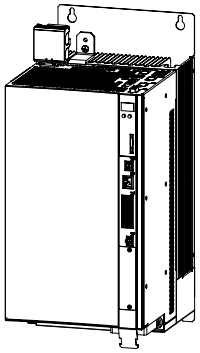
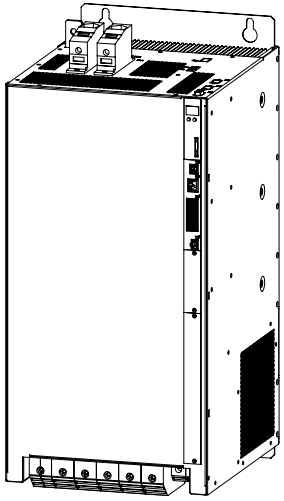
LTi DRiVES

ServoOne

Operation Manual

Multi-Axis System

Supply unit with
sinusoidal power system feedback

SO84.040.S SO84.076.S BG5 (size 5)	SO84.115.S SO84.170.S BG6a (size 6a)
	

ServoOne High-Performance Drives

The modular design of ServoOne ensures optimal 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 is a master of both.

ServoOne Operation Manual Multi-Axis System Supply Unit

ID no.: 1101.21B.0-00

Date: 04/2010

Applicable as from firmware version: V220.13-01

The German version is the original of this Operation Manual.

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.
Please visit http://drives.lt-i.com for details of the latest versions.

How to use this document

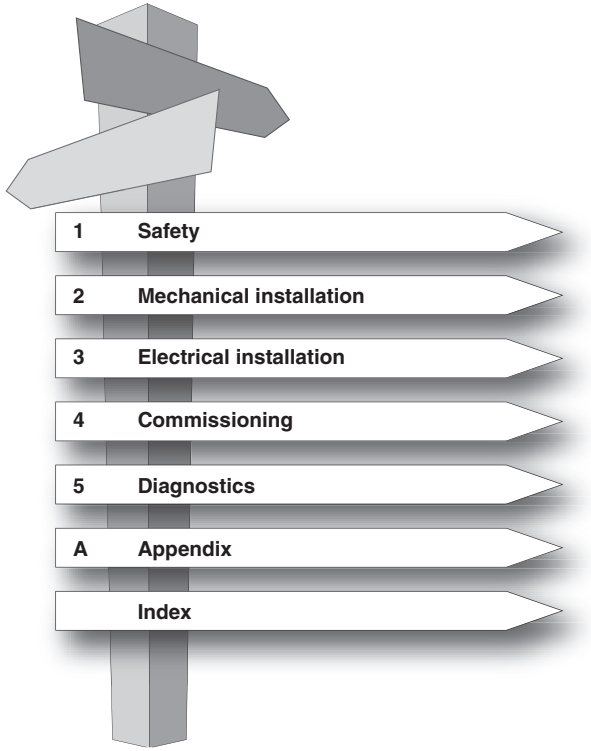
Dear user,

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 device 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 supply unit very quickly and easily.	Quick-start guide
2.	Simply follow the step-by-step tables in the various sections.	And away you go!

Documentation system for the ServoOne multi-axis system

Document	Contents	Description
ServoOne Supply Unit Operation Manual	Mechanical installation, Electrical installation, Safety, Specification	Hardware and software
ServoOne DC Axis Controller Operation Manual	Mechanical installation, Electrical installation, Safety, Specification	Hardware and software
ServoOne Application Manual	Description of base software	Software
CANopen/EtherCAT User Manual	Description and parameter setting of the ServoOne on the CANopen/EtherCAT field bus system	Hardware and software of the field bus option
SERCOS User Manual	Description and parameter setting of the ServoOne on the SERCOS II field bus system	Hardware and software of the field bus option
PROFIBUS-DPV User Manual	Description and parameter setting of the ServoOne on the Profibus-DPV field bus system	Hardware and software of the field bus option



Order code

The order designation indicates the design variant of the supply unit supplied to you. For details on the order code refer to the ServoOne Order Catalogue.

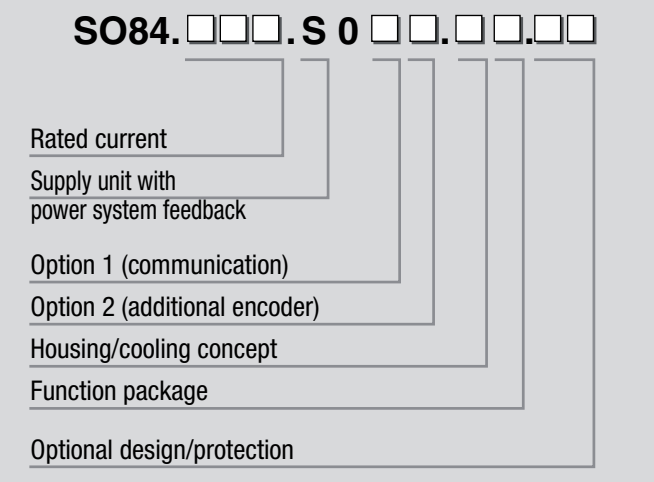


Figure 0.1 Order code – ServoOne multi-axis system supply unit

Rating plate

On rating plates of the ServoOne junior supply unit you will find the serial number, from which you can identify the date of manufacture based on the following key. You will find details of the rating plate's location on the ServoOne starting on page 27.

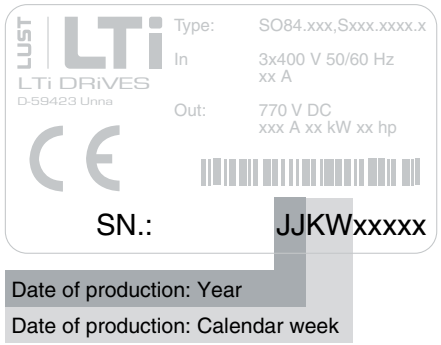


Figure 0.2 Rating plate, hardware – ServoOne multi-axis system supply unit

Supply package

The supply package includes:

- ServoOne supply unit
- Ready made-up cables
- Product DVD

Required mains connection set

The mains connection set is required to ensure compliance with the intended use of the ServoOne supply unit. The supply package includes:

- Mains filter
- Input reactor with membrane capacitor
- Step-up reactor
- Shields and clamps

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.

Warning symbols (see also section 1.1)	
	ATTENTION! Misoperation may result in damage to the drive or smalfunctions.
	DANGER FROM ELECTRICAL TENSION! Improper conduct may endanger human life.
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 Measures 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.

1.1.1 Read the Operation Manual first!

	Read the Operation Manual and the reference documents first! • Follow the safety instructions! • Refer to the user information!
	Electric drives are dangerous: • Electrical voltages 230 V AC / 320 V DC to 480 V AC / 770 V DC **Dangerously high voltages ≥ 50 V may still be present 10 minutes after the power is cut (capacitor charge). The discharge time depends on the number of controllers connected to the multi-axis system. So check that the power has been cut!** • Rotating parts • Hot surfaces
	Protection against magnetic and/or electromagnetic fields during installation and operation. • Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas: – Areas where drive systems are installed, repaired and operated. – Areas where motors are installed, repaired and operated. Motors with permanent magnets pose a particular hazard. NOTE: If it is necessary to access such areas, suitability to do so must be determined beforehand by a doctor

Table 1.1 Safety precautions

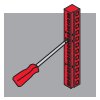
	Your qualification: • In order to prevent personal injury and damage to property, only personnel with electrical engineering qualifications may work on the device. • The said qualified personnel must be familiar with the contents of the Operation Manual (cf. IEC364, DIN VDE0100). • Knowledge of the national accident prevention regulations (e.g. BGV A3 in Germany)
	During installation observe the following instructions: • Always comply with the connection conditions and technical specifications. • Comply with the standards for electrical installations, such as regarding B. Cable cross-section, PE conductor and earth connections. • Do not touch electronic components and contacts (electrostatic discharge may destroy components).

Table 1.1 Safety precautions

1.1.2 Warning symbols used

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.

Table 1.2 Explanations of warning symbols

1.2 Intended use

The ServoOne supply unit is intended for use in a ServoOne multi-axis system. The multi-axis system comprises a ServoOne supply unit with the mains connection set and a number of ServoOne DC axis controllers connected to it. In motorized mode, the supply unit draws power from the supply system and makes it available to the connected DC axis controllers via the DC link. In regenerative mode, the supply unit feeds surplus power back into the supply system in sine wave form.

The supply unit additionally performs the function of a reactive power compensator as required. (For details please consult your project engineer.)

The supply unit is a component intended for 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 Directive2006/42/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 supply unit conforms to the Low Voltage Directive 2006/95/EC.

The supply unit conforms to the requirements of the harmonized product standard EN 61800-5-1:2008.

If the drive controller is used for special applications (e.g. 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 supply unit in non-stationary equipment is classed as non-standard ambient conditions, and is permissible only by special agreement.

1.3 Usage contrary to intended use

The supply unit must not be used:

- without the mains connection set (filters, reactors)
- outside a switch cabinet
- in a photovoltaic system
- with a directly connected DC motor
- in island mode

1.4 Responsibility

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

EN 60204-1/DIN VDE 0113 "Safety of machines", in the section on "Electrical equipment 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 system 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 General notes for installation

ATTENTION! During installation, please avoid:
- drill chippings, screws or foreign bodies dropping into the device;
- penetration of damp into the device.

The device is solely intended for installation in a stationary switch cabinet. The switch cabinet must as a minimum provide IP4x protection. The drive controllers must not be installed in areas where they would be permanently exposed to vibrations. For more information refer to Table A.10 in the appendix.

ATTENTION: The device heats up in operation and at the heat sink may reach temperatures of up to 100 °C.
The connected reactors heat up in operation and may reach temperatures of up to 145 °C.
Keep a safe distance from adjacent assemblies.

NOTE: For installation of the supply unit within a ServoOne multi-axis system, be sure also to observe the Operation Manual for the DC axis controllers.

The layout and installation of the supply unit and the DC axis controllers is subject to the following basic rules:

- The backing plate must be well earthed.
- To attain the best result for effective EMC installation use a chromated or galvanized backing plate. If backing plates are varnished, remove the coating from the contact area. The devices themselves have a rear panel made of aluminized/galvanized sheet steel.
- Pollution severity 2 to EN 60664-1. Further information on environmental conditions can be found in Table A.8 in the appendix.
- 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.
- Devices with different housing variants (wall-mounted and liquid-cooled) can be installed next to each other in any combination.
- Devices with liquid-cooled housings have a spacer on the rear in place of the heat sink. Consequently, it is possible to connect to devices with wall-mounted housings using the ready made-up DC link cables without additional measures to compensate for differing unit depth.
- No minimum clearance between the devices is required. Exceptions to this rule are the following wall-mounted devices:
    - DC axis controller in Size BG6a (Figure 2.5 and Table 2.2)
    - Supply units in size BG6a (Figure 2.9 and Table 2.3)
- The maximum distance between the devices is dictated by the supplied ready made-up cables, and is 1.5 mm (for exceptions see above).

ATTENTION! Use only the supplied DC link cable for the electrical connections between the devices. If other cables are used, LTi DRiVES can provide no guarantee of stable and safe operation.

- Axis controllers may only be installed on one side (to the left or right) of larger sized devices. On the other side a device of equal or smaller size must be installed.
- A vertical offset of 18.5 mm must be allowed between the top fixing screws for devices of sizes BG1 to BG5 and devices of size BG6a (see Figure 2.5 and Figure 2.9).

If you need more details on installation please contact the LTi Helpline (see page 55).

2.2 Effective EMC installation

2.2.1 General notes

Supply units are components intended for installation in industrial and commercial plant and machinery. They must only be installed in switch cabinets providing minimum IP4x protection.

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 61800-3:2008. The transition period for the old EN 61800-3:1996 ended on October 1, 2007.

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

The multi-axis system is a special case with regard to EMC installation. The high DC link voltage (up to 4000 V DC) and its routing over long cables between the supply unit and DC axis controllers demands great care when implementing EMC installation.

Timely planning and diligent implementation of the EMC installation measures detailed here will help avoid complex and costly retooling of plant.

2.2.2 Switch cabinet design

The placement of components in the switch cabinet is a key factor in operating plant and machinery without disturbance. Your planning should take account of the following points:

- Assess the assemblies used in terms of their electromagnetic compatibility.
- Split the switch cabinet into zones of different power and interference levels.
- Keep units susceptible to interference at a minimum clearance of 0.2 metres from the following components:
  - Drive controllers
  - Input and output reactors, transformers
  - Mains, motor, DC power supply and braking resistor cables (even if shielded)
  - Relays and contactors (even if interference-suppressed)
- When installing close, use isolating plates mounted directly and conductively on the backing plate as shielding.
- When using a motor contactor or a reactance coil, the respective component should be directly mounted to the drive controller.
- Do not use fluorescent lamps in switch cabinets, as they emit high-frequency interference.
- Provide contactors, relays, solenoid valves, switched inductors and capacitors with suppressors.
- The mains filter must be sealed tight as far as possible, and be mounted on the backing plate across a wide area at the feed-in point. The backing plate must have a low-resistance connection to the central earthing point. No unfiltered cables may be routed on the mains input side of the filter, to prevent interference.

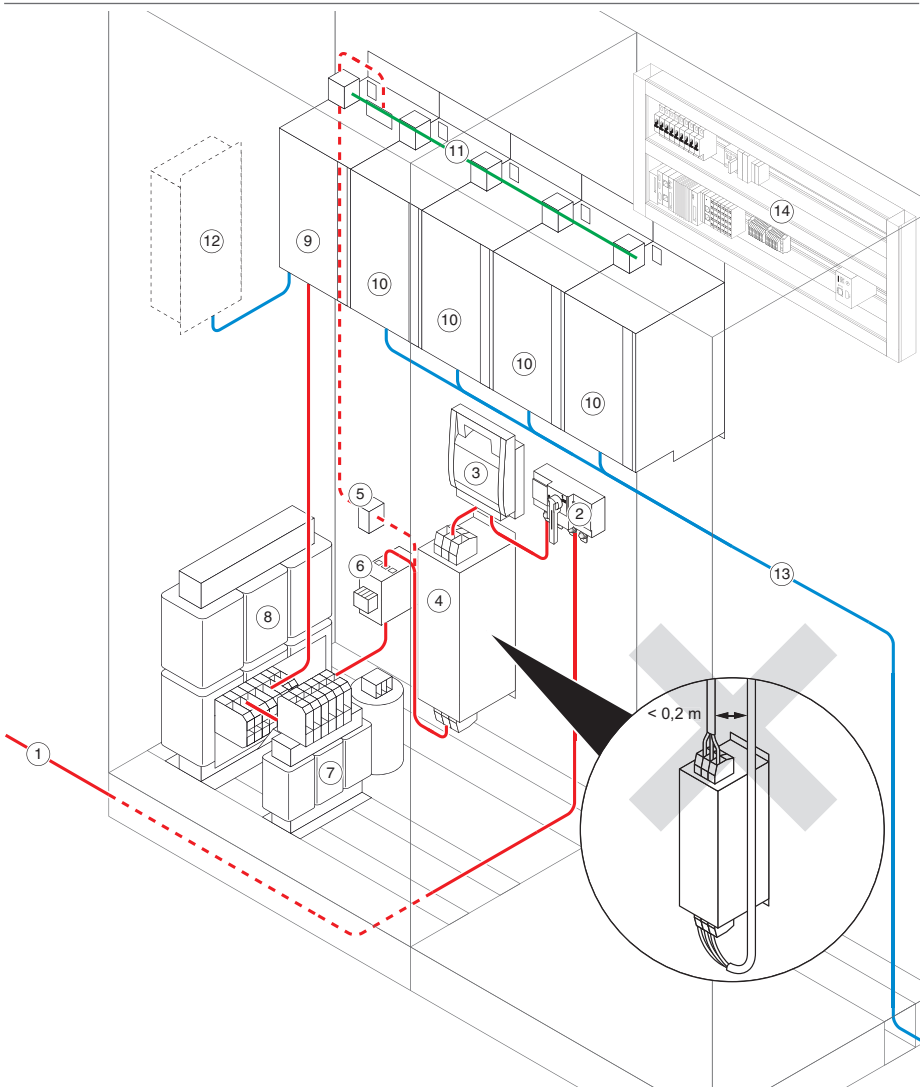


Figure 2.1 Example: Switch cabinet layout

	Designation
1	Mains cable
2	Main switch
3	Fuses
4	Mains filter - unfiltered cables must be routed at a distance of least 0.2 metres from the mains input side of the filter, to prevent interference.
5	Circuit-breaker
6	Mains contactor
7	Input reactor with connected capacitor
8	Step-up reactor
9	ServoOne supply unit
10	ServoOne DC axis controller
11	DC power supply via DC link cable
12	Braking resistor
13	Motor cables
14	Open-loop control - arrange the control section separately from the power section, so as to avoid electromagnetic interference mechanisms.
Control and signal cables and shields have been omitted for the sake of clarity	

Table 2.1 Key

- Use metallically bright backing plates.
- The rear panel of the drive controller must have good contact with the switch cabinet earth. The contact area must be metallically bright, in order to make a good earth connection to the switch cabinet earth. There must be no air gap between the rear panel of the drive controller and the switch cabinet wall.
- The reactor bases must have good contact with the switch cabinet earth. The contact area must be metallically bright, in order to make a good earth connection to the switch cabinet earth.

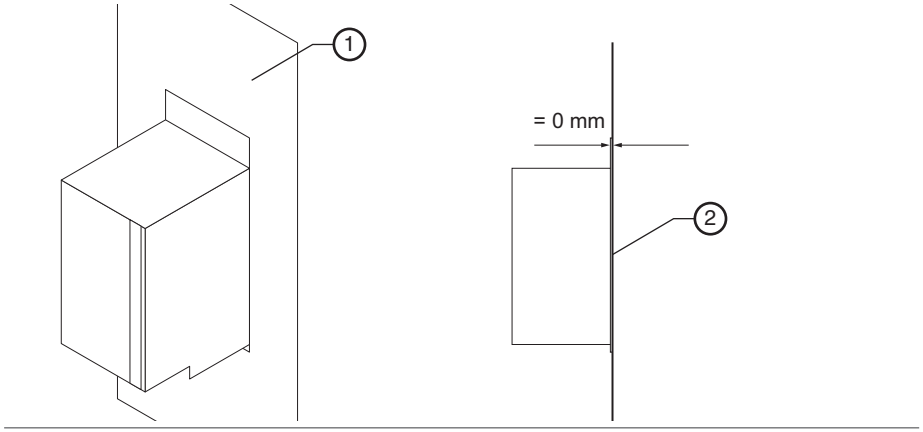


Figure 2.2 Drive controller installation CORRECT

Key

1. Backing plate metallically bright
2. Wide-area contact

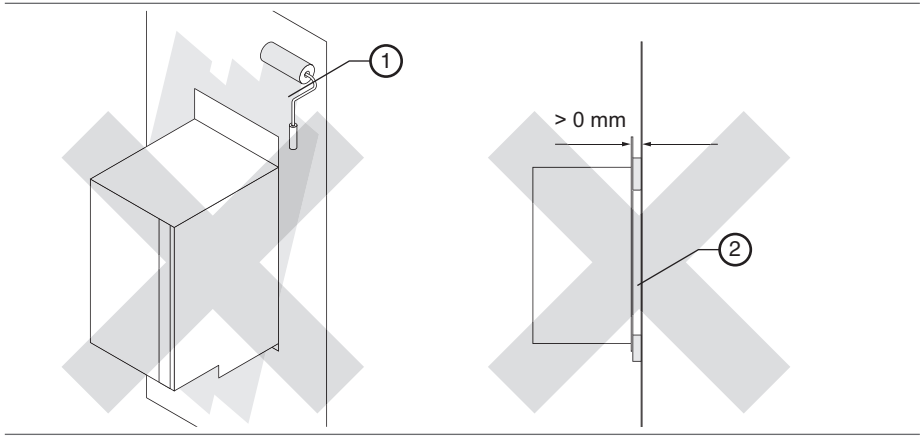


Figure 2.3 Drive controller installation INCORRECT

Key

1. Varnish
2. Air gap

2.3 Supply unit installation Wall-mounted housing

Step	Action	Comment
1.	Arrange the devices starting from the supply unit to the right or left sorted in descending order of power output, in order to exclude thermal influences. Align supply unit **BG5** and all ServoOne DC axis controllers in a line along the top edge of the unit (see Figure 2.4). Align all ServoOne DC axis controllers in a line along the top edge of the unit. Align supply unit **BG6a** offset 18.5 mm down (see Figure 2.5). Be sure to adhere to the mounting clearances set out in Table 2.2.	Before installing the devices and components in the switch cabinet refer to the instructions relating to EMC installation. This is necessary in order to execute the DC power supply using the ready made-up cables.
2.	Mark out the position of the tapped holes on the backing plate. Cut a tap for each fixing screw in the backing plate.	Pay attention to the mounting clearances! Also take into account the bend radius of the connecting cables! Dimensional drawings/hole spacing see Figure 2.6 and Table 2.2.
3.	Mount the supply unit vertically and abutting on the backing plate.	The contact area must be metallically bright. For the DC power supply use the supplied ready made-up cables.
	The next stage is installation of the mains connection set.	

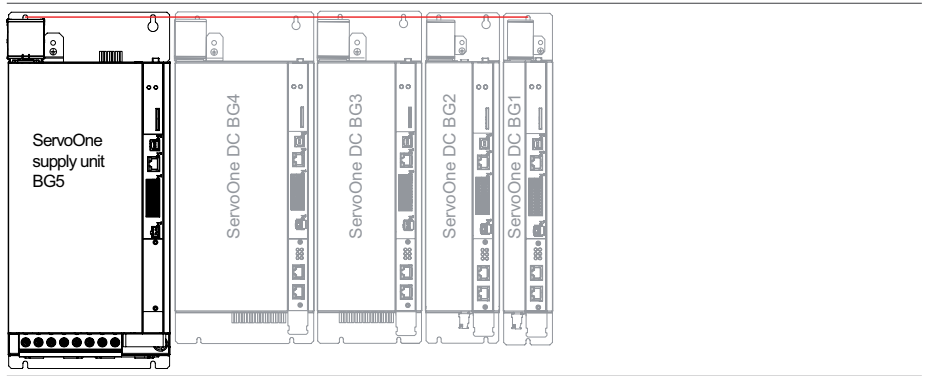


Figure 2.4 Butt-mounting, axis array, wall-mounted, with supply unit BG5

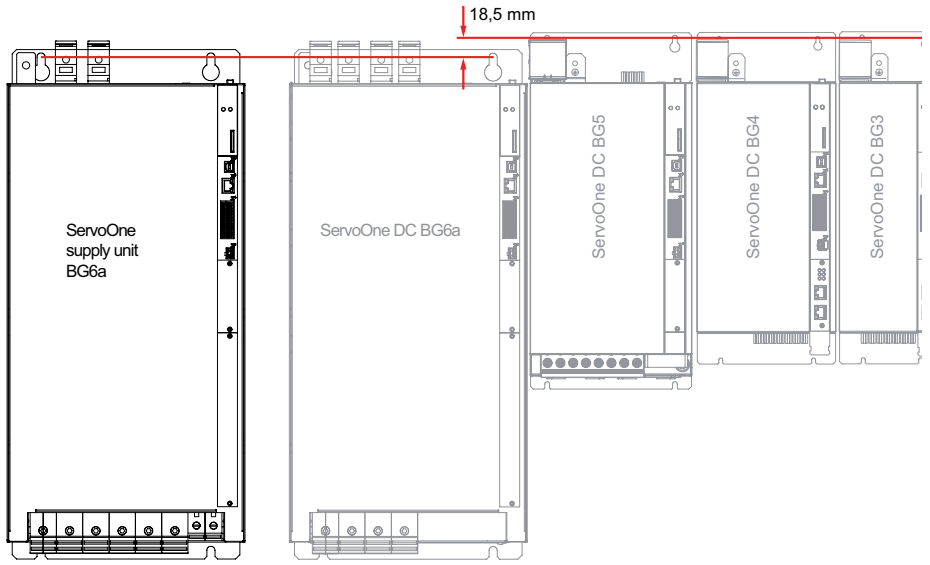


Figure 2.5 Butt-mounting, axis array, wall-mounted, with supply unit BG6a

2.3.1 Dimensions, wall-mounted housing

ServoOne	BG5	BG6a
	SO.84.040.Sxxx.0 SO.84.076.Sxxx.0	SO.84.115.Sxxx.0 SO.84.170.Sxxx.0
Weight [kg]	13	32
W (width)	190	280
H (height) [1]	345	540
T (depth) [1]	240	322
A	150	200
C	406.5	581
C1	6	10
H1	418.5	600
H2	15	20
H3	64	166
D	5.6	9.5
Screws	4 x M5	4 x M8
E	Direct butt-mounted, max. 2 mm	Direct butt-mounted, max. 2 mm / 40 [2]
F [3]	≥ 180	
G [3]	≥ 300	≥ 500

All Dimensions in mm,
1) Without terminals/connectors
2) Mounting pitch BG6a to other BG6a
3) Also take into account the bend radius of the connecting cables

Table 2.2 Dimensions, wall-mounted housing

NOTE: Arrange devices with different drive power in descending order of power output (e.g. viewed from the left BG4-BG3-BG2-BG1). This minimizes the mutual thermal influence. The supply unit must always be arranged on the side of the most powerful axis controller.
When butt-mounting other devices with the multi-axis system, you must make sure that the devices do not affect one another thermally.

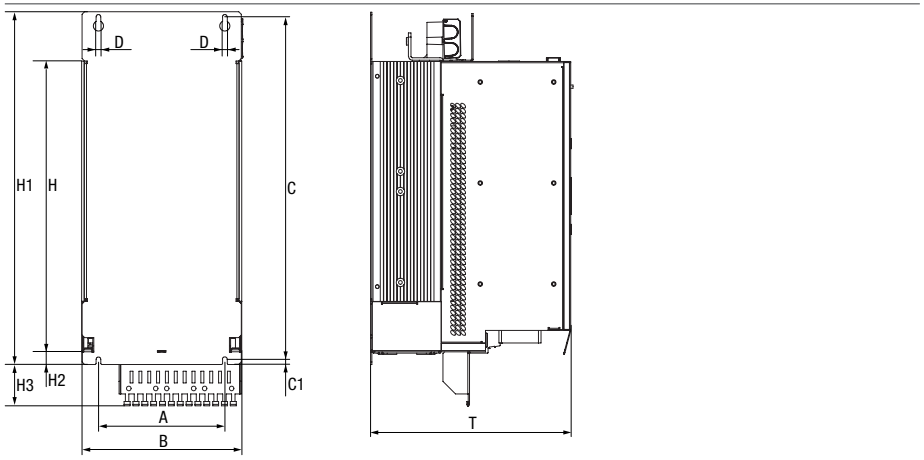


Figure 2.6 Dimensional drawing, wall-mounted housing

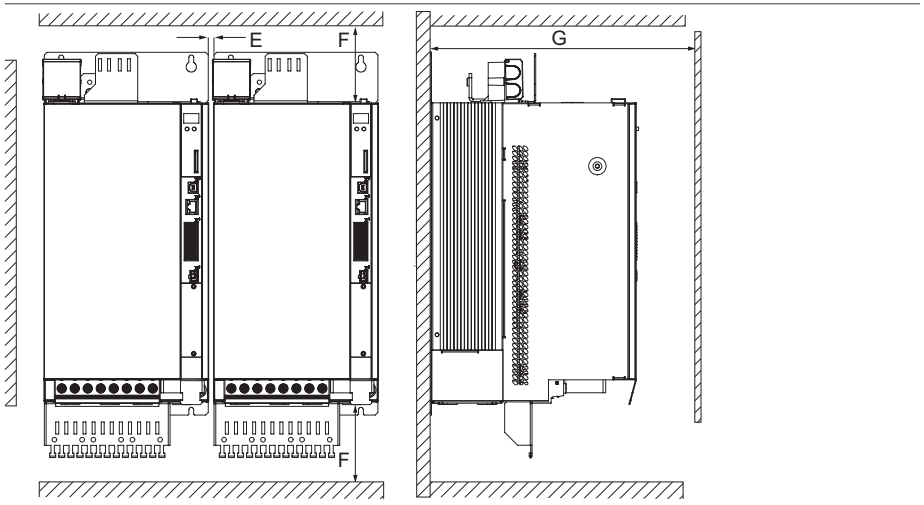


Figure 2.7 Mounting pitch, wall-mounted housing

2.4 Supply unit installation Liquid-cooled housing

Step	Action	Comment
1.	Arrange the devices starting from the supply unit to the right or left sorted in descending order of power output, in order to exclude thermal influences. Align supply unit **BG5** and all ServoOne DC axis controllers in a line along the top edge of the unit (see Figure 2.8). Align all ServoOne DC axis controllers in a line along the top edge of the unit. Align supply unit **BG6a** offset 18.5 mm down (see Figure 2.9).	Before installing the devices and components in the switch cabinet refer to the instructions relating to EMC installation. This is necessary in order to execute the DC power supply using the ready made-up cables.
2.	Mark out the positions of the tapped holes and the pipe socket on the backing plate. Drill holes and cut a thread for each fixing screw in the backing plate.	Pay attention to the mounting clearances! Also take into account the bend radius of the connecting cables! Dimensional drawings/hole spacing see Figure 2.10 and Table 2.3.
3.	Mount the supply unit vertically and abutting on the backing plate.	The contact area must be metallically bright. For the DC power supply use the supplied ready made-up cables.
4.	When fitting the hose connections (not supplied) in the pipe sockets, brace with a 22 mm open-ended wrench in order to prevent damage to the device by torsion.	Ensure a perfect liquid-tight connection (e.g. using a Teflon sealing strip)!
	The next stage is installation of the mains connection set.	

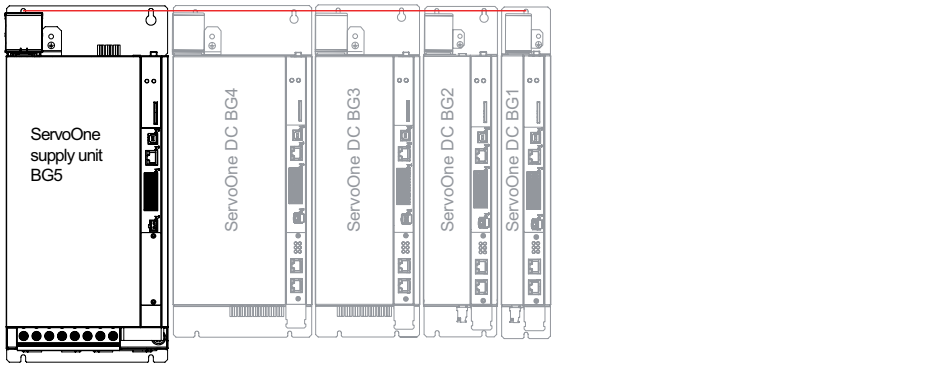


Figure 2.8 Butt-mounting, axis array, liquid-cooled, with supply unit BG5

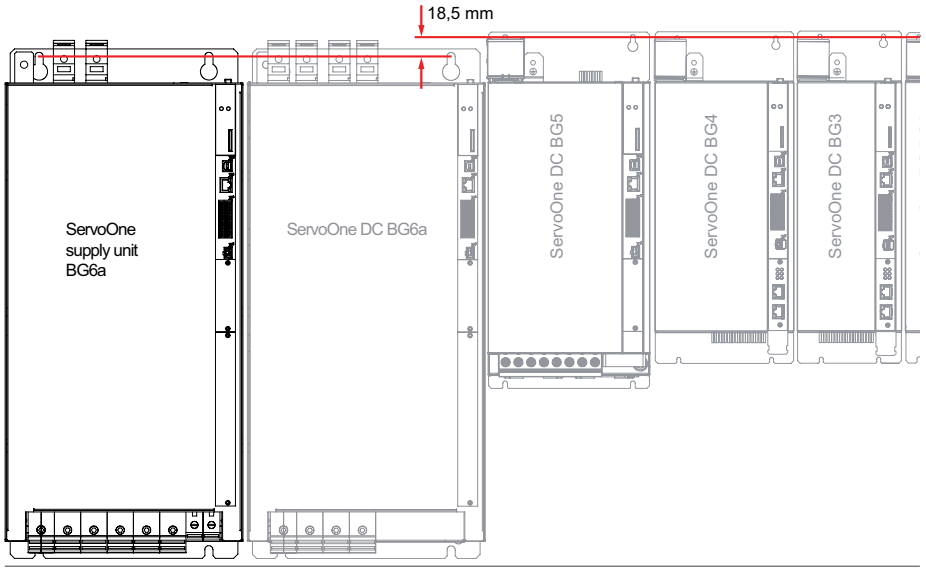


Figure 2.9 Butt-mounting, axis array, liquid-cooled, with supply unit BG6a

2.4.1 Dimensions, liquid-cooled housing

ServoOne	BG5	BG6a
	SO.84.040.Sxxx.8 SO.84.076.Sxxx.8	SO.84.115.Sxxx.8 SO.84.170.Sxxx.8
Weight [kg]	13	32
W (width)	190	280
H (height) [1]	345	540
T (depth) [1]	238.5	285
A	150	200
A1	40	65
A2	70	
C	406.5	581
C1	6	10
H1	418.5	600
H2	15	20
H3	54	56.5
H4	64	166
D1	73.5	
D	6.5	9.5
Screws	4 x M6	4 x M8
S inside thread	3/8 inch	
D1 hole for pipe socket	48	
E [2]	Direct butt-mounted, max. 2 mm	
F [2] [3]	≥ 180	
G [2] [3]	≥ 300	≥ 500

All dimensions in mm
1) Without terminals/connectors
2) see Figure 2.11, p. 20
3) Also take into account the bend radius of the connecting cables

Table 2.3 Dimensions, liquid-cooled housing

NOTE: Arrange devices with different drive power in descending order of power output (e.g. viewed from the left BG4-BG3-BG2-BG1). This minimizes the mutual thermal influence. The supply unit must always be arranged on the side of the most powerful axis controller.
When butt-mounting other devices with the multi-axis system, you must make sure that the devices do not affect one another thermally.

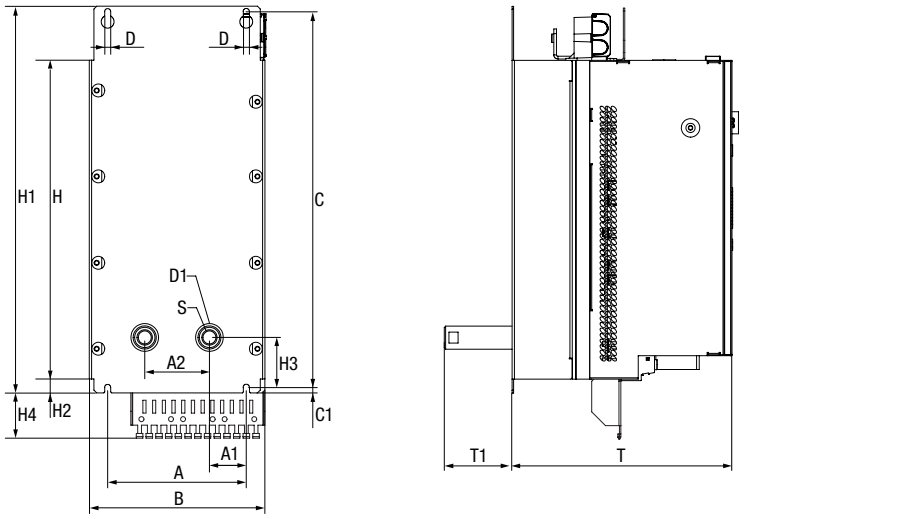


Figure 2.10 Dimensional drawing, liquid-cooled housing

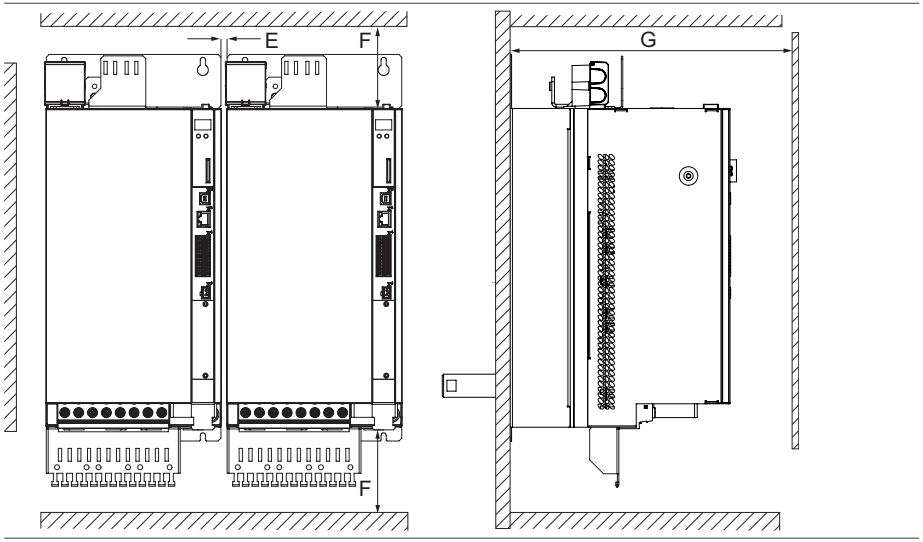


Figure 2.11 Mounting pitch, liquid-cooled housing

2.5 Step-up reactor installation

Step	Action	Comment
1.	Mark out the position of the tapped holes on the mounting rail. Cut a tap for each fixing screw in the backing plate.	Arrange the components and cables at a distance of >100 mm from the step-up reactor, so as to minimize influencing of the adjacent components by magnetic leakage flux and ensure adequate air circulation for cooling. Position the step-up reactor as close as possible to the supply unit. Take into account the bend radius of the connecting cables! For dimensional drawings/hole pitch see Figure 2.12 and Table 2.4.
2.	Mount the step-up reactor on the mounting rail.	The tapping area will provide you with good, full-area contact. The contact area must be metallically bright, in order to make a good earth connection to the switch cabinet earth.

NOTE: The step-up reactor is a primary heat source, and should be treated as a hotspot component. This component is cooled by natural air convection (gravity circulation). In order to make effective use of this physical effect, this component should be installed in the lower plinth area of the switch cabinet on stable mounting rails (permitting unhindered air flow from below). When selecting the position, air inlet at the filter mat or – better still – at the input fan zone is advisable.

2.5.1 Dimensions

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
W (width)	239	299	335	380
H (height)	273	300	344	399
D (depth)	124	135	158	200
A	185	210	248	280
A1	75	95	122	127
D	10x18	12x20	12x20	12x20
Screws	4 x M8	4 x M10	4 x M10	4 x M10
Weight [kg]	16	27	37.5	56
All dimensions in mm and excluding terminals/connectors				

Table 2.4 Step-up reactor dimensions

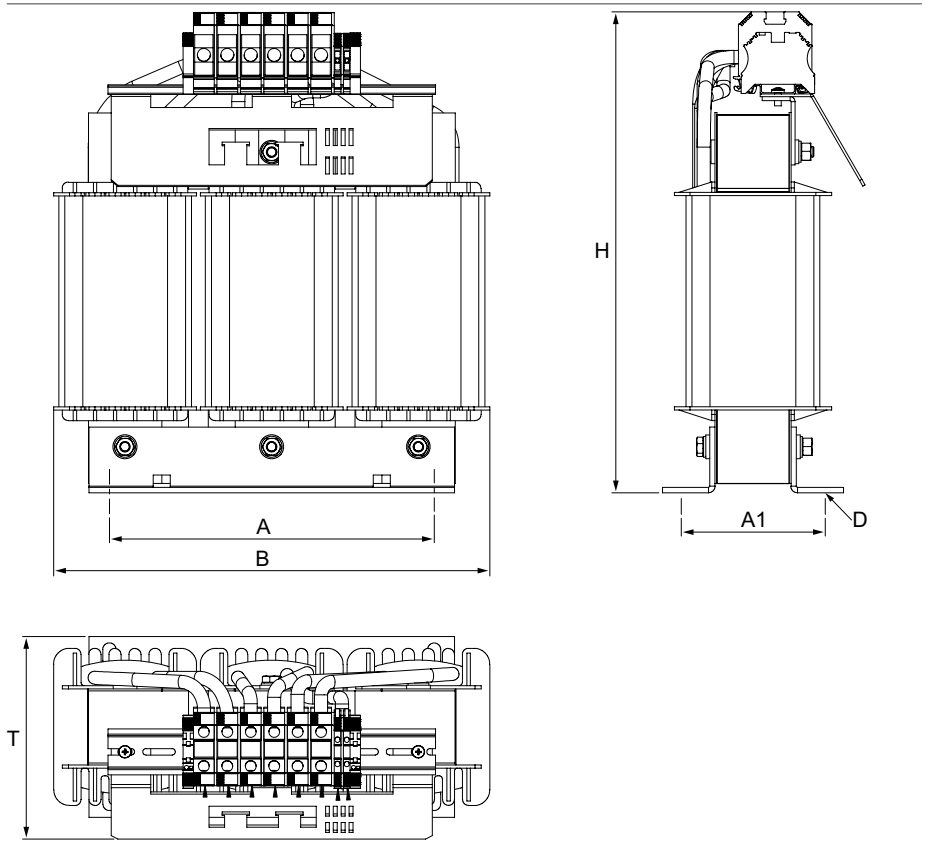


Figure 2.12 Dimensional drawing, step-up reactor

2.6 Installation - input reactor with membrane capacitor

Step	Action	Comment
1.	Mark out the position of the tapped holes on the mounting rail. Cut a tap for each fixing screw in the backing plate.	Arrange the components so as to ensure sufficient air circulation for cooling. As the membrane capacitor has a viscose filling, the input reactor must be installed **upright** with the membrane capacitor. Take into account the bend radius of the connecting cables! For dimensional drawings/hole pitch see Figure 2.13 and Table 2.5.
2.	Mount the input reactor on the mounting rail.	The tapping area will provide you with good, full-area contact. The contact area must be metallically bright, in order to make a good earth connection to the switch cabinet earth.

2.6.1 Dimensions

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
W (width)	289	289	342	348
H (height)	252	268	292	321
D (depth)	119	136	175	175
A	156	156	176	176
A1	63	80	95	95
D	7x13	7x13	9x13	9x13
Screws	4 x M6	4 x M6	4 x M8	4 x M8
Weight [kg]	10.5	14	20	22
All dimensions in mm and excluding terminals/connectors				

Table 2.5 Input reactor dimensions

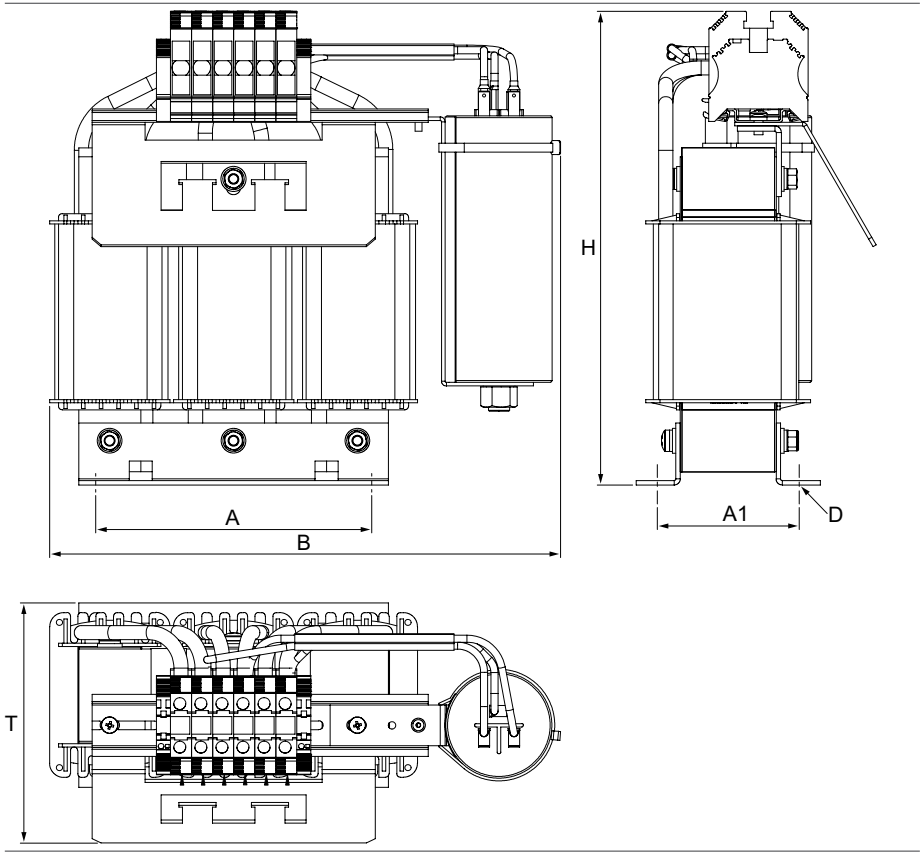


Figure 2.13 Dimensional drawing, input reactor

2.7 Mains filter installation

Step	Action	Comment
1.	Mark out the position of the tapped holes on the backing plate. Cut a tap for each fixing screw in the backing plate.	Arrange the components so as to ensure sufficient air circulation and cooling. Take into account the bend radius of the connecting cables! Dimensional drawings/hole spacing see Figure 2.14 and Table 2.6.
2.	Mount the mains filter on the backing plate.	The tapping area will provide you with good, full-area contact. The contact area must be metallically bright.

2.7.1 Dimensions

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Type	FFU 3x56 K	FFU 3x80 K	FFU 3x130 K	FFU 3x180 K
W (width)	85	80	90	130
H (height)	250	270	270	380
D (depth)	90	135	150	180
A	60	60	65	102
C	235	225	255	365
G Ø	5.4	6.5	6.5	6.5
Screws	M5	M6	M6	M6
Weight [kg]	1.9	2.6	4.2	6.0
All dimensions in mm and excluding terminals/connectors				

Table 2.6 Mains filter dimensions

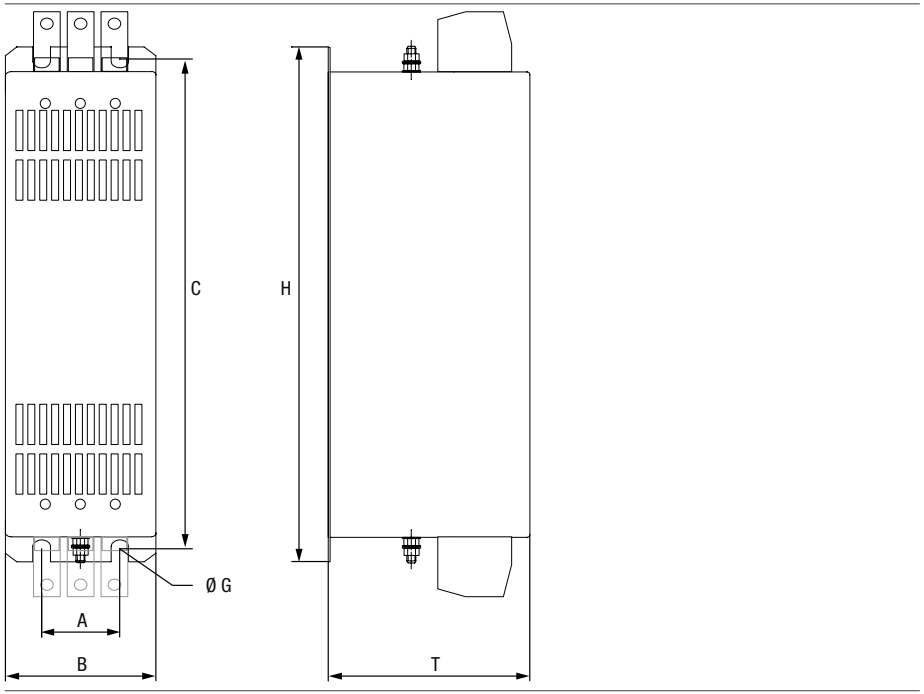


Figure 2.14 Dimensional drawing, mains filter

3. Electrical installation

3.1 Before you start

Please be sure to observe the following notices and warnings before and during electrical installation.

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 check that the power has been cut!

Hazardous voltage may be applied to the device, even if the device does not show any visual signs or emit any audible signals (e.g. with mains voltage applied to terminal X12 or X21) and missing control voltage (+24 V on X9, X10)! So check that the power has been cut!

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

ATTENTION: The device heats up in operation and at the heat sink may reach temperatures of up to 100 °C.
The connected reactors heat up in operation and may reach temperatures of up to 145 °C.
Keep a safe distance from adjacent assemblies.

ATTENTION! During installation, please avoid:
- screws or cable residues dropping into the device;
- penetration of damp into the device.

NOTE: For installation of the supply unit within a ServoOne multi-axis system, be sure also to observe the Operation Manual for the DC axis controllers.

3.2 Effective EMC installation

3.2.1 Cable type

- Use shielded mains, motor and signal cables, as shown in Figure 3.7, p. 29. Use a cable type with double copper braiding, with 60 - 70% coverage, for all shielded connections.
- If very large cable cross-sections have to be installed, shielded single wires may also be used instead of shielded cables.

ATTENTION! Use only the supplied DC link cable for the electrical connections between the devices. If other cables are used, LTi DRiVES can provide no guarantee of stable and safe operation.

3.2.2 Cable laying

Pay attention to the following points when laying cables:

- Lay mains, motor and signal cables isolated from each other. Observe a minimum clearance of 0.2 metres.
- When installing close, use isolating plates mounted directly and conductively on the backing plate as shielding.
- Lay the conductors tight to the earth potential. When using plastic cable ducts, they must be mounted directly on the backing plates or the frame. Cables must not be spanned over free space, otherwise they might act as antennas.
- Avoid unnecessary cable lengths and “spare loops”.
- Lay long cables at locations not susceptible to interference. Otherwise additional coupling points may be created.
- Lay motor cables without interruptions (e.g. not via terminals) and by the shortest route out of the switch cabinet.
- Twist cables of the same circuit.
- Ideally, lay the signal cables isolated from the encoder cables.
- All signal cables should be grouped together and routed away Up.
- Avoid extending cables by way of terminals.

- Earth residual wires on at least one side, so as to prevent static.

3.2.3 Earthing measures

All earthed points and components must, as far as possible, be routed by low-resistance, highly conductive means directly to the central earthing point (e.g. PE rail, main earth). This creates an earthing system which connects all connection locations in a star configuration to the earthing point. This central earthing point must be unambiguously defined. This earthing point can be expanded across the entire backing plate with an EMC connection.

Pay attention to the following points in relation to earthing:

- Earthed surfaces act as shields and reduced electromagnetic fields in the surrounding area. Consequently, metallic surfaces should be connected to earth via low-resistance HF connections. In EMC terms, it is not the cross-section of the cable which is decisive, but the surface on which high-frequency currents (caused by the skin effect) can discharge.
- Connect the PE conductors of the components in a star configuration inside the switch cabinet.
- Avoid plug-in connections.
- Also connect the walls and doors of the switch cabinet to earth.
- Large openings in the switch cabinet (windows, fans, display) will impede the shielding effect of the cabinet and must be protected by additional shielding for the HF area.
- Earth residual wires on at least one side, so as to prevent static.
- Remove paint and corrosion from contact points and connect them across a wide area.
- Tin-plated, galvanized, aluminized or cadmium-plated elements should be preferred to painted components. This will also avoid having to scratch off varnish layers. Avoid plug-in connections, or use multiple contacts for the shield connection in the connector. The ServoOne units have a rear panel made of aluminized and galvanized sheet steel.
- For more information on the protective conductor cross-section see Table 3.2, p. 30.

3.2.4 Shielding

Shielding should take account of the following points:

- Use shielded mains, motor and signal cables, as shown in Figure 3.7, p. 29. Use a cable type with double copper braiding, with 60 - 70% coverage, for all shielded connections.
- Apply the shield on both sides, across a wide area. Extending the shield to the earthing point by a wire (pigtail) will reduce the shielding effect by as much as 90 %.

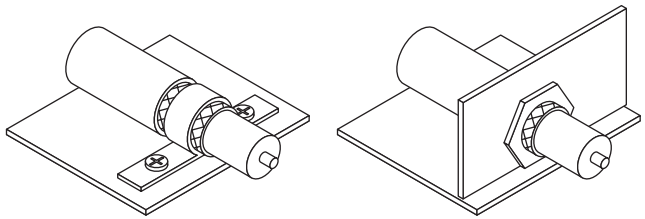


Figure 3.1 Shield connection CORRECT

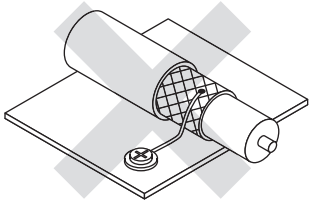


Figure 3.2 Shield connection INCORRECT - do not use an extension wire to the earthing point (pigtail)

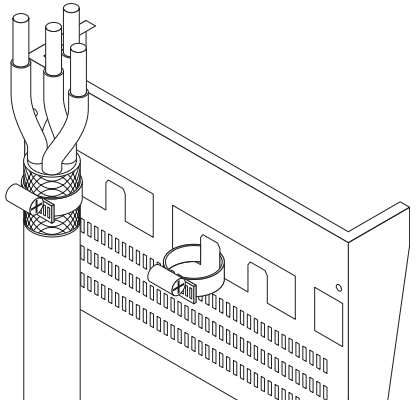


Figure 3.3 ServoOne shield connection

- Do not strip the shield too early.
- Shields must not be used for current carrying, such as replacing the N or PE conductor.
- The shielding effect can be improved by laying in metal ducts/pipes.
- If very large cable cross-sections have to be installed, shielded single wires may also be laid instead of shielded cables.
- Shields must be applied on at least one side. Multi-layer application is recommended, otherwise equipotential bonding currents may flow through widespread systems. If long earth connections are subject to interference, they can be made by way of coupling capacitors. This enables a high-frequency connection to discharge interference, without transmitting the 50 Hz component.
- The reactor bases must have good contact with the switch cabinet earth. The contact area must be metallically bright, in order to make a good earth connection to the switch cabinet earth.

3.3 Overview of connections

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

3.3.1 Layout, BG5 (SO84.040.S and SO84.076.S)

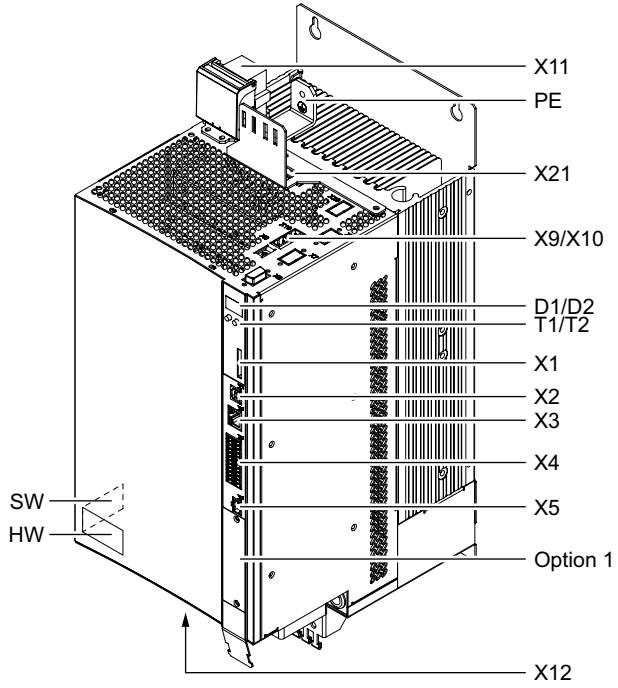


Figure 3.4 Layout, BG5

3.3.2 Layout, BG6a (SO84.115.S and SO84.170.S)

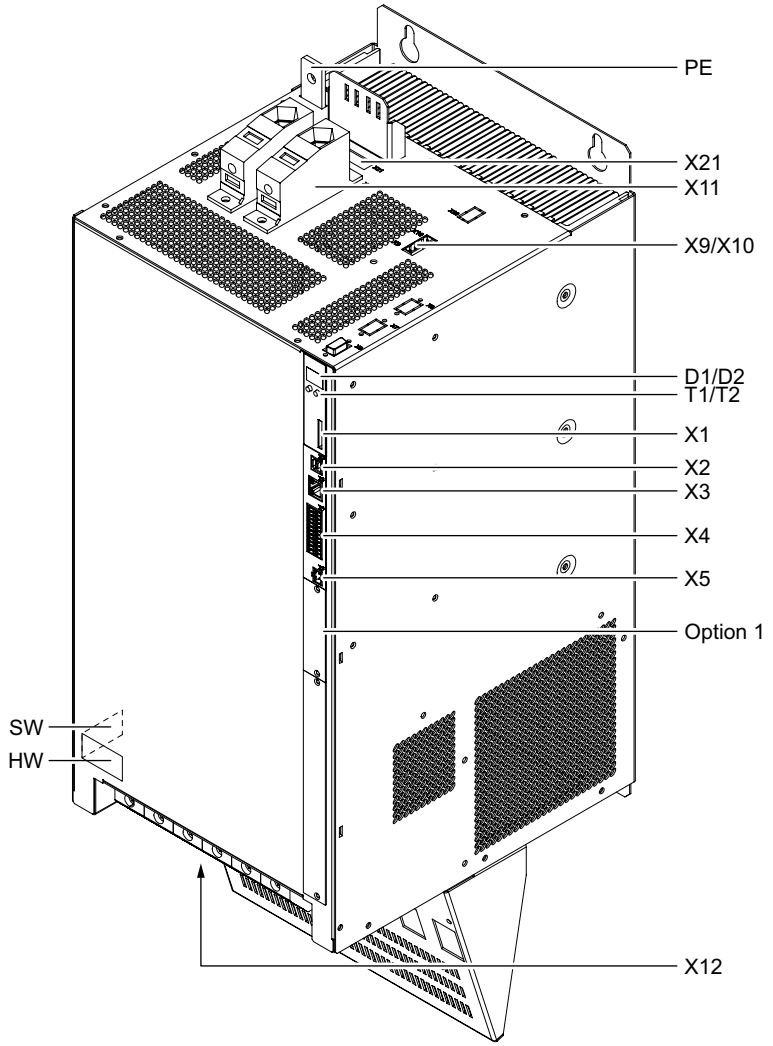


Figure 3.5 Layout, BG6a

3.3.3 Overview of connections, BG5 and BG6a

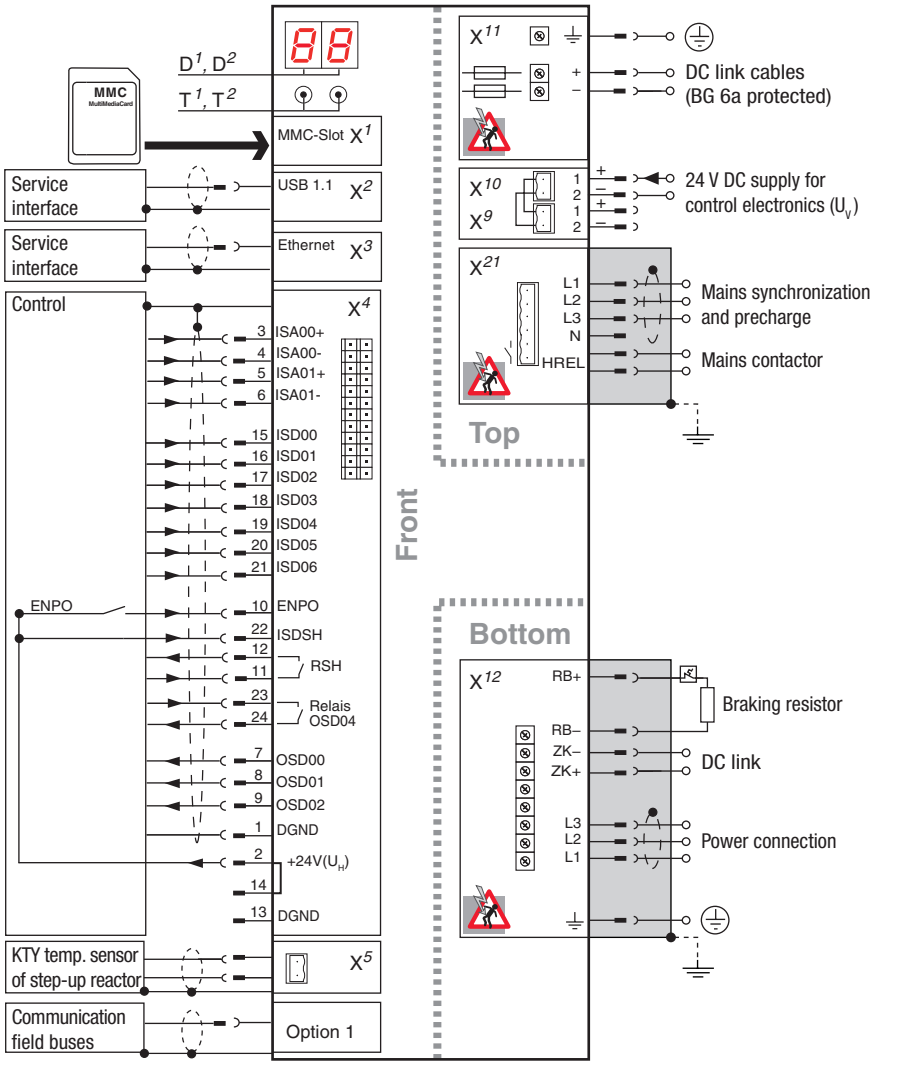
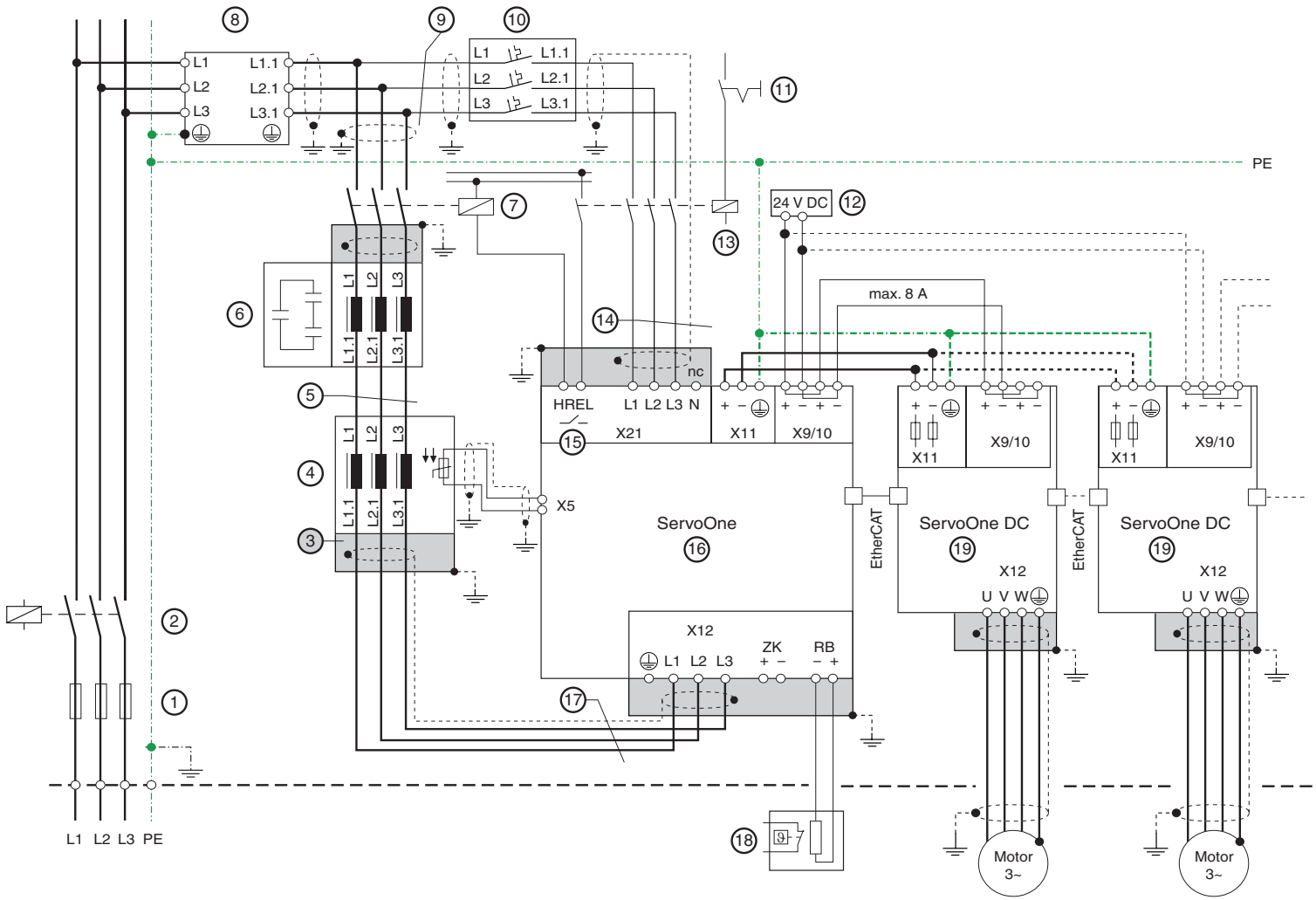


Figure 3.6 Overview of connections, BG5 and BG6a

No.	Designation	Function	Page
D1, D2	7-segment display	Device status display	54
T1, T2	Button	Switch to bootstrap mode	53
Option 1	Communication	Optional module for field buses, e.g. SERCOS, PROFIBUS-DP, EtherCAT or CANopen	
X1	Slot for MMC removable storage device	Enables firmware download without PC for example	52
X2	USB 1.1 port	Service interface, Plug & Play connection to PC	42
X3	Ethernet interface	Service interface, fast TCP/IP port (RJ45)	42
X4	Control connections	8 digital inputs, 3 digital outputs, 1 additional relay output	39
X5	Temperature monitor connection	KTY temperature sensor of step-up reactor	43
X10, X9	Connection of control supply U_V	Supply voltage for control electronics of servocontroller, 24 V DC	33
X11	DC power supply	Connection of DC power supply (BG6a protected), PE connection	35 30
X12	Power connection	AC power connection (supply and mains feedback), PE connection with shield, braking resistor, (DC power supply connection, supply unit BG6a to ServoOne DC axis controller BG6, 6a)	34
X21	Connection of mains synchronization/DC link precharge; auxiliary relay	Mains synchronization, DC link precharge, mains connection after precharge with shield	33
SW, HW	Rating plates	Software and Hardware rating plates	
⏚	Shield connection to earth	Possible via shield (optional)	

Table 3.1 Key - Overview of connections, BG5 and BG6a

3.4 Connection diagram



Key

1. Mains fuses
2. Mains supply/emergency stop
3. Shields (grey)
4. Step-up reactor with KTY temperature sensor
5. Above a cable length of >500 mm shielded cables should be used
6. Input reactor with membrane capacitor
7. Mains contactor (after precharge by HREL)
8. Mains filter
9. Short-circuit-proof cables
10. Circuit-breaker
11. Multi-axis system On/Off
12. External 24 V DC control supply
13. Auxiliary contactor (precharge/synchronization)
14. Connection of DC link precharge and mains synchronization
15. Floating contact:250 V_{AC}/5 A or 30 V_{DC}/6 A(active when precharge complete)
16. ServoOne supply unit BG6a
17. AC power connection
18. Braking resistor
19. ServoOne DC axis controller
20. Switch cabinet
21. Field

Figure 3.7 Overview, supply unit connection diagram (schematic view)

3.5 Connection of PE conductors

The PE conductor cross-section depends on the cross-section of the outer conductor, and is defined as follows in EN 61800-5-1. The leakage current is > 3.5 mA. Use PE conductors with a cross-sectional area of ≥ 10 mm².

Cross-sectional area of outer conductors [mm²]	Minimum cross-sectional area of corresponding PE conductor [mm²]
Q ≤ 16	Q
16 < Q ≤ 35	16
35 < Q	Q/2

Table 3.2 Protective conductor cross-section

3.5.1 PE conductor X11 supply unit BG5

Step	Action	Comment
1.	Earth each supply unit and DC axis controller! Connect the PE terminal ⏚ X11/PE of the supply unit directly to the PE rail (main earth) in the switch cabinet.	Select the PE conductor cross-section according to Table 3.2, p. 30. Use a suitable PE conductor for the purpose (screw M5). Also comply with local and national regulations and conditions.
2.	Connect the PE terminal ⏚ X11/PE of the supply unit to the PE terminals X11/PE of the butt-mounted DC axis controllers in series.	Use the ready made-up PE conductors.

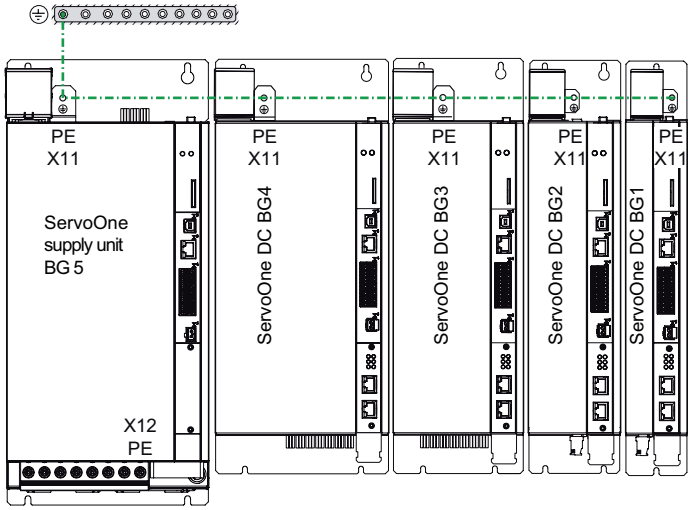


Figure 3.8 Schematic: Connection of the PE conductor

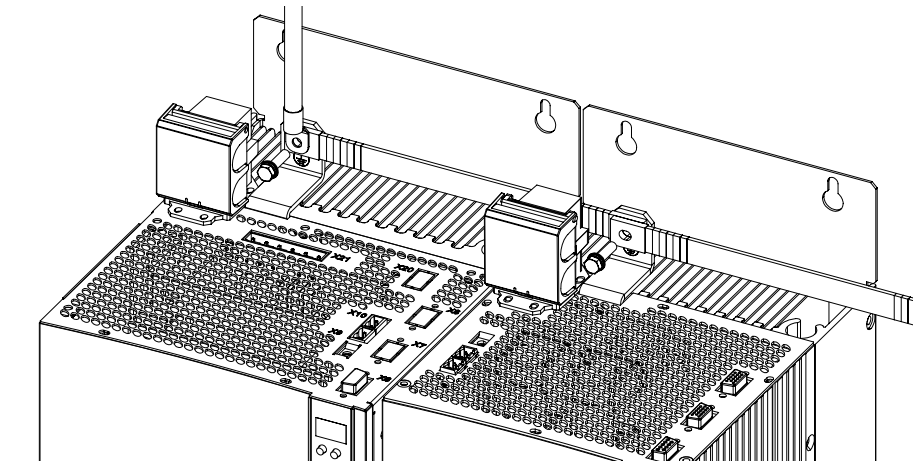


Figure 3.9 Detail: Connection of the PE conductor

3.5.2 PE conductor X11 supply unit BG6a

Step	Action	Comment
1.	Earth each BG6a supply unit and each BG6a DC axis controller separately. Connect the PE terminal ⏚ X11/PE of the supply unit directly to the PE rail (main earth) in the switch cabinet.	Select the PE conductor cross-section according to Table 3.2, p. 30. Use a suitable PE conductor for the purpose (screw M8). Also comply with local and national regulations and conditions.
2.	Earth all other DC axis controllers BG5 to 1 via a common PE conductor! Connect the PE terminal ⏚ X11/PE of the first butt-mounted DC axis controller to the PE rail (main earth) in the switch cabinet. Connect all other PE terminals X11/PE of the butt-mounted DC axis controllers in series.	 Use a suitable PE conductor for the purpose. Also comply with local and national regulations and conditions. Use the ready made-up PE conductors.

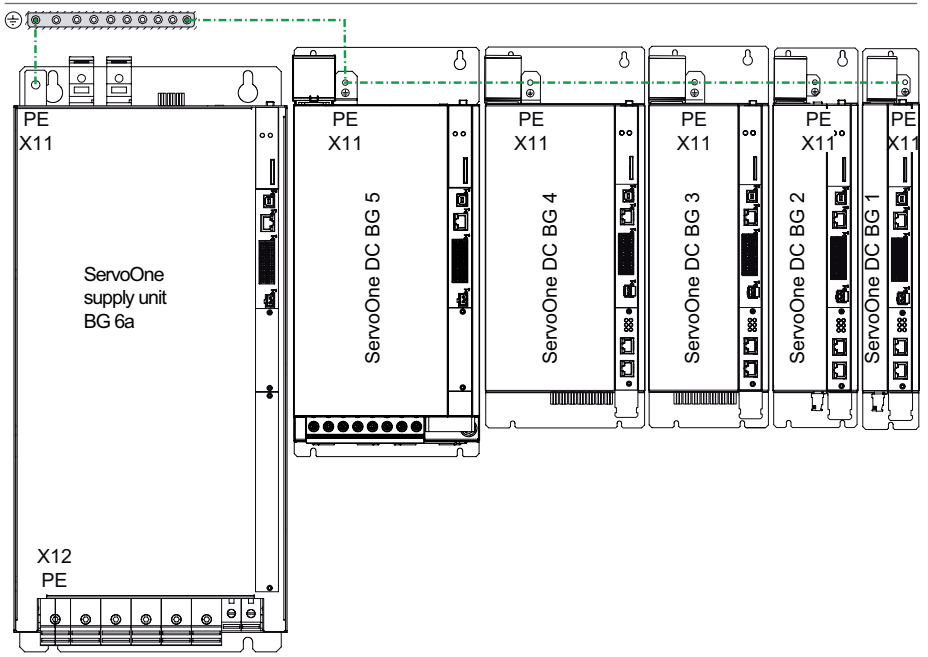


Figure 3.10 Schematic: Connection of the PE conductor

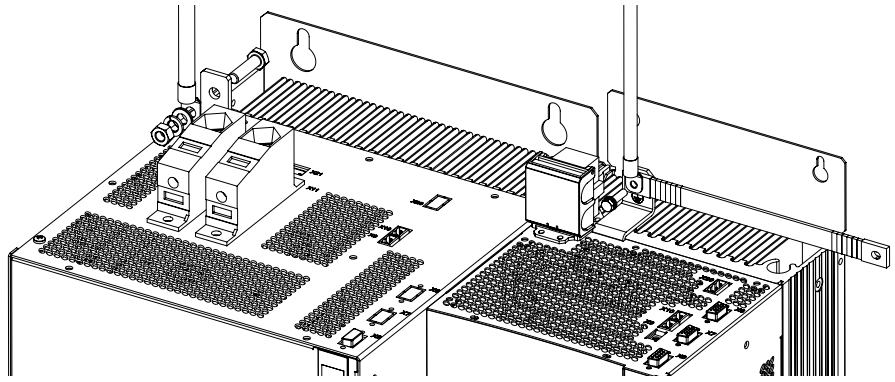


Figure 3.11 Detail: Connection of the PE conductor

3.5.3 PE conductor components

Step	Action	Comment
1.	Connect the PE terminals of all other components, such as mains filters etc., **in star configuration** to the PE rail (main earth) in the switch cabinet.	See Overview, supply unit connection diagram (schematic view) Figure 3.7, p. 29. Also comply with local and national regulations and conditions.

WARNING: The reactors have no PE connection. They are intended solely for installation in a switch cabinet, as with IP00 protection they offer no protection against direct or indirect touch contact.

3.6 Electrical isolation method

The control electronics, with its logic (µP), the inputs and outputs, are electrically isolated from the power section (mains 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 voltages from 5 V to 50 V, as per the relevant specification. This provides reliable protection against electric shock on the control side. You therefore need a separate control supply, compliant with the requirements of a SELV/PELV.

The opposite overview shows the potential supplies for the individual terminals in detail. This concept also delivers higher operational safety and reliability of the servocontroller.

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

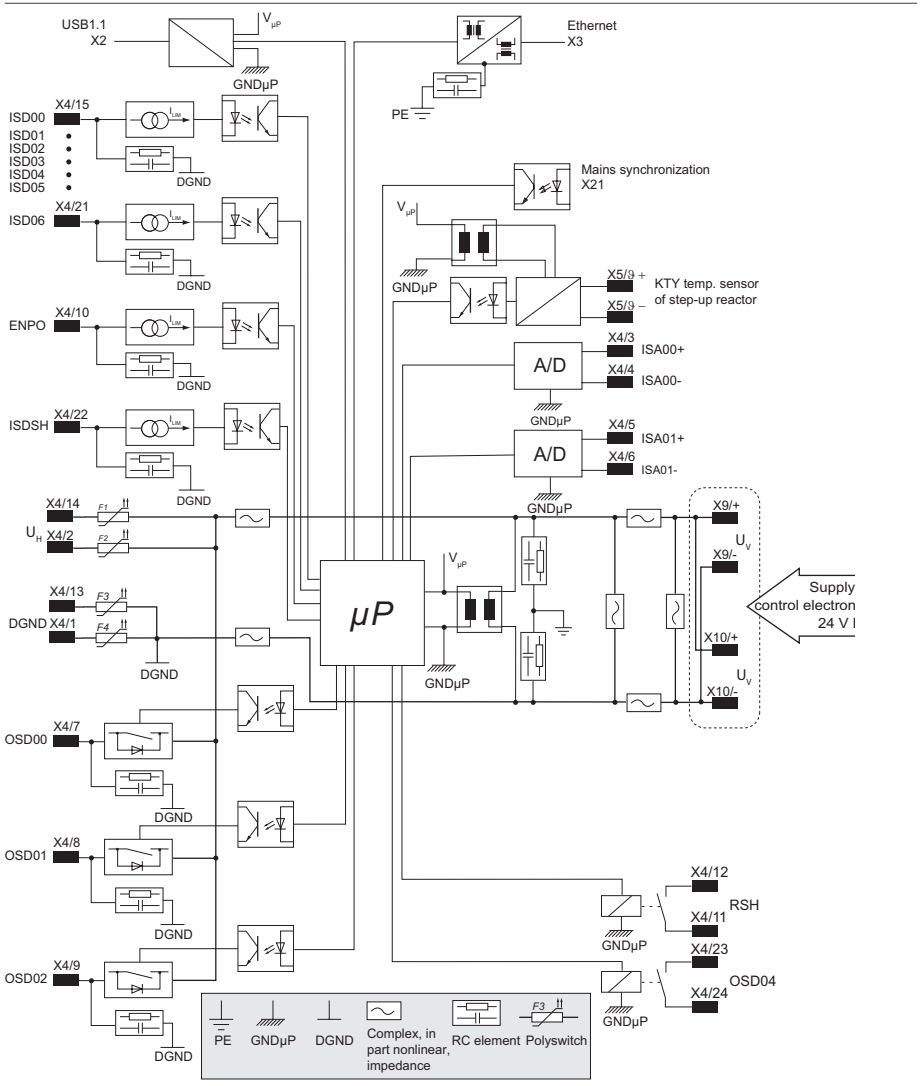


Figure 3.12 Electrical isolation method

3.7 Connection of supply voltages

The power supply for the ServoOne is separated into the supplies for control and power sections. The supply for the control must always be connected **first**, so that actuation of the ServoOne can first be checked or the device can be parameterized for the intended application.

3.7.1 Control supply X9, X10 (24 V DC)

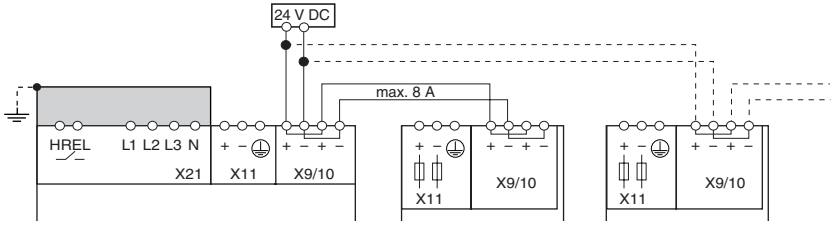


Figure 3.13 Control supply connection

WARNING: Hazardous voltage may be applied to the device, even if the device does not show any visual signs or emit any audible signals (e.g. with mains voltage applied to terminal X12) and missing control voltage (+24 V on X9, X10)!

ATTENTION: Take suitable measures to provide adequate cable protection (e.g. fusing 10 A gG). If the permissible current capacity is exceeded, an additional separate control supply must be connected.

NOTE: The external control supply also supplies the digital inputs and outputs as well as the control section ($I_{CONTROLSECTION}$ + $I_{I/O}$). Also pay attention to the current demand on start-up and in operation. See Table A.5, p. 58.

Specification of control supply		
Control supply	X9 1/+ 2/–	• U_V = 24 V DC -10 % +20 %, stabilized and smoothed. • Max. For start-up/continuous current see Table A.5, p. 58 • Current capacity of terminal continuous I_B = 8 A max. • Internal polarity reversal protection • 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. • Internally wired with X10
	X10 1/+ 2/–	• Current capacity of terminal continuous I_B = 8 A max. • Internally wired with X9

Table 3.3 Specification of control supply

3.7.2 Precharge and mains synchronization X21

The DC link is precharged via terminal X21/L1,L2,L3 (Figure 3.14, p. 34). At a defined DC link voltage the contact of the internal relay on terminal X21/HREL is closed. The mains contactor closes and switches the supply system to terminal X12/ L1,L2,L3. The supply unit is synchronized with the mains via terminal X21/L1,L2,L3. For technical data of mains contactor see section A.11 , p. 62.

ATTENTION: The cable must be protected by a circuit-breaker. Ensure the correct phase angle of the conductors during installation (Figure 3.14). For technical data of circuit-breaker see section A.12 , p. 62.

Specification of precharge and mains synchronization X21		
Precharge and mains synchronization (L1, L2, L3)	X21 L1 L2 L3 N HREL	• U = 400/460/480 V AC • $I_{Precharge}$ = 20 A (falling over a period of < 1.5 s) • $I_{Synchronization}$ < 100 mA • Cable cross-section = 1.0 ... 1.5 mm² • (N: Not used)
Auxiliary relay (HREL)		Max values of connection • U_{Max} = 250 V AC / I_{Max} = 5 A • U_{Max} = 30 V DC / I_{Max} = 6 A

Table 3.4 Specification of precharge and mains synchronization X21

3.7.3 Mains supply X12 (400/480 V AC)

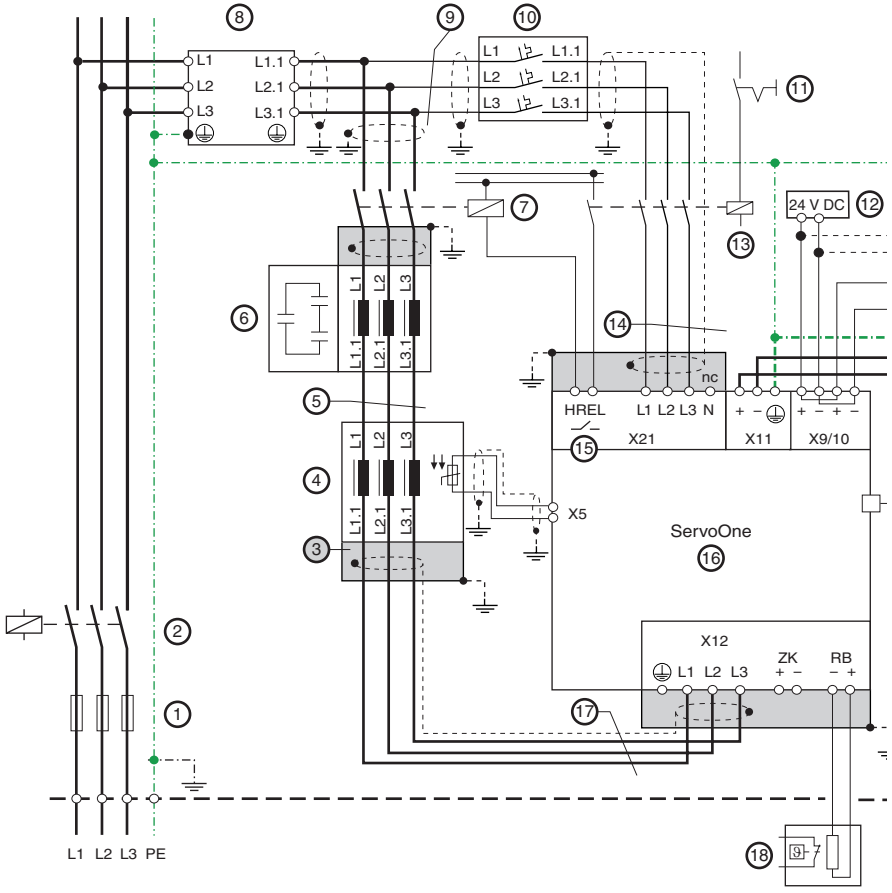


Figure 3.14 Connection of mains supply (schematic view)

ATTENTION: 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 check that the power has been cut!

Key

1. Mains fuses
2. Mains supply/emergency stop
3. Shields (grey)
4. Step-up reactor with KTY temperature sensor
5. Above a cable length of >500 mm shielded cables should be used
6. Input reactor with membrane capacitor
7. Mains contactor (after precharge by HREL)
8. Mains filter
9. Short-circuit-proof cables
10. Circuit-breaker
11. Multi-axis system On/Off
12. External 24 V DC control supply
13. Auxiliary contactor (precharge/synchronization)
14. Connection of DC link precharge and mains synchronization
15. Floating contact:250 V AC/5 A or 30 V DC/6 A (active when precharge complete)
16. ServoOne supply unit BG6a
17. AC power connection
18. Braking resistor

Procedure:

Step	Action	Comment
1.	Specify the **cable cross-section** depending on the maximum current and ambient temperature.	Cable cross-section according to local regulations and conditions. Use shielded cables, as shown in Figure 3.14.
2.	Wire the supply unit with the mains supply as shown in Figure 3.14. **Do not switch on the power!**	For more information on connection of the terminal X21 precharge see section 3.7.2 , p. 33. For more information on connection of the components see section 3.16 , p. 43 ff. For technical data of components see section A.7 , p. 61 ff.

ATTENTION: If local regulations require the installation of a residual current operated protective device, the following applies:
In case of a fault the supply unit is able to generate DC fault currents without zero crossing. The supply unit therefore must only be operated with RCDs[1] of type B for AC fault currents, pulsating and smooth DC fault currents which are suitable for servocontroller operation - see IEC 60755. RCMs[2] can additionally be used for monitoring purposes.

1) Residual current protective device
2) Residual current monitor

Terminal X12/L1,L2,L3

ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Cable connection capacity	0.5 - 25 mm² (AWG 20 - AWG 4) [1]		50 - 150 mm² (AWG 0 - AWG 5/0) [2]	
Tightening torque	2.5 - 4.5 Nm		25 - 30 Nm	

1) Flexible cable with ferrule
2) Flexible cable with or without ferrule

Mains connection conditions

To ensure undisturbed operation on the supply system with a ServoOne supply unit, a minimum requirement for the short-circuit power at the mains connection applies. The transition at the mains filter is defined as the mains connection.

The requirement must be met in order to avoid impairment at the supply unit and interference with other devices connected in parallel to this mains connection, and to enable a reliable operating state.

The term "short-circuit power" is a theoretical value of an apparent power occurring in a current network when a short-circuit is caused at a transfer point.

ServoOne supply unit	Short-circuit ratio Rsc [1]	Minimum requirements for the short-circuit power at the mains connection for undisturbed operation
SO84.040.S (Sn = Pn = 26 kW)	30 ... 50	800 kVA ... 1300 kVA
SO84.076.S (Sn = Pn = 50 kW)		1500 kVA ... 2500 kVA
SO84.115.S (Sn = Pn = 75 kW)		2250 kVA ... 3750 kVA
SO84.170.S (Sn = Pn = 110 kW)		3300 kVA ... 5500 kVA

1) Rsc is defined as the short-circuit ratio of the short-circuit power (Sk) at the mains connection to the rated power (Sn) of the ServoOne supply unit (Rsc = Sk/Sn).

Table 3.5 Mains connection conditions

Note the following points:

- Switching the mains power:
  - In case of too frequent switching of the precharge, 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 network and TT network: Permitted without restriction.
- IT network (insulated neutral point): Not permitted!
  - In case of an earth fault the electrical stress is approx. twice as high. Clearances and creepages to EN 61800-5-1 are no longer maintained.
- For more information on permissible current loads, technical data and ambient conditions refer to the appendix.

NOTE: Please be aware that the ServoOne junior is not rated for electromagnetic environment class 3 (EN 61000-2-4). Further measures are essential in order for that environment class to be attained! For further information please consult your project engineer.

3.8 Connection of DC power supply X11

ATTENTION! Use only the supplied DC link cable for the electrical connections between the devices. If other cables are used, LTi DRiVES can provide no guarantee of stable and safe operation.

ATTENTION! The cover over terminal X11 (DC connection) on sizes BG1 to BG5 must be closed after installing the ready made-up cables. Operation without the cover is not permitted.

NOTE: Prior to commissioning, the value of the connected supply voltage must be set in the drive controller. For more details see section 4. „Commissioning", p. 45.

Terminal X11

ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Cable connection capacity	Use only the preassembled connecting cables supplied. (Hole diameter 5.5 mm)		35 - 95 mm² (AWG 2 - AWG 3/0) 1)	
Tightening torque	2.5 - 4.5 Nm		25 - 30 Nm	

1) Flexible cable with or without ferrule

3.8.1 Supply unit BG5

Step	Action	Comment
1.	Connect terminal X11/+ of the supply unit to terminal X11/+ of the next butt-mounted DC axis controller. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use the ready made-up DC power supply cables.
2.	Connect terminal X11/- of the supply unit to terminal X11/- of the next butt-mounted DC axis controller. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use the ready made-up DC power supply cables.
3.	Connect the touch protection to DC link terminals X11.	For more information refer to the ServoOne DC axis controller operation manual.

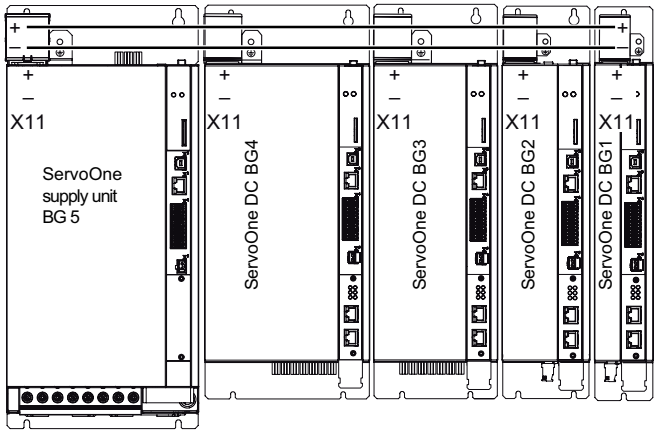


Figure 3.15 Schematic: DC power supply connection, BG5

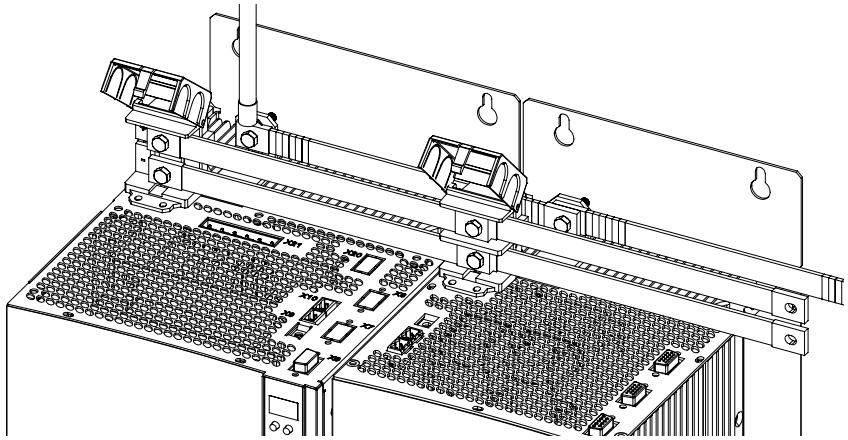


Figure 3.16 Detail: DC power supply connection, BG5

3.8.2 Supply unit BG6a

BG6a connection to smaller DC axis controllers

Step	Action	Comment
1.	Connect terminal X11/+ of the supply unit to terminal X11/+ of the next butt-mounted DC axis controller. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use the ready made-up DC power supply conductors for the purpose. Take off the shrink tubing on the round end. Use the longer conductor for servocontrollers butt-mounted on the right, and the shorter conductor for left-mounted servocontrollers.
2.	Connect terminal X11/- of the supply unit to terminal X11/- of the next butt-mounted DC axis controller. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use the ready made-up DC power supply conductors for the purpose. Take off the shrink tubing on the round end. Use the shorter conductor for servocontrollers butt-mounted on the right, and the longer conductor for left-mounted servocontrollers.
3.	Connect the touch protection to DC link terminals X11.	For more information refer to the ServoOne DC axis controller operation manual.

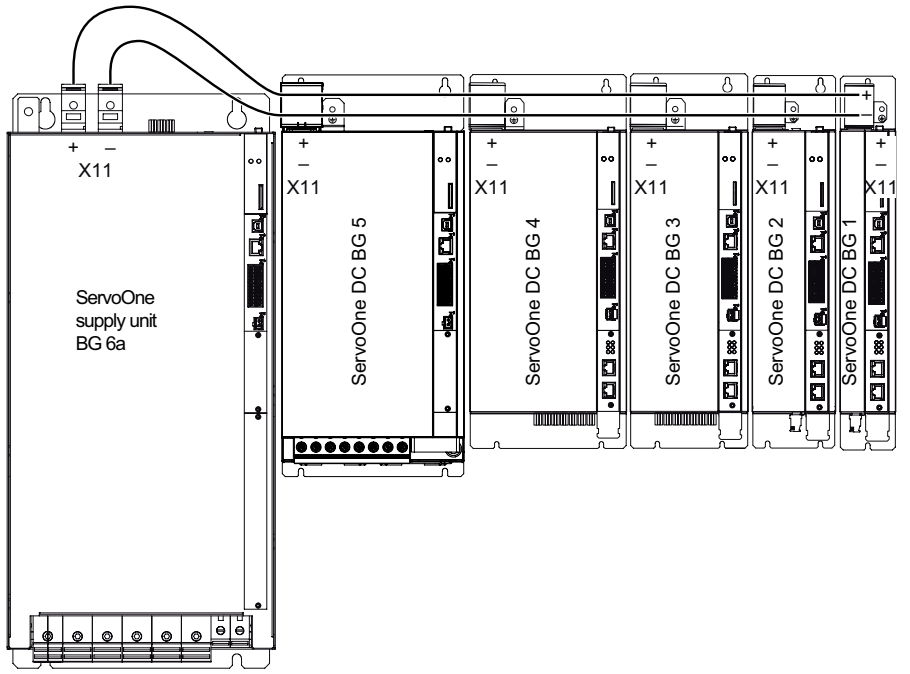


Figure 3.17 Schematic: BG6a DC power supply connection to smaller DC axis controllers

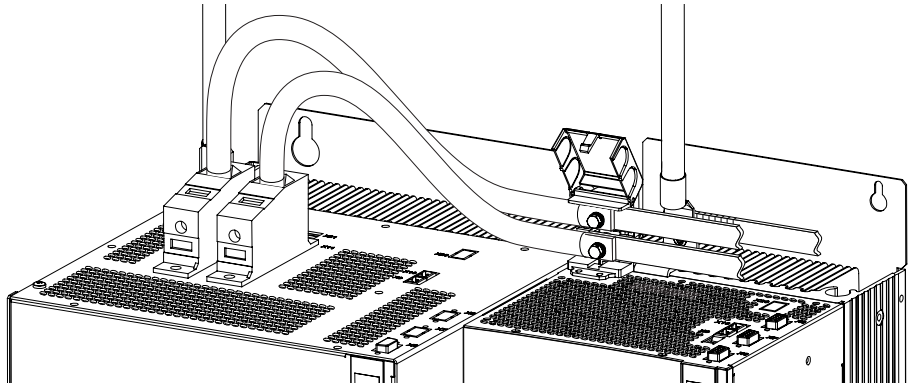


Figure 3.18 Detail: BG6a DC power supply connection to smaller DC axis controllers

BG6a connection to BG6a DC axis controllers

Step	Action	Comment
1.	Connect terminal X12/ZK+ of the supply unit to terminal X11/ZK+ of the next butt-mounted DC axis controller BG6a. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use dedicated conductors for the purpose. The connection of the DC link must be made with parallel cables. The conductor cross-section must be at least 50 mm² (CU). The cables must be short-circuit, earth fault proof, and shielded. A length of 2 metres may not be exceeded. If other cables are used, LTi DRiVES can provide no guarantee of stable and safe operation.
2.	Connect terminal X12/ZK- of the supply unit to terminal X11/ZK- of the next butt-mounted DC axis controller BG6a. On the DC axis controller connect the DC power supply conductor to the next butt-mounted DC axis controller.	Use dedicated cables for the purpose.
3.	Connect the touch protection to DC link terminals X11.	For more information refer to the ServoOne DC axis controller operation manual.

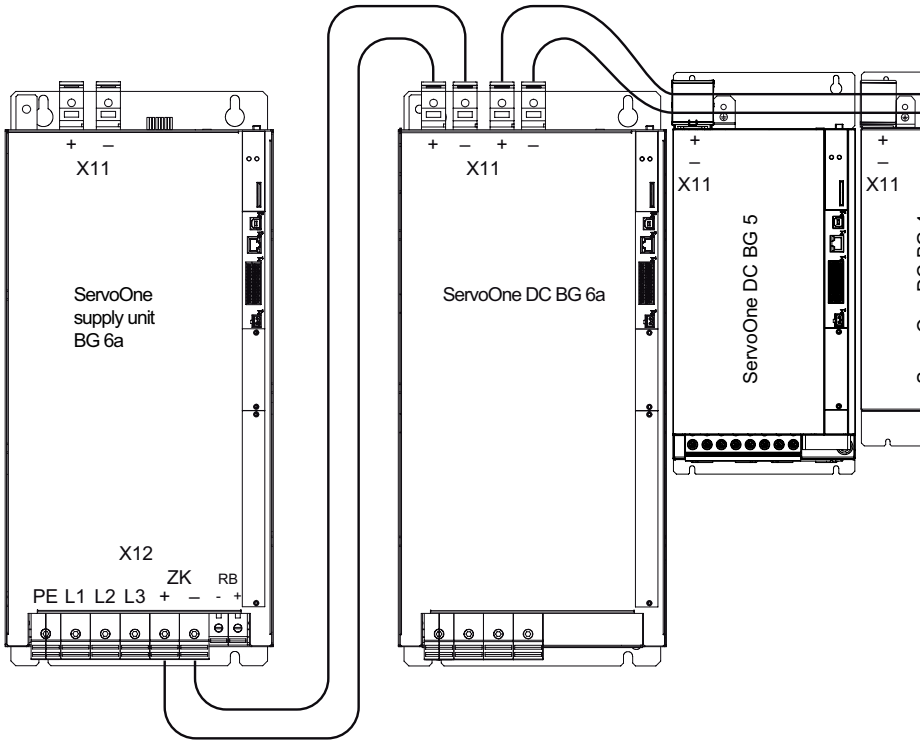


Figure 3.19 Schematic: BG6a DC power supply connection to BG6a

3.9 Control connections X4

Step	Action	Comment
1.	Check whether a complete device setup is already available, i.e. whether the drive has already been configured.	
2.	If this is the case, a special control terminal assignment applies. Please contact your project engineer to obtain the terminal assignment!	
3.	Choose a terminal assignment.	Initial commissioning
4.	Wire the control terminals with shielded cables. The following is strictly required: 24 V_{DC} at X4/22 and ENPO X4/10 as start signal.	Earth the cable shields over a wide area at both ends. Conductor sizes fixed: 0.2 to 1.5 mm² Flexible conductor sizes with ferrule: 0.2 to 1.5 mm²
5.	Keep all contacts open (inputs inactive).	
6.	Check all connections again!	Continue with commissioning in section 4. , p. 45.

Note the following points:

- Always wire the control terminals with shielded cables.
- Lay mains, motor, signal, DC power supply and braking resistor cables isolated from each other. Observe a minimum clearance of 0.2 metres.
- A cable type with double copper braiding, with 60 - 70% coverage, must be used for all shielded connections.

3.9.1 Specification of control connections

Des.	Term.	Specification	Electrical isolation
Analog inputs			
ISA0+ ISA0- ISA1+ ISA1-	X4/3 X4/4 X4/5 X4/6	No function	No
Digital inputs			
ISD00 ISD01 ISD02 ISD03 ISD04 ISD05 ISDSH	X4/15 X4/16 X4/17 X4/18 X4/19 X4/20 X4/22	• Frequency range < 500 Hz • Terminal scanning cycle = 1 ms • Switching level Low/High: ≤4.8 V / ≥18 V • at 24 V typ. 3 mA	Yes
ISD06	X4/21	• Frequency range ≤ 500 Hz • Switching level Low/High: ≤4.8 V / ≥18 V • I_{max} at 24 V = 10 mA, R_{IN} approx. 3 kΩ • Internal signal delay time < 2 µs suitable as trigger input for quick saving of actual position	Yes
ENPO	X4/10	• Frequency range < 500 Hz • Reaction time approx. 10ms • Switching level Low/High: ≤4.8 V / ≥18 V • at 24 V typ. 3 mA	Yes
Digital outputs			
OSD00 OSD01 OSD02	X4/7 X4/8 X4/9	• Short-circuit proof • I_{max} = 50 mA, PLC-compatible • Terminal scanning cycle = 1 ms • High-side driver	Yes

Table 3.6 Specification of control connections

Des.	Term.	Specification		Electrical isolation
Relay outputs				
REL	X4/23 X4/24	Relay, 1 NO contact Functions selectable as in case of digital outputs • 25 V / 1.0 A AC, cos φ = 1 • 30 V / 1.0 A DC, cos φ = 1 • Switching delay approx. 10 ms • Cycle time 1 ms	X4:23 X4:24	
RSH RSH	X4/11 X4/12	No function		Yes
Auxiliary voltage				
+ 24 V	X4/2 X4/14	• Auxiliary supply to feed the digital control inputs • $U_H = U_V - \Delta U$ (ΔU typically approx. 1.2 V), no destruction in case of short-circuit (+24 V -> GND), but device may briefly shut down. • I_{max} = 80 mA (per pin) with self-resetting circuit-breaker (polyswitch)		Yes
Digital earth				
DGND	X4/1 X4/13	Reference earth for 24 V, with automatically resetting circuit-breaker (polyswitch)		Yes

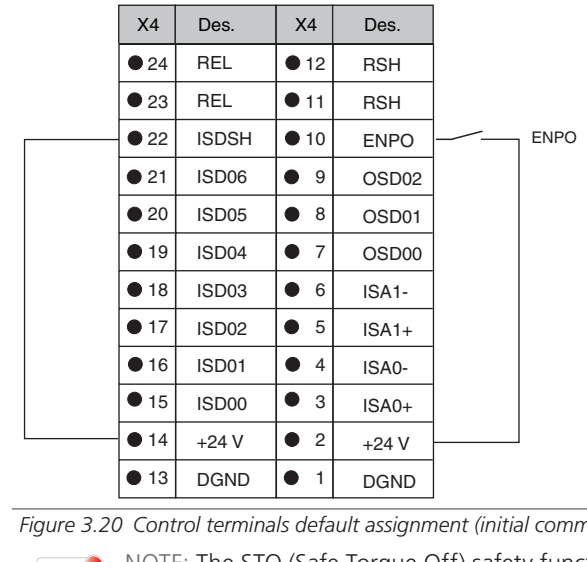


Table 3.6 Specification of control connections

NOTE: With high currents flowing through the earth terminals a high resistance isolation from the device earth is required. This may cause incorrect response of the drive (avoid ring currents in the wiring).

3.9.2 Default terminal assignment

Terminal assignment with factory setting

Figure 3.20 Control terminals default assignment (initial commissioning)

NOTE: The STO (Safe Torque Off) safety function is not required for the ServoOne supply unit, as no motors are connected. In order to start the supply unit, a jumper must be placed between X4/14 and X4/22. The STO safety function is used in conjunction with a ServoOne DC axis controller.

3.10 Functions of the digital inputs

The following functions can be selected for digital inputs ISD00 to ISD06:

Value	Value name	Description
0	MPRO_INPUT_FS_OFF	No function
1	MPRO_INPUT_FS_START	Start loop control
2	MPRO_INPUT_FS_E_EXT	External error on another device
3	MPRO_INPUT_FS_WARN	External warning on another device
4	MPRO_INPUT_FS_RSERR	Reset an error message

Table 3.7 Selectable functions of digital inputs ISD00 to OSD06

3.11 Functions of the digital outputs

The following functions can be selected for digital outputs OSD00 to OSD02:

Value	Value name	Description
0	OUTPUT_FS_OFF	No function
1	OUTPUT_FS_ERR	General error
2	OUTPUT_FS_ACTIV	Control in function
3	OUTPUT_FS_S_RDY	Device initialized
4	OUTPUT_FS_PRECHARGE_RDY	Device precharged
5	OUTPUT_FS_C_RDY	Device ready (DC link voltage present)
6	OUTPUT_FS_REF	DC link voltage setpoint reached
7	OUTPUT_FS_E_FLW	No function
8	OUTPUT_FS_LIMIT	DC link voltage setpoint limitation active (the voltage is outside the defined range.)
9	OUTPUT_FS_UDC_GT_UDCX	Actual DC link voltage higher than defined in parameter P-0740 Voltage threshold
10	OUTPUT_FS_P_LIM_ACTIV	No function
11	OUTPUT_FS_UDC_LIM_ACTIV	DC link voltage setpoint limitation active (the voltage is outside the defined range.)
12	OUTPUT_FS_I_LIM_ACTIV	No function
13	OUTPUT_FS_ENMO	No function
14	OUTPUT_FS_PLC	No function
15	OUTPUT_FS_WARN	General warning
16	OUTPUT_FS_WUV	Warning: undervoltage in DC link (defined in P-0730[0,1])
17	OUTPUT_FS_WOV	Warning: overvoltage in DC link (defined in P-0730[2,3])
18	OUTPUT_FS_WIIT	Warning: I2t-power stage protection threshold reached (defined in P-0730[6,7])
19	OUTPUT_FS_WOT_PTC	Warning: KTY sensor of step-up reactor (defined in P-0730[12,13])
20	OUTPUT_FS_WOTI	Warning: heat sink temperature of inverter (defined in P-0730[08,9])
21	OUTPUT_FS_WOTD	Warning: internal temperature in inverter (defined in P-0730[10,11])
22	OUTPUT_FS_WLIS	Warning: apparent current limit value exceeded (defined in P-0730[4,5])
23	OUTPUT_FS_WLVOLT	Warning: DC link voltage limit value exceeded (defined in P-0730[14,15])
24	OUTPUT_FS_COM_1MS	Setting outputs via COM Option in 1 ms cycle
25	OUTPUT_FS_COM_NC	Setting outputs via COM Option in NC cycle
26	OUTPUT_FS_SH_S	No function
27	OUTPUT_FS_BC_FAIL	Braking chopper fail error (Error = LOW)
28	OUTPUT_FS_WLPOW	Effective power limit exceeded (defined in P-0730[16,17])
29	OUTPUT_FS_GRID_OK	Mains OK (frequency AND voltage within tolerance window = high)

Table 3.8 Selectable functions of digital outputs OSD00 to OSD02

3.12 Specification of USB port X2

The service and diagnostic interface X2 is executed as a USB V1.1 port. It is suitable only for connection of a PC for commissioning, service and diagnosis purposes using the DriveManager 5 software.

Technical specification:

- USB 1.1 standard - full speed device port
- Connection via standard commercially available USB interface cable type A to type B (see also ServoOne order catalogue)

3.13 Specification of Ethernet port X3

The service and diagnostic interface X3 is executed as an Ethernet port. It is suitable only for connection of a PC for commissioning, service and diagnosis purposes using the DriveManager 5 software.

Technical specification:

- Transfer rate 10/100 MBits/s BASE-T
- Transfer profile conforming to IEEE802.3
- Connection via standard commercially available crosslink cable (see also ServoOne order catalogue)

3.14 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.

3.15 Braking resistor X12/RB

In regenerative operation, e.g. when braking the motor, power is routed into the DC link of the multi-axis system and fed back via the supply unit to the mains. If feedback to the mains is not possible (such as in the event of a power failure), the internal braking transistor is activated and the regenerated power is converted into heat by way of a braking resistor.

3.15.1 Connection of the external braking resistor

DANGER: Terminal RB+ is permanently switched to DC link potential (>15 V DC). The connection is not protected inside the device. 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 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 supply unit must be disconnected from the mains supply.

ATTENTION:

- The external braking resistor can only be installed in conjunction with a supply unit without an internal braking resistor.
- Be sure to follow the installation instructions for the external braking resistor.

- The minimum permissible connection resistance of the supply unit must not be infringed. For technical data for rating of the braking resistors see A.2 on page 58 and A.4 on page 59.
- The cable cross-section depends on the performance of the braking resistor.
- The braking resistor may radiate intensive heat. So be sure to keep the braking resistor an adequate distance from adjacent assemblies, or install it outside the switch cabinet.

Terminal X12/RB

ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Cable connection capacity	0.5 - 25 mm² (AWG 20 - AWG 4) [1]		25 - 50 mm² (AWG 4 - AWG 0) [2]	
Tightening torque	2.5 Nm		6 - 8 Nm	

1) Flexible cable with ferrule
2) Flexible cable with or without ferrule

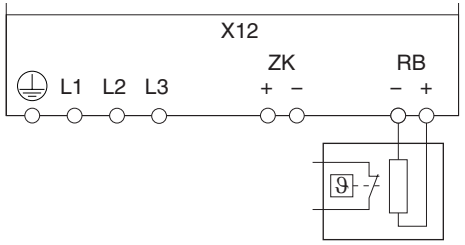


Figure 3.21 Connection of external braking resistor (example: BG6a)

3.16 Overview of step-up reactor connections

The following shows the layout with the respective positions and labelling of the terminals. The temperature is evaluated with a KTY sensor via terminal X5. At 145 °C the supply unit is switched off. For technical data of step-up reactor see section A.7 , p. 61.

WARNING: The reactor has no PE connection. It is intended solely for installation in a switch cabinet, as with IP00 protection they offer no protection against direct or indirect touch contact.

WARNING: The reactor will reach temperatures of up to 145 °C when in continuous operation! Touching may cause serious burns. Touch the reactor only wearing protective gloves, or after allowing it to cool for a lengthy period of time.

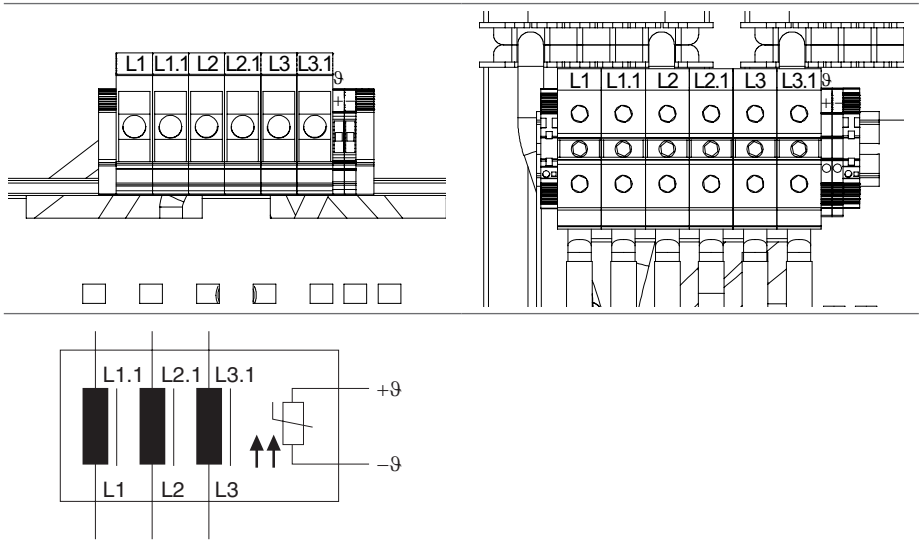


Figure 3.22 Step-up reactor connections for BG5 and BG6a

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Power connections				
Cable connection capacity (flexible without / with ferrule)	1 - 6 mm² 1.5 - 16 mm² (AWG 18 - AWG 6)	2.5 - 35 mm² 2.5 - 35 mm² (AWG 12 - AWG 1)	2.5 - 35 mm² 2.5 - 35 mm² (AWG 12 - AWG 1)	16 - 120 mm² 16 - 95 mm² (AWG 4 - kcmil 250)
Tightening torque	1.2 - 2.4 Nm	4 - 5 Nm	4 - 5 Nm	12 - 20 Nm
KTY sensor				
Cable connection capacity (flexible cable with ferrule)	0.5 - 2.5 mm² (AWG 20 - AWG 13)			
Tightening torque	0.4 - 0.8 Nm			

3.17 Overview of input reactor connections

The following shows the layout with the respective positions and labelling of the terminals. For technical data of input reactor see section A.8 , p. 61.

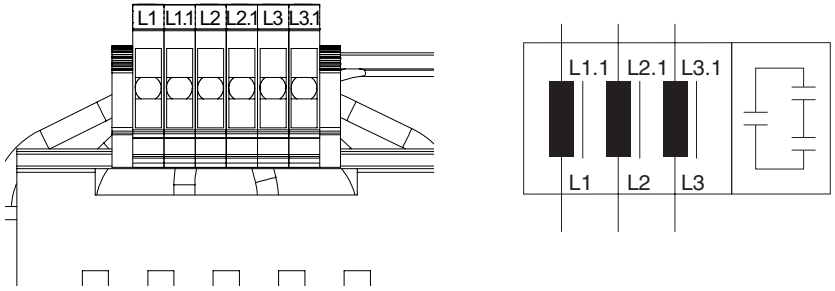


Figure 3.23 Input reactor connections for BG5 and BG6a

WARNING: The reactor has no PE connection. It is intended solely for installation in a switch cabinet, as with IP00 protection they offer no protection against direct or indirect touch contact.

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Cable connection capacity (flexible without / with ferrule)	1 - 6 mm² 1.5 - 16 mm² (AWG 18 - AWG 6)	2.5 - 35 mm² 2.5 - 35 mm² (AWG 12 - AWG 1)	2.5 - 35 mm² 2.5 - 35 mm² (AWG 12 - AWG 1)	16 - 120 mm² 16 - 95 mm² (AWG 4 - kcmil 250)
Tightening torque	1.2 - 2.4 Nm	4 - 5 Nm	4 - 5 Nm	12 - 20 Nm

3.18 Overview of mains filter connections

The following shows the layout with the respective positions and labelling of the terminals. For technical data of mains filter see section A.9 , p. 61.

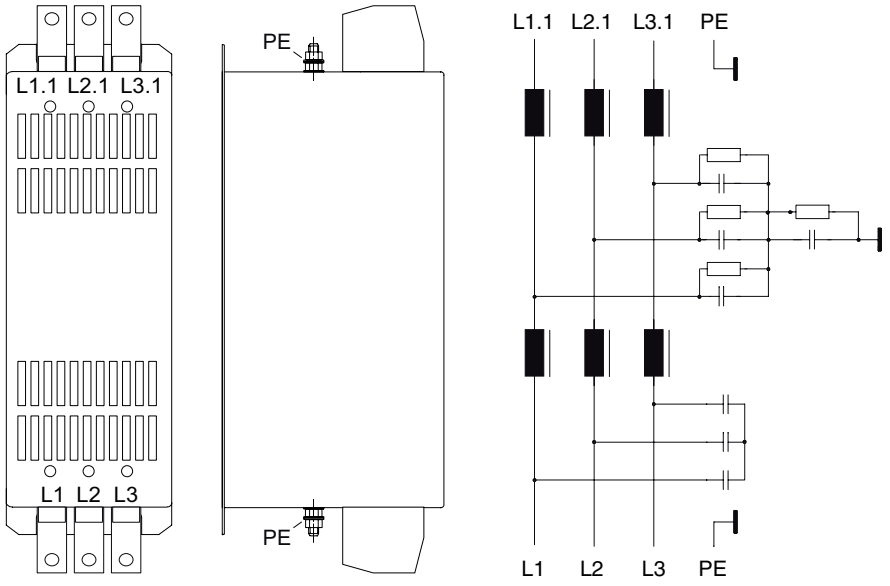


Figure 3.24 Mains filter connections for BG5 and BG6a

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Tightening torque	2 Nm	4 Nm	6 Nm	15 Nm

4. Commissioning

4.1 Notes for operation

ATTENTION:

- Cooling air must be able to flow through the device and the mains connection components without restriction.
- Pollution severity 2 to EN 60664-1.

Please be sure to avoid:

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

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

4.2 Initial commissioning (actuation via terminals)

The following details commissioning of the supply unit. The device is controlled via control terminal X4. The setpoint reference for the DC link voltage is set internally as a fixed value. Commissioning is divided into the following steps:

DANGER FROM ELECTRICAL TENSION! Never wire or disconnect electrical connections while they are live. Disconnect the device from the mains supply (400/460/480 V AC) before working on it. Work on the device only once the DC link voltage has fallen below 50 V residual voltage (measured at terminals X12/ZK+ and X12/ZK–).

Step	Action	Comment
1.	Wiring of components	See section 3.4 , p. 29 ff.
2.	Switching on control voltage External 24V supply voltage	See section 3.7.1 , p. 33.
3.	Communication setup with DriveManager 5	For details on installation refer to the DriveManager 5 Installation Manual and the Online Help.
4.	Adaptation to the parameters of the supply system	
5.	Automatic identification of DC link capacity and equivalent time constant of current control	
6.	Parameter setting of the controller for the DC link capacity	See section 4.2.7 , p. 49.
7.	Parameter setting of the controller for the DC link voltage	
8.	Programming monitoring of the braking resistor	See section 4.2.9 , p. 50.
9.	Connecting the mains supply voltage	Via main switch
10.	Activating closed-loop control	Start with ENPO high.

4.2.1 System requirements

- An installed supply unit (see section 3. , p. 24) Details on initial commissioning are set out in the following section 4.2.2 , p. 46
- Section 2, "Installation", and section 3, "Starting DriveManager 5", of the DriveManager 5 Installation Manual worked through
- Connection between PC and ServoOne supply unit (Ethernet or USB)

ATTENTION: During commissioning, be sure to comply with the safety regulations specified in section 1. , p. 9.

4.2.2 Wiring of components

For complete wiring all power supply, communication and service connections must be connected to the appropriate terminals, using the cables and leads provided for this purpose. Ensure adequate shielding - see section 3.2 , p. 24.

DANGER FROM ELECTRICAL TENSION! Never wire or disconnect electrical connections while they are live. Disconnect the device from the mains supply (400/460/480 V AC) before working on it. Work on the device only once the DC link voltage has fallen below 50 V residual voltage (measured at terminals X12/ZK+ and X12/ZK–).

= selected setting/component

Connections	Terminals	Terminal designation	Cable type
Control supply	X9/10	+24 V DC / pin 1 = + , pin 2 = –	Standard
Precharge/mains synchronization, auxiliary relay	X21	L1/L2/L3 (400/460/480 V AC) HREL	Standard shielded
Mains supply	X12	L1/L2/L3/PE (400/460/480 V AC)	Standard shielded
See section 3.3 Overview of connections, p. 27			

Table 4.1 Voltage supply

Connection	Socket	Designation	Cable type
USB	X2	USB A	• CC-USB 03
TCP / IP (Ethernet)	X3	RJ45	• CC_ECL 03

Table 4.2 Communication with PC using DriveManager 5 user software

Connection	Terminals	Terminal designation	Cable type
+24 V DC	X4/22	ISDSH	Standard shielded
ENPO (Start)	X4/10	ENPO	Standard shielded
See section 3.9.2 Default terminal assignment, p. 40			

Table 4.3 Communication via terminals

4.2.3 Switching on control voltage (24 V_{DC})

2.	In order to initialize and parameterize the supply unit, only the 24 DC control voltage supply needs first to be connected to X2 or X10. Ensure correct polarity.

After successful switching on you will be able to read two conditions in the 7-segment display. Other message see section 5. , p. 52.

D1	D2	Action	Reaction	Explanation
	0	Switch-on of ext. 24 V control voltage	Initialization OK	Initialization time < 5 s
	1	Not ready for start	No DC link voltage	Device is initialized

Table 4.4 Switch-on status of ServoOne (on connection of 24 V control supply)

4.2.4 Communication with DriveManager 5

3.	The DriveManager 5 user software must be installed on a PC. The PC can be connected to the drive controller via USB or Ethernet (TCP/IP).

For a detailed description of DriveManager 5 refer to the DriveManager 5 Online Help.

ATTENTION: Communication between the PC and the drive controller may only be established once the drive controller has completed its initialization. The display D1/D2 no longer indicates "88" or "0".

NOTE: The supply unit is factory pre-configured and adapted to the mains connection set. The factory parameter setting may only be changed by trained specialist personnel. The parameter changes described in the following are used to adapt the supply unit to the parameters of the supply system and to the number and type of DC axis controllers connected to the DC terminals X11.

NOTE: The firmware of the supply unit must be compatible with the DriveManager 5 version. If communication fails, the compatibility must be checked.

4.2.5 Setting the mains voltage and frequency of the supply system

4.	The supply unit is factory-configured to a 1 x 230 V AC (50 Hz) system. If the supply unit is to be operated on such a system, continue with step 5. If the supply unit is to be operated on a different system, parameters P-0307 Mains voltage and P-0452 Mains frequency must be set to the corresponding values.

NOTE: Only the fixed mains voltages 400 V, 460 V and 480 V and the mains frequencies 50 Hz and 60 Hz can be set.

The supply unit regulates the DC link voltage to an internally preset fixed value. At an input voltage of 400 V_{AC}, the DC link voltages 650 and 770 V_{DC} are possible. At an input voltage of 460 V and 480 V_{AC}, the DC link voltage 770 V_{DC} is possible.

- Set the mains voltage P-0307.

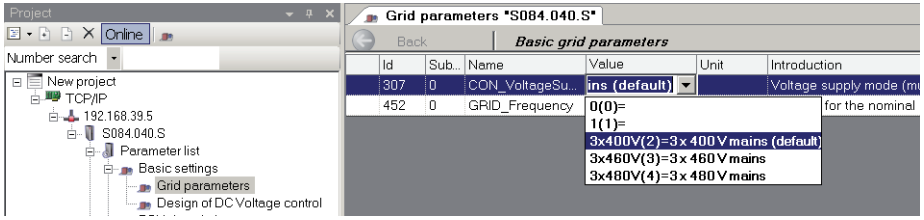


Figure 4.1 Parameter editor - parameter P-0307

- Set the mains frequency P-0452.

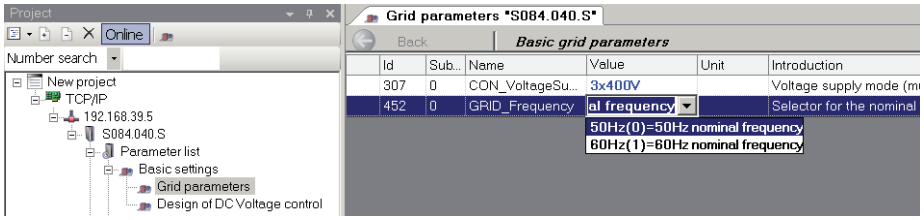


Figure 4.2 Parameter editor - parameter P-0452

NOTE: For the parameters to take effect also after a restart, the changed settings must be permanently saved to the device and a 24V reset performed.

Save setting

1. To save the parameter setting on the device click the "Save setting permanently to device" button.
2. It is also possible to save the parameter data set to the connected PC as a file. To do so, click the "Save current device setting to file" button, select the desired directory and click "Save" to confirm.

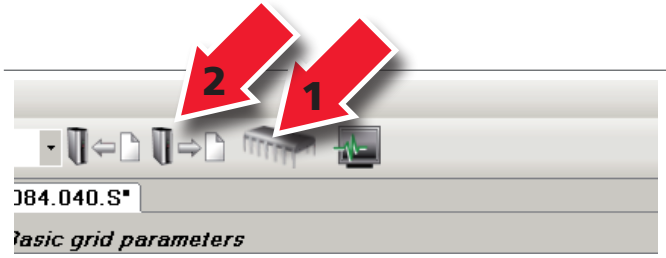


Figure 4.3 Save setting

4.2.6 Automatic identification of DC link capacity and equivalent time constant of current control

5.	The DC voltage controller of the supply unit regulates DC link voltage to an internally preset fixed value. Control depends on the DC link capacity of the multi-axis system and the equivalent time constant of current control. Both values can and should be determined by automatic identification first.

ATTENTION: the maximum total capacity of the multi-axis system DC link may not exceed 10,000 µF on a ServoOne supply unit BG5 (incl.) and 20,000 µF on BG6a (incl.).

- Before starting automatic identification, set the specified value for DC link voltage to 700 V_{DC} under parameter P-0410 "CON_VCON_VdcRef".
- Start automatic identification by setting parameter P-1501 "SCD_AT_VdcCAP_Con" to START(2).

As soon as the parameter switches to the value READY(0), the identification process is complete.

The values determined for total DC link capacity (P-1500) and the equivalent time constant for current control (P-0406) are now available for designing the DC voltage controller.

NOTE: in the next step, the value determined for total DC link capacity (P-1500) section 4.2.7 should be checked for plausibility and, if necessary, replaced with the known value. The specified value for DC link voltage (P-0410) section 4.2.8 should likewise be set.

4.2.7 Setting DC link capacity

6.	The settings of the DC voltage controller depend on the DC link capacity of the complete multi-axis system. You will find the DC link capacities under "Technical data" in the appendix to the operation manuals of the supply unit and the DC axis controllers.

- Add together the DC link capacities of all the controllers connected to the multi-axis system.
- Set the overall value of DC link capacity P-1500 (in µF).

ATTENTION: the maximum total capacity of the multi-axis system DC link may not exceed 10,000 µF on a ServoOne supply unit BG5 (incl.) and 20,000 µF on a BG6a (incl.).

- Set the relative controller dynamics P-0405 of the voltage controller. Recommended value: 100 %.

NOTE:parameter P-0405 must in all cases be activated by double-clicking in the "Value" field and confirming by pressing "Enter", even if you do not make any changes. Otherwise the voltage controller will not be designed automatically.

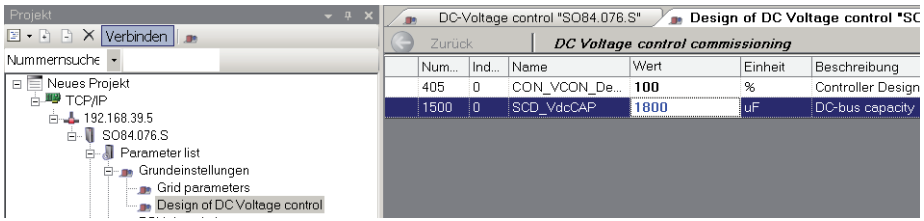


Figure 4.4 Parameter editor - parameters P-0405 and P-1500

NOTE: for the parameters to take effect even after a restart, the changed settings must be permanently saved to the device and a 24V reset performed.

This completes all necessary parameter settings.

4.2.8 Setting DC link voltage

7. The supply unit regulates the DC link voltage to an internally preset fixed value. At an input voltage of 400 V_{AC}, the DC link voltages 650 and 770 V_{DC} are possible. At an input voltage of 460 V and 480 V_{AC}, the DC link voltage 770 V_{DC} is possible.

- Set the DC link voltage to 650 or 770 V_{DC} P-0410.

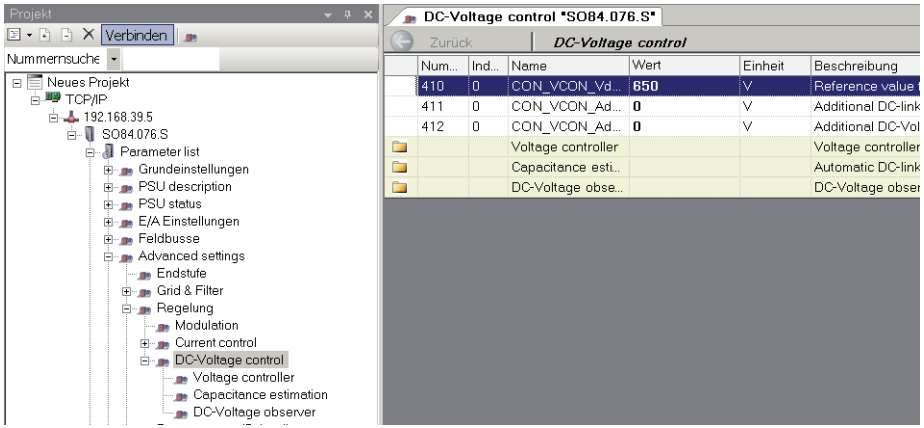


Figure 4.5 Parameter editor - parameter P-0410

4.2.9 Programming monitoring of the braking resistor

8. Braking resistor setting.

- Set the braking resistor:
  - P-0741 Resistance
  - P-0742 Rated power
  - P-0743 Maximum energy
  - P-0745 Threshold value for warning
- Set parameter P-0740 to 1 in order to activate the braking resistor.

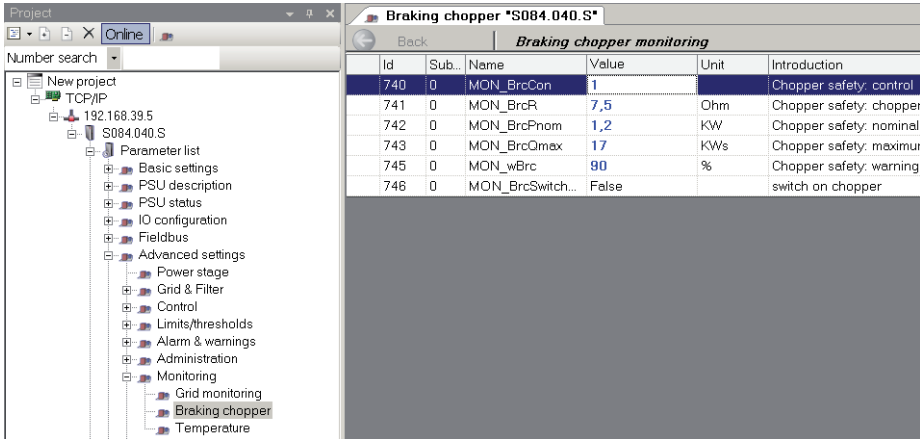


Figure 4.6 Parameter editor - parameter P-0740

If the braking chopper is actuated (DC link voltage ≥ 820V), the power converted in the braking resistor is up-integrated.

$$P = \frac{(820\ V)^2}{MON\_BrcR}$$

If the braking chopper is not actuated, the power is down-integrated with the parameterized value for the braking chopper rated power (MON_BrcPnom).

When the shut-off threshold MON_BrcQmax is reached, a device error (ErrID=>24, Location=>01) is triggered and actuation of the braking chopper is disabled.

NOTE: Any pre-heating of the braking resistor is not taken into account!

4.2.10 Connecting the mains supply voltage

ATTENTION: Before connecting, check that the wiring phase is correct.

9.	The mains power can now be connected via the main switch. When the DC link precharge is complete, the supply unit display changes from value 1 to value 2.

4.2.11 Activating closed-loop control

10.	After DC link precharging, closed-loop control can be activated by enabling the ENPO input (X4/10). The supply unit then synchronizes the control to the mains voltage. In this phase the display indicates the value 4. When up-synchronization has completed successfully, closed-loop control is activated and the pre-specified reference setpoint for the DC link voltage is set. The display indicates the value 5. The current measured DC link voltage is indicated via parameter P-0332 in the "Parameter list > PSU status > Actual values > DC Voltage" subject area of the parameter tree. If the mean of this value corresponds to the pre-specified reference, the supply unit has been successfully commissioned into operation.

4.3 Diagnostics

► Dual 7-segment display, see section 5. , p. 52.

4.3.1 Faults and warnings in DriveManager 5

Parameters P-0031 ErrorStack and P-0033 ActualError contain additional information on an error or warning. This information is retrieved by way of the "Device State monitor" in DriveManager 5.

NOTE: For more details refer to the ServoOne DC Axis Controller Operation Manual.

5. Diagnostics

5.1 Device states

The device states can be read from the 7-segment display (D1, D2).

Display	Meaning	Parameters
System states		
	Device in reset state	
	Self-initialization on device start up	(Start)
 1)	Not ready (no DC link voltage)	(NotReadyToSwitchOn)
 1)	Starting lockout (ENPO not set) (DC link precharged to ideal voltage, power stage not ready)	(SwitchOnDisabled)
	READY (ENPO set) (power stage ready)	(ReadyToSwitchOn)
	On (DC link voltage is increased to reference setpoint / soft-start active)	(SwitchedOn)
	Supply unit ready (DC link voltage setpoint reached)	(OperationEnabled)
	Fault reaction active	(FaultReactionActiv)
1) Not a "Safe" display under the terms of EN 61800-5-2.		

Table 5.1 Device states

Display	Meaning	Parameters
	Error (see Table 5.3 Error list)	(Fault)
1) Not a "Safe" display under the terms of EN 61800-5-2.		

Table 5.1 Device states

NOTE: The STO (Safe Torque Off) safety function is not required for the ServoOne supply unit, as no motors are connected. In order to start the supply unit, a jumper must be placed between X4/14 and X4/22.
If this jumper is forgotten, the fact is indicated by a flashing dot on the device display. The STO safety function is used in conjunction with a ServoOne DC axis controller.

5.1.1 Errors

In event of error alternating display: ER > 02 > 05 * ER > 02 > 05 ...

Display	Meaning	Explanation
	Error	ER = Error
	Error name:	02 = "Error in parameter list"
	Description of error:	05 = "Function to check current parameter list"

Table 5.2 Display in case of error

NOTE: The errors can be acknowledged in accordance with their programmed reaction (ER) or reset only via a 24 V reset (X9/10) (ER▪).

ATTENTION: Errors marked with a dot can only be reset when the cause of the fault has been eliminated.

5.2 Error list

The following table lists the error messages (error number, error location, error text) of the supply unit. In the event of an error the supply unit display alternates cyclically between "Er", ">error number<", ">error location<". The error messages can be reset by switching the ENPO input (X4/10).

Error number	Error location	Error text
01		Runtime error
	00	Unknown runtime error
02		Error in parameter list
	00	Unknown runtime error
	01	Parameter initialisation failed
	02	Parameter virgin initialisation failed
	03	Error in parameter saving routine
	04	Error in paralist while adding a new parameter
	05	Parameter check failed
	06	Parameter ID is multiply defined
	07	PowerStage data are corrupt
	08	Device cannot be used in this voltage level
03		Under voltage
	00	Unknown error
	01	Undervoltage detected
04		
	00	Unknown error
	01	Overvoltage detected
05		Over current
	00	Unknown error
	01	Overcurrent (hardware) detected
	02	Overcurrent (software) detected
	03	Overcurrent (software) detected
06		Overtemperature PTC
	00	Unknown error
	01	PTC temp. too high
	02	PTC DIN2 error detected (shortcut, resistance smaller 50 Ohm)
	03	PTC DIN3 error detected (overtemperature, resistance higher than 3500 Ohm)
	04	PTC DIN1 error detected (hysteresis after over temperature, resistance higher than 1650 Ohm)
07		Overtemperature powerstage cooler
	00	Unknown error
	01	Overtemperature inverter detected
08		Overtemperature PSU interior
	00	Unknown error
	01	Overtemperature PSU interior detected
09		Error grid
	00	Unknown grid error
	01	Grid frequency out of range
	02	Grid voltage out of range
	03	Timeout during synchronization
10		Error I2t power amplifier
	00	Unknown error
	01	I2t power amplifier detected
11		External error at digital input detected
	00	Unknown external error
	01	External error triggering at digital input
12		Error in CAN option
	00	Unknown CAN option error

Table 5.3 Error list

Table 5.3 Error list

Error number	Error location	Error text
	01	CAN option: BusOff error
	02	CAN option: Guarding error
	03	CAN option: Message transmit failed
	04	CAN option: Heartbeat error
	05	CAN option: Illegal address
	06	CAN option: mapping error
	07	CAN option: Sync / RxPDO timeout error
13		Error in SERCOS option
	00	Unknown SERCOS error
	01	SERCOS option: Error while hardware initialisation
	02	SERCOS option: Illegal communication phase
	03	SERCOS option: Optical fiber break
	04	SERCOS option: Receive data disturbed
	05	SERCOS option: MST failure
	06	SERCOS option: MDT failure
	07	SERCOS option: 2 devices with same address in the ring
	08	SERCOS option: Phase upshift failure
	09	SERCOS option: Phase downshift failure
	10	SERCOS option: Phase switching without ready acknowledge
	11	SERCOS option: Error while parameter initialisation
	12	SERCOS option: Run time error
	13	SERCOS option: Watchdog failure
	14	SERCOS option: Error in parameter data
14		Error in EtherCAT option
	00	Unknown EtherCat-option error
	01	Sync manager 0 watchdog error
15		Parameter error

Table 5.3 Error list

Error number	Error location	Error text
	00	Unknown Parameter error
	01	Error while init current monitoring
	02	Error while initializing control
	03	Drive commissioning: Watchdog failure via service tool access
	04	Drive initialization: Unexpected error during drive initialization
16		DC voltage tracking error
	00	Unknown VoltageDiff error
	01	Max. voltage difference detected
	02	reserved
17		Fatal error
	00	Unknown fatal error error
	01	Error while power stage initialisation
	02	Error while power stage initialisation
	03	Error while power stage initialisation
	04	Error while power stage initialisation
	05	Error while power stage initialisation
	06	Error while power stage initialisation
	07	Cannot switch off brake transistor. Disconnect power supply immediately!
	08	Hardware identification failed
18		CPU error
	00	Unknown TC error
	01	reserved
	02	reserved
	03	FPU, Error in floating point unit
	04	FPU, Error in floating point unit
19		Control initialisation error

Table 5.3 Error list

Error number	Error location	Error text
	00	Unknown error during Initialisation of Control
	01	Invalid calibration Value (Division by Zero)
	02	reserved
	03	reserved
	04	reserved
20		PLC error
	00	User defined error in the PLC program detected.
21		Error in PROFIBUS option
	00	PROFIBUS option: Unknown error
	01	PROFIBUS option: process data timeout
22		Task overload
	00	Internal timing error
	01	Internal timing error
	02	Internal timing error
23		Power fail detected
	00	Power fail detected
24		Error braking chopper
	00	Unknown braking chopper error
	01	P*t-integrator value exceeds maximum

Table 5.3 Error list

For detailed information on error management refer to the "ServoOne Application Manual".

5.3 Helpline/Service

If you have any technical queries about project planning or commissioning of the drive unit, please contact our Helpline.

- Helpline - You can reach us:
  Mon.-Fri.: 8.00 a.m. - 5.00 p.m.
  Phone: +49 6441/966-180
  E-mail: helpline@lt-i.com

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

- Service & Service - You can reach us:
  Mon.-Fri.: 8.00 a.m. - 5.00 p.m.
  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 our website, www.lt-i.com, in the section of the same name.

A. Appendix

A.1 Technical data - supply unit

Size	BG5					
Device	SO84.040.Sxxx.x			SO84.076.Sxxx.x		
Mains supply voltage (±10 %)	400 V_{AC}		460 / 480 V_{AC}	400 V_{AC}		460 / 480 V_{AC}
Controlled DC link voltage	650 V_{DC}	770 V_{DC}	770 V_{DC}	650 V_{DC}	770 V_{DC}	770 V_{DC}
Input, mains side						
Continuous current [$A_{AC\ eff}$]	40	40	33	76	76	63
Peak current[1] [A_{AC}]	80	80	67	144	144	120
Switching frequency [kHz]	12			4		
Continuous power [kVA]	27.5			52.5		
Power loss [W]	1010					
Asymmetry of mains voltage	± 3 % max.					
Frequency	50/60 Hz					
Max. Cable cross-section[2] of terminals X12	25 mm²					
DC link output						
Continuous current [A_{DC}]	40	34	34	76	64	64
Peak current[1] [A_{DC}]	80	68	68	144	122	122

Technical data applies to wall-mounted and liquid-cooled housing variants

1) for 10 s

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 supply unit.

Table A.1 BG5 technical data dependent on mains input voltage and controlled DC link voltage

Size	BG5					
Device	SO84.040.Sxxx.x			SO84.076.Sxxx.x		
Mains supply voltage (±10 %)	400 V_{AC}		460 / 480 V_{AC}	400 V_{AC}		460 / 480 V_{AC}
Controlled DC link voltage	650 V_{DC}	770 V_{DC}	770 V_{DC}	650 V_{DC}	770 V_{DC}	770 V_{DC}
Continuous power [kW]	26			50		
Peak power[1] [kW]	52			94		
DC link capacity [µF]	900					

Technical data applies to wall-mounted and liquid-cooled housing variants

1) for 10 s

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 supply unit.

Table A.1 BG5 technical data dependent on mains input voltage and controlled DC link voltage

ATTENTION: The maximum overall capacity of the multi-axis system DC link for a ServoOne supply unit BG5 (incl.) must not exceed 10,000 µF.

Size	BG5	
Device	SO84.040.Sxxx.x	SO84.076.Sxxx.x
Braking chopper power electronics[2]		
Software response threshold[1] [V_{DC}]	820	
Hardware response threshold [V_{DC}] on/off	860/840	
Peak braking power [kW] on software/hardware side	90/99	
Minimum ohmic resistance of an externally installed braking resistor	7.5 Ω	
Continuous chopper power [kW]	2	

1) Minimum switch-on time 250 µs

2) Optionally with liquid cooling: Internal braking resistor (mounted on cooler floor) on request

Table A.2 Braking chopper power electronics BG5

Size	BG6a					
Device	SO84.115.Sxxx.x			SO84.170.Sxxx.x		
Mains supply voltage (±10 %)	400 V_{AC}		460 / 480 V_{AC}	400 V_{AC}		460 / 480 V_{AC}
Controlled DC link voltage	650 V_{DC}	770 V_{DC}	770 V_{DC}	650 V_{DC}	770 V_{DC}	770 V_{DC}
Input, mains side						
Continuous current [$A_{AC\ eff}$]	115	115	96	170	170	142
Peak current[1] [A_{AC}]	195	195	163	245	245	204
Switching frequency [kHz]	8			4		
Continuous power [kVA]	80			118		
Power loss [W]	2500					
Asymmetry of mains voltage	± 3 % max.					
Frequency	50/60 Hz					
Cable cross-section[2] of terminals X11	35 ... 95 mm²					
Cable cross-section[2] of terminals X11	10 ... 95 mm²			50 ... 150 mm²		
Cable cross-section[2] of terminals X12 for DC link + and -	50 ... 150 mm²					
Cable cross-section[2] of terminals X12 RB + and -	25 ... 70 mm²					
DC link output						
Continuous current [A_{DC}]	115	97	97	170	144	144
Peak current[1] [A_{DC}]	195	165	165	246	207	207

Technical data applies to wall-mounted and liquid-cooled housing variants; power stage switching frequency 4 kHz

1) for 10 s

2) The minimum cross-section of the cable depends on the local regulations and conditions, as well as on the rated current of the supply unit.

3) With inserts for SO84.115.Sxxx.x

Table A.3 BG6a technical data dependent on mains input voltage and controlled DC link voltage

Size	BG6a					
Device	SO84.115.Sxxx.x			SO84.170.Sxxx.x		
Mains supply voltage (±10 %)	400 V_{AC}		460 / 480 V_{AC}	400 V_{AC}		460 / 480 V_{AC}
Controlled DC link voltage	650 V_{DC}	770 V_{DC}	770 V_{DC}	650 V_{DC}	770 V_{DC}	770 V_{DC}
Continuous power [kW]	75			110		
Peak power[1] [kW]	127			160		
DC link capacity [µF]	4240					

Technical data applies to wall-mounted and liquid-cooled housing variants; power stage switching frequency 4 kHz

1) for 10 s

2) The minimum cross-section of the cable depends on the local regulations and conditions, as well as on the rated current of the supply unit.

3) With inserts for SO84.115.Sxxx.x

Table A.3 BG6a technical data dependent on mains input voltage and controlled DC link voltage

ATTENTION: The maximum overall capacity of the multi-axis system DC link for a ServoOne supply unit BG6a (incl.) must not exceed 20,000 µF.

Size	BG6a	
Device	SO84.115.Sxxx.x	SO84.170.Sxxx.x
Braking chopper power electronics[2]		
Software response threshold[1] [V_{DC}]	820	
Hardware response threshold [V_{DC}] on/off	860/840	
Peak braking power [kW] on software/hardware side	143/157	
Minimum ohmic resistance of an externally installed braking resistor	4.7 Ω	
Continuous chopper power [kW]	10	

1) Minimum switch-on time 250 µs

2) Optionally with liquid cooling: Internal braking resistor (mounted on cooler floor) on request

Table A.4 Braking chopper power electronics BG6a

A.2 Current consumption of control supply

Housing variant	Size	Max. start-up current	Continuous current
Wall mounted	BG5	7 A	2.5 A
	BG6a	10 A	8 A
Liquid-cooled	BG5	7 A	2 A
	BG6a	8 A	2 A

Table A.5 Current consumption of control supply X9 and X10

A.3 Ready made-up cables

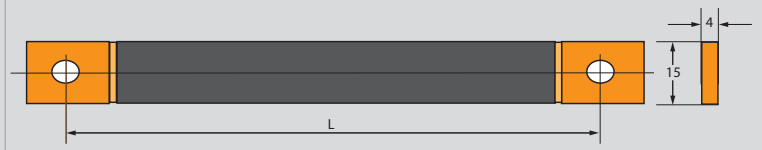
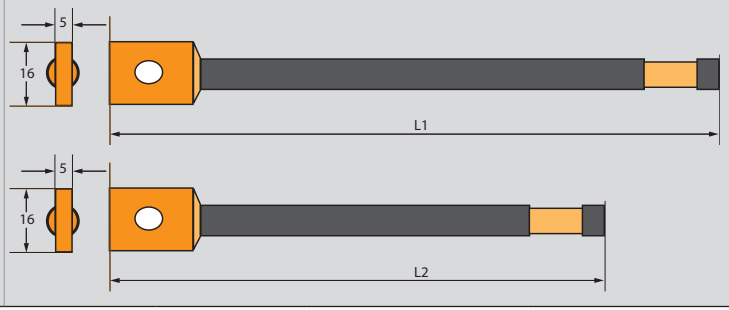
Type	L	Cross-section	Version	Connection
DC link BG5	193 mm	42 mm²	Flat copper braiding with double shrink-fit tube covering	Flat sheath on both sides with hole Ø 5.5 mm
Sketch				
DC link BG6a	L1 = 385 mm L2 = 345 mm	29.4 mm²	Round stranded copper with double shrink-fit tube covering	One side flat sheath with hole Ø 5.5 mm, second side stripped strand
Sketch				

Table A.6 Technical data – ready made-up encoder cables

A.4 Hydrological data of liquid cooling

ATTENTION! The temperature of the cooling plate must not be more than 10 °C below the ambient temperature. Condensation will result in destruction of the device.

NOTE: Customers must provide adequate heat dissipation for the water cooler. The coolant should be approved by LTi DRiVES if it deviates from the details below.

Requirements		Limits
Coolant quality		Recommended: Drinking water + corrosion inhibitor (e.g. ethylene glycol) Not permitted: Chloride ions (Cl- > 100 ppm) Calcium carbonate (CaCO3 > 160 ppm)
Pollution		The coolant must be as pure as possible so as not to clog the ducts. At a suspension concentration above 15 mg/dm³ continuous cleaning is recommended.
Operating coolant temperature		The coolant temperature may be between 5 °C and 40 °C. However, the coolant temperature must not be more than 10 °K below the ambient temperature, so as to prevent condensation on the heat sink.
Cooler material		Aluminium
Coolant mean pressure (nominal/maximum value)		1 / 2 bar [1]
Coolant flow rate (nominal/maximum value)	BG5	7.85 / 11 l per min [2]
	BG6a	10.5 / 12.6 l per min [2]

1) Rating for devices without internal braking resistor
2) Preliminary data

Table A.7 Liquid cooling requirements

A.5 Dynamic cooler temperature monitoring

If the coolant flow breaks down or is not generated, the power stage may overheat. For this reason the drive controller is fitted with a dynamic cooler temperature monitor which shuts off the drive controller in the event of overheating. The drive controller shuts down at a heat sink temperature of 65 °C regardless of the temperature gradient.

A.6 Ambient conditions

Ambient conditions	ServoOne
Protection	IP20 except terminals (IP00)
Accident prevention regulations	According to local regulations (in Germany e.g. BGV A3)
Mounting height	Up to 1000 m above MSL, over 1000 m above MSL with power reduction (1 % per 100 m, max. 2000 m above MSL)
Pollution severity as per EN 60664-1	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.8 ServoOne ambient conditions

Climatic conditions		Supply unit and components
in transit	as per EN 61800-2, IEC 60721-3-2 class 2K3[1)]	
	Temperature	-25 °C bis +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 Air-cooled, liquid-cooled	-10 °C to +40 °C BG5 to BG6a above up to 55 °C with power reduction (2 % per °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.9 ServoOne climatic conditions

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

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

Table A.10 ServoOne mechanical conditions

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

ATTENTION: The supply unit and the DC drive controllers must not be installed in areas where they are exposed to continuous shaking.

A.7 Technical data - step-up reactor

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Rated alternating current	3 x 40 A	3 x 76 A	3 x 115 A	3 x 170 A
System voltage	3 x 400 V_{AC} ... 3 x 480 V_{AC}			
Rated for effective power (step-up mode 650 V_{DC}/770 V_{DC})	26 kW	50 kW	75 kW	110 kW
Power loss at 100 % ED	225 W	440 W	400 W	930 W
Frequency	50/60 Hz			
Max. cable cross-section of terminals	10 mm^2	35 mm^2	35 mm^2	70 mm^2
Protection	IP00			
Temperature sensor	KTY84-130			

Table A.11 Technical data - step-up reactor

A.8 Technical data - input reactor with membrane capacitor

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Rated alternating current	3 x 40 A	3 x 76 A	3 x 115 A	3 x 170 A
System voltage	3 x 400 V_{AC} ... 3 x 480 V_{AC}			
Power loss at 100 % ED	120 W	144 W	180 W	174 W
Frequency	50/60 Hz			
Max. cable cross-section of terminals	10 mm^2	16 mm^2	35 mm^2	70 mm^2
Protection	IP00			
Fitting position	Condensers with liquid or viscous fillings must be installed upright, with the terminals Up.			

Table A.12 Technical data - input reactor with membrane capacitor

A.9 Technical data - mains filter

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Type	FFU 3 x 56 K	FFU 3 x 80 K	FFU 3 x 130 K	FFU 3 x 180 K
Rated alternating current[1)]	3 x 56 A_{eff}	3 x 80 A_{eff}	3 x 130 A_{eff}	3 x 180 A_{eff}
System voltage	3 x 400 V_{AC} ... 3 x 480 V_{AC}			
Max. cable cross-section of terminals	16 mm^2	25 mm^2	50 mm^2	95 mm^2
Protection	IP 20			

1) Rated alternating current at 40 °C ambient temperature

Table A.13 Technical data - mains filter

A.10 Technical data - mains fuse

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Specified mains fuse, duty class gG	3 x max. 63 A	3 x max. 100 A	3 x max. 150 A	3 x max. 200 A

Table A.14 Technical data - mains fuse

A.11 Technical data - mains contactor

We suggest the following mains contactors:

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Type	Siemens 3RT1035-1BB40	Siemens 3RT1045-1BB40	Siemens 3RT1054-1NB36	Siemens 3RT1056-6NB36
Control supply voltage	24 V_{DC}	24 V_{DC}	21 V … 27.3 V_{DC}	21 V … 27.3 V_{DC}
Rated current AC-2 and AC-3 to 500V	40 A	80 A	115 A	185 A

Table A.15 Technical data - mains contactor

A.12 Technical data - circuit-breaker

We suggest the following circuit-breakers in the mains synchronization line:

For ServoOne	SO84.040.S	SO84.076.S	SO84.115.S	SO84.170.S
Type	Siemens 3RV1721-1ED10		Siemens 3RV1721-1GD10	
Rated current to AC 500V +10%	4 A		6.3 A	
No back-up fuse required, as short-circuit proof to 100kA				

Table A.16 Technical data - circuit-breaker

A.13 UL approbation

UL approbation of the ServoOne multi-axis system is in work.

Index

Symbole

A

C

D

E

F

H

I

M

O

P

Q

R

S

T

U

X

LTi DRiVES GmbH

Gewerbestrasse 5-9
35633 Lahnau
Germany
Phone +49 (0) 6441/ 96 6-0
Fax +49 (0) 6441/ 96 6-137

Heinrich-Hertz-Strasse 18
59423 Unna
Germany
Phone +49 (0) 2303/ 77 9-0
Fax +49 (0) 2303/ 77 9-397

www.lt-i.com
info@lt-i.com

We reserve the right to make technical changes.

The content of our Operation Manual 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. Please visit www.lt-i.com for details of the latest versions.

ID no.: 1101.21B.0-00 • 04/2010