STEERD-TRACTION UNIT
ST-1000-225-54-48-C

MOBOTIC

DATASHEET

The images might not be from exactly same model as described in datasheet

MOBOTIC

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MOBOTIC

list of abbreviations

Abbreviation	Description
MCU	Motor controller
SSI	Synchronous Serial Interface for absolute position readings of encoder
PLC	Programable Logic Controller. Main computer of vehicle.

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1 INTRODUCTION

Steered-Traction Unit has been designed for highly maneuverable Autonomous Mobile Robots operating in the indoor industrial areas. The unit has combined traction and steering functionality, which is ensured by a traction unit and a steering actuator with integrated motor control electronics. The unit takes care of all control and safety requirements in a typical mobile robotic application.

Traction unit key features:

- Brushless permanent magnet synchronous motor
- Encoder with SSI and SIN/COS absolute output for the control and speed supervision purposes.
- Lifetime lubricated planetary gearbox.
- An integrated thermal protection.
- Electrically operated spring-loaded brake with optional manual release lever.
- Motor control electronics
- Wheel

Steering unit key features:

- Brushless permanent magnet synchronous motor
- Cycloidal gearbox
- Bearing system for supporting high radial, axial and tilting loads
- Slip ring for power and signal transmission, providing endless steering rotation and immunity on cable fatigue
- Integrated encoder system with two independent measurements and signal processing on the motor shaft and actuator output. Absolute position is available on SSI for supervision purposes.

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2 SPECIFICATIONS

2.1 Performance and Operating conditions

Characteristics	Values
Continuous power traction Unit	1.000W
Continuous traction wheel torque	54Nm
Max. power traction Unit (S2 1min)	1.800W
Max. traction wheel torque (S2 1min)	120Nm
Max. Traction wheel speed	200rpm
Wheel Dimensions	225mm x 50mm
Wheel Materials	Coating: NDI, hardness 95+/-3 SH.A
Brake holding torque (Spring-loaded)	55Nm
Max. steering torque	250Nm
Continuous power steering Unit	240W
Max. Steering speed (@ no load)	150deg/s
Permissible dynamic tilting moment on the steering unit*	600Nm
Permissible static tilting moment on the steering unit*	2.500Nm
Steering range of motion	Infinite
Unit mounting Height	287mm
Unit turning diameter	293mm
Load capacity	1000kg
IP protection	IP54
Weight	19,8kg
Operating life time	20.000h
Ambient temperature (operation)	0..70 °C
Ambient temperature (storage)	-40..85 °C
*Permissible tilting moment on the steering unit is calculated for the fixation plane/plate. Permissible dynamic tilting moment applies to the rotating condition, whereas permissible static tilting moment applies to the stand-still condition of the steering actuator.	

2.2 Dimensions

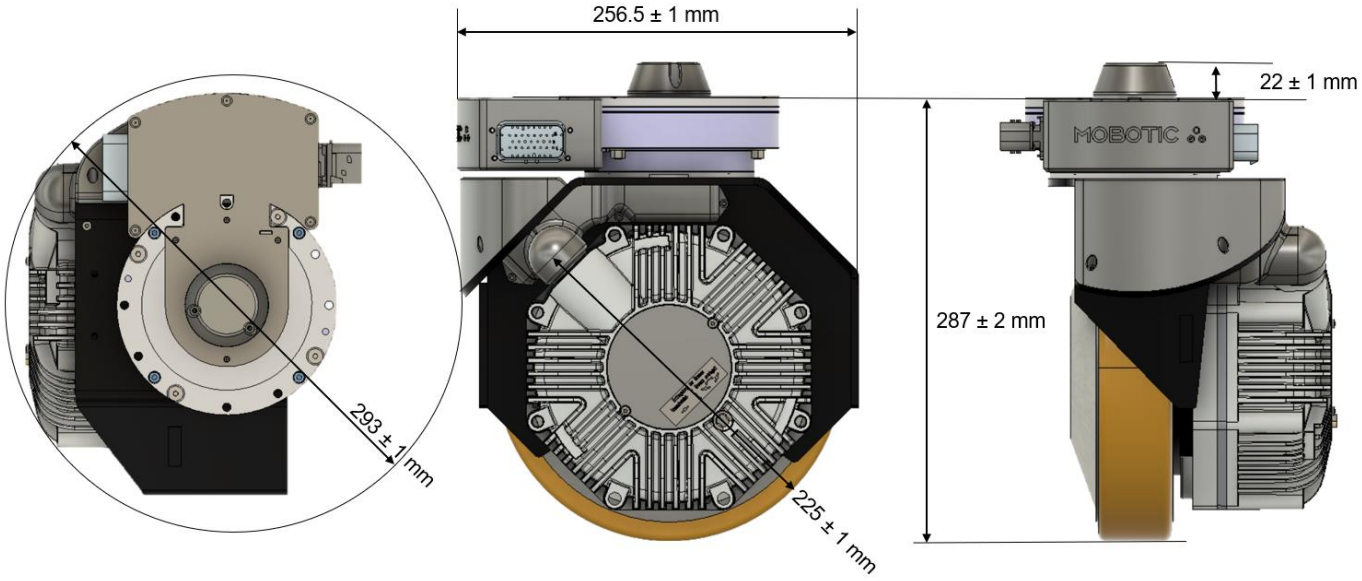

Figure 1: Dimensions

2.3 Traction Unit Motor characteristics

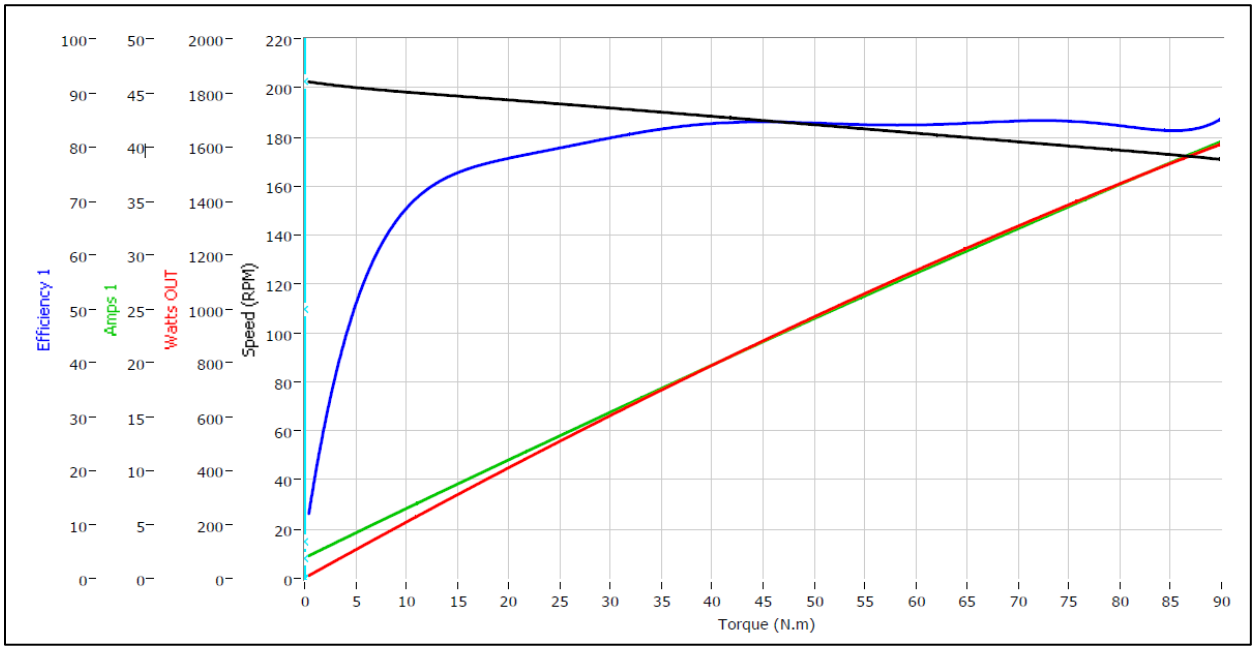

Figure 2: Traction Unit: Measured natural motor characteristics (System: motor + controller)

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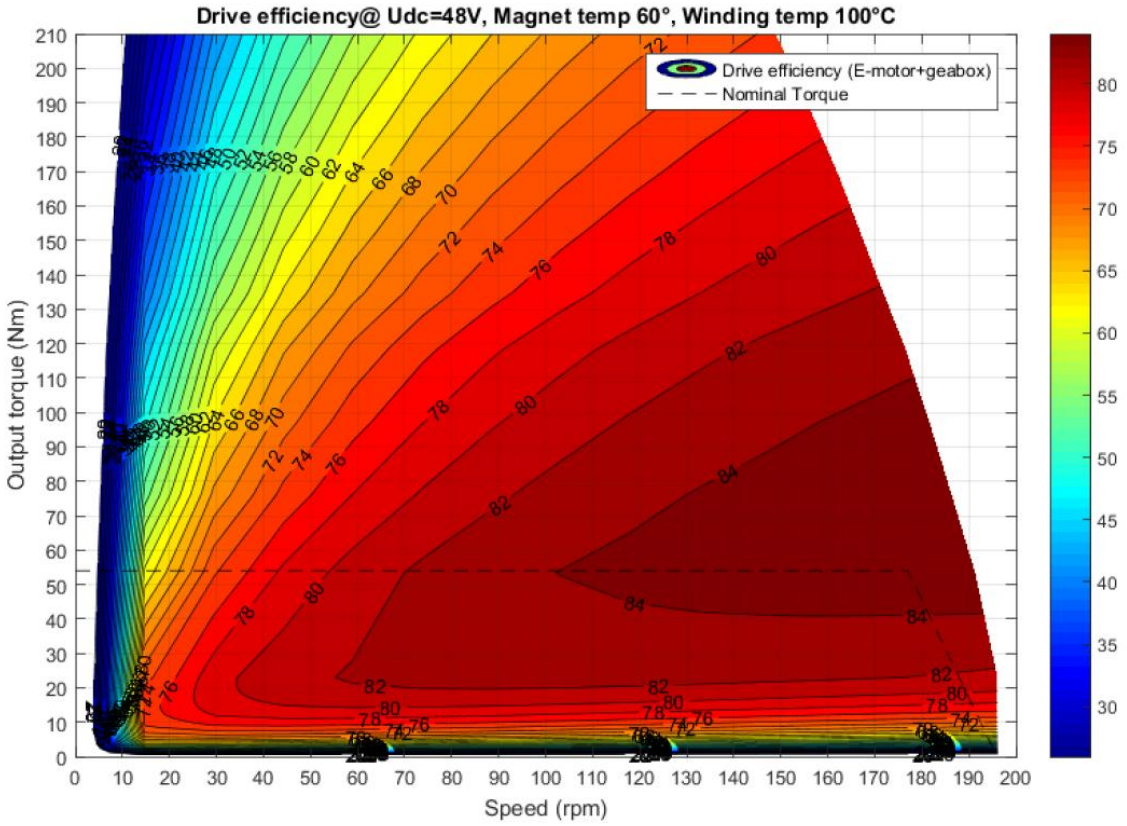
Simulation parameters for torque/speed maps:

- Udc = 48V
- Maximal phase rms current for breakaway torque = 105 Arms
- Results for magnet temperature 60°C, winding temperature 100°C
- Drive efficiency and DC Current@48V – E-motor and gearbox efficiency considered without controller losses
- Drive can operate over nominal torque for short time, dependent on temperatures and cooling conditions.



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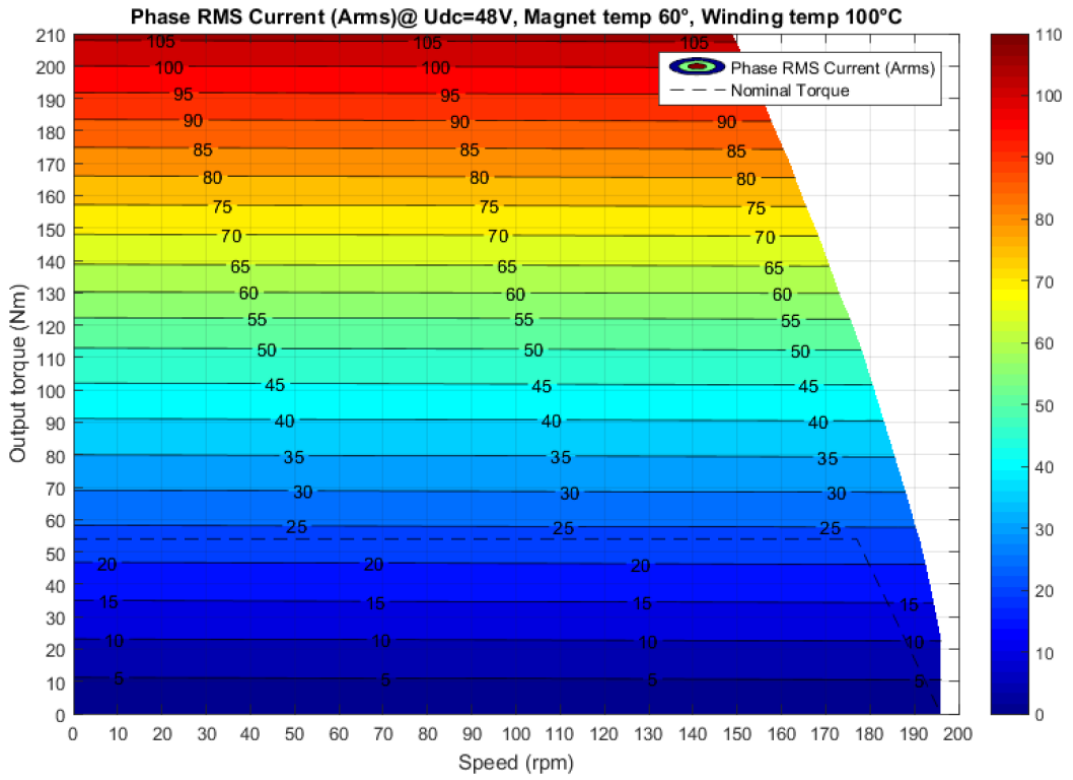
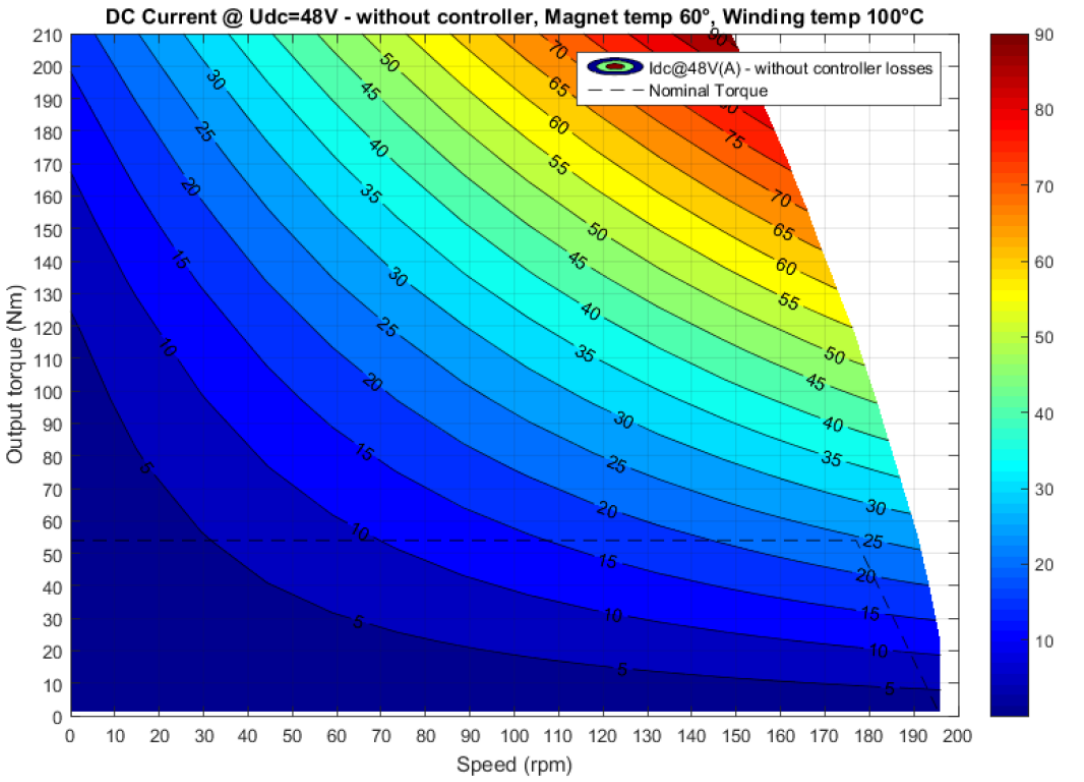

Phase RMS Current (Arms)@ Udc=48V, Magnet temp 60°, Winding temp 100°C
Phase RMS Current (Arms)
Nominal Torque
Output torque (Nm)
Speed (rpm)


DC Current @ Udc=48V - without controller, Magnet temp 60°, Winding temp 100°C
Idc@48V(A) - without controller losses
Nominal Torque
Output torque (Nm)
Speed (rpm)

2.4 Electromagnetic Brake

Traction motor is equipped with an inbuilt electromagnetic brake whose primary purpose is to serve as a parking brake. In some situations, the same brake can be used as an emergency brake. The brake disables only with the supply of 24V DC, which in normal operation is provided through the external PLC.

Parking braking mode:
In a normal operation, the control system has to electrically release the spring-loaded brake before applying any movements. When stopping, the control system has to first bring the motor to a stop before the brake is applied in order to prevent premature wear of the brake.

Emergency braking mode:
Emergency stops with heavy loads and/or at high speeds cause increased wear to the brake's components. For this reason, the brake requires a service after 2,000 emergency braking operations.

Brake manual release:
To be able to move the vehicle also when the battery is flat, or in similar cases, it is possible to release the brake mechanically. To release, the projecting release shaft (diameter 8 mm) must be moved by 30° either to the left or right. In this mode the traction unit still has some resistance (back driving torque) mainly originating from the planetary gearbox and sealing. Back driving torque of the traction unit is always lower than 10Nm.

The motor should not be operated electrically when the brake has been released mechanically. To operate the motor in normal mode the release shaft should be returned to the middle position, where it should engage.

When the brake is mechanically released, then the brake coil circuit is open. That means no current can flow through the brake coil, which can be detected by the supervising PLC.

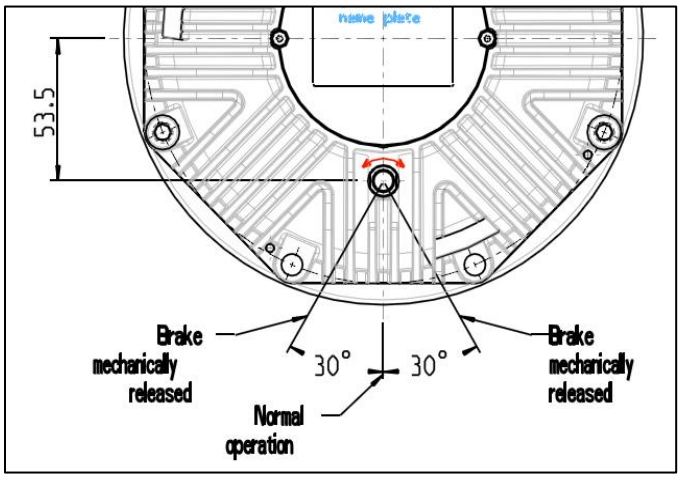


Figure 3: Mechanical release of brake (optional feature)

3 INSTALLATION INSTRUCTIONS

3.1 Mounting of unit

Mounting is done by 8xM5 screws as indicated with black arrows with 7Nm of torque. The length of the screws should be 40mm + thickness of vehicle chassis. The strength of screws should be 12.9.

Load should only be applied on area marked blue. If load is applied on other areas the unit can be damaged.

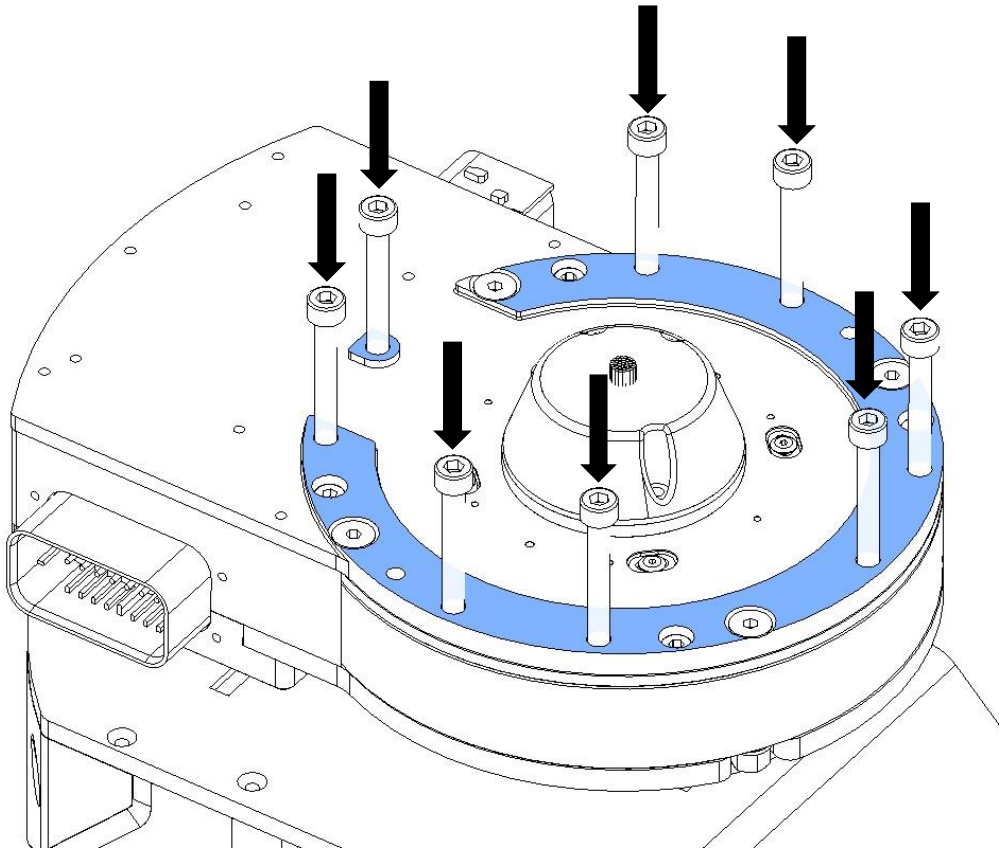


Figure 4: Mounting of unit

The unit should only be touching the vehicle with areas marked in blue

Note: The motor itself and connector can differ as seen in picture, but mountings are always the same

3.2 Wheel replacement

Wheel is mounted by 6 M8x25 screws like shown on figure below. The nuts should be fastened with LOCTITE 243 to protect nuts from unscrewing.

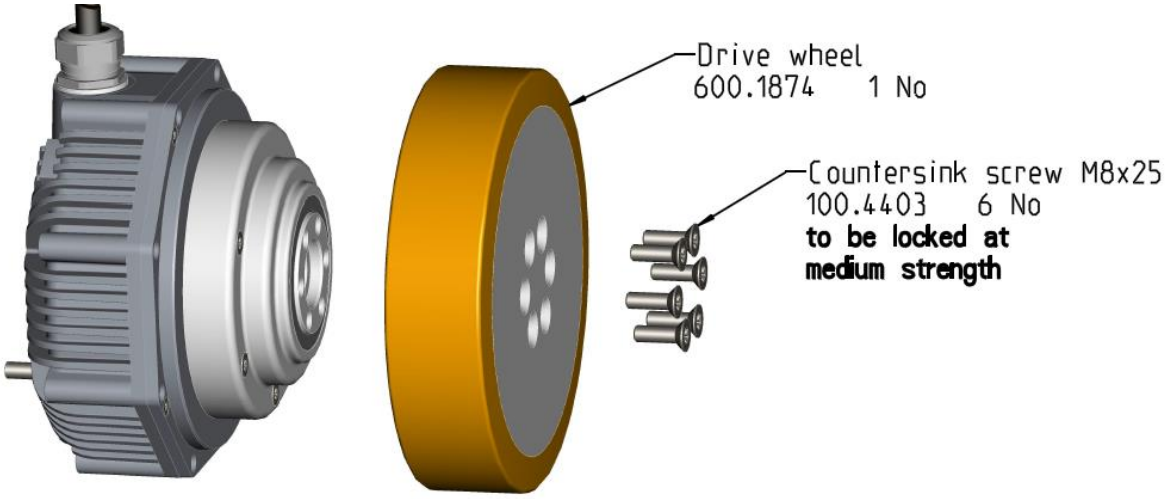


Figure 5: Exchange of the Wheel

Note: The motor itself and connector can differ as seen in picture, but wheel mountings are always the same

Note: Medium strength is 8,5Nm

4 ELECTRICAL CHARACTERISTICS

Absolute maximum ratings (destruction limits)	
Power supply voltage PS_POW, no polarity reversal protection	70 V
Continuous Electronic supply voltage PS_EL, **no polarity reversal protection**	33 V
Short term peak voltage < 1s PS_EL, **no polarity reversal protection**	37 V
Max current on power connector (Continuous)	40A

Operating conditions	
Logical supply voltage PS_EL	18…30V
Electronic current consumption@ PS_EL =24V*	typ. 65 mA
Power supply voltage PS_POW	9…60V
Input current PS_POW	40A

CAN Bus CANOpen protocol	
Protocol	DS301
Device Profile	DS402
Max baudrate	1Mb/s
CAN specification	2.0B
Galvanically isolated	No
Termination	No

Digital Inputs, Outputs and STO (Safe Torque Off)	
Low voltage	0..5 V
High voltage	8…30V

Mechanical brake	
Active	0V
Released	16-24V
Brake current consumption	0,27A@16V – 0,40A@24V

5 ELECTRICAL CONNECTION

There are two connectors on the unit. One for signals and the other for power.

5.1 Signal connector type:

TE Connectivity AMPSEAL 776087-1

https://www.te.com/deu-de/product-776087-1.html

5.2 Mating female signal connector:

TE Connectivity AMPSEAL 770680-1

https://www.te.com/deu-de/product-770680-1.html

Compatible pins :

https://www.te.com/deu-de/product-CAT-AM78-T273.html?r=0&compatible=770680-1

With sample orders the female connectors including pins are included in delivery.

5.3 Signal Connector Pinout

Pin Nr	Description	
1	CAN_H	Can Bus High signal
2	CAN_L	Can Bus Low signal

3	/DO Steering	SSI DO- Steering unit
4	DO Steering	SSI DO+ Steering unit
5	/CLK Steering	SSI CLK- Steering unit
6	CLK Steering	SSI CLK+ Steering unit
7	/DO Traction	SSI DO- Traction unit
8	DO Traction	SSI DO+ Traction unit
9	/CLK Traction	SSI CLK- Traction unit
10	CLK Traction	SSI CLK+ Traction unit
11	STO_A	Safety Torque Off A
12	STO_B	Safety Torque Off B
13	BRK	Brake Power supply
14	GND	Signal Ground
15	DI for Traction	General purpose traction controller DI. (SS1 option)
16	PS_EL	Electronic Supply 24V
17	TX_IN-	ProfiBus/Ethercat (Optional)
18	TX_IN+	ProfiBus/Ethercat (Optional)
19	RX_IN-	ProfiBus/Ethercat (Optional)
20	RX_IN+	ProfiBus/Ethercat (Optional)
21	DO	General Purpose DI
22	DI	General Purpose DO
23	NC	Not connected

5.4 Power connector type:

APTIV 2-way F6.3 CTCS XP Connector 33285118

https://www.aptiv.com/en/solutions/connection-systems/catalog/item?language=en&id=33285118_en

5.5 Mating female power connector:

APTIV 2-way F6.3 CTCS XP Connector 33285119

https://www.aptiv.com/en/solutions/connection-systems/catalog/item?language=en&id=33285119_en

Compatible pins:

APTIV CTS 6.3 Female Locking Lance Sealed Series

https://www.aptiv.com/en/solutions/connection-systems/catalog/item?language=en&id=13984323_en

With sample orders the female connectors including pins are included in delivery.

5.6 Power Connector Pinout

Pin Nr	Description	
1	PS_POW	Motor positive power supply
2	GND_POW	Motor negative power supply

6 SAFETY

6.1 Encoders for speed and steering supervision

There are two SSI encoder readings available on main connector. One from Steering and one from Traction unit. Primary goal of those signal is for safety. Both encoders are based on hall sensors readings.

The SSI signals available on main connector are tapping to existing SSI communication between encoders and motor controllers. ***The controller that reads SSI signal must be put into Slave Mode***

SSI Characteristics	
Resolution per rotation*	12bit (4096 positions)
Permissible clock Frequency	10MHz
Clock mode	Slave (Listen only). The clock is provided by onboard motor controller.
Input Threshold Voltage hi	2V
Input Threshold Voltage lo	0.8V
Mode	Standard SSI, no error-bit, Binary coded
ESD Susceptibility at All Pins	4kV

*If required resolution per rotation can be increased up to 19bits.

Steering position

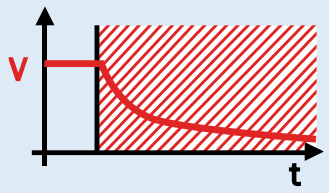
Encoder is mounted on output shaft of the unit so it is outputting absolute position of steering in range 0-360deg, with 0,088 degree resolution.

Traction position

Traction encoder is mounted on motor shaft. To read absolute position of wheel, the gear ratio of i=8,786 needs to be taken into consideration.

6.2 Safety torque off - STO

Safety functions of servo drives are according to IEC 61800-5-2.

	Safe Torque Off (STO) • Corresponds to stop category 0 in accordance with IEC 60204-1 • Uncontrolled stopping by means of immediate interruption of the supply of power to the actuators. • Safe restart interlock: Prevents unexpected starting of the motor

Both steering and traction unit are sharing same STO line. That means that in case STO is triggered both units will be deenergized.

7 REGULATORY

CE