MSc DC/DC Converter – User manual

80 A

200 A

MSc Electronics Oy, Alasniitynkatu 30, FIN-33560 Tampere, Finland. **www.msc.eu** info@msc.eu

1 SAFETY

ONLY A COMPETENT ELECTRICIAN MAY CARRY OUT THE ELECTRICAL INSTALLATION

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

	**= DANGER! DANGEROUS VOLTAGE**
	**= WARNING! or CAUTION!**
	**= CAUTION! Hot surface**

In case you are in doubt about your ability to perform installation or commissioning, do not proceed. Contact your local MSc partner for advice.

1.1 WARNINGS

1	The MSc DC/DC Converter is meant for fixed installations only.
2	Do not perform any measurements when the MSc DC/DC Converter is connected to DC link or the Energy Source.
3	Do not perform any voltage withstand tests on any part of the MSc DC/DC Converter. This may damage the MSc DC/DC Converter.
4	The MSc DC/DC Converter has a large capacitive leakage current.
5	The earth leakage current of the MSc DC/DC Converter exceeds 3.5 mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured. See chapter 1.3.
6	MSc DC/DC Converter can only be installed in grounded systems.
7	Only spare parts delivered by MSc Electronics Oy may be used.
8	Do not touch any components on the circuit boards. Static voltage discharge may damage the components.
9	 When running, the sides and the bottom of the MSc DC/DC Converter are burning hot. Do not touch with hands! Therefore the MSc DC/DC Converter MUST NOT be mounted onto a surface which is not fireproof.
10	Welding of the cabinet might risk sensitive components in the MSc DC/DC Converter. Ensure that no earthing currents can flow through any part of the MSc DC/DC Converter.

1.2 SAFETY INSTRUCTIONS

	**1**	The inside components and circuit boards of the MSc DC/DC Converter are live when input and output terminals are connected. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.**
	2	Always disconnect the MSc DC/DC Converter from the DC link and Energy Source before doing any work on the MSc DC/DC Converter. After disconnecting the MSc DC/DC Converter, wait for cooling fan to stop. Wait at least 5 more minutes before doing any work on the MSc DC/DC Converter connections. Do not even open the cabinet door or cover before this time has expired. Always ensure absence of voltage before starting any electrical work!
	3	The control I/O-terminals are isolated from the DC link and Energy Source potentials. However, the control I/O-terminals may have dangerous control voltages present even when the DC link and Energy Source terminals are not powered.
	4	Before any contact is made to inside parts of the MSc DC/DC Converter, measure and make sure that there is no dangerous voltage present on terminals.
	5	Make sure that the front cover and the cable connection box cover are closed before connecting the MSc DC/DC Converter to the DC link and Energy Source.

NOTE! If a fault protection relay is used, it must be of at least type B, preferably B+ (according to EN 50178), with a trip level of 300 mA. This is for fire protection, not for touch protection in grounded systems.

1.3 EARTHING

The MSc DC/DC Converter must always be earthed with an earthing conductor connected to the earthing connection.

The earth leakage current of the MSc DC/DC Converter exceeds 3.5 mA AC. According to EN61800-5-1, the following conditions for the associated protective circuit shall be satisfied:

The protective conductor shall have a cross-sectional area of half of the cross section of the Energy Source and DC link cabling. For more detailed information, see chapter 8.1 POWER CONNECTIONS.

Note that the MSc DC/DC Converter does not include such earth fault protection, which is intended for personal safety.

Due to the high capacitive currents present in the MSc DC/DC Converter, fault current protective switches may not function properly.

2 INTRODUCTION

2.1 ABOUT THIS MANUAL

This manual consists of operating and installation instructions for the MSc DC/DC Converter. It also describes the features and operation of the product and provides important safety information.

2.2 COMPLIANCE

2.2.1 CE Marking

The CE Marking on the product guarantees the free movement of the product within the EEA (European Economic Area).

The MSc DC/DC Converters carry the CE label as a proof of compliance with the Low Voltage Directive (LVD) and the Electro Magnetic Compatibility (EMC).

2.2.2 EMC Directive

The EMC Directive provides that the electrical apparatus must not excessively disturb the environment they are used in and, on the other hand, it shall have an adequate level of immunity toward other disturbances from the same environment.

The MSc DC/DC Converter complies with the following EMC guidelines:
EN/IEC 61800-3:2004, Industrial level: Immunity standard for industrial environments.
EN/IEC 61800-3:2004, Industrial level: Emission standard for industrial environments (with external conducting emission filter, which is not included in MSc DC/DC Converter delivery).

2.2.3 Manufacturer's declaration of conformity

The following page presents the Manufacturer's Declaration of Conformity assuring the compliance of the MSc DC/DC Converters with the EMC and the LVD directives.

EU DECLARATION OF CONFORMITY

We

Manufacturer's Name:	MSc Electronics Oy
Manufacturer's Address:	Alasniitynkatu 30 FIN-33560 Tampere Finland

Hereby declare that the product

Product name:	MSc DC/DC Converter
Model designation:	80DCDC750DE 200DCDC750DE

has been designed and manufactured in accordance with the following standards:

Safety:	EN 61800-5-1 (2007)
EMC:	EN61800-3 (2004) for the 2nd environment (not including conducting emission protection)

and conforms to the relevant safety provisions of the Low Voltage Directive 2006/95/EC and EMC directive 2004/108/EC.

It is ensured through internal measures and quality control that the product conforms at all times to the requirements of the current directives and the relevant standards.

Tampere, 15 March 2016

Pekka Seppälä
Managing Director

3 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	Two models: 80DCDC750DE 200DCDC750DE
ES	Energy Source (e.g. batteries, supercapacitors, solar cells, fuel cells)
ES Current	Energy Source current
ES Voltage	Energy Source voltage
ES limit high	Energy Source voltage high limit
ES limit low	Energy Source voltage low limit
DC limit high	DC link voltage high limit
DC limit low	DC link voltage low limit
DC link voltage	DC link voltage
DC Voltage	DC link voltage

4 RECEIPT OF DELIVERY, STORAGE AND TRANSPORTATION

4.1 RECEIPT OF DELIVERY

Note the lifting instructions in chapter 7 before taking out the MSc DC/DC Converter of its package.

After unpacking the product check that no signs of transport damages are to be found on the product and that the delivery is complete.

If the MSc DC/DC Converter has been damaged during the transportation, please contact primarily the cargo insurance company or the carrier.

If the delivery does not correspond to your order, contact the supplier immediately.

Note! The MSc DC/DC Converter **does not** include any pre-charging resistors, fuses, circuit breakers nor external conducting emission filter.

4.2 STORAGE AND TRANSPORTATION (IN THE PROTECTED PACKAGE)

If the MSc DC/DC Converter is kept in storage or transported before use, make sure that the ambient conditions are acceptable, see chapter 6.1.3.
The storing environment should also be free from dust and moisture. If there is dust in the air, the MSc DC/DC Converter should be well protected to make sure dust does not get into the MSc DC/DC Converter.

The storage area must be located indoors.

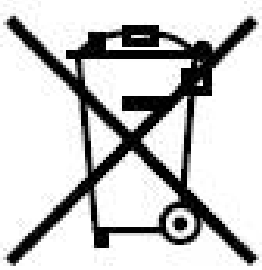
If the MSc DC/DC Converter has been left more than 2 years without operation, please contact the party having sold you the MSc DC/DC Converter.

For lifting instructions, see chapter 7 MECHANICAL INSTALLATION.

4.3 WITHDRAWAL FROM USE AND DISPOSAL

Observe chapter 1 SAFETY in all details and chapter 10.2.2 Shutdown procedure. When withdrawing the unit from service, it must be safely disconnected. Then all connectors and supply leads can be removed. Finally the unit can be dismantled, and if necessary stored.

The unit consists to a large extent of recyclable aluminium alloys, galvanized steel plates and iron + copper (magnetic components). All plastics employed are halogen free. Neither the unit nor any components used contain any PCB (polychlorbiphenyle) compounds. None of the power semiconductors employed contains beryllium oxide.

	When the drive is at the end of its operation life, do not discard it as a part of municipal waste. You can recycle the primary components of the drive. You must disassemble some components before you can remove the different materials. Recycle the electrical and electronic components as waste. To make sure that the waste is recycled correctly, send the waste to a recycling centre. You can also send the waste back to the manufacturer. Obey the local and other applicable regulations.

5 WARRANTY, DISCLAIMERS

The Manufacturer is not responsible for the use of the MSc DC/DC Converter against the instructions.

All specifications and information are subject to changes without further notice.

Only manufacturing defects are covered by the warranty. The Manufacturer assumes no responsibility for damages caused during or resulting from transport, receipt of the delivery, installation, commissioning or use.
The Manufacturer shall in no event and under no circumstances be held responsible for damages and failures resulting from misuse, wrong installation, unacceptable ambient temperature, dust, corrosive substances or operation outside the rated specifications. Neither can the manufacturer be held responsible for consequential damages.

The Manufacturer's time of warranty is 18 months from the delivery or 12 months from the commissioning whichever expires first (General Conditions Orgalime S2012).

The local distributor may grant a warranty time different from the above. This warranty time shall be specified in the distributor's sales and warranty terms. The Manufacturer assumes no responsibility for any other warranties than that granted by the Manufacturer itself.

The warranty of the MSc DC/DC Converter is valid only if the commissioning has been performed as instructed in this document. The commissioning report must be correctly and completely filled in and delivered to MSc Electronics Oy.

In all matters concerning the warranty, please contact first the party having sold you the MSc DC/DC Converter.

6 TECHNICAL INFORMATION

6.1 TECHNICAL DESCRIPTION

6.1.1 Introduction

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

6.1.2 Technical data

MODEL	**80DCDC750DE**	**200DCDC750DE**
Topology		
Operation mode	Bidirectional	Bidirectional
Control method	DC link voltage reference Energy Source voltage reference Energy Source current reference	DC link voltage reference Energy Source voltage reference Energy Source current reference
Input (Energy Source)		
DC Input Voltage range	35-700 V DC	35-700 V DC
Nom. Input Current	80A	120A
Max. Input Current	80A	200A, 1 min./10 min.
Output (DC link)		
DC Output Voltage Range	100-800 V DC	100-800 V DC
Nom. Output Current	80A	120A
Max. Output Current	80A	200A, 1 min./10 min.
Efficiency		
Max. Efficiency	97	97
Quiescent power	< 100 W	< 100 W
I/O Connections		
Input signals	Digital/Analogue	Digital/Analogue
Output signals	Digital/Analogue	Digital/Analogue
General Data		
Dimensions (wxhxd) in mm	160 x 561 x 291	285 x 686 x 344
Weight (kg)	20	27
Cooling	forced air cooled	forced air cooled
Operation temperature	-10°C - +40°C	-10°C - +40°C
Degree of protection (IEC 60529)	IP 20	IP 20
Noise level	<80 dB	<80 dB
Standards		
EMC	EN 61800-3	
Electrical safety	EN 61800-5-1	

(table continued on next page)

Protections	
Protections	Internal overtemperature DC link overvoltage Energy Source overvoltage Energy Source overcurrent
Limitations	DC link & Energy Source voltage

- **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!

6.1.3 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 6.1.2 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	200DCDC750DE 425 m^3/h 80DCDC750DE 300 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. 3000 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 6.1.2 Technical data, should be taken into account.

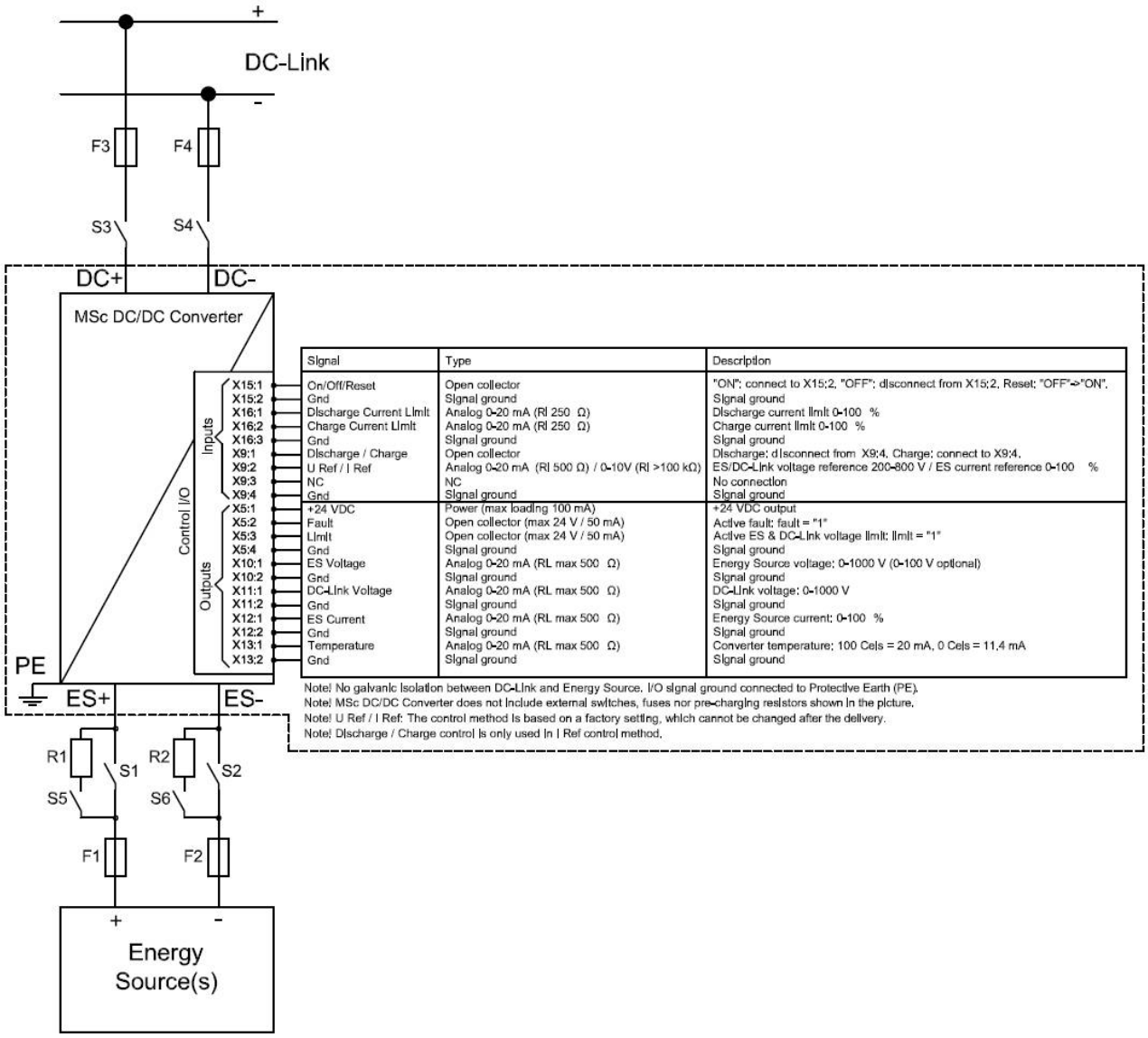
WARNING: Conductive dust may cause damage to this equipment. Ensure that the MSc DC/DC Converter is installed in a room where no conductive dust is present.

6.1.4 Operational description and functions

6.1.4.1 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.

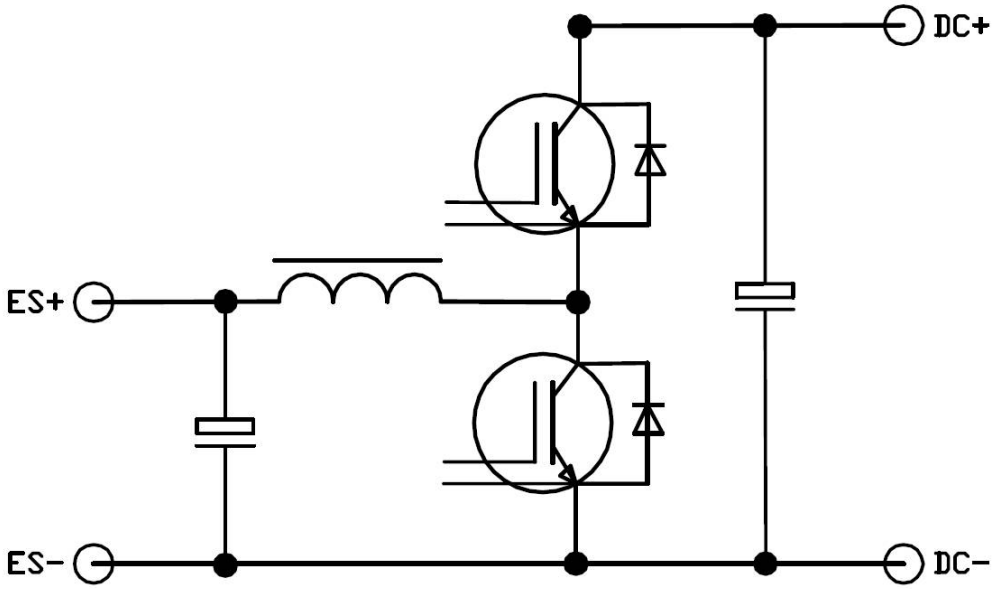
See relevant chapters below for more information about different control methods. Note! The control method is based on a factory setting, which cannot be changed after the delivery.



Signal	Type	Description
X15:1 On/Off/Reset	Open collector	"ON": connect to X15:2. "OFF": disconnect from X15:2. Reset: "OFF"->"ON".
X15:2 Gnd	Signal ground	Signal ground
X16:1 Discharge Current Limit	Analog 0-20 mA (Rl 250 Ω)	Discharge current limit 0-100 %
X16:2 Charge Current Limit	Analog 0-20 mA (Rl 250 Ω)	Charge current limit 0-100 %
X16:3 Gnd	Signal ground	Signal ground
X9:1 Discharge / Charge	Open collector	Discharge: disconnect from X9:4. Charge: connect to X9:4.
X9:2 U Ref / I Ref	Analog 0-20 mA (Rl 500 Ω) / 0-10V (Rl >100 kΩ)	ES/DC-Link voltage reference 200-800 V / ES current reference 0-100 %
X9:3 NC	NC	No connection
X9:4 Gnd	Signal ground	Signal ground
X5:1 +24 VDC	Power (max loading 100 mA)	+24 VDC output
X5:2 Fault	Open collector (max 24 V / 50 mA)	Active fault: fault = "1"
X5:3 Limit	Open collector (max 24 V / 50 mA)	Active ES & DC-Link voltage limit: limit = "1"
X5:4 Gnd	Signal ground	Signal ground
X10:1 ES Voltage	Analog 0-20 mA (RL max 500 Ω)	Energy Source voltage: 0-1000 V (0-100 V optional)
X10:2 Gnd	Signal ground	Signal ground
X11:1 DC-Link Voltage	Analog 0-20 mA (RL max 500 Ω)	DC-Link voltage: 0-1000 V
X11:2 Gnd	Signal ground	Signal ground
X12:1 ES Current	Analog 0-20 mA (RL max 500 Ω)	Energy Source current: 0-100 %
X12:2 Gnd	Signal ground	Signal ground
X13:1 Temperature	Analog 0-20 mA (RL max 500 Ω)	Converter temperature: 100 Cels = 20 mA, 0 Cels = 11,4 mA
X13:2 Gnd	Signal ground	Signal ground

Note! No galvanic isolation between DC-Link and Energy Source. I/O signal ground connected to Protective Earth (PE).
Note! MSc DC/DC Converter does not include external switches, fuses nor pre-charging resistors shown in the picture.
Note! U Ref / I Ref: The control method is based on a factory setting, which cannot be changed after the delivery.
Note! Discharge / Charge control is only used in I Ref control method.

A simplified main circuit diagram is shown below:

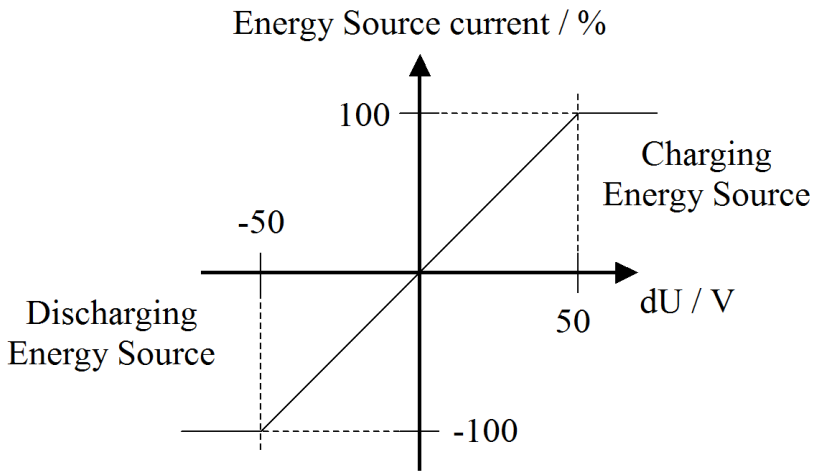


6.1.4.2 ES/DC link voltage reference control

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.

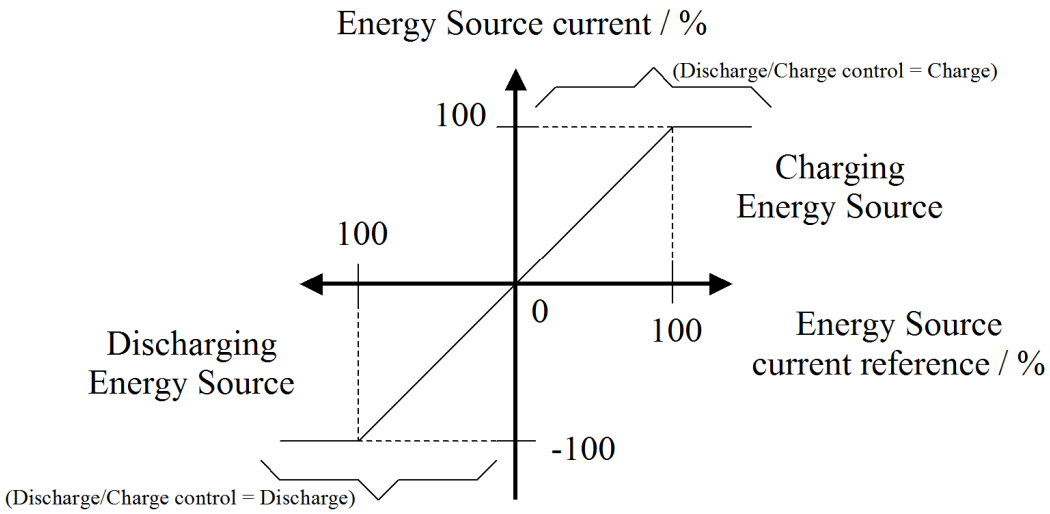
Energy Source voltage reference control: The Energy Source will be charged when the Energy Source voltage is lower than the reference value. The Energy Source will be discharged when the Energy Source voltage is higher than the reference value.



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

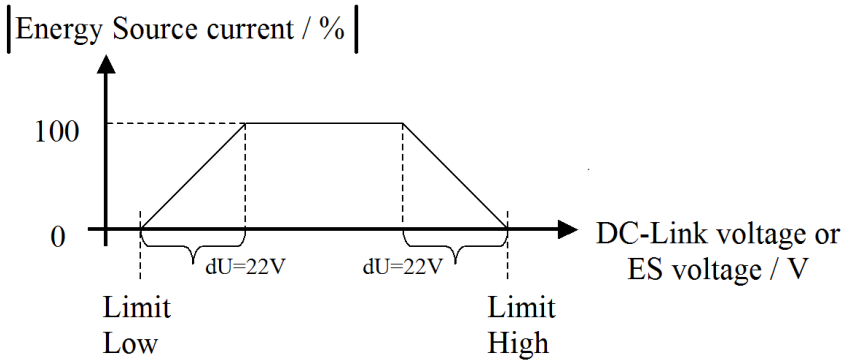
6.1.4.3 Energy Source current reference control

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.



6.1.4.4 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.



6.1.4.5 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.

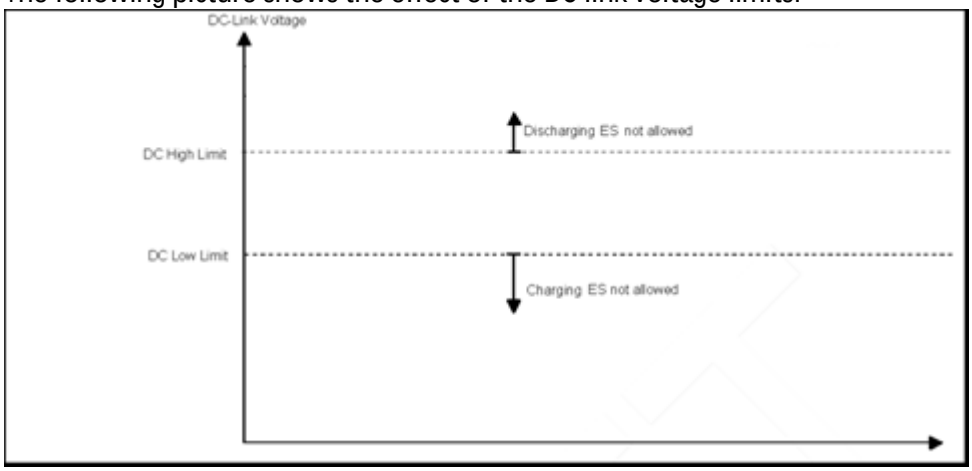
See block diagram in chapter 6.1.4.1 for electrical characteristics of control I/O.

6.1.4.6 Output I/O, indicator LEDs

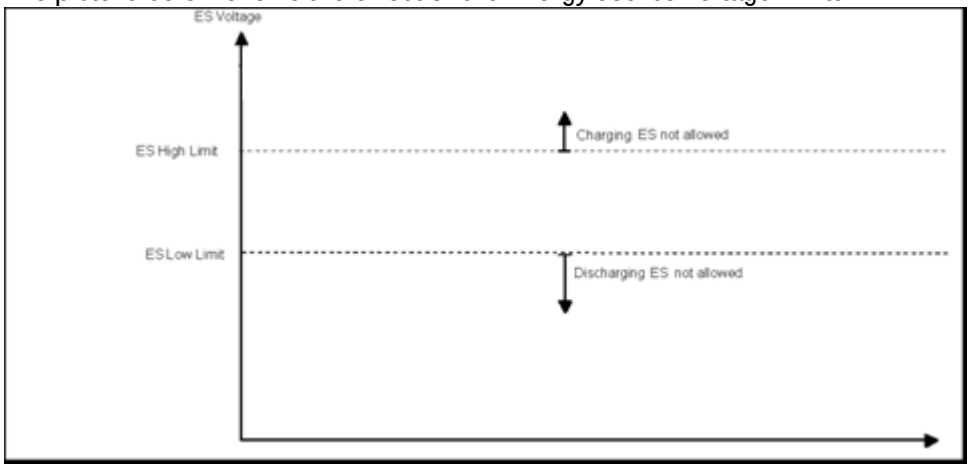
The DC link voltage, the Energy Source voltage, the Energy Source current and the MSc DC/DC Converter temperature can be monitored via analogue outputs.

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.

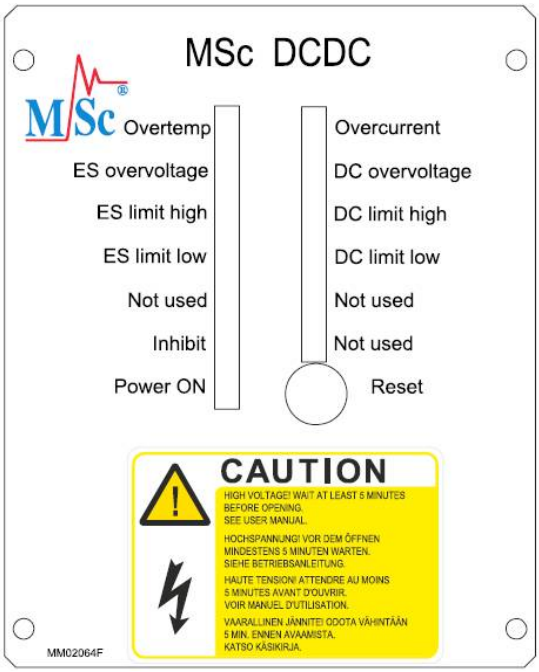
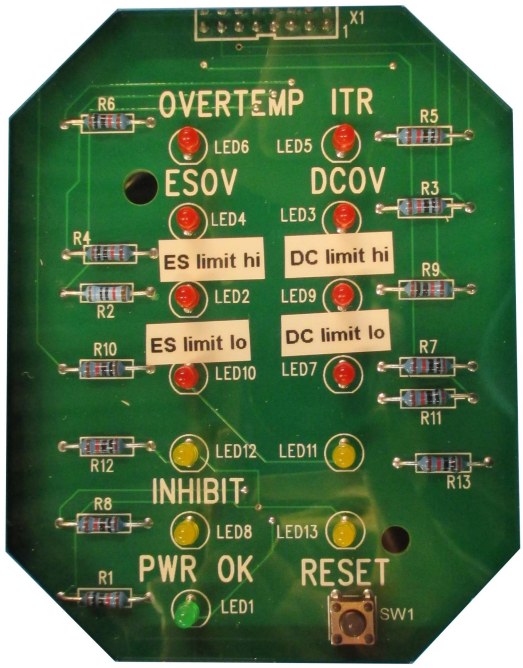
Active voltage limitation and faults light up one or more LEDs on the front cover. The causes and effects on the operational state are explained in chapter 6.2.1 LED indicators.

See block diagram in chapter 6.1.4.1 for electrical characteristics of control I/O.

6.2 CONTROL

6.2.1 LED indicators

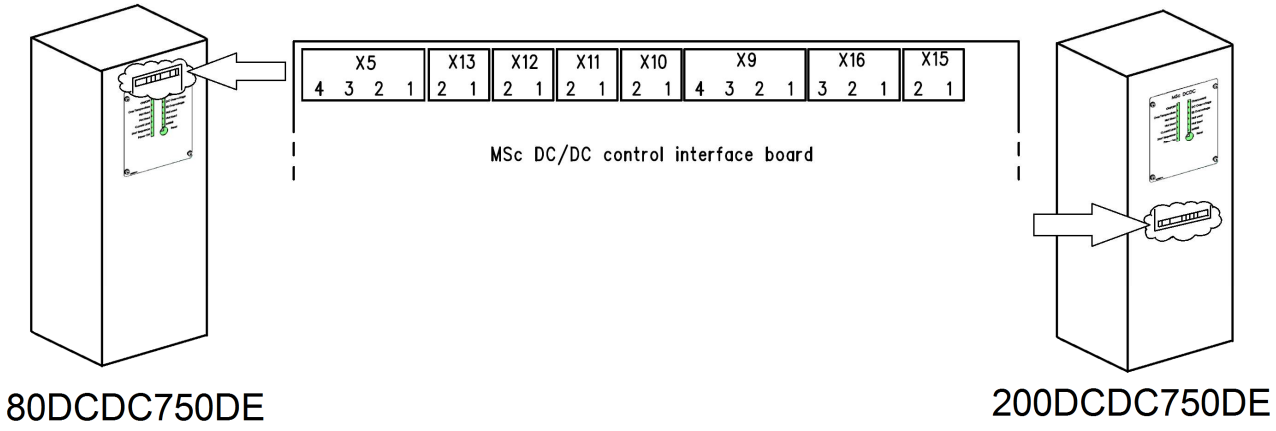
The LED indicators give you information on both fault and normal situations. For corrective actions and more detailed information see chapter 10 MAINTENANCE.

200DCDC750DE	80DCDC750DE
	

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

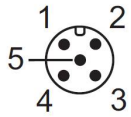
6.2.2 Control interface - inputs and outputs

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 6.1.4.



6.2.3 Optional control interface – CAN bus

6.2.3.1 General information

CAN connection	Interface	M12 female connector 	1. Chassis ground (PE) 2. No connection 3. CAN ground (PE) 4. CAN_H 5. CAN_L
	Data transfer method	CAN 2.0 A/B, ISO 11898	
	Transfer cable	2 wire twisted shielded cable	
	Electrical isolation	No	
Communication	Protocol	CANopen • CiA DS 301 version 4 • CiA DS 401 version 1.4 • Default PDO transmit interval 250 ms	
	Baud rate	0) 20 kBit/s 1) 50 kBit/s 2) 100 kBit/s 3) 125 kBit/s 4) 250 kBit/s *(default option)* 5) 500 kBit/s	
	Node-ID	1-127 (*default value 127)*	

6.2.3.2 Default CANopen PDO-mapping

PDO	COB-ID	Byte	Type	Bit	Name	Description
Outputs						
TPDO1	180h + Node ID	1	Uint8	0	Limit	Limit = 1
				1	DC overvoltage	Fault = 1
				2	ES overvoltage	Fault = 1
				3	Overcurrent	Fault = 1
				4	Overtemp	Fault = 1
				5	Auxiliary power fault	Fault = 1
				6 - 7	*Empty*	
TPDO2	280h + Node ID	1 – 2	Uint16		ES Voltage 1) Default setting 2) Upon request[1]	 1) 0-1000 V = 0-1000 2) 0-100 V = 0-1000
		3 – 4	Uint16		DC link Voltage	0-1000 V = 0-1000
		5 – 6	Uint16		ES Current	0-100 % = 0-1000
		7	Int8		Temperature	-10 °C - +100 °C = -10 - 100
Inputs						
RPDO1	200h + Node ID	1	Uint8	0	On/off/reset	On = 1, Off = 0, Reset = 0→1
				1	Discharge/Charge	Discharge = 1, Charge = 0
				2 - 7	*Empty*	
		2 – 3	Uint16		Factory-set control method: 1) U Ref 2) I Ref	 1) 200-800V = 0-1000 2) 0-100 % = 0-1000
		4 – 5	Uint16		Current limit charge	0-100 % = 0-1000
		6 – 7	Uint16		Current limit discharge	0-100 % = 0-1000

[1]Only if ES limit high is below 100 V.

6.2.3.3 CANopen start-up procedure

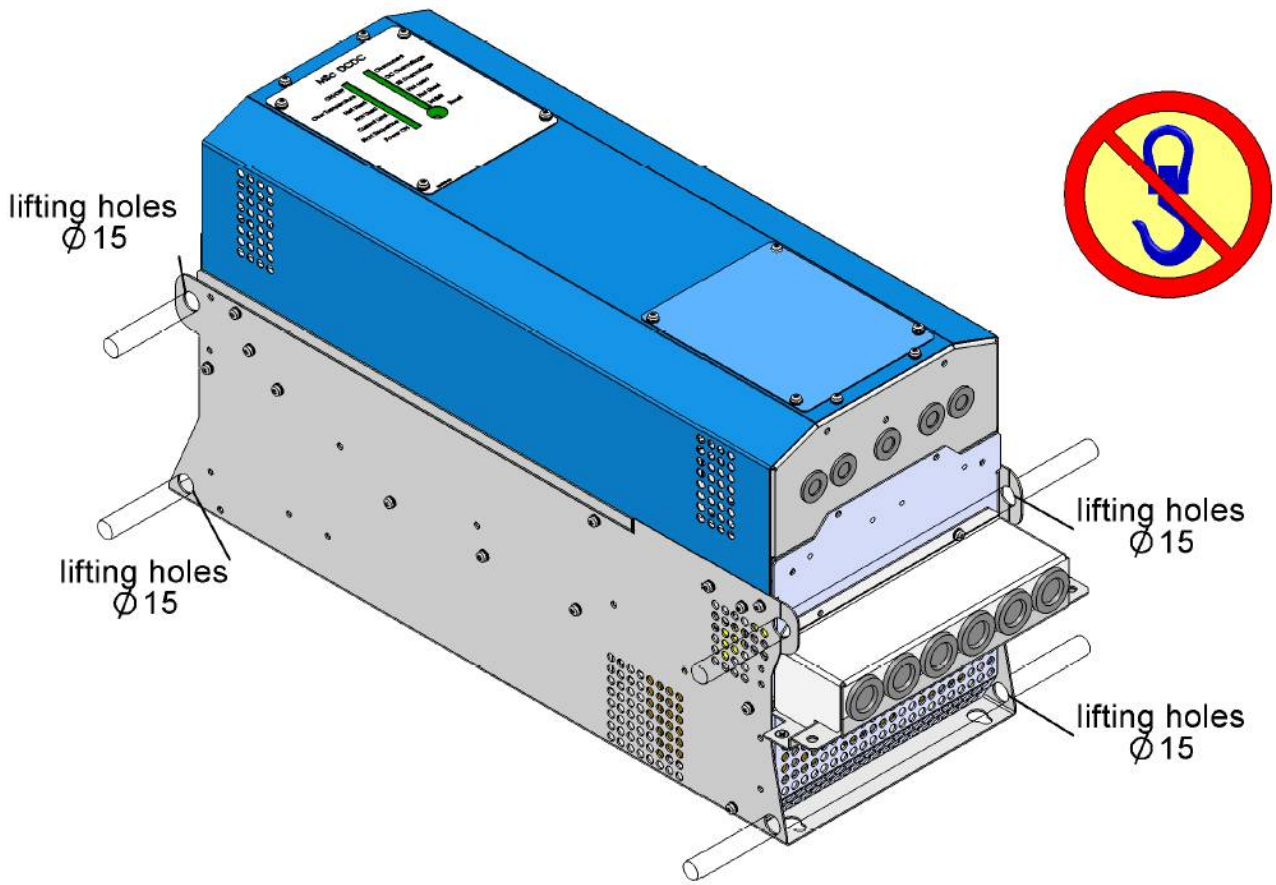
- Ensure MSc DC/DC Converter is powered up.
- CANopen node starts up automatically to operational state. Default Baud rate is 250 kBit/s and default Node-ID is 127.
- Change Node-ID: NMT master executes SDO write (1-127), index 0x5001, sub-index 0 (UINT8)
- Change Baud rate: NMT master executes SDO write (0-5), index 0x5002, sub-index 0 (UINT8)
- Apply changes for Node-ID and Baud rate: NMT master executes SDO write (TRUE), index 0x5000, sub-index 0 (BOOL)
- MSc DC/DC Converter operates with new Node-ID and Baud rate after powering up again.

7 MECHANICAL INSTALLATION

Please note the weight of the MSc DC/DC Converter equipment, see chapter 6.1.2 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).

80DCDC750DE
NEVER lift the 80DCDC750 MSc DC/DC Converter using the front cover, only the grey structure is designed for lifting.

200DCDC750DE
The 200DCDC750DE 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.

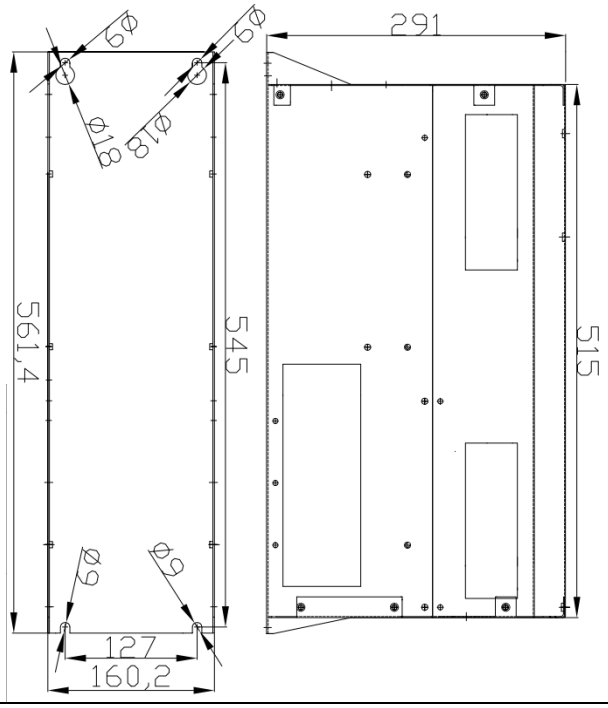


Lifting

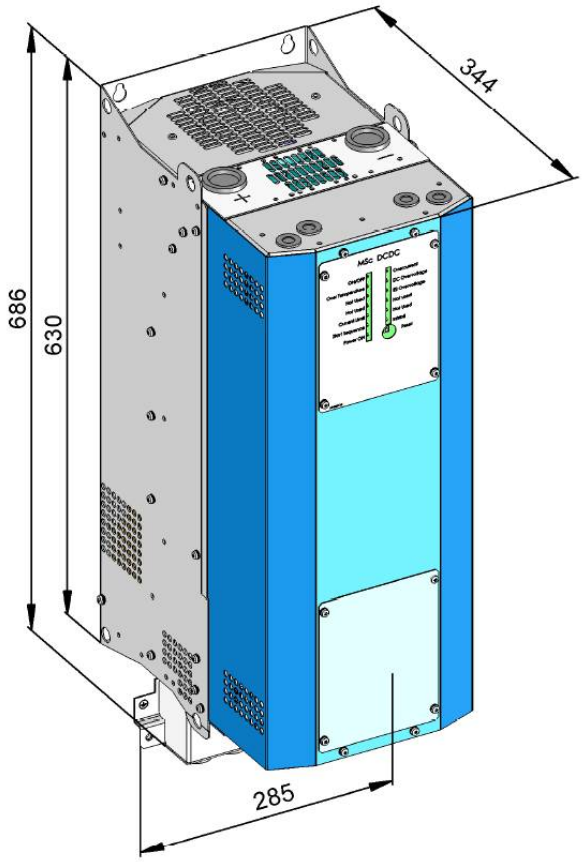
7.1 MOUNTING

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 6.1.2 Technical data. Enough free space must be reserved around the MSc DC/DC Converter in order to guarantee proper cooling (see chapter 7.2). 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 200DCDC750DE see next pages):

80DCDC750DE

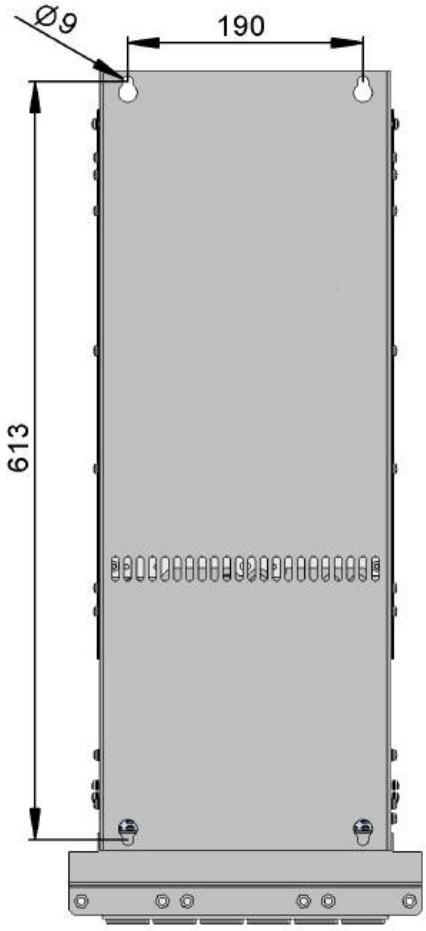


200DCDC750DE

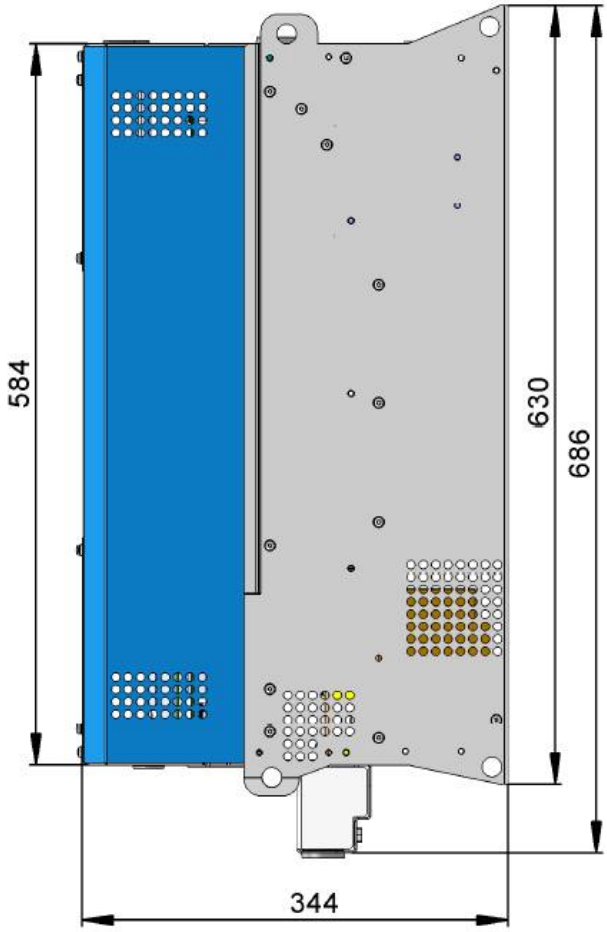


Main dimensions

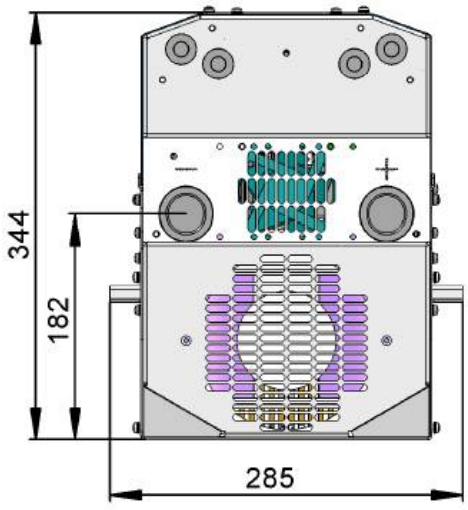
200DCDC750DE



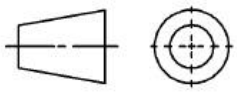
back



side



top



Wall mounting

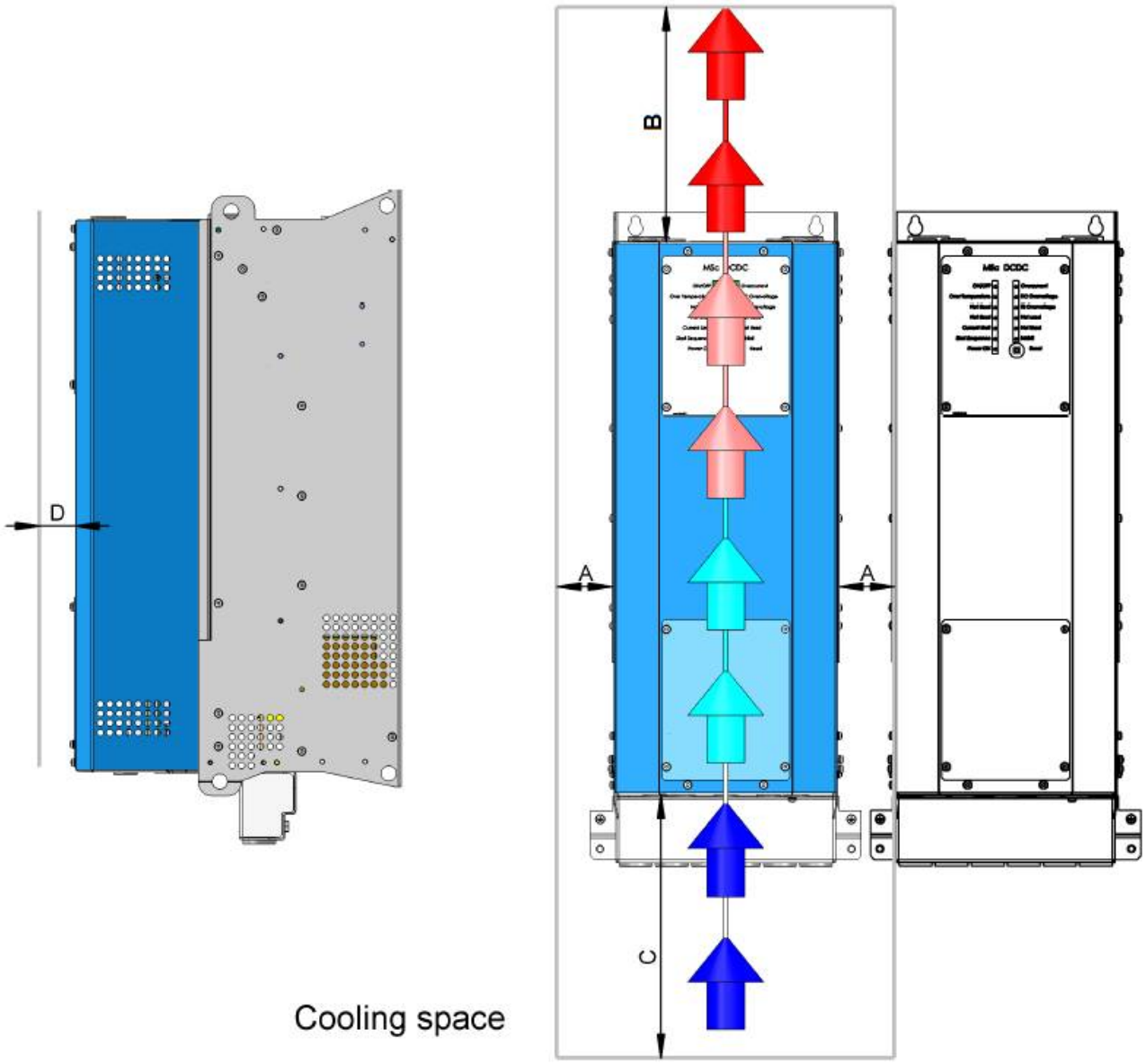
7.2 COOLING

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 6.1.3 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.

200DCDC750DE



80DCDC750DE	200DCDC750DE	Letter in picture	Description
50 mm	80 mm	A	free space to both sides of the MSc DC/DC Converter / free space between two MSc DC/DC Converters
100 mm	300 mm	B	free space above the MSc DC/DC Converter
50 mm	150 mm	C	free space underneath the MSc DC/DC Converter
30 mm	30 mm	D	free space in front of MSc DC/DC Converter

8 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.

8.1 POWER CONNECTIONS

In the block diagram in chapter 6.1.4 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.

8.1.1 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:

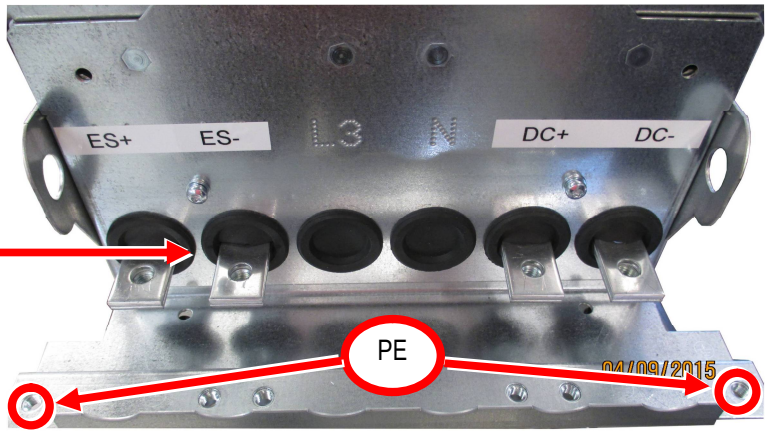
	80DCDC750DE	200DCDC750DE
Energy Source and DC link cabling	recommended cross section 25 mm^2/Cu (heat resistance at least +70°C) shielded cable MCMK/NKCABLES or similar	recommended cross section 50 mm^2/Cu (heat resistance at least +70°C) shielded cable MCMK/NKCABLES or similar
Energy Source connectors and DC connectors	see pictures further below	see pictures further below
Earthing cable	min. 16 mm^2 Cu	min. 25 mm^2 Cu
Energy Source and DC link fuse ampere rating and type (F1-F4)	100A / 690V aR	250A / 690V aR
DC-Circuit breakers (S1-S4)	100A / 690V	250A / 690V

8.1.2 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. (for 80DCDC750DE see next pages)

200DCDC750DE	
 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.

80DCDC750DE (steps 1 and 2, continued on next page)

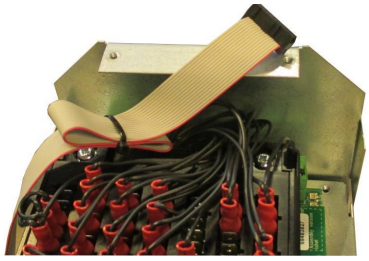
1. Lift the front cover (three M4 Torx T20 screws).

NOTE! There is a cable attached to the front cover, lift the front cover towards you very carefully.

Torx T20 max. 2 Nm

2. If you need to remove the front cover completely, carefully detach the cable from the front cover.

Cable attached

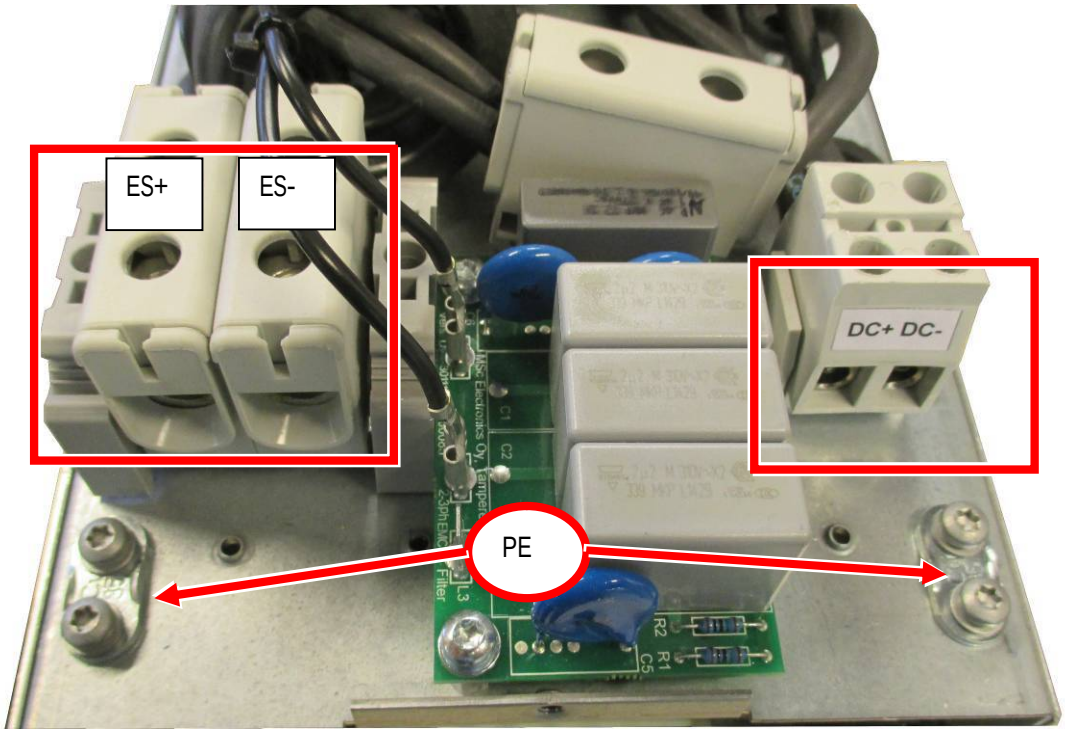


Cable detached, front cover removed completely

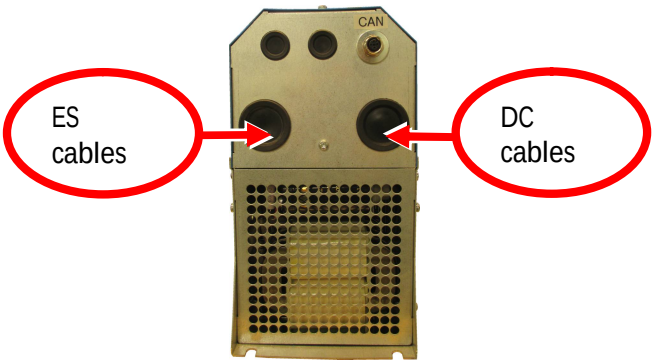
continued on next page

80DCDC750DE (step 3)

3. **Make the power connections. The power connectors and the PE connectors are located behind the bottom cover you lifted in step 3. See picture below.**



ES	Hex key 5 mm, 10 Nm
DC	Slot screw 1.2 x 6.5 mm, 2.5 Nm
PE	Torx T20, 2.5 Nm



8.2 CONTROL CONNECTIONS

The control cable sizes and types are listed below (1-3 control cables).
For the optional CAN, see chapter 6.2.3 Optional control interface – CAN bus.

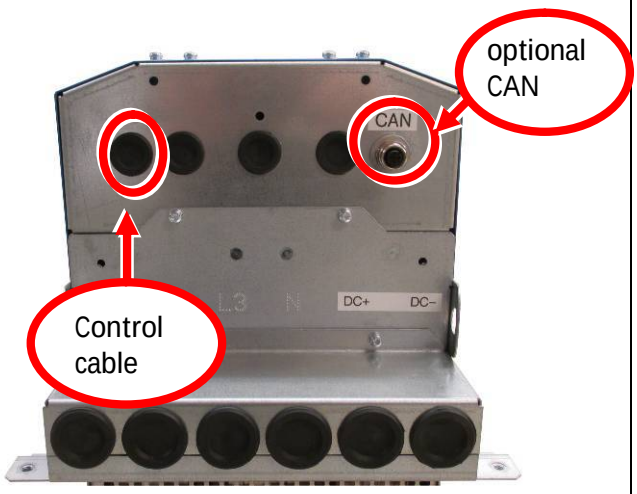
Control connectors and cross sections	Connection method: screw terminals, torque 0.6 Nm Cross section: 0.25 mm² - 2.5 mm²
PE connectors for control cable shield grounding	Clamp connection
Cable type for control cable	Screened cable equipped with low impedance shield and grounded from both ends

Further details for 200DCDC750DE see below, for 80DCDC750DE see next page.

200DCDC750DE

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 6.2.2. 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)

80DCDC750DE

Proceed as follows:

The control cable terminals are located under the front cover. The location of the control terminals can be seen in the picture in chapter 6.2.2. Grounding of the control cable shield is done to PE clamp terminal shown in the picture below. If you use the optional CAN, do not open anything, just connect your cable to the CAN connector at the bottom of the device (see picture in the right corner at the bottom of this page).

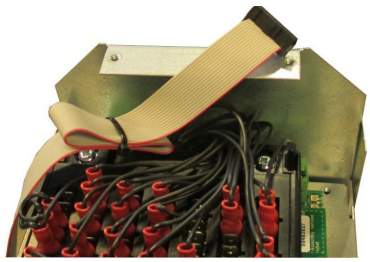
1. **Lift the front cover (three M4 Torx T20 screws).**

NOTE! There is a cable attached to the front cover, lift the front cover towards you very carefully.

Torx T20 max. 2 Nm

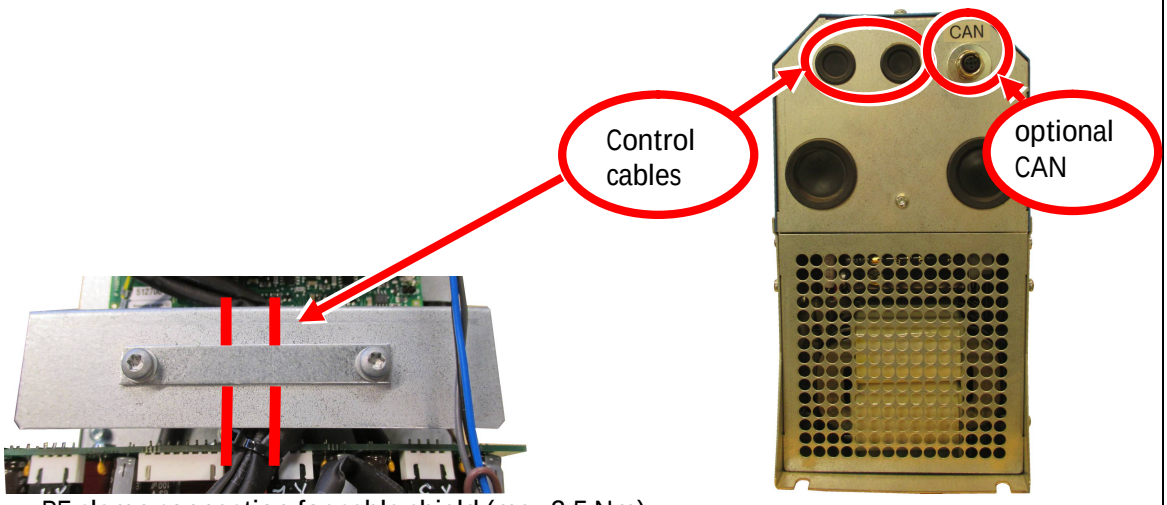
2. **If you need to remove the front cover completely, carefully detach the cable from the front cover.**

Cable attached



Cable detached, front cover removed completely

3. **Make the control connections**



PE clamp connection for cable shield (max 2.5 Nm)

9 COMMISSIONING

9.1 ABOUT THIS CHAPTER

This chapter and its subchapters are applicable to MSc 80DCDC750DE and 200DCDC750DE devices only! Check the type plate of your device!

9.2 SAFETY

Before commissioning note the directions and warnings given in chapter 1.

9.3 COMMISSIONING REPORT

Before commissioning, print out the empty commissioning report form (see chapter 9.6). Fill in the form during commissioning.

The warranty of the MSc DC/DC Converter is valid only if the commissioning has been performed as instructed in this document. The commissioning report must be correctly and completely filled in and delivered to MSc Electronics Oy.

9.4 START-UP PROCEDURE

This start-up procedure gives step-by-step instructions on how to start-up the MSc DC/DC Converter for the first time.

Make sure all mechanical and electrical installations are done according the instructions and block diagram given in chapter 6.

Fill in sections 1 and 2 of the commissioning report. After filling in the section 1 and 2 without any “NOK” markings, proceed to fill in either section 3 of the commissioning report (if CAN bus NOT used) OR section 4 (if CAN bus is used).

9.5 SHUTDOWN PROCEDURE AND REMOVAL

See chapter 10.2.2.

9.6 COMMISSIONING REPORT (EMPTY FORM)

Disclaimer: This commissioning report is only an additional aid. Reading the user manual is explicitly required.

1. MSc DC/DC Converter identification

1.1	Converter type	MSc 80DCDC750DE ☐	MSc 200DCDC750DE ☐
	Unit/serial number		Serial number
1.2		Unit 1	
1.3		Unit 2	
1.4		Unit 3	
1.5		Unit 4	
1.6		Unit 5	
1.7		Unit 6	
1.8	Installation location		

2. Inspection on site – verification of the MSc DC/DC Converter after installation

Check installation environment		OK/NOK
2.1	Take a picture of the installation environment	
2.2	Check the ambient temperature (< 40°C/104°F) (if > 40°C/104°F, derating is required)	
2.3	Check the installation altitude (< 1000m/3300ft)	
2.4	Check the ventilation (room and enclosure) Check also room ventilation summer/winter setting.	
Check cabinet		
2.5	Air filters are correctly assembled and they are clean.	
2.6	Ensure that no sources of conductive dust are present (cabinet IP rating) and MSc DC/DC Converter IP rating	

Check cabling and protection		
2.7	ES/DC link protection installed (S1-S4). Check the setting and operation of the protective apparatus.	
2.8	Check cross-section of ES/DC link cabling and control I/O cabling. (see chapter 8 ELECTRICAL INSTALLATION)	
2.9	Check cross-section of protective conductors (PE) connected to each enclosure. (see chapter 8 ELECTRICAL INSTALLATION)	
2.10	Check rated current and type of the ES/DC link cable fuses (see chapter 8 ELECTRICAL INSTALLATION)	
2.11	Check tightness of conductor fixations	
2.12	The material of busbars, terminals and cables must be compatible (corrosion)	
2.13	Cable connection box cover is installed.	
Check internal connections, DC link, Energy Source and control IO		
2.14	Disconnect the MSc DC/DC Converter from the ES/DC link (disconnection recommended by S1-S4)	
2.15	If MSc DC/DC Converter connected to the ES/DC link before, wait 5 minutes.	
2.16	Remove the MSc DC/DC Converter front cover and cable connection box cover.	
2.17	Wiring of ES/DC link and auxiliary circuits	
2.18	Tightness of all electrical connections	
2.19	Connectors properly plugged in	
2.20	Clearances	
2.21	Check the cabling of the I/O (if present)	
Check Energy Source and DC link voltage		
2.22	Check the voltage in accordance with the specification (type designation label)	
2.23	Close all protective covers (front cover and cable connection box cover).	

3. Connecting the MSc DC/DC Converter to the Energy Source and DC link (CAN bus is NOT used. If CAN bus IS used, fill in section 4 instead.)

Before connecting the MSc DC/DC Converter to ES/DC link		OK/NOK
3.1	Check that the MSc DC/DC Converter ON/OFF/RESET control input is in OFF position.	
3.2	Check that Voltage/Current Reference value is set to desired value.	
3.3	Check that Discharge/Charge current limits are set to 0 A.	
3.4	Make sure that DC switches S1-S4 are opened.	
3.5	Close switches S3 and S4 to connect Converter to DC link.	
3.6	Close switches S1 and S2 to connect the Converter to Energy Source.	
3.7	Raise current limit signals to desired value.	
3.8	Check that MSc DC/DC Converter LEDs indicate normal operation. Unit is ready for use.	

4. Connecting the MSc DC/DC Converter to the Energy Source and DC link (CAN bus is used. If CAN bus is NOT used, fill in section 3 instead.)

Before connecting the MSc DC/DC Converter to ES/DC link		OK/NOK
4.1	Make sure that DC switches S1-S4 are opened.	
4.2	Close switches S3 and S4 to connect Converter to powered DC link (>360 V DC).	
4.3	Check that MSc DC/DC Converter LEDs indicate normal operation.	
4.4	Follow instructions in chapter 6.2.3.3 to change the CANopen Baud rate and Node-ID.	
4.5	Open switches S3-S4. Wait for the Converter to shut down.	
4.6	Close switches S3 and S4 to connect Converter to DC link.	
4.7	Close switches S1 and S2 to connect the Converter to Energy Source.	
4.8	Check that MSc DC/DC Converter LEDs indicate normal operation. Unit is ready for use.	

	Commissioning Engineer	Customer's representative
Name		
Signature		
Date		

4. Comments

9.7 COMMON INSTALLATION ERRORS CAUSING COMMISSIONING PROBLEMS

wrong installation	Installation of ES/DC link cables		Installation of control I/O cables				Observations
number	to Energy Source	to DC link	ON/OFF/RESET	ES/DC link voltage reference OR ES current reference	Discharge and charge current limitations	Discharge/ charge	
1	NOK	NOK	OK	OK	OK	OK	- Start-up side voltage is not sufficient to start-up the auxiliary power supply due to lack of connection. - LED indicators of MSc DC/DC Converter: All the LEDs are off
2	OK	OK	NOK	OK	OK	OK	- ON/OFF/RESET control has no effect. - LED indicators of MSc DC/DC Converter: Inhibit LED is constantly on. Other LEDs indicate normal operation.
3	OK	OK	OK	NOK	OK	OK	- Energy Source current does not correspond to reference value given via control I/O. - LED indicators of MSc DC/DC Converter: LEDs indicate normal operation.
4	OK	OK	OK	OK	NOK	OK	- Energy Source current is constantly 0 A - LED indicators of MSc DC/DC Converter: LEDs indicate normal operation.

10 MAINTENANCE

10.1 PREVENTIVE MAINTENANCE

In normal conditions, the MSc DC/DC Converter is maintenance-free. However, regular maintenance is recommended to ensure a trouble-free operation and a long lifetime of the MSc DC/DC Converter. We recommend to follow the table below for maintenance intervals.

Maintenance interval	Maintenance action
24 months (if unit stored)	Please contact the party having sold you the MSc DC/DC Converter after a storage period longer than 24 months.
6-24 months (depending on the environment)	• Check the tightness of the Energy Source, DC link and I/O terminals. • Check the operation of cooling fan, check for corrosion on the terminals, bus bars and other surfaces. • Check the cooling air filters in case of cabinet installation.
4 -7 years	• Change the cooling fan.
5 - 10 years	• Change DC bus capacitors.

10.2 CORRECTIVE MAINTENANCE

Faults are indicated by one or more LED lights on the front cover of the MSc DC/DC Converter. The operational meaning of all faults is described in the chapters below. The corrective maintenance procedure is shown in the table below:

Corrective maintenance procedure
Step 1: Does resetting help? -> see chapter 10.2.3 Reset
Step 2: Follow the corrective maintenance actions -> see chapters below
Step 3: Check possible external reasons: - Mechanical and electrical installation done according to instructions? - Ambient conditions as required? - MSc DC/DC Converter specifications checked? - Other external reasons eliminated?
Step 4: Replace the MSc DC/DC Converter (see Shutdown instructions in chapter 10.2.2) - If this helps, the MSc DC/DC Converter was defective. Send it in to be serviced (see instructions in chapter 10.2.4). - If this does not help, go back to steps 2 and 3 to find the external reason.

10.2.1 LED indications and corrective actions

See also chapter 6.2.1 LED indicators for information on the meaning of the LED indicators.

LED indication	Operational state	Criteria to be fulfilled for LED indication	Corrective actions
Overtemp	Stopped	Internal temperature limit exceeded (see also chapter 6.2.1 LED indicators)	- Check the cooling air temperature. - Make sure that there are no obstructions for cooling air availability. - Are the cabinet air filters clean and free of dirt? - Check that the cooling fan is working correctly
ES overvoltage	Stopped	Energy Source overvoltage limit exceeded Case 1): Sudden change in load Case 2): MSc DC/DC Converter internal failure	Case 1):Reset the fault. Case 2): Send the faulty MSc DC/DC Converter to be serviced.
ES limit high	ES charging prevented	Energy Source voltage has reached maximum limit	No action needed.
ES limit low	ES discharging prevented	Energy Source voltage has reached minimum limit	No action needed.
Inhibit	Stopped	Indication of operational status “Stopped” Case 1): There is some fault indicated by the fault LEDs. Case 2): MSc DC/DC Converter has been switched off (I/O input at OFF state).	Case 1): Follow corrective actions for fault in question. Case 2): Follow instructions for ON/OFF/RESET control input. Check cabling of control input if needed.
Power ON	ON	Case 1): If this LED is on, this is normal operation. Case 2): If this LED is off, it may be that the MSc DC/DC Converter is not connected to the ES/DC link or the start-up side voltage is not sufficient for start-up.	Case 1): No action needed. Case 2): Check that the MSc DC/DC Converter is connected to the ES/DC link and check the start-up side voltage level. If everything is OK and still the LED is off, remove the MSc DC/DC Converter and send it to be serviced.

LED indication	Operational state	Criteria to be fulfilled for LED indication	Corrective actions
Overcurrent	Stopped	Energy Source overcurrent limit exceeded Case 1): Sudden change in load Case 2): MSc DC/DC Converter internal failure	Case 1):Reset the fault. Case 2): Send the faulty MSc DC/DC Converter to be serviced.
DC overvoltage	Stopped	DC link overvoltage limit exceeded (see also chapter 6.2.1 LED indicators) Case 1): Sudden change in load Case 2): MSc DC/DC Converter internal failure	Case 1):Reset the fault. Case 2): Send the faulty MSc DC/DC Converter to be serviced.
DC limit high	ES discharging prevented	DC link voltage has reached maximum limit	No action needed.
DC limit low	ES charging prevented	DC link voltage has reached minimum limit	No action needed.

10.2.2 Shutdown procedure

1. Stop the MSc DC/DC Converter by setting ON/OFF/RESET input to the OFF position.

2. If MSc DC/DC Converter needs to be disconnected from the DC link and Energy Source, first open switches S3 and S4. After that switches S1 and S2 can be opened.

3. Wait 5 minutes for MSc DC/DC Converter internal capacitors to be fully discharged. Make sure that there are no dangerous voltages present on the MSc DC/DC Converter connectors before proceeding further!

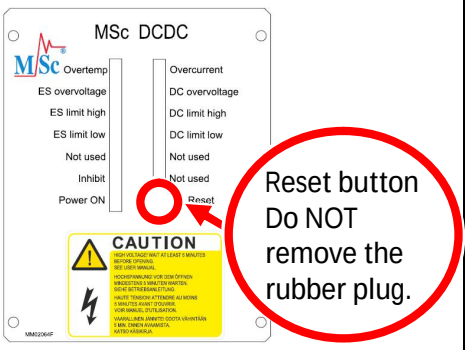
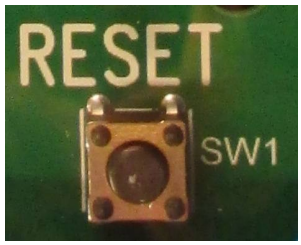
4. **The Energy Source may be required to be fully discharged** for service actions. The MSc DC/DC Converter **does not include any discharging resistors**, this means that external discharging circuits are needed for safe discharging of the Energy Source.

5. Remove the ES/DC link and control I/O cabling and unmount the MSc DC/DC Converter from the assembly. **Caution!** Control I/O could be connected to dangerous voltages even if the MSc DC/DC Converter is disconnected from the ES/DC link.

10.2.3 Reset

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.

An alternative method for resetting faults is to push the Reset button on the LED panel.

200DCDC750DE	80DCDC750DE
	

10.2.4 Sending in a defective device

Follow the corrective maintenance procedure as described in chapter 10.2.
When you have replaced an MSc DC/DC Converter, send in the defective one to be serviced. Provide all the relevant information, i.e. MSc DC/DC Converter serial number and type, status of the control LEDs at the time of the failure and a short description of the abnormal behaviour of the MSc DC/DC Converter.
Please contact the company that sold you the MSc DC/DC Converter for shipment address details.