EDCi

Installation Manual

(original manual)

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1 Safety

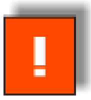
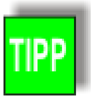
1.1 General Safety Hints

Read this manual carefully before starting with the installation and operation of the EDC. False handling of the instrument can cause severe damage to persons and property. It is essential to adhere to the technical directions and connection conditions from the name plate and documentations.

1.1.1 Warning Signs

The manual contains warning signs adverting to possibly dangerous situations. These warning signs may be found on the instrument, too. It is essential to adhere to the warning signs and the related hints:

Table 1: Symbols and their meanings

Symbol	Meaning
	**Safety Instructions:** In order to avoid interruptions in the workflow as well as damages to man and machine, follow the safety instructions at all cost.
	**Safety Instructions: Danger by electricity and its effects** In order to avoid interruptions in the workflow as well as damages to man and machine, follow the safety instructions at all cost.
	**Note:** Important note for the operation, the function or for the working procedures.
	**Tipp/Hint:** **Gives tips for easy handling of the EDCs or the testing instrument.**

1.1.2 Demands on personnel

Attention! Only qualified personnel are allowed to perform transport, mounting, installation, start-up, operation or maintenance.

Qualified personnel are people being well acquainted with transport, mounting, installation, start-up, operation or maintenance. These people must be adequately qualified for their occupations. In detail:

- Transport: Personnel skilled in treating componentry are being susceptible to electrical discharge, only!
- Installation: Personnel with electro-technical apprenticeship, only!
- Start-up: Personnel with wide-ranged skills in the fields of electrotechnics and/or drive engineering, only!
- The qualified personnel must know and adhere to the following standards and directions:
  HD 60364 respectively CENELEC HD 384 or DIN VDE 0100
  National accident prevention directives or DGUV V3, DGUV V4.

Attention! The devices do contain components being susceptible to electrical discharge. These components may be damaged by incorrect treatment. Always wear an earth strap to dissipate any electrostatic body charge before handling any instrumentation. Avoid the contact with highly insulating material (synthetic fibers, synthetic foils etc.). Place all units on a conductive base mat.

Attention! Do not open the devices! Keep all coverings closed during operation. There is danger of dead or severe damage to persons or property.

Attention! Draw the mains plug before opening the covering of the devices. There is danger of dead or severe damage to persons or property.

Attention! Never disconnect any electrical connection while the device is still energized. In bad cases, electric arcs may emerge and damage persons or property.

Attention! Mount and place the EDC in a manner, that the emergency-off can be reached and activated easily and that the mains plug can be reached and drawn easily.

Attention! After having drawn the mains plug, wait at least two minutes before touching potentially live components (e.g. contacts, thread bolts) or disconnecting any electrical connection. After disconnection of the supply voltage, capacitors may bear dangerous voltages for up to two minutes. For your safety, it is recommended to measure the voltage in the link and wait, until it has fallen below 40V.

1.2 Legal use of the EDC

The EDC is designed for use with testing instrument systems and must only be operated as an integrated component. The EDC must only be used with a 230/115V, 50/60Hz. single-phase mains supply and in accordance with the environmental conditions defined in this manual. Adhere to the instructions given in this manual.

Attention! Inappropriate handling of the device may affect its functionality or cause severe damage to persons or property.

1.3 CE Conformity, Directives and Standards

DOLI EDC appliances and components meet the requirements of the following directives:

- EMC Directive 2014/30/EC
- Low Voltage Directive 2014/35/EC
- EC RoHS Directive 2011/65/EC and Delegated Directive (EU) 2015/863

If these appliances are used as integrated control for testers, they will be considered as electronic component supporting Machinery Directive 2006/42/EC, e.g. E-Stop button.

<u>Standards for the adherence of the Machinery Directive 2006/42/EC</u>
EN ISO 12100
DIN EN ISO 13849-1:2008
DIN EN ISO 13850:2008

<u>Standards for the adherence of the EMC Directive 2014/30/EC</u>
IEC 61326-1:2012

<u>Standards for the adherence of the Low Voltage Directive 2014/35/EC</u>
IEC 61010-1:2010
IEC 61010-2-x

1.4 Switch on the Instrument

Attention! During all stages of the initializing instrument setup and until all functions have been checked, it is essential that the operator remains within easy reach of the EMERGENCY STOP, or MAINS SWITCH! Because under some faulty conditions, it may be possible to start up but not stop the instrument, except by using the EMERGENCY STOP or the MAINS SWITCH.

Attention! If the motor/piston moves intermittently or races out of control, press the EMERGENCY STOP!

1.4.1 Check position

Before activating the drive, check (if existing) the direction of the position display. If the crosshead travels in a tensile loading direction, the position display must indicate a more positive value. If this isn't so, the polarity signal of the position sensor must be altered in the setup-menu.

Attention! The motor/piston may possibly move or race out of control, if the wrong polarity was selected and can be stopped by using the EMERGENCY STOP button, only!

When the position display has the correct polarity, the active controller output must be checked due to the same reasons.

1.4.2 Starting the instrument for the first time

Before starting the instrument for the first time, check the function of the EMERGENCY STOP and all connected limit switches. If a limit switch or the EMERGENCY STOP was triggered and you try to switch on the drive, a corresponding error message should be shown. It shouldn't be possible to turn on the testing instrument.

The following signal sequence must occur, before it will be possible to start the instrument.

- No limit switch activated
- No EMERGENCY STOP active

The next step is to activate the drive of the testing instrument:

- Switch on the drive
- Attempt to move the crosshead

Note: If the crosshead races in an uncontrolled manner, the output channel polarity must be changed in the setup menu (refer to chapter 3.6).

- Repeat process and move the crosshead in a controlled manner.

If the crosshead remains out of control irrespective of the controller polarity, the problem lies elsewhere and the cause must be investigated. Possible reasons are:

- Motor connected incorrectly
- Faulty motor control amplifier
- Control output is being saturated due to wrong parameter settings
- Incremental transducer not firmly connected to the motor shaft
- Control parameters (Gain etc.) too large
- Wrong limits set

Attention! When the instrument appears to be operating correctly, the EMERGENCY STOP and LIMIT SWITCH functions must be re-checked.

The motor contactor must open as soon as a limit switch or emergency stop button is activated. A shut down message must appear on the EDC display (Standalone) or the PC.

To comply with conventional sign standards, the polarity of the position-, load- and extension sensors must be set. The following definitions stand for the sign standards:

- Position	Movement in the direction that would apply a tensile load must produce a more positive value.
- Load	Tensile loads must produce positive values and compressive loads negative values.
- Extension	A tensile extension must produce a positive value.

When utilizing pressure transducers (single and differential) or externally mounted displacement transducers for position or extension measurement, the above conditions regarding polarity must always be adhered to, if the sensor is to be used for control purposes.

Load cells and extensometers can usually be checked by manually applying a load or extension. Care must always be exercised when working with low capacity and delicate devices. Closed loop controller adjustment

Attention! The closed-loop controller adjustment program must be used by trained personnel, only.

This program is used to adjust closed-loop control parameters for position and speed in all control modes.

Before starting the closed-loop control adjustment program, the nominal data for the instrument must be calculated and entered into the setup. The following conditions are important in particular:

1. Measuring channels scaling.
2. Instrument nominal speed value.
3. Nominal acceleration value.
4. Correct polarity of measuring- and output channels (positive controller output generates positive position and load change).
5. Correct controller structure selected.
6. If possible, pre-select parameters that have been determined in previous similar configurations for the controller.

2 EDCi Overview

This chapter provides a short description of all available EDCi devices. The **EDCi** electronics from DOLI are powerful and cost-effective systems especially designed for data acquisition and closed-loop control of testing instruments. The **EDCi** systems technically succeed the well-established EDC family, starting with EDC5/25/100 and EDC60/120 up to EDC220V/222V/580V.

2.1 EDCi Application

Table 2: EDCi housing

Housing	EDCi10	EDCi15	EDCi20	EDCi22	EDCi50	EDCi52	EDCi70	EDCi72
Cabinet	✓	✓	✓		✓		✓	
Desktop				✓		✓		✓

- The **EDCi10** is designed for basic **static testing instruments**. Differences to EDCi20 are:
  - Smaller cabinet.
  - No iSI option slots.
  - No 160/320W DC drive and valve amplifiers.
  - No USB port for PC communication.
  - No standalone tests.
  - No IO signals, except IO Key for a simple RMC.
  - No serial and calculated sensors.
  - Reduced command set:
    - No block command.
    - No PC command.
    - No DynCycle sweeps, superposition, bimodal mode, modify flag.
    - No DoSA interface.
- The **EDCi15** is designed for **static creep testing instruments**. It includes the **iCREEP** distribution board with special designed connectors (no DOLI sensor plugs needed):
  - X7 SGS-IL incremental line driver sensor
  - X23A/X23C 2 x incremental 1Vpp sine sensors (Heidenhain ST1288/ST3088)
  - X2 8 x digital inputs/outputs
  - Y1 RS485 serial port for external temperature controllers
- The **EDCi20/22** are designed for **static testing instruments**. Three general purpose iSI option slots are on board. The **EDCi22** has a desktop housing and therefore an optional display, keyboard and internal 160/320W DC drive amplifiers are available.
- The **EDCi50/52** are designed for **static and dynamic testing instruments**. Three general purpose iSI option slots are on board. The **EDCi52** has a desktop housing and therefore an optional display, keyboard and internal 160/320W DC drive amplifiers are available.
- The **EDCi70/72** are designed for **static and dynamic testing instruments**. Eight general purpose iSI option slots are on board. The **EDCi72** has a desktop housing and therefore an optional display, keyboard and internal 160/320W DC drive amplifiers are available.

The **EDCi** fits for:

- Screw driven instruments. The **EDCi20/22/50/52** has a load channel and an incremental position channel with a controlled ±10 Volt output for power amplifiers. An iDCA or iCFA iSI board is available for the load channel at an **EDCi70/72**.
- Screw driven instruments with a specially adapted DOLI power amplifier for DC-servo motors. For servo motors with 160 W or 320 W, integrated amplifiers will be used (**EDCix2**).
- Screw driven instruments with any power amplifier. They are driven by a ±10 Volt or digital command output. All necessary control signals to drive external power amplifiers are provided.
- Hydraulic instruments, which are driven by a ±10 Volt powered valve.
- Hydraulic instruments, which are driven by a servo-valve.
- Dynamic instruments (**EDCi50/52/70/72**), which are driven either hydraulically / pneumatically by a servo-

valve or by a linear motor.
- Further load cells, LVDTs, extension gauges, extensometers, 2 channel incremental extensometers, serial controlled extensometers, further I/O's, synchronizing several EDCs in a multi-channel application. For these applications further options are needed!

2.2 EDCi Block Diagram

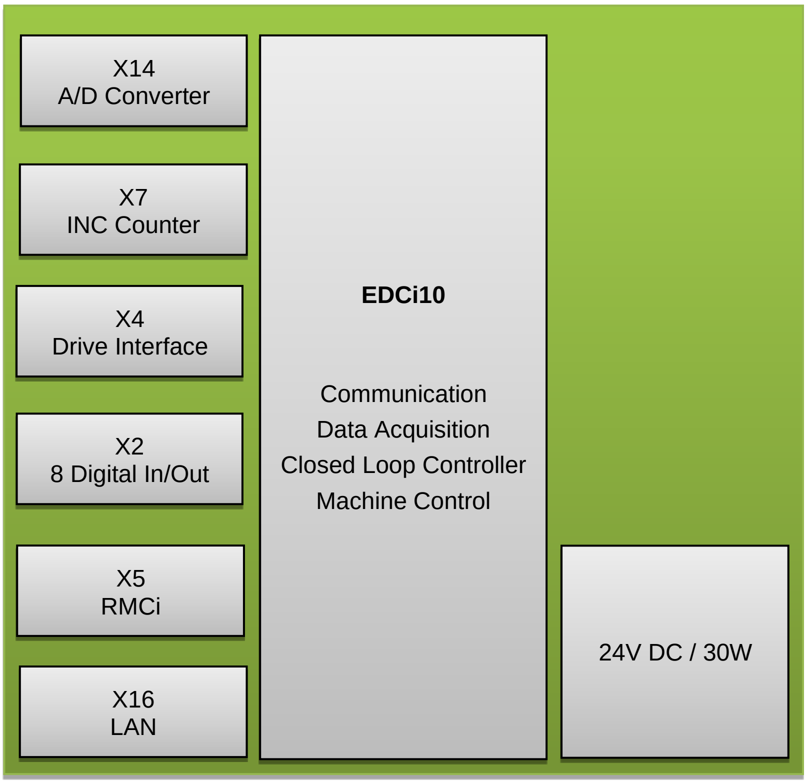


Fig. 1: Block diagram EDCi10

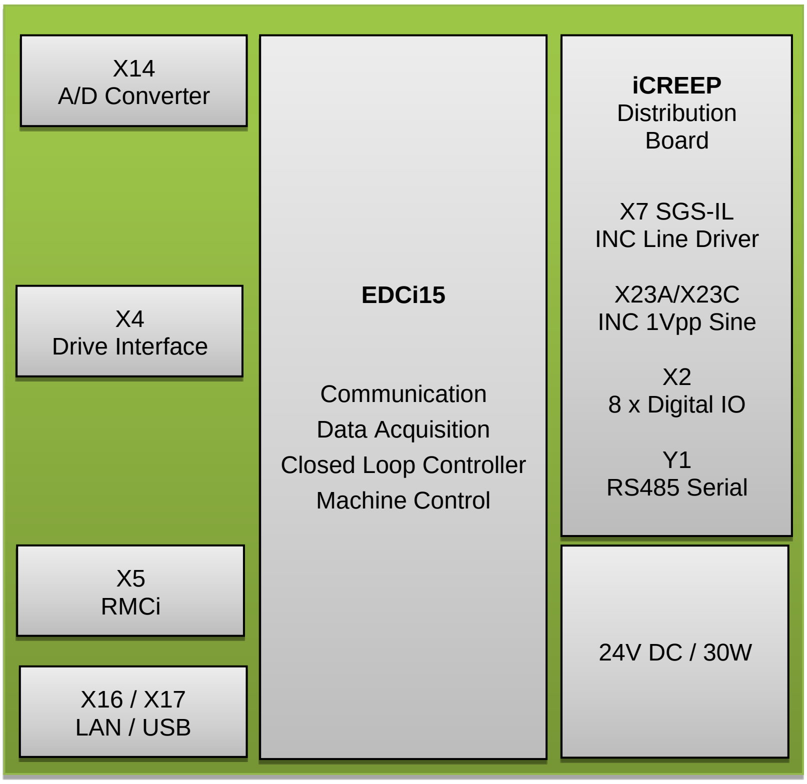


Fig. 2: Block diagram EDCi15

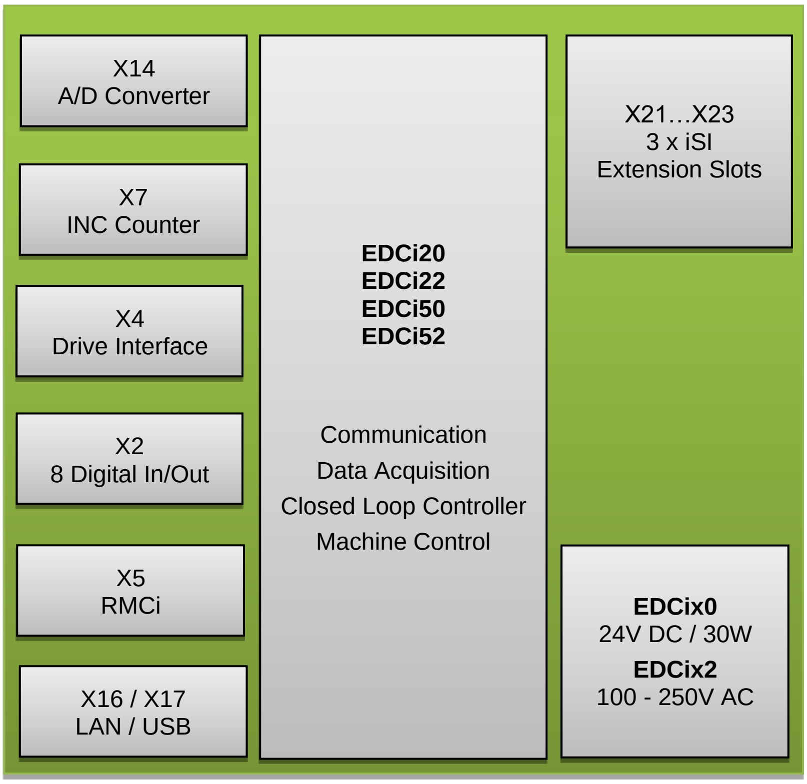


Fig. 3: Block diagram EDCi20/22/50/52

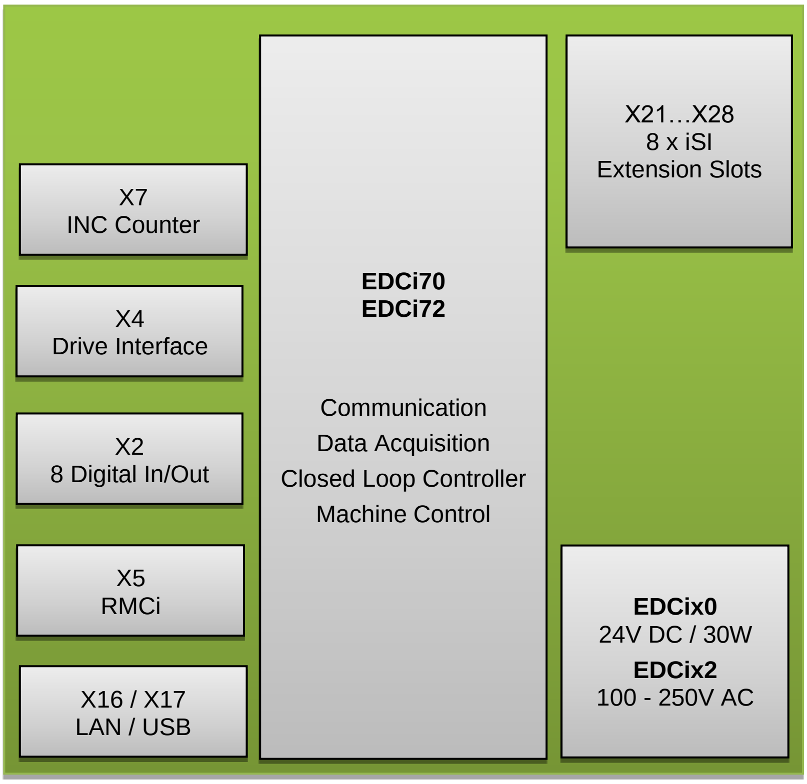


Fig. 4: Block diagram EDCi70/72

2.3 Technical Data Comparison EDCi

Table 3: Comparison technical data EDCi

Function	**EDCi10**	**EDCi15**	**EDCi20 EDCi22**	**EDCi50 EDCi52**	**EDCi70 EDCi72**
Maximum system and control loop frequency	1 kHz	1 kHz	2.5 kHz	10 kHz	10 kHz
Minimum system and control loop frequency	1 kHz	1 kHz	1 kHz	1 kHz	1 kHz
Maximum test frequency (DoPEDynCycles command)	2 Hz	5 Hz	5 Hz	500 Hz	500 Hz
CPU VortexDX86 800 MHz	✓	✓	✓	✓	✓
PC communication interface USB 2.0 B full speed	-	✓	✓	✓	✓
PC communication interface LAN 10/100 MBit	✓	✓	✓	✓	✓
Load channel ±10,000,000 steps	✓	✓	✓	✓	-
Incremental encoder: TTL / Line Driver / Sine / SSI	✓	-	✓	✓	✓
Digital inputs/outputs with 24 VDC level	8	-	8	8	8
Serial RS232 sensor interface	-	-	O	O	O
Serial RS485 sensor interface	-	-	O	O	O
iSI extension slots	-	-	3	3	8
iCREEP distribution board: 1xINC Line, 2xINC Sine, RS485, 8xIO	-	✓	-	-	-
Power supply 24 VDC, 1.5 A plus external consumption (**EDCix0**)	✓	✓	✓	✓	✓
Supply voltage 100 - 240 VAC, 50/60 Hz, 900 VA100-250 VAC (**EDCix2**)	-	-	✓	✓	✓
Internal 24 VDC, 2 A power supply for external devices (**EDCix2**)	-	-	✓	✓	✓
Cabinet housing (**EDCix0**)	✓	✓	✓	✓	✓
Desktop housing (**EDCix2**)	-	-	✓	✓	✓
EDC synchronization of data acquisition and motion control	✓	-	O	O	O
Drive interface: - ±10V command output with ±15Bit resolution - Digital command output, A/B pulse train - I/O’s and relays for safety functions	✓	✓	✓	O	O
External DriveBox: - ±10V command output with ±15Bit resolution - Digital command output, A/B pulse train - I/O’s and relays for safety functions - 16 digital inputs/outputs with 24V level	-	-	-	O	O
Any external DC / AC power amplifier	O	O	O	O	O
Hydraulic power pack	-	-	O	O	O
Internal servo valve amplifier up to 300mA	-	-	O	O	O
Internal 160W DC power amplifier (**EDCix2**)	-	-	O	O	O
Internal 320W DC power amplifier (**EDCix2**)	-	-	O	O	O

✓ Included O Optional - Not possible

2.4 Technical Data of Internal DC Power Amplifier DC160/DC320

Table 4: Technical Data DC160/DC320

Function	DC160	DC320
Maximum Power output (30s)	160W	320W
Continuous Power output	80W	160W
Maximum output voltage	48V	80V
Maximum output current	3.3A	8A
Limiting current	4.5A (for max. 0.5s)	10A (for max. 2.4s)
Adjustment of limiting current	Twice the value of the adjusted output current, not more than limiting current	
Adjustment of maximum output voltage	adjustable via software	
Adjustment of maximum output current	adjustable via software	
Maximum energy feedback	17W (for 0.5 seconds)	34W (for 2.4 seconds)
Control mode	Current control	
Drive of the command value	PWM	
Switching frequency of the power amplifier	20kHz	
Drive and safety check of the relays technics	By the driving controller	
Allowed temperature range	+5°C to +40°C	
Average environmental temperature for 24 hours	Max. +35°C	
Internal fan	Yes	
Voltage supply (single phase alternating current)	115V AC / 230V AC switchable	
Necessary fuse protection of the power socket	3.15AT	6.3AT
Limitation of the inrush current (primary winding)	ca. 3A (t < 50ms)	ca. 6A (t < 50ms)

2.5 Plug Assignment

The following table shows a connector overview of the EDCi.

Table 5: Connector overview of the EDCi

Connector	Function	EDCi10	EDCi15	EDCi20 EDCi22	EDCi50 EDCi52	EDCi70 EDCi72
X2	Universal digital I/O	✓	✓	✓	✓	✓
X4	Drive interface	✓	✓	✓	✓	✓
X5	RMC	✓	✓	✓	✓	✓
X7	Crosshead input INC- or SSI-transducer	✓	(✓)	✓	✓	✓
X11	Synchronization, SYNC In	O	-	O	O	O
X12	Synchronization, SYNC Out	O	-	O	O	O
X13	USB host for USB sticks	✓	✓	✓	✓	✓
X14	Load input	✓	✓	✓	✓	-
X16	LAN PC interface	✓	✓	✓	✓	✓
X17	USB PC interface	-	✓	✓	✓	✓
X18	Motor connection or 10V-Command-Output, Moog valve, internal power amplifier	O	-	O	O	O
X19	24V voltage supply (**EDCix0**)	✓	✓	✓	✓	✓
X21	iSI extension slot	-	-	✓	✓	✓
X22	iSI extension slot	-	-	✓	✓	✓
X23	iSI extension slot	-	-	✓	✓	✓
X24	iSI extension slot	-	-	-	-	✓
X25	iSI extension slot	-	-	-	-	✓
X26	iSI extension slot	-	-	-	-	✓
X27	iSI extension slot	-	-	-	-	✓
X28	iSI extension slot	-	-	-	-	✓
X40	External DriveBox	-	-	-	O	O
X61	Up to four calculated sensors	-	✓	✓	✓	✓
X62	Up to four serial sensors at Y1	-	✓	O	O	O
X63	RMC Digipoti	O	O	O	O	O
Y1	RS232 option (or RS232/RS485 converter) for serial sensors	-	✓	O	O	O

✓ Included   O Optional   - Not possible

2.5.1 Plug Assignment EDCi10

The pictures can include optional features.

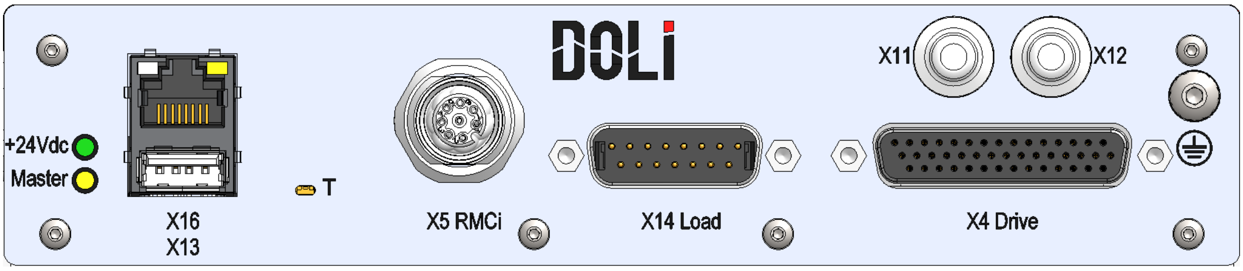


Fig. 5: Rear view EDCi10

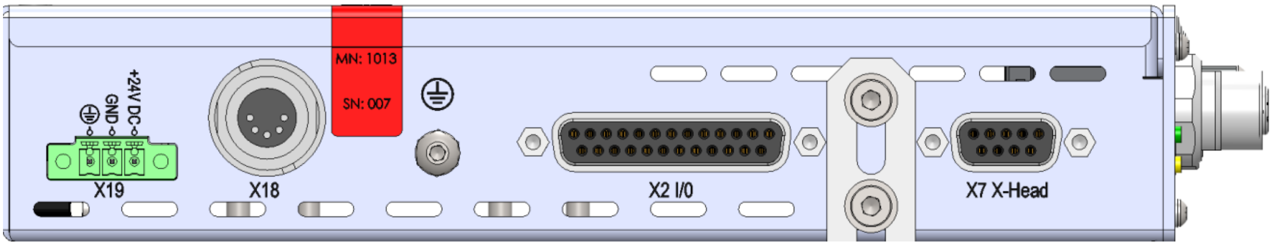


Fig. 6: Side view EDCi10

Dimensions: L 200 mm W 190 mm H 42 mm

2.5.2 Plug Assignment EDCi15 with iCREEP

The pictures can include optional features.

Fig. 7: Rear view EDCi15 with iCREEP

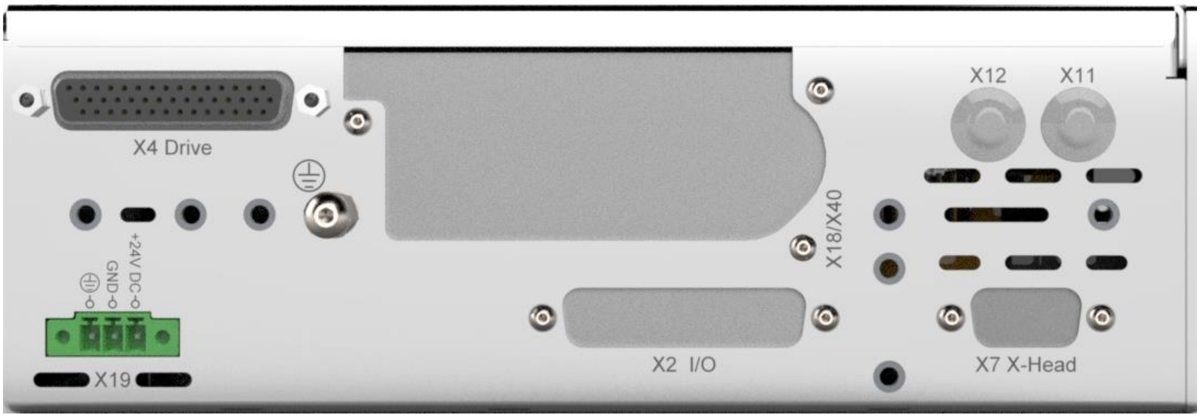


Fig. 8: Side view EDCi15 with iCREEP

Dimensions: L 200 mm W 190 mm H 67 mm

2.5.3 Plug Assignment EDCi20/50

The pictures can include optional features.

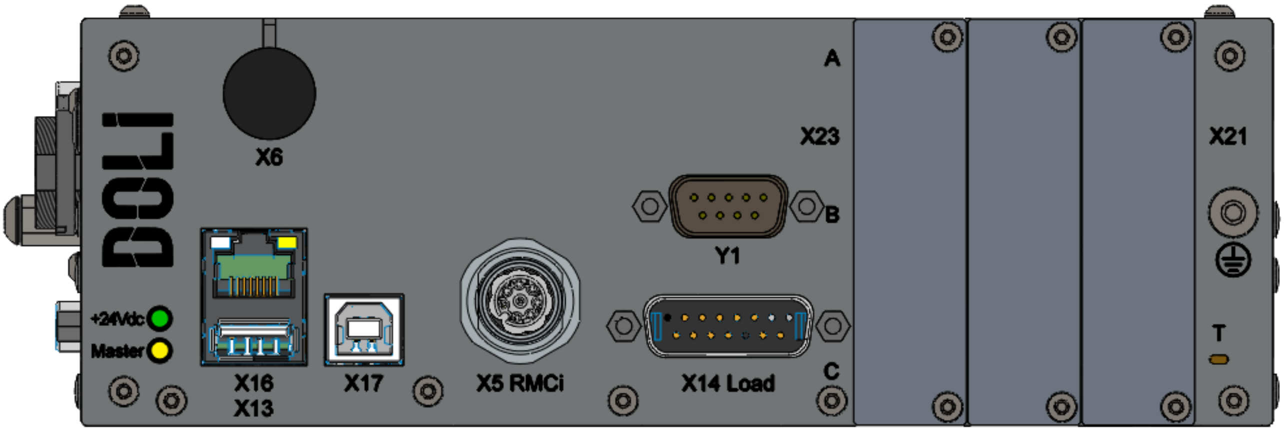


Fig. 9: Rear view EDCi20/50

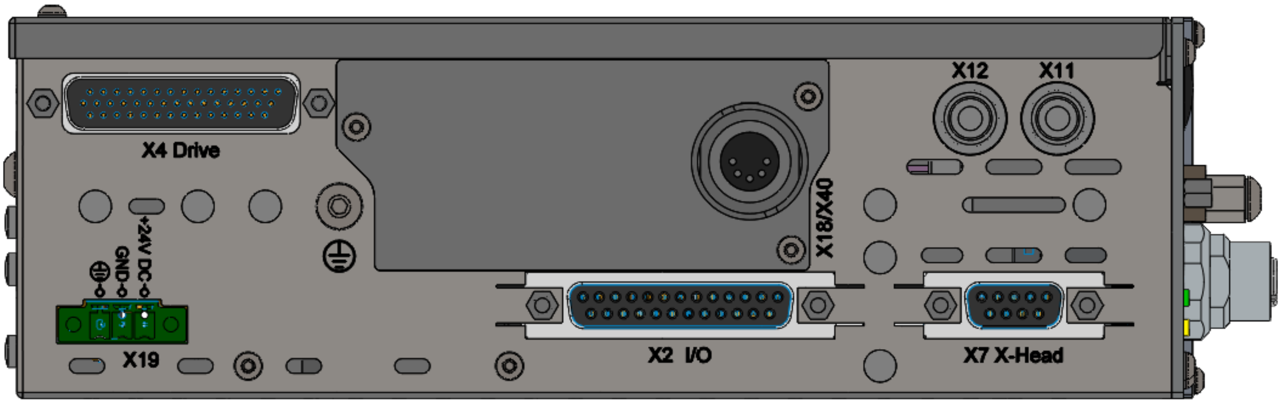


Fig. 10: Side view EDCi20/50

Dimensions: L 200 mm W 190 mm H 67 mm

2.5.4 Plug Assignment EDCi22/52

The pictures can include optional features.

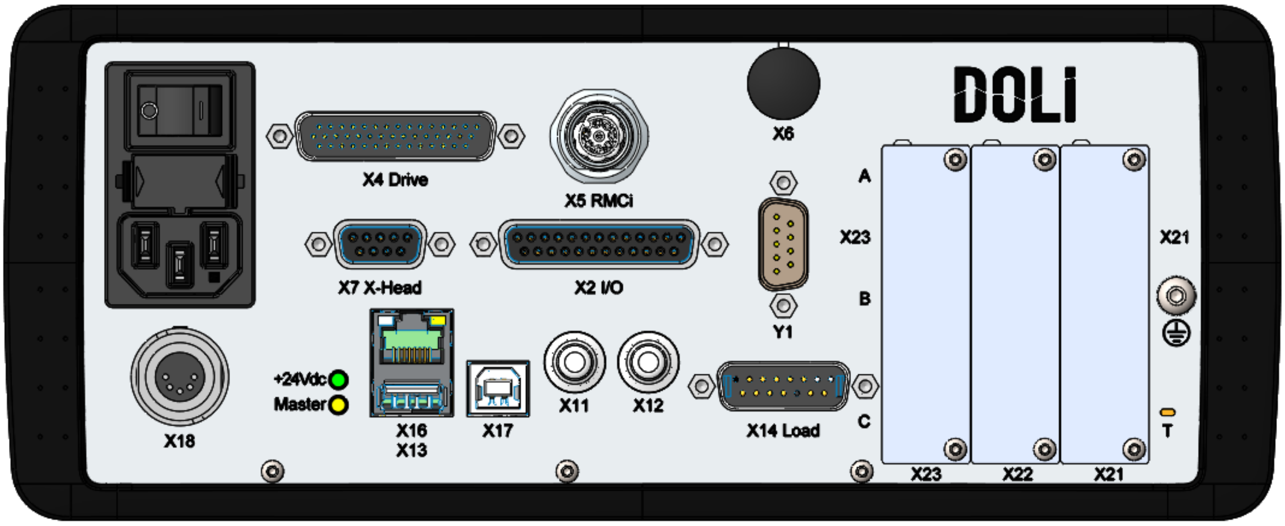


Fig. 11: Rear view EDCi22/52 with internal X4/X18 Drive Interface

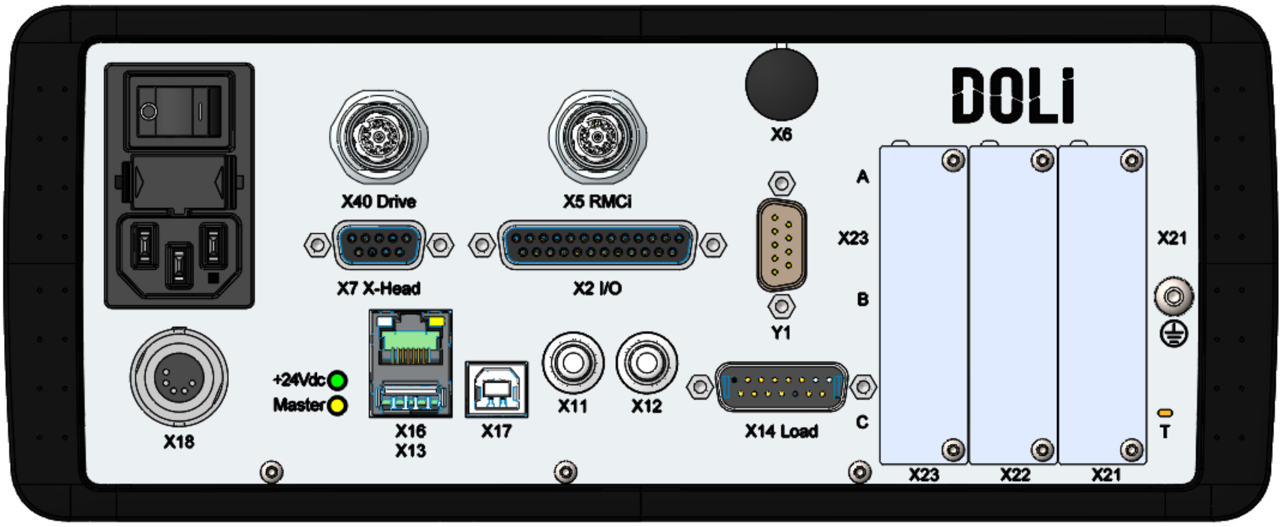


Fig. 12: Rear view EDCi52 with external X40 DriveBox

Dimensions: L 360 mm W 255 mm H 105 mm

2.5.5 Plug Assignment EDCi70

The pictures can include optional features.

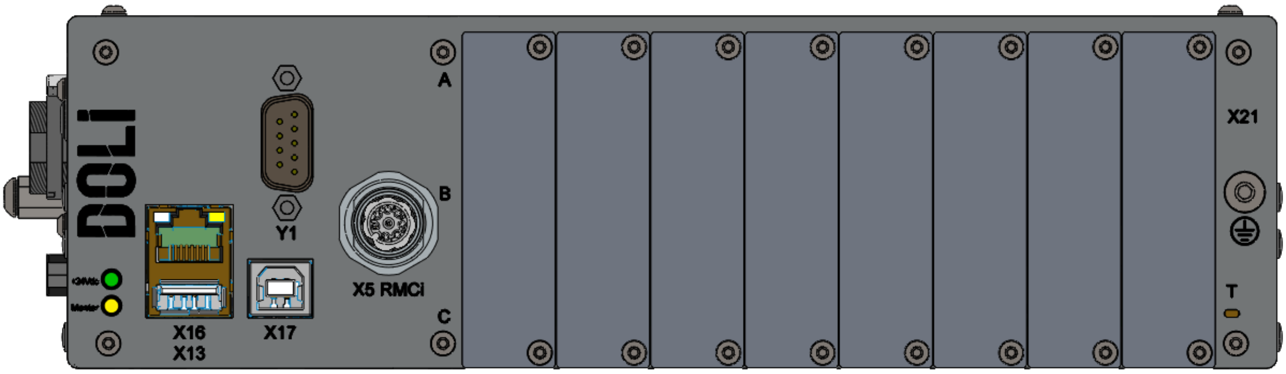


Fig. 13: Rear view EDCi70

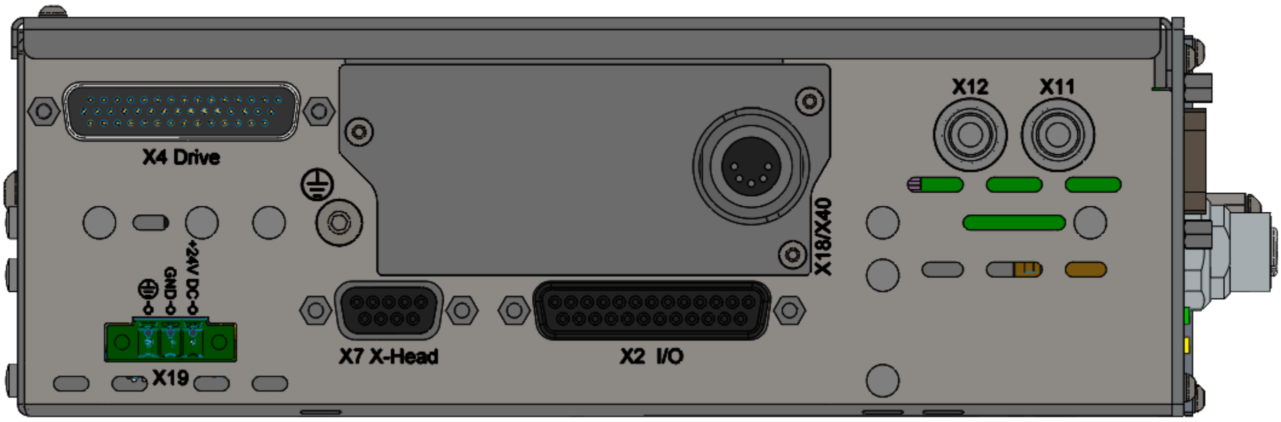


Fig. 14: Side view EDCi70

Dimensions: L 200 mm W 234 mm H 67 mm

2.5.6 Plug Assignment EDCi72

The pictures can include optional features.

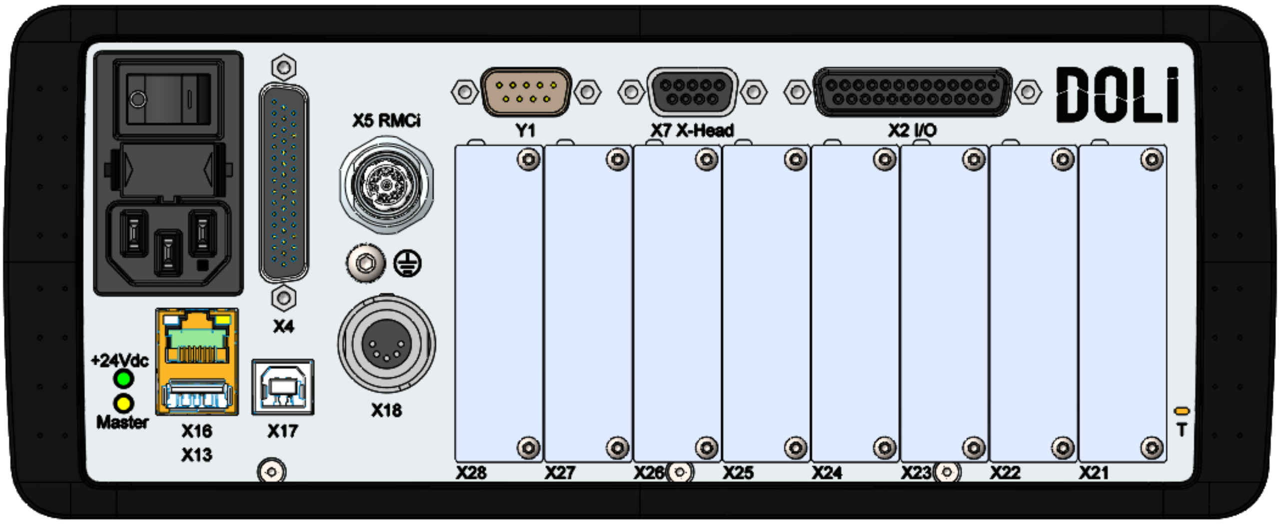


Fig. 15: Rear view EDCi72 with internal X4/X18 Drive Interface

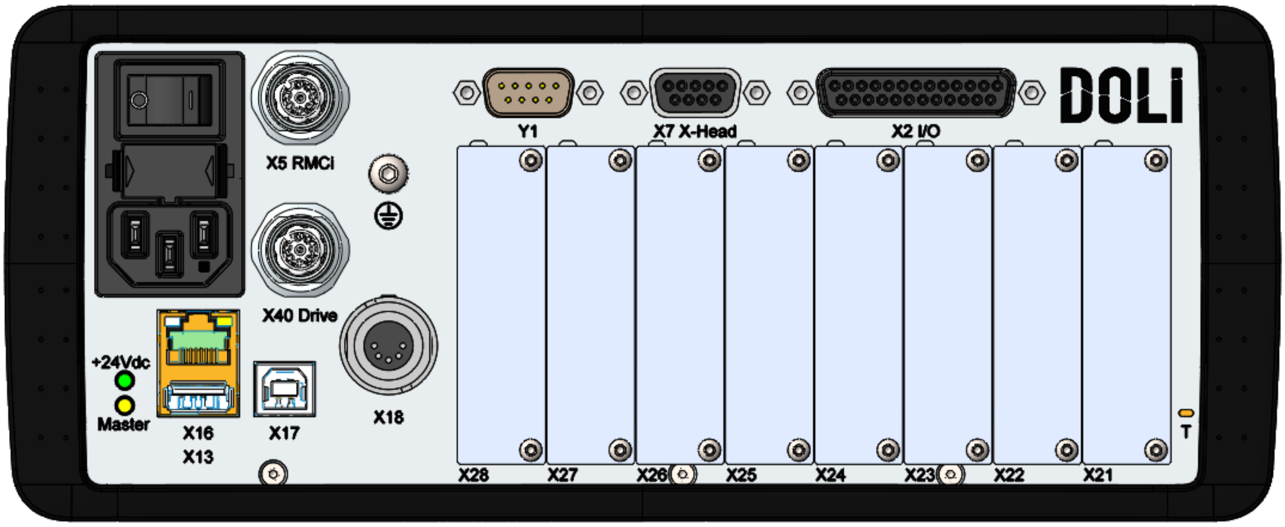


Fig. 16: Rear view EDCi72 with external X40 DriveBox

Dimensions: L 360 mm W 255 mm H 105 mm

2.5.7 Plug Assignment iSI Boards

Table 6: Connector numbers of different iSI boards

Board	Connector A	Connector B	Connector C	Connector D
iCFA **iDCA**		Analogue Sensor		
iINC	INC Sensor	Bit In Bit Out	INC Sensor	
iINCX	INC Sensor	Bit In / Bit Out (+ 24 VDC and via RS485 communication)	INC Sensor	
iIO		Bit In Bit Out		
iADA	AD Analogue In DA Analogue Out	AD Analogue In DA Analogue Out	AD Analogue In DA Analogue Out	AD Analogue In DA Analogue Out
DriveBox	DA Analogue Out Bit In Bit Out			

2.6 RMCi Overview

2.6.1 RMCi Types

Fig. 17: RMCi1

Fig. 18: RMCi6, RMCi7, RMCi8

2.6.2 RMCi Address Select

Attention! If you connect two or more RMCs of the same type (e.g. 2 x RMC7) to the EDC, the addresses of these RMCs must be different. Follow the next steps to change the RMC address.

- Switch off the EDC.
- Hold the LINK key pressed and switch on the EDC.
- Now you see a headline with the current RMC address.
- Press the LINK key several times to change the RMC address (0...3).
- Switch off and on the EDC again.

2.6.3 RMCi Brightness Select

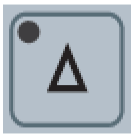
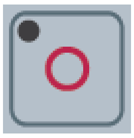
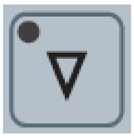
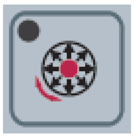
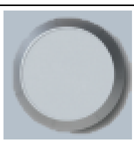
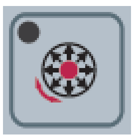
Attention! The life time of the yellow OLED of the RMCi6 and RMCi7 display is limited and depends on the brightness setting and the ambient temperature. Lower brightness values and lower ambient temperature lead to a longer life time. For systems running 24h a day or at higher temperatures we recommend setting the brightness to the lowest value at which the display is still readable.

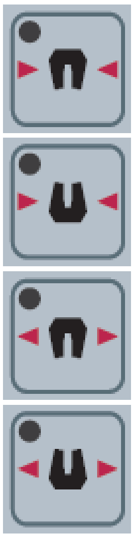
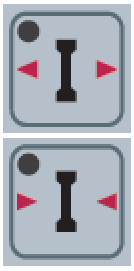
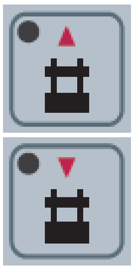
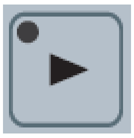
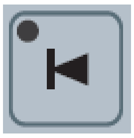
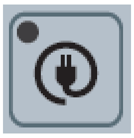
- Switch off the EDCi.
- Hold the LINK key pressed and switch on the EDCi.
- Now you see a headline with the current RMCi address.
- Press the DigiPoti key to toggle between RMCi address and brightness adjustment.
- Now you see a headline with the current brightness setting.
- Press the LINK key several times to change the brightness (10%...100%).
- Switch off and on the EDCi again.

Starting from EdcApp 9149.004 we provide a screen saver that extends the display life time a lot. The screen saver sets the display to the lowest brightness (10%) if there is no key or DigiPoti input for more than one hour. Any keyboard or DigiPoti input stops the screen saver and the display returns to normal operation mode.

2.6.4 RMCi Key Functions

Table 7: RMCi Key functions

Key	Comment	Function
	ON	Switch drive on. LED is flashing. After drive amplifier is on, LED is also on.
 + 	OFF	Press Digipoti and ON key to switch drive off. LED is off.
	UP	Moves crosshead up. LED is on during movement in this direction.
	HALT	Halts movement of crosshead. In standalone mode the key stops the running test. Test results are shown.
	DOWN	Moves crosshead down. LED is on during movement in this direction.
	POS MODE	Change operational mode of Digipoti from speed to position control mode. Both direction LEDs are on.
	Turn	In speed control mode: increase / decrease speed. In position control mode: increase / decrease position.
 + 	High / Low Pressure	Press Digipoti and POS MODE key to activate / deactivate high pressure. This function must be enabled and configured in the EDC setup. LED is on if high pressure is active.

	Close / Open Grips	These four keys operate hydraulic / pneumatic grips. This function must be enabled and configured in the EDC setup. LEDs are controlled by an external device.
	Close / Open Extensometer	These two keys operate automatic extensometer arms. This function must be enabled and configured in the EDC setup. LEDs are controlled by an external device.
	Move Fixed XHead	These two keys operate adjustment of a fixed crosshead. This function must be enabled and configured in the EDC setup. LEDs are on if crosshead is moving.
	START HALT CONTINUE	Start test (LED on). Halt running test (LED flashing). Continue test (LED on). Function depends on the standalone or PC application.
	RETURN	Return to start position. Function depends on the standalone or PC application.
	LINK	Link key. Function depends on the EDC general data setup parameter **RMC Active Mode.** If two or more RMC are connected, you can set the behavior of the active RMC. *MULTI* - All connected RMCs are active. All link LEDs are on. *SINGLE* - Only one active RMC is allowed. One link LED is on. - All other RMC keys are disabled (Estop is always active). - Press link key of the active RMC to switch to another RMC. - Now all RMC link LEDs are blinking. - Press the RMC link key of the new RMC.

  	F1…F3	Function keys are only used in PC Control. Function depends on the PC application. Build in EDCi standalone tests don’t use these keys.

2.6.5 RMCi1/RMCi8 Key and Touch Functions

If you want to use the EDCi build in standalone tests, you have to use an RMCi1/RMCi8 with touch display. With the RMCi1/RMCi8 you can edit the test parameters and you get the test results on the display.

An additional RMCi6 or RMCi7 shows only the current load and position readings.

The following tables on the next pages show the touch display handling.

Table 8: RMCi1/RMCi8 general handling in menus

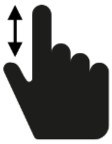
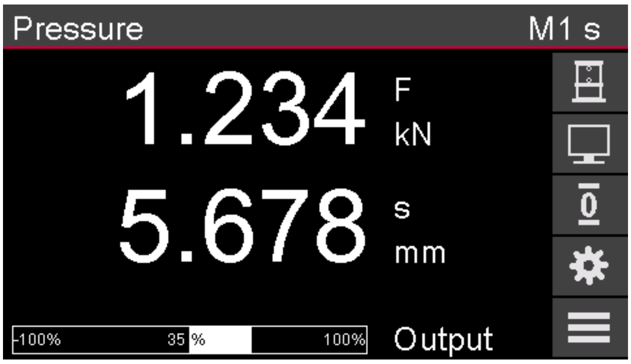
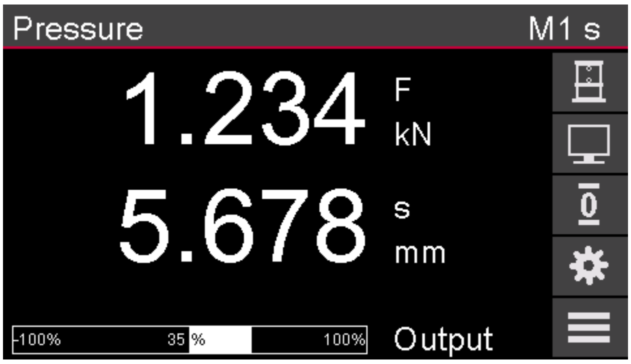
Key	Comment	Function
	Touch	ENTER function in menus or selects a menu item.
	Swipe	Moves cursor up/down or selects a choice in parameter menus.
	Turn	Moves cursor up/down or selects a choice in parameter menus.
	Press	ENTER function in menus or selects a menu item.

Table 9: RMCi1/RMCi8 Main display and menus

Display	Function
	<u>Main Display Buttons</u> ◄ Machine menu. ◄ Display mode (for future use). ◄ Tare menu. ◄ Test settings. ◄ Main menu.
	<u>Main Display Readings</u> The headline shows the test name, machine number and current control sensor. Depending on the selected test you see the sensor readings and additional info like the output.

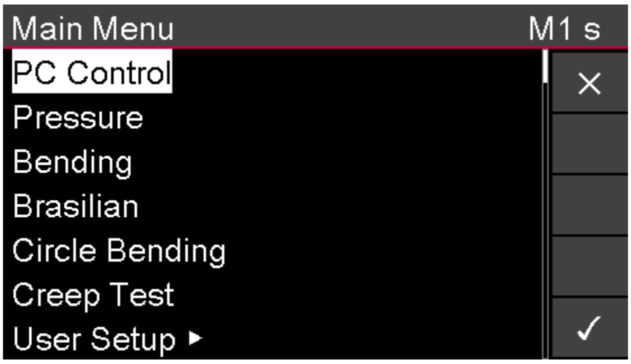
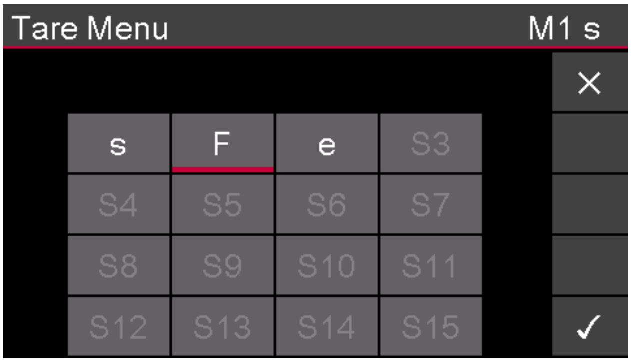
	<u>Main Menu</u> ◄ CANCEL: return to previous menu. Select PC Control for USB/LAN communication. Select a standalone test. Edit user setup parameter. Show EDC info menu. ◄ ENTER: confirm selection.
	<u>Machine Menu</u> ◄ CANCEL: return to previous menu. Select machine. ◄ ENTER: initialize selected machine.
	<u>Tare Menu</u> ◄ CANCEL: return to previous menu. Set/Reset sensor tare. ◄ ENTER: confirm new sensor tare.

Table 10: RMCi1/RMCi8 PC Control menu

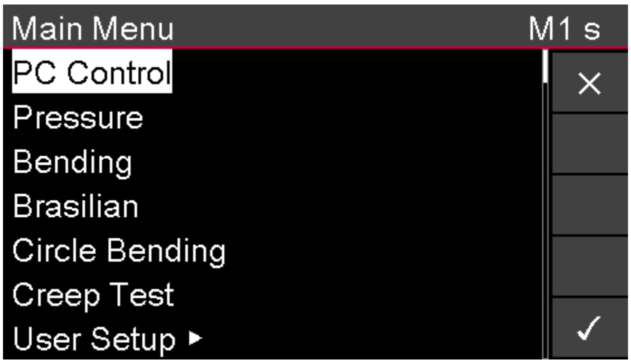
<table>
<tr><th>Display</th><th>Function</th></tr>
<tr><td>
</td><td><u>Main Menu</u>
◄ CANCEL: return to previous menu.
Select PC Control for USB/LAN communication.
◄ ENTER: confirm selection.</td></tr>
<tr><td>
</td><td><u>PC Control Offline</u>
◄ PC Control settings.
◄ Main menu.</td></tr>
<tr><td>
</td><td><u>PC Control Online</u>
◄ Function keys for PC application.</td></tr>
</table>

Table 11: RMCi1/RMCi8 test settings menu

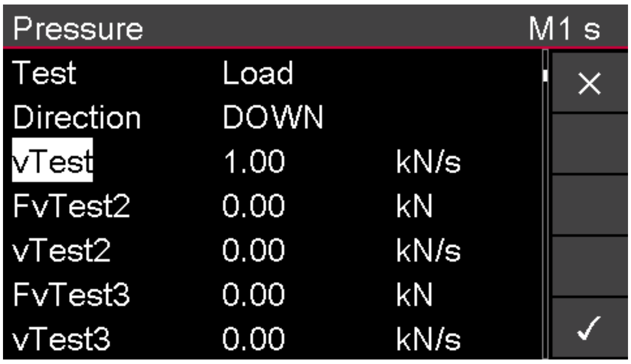
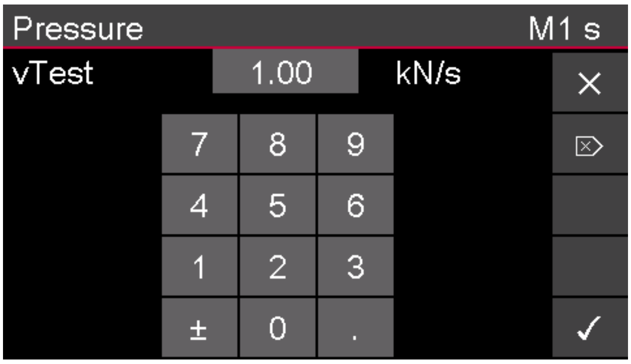
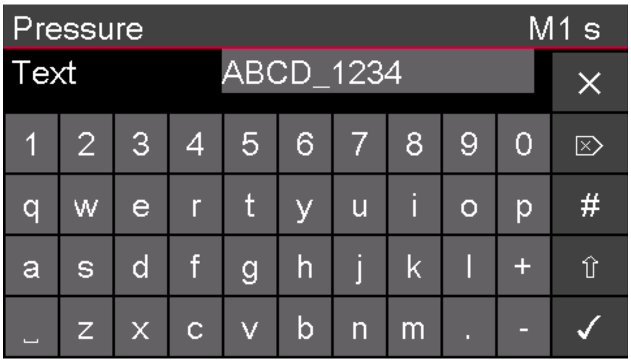
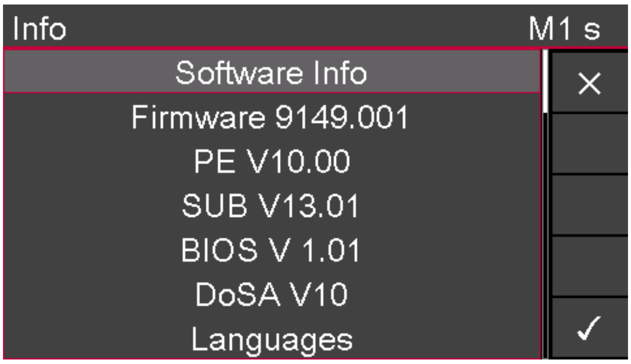
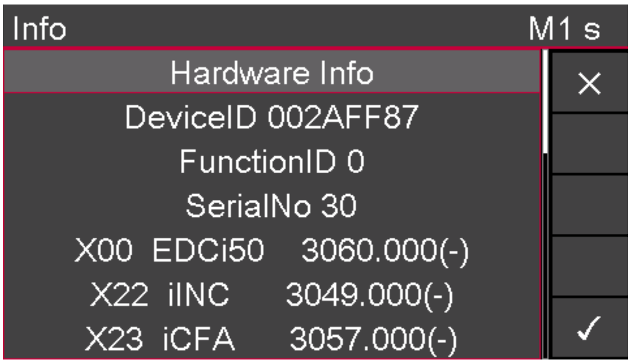
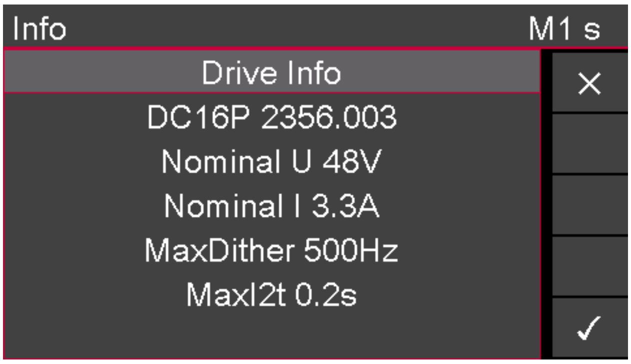
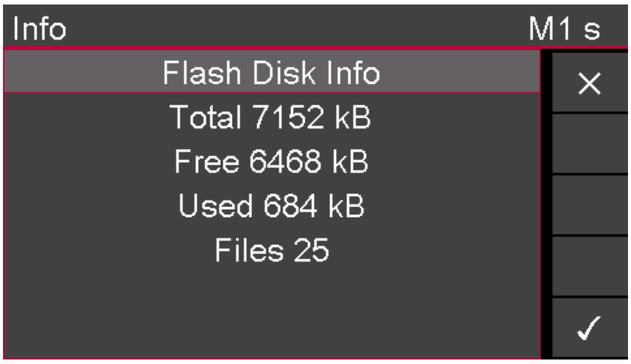
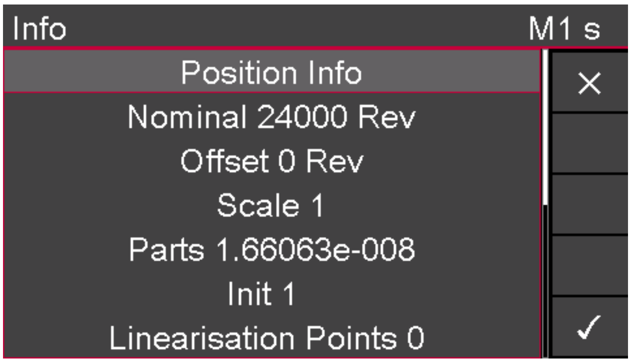
	Test Settings Menu ◄ CANCEL: return to previous menu. ◄ ENTER: edit parameter.
	Edit Value ◄ CANCEL: return to previous menu. ◄ DELETE: delete input. ◄ ENTER: confirm changed parameter.
	Edit Text ◄ CANCEL: return to previous menu. ◄ DELETE: delete input. ◄ SYMBOLS: show special symbols. ◄ SHIFT: change lower/capital characters. ◄ ENTER: confirm changed parameter.

Table 12: RMCi1/RMCi8 info menu

Display	Function
	<u>Main Menu</u> ◄ CANCEL: return to previous menu. ◄ ENTER: show info sub menu.
	<u>Info Menu</u> ◄ CANCEL: return to previous menu. ◄ ENTER: show info.
	<u>Software Info</u> ◄ CANCEL: return to previous menu. ◄ ENTER: confirm.
	<u>Hardware Info</u> ◄ CANCEL: return to previous menu. ◄ ENTER: confirm.

	<u>Drive Info</u> ◄ CANCEL: return to previous menu. ◄ ENTER: confirm.
	<u>Flash Disk Info</u> ◄ CANCEL: return to previous menu. ◄ ENTER: confirm.
	<u>Sensor Info</u> ◄ CANCEL: return to previous menu. ◄ ENTER: confirm.

3 Setup parameters

3.1 Brief installation guide

Before starting any installation or initial start-up, it is essential that all personnel is familiar with and follow all the requirements described in the safety hints (refer to the pages of Chapter 1 of this manual).

This manual has been written in the form of a checklist and provides guidance on how to setup a testing instrument correctly.

3.1.1 Installation requirements

For a successful installation you need the PC program DOLI Installation Center and an USB or LAN cable for communication with the EDC.

Install the USB or LAN drivers included in the DOLI Installation Center (follow the instructions of CommunicationDrivers.pdf in the directory CommunicationDrivers).

3.1.2 Installation procedure

- Connect the EDC to your testing instrument and to the mains supply.
- Switch on the EDC using the On/Off switch, located on the rear panel of the EDCix2. The EDCix0 is not equipped with a mains switch. It must be switched on together with the mains switch of the testing instrument.
- The front panel or the RMC “ON-LED” should not be illuminated. The “ON-LED” indicates the drive amplifier is active and the system is controlling. It isn’t a mains-ON indicator.
- If the “ON-LED” is illuminated, it is necessary to perform one of the following functions:
  - Press and release the front panel emergency stop button.
  - Press the Digipoti and then ON key to switch off the drive.
  - Switch the EDC mains off and on again.
- The “System Test” message is shown on the front panel display while an internal check sequence is performed. As long as this message is active, it is not possible to connect to the EDC.
- Check if the EDC is in PC Control mode. If not, touch the main menu button and select PC Control.
- Start DOLI Installation Center on the PC and connect to the EDC. Now you can edit the EDC setup parameters according to your used testing instrument.

Attention! The general data of the testing instrument must be edited before attempting to change additional parameters.

3.2 General Data

EDC Info	A general setup info text can be stored in the EDC. The date of last change of the EDC setup is also shown.
EDC Model	Select the type of EDC model (e.g. EDCi50).
Function ID	This is a number, and may be used by a PC program to identify a specific EDC (e.g. for a tension / torsion instrument use: ID 0 for tension function and ID 1 for torsion function). Ignore this parameter, if one EDC is connected to PC, only.
Language	Select the language of the EDC. English and German are available as default. Two user specific languages can be downloaded to the EDC.
Machine Count	Set the number of machine configurations stored by the EDC (max. 8).
Machine IO X2	Select whether digital bit inputs at connector X2 are used to select the current machine number. *NO* Don't use I/O. *INPUT* Select machine number via input bits. X2 Bit 0 selects machine 1, X2 Bit 1 selects machine 2, …
Logo	Select whether a logo will show up during a system test. *NO* No logo displayed. *YES* Logo displayed. Customer specific logo can be downloaded to the EDC.
Supervisor Password	The supervisor password is needed to enter the setup menu and will prevent that the setup parameter can be changed by unauthorized users. Choose a number between 1 and 65535. Selecting 0 disables the password protection.
RMC Count	The number of RMCs connected to EDC. For safety reasons, you won't be able to switch on the drive, if the number of the RMCs connected does not match this parameter. The EDC can support a maximum of 4 RMCs.
RMC Push Mode	Set RMC key push mode. *DISABLE* XHead still moves after releasing an arrow key. *ENABLE* XHead stops after releasing an arrow key.
RMC Active Mode	If two or more RMC are connected you can set the behavior of the active RMC. *MULTI* - All connected RMCs are active. All link LEDs are on. *SINGLE* - Only one active RMC is allowed. One link LED is on. - All other RMC keys are disabled (Estop is always active). - Press link key of the active RMC to switch to another RMC. - Now all RMC link LEDs are blinking. - Press the RMC link key of the new RMC.
EDM	Configure the External Device Monitoring on the EDC drive interface (wiring see chapter 5.1.6). *DISABLE* No EDM by the EDC. *ENABLE* EDM active.
Estop Supply	Configure the power supply of the Estop on the EDC drive interface (wiring see

chapter 5.1.6).

DISABLE	Estop supply extern.
ENABLE	Estop supply from the EDC.

Up Stop Switch

Configure the UpStop input on the EDC drive interface (wiring see chapter 5.1.6).

DISABLE	No function.
DRIVE_OFF	Switch drive off.
SHALT	Stop XHead in position control.

Down Stop Switch

Configure the DownStop input on the EDC drive interface (wiring see chapter 5.1.6).

DISABLED	No function.
DRIVE_OFF	Switch drive off.
SHALT	Stop XHead in position control.

Sync Option

Configure the sync option, if two or more EDCs are synchronized by hardware sync option (see chapter 5.1.11).

No Sync Option	Disable sync option
Sync Master	This EDC is Master (only one master is allowed)
Sync Slave	This EDC is Slave

Sync Stop

Configure the stop behavior of all connected EDCs.

DISABLE	No function
DRIVE_OFF	Switch drive off at all connected EDCs.
SHALT	Stop all connected EDCs in position control.

Sync Drive On/Off

Configure the drive behavior of all connected EDCs.

DISABLE	No function
ENABLE	Switch drive on/off at all connected EDCs.

3.3 Machine Data

Machine Info
Machine info text, stored in the EDC.

System Time
EDC system time base for closed loop controller (see chapter 3.5.2). This time is the base of all other time parameters.

Data Trans. Rate
This time controls the data transmission rate to the PC. The value must be an integral multiple of **System Time**. Normally this value should be set to the same value as **System Time**.

Control Structure
Set closed loop controller structure (see chapter 3.5.1).

Test Mode
Selects whether the EDC controls the instrument. The following modes can be selected:
CTRL EDC controls the instrument and processes the data values.
NO CTRL EDC does not control the instrument nor does it have an influence on the operation. It only processes the data values.

Piston Area
The piston area only applies to hydraulic testing instruments using a pressure transducer and is used to calculate the applied load over pressure. If an incorrect piston area is entered, the displayed load value will be incorrect too.

Fmax
Maximum load of the testing instrument. It is used to calculate the load limit. Normally this value is set 5-10% higher than F100%.
The lower value of **Fmax** or load sensor limit is used for the load limit.

Example 100kN instrument with a 2 kN load cell:
Fmax: 110 kN
F100%: 100 kN
calculated load limit: 2 kN (+ range limit)

F100%
Nominal load of the testing instrument.

Stiffness
Mechanical stiffness value for the instrument i.e. kN/mm deformation.
This parameter is only active in combination with a calculated sensor (formula: stiffness)

XHead Direction
This parameter determines whether a positive crosshead speed signal corresponds to an upward or a downward crosshead movement. This information is required for the correct interpretation by the UP and DOWN keys as well as the associated LEDs.

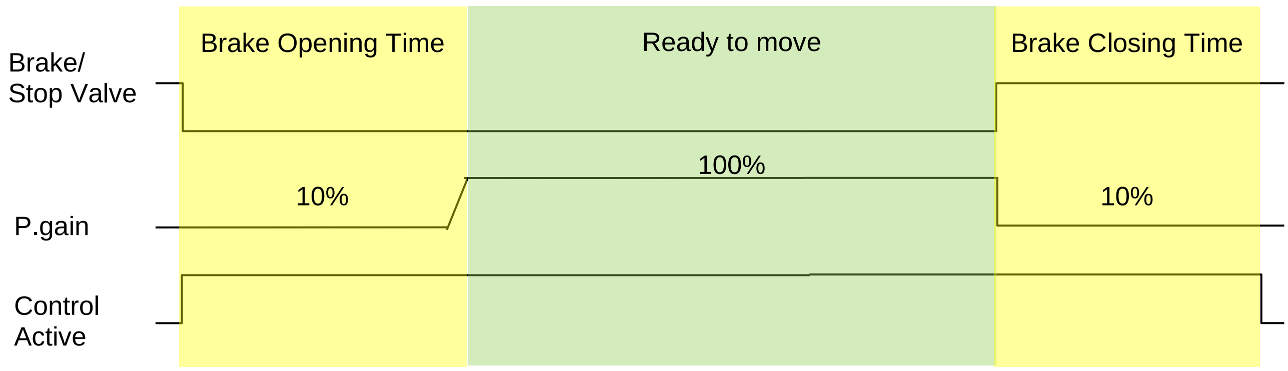
XHead Initial Mode
Crosshead mode, when EDC is switched on.
AUTOMATIC EDC uses last saved crosshead position.
MANUAL EDC uses the position from **XHead Initial Value**.

XHead Initial Value
Crosshead position, when EDC is switched on, if **XHead Initial Mode** is set to *MANUAL*).

Encoder XHead Ratio
Transmission ratio between encoder and crosshead in turns at the encoder per mm crosshead movement. Normally gearbox transmission ratio divided by the pitch of the screw.

Brake Opening Time

Delay time (max. 10 s) after releasing an instrument brake or stop valve. During this delay time, the proportional gain (P) of position controller is reduced to 10%, no moving command is accepted, and the instrument is kept in position control. 0.2 seconds before delay time ends, the P-gain of position controller is increased to 100% with a ramp.
Standard value is 0.0 s.



Brake Closing Time

Delay time (max. 60 s) after activating the brake or stop valve, caused by e.g. emergency stop and releasing control. During this time the proportional gain (P) of position controller is reduced to 10% and position controller keeps the instrument at its current position.
Standard value for screw driven instruments with a brake is 0.0 s. For hydraulic instruments use a time until pressure is released (normally between 3 s and 10 s).

CTRL On Mode

Set behavior after **ON** key was pressed.

CTRL Go to position control.

NO CTRL Don't activate closed-loop controller. This mode is used for hydraulic instruments without position control.

Fixing Output

Command value to keep the piston at its current position, if no closed loop controller is active (only used if **CTRL On Mode** is set to *NO CTRL)*.

Initial Output

First command value when switching over to closed loop control, e.g. load control (only used if **CTRL On Mode** is set to *NO CTRL)*.

Return Output

Command value to return to the starting position. This value is active as long as the bypass valve is active (only used if **CTRL On Mode** is set to *NO CTRL* and machine is in open loop mode)

EDC Main Menu

The entries of the EDC main menu can be enabled / disabled. Some EDC standalone tests need a licence file on the EDC and are only activated, if the licence is found.

3.4 Sensors

Connector	Indicates the number of the connector, to which the sensor is attached to.
Sign	The parameter to select the sensor polarity. *INV* Inverts transducer signal polarity *N-INV* Retains transducer default polarity The polarity of all control sensors must be identical under the same conditions. **E.g. an increase of a crosshead position value must result in an increase in both load and extension values from the transducers as fitted.**
Control Active	The parameter enables/disables the sensor from being used for control purposes. *YES* Sensor can be selected as a control sensor. *NO* Sensor used for measuring purposes only.
Limit Control	Reaction, when the sensor range limit is active. *STATE* No action. If selected for a load sensor, it can result in damage to both, the sensor and the instrument. *DRIVE OFF* Drive is switched off. *SHALT* XHead stops in position control.
Connector Control	Reaction to sensor plugs disconnection. *STATE* No action. If selected for a load sensor, it can result in damage to both, the sensor and the instrument. *DRIVE OFF* Drive is switched off.
Filter Time	Sensor filter time for data acquisition. With a long filter time the data is very stable, but the peak values may not always be detected correctly. With a short filter time the indicated values are less stable, but the peak values are detected correctly. Filter Time must be an integral multiple of **System Time** up to 1.0 second. Common values lie between 0.1 ms and 20 ms. Filter Time 0.0 ms sets Filter Time to System Time.
Sensor ID	Free to use ID for this sensor.
EEPROM Active	Selection of sensor data source. *YES* Sensor plug EEPROM data are used. *NO* The following data are used for this sensor.
Unit	Defines physical SI unit for the sensor (e.g. N, m, °C, …).
Initialization	Defines the measuring range for the channel. Enter 0 for all other interfaces. This parameter is calculated from the reference of the nominal value, the range limit and the correction value. For help use the Init Assistance of the DOLI Installation Center.
Nominal Value	Defines the sensor nominal value. E.g. 10000 for a load cell with a nominal value of 10 kN and **Unit** set to N.
Offset	Sensor offset value. This value is subtracted from the measured value and compensates for a sensor

offset.

Upper Limit Enter the upper range (positive) limit for the sensor as % of the nominal value. This limit must not exceed the maximum travel range of the sensor and must be a positive value (0% to 255%).

Lower Limit Enter the lower range (negative) limit for the respective sensor as % of the nominal value. This limit must not exceed the minimum travel range of the sensor and must be a positive value (0% to 255%).

Correction Value The Correction value can be calculated by using the following equation:
Correction value = sensor nominal output / sensor plug reference bridge nominal value.

Signal Period Parameter to select the scaling of linear or rotary sensors.
For linear sensors, the unit is normally m/Inc, e.g. values within the µm-range.
For rotary sensors, the unit is Inc/Rev, e.g. values within a range of 500 to 100000.
This parameter is not applicable for analogue sensors (set value to 1.0).

3.5 Closed loop control

A detailed description of all closed loop control parameters can be found in chapter 3.5.2.

3.5.1 EDC Closed Loop Control Structures

The controller structure can be set in the section Machine Data The following controller structures are available.

3.5.1.1 Controller Structure SPINDEL

The controller structure SPINDEL is suitable for spindle machines using external drive amplifiers. The output of all three position controllers is the speed of X-Head. It can be an analogue ±10V or digital signal (A/B, Up/Down, Pulse/Direction).

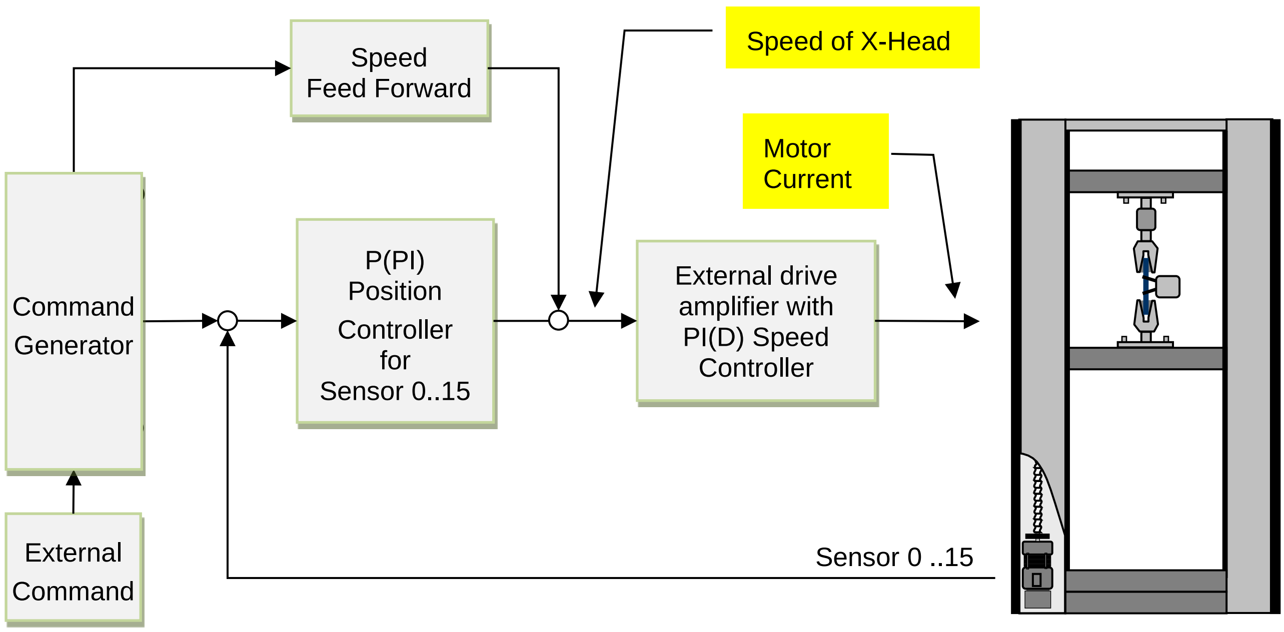


Fig. 19: Controller structure SPINDEL

3.5.1.2 Controller Structure SPINDEL as PID controller

The controller structure SPINDEL can be used as a classical PID controller by using P, I and D parameter.

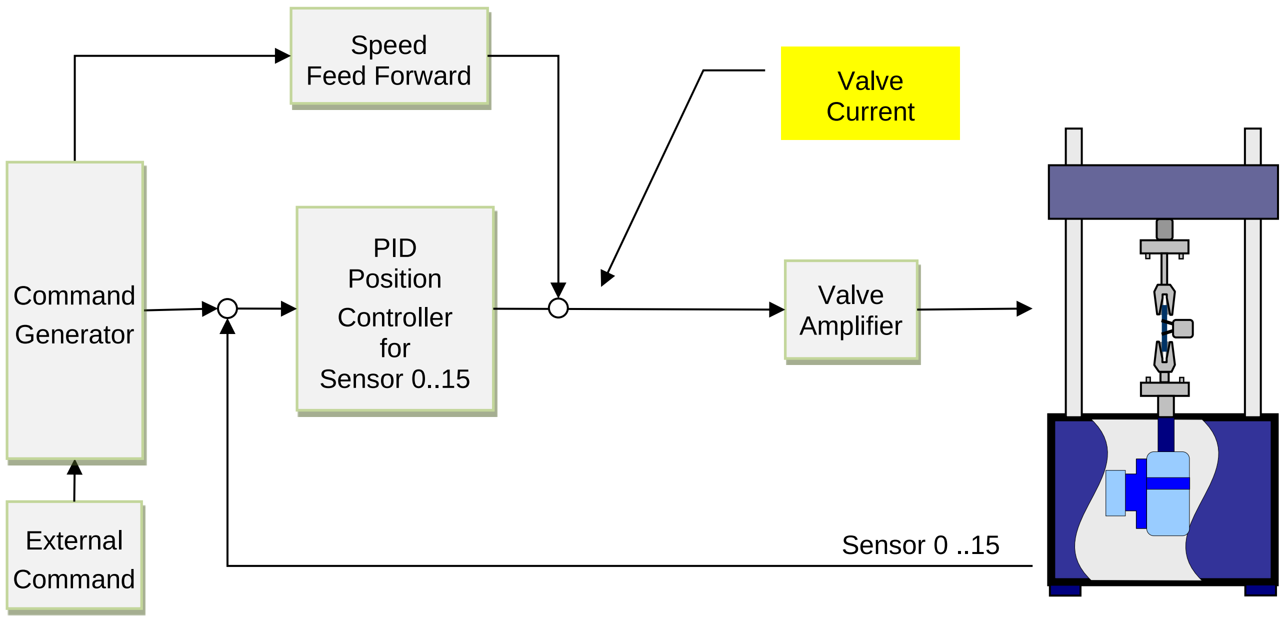


Fig. 20: Controller structure SPINDEL as PID controller

3.5.1.3 Controller Structure SPINDEL_SP

The controller structure SPINDEL_SP is suitable for spindle machines using EDC-internal or external drive amplifiers. The output of all three position controllers is the speed of X-Head. The output of the speed controller is the current for the motor.

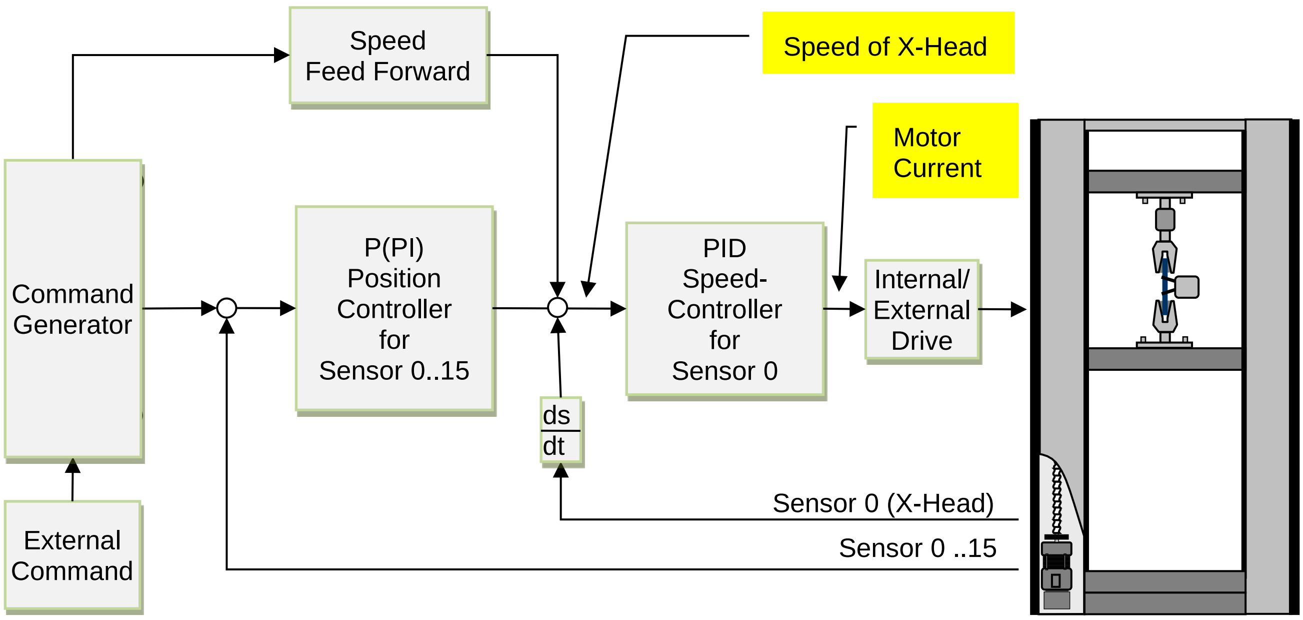


Fig. 21: Controller structure SPINDEL_SP

3.5.1.4 Controller Structure HYDRAULIC

The controller structure HYDRAULIC is suitable for hydraulic machines. For system damping the three position controllers (X-Head position, load and extension) use a cascade speed controller (position speed, load speed and extension speed).

The position speed can’t be used for load or extension control because of the bad position sensor resolution (about 1µm) at hydraulic machines.

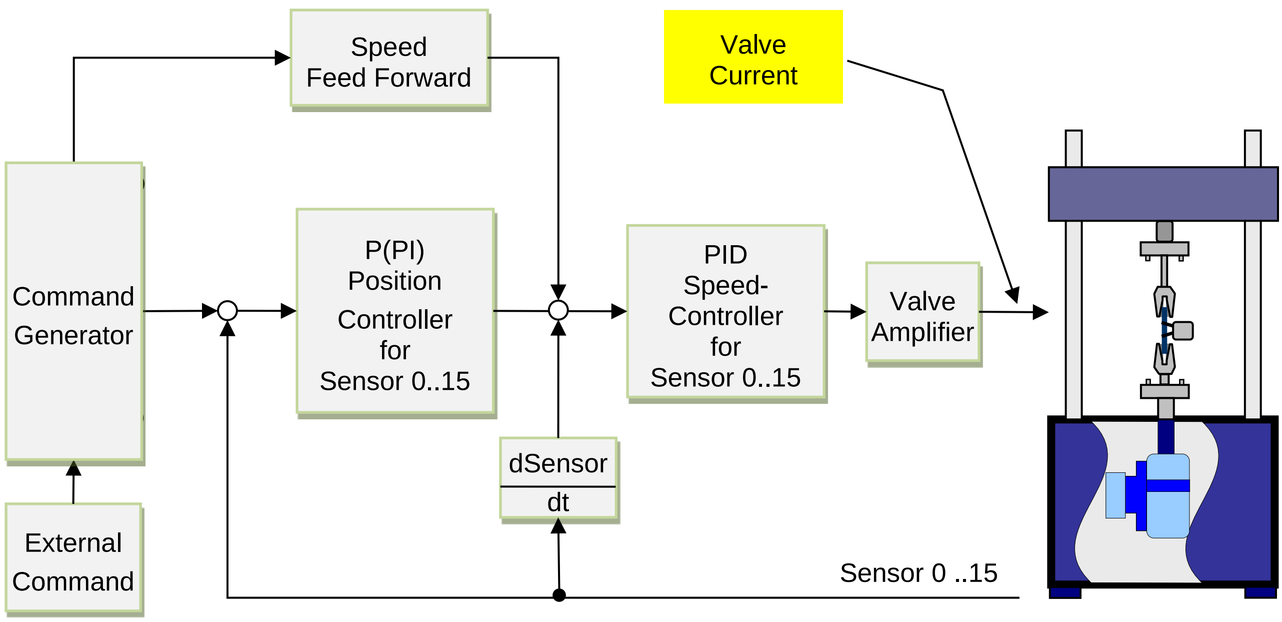


Fig. 22: Controller structure HYDRAULIC

3.5.2 Closed Loop Control Parameters

The following parameters influence the closed loop controller. Use the EDC setup wizard of the DOLI Installation Center to get suitable default parameters (see chapter 4.4.3).

3.5.2.1 Section Machine Data

System Time

EDC system time base for closed loop controller. This parameter defines the basic EDC system clock signal, which is used to synchronize the processing of all sensor data and the closed loop controller. This will ensure that all data are sampled exactly at the same time.

Limitations:

- Maximum 1.0 ms (1 kHz).
- Minimum 0.1 ms (10 kHz).
- Step 0.1 ms (e.g. 0.1, 0.2, 0.3, …).
- At 0.1 ms a maximum of six sensors is allowed.
- If USB communication to PC is used, only 1.0 ms is allowed.

Common values are:

- 1.0 ms for static machines.
- 0.1 ms … 0.4 ms for high response dynamic machines.

Attention: All other time bases are derived from System Time and must be selected as an integral multiple of this value.

Control Structure

Set closed loop controller structure (see chapter 3.5.1).

SPINDEL_SP	Position speed controller, integrated in the EDC firmware.
SPINDEL	Position speed controller, external.
HYDRAULIC	Hydraulic system.

3.5.2.2 Section Closed Loop Control

There is one set of closed loop parameters for every sensor.

Acceleration

The maximum acceleration/deceleration value of the instrument allowable under nominal load. The maximum acceleration is calculated from the maximum speed and the time needed to reach this speed. All driven accelerations are restricted to this limit in order to avoid saturating the drive signal.

Speed

The maximum instrument driven speed allowable under nominal load. All driven velocities are restricted to this limit in order to avoid saturating the drive signal.

Screw driven instruments:
This value is calculated from the maximum motor speed, the screw pitch and (if existing) the transmission ratio between motor and screw.
Nominal speed = max. motor speed * screw pitch * transmission ratio.

Hydraulic instruments:
The piston area, the hydraulic power pack and the flow rate of the control valve are used to calculate the speed.
Nominal speed = max. flow rate (valve or power pack) / piston area.

Filter Time

Filter time for feedback value when transferring to the closed loop controller.
The current value of the controlling channel is generated with this filter time. This filter time is independent from the sensor filter time for the measurement.

Common values for the filter time are 10.0 to 20.0 ms for static and 1.0 to 0.1 ms for dynamic applications.

⚠ **Attention! Changing this parameter will have influence on all gains associated with the sensors closed loop controller.**

Deviation

Maximum difference value allowed between command and feedback.

Reaction

Select EDC reaction, if the **Deviation** value is exceeded.

STATE	No reaction, controller state is set only.
STOP	Switch off drive amplifier.

PosP

Position (x) controller gain (proportional part).
Bigger values mean more effect

PosI

Position (x) controller integration time (integral part).
Smaller values mean more effect

PosD

Position (x) controller differential gain.
Bigger values mean more effect

SpeedP

Speed (dx/dt) controller gain (Proportional part)
Bigger values mean more effect

SpeedI

Speed (dx/dt) controller integration time (integral part).
Smaller values mean more effect

SpeedD Speed (dx/dt) controller differential gain.
Bigger values mean more effect

SpeedFFP Feed forward gain for speed in % of nominal speed.

PosDelay Delay cycles for position command. This parameter compensates the system delay.

Depending on the selected closed loop structure and control channel, the parameters listed in the table below are required:

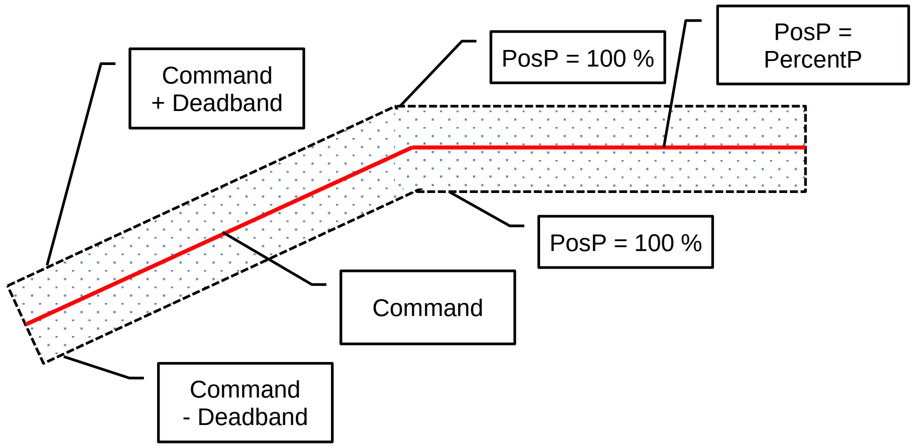
Structure	SPINDEL_SP	SPINDEL	HYDRAULIC
Position	PosP	PosP PosI PosD	PosP
	SpeedP SpeedI		SpeedP SpeedI
	SpeedFFP PosDelay	SpeedFFP PosDelay	SpeedFFP PosDelay
Sensor 1..15	PosP	PosP PosI PosD	PosP
			SpeedP SpeedI
	SpeedFFP PosDelay	SpeedFFP PosDelay	SpeedFFP PosDelay

Deadband Enable

Enable deadband controller.

DISABLE	Disable deadband control.
ENABLE	Enable deadband control.

A deadband can be used to reduce, or eliminate a limit cycle due to friction. Inside an area command plus **Deadband** and command minus **Deadband** the gain of position controller is continuously reduced from PosP = 100 % to a minimum value **PercentP.**



Note: a well-adjusted feed forward is needed for a good function of deadband control!

Deadband

Width of error deadband around command. Only used if deadband control is enabled.

PercentP

Smallest PosP inside deadband (0 % to 100 %). Only used if deadband control is enabled.

Dither Enable

Enable an analogue output channel dither. Some DOLI output amplifier like D03I, D16I, D32I have a digital dither generator function. The dither amplitude and frequency can be activated.

DISABLE	Disable dither.
ENABLE	Enable dither.

Dither Frequency

Set dither frequency. Only used if dither is enabled.

Dither Amplitude

Set dither amplitude (0 % to 33 %). Only used if dither is enabled.

RMC Speed Fast Fast Digipoti start speed (not used on EDC RMC).

RMC Speed Slow Slow Digipoti start speed (Up/Down keys on EDC RMC).

DigiPoti Sens. Speed Digipoti sensitivity in speed and openloop control mode (e.g.: 2 revolutions / maximum speed).

DigiPoti Sens. Pos Digipoti sensitivity in position control mode (e.g.: 1 mm / revolution).

3.5.2.3 High/Low Pressure Mode

If the **High/Low Pressure Mode** is enabled in the **IOSIGNALS** (see chapter 3.8.5), then there are two sets of closed loop parameters, one for low pressure and one for high pressure.

Note: Find the correct high pressure closed loop parameters first. Then copy them to the low pressure section and change only the parameter PosP:

PosP_LowPressure = PosP_HighPressure / 10

3.6 Output Channels

Connector	Output channel connector number.	
Sign	Output channel polarity.	
	INV	invert output signal polarity
	N-INV	retain default output polarity
	The polarity must be altered, if the instrument starts in an uncontrollable manner after “RUN” was activated.	
Maximum Value	Output channel maximum value (–100% to +100%).	
Minimum Value	Output channel minimum value (–100% to +100%).	
Initialisation Value	Output channel offset (–100% to +100%). For screw driven instruments, normally, this parameter is set to zero. For hydraulic instruments operated in bypass control mode, this parameter sets the servo valve offset signal which is necessary to counteract the piston weight and keep the instrument piston in a steady state.	
Offset	Analogue offset compensation.	

Signal Type of command output.

A/B	incremental digital command output.
Pulse/Sign	pulse and sign digital command output.
Up/Down	Up / Down digital command output.
Analogue	±10V analogue command output.
DCMotor	DC servo motors (PWM mode: "Sign Magnitude"). Use this type for DOLI DC drives.
DCLinearMotor	Dynamic linear drives (PWM mode: "Locked Anti Phase").

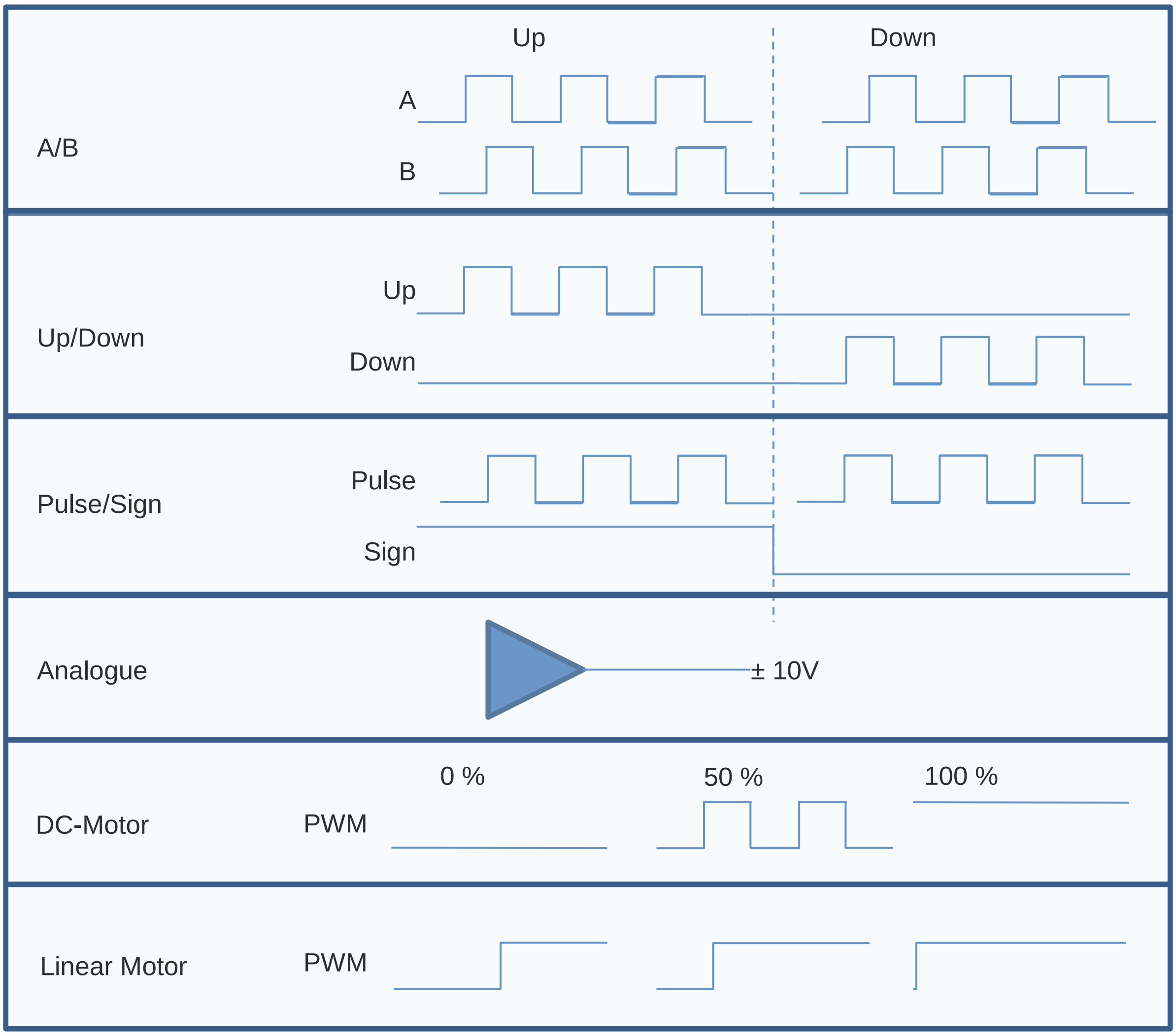


Fig. 23: Types of command output.

Signal Frequency Frequency of the digital command output signals *A/B, Pulse/Sign* and *Up/Down* (see chapter 6.3 for an example).

Note: **The next parameters are only valid for EDCs with internal DOLI drives.**

Maximum Voltage Maximum motor / valve voltage.

Maximum Current Nominal motor / valve current.

Max. Current Time Time for maximum current in seconds.
The duration of the maximum current is supervised by an I^2t calculation. The maximum time is limited by the connected power amplifier (e.g. 0.6 sec for DC160). This time may be reduced by this parameter.

If this value is set to zero, the nominal current will be used only (plus dither, if activated). If not zero, dither cannot be activated.

CurrentP: Current controller proportional gain (zero means default value).

CurrentI: Current controller integration time (a zero means default value).

CurrentD: Current controller differential gain (a zero means default value).

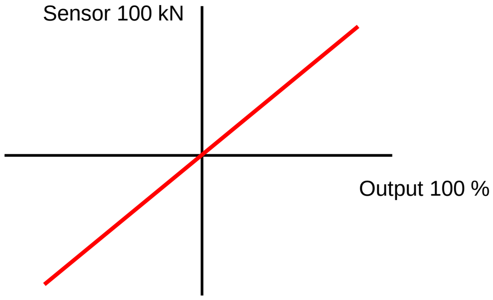
3.6.1 Sensor to Output (Mc2Output)

A sensor can be scaled and issued to an analogue output channel. This function is not available for the command output channel 0. The refresh rate for the analogue output is "System Time".

Mode:	*Disable*	disable Sensor to output
	2 Points	enable Sensor to output defined with **two** points.
	3 Points	enable Sensor to output defined with **three** points
Sensor:	Sensor number	
SensorPoint 0:	Sensor value 0 [Sensor Unit].	
OutputPoint 0:	Output channel value at Sensor Value 0 [%]	
SensorPoint 1:	Sensor value 1 [Sensor Unit].	
OutputPoint 1:	Output channel value at Sensor Value 1 [%]	
SensorPoint 2:	Sensor value 2 [Sensor Unit].	
OutputPoint 2:	Output channel value at Sensor Value 2 [%]	

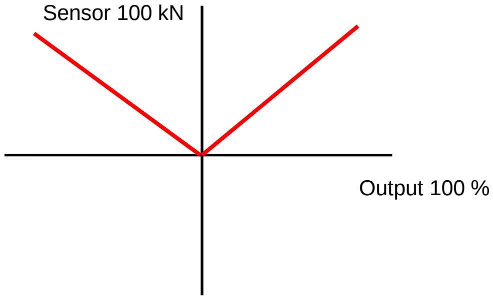
Example 1 for a load sensor with ±100 kN = ±100 % output defined by two points:

Mode:	2 Points
Sensor:	LOAD
SensorPoint 0:	-100 kN
OutputPoint 0:	-100 %
SensorPoint 1:	100 kN
OutputPoint 1:	100 %



Example 2 for a load sensor with 0 to +100 kN -> 0 to +100 % Output,
and 0 to -100 kN -> 0 to +100 % Output

Mode:	3 Points
Sensor:	LOAD
SensorPoint 0:	-100 kN
OutputPoint 0:	100 %
SensorPoint 1:	0 kN
OutputPoint 1:	0 %
SensorPoint 2:	100 kN
OutputPoint 2:	100 %



3.7 Bit Device

Connector Bit Input / Output device connector number.

Init Value Bit Output default state after initialization.

Write Protect Bit Output write protect mask. Set bits can't be changed by software.

Note: On the right side you can check the current configuration of the input and output bits of the device.

3.8 I/O-Signals

3.8.1 Overview

The EDC supports the following special functions:

- Control of grips
- Control of extensometer
- Fixed XHead adjustment
- High/Low pressure selection
- SHalt signals
- Miscellaneous I/O control
- RMC IO key configuration
- Position limit configuration
- Speed limit configuration
- Load limit configuration

All of these functions must be configured in the EDC setup. The control functions may be activated via keys on the RMC, or via commands from PC.

Each control function uses digital I/O with certain functions. The I/O bits for one function must be configured as a whole block to any I/O device. The first bit of a block can be assigned to any bit of the I/O device.

Note: On the right side you can check the current configuration of the input and output bits of the device.

3.8.2 Grip control

The grips can be operated by the corresponding RMC keys (see chapter 2.6.4).

Table 13: Digital I/O for grip control

Input	Output	
Bit 0 InGripConnected	Bit 0 OutGripOpenEnable	BitDevice, BitNo
Bit 1 InGripUpperOpened	Bit 1 OutGripUpperOpen	
Bit 2 InGripLowerOpened	Bit 2 OutGripLowerOpen	
Bit 3 InGripUpperClosed	Bit 3 OutGripUpperClose	
Bit 4 InGripLowerClosed	Bit 4 OutGripLowerClose	

Table 14: Setup parameter for grip control

Parameter	Value	Description
Mode	0 = Disabled 1 = Transparent 2 = Limit Control 3 = Limit Control Inv	
Device	Device 0...9	Device-number for BitIn- and BitOut Device
BitNo	Bit 0...15	Bit-number for I/O No. 0 (InGripConnected/ OutGripOpenEnable)
Limit	Sensor Number 0...15	Sensor for Limit monitoring (default: Load)
LimMax	xxx,xx	Maximum Limit
LimMin	xxx,xx	Minimum Limit

Mode 0 Disabled:

- Grip control is inactive.

Mode 1 Transparent:

- Connect bit active (InGripConnected).
- Limit monitoring is active (OutGripOpenEnable).
- All pressed keys are output to the corresponding digital outputs.
- Key pressed -> InGripOpen/InGripClose is HIGH.
- Key released -> InGripOpen/InGripClose is LOW.
- The inputs InGripOpened/InGripClosed will control the corresponding LEDs.

Mode 2 Limit Control:

- Connect bit active (InGripConnected).
- Limit monitoring is active (OutGripOpenEnable).
- No keys or LEDs are handled by the EDC. PC software can handle keys and LEDs, if necessary.

Mode 3 Limit Control Inv:

- Same as mode 2, but the signal OutGripOpenEnable is inverted (active low) for compatibility reason, see below.

General:

- The grips will not open, if the limit monitoring detects a higher value than allowed (OutGripOpenEnable LOW Limit exceeded).
- Mode 2 and 3 can be used to simulate the grip control of older EDC firmware versions, that was formally configured in the machine data of the EDC setup:
  Old: Active Low -> New: Mode 2 Limit Control
  Old: Active High -> New: Mode 3 Limit Control Inv

3.8.3 Extensometer control

The extensometer can be operated by the corresponding RMC keys (see chapter 2.6.4).

Table 15: Digital I/O for the extensometer control

Input	Output	
Bit 0 InExtUpperOpened	Bit 0 OutExtUpperOpen	BitDevice, BitNo
Bit 1 InExtLowerOpened	Bit 1 OutExtLowerOpen	
Bit 2 InExtUpperClosed	Bit 2 OutExtUpperClose	
Bit 3 InExtLowerClosed	Bit 3 OutExtLowerClose	

Table 16: Setup parameter for the extensometer control

Parameter	Value	Description
Mode	0 = Disabled 1 = Enabled	
Device	Device 0...9	Device-number for BitIn- and BitOut device.
BitNo	Bit 0...15	Bit-number for I/O No. 0 (InExtUpperOpened/ OutExtUpperOpen)
IOTime	Time in seconds	I/O Time for output signals (OutExt...) Time = 0 -> Function is inactive.

Mode 0 Disabled:

- Extensometer control inactive.

Mode 1 Enabled:

- Key CLOSE:
  -> LED CLOSE flashes.
  -> OutExtUpperClose and OutExtLowerClose set HIGH.
  -> Wait until InExtUpperClosed is HIGH (or IOTime has elapsed), then OutExtUpperClose set LOW.
  -> Wait until InExtLowerClosed is HIGH (or IOTime has elapsed), then OutExtLowerClose set LOW.
  -> LED CLOSE ON, LED OPEN OFF.
- Key OPEN:
  -> LED OPEN flashes.
  -> OutExtUpperOpen and OutExtLowerOpen set HIGH.
  -> Wait until InExtUpperOpened is HIGH (or IOTime has elapsed), then OutExtUpperOpen set LOW.
  -> Wait until InExtLowerOpened is HIGH (or IOTime has elapsed), then OutExtLowerOpen set LOW.
  -> LED OPEN ON, LED CLOSE OFF.
- If IOTime = 0 seconds, then IOTime is inactive.

3.8.4 Fixed XHead adjustment

The fixed XHead can be operated by the corresponding RMC keys (see chapter 2.6.4).

Table 17: Digital I/O for Fixed XHead adjustment

Input	Output	
Bit 0 InFixedXHeadUnlocked	Bit 0 OutFixedXHeadUnlock	BitDevice, BitNo
	Bit 1 OutFixedXHeadUp	
	Bit 2 OutFixedXHeadDown	

Table 18: Setup parameter for Fixed XHead adjustment

Parameter	Value	Description
Mode	0 = Disabled 1 = Enabled	
Device	Device 0...9	Device number for BitIn- and BitOut device.
BitNo	Bit 0...15	Bit-number for I/O No. 0 (InFixedXHeadUnlocked/ OutFixedXHeadUnlock)
IOTime	Time in seconds	Time for InFixedXHeadUnlocked signal. Time = 0 -> Function is inactive.

Mode 0 Disabled:

- Fixed XHead adjustment is inactive.

Mode 1 Enabled:

- Key FixedXHeadUp pressed:
  -> LED Up flashes.
  -> OutFixedXHeadUnlock set HIGH.
  -> Wait until InFixedXHeadUnlocked is HIGH (or IOTime elapsed), then OutFixedXHeadUp set HIGH.
- Key FixedXHeadDown pressed:
  -> LED Down flashes.
  -> OutFixedXHeadUnlock set HIGH.
  -> Wait until InFixedXHeadUnlocked HIGH (or IOTime elapsed) , then OutFixedXHeadDown set HIGH.
- Key released:
  -> OutFixedXHeadUp und OutFixedXHeadDown set LOW.
  -> wait 200ms.
  -> OutFixedXHeadUnlock set LOW.
  -> LED OFF.
- If IOTime = 0 sec, then IOTime inactive.

3.8.5 High/Low Pressure

High/Low pressure can be operated by the corresponding RMC keys (see chapter 2.6.4).

Table 19: Digital I/O for High/Low pressure control

Input	Output	
Bit 0 InHighPressure	Bit 0 OutHighPressure	BitDevice, BitNo
Bit 1 InHighPressureOk	Bit 1 OutHighPressureOk	
Bit 2 InLowPressure	Bit 2 OutLowPressure	
	Bit 3 OutLowPressureOk	

Table 20: Setup parameter for High/Low pressure control

Parameter	Value	Description
Mode	0 = Disabled 1 = Enabled	
Device	Device 0...9	Device-number for BitIn- and BitOut device
BitNo	Bit 0...15	Bit-number for I/O No. 0 (InHighPressure/ OutHighPressure)
IOTime	Time in seconds	Time for output signals (OutHighPressure, OutLowPressure). Time = 0 -> IOTime is inactive.
RampTime	Time in seconds	Time for analogue output ramp. This time can also be used, if PressureOutput is disabled. Time = 0 -> RampTime is inactive.
PressureOutput	0 = Disabled 1 = Enabled	Enable/disable pressure output to an analogue output channel. The following parameters are only valid, if PressureOutput is 1.
OutChannel	OutChannel 1...15	Analogue output channel for pressure output.
LowPressure	-100% ... +100%	Analogue output value for LowPressure.
HighPressure	-100% ... +100%	Analogue output value for HighPressure.

Mode 0 Disabled:

- High/Low pressure control is inactive.

Mode 1 Enabled:

- Pressing DigiPoti + Pos mode  key simultaneously toggles between HighPressure (LED on) and LowPressure (LED off).
- LowPressure is active, if drive is OFF or after drive was switched ON.
- Key **HighPressure**, or **InHighPressure** changes from LOW to HIGH:
  -> Pos mode LED flashes.
  -> OutLowPressure set LOW.
  -> OutHighPressure set HIGH. If IOTime is active and elapsed, then OutHighPressure set LOW.
  -> If PressureOutput is active, increase output from LowPressure to HighPressure within RampTime.
  -> Wait until RampTime is elapsed (if RampTime active).
  -> Wait until InHighPressureOk is HIGH.
  -> OutHighPressureOk set HIGH.
  -> Pos mode LED is ON.
  -> Change to HighPressure controller parameter (see below).
- Key **LowPressure**, or **InLowPressure** changes from LOW to HIGH:
  -> Pos mode LED flashes.
  -> Change to LowPressure controller parameter (see below).
  -> OutHighPressure set LOW.
  -> OutLowPressure set HIGH. If IOTime is active and elapsed, then OutLowPressure set LOW.
  -> If PressureOutput is active, decrease output from HighPressure to LowPressure within RampTime.
  -> Wait until RampTime is elapsed (if RampTime active).
  -> Wait until InHighPressureOk is LOW.
  -> OutHighPressureOk set LOW.
  -> Pos mode LED is OFF.
- If HighPressure is active, and InHighPressureOk becomes LOW -> Switch to LowPressure again.

Change of controller parameter:

- If the machine is moving:
  -> Stop the machine with SHalt (FixValue for Openloop).
  -> Wait until machine has stopped.
  -> Wait for brake open time.
- Change of controller parameter:
  -> Nominal acceleration, and nominal speed.
  -> PID Parameter (SpeedPID, PosPID, SpeedFFP, PosDelay).
  -> Destination window.
  -> Deviation.
  -> Deadband settings.
  -> Dither amplitude and frequency.
  -> Filter time.

3.8.6 SHalt Signal

Two digital inputs can be configured to stop the XHead in position control.

Table 21: Digital I/O for SHalt signal

Input	Output	
Bit 0 InSHaltUpper		BitDevice, BitNo
Bit 1 InSHaltLower		

Table 22: Setup parameter for SHalt signal

Parameter	Value	Description
Mode	0 = Disabled 1 = Enabled 2 = Enabled Inverted	
Device	Device 0...9	Device number for BitIn- and BitOut device
BitNo	Bit 0...15	Bit-number for I/O No. 0 (InSHaltUpper)

Mode 0 Disabled:

- SHalt signal is inactive.

Mode 1 Enabled:

- If InSHaltUpper is HIGH, XHead stops in position control. Only movement to direction DOWN is possible.
- If InSHaltLower is HIGH, XHead stops in position control. Only movement to direction UP is possible.

Mode 2 Enabled Inverted:

- Same as Mode 1, but input signals are inverted (active low).

3.8.7 Miscellaneous

Table 23: Miscellaneous Digital I/O

Input	Output	
Bit 0 InMiscTemperature1	Bit 0 OutMiscCal	InBitDevice, InBitNo
Bit 1 InMiscTemperature2	Bit 1 OutMiscNoSensorLimit	OutBitDevice, OutBitNo
Bit 2 InMiscOilLevel		
Bit 3 InMiscOilFilter		
Bit 4 InMiscPowerFail		

Table 24: Setup parameter for Miscellaneous Digital I/O

Parameter	Value	Description
InMod	0 = Disabled 1 = Enabled	
InDev	Device 0...9	Device-number for BitIn-Device
InBit	Bit 0...15	Bit-number for IN No. 0 (InMiscTemperature1)
OutMod	0 = Disabled 1 = Enabled	
OutDev	Device 0...9	Device-number for BitOut-Device
OutBit	Bit 0...15	Bit-number for OUT No. 0 (OutMiscCal)

Mode 0 Disabled:

- Miscellaneous functions not active.

InMode 1 Enabled:

- InTemperature1 is HIGH -> Warning
- InTemperature2 is HIGH -> Emergency off
- InOilLevel is HIGH -> Emergency off
- InOilFilter is HIGH -> Warning
- InPowerFail is HIGH -> Emergency off

OutMode 1 Enabled:

- OutCal:
  LOW -> Calibration contact is inactive
  HIGH -> Calibration contact is active
- OutNoSensorLimit:
  LOW -> Sensor range limit exceeded
  HIGH -> Sensor range limit not exceeded

3.8.8 RMC IO Keys

3.8.8.1 RMC IO Keys Parameter

This table shows the parameters to configure a simple RMC IO remote control with up to 16 keys and LEDs.

Table 25: Description of configurable RMC IO keys

RMC IO Keys 0…15 parameters		
Key Code	HALT, UP, DOWN, …	Key code (see table below)
Device	Device 0…9	Bit device for key and LED
Key Bit	Bit 0…15	Bit input number for the key
Led Bit	Bit 0…15	Bit output number for the LED

Table 26: Description of Key Codes for RMC IO keys

Key Code	Function
- - -	Key disabled
HALT	HALT
UP	Move UP slow
DOWN	Move DOWN slow
DPOTI	DigiPoti pressed
F1	F1 function key
F2	F2 function key
F3	F3 function key
ON	Drive ON
TEST_START	TEST start
UPR_GRIP_OPEN	Upper Grip Open
UPR_GRIP_CLOSE	Upper Grip Close
LWR_GRIP_OPEN	Lower Grip Open
LWR_GRIP_CLOSE	Lower Grip Close
EXTMETER_OPEN	Extensometer Open
EXTMETER_CLOSE	Extensometer Close
FIXED_XHEAD_UP	Fixed X-Head Up
FIXED_XHEAD_DOWN	Fixed X-Head Down
DPOTI_CONTROL	DigiPoti Speed-Position Mode
BF1	Blind F1 function key (RMC no LCD)
BF2	Blind F2 function key (RMC no LCD)
BF3	Blind F3 function key (RMC no LCD)
HIGH_PRESSURE	Activate High Pressure
LOW_PRESSURE	Activate Low Pressure
OFF	Drive OFF
UP_FAST	Move UP fast
DOWN_FAST	Move DOWN fast
TEST_STOP	Test stop
TEST_RETURN	Test return
TEST_HALT_CONTINUE	Test halt / continue
CTRL_SENSOR3	Sensor3 control active
CTRL_SENSOR4	Sensor4 control active
CTRL_SENSOR5	Sensor5 control active
CTRL_SENSOR6	Sensor6 control active
CTRL_SENSOR7	Sensor7 control active
CTRL_SENSOR8	Sensor8 control active
CTRL_SENSOR9	Sensor9 control active
CTRL_SENSOR10	Sensor10 control active
CTRL_SENSOR11	Sensor11 control active
CTRL_SENSOR12	Sensor12 control active

Key Code	Function
CTRL_SENSOR13	Sensor13 control active
CTRL_SENSOR14	Sensor14 control active
CTRL_SENSOR15	Sensor15 control active
DP	Period (decimal point)
SIGN	Change Sign
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
CTRL_POS	Position control active
CTRL_LOAD	Load control active
CTRL_EXTENSION	Extension control active
TOUCH	RMC touch display has been touched
LINK	Link function (handled by EDC)
CONNECT	RMC is connected

3.8.8.2 Example of a simple RMC IO at X2

All RMC keys can be configured to a standard IO device. Here is an example for a 4 key RMC IO connected to X2 of the EDC. Device 0 must be configured as Bit Device in the EDC setup to X2.

Table 27: Example for a simple RMC IO

Key	Bit Device	Key Bit	Led Bit
ON	Device 0 at X2	Bit 4	Bit 4
UP	Device 0 at X2	Bit 5	Bit 5
HALT	Device 0 at X2	Bit 6	Bit 6
DOWN	Device 0 at X2	Bit 7	Bit 7

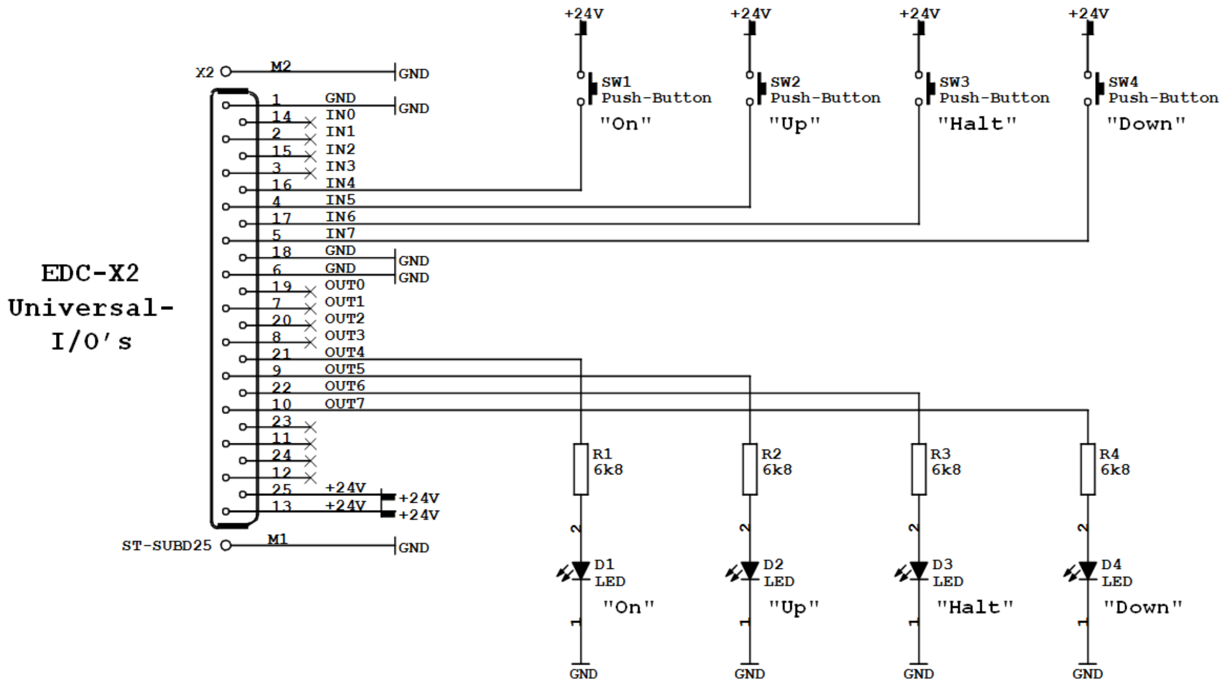


Fig. 24: Schematic diagram of a RMC IO at X2

3.8.9 IO Limit Position, Speed, and Load

An external device (e.g. a PLC) can be triggered with an output bit (OutLimitXXXOk), if the XHead position, XHead speed or load limit is over / undershoot.

Table 28: Digital I/O for Limit XHead PositionI

Input	Output	
	Bit 0 OutLimitPosOk	BitDevice, BitNo

Table 29: Digital I/O for Limit XHead SpeedI

Input	Output	
	Bit 0 OutLimitSpeedOk	BitDevice, BitNo

Table 30: Digital I/O for Limit LoadI

Input	Output	
	Bit 0 OutLimitLoadOk	BitDevice, BitNo

Table 31: Setup parameter for IO Limit Position, Speed and Load

Parameter	Value	Description
Mode	0 = Disabled 1 = Enabled	
Device	Device 0...9	Device-number for BitIn- and BitOut device
BitNo	Bit 0...15	Bit-number for I/O
Limit Max		Maximum limit
Limit Min		Minimum limit

3.8.10 Guard Option

With the guard option (GO) it is possible to use an EDCi and external, certified safety technology to build a safe machine in accordance with the applicable standards. The existing IO components X2 or iIO (iSI module) are used as hardware. Specialized hardware is no longer necessary. It should be noted that the EDCi guard option is not a 1-to-1 replacement of the safety shield option of the former EDCV series.

ATTENTION: A licence file is needed if the guard option is activated in the EDCi.

3.8.10.1 Guard Option IO

Table 32: Guard option digital I/O

Input	Output	
Bit 0 InGuardClosed	Bit 0 OutGuardLimOverrun	BitDevice, BitNo
Bit 1 InGuardUnlockReq	Bit 1 OutGuardUnlockReq	
	Bit 2 OutGuardLimModeAck	

Table 33: Guard option digital I/O description

Name	Direction	Description
InGuardClosed	In	Activates "LimitedMode" when the safety door is open. i.e. Speed and / or range are monitored and / or limited. [In Guard Closed]
InGuardUnlockReq	In	Input for a button with which the "Limited Mode" can be activated / deactivated if machine is within the limits (function dependent on "RequestButtonMode" [Toggle, Set, Static]. [In Guard Unlock Request]
OutGuardLimOverrun (low active)	Out	Signals that speed and / or range limits have been exceeded. (regardless of whether limited mode is active or inactive) [Out Guard Limit Overrun]
OutGuardUnlockReq	Out	Signal to external safety control to request unlocking of the protective door. [Out Guard Unlock Request]
OutGuardLimModeAck	Out	"Limited Mode" feedback is activated that means speed and / or sensor range are limited and are within the limits. Signal for a safety controller that external safety function (STO or SLS) can be activated. [Out Guard Limited Mode Acknowledge]

Table 34: Guard option EDC states CtrlState2 description

Name	Description
GuardLimMode	Indicates when limited mode has been activated. Speed and / or range limits as well as "LowPressure" have already been activated but can still be outside the limits. Is reset when InGuardClosed (high) and "Limited Mode" is deactivated.
GuardLimModeAck	Indicates that the EDCi is in "Limited Mode" that means speed and / or range are limited and are within the limits. If the limits are exceeded, the bit is deactivated.
GuardLimOverrun	Signals that the speed and / or range limits have been exceeded. (regardless of whether limited mode is active or inactive)

3.8.10.2 Guard Option Setup Parameter

Table 35: Guard option setup parameter

Parameter	Value	Description
Mode	0 = Disabled	Guard option not active
	1 = Limited	Limitation/monitoring of range and/or speed
	2 = CtrlOff	Switching off the control when "Limited Mode" is active
BitDevice	Device 0...9	Device-number for BitIn- and BitOut device
BitNo	Bit 0...15	Selection of the connector for the digital I/O's
SpeedLimitEnable	Disabled	Deactivate speed limit
	Enabled	Activate speed limit
SpeedLimitSensor	Sensor 0...15	Selection of sensor for speed control
SpeedLimit	Value	Limitation for speed in „Limited Mode"
SpeedLimitTolerance	Value	If „Limited Mode" is active and [*SpeedLimit* + *SpeedLimitTolerance*] is exceeded the „*LimitOverrunReaction*" is triggered
RangeLimitEnable	Disabled	Deactivate range limits
	Enabled	Activate range limits
RangeLimitSensor	Sensor 0...15	Selection of sensor for range limit
UpperRangeLimit	Value	Upper range limit in „Limited Mode"
LowerRangeLimit	Value	Lower range limit in „Limited Mode"
RangeLimitTolerance	Value	If „Limited Mode" is active and *[UpperRangeLimit + RangeLimitTolerance or LowerRangeLimit – RangeLimitTolerance*] is exceeded the „LimitOverrunReaction" is triggered
LimitOverrunReaction		Reaction if a monitored limit is exceeded in "Limited Mode"
	State	Status bit and OutGuardLimModeAck (low)
	DriveOff	Status bit and OutGuardLimModeAck (low) and drive is switched off
	SHalt	Status bit and OutGuardLimModeAck (low) and stop position controlled
LowPressureAct	Disabled	Deactivate LowPressure function
	Enabled	LowPressure is automatically activated when "Limited Mode" is activated. The OutGuardLimModeAck feedback signal is only set when the machine is in LowPressure.
RequestButtonMode	Disabled	Function and associated IO's are deactivated, (InGuardUnlockReq, OutGuardUnlockReq, OutGuardLimModeAck)
	Toggle	Activate / deactivate "Limited Mode" via a rising edge
	Set	Activate "Limited Mode" via rising edge
	Static	The "LimitedMode" is activated via a rising edge and deactivated on a falling edge

MonitoringDelay	0s..10s	Delay time to start the monitoring after the door has been closed

3.8.10.3 Guard Option Description

The GO can be activated in the IO signals in the EDC setup. It offers the option of limiting the speed of any control channel and the range of any control channel or monitoring their actual values for machines with a separating protective device when "LimitedMode" is active.

- When "LimitedMode" is active, the speed and / or range limit is always monitored, regardless of the type of control. If it triggers the "LimitOverrunReaction" will be execute.
- When "LimitedMode" is active in the type of control for which the speed limit is activated, the speed of a movement command will be limited.
- When "LimitedMode" is active, and the range is left, it will stop in the current control.

This function does not represent a safety function according to the applicable standards. Compliance with the physical limits required by the risk assessment (e.g. standstill, speed, load ...), as well as the activation and evaluation of the interlocking of the protective device, must be ensured by separate safety technology.

The GO is (de-) activated via the “Mode” setup parameter. When activated, you can choose between the "Limited" or "CtrlOff" mode. Regardless of the "Mode" which is set, the machine can be moved "normally" with no restrictions when the protective device is active (protective door closed). If the protective device is not active (protective door open), the EDC control is deactivated in "CtrlOff" mode and it is no longer possible to move. In the "Limited" mode, on the other hand, the machine can be moved within the specified limits. This is necessary to enable setup operation. The modes are described again in detail below.

Mode 0 Disabled:

- Guard option not activated.

Mode 1 Limited:

- ***Protective device open (unsafe condition):***
  The machine can be used normally within the limits. Depending on the configuration machine will also switch to “LowPressure”. In addition, depending on the type of control, the following actions take place.
  - **Regulation on the sensor for which the speed limits are active**: If the "LimitedMode" is activated via the digital I/Os "InGuardClosed" (low) and / or "InGuardUnlockReq" or via the DoPE function "DoPEGuardSetLimitedMode", the speed and the range limits are limited and monitored. The action which is to be carried out during the monitoring is set via the setup parameter "LimitOverrunReaction".
  - **All other types of rules**: If the "LimitedMode" is activated via the digital I / O's "InGuardClosed" (low) and / or "InGuardUnlockReq" or via the DoPE function "DoPEGuardSetLimitedMode", the range limits are limited (HALT in the current control mode) and monitoring, as well monitoring of the speed limit. The action which is to be carried out during the monitoring is set via the setup parameter "LimitOverrunReaction".
- ***Protective device closed (safe condition):***
  The machine can be operated normally, even outside the limits.

Mode 2 CtrlOff:

- ***Protective device open (unsafe condition):***
  If EDCi is off the ON-command is inhibited and the guard has to be closed to switch on. If the EDCi is already switched on, the controller will be disabled but stays on. Therefore the machine cannot be moved additionally if the machine is outside the activated range or speed limit the LimitOverrunReaction will be executed.
- ***Protective device closed (safe condition):***
  The machine can be moved normally, even outside the limits.

Independent of the Mode and the state of the guard, if the range or speed limits are exceeded as well as active "HighPressure" (if LowPressureActionEnable "Enabled"), the digital I / O "OutGuardLimOverrun" is low and will be high if the machine is within the limits.

The Limited Mode can be activated and deactivated by the following conditions.

- DoPE function (IOGuardSetLimitedMode())
- Digital input InGuardUnlockReq (see description above), limited mode will only be activated if the machine is within the set speed and/or range limits. OutGuardLimitOverrun (high)
- Digital input InGuardGuardClosed (low → Limited Mode activate, high → Limited Mode deactivate)

The Limited Mode can only be deactivated if the guard is closed (InGuardGuardClosed (high), otherwise EDCi remains in the Limited Mode

For simple protective door applications, it is possible to reduce the amount of digital inputs and outputs, by setting the RequestButtonMode to disable. In this case only the following digital IO's are active.

Input	**Output**	
Bit 0 InGuardClosed	Bit 0 OutGuardLimOverrun	BitDevice, BitNo

Speed limitation (Speed limit, SpeedLimitSensor 0…15)
It is checked in advance whether the desired speed of the transmitted command does not contradict the set limit. If this is outside the limit, the target speed will be reduced to the limit. This limitation only affects the selected control channel (SpeedLimitSensor)
e.g. Position control (SpeedLimitSensor = 0 (Position Ctrl))

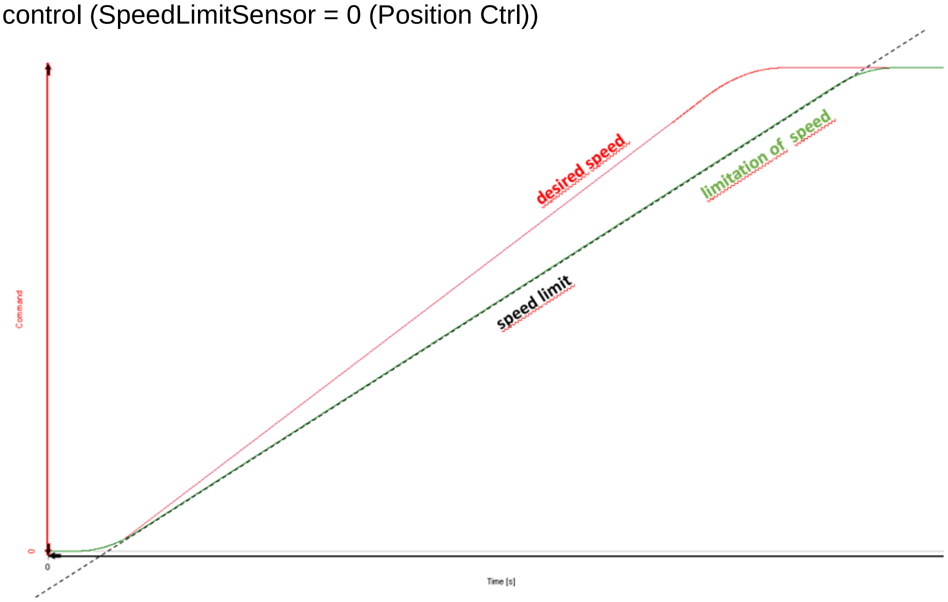


Fig. 25: Guard option speed limitation

Range limitation (Range limit, RangeLimitSensor 0…15)
The destination of a movement command is not limited in advance. However, if the machine reaches the limit it stops in the current control mode, irrespective which control channel is active.
e.g. load control (RangeLimitSensor = 1 (Load Ctrl)):

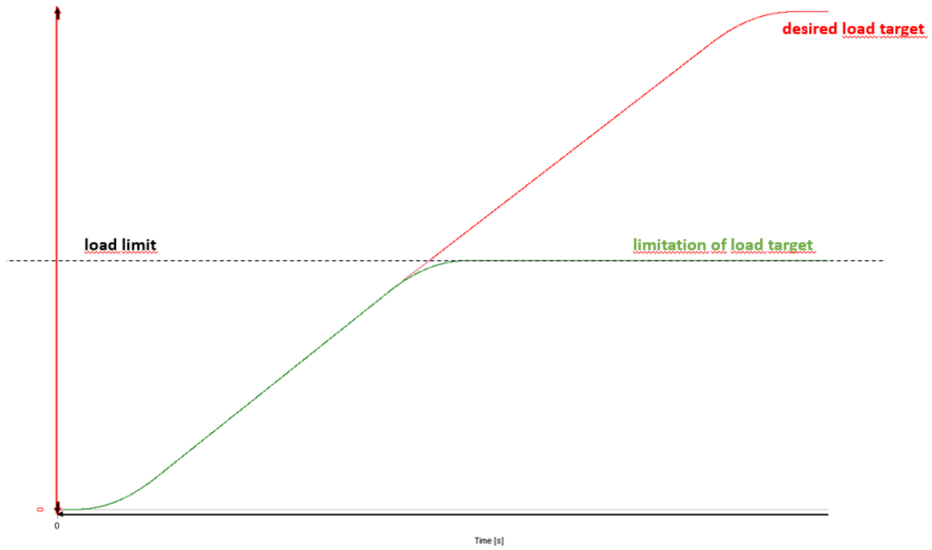


Fig. 26: Guard option range limitation

Monitoring
A comparison is made between the measured value and the set limit plus tolerance in a system cycle of 2 ms. As soon as the limits plus tolerance are reached or exceeded, a configured action (LimitOverrunReaction) is carried out. In contrast to the limitation, the monitoring of the speed (Speed Limit) is independent of the current control type.

3.8.10.4 Guard Option State Machine

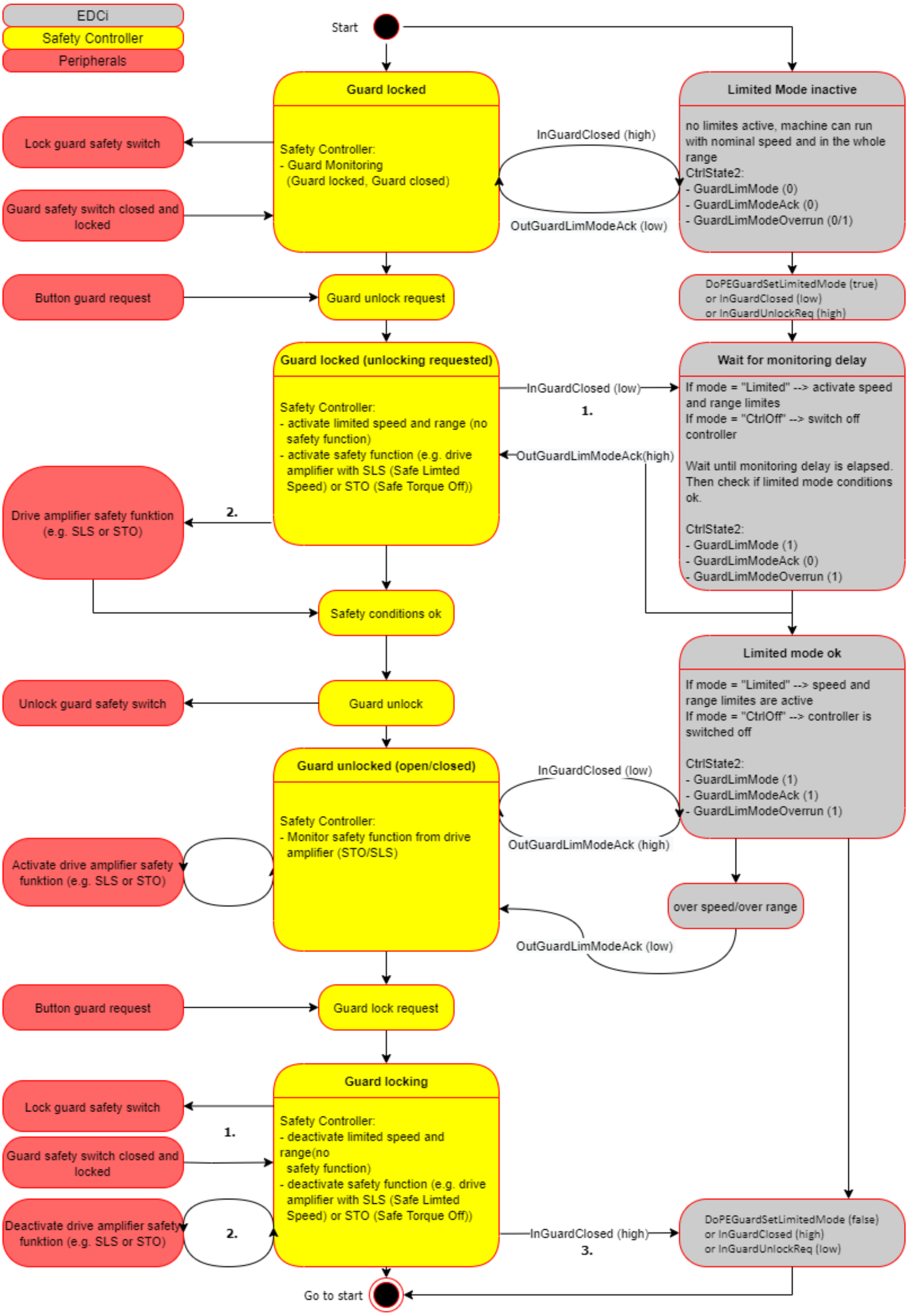


Fig. 27: Guard option state machine

3.9 Factory Settings

You can reset all parameters to factory settings. Press simultaneously the UP and DOWN keys on the RMCi1/RMCi8 at the EDC and follow the instruction on screen.

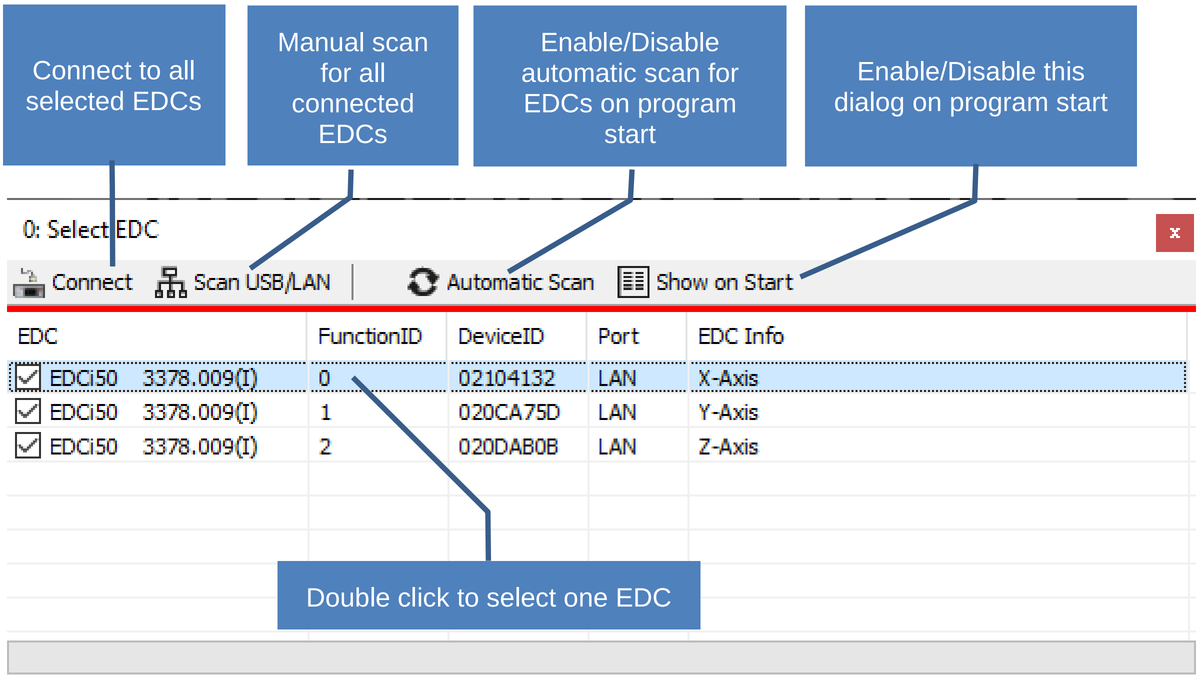
Attention! **After resetting to factory settings, all EDC data (setup, test parameters, languages and logo) must be re-entered.**

4 DOLI Installation Center

The DOLI Installation Center is developed for easy handling of EDC-Setup and installation at a testing machine.

4.1 Establish communication with an EDC

After starting the DOLI Installation Center all LAN and USB ports are automatically scanned for EDC. Select one or more EDCs and press the connect button.



Note: If automatic scan is disabled, and no EDC is shown, scan USB/LAN manually.

4.2 Overview

The main functions of the DOLI Installation Center are:

- **Setup Editor:**
  All Setup parameter can be edited here.
- **Closed Loop Control:**
  Adjusting parameter like PID etc.
- **Sensor Calibration:**
  Adjustment and linearization of a sensor. Check the adjustment of a sensor.
- **Test Center Light:**
  Perform various test functions.
  (Test Center Light replaces the former DOLI Test Center)

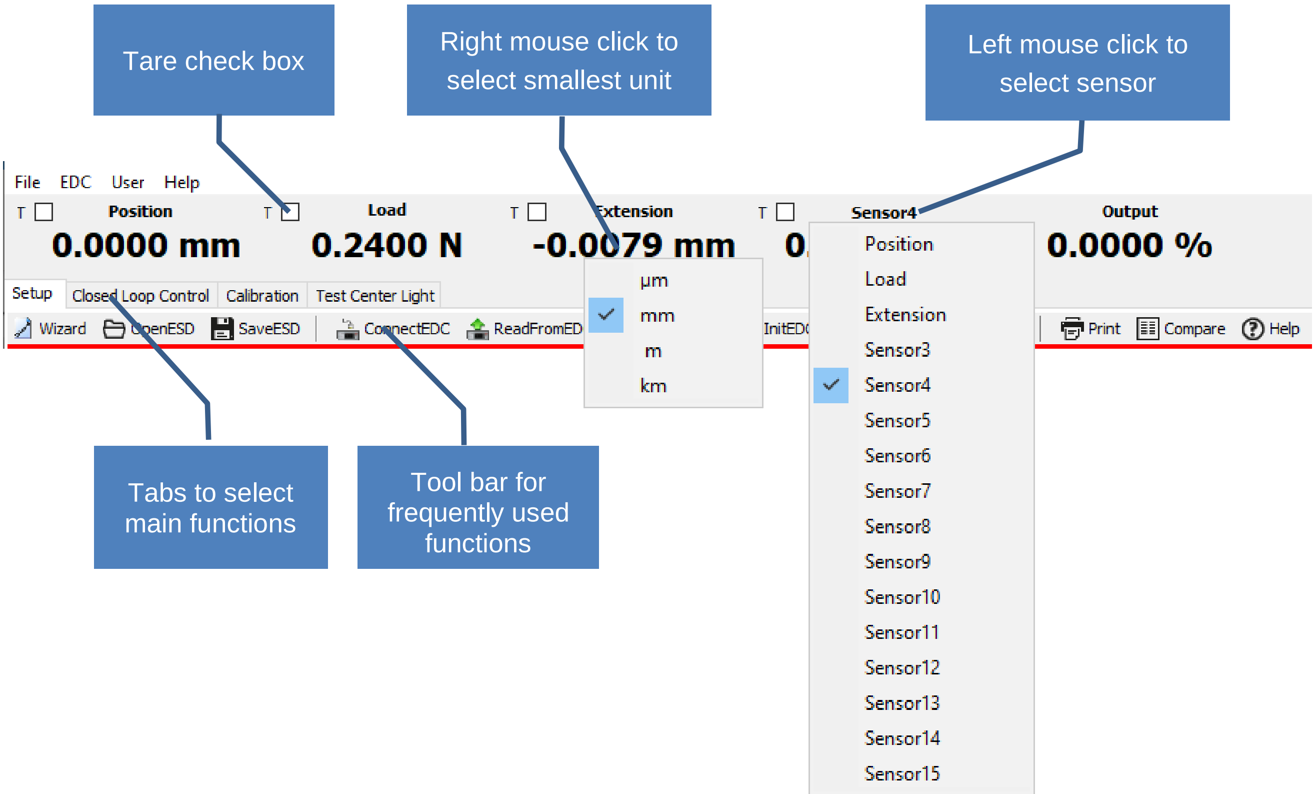


Fig. 28: Test Center Light main functions

4.3 RMC Machine Control Panel

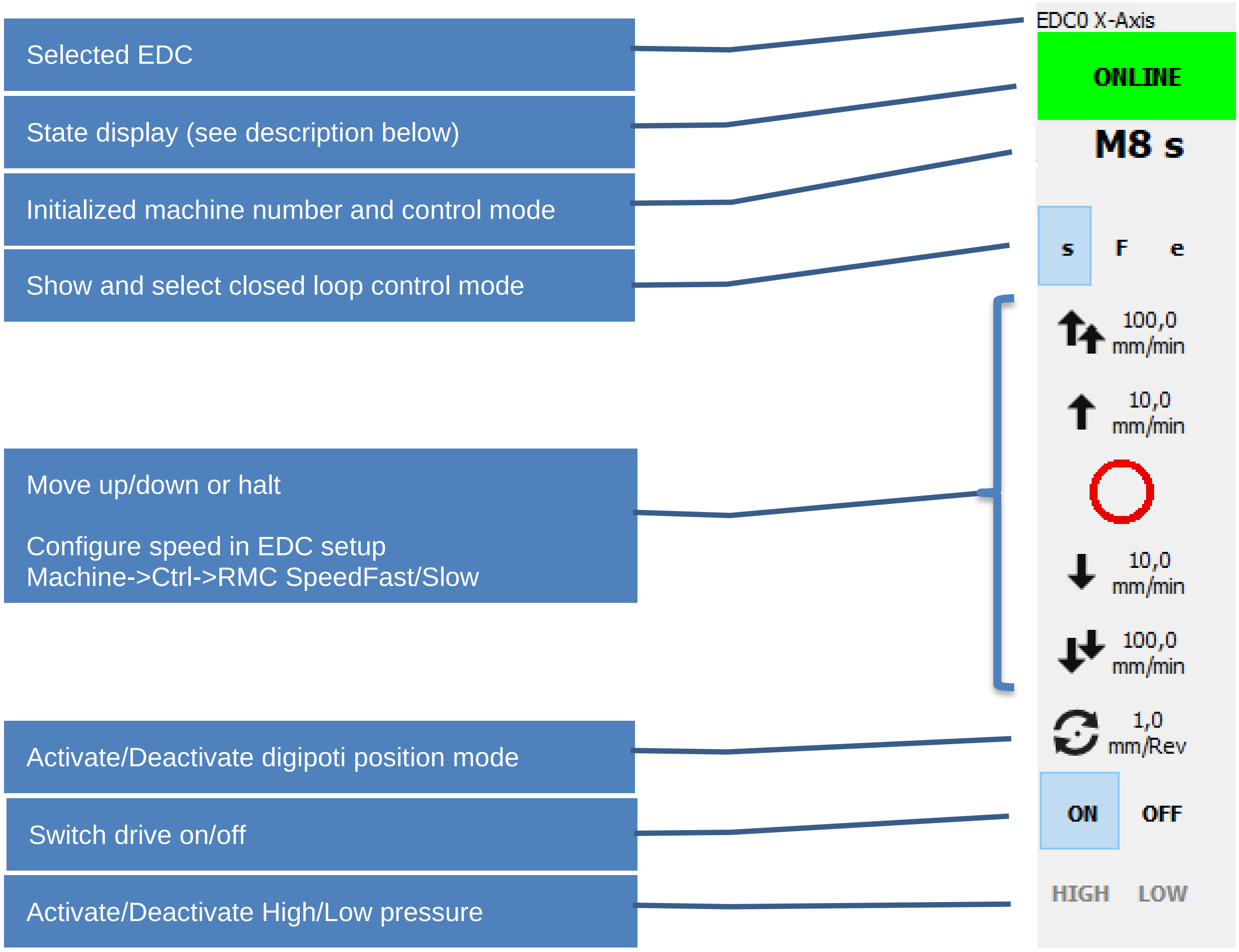


Fig. 29: RMC machine operation panel

State display description:

- **OFFLINE / ONLINE**
  EDC is offline or online.
- **RESTART**
  DOLI Installation Center must be also restarted because EDC was reseted.
- **EMERGENCY_OFF/ESTOP**
  Emergency button is active.
- **UPPER_LIMIT_SWTICH / LOWER_LIMIT_SWTICH / LIMIT_SWTICH / UPSTOP /DOWNSTOP**
  Limit switch is active.
- **RANGE_LIMITS**
  Sensor limit is active.
- **IO_SHALT**
  Upper or lower Signal IO_SHALT is active.
- **CPU_EMERGENCY_OFF**
  Possible reasons are:
  - Drive watchdog active.
  - Drive power supply failure.
  - Drive communication error.
  - CPU software emergency off (e.g. sensor limit is active).

4.4 Setup Editor

4.4.1 Information

The first page of the setup editor shows software and hardware information about the connected EDC.

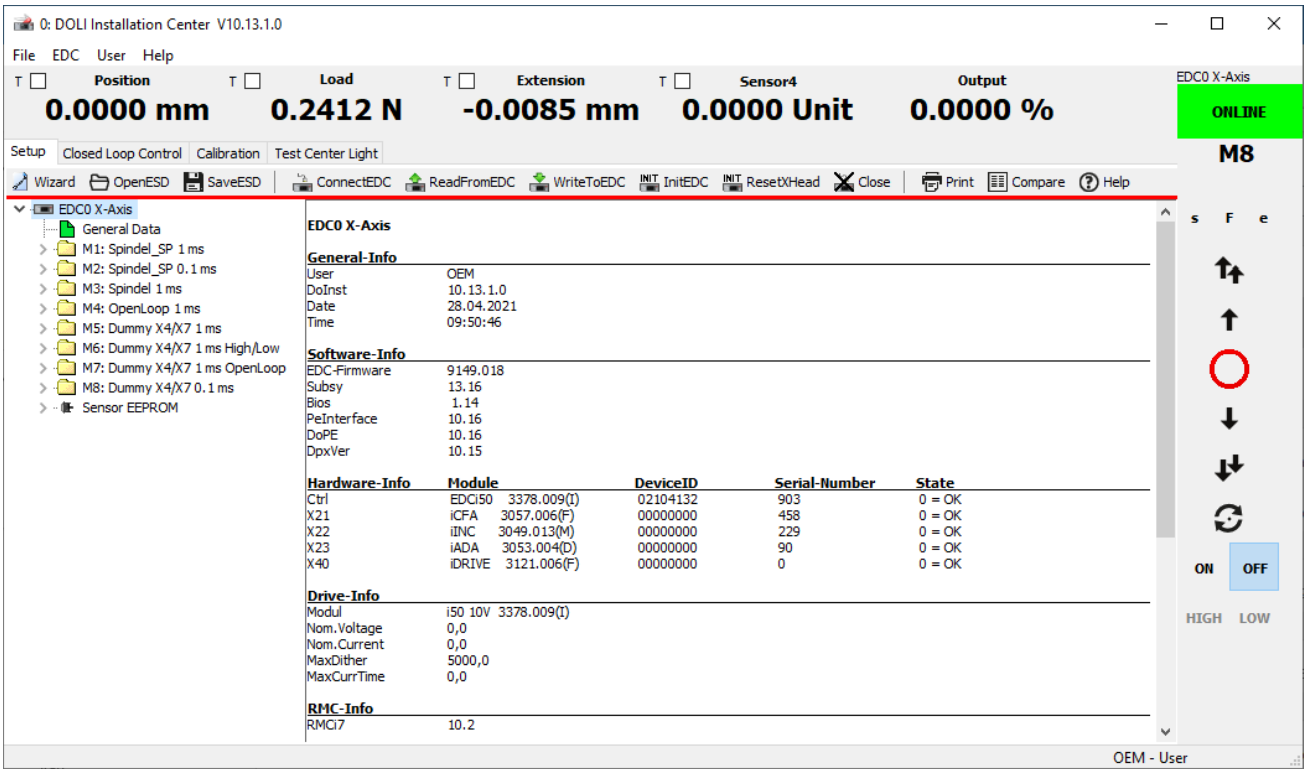
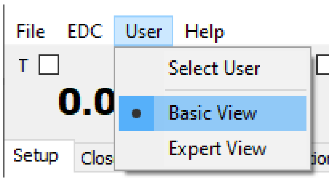


Fig. 30: Setup editor information

4.4.2 Setup Data

You can navigate through the setup using the tree at the left. A maximum of eight machine configurations can be edited. Within the tree drag and drop elements of the same class is possible.

You can select two different view modes in the main menu:



- **Basic view**: only the important setup parameters are shown (default).
- **Expert view**: all setup parameters are shown.

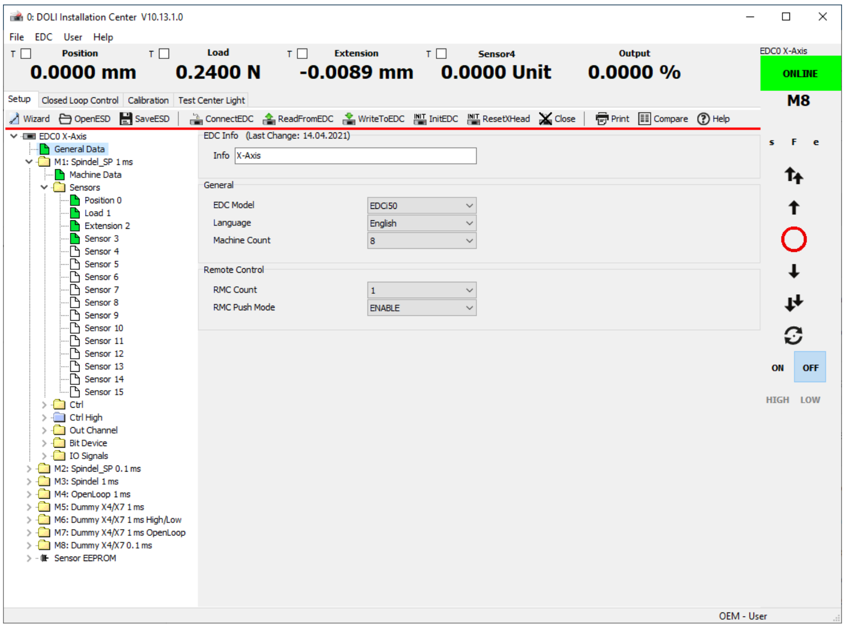


Fig. 31: Setup editor basic view

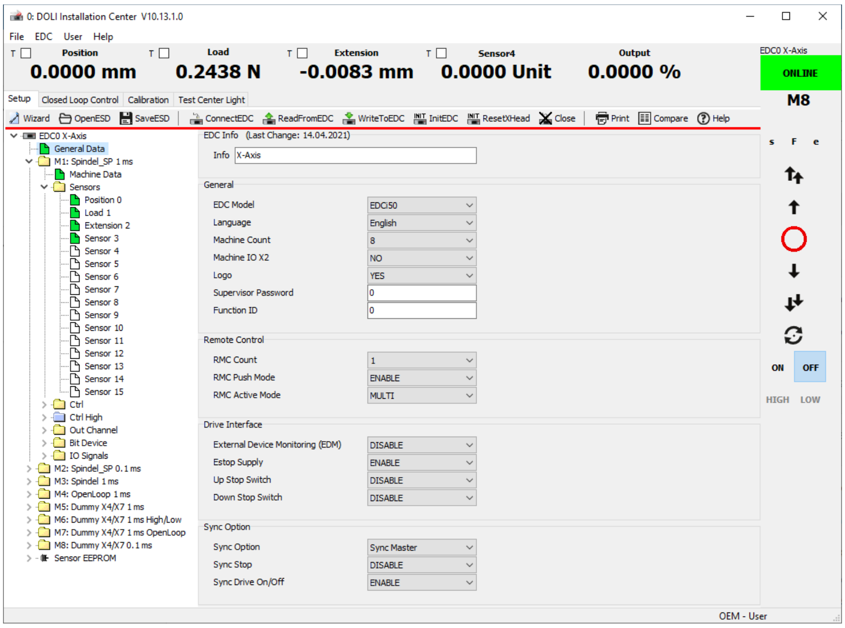


Fig. 32: Setup editor expert view

4.4.3 Setup Wizard

Use DOLI Installation Center, start the EDC setup wizard and select your EDC model.

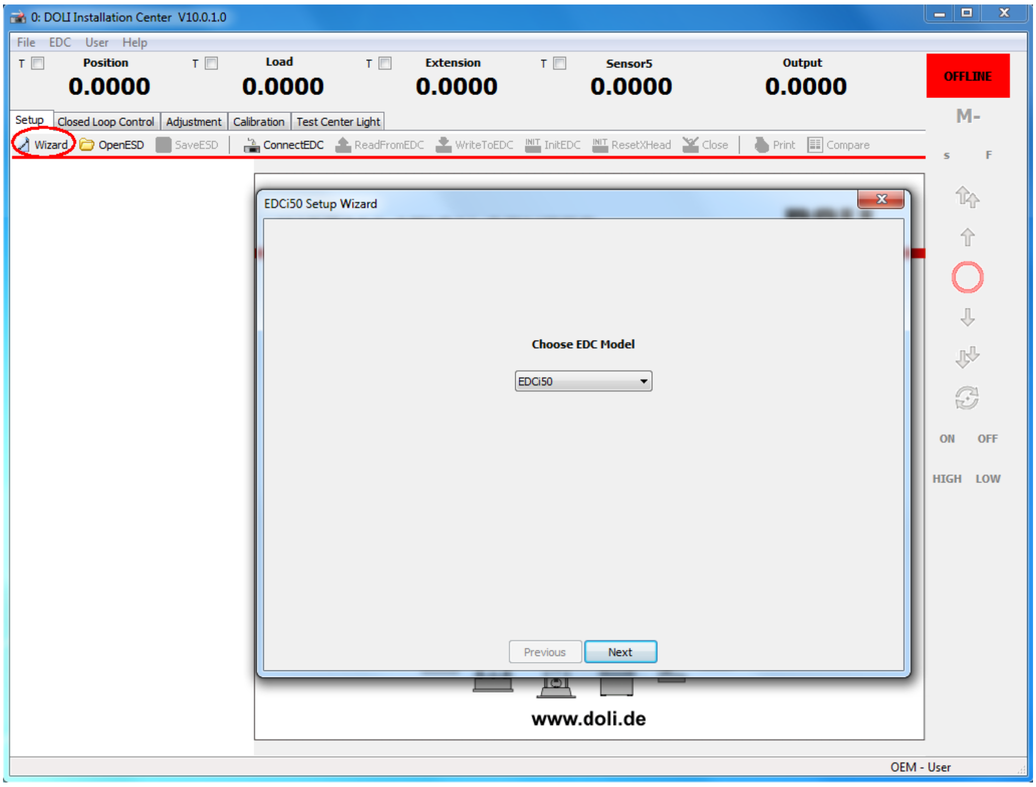


Fig. 33: Start EDC-Setup Wizard

Press the next button and set the following parameters:

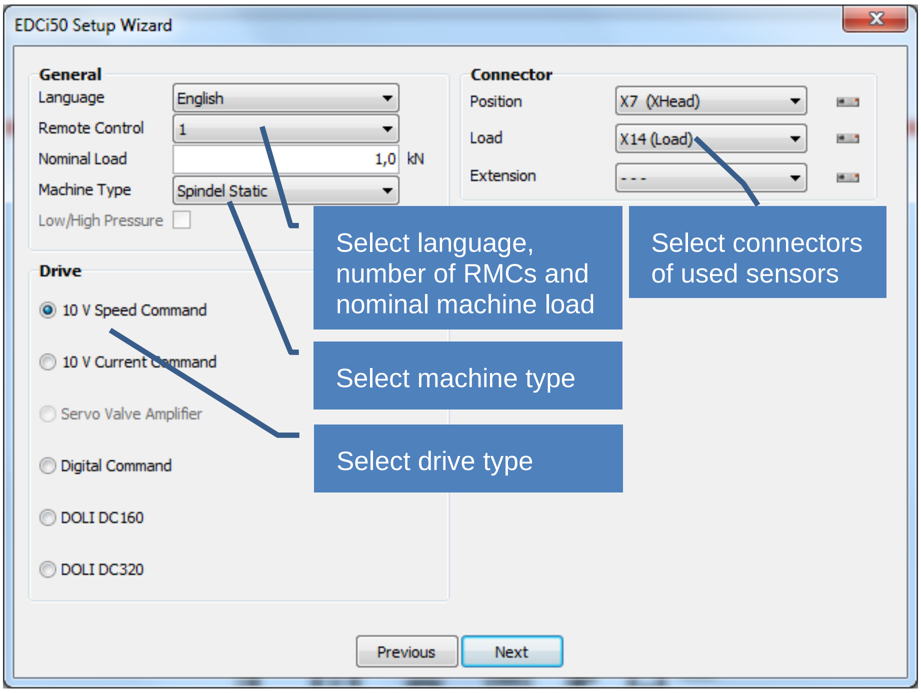


Fig. 34: Basic machine data

4.4.3.1 Setup for static 100kN machines

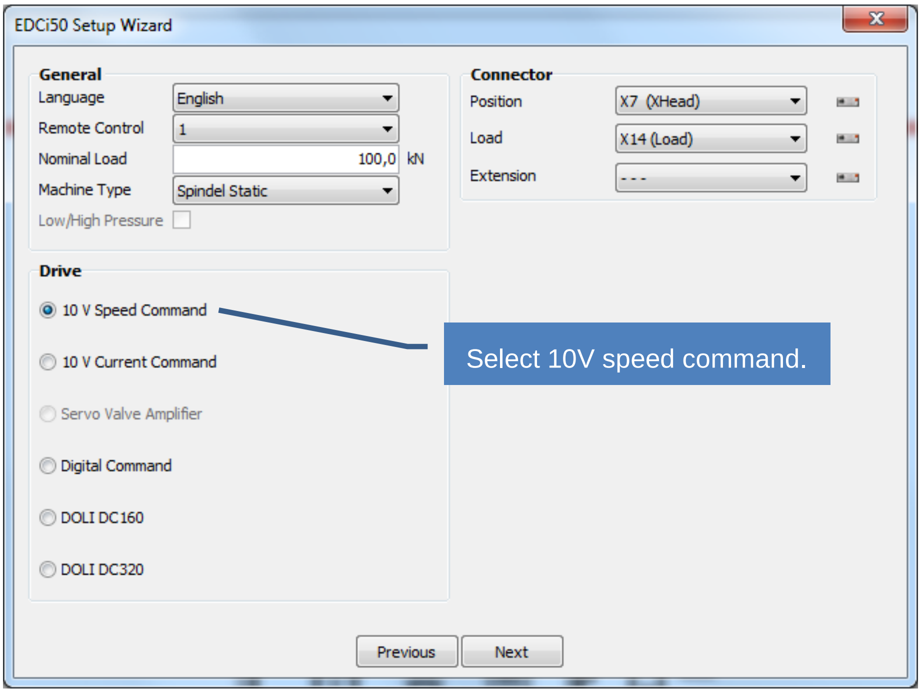


Fig. 35: Sample of a 100kN static spindle machine with 10V command

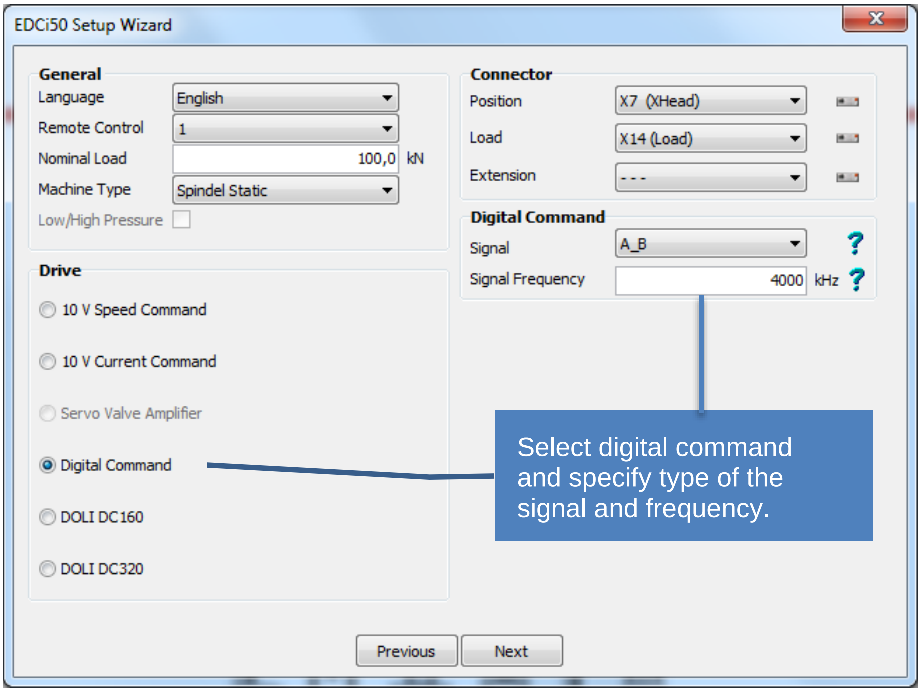


Fig. 36: Sample of a 100kN static spindle machine with digital command

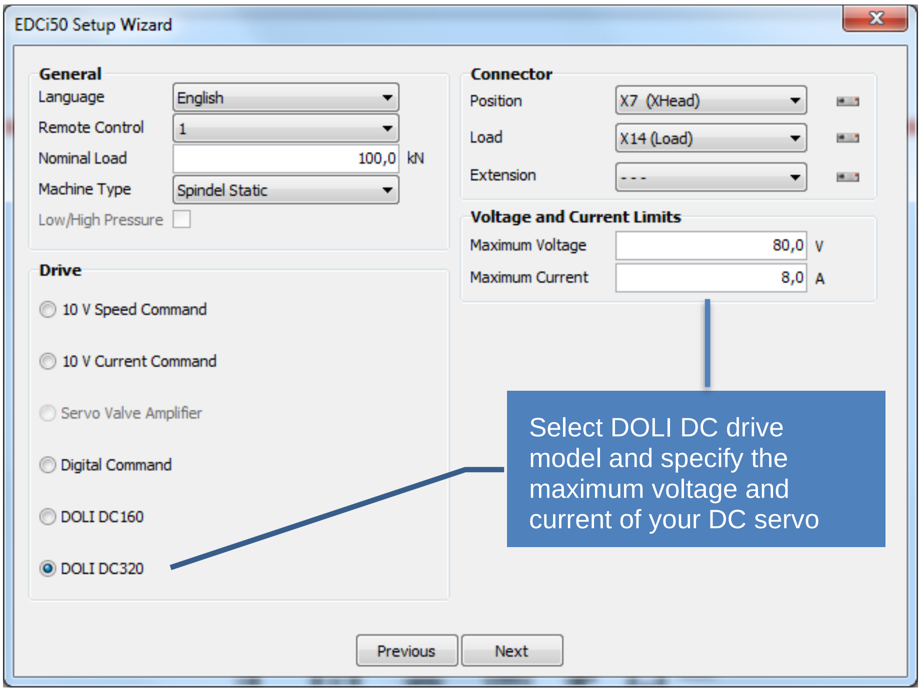


Fig. 37: Sample of a 100kN static spindle machine with DOLI DC320 drive amplifier

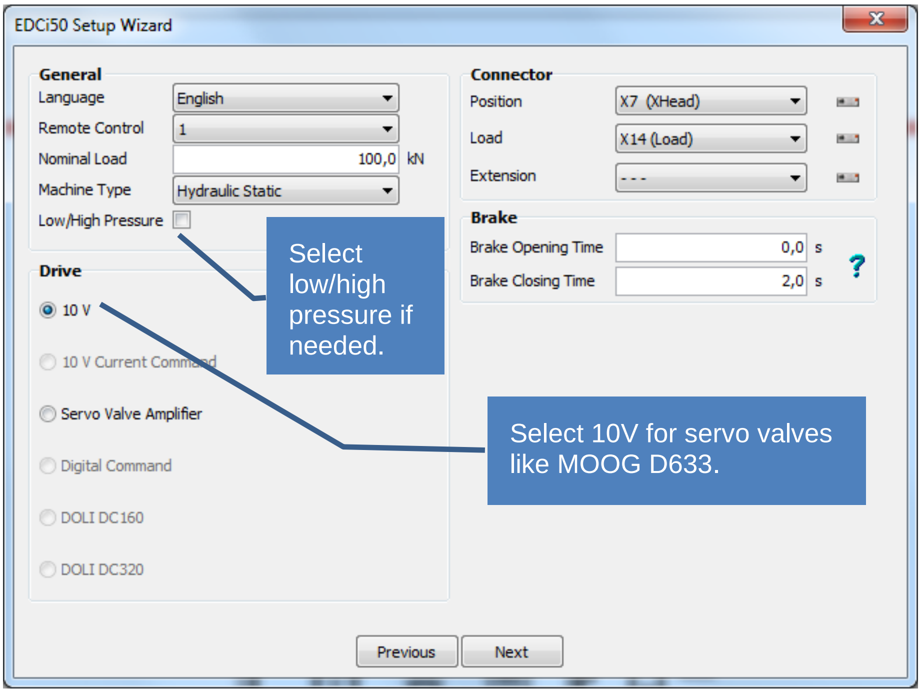


Fig. 38: Sample of a 100kN static hydraulic machine with 10V command

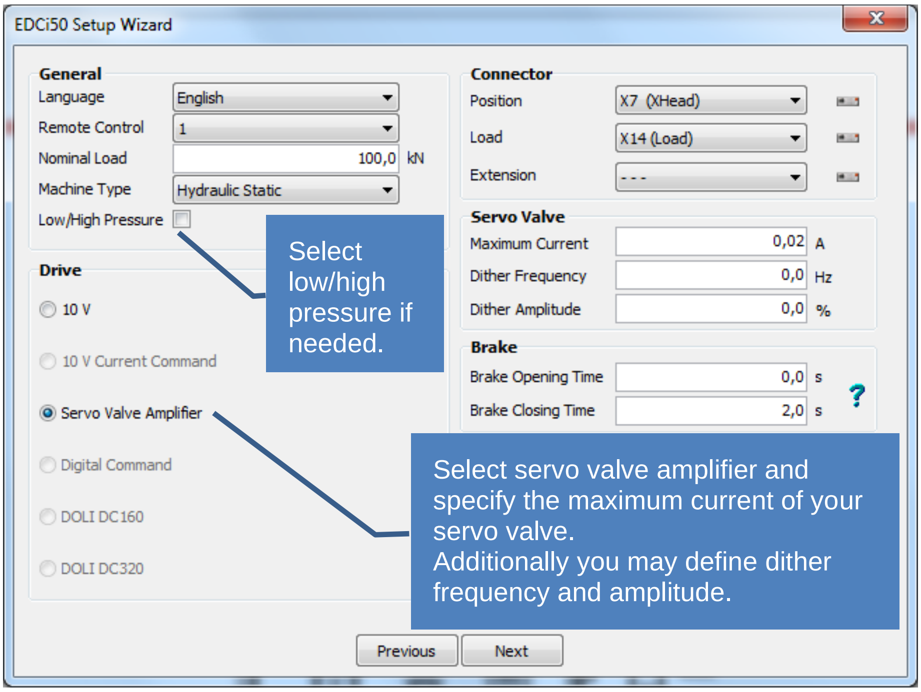


Fig. 39: Sample of a 100kN static hydraulic machine with a servo valve amplifier

4.4.3.2 Setup for dynamic 100kN machines

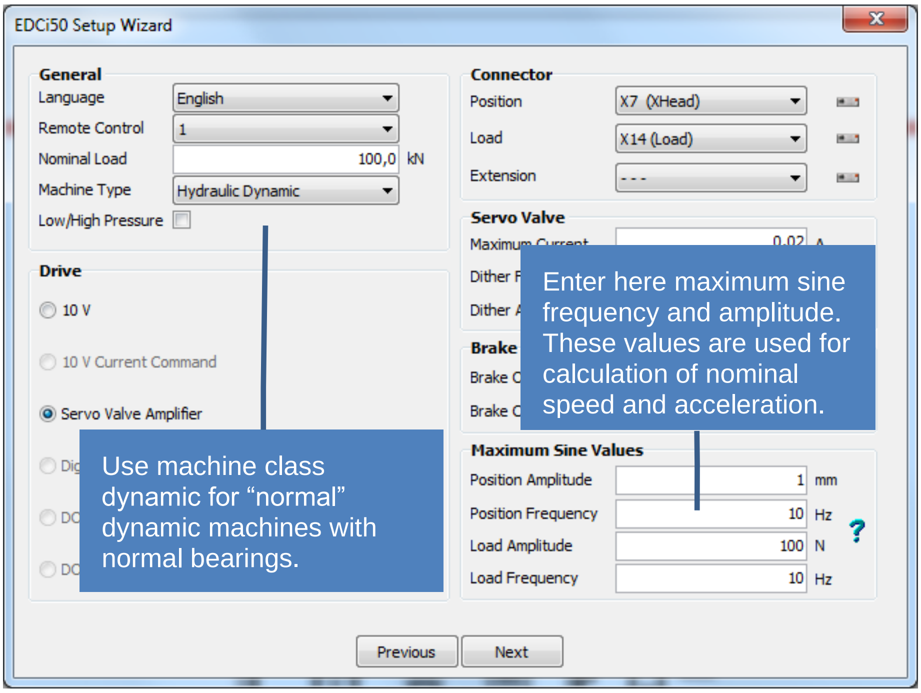


Fig. 40: Sample of a 100kN dynamic hydraulic machine with a servo valve amplifier

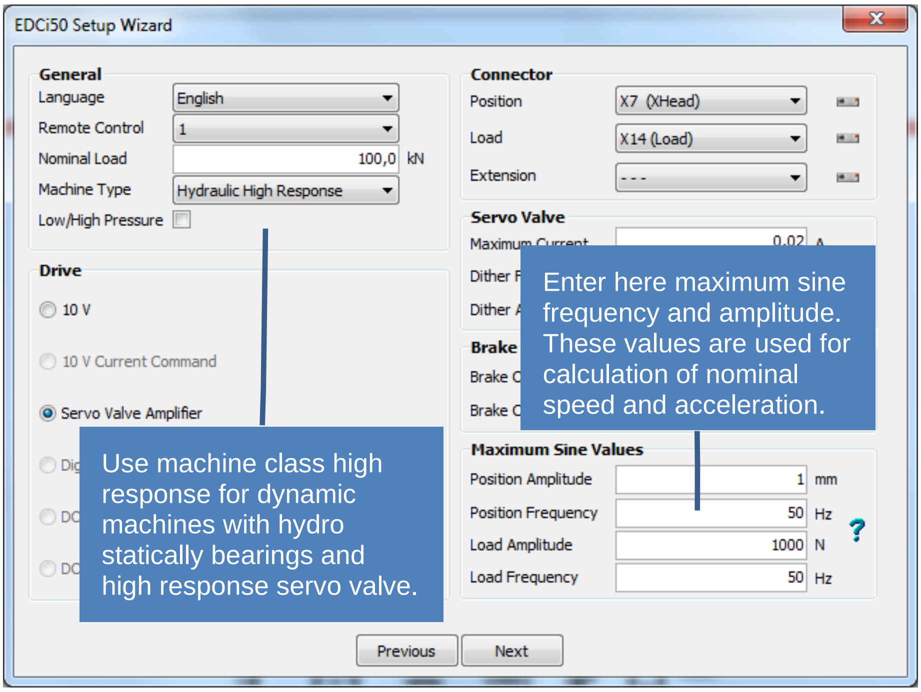


Fig. 41: Sample of a 100kN high response hydraulic machine with a servo valve amplifier

4.4.3.3 Default Setup

After Next click the wizard creates a default setup. Change and modify the setup according to your machine configuration. The closed loop parameter will fit in many cases, but of course cannot be perfect for your machine. Optimize it if needed!

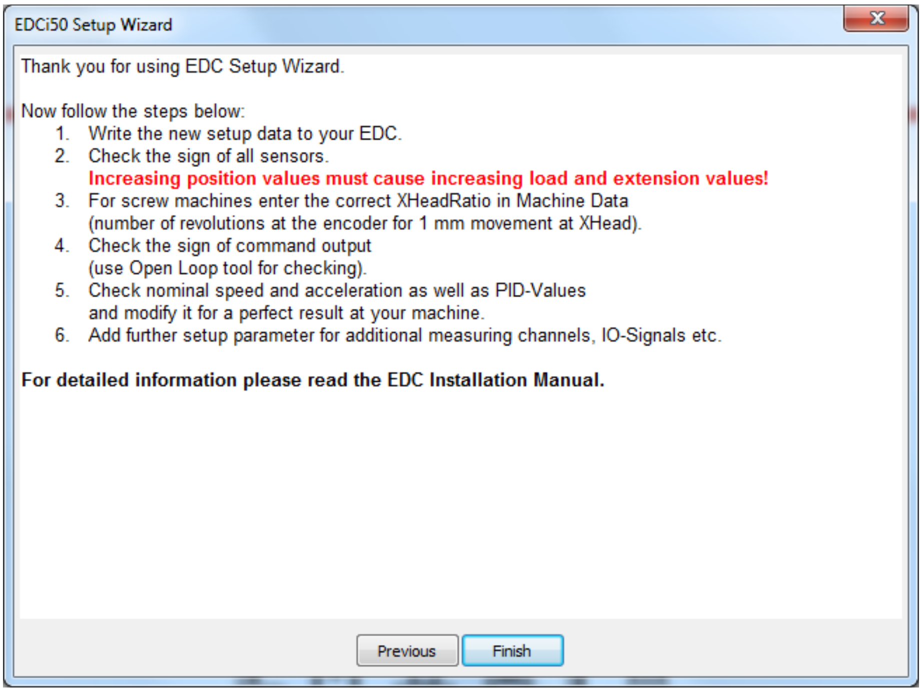


Fig. 42: Steps to do after closing wizard

4.4.1 Compare of machine data

The compare function shows the differences of two setups. Here between Machine 1 and Machine 2.

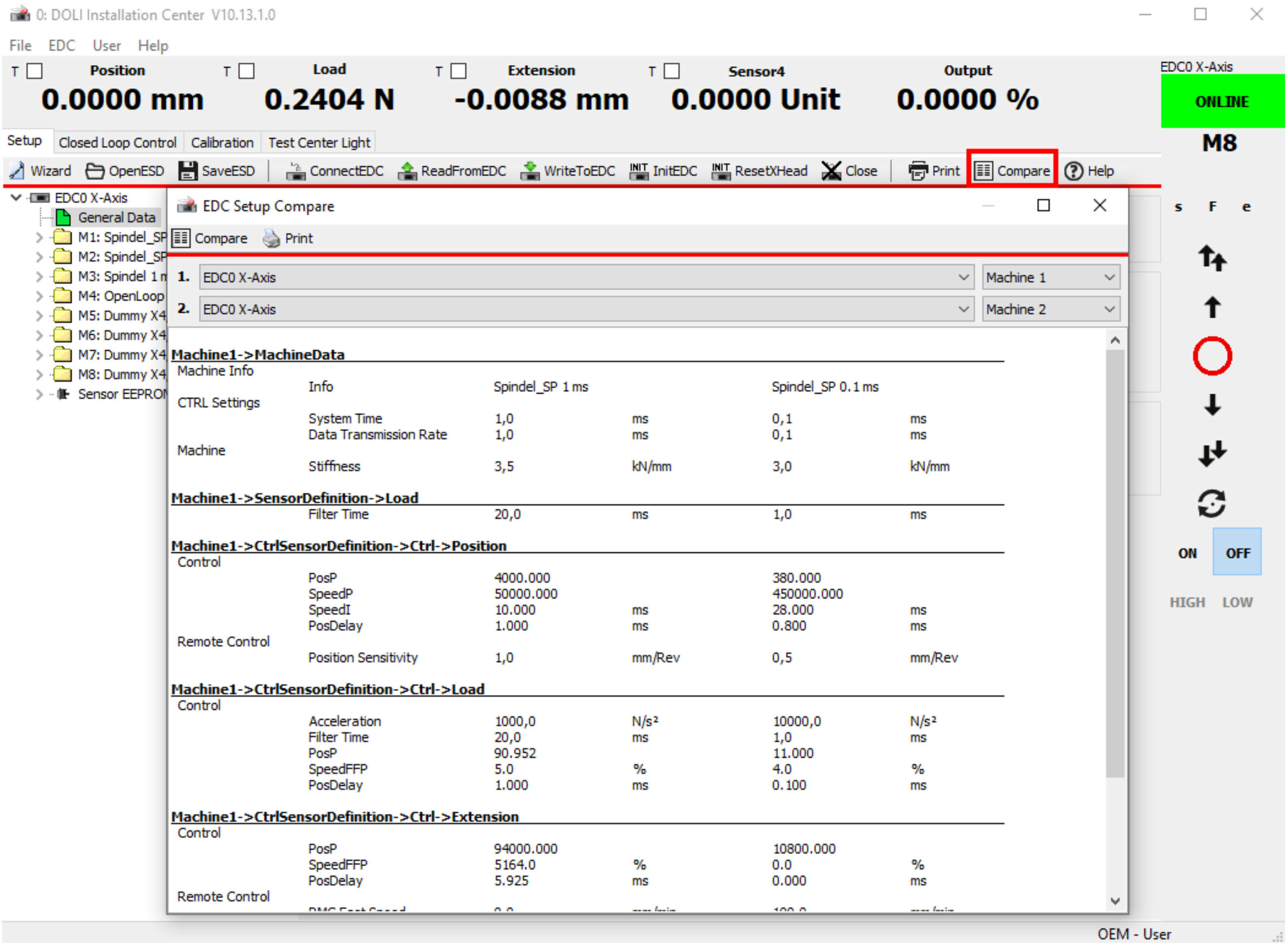


Fig. 43: Setup editor compare machine data

4.5 Tuning of the Closed Loop Control

4.5.1 Overview

4.5.1.1 Closed Loop Control

The principle of a closed loop control is on-going: **Measurement – Comparison – Process.**

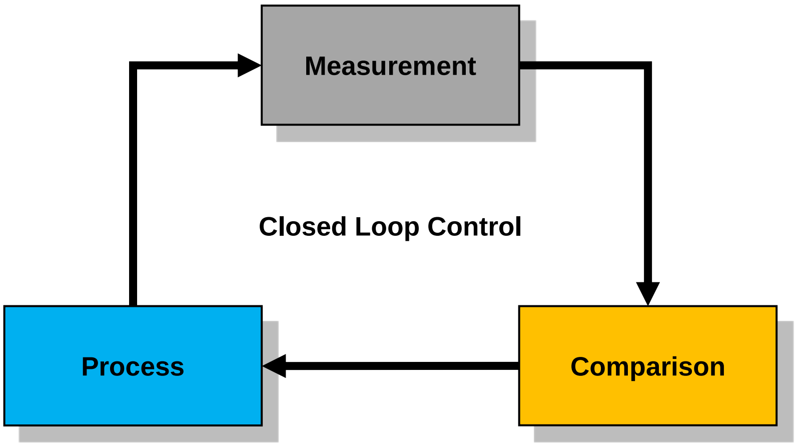


Fig. 44: Basic principle of a closed loop control

Measurement: The controlled variable is measured by sensors.

Comparison: The value of the controlled variable is compared with the command value (set point). The difference is the deviation.

Process: By the deviation, taking into account the dynamic properties of the controlled system, the output to the actuator is determined.

A control loop is used to bring about a given physical quantity (controlled variable) to a command value (set point) and keep it there, regardless of any interference occurring. In order to fulfil the control task the instantaneous value of the control variable – the actual value – must be measured and compared with the command. Deviations must be readjusted in an appropriate manner.

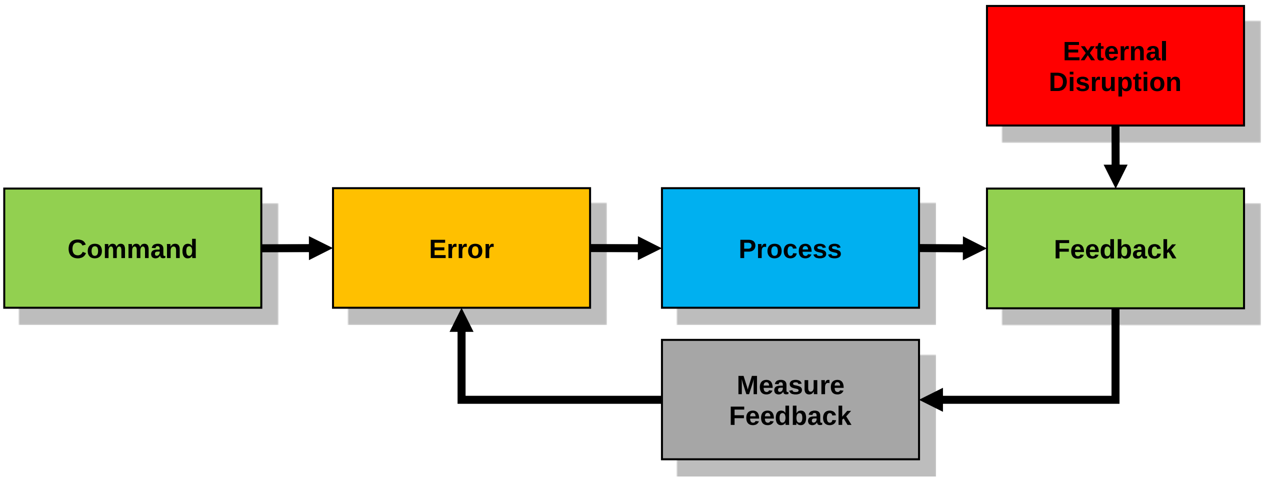


Fig. 45: Closed loop control with commands and external disruptions

A typical example of a closed loop control – a speed control – is shown in the next picture. The target speed is 80 km/h. An external disturbance, in this case a gradient, slows down the vehicle to 70 km/h. The deviation is measured by the speedometer and as corrective action more gas is given to get back on the target speed of 80 km/h.

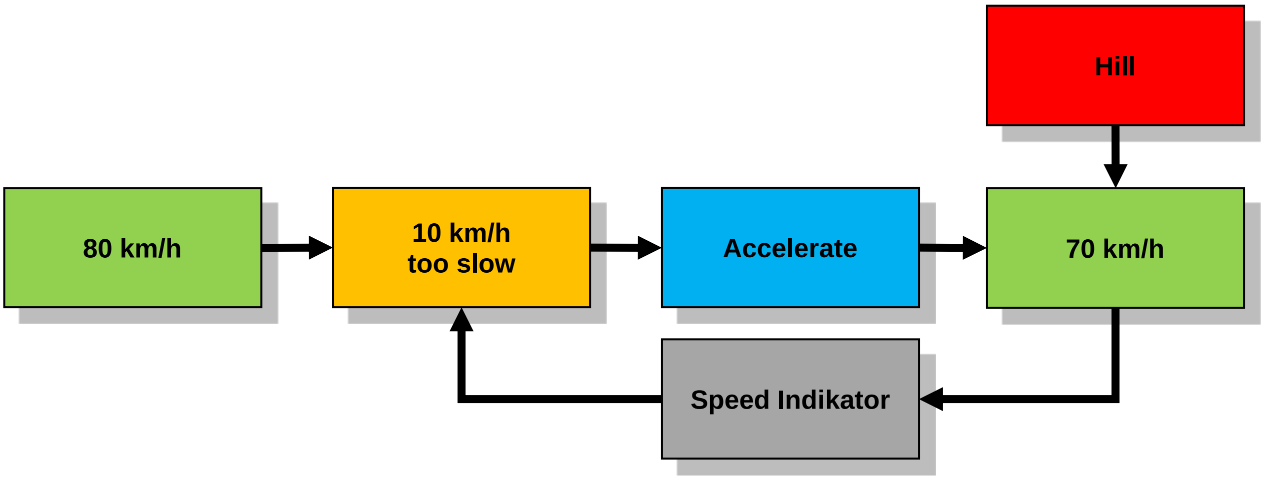


Fig. 46: Example for a speed control.

In order to solve this problem in a technical manner, there is the control technology. It is essentially based on the mathematical description and modelling of the system control circuit. For modelling, simulation, description and simulation, block diagrams with discrete signal elements are used.

A simplified block diagram of a control loop, as it is often used in control engineering, is shown in the figure below. A control loop consists of the main parts controller and controlled system.

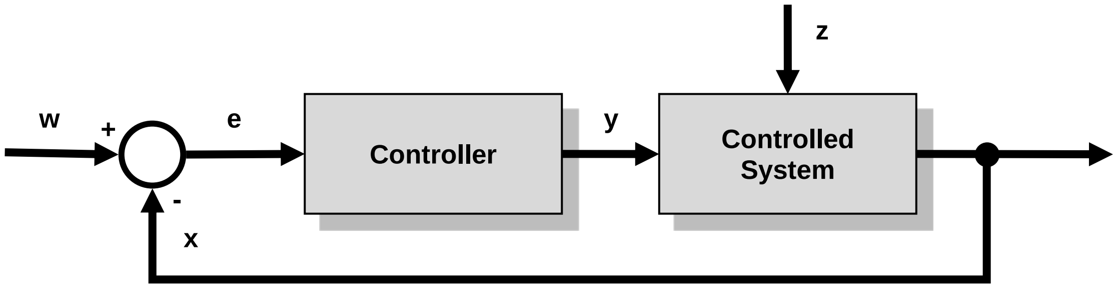


Fig. 47: Block diagram of a closed loop control

Controller: The part of the control loop, which takes into account the dynamic properties of the controlled system, the control deviation and calculates the corrective measures.

Controlled system: The part of the control loop, which is to be compensated by the controller.

Command (Set point) w: Specified value on which the controlled variable is to be held. It is supplied from “outside” and cannot be affected by the controller.

Controlled variable (actual value) x: Is the output of the controlled system. It is measured by a sensor and used for feedback comparison.

Deviation e: The difference between set point and process variable e=w-x, is the actual input of the controller.

Output variable y: Output of the controller and input of the controlled system. It transfers the controlling effect of the controller to the controlled system.

Disturbance z: An effect from the outside that causes a change of the controlled variable and triggers a control process.

4.5.1.2 Closed Loop Controller Types

The controller has the task of measuring the controlled variable, compare it with the set point change and the output variable so that set point and actual value of the controlled variable match again and the difference is minimal.

The choice of a particular type of controller depends on the timing and the required accuracy of the process. Below is a summary of the major classical types of controllers:

P-Controller

The proportional acting controller multiplies the control error with its factor Kp and outputs the result without any delay. The P-controlled circuit is simple and moderately fast, compared to other controller. The problem of the P controller is the steady deviation error.

I-Controller

The integral component of the controller sums the deviation over time and multiplying the sum (i.e. the integral) by the factor Ki. The longer a deviation exists, the greater is the output variable of the I-controller. The I-controlled loop is slow compared to other controller. But it has the advantage that the deviation is eliminated.

PI- Controller

The PI controller is the combination of P and I controllers and combines the advantage of P-controller, namely fast response, with the advantage of the I controller, the precise adjustment. The PI-controlled loop is accurate and medium fast.

PD- Controller

The proportional-differential-acting controller combines the P-controller with a D component. The D-component uses the change of an error (differentiated) and thus calculates the rate of change. This is multiplied by a factor Kd and added to the P component. The PD controller is reacting to announcements of changes already.

The PD-controlled loop is very fast compared to other controllers, and some loops (those with two-time integration) cannot be stabilized without D-part. The problem of proportional control, the steady controller error, however, still exists!

A drawback of all controllers with D-part may be noisy sensor signals. This noise is further amplified by the differentiation and re-added into the loop. The D-part of a controller increases all changes of the command value (set-point) thus making the loop faster. It decreases the effect of any changes of the feedback signal, thus damping any outside effects on the controlled signal.

PID- Controller

The PID controller is the most universal of the classic controllers and combines the good properties of other controls. The PID controlled loop is accurate and fast. Therefore, in most applications, the PID controller is used.

4.5.1.3 Comparison of Different Controller Types

In the following figure, the comparison of P, I, PI, PD and PID controller in a control loop with PT2 term is represented as a controlled system. The permanent deviation is clear to see for the controllers having no I-part (P and PD). Only the controllers with an I-part can minimize the controller error. The pure I-controller is so slow that it is no longer visible on the chart. Therefore, the main purpose of an I-component is the avoidance of permanent deviations.

The fastest controllers are those with a D-part (PD and PID). Hence, the D part is mainly used when fast dynamics is needed or the controlled system is already unstable itself. These fast controllers need a fast response of the actuators that no limitation in the actuator occurs. In practice, a limitation cannot always be avoided, so the step response is in practice for small jumps, only.

The controllers without a D-part, but with P (P and PI) are medium-fast. For simple control tasks a pure P-controller is often sufficient, if the steady-deviation can be neglected, or because of the controlled system already having an I-part.

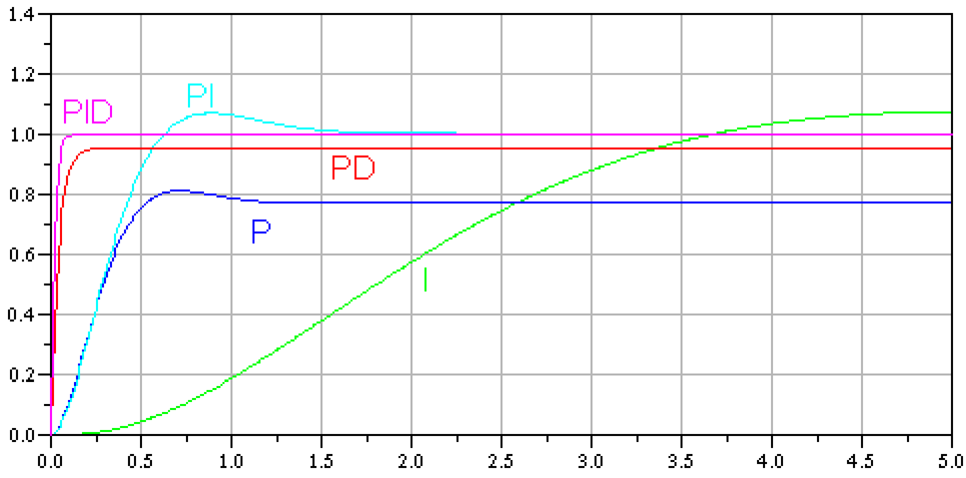


Fig. 48: Comparison of P, I, PI, PD and PID controllers in a control loop with PT2 term

From this comparison it becomes clear why the PID controller is so popular, it combines the advantages of all other controllers.

4.5.2 Adjusting closed loop parameter

Conditions for the closed loop controller setting in DOLI Installation Center:

1. The sensors required for the controller are connected and get correct readings.
2. The signs of the control sensors are set so that increasing position values generate increasing load and extension readings.
3. The sign of the output variable to the actuator is set so that increasing output values generate increasing position.

Basically, the controller of the position sensor must be adjusted first.

For the control structures and SPINDEL_SP and HYDRAULIC adjust the **position speed controller** first and then **the position controller**.

Before starting the speed controller adjustment, set the controller parameter D to zero, P and I to uncritical values. Uncritical depends on the controlled system. Dynamic systems usually have a high gain. This means the gain of the PID-controller can be smaller. For slow systems like a concrete tester, the gain of the controller can be much higher.All adjustments should be made with medium to large amplitudes.

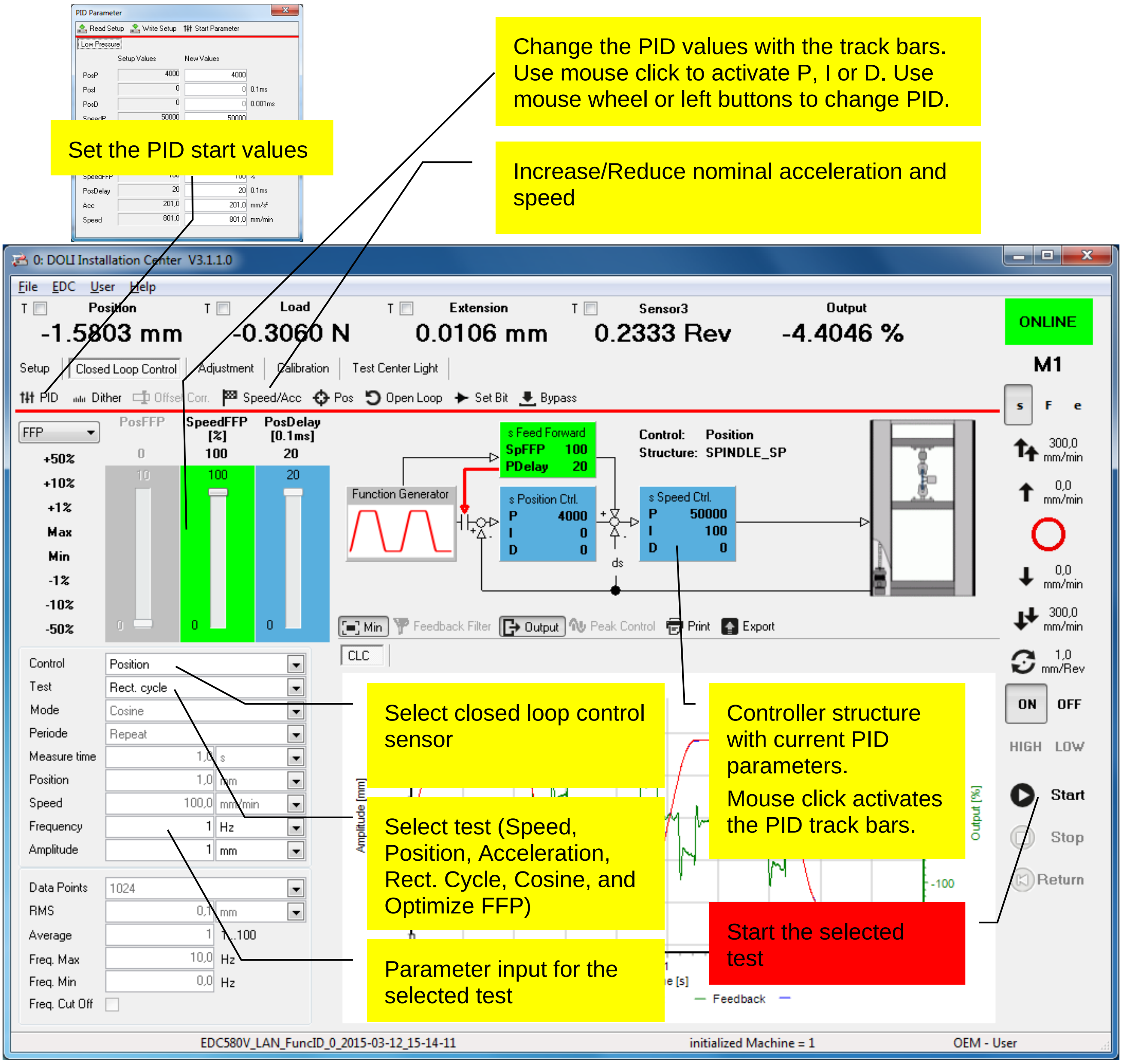


Fig. 49: Closed loop adjustment with DOLI Installation Center

4.5.3 Adjust the Speed Controller

To set the speed controller, a positive and negative speed step is applied at the input of the speed controller and the response is recorded. The machine will move up and down. The pre-selected measurement time is the total time of the test. The time for the positive and negative jump is respectively 40% of the total time. It should be noted that the speed is calculated by differentiation of the position signal. For small speed jumps, and also for systems with a low resolution of the position signal, the resolution of the speed velocity is very low, sometimes only ±1 digit. Small speed resolutions make interpretation of the speed curve sometimes difficult. In such cases it is beneficial to activate the feedback filter. If possible, you should always choose the largest possible speed.
Before adjusting the speed controller, SpeedP is set to a small value. In case of the desired speed is not reached, increase SpeedP and decrease SpeedI.

Note: The controlled system is generally more stable, when SpeedI is set to a high gain (small values) and SpeedP to a moderate gain (lower values) (See Section 5.4.7).
If one of the two parameters is set to a critical value, the system will be unstable. The parameter must be reduced immediately!

A small overshoot of the position speed controller is allowed. After SpeedP and SpeedI have been set correctly, you may try to reduce the overshoot by adding SpeedD.
The following images show some typical responses when adjusting the speed controller:

Speed Controller at a High Response Hydraulic Machine

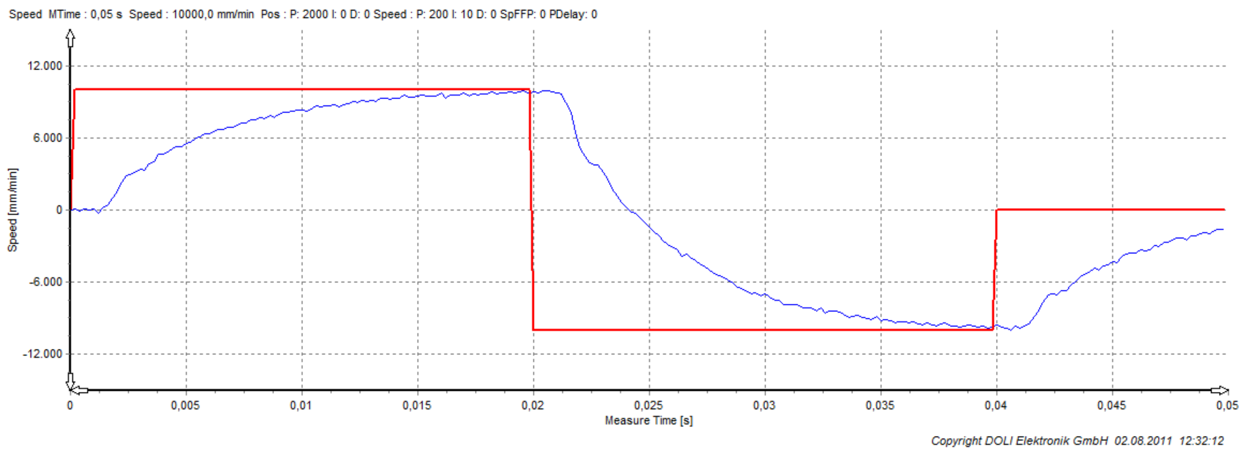


Fig. 50: Position speed controller at a 5kN high response dynamic machine; SpeedP is too small

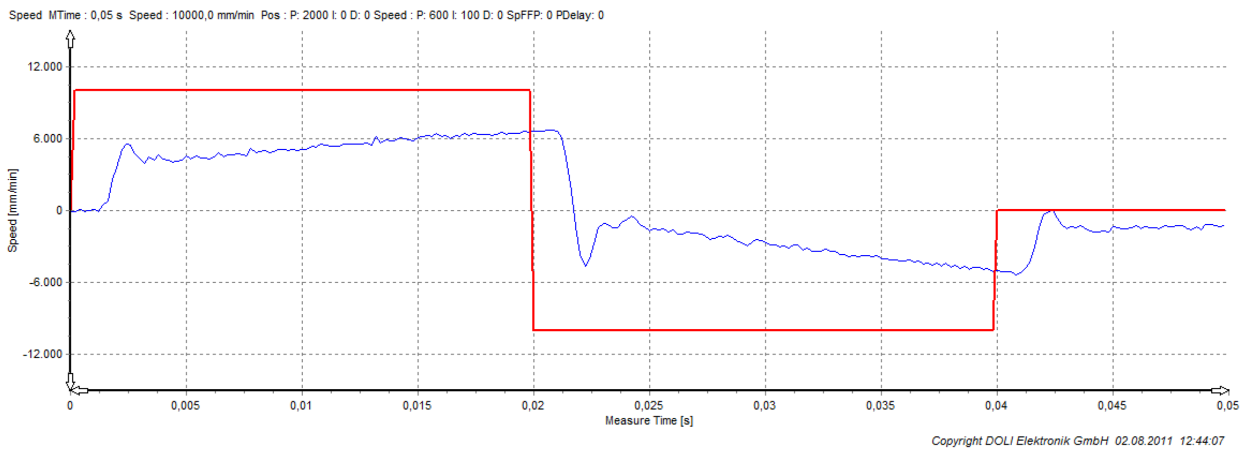


Fig. 51: Position speed controller at a 5kN high response dynamic machine; SpeedI is too big

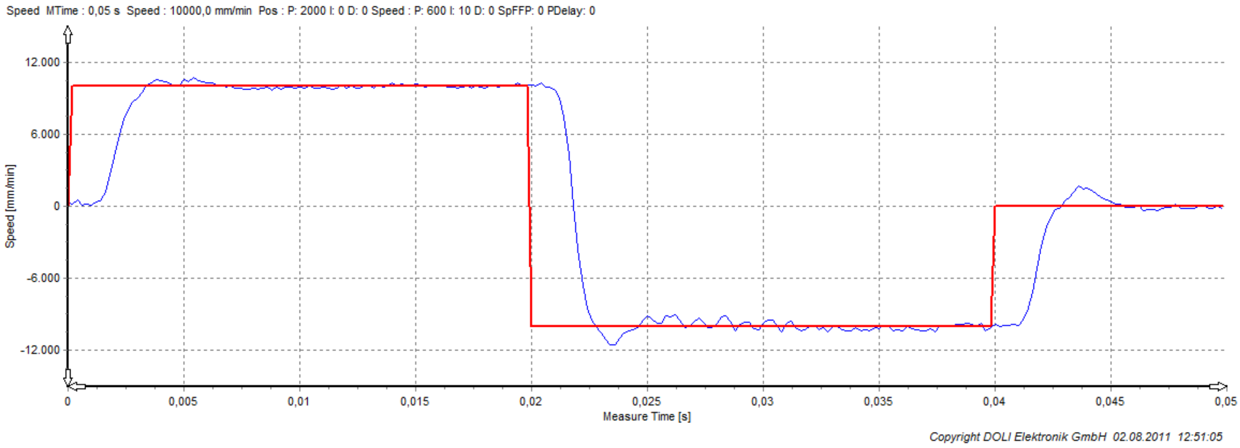


Fig. 52: Well-adjusted position speed controller at a 5kN high response dynamic machine

Speed Controller at a Screw Machine

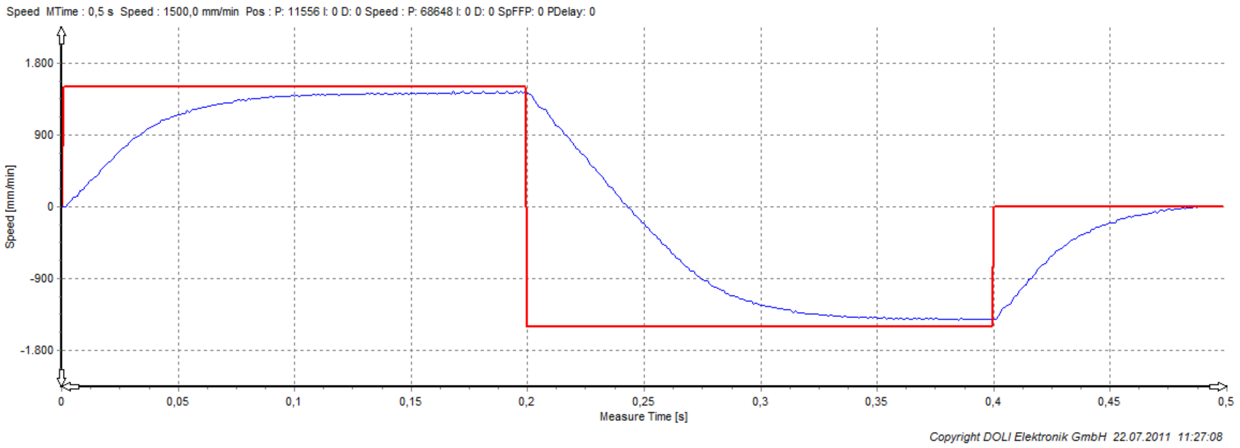


Fig. 53: Position speed controller at a 3kN screw machine with DC320; SpeedP is too small

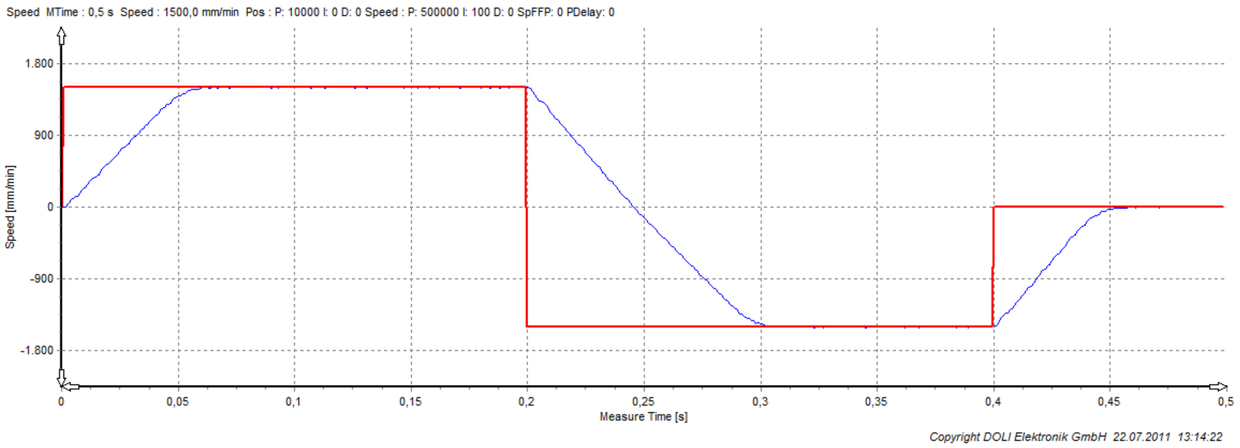


Fig. 54: Well-adjusted position speed controller at a 3kN screw machine with DC320

Speed Controller at a Hydraulic Concrete Testing Machine

In case of speed resolution is low, please activate feedback filter.

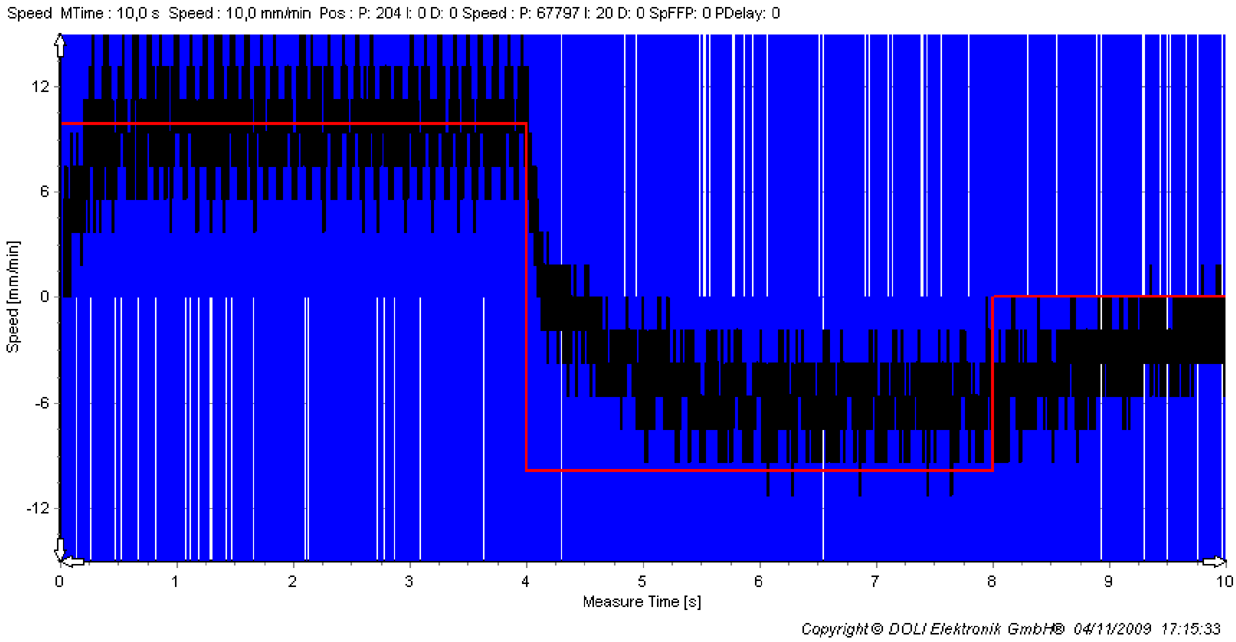


Fig. 55: Well-adjusted position speed controller at a 50kN concrete testing machine

4.5.4 Adjust the Position Controller

To set the position controller, a positive and negative position step is applied at the input of the position controller and the response is recorded. The machine will move up and down. Before adjusting the position controller you should set PosP to a small value. After start of the test, increase PosP until the position is reached in a short time without overshoot.

Position Controller at a High Response Hydraulic Machine

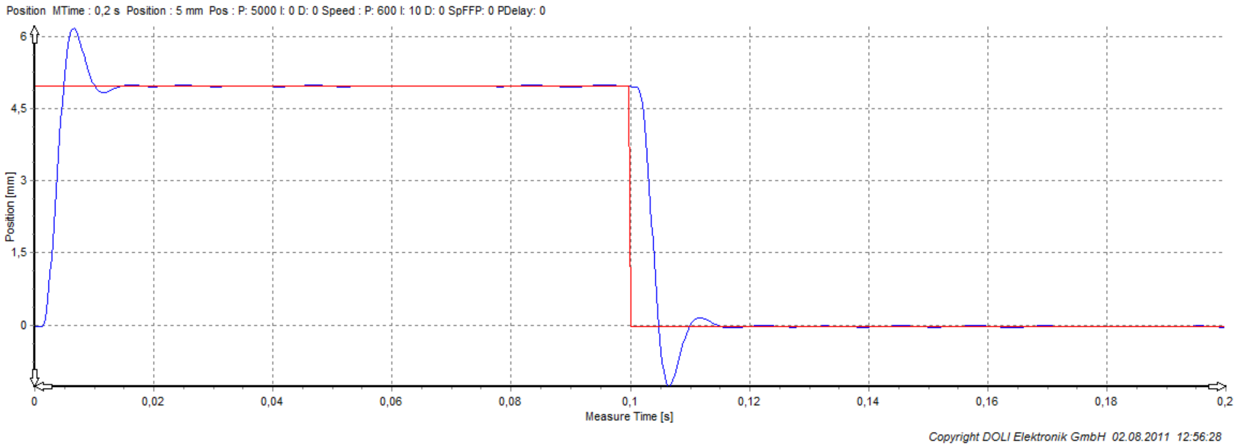


Fig. 56: Position controller at a 5kN high response dynamic machine; PosP too big

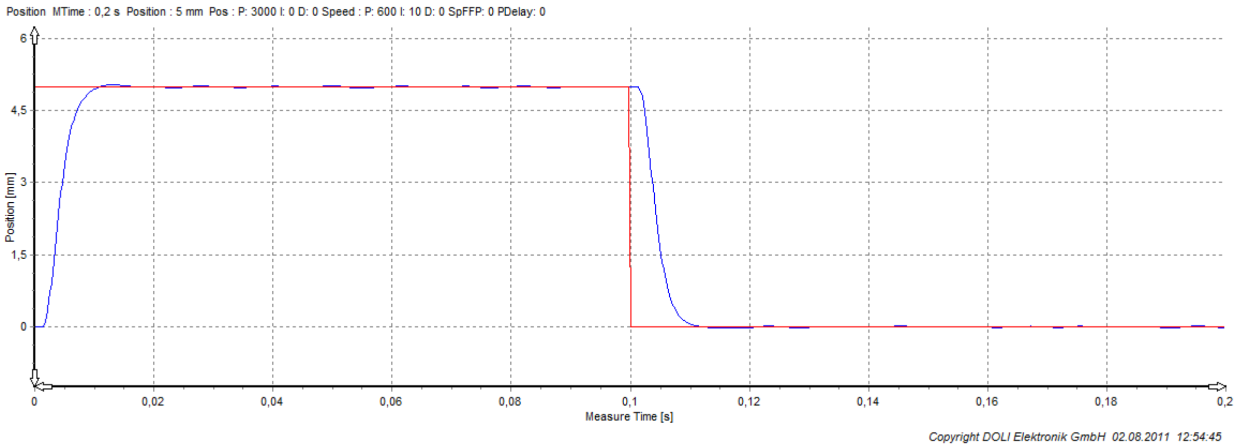


Fig. 57: Well-adjusted Position controller at a 5kN high response dynamic machine

Position Controller at a Screw Machine

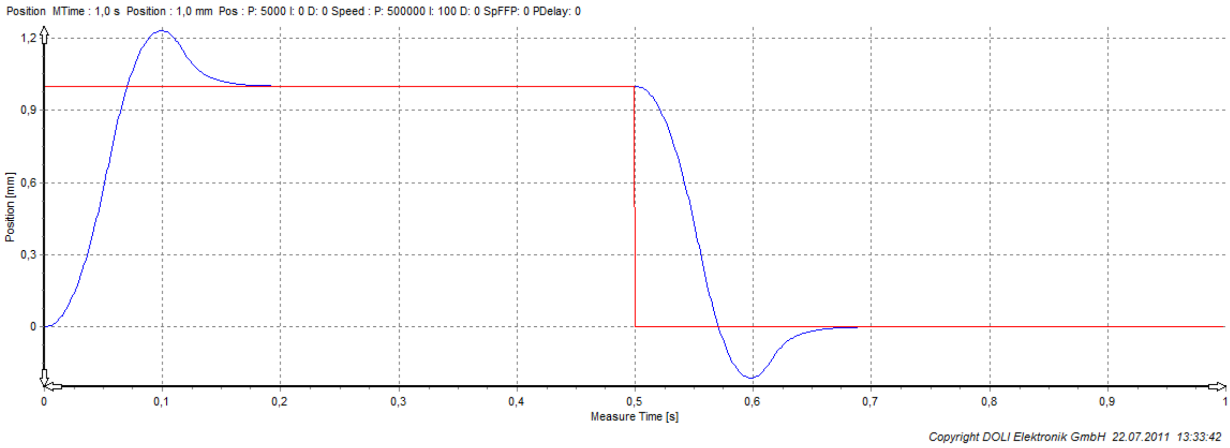


Fig. 58: Position controller at a 3kN screw machine with DC320, PosP too big

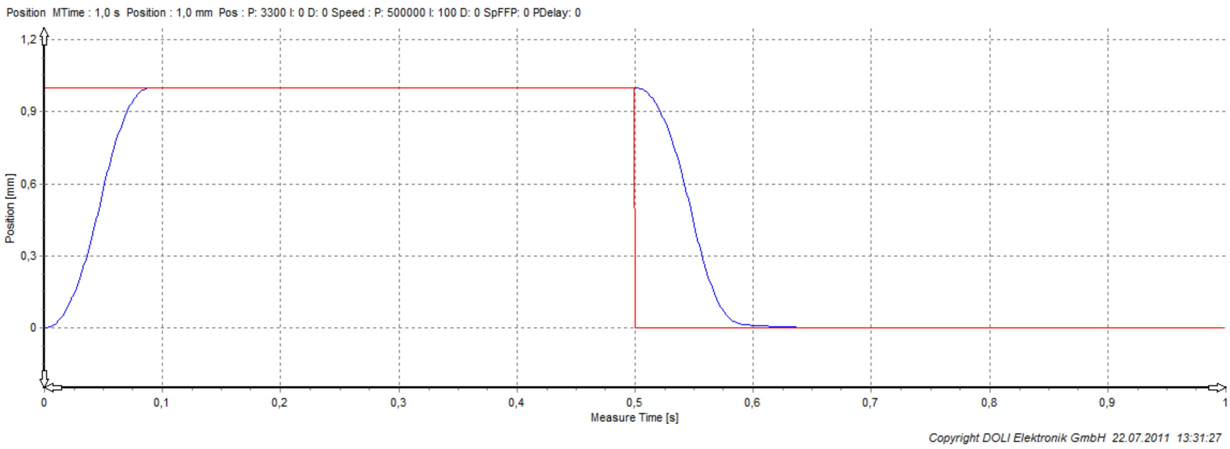


Fig. 59: Well-adjusted Position controller at a 3kN screw machine with DC320

4.5.5 Check Nominal Acceleration and Speed

The command generator limits all ramps to the set speed and acceleration. If these values are set too low, the possibilities of the machine cannot be used fully. If these values are set too high, an adjustment without overshooting is not possible. The DOLI Installation Center provides an easy way to verify these values.
First, the acceleration and speed in the setup should be deliberately high. For unknown speed and acceleration values, simply appreciate it. Then select the test “Rect. Cycle”.

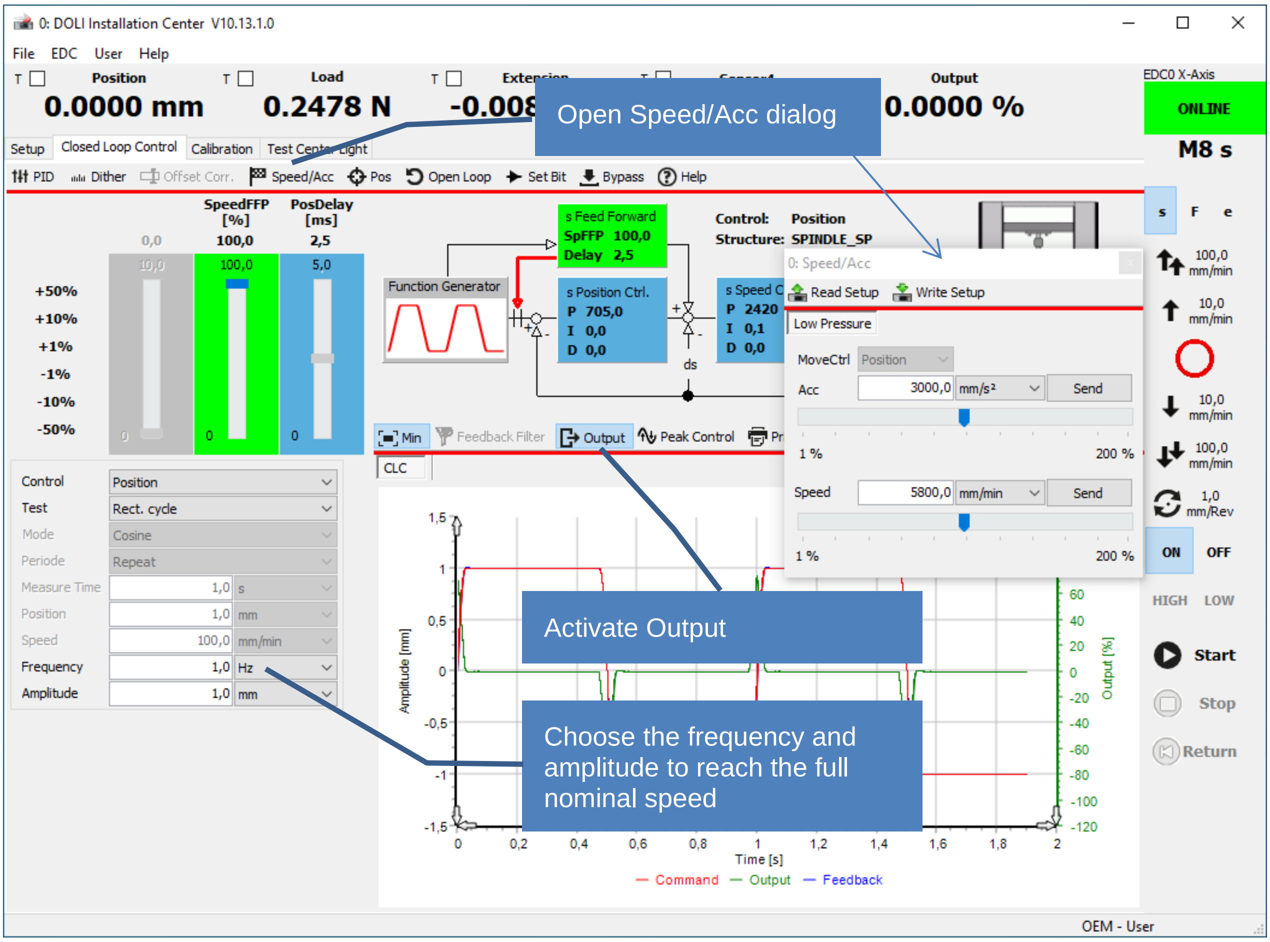


Fig. 60: Find acceleration and speed with DOLI Installation Center

During the test, the speed and acceleration can be changed with the sliders.

The buttons ‘Send Acc’ and ‘Send Speed’ send the values of the input boxes and moves the slider to 50%. So you can increase the nominal acceleration and speed values.

4.5.5.1 Adjust Nominal Speed

The review of speed is relatively simple. The speed is too high, as long as the actual value cannot follow the command value. You can recognize this by a growing distance between command and actual value. Another clear sign is the output signal. As long as the output signal is limited (usually 100%), the speed is too high.

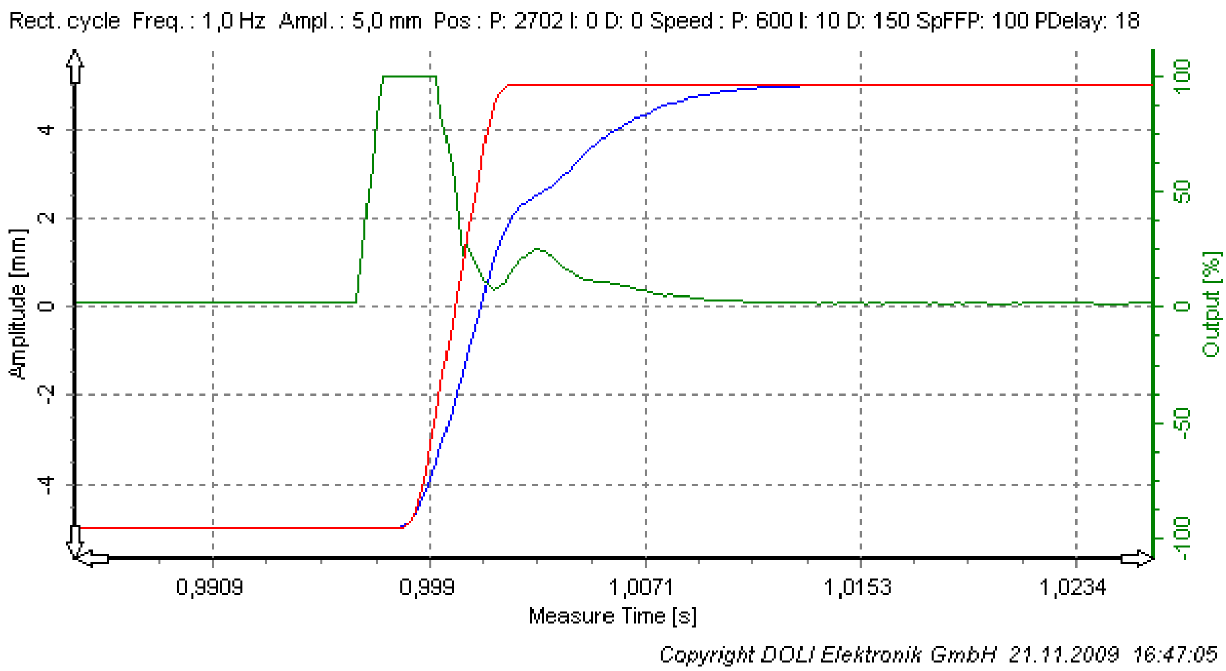


Fig. 61: Nominal speed is too high

As long as the output signal is limited, reduce nominal speed.

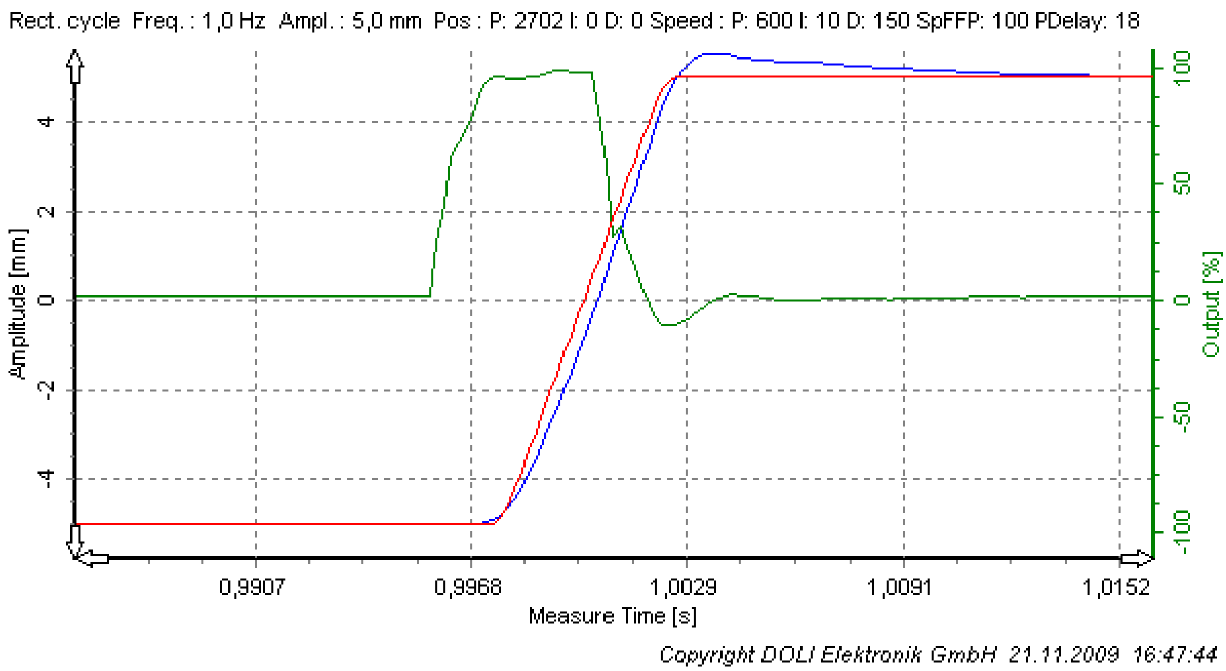


Fig. 62: Nominal speed is ok

4.5.5.2 Adjust Nominal Acceleration

Setting the correct acceleration is a little more difficult. For a properly adjusted controller, there should be no overshoot. Reduce the acceleration until there is no overshoot.

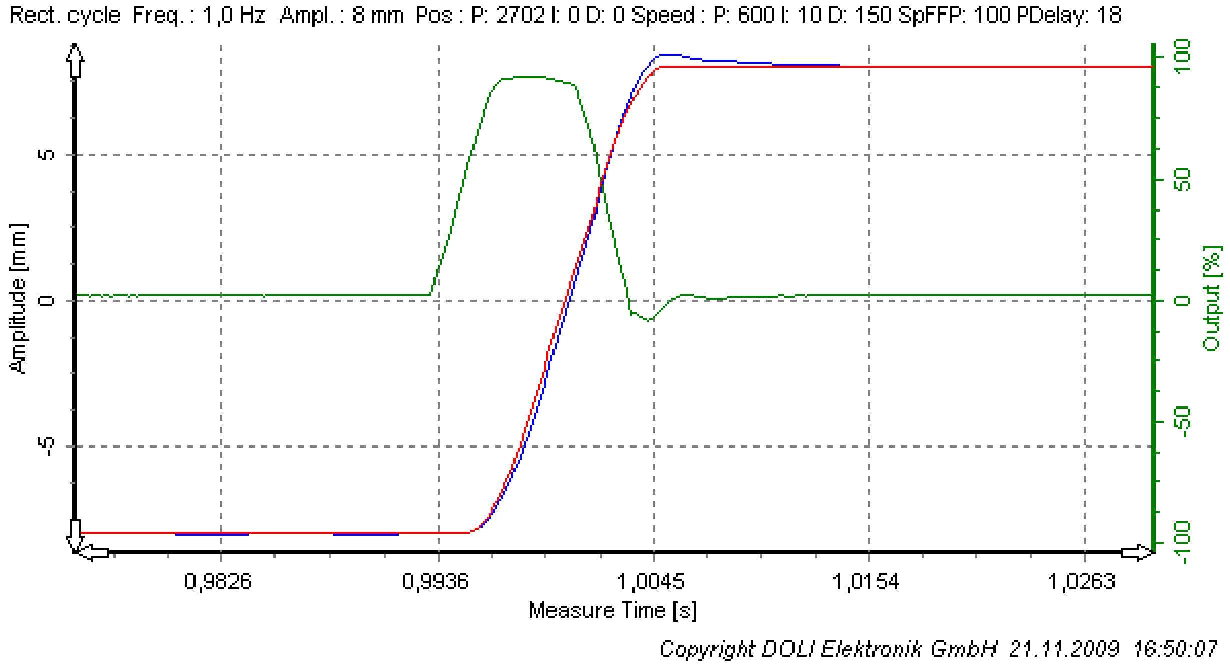


Fig. 63: Acceleration too big

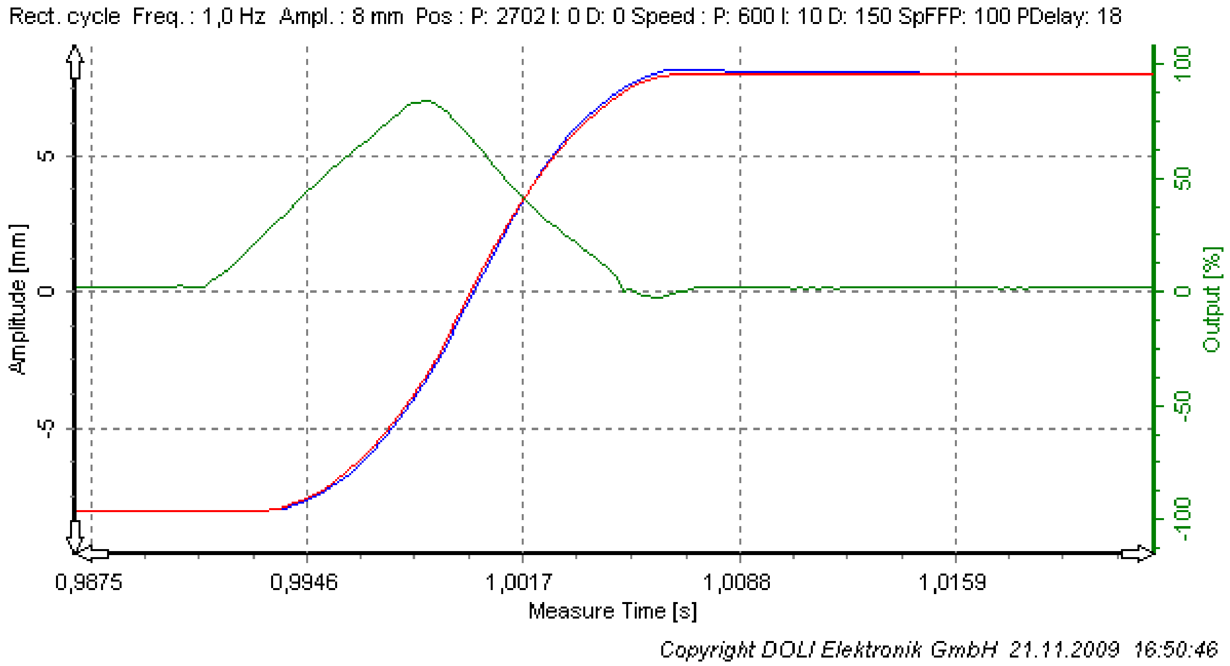


Fig. 64: Acceleration ok

4.5.6 Adjust Speed Feed Forward

Speed feed forward control is set using the parameters and **SpeedFFP** and **PosDelay**.

SpeedFFP indicates what percentage of the command speed is directly applied to the speed controller. Bypass the position controller. **SpeedFFP** is increased until the phase shift between the command- and the feedback value is close to zero. As a rule, in most cases 100% is the right setting. Only for load and extension control in HYDRAULIC control structure this is not true, because here, the input of speed controller is speed of load or extension. In this case the parameter **SpeedFFP** depends on the stiffness of the specimen!

PosDelay indicates how much time the command to the position controller is delayed. This compensates for the delay of the controlled system.

Position Controller at a High Response Hydraulic Machine

Without speed feed-forward there is always a phase shift between command- and feedback value.

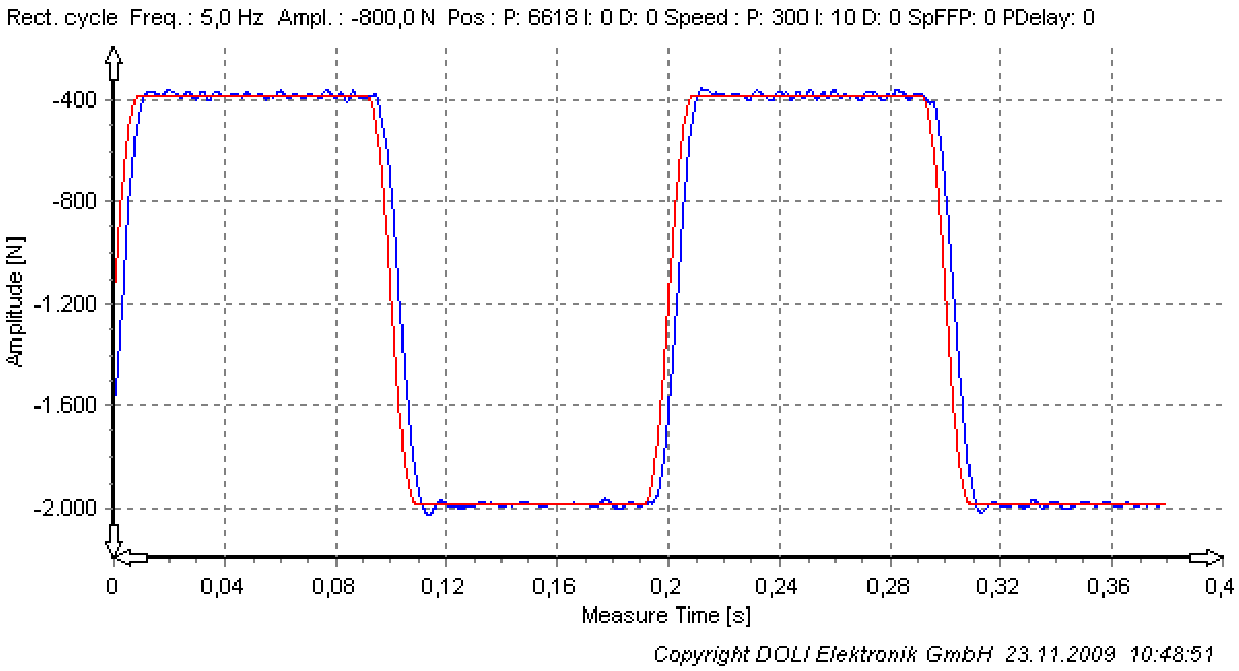


Fig. 65: Without Speed Feed-Forward

Applying **SpeedFFP**, the phase shift between command and feedback is small, and there is an overshoot of position.

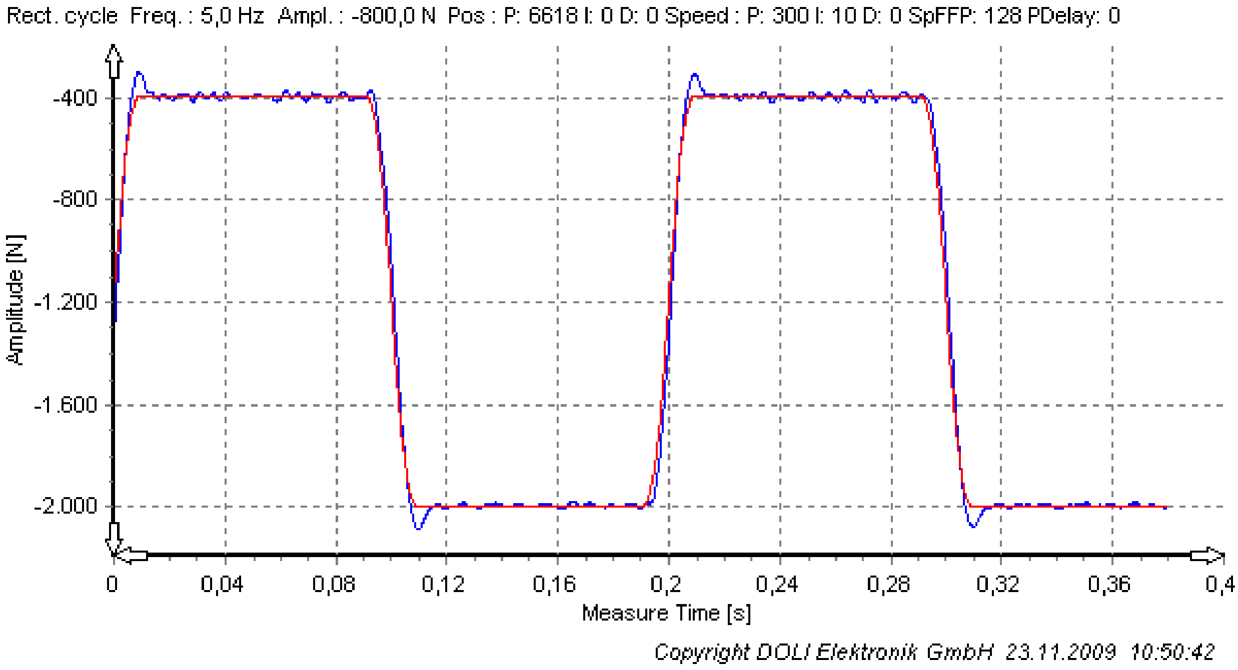


Fig. 66: Well-adjusted SpeedFFP

Applying **PosDelay** will reduce the overshoot.

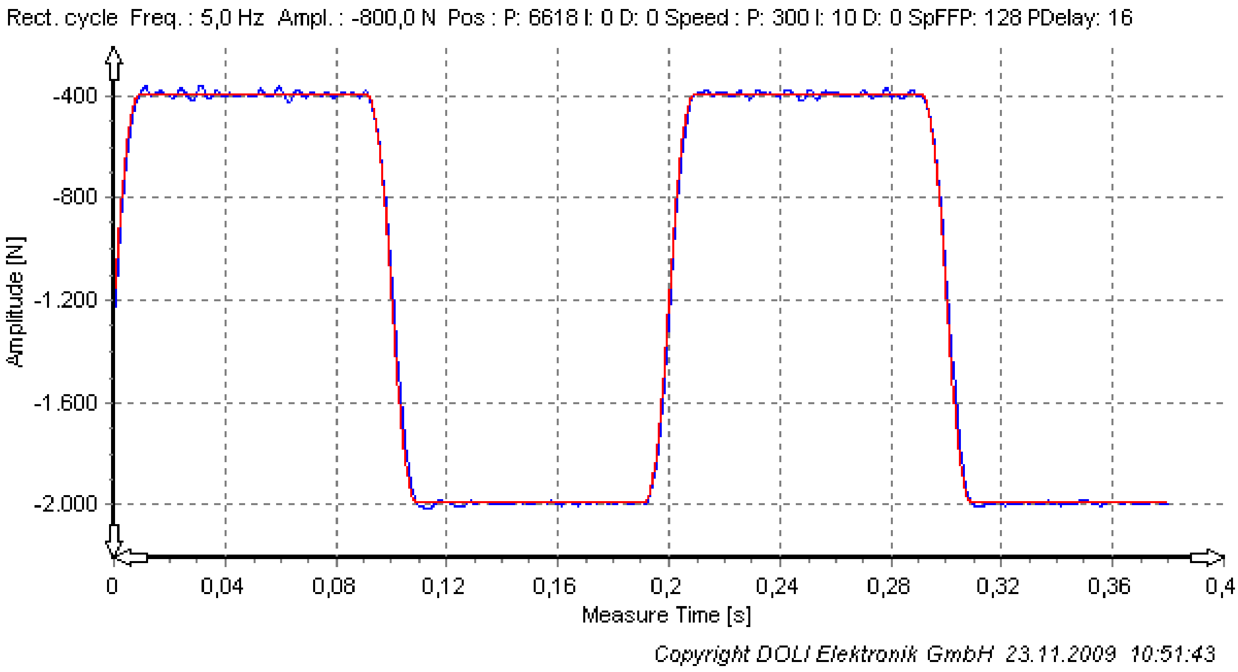


Fig. 67: Well-adjusted SpeedFFP and PosDelay

Position Controller at a Screw Machine

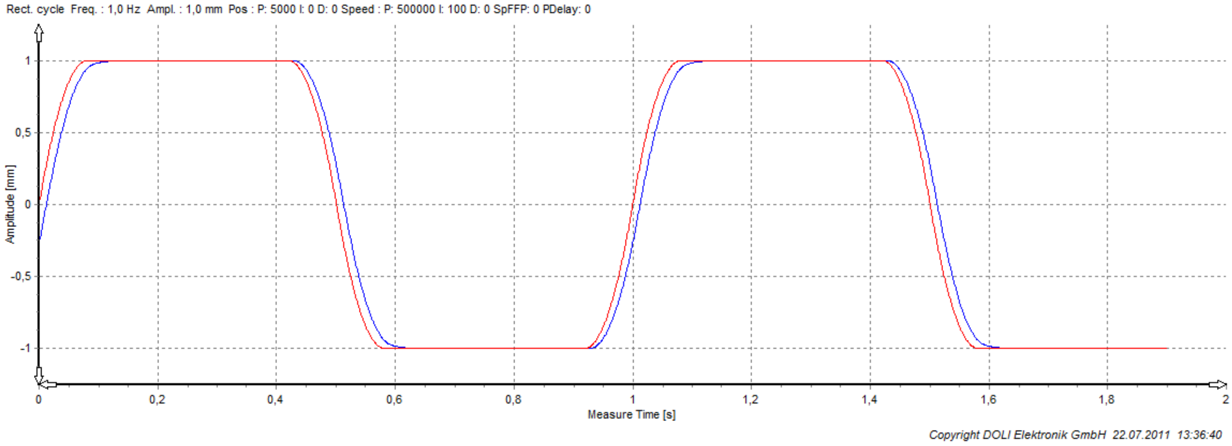


Fig. 68: Position controller at a 3kN screw machine without feed forward

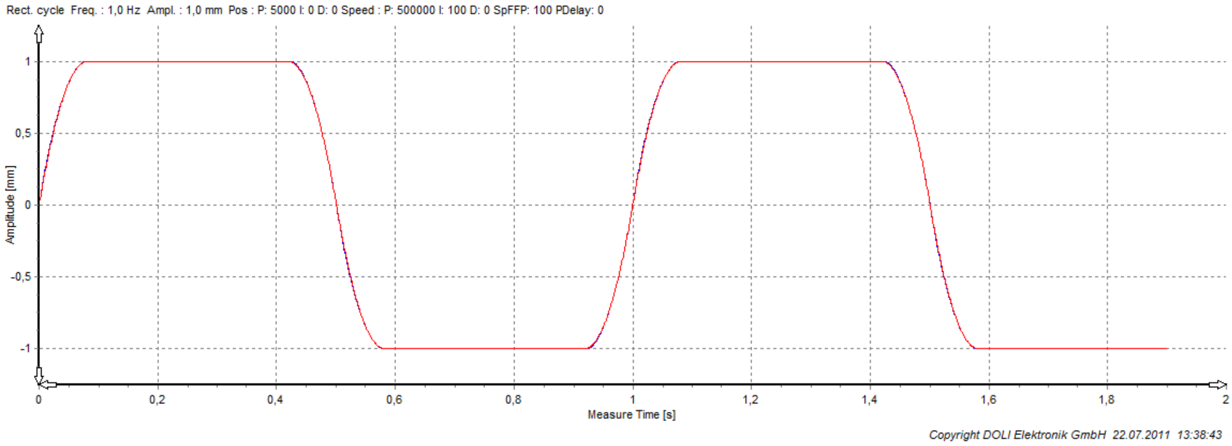


Fig. 69: Position controller at a 3kN screw machine with well-adjusted feed forward

4.5.7 Adjust Dither

Especially for hydraulic systems a dither signal helps to reduce friction. Friction causes strong nonlinear system behavior, a socalled stick-slip effect.

- A stick-slip effect will always cause a limit cycle.
- The dither signal should keep the piston of a valve moving, without having any influence on the controlled signal, e.g. position or load.
- Dither will have no or little effect if the frequency is too high or the amplitude too low.
- Common values for dither frequency are 200 to 800 Hz, and 1 to 5% amplitude.

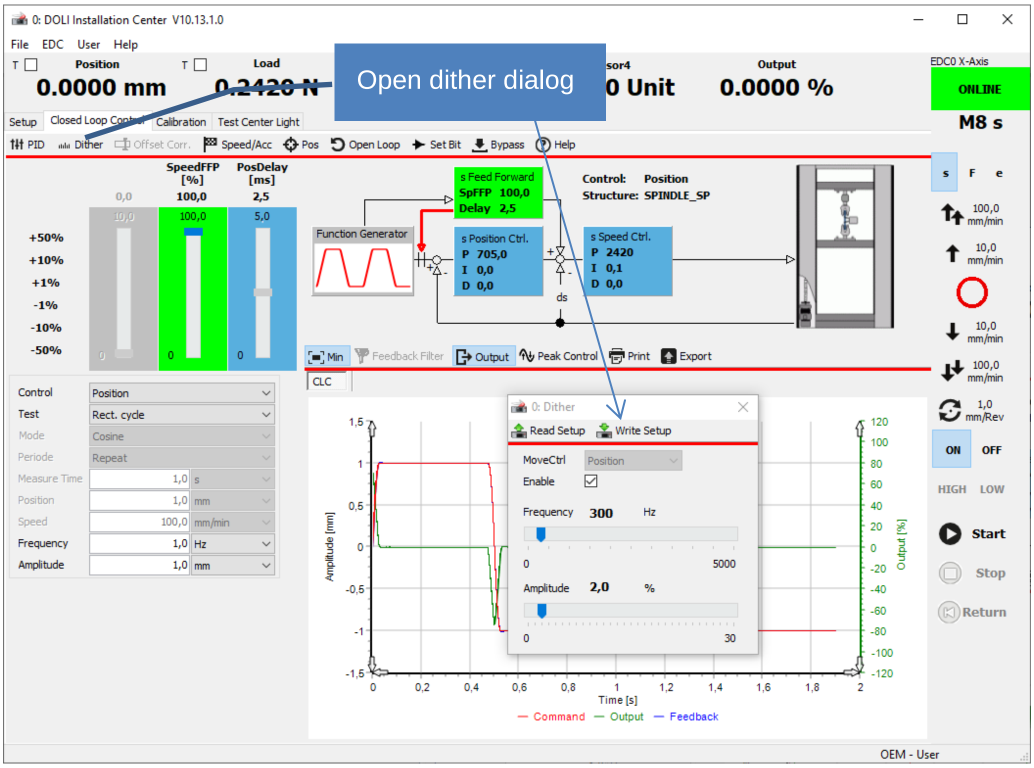


Fig. 70: Dither adjustment

4.6 Calibration

The 30 steps calibration tab combines the following topics:

- Sensor calibration check, optional with graphic.
- Sensor adjustment.
- Sensor linearization of analogue sensors.

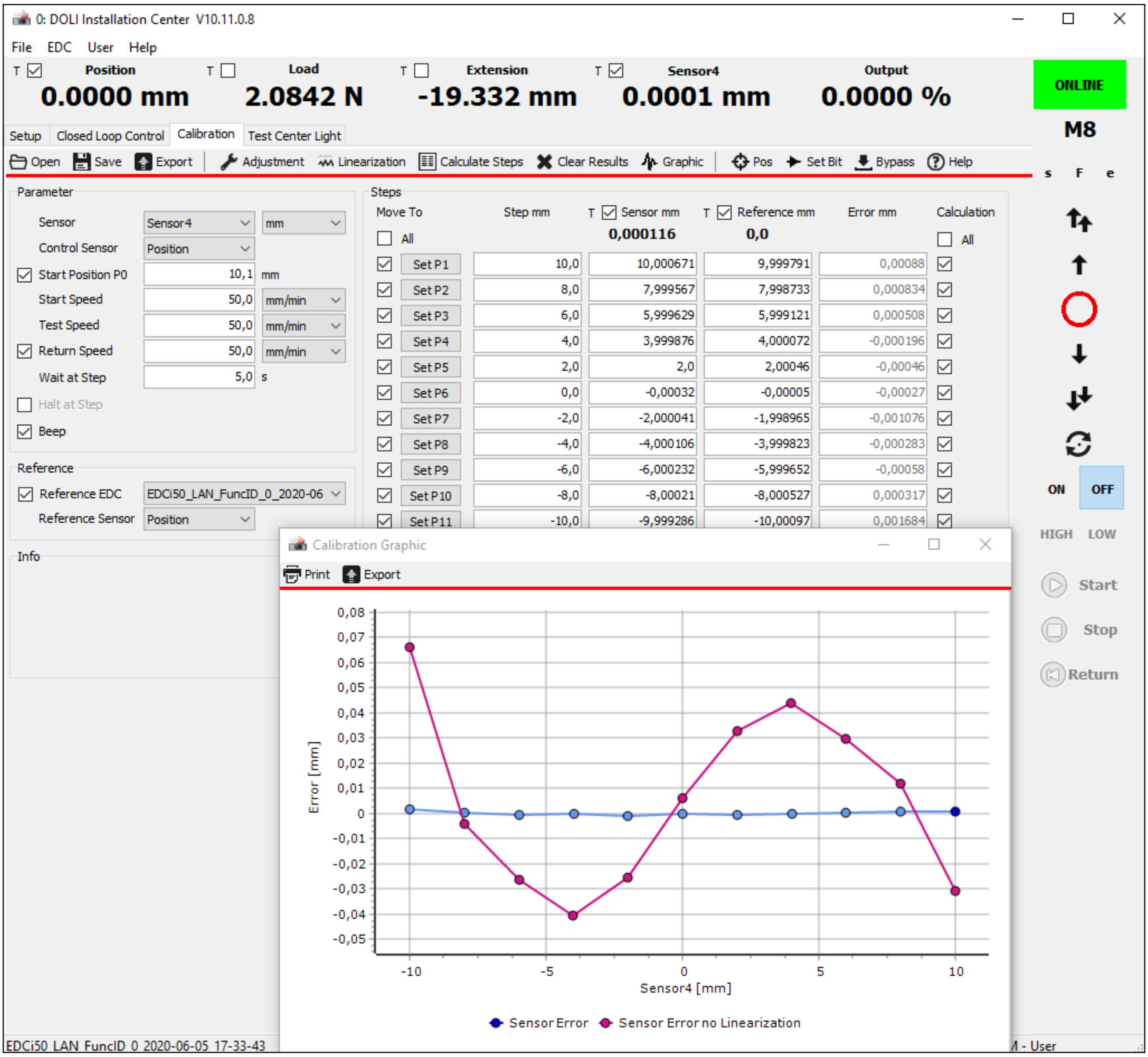


Fig. 71: Calibration Tab

4.6.1 Calibration Toolbar

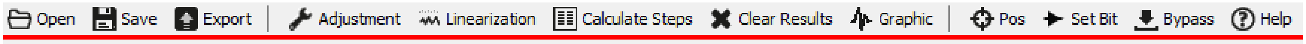


Fig. 72: Calibration Toolbar

Open	Open calibration parameters and table content.
Save	Save calibration parameters and table content.
Export	Export calibration steps table to a CSV file (comma separated values).
Adjustment	After calibration you can adjust a sensor (see chapter 4.6.6).
Linearization	After calibration and adjustment you can linearize a sensor (see chapter 4.6.7).
Calculate Steps	Calculate the steps Px according to EN ISO 7500-1 (see chapter 4.6.5).
Clear Results	Clear all calibration results in the steps table.
Graphic	Show the sensor error of the calibration table in a graphic (see chapter 4.6.7.1).
Pos	Move the machine to a certain position.
Set Bit	Set a digital IO output.
Bypass	Open the bypass valve.
Help	Show this help.

4.6.2 Calibration Parameters

First you must set the calibration parameters or open a saved parameter set.

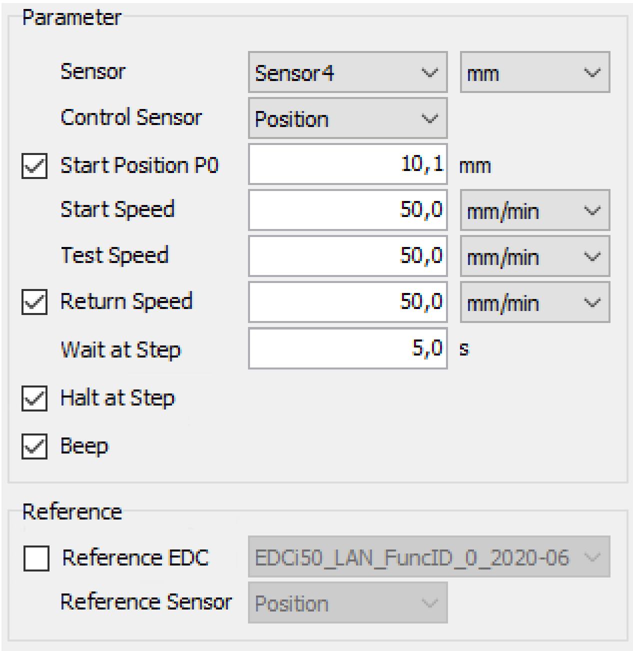


Fig. 73: Calibration Parameters

Sensor	EDC sensor, that should be calibrated. Also choose the sensor unit.
Control Sensor	EDC control sensor to move automatically to the calibration steps.
Start Position P0	If activated, the machine moves in position control to start position P0 (e.g. preload).
Start Speed	Speed to start position P0. In Openloop mode, you can set the output in [%].
Test Speed	Test speed to move automatically to the activated calibration steps (P1…P30).
Return Speed	If activated, the machine moves in position control to the return position at calibration end. In Openloop mode, you can set the output in [%] and a duration to stop.
Wait at Step	Waiting time at each calibration step, to reduce oscillation.
Halt at Step	If activated in automatic mode, the machine stops at each step and you have to press the continue button manually to go on (see chapter 4.6.3).
Beep	If activated, EDC and PC is beeping at each step after the waiting time.
Reference EDC	If activated, this or a second EDC is used for the reference sensor (see chapter 4.6.3).
Reference Sensor	EDC reference sensor.

4.6.3 Calibration Mode Manual/Automatic

The calibration can be done in manual or automatic mode.

Manual mode:

- For manual calibration, e.g. of a load cell, the reference values must be applied by dead weights, or for a position transducer by moving the transducer manually to a reference position. It's also possible to use the "Pos" command to move the machine to a certain position.
- The EDC sensor value input can be done manually or by pressing the 'Set Px' button in the steps table.
- If the reference sensor is an external sensor, deactivate the parameter 'Reference EDC'. The reference sensor value input must be done manually in the steps table.
- If the reference sensor is connected to an EDC, activate the parameter 'Reference EDC'. The reference sensor value input can be done by pressing the 'Set Px' button in the steps table.

Automatic mode:

- For automatic calibration press 'Start' button. The reference value is applied by moving the machine e.g. in load control to certain load steps.
- If the reference sensor is an external sensor, deactivate the parameter 'Reference EDC' and activate 'Halt at Step'. When the continue button is shown, you must input the reference sensor value manually in the steps table. Then press the continue button to go on.
- If the reference sensor is connected to an EDC, activate the parameter 'Reference EDC' and deactivate 'Halt at Step'. The reference sensor value input is done automatically in the steps table.
- Also, manual edited rows can be used for calculation of adjustment and linearization.

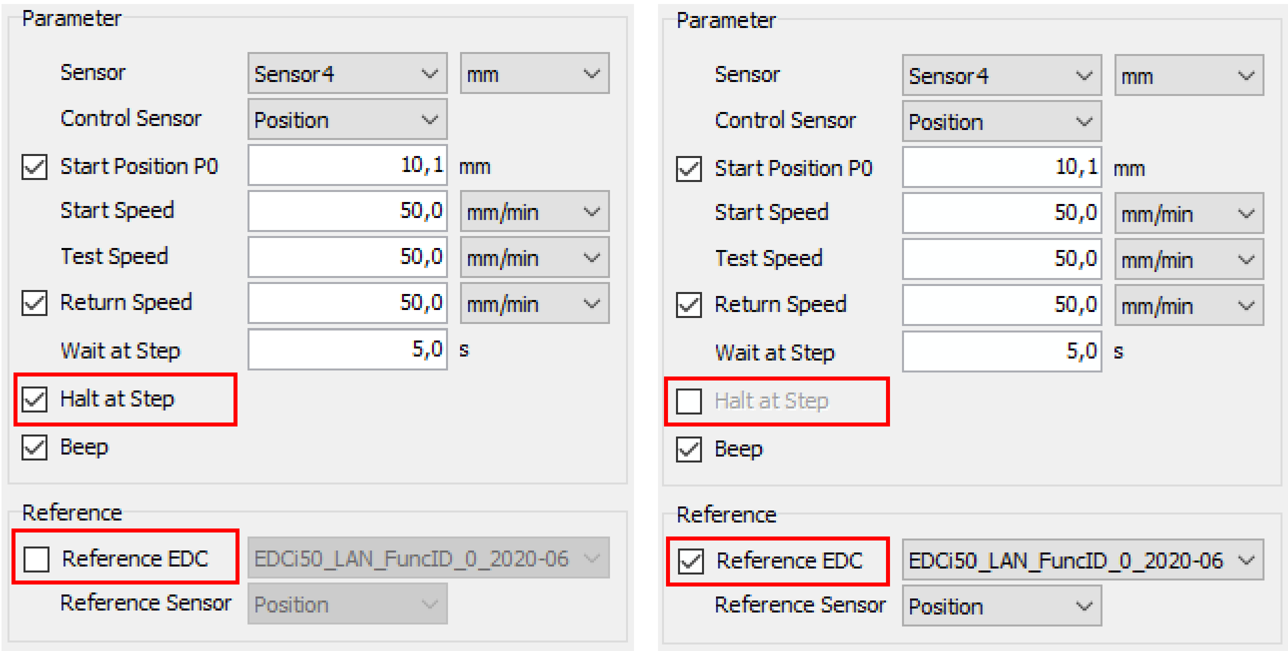


Fig. 74: Calibration with External or EDC Reference Sensor

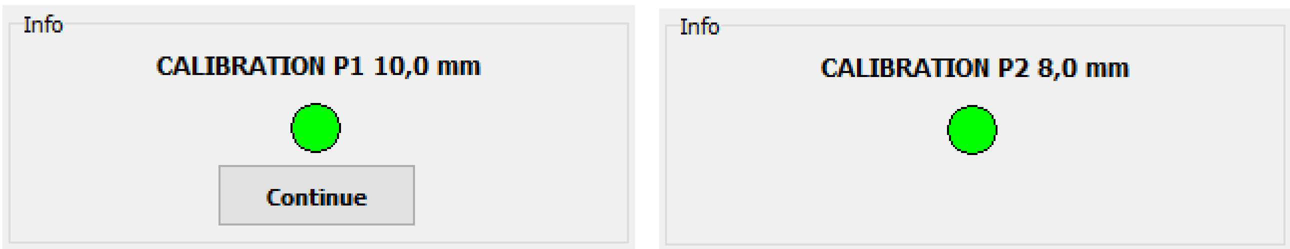


Fig. 75: Calibration with and without Halt at Step

4.6.4 Calibration Steps Table

After setting the calibration parameters, choose the desired calibration steps in the steps table. The steps can be set manually or automatically by pressing the ‘Calculate Steps’ button (see chapter 4.6.5).

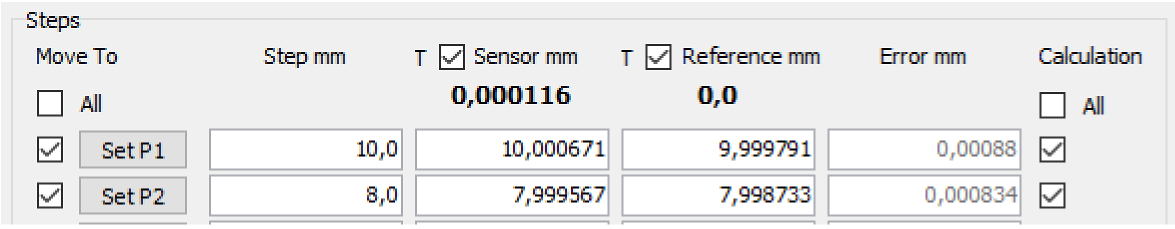


Fig. 76: Calibration Steps Table

Move To	In automatic calibration mode machine moves to activated steps.
Move To All	Activate/Deactivate all Move To check boxes.
Set Px	Set EDC sensor value (and EDC reference value, if selected).
Step	Calibration step.
T Sensor	Tare EDC sensor.
Sensor	EDC sensor value (manual or automatic input).
T Reference	Tare EDC reference sensor.
Reference	Reference sensor value (manual or automatic input).
Error	Calculated Error = Sensor - Reference.
Calculation	Activated rows are used for calculation of adjustment and linearization.
Calculation All	Activate/Deactivate all calculation check boxes.

4.6.5 Calculate Calibration Steps

The calibration steps can be set automatically by pressing the 'Calculate Steps' button.

The steps are calculated according to EN ISO 7500-1 as follows:
0%, 0.1%, 0.2%, 0.4%, 0.7%, 1%, 2%, 4%, 7%, 10%, 20%, 40%, 60%, 80%, 100%
Or in 11 equidistant steps which is suitable to do linearization.

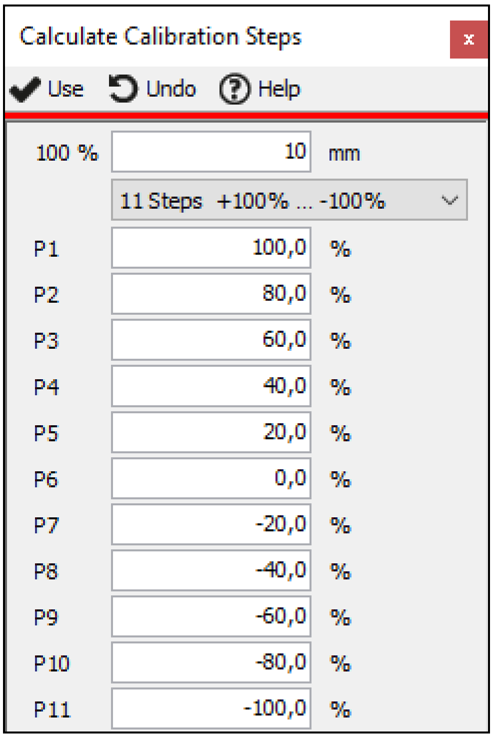


Fig. 77: Calculate Calibration Steps

100 %	Set the 100% value (default is the sensor nominal value) and choose one of the following modes: 11 Steps 0% … +100% 11 Steps 0% … -100% 11 Steps +100% … -100% 15 Steps 0% … +100% 15 Steps 0% … -100% 29 Steps 0% … +100% … 0% 29 Steps 0% … -100% … 0% 29 Steps -100% … +100% 29 Steps +100% … -100%
Use	Copy these values to the steps table.
Undo	Get back the old step values.
Help	Show this help.

4.6.6 Adjustment

With the adjustment process the output of a sensor is adjusted according to the reference sensor. All checked ‘Calculation’ steps are used for the adjustment. The result is a sensor offset and sensitivity (or correction value).

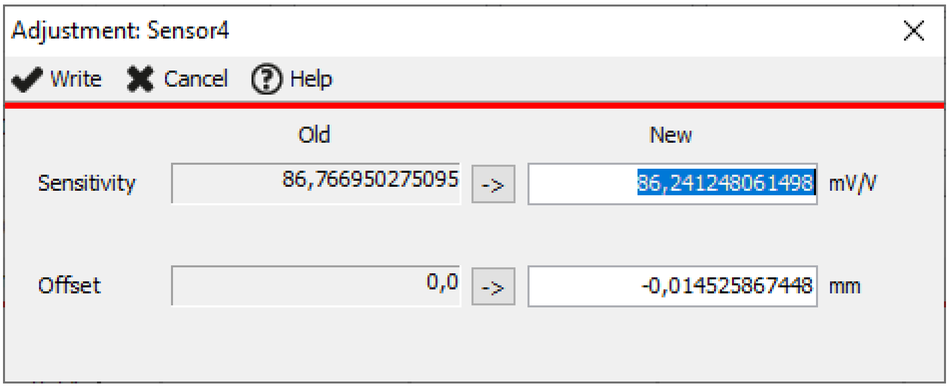


Fig. 78: Adjustment

You can change the values manually or copy the old values with the ‘->’ buttons.

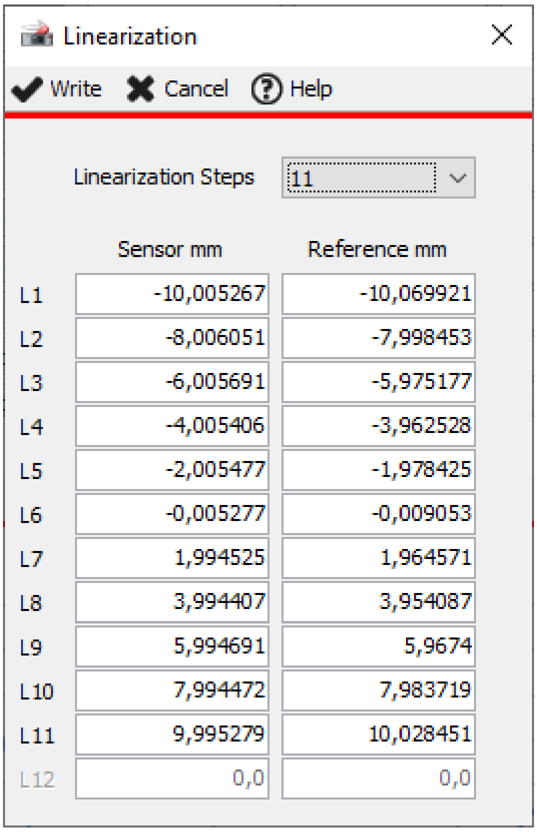
Write	Writes the values to the EEPROM of the sensor plug (if activated), or to the EDC setup.
Cancel	Abort adjustment.
Help	Show this help.

To activate the new sensor adjustment, you must initialize the EDC. To check the result, you can open the graphic window and restart the calibration process again (see example in chapter 4.6.7.1).

Note: You should disable an active sensor linearization before starting an adjustment.

4.6.7 Linearization

With the linearization process an analogue sensor with active sensor EEPROM is linearized according to the reference sensor. All checked ‘Calculation’ steps (2 to 12 steps) are used for the linearization. The result is a sensor linearization table with up to 12 points.



	Sensor mm	Reference mm
L1	-10,005267	-10,069921
L2	-8,006051	-7,998453
L3	-6,005691	-5,975177
L4	-4,005406	-3,962528
L5	-2,005477	-1,978425
L6	-0,005277	-0,009053
L7	1,994525	1,964571
L8	3,994407	3,954087
L9	5,994691	5,9674
L10	7,994472	7,983719
L11	9,995279	10,028451
L12	0,0	0,0

Fig. 79: Linearization Table

You can change the values manually. If the first/last value pair of sensor and reference is equal, the linearization ends there. If not, the linearization is extrapolated beyond the first/last values. To disable the sensor linearization, set the linearization steps to zero.

Write	Writes the values to the EEPROM of the analogue sensor plug.
Cancel	Abort linearization.
Help	Show this help.

To activate the new sensor linearization, you must initialize the EDC. To check the result, you can open the graphic window and restart the calibration process again (see example in chapter 4.6.7.1).

Note: You must finish the sensor adjustment before starting a linearization.
It is possible to calculate new linearization steps even when the linearization is already active.

4.6.7.1 Linearization Example of a LVDT

- LVDT position sensor with ±10 mm.
- Reference system is an incremental length gauge.

Below you see the none linearized (red line) and the linearized (blue line) LVDT. You can print the graphic or export it as a GIF file.

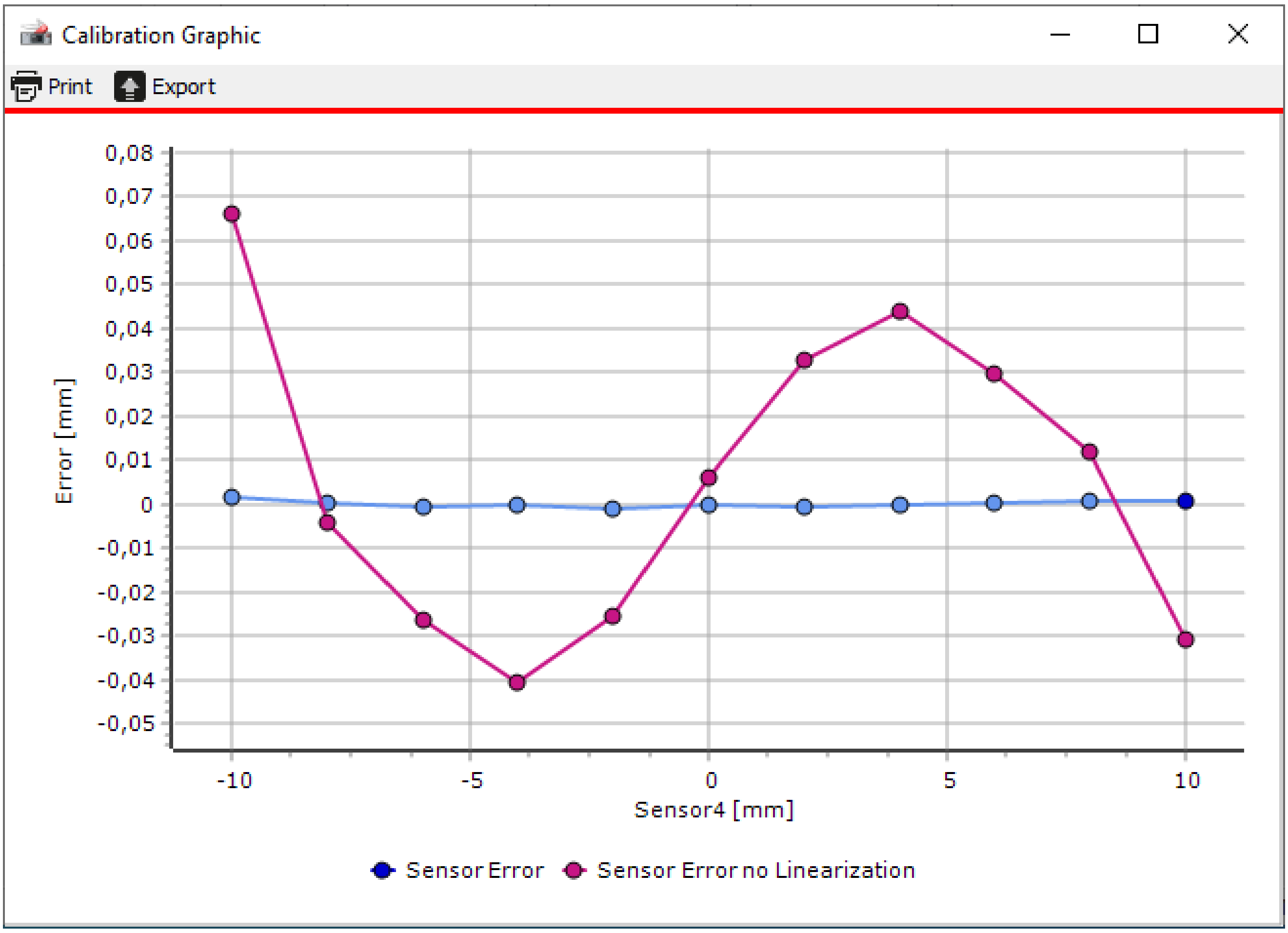


Fig. 80: Linearization Example of a LVDT

4.7 Test Center Light

4.7.1 Overview

With Test Center Light you can check all sensor readings as alphanumeric values or in a configurable graphic. You can export and import the graphic. Additionally, we offer the major functions of the DoPE programming interface with configuration and movement commands for static and dynamic machines. See the DoPE manual for a detailed description of the command parameters.

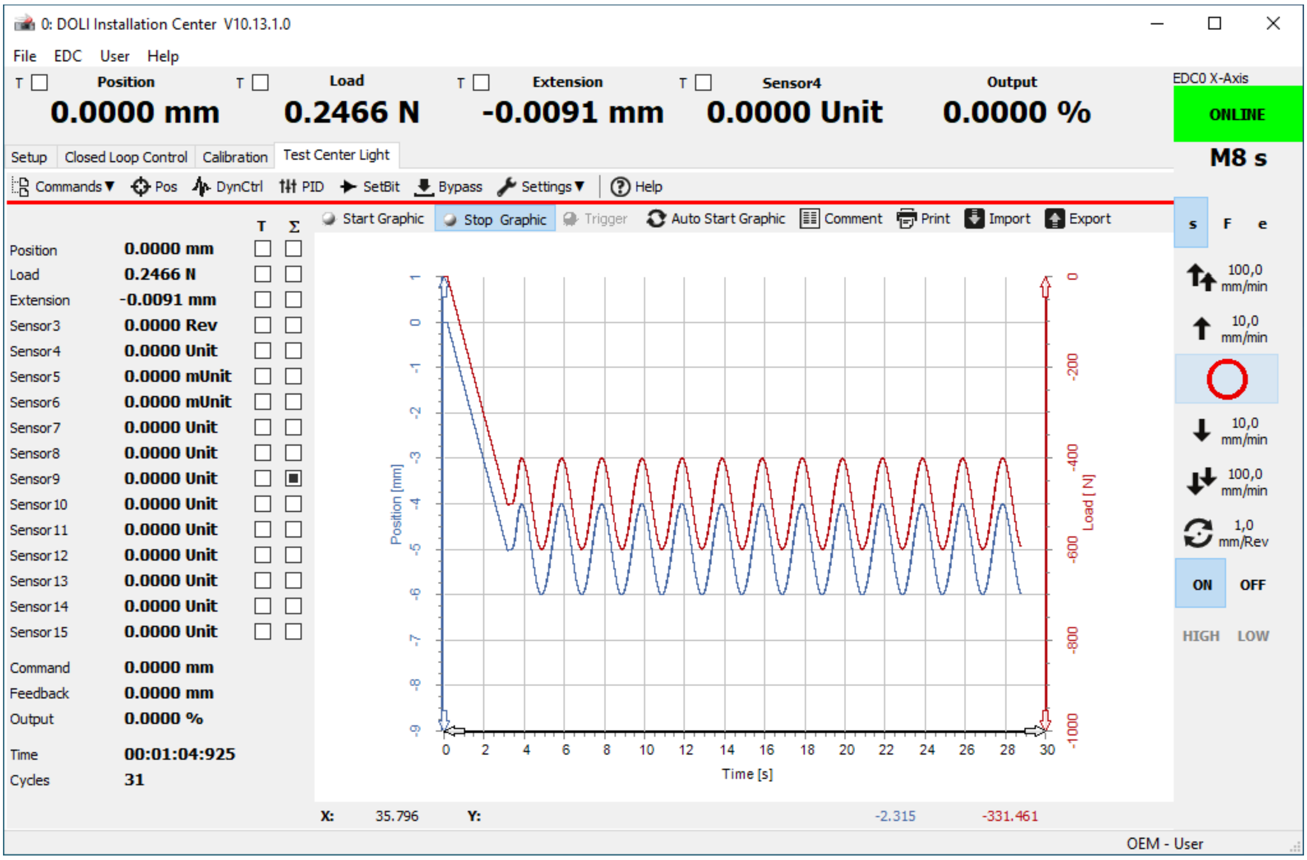


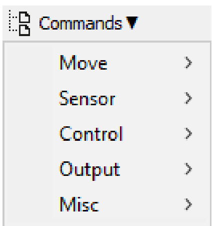
Fig. 81: Test Center Light overview

4.7.2 Toolbar

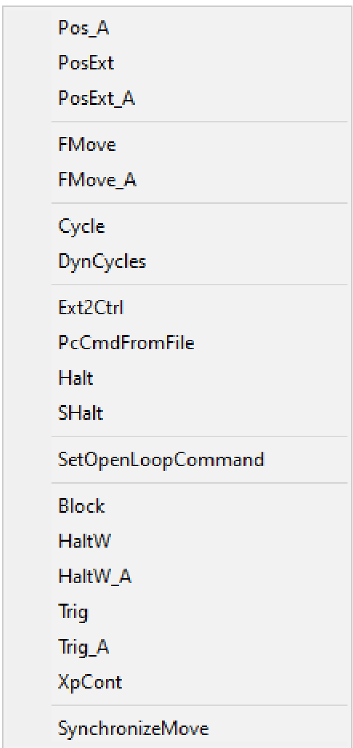
Fig. 82: Test Center Light toolbar

Commands	Open commands popup.
Pos	Positioning command.
DynCtrl	Dynamic control command.
PID	Adjust PID parameter of the closed loop controller.
SetBit	Set/Reset digital output bit.
Bypass	Open/Close bypass valve.
Settings	Open settings popup.
Help	Show this help.
T	Tare/Untare a sensor.
Σ	Edit a formula (see chapter 4.7.4).

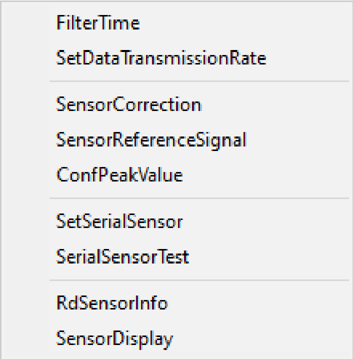
The commands popup shows all additional commands. See the DoPE manual for a detailed description of the command parameters.



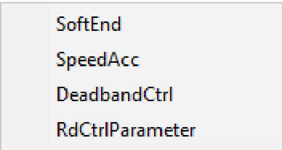
- Select the command section



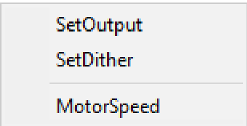
- Movement commands



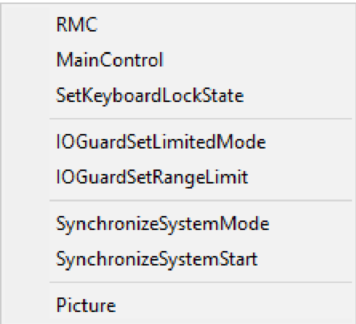
- Sensor commands



- Closed loop controller commands

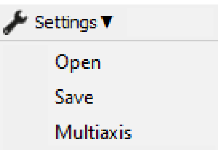


- Output commands



- Miscellaneous commands

The settings popup shows the following commands.



- Open a Test Center Light settings file
- Save a Test Center Light settings file
- Show multiaxis settings (see chapter 4.7.5)

The Test Center Light settings file (**TCLS**) can be used to save a special machine configuration and reload it later. The file contains the following information:

- Graphic settings
- All active command dialogs
- All active sensor displays
- Formula configuration
- Multiaxis settings

4.7.3 Graphic

Fig. 83: Graphic toolbar

Start Graphic	Start graphic recording.
Stop Graphic	Stop graphic recording. Now you can export the graphic.
Trigger	Enable/Disable trigger function. Trigger conditions can be set in the graphic settings dialog.
Auto Start Graphic	Start graphic with next movement command.
Comment	Add a comment as graphic headline.
Print	Print the graphic.
Import	Import offline graphic from DOLI format (**BMV2**, **BMV**, **MVL**).
Export	Export online graphic to the following formats: - **BMV2** DOLI binary format. This is a further development of the BMV file format with a complete DoPE data set, including all sensors, digital IOs, states and multiaxis graphic features. - **PNG** picture. - **CSV** file (comma separated values). CSV files can be imported by many other applications, e.g. Excel.

Zoom and Scroll
Press the left mouse button and move right/down to zoom in the graphic.
Press the left mouse button and move left/up to zoom out the graphic.
Press the right mouse button and move to scroll the graphic.

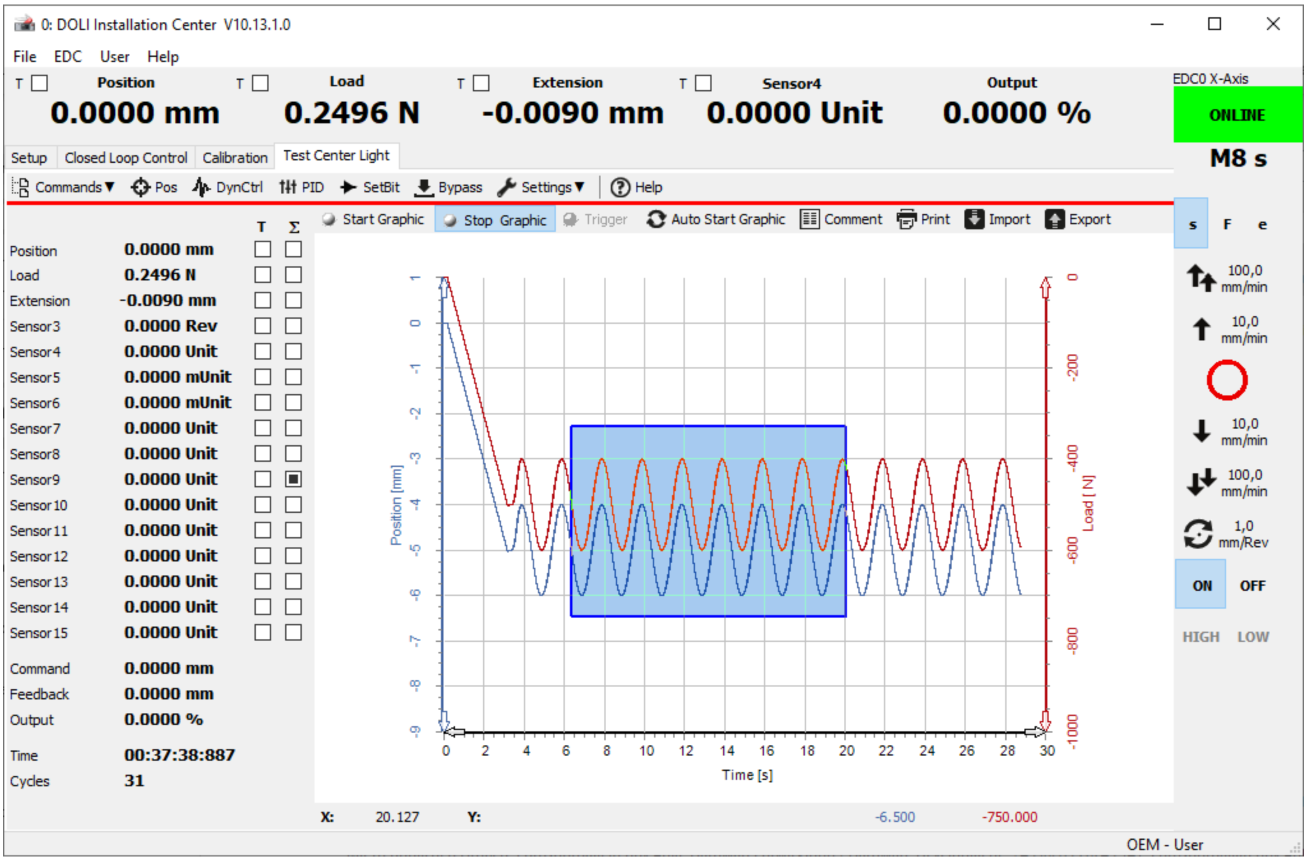


Fig. 84: Graphic zooming

With a right mouse click on the graphic, you open the graphic settings dialog.

Sensor Tab
Here you edit the parameters for the sensor axes.

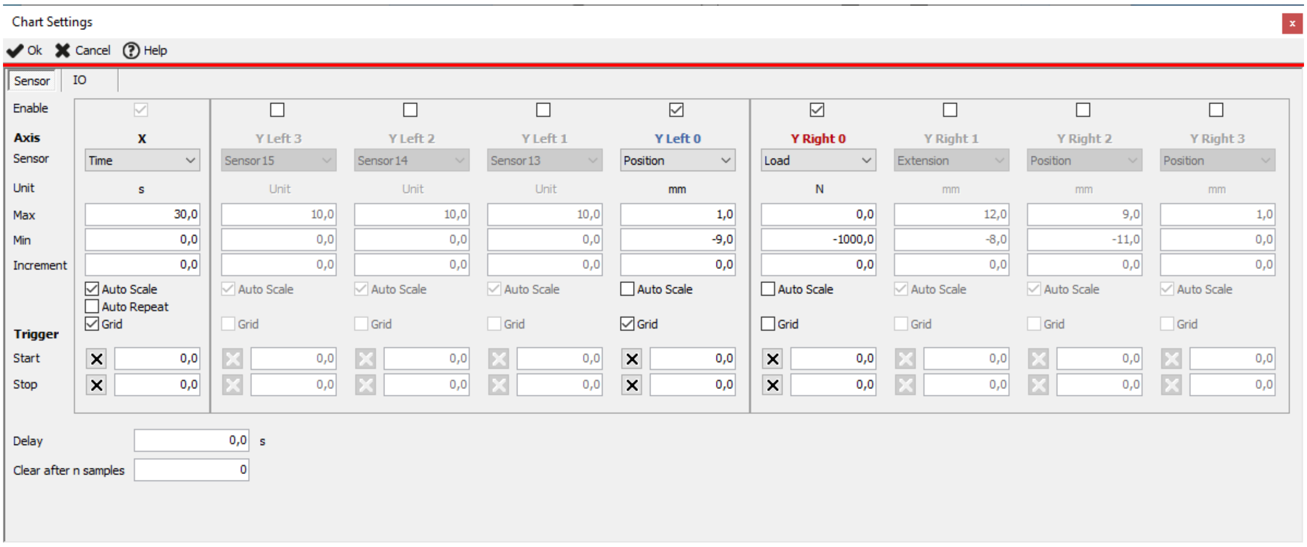


Fig. 85: Graphic settings for sensors

- Up to eight Y axes are possible, four on the left and four on the right side
- Select the sensor
- Set the axis maximum and minimum
- Set the axis label increment (0 is automatic label mode)
- Enable/Disable axis auto scale
- Enable/Disable axis auto repeat (X axis only). The graphic is cleared at X axis maximum and restarts
- Enable/Disable axis grid
- Enable/Disable trigger levels to control the graphic start/stop (off/increasing/decreasing modes)
- Set a delay time for graphic start
- Set a maximum sample limit. After reaching this, the graphic is cleared and restarts

IO Tab
Here you configure the digital inputs, outputs, EDC states and graphic start/stop triggers. The digital IOs are shown above the normal sensor graphic.

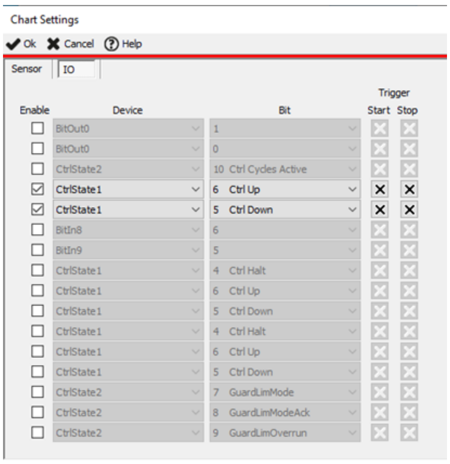


Fig. 86: Graphic settings for digital IOs

4.7.4 Formula

With a right mouse click on the **Σ** checkbox you can enter a formula. Only not configurated sensors are allowed. The result can be seen in the sensor readings and in the graphic.

The example below shows a formula on sensor nine, to calculate the speed of the position sensor (S0Speed) with a unit conversation from m/s to mm/min. The speed is calculated with an average over 100 datasets.

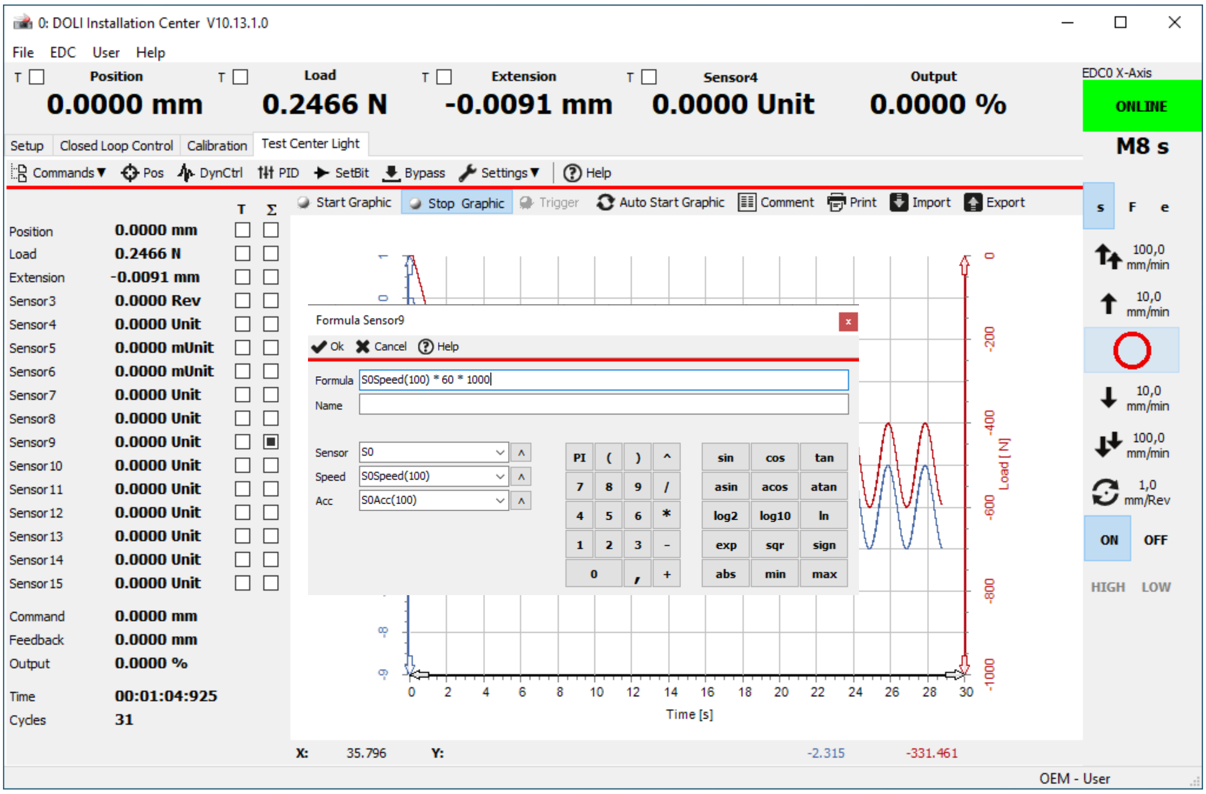
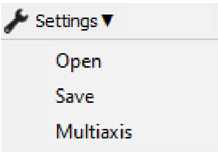


Fig. 87: Formula

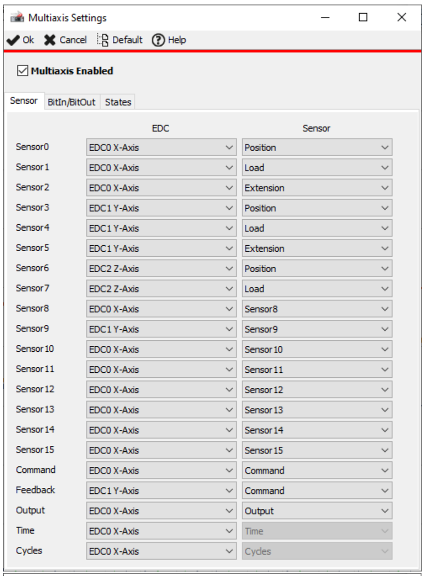
4.7.5 Multiaxis

Since version 10.13.1.0 the Test Center Light supports up to eight synchronized EDCs and offers several multiaxis features. You can send the commands to different connected EDCs, configurate a virtual sensor dataset and visualize this in the graphic.

Enter the multiaxis settings dialog and enable/disable the multiaxis feature. Here you can configurate the virtual dataset from different EDCs.

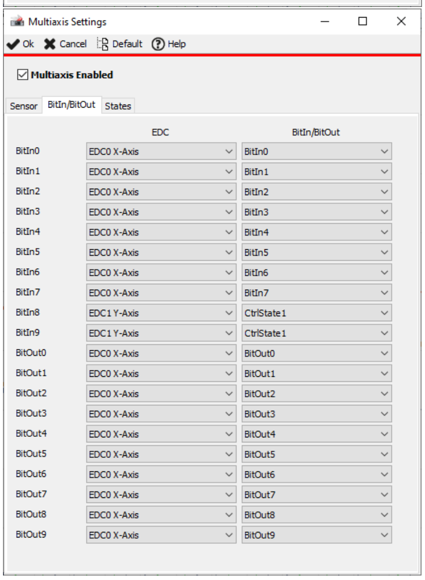


- Select Multiaxis in the settings menu

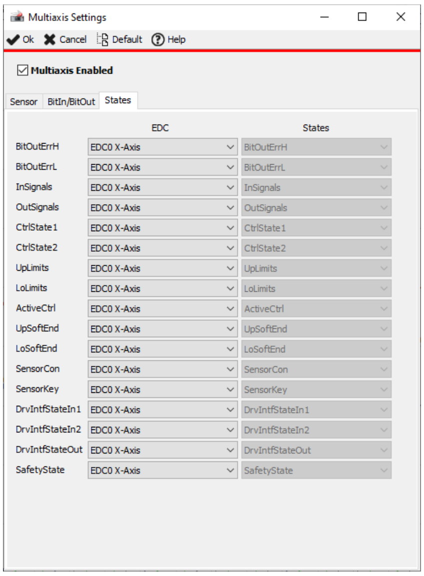


- The Ok button confirms the configuration
- The Cancel button discards the configuration
- The Default button resets the configuration to default values
- The Help button shows this help

- Enable/disable the multiaxis feature
- Configure the virtual sensors
- Select the EDC
- Select the sensor



- Configure the virtual bit inputs and outputs
- Select the EDC
- Select the bit input or output



- Configure the virtual states
- Select the EDC
- The states can't be change

If multiaxis feature is enabled, you see the word **Multiaxis** on the top left corner and the virtual dataset with the configurated EDCs and sensor readings. Use the EDC selection box in the command dialogs and the RMC command to move the different axis by hand.

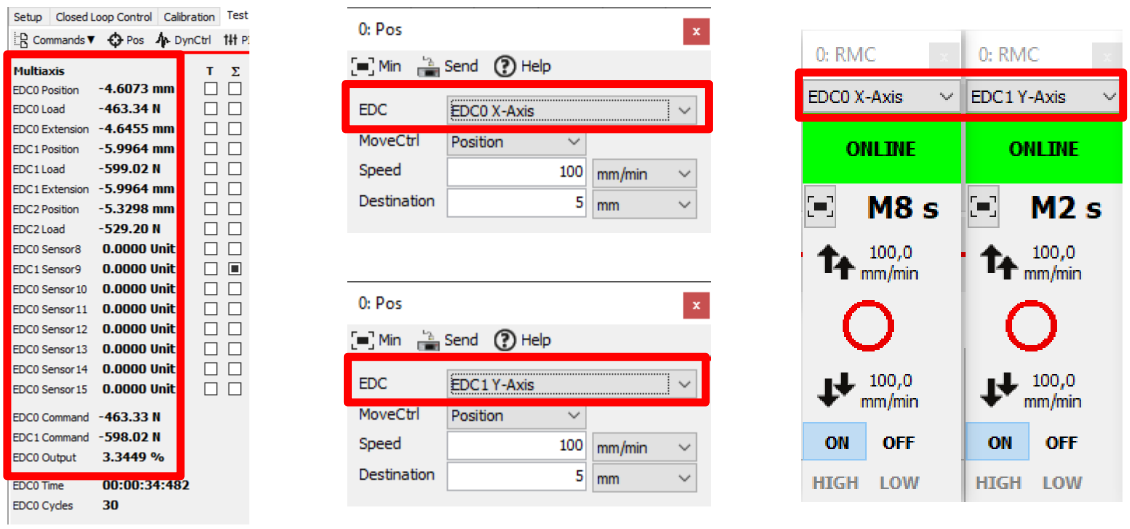
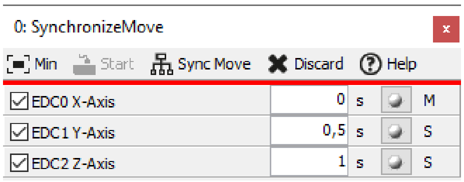


Fig. 88: Multiaxis sensor readings and commands

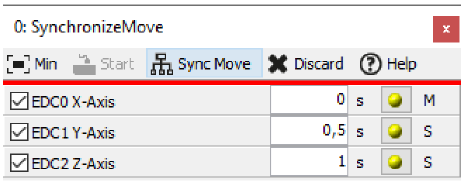
Note: The sample time of all selected EDCs is synchronized, if all EDCs are equipped with a sync option. If no sync option is used, the slowest data transmission rate of all EDCs is used for all datasets, but an exact time synchronization is not possible.

4.7.6 Synchronize Move

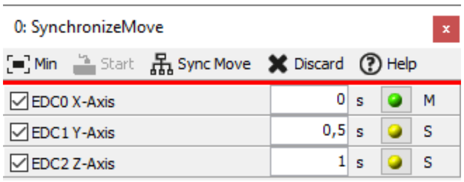
If the connected EDCs are equipped with a sync option (see chapter 5.1.11), you can use the Synchronize Move command for easy command handling. The sequence for this movement is show below.



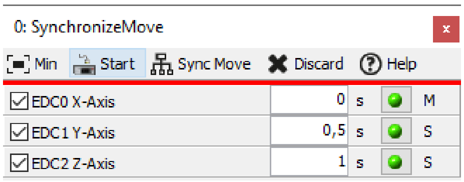
- Synchronized movement command is not active
- All LEDs are gray
- Select the EDCs to move
- Edit the start delay time of the EDCs



- Press Sync Move button to start the sequence
- All LEDs are yellow
- Now send the movement command to the selected EDCs
- Press the Discard button to stop the sequence



- EDC0 got the movement command
- EDC0 LEDs is green
- Press the Discard button to stop the sequence



- All EDCs got the movement command
- All LEDs are green
- Press the Start button to start the synchronized movement
- Press the Discard button to stop the sequence

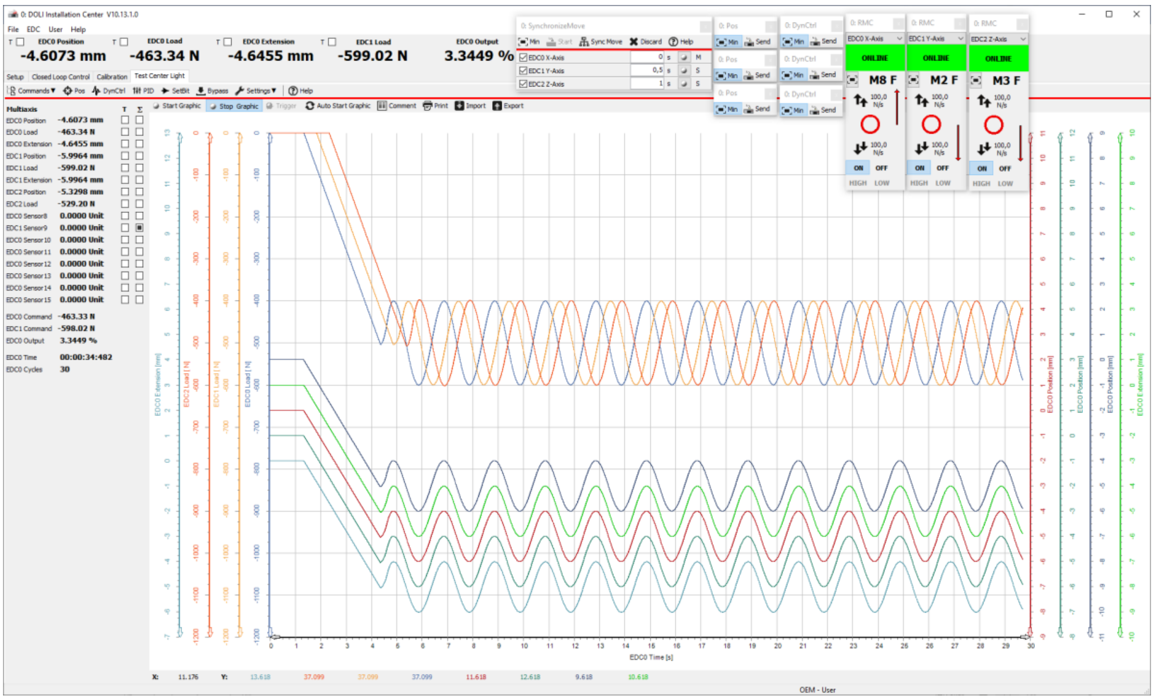


Fig. 89: Graphic with synchronized movement command

5 EDCi Hardware Descriptions

This chapter provides a short description of all assemblies available in the EDCs. Details of connector pin layout are listed also.

5.1 Connector Description

5.1.1 X19 Power supply

Connect at X19 24 VDC. Maximum power consumption for EDC is 1.5A.

In case of external devices are supplied with 24 VDC via EDC, such as valve or motor brake, add the power consumption of the external devices!

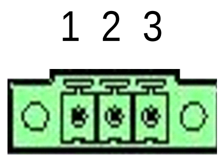


Fig. 90: 24V Power plug (female) (X19).

Table 36: Pin description 24V Power plug (female) (X19)

Pin	Name	Function
1	PE	Protective earth
2	GND	Ground
3	24V	+24 VDC

5.1.2 X17 USB

USB interfaces for communication with a PC.

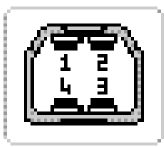


Fig. 91: USB plug (X17).

Table 37: Pin description USB 2.0 full speed slave interface with a Series "B" plug (X17)

Pin	Name	Typical Wiring
1	VBUS	Red
2	D-	White
3	D+	Green
4	GND	Black
Shell	Shield	Drain Wire

5.1.3 X16 Ethernet

Use a standard cross Ethernet cable for connection to your PC. The Ethernet port of your PC must be dedicated for communication with EDC (see communication driver manual CommunicationDrivers.pdf).

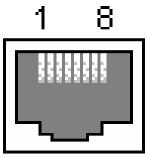


Fig. 92: Ethernet plug (X16).

Table 38: Pin description RJ45 10/100 Mbit Ethernet plug (X16)

Pin	Name	Function
1	TX+	Transmit data +
2	TX-	Transmit data -
3	RX+	Receive data +
4	-	-
5	-	-
6	RX-	Receive data
7	-	-
8	-	-

5.1.4 X14 Load channel

The load channel at X14 is a measuring amplifier for analog sensors. It provides a (10V) DC Excitation for strain gauge transducers.

Excitation:

Voltage:	10 Volt DC, 60 mA
Minimum bridge impedance:	170 Ohm
Bridge circuit:	10 Volt Full bridge, supplied asymmetrically

Measurement:

Measurement input range:	1.18 mV/V to 1.2 V/V (excitation 10 V), 11.8 mV to 12V
Input impedance:	>1 GΩ (DC measurement)
Technology:	24Bit ADC
Resolution:	10,000,000 points at DoPE interface
SNR:	81 dB @ 0.1 ms filter time 91 dB @ 1 ms filter time 104 dB @ 20 ms filter time
Total linearity:	Typical 0.01, max 0.025%

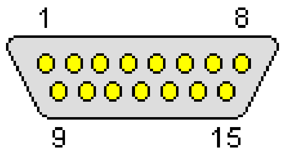


Fig. 93: 15-pin D-Sub plug (male) (X14).

Table 39 : Pin description Load, 15-pin D-Sub plug (male) (X14)

Pin	Name	Function	Signal Type
1	GND-ext.	Shield (case) + DGND	
2	SDA	I2C-data	5V tolerant
3	SCL	I2C-clock	5V tolerant
4	KE	Calibration enable	Low active, internal pull up (3.3V)
5	Signal-A	Measuring signal A	
6	Signal-B	Measuring signal B	
7	Sense-B	Supply remote sense B	Connect to Excit -B
8	Excit-A	Supply A	
9	R-Ref. B	External reference B	
10	CON	Sensor connected	Low active, internal pull up (3.3V)
11	5V-SW	+5V VDC	20mA max.
12	AGND	Analogue ground	
13	R-Ref. A	External reference A	
14	Excit-B	Supply B	
15	Sense-A	Supply remote sense A	Connect to Excit -A

5.1.5 X7 Incremental / SSI input for crosshead

Features:

- Signal type: TTL
- Track A, track B, reference
- Direction detection and impulse quadruplicating
- 32 Bit Up/down pulse counting
- Maximum input counting frequency:
  Encoder: A/B signal frequency max 8 MHz (counting frequency max 32 MHz)
  SSI-Input: max. 300 kHz
- Transducer connected detection
- Transducer ID via I2C-Bus
- 5V supply for an incremental transducer
  24V supply for SSI-transducers.

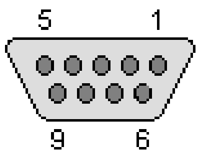


Fig. 94: 9-pin D-Sub plug (female) (X7).

Table 40: Pin description Encoder/SSI, 9-pin D-Sub plug (female) (X7)

Pin	Name	Function	Signal Type
1	Shield / GND	Screen	0V
2	/CON	Sensor connected	TTL Low active
3	I2C-C	I2C-Bus Clock	TTL
4	B	Incr. Transducer trace B-input	TTL
5	Ref.	Incr. Transducer reference-input	TTL
6	/KE	Calibration enable	TTL Low active SSI: +24V, 150mA
7	I2C-D	I2C-Bus data	TTL
8	A	Incr. Transducer trace A-input	TTL
9	5V-ext	5VDC supply	250mA max.

5.1.6 X4 Drive interface

5.1.6.1 General information

The basic functions of the drive interface are:

- ±10Volt command output with ±15 bit resolution.
- Digital command output with three modes:
  A/B incremental command
  Pulse/Sign digital command via Pulse/Sign
  Up/Down digital command via Up/Down pulses
- The output frequency of the digital command may be adjusted in steps between 31kHz and 4MHz by setup parameter.
- Main power supply and safety signal for external power contactors, drives and valves (CMDon1 and CMDon2).
- Monitoring of safety relevant drive signals (e.g. Emergency-Stop, EDM).
- Supply and monitor of drive control signals.
- Support of position limit switches.
- Dither generator.

Manual reset (since board revision 5):

- Pin *ManResetAct* set to 0V deactivates the manual reset:
  Drive can be switch on.
- Pin *ManResetAct* set to 24V activates the manual reset:
  The drive on command is disabled after every power on and Estop signal (EstopExt, EstopRmc, DoPEEmergencyOff). Pin *ManResetReq* and bit 13 at EDC states DrvIntfStateIn2 or DrvIntfStateOut show this state. The user must reset this state by the pin *ManReset* (24V pulse duration of 0.2s to 10s). Now the drive on command is allowed again.

Drive is switched ON by:

- ON button of RMCs.
- ON button of the Machine Control Panel of Installation Center (Software).
- Software instruction with DoPE.dll.

Drive is switched OFF by:

- OFF button of RMCs.
- OFF button of the Machine Control Panel of Installation Center (Software).
- Software instruction with DoPE.dll.

Drive is automatically switched off at any kind of Emergency-Stop from RMC _EstopRMC, external E Stop button _EstopExt or safety position switch _EstopUpDown (see chapter 5.1.6.3). Furthermore, drive is switched off if signal EDCrdy is set to logical “0” (see chapter 5.1.6.2).

5.1.6.2 Pin and signal description

Control signals for the drive interface are connected via a 44 pin female plug X4.

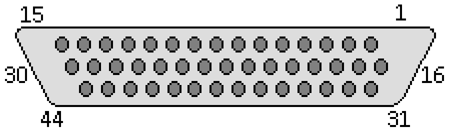


Fig. 95: 44-pin D-Sub plug (female) (X4)

Table 41: Pin description drive interface 44-pin D-Sub plug (female) (X4)

Pin	Name	Description	Signal Type	Limits
1	InCMDon1	Emergency-Stop input 1, first channel	24V-Input	E-Stop Circuit ***
2	EDCrdy	EDCi ready signal, initialization successful and controller ready to start	24V-Output	100 mA*
3	InEstop1	Emergency-Stop sense 1, first channel	24V-Input	E-Stop Circuit ***
4	ManReset	Reset pulse (24V for 0.2s to 10s) for manual reset function	24V-Input	Ie=1.5mA @ 24V**
5	Estop1	Emergency-Stop output 1, first channel	24V-Output	E-Stop Circuit ***
6	ManResetAct	0V: manual reset deactivated 24V: manual reset activated	24V-Input	Ie=1.5mA @ 24V**
7	CMDon1	Command ON signal for external contactor, drive or valve, first channel	24V-Output	E-Stop Circuit ***
8	UpStop1	Upper limit switch, top mounted, first channel; connect to 9 if single channel	24V-Input	Ie=1.5mA @ 24V**
9	UpStop2	Upper limit switch, top mounted, second channel; connect to 8 if single channel	24V-Input	Ie=1.5mA @ 24V**
10	EDM	Input of relais test signal (External Device Monitoring)	24V-Input	Ie=1.5mA @ 24V**
11	MoveEnable	Input signal to enable move control, indicates “Hydraulic valve ready”; "0" holds position controlled by EDCi	24V-Input	Ie=1.5mA @ 24V**
12	CtrlEnable	Input signal to enable controller, indicates “Drive or Valve ready”; "0" switch off controller	24V-Input	Ie=1.5mA @ 24V**
13	Bypass	Opens bypass valve of hydraulic machine	24V-Output	100 mA*
14	ManResetReq	Manual reset required ManReset input necessary	24V-Output	100 mA*
15	ACMD	Command output ±10,0V for drive	Analogue output	100mA max.
16	GND	Ground	Ground	
17	GND	Ground	Ground	
18	EDCrdyCon1	EDCi ready signal, input	relais contact, 24 V	max. 1 A
19	GND	Ground	Ground	
20	EDCrdyCon2	EDCi ready signal, output	relais contact, 24 V	max. 1 A
21	GND	Ground	Ground	
22	+24VDC	Supply voltage	Supply	max. 0.5 A
23	GND	Ground	Ground	
24	n.c.			
25	RMC_Estop1	RMC Emergency-Stop input 1, first channel	24V-Input	E-Stop Circuit ***
26	SupEstop1	+24VDC E-Stop Circuit Supply	24V-Output	max. 0.7 A, short-circuit-proof

Pin	Name	Description	Signal Type	Limits
27	SupEstop2	+24VDC E-Stop Circuit Supply	24V-Output	max. 0.7 A, short-circuit-proof
28	RMC_Estop2	RMC Emergency-Stop input 2, second channel	24V-Input	E-Stop Circuit ***
29	n.c.			
30	AGND	Analogue-Ground (for nominal value output)	Analogue-Ground	
31	InCMDon2	Emergency-Stop input 2, second channel	24V-Input	E-Stop Circuit ***
32	LED	Output for LED showing status of EDC	24V-Output	100 mA*
33	InEstop2	Emergency-Stop sense 2, second channel	24V-Input	E-Stop Circuit ***
34	BrakeOpen	Opens brake of drive	24V-Output	100 mA*
35	Estop2	Emergency-Stop output 2, second channel	24V-Output	E-Stop Circuit ***
36	n.c.			
37	CMDon2	Command ON signal for external contactor, drive or valve, second channel	24V-Output	E-Stop Circuit ***
38	DCMD Data B+	Digital Command Output, B+	RS485, positive	120 Ohm terminated
39	DCMD Data B-	Digital Command Output B- / Direction- / Down–	RS485, negative	120 Ohm terminated
40	DCMD Data A+	Digital Command Output, A+	RS485, positive	120 Ohm terminated
41	DCMD Data A-	Digital Command Output A– / Pulse– / Up–	RS485, negative	120 Ohm terminated
42	DownStop1	Lower limit switch, bottom mounted, first channel; connect to 43 if single channel	24V-Input	Ie=1.5mA @ 24V**
43	DownStop2	Lower limit switch, bottom mounted, second channel; connect to 42 if single channel	24V-Input	Ie=1.5mA @ 24V**
44	CMDrdy	Output signal to enable drive / valve, indicates controller ready to start	24V-Output	100 mA*

Notes:

* The total sum of these output currents must not exceed 350mA.

** Low: Ue<1.0V, High: Ue>4.8V

*** E-Stop Circuit is powered by SupEstop (pin 26, 27).

26, 27	**SupEstop**	Supply of the E-Stop circuit; connect 25 to 26 and 27 to 28 for internal supply. Do not connect 25, 26 to 27, 28; safety monitoring of short circuit. For external supply of E-Stop circuit by safety PLC, channel 1 should be connected to 25, channel 2 to 28. 26 and 27 should not be connected. Set set-up parameter correctly.
10	**EDM**	Can be activated or de-activated by set-up parameter. Relay contact should be connected to +24 VDC. To start EDCi EDM should be "1" (24VDC).
8, 9, 42, 43	**Up/DownStop**	EDCi stops if one of the signals goes to logical "0" (open or 0 VDC). Can be activated or de-activated by set-up parameter.
2, 13	**EDCrdy/Bypass**	Former signal "pin14" splitted in two separate signals with individual pins.
2	**EDCrdy**	Set to logical “1” (+24VDC) if initialization of EDC was successful. Set to logical “0” if initialization error occurs, communication to PC is disconnected (in PC control), drive is **switched off by** position limits (_EstopUpDown, _UpStop, _DownStop) sensor Limit Control and Connector Control, Ctrl Deviation of Position Ctrl 0, IO Signals Miscellaneous. “Drive OFF” depends on set-up parameters. **Note:** RMC Emergency-Stop and external E-Stop do not affect EDCrdy!

5.1.6.3 EDCi Emergency-Stop Circuit

Following figures show various configurations of EDCi Emergency-Stop circuit at X4 drive interface, X40 drive box and X5 RMC. All signals have a voltage level of +24 VDC.

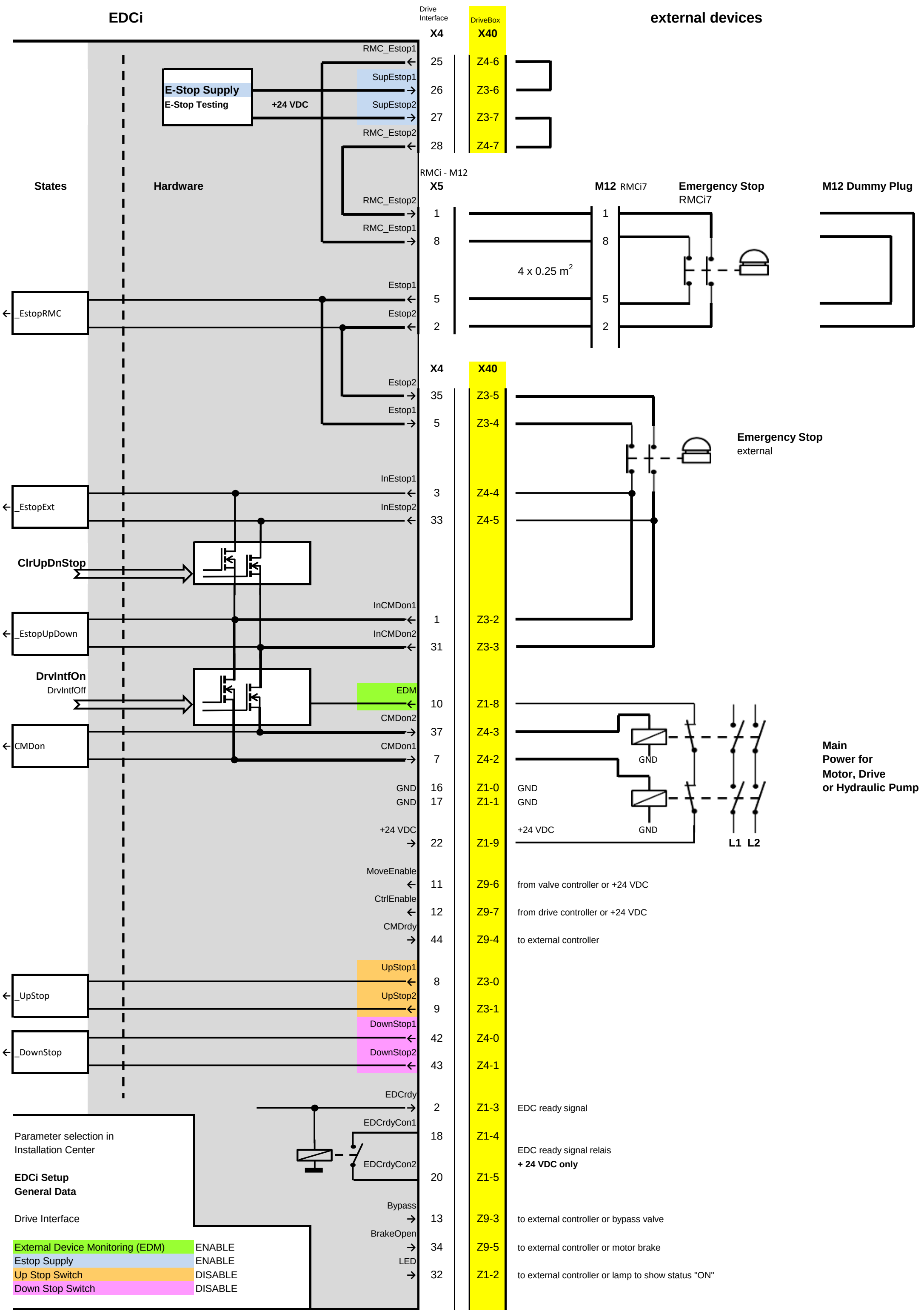


Fig. 96: EDCi Emergency-Stop Circuit: minimum configuration with Emergency-Stop but without position limit switches

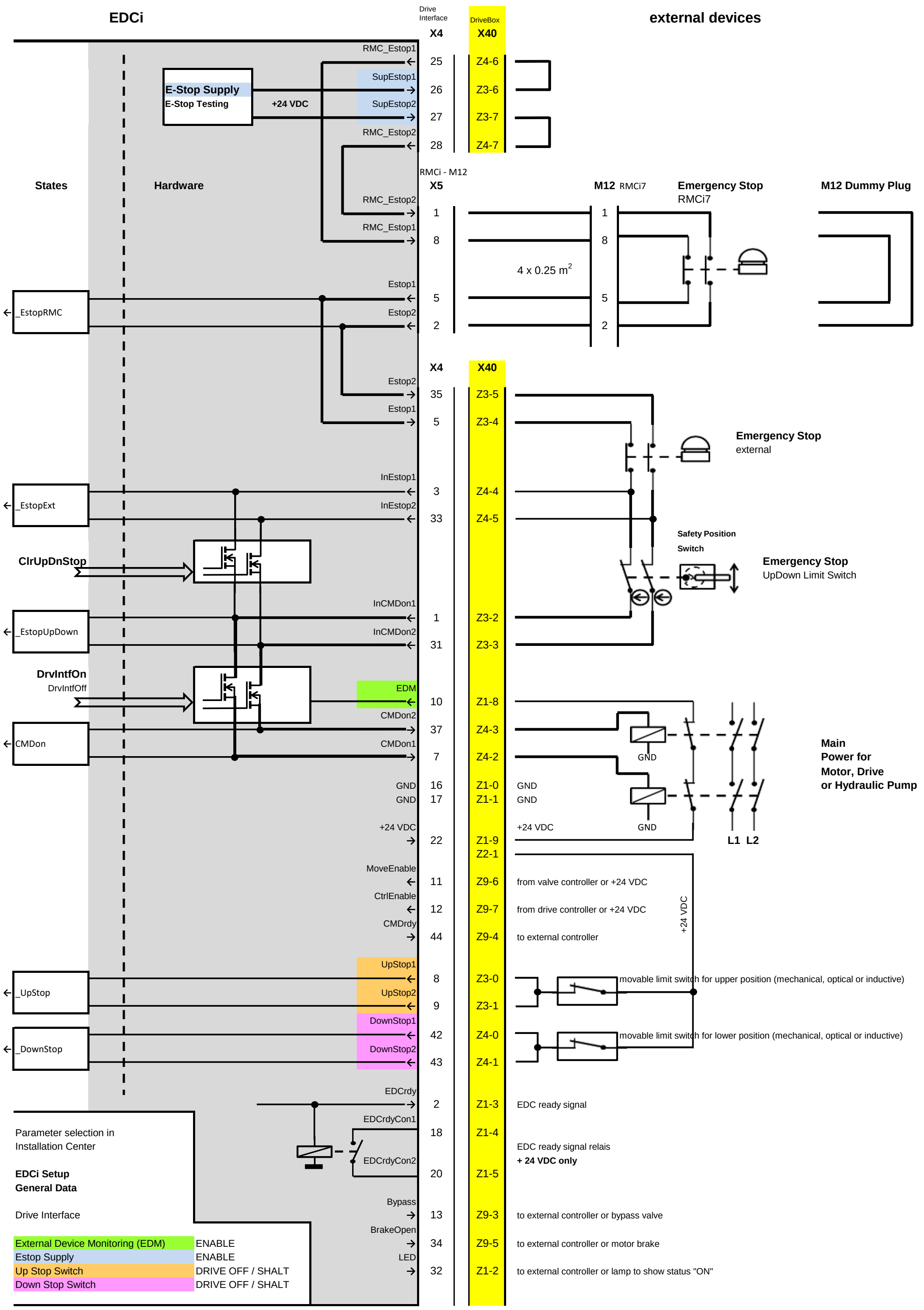


Fig. 97: EDCi Emergency-Stop Circuit: configuration with Emergency-Stop (RMCi7, external), safety position switch (UpDown Limit Switch) and movable position switches (not safe)

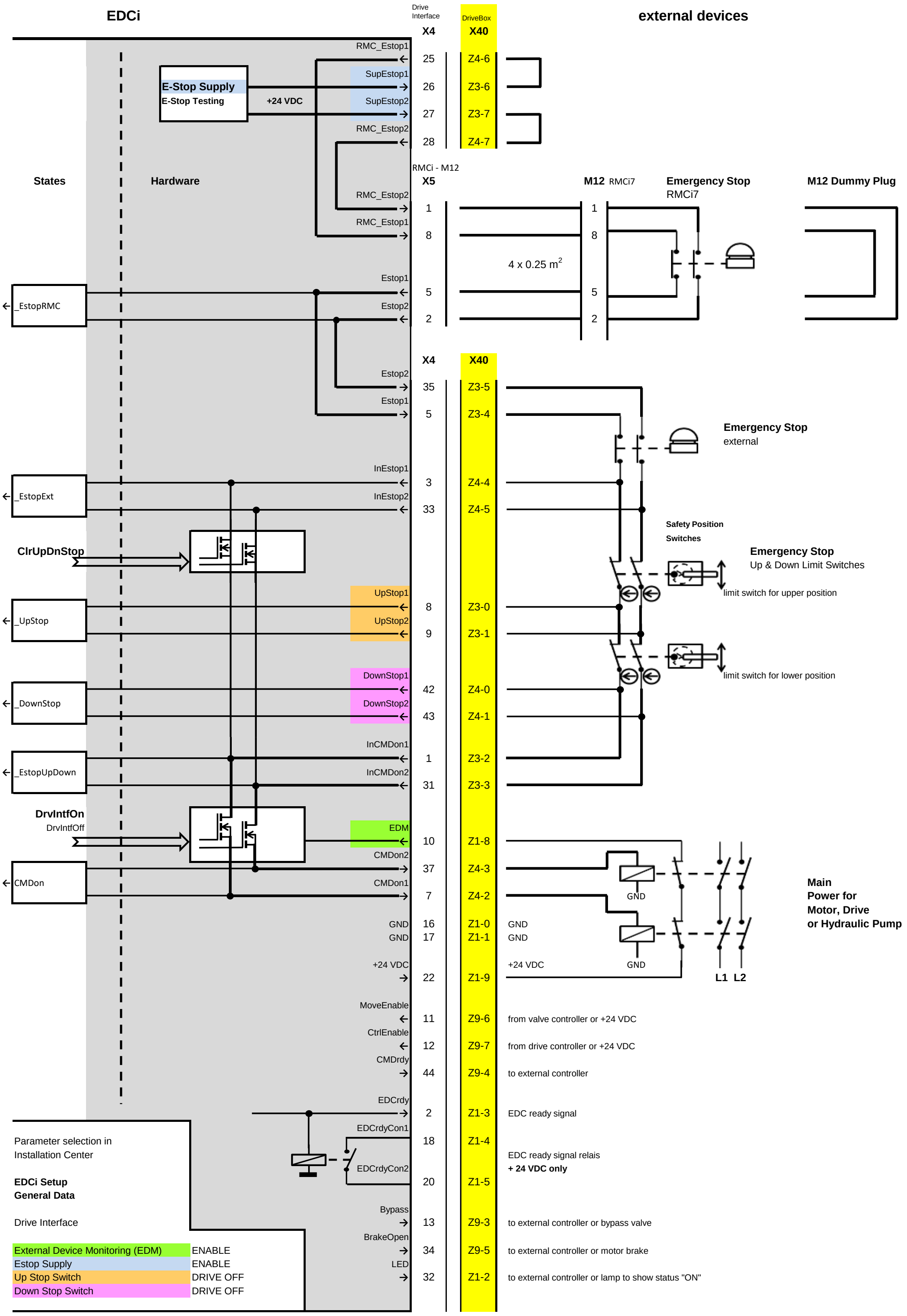


Fig. 98: EDCi Emergency-Stop Circuit: configuration with Emergency-Stop (RMCi7, external) and two safety position switches (Up and Down Limit Switches with identification via _UpStop and _DownStop)

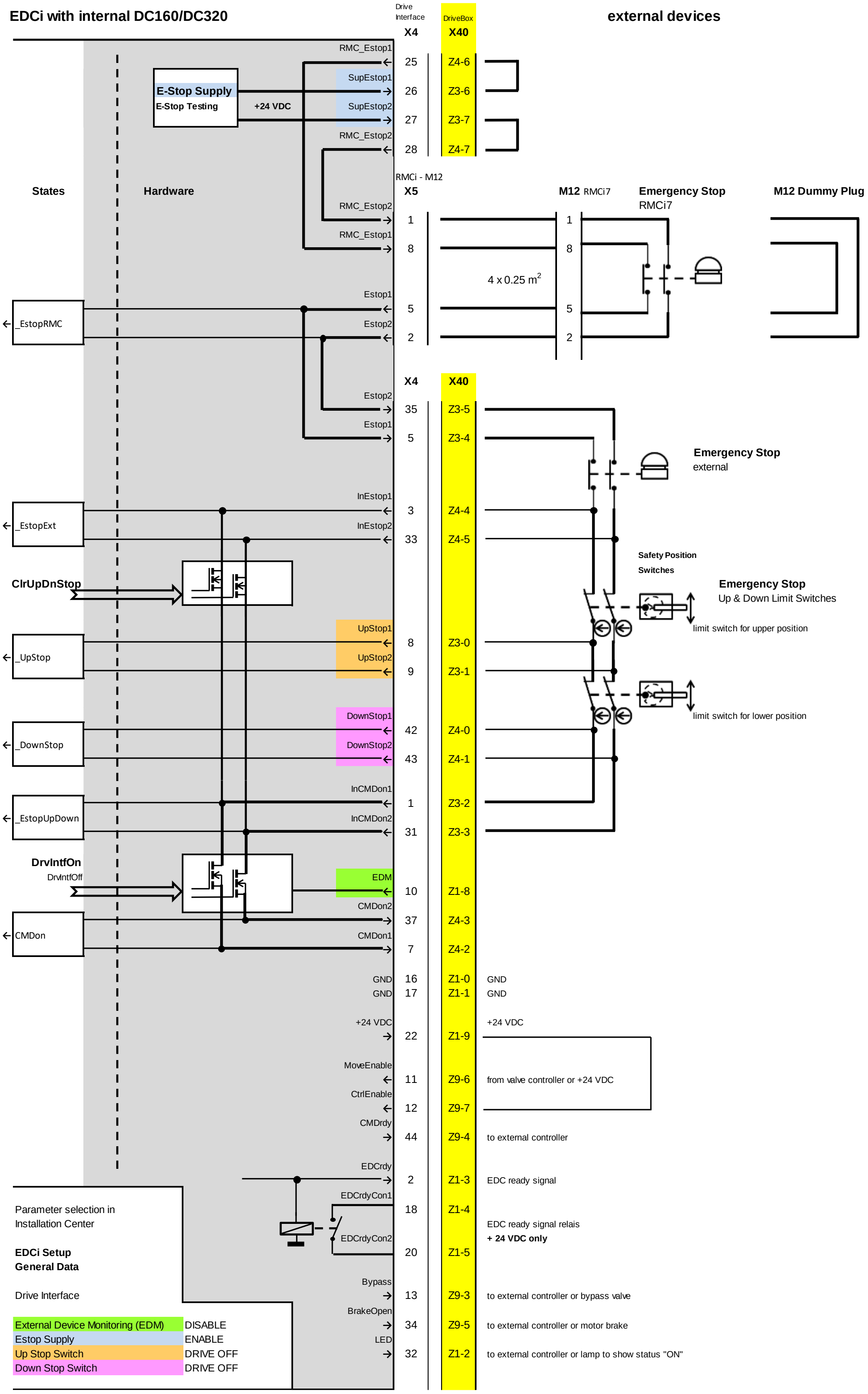


Fig. 99: EDCi Emergency-Stop Circuit: configuration with Emergency-Stop (RMCi7, external) and two safety position switches (Up and Down Limit Switches with identification via _UpStop and _DownStop) and internal drive amplifier DC160 / DC320

5.1.6.4 Setups to stop XHead automatically at defined positions

There are various configurations and setup parameters to stop XHEAD automatically. Electrical connections and linked setup parameters are shown in chapter 5.1.6.3.

Safe stop at defined positions is achieved by using electro-mechanical safety position switches – one or two – mounted at the machine in positions which must not be exceeded. Electrically these safety switches cause an emergency-stop (_EstopUpDown) and drive is switched off, too. Leaving this position after an emergency-stop is possible by using software instruction emergency move, Machine Control Panel of Installation Center or emergency move at RMC.

Stop at variable positions can be configured by using UpStop and DownStop signals at drive interface X4. Electro-mechanical, optical or inductive sensors can be used for this function. Setup parameter “General Data – Drive Interface – Up Stop / Down Stop Switch” activates or de-activates this function. When de-activated sensors must not be connected to drive interface (setup monitoring). All corresponding signals / pins (UpStop1/2 and DownStop1/2) must be set to logical “1” to move XHead. Parameters define different actions of this function: SHALT or Drive OFF.

IO Signals SHALT force XHead to stop at variable position, too (see chapter 3.8.6). Differences to UpStop and DownStop signals are that XHead stops with SHALT only and IO Signals SHALT must be set to logical “0” to move XHead. Electrical signals can be inverted by parameter.

In addition to these hardware solutions Sensor Limits (fixed in sensor EEPROM) and Soft Limits (set by software) restrict position of XHead, too.

5.1.7 X18 ±10V Command Output

Connector for 10V command output (e.g. Moog valve).

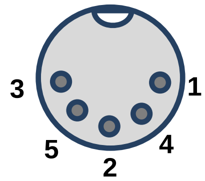


Fig. 100: 5-pin round DIN plug (female) (X18)

Table 42: Pin description ±10 Volt command output 5-pin round Din plug (female) (X18)

Pin	Name	Description
1	GND24	GND for 24 VDC supply
2	PE	Protective earth
3	+24V	+24 VDC supply
4	+10V	Analogue command output ±10V
5	AGND	Analogue ground

5.1.8 X18 Current command output

Connector of internal servo valve amplifier or internal DC power amplifier

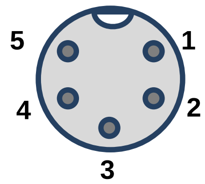


Fig. 101: 5-pin round DIN plug (female) (X18)

Table 43: Pin description current command output 5-pin round Din plug (female) (X18)

Pin	Name	Description
1, 2	+	Current +
3	PE	Protective earth
4, 5	-	Current -

5.1.9 X2 Universal-I/O

Eight outputs (24V) and eight inputs (24V) can be connected to the X2 Universal-I/O. The signals are not assigned to any function.

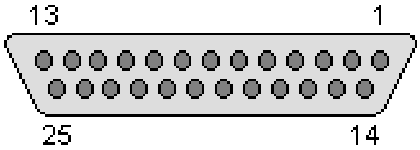


Fig. 102: 25-pin D-Sub plug (female) (X2)

Table 44: Pin description Universal-I/O 25-pin D-Sub plug (female) (X2)

Pin	Name	Function	Signal Type
1	GND-ext.	Shield (case) + digital-ground	
2	IN1	Input 1	Ie=1.9mA @ 24V
3	IN3	Input 3	Ie=1.9mA @ 24V
4	IN5	Input 5	Ie=1.9mA @ 24V
5	IN7	Input 7	Ie=1.9mA @ 24V
6	GND-ext.	GND for 24V-supply	
7	OUT1	Output 1	100 mA*
8	OUT3	Output 3	100 mA*
9	OUT5	Output 5	100 mA*
10	OUT7	Output 7	100 mA*
11	n.c.		
12	+5VDC	Supply voltage	50mA max.
13	+24VDC	Supply voltage	100mA max**
14	IN0	Input 0	Ie=1.9mA @ 24V
15	IN2	Input 2	Ie=1.9mA @ 24V
16	IN4	Input 4	Ie=1.9mA @ 24V
17	IN6	Input 6	Ie=1.9mA @ 24V
18	GND-ext.	GND for 24V-supply	
19	OUT0	Output 0	100 mA*
20	OUT2	Output 2	100 mA*
21	OUT4	Output 4	100 mA*
22	OUT6	Output 6	100 mA*
23	n.c.		
24	GND-ext.	GND for 24V-supply	
25	+24VDC	Supply voltage	100mA max**

Notes:

* The total sum of the output currents must not exceed 350mA.
Consider power supply capabilities of the complete EDCi-System.

** The total sum of the output currents at +24VDC must not exceed 100mA.

Input: Low: Ue<1.0V, High: Ue>4.8V

5.1.10 X5 RMC

X5 is a female plug for external keyboards (RMC). Besides a RS485 for data communication, the emergency off circuit is connected here also.

Attention: **In case of no RMC is connected to the X5, a dummy plug with shortened pins 1 and 2, as well as pins 5 and 8 will be needed, otherwise the emergency off circuit is always opened and it is not possible to switch on the drive.**

Up to four RMC devices are supported by the EDC. In case of using more than one RMC, a RMC-hub is needed.

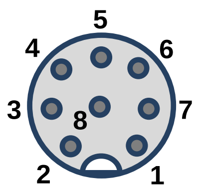


Fig. 103: 8-pin M12 plug (female) (X5)

Table 45: Pin description external keyboard, 8-pin M12 plug (female) (X5)

Pin	Name	Description
1	SupEstop2	Emergency Stop 2 Supply
2	Estop2	Emergency Stop 2
3	A+	Data Rx/Tx +
4	B-	Data Rx/Tx -
5	Estop1	Emergency Stop 1
6	GND	Ground
7	24V	Supply for RMC, max 200mA
8	SupEstop1	Emergency Stop 1 Supply

5.1.11 X11 / X12 Synchronization of several EDCs

This option is needed for synchronization of data acquisition and motion control amongst several EDC systems. All necessary signals are transmitted via a serial RS485 bus. Up to 8 EDC units may be connected to this bus. The master EDC generates the basic system clock **System Time** and additional signals.

The following setup parameters must be set in a correct manner:

- **General Data: Sync Option**:
  No Sync Option synchronization disabled
  SYNC MASTER for one Master EDC
  SYNC SLAVE for all other Slave EDCs

- **Machine data: System Time** and **Data Transmission Rate** must be set to the same value for all EDCs.

After all EDCs are switched on (power-on), only the LED of the Master EDC should be on! Correctly working synchronization can be monitored at EDC states; see chapter 7.3.5.

Two further setup parameters activate the functions Synchronized Stop and Synchronized Drive On/Off:

- General Data: Sync Option:
  Sync Stop **DISABLE**
  Disabled
  DRIVE_OFF
  In case of emergency stop or supervision of limit control, connector control and deviation (parameter DRIVE_OFF) a Drive Off command will be transmitted to all synchronized EDCs and they switch off, too.
  SHALT
  Same function as above but EDC will go to SHALT and does not switch off.
- General Data: Sync Option:
  Sync Drive On/Off **DISABLE**
  Disabled
  ENABLE
  Switching Drive On or Drive Off at one EDC by RMC or PC will transmit the command ON/OFF to all synchronized EDCs and they switch on or off, too.

The following figure shows the wiring between several EDCs. Connect X11 to X12 around in a ring.

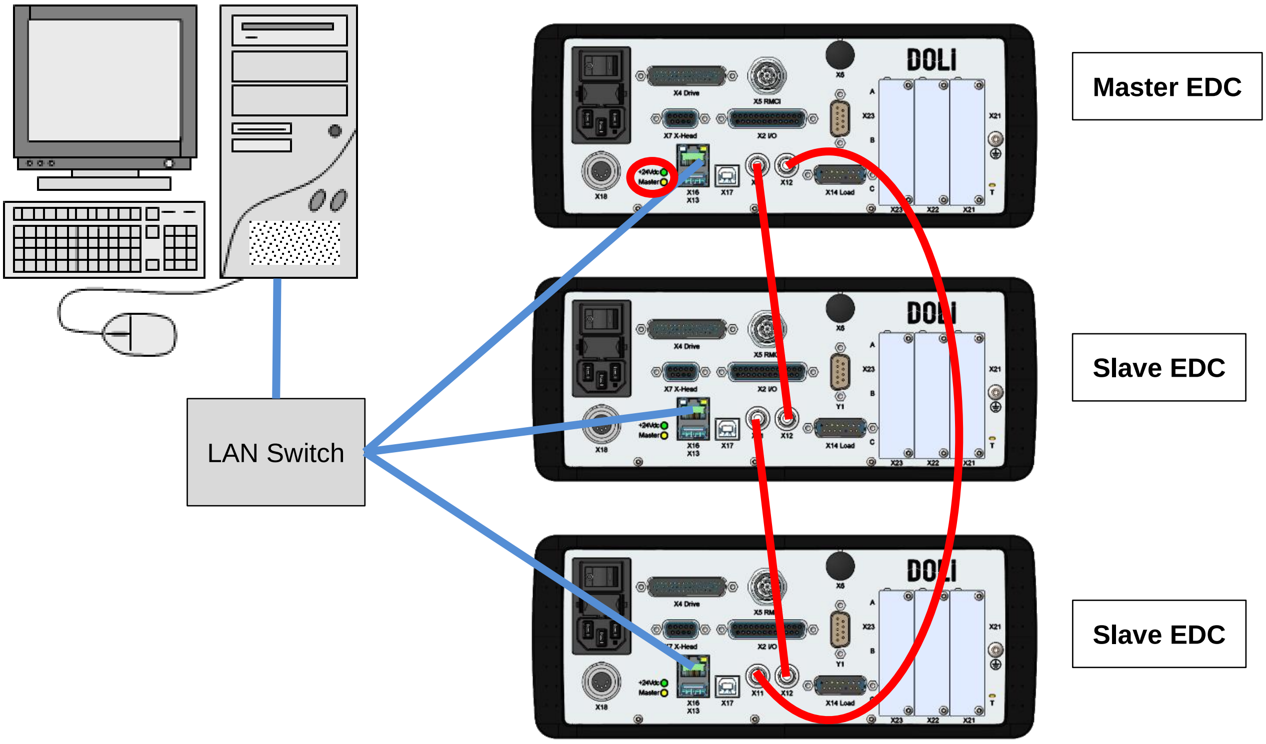


Fig. 104: Synchronization of several EDCs (wiring)

5.1.12 Y1 Communication interface for serial sensors

Features:

- Interface for serial sensors: temperature controller, extensometer
- Signal type: RS232 or RS485
- Baud rate: max. 115.2 kBaud
- Protocol, data bit and baud rate setup via DOLI Installation Center. Use sensor connectors X62A to X62D

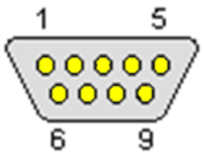


Fig. 105: 9-pin D-Sub plug (male) (Y1).

Table 46: Pin description RS232 interface, 9-pin D-Sub plug (male) (Y1)

Pin	Name	Function	Signal Type
1	n.c.		
2	RxD	Data receive	RS232
3	TxD	Data transmit	RS232
4	n.c.		
5	GND	Ground	Ground
6	n.c.		
7	n.c.		
8	n.c.		
9	n.c.		

Table 47: Pin description RS485 interface, 9-pin D-Sub plug (male) (Y1)

Pin	Name	Function	Signal Type
1	TRX-A	Data half duplex	RS485, positive
2	n.c.		
3	n.c.		
4	n.c.		
5	GND	Ground	Ground
6	TRX-B	Data half duplex	RS485, negative
7	n.c.		
8	n.c.		
9	n.c.		

5.2 iSI Option Slots

The EDCi has several iSI option slots available for additional interface boards iSI Modules.

5.2.1 iCFA

The iCFA is a carrier frequency amplifier (CF 5 kHz) with 24Bit A/D conversion especially for extension gauge and inductive transducers (LVDT). The modules allow DC excitation and DC signal input, also.

Table 48: iCFA Excitation, amplification and conversion characteristics

Excitation and Amplifier	
Excitation (carrier frequency)	AC (5kHz Sinusoidal, phase locked) or DC
Supply voltage adjustable via software (V_{eff})	0.9 or 7 VAC; 1.25 or 10 VDC
Transducer sensitivity adjustable via software	0.08 mV/V – 1.36 V/V (excitation 10V) 0.66 mV/V – 10.88 V/V (excitation 1.25V)
DC input sensitivity adjustable via software	0.83 mV – 13.6 V
Minimum resistance transducer	≥ 85 Ω
Source resistance signal source (CF operation)	≤ 1.1 kΩ
Source resistance external reference (CF operation)	≤ 1.1 kΩ
Input resistance (DC measurement)	> 1 GΩ
Common mode range	± 10 V
Common mode suppression	140 dB
Converter	
Technology	24Bit ADC
Resolution at DoPE interface	± 10,000,000 points
SNR (signal-to-noise ratio) without sensor at 2 mV/V input range	86 dB @ 0.1 ms filter time 96 dB @ 1 ms filter time 107 dB @ 20 ms filter time
Linearity of amplifier and converter	typical 0.01% (0.025%max)
Temperature influence per °Kelvin (CF measurement)	4 ppm/K temperature drift (continuous temperature compensation

Attention! **It is very important to switch off the electrical supply of the EDC before attempting to remove any plug, in order to prevent possible damage, caused by high voltages, which can be generated, when an energized inductive transducer is disconnected.**

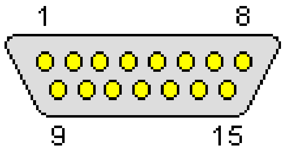


Fig. 106: iCFA 15-pin D-Sub plug (male)

Table 49: Pin description iCFA 15-pin D-Sub plug (male)

Pin	Name	Function	Signal Type
1	GND-ext.	Shield (case) + DGND	
2	SDA	I2C-data	5V tolerant
3	SCL	I2C-clock	5V tolerant
4	KE	Calibration enable	Low active, internal pull up (3.3V)
5	Signal-A	Measuring signal A	
6	Signal-B	Measuring signal B	
7	Sense-B	Supply remote sense B	Connect to Excit -B
8	Excit-A	Supply A	
9	R-Ref. B	External reference B	
10	CON	Sensor connected	Low active, internal pull up (3.3V)
11	5V-SW	+5V VDC	20mA max.
12	AGND	Analogue ground	
13	R-Ref. A	External reference A	
14	Excit-B	Supply B	
15	Sense-A	Supply remote sense A	Connect to Excit -A

5.2.2 iDCA

The iDCA module is a measuring amplifier for analog sensors. It provides a (10V) DC Excitation for strain gauge transducers.

Excitation:

Voltage:	10 Volt DC, 60 mA
Minimum bridge impedance:	170 Ohm
Bridge circuit:	10 Volt Full bridge, supplied asymmetrically

Measurement:

Measurement input range:	1.18 mV/V to 1.2 V/V (excitation 10 V), 11.8 mV to 12V
Input impedance:	>1 GΩ (DC measurement)
Technology:	24Bit ADC
Resolution:	10,000,000 points at DoPE interface
SNR:	81 dB @ 0.1 ms filter time 91 dB @ 1 ms filter time 104 dB @ 20 ms filter time
Total linearity:	Typical 0.01, max 0.025%

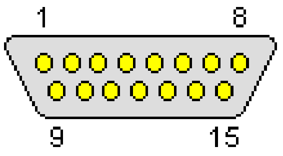


Fig. 107: iDCA 15-pin D-Sub plug (male)

Table 50 : Pin description iDCA 15-pin D-Sub plug (male)

Pin	Name	Function	Signal Type
1	GND-ext.	Shield (case) + DGND	
2	SDA	I2C-data	5V tolerant
3	SCL	I2C-clock	5V tolerant
4	KE	Calibration enable	Low active, internal pull up (3.3V)
5	Signal-A	Measuring signal A	
6	Signal-B	Measuring signal B	
7	Sense-B	Supply remote sense B	Connect to Excit -B
8	Excit-A	Supply A	
9	R-Ref. B	External reference B	
10	CON	Sensor connected	Low active, internal pull up (3.3V)
11	5V-SW	+5V VDC	20mA max.
12	AGND	Analogue ground	
13	R-Ref. A	External reference A	
14	Excit-B	Supply B	
15	Sense-A	Supply remote sense A	Connect to Excit -A

5.2.3 iINC

The iINC module provides the EDC with two incremental measuring channels and four digital I/Os.

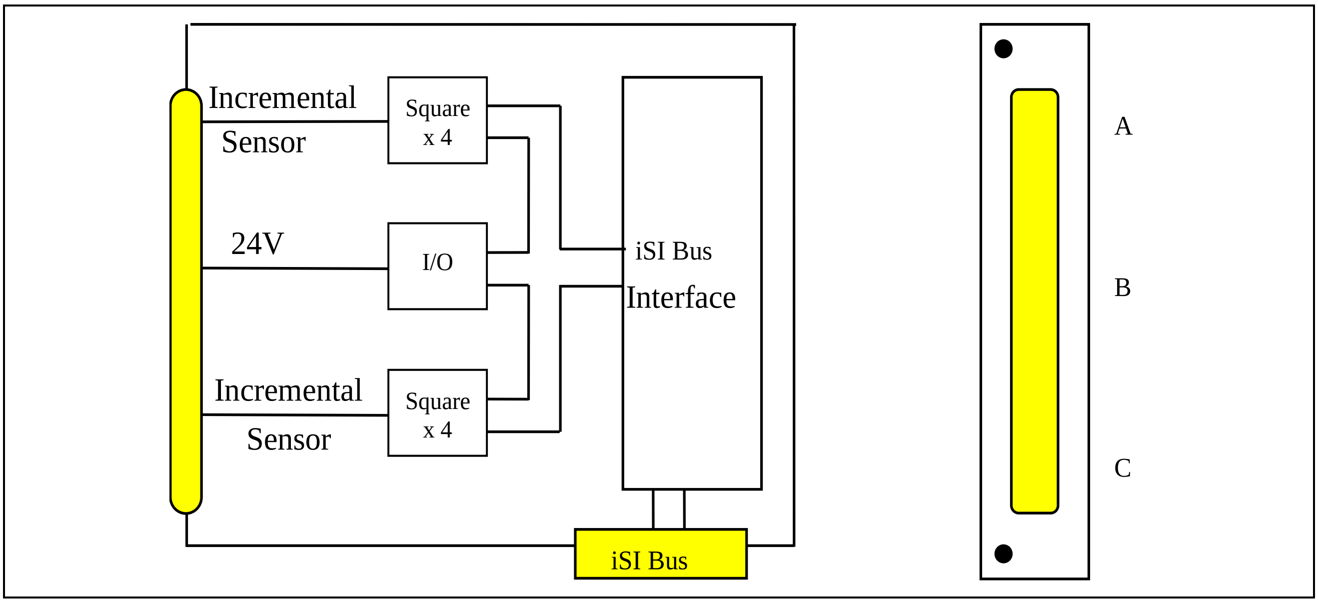


Fig. 108: iINC block diagram with connector assignment

5.2.3.1 Incremental inputs

The interface board has two incremental inputs each having the following specification:

- Transducer supply: +5 VDC (max. 250 mA) for encoder type transducer, 24 VDC for SSI Sensors
- Input level: Rectangle / TTL,
  Connecting a sensor plug per channel adapts the incremental transducer level (e.g. 1000661 SGS_4ISU2 - Sensor plug for two sine transducers with tenfold analogue resolution).
- Evaluation: Using the trace signals A and B, the resolution is digitally increased by factor 4 and the counting direction (up/down) is detected.
- Frequency: Encoder: A/B signal frequency max 8 MHz (counting frequency max 32 MHz)
  SSI-Input: max. 300 kHz
- Transducer ID: One I2C-Bus per channel, connected to an EEPROM inside the sensor plug

5.2.3.2 Digital Inputs

Four separate digital inputs are fitted on the interface board, each having the following specification:

- Low level: < +1.8 VDC
- High level: +9 V to +30 VDC

5.2.3.3 Digital Outputs

Four digital outputs are fitted on the interface board, each having the following specification:

- Driver components: with automatic shut-off at a short circuit condition
- Type: open emitter, +24 VCD (internal voltage supply)
- Low level: open output
- High level: +22 to +24 VDC/100 mA

5.2.3.4 Pin description

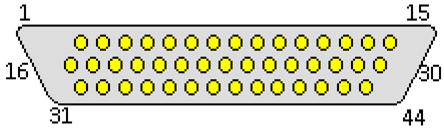


Fig. 109: iINC 44-pin D-Sub plug (male)

Table 51: Pin description iINC 44-pin D-Sub plug (male)

Pin	Name	Function	Signal Type
1	R0	Incr. Transducer ref-input 0	TTL
2	B0	Incr. Transducer trace B-input 0	TTL
3	SCL0	I2C-Bus Clock 0	5V tolerant
4	/CON0	Transducer 0 connected	Low active, internal pull up (3.3V)
5	GND		
6	n.c.		
7	GND		
8	+24VDC	Supply voltage	100mA max.
9	n.c.		
10	R1	Incr. Transducer ref-input 1	TTL
11	B1	Incr. Transducer trace B-input 1	TTL
12	SCL1	I2C-Bus Clock 1	5V tolerant
13	/CON1	Transducer 1 connected	Low active, internal pull up (3.3V)
14	GND		
15	GND		
16	GND		
17	+5V	5V Supply voltage, 20mA max.	
18	A0	Incr. Transducer trace A-input 0	TTL
19	SDA0	I2C-Bus data 0	
20	/KE0	SSI power supply Ch0	+24V 150mA in SSI mode
21	d.n.c.	reserved	Do not connect
22	Out3	Digital output, +24 VDC	100 mA*
23	Out2	Digital output, +24 VDC	100 mA*
24	Out1	Digital output, +24 VDC	100 mA*
25	Out0	Digital output, +24 VDC	100 mA*
26	+5VDC	5VDC Supply voltage	250mA max.
27	A1	Incr. Transducer trace A-input 1	TTL
28	SDA1	I2C-Bus data 1	
29	/KE1	SSI power supply Ch1	+24V 150mA in SSI mode
30	d.n.c.	reserved	Do not connect
31 - 35	n.c.		
36	IN3	Digital input, +24 VDC	Ie=1.5mA @ 24V
37	IN2	Digital input, +24 VDC	Ie=1.5mA @ 24V
38	IN1	Digital input, +24 VDC	Ie=1.5mA @ 24V
39	IN0	Digital input, +24 VDC	Ie=1.5mA @ 24V
40 - 44	n.c.		

Notes:

The total sum of the output currents must not exceed 350 mA excluding the +24 VDC supply. Consider power supply capabilities of the complete EDCi-System.

Input: Low: Ue < 1.0 V, High: Ue > 4.8 V

5.2.4 iINCX

The iINCX module provides the EDC with two incremental measuring channels and a RS485 serial communication interface to MFX extensometers. Additionally four digital I/Os can be used for external controlling.

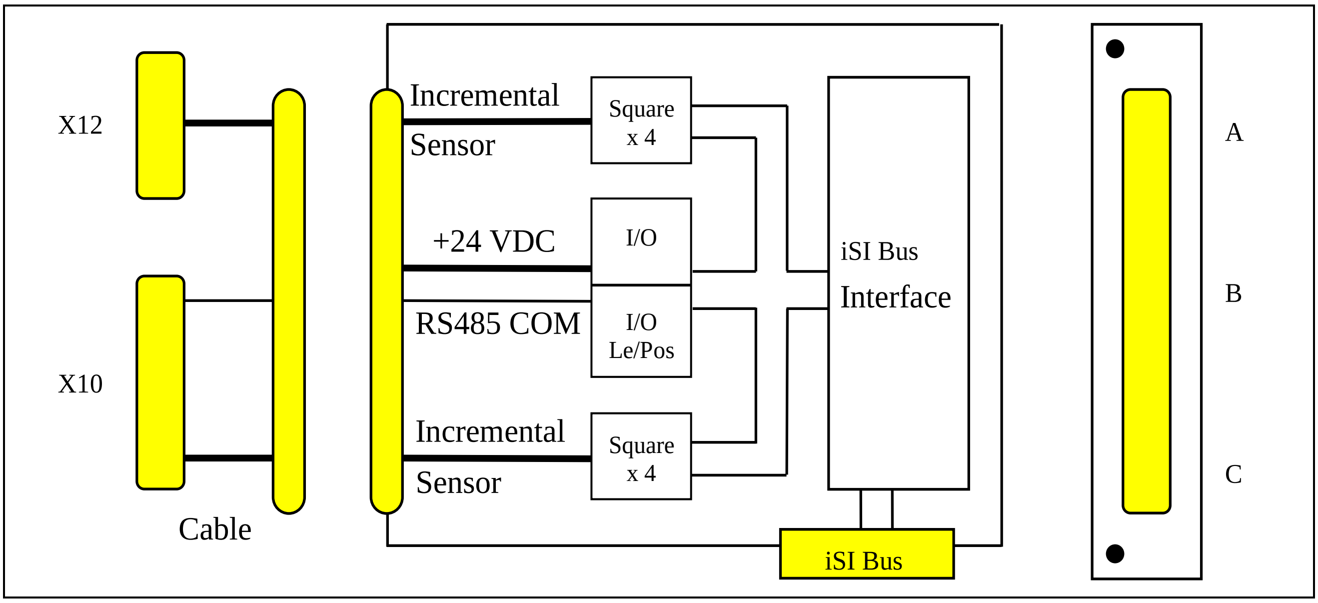


Fig. 110: iINCX block diagram with cable and connector assignment

5.2.4.1 Incremental inputs

The interface board has two incremental inputs each having the following specification:

- Transducer supply: +5 VDC (max. 250 mA) for encoder type transducer, 24 VDC for SSI Sensors
- Input level: Rectangle / TTL,
  Connecting a sensor plug per channel adapts the incremental transducer level (e.g. 1000661 SGS_4ISU2 - Sensor plug for two sine transducers with tenfold analogue resolution).
- Evaluation: Using the trace signals A and B, the resolution is digitally increased by factor 4 and the counting direction (up/down) is detected.
- Frequency: Encoder: A/B signal frequency max 8 MHz (counting frequency max 32 MHz)
  SSI-Input: max 300 kHz
- Transducer ID: One I2C-Bus per channel, connected to an EEPROM inside the sensor plug

5.2.4.2 Digital Inputs/Outputs via RS485 serial communication

All digital inputs and outputs of the iINCX module are located on connector B. The table below shows the assignment of the I/O signals to the bit device which must be configured in EDC setup. Bit 0 to 3 of BitIn and BitOut are assigned to electrical + 24 VDC in- and outputs at the connector. The logic levels of all other bits are transmitted via RS485 serial communication interface to a connected MFX extensometer. For detailed description of the signals see MFX500 manual.

Table 52: BitIn/BitOut signal description of iINCX

Bit	BitIn Signal	BitOut Signal
0	Digital input 0	Digital output 0
1	Digital input 1	Digital output 1
2	Digital input 2	Digital output 2
3	Digital input 3	Digital output 3
4	MFX online (communication established)	MFX connect (request for serial communication)
5	MFX test (measurement active)	MFX start (corresponds to button S1 of MFX)
6	MFX upper move (upper arm is moving)	MFX stop (corresponds to button S2 of MFX)
7	MFX lower move (lower arm is moving)	MFX Le/Pos (corresponds to button S3 of MFX)
8	Error of digital outputs (e.g. short circuit)	Used internally
9	MFX communication error	Used internally
10 - 15	Used internally	Used internally

Logic level 1 corresponds to active signal or pushed button.

5.2.4.3 Digital positioning Le/Pos via RS485 serial communication

For automatic testing procedures the measurement arms of MFX extensometer must be set to defined positions. MFX extensometer has two signals for positioning, Le and Pos. The iINCX module provides values for the signals Le and Pos by using and setting output channels.

Configure output channel 1 for upper measurement arm and output channel 2 for lower one in EDC setup.
Set output value in percentage corresponding to the input voltage of MFX from -10 to +10 VDC.
Set bit **MFX start** and the arm will automatically take their position.

The bit and values of Le and Pos are transmitted via RS485 serial communication interface to a connected MFX extensometer. For detailed description of positioning see MFX500 manual.

5.2.4.4 Digital Inputs

Four separate digital inputs are fitted on the interface board, each having the following specification:

- Low level: < +1.8 V
- High level: +9 V to +30 V

For setup see table above.

5.2.4.5 Digital Outputs

Four digital outputs are fitted on the interface board, each having the following specification:

- Driver components: with automatic shut-off at a short circuit condition
- Type: open emitter, +24 VCD (internal voltage supply)
- Low level: open output
- High level: +22 to +24 VDC/100 mA

For setup see table above.

5.2.4.6 Pin description

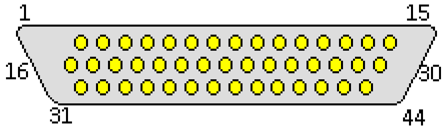


Fig. 111: iINCX 44-pin D-Sub plug (male)

Table 53: Pin description iINCX 44-pin D-Sub plug (male)

Pin	Name	Function	Signal Type
1	R0	Incr. Transducer ref-input 0	TTL
2	B0	Incr. Transducer trace B-input 0	TTL
3	SCL0	I2C-Bus Clock 0	5V tolerant
4	/CON0	Transducer 0 connected	Low active, internal pull up (3.3V)
5	GND		
6	n.c.		
7	GND		
8	+24VDC	Supply voltage	100 mA max.
9	n.c.		
10	R1	Incr. Transducer ref-input 1	TTL
11	B1	Incr. Transducer trace B-input 1	TTL
12	SCL1	I2C-Bus Clock 1	5V tolerant
13	/CON1	Transducer 1 connected	Low active, internal pull up (3.3V)
14	GND		
15	GND		
16	GND		
17	+5V	5V Supply voltage, 20mA max.	
18	A0	Incr. Transducer trace A-input 0	TTL
19	SDA0	I2C-Bus data 0	
20	/KE0	SSI power supply Ch0	+24V 150mA in SSI mode
21	d.n.c.	reserved	Do not connect
22	Out3	Digital output, +24 VDC	100 mA*
23	Out2	Digital output, +24 VDC	100 mA*
24	Out1	Digital output, +24 VDC	100 mA*
25	Out0	Digital output, +24 VDC	100 mA*
26	+5VDC	5VDC Supply voltage	250 mA max.
27	A1	Incr. Transducer trace A-input 1	TTL
28	SDA1	I2C-Bus data 1	
29	/KE1	SSI power supply Ch1	+24V 150mA in SSI mode
30	d.n.c.	reserved	Do not connect
31 - 35	n.c.		
36	IN3	Digital input, +24 VDC	Ie=1.5mA @ 24V
37	IN2	Digital input, +24 VDC	Ie=1.5mA @ 24V
38	IN1	Digital input, +24 VDC	Ie=1.5mA @ 24V
39	IN0	Digital input, +24 VDC	Ie=1.5mA @ 24V
40 - 42	n.c.		
43	TRX-B	Data half duplex	RS485, negative
44	TRX-A	Data half duplex	RS485, positive

Notes:

* The total sum of the output currents must not exceed 350 mA excluding the +24 VDC supply. Consider power supply capabilities of the complete EDCi-System.

Input: Low: Ue < 1.0 V, High: Ue > 4.8 V

5.2.5 iIO

Eight outputs (24V) and eight inputs (24V) can be connected to the iIO universal I/Os.

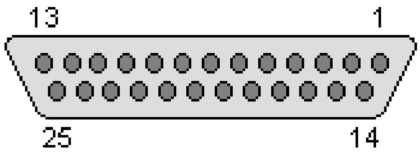


Fig. 112: iIO 25-pin D-Sub plug (female)

Table 54: Pin description iIO 25-pin D-Sub plug (female)

Pin	Name	Function	Signal Type
1	GND		
2	IN1	Digital input	Ie=1.5mA @ 24V
3	IN3	Digital input	Ie=1.5mA @ 24V
4	IN5	Digital input	Ie=1.5mA @ 24V
5	IN7	Digital input	Ie=1.5mA @ 24V
6	GND		
7	OUT1	Digital output	100 mA*
8	OUT3	Digital output	100 mA*
9	OUT5	Digital output	100 mA*
10	OUT7	Digital output	100 mA*
11	n.c.		
12	n.c.		
13	+24VDC	Supply voltage	100mA max**
14	IN0	Digital input	Ie=1.5mA @ 24V
15	IN2	Digital input	Ie=1.5mA @ 24V
16	IN4	Digital input	Ie=1.5mA @ 24V
17	IN6	Digital input	Ie=1.5mA @ 24V
18	GND		
19	OUT0	Digital output	100 mA*
20	OUT2	Digital output	100 mA*
21	OUT4	Digital output	100 mA*
22	OUT6	Digital output	100 mA*
23	n.c.		
24	GND		
25	+24VDC	Supply voltage	100mA max**

Notes:

* The total sum of the output currents must not exceed 350 mA excluding the +24 VDC supply. Consider power supply capabilities of the complete EDCi-System.

** The total sum of the output currents at +24 VDC must not exceed 100mA.

Input: Low: Ue < 1.0 V, High: Ue > 4.8 V

5.2.6 iADA

The iADA-Module provides the EDC with the following:

- Four ±10 Volt analogue output signals with 16 bit resolution. The output channels provide the function of a scaled output of assigned measuring channels.
- Four ±10 Volt analogue input channels with 24 bit resolution.

5.2.6.1 Pin description

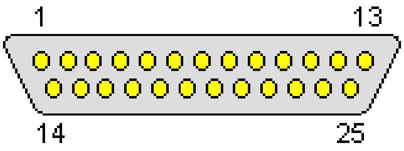


Fig. 113: iADA 25-pin D-Sub plug (male)

Table 55: Pin description iADA 25-pin D-Sub plug (male)

Pin	Name	Function	Signal Type
1	n.c.		
2	n.c.		
3	n.c.		
4	n.c.		
5	AD_A 10V	input ±10 Volt analogue channel A	Rin = 10MegOhm
6	AD_B 10V	input ±10 Volt analogue channel B	Rin = 10MegOhm
7	AD_C 10V	input ±10 Volt analogue channel C	Rin = 10MegOhm
8	AD_D 10V	input ±10 Volt analogue channel D	Rin = 10MegOhm
9	DA_AB GND	output GND for analogue channel A and B	
10	DA_B	output ±10 Volt analogue channel B	20mA maximum Load
11	DA_D	output ±10 Volt analogue channel D	20mA maximum Load
12	DA_CD GND	output GND for analogue channel C and D	
13	+24VDC	Supply Voltage	100mA max.
14	n.c.		
15	n.c.		
16	n.c.		
17	n.c.		
18	+5VDC	Supply Voltage e.g. for Poti	50mA max.
19	AGND	Analog GND for +5VDC sensor supply	
20	AD_AB GND	input GND (±10 Volt) analogue channel A and B	
21	AD_CD GND	input GND (±10 Volt) analogue channel C and D	
22	DA_A	output ±10 Volt analogue channel A	20mA maximum Load
23	DA_C	output ±10 Volt analogue channel C	20mA maximum Load
24	CON	Sensor connected	Low active, internal pull up (3.3V)
25	GND	output GND (24 Volt)	

CON-Bit (Pin 24)

The CON-Bit must be shorted with GND (pin 25). It is used to detect that the connector is connected.

Analogue output (DA_A, DA_B, DA_C, DA_D)

The nominal output voltage is ±10V; the smallest voltage step is approximately 400µV.

Analogue input (AD_A, AD_B, AD_C, AD_D)

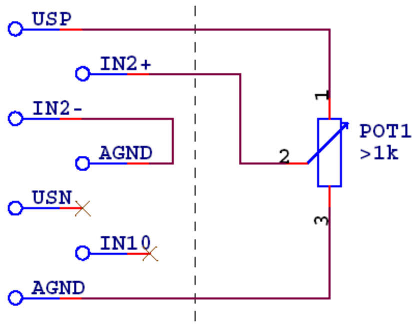
Each analogue input can handle ±10V.

Table 56: Assignment of input pins to different input signals.

Signal	Pin	Description
10V Input	IN10 AGND	The nominal input voltage is ±10V. Load > 10k

Potentiometer: The high impedance is designed for potentiometric connection, also.

USP	Supply voltage +5V DC
IN2+	Input for potentiometer, e.g. AD_x
IN2-	Connect with AD_x_GND
AGND	Supply voltage



5.2.6.2 Technical Data

Table 57: Technical data iADA.

Data	Description
Environmental temperature:	0 to +45°C
Relative humidity:	5 to 95% non-condensing
Supply voltage:	24V= / 0,1A supply for external devices
/CON-Bit:	Input TTL-level • Low: "connected"
Analogue inputs:	AD-converter 24 Bit • Input range ±10V
Analogue outputs:	DA- converter 16 Bit • Output range ±10V

5.2.6.3 EDC Setup

Select the connector number depending on the iSI slot (X21…X28).

Table 58: Assignment of iADA Devices

Device	Channel	Init value
Analogue input:	A e.g. X21A B e.g. X21B C e.g. X21C D e.g. X21D	0 for ±10V Range
Analogue output:	A e.g. X21A B e.g. X21B C e.g. X21C D e.g. X21D	-

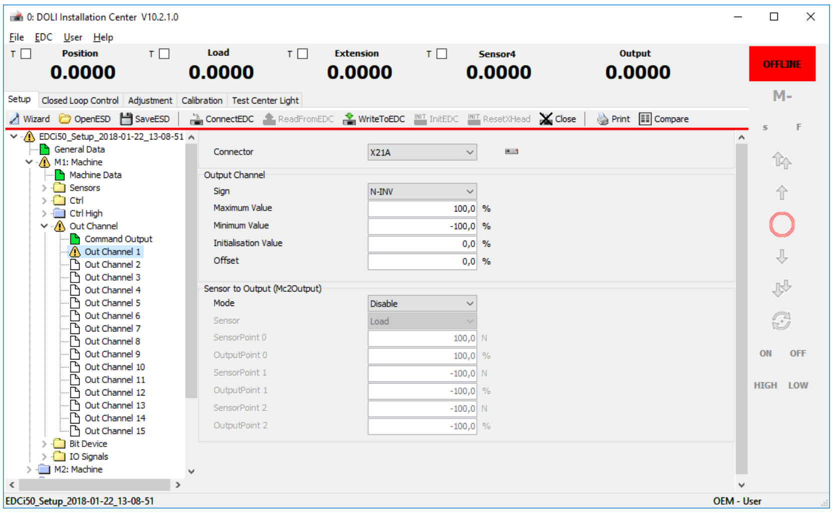


Fig. 114: EDC Setup example of a iADA analogue output at X21A ±10V

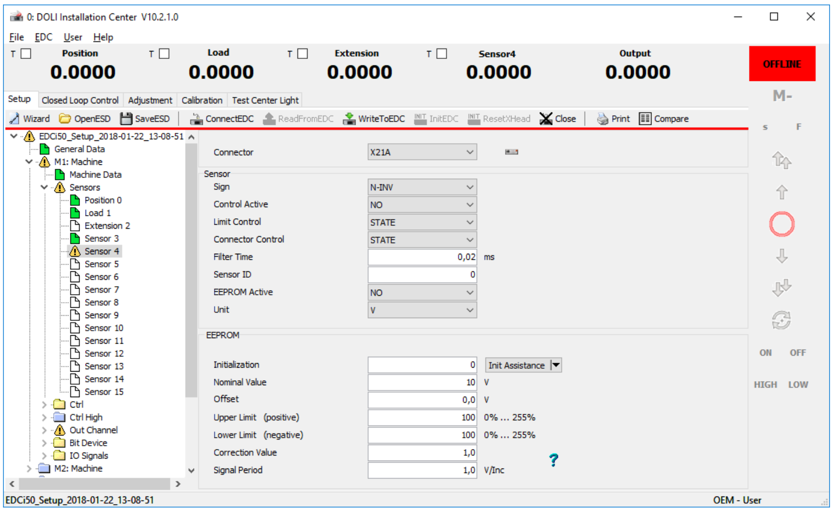


Fig. 115: EDC Setup example of a iADA analogue input at X21A ±10V

5.2.6.4 iADA Distribution Plug

The iADA distribution plug can be used to make wiring easier. It is advantageous when multiple inputs and outputs must be wired. Use P1 to P4 for ±10V input and P5 for ±10V output signals.

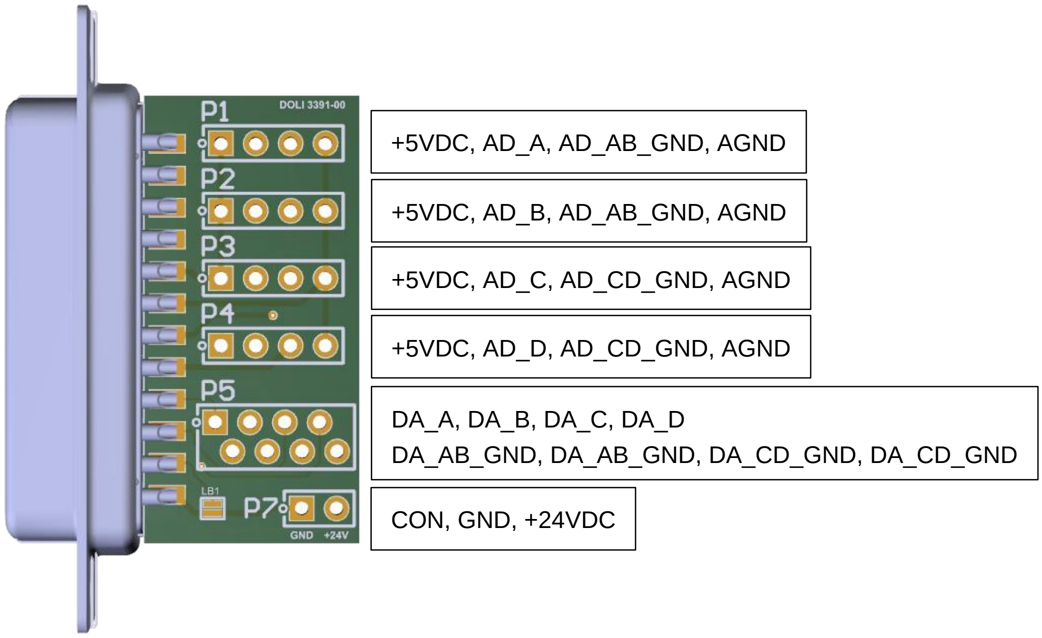


Fig. 116: iADA distribution plug

5.2.6.5 iADA Box

The iADA-box provides BNC connectors for all ±10V input and output signals and a 24V output. Use the cable assembly 2425 to connect the box with an iADA.

Fig. 117: iADA box

5.2.7 iCREEP Distribution Board

The iCREEP is the distribution board of the EDCi15 for creep testing instruments. The module provides special designed connectors with integrated sensor EEPROM plugs (no DOLI sensor plugs needed):

- X7 SGS-IL incremental line driver sensor
- X23A/X23C 2 x incremental 1Vpp sine sensors (Heidenhain ST1288/ST3088)
- X2 8 x digital inputs/outputs
- Y1 RS485 serial port for external temperature controllers

5.2.7.1 iCREEP X7 SGS-IL

Features:

- Signal type: incremental line driver
- Track A, track B, reference
- Direction detection and impulse quadruplicating
- 32 Bit Up/down pulse counting
- Encoder: A/B signal frequency max 8 MHz (counting frequency max 32 MHz)
- 5V supply for an incremental transducer
- Sensor EEPROM

Attention! This connector is NOT compatible to normal EDC incremental connectors. Never use standard DOLI sensor plugs.

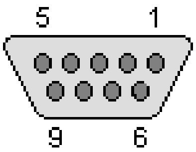


Fig. 118: 9-pin D-Sub plug (female) (iCREEP X7 SGS-IL).

Table 59: Pin description Encoder, 9-pin D-Sub plug (female) (iCREEP X7 SGS-IL)

Pin	Name	Function	Signal Type
1	A+	Trace A+ input	Line driver
2	GND	Ground	0V
3	R+	Reference R+ input	Line driver
4	n.c.		
5	B+	Trace B+ input	Line driver
6	A-	Trace A- input	Line driver
7	R-	Reference R- input	Line driver
8	+5V-ext	+5VDC supply	20mA max.
9	B-	Trace B- input	Line driver

5.2.7.2 iCREEP X23A/X23C SISU

Features:

- Connector for Heidenhain ST1288/ST3088 sensors
- Signal type: incremental 1Vpp sine
- Track A, track B, reference
- Direction detection and impulse quadruplicating
- Adjustable sine interpolation factor
- 32 Bit Up/down pulse counting
- Encoder maximum input counting frequency: 50 kHz
- 5V supply for an incremental transducer
- Sensor EEPROM

Attention! This connector is NOT compatible to normal EDC incremental connectors. Never use standard DOLI sensor plugs.

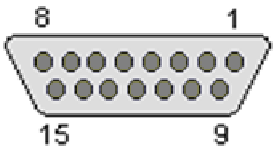


Fig. 119: 15-pin D-Sub plug (female) (iCREEP X23A/X23C).

Table 60: Pin description Encoder, 15-pin D-Sub plug (female) (iCREEP X23A/X23C)

Pin	Name	Function	Signal Type
1	A+	Trace A+ input	1Vpp sine
2	GND	Ground	0V
3	B+	Trace B+ input	1Vpp sine
4	+5V-ext	+5VDC supply	Total 250mA max.
5	n.c.		
6	n.c.		
7	R-	Reference R- input	1Vpp sine
8	n.c.		
9	A-	Trace A- input	1Vpp sine
10	GND	Ground	0V
11	B-	Trace B- input	1Vpp sine
12	+5V-ext	+5VDC supply	Total 250mA max.
13	n.c.		
14	R+	Reference R+ input	1Vpp sine
15	n.c.		

Fig. 120: Sine interpolation factor DIP switch (iCREEP X23A/X23C)

Table 61: Sine interpolation factor DIP switch (iCREEP X23A/X23C)

DIP-Switch 1	DIP-Switch 2	Sine Interpolation Factor
Off	On	50
On	On	25

Attention! According to the DIP switch, the interpolation factor must also be set in the sensor EEPROM settings of X23A/X23C.

Note: To calculate the real sensor resolution, you have to multiplay the interpolation factor by 4
25 x 4 = 100
50 x 4 = 200

5.2.7.3 iCREEP X2 Universal-I/O

Eight outputs (24V) and eight inputs (24V) can be connected to the X2 Universal-I/O. The signals are not assigned to any function.

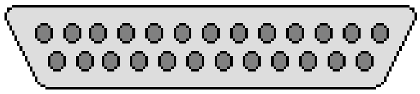


Fig. 121: 25-pin D-Sub plug (female) (iCREEP X2)

Table 62: Pin description Universal-I/O 25-pin D-Sub plug (female) (iCreep X2)

Pin	Name	Function	Signal Type
1	GND-ext.	Shield (case) + digital-ground	
2	IN1	Input 1	Ie=1.9mA @ 24V
3	IN3	Input 3	Ie=1.9mA @ 24V
4	IN5	Input 5	Ie=1.9mA @ 24V
5	IN7	Input 7	Ie=1.9mA @ 24V
6	GND-ext.	GND for 24V-supply	
7	OUT1	Output 1	100 mA*
8	OUT3	Output 3	100 mA*
9	OUT5	Output 5	100 mA*
10	OUT7	Output 7	100 mA*
11	n.c.		
12	+5VDC	Supply voltage	50mA max.
13	+24VDC	Supply voltage	100mA max**
14	IN0	Input 0	Ie=1.9mA @ 24V
15	IN2	Input 2	Ie=1.9mA @ 24V
16	IN4	Input 4	Ie=1.9mA @ 24V
17	IN6	Input 6	Ie=1.9mA @ 24V
18	GND-ext.	GND for 24V-supply	
19	OUT0	Output 0	100 mA*
20	OUT2	Output 2	100 mA*
21	OUT4	Output 4	100 mA*
22	OUT6	Output 6	100 mA*
23	n.c.		
24	GND-ext.	GND for 24V-supply	
25	+24VDC	Supply voltage	100mA max**

Notes:

* The total sum of the output currents must not exceed 350mA.
Consider power supply capabilities of the complete EDCi-System.

** The total sum of the output currents at +24VDC must not exceed 100mA.

Input: Low: Ue<1.0V, High: Ue>4.8V

5.2.7.4 iCREEP Y1 RS485 Serial Port

Features:

- Interface for external temperature controllers
- Signal type: RS485
- Baud rate: max. 115.2 kBaud
- Protocol, data bit and baud rate setup via DOLI Installation Center. Use sensor connectors X62A to X62D

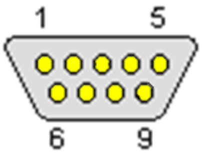


Fig. 122: 9-pin D-Sub plug (male) (iCREEP Y1).

Table 63: Pin description RS485 interface, 9-pin D-Sub plug (male) (iCREEP Y1)

Pin	Name	Function	Signal Type
1	TRX-A	Data half duplex	RS485, positive
2	n.c.		
3	n.c.		
4	n.c.		
5	GND	Ground	Ground
6	TRX-B	Data half duplex	RS485, negative
7	n.c.		
8	n.c.		
9	n.c.		

5.3 External Options

5.3.1 DriveBox

The DriveBox is an external drive interface, designed for top hat rail mounting in a cabinet. See chapter 5.1.6 for a detailed function description also.

Features:

- External drive interface, compatible to the EDCi X4 internal drive interface.
- 16 digital outputs (+12 - 24 VDC over ext. power supply, 0.5 A each output).
- 16 digital 24 VDC inputs.
- Spring-cage terminal blocks.
- Top hat/DIN rail mounting.
- M12 cable connection to EDCi.
- Decoupled to EDCi, supply voltage + 24 VDC, 0,3 A.

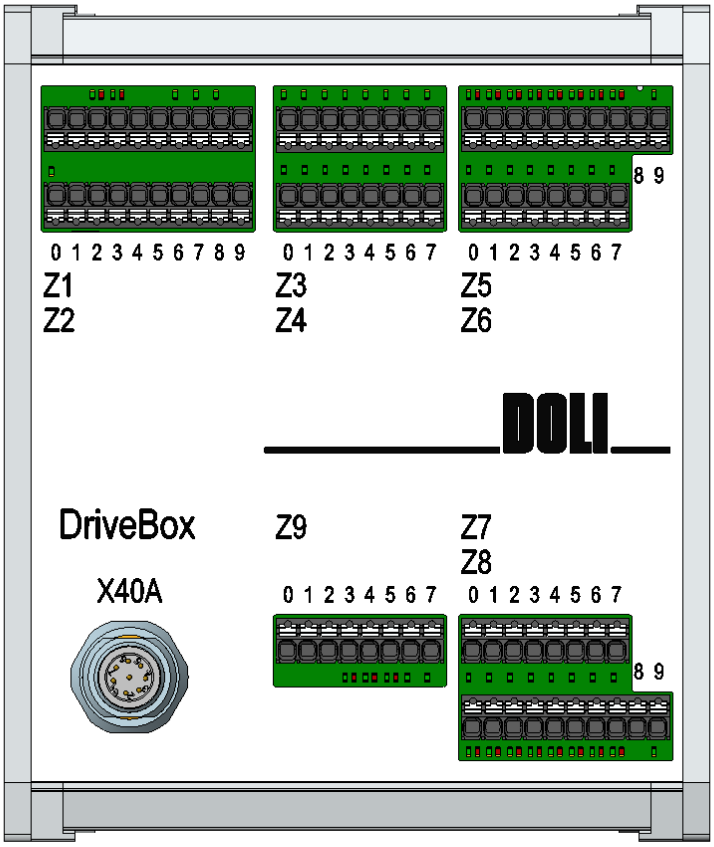


Fig. 123: DriveBox

Manual reset (since board revision 5):

- Pin *ManResetAct* set to 0V deactivates the manual reset:
  Drive can be switch on.
- Pin *ManResetAct* set to 24V activates the manual reset:
  The drive on command is disabled after every power on and Estop signal (EstopExt, EstopRmc, DoPEEmergencyOff). Bit 13 at EDC states DrvIntfStateIn2 or DrvIntfStateOut show this state. The user must reset this state by the pin *ManReset* (24V pulse duration of 0.2s to 10s). Now the drive on command is allowed again.

Table 64: Pin description DriveBox

Pin	Name	Description	Signal Type	Limits
Z1-0	GND	Ground, connected to Z1-1	Ground	
Z1-1	GND	Ground; connected to Z1-0	Ground	
Z1-2	LED	Output for LED showing status of EDC	24V-Output	100 mA*
Z1-3	EDCrdy	EDCi ready signal, initialization successful and controller ready to start	24V-Output	100 mA*
Z1-4	EDCrdyCon1	EDCi ready signal, input	relais contact, 24 V	max. 1 A
Z1-5	EDCrdyCon2	EDCi ready signal, output	relais contact, 24 V	max. 1 A
Z1-6	ManReset	Reset pulse (24V for 0.2s to 10s) for manual reset function	24V-Input	Ie=2.5mA @ 24V**
Z1-7	ManResetAct	0V: manual reset deactivated 24V: manual reset activated	24V-Input	Ie=2.5mA @ 24V**
Z1-8	EDM	Input of relais test signal (External Device Monitoring)	24V-Input	Ie=2.5mA @ 24V**
Z1-9	24V-log-out	24V logic output	24V-Output	10 mA
Z2-0	+24VDC	Supply voltage, connected to Z2-1	Supply	min. 0.5 A without ext. load CMDon
Z2-1	+24VDC	Supply voltage, connected to Z2-0	Supply	
Z2-2	DCMD Data1 B-	Digital Command Output B- / Direction- / Down–	RS485, negative	120 Ohm terminated
Z2-3	DCMD Data1 B+	Digital Command Output, B+	RS485, positive	120 Ohm terminated
Z2-4	DCMD Data1 A-	Digital Command Output A– / Pulse– / Up–	RS485, negative	120 Ohm terminated
Z2-5	DCMD Data1 A+	Digital Command Output, A+	RS485, positive	120 Ohm terminated
Z3-0	UpStop1	Upper limit switch, top mounted, first channel; connect to 9 if single channel	24V-Input	Ie=2.5mA @ 24V**
Z3-1	UpStop2	Upper limit switch, top mounted, second channel; connect to 8 if single channel	24V-Input	Ie=2.5mA @ 24V**
Z3-2	InCMDon1	Emergency-Stop input 1, first channel	24V-Input	E-Stop Circuit ***
Z3-3	InCMDon2	Emergency-Stop input 2, second channel	24V-Input	E-Stop Circuit ***
Z3-4	Estop1	Emergency-Stop output 1, first channel	24V-Output	E-Stop Circuit ***
Z3-5	Estop2	Emergency-Stop output 2, second channel	24V-Output	E-Stop Circuit ***
Z3-6	SupEstop1	+24VDC E-Stop Circuit Supply	24V-Output	max. 0.7 A, short-circuit-proof
Z3-7	SupEstop2	+24VDC E-Stop Circuit Supply	24V-Output	max. 0.7 A, short-circuit-proof
Z4-0	DownStop1	Lower limit switch, bottom mounted, first channel; connect to 43 if single channel	24V-Input	Ie=2.5mA @ 24V**
Z4-1	DownStop2	Lower limit switch, bottom mounted, second channel; connect to 42 if single channel	24V-Input	Ie=2.5mA @ 24V**
Z4-2	CMDon1	Command ON signal for external contactor, drive or valve, first channel	24V-Output	E-Stop Circuit ***
Z4-3	CMDon2	Command ON signal for external contactor, drive or valve, second channel	24V-Output	E-Stop Circuit ***
Z4-4	InEstop1	Emergency-Stop sense 1, first channel	24V-Input	E-Stop Circuit ***
Z4-5	InEstop2	Emergency-Stop sense 2, second channel	24V-Input	E-Stop Circuit ***
Z4-6	RMC_Estop1	RMC Emergency-Stop input 1, first channel	24V-Input	E-Stop Circuit ***

Pin	Name	Description	Signal Type	Limits
Z4-7	RMC_Estop2	RMC Emergency-Stop input 2, second channel	24V-Input	E-Stop Circuit ***
Z5-0	Out8	Bit Output 8	+12..24VDC Output	max. 0.5 A
Z5-1	Out9	Bit Output 9	+12..24VDC Output	max. 0.5 A
Z5-2	Out10	Bit Output 10	+12..24VDC Output	max. 0.5 A
Z5-3	Out11	Bit Output 11	+12..24VDC Output	max. 0.5 A
Z5-4	Out12	Bit Output 12	+12..24VDC Output	max. 0.5 A
Z5-5	Out13	Bit Output 13	+12..24VDC Output	max. 0.5 A
Z5-6	Out14	Bit Output 14	+12..24VDC Output	max. 0.5 A
Z5-7	Out15	Bit Output 15	+12..24VDC Output	max. 0.5 A
Z5-8	GND2	Ground for Bit Output 8..15	Ground	
Z5-9	SupOutput2	Supply voltage for Bit Output 8..15	+12..24VDC Supply	min. 0.5 A or ext. load of Out8 - 15
Z6-0	In8	Bit Input 8	24V-Input	Ie=2.5mA @ 24V**
Z6-1	In9	Bit Input 9	24V-Input	Ie=2.5mA @ 24V**
Z6-2	In10	Bit Input 10	24V-Input	Ie=2.5mA @ 24V**
Z6-3	In11	Bit Input 11	24V-Input	Ie=2.5mA @ 24V**
Z6-4	In12	Bit Input 12	24V-Input	Ie=2.5mA @ 24V**
Z6-5	In13	Bit Input 13	24V-Input	Ie=2.5mA @ 24V**
Z6-6	In14	Bit Input 14	24V-Input	Ie=2.5mA @ 24V**
Z6-7	In15	Bit Input 15	24V-Input	Ie=2.5mA @ 24V**
Z7-0	In0	Bit Input 0	24V-Input	Ie=2.5mA @ 24V**
Z7-1	In1	Bit Input 1	24V-Input	Ie=2.5mA @ 24V**
Z7-2	In2	Bit Input 2	24V-Input	Ie=2.5mA @ 24V**
Z7-3	In3	Bit Input 3	24V-Input	Ie=2.5mA @ 24V**
Z7-4	In4	Bit Input 4	24V-Input	Ie=2.5mA @ 24V**
Z7-5	In5	Bit Input 5	24V-Input	Ie=2.5mA @ 24V**
Z7-6	In6	Bit Input 6	24V-Input	Ie=2.5mA @ 24V**
Z7-7	In7	Bit Input 7	24V-Input	Ie=2.5mA @ 24V**
Z8-0	Out0	Bit Output 0	+12..24VDC Output	max. 0.5 A
Z8-1	Out1	Bit Output 1	+12..24VDC Output	max. 0.5 A
Z8-2	Out2	Bit Output 2	+12..24VDC Output	max. 0.5 A
Z8-3	Out3	Bit Output 3	+12..24VDC Output	max. 0.5 A
Z8-4	Out4	Bit Output 4	+12..24VDC Output	max. 0.5 A
Z8-5	Out5	Bit Output 5	+12..24VDC Output	max. 0.5 A
Z8-6	Out6	Bit Output 6	+12..24VDC Output	max. 0.5 A
Z8-7	Out7	Bit Output 7	+12..24VDC Output	max. 0.5 A
Z8-8	GND1	Ground for Bit Output 0..7	Ground	
Z8-9	SupOutput1	Supply voltage for Bit Output 0..7	+12..24VDC Supply	min. 0.5 A or ext. load of Out0 - 7
Z9-0	ACMD1	Command output ±10,0V for drive	Analogue output	100mA max.

Pin	Name	Description	Signal Type	Limits
Z9-1	AGND	Analogue-Ground (for nominal value output)	Analogue-Ground	
Z9-2	24V-log-out	24V logic output	24V-Output	10 mA
Z9-3	Bypass1	Opens bypass valve of hydraulic machine	24V-Output	100 mA*
Z9-4	CMDrdy1	Output signal to enable drive / valve, indicates controller ready to start	24V-Output	100 mA*
Z9-5	BrakeOpen1	Opens brake of drive	24V-Output	100 mA*
Z9-6	MoveEnable1	Input signal to enable move control, indicates “Hydraulic valve ready”; "0" holds position controlled by EDCi	24V-Input	Ie=2.5mA @ 24V**
Z9-7	CtrlEnable1	Input signal to enable controller, indicates “Drive or Valve ready”; "0" switch off controller	24V-Input	Ie=2.5mA @ 24V**

Notes:

* The total sum of these output currents must not exceed 350mA.

** Low: Ue<1.0V, High: Ue>4.8V

*** E-Stop Circuit is powered by SupEstop (pin Z3-6, Z3-7).

Z3-6, Z3-7	**SupEstop**	Supply of the E-Stop circuit; connect Z4-6 to Z3-6 and Z3-7 to Z4-7 for internal supply. Do not connect Z4-6, Z3-6 to Z3-7, Z4-7; safety monitoring of short circuit. For external supply of E-Stop circuit by safety PLC, channel 1 should be connected to Z4-6, channel 2 to Z4-7. Z3-6 and Z3-7 should not be connected. Set set-up parameter correctly.
Z1-8	**EDM**	Can be activated or de-activated by set-up parameter. Relay contact should be connected to +24 VDC. To start EDCi EDM should be "1" (24VDC).
Z3-0, Z3-1, Z4-0, Z4-1	**Up/DownStop**	EDCi stops if one of the signals goes to logical "0" (open or 0 VDC). Can be activated or de-activated by set-up parameter.
Z1-3, Z9-3	**EDCrdy/Bypass**	Former signal "pin14" splitted in two separate signals with individual pins.

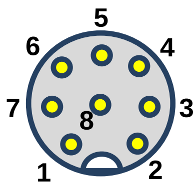


Fig. 124: DriveBox X40A 8-pin M12 plug (male)

Table 65 : Pin description DriveBox X40A 8-pin M12 plug (male)

Pin	Name	Function	Signal Type
1	RMC_Estop2	RMC Emergency-Stop 2, second channel	24V-Output
2	Estop2	Emergency-Stop 2, second channel	24V-Input
3	MOSI_P	Data (galvanically isolated)	RS485, positive
4	MOSI_N	Data (galvanically isolated)	RS485, negative
5	Estop1	Emergency-Stop 1, first channel	24V-Input
6	MISO_N	Data (galvanically isolated)	RS485, negative
7	MISO_P	Data (galvanically isolated)	RS485, positive
8	RMC_Estop1	RMC Emergency-Stop 1, first channel	24V-Output

5.4 Sensor Plugs

Attention! Do NOT hot plug any sensor plug! Hot plugging may damage EDC electronic!

5.4.1 Analogue Sensor Plugs

Load cells and other analogue transducers must be connected to the EDC via a sensor plug. Which contains a reference voltage source and an EEPROM to store all important data like unit, nominal value and calibration data of the connected sensor. The sensor plug must fit to the sensitivity of the sensor.

Note: The sensitivity of the sensor plug should always be lower than the sensitivity of the connected transducer.
Choose a sensor plug with sensitivity between 50 to 100% of the transducer sensitivity.

Since the calibration data for each transducer is stored in the EEPROM of the sensor plug together with other relevant data, it is essential that the transducer and the corresponding cable always stay together with the sensor plug.

As all characteristics are stored in the sensor plug, a further calibration is not strictly necessary when transferring transducers between systems or when connecting new factory supplied transducers.

Note: Some calibration procedures related to testing instruments may require transducer calibration carried out with each instrument i.e. BS EN 10002

The transducer cable is directly soldered to the circuit board.

After the EDC is switched on, it automatically reads the calibration information from the sensor plug.

5.4.1.1 Analog senor plug pin description

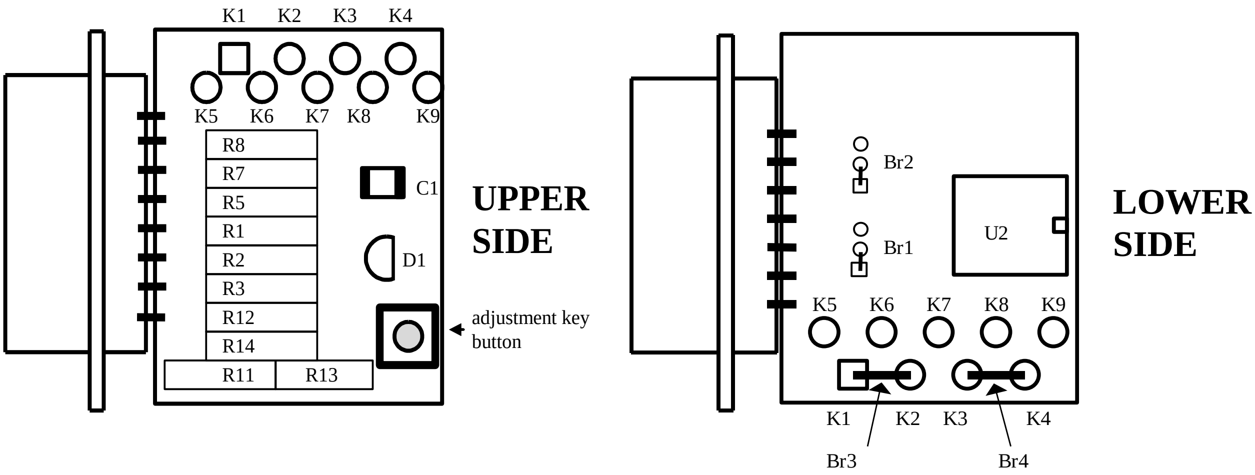


Fig. 125: Upper and lower side of the sensor plug

Table 66: Pin description analogue sensor plug

Sensor Plug Contacts	Signal
K1	Excitation voltage A
K2	Sense line for excitation voltage A
K3	Sense line for excitation voltage B
K4	Excitation voltage B
K5	Measuring signal input B
K6	Measuring signal input A
K7	Analogue GND
K8	Calibration enable – output
K9	Digital GND
Cable clamp	Screen (connected via cable clamp and connector shell to the EDC case).

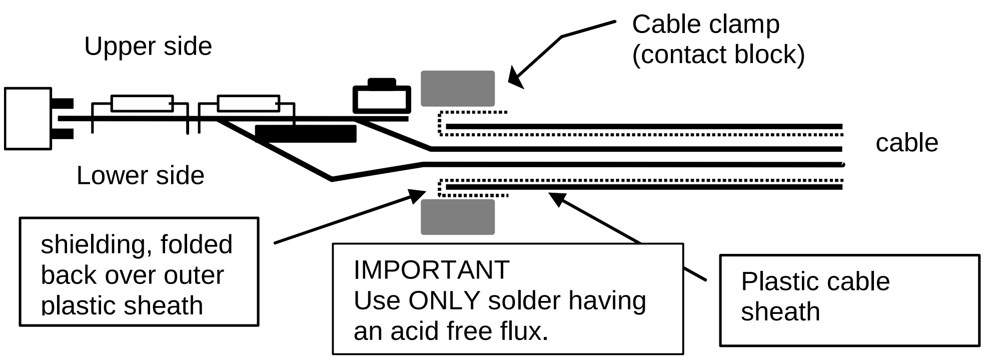


Fig. 126: Correct connection of the sensor plug to the cable

5.4.1.2 IEPE senor plug pin description

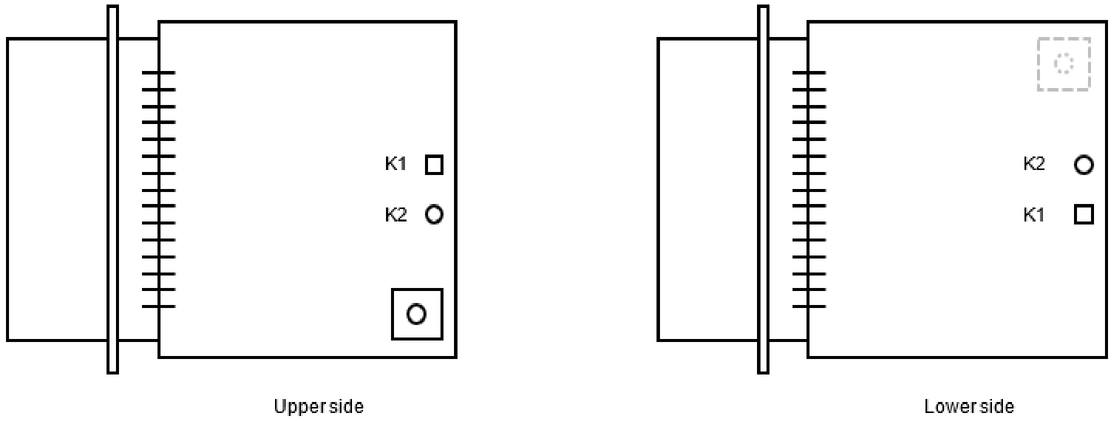


Fig. 127: Upper and lower side of the IEPE ±5 VDC sensor plug

Table 67: Pin description analogue sensor plug

Sensor Plug Contacts	Signal
K1	GND
K2	Sensor supply (4mA; max. 24VDC); signal input ±5 VDC (+ bias voltage)
Cable clamp	Shield (connected via cable clamp to the EDC case)

The IEPE ±5 VDC sensor plug is used for sensors with an IEPE-interface (Integrated Electronics Piezo Electric). Other proprietary names for this interface are ICP, CCLD, IsoTron or DeltaTron. The sensor plug supplies the sensor with a constant DC current (K1, K2) of 4mA and max. 24VDC, which results in a bias voltage (typically 8-12V). The measuring signal of the sensor is added to the bias voltage and can be up to ±5,25V maximum. For this principal only two shielded wires are needed, to transmit the sensor supply and signal. The bandwidth of the sensor plug is 0,05 Hz to 1 kHz.

Table 68: Available analogue sensor plugs

Sensor plug type	Board ID	Sensor plugs for X14, iDCA and iCFA
SGS_1mV	745	SGS sensor plug 15-pin for analogue transducers 1 mV/V
SGS_2mV	580	SGS sensor plug 15-pin for analogue transducers 2 mV/V
SGS_4mV	746	SGS sensor plug 15-pin for analogue transducers 4 mV/V
SGS_8mV	747	SGS sensor plug 15-pin for analogue transducers 8 mV/V
SGS_16mV	748	SGS sensor plug 15-pin for analogue transducers 16 mV/V
SGS_32mV	749	SGS sensor plug 15-pin for analogue transducers 32 mV/V
SGS_80mV	750	SGS sensor plug 15-pin for analogue transducers 80 mV/V
SGS_160mV	751	SGS sensor plug 15-pin for analogue transducers 160 mV/V
SGS_320mV	752	SGS sensor plug 15-pin for analogue transducers 320 mV/V
SGS_640mV	753	SGS sensor plug 15-pin for analogue transducers 640 mV/V
SGS_20mA	2073	SGS sensor plug 15-pin for analogue transducers 0-20 mA
SGS_6mV	2609	SGS sensor plug 15-pin for analogue transducers ±6 mVDC
SGS_1V	1057	SGS sensor plug 15-pin for analogue transducers ±1 VDC
SGS_2V	1135	SGS sensor plug 15-pin for analogue transducers ±2 VDC
SGS_5V	754	SGS sensor plug 15-pin for analogue transducers ±5 VDC
SGS_10V	755	SGS sensor plug 15-pin for analogue transducers ±10 VDC
SGS_IEPE	3304	SGS sensor plug 15-pin for analogue transducers IEPE ±5VDC

5.4.1.3 Connection Diagram for a Full Strain Gauge Bridge

Example: 2 mV/V

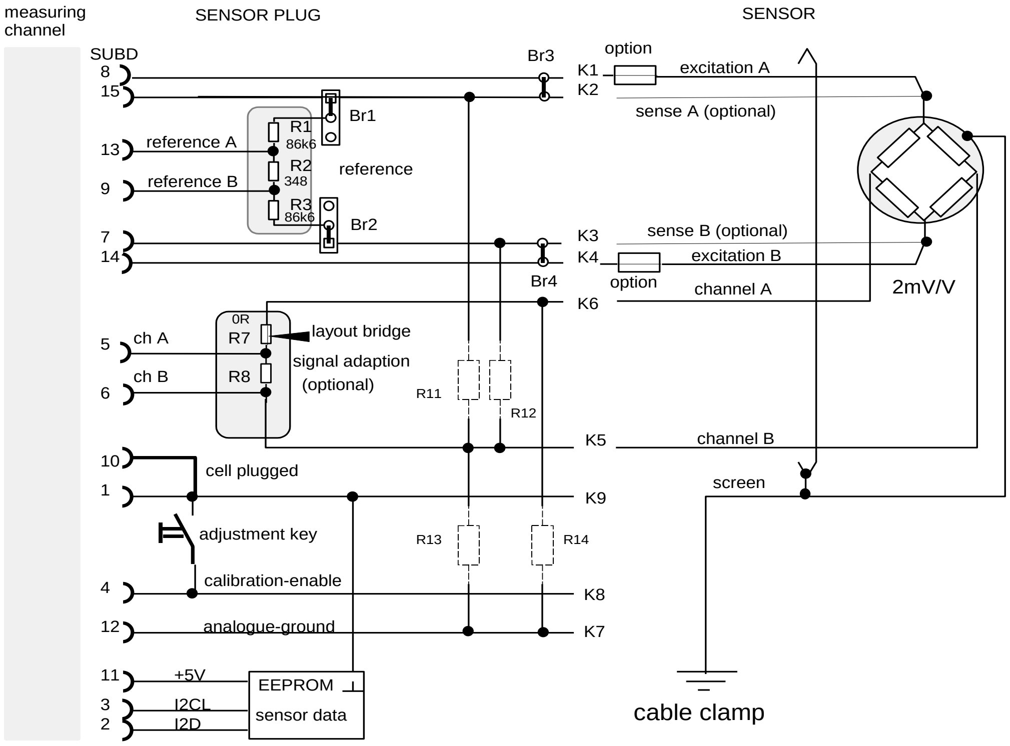


Fig. 128: Connection diagram for a full strain gauge bridge

5.4.1.4 Connection Diagram for a Differential Transformer (LVDT)

Example: 80 mV/V

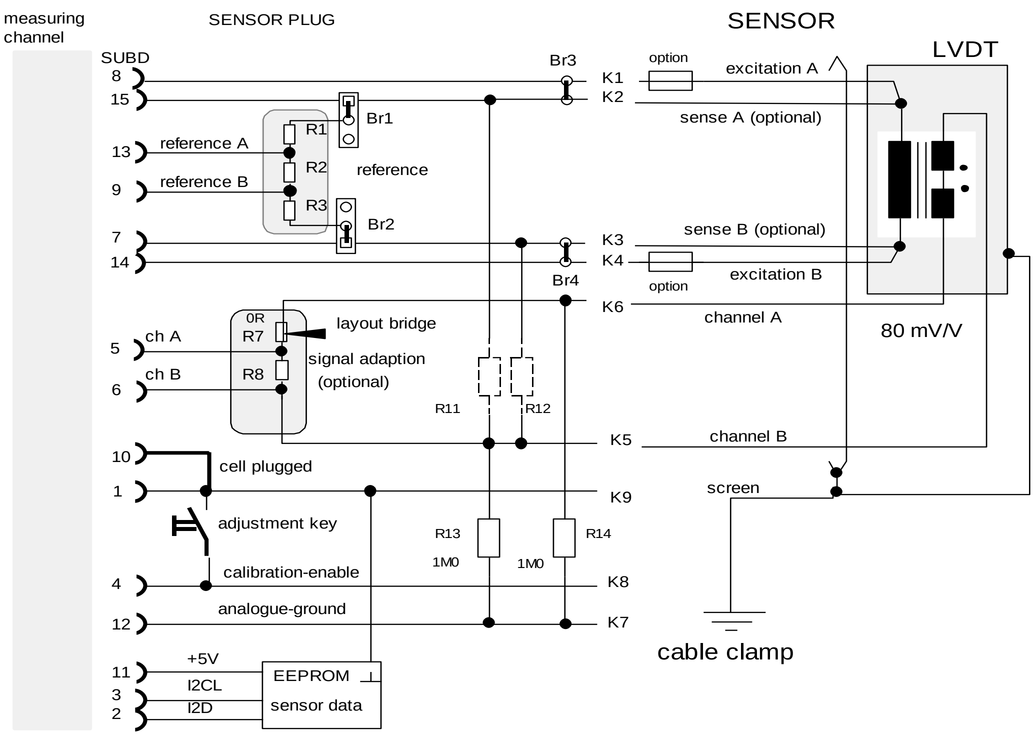


Fig. 129: Connection diagram for a differential transformer (LVDT)

Note: For more detailed information about the analogue sensor plugs refer to the analogue sensor plug manual.

5.4.2 Incremental / Absolute Sensor Plugs

Incremental / absolute sensor plugs for one or two channels and different signal types, as well as a cable adapter are available.

Table 69: Incremental/Absolute sensor plugs and cable adapter

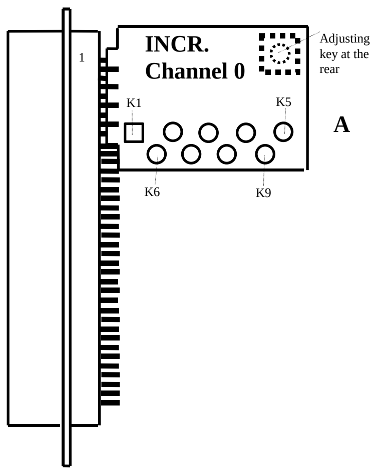
Sensor plug type	**Board ID**	**Sensor plugs for X7 and iINC**
SGS_9IL	921	1 x INC sensor plug 9-pin (line driver signal)
SGS_9IT	920	1 x INC sensor plug 9-pin (TTL signal)
SGS_9IS	2349	1 x INC sensor plug 9-pin (sine 11µA signal)
SGS_9ISU	2350	1 x INC sensor plug 9-pin (sine 1V signal)
SGS_9SSIL	1665	1 x SSI sensor plug 9-pin
SGS_4IL1	3248	1 x INC sensor plug 44-pin (line driver signal)
SGS_4IL2	3248	2 x INC sensor plug 44-pin (line driver signal)
SGS_4IT1	3245	1 x INC sensor plug 44-pin (TTL signal)
SGS_4IT2	3245	2 x INC sensor plug 44-pin (TTL signal)
SGS_4IS1	3365	1 x INC sensor plug 44-pin (sine 11µA signal)
SGS_4IS2	3365	2 x INC sensor plug 44-pin (sine 11µA signal)
SGS_4ISU1	3366	1 x INC sensor plug 44-pin (sine 1V signal)
SGS_4ISU2	3366	2 x INC sensor plug 44-pin (sine 1V signal)
SGS_4SSI1	3246	1 x SSI sensor plug 44-pin
SGS_4SSI2	3246	2 x SSI sensor plug 44-pin
iINC-Ak	3270	Cable adapter plug 44-pin for iINC to 2 x 9-pin INC (A, C) and 1 x 25-pin I/O (B)

Maximum sensor frequency:

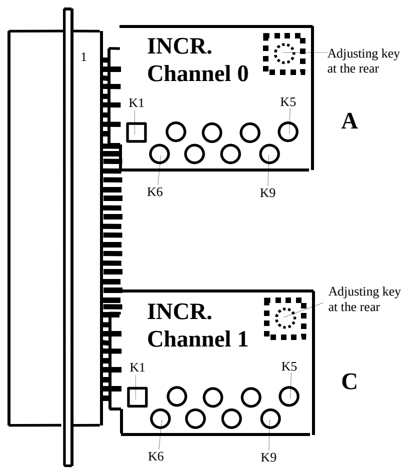
- TTL/Line driver: A/B signal frequency max 8 MHz (counting frequency max 32 MHz)
- SSI: max. 300 kHz
- Sine: max 50 kHz

Table 70: Connection points of different sensor plugs

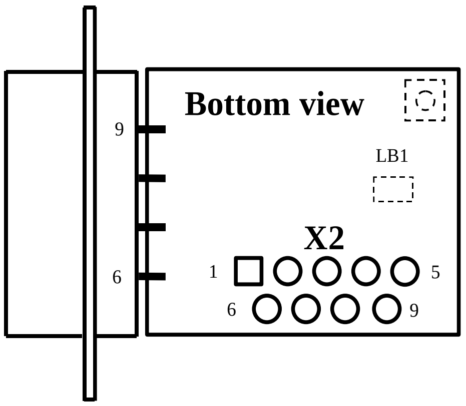
Contact	TTL	Line Driver	Sine 11µA	Sine 1Vpp	SSI
K1	GND	GND	GND	GND	GND
K2	R	R+	R+	R+	DAT-
K3	B	B+	B+	B+	CLK-
K4	A	A+	A+	A+	
K5		A-	A-	A-	+24Vdc
K6	+Sense				DAT+
K7		R-	R-	R-	CLK+
K8		B-	B-	B-	/CON
K9	Supply: +5V 250mA max	Supply: +5V 250mA max	Supply: +5V 250mA max	Supply: +5V 250mA max	
K10					Supply: +5V 250mA max



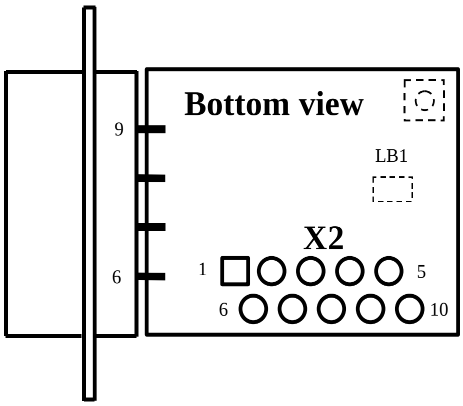
Sensor plug for one incremental channel



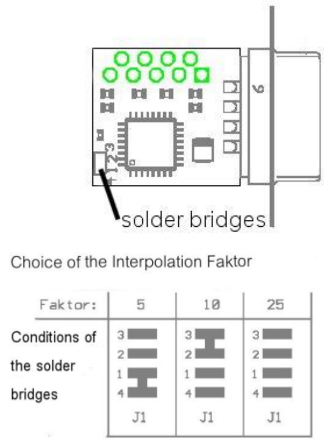
Sensor plug for two incremental channels



9SSIL Index “a”



9SSIL Index “b”



Interpolation factor for sine input sensor plugs

Fig. 130: Dual and single adaptation modules

The connection cable for a sensor with differential signal (RS422 or sine) is soldered to the connection points “K1” to “K9”.The connection cable for a sensor with single TTL signal is partially soldered to the connection points “K1” to “K9” and partially to the D-SUB socket.

Note: For more detailed information about the incremental sensor plugs, refer to the incremental sensor plug manual.

5.5 Setup examples for different sensor types

The next chapters show some typical examples of setups for sensor plug EEPROMs.

5.5.1 Incremental rotary position transducer

Setup of a rotary line driver encoder with 6000 increments per revolution.

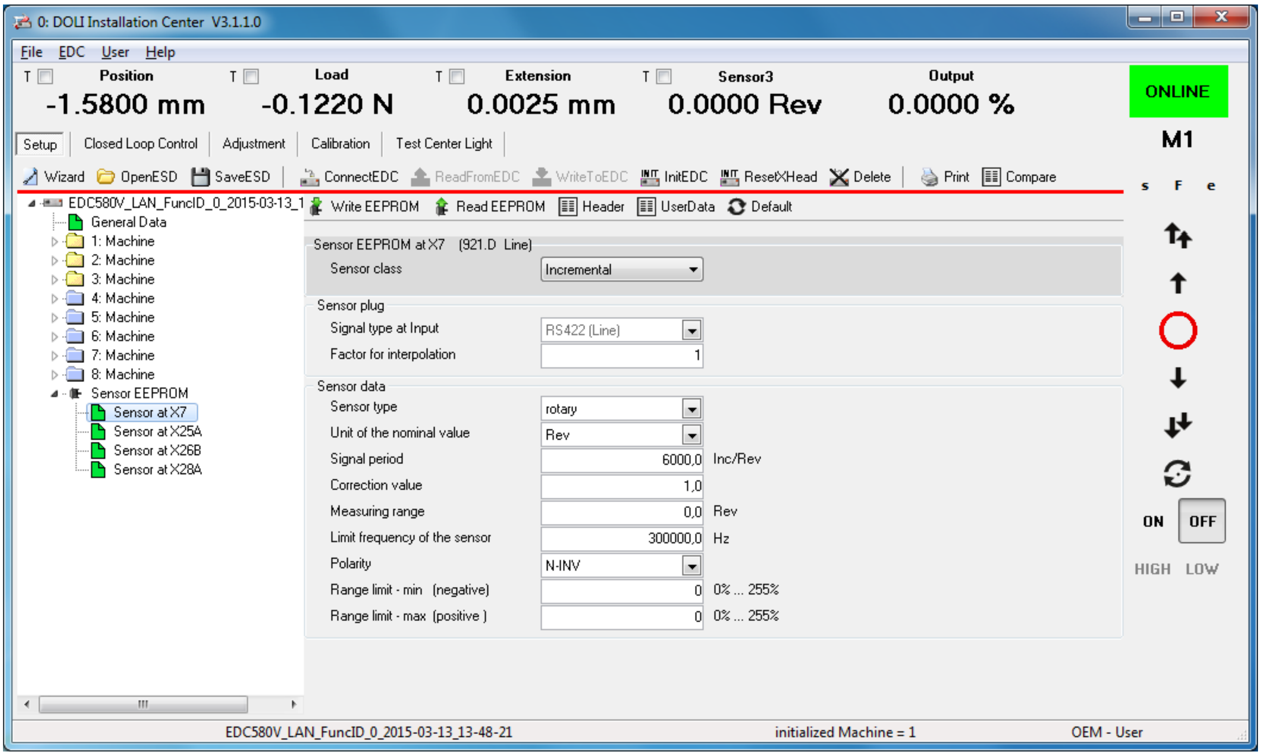


Fig. 131: Setup of a rotary encoder as incremental position transducer

5.5.2 Linear incremental position transducer

Setup of a linear incremental sine position transducer, signal period 10 µm, interpolation factor 25.

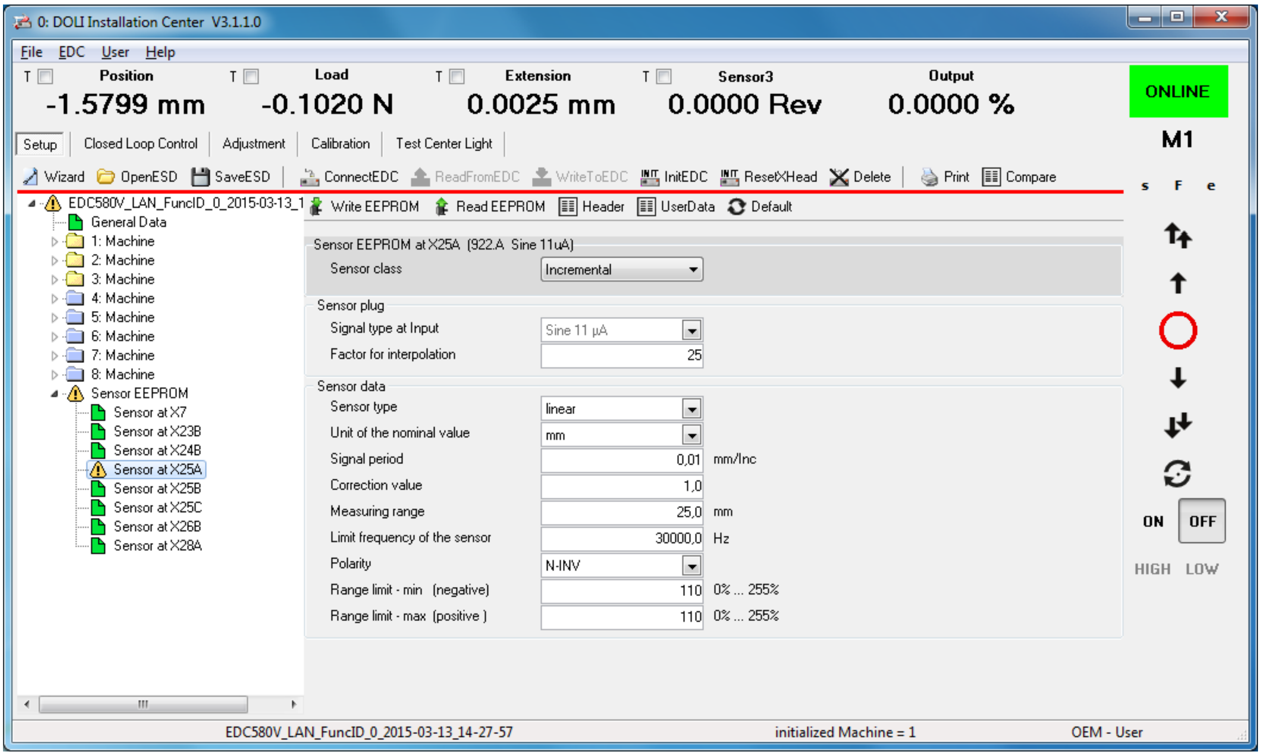


Fig. 132: Setup of a linear incremental position transducer

5.5.3 Draw wire as position transducer

Setup of a draw wire sine transducer as position transducer at X7. This draw wire transducer has a SGS_9IS sensor plug and is a linear incremental transducer (e.g.: 5000 increments per revolution).

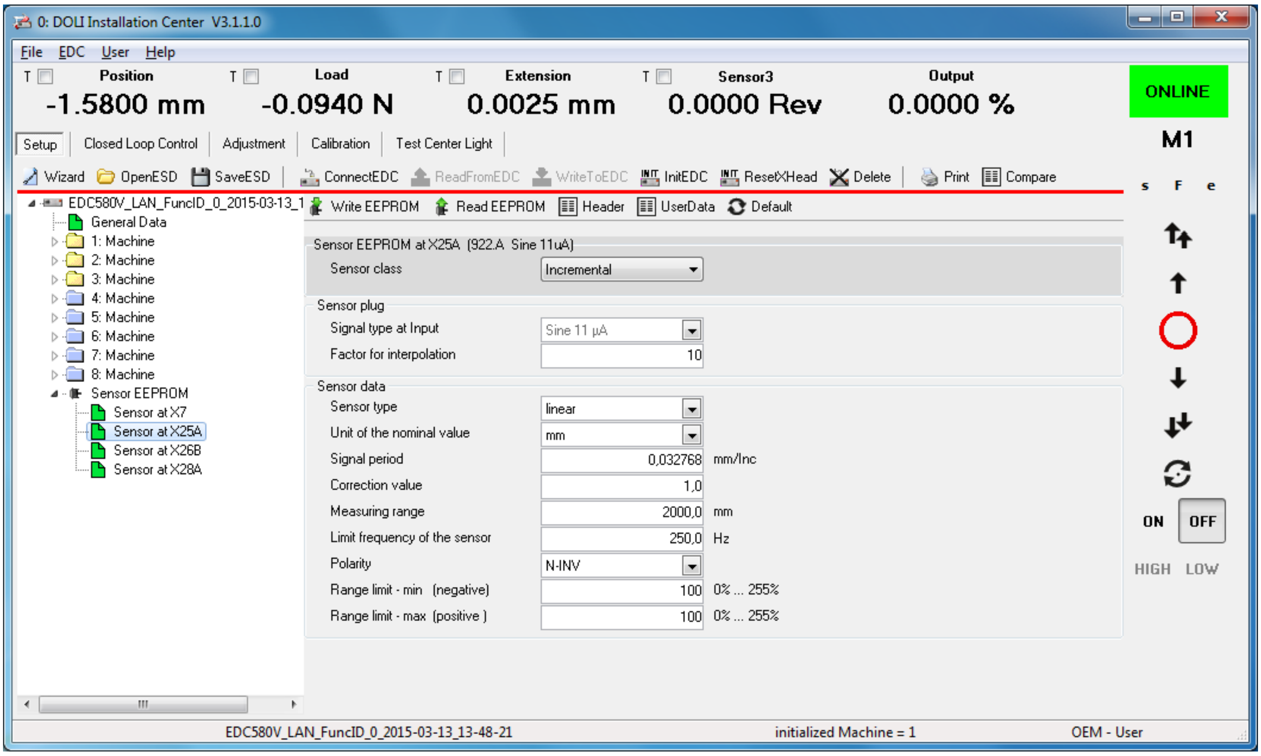


Fig. 133: Setup of a draw wire transducer at X7

5.5.4 LVDT position transducer

Setup of a LVDT position transducer with 100mm nominal value and 160 mV/V.

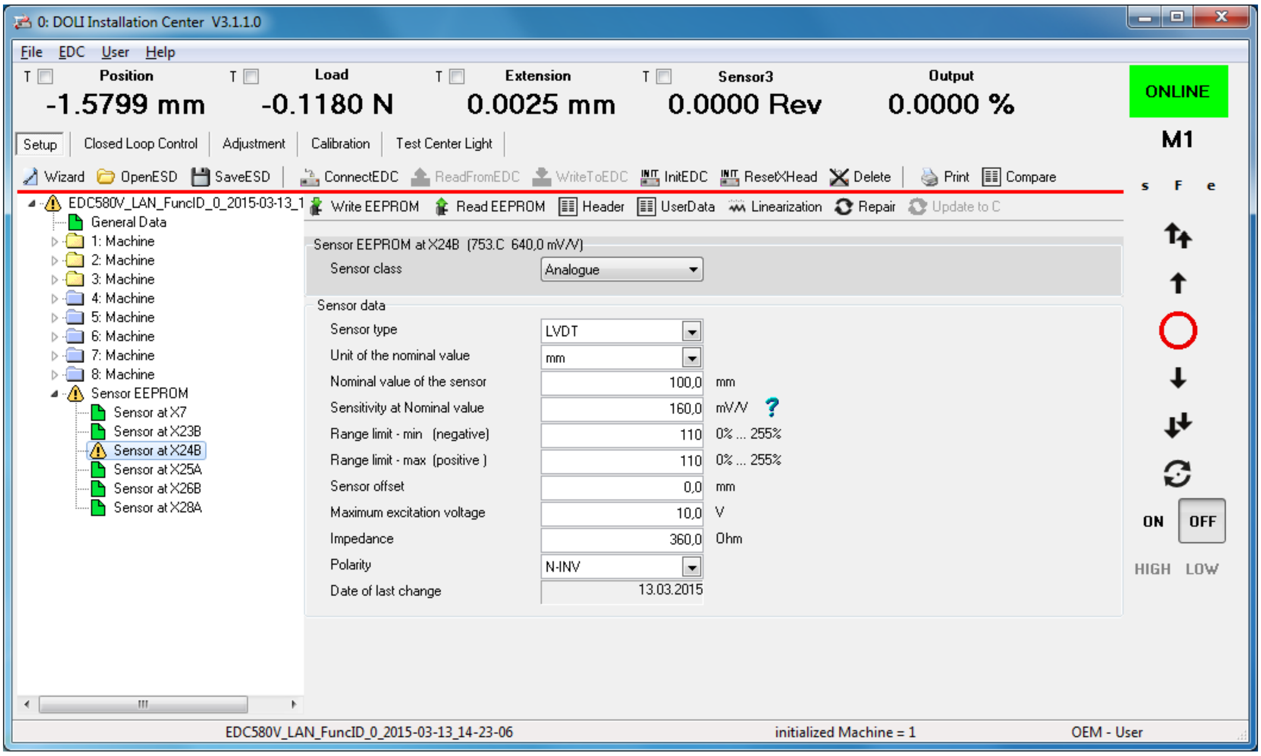


Fig. 134: Setup of a LVDT position transducer

5.5.5 Analogue load transducer

Setup of a load transducer 2 mV/V, 2 kN.

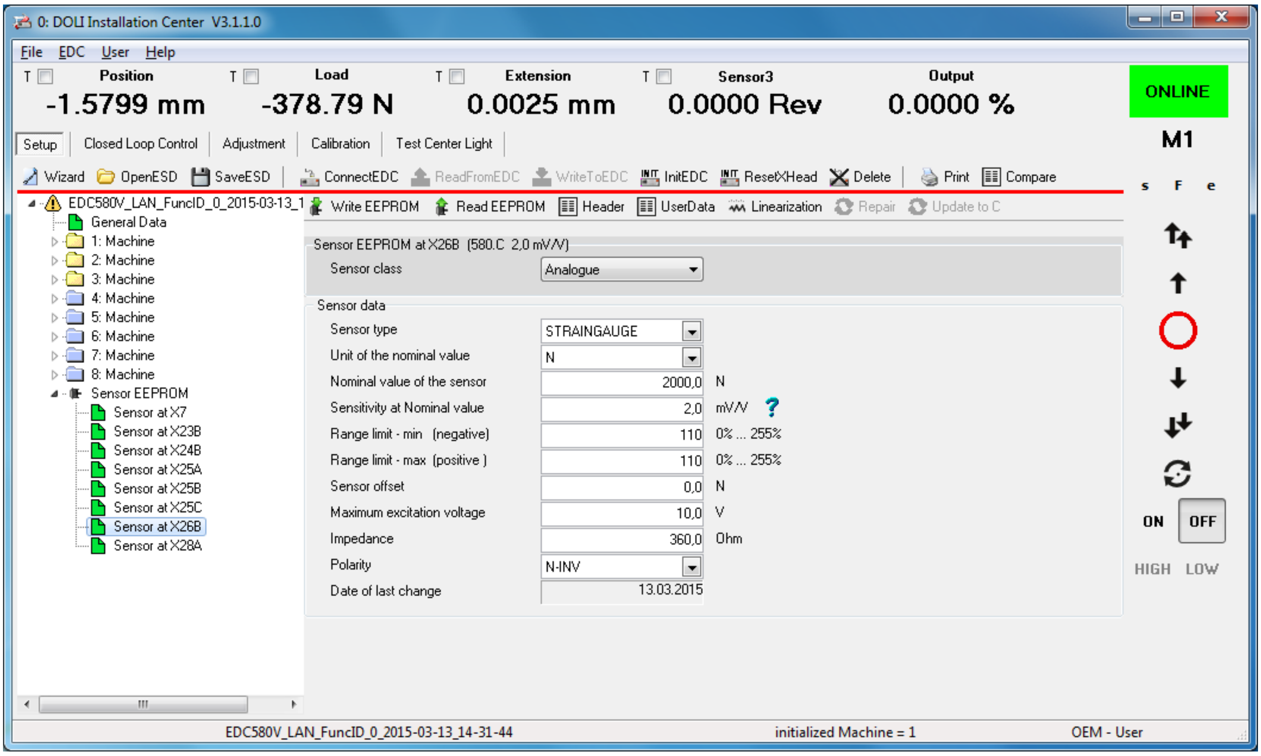


Fig. 135: Setup of an analogue load transducer

5.5.6 Analogue pressure transducer

Setup of a pressure transducer: e.g. 2 mV/V, 50 MPa (500 bar).

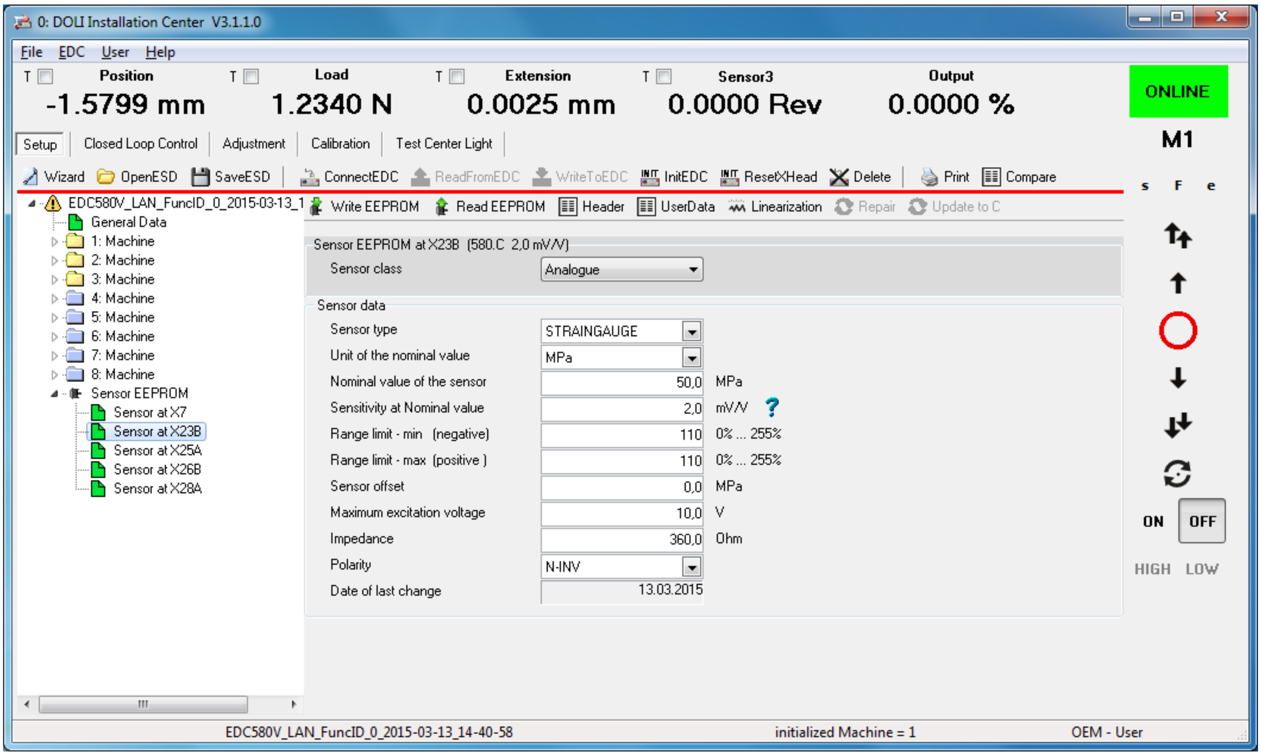


Fig. 136: Setup of an analogue pressure transducer

5.5.7 Analogue 10 V DC Sensor

Setup of an analogue 10 V DC sensor.

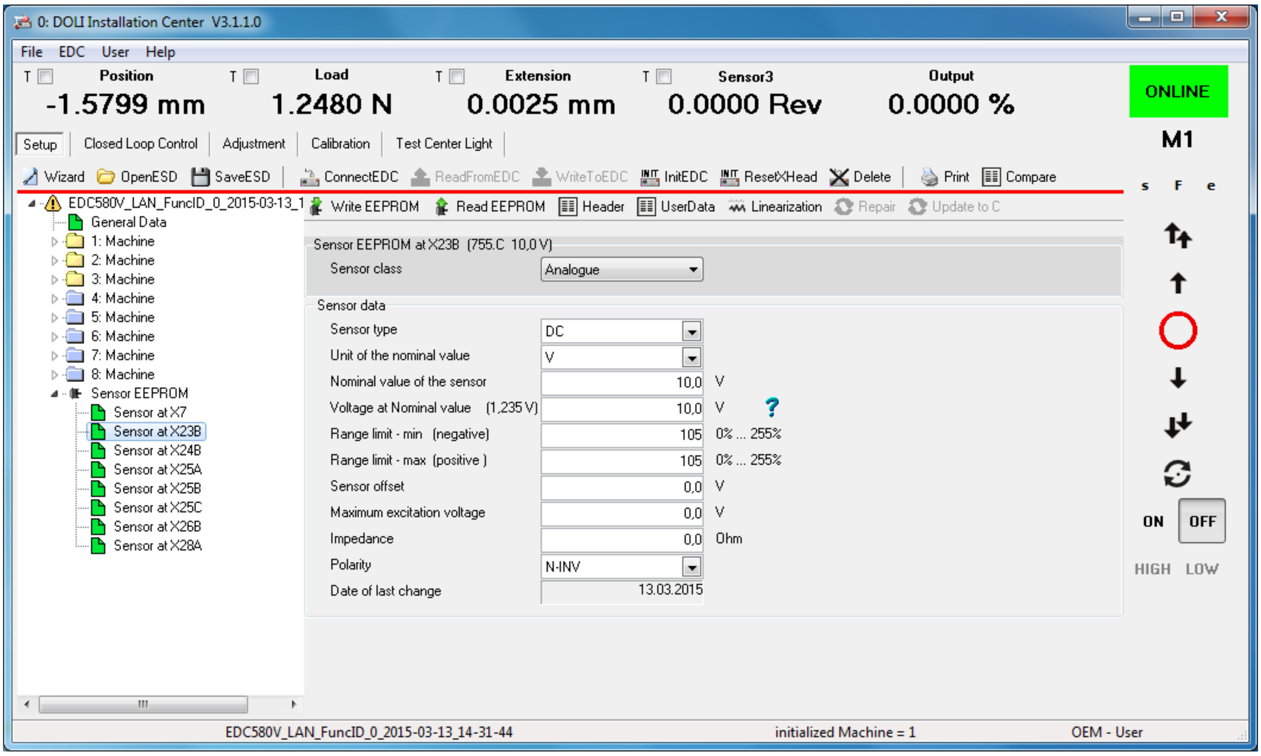


Fig. 137: Setup of an analogue 10V DC sensor

5.5.8 SSI sensor

Several SSI sensor types can be configured. There are some special defined types (Heidenhain, MTS, Posital) and a generic type with variable signal parameters. We recommend the MTS SSI S2Bx102 type.

Table 71: SSI sensor type overview

SSI sensor type	DOLI generic parameters
Heidenhain ROQ 424	Gray code, special bits
MTS SSI S2Bx102	Binary code, 24 bits
POSITAL SL G 24	Gray code, 24 bits
POSITAL SL G 16	Gray code, 16 bits
Heidenhain ROQ 425	Gray code, 25 bits
Generic	Binary or Gray code, 8…39 bits

TIPP **Hint:**

- **Some information of SSI sensor manufactures may be confusing. Especially their interpretation of the bit count is different. There may be some test necessary, to get the right generic parameters for the used SSI sensor type.**
- **To be sure, the SSI sensor parameters are set correctly, you should check at least two things:**
  - **Is the measured length correct?**
  - **Is the resolution correct? If you move the machine slowly, the measured value should continuously increase according to the resolution without unexpected steps? You can check this with the DoPE TestCenter chart. If there is a problem, the bit count may be wrong.**

Setup of a 400 mm generic SSI sensor. The signal type must be set correctly (Binary or Gray code, bit count).

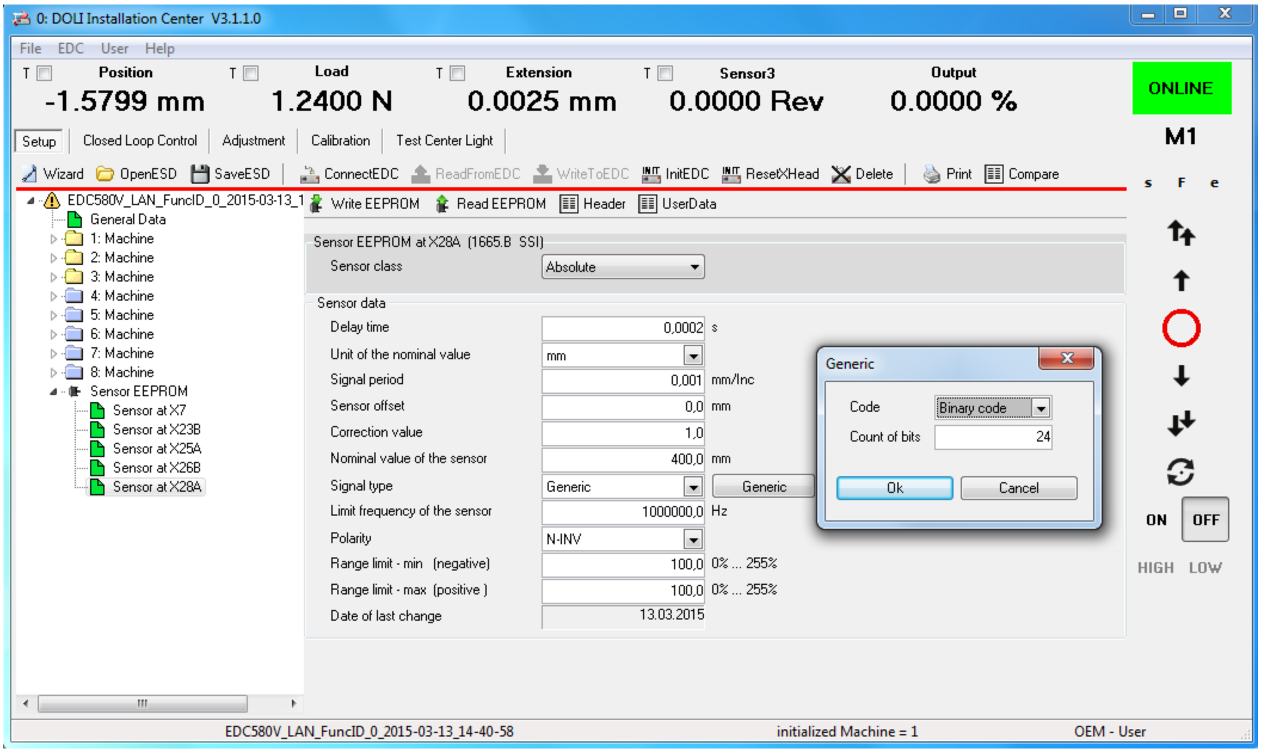


Fig. 138: Setup of a generic SSI sensor

Setup of a 400 mm MTS SSI sensor (type RHM0400MD701**S2B**8**102**) with binary code and 24 bit.

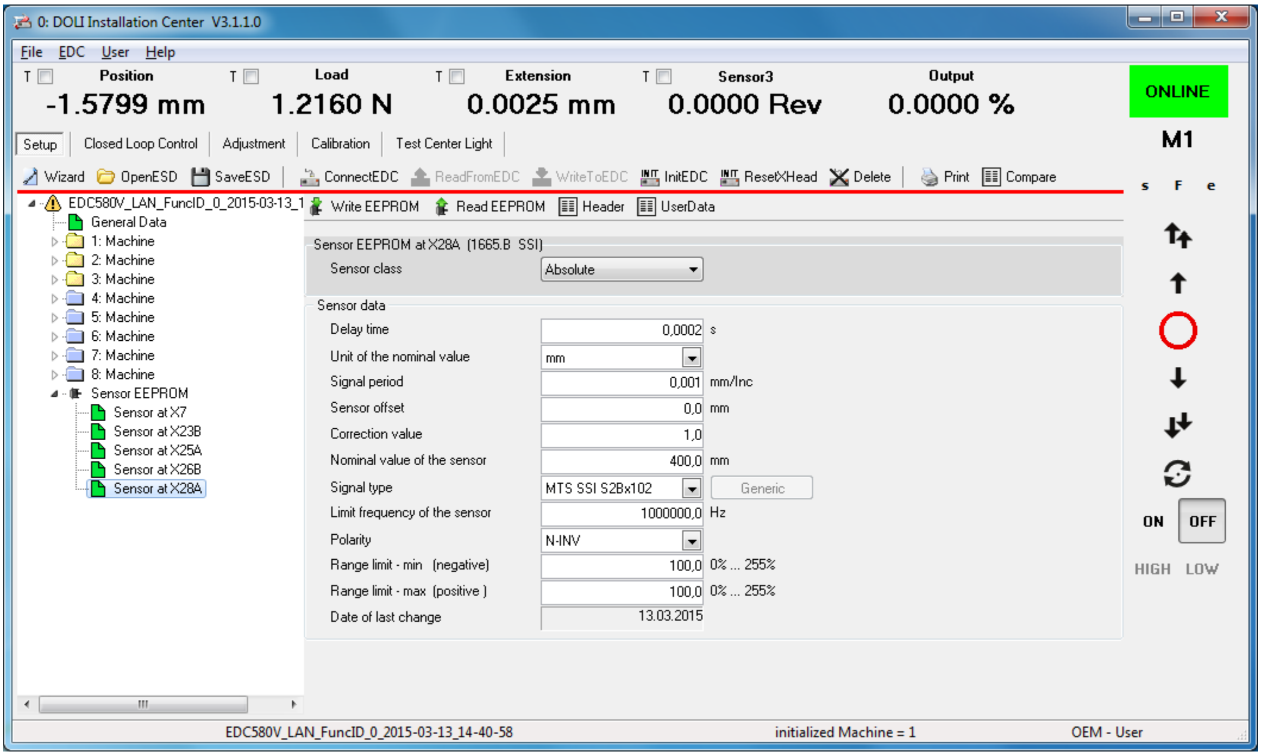


Fig. 139: Setup of a MTS SSI sensor

5.5.9 Serial sensor – Eurotherm

Setup of a serial sensor for a Eurotherm temperature controller (EI-Bisynch protocol).

Use the following Eurotherm addresses:

Sensor Connector	Eurotherm address
X62A	1
X62B	2
X62C	3
X62D	4

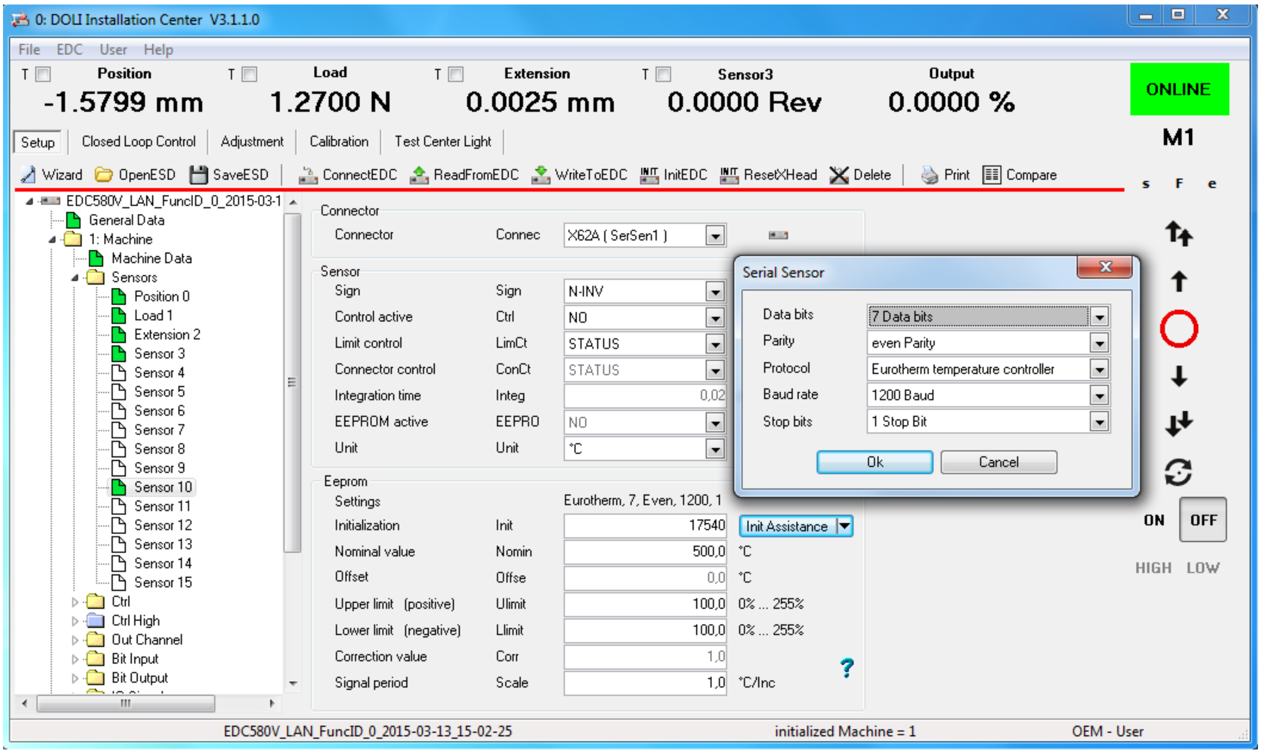


Fig. 140: Setup of a Eurotherm temperature controller

5.5.10 Serial sensor – Grado

Setup of a serial sensor for a Grado temperature controller (ASCII protocol).

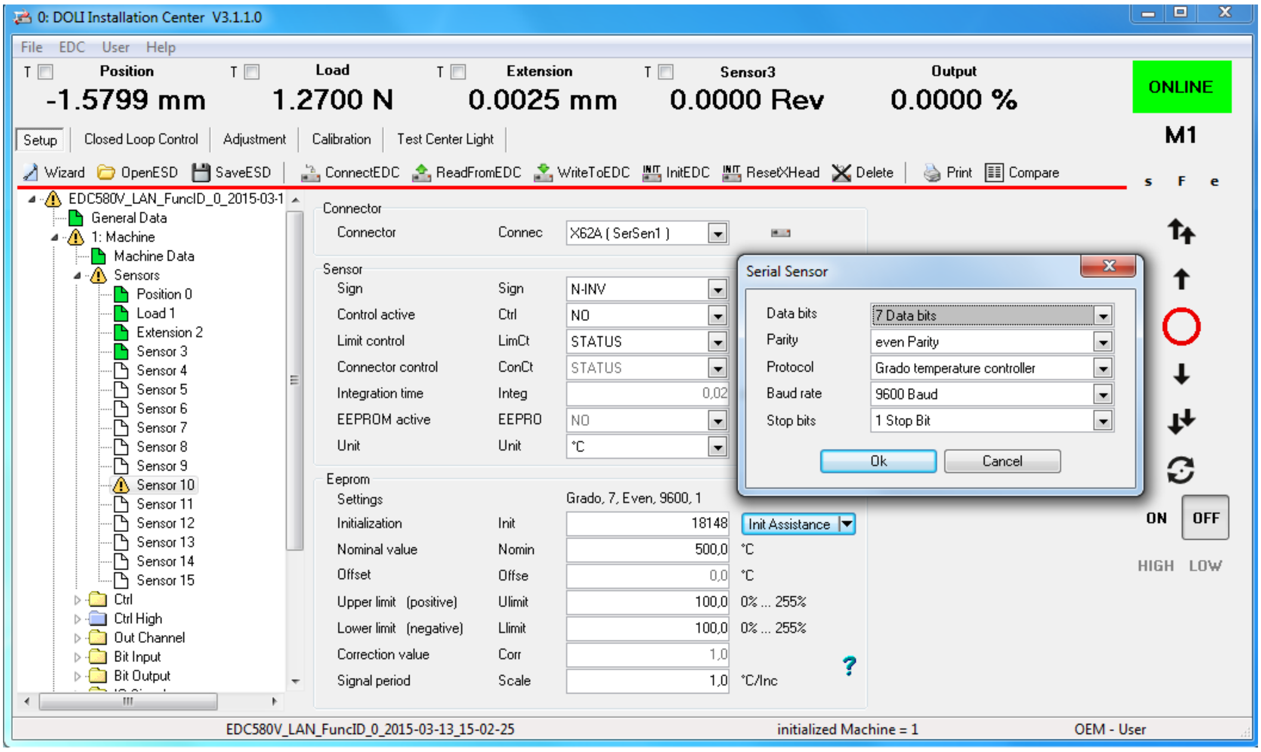


Fig. 141: Setup of a Grado temperature controller

5.5.11 Serial sensor – AI 808

Setup of a serial sensor for an AI 808 temperature controller (binary AIBUS protocol).

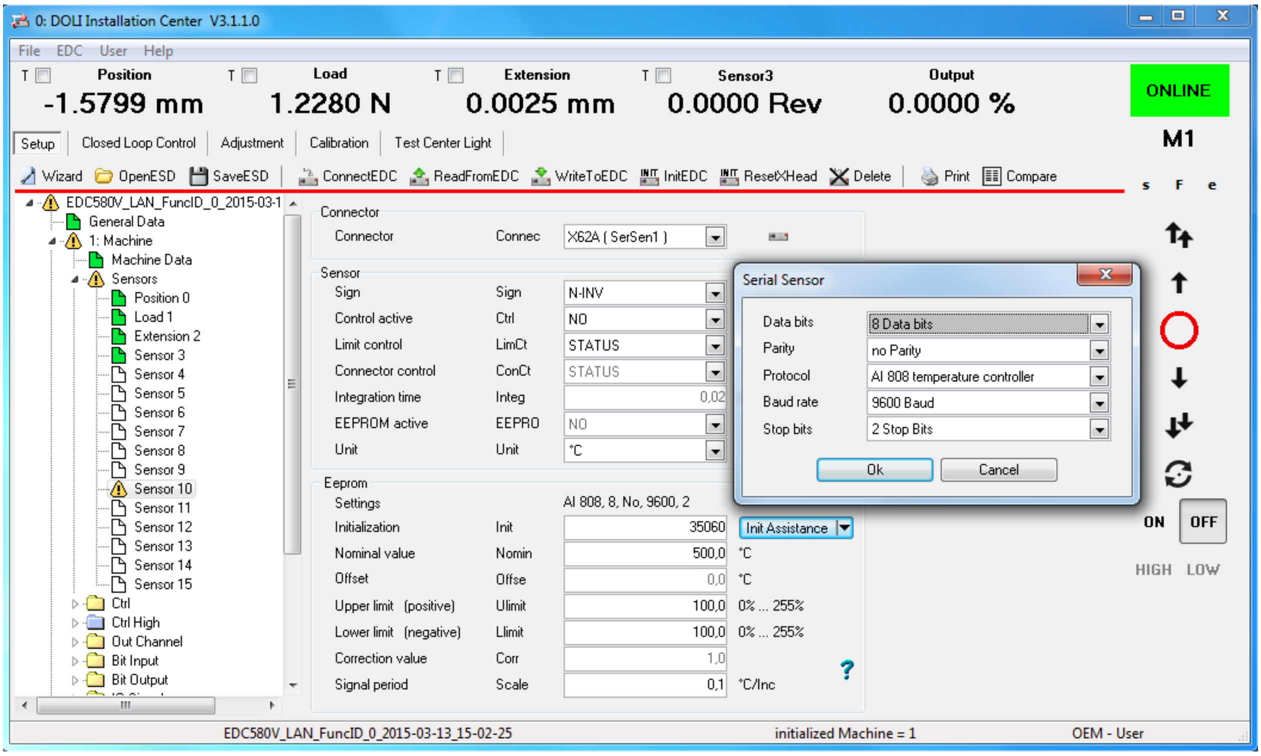


Fig. 142: Setup of an AI 808 temperature controller

5.5.12 Serial sensor – Limess RTSS Video Extensometer

Setup of a serial sensor for a Limess RTSS Video Extensometer.

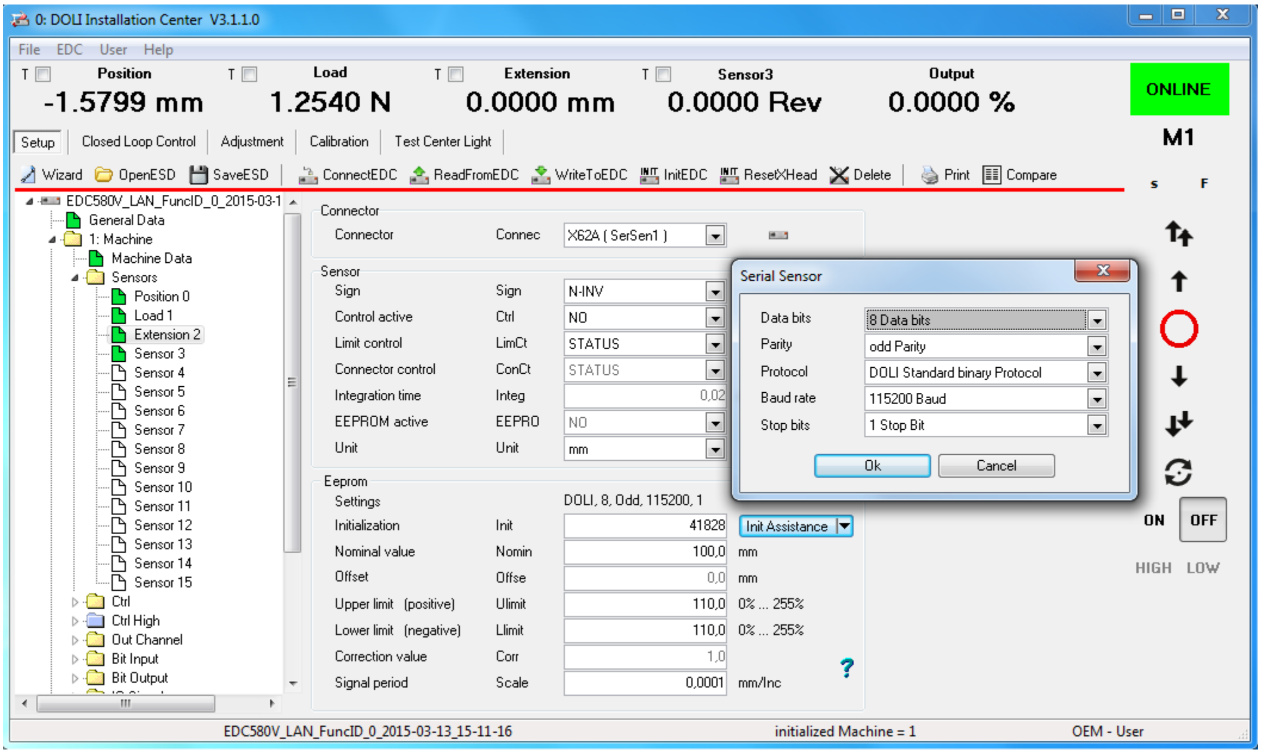
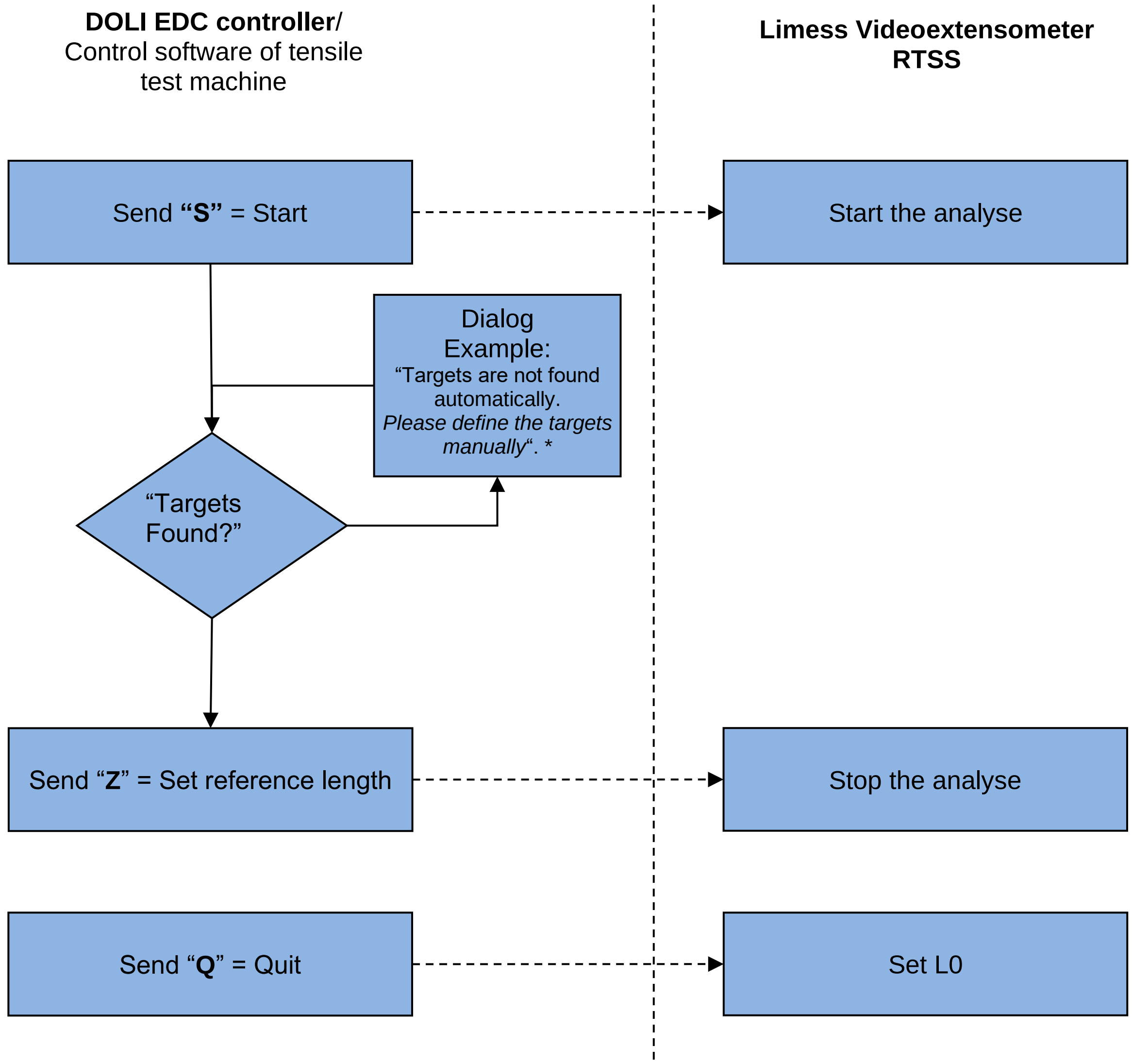


Fig. 143: Setup of a Limess RTSS Video Extensometer

5.5.12.1 Flowchart for the communication between RTSS and EDC

This flowchart describes the LIMESS communication protocol, which is used to communicate with the DOLI controllers (EDC from firmware version 9133.021). If the analysis is not yet running, the RTSS outputs -999 as measurement values. The following table shows the currently defined commands and their HEX codes.

Command	Hex Code
S	0x53
Z	0x5A
Q	0x51



* This message should be displayed on the control computer of the tensile test machine.

5.5.13 Sensor Limits, Soft Limits, Offset and Tare

The interaction between sensor limits, soft limits, offset and tare may be confusing. The following examples show the influence of the different parameters.

- The sensor **offset** moves the sensor **limits** and **soft limits**.
- The sensor **tare** moves the sensor **soft limits**, only.
- There are two different types of tare: **basic tare** is stored in the EDC, **normal tare** is active until the next initialization of the EDC, only. Both types are added and can be used at the same time.
- Depending on the EDC setup configuration, the change of the sensor soft limits changes shield limits, grip limits and sensor to analogue output limits in the same way, also.

Use sensor **offset** to correct sensor hardware errors, e.g.:

- Correction of a load cell offset.

Use sensor **tare** to change the measuring of a sensor, e.g.:

- Change the 0 position of a LVDT.
- Set LE of an extensometer.
- Compensation of grips weight at a load cell.

This is an example for sensor offset and tare, with sensor info of the DoPE Test Center:

- **Situation P1**: Sensor hardware without any offset or tare set.
- **Situation P2**: Sensor with offset of 30N set. Sensor limits and soft limits are moved.
- **Situation P3**: Sensor with tare of 30N set. Lower soft limit is moved. The upper soft limit can't exceed the sensor limits, therefore it's not moved.

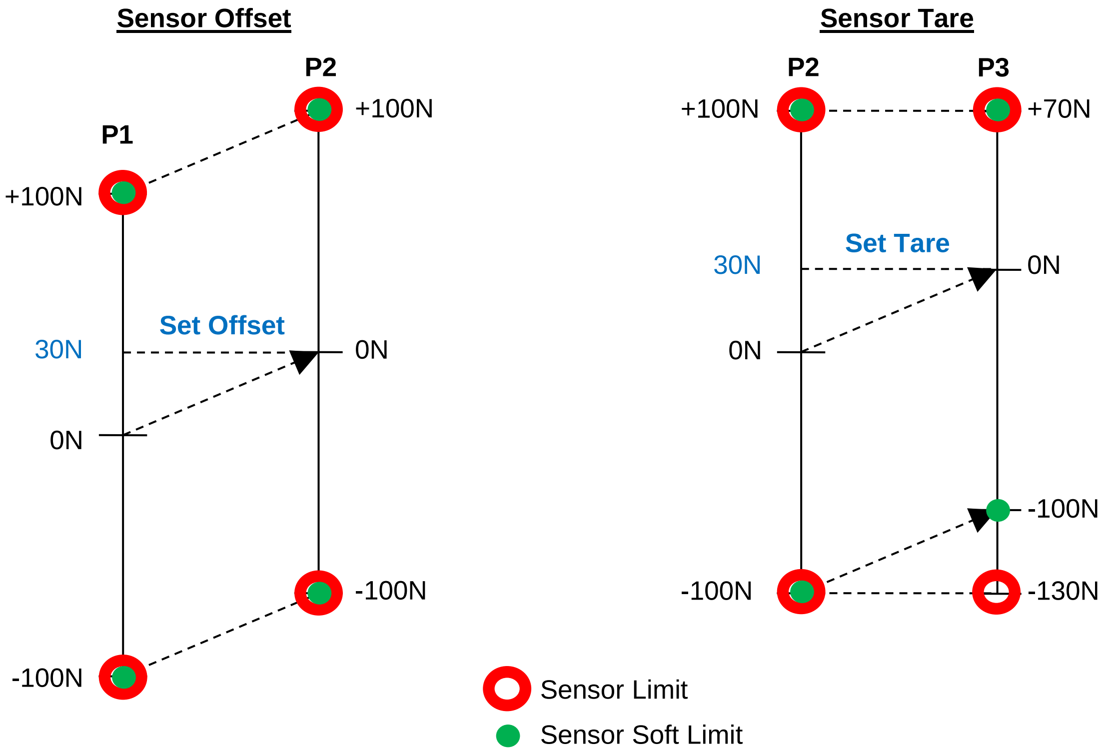


Fig. 144: Sensor limits, soft limits, offset and tare

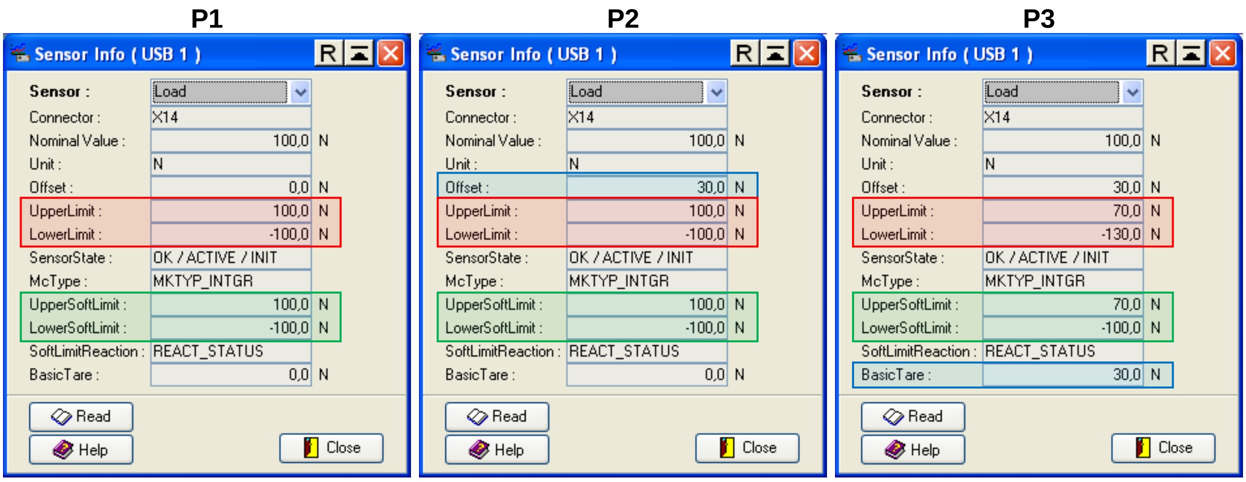
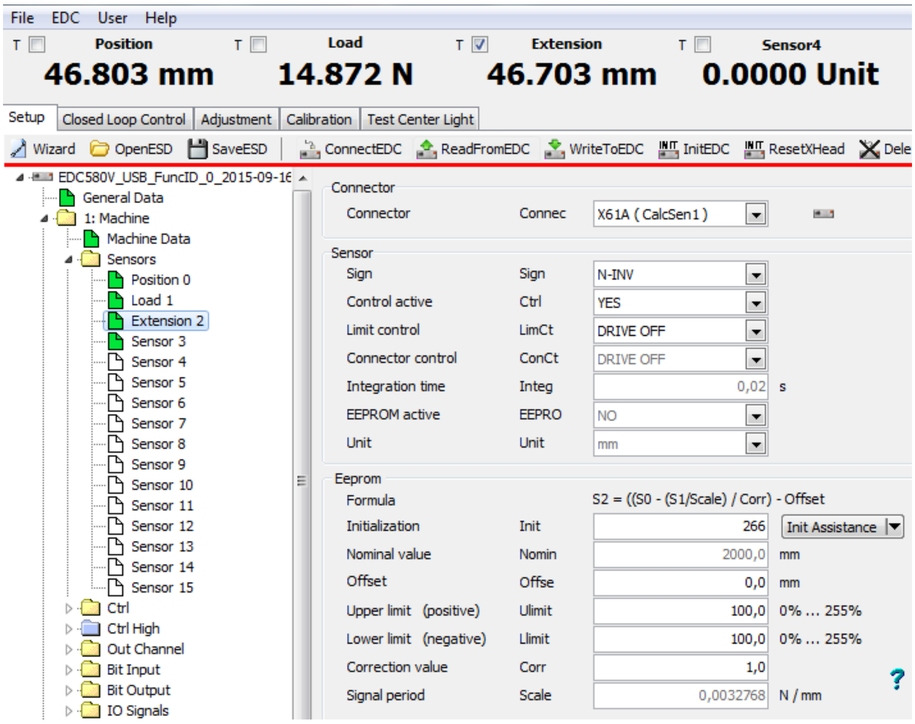


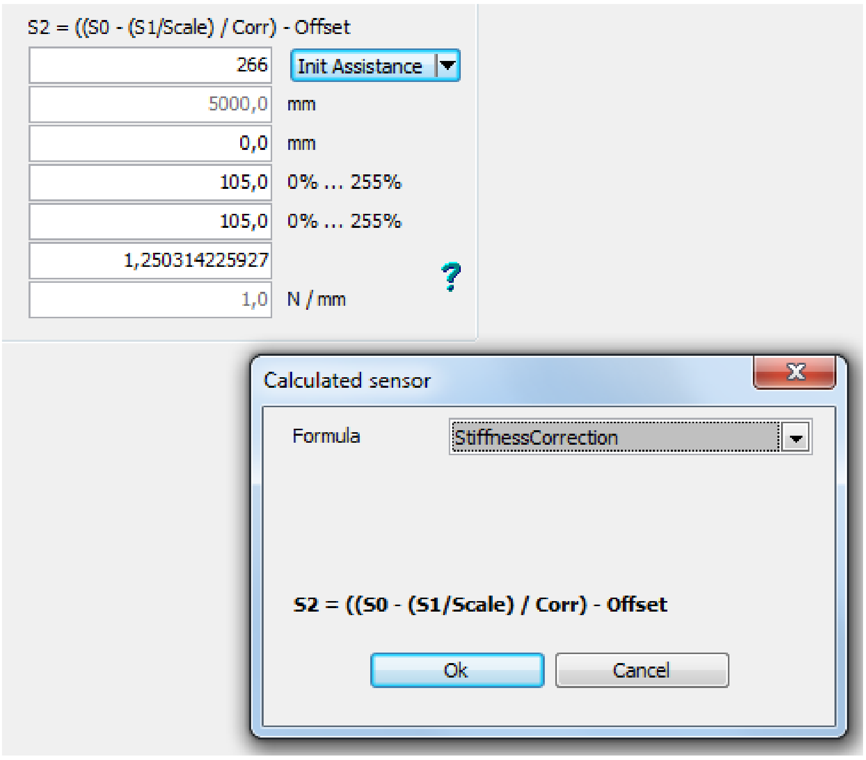
Fig. 145: Examples of Sensor Info, situations 1, 2 and 3.

6 How to …

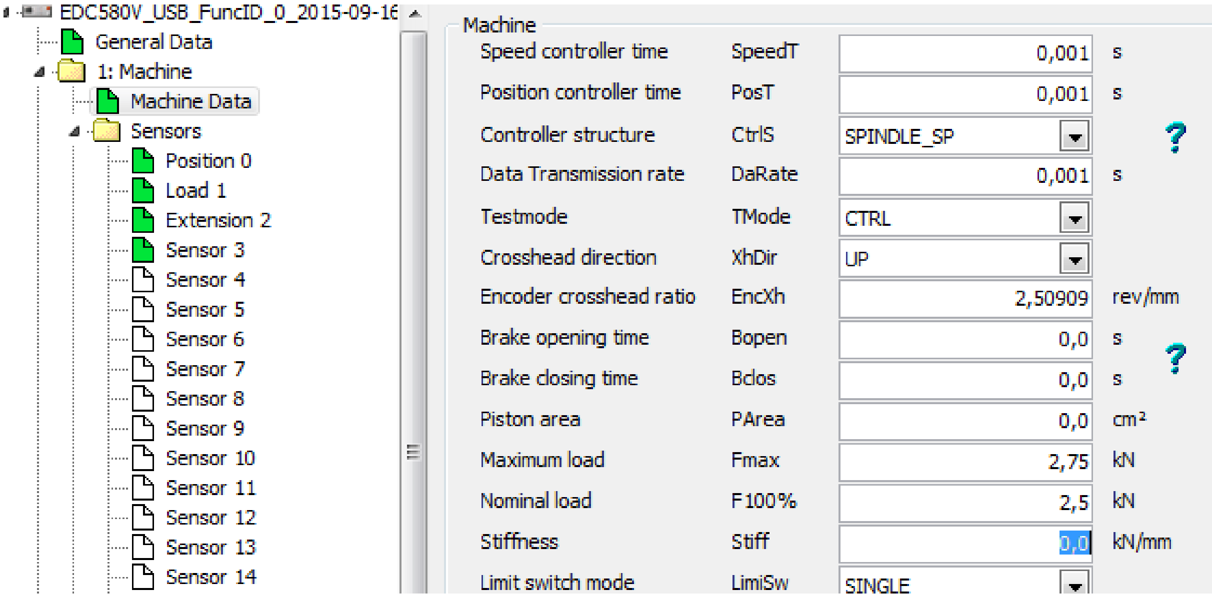
6.1 How to correct machine stiffness

1. Define an extension sensor in your setup. Use calculated sensor e.g. X61A and select StiffnessCorrection as formula:

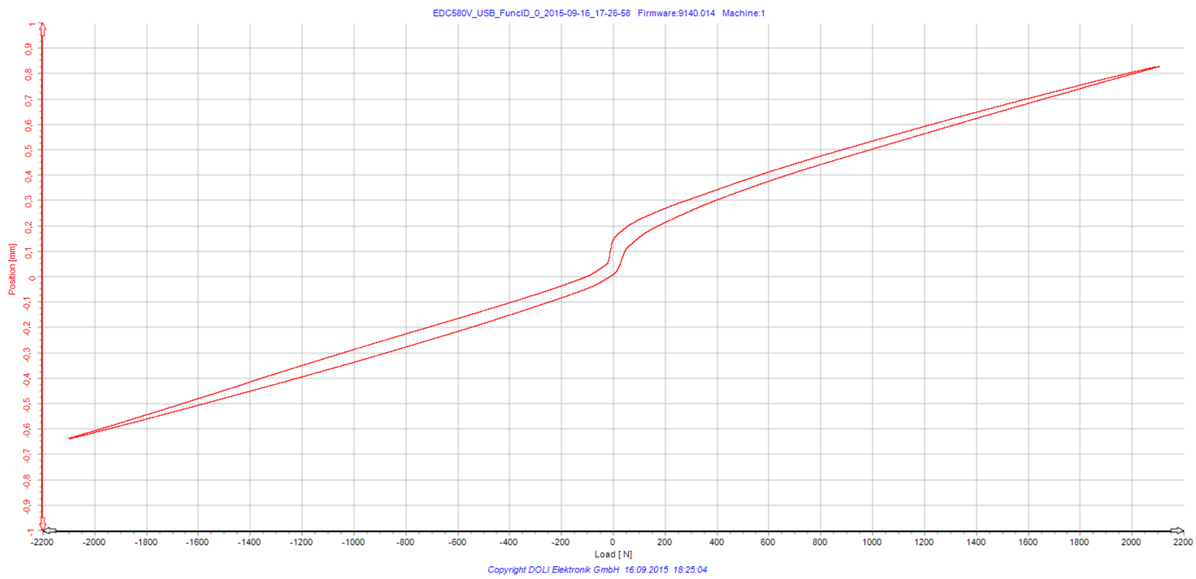




2. Check the parameter Stiffness in your machine data.
In case the stiffness is a linear function, just enter the stiffness in kN/mm here and you are ready.
For nonlinear stiffness enter 0 kN/mm here and do the following steps:

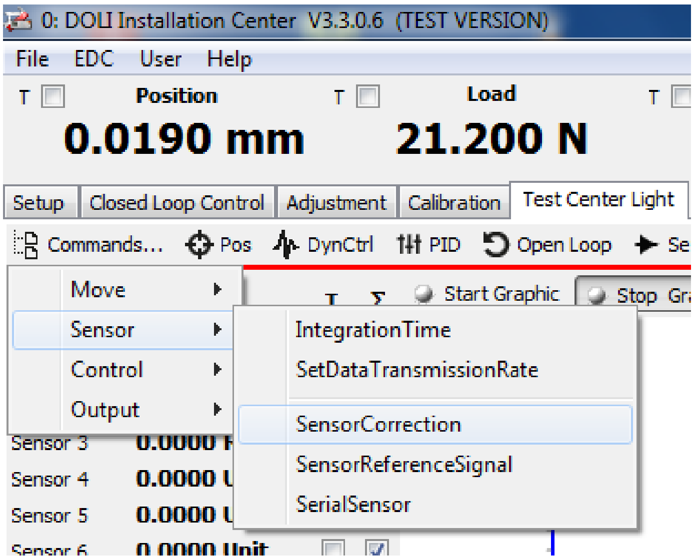


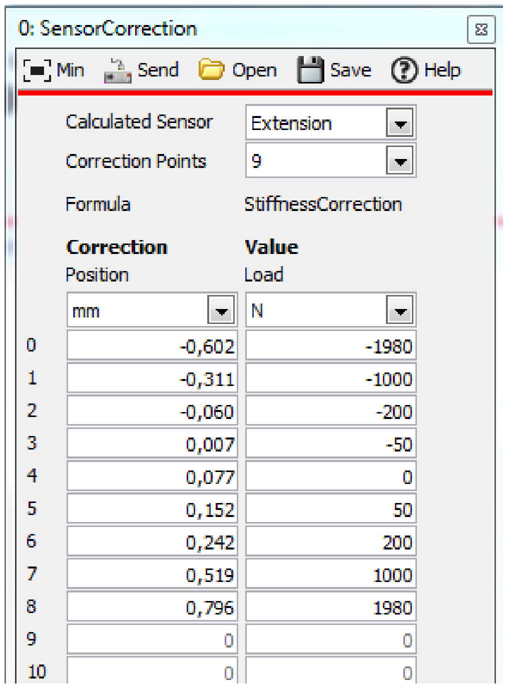
3. Normally the stiffness is not a linear function and is also depending on the machine configuration like grips, etc. For nonlinear stiffness you must first measure the machine deflection. You may use DOLI Installation Center or your application program and move the machine from e.g. -100% to +100% load and take a graph position over load.



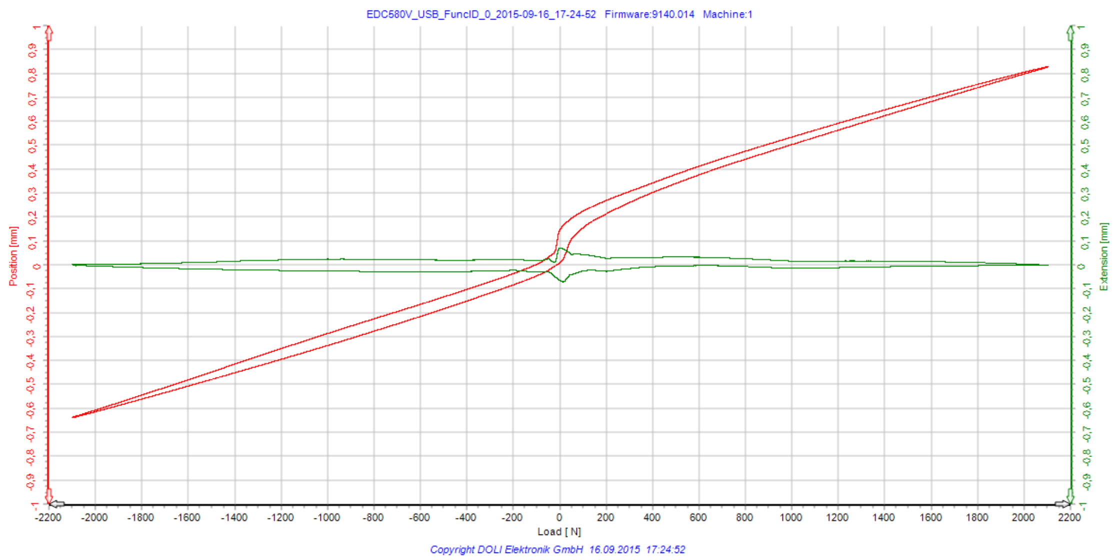
In the example above we took the graph from -100% to 100% and back to -100% load.

4. Now create the StiffnessCorrection table and define the machine deflection at different load positions. The table must be organized from smaller to bigger load values. You may enter the table in the SensorCorrection dialog of DOLI Installation Center:



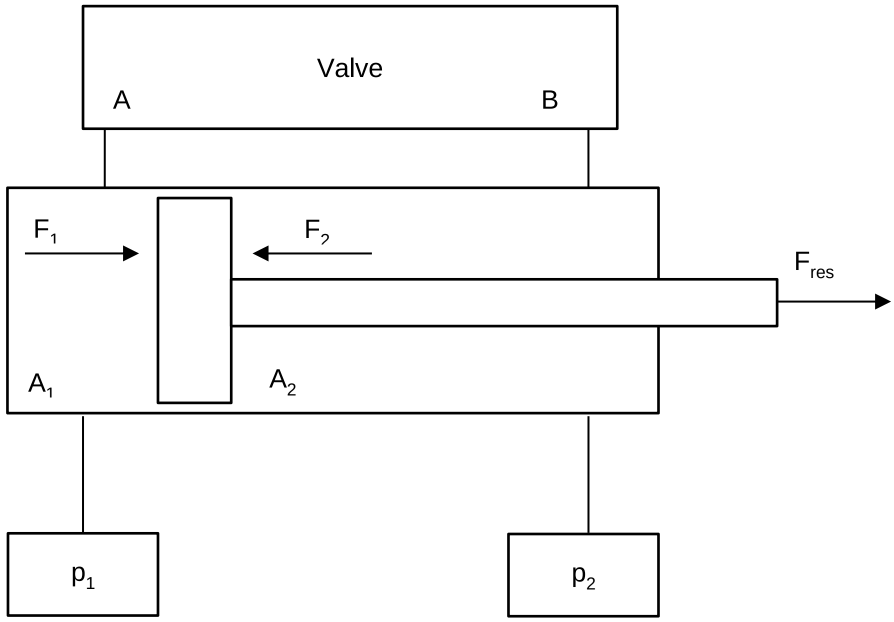


5. After sending the table to EDC, you repeat the test -100% to 100% and back to -100% load and show position AND extension over load in your graph. The extension should be more or less a straight line around 0mm. In case the result does not meet your requirements, you must optimize the correction points!



6.2 How to measure load with a differential cylinder

6.2.1 Principal diagram of a differential cylinder with two pressure transducers



$F_1 = A_1 \times p_1$

$F_2 = A_2 \times p_2$

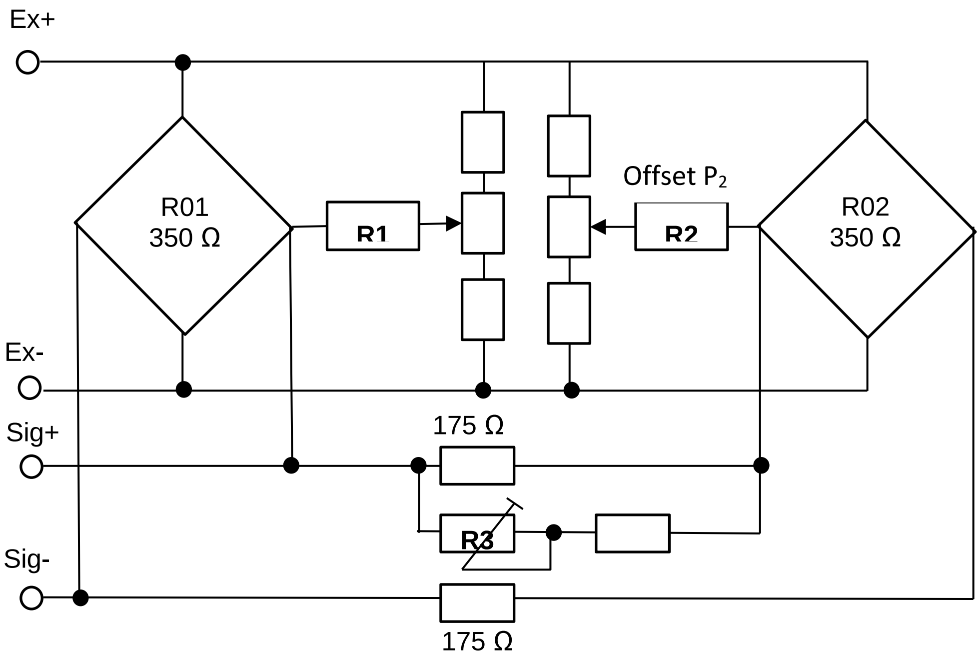
$F_{res} = F_1 - F_2$

6.2.2 Analogue solution

$$\frac{F_{res}}{A_1} = \frac{A_1 \times p_1}{A_1} - \frac{A_2 \times p_2}{A_1}$$

For $A_1 = 2A_2$:

$$\boxed{\frac{F_{res}}{A_1} = p_1 - \frac{p_2}{2}} \text{ or } \boxed{\frac{F_{res}}{A_1} = p_1 - \frac{A_2}{A_1} \times p_2}$$



$$\frac{R_x + R_{02}}{R_{01}} = \frac{A_1}{A_2} \rightarrow R_x + R_{02} = \frac{A_1}{A_2} R_{01} \rightarrow R_x = \frac{A_1}{A_2} R_{01} - R_{02}$$

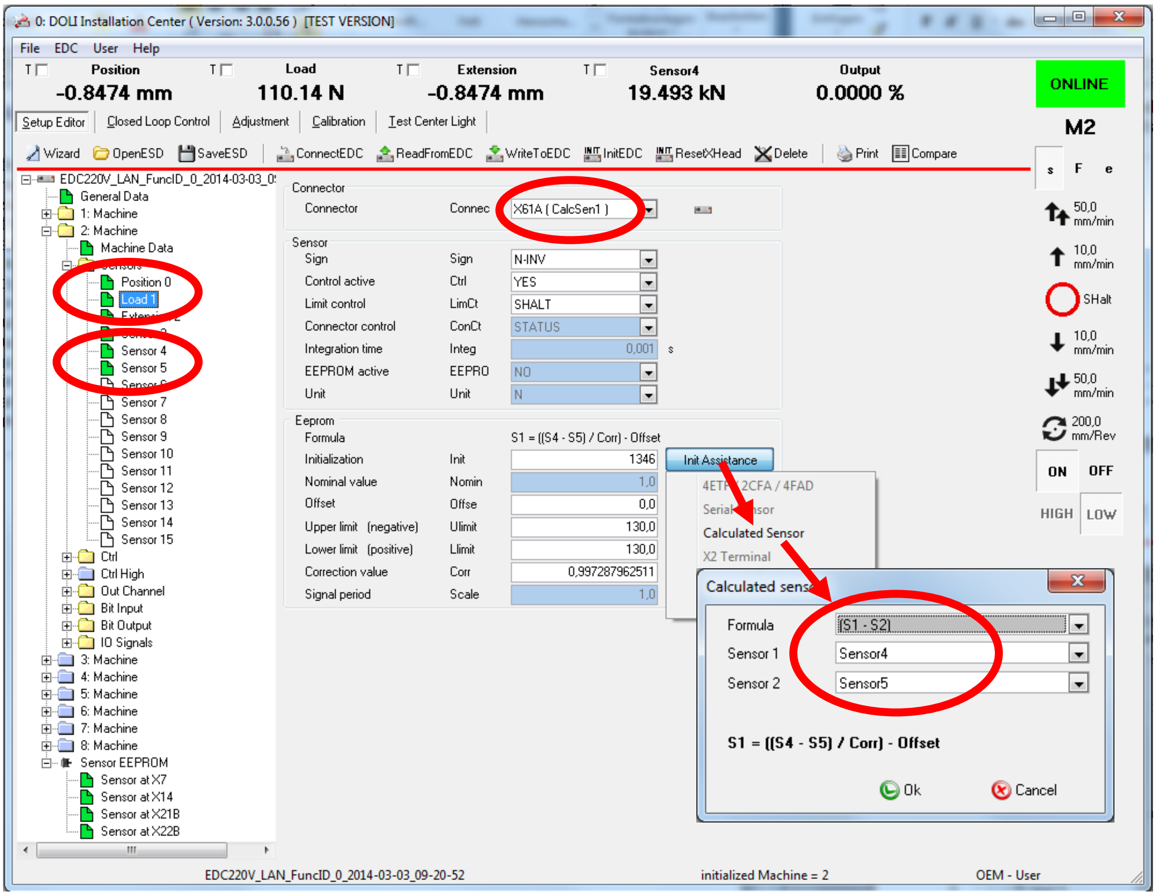
→2x350 Ω - 350 Ω = 350Ω

Adjusting:

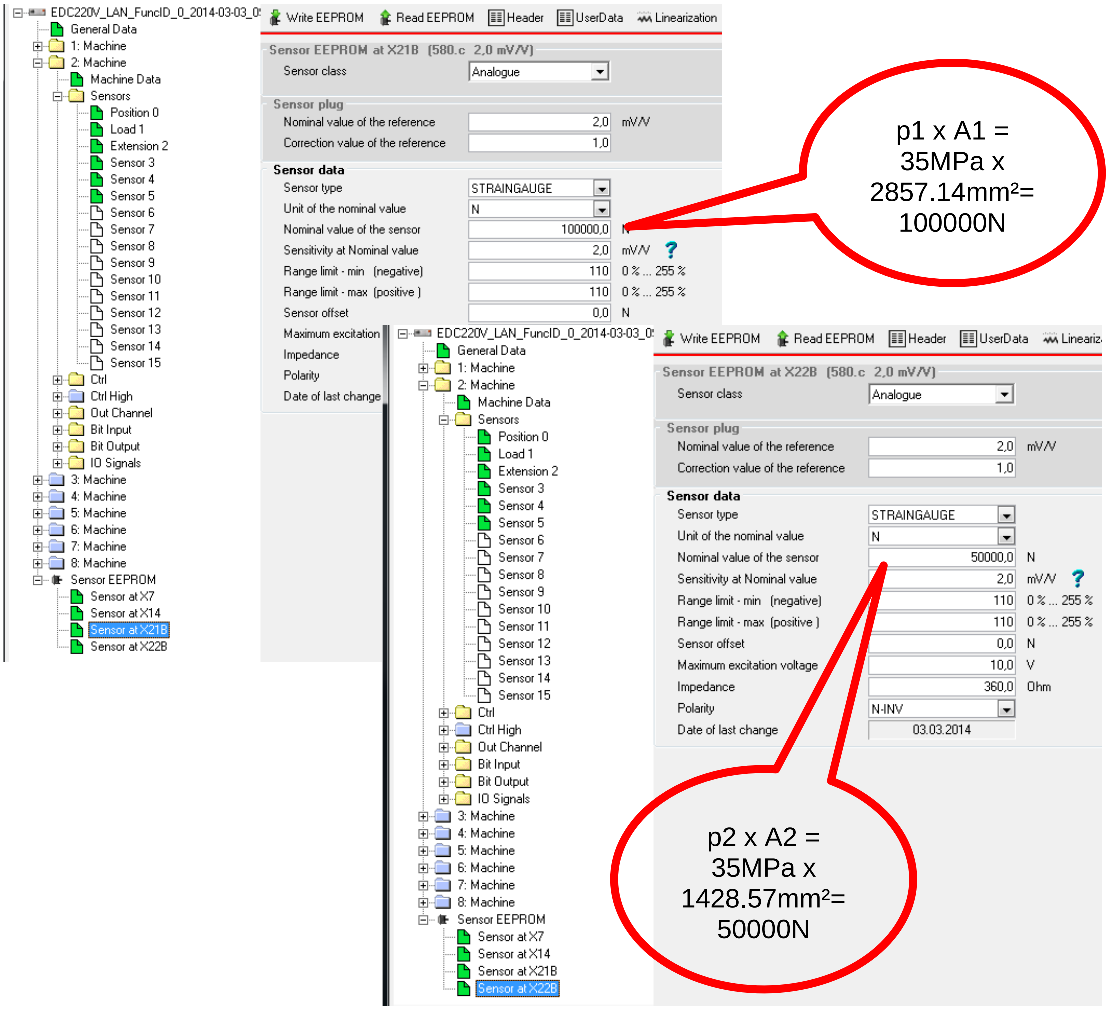
1. Set the piston to the middle position.
2. Open jumper B1 and B2. Make sure there is no tare and basic tare for the load channel! Adjust R1 until load display is ZERO.
3. Close jumper B1 and B2. Adjust R2 until load display is ZERO.
4. Start your pump. The machine should hold in position control. Adjust R3 until load display is ZERO.
5. You have to set the piston area A1 in the EDC´s machine setup parameter PArea.
6. Now adjust the different pressure sensor with the EDC adjustment program.

6.2.3 Digital solution

1. Define pressure transducer 1 (P1) as e.g. Sensor4 and pressure transducer 2 (P2) as Sensor5. For the load channel use a calculated sensor (X61A) and enter S1 – S2 as formula.



2. Adjust each pressure transducer separately in pressure, using a reference pressure transducer.
3. Now change unit to N, and nominal value to nominal pressure x piston area.
   e.g. nominal pressure = 35 MPa piston area = 2857mm² nominal load = 100000N



4. Check zero load reading:
   For a horizontal cylinder, move cylinder in a middle position.
   For a vertical cylinder, move cylinder to the low position.
   Switch the hydraulic pressure off and wait until the load reading is stable.
   Load and the value of the two pressure transducer must be ZERO. If not, change the offset of the pressure transducer.
5. Switch the machine on and move it to a middle position. The load reading of a horizontal cylinder must be ZERO, and a vertical cylinder must display the weight of the cylinder.
6. Check the adjustment with a reference load cell.

6.3 How to calculate digital command output frequency

The frequency of the digital command output depends on:

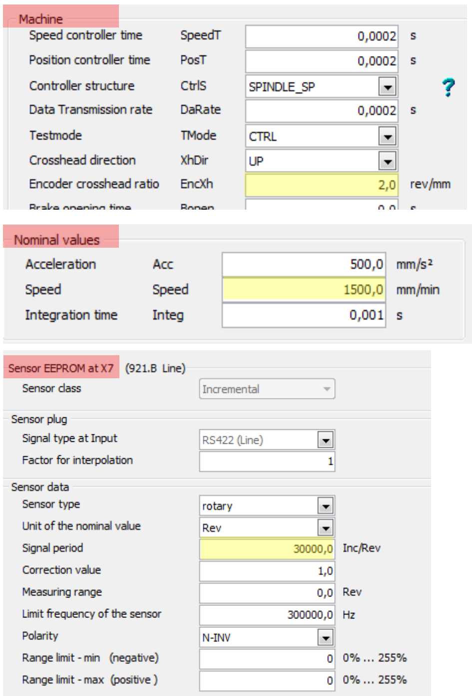
- Nominal speed of the machine
- Encoder cross head ratio
- Resolution of the encoder

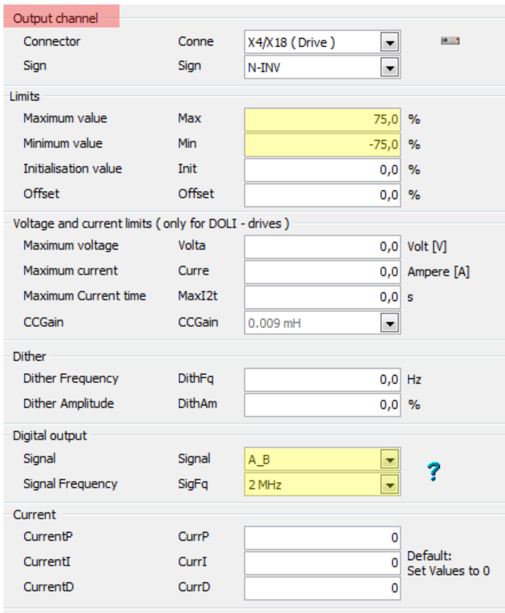
It is also limited by the maximum input frequency of the drive unit and of course the maximum output frequency of the EDC.

Example:

Nominal speed:	1500 mm/min (25 mm/s)
Encoder cross head ratio:	2.0 rev/mm
Resolution of the encoder:	30000 inc/rev
At nominal speed the motor turns with:	1500 mm/min * 2.0 rev/mm = 3000 rev/min (50 rev/s)
The pulse frequency at nominal speed is:	50 rev/s * 30000 inc/rev = 1500000 inc/s (1.5 MHz)

Next possible frequency of EDC is 2 MHz, which means the nominal speed is reached at 75% of the EDC output signal.





6.4 How to get EDC Firmware and Tools

EDC firmware and tools can be downloaded from our website (username and password are required).

http://www.doli.de

Service->Downloads EDC->Software

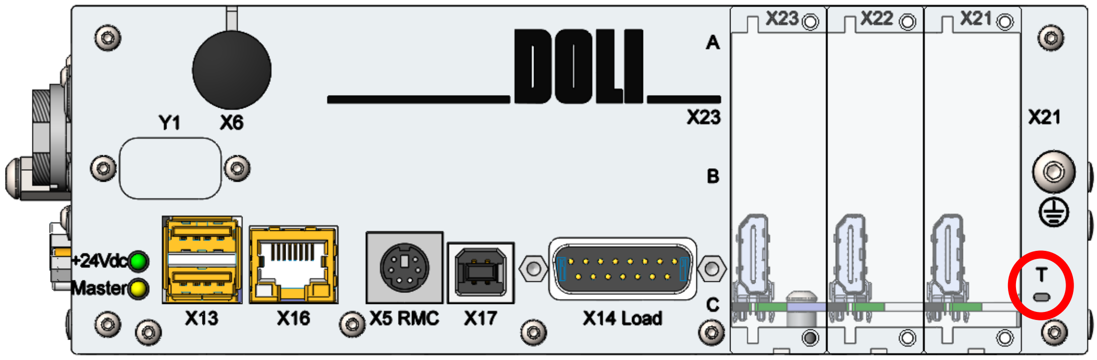
Available tools:

- DOLI Installation Center.
- DoPE Programming Interface.
- EDC Firmware.
- DOLI Language Manager.
- DOLI Remote Support.

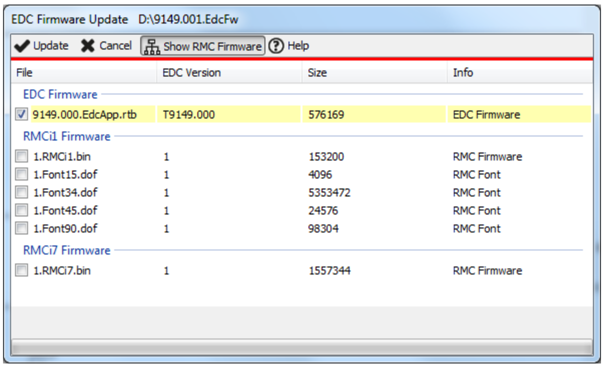
6.5 How to download EDC firmware

1. Download the latest firmware for your EDC and the DOLI Installation Center (see chapter 6.3).
2. Connect the PC via LAN or USB to the EDC. If the EDC can communicate with the PC normally, go to step 6.

3. In case an EDC will not start as usual and no communication with a PC is possible, there is another chance to flash a new firmware by following the next steps.
4. Switch EDC power supply off.
5. Use a small screw driver and press the key behind the small hole marked with **T**. (see picture below)



6. Switch EDC power supply on and wait for about 30 seconds.
7. Start the DOLI Installation Center and select Menu->EDC->EDC Firmware Update.
8. Select LAN or USB on screen and connect to the EDC.
9. Open the firmware file.
10. Select the EDC firmware. Yellow items are newer than the EDC versions. Normally the RMCs need not to be updated.



EDC Firmware Update D:\9149.001.EdcFw

Update | Cancel | Show RMC Firmware | Help

File	EDC Version	Size	Info
EDC Firmware			
[x] 9149.000.EdcApp.rtb	T9149.000	576169	EDC Firmware
RMCi1 Firmware			
[ ] 1.RMCi1.bin	1	153200	RMC Firmware
[ ] 1.Font15.dof	1	4096	RMC Font
[ ] 1.Font34.dof	1	5353472	RMC Font
[ ] 1.Font45.dof	1	24576	RMC Font
[ ] 1.Font90.dof	1	98304	RMC Font
RMCi7 Firmware			
[ ] 1.RMCi7.bin	1	1557344	RMC Firmware

11. Press the Update button and the new firmware is flashed to the EDC. This can take some minutes (up to 30 minutes, if Font34.dof is selected).
12. When finished, you get a message with the save EDC setup file location.
13. The EDC resets. Wait for about 30 seconds.
14. Connect again to the EDC and write the saved setup file to the EDC.

15. In case a RMCi is not responding after a firmware update, the recovery mode should be entered. Keep the DigiPoti key pressed, while powering on the RMCi.
16. The RMCi loader version appears on the display.
17. Perform a new RMCi firmware update by repeating steps 7 to 11.

6.6 How to create and download a user logo

If enabled in setup, a user defined logo is displayed during system test at the EDC display.

1. Create your logo with a PC tool and save it as PNG file.
2. RMCi1/RMCi8 has a maximum of 400 x 200 color pixels.
3. RMCi6/RMCi7 has a maximum of 128 x 50 monochrome pixels.
4. Write the logo to the EDC, enable the logo in the EDC setup and write the new setup to the EDC.

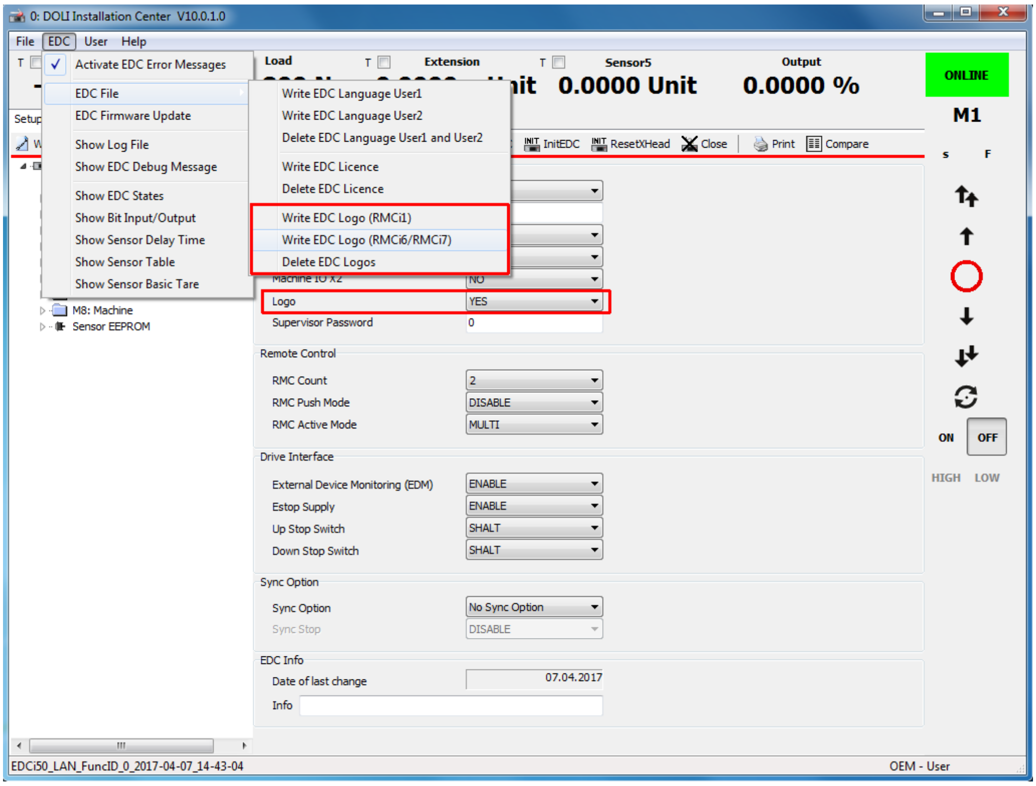
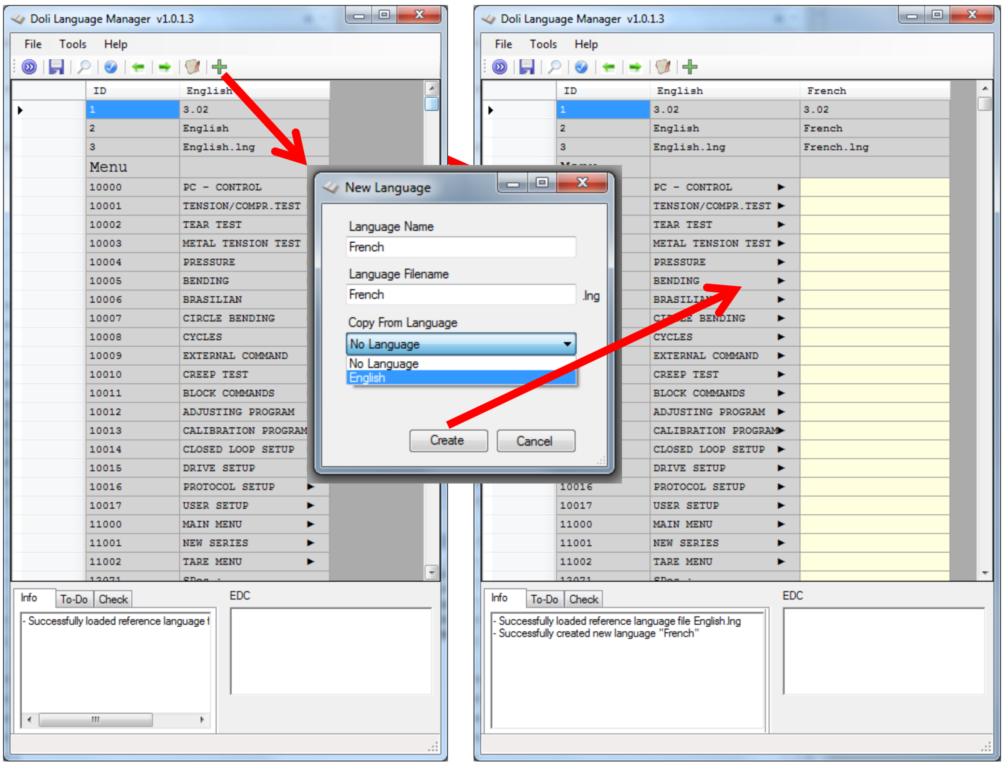


Fig. 146: EDC user logo download

6.7 How to translate the EDC Menus

Each EDC firmware has English and German Menus build in. Another two languages may be downloaded and selected in EDC-Setup. The free English language file can be ordered for each EDC firmware version. A user defined language may be created with the help of the DoliLanguageManager.

1. Download the DoliLanguageManager (see chapter 6.3). Unzip the file into a directory.
2. Download the latest EDC firmware (see chapter 6.3). Unzip the file into the same directory.
3. Delete all files in this directory except:
   DoliLanguageManager.exe
   Manual.pdf
   English.lng
4. Start **DoliLanguageManager.exe** and click the **+** button**,** define your language name and create it:



5. Now you may translate all menu items you need. Then save your language file on PC.
   Please Note:
   - You do not need to translate all items. Not translated items will be displayed in English.
   - DO NOT exceed the English text length.
   - Check the language file version (here V3.02) if you use a later firmware. In case the version has changed, you must update your translation.

6. Start the DOLI Installation Center and write your created language file to EDC. Choose Language User1 or Language User2:

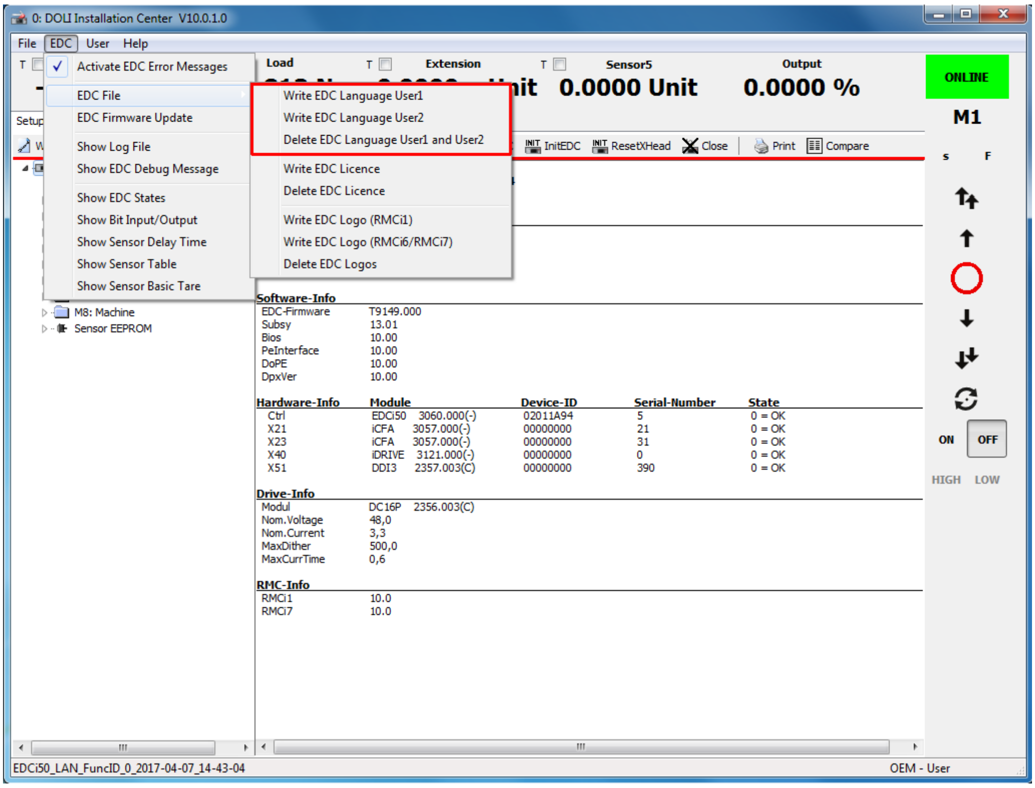


Fig. 147: EDC language file download

6.8 How to download a EDC licence file

Some of the standalone tests in the EDC need a licence (see EDC pricelist). The licence file for one or several tests must be downloaded to the EDC.

Start the DOLI Installation Center and write your licence file to the EDC:

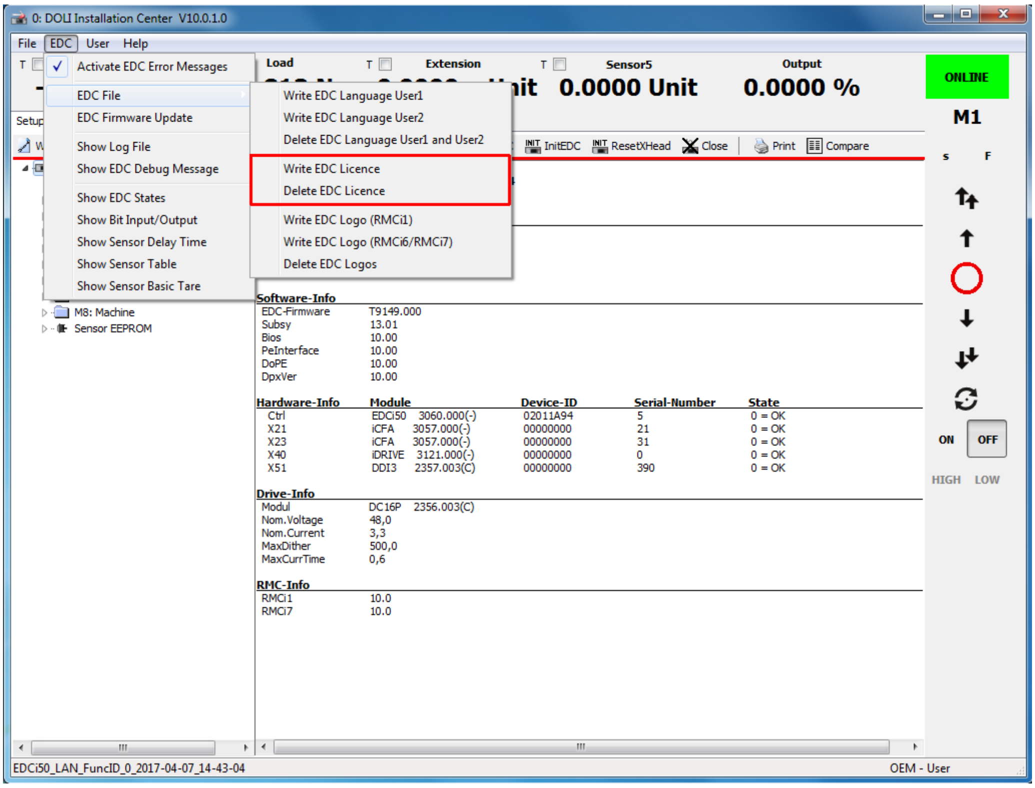


Fig. 148: EDC licence file download

6.9 How to continuously turn a sensor in one direction

If you continuously turn an incremental rotary sensor in one direction, you can get problems, if exceeding the internal 32-bit range limit of the EDC. To overcome the range limit, check the following hints:

- Set Crosshead Initial Mode in machine data to MANUAL.
- Set Crosshead Initial Value in machine data to 0.0
- Set Limit Control in sensor data to STATE.
- Don’t use DoPE taring commands for this sensor.
- Only use DoPEFMove (UP/DOWN) command for movement.

6.10 How to use calculated sensors

To use multiple physical sensors as one in the EDCi, it is possible to create up to four calculated sensors (X61A to X61D).

For example, the sum of three load cells as load channel.

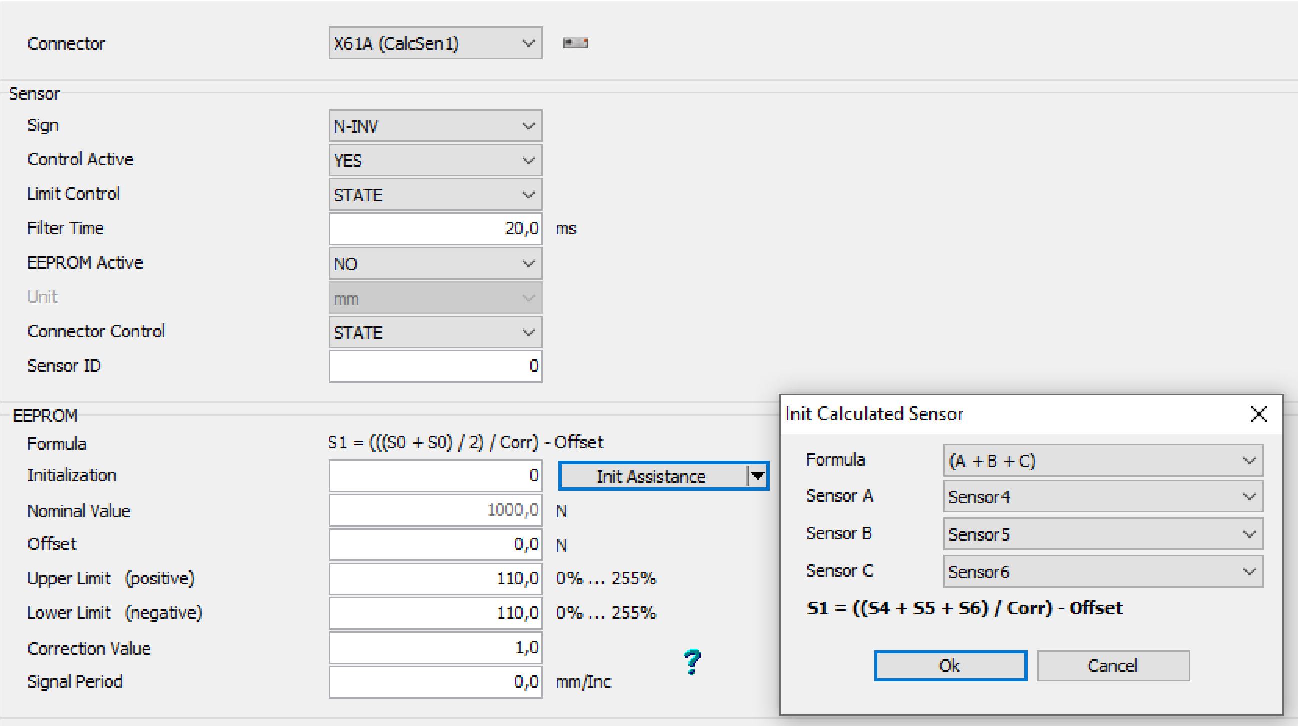
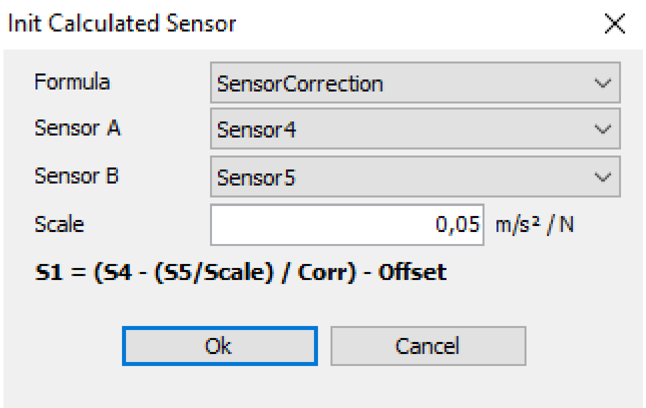


Fig. 149: Calculated sensor, sum of three load cells as load channel

There are several formulas which can be used, with some restrictions as shown in the following table.

Table 72: Calculated sensor formulas

Formula	Comment
All	- Only physical sensors (A to D) can be used. Calculated sensors can't be used for sensor A to D. - The limits for each single sensor must be set right and activated, there is no limit monitoring for the calculated sensor.
(A + B) / 2 (A - B) (A + B + C) / 3 (A + B + C) (A + B) (A + B + C + D) / 4 (A + B + C + D)	**General:** - All Sensors (A to D) must have the same physical unit. - It is only possible to use one type of sensor in a formula, combinations are not allowed ○ All single sensors (A to D) incremental ○ All single sensors (A to D) SSI-interface ○ All single sensors (A to D) analog **Incremental Sensors:** - The used sensors in the formula (A to D) must show the same "Signal Period" - If the sensor hardware has different resolution, the difference must be corrected with the "Correction Value" in each sensor (A to D). Though it doesn't matter if the sensor with the higher or lower resolution will be adapted.

Formula	Comment
	SSI-interface sensors: - The used sensors in the formula (A to D) must show the same “Signal Period” - If the sensor hardware has different resolution, the difference must be corrected with the “Correction Value” in each sensor (A to D). Though it doesn’t matter if the sensor with the higher or lower resolution will be adapted. **Analog sensors:** - All sensors with the same unit, (also with different resolutions) can be used in a formula.
StiffnessCorrection	Correction of the machine frame deformation. Position (S0) is corrected by the Load (S1) with the “Stiffness” value in the “Machine Data” or with a stiffness table by using “DoPESetStiffnessCorrection”. (see also chapter 6.1) - Position unit must be mm - Load unit must be N - Different sensor types can be used (analog, incremental, SSI-interface)
SensorCorrection	Correction of any sensor by any other sensor with a scale factor or with a correction table set by DoPESetSensorCorrection - Different kind of sensors (analog, incremental, SSI-interface) can be used - Sensors may have different physical units - The unit of the calculated sensor is the unit of sensor A For example, this formula can also be used for acceleration compensation of a moving load cell. - Sensor 4 → uncompensated load (N) - Sensor 5 → acceleration sensor attached to the loadcell (m/s²) - Scale → the approx. reciprocal value of the moving mass on the specimen side (1/kg). E.g. 20 kg → scale = 0,05 m/s²/N 

7 EDC Diagnosis Tools

This chapter provides descriptions of diagnosis tools in the Installation Center software.
Start the DOLI Installation Center, select **Menu->EDC** and a dialog opens with the tools:

- Activate EDC Error Messages
- EDC Debug Message
- EDC States
- Bit Input/Output
- Sensor Basic Tare

Use these tools for system overview, diagnosis and troubleshooting.

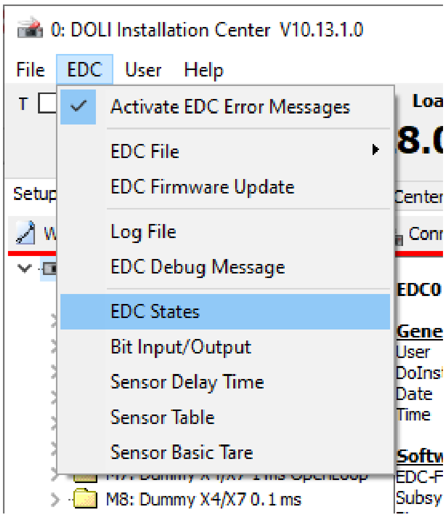


Fig. 150: EDC Diagnosis Tools

7.1 EDC Error Messages

If diagnosis tool EDC Error Messages is activated, system messages come up on screen.

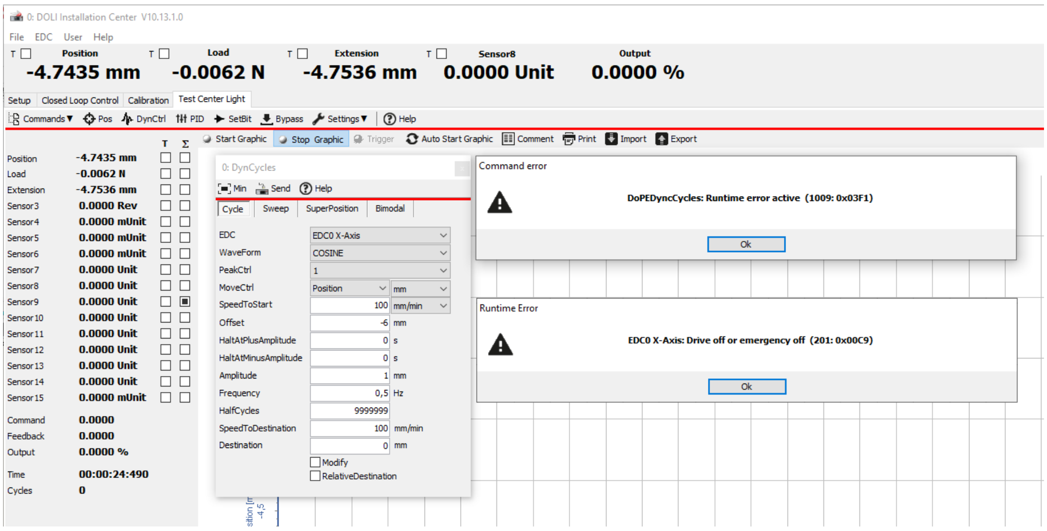


Fig. 151: EDC Error Messages

This figure shows error messages for starting the command DynCycles in Drive OFF state (on top) and the message if E-Stop buttons are pushed (on bottom). Messages at the end of initialization are described in chapter 7.6.

If a deviation error in closed-loop controller occurs during command execution following message come up on screen.

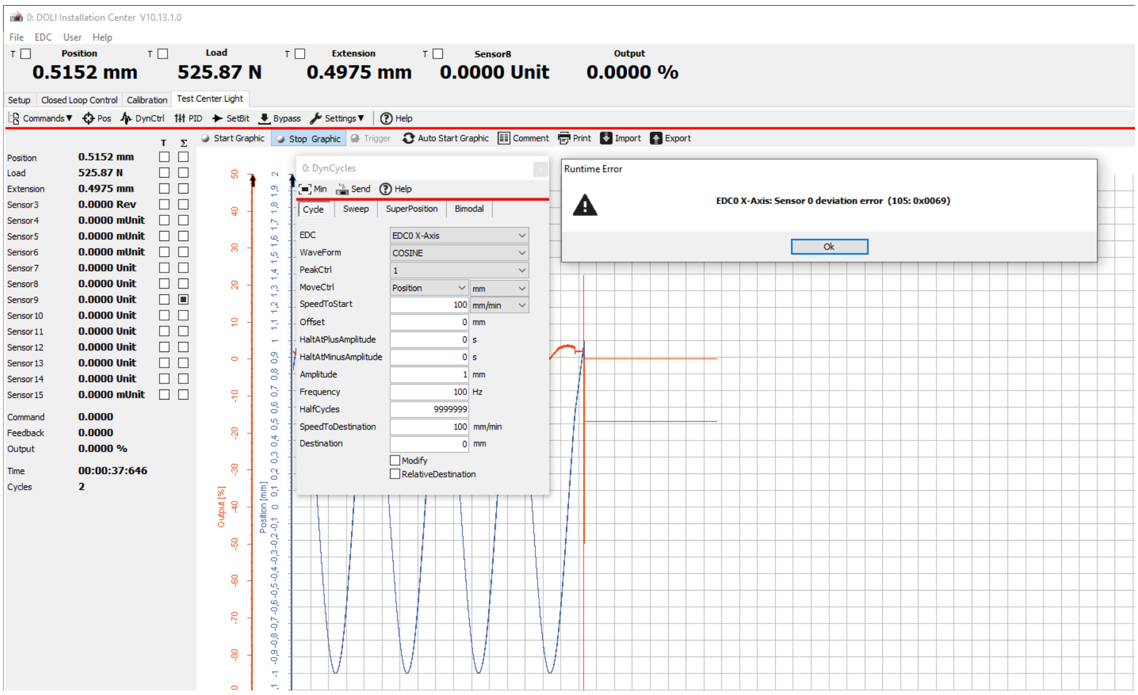


Fig. 152: EDC Error Message Deviation error

7.2 EDC Debug Messages

Successful initialization or initialization errors are monitored in the dialog EDC Debug Messages. Further every command to EDC is listed here.

If you are connected to more than one EDC, all EDC debug messages are shown. You can use the EDC Filter button to select a specific EDC.

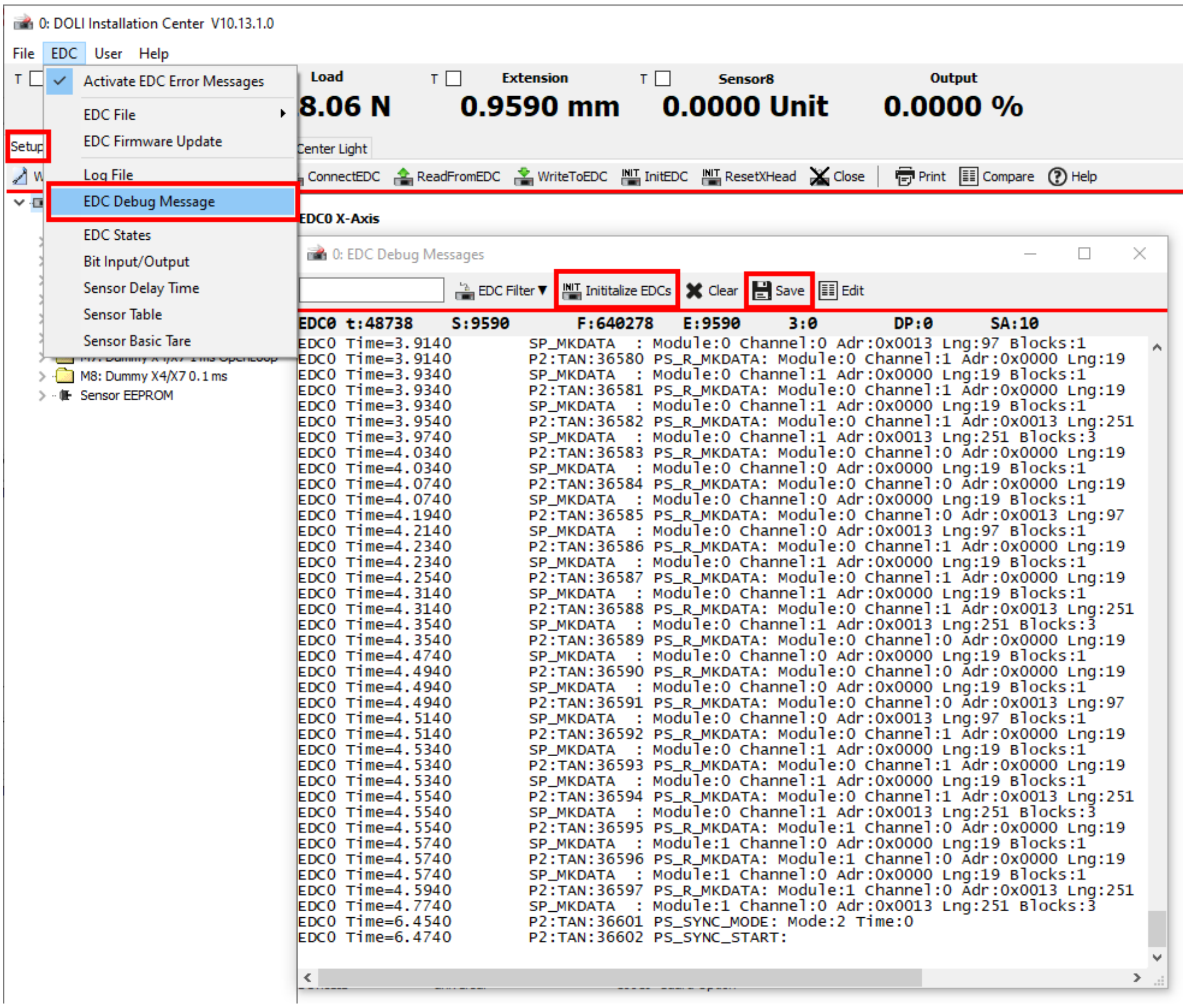


Fig. 153: EDC Debug Messages

1. Select the **setup tab**
2. Select in the main menu **EDC -> EDC Debug Message**
3. Click on **Initialize EDCs** button
4. Wait until initialization is finished
5. **Save** text file
6. Send the file to support department support@doli.de

Additionally, EDC debug messages can be logged to a plugged USB stick at the EDC. To activate this feature, you must create the subdirectory **EdcDebug** in the USB root directory. This feature requires EDC Firmware version 9149.005 or newer.

7.3 EDC States

A complete image of the actual EDC status is monitored in the dialog EDC States. These states give a system overview, provide diagnosis and help in trouble-shooting situations. This chapter is divided into several paragraphs each describing another system status as successful initialization, drive switched on, Emergency-Stop situations, and so on.

Select **Menu->EDC->EDC States** and a dialog is shown.

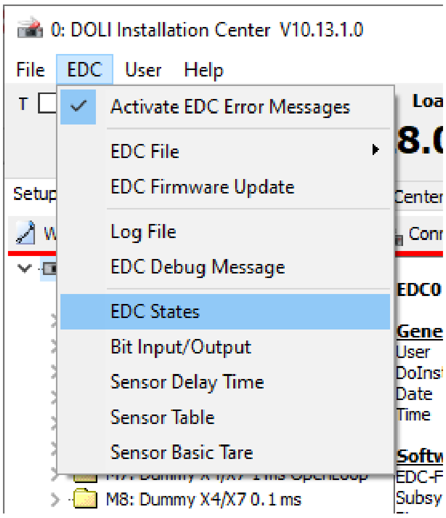


Fig. 154: Select EDC States

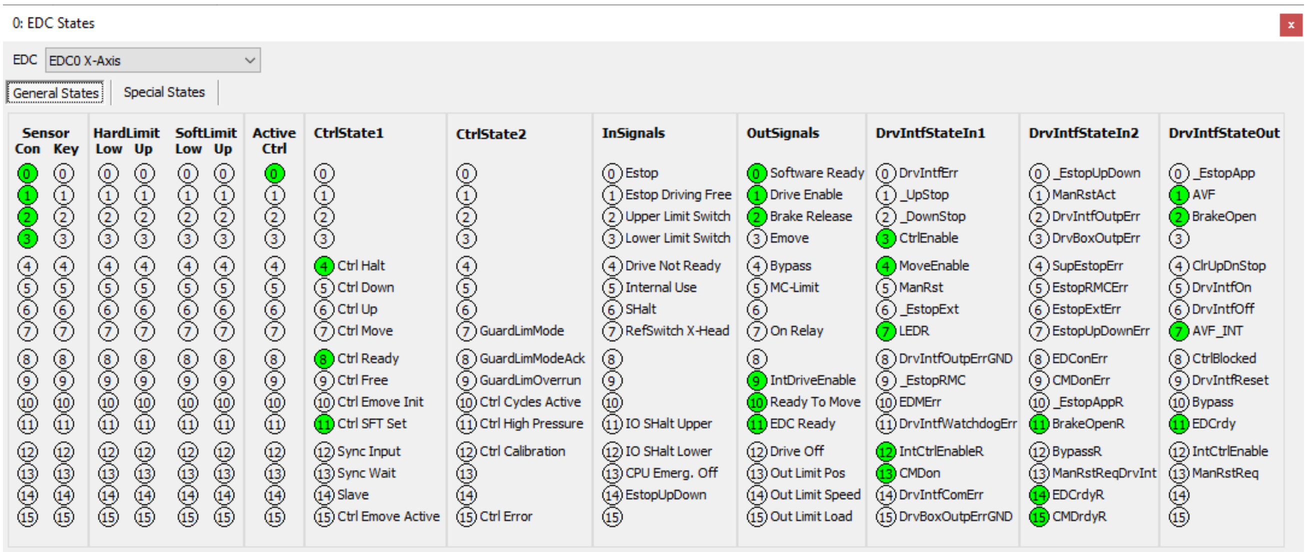


Fig. 155: EDC States

Select the connected EDC to show the states of all relevant internal and external system signals. The dialog itself is independent from EDC setup and system status. Information is given by highlighted (green or red) number of the system signal, which means active state.

All system signals are grouped into the following columns:

Sensor, HardLimit and **SoftLimit**	monitor connected and initialized sensors according to the number in EDC setup; here sensor 0, 1 and 3 are connected. Hard and soft limits are not exceeded.
Active Ctrl, CtrlState1 and 2	monitor the status of the closed-loop controller. Here Position Ctrl 0 is active and in state SHALT. No movement command is sent to EDC.
InSignals and **OutSignals**	monitor general system signals. Important signals are EDC Ready which indicates successful initialization and Ready To Move which indicates that the X-Head of machine can be moved by command.
DrvIntfStateIn1 and 2, DrvIntfStateOut	summarize signals related to X4 or X40 machine interface at Drive Interface or Drive Box. Signals show Emergency-Stop situations and machine control signals.

Note that the dialog monitors internal bits, too. The dialog refreshes automatically every half second.

7.3.1 Successful initialization

The states of a successful initialization are shown in the figure below.

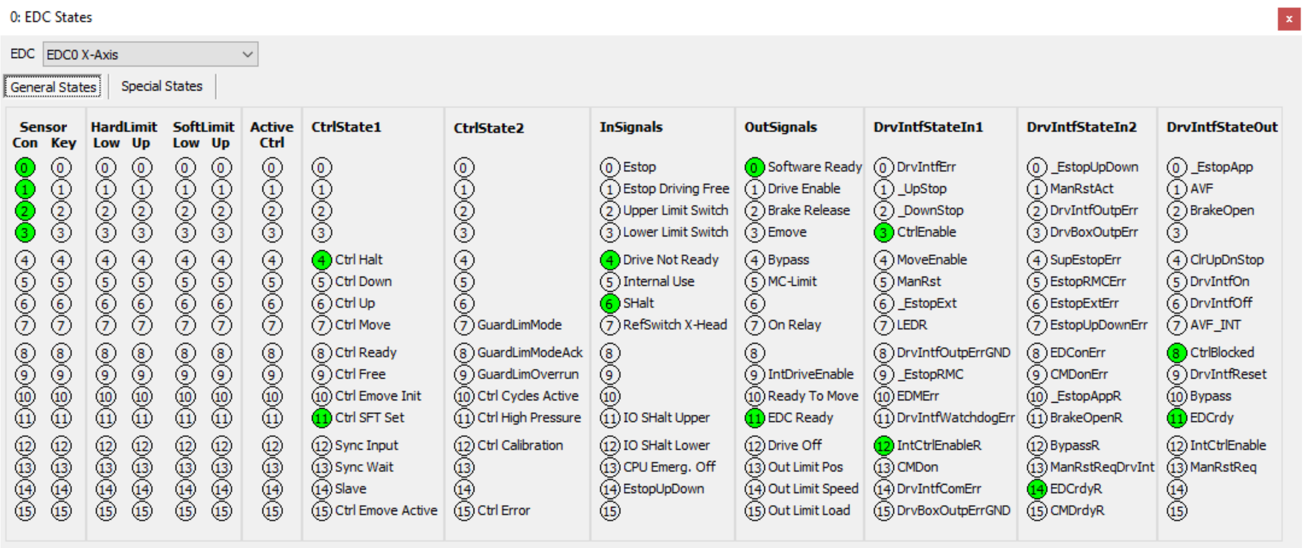


Fig. 156: EDC States at successful initialization

Important signals are

- Sensor/Con0 and Con1 indicate that position sensor and load cell are connected and initialized.
- OutSignals/Software Ready indicates all software checks passed.
- OutSignals/EDC Ready and DrvIntfStateOut/EDCrdy are active that indicates good system health.
- DrvIntfStateIn1/DrvIntErr is inactive that shows machine interface initialized successfully, too.

Next step is Drive On.

7.3.2 Drive On

The states of a successful Drive On are shown in the figure below.

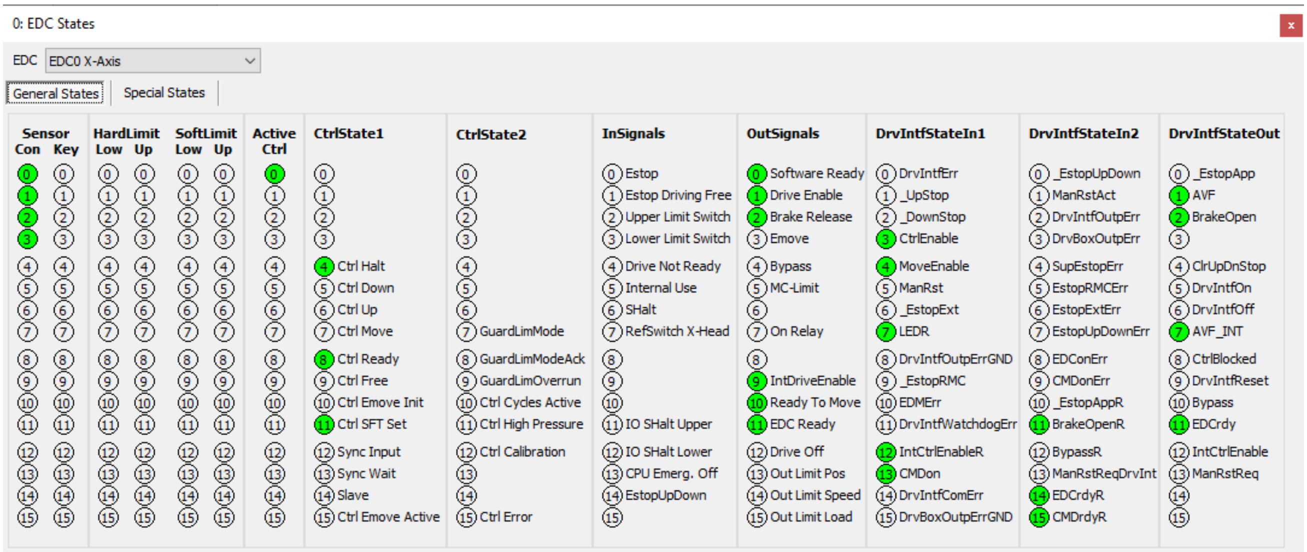


Fig. 157: EDC States at successful Drive On

Important signals are

- ActiveCtrl 0, CtrlState1/Ctrl Ready and CtrlState1/Ctrl Halt means position control of sensor 0 is active and in state HALT.
- InSignals/Drive Not Ready is in OFF State means all signals for drive control are available.
- OutSignals/Ready To Move indicates that the X-Head of machine can be moved by command.
- DrvIntfStateIn1/LEDR and /CMDon indicate active state (+24 VDC) at X4/X40 CMDon outputs for power relays or machine control.
- DrvIntfStateIn1 and 2/_Estop… and InSignals/Estop are inactive, there is no Emergency-Stop situation.
- DrvIntfStateOut/AVF means all internal signal for closed-loop control are available.

Important:

If one of the signals DrvIntfStateIn1/CtrlEnable or /MoveEnable is missing EDC has a successful Drive On **but** closed-loop control is inactive and machine cannot move.

This status is indicated by inactive signal OutSignals/Ready To Move and **flashing DrvIntfStateIn1/LEDR**.

After starting a command e.g. DynCycles

- CtrlState1/Ctrl Move is active;
- CtrlState1/Ctrl SFT Set is inactive;
- CtrlState1/Ctrl Down and Ctrl Up indicate the direction of movement.

7.3.3 Emergency-Stop situation

The states of Emergency-Stop situations are shown in the figure below. Information is provided by red highlighted _Estop signals.

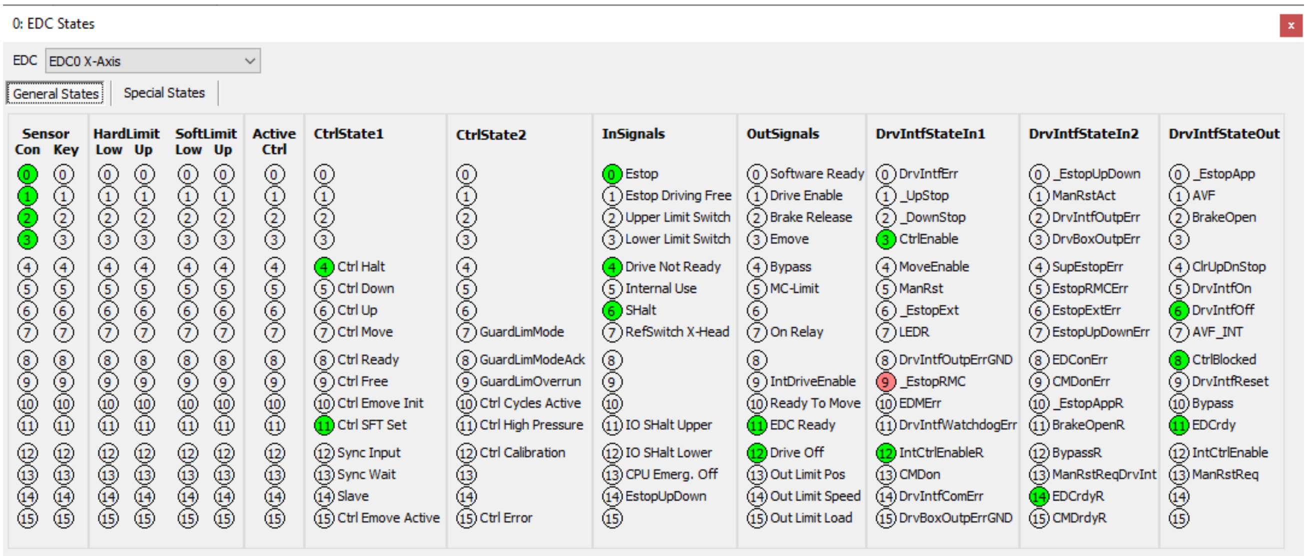


Fig. 158: EDC States at Emergency-Stop situation

Important signals are

InSignals/Estop is active; an Emergency-Stop situation occurs caused by

- DrvIntfStateIn1/_EstopExt if an external E-Stop button is pushed,
- DrvIntfStateIn1/_EstopRMC if an E-Stop button at RMC devices is pushed,
- DrvIntfStateIn2/_EstopUpDown if an UpDown Limit Switch inside the E-Stop circuit has opened,
- DrvIntfStateOut/_EstopApp if an E-Stop signal from PC switches drive off.

Important:

If the signals InSignals/Estop **and DrvIntfStateIn1/DrvIntErr** occur **an error inside the E-Stop circuit** was detected. Drive cannot be switched on. Reasons for this error are indicated by additional system signals:

- DrvIntfStateIn1/EDMErr occurs
  EDM is configured in EDC setup but not employed
  or safety relay connected to CMDon does not work properly.
- DrvIntfStateIn2/EstopRMCErr, /EstopExtErr or EstopUpDownErr occurs
  the indicated safety device switches off one channel only.
  Please make sure that dual channel devices are employed!
- CMDonErr occurs
  Estop Supply in EDC setup General Data is disabled
  and no external supply is connected or short circuit at X4/X40 CMDon pins.

For detailed information on Emergency-Stop and E-Stop circuit see chapter 5.1.6.

7.3.4 Limit monitoring

States during exceeding limits are shown in the figure below.

Status of EDC on the left side is the exceeding of soft limit of position sensor 0, still Drive ON, in position control and closed-loop controller ready for awaiting command from PC.

Status of EDC on the right side is the exceeding of hard and soft limit of load sensor 1, Drive OFF, closed-loop controller inactive and ready to initialize emergency move.

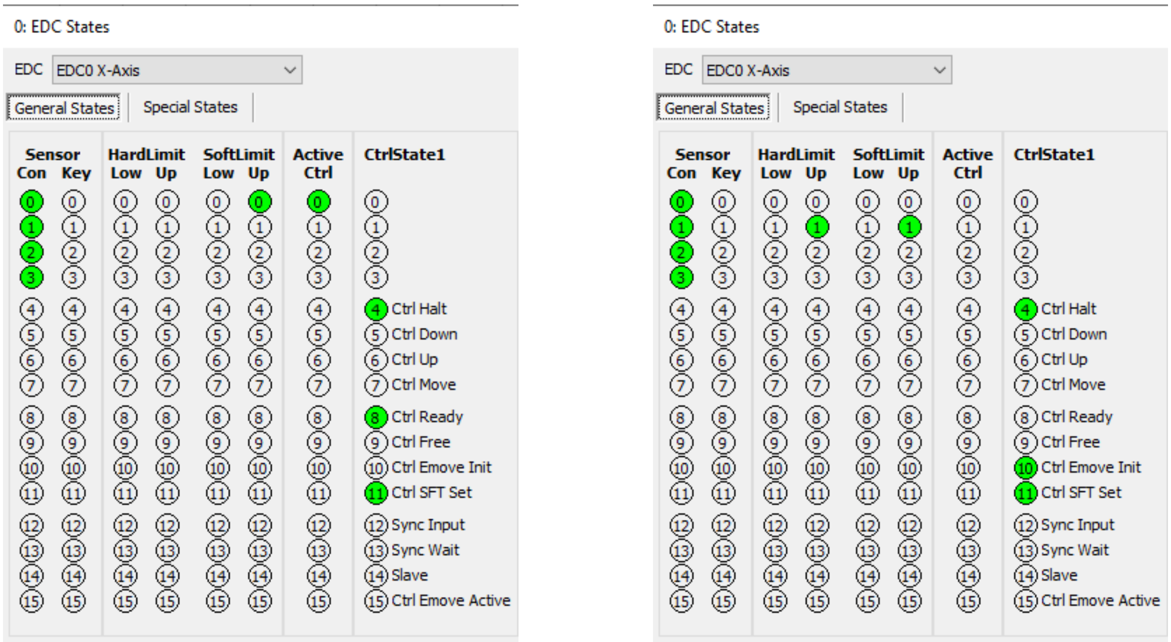


Fig. 159: EDC States of limit monitoring

Important signals for limit monitoring are

HardLimit Low/Up and SoftLimit Low/Up.

Information is given by highlighted (green) number of sensor in one or two of the four columns. Low and Up indicate exceeding lower or upper sensor limit. Depending on EDC setup limit control can be configured in different ways, as Drive OFF, status or action. Additional signals give further information on status:

- Active Ctrl and DrvIntfStateIn1/CMDon inactive indicate a Drive OFF command by limit monitoring function.
- CtrlState1/Ctrl Ready indicates that limit monitoring function has stopped movement of machine, but drive is still switched on and closed-loop controller is in status position control SHALT.
- CtrlState1/Ctrl Emove Init indicates that an emergency move should be the next step.

Important:

Limits can be set in different ways:

- Soft limits by software from PC (DoPE) or by Test Center Light of DOLI Installation Center
- Hard limits are parameters of sensor EEPROMs, see chapter 3.4.
- **Hard limit of load** is additionally monitored by the parameter Fmax of EDC setup Machine Data, see chapter 3.3.

For detailed information on different limits see chapter 5.5.13, too.

7.3.5 Synchronization monitoring

States during synchronization of several EDCs are shown in the figure below. Status of EDC in this figure is Sync Slave, synchronization established, Drive ON, in position control, command from PC in the queue and awaiting a common start command.

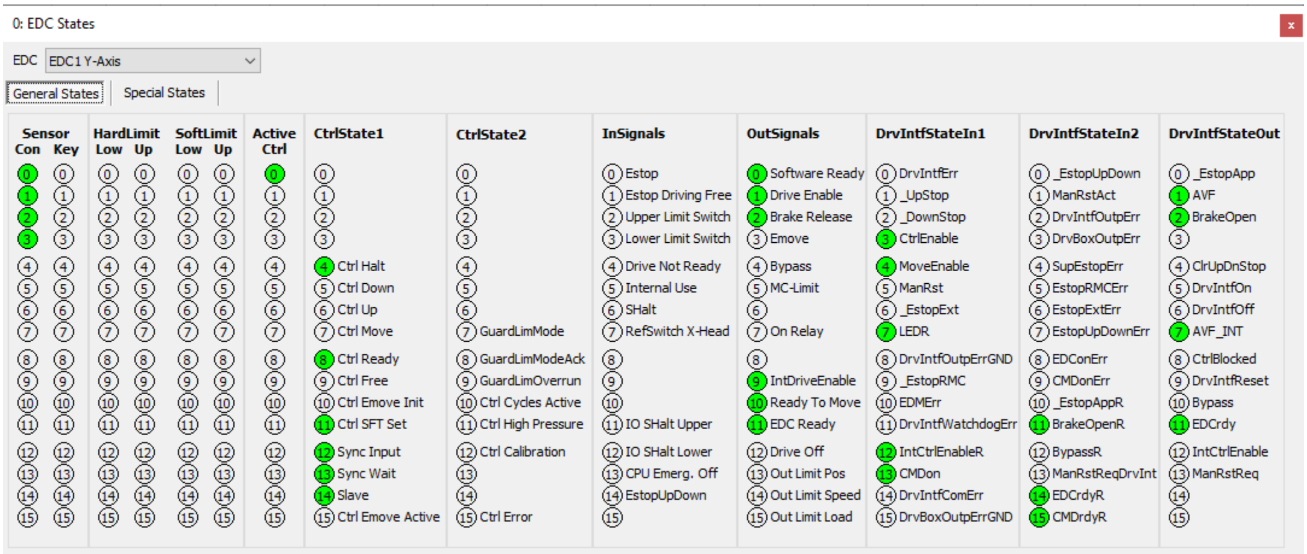


Fig. 160: EDC States of synchronization monitoring

Important signals are

CtrlState1/Sync Input is active; this indicates correctly working synchronization of all EDCs connected to the ring and configured Sync Option in EDC setup. Two additional signals give further information

- CtrlState1/Sync Wait occurs if a command was sent to EDC and the device is waiting for common start command to execute synchronized commands, after initialization or in status Drive OFF and SHALT CtrlState1/Sync Wait is inactive.
- CtrlState1/Slave is active if EDC is configured as Sync Slave in EDC setup General Data.

Important:

If the signal CtrlState1/Sync is inactive or twinkling errors in sync communication protocol are detected. Reasons for these errors are incomplete or wrong wiring if inactive signal and faulty wiring or wrong installation if signal twinkles.

For detailed information on synchronization see chapter 5.1.11.

7.4 Bit Input/Output

The states of all initialized bit devices are monitored in the dialog Bit Input/Output.

Start the DOLI Installation Center, select Menu->EDC->Bit Input/Output and a dialog shows the digital inputs and outputs of all bit devices of EDC. The bit number is shown on top of the dialog. Line In 0 corresponds to the input bits of bit device 0; line Out 1 to the output bits of bit device 1 as defined and initialized in EDC setup located in folder Bit Device.

Bits at level “high” (+24 VDC) are highlighted green.

Note that the dialog monitors internal bits, too. The dialog refreshes automatically every half second.

For definition of bit devices see chapter 3.7.

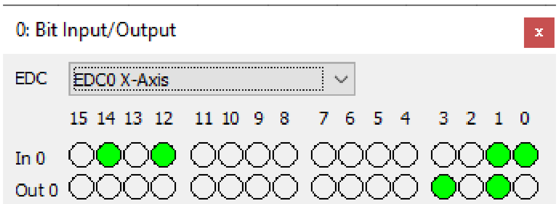


Fig. 161: Dialog Bit Input/Output

For diagnostic issues output bit can be set quickly via PC with the dialog SetBit.

Start the DOLI Installation Center, select Test Center Light and click on SetBit button.

A dialog shows the digital outputs of all bit devices. If AutoSend is activated the output is automatically set by clicking the check box of the bit.

Bits at level “high” (+24 VDC) are marked.

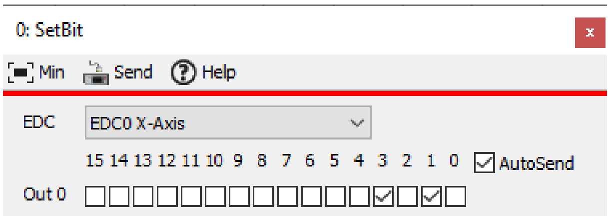


Fig. 162: Dialog SetBit

7.5 Sensor Basic Tare

The values of basic tare of all initialized sensors are shown in the dialog Sensor Basic Tare.

Start the DOLI Installation Center, select Menu->EDC->Sensor Basic Tare and this dialog is shown. Select the connected EDC and you see the basic tare value of each sensor.

The list of sensors corresponds to the defined and initialized one in EDC setup located in folder Sensors.

Sensors with basic tare are marked in the check box and the value of tare is written behind (e.g. Load). Deactivate basic tare by clicking the check box.

Set new value by using second dialog Set Basic Tare Display.

Basic tare is saved on the EDC and still active after switching EDC off and on again.

For detailed information on tare see chapter 5.5.13.

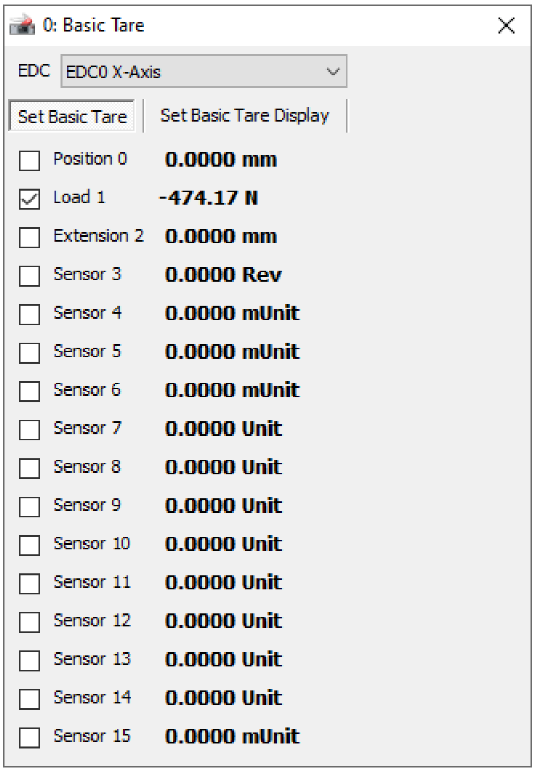


Fig. 163: Sensor Basic Tare

7.6 System Messages and Error Codes

Initialization of EDC ends with the screen of Setup-Editor which shows soft and hardware information about the connected EDC. If initialization was successful, no further messages appears. In case of initialization errors, system messages of every connected EDC are shown in the dialog below.

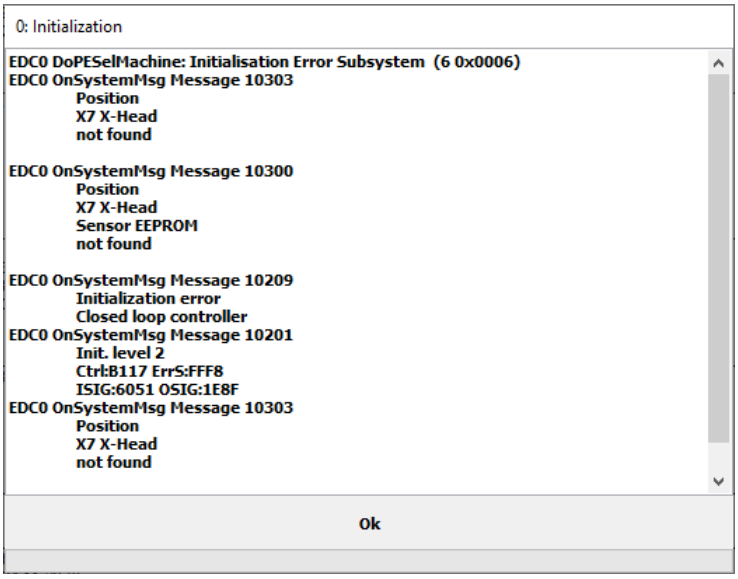


Fig. 164: Initialization System Messages

This figure gives an example of an unplugged position sensor at connector X7. It is important to work on the problem starting from the top of the list. Many other items of the list are consequences of the main problem on top. In standalone mode the RMCi1/RMCi8 display shows only the first error message.

With the system message number, you can find further information on error causes and error clearing in the following table.

Table 73: System message numbers

No.	System Message / Parameter	Error cause / Error clearing
	General runtime errors	
10000	UNKNOWN • Error number • Time • Device number • Bits	Unknown runtime error occurred. • Contact service.
10001	POWERAMP_ERROR • Connector • Drive bits • Drive CPU error	Error at power amplifier. • Error at test signal. Contactor is damaged or not wired correctly. • Turn the EDC off and on, if the error is still active, contact service.
10003	DRIVE_NOTREADY • Connector	Drive not ready. • ON light is flashing. • Check drive. If the error is still active, contact service.
10004	DRIVE_RELEASE • Connector • Drive bits	Drive release withdrawn. • Check drive. If the error is still active, contact service.
10005	UPPER_SENLIMIT • Sensor number • Connector • Upper sensor limit	Upper sensor limit exceeded. • Use emergency drive (press the following key combination simultaneously: **ON/UP** for the cross head movement upwards or **ON/DOWN** for the cross head movement downwards) to bring the sensor within the given range.
10006	LOWER_SENLIMIT • Sensor number • Connector • Lower sensor limit	Lower sensor limit exceeded. • Use emergency drive (press the following key combination simultaneously: **ON/UP** for the cross head movement upwards or **ON/DOWN** for the cross head movement downwards) to bring the sensor within the given range.
10007	LIMITSWITCH	Limit switch is active. • Release limit switch. • Use emergency drive (press the following key combination simultaneously: **ON/UP** for the cross head movement upwards or **ON/DOWN** for the cross head movement downwards) to bring the cross head within the allowed range.

No.	System Message / Parameter	Error cause / Error clearing
10008	DEVIATION • Sensor number • Connector • max. allowed standard deviation	The maximum allowed standard deviation of a control channel was exceeded. • The allowable standard deviation in the EDC control setup was set to low. • Nominal speed of the machine is set to high in the EDC control setup. • Incorrect controlling structure in the machine setup. • Open loop. Change controller output polarity sign in the setup for the output channel of the EDC. • The P value of speed controller in the EDC control setup is too small. • Signal period in the EDC sensor setup or in the sensor EEPROM is incorrect. • Incorrect encoder crosshead ratio in the EDC machine setup (position sensor only). • Controller output maximum or minimum in the EDC output channel is not configured correctly (see error number 1407 OC_PARA).
10009	NODIGIPOTI	Digipoti drive not possible, because a Digipoti is not configured. • Configure the Digipoti in the EDC Setup under **Machine setup → Sensors → Sensor Digipoti** using the following data: Conn: X63A Sign: N-INV SigPe: 15 [INC/Revolution]
10010	NORMC	The remote control (RMC) is not plugged to the connector X5, or the EDC **STOP** key is damaged. • Connect remote control (RMC) to plug X5. • If remote control is not to be used, a jumper must be plugged between pin 13 and 14, to the EDC internal 14-polarity RMC plug at the front board.
10011	EMERGENCY_OFF	Emergency stop is active. • Deactivate Emergency Stop.
10012	NOMEMORY	Not enough free EDC working memory. • Contact service.
10013	NO_LICENCE • EDC option	No licence found. Some EDC options need a licence file (e.g. creep test, guard option, sync option). • Contact service.

No.	System Message / Parameter	Error cause / Error clearing
10014	HARDWARE_VERSION • Module version • Needed minimum version	Incompatible hardware versions (see EDC firmware Version.txt). • New mainboards need new iSI- modules. • Old mainboards accept old and new iSI-modules. • Contact service.
	System EEPROM errors	
10100	SYSEEP_CRC • Block-Number	CRC-Error. Data within the System-EEPROM-Block is invalid. • Delete and re-enter EEPROM-Data (refer to error SYSEEP_NOMEMORY) • Contact service.
10101	SYSEEP_NOBLOCK • Block number	The System-EEPROM-Block could not be found. • Occurs on a new EDC prior to the first writing of setup data. • Delete and re-enter EEPROM-Data (refer to error SYSEEP_NOMEMORY)
10102	SYSEEP_BLOCKLENGTH • Block number	The System-EEPROM-Block was found but does not have the correct length. • Occurs with EDC-Software-updates. Test data should be checked. • Delete and re-enter EEPROM-Data (refer to error SYSEEP_NOMEMORY)
10103	SYSEEP_NOMEMORY • Block number	System-EEPROM memory is too small. • Too many machines are set. It is not possible to store all machine and test data in the System-EEPROM. This occurs depending on the EDC firmware version.
10104	SYSEEP_BIOSNOFUNC • Block number	System-EEPROM-BIOS-Error (1): Function missing. • Internal EDC-Error. Contact service.
10105	SYSEEP_BIOSNODEVICE • Block number	System-EEPROM-BIOS-Error (2): Device is incorrect. • Internal EDC-Error. Contact service.
10106	SYSEEP_BIOSPARA • Block number	System-EEPROM-BIOS-Error (3): Parameter error. • Internal EDC-Error. Contact service.
10107	SYSEEP_BIOSREAD • Block number	System-EEPROM-BIOS-Error (4): EEPROM read error. • Internal EDC-Error. Contact service.

No.	System Message / Parameter	Error cause / Error clearing
10108	SYSEEP_BIOSWRITE • Block number	System-EEPROM-BIOS-Error (5): EEPROM write error. • Internal EDC-Error. Contact service.
10109	SYSEEP_BIOSREENT • Block number	System-EEPROM-BIOS-Error (10): Re-entrance problem. • Internal EDC Error. Contact service.
10110	SYSEEP_USB_DISK_MISSING	No USB stick connected to the EDC. • Saving data not possible.
10111	SYSEEP_USB_DISK_FULL	USB Stick at the EDC is full. • Saving data not possible.
	General initialization errors	
10200	INIT_ENDDEV • Device type • Device number • Connector	Error during step 1 of initialization. One sensor, output channel, Bit-Input or Bit-Output could not be initialized. Check the following sensor data: • Sensitivity of reference • Sensor limits • Correction value respectively sensor sensitivity. • The DOLI service can check the hardware device data.
10201	INIT_ENDINI • Closed loop controller bits • ISIG • OSIG	Error during step 2 of initialization. • Check setup data.
10202	INIT_SYSTIME • Time • MaxTime • MinTime	System time (Cycle time for controller) incorrect. • Usual value is 0.0025s. • Min/Max: between 0.001s and 0.0025s.
10204	INIT_DATAAQTIME • Time • MinTime	Data acquisition time incorrect. • Time must be a multiple of the systems time. • Usual value is 0.02s.
10205	INIT_CLAMP • Connector	Error during the initialization of the grip limit control. Check the following data in the EDC setup: • Grip connector • The sensor to be supervised

No.	System Message / Parameter	Error cause / Error clearing
10207	INIT_MAINBOARD	Error during the initialization of the EDC controller. Possible source of errors: • Within the EDC setup it is not possible to set a Bit-output to connector X2.
10208	INIT_MODULE_ERROR • Module number • Componentry number • Module state	A module in the EDC is not operative. • Turn the EDC off and on. If error is still active, contact service.
10209	INIT_CTRL • Closed loop controller structure	Error during the initialization of the closed loop controller structure. Possible source of errors: • If no position sensor was configured or the position closed loop controller was not activated, the closed loop controller structure must not be set to SPINDEL_SP.
10210	INIT_SYSTIME_USB	System time incorrect. • The system time must be 1.0 ms for USB communication.
10211	INIT_SYSTIME_SENSORS	Error during sensor initialization. • If the system time is set to 0.1 ms, only a maximum of 6 active sensors are allowed (including Digipoti).
	Sensor errors	
10300	SEN_EEP_NOTFOUND • Sensor number • Connector	Sensor-EEPROM not found. • Sensor-EEPROM not existing or damaged. • It was not possible to read all data.
10301	SEN_EEP_BCC • Sensor number • Connector	BCC-Error at sensor-EEPROM-data. • Sensor-EEPROM-data is invalid. • A service engineer has to enter the EEPROM-data correctly.
10302	SEN_EEP_CLASS • Sensor number • Connector	Sensor-EEPROM-class unknown. • No or incorrect sensor-EEPROM-data has been entered. • A Service engineer has to enter the EEPROM-data correctly.

No.	System Message / Parameter	Error cause / Error clearing
10303	SEN_NOTFOUND • Sensor number • Connector	Sensor was not found at the declared connector. • Plug in sensor to the correct connector or set the correct connector in the EDC sensor setup.

10304	SEN_INITBYTE
	
	• Sensor number
	• Connector
	  • MaxSensitivity
	  • Sensitivity of Reference
	  • MaxRangelimit
	  • MinRangelimi
	• Correction value
	• Sensor Sensitivity
		It was not possible to calculate the Init-Byte automatically.
		
		Check the following sensor EEPROM data:
		• Sensitivity of reference
		• Sensor limits
		• Correction value (ca. 1.0) respectively sensor sensitivity.
		• Sensor type and EDC hardware must fit. E.g. a 16mV/V sensor plug is not possible at connector X14 (max. 4mV/V).

10305	SEN_INIT • Sensor number • Connector • Init-Byte	Error during the initialization of the sensor. The following data should be checked: • Connector • Init-Byte • Correction value respectively sensor sensitivity • Sensor type and sensor sensitivity must fit. E.g. a DC sensor type and a sensor sensitivity of 2V are not possible.
10306	SEN_PARA • Sensor number • Connector • Correction value • Sensor sensitivity • Sensor integr. time • Ctrl integr. time	Error at the sensor parameters. The following sensor data should be checked: • Correction value (ca. 1.0) respectively sensor sensitivity. • Sensor integration time (0.02s) • Controller integration time (0.02s)
10307	SEN_CORR • Sensor number • Connector • Correction value • Sensor sensitivity	The correction value respectively the sensor sensitivity is incorrect. • Value should be approx. 1.0. • $0.1 \leq$ correction value ≤ 10 • Sensor sensitivity

No.	System Message / Parameter	Error cause / Error clearing
10308	SEN_ MCFILTERTIME • Sensor number • Connector • Time • MaxTime • MinTime	Sensor filter time incorrect. • Time must be a multiple of the systems time. • Max 1 s. • Usual value is 0.02s.
10309	SEN_ CTRLFILTERTIME • Sensor number • Connector • Time • MaxTime • MinTime	Closed loop controller filter time incorrect. • Time must be a multiple of the systems time. • Max 1 s. • Usual value is 0.02s.
10310	SEN_LIMIT • Sensor number • Connector • MaxLimit • MinLimit	Sensor limit setting error. Check the following sensor EEPROM data: • Sensor limits • Sensitivity of Reference • Correction value respectively sensor sensitivity. • Sensor type and sensor sensitivity must fit. E.g. a DC sensor type and a sensor sensitivity of 2V are not possible.
10311	SEN_NOMINALACC • Sensor number • Connector • Acceleration • MaxAcceleration • MinAcceleration	Nominal acceleration setting error. • Check acceleration. • Note units (position and strain sensors [mm/s²], load [N/s²]). • Make sure that the sensor is showing the correct measured value (depending on the nominal value, signal period and encoder crosshead ratio (position sensor only)).
10312	SEN_NOMINALSPEED • Sensor number • Connector • Speed • MaxSpeed • MinSpeed	Nominal speed setting error. • Check speed. • Note units (position and strain sensors [mm/s], load [N/s]). • Make sure that the sensor is showing the correct measured value (depending on the nominal value, signal period and encoder crosshead ratio (position sensor only)).

No.	System Message / Parameter	Error cause / Error clearing
10313	SEN_POSCTLR • Sensor number • Connector • PosP • PosI • PosD	Incorrect position controller parameter. • PosP must not be 0.
10314	SEN_SPEEDCTLR • Sensor number • Connector • SpeedP • SpeedI • SpeedD	Incorrect speed controller parameter. • SpeedP must not be 0.
10315	SEN_BIOS • Sensor number • Connector • current BIOS version • min. needed BIOS version	Wrong EDC BIOS version. The sensor is not initialized. • Serial sensors need a newer EDC BIOS version.
10316	SEN_OFFSET • Sensor number • Connector • Offset	Wrong sensor offset. • Check sensor offset
10317	SEN_SCALE • Sensor number • Connector • Scale	Wrong sensor scale. • Check sensor scale.
10318	SEN_DITHER_FREQ • Sensor number • Connector • Frequency • MaxFrequency • MinFrequency	The adjustable dither frequency has been exceeded. • Check max/min frequency. • The dither amplitude must not be zero. • Dither is not possible, if I²t control is active.

No.	System Message / Parameter	Error cause / Error clearing
10319	SEN_DITHER_AMPL • Sensor number • Connector • Amplitude • MaxAmplitude	The adjustable dither amplitude has been exceeded. • Check max amplitude. • The dither frequency must not be zero. • Dither is not possible, if I^2t control is active.
10320	SEN_DITHER_INIT • Sensor number • Connector • Frequency • Amplitude	Error during the initialization of the dither. • Check frequency and amplitude. • Not all drive amplifiers support the dither software adjustment.
Output channel errors		
10400	OC_EEP_NOTFOUND • Output channel • Connector	Output channel EEPROM not found. • Output channel connector is not plugged-in (if output channel 1 is shown, most likely the drive connector X4 is not plugged-in). • Output channel EEPROM does not exist or is damaged. • It was not possible to read all EEPROM data correctly
10401	OC_EEP_BCC • Output channel • Connector	BCC error at output channel of EEPROM data. • Output channel EEPROM data is invalid. • A service engineer has to set the EEPROM data correctly
10402	OC_EEP_CLASS • Output channel • Connector	Output channel EEPROM class unknown. • No or incorrect output channel EEPROM data has been entered. • A service engineer has to set the EEPROM data correctly.
10403	OC_INIT • Output channel • Connector • Init-Byte	Error during the initialization of the output channel. The following data should be checked: • Connector • Output channel Init-Byte

No.	System Message / Parameter	Error cause / Error clearing
10404	OC_VOLTAGE • Output channel • Connector • Voltage • MaxVoltage	The maximum permitted voltage setting of the DOLI drive amplifier has been exceeded. • Check the voltage in the setup. • If as maximum permitted voltage 0.0V is shown, it is not possible to set the voltage of the drive amplifier by software. Change the voltage within the setup to 0.0V, also.
10405	OC_CURRENT • Output channel • Connector • Current • MaxCurrent	The maximum permitted current setting of the DOLI drive amplifier has been exceeded. • Check the current in the setup. • If as maximum permitted current 0.0A is shown, it is not possible to set the current of the drive amplifier by software. Change the current within the setup to 0.0A, also.
10406	OC_POWER • Output channel • Connector • Power • MaxPower	The maximum permitted power setting of the DOLI-drive amplifier has been exceeded. • Check voltage and current in the setup. • This error will not be checked while initializing the EDC. The engineer installing the EDC has to make sure, that the max. power of the drive amplifier is not exceeded.
10407	OC_PARA • Output channel • Connector • MaxOutputValue • MinOutputValue • InitOutputValue	Error at output channel parameters. The following data should be checked: • Max. output value • Min. output value • Init output value • A frequent error is, that the same value is set for “Max” and “Min”. e.g.: Incorrect: Max = 100%, Min = 100% Correct: Max = 100%, Min = -100%
10408	OC_MAX_CURR_TIME • Output channel • Connector • Time • MaxTime	The maximum adjustable time of the I^2t control of the DOLI drive amplifier has been exceeded. • Not all DOLI drive amplifiers support the software adjustment of this time (MaxTime = 0).
10412	OC_CURRENT_CTRL • Output channel • Connector	Error during the initialization of the current closed loop control. • Check current closed loop control parameters

No.	System Message / Parameter	Error cause / Error clearing
10413	OC_MC2OUTPUT • Output channel • Connector • Sensor	Error during the initialization of “Sensor to Output” function. • Check sensor number and limits.
10414	OC_MC2OUTPUT_MODE • Output channel • Connector • Sensor	Error during the initialization of “Sensor to Output” function. The PC-Software doesn’t support the mode “3 Points”. • The PC-Software must use DoPE V2.73 or newer.
	Bit input errors	
10500	BIN_INIT • Bit input device • Connector	Error during initialization of the bit input device. • Check the connector
	Bit output errors	
10600	BOUT_INIT • Bit output device • Connector	Error during initialization of the bit output device. • Check the connector
10601	BOUT_ERROR_HIGH • Bit output device	24 V shortcut at the bit output device.
10602	BOUT_ERROR_LOW • Bit output device	0 V shortcut at the bit output device.
	IO-Signal errors	
10700	IO_MACHINE_CONNECTOR • Machine number • Connector • Bit number	Error during initialization of machine IO connector. • Check the connector • Check the bit number
10710	IO_GRIP_MODE • Mode number	Error during initialization of IO grip function. • Check mode number
10711	IO_GRIP_BIT • Bit device	Error during initialization of IO grip function. • Check bit device

No.	System Message / Parameter	Error cause / Error clearing
10713	IO_GRIP_OC • Output channel	Error during initialization of IO grip function. • Check output channel
10714	IO_GRIP_LIMIT • Grip limits	Error during initialization of IO grip function. • Check grip limits
10730	IO_EXT_MODE • Mode number	Error during initialization of IO extensometer function. • Check mode number
10731	IO_EXT_BIT • Bit device	Error during initialization of IO extensometer function. • Check bit device
10740	IO_FIXED_XHEAD_MODE • Mode number	Error during initialization of IO fixed XHead function. • Check mode number
10741	IO_FIXED_XHEAD _BIT • Bit device	Error during initialization of IO fixed XHead function. • Check bit device
10750	IO_HIGH_PRESSURE_MODE • Mode number	Error during initialization of IO high/low pressure function. • Check mode number
10751	IO_HIGH_PRESSURE_BIT • Bit device	Error during initialization of IO high/low pressure function. • Check bit device
10753	IO_HIGH_PRESSURE_OC • Output channel	Error during initialization of IO high/low pressure function. • Check output channel
10780	IO_MISC_MODE • Mode number	Error during initialization of miscellaneous IO. • Check mode number
10781	IO_MISC_BIT • Bit device	Error during initialization of miscellaneous IO. • Check bit device
10790	IO_MISC_TEMPERATURE1	Temperature 1 limit reached. • Check temperature 1

No.	System Message / Parameter	Error cause / Error clearing
10791	IO_MISC_TEMPERATURE2	Temperature 2 limit reached. Drive is switched off. • Check temperature 2
10792	IO_MISC_OIL_LEVEL	Minimum oil level limit reached. Drive is switched off. • Check oil level
10793	IO_MISC_OIL_FILTER	Error oil filter. • Check oil filter
10794	IO_MISC_POWER_FAIL	Power supply error. Drive is switched off. • Check power supply
10820	IO_LIMIT_POS_MODE • Mode number	Error during initialization of IO LIMIT POS function. • Check mode number
10821	IO_LIMIT_POS_BIT • Bit device	Error during initialization of IO LIMIT POS function. • Check bit device
10830	IO_LIMIT_SPEED_MODE • Mode number	Error during initialization of IO LIMIT SPEED function. • Check mode number
10831	IO_LIMIT_SPEED_BIT • Bit device	Error during initialization of IO LIMIT SPEED function. • Check bit device
10840	IO_LIMIT_LOAD_MODE • Mode number	Error during initialization of IO LIMIT LOAD function. • Check mode number
10841	IO_LIMIT_LOAD_BIT • Bit device	Error during initialization of IO LIMIT LOAD function. • Check bit device
10850	IO_SHALT_MODE • Mode number	Error during initialization of IO SHALT function. • Check mode number
10851	IO_SHALT_BIT • Bit device	Error during initialization of IO SHALT function. • Check bit device
10860	IO_GUARD_MODE • Mode number	Error during initialization of IO GUARD function. • Check mode number. • EDCi10 doesn’t support the guard option.

No.	System Message / Parameter	Error cause / Error clearing
10861	IO_GUARD_BIT • Bit device	Error during initialization of IO GUARD function. • Check bit device
10862	IO_GUARD_INIT	Error during initialization of IO GUARD function. • Check guard option parameters. • Speed limit sensor must be a control sensor. • Range limit sensor must be a control sensor.
	Language errors	
10900	LANGUAGE_READ • Language	Language file not found. • Flash correct language file
10901	LANGUAGE_VERSION • Language • Versions	Language file version is wrong. • Flash correct language file
10902	LANGUAGE_SYNTAX • Language • Syntax error	Language file syntax is wrong. • Flash correct language file
	Sync errors	
11000	SYNC_ERROR_PARAM	Sync error: wrong parameter. • Check EDC Setup->General Data->Sync Option.
11001	SYNC_ERROR_VERSION • Module version • Needed minimum version	Sync error: wrong hardware version (see EDC firmware Version.txt). • Sync option needs new mainboard and new iSI-module hardware versions. • If no needed minimum version is shown, this module doesn't support sync. • Contact service.
11002	SYNC_ERROR_NO_MASTER	Sync error: no master present. The slave EDC doesn't detect a master EDC. • Check all EDCs Setup->General Data->Sync Option. One EDC must be master, all other EDCs must be slaves. • Switch on all EDC mains simultaneously.

8 Document Versions

Version	Changes	Date	Name
1.0	First version	2017-10-20	PET
1.1	• RMCi screen saver added. • EDCi hardware description added.	2018-02-27	MOR/PET
1.2	• EDCi20/22/70/72 added. • EDCi hardware descriptions updated. • Safety chapter updated.	2018-07-27	MOR/PET
1.3	• Y1 connector descriptions added. • New DOLI logo.	2018-09-20	MOR/PET
1.4	• Sync Drive On/Off parameter in general data added. • Synchronization updated. • iINCX added. • Diagnosis Tools added.	2019-01-10	MOR/PET
1.5	• New DOLI address added. • RMCi Start/Halt/Continue function added. • RMCi8 added. • EDC debug messages on EDC USB stick added. • How to: LVDT sensor removed. • Some general corrections. • EDCi standby mode for drive interface and DriveBox added.	2019-07-24	PET
1.6	• EDCi15 with iCREEP added. • RMCi8 picture added. • Technical specifications improved (X14, iCFA, iDCA). • iINC and iINCX pin description fixed. • X7 female description fixed • Y1 male picture fixed	2019-10-25	PET
1.7	• EDCi10 added. • EDCi15 picture added. • RMCi firmware update description added. • Drive interface emergency stop circuit improved. • iINC pin description fixed.	2020-04-01	PET
1.8	• New 30 steps calibration. • EDCi emergency stop circuit with DC160 /DC320 added • X5 RMC pin description fixed. • iIO pin description fixed.	2020-06-26	PET
1.9	• Fix missing links in chapter calibration.	2020-07-08	PET

Version	Changes	Date	Name
1.10	• Guard option added. • How to use calculated sensors added. • IEPE sensor added. • BitIn from IO limits position, speed and load removed. • System messages updated. • EDCi standby mode for drive interface and DriveBox removed. • Fix X14 and iDCA measurement input form 12 V/V to 1.2 V/V. • Fix X7, iINC, iINCX 5VDC supply max. 250 mA.	2020-11-20	GRS/PET
1.11	• Test Center Light chapter improved. • Multiaxis added. • Synchonize Move added. • Manual reset for drive interface and DriveBox added. • Motor brake supply removed from DC160/DC320. • Chapter 1. Safety updated. • iADA distribution plug and iADA box added. • Plug assignment options added	2021-06-17	PET
1.12	• DriveBox option removed from EDCi20/22.	2021-10-07	PET

Notes: