LTi DRiVES

# ServoOne junior

## Operation Manual


## Servocontrollers

2.0 A to 8 A

BG2 BG3 BG4

## ServoOne junior Operation Manual

ID no.: 1300.20B.0-00

Date: 03/2010

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.

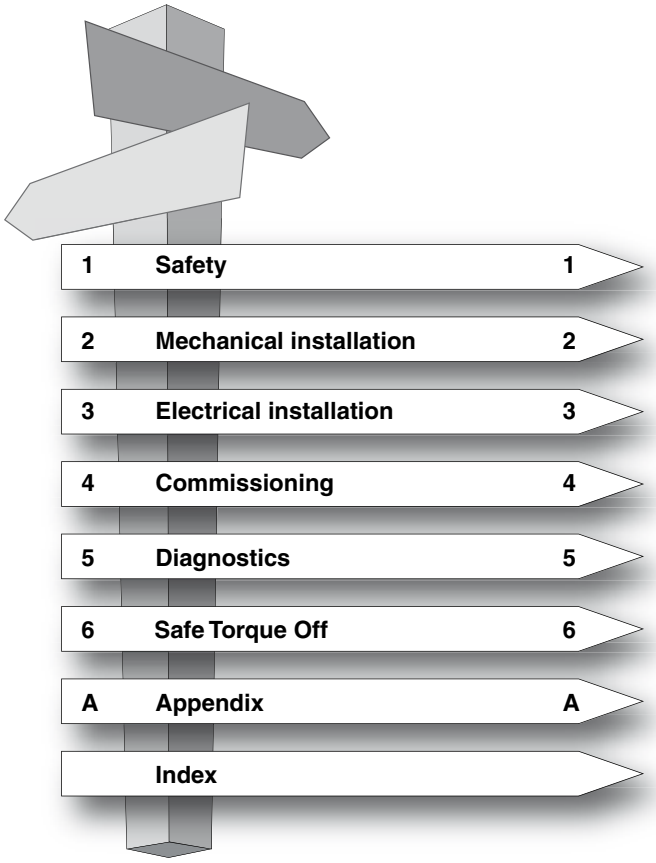
Information and specifications may be subject to change at any time. For information on the latest version please visit http://drives.lt-i.com.

# 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! |



## Order code

The order designation indicates the relevant design variant of the servocontroller delivered to you. For details on the order code refer to the ServoOne order catalogue.

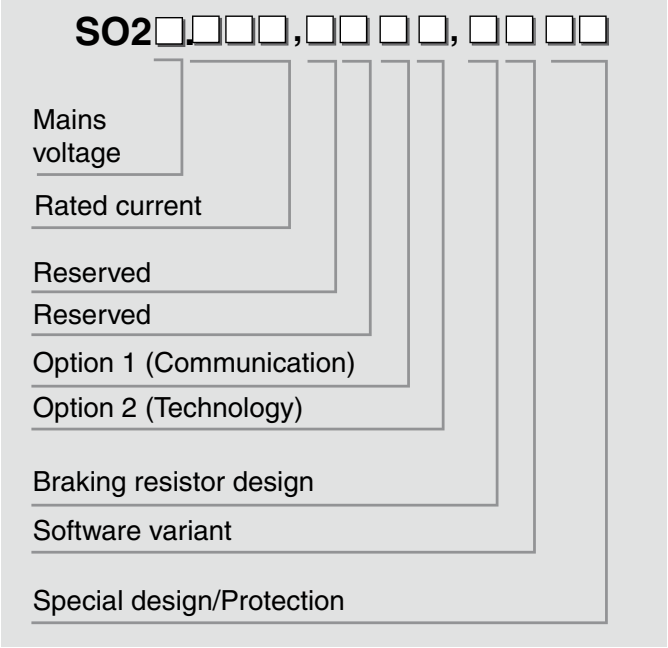



*Figure 0.1 ServoOne junior order code*

## Rating plate

On rating plates of the ServoOne junior drive units 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 figure 3.1 on page 13.

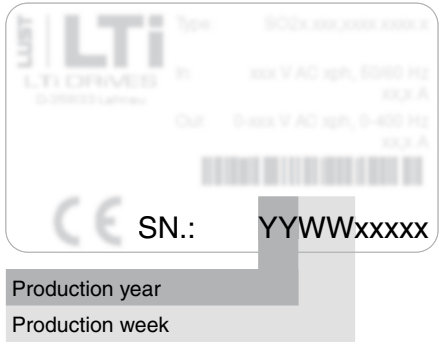



*Figure 0.2 ServoOne junior hardware rating plate*

## 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!<br>Improper behaviour may endanger human life. |
|  | DANGER FROM ROTATING PARTS!<br>Drive may start up automatically. |
| **Hints & Tips** | |
|  | NOTE: Useful information or reference to other documents |
|  | STEP: Action in a sequence of multiple actions |

Space for your own notes

# Inhaltsverzeichnis

# 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 954-1 category 3, 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!<br>• Follow the safety instructions!<br>• Refer to the user information! |
|  | Electric drives are dangerous:<br>• Electrical voltages of 230V to 480V<br>**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!**<br>• Rotating parts<br>• Hot surfaces |
|  | Protection against magnetic and/or electromagnetic fields during installation and operation.<br>• Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas:<br>– Areas where drive systems are installed, repaired and operated.<br>– Areas where motors are installed, repaired and operated. Motors with permanent magnets pose a particular hazard.<br>NOTE: If it is necessary to access such areas, suitability to do so must be determined beforehand by a doctor |
|  | Your qualification:<br>• In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device.<br>• The said qualified personnel must be familiar with the contents of the Operation Manual (cf. IEC 364, DIN VDE 0100).<br>• Awareness of national accident prevention regulations (e.g. BGV A3 in Germany). |
|  | During installation observe the following instructions:<br>• Always comply with the connection conditions and technical specifications.<br>• Comply with the standards for electrical installations, such as regarding wire cross-section, grounding lead and ground connections.<br>• Do not touch electronic components and contacts (electrostatic discharge may destroy components). |

*Table 1.1 Safety instructions*

### 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 61800-5-1:2008.

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.

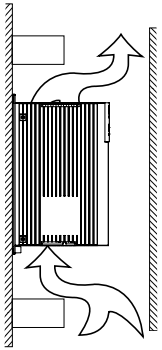
## 2.2 Wall-mounting

| Step | Action | Comment |
|---|---|---|
| 1. | Mark out the position of the tapped holes on the backing plate.<br>Cut a tap for each fixing screw in the backing plate. | Dimensional drawings/hole spacing - see table 2.2<br>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, line reactor 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



## Dimensions

| ServoOne junior | BG2 | BG3 | BG4 |
|---|---|---|---|
| | SO22.003<br>SO24.002 | SO22.006<br>SO24.004 | SO22.008<br>SO24.007 |
| Weight [kg] | 1.0 | 1.5 | 2.8 |
| W (width) | 55 | | |
| H (height) [1] | 210 | | 290 |
| D (depth)[1] | 142 | 189 | 235.5 |
| A | 27.5 | | |
| A1 | - | - | 40 |
| C | 225 | | 305 |
| C1 | 5 | | |
| D | 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/connectors*
*2) The bend radius of the connecting cables must be taken into account*

*Table 2.2 ServoOne junior dimensions - see figure 2.1 and figure 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.

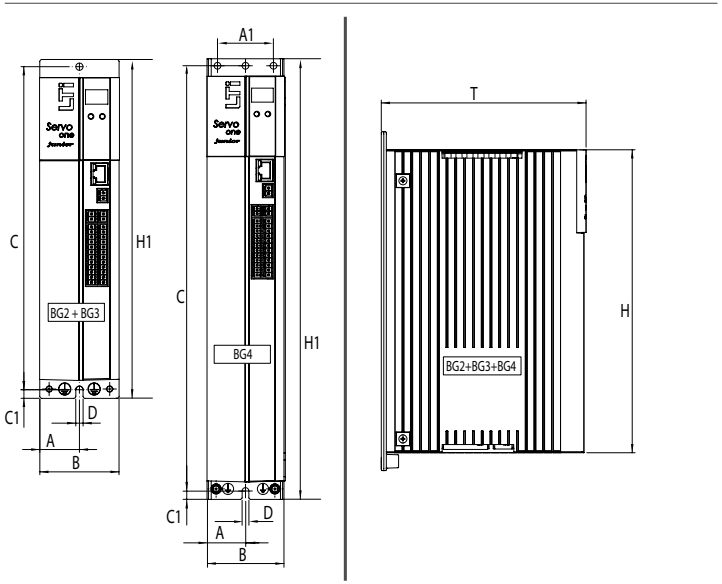



*Figure 2.1 Dimensions (in mm) – BG2, BG3, BG4*

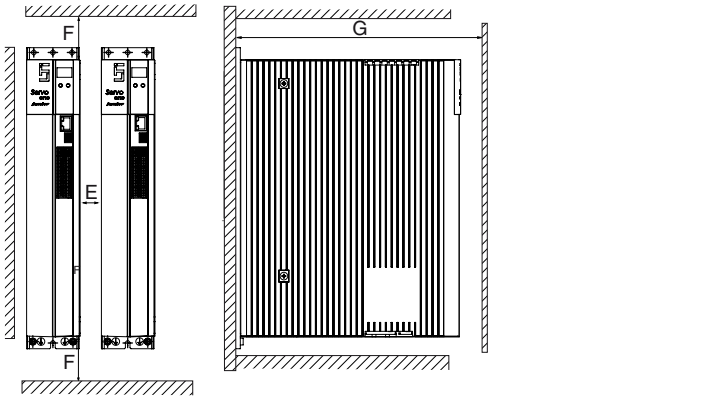



*Figure 2.2 Mounting clearances (in mm)*

# 3. Electrical installation

ATTENTION: Installation must only be carried out by qualified electricians who have undergone instruction in the necessary accident prevention measures.

## 3.1 Layout

The following shows the layout with the corresponding positions of plugs and terminals. To aid orientation, the connectors and terminals are labelled by abbreviations.

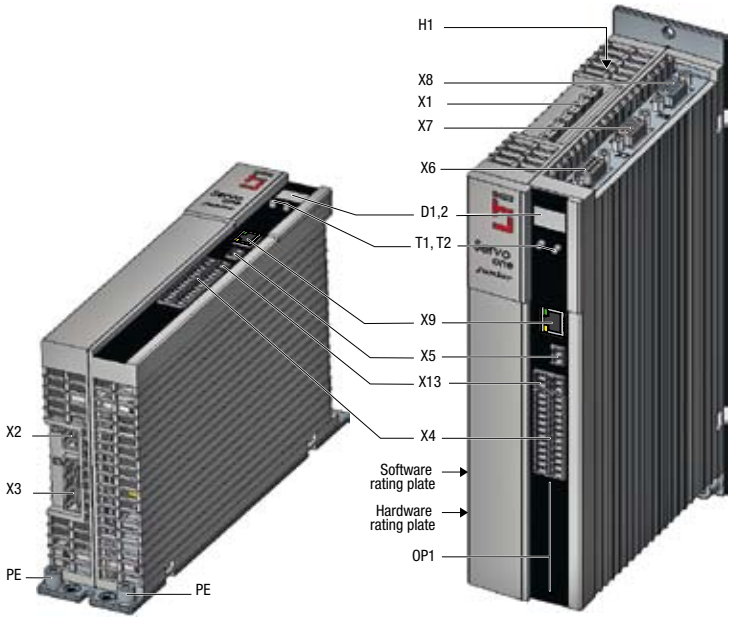



*Figure 3.1 Layout*

| No. | Designation | No. | Designation |
|---|---|---|---|
| D1, D2 | 7-segment display | X4 | Control terminals |
| H1 | DC link voltage indicator LED | X5 | Motor temperature monitoring |
| OP1 | Installation space for option 1 (Communication) | X6 | Resolver connection |
| PE | Protective conductor connection | X7 | Connection for high-resolution encoders |
| T1, T2 | Button | X8 | Option 2 - Technology |
| X1 | Power connection | X9 | Ethernet port |
| X2 | Connection of control supply $U_V$ | X13 | Connection of motor brake |
| X3 | AC mains connection | | |

*Table 3.1 Key to layout*

## 3.2 Connection diagram

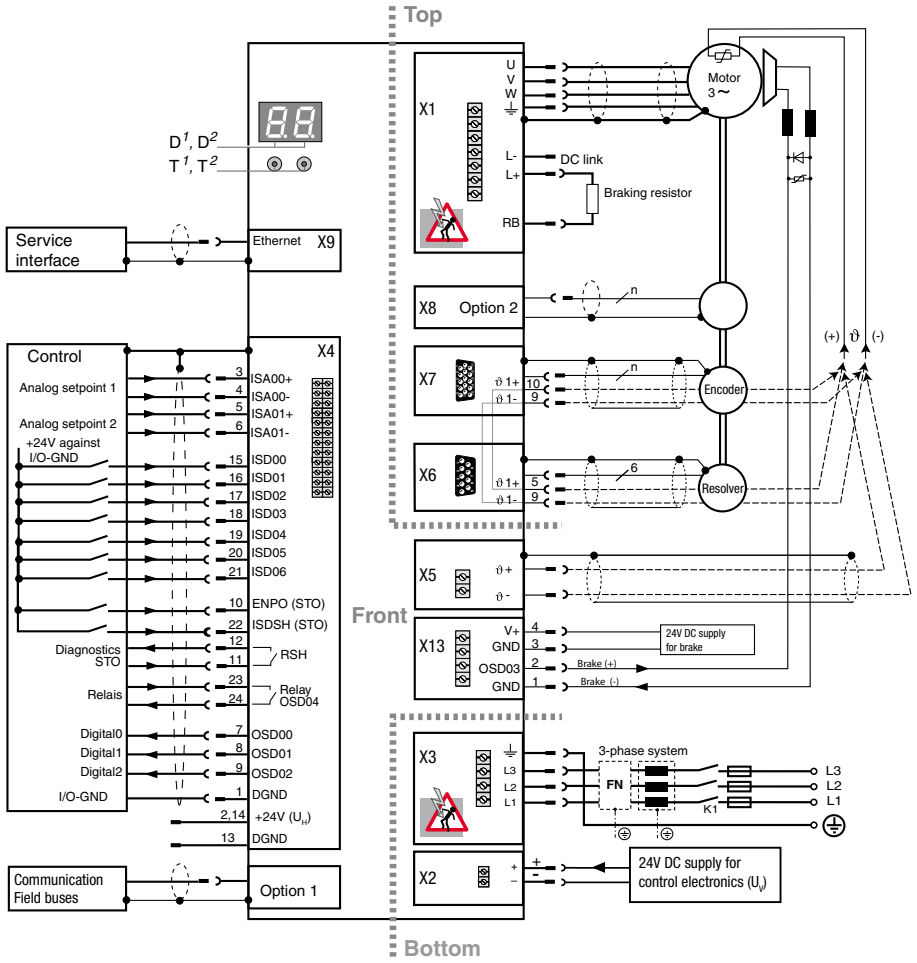



*Figure 3.2 Connection diagram*

| No. | Designation | Function | Page |
|---|---|---|---|
| D1, D2 | 7-segment display | Device status display | see p.35 |
| T1, T2 | Button | Service functions | see p.35 |
| X1 | Power connection | Motor, braking resistor and connection for measurement of DC link voltage | see p.26 |
| X2 | Connection of control supply $U_V$ | 24 V supply voltage for control electronics of drive controller | see p.18 |
| X3 | AC mains connection | Mains supply | see p.18 |
| X4 | Control terminals | Digital inputs/outputs, analog inputs, STO request incl. feedback. | see p.21 |
| X5 | Connection motor temperature monitoring | PTC, based on DIN 44082, Klixon automatic cutout | see p.26 |
| X6 | Resolver connection | Resolver, incl. motor temperature monitor | see p.25 |
| X7 | High-resolution encoder interface | Sin/Cos encoder, TTL encoder, EnDat 2.1 encoder, Hiperface® encoder, SSI encoder, incl. motor temperature monitor. | see p.25 |
| Option 1 | Communication | Factory installed module for field buses, e.g. SERCOS, EtherCAT | see p.23 |
| ⏚ | Protective conductor connection | Connection diagram see section 3.4 | see p.16 |
| X8 Option 2 | Technology | Factory installed module e.g for TTL encoder simulation, second SIN/COS encoder or EnDat 2.1 | see p.23 |
| X9 | Ethernet port | Service port, connection to PC | see p.23 |
| X13 | Connection of motor brake | Power output with cable break detector | see p.26 |

*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*

## 3.3 Effective EMC installation

Drive controllers are components that are intended for installation in industrial and commercial systems and machines. They must only be installed in switch cabinets providing minimum. 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.

Commissioning (i.e. starting intended operation) is only permitted when strictly complying with EMC product standard EN 61800-3.

NOTE: The new EMC product standard for variable-speed electric drives is EN 61800-3:2004. The transition period for the old EN 61800-3:1996 ended on October 1, 2007.

The installer/operator of a machine and/or equipment must provide evidence of the compliance with the protection targets stipulated in the EMC standard.

ATTENTION! If the installation instructions set out in this Operation Manual are followed, and the appropriate RFI filters are used, conformance to the stipulated EMC safety targets is normally achieved.

### Note the following points:

- The protective conductor must be laid out in star configuration to conform to the EMC standards.
- The backing plate must be well grounded.
- The motor, mains power and control cables must be laid separately from each other.
- Avoid loops, and lay cable over short distances.
- The operational leakage current is > 3.5 mA.
- Control, data, motor and encoder cables must be shielded.

### 3.3.1 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 (RFI) 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).

### 3.3.2 Notes on project planning and installation

| Subject | Project planning and installation rules |
|---|---|
| Protective conductor connection<br>Equipotential bonding | • Use a metallically bright backing plate.<br>• Use cables and/or grounding straps with cross-sections as large as possible.<br>• To create a low-resistance HF connection both the grounds (PE) and shield connections must have large-area contact to the PE rail (main ground) on the backing plate. |
| Cable routing | • Signal cables must be kept as far away as possible from the mains power and motor cables. They should not run in parallel. If cross-overs are unavoidable, they should wherever possible be configured at a 90° angle.<br>• Always route the motor cable without interruptions and by the shortest route out of the switch cabinet.<br>• If using a motor contactor, the component should be directly mounted on the drive controller. Do not bare the shield of the motor cable too early.<br>• Avoid unnecessary cable lengths. |
| Cable type | The drive controllers must always be wired with shielded motor cables and signal lines. A cable type with double copper braiding, with 60-70 % coverage, must be used for all shielded connections. |
| Further hints for the switch cabinet design | • Contactors, relays, solenoid valves (switched inductors) must be wired with fuses. The wiring must be directly connected to the respective coil.<br>• Switched inductors should be at least 20 cm away from process controlled assemblies.<br>• Place larger consumers near the supply.<br>• As far as possible route signal cables in from one side only.<br>• Cables of the same circuit must be twisted. Connect residual strands at both ends with the switch cabinet chassis (ground). |
| Supplementary information | Supplementary information can be found in the relevant connection description. |

*Table 3.3 Project planning notes*

## 3.4 Protective conductor connection

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

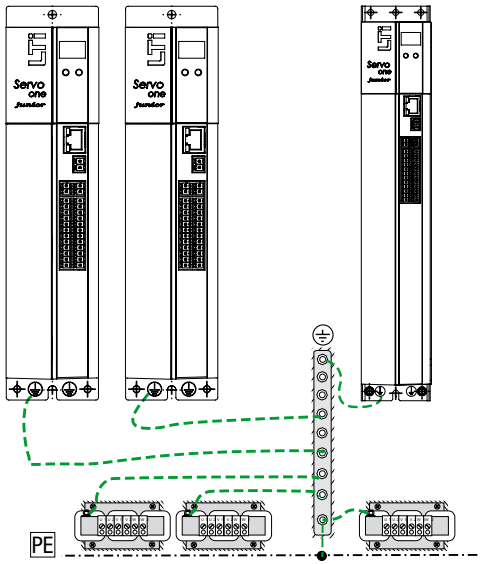



*Figure 3.3 Star configuration layout of the PE conductor*

## 3.5 Electrical isolation concept

The control electronics, with its logic (µP), the encoder terminals and the inputs and outputs, are metallically 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

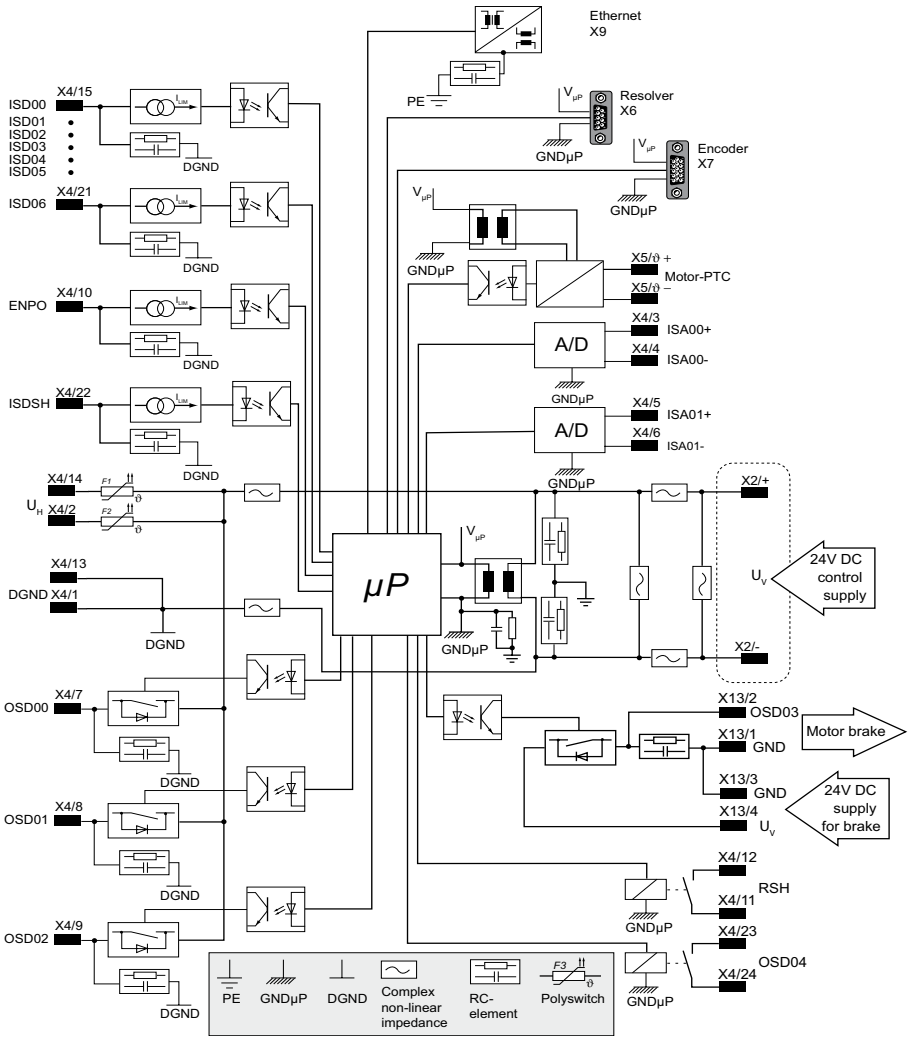



*Figure 3.4 Electrical isolation concept*

## 3.6 Connection of supply voltages

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!

### 3.6.1 Connection of control supply (24 V DC)

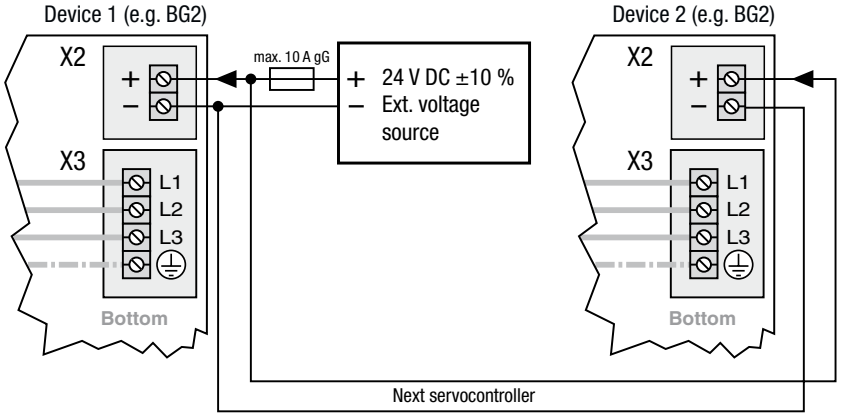



*Figure 3.5 Connection of control supply*

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

*Table 3.4 Specification of control supply*

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 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 figure 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.

### 3.6.2 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).

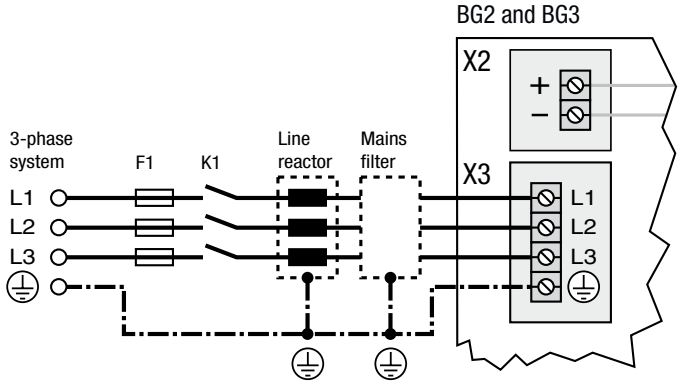



*Figure 3.6 BG2 and BG3 mains supply connection 3 x 230 V (SO22.xxx) or 3 x 400 V(SO24.xxx) depending on device design*

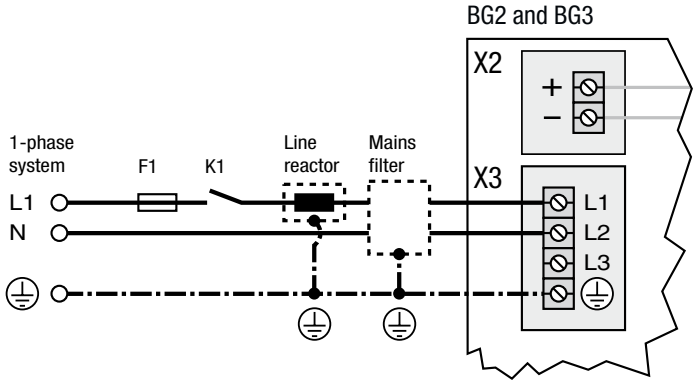



*Figure 3.7 BG2 and BG3 connection to mains supply 1 x 230 V*

## 3.6.3 Mains supply connection, 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).

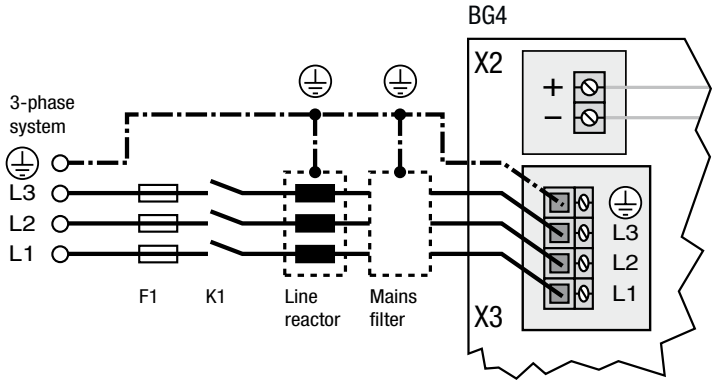



*Figure 3.8 BG4 mains supply connection 3 x 230 V (SO22.xxx) or 3 x 400 V (SO24.xxx) depending on device design*

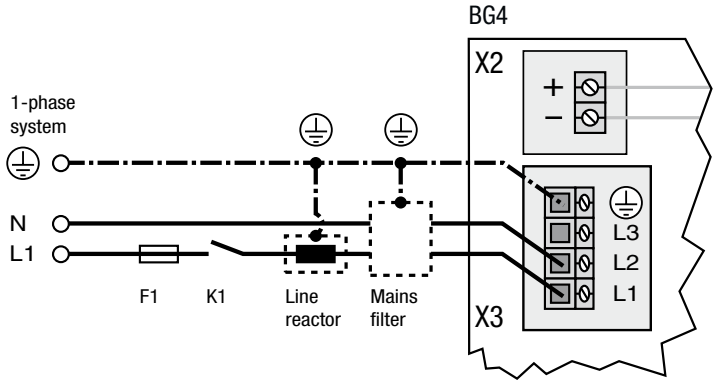



*Figure 3.9 BG4 mains supply connection 1 x 230 V*

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 line reactor *) (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 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 (isolated neutral point)!
  - 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 line reactor 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, see appendix.
- 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[2] of term. [mm²] | Specified mains fuse, duty class gG [A] |
|---|---|---|---|---|
| | With line reactor (4 % $u_K$) | Without line reactor | | |
| SO22.003 | [3] | 0.75 | 2.5 | 3 x max. 16 |
| SO24.002 | [3] | 0.75 | | 3 x max. 6 |
| SO22.006 | [3] | 1.5 | 2.5 | 3 x max. 16 |
| SO24.004 | [3] | 1.5 | | 3 x max. 10 |
| SO22.008 | [3] | 3 | 4 | 3 x max. 20 |
| SO24.007 | [3] | 3 | | 3 x max. 16 |

*1) At 3 x 230 V or 3 x 400 V 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.*

*3) Data not available at time of publication.*

*Table 3.5 Connected load and mains fuse*

## 3.7 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.<br>Please contact your project engineer to obtain the terminal assignment! | |
| 3. | Choose a terminal assignment. | Initial commissioning |
| 4. | Wire the control terminals with shielded cables.<br>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.<br>Conductor sizes fixed: 0.2 to 1.5 mm²<br>Flexible conductor sizes:<br>- Ferrule without plastic sleeve: 0.2 to 1.5 mm²<br>- Ferrule with plastic sleeve: 0.2 to 0.75 mm² |
| 5. | Keep all contacts open<br>(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.

### 3.7.1 Specification of control connections

| Des. | Term. | Specification | El.isolation |
|---|---|---|---|
| **Analog inputs** | | | |
| ISA0+<br>ISA0-<br>ISA1+<br>ISA1- | X4/3<br>X4/4<br>X4/5<br>X4/6 | • $U_{IN}$ = ±10 V DC<br>• Resolution 12-bit; $R_{IN}$ approx. 101 kΩ<br>• Terminal scan cycle in "IP mode" = 125 µs, otherwise = 1 ms<br>• Tolerance: U ±1 % of the measuring range end value. | No |
| **Digital inputs** | | | |
| ISD00<br>ISD01<br>ISD02<br>ISD03<br>ISD04 | X4/15<br>X4/16<br>X4/17<br>X4/18<br>X4/19 | • Frequency range < 500 Hz<br>• Terminal scanning cycle = 1 ms<br>• Switching level Low/High: ≤ 4.8 V / ≥ 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN}$ at 24 V = typ. 3 mA | Yes |
| ISD05<br>ISD06 | X4/20<br>X4/21 | • Frequency range ≤ 500 kHz<br>• Switching level Low/High: ≤ 4.8 V / ≥ 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN\ max}$ at 24 V = 10 mA, $R_{IN}$ approx. 3 kΩ<br>• 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<br>• OSSD-capable<br>• Reaction time approx. 10ms<br>• Switching level Low/High: ≤ 4.8 V / ≥ 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN}$ at 24 V = typ. 3 mA | Yes |
| **Digital outputs** | | | |
| OSD00<br>OSD01<br>OSD02 | X4/7<br>X4/8<br>X4/9 | • No destruction in case of short-circuit (+24 V -> DGND), but device may briefly shut down.<br>• $I_{max}$ = 50 mA, PLC-compatible<br>• Terminal scanning cycle = 1 ms<br>• High-side driver | 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 3.6 Specification of control connections X4*

| Des. | Term. | Specification | | El.isolation |
|---|---|---|---|---|
| **STO "Safe Torque Off"** | | | | |
| ISDSH (STO) | X4/22 | • "Request STO" input = Low level<br>• OSSD-capable<br>• Switching level Low/High: < 4,8 V / > 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN}$ at 24 V = typ. 3 mA | | Yes |
| RSH<br>RSH | X4/11<br>X4/12 | Diagnostics STO, both tripping channels active, one NO contact with automatically resetting circuit-breaker (polyswitch)<br>• 25 V / 200 mA AC, cos φ = 1<br>• 30 V / 200 mA DC, cos φ = 1 | X4/12<br>X4/11 | Yes |
| **Relay outputs** | | | | |
| REL | X4/23<br>X4/24 | Relay, 1 NO contact<br>• 25 V / 1.0 A AC, cos φ = 1 (AC1)<br>• 30 V / 1.0 A DC, cos φ = 1 (DC1)<br>• Switching delay approx. 10 ms<br>• Cycle time 1 ms | X4/23<br>X4/24 | |
| **Auxiliary voltage** | | | | |
| +24 V | X4/2<br>X4/14 | • Auxiliary voltage output ($U_H$) to feed the digital control inputs<br>• $U_H = U_V$-ΔU (ΔU typically approx. 1.2 V), no destruction in case of short circuit (+24 V -> DGND), but device may briefly shut down<br>• $I_{max}$ = 80 mA (per pin) with self-resetting circuit breaker (polyswitch) | | Yes |
| **Digital ground** | | | | |
| DGND | X4/1<br>X4/13 | Reference ground for 24 V | | 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 3.6 Specification of control connections X4*

## 3.7.2 Connection of motor brake X13

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

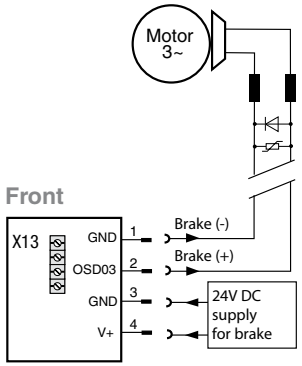
| Des. | Term. | Connection | Specification |
|---|---|---|---|
| OSD03<br>GND<br><br>GND<br>V+ | X13/2<br>X13/1<br><br>X13/3<br>X13/4 |  | • Short-circuit proof<br>• External control supply 24 V ($I_{IN}$ = 2,1 A) required via X13/3 (GND) and X13/4 (V+)<br>• $U_{BR} = U_V$-ΔU` (ΔU` typically approx. 1.4 V)<br>• 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).<br>• Overcurrent causes cyclic shutdown<br>• Also usable as configurable digital output<br>• Interruptible cable break monitor < 200 mA typically in condition "1" |

*Table 3.7 Specification of terminal connections X13*

## 3.8 Specification of Ethernet port

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 junior
- 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-ECLxx, see also ServoOne order catalogue).

## 3.9 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 ServoOne order catalogue. The user manuals for the respective options provide detailed information on commissioning.

## 3.10 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 ServoOne order catalogue. The user manuals for the respective options provide detailed information on commissioning.

## 3.11 Encoder connection

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

### Encoder connection of 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!

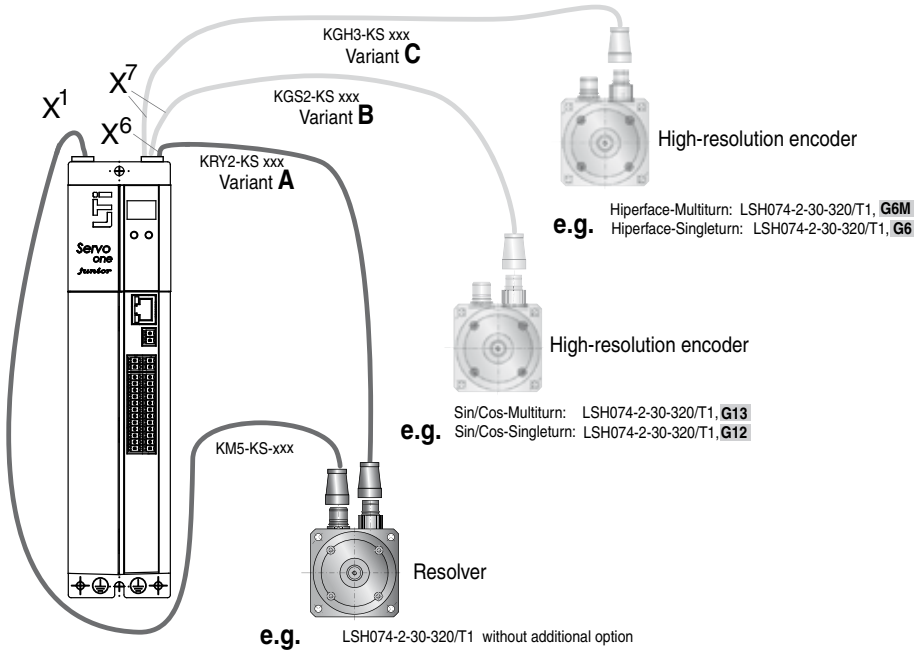



*Figure 3.10 Matching motor/encoder cable*

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<br>e.g. LSH/LST H074-2-30-320/T1<br>without further options | KRY2-KSxxx | X6 |
| Variant B | G13: = Sin/Cos multi-turn encoder with SSI/EnDat interface<br>e.g. LSH/LST H074-2-30-320/T1,G13 | KGS2-KSxxx | X7 |
| | G12: = Sin/Cos multi-turn encoder with SSI/EnDat interface<br>e.g. LSH/LST H074-2-30-320T1,G12 | KGS2-KSxxx | X7 |
| Variant C | G6: = Sin/Cos single-turn encoder with Hiperface® interface<br>e.g. LSH/LST H074-2-30-320/T1,G6 | KGH3-KSxxx | X7 |
| | G6M: = Sin/Cos multi-turn encoder with Hiperface® interface<br>e.g. LSH/LST H074-2-30-320/T1,G6M | KGH3-KSxxx | X7 |

*Table 3.8 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 | RY2 | - | KS | xxx |
|---|---|---|---|---|
| Encoder cable | | | | |
| Ready made-up cable | | | | |
| *Resolver cable* | RY2 | | | |
| *Encoder cable SSI,* | GS2 | | | |
| *EnDat Encoder cable Hiperface®* | GH3 | | | |
| Encoder system | | | | |
| Festoon compatibility | | | KS | |
| Version | | | | |
| Cable length (m) | | | | |

Encoder cable KRY2-KS-xxx Order code

## Technical data

| | KRY2-KSxxx | KGS2-KSxxx | KGH3-KSxxx |
|---|---|---|---|
| Motors with encoder system | Resolver | G3, G5, G12.x (single/multiturn encoder with SSI/ Endat interface) | G6, G6.x (single/ multiturn encoder with Hiperface® interface) |
| Controller-end assignment (sub-D connector) | 1 = S2<br>2 = S4<br>3 = S1<br>4 = n.c.<br>5 = PTC+<br>6 = R1<br>7 = R2<br>8 = S3<br>9 = PTC- | 1 = A-<br>2 = A+<br>3 = VCC (+5 V)<br>4 = DATA+<br>5 = DATA-<br>6 = B-<br>8 = GND<br>11 = B+<br>12 = VCC (Sense)<br>13 = GND (Sense)<br>14 = CLK+<br>15 = CLK-<br>7, 9, 10 = n.c. | 1 = REFCOS<br>2 = +COS<br>3 = $U_s$ = 7 - 12 V<br>4 = Data+ RS485<br>5 = Data RS485<br>6 = REFSIN<br>7 = Jumper to pin 12<br>8 = GND<br>11 = +SIN<br>12 = Jumper to pin 7<br>9, 10, 13, 14, 15 = n.c. |
| Festoon-compatible | Yes | | |
| Minimum bend radius | 90 mm | 100 mm | 90 mm |

*Table 3.9 Technical data – encoder cable*

| | KRY2-KSxxx | KGS2-KSxxx | KGH3-KSxxx |
|---|---|---|---|
| Temperature range | -40 ... +85 °C | -35 ... +80 °C | -40 ... +85 °C |
| Cable diameter approx. | 8.8 mm | | |
| Material of outer sheath | 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 3.9 Technical data – encoder cable*

### 3.11.1 Resolver connection X6

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

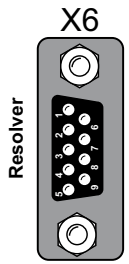
| Fig. | X6/Pin | Function |
|---|---|---|
|  | 1 | Sin+ / (S2) analog differential input track A |
| | 2 | Refsin / (S4) analog differential input track A |
| | 3 | Cos+ / (S1) analog differential input track B |
| | 4 | Supply voltage 5 ... 12 V, int. connected to X7/3 |
| | 5 | ϑ+ (PTC, KTY, Klixon)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

*Table 3.10 Pin assignment, X6-resolver connection*

[1]ATTENTION! The motor PTC (also KTY und Klixon) when connected to X6 or X7 must be designed with reinforced motor winding insulation according to EN61800-5-1.

### 3.11.2 Connection for high-resolution encoders X7

Encoder interface X7 enables evaluation of the following encoder types.

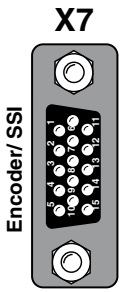
| Fig. | Function |
|---|---|
|  | **Sin/Cos encoder with zero pulse:**<br>• e.g. Heidenhain ERN1381, ROD486.<br>• $U_V$ = 5 V ±5 %, $I_{max}$ = 150 mA |
| | **Heidenhain Sin/Cos encoder with EnDat2.1 interface:**<br>• e.g. 13-bit single-turn encoder (ECN1313.EnDat01) and 25-bit multi-turn encoder (EQN1325-EnDat01).<br>• $U_V$ = 5 V ±5 %, $I_{max}$ = 150 mA |
| | **Sin/Cos encoder with SSI interface:**<br>• e.g. 13-bit single-turn and 25-bit multi-turn encoders (ECN413-SSI, EQN425-SSI)<br>• $U_V$ = 5 V ±5 %, $I_{max}$ = 150 mA |
| | **Sick-Stegmann Sin/Cos encoder with HIPERFACE® interface:**<br>• Single-turn and multi-turn encoders, e.g. SRS50, SRM50<br>• $U_V$ = 7 to 12 V (typ. 11 V) ±5 %, $I_{max}$ = 100 mA. |

*Table 3.11 Suitable encoder types on X7*

NOTE: 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.

Electrical specification of interface X7:

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.

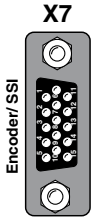
| Fig. | X7/Pin | Function Sin/ Cos and TTL | Absolute encoders SSI/ EnDat 2.1/2.2 | Absolute encoder HIPERFACE® | |
|---|---|---|---|---|---|
|  | 1 | A- | A- | REFCOS | |
| | 2 | A+ | A+ | +COS | |
| | 3 | +5 V, ±5 % at I_OUT_MAX=250 mA controlled, monitoring via sensor cable | | 7 to 12 V / (typ. 11 V) 100 mA. | The sum of the currents tapped at X7/3 and X6/4 must not exceed the specified value! |
| | 4 | R+ / Data + | | | |
| | 5 | R- / Data - | | | |
| | 6 | B- | B- | REFSIN | |
| | 7 | - | - | $U_S$ - Switch | |
| | 8 | 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+ | | $U_S$ - Switch | |
| | 13 | Sense- | | - | After connecting pin 7 to pin 12, a voltage of 11.8 V is set at X7/3 and X6/4! |
| | 14 | - | CLK+ | - | |
| | 15 | - | CLK- | - | |



*Table 3.12 Pin assignment, X7-encoder connection*

[1] ATTENTION! The motor PTC (also KTY and Klixon) when connected to X6 or X7 must be designed with reinforced motor winding insulation according to EN61800-5-1.

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.

## 3.12 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. |

ATTENTION! The motor PTC (also KTY and Klixon) when connected to X5must 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.

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.

## 3.12.1 Connection of LSH/LST motors

For connection of the servomotor series LSH xxx and 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).

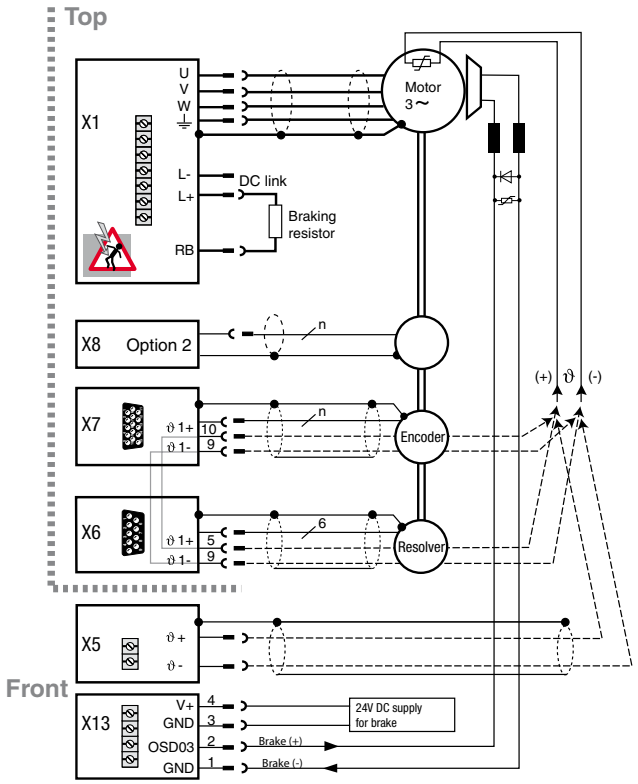
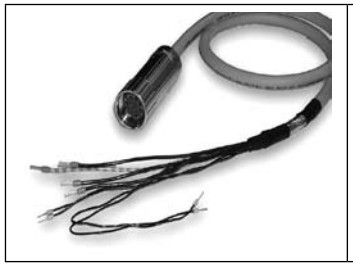



*Figure 3.11 Connection of motor*

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

### Ready made-up motor cable



Motor cable KM5-KSxxx

*Order code*

| KM5 | - | KS | xxx |
|---|---|---|---|
| Ready made-up motor cable | | | |
| | | Version | |
| | | Festoon compatibility | |
| | | | Cable length (m) |

Order code

### Technical data

| | | KM5-KSxxx |
|---|---|---|
| For motors with plug-in power connection | | to $I_N$ = 16 A |
| Minimum bend radius | in fixed installation | 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 + 2 x 2 x 0.75 mm² |
| Outer sheath material | | PUR |
| Resistance | | Resistant to oil, hydrolysis and microbic attack (VDE0472), UL 1581, flame-resistant (DIN EN 50265-2-1) |
| Wiring | | U = 1<br>V = 2<br>W = 3<br>Ground = ye/gn<br>PTC = 5<br>PTC = 6<br>Brake + = 7<br>Brake - = 8 |
| Approval | | UL AWM 80 °C - 600 V/1000 V<br>CSA AWM 80 °C - 600 V/1000 V 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.

### 3.12.2 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.

## 3.13 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.

### 3.13.1 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 **56_BC_FAIL**(56) to any digital output (expert field "I/O configuration" -> digital output -> OSD00 to OSD02). 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.

### 3.13.2 Design with integrated braking resistor (BG3+4)

The 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.

| Device | Technology | Rated resistance $R_{BR}$ | Peak braking power $P_{PBr}$ | Pulse energy $W_{IBr}$ | K1 |
|---|---|---|---|---|---|
| SO22.006 | Wire resistance | 100 Ω | 1500 W | 5) | 5) |
| SO24.004 | | 420 Ω | 1000 W 2)<br>1300 W 3)<br>1400 W 4) | 5) | 5) |
| SO22.008 | | 90 Ω | 1690 W 1) | 5) | 5) |
| SO24.007 | | | 4700 W 2)<br>6170 W 3)<br>6500 W 4) | 5) | 5) |

*1) Data referred to 1 x 230 V mains voltage (BR switch-on threshold 390 $V_{DC}$))*
*2) Data referred to 3 x 400 V mains voltage (BR switch-on threshold 650 $V_{DC}$))*
*3) Data referred to 3 x 460 V mains voltage (BR switch-on threshold 745 $V_{DC}$))*
*4) Data referred to 3 x 480 V mains voltage (BR switch-on threshold 765 $V_{DC}$))*
*5) Data not available at time of publication*

*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.

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

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 SO22.003 to SO24.007 with integrated braking resistor.

## 3.13.3 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 48.
- The braking resistor must be connected by a shielded cable.

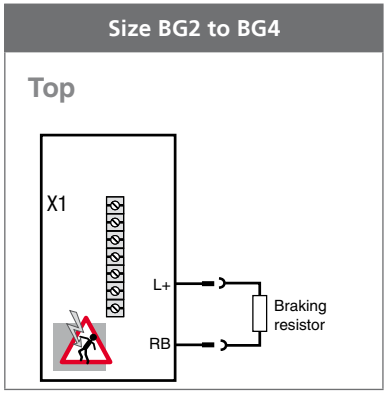



*Figure 3.12 Connection braking resistor*

ATTENTION! No additional external braking resistor must be connected to the drive controller with integrated braking 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)

| Order designation | Continuous braking power | Resistance[1)] | Peak braking power [2)] | Protection | Picture |
|---|---|---|---|---|---|
| BR-090.01.540,UR | 35 W | 90 Ω | 6250 W | IP54 |  Example: BR-090.01,430,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: Exact specifications, in particular with regard to surface temperature, maximum system voltage and high-voltage strength, are set out in the ServoOne order catalogue.

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

# 4. Commissioning

## 4.1 Initial commissioning (actuation via terminals)

Initial commissioning is divided into the following five steps. Speed-controlled operation using a resolver was chosen for parameter setting. Actuation is via terminals X4.

| Step | Action | Comment |
|---|---|---|
| 1. | Wiring of components | see section 3. "Electrical installation" |
| 2. | Switching on control voltage<br>External 24 V supply voltage | see section 3. "Electrical installation" |
| 3. | DriveManager 5<br>Operating software<br>Communication, installation | Information concerning installation can be found in the Bedlam DriveManager 5 Operation Manual |
| 4. | Parameter setting | For more details see ServoOne application manual |
| 5. | Drive under control (test run) | Mains voltage on, STOL function deactivated, start contact, specify setpoint |

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

### 4.1.1 System requirements

- A servocontroller connected as per section 3.
- A PC with installed DriveManager 5 user software
- A CAT5 Ethernet interface cable (e.g. Ethernet cable type CC-ECLxx, see ServoOne order catalogue)
- A servomotor type LSH or LST with resolver (see LSH/LST servomotors order catalogue), connected to the servocontroller as specified in section 3 (LSH and LST motor data sets can be downloaded from the LTi website:http://drives.lt-i.com).

ATTENTION! During commissioning strictly comply with the safety regulations specified in section 1.

DANGER FROM ELECTRICAL TENSION! Never wire or disconnect electrical connections while these are live. Disconnect the device from the mains supply (230/400/460/480 V) before working on it. Work on the device only once the DC link voltage has fallen below 50V residual voltage (measured at BG2-BG4 terminals X1/L- and L+).

## 4.1.2 Wiring of components

1. For complete wiring all power supply, encoder, communication and service connections must be connected to the appropriate terminals, using the cables and leads provided for this purpose. Adequate shielding must be ensured see section 3.3 "Effective EMC installation".

= selected setting/component

| Connections | Terminals | Terminal designation | Cable type |
|---|---|---|---|
| Motor connection | X1 | Motor phases: U / V / W<br>Braking resistor: L+ / RB<br>DC link: L+ / L- (only for measurement purposes) | KM5-KSxxx |
| Control supply | X2 | +24 V DC, X2/1 = (+) , X2/2 = (-) | Standard |
| Mains supply | X3 | 3-phase L1/L2/L3/PE (230 V AC)<br>3-phase L1/L2/L3/PE (400 V AC)<br>1-phase L1/L2 (230 V AC) | Standard |

*see section 3.1, "Overview of connections"*

*Table 4.1 Voltage supply*

| Encoder type | Socket | Designation | Cable type |
|---|---|---|---|
| High-resolution encoders (Sin/Cos) | X7 | D-Sub 15-pin (female) | KGS2-KSxxx<br>KGH3-KSxxx |
| Resolver, motor PTC on X6/5+9 | X6 | D-Sub 9-pin (female) | KRY2-KSxxx |

*Table 4.2 Encoder*

| Connection | Terminal | Designation | Cable type |
|---|---|---|---|
| Connection of motor temperature monitor (if not connected via X6/X7) | X5 | $\vartheta$+ and $\vartheta$- | Standard shielded |

*Table 4.3 Motor-PTC*

| Connection | Terminal | Designation | Cable type |
|---|---|---|---|
| Motor brake connection | X13 | OSD03 | Standard shielded |

*Table 4.4 Motor brake (optional)*

| Connection | Socket | Designation | Cable type |
|---|---|---|---|
| Ethernet TCP/IP | X9 | | CC-ECL 03 |

*Table 4.5 Communication with PC using DriveManager 5 user software*

| Connection | Terminals | Designation | Cable type |
|---|---|---|---|
| Request STO | X4/22 | ISDSH (STO) | Standard shielded |
| Request STO Deactivate restart inhibit | X4/10 | ENPO (STO) | Standard shielded |
| Start input digital | X4/15 | ISD00 | Standard shielded |
| Setpoint assignment input analog | X4/3 u. 4 | ISA00 | Standard shielded |

*Table 4.6 Communication via terminals*

### 4.1.3 Switching on control voltage

In order to initialize and parameterize the ServoOne junior, only the 24 DC control voltage supply needs first to be connected to X2. Ensure correct polarity.

After successful switching on you will be able to read two conditions in the 7-segment display. The meanings of other messages can be found in the "Diagnostics" section.

| D1 | D2 | Action | Reaction | Explanation |
|---|---|---|---|---|
|  | | Switch-on of ext. 24 V control voltage | Initialization OK | |
|  | | Not ready for start | DC link voltage **not** connected | Device is initialized |
|  | | Start inhibit (power stage not ready) | DC link voltage connected, closed-loop control deactivated | |

*Table 4.7 Switch-on status of ServoOne junior (on connection of 24 V control supply)*

## 4.2 Integrated operator 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 push buttons (T1, T2)

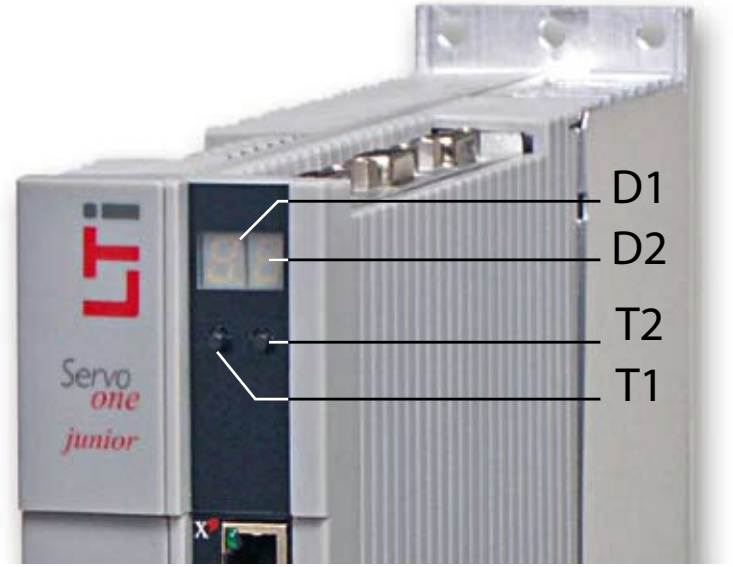



*Figure 4.1 Integrated operator control unit*

The following functions and displays are available:

- Display of device state (see section 5.1 "Device states", on page 39)
  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 39)
  If a device error occurs the display immediately switches to show the error code.
- Parameter setting (display "PA") (see section 4.2.3
  Resetting device parameters to their factory setting.
- Ethernet IP address setting (display "IP") (see section 4.2.4 )
  Setting of the Ethernet IP address and the subnet mask
- Field bus settings (display "Fb") (see section 4.2.5 )
  Setting of field bus address for example.

### 4.2.1 Functions of buttons T1 and T2

By way of the keypad the different menus are activated and the relevant functions controlled.

| Button | Function | Comments |
|---|---|---|
| T1 (left) | • Activate menu (quit device state display)<br>• Scroll through menus/submenus<br>• Set values - left-hand segment display (D1) | Button T1 can be held down for any length of time, as the display merely scrolls through the available menu items at the respective level. No settings are changed. |
| T2 (right) | • Select the highlighted menu<br>• Set values - right-hand segment display (D2) | Button T2 must **NOT** be held down for any length of time, as the display would then immediately move up in the menu structure from one level to the next and alter the parameter ultimately reached. So be sure to release button T2 every time the display changes. |
| T1 and T2 simultane-ously | • Menu level up<br>• Apply selection<br>• Acknowledgement | After simultaneously pressing T1 and T2 the applied value flashes for five seconds. During this time the save operation can be aborted by pressing any button without the setting being applied. Otherwise the new value is saved after five seconds. |
| General | | • The button press time until an action is executed is around 1 second.<br>• If no user action occurs for 60 seconds, the display switches back to the device status. |

*Table 4.8 Functions of buttons T1 and T2*

### 4.2.2 Display

The following table defines various readouts and items of status information shown on the display.

| Display | Meaning |
|---|---|
|  | Menu entries<br>("PA" is given as an example here; for other possible entries see sections 4.2.4 and 4.2.5 ) |
|  | [flashing decimal points]<br>Selected function in action |
|  | [two lines]<br>Entry/function not available |
|  | [OK]<br>Action completed successfully, no errors |
|  | [Error]<br>• Action via operator control unit **not** completed successfully, "Er" flashes alternately with error number (see section 4.2.3 )<br>• Device error display, "Er" flashes alternately with error number and error location (see "ServoOne Application Manual") |

*Table 4.9 Meaning of display*

NOTE: If no input is made via the keypad for 60 seconds, the display switches back to the device state.

### 4.2.3 Parameters menu (PA)

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

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

*Table 4.10 Parameters menu*

#### Error number

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 4.11 Error numbers*

### 4.2.4 Ethernet IP-Adress-Menü (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 | Para-meter | Value range | Meaning | Explanation |
|---|---|---|---|---|---|
| IP | Iu | b0 | 00..FF | IP address udate Byte 0 | Setting of byte 0 of the IP address in hexadecimal format (e.g. "05" for 192.168.39.**5**) |
| | | b1 | 00..FF | IP address udate Byte 1 | Setting of byte 1 of the IP address in hexadecimal format (e.g. "27" for 192.168.**39**.5) |
| | | b2 | 00..FF | IP address udate Byte 2 | Setting of byte 2 of the IP address in hexadecimal format (e.g. "A8" for 192.**168**.39.5) |
| | | b3 | 00..FF | IP address udate Byte 3 | Setting of byte 3 of the IP address in hexadecimal format (e.g. "C0" for **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 udate Byte 0 | Setting of byte 0 of the subnet mask in hexadecimal format (e.g. "00" for 255.255.255.**0**) |
| | | b1 | 00..FF | Subnetmask udate Byte 1 | Setting of byte 1 of the subnet mask in hexadecimal format (e.g. "FF" for 255.255.**255**.0) |
| | | b2 | 00..FF | Subnetmask udate Byte 2 | Setting of byte 2 of the subnet mask in hexadecimal format (e.g. "FF" for 255.**255**.255.0) |
| | | b3 | 00..FF | Subnetmask udate Byte 3 | Setting of byte 3 of the subnet mask in hexadecimal format (e.g. "FF" for **255**.255.255.0) |
| | Sr | - | - | Subnetmask reset to factory setting | Reset subnet mask to factory default setting (255.255.255.0) |
| | Po | - | 0..3 *or* - - | Transmit power | Setting of fibre-optic power output (only with SERCOS II option), otherwise display "- -" |

*Table 4.12 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.

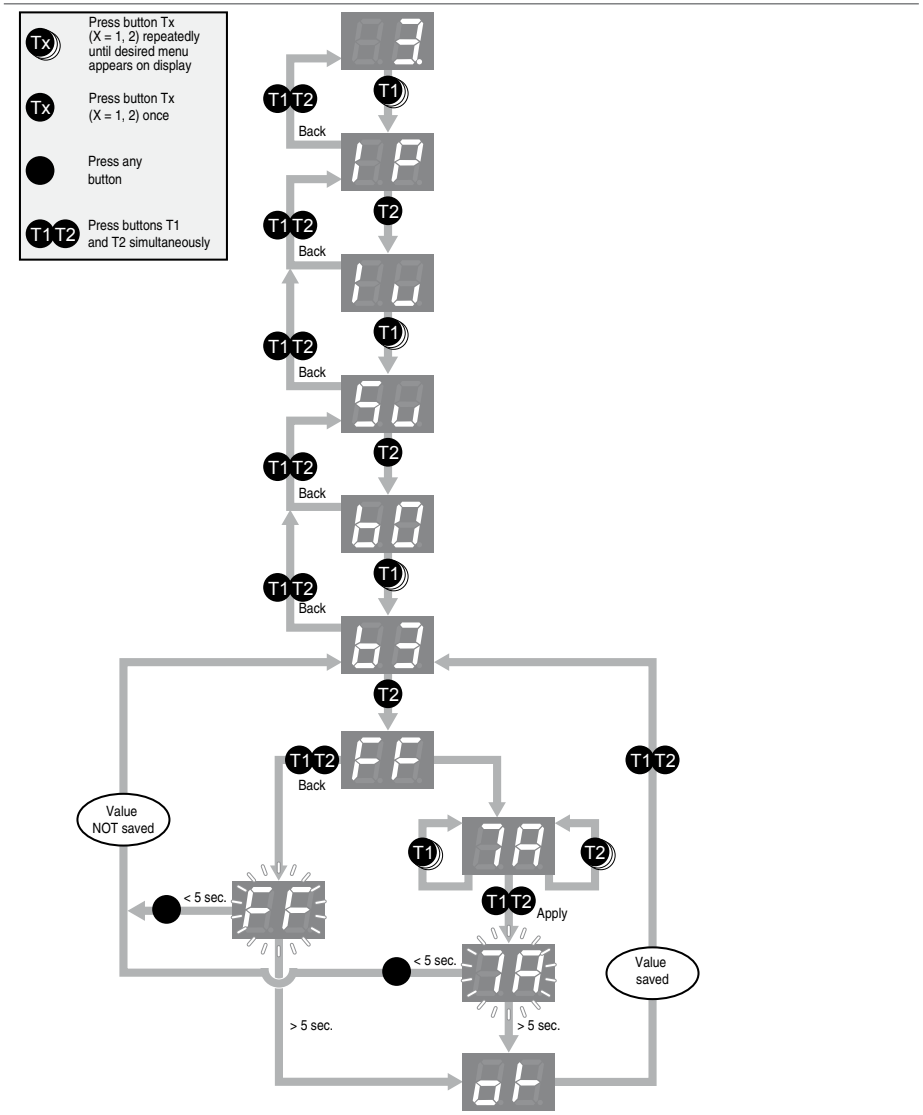



*Figure 4.2 Example configuration of subnet mask*

## 4.2.5 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 | Para-meter | 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 4.13 Field bus address menu*

### Example configuration of field bus address

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

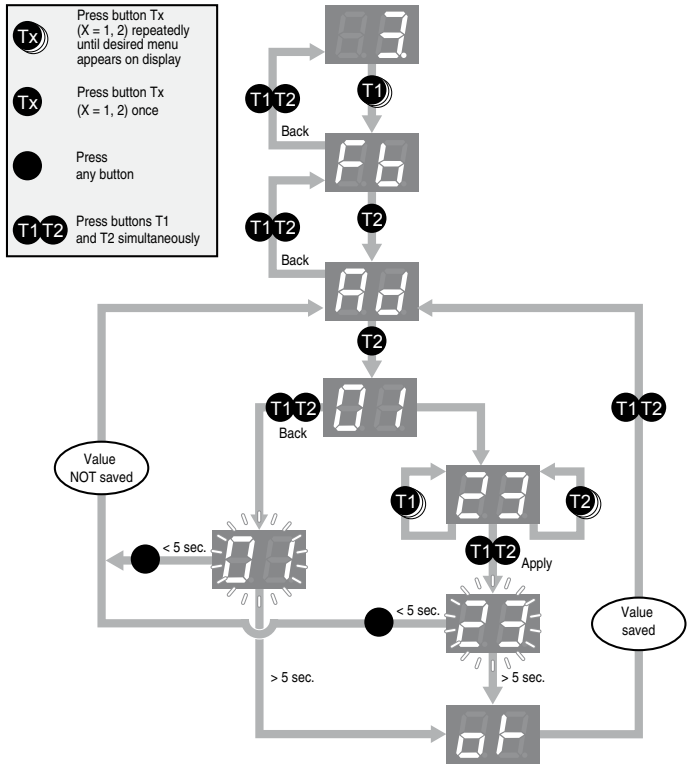



*Figure 4.3 Example configuration of field bus address*

# 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 specificerror 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):<br>Example: 05 = Overcurrent |
| ↓ Display changes after approx. 1 s | |
|  | Error location (decimal):<br>Example: 01 = Hardware monitoring |
| ↑ After approx. 1 s the display jumps to ER | |

*Table 5.2 Display of 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".

## 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:

Telefon: +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)

## 6.1 Danger analysis and risk assessment

Users of the safety functions ( STO) must comply with the latest applicable version of the Machinery Directive 2006/42/EEC.

The manufacturer or its authorized representative is obliged to conduct a risk analysis in accordance with the EU Machinery Directive 2006/42/EG) prior to marketing a machine. An analysis of hazards posed by the machine must be conducted and appropriate measures instigated to reduce/eliminate such hazards. With the danger analysis all prerequisites for establishing the required safety functions are fulfilled.

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 954-1 category 4, EN ISO 13849-1, EN 62061, EN 61800-5-2 and EN 61508 is ensured.
- The operator of the safety-related system is trained in accordance with his/her state of knowledge, appropriate to the complexity and safety integrity level of the safety-related system. his training includes the study of essential features of the production process and knowledge of the relationship between the safety-related system and the equipment under control (EUC).

## 6.2 Definition of terms

### STO = Safe Torque OFF

With the safety function STO the power supply to the drive is safely interrupted (no electrical isolation). The drive must not be able to generate a torque and so perform any hazardous movement. The standstill position is not monitored.

The "STO" function conforms to stop category 0 according to EN 60204-1.

### Emergency stop

In accordance with the national and European preface to EN 60204-1 electrical equipment may also be used for emergency stop devices provided they comply with relevant standards, such as EN 954-1 and/or IEC 61508. "STO" can thus be used for emergency stop functions.

NOTE: The term "emergency stop device" has been replaced by the new term "action in case of emergency". The term "emergency stop" has been replaced by "shutdown in case of emergency (emergency stop)", see paragraph 9.2.5.4.2 in EN 60204-1.

### EN 954-1:1996 / EN ISO 13849-1:2008

Safety of machines, safety related parts of controls.

The EN ISO 13849 standard emerged from EN 954-1 supplemented by the aspects of quality management and reliability.

NOTE: EN 954-1:1996 will be replaced in the long term by EN ISO 13849-1:1999.

### IEC 62061:2006

Safety sector standard for machinery, originating from IEC 61508

### IEC 61508:1998-2000

International basic safety standard specifying the status of safety technology in all its aspects.

## EN 61800-5-1: 2003

Electrical drives with variable speed. Part 5-1: Requirements concerning electrical, thermal and function safety.

## EUC (Equipment Under Control)

**EUC system:**
A system that responds to the input signals from the process and/or a user and generates output signals which enable the EUC to work as desired.

**EUC equipment:**
Equipment, machine, apparatus or plant used for the manufacture, production and processing, transportation, medical or other activities.

**EUC risk:**
Risk resulting from the EUC or its interaction with the EUC operating equipment.

## PFH (Probability of Failure per Hour)

Probability of Failure per Hour, in respect of a dangerous random hardware failure.

## Safety function

Function performed by an E/E/PE (electrical/electronic/programmable electronic) safety-related system, a safety-related system of other technology or external equipment for risk minimization, with the goal of attaining and maintaining a safe state for the EUC, taking into account a particular undesired event.

## Validation

Affirmation that the special requirements for a certain purpose of use are fulfilled by investigation and the submission of objective proof.

Validation describes the activity to prove that the safety-related system under investigation meets the specified safety requirements of the safety-related system in every respect, before or after installation.

## Positive opening operation of a contact element

Symbol for positive opening operation according to EN 60947-5-1 annex K 

In a positive opening operation of a contact element, the contact separation is achieved as a direct result of a certain movement of the actuating element caused by non-elastic links (no springs).

## Safety circuit

A safety circuit is designed with two channels and has been approved by accredited testing bodies on the basis of the standards. There is a large number of manufacturers offering a vast variety of safety circuits for various applications.

### 6.2.1 Function description

The ServoOne junior servocontrollers support the "STO" (Safe Torque Off) safety function in accordance with the requirements of EN 61800-5-2, EN 954-1 "Category 4", EN ISO 13849-1 "PL e" and EN 61508 / EN 62061 "SIL 3" (PFH rating to be provided subsequently).

The "STO" safety function to EN 61800-5-2 describes a safety measure in the form of an interlock and control function. "Category 4" signifies that the safety function will remain in place in the event of a single fault.

The safety-related parts must be designed in such a way that:

- a single fault in any of the said parts does not result in loss of the safety function and
- the single fault is detected on or before the next request to the safety function. If this is not possible, a series of faults does not then lead to loss of the safety function.

For the "STO" function the servo controllers are equipped with additional logic circuits and a feedback contact. The logic cuts the power supply to the pulse amplifiers to activate the power stage. In combination with the controller enable "ENPO" the system uses two channels to prevent the motor creating a torque.

This variant offers the following advantages over the solution with a motor contactor:

- No need for the external motor contactor
- So less wiring
- Space-saving
- Better EMC performance due to the all-over shielding of the motor cable
- Shorter reaction time

### 6.2.2 Fundamentals

Always draw up a validation plan. The plan specifies which tests and analyses were used by you to determine compliance of the solution with the requirements of the application.

DANGER FROM ELECTRICAL TENSION!

- BIf the servocontroller is in the "STO" state all motor and mains cables, braking resistors and DC link voltage cables conduct dangerous voltages against protective conductors.
- With the "STO" function no "shutdown of voltage in case of emergency" is possible without additional measures. There is no electrical isolation between the motor and servocontroller! This means there is a risk of electric shock or other electrical hazard.

DANGER FROM AXIS MOVEMENT ON THE MOTOR!

- If an external effect of forces can be expected in "STO" safety function, such as with a suspended load, this motion must be reliably prevented by additional measures, such as by two brakes, safety bolts or a clamping device with brake.
- Short-circuits in two remote branches of the power section may activate a short-time axis movement depending on the number of poles of the motor.

  Example – synchronous motor: With a 6-pole synchronous motor the movement may be a maximum of 30°. For a directly driven ball screw, e.g. 20 mm per revolution, this corresponds to a one-time maximum linear movement of 1.67 mm.

  Example – asynchronous motor: The short-circuits in two offset branches of the power section have almost no effect, as the exciting field collapses when the inverter is disabled and has fully decayed after approximately 1 second.

NOTE: The safety circuitry connected to the ServoOne junior should be designed in such a way that in case of a loss of electrical supply the safe state of the machine can be reached or maintained.

## 6.2.3 Overview of "STO" connections

The ServoOne offers a separate input for the "STO" request, a facility to deactivate the restart inhibit and a separate relay contact for feedback.

| Des. | Terminal | Specification | | Isolation |
|---|---|---|---|---|
| **Digital inputs** | | | | |
| ENPO (STO) | X4/10 | • Disable restart inhibit (STO) and enable power stage = High-level<br>• OSSD-capable<br>• Reaction time approx. 10ms<br>• Switching level Low/High: ≤ 4,8 V / ≥ 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN}$ at 24 V = typ. 3 mA | | Yes |
| **STO „Safe Torque Off“** | | | | |
| ISDSH (STO) | X4/22 | • Request input STO = low level<br>• OSSD-capable<br>• Frequency range < 500 Hz<br>• Switching level Low/High: < 4,8 V / > 18 V<br>• $U_{IN\ max}$ = 24 V +20 %<br>• $I_{IN}$ at 24 V = typ. 3 mA | | Yes |
| RSH<br>RSH | X4/11<br>X4/12 | Diagnostics STO, both tripping channels active, one NO contact with automatically resetting circuit-breaker (polyswitch)<br>• 25 V / 200 mA AC, cos φ = 1 (AC1)<br>• 30 V / 200 mA DC, cos φ = 1 (DC1) | X4/12<br>X4/11 | 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 6.3 Terminal assignment X4*

## 6.2.4 Wiring and commissioning

For the "STO" function the servocontrollers are equipped with additional logic circuits and a feedback contact. The logic cuts the power supply to the pulse amplifiers to activate the power stage. In combination with the controller enable "ENPO" the system uses two channels to prevent the motor creating a torque.

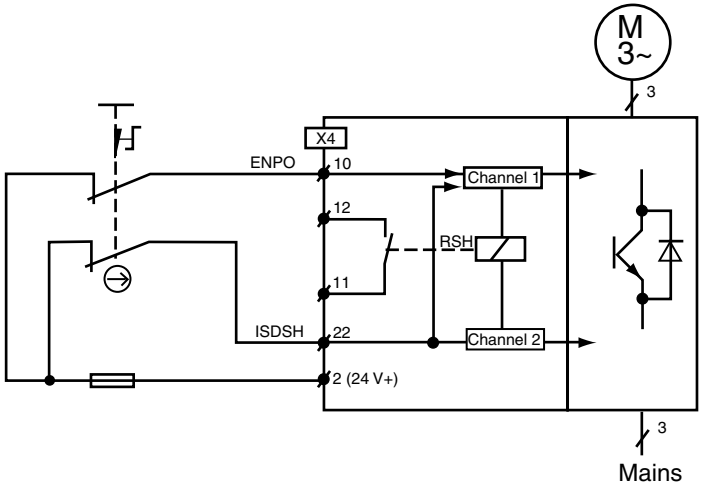



*Figure 6.4 "STO" selection of function via switch with two NC contacts (positively operated)*

| ENPO | ISDSH | STO | Restart inhibit | Controller state | RSH[1)] |
|---|---|---|---|---|---|
| L | L | ON | ON | Power stage disabled via two channels | High |
| H [3)] | H [3)] | OFF | OFF | Power stage ready | Low |
| (L) ⇨ H [2)] | (L) ⇨ H [2)] | OFF | OFF | Power stage ready | Low |
| H | (H) ⇨ L | ON | ON | Power stage disabled via two channels | High |
| (H) ⇨ L | H | OFF | OFF | Power stage locked via one channel | Low |
| (L) ⇨ H | H | OFF | OFF | Power stage ready | Low |

*( ) Previous status*

*1) 3 x $10^6$ switching cycles at 200 mA (resting: NO contact)*

*2) In order to deactivate the restart inhibit the control signals must be simultaneously (ENPO max. 5ms before ISDSH) set to High (H) or ISDSH must be reliably set to High (H) before ENPO.*

*3) This only applies when STO has been disabled by the process described in "2)".*

*Table 6.4 Switching response of the safety function*

NOTE: The plausibility between input signals (ENPO, ISDSH) and feedback (RSH) must always be monitored.

## 6.2.5 Testing the STO function

The applied control signals "ISDSH" and "ENPO" must always be checked by the operator or a superimposed control for plausibility to the feedback (RSH).

The occurrence of an implausible status is a sign of a system fault (installation or servo-controller). In this case the drive must be switched off and the fault rectified.

ATTENTION! The "STO" (Safe Torque Off) function must generally be checked for correct functionality after:

- initial commissioning
- any modification of the system wiring
- replacing one or several appliances in the system

NOTES:

- There is no protection against unexpected restarting after re-establishing the electrical power supply in the illustrated example circuit, unless an external circuit is used (figure 6.4) If ENPO and ISDSH are High when reconnecting the power supply (see table 6.4), the axle may start up if autostart is programmed. The connected safety circuit on the machine must ensure that the ServoOne junior (the SRP/CS) can attain and maintain the safe state of the machine.
- If the switch and drive controller are installed in separate locations, it must be ensured that the cables from NC contact 1 to ENPO (STO) and from NC contact 2 to ISDSH (STO) are wired separately, or that possible faults are prevented by using a protective tube for example.
- In order to cancel the STO safety function and deactivate the restart inhibit, the ISDSH signal must be set to High before the ENPO signal, or simultaneously with it.

## 6.3 Safety characteristics

**PFH:** *Rating not yet available at time of publication.*

**MTTF:** *Rating not yet available at time of publication.*

**Min. service life:** *Rating not yet available at time of publication.*

**Max. service life:** 20 years

# 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 3 x 230 V

| Device | Switching frequency of power stage | Ambient temperature | Rated current$_N$ [$A_{eff}$] | 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 | | - | - |
| | 16 | 40 | 2.0 | 4.0 | | - | - |
| SO22.006 | 4 | 45 | 5.9 | 11.8 | 10 | 17.7 | 0.08 |
| | 8 | 40 | 5.9 | 11.8 | | - | - |
| | 16 | 40 | 5.9 | 11.8 | | - | - |
| SO22.008 | 4 | 45 | 8.0 | 16.0 | 10 | 24.0 | 0.08 |
| | 8 | 40 | 8.0 | 16.0 | | - | - |
| | 16 | 40 | 5.4 | 10.8 | | - | - |

*Data applies to motor cable length ≤10m (maximum permissible motor cable length 30m).*

*Table A.1 Rated current and peak current, BG2 to BG4 (3 x 230V)*

### ServoOne junior for 3 x 400/460/480 V

| Device | Switching frequency of power stage | Ambient temperature | Rated current$_N$ [$A_{eff}$] | | | Peak current [1] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 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 | | - | - |
| | 16 | 40 | 0.7 | 0.7 | - | 1.4 | | - | - |
| 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 | | - | - |
| | 16 | 40 | 2.9 | 2.2 | - | 5.8 | | - | - |
| 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 | | - | - |
| | 16 | 40 | 4.0 | 2.4 | 1.9 | 8.0 | | - | - |

*1) Data referred to 3 x 400 V mains voltage*
*Data applies to motor cable length ≤10m (maximum permissible motor cable length 30m).*

*Table A.2 Rated current and peak current, BG2 to BG4 (3 x 400/460/480 V)*

# A.2 ServoOne junior technical data

## SO22.003 to SO24.007

| Technical data \ Designation | SO22.003 | SO22.006 | SO22.008 | SO24.002 | SO24.004 | SO24.007 |
|---|---|---|---|---|---|---|
| **Output, motor end**[1] | | | | | | |
| Voltage | 3 x $U_{DC}/\sqrt{2}$ | | | | | |
| Continuous current, effective ($I_N$) * | 3 A | 5.9 A | 8 A | 2 A | 3.5 A | 6.5 A |
| Peak current ($A_{effektiv}$) | 9 A | 17.7 A | 24 A | 6 A | 10.5 A | 19.5 A |
| Rotating field frequency | 0 ... 400 Hz | | | | | |
| Switching frequency of power stage | 4, 8, 12, 16 kHz | | | | | |
| **Input, mains side** | | | | | | |
| Mains voltage | 3 x 230 V AC -20 % +15 % | | | 3 x 400 V AC -25 % +32 % | | |
| Device connected load | 0.75 kVA | 1.5 kVA | 3 kVA | 0.75 kVA | 1.5 kVA | 3 kVA |
| Current [2] (with line reactor) | *Values not yet available at time of going to press.* | | | | | |
| Asymmetry of mains voltage | ±3 % max. | | | | | |
| Frequency | 50/60 Hz ±10 % | | | | | |
| Power loss at $I_N$ and8 kHz and 230 V/400 V | 75 W | 150 W | 200 W | 42 W | 80 W | 150 W |

*1) Data referred to output voltage 230 V/400 V and switching frequency 8 kHz*
*2) Data related to 230 V/400 V mains voltage*
*3) Connection of ext. braking resistor not permitted to devices with int. braking resistor (design. SO2x.xxx.xxxx.1xxx) not permitted!*
*4) Braking resistor always integrated. Connection of an external resistor is permissible.*
*5) Option (SO2x.xxx.xxxx.1xxx)*
** For rated current refer to table A.1 or table A.2!*

*Table A.3 Technical data – SO22.003 to SO24.007*

| Technical data \ Designation | SO22.003 | SO22.006 | SO22.008 | SO24.002 | SO24.004 | SO24.007 |
|---|---|---|---|---|---|---|
| **Braking chopper power electronics** | | | | | | |
| Peak braking power with int. braking resistor. | 400 W at 550 Ω (PTC) [4] | 1.5 kW at 100 Ω [5] | 1.7 kW at 90 Ω [5] | 200 W at 7500 Ω (PTC) [4] | 1 kW at 420 Ω [5] | 4.7 kW at 90 Ω [5] |
| Minimum ohmic resistance of an externally installed braking resistor [4] | 72 Ω | 72 Ω [3] | 72 Ω [3] | 230 Ω | 180 Ω [3] | 72 Ω [3] |

*1) Data referred to output voltage 230 V/400 V and switching frequency 8 kHz*
*2) Data related to 230 V/400 V mains voltage*
*3) Connection of ext. braking resistor not permitted to devices with int. braking resistor (design. SO2x.xxx.xxxx.1xxx) not permitted!*
*4) Braking resistor always integrated. Connection of an external resistor is permissible.*
*5) Option (SO2x.xxx.xxxx.1xxx)*
** For rated current refer to table A.1 or table A.2!*

*Table A.3 Technical data – SO22.003 to SO24.007*

NOTE: For more information on the braking chopper switch-on threshold also refer to section 3.13 .

## A.3 Ambient conditions

| Ambient conditions | SO2000 |
|---|---|
| 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.<br>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.4 ServoOne junior ambient conditions*

| Climatic conditions | | SO2000 |
|---|---|---|
| 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. +55 °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 +40 °C |
| | Relative air humidity | 5 to 85 % without 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.5 ServoOne junior climatic conditions*

| Mechanical conditions | | SO2000 | |
|---|---|---|---|
| Vibration limit in transit | as per EN 61800-2, IEC 60721-3-2 class 2M1[1] | | |
| | 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 limits of the system[1] | as per EN 61800-2, IEC 60721-3-3 class 3M1[3] | | |
| | 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.6 ServoOne junior mechanical conditions*

ATTENTION! The drive controllers must not be installed in areas where they would be permanently exposed to vibrations.

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

NOTE: 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.

## A.4 UL approbation

### Measures to comply with (UL 508C)

1. The devices may only be operated in systems of overvoltage category III.
2. The devices are usable in networks with a maximum current capacity of 5 kA, with phase-symmetrical current and maximum voltage of 480 V, with system-side protection as per table A.7.
3. The devices are rated for installation in an environment of pollution severity 2.
4. The protective device for branch lines must be executed in accordance with the manufacturers' instructions, the requirements of the NEC (National Electrical Code) and other locally applicable standards.
5. Only UL-approved 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.
6. Maximum temperature of the ambient air (surrounding temperature):



| Size | Device | Tightening torque, mains andmotor terminals X3 X1 | Tightening torque control terminals X5, X2 X1 | Mains fusing / Class |
|---|---|---|---|---|
| BG2 | SO22.003 | 0.56 - 0.79 Nm | 0.56 - 0.79 Nm | 1) |
| | SO24.002 | 0.56 - 0.79 Nm | 0.56 - 0.79 Nm | 1) |
| BG3 | SO22.006 | 0.56 - 0.79 Nm | 0.56 - 0.79 Nm | 1) |
| | SO24.004 | 0.56 - 0.79 Nm | 0.56 - 0.79 Nm | 1) |
| BG4 | SO22.008 | 1.7 Nm | 0.56 - 0.79 Nm | 1) |
| | SO24.007 | 1.7 Nm | 0.56 - 0.79 Nm | 1) |

*1) Data not available at time of publication.*

*Table A.7 Tightening torques and mains fusing, BG2 to BG4*

# Index

## Symbole



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ID no.: 1300.20B.0-00

Date: 03/2010

Applicable as from firmware version: V0.25

The German version is the original of this Operation Manual.