EN

BB1C

Control Unit with Profinet

Interface Protocol

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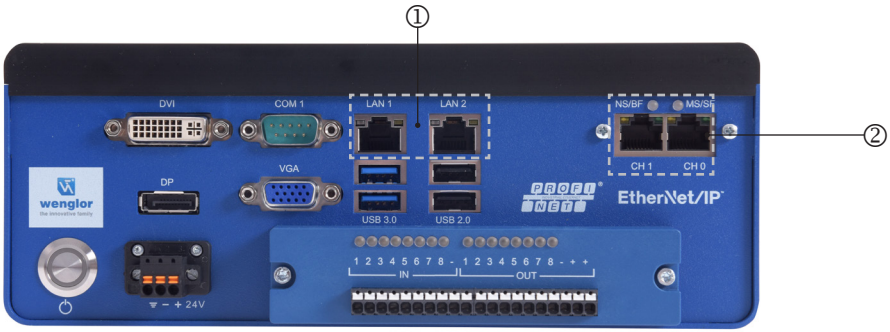
1. Use for Intended Purpose

The control unit with digital cameras or 2D/3D profile sensors is able to communicate with a PLC via Profinet. Thus, an exchange of process data between the control unit and the PLC is possible. Furthermore, the control unit sends a status to the PLC, which in turn can send commands to the control unit.

NOTE!
In the manual, the Profinet integration is shown with a control unit BB1C1xx and a Siemens S7-1200 PLC with TIA Portal V15. Details about the BB1C5xx control units can be found in the corresponding hardware manual.

2. Network Overview



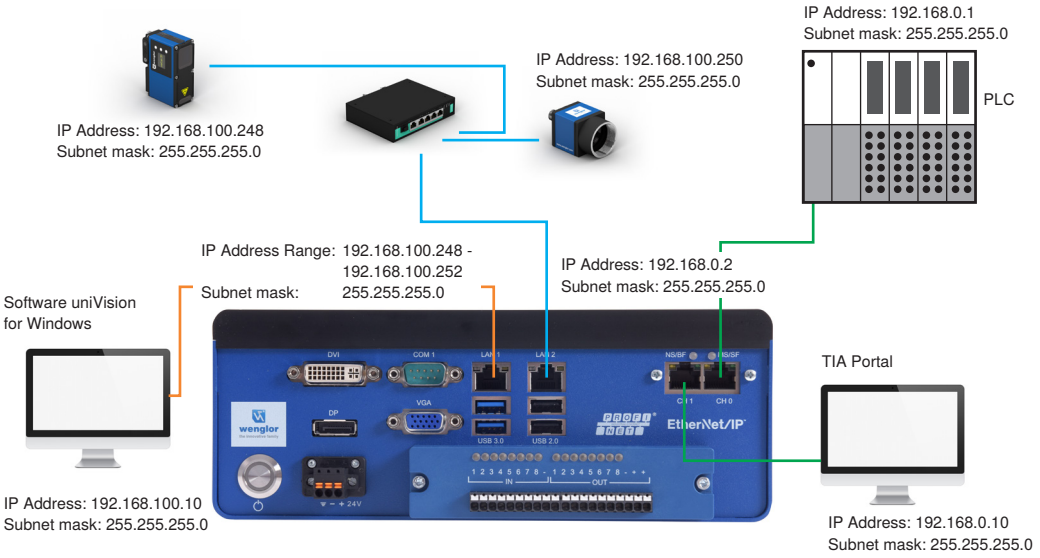
- Use LAN1 and LAN2 (Number 1) to connect digital cameras or 2D/3D profile sensors to the control unit. Further network functionalities (e.g. software uniVision for Windows, website, process data via TCP, UDP and FTP) are available via LAN1 and LAN2.
- Use CH0 and CH1 (Number 2) only for Profinet communication with a PLC. Do not use any hub in the Profinet network. A switch may be used if both Priority Tagging and LLPD (100 Mbit/s, Full Duplex) are supported.

NOTE!
The two PROFINET connections on the front of the BB1C5xx control units are not labeled. Details about the position of the PROFINET connectors of the BB1C5xx can be found in the corresponding hardware manual.

Profinet LEDs at the control unit BB1C1xx (on the BB1C5xx control units, the MS/SF or the NS/BF LEDs are not visible):

LED	Color	State	Meaning
MS/SF (System error)	(Off)	Off	No error
	(Red)	Flashing (1 Hz, for 3 s)	DCP (discovery and configuration protocol) signal activated by the PLC to find the relevant Profinet device.
	(Red)	On	System error
NS/BF (Bus error)	(Off)	Off	No error
	(Red)	Flashing (2 Hz)	No data exchange
	(Red)	On	• No Profinet configuration • Slow or missing physical connection
LINK (CH0 & CH1)	(Green)	On	• Ethernet connection is available.
	(Off)	Off	• No Ethernet connection available.
RX/TX (CH0 & CH1)	(Yellow)	Flashing	Control unit sends or recieves Ethernet frames: • 10 Hz for much Ethernet traffic • Unregular intervals for low Ethernet traffic
	(Off)	Off	• Control unit sends or recieves no Ethernet frames

Example: A network consists of digital cameras, weCat3D sensors and a PC with the software uniVision. Another network is used for Profinet communication with the PLC and for a PC with the software TIA Portal.



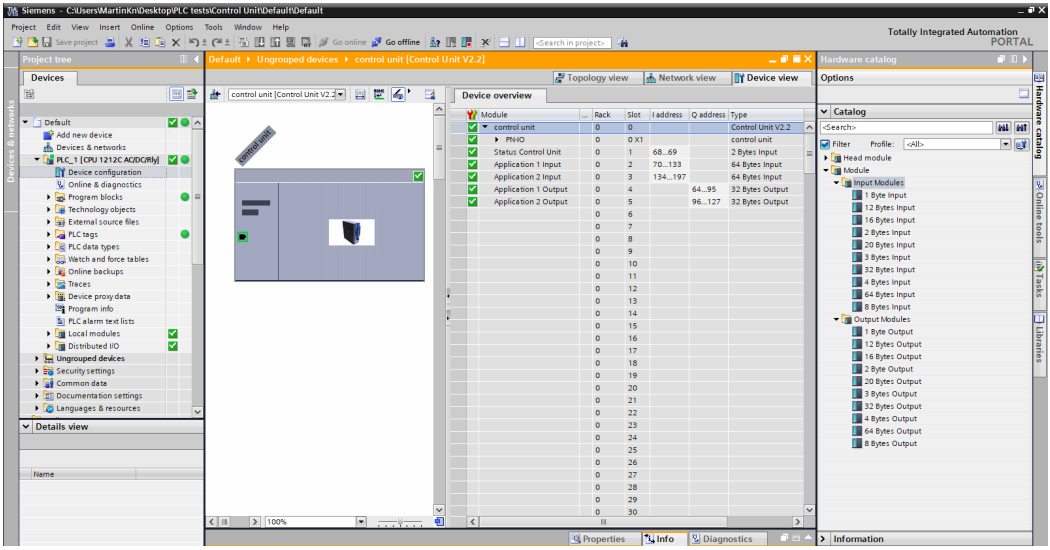
3. Input and Output Data

In the view of the PLC the following input and output data is available:

- Control unit
  - Inputs (Device to PLC)
    - 2 bytes: Status
- For each uniVision application
  - Inputs (Device to PLC)
    - 2 bytes: Status
    - x bytes: User-defined process data
  - Outputs (PLC to device)
    - 4 bytes: Commands
    - x bytes: User-defined process data

NOTE!
The size of the user-defined inputs and outputs is depending on the configuration file. Details about the configuration files are available in the attachement of the manual (see section “7. Attachements”, page 30).

Example: The following example shows the default configuration on the control unit. It is possible to transfer input and output data with up to two uniVision applications.



NOTE!
Input and output slots of the control unit must be added consecutively (without gaps and in the right order!) in order to use the address offsets provided in the uniVision project.

3.1 Status

Each uniVision device sends a two byte status information to the PLC. The following status bits are valid for each uniVision device. Not used bits are set to false.

Control Unit

Name	Data type	Bit	Description
Operation ready	Bool	0	Is true if the control unit is ready for operation.

uniVision Application

Name	Data type	Bit	Description
Operation ready	Bool	0	Is true if the uniVision application is ready for operation. Possible reasons for operation not ready: • The control unit has not yet fully booted or the start project is not yet fully loaded. • A project is currently being loaded in the uniVision application. • No network connection between acquiring device (e.g. digital camera) and control unit • Power supply of acquiring device (e.g. digital camera) is off • uniVision application cannot connect to the acquiring device because of an open connection from another uniVision application • No acquiring device is selected in the uniVision project
Toggle	Bool	1	Changes every time a data evaluation is completed. It can be used to check for new measurement results.
Processing	Bool	2	Is true when the uniVision application is evaluating data.
Command Acknowledge	Bool	3	Is an echo signal of the command signal to verify that the command is received.
Command Ready	Bool	4	Is true if the uniVision application is ready to receive commands. **NOTE!** Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.
Command Error	Bool	5	Is true if there was an error in the command. Possible reasons for command errors: • Several commands are sent at the same time • Command parameter contains an invalid entry • Command load project fails because the project is not available.

Example: The following example shows the status bits of a uniVision application in TIA Portal.

	Name	Address	Display format	Monitor value
1	"Operation Ready"	%I70.0	Bool	TRUE
2	"Toggle Bit"	%I70.1	Bool	FALSE
3	"Processing"	%I70.2	Bool	FALSE
4	"Command Acknowledge"	%I70.3	Bool	FALSE
5	"Command Ready"	%I70.4	Bool	TRUE
6	"Command Error"	%I70.5	Bool	FALSE

3.2 Commands

Commands (e.g. trigger command) are sent from the PLC to the uniVision application. In total the commands consist of four bytes – separated in the first two bytes for the commands and the second two bytes for a command parameter.

NOTE!
Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.

Commands for uniVision application (first two bytes)

Name	Data type	Bit	Description
Reserved	Bool	0	Not used
Load project	Bool	1	When the value is changed from FALSE to TRUE, the uniVision Application loads the project that defined by the command parameter 0. **NOTE!** For loading projects via profinet all projects must be saved in the following format: “xxx_testproject.u_p” (x = any integer from 0 to 9). A maximum of 255 projects can be used for all the applications combined. The project numbers can be set between 1 and 255. Every uniVision project filed needs an unambiguous number.
Reserved	Bool	2	Not used
Trigger	Bool	3	When the value is changed from FALSE to TRUE, the uniVision Application sends a trigger command to the acquiring device (e.g. digital camera). **NOTE!** The trigger source of the acquiring device must be set to software in order to enable triggering via Profinet. In the case of digital cameras, the “Start exposure” trigger selector must be selected for this purpose, and the “Line start” trigger selector must be selected for 2D/3D profile sensors.

Acquisition	Bool	4	When the value is changed from FALSE to TRUE, the uniVision Application starts or stops acquisition – depending on the command parameter. • Command parameter 0: Value 0 – Stops the acquisition • Command parameter 0: Value 1 – Starts the acquisition **NOTE!** Only when acquisition is active, the device is ready to receive trigger signals. After the system start or after loading a project, the acquisition is automatically started.

Command parameter for uniVision application (second 2 bytes)

Name	Data type	Byte	Description
Parameter 0	Byte	3	Low byte of command parameter
Parameter 1	Byte	4	High byte of command parameter

Example: The following example shows the command bits of a uniVision application in TIA Portal.

	i	Name	Address	Display format	Monitor value
34		"Load project"	%Q64.1	Bool	FALSE
35		"Trigger"	%Q64.3	Bool	FALSE
36		"Acquisition"	%Q64.4	Bool	FALSE
37		"Parameter Low"	%QB66	DEC	0
38		"Parameter High"	%QB67	DEC	0

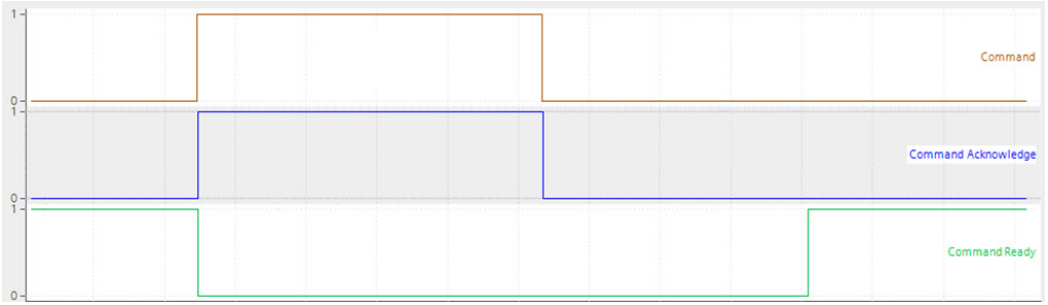
3.3 Commands and Status

For each command that is sent from the PLC to the uniVision application, an answer is sent back from the uniVision application to the PLC via the status bits.

NOTE!
Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.

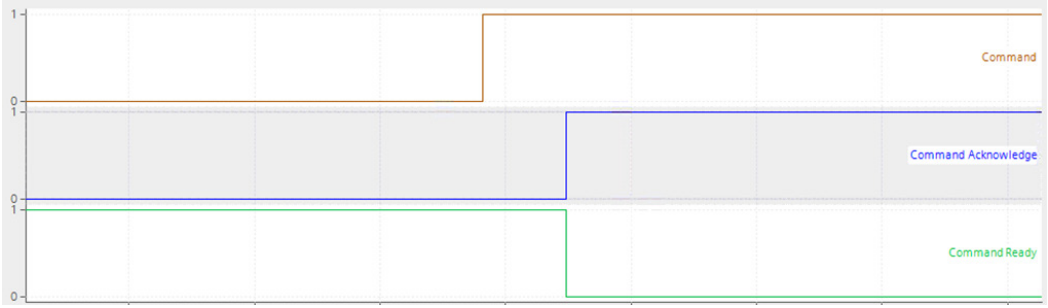
3.3.1 General Command and Status Behavior

The following example for a command and its status bits is valid for all types of commands.



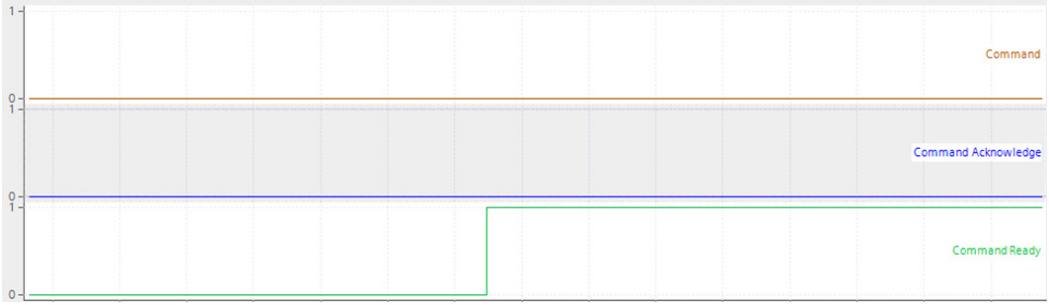
Explanation:

- The command (e.g. load project command) is sent from the PLC to the uniVision application.
- The uniVision application answers with the status bits after receiving the command:
  - The command acknowledge signal switches from FALSE to TRUE (echo signal of command)
  - The command ready signal switches from TRUE to FALSE



- When the command that is sent from PLC to the uniVision application is removed, the command acknowledge signal switches from TRUE to FALSE. (echo signal of the command).

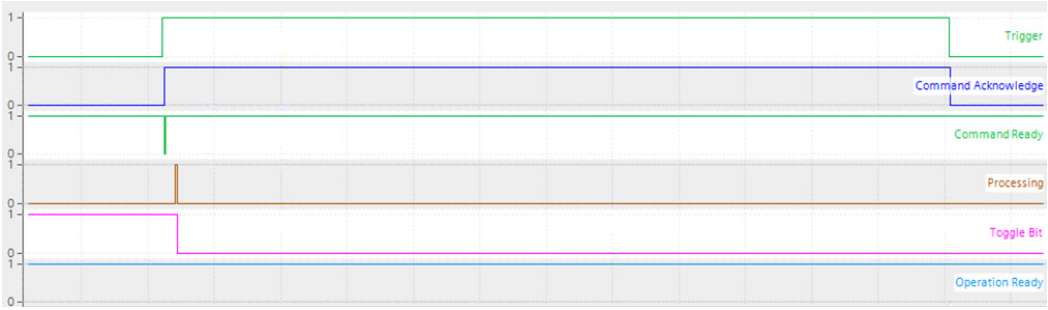
- When the execution of the command is finished, the command ready signal switches from FALSE to TRUE and the uniVision application is ready to receive a new command.



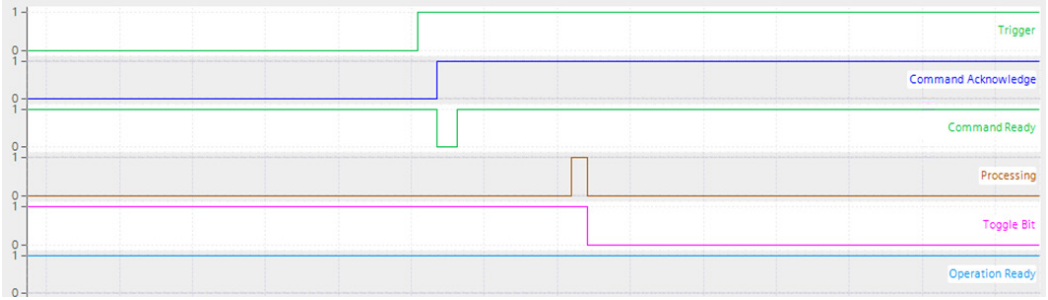
3.3.2 Trigger Command

When sending a trigger command from the PLC to the uniVision application, the application forwards the trigger command to the acquiring device (e.g. digital camera). An image or a profile is captured by the acquiring device.

NOTE!
Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.



- When the uniVision application receives the trigger command, the command acknowledge signal switches from FALSE to TRUE and the command ready signal switches from TRUE to FALSE.
- When the acquiring device confirmed that it received the trigger command, the command ready signal switches from FALSE to TRUE.
- Then the data recording (e.g. image or profile capturing) takes place and the data is sent via network to the control unit.
- As long as the uniVision application evaluates the data (e.g. image or profile), the processing signal is set to TRUE.
- As soon as the evaluation has finished, the processing signal switches from TRUE to FALSE, the toggle bit changes and all user-defined process data are available.



NOTE!

- After starting the control unit or after loading a project via Profinet, a command (e.g. trigger command) can be sent as soon as the command ready signal has switched from TRUE to FALSE.
- Use the toggle bit from the status to identify if the results that belong to the trigger signal are already available.
- Status signals of the uniVision application often apply for a very short time as data evaluation, for example, is very fast, depending on the size of the project. In order to still receive, e.g., all processing signals on the control, the Profinet cycle time may only be half the length of the command's process time. It is recommended to use a Profinet cycle time of 1 ms at a maximum.

3.3.3 Load Project Command

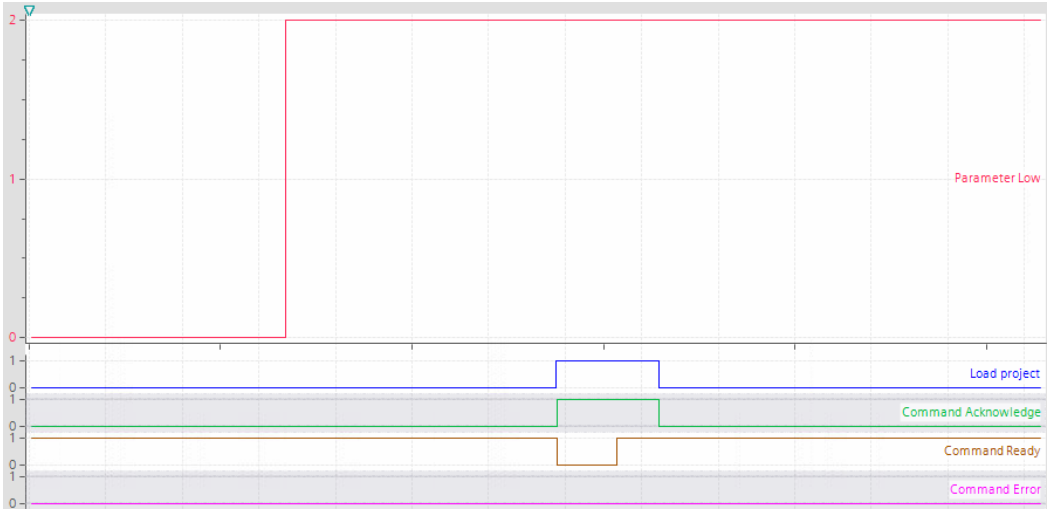
When sending a load project command from the PLC to the uniVision application, the uniVision application loads the project defined by the command parameter 0. The number that is used in the project name must be sent by the command parameter.

NOTE!

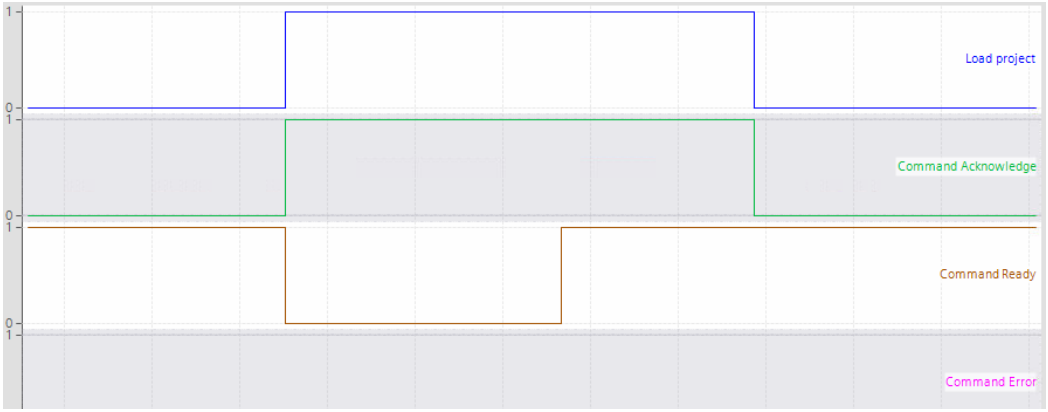
For loading projects via profinet all projects must be saved in the following format: "xxx_test-project.u_p" (x = any integer from 0 to 9).
For example 002_MyProject.u_p
A maximum of 255 projects can be loaded for all the applications combined. The project numbers can be set between 1 and 255. Every uniVision project filed needs an unambiguous number.

NOTE!

Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.



- Command parameter 0 must be set according to the number in the project file name.



- When the load project command is received by the uniVision application, the command acknowledge signal switches from FALSE to TRUE and the command ready signal switches from TRUE to FALSE.
- When the project is loaded successfully, the command ready signal switches from FALSE to TRUE.
- After removing the load project command signal, the command acknowledge signal switches from TRUE to FALSE as well.

NOTE!

- The project is loaded completely when the command ready signal has switched back to TRUE and when there was no command error. Hereafter, the next command (e.g. trigger command) can directly be sent to the uniVision application.
- For more details the project number can also be sent as process data from the control unit to the PLC. Process data are updated with each data evaluation because of a trigger signal (for more details “3.4 User-Defined Process Data”, starting from 15).

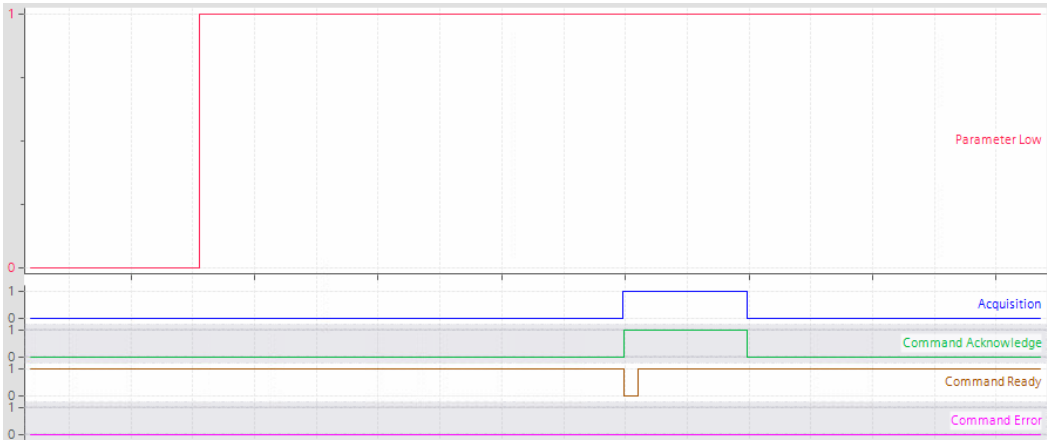
3.3.4 Start/Stop Acquisition Command

When sending an acquisition start or stop command, the uniVision application is ready or no longer ready to receive trigger signals. Depending on the command parameter, the acquisition can be started or stopped. The trigger signals can be generated for this purpose internally by the device itself or via an external interface (e.g. digital inputs or Profinet):

- Command parameter 0: Value 0 – Stops the acquisition
- Command parameter 0: Value 1 – Starts the acquisition

NOTE!
Only when acquisition is active, the device is ready to receive trigger signals. After the system start or after loading a project, the acquisition is automatically started. The trigger signals can be generated for this purpose internally by the device itself or via an external interface (e.g. digital inputs or Profinet):

NOTE!
Commands to uniVision devices may only be sent if the command ready signal is active. The status of the command ready signal must therefore be checked before commands are sent.



- The value of the command parameter 0 must be set to 0 or 1 – depending on starting or stopping the acquisition.

- When the acquisition start or stop command is received by the uniVision application, the command acknowledge signal switches from FALSE to TRUE and the command ready signal switches from TRUE to FALSE.
- When the acquisition has started or stopped successfully, the command ready signal switches from FALSE to TRUE.
- After removing the acquisition start or stop command signal, the command acknowledge signal switches from TRUE to FALSE as well.

3.4 User-Defined Process Data

User-defined process data are configured in the uniVision project. Process data can be sent from the device to the PLC and from the PLC to the device. Details are described in the control unit settings (see section “4.3 Device Industrial Ethernet”, page 18).

NOTE!
Compared to commands and status data that is continuously updated, process data is only evaluated and sent when data (e.g. image or profile) is executed because of a trigger signal.

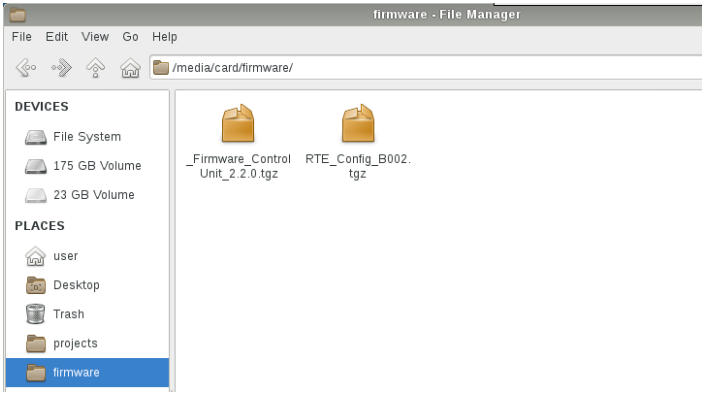
4. Control Unit Settings

4.1 Installation of Configuration Files

The control unit supports several fix configuration layouts for the Profinet communication. A detailed list of available configuration files is listed in the attachement (see section “7. Attachements”, page 30). The default configuration of the control unit works for two uniVision applications.

NOTE!
The Profinet communication is supported for the control units BB1C1xx starting with the firmware version 2.2.0. The BB1C5xx control units are supported from firmware 2.6.1. After a firmware update of the control unit, the configuration file is automatically reset to the standard configuration. It is therefore necessary to reinstall the corresponding configuration file after a firmware installation in the control unit.

Procedure to change the configuration of the control unit:
1. Select suitable configuration file (see section “7. Attachements”, page 30)
2. Download configuration file from wenglor website
3. Copy tgz configuration file to firmware folder on the control unit
   a. Via USB stick and copying the file on the control unit to /media/card/firmware

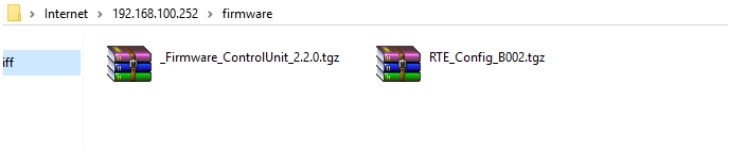


   b. Via FTP transfer to the firmware folder of the control unit.

NOTE!
For the FTP transfer a network connection from the Windows PC to the control unit is necessary. Then open the file manager and type in ftp:// + IP Address of the control unit.

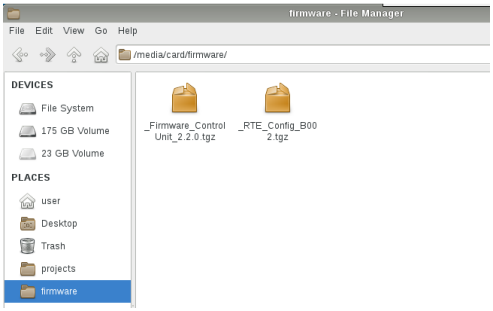
Example with the default IP Address of the control unit: ftp://192.168.100.252
Login data:

- User name: ftpuser
- Password: ftpvision



4. Restart the control unit to install the configuration file (via Menu -> Reboot).

The control unit restarts and installs the configuration file. After the successful installation, an underline is added at the beginning of the file name of the configuration file.



Open the RTE_Config.log file in order to check the currently installed configuration.

4.2 Setup uniVision Applications and Projects

In order to create a communication between the uniVision application and the PLC, the following steps are necessary:

- Setup network configuration of control unit for LAN1 and LAN2
- Add acquiring devices (e.g. digital cameras) to the control unit
- Create uniVision applications
- Create and save uniVision projects
- Setup startup behavior for uniVision applications

NOTE!
Details about all listed steps are explained in the uniVision software manual.

4.3 Device Industrial Ethernet

Add Device Industrial Ethernet from the toolbox to the project navigator in order to configure the user-defined input and output data.

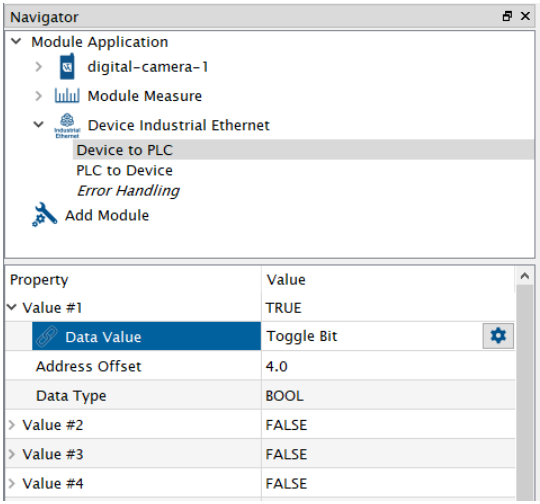
NOTE!
Compared to commands and status data that is continuously updated, process data is only evaluated and sent when data (e.g. image or profile) is executed because of a trigger signal. Adding the Device Industrial Ethernet is only possible if a uniVision application and a real acquiring device are connected. Device Industrial Ethernet cannot be added in offline projects.

Properties

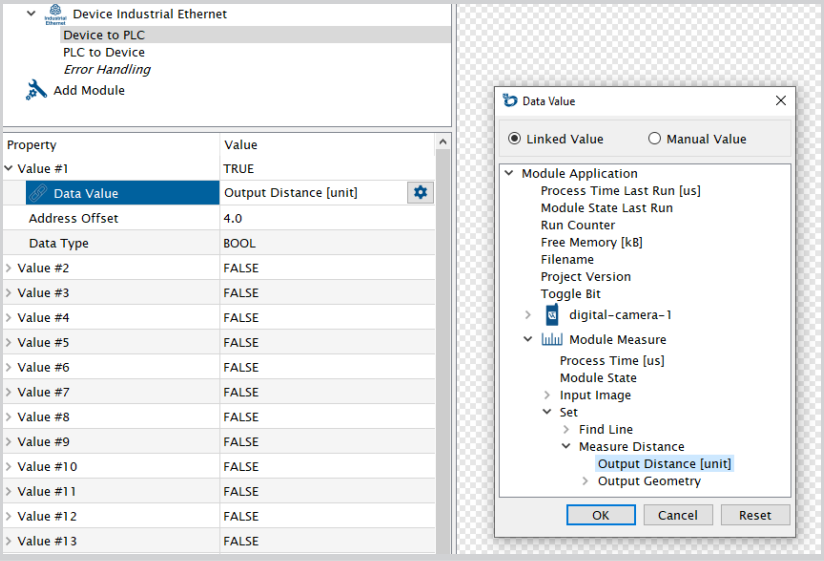
Property	Description
Process Time [us]	Time in μs for processing the module.
Module State	Signals the status of the module: • 0: No error • Value different to 0: Error (Details about the error code are available in the uniVision software manual)
Error Handling	If any process data is in error state, it is substituted by a user-defined replacement value.

4.3.1 Device to PLC

Depending on the configuration of the control unit, a list of all available process data (uniVision project results) appears.



Property	Description
Value	Shows the result of the process data (uniVision project result).
Data Value	Output can be set manual to a certain value or can be linked with any result of the project.



Data Value	**NOTE!** • Use BOOL to send or receive true/false results (e.g. toggle bit). • Use REAL to send or receive numbers with positions after decimal point (e.g. x value of a found point). • Use DINT to send or receive numbers without positions after decimal point (e.g. pixel count value of Module Threshold). • Use CHAR to send or receive text information (e.g. code result). Linking results to the different data type works the following way: • BOOL (output) – Link BOOL result: Returns true or false depending on value of bool – Link DINT or REAL result: Returns true if current value is within thresholds (between minimal and maximal thresholds) and returns false if current value is out of tolerance (lower than minimal or higher than maximal threshold) – Link CHAR: Returns true if the text is not empty and returns false if the text is empty. • DINT (output) – Link BOOL result: Returns 0 for bool value false and 1 for bool value true. – Link DINT: Returns current DINT value – Link REAL: Returns number without digits after the comma (no rounding!) – Link CHAR: Returns the number of digits of the text • REAL (output) – Link BOOL result: Returns 0 for bool value false and 1 for bool value true. – Link DINT or REAL: Returns number with digits after the comma – Link CHAR: Returns the number of digits of the text • CHAR (output) – Link BOOL result: Returns false for bool value false and true for bool value true – Link DINT or REAL: Returns the number – Link CHAR: Returns the text
Address Offset	Shows the address offset for the value. **NOTE!** To use the address offsets it is necessary to use consecutive input and output data for the control unit. The address offset has to be added to the first input or output address that is used for the control unit.
Data Type	Shows the data type of the value

4.3.2 PLC to Device

Depending on the configuration of the control unit, a list of all available process data (uniVision project inputs) appears.

Property	Description
Value	Shows the result of the value (uniVision input value)
Data Value	Shows the result of the value (uniVision input value) **NOTE!** Process data from the PLC to the uniVision application is recieved when an image or a profile is evaluated in the uniVision application because of a trigger signal.
Address Offset	Shows the address offset for the value. **NOTE!** To use the address offsets it is necessary to use consecutive input and output data for the control unit. The address offset has to be added to the first input or output address that is used for the control unit.
Data Type	Shows the data type of the value

4.3.3 Error Handling

If any process data is in error state, the substitution value can be selected for each data type.

Property	Description
Substitute Bool Types by	If a bool type used in Device Industrial Ethernet is in error state, it is replaced by low or high (Default: low).
Substitute INT Types by	If an INT type used in Device Industrial Ethernet is in error state, it is replaced by any user-defined INT value (Default: 0).
Substitute DOUBLE Types by	If a DOUBLE type used in Device Industrial Ethernet is in error state, it is replaced by any user-defined DOUBLE value (Default: 0.0000)
Substitute STRING Types by	If a STRING type used in Device Industrial Ethernet is in error state, it is replaced by any user-defined STRING value (Default: Error).

5. PLC Settings

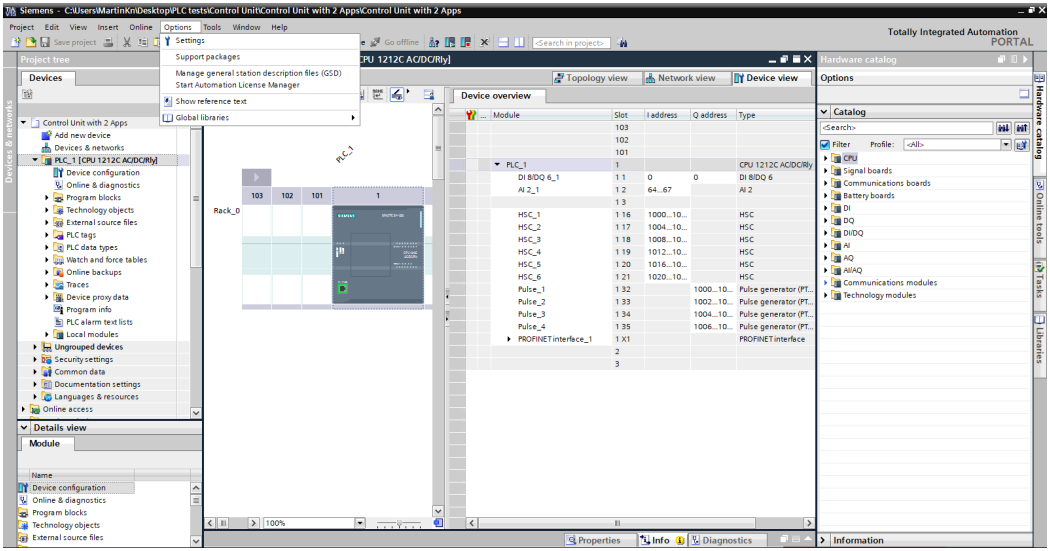
The following settings are necessary on PLC side.

5.1 GSDML File

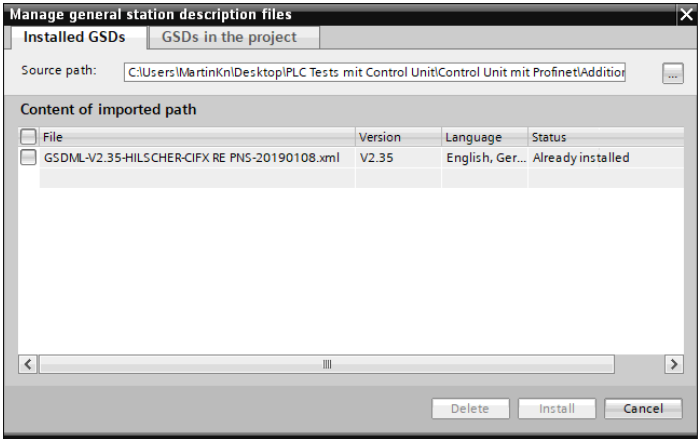
GSDML file is available on the wenglor website in the download section of the control unit. Download the GSDML file, unzip the file and install it on PLC.

NOTE!
After downloading the zip file, please unzip the file before installing it on the PLC.

In the software TIA Portal V15 the GSDML file is added via “Options” → “Manage general station description files (GSD)”.

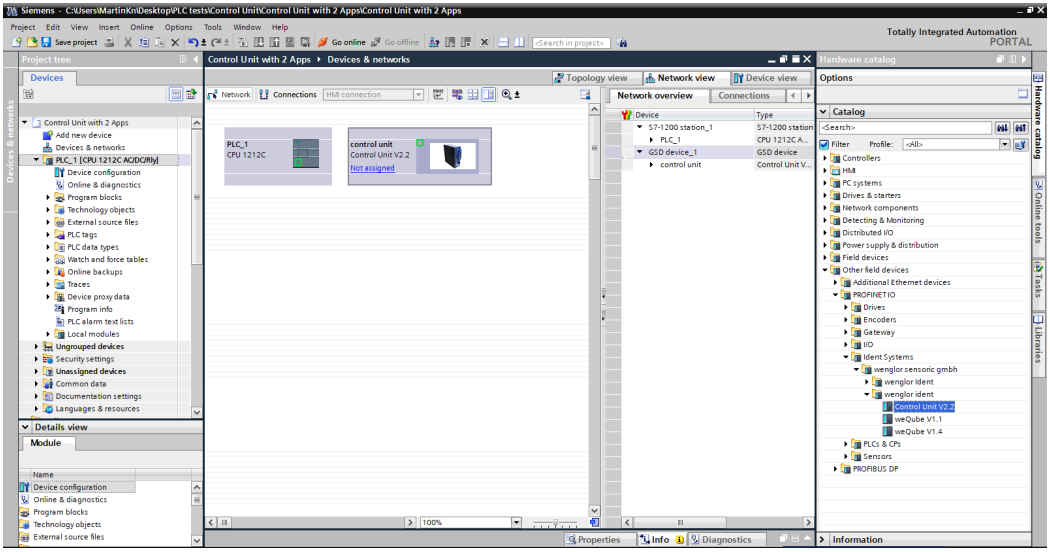


Adjust the correct source path if necessary, select the file and click on “Install”. After the successful installation, the status signals “already installed”.

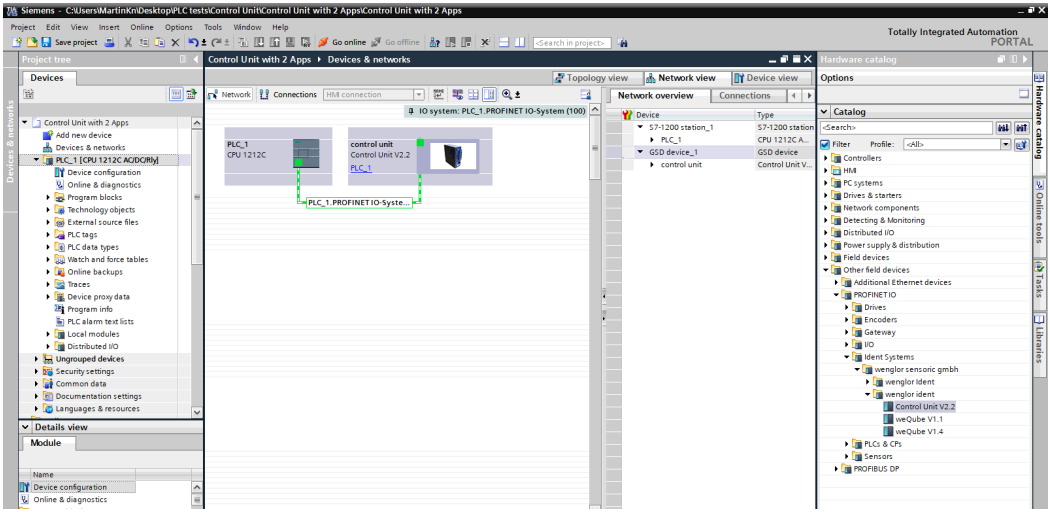


5.2 Add Control Unit to PLC Network

Search in the hardware catalog for “Other field devices” → “PROFINET IO” → “Ident Systems”.
Select “wenglor sensoric gmbh”, “wenglor ident” and add “Control Unit V2.2” to your network.

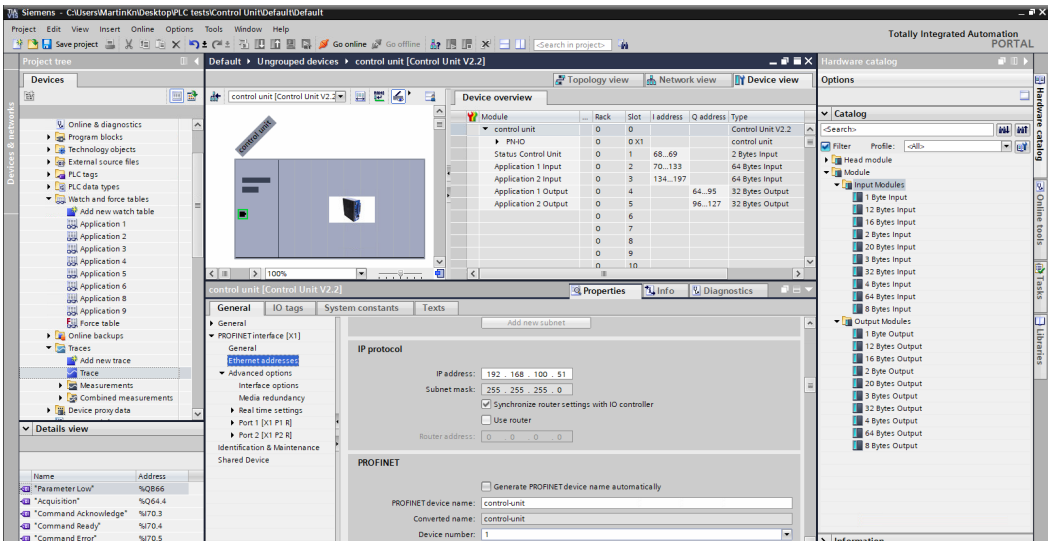


Then connect the control unit with the PLC in the network view.



5.3 Profinet Network Configuration

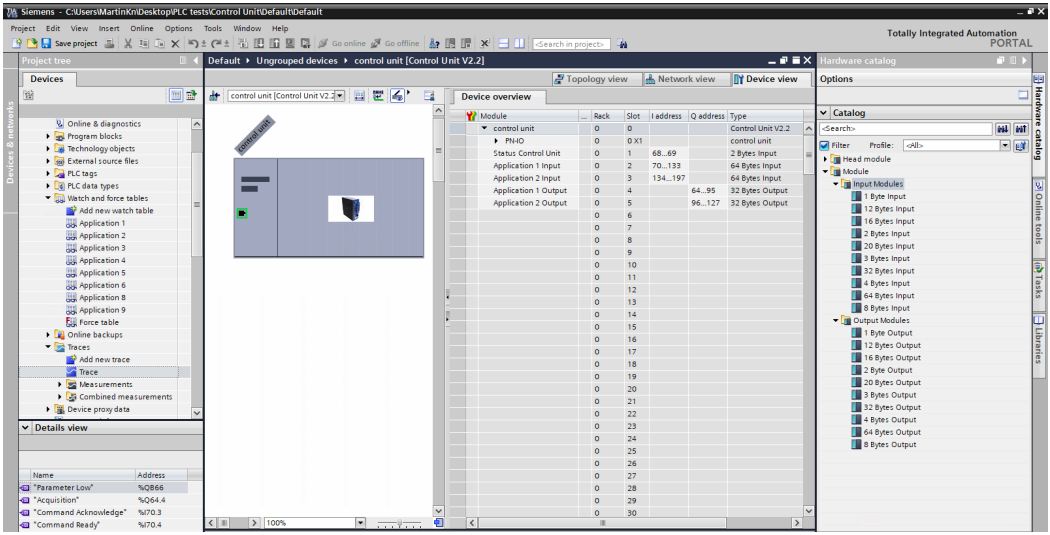
Switch to the device view of the control unit and open the properties. Then setup the network configuration for the Profinet interface of the control unit and select a device name.



5.4 Configure Input and Output Data

Add the input and output slots according to the configuration file used for the control unit.

Example: The following example shows the default configuration on the control unit. It is possible to transfer input and output data with up to two uniVision applications.

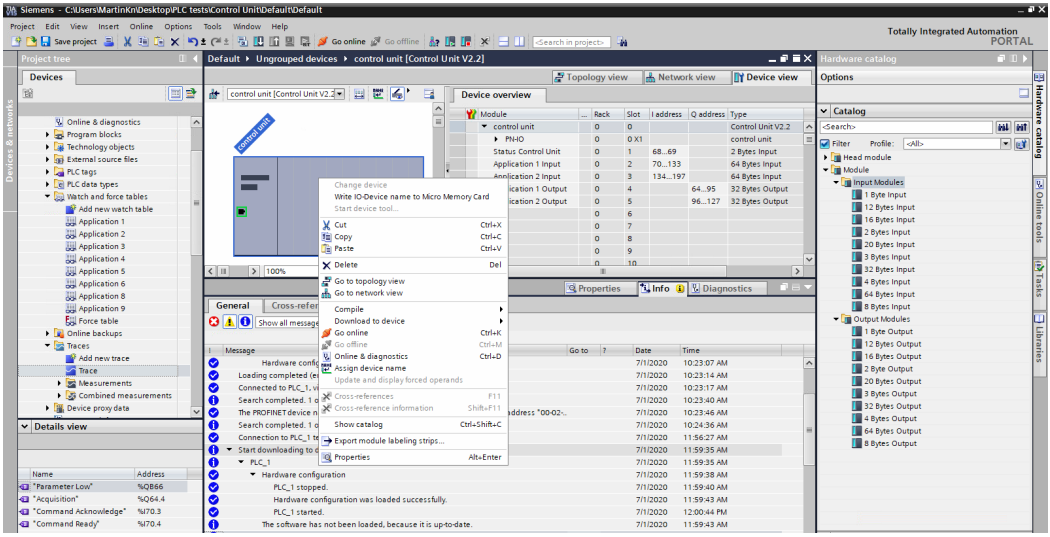


NOTE!

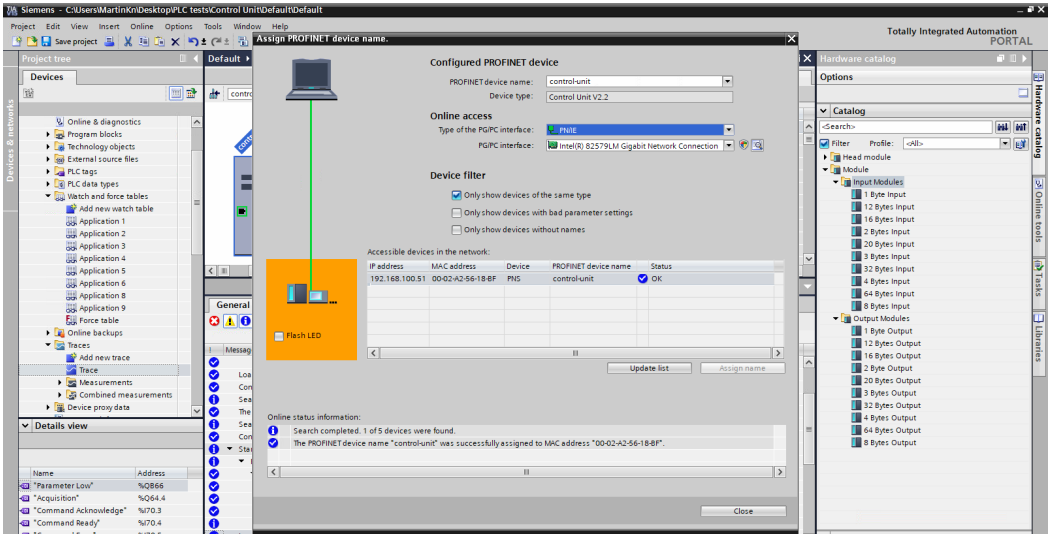
- Input and output slots of the control unit must be added consecutively (without gaps and in the right order!) in order to use the address offsets provided in the project tree.
- After changing the configuration of the input and output data in the PLC, it might be necessary to re-assign the network settings and the device name from the PLC to the control unit (see section “5.5 Download Configuration to PLC”, page 26).

5.5 Download Configuration to PLC

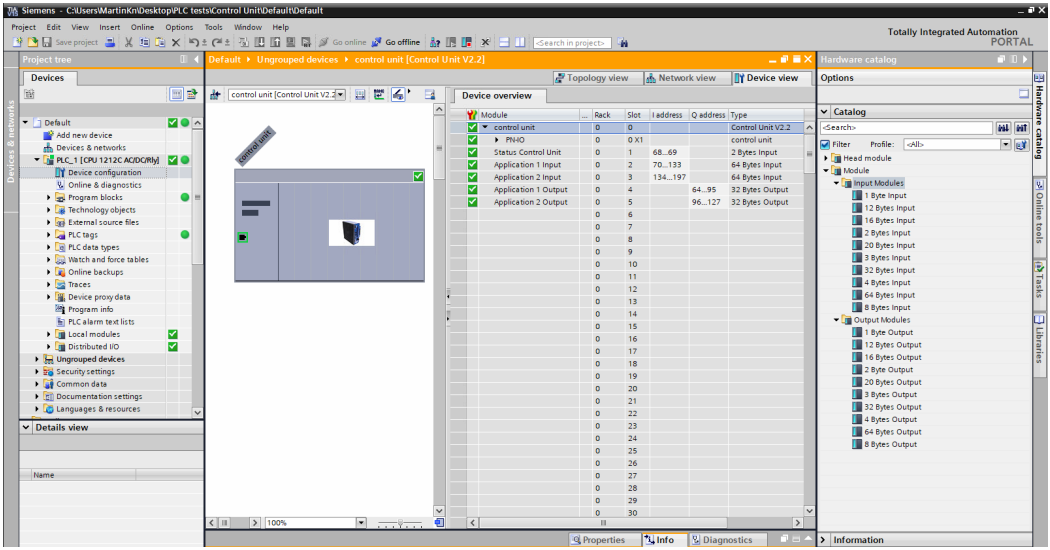
Compile and download the configuration to the PLC. Then assign the network configuration and the device name to the control unit via the context menu.



Click on “Update list” to see all control units in the network. Select the available control unit, assign the name and close the window.



Click on “Go online”. Check the status in TIA Portal to analyse if the configuration of the PLC and the control unit fit together.

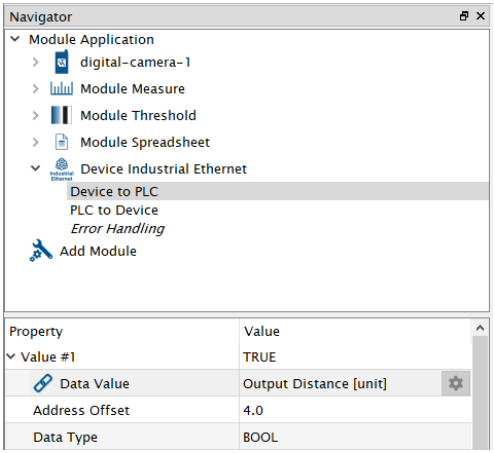


5.6 PLC Tags

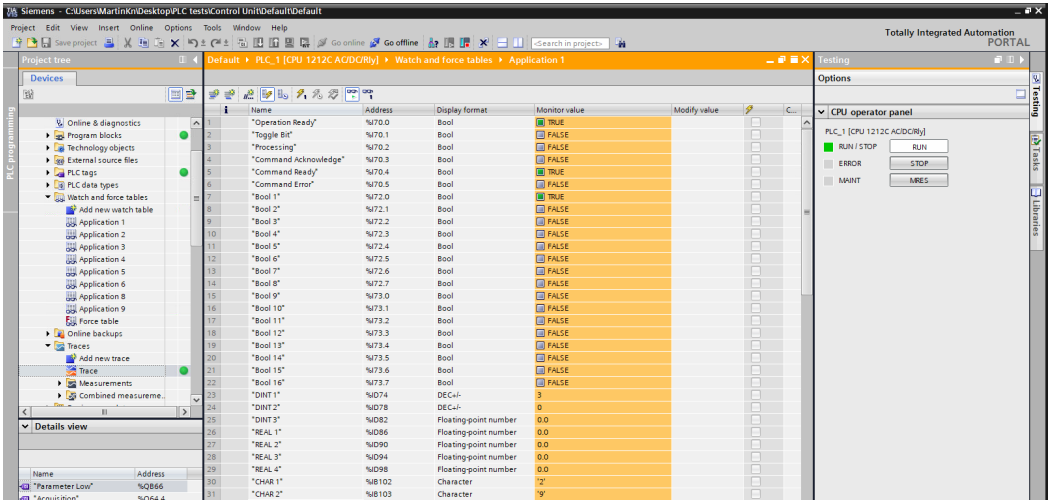
Select PLC tags to add the input and output data to your PLC project. Use the address offsets and the data types provided within the uniVision project for the process data.

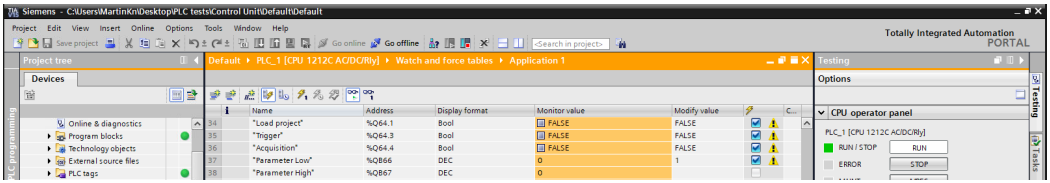
NOTE!
Data types and address offsets are available for all user-defined process data. The address offset must be added to the starting address of the first input or first output address of the control unit.

Example: In the example, the address offsets must be added to the input address 68 (first input address of the control unit) and to the output address 64 (first output address of application 1).



The example shows some of the PLC tags for application 1 (for its default configuration).





6. Sample PLC program

The sample PLC project in the download area for the control unit at www.wenglor.com can be used for the standard configuration of the control unit (RTE_Config_B002) shown in the instructions. It was created with a Siemens S7-1200 PLC using TIA Portal V15 and shows an example of how to create the PLC variables for two uniVision applications.

The download area for the control unit at www.wenglor.com contains sample PLC projects for various controllers. The projects show examples of the required settings on the controller side for PROFINET communication with the control unit.

Samples are available for the following controllers:

- Siemens S7-1200 PLC with TIA Portal V15
- Beckhoff TwinCAT 3

How to use the sample PLC programs:

1. Download the sample file from the wenglor website and unzip it.
2. Install the corresponding configuration file RTE_Config_B002.tgz on the control unit.
3. Open the sample PLC program, adjust the network configuration, and transfer the program to the PLC, or activate it on the PLC.

7. Attachements

Overview of the configuration files for the control unit.

NOTE!
By default, RTE_Config_B002 (see RTE_Config_B002) is installed in order to transfer data with two uniVision applications. If another configuration is needed, it must be installed on the control unit (see section “4.1 Installation of Configuration Files”, page 16). After a firmware update of the control unit, the configuration file is automatically reset to the standard configuration. It is therefore necessary to reinstall the corresponding configuration file after a firmware installation in the control unit.

7.1 RTE_Config_B0xx (001 – 012)

Configuration file for 1 – 12 uniVision applications (xx = number of uniVision applications)

Slot configuration:
- 2 bytes Input (Status Control Unit)
- 64 bytes Input (for every application)
  - 2 bytes: Status Application
  - 2 bytes: 16 BOOL
  - 12 bytes: 3 DINT
  - 16 bytes: 4 REAL
  - 32 bytes: 1 CHAR with 32 bytes
- 32 bytes Output (for every application)
  - 4 bytes: Commands
  - 4 bytes: 32 BOOL
  - 8 bytes: 2 DINT
  - 16 bytes: 4 REAL

7.2 RTE_Config_B1xx (101 – 112)

Configuration file for 1 – 12 uniVision applications (xx = number of uniVision applications)

Slot configuration:

- 2 bytes Input (Status Control Unit)
- 64 bytes Input (for every application)
  - 2 bytes: Status Application
  - 2 bytes: 16 BOOL
  - 28 bytes: 7 DINT
  - 32 bytes: 8 REAL
- 32 bytes Output (for every application)
  - 4 bytes: Commands
  - 4 bytes: 32 BOOL
  - 8 bytes: 2 DINT
  - 16 bytes: 4 REAL

7.3 RTE_Config_B2xx (201 – 210)

Configuration file for 1 – 10 uniVision applications (xx = number of uniVision applications)

Slot configuration:

- 2 bytes Input (Status Control Unit)
- 64 + 64 bytes Input (for every application)
  - 2 bytes: Status Application
  - 2 bytes: 16 BOOL
  - 12 bytes: 3 DINT
  - 16 bytes: 4 REAL
  - 32 + 64 bytes: 3 CHAR with 32 bytes
- 64 bytes Output (for every application)
  - 4 bytes: Commands
  - 4 bytes: 32 BOOL
  - 8 bytes: 2 DINT
  - 16 bytes: 4 REAL
  - 32 bytes: 1 CHAR of 32 bytes