MSc DC/DC Converter
Product Overview

subject to changes without notice

Type: 3 x 40 DCDC 750

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1 TERMS AND ABBREVIATIONS

Term/Abbreviation	Explanation
cover	There are two covers: Cable connection box cover: Covers the power connections. Front cover: Covers the control connections.
Manufacturer	MSc Electronics Oy
MSc DC/DC Converter	3x40DCDC750
ES	Energy Source (e.g. batteries, supercapacitors, solar cells, fuel cells)
ES Current	Energy Source current
ES Voltage	Energy Source voltage
DC Voltage	DC link voltage

2 TECHNICAL INFORMATION

2.1 TECHNICAL DESCRIPTION

2.1.1 Introduction

MSc DC/DC Converter is a bidirectional DC/DC converter, which can be used to transfer energy from an Energy Source to a DC link. The MSc DC/DC Converter is designed **for industrial environments only**.

2.1.2 Technical data

MODEL	**3x40DCDC750**
Topology	
Operation mode	Bidirectional
Control method	DC link voltage reference Energy Source voltage reference Energy Source current reference
Input (Energy Source)	
DC Input Voltage range	3 x 35...700
Nom. Input Current	3 x 40 A
Max. Input Current	3 x 65 A 1 min./10min.
Output (DC link)	
DC Output Voltage Range	200...800
Efficiency	
Max. Efficiency	97
Quiescent power	< 100 W
I/O Connections	
Input signals	Digital/Analogue
Output signals	Digital/Analogue
General Data	
Dimensions (wxhxd) in mm	285 x 686 x 344
Weight (kg)	27
Cooling	forced air cooled
Operation temperature	-10°C - +40°C
Degree of protection (IEC 60529)	IP 20
Noise level	<80 dB
Standards	
EMC	EN 61800-3
Electrical safety	EN 61800-5-1
Protections	

Protections	Internal overtemperature DC link overvoltage Energy Source overvoltage Energy Source overcurrent

- **Startup from DC link side at voltage level of 360 V DC or more**
- **Non-standard startup voltage side and level change upon request**
- **Control method is based on factory setting, which cannot be changed after the delivery.**

NOTE: The Energy Source voltage has to be lower than the DC link voltage all the time to avoid uncontrollable current flow! For stable performance it is advised to keep the Energy Source voltage at least 100 V DC lower than the DC link voltage.

NOTE: MSc DC/DC Converter does not galvanically isolate the Energy Source from the DC link. All voltages connected to the Energy Source terminals are also connected to the DC link terminals!

2.1.3 Ambient conditions

The MSc DC/DC Converter is suitable for indoor wall-mount installation, in a well-ventilated area without dust and excessive aggressive gases where the ambient operating conditions do not exceed the following values:

Ambient operating temperature/Cooling air temperature	See chapter 2.1.2 Technical data
Storage/transportation temperature (in the protected package)	-40°C…+70°C
Relative humidity	0 - 95% RH, non-condensing, non-corrosive, no dripping water
Cooling air required	3x40DCDC750 425 m^3/h
Air quality / chemical vapours	IEC 721-3-3, MSc DC/DC Converter in operation, class 3C2[(a)]
Air quality / mechanical particles	IEC 721-3-3, MSc DC/DC Converter in operation, class 3S2[(b)]
Altitude	100 % load capacity (no derating) 1000 m 1 % derating for each 100 m above 1000 m; max. 2000 m
Vibration	50 ... 150 Hz, EN50178 / EN60068-2-6
Shock	EN50178, EN60068-2-27. Storage and shipping max 15G/11ms (in the protected package).

Remarks:

[(a)] Locations with normal levels of contaminants, experienced in urban areas with industrial activities scattered over the whole area, or with heavy traffic.

[(b)] Locations without special precautions to minimize the presence of sand or dust, but not situated in proximity to sand or dust sources.

The MSc DC/DC Converter installation must be indoors and the degree of protection (IEC 60529), in chapter 2.1.2 Technical data, should be taken into account.

WARNING: Conductive dust may cause damage to this equipment. Ensure that the MSc DC/DC Converter is installed in a room where no conductive dust is present.

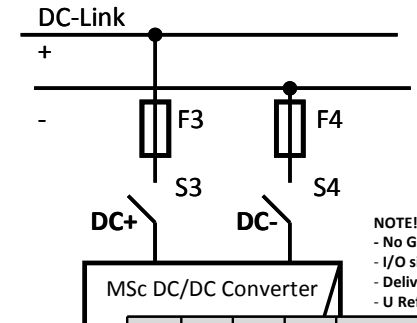
2.1.4 Operational description and functions

2.1.4.1 Overall functional description

Msc DC/DC Converter is bidirectional which means that when connected to an Energy Source it can be used both for charging and for discharging in turn.

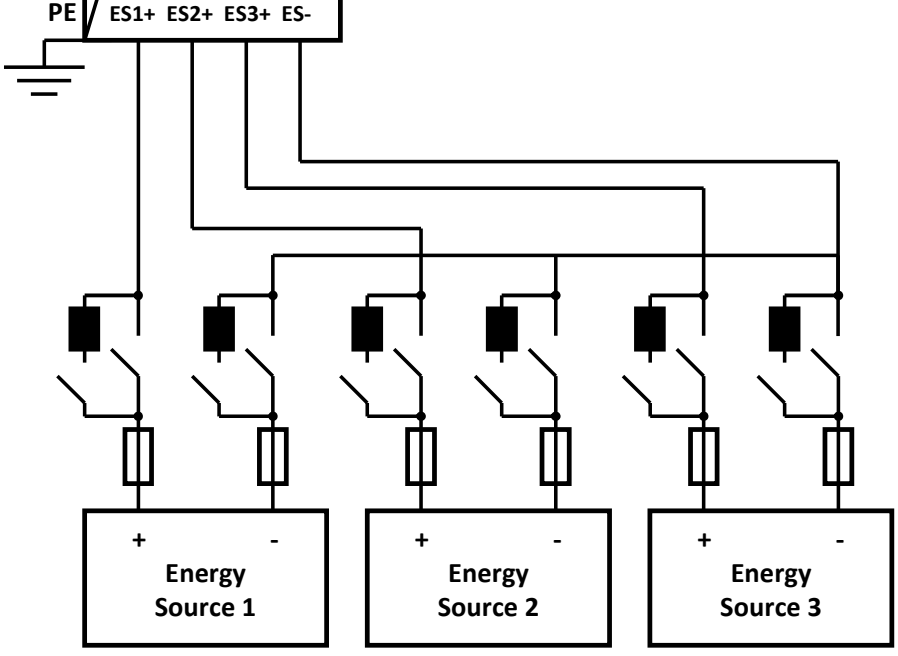
The control I/O can be seen in the block diagram below. A simplified main circuit diagram is shown on the next page.

See relevant chapters below for more information about different control methods. Note! The control method is based on a factory setting, which cannot be changed after the delivery.

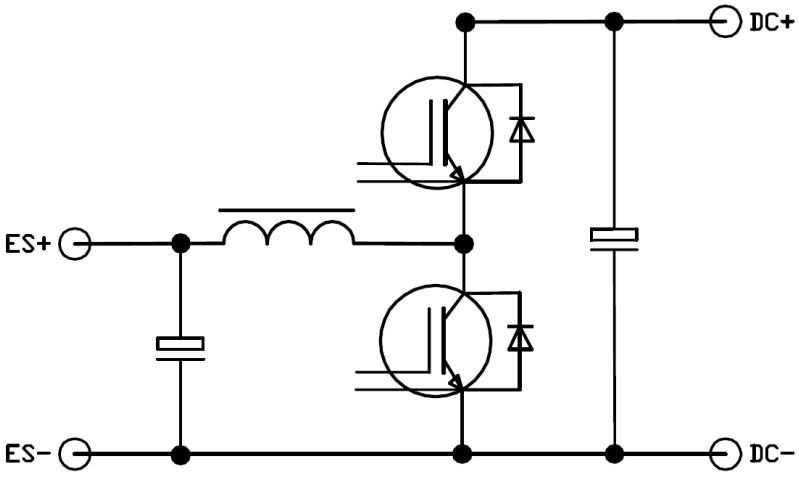


NOTE!
- **No Galvanic isolation between DC-link and Energy Sources**
- **I/O signal ground connected to Protective Earth (PE)**
- **Delivery scope does not include external switched, fuses nor pre-charging resistors as shown in picture**
- **U Ref / I Ref: The chosen control method is based on factory setting. Cannot be changed after delivery**

	ES1	ES2	ES3	Signal	Type	Decription
In	X15:1	X20:1	X21:1	On / Off / Reset	Open collector	ON = Connected, Off = Disconnected, Reset = OFF->ON
	X15:2	X20:2	X21:2	Gnd	Signal Ground	
	X16:1	X22:1	X23:1	Discharge current limit	Analog 0...20 mA (RL 250 Ω)	Discharge current limit 0...100 %
	X16:2	X22:2	X23:2	Charge current limit	Analog 0...20 mA (RL 250 Ω)	Charge current limit 0...100 %
	X16:3	X22:3	X23:3	Gnd	Signal Ground	
	X9:1	X24:1	X25:1	Discharge / Charge	Open Collector	Discharge = Disconnected Charge = Connected
	X9:2	X24:2	X25:2	U Ref / I ref	Analog 0...20 mA (RL 250 Ω) / 0-10V (RL >100k Ω)	Voltage reference 200...800 Vdc Current reference 0...100 %
	X9:3	X24:3	X25:3	NC	No connection	
	X9:4	X24:4	X25:4	Gnd	Signal Ground	
Out	X5:1	X30:1	X31:1	+24 Vdc	Power (max loading 100 mA)	+24 Vdc Output
	X5:2	X30:2	X31:2	Fault	Open Collector (Max 24V / 50 mA)	Active Fault, Fault = 1
	X5:3	X30:3	X31:3	Limit	Open Collector (Max 24V / 50 mA)	Active ES/DC-Link voltage limit Limit on = 1
	X5:4	X30:4	X31:4	Gnd	Signal Ground	
	X10:1	X26:1	X27:1	ES Voltage	Analog 0...20 mA (RL max 500 Ω)	Energy source voltage 0...1000 Vdc (0...100 Vdc optional)
	X10:2	X26:2	X27:2	Gnd	Signal Ground	
	X11:1			DC-Link Voltage	Analog 0...20 mA (RL max 500 Ω)	DC-Link voltage 0...1000 Vdc
	X11:2			Gnd	Signal Ground	
	X12:1	X28:1	X29:1	ES Current	Analog 0...20 mA (RL max 500 Ω)	Energy Source current 0...100 %
	X12:2	X28:2	X29:2	Gnd	Signal Ground	
	X13:1			Temperature	Analog 0...20 mA (RL max 500 Ω)	Heat sink temperature 100 °C = 20 mA, 0 °C = 11,4 mA
	X13:2			Gnd	Signal Ground	



A simplified main circuit diagram is shown below:

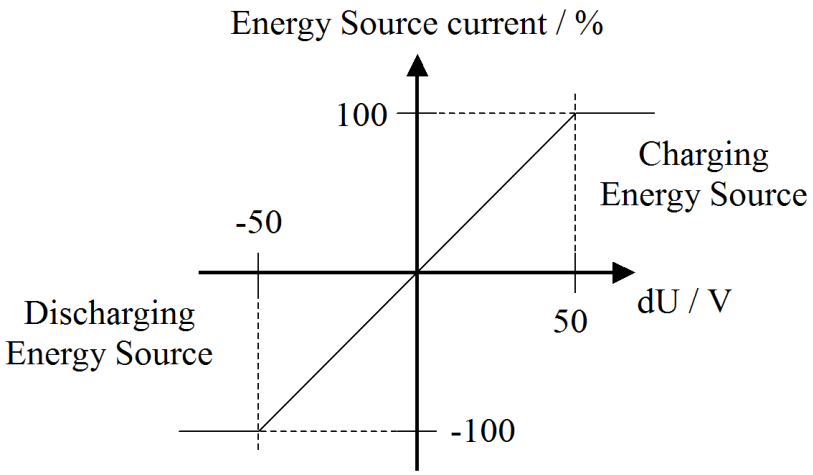


2.1.4.2 ES/DC link voltage reference control

In the voltage reference control method either the Energy Source voltage or the DC link voltage is regulated by the internal P-controller. The direction of the power flow and the amount of Energy Source current is determined by the voltage difference between the reference value and the measured voltage. The maximum current value is reached at a voltage difference of 50 volts as shown in the picture below. Current limitation inputs are used to limit the maximum value of discharging and charging current set by the internal P-controller.

DC link voltage reference control: The Energy Source will be charged when the DC link voltage is higher than the reference value. The Energy Source will be discharged when the DC link voltage is lower than the reference value.

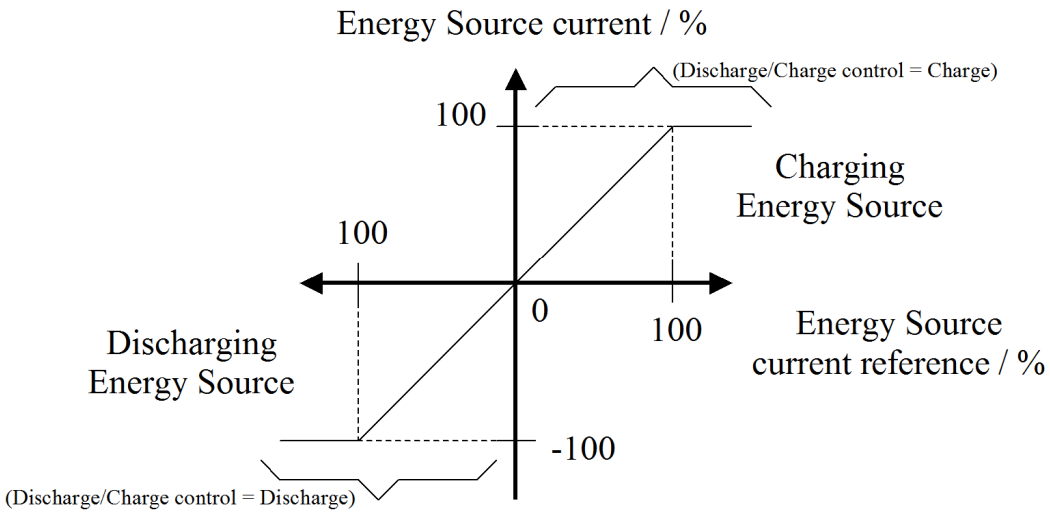
Energy Source voltage reference control: The Energy Source will be charged when the Energy Source voltage is lower than the reference value. The Energy Source will be discharged when the Energy Source voltage is higher than the reference value.



DC-Link voltage reference model: dU = measured voltage - voltage reference)
Energy Source voltage reference model: dU = voltage reference - measured voltage

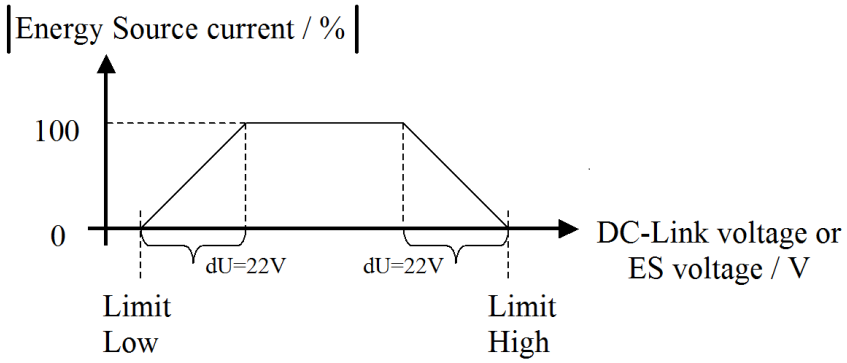
2.1.4.3 Energy Source current reference control

The Energy Source current is controlled directly with the Energy Source current reference. The direction of the current flow is controlled with the Discharge/Charge command. Current limitation inputs are used to limit the maximum value of discharging and charging current set by the current reference input.



2.1.4.4 Voltage drooping (optional)

The voltage drooping function limits the Energy Source current when the DC link voltage or the Energy Source voltage is getting close to the voltage limits as shown in the picture below. The factory-set default value for the drooping slope value is 22 V DC.



2.1.4.5 Control functions, input I/O

The MSc DC/DC Converter ON/OFF/RESET states are controlled by the ON/OFF/RESET input. Faults can be reset by changing the ON/OFF/RESET input from ON to OFF to ON. The reset happens when the input turns from OFF to ON.

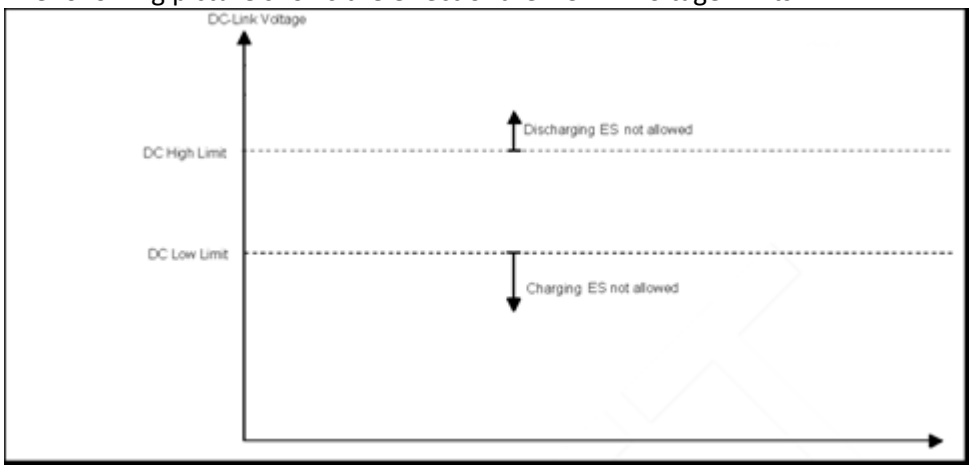
See block diagram in chapter 2.1.4.1 for electrical characteristics of control I/O.

2.1.4.6 Output I/O, indicator LEDs

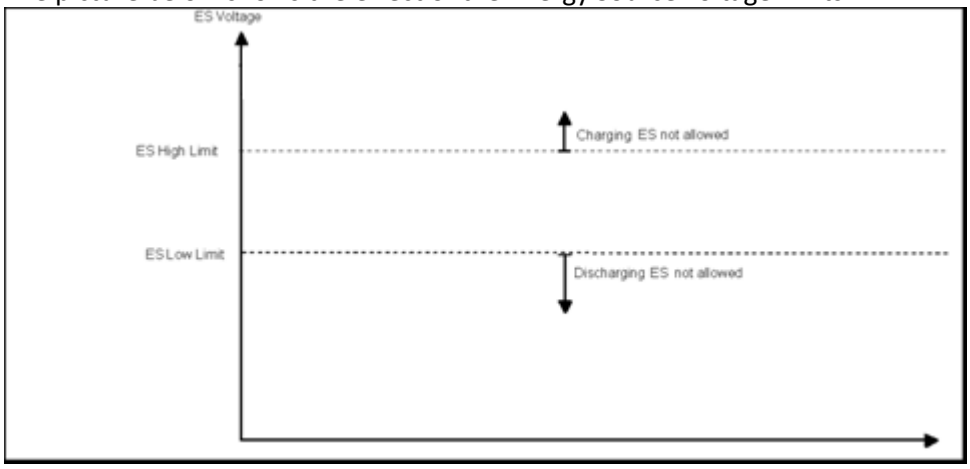
The DC link voltage, the Energy Source voltage, the Energy Source current and the MSc DC/DC Converter temperature can be monitored via analogue outputs.

When the Energy Source voltage limit low level or the DC link voltage limit high level is reached, the discharging of the Energy Source is prevented and the Limit output activated. When the Energy Source voltage limit high level or the DC link voltage limit low level is reached, the charging of the Energy Source is prevented and the Limit output activated. Voltage limitation has 25 V DC hysteresis on default setting, which requires the voltage to change 25 V DC towards normal operational area before the limitation is deactivated and discharging/charging permitted. These voltage limits have default factory settings that can be found on the type designation label attached to the MSc DC/DC Converter. See also the pictures below.

The following picture shows the effect of the DC link voltage limits.



The picture below shows the effect of the Energy Source voltage limits.



When a fault occurs the “Fault” output is activated.

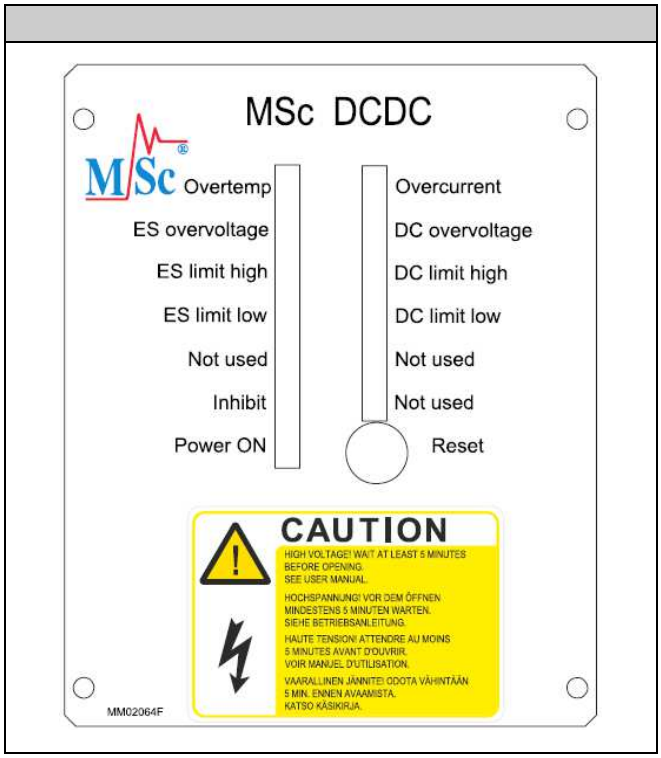
Active voltage limitation and faults light up one or more LEDs on the front cover. The causes and effects on the operational state are explained in chapter 2.2.1 LED indicators.

See block diagram in chapter 2.1.4.1 for electrical characteristics of control I/O.

2.2 CONTROL

2.2.1 LED indicators

The LED indicators give you information on both fault and normal situations.



LED indication	LED status and colour	Operational status	Meaning
Overtemp	On (red)	Stopped	Internal temperature limit exceeded (+80°C)
ES overvoltage	On (red)	Stopped	Energy Source overvoltage limit exceeded
ES limit high	On (red)	ES charging prevented	Energy Source voltage has reached maximum limit
ES limit low	On (red)	ES discharging prevented	Energy Source voltage has reached minimum limit
Inhibit	On (yellow)	Stopped	Indication of operational status “Stopped”. Possible cause: ON/OFF/RESET in OFF-state, fault or no auxiliary power.
Power ON/PWR OK	On (green)	ON	Normal operation
	Off	Stopped	No auxiliary power
Overcurrent/ITR	On (red)	Stopped	Energy Source overcurrent limit exceeded
DC overvoltage	On (red)	Stopped	DC link overvoltage limit exceeded (900 V DC)
DC limit high	On (red)	ES discharging prevented	DC link voltage has reached maximum limit
DC limit low	On (red)	ES charging prevented	DC link voltage has reached minimum limit

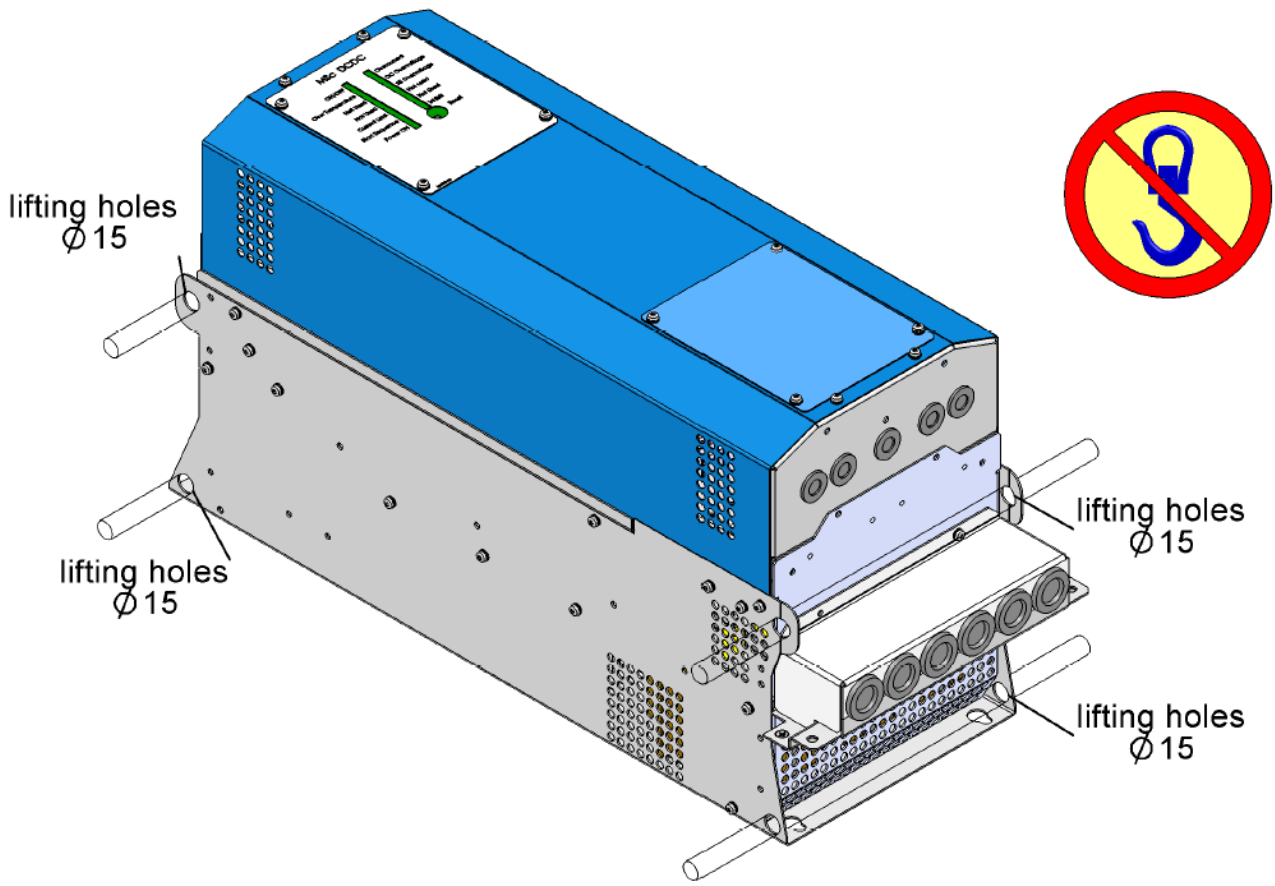
2.2.2 Control interface - inputs and outputs

The physical location of the control connections can be seen in the picture below. The control interface board is located under the cover. The description of the control connections can be seen in the block diagram in chapter 2.1.4.

3 MECHANICAL INSTALLATION

Please note the weight of the MSc DC/DC Converter equipment, see chapter 2.1.2 Technical data. Care should be taken to ensure that correct handling facilities are used. See further instructions below for your MSc DC/DC Converter (see type plate).

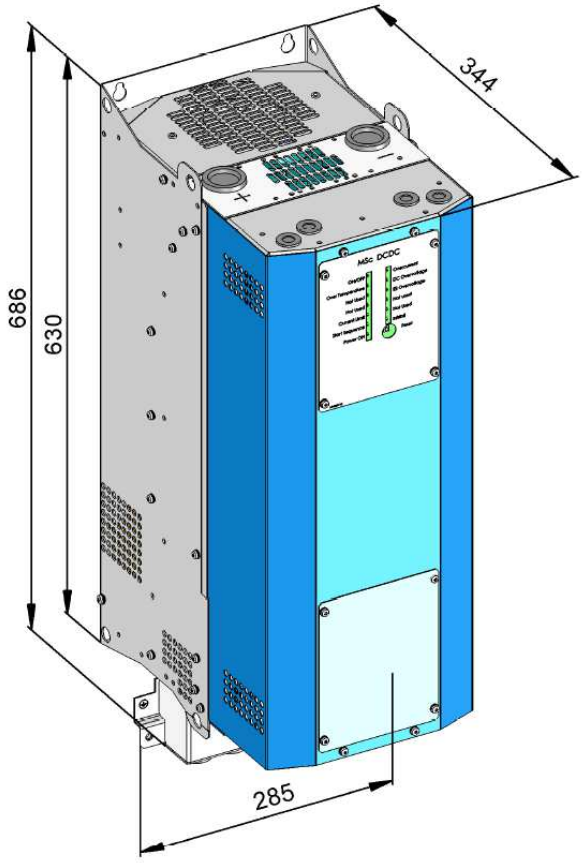
The 3x40DCDC750 MSc DC/DC Converter may only be lifted with a steel bar as shown in the picture below. The steel bar (diameter 15 mm) must be put through the lifting holes of the MSc DC/DC Converter. The MSc DC/DC Converter may NOT be lifted with hooks but only with the steel bar (otherwise risk of deformation/bending). Also NEVER lift the MSc DC/DC Converter using the front cover, only the grey structure and its lifting holes are designed for lifting.



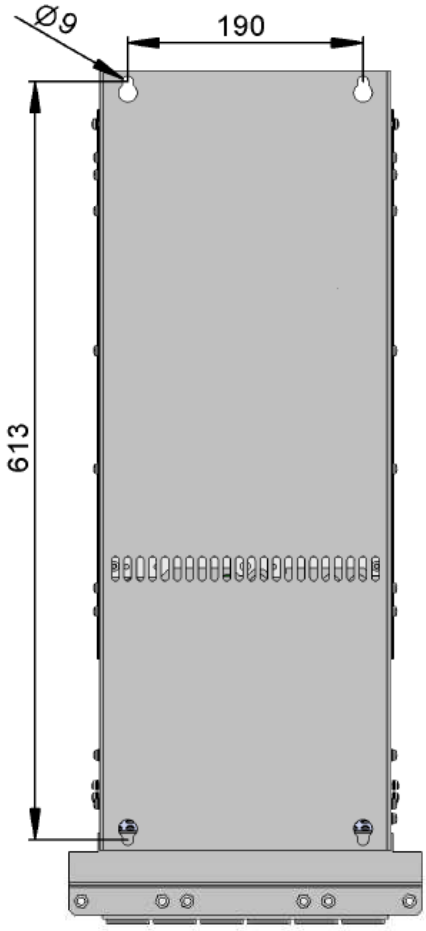
Lifting

3.1 MOUNTING

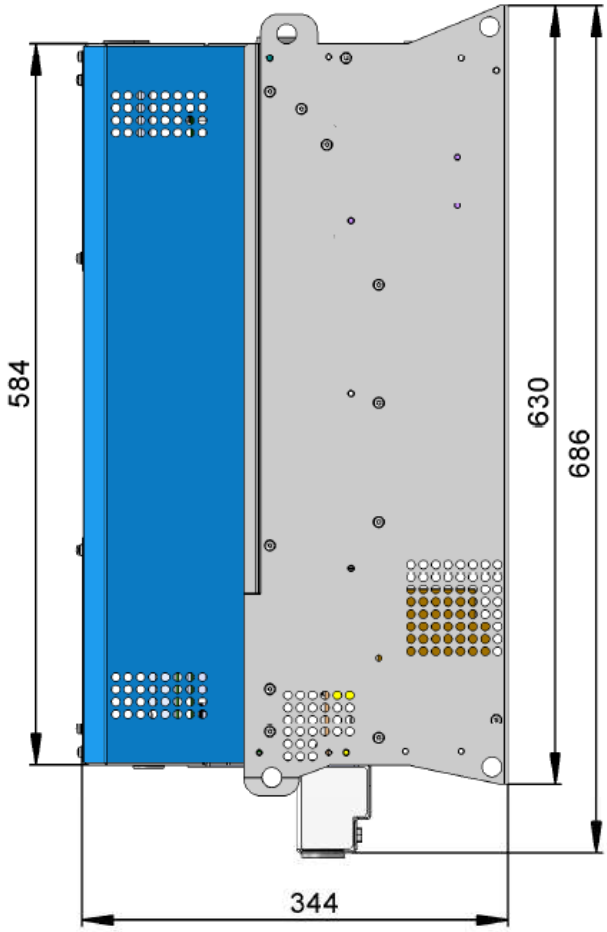
The MSc DC/DC Converter must be mounted in vertical position on the wall or on the back plane of a cabinet. The wall on which the MSc DC/DC Converter unit is mounted must be able to support the weight of the MSc DC/DC Converter, see chapter 2.1.2 Technical data. Enough free space must be reserved around the MSc DC/DC Converter in order to guarantee proper cooling (see chapter 3.2). Also the MSc DC/DC Converter identification tag should always remain readable to ensure proper identification during the life of the MSc DC/DC Converter. To ensure safe mounting, the use of an even mounting plane is required. Fastening must be done with four M8 (steel 8.8) bolts. The dimensions of the MSc DC/DC Converter with its enclosure are shown in the pictures below (for 3x40DCDC750 see next pages):

3x40DCDC750
 Main dimensions

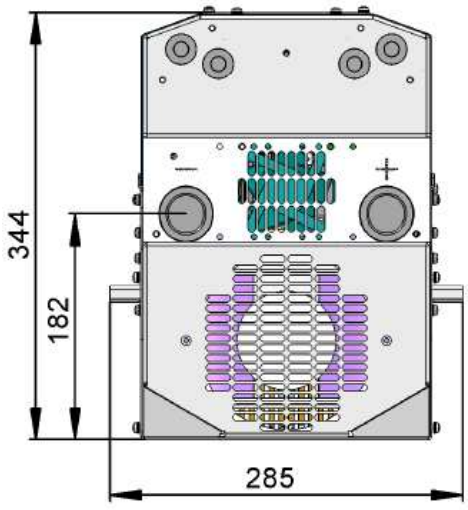
3x40DCDC750



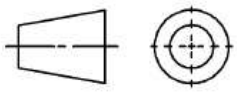
back



side



top



Wall mounting

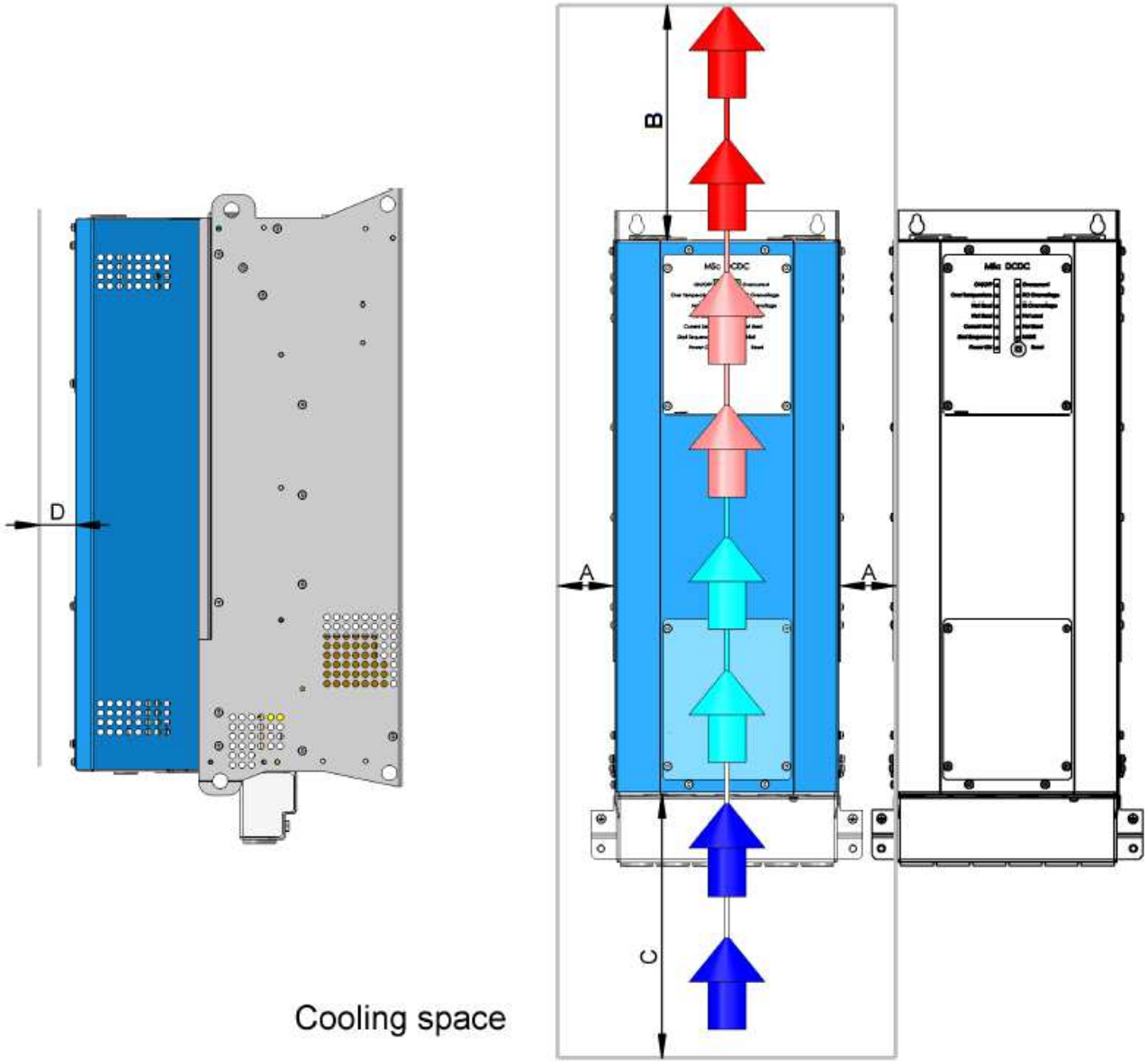
3.2 COOLING

Enough free space shall be left around the MSc DC/DC Converter to ensure sufficient air circulation, cooling as well as maintenance. You will find the required dimensions for free space in the picture and table below.

If an MSc DC/DC Converter system consists of more than one MSc DC/DC Converter unit, the units should be installed next to each other. If several units are mounted above each other the required free space equals B + C. Moreover, the outlet air used for cooling by the lower unit must be directed away from the air intake of the upper unit. The amount of cooling air required is indicated in chapter 2.1.3 Ambient conditions.

Also make sure that the temperature of the cooling air does not exceed the maximum ambient temperature of the MSc DC/DC Converter. Please ensure that the air used for cooling does not contain conductive particles, significant amounts of dust, or corrosive or otherwise harmful gases. The cooling air intake temperature must not exceed the operating temperature.

3x40DCDC750



3x40DCDC750	Letter in picture	Description
80 mm	A	free space to both sides of the MSc DC/DC Converter / free space between two MSc DC/DC Converters
300 mm	B	free space above the MSc DC/DC Converter
150 mm	C	free space underneath the MSc DC/DC Converter
30 mm	D	free space in front of MSc DC/DC Converter

4 ELECTRICAL INSTALLATION

WARNING: The MSc DC/DC Converter does not incorporate protective power line fuses. Hence the customer has to ensure that the power cables to each MSc DC/DC Converter are adequately protected taking into account the MSc DC/DC Converter maximum current rating and the cable section used.

4.1 POWER CONNECTIONS

In the block diagram in chapter 2.1.4 you see the power connections and the location of the fuses and DC-circuit breakers that need to be installed. Further details are given in the following chapters.

4.1.1 Selection of the power cable size

Several types of power cable can be used to connect the MSc DC/DC Converter to an Energy Source and a DC link. Local regulations and habits often determine the user's choice.

The cable and fuse sizes are listed below:

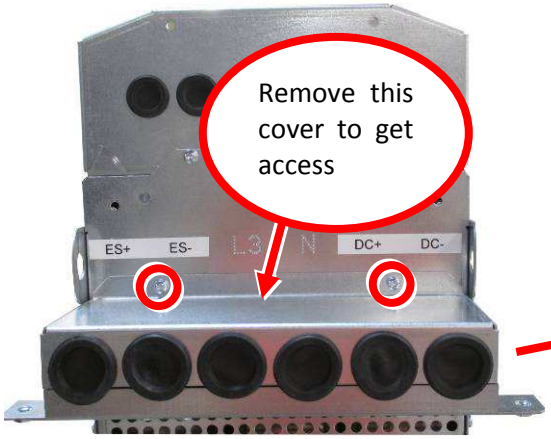
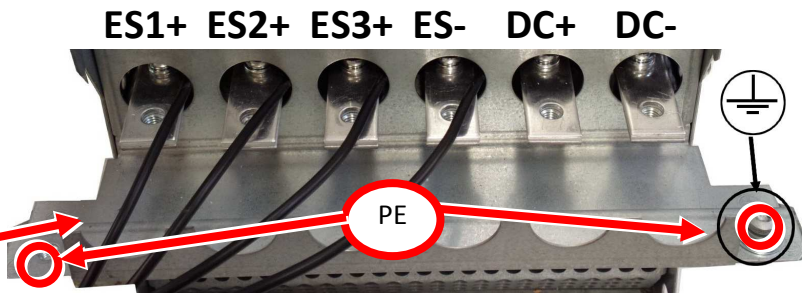
	3x40DCDC750
Energy Source and DC link cabling	recommended cross section 25 mm^2/Cu (heat resistance at least +70°C) shielded cable MCMK/NKCABLES or similar
Energy Source connectors and DC connectors	see pictures further below
Earthing cable	min. 25 mm^2 Cu
Energy Source DC link fuse Ampere rating and type (F1-F4)	80A / 690V aR 250A / 690V aR

Making the power connections

Warning

Before starting the installation, check that none of the ES/DC link cables and control cables to be connected to the MSc DC/DC Converter is live.

The connections are shown below.

3x40DCDC750	
 Torx T20 max. 2 Nm	 Use contact treatment grease in the aluminium power connections, e.g. electrolube CG70. 4 aluminium busbars (including M8 nut for M8x20 bolt) max. 24 Nm. Protective earth (PE) point (including M6 nut for M6x10 bolt) max. 10 Nm. Only use tools on the bolt heads.

4.2 CONTROL CONNECTIONS

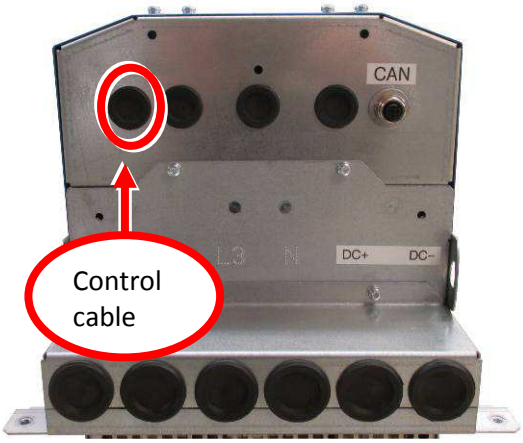
The control cable sizes and types are listed below (1-3 control cables).

Control connectors and cross sections	Connection method: screw terminals, torque 0.6 Nm Cross section: 0.25 mm² - 2.5 mm²
PE connectors for control cable shield grounding	Clamp connection
Cable type for control cable	Screened cable equipped with low impedance shield and grounded from both ends

Further details for 3x40DCDC750 see below

3x40DCDC750
Proceed as follows: The control cable terminals are located under the front cover. Remove the four M4 Torx T20 screws shown in the picture below in order to lift the front cover towards you and to remove it. The location of the control terminals can be seen in the picture in chapter 2.2.2. Grounding of the control cable shield is done to PE clamp terminal shown in the picture below.

Torx T20 max. 2 Nm



PE clamp connection for cable shield (max 2.5 Nm)