



**TM4**

**Installation Guide**

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## SUMO LD



**Motor:** LSM110E  
**Model:** MA-270\_165-xx



## Product information

Product series:	SUMO™ LD
Model number:	MA-270_165-xx

## Document information

Reference:	TG-0288 TM4 SUMO LD Motor (MA-270_165-xx) Installation Guide
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## Template information

Reference:	IN-8032_3
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## 1 Introduction

From the TM4 SUMO™ LD series, TM4 introduces this system, designed for light and mid-duty EV and HEV trucks and buses, which is composed of the TM4 LSM110E-MV/HV motor and the CO150-MV/HV Motor Control Unit (MCU).

TM4 LSM110E technology uses permanent magnets to offer high efficiency. The motor topology is based on an inverted rotor technology that maximizes the use of the magnets and reduces the amount of magnetic material. The high torque/low speed of the system is designed to directly interface with standard axle differentials or combustion engines without the need for an intermediate gearbox.

The TM4 LSM110E has an interface to allow for the installation of a standard parking brake.

### 1.1 Purpose

The information given in this Installation Guide takes you through the steps required to safely and securely install SUMO LD MA-270\_165-xx motors.

### 1.2 Scope

This guide is divided as follows:

- **Introduction** – general information about the motor, safety warning format, definitions and document reference information.
- **Transport and storage conditions** – guidelines on environmental conditions to be respected during motor storage and transport.
- **Receiving and unpacking the motor** – general guidelines on how to safely unpack, lift and inspect the motor.
- **Installing the motor in the vehicle** – how to safely install the motor and install the software.
- **Customer service** – TM4 customer service contact details.

### 1.3 What's new

This is the first version of this guide. In future releases, this section will contain information on modifications and corrections.

## 1.4 Disclaimer

All installation instructions, limits and warnings given in the technical documentation supplied by Dana TM4 must be respected in order to ensure that the system runs optimally and is not at risk of damage by misuse. Operating the system outside of the established limits constitutes misuse and may invalidate any warranty.

## 1.5 Safety instructions

TM4 products must be installed and manipulated by qualified personnel who are fully aware of the types of hazards involved in working with electrical circuitry and are familiar with standard practices for preventing accidents. The vehicle integrator is responsible for ensuring that proper training is given to all those who use this system in order to avoid physical, electrical and operational hazards.

### 1.5.1 Format and location of safety warnings in this guide

Each warning in this guide follows the same format and includes the reason for the potential hazard and how to avoid it:



**WARNING**

**Reason for the warning – explanation of the potential hazard.**

How to avoid the hazard.

**Note:** When more than one safety warning applies to the same procedure, they are grouped together in one box and identified with the appropriate safety symbol:



**General/Irritant/Operational:** This warning symbol indicates that you are in a potentially hazardous situation that could result in damage to the product or in some situations lead to bodily harm or death.



**Electrical:** This warning symbol indicates that you are in a potentially hazardous situation that is electrical in nature and could result in damage to the product or in some situations lead to bodily harm or death.

To remind you of the potential hazards involved, appropriate safety warnings are located throughout this guide in procedures that if performed incorrectly may harm you or damage the product.

## 1.6 Definitions, acronyms and abbreviations

<b>Auxiliary battery</b>	Standard 12 V vehicle battery.
<b>AWG</b>	American Wire Gauge.
<b>CAN</b>	Controller Area Network (communication protocol).
<b>CSC</b>	Critical/Safety Characteristics
<b>ESD</b>	ElectroStatic Discharge
<b>MCU</b>	Motor Control Unit.
<b>MKC</b>	Major Key Characteristics
<b>TM4 ODIN</b>	TM4 diagnostic software.

## 1.7 References

All system and product documentation is available in the Documentation section of the TM4 Extranet. Requests to open an account can be made online via <https://extranet.tm4.com>.

**Table 1** Related document references

	Reference	Title/Description	Note
[1]	TG-0001	TM4 ODIN v4 Technical Guide	1
[2]	TG-0200	TM4 CO150-A3 Installation Guide	1
[3]	TG-0239	TM4 SUMO LD Operations and Maintenance Guide	1
[4]	TG-xxxx	System Specifications	1, 2
[5]	INT3-0113	Interface drawing	1, 2
[6]	Application note	TM4 SUMO Fuse and DC Cable Selection	1
[7]	WExxxx	Cable end specification	1, 2
[8]	WH-xxxx	Cable harness specification	1, 2
[9]	SC-6011E	Harness selection form	1
[10]	SC-6010E-001	Assembly instructions for TM4 Quick Connect Connectors	1
[11]	(See note)	<a href="https://extranet.tm4.com">https://extranet.tm4.com</a>	-

**Notes:**

1. Refer to the latest published version of documentation and/or software package on the TM4 Extranet site.
2. Documentation specific to your system is available on the TM4 Extranet.

## 2 Transport and storage conditions

This section describes the conditions that must be adhered to when either transporting or storing TM4 products in order to ensure optimum performance once installed in a vehicle.

On leaving TM4 facilities, the product is void of all coolant and all connectors are covered. The packaging is designed to protect the content against damage from vibrations and impacts and is able to withstand maritime conditions during transportation.

TM4 products must be transported and stored in well-ventilated facilities with adequate protections against dust and excessive humidity. See Table 2 for details of recommended conditions.

While the products are in the original shipping crates, there are no precautions to take against electrostatic discharge (ESD); however, when unpacking and manipulating the products, you must avoid touching the connector pins.

**Table 2** Recommended transport and storage conditions

Condition	Information
Max. ambient temperature	+85 °C
Min. ambient temperature	-40 °C
Max. relative humidity	85%
Min. relative humidity	5%
Condensation	Not permitted
Precipitation	Not permitted
Icing	Not permitted
Direct exposure to sunlight	Not permitted
Max. storage period	6 months

**Note:** Refer to the ISO-16750-4 standard for information related to ambient temperature values.

### 3 Receiving and unpacking the motor

All TM4 products are carefully inspected and tested before being packed at our facilities; however we recommend that you carry out a full visual inspection when unpacking as it is possible that the crate and contents might become damaged during the shipping process.

#### 3.1 Safety warnings related to product handling

Read these general safety warnings before handling the product.

**WARNING**

**Mishandling of this product may damage the product and/or cause injury or death.**

- All limitations and specifications communicated by TM4 regarding the product must be respected.
- Do not attempt to open, repair or modify this product. In case of damaged casing or suspected product malfunction, contact TM4 Customer Service.
- Use only recommended points to lift and secure the product.
- If using chains or other lifting tools, ensure they do not touch or put pressure on any part of the product exterior (surface, connectors, and/or cables).
- Do not attach the motor to the MCU using a shared support or bracket.
- Do not apply any external load to the casing of the product.

#### 3.2 Inspecting and moving the motor

1. On receiving the product, verify that the crate is undamaged.
2. On opening the crate, perform a quick physical check of the contents:
  - Inspect for damaged packaging materials.
  - Verify that the product has remained in place in the crate during shipping.
  - Verify the contents of the crate against the list of delivered goods on the packing slip (a copy of which is located inside the crate).
3. Refer to the Figure 1 for the location of the removable lifting brackets and the product interface drawing [5] for recommendations on moving the product. Note the following warning information before carefully lifting the product out of the crate.

**WARNING**

**Mishandling of this product may damage the product and/or cause injury or death.**

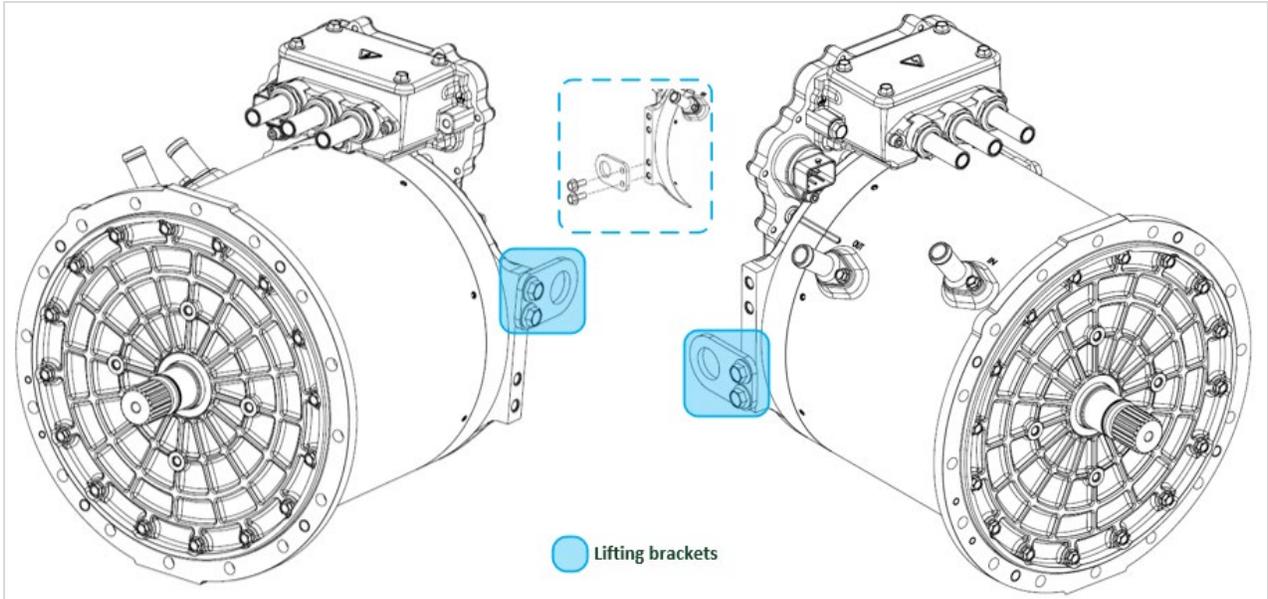
- If using chains or other lifting tools, ensure they do not touch or put pressure on any part of the product exterior (surface, connectors, and/or cables).
- To reduce risk of accident, ensure that the chains or straps are fully secured and the weight of the product is evenly distributed before attempting to lift it.

4. Remove all packaging materials before carrying out a full visual inspection to ensure that it is entirely to your satisfaction.

**Note:** If the packaging and/or the product are damaged, take photographs of the damage, save all packaging materials and immediately notify the carrier as well as Customer Service at TM4. See Section 5 for TM4 contact information.



**Figure 1** Lifting brackets



**Note:** The lifting brackets can be removed and the holes can be used for other purposes, see product interface drawing [5].

## 4 Installing the motor in the vehicle

The following sections describe how to install the motor in a vehicle. The final installation sequence should be defined by the integrator as it depends on the type of application.

Read these general safety warnings before installing the product.

**WARNING**

**Mishandling of this product may damage the product and/or cause injury or death.**

- All limitations and specifications communicated by Dana TM4 regarding the product must be respected.
- Do not attempt to open, repair or modify this product. In case of damaged casing or suspected product malfunction, contact TM4 Customer Service.
- Use only recommended points to lift and secure the product.
- If using chains or other lifting tools, ensure they do not touch or put pressure on any part of the product exterior (surface, connectors, and/or cables).

### 4.1 Planning to install the motor

- Ensure that everyone coming into contact with the motor has received full training and has read all the safety warnings in this guide.
- Follow all instructions in this guide on how to lift and install the product.
- Call TM4 Customer Service if in doubt (see Section 5 for contact details).

#### 4.1.1 Respecting CSC and MKC markings on interface drawings

Before installing the product, refer to CSC and MKC markings on the product interface drawings [5]. These markings highlight areas that may potentially impact product safety, operation or longevity if proper instructions are not followed:

- **CSC** is used to indicate Critical/Safety Characteristics with specific instructions that must be followed in order to avoid potentially dangerous, hazardous or non-regulatory situations.
- **MKC** is used to indicate Major Key Characteristics with specific instructions that must be followed in order to avoid major inconvenience to the user. Items marked with MKC do not, however, represent a hazard in terms of operational safety.

### 4.2 Preventing damage to the motor

These subsections give information on how to prevent damage to the motor.

**WARNING**

**Mishandling of this motor may damage the product and/or cause injury or death.**

When manipulating and/or installing this product, you must **NOT**:

- Attach the motor to the MCU using a shared support or bracket (see Section 4.2.1).
- Modify any part of the motor and/or MCU.
- Apply any external load to the casing of the motor.
- Install the product in the vehicle in an inverted, up-ended or tilted position (see Section 4.2.6).

#### 4.2.1 Using separate brackets to support motor and MCU

The motor must **not** be attached to the MCU using the same support or bracket.

The motor must be decoupled from the MCU as the motor and the MCU were designed to resist to different vibration profiles. The MCU could be permanently damaged if exposed to the vibration profile of the motor.

The motor must be installed on its own support which is attached to the frame of the vehicle.

**Note:** It is the responsibility of the system integrator to design the motor support brackets and vibration damping mechanism in order to ensure that the vibration profile of the motor does not exceed the limitations referred to in the System Specifications [4].

#### 4.2.2 Respecting the physical integrity of the motor

The motor is a sealed unit requiring no physical customization before or after installation. You must **not** under any circumstances attempt to modify any part of the product as this could cause permanent damage to the motor and injury to the user. This includes any modification that changes the state of the original product, such as:

- Drilling holes into the casing.
- Adding and/or removing parts including hardware, screws, and connectors.

#### 4.2.3 Protecting the casing from external loads

The product casing was **not** designed to bear weight from external loads such as:

- Components sitting on top of the casing.
- Components suspended from the bottom of the casing.
- Components attached to the sides of the casing.
- Maximum radial loads on motor shaft.

#### 4.2.4 Protecting the output shaft from damage

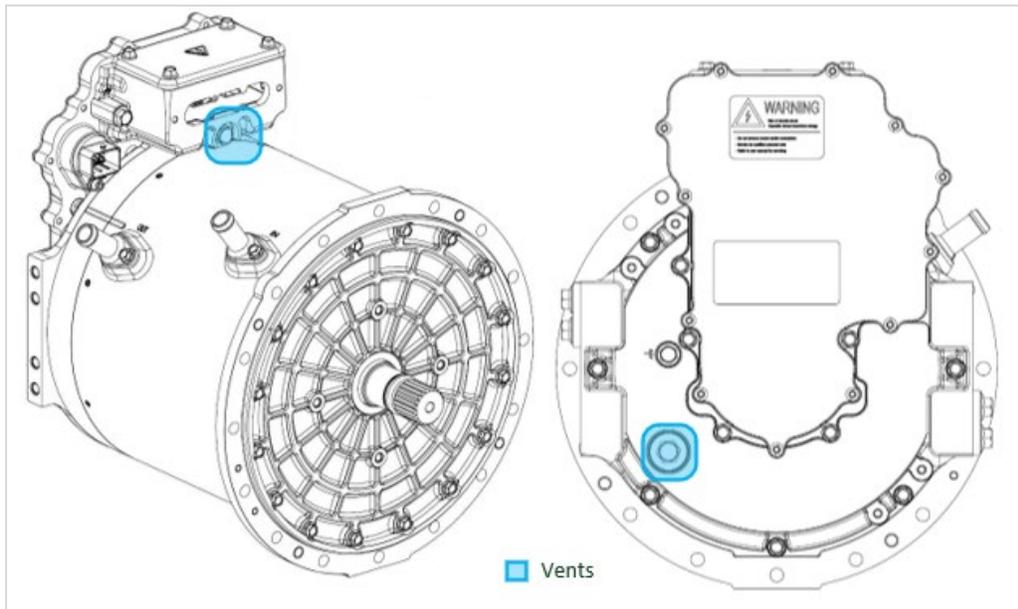
Prior to use, the output shaft splines must be lubricated with good quality lithium-based EP grease that meets with NLGI grade 2 requirements. This will help prevent premature corrosion or other damage that could impact product safety and longevity.

## 4.2.5 Correctly positioning the motor

When installing the motor in the vehicle, ensure that the position of the motor respects the limits shown in the product interface drawing [5].

Ensure that any warning labels on the product remain visible at all times and are not removed or obscured by cables or accessories. Also take care to avoid obstructing the vents located at the front and back of the motor, see Figure 2.

**Figure 2** Vents on motor casing

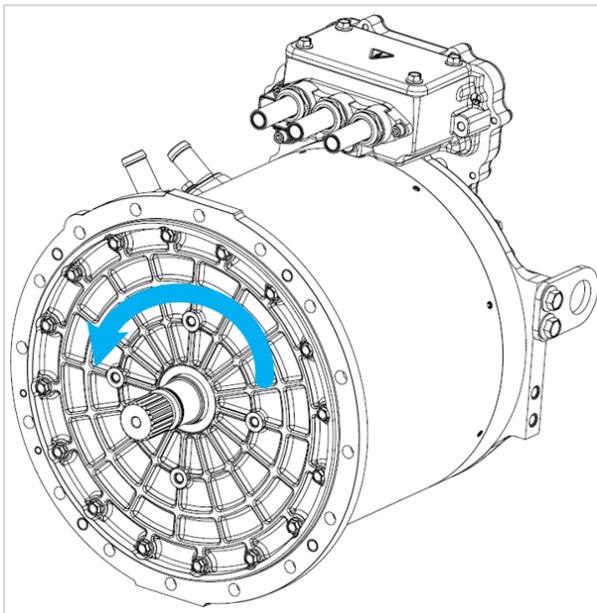


#### 4.2.6 Default motor rotation direction

The direction of rotation of the motor and the corresponding direction in which the vehicle will move depend on the type of gearbox used.

By default in the product software, the direction of rotation of the motor output shaft is configured as counter-clockwise, see Figure 3. When the CAN control protocol sends a positive torque request to the motor, the resulting positive torque promotes a counter-clockwise rotation of the output shaft which can then yield a forward or reverse motion of the wheels depending on the configuration used. See Section 4.2.6.1 for more information.

**Figure 3** Default motor rotation direction



##### 4.2.6.1 Configuring direction of rotation at the motor

The direction of rotation at the motor is configurable to allow the motor to be installed in a variety of integration scenarios.

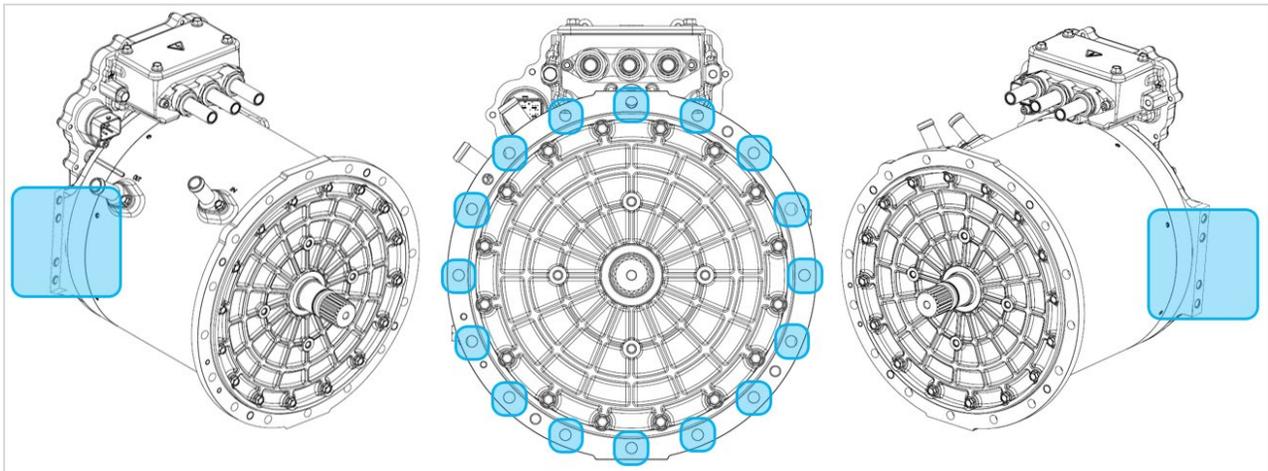
There are two possible directions of rotation – normal and reverse. Normal indicates the default rotation (counter-clockwise) and reverse indicates the clockwise direction. See the software section in the product Operations and Maintenance Guide [3] for details of which parameters can be configured to achieve the desired result.

### 4.3 Securing the motor

**Note:** Ensure that when the motor is installed that there is nothing covering or touching the motor body and that air can circulate freely around the body of the motor.

The motor should be properly installed and secured using the mounting points shown in **Error! Reference source not found.** For full information see the product interface drawing [5]. It is the responsibility of the integrator to design appropriate brackets to support the motor in the selected integration.

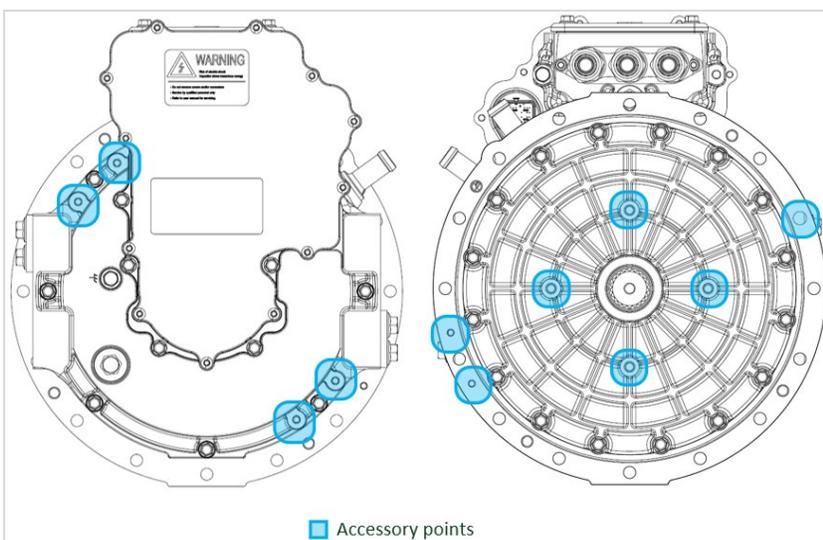
**Figure 4** Mounting points



#### 4.3.1 Accessory points

Points are available on the casing designed to securely fix accessories relevant to the integration of the product in the system. For accessory point specifications, refer to the product interface drawing [5].

**Figure 5** Accessory points



## 4.4 Installing the cooling system

As power is delivered to the wheels, temperatures of the various components within the motor and the MCU rise. Therefore, a cooling unit/radiator must be installed in the vehicle and connected to the MCU and the motor to dissipate the excess heat.

The following two configurations are supported allowing the integrator to make a selection depending on the vehicle topology, available pumps or other factors:

- Serial configuration, Section 4.4.2.
- Parallel configuration, Section 4.4.3.

**Note:** Dana TM4 does **not** supply any cooling equipment or accessories.

### 4.4.1 Safety warnings related to handling the cooling agent

Read all safety warnings associated with handling the cooling agent before working with the cooling system.



#### WARNING

**Regardless of the cooling system used, when in a system, the MCU can be irreparably damaged and may become highly unstable if the coolant liquid pressure reaches or exceeds a pressure of 30 PSI (static pressure measured at the entrance of the MCU, upstream of the MCU in the circuit).**

Ensure that the pump is adjusted accordingly.

**The cooling agent contains ethylene glycol that is a highly flammable product. Ethylene glycol can burn with an invisible flame that can cause serious burns and/or other injuries.**

Always handle the cooling agent carefully wearing appropriate safety clothing and eye-glasses.

**The cooling agent can irritate the skin, the eyes and the mucous membranes.**

- Always work in a well-ventilated area when handling the cooling agent; breathing in high concentrations of ethylene glycol can cause nausea.
- In case of contact with eyes and skin, rinse with water and consult a doctor.
- In case of ingestion, seek medical help immediately.

**The cooling agent is under pressure when heated; removing the cap when the coolant is hot can cause serious burns and/or other injuries.**

Wait until the coolant reaches an ambient temperature before removing the cap.

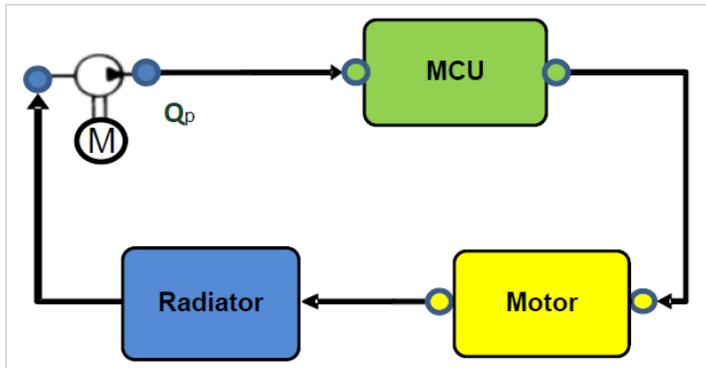
**All potential dangers of handling cooling agents cannot be listed here.**

Consult manufacturer warnings and recommendations for safe handling of the cooling agent.

## 4.4.2 Serial configuration

When there is only one cooling unit/radiator installed in the vehicle, a serial configuration is used to supply the cooling agent to both MCU and motor using the same flow of coolant. In a serial configuration, the coolant coming from the cooling unit **must** first go through the MCU and then through the motor before returning to the cooling unit as shown in Figure 6.

**Figure 6** Serial cooling configuration



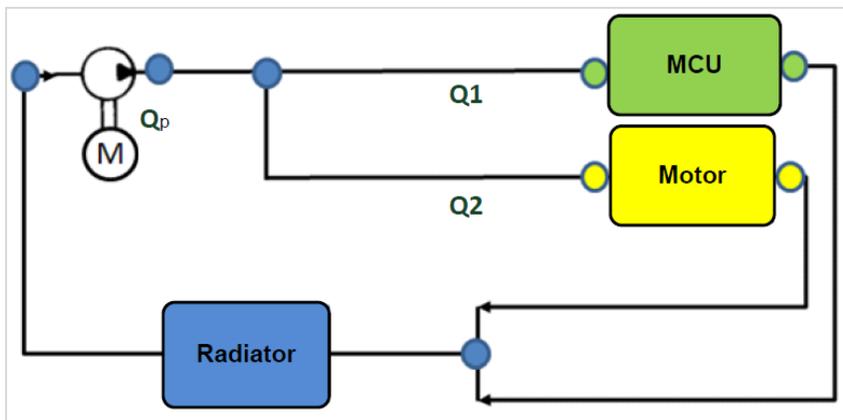
See the System Specifications [4] for exact coolant flow rate.

## 4.4.3 Parallel configuration

This cooling configuration involves the MCU and motor being cooled in parallel.

As the cooling units are supplied by the vehicle integrator and the cooling system setup involves fine-tuning and testing at the customer site, Dana TM4 has no specific recommendations or limitations on how to achieve optimal configuration.

**Figure 7** Parallel cooling configuration



**Note:** A flow splitter should be used to ensure that both the MCU and motor are supplied with coolant at the required flow rate. The pump should then be selected taking into consideration the sum of the coolant requirements of both components.

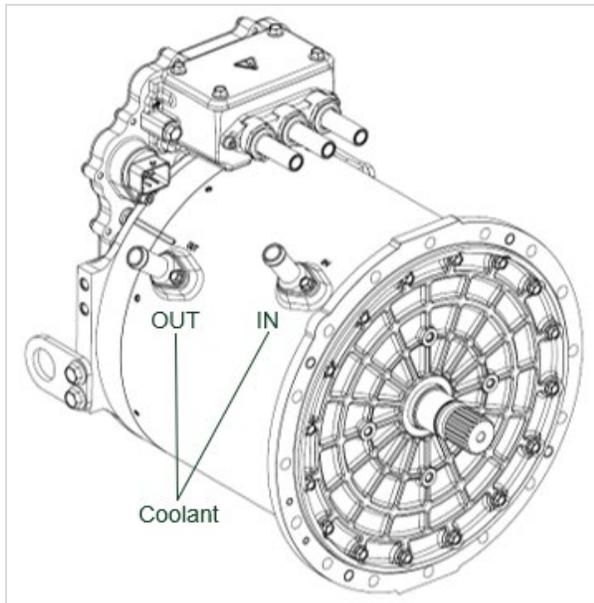
See the System Specifications [4] for exact coolant flow rate.

## 4.4.4 Coolant inlet/outlet

The motor has clearly marked coolant inlet and outlet points, see Figure 8.

Specific hose types should be used to connect the cooling unit to this system. Refer to the product interface drawing [5] for coolant inlet/outlet specifications; see the System Specifications [4] for more information on coolant pressure drops and rate flow management specific to your system.

**Figure 8** Cooling inlet/outlet locations



## 4.4.5 Coolant specifications



### WARNING

The internal mechanisms of the MCU may be prematurely damaged if not protected from corrosion by use of an automotive antifreeze product in the coolant liquid.

Refer to the recommended best practices in this section.

**Regardless of the cooling system used, the MCU can be irreparably damaged and may become highly unstable if the coolant liquid pressure reaches or exceeds a pressure of 30 PSI (static pressure measured at the entrance of the MCU, upstream of the MCU in the circuit).**

Ensure that the pump is adjusted accordingly.

To prevent corrosion problems in cooling systems, here are the recommended best practices.

- The cooling circuit must be rinsed with de-ionized water each time before filling.
- The ethylene glycol must respect the standard corresponding to its application (ASTM D3306 Type III or ASTM D6210 Type III).
- The ethylene glycol must contain some type of active corrosion inhibitors.
- The ethylene glycol must be diluted with de-ionized water (not distilled water).
- The dilution ratio must be 60% ethylene glycol to 40% de-ionized water (minimally 50% ethylene glycol to 50% de-ionized water).
- Two different types of coolant should not be mixed.



## Installation Guide

As the cooling unit, cooling hose and cooling agent are not supplied by Dana TM4, the vehicle integrator has full responsibility for following specifications and operating methods given by the manufacturers of each of these parts.

In order to meet Dana TM4 specifications and to obtain maximum system performance, the cooling system should respect both the maximum coolant temperature and the minimum coolant flow rate as described in the System Specifications [4]; above this temperature and/or with a below minimum flow rate, the system may degrade the duration of continuous performance and peak performance in order to protect its internal components.

When using either the serial or parallel cooling configuration, (see Figure 6 and Figure 7), there can be associated drops in pressure that have to be managed; see the System Specifications [4] for more detailed information.

## 4.5 Electrical installation

This section describes the procedures in order to safely undertake the electrical installation of the system. Although the final installation sequence will be decided by the system integrator, there are two suggested installation sequences given in Section 4.5.2.

**Note:** It is imperative that you are aware of the safety risks involved in this type of electrical installation; before you start, refer to Section 4.5.1 for more detailed information.

### 4.5.1 Safety instructions related to electrical installation

Carefully read all safety instructions before making any electrical connections in the system.



#### WARNING

**This product generates high-voltage that can cause an electric discharge or electrocution resulting in injury or death.**

Before manipulating the product, verify that:

- The traction battery (high-voltage battery) is disconnected.
- The auxiliary battery (12 V battery) is disconnected.

**Incorrect assembly or an incorrect electrical connection during assembly of this product can cause electrocution and/or fire.**

The assembly and connections must conform to the instructions included in this Technical Guide.

**Care must be taken when manipulating electrical equipment.**

This product must be installed by qualified and authorized personnel in accordance with applicable vehicle standards and industry practices. Always use appropriate insulation and protection before manipulating the product even when the product is disconnected from a high-voltage source.

**ESD sensitive – do not touch connector pins**

The internal electronics are sensitive to electrostatic discharges.

**Risk of electric shock – do not open the MCU and/or motor.**

The electrical installation of the system does not require the MCU and/or the motor to be opened or disassembled.

**Risk of electric shock – capacitor stores hazardous energy.**

Wait 10 minutes after powering off all sources of supply prior to removing cables and/or servicing.

#### 4.5.2 General information for installing and handling cables/harnesses

During installation and connection of cables and harnesses follow these recommendations:

**User security:**

- Ensure that each cable is clearly identified for specific usage to prevent errors during installation and operation that may damage the system or cause injury to the user.
- Ensure that, once installed, cables do not obscure any warning labels on the product.

**When installing:**

- Ensure cable bending radius of x5 of the cable diameter or greater. A correctly installed cable should be smooth with no creases or signs of strain that might eventually compromise cable integrity.
- Ensure that cables do not touch or cross over each other.
- Never place cables near sharp edges or on abrasive surfaces.
- Protect cables from damage due to gravel or other environmental factors.
- Allow for enough room for air circulation, clearance space for movement and access to cables for maintenance etc.

**When securing cables:**

- Ensure that each cable is appropriately supported (connector strain relief):
  - High-voltage cables – secured no more than 10 cm from the connectors.
  - Low-voltage cables – secured no more than 30 cm from the connectors.
- To restrict movement and vibration in longer cables, a maximum of 3 cables should be fastened together **in parallel** every 40 cm or less; do **not** gather cables in a tight bundle.
- Ensure that the brackets/fasteners used to support/secure the cables do not compromise cable integrity.
- Never apply perpendicular loads on the connectors/cables when using cable fasteners as this could compromise ingress protection (i.e. IP6K9K).

### 4.5.3 Example installation sequence

The system integrator will define the final electrical connection sequence of the MCU and motor taking the complete installation into consideration.

Several cables and harnesses are required for the electrical connections. The following steps summarize the electrical connection sequence.

1. Connect the grounding strap, see Section 4.5.4.
2. Connect the phase cables, see Section 4.5.5.
3. Connect the motor sensor harness, see Section 4.5.6.

**Note:** Reverse sequence when removing the system from the application (remove the grounding strap last).

### 4.5.4 Grounding the system

The system must be securely grounded to ensure user safety in case of an insulation fault in the motor and/or the MCU. An incorrectly grounded connection may result in MCU functionality losses and safety risks for the user.

#### 4.5.4.1 Grounding strap recommendations

The grounding straps or wires must be sized to support the:

- Maximum current of the auxiliary battery specified by the auxiliary battery fuse current rating (refer to the Installation Guide for the MCU [3] for more information).
- Insulation fault of the high-voltage battery to the chassis.

**Notes:**

1. The integrator should also consider the possibility of an insulation fault where the high-voltage battery current might find a path through the grounding strap. The ground must support the maximum current of the high-voltage battery for a sufficient time for the high-voltage battery fuse to open.
2. As long as the wire size of the grounding strap is equivalent to the size of the wire coming from the high-voltage battery, it should be adequate to withstand a short circuit between the high-voltage battery and the chassis..

**Table 3** Grounding – Strap size

Specifications	Units	Values	Notes
Wire size	AWG	1/0	1

**Notes:**

1. As long as the wire size of the grounding strap is equivalent to the size of the wire coming from the high-voltage battery, it should be adequate to withstand a short circuit between the high-voltage battery and the chassis.

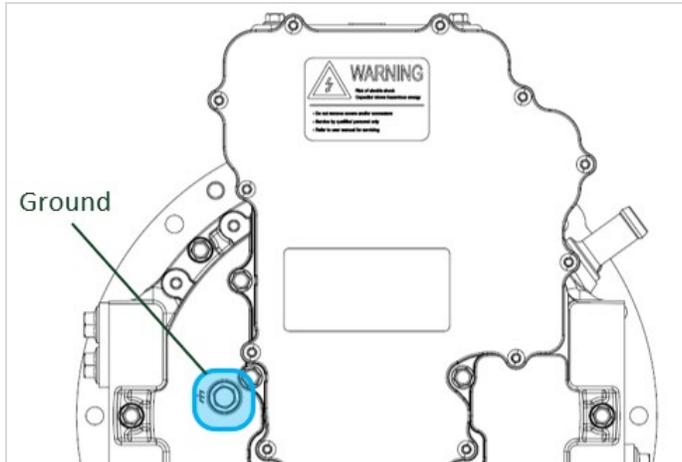
See the Application Note on SUMO Fuse and DC Cable Selection [6] for more information.

#### 4.5.4.2 Connecting the grounding strap to the motor

The grounding strap must be connected to its dedicated connection point on the motor. The type of grounding configuration used may vary depending on the type of vehicle integration.

**Note:** To prevent oxidation of the aluminum surfaces and any malfunction of the connection during operation, we recommend that you sand the contact point on the motor and apply a layer of conductive grease on the grounding strap contact surfaces before connecting the strap.

**Figure 9** Grounding location



**Table 4** Grounding strap installation

First end	Second end
Refer to Figure 9	Vehicle chassis (frame) or earth ground (test bench)

Note: The location of the second end connection point of the grounding strap depends on the type of application being used by the vehicle integrator. Dana TM4 provides one screw for grounding purposes.

#### 4.5.4.3 Connecting the grounding strap to the chassis

When the grounding strap is to be connected to the vehicle chassis, before connecting the strap, you must prepare the chassis. First remove the paint from the contact area, then sand and apply a layer of conductive grease.

It is important to note that when integrating the system, both the motor and MCU must be grounded in the same place on the chassis, or at least on the same connected frame before checking that the resistance between the chassis and another metallic part of the vehicle is less than 0.1 Ohm.

#### 4.5.5 Phase cables

Power cables are required between the MCU and the motor to connect each phase.

**IMPORTANT NOTE:** Carefully read all safety instructions related to electrical installation in Section 4.5.1 and general information for installing cables and harnesses in Section 4.5.2 before continuing with your integration.

##### 4.5.5.1 Preparing phase cables

TM4 SUMO LD MA-270\_165\_xx motors use Quick Connect cables that can be:

- Purchased pre-assembled from TM4; see [9] for information to help you select the appropriate harness configuration for your integration.
- Prepared by the integrator following the instructions provided by TM4; see the assembly instructions [10].

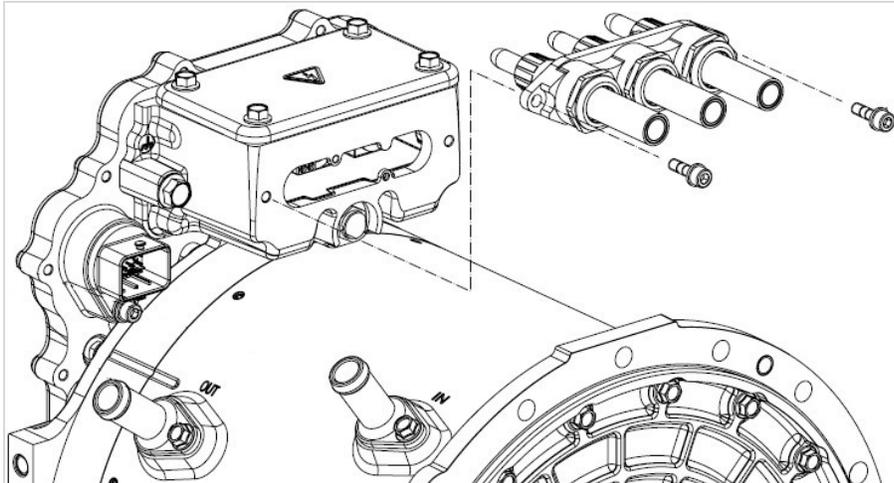
**Note:** Phase cables can be up to a length of 5 m.

## 4.5.5.2 Installing the phase cable harness

Power cables connect phases between the MCU and the motor; both components have numbers/letters engraved on the casing to help you with the installation, see Table 5 for standard and reversed mappings.

Using the harness you have prepared or purchased from Dana TM4, refer to the product interface drawing [5] and cable harness drawing [8] for illustrated cable installation information.

**Figure 10** Phase cable installation with Quick connect cables



### 4.5.5.2.1 Modifying the phase cable mapping

Cable configuration can be modified to suit your integration. To provide greater flexibility when integrating the system into the vehicle and to prevent the cables from touching or crossing over each other when connecting the motor to the MCU, we recommend two possible phase cable configurations: standard and reversed. See Table 5 for both standard and reversed mappings.

- **Standard:** Cables connected with logical/letter number sequence.
- **Reversed:** Cables connected with reversed letter/number sequence.

**Table 5** Phase cable installation mapping

Standard		Reversed	
Motor	MCU	Motor	MCU
A1	1	A1	3
B1	2	B1	2
C1	3	C1	1

**Note:** If the reversed connection scenario is chosen, the **PhaseCableReversed** parameter value must be set to 1, and the **DrvParameters.Save** parameter value must be set to 1.

For more information, refer to the product Operations and Maintenance Guide [3].

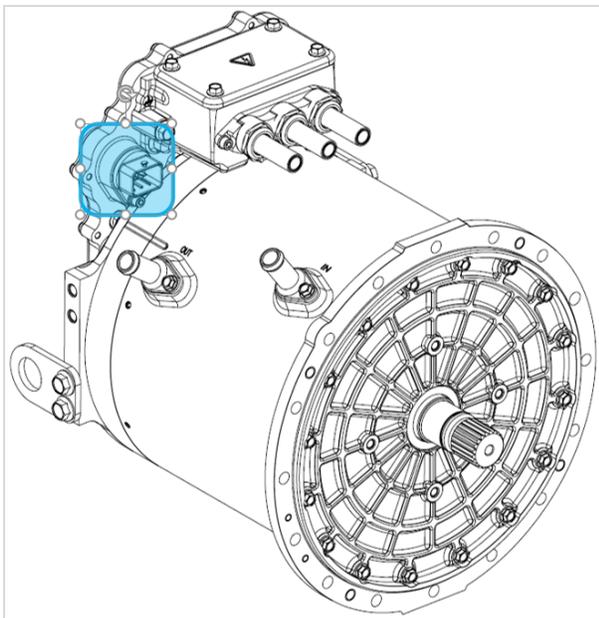
When purchasing a Quick Connect cable assembly, you can select from a number of possible configurations [9] including Standard and Reversed phase order.

#### 4.5.6 Motor sensor interface harness

For detailed harness pinout information, see the Motor sensor interface section in the Installation Guide for the TM4 Motor Control Unit (MCU) you are using in your integration.

**Note:** Carefully read all safety instructions related to electrical installation (Section 4.5.1) and general information for installing cables and harnesses in Section 4.5.2 before continuing with your integration. Before connecting or reconnecting the motor sensor interface harness connector, carry out a visual inspection to ensure that the pins on both connectors of the harness are undamaged and that there is no dirt or debris that might interfere with the contacts. Also, please note that although the signal connectors are fully watertight when correctly installed, we strongly recommend that you help direct water away from the connector heads by creating a drip loop with the cable in your installation.

**Figure 11** Motor sensor interface location



For general information on connectors available for the LSM110E, refer to the product interface and cable drawings, [5] and [8].

## 5 Customer service

For further technical assistance, please contact us at [tm4customersupport@dana.com](mailto:tm4customersupport@dana.com).