

<b>IT</b>	<b>OPDEP ProfiNET – B&amp;R X20 – Automation Studio 4.11</b>	
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## 1.1 INTRODUCTION

The purpose of this document is to provide users the necessary knowledge for the communication structure between BDF Digital OPDEp and B&R PLC via ProfiNET interface. The hardware and software configurations necessary for the operation of the interface and the drive will be deeply analyzed in the following chapters.

## 2.1 HARDWARE & SOFTWARE REQUIREMENTS

OPDE o OPDEplus with Profinet Communication Card  
 CPU B&R X20 Compact + X20 Interface PROFINET RT Master (DTM)  
 Automation Studio 4.11  
 OPDEplorer v2.0.4.0.  
 Application **PosSys\_12**

## 3.1 DRIVE SETTINGS

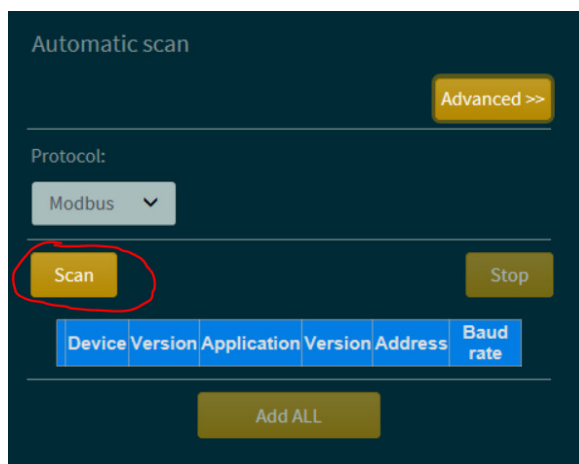
In order to run this example on this hardware, you need to set the following settings using OPDEplorer:

### 3.1.1 FIELD-BUS SETTINGS

Drive Connection setup:

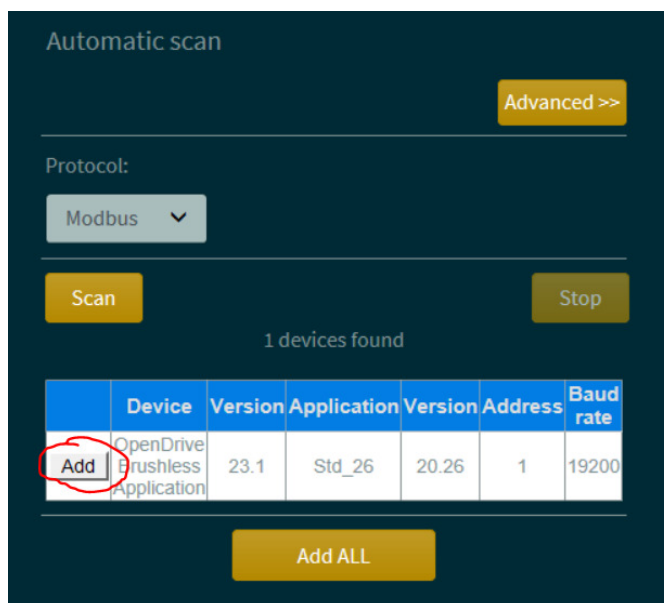
- Connect the PC running OPDEplorer to the drive using the RS485 – USB Adapter
- Click on Advanced>> and set the com port of the USB – RS485 adapter

Then Click Scan

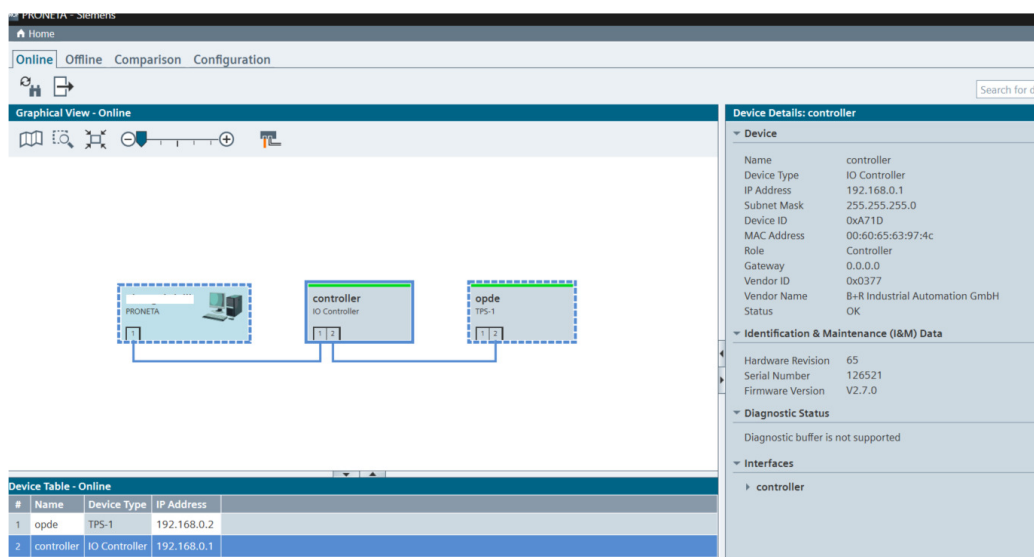


Once the drive has been detected, Click on Add

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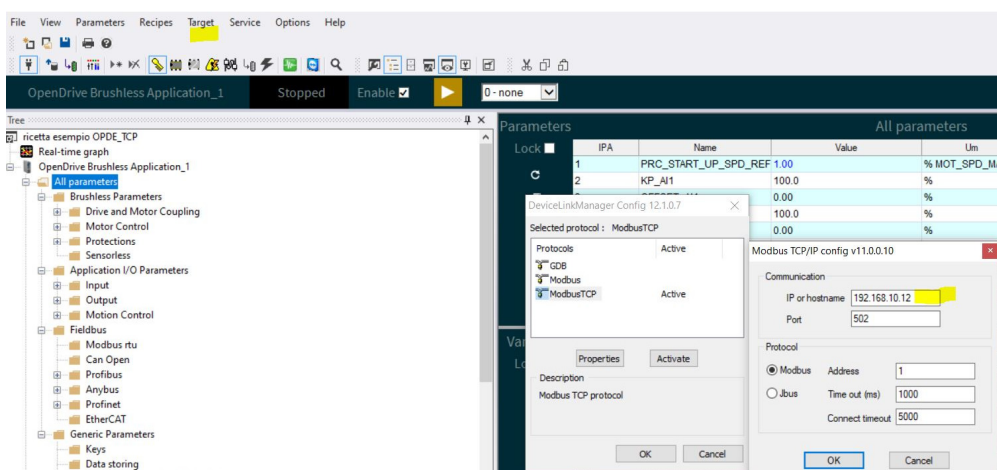
- The network ProfiNET Card has the following default IP Address: **192.168.0.1**. By using Proneta software (PRONETA Basic 3.2 Commissioning and Diagnostics Tool for PROFINET) is possible to assign the profinet name and IP address ( **192.168.0.2**)



Once the IP address has been setted on the drive profiNET Card, is possible to connect to it via OPDEplorer TCP/IP interface as descrided below:

- Online TCP/IP: Click on Target -> Communication Settings
- Select ModbusTCP and click Activate
- Click on Properties and set the required data as follows:

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Pay attention to set also the correct IP and Modbus addresses in this window.

Once you have connected successfully to the drive, click on Filedbus → Profinet → Configuration and State and set the parameters as follows:

(In the IP address settings, set an IP address compatible to the IP address class of the CPU)



**EN\_BIG\_ENDIAN = NO**

Click on the Cyclic Mapping folder and set the data as shown from the below image. These data are the exchange words between PLC and Drive likewise. It is suggested to read the profinet manual (downloadable [here](#)) to freely configure the data exchanged based on the application designed.

- 0x201F: Input logic function writing via fieldbus (control DWORD)
- 0x30c0: Position / Preset value requested [engineering units]
- 0x3015: Feed Override (Multiplicative factor of velocity for Position Mode and Velocity Mode)
- 0x3010: Standard logic output reading via fieldbus (Status DWORD)
- 0x305a: Axis Current Position [Eng. Units]
- 0x2018: Alarms

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OpenDrive Brushless Application\_1 Disabled Enable ☐

PosSysOPDE

- Real-time graph
- OpenDrive Brushless Application\_1
  - All parameters
    - Brushless Parameters
      - Drive and Motor Coupling
      - Motor Control
      - Protections
      - Sensorless
    - Application I/O Parameters
      - Input
      - Output
      - Motion Control
    - Fieldbus
      - Modbus rtu
      - Can Open
      - Profibus
      - Anybus M30
      - Profinet
        - Configuration and State
        - Cyclic Mapping
        - Cyclic Data Exchange
        - EtherCAT
    - Generic Parameters
      - Keys
      - Data storing
      - Digital Commands and Control

Parameters Configuration and State

Lock	IPA	Name	Value	Um	Default
	265	EN_FLDBUS	Profinet		No
	2885	EN_BIG_ENDIAN	No		No
	2977	IP_ADDR_00	192		192
	2978	IP_ADDR_01	168		168
	2979	IP_ADDR_02	0		0
	2980	IP_ADDR_03	2		1
	2981	SUBNET_MASK_00	255		255
	2982	SUBNET_MASK_01	255		255
	2983	SUBNET_MASK_02	255		255
	2984	SUBNET_MASK_03	0		0
	2985	GATEWAY_00	0		0

Variables Configuration and State

Lock	IPA	Name	Value	Um	Default	Min
	8125	FLDBUS_STATE	SETUP		SETUP	
	8186	PN_LED_STATUS	0		0	

OpenDrive Brushless Application\_1 Disabled Enable ☐

PosSysOPDE

- Real-time graph
- OpenDrive Brushless Application\_1
  - All parameters
    - Brushless Parameters
      - Drive and Motor Coupling
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      - Protections
      - Sensorless
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      - Input
      - Output
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    - Fieldbus
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      - Can Open
      - Profibus
      - Anybus M30
      - Profinet
        - Configuration and State
        - Cyclic Mapping
        - Cyclic Data Exchange
        - EtherCAT
    - Generic Parameters
      - Keys
      - Data storing
      - Digital Commands and Control

Parameters Cyclic Mapping

Lock	IPA	Name	Value	Um	Default
	2817	RX0_INDEX	201f	Hex	0
	2818	RX0_SUB_INDEX	0	Hex	0
	2819	RX1_INDEX	30c0	Hex	0
	2820	RX1_SUB_INDEX	0	Hex	0
	2821	RX2_INDEX	3015	Hex	0
	2822	RX2_SUB_INDEX	0	Hex	0
	2823	RX3_INDEX	0	Hex	0
	2824	RX3_SUB_INDEX	0	Hex	0
	2825	RX4_INDEX	0	Hex	0
	2826	RX4_SUB_INDEX	0	Hex	0
	2827	RX5_INDEX	0	Hex	0

Variables Cyclic Mapping

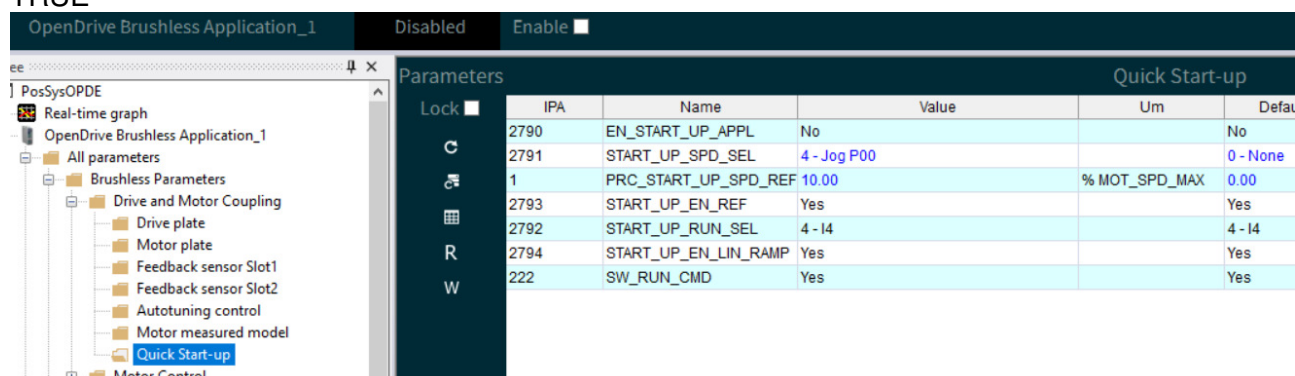
Lock	IPA	Name	Value	Um	Default	Min
	2865	MAP_ERROR_CODE	Ok		Ok	
	2866	MAP_ERROR_OBJ	0	Hex	0	

Parameters Cyclic Mapping

Lock	IPA	Name	Value	Um	Default	Min
	2832	RX7_SUB_INDEX	0	Hex	0	
	2833	RX8_INDEX	0	Hex	0	
	2834	RX8_SUB_INDEX	0	Hex	0	
	2835	RX9_INDEX	0	Hex	0	
	2836	RX9_SUB_INDEX	0	Hex	0	
	2837	TX0_INDEX	3010	Hex	0	
	2838	TX0_SUB_INDEX	0	Hex	0	
	2839	TX1_INDEX	305a	Hex	0	
	2840	TX1_SUB_INDEX	0	Hex	0	
	2841	TX2_INDEX	2018	Hex	0	
	2842	TX2_SUB_INDEX	0	Hex	0	

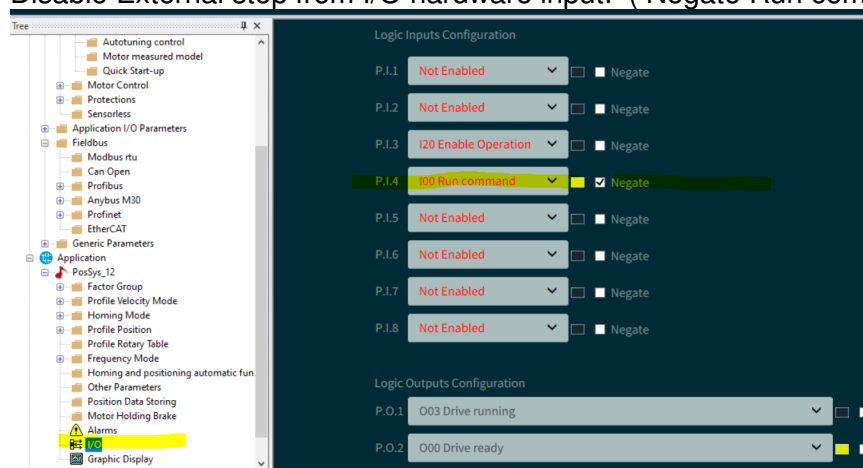
IT	OPDEP ProfiNET – B&R X20 – Automation Studio 4.11	
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Enable internal application PosSys\_12: SW\_RUN\_CMD = TRUE



IPA	Name	Value	Um	Defat
2790	EN_START_UP_APPL	No		No
2791	START_UP_SPD_SEL	4 - Jog P00		0 - None
1	PRC_START_UP_SPD_REF	10.00	% MOT_SPD_MAX	0.00
2793	START_UP_EN_REF	Yes		Yes
2792	START_UP_RUN_SEL	4 - I4		4 - I4
2794	START_UP_EN_LIN_RAMP	Yes		Yes
222	SW_RUN_CMD	Yes		Yes

Disable External stop from I/O hardware input: ( Negate Run command+ External Enable)



**Important notice:** It is reminded that after every modification done to the parameters inside OPDE Explorer has to be written into the drive by clicking on Write (W) button located on the left side of the view window. Moreover it is important to save the parameters written into the drive by clicking on the button shown below in order to save the parameters into the EPROM memory. This makes the setting permanent even if the drive is restarted.

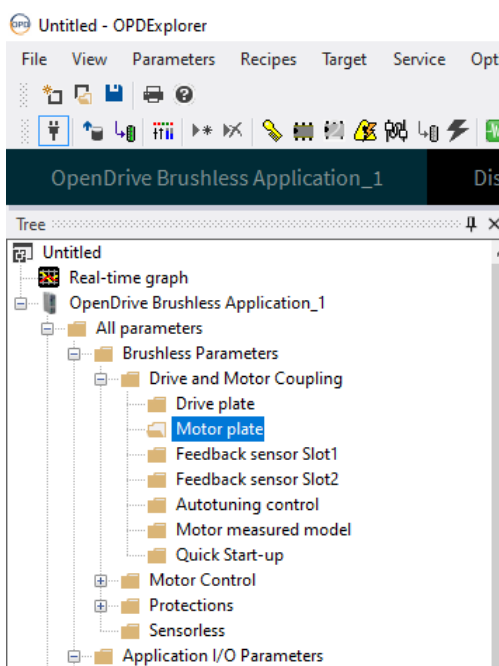


### 3.2.1 MOTOR TUNING

In order to tune the motor, it is necessary to configure some parameters:

Click on Drive and Motor Coupling → Motor Plate

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Set the motor data in the fields highlighted below:

Parameters

Lock ☐

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Enable the Quick Startup commands:

EN\_START\_UP\_APPL YES  
SW\_RUN\_CMD NO

Parameters

Quick

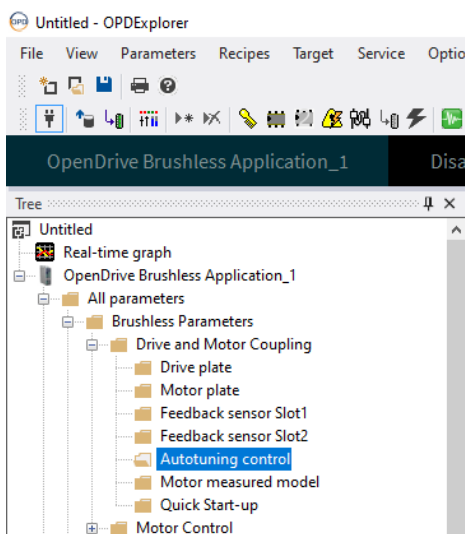
Lock

</

**Connection test:** Click on Drive and Motor Coupling → Autotuning control:



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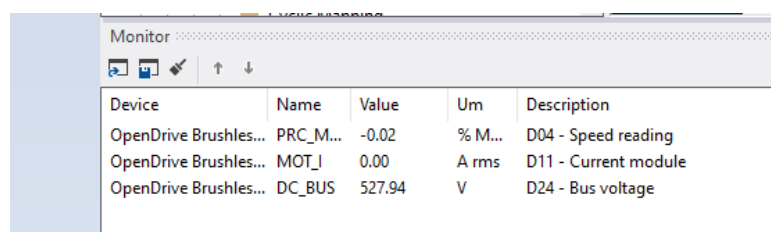
**EN\_TEST\_CONN**: connection test (phase test)

**EN\_AUTOTUNNING**: autotuning procedure enable

Set Yes on the parameter corresponding to the desired test:

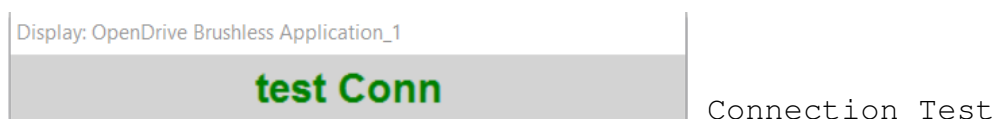
Parameters							Autotuning	
Lock	IPA	Name	Value	Um	Default	Min	Max	
	241	EN_AUTO_TOT	No		No	0	1	C4
	115	PRC_I_TEST_CONN	100.0	% DRV_I_NOM	100.0	0.0	100.0	P1:
	242	EN_TEST_CONN	No		No	0	3	C4
	243	EN_AUTOTUNNING	No		0 - No	0	3	C4
	276	DIS_DEF_START_AUTO	Yes		No	0	1	C7
	130	PRC_I_TEST_DELTA_VLS	Yes, without sens	% MOT_I_NOM	20.0	0.0	100.0	P1:
	2786	EN_TEST_SPD	Yes, Start Angle		0 - Not Enable	0	2	U0
	131	TEST_SPD_T_MAX	40.0	% MOT_T_NOM	40.0	0.0	100.0	P1:

For diagnostic purpose, add the following parameters into the Monitor window by dragging and dropping them from the main window:



Device	Name	Value	Um	Description
OpenDrive Brushles...	PRC_M...	-0.02	% M...	D04 - Speed reading
OpenDrive Brushles...	MOT_I	0.00	A rms	D11 - Current module
OpenDrive Brushles...	DC_BUS	527.94	V	D24 - Bus voltage

On the drive display will appear CRun. Wait until the end of the tuning. When the test is finished the drive will display CEnd.



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test Auto

Auto tuning servo drive

On the drive display it will appear Arun, wait until the end of the tuning. When the tuning is finished the drive will display AEnd.

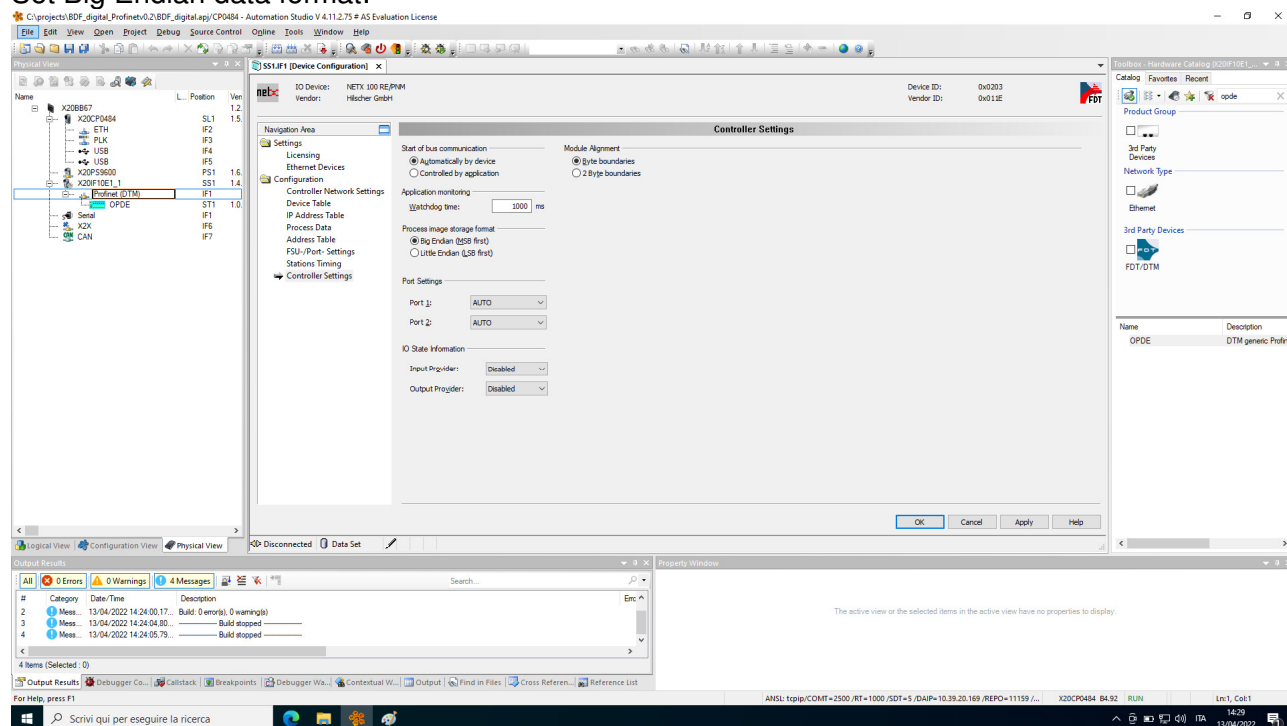
Restore the start commands on the drive:

EN\_START\_UP\_APPL NO  
SW\_RUN\_CMD YES

Once all the tuning tests are executed successfully, is possible to run the PLC program.

## 4.1 PLC B&R ( AUTOMATION STUDIO)

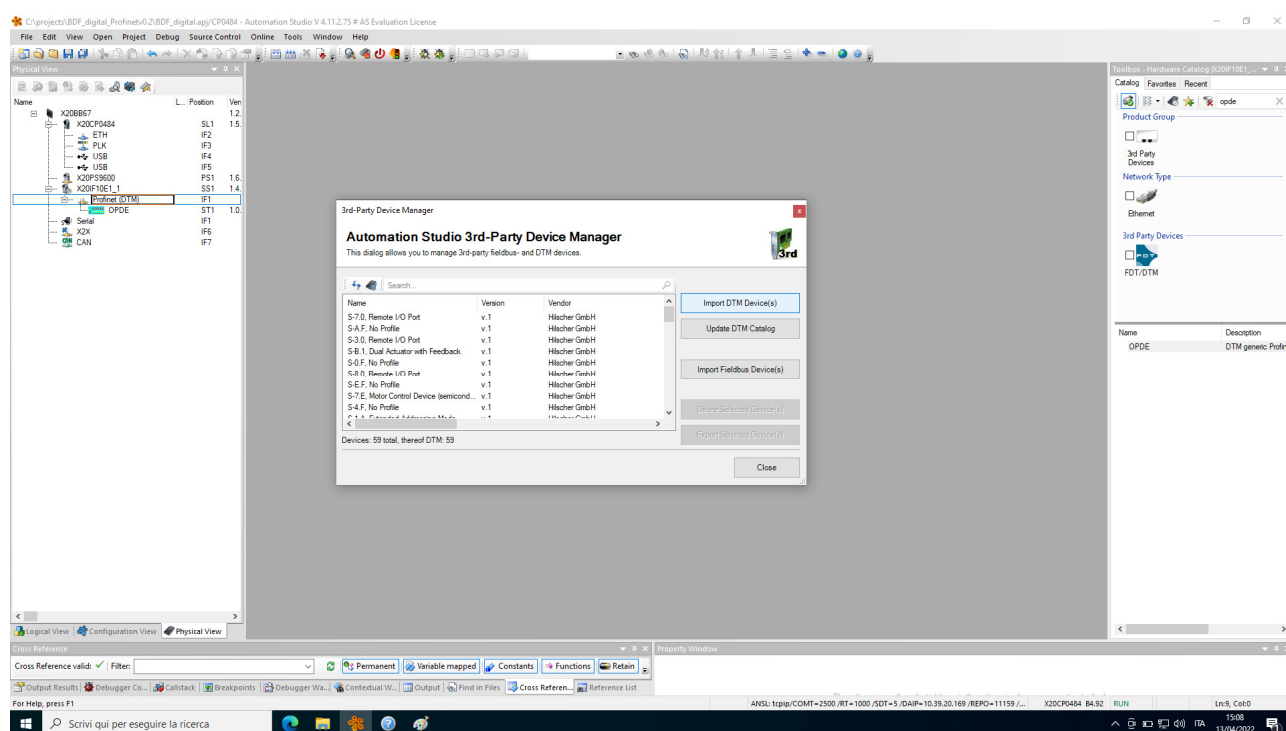
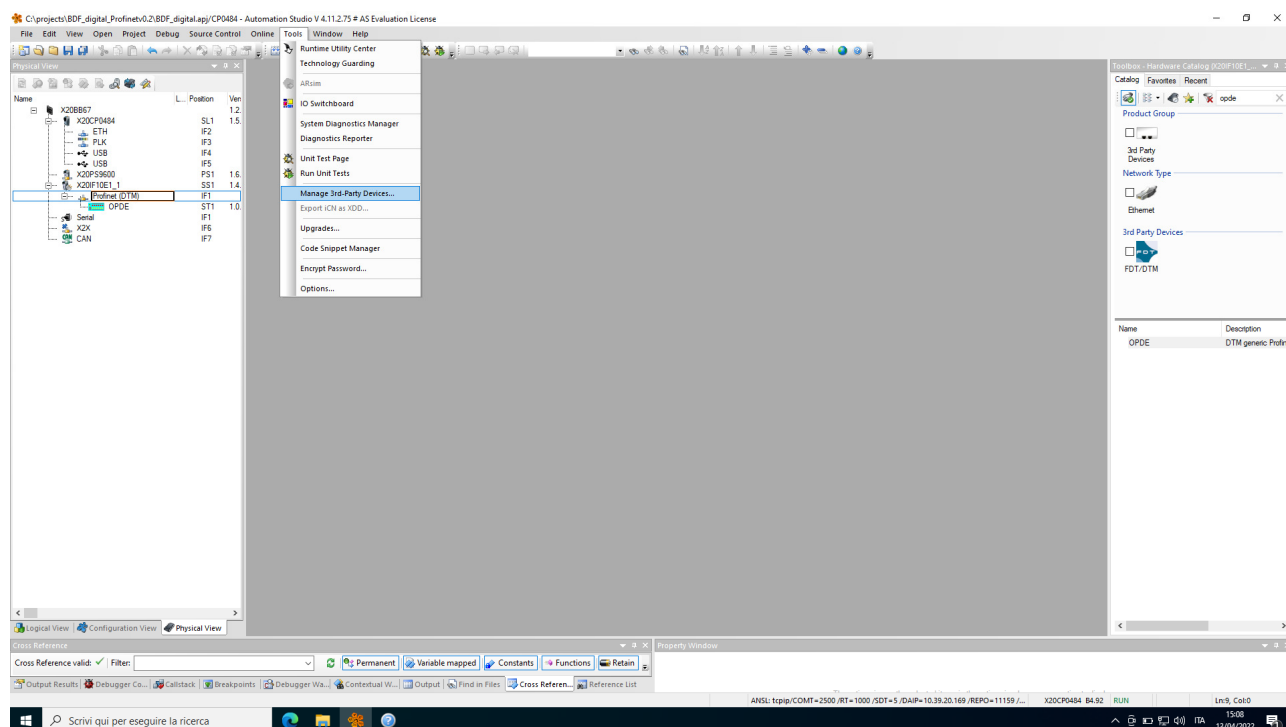
Set Big Endian data format:



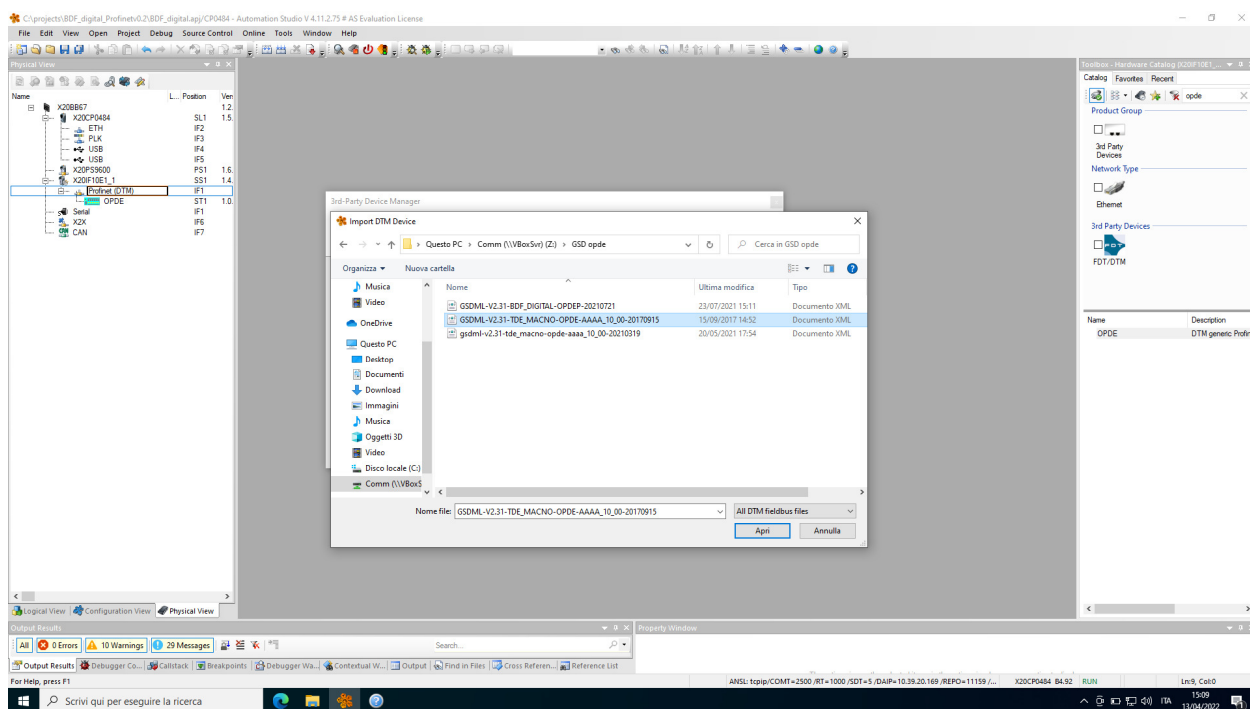
In order to insert GSDML-V2.31-TDE\_MACNO-OPDE-AAAA\_10\_00-20170915:

Tools\Manage 3<sup>rd</sup>-party Devices...

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Example PLC X20 + CP0484

From Profinet DTM\ Device configuration\Process data:  
Add 5 WORDS IN\ 5 WORDS OUT

X20BB67		1.2.0.0	Bus Base for Compact-S CPU with RS232 and CAN, 1x IF
X20CP0484	SL1	1.5.0.0	X20 Compact-S CPU, 667MHz, PLK, ETH 100 Base-T, PCI
ETH	IF2		Ethernet
PLK	IF3		POWERLINK
USB	IF4		Universal Serial Bus
USB	IF5		Universal Serial Bus
X20PS9600	PS1	1.6.0.0	X20 Compact-S Pwr Feed, 24V Bus Supply
X20IF10E1_1	SS1	1.4.0.0	X20 Interface PROFINET RT Master (DTM)
Profinet (DTM)	IF1		
OPDE	ST1	1.0.0	DTM generic Profinet RT device, Vendor: TDE MACNO, Version:

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X20CP0484 [Software] | OPDEpPosSys::Cyclic.st [Structured Text] | Online Settings | OPDEpPosSys::OPDEpPosSy.pvm [Watch] | X20CP0484.IF2 [Configuration] | Visu - Init\_Page [Visual Components VC4] | SS1.1

netX IO Device: NETX 100 RE/PNM  
 Vendor: Hilscher GmbH

Navigation Area	Type	Process Data
Settings		
Licensing		
Ethernet Devices		
Configuration		
Controller Network Settings		
Device Table		
IP Address Table		
Process Data		
Address Table		
FSU-/Port- Settings		
Stations Timing		
Controller Settings		

OPDE <opde>	Type	OPDE
5 WORDS IN <Slot 1>		5 WORDS IN <Slot 1>
5 words data IN <Subslot 1>		5 words data IN <Subslot 1>
Unsigned16 input		data_input_I_00
Unsigned16 input		data_input_I_01
Unsigned16 input		data_input_I_02
Unsigned16 input		data_input_I_03
Unsigned16 input		data_input_I_04
5 WORDS OUT <Slot 2>		5 WORDS OUT <Slot 2>
5 words data IN <Subslot 1>		5 words data IN <Subslot 1>
Unsigned16 output		data_output_O_00
Unsigned16 output		data_output_O_01
Unsigned16 output		data_output_O_02
Unsigned16 output		data_output_O_03
Unsigned16 output		data_output_O_04

In the example we have prepared Logical view \Data type declaration data structures ready to use for OPDEp PosSys application:

RXStruct: Data Received from OPDEp

BDF\_digital  
 Global.typ  
 OPDEpPosSys\_RXStruct  
 OPDEpPosSys\_TXStruct  
 OPDEpPosSysAirWord  
 OPDEpPosSysCmdWord  
 OPDEpPosSysStsWord

Status word

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name

OPDEpPosSysStsWord
x00_READY
x01
x02_SPEED_GREATER_MIN
x03_RUNNING
x04_EN_OPER_REPLY
x05_OP_MODE_REPLY_00
x06_OP_MODE_REPLY_01
x07_OP_MODE_REPLY_02
x08
x09
x10_SP_ACK
x11
x12
x13
x14_TARGET_REACHED
x15_HOMING_ATTAINED
x16
x17
x18
x19
x20
x21
x22
x23
x24
x25
x26
x27
x28
x29
x30
x31

## Status ALARM word

OPDEpPosSysAlrWord		
A00_0	<input type="checkbox"/>	A00.0
EEPROM_ALM	<input type="checkbox"/>	A01.0 EEPROM alarm
ABSOLUTE_ALM	<input type="checkbox"/>	A02.0 Absolute sensor alarm
POWER_FAULT	<input type="checkbox"/>	A03.0 Power fault
APP_ALM	<input type="checkbox"/>	A04.0 Application alarm
THERMAL_ALM	<input type="checkbox"/>	A05.0 Thermal alarm
MOTOR_THERMAL_ALM	<input type="checkbox"/>	A06.0 Motor I <sup>2</sup> t thermal alarm
UNFINISH_AUTO_TUNING	<input type="checkbox"/>	A07.0 Auto-tuning test unfinished
EXT_ALM	<input type="checkbox"/>	A08.0 External Alarm
SPEED_SENSOR	<input type="checkbox"/>	A09.0 Speed Sensor
MIN_POWER_CIRCUIT	<input type="checkbox"/>	A10.0 Minimum power circuit voltage
MAX_POWER_CIRCUIT	<input type="checkbox"/>	A11.0 Power circuit overvoltage
INT_ALM	<input type="checkbox"/>	A12.0 Internal alarm
POWER_START_PROBLEM	<input type="checkbox"/>	A13.0 Power Soft start problem
ERROR_CONNECTION_U_V_W	<input type="checkbox"/>	A14.0 Connection U,V,W error alarm
ERROR_PARAMETER_SETTING	<input type="checkbox"/>	A15.0 Parameter setting error alarm

## TXStruct: Data Transferred to OPDEp

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## Command DWord

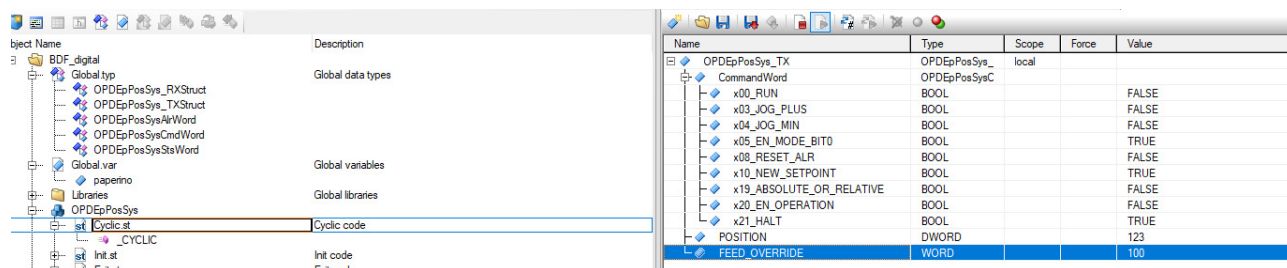
OPDEpPosSysCmdWord		
	x00_RUN	<input type="checkbox"/>
	x01	<input type="checkbox"/>
	x02_EN_EXT	<input type="checkbox"/>
	x03_JOG_PLUS	<input type="checkbox"/>
	x04_JOG_MIN	<input type="checkbox"/>
	x05_EN_MODE_BIT0	<input type="checkbox"/>
	x06_EN_MODE_BIT1	<input type="checkbox"/>
	x07_EN_MODE_BIT2	<input type="checkbox"/>
	x08_RESET_ALR	<input type="checkbox"/>
	x09	<input type="checkbox"/>
	x10_NEW_SETPOINT	<input type="checkbox"/>
	x11	<input type="checkbox"/>
	x12	<input type="checkbox"/>
	x13	<input type="checkbox"/>
	x14	<input type="checkbox"/>
	x15	<input type="checkbox"/>
	x16	<input type="checkbox"/>
	x17	<input type="checkbox"/>
	x18	<input type="checkbox"/>
	x19_ABSOLUTE_OR_RELATIVE	<input type="checkbox"/>
	x20_EN_OPERATION	<input type="checkbox"/>
	x21_HALT	<input type="checkbox"/>
	x22_QUICK_STOP	<input type="checkbox"/>
	x23	<input type="checkbox"/>
	x24	<input type="checkbox"/>
	x25	<input type="checkbox"/>
	x26	<input type="checkbox"/>
	x27	<input type="checkbox"/>
	x28_POSITIVE_LIMIT	<input type="checkbox"/>
	x29_NEGATIVE_LIMIT	<input type="checkbox"/>
	x30_HOME	<input type="checkbox"/>
	x31	<input type="checkbox"/>

## + Set position and Override

OPDEpPosSys_TXStruct	
	CommandWord
	POSITION
	FEED_OVERRIDE

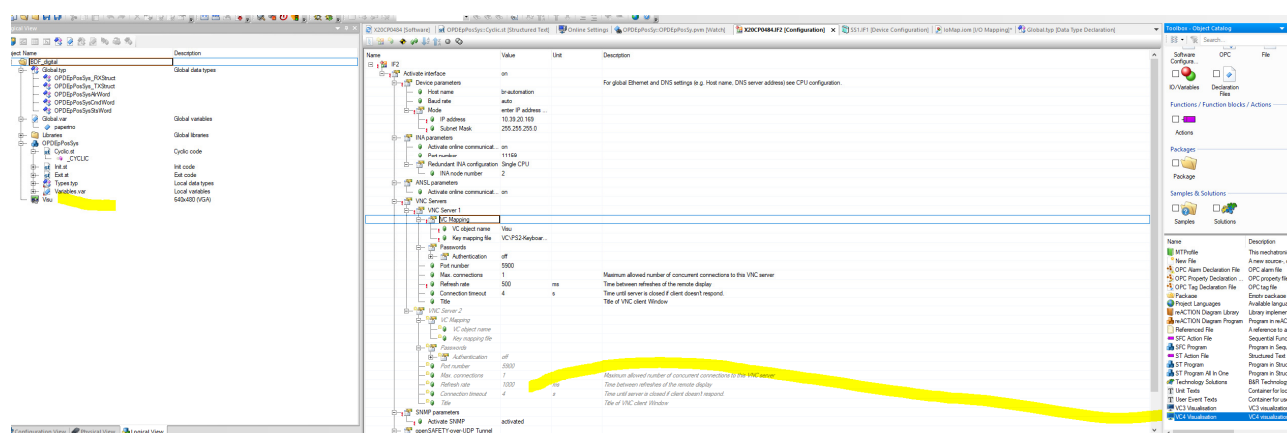
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Its possible to test communication ad application from Watch:



Name	Type	Scope	Force	Value
CommandWord	OPDEP_PosSysC	local		
x00_RUN	BOOL			FALSE
x03_JOG_PLUS	BOOL			FALSE
x04_JOG_MIN	BOOL			FALSE
x05_EN_MODE_BIT0	BOOL			TRUE
x08_RESET_ALR	BOOL			FALSE
x10_NEW_SETPOINT	BOOL			TRUE
x19_ABSOLUTE_OR_RELATIVE	BOOL			FALSE
x20_EN_OPERATION	BOOL			FALSE
x21_HALT	BOOL			TRUE
POSITION	DWORD			123
FEED_OVERRIDE	WORD			100

Also Visual component Vc4 are available to do some test:



012 012 AlarmText
%m/%d/%Y %H:%M:%S

POS

0

0

OVR

0

RUN

EXT ENBL

NEW SETP

STOP

Reset

ModeBit0

ModeBit1

ModeBit2



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Sequence to run a positioning test:

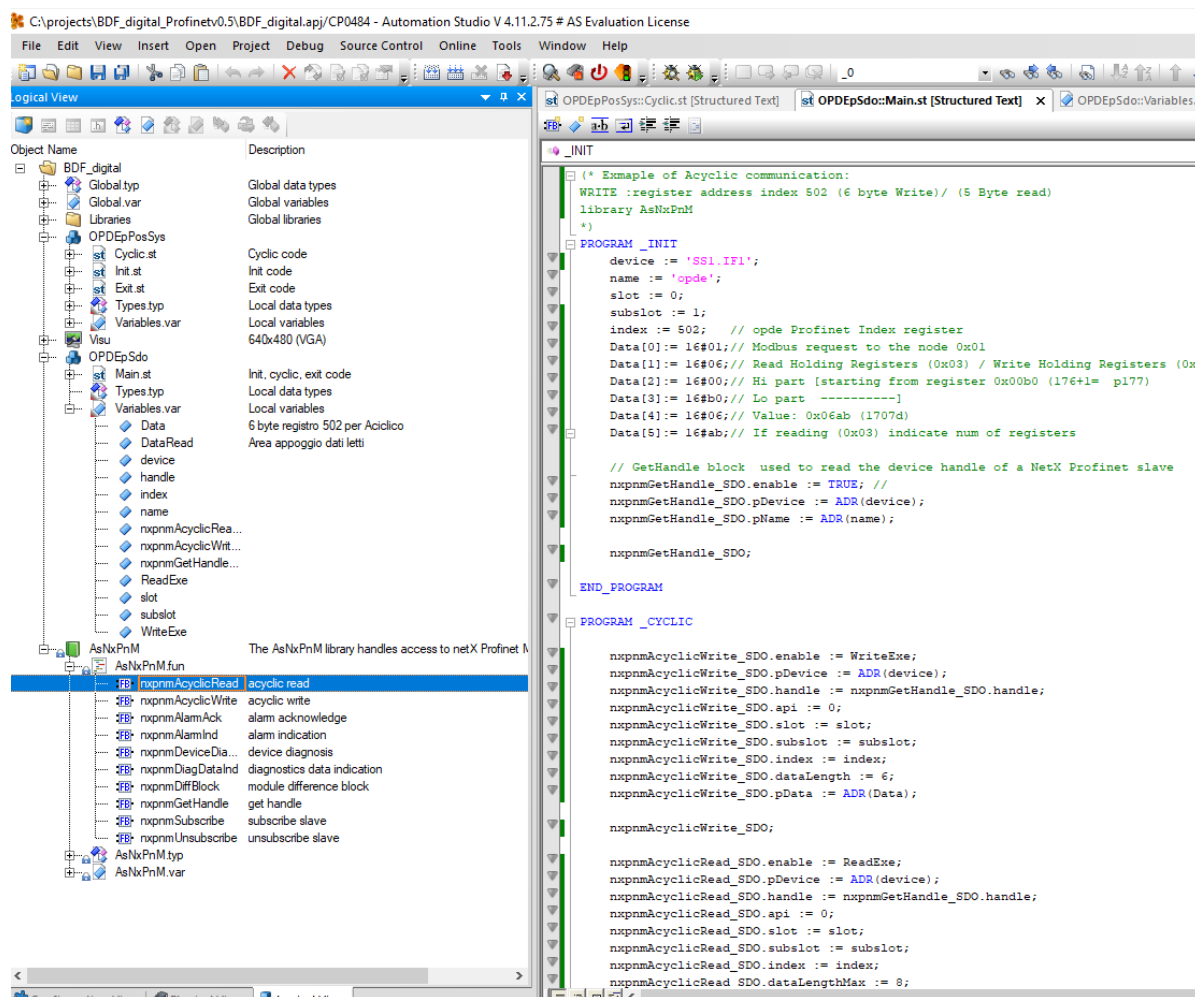
RUN=1  
EXT ENABLE=1  
ModeBit0=1 ( position)

Set te position target and velocity then NewSetpoint  
POSITION = yy  
OVERRIDE = xx [%]  
New Setpoint = 1

For futher technical information about PosSys\_12 Application refer to MW00601E00\_N03  
POSITIONING SYSTEM V\_1.5.pdf

## 4.2PLC B&R ( ACYCLIC DATA TRANSFER)

OPDEpSdo task its an example of acyclic data transfer from cpu X20 and Opde.  
Values that are not available as cyclic data points on the PROFINET bus can be queried using the acyclic  
read and write functions **nxpnmAcyclicRead/Write**



The screenshot displays the Automation Studio 4.11.2.75 interface. On the left, the 'Object Name' tree shows the project structure, including 'OPDEpSdo' and its associated variables. The 'OPDEpSdo' task is selected, showing its configuration in the 'Variables.var' section. The 'Data' variable is set to 'DataRead', and the 'Device' is set to 'device'. The 'Index' is set to 'index', and the 'Subslot' is set to 'subslot'. The 'DataLength' is set to '6'. The 'Data' variable is also set to 'DataRead'.

The main window shows the 'OPDEpSdo:Main.st' file, which contains the following code:

```

(* Example of Acyclic communication:
WRITE :register address index 502 (6 byte Write)/ (5 Byte read)
library AsNxPnM
*)

PROGRAM _INIT
device := 'S1.IF1';
name := 'opde';
slot := 0;
subslot := 1;
index := 502; // opde Profinet Index register
Data[0] := 16#01; // Modbus request to the node 0x01
Data[1] := 16#06; // Read Holding Registers (0x03) / Write Holding Registers (0x03)
Data[2] := 16#00; // Hi part [starting from register 0x00b0 (176+1= p177)
Data[3] := 16#b0; // Lo part -----]
Data[4] := 16#06; // Value: 0x06ab (1707d)
Data[5] := 16#ab; // If reading (0x03) indicate num of registers

// GetHandle block used to read the device handle of a NetX Profinet slave
nxpnmGetHandle_SDO.enable := TRUE; //
nxpnmGetHandle_SDO.pDevice := ADR(device);
nxpnmGetHandle_SDO.pName := ADR(name);

nxpnmGetHandle_SDO;

END_PROGRAM

PROGRAM _CYCLIC

nxpnmAcyclicWrite_SDO.enable := WriteExe;
nxpnmAcyclicWrite_SDO.pDevice := ADR(device);
nxpnmAcyclicWrite_SDO.handle := nxpnmGetHandle_SDO.handle;
nxpnmAcyclicWrite_SDO.api := 0;
nxpnmAcyclicWrite_SDO.slot := slot;
nxpnmAcyclicWrite_SDO.subslot := subslot;
nxpnmAcyclicWrite_SDO.index := index;
nxpnmAcyclicWrite_SDO.dataLength := 6;
nxpnmAcyclicWrite_SDO.pData := ADR(Data);

nxpnmAcyclicWrite_SDO;

nxpnmAcyclicRead_SDO.enable := ReadExe;
nxpnmAcyclicRead_SDO.pDevice := ADR(device);
nxpnmAcyclicRead_SDO.handle := nxpnmGetHandle_SDO.handle;
nxpnmAcyclicRead_SDO.api := 0;
nxpnmAcyclicRead_SDO.slot := slot;
nxpnmAcyclicRead_SDO.subslot := subslot;
nxpnmAcyclicRead_SDO.index := index;
nxpnmAcyclicRead_SDO.dataLengthMax := 8;

```

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For asynchronous accessing to all the converter parameters and run-time data there is a special register Data Record with **index 502 (0x1F6)** to be used

For example to Read parameter (IPA 264) always requires 2 actions:

- 1) The desired register address must be defined with a "Record write".
- 2) The value of the previously defined register can be read out with a "Record read".

#### Example

If the PROFINET master write into Record-Data 502 the following 6 bytes:

0x01	0x03	0x01	0x08	0x00	0x01
------	------	------	------	------	------

the reply readed back from Record-Data 502 will be the following 5 bytes:

0x01	0x03	0x02	0x00	0x05
------	------	------	------	------

The Modbus request to the node 0x01 is a Read Holding Registers (0x03) starting from register address 0x0108 and involving just one register (0x0001).

The Modbus reply comes from node 0x01 for a Read Hold Register (0x03) request with a total data lenght of 0x02 bytes (1 register) that are 0x0005.

So register 0x0108 (264) is equal do 5: that's not surprising as 264 is the address of Connection C64 and value 5, as we see before, is enabling the PROFINET management!

In the plc example Task OPDEpSdo, there are Data record of 6 Bytes

Data[1]:= 3 Read or 6 Write

Data[2] Data[3] := IPA address(+1) Opdexplorer parameters

Data[4] Data[5] := Value to write or Num registers readed

WriteExe:= run a Write execution

ReadExe:= run a Read execution

```

device := 'SS1.IF1';
name := 'opde';
slot := 0;
subslot := 1;
index := 502; // opde Profinet Index register
Data[0] := 16#01; // Modbus request to the node 0x01
Data[1] := 16#06; // Read Holding Registers (0x03) / Write Holding Registers (0x06)
Data[2] := 16#00; // Hi part [starting from register 0x00b0 (176+1= p177)
Data[3] := 16#b0; // Lo part -----]
Data[4] := 16#06; // Value: 0x06ab (1707d)
Data[5] := 16#ab; // If reading (0x03) indicate num of registers

```