# OPERATION MANUAL

## DIGIFORCE® 9311
## PROFINET Integration into TIA Portal

Manufacturer:
burster
präzisionsmesstechnik gmbh & co kg
Talstr. 1 - 5
76593 Gernsbach
Germany

P.O. Box 1432
76587 Gernsbach
Germany

Valid from: **01.08.2018**
Applies to: **DIGIFORCE® 9311-VXX03**

Tel.: +49-7224-645-0
Fax.: +49-7224-645-88
Email: info@burster.com
www.burster.com

# Table of Contents

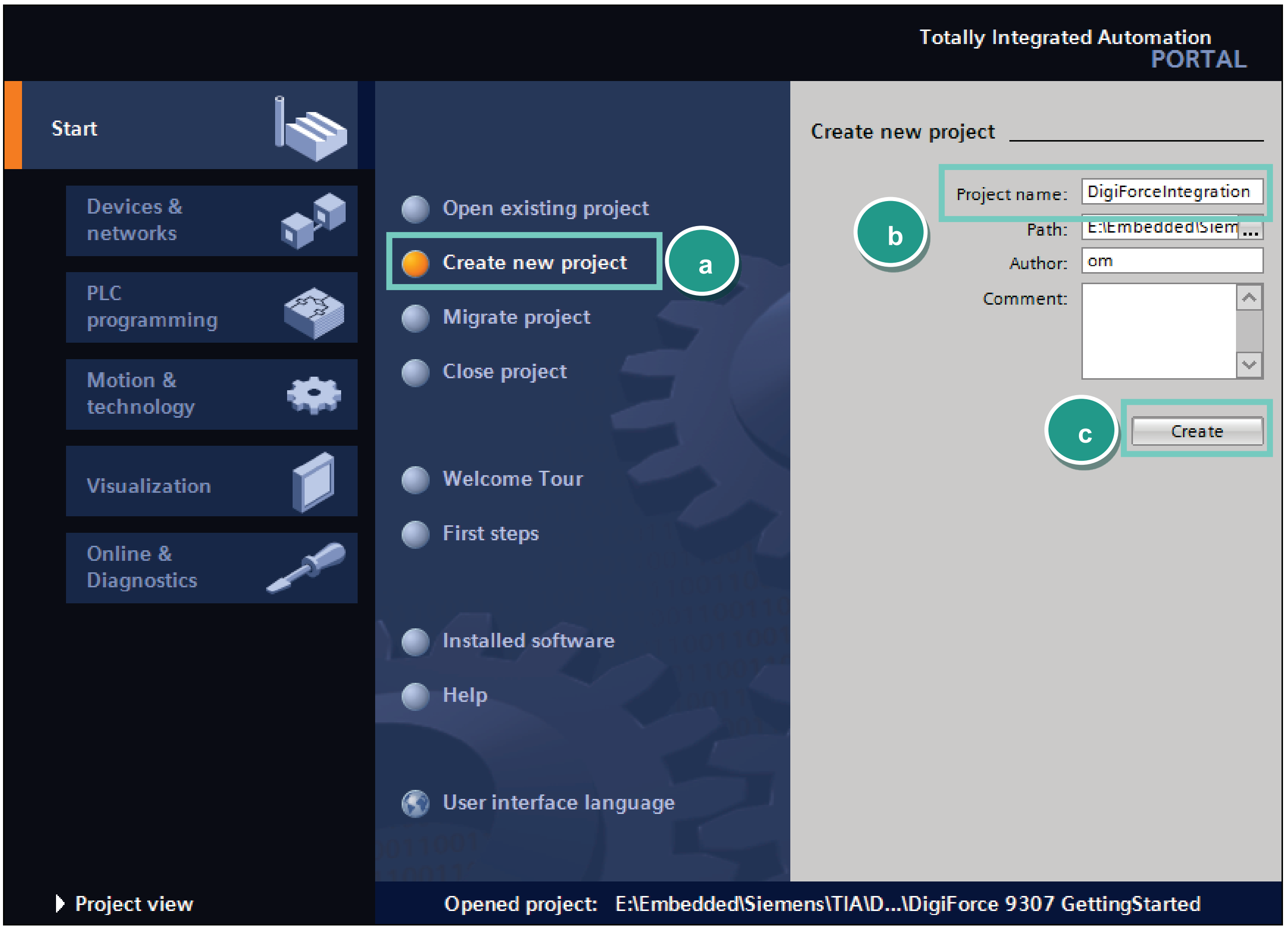
# Introduction

This quick start guide describes an approach how you can configure the DIGIFORCE® 9311 via TIA Portal using the example of S7-1511 CPU. Please note that the samples here cannot be directly used in your production line because they have beed extremely simplified to reach a better understanding. Therefore, you may have to complete them by checking of status, error, length values etc.

***Please also note that you will have to use the DIGIFORCE 9311 PROFINET manual to get futher information about input and output parameters (cyclic as well acyclic data transfer)***

# 1. Creating new project

- Start the **Totally Integrated Automation Protal**, select ***Create New Project*** (a), assign the project a name (b) and click ***Create*** (c):



Create new project

Project name: DigiForceIntegration

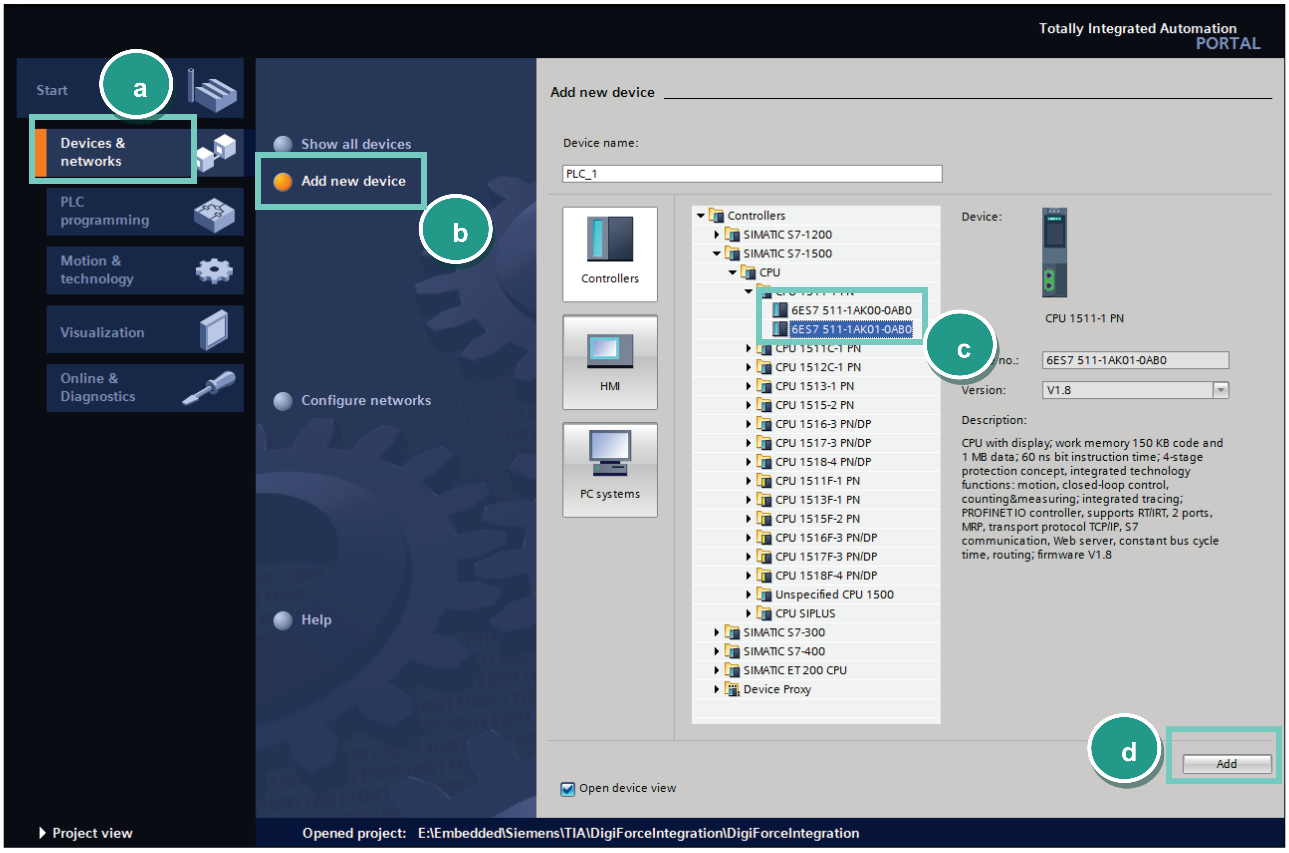
Path: E:\Embedded\Siem

Author: om

Comment:

Opened project: E:\Embedded\Siemens\TIA\D...\DigiForce 9307 GettingStarted

- Go to ***Devices & networks*** (a) on the left side select ***Add new device*** *(b)* and look for yor CPU (c). Afterwards click the **Add** button (d).



Add new device

Device name: PLC_1

Device: CPU 1511-1 PN

Article no.: 6ES7 511-1AK01-0AB0

Version: V1.8

Description:

CPU with display; work memory 150 KB code and 1 MB data; 60 ns bit instruction time; 4-stage protection concept, integrated technology functions: motion, closed-loop control, counting&measuring; integrated tracing; PROFINET IO controller, supports RT/IRT, 2 ports, MRP, transport protocol TCP/IP, S7 communication, Web server, constant bus cycle time, routing; firmware V1.8

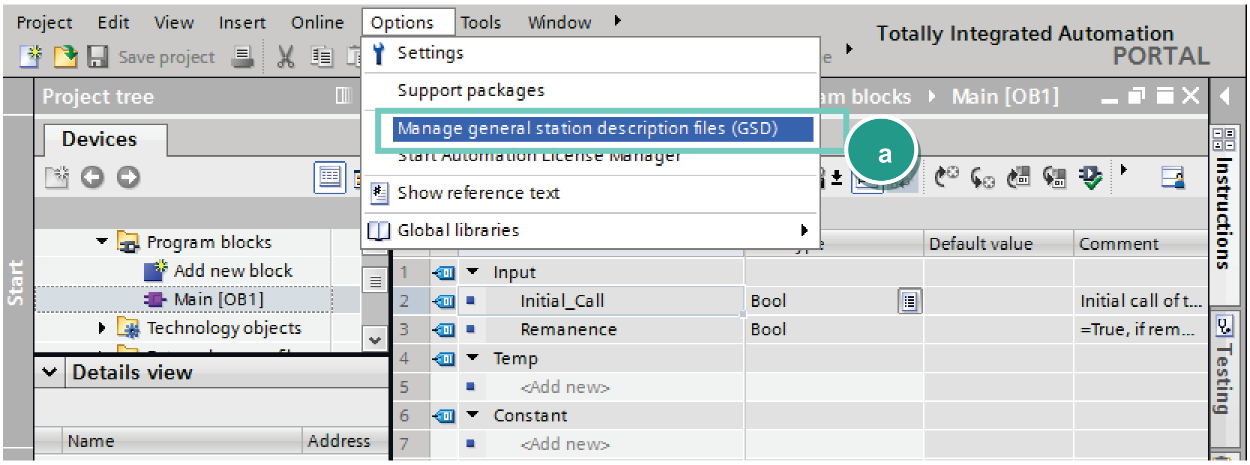
☑ Open device view

Opened project: E:\Embedded\Siemens\TIA\DigiForceIntegration\DigiForceIntegration

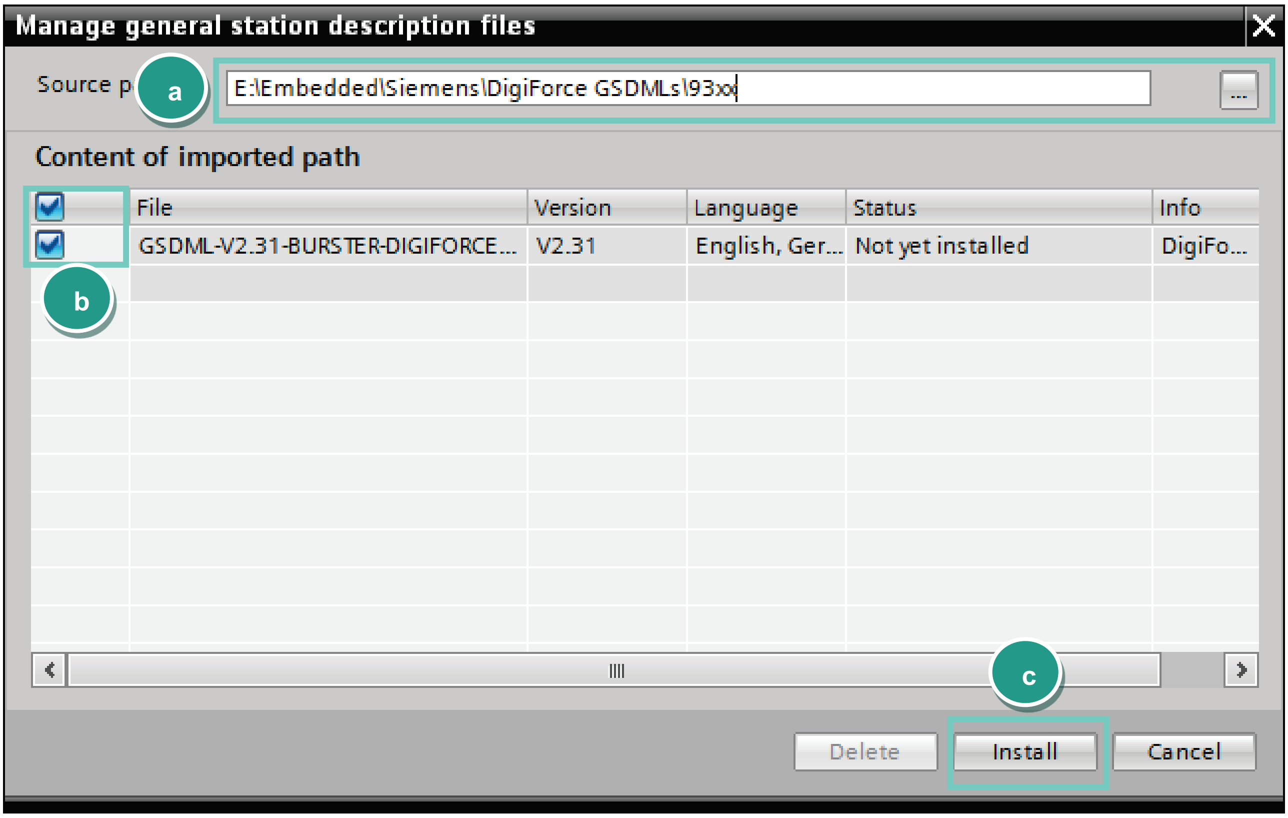
## 2. Installation of GSDML files

**Note:** Please make sure that your GSDML file is compatible to the field bus firmware in the DIGIFORCE® 9311. Also for compatibility reasons, uninstall all previous GSDML files of particular device if you have any!

- Go to ***Options->Manage general station description files (GSD)***



- Navigate to your DIGIFORCE® 9311 GSDML directory (a)(you will find the GSD files on burster DVD that you got with your DIGIFORCE® 9311 device or on burster.com), select the GSD file (b) and click ***Install*** (c)



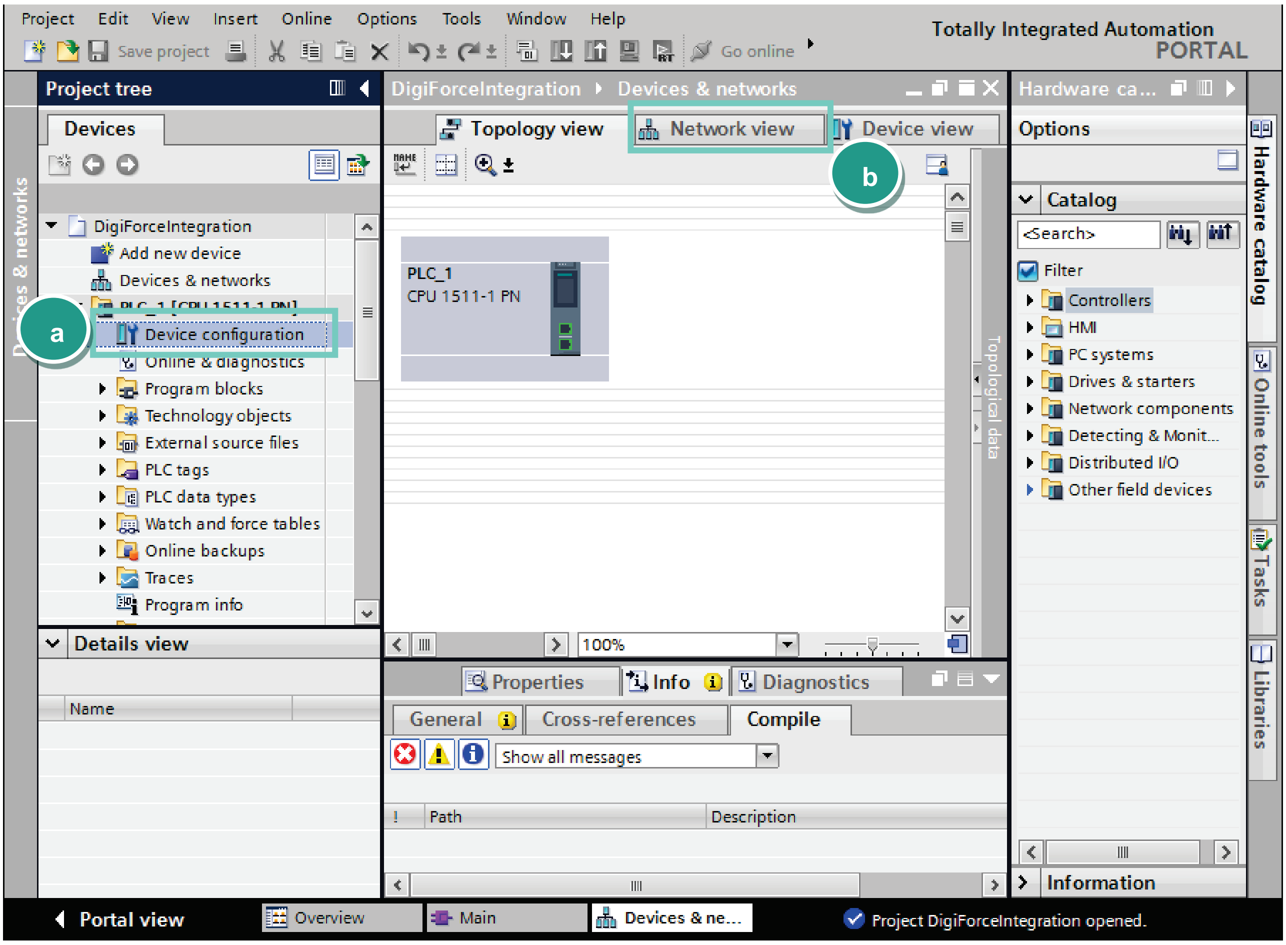
Source p: E:\Embedded\Siemens\DigiForce GSDMLs\93xx

Content of imported path

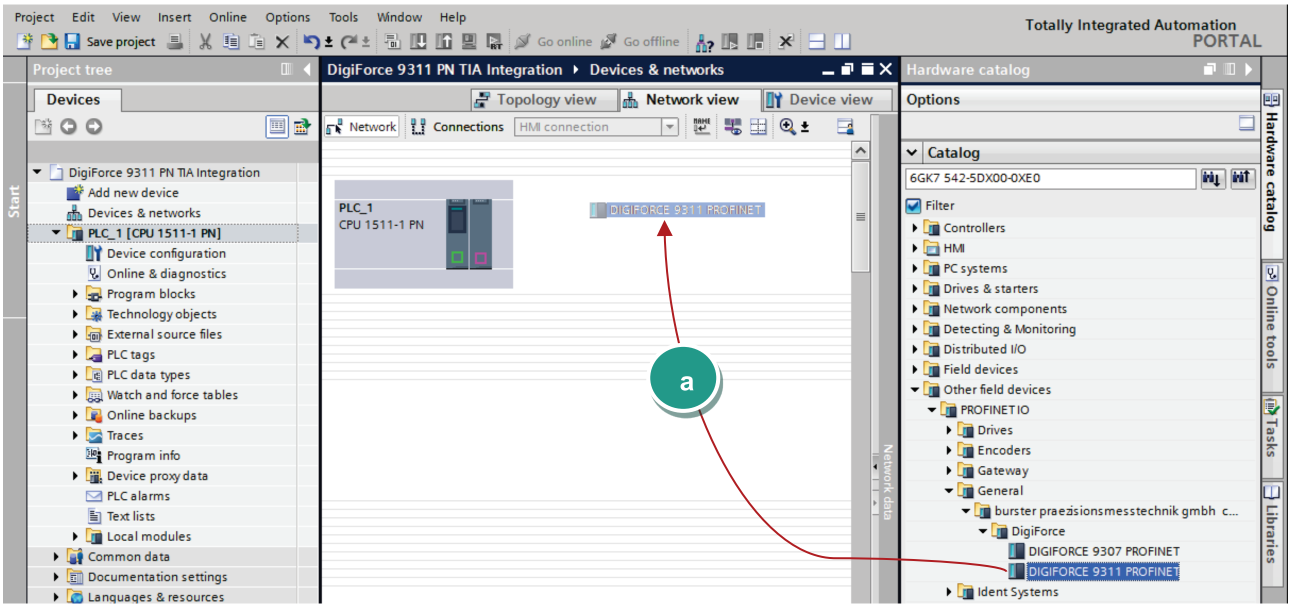
| ☑ | File | Version | Language | Status | Info |
|---|---|---|---|---|---|
| ☑ | GSDML-V2.31-BURSTER-DIGIFORCE... | V2.31 | English, Ger... | Not yet installed | DigiFo... |

## 3. Creation of network connections

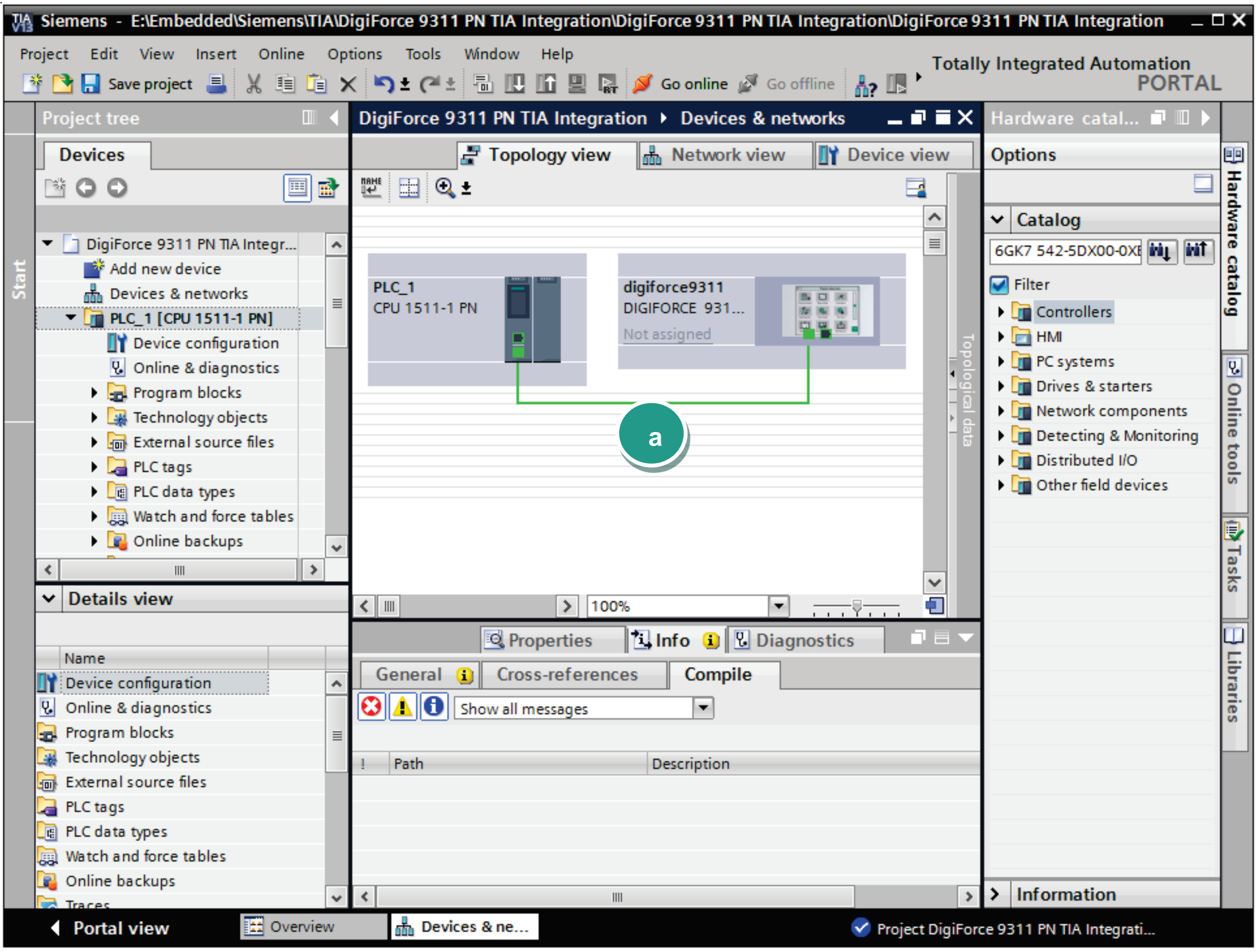
- Double click ***Device Configuration*** (a) in the project tree und switch to **Network view** (b) :



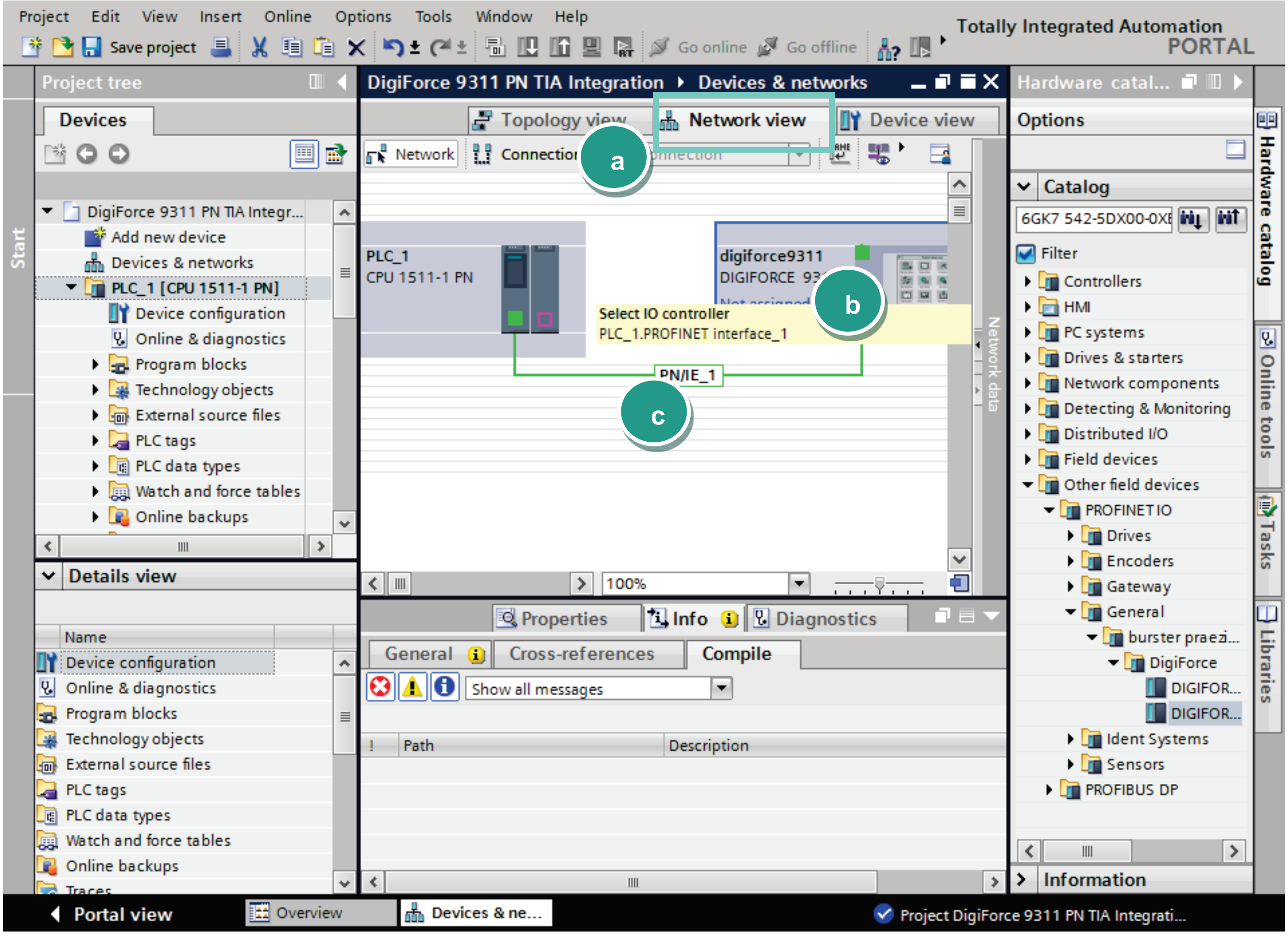
- Now select the DIGIFORCE® 9311 device in the catalog and drag & drop it into the working area (a):



- Please select an ethernet port on the S7 and hold the left mouse button down to connect the S7 with DIGIFORCE® 9311:



- ➢ Change now to **Network view** (a) to assign a controller to the DIGIFORCE® 9311. Click on the link “Not assigned” (b) of DIGIFORCE® 9311 and select your controller (c):

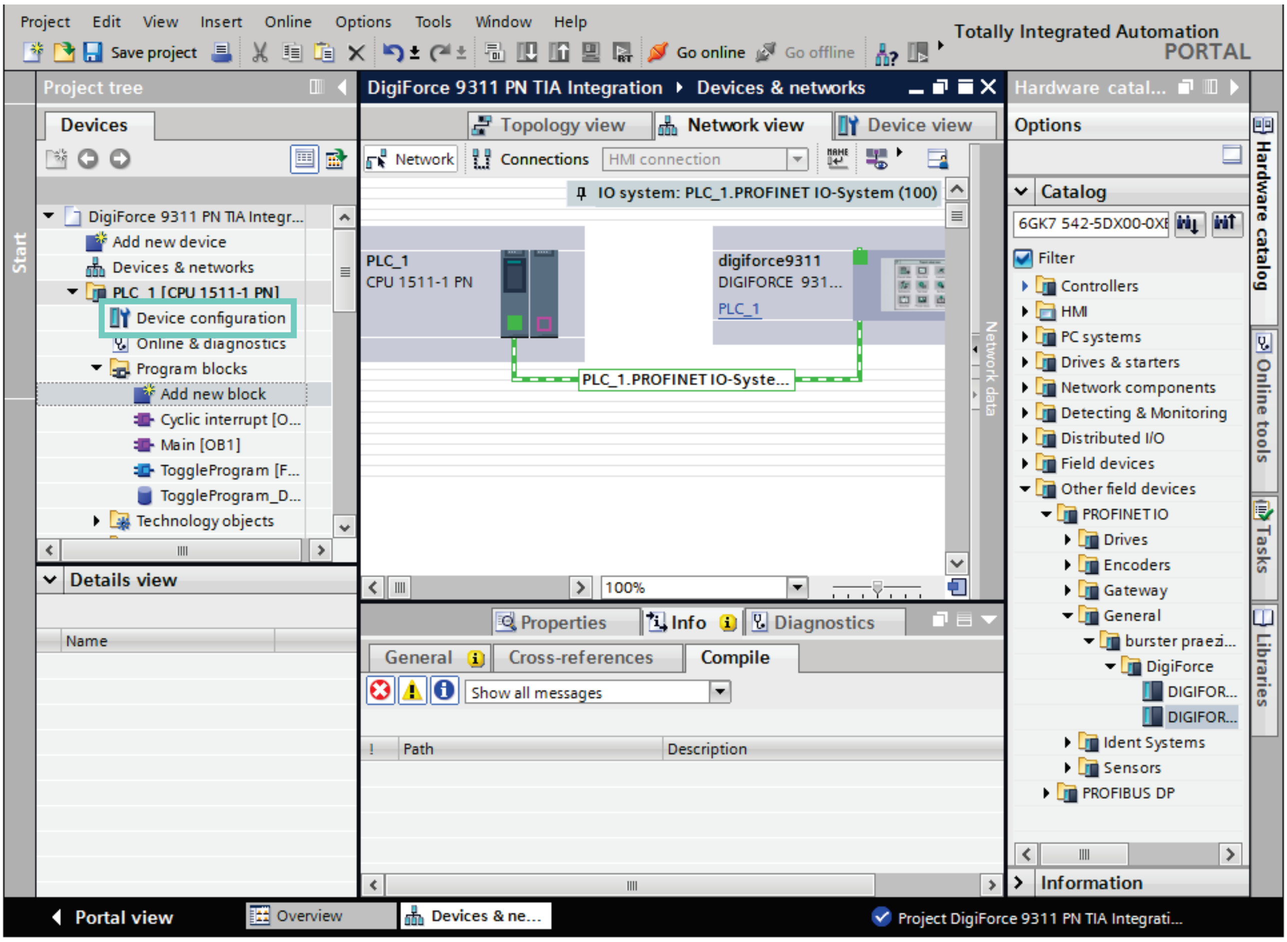


Check if devices also connected physically to the right ports. You find the port number assignment in the section *4.3 Port-Identification of* **DIGIFORCE® 9311 PROFINET** manual

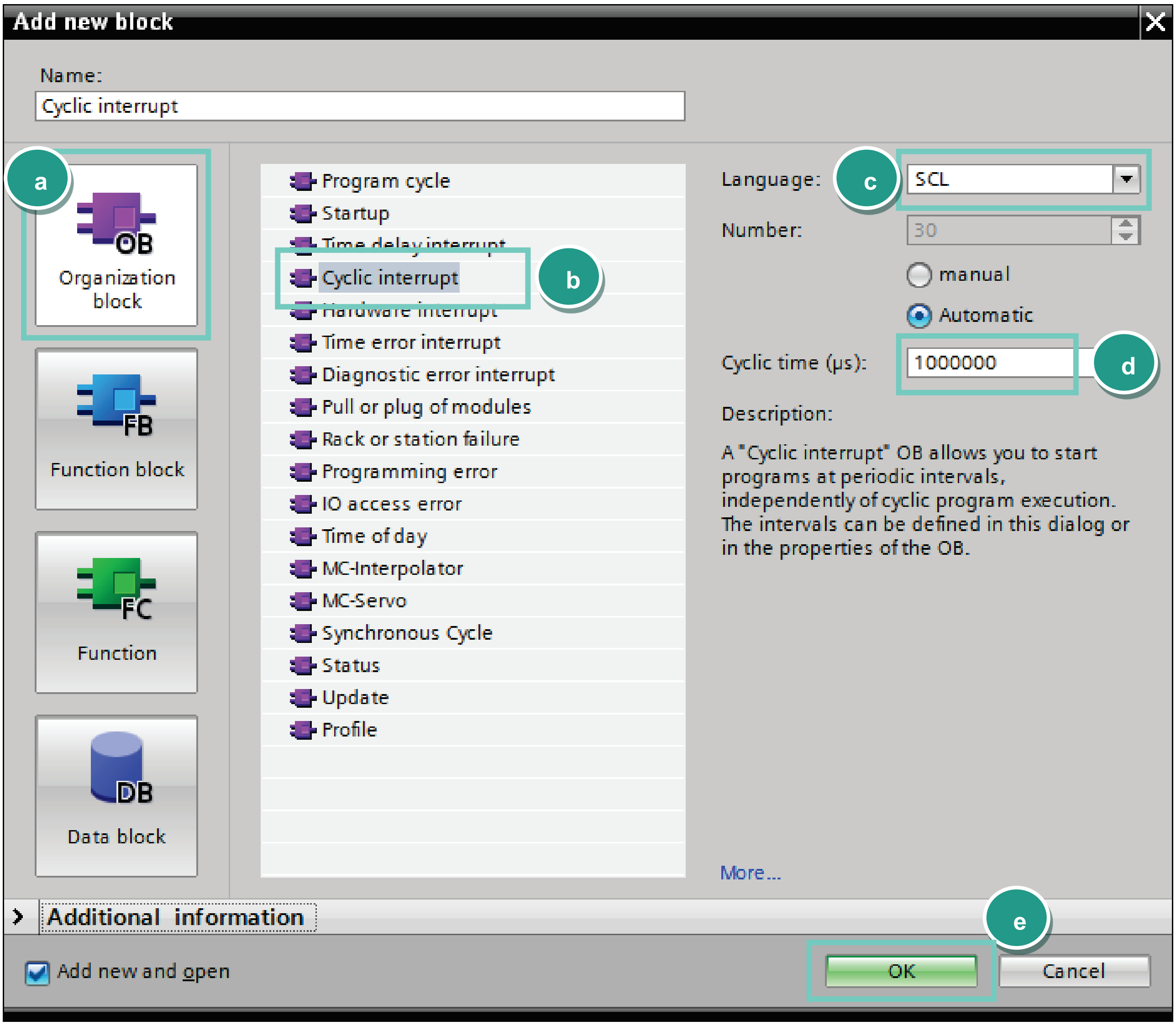
# 4. Create a sample program

In this section, you will learn how to create a simple program to start and stop a measurement periodically. You will need to refer to sections *7.2 PLC inputs* and *7.3 PLC outputs* of the **DIGIFORCE® 9311 PROFINET** manual to understand the meaning of inputs and outputs bytes.

- ➢ Expand the tree node ***Program blocks*** in the Project tree and double click ***Add new block:***



- Select in the new window ***Organization block*** (a) and then ***Cyclic interrupt*** (b). As language set SCL (c), change the cyclic time to 1.000.000 µs (d) and click OK (e):



Add new block

Name: Cyclic interrupt

Language: SCL

Number: 30

○ manual

● Automatic

Cyclic time (µs): 1000000

Description:

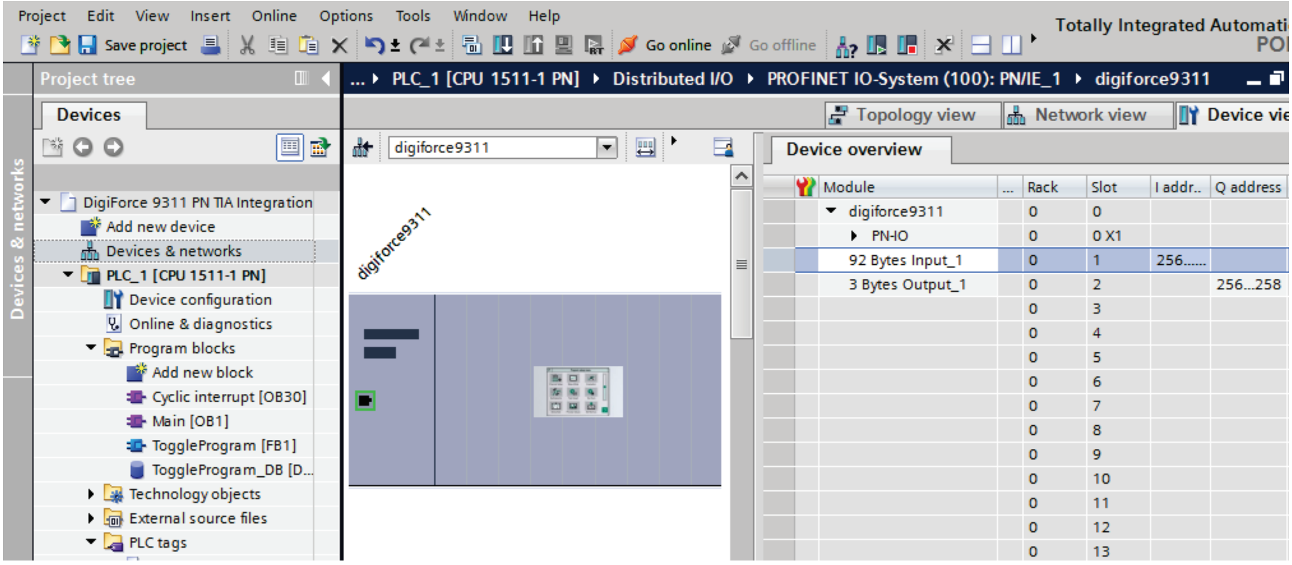
A "Cyclic interrupt" OB allows you to start programs at periodic intervals, independently of cyclic program execution. The intervals can be defined in this dialog or in the properties of the OB.

☑ Add new and open

- Type in the following source code in the code fild of the new block:

```
IF %Q258.0 = TRUE THEN                         // is IN_START (measurement start) set?
  %Q258.0 := FALSE;                            // IN_START (measurement start) is set, then reset it
ELSE                                           // IN_START is not set
  IF %I256.0 = FALSE THEN                      // is OUT_READY  (DIGIFORCE® 9311 ready for
                                               measurement) set?
    RETURN;                                    // If not -
  END_IF;                                      // return
  %Q258.0 := TRUE;
END_IF;                                        // set IN_START(measurement start)
```

**Please note**: the addresses may be different. You have to check them in the **Device view->Device overview** of the DIGIFORCE® 9311.



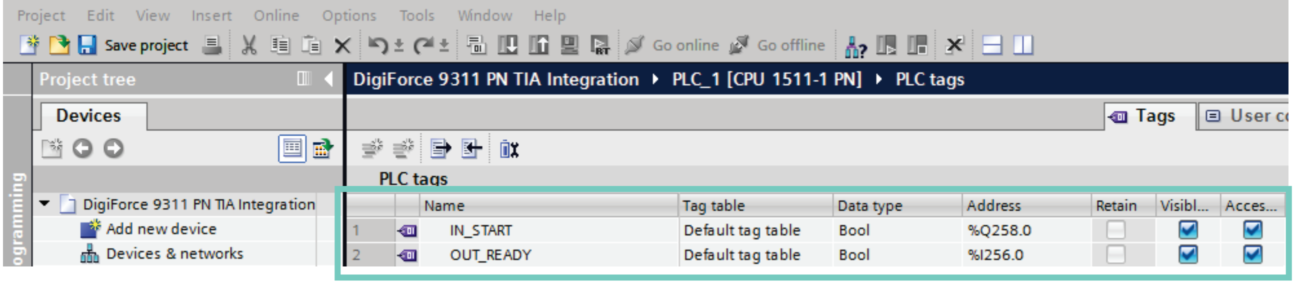
... ▸ PLC_1 [CPU 1511-1 PN] ▸ Distributed I/O ▸ PROFINET IO-System (100): PN/IE_1 ▸ digiforce9311

- DigiForce 9311 PN TIA Integration
  - Add new device
  - Devices & networks
  - PLC_1 [CPU 1511-1 PN]
    - Device configuration
    - Online & diagnostics
    - Program blocks
      - Add new block
      - Cyclic interrupt [OB30]
      - Main [OB1]
      - ToggleProgram [FB1]
      - ToggleProgram_DB [D...
    - Technology objects
    - External source files
    - PLC tags

Device overview

| Module | ... | Rack | Slot | I addr.. | Q address |
|---|---|---|---|---|---|
| digiforce9311 | | 0 | 0 | | |
| PN-IO | | 0 | 0 X1 | | |
| 92 Bytes Input_1 | | 0 | 1 | 256...... | |
| 3 Bytes Output_1 | | 0 | 2 | | 256...258 |
| | | 0 | 3 | | |
| | | 0 | 4 | | |
| | | 0 | 5 | | |
| | | 0 | 6 | | |
| | | 0 | 7 | | |
| | | 0 | 8 | | |
| | | 0 | 9 | | |
| | | 0 | 10 | | |
| | | 0 | 11 | | |
| | | 0 | 12 | | |
| | | 0 | 13 | | |

You will also see that the TIA-Editor replaces the input/output addresses with tags. You can change the tags names in PLC Tag table (e.g. to IN_START and OUT_READY):



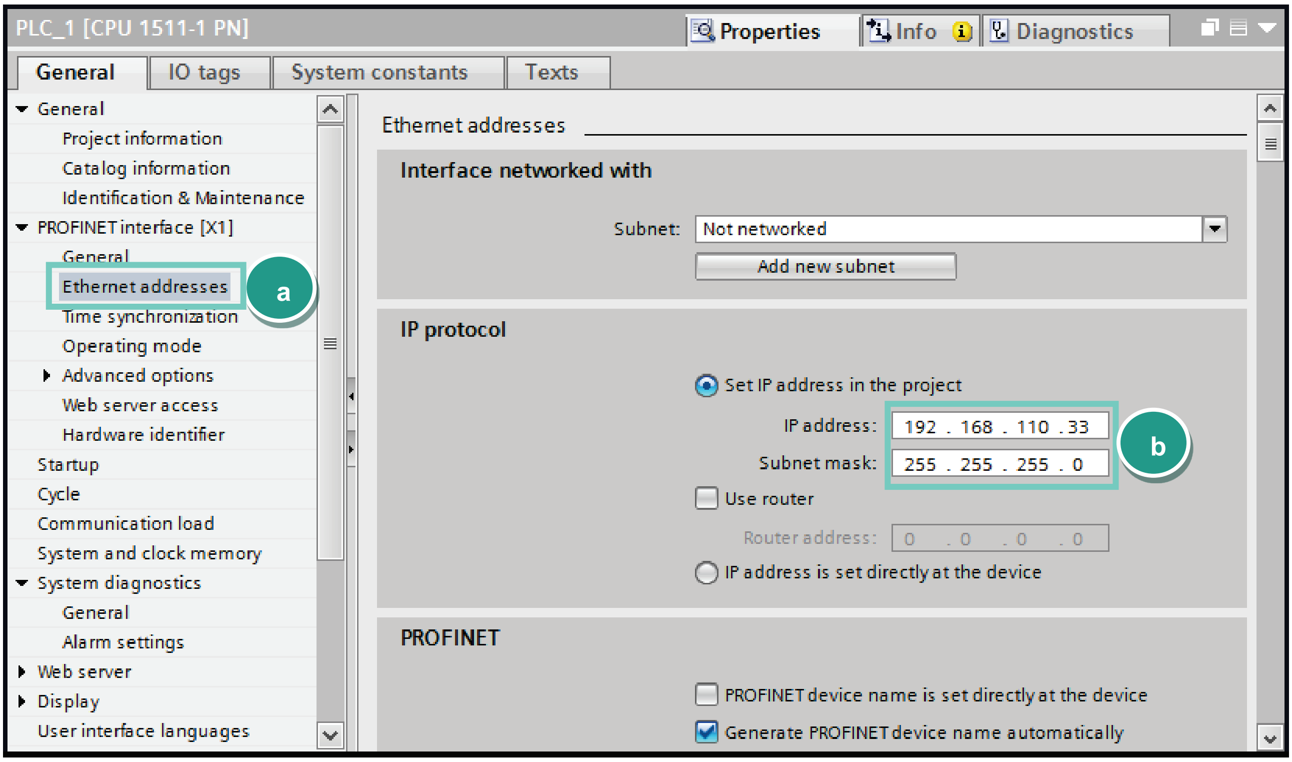
DigiForce 9311 PN TIA Integration ▸ PLC_1 [CPU 1511-1 PN] ▸ PLC tags

- DigiForce 9311 PN TIA Integration
  - Add new device
  - Devices & networks

PLC tags

| | Name | Tag table | Data type | Address | Retain | Visibl... | Acces... |
|---|---|---|---|---|---|---|---|
| 1 | IN_START | Default tag table | Bool | %Q258.0 | □ | ☑ | ☑ |
| 2 | OUT_READY | Default tag table | Bool | %I256.0 | □ | ☑ | ☑ |

- Before you load the project into the CPU you have to set the IP address of your CPU. To do this please go to **Device view** and select ***Ethernet addresses*** (a) in ***General*** tab. Set now the IP-Address and a subnet mask(b) assigned to your in section ***IP-Protocol***:



Subnet: Not networked

● Set IP address in the project

IP address: 192 . 168 . 110 . 33

Subnet mask: 255 . 255 . 255 . 0

□ Use router

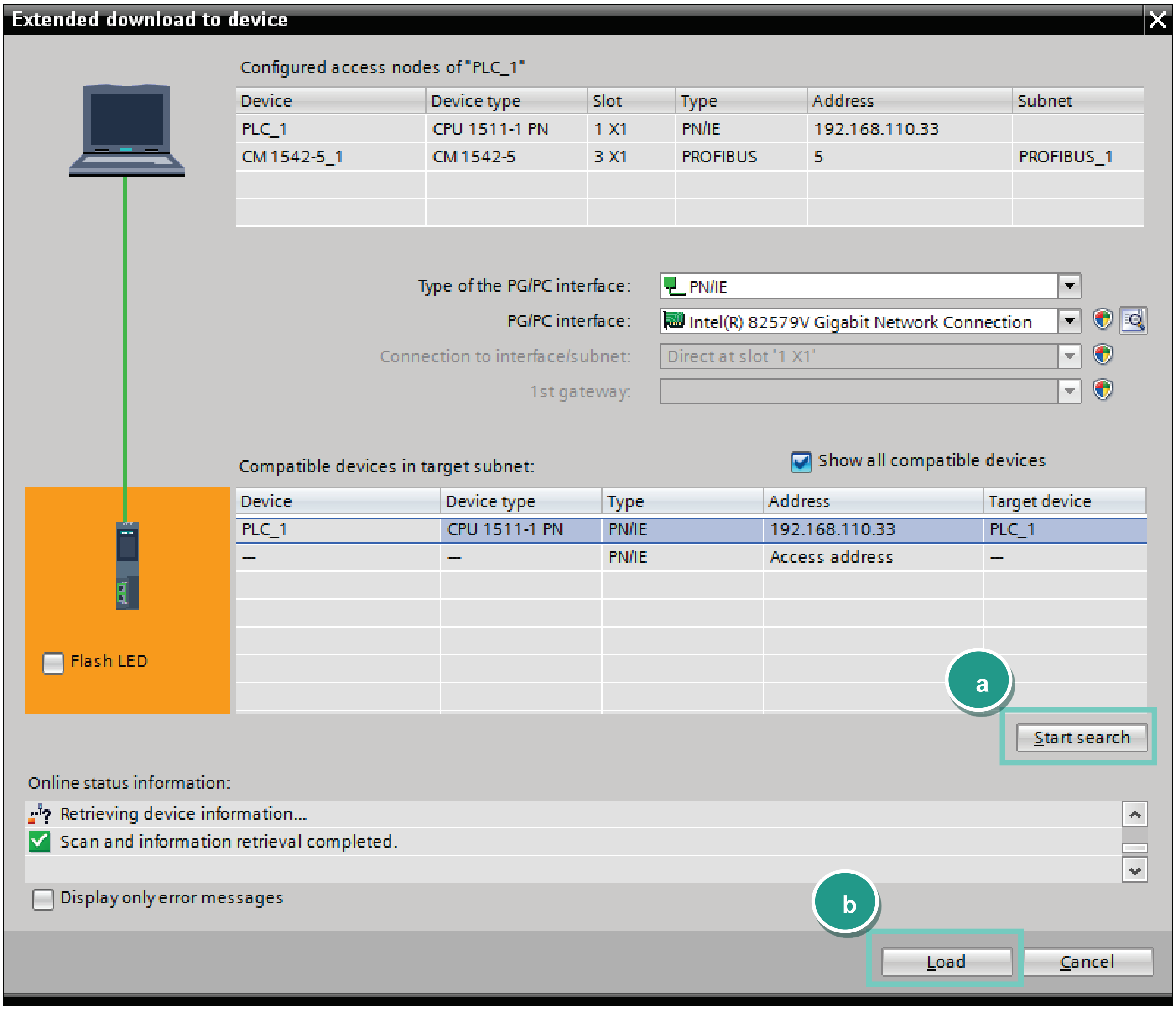
Router address: 0 . 0 . 0 . 0

○ IP address is set directly at the device

□ PROFINET device name is set directly at the device

☑ Generate PROFINET device name automatically

- To load the configuration into the CPU select it first go to ***Online->Download to device*** and click on ***Start search*** (a) to look for your controller. Then select the controller and click on ***Load*** (b):



Extended download to device

Configured access nodes of "PLC_1"

| Device | Device type | Slot | Type | Address | Subnet |
|---|---|---|---|---|---|
| PLC_1 | CPU 1511-1 PN | 1 X1 | PN/IE | 192.168.110.33 | |
| CM 1542-5_1 | CM 1542-5 | 3 X1 | PROFIBUS | 5 | PROFIBUS_1 |

Type of the PG/PC interface: PN/IE

PG/PC interface: Intel(R) 82579V Gigabit Network Connection

Connection to interface/subnet: Direct at slot '1 X1'

1st gateway:

Compatible devices in target subnet:

☑ Show all compatible devices

| Device | Device type | Type | Address | Target device |
|---|---|---|---|---|
| PLC_1 | CPU 1511-1 PN | PN/IE | 192.168.110.33 | PLC_1 |
| — | — | PN/IE | Access address | — |

Online status information:

Retrieving device information...

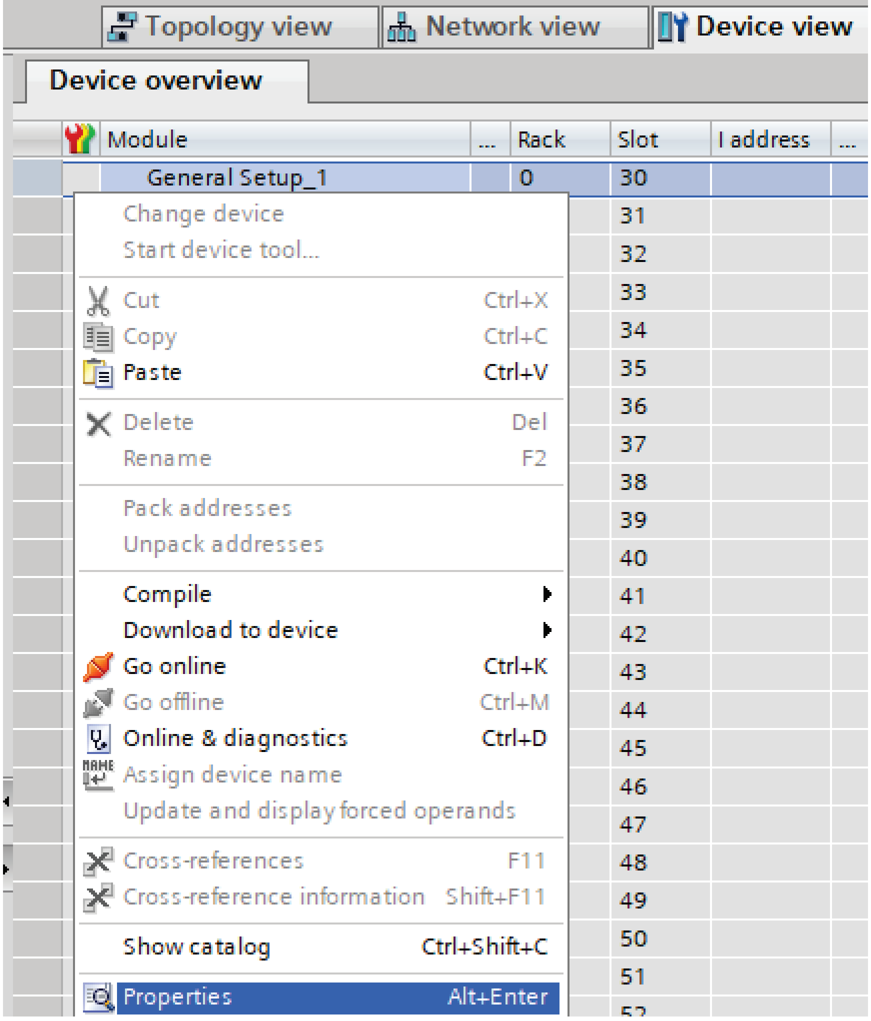
✓ Scan and information retrieval completed.

The DIGIFORCE® 9311 starts now a new measurement, wait a second, stops the measurement, wait a second and starts the measurement again and so on.

**Note:** Make sure that PROFINET Control is enabled in DIGIFORCE® 9311. For details, see chapter *4.5 Configuration menu in DIGIFORCE® 9311* of the **DIGIFORCE® 9311 PROFINET** manual.

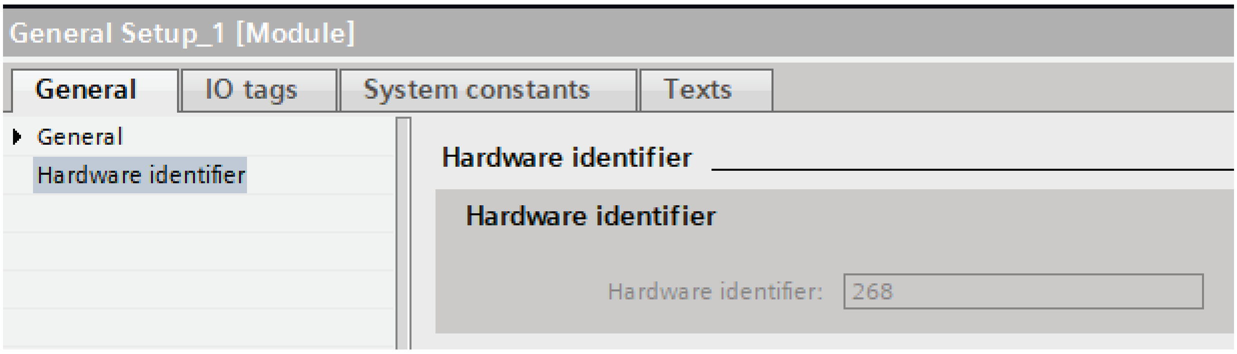
# 5. Further Examples

In the followed examples, a *Hardware-ID* is used to access a certain slot. To find this, please select a DIGIFORCE® 9311 device in **Topology view** or **Network view** and then switch to **Device view**. Click with the right mouse button on the desired module, e.g. *General Setup* and select ***Properties***:



| Module | ... | Rack | Slot | I address | ... |
|---|---|---|---|---|---|
| General Setup_1 | | 0 | 30 | | |
| | | | 31 | | |
| | | | 32 | | |
| | | | 33 | | |
| | | | 34 | | |
| | | | 35 | | |
| | | | 36 | | |
| | | | 37 | | |
| | | | 38 | | |
| | | | 39 | | |
| | | | 40 | | |
| | | | 41 | | |
| | | | 42 | | |
| | | | 43 | | |
| | | | 44 | | |
| | | | 45 | | |
| | | | 46 | | |
| | | | 47 | | |
| | | | 48 | | |
| | | | 49 | | |
| | | | 50 | | |
| | | | 51 | | |

You will see the hardware indentifier in the tab ***General***:



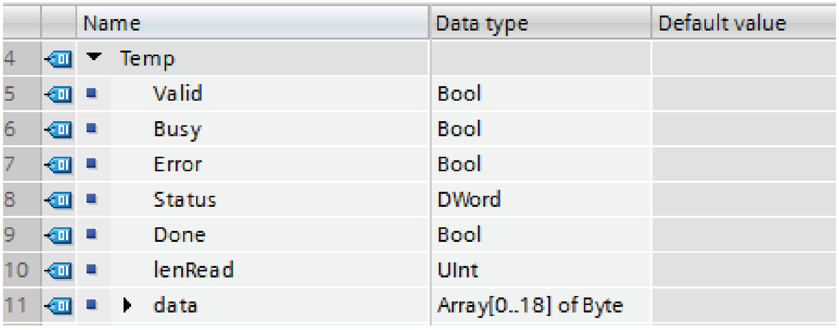
Hardware identifier: 268

## 5.1 Reading and Writing of string data types

**Example 1**: Reading Device ID and write it as station name to device

In this example, we perform a read access on slot 30/Subslot 1/index 10 to get the device type of DIGIFORCE® 9311 and then we will set the first nine characters of this string as DIGIFORCE® 9311 station name on Slot 30/Subslot 1/Index 17. For these acyclic operations, you will need an instance of RDREC und WRREC blocks. You can see the new station name in the **info menu** of DIGIFORCE® 9311.

**PLC parameters table:**



| | Name | Data type | Default value |
|---|---|---|---|
| 4 | ▼ Temp | | |
| 5 | ■ Valid | Bool | |
| 6 | ■ Busy | Bool | |
| 7 | ■ Error | Bool | |
| 8 | ■ Status | DWord | |
| 9 | ■ Done | Bool | |
| 10 | ■ lenRead | UInt | |
| 11 | ■ ▸ data | Array[0..18] of Byte | |

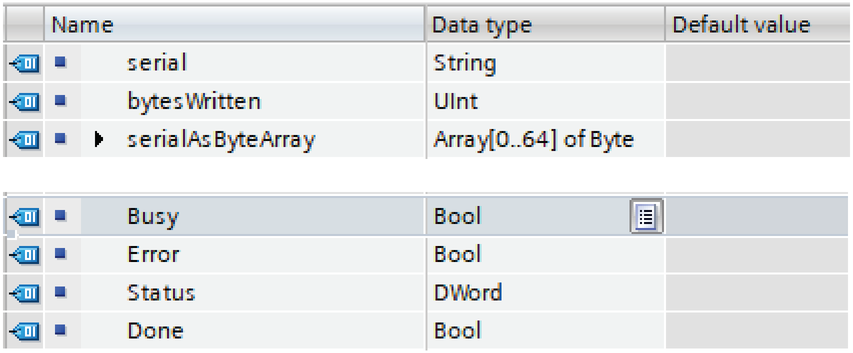
**Sourcecode:**

```
REPEAT
"RDREC_DB"(REQ:=TRUE,
        ID:=268,                 // 268: HW-ID for General Setup (see introduction of 'Further examples')
        INDEX:=10,               // Index 10: Device Detection
        MLEN:=18,                // Max. lenth of data to read
        VALID=>#Valid,           // New Data Received and valid
        BUSY=>#Busy,             // Read not completed yet
        ERROR=>#Error,           // Error
        STATUS=>#Status,         // State
        LEN=>#lenRead,           // Number of bytes was read from device
        RECORD:= #data);         // Array[0..18] of Byte
UNTIL NOT #Busy
END_REPEAT;

IF #Error = TRUE OR #Status <> 0 THEN
   RETURN;
END_IF;

REPEAT
"WRREC_DB"(REQ:=TRUE,
        ID:=268,                 // 268: HW-ID for General Setup (see introduction of 'Further examples')
        INDEX:=17,               // Index 17: Station Name
        LEN:=9,                  // Length of data to write
        DONE=>#Done,             // Write done
        BUSY=>#Busy,             // Write not completed yet
        ERROR=>#Error,           // Error
        STATUS=>#Status,         // State
        RECORD:=#data);  // Write the data has being read in RDREC_DB (first 9 bytes)
UNTIL NOT #Busy AND #Done
END_REPEAT;
```

**Example 2**: Writing of serial number SN1 into device order sheet

**Note:** Datatype **String** in TIA Portal contains two additional bytes, which represent the length of the string. To avoid these two bytes being sent use the function ‘Strg_TO_Chars’ to convert the String to a byte array as shown below:

**PLC parameters table:**



| Name | Data type | Default value |
|---|---|---|
| serial | String | |
| bytesWritten | UInt | |
| serialAsByteArray | Array[0..64] of Byte | |
| Busy | Bool | |
| Error | Bool | |
| Status | DWord | |
| Done | Bool | |

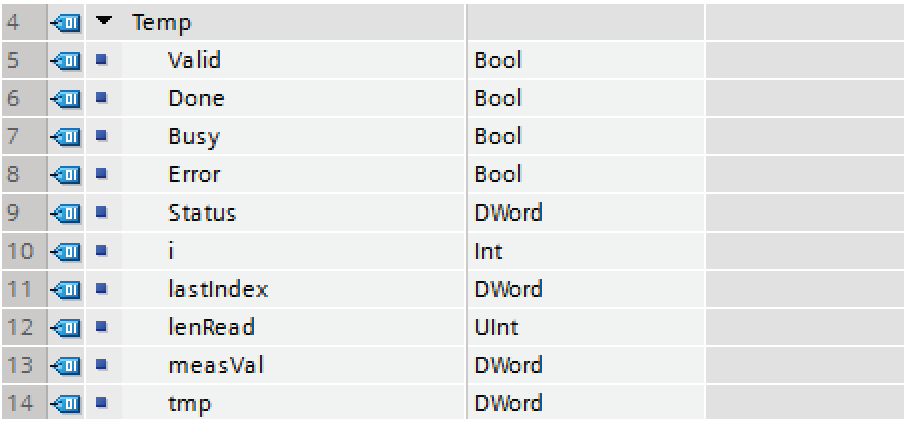
**Sourcecode:**

```
#serial := 'SN123456789';

Strg_TO_Chars(Strg:= #serial,                   // Serial as String
          pChars:= 0,                            // Position in serialAsByteArray
          Cnt => #bytesWritten,                  // Number of Bytes have been written to serialAsByteArray
          Chars:= #serialAsByteArray);

REPEAT
   "WRREC_DB"(REQ := TRUE,
          ID := 268,                             // HW-ID General Setup (see introduction of 'Further examples')
          INDEX := 65,                           // Index 65: Order sheet - Serial number 1
          LEN := INT_TO_UINT(LEN(#serial)),      // Length of serial
          DONE => #Done,                         // Write done
          BUSY => #Busy,                         // Write not completed yet
          ERROR => #Error,                       // Error
          STATUS => #Status,                     // State
          RECORD := #serialAsByteArray);
UNTIL NOT #Busy AND #Done
END_REPEAT;
```

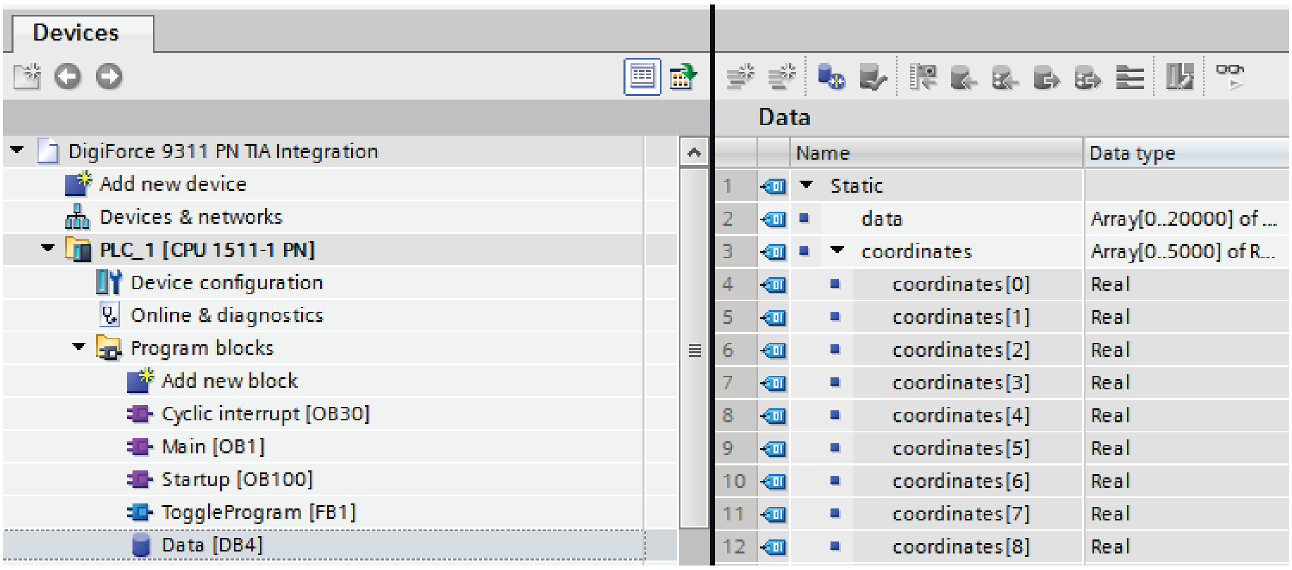
## 5.2 Retrieving of measurement results

This example shows you how to read the X-Coordinates of the current curve.

**PLC parameters table:**



| | Name | Data type | |
|---|---|---|---|
| 4 | ▼ Temp | | |
| 5 | ■ Valid | Bool | |
| 6 | ■ Done | Bool | |
| 7 | ■ Busy | Bool | |
| 8 | ■ Error | Bool | |
| 9 | ■ Status | DWord | |
| 10 | ■ i | Int | |
| 11 | ■ lastIndex | DWord | |
| 12 | ■ lenRead | UInt | |
| 13 | ■ measVal | DWord | |
| 14 | ■ tmp | DWord | |



Devices

- ▼ DigiForce 9311 PN TIA Integration
  - Add new device
  - Devices & networks
  - ▼ PLC_1 [CPU 1511-1 PN]
    - Device configuration
    - Online & diagnostics
    - ▼ Program blocks
      - Add new block
      - Cyclic interrupt [OB30]
      - Main [OB1]
      - Startup [OB100]
      - ToggleProgram [FB1]
      - Data [DB4]

Data

| | Name | Data type |
|---|---|---|
| 1 | ▼ Static | |
| 2 | ■ data | Array[0..20000] of ... |
| 3 | ■ ▼ coordinates | Array[0..5000] of R... |
| 4 | ■ coordinates[0] | Real |
| 5 | ■ coordinates[1] | Real |
| 6 | ■ coordinates[2] | Real |
| 7 | ■ coordinates[3] | Real |
| 8 | ■ coordinates[4] | Real |
| 9 | ■ coordinates[5] | Real |
| 10 | ■ coordinates[6] | Real |
| 11 | ■ coordinates[7] | Real |
| 12 | ■ coordinates[8] | Real |

**Sourcecode:**

```
REPEAT
    "WRREC_DB"(REQ := TRUE,                      // Write access to index 10 to prepare the curve
             ID := 352,                          // Hardware-ID  (see introduction of 'Further examples')
             INDEX := 10,                        // Index
             LEN := 2,                           // Length in bytes to write
             DONE => #Done,
             BUSY => #Busy,
             ERROR => #Error,
             STATUS => #Status,
             RECORD := "Data".data);             // Any 2 bytes to prepare the curve
UNTIL NOT #Busy AND #Done
END_REPEAT;

IF #Error = TRUE OR #Status <> 0 THEN
  RETURN;                                        // If write failed -> return
END_IF;
```

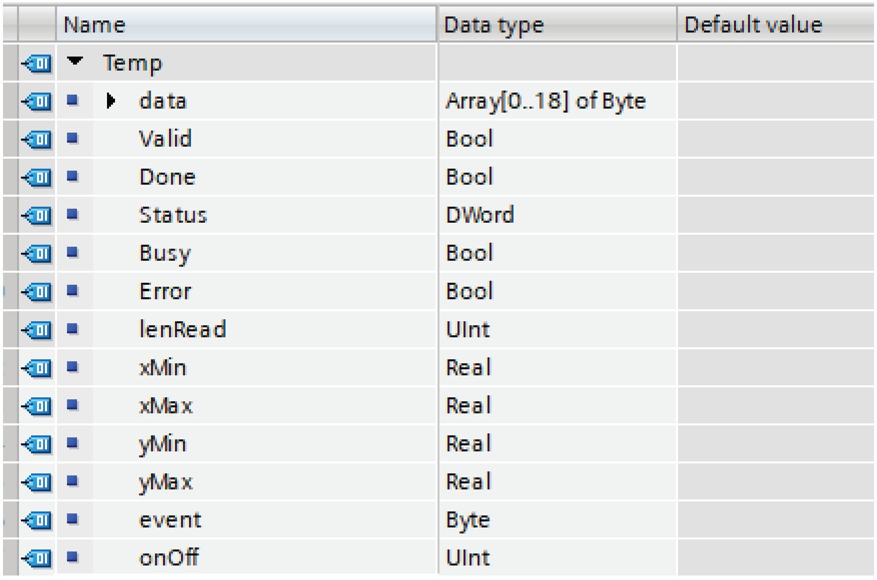
```
REPEAT
    "RDREC_DB"(REQ := TRUE,                      // Read the number of curve values
            ID := 352,                           // Hardware-ID (see introduction of 'Further examples')
            INDEX := 10,                         // Index
            MLEN := 4,                           // Max. length to read
            VALID => #Valid,
            BUSY => #Busy,
            ERROR => #Error,
            STATUS => #Status,
            LEN => #lenRead,                     // Number of bytes read
            RECORD := #lastIndex);               // Number of values in the curve - 1
UNTIL NOT #Busy
END_REPEAT;

#lastIndex := SHR(IN := #lastIndex, N := 16);    // upto and including DIGIFORCE® 9311 field bus
                                                 firmware FW-2018.1.0 we have to use DWord to get
                                                 U16 Types from DIGIFORCE® 9311 and shift left the
                                                 result by 2 bytes

IF #Error = TRUE OR #Status <> 0 OR #lenRead <> 2
OR #lastIndex = 0 THEN                           // If read failed -> return
     RETURN;
END_IF;
REPEAT
     "RDREC_DB"(REQ := TRUE,
            ID := 352,                           // Read access to read out curve coordinates
            INDEX := 11,                         // Hardware-ID (see introduction of 'Further examples')
            MLEN := 20000,                       // Index
            VALID => #Valid,                     // Max. length to read
            BUSY => #Busy,
            ERROR => #Error,
            STATUS => #Status,
            LEN => #lenRead,
            RECORD := "Data".data);              // Number of bytes read
UNTIL NOT #Busy                                  // Array to store the read coordinates
END_REPEAT;

IF #Error = TRUE OR #Status <> 0 OR #lenRead < 4
THEN                                             // If read failed -> return
     RETURN;
END_IF;

FOR #i := 0 TO DWORD_TO_INT(#lenRead - 1) BY 4
DO                                               // Write bytes to DWORD and convert to Real
     #measVal := 0;
     #tmp := BYTE_TO_DWORD("Data".data[#i]);
     #measVal := #measVal + SHL(IN := #tmp, N := 24);     // Shift left the value by 24 bit
     #tmp := BYTE_TO_DWORD("Data".data[#i + 1]);
     #measVal := #measVal + SHL(IN := #tmp, N := 16);     // Shift left the value by 16 bit
     #tmp := "Data".data[#i + 2];
     #measVal := #measVal + SHL(IN := #tmp, N := 8);      // Shift left the value by 8 bit
     #measVal := #measVal + "Data".data[#i + 3];
     "Data".coordinates[#i / 4] :=               // Convert to Real and store in MeasValues[] Array
DWORD_TO_REAL(#measVal);
END_FOR;
```

## 5.3 Changing of window limits

This example shows you how to enable Evaluation Window 1 and set its coordinates.

**Note:** You have to write all four window limits and then confirm them with index 15. It is not possible to change only one single limit, e.g. xMax.

**PLC parameters tables:**



| Name | Data type | Default value |
|---|---|---|
| ▼ Temp | | |
| ▶ data | Array[0..18] of Byte | |
| Valid | Bool | |
| Done | Bool | |
| Status | DWord | |
| Busy | Bool | |
| Error | Bool | |
| lenRead | UInt | |
| xMin | Real | |
| xMax | Real | |
| yMin | Real | |
| yMax | Real | |
| event | Byte | |
| onOff | UInt | |

**Sourcecode:**

```
#onOff := 1;                      // Activate Window 1
#event := 1;                      // Acknowledgement for indices 11, 12, 13,14

#xMin := 1.5;                     // Xmin coorrdinate of window 1
#xMax := 3.0;                     // Xmax coorrdinate of window 1
#yMin := 2.5;                     // Ymin coorrdinate of window 1
#yMax := 4.0;                     // Ymax coorrdinate of window 1

REPEAT
  "WRREC_DB"(REQ := TRUE,
        ID := 286,                //  HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
        INDEX := 10,              // Index 10: switch on window 1
        LEN := 2,                 // Length of UINT16
        DONE => #Done,            // Write done
        BUSY => #Busy,            // Write not completed yet
        ERROR => #Error,          // Error
        STATUS => #Status,        // State
        RECORD := #onOff);
UNTIL NOT #Busy AND #Done
END_REPEAT;

REPEAT
  "WRREC_DB"(REQ := TRUE,
        ID := 286,                // 286: HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
        INDEX := 11,              // Index 11: Window 1 limit Xmin
        LEN := 4,                 // Length of UINT16
        DONE => #Done,            // Write done
        BUSY => #Busy,            // Write not completed yet
```

```
            ERROR => #Error,            // Error
            STATUS => #Status,          // State
            RECORD := #xMin);
UNTIL NOT #Busy AND #Done
END_REPEAT;

REPEAT
   "WRREC_DB"(REQ := TRUE,
            ID := 286,                  // HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
            INDEX := 12,                // Index 12: Window 1 limit Xmax
            LEN := 4,                   // Length of Real
            DONE => #Done,              // Write done
            BUSY => #Busy,              // Write not completed yet
            ERROR => #Error,            // Error
            STATUS => #Status,          // State
            RECORD := #xMax);
UNTIL NOT #Busy AND #Done
END_REPEAT;

REPEAT
   "WRREC_DB"(REQ := TRUE,
            ID := 286,                  // HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
            INDEX := 13,                // Index 13: Window 1 limit Ymin
            LEN := 4,                   // Length of Real
            DONE => #Done,              // Write done
            BUSY => #Busy,              // Write not completed yet
            ERROR => #Error,            // Error
            STATUS => #Status,          // State
            RECORD := #yMin) ;
UNTIL NOT #Busy AND #Done
END_REPEAT;

REPEAT
   "WRREC_DB"(REQ := TRUE,
            ID := 286,                  // HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
            INDEX := 14,                // Index 14: Window 1 limit Ymax
            LEN := 4,                   // Length of Real
            DONE => #Done,              // Write done
            BUSY => #Busy,              // Write not completed yet
            ERROR => #Error,            // Error
            STATUS => #Status,          // State
            RECORD := #yMax);
UNTIL NOT #Busy AND #Done
END_REPEAT;

REPEAT
   "WRREC_DB"(REQ := TRUE,
            ID := 286,                  //  HW-ID for Evaluation Window 1 (see introduction of 'Further examples')
            INDEX := 15,                // Index 15: adopt values entered into indices 11, 12, 13,14
            LEN := 1,                   // Length of Real
            DONE => #Done,              // Write done
            BUSY => #Busy,              // Write not completed yet
            ERROR => #Error,            // Error
            STATUS => #Status,          // State
            RECORD := #event);
UNTIL NOT #Busy AND #Done
END_REPEAT;
```