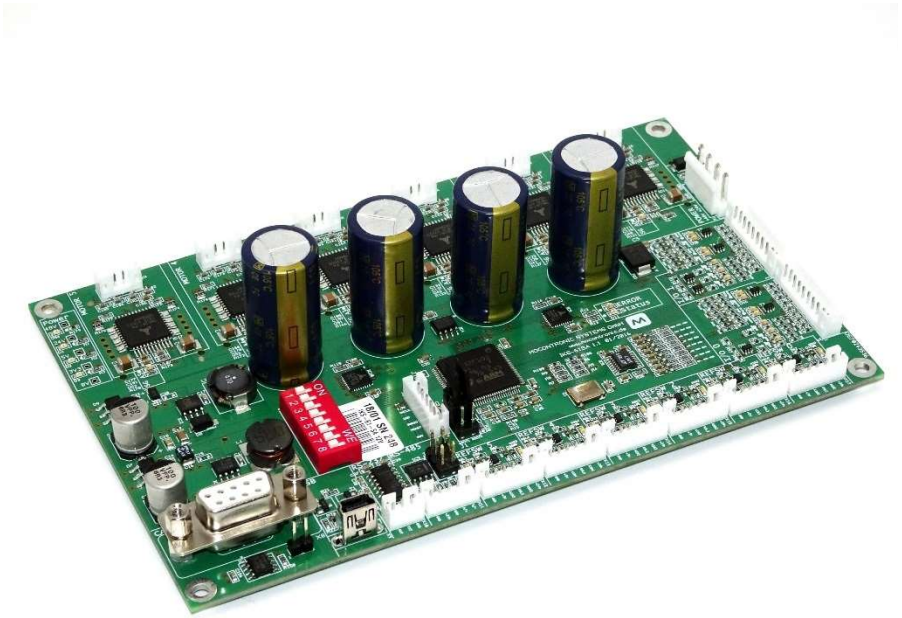
IKS-61SA



Product manual

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Safety and warning notes

Before installing and operating the product, please read this product manual carefully and observe all warnings and safety instructions. Always keep this product manual within easy reach near the product.

Please note:

WARNING

Failure to observe warnings may result in death, serious injury or considerable damage to property in extreme cases.

NOTE

Failure to observe notes may result in minor personal injury, damage to property due to heat generation or malfunction.

General precautions

WARNING

To avoid protection against electric shock, do not remove the cover of the housing. There is voltage inside the case which may cause electric shock. Have the unit used only by qualified personnel.

WARNING

- Installation, operation and maintenance of this product may only be performed by qualified personnel who are fully familiar with the operation of the control system.
- To prevent injury and damage, do not touch any components inside the housing - either with your hands or with any objects when voltage is present.
- Also exclude dust, dirt, flammable atmospheres and aggressive gases. The installation location should be a well-ventilated place not exposed to direct sunlight.
- Install the unit on a non-flammable wall that is as vertical as possible and transmits as little vibration as possible.
- Never disconnect the motor connection when the controller is live.
- Never apply voltage to inputs (motor, outputs) that are not designed for this purpose.
- Do not work on the wiring when voltage is applied.
- Make sure that the input voltage corresponds to that of the control.
- During proper use, the motor controls may heat up due to their design.
- Improper use, such as reversing the polarity of the supply voltage or overvoltage, may result in the formation of flames or even a fire. Injuries due to exploding components are also possible.

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NOTE

After delivery of the controller, make sure that there is no transport damage. Check whether the delivered goods correspond to the information on the delivery note and your order.

Intended use of the control unit

This product is not a household appliance, but an "unfinished machine" in the sense of the Machinery Directive 2006/42/EC, which is intended exclusively for further use for commercial purposes. This control unit is electrical equipment for controlling stepper motors and is intended for installation in machines or assembly with other components to form a machine.

Operation is prohibited until the operator has determined that the entire machine complies with the EMC Directive 2004/108/EC and EN 60204-1 on electrical equipment. The responsibility for compliance with the European Directives in the use of the machine lies with the subsequent user (Industrial Safety Regulation, Work Equipment Directive). This applies in particular to the risk assessment.

The technical data and descriptions in this operating manual have been compiled to the best of our knowledge and belief. No liability can be accepted for errors.

NOTE

Mocontronic considers the following standards during development and production: Low Voltage Directive 2006/95/EC, Machinery Directive 2006/42/EC, Product Safety Directive 2001/95/EC, EMC Directive 2004/108/EC, Product Liability Directive 85/374/EEC.

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Description and technical data

1.1 General Description

The IKS-61SA is a compact six axis stepper motor controller. The controller has a Trinamic TMCL compatible command set and is scriptable. Thus, it is designed for stand-alone and or host controlled operation.

Power supply:

- 1x +12V to +24V input for power supply of the controller and Ios
- 1x +12V to +49V input for motor supply

Communication:

- 1x Mini-USB socket. A virtual COM port provides a serial interface
- 1x CAN Sub-D 9
- 1x RS485 interface, with switchable terminating resistor
- Optional RS232 port
- Inputs and Outputs:
- 6x 0-5V analog inputs, 16-bit resolution
- 2x 0-10V analog inputs, 16-bit resolution
- 6x +24V level reference switch inputs. For each axis one right and one left.
- 8x +24V level outputs, 100mA max. each, open drain
- 6x +24V level inputs

Motors:

- 3 connectors for bipolar stepper motors, 24V, 1.4 A_{rms}, 2 A_{Peak}.

1.1.1 Technical data, maximum ratings

table 1 technical data, maximum values

Symbol	Parameter	Min	Typ	Max	Unit
U_{+24V}	control supply voltage	20	24	26	V
U_{+VM}	Motor supply voltage und +24V level Inputs and Outputs. Note: The values for the +24V voltage outputs and the digital +24V outputs are defined by this voltage!		24	26	V
$I_{in\ U+24V\ Max.}$	Control Current consumption (into U_{+24V})			0,1	A
$I_{in\ UVM\ Max.}$	Motor Current consumption (into U_{+VM})		<< 2 x $I_{Motor\ (peak)}$ + $I_{max\ +24V\ digital\ outputs}$ + $I_{+24V\ supply\ outputs}$	1.4 x 2 x $I_{Motor\ (peak)}$ + $I_{max\ +24V\ digital\ outputs}$ + $I_{+24\ supply\ outputs}$	A
$I_{+24\ supply\ outputs}$	Output current of the +24V supply outputs			0.1[3)]	A
$P_{Pmax\ +24\ supply\ outputs}$	Maximum power of the digital outputs 0 through 3, and 4 through 7			4	W
$I_{+24V\ supply\ outputs}$	Output current of the digital +24V outputs			0.1[3)]	A
$I_{+3,3V\ outputs}$	Output current of the digital +3,3V outputs			0.005	A

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Symbol	Parameter	Min	Typ	Max	Unit
$U_{+24V\ supply\ outpus}$	Voltage of the +24V supply outputs			U_{+VM}	V
$U_{+24V\ supply\ outputs}$	Voltage of the +24V supply outputs			U_{+VM}	V
$U_{+3,3V\ digital\ outputs}$	Voltage of the digital +3,3V outputs		3.3		V
U_{Motor}	Motor voltage			U_{+VM}	V
$I_{Motor\ (rms)}$	Motor current (rms, root mean square)			1.4	A
$I_{Motor\ (peak)}$	Motor current (peak)			2	A
$U_{in\ high\ digital\ inputs}$	high level voltage für digital inputs	3.3			V
$U_{in\ low\ digital\ inputs}$	low level voltage für digital outputs			1.0	V
$U_{in\ high\ reference\ switches}$	high level voltage für reference switch inputs	3.3			V
$U_{in\ Low\ reference\ switches}$	Low level voltage für reference switch inputs			1.0	V
U_{Ain}	Voltage of the analog inputs	0		10	V
$T_{Amb.}$	Ambient temperature	0	25	30°	°C
	Relative humidity (important: noc condensation!)	20		90	%
	Product life time due to electrolytic capacitors		2000		h

1) w/o heatsink. Only allwowed at $T_{amb.}$ of 25°C max.
2) with heatsink. Only allwowed at $T_{amb.}$ of 25°C. max.
3) Only allwowed at $T_{amb.}$ of 25°C. max.

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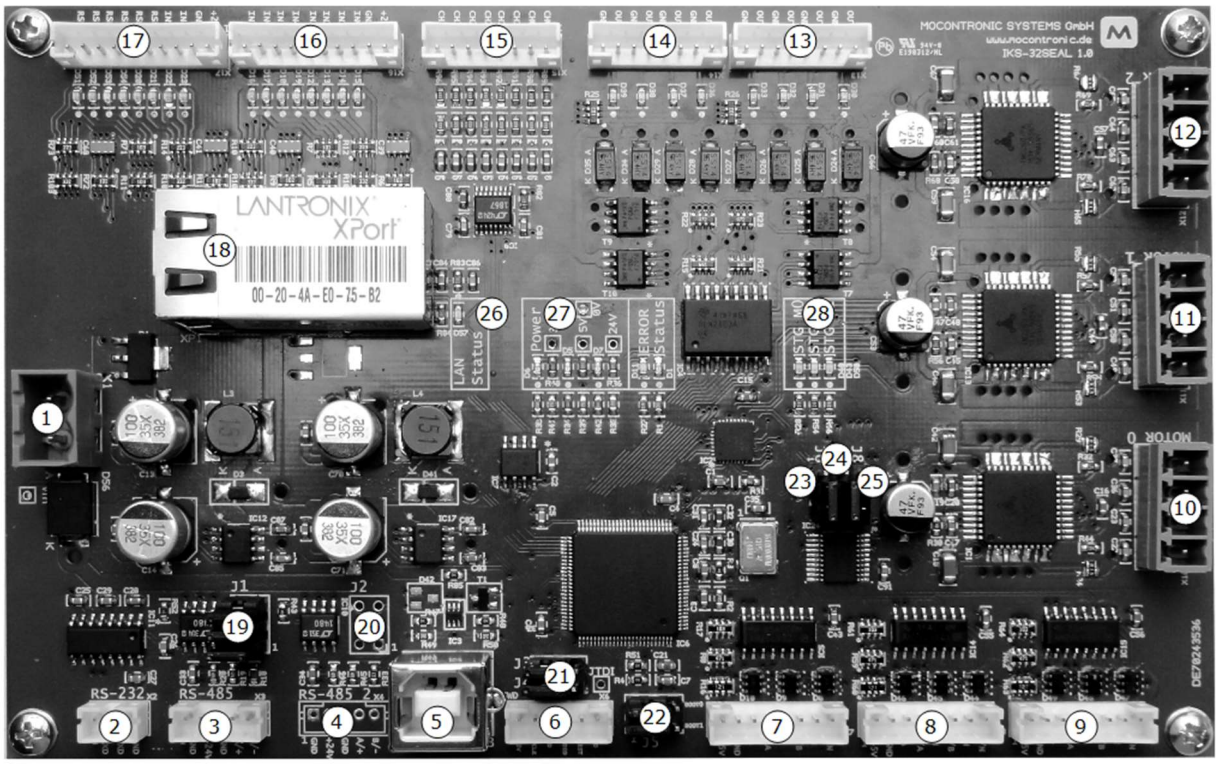
Overview of connections and their functions



1. power supply (X1)
2. RS-232 (X2)
3. RS-485 (X3)
4. RS-485 (X4)
5. USB (X5)
6. SWD (interal use only) (X6)
7. Encoder axis 0 (X7)
8. Encoder axis 1 (X8)
9. Encoder axis 2 (X7)
10. Motor 0 (X10)
11. Motor 1 (X11)
12. Motor 2 (X12)
13. digital +24V outputs OUT0-OUT3 (X13)
14. digital +24V outputs OUT4-OUT7 (X14)
15. Analog inputs (X15)
16. digital +24V inputs 0-7 (X16)
17. digital +24V inputs 8/9 and ref. switches (X17)
18. Optional LAN port (X18))
19. Jumpers for RS485 1 (J1)
20. Jumpers for RS485 2 (J2)
21. Jumpers RS-232 or LAN (J3)
22. Jumper bootmode (J4)
23. jumper Ref. Axis 0 (J6)
24. jumper Ref. Axis 1 (J7)
25. jumper, Ref. Axis 2 (J8)
26. LAN Status LED
27. Power Status LED
28. Motor Status LED

figure 1 overview of connectors

Description of connectors

3.1 Power supply (X1)

The supply voltage is fed to the control unit via connection X1.

Note!

- The wire size must be suitable for the maximum current consumption! EN 60 204-1 must be observed.
- Observe polarity and correct supply voltage! Failure to observe this may result in the formation of flames or even a fire. Injuries due to exploding components are also possible.

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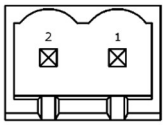
table 2 power supply connector (X1)

	Pin	Bezeichnung	Beschreibung
	2	GND	GND, ground
	1	+VM	+24V power

3.1.1 motor control

The motor control of the IKS-32SEAL requires a stabilized DC voltage of +24V. This is supplied to the control via pins 1 and 1 of the pluggable screw strip X1. From this, the control generates the intermediate voltages of 3.3V and 5.0V required for the control logic.

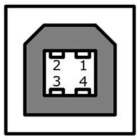
3.2 Communication ports

The controller has a USB port. This provides a virtual serial interface. This is used for communication with the motor controller.

The controller also has an optional LAN port.

3.2.1 USB port (X5)

table 3 USB port

	Pin	name	function
	1	+V Bus	+5V from USB host (PC)
	2	GND	GND, ground
	3	D+	USB data+
	4	D-	USB data-+

3.2.2 RS-485 ports (X2, X3)

Hint!

- Each bus participant (node) must have its own address.
- Shielded twisted pairs should be used
- The shielding should only be connected to ground at one point on the bus
- A terminating resistor of 120Ω should be installed at the master and at the last bus participant (node)
- The maximum cable length should not exceed 10m.

table 4 RS-485 ports (X2, X3)

	pin	name	function
	1	B/-	RS485 B. normally pin of a 2 of a 9-pin D-Sub connector
	2	A/+	RS485 A. normally pin of a 7 of a 9-pin D-Sub connector
	3	GND	GND, ground

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figure 2 shows the schematic structure of the bias and the terminating resistor.

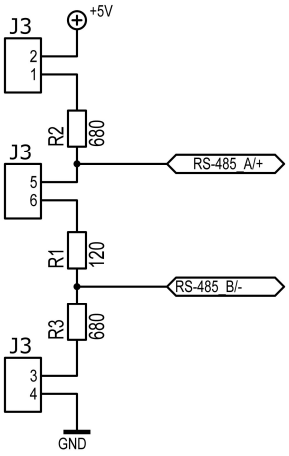


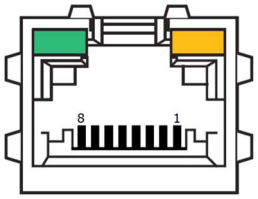
figure 2 RS-485 bias and termination

3.2.3 LAN-Anschluss

The IKS-32SEAL has a LAN port. This can be used as an alternative to the RS-232 connection. The Ethernet connection is implemented with a Lantronix XPort. The XPort provides a serial RS232 interface tunneled over the LAN. On the control computer side, the board is set up as a virtual serial interface (virtual COM port).

Also see section JUMPERS for switching between LAN and RS232 use.

Table 7 pinning RS45



Pin	Marking	Description
1	TX+	Send +
2	TX-	Send -
3	RX+	Receive +
4	-	Not used
5	-	Not used
6	RX-	Receive -
7	-	Nicht benutzt.
8	-	Nicht benutzt.

Status LEDs for LAN are marked with position 26 in figure 3 above

3.3 Analog inputs (0…+10V) (X5, X6, X7, X8)

figure 1 no. 5 through 8 shows the analog inputs (0-10V). An overview of the pin out is shown in table 5. The inputs circuitry is shown in figure 3.

The integrated analog to digital converter (ADC) has a 12bit resolution with a step width of 2.46582mV per LSB.

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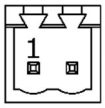
Hint!

- correct polarity has to respected.
- the maximum input voltage must not be exceeded.

table 5 analog inputs 0...+10V (X5, X6, X7, X8)



pin	name	function
1	GND	GND, ground
2	AIN0 / AIN1	analog input 0-10V

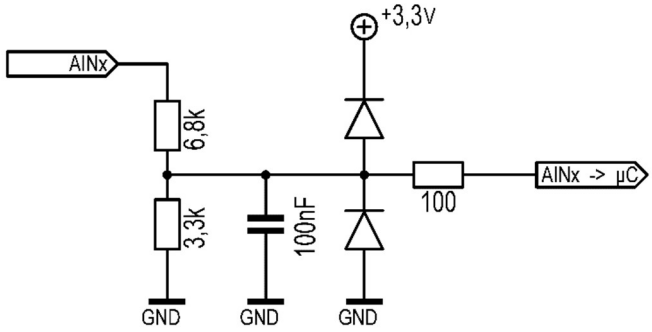


figure 3 analog input circuitry

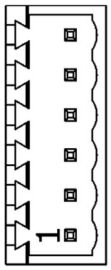
3.4 Digital +24V inputs (X9, X10)

figure 1 no. 7 shows the digital +24V inputs. The pin out is listed in table 6. Every input line has an LED next to the input pin. The input circuitry is shown in figure 4.

Hint!

- correct polarity has to respected.
- the maximum input voltage must not be exceeded.

table 6 digital +24V inputs (X9, X10)



pin	name	function
1	GND	GND, ground
2	+VM	power output +VM (+24V)
3	IN 0/4	digital +24V input no. 0/4
4	IN 1/5	digital +24V input no. 1/5
5	IN 2/6	digital +24V input no. 2/6
6	IN 3/7	digital +24V input no. 3/7

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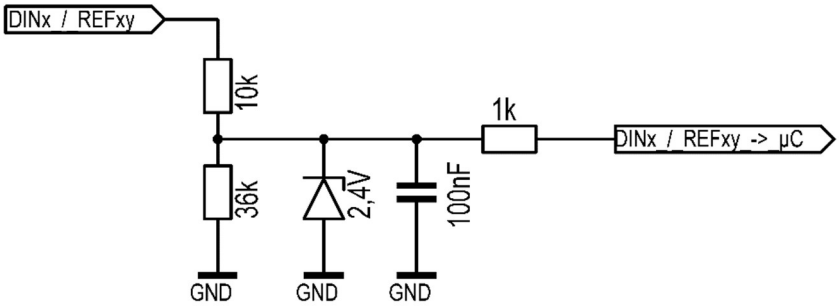


figure 4 circuitry of digital an reference switch inputs

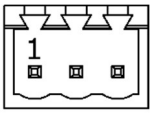
3.5 Reference switch inputs (X11, X12, X13, X14)

figure 1 no. 11 through 14 show the reference switch inputs. Each axis has a left and a right switch input. They can be used for referencing and as a stop switch. An overview of the pin assignment is shown in table 7. For control purposes, there is a status LED for each input above the terminal connection. The input wiring corresponds to that of the digital inputs. This is shown schematically in figure 4.

Hint!

- correct polarity has to respected.
- the maximum input voltage must not be exceeded.

table 7 reference switch inputs (X11, X12, X13, X14, X15, X16)



pin	name	function
1	GND	GND, ground
2	REF xy	referende switch input, +24V, x=0..1 (axis), y=R/L (right/left)
3	+VM	power supply output +VM (+24V)

3.6 Digital +24V Outputs (X17, X18)

figure 1 no. 15 and 16 show the +24V digital outputs. The pin out is shown in table 8. For control purposes, there is a status LED for each output above the terminal connection.

Hint!

- correct polarity must be respected.
- the maximum output current must not be exceeded!
- the digital outputs are NOT protected against short circuits!
- the maximum output power of the digital outputs 0 through 7 is 4 Watts.

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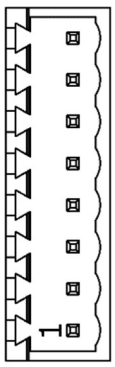
table 8 digital +24V outputs (X17, X18)



pin	name	function
1	GND	GND, ground
2	OUT0/4	output OUT0/4, voltage level +VM (+24V), I_{max} 0,1A, suitable for inductive loads, No short circuit protection! no freewheeling diode!
3	GND	GND, ground
4	OUT1/5	output OUT1/5, voltage level +VM (+24V), I_{max} 0,1A, suitable for inductive loads, No short circuit protection! no freewheeling diode!
5	GND	GND, ground
6	OUT2/6	output OUT2/6, voltage level +VM (+24V), I_{max} 0,1A, suitable for inductive loads, No short circuit protection! no freewheeling diode!
7	GND	GND, ground
8	OUT3/7	output OUT3/7, voltage level +VM (+24V), I_{max} 0,1A, suitable for inductive loads, No short circuit protection! no freewheeling diode!

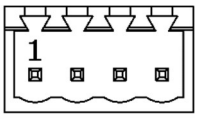
3.7 Motor connectors (X19,X20)

The figure 1 no. 19, 20 show the motor connectors. The pin out is listed in table 9.

Hint!

- The wire gauge and current rating of connectors must be adapted to the peak value of the motor current which is 1.4 times the effective value.
- The cable length between the controller and stepper motor should be less than 3m. Longer motor cables lead to poorer EMC behavior.
- The motor cabling should be shielded! The shield should be connected to ground over a large area at the controller and at the motor.
- Only change the motor cabling when the power is off!

table 9 motor connector (X19,X20)



pin	name	function
1	0/1A1	motor phase A1
1	0/1A2	motor phase A2
1	0/1B1	motor phase B1
1	0/1B2	motor phase B2

3.8 Optional connectors

The following section describes the optional connections that are provided for special applications.

3.8.1 RS-232, 3.3V level (X24) – optional

In figure 1 no. 21 the optional 3,3V level RS-232 connector is shown.

3.8.2 SWD connector (X25)

The figure 1 no. 22 shows the SWD connector (manufacturer use only).

3.8.3 Optional IO (X26)

The figure 1 no. 23 shows the optional IO connector.

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3.9 Status LED

The IKS-24S has various LEDs that indicate the status of the controller.

table 10 Status LED

Pos	LED name	Position as shown in figure 1	colour	description
1	+VM	status field, Nr. 27	Green	The +24V voltage supply for the motors, the +24V voltage outputs as well as the +24V switching outputs is present. Remark: Makes no statement about the exact voltage value!
2	+24V		Green	The +24V voltage supply is available. Remark Makes no statement about the exact voltage value!
3	+3.3V		Green	The +3.3V auxiliary voltage is available. Remark Makes no statement about the exact voltage value!
4	Error		Red	Error display. In the normal state, the LED is off. When the +VM voltage drops below 15V, the LED is on continuously.
5	CPU		Green	Flashes with the frequency of 1 Hz. Indicates that the microcontroller is running. If the LED is not lit, the controller is in bootloader mode. Check the jumper settings in section 3.9. Or no firmware has been uploaded yet..
6	USB RxD	at the USB socket, no. 28	Yellow	Data from a host to the control via USB or RS-485 is being received.
7	USB TxD		Green	Data to a host from the control via USB or RS-485 is transmitted.
8	INx	above connector no. 9/10	Yellow	Shows activity of the +24V digital inputs. x=0..3.
9	REFxy	above connectors no 11 through. 14	Yellow	Shows activity of the reference switch inputs. x=0..1 (axis), y= R/L (right/left).
10	OUTx	above connector no. 15/16	Yellow	Shows activity of the +24V digital outputs. x=0..3.
11	SG M0	at no. 30	Red	When the Trinamic StallGuard2 detection detects that the motor is blocked, the red LED lights up. NOTE: This function requires parameterization!
12	SG M1	at no. 29	Red	When the Trinamic StallGuard2 detection detects that the motor is blocked, the red LED lights up. NOTE: This function requires parameterization!

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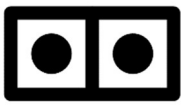
3.10 Jumper

3.10.1 BOOT0 (J1) - optional

The figure 1 no. 26 shows jumper J1 which activates the bootloader mode. An overview of the functionality is shown in table 11.

table 11 Jumper J1 - Bootloader

pos.	jumper setting		Beschreibung
1		Boot: 1-2 open	normal operation
2		Boot: 1-2 connected	bootloader mode In this jumper position the IKS-24S is set into the bootloader mode after applying the operating voltage. This is used to load a new firmware.

3.10.2 BOOT1 (J2) - optional

In figure 1 no 25 jumper J2 is marked. In figure 5 the pin numbers are shown. This jumper is used to switch between boot mode and input IN3. An overview of the functionality of the jumper is shown in table 12.

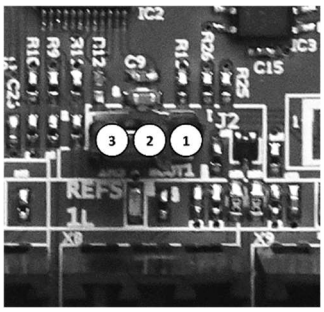
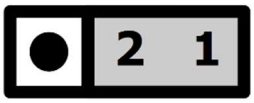
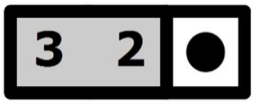


figure 5 Jumper J2 - Pin1

table 12 Jumper J2 – Bootloader / IN3

Pos	Jumper Stellung		Beschreibung
1		Boot: 1-2 connected	bootloader mode In this jumper position the IKS-24S is set into the bootloader mode after applying the operating voltage. This is used to load a new firmware.
2		IN3: 2-3 connected	normal operation. Input IN3 ist active.

3.10.3 RS-485 (J3)

In figure 1 no. 24 jumper J3 is marked. In figure 6 positions of the pins are shown. These jumpers can be used to activate two bias resistors and a 120Ω terminating resistor for the RS-485 serial interface. An overview of the functionality of the jumper is listed in table 13.

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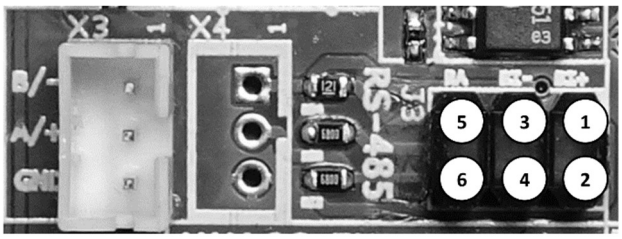
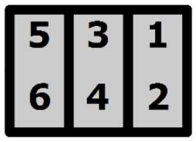


figure 6 Jumper J3 - Pin1

table 13 jumper J3 – RS-485

	Jumper	Jumper setting	Function
	1	pins 1 and 2 connected	activates a 680Ω bias resistor between RS-485 A/+ and +5V
		pins 1 and 2 open	deactivates a 680Ω bias resistor between RS-485 A/+ and +5V
	2	pins 3 and 4 connected	activates a 680Ω bias resistor between RS-485 B/- and ground
		pins 3 and 4 open	deactivates a 680Ω bias resistor between RS-485 B/- and ground
	3	pins 5 and 6 connected	activates the 120Ω termination resistor between RS-485 A/+ and RS-485 B/-
		pins 5 and 6 open	deactivates the 120Ω termination resistor between RS-485 A/+ and RS-485 B/-

3.10.4 CAN bus termination (J4)

In figure 1 no. 30 jumper J4 is marked. It activates the CAN bus termination resistor. An overview of the functionality of the jumper is listed in table 14.

table 14 Jumper J4 – CAN bus termination

Pos	Jumper setting		Function
1		1-2 open	120Ω termination resistor not active
2		1-2 connected	120Ω termination resistor active

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Firmware/Software

The functions of the IKS-32SEAL are based on the TRINAMIC TMCM-3110 controller.

4.1 Programming tools

TRINAMIC TMCL-IDE and TMCL-PC are free programs for evaluation and development of own sequence programs. They also support the TRINAMIC Motion Control Language (TMCL) and are therefore ideally suited for the initial commissioning of the IKS-32SEAL.

The free Mocontronic tool **MoCom** will be avaiable in Q1/2023.

4.2 USB driver

The controller uses the FTDI (Future Technology Devices International Limited) IC FT232RQ. Current operating systems already have a suitable USB driver. If the operating system you are using does not include a driver, a corresponding driver is available for download from the FTDI website:

- http://www.ftdichip.com/Drivers/VCP.htm

4.3 module (serial) address and broadcast address

Hint!

- the default module address is 1 and the default reply address is 2
- the default baud rate is 9600

The default module address is 1 and the default reply address is 2. Any other address can be assigned via global parameter 66 (SGP 66). Please note that the Reply address must not be used.

4.4 Mocontronic specific TMCL-Instructions

The extended functionality of the IKS-32SEAL requires a few Mocontronic specific TMCL commands which are listed below.

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4.4.1 Read exteral Encoder

The external encoder can be written or read using SAP/GAP. The evaluation is adapted to the 500 line encoder WEDL-WEDS5514 from Nanotec. The Table shows how the command is used and the required parameters.

SAP/GAP	Descriptiom	Type	Motor/ Bank	Value	R/W
216	Set encoder position / get encoder position	0	**0**		R/W

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4.4.2 reading analog inputs

The analog inputs can be queried with the command GIO (15, Get Input Output). A detailed description can be found in the table

reading analog inputs

Instruction GIO (15)	Function	Type	Motor/ Bank	Value	R/W
	reading analog inputs.	**0..7:** external input AIN0..7 (0-10V)	**1:** analog	**0...4096**	R

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Hints for comissioning

5.1 Communication ports

We recommend to use the TRINAMIC TMCL-IDE for the initial commissioning of the controller (see also chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**). Further information can be found on these websites:

- http://www.mocontronic.de
- https://www.trinamic.com/support/software/

5.1.1 module (serial) address

The default module address is 1 and the default reply address is 2.

5.1.2 Baudrate

The default Baudrate is 9600 Baud.

FAQ - Answers

- The IC7 at the digital outputs heats up during normal operation. When the outputs are switched off, the temperature can be around 40°C.
- If the digital input IN3 is always read out as 1 "high" via the software, the jumper J2 should be checked. This must be in position IN3.
- If not all parameters can be set with the TMCL IDE 3.0, the TMCL IDE 2.17 can be used.
- The TMCL script processing is stopped if the voltage VM+ is below 15V!

Mounting

The control unit is an incomplete machine in the sense of the Machinery Directive 2006/42/EC, which requires installation in a housing or control cabinet, preferably made of metal.

Environmental influences such as high temperatures, high humidity, condensation must be prevented. Dust, dirt, flammable atmospheres and aggressive gases must also be excluded. The place of installation should be a well ventilated place, not exposed to direct sunlight. Install the device on a non-flammable, vertical wall that does not transmit vibrations.

When mounting, be aware that the control unit generates heat. For this reason, mount the controller vertically and make sure that the installation location is well ventilated to ensure adequate heat convection.

7.1 EMC compliant installation

Installation instructions:

- Mounting the controller in a grounded metal enclosure.
- Ground the controller at the connections provided for this purpose.
- Shielded motor cable; shield coverage ≥ 85%; apply shield on both sides and over a large area
- Separate the control lines from the mains, power supply and motor lines; if unavoidable, make crossings of control and motor lines at right angles.
- The cable length between control and stepper motor should be less than 3m. Longer motor cables lead to worse EMC behavior.

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- During installation, ensure that the RF impedance between the controller and ground is as small as possible.
- Ensure that the metallic connections are as large as possible.
- Conductor loops act like antennas. Especially if they are spatially extended.
- Avoid unnecessary conductor loops.
- Avoid parallel routing of "clean" and interfering cables.
- Lay the motor cable and all analog and digital control and regulation lines shielded.
- You should leave the effective shielding area of these cables as large as possible, i.e. do not place the shield further than absolutely necessary.
- The shield must be connected to ground on both sides over a large area; if necessary, note exceptions for control lines in branched systems.
- A large-surface contacting can be realized by metallic cable glands or metallic mounting clamps.
- Use only copper braided cable (CY) with a coverage of 85%.
- The shielding should not be interrupted over the entire cable length. If, for example, the use of chokes or clamps is required in the motor cable, the unshielded part should be kept as short as possible.
- Very often interference is coupled in via the installation cables. You can minimize this influence.
- Lay interfering cables separately - minimum distance 0.25m - from interference-sensitive cables. The parallel laying of cables over longer distances is particularly critical. If two cables cross each other, the interference is smallest if the crossing is at an angle of 90 degrees.

Risk accessment

Mocontronic motor controllers can potentially pose hazards due to electric shock, high temperatures and electromagnetic interference. When using electric motors, there are also possible mechanical hazards.

Due to the overall low amounts of energy absorbed at also low extra-low voltages, the risks are assessed as low, provided that the following protective measures are followed:

8.1 Protection against electric shock

All controllers are operated with extra-low voltage according to IEC 60449, therefore, according to DIN VDE0100-410, protection against accidental contact is only required from 60 volts DC, unless "normal, dry environment" is to be assumed. We recommend contact protection from 48 volts for operation in dry rooms.

All controllers are designed for installation in an earthed metal housing which ensures a protection class appropriate to the environment in accordance with DIN VDE 0470-1.

In case Mocontronic delivers unfinished machines which are operated on mains voltage, they are installed in an appropriate housing. To avoid protection against electric shock do not remove the cover of the housing. There is voltage inside the housing which can cause an electric shock. Have the device used only by qualified personnel. As a protective measure, a residual current circuit breaker (RCCB) must be used in the supply line. According to VDE 0100 410, a residual current circuit breaker with a cut-off current ≤ 30mA and a cut-off time ≤ 0.3s must be used. In addition,

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a miniature circuit breaker of 16A must be used. Failure to observe these instructions may result in death, serious physical injury or considerable damage to property. The power supplies used by Mocontronic and their mounting comply with SELV construction according to DIN EN / UL 90750-1. This ensures a safe separation of mains and secondary protective extra-low voltage.

8.2 Protection against extreme temperatures

Motor controllers generate waste heat due to their design, the safe dissipation of which must be checked after installation in the customer's system. The use of fans may be necessary.

In addition, provision must be made for suitable automatic shutdown of the supply voltage and/or limitation of the operating current so that no overheating of touchable parts can occur even in the event of a fault. This also applies to connected cables, whose appropriate conductor cross-sections must be taken into account. EN 60 204-1 and VDE 0298-4 must be observed.

Improper use, such as reversing the polarity of the supply voltage or overvoltage, may result in the formation of flames or even a fire. Injuries due to exploding components are also possible.

In case Mocontronic delivers unfinished machines which are operated at mains voltage, they are installed in an appropriate housing. For protection against fire and danger of burns, a current limiter and a thermal switch are provided. In addition, a residual current circuit breaker (RCCB ≤ 30mA, ≤ 0.3s) and circuit breakers of 16A must be used.

8.3 Protection against electromagnetic interference

If power supplies with a final interference filter are used, the control unit is installed in a grounded metal housing and shielded cables are used, the basic EMC requirements are usually met. However, since the EMC behavior depends to a large extent on the design and location of the overall machine, the customer must test in accordance with the relevant environmental standard EN 55011, the product standard EN 61800-3 and the "mains standard" EN 61000-3-12.

8.4 Protection against mechanical hazards after installation in the customer product:

Due to the installation of motor controls and motors, the following points of the Machinery Directive must be observed in particular:

- Annex 1, point 1.2.3. starting up
- Annex 1, point 1.2.4. stopping
- Annex 1, point 1.2.5. selection of control or operating modes
- Annex 1, point 1.3. protective measures against mechanical hazards
- Annex 1, point 1.5.5 Extreme temperatures
- Annex 1, point 1.5.6 Fire
- Annex 1, point 1.7.2 Warning of residual risks

We recommend that the safety distances according to EN ISO 13857 for moving parts be taken into account as early as possible in the design process. Furthermore, we point out that both stepper and BLDC motors have only a very low holding torque when de-energized. A mechanical brake is therefore required for safe stopping, especially for larger moving masses. The STO (safe torque off) safety function can only be achieved by switching off the supply.

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For the individually required protection and safety measures, the standard EN ISO 12 100 "Safety of machinery" should be taken into account, for example.

For electrical installation, EN 60204 (electrical equipment of machines), listed as a B standard in the Machinery Directive, should be observed, in particular the protective measures described there:

- Insulation of conductors
- Installation in housings
- Safety-conscious design of circuit diagrams
- Sensible arrangement of reclosing devices
- Overcurrent protection
- Protective grounding

Maintenance and inspection

In principle, no complex maintenance or inspection work is required on the motor control units. We recommend checking the following points at appropriate intervals:

- Cleaning the motor control unit of impurities such as dust and dirt.
- Checking the ventilation. Such as clear ventilation slots, functional fans, and clear air filters.
- Checking cable connections for secure connection.

Directories

10.1 Directory of figures

10.2 Directory of tables

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Revision History

11.1 Document Revisions

table 15 document revisions

Version	Date	Author	Description
1.000	24.09.2021	CR	first draft
1.01	Oct 10th, 2021	AS	minor corrections

11.2 Hardware Revisions

table 16 Hardware Revisions

Version	Date	Author	Description
1.2	24.09.2021	CR	first prototype

11.3 Firmware Revisions

table 17 Firmware Revisions

Version	Datum	Autor	Description
1.2	24.09.2021	CR	first version

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