



CAN 300 PRO - Application Example DS402 Maxon

CAN Communication Module for S7-300
Application Example of CANopen[®] DS402 with Maxon Motors

Manual

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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	06.04.2009	1 st version
2	24.06.2009	minor corrections
3	15.04.2010	Modification for CANParam v4.20
4	22.12.2011	Adaptation for the example with current mode and further small corrections

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1 Overview



1.1 Application and function description

This manual describes the application example (handling blocks) for controlling a Maxon motor with an EPOS24/5 controller using a CAN 300 PRO module according to the CANopen® profile DS402. The application example should also work with EPOS 24/1, EPOS 70/10, EPOS2 24/5, EPOS2 50/5 und MCD EPOS 60W.

This is for use in conjunction with the manual for the CAN 300 PRO module. The information in these manuals is assumed to be known, in particular, the description of the CANopen® protocol and the CANopen® master handling modules.

In addition to this, the CANopen® profile description “DSP-402 Device Profile for Drives and Motion” and the CANopen® description from Maxon “EPOS Firmware Specification,” especially Section “Object Dictionary” are very helpful.

The handling blocks described here (FBs) and the example project for CANParam provide the following basic functions:

- Basic initialization of a drive
- Profile velocity mode
- Profile position mode
- Homing mode
- Current mode

The handling blocks are functionally based on the Maxon instruction “EPOS Application Note Device Programming.”

1.3 Maxon motor configuration

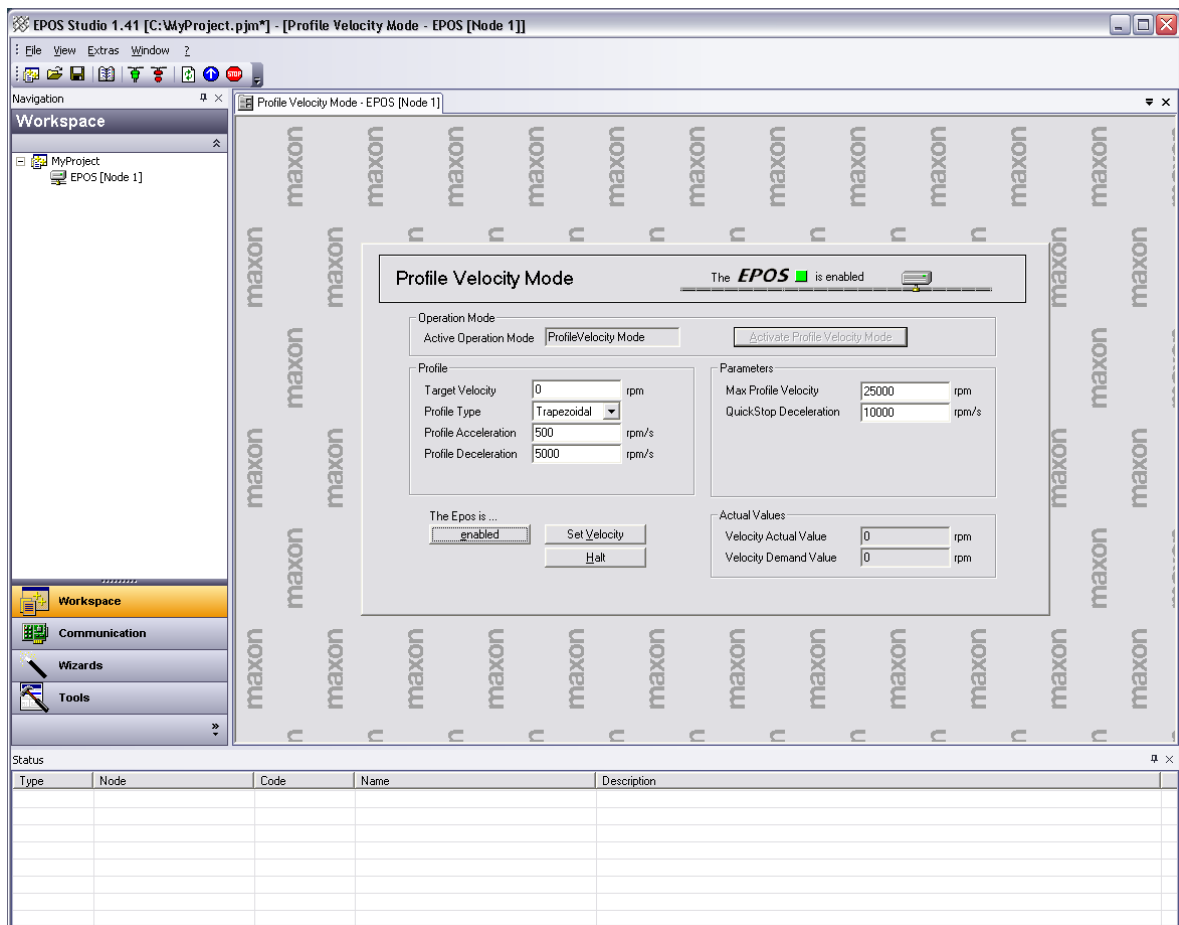
The handling example was created with an EPOS 24/5. The motor is connected as Node 1.

This handling example assumes that the EPOS system is ready for use (cabling, tuning, parameters of the motor used, etc.).

Please read carefully the Maxon Motor documentation on configuring and commissioning the EPOS and the motor.

With the “Object Dictionary” of the EPOS User Interfaces it is possible to monitor the CANopen® SDO Objects directly.

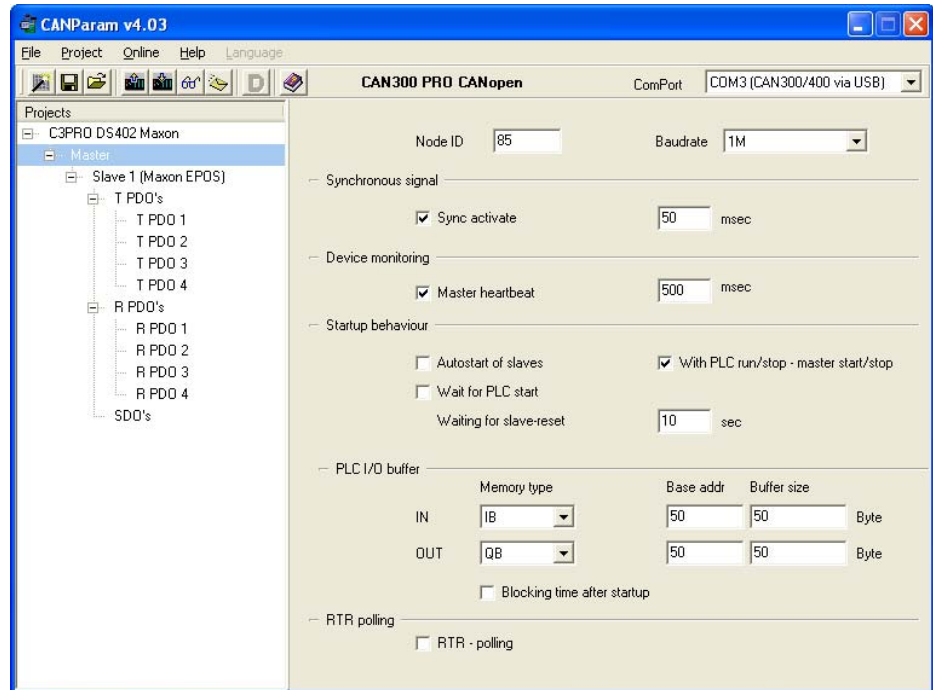
We recommend testing the basic motor functions with the EPOS software:



2 Configuring the CAN module

To use the example program, the provided CAN project “C3PRO DS402 Maxon.par” with the CANParam software (Version 4 and higher) must be transferred to the CAN 300 PRO module.

2.1 Setting the CANopen Master

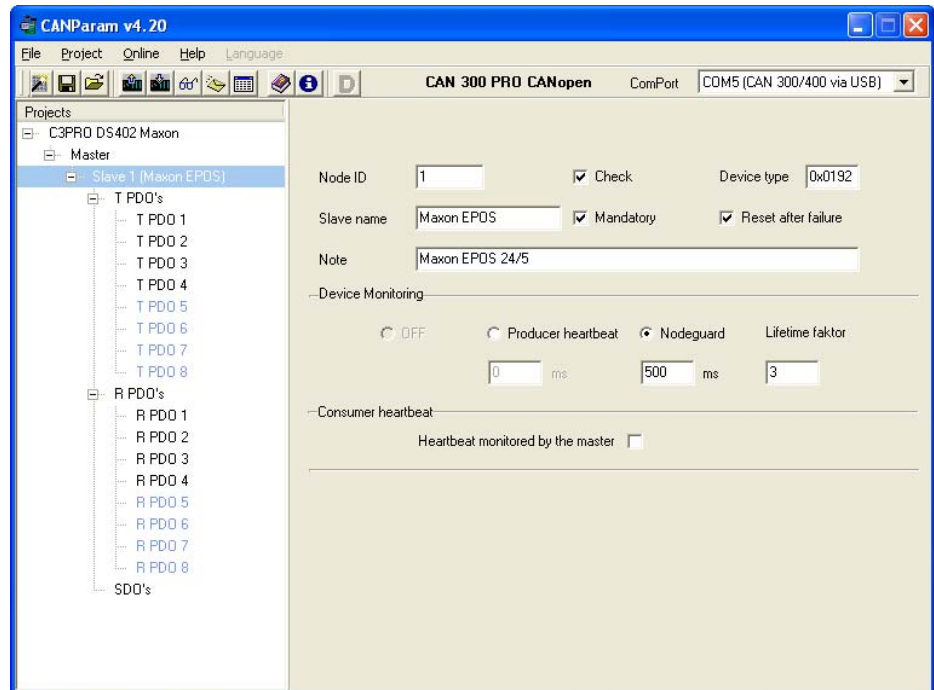


The application example works with a 1 Mbit CAN bus.

The SYNC signal is used for PDO communication with the Maxon EPOS. The time for the SYNC signal can be adapted to the required response time and the cycle time of the PLC.

The data of the PDOs are mapped in the PLC in the input or output image starting at IB 50 and QB 50.

2.2 Setting the Maxon motor as a slave



The Maxon EPOS is identified by the device type 0x0192. The device type is compared with the SDO 0x1000 when the master starts up.

The slave is monitored by the master every 500ms by means of node guarding.

2.3 Setting the PDOs

The handling blocks are based on the DS402 standard PDO mapping of the Maxon motor. The PDO 4 has been extend for the current mode.

TPDO1 (is transmitted by the EPOS):

Byte 0-1: SDO 6041/0 Status word

TPDO2 (is transmitted by the EPOS):

Byte 0+1: SDO 6041/0 Status word

Byte 2: SDO 6061/0 Mode of operation display

T PDO 2 activate

COB ID 0x281 Offset Byte (IB 52 - 54)

Transmission type

Data length 3 Byte

Transmit PDO mapping to the slave

	Data type	Index	Subindex
IW 52	<input type="text" value="Unsigned16"/>	<input type="text" value="0x6041"/>	<input type="text" value="0x00"/>
IB 54	<input type="text" value="Unsigned8"/>	<input type="text" value="0x6061"/>	<input type="text" value="0x00"/>
IB ..	<input type="text" value=""/>	<input type="text" value="0x0000"/>	<input type="text" value="0x00"/>

TPDO3 (is transmitted by the EPOS):

Byte 0+1: SDO 6041/0 Status word

Byte 2-5: SDO 6064/0 Position actual value

T PDO 3 activate

COB ID 0x381 Offset Byte (IB 60 - 65)

Transmission type

Data length 6 Byte

Transmit PDO mapping to the slave

	Data type	Index	Subindex
IW 60	<input type="text" value="Unsigned16"/>	<input type="text" value="0x6041"/>	<input type="text" value="0x00"/>
ID 62	<input type="text" value="Unsigned32"/>	<input type="text" value="0x6064"/>	<input type="text" value="0x00"/>
IB ..	<input type="text" value=""/>	<input type="text" value="0x0000"/>	<input type="text" value="0x00"/>

TPDO4 (is transmitted by the EPOS):

Byte 0+1: SDO 6041/0 Status word

Byte 2-5: SDO 606C/0 Velocity actual value

Byte 6+7: SDO 2027/0 Current act. value averaged

TPDO 3 & TPDO4 are transmitted to the SYNC signal.

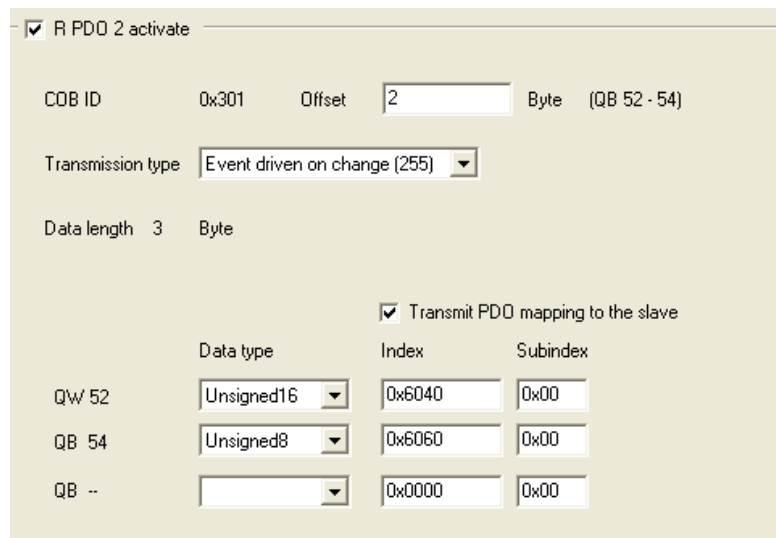
RPDO1 (is received by the EPOS):

Byte 0+1: SDO 6040/0 Control word

RPDO2 (is received by the EPOS):

Byte 0+1: SDO 6040/0 Control word

Byte 2: SDO 6060/0 Modes of operation



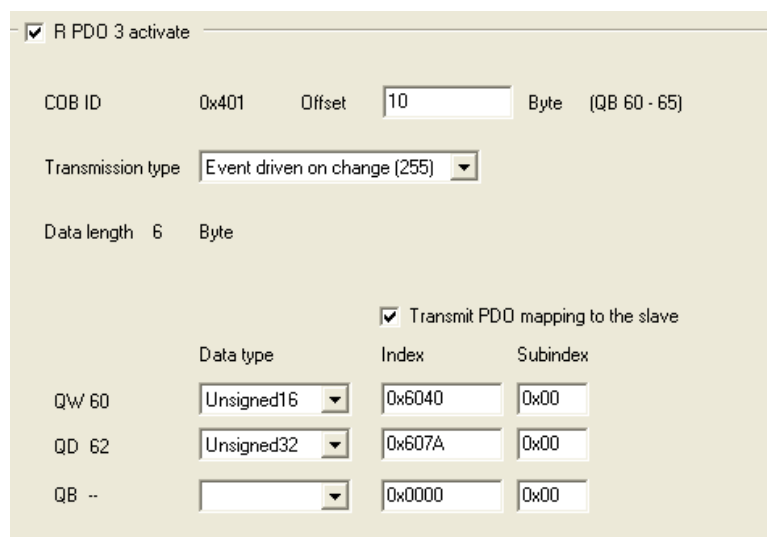
The screenshot shows the configuration for RPDO 2. It is activated. The COB ID is 0x301, and the offset is 2 bytes (QB 52-54). The transmission type is 'Event driven on change (255)'. The data length is 3 bytes. The 'Transmit PDO mapping to the slave' checkbox is checked. The mapping table is as follows:

	Data type	Index	Subindex
Q/W 52	Unsigned16	0x6040	0x00
QB 54	Unsigned8	0x6060	0x00
QB --		0x0000	0x00

RPDO3 (is received by the EPOS):

Byte 0+1: SDO 6040/0 Control word

Byte 2-5: SDO 607A/0 Target position



The screenshot shows the configuration for RPDO 3. It is activated. The COB ID is 0x401, and the offset is 10 bytes (QB 60-65). The transmission type is 'Event driven on change (255)'. The data length is 6 bytes. The 'Transmit PDO mapping to the slave' checkbox is checked. The mapping table is as follows:

	Data type	Index	Subindex
Q/W 60	Unsigned16	0x6040	0x00
QD 62	Unsigned32	0x607A	0x00
QB --		0x0000	0x00

RPDO4 (is received by the EPOS):

Byte 0+1: SDO 6040/0 Control word

Byte 2-5: SDO 60FF/0 Target velocity

Byte 6+7: SDO 2030/0 Current mode setting value

3 Programming in the PLC

3.1 Overview

The example contains the handling blocks of the CANopen[®] Master handling (FB20 – FB24) that are explained in detail in the “CAN 300 PRO” manual.

FB40 and FB43 are the blocks specially created for handling the Maxon motor and they call the blocks of the CANopen[®] Master handling.

The input process data are read from the CAN 300 PRO module at the start of the OB1 by calling FB20 “IO Read”. At the end of OB1, the output data are transferred to the CAN 300 PRO with FB21 “IO Write”.

3.2 Process image assignment

Assignment of the EPOS values in the process image:

IW 50	TPDO1	Status word
IW 52	TPDO2	Status word
IB 54	TPDO2	Actual mode of operation
IW 60	TPDO3	Status word
ID 62	TPDO3	Actual position
IW 70	TPDO4	Status word
ID 72	TPDO4	Actual velocity
IW 76	TPDO4	Current act. value averaged
QW 50	RPDO1	Control word
QW 52	RPDO2	Control word
QB 54	RPDO2	Set mode of operation
QW 60	RPDO3	Control word
QD 62	RPDO3	Set position
QW 70	RPDO4	Control word
QD 72	RPDO4	Set velocity
QW 76	RPDO4	Current mode setting value

3.3 Example FC 1 (DS402 Maxon test)

The functions of the handling blocks are triggered in FC1 by the bits of marker bytes 108, 109 and 112.

The drive functions are activated with the following markers in FC1:

Network 1:

M 108.0	Init profile velocity mode (FB40)
M108.1	Set velocity
MD 120	Target velocity

Network 2:

M 108.4	Init profile position mode (FB41)
M108.5	Activate positioning
MD 124	Target position

Network 3:

M 109.0	Init homing mode (FB42)
M 109.1	Activate homing
MW 32	Homing method

Network 4:

M 112.0	Init profile current mode (FB43)
M 112.1	Set current
MW 116	Target current

3.4 Profile velocity (FB 40)

The **INIT_VELOCITYMODE (FB 40)** function block activates the profile velocity mode of the drive and transfers the necessary parameters.

The block requires information of the EPOS (“Status word,” “Actual mode of operation”) from the input image and sets the “Control word” and “Mode of operation” in the output image accordingly.

```

CALL FB    40 , DB20
  Activate          :=M108.0
  Base              :=256
  Node              :=1
  Statusword        :=IW52
  Mode_of_Operation :=IB54
  MaxProfileVelocity :=L#5000
  ProfileAcceleration :=L#2000
  ProfileDeceleration :=L#2000
  QuickStopDecel    :=L#4000
  Busy              :=M110.0
  Done              :=M110.1
  Error             :=M111.7
  RetVal            :=MW114
  Controlword       :=QW52
  Set_Mode_of_Operation:=QB54

```

Parameter	Type		Function
Activate	IN	BOOL	Activation bit
Base	IN	INT	Basic address of the module
Node	IN	INT	Node ID
Status word	IN	WORD	Actual status word of the EPOS
Mode_of_Operation	IN	BYTE	Actual EPOS “Mode of Operation”
MaxProfileVelocity	IN	DWORD	→ SDO 607F/0
ProfileAcceleration	IN	DWORD	→ SDO 6083/0
ProfileDeceleration	IN	DWORD	→ SDO 6084/0
QuickStopDecel	IN	DWORD	→ SDO 6085/0
Busy	OUT	BOOL	Flag bit for current function
Done	OUT	BOOL	Flag bit for initialization complete
Error	OUT	BOOL	Flag bit for error occurred
RetVal	OUT	WORD	Error number
Control word	OUT	WORD	Output of the control word to the EPOS
Set_Mode_of_Operation	OUT	BYTE	Output of the mode of operation to the EPOS

3.5 Profile position (FB 41)

The **INIT_POSITIONMODE (FB 41)** function block activates the profile position mode of the drive and transfers the necessary parameters.

The block requires information of the EPOS (“Status word,” “Actual mode of operation”) from the input image and sets the “Control word” and “Mode of operation” in the output image accordingly.

```

CALL FB    41 , DB41
  Activate          :=M108.4
  Base              :=256
  Node              :=1
  Statusword        :=IW52
  Mode_of_Operation :=IB54
  ProfileVelocity   :=L#5000
  ProfileAcceleration :=L#2000
  ProfileDeceleration :=L#2000
  QuickStopDecel    :=L#4000
  Busy              :=M110.4
  Done              :=M110.5
  Error             :=M111.7
  RetVal            :=MW114
  Controlword       :=QW52
  Set_Mode_of_Operation:=QB54

```

Parameter	Type		Function
Activate	IN	BOOL	Activation bit
Base	IN	INT	Basic address of the module
Node	IN	INT	Node ID
Status word	IN	WORD	Actual status word of the EPOS
Mode_of_Operation	IN	BYTE	Actual EPOS “Mode of Operation”
ProfileVelocity	IN	DWORD	→ SDO 6081/0
ProfileAcceleration	IN	DWORD	→ SDO 6083/0
ProfileDeceleration	IN	DWORD	→ SDO 6084/0
QuickStopDecel	IN	DWORD	→ SDO 6085/0
Busy	OUT	BOOL	Flag bit for current function
Done	OUT	BOOL	Flag bit for initialization complete
Error	OUT	BOOL	Flag bit for error occurred
RetVal	OUT	WORD	Error number
Control word	OUT	WORD	Output of the control word to the EPOS
Set_Mode_of_Operation	OUT	BYTE	Output of the mode of operation to the EPOS

3.6 Homing (FB 42)

The **INIT_HOMINGMODE (FB 42)** function block activates the homing mode of the drive and transfers the necessary parameters.

The block requires information of the EPOS (“Status word,” “Actual mode of operation”) from the input image and sets the “Control word” and “Mode of operation” in the output image accordingly.

```

CALL FB    42 , DB42
  Activate          :=M109.0
  Base              :=256
  Node              :=1
  Statusword        :=IW52
  Mode_of_Operation :=IB54
  HomingMethod      :=MW32
  HomeOffset        :=L#0
  HomingAcceleration :=L#2000
  SpeedSwitchSearch :=L#1000
  SpeedZeroSearch   :=L#1000
  CurrentThreshold  :=500
  QuickStopDecel    :=L#4000
  Busy              :=M111.0
  Done              :=M111.1
  Error             :=M111.7
  RetVal            :=MW114
  Controlword       :=QW52
  Set_Mode_of_Operation:=QB54

```

Parameter	Type		Function
Activate	IN	BOOL	Activation bit
Base	IN	INT	Basic address of the module
Node	IN	INT	Node ID
Status word	IN	WORD	Actual status word of the EPOS
Mode_of_Operation	IN	BYTE	Actual EPOS “Mode of Operation”
HomingMethod	IN	WORD	→ SDO 6098/0
HomeOffset	IN	DWORD	→ SDO 607C/0
HomingAcceleration	IN	DWORD	→ SDO 609A/0
SpeedSwitchSearch	IN	DWORD	→ SDO 6099/1
SpeedZeroSearch	IN	DWORD	→ SDO 6099/2
CurrentThreshold	IN	DWORD	→ SDO 2080/0
QuickStopDecel	IN	DWORD	→ SDO 6085/0
Busy	OUT	BOOL	Flag bit for current function
Done	OUT	BOOL	Flag bit for initialization complete
Error	OUT	BOOL	Flag bit for error occurred
RetVal	OUT	WORD	Error number
Control word	OUT	WORD	Output of the control word to the EPOS
Set_Mode_of_Operation	OUT	BYTE	Output of the mode of operation to the EPOS

3.7 Profile current (FB 43)

The **INIT_CURRENTMODE (FB 43)** function block activates the homing mode of the drive and transfers the necessary parameters.

The block requires information of the EPOS (“Status word,” “Actual mode of operation”) from the input image and sets the “Control word” and “Mode of operation” in the output image accordingly.

```

CALL FB    43 , DB43
  Activate          :=M112.0
  Base              :=256
  Node              :=1
  Statusword        :=IW52
  Mode_of_Operation :=IB54
  ProfileCurrent    :=0
  CurrentLimit      :=1000
  MaxSpeed          :=1000
  ThermalTime       :=40
  Busy              :=M113.0
  Done              :=M113.1
  Error             :=M111.7
  RetVal           :=MW114
  Controlword       :=QW70
  Set_Mode_of_Operation:=QB54

```

Parameter	Type	Function
Activate	IN BOOL	Activation bit
Base	IN INT	Basic address of the module
Node	IN INT	Node ID
Status word	IN WORD	Actual status word of the EPOS
Mode_of_Operation	IN BYTE	Actual EPOS “Mode of Operation”
ProfileCurrent	IN INT	→ SDO 2030/0
CurrentLimit	IN INT	→ SDO 6410/1
MaxSpeed	IN INT	→ SDO 6410/4
ThermalTime	IN INT	→ SDO 6410/5
Busy	OUT BOOL	Flag bit for current function
Done	OUT BOOL	Flag bit for initialization complete
Error	OUT BOOL	Flag bit for error occurred
RetVal	OUT WORD	Error number
Control word	OUT WORD	Output of the control word to the EPOS
Set_Mode_of_Operation	OUT BYTE	Output of the mode of operation to the EPOS

3.8 Use with several drives

If multiple drives are used, they must all be defined in the CANopen® Master project. In the process image, make sure that the addresses do not overlap.

The function blocks are used for various drives. Only the parameter “node” has to be adapted.

Please note that simultaneous activation of the “INIT_...” block must be avoided because transmission of the SDOs executed in the blocks cannot be performed simultaneously. These blocks must only be called successively for each drive.



The “INIT_” blocks must not be activated simultaneously.

3.9 Content of the status word

The status word of the EPOS is stored in IW50:

Bit	Description	PPM	PVM	HMM
15	Position referenced to home position			
14	Refresh cycle of power stage			
13	<i>Operation mode specific</i>	Following error	Not used	Homing error
12	<i>Operation mode specific</i>	Set-point ack	Speed	Homing attained
11	not used (Internal limit active)			
10	<i>Operation mode specific</i>	Target reached	Target reached	Target reached
9	Remote (NMT operational state)			
8	Offset current measured			
7	Warning			
6	Switch on disable			
5	Quick stop			
4	Voltage enabled (power stage on)			
3	Fault			
2	Operation enable			
1	Switched on			
0	Ready to switch on			

State	Statusword [binary]	Description
Start	x0xx xxx0 x000 0000	Bootup
Not Ready to Switch On	x0xx xxx1 x000 0000	The current offset will be measured The drive function is disabled
Switch On Disabled	x0xx xxx1 x100 0000	The drive initialization is complete The drive parameters may be changed The drive function is disabled
Ready to Switch On	x0xx xxx1 x010 0001	The drive parameters may be changed The drive function is disabled
Switched On	x0xx xxx1 x010 0011	The drive function is disabled
Refresh	x1xx xxx1 x010 0011	Refresh power stage
Measure Init	x1xx xxx1 x011 0011	The power is applied to motor The motor resistance or the commutation delay is measured
Operation Enable	x0xx xxx1 x011 0111	No faults have been detected The drive function is enabled and power is applied to motor
Quick Stop Active	x0xx xxx1 x001 0111	The quick stop function is being executed The drive function is enabled and power is applied to motor
Fault Reaction Active (disabled)	x0xx xxx1 x000 1111	A fault has occurred in the drive The drive function is disabled
Fault Reaction Active (enabled)	x0xx xxx1 x001 1111	A fault has occurred in the drive The quick stop function is being executed The drive function is enabled and power is applied to motor
Fault	x0xx xxx1 x000 1000	A fault has occurred in the drive The drive parameters may be changed The drive function is disabled

You will find more detailed explanations on the status and control word in the “EPOS Firmware Specification” in Section 8.