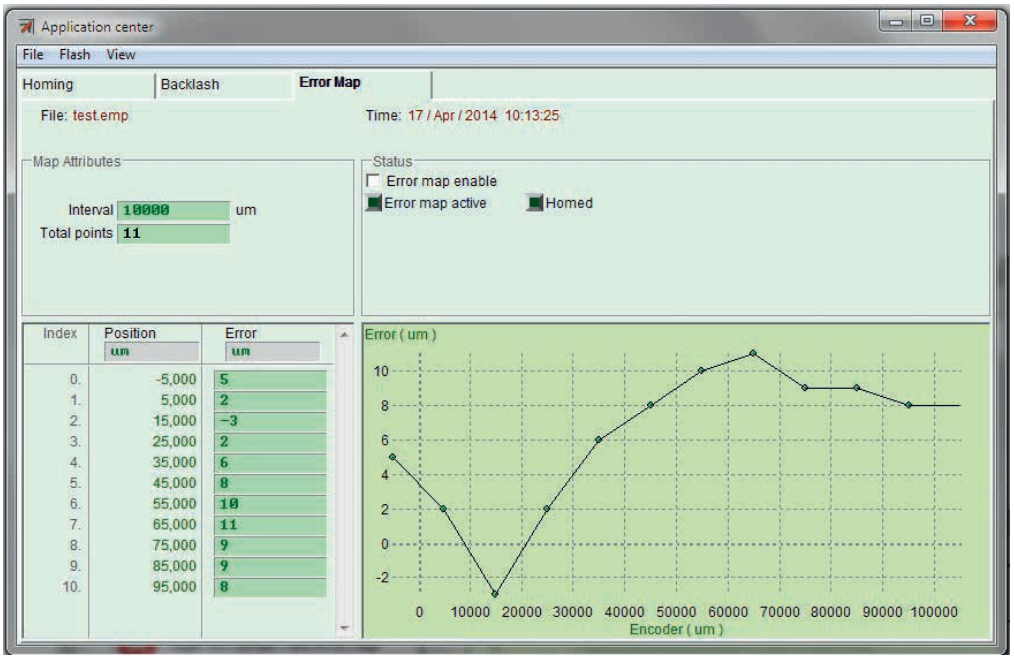


Fig. 6.51 **"Application center" – "Error Map"**

If no position correction points are stored in the device, this message appears:

Fig. 6.52 **"Application Center" – "Error Map": no values stored in flash**

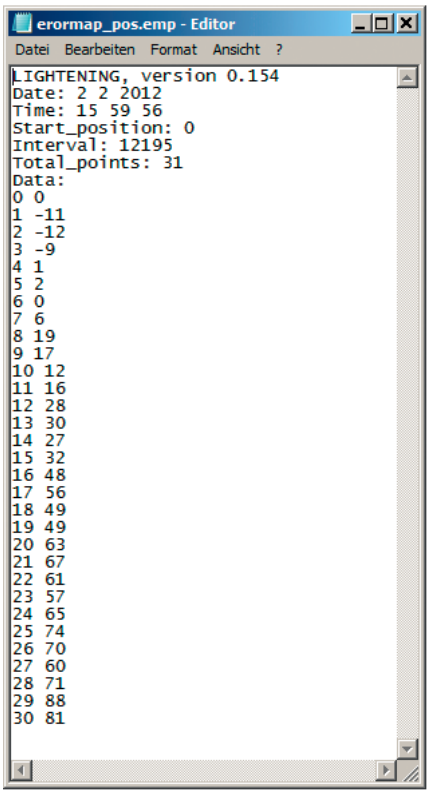


Fig. 6.53 **Example of an error map table**

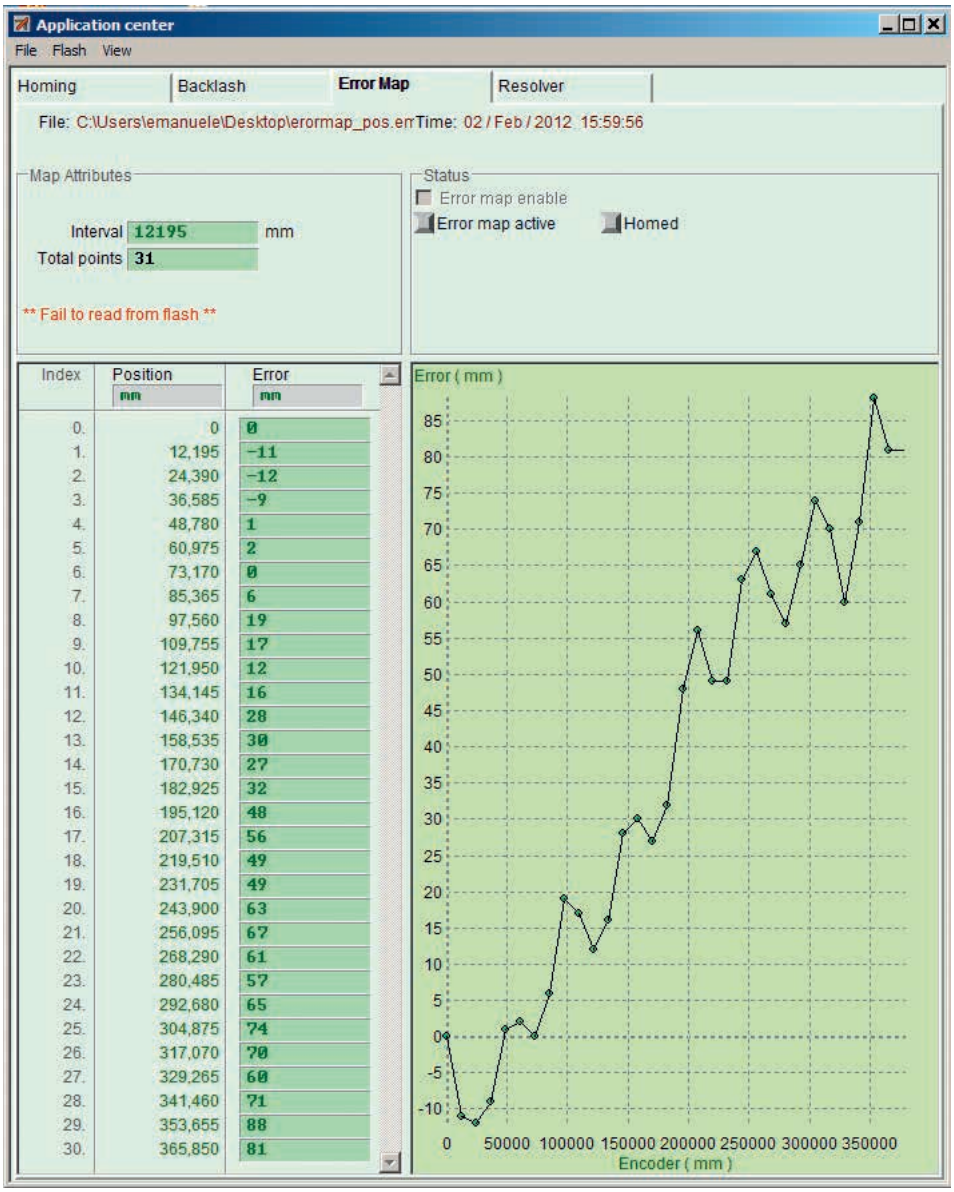


Fig. 6.54 **Correction on a belt axis**

6.6 "Protection center" (limitations)

ATTENTION!

Risk of material damage due to wrong limit values for moving parameters!
Be sure to correctly set the maximum permissible position error **"maximum pos error"**. This setting is important for enabling the drive amplifier to deactivate the motor in the event of too great a deviation from nominal position. If desired, values for position errors and speed errors above which a warning is to be output can also be set under **"Warning Windows"**. These warnings do NOT however stop motor movement if the values are exceeded.

Depending on application, the position error may have to be kept within certain limits. The same applies to the speed. The **"Protection center"** therefore allows you to set limit values for these parameters. The software limit switches **"sw limit"** can also be set here. If the system is not allowed to exceed a particular speed range, or the acceleration needs to be limited, this can also be done in the **"Protection center"**.

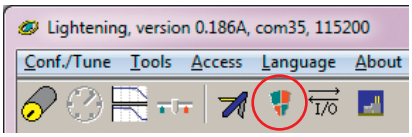


Fig. 6.55 **Accessing the "Protection center"**

6.6.1 "Protection"

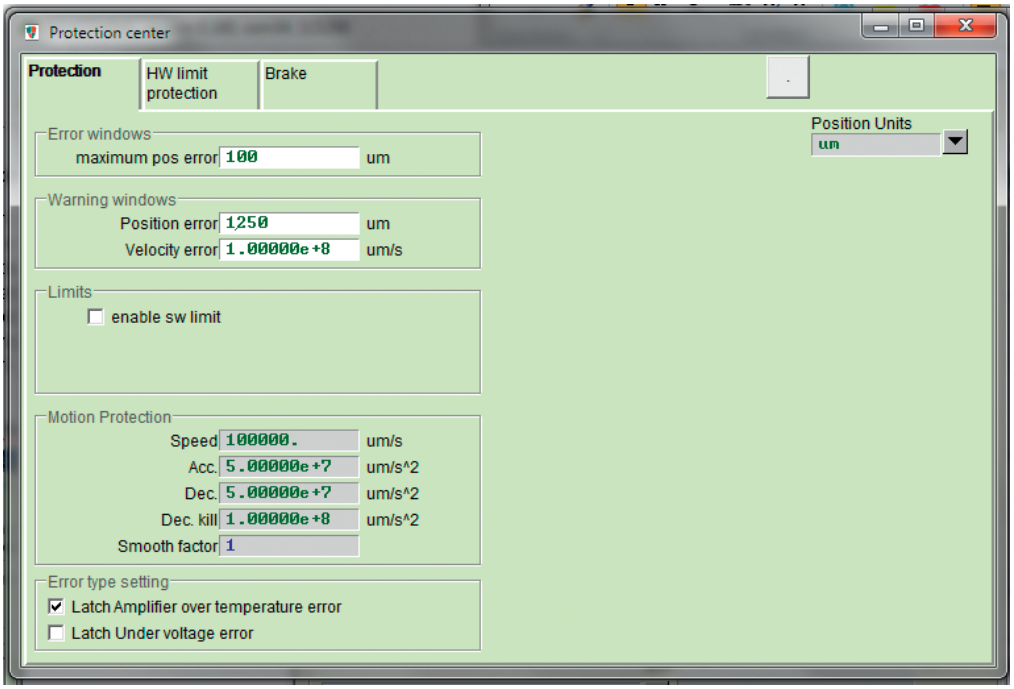


Fig. 6.56 **"Protection center" – Protection**

6.6.2 "HW limit protection"

If limit switches are used, switch monitoring can be activated in this tab.

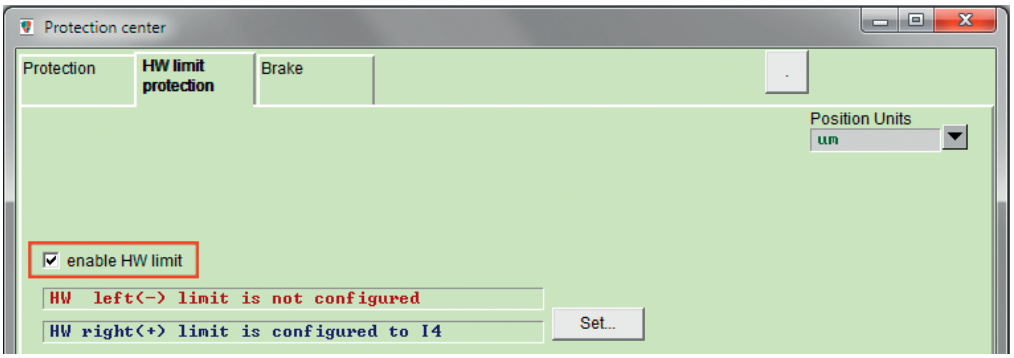


Fig. 6.57 **"Protection center" – "HW limit protection"**

NOTE

The relevant inputs for limit switches can be configured in the "I/O center" (see Section 6.7).

6.6.3 "Brake"

The **"Brake"** tab clearly shows all the parameters needed to configure the brake behaviour.

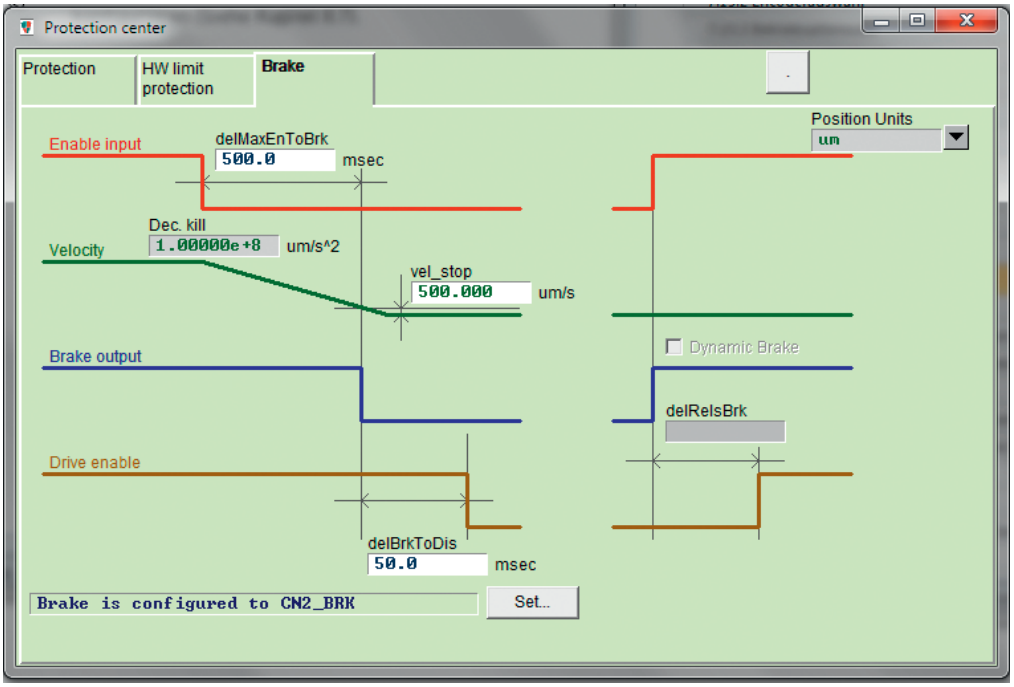


Fig. 6.58 **"Protection center" – "Brake"**

"delMaxEnToBrk": States the maximum time which may pass after the **"Controller enable"** disappears before the brake is closed (regardless of **"vel_stop"**).

"Dec. Kill": Shows the delay with which the motor is braked after the **"Controller enable"** disappears. This delay can be changed in the **"Performance center"**.
Attention: This acceleration ramp also depends on the **"Smooth factor"**.

"vel_stop": If the motor speed has fallen below this speed value, the brake closes (even if the time **"delMaxEnToBrk"** hasn't yet been reached).

"delBrkToDis": Time between the brake being activated and control being shut down.

The **"Set..."** button can be used to select the drive amplifier output for brake activation.

6.7 Digital inputs and outputs/"I/O center"

In the **"I/O center"** all digital inputs and outputs for the D2 can be configured and monitored.
Launch the **"I/O center"** by clicking on the corresponding button in the main operating interface or the "Lightening" **"Conf./Tune"** menu.

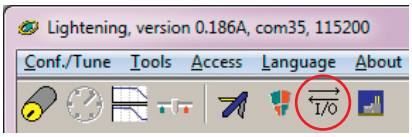


Fig. 6.59 **Launching "I/O Center"**

6.7.1 "Inputs"

⚠ CAUTION!

Danger of damage or injury due to uncontrolled movement!
When inverting the I/O settings, a **"Controller enable"** may be issued and the motor may commutate and move in an uncontrolled manner.
▶ For safety reasons, initial start-up should be performed with the motor plug disconnected to prevent accidents.

Any function can be assigned to each input in the **"Inputs"** tab. The logic of each input can also be inverted to undertake adaptation, e.g. to the switch type used.

Fig. 6.60 **"I/O center" – "Inputs"**

Any function can be assigned to each input in the **"Inputs"** tab. The logic of each input can also be inverted to undertake adaptation, e.g. to the switch type used.

If the "Axis enable" function is not used, this input must be inverted otherwise a controller enable is not possible.

NOTE

6.7.2 "Outputs"

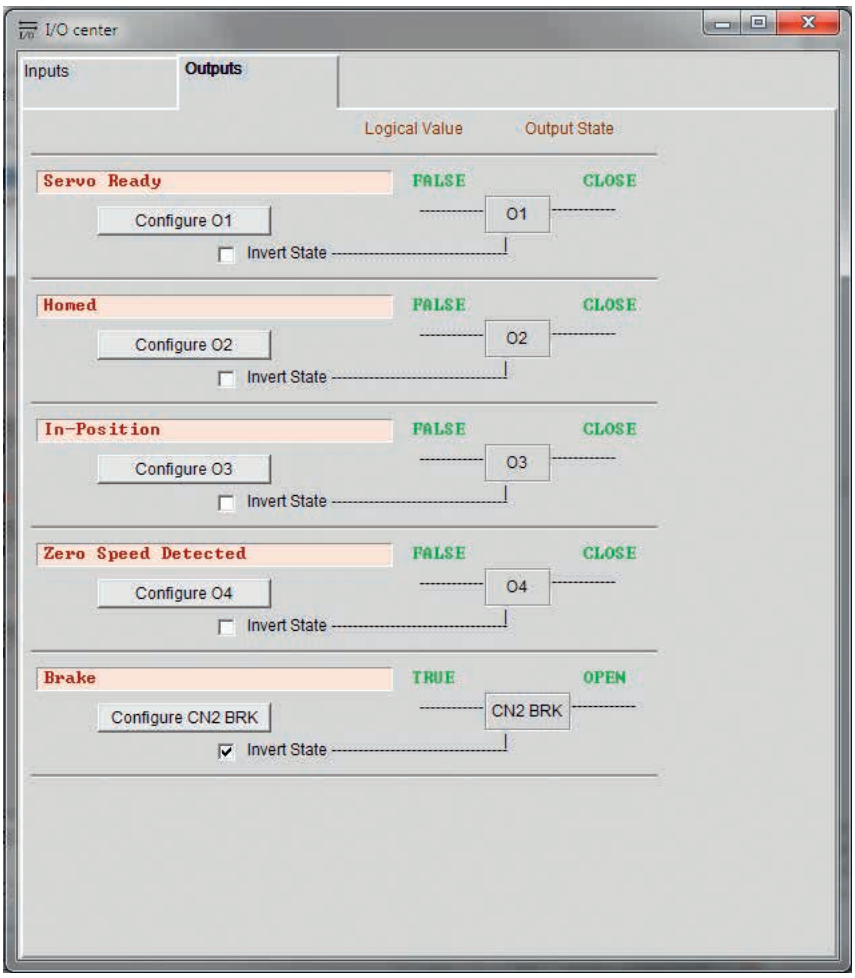


Fig. 6.61 **"I/O center" – "Outputs"**

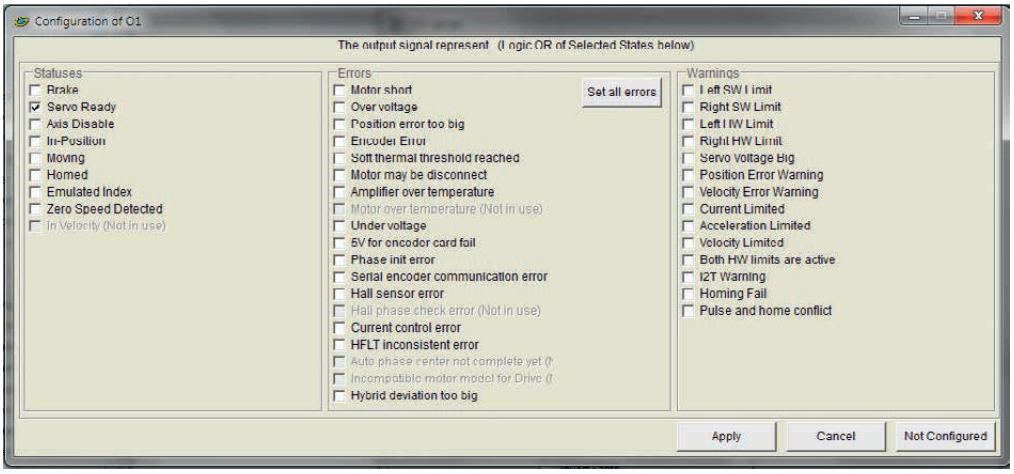


Fig. 6.62 **"I/O center" – "Configuration of Ox"**

6.8 Firmware update

⚠ CAUTION!

Danger of damage or injury due to uncontrolled movement!
If you undertake a firmware update while the motor is energised/moving, the drive amplifier immediately de-energises the motor. The motor is NOT decelerated by the drive amplifier.
- Before undertaking a firmware update, de-energise the motor.
- Note that the status of the digital inputs and outputs can change during the download.

A firmware update irrevocably deletes all existing data in the device. The parameters must be backed up! **NOTE**

The following process shows how new firmware is loaded in the D2.
- Open the **"Tools"** menu (see Section 6.3.2).
- Select **"Upgrade/Downgrade Firmware"** (see Fig. 6.63).
  The new window shows all firmware versions which are available and which version is currently stored in the device (see Fig. 6.64).
- Select new firmware and start process under File –> **"Update selected Firmware to amplifier"**.
- "Lightening" opens a new **"Backup parameters"** message window to produce a backup copy of the device parameters (see Fig. 6.66).
- Press **"Yes"** and save file (see Fig. 6.67).
- "Lightening" opens a new **"Update new Firmware to amplifier"** message window. Press **"OK"** button (see Fig. 6.68).
- "Lightening" opens a new **"Auto load programs"** window and indicates the progress using a blue progress bar (see Fig. 6.69).
- A new message window confirms that the firmware update has been successfully completed (see Fig. 6.70).
- Note **"Upgrade/Downgrade Firmware"** window to check (see Fig. 6.71).

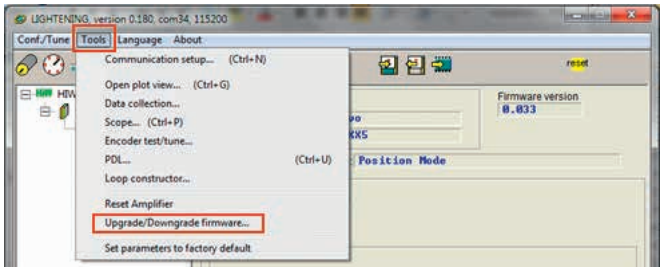


Fig. 6.63 **Menu "Tools" – "Upgrade/Downgrade firmware"**

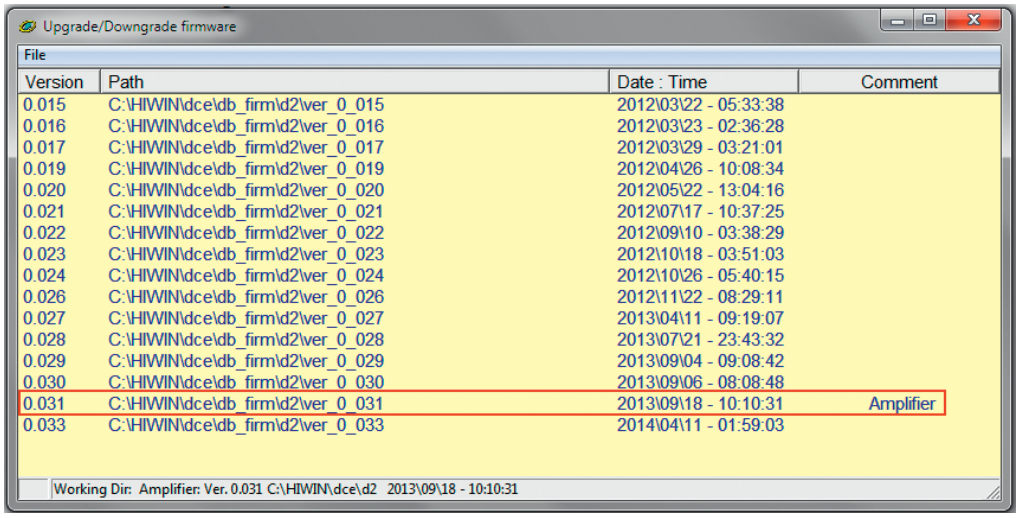


Fig. 6.64 **"Upgrade/Downgrade firmware" – current firmware in device**

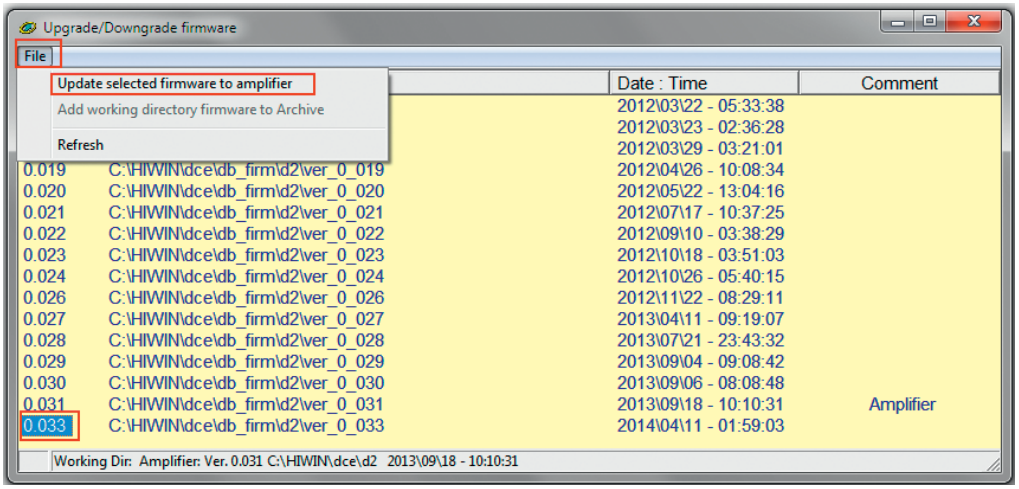


Fig. 6.65 **"Upgrade/Downgrade firmware" – "Upgrade selected firmware to amplifier"**

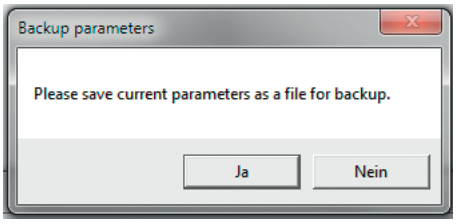


Fig. 6.66 **"Upgrade/Downgrade firmware" – "Backup parameters"**

Fig. 6.67 **"Upgrade/Downgrade Firmware" – save backup parameters**

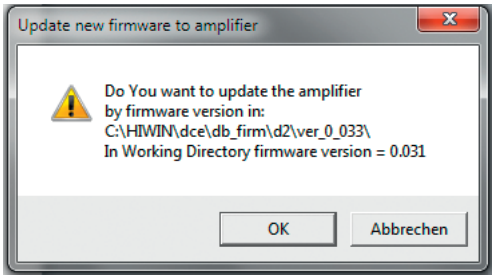


Fig. 6.68 **"Upgrade/Downgrade firmware" – "Update new firmware to amplifier"**

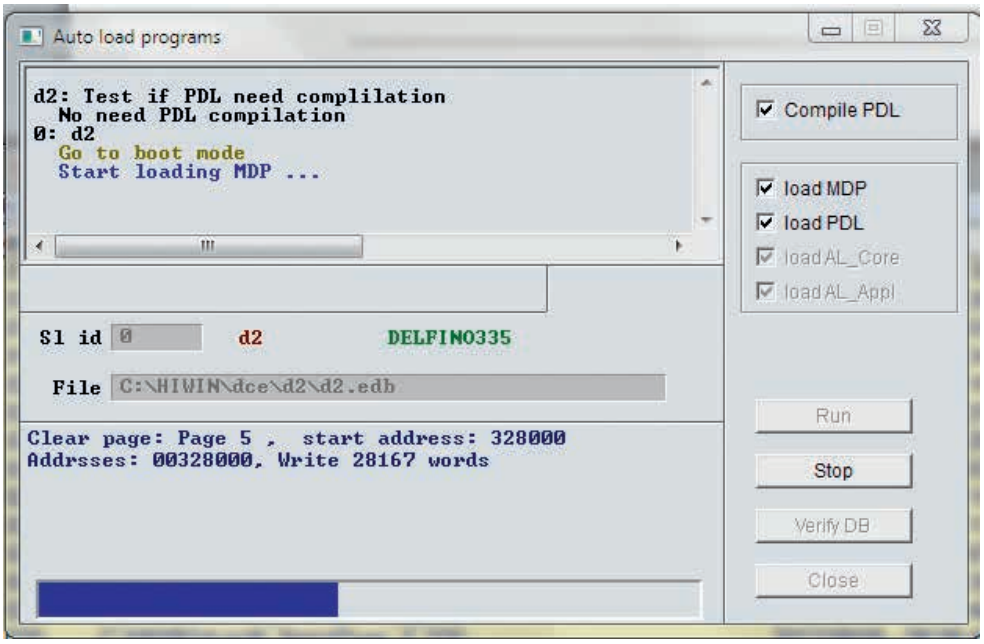


Fig. 6.69 **"Upgrade/Downgrade firmware" – "Auto load programs"**

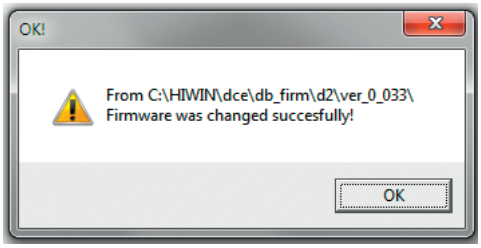


Fig. 6.70 **"Upgrade/Downgrade firmware" – "OK"**

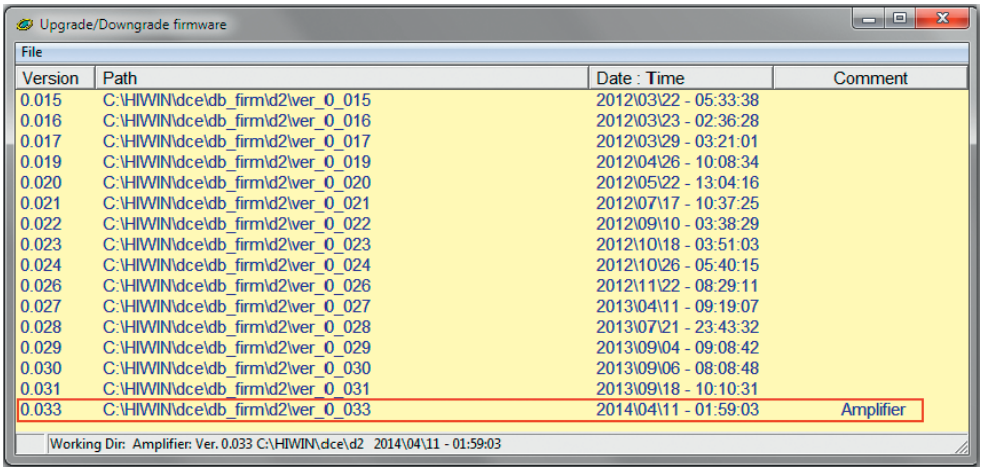


Fig. 6.71 **"Upgrade/Downgrade firmware" – check**

7. Commissioning

Once the parameters for the motor have been set as described in Section 6.4.1 commissioning can begin.

⚠ DANGER!

Danger from electrical voltage!

- The drive amplifiers should be de-energised before and during all assembly, disassembly or repair work. Ensure that no-one can reestablish the mains connection. Otherwise there is a risk of death and injury.
- Always ensure that the drive amplifiers are correctly earthed using the PE bar in the switch cabinet as reference potential. Safety is not guaranteed if there is no low-ohm earthing.
- Power connections may be live even if the motor is not moving. Never disconnect the electrical connections of motors and drive amplifiers when live. In the worst case scenario, electric arcs may form, causing personal injury and damage to contacts.
- After disconnecting the drive amplifiers from the supply voltages, wait at least five minutes before touching live parts (e.g. contacts, threaded bolts etc.) or breaking connections. For your own safety measure the voltage in the intermediate circuit and wait until it has fallen below 40 VDC.
- The drive amplifiers should always be operated in conjunction with appropriate safety equipment (zero contact protective equipment, mechanical protective equipment etc.). This protective equipment must be designed, installed and regularly checked in accordance with applicable national and international legislation and specifications.

⚠ WARNING!

Risk of burns!

The surface of the drive amplifier may reach temperatures in excess of 50 °C. There is therefore a risk of burns. The housing must not be touched during or shortly after operation.

- Leave the drive amplifier to cool for at least 15 minutes after switching off.

⚠ WARNING!

Risk of serious injury or death due to uncontrolled movement of motors and machine parts!

Uncontrolled movement of motors and machine parts during installation and during operation can occur after a not defined period of time. Potential causes of uncontrolled movements may be:

- Damaged or defective components
- Incorrect parameterization of the drive
- Error in the software or firmware
- Incorrect handling of the software
- Wiring error
- Manipulation or modification of the wiring during operation
- Signal failure of encoders
- Exceeding the permissible payload of the motor

- Keep out of the dangerous zone of moving machine parts.
- Stop all motor movements safely before entering the dangerous zone.
- Protect the danger zone against unauthorised access.

ATTENTION!

Damage to the drive amplifier!

- Discharge your body before you touch the drive amplifier.
- Avoid contact with highly insulating materials (plastic fibres, plastic films etc.). Place the drive amplifier on a conductive surface. The drive amplifiers contain components at risk from electrostatic which may be damaged if handled incorrectly.

7.1 Commissioning

Overview of basic commissioning steps:

- Check motor encoder connection
- Disconnect motor cable
- Switch on device
- Enter motor and encoder parameters
- Check function of distance measuring system
- Permanently save settings (save in flash memory)
- De-energise device
- Connect motor cable
- Switch on device
- Perform all steps of **"Auto tune center"**
- Perform test run at slow speed
- Optimise controller if need be.
- Permanently save settings (transfer into flash)
- If test run is completed successfully, run test under usage conditions

To begin commissioning the motor, start the **"Auto tune center"**.

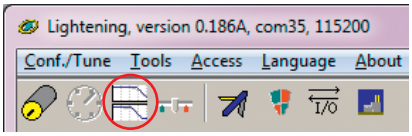


Fig. 7.1 **Launching "Auto tune center"**

7.2 "Auto tune center"

⚠ CAUTION!

Danger of uncontrolled motor movement due to uncorrected reversal of the motor phases or encoder counting direction!

- The **"Auto tune center"** should be run each time the motor, encoder or their cables are replaced. Should the motor phases or encoder counting direction have reversed without you noticing, incorrect cabling is automatically corrected.

NOTE

The "Auto tune center" is only needed when commissioning for the first time.

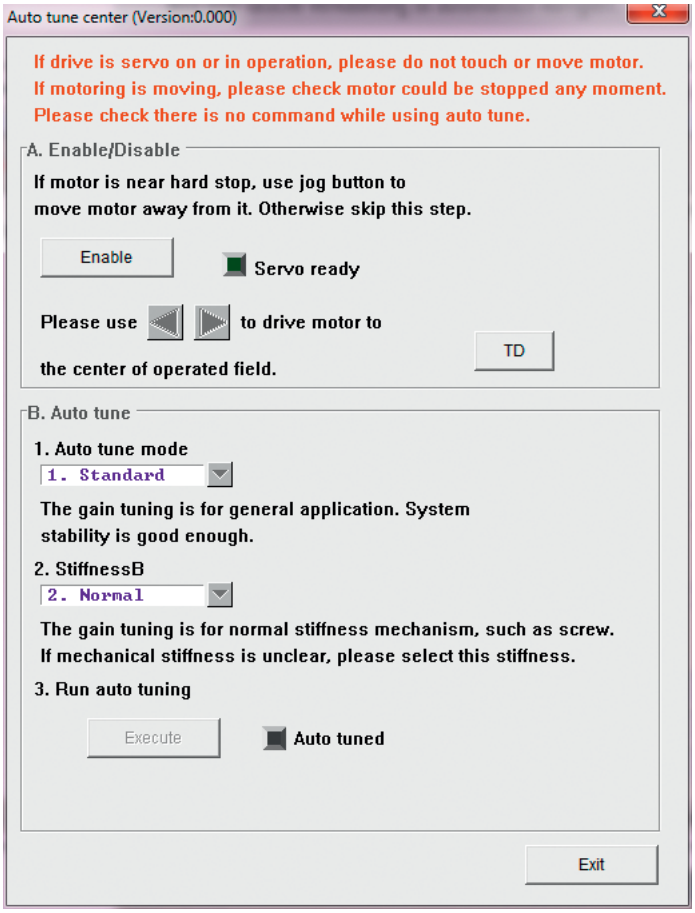


Fig. 7.2 **"Auto tune center"**

- Press **"Enable"** button.

The motor is energised in the following step.

NOTE

- Check whether the drive can move freely. With the green arrow buttons the motor can be moved to a free position.

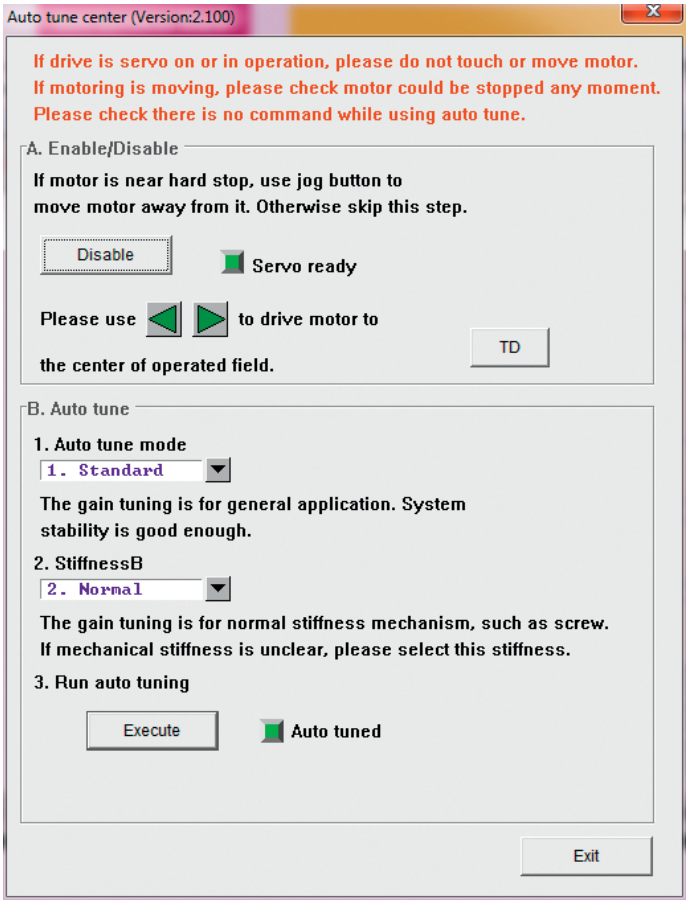


Fig. 7.3 **Energising the motor**

- Press **"Execute"** button.

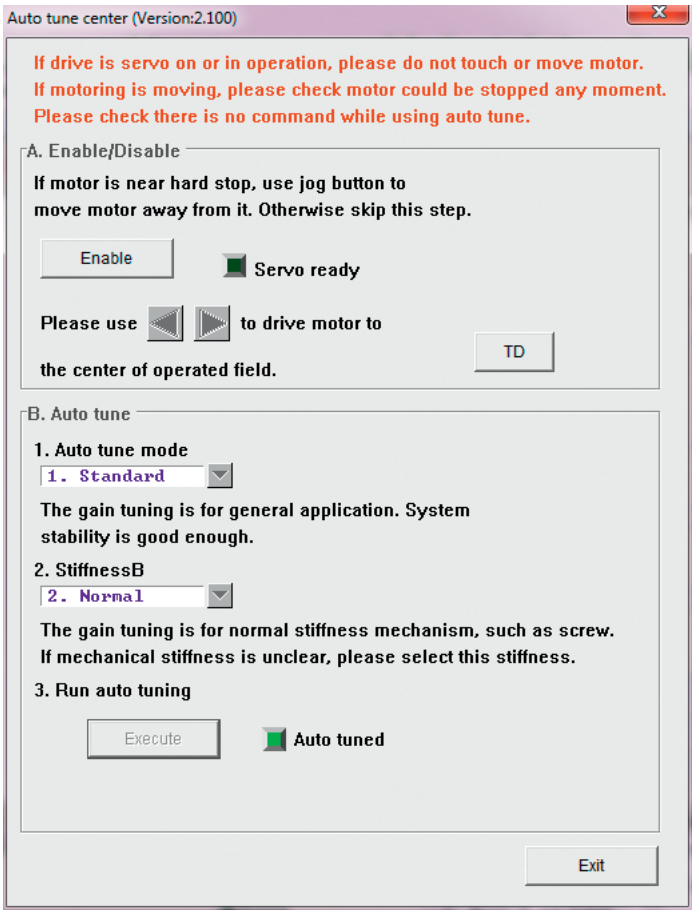


Fig. 7.4 **Automatic adaptation of controller parameters**

The D2 drive amplifier measures the system's mass inertia and minimises the position error

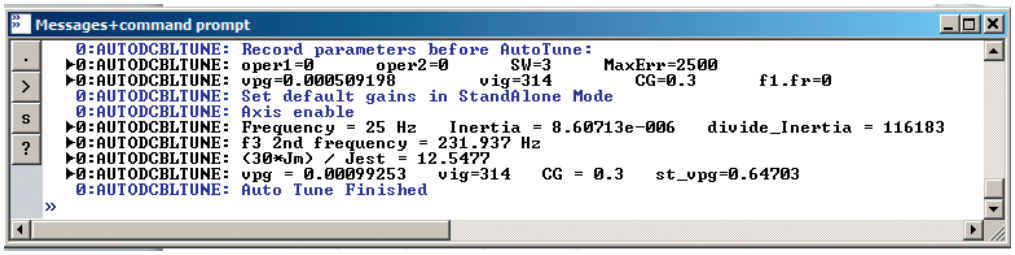


Fig. 7.5 **Auto-tuning, visualisation via terminal in "Performance center" (see Section 7.3)**

7.3 "Performance center" – optimisation of control parameters

In the **"Performance center"** you can move your motor/axis in a controlled manner in manual mode using defined parameters. Continuous travel between two points is also possible.
To launch the **"Performance center"**, go to the main screen in the "Lightening" software and click on the "**Performance center"** button or launch it from the **"Conf./Tune"** menu in "Lightening".

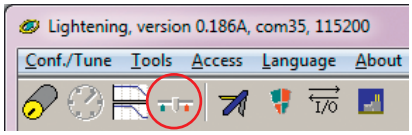


Fig. 7.6 **Launching the "Performance center"**

7.3.1 Main interface functions

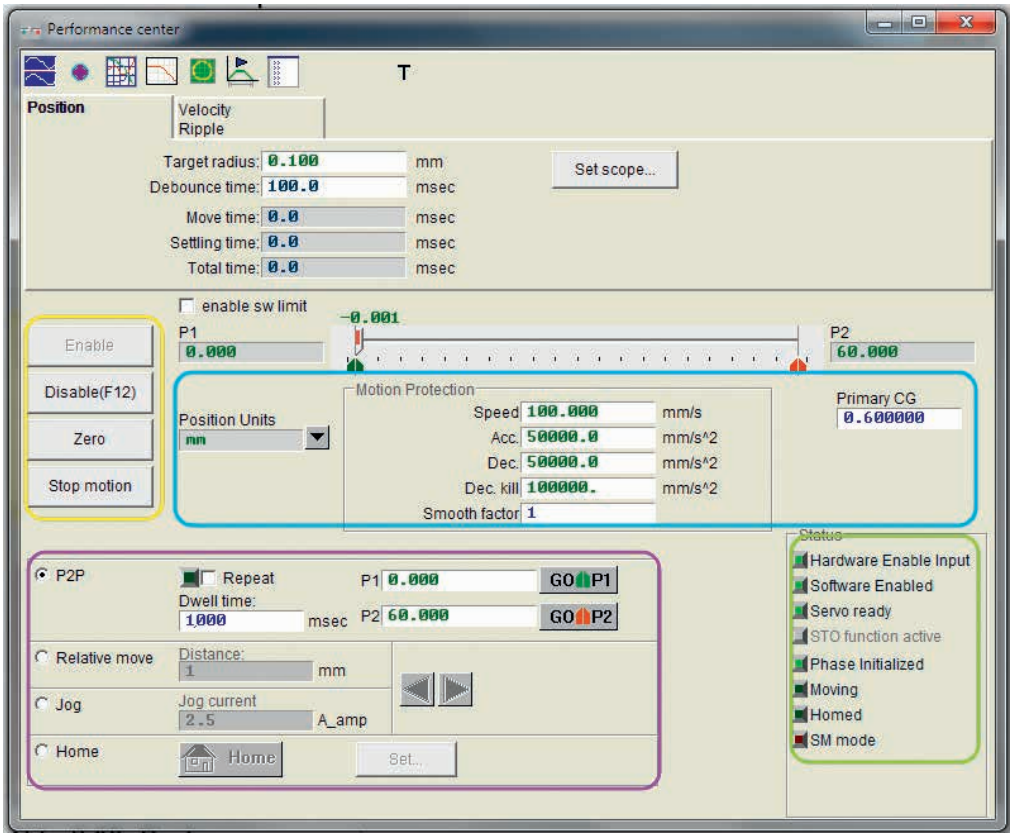


Fig. 7.7 **Operating interface of the "Performance center"**

1. Buttons (Yellow frame)

- **Enable:** Software controller enable. If **"HW enable"** and **"Enable"** are active, the motor is energised
- **Disable (F12):** Software controller enable is deactivated
- **Zero:** Sets the current position to 0
- **Stop motion:** Stops the current movement immediately. Motor remains subject to control and can be moved further using another motion command

2. Status (green frame)

- **HW Enable:** **"Hardware enable"** is active
- **SW Enable:** **"Software Enable"** is active
- **Servo ready:** Motor is subject to control and is ready
- **Phase Initial.:** Motor has commutated
- **Moving:** Motor is in motion (is 1 for as long as the nominal speed is not 0)
- **Homed:** Motor/axis is referenced to the reference point
- **SM mode:** Motor is energised in stepper mode (not subject to control)

3. Motion data (blue frame)

- **Position Units:** Defines the units in which all values are entered and displayed
- **Speed:** Traversing speed
- **Acc.:** Acceleration
- **Dec.:** Delay
- **Dec. kill:** Delay for emergency stop
- **Smooth factor:** Defines the jerk limitation. 1 means maximum jerk. Higher values result in a gentler start
- **Common Gain:** Amplification factor which impacts on the **"Settling time"** and position errors. Must be adapted depending on application and load

4. Moving motor (purple frame)

NOTE

The positions and spacing are entered in the unit selected under "Position Units".

- **P2P:** Motor continually moves this way and that between position P1 and position P2. Pause between the movements can be defined under **"Dwell time"**
- **Relative move:** Motor moves away from current position by **"Distance"**
- **Jog:** The motor can be moved positively and negatively with the two buttons. The motor moves for as long as the button is pressed
- **Home:** Starts homing

7.4 First travel subject to control

⚠ CAUTION!

Danger of damage or injury due to unexpected movement!
The motor is now energised and will commutate if this has not already been done. Depending on its position, it may jerk a little.
▶ Before energising the motor make sure, that the drive can move freely!

Under **"Position Units"** define a unit which is appropriate for your application. Enter realistic values and start with lower values for **"Speed"**, **"Acc"**, **"Dec"** and **"Dec. Kill"**.
Now start the control process by clicking on the **"Enable"** button.

Now check whether the motor can be moved. To do this, go to **"Jog"** mode and move the motor with the green arrow buttons.

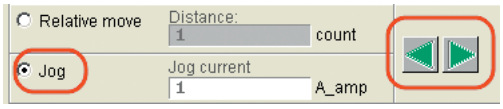


Fig. 7.8 **"Jog" mode**

Once the speed and acceleration have been tested in **"Jog"** mode, you can use the **"P2P"** function to keep the motor in permanent motion and test other parameters in the process.

Fig. 7.9 **Point-to-point movement ("P2P")**

To keep the motor in continuous motion, tick **"Repeat"** and enter permissible positions for **"P1"** and **"P2"**. The motor is moved back and forth between these two positions and waits the time specified (**"Dwell time"**) each time a position is reached. Start the movement by clicking on the **"GO P1"** or **"GO P2"** button.

NOTE

While the motor is moving, if needed you can adapt parameters such as speed, acceleration and amplifications in order to test the impact of such changes.

7.4.1 "Debounce time" and "Target radius" in the "Performance center"

The **"Moving"** flag remains in place for as long as the speed is not 0. It switches to **"Low"** as soon as the speed reaches a value of 0.
The **"Debounce time"** is a counter and starts counting down (e.g. 100 ms to 0) as soon as the actual position is within the **"+/– Target radius"**.
The **"In Position"** flag is set to 1 as soon as the **"Debounce time"** has reached 0.

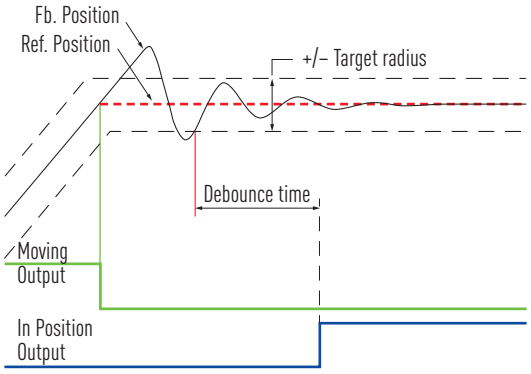


Fig. 7.10 **"Target radius" and "Debounce time"**

7.5 Using the "Scope" functions

The **"Scope"** function can be used to measure all important drive amplifier values and depict their course graphically. The software constantly accesses the current values from the drive.
To start the **"Scope"** function, simply click on the **"Set scope"** button in the **"Performance center"** (start **"Scope"** function with preset channels).
Alternatively, the **"Scope"** can be started from the quick-start bar.

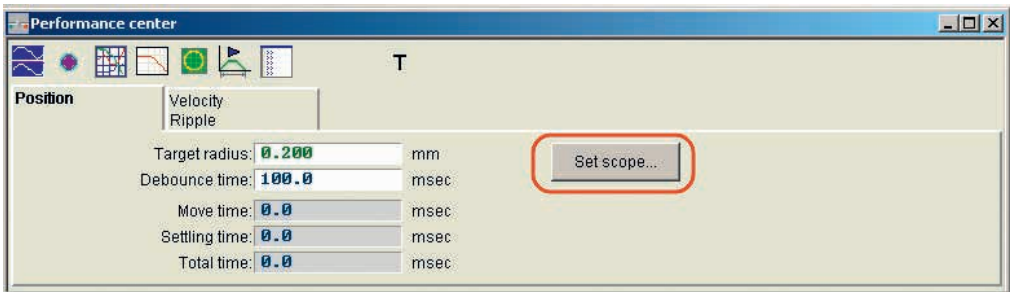


Fig. 7.11 **Starting "Scope"**

Once the **"Set scope"** button has been clicked on, the **"Scope"** area opens and 4 channels are set automatically:

- **"Position Error"**
- **"Feedback Velocity"**
- **"Reference Acceleration"**
- **"Feedback Position"**

You can also select other parameters for each channel and can set the relevant units for the display separately.

NOTE

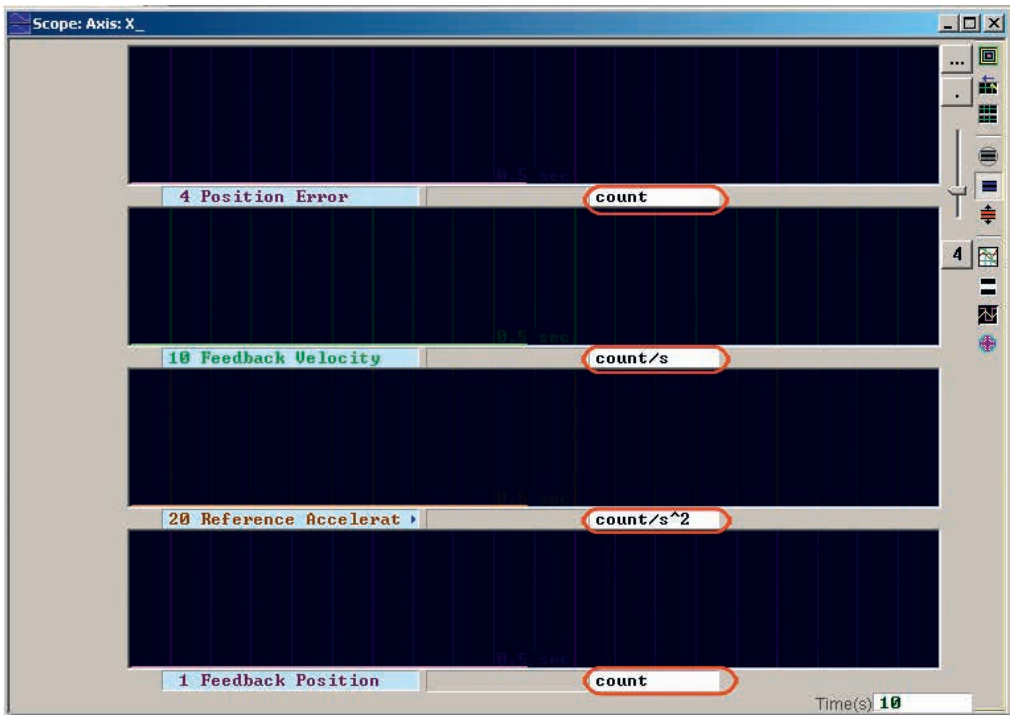


Fig. 7.12 **"Scope"**

The **"Scope"** is operated using the elements arranged along the right hand edge of the screen:

- Switch **"Scope"** on/off
- **"Continuous paper"** depiction mode
- Full-screen mode for one channel. Press several times to switch between the active channels
- Adapt Y-axis scaling to window size
- Adapt Y-axis scaling dynamically to window size
- Adapt Y-axis scaling dynamically to window size, but only in the direction of larger values
- Start **"Plot view"**
- Reset **"Scope"** and delete current measurement curves
- Display all curves in a window
- Start **"Data collection"** tool
- Select preset input variables
- Toggle the **"Always to the fore"** view
- Change number of channels

- The grid intensity can be set using the slider
- The time for the recording is set in the **"Time"** field in the bottom right of the screen

The **"Plot view"** function is provided for more detailed analysis of curve progress. This tool does not work continuously like the **"Scope"** function but is used to analyse the curves recorded in the **"Scope"** or with the **"Data Collector"** (Record Window) at a later point.
This tool also allows you to save and print recorded curves. To save and print, open the **"File"** menu and select the desired option. You can save the curve as both an image and in raw data format.
Start **"Plot view"** using the corresponding button in the **"Scope"** function tool bar or via the **"Tools"** menu in the "Lightening" interface.

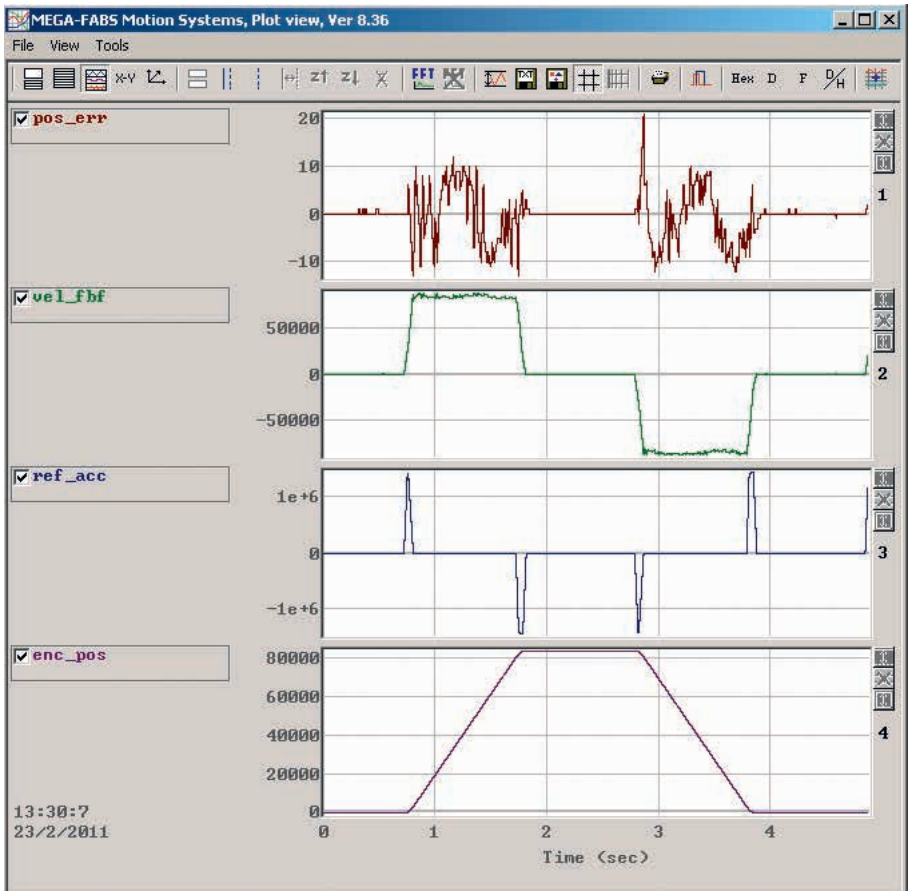


Fig. 7.13 **"Plot view"**

Example of a curve analysis:
Analysis of position error (**"pos_err"**). Measuring of minimum and maximum and FFT analysis:
To analyse a curve, we would advise only displaying one single curve so that as many details as possible can be seen. Do this using the **"Set show mode"** button in the tool bar. Then select **"only Graph 'X'"** where **'X'** is the channel that you want to look at in more detail. You can also use the left and right mouse buttons to place cursors to define the area to be analysed. You can then use the **"Zoom the area between cursors"** button to zoom into the selected section.

Fig. 7.14 **Operating the "Plot view" cursors**

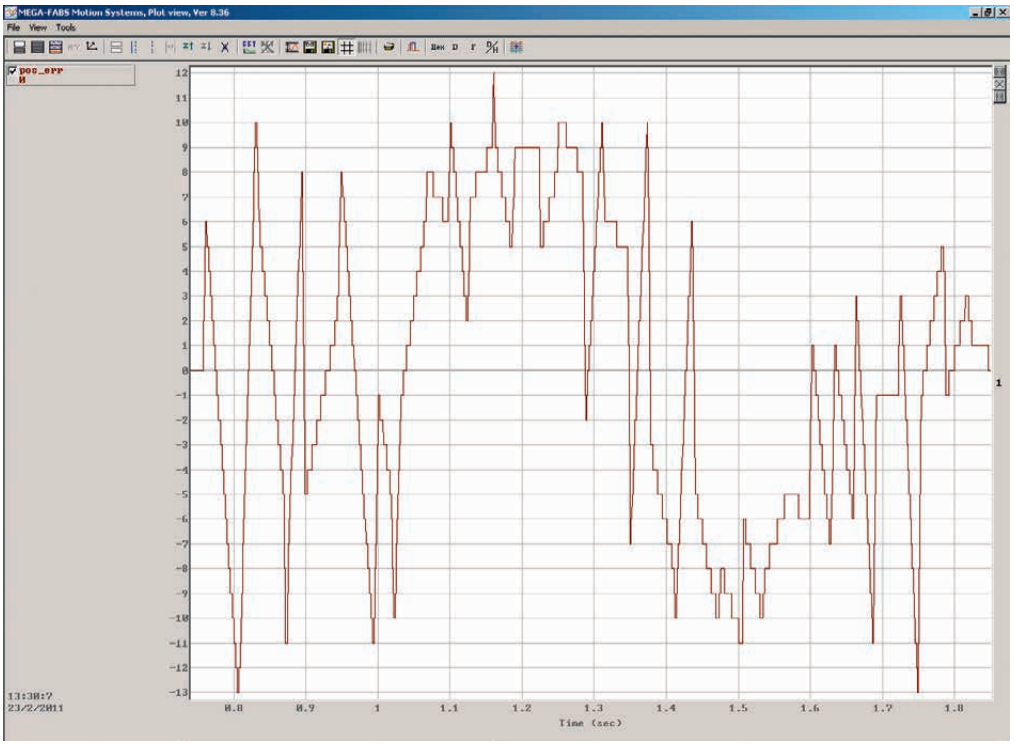


Fig. 7.15 **Enlarged area**

The **"Statistics table"** button in the tool bar for the **"Plot view"** tool allows you to automatically display the characteristics of the selected area.

Fig. 7.16 **Starting the "Statistics table"**

The **"Plot statistic"** now automatically shows you the maximum and minimum for the section displayed.

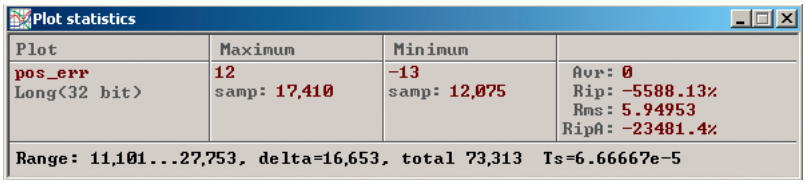


Fig. 7.17 **"Statistics table"**

The FFT analysis allows you to determine the frequency elements occurring in a recorded curve. To perform an FFT analysis, click on the **"FFT"** button in the tool bar for the **"Plot view"** tool.

Fig. 7.18 **Starting "FFT"**

In the new window, first select the curve that you want to analyse – in this case, the position error. Select the **"Direct FFT"** method and press the **"Run FFT"** button to start the process.

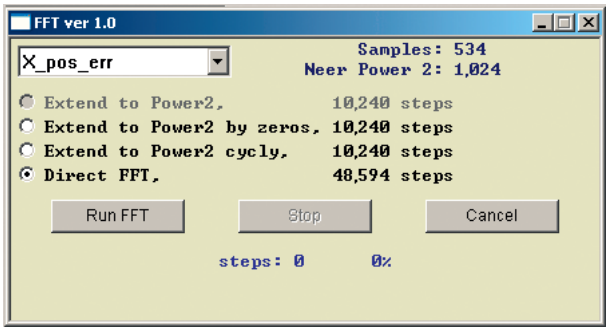


Fig. 7.19 **Setting up the FFT analysis**

The **"Plot view"** tool now no longer shows the curve progress but the calculated frequency spectrum of the FFT analysis. The proportion of all frequency elements can be seen here.

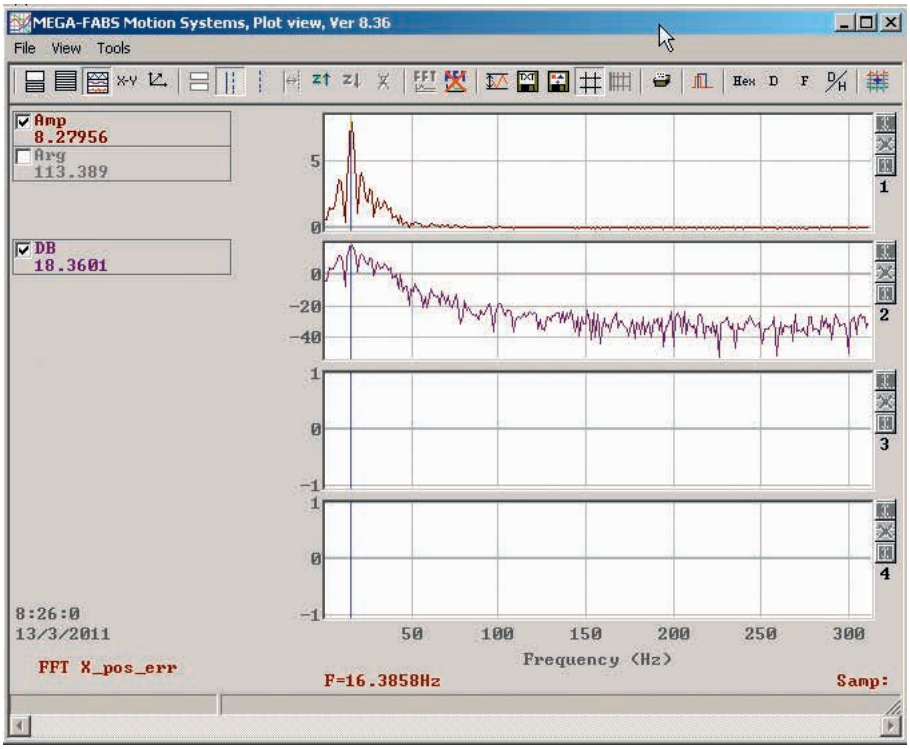


Fig. 7.20 **Result of the FFT analysis**

The **"Scope"** function also provides a function for recording value trends and then displaying them with **"Plot view"**. Access this function using the **"Open record window"** button in the scope tool bar or via the **"Tools"** menu in the "Lightening" interface.
Use **"Samples"** to define the number of measurements which are to be recorded. **"Rate"** defines the sampling rate with which the values are recorded. At the same time, these two values determine the recording period. The recording time resulting from **"Samples"** and your chosen **"Rate"** is displayed in the two fields under **"samples*dt ="**. Enter the variables that you want to record in the text boxes under **"Variables to be recorded"**. Start the recording with the **F5** button or click on **"Start"**. You can stop the recording prematurely at any time by pressing the **"Stop"** button. To display the values recorded directly, click on the **"Graph"** button and the current measurements are depicted in **"Plot view"**.

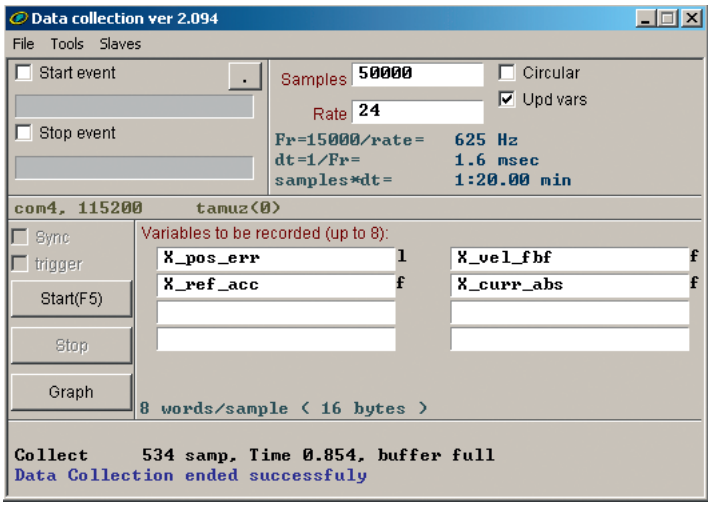


Fig. 7.21 **"Record Window"**

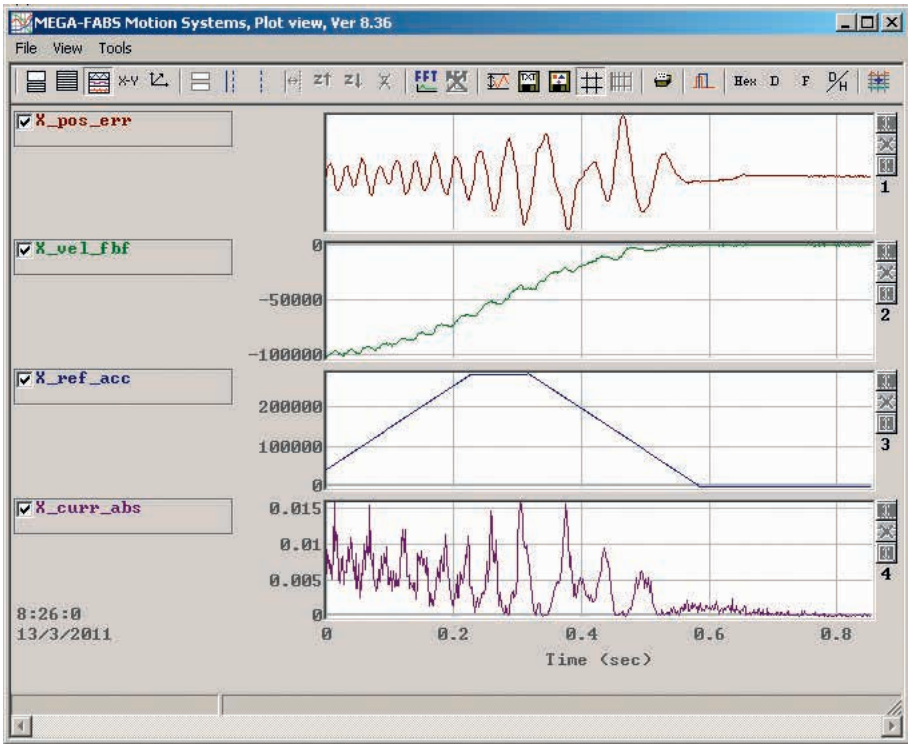


Fig. 7.22 **Curves recorded**

7.6 Controller tuning

To optimise the control parameters, **"Scope"** is used in conjunction with a continuous point-to-point movement. Fig. 7.23 shows the **"Scope"** recording of a motor displaying a position error of up to 2° during movement.
The motor was operated here with a **"Common Gain"** of 0.5.

Fig. 7.23 **"Scope" evaluation of point-to-point movement**

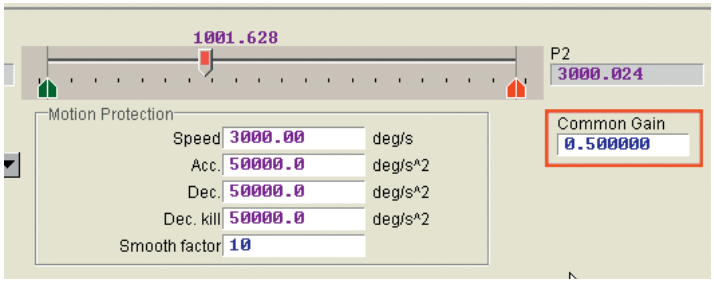


Fig. 7.24 **"Common Gain"**

Increasing the **"Common Gain"** makes control stricter. In this example, the position error is reduced significantly to approx. 0.7° once the **"Common Gain"** is increased to 0.8.

Fig. 7.25 **Position error after increasing the "Common Gain"**

The optimum value for the **"Common Gain"** is highly dependent on the motor used and its application. Proceed as shown above to establish the **"Common Gain"**. Use the **"Scope"** function to display the values of importance to your application (e.g. the **"Position error"**). Keep the motor moving and watch the values while gradually and slowly changing the **"Common Gain"** until you find the best possible motor behaviour.

7.7 "Advanced gains" – filter

The control parameters can be further optimised with **"Advanced gains"**. To undertake further fine tuning of the control circuit and to set filters, open the **"Advanced gains"** menu. Here you can filter frequency elements out of the control circuit and activate special controller functions. Open the **"Advanced gains"** window from the **"Conf./Tune"** menu in the main "Lightening" interface.

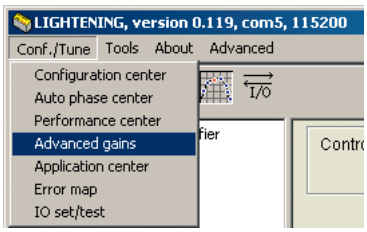


Fig. 7.26 **Opening the "Advanced gains" window**

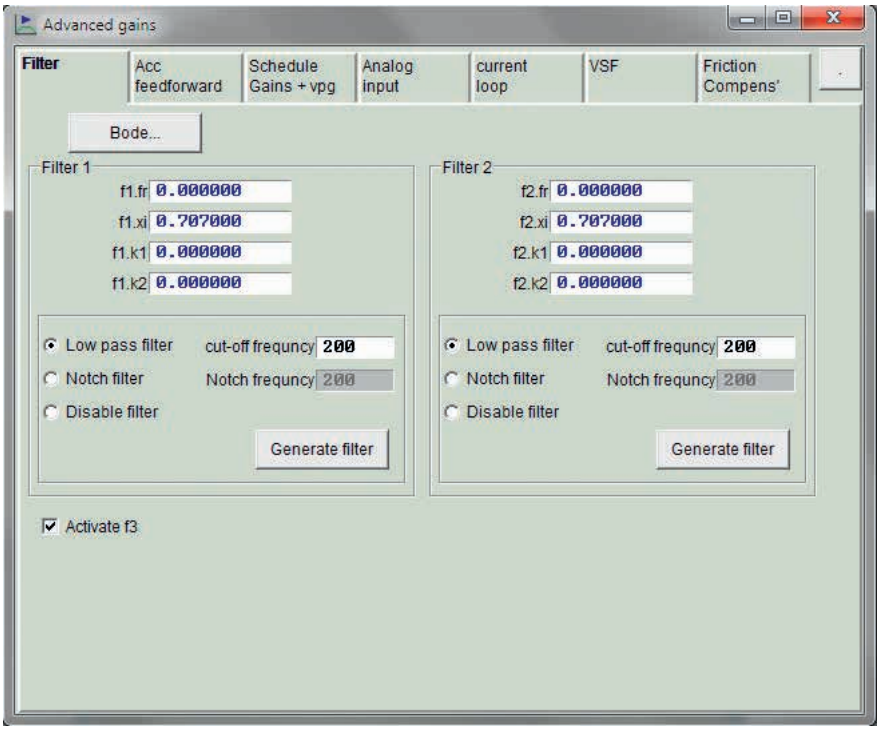


Fig. 7.27 **"Advanced gains"**

- **"Filter"** provides filter functions for frequencies or frequency ranges.
- **"Acc feedforward"** provides settings for the acceleration feedforward.
- **"Schedule Gains +vpg"** allows the amplification factor for the accelerator controller to be set manually.
- **"Analog Input"** contains functions for setting and evaluating the analogue input
- **"current loop"** provides settings for optimising the current controller.
- **"VSF"** (Vibration Suppression Function) provides active vibration suppression.
- **"Friction compensation"** is used to set the friction compensation.

7.7.1 Setting filters

Clicking on the **"Bode"** button opens a window for depicting the frequency response. The following settings apply for a typical low pass filter:

- **"Fr"**: Limit frequency in Hz, the default of 500 Hz is normally sufficient. Too low a value decreases the cut-off frequency and therefore the drive amplifier's bandwidth.
- **"xi"**: Damping, range of values between 0 and 1
- **"k1"**: 0
- **"k2"**: 0

The filter can either be entered using the framed filter **"assistant"** or directly. To activate the filter, click on the **"Generate filter"** button.

Further improvements cannot be gained at resonance frequencies below 250 Hz with a low pass filter. A notch filter is provided for pronounced frequencies.

7.7.2 "Advanced gains" – "Acc feedforward"

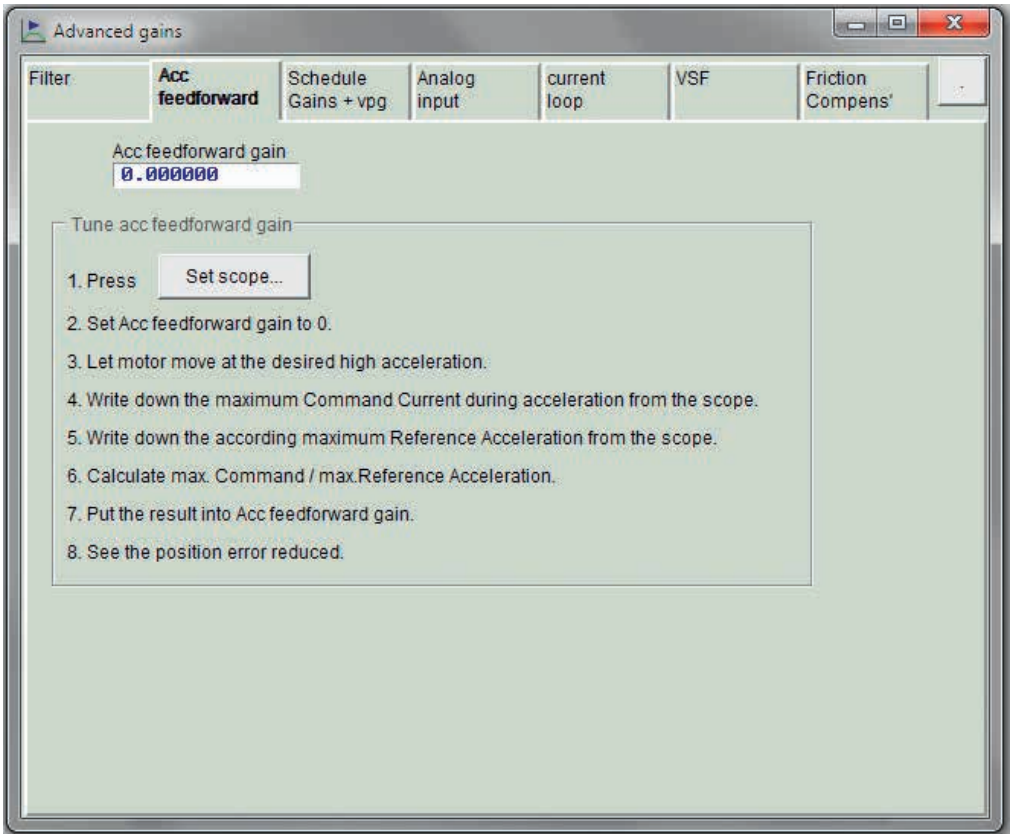


Fig. 7.28 **Setup of acceleration feedforward**

Proceed as follows to correctly set the feedforward.
First set the value for **"Acc feedforward gain"** to 0. Then start the **"Scope"** using the button in the window. Ensure that the motor performs the desired acceleration profile during the recording. The feedforward is calculated as follows:
"Acc feedforward gain" = "max Command"/"max ref. acceleration"
In the following example, the **"max Command"** is 17 and **"max ref acceleration"** 95,000
This produces a **"gain"** of 1.789e^{-4}.

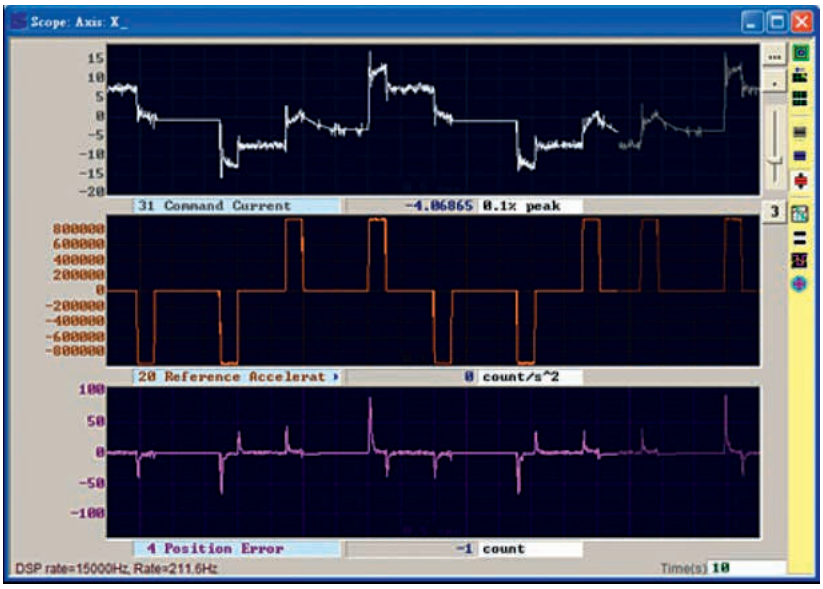


Fig. 7.29 **"Scope" for determining the acceleration feedforward**

The position error in the acceleration was reduced from 90 to 60 counts.

Fig. 7.30 **Result obtained with feedforward**

7.7.3 "Advanced gains" – "Schedule Gains + vpg"

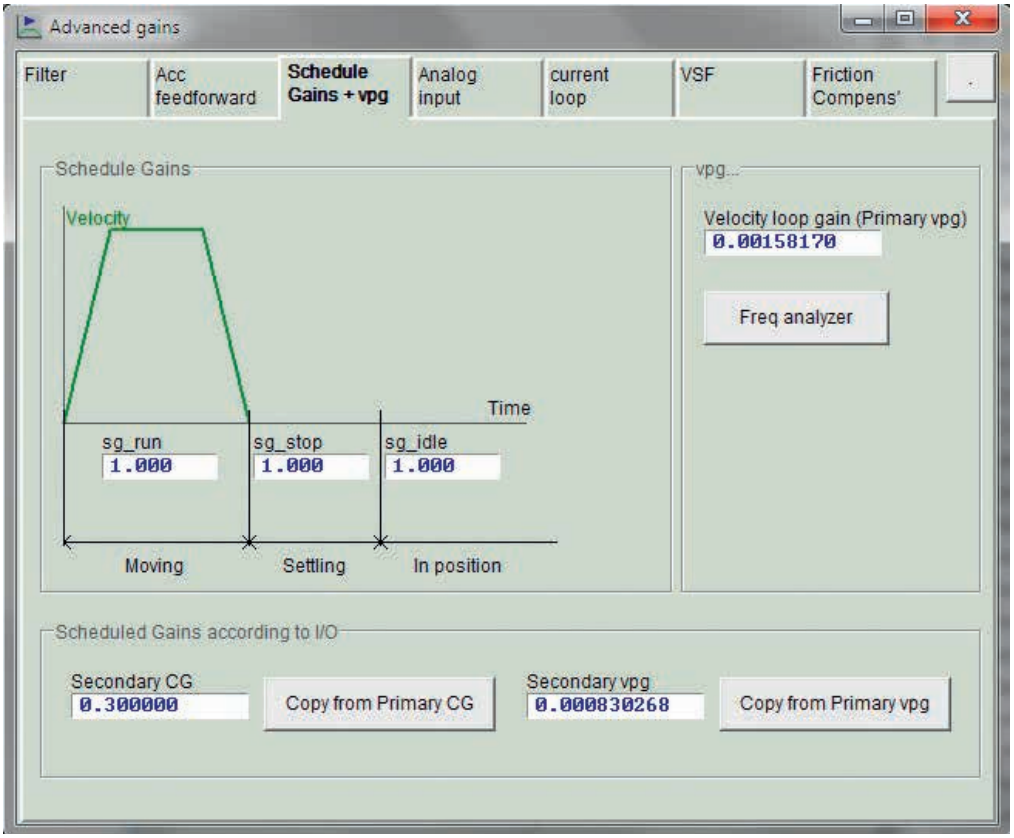


Fig. 7.31 **"Advanced gains" – "Schedule Gains + vpg"**

The D2 has what is known as a **"Common gain (CG)"** for speed and position controller amplification. The effect of this amplification can also be adapted in three sections of the motion profile:

- **"sg_run"**: Mainly when the drive is in motion (**"Moving"**)
- **"sg_stop"**: Mainly when the drive is in its settling time (**"Settling"**)
- **"sg_idle"**: Mainly when the drive is stationary in a position (**"In position"**)

The value entered is multiplied internally by the **"CG"**.

The **"vpg"** (Velocity proportional gain) was set automatically after the mass inertia measurement. This value is ideal when the load and friction don't change. However, if these parameters change, a second gain (**"Secondary CG"** and **"Secondary vpg"**) can be used to adjust the optimum controller amplification. A digital input must be assigned accordingly for the changeover.

7.7.4 "Advanced gains" – "Analog input"

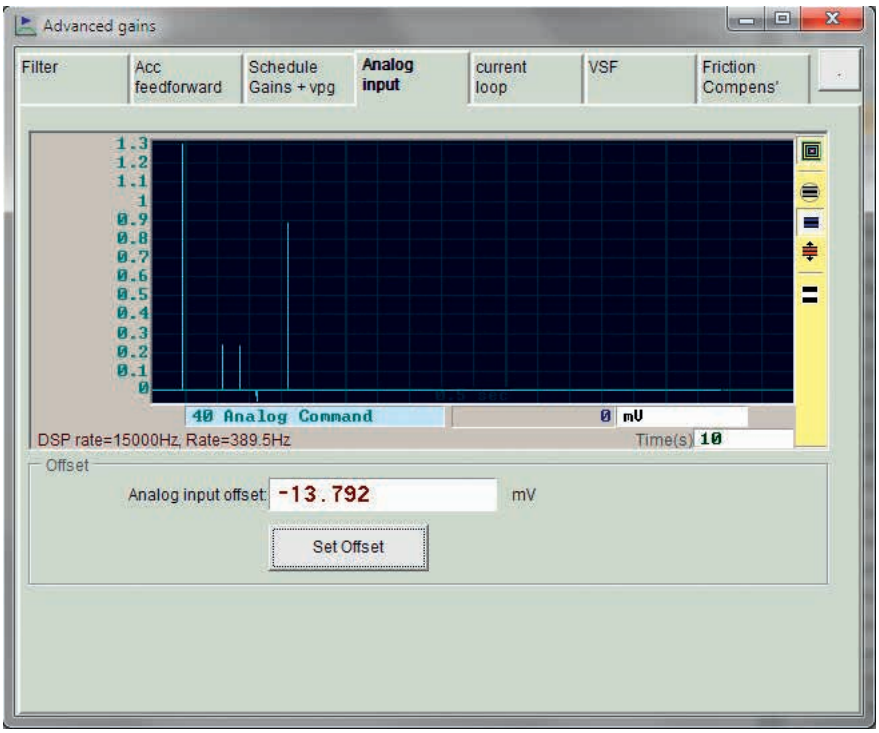


Fig. 7.32 **"Advanced gains" – "Analog input"**

If a nominal analogue value is used for speed or torque/force control, an offset correction can be undertaken.
If the voltage value at zero volts is not zero or is slightly unstable, the negative effect of this offset can be corrected by pressing the **"Set Offset"** button.

7.7.5 "Advanced gains" – "current loop"

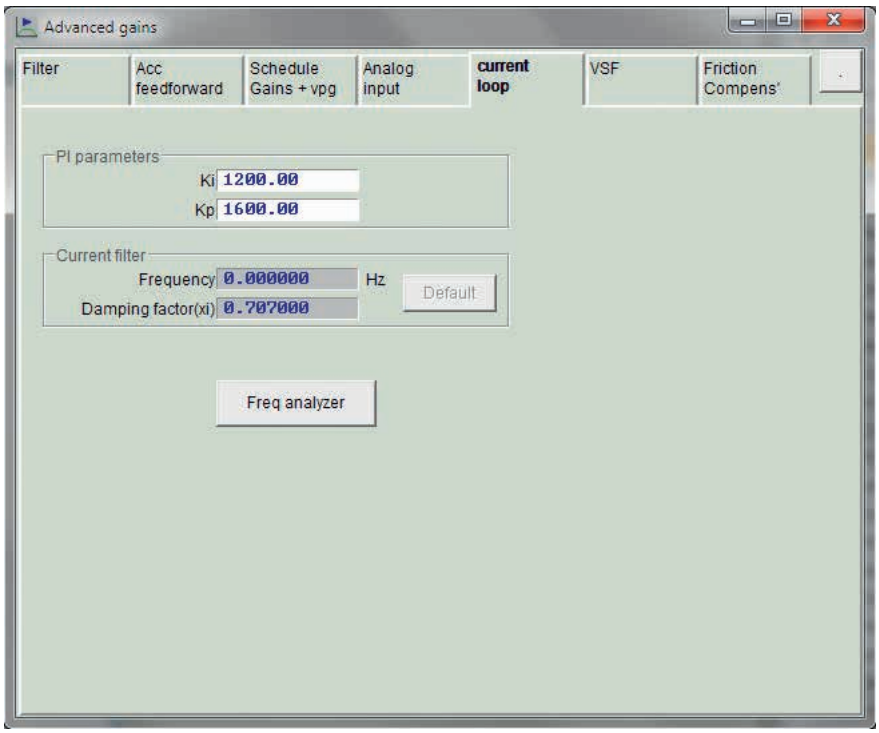


Fig. 7.33 **"Advanced gains" – "current loop"**

The drive amplifier calculates the amplification factors for the current loop using motor inductance and motor resistance. For most applications, these values do not have to be adapted. The **"Freq analyzer"** can be used to determine whether these values are ideal or require tuning. A low pass filter is used as the current filter to minimise motor noise. The standard filter has a cut-off frequency of 1,000 Hz.

7.7.6 "Advanced gains" – "VSF" (vibration suppression function)

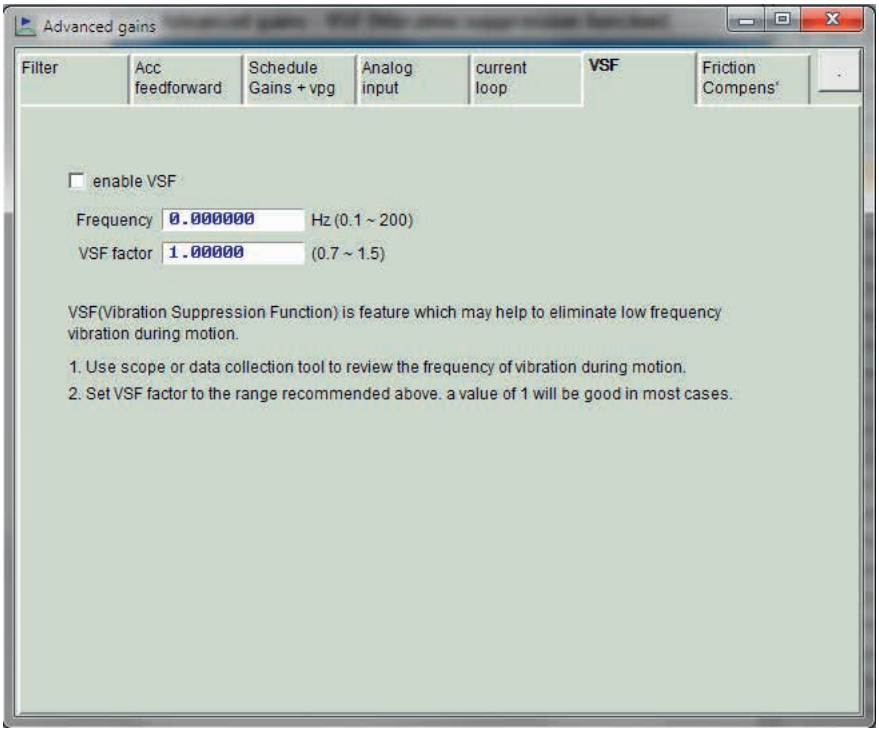


Fig. 7.34 **"Advanced gains" – "VSF"**

This function is used to filter low-frequency oscillation. The frequency in question can be determined with the **"Scope"** and/or **"Plot view"**.

7.7.7 "Advanced gains" – "Friction Compensation"

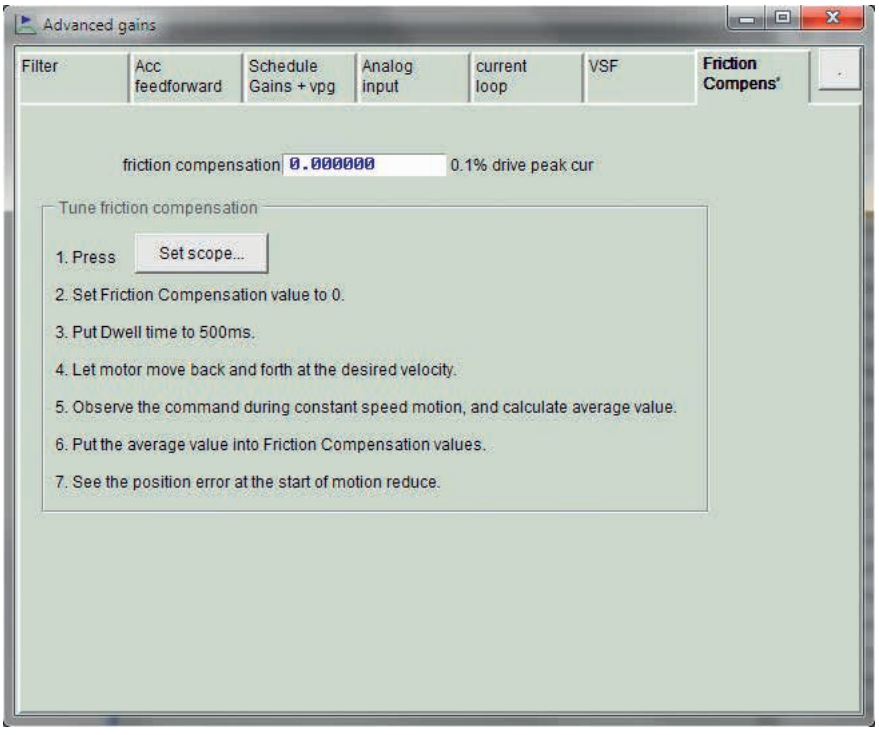


Fig. 7.35 **"Advanced gains" – "Friction Compensation"**

Before determining the appropriate value, set the start value to 0. Start the desired movement via the **"Performance center"** or specify the corresponding nominal values. Start the **"Scope"** by clicking on the **"Set scope"** button.

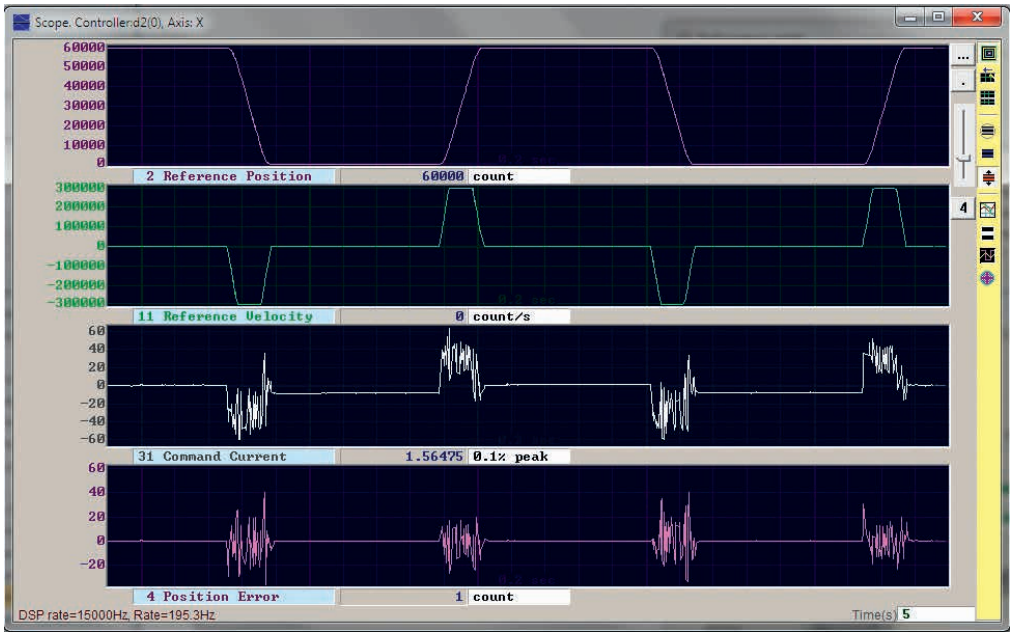


Fig. 7.36 **Recording current and position error**

Use the **"Plot view's"** statistics function to assess the position error and current.

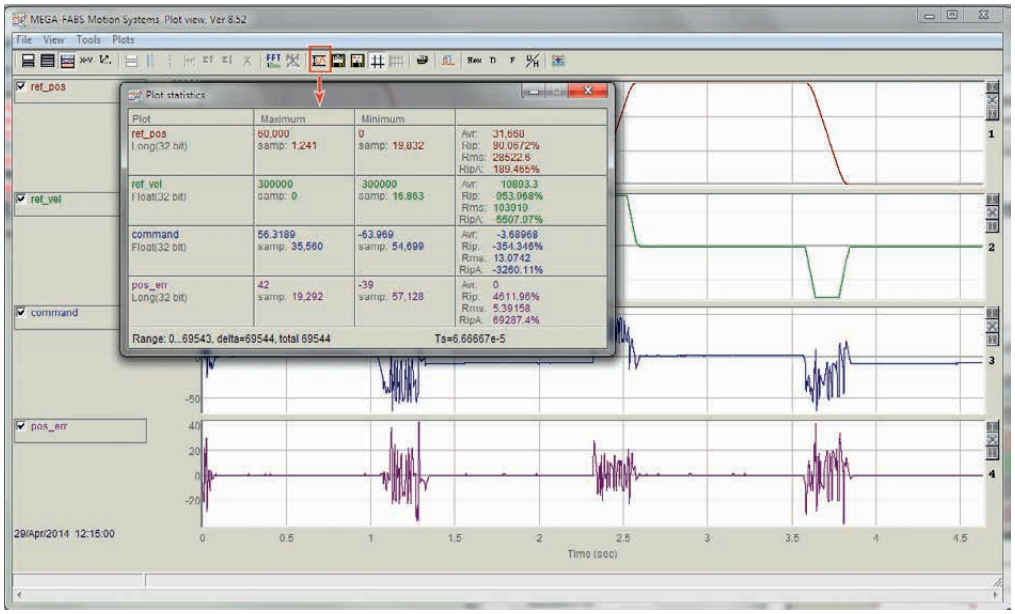


Fig. 7.37 **Assessing with "Plot view"**

Fig. 7.38 **Assessing current and position error**

Enter the command's **"Avr"** value in the field for friction compensation. You will see a reduction in the position error.

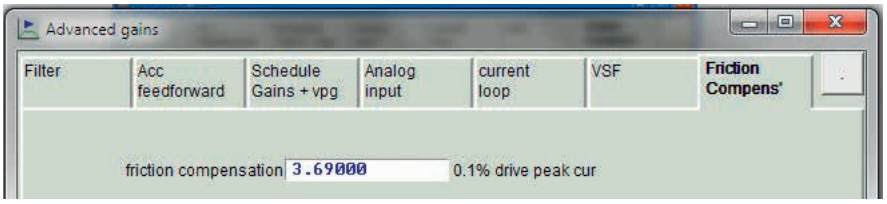


Fig. 7.39 **Entering the "command Avr" for friction compensation**

7.8 Error history

The "Lightening" software logs all errors and warnings since the drive amplifier's logic was last restarted. You can display the logged errors and error statistics using the **"Errors and Warnings Log"**. You can also save this log as a text file on your PC.

Please refer to Chapter 10 for the meaning of the individual errors and how to remedy them.

NOTE

You can start the **"Errors and Warnings Log"** from the main Lightning operating interface by going to the **"Conf./Tune"** menu item.

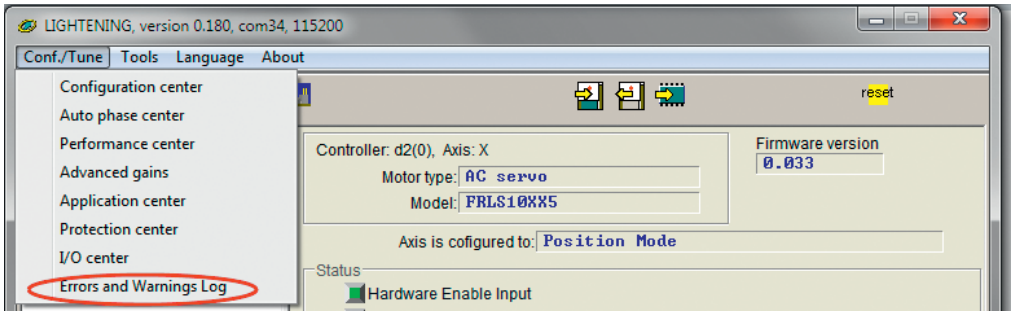


Fig. 7.40 **Starting "Errors and Warnings Log"**

The **"Errors and Warnings Log"** operating interface shows a list of all the errors which have occurred since the drive amplifier was last restarted. They are sorted in chronological order. The Time (seconds) column states at how many seconds after the device start the error occurred.

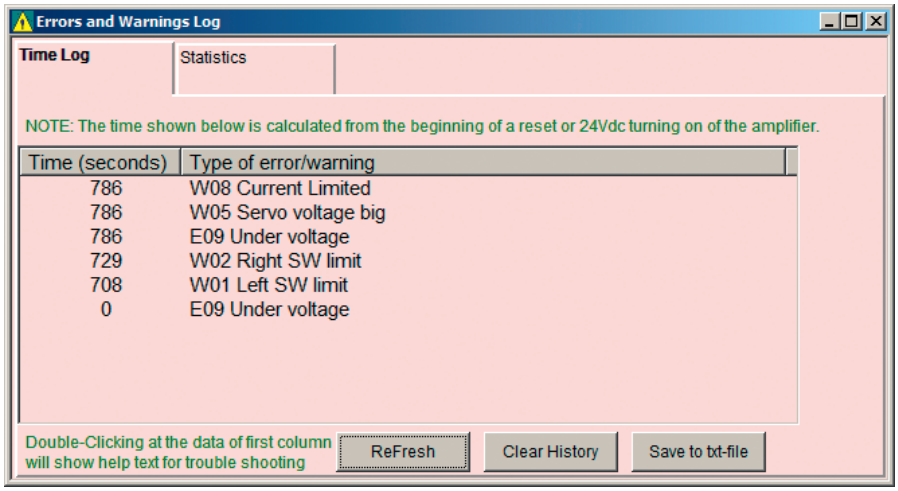


Fig. 7.41 **"Errors and Warnings Log"**

8. LCD display

This section looks at the LCD display which is integrated directly in the drive amplifier. The display shows the status of the amplifier and allows you to display and modify each parameter. Movements can also be initiated via the display.

8.1 Controls

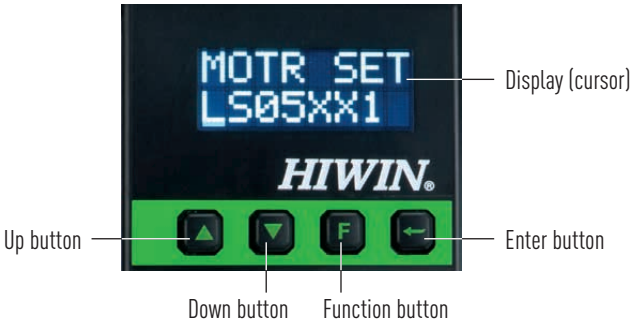


Fig. 8.1 **Display elements**

Table 8.1 **Overview features LCD display**

Name	Function
Display	Shows status and parameters
Up button	Selection and modification of parameters, JOG movement positive
Down button	Selection and modification of parameters, JOG movement negative
Function button	Mode change, start of parameter input
Enter button	Access to menu, confirmation of changed parameters
Cursor	Static cursor: Flashing underscore —> parameter can be edited; Dynamic cursor: Flashing field —> parameter being changed/jogging active No cursor: Display of parameters only

8.2 Displays modes

The display has four basic operating modes between which you can switch: Start page – Display parameters – Change parameters – Perform action.
You can switch between the modes by pressing the F button.

Start page: Displays the amplifier status, errors, warnings and the motor status
Display parameters: Displays the desired parameters.
Change parameters: Allows you to change the drive amplifier parameters.
Perform action: In this mode, you can switch the control function to inactive/active and move the motor in JOG mode and absolute terms.

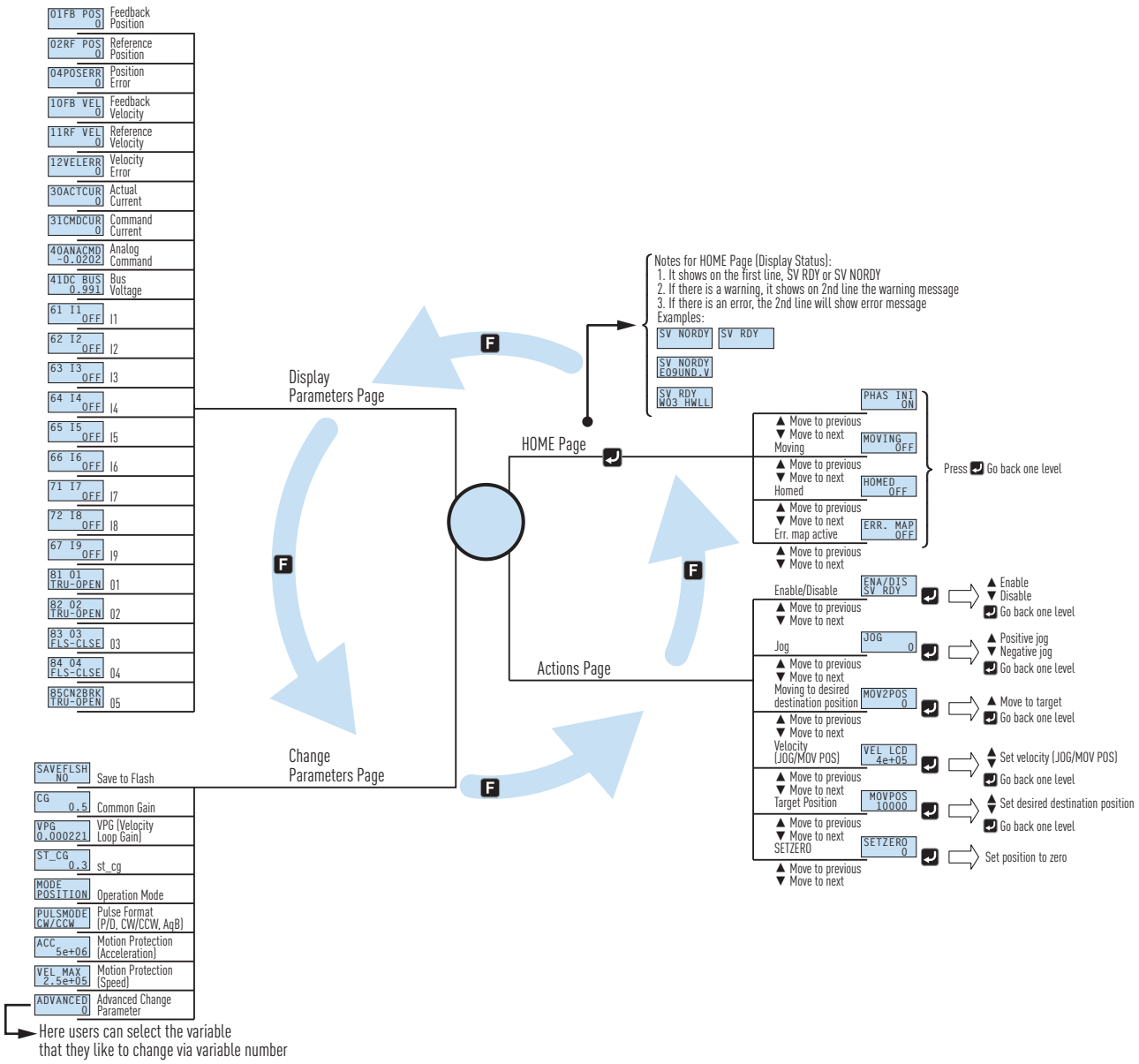


Fig. 8.2 **Function tree**

8.3 Start page

The first level always shows the current status and any errors and warnings.

NOTE

You will find the meaning of the error codes in chapter 10.

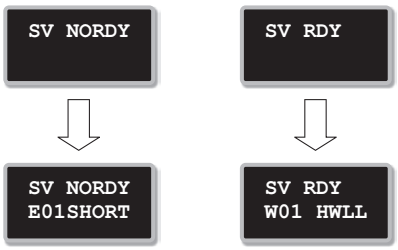


Fig. 8.3 **Status display on the LCD, errors and warnings**

Level 2 (reached by pressing the Enter button) shows more information about the status. You can return to level 1 at any time by again pressing the Enter button.

Table 8.2 **Overview display level 2**

Display	Meaning
PHAS INI	Status of motor commutation
MOVING	Motor moving
HOMED	Motor is homed
ERR. MAP	Error mapping

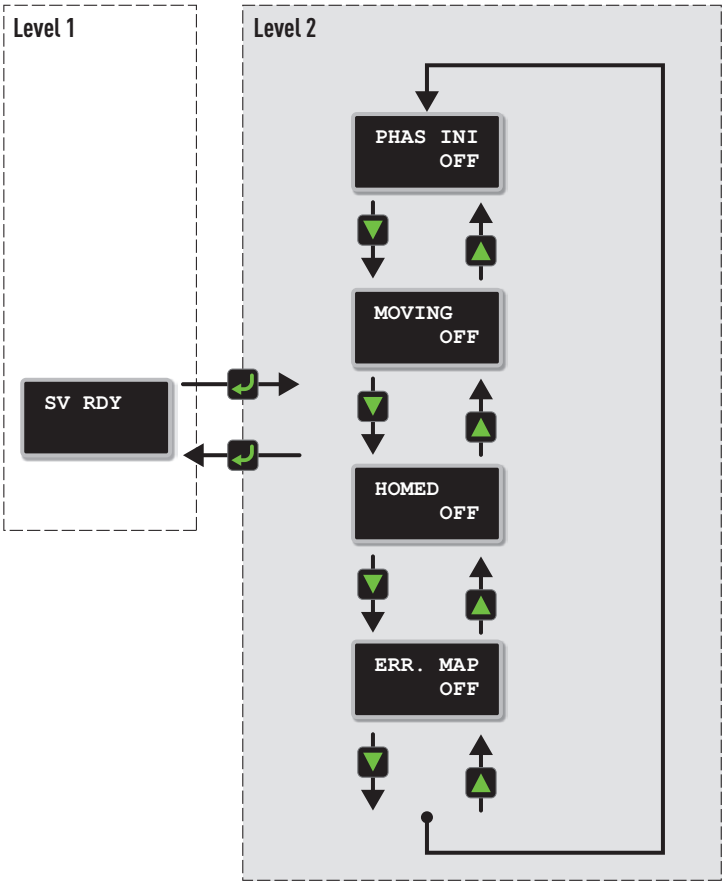


Fig. 8.4 **Navigation start pages**

8.4 Displaying parameters

In this mode you can display the drive's parameters on the display. If you are on the start page, go to the parameter display by pressing the F button once. The first line shows the parameter name and the second line the value of the relevant parameter. You can navigate through the individual parameters using the Up and Down buttons.

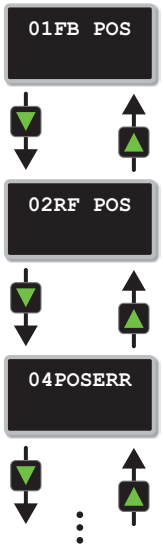


Fig. 8.5 **Display parameters**

Table 8.3 **Overview of display parameters**

Display	Variable	Description	Unit
01FB POS	Feedback position	Actual motor position	Counts
02RF POS	Reference position	Nominal motor position	Counts
04POSERR	Position error	Position error	Counts
10FB VEL	Feedback velocity	Actual motor speed	Counts/s
11RF VEL	Reference velocity	Nominal motor speed	Counts/s
12VELERR	Velocity error	Speed error	Counts/s
30ACTCUR	Actual current	Motor current	A_amp
31CMDCUR	Command current	Nominal motor current	A_amp
40ANACMD	Analogue command	Level of analogue input	Volt
41DC BUS	Bus voltage	Intermediate circuit voltage	Volt
61 I1	I1	Digital input 1	–
62 I2	I2	Digital input 2	–
63 I3	I3	Digital input 3	–
64 I4	I4	Digital input 4	–
65 I5	I5	Digital input 5	–
66 I6	I6	Digital input 6	–
71 I7	I9	Digital input 7	–
72 I8	I10	Digital input 8	–
67 I9	I11	Digital input 9	–
81 O1	O1	Digital output 1	–
82 O2	O2	Digital output 2	–
83 O3	O3	Digital output 3	–
84 O4	O4	Digital output 4	–
85 CN2BRK	CN2 BRK	Brake output status	–

You will find the status of outputs 01 to 04 below:

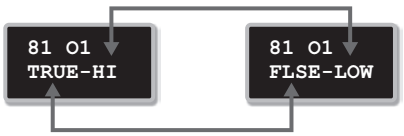


Fig. 8.6 **Display showing status of outputs 01 to 04**

Table 8.4 **Description of codes for status of outputs 01 to 04**

Code	Description
TRUE	Active
FLSE	Not active
HI	"High" voltage level
LOW	"Low" voltage level

8.5 Changing parameters

This page allows you to change parameters. You can reach this page from the start page by pressing the F button twice..

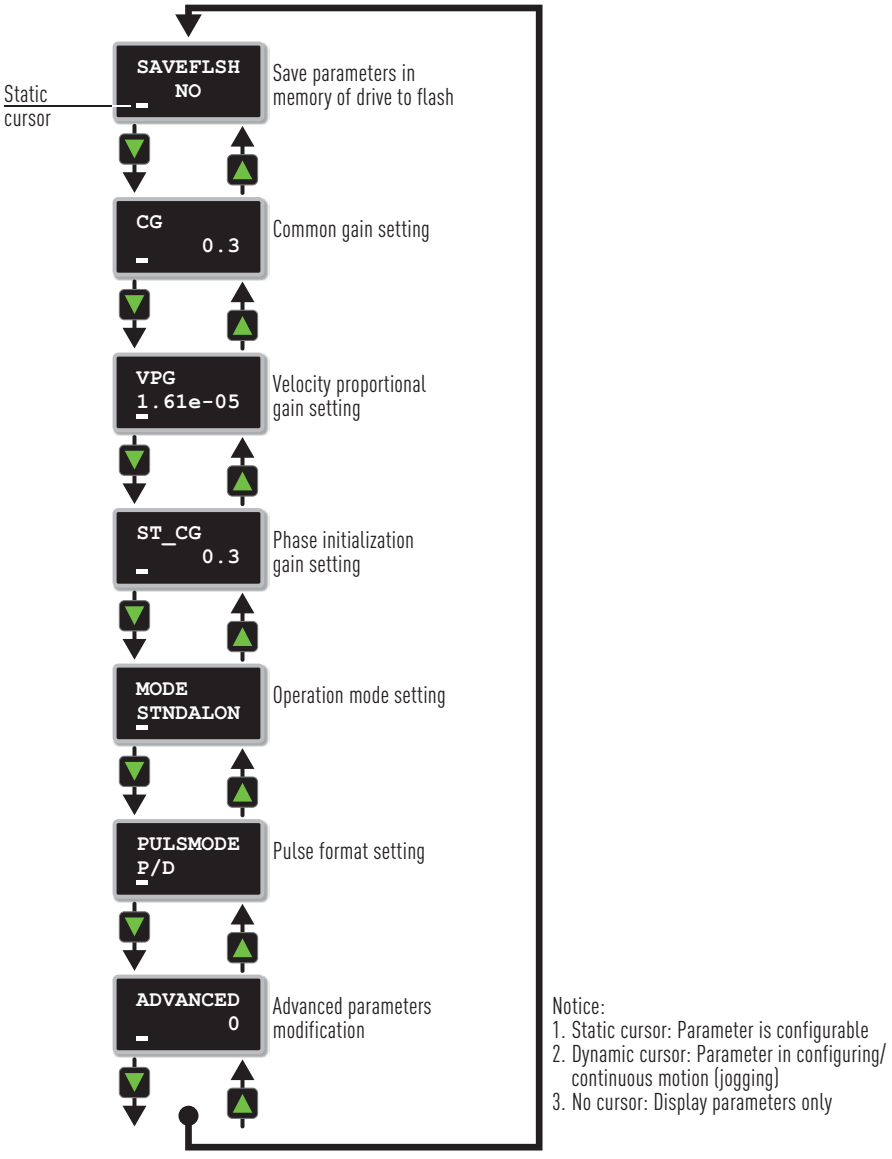


Fig. 8.7 **Changing parameters**

8.5.1 Saving parameters to flash

This section describes the process of saving new parameters to flash.

For the changes to be transferred to flash, the motor must be de-energised.

NOTE

- Press the Enter button to activate the **"SAVEFLSH"** entry (a flashing cursor appears in the bottom left)
- Press the Up or Down button to select **"YES"** or **"NO"**. **"YES"** saves the parameters to flash, **"NO"** saves the parameters to RAM. Select **"YES"** for the next step. Press the Enter button to confirm your choice.
- If the drive amplifier is not subject to control (**"DISABLED"**), the process is carried out and the display shows the level of progress. If the drive amplifier is subject to control (**"ENABLE"**), an error message is shown (**"DO DISBL"**) and the parameters are not written to flash. To save parameter to flash, the amplifier must be **"DISABLED"**.

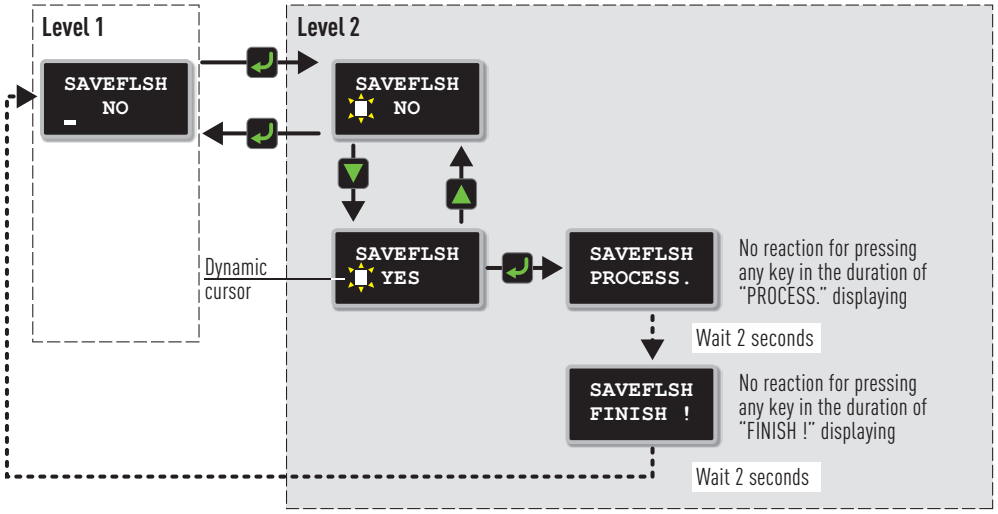


Fig. 8.8 **Saving changes to flash (successful if amplifier is DISABLED)**

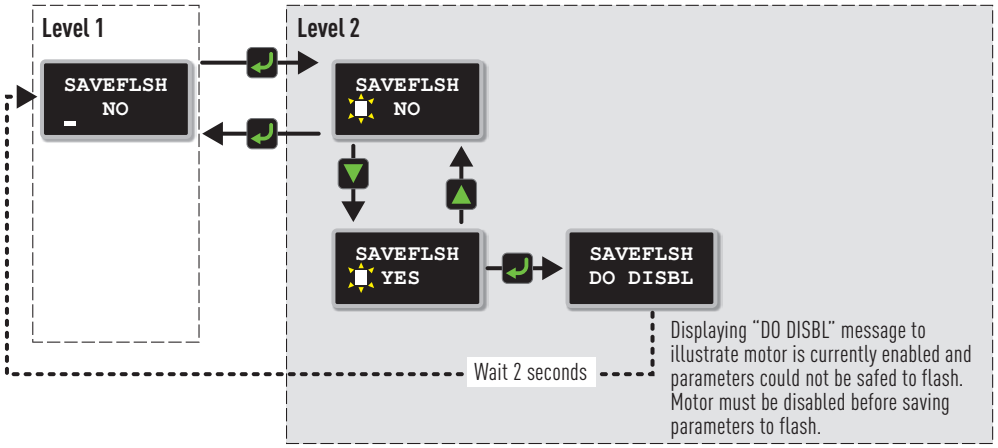


Fig. 8.9 **Saving changes to flash (not successful because amplifier is ENABLED)**

8.5.2 Changing parameters

The directly configurable parameters such as **"CG"**, **"VPG"**, **"ST_CG"**, etc., which are assigned numerical values, can be set directly with the aid of the display's change function. The Up and Down buttons can be used to move the cursor or change the numbers. Press the F button to switch between the two cursor modes.
The following example shows a change to the **"CG"** (Common Gain):

- Select the parameter you want to change.
- Press the Enter button to go to the configuration menu (a flashing block cursor appears).
- Press the Down button to move the cursor to the first position.
- Press the F button to change the cursor mode to numerical mode
- Press the Up button twice to select the number 1
- Press the F button to change the cursor mode
- Press the Down button twice to go to the next position
- Press the F button to change the cursor mode to numerical mode
- Press the F button several times to set the desired number.
- Press the Enter button to activate the newly selected value.

NOTE

Pressing the F button for less than a second switches between the two cursor modes

NOTE

Pressing the F button for more than 2 seconds causes the display to jump back to level 1 and aborts the change.

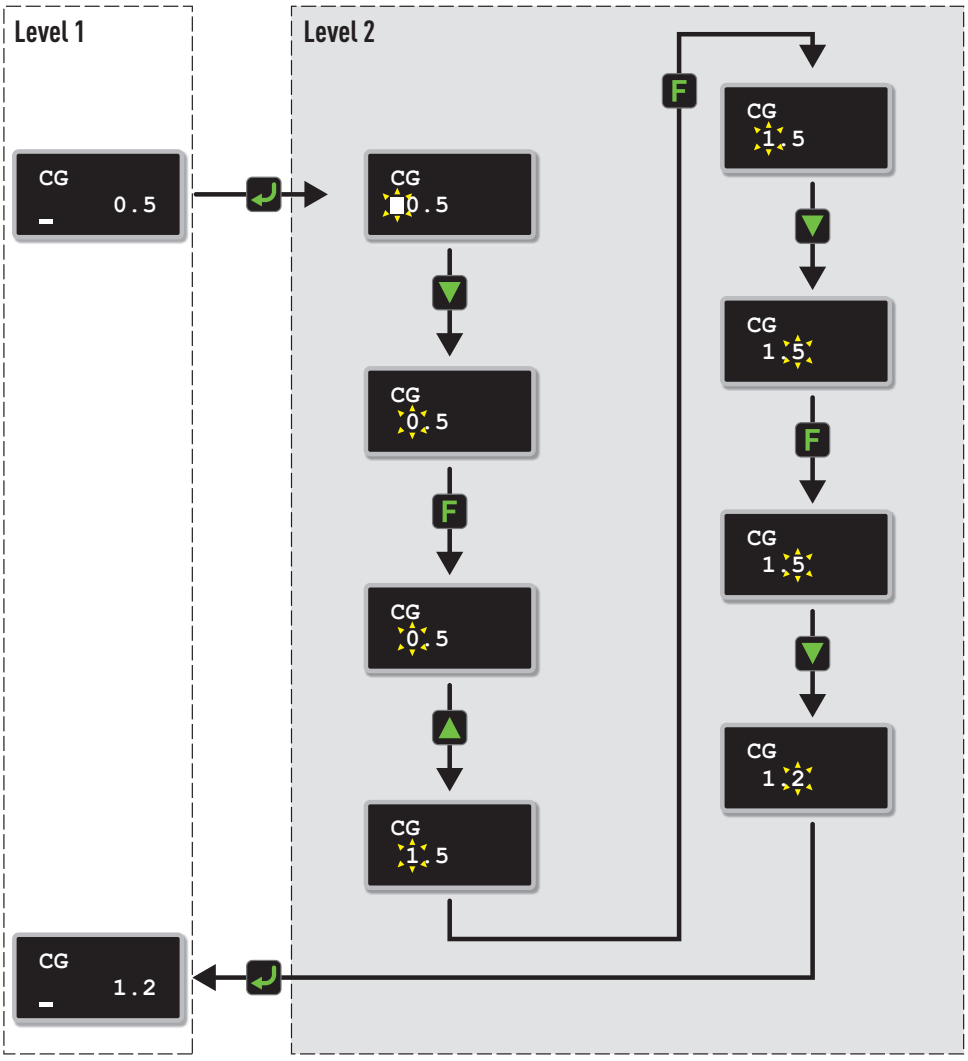


Fig. 8.10 **Example: changing the "Common Gain"**

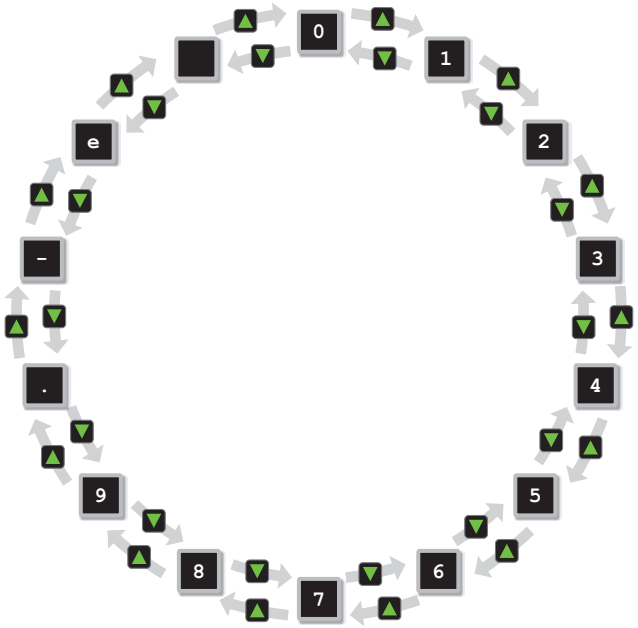


Fig. 8.11 **Numerical sequence for parameter configuration**

8.5.3 Changing non-numerical values

The procedure for parameters which do not contain numerical values is similar to that for numerical parameters. However, they don't have a number wheel and don't contain several positions; instead you can directly switch through all available options.

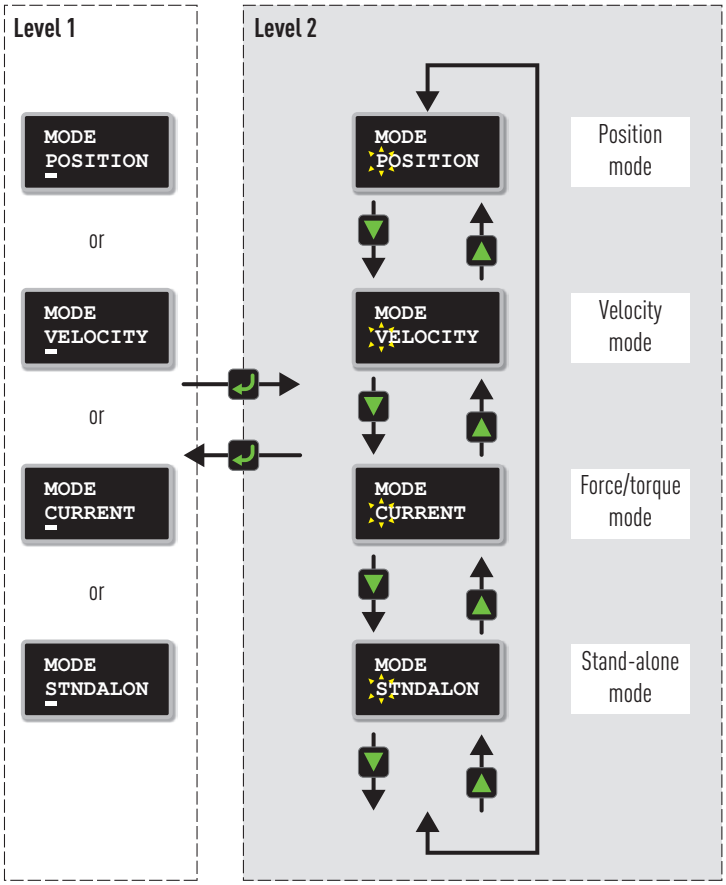


Fig. 8.12 **Example: changing a non-numerical value**

Table 8.5 **List of advanced parameters**

No.	Parameter	Description	Unit
Axis parameters			
1	**X_acc**	Acceleration	counts/s²
2	**X_dcc**	Deceleration	counts/s²
3	**X_dcc_kill**	Deceleration for emergency stop	counts/s²
4	**X_vel_max**	Max velocity	counts/s
5	**X_en**	Read only parameter for software enable (0-1)	–
6	**X_en_fl**	Read only parameter for drive enable (0-1)	–
7	**X_sw1_pos**	Negative software limit	counts
8	**X_sw2_pos**	Positive software limit	counts
9	**X_p2p_del**	Dwell time for point to point movement	msec
10	**X_p2p_pos1**	Point 1 for point to point movement	counts
11	**X_p2p_pos2**	Point 2 for point to point movement	counts
16	**X_sof_fr**	Cut-off frequency for filter 1	Hz
17	**X_sof_xi**	Damping filter 1	–
18	**X_sof_k1**	Parameter 1 filter 1	–
19	**X_sof_k2**	Parameter 2 filter 1	–
20	**X_nf_fr**	Cut-off frequency for filter 2	Hz
21	**X_nf_xi**	Damping filter 1	–
22	**X_nf_k1**	Parameter 1 filter 2	–
23	**X_nf_k2**	Parameter 2 filter 2	–
24	**X_f1_fr**	Cut-off frequency filter 1 in close-loop	Hz
25	**X_f1_xi**	Damping filter 1 in close-loop	–
26	**X_f1_k1**	Parameter 1 filter 1 in close-loop	–
27	**X_f1_k2**	Parameter 2 filter 1 in close-loop	–
28	**X_f2_fr**	Cut-off frequency filter 2 in close loop	Hz
29	**X_f2_xi**	Damping filter 2 in close-loop	–
31	**X_f2_k2**	Parameter 2 filter 2 in close-loop	–
32	**X_f3_fr**	Cut-off frequency filter 3 in close-loop	–
33	**X_f3.xi**	Damping filter 3 in close-loop	–
34	**X_Upi_kp**	Current loop proportional gain in D-direction	–
35	**X_Upi_ki**	Current loop I-part in D-direction	–
36	**X_Vpi_kp**	Current loop proportional gain in Q-direction	–
37	**X_Vpi_ki**	Current loop I-part in Q-direction	–
38	**X_Aenc_th**	Protection value for square of minimum radius of Lissajous circle of analog encoder	–
39	**X_index_vel**	Velocity for finding index	counts/s
40	**X_index_tout**	Timeout for finding index	62.5 µs
41	**X_ind**	Read-only parameter for index mark (0 = low, 1 = high)	–
42	**out_xor**	Setting of output voltage inversion of digital output	–
43	**X_cntperunit**	Number of counts for motor move unit distance. Number of counts per 100 mm for linear motor moment. Number of counts per revolution for rotary motor rotation.	–
44	**X_pitchScrew**	Lead of ballscrew	mm
45	**X_rotor_inertia**	Total moment of inertia of motor	kgm²
46	**X_enc_360**	Pole pitch of linear motor	mm
47	**X_sm_ampl**	Enable current for phase initialization	(A_amp × 1000)/36
48	**X_enc_360_div**	Pole pair number of rotary motor	–
49	**X_st_vpg**	Velocity proportional gain for enable by SW method 1	–
50	**X_st_cg**	Common gain for enable by SW method 1	–

Table 8.5 **List of advanced parameters (continuation)**

No.	Parameter	Description	Unit
51	**X_max_err**	Limitation value of maximum position error	counts
52	**X_curr_mot_peak**	Motor peak current	A_amp
53	**X_curr_mot_cont**	Motor continuous current	A_amp
54	**X_Upi.ki /X_Vpi.ki**	Integral part from current loop	–
55	**X_Upi.kp /X_Vpi.kp**	Proportional part for current loop	–
56	**X_vpg**	Velocity proportional gain in closed loop	–
57	**X_affg**	Acceleration feedforward gain in closed loop	–
58	**X_CG**	Common gain	–
59	**X_second_cg**	Secondary CG – general secondary gain for velocity and position loop	–
60	**X_second_vpg**	Secondary VPG – second proportional gain for velocity loop	–
61	**X_sg_run**	Gain in moment phase of Schedule Gains	–
62	**X_sg_idle**	Gain in in-position phase of Schedule Gains	–
63	**X_sg_stop**	Gain in settle phase of Schedule Gains	–
64	**X_fric_comp_up**	Friction compensation	0,1 %*curr_drv_ peak (A_amp)
65	**X_backlash**	Backlash	counts
66	**X_rip_vel_max**	Read only parameter for max. velocity error	counts/s
67	**X_rip_vel_min**	Read only parameter for min. velocity error	counts/s
68	**X_rip_vel_avr**	Read only parameter for average velocity error	counts/s
69	**X_Ucf_fr**	Cut-off frequency of filter in current loop (D axis)	Hz
70	**X_Ucf_xi**	Damping ratio of filter in current loop (D axis)	–
71	**X_Vcf_fr**	Cut-off frequency of filter in current loop (Q axis)	Hz
72	**X_Vcf_xi**	Damping ratio of filter in current loop (Q axis)	–
73	**X_tr_time**	Debounce time of In-Position	msec
74	**X_tr**	Target radius of In-Position	counts
75	**X_tr_move_time**	Time for "In-Position"	msec
76	**X_tr_setl_time**	Move Time	msec
77	**X_tr_move_setl**	Settling time	msec
78	**X_forceConstant**	Force constant	N/A_amp Nm/A_amp
79	**X_mass**	Load mass of linear motor	kg
80	**X_mInert**	Moment inertia of servo motor	kgm^2
81	**X_gearRatio**	Gear ratio of servo motor	–
82	**Vcmd_offs**	Offset adjustment of analog command	V
83	**Vcmd**	Value of analog input	V
	Vcmd_filt_en	value of analog input (filter)	–
84	**X_cmd_ext_N**	Numerator of electronic gear ratio (output)	–
85	**X_cmd_ext_M**	Denominator of electronic gear ratio (input)	–
86	**X_cmd_ext_v_sc**	Velocity command ratio. 1 input voltage corresponds to rotary speed.	(counts/s) = 1 V
87	**X_cmd_ext_v_dz**	Dead band of velocity command. Velocity command is 0 for input voltage less than setting.	V
88	**X_cmd_ext_i_sc**	Current command ratio, 1 input voltage corresponds to current.	(A_amp × 1000)/36 = 1 V
89	**X_cmd_ext_i_dz**	Dead band of current command. Current command is 0 for input voltage less than setting.	V
90	**X_pos_err_warn_win**	Warning of position error	counts
91	**X_vel_err_warn_win**	Warning of velocity error	counts/s
92	**X_Resistance**	Resistance (line to line) of motor coils	Ω

Table 8.5 **List of advanced parameters (continuation)**

No.	Parameter	Description	Unit
93	**X_Inductance**	Inductance (line to line) of motor coils	mH
94	**X_en_sw**	Software enable in mega-ulink	—
95	**X_vel_stop**	Velocity while closing the brake	counts/s
96	**X_stop**	Read only parameter for "In position" (0 = reached, 1 = not reached)	counts/s
97	**X_delMaxEnToBrk**	Delay time of brake activation	msec
98	**X_delBrkToDis**	Brake function time	msec
99	**X_index_offs**	Index offset	counts
103	**X_new_sm_fac**	Smooth factor (jerk time)	—
104	**in_xor**	Logic inversion of digital input	—
105	**X_hall_mode**	Hall sensor type (0 = no hall, 1 = digital hall, 2 = analog hall)	—
106	**pullupdn**	Signal level of digital input	—
107	**X_rotaryType**	Motor type	—
108	**X_st_phase**	Motor current inversion	—
109	**X_oper_mode**	Operation mode	—
110	**X_oper_mode2**	Second operation mode	—
111	**X_pulse_mode**	Pulse format	—
112	**X_pulse_dir**	Pulse command inversion	—
113	**X_fall_rise**	Trigger type of pulse command (falling or rising edge)	—
114	**X_cmd_pwm_mode**	Input command format under velocity and current mode	—
115	**out_config[0]**	O4 output signal configurations	—
116	**out_config[1]**		—
117	**out_config[2]**		—
118	**out_config[3]**		—
119	**out_config[4]**	O1 output signal configurations	—
120	**out_config[5]**		—
121	**out_config[6]**		—
122	**out_config[7]**		—
123	**out_config[8]**	O2 output signal configurations	—
124	**out_config[9]**		—
125	**out_config[10]**		—
126	**out_config[11]**		—
127	**out_config[12]**	O3 output signal configurations	—
128	**out_config[13]**		—
129	**out_config[14]**		—
130	**out_config[15]**		—
131	**X_StIdenext**	Setting of hardware enable signal	—
132	**X_StIdRL**	Setting of hardware right limit signal	—
133	**X_StIdLL**	Setting of hardware left limit signal	—
134	**X_StIdmotTOvr**	Setting of motor over temperature signal	—
135	**X_StIdhome**	Setting of Home complete command from host controller	—
136	**X_StIdOutBrake**	Setting of brake signal	—
137	**X_sw_pos_prot_en**	On/off software limit	—
138	**X_hw_lim_prot_en**	On/off hardware limit	—
139	**X_emu_N**	Numerator of ratio of emulated encoder output	—
140	**X_emu_M**	Denominator of ratio of emulated encoder output	—
141	**X_emap_en**	On/off Error map	—
142	**X_emap_interval**	Pitch error compensation	counts
143	**X_emap_nump**	Error compensation points	—

Table 8.5 **List of advanced parameters (continuation)**

No.	Parameter	Description	Unit
144	**X_emap_active**	Read only parameter for status error mapping (0 = not active, 1 = active)	–
145	**X_StIdReset**	Setting of drive reset signal	–
146	**X_home_smooth**	Parameters of the smooth movement	–
147	**ver_mdp**	Firmware version	–
148	**X_emu_i_radius**	The origin of the frame encoder simulation	counts
149	**X_emu_i_jitter**	The filter factor encoder simulation	counts
150	**X_dcbl**	Read only parameter for motor commutation (0= not successful 2 = commutation successful)	–
151	**X_dcbl_pulse_mode**	Phase initialization mode (0 = SW method 1)	–
152	**X_dcbl_pulse_amp**	SW method 2 initialization phase current	(Amp × 1000)/36
153	**X_dcbl_pulse_del**	SW method 2 phase initialization time factor	66.67 µs
154	**X_vsf.fr**	VSF frequency	Hz
155	**X_vsf.xi**	VSF damping	–
156	**X_vsf_en**	VSF enable	–
157	**X_homed**	Read only parameter for homing status	–
158	**X_home_method**	Read only parameter for homing method	–
159	**X_init_exec**	Start order for homing procedure	–
160	**X_locate_pos**	Write only variable to set the current position to zero (X_locate_pos = 0)	–
Velocity observer			
167	**X_VOF.FB_Switch**	Write only parameter for activate velocity observer (0 – 1)	–
168	**X_VOF.J_div**	Velocity observer (inverse of mass)	–
169	**X_name**	Name of the axis (display)	Hex
170	**Vbus**	Read only parameter for bus voltage	V
171	**X_volt_abs2**	Read only parameter of used bus voltage in percent	0 to 100 %
172	**X_hall_bits**	Status request of hall bit	–
173	**X_temperature**	Read only parameter for amplifier temperature	°C
174	**X_avr_curr**	Read only parameter for software thermal accumulator (AC-servo)	–
175	**X_Aenc_mode**	Type of Encoders: 0 = analog, 1 = digital, 2 = Tamagawa SI	–
Status request			
176	**X_en_sw**	Read only parameter for software enable (0 – 1)	–
177	**X_StIdenext**	Read only parameter for external hardware enable (0 = not active, 1 = active)	–
178	**X_ready**	Read only parameter for axis ready (0 = not ready, 1 = ready)	–
179	**X_dsbl**	Read only parameter for axis disable (0 = enable, 1 = disable)	–
180	**X_run**	Read only parameter for axis movement (0 = standstill, 1 = move)	–
181	**X_I_flag**	Read only parameter for homing (0 = no homing, 1 = homing in process, 2 = homing complete)	–
182	**X_stp**	Read only parameter for "stepper mode" (0 = active, 1 = active)	–
Failure			
182	**X_DRV_OC_FLT**	Read only parameter for motor short (0 = no short, 1 = short detect)	–
183	**X_DRV_OV_FLT**	Read only parameter for over voltage (0 = no over voltage, 1 = over voltage detect)	–
184	**X_pe**	Read only parameter for position error too big (0 = no position error, 1 = position error)	–

Table 8.5 **List of advanced parameters (continuation)**

No.	Parameter	Description	Unit
185	**X_Ae_err**	Read only parameter for encoder error (0 = no encoder error, 1 = encoder error)	–
187	**X_mot_discon**	Read only parameter for motor connection (0 = motor connected, 1 = motor disconnected)	–
188	**X_Temp_Drv**	Read only parameter for over temperature in amplifier (0 = no over temperature, 1 = over temperature detect)	–
190	**under_hv**	Read only parameter for under voltage (0 = no under voltage, 1 = under voltage detect)	–
191	**X_5V_ENC_Err**	Read only parameter for missing 5 V encoder supply (0 = ok, 1 = 5 V fail)	–
193	**X_Serial_ENC_Err**	Read only parameter for communication with serial encoder interface (0 = ok, 1 = failure)	–
194	**X_Hall_Sensor_Err**	Read only parameter for hall sensor error (0 = ok, 1 = hall sensor fail)	–
195	**X_Hall_PH_Err**	Read only parameter for hall sensor phase	–
196	**X_Cur_Err**	Read only parameter for current control error (0 = ok, 1 = failure)	–
Warning			
197	**X_sw1_flag**	Read only parameter for negative software limit (0 = not reached, 1 = reached)	–
198	**X_sw2_flag**	Read only parameter for positive software limit (0 = not reached, 1 = reached)	–
199	**X_LL**	Read only parameter for negative hardware limit (0 = not reached, 1 = reached)	–
200	**X_RL**	Read only parameter for positive hardware limit (0 = not reached, 1 = reached)	–
201	**X_pwm_worn**	Bus voltage warning	–
202	**X_pos_err_worn**	Read only parameter position error warning (0 = no warning, 1 = warning active)	–
203	**X_vel_err_worn**	Read only parameter for velocity error warning (0 = no warning, 1 = warning active)	–
204	**X_lim_curr**	Read only parameter for current limit (0 = no warning, 1 = warning active)	–
205	**X_lim_acc**	Read only parameter for acceleration limit (0 = no warning, 1 = warning active)	–
206	**X_lim_vel**	Read only parameter for velocity limit (0 = no warning, 1 = warning active)	–
207	**X_both_hwl**	Read only parameter for both limit switch are active (0 = not active, 1 = both limit switch active)	–

8.6 Performing actions

On this page you can

- activate/deactivate the drive amplifier (ENABLE/DISABLED)
- move the motor in JOG mode
- move the motor in absolute terms.

You can also select the speed and position. You get to this page from the start page by pressing the F button three times.

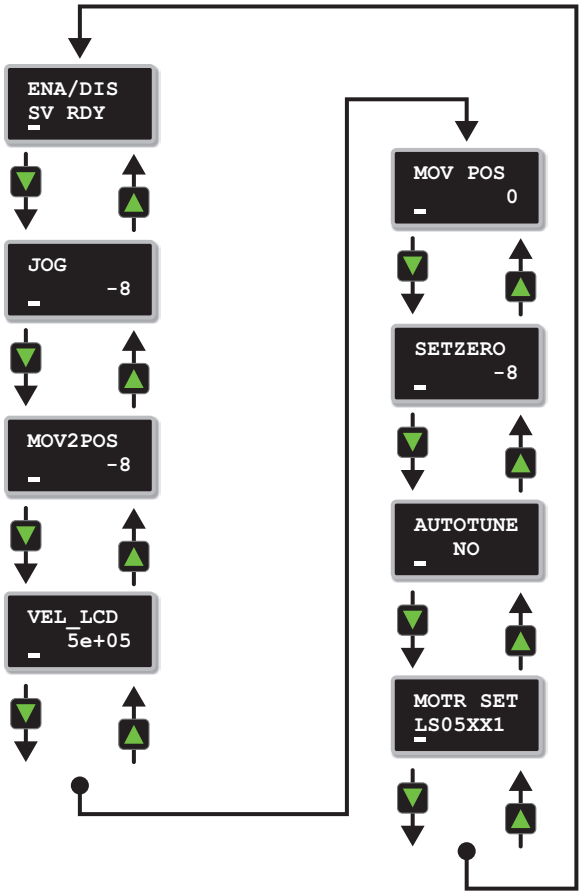


Fig. 8.13 **Page – Performing actions**

8.6.1 Enable/Disable (ENA/DIS)

This function can be used to de-energise the motor and/or re-activate it.

Procedure:

- ▶ Press the Enter button to go to the ENA/DIS menu (a flashing block cursor appears).
- ▶ Use the Up and Down button to select the desired status
- ▶ Once the desired status has been selected, press the Enter button to activate it.

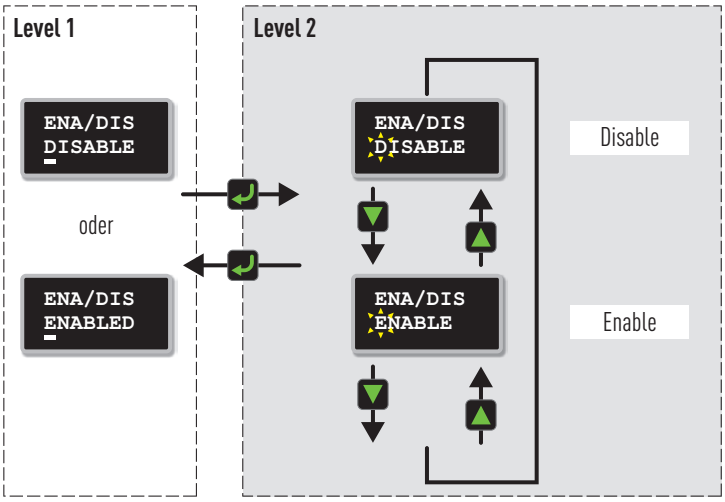


Fig. 8.14 **Enable/Disable**

8.6.2 Jog

You can use this function to move the motor to the left or right.

- To do so, select JOG mode by pressing the Enter button (a flashing cursor box appears)
- Press the Up and Down button to move the motor in a positive and negative direction. The current position is also shown. When the button is released, the motor stops instantly.

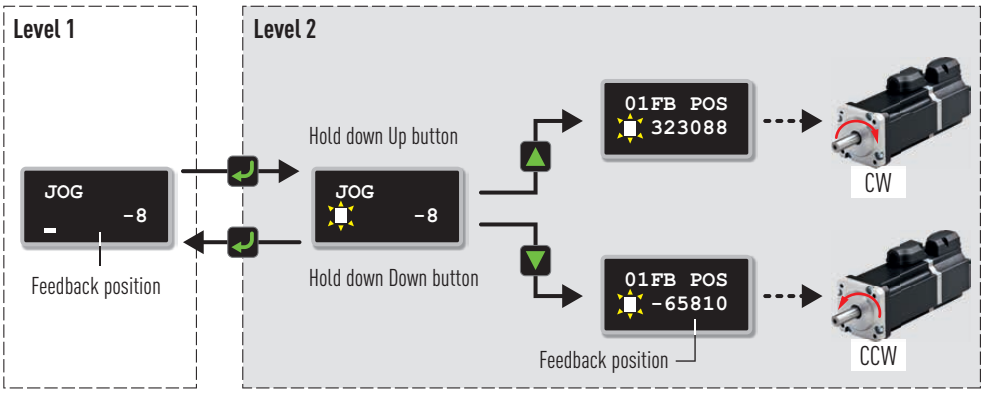


Fig. 8.15 **Jog**

8.6.3 Absolute travel

In this mode, you can move the motor in absolute terms.
Example:

- Press the Up or Down button to select the **"M0V POS"** entry. Set the desired target position.
- Now select the **"M0V2POS"** menu entry and activate it with the Enter button (a flashing block cursor appears).
- Press the Up button to move the motor to the position specified under **"M0V POS"** During the movement, the words **"01FB POS"** and the current position are displayed.
- Press the Down button to move the motor to absolute position 0. During the movement, the words **"01FB POS"** and the current position are displayed.
- Press the Enter button to return to level 1.

NOTE **The position details are provided in counts.**

NOTE **If you press the other direction button before the movement is complete, the motor interrupts its current movement and moves back to the other position.**

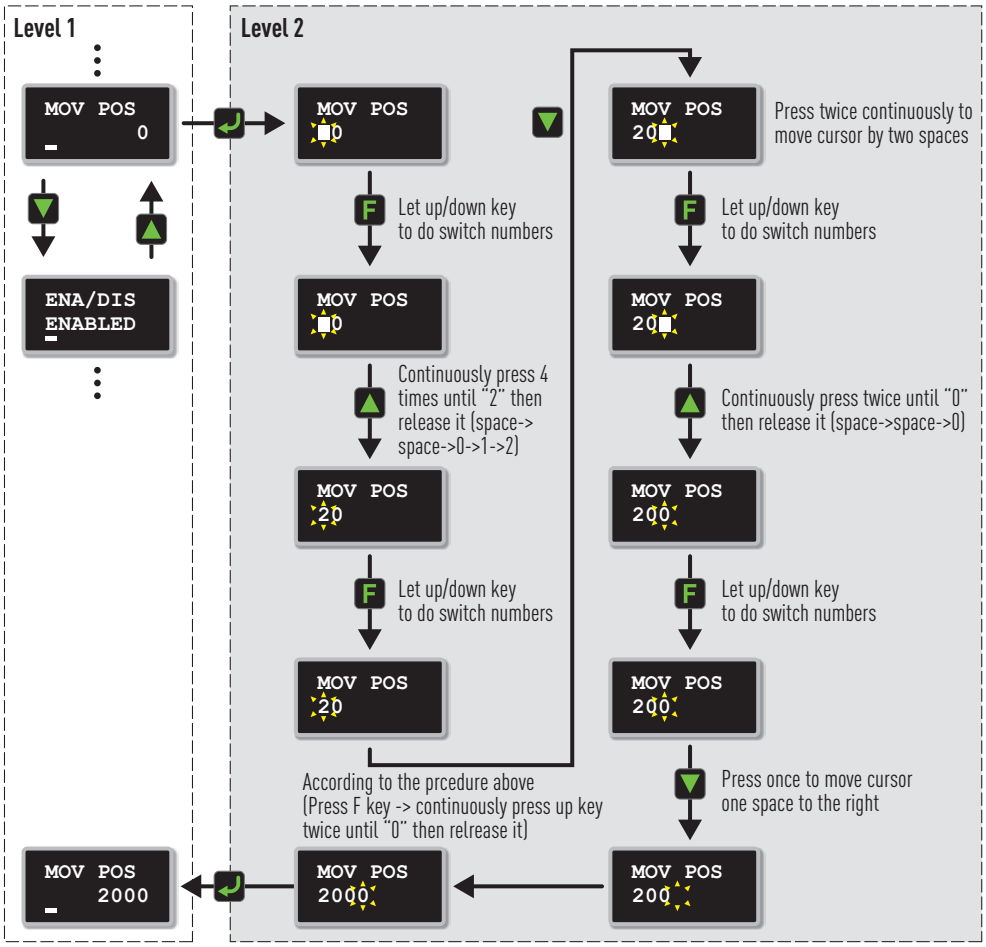


Fig. 8.16 **Absolute positioning**

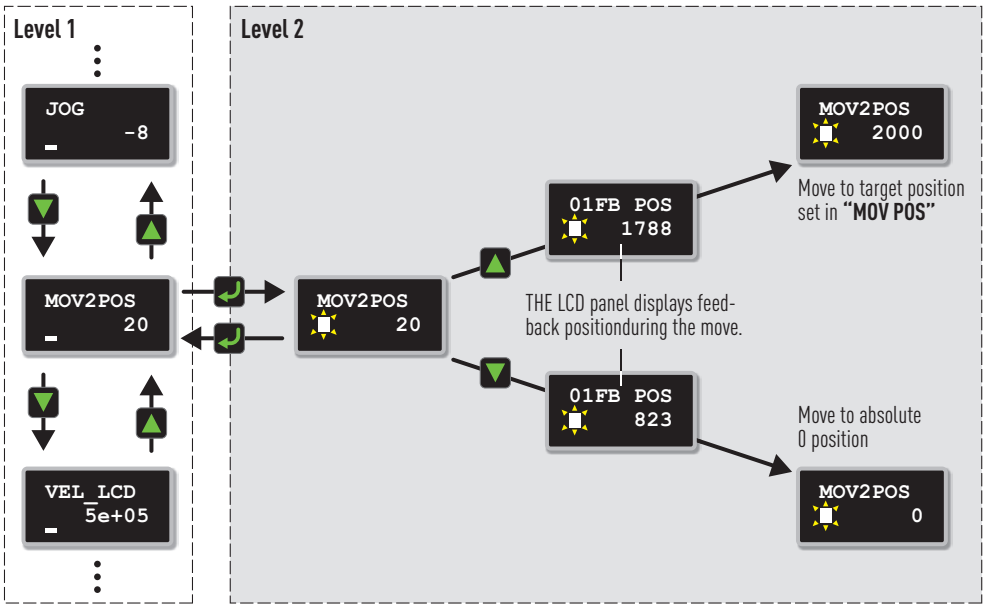


Fig. 8.17 **Starting absolute positioning**

8.6.4 "Motor Set"

The following process shows the steps required to select and set parameters for a HIWIN servo motor directly via the display.

- Press the Enter button to select the **"MOTR SET"** function.
- Press the Up or Down button to select a motor.
- The display automatically switches to **"AUTOTUNE"** mode. Press the Enter button and undertake auto tuning (see Section 8.6.5).
- The LCD automatically switches to **"MODE"** function.
- Press the Enter button to select the **"MODE"** function.
- Press the Up or Down button to select e.g. **"STNDALON"** (stand alone) mode.
- Press the Enter button.
- The display automatically switches to the **"SAVE FLSH"** (save to flash) function.
- Press the Enter button.
- Press the Up or Down button and select **"No"**.
- Press the Enter button, the parameters are not saved to the flash memory (see Section 8.5.1).
- The display automatically switches to **"PHASE INI"** mode.
- The initial initialisation is completed successfully when **"ON"** is shown on the display.

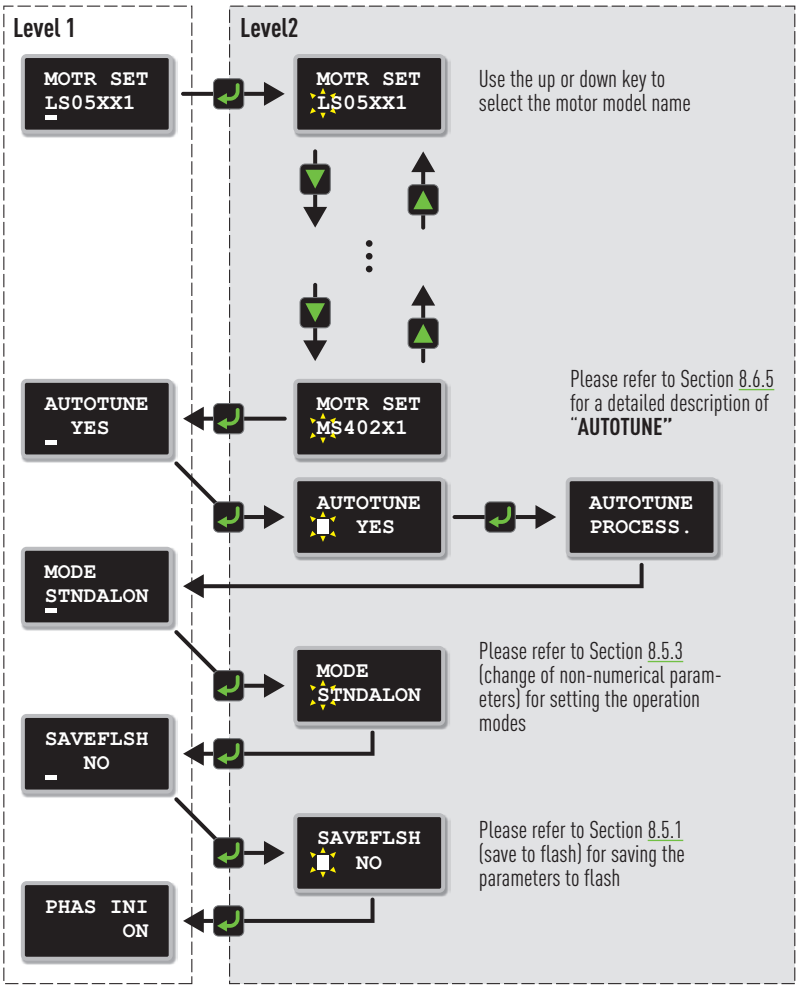


Fig. 8.18 **"Motor Set" process**

8.6.5 "AUTOTUNE"

The following process shows the steps required to perform the **"AUTOTUNE"** function.

- Press the Enter button to select the **"AUTOTUNE"** function (a flashing indicator appears on the left side of the second line)
- Press the Up or Down button to select whether **"AUTOTUNE"** is to be performed or not.
- The drive amplifier will perform **"AUTOTUNE"** if **"AUTOTUNE YES"** is selected and the Enter button is pressed (**"AUTOTUNE"** is not performed if **"AUTOTUNE NO"** is selected). The motor runs at a frequency of 25 Hz.
- The following appears in the display at the end of the process: **"AUTOTUNE FINISH!"**
- Disable drive (see Section 8.6.1).
- Save drive data (see Section 8.5.1).

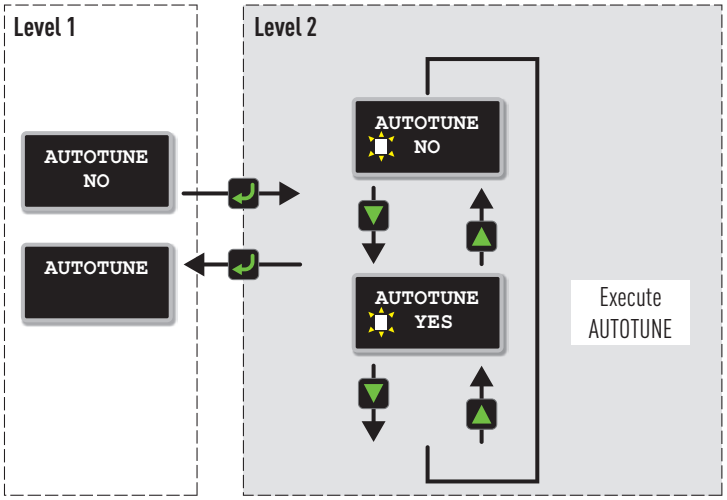


Fig. 8.19 **"AUTOTUNE" process**

8.6.6 "SETZERO"

The following process shows the steps required to set the current motor or drive position to zero.

- Press the Up or Down button to go to the **"SETZERO"** setting.
- Press the Enter button to set the current position to zero.

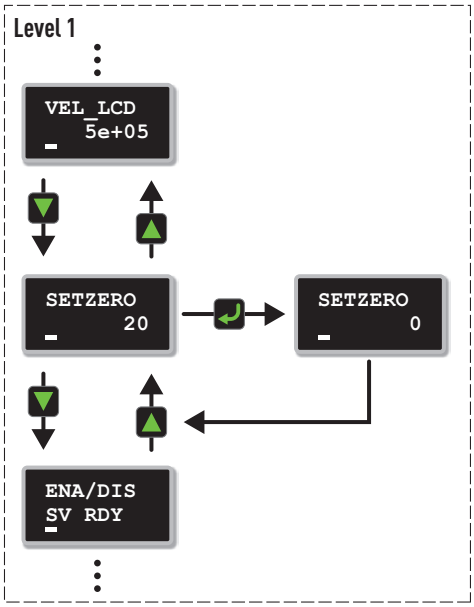


Fig. 8.20 **"SETZERO" process**

9. mega-ulink protocol

The D2 servo drive amplifier supports the proprietary mega-ulink protocol via both USB and the EtherCAT interface.
The MPI library handles communication and control between the PC and drive controller. A detailed description of this library and how to use it can be found in a separate document called mpi.pdf and can be downloaded from www.hiwin.de. Alternatively, contact the technical support team at HIWIN (see Section 2.5).
This library can run on Microsoft Visual C++, Visual Basic and LabView applications and can be installed with the following operating systems: Windows 95/98/2000/XP/Win7.
The MPI library consists of 4 files:

- mpi.lib
- mpi.dll
- canlib32.dll
- mpint.h.

Additional software called WinPcap must be installed for devices which are to be controlled via EtherCAT. This is open-source software that can be downloaded from http://www.winpcap.org.

9.1 Features of the MPI library

- Communication settings (port number baud rate, USB/EtherCAT)
- Simultaneous exchange of data with several communication ports , each of which is connected to a D2
- Multitasking support: Several tasks can be undertaken via the DLL interface with a minimum latency period
- Troubleshooting
- Read/write any variable/array in D2 with 64-bit support
- Run PDL functions/PDL programs

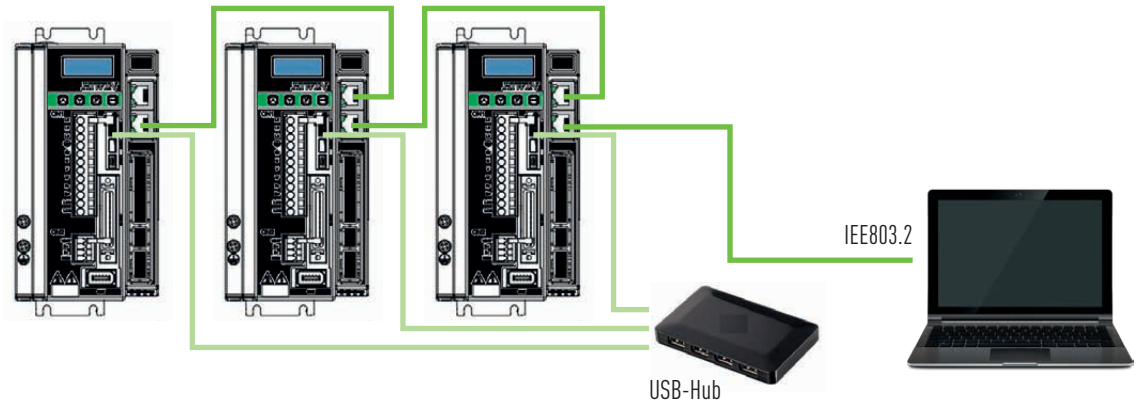


Fig. 9.1 **Example of PC control via Ethernet EtherCAT or USB port**

9.2 PDL (Process Description Language) programming

The D2 servo drive amplifier has its own PLC functionality and can be used via the proprietary PDL programming language. A detailed description of this programming and how to use it can be found in a separate document called **PDL.pdf** and can be downloaded from www.hiwin.de. Alternatively, contact the technical support team at HIWIN (see Section 2.5).
Position orders can be undertaken, operating changeovers (e.g. position control, speed control or current control) can be performed, and outputs can be controlled via the digital inputs.

9.3 Features of PDL programming

- Capable of multitasking, up to 4 tasks can be processed in parallel
- Quick execution of individual sentences (62.5 µs)
- Definition of user variables (name, type, size)
- Support for arrays and pointers
- Procedures with parameters
- Use of Loop, While, If, Else, Till, Goto commands
- Mathematics functions
- Blocking and unblocking of commands

9.4 Programming examples

(no liability accepted)

Example 1: Simple absolute positioning between 2 positions with zero point correction

```
#task/1;                    // First task, this task runs immediately after controller initialisation
call _sequence program;     // Program called _sequence program is called up
ret;

_sequence program:
till(X_en=1);               // Wait for controller enable and/or until motor is energised
till(X_I_flag=2);           // Wait for index mark of motor once reference travel has been started
                            // Reference travel is permanently assigned in "Lightening" and is started via
                              a dig. input
X_trg = 107888;             // Zero point correction, motor positioned absolutely
sleep 500;                  // Pause 500 ms
X_locate_pos=0;             // Machine zero point
seton O3;                   // Message that reference travel is complete; set output O3
sleep 500;                  // Pause 500 ms
setoff O3;                  // Reset output O3

_Loop:                      // Label name for jumping to end of program
till(I5);                   // Wait until input I5 is activated
X_trg = 720896;             // Absolute positioning in increments
till(~X_run);               // Wait until motor has reached the position
till(I5);                   // Wait until input I5 is activated
X_trg = 1441792;            // Absolute positioning in increments
till(~X_run);               // Wait until motor has reached the position
goto _Loop;                 // Program jump
ret;
```

Example 2: Using a procedure for positioning with the variable factors speed, acceleration, deceleration, jerk limitation and input-coded position orders

```
proc move_p_v_a_d(long p, long v, long a, long d) do
                            // Procedure definition P = Position, V = Velocity, a = acceleration,
                              d = deceleration
#long m_p;                  // Variable position
#long m_v;                  // Variable velocity
#long m_a;                  // Variable acceleration
#long m_d;                  // Variable deceleration

m_p = X_trg;                // Assign PDL variable of drive controller variable
X_trg=p;
m_v = X_vel_max;
X_vel_max = v;
```

```
m_a = X_acc;
X_acc = a;
m_d = X_dcc;
X_dcc = d;
end;
#task/1;                                  // This task runs immediately after controller initialisation
_Test1:
call _Reference travel;                   // Call up the program called "_Reference travel"
ret;
_Reference travel:                        // Jump mark for jumping to program
till(X_en=1);                             // Wait until motor is subject to control
till(I1);
sleep 2000;                               // Wait until enable is received for reference travel
call _X_init_exec;                        // Start reference travel as set in "Lightening"
till(~X_run);                             // Wait until reference travel is complete and/or motor is no longer moving
sleep 2000;
move_p_v_a_d(166350,20000,200000,200000); // in incr.
till(~X_run);
sleep 500;

_Loop:                                    // Jump mark for jumping to program

// reset signals after cover up
if (~I1) do                               // If input 1 is reset, then ....

setoff O1;                                // Deactivate O1
setoff O2;                                // Deactivate O2
setoff O3;                                // Deactivate O3
sleep 500;
end;

//Pos1
if (I1&I2&~I3&~I4) do                     // If input I1=1 and I2=1 and I3=0 and I4=0, then ....
move_p_v_a_d(8850,20000,20000,20000);     // Position order in count absolute values, 1 count = 1 µm standardised
till(~X_run);
seton O1;
setoff O2;
setoff O3;
sleep 500;
end;

//Pos2
if (I1&~I2&I3&~I4) do                     // If input I1=1 and I2=0 and I3=1 and I4=0, then ....
move_p_v_a_d(113850,20000,200000,200000); //in count
till(~X_run);
setoff O1;
seton O2;
setoff O3;
sleep 500;
end;

// Pos5
if (I1&I2&~I3&I4) do
move_p_v_a_d(166350,30000,200000,200000); //in count
till(~X_run);
setoff O1;
setoff O2;
setoff O3;
```

```
sleep 500;
end;
goto _Loop;                    // Jumps back
ret;
```

Example 3: Simple relative positioning between 2 positions with zero point correction

```
#task/1;                       // First task; this task runs immediately after controller initialisation
call _sequence program;        // Program called "_sequence program" is called up
ret;
_sequence program:
till(X_en=1);                  // Wait for controller enable and/or until motor is energised
till(X_I_flag=2);              // Wait for index mark of motor once reference travel has been started
                               // Reference travel is permanently assigned in "Lightening" and is started via
                                  a digital input
X_trg = 107888;                // Zero point correction, motor positioned absolutely
sleep 500;                     // Pause 500 ms
X_locate_pos=0;                // Machine zero point
seton 03;                      // Message that reference travel is complete; set output 03
sleep 500;                     // Pause 500 ms
setoff 03;                     // Reset output 03

_Loop:                         // Label name for jumping to end of program
till(I5);                      // Wait until input I5 is activated
X_trg += 720896;               // Relative position in positive direction in increments
till(~X_run);                  // Wait until motor is no longer moving
till(I5);
X_trg -= 1441792;              // Relative position in negative direction in increments
till(~X_run);
goto _Loop;                    // Program jump
ret;
```

Example 4: Use of customer-specific variables, motion profile parameters, IF-ELSE DO conditions and stop command

```
//######### Custom variable = Cycle counter and automatic stop once the Stop conditions are reached #########
#long ciclo;                   // Cycle variable
#long numero;                  // Number variable

#task/1;
X_vel_max = 1000000;           // Max. speed in incr./s
X_acc = 20000000;              // Max. acceleration in incr./s²
X_dcc = 20000000;              // Max. deceleration in incr./s²
X_new_sm_fac=50;               // Jerk limitation

X_max_err = 32000;             // Max. position error before motor commutation in incr.
ciclo = 0;                     // Set cycle variable to zero
numero = 0;                    // Set number variable to zero
till(X_en=1 & X_dcbl);         // Wait until motor commutation takes place
till(~X_run);                  // Wait until motor is not moving
sleep 1000;                    // Wait 1000 ms
X_locate_pos = 0;              // Position = set 0

_Test1:                        // Jump mark
sleep 300;                     // Wait 300 ms
X_max_err = 700;               // Max. position error in motion in incr.
```

```
X_trg = 58000;                  // Position absolute 25,000 incr = 25 mm
till(~X_run & X_en=1 );         // Wait until motor is not moving but is still energised
sleep 300;                      // Wait 1000 ms
X_max_err = 700;                // Max. position error in motion in incr.
X_trg = 1000;                   // Position absolute 5,000 incr = 5 mm
till(~X_run & X_en=1 );         // Wait until motor is not moving but is still energised
numero = numero+1;              // Count
ciclo = numero;                 // Number of cycles
if (numero = 10000000) do       // Stop condition
stop 1;                         // Task 1 is stopped
else do                         // otherwise
goto _Test1;                    // Return to jump mark

ret;
end;                            // End of if/else do condition
```

9.5 Writing PDL program to D2 and saving

"Lightening" software is used to write PDL programs, compile them and save them to D2. For a description of the "Lightening" software and how to install it, see Chapter 6.
Once motor commissioning is complete (see Chapter 7), select the PDL symbol in the main tool bar in the main window.

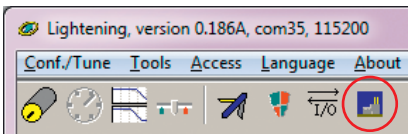


Fig. 9.2 **Selecting PDL programming**

In the following window, press the button "**Edit**":

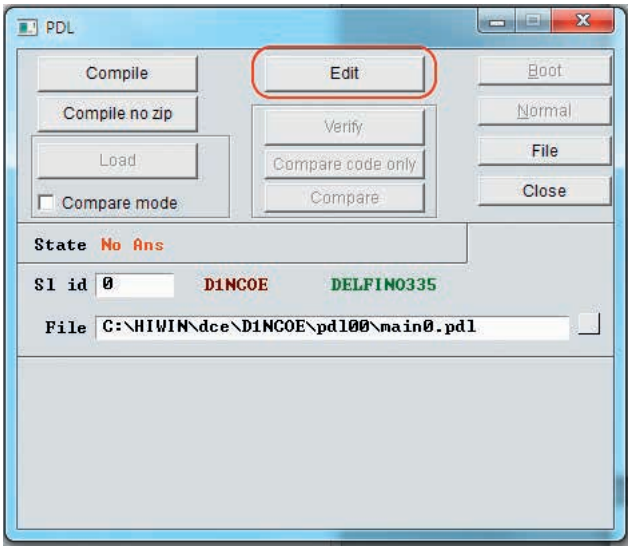


Fig. 9.3 **Opening the compiler**

Programming takes place in three steps (see Fig. 9.4):

- Save program code in User-PDL (1)
- Run syntax check (2)
- Save program to device (3)

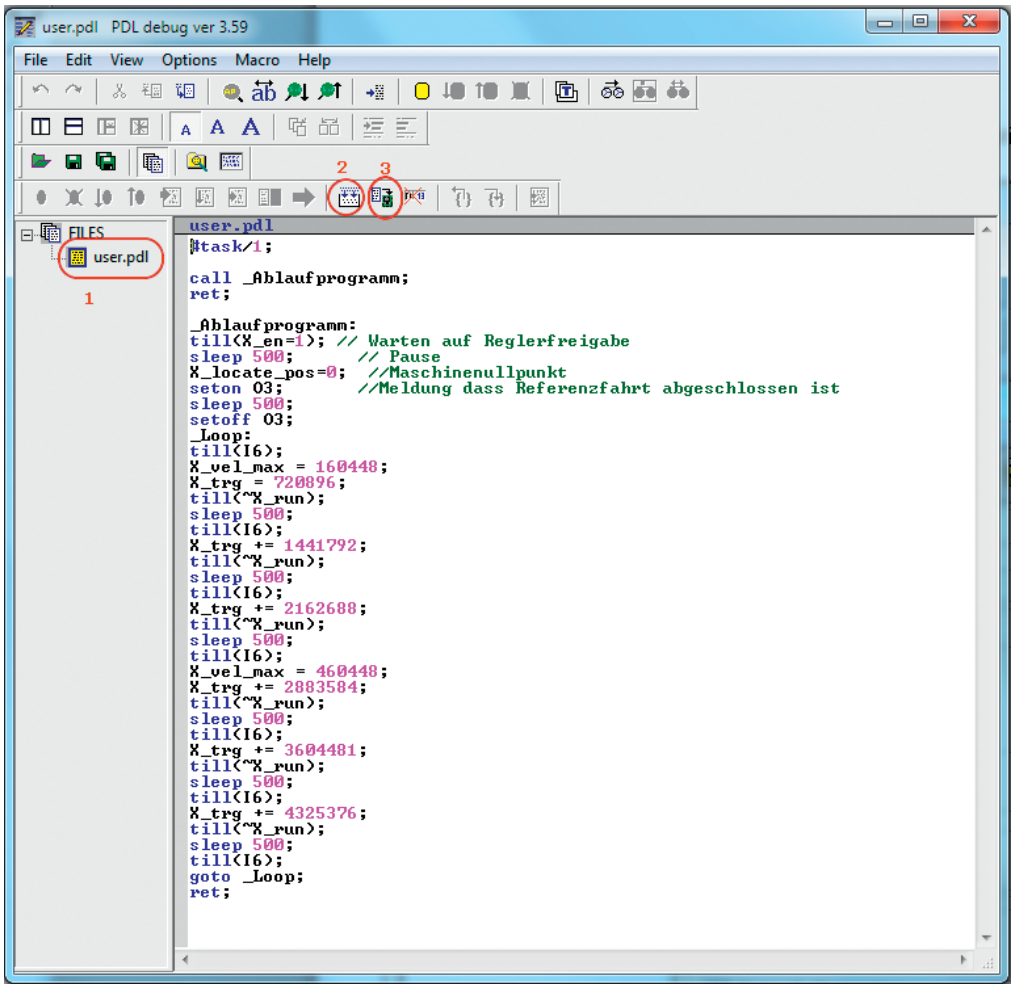


Fig. 9.4 **PDL compiler**

Programs can be written as txt files and copied/pasted to **"user.pdl"**. Alternatively, the program can be written directly in the compiler.
The syntax check looks for spelling mistakes or whether variables and parameters not available have been used. It is important that there are no errors (Errors: 0).

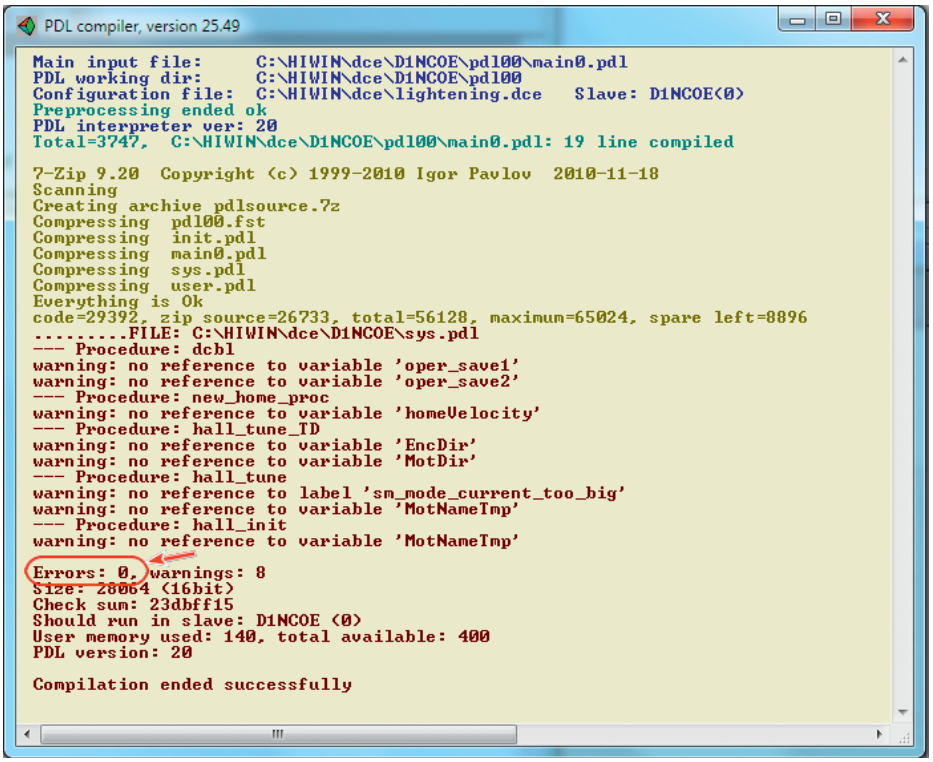


Fig. 9.5 **PDL compiler, result of syntax check**

The program can now be sent to the D2 and permanently saved in the flash memory. The drive amplifier is restarted (rebooted) in this procedure.

⚠ CAUTION!

Danger of damage or injury due to uncontrolled movement!

If you press the **"Download to amplifier"** button while the motor is energised/moving, the drive amplifier immediately de-energises the motor. The motor is NOT decelerated by the drive amplifier and coasts to a stop.

- Stop the drive before downloading.
- Note that the status of the digital inputs and outputs can change during the download.

To check whether the written program is active in the D2, press the **"Strg"** and **"X"** keys on your keyboard. A new item called **"Advanced"** appears in the "Lightening" main tool bar.

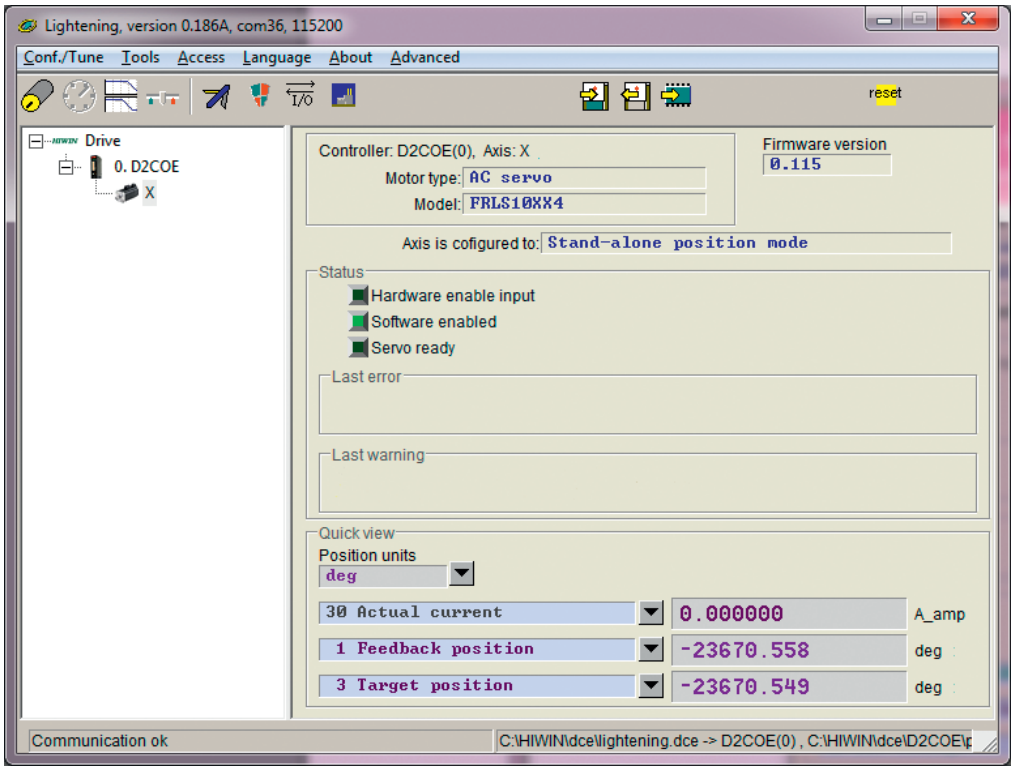


Fig. 9.6 **"Advanced" menu in "Lightening"**

▶ Open **"Advanced"** menu and select **"PDL task list..."**.

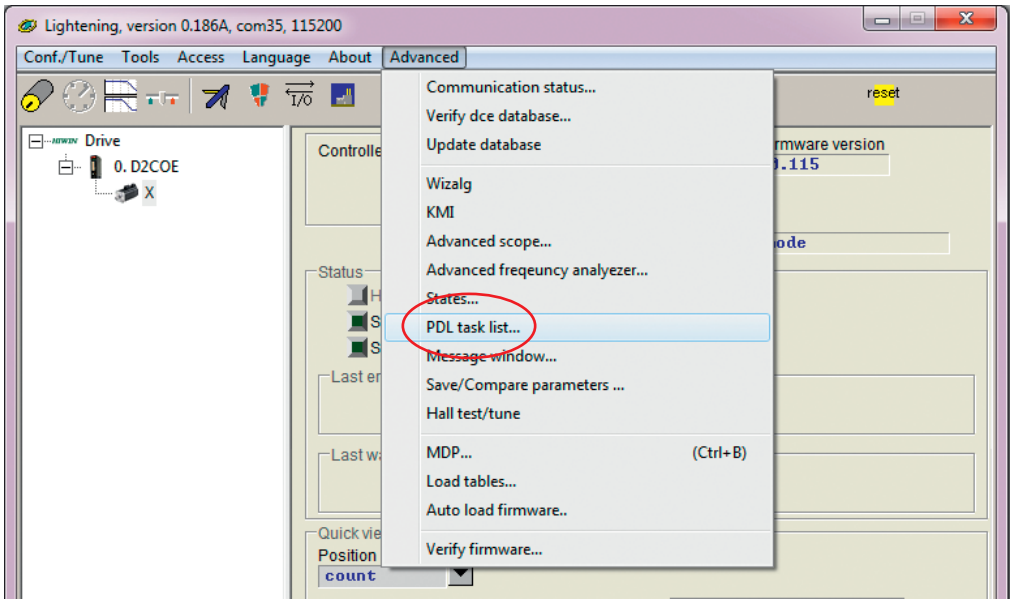


Fig. 9.7 **"PDL task list..." in "Lightening" selection**

If **"Run"** is displayed in the **"State"** column of the individual tasks, the saved program is running in the D2.

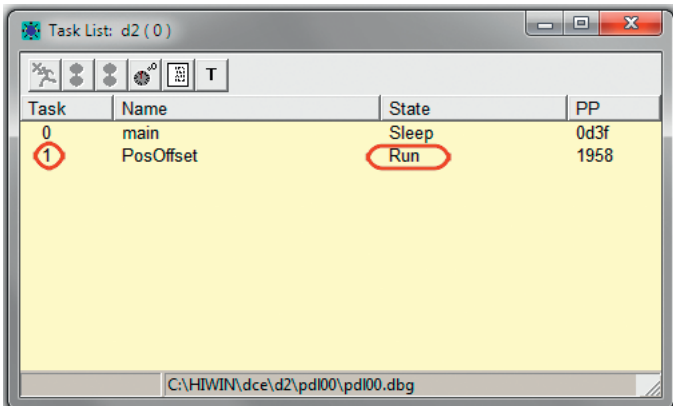


Fig. 9.8 **"Task List" in "Lightening" selection**

9.6 Stopping PDL program, allowing it to run on and deleting it

The "Lightening" software has an input window called **"Message window"** under **"Performance center"** for stopping a PDL program.

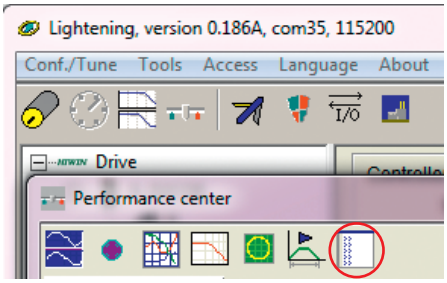


Fig. 9.9 **Calling up the "Message window"**

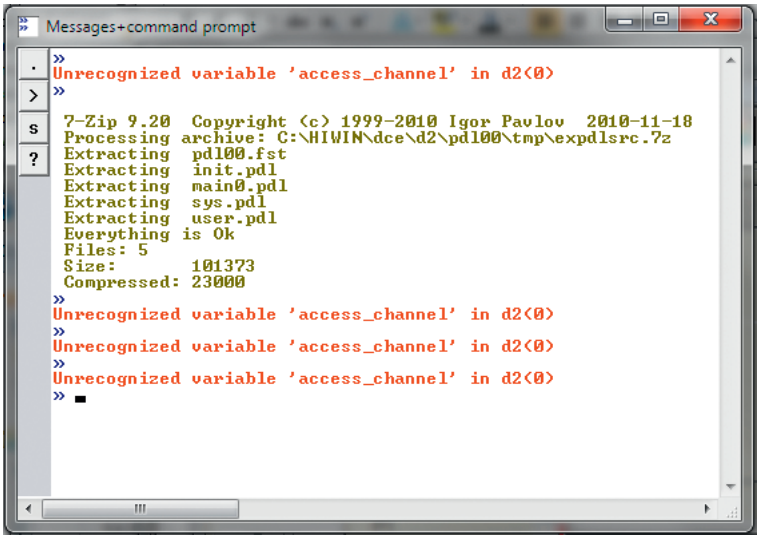


Fig. 9.10 **"Message window" – "Messages + command prompt"**

Task 1 (see Fig. 9.8) can be stopped using the following command: **stop 1**
Enter commands in **"Message window"** and press the Enter button.

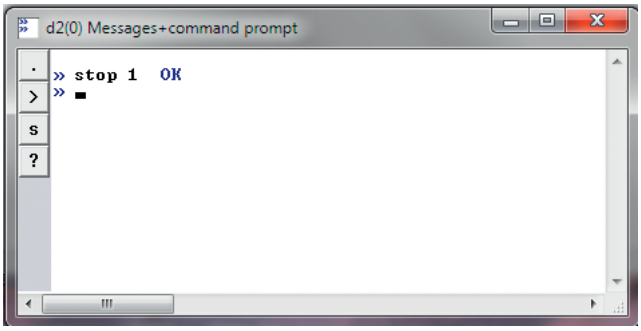


Fig. 9.11 **"Message window" – stopping task 1**

The drive amplifier confirms the command with **"OK"**.
To check, you can open **"PDL Task List"** (see Fig. 9.7 and Fig. 9.8)

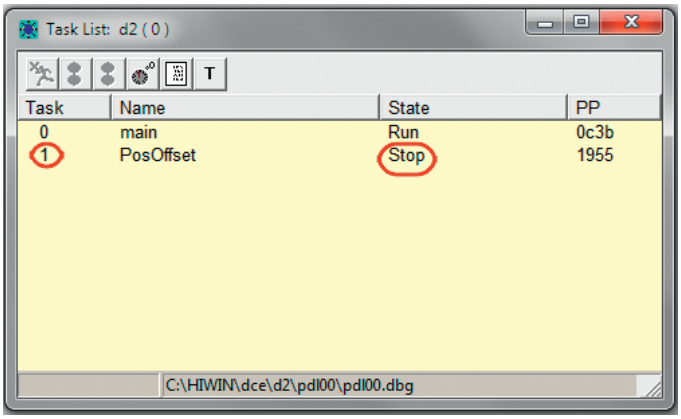


Fig. 9.12 **"Message window" – task 1 stopped**

Task 1 (see Fig. 9.12) can be started using the following comma: **cont 1**
Enter commands in **"Message window"** and press the Enter button.

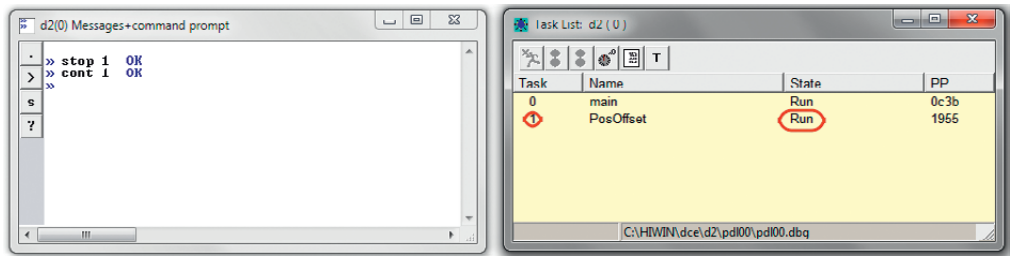


Fig. 9.13 **"Message window" – task 1 started again**

Task 1 (see Fig. 9.12) can be cancelled using the following command: **kill 1**
Enter commands in **"Message window"** and press the Enter button.

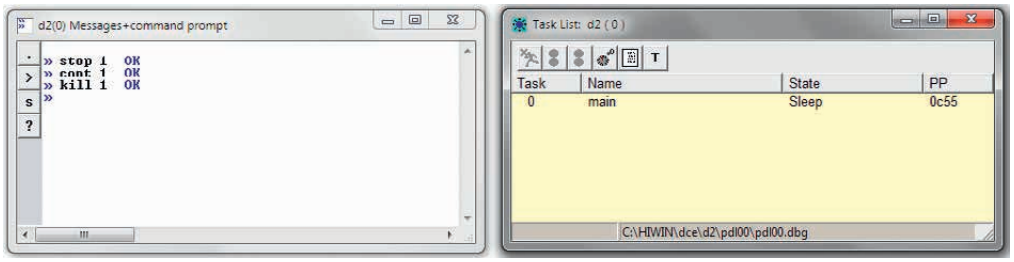


Fig. 9.14 **"Message window" – cancelling task 1**

NOTE

While the drive amplifier is energised, task 1 remains cancelled. This task is automatically restarted either with the "Reset" button (see Section 6.3.4), or if the drive controller is separated from the mains (disconnection of logic voltage).

10. Troubleshooting

⚠ DANGER!

Danger from electrical voltage!

- The drive amplifiers should be de-energised before and during all assembly, disassembly or repair work. Ensure that no-one can reestablish the mains connection. Otherwise there is a risk of death and injury.
- Always ensure that the drive amplifiers are correctly earthed using the PE bar in the switch cabinet as reference potential. Safety is not guaranteed if there is no low-ohm earthing.
- Power connections may be live even if the motor is not moving. Never disconnect the electrical connections of motors and drive amplifiers when live. In the worst case scenario, electric arcs may form, causing personal injury and damage to contacts.
- After disconnecting the drive amplifiers from the supply voltages, wait at least five minutes before touching live parts (e.g. contacts, threaded bolts etc.) or breaking connections. For your own safety measure the voltage in the intermediate circuit and wait until it has fallen below 40 VDC.
- The drive amplifiers should always be operated in conjunction with appropriate safety equipment (zero contact protective equipment, mechanical protective equipment etc.). This protective equipment must be designed, installed and regularly checked in accordance with applicable national and international legislation and specifications.

⚠ WARNING!

Risk of burns!

The surface of the drive amplifier may reach temperatures in excess of 50 °C. There is therefore a risk of burns. The housing must not be touched during or shortly after operation.

- Leave the drive amplifier to cool for at least 15 minutes after switching off.

⚠ WARNING!

Risk of serious injury or death due to uncontrolled movement of motors and machine parts!

Uncontrolled movement of motors and machine parts during installation and during operation can occur after a not defined period of time. Potential causes of uncontrolled movements may be:

- Damaged or defective components
- Incorrect parameterization of the drive
- Error in the software or firmware
- Incorrect handling of the software
- Wiring error
- Manipulation or modification of the wiring during operation
- Signal failure of encoders
- Exceeding the permissible payload of the motor

- Keep out of the dangerous zone of moving machine parts.
- Stop all motor movements safely before entering the dangerous zone.
- Protect the danger zone against unauthorised access.

ATTENTION!

Damage to the drive amplifier!

- Discharge your body before you touch the drive amplifier.
- Avoid contact with highly insulating materials (plastic fibres, plastic films etc.). Place the drive amplifier on a conductive surface. The drive amplifiers contain components at risk from electrostatic which may be damaged if handled incorrectly.

10.1 Error codes and troubleshooting

Table 10.1 **Error codes and troubleshooting**

Code	Display	Error shown in "Lightening"	Description
E01	E01SHORT	Motor short (over current) detected	Short-circuit in the motor power supply
	Rectification of problem: Switch off the amplifier and remove the motor connector. Measure the resistance of all three motor phases on the connector and check whether the measured values deviate from the specifications of the motor. Remove the cable from the motor connector and do the same measurement again directly on the motor to make sure the motor cable does not have a short circuit.		
E02	E02OVERV	Over voltage detected	Intermediate circuit voltage too high
	Rectification of problem: Check whether the main energy supply for the drive amplifier is within the specifications. Also check whether the moved motor mass or its mass inertia is too large. Check whether a brake resistor is required for the used mass.		
E03	E03PEBIG	Position error too big	The actual position error is greater than the **"maximum pos error"** set in the **"Protection center"**
	Rectification of problem: Check whether the **"Common Gain"** amplification is set correctly or whether too low a "**maximum pos error"** value is perhaps selected under the **"Protection"** tab in the **"Application center"**. Check the mechanics for increased friction.		
E04	E04ENCOD	Encoder error	Error in encoder signal
	Rectification of problem: Check whether the encoder is connected correctly and whether the correct encoder type has been selected in the **"Configuration center"**. Use twisted pair and shielded cables.		
E05	E05SWHOT	Soft-thermal threshold reached	Motor overtemperature protection active
	Rectification of problem: Check whether the motor is overloaded. Check whether too high an acceleration has been selected, whether there are any obstacles in the way of the motor and whether the motor has been maintained and lubricated in accordance with the relevant service instructions. Check whether the motor data set in the amplifier deviate from the data of the motor used. Check whether acceleration and speed are too high.		
E06	E06UVWCN	Motor maybe disconnected	Motor cable is not connected correctly
	Rectification of problem: Switch off the amplifier and remove the motor connector. Measure the resistance of all three motor phases on the connector and check whether the measured values deviate from the specifications of the motor. Remove the cable from the motor connector and do the same measurement again directly on the motor to make sure the motor cable does not have a short circuit. The values should be symmetrical.		
E07	E07D.HOT	Amplifier over temperature	Drive amplifier is too hot
	Rectification of problem: Check whether the area around the drive amplifier has sufficient ventilation. A more effective heat sink may be needed for applications with high motor currents. Observe the installation specifications, see Section 4.4 "Switch cabinet assembly" on Page 23.		
E09	E09UND.V	Motor over temperature sensor activated	Motor overtemperature sensor triggered
	Rectification of problem: Check whether the main energy supply is correctly connected to the drive amplifier and whether the energy supply voltage is within the drive amplifier specification. Check the voltage settings in the **"Configuration center"**.		
E10	E10V5ERR	Undervoltage detected	Supply voltage is too low
	Rectification of problem: Please switch off the drive amplifier and connect the encoder plug again. Check the encoder cable for damage.		
E11	E11PHINI	5 V for encoder card fail	Error in encoder power supply
	Rectification of problem: Check whether the motor parameters and encoder parameters in the **"Configuration center"** are set correctly, whether the encoder signal is free of errors, whether the motor load is too high, whether the friction is too high and whether there are any obstacles blocking the motor.		

Table 10.1 **Error codes and troubleshooting (continuation)**

Code	Display	Error shown in "Lightening"	Description
E12	E12SER.E	Serial encoder communication error	Communication error of serial encoder
	Rectification of problem: Switch off the drive amplifier and check whether the encoder cable is connected correctly. Check the wiring of the encoder cable.		
E13	E13HAL.E	Hall sensor error	Encoder Hall sensor error
	Rectification of problem: Check whether the encoder is correctly connected and whether the correct motor type is selected.		
E14	E14PHERR	Hall phase check error	Incorrect Hall sensor check.
	Rectification of problem: Replace motor.		
E15	E15CURER	Current control error	Error Current Loop
	Rectification of problem: Check that the correct motor type has been selected and that the correct KP has been set for the common gain and the current controller's proportional gain. In addition, check the encoder cable.		
E17	E17HYBDV	Hybrid deviation too big	In dual loop mode, the hybrid deviation exceeds the threshold
	Rectification of problem: Please check that the correct linear encoder parameters have been set, the linear and rotary encoder directions agree, and the linear encoder is not experiencing EMC problems. Please check that the motor coupling and gears are connected correctly and that the pitch tolerance and spindle backlash are small enough.		
E19	E19HFLT	HFLT inconsistent error	The drive error messages are inconsistent.
	Rectification of problem: Incoming fault events have a temporal overlap, as a result of which the drive amplifier produced the error mentioned. Analyse the timing of digital or safety inputs that are set. Improving earthing can also help.		
E21	E21WRGMT	Incompatible motor model and drive	Motor type and drive amplifier are incompatible.
	Rectification of problem: Check motor data and motor type and compare the values with the performance data of the amplifier.		
E22	E22BUS.E	DC bus voltage abnormal	Intermediate circuit voltage defect.
	Rectification of problem: Check the supply to the drive amplifier.		
E23	E23NOET	EtherCAT interface is not detected	EtherCAT hardware not detected.
	Rectification of problem: Check the firmware version of the drive amplifier, if necessary, contact technical support (Section 2.5 "HIWIN technical support" on Page 10).		
E24	E24HOM.E	CiA 402 homing error	Error on executing the CiA402 reference travel
	Rectification of problem: Check the function of reference switch, limit switch, and reference mark. Check the cam switch and the strength of the encoder head. Check whether the reference run has been interrupted by an incident.		
E25	E25FAN.E	Fan fault error	Problem with internal fan
	Rectification of problem: Check the function of the internal fan.		

10.2 Warnings and problem rectification

Table 10.2 **Warnings and problem rectification**

Code	Display	Error shown in "Lightening"	Description
W01	W01SWLL	Left SW limit	Motor has reached maximum left position and must not exceed this.
	Rectification of problem: If an undesired event has occurred, adapt the **"Lower SW limit"** value under the **"Protection"** tab in the **"Application center"**.		
W02	W02SWRL	Right SW limit	Motor has reached maximum right position and must not exceed this.
	Rectification of problem: If an undesired event has occurred, adapt the **"Upper SW limit"** value under the **"Protection"** tab in the **"Application center"**.		
W03	W03HWLL	Left HW limit	Negative hardware limit switch active. Motor must not exceed this position.
	Rectification of problem: If this is an unexpected event, check whether the hardware limit switch has actually triggered. Also check in the **"I/O set/test"** window whether the limit switch logic is set correctly.		
W04	W04HWRL	Right HW limit	Positive hardware limit switch active. Motor must not exceed this position.
	Rectification of problem: If this is an unexpected event, check whether the hardware limit switch has actually triggered. Also check in the **"I/O set/test"** window whether the limit switch logic is set correctly.		
W05	W05SVBIG	Servo voltage big	Motor speed is just under the limit above which the amplifier voltage is no longer sufficient.
	Rectification of problem: If this is an unexpected event, check whether the input voltage is perhaps too low, the motor cable is defective or the moved mass of the motor or its mass inertia is too high.		
W06	W06PE	Position error warning	Position error exceeds set warning level
	Rectification of problem: If this is an unexpected event, check whether the **"Common Gain"** amplification is set correctly and whether too low a **"Position error"** value is perhaps selected under the **"Protection"** tab in the **"Application center"**.		
W07	W07VE	Velocity error warning	Motor speed exceeds set warning limit
	Rectification of problem: Check whether the **"Common Gain"** amplification is set correctly and whether too low a **"Position error"** value is perhaps selected under the **"Protection"** tab in the **"Application center"**.		
W08	W08CUR.L	Current Limited	The motor output current has reached the permissible limit and is now limited to the maximum permitted current.
	Rectification of problem: Check whether the acceleration is set too high or there are any obstacles in the way of the motor.		
W09	W09ACC.L	Acceleration Limited	The acceleration has reached the limit set in **"Velocity mode"**. Acceleration does not exceed the set limit value.
	Rectification of problem: Increase the corresponding value in the **"Performance center"** under **"Motion Protection"**.		
W10	W10VEL.L	Velocity Limited	The speed has reached the limit set in **"Velocity mode"**. Speed does not exceed the set limit value.
	Rectification of problem: Increase the corresponding value in the **"Performance center"** under **"Motion Protection"**.		

Table 10.2 **Warnings and problem rectification (continuation)**

Code	Display	Error shown in "Lightening"	Description
W11	W11BOTH	Both HW limits are active	Positive and negative hardware limit switches are active..
	Rectification of problem: If your limit switches are really not triggering at the same time, check the setting of the logic for the two limit switches in the **"I/O set/test"** window		
W12	W12I2T	I2T warning	I2T warning, motor overload
	Rectification of problem: Change cycle time, reduce dynamism or load.		
W13	E13HOM.E	Homing fail	Reference travel failed.
	Rectification of problem: Please check the limit sensor switch (positive and negative), the reference switch, and the reference mark of the measuring system. Check the values for **"Search end stop current"** and **"Time out"** (Section 6.5.1 and 6.5.2).		
W14	W14HOM.C	Pulse command and homing conflict	Homing procedure influenced by pulse/ direction signals
	Rectification of problem: Please do not send pulse/direction commands during reference travel, which runs internally in the amplifier.		
W15	E15BAT.E	Absolute encoder battery warning	Voltage of encoder battery too low
	Rectification of problem: Change batteries.		
W16	E16ABS.W	Wrong absolute position	Absolute position is not correct
	Reset the home position (zero position).		

10.3 Other errors and problem rectification

Table 10.3 **Other errors and problem rectification**

No	Description	Rectification of problem
1	Speed or acceleration is too low if the amplifier is getting its nominal values externally via the I/O interface CN6.	Check the permitted limit values in the **"Performance center"** under **"Motion Protection"** and increase them if necessary.
2	The motor's direction of motion has changed over.	Run the **"Auto tune center"** again and use the **"TD"** button to adapt the positive direction of motion.
3	The motor is subject to control but is not moving.	1. Use the **"Scope"** function to check whether the amplifier is receiving pulses from the controller. 2. Check the control cable 3. Check whether the 0 V potential and earth and/or shielding are short circuited. 4. Check whether the drive amplifier and motor are earthed correctly.
4	The motor is too loud	1. Reduce the **"Common Gain"** (CG) 2. Configure a filter

10.4 Status LED

Fig. 10.1 **Status LED**

The drive' status LED is located next to the CN3 USB port on the front. It shows the current state of the device, see Table 10.4.

Table 10.4 **Description of LED status**

State of the LED	Meaning
LED off	There is no voltage
Red and green flashing	Boot sequency
Green flashing	Motor is not energised
Solid green	Motor is energised
Green flashing and solid red	Motor is not energised and there is an error.

NOTE

If the status of the LED is orange, the green and red LED will light simultaneously.

11. EtherCAT

11.1 D2 EtherCAT with CoE protocol

The D2 servo drive amplifier supports the Ethernet-based EtherCAT field bus system. EtherCAT technology is regulated in international standards IEC 61158, IEC 61784 and ISO 15745-4. The real time capability of this bus system is suited to use in cycle-synchronous motion control applications.
EtherCAT with CoE (CAN over EtherCAT) protocol is supported only by devices with the following type code:
D2(T)-xxxx-E-xx

EtherCAT with mega_ulink (HIWIN) protocol (see Chapter 9 on Page 122) is supported only by devices with the following type code:
D2(T)-xxxx-F-xx

Features

- Physical interface: 1 × RJ45 (IN) and 1 × RJ45 (OUT)
- Transmission rate: 100 Mbit/s
- Status display: 2 × LED link/activity
- Communication profile: CoE DS402
- Synchronisation methods: DC-synchronous (distributed clock, jitter < 1 µs)
- Communication cycle time: 62.5 µs (16 kHz)

CiA 402 operation modes

The following modes are supported:

- Cyclic synchronous position mode
- Cyclic synchronous velocity mode

11.1.1 Integration of a D2 in a TwinCAT project

These instructions describe only the settings needed to operate the D2 at a Beckhoff controller. Basic knowledge of TwinCAT system operations is assumed and is not part of these instructions.

11.1.2 Installing the ESI file

An ESI file (EtherCAT slave information) for the D2 is available for download in the XML format. This file can be downloaded from the internet address www.hiwin.de. Alternatively, contact HIWIN support (see Section 2.5 on Page 10). The ESI file described in Section 11.1.3 must first have been installed correctly before the D2 can be used in a TwinCAT project. For TwinCAT 3.1 systems, the file must be copied to the directory "C:\TwinCAT\3.1\Config\Io\EtherCAT". For older TwinCAT 2.xx versions, the file must be copied to "C:\TwinCAT\Io\EtherCAT".
Launching the TwinCAT development environment automatically reads in and adds the new file to the list of available devices.

11.1.3 Adding devices by scan

The easiest way to add a new device or all new devices to a project is to scan them in. For this purpose, the EtherCAT network must be wired correctly (see Section 5.7 on Page 42).

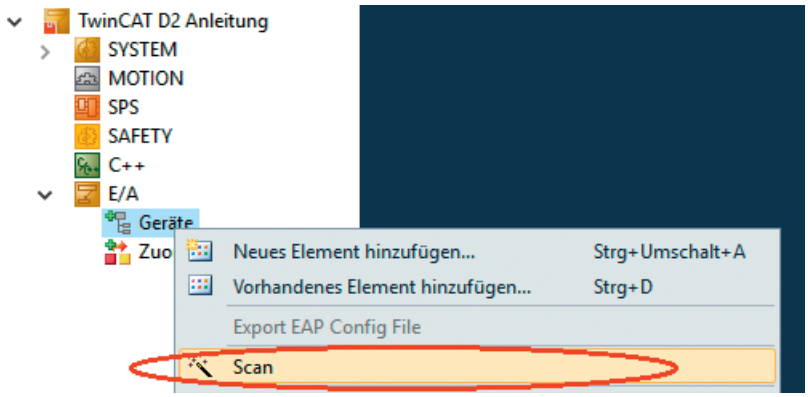


Fig. 11.1 **Scanning available devices**

The message stating that not all available devices can be detected automatically must be acknowledged with **"OK"**. When all devices have been scanned successfully, the input mask depicted in Fig. 11.3 appears. Normally, an EtherCAT master with links to slaves is preselected automatically. This dialogue must be confirmed with **"OK"**.

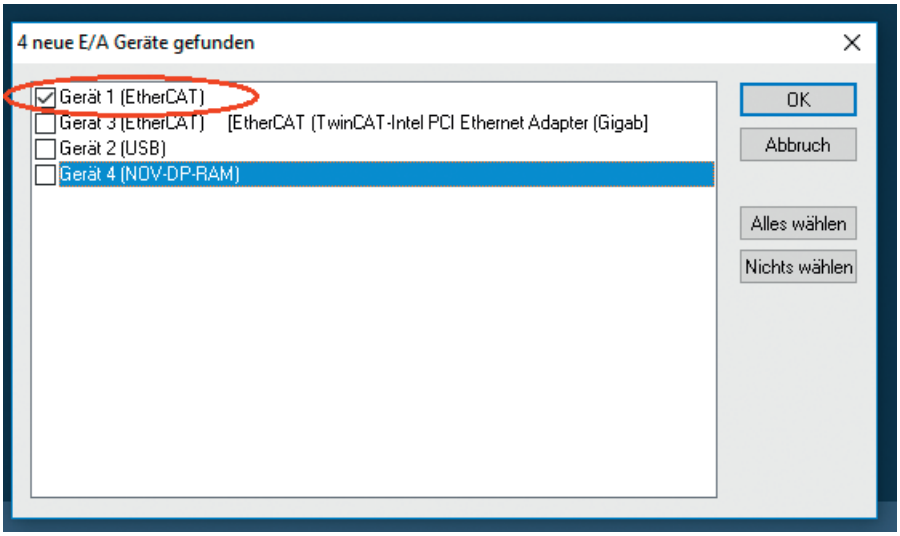


Fig. 11.2 **Dialogue for adding new devices**

The next step prompts the user to find **"new boxes"**. The system then searches for and adds the slaves.

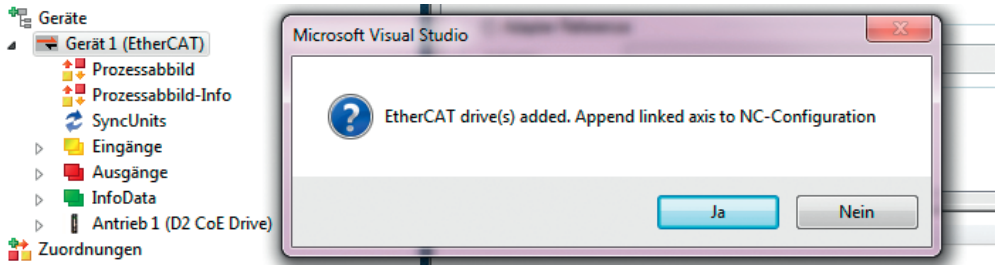


Fig. 11.3 **Automatically adding NC axes**

When the TwinCAT system detects a drive, its NC axis may be added automatically as well (Fig. 11.3). The great advantage here is that all PDOs are linked automatically for this NC axis. Fig. 11.4 depicts a device that has been integrated correctly.

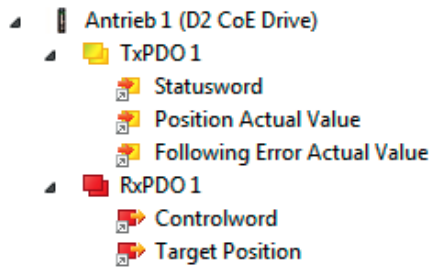


Fig. 11.4 **Completely linked device**

Automatically adding a drive's NC axis also configures most of the basic parameters. Only the following parameters need then be configured for operating the axis.

11.1.4 Setting the axis resolution

The scaling factor for the NC axis must be adjusted to the "Lightening" encoder resolution or interpolation factor (Fig. 11.5).

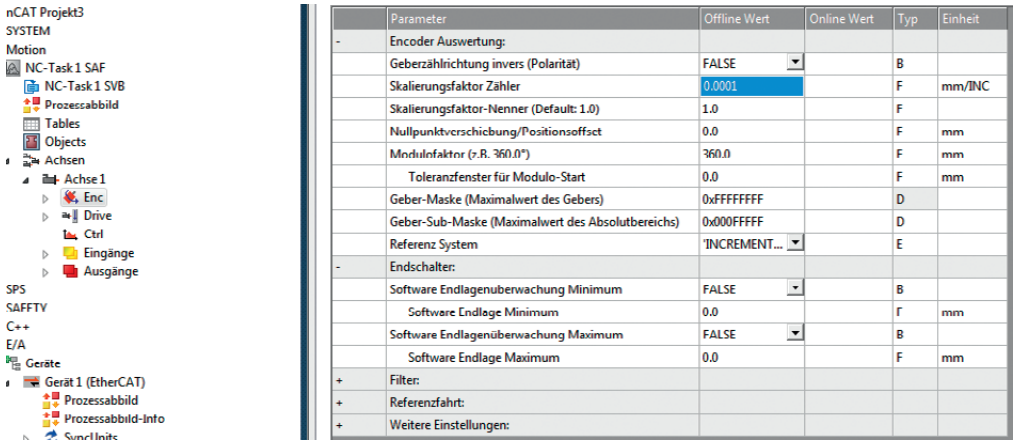


Fig. 11.5 **Parameterising the axis resolution**

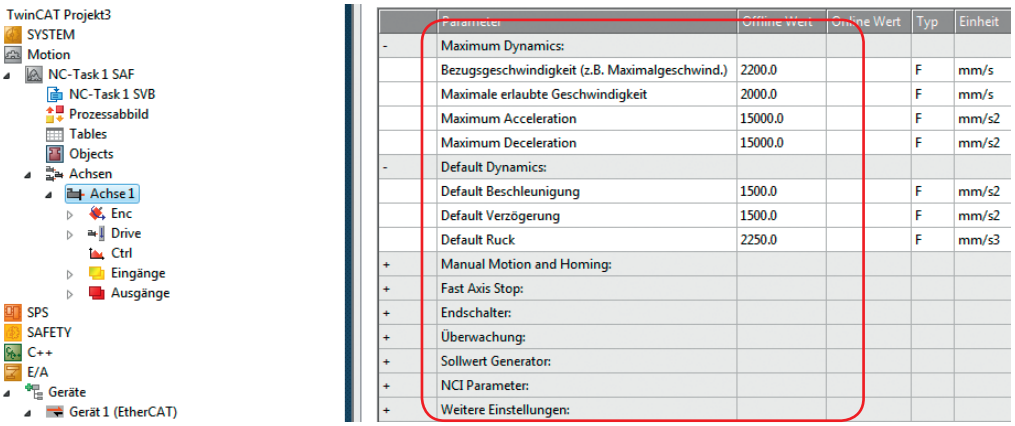
For example, a linear, analogue positioning measurement system with 1 mm graduations and an interpolation factor of 1,000 operates with a resolution of 0.001 mm/incr. The values must be calculated analogously for rotary axes.

11.1.5 Setting the maximum speed

ATTENTION!

Choosing bigger values for speed and acceleration than the limit values in "Lightening", leads to a not synchronous movement and position error.

The "Lightening" limits for speed and acceleration serve to monitor movements and hence contain the maximum dynamic response. This limit should be entered analogously for the NC axis (Fig. 11.6).



	Parameter	Offline Wert	Online Wert	Typ	Einheit
-	Maximum Dynamics:				
	Bezugsgeschwindigkeit (z.B. Maximalgeschwind.)	2200.0		F	mm/s
	Maximale erlaubte Geschwindigkeit	2000.0		F	mm/s
	Maximum Acceleration	15000.0		F	mm/s2
	Maximum Deceleration	15000.0		F	mm/s2
-	Default Dynamics:				
	Default Beschleunigung	1500.0		F	mm/s2
	Default Verzögerung	1500.0		F	mm/s2
	Default Ruck	2250.0		F	mm/s3
+	Manual Motion and Homing:				
+	Fast Axis Stop:				
+	Endschalter:				
+	Überwachung:				
+	Sollwert Generator:				
+	NCI Parameter:				
+	Weitere Einstellungen:				

Fig. 11.6 **Defining dynamic response limits**

The limits defined here should always equal the values entered in "Lightening". However, also smaller values may be selected.

12. Repair and replacement

In case the D2 is defective or does not work correctly anymore, please contact HIWIN (see Section 2.5).
They will support you for repair or replacement of the D2.

⚠ DANGER!

Danger from electrical voltage!

- The drive amplifiers should be de-energised before and during all assembly, disassembly or repair work. Ensure that no-one can reestablish the mains connection. Otherwise there is a risk of death and injury.
- Always ensure that the drive amplifiers are correctly earthed using the PE bar in the switch cabinet as reference potential. Safety is not guaranteed if there is no low-ohm earthing.
- Power connections may be live even if the motor is not moving. Never disconnect the electrical connections of motors and drive amplifiers when live. In the worst case scenario, electric arcs may form, causing personal injury and damage to contacts.
- After disconnecting the drive amplifiers from the supply voltages, wait at least five minutes before touching live parts (e.g. contacts, threaded bolts etc.) or breaking connections. For your own safety measure the voltage in the intermediate circuit and wait until it has fallen below 40 VDC.
- The drive amplifiers should always be operated in conjunction with appropriate safety equipment (zero contact protective equipment, mechanical protective equipment etc.). This protective equipment must be designed, installed and regularly checked in accordance with applicable national and international legislation and specifications.

⚠ WARNING!

Risk of burns!

The surface of the drive amplifier may reach temperatures in excess of 50 °C. There is therefore a risk of burns. The housing must not be touched during or shortly after operation.

- Leave the drive amplifier to cool for at least 15 minutes after switching off.

⚠ WARNING!

Risk of serious injury or death due to uncontrolled movement of motors and machine parts!

Uncontrolled movement of motors and machine parts during installation and during operation can occur after a not defined period of time. Potential causes of uncontrolled movements may be:

- Damaged or defective components
- Incorrect parameterization of the drive
- Error in the software or firmware
- Incorrect handling of the software
- Wiring error
- Manipulation or modification of the wiring during operation
- Signal failure of encoders
- Exceeding the permissible payload of the motor

- Keep out of the dangerous zone of moving machine parts.
- Stop all motor movements safely before entering the dangerous zone.
- Protect the danger zone against unauthorised access.

ATTENTION!

Damage to the drive amplifier!

- Discharge your body before you touch the drive amplifier.
- Avoid contact with highly insulating materials (plastic fibres, plastic films etc.). Place the drive amplifier on a conductive surface. The drive amplifiers contain components at risk from electrostatic which may be damaged if handled incorrectly.

13. Parts numbers and accessories

13.1 Article numbers for drive amplifier sets

Table 13.1 **Article numbers for drive amplifier sets D2**

Description	Content	Article number
D2-0123-S-A0	1 × D2, standard, 100 W, 1 × connector kit CK3	23.00023
D2-0423-S-B0	1× D2, standard, 400 W, 1 × connector kit CK3	23.00022
D2-1023-S-C0	1× D2, standard, 1.000 W, 1 × connector kit CK3	23.00024
D2-0123-F-A0	1 × D2, mega-ulink, 100 W, 1 × connector kit CK3	23.00029
D2-0423-F-B0	1 × D2, mega-ulink, 400 W, 1 × connector kit CK3	23.00028
D2-1023-F-C0	1 × D2, mega-ulink, 1.000 W, 1 × connector kit CK3	23.00030
D2-0123-E-A0	1 × D2, EtherCAT (CoE), 100 W, 1 × connector kit CK3	23.00025
D2-0423-E-B0	1 × D2, EtherCAT (CoE), 400 W, 1 × connector kit CK3	23.00026
D2-1023-E-C0	1 × D2, EtherCAT (CoE), 1.000 W, 1 × connector kit CK3	23.00027

Table 13.2 **Article numbers for drive amplifier sets D2T**

Description	Content	Article number
D2T-0123-E-A4	1 × D2T, EtherCAT (CoE) for singleturn absolute encoder, 100 W, 1 × connector kit CK3	23.00033
D2T-0423-E-B4	1 × D2T, EtherCAT (CoE) for singleturn absolute encoder, 400 W, 1 × connector kit CK3	23.00034
D2T-1023-E-C4	1 × D2T, EtherCAT (CoE) for singleturn absolute encoder, 1,000 W, 1 × connector kit CK3	23.00035
D2T-2032-E-D4	1 × D2T, EtherCAT (CoE), for singleturn absolute encoder, 2,000 W, 1 × connector kit CK3	23.00036
D2T-0123-E-A5	1 × D2T, EtherCAT (CoE) for multiturn absolute encoder, 100 W, 1 × connector kit CK3	23.00037
D2T-0423-E-B5	1 × D2T, EtherCAT (CoE) for multiturn absolute encoder, 400 W, 1 × connector kit CK3	23.00038
D2T-1023-E-C5	1 × D2T, EtherCAT (CoE) for multiturn absolute encoder, 1,000 W, 1 × connector kit CK3	23.00039
D2T-2023-E-D5	1 × D2T, EtherCAT (CoE) for multiturn absolute encoder, 2,000 W, 1 × connector kit CK3	23.00040
D2T-0123-F-A4	1 × D2T, mega-ulink for singleturn absolute encoder, 100 W, 1 × connector kit CK3	23.00041
D2T-0423-F-B4	1 × D2T, mega-ulink for singleturn absolute encoder, 400 W, 1 × connector kit CK3	23.00042
D2T-1023-F-C4	1 × D2T, mega-ulink for singleturn absolute encoder, 1,000 W, 1 × connector kit CK3	23.00043
D2T-2032-F-D4	1 × D2T, mega-ulink for singleturn absolute encoder, 2,000 W, 1 × connector kit CK3	23.00044

13.2 Article numbers for motor cables

Table 13.3 **Article numbers for motor cables D2/D2T**

Description	Length [m]	Article number
HIWIN motor cables for HIWIN servo motors with brake	3	8-10-0623
	5	8-10-0624
	7	8-10-0625
	10	8-10-0630
HIWIN motor cables for HIWIN servo motors without brake	3	8-10-0627
	5	8-10-0628
	7	8-10-0629
	10	8-10-0626
HIWIN motor cables for HIWIN servo motors for models 1 kW and 2 kW	3	8-10-0851
	5	8-10-0852
	7	8-10-0853
	10	8-10-0854
HIWIN brake lines for HIWIN servo motors for models 1 kW and 2 kW	3	8-10-0855
	5	8-10-0856
	7	8-10-0857
	10	8-10-0858

13.3 Article numbers for encoder cables

Table 13.4 **Article numbers for encoder cables D2**

Description	Length [m]	Article number
HIWIN encoder cables for HIWIN servo motors	3	8-10-0751
	5	8-10-0752
	7	8-10-0753
	10	8-10-0754

Table 13.5 **Article numbers for encoder cables D2T**

Description	Length [m]	Article number
HIWIN encoder cables for HIWIN servo motors (singleturn)	3	8-10-0983
	5	8-10-0984
	7	8-10-0985
	10	8-10-0986
HIWIN encoder cables for HIWIN servo motors 1 kW and 2 kW (singleturn)	3	8-10-0987
	5	8-10-0988
	7	8-10-0989
	10	8-10-0990
HIWIN encoder cables for HIWIN servo motors (multiturn)	3	8-10-0991
	5	8-10-0992
	7	8-10-0993
	10	8-10-0994
HIWIN encoder cables for HIWIN servo motors 1 kW and 2 kW (multiturn)	3	8-10-0995
	5	8-10-0996
	7	8-10-0997
	10	8-10-0998

13.4 Article number for control cable

Table 13.6 **Article number for control cable**

Description	Length [m]	Article number
D2 I/O cable with connector (CN6) and open end	3	8-10-0763

13.5 USB communication cable

Standard USB communication cables with ferrite rings can be used.

13.6 Article number for connector kits

Table 13.7 **Article number for connector kits**

Description	Contents	Quantity	Article number
D2 connector kit CK3	**Connectors for CN1**	1	8-10-0805
	Connectors for CN2	1	
	Connectors for CN6	1	

13.7 Article numbers for EMC accessories package

Table 13.8 **Article numbers for EMC accessories package**

Description	Quantity	Article number
D2 EMC1 filter 1-phase 50 – 400 W	1	8-09-0439
D2 EMC1 filter 1-phase 750 – 1,000 W	1	8-09-0374
D2 EMC1 filter 3-phase	1	8-09-0440

13.8 Article number for brake resistor

Table 13.9 **Article number for brake resistor**

Description	Quantity	Article number
300 W/80 Ω brake resistor	1	8-09-0015

13.9 Article number for mains filter

Table 13.10 **Article number for mains filter**

Description	Quantity	Article number
Motor filter	1	8-09-0564

14. Declaration of Conformity

According to EC directive 2014/35/EU (Low Voltage Directive)

Manufacturer:
HIWIN MIKROSYSTEM CORP., Ltd
No.6, Jingke Central Rd.
Taichung Precision Machinery Park
Taichung City 40852, Taiwan

This declaration relates exclusively to the following product in the state in which it was placed on the market, and excludes components which are added and/or operations carried out subsequently by the final user. The declaration is no more valid, if the product is modified without agreement.

Product denomination:	Servo drive amplifier
Model/type:	D2-0123, D2-0423, D2-1023, D2-2023, D2T-0123, D2T-0423, D2T-1023, D2T-2023
Year of manufacture:	From 2017

The manufacturer hereby declares that the product is complying with all essential requirements of the Directive 2014/35/EU (Low Voltage Directive) relating to electrical equipment.

In addition the product is in conformity with the EC Directive:
- EC Directive on electromagnetic compatibility (2014/30/EU)
- EC RoHS Directive on the restriction of hazardous substances (2011/65/EU)

Harmonised standards used:
- EN 55011:2009+A1:2010
- EN 61000-6-2:2005
- EN 61000-6-4:2007 + A1:2011
- EN 61800-5-1:2007

Offenburg, February 2017

Werner Mäurer
Managing Director

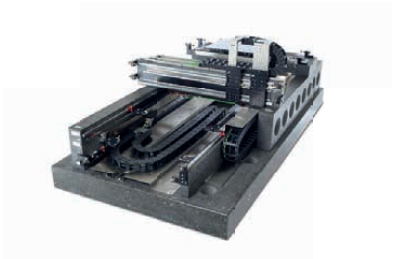
Notes

Notes

Notes

Linear Guideways

Ballscrews



Linear Motor Systems

Linear Axes

Linear Actuators

Robots

Linear Motor Components

Rotary Tables

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