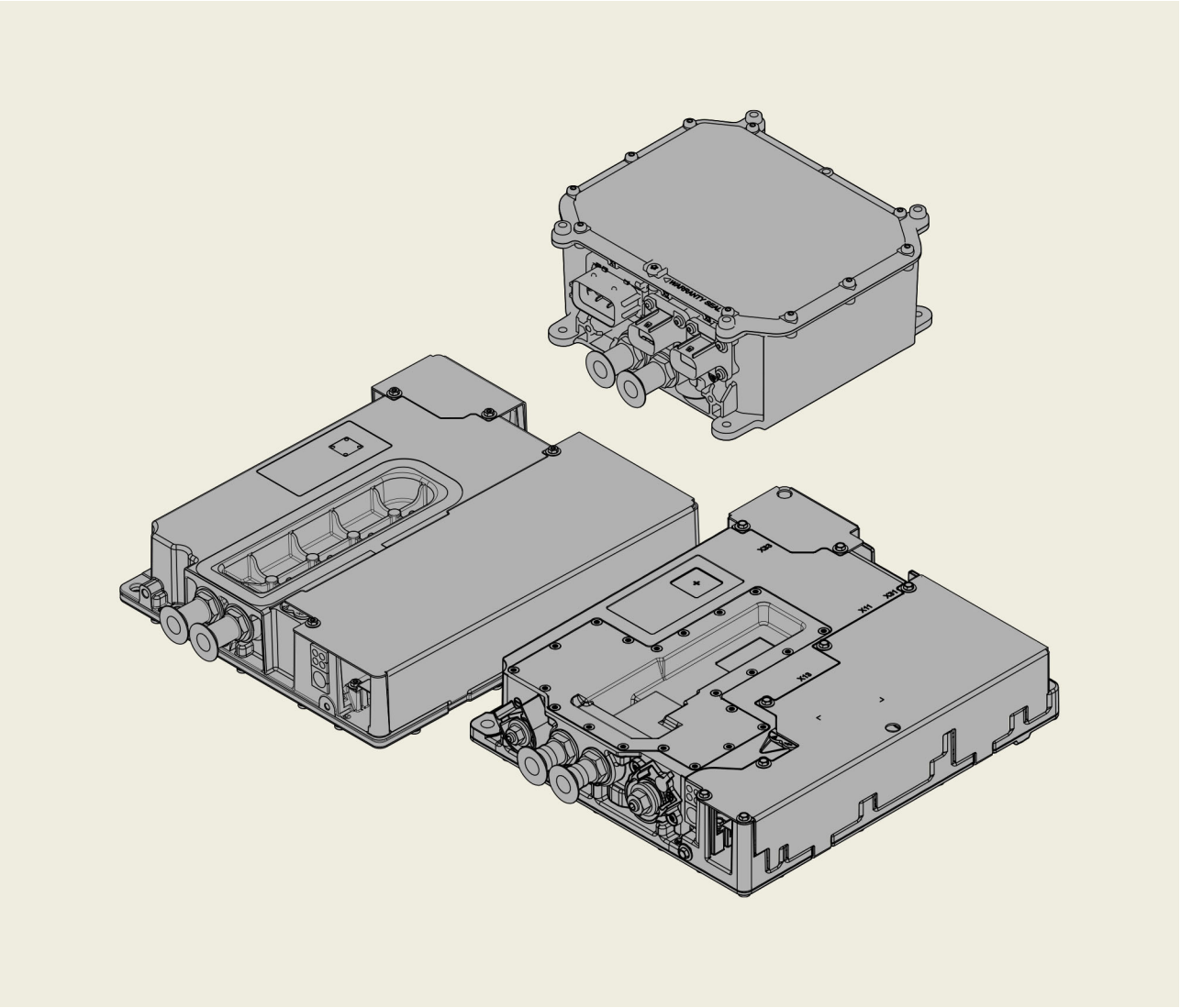
BUCHER hydraulics

Hardware Manual



MOBILE DCU, MOBILE PSU, MOBILE DCU PSU, MOBILE DCU S

EMDxGxxxxxxxxxx0x, EMDxGxxxxxxxxxx1x

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Because the products are subject to continual improvement, we reserve the right to amend the product specifications contained in this catalogue. The original language and legal terminology of all Bucher Hydraulics documentation is exclusively German. Bucher Hydraulics cannot be held liable for any possible errors in translation.

Contents

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1 About this documentation

This manual contains the complete information on the intended use of components of the MOBILE product platform in mobile applications in or on vehicles.

NOTE!
Information and tools regarding the Bucher products can be found in the download area under
www.buchertdrives.com

1.1 Target group

This manual is intended for all persons who dimension, install, commission and adjust drives with the MOBILE product platform.

1.2 Information regarding the validity

This manual is valid for the components with the type destignation:

Device type	Type designation	from SW
MOBILE Advanced DCU	EMDAG2xxxxxxxxx1x	06.0
MOBILE Advanced PSU	EMDAG3xxxxxxxxx1x	06.0
MOBILE Advanced DCU PSU	EMDAG4xxxxxxxxx1x	06.0
MOBILE Advanced DCU S	EMDAG5xxxxxxxxx0x	06.0
Accessories	EMDAZ…	–

IMPORTANT!:
The breakdown of the type designation can be found in the "Product description" chapter ⇒ 26

1.3 Document history

Version	Description	Description
4.1	11.2022	Adaptation to version 4.1 - housing DCU
4.0	07.2021	Rebranding to Bucher Hydraulics AG
3.0	11.2020	Revision of the device manual for the hardware version x1x
1.1	10.2014	Corrections
1.0	09.2014	First edition

1.4 Conventions used

This documentation uses the following conventions to distinguish between different types of information:

Spelling of numbers		
Decimal separator	Point	The decimal point is always used. For example: 1234.56
Text		
Program name	» «	PC software For example: »MOBILE Engineer«
Icons		
Page reference	⇒	Reference to another page with additional information For example: ⇒ 16 = see page 16
Documentation reference	🕮	Reference to another documentation with additional information For example: 🕮 EDKxxx = see documentation EDKxxx

1.5 Terminology used and abbreviations

Term	Description
AppC	Application Controller
CAN	Controller Area Network or electric circuit for CAN with its own current supply
DC	Direct current
DCU	DC/AC inverter *Drive Control Unit*
DCU PSU	Combined device
Double inverter	Inverter for two motors or two drives
Single inverter	Inverter for one motor or one drive
HCU	Host Control Unit (also Vehicle Control Unit or Machine Control Unit)
HV on-board supply system	High-voltage (on-board) system ISO 6469-3, voltage class B *engl.: High Voltage*
IT	Isolé Terre system (star point not earthed)
TRM15	Terminal 15: Terminal 15 is the original contact "Ignition on" at the steering lock which switches on the MOBILE PSU/DCU by a switch-on pulse (LOW-HIGH edge).
TRM30	Positive voltage of the voltage supply (12 V or 24 V)
TRM30	Negative voltage of the voltage supply (0 V). This signal is potentially connected to the vehicle chassis.
Performance electronics	Rectification, DC bus and DC-AC converter
LV on-board supply system	Low-voltage (on-board) system ISO 6469-3, voltage class A *engl.: Low Voltage*
MC	Motor Controller
MOBILE	Product platform for automotive drive solutions
»MOBILE Engineer«	Engineering tool, software solution for easy engineering in all phases
Module	Electronic unit or device *engl.: Unit*
Motor A	First motor controlled by MC
Motor B	Second motor controlled by MC (optional)
n.c.	Not connected *engl.: not connected*
PE	Chassis *Protective earth*
Private CAN	Real time CAN Bus which is used for controlling drives.
PSU	DC/DC converter *Power Supply Unit*

Term	Description
Public CAN	CAN bus on the vehicle side which is used for integrating the MOBILE PSU/DCU into vehicles.
Control electronics	Open-loop control, closed-loop control, setpoint generation, monitoring
SM	Synchronous motor
TN	Terre Neutre system (star point is earthed)
DC bus	DC bus
SLVCI	Sensorless vector control for asynchronous motors
SLVCS	Sensorless vector control for synchronous motors
SLVFCI	Sensorless V/f characteristic control for asynchronous motors
Ctrl	Control
VCI	Vector control for asynchronous motors
VCS	Vector control for synchronous motors
DC-bus level	Energy storage between rectification and DCAC conversion, for one or more controllers
DC-bus connection, DC-bus operation	Interconnection of several inverters on the DC-bus level

2 Safety instructions

2.1 Legal notice

The product Bucher Hydraulics Mobile Drives does not contain a safety system. Without a safety system, the product is not allowed to perform any safety functions. The security system is the responsibility of the customer. If the product is used for a safety function without a safety system, Bucher Hydraulics Mobile Drives excludes all liability.

2.2 Description of the safety notices

The following pictographs and signal words are used in this documentation to indicate dangers and important information:

2.2.1 Meaning of the signal words

The table below shows the meaning of the signal words that are used to identify the different levels of danger!!

Signal words	Meaning
DANGER!	Describes the danger and gives information about how to prevent dangerous situations.

2.2.2 Meaning of the pictograms

The following pictograms are used as warning symbols. They are combined with the appropriate signal word, depending on the danger level.

Warning symbol	Meaning
	**Danger of personal injury through dangerous electrical voltage** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	**Danger of personal injury through a general source of danger** Reference to an imminent danger that may result in death or serious personal injury if the corresponding measures are not taken.
	**Danger of property damage** Reference to a possible danger that may result in property damage if the corresponding measures are not taken.

2.2.3 Example of a safety notice

- Pictogram
- Signal word
- Note

	**DANGER!**
	Type of danger Possible consequences Measures for preventing the danger

2.2.4 Application notes

Pictographs	Meaning
	**IMPORTANT!** or **NOTE!** Important note to ensure trouble-free operation or useful tip for easy handling.
	Reference to another document.

2.3 General safety instructions and application notes

Observe the following basic safety instructions when using the MOBILE inverters (devices). A non-compliance may cause severe injury to persons and/or damage to material assets.

2.3.1 General

- For devices with ECE R10 approval, the ECE regulation no. 100 has to be observed.

2.3.2 For your personal safety

- The product Bucher Hydraulics Mobile Drives does not contain a safety system. Without a safety system, the product is not allowed to perform any safety functions.
- Only use the devices as directed.
- Never commission the devices in the event of visible damage.
- Never commission the devices before they have been completely mounted.
- Only separate or plug connectors if the high-voltage mains is switched off and discharged:
  - Power connector (marked with a warning sign on the cover)
  - Signal connector
- Do not open the housing of the devices. If the housing is opened, the warranty is void.
- Do not carry out any technical changes on the devices.
- Only use the accessories approved for the devices.
- Only use original spare parts from MOBILE.
- Observe all regulations for the prevention of accidents, directives and laws applicable on the site of installation.
- Transport, installation, commissioning and maintenance work must only be carried out by qualified personnel.
  - Observe IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and all national regulations for the prevention of accidents.
  - According to this basic safety information, qualified, skilled personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.
- Observe all specifications in the documentation.
  - Carry out installation and operation in accordance with the documentation.
  - This is the condition for safe and trouble-free operation and the achievement of the specified product features.

  - The procedural notes and circuit details described in the documentation are only proposals. It is up to the user to check whether they can be transferred to the particular applications. Bucher Hydraulics AG does not accept any liability for the suitability of the procedures and circuit proposals described.
- The devices and related components can - depending on the degree of protection - have live, movable or rotating parts during operation.
  - Surfaces can be hot.
  - Do not remove required covers.
  - Do not touch exposed contacts or non-insulated cable ends.
  - For more information, please see the documentation.
- Before touching conductive components, ensure isolation from supply by means of measurement.

The device-specific safety and application notes given in the chapter "Residual hazards" of this documentation must be observed.

2.3.3 Application as directed

- The devices meet the requirements of the Low-Voltage Directive 2006/95/EC. The harmonised standard EN 61800-5-1 applies to the devices.
- The product Bucher Hydraulics Mobile Drives does not contain a safety system. Without a safety system, the product is not allowed to perform any safety functions.
- The devices marked with E1 are components which are designed for installation in vehicles (ECE approval). They are not to be used as domestic appliances, but only for industrial purposes according to EN 61000-3-2.
- The technical data and supply conditions can be obtained from the nameplate and the documentation. They must be strictly observed.
- An insulation monitoring unit according to IEC 61557-8 must be available in the IT network on the system side.
- The connecting cables used must meet the fire safety requirements of ECE R118.
- Commissioning (i.e. start of the operation as intended) of devices installed in vehicles is only permissible if the following has been verified:
  - The vehicle corresponds to the valid vehicle standards (e.g. ECE R 100, safety requirements with respect to the electric power train of road vehicles); EN 60204 is observed.
  - The EMC Directive 2004/104/EC (last supplemented by 2009/19/EC) is complied with.

2.3.4 Transport, storage

Please observe the notes on transport, storage, and appropriate handling. Observe the climatic conditions according to the technical data.

2.3.5 Installation

You have to mount, connect and cool the devices according to the specifications of the respective documentation. The equipotential bonding has to be dimensioned sufficiently and protected against corrosion.

When plug connections are open, the degree of pollution 2 must not be exceeded according to EN 61800-5-1.

Ensure proper handling and avoid excessive mechanical stress.

Do not touch any electronic components and contacts. The devices contain electrostatic sensitive devices that can be damaged easily by improper handling. Damaged devices must not be commissioned.

2.3.6 Electrical connection

When working on live devices, observe the applicable national regulations for the prevention of accidents and technical measures for occupational safety and health.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). Additional information can be obtained from the documentation.

The documentation contains notes concerning wiring according to EMC regulations (shielding, earthing, filters and cable routing). The compliance with limit values required by the EMC legislation is the responsibility of the manufacturer of vehicles or systems or machines.

2.3.7 Operation

If necessary, systems including these devices must be equipped with additional monitoring and protection devices according to the valid safety regulations (e.g. law on technical equipment, regulations for the prevention of accidents). The devices can be adapted to your application by parameter settings. Please observe the corresponding information given in the documentation.

After the devices have been disconnected from the supply voltage, all live components and connectors must not be touched immediately because capacitors can still be charged. Please observe the corresponding stickers on the devices.

Ensure that all protection covers are closed and screwed during operation.

2.3.8 Maintenance and servicing

The devices do not require any maintenance if the prescribed operating conditions are observed.

The external cleaning of the devices has to be made in the course of the general care of the vehicles, machines, or systems.

Depending on the mounting place and the possible pollution, the cover sensor has to be cleaned regularly.

Position of the cover sensor:

- MOBILE DCU (EMDxG2…) ⇒ page 20
- MOBILE PSU (EMDxG3…) ⇒ page 21
- MOBILE DCU/PSU (EMDxG4…) ⇒ page 22

2.3.9 Disposal

For a professional disposal and utilisation of the devices, please comply with the valid regulations, e.g. 2000/53/EC (last amended by 2011/37/EC).

2.4 Residual hazards

2.4.1 Protection of persons

- Switch off the high voltage on*board voltage completely before working on the devices.
- Before working on the device, check whether all power terminals are deenergised because
  - after disconnection, the power terminals U, V and W remain live for at least 5 minutes depending on the system.
  - the power terminals +UG, -UG, U, V and W remain live while the motor is rotating.
  - Batteries and energy storages can carry hazardous voltage over a longer period of time.

2.4.2 Device protection

- Connect or disconnect all pluggable connection terminals only in de-energized state!
- Only disconnect the inverters from the installation, e.g. from the motor or the mounting wall, in a de-energized state!
- Close all unused connectors with protective caps or blind plugs.

2.4.3 Motor protection

- With certain inverter settings, the connected motor may overheat:
  - E.g. longer operation of the DC-injection brake.
  - Longer operation of self*ventilated motors at low speeds.
  - Incorrect frequency or voltage settings in the motor parameters (especially for 120 Hz motors).

2.4.4 Protection of the machine/plant

- Drives can reach dangerous overspeeds (e.g. setting of high output frequencies with unsuitable motors and machines):
  - The inverters offer no protection against such operating conditions. Use additional components for this purpose.

1

Warning symbol	Meaning
	**Long discharge time:** All power terminals remain live for few minutes after mains disconnection! The duration is given under the warning symbol on the device.
	**High leakage current:** Carry out fixed installation and PE connection according to EN 6180051!
	**Electrostatic sensitive devices:** Before working on the device, the personnel must be free of electrostatic charge!
	**Hot surface:** Risk of burns! Hot surfaces should not be touched without wearing protective gloves.
	**Read the documentation:** Before working on the device, the personnel must read and act in accordance with the documentation supplied with the product, especially the warnings and the safety instructions!
 	**Dangerous voltage:** Before working on the device, switch off the HV on-board voltage completely!

3 Product description

3.1 System overview

The components from the MOBILE modular system are used to realize auxiliary unit applications in commercial vehicles by means of:

- Electric motors for air-conditioning compressors or air compressors
- A charging function for 12 V or 24 V batteries, which in conventional vehicles was performed by an alternator.

Overview of possible device-dependent applications:

	MOBILE			
	DCU	PSU	DCU PSU	DCU S
Device type				
Double inverter for two motors	●	–	–	–
DC/DC converter (converter HV on-board supply system/ LV on-board supply system)	–	●	●	–
Combination of single inverter for one motor and DC/DC converter	–	–	●	–
Single inverter for one motor	–	–	–	●
Application				
Simple drives of pumps and fans	●	–	●	●
Controlled and positioning drives	●		●	●
Charging the LV on-board supply with regenerative energy if drives	–	●	●	–

3.2 MOBILE DCU

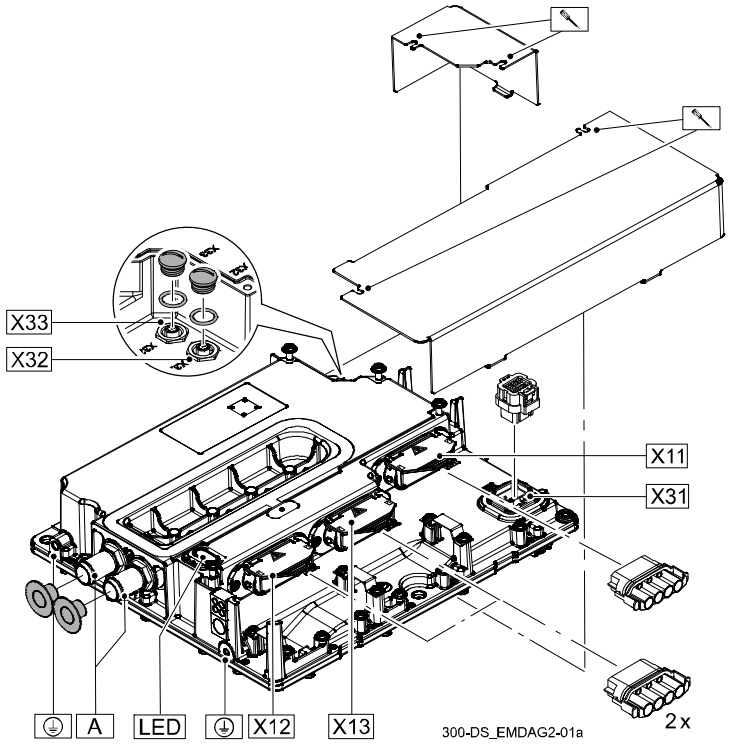


Fig.1 MOBILE DCU (EMDxG2…)

Connections and elements		Info
A	Connection of water cooling	⇒ 49
X11	Connection of HV system 800 V DC	⇒ 60
X12	Connection of Motor A	⇒ 62
X13	Connection of Motor B	⇒ 62
X31	Vehicle interface, connection of control voltage, control signals, CAN	⇒ 65
X32	Connection of resolver and temperature monitoring of motor A (by default sealed with plug)	⇒ 63
X33	Connection of resolver and temperature monitoring of motor B (by default sealed with plug)	⇒ 63
⏚	PE connection	⇒ 51 ⇒ 60
LED	LED status display	⇒ 75
	Cover sensor	

3.3 MOBILE PSU

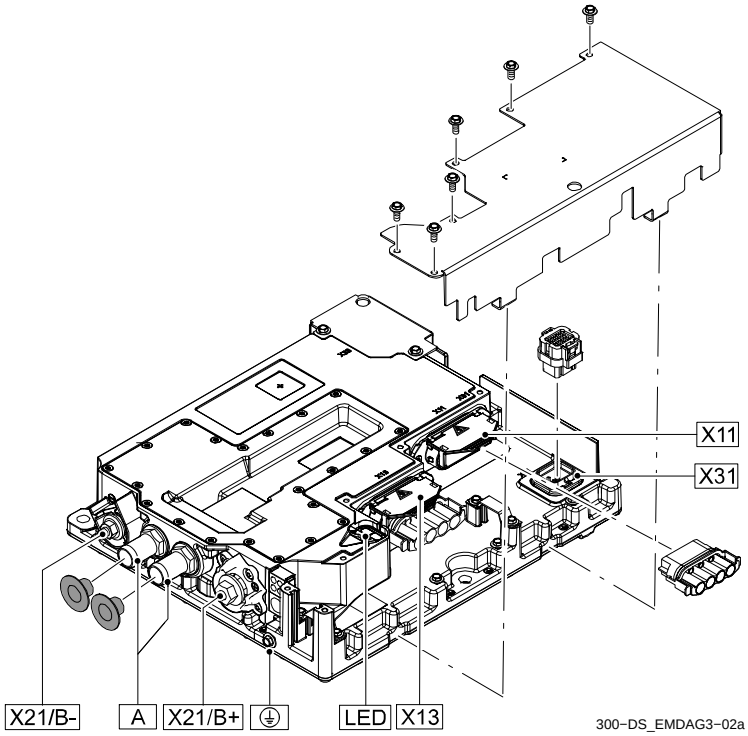


Fig.2 MOBILE PSU (EMDxG3…)

Connections and elements		Info
A	Connection of water cooling	⇒ 49
X11	Connection of HV system 400 V DC or 800 V DC	⇒ 60
X13	Connection of Motor is supplied as a blanking plug (must not be removed)	
X21/B+ X21/B-	LV mains 14 V DC or 28 V DC Connection of the on-board battery	⇒ 64
X31	Vehicle interface, connection of control voltage, control signals, CAN	⇒ 65
⏚	PE connection	⇒ 51 ⇒ 60
LED	LED status display	⇒ 75
	Cover sensor	

DANGER!

Dangerous electrical voltage

The terminal X13 carries electrical voltage.

Possible consequences:

Death or severe injury if the power terminals are touched.

Protective measures:

Do not remove the blanking plug from X13.

3.4 MOBILE DCU PSU

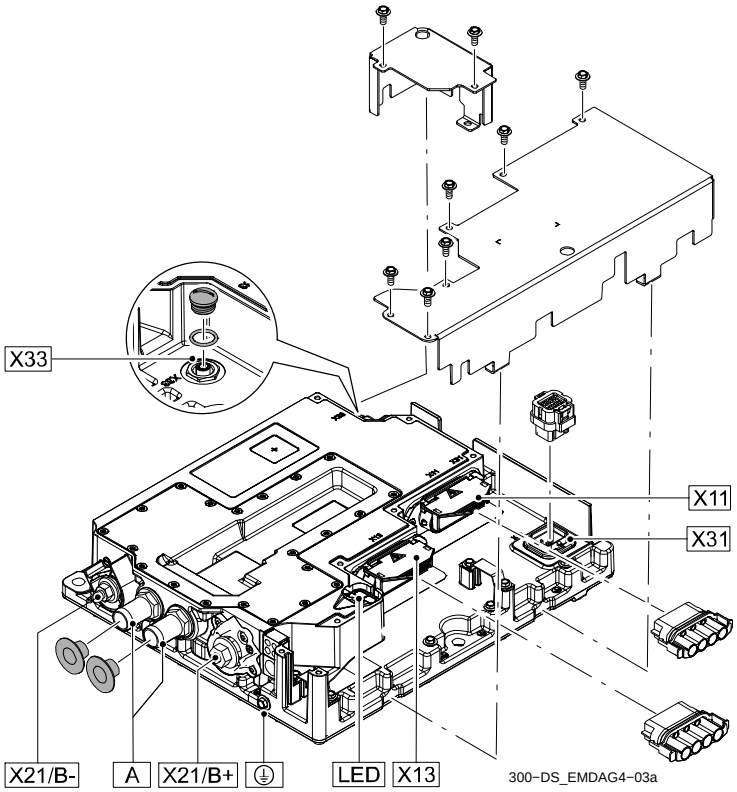


Fig.3 MOBILE DCU/PSU (EMDxG4…)

Connections and elements		Info
A	Connection of water cooling	⇒ 49
X11	Connection of HV system 400 V DC or 800 V DC	⇒ 60
X13	Connection of Motor	⇒ 62
X21/B+ X21/B-	LV mains 14 V DC or 28 V DC Connection of the on-board battery	⇒ 64
X31	Vehicle interface, connection of control voltage, control signals, CAN	⇒ 65
X33	Connection of resolver and temperature monitoring of motor (by default sealed with plug)	⇒ 63
⏚	PE connection	⇒ 51 ⇒ 60
LED	LED status display	⇒ 75
	Cover sensor	

3.5 MOBILE DCU S

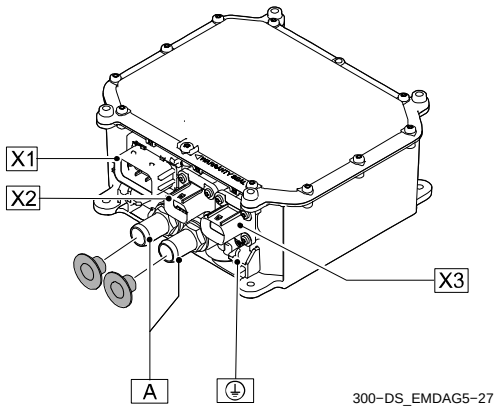


Fig.4 MOBILE DCU S (EMDxG5…)

Connections and elements		Info
A	Connection of water cooling	⇒ 49
X1	Vehicle interface, connection of control voltage, control signals, CAN	⇒ 70
X2	Connection of HV on-board supply system 800 V DC	⇒ 69
X3	Connection of Motor	⇒ 70
⏚	PE connection	⇒ 69 ⇒ 51

3.6 Device features

Device feature		EMDAG2…	EMDAG3…	EMDAG4…	EMDAG5…
Power range (Peak Power)	kW	7.5 ... 60	2.8 ... 5.6	2.8 ... 60	11 ... 22
DC/AC inverter		2	–	1	1
DC/DC converter (electrically isolated)		–	1	1	1
Approval acc. to ECE R10		●	●	●	●
Degree of protection		IP6K9K	IP6K9K	IP6K9K	IP6K9K
Cooling		Water / glycol ⇒ 42			
Standards fulfilled		ASTM D 3306, AS 2108-2004, ASTM D 4985 BS 6580:2010, SAE J1034, SANS 1251:2005 CUNA NC 956-16, ONORM V 5123, AFNOR NFR 15-601			
Mounting type		free Mounting with screws (see mounting instructions)			
12/24-V voltage for maintaining the control functionality in the case of mains failure		●	●	●	●
Digital inputs		4	4	4	4
configurable as analog input		2	2	2	2
configurable as frequency input		2	2	2	–
Digital outputs		4	4	4	–
Resolver connection		2	–	1	–
Motor temperature monitoring		PT1000, KTY83/110, KTY84/130, thermostat (normally-closed contact) acc. to DIN 44080, PTC acc. to DIN 44081			
Public CAN		●	●	●	●
Baud rate	kbps	125 ... 500	125 ... 500	125 ... 500	125 ... 500
Private CAN		●	●	●	●
Baud rate	kbps	125 ... 1000	125 ... 1000	125 ... 1000	125 ... 500
Operation in generator mode (optional)		●	–	●	●
Loop-through of HV system		●	●	●	–
Overload cycle at 1.8 x I_{rated}		10s	–	10s	10s
Overload cycle at 1.5 x I_{rated}		60s	–	60s	60s
Motor speed range	rpm	-32000 … 32255	2.8 ... 56	2.8 ... 60	7.5 ... 22
Non-parameterizable functions					
Interlock (HVIL)		–	–	–	●
Parameterizable functions					
Interlock (HVIL)		(see reference manual)			–
Precharge		(see reference manual)			–
Technology application					
Actuator speed		●	–	●	●
Switch-off positioning		❍	–	❍	–
Absolute positioning		❍	–	❍	–

● Included as standard
❍ Optionally available
– Not available

3.7 Identification

Each device is marked with a clear nameplate. The following data on the nameplate serves to identify each device:

- Type designation (product key)
- Technical data
- Serial number (SN)

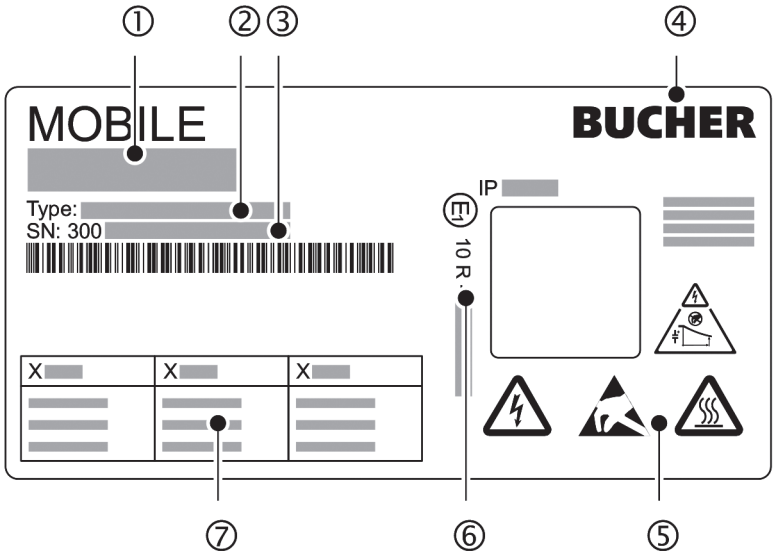


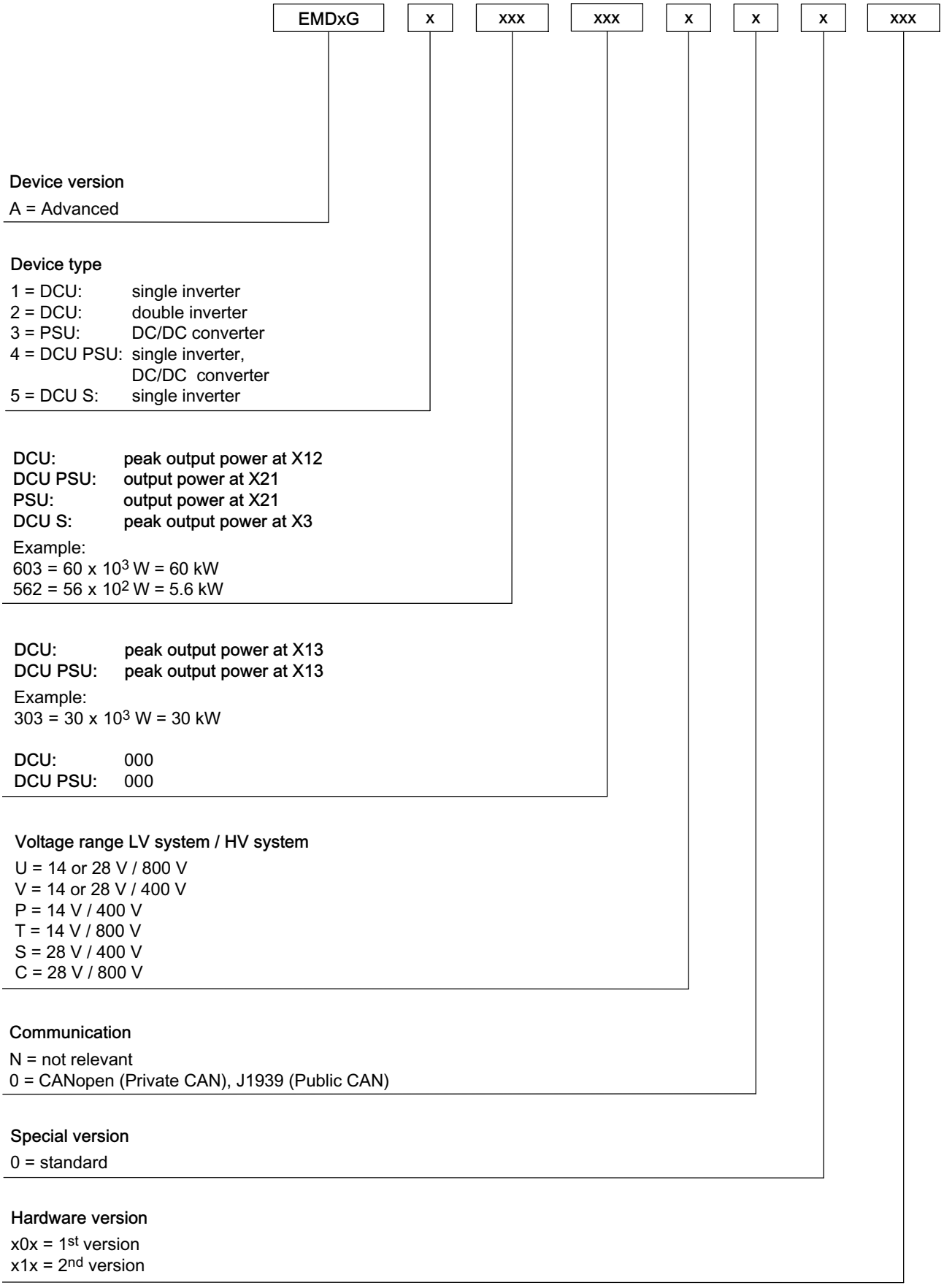
Fig. 5 Nameplate

① Product name
② Type designation
③ Serial number
④ Manufacturer
⑤ Warning symbol: discharge time, dangerous electrical voltage, hot surface
⑥ Approval identification
⑦ Technical data

Note:

Detailed device characteristics can be identified by means of the type designation with the following type code. The listing of the type code, equipment features and device properties does not take into account restrictions on the possible combinations.

3.8 Type code


EMDxG
x
xxx
xxx
x
x
x
xxx
Device version
A = Advanced
Device type
1 = DCU: single inverter
2 = DCU: double inverter
3 = PSU: DC/DC converter
4 = DCU PSU: single inverter, DC/DC converter
5 = DCU S: single inverter
DCU: peak output power at X12
DCU PSU: output power at X21
PSU: output power at X21
DCU S: peak output power at X3
Example:
603 = 60 x 10^3 W = 60 kW
562 = 56 x 10^2 W = 5.6 kW
DCU: peak output power at X13
DCU PSU: peak output power at X13
Example:
303 = 30 x 10^3 W = 30 kW
DCU: 000
DCU PSU: 000
Voltage range LV system / HV system
U = 14 or 28 V / 800 V
V = 14 or 28 V / 400 V
P = 14 V / 400 V
T = 14 V / 800 V
S = 28 V / 400 V
C = 28 V / 800 V
Communication
N = not relevant
0 = CANopen (Private CAN), J1939 (Public CAN)
Special version
0 = standard
Hardware version
x0x = 1st version
x1x = 2nd version

4 Technical data

4.1 General data and operating conditions

4.1.1 Conformity and approval			
Approval			
ECE	R10 Rev. 5	(E1) 10R - 05 7105 (see nameplate)	MOBILE DCU MOBILE PSU MOBILE DCU PSU
		(E1) 10R - 05 8467 (see nameplate)	MOBILE DCU S

4.1.2 Protection of persons and devices protection			
Degree of protection	ISO 20653	IP6K9K	• Plug mounted • Cover sheet mounted
		IP6K7	• Plug mounted • Without cover sheet
		IP2XB	• Plug not mounted • Without cover sheet
Insulation test	EN 61800-5-1	Final test with 2.6 kV DC between HV on-board supply system/LV on-board supply system and HV on-board supply system/PE	
Insulation of control circuits	EN 61800-5-1 IEC 60664-1	Safe isolation by double/reinforced insulation to the HV on-board supply system	
Short-circuit strength		• Motor connection: When connecting a 3-phase electric motor, the DCU motor output is short-circuit proof. The controller is locked, error acknowledgement is required. • Control terminal: permanently short-circuit-proof	
Protective measures against		• Short circuit • Overvoltage • Motor Connection Test • Device overtemperature • Motor overtemperature (PTC or thermal contact, I^2t monitoring)	
Leakage current	EN 61800-5-1	I_{AC} > 3.5 mA I_{DC} > 10 mA	Observe regulations and safety instructions!
On / off switching		MOBILE devices are suitable for frequent on/off switching, e.g. in the setting-up operation.	

4.1.3 Ambient conditions			
Climate			
Storage	IEC/EN 60721-3-1	1 year: 1K22 (-25 ... +55 °C) 3 years: 1K21 (+5 ... +40 °C)	
Transport	IEC/EN 60721-3-2	1K23 (-45… +70 °C)	
Operation			
Inverter, DC/DC converter		-40… +85 °C)	
Coolant		-30… +65 °C)	Coolant pump switches on at a coolant temperature of +30 °C
Service life		50000 h	at a coolant temperature of 55 °C
Humidity, relative		5 ... 100 %	
Altitude			
MOBILE DCU MOBILE PSU MOBILE DCU PSU	EN 61800-5-1 EN 60664-1	0 ... 2000 m amsl	Overvoltage category II
		2000 ... 4000 m amsl	Overvoltage category I
MOBILE DCU S	EN 61800-5-1 EN 60664-1	2000 ... 4000 m amsl	Overvoltage category II
		2000 ... 4000 m amsl	Overvoltage category I
Pollution	EN 61800-5-1 EN 60664-1	Degree of pollution 4	all plugs closed
		Degree of pollution 2	Plugs opened
Vibration resistance (9.81 m/s^2 = 1 g)			
Transport & Operation	ISO 16750-3, code L	vertical, tested with 57.9 m/s^2	
		horizontal, tested with 57.9 m/s^2	
		mechanical shock, tested with 500 m/s^2 for 6 ms	

4.1.4 Mounting conditions		
Mounting place		in commercial vehicles (spring-loaded masses)
Mounting position		
MOBILE DCU MOBILE PSU MOBILE DCU PSU		⇒ 47
MOBILE DCU S		⇒ 48
Mountain clearances		
in the connection area		≥ 150 mm Observe bend radii for cables and hoses.
more pages		No special requirements

4.1.5 Supply conditions		
HV on-board supply system		Direct connection to the HV on-board supply system When switching elements are used in the HV on-board supply system, the DC-bus capacitors must be precharged.
DC-bus operation		• Permissible • Observe maximum contact load. • Only use devices with the same voltage range.
Power systems		
IT		Standard
TT, TN		On request
Motors		Only use motors that are suitable for operation on the inverter.

4.1.6 Requirements related to cables for HV on-board supply system and motor		
Capacitance per unit length		
≤2.5 mm²/AWG 14		$C_{core-core}/C_{core-shield}$ <75/150 pF/m
≤4 mm²/AWG 12		$C_{core-core}/C_{core-shield}$ <150/300 pF/m
Electric strength		
	VDE 0250-1	V_0/V = 0.6/1.0 kV (V_0 = r.m.s. value external conductor to PE, V = r.m.s. value external conductor/external conductor)
Cable type		
Recommendation		• RADOX® cable 155S • Huber & Suhner

4.1.7 EMC		
Interference emission	ECE R10, Rev. 5	• radiated broad and narrow-band electromagnetic interferences • cable-guided transient noise emissions on the supply cables
Immunity to interference	ECE R10, Rev. 5	• Immunity to radiated electromagnetic fields • Immunity to injected interferences on the supply cables

4.1.8 Precharge		EMDAG2…	EMDAG3…	EMDAG4…	EMDAG5…
Max. precharge voltage	V DC	848			–
Max. precharge time to rated voltage at KL30 = 24 V	s	10	6		

IMPORTANT!:
The precharge power supply is only dimensioned for precharging the internal capacities. During the precharging process the DC bus must not be loaded externally.

4.1.9 DC bus			EMDAG2…	EMDAG3…	EMDAG4…	EMDAG5…
Rated voltage - HV on-board supply system		V DC	800	800	800	800
DC-bus capacity	C_x	µF	240	120	120	80
Discharge resistance	R_{pd}	kΩ	300	300	300	573
Capacity	C_y	nF	4.7	9.4	9.4	4.7
Insulation resistance	R_{iso}	MΩ	20	20	20	>50
Max. discharge time (acc. to EN 61800-5-1)		s	300	300	300	180
No active discharge available	R_{ad}					

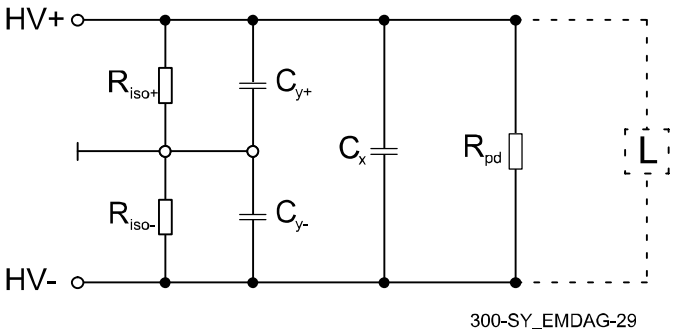


Fig.4-1 Equivalent circuit diagram of DC bus

HV+, HV-	DC HV electric ciruit
R_{iso+}, R_{iso-}	Resulting resistance per HV potential
R_{pd}	Resistance for passive discharge
C_x	Capacity of the X-capacitors
C_{y-}, C_{y-}	Resulting capacitance of Y-capacitors, parasitic capacitance, capacitance between HV+ or HV- and electrical ground
L	Load
⊥	Electrical ground

4.1.10 Open and closed loop control		
Open and closed loop control processes	Sensorless V/f characteristic control for asynchronous motors (SLVFCI) • Operation with linear load torque characteristic • Operation with square-law load torque characteristic • Operation of socket applications with V/I characteristic	
	Sensorless vector control for asynchronous motors (SLVCI) • Dynamic control in all quadrants • Blocking zone at low negative speeds and positive torque • Blocking zone at low positive speeds and negative torque	
	Sensorless vector control for synchronous motors (SLVCS) • Dynamic control in all quadrants • Restricted torque at low speeds	
	Vector control for asynchronous motors (VCI) • Dynamic control in all quadrants	
	Vector control for synchronous motors (VCS) • Dynamic control in all quadrants	
Switching frequency	2 kHz, 4 kHz, 8 kHz, 16 kHz, optionally fixed or variable Default setting: 8 kHz variable	
Output frequency		
Range	-599 Hz ... +599 Hz	
Absolute resolution	0.00024 Hz	
Digital Setpoint selection via Public CAN		
Resolution	Speed	1 rpm
	Torque	0.2 Nm
	Voltage (PSU)	0.001 V
	Current (PSU)	0.05 A

4.2 Rated data of the devices for HV on-board supply system 800 V

4.2.1 Product finder

How to find the data for the desired MOBILE device:

Device	Type	DC/AC inverter		DC/DC converter
		X12	X13	X21
MOBILE DCU	EMDAG2603603U	60 kW	60 kW	–
	EMDAG2303303U	30 kW	30 kW	–
	EMDAG2303153U	30 kW	15 kW	–
	EMDAG2153752U	15 kW	7.5 kW	–
MOBILE PSU	EMDAG3562000C	–	–	5.6 kW, 24 V
	EMDAG3282000T	–	–	2.8 kW, 12 V
MOBILE DCU PSU	EMDAG4562603C	–	60 kW	5.6 kW, 24 V
	EMDAG4282603T	–	60 kW	2.8 kW, 12 V
	EMDAG4562303C	–	30 kW	5.6 kW, 24 V
	EMDAG4282303T	–	30 kW	2.8 kW, 12 V
	EMDAG4562153C	–	15 kW	5.6 kW, 24 V
	EMDAG4282153T	–	15 kW	2.8 kW, 12 V
		X3		
MOBILE DCU S	EMDAG5223000U	22 kW	–	–
	EMDAG5113000U	11 kW	–	–
How to find the data:		⇒ 33		⇒ 35

4.2.2 DC/AC inverter

DC/AC inverter			7.5 kW	11 kW	15 kW	22 kW	30 kW	60 kW
Input voltage - HV on-board supply system								
Rated voltage		V DC	800					
Voltage range		V DC	100 ... 848					
Output voltage			3 AC 0 V ... 575 V					
Output frequency f_{out}		Hz	-599 ... +599					
Max. rise of voltage with 10 m motor cable		du/dt	4…9 kV / µs					
Switch-off at short-circuit current		A_{peak}	24	36.1	48.1	72.1	96.2	192.3
Efficiency								
typical		%	98.5					
Valid for operating point			DC 600 V, AC 400 V, 58 A, 8 kHz, 40 kW, cos phi 1.0					
Continuous operation								
Current consumption - HV * on-board supply system		A	9.8	13.5	18.4	26.3	39.2	71
Output power		kW	5	7.3	10	14.7	20	40
Output current at f_{out} < 5 Hz	2 kHz permanent	A	8	11	15	21.5	32	58
	4 kHz permanent	A	6.4	8.8	12	17.2	25.6	46.4
	8 kHz permanent	A	4.8	6.6	9	12.9	19.2	34.8
	16 kHz permanent	A	2.4	3.3	4.5	6.5	9.6	17.4
	4 kHz auto	A	8	11	15	21.5	32	58
	8 kHz auto	A	7.2	9.9	13.5	19.4	28.8	52.2
	16 kHz auto	A	4.4	6.1	8.3	11.8	17.6	31.9
Output current at f_{out} > 5 Hz	2 kHz permanent	A	12.8	17.6	24	34.4	51.2	72.5 **
	4 kHz permanent	A	10	13.8	18.8	26.9	40	72.5 **
	8 kHz permanent	A	7.2	9.9	13.5	19.4	28.8	52.2
	16 kHz permanent	A	4	5.5	7.5	10.8	16	29
	4 kHz auto	A	10	13.8	18.8	26.9	40	72.5 **
	8 kHz auto	A	8	11	15	21.5	32	58
	16 kHz auto	A	4.8	6.6	9	12.9	19.2	34.8
Output current for "socket" application (VAC)								
f_{out} < 10 Hz, VAC	16 kHz permanent	A	2.8	3.9	5.3	7.5	10.6	18.6
f_{out} > 10 Hz, VAC	16 kHz permanent	A	5	6.9	9.5	13.5	18.9	34.2

* This value is valid at 800 VDC and the current, which is possible with 8kHz Auto.

** From MOBILE firmware version 6.3:
Derating to min. 58 A if the coolant and ambient temperatures are above 60 5C (DCU) or 55 5C (PSU) for more than 60 minutes.

DC/AC inverter			7.5 kW	11 kW	15 kW	22 kW	30 kW	60 kW
Overcurrent cycle 60 s								
Operation for 60 s with up to 150 % of the continuous output current if afterwards a recovery time of 120 s with max. 50 % of the continuous output current is observed.								
Current consumption - HV * on-board supply system		A	14.7	20.2	27.6	39.5	58.8	106.6
Max. output power		kW	7.5	11	15	22	30	60
Max. output current at f_{out} < 5 Hz	2 kHz permanent	A	12	16.5	22.5	32.3	48	87
	4 kHz permanent	A	9.2	12.7	17.3	24.7	36.8	66.7
	8 kHz permanent	A	5.6	7.7	10.5	15.1	22.4	40.6
	16 kHz permanent	A	3.2	4.4	6	8.6	12.8	23.2
	4 kHz auto	A	12	16.5	22.5	32.3	48	87
	8 kHz auto	A	10.4	14.3	19.5	28	41.6	75.4
	16 kHz auto	A	8	11	15	21.5	32	58
Max. output current at f_{out} > 5 Hz	2 kHz permanent	A	16	22	30	43	64	107.3
	4 kHz permanent	A	12	16.5	22.5	32.3	48	87
	8 kHz permanent	A	8.8	12.1	16.5	23.7	35.2	63.8
	16 kHz permanent	A	5.2	7.2	9.8	14	20.8	37.7
	4 kHz auto	A	14.8	20.4	27.8	39.8	59.2	107.3
	8 kHz auto	A	12	16.5	22.5	32.3	48	87
	16 kHz auto	A	8	11	15	21.5	32	58
Max. output current for "socket" application (VAC)								
f_{out} < 10 Hz, VAC	16 kHz permanent	A	3.4	4.6	6.3	9.0	12.8	22
f_{out} > 10 Hz, VAC	16 kHz permanent	A	6.1	8.4	11.4	16.3	22.7	41.2
Overcurrent cycle 10 s								
Operation for 10 s with up to 180 % of the continuous output current if afterwards a recovery time of 20 s with max. 120 % of the continuous output current is observed.								
Current consumption - HV * on-board supply system		A	17.6	24.2	33.1	47.4	70.5	127.9
Max. output power		kW	9	13.2	18	26.4	36	72
Max. output current at f_{out} < 5 Hz	2 kHz permanent	A	12.8	17.6	24	34.4	51.2	92.8
	4 kHz permanent	A	10	13.8	18.8	26.9	40	72.5
	8 kHz permanent	A	6.4	8.8	12	17.2	25.6	46.4
	16 kHz permanent	A	3.6	5	6.8	9.7	14.4	26.1
	4 kHz auto	A	12.8	17.6	24	34.4	51.2	92.8
	8 kHz auto	A	12	16.5	22.5	32.3	48	87
	16 kHz auto	A	9.6	13.2	18	25.8	38.4	69.6
Max. output current at f_{out} < 5 Hz	2 kHz permanent	A	17.6	24.2	33	47.3	70.4	120
	4 kHz permanent	A	14.4	19.8	27	38.7	57.6	104.4
	8 kHz permanent	A	10	13.8	18.8	26.9	40	72.5
	16 kHz permanent	A	6	8.3	11.3	16.1	24	43.5
	4 kHz auto	A	18	24.8	33.8	48.4	72	120
	8 kHz auto	A	14.4	19.8	27	38.7	57.6	104.4
	16 kHz auto	A	9.6	13.2	18	25.8	38.4	69.6
Max. output current for "socket" application (VAC)								
f_{out} < 10 Hz, VAC	16 kHz permanent	A	3.5	4.8	6.6	9.5	13.1	23.2
f_{out} > 10 Hz, VAC	16 kHz permanent	A	6.3	8.7	11.9	17	23.7	42.9

* This value is valid at 800 VDC and the current, which is possible with 8kHz Auto.

4.2.3 DC/DC converter

DC/DC converter		2.8 kW	5.6 kW
Input data - HV on-board supply system			
Rated voltage	V DC	800	800
Voltage range	V DC	100 … 848	100 … 848
Max. current consumption	A	16.5	18.3
Output data			
Max. output power	kW	2.8	5.6
Rated output voltage	V DC	14	28
Output voltage range	V DC	6 … 16	6 … 32
Max. output current	A	200	200
Efficiency			
typical	%	92	
Valid for operating point		DC 500 V, AC 28 V, 100 A, 2.8 kW, 40 °C	

Diagram of the output voltage of the DC/DC converter

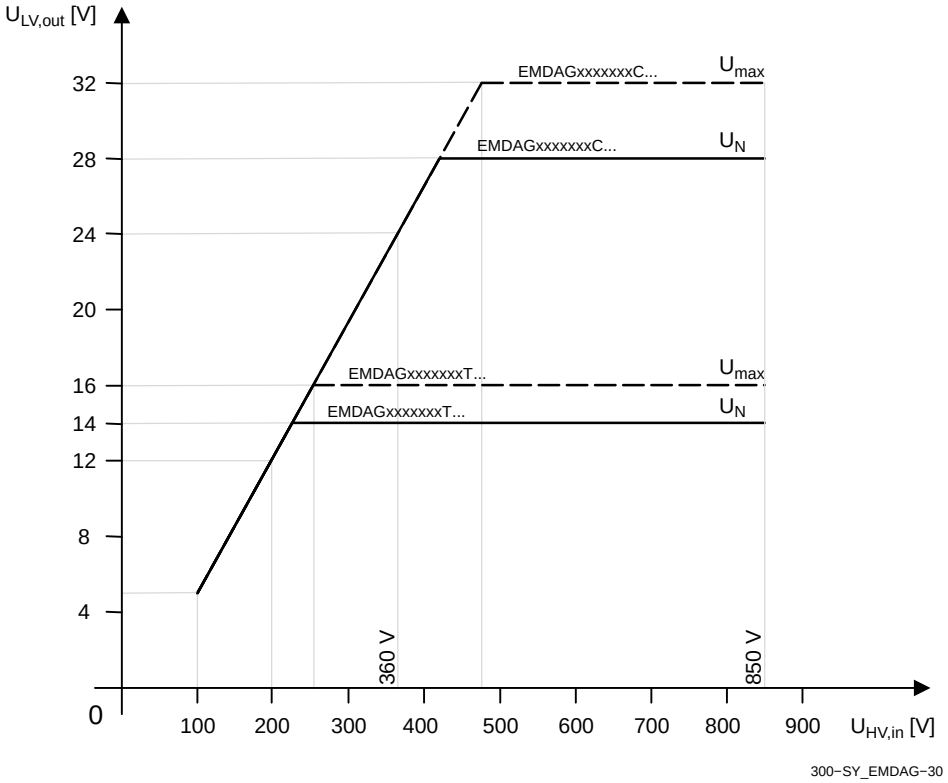
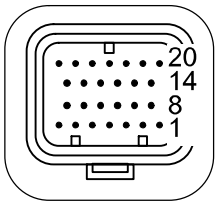


Fig. 4-2 DC/DC converter: output voltage with reference to the HV on-board voltage

$V_{HV,in}$	Voltage of HV on-board supply system
$V_{LV,out}$	Output voltage of DC/DC converter
V_{rated}	Rated output voltage
V_{max}	Max. output voltage

4.3 Control of MOBILE DCU, PSU, DCU PSU

The MOBILE device is controlled via the X31 terminal:



300−DS_EMDAG−21

4.3.1 Voltage supply

Voltage supply (KL30)			LV on-board supply system	
			12 V	24 V
Supply voltage TRM30				
Rated voltage		V DC	12	24
Voltage range		V DC	10 … 36	10 … 36
Absolute voltage (Pulse forms: ISO 16750-2) (Behaviour: ISO 16750-1)	Min.	V DC	6	6
	Max.	V DC	60	60
Current consumption		A	1 … 2.5	0.5 … 1.3
Quiescent current at T_{amb} = 25 °C		µA	40 … 60	40 … 60
Switch on/off device TRM15				
Switching threshold		V DC	8	8
Current consumption		mA	1.7	1.7

4.3.2 Digital inputs

Digital inputs (FLX_IN)		LV on-board supply system	
		12 V	24 V
Rated input voltage	V DC	12	24
Voltage range	V DC	8 … 36	8 … 36
Digital HIGH	V DC	7.8 … 9	15.6 … 18.2
Digital LOW	V DC	3 … 4.5	6.2 … 8.8
Hysteresis	V DC	3.3 … 6	6.8 … 12
Measuring impedance	kΩ	40	
Pull-up resistor or pull-down-resistor	kΩ	4.75 connectable/parameterizable	
Reference potential		TRM31	
Diagnostics option		Wire breakage/short circuit	
Digital frequency inputs FLX_IN3, FLX_IN4			
Frequency range	kHz	0 …10	
Response time	µs	90	
Analog inputs FLX_IN1, FLX_IN2, FLX_IN3, FLX_IN4			
Input frequency	Hz	0 … 500	
Resolution	Bit	12	

4.3.3 Digital outputs

Digital outputs (FLX_OUT)		LV on-board supply system	
		12 V	24 V
Rated output voltage	V DC	12	24
Voltage range	V DC	8 … 36	8 … 36
Digital HIGH	V DC	8 … 10.8	≥21.6
Digital LOW	V DC	0 … 5	0 … 5
Output current HIGH	A	0 … 2	
Output current LOW	mA	0 … -0.05	
Output frequency	kHz	0 …1	
Response time	µs	95	
Reference potential		TRM31	
Diagnostics option		Wire breakage/short circuit	

4.3.4 Interlock

An HV interlock system monitors the correct connection of connectors in the HV supply of a vehicle with the aim of preventing an electrical hazard due to unintentional, improper or otherwise caused disconnection of an HV connector while the HV supply is switched on.

For this purpose, the HV system is equipped with a so-called pilot or interlock line (HVIL or High Voltage Interlock Line). This is an LV signal that is routed via several connectors or connections. If the circuit of the pilot line is interrupted by the removal of one of the connectors and the resulting disconnection of the pilot contacts in the connector, this is detected by the vehicle control unit and the control unit immediately opens the HV main relay(s), thus switching off the HV system.

The MOBILE DCU and PSU devices feature intelligent HVIL interlock functionality that is activated when the cover is removed.

With the two pins InterLock1 and InterLock2 on X31 of the MOBILE unit it can be integrated into a HV network. In contrast to simple HVIL contacts in HV connectors, the status of the protective device (cover mounted or removed) can only be read out via SDO, not via the transmit message also available on the CAN bus and thus the location of the interruption can be diagnosed.

IMPORTANT!: The cover must be mounted correctly to ensure trouble-free operation of the Interlock.
The interlock is only activated when the device is switched on (KL30 and KL15 applied).

- MOBILE DCU (EMDxG2…) (⇒ 20)
- MOBILE PSU (EMDxG3…) (⇒ 21)
- MOBILE DCU/PSU (EMDxG4…) (⇒ 21)

Digital switching output		LV on-board supply system	
		12 V	24 V
Max. switching voltage	V DC	60	60
Voltage potential to X31/20, X31/21	V DC	-60 … 60	-60 … 60
Max. permissible capacitive load [1)]	µF	22	22
InterLock-OK (closed)			
Contact resistance	Ω	6 …15	6 …15
Max. current	mA	50	
InterLock-NOK (open)			
Max. fault current	µA	1	1

1) In case of a higher capacitive load, provide for an external current limitation, e.g. by means of a resistor in series connection

4.3.5 Feedback

Feedback (X32/X33)		Resolver
Carrier OSZ		
Output voltage	V_{pp}	0 …12
Output frequency	kHz	typ. 8
Output current	mA	max. 50
SIN/COS		
Input voltage	V_{pp}	0 … 5
Resolution	Bit	12

Thermal sensor input		Value
Evaluable thermal sensors		PT1000, KTY83/110, KTY84/130, PTC acc. to DIN 44081, thermostat (normally-closed contact) acc. to DIN 44080
Diagnostics option		Wire breakage/short circuit
Resistance measuring range	Ω	280 …3050
Measuring current	mA	max. 0.2
Limit frequency of input filter	Hz	10
Resolution	Bit	12

4.3.6 CAN bus

Public CAN		
Protocol		SAE J1939
Baud rate	kbps	125, 250, 500
Max. cable length		
at 125 kbps	m	250
at 250 kbps	m	250
at 500 kbps	m	100
Loop delay of all nodes	ns	<300

Private CAN		
Protocol		CANopen
Baud rate	kbps	125, 250, 500, 1000
Max. cable length		
at 125 kbps	m	250
at 250 kbps	m	250
at 500 kbps	m	100
at 1000 kbps	m	20
Loop delay of all nodes	ns	<300

4.4 Control of MOBILE DCU S

The MOBILE device is controlled via the X1 terminal.

4.4.1 Voltage supply

Voltage supply			LV on-board supply system	
			12 V	24 V
Supply voltage TRM30				
Rated voltage		V DC	12	24
Voltage range		V DC	10 … 36	10 … 36
Absolute voltage (Pulse forms: ISO 16750-2) (Behaviour: ISO 16750-1)	Min.	V DC	6	6
	Max.	V DC	60	60
Current consumption		A	0.4 … 0.9	0.2 … 0.6
Quiescent current at T_{amb} = 25 °C		µA	40 … 60	40 … 60
Switch on/off device TRM15				
Switching threshold		V DC	8	8
Current consumption		mA	1.7	1.7
Secondary Wake Up (SWUP)				
Switching threshold		V DC	8	8
Current consumption		mA	1.7	1.7

4.4.2 Digital inputs

Digital inputs (FLX_IN)		LV on-board supply system	
		12 V	24 V
Rated input voltage	V DC	12	24
Voltage voltage	V DC	8 … 36	8 … 36
Digital HIGH	V DC	7.8 … 9	15.6 … 18.2
Digital LOW	V DC	3 … 4.5	6.2 … 8.8
Hysteresis	V DC	3.3 … 6	6.8 … 12
Measuring impedance	kΩ	40	
Pull-up resistor or pull-down-resistor	kΩ	4.75 connectable/parameterizable	
Reference potential		TRM31	
Diagnostics option		Wire breakage/short circuit	
Use as analog inputs			
Input frequency	kHz	0 … 500	
Resolution	Bit	12	

4.4.3 Interlock

An HV interlock system monitors the correct connection of connectors in the HV supply of a vehicle with the aim of preventing an electrical hazard due to unintentional, improper or otherwise caused disconnection of an HV connector while the HV supply is switched on.

For this purpose, the HV system is equipped with a so-called pilot or interlock line (HVIL or High Voltage Interlock Line). This is an LV signal that is routed via several connectors or connections. If the circuit of the pilot line is interrupted by the removal of one of the connectors and the resulting disconnection of the pilot contacts in the connector, this is detected by the vehicle control unit and the control unit immediately opens the HV main relay(s), thus switching off the HV system.

The MOBILE DCU S device has a fixed HVIL interlock connection in connector X2. The HVIL interlock connection is disconnected when connector X2 is removed.

Interlock in connector X2		LV on-board supply system	
		12 V	24 V
Max. voltage	V DC	60	60
InterLock-OK (closed)			
Contact resistance	Ω	0	
Max. current	mA	500	

4.4.4 Thermal sensor input

Thermal sensor input		Value
Evaluable thermal sensors		PT1000, KTY83/110, KTY84/130, PTC acc. to DIN 44081, thermostat (normally-closed contact) acc. to DIN 44080
Diagnostics option		Wire breakage/short circuit
Resistance measuring range	Ω	280 …3050
Measuring current	mA	max. 0.2
Limit frequency of input filter	Hz	10
Resolution	Bit	12

4.4.5 CAN bus

Public CAN and Private CAN communicate via a bus cable.

Public CAN, Private CAN		
Protocol		
Public CAN		SAE J1939
Private CAN		CANopen
Baud rate	kbps	125, 250, 500
Max. cable length		
at 125 kbps	m	250
at 250 kbps	m	250
at 500 kbps	m	100
Loop delay of all nodes	ns	<200

4.5 Water cooling

For cooling the MOBILE device, the integrated water cooler is connected to the vehicle-specific cooling circuit.

		EMDAG2…	EMDAG3… EMDAG4…	EMDAG5…
Connection of suction and pressure hoses		DN 20 (internal)		
Securing the hoses		Suitable hose clamps		
Flow direction				
in case of vertical installation		Not relevant (see capter 5.2.1)		
in case of horizontal or pending installation		Not relevant		
Fluid volume	l	0.105	0.16	0.12
Composition of the cooling fluid				
Water/ethylene glycol	%	50/50	50/50	50/50
Flow rate				
without derating	l/min	15 … 25	15 … 25	15 … 25
with derating [1)]	l/min	5 …15	5 …15	5 …15
Permissible pressure in the cooling system (relative)	bar	1 … 2	1 … 2	1 … 2
Max. test pressure	bar	5	5	5
Permissible temperatures of the cooling fluid in continuous operation	°C	30 … 65	30 … 65	30 … 65
Recommended switch-on temperature for coolant pump	°C	30	30	30

1) Per 1 l/min reduced flow rate reduce the output power by 5 %

Decrease in pressure in the water cooler

Decrease in pressure in the water cooler of the MOBILE device with a coolant mixture of water/ethylene glycol in a ratio of 50/50 and at a coolant temperature of 60 °C.

MOBILE DCU, PSU, DCU PSU

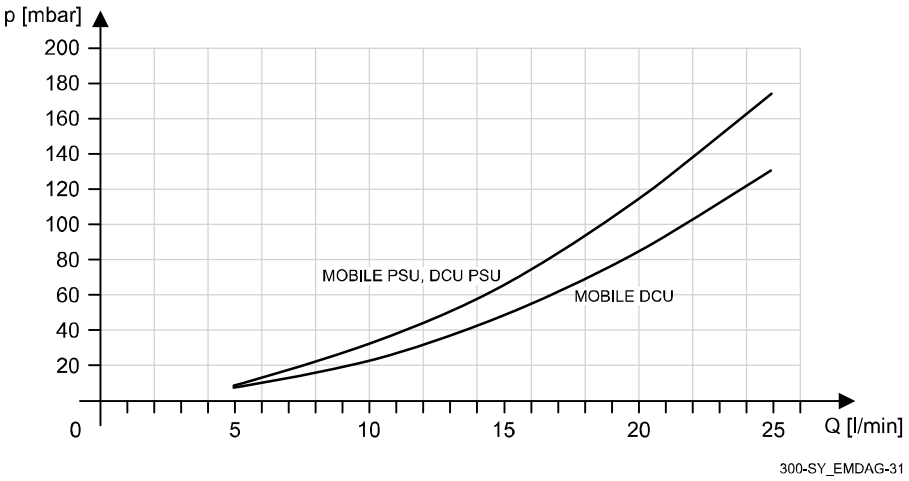


Fig. 4-3 Typical decrease in pressure in the water cooler

MOBILE DCU S

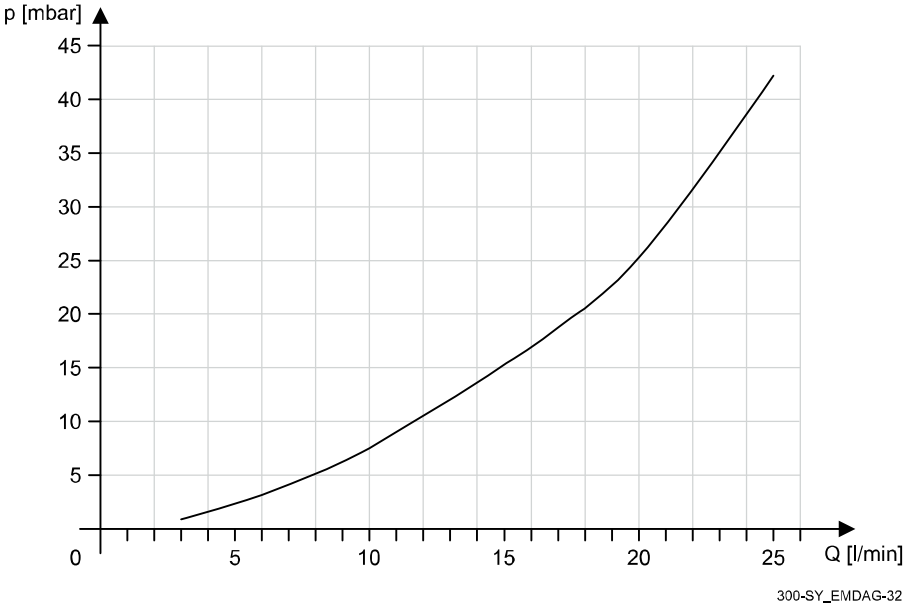


Fig. 4-4 Typical decrease in pressure in the water cooler

4.6 Dimensions

Dimensions and weights can be found in the “Mechanical installation” chapter. (⇒ 47)

5 Installation

5.1 Important notes

DANGER!

Dangerous electrical voltage

Even after the HV on-board voltage or mains voltage has been switched off, all power terminals continue to carry electrical voltage for some time, e. g. from capacitors.

Possible consequences:

- Death or severe injury if the power terminals are touched.

Protective measures:

- Switch off the HV on*board supply system or power supply and wait until the power terminals are discharged before working on them.
- Make sure that all power terminals are deenergised before working on them.

5.1.1 Device protection

STOP!

No device protection if the HV on-board voltage or mains voltage is too high.

The input for the HV on-board supply system or the mains is not fused internally.

Possible consequences:

- Destruction of the device if the HV on-board voltage or the mains voltage is too high.

Protective measures:

- Observe the maximum permissible HV on-board voltage or mains voltage.
- Fuse the device correctly on the supply side against mains fluctuations and voltage peaks.

STOP!

The input for the HV on-board supply system or the mains does not have an electrical polarity reversal protection.

Possible consequences:

- Destruction of the device is the HV on-board supply system or the mains is connected incorrectly.

Protective measures:

- Check wiring for possible polarity reversal.

STOP!

Wrong parameter setting of the HV DC-bus controller and the overvoltage shutdown.

Possible consequences:

- Damage of the HV DC-bus connection

Protective measures:

- **Check HV DC-bus controller and overvoltage shutdown** for correct parameterization.

STOP!

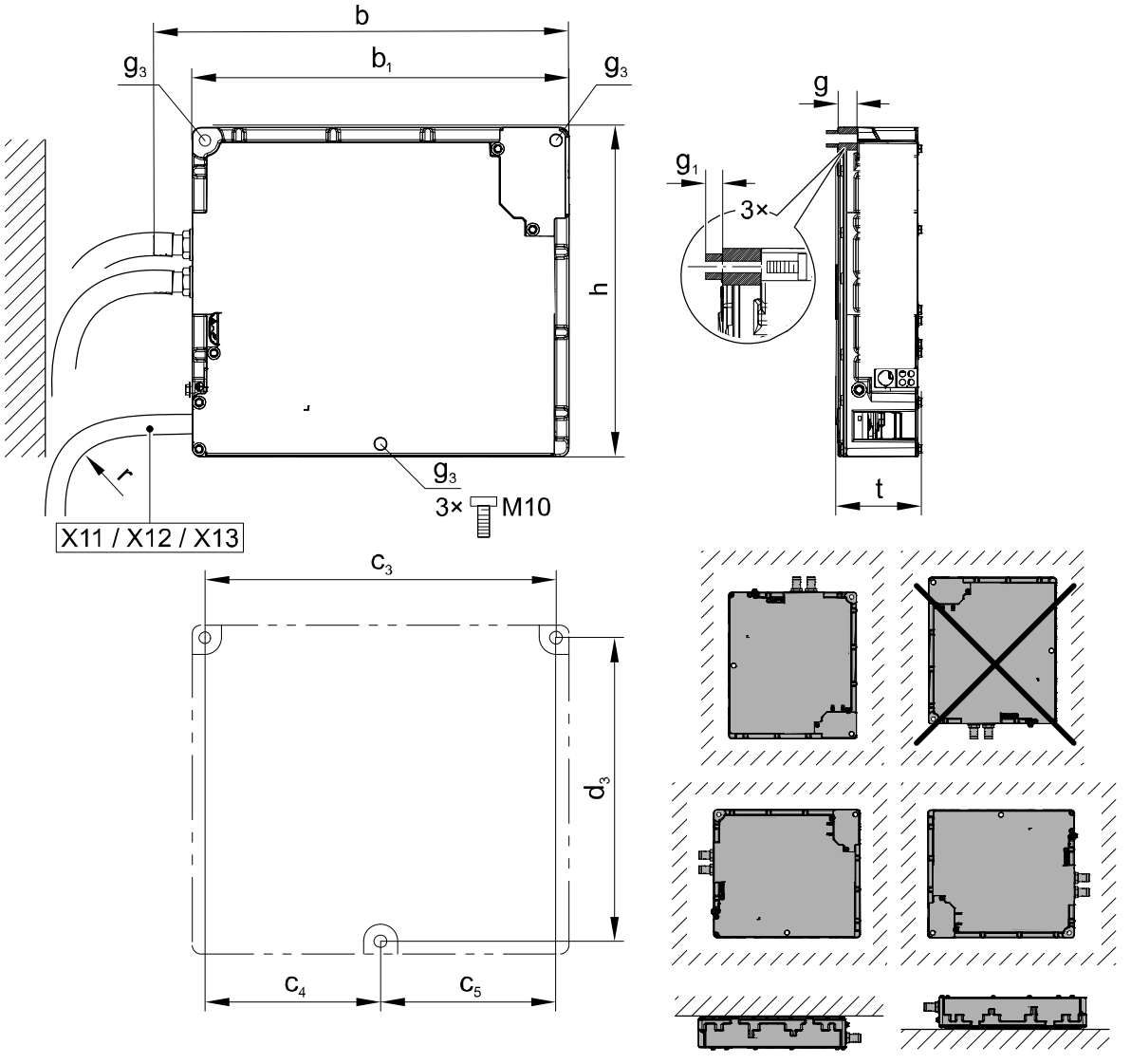
The device contains components that can be damaged by electrostatic discharge!
Before working on the device, the personnel must be free of electrostatic charge.

5.2 Mechanical installation

5.2.1 EMDAG2…, EMDAG3…, EMDAG4…

The installation material must ensure the mechanical connection on a permanent basis. The fixing points are designed for:

- M10 cheese head screw, hexagon socket, according to DIN 912/ISO 4762
- M10 cheese head screw, torx, according to ISO 14579



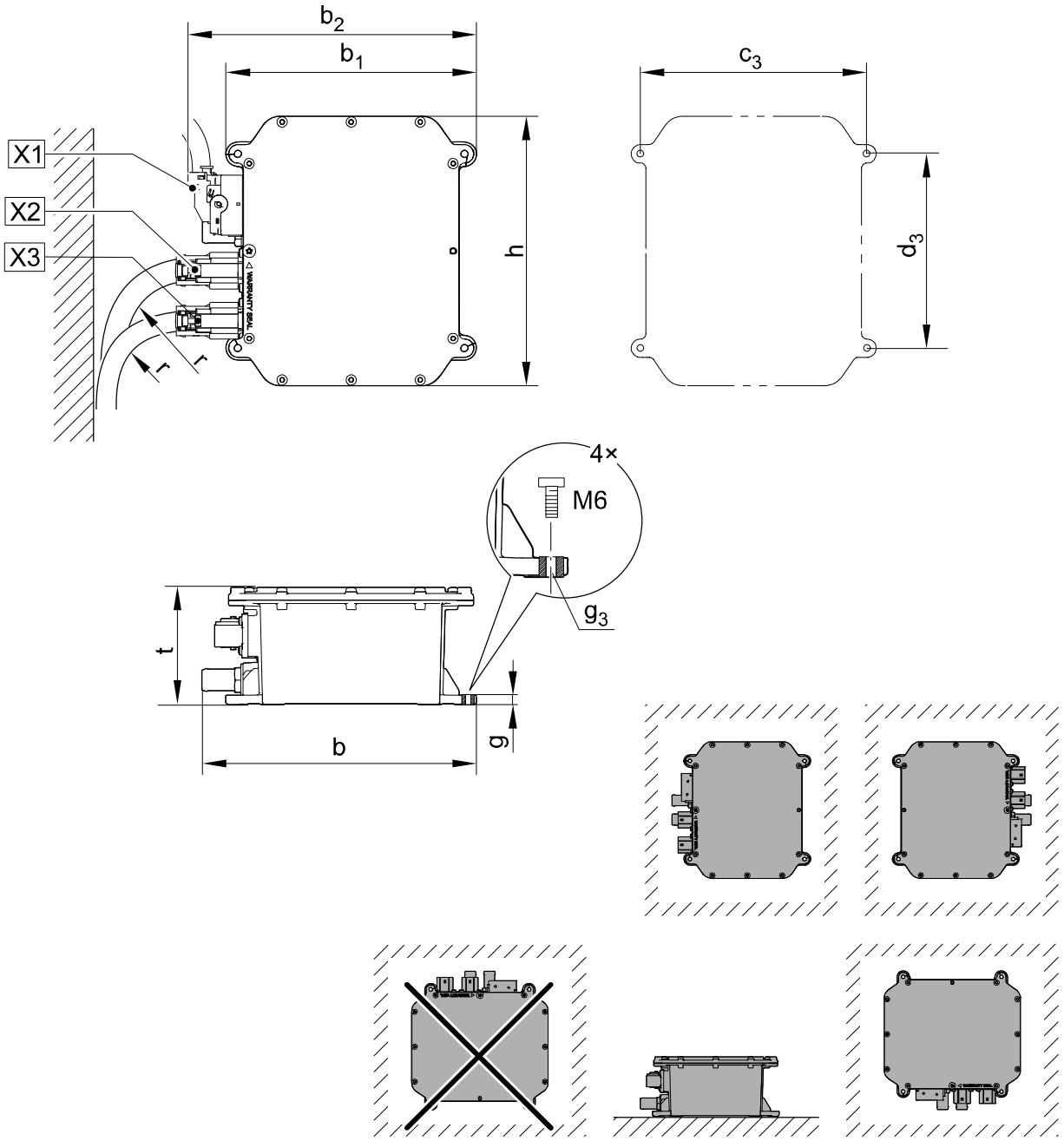
	h	b	t	b_1	c_3	c_4	c_5	d_3	g	g_1 [1]	g_3	r	
	[mm]												[kg]
EMDxG2…	310	394	81	355	331	165.5	165.5	286	13.3	>8	Ø 11	106	6.5
EMDxG3…													8.4
EMDxG4…													8.4

1) Use distance sleeve or nut

5.2.2 EMDAG5…

The installation material must ensure the mechanical connection on a permanent basis. The fixing points are designed for:

- M6 cheese head, hexagon socket, acc. to DIN 912/ISO 4762
- M6 cheese head, Torx, acc. to ISO 14579



300-DS_EMD-G5-33

	h	b	t	b_1	b_2	c_3	d_3	g	g_3	r	
	[mm]										[kg]
EMDxG5…	250	254	109	232	237	210	180	9	Ø 6.7	106	3.9

5.3 Water cooling

For operating the Mobile devices, a working water cooling system is required.

Operation without water cooling is not permissible and destroys the devices.

A subsequent loosening or tightening of the screws in the cooling cover is not permissible. The water cooler is mounted in the factory and checked for tightness.

The water cooling has to be dimensioned according the technical data (⇒ 42).

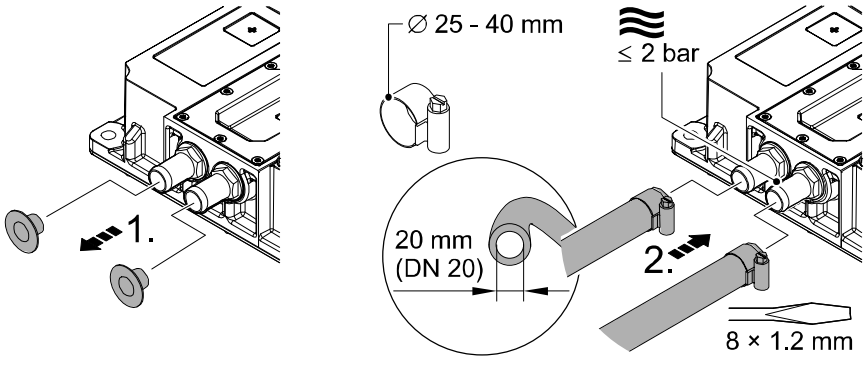
How to connect a proper cooling system:

- Remove the protective caps from the adaptors (delivery status).
- Connect suction and pressure hoses.
- Fix and secure the hoses with suitable clips.
- Fill and vent water cooling.

IMPORTANT!:
The cooling circuit can also be vented by vacuuming the entire cooling system, if the entire cooling system is designed for this.
The MOBILE devices do not have any restrictions here.

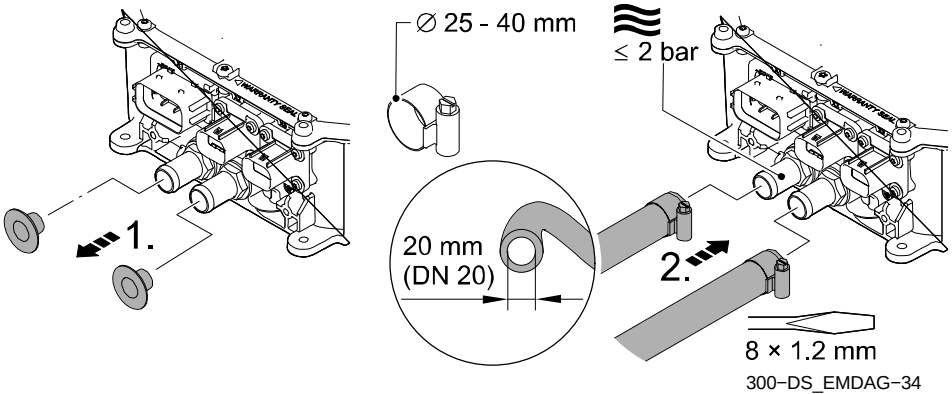
Prior to every switch-on, the proper functioning of the cooling needs to be ensured.

EMDAG2..., EMDAG3..., EMDAG4...



300-DS_EMDAG-08

EMDAG5...



300-DS_EMDAG-34

5.4 EMC/compliant installation

EMC-compliant installation is a prerequisite for a safe and trouble-free operation of the devices.

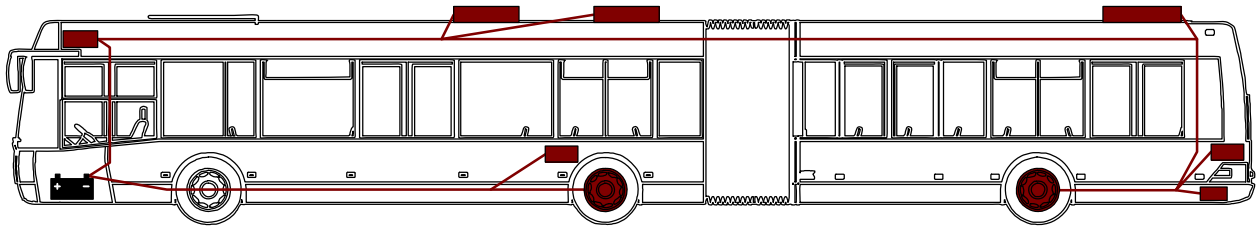
EMC interferences can

- cause the drives and on-board converters to be switched off to protect the systems.

5.4.1 Equipotential bonding

Conditions for a working EMC concept:

- Avoid current loops because they cause induced voltage differences.
- Arrange the equipotential bonding in star shape and avoid earth loops.
- Install equipotential bonding conductors in parallel to the supply and communication cables.
  - A equipotential bonding conductor in the motor cable extends the current compensation by high-frequency currents and avoids an overload of the cable shield.



300−DS_EMDAG−35

MOBILE device
Equipotential bonding conductor

5.4.2 Shielding

- The effectiveness of a shielded cable is achieved by:
  - Establish a good shield connection by using a large-area shielding support.
  - Only use shielding braid with low shielding resistance made of tinned or nickel-plated copper braid.
  - Use braid with an overlap rate > 70 % and an overlap angle of 90 °.
  - Keep unshielded cable ends as short as possible.

Make these connections with system cables or shielded:

- Motor
- HV on-board supply system

You can make these connections unshielded:

- LV on-board supply system (only PSU)
- 24-V supply
- Digital signal (inputs and outputs).
  - From approx. 5 m cable length or in heavily disturbed environments we recommend the use of shielded cables.

Connection system

Prefabricated cables for the motor connection and the connection to the HV on-board supply system are provided with cable glands and ensure an optimum connection of the shield to the vehicle mass. This guarantees an optimum EMC-compliant installation and the required environmental conditions are met.

- When installing the motor cable and the HV on-board cable, slide the cable gland into the respective holders and fix it by tightening the mounting bracket.

5.4.3 LV on-board cable

Lay the cables LV+ and LV- as close as possible.

NOTE!
Use angled cable lugs.

5.4.4 HV on-board cable

The descriptions in the next chapter regarding shielded motor cables analogously also apply to the HV mains cables.

5.4.5 Motor cable

- Only use shielded motor cables with braids made of tinned or nickel-plated copper. Shields made of steel braids are not suitable.
  - The overlap rate of braid must be at least 70 % with an overlap angle of 90 °.
- The cables used must correspond to the requirements at the location (e.g. EN 60204-1).
- Use Bucher system cables.
- Extensively apply the shielding with the compressed cable gland and ensure electrical conductivity.
- The motor cable is optimally installed if
  - it is separated from mains cables and control cables,
  - it only crosses mains cables and control cables at right cables,
  - it is not interrupted.
- If the motor cable must be opened all the same (e.g. due to contactors, or terminals):
  - The unshielded cable ends may not be longer than 100 mm (depending on the cable cross-section).
  - Install contactors, terminals etc. spatially separated from other components (with a min. distance of 100 mm).
  - Install the shield of the motor cable directly before and behind the point of separation to the conducting mounting plate with a large surface.

Wiring on the motor side

STOP!

The motor cable is highly susceptible to interference. The following measures enable you to achieve an optimum wiring on the motor side:.

- Exclusively use shielded and low-capacitance motor cables.
- If possible, integrate the equipotential bonding conductor inside the motor cable shield or install it in parallel to the motor cable.
- Do not integrate any further cables (e.g. for blowers etc.).
- Shield the supply cable for temperature monitoring of the motor (PTC or thermostat) and install it separately from the motor cable.

5.4.6 Control cable

- Shield control cables to minimise interference injections.
- Connect the shield correctly:
  - Connect the shield of digital input and output cables at both ends.
  - Connect the shield of analog input and output cables at one end of the inverter.
- To achieve an optimum shielding effect (in case of very long cables, with high interference) one shield end of analog input and output cables can be connected to PE potential via a capacitor (e.g. 10 nF/250 V).
- Lay control cables and LV cables as separately as possible from HV cables.

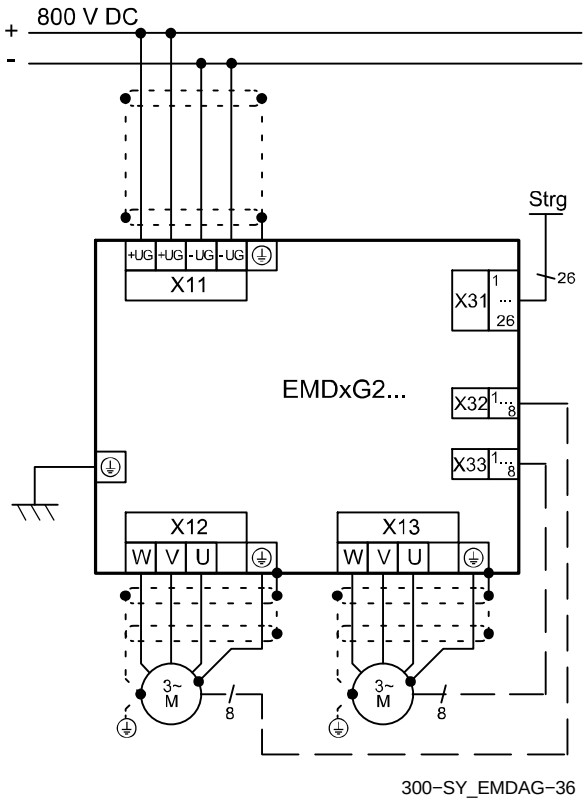
5.4.7 Detect and eliminate EMC interferences

Interference	Cause	Remedy
Interference of analog set-points of the own or other devices and measuring systems	Unshielded HV mains cable Unshielded motor cable	Use shielded cables
	Shield contact is not extensive enough	Carry out optimal shielding as specified
	Shield of the motor cable is interrupted by terminal strips, switched, etc.	• Separate components from other component parts with a minimum distance of 100 mm • Use motor choke/motor filter
	Install additional unshielded cables inside the motor cable (e.g. for motor temperature monitoring)	Install and shield additional cables separately
	Too long and unshielded cable ends of the motor cable	Shorten unshielded cable ends to maximally 40 mm
CAN time out or CAN Bus Heavy	CAN communication is disturbed	• Use cable according to CAN specification • Wire terminals completely • Connect the shield with a good electric conductivity • Check terminating resistor

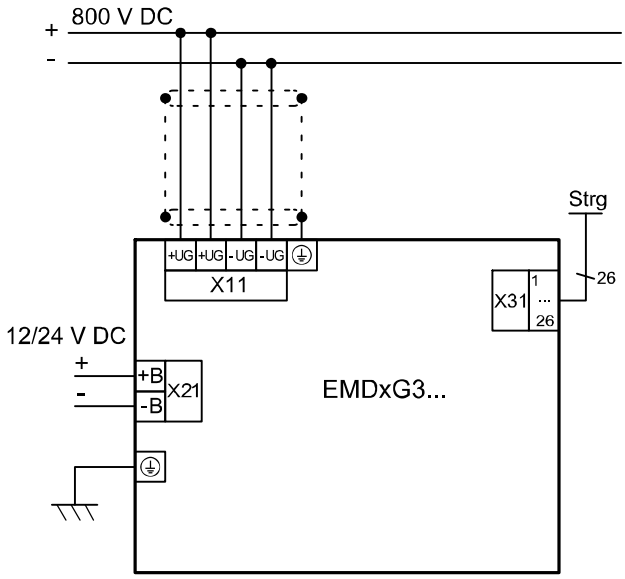
5.5 Electrical installation

5.5.1 Basic circuit diagrams

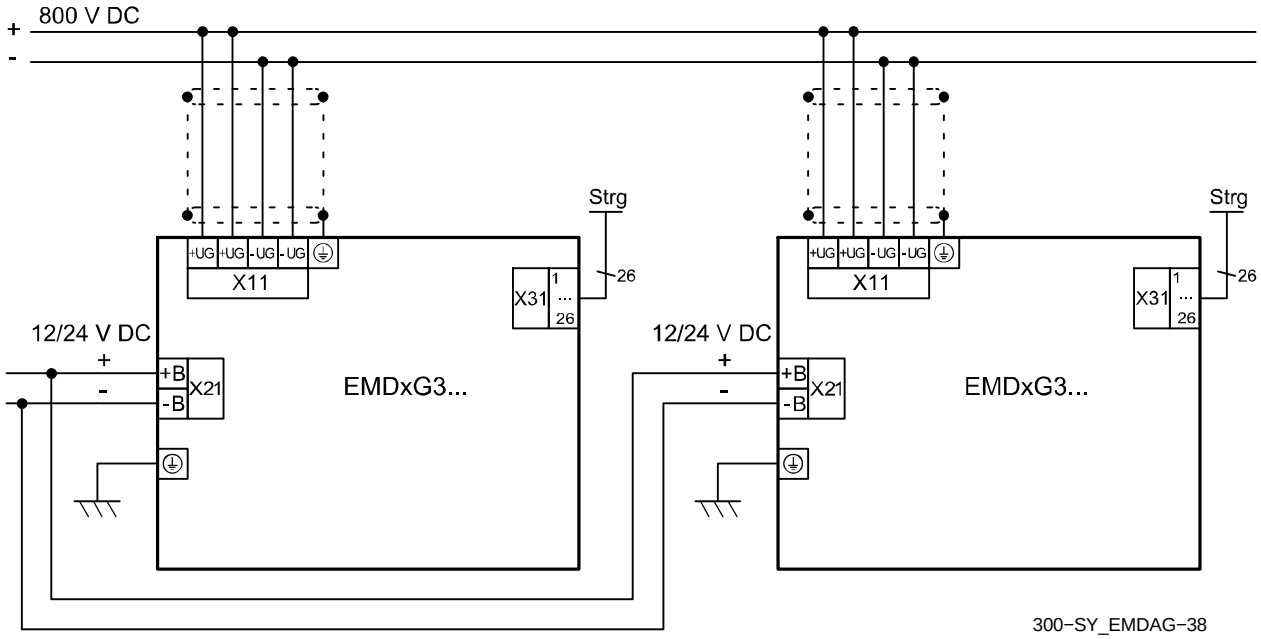
MOBILE DCU



MOBILE PSU

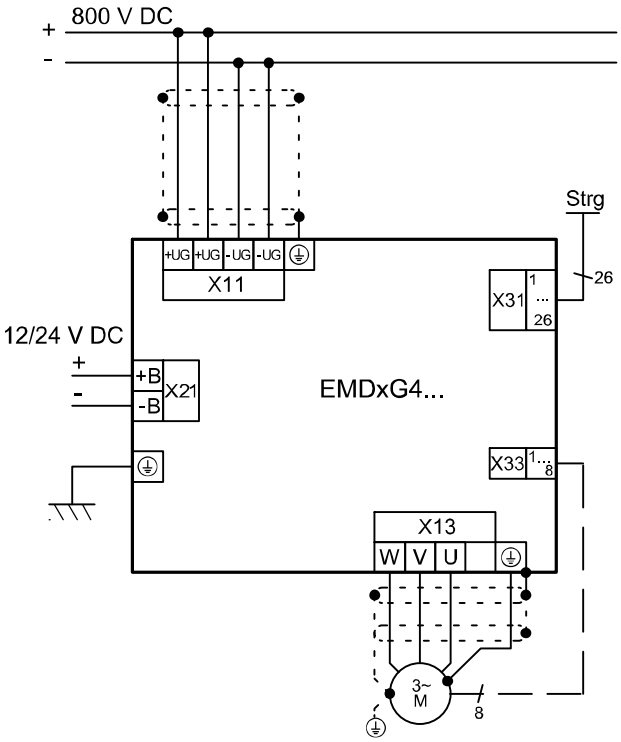


300-SY_EMDAG-37



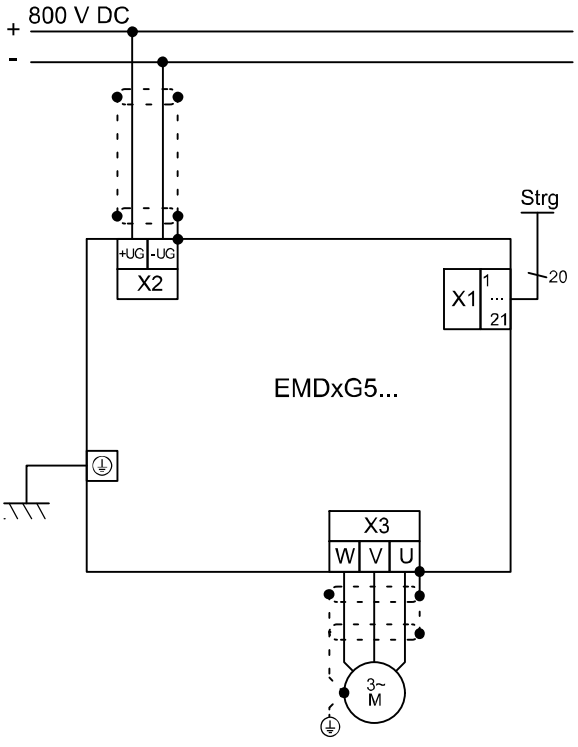
300-SY_EMDAG-38

MOBILE DCU PSU



300−SY_EMDAG−39

MOBILE DCU S



300−SY_EMDAG−40

5.5.2 Fuses and cable cross-sections

Installed cables have to be protected against short circuit and overload. The execution of these protective measures essentially depends on the available energy sources (generator, memory, connection to supply system, etc.) and is the responsibility of the vehicle manufacturer or the equipment suppliers.

Fuses and circuit breakers have to be dimensioned in such a way that the occurring short-circuit currents caused by the internal resistances of the energy sources are sufficiently high to safely trip the fuses. Otherwise, there is no reliable switch-off in case of short circuit.

When dimensioning fuses, consider the ambient conditions in such a way that the cables are protected from overload in the entire temperature range. Here, the type of installation and cooling of the cables have to be considered sufficiently.

If a memory with battery management is available that can switch off the short-circuit current reliably, no fuses are needed.

5.5.3 Polarity reversal protection

HV on-board supply system

The input for the HV on-board supply system or the mains does not have an electrical polarity reversal protection. (⇒ 60)

LV on-board supply system

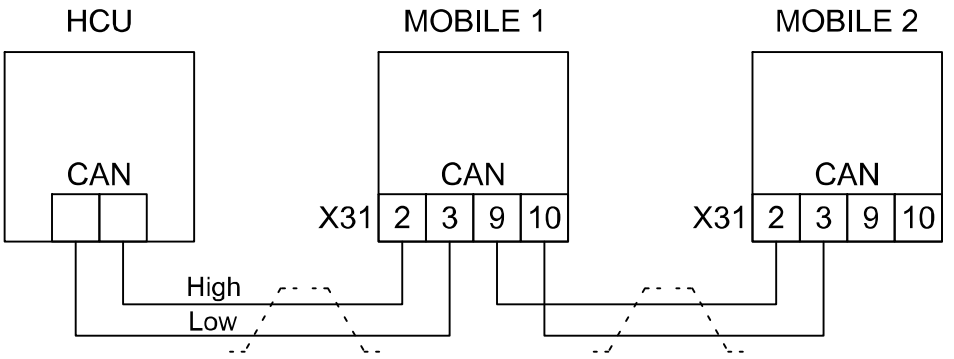
The input for the LV on-board supply system has an electrcial polarity reversal protection.

The polarity is only checked at power-on, not during operation. (⇒ 64)

5.5.4 Wiring the CAN bus

Wiring must meet the following requirements:

- The CAN cable complies with the specification acc. to ISO 11898-2.
- The CAN cable has twisted cores (CAN_H, CAN_L) to avoid interferences on the bus (Bus-Off, Bus-Heavy, etc).
- When looping through the signals “CAN_HIGH” and “CAN_LOW”, avoid double crimping. For this purpose, the Public CAN is provided with two pins each.
- Stubs are <0.2 m. Ideally, stubs are avoided.
- The cable length matches the data transfer rate.
- The CAN cable runs along the LV on*board cable and is installed separately from the power cables.
- The CAN bus is completely wired. Unwired terminals are not permissible.
- The first and last node of the CAN bus are connected to the integrated terminating resistor.

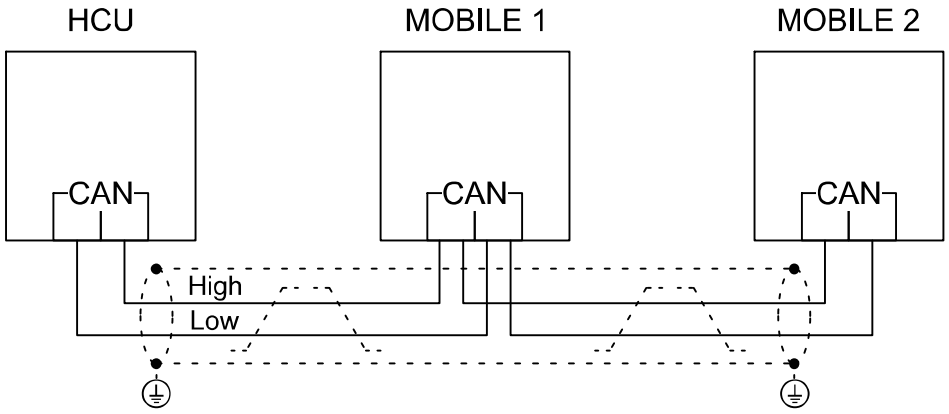


300−SY_EMDAG−41

5.5.5 Interferences on the CAN bus

In case of interferences on the CAN bus, a shielded cable must be used. The shield is connected to PE (chassis ground). The shield/PE connection must have a low resistance to avoid shield currents in the system.

- Connect the shield on one side to PE.
- Connect the shield on both sides to PE if interferences continue to occur in case the shield is only connected on one side.



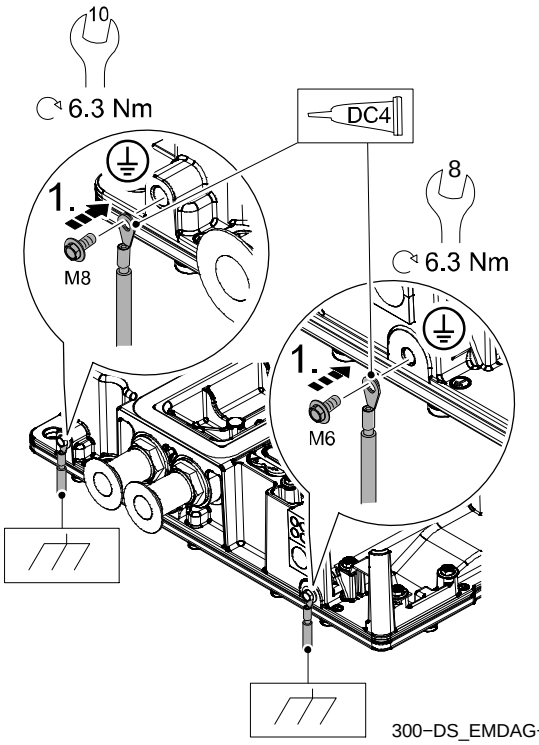
300-SY_EMDAG-42

5.6 Connections of MOBILE DCU, PSU, DCU PSU

5.6.1 PE conductor

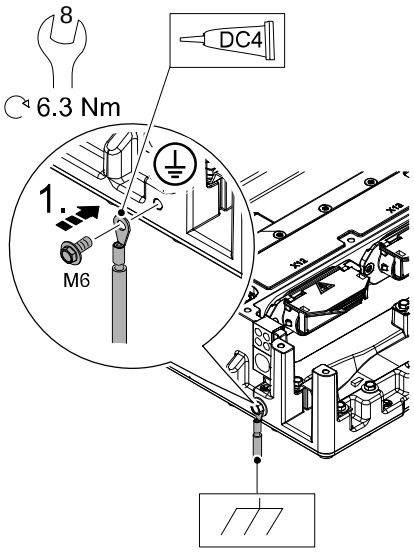
PE	[mm²] [*AWG*]		
⏚		MOBILE DCU	Same conductor cross-section as the HV on-board cable Connection with non-insulated ring cable lug, M6, M8
	>10 *>000*	MOBILE DCU PSU MOBILE PSU	Connection (X11) with non-insulated ring cable lug, M6 Same conductor cross-section as the LV on-board cable (X21)

MOBILE DCU



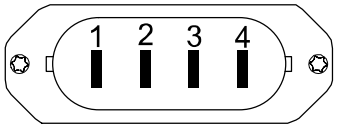
300-DS_EMDAG-09

MOBILE PSU, MOBILE DCU PSU



300-DS_EMDAG-09a

5.6.2 HV on-board supply system

X11			U_{max} [V DC]	[mm²] [*AWG*]	Belastungsgrenze pro Pin
 300-DS_EMDAG-17	1	+UG	848	2.5…12 *12…6*	100A at 20°C 80A at 80°C
	2	+UG			
	3	-UG			
	4	-UG			

Per potential, the terminal contains two contacts for looping through the DC-bus voltage.

STOP!

The input for the HV on-board supply system or the mains does not have an electrical polarity reversal protection.

Possible consequences:

- Destruction of the device is the HV on-board supply system or the mains is connected incorrectly.

Protective measures:

- Check wiring for possible polarity reversal.

STOP!

Wrong parameter setting of the HV DC-bus controller and the overvoltage shutdown.

Possible consequences:

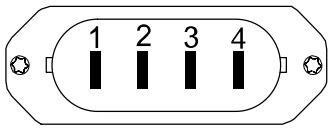
- Damage of the HV DC-bus connection.

Protective measures:

- Check HV DC-bus controller and overvoltage shutdown for correct parameterization.

5.6.3 Motor

		X12	X13
MOBILE DCU	EMDxG2…	●	●
MOBILE PSU	EMDxG3…	–	(O) ⚠
MOBILE DCU PSU	EMDxG4…	–	●

X12, X13			U_{max} [V AC]	[mm²] [*AWG*]
 300−DS_EMDAG−17	1	W	600	2.5…12 *12…6*
	2	V		
	3	U		
	4	–	–	–
	⏚	PE	–	2.5…12 *12…6*

⚠ EMDxG3…

DANGER!

Dangerous electrical voltage

The terminal X13 carries electrical voltage.

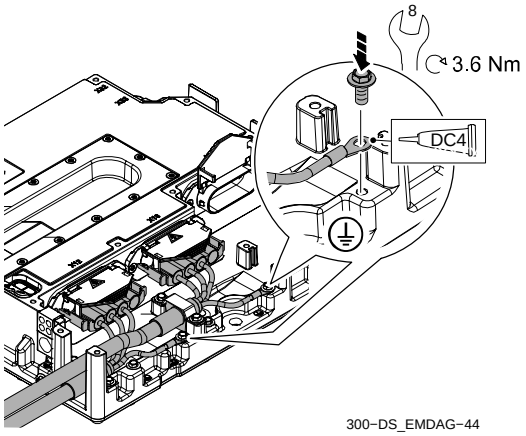
Possible consequences:

- Death or severe injury if the power terminals are touched.

Protective measures:

- Do not remove the blanking plug from X13.

PE conductor



300−DS_EMDAG−44

5.6.4 Feedback

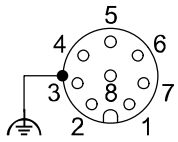
X32 and X33 serve to connect feedback systems for servo control and sensors for motor temperature monitoring.

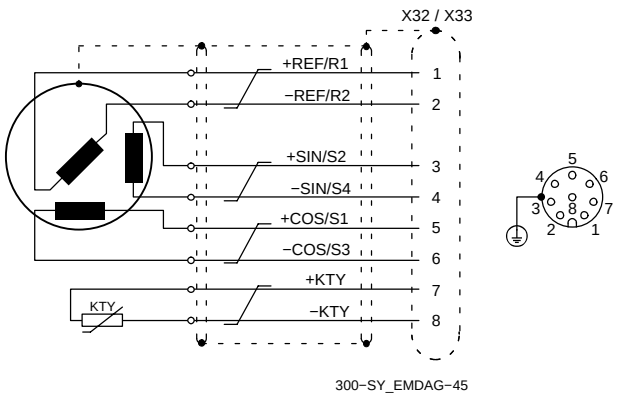
- Supported feedback system: resolver
- Supported sensors for motor temperature monitoring: PT1000, KTY83/110, KTY84/130, PTC acc. to DIN 44081, thermostat (normally-closed contact) acc. to DIN 44080.
  - Maximally three PTC thermistors may be connected in series.
  - Monitored: short circuit and cable breakage. Thermostats are not monitored.

Each connection is assigned to a motor connection. The MOBILE DCU assignment is configurable.

- X32 <=> motor connection X12
- X33 <=> motor connection X13

		X32	X33
MOBILE DCU	EMDAG2…	●	●
MOBILE PSU	EMDAG3…	–	–
MOBILE DCU/PSU	EMDAG4…	–	●

X32, X33 (M12 female socket A-coding)					
	1	+Ref (+OSZ)	5	+COS	
	2	-Ref (-OSZ)	6	-COS	
	3	+Sin	7	+KTY (+TEMP)	● KTY83/110 ● KTY84/130 ● PT1000 ● PTC (DIN 44081) ● ϑ-Switch NC
	4	-Sin	8	-KTY (-TEMP)	

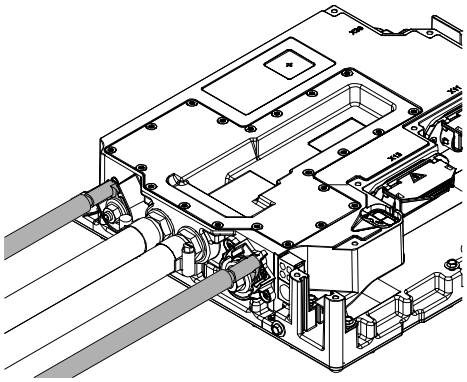


5.6.5 LV on-board supply system

		X21
MOBILE DCU	EMDAG2…	–
MOBILE PSU	EMDAG3…	●
MOBILE DCU/PSU	EMDAG4…	●

X21		V_{max}		
		[V]	[mm²] [*AWG*]	
X21/B+	M10	32	70 *000*	with ring cable lug
X21/B-	M8			

X21/B- must be connected to “chassis ground” (TRM31).



300-DS_EMDAG-46

IMPORTANT!:
The input for the LV on-board supply system has an electrical polarity reversal protection.
The polarity is only checked at power-on, not during operation.

STOP!

Exchanging the battery phases during operation, e.g. by changing the wiring or exchanging devices when the LV supply is switched on.

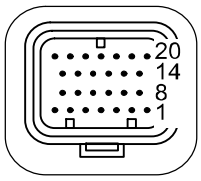
Possible consequences:

- Destruction of the device is the LV on-board supply system or the mains is connected incorrectly.

Protective measures:

- Observe the maximum permissible HV on-board voltage or mains voltage.
- Work on batteries and devices only when the LV on-board power supply is switched off.

5.6.6 Control

X31			Description
 300−DS_EMDAG−21	1	CAN_H_TERM_PUBLIC	Public CAN, bus termination CAN-High
	2	CAN_H_PUBLIC	Public CAN In
	3	CAN_L_PUBLIC	
	4	InterLock2	Potential-free output, connection 2
	5	CAN_L_PRIVATE	Private CAN
	6	CAN_H_PRIVATE	
	7	InterLock1	Potential-free output, connection 1
	8	TRM15	Switch on/off device
	9	CAN_H_PUBLIC	Public CAN Out
	10	CAN_L_PUBLIC	
	11	CAN_L_TERM_PUBLIC	Public CAN, bus termination CAN-Low
	12	ID_PIN1	Address offset for setting the CAN address
	13	ID_PIN3	
	14	FLX_IN4	Digital inputs • Can also be parameterised as frequency inputs
	15	FLX_IN3	
	16	FLX_IN2	Digital inputs • Can also be parameterised as analog inputs
	17	FLX_IN1	
	18	ID_PIN2	Address offset for setting the CAN address
	19	ID_PIN4	
	20	TRM31	Vehicle mass, negative pole of the vehicle battery
	21	TRM30	Supply voltage for control electronics
	22	TRM30	
	23	FLX_OUT4	Digital outputs
	24	FLX_OUT3	
	25	FLX_OUT2	
	26	FLX_OUT1	

5.6.7 Adressing CAN bus nodes

The MOBILE devices can be operated via the following CAN bus systems:

- Public CAN: Communication with vehicle or subsystem control (e. g. air conditioning system).
  - The Public CAN is the customer interface provided for applications in commercial vehicles which can be adapted to the respective communication and diagnostic environments of the single OEM's. By default, the control is carried out according to SAE J1939 and the diagnostics is carried out according to UDS (Unified Diagnostic Services) which is implemented in the Application Controller (AppC).
  - The Public CAN is implemented twice on X31. This enables a simple looping through (daisy chain).
  - The bus terminating resistor is integrated in X31.
- Private CAN: Communication with subsystem or other drives.
  - The Application Controller (AppC) and the Motor Controller (MC) are connected via the Private CAN (CAN 2.0A) and communicate in accordance with CANopen, Drive Profile DS 402. This Private CAN interface enables the Application Controller to transmit the control commands received via the Public CAN to the Motor Controller(s).
  - The Private CAN must be completed with an external bus terminating resistor.

Setting the address offset

Each MOBILE device has one address for the Public CAN and three addresses for the Private CAN. An address consists of the basic address and the address offset (address = basic address + address offset).

- Default setting of the address offset: 13 (ID pins are not wired)
- Default setting of the basic address for Public-CAN: 234
- Default setting of the basic addresses Private-CAN:
  - AppC: 32
  - MC (Kanal 1): 1
  - MC (Kanal 2): 64

The address offset is defined by wiring ID-Pin1 ... ID-Pin4 to X31. Thanks to the combinations, 14 different address offsets are possible which means that up to 14 MOBILE devices can be operated at a CAN bus.

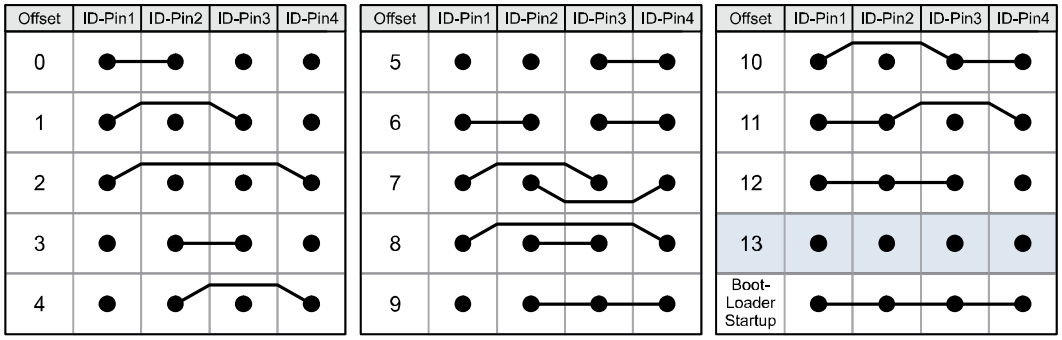


Fig. 5-1 Wiring at X31

ID-PIN1	X31/12
ID-PIN2	X31/18
ID-PIN3	X31/13
ID-PIN4	X31/19
Offset 13	Default setting
Boot Loader Startup	Device remains in the Boot Loader, firmware is not started.

The length of the wire jumpers may be maximally 50 mm. If the ID pins are double assigned the contact must be double crimped.

5.6.8 Activating the terminating resistor

In order to ensure a trouble-free operation, a 120 Ω terminating resistor must be connected to the last device of a CAN bus.

- For Public CAN, the terminating resistor is integrated in each device. It is activated by two bridges:
  - Bridge between X31/1 (CAN_H_TERM_PUBLIC) and X31/2 (CAN_H_PUBLIC)
  - Bridge between X31/11 (CAN_L_TERM_PUBLIC) and X31/3 (CAN_L_PUBLIC)
- For Private CAN. no terminating resistor is integrated. The terminating resistor must be connected externally.

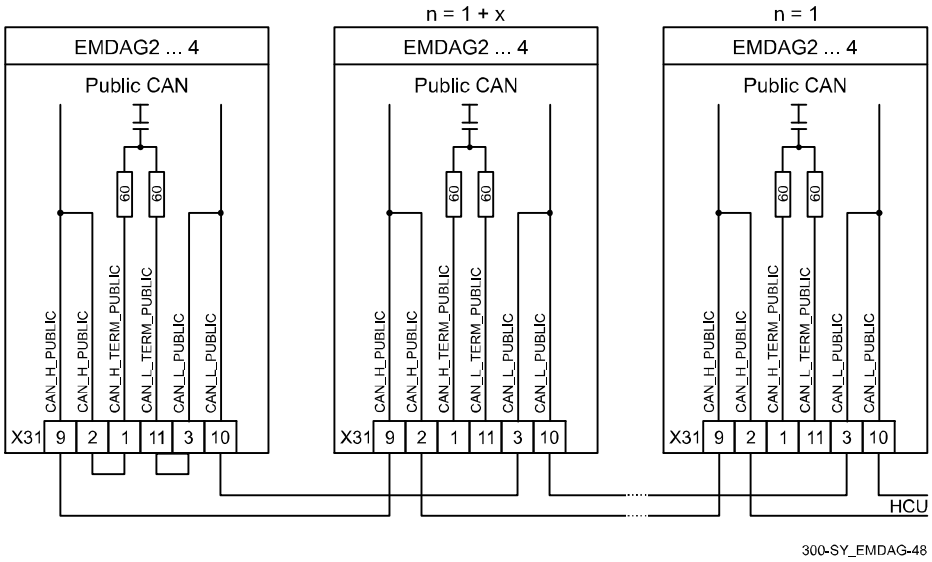


Fig. 5-2 Public CAN: activate terminating resistor

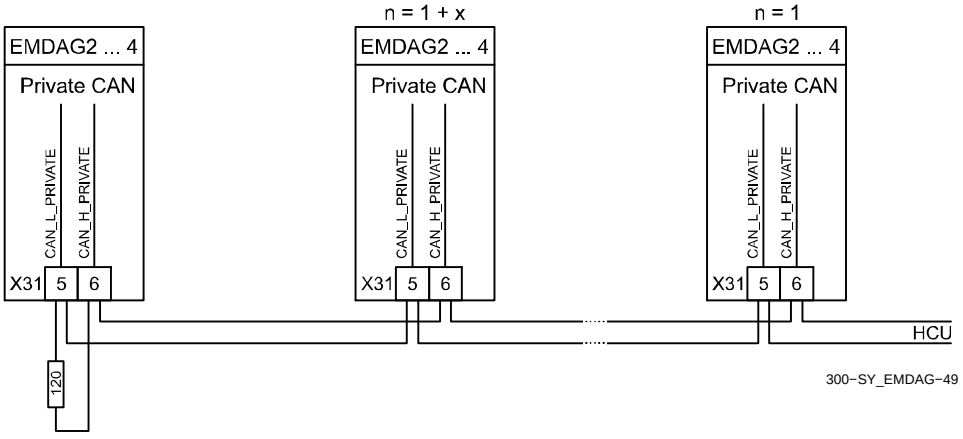
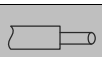
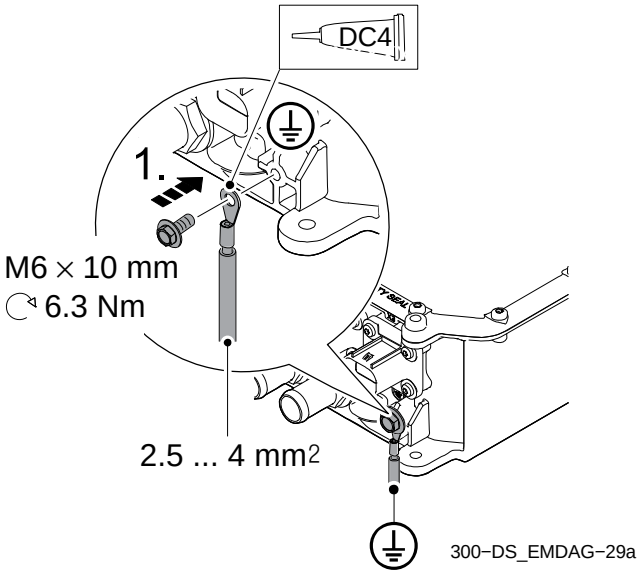


Fig. 5-3 Private CAN: activate terminating resistor

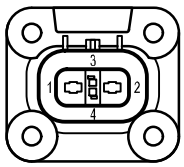
5.7 Connections of MOBILE DCU S

5.7.1 PE conductor

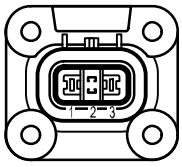
PE		
	[mm²] [*AWG*]	
⏚	2.5 … 4 *12 … 10*	Connection with non-insulated ring cable lug, M6



5.7.2 HV on-board supply system

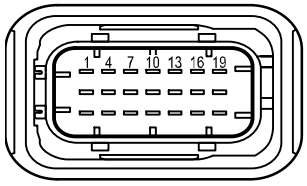
X2			U_{max}		
			[V DC]	[mm²] [*AWG*]	
 300−SY_EMDAG−50	1	+UG	848	2.5 … 4 *12 … 10*	
	2	-UG			
	3	InterLock1		0.5 … 0.75 *20 … 18*	
	4	InterLock2			

5.7.3 Motor

X3			U_{max} [V AC]	[mm²] [*AWG*]	
 300-SY_EMDAG-51	1	U	600	2.5 *12*	
	2	V			
	3	W			

- In addition, a equipotential bonding between motor and DC/AC inverter is required.
- Install the equipotential bonding conductor in parallel to the motor cable.

5.7.4 Control

X1			Description
 300-SY_EMDAG-52	1	CAN_H	Public CAN and Private CAN network
	2	CAN_L	
	3	CAN_L_TERM	Bus terminating resistor for CAN
	4	n.c.	Do not use
	5	TEMP_MA+	Analog thermal sensor
	6	TEMP_MA-	
	7	TRM15	Switch on/off device
	8	TRM30	Supply voltage for control electronics
	9	CAN_H	Public CAN and Private CAN network
	10	CAN_L	
	11	FLX_IN4	Digital inputs
	12	FLX_IN3	
	13	n.c.	Do not use
	14	n.c.	Do not use
	15	TRM31	Vehicle mass, negative pole of the vehicle battery
	16	FLX_IN1	Digital inputs
	17	FLX_IN2	
	18	ID_PIN1	Address offset for setting the CAN address
	19	ID_PIN2	
	20	ID_PIN3	
	21	n.c.	Do not use

5.7.5 Addressing CAN bus nodes

The MOBILE devices can be operated via the following CAN bus systems:

- Public CAN: Communication with vehicle or subsystem control (e. g. air conditioning system).
  - The Public CAN is the customer interface provided for applications in commercial vehicles which can be adapted to the respective communication and diagnostic environments of the single OEM's. By default, the control is carried out according to SAE J1939 and the diagnostics is carried out according to UDS (Unified Diagnostic Services) which is implemented in the Application Controller (AppC).
  - The Public CAN is implemented twice on X31. This enables a simple looping through (daisy chain).
  - The bus terminating resistor is integrated in X31.
- Private CAN: Communication with subsystem or other drives.
  - The Application Controller (AppC) and the Motor Controller (MC) are connected via the Private CAN (CAN 2.0A) and communicate in accordance with CANopen, Drive Profile DS 402. This Private CAN interface enables the Application Controller to transmit the control commands received via the Public CAN to the Motor Controller(s).
  - The Private CAN must be completed with an external bus terminating resistor.

Setting the address offset

Each MOBILE device has one address for the Public CAN and up to three addresses for the Private CAN. An address consists of the basic address and the address offset (address = basic address + address offset).

- Default setting of the address offset: 13 (ID pins are not wired)
- Default setting if the basic address for Public-CAN: 234
- Default setting of the basic addresses Private-CAN:
  - AppC: 32
  - MC (channel 1): 1
  - MC (channel 2): 64

Each device has one address for the Public CAN and three addresses for the Private CAN. An address results from the addition of the basic address and the address offset (0 ... 3).

The address offset is defined by wiring ID-Pin1 ... ID-Pin3 to X1. Thanks to the combinations, 4 different address offsets are possible which means that up to 4 MOBILE devices can be operated at a CAN bus.

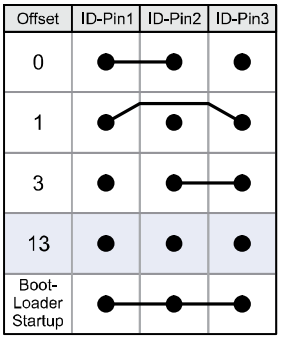


Fig. 5-4 Wiring at X1

ID-PIN1	X1/18
ID-PIN2	X1/19
ID-PIN3	X1/20
Offset 13	Default setting
Boot Loader Startup	Device remains in the Boot Loader, firmware is not started.

The length of the wire jumpers may be maximally 50 mm. If the ID pins are double assigned the contact must be double crimped.

5.7.6 Activating the terminating resistor

In order to ensure a trouble-free operation, a 120 Ω terminating resistor must be connected to the last device of a CAN bus.

- The terminating resistor is integrated in each device. It is activated by a bridge:
  - Bridge between X1/3 (CAN_L_TERM) and X1/9 (CAN_H)

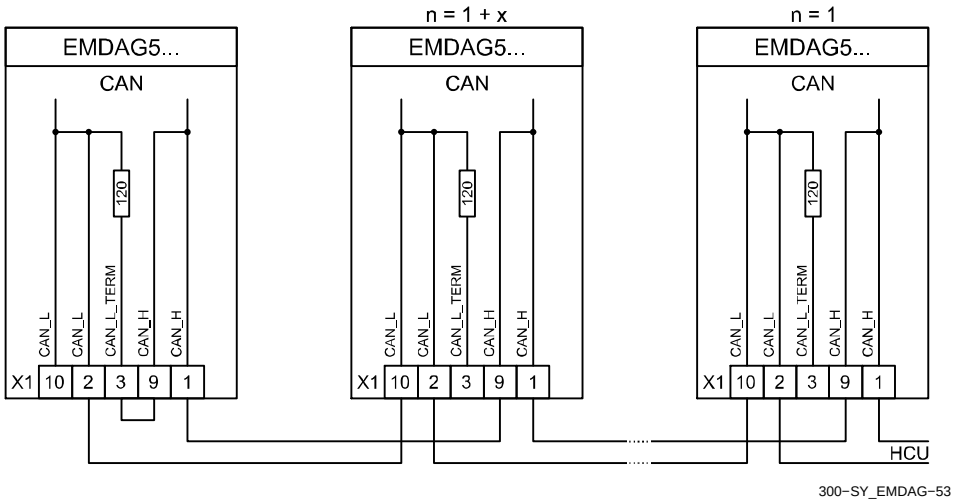


Fig. 5-5 CAN: activate terminating resistor

6 Commissioning

IMPORTANT!:

- Please observe the general safety instructions (⇒ 13)
- Please observe the notes on residual hazards (⇒ 17)

The »MOBILE Engineer« tool supports you during the commissioning phase.

You are led through the commissioning steps and obtain additional information on the settings. This information is also contained in the MOBILE reference manual which is available in the download area.

7 Diagnostics

7.1 Device status

7.1.1 MOBILE DCU, PSU, DCU PSU

Two LEDs at the device display the current device status:

LED1	LED2	Device status	Comments	
○		Switched off	–	
●		Switched on - nor error	No Public CAN messages are received.	
◎		Switched on - nor error	Public CAN messages are received.	
◎		Switched on - boot loader active	–	
●		Switched on - error	For a more detailed diagnosis, read the error memory or error code.	
◉		Switched on - error	CAN communication is interrupted. Diagnostics via CAN is not possible.	
			1x blinking:	Invalid CAN address offset
			4x blinking:	Initialisation of the internal flash failed
			5x blinking:	Bootloader/firmware incompatibility
	◎	Precharge / discharge active	Blinking slowly	
	●	DC bus loaded	V_{DC} > 50 V	
	◉	Cover is not closed	Blinking fast	

○ LED off
● LED permanently on
◎ LED blinking every 0.4 s
◎ LED blinking every 0.2 s
◉ LED blinking pattern: blinking once or several times with a break of 1 s
● ● ● green - red - yellow

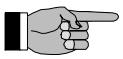
- The device status can also be read via the CAN bus.
- The Bucher »Mobile Engineer« allows for a detailed diagnostics.

7.1.2 MOBILE DCU S

- The device status can also be read via the CAN bus.
- The Bucher »Mobile Engineer« allows for a detailed diagnostics.

8 Accessories (overview)

For a proper installation according to ECE R10, materials have to be processed professionally complying with the respective standards and required approvals at the location.



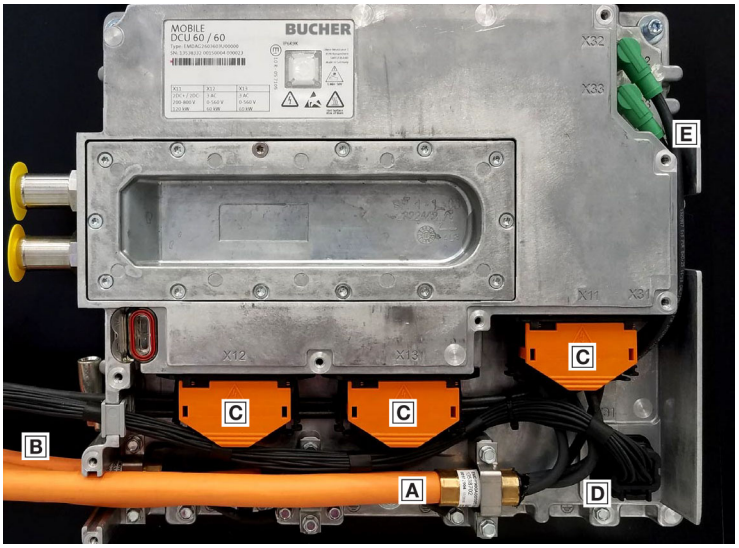
IMPORTANT!:
The Unused plug connections have to be sealed with covers or blanking plugs. This is the only way to comply with the class of protection and prevent waterfrom entering.

Note!
Spare parts can be obtained on request from the Expert Helpline at www.bucherdrives.com

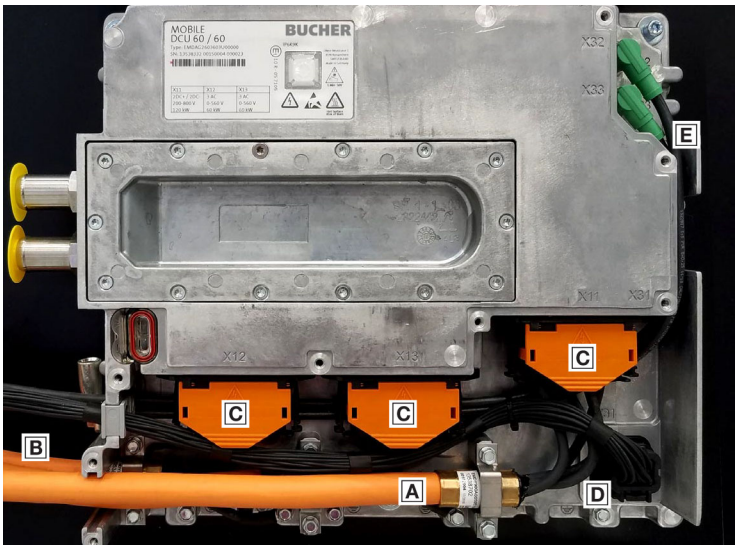
8.1 Prefabricated cables and plug accessories

Prefabricated cables and plug accessories serve to realise MOBILE installations quickly.

8.1.1 MOBILE DCU, PSU, DCU PSU



Pos.	Function	Name	Type*	Use
A	HV on-board supply system	High-voltage cable EMD X11, 2 x 10 mm²	EMDY904AxxxxE15A00	MOBILE DCU MOBILE PSU MOBILE DCU PSU
		High-voltage cable EMD X11, 2 x 6 mm²	EMDY905AxxxxE25A00	
		High-voltage cable EMD X11, 2 x 4 mm²	EMDY906AxxxxE35A00	
		High-voltage cable EMD X11, 4 x 10 mm²	EMDY900AxxxxE11A00	
		High-voltage cable EMD X11, 4 x 6 mm²	EMDY901AxxxxE21A00	
		High-voltage cable EMD X11, 4 x 4 mm²	EMDY902AxxxxE31A00	
		High-voltage cable EMD X11, 4 x 2.5 mm²	EMDY903AxxxxE41A00	
B	Motor	Motor cable EMD X12, 4 x 10 mm²	EMDY900AxxxxE12A00	MOBILE DCU
		Motor cable EMD X13, 4 x 10 mm²	EMDY900AxxxxE13A00	MOBILE DCU
		Motor cable EMD X13, 4 x 10 mm²	EMDY900AxxxxE14A00	MOBILE DCU PSU
		Motor cable EMD X12, 4 x 6 mm²	EMDY901AxxxxE22A00	MOBILE DCU
		Motor cable EMD X13, 4 x 6 mm²	EMDY901AxxxxE23A00	MOBILE DCU
		Motor cable EMD X13, 4 x 6 mm²	EMDY901AxxxxE24A00	MOBILE DCU PSU
		Motor cable EMD X12, 4 x 4 mm²	EMDY902AxxxxE32A00	MOBILE DCU
		Motor cable EMD X13, 4 x 4 mm²	EMDY902AxxxxE33A00	MOBILE DCU
		Motor cable EMD X13, 4 x 4 mm²	EMDY902AxxxxE34A00	MOBILE DCU PSU
		Motor cable EMD X12, 4 x 2.5 mm²	EMDY903AxxxxE42A00	MOBILE DCU
		Motor cable EMD X13, 4 x 2.5 mm²	EMDY903AxxxxE43A00	MOBILE DCU
		Motor cable EMD X13, 4 x 2.5 mm²	EMDY903AxxxxE44A00	MOBILE DCU PSU



Pos.	Function	Name	Type*	Use
C	HV power connector	Plug EMD accessory kit 7 pol. cpl. for X11 - X13, 2.5 mm^2	EZAEVE027-3	MOBILE DCU MOBILE PSU MOBILE DCU PSU
		Plug EMD accessory kit 7 pol. cpl. for X11 - X13, 4-6 mm^2	EZAEVE027-2	
		Plug EMD accessory kit 7 pol. cpl. for X11 - X13, 10 mm^2	EZAEVE027-1	
D	Control plug	Plug EMD accessory kit 26 pole cpl. for X31	EZAEVE028	MOBILE DCU MOBILE PSU MOBILE DCU PSU
E	Resolver	Resolver cable Mobile X32, X33	EMDY700FxxxxB03A01	MOBILE DCU MOBILE DCU PSU
	Operation without drive	Power connector cover for X12, X13	EZAMSK002	

* xxxx = cable length in dm
Order example: Motor cable EMD X12, 4 x 10 mm^2, length 10 m for DCU: EMDY900A0100E12A00

8.2 Individual parts for the electrical installation

8.2.1 MOBILE DCU, PSU, DCU PSU

Here, the required material for plugs, plug parts and cables are listed and assigned to terminals.

HV on-board supply system at X11

Name		EAN numbers	Manufacturer	Use
7-pole receptacle housing 1x per X11		4026736028183	Herth & Buss	MOBILE DCU MOBILE PSU MOBILE DCU PSU
Flat connector 4x per X11	2.5 ... 4 mm^2 6.3 x 0.8 LSK8 ELA	4026736362669		
	4 ... 6 mm^2 6.3 x 0.8 LSK8 ELA	4026736015442		
	8 ... 12 mm^2 6.3 x 0.8 LSK8 ELA	4026736016661		
Single conductor sealing				
	light yellow (2.5 ... 4 mm^2)	4026736020798		
	orange (4 ... 6 mm^2)	4026736020729		
	black (10 ... 12 mm^2)	4026736020736		
Blanking plug, green		4026736020767		
Radox® 155 Cable with vehicle-specific properties typical cross-section: 4 x 10 mm^2, shielded, Ø ~ 17.2 mm		841 370 53	Huber & Suhner	

Tightness according to manufacturer information:

- Use 4x light yellow, orange or black single conductor seals and 3x green blanking plugs per receptacle housing.

Motor at X12, X13

Name		EAN numbers	Manufacturer	Use
7-pole receptacle housing 1x per X12 or X13		4026736028183	Herth & Buss	MOBILE DCU MOBILE DCU PSU
Flat connector 3x per X12 or X13	2.5 ... 4 mm^2 6.3 x 0.8 LSK8 ELA	4026736362669		
	4 ... 6 mm^2 6.3 x 0.8 LSK8 ELA	4026736015442		
	8 ... 12 mm^2 6.3 x 0.8 LSK8 ELA	4026736016661		
Single conductor sealing				
	light yellow (2.5 ... 4 mm^2)	4026736020798		
	orange (4 ... 6 mm^2)	4026736020729		
	black (10 ... 12 mm^2)	4026736020736		
Blanking plug, green		4026736020767		
Blanking plug, yellow		4026736084714		
Radox® 155 Cable with vehicle-specific properties typical cross-section: 4 x 10 mm^2, shielded, Ø ~ 17.2 mm		841 370 53	Huber & Suhner	

Tightness according to manufacturer information:

- Use 3x light yellow, orange or black single conductor seals and 3x green blanking plugs and 1x yellow blanking plugs.

LV on-board supply system at X21/B+, X21/B-

Name Additional information	Type	Manufacturer	Use
Ring cable lug M10 for 70 mm^2, 90° angled 1x per X21 B+	–	–	MOBILE DCU PSU MOBILE PSU
Ring cable lug M8 for 70 mm^2, 90° angled 1x per X21 B-	–	–	

Control at X31

Name		Type	Manufacturer	Use
Socket housing Superseal 1.0, 26-pole		3-1437290-7	TE Connectivity	MOBILE DCU MOBILE PSU MOBILE DCU PSU
Crimp socket	0.75 ... 1.25 mm^2	3-1447221-3		
	0.5 mm^2	3-1447221-4		
	0.3 mm^2	3-1447221-5		
Sealing plug		4-1437284-3		
Strands suitable for vehicles	0.3 ... 1.25 mm^2	3-1437290-7		
CAN cable acc. to ISO 11898-2		–	–	

Tightness according to manufacturer information:

- Use a strand diameter of 1.6 ... 2.2 mm.

Feedback at X32, X33

Name	Type	Manufacturer	Use
M12 connector with prefabricated cable, 8 x 0.25 mm^2 (AWG24), shielded A coded, 90° angled	M12	e.g. Phoenix Contact	MOBILE DCU MOBILE DCU PSU

8.2.2 MOBILE DCU S

Here, the required material for plugs, plug parts and cables are listed and assigned to terminals.

Control at X1

Name		Type	Manufacturer
Socket housing Leavyseal AMP MCP 2.8 SOCKET HSG.,21POS.ASSY code A	black/yellow	1-1534127-1	TE Connectivity
COVER F.21P REC-HSG	black	9-1394050-1	
2,8 blanking plug	transparent	828922-1	
2,8 single conductor seal 1.4 ... 2.1 mm	blue	828904-1	
2,8 single conductor seal 2.2 ... 3.0 mm	white	828905-1	
AMP MCP 2.8, CONTACT SWS 2 µm-goldplated	0.5 ... 1.0 mm^2	1-968855-2	
AMP MCP 2.8, CONTACT SWS 1 ... 3 µm-tinplated	0.5 ... 1.0 mm^2	1-968855-1	
AMP MCP 2.8, CONTACT SWS 3 ... 5 µm-silverplated	0.5 ... 1.0 mm^2	1-968855-3	
AMP MCP 2.8, CONTACT SWS 2 µm-goldplated	1.5 ... 2.5 mm^2	1-968857-2	
AMP MCP 2.8, CONTACT SWS 1 ... 3 µm-tinplated	0.5 ... 1.0 mm^2	1-968857-1	
AMP MCP 2.8, CONTACT SWS 3 ... 5 µm-silverplated	0.5 ... 1.0 mm^2	1-968857-3	

HV on-board supply system at X2

Name			Type	Manufacturer
HVA280 cable 2 x 4 mm^2 A coded		500 mm	1-2208103-0	TE Connectivity
		1000 mm	1-2208103-1	
		2000 mm	1-2208103-2	
		3000 mm	1-2208103-3	
		4000 mm	1-2208103-4	
		5000 mm	1-2208103-5	
		6000 mm	1-2208103-6	
HVA280-2PHM Individual parts	Plug Sub-Assy Code A	1x per X2	4-2103015-1	
	Collet Size 1	1x per X2	2103155-1	
	Seal Retainer Size 1	1x per X2	2103013-1	
	Seal Cable Size 1	1x per X2	2103154-1	
	Outer Ferrule Size C	1x per X2	1587724-3	
	Plug Shield Size 1	2x per X2	1-2103157-1	
	Spacer	1x per X2	2103153-1	
	Inner Ferrule Size C	1x per X2	1587723-3	
	Inner Housing	1x per X2	1587985-1	
	AMP MCP 2,8K Contact 4 mm^2 silverplated	2x per X2	1-968853-3	
	Power Cable	2 x 4 mm^2	2177114-1	

Motor at X3

Name			Type	Manufacturer
HVA280 cable 3 x 2.5 mm^2 B-coded		500 mm	2-2177626-0	TE Connectivity
		4000 mm	2-2177626-4	
HVA280-3PXM Individual parts	Plug Sub-Assy Code B	1x per X3	4-2103015-2	
	Collet Size 2	1x per X3	2103155-2	
	Seal Retainer Size 2	1x per X3	2103013-3	
	Seal Cable Size 2	1x per X3	2103154-2	
	Outer Ferrule Size B	1x per X3	1587724-2	
	Plug Shield Size 2	2x per X3	1-2103157-2	
	Spacer	1x per X3	2103153-1	
	Inner Ferrule Size B	1x per X3	1587723-2	
	Inner Housing	1x per X3	2103306-1	
	AMP MCP 2,8K Contact 1.0 … 2.5 mm^2 silverplated	3x per X3	1241390-3	
	Power Cable	3 x 2.5 mm^2	2177877-1	

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