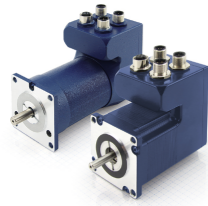


## PD4-E-MA EtherCAT



Short instructions  
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## Introduction

The *PD4-E-M* is a brushless motor with integrated controller in protection class IP65. The integrated absolute encoder makes immediate operation possible in *closed loop* mode without homing.

This instruction describes the installation and commissioning of the motor. You can find the detailed documentation for the product and motor data sheets on [us.nanotec.com](http://us.nanotec.com). The short instructions do not replace the *technical manual* of the motor.

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## Intended use

The *PD4-E-M* motor with integrated controller is used as a component of drive systems in a range of industrial applications.

Use the product as intended within the limits defined in the technical data (in particular, see ) and the approved **Environmental conditions**.

Under no circumstances may this Nanotec product be integrated as a safety component in a product or system. All products containing a component manufactured by Nanotec must, upon delivery to the end user, be provided with corresponding warning notices including instructions for safe use and safe operation. All warning notices provided by Nanotec must be passed on directly to the end user.

## Warranty and disclaimer

Nanotec is not liable for damage and malfunction from installation errors, failure to observe this document, or improper repair. Responsible for the selection, operation, use of our products is the plant engineer, operator and user. Nanotec accepts no liability for product integration in the end system. The general terms and conditions at [www.nanotec.com](http://www.nanotec.com) apply (customers of Nanotec Electronic USA please see [us.nanotec.com](http://us.nanotec.com)). **Note:** Product modification / alteration is illicit.

## Target group and qualification

The product and this documentation are directed towards technically trained specialists staff such as: development engineers, plant engineers, installers/service personnel, and application engineers.

Only specialists may install, program and commission the product. Specialist staff are persons who

- have appropriate training and experience in working with motors and their control,
- are familiar with and understand the content of this technical manual,
- know the applicable regulations.

## EU directives for product safety

The following EU directives were observed:

- RoHS directive (2011/65/EU, 2015/863/EU)
- EMC directive (2014/30/EU)

## Other applicable regulations

In addition to this technical manual, the following regulations are to be observed:

- Accident-prevention regulations
- Local regulations on occupational safety

## Safety and warning notices

### NOTICE

#### Damage to the controller!

Changing the wiring during operation may damage the controller.

- ▶ Only change the wiring in a de-energized state. After switching off, wait until the capacitors have discharged.

### NOTICE

#### Damage to the controller due to excitation voltage of the motor!

Voltage peaks during operation may damage the controller.

- ▶ Install suitable circuits (e. g., charging capacitor) that reduce voltage peaks.

### NOTICE

#### Damage to the electronics through improper handling of ESD-sensitive components!

The device contains components that are sensitive to electrostatic discharge. Improper handling can damage the device.

- ▶ Observe the basic principles of ESD protection when handling the device.

### NOTICE

#### Damage to the electronics if the supply voltage is connected with reversed polarity!

Polarity reversal results in a short-circuit between supply voltage and GND (earth) via the power diode.

- ▶ Install a line protection device (fuse) in the supply line.

## Technical details and pin assignment

### Environmental conditions

Environmental condition	Value
Protection class	IP65 (except for shaft output)
Ambient temperature (operation)	-10 ... +40°C
Air humidity (non-condensing)	0 ... 85%
Max. Altitude of site above sea level (without drop in performance)	1500 m
Ambient temperature (storage)	-25 ... +85°C

### Electrical properties and technical data

#### Technical data – motor

	PD4-E	PD4-EB
Type	Stepper motor	BLDC
Operating voltage	12 - 48 V DC ±5%	12 - 48 V DC ±5%
Rated current rms	4.2 A	6 A
Peak current rms for 5 s	5.5 A	18 A

#### Technical data

Operating modes	<i>Profile Position Mode, Profile Velocity Mode, Profile Torque Mode, Velocity Mode, Homing Mode, Interpolated Position Mode, Cyclic Sync Position Mode, Cyclic Sync Velocity Mode, Cyclic Synchronous Torque Mode,</i>
Set value setting / programming	<i>EtherCAT, analog input, NanoJ program</i>
Inputs	6 digital inputs (+5 V/+24 V DC), individually switchable by means of software, factory settings: 5 V 1 analog input 0–10 V or 0–20 mA (switchable by means of software)
Outputs	2 outputs, <i>Open Drain</i> , max. 100 mA
Integrated encoder	Magnetic multiturn absolute encoder, single-turn resolution: 17 bit (131072 per revolution), multiturn resolution: 16-bit (+/-2 <sup>15</sup> revolutions)

### Protection circuit

#### Overvoltage and undervoltage protection

Overtemperature protection (> 68° Celsius on rear cover)

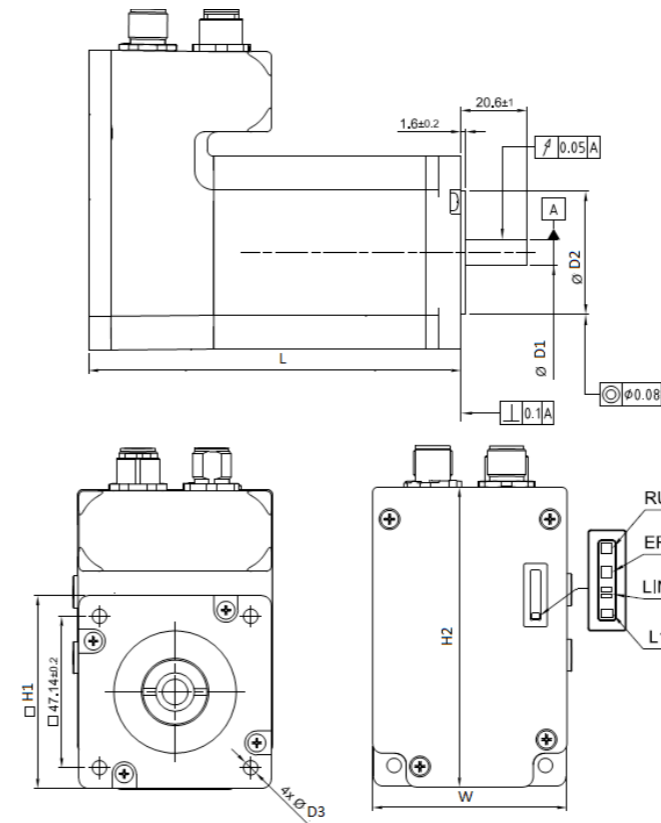
Polarity reversal protection: In the event of a polarity reversal, a short-circuit will occur between supply voltage and GND over a power diode; a line protection device (fuse) is therefore necessary in the supply line. The values of the fuse are dependent on the application and must be dimensioned

- greater than the maximum current consumption of the controller,
- less than the maximum current of the voltage supply.

If the fuse value is very close to the maximum current consumption of the controller, a medium / slow tripping characteristics should be used.

### Dimensioned drawings

All dimensions are in millimeters.



Dimension	Value
L	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 126.5±1</li> <li>• PD4-EB59CD-M-65: 146.5±1</li> </ul>
W	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 57</li> <li>• PD4-EB59CD-M-65: 57</li> </ul>
H1	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 56.4±0.5</li> <li>• PD4-EB59CD-M-65: 56.6±0.5</li> </ul>
H2	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 89.7</li> <li>• PD4-EB59CD-M-65: 89.7</li> </ul>
D1	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 6.35<sup>+0</sup><sub>-0.013</sub></li> <li>• PD4-EB59CD-M-65: 8<sup>+0</sup><sub>-0.013</sub></li> </ul>
D2	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 38.1±0.025</li> <li>• PD4-EB59CD-M-65: 38.1<sup>+0</sup><sub>-0.05</sub></li> </ul>
D3	<ul style="list-style-type: none"> <li>• PD4-E591L42-M-65: 5</li> <li>• PD4-EB59CD-M-65: 5.2±0.25</li> </ul>

### Overtemperature protection

Above a temperature of approx. 75°C on the power board (corresponds to 65–72°C outside on the back cover), the power part of the controller switches off and the error bit is set. After cooling down and confirming the error, the controller again functions normally.

### LED signaling

#### Power LED

The power LED indicates the current status.

#### Normal operation

In normal operation, the green power LED L1 flashes briefly once per second.

#### Case of an error

If an error has occurred, the LED turns red and signals an error number.

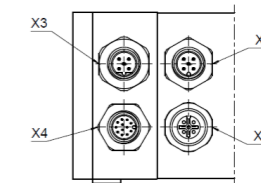
The following table shows the meaning of the error numbers.

Flash rate	Error
1	General
2	Voltage
3	Temperature
4	Overcurrent
5	Controller
6	Watchdog-Reset

### NOTICE

For each error that occurs, a more precise error code is stored in object **1003<sub>n</sub>**.

### Pin assignment



Connector	Function	Pin assignment / description
X1	EtherCAT IN	1. TD+
X2	EtherCAT OUT	2. RD+
		3. TD-
		4. RD-
X3	Voltage supply 12 - 48 V DC ±5%	1. +Ub 2. +Ub 3. GND 4. GND 5. n.c
X4	Inputs/outputs and external logic supply  Switching thresholds for digital inputs 1 - 6: <b>5 V (factory setting):</b> On: >4.09 V; Off: <0.95 V <b>24 V:</b> On: >14.74 V; Off: <3.78 V	1. GND 2. Digital input 1: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 3. Digital input 2: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 4. Digital input 3: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 5. Digital input 4: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 6. Digital input 5: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 7. Digital input 6: 5 V / 24 V, switchable with object 3240 <sub>n</sub> , max. 1 MHz 8. Analog input: 10 Bit, 0-10 V or 0-20 mA, switchable with object 3221 <sub>n</sub> 9. Digital output 1: Open drain, max 24 V/100 mA 10. Digital output 2: Open drain, max 24 V/100 mA 11. 5V output: +5 VDC, max. 100 mA 12. +UB Logic: 4 V DC/approx. 39 mA

If you set 3240<sub>h</sub>:07<sub>h</sub> to the value "1", three differential inputs are available instead of six single-ended inputs.

#### NOTICE

- EMC: For a DC power supply line longer than 30 m or when using the motor on a DC bus, additional interference-suppression and protection measures are necessary.
- An EMI filter is to be inserted in the DC supply line as close as possible to the controller/motor.
- Long data or supply lines are to be routed through ferrites.



## Commissioning

The *Plug & Drive Studio* software offers you an option for performing the configuration and adapting the motor parameters to your application. You can find further information in document *Plug & Drive Studio: Quick Start Guide* at [us.nanotec.com](http://us.nanotec.com).

Observe the following notes:

#### CAUTION!



##### Moving parts can cause hand injuries.

If you touch moving parts during running operation, hand injuries may result.

- Do not reach for moving parts during operation. After switching off, wait until all movements have ended.

#### CAUTION!



##### In free-standing operation, motor movements are uncontrolled and can cause injuries.

If the motor is unsecured, it can, e. g., fall down. Foot injuries or damage to the motor could occur.

- If you operate the motor free-standing, observe the motor, switch it off immediately in the event of danger and make certain that the motor cannot fall down.

#### CAUTION!



##### Moving parts can catch hair and loose clothing.

During running operation, moving parts can catch hair or loose clothing, which may lead to injuries.

- If you have long hair, wear a hairnet or take other suitable protective measures when near moving parts. Do not work with loose clothing or ties near moving parts.

#### CAUTION!



##### Risk of overheating or fire if there is insufficient cooling!

If cooling is insufficient or if the ambient temperature is too high, there is a risk of overheating or fire.

- During use, make certain that the cooling and environmental conditions are ensured.

#### NOTICE

**EMC: Current-carrying cables – particularly around supply cables – produce electromagnetic alternating fields. These can interfere with the motor and other devices.**

Suitable measures may be:

- Use shielded cables and earth the cable shielding on both ends over a short distance.
- Keep power supply cables as short as possible.
- Use cables with cores in twisted pairs.
- Earth motor housing with large contact area over a short distance.
- Lay supply and control cables separately.



## Configuration via EtherCAT

### Software connection

#### TIP

The following description assumes that an EtherCAT master from Beckhoff with the *TwinCAT* software is used.

- Connect the EtherCAT master to the controller, see .
- Supply the controller with voltage.
- Obtain the *ESI file* that corresponds exactly to the used **firmware version** from the following sources:
  - From the Nanotec website [us.nanotec.com](http://us.nanotec.com). The current version of the firmware and the *ESI file* can be found in the *Plug & Drive Studio* download folder.
  - From Nanotec support.
- Close the *TwinCAT* system manager if it is open.

- Then copy the *ESI file* to the *TwinCAT* subfolder:

- If you use *TwinCAT* version 2, use folder <TWINCAT INSTALL DIR>/Io/EtherCAT
- If you use *TwinCAT* version 3, use folder <TWINCAT INSTALL DIR>/3.1/Config/Io/EtherCAT

#### Example

Example: If *TwinCAT 2* is installed on your computer under path C:\TwinCAT\, copy the *ESI file* to path C:\TwinCAT\Io\EtherCAT\.

- Open the *ESI file* with an editor. Find the *AddInfo* parameter. Enter:

- the value "2" if you would like to integrate the controller as *Box* (factory settings)
- the value "0" if you would like to integrate the controller as *NC-Axis*

Save and close the file.

- Now restart the *TwinCAT* system manager. The *ESI files* are read in again following a restart.

#### NOTICE



The cycle time of the sync signal must always be set to 1 ms. You can set the bus cycle time (and, consequently, the interpolation time in 60C2<sub>h</sub>) to integer multiples of 1 ms.

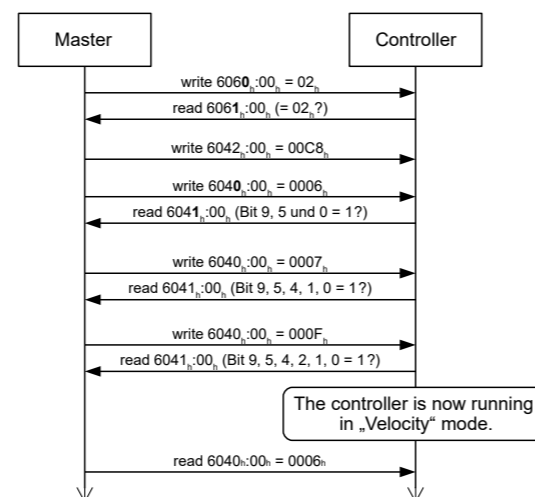
### Test run

After configuring and the auto setup, a test run can be performed. As an example, the **Velocity** operating mode is used.

The values are transferred from your *EtherCAT master* to the controller. After every transfer, the *master* should use the status objects of the controller to ensure successful parameterization.

- Select the *Velocity* mode by setting object 6060<sub>h</sub> (Modes Of Operation) to the value "2".
- Write the desired speed in 6042<sub>h</sub>.
- Switch the *power state machine* to the *Operation enabled*.

The following sequence starts *Velocity* mode; the motor turns at 200 rpm.



- To stop the motor, set controlword (6040<sub>h</sub>) to "6".