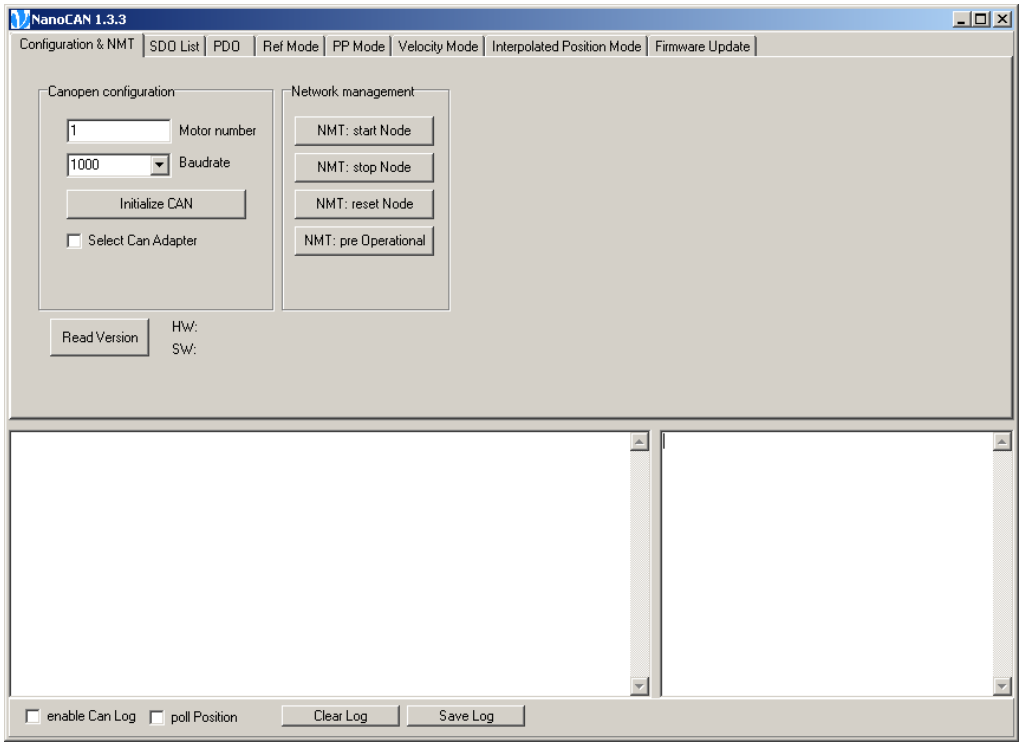
User Manual



NanoCAN

Demo application for stepper motor controls and Plug & Drive motors

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Editorial

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Version/Change overview

Version	Date	Changes
1.0	2009-06-20	New issue enders
1.1	2009-12-14	Revision C+P

About this manual

Target group

This user manual is aimed at designers and developers who need to configure a CANopen-capable motor control from Nanotec® with the aid of the NanoCAN software without much experience in stepper motor technology.

Important information

This user manual must be carefully read before installation of the software.

Nanotec® reserves the right to make technical alterations and further develop hardware and software in the interests of its customers to improve the function of this product without prior notice.

For criticisms, proposals and suggestions for improvement, please contact the above address or send an email to: info@nanotec.com

Additional manuals

Please also note the following manuals from Nanotec:

Nanotec CANopen reference	Detailed documentation of the CANopen functions	
Technical manuals	Connection and commissioning of stepper motor controls or Plug & Drive motors	

The manuals are available for download on www.nanotec.com.

Contents

1 Installation

System requirements

The NanoCAN software only operates with adapters from IXXAT. The corresponding VCI drivers (version 3) must be installed. The driver is available for download at www.ixxat.de under the "Support" section.

Procedure

To install NanoCAN on your PC, you must download the software from the Nanotec website.

Proceed as follows:

Step	Action
1	Open the Nanotec website in your browser: http://www.nanotec.com
2	Navigate to the "Technology → CANopen" section.
3	Download the "NanoCAN_1.31 - software.zip" file (on the right side in the download area) onto your PC.
4	Unpack the zip file on your PC in the required directory.
5	Open the "CanopenDemo_1.31" directory and start the program by double-clicking on the "NanoCAN.exe" file.

2 Overview of the user interface

2.1 General information

The NanoCAN software can be used to easily configure the CAN communication of the stepper motor controls and the Plug & Drive motors on a PC with a CAN interface.

Transparent interfaces and simple test functions enable rapid entry into operation and facilitate commissioning.

Familiarize yourself with the user interface of the NanoCAN software before starting to configure the stepper motor controls or Plug & Drive motors.

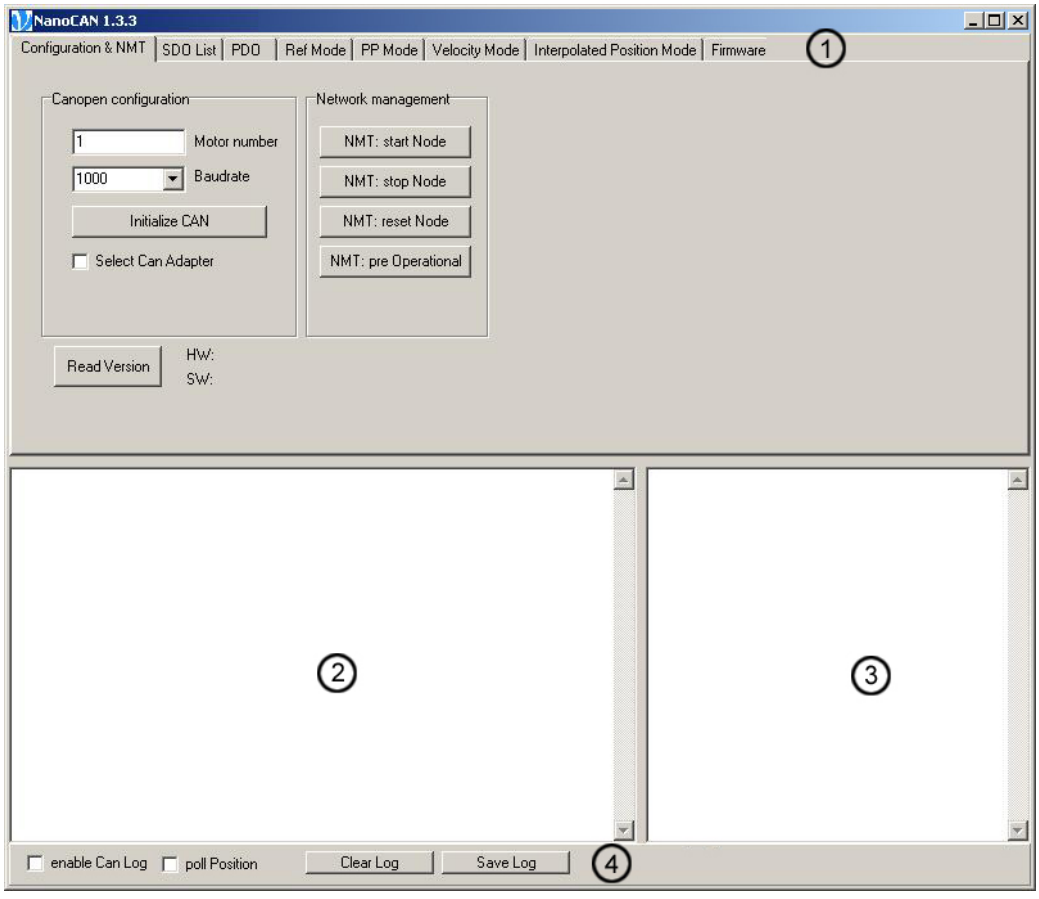
2.2 Arrangement of the user interface

Areas

The user interface consists of the following areas:

- Tabs (1)
- Log window (2)
- Message output (3)
- Log function bar (4)

View



Tabs

The user interface consists of the following tabs:

Tab	Function	See section
<Configuration & NMT>	CANopen settings and commands	3 „<Configuration & NMT> tab“
<SDO List>	Read, write, etc., service data objects (SDO).	4 „<SDO List> tab“
<PDO>	PDO mapping	5 „<PDO> tab“
<Ref Mode>	Reference run settings	6.2 „<Ref Mode> tab“
<PP Mode>	Positioning mode settings	6.3 „<PP Mode> tab“
<Velocity Mode>	Velocity mode settings	6.4 „<Velocity Mode> tab“
<Interpolated Position Mode>	Interpolated position mode settings	6.5 „<Interpolated Position Mode> tab“
<Firmware Update>	Update of the motor control firmware	7 „<Firmware Update> tab“

Note:
When one of the following tabs – <Ref Mode>, <PP Mode>, <Velocity Mode> or <Interpolated Position Mode> – is activated, the corresponding SDO is immediately written to the control to activate the selected mode.

Log window

In the log window, the data sent and received via the CAN bus can be displayed.

Message output

In the message output, various messages (including error messages) are displayed that occur during the writing of the SDOs to the control or reading of the SDOs from the control.

Log function bar

The log function bar contains the following buttons and checkboxes:

Button/ checkbox	Function
<enable Can Log>	Activate and deactivate the display of the CAN logs in the log window.
<Clear Log>	Delete the CAN logs displayed in the log window.
<Save Log>	Save the CAN logs in a log file.
<poll Position>	Activate and deactivate reading out and displaying of the current position (every 100 ms) in the log window.

3 <Configuration & NMT> tab

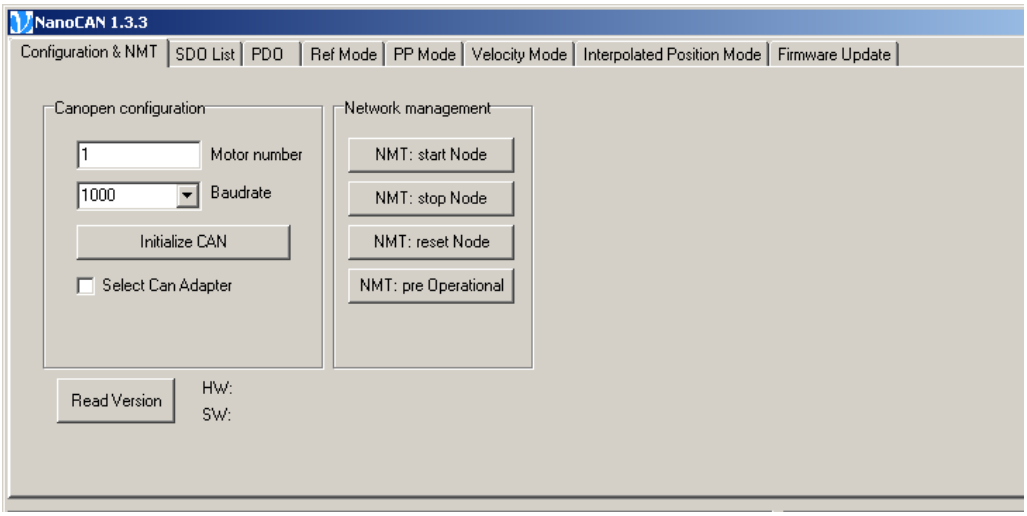
3.1 User interface

Overview

The <Configuration & NMT> tab contains the following areas:

- [Canopen configuration]
- [Network management]

View



3.2 Selecting the control

Introduction

In the [Canopen configuration] area, the control with which communication is to take place is selected by entering the CANopen node ID and the baud rate.

Provisions

There are two basic ways of setting the CANopen node ID and the baud rate:

- Hardware setting: via rotary switches on the control
- Software setting: with NanoCAN; see Section 4.2 "Motor-related basic settings"

To be able to make a software setting with NanoCAN, a certain value must be set on the rotary switches of the control; see the following tables:

Control with two rotary switches (e.g. PD6-N)

Rotary switch value dec (hex)	Node ID	Baud rate
0 (0x00)	From EEPROM	= 1 MBaud
1 - 127 (0x01 - 0x7F)	= rotary switch value	
128 (0x80)	From EEPROM	From EEPROM
129 - 255 (0x81 - 0xFF)	= rotary switch value minus 128	

Control with a rotary switch (e.g. PD4-N)

Rotary switch value dec (hex)	Node ID	Baud rate
0 (0x00)	From EEPROM	= 1 MBaud
1 - 7 (0x01 - 0x07)	= rotary switch value	
8 (0x08)	From EEPROM	From EEPROM
9 - 15 (0x09 - 0x0F)	= rotary switch value minus 8	

Setting the rotary switches (controls with two rotary switches)

Note:
The rotary switches must be set to the desired value before the control is switched on since this value is only read in when the control is restarted.

The rotary switches can be used to set a two-digit hexadecimal number (0x00 to 0xFF):

- Right-hand rotary switch: 16's place (e.g. 0xF0)
- Left-hand rotary switch: 1's place (e.g. 0x0**F**)

Example 1:

If the right-hand rotary switch is set to 2 and the left-hand rotary switch is set to 1 (0x21), this results in a number equivalent to the decimal number 33 (= 2*16 + 1*1).

In this case, the node ID is set to 33 on the hardware. The baud rate is set to 1 MBaud.

Example 2:

If the right-hand rotary switch is set to 8 and the left-hand rotary switch is set to 0 (0x**80**), this results in a number that is equivalent to the decimal number 128 (= 8*16 + 0*1).

In this case, the node ID and baud rate are read out of the EEPROM.

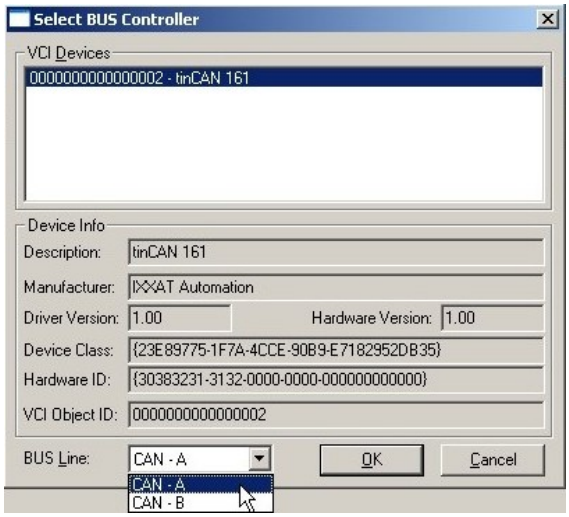
Example 3:

If the right-hand rotary switch is set to 9 and the left-hand rotary switch is set to 4 (0xA1), this results in a number that is equivalent to the decimal number 161 (= 10*16 + 1*1).

In this case, the node ID, as shown in example 1, is set to 33 (= 161 – 128) on the hardware, but the baud rate is read out from the EEPROM.

Procedure

Proceed as follows to select a control:

Step	Action
1	Enter the desired node ID (1 to 127) in the "Motor number" field.
2	Select the baud rate set for the control in the "Baudrate" selection field.
3	If exactly one CANopen control is connected with only one channel: continue with step 8. In all other cases, continue with step 5.
4	Activate the <Select Can Adapter> checkbox. The "Select BUS Controller" window appears. 
5	Select the desired control in the "VCI Devices" area.
6	Select the desired channel in the "Bus Line" selection field and click on the <OK> button to close the window.
7	Click on the <Initialize CAN> button.

3.3 Network management

The [Network management] area contains the following buttons:

Button	Function	Effect
<NMT: start Node>	Start the control	"Operational" status: PDOs can be written and read.
<NMT: stop Node>	Stop the control	"Stopped" status: PDOs **cannot** be written and read.
<NMT: reset Node>	Restart the control (reset)	All changes that were not stored in the EEPROM are reset.
<NMT: pre Operational>	Return the system to the state after application of the operating voltage or a reset	"Pre-operational" status: PDOs **cannot** be written and read

3.4 Reading out the hardware and software version

Introduction

The <Read Version> button in the <Configuration & NMT> tab can be used to read out the hardware and software version of the control. This button is also used to check that communication of the PC with the control unit is functioning properly.

Procedure

Proceed as follows:

Step	Action
1	Click on the <Read Version> button.
2	To check the messages of the user interface: • When communication is functioning properly, the hardware (HW) and software (SW) versions are displayed next to the button. • When communication is faulty, the following error messages appear: "rec_SDO[1018] failed“ "bus dead"

4 <SDO List> tab

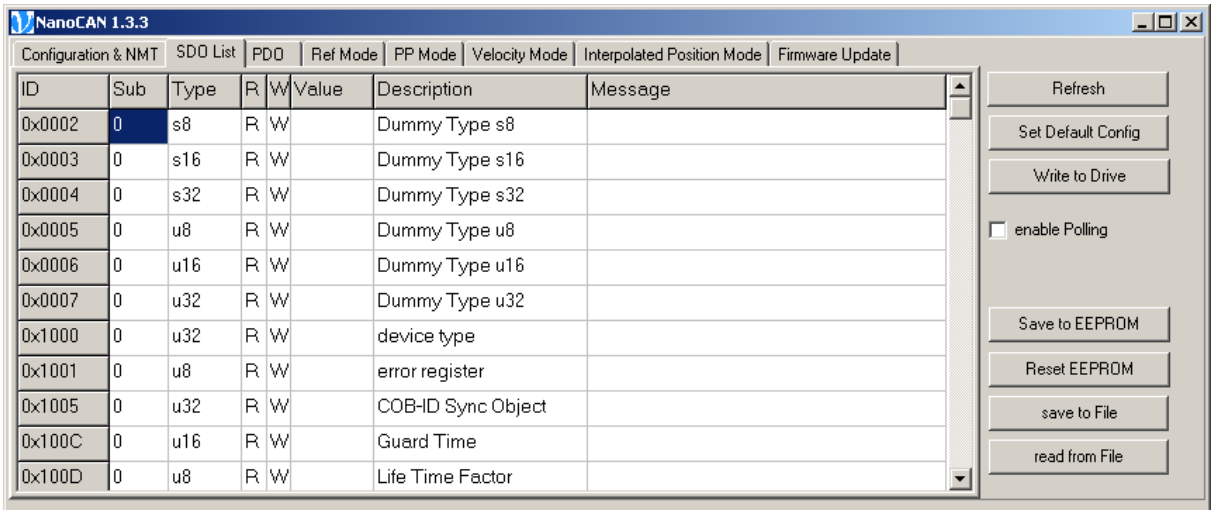
4.1 User interface

Introduction

The buttons in the <SDO List> tab can be used to read and write the service data objects (SDOs) of the control.

More information on the service data objects can be found in the Nanotec CANopen reference.

View



List window

The list window contains one row for each existing service data object, and if there are multiple subindices, one row per subindex.

The list window consists of the following columns:

Column	Contents
ID	Address of the service data object
Sub	Subindex
Type	Data type
R	**Button** for reading the SDOs
W	**Button** for reading the SDOs
Value	Value of the SDO that was read or is to be written
Description	Brief description of the SDO
Message	Messages

Buttons

The following buttons and checkboxes are located to the right of the list window:

Button/ checkbox	Function
<Refresh>	Read all SDOs
<Set Default Config>	Write default values to some SDOs
<Write to Drive>	Write all SDOs
<enable Polling>	Read out the SDOs continuously to track values that change during operation.
<Save to EEPROM>	Save the current values of the SDOs in the EEPROM (changes that are not saved are lost after a restart of the control)
<Reset EEPROM>	Set the default values and save them in the EEPROM
<save to File>	Save the current configuration to a file
<read from File>	Load the configuration from a file

Reading and writing SDOs

Note:
The values are only permanently saved in the control if they are saved in the EEPROM (<Save to EEPROM> button); in this case, they will still be present after the control is switched on again.

- To read or write individual SDOs:
  Click the <R> or <W> button in the row of the corresponding SDO.
- To read or write all SDOs:
  Click the <Refresh> or <Write to Drive> button.

4.2 Motor-related basic settings

Introduction

To be able to operate the motor, the following motor-related settings must be written to the control via SDOs.

SDO 0x2004 Subindex 1

Phase current of the motor as a percentage of the maximum current.

The default setting is 20%.

For the SMCI47-S, 7.5 A (rms value) correspond to 100%.

SDO 0x2004 Subindex 2

Quiescent current of the motor as a percentage of the maximum current. This current is applied to the motor winding when the motor is at a standstill.

The default setting is 20%.

SDO 0x2005 Subindex 0

Activate the CAN interface of the motor control and set the baud rate.

The possible baud rates and the corresponding value of the SDO are listed in the following table. The default setting is 125 kBaud.

The highest-value bit of this byte is used to switch on and off the CANopen mode.

Baud rate	Value SDO 0x2005, Sub 0x0; CAN is deactivated	Value SDO 0x2005, Sub 0x0; CAN is activated
10 kBaud	1	129
20 kBaud	2	130
50 kBaud	3	131
125 kBaud (default)	4	132
250 kBaud	5	133
500 kBaud	6	134
1000 kBaud	7	135

If the baud rate is permanently set to 1 MBaud due to the setting of the rotary switches (see Section 3.2 "Selecting the control"), a value of 135 must be entered here.

Note:
For the setting to be adopted, the control must be restarted afterwards via the <NMT: reset Node> button in the <Configuration & NMT> tab.

SDO 0x2006 Subindex 0

Number of pole pairs.

The number of pole pairs of the stepper motor determines its step angle. The formula for the conversion is:

Number of pole pairs = 360° / (4 * step angle)

Example: A motor with a step angle of 1.8° has 50 pole pairs (default setting of the SMCI47-S) and a motor with a step angle of 0.9° has 100 pole pairs.

SDO 0x2009 Subindex 0

CANopen node ID.

Precondition: the rotary switches are set accordingly; see 3.2 "Selecting the control".

If a CANopen node ID is set with the rotary switches, this object can be written to and stored in the EEPROM, but after a restart it will return to the value of the rotary switches.

SDO 0x608F Subindex 1

Encoder resolution.

The default value is 2000.

If an encoder is used, its resolution must be known to the control. The resolution is specified in increments per rotation. Because of the quadrature principle, an encoder with 500 marks per rotation, for example, has four time the number of increments per rotation, or 2000.

5 <PDO> tab

5.1 Introduction

Purpose of the PDOs

Process data objects (PDOs) are used to transfer objects that frequently need to be updated while the control is running. For example, this is useful for the "Position Actual Value" object.

Advantages of PDOs

PDOs have the following advantages compared to SDOs:

- Higher and adjustable priority
- Low overhead
- Additional functions, such as "Automatic sending upon change" or "Cyclical sending"

The higher priority and the low overhead of the PDOs result because the corresponding objects from the object directory are allocated to a CAN object with a certain COB-ID without use of the SDO protocol. These allocations are set during the PDO mapping.

Receive and transmit PDOs

PDOs can be differentiated into receive PDOs (RPDO) and transmit PDOs (TPDO):

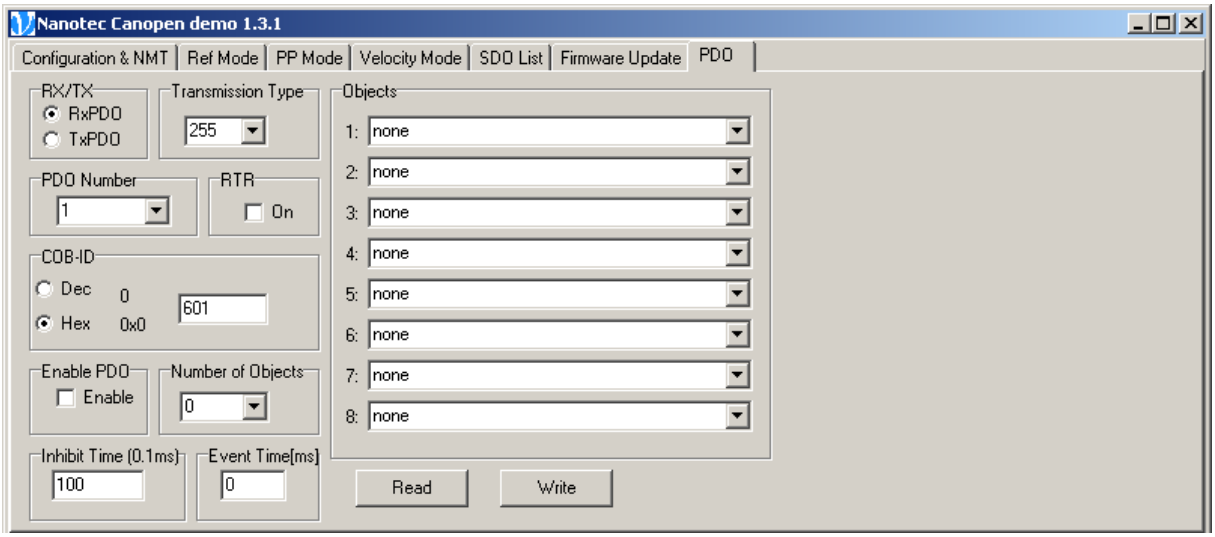
- RPDOs are received by the control and the received data are used in the set objects.
- TPDOs are transmitted by the control in certain (adjustable) situations.

5.2 PDO mapping

Introduction

Process data objects can be mapped via the <PDO> tab. More detailed information on this can be found in the Nanotec CANopen reference.

View



Functions

For the PDO mapping, the following functions are available in the <PDO> tab:

Button/field	Function
[RX/TX] <RxPDO>/<TxPDO>	Select the PDO type: • RxPDO = receive PDO • TxPDO = transmit PDO
"Transmission Type"	Set the PDO type: • asynchronous = the data are sent immediately • synchronous = the data are sent after a sync object Rx PDOs: 255 asynchronous 0-240 synchronous Tx PDOs: 255 asynchronous 0 synchronous after change 1-240 synchronous for each 1-240. sync object
"PDO Number"	Select the PDO. A total of four PDOs can be mapped. Each PDO must be individually read by the control or written to the control via the <Read> and <Write> buttons.
[RTR] <On>	Activate and deactivate the Remote Transmission Request (RTR). When the checkbox is activated, a configured PDO is sent on request.

Button/field	Function
[COB-ID] <Dec>/<Hex>	Set the CAN object identifier (COB-ID) as a decimal or hexadecimal number. Notes: • The COB-ID is assigned for the actual mapping. • Each COB-ID may only be assigned once. • The smaller the COB-ID, the higher the priority on the CAN bus.
[Enable PDO] <Enable>	Activate and deactivate the PDO mapping of the selected PDO.
"Number of Objects"	Select the number of mapped objects of the selected PDO (= number of objects to be mapped in the [Objects] field).
"Inhibit Time"	Enter the Inhibit Time (in ms *0.1) When transmission type 255 is used, this value indicates the minimum time between the transmission of two consecutive objects in 100µs steps. In this way, it can be prevented, for example, that the current position, which changes continuously during travel, blocks the CAN bus.
"Event Time"	Enter the Event Time (in ms) When transmission type 255 is used, this value indicates the maximum time between two transmitted objects of the same type in ms steps. This setting can be used to cyclically send objects that rarely change. A value of "0" deactivates this behavior (default).
[Objects]	Select the objects to be mapped. A maximum of 64 bits can be transmitted, e.g. 2x 32bit (e.g. pos demand + pos actual value) or 4x 16bit, etc.
<Read>	Read the settings from the control.
<Write>	Write the settings to the control.

Procedure

Proceed as follows to map the RPDOs and TPDOs:

Step	Action
1	Put the control into the "Pre-operational" status; see Section 3.3 "Network management".
2	On the <PDO> tab, click on the <Read> button. The PDOs currently mapped in the connected control are read and displayed.
3	Change the PDOs or remap them.
4	Click on the <Write> button. The settings are written to the control. The PDO is mapped automatically (all necessary transitions of the state machine according to the CANopen reference are executed).
5	On the <SDO List> tab, click on the <Save to EEPROM> button. The PDO is retained even after a reset.

6 Tabs for operation modes

6.1 General functions

Introduction

The connected motor can be operated in various operation modes.

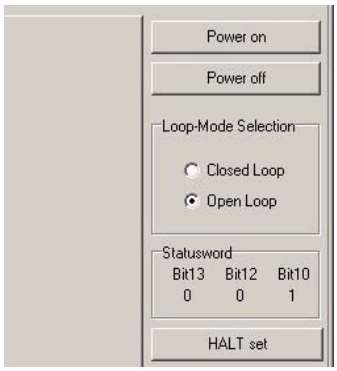
- <Ref Mode>: reference run
- <PP Mode>: positioning mode
- <Velocity Mode>: velocity mode
- <Interpolated Position Mode>: interpolated position mode

Activating the operation mode

When one of the following tabs – <Ref Mode>, <PP Mode>, <Velocity Mode> or <Interpolated Position Mode> – is activated, the corresponding SDO is immediately written to the control to activate the selected mode.

Functions for all operation modes

The following functions are available in all operation modes:



Buttons/option field/display	Function
<Power on> / <Power off>	Switch motor on/ off
<Closed Loop>/ <Open Loop>	Activate closed-loop mode or open-loop mode
Status word	Bit 10: Set to "1" when the motor is at a standstill (status: Target reached). Bit 12: Set to "1" when the reference position is reached (status: Homing attained). Bit 13: Set to "1" when an error occurs (status: Error).
<HALT set>	• Set the motor stop (with the ramp setting in each case) • Reset the motor stop if the motor has not yet come to a halt

Units

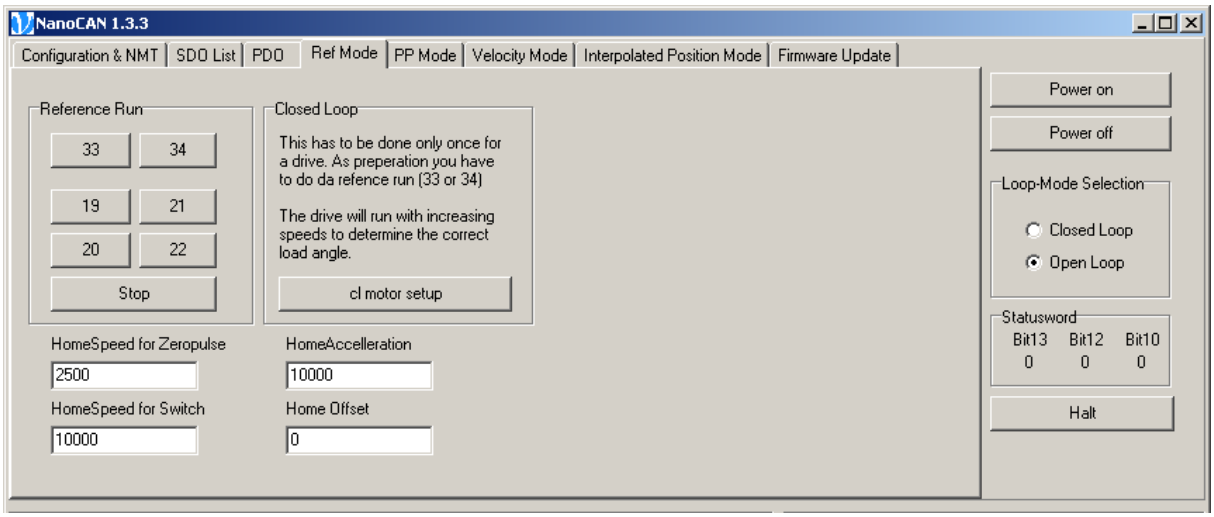
All speeds are specified in user units (standard: one-tenth step mode). Mode-dependent calculation via the objects 608F-6092 or 604C.

6.2 <Ref Mode> tab

Introduction

The various reference runs can be performed via the <Ref Mode> tab. More detailed information on reference runs can be found in the Nanotec CANopen reference.

View



Functions

The following functions are available in the <Ref Mode> tab:

Button/field	Function
Buttons in the [Reference Run] area	Select the reference run and start it at the same time. (Note: The motor must be switched on first.)
<cl motor setup>	Perform a closed-loop test run.
<Stop>	Interrupt the reference run.
"HomeSpeed for Zeropulse"	Enter the speed for the search for the reference position.
"HomeSpeed for Switch"	Enter the speed for the search for the switch. Note: The value must be greater than the speed for the reference position.
"HomeAcceleration"	Enter the acceleration ramp for the reference run.
"Home Offset"	Enter the offset of the reference position.

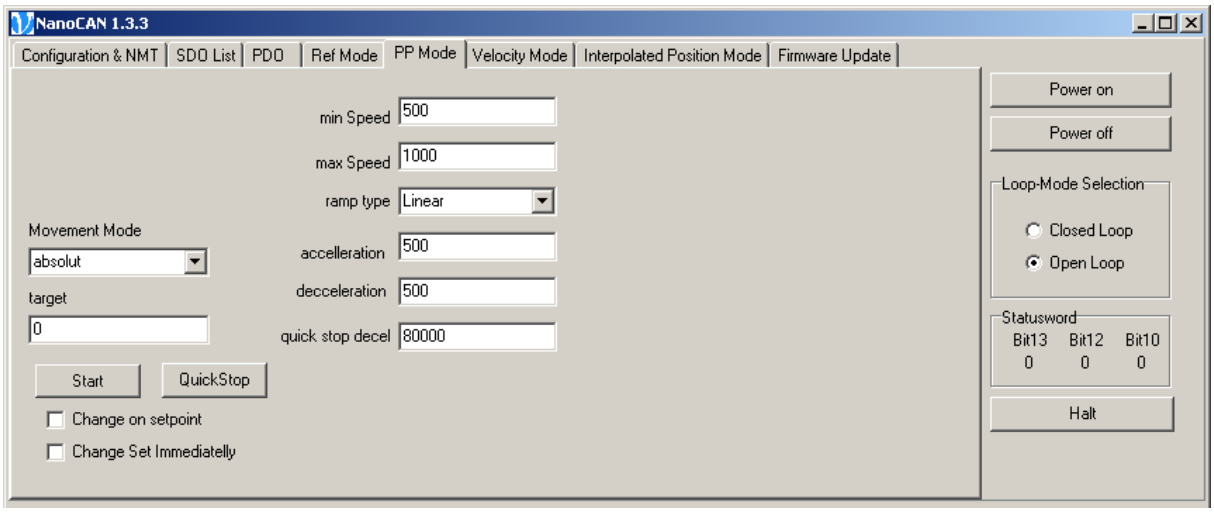
Note:
The ramp is only used when setting off. When the switch is reached, the unit is automatically switched to the lower speed and is stopped as soon as it reaches the limit position.

6.3 <PP Mode> tab

Introduction

The motor can be operated in the positioning mode via the <PP Mode> tab.

View



Functions

The following functions are available in the <PP Mode> tab:

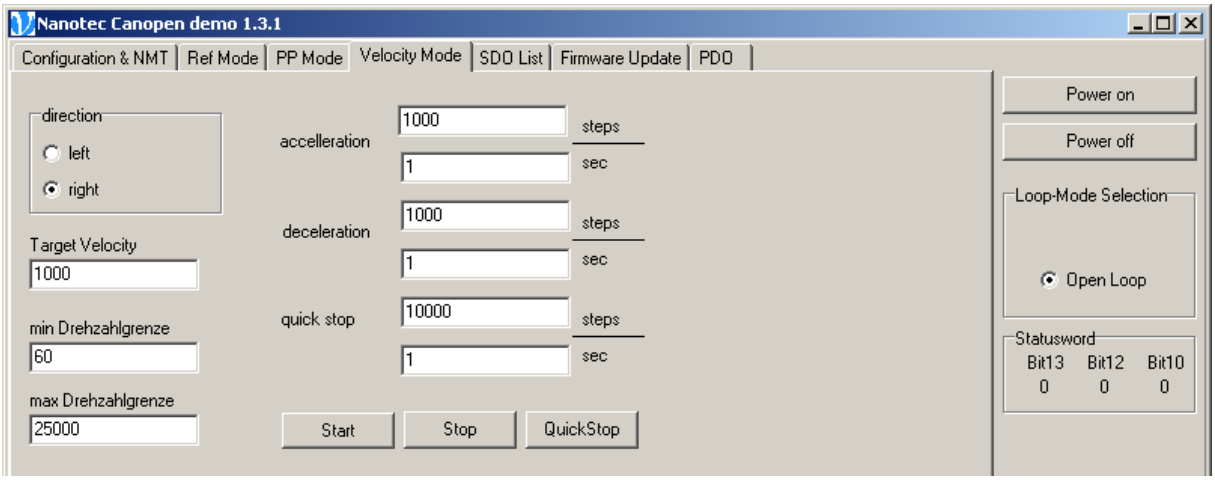
Button/field	Function
"Movement Mode"	Select the positioning type (absolute or relative to the current position).
"target"	Enter the destination of the movement.
<Start>	Start the movement.
<Quick Stop>	Stop the movement immediately (the motor is subsequently switched off).
<Change on setpoint>	If the checkbox is activated, a activated run command is executed immediately, even if the current run command is not yet finished.
<Change Set Immed>	If the checkbox is activated and if the <Change on setpoint> checkbox is not activated at the same time (new move command is executed after the end of the current move command), the speed is not changed until the first target position is reached. Before the first destination is reached, braking is not performed since the motor should not stop at this position.
"min Speed"	Enter the start speed of the move command.
"max Speed"	Enter the maximum speed of the move command.
"ramp type"	Select the ramp type of the acceleration and deceleration (linear or sinusoidal)
"acceleration"	Enter the slope of the acceleration ramp.
"deceleration"	Enter the slope of the deceleration ramp.
"quick stop decel"	Enter the slope of the deceleration ramp during an emergency stop.

6.4 <Velocity Mode> tab

Introduction

The motor can be operated in the velocity mode via the <Velocity Mode> tab.

View



Functions

The following functions are available in the <Velocity Mode> tab:

Button/field	Function
[direction] <left>/<right>	Select the direction of rotation (counterclockwise or clockwise).
"Target Velocity"	Enter the target rpm.
"min Drehzahlgrenze"	Enter the minimum rpm. Note: If a lower rpm is entered as the target rpm, the motor stops.
"max Drehzahlgrenze"	Enter the maximum rpm. Note: If a higher rpm is entered as the target rpm, the target rpm is set to the maximum rpm.
"acceleration"	Enter the acceleration ramp (in X user units (steps) per Y seconds (sec)).
"deceleration"	Enter the deceleration ramp (in X user units (steps) per Y seconds (sec)).
"quick stop"	Enter the acceleration ramp for an emergency stop (in X user units (steps) per Y seconds (sec)).
<Start>	Start the motor.
<Stop>	Stop the motor.
<QuickStop>	Initiate an emergency stop.

6.5 <Interpolated Position Mode> tab

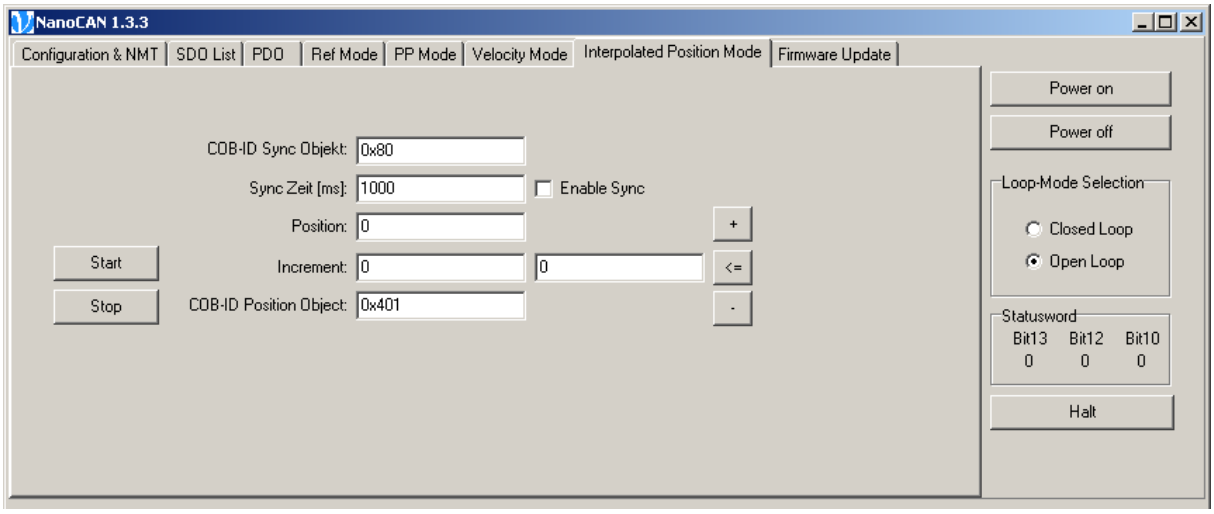
Introduction

The <Interpolated Position Mode> tab is used to test the interpolated position mode: the control moves to predefined PDO positions within the synchronization period.

Provisions

To be able to use the tab, an Rx-PDO must be mapped onto object "0x60C1 sub 0x01 s32 Interpolation Data Record #1". This COB-ID must be entered in the "COB-ID Position Object" field.

View



Functions

The following functions are available in the <Interpolated Position Mode> tab:

Button/field	Function
"COB-ID Sync Objekt"	ID of the sync object. By default, this object is set to COB-ID 0x80 and should not be changed.
"Sync Zeit [ms]"	Time in ms with which the sync object is transmitted. This time should lie between 100 and 1000 ms.
"Position"	Current target position to which the control is to move.
"Increment"	Left field: Position change per sync (speed) Right field and +, <=, – buttons: Change increment (= rotational rpm change): • **<=** adds the value from the right field to the left field • **+/–** increases/decreases the increment by the value shown in the right field
"COB-ID Position Object"	COB-ID of the mapped Rx-PDO; see above.
"Enable Sync"	Activate/deactivate the transmission of sync messages.
<Start>/<Stop>	Start/stop the motor.

Procedure

Proceed as follows:

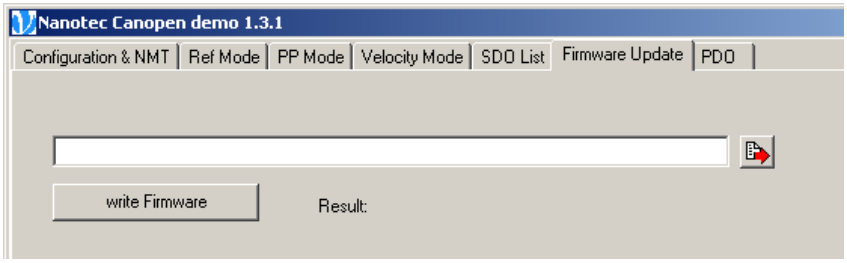
Step	Action
1	Enter the desired value in the "Sync Zeit [ms]" field.
2	Activate the <Enable Sync> checkbox. Sync messages are transmitted.
3	Enter the current value in the "Position" field. Otherwise, the motor will attempt to move from its current position to the set position in one step.
4	Enter the desired value in the "Increment" field.
5	Click on the <Start> button. The motor travels at a constant speed.

7 <Firmware Update> tab

Introduction

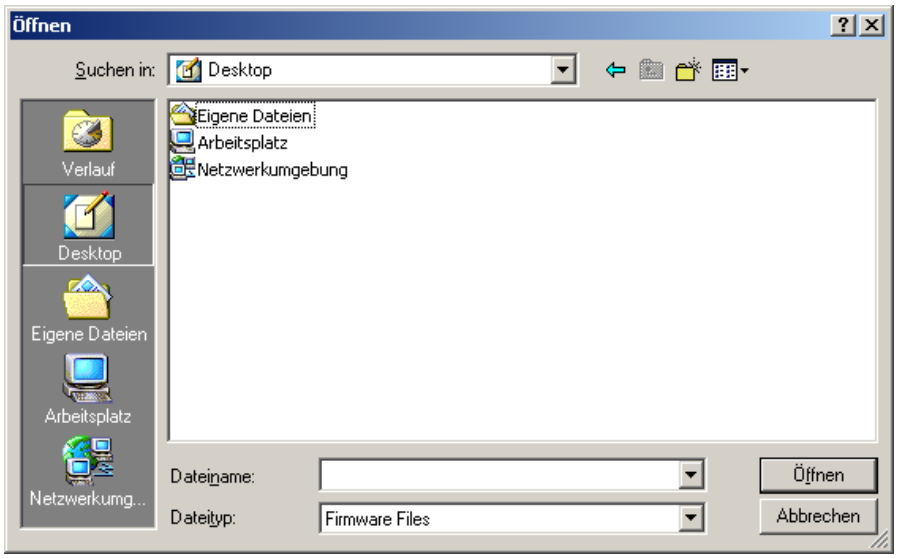
The NanoCAN firmware can be updated via the <Firmware Update> tab.

View



Procedure

Proceed as follows:

Step	Action
1	Click on the button. A window opens in which the firmware file can be selected. 
2	Select the firmware file and click on the <Open> button.
3	Click on the <write Firmware> button. The selected firmware is written to the control. The "Result" area shows whether the firmware update was successful or not.