N6-1-2..., N6-2-2...





Short instructions Translation of the

Nanotec Electronic GmbH & Co. KG Kapellenstraße 6

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Introduction

The N6 is a controller for the open-loop or closed loop operation of stepper motors and the closed loop operation of BLDC motors.

This manual describes the functions of the controller and the available operating modes. It also shows how you can address and program the controller via the communication interface

You can find further information on the product on us.nanotec.com.

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Intended use

The N6 serves to control stepper motors and BLDC motors and is used as a component in drive systems in a wide range of industrial applications.

Use the product as intended within the limits defined in the technical data (in particular, see Permissible operating voltage) and the approved Environmental conditions. This Nanotec product may under no circumstances 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.

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
- are familiar with and understand the content of this technical manual,
- · know the applicable regulations.

Warranty and disclaimer

Nanotec shall not be liable for damage and malfunctions attributable to installation errors, failure to observe this document or improper repair. The plant engineer, operating company and user shall be responsible for the selection, operation and use of our products. Nanotec shall not take responsibility for integration of the product in the end system. The general terms and conditions listed at www.nanotec.de shall apply. Note: Conversion/modification as well as opening of the product are prohibited.

Other applicable regulations

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

- Accident-prevention regulations
- · Local regulations on occupational safety

EU directives for product safety

The following EU directives were observed:

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

Safety and warning notices

NOTICE

Damage to the controller!

Changing the wiring during operation may damage the

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

NOTICE



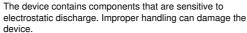
Damage to the controller due to excitation voltage of the

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!**



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

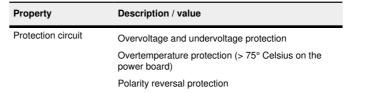
Technical details and pin assignment

Environmental conditions

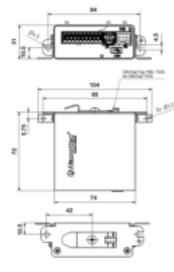
Environmental condition	Value
Protection class	IP20
Degree of contamination	2
Ambient temperature (operation)	-10 +40°C
Ambient temperature (storage and transport)	-25 +85°C
Relative humidity (operation), non-condensing	0 85%
Relative humidity (storage and transport), non-condensing	0 %
Absolute humidity (storage and transport), non- condensing	30 g/m ³
Max. altitude of site above sea level	2000 m (drop in performance above 1000 m: -1%/100 m)
Max. altitude of site above sea level (storage and transport)	3000 m

Electrical properties and technical data

Property	Description / value	
Operating voltage	12 V -5%57.6 V DC	
Rated current	6 A _{rms}	
Peak current	N6-1 (low current): 6 A _{rms}	
	N6-2 (high current): 18 A _{rms} for 5 seconds	
Commutation	Stepper motor – open loop, stepper motor – closed loop with encoder, BLDC motor – closed loop with Hall sensor, and BLDC motor – closed loop with encoder	
Operating modes	Profile Position Mode, Profile Velocity Mode, Profile Torque Mode, Homing Mode, Interpolated Position Mode, Cyclic Sync Position Mode, Cyclic Sync Velocity Mode, Cyclic Synchronous Torque Mode, Clock-Direction Mode	
Set value setting / programming	CANopen, Clock-direction, analog, NanoJ program	
Interfaces	CANopen, USB	
Inputs	 6 inputs, 5 V/24 V (=UB_Logic), switchable by means of software, factory setting: 5 V 2 analog inputs 0 to +24 V, 12-bit resolution 	
Outputs	3 outputs, 5 V/24 V (=UB_Logic), switchable by means of software, 100 mA	
Brake connection	1 PWM output, max. 1.5 A, 20 kHz	
Sensor inputs 1 incremental encoder (5 V), 3 Hall sensors SSI encoder (10 V)		



Dimensioned drawings and installation options



You can secure the controller by its side tabs to a flat mounting surface using screws or mount it on a TH35 DIN rail in your switch cabinet using the supplied

Overtemperature protection

Above a temperature of approx. 75°C on the power board the power part of the controller switches off and the fault bit is set. After cooling down and resetting the fault, 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.

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

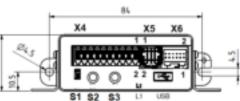


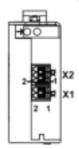
For each error that occurs, a more precise error code is stored in

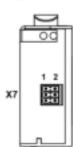
Pin assignment

Pin 1 and 2 are marked below

object 1003_h.







Connector	Function	Pin assignment / description
X1 min. : 1 mm ² (AWG 17)	Motor Note: Motor wires are to be routed through ferrites (74271222 from Würth or equivalent).	 A (Stepper) U (BLDC) A\ (Stepper) V (BLDC) B (Stepper) W (BLDC) B\ (Stepper)
X2 UB: 1 mm ² (AWG 17) UB_Logic; 0.8 mm ² (AWG 18)	Supply	 GND_L-, GND for the Logic Supply UB_Logic +UB_Logic;12 V - 30 V DC Ballast- GND_P, GND for the Main Supply UB +UB;12 V - 57,6 V DC
X4	In- / Outputs	 +10 V; Output voltage, max. 350 mA GNDD; GND for digital In/Outs +5 V; Output voltage, max. 350 mA GNDD; GND for digital In/Outs Digital output 1:5 / 24 V (UB_Logic) switchable, 100 mA Digital output 2: :5 / 24 V (UB_Logic) switchable, 100 mA Digital output 3: :5 / 24 V (UB_Logic) switchable, 100 mA GNDD; GND for digital In/Outs Digital input 1; 5 V / 24 V, switchable Digital input 2: 5 V / 24 V, switchable Digital input 3; 5 V / 24 V, switchable Digital input 4; 5 V / 24 V, switchable Digital input 4; 5 V / 24 V, switchable Digital input 5; 5 V / 24 V, switchable Digital input 6; 5 V / 24 V, switchable GNDA; GND for Analog input Analog input 1: 0 V+24 V, 12-Bit-resolution GNDA; GND for Analog input Analog input 2: 0 V+24 V, 12-Bit-resolution Brake-: GND for brake Brake+: PWM-controlled output, 5 V / 24 V switchable, up to 20 KHz, max. 1500 mA
X5	SSI Encoder	 GND SHIELD n.c. DATA B DATA A CLCK B; up to 10 MHz CLCK A; up to 10 MHz Vcc; +10 V DC, outputs- und Supply voltage for SSI Encoder, max. 350 mA

Connector	Function	Pin assignment / description		
X6	Incrmental encoder and Hall sensor Max. 1 MHz	 GND Vcc: +5 V DC, output, Supply voltage for Encoder / Hall Sensor; max. 350 mA A B A\ B I\ Hall 1 Hall 2 Hall 3 Shielding Connector for the shileding 		
X7	CANopen IN / OUT	1. GND 2. GND 3. CAN_L 4. CAN_L 5. CAN_H 6. CAN_H		
S1	DIP switch for 120 Ω termination for CANBus.	OFF (down): The CAN bus termination is off. ON (up): The CAN bus termination is on.		
S2 and S3	Two Hex coding switches for setting the <i>Node-ID</i> and baud rate: • \$2.16 ¹ • \$3.16 ⁰	Value Noo of the switches	de-ID Baud rate	
		80 _h Obj. 200 81 _h -FF _h (Val of the swite	9 _h 2005 _h ue Object	

NOTICE



EMC: For a DC power supply line longer than 30 m or when using the motor on a DC bus, additional interferencesuppression and protection measures are necessary.

- ► An EMI filter (810911010 from Würth or equivalent) is to be inserted in the DC supply line(s) as close as possible to the
- ▶ Long data or supply lines are to be routed through ferrites.
- ▶ Motor wires are to be routed through ferrites (74271222 from Würth or equivalent).

Commissioning

The Plug & Drive Studio 3 software offers you an option for performing the configuration and adapting the controller to the connected motor. You can find further information in document Plug & Drive Studio: User Manual at us.nanotec.com

CAUTION



■ ■ The loss of the safety function due to incorrect wiring may lead to injuries!

Incorrect wiring or the use of unsuitable external components may lead to the loss of the safety function. This could result in injuries.

- ▶ Only use components that correspond to the safety category of
- ► Check the electrical installation (wiring, pin assignment) and validate the STO function prior to the initial commissioning and after every intervention in the wiring and each time components/ equipment are replaced
- ▶ Do not bypass the STO function. If the wiring for the initial commissioning does not correspond to the required safety category of the application, remove it immediately after the initial commissioning

CAUTION



The loss of the safety function due to electromagnetic interference may lead to injuries!

External interference may affect and result in the loss of the safety function.

- ➤ Observe the maximum permissible cable length of 30 m for all STO signals. Longer cables reduce the interference immunity (EMC) and require additional interference-suppression and protection measures.
- ▶ Use shielded cables for the STO signals.
- ▶ Lay supply, signal and control cables physically separate from one another.

Configuration via USB

General

The following options are available for configuring the controller via USB:

Configuration file

This file can be saved to the controller via the USB connection. For further information, read chapters USB connection and Configuration

NanoJ program

This program can be programmed, compiled and then transferred to the controller with NanoJ via USB. NanoJ is integrated in the Plug & Drive Studio 3 software. You can find further information in document Plug & Drive Studio 3: User manual at us.nanotec.com.

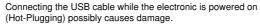
After connecting to a voltage supply, the controller reads out the configuration in the following order

- 1. The configuration file is read out and processed.
- 2. The NanoJ program is started.

USB connection

NOTICE

Damage of the product and/or external hardware due to potential differences on the USB.



- ► Connect the USB bevor you switch on the voltage supply.
- ▶ If possible, balance any potential differences between PC and the product or use a USB isolator.
- ► Connect the USB cable first to the product and then to the

If the controller is connected to a PC via a USB cable, an MTP device is created in the Windows file explorer, which contains a data storage device.

Three files are displayed: the configuration file (cfg*.txt), the NanoJ program (nanoj*.usr) and the firmware file (*.fw).

You can thereby store the configuration file or the NanoJ program on the controller. The voltage supply of the controller must also be connected during

Configuration file

General

The cfg.txt configuration file is used to preset values for the object dictionary to a certain value during startup. This file uses a special syntax to make accessing the objects of the object dictionary as easy as possible. The controller evaluates all assignments in the file from top to bottom.

Reading and writing the file

How to access the file:

- 1. Connect and switch on the voltage supply.
- 2. Connect the controller to your PC using the USB cable.
- 3. After the PC has detected the device as a removable storage device, navigate in the Explorer to the directory of the controller. File cfg.txt is
- 4. Open this file with a simple text editor, such as Notepad or Vi. Do not use any programs that use markup (LibreOffice or similar).

After you have made changes to the file, proceed as follows to apply the changes through a restart:

- 1. Save the file if you have not yet already done so. The motor stops.
- 2. Disconnect the USB cable from the controller
- 3. Disconnect the voltage supply from the controller for approx. 1 second until the power LEDs stop flashing.
- 4. Reconnect the voltage supply. When the controller is now restarted, the values in the configuration file are read out and applied.

Establishing communication via CANopen

- 1. Connect the CANopen master to the controller via the CAN L, CAN H cables. Check the connection of your CAN-GND and that the necessary termination resistor termination resistor is present between CAN H and CAN L.
- 2. Supply the controller with voltage (+UB Logic).
- 3. Change the configuration values if necessary.
- 4. To test the interface, send bytes $40\ \ 41\ \ 60\ \ 00\ \ 00\ \ 00\ \ 00$ to the

Statusword (6041h) was read; you receive this response: 4B 41 60 00 XX XX 00 00.

Setting the motor data

Prior to commissioning, the motor controller requires a number of values from

- Number of pole pairs: Object 2030_h:00_h (pole pair count) The number of motor pole pairs is to be entered here. With a stepper motor, the number of pole pairs is calculated using the step angle, e.g., 1.8° = 50 pole pairs, 0.9° = 100 pole pairs (see step angle in motor data sheet). With BLDC motors, the number of pole pairs is specified directly in the motor data sheet.
- Object 6075_h:00_h: rated current of the motor in mA (see motor data sheet)
- Object 6073_h:00_h: maximum current (for a stepper motor, generally corresponds to the rated current, bipolar) in tenths of a percent of the set rated current (see motor data sheet). Factory settings: "1000", which corresponds to 100% of the value in 6075h.
- Object 3219_h:01_h Maximum duration of the maximum current (6073_h) in ms (for initial commissioning, Nanotec recommends a value of 100 ms; this value is to be adapted later to the specific application).
- Setting the motor type:
 - Stepper motor:
 - ▶ Object 3202h (Motor Drive Submode Select): Set bit 6 to "0" for stepper and choose via Bit 0 bewtween open and closed loop: value 0s or 1s.
 - Object 3219h:03h (Open loop idle state current): value in tenths of percent, to which the rated current is to be reduced if current reduction is activated in open-loop.
 - BLDC motor
 - Object 3202_h (Motor Drive Submode Select): Bit 6 for BLDC, bit 0 for recommended closed-loop: 00000041h
- Motor with encoder without index: You must set the encoder parameters after the Auto setup, see chapter Configuring the sensors in the technical manual
- Motor with brake: Object 3202h:00h (Motor Drive Submode Select): The brake control is activated for the initial commissioning. Depending on the specific application, this configuration can be deactivated later if necessary. One of the following values is to be entered depending on the motor type:
 - Stepper motor, brake control activated: 00000004h
 - BLDC motor, brake control activated, closed-loop: 00000045h

NOTICE

Due to the sine commutation and the sinusoidal current flow the current of a motor winding can achieve an alternating current value that is briefly greater (by max. $\sqrt{2}$ times) than the set current.



At especially slow speeds or while at a standstill with full load, one of the windings can therefore be supplied with overcurrent for a longer period of time. Take this into account when dimensioning the motor and select a motor with larger torque reserve if necessary if required by the application.

Auto setup

To determine a number of parameters related to the motor and the connected sensors (encoders/Hall sensors), you must perform an auto setup.





As long as the motor connected to the controller or the sensors for feedback (encoders/Hall sensors) are not changed, auto setup is only to be performed once during initial commissioning.

NOTICE

Note the following prerequisites for performing the auto



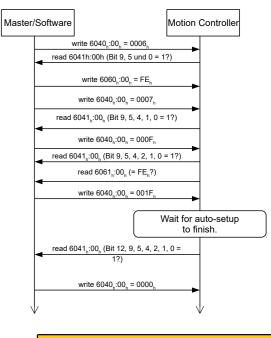
- ➤ The motor must be load-free.
- ► The motor must not be touched. ▶ The motor must be able to turn freely in any direction.
- ► No NanoJ programs may be running (object 2300_h:00_h bit 0
- = "0").

Execution

- 1. To preselect the *auto setup* operating mode, enter the value "-2" (="FE_h") in object 6060_h:00_h.
- The power state machine must now switch to the Operation enabled state 2. Start auto setup by setting bit 4 OMS in object 6040_h:00_h (controlword).

To determine the values, the direction of the measurement method is reversed and edge detection re-evaluated.

Value 1 in bit 12 OMS in object 6041_h:00_h (statusword) indicates that the auto setup was completely executed and ended. In addition, bit 10 TARG in object 6041_h:00_h can be used to query whether (= "1") or not (= "0") an encoder index was found.



CAUTION!



Uncontrolled motor movements! After the auto setup, the internal coordinate system is no

longer valid. Unforeseen reactions can result. ▶ Restart the device after an auto setup. Homing alone does not suffice.