HIWIN®


MC03UE01-2309_V1.3

# User Manual

EM1 Series AC Servo Motors

EM1-01-1-EN-2307-MA

hiwin.de

# Imprint

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# Contents

# 1 About this Manual

This manual explains the features of the product, possibilities for use, operating conditions and operation limits of E1 series AC servo motor.
This manual is only intended for the use of trained specialists in automation and control engineering who are familiar with the applicable national standards. It is the duty of the technical personnel to use the manual published at the respective time of each installation and commissioning.
The responsible staff must ensure the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations guidelines and standards.
Be sure to refer to this manual and to keep this manual in a location where it can be accessed at any time.

- Documents

For configuring, you require the catalog or manual as print version or online with the following website.

https://www.hiwin.de/en/service/downloads

## 1.1 General precautions

Before using the product, please carefully read through this manual. HIWIN is not responsible for any damage, accident or injury caused by failure in following the installation instructions and operating instructions stated in this manual.

- Before installing or using the product, check the package to see if it has been damaged or broken. If there is any damage, please contact the sales representatives of HIWIN or agents or dealers.
- Check if the cables have been damaged and if they can be used for connection.
- Read the performance specifications indicated on the label or in the enclosed document before installation. Install the product based on the limit of the performance with installation guide and only use genuine spare parts from HIWIN.
- Please comply with the instructions and regulations when using the product.
- AC servo motor must be operated within the specified performance limits (see technical information and the approval drawing).
- AC servo motor must only be used for the intended purpose as described. Any other use of the AC servo motor shall be considered as improper usage. HIWIN is not responsible for any product damage or personal injury caused by this.
- For safe operation of the AC servo motor, appropriate safety precautions must be taken to protect the motor against overload.
- Servo motors must not be used outdoors or in potentially explosive environments.
- Do not disassemble or modify the product by yourselves. The product has been designed with structural calculations, computer simulations, and physical testing. Do not disassemble or modify the product without the permission of professionals.
- Children are not allowed to operate this product.
- People who have physical or mental disease or who do not have experience with the use of related products should not be allowed to use this product unless they are accompanied by supervisors or personnel familiar with the product to ensure their safety.
- Damaged products must not be installed or operated.
- If the information of registration does not match with your purchasing or if there are any questions related to the product, please contact the sales representatives of HIWIN or agents or dealers.

HIWIN offers 1-year warranty for the product. The warranty does not cover damage caused by improper usage (refer to the precautions and instructions stated in this manual) or natural disaster.

- Protective requirement

Table 1.1:

| Operating Phase | Personal Protective Equipment |
|---|---|
| Normal Operation | In the vicinity of AC servo motor, the following personal protective equipment is required:<br>○ Safety shoes<br>○ Protective helmet<br>○ Protective gloves |
| Cleaning | When cleaning AC servo motor, the following personal protective equipment is required:<br>○ Safety shoes<br>○ Protective helmet<br>○ Protective gloves<br>○ Protective goggles |
| Maintenance | When carrying out maintenance and repairs, the following personal protective equipment is required:<br>○ Safety shoes<br>○ Protective helmet<br>○ Protective gloves |

- Installation precautions

⚠ **Warning**! Risk of personal injury or damage to property.

- Follow the technical instruction and install the AC servo motor at a location with bearable load.
- When installing, do not impact or strike the motor.
- When installing, prevent foreign objects from entering the product.
- The spacing for installing the AC servo motor, servo drive, controller and other machines should follow specifications.
- When installing, please set up an external emergency stop loop that can immediately stop the product and cut off power.

- Wiring precautions

⚠ **Warning**! Risk of personal injury or damage to property.

- Ensure wiring is correctly performed. Otherwise, it may lead to product malfunction or burn-out. There could be a risk of injury or fire.
- Before using the product, carefully read through the specification noted on product label, and ensure the product is used with power supply specified in product requirement.
- Check if the wiring is correct. Incorrect wiring may make the AC servo motor operate abnormally, or even cause permanent damage to the motor.
- Select extension cable with shield. The shield must be grounded.

⚠ **Caution!** Risk of personal injury.

- Ensure the AC servo motor is correctly grounded.
- The resistance of grounding terminal connection shall be less than 10 Ω when the input voltage of the drive is 400 V; less than 50 Ω when it is 220 V; less than 100 Ω when it is 110 V.

- Operation precautions

⚠ **Warning**! Risk of personal injury or damage to property.

- Please follow the requirements of installation direction.
- Avoid excessive friction when the motor is running.
- Ensure there is no object in the motion range of the system.
- Before starting the AC servo motor, ensure the main switch is on.
- Before transmitting electricity, ensure there is at least one ground wire connecting to all electrical products.
- Do not directly touch the motor parts after the AC servo motor is assembled.
- Do not operate the product in an environment that exceeds its rated load.
- If any abnormal odor, noise, smoke, temperature rise or vibration is detected, stop the AC servo motor and cut off the power immediately.

- Storage precautions

⚠ **Caution!** Risk of damage to property.

- Follow the precautions of AC servo motor storage conditions.
- Do not store the product in an inflammable environment or with chemical agents.
- Do not store the product in a place with humidity, dust, harmful gases or liquids.
- Clean and protect used AC servo motor before storage.
- When storing AC servo motor, attach signs warning of magnetic fields.
- Storage conditions must comply with EN 60721-3-1(Refer to the table below for Storage conditions)
- Motor can be stored for up to two years indoor with the following conditions:
  - Dry
  - Dust-free
  - No vibration
  - Good ventilation
  - Resistance to extreme weather
  - Indoor air does not contain corrosive gases
  - Prevent motor vibration and moisture
- If no dry storage environment is available, the following measures need to be taken:
  - Wrap the motor with moisture-absorbing material, and then seal the motor.
  - Put desiccant in the sealed package; the desiccant needs to be checked and replaced if necessary.
- Check the AC servo motor regularly.

Storage Conditions are listed as below:

| Environmental parameter | Unit | Value |
|---|---|---|
| Air temperature | (°C) | -15 ~ 70 |
| Relative humidity | (%) | 20 ~ 80 |
| Rate of change of temperature | (°C/min) | 0,5 |
| Air pressure | kPa | 70 ~ 106 |
| Condensation | - | Not allowed |
| Formation of ice | - | Not allowed |
| Store the motor in an environment with good protection. (indoor/factory) | | |

- Transportation precautions

⚠ **Caution!** Risk of personal injury or damage to property.

Follow the precautions of AC servo motor transport conditions.

- Carefully move the product to avoid damage.
- Do not apply excessive force to the product.
- Do not stack the product to avoid collapse.
- Transport conditions must comply with EN 60721-3-1 (Refer to the table below for transportation conditions).

- Transportation Conditions

| Environmental parameter | Unit | Value |
|---|---|---|
| Air temperature | (°C) | -15 ~ 70 |
| Relative humidity | (%) | 20 ~ 80 |
| Rate of change of temperature | (°C/min) | 0,5 |
| Air pressure | kPa | 70 ~ 106 |
| Condensation | - | Not allowed |
| Formation of ice | - | Not allowed |
| Store the motor in an environment with good protection. (indoor/factory) | | |

- Maintenance precautions

⚠ **Warning**! Risk of personal injury or damage to property.

- Do not disassemble or modify the product.
- If the product malfunctions, do not repair the product by yourselves, please contact HIWIN for repairs.

- Disposal precautions

⚠ **Warning**! Risk of personal injury or damage to property.

- If it is not correctly performed, it may cause personal injury or damage to material.
- If AC servo motor or related components (especially the rotor with strong magnets) are not handled correctly, it may cause personal injury, death or property damage.
- Please ensure that the AC servo motor and related components are disposed correctly.

## 1.2 Safety instruction

- Carefully read through this manual before installation, transportation, maintenance and examination. Ensure the product is correctly used.
- Carefully read through electromagnetic (EM) information, safety information and related precautions before using the product.
- Safety precautions in this manual are classified into “DANGER”, “WARNING” and “ CAUTION”.

⚠ **Danger!** Imminent danger!

Indicates that death or severe personal injury will result if proper precautions are not taken.

⚠ **Warning**! Potentially dangerous situation!

Indicates that death or severe personal injury may result if proper precautions are not taken.

⚠ **Caution!** Moderate danger!

Indicates that minor personal injury can result if proper precautions are not taken.

| Warning Signs | | | |
|---|---|---|---|
|  | No access for people with active implanted cardiac devices! |  | Substance hazardous tot he environment! |
|  | Warning! |  | Warning of crushing of hands! |
|  | Warning of electricity! |  | Warning of hot surface! |
|  | Warning of magnetic field! | | |

| Mandatory Signs | | | |
|---|---|---|---|
|  | Wear head protection! |  | Refer to user manual! |
|  | Wear protective gloves! |  | Disconnect before carrying out maintenance or repair. |
|  | Wear safety footwear! |  | Lifting point. |
|  | Connect an earth terminal to the ground! | | |

⚠ **Danger!** Danger from operation!

- Do not repair the product by yourselves if something abnormal occurs. The product can
- only be repaired by HIWIN qualified technicians or sent back to HIWIN for repairs.
- Do not apply the load exceeding the specification standards to the product.
- Do not change product parts or remove product screws without authorization, or the product will be damaged. HIWIN is not responsible for any damage, accident or injury caused by this.
- Do not touch the product's keyway with hands.
- Do not touch the rotating parts of the product when it is operating.

⚠ **Danger!** Danger from hot surface!

- Do not place flammable materials around the AC servo motor, servo drive or regenerative resistor.
- Do not use the product in an environment with corrosive, flammable gases or flammable materials.
- Do not touch the surface of the AC servo motor, servo drive or regenerative resistor which will be hot while operating.

⚠ **Danger!** Danger from electrocution!

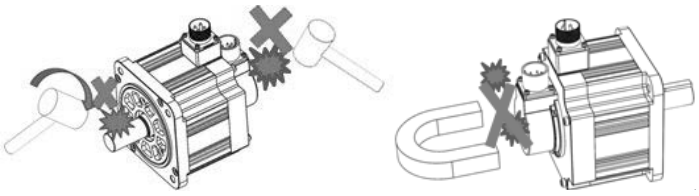
- To prevent risk of electric shock, do not use damaged cables with excessive pressure or press and clamp the wire overly.
- Do not remove the cover, cables, or connector from AC servo motor while the power is ON.
- Do not touch wires or operate the equipment with wet hands.
- Do not use when wires are in contact with oil or water.

⚠ **Danger!** Danger from strong magnetic fields!

- Strong magnetic fields around AC servo motor pose a health risk to persons with implants (e.g., cardiac pacemakers) that are affected by magnetic fields.
- People with implants are affected by magnetic fields should maintain a safe distance of at least 1 m from the AC servo motor.

⚠ **Warning**! Risk of personal Injury or damage to property.

- Read this manual and follow it carefully before using the product.
- If the product is used with excessive load, it may rise the temperature of the motor housing.
- There may be electromagnetic compatibility (EMC) problems in other environments.
- Do not use the product in an environment where it may be shocked. Do not directly strike the shaft or encoder, as hitting or pounding. HIWIN is not responsible for any damage, accident or injury caused by this.
- Do not pick up or place the motor only by pulling its cable or shaft.
- Since AC servo motor contains a precision encoder, please take sufficient measures to prevent electromagnetic interference or abnormal temperature change while using.
- The absolute encoder has an attached magnetic sensor. Do not operate magnetic equipment on the top of the encoder cover or around the encoder.



⚠ **Caution!** Risk of personal injury or damage to property.

- Please follow the requirements of installation direction.
- Follow the technical instruction and install the AC servo motor at a location with bearable load.
- When installing, do not impact or strike the motor.
- When installing, prevent foreign objects from entering the product.
- The spacing for installing the AC servo motor, servo drive, controller and other machines should follow specifications.
- When installing, please set up an external emergency stop loop that can immediately stop the product and cut off power.

⚠ **Caution!** Risk of physical damage to watches and magnetic storage media.

- Strong magnetic force may destroy watches and magnetizable data storage media near the AC servo motor!
- Do not bring watches or magnetizable data storage media in the vicinity (<300 mm) of the AC servo motor!

## 1.3 Copyright



**Note**

HIWIN reserves the right to change the contents of this manual or product specifications without prior notice.

## 1.4 Manufacturer information

| | |
|---|---|
| **Company** | HIWIN GmbH |
| **Address** | Brücklesbünd 1<br>77654 Offenburg |
| **Tel** | +49 (0) 781 / 9 32 78 - 0 |
| **Fax** | +49 (0) 781 / 9 32 78 - 90 |
| **Technical Customer Service** | +49 (0) 781 / 9 32 78 - 77 |
| **Technical Customer Service Fax** | +49 (0) 781 / 9 32 78 - 97 |
| **Mail** | support@hiwin.de |
| **Website** | hiwin.de |

## 1.5 Product monitoring

Please inform HIWIN, the manufacturer of AC servo motor, of:

- Accidents.
- Potential sources of danger in AC servo motor.
- Anything in this user manual which is difficult to understand.

# 2 Basic safety information

## 2.1 Overview

This chapter explains safety notices and risk management approach of using the product.

## 2.2 Basic safety notices

⚠ **Danger!** Danger from strong magnetic fields!

- Strong magnetic fields around AC servo motor pose a health risk to persons with implants (e.g., cardiac pacemakers) that are affected by magnetic fields.
- People with implants are affected by magnetic fields should maintain a safe distance of at least 1 m from the AC servo motor.

⚠ **Danger!** Danger from operation!

- If an abnormality occurs with this product, do not attempt to repair it yourself. This product should only be repaired by this company's qualified technical personnel or the product should be sent back to this company for repairs.
- Do not use the servo motor for loads that exceed its specification standards.
- Do not change servo motor parts or remove motor screws on your own because this can damage the servo motor. This company will not be responsible for any damage, accidents, or injuries caused by products that have been improperly tampered with.
- Do not touch the keyway of motor with hands.
- Never touch the rotating parts of the motor when the motor is operating.

⚠ **Danger!** Danger from hot surface!

- Do not place flammable materials around the AC servo motor, servo drive or regenerative resistor.
- Do not use the product in an environment with corrosive, flammable gases or flammable materials.
- Do not touch the surface of the AC servo motor, servo drive or regenerative resistor which will be hot while operating.

⚠ **Caution!** Risk of physical damage to watches and magnetic storage media.

- Strong magnetic force may destroy watches and magnetizable data storage media near the AC servo motor!
- Do not bring watches or magnetizable data storage media in the vicinity (<300 mm) of the AC servo motor!

## 2.3 Reasonably foreseeable misuse

⚠ **Warning!** Risk of damage to property.

AC servo motors must not be operated:

- Outdoors.
- In potentially explosive atmospheres.

## 2.4 Conversions and modifications

⚠ **Warning!** Risk of personal injury or damage to property.

▶ Conversions or modifications to AC servo motor are prohibited.

Modifications of AC servo motor are not permitted. Please contact HIWIN for special request.

## 2.5 Residual risks

⚠ **Caution!** Personal injury or damage to property.

▶ During normal operation, there are no residual risks associated with AC servo motor components. Warnings about risks that may arise during commissioning, maintenance and repair work are provided in the relevant sections.

## 2.6 Personnel requirements

- Operation staff are trained in the safe operation practices for servo drives and have fully read and understood this user manual.
- Maintenance staff maintain and repair servo drives in such a way that they pose no danger to people, property or the environment.
- Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products.

⚠ **Caution!**

▶ Only authorized and competent ones may carry out work on AC servo motor components. They must be familiar with the safety equipment and regulations before starting work.

| Activity | Qualification |
|---|---|
| Commissioning | Trained specialist personnel of the operator or manufacturer |
| Normal Operation | Trained personnel |
| Cleaning | Trained personnel |
| Maintenance | Trained specialist personnel of the operator or manufacturer |
| Repairs | Trained specialist personnel of the operator or manufacturer |

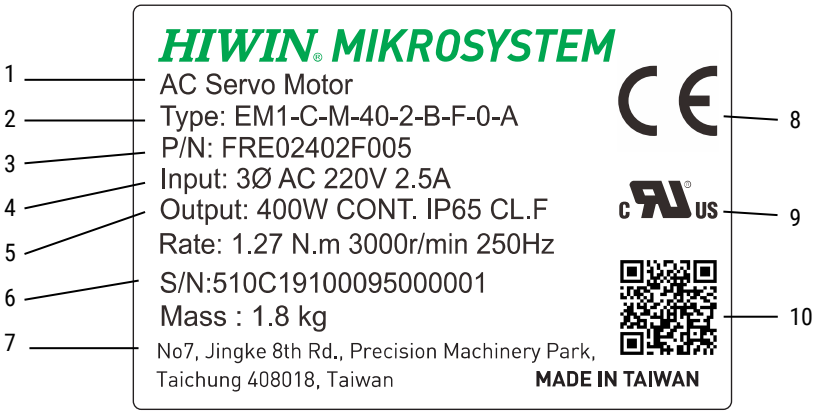
## 2.7 Protective equipment

Possible safety equipment/measures:

- Personal protective equipment in accordance with regional regulations.
- Zero-contact protective equipment.
- Mechanical protective equipment.

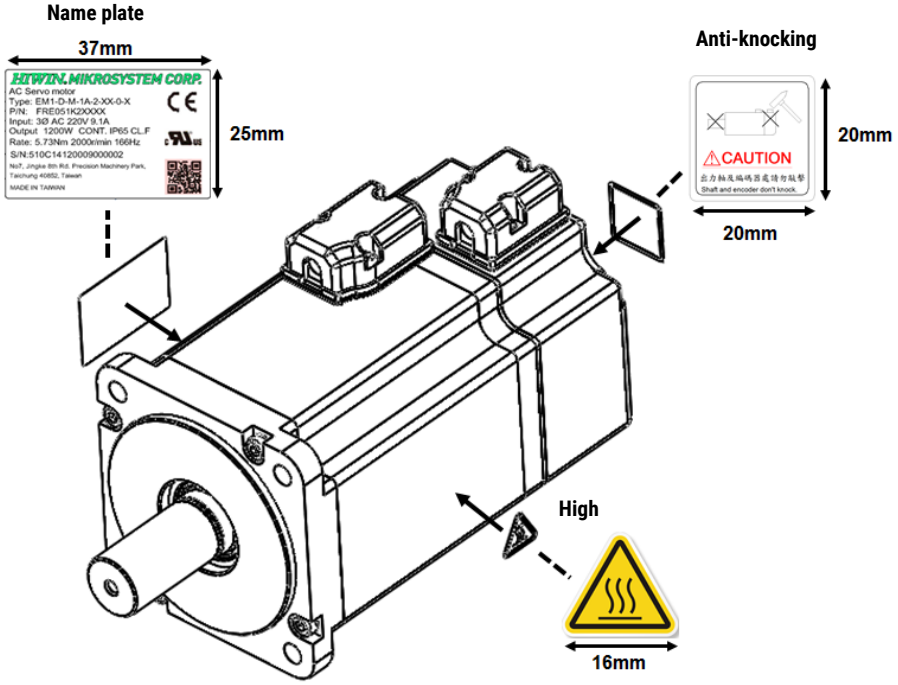
## 2.8 Labels on servo motor

- Nameplate




| | | | |
|---|---|---|---|
| 1 | Product name | 6 | Serial No. |
| 2 | Motor type | 7 | Company address |
| 3 | Part No. | 8 | CE mark |
| 4 | Input spec. | 9 | UL mark |
| 5 | Output spec. | 10 | QR mark |

- Location of Safety Symbols on Motor



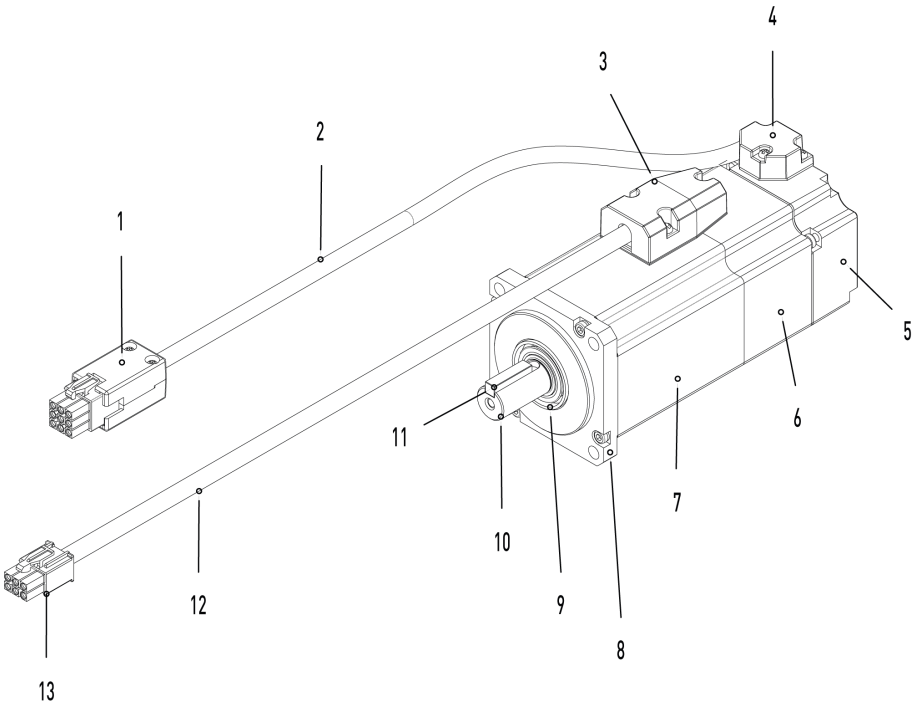
# 3 Product description

## 3.1 Servo motor description

AC servo motor is a high speed and low torque motor. It can control rotating motor, and control the current, speed, and position through the servo drive. It has the characteristics of high precision, low noise, high response, and high instantaneous output.

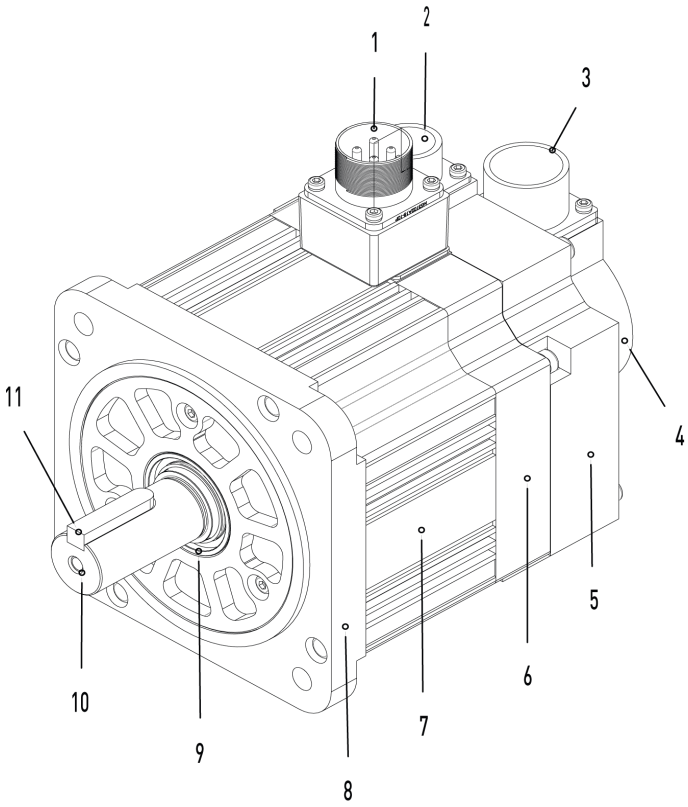
New developed AC servo motor can be applicable to FPD, semiconductor, laser cutting, PCB, machine tool, 3C electronics, energy, automobile, measuring/inspection industry, and related automation industry. Compared with the last generation of FR series, EM1 servo motor enhances maximum speed, encoder resolution, compact size, and ensure speedy settling, stability, tuneless function with dynamic payload by working with brand-new E1 servo drive, that can effectively improve production efficiency.

- Appearance of servo motor 50 W – 750 W AC




| | | | |
|---|---|---|---|
| 1 | Encoder connector | 8 | Front cover |
| 2 | Encoder cable | 9 | Oil seal |
| 3 | Power cab | 10 | Shaft (rotor) |
| 4 | Encoder cab | 11 | Key |
| 5 | Encoder cover (encoder) | 12 | Power cable |
| 6 | Brake cover (brake) | 13 | Power connector |
| 7 | Motor cover (stator) | | |

- 1 kW – 2 kW AC servo motor appearance are as bellowing.




| | | | |
|---|---|---|---|
| 1 | Power connector | 7 | Motor cover (stator) |
| 2 | Brake connector | 8 | Front cover |
| 3 | Encoder connector | 9 | Oil seal |
| 4 | Encoder cover (encoder) | 10 | Shaft (rotor) |
| 5 | Brake cover (brake) | 11 | Key |
| 6 | Back cover | | |

## 3.2 Main components of servo motor

- Combination of HIWIN AC servo motors and servo drives.

| Servo Motor Model | Rated Output | Rated Torque | Rated Speed | Servo Drive Model |
|---|---|---|---|---|
| EM1-C-M-05-2-□-□-0-□ | 50 W | 0,16 Nm | 3.000 rpm | ED1□-□□-0422-A□ |
| EM1-C-M-10-2-□-□-0-□ | 100 W | 0,32 Nm | 3.000 rpm | ED1□-□□-0422-A□ |
| EM1-C-M-20-2-□-□-0-□ | 200 W | 0,64 Nm | 3.000 rpm | ED1□-□□-0422-A□ |
| EM1-C-M-40-2-□-□-0-□ | 400 W | 1,27 Nm | 3.000 rpm | ED1□-□□-0422-A□ |
| EM1-C-M-75-2-□-□-0-□ | 750 W | 2,39 Nm | 3.000 rpm | ED1□-□□-1022-A□ |
| EM1-A-M-1K-2-□-□-0-□ | 1 kW | 4,77 Nm | 2.000 rpm | ED1□-□□-1022-A□ |
| EM1-D-M-1A-2-□-□-0-□ | 1,2 kW | 5,73 Nm | 2.000 rpm | ED1□-□□-2022-A□ |
| EM1-D-M-2K-2-□-□-0-□ | 2 kW | 9,55 Nm | 2.000 rpm | ED1□-□□-2022-A□ |

## 3.3 Order code

### 3.3.1 Model explanations

#### 3.3.1.1 E1 series AC servo motor

For further use with drive, cable, and accessory, please refer to chapter 5 and 11.

| Number | | 1 | 2 | 3 | - | 4 | - | 5 | - | 6 | 7 | - | 8 | - | 9 | - | 10 | - | 11 | - | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | | E | M | 1 | - | C | - | M | - | 0 | 5 | - | 2 | - | B | - | E | - | 0 | - | A |
| 1, 2, 3 | EM1 | Mode name | | | | | | | | | | | | | | | | | | | |
| 4 | C | Rated/Max.Speed:<br>A: 2.000 / 3.000 rpm<br>C: 3.000 / 6.000 rpm<br>D: 2.000 / 5.000 rpm | | | | | | | | | | | | | | | | | | | |
| 5 | M | Rotor Inertia:<br>M: Medium inertia | | | | | | | | | | | | | | | | | | | |
| 6, 7 | 05 | Rated output:<br>05: 50 W<br>10: 100 W<br>20: 200 W<br>40: 400 W<br>75: 750 W<br>1K: 1.000 W<br>1A: 1.200 W<br>2K: 2.000 W | | | | | | | | | | | | | | | | | | | |
| 8 | 2 | Input voltage:<br>2: 220 VAC | | | | | | | | | | | | | | | | | | | |
| 9 | B | Brake option:<br>0: Without brake<br>B: With brake | | | | | | | | | | | | | | | | | | | |
| 10 | E | Encoder option:<br>E: 23bit incremental (battery is not required)<br>F: 23bit single-turn /16bit multi-turn absolute (battery is required) | | | | | | | | | | | | | | | | | | | |
| 11 | 0 | Reserved:<br>0: Standard<br>1: Customized | | | | | | | | | | | | | | | | | | | |
| 12 | A | Shaft type:<br>A: Round shaft / without oil seal<br>B: Round shaft / with oil seal<br>C: Shaft with key / without oil seal<br>D: Shaft with key / with oil seal | | | | | | | | | | | | | | | | | | | |

#### 3.3.1.2 Servo Drive

For detailed functions of E1 series servo drive, please refer to “ED1 Series Servo Drive User Manual”.

| Number | | 1 | 2 | 3 | 4 | - | 5 | 6 | - | 7 | 8 | 9 | 10 | - | 11 | 12 | - | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | | E | D | 1 | S | - | V | G | - | 0 | 4 | 2 | 2 | - | 0 | 1 | - | 0 | 0 |
| 1, 2, 3 | ED1 | Mode name | | | | | | | | | | | | | | | | | |
| 4 | S | Type:<br>S: Standard<br>F: Fieldbus | | | | | | | | | | | | | | | | | |
| 5 | V | Control Interface:<br>V: Voltage command and pulse<br>E: EtherCAT (CoE)<br>H: mega-ulink (with HIWIN MoE HIMC motion controller or API/MPI motion control command library)<br>L: MECHATROLINK-III<br>P: PROFINET | | | | | | | | | | | | | | | | | |
| 6 | G | Special Function:<br>G: Gantry<br>N: No special function | | | | | | | | | | | | | | | | | |
| 7, 8 | 04 | Rated output:<br>04: 400 W<br>05: 500 W<br>10: 1kW<br>12: 1,2 kW<br>20: 2 kW<br>40: 4 kW<br>50: 5 kW<br>75: 7,5 kW | | | | | | | | | | | | | | | | | |
| 9 | 2 | AC Phase:<br>2: Single/Three-phase (For 400 W/ 500 W/ 1 kW/ 1,2 kW/ 2 kW model)<br>3: Three-phase (For 4 kW/ 5 kW/ 7,5 kW model) | | | | | | | | | | | | | | | | | |
| 10 | 2 | AC Power:<br>2: 110 V/ 220 V (100 VAC – 240 VAC)<br>3: 400 V (380 VAC – 480 VAC) | | | | | | | | | | | | | | | | | |
| 11 | 0 | Applicable Category:<br>0: AC, LM, DM, and TM<br>A: AC only<br>T: GT | | | | | | | | | | | | | | | | | |
| 12 | 1 | Safety Version:<br>1: STO function security approval | | | | | | | | | | | | | | | | | |
| 13, 14 | 00 | Reserved | | | | | | | | | | | | | | | | | |

**Note**

- Servo drive model no. 12 digits (ED1□ - □□ - □□□□ - □ 0): STO function without security approval.
- Servo drive model no. 14 digits (ED1□ - □□ - □□□□ - □ 1 - □□): STO function with security approval.
- For the communication settings and details about fieldbus servo drive (ED1F-E), please refer to “E1 Series Servo Drive EtherCAT(CoE) Communications Command Manual.”
- For the communication settings and details about fieldbus servo drive (ED1F-L), please refer to “E1 Series Servo Drive MECHATROLINK-III Communication Command Manual.”
- For the settings and details about gantry function servo drive (ED1□ - □ G), please refer to “E1 Series Servo Drive Gantry Control System User Manual.”
- When the 10th digit of the model number is 2 and the AC voltage is 100 – 120 VAC, only single-phase input power can be used.

- 400 V servo drives (ED1□ - □□- □□□ 3) and gantry function servo drives (ED1□ - □G) only support Thunder 1.6.11.0 or later versions.
- If the 10th digit = 2, the following drives are supported: 400 W / 500 W / 1 kW / 1.2 kW / 2 kW / 4 kW. If the 10th digit = 3, the following drives are supported: 5 kW / 7,5 kW.
- CoE is the acronym for “CANopen over EtherCAT”; MoE is the acronym for “mega-ulink over EtherCAT.”
- When using API/MPI library with servo drive, users should carefully read through “API/MPI Library Reference Manual” to check if Windows system is supported.
- ED1□ - □□-□□□□-T1- □□ is a GT servo drive, its functions are as follows:
  - Support nano precision function.
  - Support 2D Error map (with ED1□ - □G-□□□□-T1- □□). Gantry function cannot be used while users enable 2D Error map.
  - Support DC 96-120 V.

#### 3.3.1.3 Power cable

For combination of E1 series servo motors and servo drives, please refer to section 3.3.5.

| Number | | 1 | 2 | 3 | 4 | - | 5 | 6 | - | 7 | 8 | - | 9 | 10 | 11 | - | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | | H | V | P | S | - | 0 | 4 | - | A | B | - | 0 | 3 | M | - | B |
| 1, 2, 3 | HVP | Mode name | | | | | | | | | | | | | | | |
| 4 | S | Capacity:<br>S: Small capacity (50 W–750 W)<br>M: Medium capacity (1 KW–2 KW) | | | | | | | | | | | | | | | |
| 5, 6 | 04 | Pin assignment:<br>04: U / V / W / GND<br>06: U / V / W / GND / B+ / B- | | | | | | | | | | | | | | | |
| 7 | A | Motor connector<br>A: AMP connector<br>B: Straight military type connector<br>C: L shape military type connector | | | | | | | | | | | | | | | |
| 8 | B | Drive connector:<br>B: R-type terminal | | | | | | | | | | | | | | | |
| 9, 10, 11 | 03M | Cable length:<br>03M: 3 meter<br>05M: 5 meter<br>07M: 7 meter<br>10M: 10 meter<br>15M: 15 meter | | | | | | | | | | | | | | | |
| 12 | B | Cable type:<br>B: Flexible type | | | | | | | | | | | | | | | |

**Note**

- Cable length is not allowed to use exceeds 30 m.
- Cable length can be customized for integer number, for example (1 m, 2 m, 3 m...30 m)
- Pin assignment and connector specification can be referred to chapter 5.2.1.
- Bending radius limitation of power cable can be referred to chapter 5.2.1.4.

#### 3.3.1.4 Encoder cable

For combination of servo motors and servo drives, please refer to section 3.3.5.

| Number | | 1 | 2 | 3 | - | 4 | 5 | 6 | - | 7 | 8 | - | 9 | 10 | 11 | - | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | | H | V | E | - | 2 | 3 | A | - | A | B | - | 0 | 3 | M | - | B |
| 1, 2, 3 | HVE | Mode name | | | | | | | | | | | | | | | |
| 4, 5, 6 | 23A | Encoder type:<br>23A: 23 bit multi-turn absolute encoder<br>23I: 23 bit single-turn absolute encoder | | | | | | | | | | | | | | | |
| 7 | A | Motor connector:<br>A: AMP connector<br>B: Straight military type connector<br>C: L shape military type connector | | | | | | | | | | | | | | | |
| 8 | B | Drive connector:<br>B: 3M SCR type connector | | | | | | | | | | | | | | | |
| 9, 10, 11 | 03M | Cable length:<br>03M: 3 meter<br>05M: 5 meter<br>07M: 7 meter<br>10M: 10 meter<br>15M: 15 meter | | | | | | | | | | | | | | | |
| 12 | B | Cable type:<br>B: Flexible type | | | | | | | | | | | | | | | |

**Note**

- Cable length is not allowed to use exceeds 30 m.
- Cable length can be customized for integer number, for example (1 m, 2 m, 3 m...30 m)
- Pin assignment and connector specification can be referred to chapter 5.2.1.
- Bending radius limitation of power cable can be referred to chapter 5.2.1.4.

### 3.3.1.5 Combination of E1 series AC servo motor, servo drive and cable

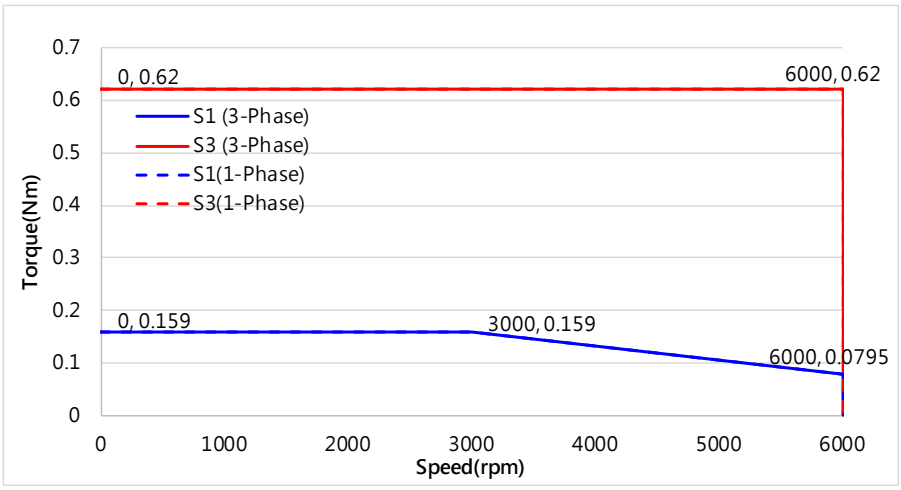
| Servo motor | Capacity | Power cable | Encoder cable | Servo drive |
|---|---|---|---|---|
| EM1CM0520E0□ | 50 W | HVPS04AB□□MB | HVE23IAB□□MB | ED1□-□□-0422-A□ |
| EM1CM052BE0□ | | HVPS06AB□□MB | | |
| EM1CM0520F0□ | | HVPS04AB□□MB | HVE23AAB□□MB | |
| EM1CM052BF0□ | | HVPS06AB□□MB | | |
| EM1CM1020E0□ | 100 W | HVPS04AB□□MB | HVE23IAB□□MB | |
| EM1CM102BE0□ | | HVPS06AB□□MB | | |
| EM1CM1020F0□ | | HVPS04AB□□MB | HVE23AAB□□MB | |
| EM1CM102BF0□ | | HVPS06AB□□MB | | |
| EM1CM2020E0□ | 200 W | HVPS04AB□□MB | HVE23IAB□□MB | |
| EM1CM202BE0□ | | HVPS06AB□□MB | | |
| EM1CM2020F0□ | | HVPS04AB□□MB | HVE23AAB□□MB | |
| EM1CM202BF0□ | | HVPS06AB□□MB | | |
| EM1CM4020E0□ | 400 W | HVPS04AB□□MB | HVE23IAB□□MB | |
| EM1CM402BE0□ | | HVPS06AB□□MB | | |
| EM1CM4020F0□ | | HVPS04AB□□MB | HVE23AAB□□MB | |
| EM1CM402BF0□ | | HVPS06AB□□MB | | |
| EM1CM7520E0□ | 750 W | HVPS04AB□□MB | HVE23IAB□□MB | ED1□-□□-1022-A□ |
| EM1CM752BE0□ | | HVPS06AB□□MB | | |
| EM1CM7520F0□ | | HVPS04AB□□MB | HVE23AAB□□MB | |
| EM1CM752BF0□ | | HVPS06AB□□MB | | |
| EM1AM1K20E0□ | 1 kW | HVPM04□B□□MB | HVE23I□B□□MB | |
| EM1AM1K2BE0□ | | HVPM06□B□□MB | | |
| EM1AM1K20F0□ | | HVPM04□B□□MB | HVE23A□B□□MB | |
| EM1AM1K2BF0□ | | HVPM06□B□□MB | | |
| EM1DM1A20E0□ | 1.2 kW | HVPM04□B□□MB | HVE23I□B□□MB | ED1□-□□-2022-A□ |
| EM1DM1A2BE0□ | | HVPM06□B□□MB | | |
| EM1DM1A20F0□ | | HVPM04□B□□MB | HVE23A□B□□MB | |
| EM1DM1A2BF0□ | | HVPM06□B□□MB | | |
| EM1DM2K20E0□ | 2 kW | HVPM04□B□□MB | HVE23I□B□□MB | |
| EM1DM2K2BE0□ | | HVPM06□B□□MB | | |
| EM1DM2K20F0□ | | HVPM04□B□□MB | HVE23A□B□□MB | |
| EM1DM2K2BF0□ | | HVPM06□B□□MB | | |

### 3.3.2 Technical data

#### 3.3.2.1 EM1-C-M-05-2-X-X-0-XX technical data

EM1-C-M-05-2-X-X-0-X Data Sheet

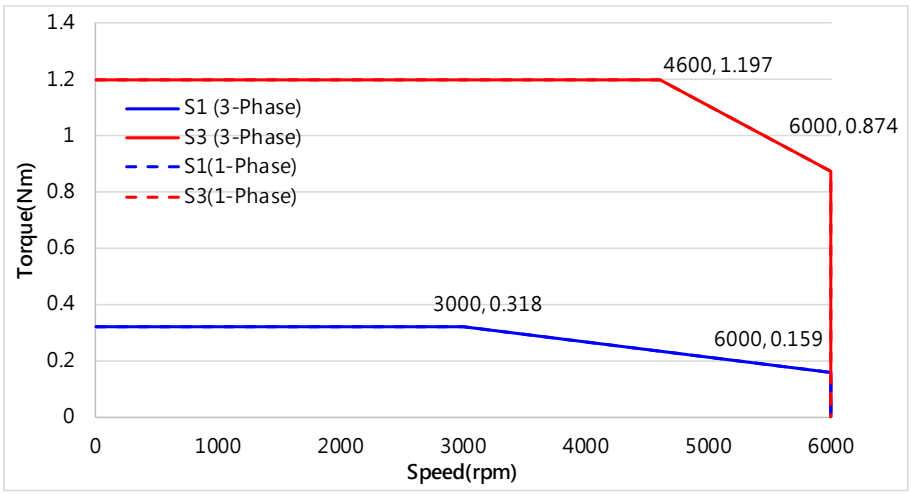
| Designation | Symbol | Unit | EM1-C-M-05-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 50 |
| Rated torque | $T_c$ | Nm | 0,16 |
| Rated current | $I_c$ | $A_{rms}$ | 0,64 |
| Maximum torque | $T_p$ | Nm | 0,59 |
| Maximum current | $I_p$ | $A_{rms}$ | 2,8 |
| Rated speed | $\omega_c$ | rpm | 3.000 |
| Maximum speed | $\omega_p$ | rpm | 6.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,25 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 18,526 |
| Winding resistance | R | Ω | 25,24 |
| Winding inductivity | L | mH | 13,09 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 0,0368 (0,0401) |
| Weight | M | kg | 0,36 (0,56) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 0,32 |
| Brake rated current | $I_b$ | A | 0,25 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 40 |
| Release time | $T_r$ | ms | 20 |



### 3.3.2.2 EM1-C-M-10-2-X-X-0-XX technical data

EM1-C-M-10-2-X-X-0-X Data Sheet

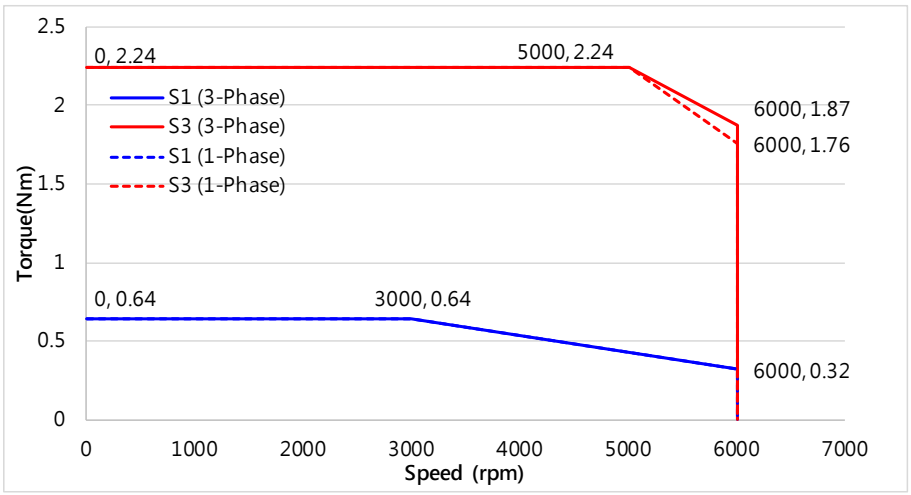
| Designation | Symbol | Unit | EM1-C-M-10-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 100 |
| Rated torque | $T_c$ | Nm | 0,32 |
| Rated current | $I_c$ | $A_{rms}$ | 0,78 |
| Maximum torque | $T_p$ | Nm | 1,18 |
| Maximum current | $I_p$ | $A_{rms}$ | 3,45 |
| Rated speed | $\omega_c$ | rpm | 3.000 |
| Maximum speed | $\omega_p$ | rpm | 6.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,41 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 28,364 |
| Winding resistance | R | Ω | 22,72 |
| Winding inductivity | L | mH | 13,86 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 0,0620 (0,0653) |
| Weight | M | kg | 0,47 (0,67) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 0,32 |
| Brake rated current | $I_b$ | A | 0,25 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 40 |
| Release time | $T_r$ | ms | 20 |



### 3.3.2.3 EM1-C-M-20-2-X-X-0-X – Technical Data

EM1-C-M-20-2-X-X-0-X Data Sheet

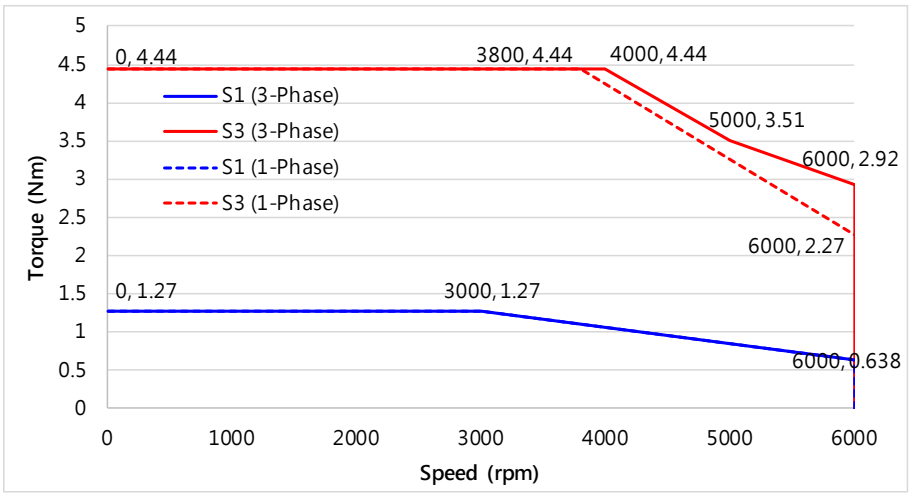
| Designation | Symbol | Unit | EM1-C-M-20-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 200 |
| Rated torque | $T_c$ | Nm | 0,64 |
| Rated current | $I_c$ | $A_{rms}$ | 1,6 |
| Maximum torque | $T_p$ | Nm | 2,24 |
| Maximum current | $I_p$ | $A_{rms}$ | 6,4 |
| Rated speed | $\omega_c$ | rpm | 3.000 |
| Maximum speed | $\omega_p$ | rpm | 6.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,4 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 27,23 |
| Winding resistance | R | Ω | 5,53 |
| Winding inductivity | L | mH | 8,76 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 0,263 (0,326) |
| Weight | M | kg | 0,851 (1,085) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 1,3 |
| Brake rated current | $I_b$ | A | 0,32 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 30 |
| Release time | $T_r$ | ms | 20 |



### 3.3.2.4 EM1-C-M-40-2-X-X-0-X – Technical Data

EM1-C-M-40-2-X-X-0-X Data Sheet

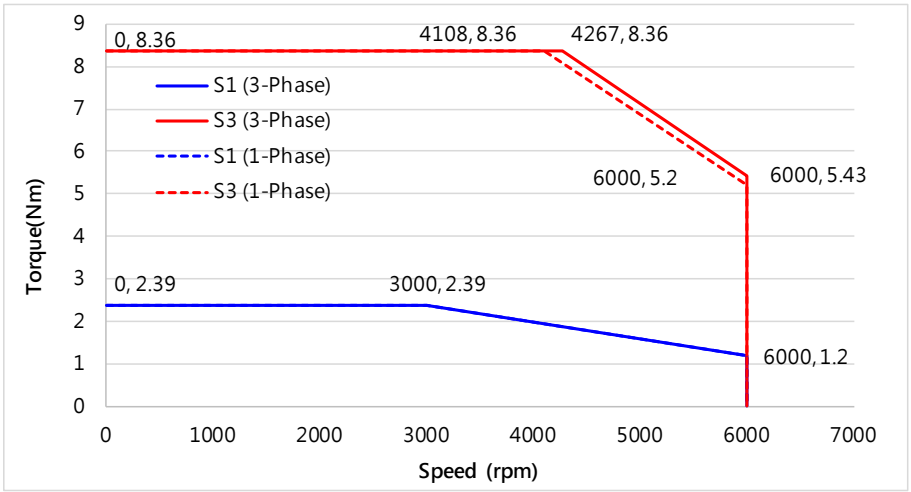
| Designation | Symbol | Unit | EM1-C-M-40-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 400 |
| Rated torque | $T_c$ | Nm | 1,27 |
| Rated current | $I_c$ | $A_{rms}$ | 2,5 |
| Maximum torque | $T_p$ | Nm | 4,44 |
| Maximum current | $I_p$ | $A_{rms}$ | 10 |
| Rated speed | $\omega_c$ | rpm | 3.000 |
| Maximum speed | $\omega_p$ | rpm | 6.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,508 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 33,87 |
| Winding resistance | R | Ω | 3,59 |
| Winding inductivity | L | mH | 7,22 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 0,48 (0,49) |
| Weight | M | kg | 1,25 (1,8) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 1,3 |
| Brake rated current | $I_b$ | A | 0,32 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 30 |
| Release time | $T_r$ | ms | 20 |



### 3.3.2.5 EM1-C-M-75-2-X-X-0-X – Technical Data

EM1-C-M-75-2-X-X-0-X Data Sheet

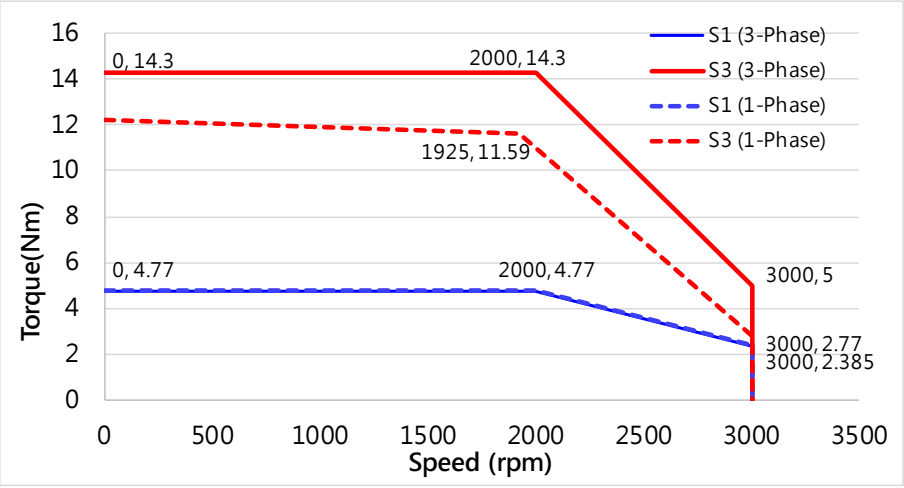
| Designation | Symbol | Unit | EM1-C-M-75-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 750 |
| Rated torque | $T_c$ | Nm | 2,39 |
| Rated current | $I_c$ | $A_{rms}$ | 4,65 |
| Maximum torque | $T_p$ | Nm | 8,36 |
| Maximum current | $I_p$ | $A_{rms}$ | 18,6 |
| Rated speed | $\omega_c$ | rpm | 3.000 |
| Maximum speed | $\omega_p$ | rpm | 6.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,514 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 33,48 |
| Winding resistance | R | Ω | 1,08 |
| Winding inductivity | L | mH | 4,6 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg{\cdot}m^2$ ($x10^{-4}$) | 1,44 (1,47) |
| Weight | M | kg | 2,7 (3,36) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 2,4 |
| Brake rated current | $I_b$ | A | 0,358 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 45 |
| Release time | $T_r$ | ms | 10 |



### 3.3.2.6 EM1-A-M-1K-2-X-X-0-XX technical data

EM1-A-M-1K-2-X-X-0-X Data Sheet

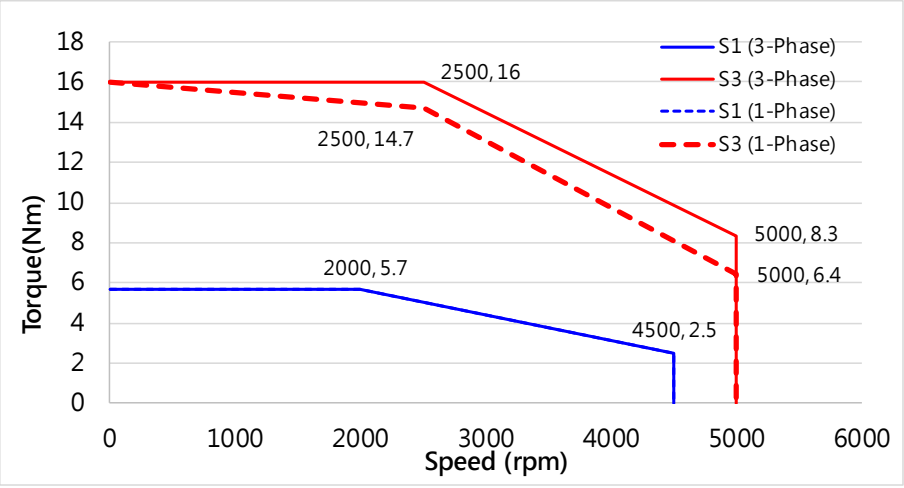
| Designation | Symbol | Unit | EM1-A-M-1K-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 1.000 |
| Rated torque | $T_c$ | Nm | 4,77 |
| Rated current | $I_c$ | $A_{rms}$ | 5,1 |
| Maximum torque | $T_p$ | Nm | 14,3 |
| Maximum current | $I_p$ | $A_{rms}$ | 15,3 |
| Rated speed | $\omega_c$ | rpm | 2.000 |
| Maximum speed | $\omega_p$ | rpm | 3.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,935 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 54,15 |
| Winding resistance | R | Ω | 0,81 |
| Winding inductivity | L | mH | 8 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 7,2 (8,0) |
| Weight | M | kg | 5,4 (6,2) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 10 |
| Brake rated current | $I_b$ | A | 0,56 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 80 |
| Release time | $T_r$ | ms | 30 |



### 3.3.2.7 EM1-D-M-1A-2-X-X-0-X – Technical Data

EM1-D-M-1A-2-X-X-0-X Data Sheet

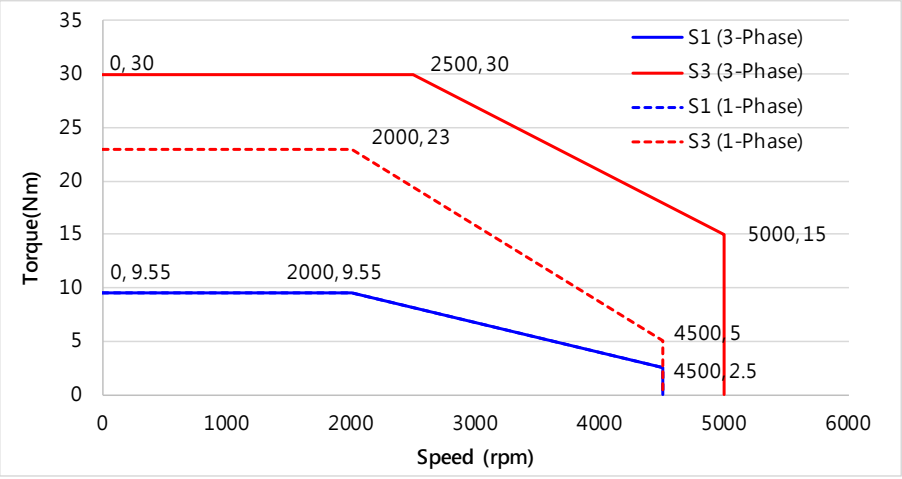
| Designation | Symbol | Unit | EM1-D-M-1A-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 1.200 |
| Rated torque | $T_c$ | Nm | 5,73 |
| Rated current | $I_c$ | $A_{rms}$ | 9,1 |
| Maximum torque | $T_p$ | Nm | 16 |
| Maximum current | $I_p$ | $A_{rms}$ | 27 |
| Rated speed | $\omega_c$ | rpm | 2.000 |
| Maximum speed | $\omega_p$ | rpm | 5.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,63 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 41,52 |
| Winding resistance | R | Ω | 0,482 |
| Winding inductivity | L | mH | 4,54 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 7,2 (8,0) |
| Weight | M | kg | 5,3 (6,1) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 10 |
| Brake rated current | $I_b$ | A | 0,56 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 80 |
| Release time | $T_r$ | ms | 30 |



### 3.3.2.8 EM1-D-M-2K-2-X-X-0-X – Technical Data

EM1-D-M-2K-2-X-X-0-X Data Sheet

| Designation | Symbol | Unit | EM1-D-M-2K-2-X-X-0-X |
|---|---|---|---|
| **Electrical data** | | | |
| Drive input voltage | V | V | AC 220 |
| Output power | P | W | 2.000 |
| Rated torque | $T_c$ | Nm | 9,55 |
| Rated current | $I_c$ | $A_{rms}$ | 12 |
| Maximum torque | $T_p$ | Nm | 30 |
| Maximum current | $I_p$ | $A_{rms}$ | 42 |
| Rated speed | $\omega_c$ | rpm | 2.000 |
| Maximum speed | $\omega_p$ | rpm | 5.000 |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | 0,796 |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | 50,49 |
| Winding resistance | R | Ω | 0,264 |
| Winding inductivity | L | mH | 2,825 |
| **Mechanical data** | | | |
| Moment of inertia of the rotor | J | $kg \cdot m^2$ ($x10^{-4}$) | 12,8 (13,3) |
| Weight | M | kg | 7,9 (8,7) |
| Insulation class | - | - | Class F |
| Cooling type | - | - | Natural air cooling |
| Degree of protection | - | - | *IP65 |
| **Brake data** | | | |
| Static friction torque | $T_b$ | Nm | 10 |
| Brake rated current | $I_b$ | A | 0,56 |
| Brake input voltage | $V_b$ | V | DC 24±10 % |
| Braking time | $T_o$ | ms | 80 |
| Release time | $T_r$ | ms | 30 |



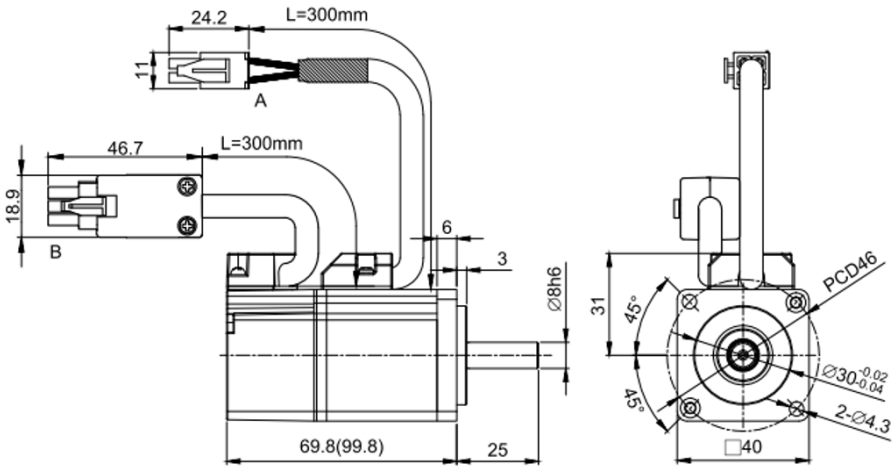
**Note**

Note for section 3.3.2.1 to 3.3.2.8 are as fillows:

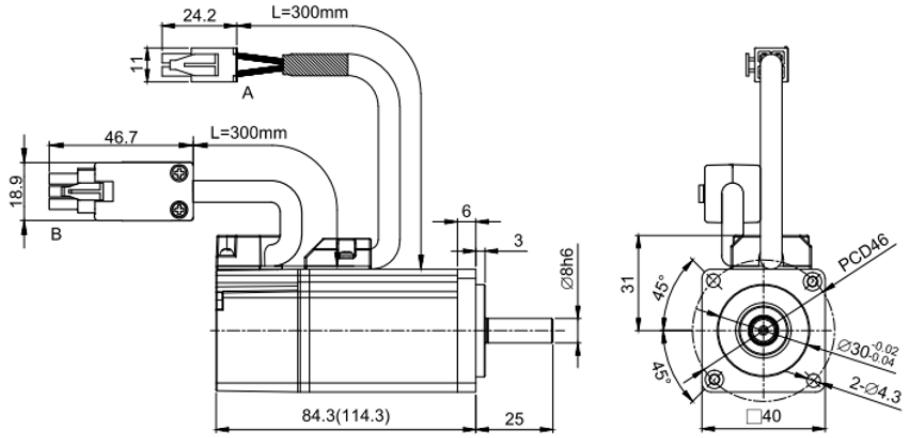
- Manufacturing tolerance : ±10%
- (…) indicates motors with brakes.
- * indicates motor shaft and connector are not included.(If the motor shaft needs IP protection, oil seal is necessary).
- The nominal motor properties are all single-phase/three-phase 220V input power. Please contact the sales representatives of HIWIN if you need 110V motor properties.

### 3.3.3 Mechanical overview

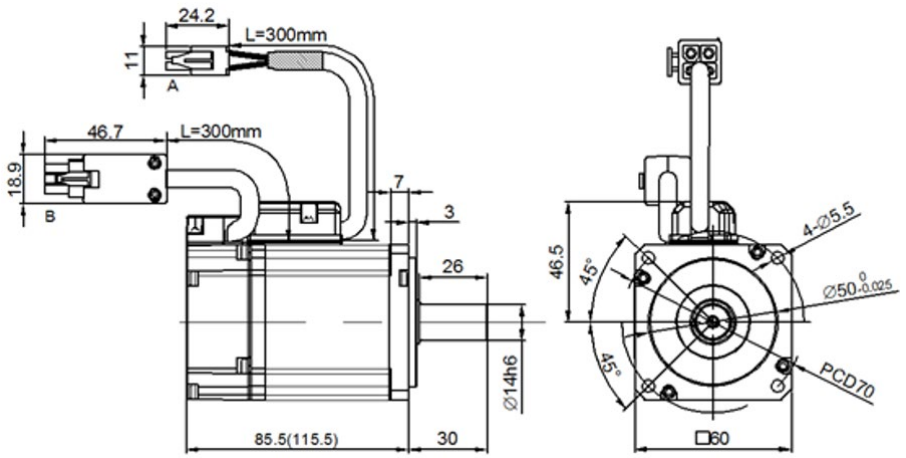
- EM1-C-M-05-2-X-X-0-X



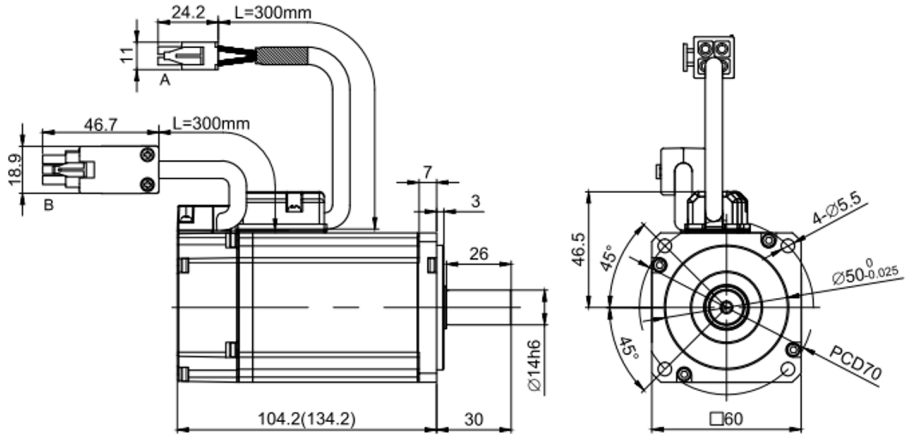

- EM1-C-M-10-2-X-X-0-X



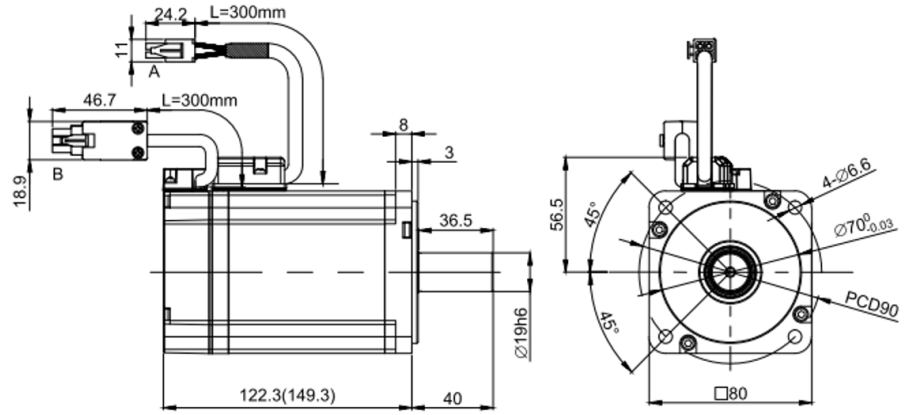

- EM1-C-M-20-2-X-X-0-X



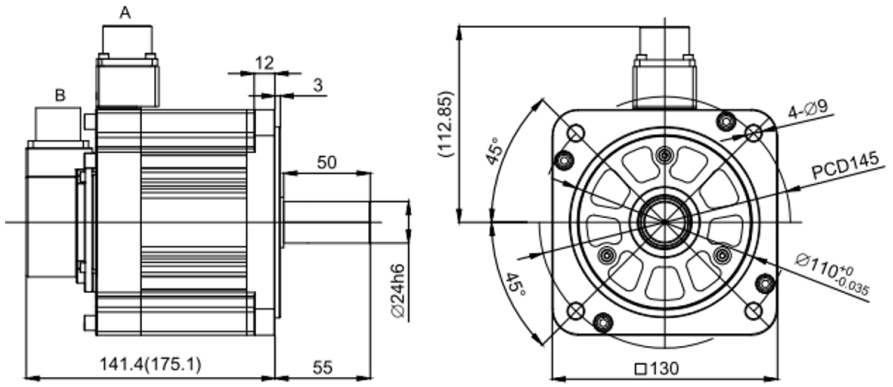
- EM1-C-M-40-2-X-X-0-X



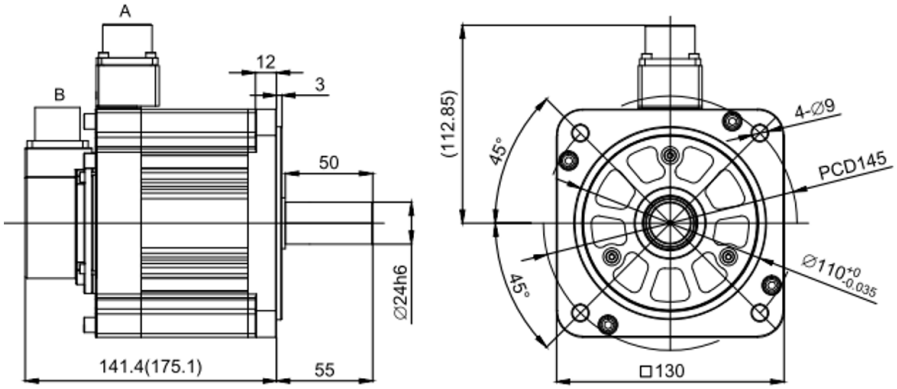

- EM1-C-M-75-2-X-X-0-X



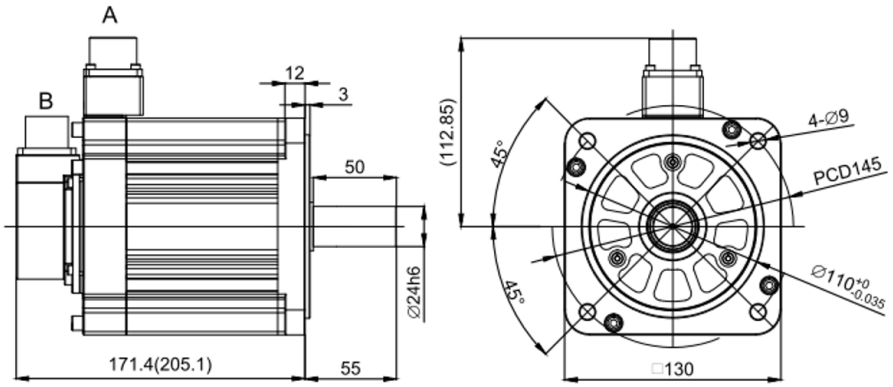

- EM1-A-M-1K-2-X-X-0-X




- EM1-D-M-1A-2-X-X-0-X



- EM1-D-M-2K-2-X-X-0-X




**Note**

Motor shaft and connector are not included.(If the motor shaft needs IP protection, oil seal is necessary)

### 3.3.4 Selection calculation

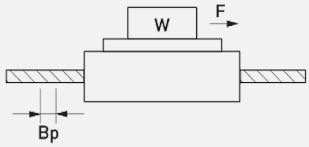
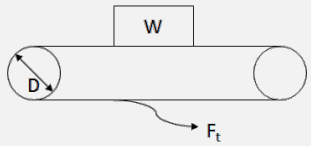
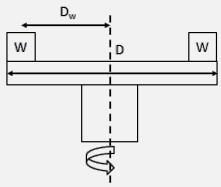
#### 3.3.4.1 Mechanical mechanism

The way to select a suitable motor is based on speed, moving distance, and loading inertia as described in the following contents. The basic process for sizing a motor is as follows.

- Step 1: Provide mechanical transmission mechanism.
- Step 2: Provide motion profile.
- Step 3: Provide load condition.
- Step 4: Load inertia calculation.
- Step 5: Motor speed calculation.
- Step 6: Motor torque calculation.
- Step 7: Motor sizing completed.

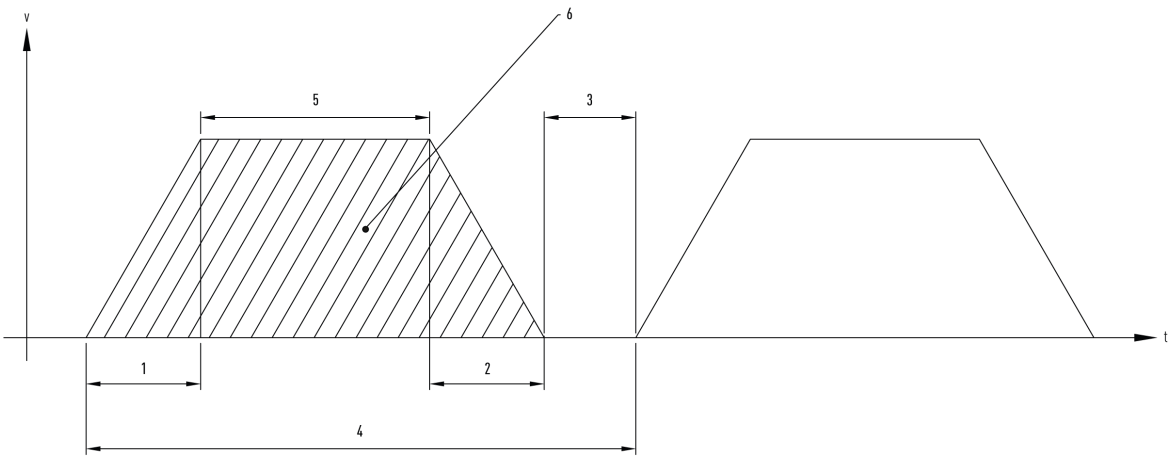
| | | | |
|---|---|---|---|
| $t_f$ | Moving time (sec) | $J_b$ | Ball screw inertia (kgm$^2$) |
| ta | Acceleration time (sec) | $J_P$ | Pulley inertia (kgm$^2$) |
| td | Deceleration time (sec) | $J_T$ | Rotary table inertia (kgm$^2$) |
| $t_c$ | Cycle time (sec) | $J_W$ | Work pieces inertia (kgm$^2$) |
| N | Motor speed (rpm) | J | Total inertia (kgm$^2$) |
| $J_L$ | Load inertia (kgm$^2$) | D | Outer diameter (m) |
| $J_r$ | Rotor inertia (kgm$^2$) | W | Work piece weight (kg) |
| $T_p$ | Peak torque (Nm) | D | Inner diameter (m) |
| $T_t$ | Travelling torque (Nm) | L | Length (m) |
| n | Work pieces amount (pcs) | a, b, c | Side length (m) |
| $T_a$ | Acceleration torque (Nm) | $T_d$ | Deceleration torque (Nm) |

There are many types of mechanical transmission, here we list three types of common transmission mechanism and requirements for motor sizing, as the table below:

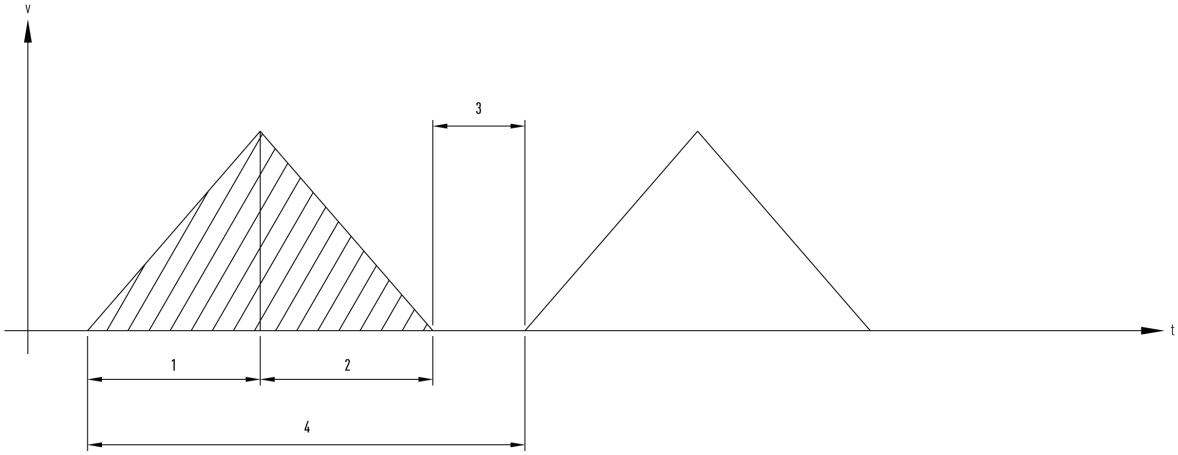
| Transmission mechanism | Requirements |
|---|---|
| **Ball Screw**<br>  | ○ Installation direction: horizontal or vertical<br>○ Ball screw diameter / length / lead<br>○ Work pieces weight<br>○ Outer force |
| **Pulley & Belt**<br>  | ○ Installation direction: horizontal or vertical<br>○ Pulley dimension / weight<br>○ Work pieces weight / Belt weight<br>○ Belt tension force ($F_t$) |
| **Rotary Table**<br>  | ○ Installation direction: horizontal or vertical<br>○ Table dimension / weight<br>○ Work pieces weight / quantities<br>○ Distance from work pieces to rotation axis |

### 3.3.4.2 Motion Profile

○ Trapezoidal profile




○ Triangle profile

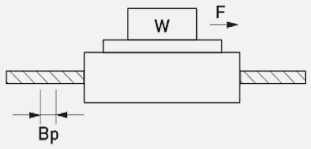
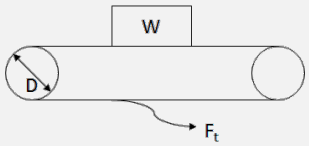
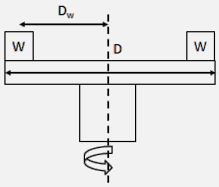



Legend table „Motion Profile“

| | |
|---|---|
| 1 | Acceleration time |
| 2 | Deceleration time |

| | |
|---|---|
| 3 | Stop time |
| 4 | Cycle time |
| 5 | Constant-velocity time |
| 6 | Travel distance (shaded area) |

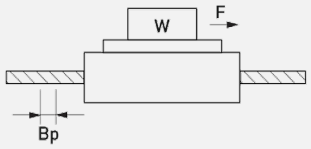
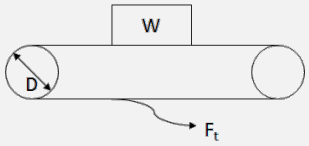
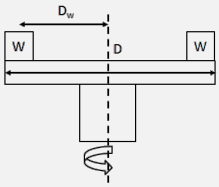
### 3.3.4.3 Load Inertia Calculation

| Transmission mechanism | Load inertia calculation |
|---|---|
| **Ball Screw**   | $J_L = J_B + \frac{WB_p^2}{4\pi^2}$ $B_p$ : Ball screw lead (m) |
| **Pulley & Belt**   | $J_L = J_P + \frac{W \times D^2}{4}$ |
| **Rotary Table**   | $J_L = J_T + n \times (J_w + WD_w^2)$ |

- It is suggested to keep the load inertia ratio below 15 times of normal operation:

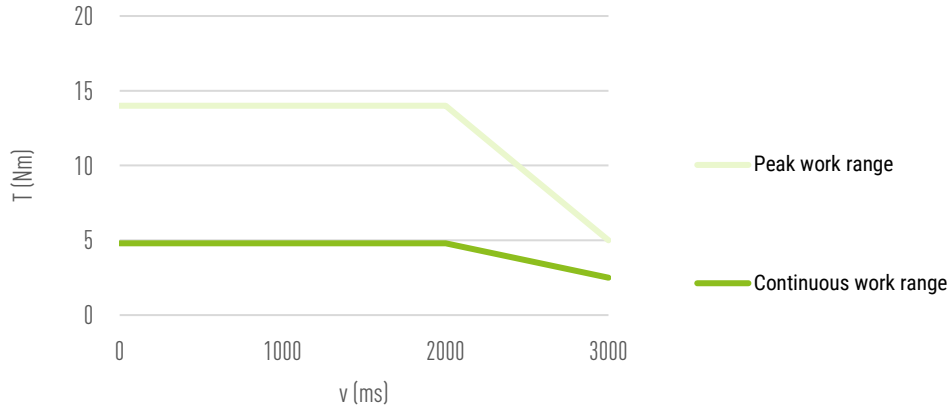
$$\textbf{Load inertia ratio} = \frac{(J_r + J_L)}{J_r} < 30$$

### 3.3.4.4 Motor Speed Calculation

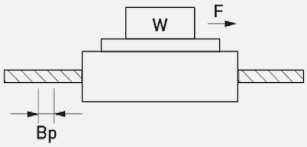
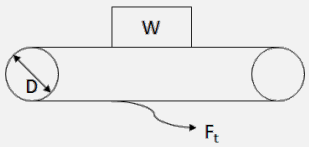
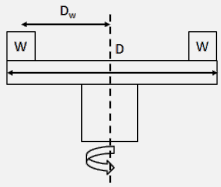
| Transmission mechanism | Motor speed calculation |
|---|---|
| **Ball Screw**   | $N = \frac{V}{B_p} \times 60$ V : velocity $(\frac{m}{s})$ |
| **Pulley & Belt**   | $N = \frac{V}{\pi D} \times 60$ V : velocity $(\frac{m}{s})$ |
| **Rotary Table**   | $N = \frac{\omega}{\pi} \times 30$ $\omega$ : angular velocity $(\frac{rad}{s})$ |

- Motor calculation speed should be under motor continuous work range.

  Ex: As bellowing T-N curve, 3.000 rpm is the continuous work range of motor speed.




### 3.3.4.5 Motor Torque Calculation

| Transmission mechanism | Travelling torque calculation |
|---|---|
| **Ball Screw**   | $T_t = \frac{B_P}{2\pi B_{eff}} \times (\mu g W + F)$<br>$B_{eff}$ : Ball screw efficiency (%)<br>g : gravity ($m/s^2$)<br>μ : friction coefficient |
| **Pulley & Belt**   | $T_t = \frac{D}{2P_{eff}} \times (\mu g W + \mu g W_b + 2F_t)$<br>$P_{eff}$ : Pulley efficiency (%)<br>$F_t$ : Belt tension force (N)<br>$W_b$ : Belt weight (kg) |
| **Rotary Table**   | $T_t = \mu g W_T + n \times \mu g W$<br>$W_T$ : Rotary table weight (kg) |

- **Acceleration torque**

$$T_a = \frac{\pi N}{30 t_a} \times (J_L + J_r) + T_f$$

- **Deceleration torque**

$$T_a = \frac{\pi N}{30 t_d} \times (J_L + J_r) - T_f$$

- **Equivalent torque**

$$T_e = \sqrt{\frac{T_a^2 \times t_a + T_f^2 \times t_f + T_d^2 \times t_d}{tc}}$$

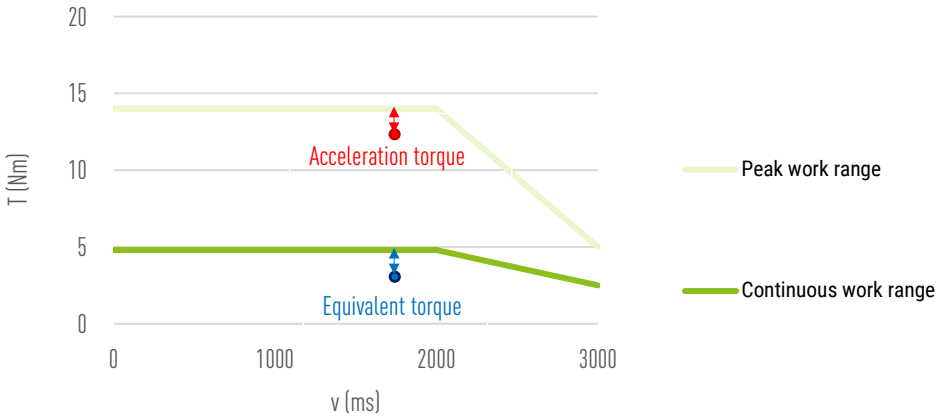
$tc = ta + tf + td + ts$ ts : stop time (sec)

- Its is suggested to keep motor calculation acceleration torque below 80% of motor peak torque.

$$\textbf{Acceleration torque} < 0,8 \times \textbf{Motor peak torque}$$

- Its is suggested to keep motor calculation equivalent torque below 80% of motor rated torque

$$\textbf{Equivalent torque} < 0,8 \times \textbf{Motor rated torque}$$




### 3.3.4.6 Regenerative energy calculation

The section mainly describe how to calculate the regenerative energy during operation, the procedure for regenerative energy are is follows.

- Step 1: Calculate rotation energy (ES) of Servo motor.

$$E_s = \frac{J_t n_m^2}{182}$$

- Step 2: Calculate energy (EL) consumed by load loss during deceleration period.

$$E_L = \frac{\pi \times n_m T_L t_D}{182} (if\ load\ loss\ is\ unknown, set\ E_L = 0)$$

- Step 3: Calculate energy (EM) consumed from Servo motor sinding resistance.

$$E_M = \frac{3 \times I_M^2 \times R_M \times t_D}{2}$$

- Step 4: Calculate the energy that can be absorbed by Servo drive (ED).

$$E_D = \frac{C_{drive} \times (V_{gen}^2 - V_{main}^2)}{2 \times 10^6}$$

- Step 5: Calculate the energy for continuous period of regenerative operation (EG).

$$E_G = \frac{2\pi \times (n_m \times T_m \times t_m)}{60}$$

- Step 6: Calculate energy (capacity) consumed by the regenerative resistor (PR).

$$P_R = \frac{E_s - (E_L + E_M + E_D) + E_G}{t_c}$$

| Symbol | Unit | Description |
|---|---|---|
| $J_t$ | $kgm^2$ | Total inertia (motor+load) |
| $n_m$ | Rpm | Motor speed |
| $T_L$ | Nm | Load torque |
| $t_D$ | s | Deceleration time |
| $I_M$ | Amp | Motor current during deceleration |
| $R_M$ | Ohm | Motor resistance |
| $C_{drive}$ | uF | Drive capacitance |
| $V_{gen}$ | Vdc | Voltage at regeneration |
| $V_{main}$ | Vdc | Voltage from DC bus |
| $T_m$ | Nm | Motor torque during regeneration |
| $t_m$ | s | Time during regeneration |
| $t_c$ | s | Cycle time |
| $E_S$, $E_L$, $E_M$, $E_D$, $E_G$ | Joule | – |
| $P_R$ | Watt | – |

### 3.3.5 Operating Instructions

- Operating temperature: 0°C to 50°C (From 40 to 50 de-rating avoid condensation and icing)
- Operating humidity: 20 % to 80 % RH (Avoid condensation and icing)
- Vibration/Shock resistance: Less than 49 $m/s^2$ (In three direction: Vertical, side to side, and front to back)
- Elevation: Less than 1.000 meters (From 1.000 m to 2.000 m de-rating)

Prevent the operation of high-frequency, remote control and radio equipment near components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

⚠ **Danger!** Danger from Hot Surface!

- Do not place flammable materials around the motor, driver or regenerative resistor.
- Do not use in environment with corrosive, flammable gases or flammable materials.
- Do not touch the surface of servo motor, regenerative resistor and driver which will be hot when operating.

⚠ **Warning**! Personal Injury or Damage to Property.

- The environment temperature will rise due to the motor operating.
- AC servo motor grounding terminal must be installed properly.

### 3.3.6 De-rating curve

The rated value of AC servo motor is the continuous allowable value at the ambient air of 40°C when a heat sink is installed. The dimensions of the heat sinks used for different types of AC servo motors are shown in Table 3.1. If the AC servo motor is operated over 40°C ( Maximum 60°C), please apply the appropriate derating curve as shown in Abb. 3.1 to Abb. 3.8.

Table 3.1:

| AC servo motor | Heat Sink Size (Material) |
|---|---|
| EM1-C-M-05<br>EM1-C-M-10 | 200 (L) * 200 (W) * 6 (T) mm<br>Aluminum Alloys |
| EM1-C-M-20<br>EM1-C-M-40<br>EM1-C-M-75 | 250 (L) * 250 (W) * 6 (T) mm<br>Aluminum Alloys |
| EM1-A-M-1K<br>EM1-D-M-1A<br>EM1-D-M-2K | 300 (L) * 300 (W) * 6 (T) mm<br>Aluminum Alloys |

Abb. 3.1: EM1-C-M-05 (50 W)

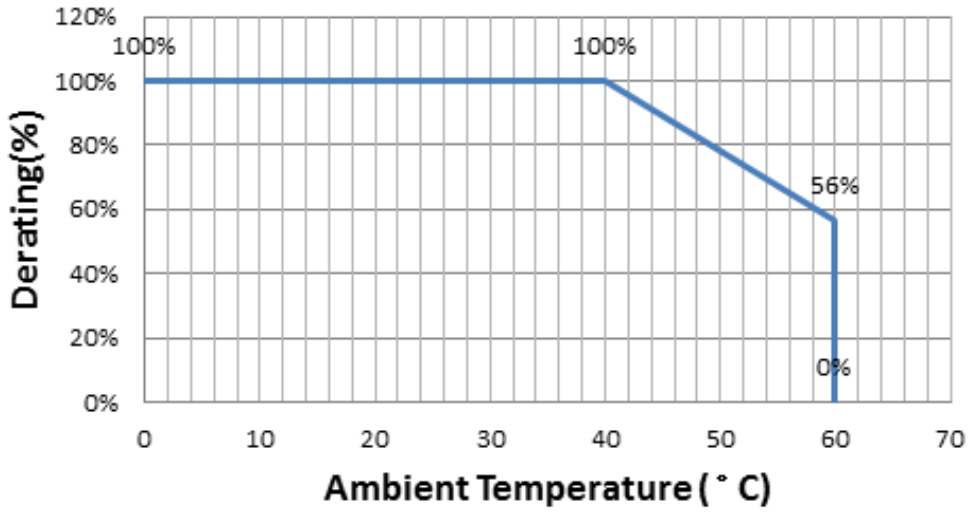



Abb. 3.2: EM1-C-M-10 (100 W)

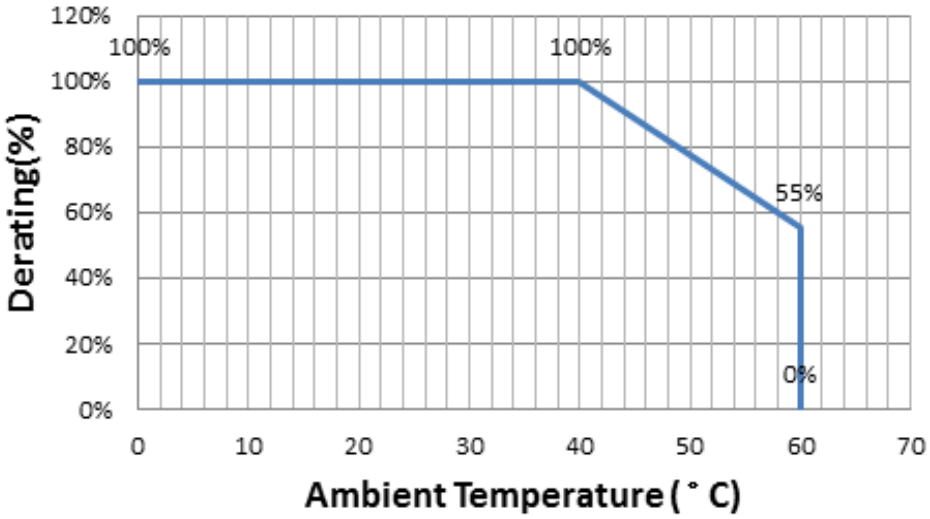


Abb. 3.3: EM1-C-M-20 (200 W)

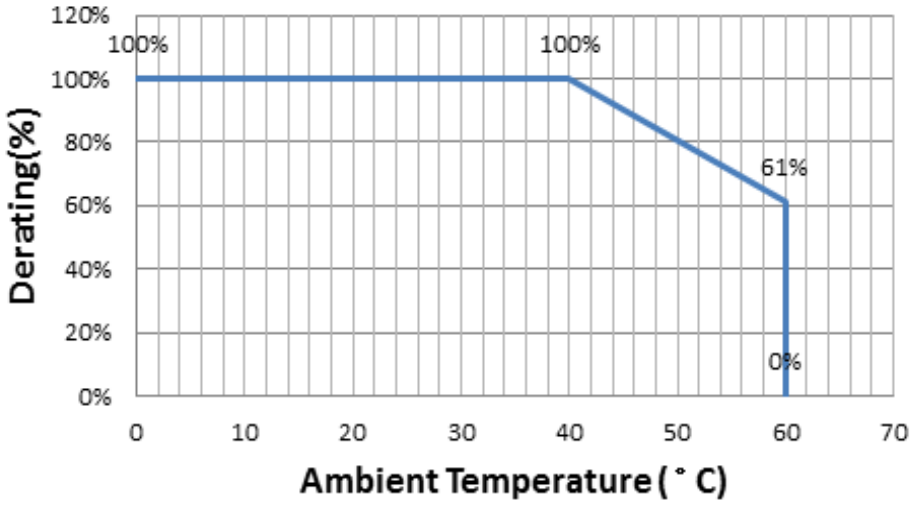



Abb. 3.4: EM1-C-M-40 (400 W)

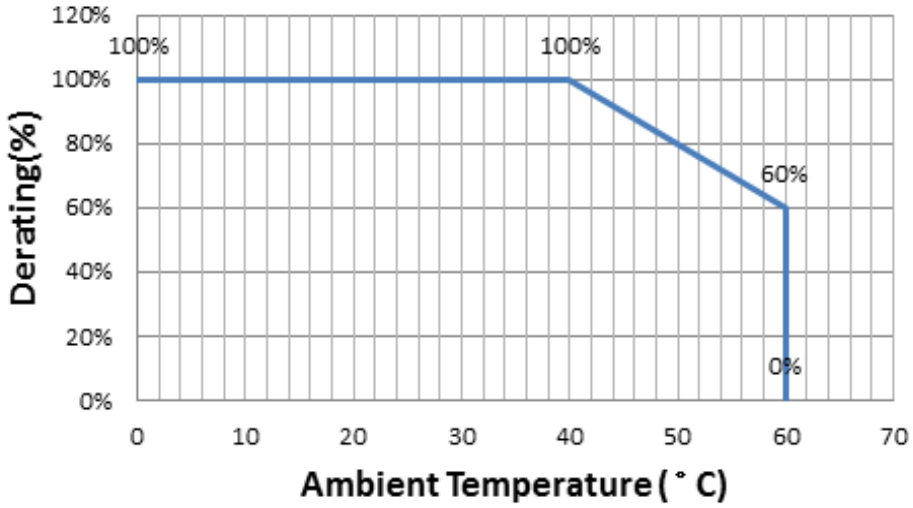



Abb. 3.5: EM1-C-M-75 (750 W)

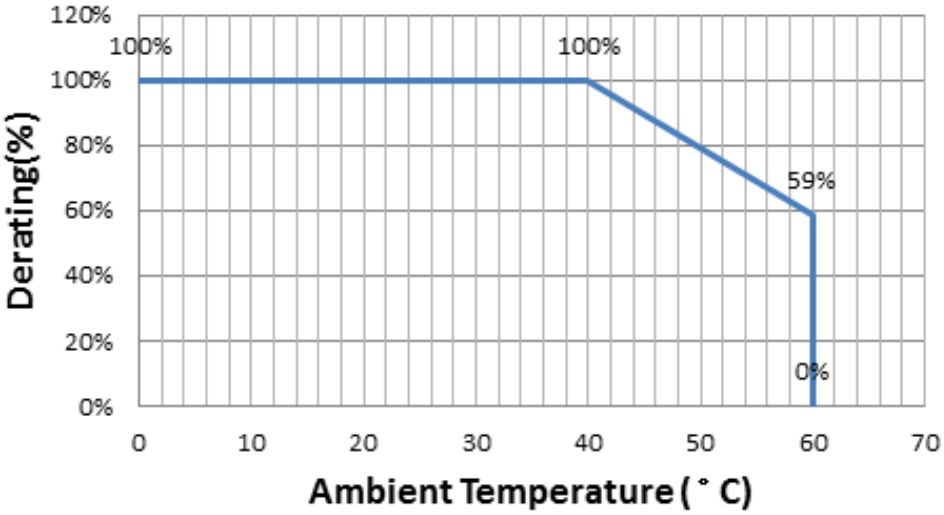


Abb. 3.6: EM1-A-M-1K (1 KW)

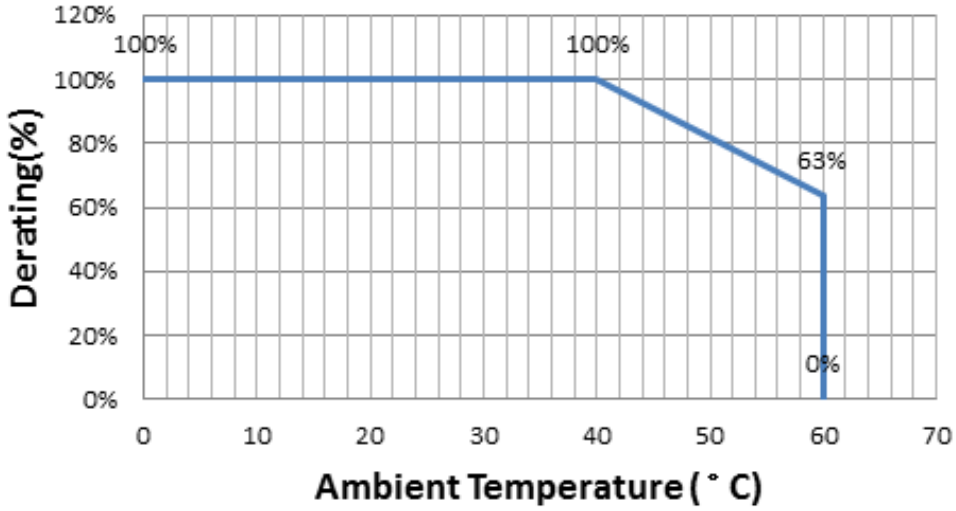



Abb. 3.7: EM1-D-M-1A (1,2 KW)

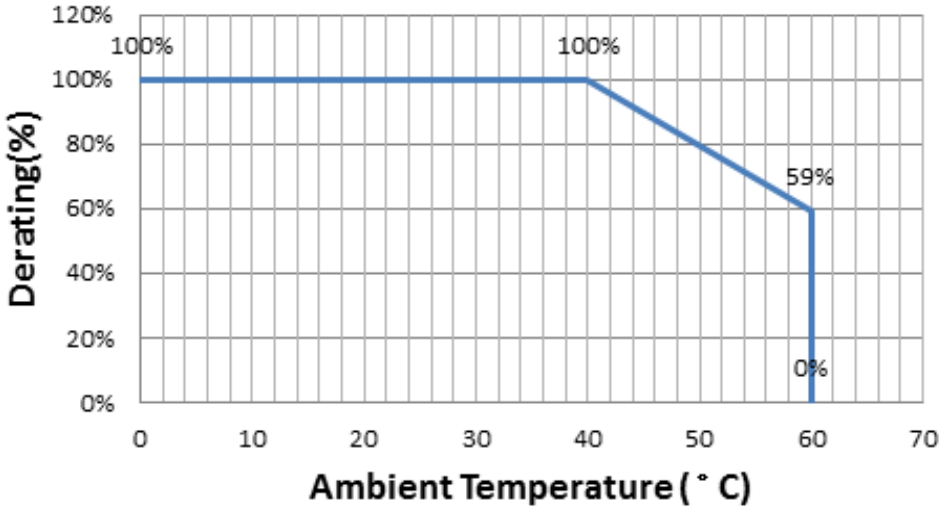
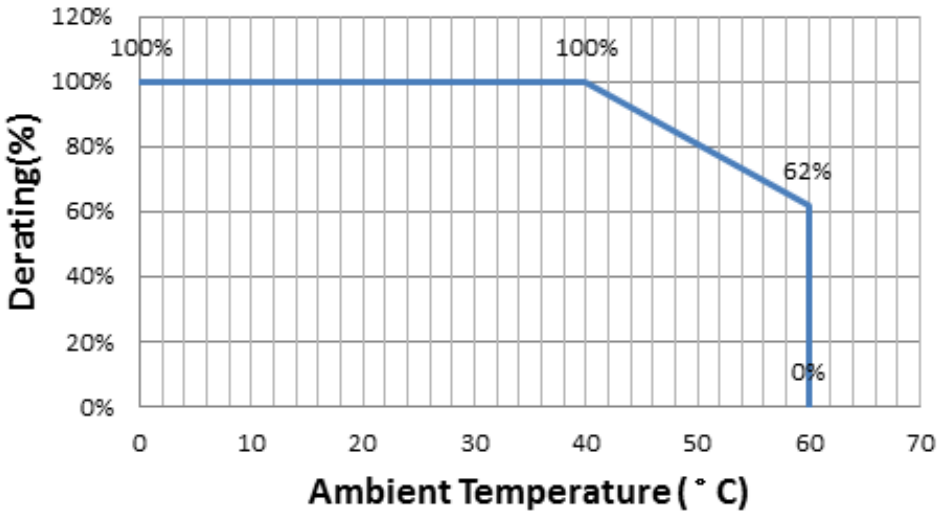



Abb. 3.8: EM1-D-M-2K (2 KW)



# 4 Transport and setup

## 4.1 Delivery

### 4.1.1 Delivery State

The AC servo motors are supplied fully assembled, function tested and ready for connection. To prevent damage arising during transport, the AC servo motors are provided with transportation safety devices and shipping devices.

### 4.1.2 Scope of Delivery

For the scope of delivery, please see the contractual documentation.

### 4.1.3 Delivery Ambient Conditions

| Environmental parameter | Unit | Value |
|---|---|---|
| Air temperature | (°C) | -15 – 55 |
| Relative humidity | (%) | 20 – 80 |
| Rate of change of temperature | (°C/min) | 0,5 |
| Air pressure | kPa | 70 – 106 |
| Condensation | - | Not allowed |
| Formation of ice | - | Not allowed |
| Delivery the motor in an environment with good protection. (indoor/factory) | | |

**Note**

- Avoid exposing to direct sunlight.
- Keep away from electric magnetic interference source sites such as welding and discharge machines.

## 4.2 Transport to the Installation Site

⚠ **Danger!** Danger from Strong Magnetic Fields!

Strong magnetic fields around AC servo motor pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.

- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from AC servo motor systems.

⚠ **Warning**! Risk of Personal Injury.

- Lifting heavy loads may damage your health.
- For total load of package with AC servo motors weight over 20 kg, use a hoist of an appropriate size when positioning heavy loads!
- Observe applicable occupational health and safety regulations when handling suspended loads!

⚠ **Caution!** Risk of physical damage to watches and magnetic storage media.

- Strong magnetic force may destroy watches and magnetizable data storage media near the AC servo motor!
- Do not bring watches or magnetizable data storage media in the vicinity (<300 mm) of the AC servo motor!

⚠ **Caution!** Risk of damage to the AC servo motor!

The AC servo motor may be damaged by mechanical loading.

- No heavy load on the cover!
- During transportation, do not put any additional loads on the AC servo motors.

## 4.3 Requirements at the installation site

| | | |
|---|---|---|
| Air temperature | (°C) | 0 – 50 |
| Relative humidity | (%) | < 80 RH (non-condensing) |
| Altitude | m | < 1.000 |
| Installation site | - | Flat, dry, vibration-free |
| Protection class | - | No interference from corrosive solvent or strong magnetic |
| Grounding | - | Plant power grounding line conforms to international requirements |

**Note**

- Avoid exposing to direct sunlight.
- Keep away from electric magnetic interference source sites such as welding and discharge machines.

## 4.4 Storage

⚠ **Danger!** Danger from Strong Magnetic Fields

- Strong magnetic fields around AC servo motor pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.
- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 meter from AC servo motor systems.

- Store the AC servo motor in its transport packaging.
- Only store the AC servo motor in dry, frost-free areas with a corrosion-free atmosphere.
- Clean and protect used AC servo motor before storage.
- When storing AC servo motor, attach signs warning of magnetic fields.

### 4.4.1 Storage Ambient Conditions

| Environmental parameter | Unit | Value |
|---|---|---|
| Air temperature | (°C) | -15 ~ 70 |
| Relative humidity | (%) | 20 ~ 80 |
| Rate of change of temperature | (°C/min) | 0,5 |
| Air pressure | kPa | 70 ~ 106 |
| Condensation | - | Not allowed |
| Formation of ice | - | Not allowed |
| Delivery the motor in an environment with good protection. (indoor/factory) | | |

## 4.5 Unpacking and setup

⚠ **Caution!** Risk of damage to the AC servo motor!

The AC servo motor may be damaged by mechanical loading.

- No heavy load on the cover!
- During transportation, do not put any additional loads on the AC servo motors.

**Note**

- The AC servo motor can only be unpacked indoors.
- The AC servo motor (50W-750W) are provided with power outgoing line and encoder outgoing line. During unpacking, the outgoing line of AC servo motor must not be bended or pulled.

- Procedure of unpacking the AC servo motor:

- Step 1: Unbox the carton and take out the AC servo motor.
- Step 2: Remove protective film and shaft cover outside the AC servo motor.
- Step 3: Do not to touch the shaft by hand without gloves to prevent shaft from getting rusted.
- Step 4: Carefully handle the outgoing line from the AC servo motor. Do not bend or pull the wiring.
- Step 5: Ensure the appearance and nameplate on AC servo motor are the same with the catalogue.
- Step 6: Dispose of packaging in an environmentally friendly way.

# 5 Assembly and connection

### 5.1.1 Installation Environment

- **Operating temperature:** 0°C to 50°C (From 40 to 50 de-rating avoid condensation and icing)
- **Operating humidity:** 20 % to 80 % RH (Avoid condensation and icing)
- **Storage temperature:** -15°C to 70°C (Avoid condensation and icing)
- **Storage humidity:** 20 % to 80 % RH (Avoid condensation and icing)
- **Vibration/Shock resistance:** Less than 49 $m/s^2$ (In three direction: Vertical, side to side, and front to back)
- **Elevation:** Less than 1.000 meters (From 1.000 m to 2.000 m de-rating)
- **Installation Precautions:**

1. Please install this product indoors, out of direct sunlight.
2. Please install this product in a site without humidity, dust or hazardous/corrosive gases or liquids.
3. The servo motor's shaft is not water or oil proof. Thus, do not install or use this servo motor in an environment with water or oil droplets, excessively high humidity or corrosive/flammable gases.
4. Do not store this product in a site with vibration that exceeds the quantity stated in the specification document.
5. The servo motor shaft material is not rust-resistant. Although grease has been applied to prevent rust before the products shipped, if the storage time exceeds six months, inspect the shaft every three months to make sure that it is not rusted. Apply an appropriate amount of rust-prevention grease when needed.

### 5.1.2 Tools and Equipment

- Installation

| Item | Tool |
|---|---|
| Motor | Torque wrench |
| Oil seal | – |
| Key | Hand press machine |
| Belt | Screwdriver or wrench |
| Cable | – |

- Personal Protective Equipment

When in the vicinity of the AC servo motor systems, the following personal protective equipment is required:

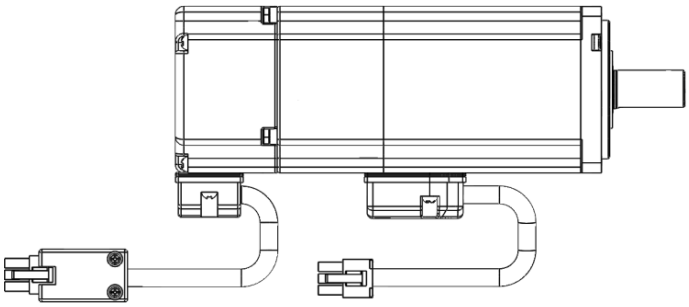
1. Safety shoes
2. Protective helmet
3. Protective gloves

### 5.1.3 Servo motor installation

#### 5.1.3.1 Motor

- Orientation

Horizontal: cable lead must face downward to prevent oil or water penetration.



Vertical direction: when the motor shaft mounted with reducer is installed facing upwards, oil seal must be used to prevent the reducer oil from flowing into the inside of the motor.

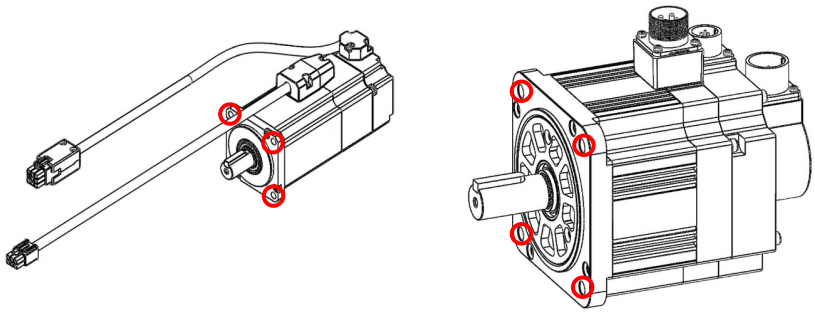
- Installation Interface

The motor rated specifications (rated output, rated torque, and rated speed) are the continuous allowable values at an ambient temperature of 40°C (from 40 to 50 de-rating avoid condensation and icing) when servo motors are installed with the following heat sinks and screws.

| Motor | PCD screw hole (mm) | Interface(mm) | Screw Type | Tightening Torque |
|---|---|---|---|---|
| 50 W to 100 W | 4,3 | 200x200x6, aluminum plate | 2*M4x20 | 1,63 Nm (16,6 kgf·cm)±10 % |
| 200 W to 400 W | 5,5 | 250x250x6, aluminum plate | 4*M5x20 | 3,28 Nm (33,4 kgf·cm)±10 % |
| 750 W | 6,6 | 250x250x6, aluminum plate | 4*M6x20 | 5,58 Nm (56,9 kgf·cm)±10 % |
| 1 kW to 2 kW | 9 | 400x400x20, iron plate | 4*M8x20 | 13,5 Nm (138 kgf·cm)±10 % |

**Note**

1 Nm = 10,1972 kgf·cm

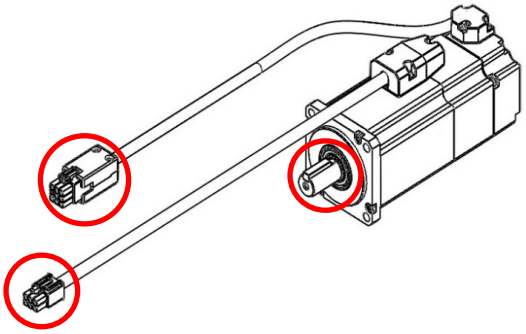


- Protective Structure

HIWIN servo motor protective structure is described below.

1 50 W to 750 W: IP65

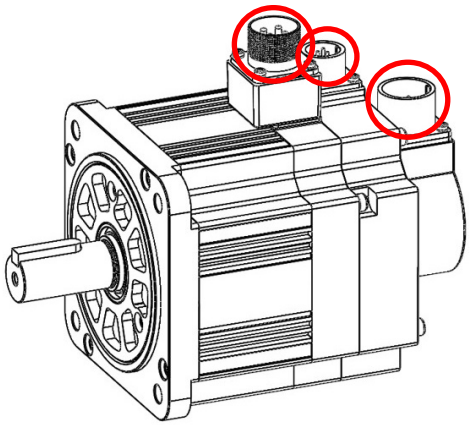
Except for power connector, encoder connector, motor through shaft section need to add oil seal which is optional for all type of AC servo motor.



2 1 kW to 2 kW: IP65

For 1 kW to 2 kW servo motors, the protective structure specifications can only be satisfied when military connector connecting with cable.

Motor through shaft section need to add oil seal which is optional for all type of AC servo motor.



- Preparation

Prepare motor assembly as following instructions:

1. Procure tools, supplies, measuring and test equipment.
2. Check all components for visible damage. Damaged components may not be mounted.
3. Ensure that dimensions and tolerances on the system side are suitable for motor attachment (for details, see the dimension sheet).
4. Inspect all components, mounting surfaces and threads to ensure they are clean.
5. Make sure that the assembly can be carried out in a dry and dust-free environment.
6. Make sure that the holder for the motor flange is deburred.
7. Remove the protective sleeve of the motor drive shaft and keep it for further use.

- Assembly

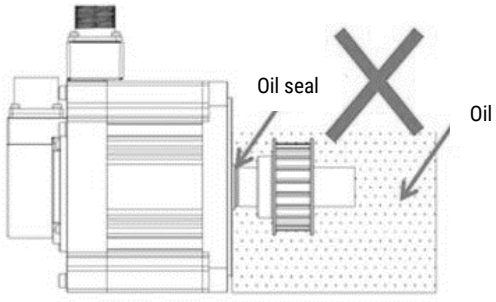
Assemble the motor and observe that:

1. Avoid pinching or jamming the centering collar on the motor side.
2. Avoid damage to the insertion fitting on the system side.
3. Connect the motor with the machine and observe the tightening torques.
4. Check whether the connection is firm and accurate before carrying out any further steps.

After having assembled the motor mechanically, prepare it for electrical connection. (See section 5.2 Electrical installation)

### 5.1.3.2 Oil Seal

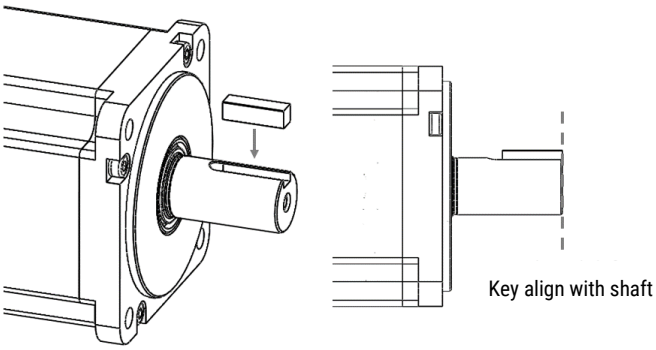
- If the servo motor shaft and flange opening is easily affected by oil spray in the operation environment, use a motor with an oil seal.
- Check the operation environment to make sure that the oil seal material is appropriate.
- The oil seal should not be used in a location lower than the oil surface or the oil can leak in through the opening of motor flange to damage the servo motor.



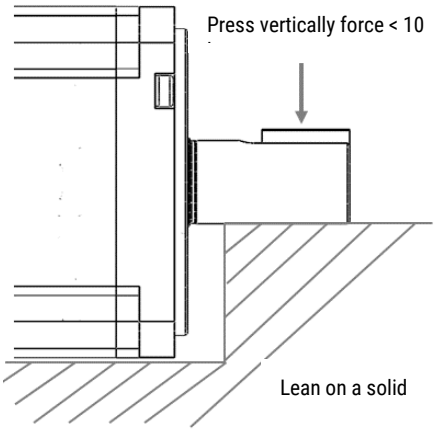

### 5.1.3.3 Key

- Installation Procedures:

1. Clean dirt from keyway.
2. Clean dirt from key.
3. Press key into shaft without deformation.
4. Put key onto keyway.



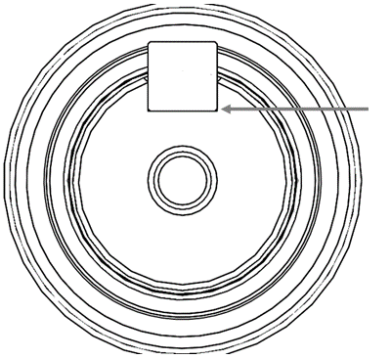

5. Lean shaft on a solid surface. Make sure key be pressed vertically. Press velocity should under 400 mm/min. Punching is prohibited.



6 Press key vertically to the bottom side. Press height is as in following table.

| Motor Type | Press Height (mm) |
|---|---|
| 50 W / 100 W | 1,8 |
| 200 W / 400 W | 3 |
| 750 W | 3,5 |
| 1 kW / 2 kW | 4 |

7 Check key be the bottom side of keyway.




○ Uninstallation Procedures:

▶ For 50 W / 100 W:

1 Remove plastic cover from shaft.

2 Prepare diagonal pliers.

3 Clip key with pliers.

4 Remove key from shaft.

▶ For 200 W / 400 W / 750 W / 1 kW / 2 kW

1 Remove plastic cover from shaft.

2 Attach jig on motor shaft.

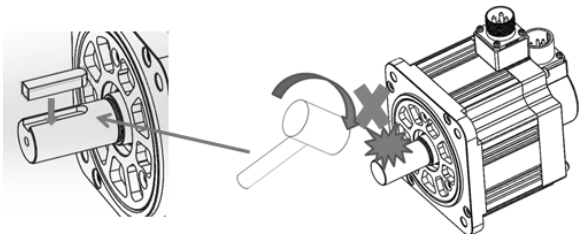
3 Rotate jig clockwise.

4 Couple puller with jig on.

5 Rotate puller clockwise to remove key from keyway.

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

▶ When putting the key that comes with the product or a key designated by the manual into the keyway, do not directly strike the shaft, which can cause damage.



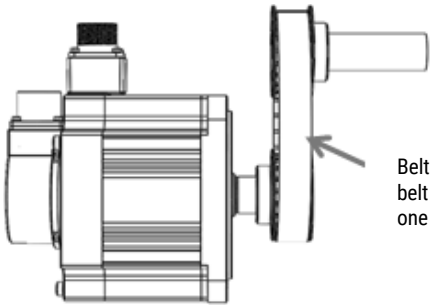
⚠ **Caution!** Risk of Personal Injury or Damage to Property.

▶ Be sure that key be pressed vertically.

▶ Be careful with the sharp keyway when cleaning or installing key.

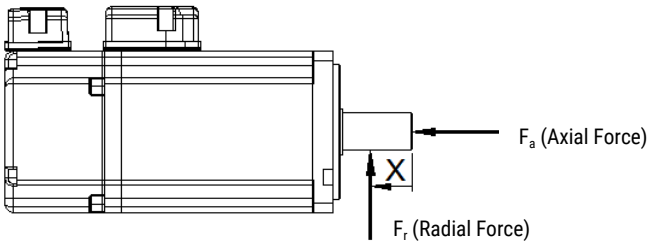
#### 5.1.3.4 Belt

- Choose a belt that is suitable for the servo motor is allowable radial load and output power.
- When the motor accelerates or decelerates, the reaction force to the acceleration/deceleration will increase the initial belt tension. Thus, when choosing a belt, please consider the load of motion and the belt's safety coefficient.
- When installing the belt, suitably adjust the belt tension force and consider the allowable radial load stated in the motor operating instruction. Please reference to the following information.



Belt adjustment: measure and adjust belt tension force multiple times in one circle.

- Motor Shaft Allowable Axial and Radial Force




$F_a$ (Allowable axial force):

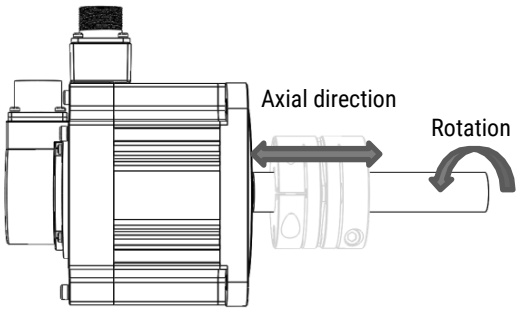
| Frame size | Allowable axial force |
|---|---|
| 40 mm | 54 N |
| 60 mm | 74 N |
| 80 mm | 147 N |
| 130 mm | 343 N |

$F_r$ (Allowable radial force):

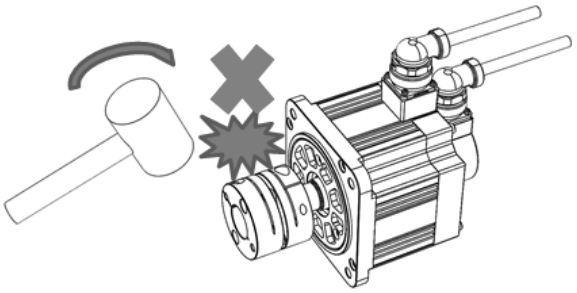
| Frame size | Allowable radial force(X) [Force unit: Newton] / [X unit: mm] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | x=0 | x=5 | x=10 | x=15 | x=20 | x=25 | x=30 | x=35 | x=40 | x=45 | x=50 |
| 40 mm | 68 | 74 | 80 | 88 | 98 | - | - | - | - | - | - |
| 60 mm | 190 | 200 | 215 | 230 | 245 | 270 | - | - | - | - | - |
| 80 mm | 340 | 350 | 365 | 380 | 395 | 415 | 435 | - | - | - | - |
| 130 mm | 640 | 660 | 685 | 715 | 745 | 775 | 810 | 850 | 890 | 940 | 990 |

#### 5.1.3.5 Coupling

- Before installation, please clean and remove the rust spots, dust and oil on the outer surface of the motor shaft and inner surface of coupling, especially molybdenum, silicon and fluorine type lubricant or esters. These lubricants and ester affect the friction coefficient and should never be on the motor shaft and coupling.
- According to load conditions, choose suitable coupling. Excessively large or small coupling can cause damage to coupling.
- When the two clamping screw bolts on coupling are loose, check whether or not the coupling can slightly move along the axial direction and rotating direction. If the coupling cannot be smoothly moved, re-adjust the concentricity of both axis of motor shaft and coupling. This is an easy way to check the concentricity between both ways. If this method cannot be used to check, then use machine part precision management or other methods to check installation concentricity.



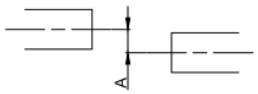

- When installing the coupling on motor shaft, do not apply too much compressive or tensile force. Do not impact the motor shaft or it can affect the installation precision.



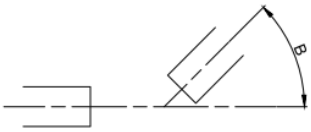
- Before coupling install with the motor shaft, do not fasten the screw bolt.
- When choosing the coupling, do not exceed the maximum torque limit of the transmission. Choose the model according to the allowable eccentricity, declination, and axial direction deviation stated in the instructions.
- If an abnormal coupling noise (metallic noise) is discovered during operations, stop operations immediately and check if the eccentricity of shaft are affected or if screws are loose.
- Do not change the screws that match the coupling, or change screws referencing its use specifications.
- Do not touch coupling while operating. To prevent danger, install a protective outer cover and other safety measures.
- Conduct installation only when the main power is shut OFF.

- When installing the motor, pay attention to the following three types of basic deviation. Illustrations are shown below.

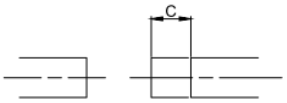
1. Eccentricity (A):



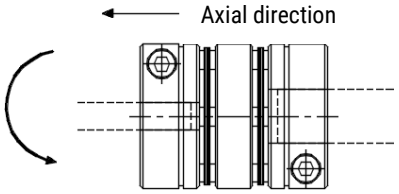

2. Declination (B):




3. Axial direction displacement (C):




- The simple method for calibration of the centerline between two axis is to loosen the coupling located on the shaft of AC servo motor and the load end's shaft shoulder, and rotate the coupling to confirm if it can slightly move in axial and rotational direction, to confirm the concentricity of the two axes. Refer to the diagram as follows:




- Please check the concentricity when installing through motor flange and the PCD hole position of the flange. The size of the recommended flange holes for installation is shown as below.

| Motor output power | Flange circle size | Tolerance |
|---|---|---|
| 50 W – 100 W | 30 mm | H7 |
| 200 W – 400 W | 50 mm | H7 |
| 750 W | 70 mm | H7 |
| 1 kW – 2 kW | 110 mm | H7 |

- When installing the motor flange, please make sure that the deviation between the motor flange position hole and the load-end axis needs to be within the coupling's related allowable deviation.
- If the deviation between the motor shaft and the load-end axis shoulder is too high, and the coupling is forcefully installed, it can cause the motor shaft, coupling, or load-end axis shoulder to break. So make sure that the deviation between the two axes is within the coupling's allowable deviation.
- When choosing a coupling, we recommend choosing a flexible coupling that can absorb the eccentricity, declination and axial direction displacement.

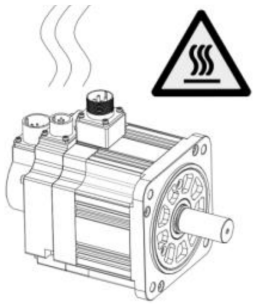
#### 5.1.3.6 Safety brakes

- Precautions for using safety brakes

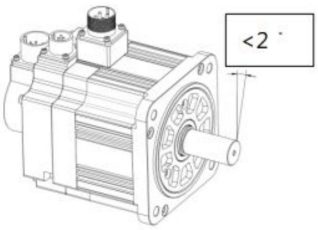
1. The brake is used to keep the motor at a stop for long-period holding or for emergency stop in case of power shortage. Do not use the brake for dynamic braking to perform motor emergency stop, or it may be damaged from improper use.
2. Before operating the motor, check the supply power and function of the brake. For other detailed information, please refer to the sequence diagram in the manual.
3. The brake voltage is DC 24 V. Check the input voltage before use.
4. Before operating the servo motor, check the braking and release time of the brake's armature.
5. Environment for brake operation: if there is water or oil on the friction surface of the brake, the braking torque would be decreased. Since the cable is not oil-resistant, an outer cover must be used for protection in an environment with oil or grease.

- The following conditions are often mistaken for brake damage

1. Heat: even if the servo motor is shut off, the power that maintains the brake holding will heat up the servo motor.



2. Rotational backlash: The brake still have the rotational backlash in holding state. The maximum rotational backlash is within 2 degrees.




3. Noise: when the motor is operating at a low rotation, accelerating, stopping or changing directions, sometimes the friction plate will produce a noise. This is not a malfunction noise but a sound from the brake module structure, which will not affect motor function.

- Brake maintenance and inspection

Maintaining and inspecting the brakes regularly may prolong its function.

1. Check if the ON/OFF operation is correct.
2. Check if there are any noises.
3. Check if there is abnormal heating.
4. Check if the release time is abnormal.
5. Check if the input voltage is correct.

## 5.2 Electrical installation

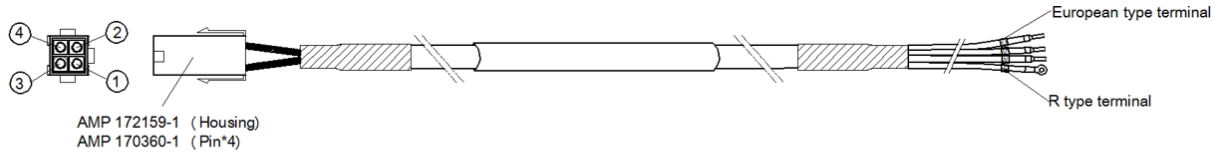
### 5.2.1 Motor Cable Pin Assignment

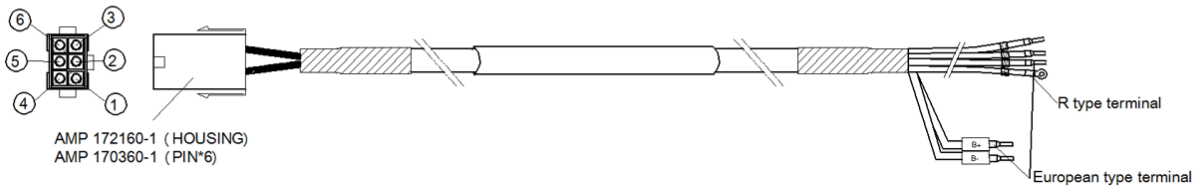
#### 5.2.1.1 Motor Power Cable Connector

- Small Capacity Series / 50 W – 750 W

HVPS04AB / HVPS06AB

| Signal | AMP 172159-1<br>AMP 170360-1 | | AMP 172160-1<br>AMP 170360-1 | | - | Conductors | Insulators |
|---|---|---|---|---|---|---|---|
| | (without brake) | | (with brake) | | | | |
| U | 3 | Red | 3 | Red | European terminal | 18 AWG | 2,8 mm |
| V | 2 | White | 2 | White | European terminal | 18 AWG | 2,8 mm |
| W | 1 | Black | 1 | Black | European terminal | 18 AWG | 2,8 mm |
| GND | 4 | Green | 4 | Green | R type terminal | 18 AWG | 2,8 mm |
| B+ | - | | 5 | Yellow | European terminal | 18 AWG | 2,8 mm |
| B- | - | | 6 | Blue | European terminal | 18 AWG | 2,8 mm |

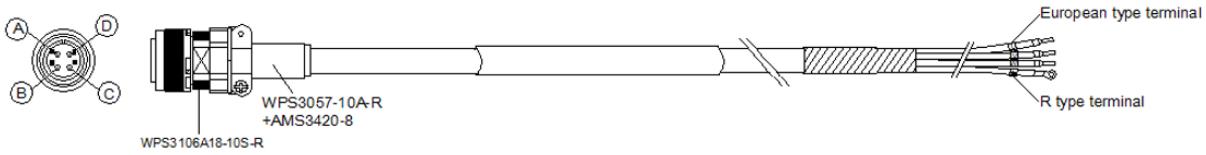


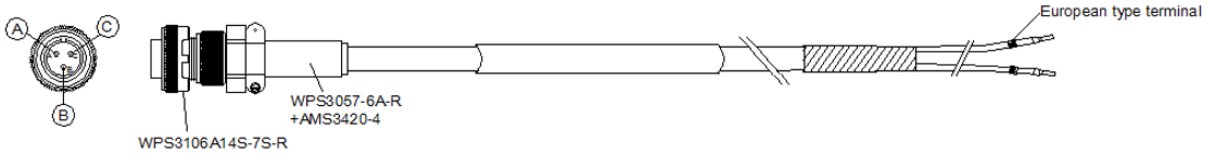



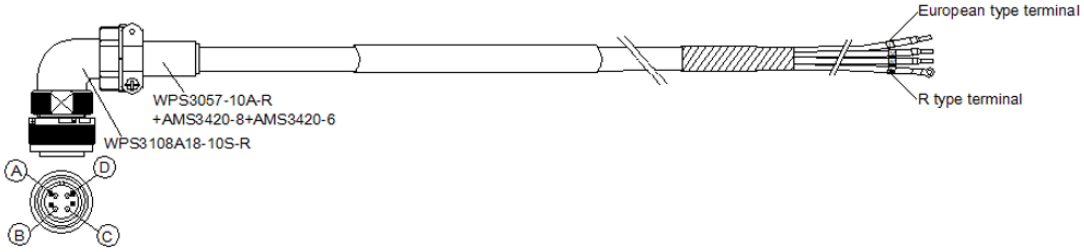
- Middle Capacity Series / 1kW – 2 kW

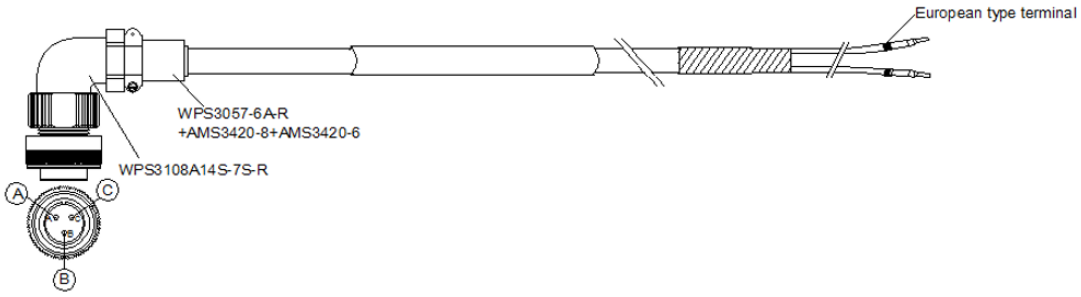
HVPM04BB / HVPM04CB / HVPM02BA / HVPM02CA

| Signal | WPS3106A18-10S-R<br>WPS3108A18-10S-R | | WPS3106A14S-7S-R<br>WPS3108A14S-7S-R | | - | Conductors | Insulators |
|---|---|---|---|---|---|---|---|
| U | A | Red | - | - | European terminal | 14 AWG | 3,6 mm |
| V | B | White | - | - | European terminal | 14 AWG | 3,6 mm |
| W | C | Black | - | - | European terminal | 14 AWG | 3,6 mm |
| GND | D | Green | - | - | R type terminal | 14 AWG | 3,6 mm |
| B+ | - | - | A | White | European terminal | 20 AWG | 1,8 mm |
| B- | - | - | C | Black | European terminal | 20 AWG | 1,8 mm |



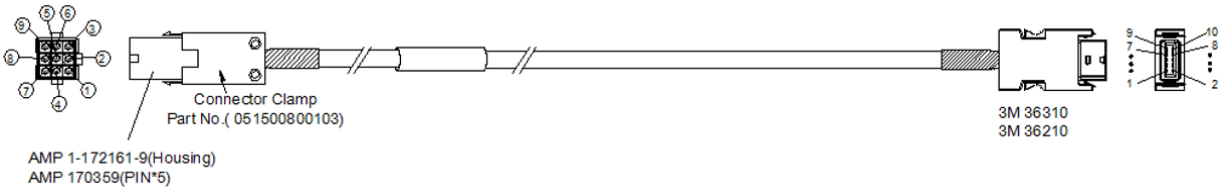



#### 5.2.1.2 23 bit Single-Turn Absolute Encoder Cable Connector

- Small Capacity Series / 50 W – 750 W

HVE23IAB

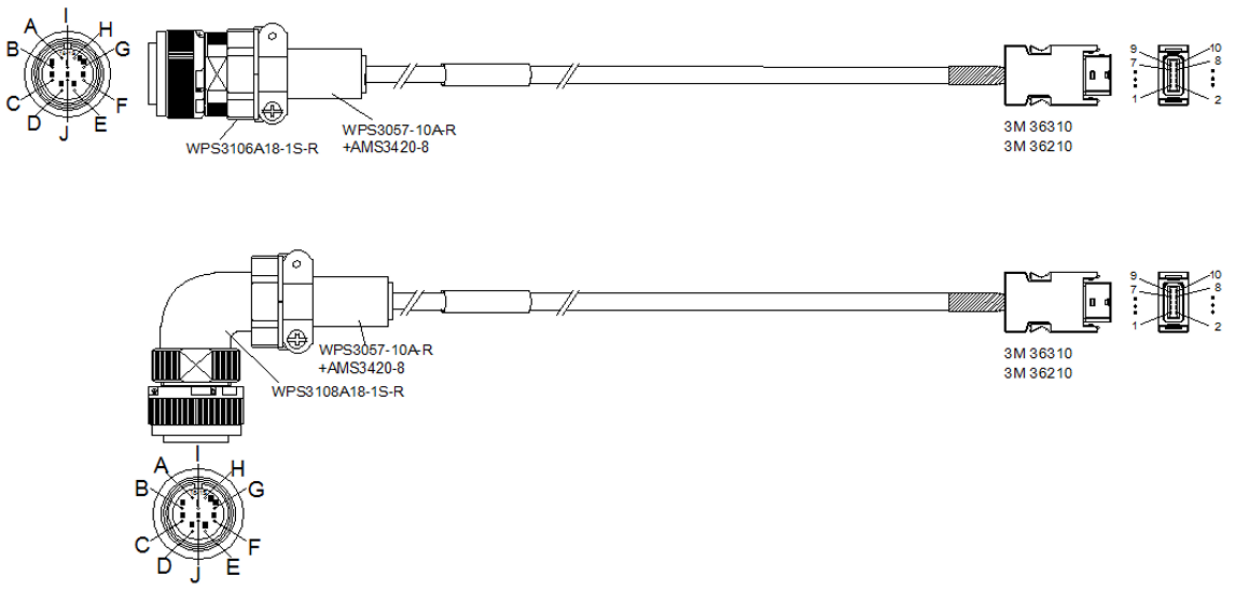
| Function | Signal | AMP 1-172161-9<br>AMP 170359-1 | Color | 3M 36310<br>3M 36210 | Conductors | Insulators |
|---|---|---|---|---|---|---|
| Power | 5 V | 1 | Blue (Red) | 1 | 24 AWG | 1,3 mm |
| | 0 V | 2 | Blue (Black) | 2 | 24 AWG | 1,3 mm |
| Serial Data Signal | SD+ | 7 | Yellow (Red) | 3 | 24 AWG | 1,3 mm |
| | SD- | 8 | Yellow (Black) | 4 | 24 AWG | 1,3 mm |
| Shielding | Shielding | 9 | Black | Housing | Shielding | - |




- Middle Capacity Series / 1 kW – 2 kW

HVE23IBB / HVE23ICB

| Function | Signal | WPS 3106A18-1S-R<br>WPS 3108A18-1S-R | Color | 3M 36310<br>3M 36210 | Conductors | Insulators |
|---|---|---|---|---|---|---|
| Power | 5 V | A | Blue (Red) | 1 | 24 AWG | 1,3 mm |
| | 0 V | B | Blue (Black) | 2 | 24 AWG | 1,3 mm |
| Serial Data Signal | SD+ | G | Yellow (Red) | 3 | 24 AWG | 1,3 mm |
| | SD- | H | Yellow (Black) | 4 | 24 AWG | 1,3 mm |
| Shielding | Shielding | I | Black | Houing | Shielding | - |

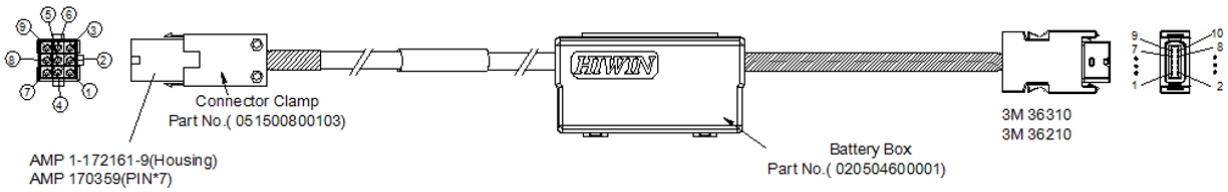


#### 5.2.1.3 23 bit Multi-Turn Absolute Encoder Cable Connector with Battery Box

- Small Capacity Series / 50 W – 750 W

HVE23AAB

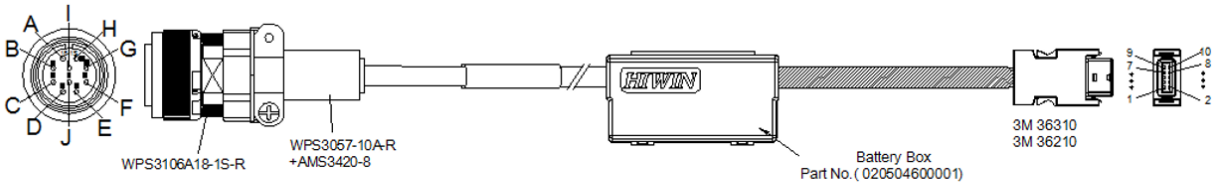
| Function | Signal | AMP 1-172161-9<br>AMP 170359-1 | Color | 3M 36310<br>3M 36210 | Battery Box<br>HRS DF3-2EP-2C | Conductors | Insulators |
|---|---|---|---|---|---|---|---|
| Power | 5 V | 1 | Blue (Red) | 1 | - | 24 AWG | 1,3 mm |
| | 0 V | 2 | Blue (Black) | 2 | - | 24 AWG | 1,3 mm |
| Battery | VB | 5 | Green (Red) | - | Red | 24 AWG | 1,3 mm |
| | GND | 6 | Green (Black) | - | Black | 24 AWG | 1,3 mm |
| Serial Data Signal | SD+ | 7 | Yellow (Red) | 3 | - | 24 AWG | 1,3 mm |
| | SD- | 8 | Yellow (Black) | 4 | - | 24 AWG | 1,3 mm |
| Shielding | Shielding | 9 | Black | Housing | - | Shielding | - |

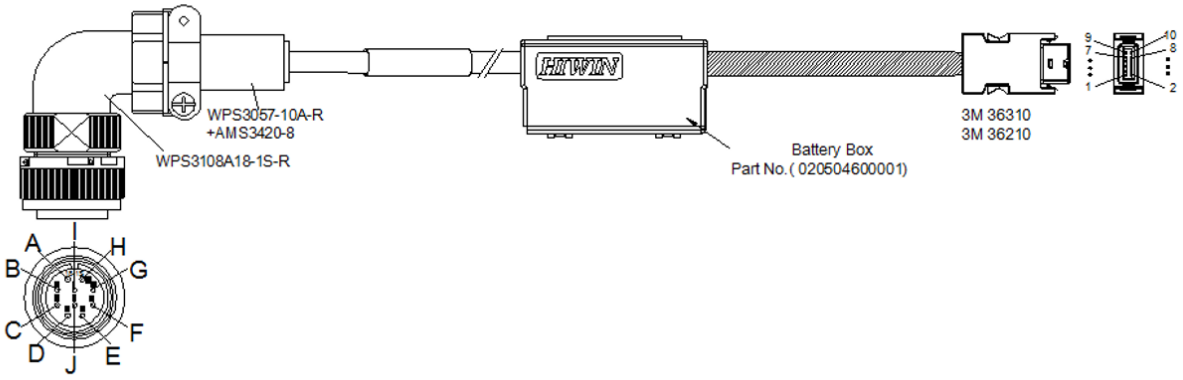


- Small Capacity Series / 1 kW – 2 kW

HVE23ABB / HVE23ACB

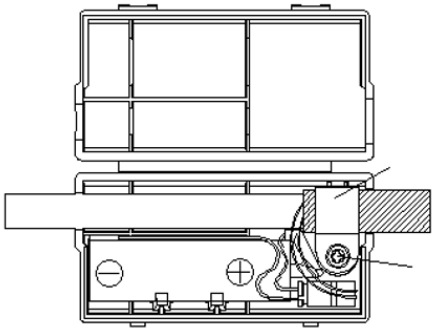
| Function | Signal | WPS 3106A18-1S-R<br>WPS 3108A18-1S-R | Color | 3M 36310<br>3M 36210 | Battery Box<br>HRS DF3-2EP-2C | Conductors | Insulators |
|---|---|---|---|---|---|---|---|
| Power | 5 V | A | Blue (Red) | 1 | - | 24 AWG | 1,3 mm |
| | 0 V | B | Blue (Black) | 2 | - | 24 AWG | 1,3 mm |
| Battery | VB | E | Green (Red) | - | Red | 24 AWG | 1,3 mm |
| | GND | F | Green (Black) | - | Black | 24 AWG | 1,3 mm |
| Serial Data Signal | SD+ | G | Yellow (Red) | 3 | - | 24 AWG | 1,3 mm |
| | SD- | H | Yellow (Black) | 4 | - | 24 AWG | 1,3 mm |
| Shielding | Shielding | I | Black | Housing | - | Shielding | - |



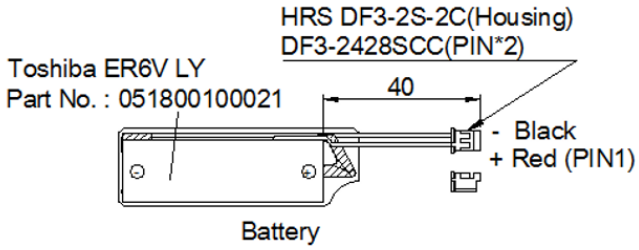



- Absolute Encoder Cable Battery Replacement Procedures:

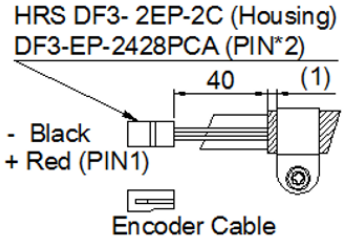
1. Remove screw from upper cover.
2. Remove upper cover from battery case.
3. Remove battery from battery case.
4. Check battery type is correct.
5. Replace the old battery to new one.
6. Recover upper case and tighten the screw back.



Inside Battery Box

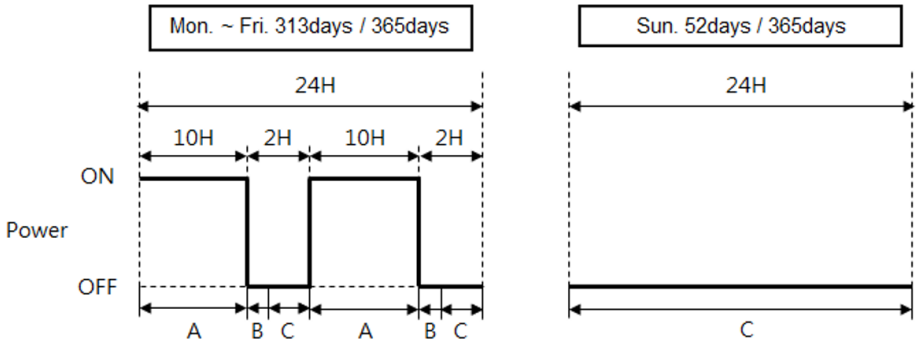



Battery




Encoder Cable

- Battery lifespan calculation

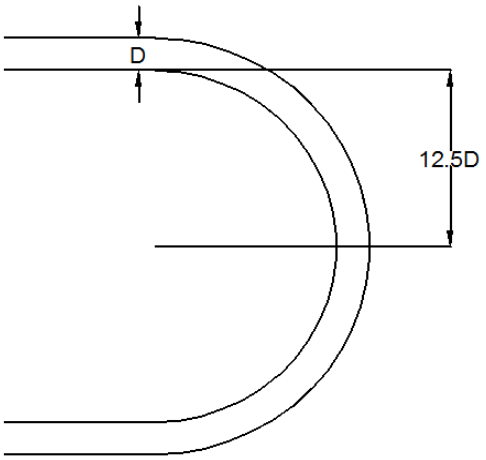



| Function | Power consumption |
|---|---|
| A: Power on | 3,6 uA |
| B: Momentary outage | 150 uA |
| C: Power off operation | 110 uA |

$$\text{power consumption (year)} = (10\text{H} \times \text{A} + 0{,}0014\text{H} \times \text{B} + 2\text{H} \times \text{C}) \times 2 \times 313 + 24\text{H} \times \text{C} \times 52 = 298(\text{mAh})$$

$$\text{Battery life} = \frac{1440\text{mAh}}{298\text{mAh}} = 4{,}8(\text{year})$$

#### 5.2.1.4 Allowable Bending Radius




Cable Overall Diameter = D

Allowable Bending Radius = 12,5 D

- Outer Diameter

| Item | Outer diameter (mm) | Allowable bending radius (mm) |
|---|---|---|
| Power cable (50 W – 750 W) | 8,5 | 106,25 |
| Power cable (with brake) 50 W – 750 W | 10,5 | 131,25 |
| Power cable (1 KW / 2 KW) | 10,5 | 131,25 |
| Brake cable (1 KW / 2 KW) | 5,2 | 65 |
| Encoder cable (50 W – 2 KW) | 8 | 100 |

### 5.2.2 Electrical Connection

Before connecting, you must use HIWIN power cables and encoder cables. Our cables provide a number of advantages, such as UL/CSA authorization, extreme load capability and resistance as well as a design suitable for EMC.

⚠ **Danger!** Danger from Electric Voltage!

- Work may only be carried out by a qualified electrician and with the power supply disconnected!
- Before carrying out work on the servo motor system, you must disconnect the power supply and protect it from being switched back on!
- Do not remove the cover, cables, or connector from the servo motor while the power is ON.
- Do not touch wires or operate the equipment with wet hands.
- Do not use when wires are in contact with oil or water.
- Before starting to work, check with measuring device whether parts of the servo system are still under residual voltage. If so, wait until all parts of system have discharged.

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

- Before using this product, please read the operation voltage marked in the specification labels and make sure that the supplied power meets product requirements.
- Have professional electricians distributed the wiring.
- Make sure the wires distributions execute properly or the servo motor will experience unexpected reactions.
- Please connect the power terminal and motor terminal securely.
- When distribute the wiring, the AC servo motor grounding terminal must be installed properly.
- Please check if the motor input, driver input and brake input voltage is correct. It is especially important to check if the power and signal wires connected to the encoder are

correct. Incorrectly distributed wires can cause abnormal motor operation and cause damage or malfunction in motors and drivers.

- Try to separate the motor power cable and the encoder power cable and signal cable. This is to prevent electrical signal coupling and noise (do not install the power and signal on the same circuit).
- Do not conduct voltage resistance test on the encoder. This can damage the encoder.
- Do not connect the servo motor U, V, W directly to the input power.
- Install an external emergency stop circuit to ensure that power can be shut off in an emergency situation.
- Do not touch the terminal within 5 minutes after power off because the residual high voltage may still remain in the connector.

⚠ **Warning**! Risk of Short Circuit Caused by Liquid, Lubricant or Pollutions.

- When installing or replacing drive components, provide open sides of power connectors with protective caps.
- Do only open terminal boxes for connection purpose and close them immediately after the connection is done.

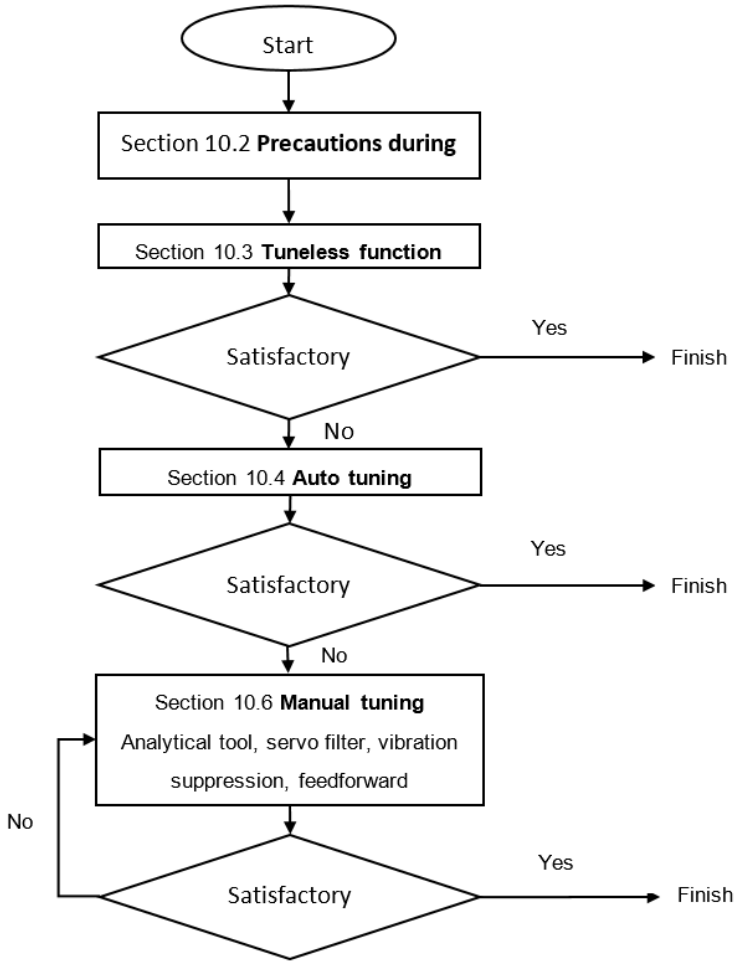
⚠ **Caution!** Risk of Personal Injury.

- Ensure the servo motor is correctly grounded.
- The resistance of ground terminal connection shall be less than 10 Ω when the input voltage of the drive is 400 V; Less than 50 Ω when it is 220 V and shall be less than 100 Ω when it is 110 V.

# 6 Commissioning

### 6.1.1 Flow chart for tuning

Tuning can optimize the response of motor by adjusting servo gains. Servo gains are set by several parameters (position loop gain, velocity loop gain, filter, vibration suppression and feedforward compensation). Gain-related parameters can affect the performance of each other, so please consider the balance among their settings. The default settings of gain-related parameters are set to have relatively stable servo gains. Use tuning functions provided in E1 series servo drive to improve response performance according to your mechanism and operating condition. The flow chart for tuning procedure is as below. For the sections mentioned in the below, please refer to “ED1 Series Servo Drive User Manual.”



### 6.1.2 Tuning function

| Tuning Function | Description | Control Mode | Reference |
|---|---|---|---|
| Tuneless | Tuneless function can be applied for any machine type and load variation to have stable response performance. | Velocity mode, position mode and torque mode | Refer to section 10.3 in "ED1 Series Servo Drive User Manual." |
| Auto tuning | The servo drive automatically adjusts control loops without receiving commands from the controller. During the process, parameters will be adjusted according to mechanical characteristics. | Velocity mode, position mode and torque mode | Refer to section 10.4 in "ED1 Series Servo Drive User Manual." |
| Manual tuning | Manually adjust servo gains to improve response. | Velocity mode, position mode and torque mode | Refer to section 10.6 in "ED1 Series Servo Drive User Manual." |
| Feedforward Compensation | Use model-based control provided by the servo drive. | Position mode | Refer to section 10.6.5 in "ED1 Series Servo Drive User Manual." |
| Vibration suppression | Suppress 1 Hz–100 Hz low-frequency vibration caused by machine vibration during positioning. | Position mode | Refer to section 10.6.4 in "ED1 Series Servo Drive User Manual." |
| Ripple compensation | Suppress low speed ripple caused by the magnetic poles of motor. | Velocity mode and position mode | Refer to section 10.6.5 in "ED1 Series Servo Drive User Manual." |
| Friction compensation | Compensate viscous friction fluctuation and regular load fluctuation. | Velocity mode and position mode | Refer to section 10.6.6 in "ED1 Series Servo Drive User Manual." |

### 6.1.3 Precautions during tuning

⚠ **Caution!** Art und Quelle der Warnung

- Ensure the precautions below are followed when tuning.
  - Do not touch the rotating parts of the motor at servo ON.
  - Ensure emergency stop can be activated anytime when motor is in operation.
  - Perform tuning after trial operation is completed.
  - For safety, install a stopping device on mechanism.

For settings to be checked, please refer to servo drive sections 10.2.1, 10.2.2 and 10.2.3 in "ED1 Series Servo Drive User Manual."

# 7 Maintenance and cleaning

## 7.1 Maintenance

| | |
|---|---|
| **Tool or equipment** | ▶ Screwdriver or torque wrench<br>▶ Lubricant<br>▶ Insulation resistance meter |
| **Personal protective equipment** | ▶ Safety shoes<br>▶ Protective helmet<br>▶ Protective gloves |

Please read all safety instructions before performing motor maintenance.

⚠ **Danger!** Danger from Electrical Voltage!

- Work may only be carried out by a qualified electrician and with the power supply disconnected!
- Before carrying out work on the servo motor system, you must disconnect the power supply and protect it from being switched back on!

⚠ **Danger!** Danger from Strong Magnetic Fields!

- Strong magnetic fields around servo motor systems pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.
- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from servo motor systems.

⚠ **Danger!** Risk of Crushing from Strong Forces of Attraction!

- The shaft and magnetizable objects may accidentally attract each other and collide!
- Do not underestimate the attraction force and operate carefully.
- Wear safety gloves when necessary.
- At least two people are required to cooperate during operation.
- If the assembly steps have not yet reached the installation of the rotor, please place the rotor in a safe and proper place first.
- Never take multiple motors at once.
- Do not bring any magnetizable materials close to the shaft! If the tool must be magnetized, please hold it firmly with both hands and slowly approach the shaft!

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

- Do not disassemble the servo drive or motor.
- Do not attempt to change wiring while the power is ON.
- When replacing the servo drive or motor, resume operation only after transferring the previous servo system parameters to the new servo system.

⚠ **Warning**! Risk of Personal Injury.

- Lifting heavy loads may damage your health.
- Use a hoist of an appropriate size when positioning heavy loads which are over 20 kg!
- Observe applicable occupational health and safety regulations when handling suspended loads!

⚠ **Caution!** Risk of Physical Damage to Watches and Magnetic Storage Media.

Strong magnetic forces may destroy watches and magnetisable data storage media near to the servo motor system!

- Do not bring watches or magnetisable data storage media into the vicinity (<300 mm) of the servo motor systems!

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

- Obstacle removal and maintenance can only be performed by HIWIN technicians or authorized dealers, and with appropriate protective equipment.
- Do not perform any maintenance actions while the motor is running. The controller must stop the motor first.
- Please turn off the power and the main switch of the machine (Please refer to the machine manufacturer's instructions for operation).
- After the power is turned off, there will be residual voltage in the system within a few minutes. Make sure that the power indicator for the servo drive is off, then use a test instrument to check the voltage between the terminals on the servo unit before starting inspection work.
- Clean the metal particles on the motor regularly.

## 7.2 Cleaning

| | |
|---|---|
| **Tool or equipment** | ▶ Rag<br>▶ 70% alcohol |
| **Personal protective equipment** | ▶ Safety shoes<br>▶ Protective helmet<br>▶ Protective gloves<br>▶ Protective goggles |

○ Frequency of the inspections/tests/maintenance

AC servo motor is a rotary actuator that can precisely control angular position, velocity and acceleration. Improper operation or incorrect application environment will shorten the life of the motor or even damage it. It is recommended to conduct measurement and maintenance every quarter, please refer to the following instructions for maintenance and inspection:

1. The detection mechanism or electrical connection must not be loosened.
2. Detect possible wear or aging of the cable.
3. Clean the dirt on the surface of the motor cover, brake cover, encoder cover with 70 % alcohol.
4. Use the insulation resistance meter to test the isolation resistance of the three phases of the motor. It must meet the requirements of 500 VDC for 1 second, >10M Ω @ 25°C. If the insulation resistance decreases gradually at the same temperature compared to the previous several measurements, the motor may have begun to age, so special attention should be paid.

### 7.2.1 Test run

Procedures of inspection before trial operation are provided in the following sections. Do not connect motor and mechanism while executing trial operation. If the motor cannot be removed from the mechanism, its load must be removed. The purpose of trial operation is to check the combination of the servo drive and motor as well as the wiring of servo drive. Perform inspection based on the motor in use.

#### 7.2.1.1 Inspection procedure for servo motor

While using HIWIN EM1 series servo motor, perform inspection based on the procedure provided below.

| Item | Description | Reference in "ED1 Series Servo Drive User Manual." |
|---|---|---|
| Hardware | 1 Check if the servo drive is correctly installed inside the control box.<br>2 Check the wiring of the servo drive<br>▶ CN1 power-Check the voltage of the input power. Check if the connectors are firmly connected.<br>▶ CN2 motor power-Check if the UVW power terminals on the servo drive and motor power cable are correctly wired. Check if the terminals are secure.<br>▶ CN7 encoder-Check if the motor and the servo drive are firmly connected.<br>3 Confirm the encoder information. Ensure the software setting is correct.<br>4 Loosen the coupling. Do not connect the motor and mechanism. | Refer to section 4.1.2. |
| Software | 5 Download the latest version of Thunder. And connect to the servo drive.<br>6 Do software setting by following the procedures provided in Thunder.<br>7 Check the moving direction. Execute trial operation, such as JOG or point-to-point (P2P) motion.<br>8 Operate with controller. | Refer to section 7.2.<br>Refer to section 7.3.<br>Refer to section 7.6.<br>Refer to section 10.1. |

# 8 Disposal

## 8.1.1 General

⚠ **Danger!** Danger from electrical voltage!

Before and during assembly, disassembly and repair work, dangerous currents may flow.

- Work may only be carried out by a qualified electrician and with the power supply disconnected!
- Before carrying out work on the servo motor system, disconnect the power supply and protect it from being switched back on!

⚠ **Danger!** Danger from strong magnetic fields!

- Strong magnetic fields around servo motor systems pose a health risk to persons with implants (e.g. cardiac pacemakers) that are affected by magnetic fields.
- Persons with implants that are affected by magnetic fields should maintain a safe distance of at least 1 m from servo motor systems.

⚠ **Attention!** Risk of physical damage to watches and magnetic storage media.

- Strong magnetic forces may destroy watches and magnetisable data storage media near to the servo system!
- Do not bring watches or magnetisable data storage media into the vicinity (<300 mm) of the servo system!

## 8.1.2 Tools and Equipment

| | |
|---|---|
| **Tool or equipment** | ▶ Screwdriver or torque wrench<br>▶ Box<br>▶ Cart |
| **Personal protective equipment** | ▶ Safety shoes<br>▶ Protective helmet<br>▶ Protective gloves |

### 8.1.3 Decommissioning

When disassembling or deactivating the motor, please follow the orders instructed below:

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

- If you do not follow the orders to deactivate the motor, it may cause personal injury, death or property damage.
- Please disassemble or deactivate the motor according to the order below.

1. Stop operating servo motor and wait for the driver power supply to discharge completely.
2. Remove all power cables, signal cables.
3. If necessary, isolate all power connections to avoid the risk of electric shock due to voltage generated by the rotating motor during disassembly, or braking torque due to short circuits.
4. Clean the foreign matter, debris and dust on the motor.
5. When there are fixation plates of motor or self-designed motor fixing jigs, use these plates/jigs to fix the motor. If the guiding fixture method is used, it is necessary to confirm that the related fixture and configuration are installed.
6. Remove all the fixings at the machine end. If the motor is fixed, it can be separated from the machine at the same time; if the guiding method is used, please remove the motor in the reverse order during assembly.
7. Use the original packaging or a safe way to pack and store it correctly.

### 8.1.4 Disposal

Products need to be disposed according to the normal recycling process in accordance with laws and regulations.

⚠ **Warning**! Risk of Personal Injury or Damage to Property.

- If the servo motor or related components (especially the rotor with strong magnets) are not handled correctly, it may cause personal injury, death or property damage.
- Please ensure that the servo motor and related components are disposed of correctly.

Appropriate disposal process:

- The permanent magnets in the rotor assembly must be completely demagnetized.
- The components to be recycled need to be disassembled:

1. Electronic waste (e.g. encoder components, temperature control modules, etc.)
2. Electrical waste (e.g. stator, cables, etc.)
3. Scrap metal alloys (classified by metal)
4. Insulation material

- No mixing with solvents, cold cleaning agents, or residue of paint.

# 9 Troubleshooting

| Fault | Possible cause or procedure for detecting the fault | Solution |
|---|---|---|
| Motor cannot be rotated manually without connecting the controller. | Mechanical interference | Remove interference. |
| | Motor three-phase short circuit | Fix three-phase short circuit. |
| Motor can't rotate at all. | Wrong cable wiring | Check the cable connected to the controller. |
| | Current overload | Check whether there are interfering objects and remove them. Fix the brake clamping failure. |
| | Over temperature protection | Check the over temperature setting of controller. |
| | Abnormal insulation resistance | Measure insulation resistance after cooling. Measurement of stator three-phase to ground (U/V/W to PE):<br>500 VDC 1 sec >10 M Ω @°C.<br>If it does not reach 10 M Ω, please contact HIWIN. |
| Wrong rotating direction. | Wrong controller setting | Check controller setting. |
| | Wrong motor power cable wiring | Interchange the two-phase power cable connected to the controller. |
| Smell of burning. | Wrong controller setting | Check controller setting. |
| | Wrong motor parameters setting | Check motor parameters setting. |
| Abnormal temperature of motor outer casing. | Wrong controller setting | Check controller setting. |
| | Wrong motor parameters setting | Check motor parameters setting. |
| | Abnormal operation of bearing | Check installation. |
| Unstable rotation (vibration). | Insulation failure | Check the resistance value of phase/earth is larger than 10 M Ω. |
| | Wrong encoder installation | Check installation stiffness of encoder. |
| | Wrong encoder signal | Check encoder connection. |
| | Wrong controller setting | Check controller setting. |
| | Wrong motor parameters setting | Check motor parameters setting. |
| Abnormal friction noise. | Motor brake doesn't work | Check brake. |
| | Unbalanced system | Check the dynamic balance. |
| | Loose system | Fix it tight again. |

### 9.1.1 Troubleshooting Form

In the event of a motor failure or error, this form assists users to provide essential details to HIWIN, which facilitates effective troubleshooting and repair, avoiding any possible and unnecessary downtime. Please complete the form.

**Caution**

Do not dismount the motor before performing all the required measurements.

- **Identification of Motor**

Product code:

Serial number of motor (see nameplate): _____

Motor orientation: ☐ Horizontal / ☐ Vertical

Motor in service since (yyyy-mm-dd): _____

- **Failure Situation**

Failure description: _____

Please describe the status when the motor is failed.

☐ During commissioning stage, please describe:

_____

☐ During normal operation stage (e.q. turning, milling, stalled), please describe:

_____

☐ Other operation:

_____

Failure message from the driver: ☐ No / ☐ Yes

☐ Rapid stop, please describe:

_____

☐ Performance degradation (vibration, ripple, noise), please describe:

_____

☐ Other, please describe:

_____

Did the same failure occur before?

☐ No / ☐ Yes, occurrence date (yyyy-mm-dd): _____, failure motor type: _____

### Electrical Troubleshooting

Before starting the measurements below, switch off the drive's power and disconnect the cable after the drive is discharged. Wait until the motor cools down to ambient temperature (25±5°C):

Check the entire wiring for any interruption or loose connection.

☐ No / ☐ Yes, abnormal position: _____

Measure line resistance: $R_{UV}$: _____, $R_{VW}$: _____, $R_{UW}$: _____

Inspection of cables and connectors:

Any damage on cables/cable glands/cable connectors: ☐ No / ☐ Yes

Shaft inspection:

Is the motor shaft damage? ☐ No / ☐ Yes, please describe: _____

### Operation Conditions

Which component is attached to motor?

☐ None ☐ Belt ☐ Coupling ☐ Screw ☐ Linear guide way ☐ Others: _____

### Appendix

Please share all relative information with HIWIN for analyzing the problem (photos, NC records, damaged parts). List all the files and parts sent to HIWIN:

_____
_____
_____

### Contact Information

Company / Institute / Department:

_____

Contact person:

_____

E-mail:

_____

Phone:

_____

Address:

_____

# 10 Declaration of incorporation

according to Low Voltage EC directive 2014/35/EU

**Name and address of the manufacturer:**
HIWIN MIKROSYSTEM CORP
No.6, Jingke Central Rd.,
Taichung Precision Machinery Park,
Taichung 40826, Taiwan

This declaration relates exclusively to the product in the state in which it was placed on the market, and excludes components which are added and/or operations carried out subsequently by the final user. The declaration is no more valid, if the product is modified without agreement.

**Herewith we declare**, that the machinery described below:

| Product Denomination | Servomotor |
|---|---|
| Model / Type: | FR (50, 100, 200, 400, 750, 1.000, 2.000 W)<br>EM1 (50, 100, 200, 400, 750, 1.000, 1.200, 2.000 W) |
| Year of Manufacture: | From 2021 |

Is complying with all essential requirements of Directive 2014/35/EU low voltage directive. In addition the product is in conformity with the EC Directive 2014/30/EU EMC and 2011/65/EU RoHS and the amendment Directive EU 2015/863.

**Harmonized standards used:**

EN 60034-1: 2010 / AC: 2010
EN 60034-5: 2001 / A1: 2007
EN 61000-6-2: 2005 / AC: 2005
EN 61000-6-4: 2007 / A1: 2011
EN 60204-1: 2018

# 11 Appendix

## 11.1 Glossary

Parameters used in the manual are listed in the following table.

Table 11.1: Parameters on the data sheet

| Motor parameter | Symbol | Unit | Description |
|---|---|---|---|
| Drive input voltage | V | V | Input voltage of the drive |
| Output power | P | W | Output power of the motor operating at rated point |
| Rated torque | $T_c$ | Nm | Output torque of the motor operating at rated point |
| Rated current | $I_c$ | $A_{rms}$ | Input current of the motor operating at rated point |
| Maximum torque | $T_p$ | Nm | Maximum torque that can be applied for about 400 ms at maximum current |
| Maximum current | $I_p$ | $A_{rms}$ | Maximum current |
| Rated speed | $\omega_c$ | rpm | Velocity of the motor operating at rated point |
| Maximum speed | $\omega_p$ | rpm | Maximum allowable velocity of the motor |
| Torque constant | $K_t$ | $Nm/A_{rms}$ | Relation of rated torque and motor line current at a motor temperature of 25°C |
| Voltage constant (back EMF constant) | $K_e$ | V/krpm | Root-mean-square (RMS) value of the induced motor voltage at a motor temperature of 25°C and 1.000 revolutions per minute (rpm) |
| Winding resistance | R | Ω | Measured winding resistance between two strands at 25 °C |
| Winding inductance | L | mH | Measured inductivity between two strands |
| Inertia of rotor without brake | J | $kg{\cdot}m^2\,(x10^{-4})$ | Inertia of the rotor without the optional brake |
| Inertia of rotor with brake | J | $kg{\cdot}m^2\,(x10^{-4})$ | Inertia of the rotor with the optional brake |
| Mass | M | kg | Mass of the motor |
| Insulation class | - | - | Insulation class according to DIN EN 60034-1 |
| Protection class | - | - | IP protection mode according to EN 60034 |
| Static friction torque | $T_b$ | Nm | Holding torque of the brake |
| Enabled current | $I_b$ | A | Continuous current of the brake |
| Brake input voltage | $V_b$ | V | Input voltage of the brake |
| Braking time | $T_o$ | ms | Duration until the brake applies |
| Release time | $T_r$ | ms | Duration until the brake releases |

## 11.2 Unit conversion

To convert the unit in column B to the unit in column A, multiply by the corresponding figure in the table.

### Mass

| | | B | | | |
|---|---|---|---|---|---|
| | | g | kg | lb | oz |
| A | g | 1 | 0,001 | 0,0022 | 0,03527 |
| | kg | 1000 | 1 | 2,205 | 35,273 |
| | lb | 453,59 | 0,45359 | 1 | 16 |
| | oz | 28,35 | 0,02835 | 0,0625 | 1 |

### Angular velocity

| | | B | | | |
|---|---|---|---|---|---|
| | | deg/s | rad/s | rpm | rps |
| A | deg/s | 1 | $1{,}745 \times 10^{-2}$ | 0,167 | $2{,}777 \times 10^{-3}$ |
| | rad/s | 57,29 | 1 | 9,549 | 0,159 |
| | rpm | 6 | 0,105 | 1 | $1{,}667 \times 10^{-2}$ |
| | rps | 360 | 6,283 | 60 | 1 |

### Rotary inertia

| | | B | | | |
|---|---|---|---|---|---|
| | | $kg\text{-}m^2$ | $kg\text{-}m^2$ | $kg\text{-}m^2$ | $kg\text{-}m^2$ |
| A | $kg\text{-}m^2$ | 1 | 3.417,63 | 23,73 | 54.644,81 |
| | $lb\text{-}in^2$ | $2{,}926 \times 10^{-4}$ | 1 | $6{,}943 \times 10^{-3}$ | 15,99 |
| | $lb\text{-}ft^2$ | $4{,}214 \times 10^{-2}$ | 144.02 | 1 | 2.302,73 |
| | $oz\text{-}in^2$ | $1{,}83 \times 10^{-5}$ | $6{,}254 \times 10^{-2}$ | $4{,}34 \times 10^{-4}$ | 1 |

### Torque

| | | B | | | |
|---|---|---|---|---|---|
| | | N-m | N-m | N-m | N-m |
| A | N-m | 1 | 8,851 | 0,7375 | 140,84 |
| | lb-in | 0,113 | 1 | $8{,}333 \times 10^{-2}$ | 16 |
| | lb-ft | 1,355 | 11,99 | 1 | 191,94 |
| | oz-in | $7{,}1 \times 10^{-3}$ | $6{,}25 \times 10^{-2}$ | $5{,}21 \times 10^{-3}$ | 1 |

### Temperature

| | | B | |
|---|---|---|---|
| | | °C | °F |
| A | °C | 1 | (°F - 32) x 5 / 9 |
| | °F | (°C x 9 / 5) + 32 | 1 |

## 11.3 Tolerances and hypotheses

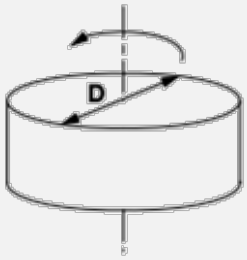
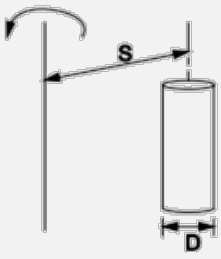
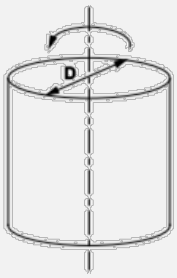
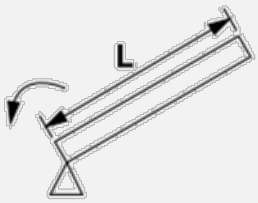
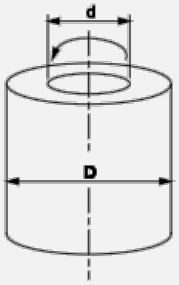
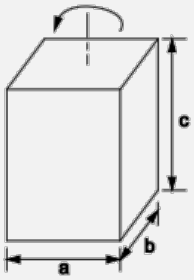
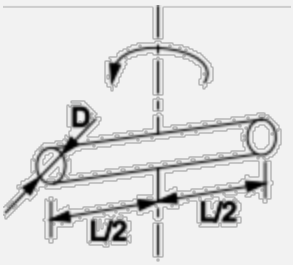
### 11.3.1 Tolerances

| Tolerances (mm) | | | | | | | |
|---|---|---|---|---|---|---|---|
| <6 | 6–30 | 30–120 | 120–300 | 300–600 | 600–1.200 | 1.200–2.400 | >2.400 |
| ±0,1 | ±0,2 | ±0,3 | ±0,4 | ±0,5 | ±0,8 | ±1,0 | ±1,5 |

### 11.3.2 Hypotheses

Operation staff are trained in the safe operation practices for AC servo motor and have fully read and understood this user manual. Maintenance staff maintain and repair AC servo motor in such a way that they pose no danger to people, property or the environment.

## 11.4 Supplementary formula

| Shape | Inertia calculation formula | Shape | Inertia calculation formula |
|---|---|---|---|
| Disk   | $J = \frac{1}{8}\mathrm{MD}^2$ | Separated   | $J = \frac{1}{8}\mathrm{MD}^2 + MS^2$ |
| Solid cylinder   | $J = \frac{1}{8}\mathrm{MD}^2$ | Straight rod   | $J = \frac{1}{3}\mathrm{M}L^2$ |
| Hollow cylinder   | $J = \frac{1}{8}\mathrm{M}(\mathrm{D}^2 + d^2)$ | Prism   | $J = \frac{1}{12}\mathrm{M}(a^2 + b^2)$ |
| Uniform rod   | $J = \frac{1}{48}\mathrm{M}(\mathrm{D}^2 + 4L^2)$ | | |

| List of symbol: | If mass (M(kg)) is unknown, calculate it with the following formula: |
|---|---|
| J: Inertia (kg-m$^2$) | Mass M (kg) = Density ρ (kg/m$^3$) x Volume V (m$^3$) |
| M: Mass (kg) | Density of each material |
| D: Outer diameter (m) | Iron ρ = 7,9 x 10$^3$ (kg/m3) |
| D: Inner diameter (m) | Brass ρ = 8,5 x 10$^3$ (kg/m$^3$) |
| L: Length (m) | Aluminium ρ = 2,8 x 10$^3$ (kg/m$^3$) |
| a, b, c: Side length (m) | |
| S: Distance (m) | |

## 11.5 Optional accessories

For the connection of accessories from section 11.5.1 to 11.5.2 please refer to “ED1 Series Servo Drive User Manual.“

### 11.5.1 Accessory kit

The accessory kit of E1 series servo drive is included when the servo drive is shipped out. For the contents inside the accessory kit, please refer to the table below.

Input rated voltage 110 VAC / 220 VAC

| Name | HIWIN Part Number | Description | Qty. |
|---|---|---|---|
| ED1 CK1 accessory kit (400 W – 2 kW Standard) | 051800200158 | CN1: AC main input power terminal, control input power terminal, terminal for regenerative resistor and terminal for DC reactor (11 pins, TE 1-2229794-1-PT1) | 1 |
| | | CN2: Motor power connector (3 pins, TE 3-2229794-1) | 1 |
| | | CN4: STO connector (TE 1971153-1) | 1 |
| | | CN6: Control signal connector (50 pins welded type EUMAX XDR-10350AS) | 1 |
| | | Headers and wire housings for CN1 and CN2 connectors (TE 1981045-1) | 2 |
| ED1 CK2 accessory kit (400 W – 2 kW Fieldbus) | 051800200159 | CN1: AC main input power terminal, control input power terminal, terminal for regenerative resistor and terminal for DC reactor (11 pins, TE 1-2229794-1-PT1) | 1 |
| | | CN2: Motor power connector (3 pins, TE 3-2229794-1) | 1 |
| | | CN4: STO connector (TE 1971153-1) | 1 |
| | | CN6: Control signal connector (36 pins welded type EUMAX XDR-10336AS) | 1 |
| | | Headers and wire housings for CN1 and CN2 connectors (TE 1981045-1) | 2 |
| ED1 CK3 accessory kit (4 kW Standard) | 180600100003 | CN4: STO connector (TE 1971153-1) | 1 |
| | | CN6: Control signal connector (50 pins welded type EUMAX XDR-10350AS) | 1 |
| ED1 CK4 accessory kit (4 kW Fieldbus) | 180600100004 | CN4: STO connector (TE 1971153-1) | 1 |
| | | CN6: Control signal connector (36 pins welded type EUMAX XDR-10336AS) | 1 |

Input rated voltage 400 VAC

| Name | HIWIN Part Number | Description | Qty. |
|---|---|---|---|
| ED1 HV<br>CK1 accessory kit<br>(5 kW – 7.5 kW<br>400 V Standard) | 180600100005 | CN1A: AC main input power terminal, terminal for regenerative resistor, terminal for DC reactor<br>(8 pins, PC 5/8-STF1-7,62-1777891) | 1 |
| | | CN1C: control input power terminal (4 pins, R-2ESDVM-04P) | 1 |
| | | CN2B: Motor power connector<br>(4 pins, R-PC5/4-STF-SH1-7.62 (1778191), female, Pitch: 7,62mm | 1 |
| | | CN4: STO connector. (TE 1971153-1) | 1 |
| | | CN6: Control signal connector<br>(50 pins welded type EUMAX XDR-10350AS) | 1 |
| ED1 HV<br>CK2 accessory kit<br>(5 kW – 7.5 kW<br>400 V Fieldbus) | 180600100006 | CN1A: AC main input power terminal, terminal for regenerative resistor, terminal for DC reactor<br>(8 pins, PC 5/8-STF1-7,62-1777891) | 1 |
| | | CN1C: control input power terminal (4 pins, R-2ESDVM-04P) | 1 |
| | | CN2B: Motor power connector<br>(4 pins, R-PC5/4-STF-SH1-7.62 (1778191), female, Pitch: 7,62mm | 1 |
| | | CN4: STO connector (TE 1971153-1) | 1 |
| | | CN6: Control signal connector<br>(36 pins welded type EUMAX XDR-10336AS) | 1 |

The accessory kit of Excellent Smart Cube (ESC) is included when ESC is shipped out. For the contents inside the accessory kit, please refer to the table below.

| Name | HIWIN Part Number | Description | Qty. |
|---|---|---|---|
| ESC accessory kit<br>(Applicable to all ESC models) | 051800200172 | TS: PTC thermal sensor input<br>2 pins, FK-MC 0,5/ 2-ST-2,5 | 1 |
| | | PT: Position trigger signal output<br>2 pins, FK-MC 0,5/ 2-ST-2,5 | 1 |
| | | Terminal block for connecting motor thermal wires and ESC temperature cable<br>AVC Corp. PA-8-H-2, without washer | 1 |

### 11.5.2 Power supply filter and accessories

- Power supply filter (Optional)

Input rated voltage 110 VAC / 220 VAC

| Name | HIWIN Part Number | Description |
|---|---|---|
| Filter<br>(For single-phase power supply) | 051800200044 | 051800200044 Single-phase filter FN2090-10-06, for 400 W – 1 kW models<br>(rated current: 10 A, leakage current: 0,61 mA) |
| Filter<br>(For single-phase power supply) | 051800200100 | Single-phase filter FN2090-16-06, for 1,2 kW – 2 kW models<br>(rated current: 16 A, leakage current: 0,93 mA) |
| Filter<br>(For three-phase power supply) | 051800200071 | Three-phase filter FN3025HL-20-71, for 400 W – 4 kW models<br>(rated current: 20 A, leakage current: 0,4 mA) |

Input rated voltage 400 VAC

| Name | HIWIN Part Number | Description |
|---|---|---|
| Filter<br>(For three-phase power supply) | 920301400009 | Three-phase filter FN3270HQ1-20-44, for 5 kW 400 V models<br>(rated current: 20 A, leakage current: 0,4 mA) |
| Filter<br>(For three-phase power supply) | 920301400010 | Three-phase filter FN3270HQ1-35-33, for 7,5 kW 400 V model<br>(rated current: 35 A, leakage current: 0,4 mA) |

- Fuse accessory kit

| Name | HIWIN Part Number | Description |
|---|---|---|
| Fuse accessory kit<br>(400 W, 500W) | 180600600002 | Fuse: JLLN006.T, Class T 300 VAC / 6 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT300303C, Class T 300 VAC / 30 A, Qty: 1<br>Fuse stand cover: LFT30030FBC, Qty: 3<br>For three-phase input power of 400 W, 500 W servo drive |
| Fuse accessory kit<br>(1 kW, 1,2 kW) | 180600600008 | Fuse: JLLN025.T, Class T 300 VAC / 25 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT300303C, Class T 300 VAC / 30 A, Qty: 1<br>Fuse stand cover: LFT30030FBC, Qty: 3<br>For three-phase input power of 1 kW, 1,2 kW servo drive |
| Fuse accessory kit<br>(2 kW) | 180600600004 | Fuse: JLLN050.T, Class T 300 VAC / 50 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT300603C, Qty: 1<br>Fuse stand cover: LFT30060FBC, Qty: 3<br>For three-phase input power of 2 kW servo drive |
| Fuse accessory kit<br>(4 kW) | 180600600005 | Fuse: JLLN070.V, Class T 300 VAC / 70 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT301003CS, Qty: 1<br>Fuse stand cover: LFT30100FBC, Qty: 3<br>For three-phase input power of 4 kW servo drive |
| Fuse accessory kit<br>(5 kW) | 180600600006 | Fuse: JLLS040.T, Class T 600 VAC / 40 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT600603C, Qty: 1<br>Fuse stand cover: LFT60060FBC, Qty: 3<br>For three-phase input power of 5 kW servo drive |
| Fuse accessory kit<br>(7,5 kW) | 180600600007 | Fuse: JLLS060.T, Class T 600 VAC / 60 A / Fast-Acting, Qty: 3<br>Fuse holder: LFT600603C, Qty: 1<br>Fuse stand cover: LFT60060FBC, Qty: 3<br>For three-phase input power of 7,5 kW servo drive |

**Note**

For UL certification, filter (For three-phase power supply) and fuse accessory kit are required.

- Power reactor (optional)

| Name | HIWIN Part Number | Description |
|---|---|---|
| Reactor<br>(three phase 400 V input power) | 920302200001 | Reactor GOOVAR GP-40010, for 400 V model<br>(rated voltage: three phase AC 480 V, rated current: 30 A) |

- Regenerative resistor (Optional)

| Name | HIWIN Part Number | Description |
|---|---|---|
| Regenerative resistor | 050100700001 | 68 Ohm/100 W |
| Regenerative resistor | 050100700004 | 190 Ohm/1.000 W |

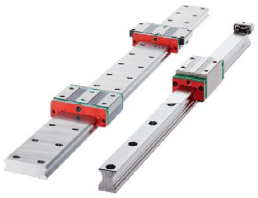
## 11.6 Customer request form

*Require

| | | |
|---|---|---|
| *Customer | | Date:<br>Contact person:<br>Title: |
| Email | | |
| Drive Series | ☐ E1 | Note: |
| *AC Motor Series | Middle inertia: ☐ 50 W ☐ 100 W ☐ 200 W ☐ 400 W<br>☐ 750 W ☐ 1000 W ☐ 1.200 W ☐ 2.000 W | |
| *Key | ☐ No ☐ Yes | |
| *Brake | ☐ No ☐ Yes | |
| *Seal | ☐ No ☐ Yes | |
| AC input voltage(V) | ☐ Single phase 220 V ☐ Three phase 220 V | |
| *Servo motor connecting wire | Motor power (flexure strength)<br>Cable length: ☐ 3 m ☐ 5 m ☐ 7 m ☐ 10 m<br>Encoder (flexure strength)<br>Cable length: ☐ 3 m ☐ 5 m ☐ 7 m ☐ 10 m | |
| *Related accessory requirements | ☐ Pulse Wire ☐ USB cable<br>☐ Single phase filter ☐ Three phase filter | |
| *Control mode | ☐ Position control ☐ Velocity control<br>☐ Torque control ☐ EtherCAT(CoE)<br>☐ Other | |
| Match method | ☐ Slide/model no: _____<br>☐ Reducer/reduction ratio: _____<br>☐ Timing belt<br>☐ Gear rack<br>☐ Ball screw/guiding distance: _____<br>Screw outer diameter: _____ | |
| Host | ☐ PLC/manufacture: _____ model: _____<br>☐ Axis card/manufacture: _____ model: _____ | |
| Special Needs | | |
| Installation | ☐ Horizontal ☐ Vertical | |
| Speed requirement | | |
| Acceleration requirement | | |
| Weight requirement | | |

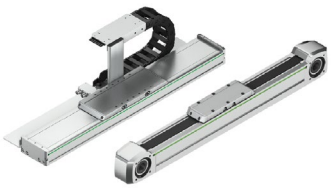
**Recommended specifications:** (Filled in by HIWIN or authorized agents.)

# We live motion.

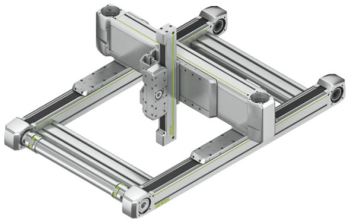


Linear Guideways

Ballscrews



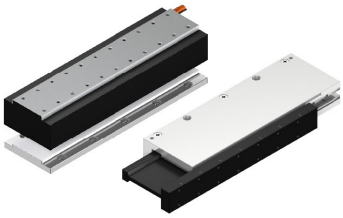
Linear Axes



Linear Axis Systems

Torque Motors


Robots



Linear Motors

Rotary Tables

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