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CAN 300 PRO

CAN Communication Module for S7-300

Start-Up Guide for CANopen®

Edition 3 / 22.12.2011

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Note:

We have checked the content of this manual for conformity with the hardware and software described. Nevertheless, because deviations cannot be ruled out, we cannot accept any liability for complete conformity. The information in this manual is regularly updated. When using purchased products, please heed the latest version of the manual, which can be viewed in the Internet at www.helmholz.com, from where it can also be downloaded.

Our customers are important to us. We are always glad to receive suggestions for improvement and ideas.

Revision history of this document:

Edition	Date	Revision
1	29.9.2009	1st version
2	30.04.2010	Corrections for CANParam V4.20 and Firmware V1.20
3	22.12.2011	Correction of the "SF" LED behavior and further small corrections

Contents

1 Introduction

This document is intended as a start-up guide for initial start-up of a CAN 300 PRO with any CANopen® device. This is for use in conjunction with the manual for the CAN 300 PRO module.

1.1 Structure of this document

This start-up guide provides step-by-step instructions for installation and initial start-up of the CAN 300 PRO for CANopen® master applications.

Each section deals with a separate step and the steps are to be performed one after the other.

The left-hand margin of the document shows important notes and references to sections of the CAN 300 PRO manual, which you should have close by.

1.2 What you require

- CAN 300 PRO module with the latest firmware
- USB cable
- Latest version of CAN-CD with the CANParam software, CANopen® data handling blocks for CAN 300 PRO, and manuals
- Two CAN connectors with terminating resistors
- CAN cable
- Manual of your CANopen® device with documentation of the CANopen® functionality (SDO list) and the terminals
- PC with Windows 2000,XP or 7, installed Simatic Manager and USB interface
- S7-300 CPU
- Voltage supply for CPU and CANopen® device
- Tool

1.3 What is not included

This Start-Up Guide does not explain how a CANopen® network works. The basic terms of CANopen® communication are explained in Section 7.3 of the CAN 300 PRO Manual.

Systeme Helmholz GmbH offers regular 1-day training courses on the entire topic of CAN and CANopen® protocol, start-up and programming of the CAN 300 PRO and an error analysis.

It does not either explain how to start up CAN devices with protocols other than CANopen®, e.g. with SAE J1939 or with Layer 2. Use the CAN 300 PRO manual for this purpose.

2 Setting Up the Hardware

2.1 Set-up and wiring

Manual: Section 2

The CAN 300 PRO is connected to the S7-CPU on the S7-300 mounting rail with the backplane bus connector supplied.

The DIP switch of the CAN 300 PRO has no function in this start-up application because all settings are made in the project.

Manual: Section 3.2

The CAN 300 PRO and the CANopen® device now have to be connected on the CAN bus. Please pay attention to the terminating resistors (120 ohms) between CAN High and CAN Low at both ends of the cable and ensure that the three cables CAN High, CAN Low, CAN-GND are not confused.

The following table shows the pin assignment of the CAN 300 PRO module:

Pin	SUBD connector CAN
1	-
2	CAN Low
3	CAN GND
4	-
5	-
6	-
7	CAN High
8	-
9	-

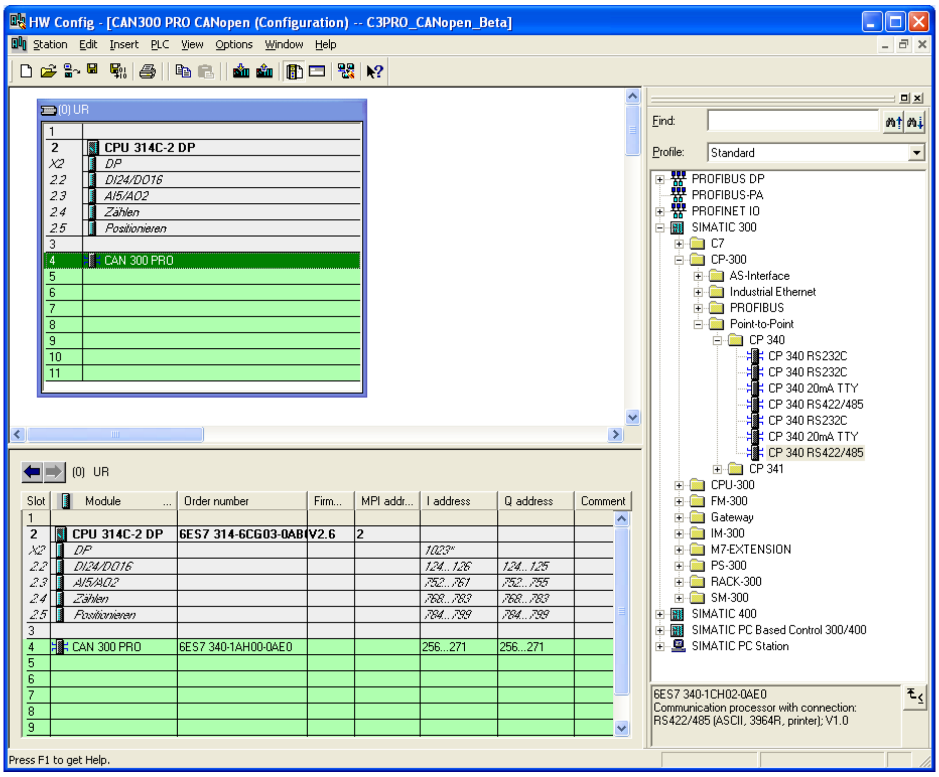
No terminating resistor is integrated into the CAN 300 PRO module.

Please note that the CAN 300 PRO module does not have a ready installed terminating resistor. The terminating resistor must be installed or activated in the connector.

2.2 Configuration in the PLC

Manual: Section 4

The CAN 300 PRO module is configured as the CP 340 communication module in the programming software of the PLC.


HW Config - [CAN300 PRO CANopen (Configuration) -- C3PRO_CANopen_Beta]

(0) UR

1	
2	**CPU 314C-2 DP**
X2	*DP*
2.2	*DI24/DO16*
2.3	*AI5/AO2*
2.4	*Zählen*
2.5	*Positionieren*
3	
4	CAN 300 PRO
5	
6	
7	
8	
9	
10	
11	

(0) UR

Slot	Module ...	Order number	Firm...	MPI addr...	I address	Q address	Comment
1							
2	**CPU 314C-2 DP**	**6ES7 314-6CG03-0AB(**	**V2.6**	**2**			
X2	*DP*				*1023**		
2.2	*DI24/DO16*				*124...126*	*124...125*	
2.3	*AI5/AO2*				*752...761*	*752...755*	
2.4	*Zählen*				*768...783*	*768...783*	
2.5	*Positionieren*				*784...799*	*784...799*	
3							
4	CAN 300 PRO	6ES7 340-1AH00-0AE0			256...271	256...271	
5							
6							
7							
8							
9							

Press F1 to get Help.

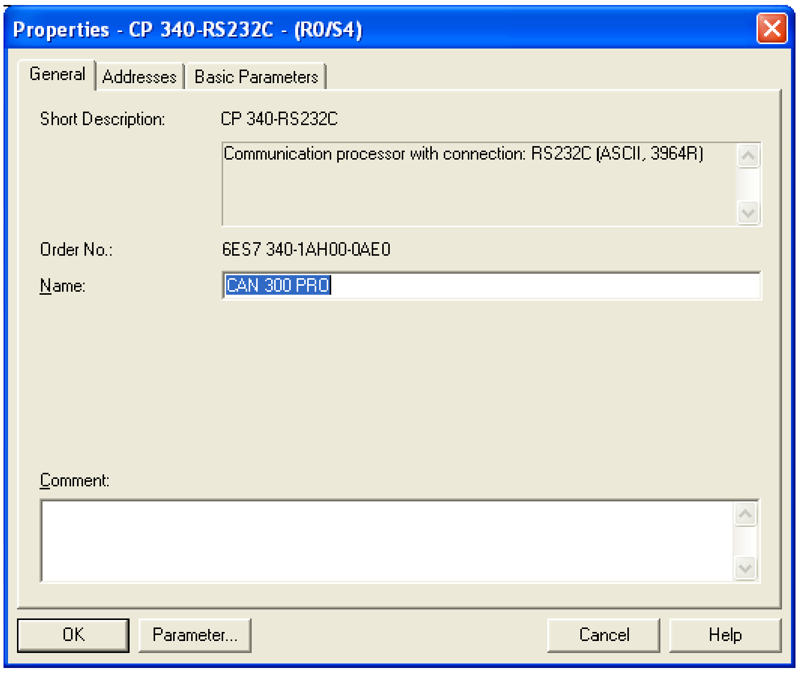
Find:

Profile: Standard

- PROFIBUS DP
- PROFIBUS-PA
- PROFINET IO
- SIMATIC 300
  - C7
  - CP-300
    - AS-Interface
    - Industrial Ethernet
    - PROFIBUS
    - Point-to-Point
      - CP 340
        - CP 340 RS232C
        - CP 340 RS232C
        - CP 340 20mA TTY
        - CP 340 RS422/485
        - CP 340 RS232C
        - CP 340 20mA TTY
        - CP 340 RS422/485
      - CP 341
  - CPU-300
  - FM-300
  - Gateway
  - IM-300
  - M7-EXTENSION
  - PS-300
  - RACK-300
  - SM-300
- SIMATIC 400
- SIMATIC PC Based Control 300/400
- SIMATIC PC Station

6ES7 340-1CH02-0AE0
Communication processor with connection:
RS422/485 (ASCII, 3964R, printer); V1.0

The module can be used wherever a CP module is allowed, i.e. also in the expansion unit after an interface module.


Properties - CP 340-RS232C - (R0/S4)

Short Description: CP 340-RS232C

Communication processor with connection: RS232C (ASCII, 3964R)

Order No.: 6ES7 340-1AH00-0AE0

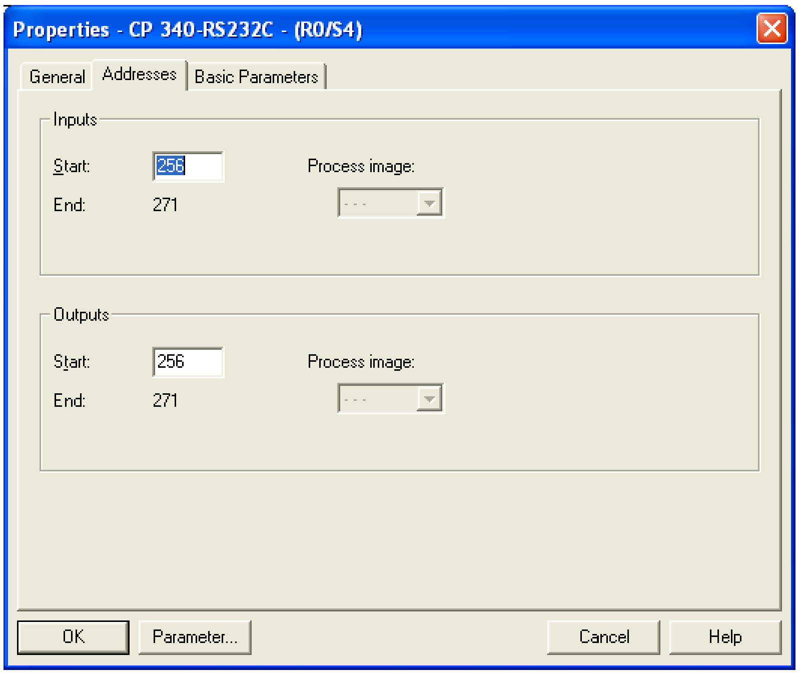
Name: CAN 300 PRO

Comment:

You should change the name of the module to “CAN 300 PRO” for easier identification in the Hardware Configurator.

*The I/O addresses should **not** be in the cyclic process image!*

The next step is to set the addresses of the inputs and outputs of the CAN 300 PRO in the PLC.



Properties - CP 340-RS232C - (R0/S4)

General | Addresses | Basic Parameters

Inputs

Start: 256   Process image: ---

End: 271

Outputs

Start: 256   Process image: ---

End: 271

The "Basic parameters" tab card has not function with the CAN 300 PRO.

2.3 Connecting to the PC

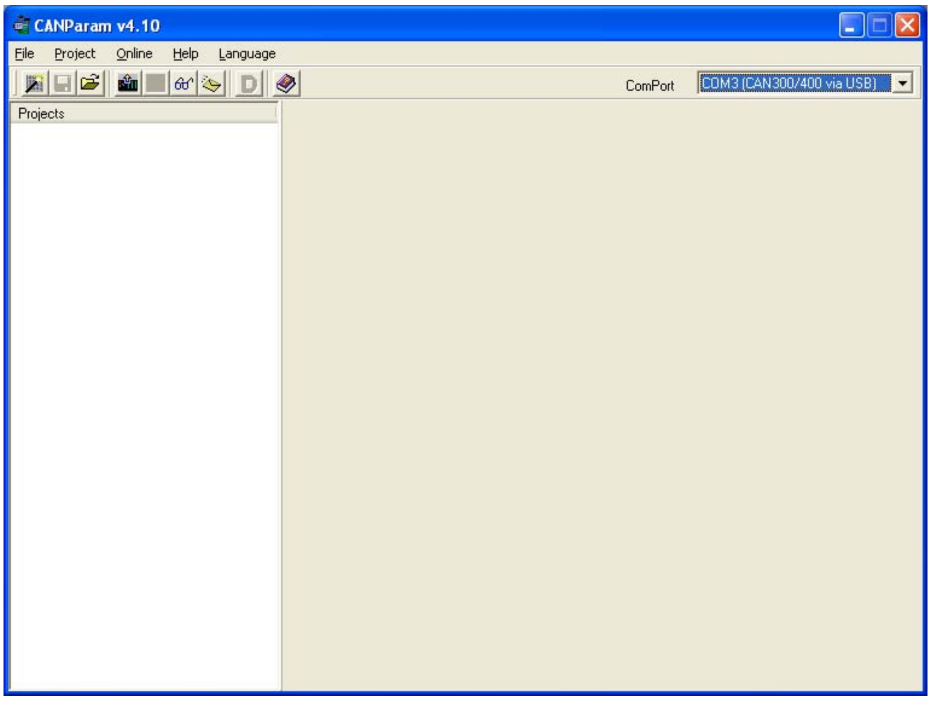
Manual: Section 6.2

Connect a USB cable to the CAN 300 PRO and connect it to your PC.

If you are connecting the CAN 300 PRO to your PC for the first time, the USB driver will be installed. This is located on the CAN-CD.

3 Configuring the CAN Module

Install and start the CANParam V4 software (at least V4.1x or later). Set the COM port of the USB connection to the CAN 300 PRO in the upper right field.

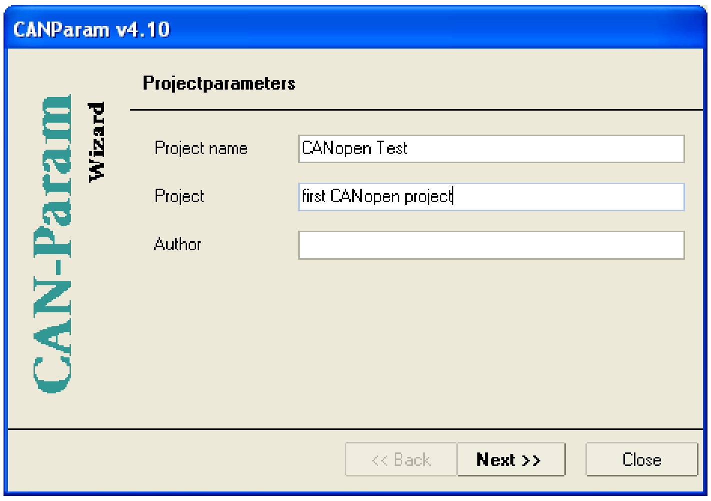


3.1 Creating a new project

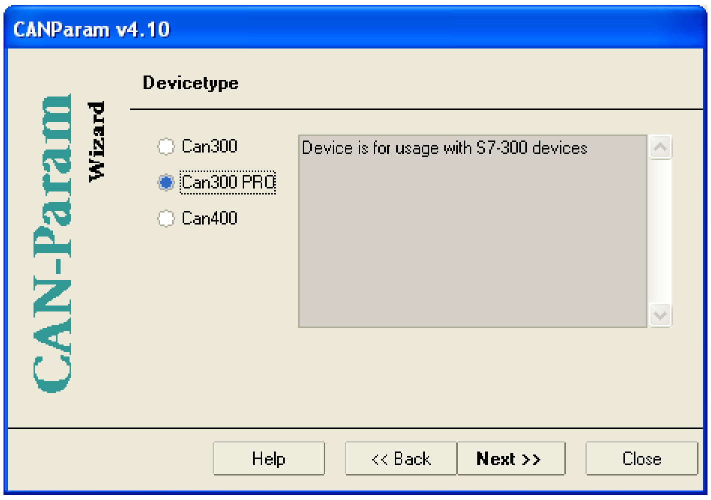
Manual: Section 6.4

Activate the “wizard” with “Set project” in the “Project” menu. You will now be guided through some dialog boxes in which basic settings about your project are queried.

Make the settings as shown in the following dialog boxes.



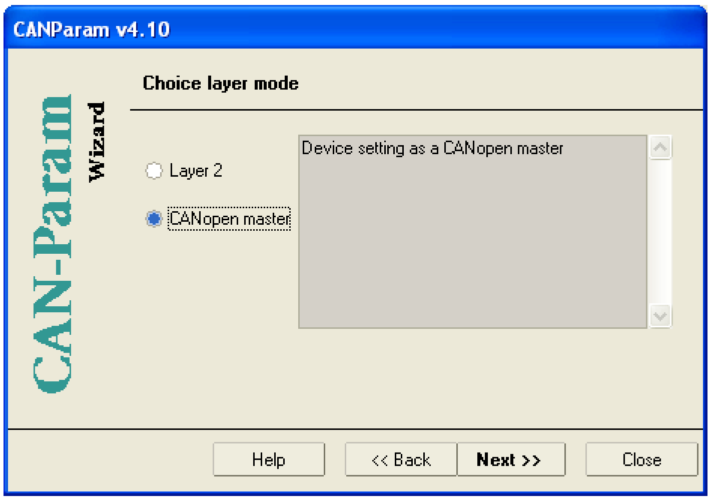
Project name: CANopen Test
Project: first CANopen project
Author:


CANParam v4.10

Devicetype

- ○ Can300
- ● Can300 PRO
- ○ Can400

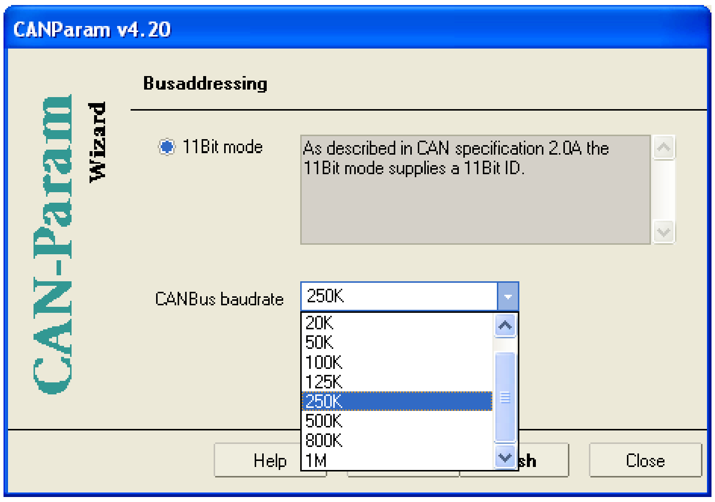
Device is for usage with S7-300 devices


CANParam v4.10

Choice layer mode

- ○ Layer 2
- ● CANopen master

Device setting as a CANopen master


CANParam v4.20

Busaddressing

● 11Bit mode

As described in CAN specification 2.0A the 11Bit mode supplies a 11Bit ID.

CANBus baudrate: 250K

20K, 50K, 100K, 125K, [✓ 250K], 500K, 800K, 1M

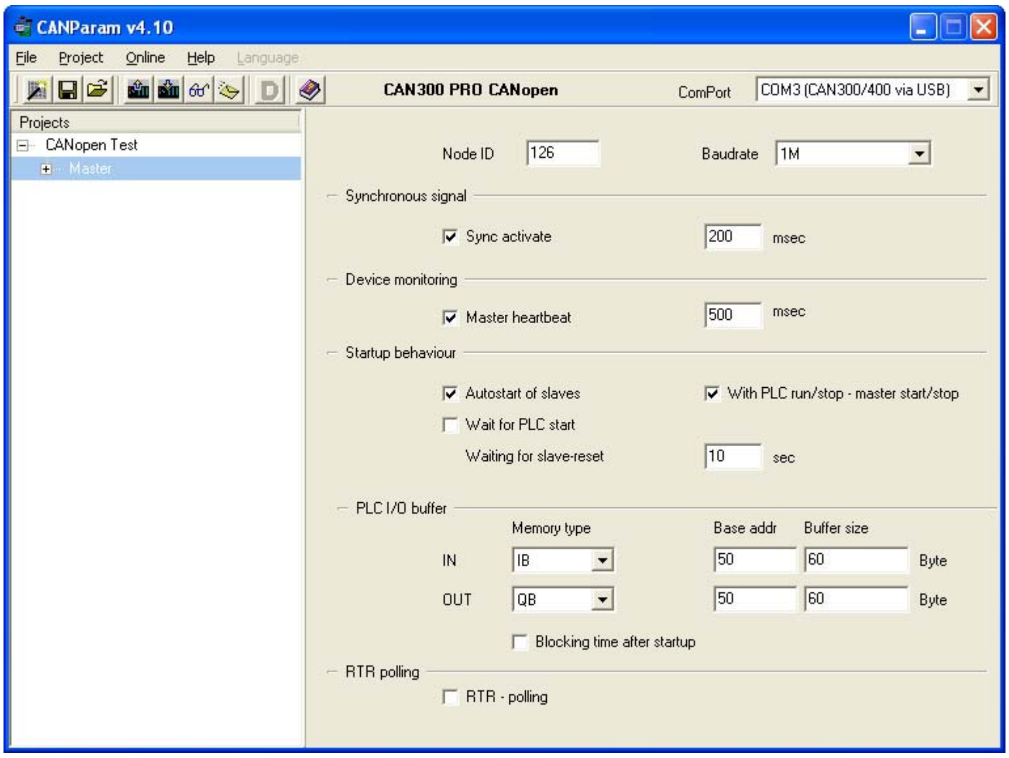
In this dialog box, select the CAN baud rate, which is preset for your CANopen® device.

We recommend setting lower baud rates, such as 500 kpbs for initial start-ups.

3.2 Setting the master

Manual: Section 6.4.1

Select the “Master” line in the left-hand field.



CAN300 PRO CANopen

ComPort: COM3 (CAN300/400 via USB)

Node ID: 126

Baudrate: 1M

Synchronous signal

☑ Sync activate: 200 msec

Device monitoring

☑ Master heartbeat: 500 msec

Startup behaviour

☑ Autostart of slaves

☑ With PLC run/stop - master start/stop

☐ Wait for PLC start

Waiting for slave-reset: 10 sec

PLC I/O buffer

	Memory type	Base addr	Buffer size	
IN	IB	50	60	Byte
OUT	QB	50	60	Byte

☐ Blocking time after startup

RTR polling

☐ RTR - polling

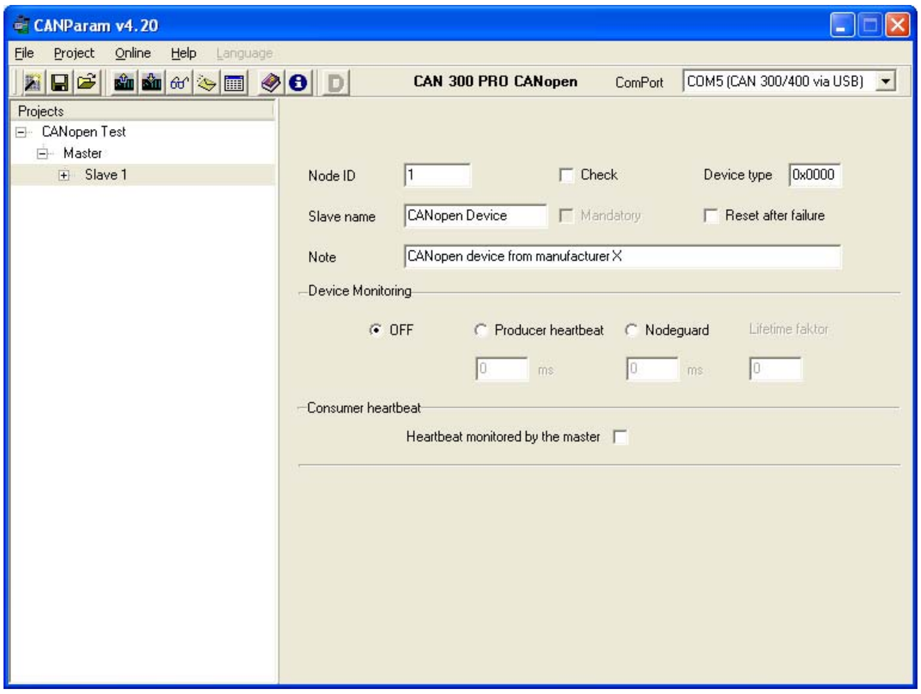
- Set the node ID of the master to address 127
- Set the baud rate to the preset baud rate of your CANopen® device
- The synchronous signal and master heartbeat should be activated and initially set to the suggested times
- The options in the Start-up behavior group box can be retained
- Set the PLC I/O buffer as described above; matching parameters will be set for the Step 7 data handling modules later

Leave the remaining parameters as they are already set.

3.3 Setting the slave

Manual: Section 6.4.2

Open the entries below the master in the left-hand field and select “Slave 1.”


CANParam v4.20
File Project Online Help Language
CAN 300 PRO CANopen
ComPort COM5 (CAN 300/400 via USB)
Projects
CANopen Test
Master
Slave 1

Node ID: 1
Check: ☐
Device type: 0x0000
Slave name: CANopen Device
Mandatory: ☐
Reset after failure: ☐
Note: CANopen device from manufacturer X

Device Monitoring
[✓ OFF] Producer heartbeat Nodeguard Lifetime faktor
0 ms 0 ms 0

Consumer heartbeat
Heartbeat monitored by the master ☐

In this dialog box, your connected CANopen® device is made known to the master.

You must set the node ID of the CANopen® device here and should assign a name to the device.

It should be possible to set node ID (device address, device ID) on your device either by DIP switch or rotary switch, or you can at least find out standard setting from the manual for your device.

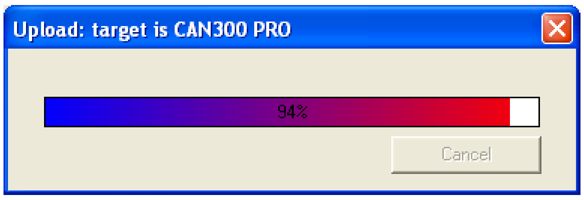
If the node ID of the device is not known, the “Scan to slaves” function will help!

If you do not know the node ID of your device, you can use the “Scan for slaves” function after importing the project created so far into the CAN 300 PRO (see below) in the “Online / CANopen® Tools” menu.

3.4 Importing a project into the CAN 300 PRO

Activate the “Upload” function in the “online” menu, to import the project into the CAN 300 PRO. The PLC should be in the STOP state.

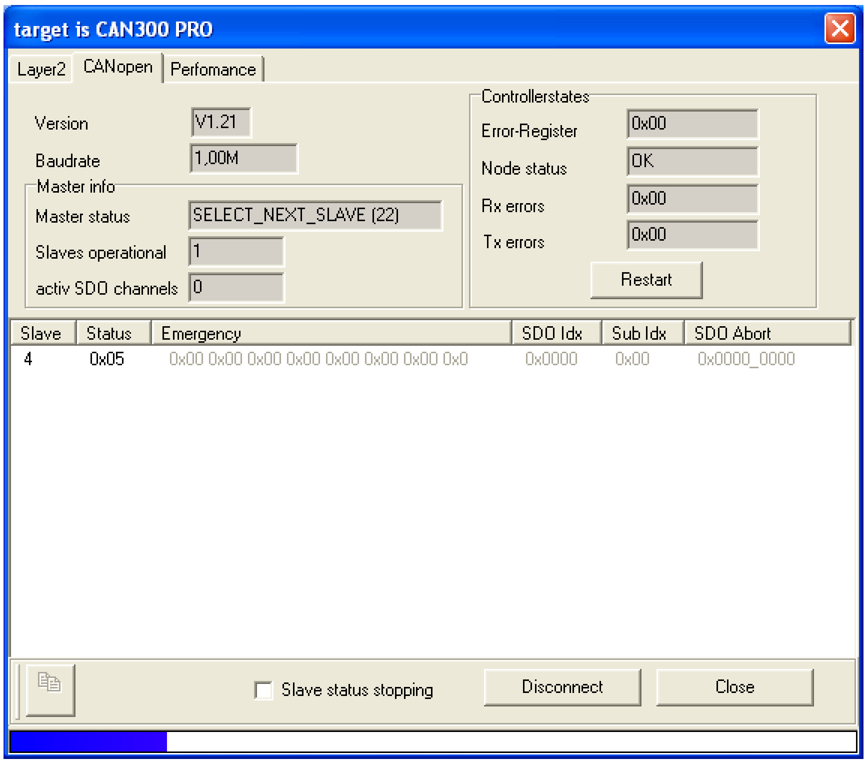
If no connection can be established with the CAN 300 PRO, check the USB connection and installation of the driver.



Importing the project automatically sets the CAN 300 PRO to the set baud rate and the following diagnostic functions can now be used.

3.5 First diagnosis

Now call the “Debug” function in the “Online” menu and activate the “CANopen®” tab card. Press the “Connect” button below right.



target is CAN300 PRO

Layer2 | CANopen | Perfomance

Version	V1.21
Baudrate	1,00M

Master info

Master status	SELECT_NEXT_SLAVE (22)
Slaves operational	1
activ SDO channels	0

Controllerstates

Error-Register	0x00
Node status	OK
Rx errors	0x00
Tx errors	0x00

Slave	Status	Emergency	SDO Idx	Sub Idx	SDO Abort
4	0x05	0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x0	0x0000	0x00	0x0000_0000

Manual: Section 6.7.2

The status of the CAN controller in the CAN 300 PRO is displayed in the controller status on the right-hand side of the dialog box. This should show 0x00 in the error register and the error counters. The node status should be OK. For further information on this, see Section 6.7.2 in the CAN 300 PRO Manual.

If this is not the case, check the cabling and the baud rate!

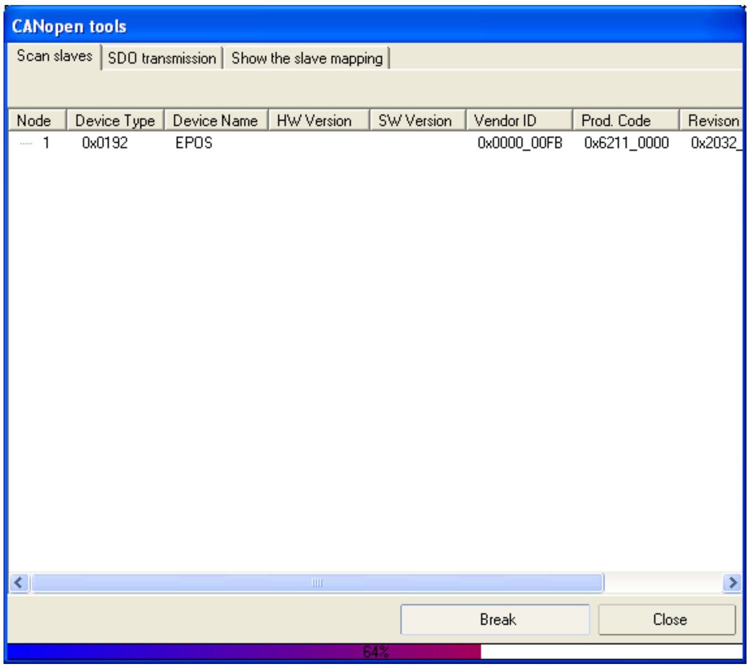
The Tx and Rx error counters must be 0x00! Node Status muss auf ‚OK' stehen!

3.6 Scan for slaves

Manual: Section 6.8.1

To check the devices connected on the CAN bus for accessibility, you can perform a search on the CAN bus using the “Scan for slaves” function in the “Online / CANopen® Tools” menu. This function tries out all CAN addresses from 1 to 127 one after the other to find devices.

Devices found are displayed with their node ID, device type, their name, and further information.



Node	Device Type	Device Name	HW Version	SW Version	Vendor ID	Prod. Code	Revison
1	0x0192	EPOS			0x0000_00FB	0x6211_0000	0x2032_

If the CAN device does not support the SDO 0x1000, it cannot be used in CANopen mode with the CAN 300 PRO.

If the list remains empty, the device you have connected cannot be detected as a CANopen® slave on the CAN bus, the baud rate is wrong, or the cabling is not correct.

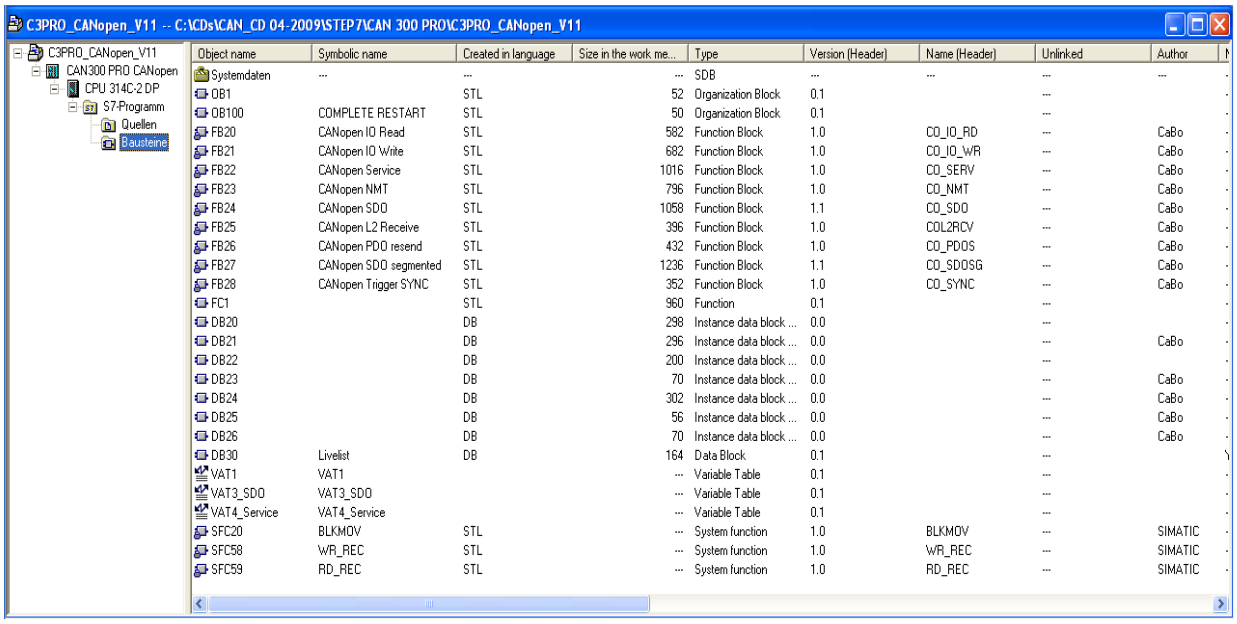
For the CAN 300 PRO to be able to detect a CAN device as a CANopen® slave, the device must support the SDO (service data object) 0x1000. Please consult the manual of your device to see whether the objects from 0x1000 exist in your device.

If this is not the case, the device cannot be used in conjunction with the CAN 300 PRO as a CANopen® master.

4 Preparations in the PLC

4.1 Loading data handling blocks

The CAN CD contains the data handling blocks for the CAN 300 PRO in the form of a Step 7 example project (ZIP file or directory). You will find the project as “C3PRO_CANopen®_V1x.ZIP” and newer in the “STEP7\CAN 300 PRO” directory. Open this project to use the blocks.


C3PRO_CANopen_V11 -- C:\CDs\CAN_CD 04-2009\STEP7\CAN 300 PRO\C3PRO_CANopen_V11

```
C3PRO_CANopen_V11
  CAN300 PRO CANopen
    CPU 314C-2 DP
      S7-Programm
        Quellen
        Bausteine
```

Object name	Symbolic name	Created in language	Size in the work me...	Type	Version (Header)	Name (Header)	Unlinked	Author
Systemdaten	---	---	---	SDB	---	---	---	---
OB1		STL	52	Organization Block	0.1		---	
OB100	COMPLETE RESTART	STL	50	Organization Block	0.1		---	
FB20	CANopen IO Read	STL	582	Function Block	1.0	CO_IO_RD	---	CaBo
FB21	CANopen IO Write	STL	682	Function Block	1.0	CO_IO_WR	---	CaBo
FB22	CANopen Service	STL	1016	Function Block	1.0	CO_SERV	---	CaBo
FB23	CANopen NMT	STL	796	Function Block	1.0	CO_NMT	---	CaBo
FB24	CANopen SDO	STL	1058	Function Block	1.1	CO_SDO	---	CaBo
FB25	CANopen L2 Receive	STL	396	Function Block	1.0	COL2RCV	---	CaBo
FB26	CANopen PDO resend	STL	432	Function Block	1.0	CO_PDOS	---	CaBo
FB27	CANopen SDO segmented	STL	1236	Function Block	1.1	CO_SDOSG	---	CaBo
FB28	CANopen Trigger SYNC	STL	352	Function Block	1.0	CO_SYNC	---	CaBo
FC1		STL	960	Function	0.1		---	
DB20		DB	298	Instance data block ...	0.0		---	
DB21		DB	296	Instance data block ...	0.0		---	CaBo
DB22		DB	200	Instance data block ...	0.0		---	
DB23		DB	70	Instance data block ...	0.0		---	CaBo
DB24		DB	302	Instance data block ...	0.0		---	CaBo
DB25		DB	56	Instance data block ...	0.0		---	CaBo
DB26		DB	70	Instance data block ...	0.0		---	CaBo
DB30	Livelist	DB	164	Data Block	0.1		---	
VAT1	VAT1		---	Variable Table	0.1		---	
VAT3_SDO	VAT3_SDO		---	Variable Table	0.1		---	
VAT4_Service	VAT4_Service		---	Variable Table	0.1		---	
SFC20	BLKMOV	STL	---	System function	1.0	BLKMOV	---	SIMATIC
SFC58	WR_REC	STL	---	System function	1.0	WR_REC	---	SIMATIC
SFC59	RD_REC	STL	---	System function	1.0	RD_REC	---	SIMATIC

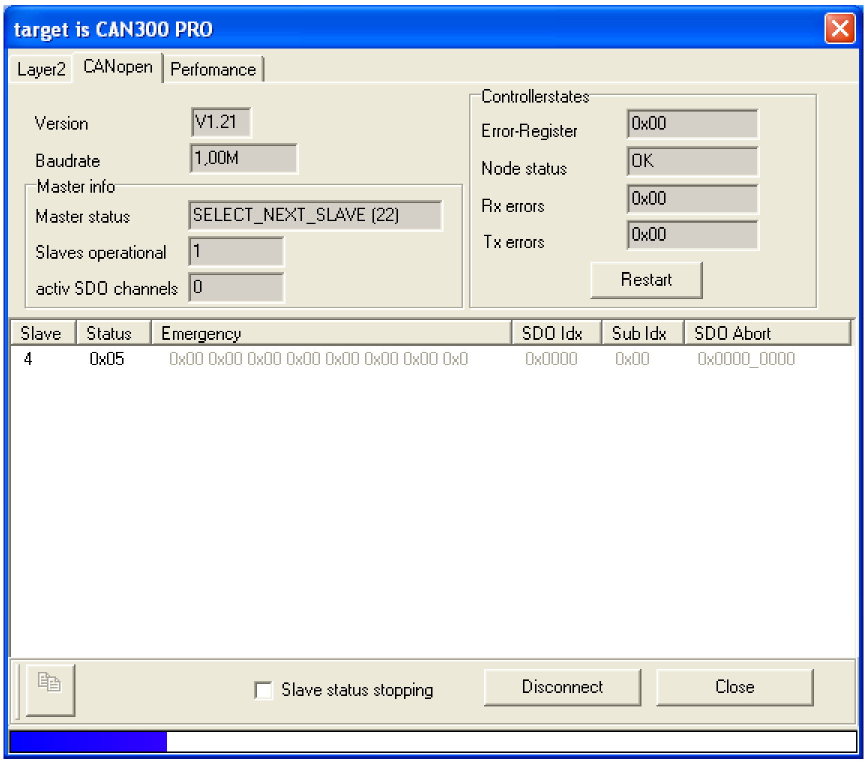
Copy the blocks into the project you created with your hardware configuration and transfer all block to the PLC.

4.2 PLC in the RUN state

Start the PLC to put the CAN 300 PRO into the “operational” mode, too.

On every STOP → RUN transition of the PLC, the CAN 300 PRO tries to start the CANopen® bus and start the devices defined in the project.

Now call the CANopen® debug screen in the CANParam again.



Version: V1.21
Baudrate: 1,00M

Master info
Master status: SELECT_NEXT_SLAVE (22)
Slaves operational: 1
activ SDO channels: 0

Controllerstates
Error-Register: 0x00
Node status: OK
Rx errors: 0x00
Tx errors: 0x00

Slave	Status	Emergency	SDO Idx	Sub Idx	SDO Abort
4	0x05	0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x0	0x0000	0x00	0x0000_0000

☐ Slave status stopping

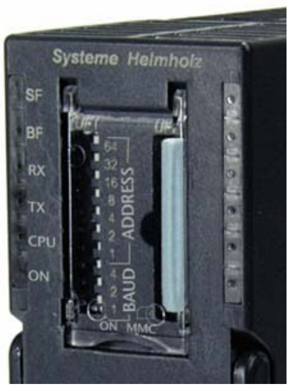
Manual: Section 6.7.2

If everything has succeeded so far, the master status should be “SELECT_NEXT_SLAVE (22)” and status 0x25 (operational) should be shown for the configured slave in the list of slaves below that.

If the slave status is 0x00, the slave has not been found. If the status is 0x04 (stop), 0x6A (slave detected but not yet initialized), or 0x7F (preoperational), the slave may have been detected but has not been started. In these cases, you should speak to the manufacturer of the device about which device-specific settings must be made on the device to enable it to start on the CAN bus.

Also check the “Operating conditions for CANopen® slave devices” in Section 7.4.

4.3 LEDs of the CAN 300 PRO



The LEDs of the CAN 300 PRO can also be a great help.

The “SF” LEDs should not be lighted; otherwise there is a system error.

If the “BF” LED is lighted, a CAN error is still present. Check the cabling and the CAN baud rate of all bus nodes. You will find more detailed information on the debug screen in the “Controller status” area.

The “Rx” and “Tx” LEDs show the traffic on the CAN bus. If the PLC is in the RUN state and a valid project has been imported, both LEDs should flash or shine steadily, depending on the CAN traffic.

The “ON” LED flashes until the PLC is in the STOP state of the master of the CAN 300 PRO was not yet able to enter cyclic operation. The “ON” LED shines steadily if the master has initialized the slave devices and has entered cyclic operation.

If the “ON” LED flashes after the PLC has started, an error has occurred during start-up and initialization of the slave. Also check what the cause of this could be on the debug screen.

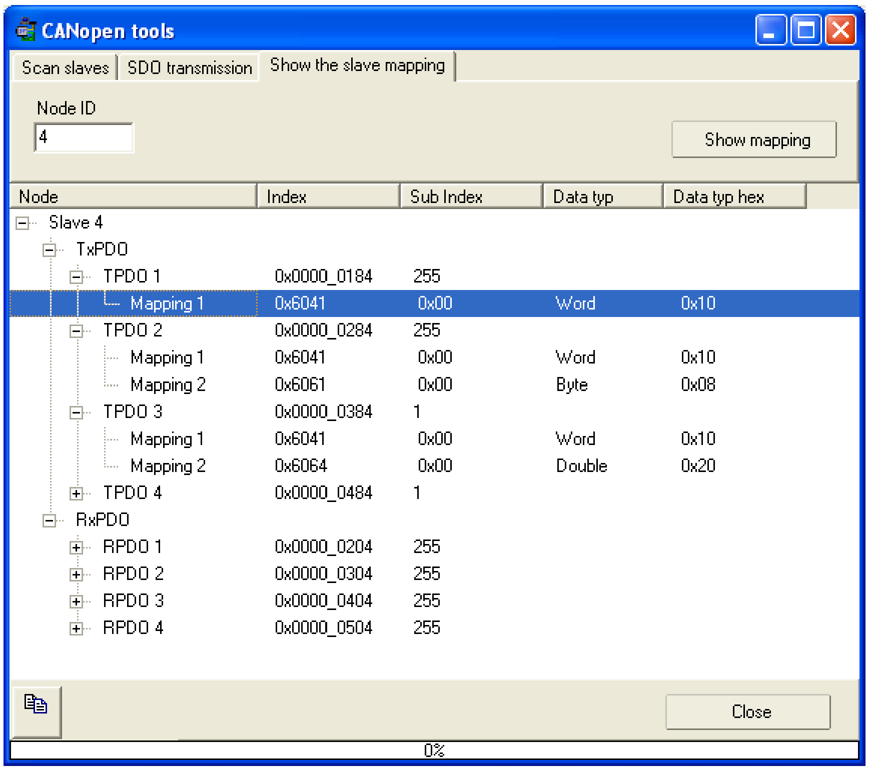
5 Assignment of the Process Data

If the CAN 300 PRO has been able to detect the device on the CAN bus, the next step is to assign the process data of the device (PDOs) to the PLC.

Manual: Section 6.4.5

There are up to 8 transmit PDOs (TPDO) and 8 receive PDOs (RPDO). Transmit PDOs are transmitted from the device to the CAN 300 PRO; receive PDOs are received by the device. Each PDO has up to 8 data bytes. The assignment of the PDOs to the PLC memory is defined on each slave in the CANParam software.

The content of the PDOs is usually preset in the CANopen® slave device, but can be modified as required. You can find out which data are located where in which PDO either from the device manual or with the “Show the slave mapping” read-out function in the “Online / CANopen® Tools” menu.



Node ID: 4

Node	Index	Sub Index	Data typ	Data typ hex
Slave 4				
TxPDO				
TPDO 1	0x0000_0184	255		
Mapping 1	0x6041	0x00	Word	0x10
TPDO 2	0x0000_0284	255		
Mapping 1	0x6041	0x00	Word	0x10
Mapping 2	0x6061	0x00	Byte	0x08
TPDO 3	0x0000_0384	1		
Mapping 1	0x6041	0x00	Word	0x10
Mapping 2	0x6064	0x00	Double	0x20
TPDO 4	0x0000_0484	1		
RxPDO				
RPDO 1	0x0000_0204	255		
RPDO 2	0x0000_0304	255		
RPDO 3	0x0000_0404	255		
RPDO 4	0x0000_0504	255		

In this case, the device has 4 RPDOs and 4 TPDOs.

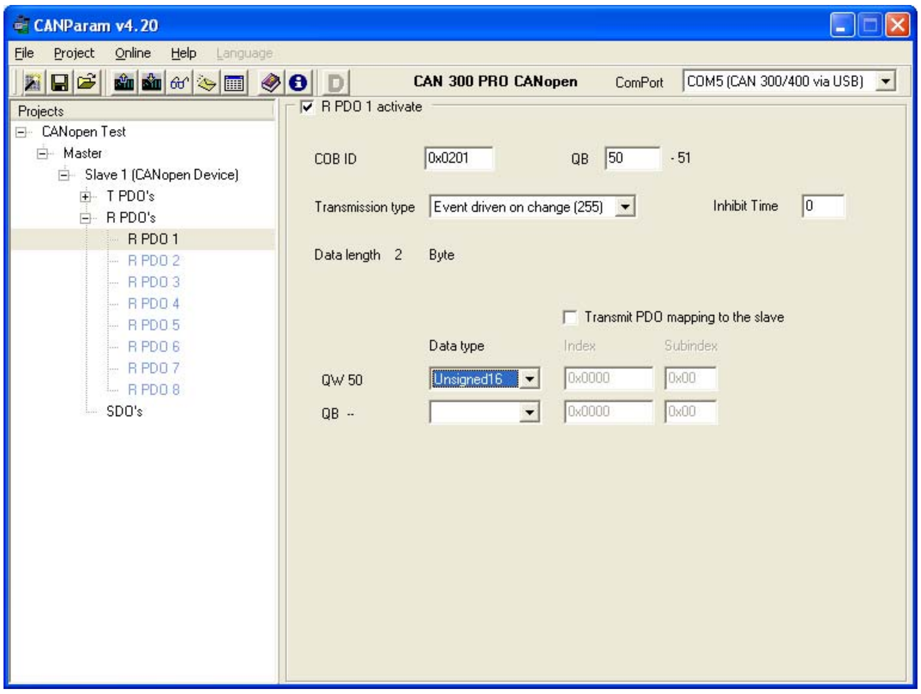
The first receive-PDO (RPDO1) is linked with the service data object (SDO) 0x6040 and is 2 bytes (1 word) long. The RPDO2 is also linked with the SDO 0x6040 and the SDO 0x6060 and is 3 bytes (1 word + 1 byte) long.

These assignments are called “PDO Mapping.” A preset PDO mapping is usual for CANopen® devices. If your device does not have a preset PDO mapping, it is up to you to fill the PDOs with SDOs that you require.

The PDO mapping must be made known to the CAN 300 PRO in the project for the slave.

5.1 Setting the PDO mapping

In the project, go to the entry “RPDO 1” in the left-hand field for the slave:



R PDO 1 activate [✓]

COB ID 0x0201 QB 50 - 51

Transmission type Event driven on change (255) Inhibit Time 0

Data length 2 Byte

Transmit PDO mapping to the slave [ ]

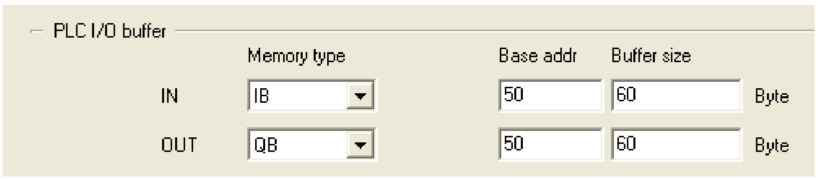
	Data type	Index	Subindex
QW 50	Unsigned16	0x0000	0x00
QB --		0x0000	0x00

ComPort COM5 (CAN 300/400 via USB)

Manual: Section 6.4.5

Activate the RPDO1 and set “unsigned 16” for the data type. That corresponds to the size of the SDO 0x6040 which is located in this PDO.

In this dialog box, it is now possible to make the assignment to the memory in the PLC. On the master page of the dialog box, the memory area in the PLC is already defined:



PLC I/O buffer

	Memory type	Base addr	Buffer size	
IN	IB	50	60	Byte
OUT	QB	50	60	Byte

In this example, that is input bytes IB50 to IB 109 (60 bytes) for the TPDOs transmitted by the slave and for the data to be transmitted to the slave (RPDOs) output bytes QB50 to QB 109 (so 60 bytes). These two memory areas are cyclically exchanged by the data handling blocks.

The RPDO1 defined above is now assigned to the QW50 in the PLC.

For further information on this, see Section 6.4.5 in the CAN 300 PRO Manual.

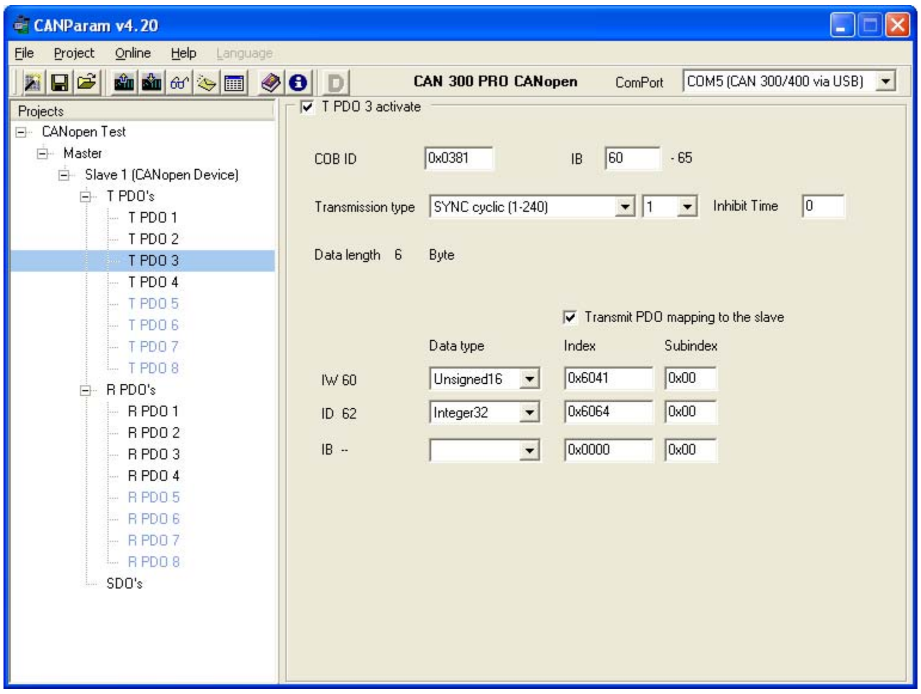
Now proceed exactly as described above for all PDOs you know about and require. Make sure that there are no overlaps in the memory area of the PLC.

5.2 Defining the PDO mapping in the slave

If your device does not have a preset PDO mapping or you require other SDOs in the PDOs for your application, you can communicate these to the master in the project. This ensures that the master transfer the mapping into the device on each start-up.

Manual: Sections 6.4.3 and 6.4.4

For this purpose, activate the “Transmit PDO mapping to the slave” option and enter the require SDOs in the list. Make sure the data types are correct. You can find out about them in the device manual.



ComPort: COM5 (CAN 300/400 via USB)

☑ T PDO 3 activate

COB ID: 0x0381 IB: 60 - 65

Transmission type: SYNC cyclic (1-240) 1 Inhibit Time: 0

Data length 6 Byte

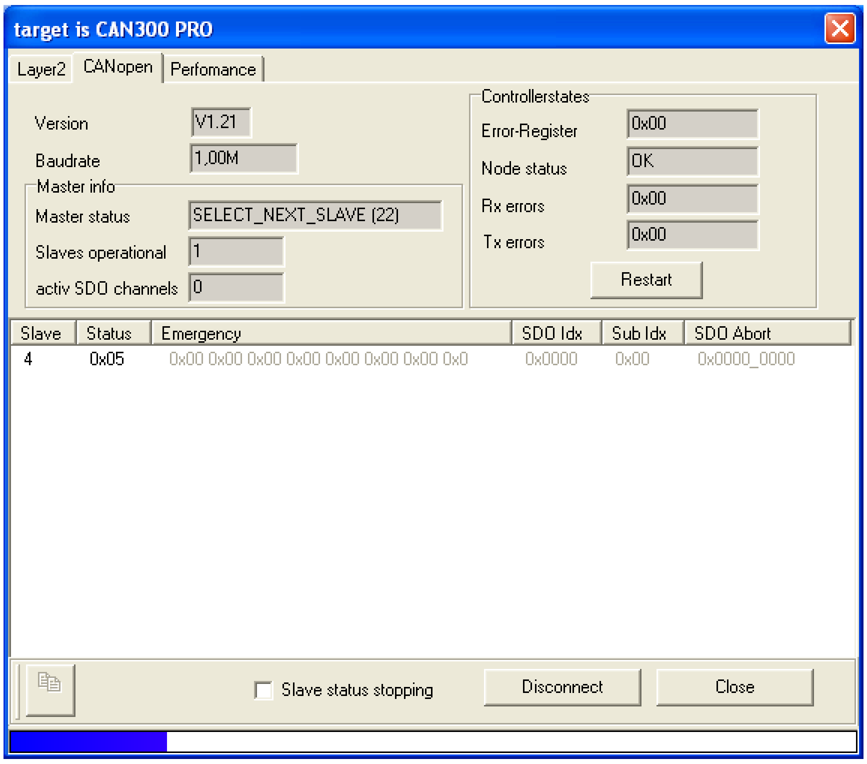
☑ Transmit PDO mapping to the slave

	Data type	Index	Subindex
IW 60	Unsigned16	0x6041	0x00
ID 62	Integer32	0x6064	0x00
IB --		0x0000	0x00

5.3 Testing the PDO mapping

Manual: Section 6.7.2

Import the project created with the PDO mapping into the CAN 300 PRO and start the PLC again. After the PLC has started check on the CANopen® debug screen whether the device is returned to status 0x05 “operational.”



target is CAN300 PRO

Layer2 | CANopen | Perfomance

Version	V1.21
Baudrate	1,00M

Master info

Master status	SELECT_NEXT_SLAVE (22)
Slaves operational	1
activ SDO channels	0

Controllerstates

Error-Register	0x00
Node status	OK
Rx errors	0x00
Tx errors	0x00

Slave	Status	Emergency	SDO Idx	Sub Idx	SDO Abort
4	0x05	0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x0	0x0000	0x00	0x0000_0000

If the slave does not go into operational status, there is something wrong with the PDO mapping. You can use the content of any emergency messages that may have been sent or the code of the SDO abort, both displayed on the debug screen, to find the cause.

5.4 SDO abort codes

The SDO abort code is the response of the CANopen® slave device to the writing or reading of an SDO. The CAN 300 PRO writes and reads some SDOs as the master starts in order to make the CANopen® slave device ready for operation.

If errors occur during this procedure, the last error will be visible on the debug screen. This lists for which SDO (index, subindex), the error has occurred and which abort code has been reported.

Manual: Section 7.8

The manual of your device should contain a list of SDO abort codes.

You will find a list of the usual SDO abort codes in Section 7.8 of the CAN 300 PRO.

5.5 Emergency messages

An emergency message is a frame transmitted by the CANopen® slave in the event of an error that provides information about the cause of the error. You can see the 8 data bytes of the last emergency message transmitted in the "Emergency" column of the debug screen.

Structure of the emergency message:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Emergency Error Code		Error Register (0x1001)	Manufacturer-specific Error				

The manual of your device should contain a list of the possible emergency messages, or ask the manufacturer of your device.

6 Programming in the PLC

Manual: Section 7.7

If the slave is in “Operational” status, we can now turn to the PLC program. All data handling blocks should now have been imported into the PLC. However, you do not actually require all of blocks FB 20 to FB 28.

The project with the CANopen® data handling blocks also contains an FC 1 that shows all block calls as examples.

The function blocks that are important in the first step are FB 20 “CANopen® IO Read” and FB 21 “CANopen® IO Write,” which are responsible for data exchange of the IO memory area that contains the PDO data.

The block FB 20 “CANopen® IO Read” is called at the start of the PLC cycle to read the received data (TPDOs of the slave) from the CAN 300 PRO into the PLC.

```
CALL  FB    20 , DB20
 Base   :=256
 Dest   :=P#E 50.0 BYTE 60
 STAT   :=MW20
 Err    :=M22.6
 RetVal :=MW24
 NewData:=M22.0
```

After this call, you can process the current data of the slave in the input image (IB50 – IB109).

To transmit values to the slave, you only need to change the values in the output image (QB50 – QB109) and call FB 21 “CANopen® IO Write” at the end of the cycle.

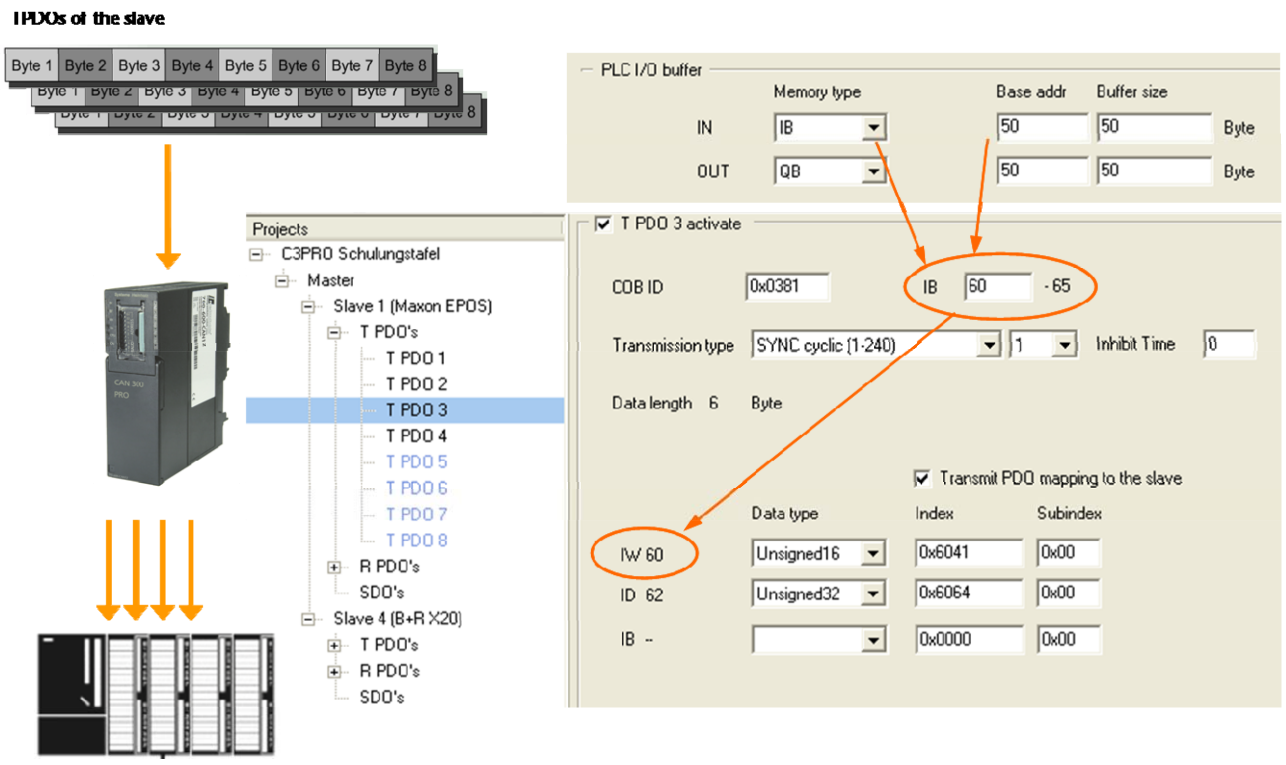
The block FB 21 “CANopen® IO Write” is called at the end of the PLC cycle to write the new output data (RPDOs of the slave) from the PLC into the CAN 300 PRO.

```
CALL  FB    21 , DB21
 Base  :=256
 Source:=P#A 50.0 BYTE 60
 STAT  :=MW20
 Err   :=M22.7
 RetVal:=MW24
```

All further block calls are not required for basic operation and are initially ignored or commented out of the FC 1.

6.1 How PDOs are assigned to the PLC

The following figure illustrates how PDOs are assigned to the PLC memory.



PLC I/O buffer

	Memory type	Base addr	Buffer size	
IN	IB	50	50	Byte
OUT	QB	50	50	Byte

☑ T PDO 3 activate

COB ID 0x0381 IB 60 - 65

Transmission type SYNC cyclic (1-240) 1 Inhibit Time 0

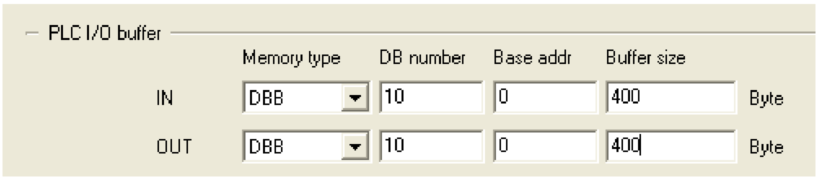
Data length 6 Byte

☑ Transmit PDO mapping to the slave

	Data type	Index	Subindex
IW 60	Unsigned16	0x6041	0x00
ID 62	Unsigned32	0x6064	0x00
IB -		0x0000	0x00

Alternatively, it is possible to select assignment of the PDOs to flag areas or in data blocks.

For larger CANopen® projects, in particular, the use of data blocks is recommended because of the quantity of PDO data.



PLC I/O buffer

	Memory type	DB number	Base addr	Buffer size	
IN	DBB	10	0	400	Byte
OUT	DBB	10	0	400	Byte

However, be sure to adapt the parameters in FB 20 and FB 21 accordingly.

```
CALL  FB    20 , DB20
 Base    :=256
 Dest    :=P#DB10.DBX 0.0 BYTE 400
 STAT    :=MW20
 Err     :=M22.6
 RetVal  :=MW24
 NewData:=M22.0
```

7 What Else Is Required ...

Now you have the basic function with CAN 300 PRO in operation, you can extend your application according to your needs. You can easily add further slaves or adapt the PDO mapping with the CANParam and test this in the debug tools.

The following sections will explain what else you require...

7.1 I/O area in the PLC

Manual: Section 5

In the I/O area of the CAN 300 PRO, which is located as from address PIB 256 in our example, you obtain information about the operating state of the CAN 300 PRO as a CANopen® master.

Byte	Meaning
PIB 256	Module status generally, CAN group error display
PIB 257	**CAN controller status (register of the CAN controller)**
PIB 258	FIFO status bits (send & receive)
PIB 259	**CAN controller: TX error counter**
PIB 260	**CAN controller: RX error counter**
PIB 261	**CANopen®: Masterstatus**
PIB 262	CANopen®: Assignment of the SDO request mailboxes
PIB 263	**CANopen®: Number of nodes in operational**
PIB 264	Node ID on use of the bit filter or of the master

PIB 257, PIB 259, and PIB 260 provide information about the status of the CAN communication.

In PIB 261, you can see the status of the CANopen® master.

In PIB 263, you can see the number of connected CANopen® slave devices that are operational.

You will find more detailed information about these bytes in the CAN 300 PRO manual in Section 5.

7.2 Monitoring slave devices

As soon as a CANopen® slave device is functioning correctly on the CAN 300 PRO, it is advisable to monitor this device on the bus for failure. In the previous example, this is not yet done automatically.

To monitor CANopen® slave devices, there are two methods with CANopen®: “Nodeguarding” and “Heartbeat.”

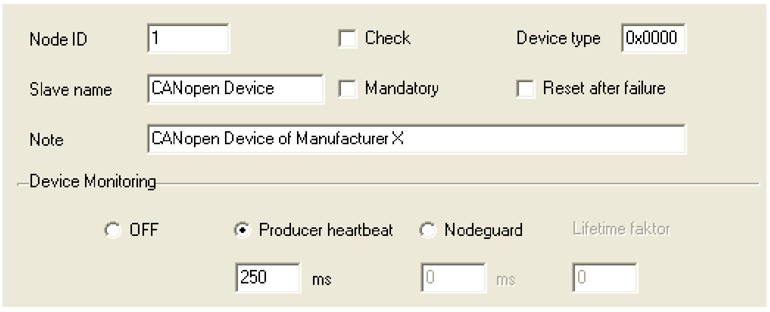
In the case of *Nodeguarding*, the master monitors the CANopen® slave device by cyclically transmitted frames. Each CANopen® slave must respond to the nodeguarding frame with a status frame.

At the same time, the CANopen® slave device checks whether it is regularly receiving frame from the CANopen® master to be able to detect a failure of the master. If the nodeguarding frame of the master is not received, the CANopen® slave device can enter a safe state.

In the case of *Heartbeat*, the CANopen® slave device autonomously transmits frames with its status information ("Producer Heartbeat") in a fixed timebase. The master monitors whether these frames are regularly received. Otherwise, the CANopen® slave device is assumed to have failed.

Manual: Section 6.4.2

The monitoring times can be set both for nodeguarding and for heartbeat.

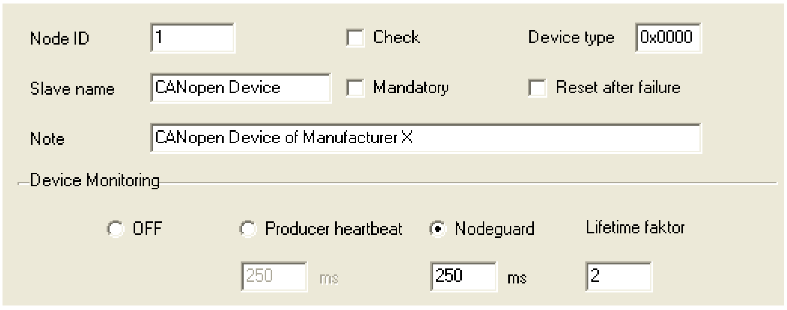


Node ID	1	☐ Check	Device type 0x0000
Slave name	CANopen Device	☐ Mandatory	☐ Reset after failure
Note	CANopen Device of Manufacturer X		

Device Monitoring

OFF	[✓ Producer heartbeat]	Nodeguard	Lifetime faktor
	250 ms	0 ms	0

With the Device Monitoring setting *Producer Heartbeat*, the time for transmission of the heartbeat frame is defined for the CANopen® slave device, in this case 200ms. The master then automatically monitors this device with a time that is 1.5 times longer than the set heartbeat time, that is, in this case 300ms.



Node ID	1	☐ Check	Device type 0x0000
Slave name	CANopen Device	☐ Mandatory	☐ Reset after failure
Note	CANopen Device of Manufacturer X		

Device Monitoring

OFF	Producer heartbeat	[✓ Nodeguard]	Lifetime faktor
	250 ms	250 ms	2

With the Device Monitoring setting *Nodeguard*, the time base for querying the CANopen® slave device is defined for the master, every 200 ms in this case. The *Lifetime Factor* defines the monitoring factor for the response by the device. If the device has not responded after 2x200ms, we can consider it to have failed.

Please see the device manual to find out which of the two monitoring methods you device supports. If both methods are supported, the modern *Heartbeat* method should be used.

Manual: Section 7.7.3

You can monitor whether the monitored CANopen® slave device is still active on the CAN bus active either in PIB 263 or, if there are multiple devices on the bus, in detail by using the FB 22 "CANopen® Service" with the *Livelist*.

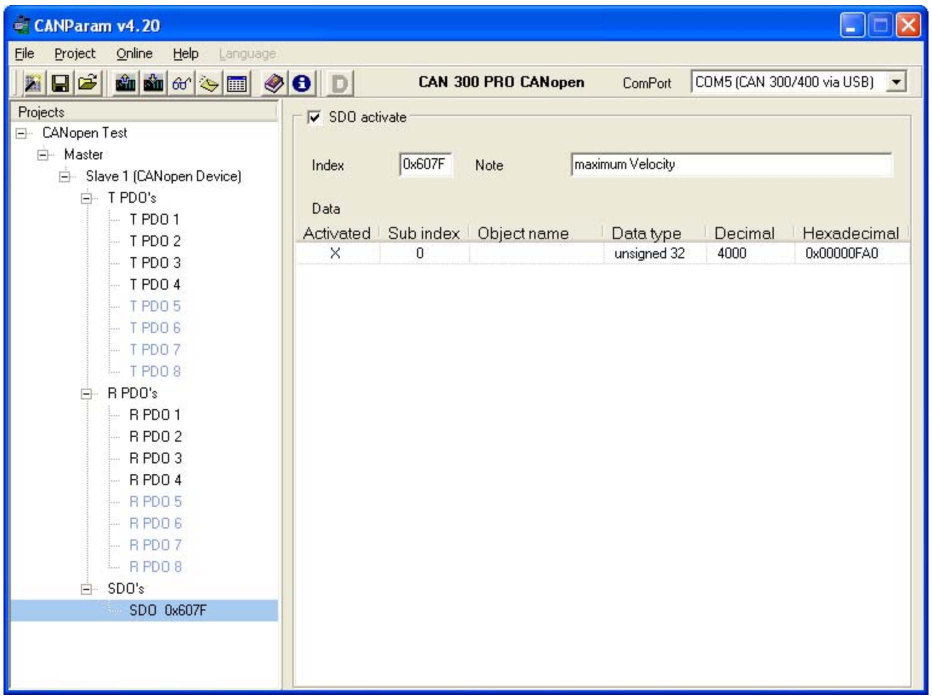
7.3 Writing SDOs in the slave device

Some CANopen® slave devices require a certain parameterization of their SDOs on start-up, for example, to make some basic settings.

To provide a simple solution, a list of SDOs can be communicated to each CANopen® slave device in the CANParam software during parameterization. These are always written into the device on start-up.

Manual: Section 6.4.6

The required SDOs can be inserted as a list into the CANParam on the slave.



ComPort: COM5 (CAN 300/400 via USB)

SDO activate: ✓

Index: 0x607F Note: maximum Velocity

Activated	Sub index	Object name	Data type	Decimal	Hexadecimal
X	0		unsigned 32	4000	0x00000FA0

Manual: Section 7.7.5

SDOs can also be written or read from the PLC during operation. For this purpose, use the FB 24 "CANopen® SDO."

7.4 Operating conditions for CANopen® slave devices

To be able to use a CANopen® Slave on the CAN 300 PRO in CANopen® master operation, the slave must meet the following conditions:

1. It must be possible to read out the SDO 0x1000.
2. The slave should perform a restart after the NMT reset command.
3. After the slave has been reset, it should transmit a boot-up message (0x700 + node ID; data: 0x00)
4. For monitoring by the master, the slave should support either nodeguarding or producer heartbeat.

Please use the device manual to check whether the conditions stated above have been met or speak to your device manufacturer.

If a device to be used does not meet these conditions, some functional restrictions may result, or the device cannot be used with the CAN 300 PRO via CANopen®.

Alternatively, such a device can be used in Layer 2 mode of the CAN 300 PRO. Please contact us about this ...

8 Troubleshooting

8.1 Looking for errors

To facilitate start-up of a CANopen® network, the following tips must be taken into account.

- If the LED BF ("CAN bus error") is still lit or blinking, check the physical structure of the CAN bus (terminating resistor, baud rate, etc.). Use the layer 2 debug display.
- If the SF "system errors" LED lights up, there is a defective MMC in the module, or the imported CAN project has an internal error.
- Check which "device monitoring" method (heartbeat or nodeguarding) is supported by the slave in question. Do not use "Consumer Heartbeat" until everything else has been started up.
- On all devices, do not yet activate the option "Mandatory device" so that the master will definitely start up and show all the stations found in the slave list of the CANopen® debug display. These stations can be defined as a mandatory device if necessary.
- Initially set "Wait after reset" to a long time (e.g. 30 seconds) if the master displays all slaves as "operational" for a shorter time, this time can be reduced.
- If the slave device fulfills all requirements from Section 7.4 ?
- If a slave is displayed as operational after the master has started up, but no data is being received, check the PDO mapping and the assignment of the PDOs in the PLC I/O buffer of the PLC
- Check whether emergency messages are present after start-up: CANopen® Debug → Emergency
- Check whether an error has occurred during SDO initialization of the slaves: CANopen® Debug → SDO Abortcode

If these tips do not help, contact our support Either by phone on +49 9135 7380-0 or by e-mail to support@helmholz.de.

If information about their slave device is also at hand (manual), please also send this information.

8.2 Training

Systeme Helmholz GmbH offers regular 1-day training courses on the entire topic of CAN, the CANopen® protocol, start-up and programming of the CAN 300 PRO and an error analysis.

You will find the next dates in the Internet at www.helmholz.com.

Training courses can also be held on your site.

8.3 Start-up support

Furthermore, we will gladly support you with start-up and develop customized function blocks and projects for your application.

Just contact us ...

Notes