

# Operating Instructions

## Brake Chopper

For use with the following devices:

BC72-50



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## 1 Introduction

During braking, electrical energy is fed back into the DC-link through self-induction of the motor. If not using a power supply with regenerative-feedback capability, the brake power can cause the DC-link voltage to increase which, if no additional measures are taken, is limited only by the internal consumption and capacitances in the DC-link.

To prevent damage to the controller through overvoltage, it may – depending on the level of the braking power – be necessary to dissipate excess energy in the form of heat. The *brake chopper* dissipates – if an adjustable voltage value is exceeded – this excess energy via a resistor into heat.

### 1.1 Version information

Document version	Date	Changes	Hardware version
1.0.0	05/2021	Edition	W004
1.0.1	06/2021	Improvements in <u>Setting the switching threshold</u> .	W004
1.0.2	07/2021	<u>Internal braking resistor overload</u> leads to an error.	W004
1.1.0	10/2021	<ul style="list-style-type: none"> <li>■ <u>Overcurrent</u> leads to an error.</li> <li>■ Added chapter <u>Increasing the continuous braking power</u></li> </ul>	W004
1.2.0	12/2021	<ul style="list-style-type: none"> <li>■ Mating connectors updated in chapter <u>Pin assignment</u></li> <li>■ Warning and safety messages updated</li> </ul>	W004

### 1.2 Copyright, marking and contact

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### 1.3 Intended use

The *brake chopper* is used as a component of drive systems in various industrial applications.

Use the product as intended within the limits defined in the technical data (see Electrical properties and technical data) 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 and instructions for safe use and safe operation. All warning notices provided by Nanotec must be passed on directly to the end user.

## 1.4 Warranty and disclaimer

Nanotec assumes no liability for damages and malfunctions resulting from installation errors, failure to observe this manual or improper repairs. The selection and use of Nanotec products is the responsibility of the plant engineer or end user. Nanotec accepts no responsibility for the integration of the product in the end system.

Our general terms and conditions at [www.nanotec.com](http://www.nanotec.com) apply.

Customers of Nanotec Electronic US Inc. please refer to [us.nanotec.com](http://us.nanotec.com).



### NOTICE

Changes or modifications to the product are not permitted.

## 1.5 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
- Application engineers

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

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

## 1.6 EU directives for product safety

The following EU directives were observed:

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

## 1.7 Used icons

All notices are in the same format. The degree of the hazard is divided into the following classes.

### WARNING



**The WARNING notice indicates a possibly dangerous situation.**

Failure to observe the notice **may** result in severe or fatal injuries.

- ▶ Describes how you can avoid the danger.

### CAUTION



**The CAUTION notice indicates a possibly dangerous situation.**

Failure to observe the notice **may** result in moderately severe injuries.

- ▶ Describes how you can avoid the dangerous situation.

**NOTICE**

**Indicates a possible incorrect operation of the product.**

Failure to observe the notice may result in damage to this or other products.

▶ Describes how you can avoid the incorrect operation.

**TIP**

Shows a tip for the application or task.

## 1.8 Emphasis in the text

The following conventions are used in the document:

Underlined text indicates cross references and hyperlinks:

- Use the product as intended within the limits defined by the technical data (see Electrical properties and technical data)
- and under the approved Environmental conditions.

Text set in *italics* marks named objects:

- The *NME2* is an external magnetic encoder for detecting the rotor position of motors.

## 2 Safety and warning notices

### WARNING

**Risk of overheating or fire if the limits defined in the technical data (see Electrical properties and technical data) are not observed and there is insufficient cooling!**



- ▶ Do **not** use the product in potentially explosive areas (EX areas).
- ▶ During use, make certain that the cooling and environmental conditions are ensured.
- ▶ Ensure that good heat dissipation is favored by either installing the device in vertical position or —if in a horizontal position— with the metal housing on top.
- ▶ Ensure that the permissible current is not exceeded when choosing an external braking resistor.
- ▶ Monitor the status during commissioning and operation, via the LEDs and/or the status output.

### CAUTION

**Risk of injury from electric shock if the product is damaged!**



If the product is damaged, voltage carrying parts can cause an electric shock which can possibly lead to burns and injuries.

- ▶ Only change the wiring or touch the product in a de-energized state. After switching off, wait at least three minutes until the voltage in the capacitors has dissipated.

### CAUTION

**Risk of injury in case of a short circuit!**



A short circuit can damage the product and possibly lead to burns and injuries.

- ▶ If you notice a short circuit or the product signals an error via the LEDs and/or the status output, immediately switch off the power supply. Commission the product again in a protected environment and check the error message,

### CAUTION

**Risk of burning!**



The product may become very hot during operation

- ▶ During use, make certain that the cooling and environmental conditions are ensured.
- ▶ Do not touch the product while in operation. After switching off, wait until all components have cooled before you touch them.

### CAUTION

**Risk of injury from sharp edges!**



Due to production tolerances, sharp edges may form on the DIN rail clip and the mounting lugs that could cause hand injuries.

- ▶ Do not touch the DIN rail clip or the mounting lugs to unpack or mount the product.

**CAUTION****EMC: Interference and risk of injury from electromagnetic alternating fields!**

Current-carrying cables – particularly around supply cables – produce electromagnetic alternating fields.



These can interfere with the product and other devices and lead to uncontrolled behavior and injuries.

- ▶ Connect the product to earth over a short distance using the PE conductor.
  - ▶ Perform a risk assessment for the entire machine/system to identify possible risks due to electromagnetic interference and initiate suitable protection measures if necessary.
- 

**CAUTION****Risk of injury in case of electronics damaged through improper handling of ESD-sensitive components!**

The device contains components that are sensitive to electrostatic discharge. Improper handling and lack of ESD protection measures can damage the device and lead to uncontrolled behavior and injuries.

- ▶ Observe the basic principles of ESD protection when handling the device.
  - ▶ If you notice an unexpected behavior, restart the device and check the correct LED signaling. If an error is signaled, do not commission the device.
-

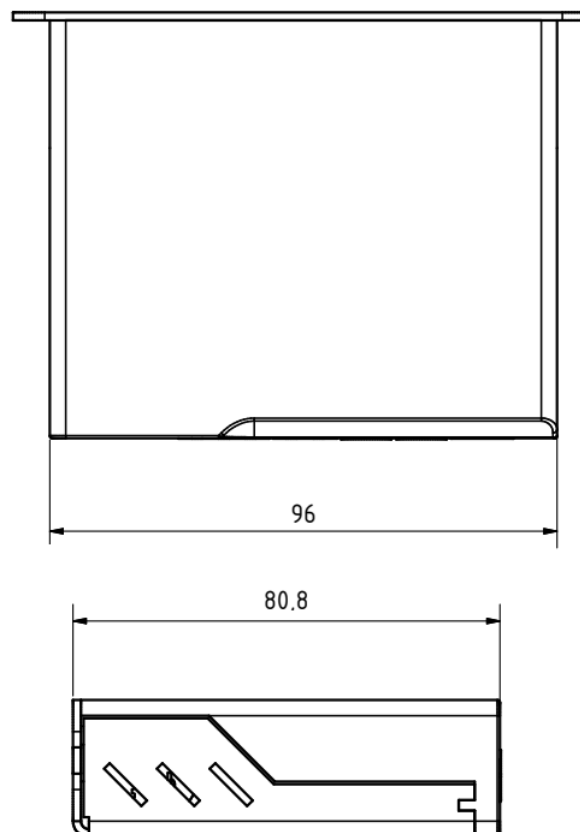
## 3 Technical details and pin assignment

### 3.1 Environmental conditions

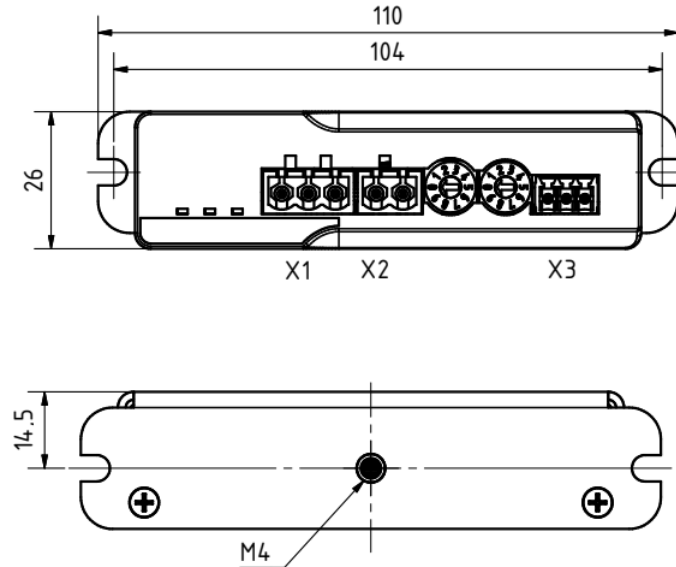
Environmental condition	Value
Protection class according to EN/IEC 60529	IP30
Ambient temperature (operation)	-10... +40°C
Ambient temperature (storage)	-25... +85°C
Air humidity (non-condensing)	0 ... 95%
Altitude of site above sea level	1500 m

### 3.2 Dimensioned drawings and installation options

All dimensions are in millimeters.







You can secure the *brake chopper* with screws on a plane mounting surface using the lugs on the side or install it with the delivered DIN rail clip in your switch cabinet.

#### CAUTION



**Risk of overheating or fire if the limits defined in the technical data (see [Electrical properties and technical data](#)) are not observed and there is insufficient cooling!**

- ▶ During use, make certain that the cooling and environmental conditions are ensured.
- ▶ Ensure that heat dissipation is favored by either installing the device in vertical position or—in a horizontal position—with the metal housing on top.

### 3.3 Electrical properties and technical data

Property	Description/value
Operating voltage	12 ...75 V DC
Rated power @40°C	20 W (see <a href="#">table with assembly variants</a> )
Power for max. 5 seconds	250 W
Max. permissible Power (for 1 second)	1 kW
Max. permissible current for internal and external braking resistor (for 1 second)	40 A
Capacity of the integrated capacitors (between power supply and ground)	400 µF

You can increase the continuous power up to 100 W by improving the heat dissipation and connecting an external resistor at X2 (BRK). Nanotec recommends a 2.2 or 1.1 Ohm external power resistor parallel to the internal 4.7 Ohm resistor.

Assembly variant	Continuous power @40°C
BC72-50 mounted on DIN-Rail	20 W
BC72-50 mounted on metal plate	30 W
BC72-50 with 2.2 Ohm external braking resistor, mounted on metal plate	60 W
BC72-50 with 1.1 Ohm external braking resistor, mounted on metal plate	100 W

**NOTICE**



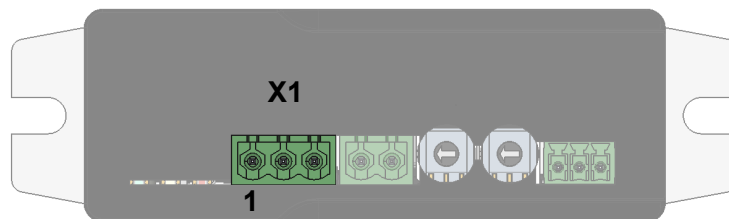
Aside from the installation location and the heat transfer there, the exact temperature behavior is also dependent on the convection in the application. For this reason, Nanotec recommends always performing an endurance test in the actual environment for applications in which power and ambient temperature pose a problem.

### 3.4 Pin assignment

#### 3.4.1 X1 (PWR) – power supply

Type: DEGSON Electronics 2EDGRC-5.08-03P-14-00AH

Mating connector (included in scope of delivery): DEGSON Electronics 2EDGKD-5.08-03P-14-00AH or equivalent



Pin	Function	Note
1	PE	Connection for the protective earth conductor
2	+U <sub>p</sub>	Connection for the supply voltage 12...75 V DC
3	GND	Ground

**CAUTION**

**EMC: Interference and risk of injury from electromagnetic alternating fields!**

Current-carrying cables – particularly around supply cables – produce electromagnetic alternating fields.

These can interfere with the product and other devices and lead to uncontrolled behavior and injuries.

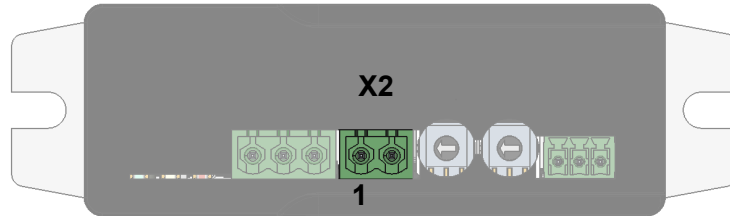
- ▶ Connect the product to earth over a short distance using the PE conductor.
- ▶ Perform a risk assessment for the entire machine/system to identify possible risks due to electromagnetic interference and initiate suitable protection measures if necessary.



### 3.4.2 X2 (BRK) – external braking resistor (optional)

Type: DEGSON Electronics 2EDGRC-5.08-02P-14-00AH

Mating connector (included in scope of delivery): DEGSON Electronics 2EDGKD-5.08-02P-14-00AH or equivalent



Pin	Function	Note
1	R <sub>b_ext</sub> , Pin 1	optional
2	R <sub>b_ext</sub> , Pin 2	optional

#### Sizing the external braking resistor

**NOTICE**

**The selection of the external braking resistor is the responsibility of the machine builder or plant engineer.**



Whether and which external braking resistor is necessary depends on the circumstances of the machine in which this component is to be installed.

- ▶ Changes or modifications to the product are not permitted without the prior written consent of Nanotec.
- ▶ Contact Nanotec if you wish help selecting the external braking resistor or a specific customization of the product.

The value of the overall braking resistor ( $R_b$ ) depends on the maximum needed power ( $P_{max}$ ) of your application and the desired switching threshold of the brake chopper ( $U_{on}$ ):

$$R_b = U_{on}^2 / P_{max}$$

The value of the overall braking resistor results from the internal (4.7 Ohm) and the external resistor you select. The external braking resistor is connected in parallel to the internal.

**NOTICE**

When selecting the external braking resistor, make sure that the permissible current of 40 A is not exceeded (see [Electrical properties and technical data](#)). Following minimum values result depending on the operating voltage:

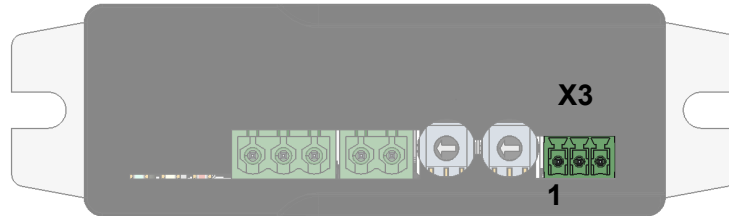


Operating voltage	external braking resistor
24 V (max. 30)	min. 1.1 Ohm
48 V (max. 58)	min. 2.2 Ohm

### 3.4.3 X3 (STS) – digital output (status output)

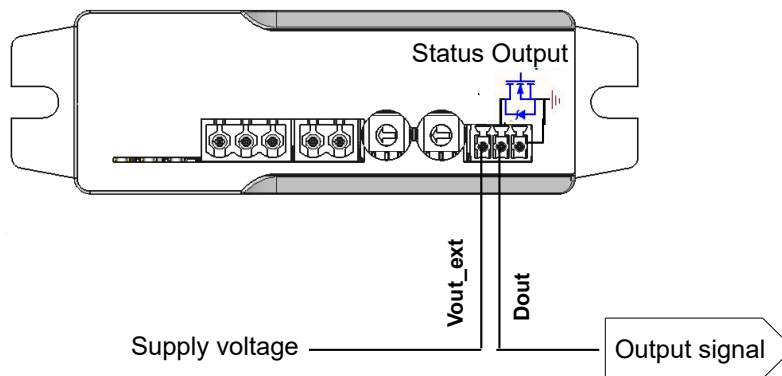
Type: DEGSON Electronics 15EDGRC-3.5-03P-14-00AH

Mating connector (included in scope of delivery): DEGSON Electronics 15EDGKN-3.5-03P-14-00AH or equivalent



Pin	Function	Note
1	$V_{out\_ext}$	Connection for the external voltage supply of the output max. 36 V
2	$D_{out}$	digital output, open-drain max. 36 V/ 1 A, short circuit proof up to 36V
3	GND	Ground

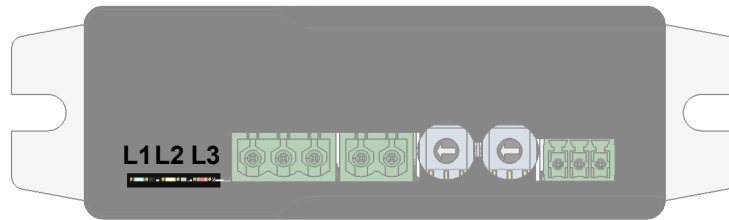
The output is implemented as "open drain". Hence, an external voltage supply as shown in the following figure is always necessary.



The output signals the state of the brake chopper: as long as the output is HIGH ( $D_{out}=V_{out\_ext}$ ), the supply voltage ( $U_p$ ) is available and no errors have occurred. If the output turns LOW ( $D_{out}=GND$ ), an error has occurred. The red LED signals the exact error number,

## 3.5 LED signaling

The *brake chopper* is equipped with three LEDs, *L1 PWR* (green), *L2 STS* (yellow) and *L3 ERR* (red).



LED behavior	Status
L1 off	Power supply +U <sub>p</sub> not applied
L1 steady green	Voltage under the set switching threshold of the brake chopper, normal operation
L2 and L3 off	
L2 lights/blinks yellow	Voltage over the set switching threshold of the brake chopper, brake-chopper active
L3 blinks red	error occurred

If an error has occurred, the red LED signals an error number by blinking n times. The blinking is repeated after a pause of one second. The following table shows the meaning of the error numbers.

Blink rate	Error
1	U <sub>p</sub> exceeds the set <u>switching threshold</u> at power on.
2	The <u>switching threshold</u> is out of the permitted range or was changed during operation.
3	Over-temperature on the internal braking resistor
4	Braking resistor not connected or defective
5 to 10, 12	Internal error
11	Internal braking resistor overload
13	Overcurrent

#### NOTICE



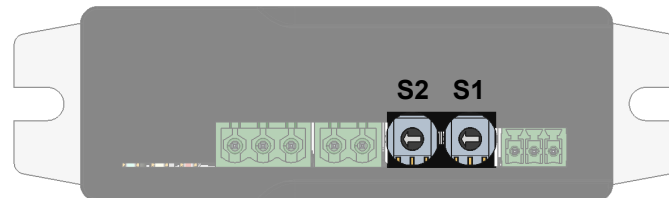
When the internal temperature sensor detects an overtemperature condition, the *brake chopper* is turned off for three seconds.

## 4 Installation and commissioning

### 4.1 Setting the switching threshold

The *brake chopper* is equipped with two rotary switches. With the combination of numbers from both rotary switches you can set the operating voltage of your application.

The combination of numbers is formed using rotary switches S1 and S2, where S1 is multiplied with 1 and S2 is multiplied with 10. Values under 12 and over 72 are registered by the *brake chopper* as an error.



#### NOTICE



The voltage threshold, above which the *brake chopper* is activated and shall limit the voltage, is **2 V higher than the operating voltage set**.

#### Example

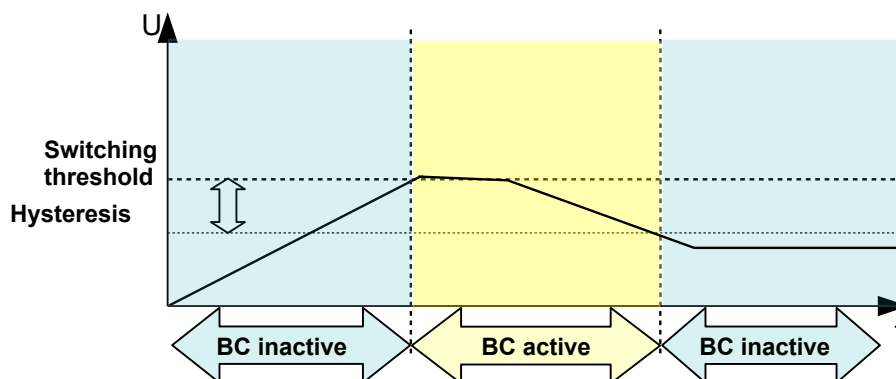
Switch S2 is set to the value "5", switch S1 to the value "2"; the result is the value "52" and the switching threshold is 54 V.

#### TIP



The switches are set to "90" in delivery state. The *brake chopper* signals an error at power on, until you have set an appropriate value and reset the *brake chopper*.

The *brake chopper* gets deactivated as soon as the incoming voltage is again lower than the threshold, with a hysteresis of 0.837 V (+/- 20%).



## 4.2 Connect the brake chopper

### CAUTION

#### EMC: Interference and risk of injury from electromagnetic alternating fields!

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These can interfere with the product and other devices and lead to uncontrolled behavior and injuries.

- ▶ Connect the product to earth over a short distance using the PE conductor.
- ▶ Perform a risk assessment for the entire machine/system to identify possible risks due to electromagnetic interference and initiate suitable protection measures if necessary.

### NOTICE

#### Damage to the product!



Changing the wiring during operation may damage the connectors.

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

Connect the brake chopper in parallel to the power supply, as shown in the following figure.

