



# LUGE - Steering Wheel System

Built in pre debugging parameters, plug and play cables and plugs, reliable and stable

**E-Motion AI Vehicle Division**

## LUGE:

The LUGE brand is a motion control product brand created by the AI Vehicle Division of E-Motion specifically for AGV/RGV/ROV/AMR vehicles, electric drive vehicles, and AI vehicles. Our products and customized services include: system scheduling management software, HMI and handheld terminals, joysticks, CAN-BUS controllers, CAN-BUS drivers, hub reduction motors, steering wheels, walking wheels, steering motors, traction motors, lifting and flipping motors, reducers, encoders, positioning and navigation systems, energy recovery devices, circuit protectors, brakes, clutches, safety detectors, as well as anti-static, shielding, and grounding drag chains.

The key components of the LUGE steering wheel system, including the wheel system, motor, reducer, driver, encoder, and shunt regulator, are all provided by well-known domestic and foreign manufacturers on the e-motionsupply e-commerce platform. Based on the specific application of the customer, the system configuration, parameter optimization, debugging, and aging of each drive were completed before leaving the factory, ensuring that the entire system can cope with most road conditions without debugging, eliminating the uncertainty brought by on-site debugging. Professional wiring solutions and the use of specialized cables greatly reduce the safety and reliability issues of the overall vehicle caused by electromagnetic compatibility. The smoothness and stability indicators of the LUGE steering wheel system are not only suitable for AGV, RGV, and ROV applications, but also meet the precise smoothness requirements of AMR equipment production.

Integrated solution for heavy-duty AGV motion control system. Used for multi steering or multi drive wheel traction, steering, jacking, and flipping control.

I/O expansion board MACCIO01  
 8AI, 16bits  
 8DI, 16bits  
 16 optically coupled digital inputs  
 16 optically coupled digital outputs  
 2x4 isolated high-speed RS422 differential outputs  
 4 isolated high-speed RS422 differential inputs  
 4 encoder inputs



Handheld AGV terminal  
 Built in Linux or Windows operating system, ARM A9, LCD touch screen, 3 emergency stop switches, 1 enable switch, 12 manual switches, 3 function display LEDs, 3 status display LEDs, 4 direction keys, and 3 function keys.

Controller MACC-02  
 As an independent controller, MACC02 can replace the PC in the control system to reduce costs, or can be configured to work with the PC, where MACC02 handles real-time and time critical processes such as motion control, and the PC handles less time critical processes such as HMI  
 ARM Cortex-A9 microprocessor; Micro SD card memory; Real time Linux; Fieldbus I/O connection; Multi axis motion control 1-96 axes; CANopen, EtherCAT, POWERLINK, or Modbus TCP main function



Walking servo driver

Steering servo driver





## Contents

<b>LUGE</b>	<b>01</b>
<b>Steering wheel system</b>	<b>03</b>
<b>Description of ordering number for steering wheel system</b>	<b>05</b>
<b>MR150LRS</b>	<b>06</b>
<b>MR220LRS</b>	<b>07</b>
<b>MR250LRS</b>	<b>08</b>
<b>MR270LRS</b>	<b>09</b>
<b>MR320LRS</b>	<b>10</b>
<b>MR350LRS</b>	<b>11</b>
<b>MR406LRS</b>	<b>12</b>
<b>MR600LRS</b>	<b>13</b>
<b>WR230LMS</b>	<b>14</b>
<b>WR260LMS</b>	<b>15</b>
<b>WR350LMS</b>	<b>16</b>
<b>WR406LMS</b>	<b>17</b>
<b>Motor selection calculation</b>	<b>18</b>
<b>Customized steering wheel system</b>	<b>19</b>

The LUGE steering wheel system is the most important core hardware subsystem of automatic vehicles, which together with the dispatch management system, computer control system, navigation system, power supply system, functional (such as lifting, flipping, etc.) system, and vehicle body system constitute the seven major subsystems of AGV.

### LUGE steering wheel system configuration:

1. Drive wheels, reducer, electromagnetic brake (including manual release), permanent magnet synchronous motor, 5VDC incremental encoder;
2. Steering gear, drive gear, speed measuring gear, reducer, DC brush motor, left and right limit switches and mechanical limit switches, 5VDC incremental encoder with anti impact vibration or optional multi turn absolute encoder;
3. Drive controller: Maximum rated current 175A, maximum peak current 350A. Analog or CANopen digital;
4. LUGE-SR series shunt voltage regulator: When the energy returned by the actuator during deceleration in the servo system causes the bus voltage to rise to the clamp voltage set by the shunt voltage regulator, the shunt voltage regulator starts working to ensure that the bus voltage does not overvoltage. The shunt circuit can withstand a peak current of 160A;
5. Steering wheel system operation software and secondary development library: DriveWare is a powerful software for communication, configuration, debugging, monitoring, and control of steering wheel systems. The built-in motion control function can achieve trajectory planning and motion optimization of the wheel system, and reduce the burden on the upper controller. DriveLibrary is an advanced API interface that defines a collection of control functions to support developers of motion control solutions;
6. Preset parameter document: The system configuration, parameter optimization, debugging, and aging of each drive are completed before leaving the factory, ensuring that the entire system can cope with most road conditions without debugging, eliminating the uncertainty brought by on-site debugging. The preset parameters have been stored on the corresponding drive and will be sent to customers and our after-sales service team via email.

### Optional configurations:

- ★ E/M brake: Electromagnetic brakes are included in the product catalog and can be provided upon request. We can also provide brakes with IP65 casing;
  - ★ Thermal protection: We can provide Thermal protection switches or thermal sensors;
  - ★ Brush detection tool: used to detect the wear of brushes.
  - ★ Motor cooling: For cost sensitive industries, we choose induction motors as traction and steering motors. If the work is intensive, forced ventilation may be required, such as installing fans or water cooling systems, which is common on vertical steering wheels;
  - ★ Limit switch: Electric and mechanical limit switches can be installed on the steering wheel, and the system software can set soft limits;
  - ★ Encoder: Incremental encoder or absolute value encoder, single or multiple turns, directly installed on the motor shaft or the steering shaft installed on the steering wheel;
  - ★ Potentiometer: Multiple turns, usually 10k Ohm-10 turns, directly installed on the steering wheel.
  - ★ Speed measuring machine: usually 10v/1000rpm, directly installed on the motor shaft (traction and steering);
  - ★ According to the requirements, we can install motors with different performance based on power, voltage, and speed;
  - ★ The cable is customized and processed according to the on-site wiring design, and the length is determined according to the on-site wiring design;
- Anti static grounding chain: releases static charges to prevent static damage.
- ★ For customized requests, please fill out the "Drivewheels request form " and provide as much detail as possible: we will be able to choose the best solution among different choices;



### Advantages of LUGE rudder system:

★ Using permanent magnet synchronous motor as the driving traction motor instead of induction asynchronous motor. Despite the increase in cost, it brings permanent energy savings to AGVs and improves battery life. Not only that, permanent magnet synchronous motors combined with AMC or LUGE servo drives will achieve better rigidity, which means that position error and tracking error are small. This is reflected in the AGV system, which is easy to debug, has smooth acceleration, deceleration, and walking, and does not cause nodding or creep. The positioning accuracy can meet the assembly process requirements of the factory production line. When on a slope, the vehicle can park on the slope using its electrical characteristics without the need for brakes. For more advantages, please browse the relevant training materials on [www.e-motionsupply.cn](http://www.e-motionsupply.cn).

★ Using a DC brushless motor as the steering motor, the characteristics of good linearity and rigidity of the DC brushless motor are utilized to avoid slow response, creep, and left and right sway during steering. These behaviors may cause disturbances to the smoothness, control accuracy, and efficiency of the system.

★ Adopting the most influential servo drives (AMC) or (LUGE) in the global AGV industry. Its unique design for large inertial loads ensures that the LUGE steering wheel system assembly achieves the goals of power-saving, accuracy, and reliability.

★ Vehicles often require braking during operation. When braking, the motor's back electromotive force increases when facing inertia torque, and current accumulation may damage electrical equipment. In addition, when the key is turned on to enable the motor, the instantaneous current surge can also destroy electrical equipment. The LUGE-EPSPB series is designed specifically for the accumulation of braking current and energizing surges in electrically driven vehicles, protecting the circuit and absorbing and releasing energy.

★ The configuration, parameter optimization, debugging, and aging of each drive system are completed before leaving the factory, ensuring that the entire system can cope with most road conditions without debugging, eliminating the uncertainty brought by on-site debugging





## Description of ordering number for LUGE steering wheel system :

MRxxxLRS-TE<sub>x</sub>-SE<sub>x</sub>-TD<sub>x</sub>-SD<sub>x</sub>-SR<sub>x</sub>-ST<sub>x</sub>-Pxxxxxxx

MR: horizontal WR: vertical	TE <sub>x</sub> : Feedback encoder equipped for traction wheel motor	TD <sub>x</sub> : traction motor with servo driver SD <sub>x</sub> : Steering motor with servo driver	SR <sub>x</sub> : shunt voltage regulator SR0 : no shunt voltage regulator SR1 : LUGE-SR060/080 SR2 : LUGE-SR060/200
xxx Traction wheel diameter (mm)	TE1: 2500 line incremental encoder TE2: 1024 line incremental encoder	TD1: DVC-250A060, 150/250A, 20-54VDC TD2: DVC-200A100, 125/200A, 20-80VDC TD3: LUGE-350, 175/350A, 24/48VDC SD1: DPCANTE-20B080 , 10/20A20-80VDC Single axis modular servo driver	ST <sub>x</sub> : Pre debugging or not ST0 : No need for pre debugging ST1 : Pre debug the system and provide parameter files
MR150LRS MR220LRS MR250LRS MR270LRS MR320LRS MR350LRS MR406LRS MR600LRS WR230LMS WR260LMS WR350LMS WR406LMS	SE <sub>x</sub> : Feedback encoder equipped for steering motor SE1: 2500 line incremental encoder SE2: 1024 line incremental encoder SE3: EnDat2.1 Absolute value feedback encoder SE4: Hiperface absolute value feedback encoder	SD2: DPCANTE-40B080 , 20/40A, 20-80VDC , Single axis modular servo driver SD3: DPCANTE-60B080 , 30/60A, 20-80VDC Single axis modular servo driver SD4: CZCANTE-020B080, 12/20A, 10-80VDC Single axis modular servo driver SD5: CZCANTE-040B080, 20/40A, 10-80VDC Single axis modular servo driver SD6: CZCANTE-060B080, 30/60A, 10-80VDC Single axis modular servo driver	Pxxxxxxx - Project customization code, factory fills in the number  First and second place: Drive wheel reduction ratio  Third and fourth place: steering reduction ratio  Fifth digit: Drive wheel motor code  Sixth digit: Steering motor code Seventh place: Special agreement

Choose an absolute value feedback encoder (EnDat2.1 or Hiperface) as the feedback for the steering motor, equipped with the following servo drivers:

- SD7: DPCANTA-20B080, 10/20A, 20-80VDC  
Single axis modular servo driver
- SD8: DPCANTA-40B080, 20/40A, 20-80VDC  
Single axis modular servo driver
- SD9: DPCANTA-60B080, 30/60A, 20-80VDC  
Single axis modular servo driver

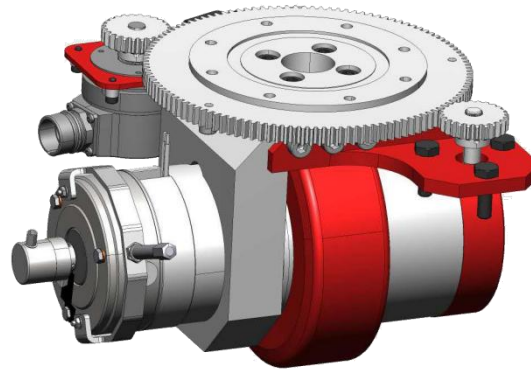
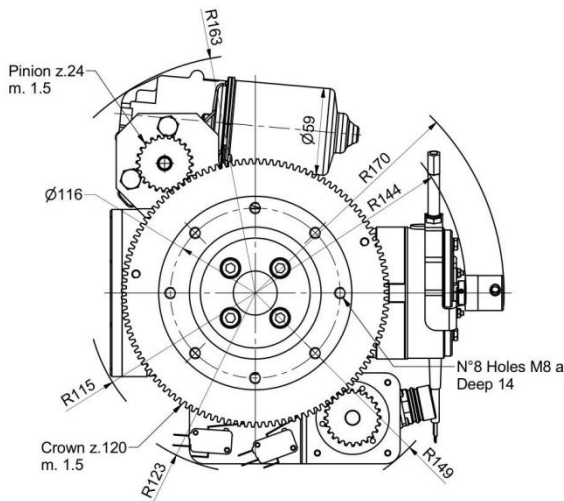
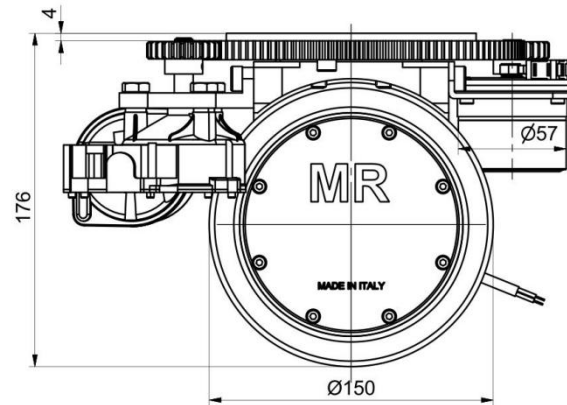
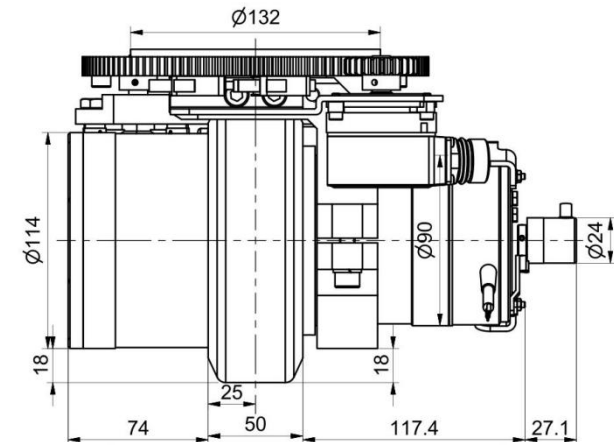
**Explanation:** The above is the selection code for servo drives that are compatible with CANopen. If you need other types of drives, please contact us

### Example: MR250LRS-TE1-SE1-TD1-SD1-SR1-ST1-P5634AAL

The diameter of the horizontal steering wheel is 250mm, the traction motor is equipped with a 2500 line incremental encoder, the steering motor is equipped with a 2500 line incremental encoder, the traction motor is equipped with a servo drive model: DVC250A060, the steering motor is equipped with a servo drive model: DPCANTE-20B080, the shunt regulator model: LUGE-SR060/080, the system has been pre debugged and parameter files have been provided. Other agreements include P5634AAL (see scheme drawings)

# LUGE Horizontal steering wheel system MR150LRS-TE1-SE1-TD3-SD3-SR1-ST1-Pxxxxxx

Maximum load-bearing capacity of 200Kg,  
with a height of 176mm above the ground



weight: 14kg

### Model Description:

MR150LRS-TE1-SE1-TDx-SDx-SR1-ST1-Pxxxxxx horizontal rudder wheel diameter 150mm, traction motor equipped with 1024 line incremental encoder, The steering motor is equipped with a 1024 line incremental encoder, the traction driver is equipped with TDx, the steering motor is equipped with SDx, and the shunt regulator model is LUGE-SR060/080. The system has been pre debugged and parameter files have been provided.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

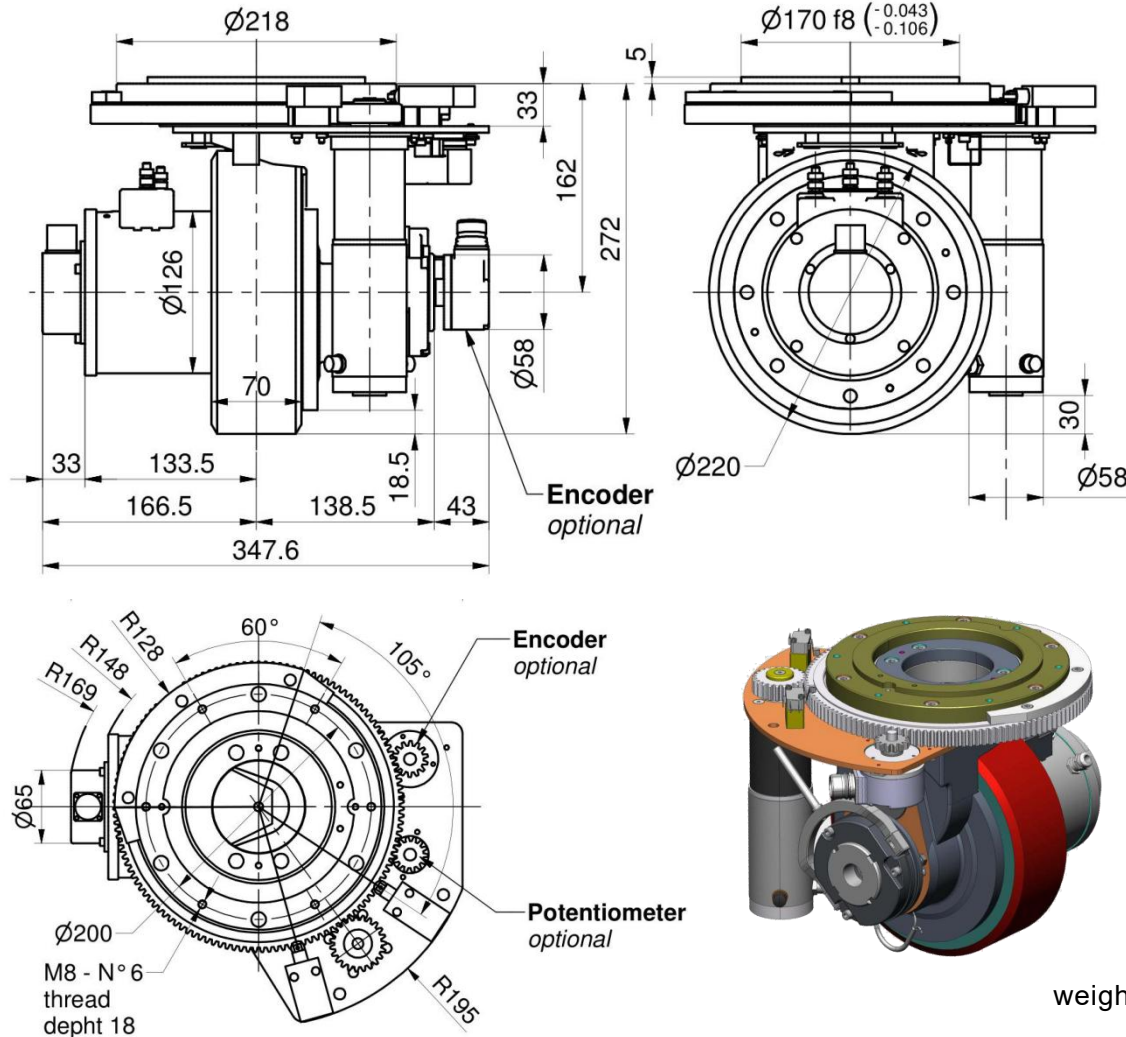
## MR150LRS-TE1-SE1-TD3-SD3-SR1-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	150
Supply Voltage	V	24
velocity	Rpm	2000
persistent current	A	8
Wheel torque	Nm	90
reduction ratio	i	1:10
IP GRADE	IP	55
Voltage during braking	V	24
Torque during braking	Nm	5
Encoder resolution	Ppr	1024
Maximum wheel load (polyurethane, ester)	Kg	200

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	54
Supply Voltage	V	24
velocity	Rpm	3600
persistent current	A	2.3
Reduction ratio/gear ratio	i	1:69/1:345
IP GRADE	IP	20
Encoder resolution	Ppr	1024

LUGE Horizontal steering wheel system  
MR220LRS-TE1-SE1-TD1-SD1-SR1-ST1-Pxxxxxx

Maximum load-bearing capacity of 600Kg,  
with a height of 272mm above the ground



weight: 42kg

**Model Description:**

MR220LRS-TE1-SE1-TD1-SD1-SR1-ST1-Pxxxxxx horizontal rudder wheel diameter 220mm, traction motor equipped with 2500 line incremental encoder, The steering motor is equipped with a 2500 line incremental encoder, the traction driver is equipped with DVC250A060, the steering motor is equipped with DPCANTE-020B080, and the shunt regulator model is LUGE-SR060/080. The system is pre debugged and parameter files are provided.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

MR220LRS-TE1-SE1-TD1-SD1-SR1-ST1-Pxxxxxx

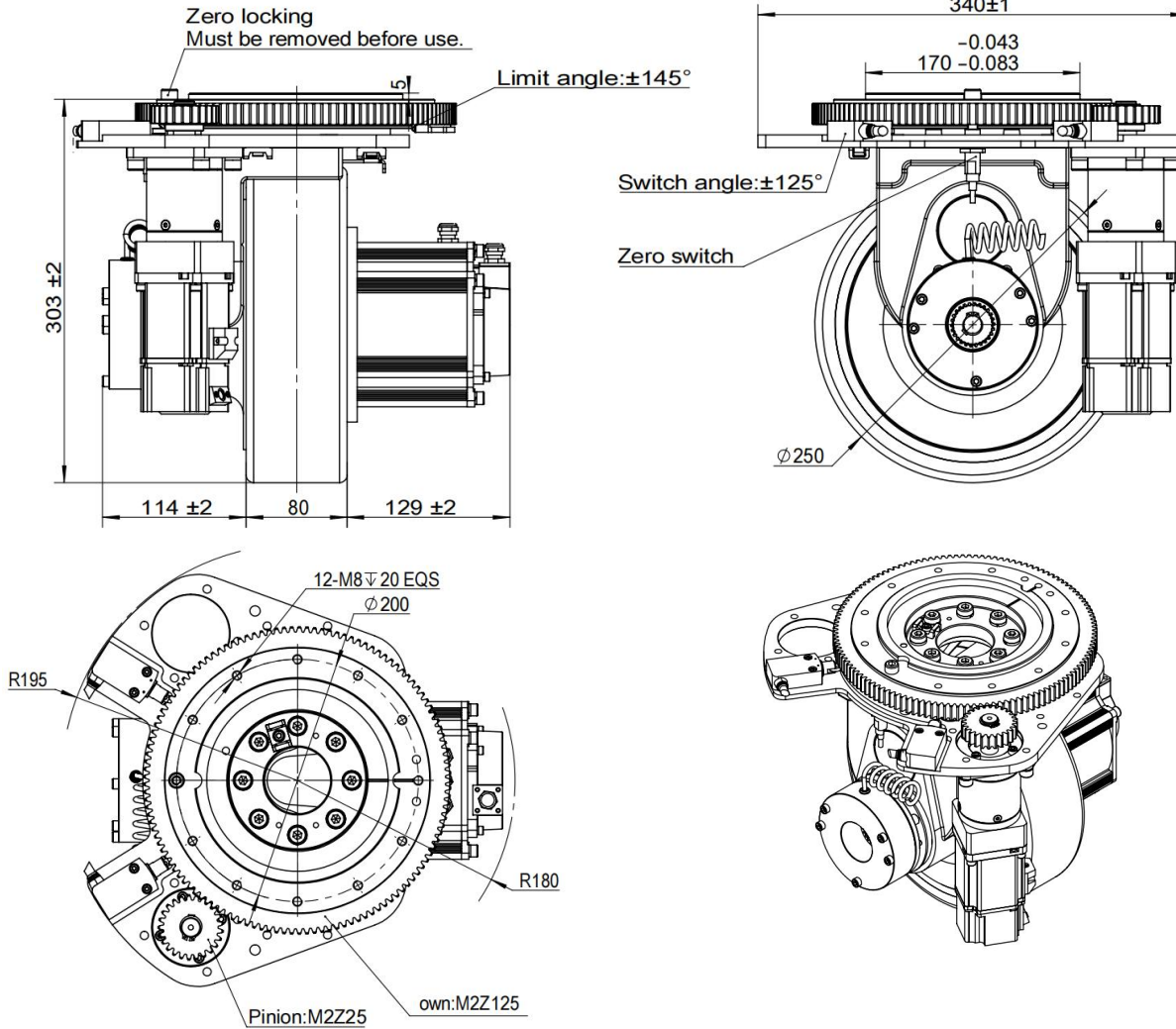
Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	1200
Supply Voltage	V	24
velocity	Rpm	3000
persistent current	A	62
Wheel torque	Nm	103
reduction ratio	i	1:27
IP GRADE	IP	54
Voltage during braking	V	24
Torque during braking	Nm	10
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	600

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	85
Supply Voltage	V	24
velocity	Rpm	4000
persistent current	A	5.3
Reduction ratio/gear ratio	i	1:80/1:552
IP GRADE	IP	44
Encoder resolution	Ppr	2500



# LUGE Horizontal steering wheel system MR250LRS-TE1-SE1-TD1-SD1-SR1-Pxxxxxx

Maximum load-bearing capacity of 1200Kg,  
with a height of 303mm above the ground



## MR250LRS-TE1-SE1-TD1-SD1-SR1-Pxxxxxx

Traction motor parameters		
Motor type: servo motor		
power ( S2-60` )	W	1570
Supply Voltage	V	48
velocity	Rpm	3000
persistent current	A	39
Wheel torque	Nm	144
reduction ratio	i	1:32
IP GRADE	IP	65
Voltage during braking	V	24
Torque during braking	Nm	8
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	1200

Steering motor parameters		
Motor type: servo motor		
power ( S2-60` )	W	400
Supply Voltage	V	48
velocity	Rpm	3000
persistent current	A	10.2
Reduction ratio	i	1:40
IP GRADE	IP	65
Encoder resolution	Ppr	2500

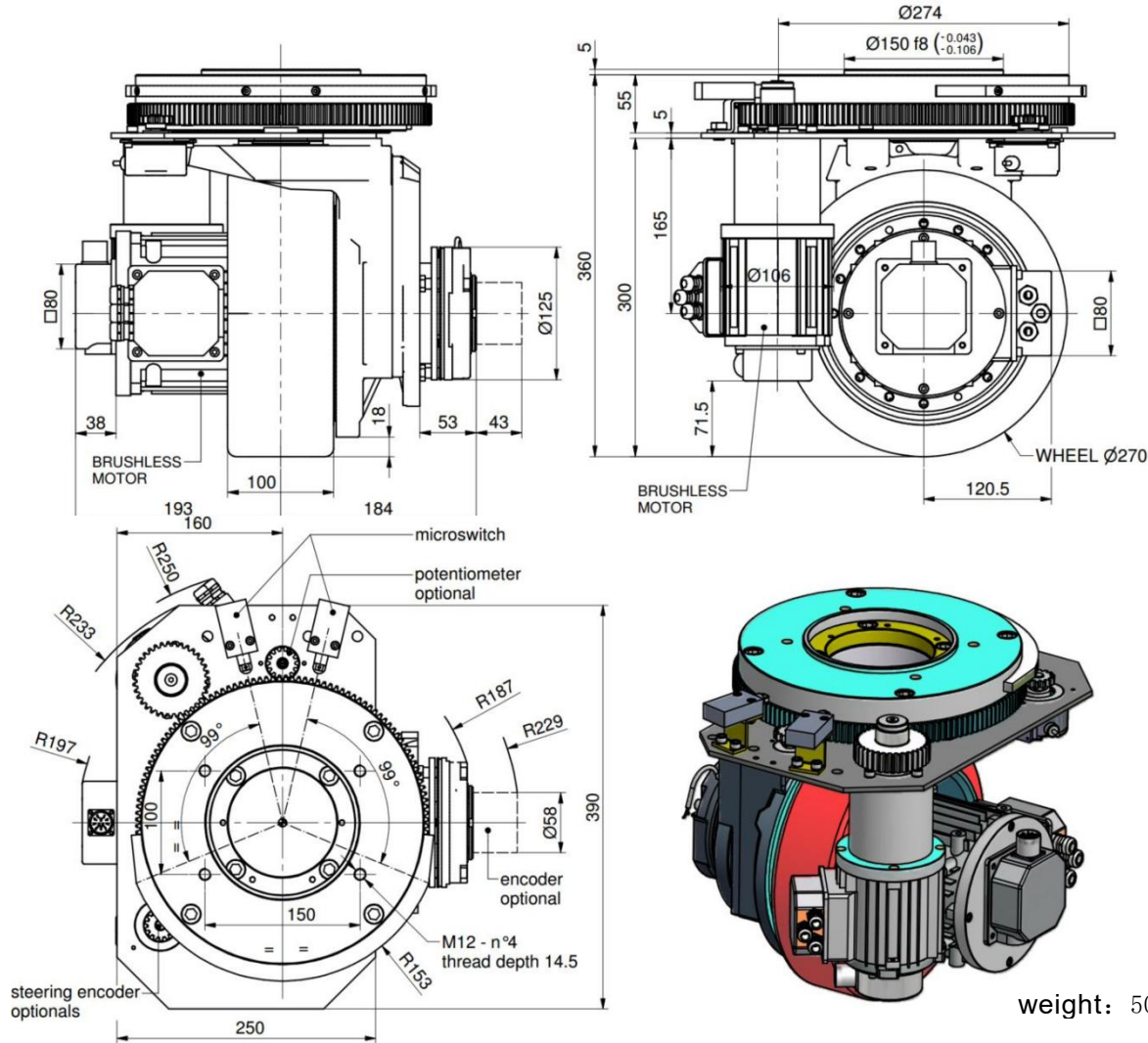
### Model Description:

MR250LRS-TE1-SE1-TD1-SD1-SR1-ST1-Pxxxxxx horizontal rudder wheel diameter 250mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-020B080, shunt voltage regulator model: LUGE-SR060/080, pre test the system and provide parameter files.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

# LUGE Horizontal steering wheel system MR270LRS-TE1-SE1-TD1-SD2-SR1-Pxxxxxx

Maximum load-bearing capacity of 1300Kg,  
with a height of 360mm above the ground



MR270LRS-TE1-SE1-TD1-SD2-SR1-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	1500
Supply Voltage	V	48
velocity	Rpm	3000
persistent current	A	32
Wheel torque	Nm	163
reduction ratio	i	1:34
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	20
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	1300

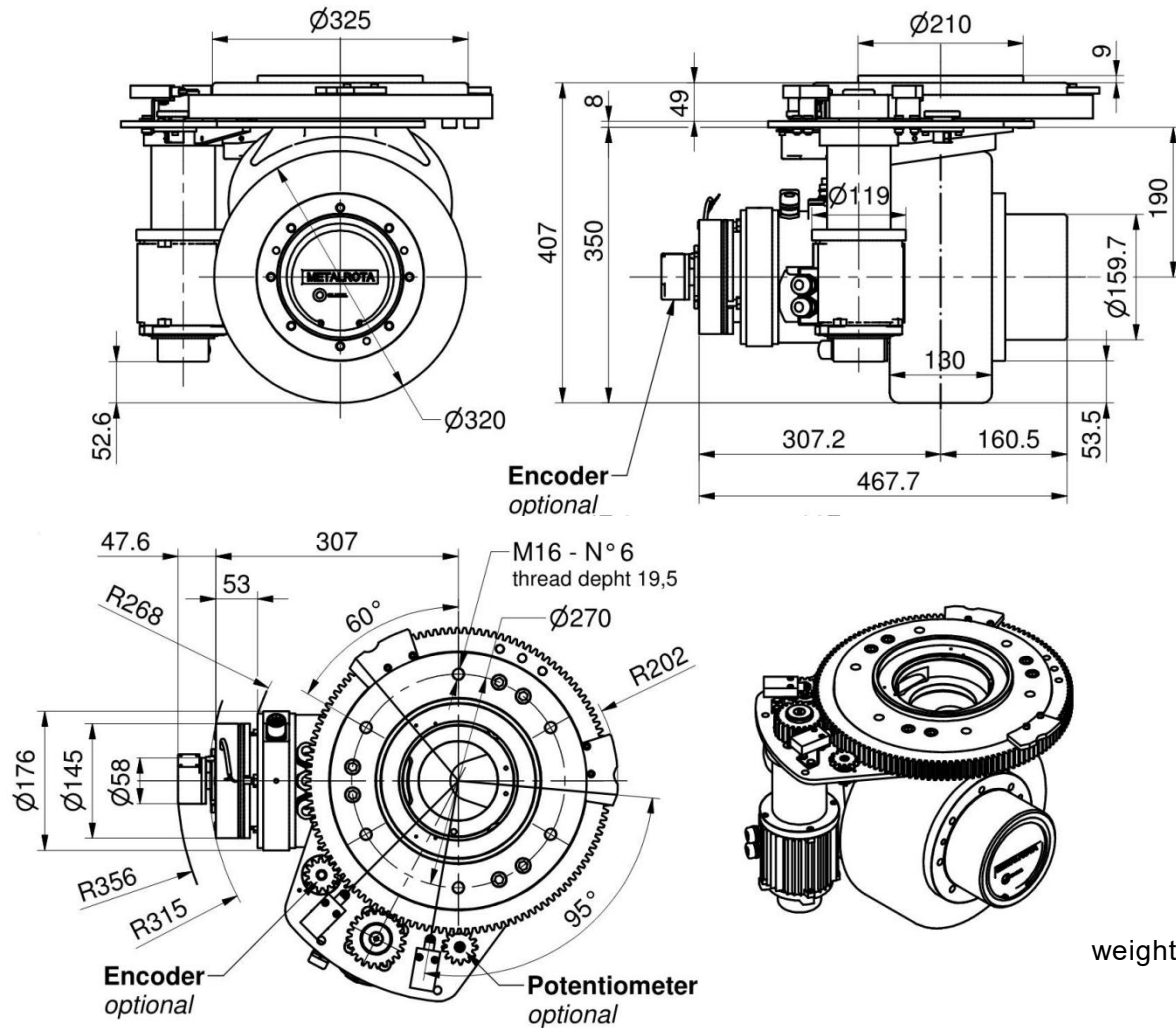
Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	500
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	12
Reduction ratio/gear ratio	i	1:46/1:184
IP GRADE	IP	20
Encoder resolution	Ppr	2500

**Model Description:**  
MR270LRS-TE1-SE1-TD1-SD2-SR1-ST1-Pxxxxxx horizontal rudder wheel diameter 270mm, traction motor equipped with 2500 line increments Encoder, steering motor with 2500 line incremental encoder, traction driver with DVC250A060, steering motor with DPCANTE-040B080, Shunt voltage regulator model:LUGE-SR060/080, pre debug the system and provide parameter files.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

LUGE Horizontal steering wheel system  
MR320LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 2000Kg,  
with a height of 407mm above the ground



weight: 150kg

Model Description:

MR320LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx horizontal steering wheel diameter 320mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-040B080, shunt voltage regulator model: LUGE-SR060/200, pre commissioning system. and providing parameter files.

MR320LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx

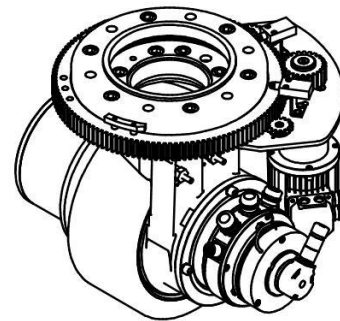
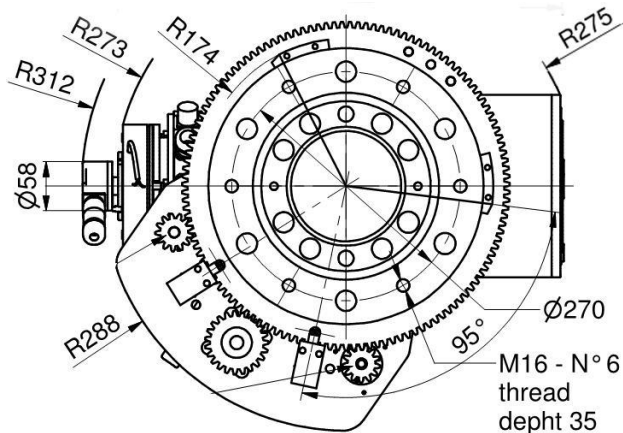
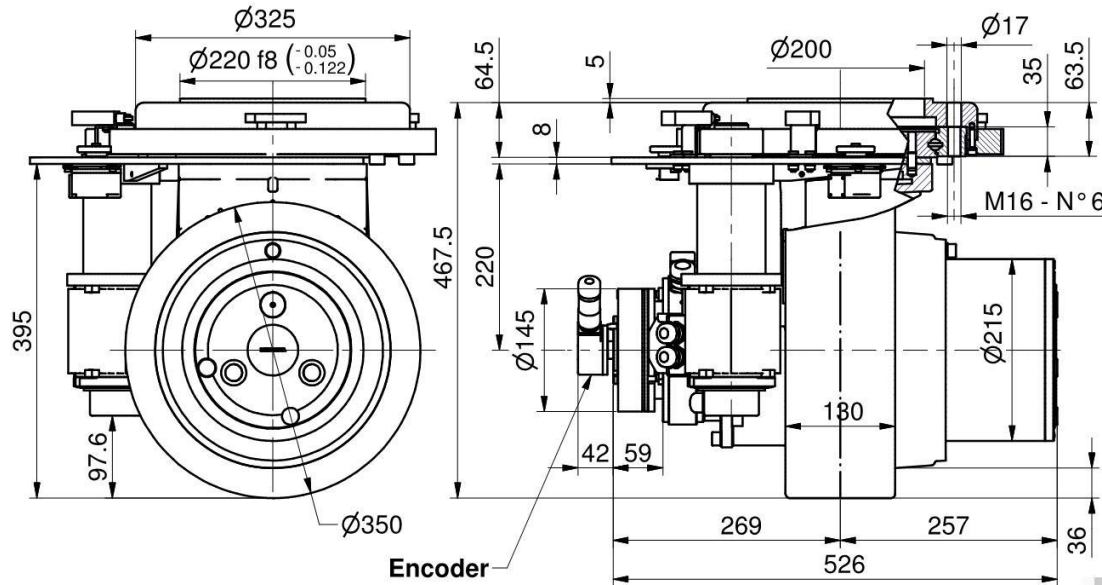
Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	3000W
Supply Voltage	V	48
velocity	Rpm	2000
persistent current	A	80
Wheel torque	Nm	430
reduction ratio	i	1:30
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	40
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	2000

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	500
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	12
Reduction ratio/gear ratio	i	1:51/1:282
IP GRADE	IP	20
Encoder resolution	Ppr	2500

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

LUGE Horizontal steering wheel system  
MR350LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 2600Kg,  
with a height of 467.5mm above the ground



weight: 169kg

**Model Description:**

MR350LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx horizontal rudder wheel diameter 350mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-040B080, shunt voltage regulator model: LUGE-SR060/200, pre commissioning system, and providing parameter files.

MR350LRS-TE1-SE1-TD1-SD2-SR2-ST1-Pxxxxxx

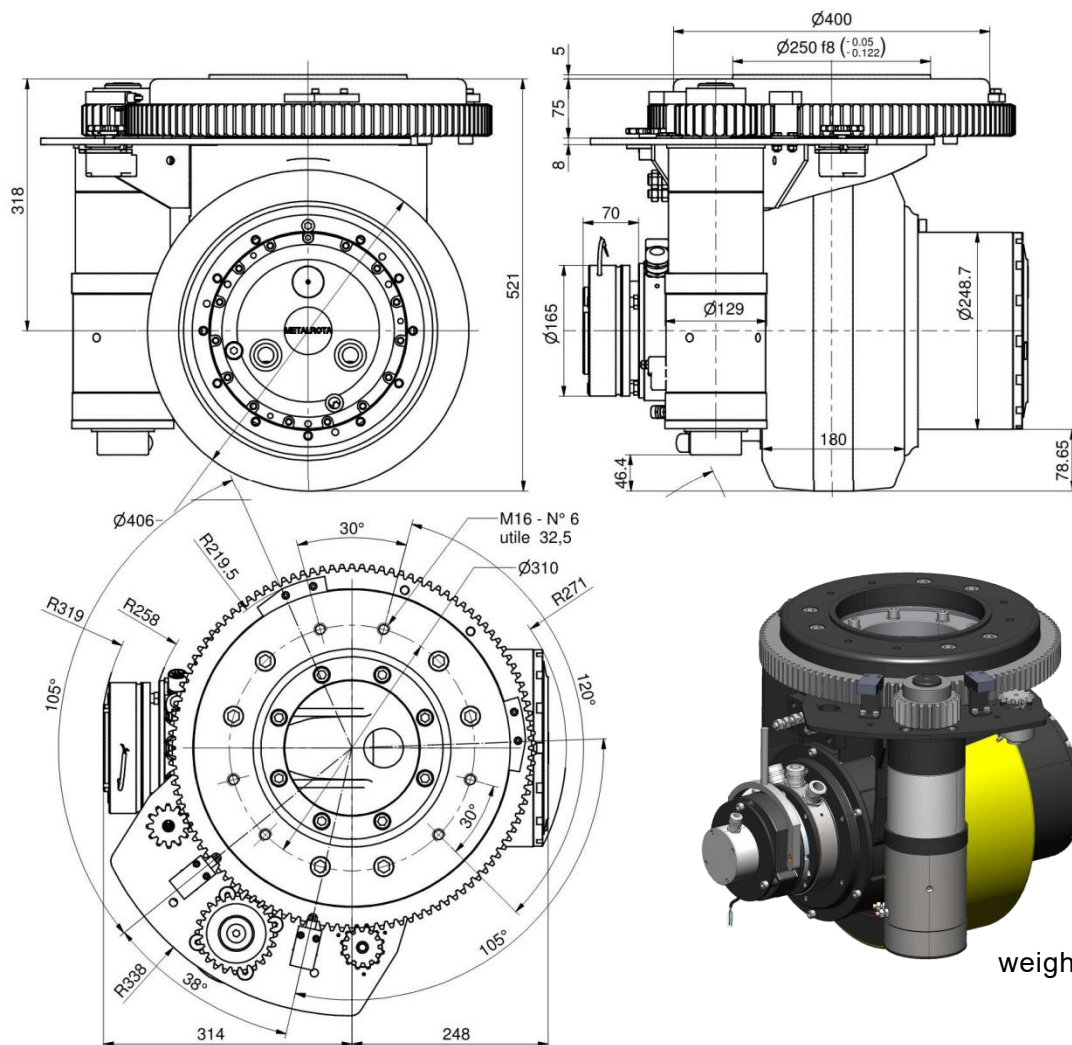
Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	3500W
Supply Voltage	V	48
velocity	Rpm	2000
persistent current	A	90
Wheel torque	Nm	501
reduction ratio	i	1:30
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	40
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	2600

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	500
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	12
Reduction ratio/gear ratio	i	1:51/1:552
IP GRADE	IP	20
Encoder resolution	Ppr	2500

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

LUGE Horizontal steering wheel system  
MR406LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 4000Kg,  
with a height of 521mm above the ground



**Model Description:**

MR406LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx horizontal rudder wheel diameter 406mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental code disk, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-060B080, shunt regulator model: LUGE-SR060/200, pre debugging system, and providing parameter files.

MR406LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

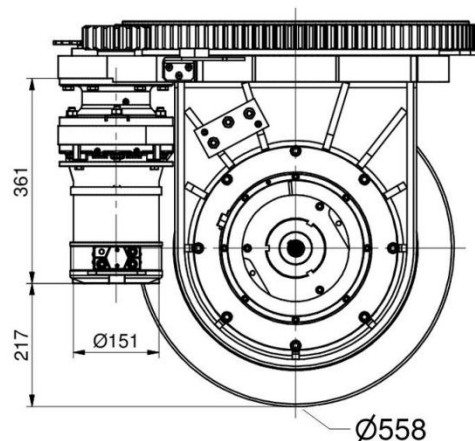
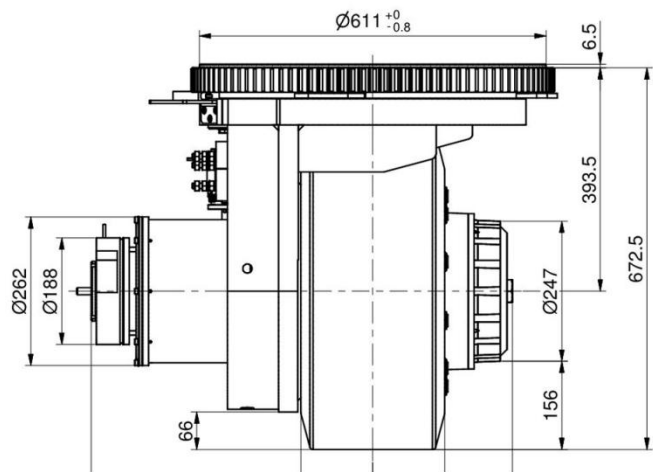
Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	5000W
Supply Voltage	V	48
velocity	Rpm	2000
persistent current	A	129
Wheel torque	Nm	873
reduction ratio	i	1:25.6
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	75
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	4000

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	800
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	19
Reduction ratio/gear ratio	i	1:51/1:475
IP GRADE	IP	20
Encoder resolution	Ppr	2500

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

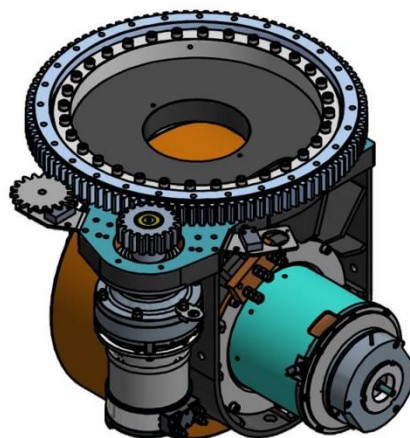
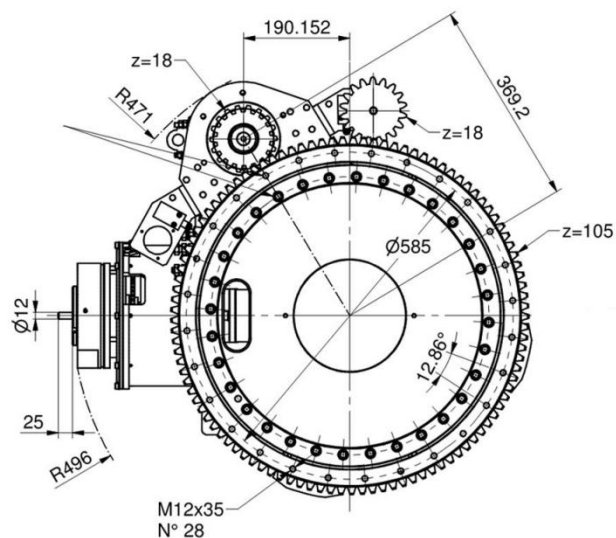
# LUGE Horizontal steering wheel system MR600LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 6000Kg,  
with a height of 672.5mm above the ground



## MR600LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Permanent magnet synchronous motor		
power (S2-60`)	W	5000W
Supply Voltage	V	48
velocity	Rpm	1800
persistent current	A	125
Wheel torque	Nm	5000
reduction ratio	i	1:54
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	100
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	6000



weight: 640kg

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60`)	W	1500
Supply Voltage	V	48
velocity	Rpm	2300
persistent current	A	50
Reduction ratio/gear ratio	i	1:87/1:583
IP GRADE	IP	20
Encoder resolution	Ppr	2500

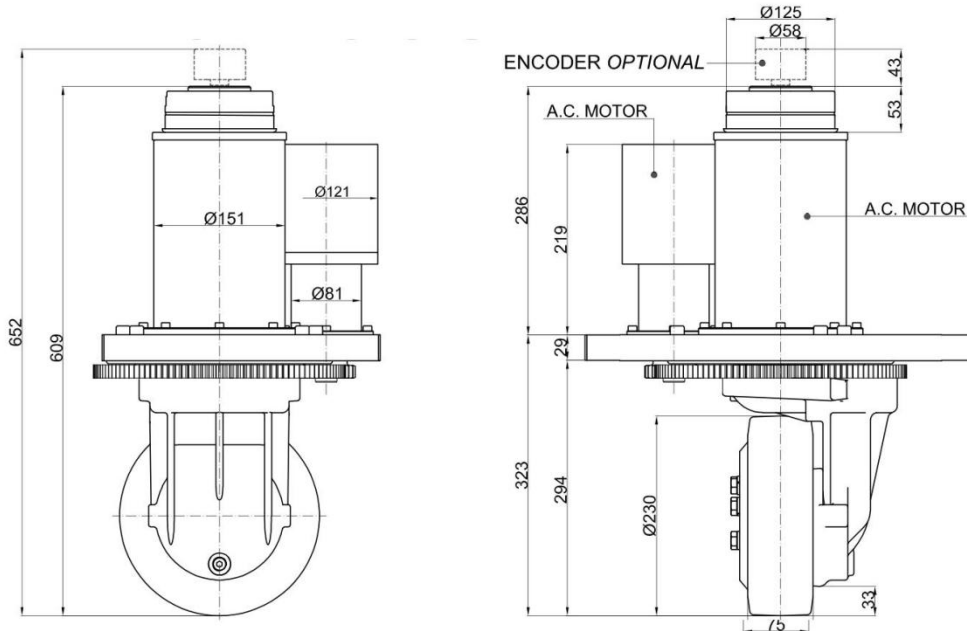
### Model Description:

MR600LRS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx horizontal steering wheel diameter 600mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-060B080, shunt voltage regulator model: LUGE-SR060/200, pre commissioning system, and providing parameter files.

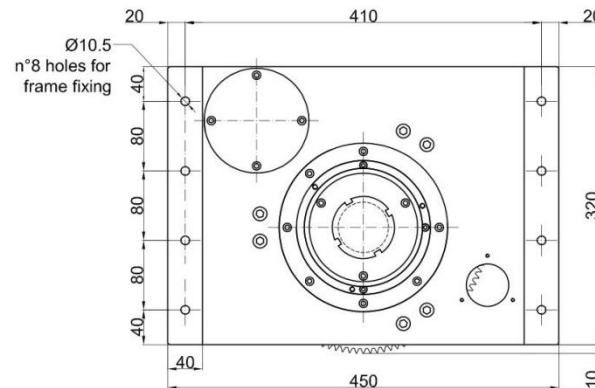
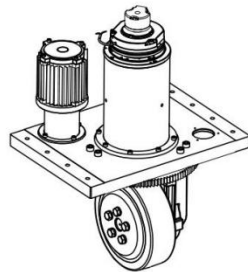
For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

LUGE Vertical steering wheel system  
 WR230LMS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 1000Kg,  
 with a height of 323mm above the ground



**WR151ECOFMS**



weight: 120kg

WR230LMS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Asynchronous induction motor		
power (S2-60')	W	1500
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	41
Wheel torque	Nm	400
reduction ratio	i	1:20
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	20
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	1000

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60')	W	80
Supply Voltage	V	48
velocity	Rpm	4000
persistent current	A	5.3
Reduction ratio/gear ratio	Nm	
IP GRADE	i	216
Encoder resolution	IP	20
power (S2-60')	Ppr	2500

**Model Description:**

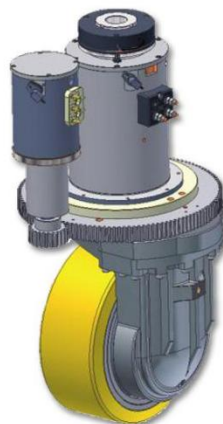
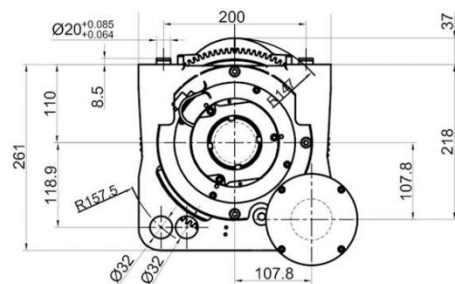
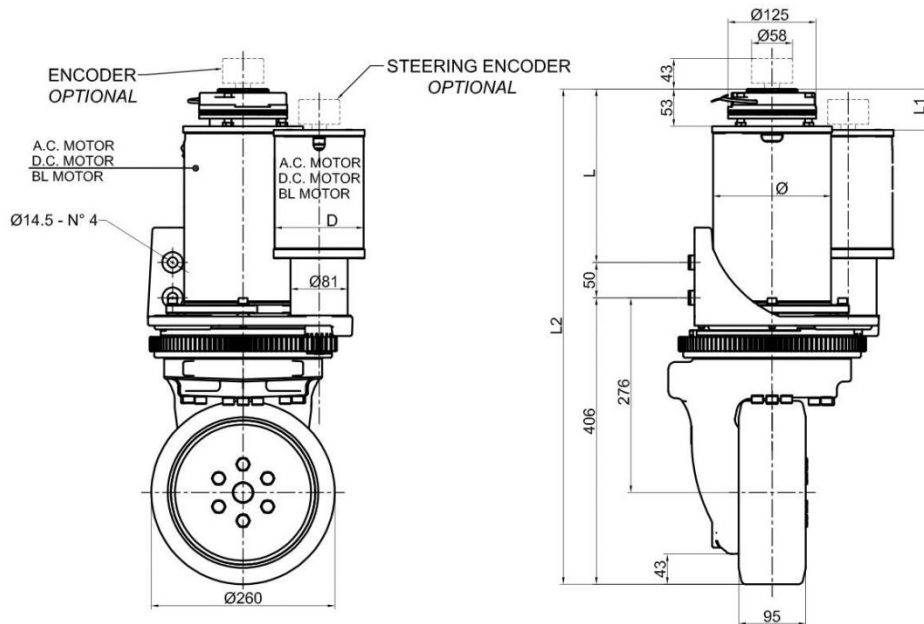
WR230LMS-TE1-SE1-TD1-SD3-SR2-ST1-Pxxxxxx vertical rudder wheel diameter 230mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-020B080, shunt voltage regulator model: LUGE-SR060/200, pre test the system and provide parameter files.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

# LUGE Vertical steering wheel system

## WR260LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 1800Kg,  
with a height of 406mm above the ground



weight: 110kg

WR260LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Traction motor parameters		
Motor type: DC brushless motor		
power (S2-60')	W	3000
Supply Voltage	V	48
velocity	Rpm	1800
persistent current	A	110
Wheel torque	Nm	500
reduction ratio	i	1:18
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	20
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	1800

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60')	W	700
Supply Voltage	V	48
velocity	Rpm	3000
persistent current	A	15
Reduction ratio/gear ratio	i	1:46
IP GRADE	IP	20
Encoder resolution	Ppr	2500

### Model Description:

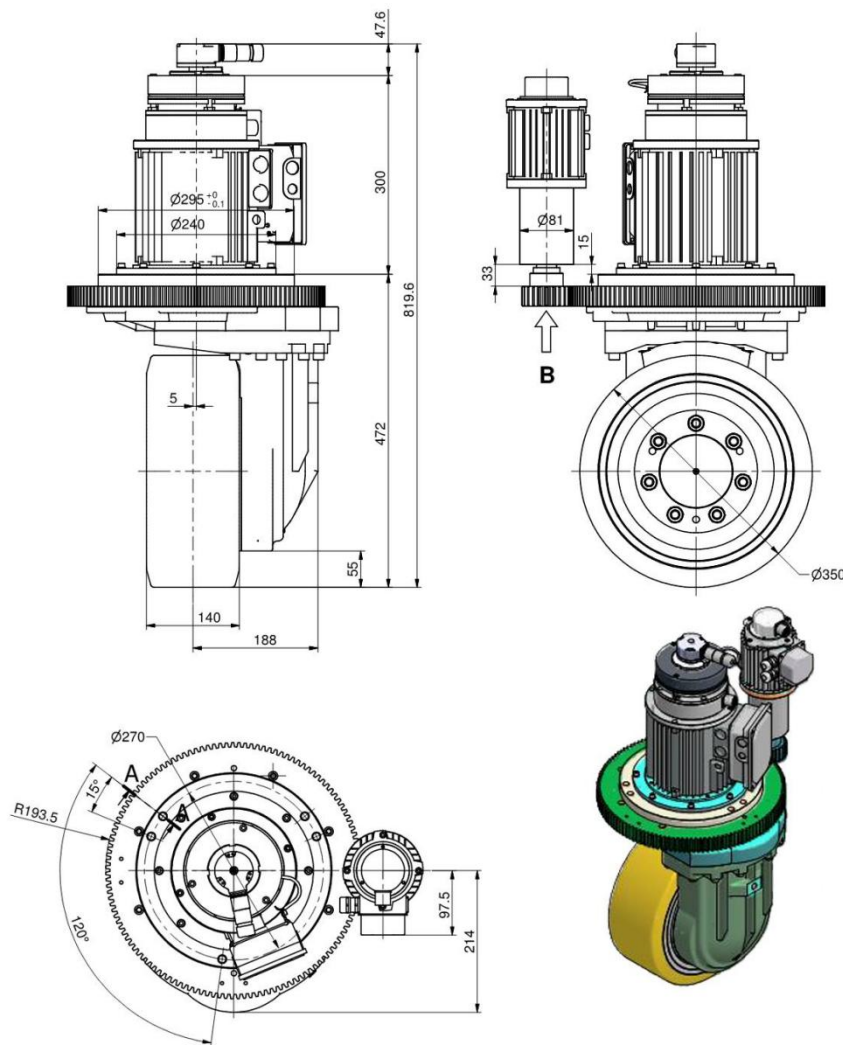
WR260LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx vertical rudder wheel diameter 260mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver DVC250A060, steering motor equipped with DPCANTE-040B080, shunt voltage regulator model: LUGE-SR060/200, pre debugging system, and providing parameter files.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.



LUGE Vertical steering wheel system  
WR350LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 3000Kg,  
with a height of 472mm above the ground



weight: 240kg

WR350LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Asynchronous induction motor		
power (S2-60')	W	3500
Supply Voltage	V	48
velocity	Rpm	3000
persistent current	A	90
Wheel torque	Nm	279
reduction ratio	i	1:25
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	40
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	3000

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60')	W	500
Supply Voltage	V	48
velocity	Rpm	2800
persistent current	A	12
Reduction ratio/gear ratio	i	1:51
IP GRADE	IP	20
Encoder resolution	Ppr	2500

Model Description:

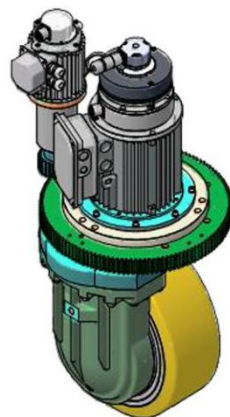
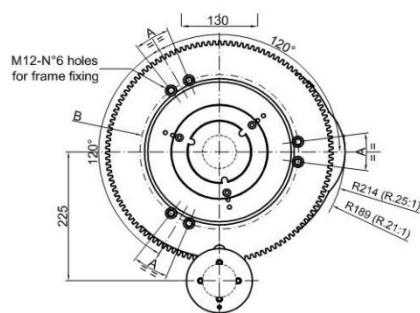
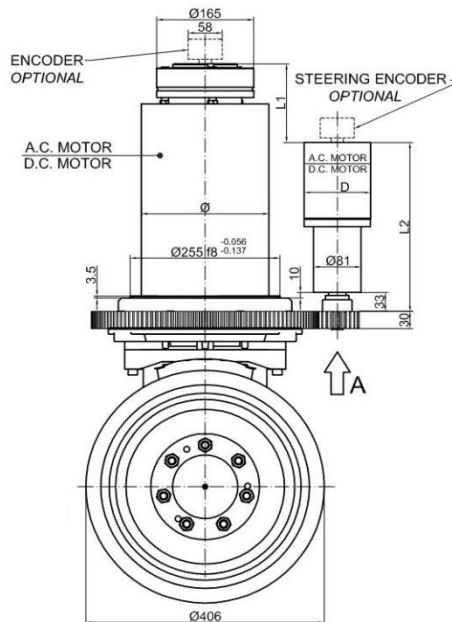
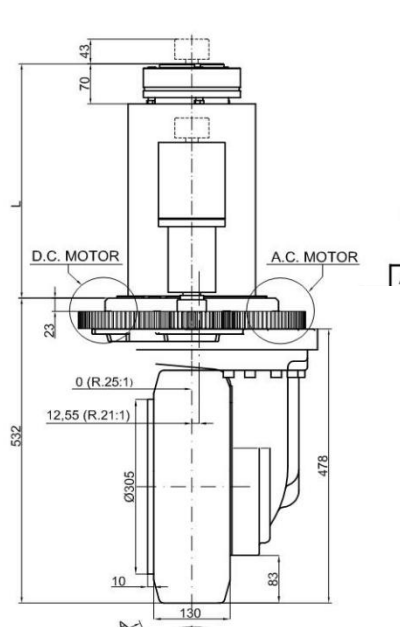
WR350LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx vertical rudder wheel diameter 350mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-040B080, shunt voltage regulator model: LUGE-SR060/200, pre test the system and provide parameter files.

For other configuration options, please select or contact our local engineer based on the steering wheel order number on page 5.

# LUGE Vertical steering wheel system

## WR406LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Maximum load-bearing capacity of 3100Kg,  
with a height of 532mm above the ground



weight: 255kg

WR406LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx

Traction motor parameters		
Motor type: Asynchronous induction motor		
power (S2-60')	W	5000
Supply Voltage	V	48
velocity	Rpm	1800
persistent current	A	125
Wheel torque	Nm	2500
reduction ratio	i	1:25
IP GRADE	IP	55
Voltage during braking	V	48
Torque during braking	Nm	75
Encoder resolution	Ppr	2500
Maximum wheel load (polyurethane, ester)	Kg	3100

Steering motor parameters		
Motor type: DC brushless motor		
power (S2-60')	W	700
Supply Voltage	V	48
velocity	Rpm	2300
persistent current	A	15
Reduction ratio/gear ratio	i	1:51
IP GRADE	IP	20
Encoder resolution	Ppr	2500

### Model Description:

WR406LMS-TE1-SE1-TD1-SD4-SR2-ST1-Pxxxxxx vertical rudder wheel diameter 406mm, traction motor equipped with 2500 line incremental encoder, steering motor equipped with 2500 line incremental encoder, traction driver equipped with DVC250A060, steering motor equipped with DPCANTE-040B080, shunt regulator model: LUGE-SR060/200, pre commissioning system, and providing parameter files.

For other configuration options. please select or contact our local engineer based on the steering wheel

The two most important parameters to calculate for motor selection are: Static torque and dynamic torque

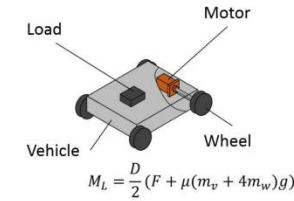


On the homepage of the E-Motion e-commerce platform ([www.e-motionsupply.com](http://www.e-motionsupply.com)), there is a Solution Design Support page. Upon entering, you will see What (basic concepts) and How (how to select and calculate formulas, parameter tables). You can also enter the Motor Sizing Tool online of the Tool, select the AGV model, and calculate the static and dynamic torque separately. Online calculation is a free service. Additionally, for customers who require long-term calculations, they can download the Rotary Motor Calculator for calculation

## AGV vehicle calculation formula and parameter explanation

<b>Four-Wheel Vehicle</b>	<p><math>F</math>: Force (N)  <math>m_2</math>: Mass of Load on Wheel (kg)  <math>J_V</math>: Vehicle Inertia (kg·m<sup>2</sup>)  <math>v</math>: Velocity (m/s)</p>	<p><math>D</math>: Wheel Diameter (m)  <math>m_1</math>: Mass of Wheel (kg)  <math>J_W</math>: Four wheels Inertia (kg·m<sup>2</sup>)  <math>J_L</math>: Motor Shaft Conversion Load Inertia (kg·m<sup>2</sup>)  <math>J_M</math>: Motor Inertia (kg·m<sup>2</sup>)</p>	<p>Speed of Rotation</p> $n = \frac{60}{\pi D} \cdot v$
		<p><math>n</math>: Rotation Speed (rpm)  <math>t_1</math>: Acceleration/Deceleration Time (s)</p>	<p>Inertia</p> $J_W = \frac{1}{8} \cdot m_1 \cdot D^2 \cdot 4$ $J_V = m_2 \cdot \left(\frac{D}{2}\right)^2$ $J_L = J_W + J_V$
	<p><math>M</math>: Torque (N·m)  <math>M_A</math>: Additional Acceleration Torque (N·m)  <math>\eta</math>: Efficiency</p>	<p>Torque</p> $M = F \cdot \frac{D}{2\eta}$ $M_A = \frac{2\pi n}{60t_1} \cdot \left(\frac{J_L}{\eta} + J_M\right)$	

## AGV - Automatic Guided Vehicle (Four Wheels) Calculation



### Input

g:	Gravity Acceleration	9.8	m/s <sup>2</sup>
F:	External Force (positive when against operation direction)	<input type="text"/>	N
m <sub>v</sub> :	Vehicle Mass (Loads Included)	<input type="text"/>	kg
m <sub>w</sub> :	Wheel Mass (Single)	<input type="text"/>	kg
μ:	Rolling Friction Coefficient	<input type="text"/>	<a href="#">Reference Table</a>
D:	Wheel Diameter	<input type="text"/>	m

Calculate

### Output

M <sub>L</sub> :	Static Load Torque	<input type="text"/>	Nm
------------------	--------------------	----------------------	----

Clear All

For dynamic calculation please use [Advanced Calculation](#)  
[View motor selection steps](#)

### Output

M <sub>L</sub> :	Static Load Torque	<input type="text"/>	Nm
------------------	--------------------	----------------------	----

Clear All

For dynamic calculation please use [Advanced Calculation](#)  
[View motor selection steps](#)

You can click on Advanced Calculation to calculate dynamic parameters online, or click on View motor selection steps to select different motors.

Rolling Friction Coefficient	
Material	
Car tires on concrete, new asphalt	0.01-0.015
Car tires on tar or asphalt	0.02-0.035
Car tires on cobbles (new - worn)	0.01-0.03
Car tires on gravel (new - worn)	0.02-0.08
Car tires on solid sand	0.04-0.08
Car tires on loose sand	0.2-0.4

If the existing parameters of the steering wheel system cannot meet the vehicle design requirements, please provide the following information to apply for a customized steering wheel system, and send this requirement table to the engineer of E-Motion AI Vehicle Business Unit or local

Company Name:					
Company address:					
Contact person:		telephone:		E-mail:	
Vehicle type:		Quantity per batch :		Annual production::	
Wheel diameter (mm):		Ground material:			
Direct Weight over the wheel (kg):		without load :		with load:	
Vehicle self weight (Kg):		Maximum load capacity (Kg):		Towing capacity (if any additional trolley behind) (kg)	
Maximum speed without load on flat ground (Km/h):		Maximum speed under full load on flat ground (Km/h):		Maximum no-load climbing slope (%):	
Maximum climbing slope under full load (%):		Maximum no-load climbing speed (Km/h):		Maximum climbing speed under full load (Km/h):	
Maximum acceleration (m/s <sup>2</sup> ):		Maximum deceleration (m/s <sup>2</sup> ):		Shift change (shift/day):	
Number of cycles (times/shift):		Each service time (minutes):		Each rest time (minutes):	
Drive wheel type: Horizontal <input type="checkbox"/> , Vertical <input type="checkbox"/>		Traction motor power (W):		Voltage (12, 24, 48, 72, 80, 96) : Other:	
Motor type: permanent magnet DC motor <input type="checkbox"/> , Permanent magnet synchronous motor <input type="checkbox"/> , ac induction motor <input type="checkbox"/> , Other:					
Speed Sensor:		temperature sensor:		IP degree:	
E/M brake: Yes <input type="checkbox"/> , No <input type="checkbox"/>		Preferred wheel material: Vulkollan <input type="checkbox"/> , Poliurethane <input type="checkbox"/> , Rubber <input type="checkbox"/> , Other:			
Incremental encoder parameters: voltage: 5V TTL <input type="checkbox"/> , 9-12VDC HTL <input type="checkbox"/>		Connector type: 8Pin M12 <input type="checkbox"/> , 12Pin EML <input type="checkbox"/> , cable <input type="checkbox"/>			
Absolute value encoder:		Tachometer:			
Steering motor power (W):		Steering Motor type: permanent magnet DC motor <input type="checkbox"/> , Permanent magnet synchronous motor <input type="checkbox"/> , ac induction motor <input type="checkbox"/>			
Incremental encoder parameters: voltage: 5V TTL <input type="checkbox"/>		9-12VDC HTL <input type="checkbox"/>			
Connector type: 8Pin M12 <input type="checkbox"/>		12Pin EML <input type="checkbox"/>		cable <input type="checkbox"/>	
Absolute value encoder:		Potentiometer:	Limit switch:	Mechanical limit:	
Communication method or command type between the Drive wheel system and the control system:					
Canopen <input type="checkbox"/> RS485 <input type="checkbox"/> Powerlink <input type="checkbox"/> Ethernet IP <input type="checkbox"/> CAN <input type="checkbox"/> EtherCat <input type="checkbox"/> Profinet <input type="checkbox"/>					
10V DC analog voltage <input type="checkbox"/> 5V DC analog voltage <input type="checkbox"/> PWM/direction <input type="checkbox"/> Pulse/direction <input type="checkbox"/>					
<b>Driver supply voltage:</b> 12 <input type="checkbox"/> , 24 <input type="checkbox"/> , 48 <input type="checkbox"/> , 72 <input type="checkbox"/> , 96 <input type="checkbox"/> , Other:					
Operating temperature of the driver:		IP degree of the drive:		Safety torque switch (STO) for the driver:	
Drive volume requirements:		Driver weight requirements:			
Does the circuit system require surge protection devices:		Yes <input type="checkbox"/>		No <input type="checkbox"/>	
Does the circuit system require regenerative circuits and brake resistors:		Yes <input type="checkbox"/>		No <input type="checkbox"/>	
Maximum surge current:		Maximum surge voltage:			
Maximum energy consumption during braking:		IP Grade of circuit protector:		Operating temperature of circuit protector:	
Does the Drive wheel system operate in special environments such as high temperature, low temperature, explosion-proof, vacuum, and humidity:					
Do you need matching cables and plugs, specific specifications and lengths:					
Do you need to provide software and preset parameter configuration files:					

E-Motion's AI Vehicle Division in China  
[www.E-MotionSupply.cn](http://www.E-MotionSupply.cn)  
[support@e-motionsupply.com](mailto:support@e-motionsupply.com)

Beijing  
Address: B1603, Huazun Building, No.49 North Third Ring Middle Road, Beijing  
Tel: 010-82025588 Fax: 010-82025558

Shanghai  
Address: Room B506, No. 628 Huaxu Road, Qingpu District, Shanghai  
Tel: 021-64757354

Xian  
Address: Room 2106, Building D, Changhe, No. 87 Mingguang Road, Weiyang District, Xi'an City  
Tel: 029-86262846

Shenzhen  
Address: 11F-G20, Block B, Aerospace Science and Technology Square, Nanshan District, Shenzhen  
Tel: 0755-21846838

Chengdu  
Address: 25th Floor, Office Building 1, IFS International Financial Center, Jinjiang District, Chengdu City  
Tel: 028-65088599

E-Motion's AI Vehicle Division Overseas  
[www.E-MotionSupply.com](http://www.E-MotionSupply.com)  
[support@e-motionsupply.com](mailto:support@e-motionsupply.com)

California, USA  
27274 Via Industria, Suite B  
Temecula, CA 92590  
Ph.+1-951.595.4200 Fx951.905.5538

Texas, USA  
4545 Fuller Drive, Ste.  
240 Irving, TX 75038  
Ph. +1-972.719.5555

Canada  
111 2nd Avenue South, Unit 400, Saskatoon, S7K 1K6  
Ph. +1-3069121550

Bangalore, India  
2202A, 22nd Floor, WTC,  
Bangalore, 560055, India  
Ph. +91-90351-91906