LinMot®

PROFINET INDUSTRIAL ETHERNET

Documentation of the PROFINET Interface of the following Drives:

- E1250-PN-UC
- E1450-PN-QN
- C1250-PN-XC
- C1150-PN-XC

PROFINET Interface

User Manual

Document version 6.1 / Whp, September 2014

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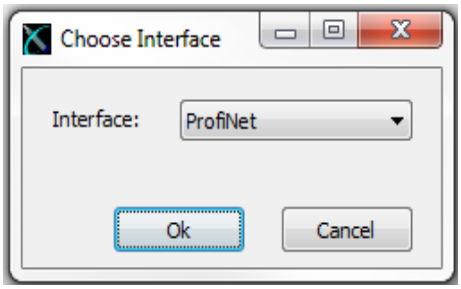
1 System overview

The LinMot PROFINET drives E1250-PN and E1450-PN are PROFINET-IO slaves.
Further information on PROFINET can be found under: http://www.profibus.com

Programming examples provided by LinMot are listed under:
http://www.linmot.com/index.php?id=141

2 Installation on Servo Drive

For installing the PROFINET-IO firmware on the servo drive, start the LinMot-Talk software and press the install firmware button  . Choose the file “Firmware_Buildxxxxxxxx.sct” and press “Open“. The wizard will guide you through the installation. When asking for the interface software choose “PROFINET”:



Press ok and follow the rest of the wizard.

3 Connecting to the PROFINET

3.1. Pin Assignment of the Connectors X17-X18

The Ethernet/IP connector is a standard RJ45 female connector with a pin assignment as defined by EIA/TIA T568B:

X17 – X18	RealTime Ethernet Connector		
	Pin	**Wire color code**	**Assignment 100BASE-TX**
	1	WHT/ORG	Rx+
	2	ORG	Rx-
	3	WHT/GRN	Tx+
	4	BLU	-
	5	WHT/BLU	-
	6	GRN	Tx-
	7	WHT/BRN	-
	8	BRN	-
	case	-	-
RJ-45	Use standard patch cables (twisted pair, S/UTP, AWG26) for wiring. This type of cable is usually referred to as a “Cat5e-Cable”.		

4 PROFINET Parameters

The PROFINET Servo drives have an additional parameter tree branch, which can be configured with the distributed LinMot-Talk software. With these parameters, the PROFINET behaviour can be configured. The software LinMot-Talk can be downloaded from http://www.linmot.com under the section download, software & manuals.

Dis-/Enable With the Dis-/Enable parameter the LinMot servo drive can be run without the PROFINET going online. So in first step the system can be configured and run without any bus connection.

PROFINET Interface\ Dis-/Enable	
Disable	Servo drive runs without PROFINET.
Enable	Servo drive runs only with a PROFINET connection.

Byte Order Defines the used byte order.

PROFINET Interface\ Byte/Word Order\Byte Order	
Reversed	Byte order is reversed. For S7 PLCs select reversed.
Not reversed	Byte order is not reversed.

Word Order Defines the used word order.

PROFINET Interface\ Byte/Word Order\Word Order	
Reversed	Word order is reversed. For S7 PLCs select reversed.
Not reversed	Word order is not reversed.

MC CMD Intf Par Order Defines the used parameter word order.

PROFINET Interface\ Byte/Word Order\MC CMD Intf Par Order	
Reversed	Order is reversed. CMD Header - Par word 1 - Par word 0 - Par word 3 - Par word 2 - etc...
Not reversed	Order is not reversed. CMD Header - Par word 0 - Par word 1 - Par word 2 - Par word 3 - etc...

Diagnose Priority Defines the behaviour of the diagnostic telegram.

PROFINET Interface\ Diagnose Priority	
None	Only minimal diagnostic data is transmitted.
Low	The diagnostic data is sent as status information only.
High	The diagnostic data is sent with high priority in the error state.

Monitoring Channels Defines the source variable by UPID of the four monitoring channels.

PROFINET Interface\ Monitoring Channels	
Channel 1 UPID	Source UPID for Monitoring Channel 1
Channel 2 UPID	Source UPID for Monitoring Channel 2
Channel 3 UPID	Source UPID for Monitoring Channel 3
Channel 4 UPID	Source UPID for Monitoring Channel 4

5 PROFINET Variables

5.1. ProfiNet

In the Variables directory of the LinMot-Talk there is a section \PROFINET containing some information about the actual state of the PROFINET interface:

- **Device Type**:
  Device type string, this string is fix for each device type.
- **Device Name:**
  The Device name can be freely defined by the user, this string is normally defined with the HW manager of Step 7 and is used for identifying the device in the PROFINET network.
- **MAC ID:**
  Individual unique MAC address of the PROFINET-IO device, can be used to identify a device.
- **IP Address:**
  Actual configured (normally written from the PLC during power up) IP address.
- **Net Mask:**
  Net mask for the IP address.
- **Standard Gateway IP Address:**
  IP address of the standard gateway.
- **Receive Data Counter:**
  Counts the received PROFINET-IO data messages up to 1000, then restarts with 0.
- **IO Cycle Time:**
  Actual period time between the received PROFINET-IO data messages.

5.2. ProfiNet: Slot Configuration

In this directory the configured modules for the Slots 1..7 are displayed. The configuration of the modules is done in the HW manager of the Step 7.

6 PROFINET Modules

The LinMot drive is a PROFINET-IO slave. To configure it with a PROFINET master, the GSD file is used. You can find the GSD file LINM092D.GSD in the LinMot-Talk installation directory (typically C:\Program Files\LinMot\LinTalk-Talk 4 Build xxxxxxxx\Firmware\PROFINET\GSD).

There are the following modules defined, to be configured according the demands of the desired application:

Default IO mapping with Config

With the data configured in this module, most of the applications could be solved.

Output Data Mapping

In this real time IO mapping the 16 bit control word, the 16 bit motion command header and the motion command parameters are exchanged. The size of this mapping is 32 bytes.

Byte Offset	Description	Size/Type
00h	MC SW_ControlWord	Uint16 / Bit coded
02h	MC SW_MotionCommandHeader	Uint16 / 12Bit Command 4Bit count nibble
04h	MC SW_MotionCommandPar Bytes 00..03	Uint32 / Command specific
08h	MC SW_MotionCommandPar Bytes 04..07	Uint32 / Command specific
0Ch	MC SW_MotionCommandPar Bytes 08..11	Uint32 / Command specific
10h	MC SW_MotionCommandPar Bytes 12..15	Uint32 / Command specific
14h	MC SW_MotionCommandPar Bytes 16..19	Uint32 / Command specific
18h	Cfg Module Control Word	Uint16
1Ah	Cfg Module Index/..	Uint16
1Ch	Cfg Module Value/..	Uint32/Sint32

Input Data Mapping

In this real time IO mapping the StateVar for the main state machine and several other helpful data are exchanged. The size of this mapping is 26 bytes.

Byte Offset	Description	Size/Type
00h	MC SW StateVar	Uint16 / coded state depending
02h	MC SW StatusWord	Uint16 / Bit coded
04h	MC SW WarnWord	Uint16 / Bit coded
06h	MC SW DemandPosition	Int32 / Position [100nm]
0Ah	MC SW ActualPosition	Int32 / Position [100nm]
0Eh	MC SW DemandCurrent	Int32 / Current [1mA]
12h	Cfg Module Status Word	Uint16
14h	Cfg Module Index/..	Uint16
16h	Cfg Module Value/..	Uint32/Sint32

The use of the Control word and Motion Command interface is described in [1]. The real time configuration module is described in [2].

Control/Status

This module should always be configured. It contains the Control and Status word, which are described in the document “User Manual Motion Control Software”.

MC Cmd Interface

This maps the MC Command interface of the drive. Please refer to the documentation of the MC software.

Get Actual Position

Returns the actual position of the motor. (32 Bit integer value, resolution 0.1µm)

Get Demand Position

Returns the demand position of the motor. (32 Bit integer value, resolution 0.1µm)

Get Current

Returns the set current of the motor. (32 Bit integer value, resolution 1mA)

Get StateVar

The StateVar consists of the MainState and the SubState. Please refer to the table “State Var” on chapter 3 of the “User Manual Motion Control Software”.
The StateVar has all relevant flags and information for clean handshaking within one word and can therefore replace the modules “Get MC Header Echo” and “Get Error Code”.

Get WarnWord

Returns the Warn Word. Please refer to chapter 10.

Get ErrorCode

Returns the Error Code. Please refer to chapter 9.

Monitoring Channel 1..4

Transmits cyclically the value of the variable, which is defined by the Monitoring Channel Parameter (see chapter 4).

NC Setpoint Values

With this setpoint module the axis could be connected to a NC axis.

Byte Offset	Description	Size/Type
00h	Streamed Position Setpoint	Int32 / Position [100nm]
04h	Streamed Velocity Setpoint	Int32 / Velocity [1um/s]
08h	Streamed Acceleration Setoint	Int32 / Velocity [10um/s^2]

Real Time Config

The Real Time Config module allows access to parameters, variables, curves, error log and command table. Also restart, start and stop of the drive is possible. Of course the Parameter Channel module works independently from the MC Cmd Interface. For this reason changing a parameter and sending a motion command can be done in parallel.

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Argument (meaning depends on Cmd ID)	Argument (meaning depends on Cmd ID)
3.	Argument (meaning depends on Cmd ID)	Argument (meaning depends on Cmd ID)
4.	Argument (meaning depends on Cmd ID)	Argument (meaning depends on Cmd ID)

Real Time Config Control

Parameter Command ID to be executed								**Reserved**				**Command Count**			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

The Parameter Channel Control is split in two parts:

- Parameter Command ID to be executed (bits 8-15), see table Command ID
- Command Count (bits 0-3)

Real Time Config Status

Parameter Status								**Reserved**				**Command Count Response**			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

The Parameter Channel Status is split in two parts:

- Parameter Status (bits 8-15), see table Parameter Status
- Command Count Response (bits 0-3)

Command Count

A new command is only evaluated, if the value of the command count changes. In the easiest way bit 0 can be toggled.

Parameter Command ID

This selects the command.

Possible Commands are:

Command ID	**Description**
00h	No Operation
Parameter Access	
10h	Read ROM Value of Parameter by UPID
11h	Read RAM Value of Parameter by UPID
12h	Write ROM Value of Parameter by UPID
13h	Write RAM Value of Parameter by UPID
14h	Write RAM and ROM Value of Parameter by UPID
15h	Get minimal Value of Parameter by UPID
16h	Get maximal Value of Parameter by UPID
17h	Get default Value of Parameter by UPID

Parameter (UPID) List	
20h	Start Getting UPID List
21h	Get next UPID List item
22h	Start Getting Modified UPID List
23h	Get next Modified UPID List item
Stop / Start / Default	
30h	Restart drive
31h	Set parameter ROM values to default (OS SW)
32h	Set parameter ROM values to default (MC SW)
33h	Set parameter ROM values to default (Interface SW)
34h	Set parameter ROM values to default (Application SW)
35h	Stop MC and Application Software (for Flash access)
36h	Start MC and Application Software
Curve Service	
40h	Save all Curves from RAM to Flash
41h	Delete all Curves (RAM)
50h	Start Adding Curve (RAM)
51h	Add Curve Info Block (RAM)
52h	Add Curve Data (RAM)
53h	Start Modifying Curve (RAM)
54h	Modify Curve Info Block (RAM)
55h	Modify Curve Data (RAM)
60h	Start Getting Curve (RAM)
61h	Get Curve Info Block (RAM)
62h	Get Curve Data (RAM)
Error Log	
70h	Get Error Log Entry Counter
71h	Get Error Log Entry Error Code
72h	Get Error Log Entry Time low
73h	Get Error Log Entry Time high
74h	Get Error Code Text Stringlet
Command Table	
80h	Command Table: Save to Flash
81h	Command Table: Delete All Entries (RAM)
82h	Command Table: Delete Entry
83h	Command Table: Write Entry
84h	Command Table: Write Entry Data
85h	Command Table: Get Entry
86h	Command Table: Get Entry Data
87h	Get Presence List of Entries 0..31 from RAM
88h	Get Presence List of Entries 32..63 from RAM
89h	Get Presence List of Entries 64..95 from RAM
8Ah	Get Presence List of Entries 96..127 from RAM
8Bh	Get Presence List of Entries 128..159 from RAM
8Ch	Get Presence List of Entries 160..191 from RAM
8Dh	Get Presence List of Entries 192..223 from RAM
8Eh	Get Presence List of Entries 224..255 from RAM

Parameter Status	Description
00h	OK, done
02h	Command Running / Busy
04h	Block not finished (Curve Service)
05h	Busy
C0h	UPID Error
C1h	Parameter Type Error
C2h	Range Error
C3h	Address Usage Error
C5h	Error: Command 21h “Get next UPID List item” was executed without prior execution of “Start Getting UPID Lis”
C6h	End of UPID List reached (no next UPID List item found)
D0h	Odd Address
D1h	Size Error (Curve Service)
D4h	Curve already defined / Curve not present (Curve Service)

Overview Parameter access:

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Parameter UPID	Parameter UPID
3.	Parameter Value Low	Parameter Value Low
4.	Parameter Value High	Parameter Value High

Overview Curve access:

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Curve Number	Curve Number
3.	Data Value Low / Info Block size	Data Value Low / Info Block size
4.	Data Value High / Data Block size	Data Value High / Data Block size

Start getting UPID List:

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Start UPID (search from this UPID)	-
3.	-	-
4.	-	-

Get next UPID List item:

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	UPID found
3.	-	Address Usage
4.	-	-

Address Usage:

			Not used for Hash calculation				Life Parameter					ROM Write	ROM Read	RAM Write	RAM Read
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Start getting Modified UPID List (Command ID 22h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Start UPID (search from this UPID)	-
3.	-	-
4.	-	-

Get next Modified UPID List item (Command ID 23h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	UPID found
3.	-	Data Value Low
4.	-	Data Value High

Get Error Log Entry Counter (Command ID 70h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	-
3.	-	Number of Logged Errors
4.	-	Number of Occurred Errors

Get Error Log Entry Error Code (Command ID 71h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number (0..20)	Entry Number
3.	-	Logged Error Code
4.	-	-

Get Error Log Entry Time Low (Command ID 72h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number (0..20)	Entry Number
3.	-	Entry Time Low Word
4.	-	Entry Time Mid Low Word

Get Error Log Entry Time High (Command ID 73h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number (0..20)	Entry Number
3.	-	Entry Time Mid High Word
4.	-	Entry Time High Word

The Error Log Entry Time consists of 32Bit hours (Time High) and 32Bit ms (Time Low).

Get Error Code Text Stringlet (Command ID 74h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Error Code	Error code
3.	Stringlet Number (0..7)	Stringlet Byte 0 and 1
4.	-	Stringlet Byte 2 and 3

Command Table: Save to Flash (Command ID 75h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	-
3.	-	-
4.	-	-

For this command, the MC software must be stopped (with command “35h: Stop MC and Application Software”).
The PROFINET Interface will stay active while the MC software is stopped.

Command Table: Delete All Entries (RAM) (Command ID 81h)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	-
3.	-	-
4.	-	-

Command Table: Delete Entry (Command ID 82h):

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number	Entry Number
3.	-	-
4.	-	-

Command Table: Write Entry (Command ID 83h)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number	Entry Number
3.	Block Size (even number of bytes)	Block Size
4.	-	-

Command Table: Write Entry Data (Command ID 84h)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number	Entry Number
3.	Data	Data
4.	Data	Data

Command Table: Get Entry (Command ID 85h)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number	Entry Number
3.	-	Block Size
4.	-	-

Command Table: Get Entry Data (Command ID 86h)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	Entry Number	Entry Number
3.	-	Data
4.	-	Data

Command Table: Get Entry List (0..7) (Command IDs 87h .. 8Eh)

Word	DO	DI
1.	Parameter Channel Control	Parameter Channel Status
2.	-	Offset in bytes
3.	-	Bit field (Bit set= undefined / Bit cleared = used)
4.	-	Bit field (Bit set= undefined / Bit cleared = used)

Further documentation on how to configure a drive by fieldbus and handle curves can be found on the additional manual “Parameterization of LinMot SG5 servo drives over Fieldbus Interfaces”.

7 State Machine

Please refer to “User Manual Motion Control Software”.

8 PROFINET Diagnosis

The LinMot drive supports 12 bytes of diagnostic data. The diagnosis telegram is according the following table:

Byte	Description
0..5	Data according PROFINET-IO standard
6..7	Extended Diagnosis Header and stuffing
8..9	Warn Word (see chapter 10 for description)
10..11	Error Code (see chapter 9 for description)

9 Error Codes

Please refer to “User Manual Motion Control Software” for the Error Codes of the MC Software. The PROFINET Interface has the following additional Error Codes:

Error Code Hexadecimal	Error Description
C1h	Fatal Error: drive not supported
C2h	Config Error: Invalid MACID
C3h	IO Err: Connection lost

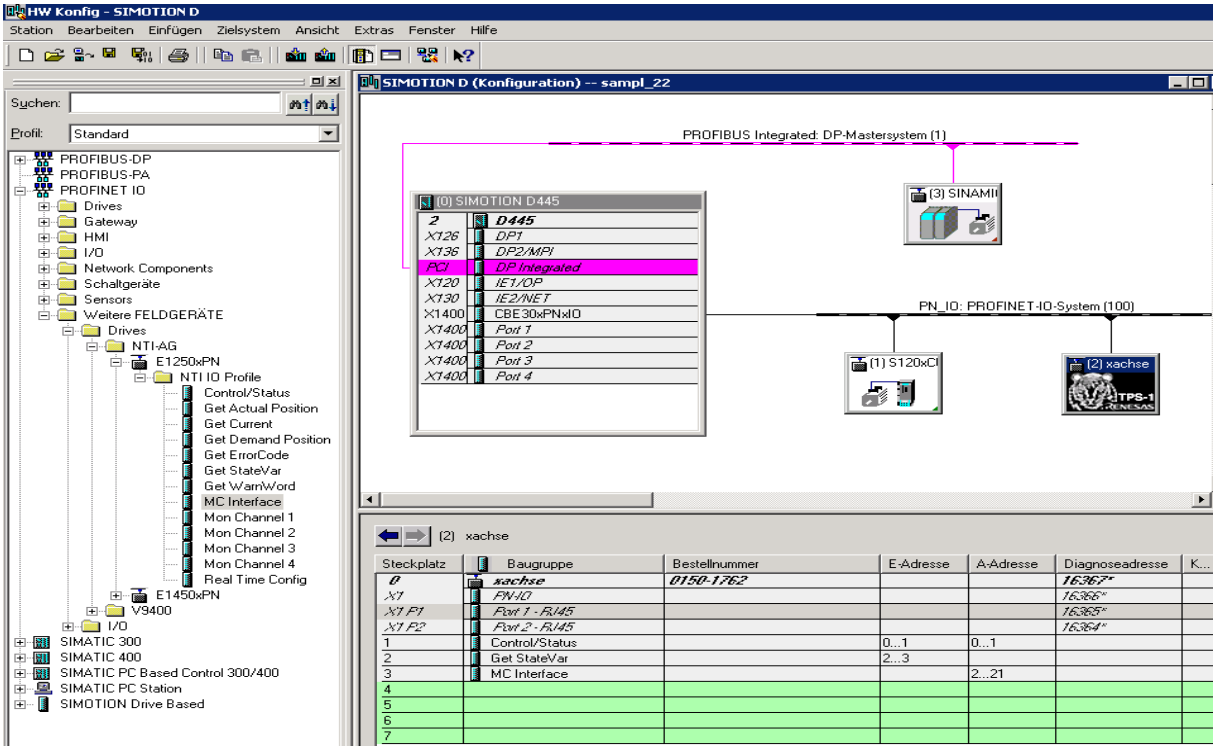
10 Warn Word

Please refer to “User Manual Motion Control Software”.

11 Example for Siemens Simatic S7

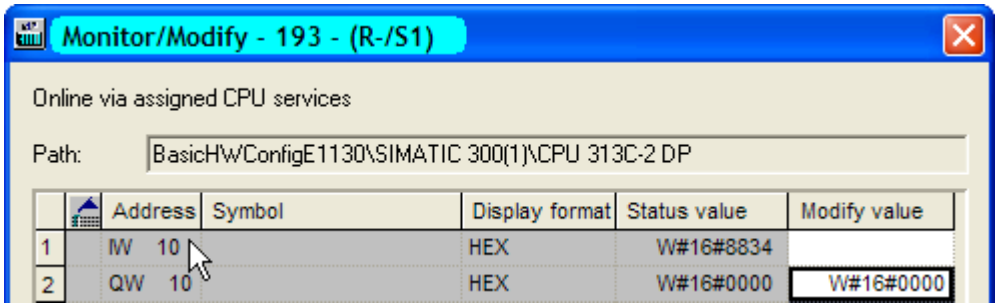
The following example shows the homing procedure, the execution of a motion command and the change of a parameter together with S7 and Simatic from Siemens:

11.1. Bus configuration (HW Config)

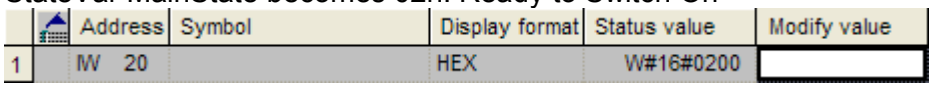


11.2. Homing procedure

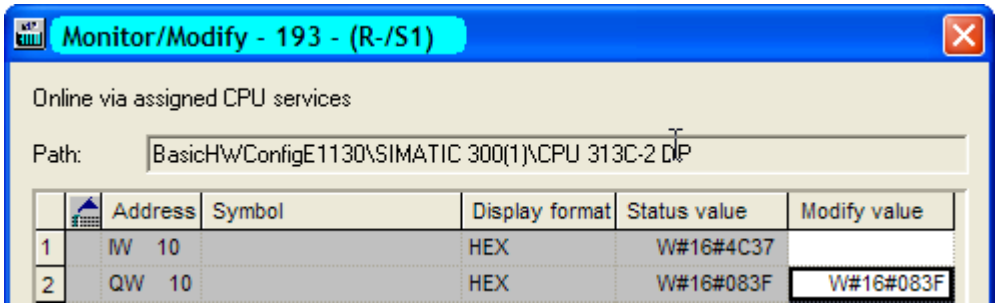
1. Release lock state: Control Word = 0000h (Only needed if StateVar MainState is 00h) :



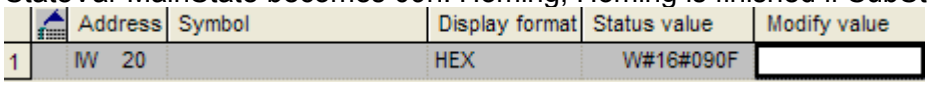
StateVar MainState becomes 02h: Ready to Switch On



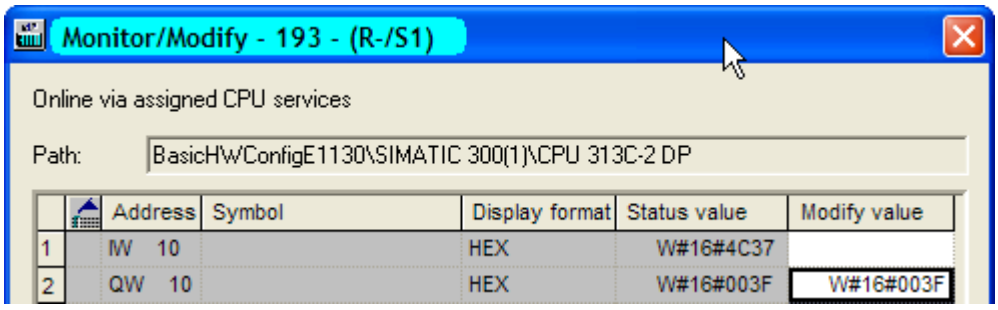
2. Homing: Control Word = 083Fh



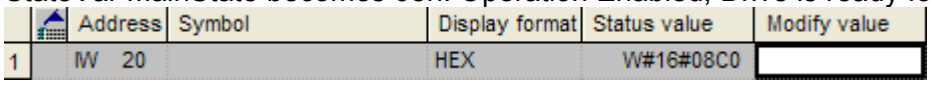
StateVar MainState becomes 09h: Homing, Homing is finished if SubState becomes 0Fh



3. Enter Operational State: Control Word = 003Fh



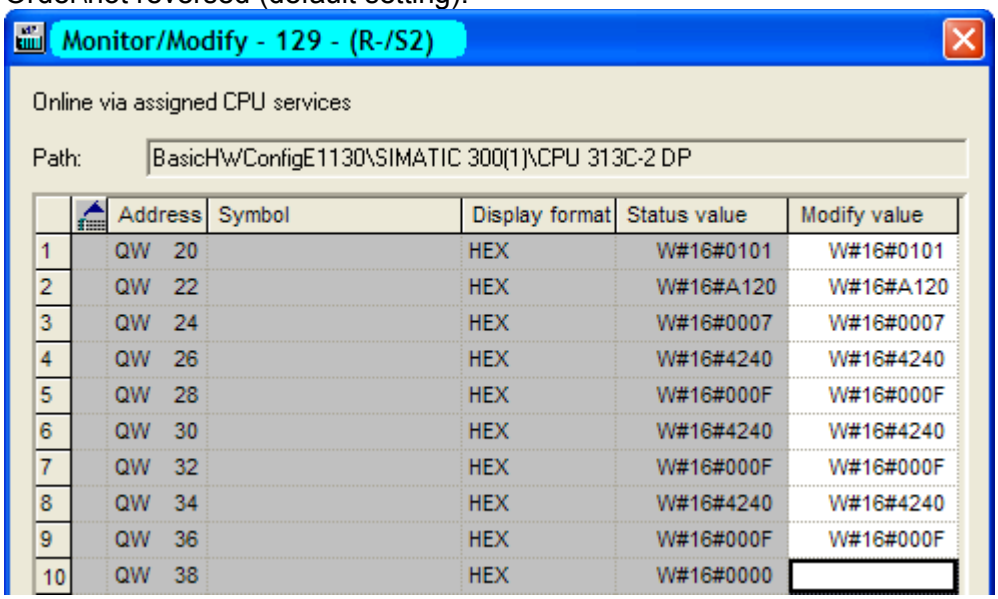
StateVar MainState becomes 08h: Operation Enabled, Drive is ready for motion commands



11.3. Execute Motion Command: VAI Go To Pos (010xh)

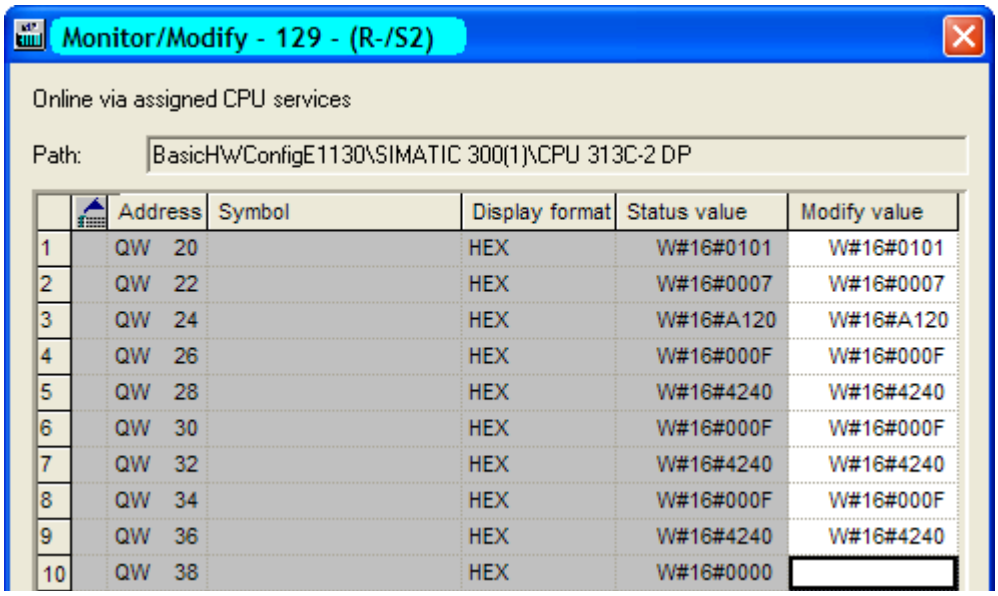
Name	Description	Scaled Value	Int. Value (HEX)
Header	VAI Go To Pos (010xh)	257	0101h
1. Par	Target Position:	50mm	0007A120h
2. Par	Maximal Velocity:	1m/s	000F4240h
3. Par	Acceleration:	10m/s^2	000F4240h
4. Par	Deceleration:	10m/s^2	000F4240h

In the case of \Parameters\PROFINET Interface\Byte/Word Order\MC CMD Intf Par Order\not reversed (default setting):



	Address	Symbol	Display format	Status value	Modify value
1	QW 20		HEX	W#16#0101	W#16#0101
2	QW 22		HEX	W#16#A120	W#16#A120
3	QW 24		HEX	W#16#0007	W#16#0007
4	QW 26		HEX	W#16#4240	W#16#4240
5	QW 28		HEX	W#16#000F	W#16#000F
6	QW 30		HEX	W#16#4240	W#16#4240
7	QW 32		HEX	W#16#000F	W#16#000F
8	QW 34		HEX	W#16#4240	W#16#4240
9	QW 36		HEX	W#16#000F	W#16#000F
10	QW 38		HEX	W#16#0000	

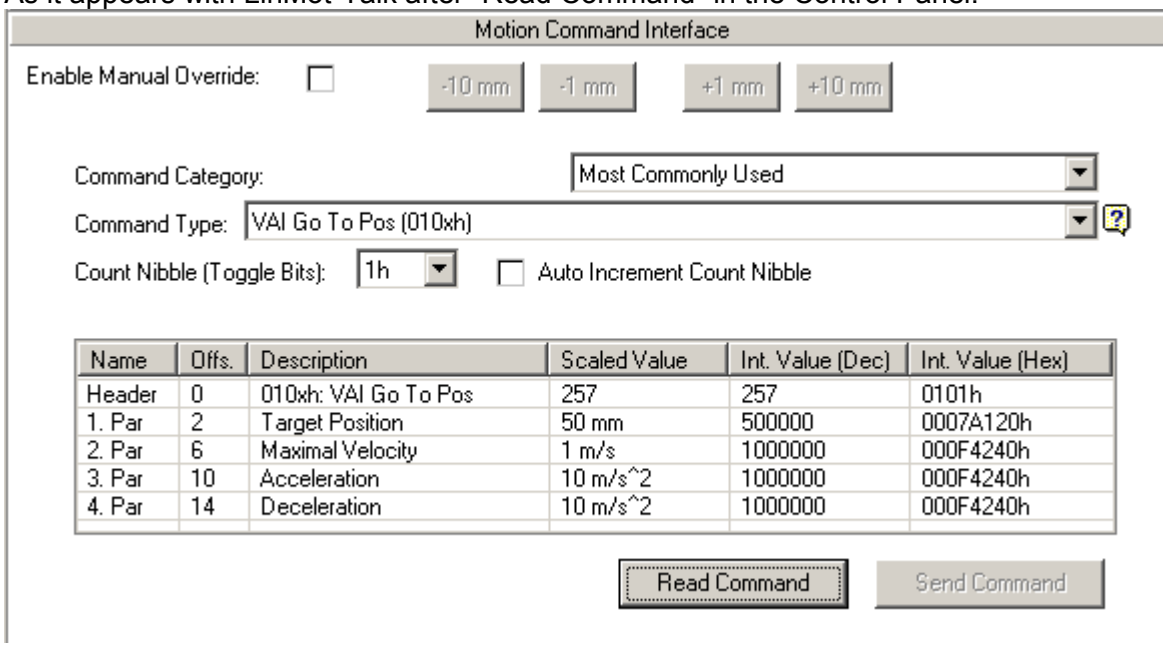
In the case of \Parameters\PROFINET Interface\Byte/Word Order\MC CMD Intf Par Order\ reversed:



	Address	Symbol	Display format	Status value	Modify value
1	QW 20		HEX	W#16#0101	W#16#0101
2	QW 22		HEX	W#16#0007	W#16#0007
3	QW 24		HEX	W#16#A120	W#16#A120
4	QW 26		HEX	W#16#000F	W#16#000F
5	QW 28		HEX	W#16#4240	W#16#4240
6	QW 30		HEX	W#16#000F	W#16#000F
7	QW 32		HEX	W#16#4240	W#16#4240
8	QW 34		HEX	W#16#000F	W#16#000F
9	QW 36		HEX	W#16#4240	W#16#4240
10	QW 38		HEX	W#16#0000	

To send the next command the count nibble has to be changed. The header for the next VAI Go To Pos command is therefore 010**0**h.

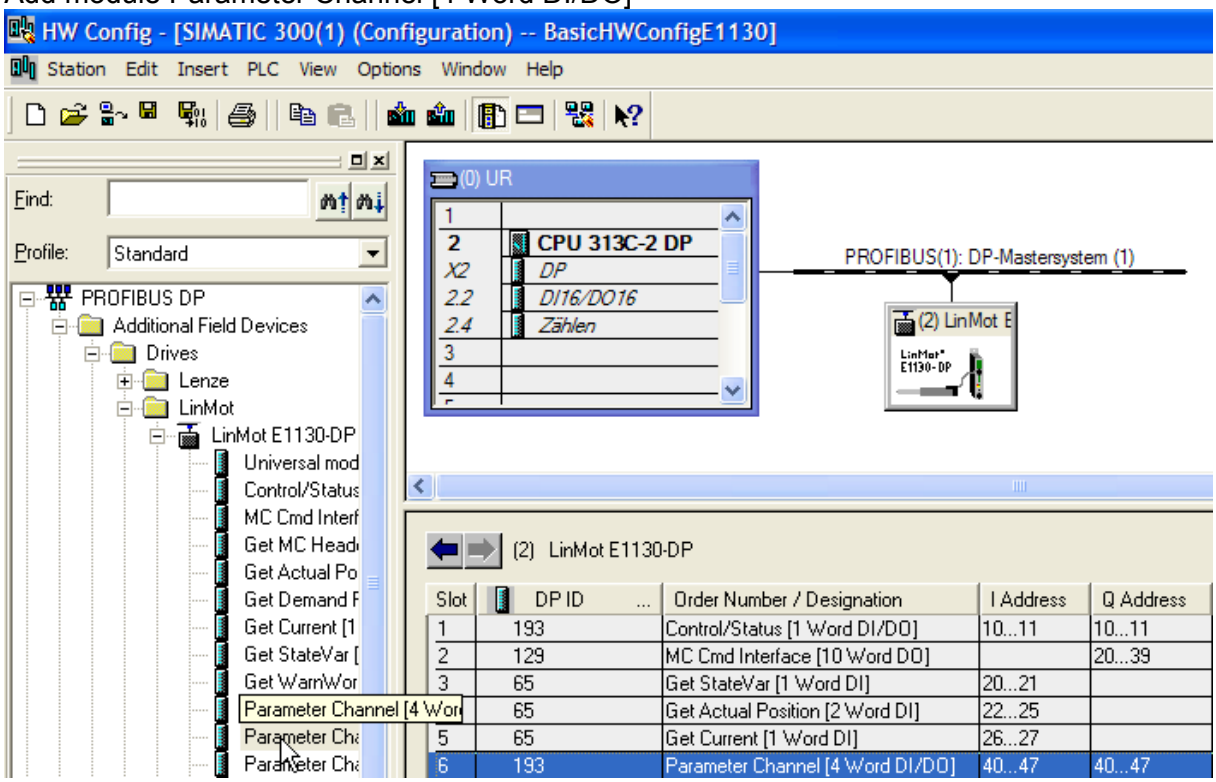
As it appears with LinMot-Talk after “Read Command” in the Control Panel:



11.4. Change a parameter of the drive with the Parameter Channel Module

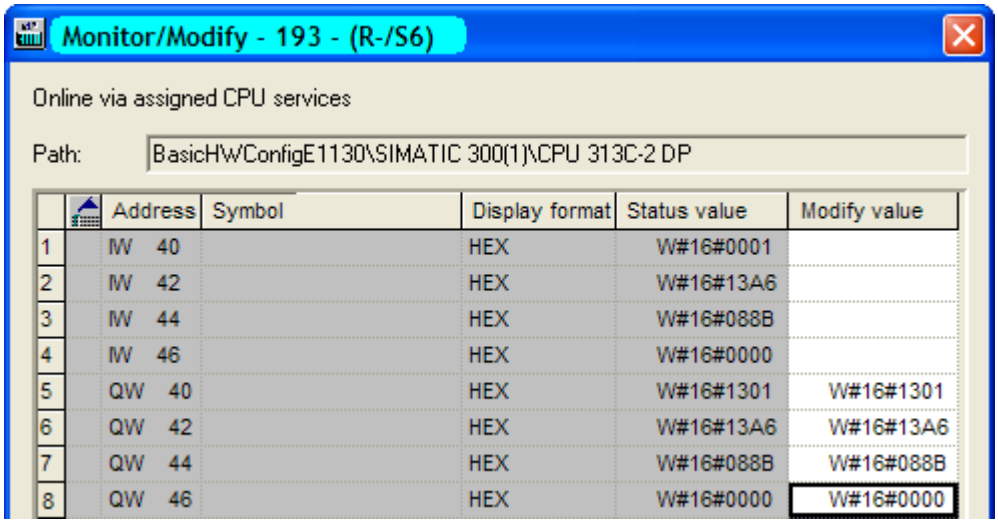
Example: Change the “Maximal Current” (UPID 13A6h) over PROFINET while firmware is running

Add module Parameter Channel [4 Word DI/DO]



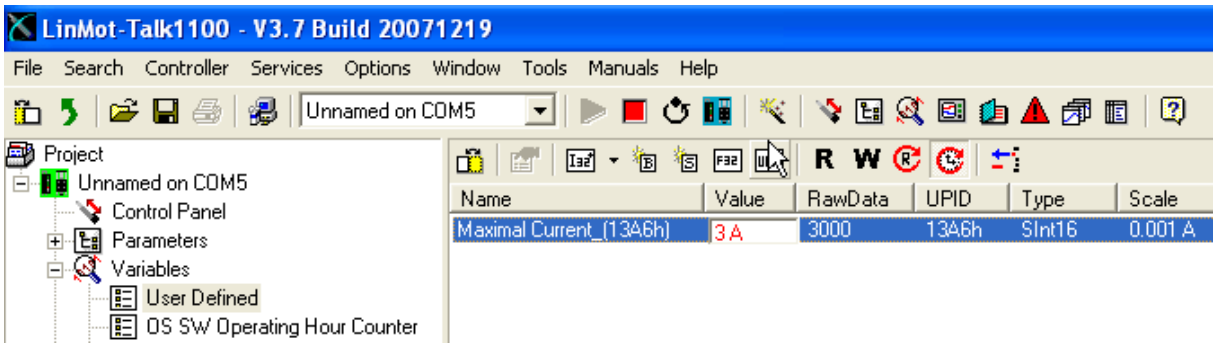
As Command ID use 13h “Write RAM Value of Parameter by UPID”, Command Count 1
The UPID of “Maximal Current” is 13A6h. The internal scaling of the current value is 0.001A:
3A (Scaled) = 3000 (Int) = 0000088Bh (HEX)

Word	Description	Value (Hex)
1.	Parameter Channel Control	1301h
2.	Parameter UPID	13A6h
3.	Parameter Value Low	088Bh
4.	Parameter Value High	0000h



Check if parameter has been changed with LinMot-Talk.

Add a new User Defined variable by clicking on the button UPID and search for the UPID 13A6h



Hint: Consider the Command Count in the Parameter Channel Control. A new command is only evaluated, if the value of the command count changes. In the easiest way bit 0 is toggled.

11.5. PLC Library

For the Siemens S7 developing environment exists PLC libraries which could ease the programming of your application, it could be downloaded under:

http://linmot2.dynalias.net/plc_lib/

For further information please contact our support.

12 Troubleshooting

If the PROFINET connection is not working, proceed as followed:

- Is the correct firmware installed on the drive? When installing the firmware the PROFINET interface must be selected. The actual firmware and configuration software can always be downloaded from http://www.linmot.com

- Check if the correct GSD file is used (LINM092D.GSD, which is provided together with LinMot4Talk 4 in the subdirectory. \firmware\PROFINET\GSDML).

13 Contact Addresses

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