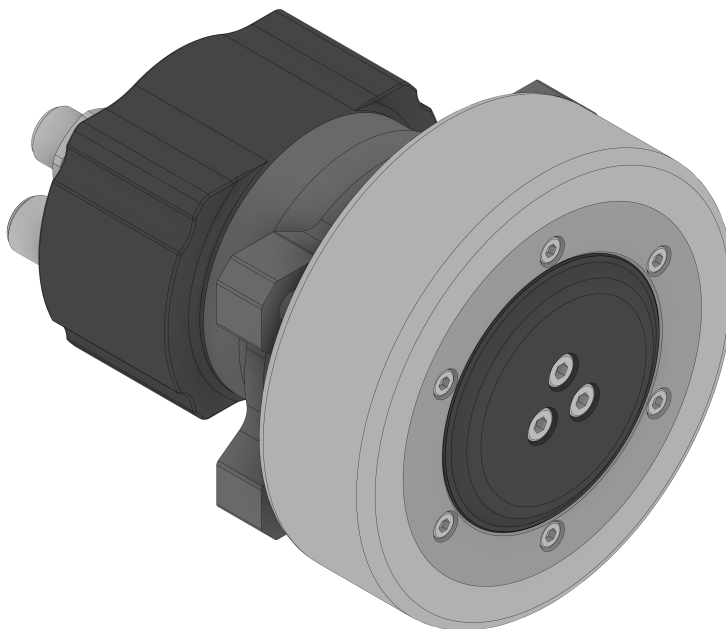


# Technical Datasheet **WD42**

For the following variants:

Wheel size 07530, 10030, 12530, 14030



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## 1 Document aim and conventions

This document explains product data, product use and function. For combinations with other Nanotec products, please ask our sales team. We use the following typefaces:

Underlined text marks a cross reference or hyperlink.

Example 1: Observe our safety notes.

Example 2: Download needed code templates from our website for EMEA/APAC or AMERICA.

**Gray bold italics** call out **menu paths**, **buttons**, **tab** and **file names**.

Example 1: Select **Home > Connect controller > CANopen**.

Example 2: In the **NanoJ** tab, select **NanoJ project** and open **Analog Input.cpp**.

*Plain italics* mark *freehand entries* and *foreign-language* expressions. They also emphasize words of critical weight. Alternatively, bracketed exclaim marks(!) give critical weight.

Example 1: Enter *Plug & Drive Studio*. In addition to users (= *Nutzer; usuario; utente; utilisateur; utente* etc.), this document also addresses:

- Third-party users (= *Drittnutzer; terceiro usuario; terceiro utente; tiers utilisateur; terzo utente* etc.).
- End users (= *Endnutzer; usuario final; utente final; utilisateur final; utente finale* etc.).

Example 2: Protect yourself, others and your equipment. Follow our *general* safety notes that are generally applicable to *all* Nanotec products. Also follow the *specific* safety notes that apply to *this* specific product.

**Courier marks** code blocks or programming commands.

Example 1: Via Bash, call `sudo make install` to copy shared objects; then call `ldconfig`.

Example 2: Use the following NanoLibAccessor function to change the logging level in NanoLib:

```
//
    ***** C++ variant *****
void setLoggingLevel(LogLevel level);
```

The verb *to co-click* means a mouse click by secondary key to open context menus etc.

Example 1: Co-click the file, select **Rename**, and rename the file.

Example 2: Co-click the file to check and select **Properties**.

## 2 For your safety

Before product use, please ensure that all users read, understand and follow the instructions in this document fully. Its hazard warnings, alert symbols and signal words mark specific risk levels.

### CAUTION!



**CAUTION** warns of *possible physical danger!*

Minor / moderate injury possible.

- ▶ Instruction against **unhealthy** user errors.

### NOTICE



**A NOTICE** warns of *wrong operation*.

Material or ecological damage possible (not strictly injury).

- ▶ Instruction against **destructive** user errors (= mere material risks).

**Note:** A mere note in the flow text explains or simplifies a single step.

## 2.1 General safety notes

Protect lives and equipment. Observe these **general** warning messages for **all** our products.



### CAUTION!

**Electric shock, injury, damage, warranty loss: from opening the product undue!**

- ▶ Have only authorized Nanotec partners open the product.



### NOTICE

**Heat damage: from self-warming.**

- ▶ Keep the product far enough from other parts and duly ventilate / cool it.

## 2.2 Specific safety notes

For due protection, observe the **specific** warning messages that cover **this** specific product.



### CAUTION!

**Injury, electric arc, electronic damage: from induced voltage in generative operation!**

- ▶ Operate the product only as motor (never as generator!).



### CAUTION!

**Injury, caught hair, caught clothes: from moving parts!**

- ▶ Stay away from moving parts.
- ▶ Wear a hair net / protection.
- ▶ Remove loose clothes, ties, rings, jewelry etc.
- ▶ After motor switch-off, wait for parts to stand still.
- ▶ Touch parts at standstill only.



### CAUTION!

**Injury and material damage: from rolling away on an incline!**

- ▶ Secure the product against accidental rolling!



### CAUTION!

**Scorch: from overload!**

- ▶ Observe allowed motor limits, voltages and current peaks.
- ▶ Prevent motor overheating in operation.
- ▶ Only touch unpowered, stilled, cooled-off parts.
- ▶ Wear safety gloves if needed.

### NOTICE



**Damage: from worn / damaged tires (changeable only in diameters  $\geq 100$  mm).**

- ▶ Change the tires if needed.

## 3 Before you start

Handle the product as a qualified expert only. Observe the instructions and requirements in this document.

### Check upon receipt

- Packaging / product free of damage?
- Wheel freely rotatable?

### Ensure before commissioning

- Product correctly mounted / oriented without jamming?
- Connector correct (see data sheet)? Wiring verified?
- Control correctly parametrized?
- Floor dry and oil-free?

### Audience, qualification

The product and this document address to technically trained experts alone, such as **development, application, plant engineers, installers**, and **service staff**. Only experts may install, commission and operate the product. Absolutely required are:

- Training and experience in working with motors, their control and electrostatically threatened components
- Reading and understanding of this and all applicable documents
- Knowledge of all valid regulations

### Intended use, delivery scope, warranty

The *WD42* motorized wheel is partly completed machinery in the context of the Machinery Directive 2006/42/EC. Commissioning is prohibited until it has been determined that – where applicable – the machinery into which this motorized wheel is to be installed complies with the provisions of the Machinery Directive 2006/42/EC. *WD42* contains:

- A combination of motor, gearbox and encoder
- A wheel  $\varnothing$  75 to 140 mm ( $\geq 100$  mm changeable)

For warranty scope, please observe our terms and conditions for either EMEA/APAC or AMERICA. Nanotec is **not** liable for wrong quality, handling, installation, operation, use, maintenance of third-party goods! Follow valid OEM instructions.

## 4 Product and installation data

Artikel numbers for *WD42* variants read like this:

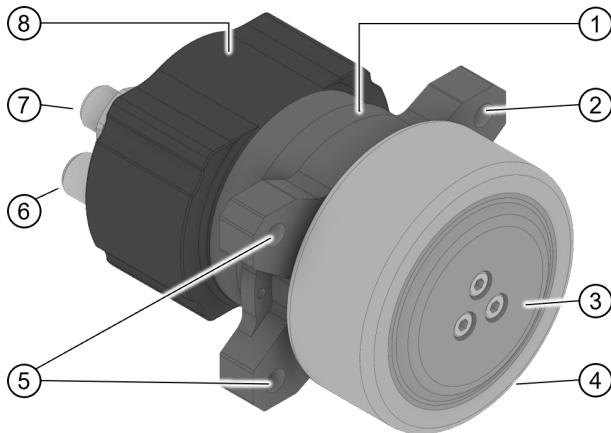
<b>WD</b> <sub>xxxx-42xx-50-xxxx</sub>	Product group <b>Wheel Drive</b>
WD <b>XXX</b> <sub>xx-42xx-50-xxxx</sub>	Wheel $\varnothing$ (mm)
WDxx <b>XX</b> <sub>-42xx-50-xxxx</sub>	Wheel width (mm)
WDxxxx- <b>42</b> <sub>xx-50-xxxx</sub>	Gearbox size (mm)
WDxxxx-42 <b>XX</b> <sub>-50-xxxx</sub>	Gear reduction
WDxxxx-42xx- <b>50</b> <sub>.xxxx</sub>	Motor size (mm)
WDxxxx-42xx-50- <b>XX</b> <sub>xx</sub>	Encoder <b>E3</b> : incemental   <b>E4</b> : SSI absolut

### Ambient conditions

Ambient temperature -15 to +40 °C (5 to +104 °F)

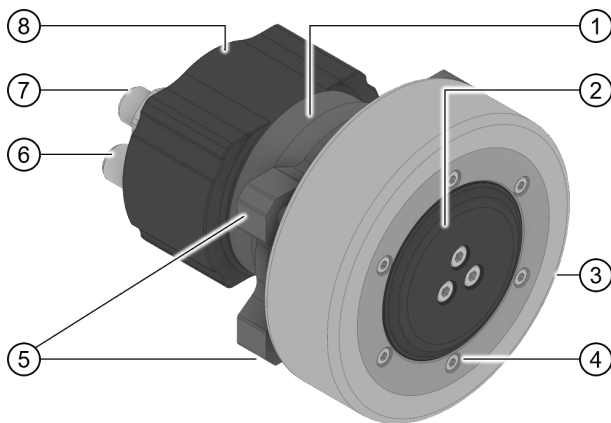
Air humidity ≤ 85 % (no condensation)  
 Protection class IP54

**Layout (example wheel 75 and 100 mm)**



1. Motor
2. Mounting point
3. Planetary gear in rim barrel
4. 75-mm tire (= **not** changeable)
5. Mounting point
6. 5-pin motor connector M12 (L-coded)
7. Depending on version: 8- or 12-pin encoder connector M12 (A-coded)
8. Integrated Encoder

Fig. 1: WD42 with 75 mm wheel (not changeable). Well visible: three of four mounting points (2, 5).



1. Motor
2. Planetary gear in rim barrel
3. Tire size ≥ Ø 100 mm (= **changeable**)
4. Wheel flange (= only if changeable tire), removable by six Allen screws (2.5 mm)
5. Mounting point
6. 5-pin motor connector M12 (L-coded)
7. Depending on version: 8- or 12-pin encoder connector M12 (A-coded)
8. Integrated Encoder

Fig. 2: WD42 with 100-mm wheel. The changeable tire (3) partly covers the mounting points (5); the wheel rim (4) acts as a flange to change the wheel.

**Wheel and tire**

All WD42 wheels have 30-mm-wide Vulkollan tires of a 92 Shore A hardness and a 200 kg load capacity. On dry smooth concrete, the friction value  $\mu$  exceeds 0.25. **NOTICE:** ► Use wheel size, reduction ratio and torque to calculate the correct traction.

Gear reduction	11.76	15.45	20.64	25.62
Rated speed m/s (100-mm wheel)	1.6	1.2	0.9	0.7
Output torque (Rated / max.) Nm	4.88 / 14.64	6.41 / 19.23	8.56 / 25.68	10.63 / 26.28

**Motor**

Rated voltage 48 VDC  
 Rated current 5.9A  
 Peak current 17.7 A (14.6 for gear ratio 26)  
 Rated speed at 48 V 35000 rpm

**Encoder**

The WD42's encoder resolves incrementally with 4096 cpr / 16384 ppr and via SSI with 17 bit (single-turn).

	<b>SSI</b>	<b>Inkremental</b>
Operating voltage	9 to 30 V DC	4,5 to 5,5 V DC
Consumption (typical value)	≤40 mA (@12 V, no load)	≤50 mA (@5 V, no load)
Clock input	RS 422	
Sensor type	Magnetic	Magnetic
Incremental resolution		4096 cpr (16384 ppr with quadrature)
SSI resolution <i>single-turn</i>	17 bit	

## 5 Tooling and assembly

**NOTICE**



**ESD-sensitive module damage: from electrostatics!**

- ▶ Observe basic principles for ESD protection.

**NOTICE**



**Electronic damage, short circuit: from mispolarized supply voltage!**

- ▶ Assign connectors correctly.
- ▶ Use correct connector types.
- ▶ Protect the supply line by fuse.

For product installation, please use the dimensional drawing from our website: Just use *Products > [Product group]* to scroll to the results list, then click on *WD<sup>[variant]</sup>42 > Dimensions*, select a download format, and use the cloud button to save it. You also need:

- **Four M8x1.25 screws ISO 4762-8.8:** thread depth 12-14 mm (advised)
- **Torque tool:** 20.8 Nm (tightening torque advised for the above-listed thread depth)
- **Motor cable:** with M12 plug L-coded
- **Encoder cable:** with M12 plug A-coded (SSI 8-pin; incremental 12-pin)

**Observe the pinouts for motor and encoder**

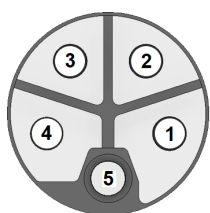


Fig. 3: **Motor:** L-coded M12, male (some pins no function).

- 1: U                      2: V                      3: W                      4: n/c                      5: n/c

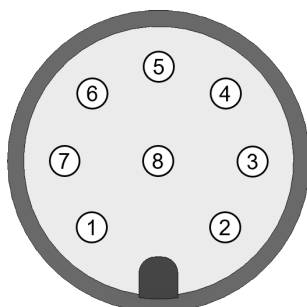


Fig. 4: **SSI encoder:** A-coded M12, male.

- |                      |                     |                    |
|----------------------|---------------------|--------------------|
| 1: Clk+ <sup>1</sup> | 4: Data-            | 7: n/c             |
| 2: Clk- <sup>1</sup> | 5: Gnd <sup>2</sup> | 8: Ub <sup>3</sup> |
| 3: Data+             | 6: <u>Preset</u>    |                    |

<sup>1</sup> 120 Ω between Clk+ und Clk- internal. <sup>2</sup> Not connected to motor housing. <sup>3</sup> Voltage supply.

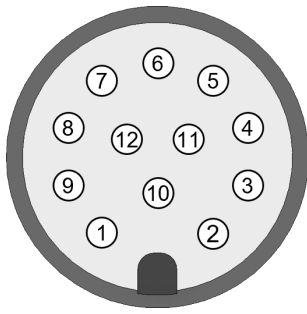
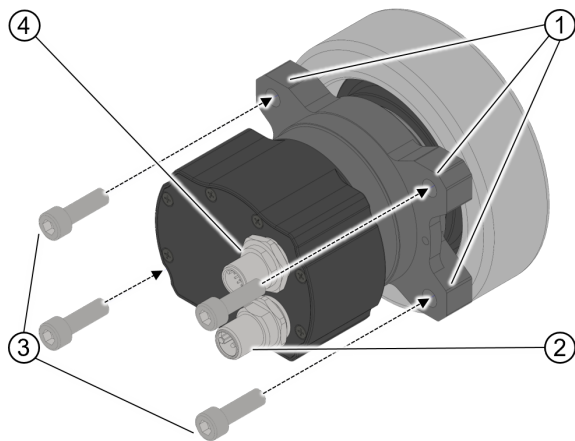


Fig. 5: **Incremental encoder: A-coded M12, male.**

- |                    |       |                      |
|--------------------|-------|----------------------|
| 1: Ub <sup>1</sup> | 5: B  | 9: H2                |
| 2: A\              | 6: I\ | 10: H3               |
| 3: A               | 7: I  | 11: <u>Preset</u>    |
| 4: B\              | 8: H1 | 12: Gnd <sup>2</sup> |

<sup>1</sup>Voltage supply. <sup>2</sup>Not connected to motor housing.

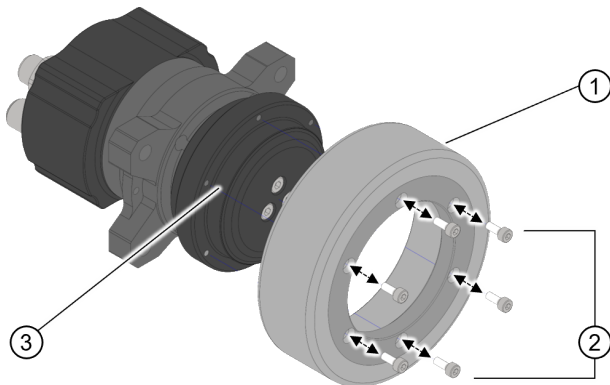
**Install and connect**



1. Using suitable screws / tightening torques (3): fix the WD42 to your carry work at all four mounting points (1).
2. Connect the control cables for encoder (4) and motor (2).
3. Calculate the correct traction.

Fig. 6: Three of the four mounting points. (1)

**Tire change (if allowed)**



**NOTICE: Damage: from wrong wheel tightening.** Apply correct torque. Recommended screw (in case of loss): six M3x10 (ISO 4762-8.8).

1. De-energize the motor (3).
2. Use a 2.5-mm Allen key to loosen the six fixing screws (2) on the wheel flange.
3. Change and re-tighten the tire (1) with **1.31 Nm** (2) on the wheel rim (3).
4. Secure the screws (2); duly recycle the old tire.

Fig. 7: Six secured **ISO 4762 M3x10** Allen screws (2) hold the change tire (1) on the wheel rim (3).

**Preset function**

With the preset function, you can set the internal index or the zero position of the encoder to a new position. The electronics of the encoder then stores this position and in the future then outputs the index signal or the zero position at this position.

**CAUTION!**



**Uncontrolled motor movements!**

- ▶ Switch off the control before you trigger the preset function.
- ▶ Restart your controller after the preset and, if necessary, recalibrate or perform another auto setup before switching the drive back to control operation.



To define the new index or zero position, proceed as follows:

1. Move to the desired position with the motor.
2. Trigger the preset function by applying the supply voltage of the encoder to the preset pin. The voltage should be applied for at least 3 seconds.
3. Switch off the power supply of the encoder.  
The next time the encoder is switched on, it outputs the index signal at this position (zero position).

## 6 Sensor data format

Depending on type, the WD42's encoder sends the data incrementally via two channels **A**, **B** plus index **I** or via synchron-seriell-interface (SSI) as a 23-bit packet.

### Incremental output

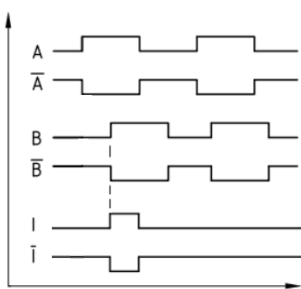


Fig. 8: Clockwise (viewing the motor drive shaft), the channel A signal precedes channel B by 90° (electrically). The index signal is 90° wide and synchronous to the channel B edge.

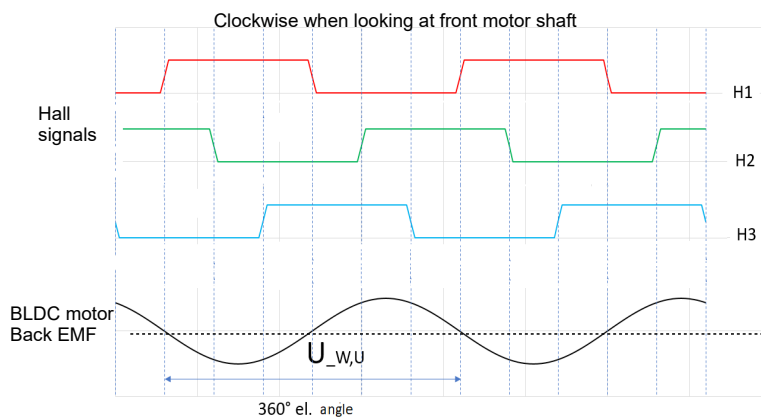


Fig. 9: The Hall signals (preconfigured only if attached to BLDC motors) are arranged such that the rising and falling Hall 1 edges lie at the zero crossings of the back EMF voltage  $U_{w,u}$  (phase voltage  $W$  after  $U$ ).

The following signal levels ( $U_b = 5\text{ V}$ , load = 20 mA) apply for differential encoder signals A,  $\bar{A}$ , B,  $\bar{B}$ , I,  $\bar{I}$  :

High level	Low level
$\geq 2.4\text{ V}$	$\geq 0.4\text{ V}$

The following signal levels ( $U_b = 5\text{ V}$ , load = 4 mA) apply for Hall sensors Hall 1, Hall 2, Hall 3:

High level ( $U_b = 4.5\text{ V}$ )	Low level ( $U_b = 4.5\text{--}5.5\text{ V}$ )
$\geq 4\text{ V}$	$\geq 0.5\text{ V}$

### SSI-Output

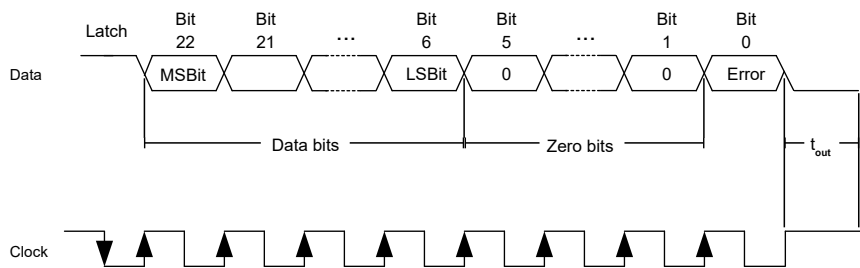


Fig. 10: SSI signal curve, binary-coded from a total of 23 bits.

**Latch:** Data do flow as of the first falling clock signal edge; first bit is 1.

**Data bits (position value):** The actual position transmits as of the next rising clock signal edge = data transfer (17 bits) with the highest value bit (MSB) first, each bit on the rising clock signal edge.

**Zero bits:** Five zero bits follow the data bits. **Error bit:** This end bit tells if internal errors occurred (= 0) or not (= 1). After a **20-µs timeout** ( $t_{out}$ ), you can fetch a new data packet by clock signal. Ex works, the absolute encoder zero position is at the zero crossing of the back EMF voltage  $U_{w, u}$  (phase voltage W after U).

### Prepare the SSI for Nanotec controllers

Edit the 33B0<sub>h</sub> **sub-indices** below so that the Nanotec CPB controllers in *Autosetup* (see controller manual) duly process the encoder and its data:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
									POS	POS	POS	POS	POS	POS	POS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
POS	POS	POS	POS	POS	POS	POS	POS	POS	POS	0	0	0	0	0	E

- **0** (= error): value 1 if no error occurred
- **1-5:** always value 0

Fig. 11: Data in 23 bits: **E** for error, 17 **POS** for position, 5 zero bits

You need to write the following **sub-indices** of 33B0<sub>h</sub> accordingly and restart the controller after saving:

1. Set 33B0<sub>h</sub>:06<sub>h</sub> to 2625000 ( baud rate in Hz).
2. Set 33B0<sub>h</sub>:05<sub>h</sub> to 23 (number of bits).
3. Set 33B0<sub>h</sub>:07<sub>h</sub> to 7FFFC0<sub>h</sub> (Position data: POS bits 6 to 22).
4. Set 33B0<sub>h</sub>:09<sub>h</sub> to 1 (error bit 0).
5. Set 33B0<sub>h</sub>:0B<sub>h</sub> to 1 (error bit should have the value 1).
6. To store the object: Insert 65766173<sub>h</sub> to 1010<sub>h</sub>:06<sub>h</sub>.
7. Restart the controller.

## 7 Applied norms, conformities

The risk analysis for this product proves the following conformities:

- RoHS directive 2011/65/EU/2015/863/EU
- Machinery directive 2006/42/EU

Only risks / hazards of duly installed and connected stand-alone products were assessed. Target group are technically trained experts, qualified for the product's assembly, commissioning and maintenance as part of an overall machine or system. Risks / hazards of the overall construction are excluded, as they must be rated by the target group. Before first start-up, you must integrate the product duly to standard, using the given fastening points.

## 8 Imprint, versions

© 2023 Nanotec Electronic GmbH & Co. KG | Kapellenstr. 6 | 85622 Feldkirchen | Germany | Tel. +49 (0) 89 900 686-0 | Fax +49 (0) 89 900 686-50 | info@nanotec.de | www.nanotec.com | All rights reserved. Error,

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<b>Document</b>	<b>++ Added   &gt;&gt; Changed   ## Fixed</b>
1.0.0 <sup>2023.09</sup>	Release