LTi DRiVES

ServoOne junior

Operation Manual

Servocontroller

2.0 A to 8 A

BG2 BG3 BG4

ServoOne junior Operation Manual

ID no.: 1300.20B.2-01

Date: 12/2011

Applicable as from firmware version: V0.25

The German version is the original of this Operation Manual.

ServoOne junior High-Performance Drives

The modularity of the ServoOne junior guarantees you optimum integration into the machine process. Whether in high-speed field bus communication with the central multi-axis machine controller or with distributed programmable Motion Control intelligence in the drive controller, the ServoOne junior is a master of both.

We reserve the right to make technical changes.

The content of our documentation was compiled with the greatest care and attention, and based on the latest information available to us.

We should nevertheless point out that this document cannot always be updated in line with ongoing technical developments in our products.

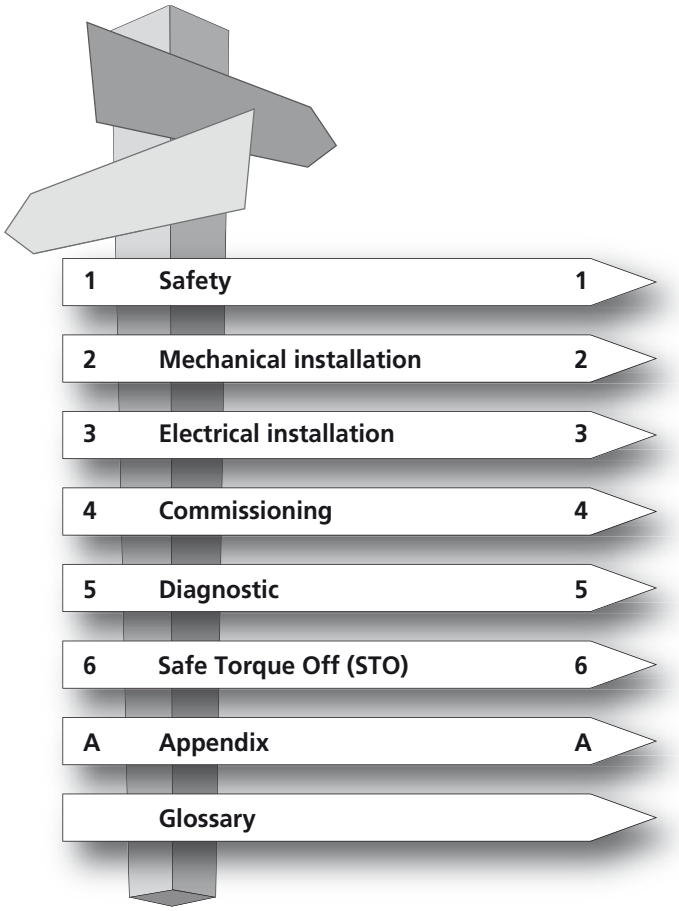
Information and specifications may be subject to change at any time. For information on the latest version please visit http://drives.lt-i.com.

How to use this document

Dear user,

We are happy that you have made a decision in favour of a product from LTi DRiVES. In order to be able to start using your new ServoOne junior quickly and without problems, we ask you kindly to read this Operation Manual thoroughly beforehand.

Step	Action	Comment
1.	This Operation Manual will enable you to install and commission the ServoOne junior drive system very quickly and easily.	Quick-start guide
2.	Simply follow the step-by-step tables in the chapters.	Off you go!



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Order code

The order designation SO2x.xxx.0xxx.xxxx.x informs you about the corresponding variant of the drive controller delivered to you. The significance of the individual characters of the order designation is given in the following order code. You will find the complete order code with all values in the ServoOne system catalogue.

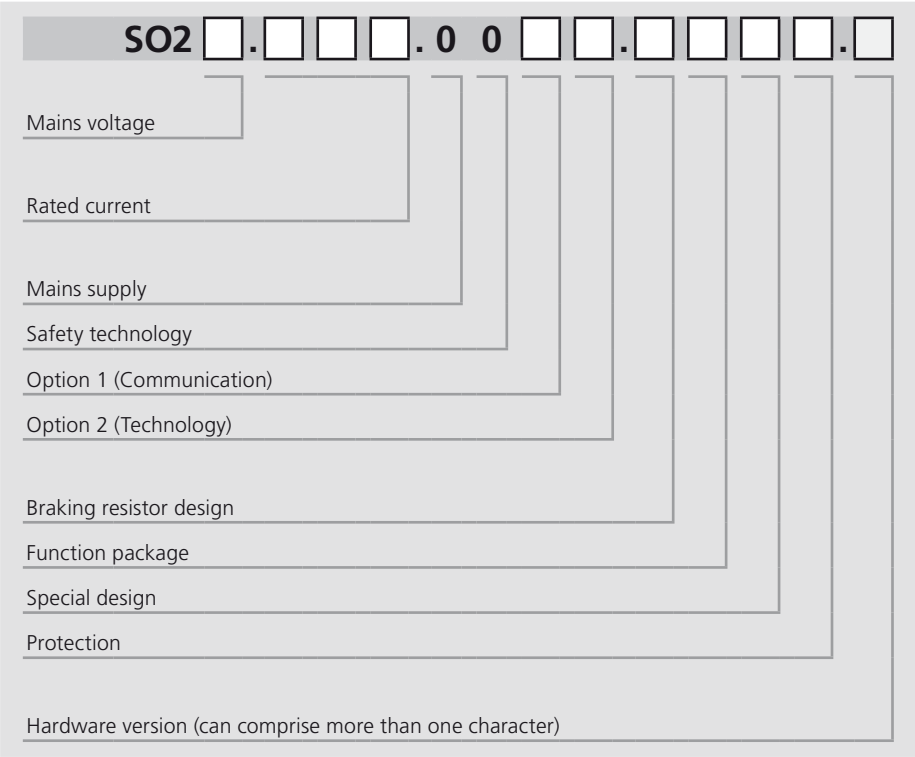

Fig. 0.1 ServoOne junior order code

Rating plate

On rating plates of the ServoOne junior drive controllers you will find the serial number, from which you can identify the date of manufacture based on the following key. For the location of the rating plate on the ServoOne junior refer to Fig. 3.1 on page 14.

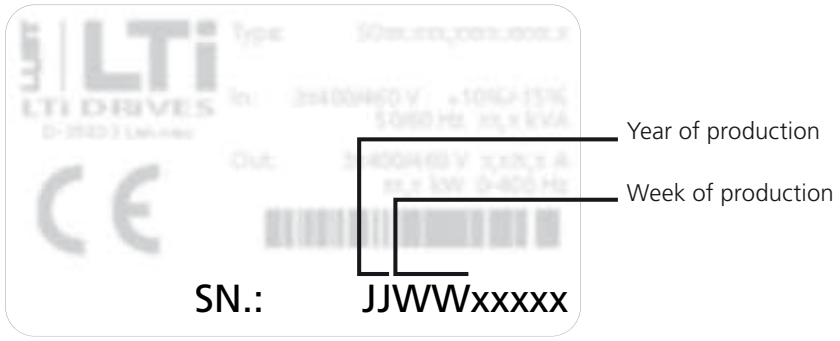

Fig. 0.2 ServoOne junior hardware rating plate

Supply package

The supply package includes:

- ServoOne junior drive controller
- Terminal kit for control and power terminals (depending on device power and variant)
- Set with shield connecting plates and fixing material
- Product DVD

Pictograms

To provide clear guidance, this Operation Manual uses pictograms. Their meanings are set out in the following table. The pictograms always have the same meanings, even where they are placed without text, such as next to a connection diagram.

Warnings (see also section 1.1)	
	ATTENTION! Misoperation may result in damage to the drive or malfunctions.
	DANGER FROM ELECTRICAL TENSION! Improper behaviour may endanger human life.
	DANGER FROM ROTATING PARTS! Drive may start up automatically.
Hints & Tips	
	NOTE: Useful information or reference to other documents
	STEP: Action in a sequence of multiple actions.

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Space for personal notes

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1 Safety

1.1 For your safety

The instructions set out below should be read through prior to initial commissioning in order to prevent injury and/or damage to property. The safety instructions must be followed at all times.

ATTENTION! The ServoOne junior's "Safe Torque Off (STO)" safety function must be approved by the TÜV-Rheinland accredited certification body. This certification is currently still in preparation. Conformance to parts of EN ISO 13849-1, EN 62061, EN 61800-5-1 and EN 61508 is ensured.

1.1.1 Read the Operation Manual first!

	Read the Operation Manual first! • Follow the safety instructions! • Refer to the user information!
	Electric drives are dangerous: • Electrical voltages of 230 V to 480 V **Dangerously high voltages of ≥ 50V may still be present 10 minutes after the power is cut (capacitor charge). So check that the power has been cut!** • Rotating parts • Hot surfaces
	Protection against magnetic and/or electromagnetic fields during installation and operation. • Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas: – Areas where drive systems are installed, repaired and operated. – Areas where motors are installed, repaired and operated. Motors with permanent magnets pose a particular hazard. NOTE: If it is necessary to access such areas, suitability to do so must be determined before hand by a doctor.
	Your qualification: • In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device. • The said qualified personnel must be familiar with the contents of the Operation Manual (cf. IEC 364, DIN VDE 0100). • Awareness of national accident prevention regulations (e.g. BGV A3 in Germany)
	During installation observe the following instructions: • Always comply with the connection conditions and technical specifications. • Comply with the standards for electrical installations, such as regarding wire cross-section, grounding lead and ground connections. • Do not touch electronic components and contacts (electrostatic discharge may destroy components).

Table 1.1 Safety instructions

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1.1.2 Warning symbols

The safety instructions detail the following hazard classes.
The hazard class defines the risk posed by failing to comply with the safety notice.

Warning symbols	General explanation	Hazard class to ANSI Z 535
	ATTENTION! Misoperation may result in damage to the drive or malfunctions.	Serious injury or damage to property may occur.
	DANGER FROM ELECTRICAL TENSION! Improper behaviour may endanger human life.	Death or serious injury will occur.
	DANGER FROM ROTATING PARTS! Drive may start up automatically.	Death or serious injury will occur.

Table 1.2 Explanations of warning symbols

1.2 Intended use

ServoOne junior drive controllers are components designed solely for vertical installation in stationary electrical systems or machines.

When installed in machines the commissioning of the drive controller (i.e. start-up of intended operation) is prohibited, unless it has been ascertained that the machine fully complies with the provisions of the Machinery Directive 2006/42/EC; compliance with EN 60204 is mandatory.

Commissioning (i.e. start-up of intended operation) is only permitted when strictly complying with the EMC Directive (2004/108/EC).

CE The ServoOne junior conforms to the Low Voltage Directive 2006/95/EC.

The drive controllers fulfill the demands of the harmonized product standard EN 61800-5-1.

If the drive controller is used for special applications, such as in areas subject to explosion hazard, the required standards and regulations (e.g. EN 50014, "General provisions" and EN 50018, "Flameproof housing") must always be observed.

Repairs may only be carried out by authorized repair workshops. Unauthorized opening and incorrect intervention could lead to death, physical injury or material damage. The warranty provided by LTi DRiVES would thereby be rendered void.

NOTE: Deployment of the drive controllers in non-stationary equipment is classed as non-standard ambient conditions, and is permissible only by special agreement.

1.3 Responsibility

Electronic devices are fundamentally not fail-safe. The company setting up and/or operating the machine or plant is itself responsible for ensuring that the drive is rendered safe if the device fails.

In the section on "Electrical equipment of machines" the standard EN 60204-1/ DIN VDE 0113 "Safety of machines" stipulates safety requirements for electrical controls. They are intended to protect personnel and machinery, and to maintain the function capability of the machine or plant concerned, and must be observed.

The function of an emergency off system does not necessarily have to cut the power supply to the drive. To protect against danger, it may be more beneficial to maintain individual drives in operation or to initiate specific safety sequences. Execution of the emergency stop measure is assessed by means of a risk analysis of the machine or plant, including the electrical equipment in accordance with EN ISO 14121 (previously DIN EN 1050), and is determined in accordance with EN ISO 13849-1 (previously DIN EN 954-1), "Safety of machines - Safety-related parts of controls" by selecting the circuit category.

2 Mechanical installation

2.1 Notes for operation

Please strictly avoid ...

- penetration of damp into the device;
- aggressive or conductive substances in the immediate vicinity;
- drill chippings, screws or foreign bodies dropping into the device;
- ventilation openings being covered over, as otherwise the device may be damaged.

Note the following points:

- Cooling air must be able to flow through the device without restriction.
- For mounting in switch cabinets with convection (= heat loss is discharged to the outside via the cabinet walls), always fit an internal air circulation fan.
- The backing plate must be well grounded.
- The device is designed only for vertical installation in switch cabinets. The switch cabinet must as a minimum provide IP4x protection.

ATTENTION! According to EN ISO 13849-2 the switch cabinet must have IP54 protection or higher when using the STO (Safe Torque OFF) safety function.

- To attain the best result for EMC-compatible installation you should use a chromated or galvanized backing plate. If backing plates are varnished, remove the coating from the contact area. The devices themselves have an aluminium back panel.
- Max. pollution severity 2.

Further information on environmental conditions can be found in the appendix.

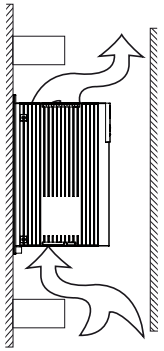
2.2 Wall mounting

Step	Action	Comment
1.	Mark out the position of the tapped holes on the backing plate. Cut a tap for each fixing screw in the backing plate.	Dimensional drawings/hole spacing - see table 2.2, Fig. 2.1 and Fig. 2.2 The tapping area will provide you with good, full-area contact.
2.	Mount the servocontroller **vertically** on the backing plate.	Observe the mounting clearances! The contact area must be metallic bright.
3.	Mount the other components, such as the mains filter, mains choke etc., on the backing plate.	The cable between mains filter and servocontroller may be max. 30 cm long.
4.	Continue with the electrical installation in section 3.	

Table 2.1 Mechanical installation

NOTE: For all sizes of the ServoOne junior forced cooling by external air flow is necessary. The air must be able to flow unhindered through the device. If a temperature cut-out occurs, the cooling conditions must be improved.

Air flow: min. 1.2 m/s



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Dimensions

ServoOne junior	BG2	BG3	BG4
	SO22.003 SO24.002	SO22.006 SO24.004	SO22.008 SO24.007
Weight [kg]	1.0	1.5	2.8
B (width)	55		
H (height) 1)	210		290
T (depth) 1)	142	189	235.5
A	27.5		
A1	-	-	40
C	225		305
C1	5		
D Ø	4.8		
E	for direct butt mounting (see note)		
F 2)	≥100	≥150	
G 2)	≥235		≥280
H1	235		315
Screws	2 x M4		4 x M4

All dimensions in mm
1) without terminals/connections
2) The bend radius of the connecting cables must be taken into account

Table 2.2 ServoOne junior dimensions - see Fig. 2.1 and Fig. 2.2

NOTE: The minimum distance specified in the table for sizes 2-4 applies for devices of the same power. When butt mounting devices with different drive power you should arrange the devices according to their power (e.g., viewed from the left, BG4-BG3-BG2). This minimizes the thermal influence among each other.

When butt mounting ServoOne junior controllers together with other devices, you must make sure that these device do not affect one another thermally.

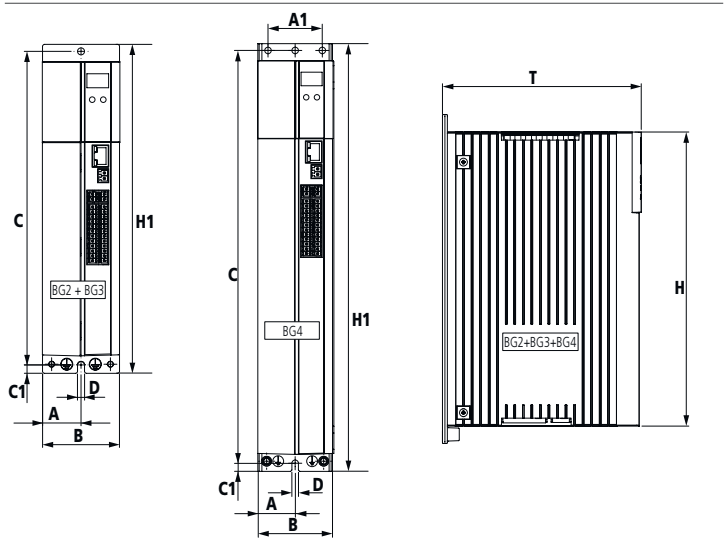

Fig. 2.1 Dimensions (in mm) BG2, BG3, BG4

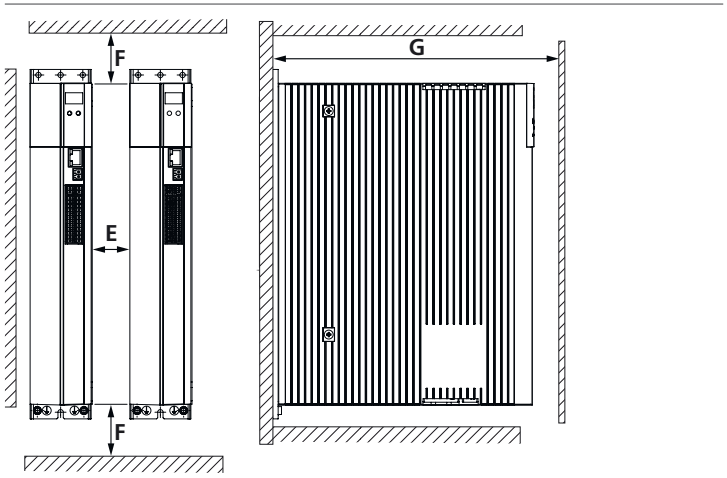

Fig. 2.2 Mounting clearances (in mm)

3 Installation

3.1 Notes for installation

ATTENTION!

- **Qualified personnel**
  Installation must only be carried out by electrical engineering experts who have been specially instructed in the necessary accident prevention measures.
- **During installation work**
  Strictly avoid that ...
  – screws, cable rests or foreign bodies drop into the device
  – moisture enters into the device

DANGER CAUSED BY HIGH VOLTAGE!

- **Danger to life!**
  – Never wire or disconnect electrical connections while they are live. Isolate the device from the mains supply (230/400/460/480 V AC) before working on it. Even 10 minutes after switching off the mains supply dangerously high voltages of ≥50 V may still be present (capacitor charge). Work on the device must only be carried out, after the DC link voltage has dropped below a residual voltage of 50 V (indicated by monitoring LED H1 **and** to be measured on terminals X1/L- and L+).
  – Dangerous voltage may be applied to the device, even if the device does not emit any visual or audible signals/indications (e.g. with mains voltage applied to terminal X3) and missing control supply (+24 V on X2)!

The following general guidelines apply for the installation of single axis controllers:

- **Compliance with the EMC product standard**
  Commissioning (i.e. starting intended operation) is only permitted when strictly complying with EMC product standard EN 61800-3. The installer/operator of a machine and/or equipment must provide evidence of the compliance with the protection targets stipulated in the EMC-standard.
- **Cabel type**
  Use only shielded mains, motor and signal lines with double copper braiding that is overlapping by 60 to 70 %.
- **Routing of cables**
  – Route mains, motor and signal cables separated from one another. If possible, keep a distance of at least 0.2 m, otherwise use separators. They should not run in parallel. If crossovers are unavoidable, they should wherever possible be configured perpendicular (at a 90° angle).
  – Always route the motor cable without interruptions and the shortest way out of the control cabinet. When using a motor contactor for example, the component should be directly mounted to the drive controller and the shielding of the motor cable should not be stripped off too soon.
  – If possible enter signal lines only from one side into the control cabinet.
  – Lines of the same electric circuit must be twisted.
  – Avoid unnecessary cable lengths and loops.
- **Grounding measures**
  Grounding measures of relevance for the drive controller are described in section 3.5 "Connection PE conductor".
- **Shielding measures**
  Do not strip the cable shields too soon, and lay them across wide areas both on the component and on the backing plate or on the PE rail (main ground) of the backing plate.
- **External components**
  – Place larger consumers near the supply.
  – Contactors, relays, solenoid valves (switched inductivities) must be wired with fuses. The wiring must be directly connected to the respective coil.
  – Any switched inductance should be at least 0.2 m away from the process controlled assemblies.

Additional information can be found in the corresponding connection description.
If you require further detailed information on installation you should consult the LTi Helpline (see page 44).

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3.2 Layout

The following shows the layout with the corresponding positions of plugs and terminals. For better orientation we have identified the designations of plugs and terminals with an abbreviation.

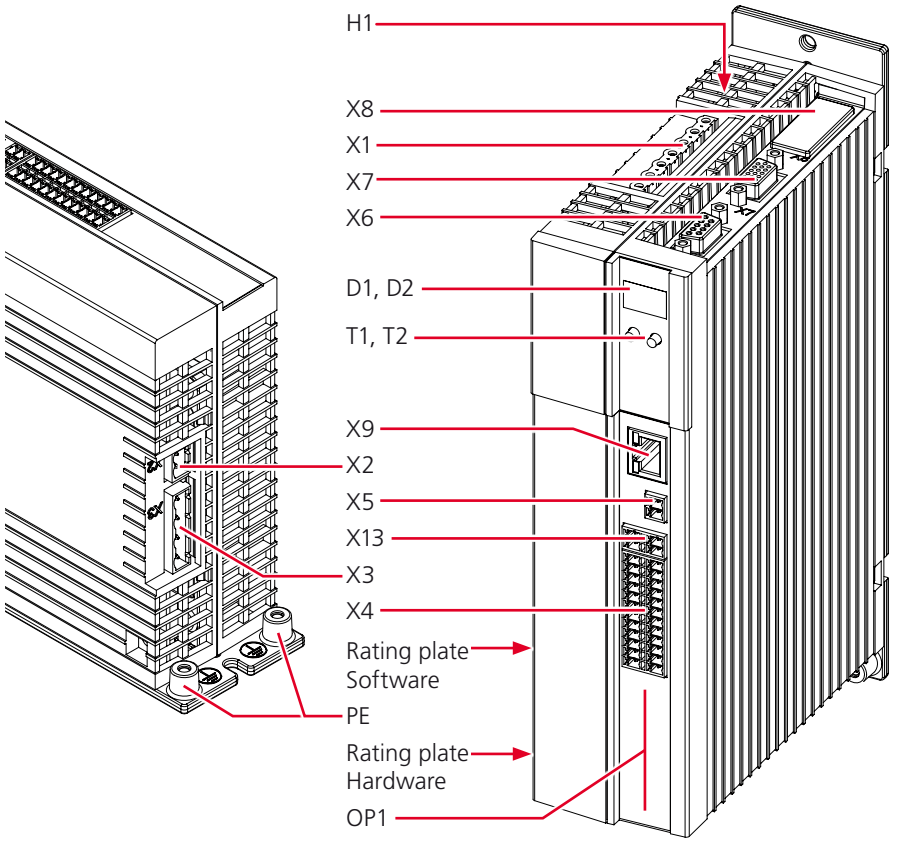

Fig. 3.1 Layout ServoOne junior

Number	Designation
D1, D2	7-segment display
H1	DC link voltage indicator LED
OP1	Installation space for option 1 (Communication)
PE	Connection PE conductor
T1, T2	Button
X1	Power connection
X2	Connection control supply U_V
X3	Connection AC power supply
X4	Terminals
X5	Motor temperature monitoring
X6	Connection resolver
X7	Connection high-resolution encoder
X8	Option 2 (Technology)
X9	Ethernet interface
X13	Connection Motor brake

Table 3.1 Key to layout ServoOne junior

3.3 Connection diagram

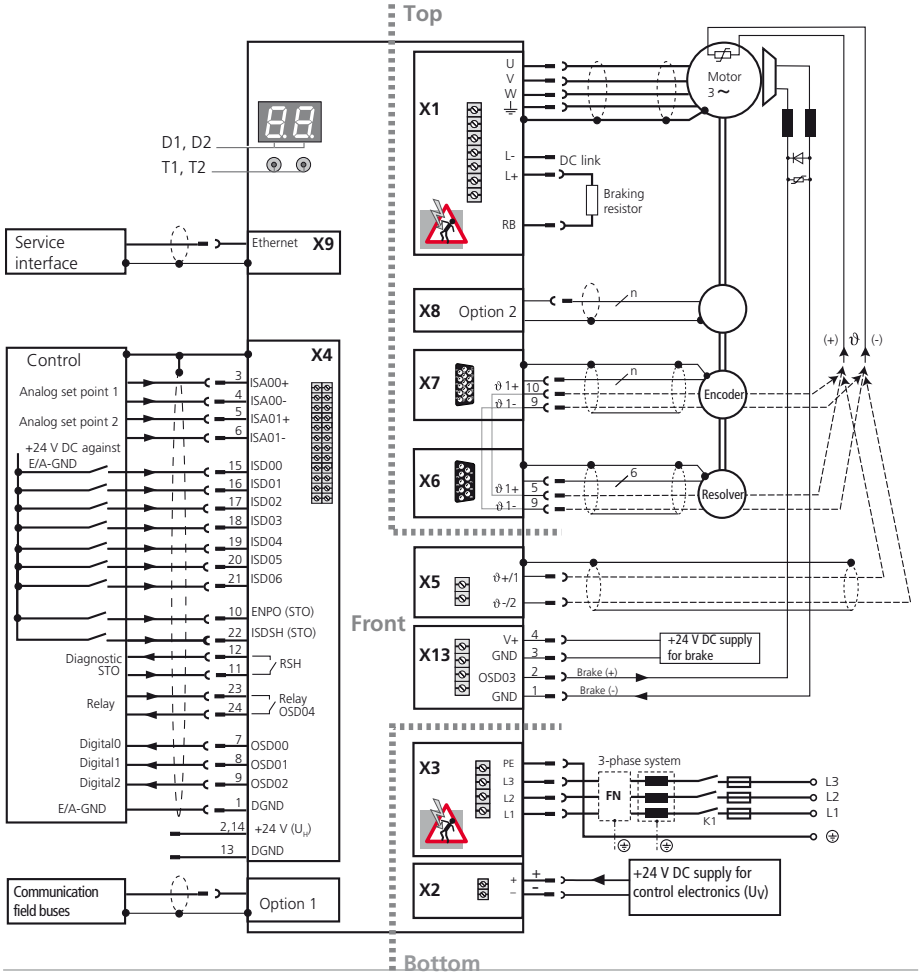

Fig. 3.2 Connection diagram

Number	Designation	Details
D1, D2	7-segment display	page 39
T1, T2	Button	page 39
X1	Connection for motor, braking resistor and measurement of DC link voltage	page 29
X2	Connection control supply	page 21
X3	Connection AC power supply	page 21
X4	Terminals	page 24
X5	Connection motor temperature monitoring [1]	page 29
X6	Connection resolver [1]	page 28
X7	Connection high-resolution encoder [1]	page 28
Option 1	Communication	page 26
PE	Connection PE conductor	page 19
X8 (Option 2)	Technology	page 26
X9	Ethernet interface	page 26
X13	Connection motor brake	page 29

1) NOTE: The temperature sensor of the motor winding can be optionally connected via the encoder cables (X6 or X7) or to terminal X5.

Table 3.2 Key to connection diagram

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3.4 Effective EMC installation

3.4.1 Interference immunity of drive controllers

ATTENTION! This is a restricted availability product in accordance with IEC 61800-3. This product may cause radio interference in domestic environments; in such cases the operator may need to take appropriate countermeasures.

External radio frequency interference suppression filters (EMCxxx) are available for the drive controllers. With the measurement method specified and the external mains filter, these drive controllers conform to the EMC product standard IEC 61800-3 for "First environment" (residential C2) and "Second environment" (industrial C3).

3.4.2 Specimen setup

The specimen setup presented on the following pages is intended to illustrate the key measures necessary to ensure EMC-compatible setup.

NOTE: The specimen setup merely presents a recommendation, and does not automatically guarantee compliance with applicable EMC directives. The installer/ operator of a machine and/or item of plant must provide proof of compliance with the protection targets stipulated in the standard.

Overview

Fig. 3.3 presents an overview of the minimum components required:

A. Backing plate with cable ducts
B. ServoOne junior
C. Mains filter
D. Mains choke
E. Distributor rail for AC power supply an control supply (+24 V DC)

The layout and cabling are based on the instruction set out in section 3.1 "Notes for installation" on page 13. The numbered red arrows refer to four very important detailed notices presented on the following pages.

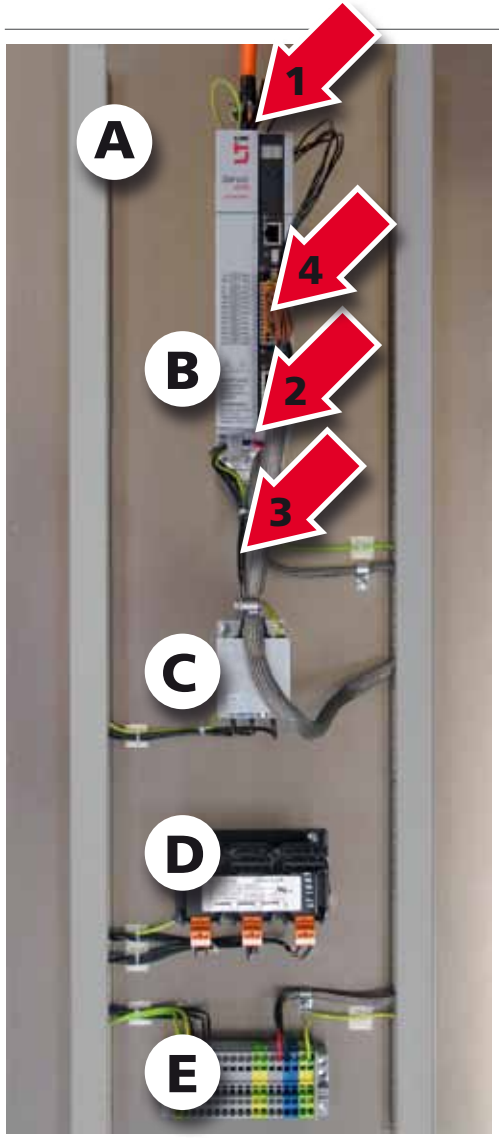

Fig. 3.3 Specimen setup - Overview

Detail 1: Motor cable

At the motor connection (X1) of the ServoOne junior note the following points:

- Secure one of the two supplied shield connection plates by the screw to the mount on the top of the unit. Ensure the plate contacts across a wide area with the heat sink of the ServoOne junior and with the backing plate. Use a toothed ring.
- Strip back the shield of the motor cable on the motor connection (X1) of the ServoOne junior as little as absolutely necessary.
- Connect the motor cable shield across a wide area to the shield connection plate by the clamp supplied.

NOTE: Ready made-up motor cables are available for LTi DRiVES servomotors. For details refer to the Servomotors order catalogue (ID no.: 0814.25B.x).

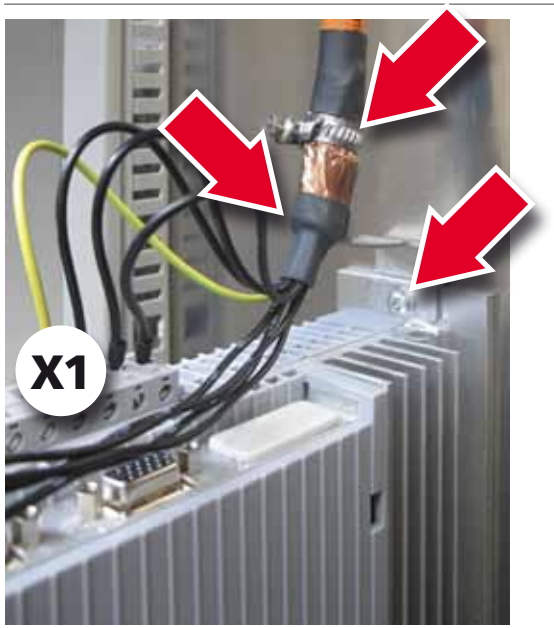

Fig. 3.4 Specimen setup - Detail 1: Motor cable

Detail 2: Control supply (+24 V DC)

At the control supply connection (X2):

- Secure the second of the two supplied shield connection plates by the screw to the mount on the bottom of the unit. Ensure the plate contacts across a wide area with the heat sink of the ServoOne junior and with the backing plate. Use a toothed ring.
- Slot a shield tube over the control supply cable and strip it back only as short as necessary before the control supply connection (X2).
- Connect the shielding tube of the control supply cable across a wide area to the shield connection plate by the clamp supplied.

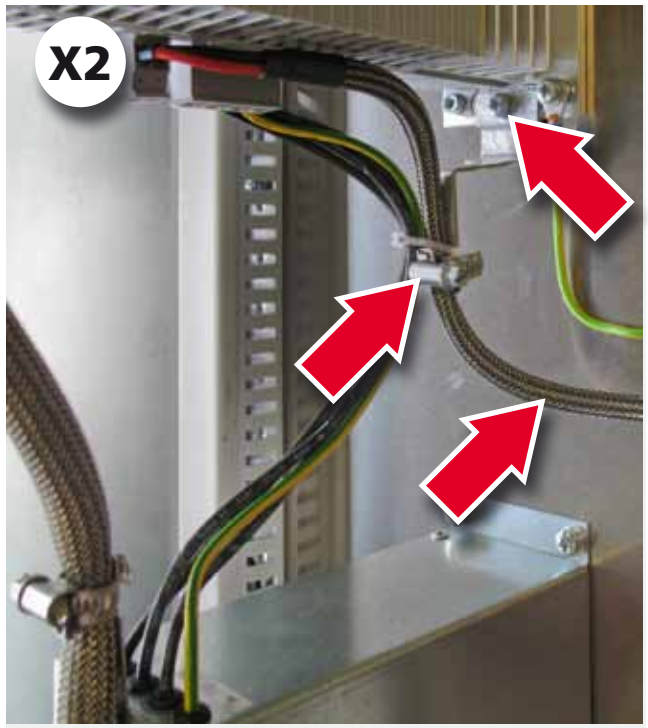

Fig. 3.5 Specimen setup - Detail 2: Control supply

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Detail 3: Mains filter and mains connection

At the output of the mains filter and the AC mains connection (X3):

- Connect the wire strands at the output of the mains filter directly to the AC mains (X3) of the ServoOne junior. The strands must **not** be extended, so the mains filter should be installed correspondingly close to the ServoOne junior. But be sure to maintain the necessary minimum clearance (see table 2.2 on page 12).
- Fix the strands to the shield connection plate using a cable tie as necessary.
- The leakage current of the ServoOne junior is >3.5 mA. So:
  - Connect the protective conductor from the output of the mains filter to the connection (X3) of the ServoOne junior **and**
  - one of the PE – connections on the heat sink of the ServoOne junior via a cable of at least the same cross-section to the main ground of the distributor rail.

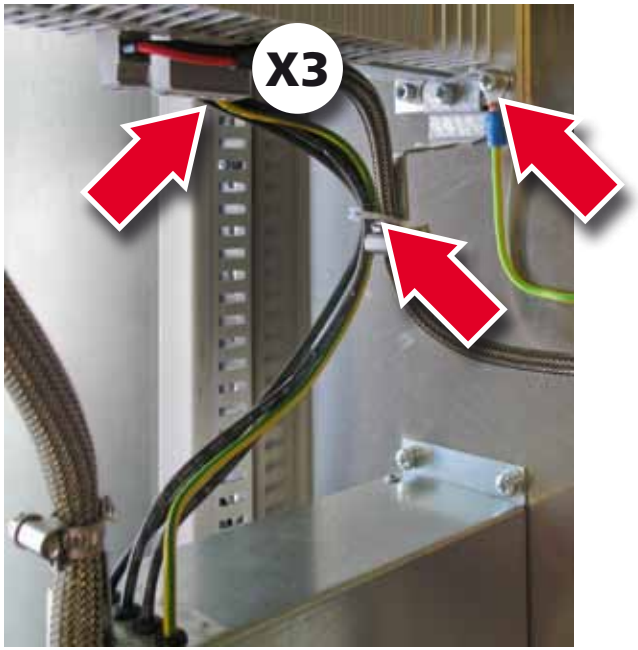

Fig. 3.6 Specimen setup - Detail 3: Mains filter and mains connection

Detail 4: Control cables

At the control terminals (X4) of the ServoOne junior:

- Strip the shielding of the control cables back only as short as absolutely necessary.
- Connect the control cable shields across a wide area to the shield connection tab of the mains filter by the clamp supplied. If this is not possible, lay the control cable shielding directly across a wide area on the backing plate directly adjacent to the ServoOne junior.

Fig. 3.7 Specimen setup - Detail 4: Control cables

3.5 Connection PE conductor

Step	Action	PE mains connection to DIN EN 61800-5-1
1.	Ground each of the drive controllers! Connect terminal ⏚ **in star configuration and amply dimensioned** with the PE bar (main ground) in the control cabinet.	Rules for the PE terminal (as leakage current > 3.5 mA): Use protective conductors with the same cross-section as the mains power cables, though at least 10 mm².
2.	Also connect the PE-conductor terminals of all other components, such as mains choke, filter, etc. in a **star configuration and amply dimensioned** with the PE bar (main ground) in the control cabinet.	Also comply with local and national regulations and conditions.

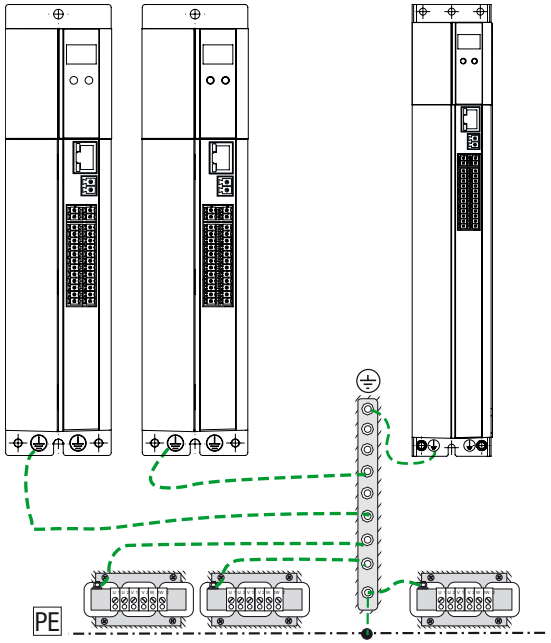

Fig. 3.8 Star configuration layout for the PE conductor

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3.6 Electrical isolation concept

The control electronics, with its logic (µP), the encoder terminals and the inputs and outputs, are electrically isolated from the power section (power supply/DC-link). All control terminals are designed as safety extra-low voltage/protective extra-low voltage (SELV/PELV) circuits and must only be operated with such SELV/PELV voltages, as per the relevant specification. This provides reliable protection against electric shock on the control side.

A separate control supply, compliant with the requirements of a SELV/PELV, is therefore needed.

The opposite overview shows the potential supplies for the individual terminals in detail.

This concept also delivers higher operational safety and reliability of the drive controller.

SELV = Safety Extra Low Voltage
PELV = Protective Extra Low Voltage

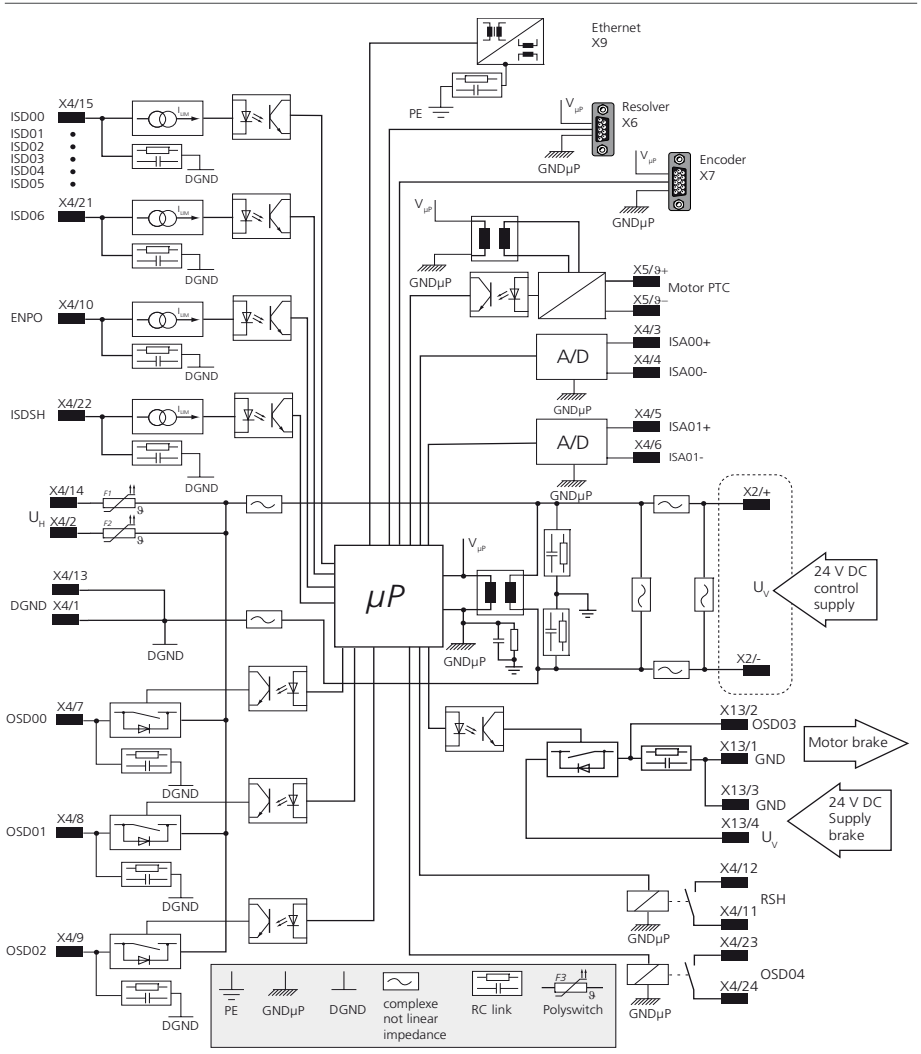

Fig. 3.9 Electrical isolation concept ServoOne junior

3.7 Connection of supply voltage

The voltage supply to the ServoOne junior is separate for the control and power sections. The control supply should always be connected **first**, so that the device can be parameterized with DriveManager 5 and, above all, set to the correct power supply.

ATTENTION! Only when the mains voltage has been set and the ServoOne junior restarted (if the mains voltage or switching frequency has been changed) may the mains power supply be activated. Otherwise the device may be destroyed!

3.7.1 Connection of control supply (+24 V DC)

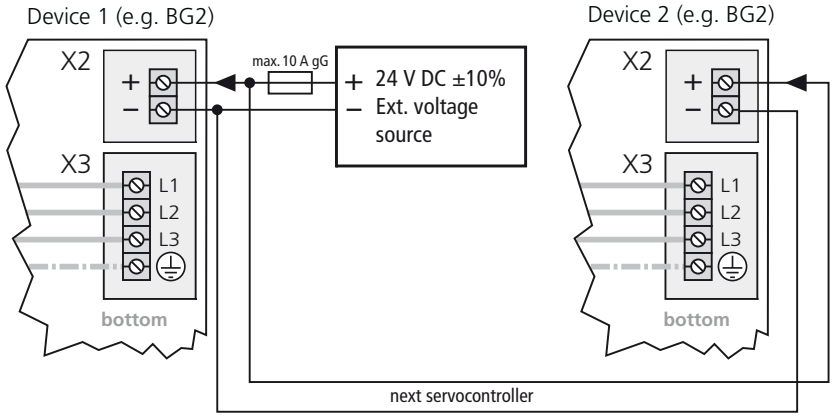

Fig. 3.10 Connection of control supply ServoOne junior

Control supply (Specification)		
Control supply	X2/+ X2/-	• U_V = +24 V DC ±10%, stabilized and filtered. • I_V = 2 A (BG2 to BG4) • Internal polarity reversal protection • The power supply unit used must have a safe and reliable isolation against the mains system acc. to EN 50178 or EN 61800-5-1

Table 3.3 Specification of control supply ServoOne junior

ATTENTION! Suitable measures must generally be applied to provide adequate line protection.

DANGER FROM ELECTRICAL TENSION! When the mains voltage is switched on at terminal X3 and there is no control supply (+24 V DC at X2), dangerous voltage is connected to the device with no visual signal on the display or acoustic indication by fan noise. If visible in the installed state, LED H1 (see Fig. 3.1) indicates whether voltage is connected to the device. Even when H1 is out, X1 must be checked to ensure no voltage is connected.

NOTE: The start-up current for the supply voltage to the BG2 to BG4 may be two to three times the operating current.

3.7.2 Connection of mains supply BG2 and BG3

NOTE: Before commissioning, the value of the connected mains voltage must be set on the drive controller (factory setting = 3 x 230 V AC / 3 x 400 V AC).

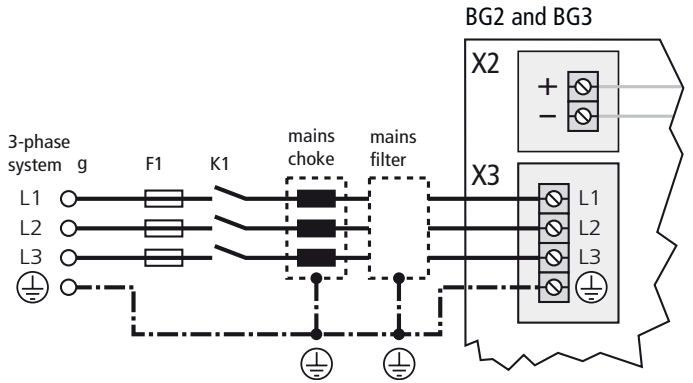

Fig. 3.11 Connection BG2 and BG3 mains supply 3 x 230 V (SO22.xxx) or 3 x 400 V (SO24.xxx) depending on device design

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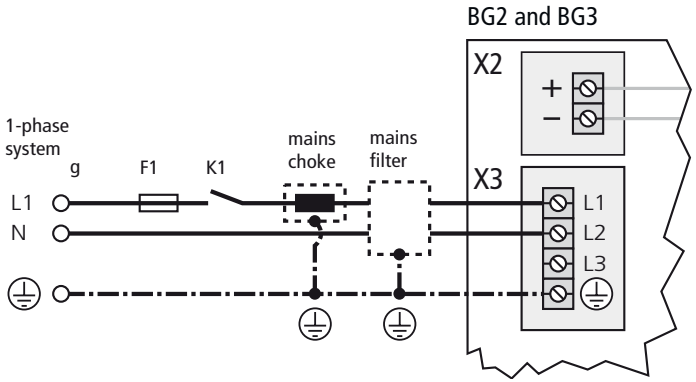

Fig. 3.12 Conection BG2 and BG3 mains supply 1 x 230 V

3.7.3 Connection of mains supply BG4

NOTE: Before commissioning, the value of the connected mains voltage must be set on the drive controller (factory setting = 3 x 230 V AC / 3 x 400 V AC).

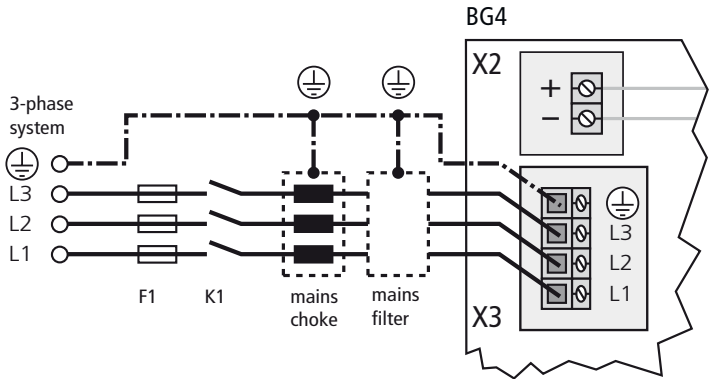

Fig. 3.13 Connection BG4 mains supply 3 x 230 V (SO22.xxx) or 3 x 400 V (SO24.xxx) depending on device design

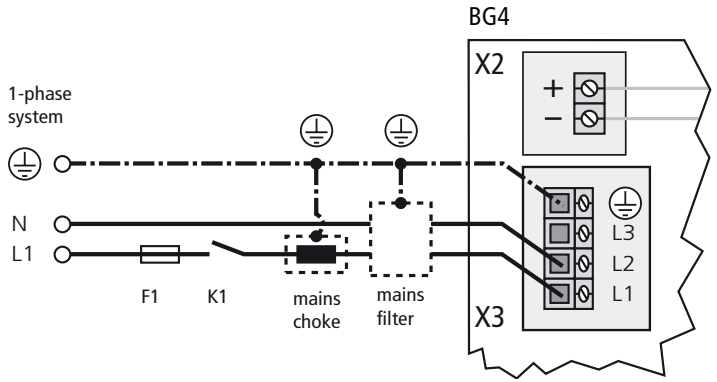

Fig. 3.14 Connection BG4 mains supply 1 x 230 V

Procedure:

Step	Action	Comment
1.	Specify the cable cross-section dependent on the maximum current and ambient temperature.	Cable cross-section according to local regulations and conditions.
2.	Wire the drive controller with the mains filter*), max. cable length 0.3 m (with non-shielded cable)!	
3.	Wire the mains choke*) (if installed)	Reduces the voltage distortions (THD) in the system and prolongs the life of the drive controller.
4.	Install a K1 circuit breaker (power circuit breaker, contactor, etc.).	Do not switch on the power!
5.	Use mains fuses (duty class gG) to isolate all poles of the drive controller from the mains supply.	For compliance with equipment safety requirements laid down in EN 61800-5-1

*) optional

DANGER FROM ELECTRICAL TENSION! Danger to life! Never wire or disconnect electrical connections while these are live. Always disconnect the power before working on the device. Dangerously high voltages of ≥50 V may still be present 10 minutes after the power is cut (capacitor charging). So always check that the power has been cut.

ATTENTION! If local regulations require the installation of a residual current operated protective device, the following applies: In case of a fault the drive controller is able to generate d.c. leak currents without zero crossing. Drive controllers therefore must only be operated with (RCDs) [1] type B for a.c. fault currents, pulsating or smooth d.c. fault currents, which are suitable for servo controller operation, see IEC 60755. RCMs [2] can additionally be used for monitoring purposes.

1) Residual current protective device
2) Residual current monitor

Note the following points:

- Switching the mains power:
  - In case of too frequent switching the unit protects itself by high-resistance isolation from the system. After a rest phase of a few minutes the device is ready to start once again.
- TN and TT network: Operation is permitted if:
  - in the case of single-phase devices for 1 x 230 V AC the supply system conforms to the maximum overvoltage category III as per EN 61800-5-1.
  - in the case of three-phase devices with external conductor voltages 3 x 230 V AC, 3 x 400 V AC, 3 x 460 V AC and 3 x 480 V AC
    1. **the neutral point** of the the supply system **is grounded** and
    2. the supply system conforms to the maximum overvoltage category III as per EN 61800-5-1 at a system voltage (external conductor → neutral point) of maximum 277 V.
- IT network: **not** permitted!
  - In case of an ground fault the electrical stress is approx. twice as high. Clearances and creepages to EN 61800-5-1 are no longer maintained.
- Connection of the drive controllers by way of a mains choke is mandatory:
  - where the drive controller is used in applications with disturbance variables corresponding to environment class 3, as per EN 61000-2-4 and above (hostile industrial environment)
  - in the case of single-phase mains supply
  - for compliance with EN 61800-3 or IEC 61800-3
- For further information on permissible current loads, technical data and ambient conditions please refer to the appendix.

NOTE: Please be aware that the ServoOne junior is not rated for environment class 3. Further measures are essential in order for that environment class to be attained! For further information please consult your project engineer.

Drive controller	Device connected load [1] [kVA]		Max. cable cross-section [mm²]	Specified mains fuse, duty class [A]
	with mains choke (4% u_K)	without mains choke		
SO22.003	1.3	1.6	2.5	1 x max. 16 (1-phase) 3 x max. 16 (3-phase)
SO24.002	1.5	1.9		3 x max. 6
SO22.006	2.6	3.2	2.5	1 x max. 16 (1-phase) 3 x max. 16 (3-phase)
SO24.004	2.7	3.3		3 x max. 10
SO22.008	3.5	4.3	4	1 x max. 20 (1-phase) 3 x max. 20 (3-phase)
SO24.007	5.0	6.1		3 x max. 16

1) At 3 x 230 V AC or 3 x 400 V AC mains voltage
2) The minimum cross-section of the mains power cable depends on the local regulations and conditions, as well as on the rated current of the drive controller.

Table 3.4 Connected load and mains fuse

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3.8 Control connections

Step	Action	Comment
1.	Check whether a complete device setup is already available, i.e. whether the drive has already been configured.	
2.	If this is the case, a special control terminal assignment applies. Please contact your project engineer to obtain the connecting assignment!	
3.	Choose a connecting assignment.	Initial commissioning
4.	Wire the control terminals with shielded cables. The following is strictly required: STO request X4/22, ENPO X4/10 and a start signal (with control via terminal).	Ground the cable shields over a wide area at both ends. Conductor sizes fixed: 0.2 to 1.5 mm² Flexible conductor sizes: - Ferrule without plastic sleeve: 0.2 to 1.5 mm² - Ferrule with plastic sleeve: 0.2 to 0.75 mm²
5.	Keep all contacts open (inputs inactive).	
6.	Check all connections again!	Continue with commissioning in section 4.

Note the following points:

- Always wire the control terminals with shielded cables.
- Lay the control cables separately from the mains power and motor cables.
- A cable type with double copper braiding, with 60 - 70% coverage, must be used for all shielded connections.

3.8.1 Specification of control connections

Des.	Term.	Specification	El. isolation
Analog inputs			
ISA0+ ISA0- ISA1+ ISA1-	X4/3 X4/4 X4/5 X4/6	• U_{IN} = ±10 V DC • Resolution 12 Bit; R_{IN} approx. 101 kΩ • Terminal scan cycle in "IP mode" = 125 µs, otherwise = 1 ms • Tolerance: U ±1% of the measuring range end value	no
Digital inputs			
ISD00 ISD01 ISD02 ISD03 ISD04	X4/15 X4/16 X4/17 X4/18 X4/19	• Frequency range <500 Hz • Terminal scan cycle in = 1 ms • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20% • I_{IN} at +24 V DC = typ. 3 mA	yes
ISD05 ISD06	X4/20 X4/21	• Frequency range ≤500 kHz • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20% • $I_{IN\ max}$ at +24 V DC = 10 mA, R_{IN} approx. 3 kΩ • internal signal delay time < 2 µs suitable as trigger input for quick saving of actual position	yes
ENPO	X4/10	• Disable restart inhibit (STO) and enable power stage = High level • OSSD-capable • Reaction time approx. 10 ms • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20% • I_{IN} at +24 V DC = typ. 3 mA	yes
Digital outputs			
OSD00 OSD01 OSD02	X4/7 X4/8 X4/9	• No destruction in case of short-circuit (+24 V DC -> DGND), but device may briefly shut down. • I_{max} = 50 mA, PLC-compatible • Terminal scan cycle in = 1 ms • High-side driver	yes

X4

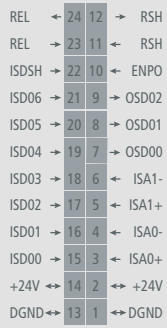


Table 3.5 Specification of control connections X4

Des.	Term.	Specification		El. isolation
STO "Safe Torque Off"				
ISDSH (STO)	X4/22	• "Request STO" input = Low level • OSSD-capable • Switching level Low/High: ≤4.8 V / ≥18 V • $U_{IN\ max}$ = +24 V DC +20% • I_{IN} at +24 V DC = typ. 3 mA		yes
RSH RSH	X4/11 X4/12	Diagnostics STO, both tripping channels active, one NO contact with automatically resetting circuit-breaker (polyswitch) • 25 V / 200 mA AC, cos φ = 1 • 30 V / 200 mA DC, cos φ = 1	X4/12 X4/11	yes
Relay outputs				
REL	X4/23 X4/24	Relay, 1 NO contact • 25 V / 1.0 A AC, cos φ = 1 (AC1) • 30 V / 1.0 A DC, cos φ = 1 (DC1) • Switching delay approx. 10 ms • Cycle time 1 ms	X4/23 X4/24	
Auxilliary voltage				
+24 V	X4/2 X4/14	• Auxiliary voltage output (U_H) to feed the digital control inputs • $U_H = U_V$-ΔU (ΔU typically approx. 1.2 V),no destruction in case of short circuit (+24 V DC -> DGND), but device may briefly shut down. • I_{max} = 80 mA (per pin) with self-resetting circuit breaker (polyswitch)		yes
Digital ground				
DGND	X4/1 X4/13	Reference ground for +24 V DC		yes

X4

REL	24	12	RSH
REL	23	11	RSH
ISDSH	22	10	ENPO
ISD06	21	9	OSD02
ISD05	20	8	OSD01
ISD04	19	7	OSD00
ISD03	18	6	ISA1-
ISD02	17	5	ISA1+
ISD01	16	4	ISA0-
ISD00	15	3	ISA0+
+24V	14	2	+24V
DGND	13	1	DGND

Table 3.5 Specification of control connections X4

3.8.2 Connection of motor brake X13

Connector X13 (BG2 to BG4) is intended for connection of a motor brake.

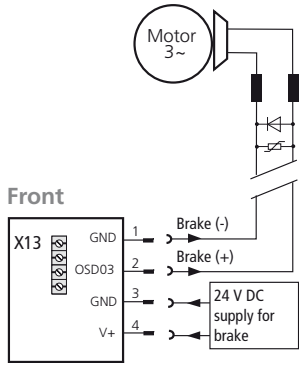
Des.	Term.	Connection	Specification
OSD03 GND GND V+	X13/2 X13/1 X13/3 X13/4		• Short-circuit proof • External control supply +24 V DC (I_{IN} = 2.1 A) required via X13/3 (GND) and X13/4 (V+) • $U_{BR} = U_V$-ΔU` (ΔU` typically approx. 1.4 V) • To actuate a motor holding brake up to I_{BR} = 2.0 A max. (for brakes with higher current requirements a relay must be interposed). • Overcurrent causes cyclic shutdown • Also usable as configurable digital output • Interruptible cable break monitor < 200 mA typically in condition "1"

Table 3.6 Specification of the terminal connections X13

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3.9 Specification of Ethernet interface

The service and diagnostic interface X9 is executed as a TCP/IP Ethernet port. It is suitable for connection of a PC for commissioning, service and diagnostics and for programming of the drive controller.

The following software can communicate via the Ethernet port with the drive controller:

- LTi DRiVES DriveManager 5 for commissioning, service and diagnostics of the ServoOne juniors
- CoDeSys 3.x programming system for programming of the ServoOne junior in the languages of IEC 61131-3. This requires a drive controller licence.

Specification of interface:

- Transfer rate 10/100 MBits/s BASE
- Line protocol IEEE802.3 compliant
- Connection via standard commercially available crosslink cable, CAT 5 (e.g. LTi-DRiVES accessory CC-ECL03, see also ServoOne system catalogue)

3.10 Option 1

Depending on the ServoOne variant, Option 1 is factory-configured with various options. Field bus options such as EtherCAT or Sercos are available.

You will find all available options in the system catalogue. The user manuals for the respective options provide detailed information on commissioning.

3.11 Option 2

Option 2 can be fault-configured with various technology options. Additional or special encoders can be evaluated with it for example.

You will find all available options in the system catalogue. The user manuals for the respective options provide detailed information on commissioning.

3.12 Encoder connection

All encoder connections are located on the top of the unit.

Encoder connection of the LSH/T motors

Please use the ready made-up motor and encoder cables from LTi DRiVES GmbH to connect the LSH/T synchronous motors (see Servomotors order catalogue).

Matching motor - encoder cable - drive controller connection

Compare the rating plates of the components. Make absolutely sure to use the correct components according to variant A, B or C!

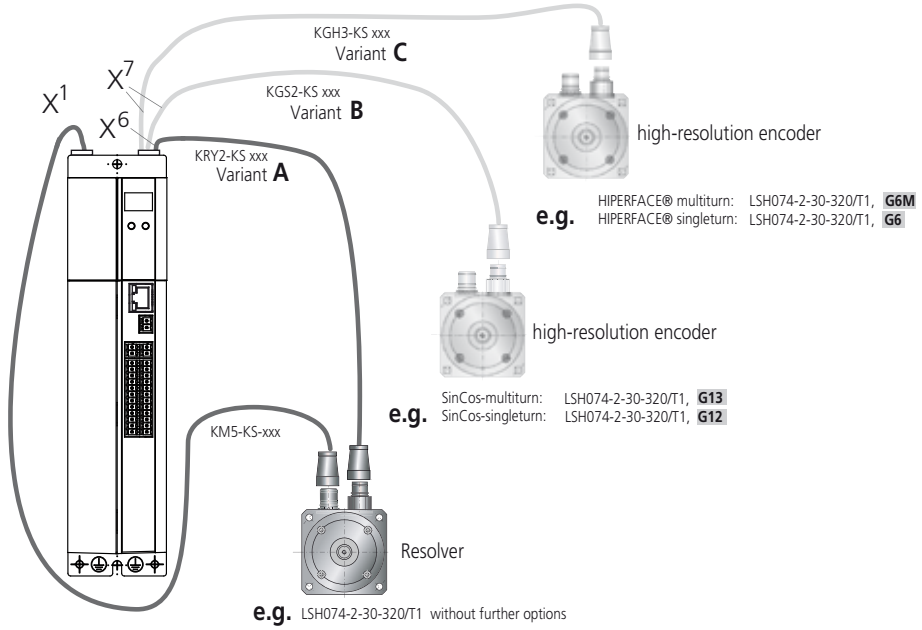

Fig. 3.15 Matching motor/encoder cable

NOTE: Do not split the encoder cable, for example to route the signals via terminals in the switch cabinet. The knurled screws on the D-Sub connector housing must be tightly locked!

	Motor (with installed encoder)	Encoder cable	Drive controller connection
Variant A	with resolver e.g. LSH/LST H074-2-30-320/T1 without further options	KRY2-KSxxx	X6
Variant B	G13: = SinCos-multiturn encoder with SSI/EnDat-interface e.g. LSH/LST H074-2-30-320/T1,G13	KGS2-KSxxx	X7
	G12: = SinCos-singleturn encoder with SSI/EnDat-interface e.g. LSH/LST H074-2-30-320T1,G12	KGS2-KSxxx	X7
Variant C	G6: = SinCos-singleturn encoder with HIPERFACE®-interface e.g. LSH/LST H074-2-30-320/T1,G6	KGH3-KSxxx	X7
	G6M: = SinCos-multiturn encoder with HIPERFACE®-interface e.g. LSH/LST H074-2-30-320/T1,G6M	KGH3-KSxxx	X7

Table 3.7 Variants of motors, encoder type and encoder cable

Ready made-up encoder cables

The specifications can only be assured when using the LTi system cables.

			K	xxx	- KS	xxx
Ready made-up cable						
Encoder system	*Resolver cable*	RY2				
	Encoder cable SSI, EnDat	GS2				
	Encoder cable HIPERFACE®	GH4				
capable for energy chains					KS	
Cable length (m)						

Encoder cable KRY2-KS-xxx — Order code

Technical data

	KRY2-KSxxx	KGS2-KSxxx	KGH4-KSxxx
Encoder system	Resolver	G3, G5, G12.x (Single / Multiturn with SSI-/EnDat-interface)	G6, G6.x (Single / Multiturn with HIPERFACE®-interface)
Controller-end assignment (sub-D connector)	1 = S2 2 = S4 3 = S1 4 = n.c. 5 = PTC+ 6 = R1 7 = R2 8 = S3 9 = PTC-	1 = A- 2 = A+ 3 = VCC (+5 V) 4 = DATA+ 5 = DATA- 6 = B- 8 = GND 11 = B+ 12 = VCC (Sense) 13 = GND (Sense) 14 = CLK+ 15 = CLK- 7, 9, 10 = n.c.	1 = REFCOS 2 = +COS 3 = Us 7 – 12 V 4 = Data+ RS485 5 = Data- RS485 6 = REFSIN 7 = Jumper to pin 12 8 = GND 11 = +SIN 12 = Jumper to pin 7 9, 10, 13, 14, 15 = n.c.
capable for energy chains	yes		
Minimum bend radius	90 mm	100 mm	90 mm

Table 3.8 Technical data encoder cable

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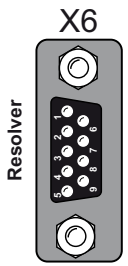
	KRY2-KSxxx	KGS2-KSxxx	KGH4-KSxxx
Temperature range	-40 ... +85 °C	-35 ... +80 °C	-30 ... +80 °C
Cable diameter approx.	8.8 mm		
Material of outer sheat	PUR		
Resistant to	oil, hydrolysis and microbic attack (VDE0472)		
Approvals	UL-Style 20233, 80 °C - 300 V, CSA-C22.2N.210-M90, 75 °C - 300 V FT1		

Table 3.8 Technical data encoder cable

3.12.1 Resolver connection X6

A resolver is connected to slot X6 (9-pin D-Sub socket).

Fig.	X6/Pin	Function
	1	Sin+ / (S2) analog differential input track A
	2	Refsin / (S4) analog differential input track A
	3	Cos+ / (S1) analog differential input track B
	4	Supply voltage 5 ... 12 V, internally connected to X7/3
	5	ϑ+ (PTC, KTY, Klixon) internally connected to X7/10 [1]
	6	Ref+ analog excitation
	7	Ref- analog excitation (ground reference point to pin 6 and pin 4)
	8	Refcos / (S3) analog differential input B
	9	ϑ- (PTC, KTY, Klixon) internally connected to X7/9 [1]

1) Be sure to pay attention to the notice headed "ATTENTION" in Table 3.12!

Table 3.9 Pin assignment X6 resolver connection

3.12.2 Connection for high-resolution encoder

The interface X7 enables evaluation of the following encoder types.

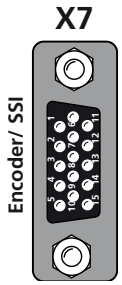
Fig.	Function
	**SinCos encoder with zero pulse** e.g. Heidenhain ERN1381, ROD486
	Heidenhain SinCos encoder with EnDat interface e.g. 13 bit singleturn encoder(ECN1313.EnDat01) and 25 bit multiturn encoder (EQN1325-EnDat01)
	Heidenhain encoder with digital EnDat interface Single or multiturn encoder
	SinCos encoder with SSI interface e.g. 13 bit singleturn and 25 bit multiturn encoder (ECN413-SSI, EQN425-SSI)
	Sick-Stegmann SinCos encoder with HIPERFACE® interface Single and multiturn encoder, e.g. SRS50, SRM50

Table 3.10 Suitable encoder types on X7

NOTES:

- The usage of encoders not included in the range supplied by LTi requires special approval by LTi DRiVES.
- The maximum signal input frequency is 500 kHz.
- Encoders with a power supply of 5 V ± 5 % must have a separate sensor cable connection. The encoder cable detects the actual supply voltage at the encoder, thereby compensating for the voltage drop on the cable. Only use of the sensor cable ensures that the encoder is supplied with the correct voltage. The sensor cable must always be connected.

Select the cable type specified by the motor or encoder manufacturer, bearing in mind the following:

- Always used shielded cables. Apply the shield on both sides.
- Connect the differential track signals A, B, R or CLK, DATA to each other via twisted wires.
- Do not separate the encoder cable, for example to route the signals via terminals in the switch cabinet.

Fig.	X7 Pin	SinCos and TTL	SinCos Absolute encoder SSI/EnDat	Absolute encoder EnDat (digital)	Absolute encoder HIPER-FACE®	
	1	A-	A-	-	REFCOS	
	2	A+	A+	-	+COS	
	3	+5 V DC ±5%, IOUT max = 250 mA (150 mA for hardware versions 0..1), monitoring via sensor cable			7 to 12 V (typ. 11 V) max. 100 mA	The sum of the currents tapped at X7/3 and X6/4 must not exceed the specified value!
	4	R+	Data +	Data +	Data +	
	5	R-	Data -	Data -	Data -	
	6	B-	B-	-	REFSIN	
	7	-	-	-	U_s - Switch	
	8	GND	GND	GND	GND	
	9	ϑ- (PTC , KTY, Klixon) internally connected to X6/9 [1]				
	10	ϑ+ (PTC , KTY, Klixon) internally connected to X6/5 [1]				
	11	B+	B+	-	+SIN	
	12	Sense +	Sense +	Sense +	U_s - Switch	
	13	Sense -	Sense -	Sense -	-	After connecting pin 7 to pin 12, a voltage of 11.8 V is set at X7/3 and X6/4!
	14	-	CLK+	CLK+	-	
	15	-	CLK -	CLK -	-	

1) Be sure to pay attention to the notice headed "ATTENTION" in table 3.12!

Table 3.11 Pin assignment of the X7 terminal connection

NOTE: The encoder supply at X7/3 is short-circuit proof in both 5 V and 11 V operation. The controller remains in operation enabling the generation of a corresponding error message when evaluating the encoder signals.

3.13 Motor connection

Step	Action	Comment
1.	Specify the cable cross-section dependent on the maximum current and ambient temperature.	Cable cross-section according to local and country-specific regulations and conditions.
2.	Connect the shielded motor cable to terminals X1/ U, V, W and connect the motor to ground at ⏚.	Mount shield at both ends to reduce interference emission.
3.	Wire the motor temperature sensor and activate temperature evaluation by means of DriveManager. See also related note.	Mount shield at both ends to reduce interference emission.

Motor temperature sensor		
ATTENTION! The motor PTC when connected to X5 must be provided with **basic insulation**, against the motor winding and when connected to X6 or X7 must be provided with **reinforced insulation** as per EN 61800-5-1.		
X5	Temperature switch (Klixon), PTC	Sensor with basic insulation
X6	Temperature switch (Klixon), PTC, KTY	Sensor with increased insulation
X7	Temperature switch (Klixon), PTC, KTY	Sensor with increased insulation

Table 3.12 Motor temperature sensor terminal configuration

NOTE: In the event of a short-circuit or ground fault in the motor cable, the power stage is disabled and an error message is issued.

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3.13.1 Connection of the LSH/LST motors

For connection of the servomotor series LSH xxx und LST xxx please use the ready made-up motor cable KM3-KS-xxx (4 x 1.5 mm² + 2 x 2 x 0.75 mm²) or KM4-KS-xxx (4 x 1.5 mm²).

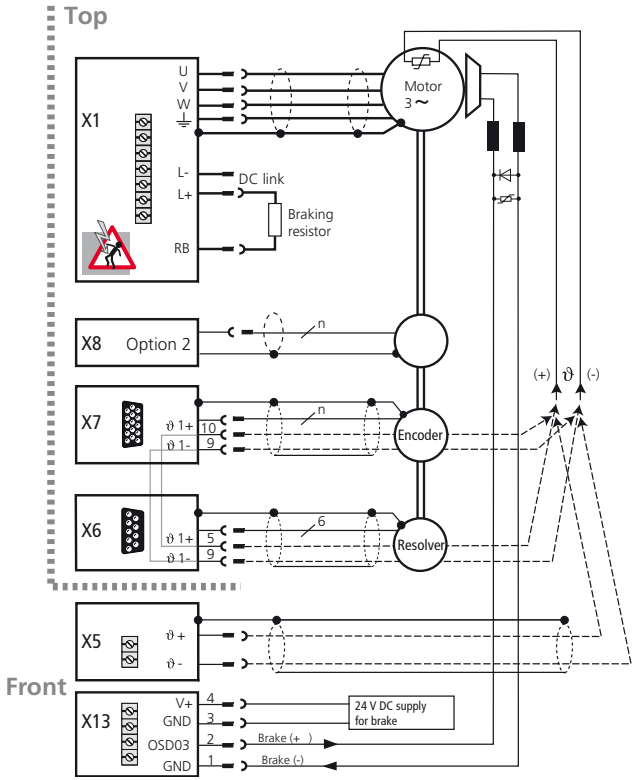
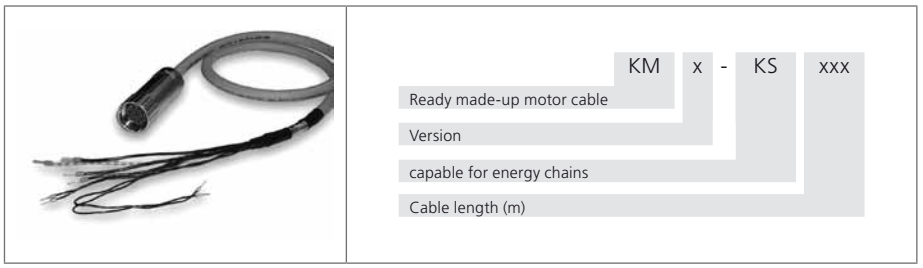


Fig. 3.16 Connection of motor

ATTENTION! DC linking of multiple drive controllers is **not** permitted!

Ready made-up motor cable



Motor cable KMx-KSxxx Order code

Technical data

		KM4-KSxxx	KM5-KSxxx
For motors with plug-in power connection		up to I_N = 16 A	
Minimum bend radius	in fixed installtion	90 mm	
	in flexible use	120 mm	
Temperature range		-30 ... +80 °C	
Cable diameter approx.		12 mm	
Cable cross-section		(3+T) x 1.5 mm²	(3+T) x 1.5 mm² + 2 x 2 x 0.75 mm²
Material of the outer sheat		PUR	
Resistance		Resistant to oil, hydrolysis and microbic attack (VDE0472),UL 1581, flame-resistant (DIN EN 50265-2-1)	
Wiring		U = 1 V = 2 W = 3 Ground = ye/gn	U = 1 V = 2 W = 3 Ground = ye/gn PTC = 5 PTC = 6 Brake + = 7 Brake - = 8
Approvals		UL AWM 80°C - 600V/1000V CSA AWM 80°C - 600V/1000V FT1	

Table 3.13 Technical data motor cable

NOTE: Wires 5 and 6 (PTC) are required only for motors in which the motor PTC cannot be connected via the encoder cable. In the case of LSH/LSTxxx motors with resolver, the PTC is connected via the resolver cable.

3.13.2 Switching in the motor cable

ATTENTION! Switching in the motor cable must take place with the power cut and the power stage disabled, as otherwise problems such as burned-off contactor contacts may occur. In order to ensure unpowered switch-on, you must make sure that the contacts of the motor contactor are closed before the drive controller power stage is enabled. At the moment the contactor is switched off it is necessary for the contact to remain closed until the drive controller power stage is shut down and the motor current is 0. This is done by inserting appropriate safety times for switching of the motor contactor in the control sequence of your machine.

Despite these measures, the possibility cannot be ruled out that the drive controller may malfunction during switching in the motor cable.

3.14 Braking resistor (RB)

In regenerative operation, e.g. when braking the drive, the motor feeds energy back to the drive controller. This increases the voltage in the DC link. If the voltage exceeds a threshold value, the internal braking transistor is activated and the regenerated power is converted into heat by means of a braking resistor.

3.14.1 Protection in case of braking chopper fault

ATTENTION! If the internal braking chopper transistor is permanently switched on, because it is alloyed through by overload (= 0 Ω), there is a protective function to protect the device against overheating.

You activate this function by assigning to any digital output (DriveManager 5 ►expert field "I/O configuration" ►digital outputs ►OSD00 to OSD02) with **BC_FAIL(56)**. In the event of a fault the selected output then switches from 24 V to 0 V. This signal ensures that the drive controller is safely disconnected from the mains supply.

For detailed information on parameterization refer to the ServoOne application manual.

3.14.2 Design with integrated braking resistor (BG3+4)

The system catalogue only specifies the peak braking power for the drive controllers with integrated braking resistor (model SO2x.xxx.xxxx.1xxx). The permissible continuous braking power must be calculated. It depends on the effective loading of the controller in the corresponding application.

The drive controller is thermally designed in such a way that no energy input by the internal braking resistor is permitted during continuous operation with rated current and at maximum ambient temperature.

Consequently, a controller design featuring an integrated braking resistor only makes sense when the effective drive controller load is ≤80 % or the braking resistor is designed for one-off emergency stop. In the event of an emergency stop, only the heat capacity of the braking resistor can be used for a one-off braking action. The permissible energy W_{IBr} can be taken from the following table.

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Device	Technology	Rated resistance R_{BR}	Peak braking power P_{PBr}	Pulse energy W_{IBr}	K1
SO22.006	Wire resistance	100 Ω	1500 W *1)*	150 Ws	120
SO24.004		420 Ω	1000 W *2)* 1300 W *3)* 1400 W *4)*	140 Ws	50
SO22.008		90 Ω	1690 W *1)*	6000 Ws	170
SO24.007			4700 W *2)* 6170 W *3)* 6500 W *4)*	6000 Ws	120

1) Data referred to 1 x 230 V AC mains voltage (BR switch-on threshold 390 V DC)
2) Data referred to 3 x 400 V AC mains voltage (BR switch-on threshold 650 V DC)
3) Data referred to 3 x 460 V AC mains voltage (BR switch-on threshold 745 V DC)
4) Data referred to 3 x 480 V AC mains voltage (BR switch-on threshold 765 V DC)

Table 3.14 Data of the integrated braking resistor (design SO2x.xxx.xxxx.1xxx)

If the drive is not permanently operated at its power limit, the saved power dissipation of the drive can be used as braking power.

NOTE: Further calculation assumes that the drive controller is used at maximum permissible ambient temperature. This means that any additional energy input from the internal braking resistor caused by low ambient temperature will be neglected.

Method to calculate the continuous braking power:

- Calculation of effective drive controller loading in a cycle T:

$$I_{eff} = \sqrt{\frac{1}{T}\int_0^T i^2\,dt}$$

- Determination of permissible continuous braking power based on unused drive power:

$$P_{DBr} = \left(1 - \frac{I_{eff}}{I_N}\right) \times K1$$

Marginal conditions

- A single braking action must not exceed the maximum pulse energy of the braking resistor.

$$W_{IBr} \geq P_{PBr} \times T_{Br}$$

- The continuous braking power calculated for the device must be greater than the effective braking power of a device cycle.

$$P_{DBr} \geq \frac{1}{T} \times \int_0^T P_{PBr}\,dt_{Br}$$

This results in the minimum permissible cycle time T with calculated continuous braking power:

$$T = \frac{P_{PBr}}{P_{DBr}} \times \int_0^T dt_{Br}$$

The maximum total on-time of the braking resistor over a specified cycle time T with calculated continuous braking power results as:

$$T_{BrSum} = \frac{P_{PBr}}{P_{DBr}} \times T$$

ATTENTION! No additional external braking resistor may be connected to drive controllers SO22.006 to SO24.007 with integrated braking resistor.

3.14.3 Connection of an external braking resistor

ATTENTION!

- Be sure to follow the installation instructions for the external braking resistor.
- The temperature sensor (bimetal switch) on the braking resistor must be wired in such a way that the power stage is deactivated and the connected drive controller is disconnected from the mains supply if the braking resistor overheats.
- The minimum permissible connection resistance of the drive controller must not be infringed – for technical data see section A.2 on page 49.
- The braking resistor must be connected by a shielded cable.

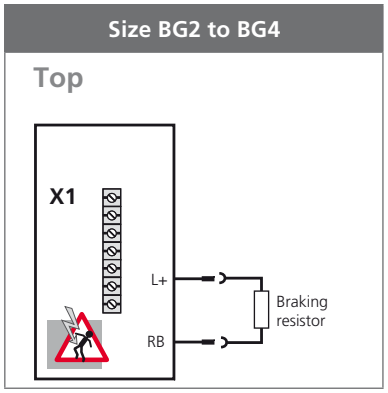

Fig. 3.17 Connection braking resistor

ATTENTION! No additional external braking resistor of the size 3 and 4 (SO22.006 - SO24.007) must be connected to the drive controller with integrated braking resistor.

DANGER FROM ELECTRICAL TENSION! Danger to life! Never wire or disconnect electrical connections while these are live. Always disconnect the power before working on the device. Dangerously high voltages of ≥50 V may still be present 10 minutes after the power is cut (capacitor charging). So always check that the power has been cut!

ATTENTION! The external braking resistor must be monitored by the control. The temperature of the braking resistor is monitored by a temperature watchdog (Klixon). In the event of overheating the drive controller must be disconnected from the mains supply.

Available braking resistors (excerpt)

Article designation	Continuous braking power	Resist-ance[1)]	Peak braking power [2)]	Protec-tion	Fig.
BR-090.01.540-UR	35 W	90 Ω	6250 W	IP54	 Example: BR-090.01.540-UR
BR-090.02.540-UR	150 W		6250 W	IP54	
BR-090.03.540-UR	300 W		6250 W	IP54	
BR-090.10.650-UR	1000 W		6250 W	IP65	

1) Tolerance ±10%
2) The maximum possible braking power dependent on ON-time and cycle time

Table 3.15 Technical data - braking resistors

NOTE: The available braking resistors with the exact specifications, in particular with regard to surface temperature, maximum system voltage and high-voltage strength, are set out in the ServoOne system catalogue.

Please consult your projecting engineer for more detailed information on the design of braking resistors.

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4 Commissioning

4.1 Notes for operation

ATTENTION!

- **Notes on safety**
  During operation pay attention to the notes on safety in chapter 1
- **During operation**
  Strictly avoid that ...
  – foreign objects or moisture enters into the device
  – aggressive or conductive substances are in the vicinity
  – ventilation openings are covered
- **Cooling**
  – The device heats up during the operation and the temperature on the heat may reach 100 °C. Danger of skin injury when touching.
  – Cooling air must be able to flow through the device without restriction.

4.2 Initial commissioning

Once the ServoOne junior has been installed as described in chapter 2 and wired with all required voltage supplies and external components as described in chapter 3, initial commissioning can performed in the following sequence:

Step	Action	Comment
1.	Installation and start of PC software	see Installation Manual DriveManager 5
2.	Switching on control voltage	see section 4.2.1
3.	Connection between PC and drive controller	see section 4.2.2
4.	Parameter setting	see section 4.2.3
5.	Drive control with DriveManager 5	see section 4.2.4

NOTE: Details concerning STO (Safe Torque Off) have not been taken into account for initial commissioning, see chapter 6

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4.2.1 Switching on control supply

2. First only switch on the 24 V control supply for initializing and parameterizing. Do **not** yet switch on the AC mains supply..

Display reading after switching on the control supply

D1	D2	Action	Explanation
		Switching on the external 24 V control supply	Initialization is running
		Initialization completed	Not ready for starting

Table 4.1 Switch-on status of the ServoOne (after connection of the 24 V DC control supply)

NOTE: Details concerning the control supply can be found in section 3.7 „Connection of supply voltage" starting at page 21.

4.2.2 Connection between PC and drive controller

3. The PC can be linked with the drive controller via Ethernet (TCP/IP). Connect PC and drive controller with an ethernet connecting cable.

NOTES:

- **Initialization**
  The communication link between PC and drive controller can only be set up after the drive controller has completed the initialization.
- **TCP/IP configuration**
  If the PC does not recognize the connected drive controller you should check the driver or the settings for the corresponding interfaces (see installation manual DriveManager 5).

4.2.3 Parameter setting

4. The Commissioning Wizard in DriveManager 5 helps to make settings to the drive system. Start the wizard.

NOTES:

- **Help DriveManager**
  A detailed description of DriveManagers 5 as well as the commissioning wizard can be found in the DriveManager 5 help system.
- **Motor dataset**
  When using LTi servo motors type LSH or LST the latest version of the required motor dataset can be downloaded from http://drives.lt-i.com, category "Downloads".

4.2.4 Drive control with DriveManager 5

5. Switch on the AC mains supply. Subsequently enable the power stage and activate the controller. The drive should be tested without the coupled mechanics.

DANGER CAUSED BY ROTATING PARTS! Danger to life from uncontrolled rotation! Before starting motors with feather keys in the shaft end these must be reliably secured against being ejected, as far as this is not already prevented by drive elements such as belt pulleys, couplings or similar.

ATTENTION!

- **Avoid damage caused by motor test run!**
  In this case it must be assured that the test will not cause any damage to the system! Pay particular attention to the limitations of the travel range. Please note that you yourself are responsible for safe operation.
  LTi DRiVES GmbH will not assume liability for any occurring damage.

- **Destruction of motor!**
  - Certain motors are intended for operation on the drive controller. Direct connection to the mains supply can destroy the motor.
  - The motor surfaces may become extremely hot. No temperature sensitive parts may touch or be mounted to these areas, appropriate measures to prevent contact must be applied wherever necessary.
  - In order to avoid overheating of the motor, the temperature sensor installed in the winding must be connected to the terminals of the temperature monitoring system for the drive controller (X5 or X6).
  - The motor brake (if installed) should be checked for fault-free functioning before commissioning of the motor. Standstill holding brakes are only designed for a limited number of emergency braking operations. se as working brake is strictly prohibited.

Display reading after switching on the AC mains supply

D1	D2	Action	Reaction	Explanation
5	2	Switching on the AC mains supply	Control ready, power stage ready, control deactivated	Device is ready for switching on

Table 4.2 Display D1/D2 after switching on the AC mains supply

NOTES:

- **Inputs "ISDSH" and "ENPO"**
  For step 1 in table 4.3 at least the two inputs "ISDSH" and "ENPO" for terminal X4 must be interconnected.
- **Manual operation dialog**
  For step 2 in table 4.3 best via the "Manual operation" dialog of DriveManager 5, details can be found in the help system.
- **Configuration of inputs/outputs**
  If step 2 is to be executed via the inputs of terminal X4, the sources for "START CONTROL" and speed setpoint must be configured accordingly in the subject area "Inputs/Outputs" of DriveManager 5.

Switching on sequence to start the drive

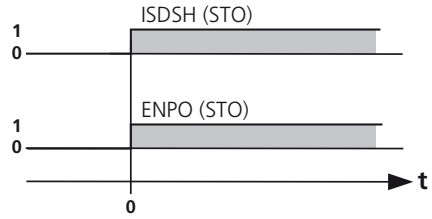
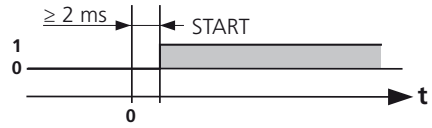
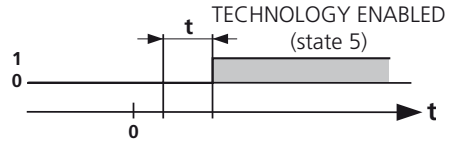
1. Deactivate the safety function "STO" by setting the inputs ISDSH" and "ENPO" (see chapter 6).	
2. Activate "START CONTROL" at the earliest 2 ms after step 1 and specify the speed setpoint.	
3. Monitor your system or plant and check the drive behaviour.	
t = motor dependent delay time	

Table 4.3 Switching on sequence

Display reading after start of drive

D1	D2	Action	Reaction	Explanation
3		Enable "STO" and power stage "ENPO"	Ready for switching on	Power stage ready
		ATTENTION! Before the next step "Enable start" you must specify a plausible setpoint, because the pre-set setpoint is transferred to the drive directly after the motor control has started.		
5		"Start" enabled	Technology enabled	Motor energized, control active

Table 4.4 Display D1/D2 during activation of motor

Details for optimizing the drive on your application can be found in the DriveManager 5 Online help and in the ServoOne application manual.

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4.3 Serial commissioning

An existing parameter dataset can be transferred to other ServoOne junior drive controllers by using DriveManager 5. Details can be found in the DriveManager 5 help system.

4.4 Integrated control unit

The built-in operator control unit permits diagnostics of the ServoOne junior. The operator control unit comprises the following elements, all located on the front of the device:

- 2-digit 7-segment display (D1, D2)
- 2 buttons (T1, T2)

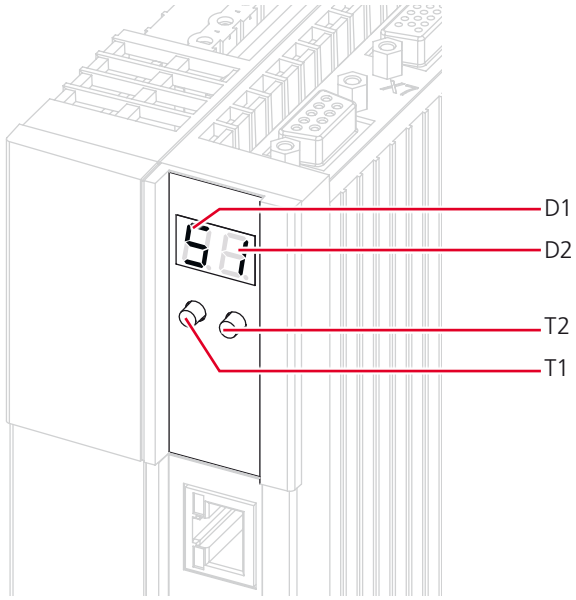

Fig. 4.1 Integrated control unit ServoOne junior

The following functions and displays are available:

- Display of device state (see section 5.1 "Device states“ on page 43)
  The device state is displayed after switching on the control voltage. If no input is made via the keypad for 60 seconds, the display switches back to the device state.
- Display of device error state (see page 43)
  If a device error occurs the display immediately switches to show the error code.
- Parameter setting (display "PA") (see section 4.4.3)
  Resetting device parameters to their factory setting.
- Ethernet IP address setting (display "IP") (see section 4.4.4)
  Setting of the Ethernet IP address and the subnet mask.
- Field bus settings (display "Fb") (see section 4.4.5)
  Setting of field bus address for example.

4.4.1 Function of buttons T1 and T2

These buttons are used to activate the different menus and to control the corresponding functions.

Button	Function	Comment
T1 (left)	• Activation of menu (exit the device status display) • Scrolling through the menus/ sub-menus • Setting of values - left segment display (D1)	The button T1 can be held de-pressed for any time, because the display will only scroll through the menu options of the corresponding level. No settings will be changed.
T2 (right)	• Selection of chosen menu • Setting of values - right segment display (D2)	The button T2 must **not** be held depressed for any length of time, because the display will change from one menu level to the next within the menu structure and then change the parameter that is reached at the end. You should therefore always release the button T2 after each change in display.
T1 and T2 together	• Menu level up • Accept selection • Acknowledge	When pressing T1 and T2 at the same time, the accepted value will be flashing for five seconds. During this time the Save procedure can still be aborted by pressing any button, without the set value being accepted. Otherwise the new value will be saved after 5 seconds.
General		• The time the button needs to be held depressed until an action is executed, is approx. 1 second. • If there is no action by the user over a period of 60 seconds, the display returns to the device status display.

Table 4.5 Function of buttons T1 and T2

4.4.2 Display

The following table defines various displays and status information about the display.

Display	Meaning
	Menu entries ("PA" in this case serves as an example, further possible entries see section 4.4.4 and 4.4.5)
	[flashing decimal points] Selected function in action
	[two dashes] Entry/function not available
	[OK] Action executed successfully, no errors
	[Error] • Action via control unit **not** executed successfully, "Er" flashes in alternation with error number (see section 4.4.3) • Display device error, "Er" flashes in alternation with error number and error location (see "ServoOne Application Manual")
	Numerical values ("10" in this case serves as an example) • In the parameter menu (PA) error numbers are shown as **decimal**. • All other values are displayed in **hexadecimal** mode. In these cases the diplayed 10 would represent the decimal value 16

Table 4.6 Meaning of display

NOTE: If no input is made via the keyboard over a period of 60 seconds, the display returns to the device status display.

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4.4.3 Parameter menu (PA)

On the Parameter menu the device settings can be reset to their factory defaults.

Menu level 1	Menu level 2	Parameter	Value range	Meaning	Explanation
PA	Pr	-	-	Parameter reset	Reset device settings to factory defaults

Table 4.7 Parameter menu

Error numbers

A failed user action is indicated by an error message. The message consists of an alternating display of "Er" and the error number.

NOTE: The error messages displayed during user input should not be confused with drive error messages. For detailed information on the error codes and on error management refer to the "ServoOne Application Manual".

Error number	Meaning
17	Parameter reset to factory settings failed
18	Parameter write access failed
19	Save parameter data set non volatile failed
20	Not all parameters written
21	Error while reset to factory settings

Table 4.8 Error numbers

4.4.4 Ethernet IP-address menu (IP)

An Ethernet TCP/IP port is available as a service and diagnostics interface. The IP address is set by default to 192.168.39.5 and the subnet mask to 255.255.255.0. Both can be changed by way of the IP-address menu.

Menu level 1	Menu level 2	Parameter	Value range	Meaning	Explanation
IP	Iu	b0	00..FF	IP address update Byte 0	Setting of byte 0 of the IP address in hexadecimal format (e.g. "05" at 192.168.39.**5**)
		b1	00..FF	IP address update Byte 1	Setting of byte 1 of the IP address in hexadecimal format (e.g. "27" at 192.168.**39**.5)
		b2	00..FF	IP address update Byte 2	Setting of byte 2 of the IP address in hexadecimal format (e.g. "A8" at 192.**168**.39.5)
		b3	00..FF	IP address update Byte 3	Setting of byte 3 of the IP address in hexadecimal format (e.g. "C0" at **192**.168.39.5)
	Ir	-	-	IP reset to factory setting	Reset IP address to factory default (192.168.39.5)
	Su	b0	00..FF	Subnetmask update Byte 0	Setting of byte 0 of the subnet mask in hexadecimal format (e.g. "00" at 255.255.255.**0**)
		b1	00..FF	Subnetmask update Byte 1	Setting of byte 1 of the subnet mask in hexadecimal format (e.g. "FF" at 255.255.**255**.0)
		b2	00..FF	Subnetmask update Byte 2	Setting of byte 2 of the subnet mask in hexadecimal format (e.g. "FF" at 255.**255**.255.0)
		b3	00..FF	Subnetmask update Byte 3	Setting of byte 3 of the subnet mask in hexadecimal format (e.g. "FF" at **255**.255.255.0)
	Sr	-	-	Subnetmask reset to factory setting	Reset subnet mask to factory default setting (255.255.255.0)

Table 4.9 IP-address menu

Example configuration of subnet mask

In this example the subnet mask is changed from 255.255.255.0 to 122.255.255.0.

NOTE: Changes on the IP-address menu are only saved when the control electronics are subsequently restarted.

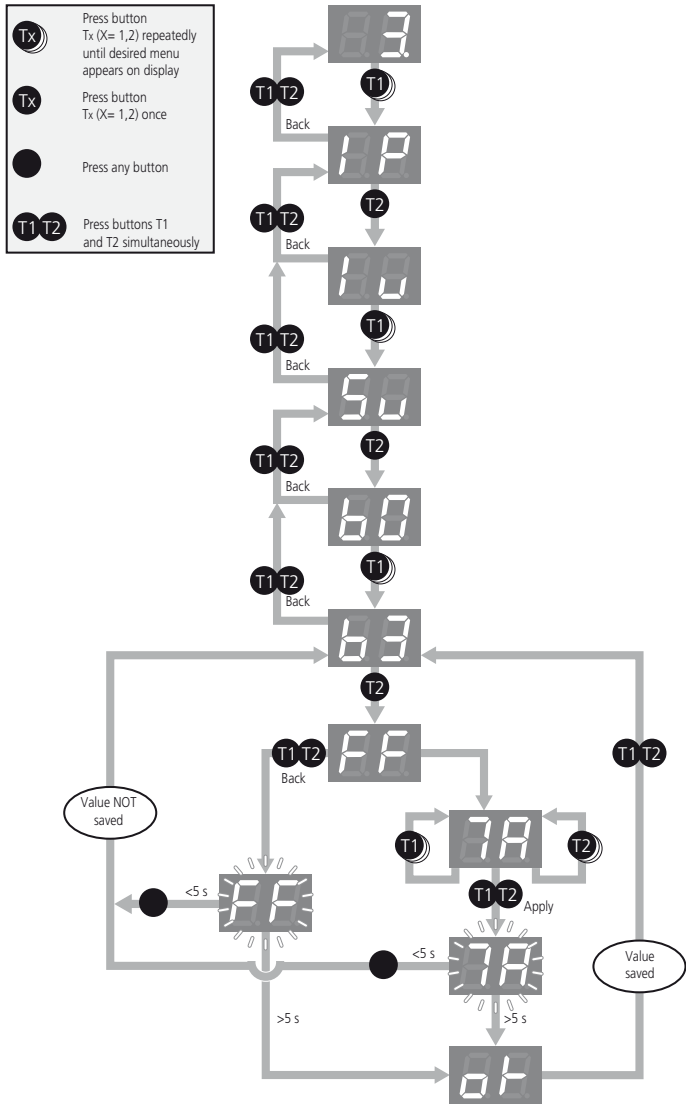

Fig. 4.2 Example configuration of subnet mask

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4.4.5 Field bus address menu (Fb)

The functions available under this menu item depend on the device expansion option. For detailed information refer to the relevant specification.

Menu level 1	Menu level 2	Param-eter	Value range	Meaning	Explanation
Fb	Ad	-	00..xx or - -	Field bus address	Setting of field bus address (only when field bus option used), otherwise display "- -" (The maximum programmable value depends on the option)
	Po	-	0..3 or - -	Transmit power	Setting of fibre-optic power output (only with SERCOS II option), otherwise display "- -"

Table 4.10 Field bus address menu

Example configuration of field bus address

In this example the field bus address is changed from 1 to 23.

NOTE: Changes on the field bus address menu are only saved when the control electronics are subsequently restarted.

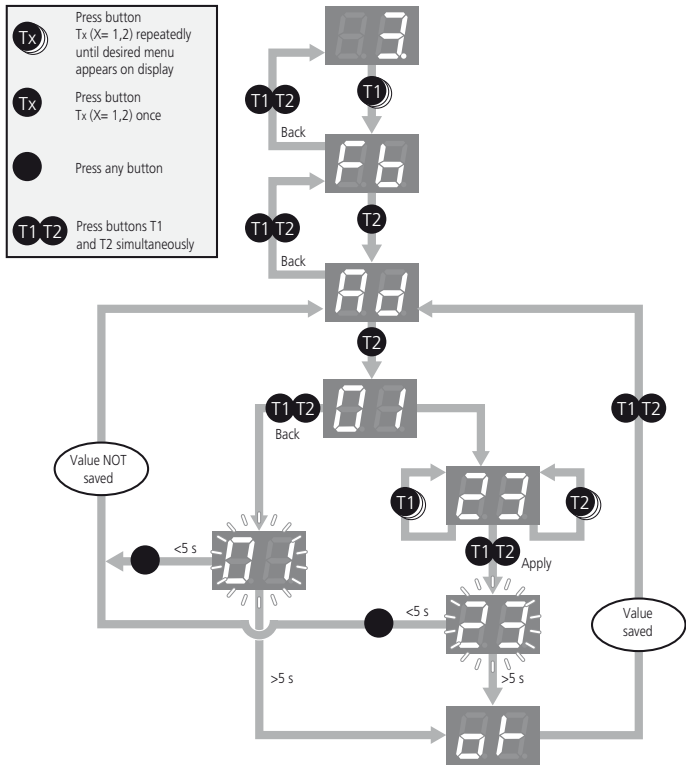

Fig. 4.3 Example configuration of field bus address

5 Diagnostics

The device states and error displays are indicated on the device by way of the 7-segment display of the integrated operator control unit.

5.1 Device states

Display	System status
	Device in reset state
	Self-initialization on device startup
 *)	Not ready to switch on (no DC link voltage) [1]
 *)	Start inhibit (DC link OK, power stage not ready) [1]
	Ready (power stage ready)
	Switched on (drive powered) [2]
	Drive ready (power applied to drive and drive ready for setpoint input) [2]
	Quick stop [2]
	Error response active [2]

**) Not a "safe indication" as specified in EN 61800-5-2.*
*1) **S.** flashes when the STO (Safe Torque Off) function is active, display goes out when function is inactive.*
2) The dot flashes when the power stage is active.

Table 5.1 Device states

5.2 Error display

The 7-segment display shows the specific error codes. Each error code comprises the alternating sequence ►"Er" ►error number ►error location.

Display	Meaning
	Device error
↓ Display changes after approx. 1 s	
	Error number (decimal) Example: 05 = Overcurrent
↓ Display changes after approx. 1 s	
	Error location (decimal) Example: 01 = Hardware monitoring
↑ After approx. 1 s the display jumps to ER	

Table 5.2 Display of the error code

NOTE: The errors can be reset in accordance with their programmed reaction (ER) or only via a 24 V reset (X2) (ER.). Errors marked with a dot can only be reset when the cause of the fault has been eliminated.

5.3 Error codes

NOTE: For detailed information on the error codes and on error management refer to the "ServoOne Application Manual".

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5.4 Helpline/Support & Service

Our Helpline can provide you with fast, targeted assistance if you have any technical queries relating to project planning or commissioning of the drive unit. To that end, please collect the following information prior to making contact:

1. Type designation, serial number and software version of the devices (see software rating plate)
2. DriveManager version in use (menu ►Help ►Information... ►Version)
3. Displayed error code version (on 7-segment display or DriveManager)
4. Description of the error symptoms, how it occurred and relevant circumstances
5. Save device settings to file in DriveManager
6. Name of company and contact, telephone number and e-mail address

The Helpline is available Monday to Friday from 8 a.m. to 5 p.m. (CET), and can be accessed by telephone, e-mail or over the Internet:

Phone:	+49 6441 966-180
E-Mail:	helpline@lt-i.com
Internet:	http://drives.lt-i.com ►Support & Service ►Trouble Ticket

If you need further assistance, our specialists at the Service & Support Center will be happy to help.

- Support & Service - How to reach us:

Mo.-Fr.:	8 a.m. - 5 p.m. (CET)
Phone:	+49 6441 966-888
E-Mail:	service@lt-i.com

NOTE: If you need more detailed assistance and advice, you will find all the services we offer in the “Support & Service” order catalogue. You can download the order catalogue from the “Support & Service” section of our website at http://drives.lt-i.com.

6 Safe Torque Off (STO)

NOTE: You will find all information on the “STO” function in the 24-language document “Description of the STO Safety Function” (ID no. 1100.10B.x).

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A Appendix

A.1 Current capacity of servocontrollers

The maximum permissible servocontroller output current and the peak current are dependent on the mains voltage, the motor cable length, the power stage switching frequency and the ambient temperature. If the conditions change, the maximum permissible current capacity of the servocontrollers also changes.

ServoOne junior for 1 x 230 V

Device	Switching frequency of power stage	Ambient temperature	Rated current I_N [A_{eff}]	Peak current			
				200% (2 I_N)		300% (3 I_N)	
	[kHz]	max. [°C]	at 1 x 230 V	[A_{eff}]	for time [s]	[A_{eff}]	for time [s]
SO22.003	4	45	3.0	6.0	10	9.0	0.08
	8	40	3.0	6.0		9.0 [1)]	0.08 [1)]
	16	40	2.0	4.0		6.0 [1)]	0.08 [1)]
SO22.006	4	45	5.9	11.8	10	-	-
	8	40					
	16	40					
SO22.008	4	45	8.0	16.0	10	-	-
	8	40	8.0	16.0			
	16	40	5.4	10.8			

1) Automatic power stage switching frequency change to 4 kHz.
Data applies to motor cable length ≤10m. Maximum permissible motor cable length 30 m.
All current ratings with recommended mains choke.

Table A.1 Rated current and peak current BG2 to BG4 (1 x 230 V AC)

ServoOne junior for 3 x 230 V

Device	Switching frequency of power stage	Ambient temperature	Rated current I_N [A_{eff}]	Peak current			
				200% (2 I_N)		300% (3 I_N)	
	[kHz]	max. [°C]	at 3 x 230 V	[A_{eff}]	for time [s]	[A_{eff}]	for time [s]
SO22.003	4	45	3.0	6.0	10	9.0	0.08
	8	40	3.0	6.0		9.0 [1)]	
	16	40	2.0	4.0		6.0 [1)]	
SO22.006	4	45	5.9	11.8	10	17.7	0.08
	8	40				17.7 [1)]	
	16	40				17.7 [1)]	
SO22.008	4	45	8.0	16.0	10	24.0	0.08
	8	40	8.0	16.0		24.0 [1)]	
	16	40	5.4	10.8		16.2 [1)]	

1) Automatic power stage switching frequency change to 4 kHz.
Data applies to motor cable length ≤10m. Maximum permissible motor cable length 30 m.

Table A.2 Rated current and peak current BG2 to BG4 (3 x 230 V AC)

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ServoOne junior for 3 x 400/460/480 V

Device	Switching frequency of power stage	Ambient temperature	Rated current I_N [A_{eff}]			Peak current 2)			
						200% (2 I_N)		300% (3 I_N)	
	[kHz]	max. [°C]	at 400 V	at 460 V	at 480 V	[A_{eff}]	for time [s]	[A_{eff}]	for time [s]
SO24.002	4	45	2.0	2.0	2.0	4.0	10	6.0	0.08
	8	40	2.0	2.0	1.7	4.0		6.0 1)	
	16	40	0.7	0.7	-	1.4		2.1 1)	
SO24.004	4	45	3.5	3.5	3.5	7.0	10	10.5	0.08
	8	40	3.5	3.5	2.6	7.0		10.5 1)	
	16	40	2.2	1.3	-	4.4		6.6 1)	
SO24.007	4	45	6.5	6.5	6.5	13.0	10	19.5	0.08
	8	40	6.5	6.5	6.5	13.0		19.5 1)	
	16	40	4.0	2.4	1.9	8.0		12.0 1)	

1) Automatic power stage switching frequency change to 4 kHz.
2) Data referred to 3 x 400 V mains voltage
Data applies to motor cable length ≤10m. Maximum permissible motor cable length 30 m.

Table A.3 Rated current and peak current BG2 to BG4 (3 x 400/460/480 V AC)

A.2 Technical data ServoOne junior

SO22.003, SO22.006 and SO22.008

Technical data \ Designation		SO22.003	SO22.006	SO22.008
Output motor side [1]				
Voltage		3 phase U_{Mains}		
Continuous current effective (I_N) [2]		3 A	5.9 A	8 A
Peak current ($A_{effective}$)		see table A.1 and A.2		
Rotating field frequency		0 ... 400 Hz		
Switching frequency of power stage		4, 8, 16 kHz		
Input mains side				
Mains voltage		(1 x 230 V AC / 3 x 230 V AC) -20%/+15%		
Device connected load [1] (with mains choke)		1.3 kVA	2.6 kVA	3.5 kVA
Current [1] (with mains choke)	1 x 230 V AC	5.4 A	10.6 A	14.4 A
	3 x 230 V AC	3.3 A	6.5 A	8.8 A
Asymmetry of mains voltage		±3% max.		
Frequency		50/60 Hz ±10%		
Power loss at I_N [1]		75 W	150 W	200 W

1) Data referred to output voltage 230 V AC and switching frequency 8 kHz.
2) For rated current refer to table A.1 or table A.2!
3) Connection of ext. braking resistor not permitted to devices with int. braking resistor (design SO2x.xxx.xxxx.1xxx)!
4) Braking resistor always integrated. Connection of an external resistor is permissible.
5) Option (SO2x.xxx.xxxx.1xxx)

Table A.4 Technical data SO22.003, SO22.006 and SO22.008

Technical data \ Designation	SO22.003	SO22.006	SO22.008
DC link			
Braking chopper switch-on treshold	390 V DC		
Minimum ohmic resistance of an externally installed braking resistor	72 Ω	72 Ω [3]	72 Ω [3]
Brake chopper continuous power with external braking resistor	2.1 kW		
Peak brake chopper with external braking resistor	2.1 kW		
Internal braking resistor	550 Ω (PTC) [4]	100 Ω [5]	90 Ω [5]
Brake chopper continuous power with internal braking resistor	0 W	depending on the effective load on the controller in the specific application	
Peak brake chopper with internal braking resistor	400 W	1500 W	1700 W

1) Data referred to output voltage 230 V AC and switching frequency 8 kHz.
2) For rated current refer to table A.1 or table A.2!
3) Connection of ext. braking resistor not permitted to devices with int. braking resistor (design SO2x.xxx.xxxx.1xxx)!
4) Braking resistor always integrated. Connection of an external resistor is permissible.
5) Option (SO2x.xxx.xxxx.1xxx)

Table A.4 Technical data SO22.003, SO22.006 and SO22.008

NOTE: For more information on the braking chopper switch-on threshold also refer to section 3.14 from page 31.

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SO24.002, SO24.004 and SO24.007

Designation / Technical data	SO24.002	SO24.004	SO24.007
Output motor side [1]			
Voltage	3 phase U_{Mains}		
Continuous current effective (I_N) [2]	2 A	3.5 A	6.5 A
Peak current ($A_{effective}$)	see table A.3		
Rotating field frequency	0 ... 400 Hz		
Switching frequency of power stage	4, 8, 16 kHz		
Input mains side			
Mains voltage	(3 x 400 V AC / 3 x 460 V AC / 3 x 480 V AC) ±10%		
Device connected load [1] (with mains choke)	1.5 kVA	2.7 kVA	5.0 kVA
Current [1] (with mains choke)	2.2 A	3.9 A	7.2 A
Asymmetry of mains voltage	±3% max.		
Frequency	50/60 Hz ±10%		
Power loss at I_N [1]	42 W	80 W	150 W
DC link			
Braking chopper switch-on treshold	650 V DC [1]		
Minimum ohmic resistance of an externally installed braking resistor	230 Ω	180 Ω [3]	72 Ω [3]
Brake chopper continuous power with external braking resistor	1.8 kW	2.3 kW	5.9 kW
Peak brake chopper with external braking resistor	1.8 kW	2.3 kW	5.9 kW
Internal braking resistor	7500 Ω (PTC) [4]	420 Ω [5]	90 Ω [5]
Brake chopper continuous power with internal braking resistor	0 W	depending on the effective load on the controller in the specific application	
Peak brake chopper with internal braking resistor	200 W [1]	1000 W [1]	4700 W [1]

1) Data referred to output voltage 400 V AC and switching frequency 8 kHz.
2) For rated current refer table A.3!
3) Connection of ext. braking resistor not permitted to devices with int. braking resistor (design SO2x.xxx.xxxx.1xxx)!
4) Braking resistor always integrated. Connection of an external resistor is permissible.
5) Option (SO2x.xxx.xxxx.1xxx)

Table A.5 Technical data SO24.002, SO24.004 and SO24.007

NOTE: For more information on the braking chopper switch-on threshold also refer to section 3.14 from page 31.

A.3 Ambient conditions

Ambient conditions	ServoOne junior
Protection	IP20 except terminals (IP00)
Accident prevention regulations	according to local regulations (in Germany e.g. BGV A3)
Mounting height	up to 1000 m above MSL, over 1000 m above MSL with power reduction (1 % per 100 m, max. 2000 m above MSL)
Pollution severity	2
Type of installation	Built-in unit, only for vertical installation in a switch cabinet with min. IP4x protection, when using STO safety function min. IP54

Table A.6 Ambient conditions ServoOne junior

Climatic conditions		ServoOne junior
in transit	as per EN 61800-2, IEC 60721-3-2 class 2K3 [1]	
	Temperature	-25 °C to +70 °C
	Relative air humidity	95% at max. +40 °C
in storage	as per EN 61800-2, IEC 60721-3-1 class 1K3 and 1K4 [2]	
	Temperature	-25 °C to +55 °C
	Relative air humidity	5 to 95%
in operation	as per EN 61800-2, IEC 60721-3-3 class 3K3 [3]	
	Temperature	-10 °C to +45 °C (4 kHz), up to 55 °C with power reduction (2%/°C) -10 °C to +40 °C (8, 16 kHz), up to 55 °C with power reduction (2%/°C)
	Relative air humidity	5 to 85% witout condensation

1) *The absolute humidity is limited to max. 60 g/m³. This means, at 70 °C for example, that the relative humidity may only be max. 40 %.*
2) *The absolute humidity is limited to max. 29 g/m³ . So the maximum values for temperature and relative air humidity stipulated in the table must not occur simultaneously.*
3) *The absolute humidity is limited to max. 25 g/m³. That means that the maximum values for temperature and relative air humidity stipulated in the table must not occur simultaneously.*

Table A.7 Climatic conditions ServoOne junior

Mechanical conditions		ServoOne junior	
Vibration limit in transit	as per EN 61800-2, IEC 60721-3-2 class 2M1		
	Frequency [Hz]	**Amplitude [mm]**	**Acceleration [m/s²]**
	2 ≤ f < 9	3.5	not applicable
	9 ≤ f < 200	not applicable	10
	200 ≤ f < 500	not applicable	15
Shock limit in transit	as per EN 61800-2, IEC 60721-2-2 class 2M1		
	Drop height of packed device max. 0.25 m		
Vibration limit of the system[1]	as per EN 61800-2, IEC 60721-3-3 class 3M1		
	Frequency [Hz]	**Amplitude [mm]**	**Acceleration [m/s²]**
	2 ≤ f < 9	0.3	not applicable
	9 ≤ f < 200	not applicable	1

1) *NOTE: The devices are only designed for stationary use.*

Table A.8 Mechanical conditions ServoOne junior

ATTENTION!

- **No continuous vibrations!**
  The drive controllers must not be installed in areas where they would be permanently exposed to vibrations.
- **Control cabinet min. IP54 for STO!**
  According to EN ISO 13849-2, when using the STO (Safe Torque OFF) safety function the switch cabinet must have IP54 protection or higher.
- **Observe cooling conditions!**
  Forced cooling by external air flow necessary. Air must be able to flow unhindered through the device (air flow at least 1.2 m/s). If a temperature cut-out occurs, the cooling conditions must be improved.

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A.4 UL certification

The devices are certified as per UL 508C. For this purpose the following conditions are to be met by the user:

1. The devices may only be operated in systems of overvoltage category III.
2. The devices are rated for installation in an environment of pollution severity 2.
3. The protective device for branch lines must be executed in accordance with the manufcturers' instructions, the requirements of the NEC (National Electrical Code) and other locally applicable standards.
4. Only UL certificated device connection cables (mains, motor and control cables) may be used:
   - Use copper conductors with a temperature resistance of at least 75 °C.
   - Specified tightening torques for the terminals:
5. Maximum temperature of the ambient air (surrounding temperature): see table A.7
6. Multiple rated equipment: For details see tables A.1, A.2 and A.3.
7. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.
8. Control outputs (X4/23; X4/24) and OSD00, OSD01, OSD02 (see ratings of control circuitry): Use secondary isolating source rated 25 V AC, 30 V DC or 24 V DC as appropriate for rating of the given output. Fuse in accordance with UL248, rated 100 V must be connected between the source and the output.
9. Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical Amperes @ Volts maximum (240 V maximum for SO22.00x / 480 Volts maximum for SO24.00x), when protected by class RK5 fuses:

Size	Device	Tightening torque mains terminal X3	Tightening torque motor terminal X1	max. mains fuse / class
BG2	SO22.003	5 - 7 lb-in (0.56 - 0.79 Nm)		10 A, 250 V / RK5
	SO24.002	5 - 7 lb-in (0.56 - 0.79 Nm)		6 A, 600 V / RK5
BG3	SO22.006	5 - 7 lb-in (0.56 - 0.79 Nm)		20 A, 250 V / RK5
	SO24.004	5 - 7 lb-in (0.56 - 0.79 Nm)		15 A, 600 V / RK5
BG4	SO22.008	4.4 - 5.3 lb-in (0.50 - 0.60 Nm)	7 lb-in (0.79 Nm)	25 A, 250 V / RK5
	SO24.007	4.4 - 5.3 lb-in (0.50 - 0.60 Nm)	7 lb-in (0.79 Nm)	20 A, 600 V / RK5

Table A.9 Tightening torques and mains fuse BG2 to BG4

Certifications

The ServoOne junior servocontroller has the following acceptances:

Servocontroller	Certification
SO22.003.xxxx.0xxx.x	UL Recognized
SO22.006.xxxx.0xxx.x	UL Listed
SO22.008.xxxx.0xxx.x	UL Listed
SO24.002.xxxx.0xxx.x	UL Recognized
SO24.004.xxxx.0xxx.x	UL Listed
SO24.007.xxxx.0xxx.x	UL Listed

NOTE: An Ul certification for dvices with integrated braking resistor (SO2x.xxx.xxxx.1xxx.x) is planned.

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ID no.: 1300.20B.2-01

Date: 12/2011

Applicable as from firmware version: V0.25

The German version is the original of this Operation Manual.