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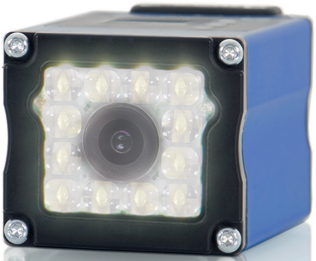
Smart Camera weQube with Profinet



Interface Protocol

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www.wenglor.com

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1. Use for Intended Purpose

The Smart Camera weQube is able to communicate with a PLC via Profinet. Thus, an exchange of process data between the Smart Camera and the PLC is possible. Furthermore, the Smart Camera sends a status to the PLC, which in turn can send commands to the Smart Camera.

NOTE!
In the manual, the Profinet integration is shown at a Siemens S7-1200 PLC with TIA Portal V15.

2. Electrical Connection and Network Overview

Connect port 1 of the Smart Camera to 18…30 V DC. Connect pin 1 (wenglor standard cable: Brown) to the plus pole and pin 2 (wenglor standard cable: Blue) to the minus pole.

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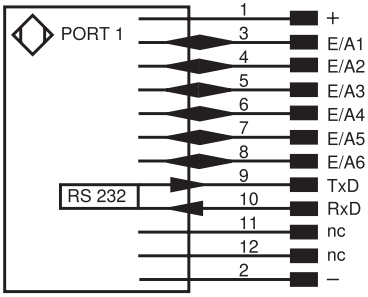
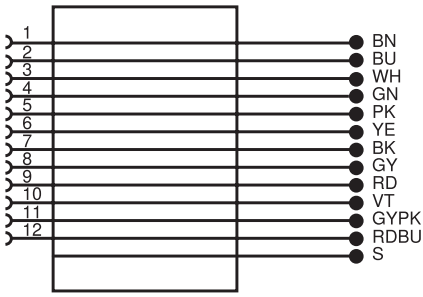


Connection Diagram, weQube Smart Camera, Port 1

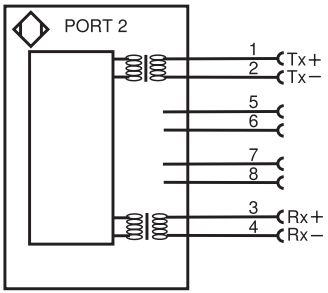
S89



Matching wenglor Connection Equipment

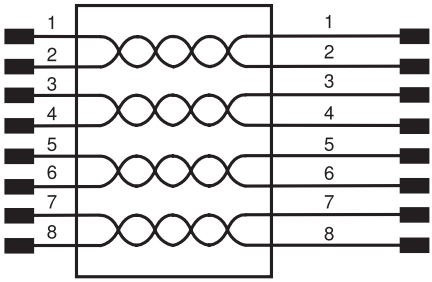
- Connect port 2 of the Smart Camera for Profinet communication with a PLC – directly or via a switch.

002



Connection Diagram, weQube Smart Camera, Port 2

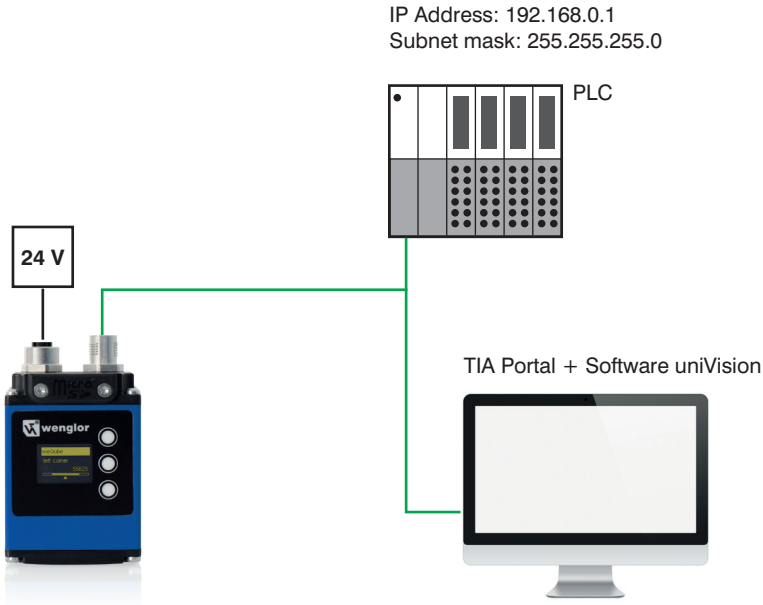
S81



Matching wenglor Connection Equipment

NOTE!
Port 2 of the Smart Camera supports Profinet communication and further network functionality (e.g. Software uniVision for Windows, website, process data via TCP, UDP and FTP).

Example: The Smart Camera weQube, the PLC and a PC with the software TIA Portal and uniVision are in the same network.



3. Input and Output Data

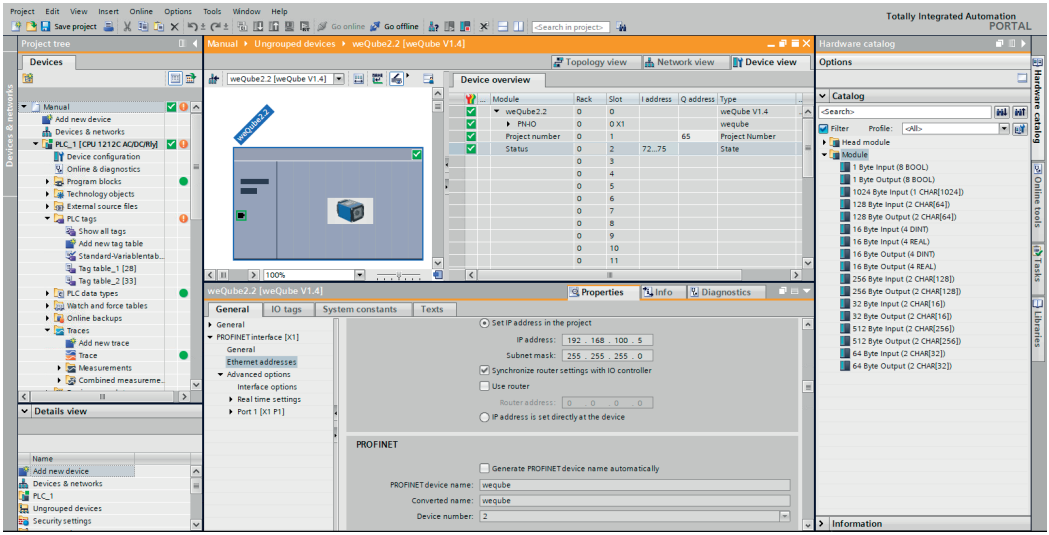
In the view of the PLC, the following input and output data are available for the Smart Camera:

- Slot 1 (fix): Project number (1 Byte Output of PLC)
- Slot 2 (fix): Status (4 Bytes Input of PLC)
- Slots 3–6 (flexible): User-defined process data (x Bytes Input or Output of PLC)

NOTE!
By default, slots 1 and 2 are always present. Slots 3 to 6 are optional. The number of optional slots and the data types of such user-defined slots are adjustable.

The following example shows the default slot configuration of the Smart Camera weQube with slots 1 and 2.

Example:



3.1 Status

The Smart Camera weQube sends a four-byte status information to the PLC. The status gives feedback as to whether the Smart Camera works correctly or is in an error state:

- Status 0: No error
- Status not 0: Error

In case of an error, the binary number indicates the reason of the respective error. The bit number starts with zero. Bits with value true give more information about the error.

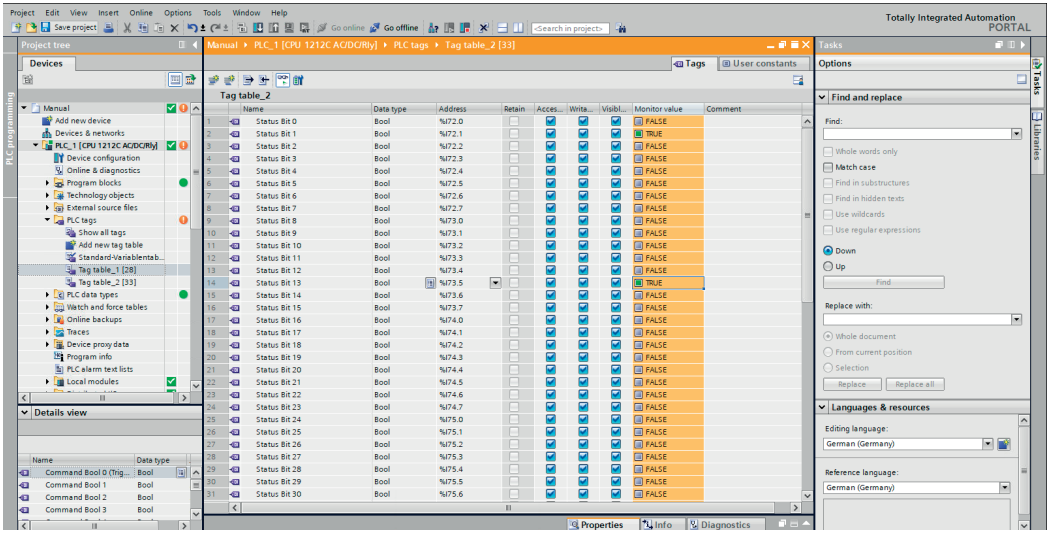
Bit	Section	Signal	Description
0	General	Information	Busy Is high while processing LIMA commands (e.g. because of loading a project or changing any project parameter).
1		Warning	There is at least one bit set, level = Warning
2		Critical Error	There is at least one bit set, level = Critical Error
3		Fatal Error	There is at least one bit set, level = Fatal Error
6	Peripheral	TCP/IP	There is an error concerning the TCP/IP socket
7		UDP	There is an error concerning the UDP socket
8		Industrial Ethernet	There is an error concerning industrial ethernet
12		UART	There is an error concerning the UART device
13		FTP	There is an error concerning the FTP interface.
14	Memory	Flash	There is an error concerning the flash access
15		RAM	There is an error concerning the RAM access
16		SD-Card	There is an error concerning the SD card access
17		File access	There is an error concerning a general file access.
18		Compatibility	There is an error concerning the version of the loaded project
24	Image Processing	Sequencing	There is an error concerning IData vision engine
25		Processing	There is an error concerning a vision module.
26		Trigger	There is an error concerning HW trigger

NOTE!
More details about errors and possible solutions are available in the uniVision software manual.

Example:
The status with the binary number 10 0000 0000 0010 shows an error at bit 1 and bit 13. Consequently, there is a warning that indicates a problem with the FTP interface. An example may be that the Smart Camera is configured to save data on a FTP server, but the FTP server is not available in the network.

Bit	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary number	1	0	0	0	0	0	0	0	0	0	0	0	1	0

The following screen shows the status bits of the Smart Camera weQube in TIA Portal in case of the described FTP error.



3.2 Commands

Commands (e.g. trigger commands) are sent from the PLC to the Smart Camera. The Smart Camera weQube supports the following commands:

- Trigger
- Load project

It is not allowed to send several commands (e.g. trigger and project load commands) at the same time! Before sending the next command, it is necessary to wait until the processing of the last command has finished completely.

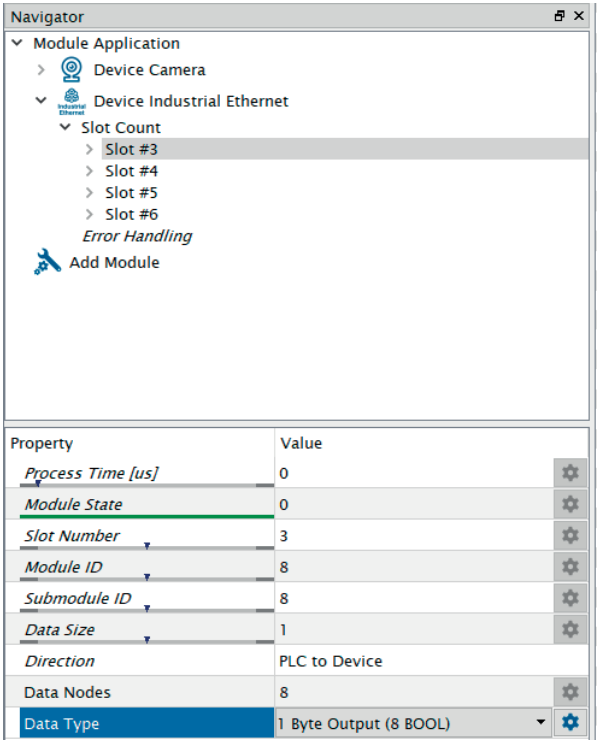
NOTE!
When the PLC sends a command to the Smart Camera, the Smart Camera captures an image or loads the project. Commands are executed immediately in contrast to process data, which is only sent or received by the Smart Camera in case of an evaluation that was started by a trigger signal.

3.2.1 Trigger Command

When the PLC sends a trigger command to the Smart Camera, the Smart Camera captures and evaluates an image and sends the results.

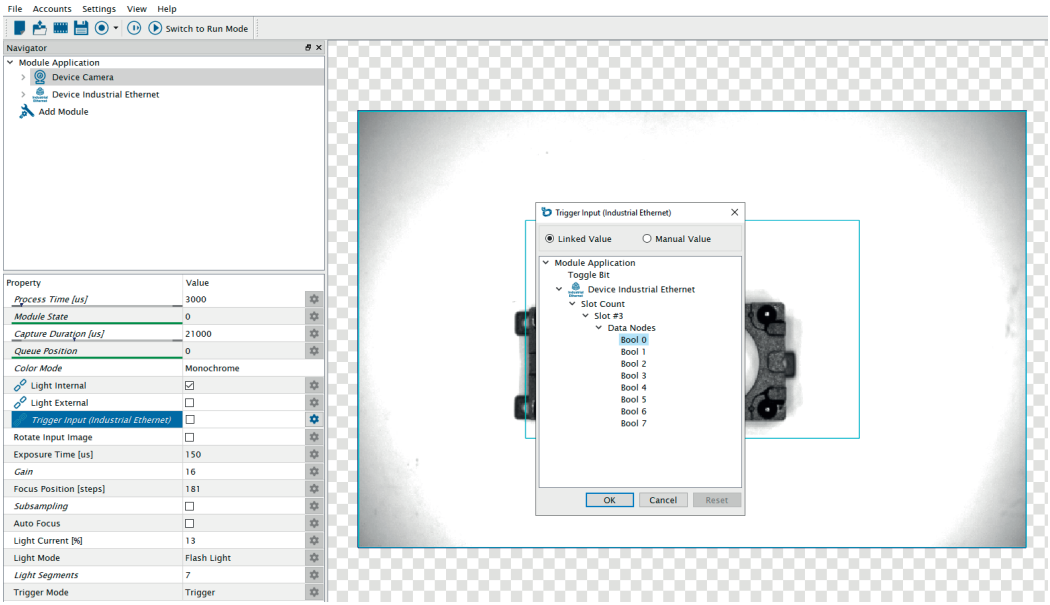
The following steps are necessary to set up a trigger command via Profinet:
1. Connect to the Smart Camera via the software uniVision for Windows.
2. Add Device Industrial Ethernet to the project.
3. Set Slot Count to define the number of flexible slots (At least one flexible slot is required for the trigger command).
4. Configure one of the flexible slots as 1 Byte Output (8 BOOL)

In the following example, the trigger command via Profinet is sent at slot 3.



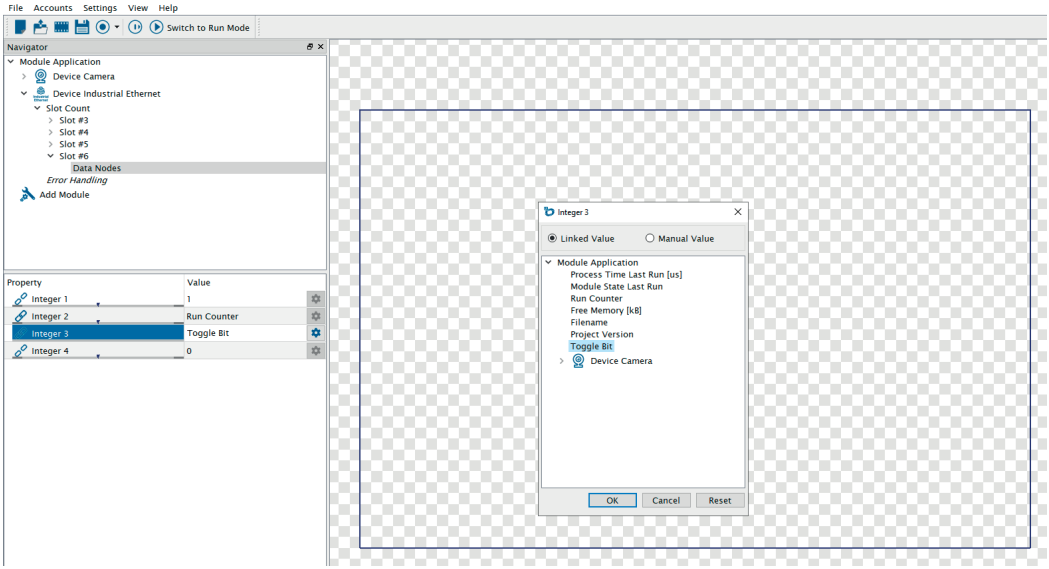
5. Select Device Camera and link one of the bools of slot 3 to Trigger Input (Industrial Ethernet). In the example, the PLC sends the trigger command at Bool 0 of slot 3.

NOTE!
For triggering via Profinet, the Trigger Mode of Device Camera must be set to Trigger.

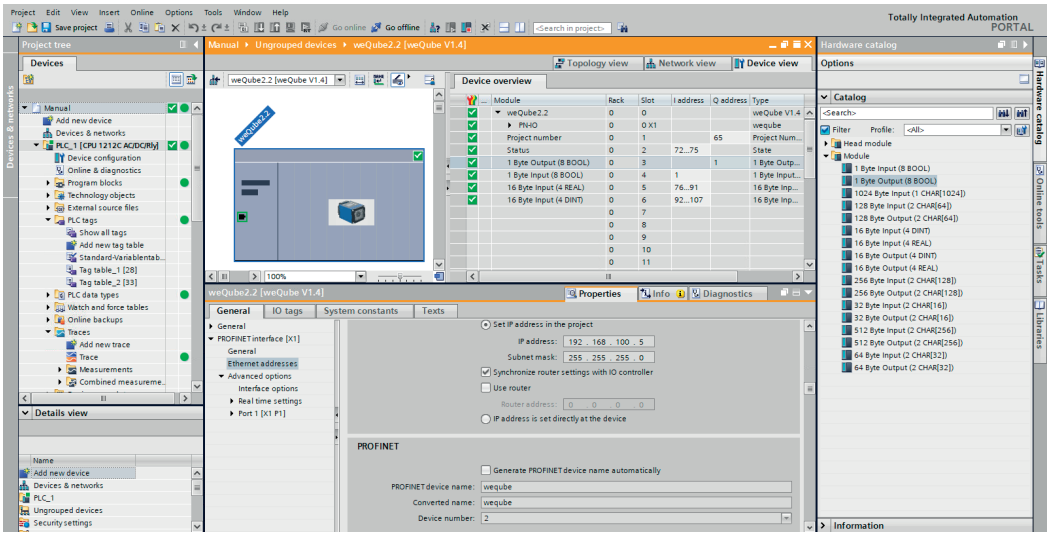


6. Use the last slot in order to verify that all new results of the image evaluation are available on the PLC. For example, configure slot 6 as “16 Byte Input (4 DINT)” and link the toggle bit and the run counter:

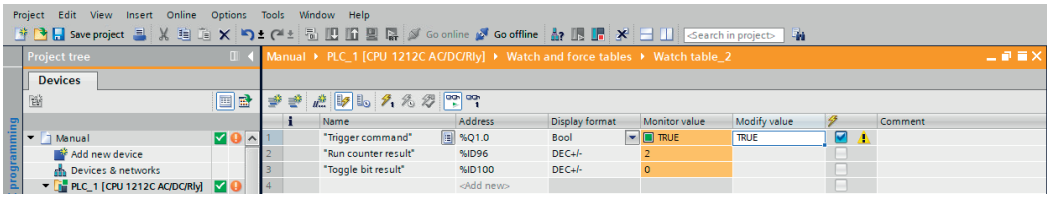
- Integer 1: Fix project number
- Integer 2: Run counter
- Integer 3: Toggle bit



7. Open the software TIA Portal and add slot 3 with the module “1 Byte Output (8 BOOL)” at the Smart Camera. Furthermore, add the other slots according to the configuration in the software uniVision.



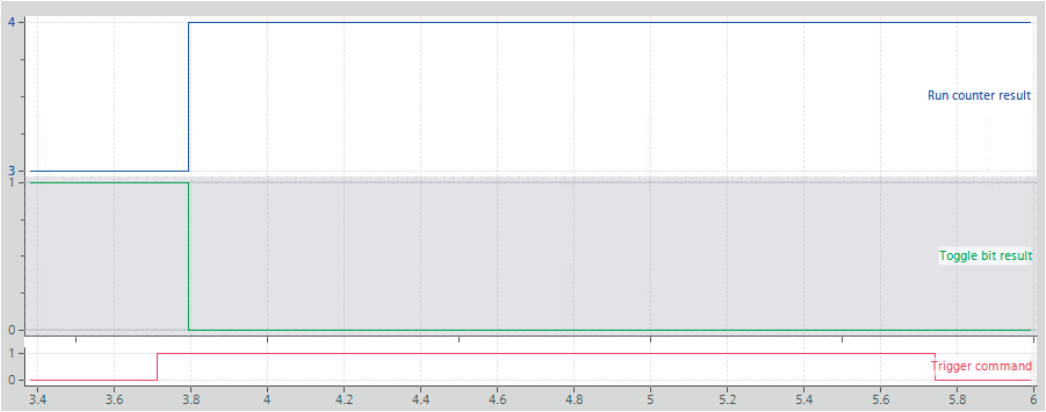
8. Send the value TRUE to the correct address to send a trigger command to the Smart Camera. With every change from FALSE to TRUE for the trigger command bit, the Smart Camera captures and evaluates an image.



NOTE!

After capturing and evaluating the image, the Smart Camera sends results in the form of process data (also via Profinet if configured accordingly).

- The processing of the trigger signal and the evaluation of the image is completed when the toggle bit has changed and the run counter has increased by one.
- It is not allowed to send several commands at the same time (e.g. trigger and load project commands).
- After a trigger command has been sent from the PLC to the Smart Camera, wait until the results are available on the PLC before sending the next command.



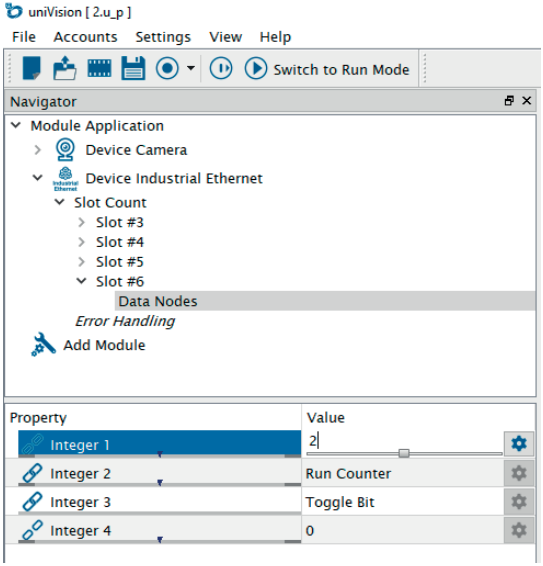
3.2.2 Load Project Command

The load project command allows loading another project onto the Smart Camera. Up to 255 different projects can be loaded via Profinet.

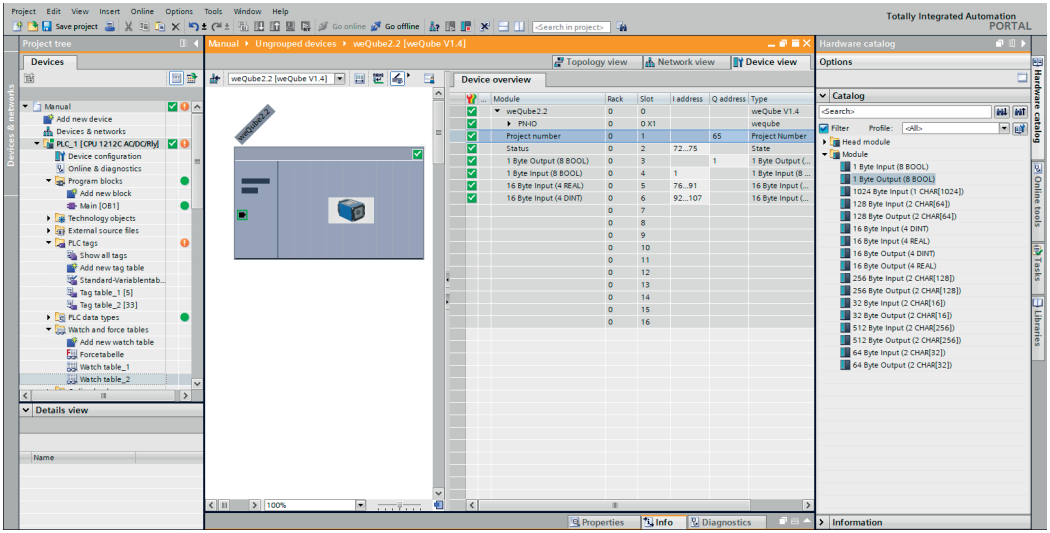
The following steps are necessary to set up a load project command via Profinet:
1. Open the software uniVision for Windows and connect to the Smart Camera weQube.
2. Create uniVision projects and save them with a number at the beginning of the filename.

NOTE!
In order to load projects via Profinet, all projects must be saved in the following format: “xxx_testproject.u_p” (x = any integer from 0 to 9). For example “001_MyProject.u_p”. Project numbers can be set between 1 and 255 (0 is ignored – default value). Use unique numbers for every uniVision project file. The number of slots and the slot configuration must be identical in all uniVision projects in the Smart Camera in order for the project change to be possible from the PLC.

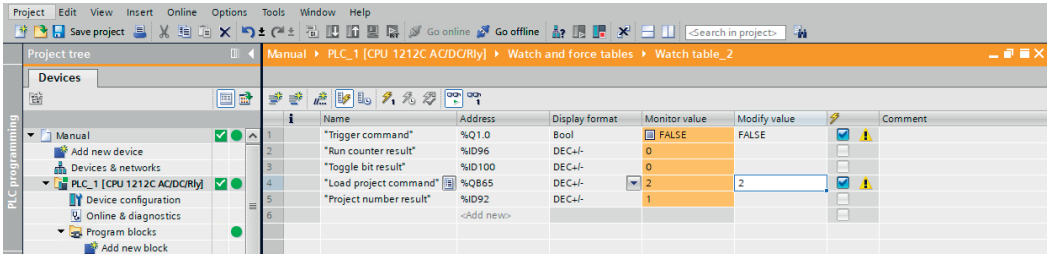
3. Use the last slot in order to send the project number as a fix result from the Smart Camera to the PLC. This value can be used to verify that the project has finished loading.



4. Open the software TIA Portal.
5. Slot 1 (fix) of the Smart Camera is pre-configured for loading uniVision projects.

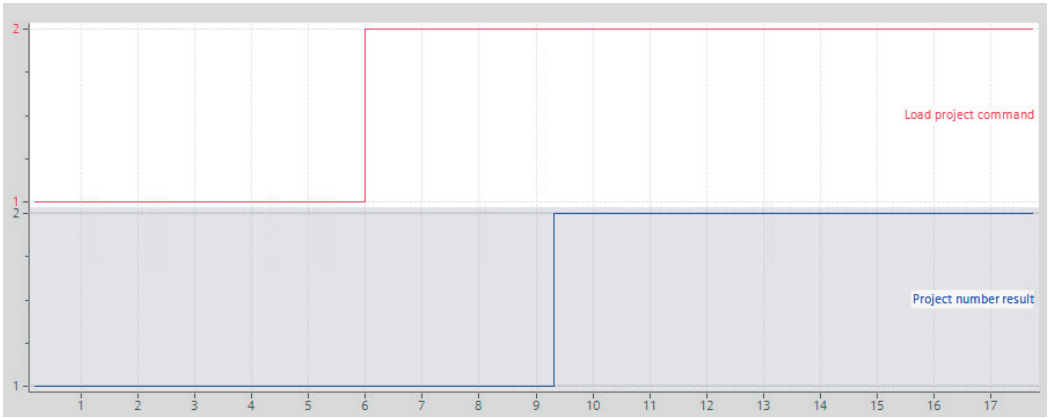


6. Send the number defined in the filename of the uniVision project from the PLC to the Smart Camera in order to load the project. With every change of the project number sent by the PLC to the Smart Camera, the Smart Camera loads the project (only if the uniVision project is available and if the project number is different to the currently loaded project).



NOTE!

- After loading the project, the Smart Camera initializes all results (e.g. run counter is reset to 0).
- The project has finished loading when the result of the project number is available on the PLC.
- It is not allowed to send several commands at the same time (e.g. trigger and load project commands).
- After a load project command is sent from the PLC to the Smart Camera, wait until the result of the project number is available on the PLC before sending the next command.



NOTE!

After starting the Smart Camera weQube, the startup project defined in the global properties is loaded. It is possible to send a command to load another project from the PLC to the Smart Camera before the booting process is finished, but it is necessary to wait until the Smart Camera responds with the correct project number before sending the first trigger command.

3.3 User-Defined Process Data

All other Profinet values in the uniVision project are process data. Process data is sent from the device to the PLC and vice versa. Details are available in the Smart Camera settings (see section “4.2 Device Industrial Ethernet”, page 17).

NOTE!
Compared to commands and status data that are updated continuously, process data is only evaluated and sent when an image is executed because of a trigger signal.

4. Smart Camera Settings

For Profinet communication, the following steps are necessary at the Smart Camera.

NOTE!

- The Smart Camera weQube supports Profinet functionality starting with the Smart Camera firmware version 2.2.0 and the software uniVision version 2.2.0.
- Not all Smart Cameras support Profinet communication. Check the technical data on the wenglor website for details about every Smart Camera version.

4.1 Set Up uniVision Projects

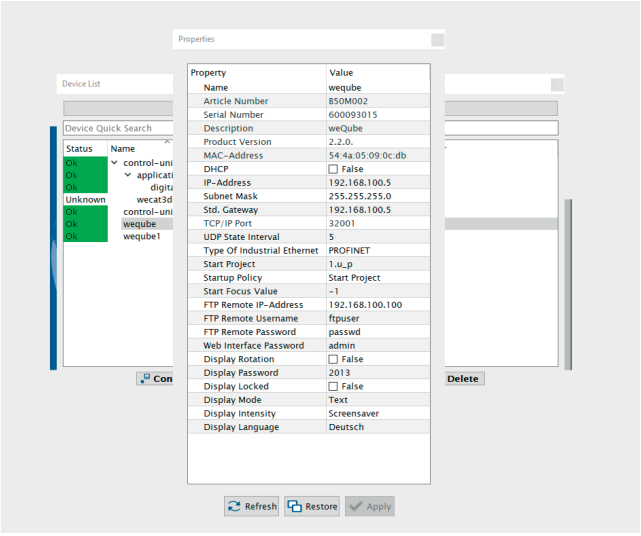
The following steps are necessary in order to create a communication between the Smart Camera and the PLC:

1. Install and open the software uniVision for Windows.
2. Set up the network configuration and the device name of the Smart Camera via the software uniVision.

NOTE!

It is recommended to directly allocate the network configuration and device name to the Smart Camera that is to be used in the Profinet network later.

3. Connect to the Smart Camera.
4. Edit and save uniVision projects on the Smart Camera. All projects must contain Device Industrial Ethernet (see section “4.2 Device Industrial Ethernet”, page 17).
5. Open the Properties of the Smart Camera in the Device List to set up the startup behavior. It is necessary to select a valid startup project with a suitable Profinet configuration.

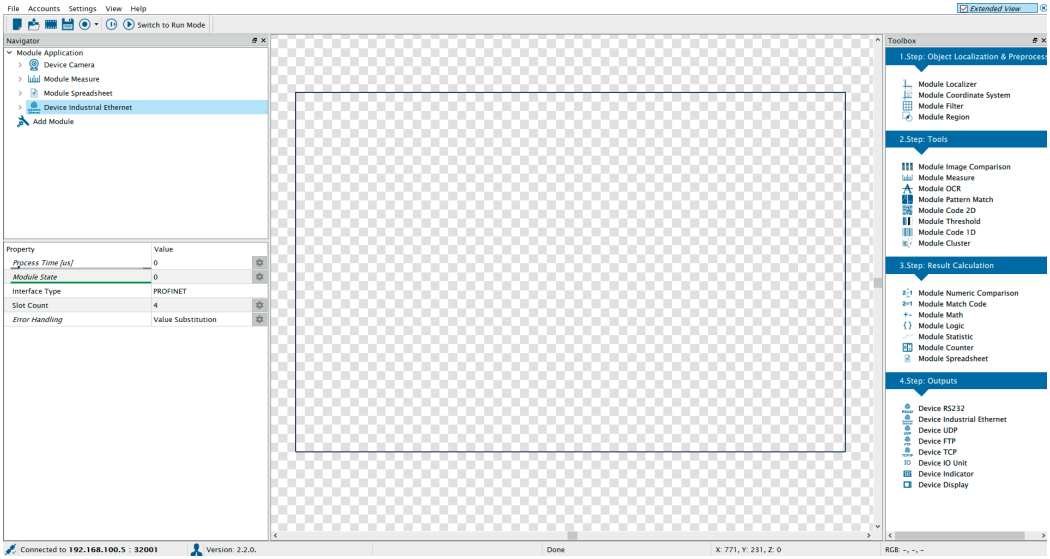


NOTE!

- Make sure that Type of Industrial Ethernet is set to PROFINET at the properties of the Smart Camera.
- Details about all listed steps are explained in the uniVision software manual.

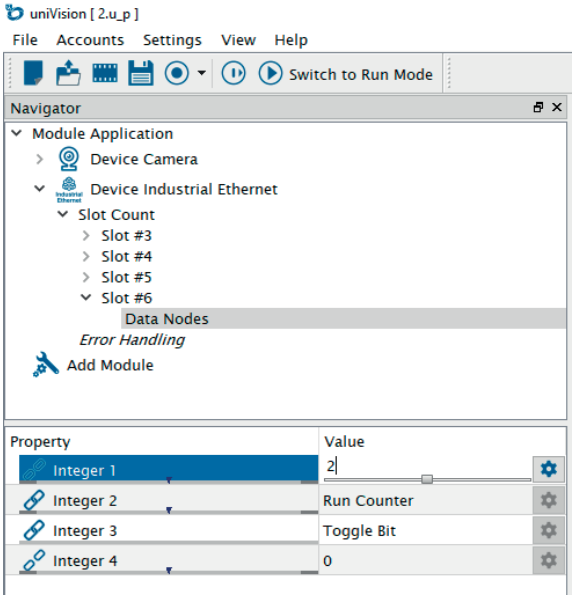
4.2 Device Industrial Ethernet

Add Device Industrial Ethernet to the uniVision projects from the toolbox to configure the flexible slots. The Smart Camera supports up to four slots to send or receive process data. With one of the flexible slots, it is also possible to send the trigger command to the Smart Camera (see section “3.2.1 Trigger Command”, page 8).



NOTE!

- Compared to commands and status data that are updated continuously, process data is only evaluated and sent when an image is evaluated because of a trigger signal.
- Only within one slot is the process data sent and received consistently in one Profinet cycle. The process data from different slots of the Smart Camera to the PLC may be updated in different Profinet cycles. Use the last slot to make sure that all results are refreshed, e.g. by linking the run counter or the toggle bit to a value from the last slot.
- Furthermore, it is recommended to also send the project number as fixed value in the last slot in order to verify on the PLC side that the project loading process is finished.
- After changing the number of slots or the slot configuration, the Smart Camera must be restarted with a suitable start-up behavior (e.g. fixed start-up project) in order for the settings to be applied correctly.
- The number of slots and the slot configuration must be identical in all uniVision projects in the Smart Camera in order for the project change to be possible from the PLC.



Property	Description
Process Time [us]	Time in µs for processing the module.
Module State	Indicates 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)
Interface Type	Indicates the interface type.
Slot Count	Number of flexible slots (Slots 3 – 6). **NOTE!** • By default, the number of flexible slots is set to 0. • Fours flexible slots can be configured at a maximum.
Error handling	If any process data is in error state, it is substituted by a user-defined replacement value (see section “4.2.2 Error Handling”, page 22).

4.2.1 Slots

Set up the configuration for every Profinet slot.

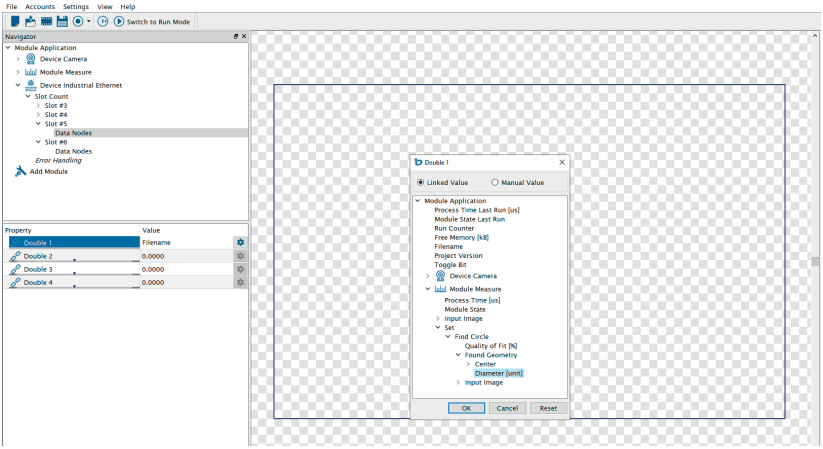
Property	Description
Process Time [us]	Time in µs for processing the module.
Module State	Indicates the status of the module: • 0: No error • Value different to 0: Error (Details about the error code are available in the uniVision software manual)
Slot Number	Indicates the slot number.
Module ID	Indicates the Module ID.
Submodule ID	Indicates the Submodule ID.
Data Size	Indicates the data size in bytes.
Direction	Indicates the direction in which data is sent: • Device to PLC: Values are sent from the Smart Camera to the PLC. • PLC to Device: Values are sent from the PLC to the Smart Camera.
Data Nodes	Indicates the number of data nodes.
Data Type	Select the data type of the slot. The Smart Camera supports the following data types: • 16 Byte Input (4 DINT) • 16 Byte Input (4 REAL) • 1 Byte Input (8 BOOL) • 128 Byte Input (2 CHAR) • 1024 Byte Input (1 CHAR) • 16 Byte Output (4 DINT) • 16 Byte Output (4 REAL) • 1 Byte Output (8 BOOL) • 128 Byte Output (2 CHAR) • 32 Byte Input (2 CHAR) • 64 Byte Input (2 CHAR) • 256 Byte Input (2 CHAR) • 512 Byte Input (2 CHAR) • 32 Byte Output (2 CHAR) • 64 Byte Output (2 CHAR) • 256 Byte Output (2 CHAR) • 512 Byte Output (2 CHAR) **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).

Property	Description
Data Type	Linking results to the different data types works as follows: • BOOL (output) – Link BOOL result: Returns true or false depending on value of bool – Link DINT or REAL result: Returns true if the current value is within thresholds (between the minimum and maximum thresholds) and returns false if the current value is out of tolerance (lower than the minimum or higher than the maximum thresholds) – 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 a number without decimal places (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 a number with decimal places – 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

In the project tree, data nodes appear below the slot.

Double, Integer, BOOL or String (depending on the data type of the slot)

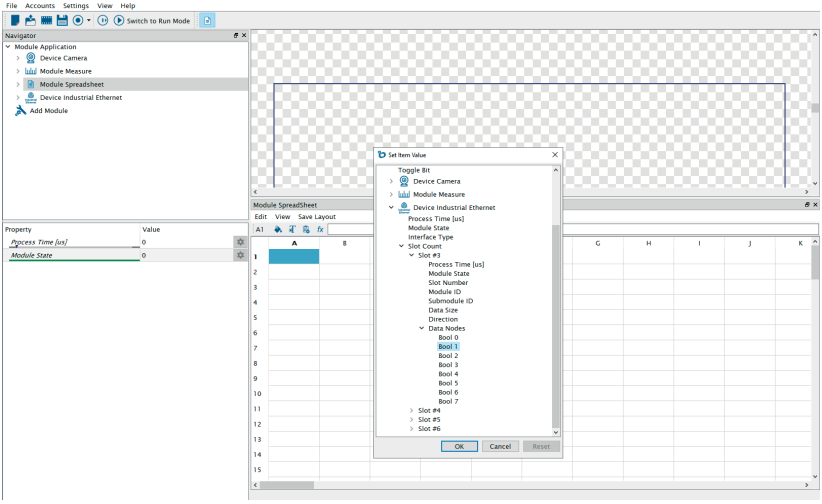
Values (Results) from the device to the PLC can be set to a certain value manually or can be linked with any result of the project (e.g. with the diameter of the Module Measure).



Values from the PLC to the device are shown as uniVision input values.

NOTE!

- Process data from the PLC to the Smart Camera is only received when an image is evaluated in the Smart Camera because of a trigger signal.
- Process data from the PLC to the Smart Camera is linked as input in other modules (e.g. in the Module Spreadsheet).



4.2.2 Error Handling

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

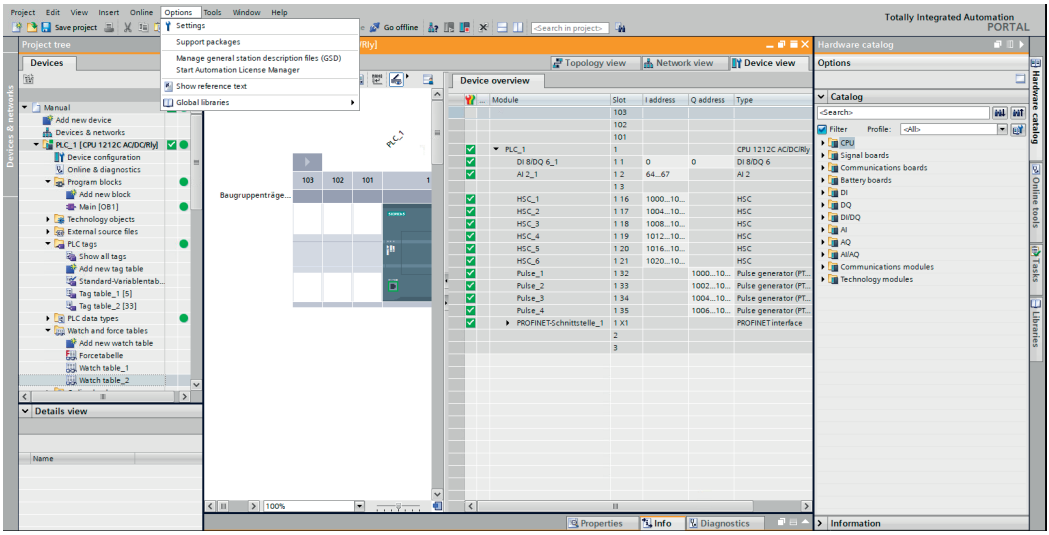
The following settings are necessary on the PLC side.

5.1 GSDML File

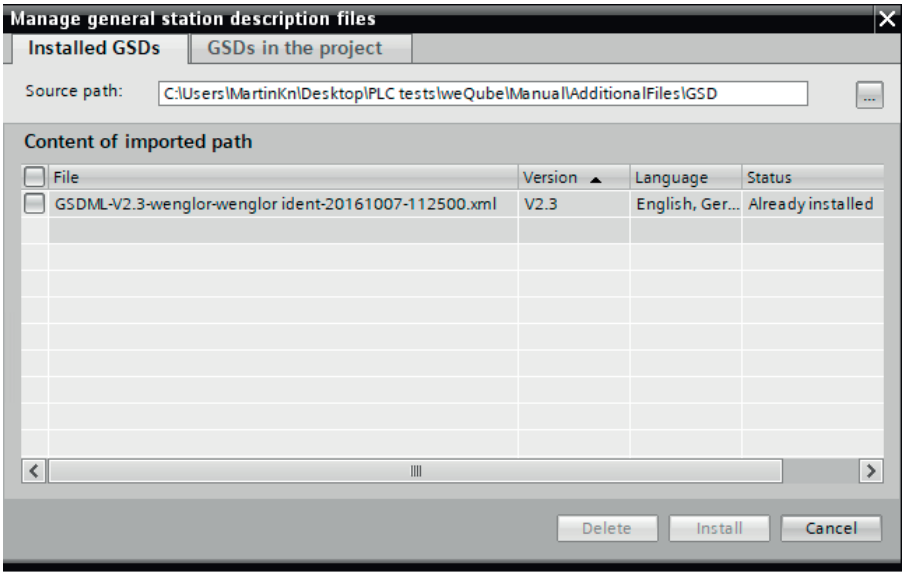
GSDML file is available on the wenglor website in the Download section of the Smart Camera. Download the GSDML file, unzip the file and install it on the PLC.

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)”.

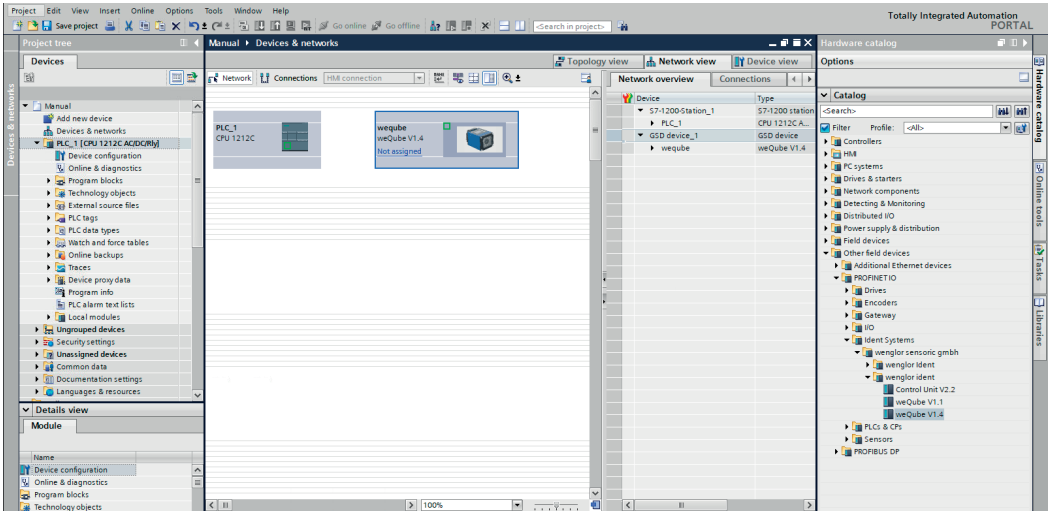


Adjust the correct source path if necessary, select the file and click on “Install”. After successful installation, the status switches to “Already installed”.

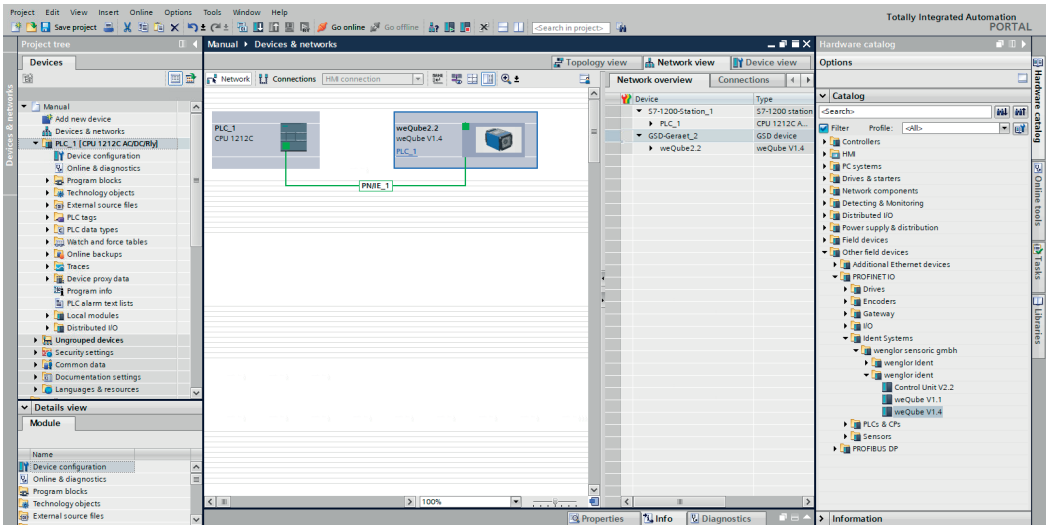


5.2 Add Smart Camera to PLC Network

Search in the hardware catalog for “Other field devices” → “PROFINET IO” → “Ident Systems”. Select “wenglor sensoric gmbh” and add “weQube V1.4” to your Profinet network.



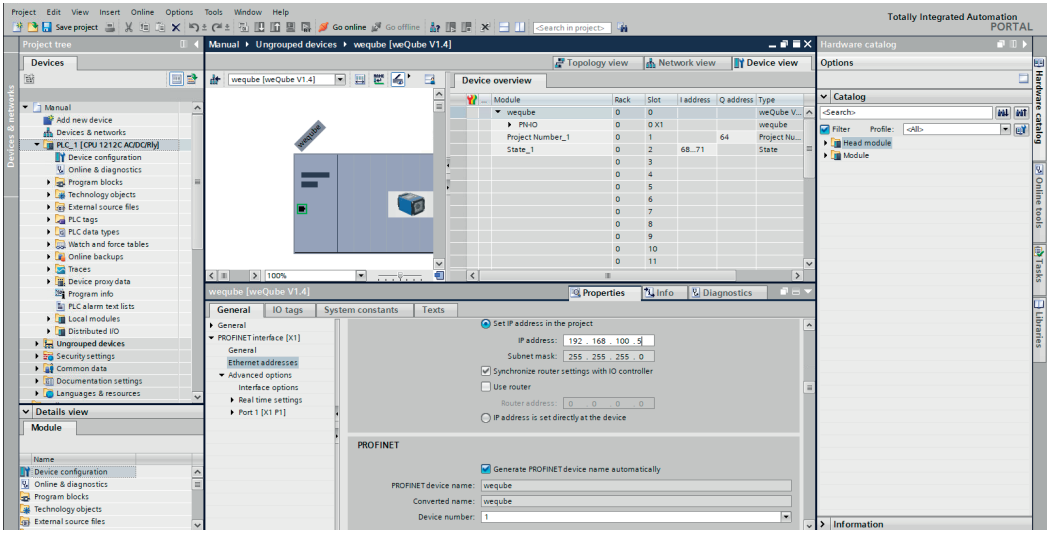
Then connect the Smart Camera to the PLC in the network view.



5.3 Profinet Network Configuration

Switch to the device view of the Smart Camera and open the Properties. Then set up the network configuration for the Profinet interface of the Smart Camera and select a device name.

NOTE!
It is necessary to use the same network configuration and the same device name on the PLC side and on the software for uniVision side.

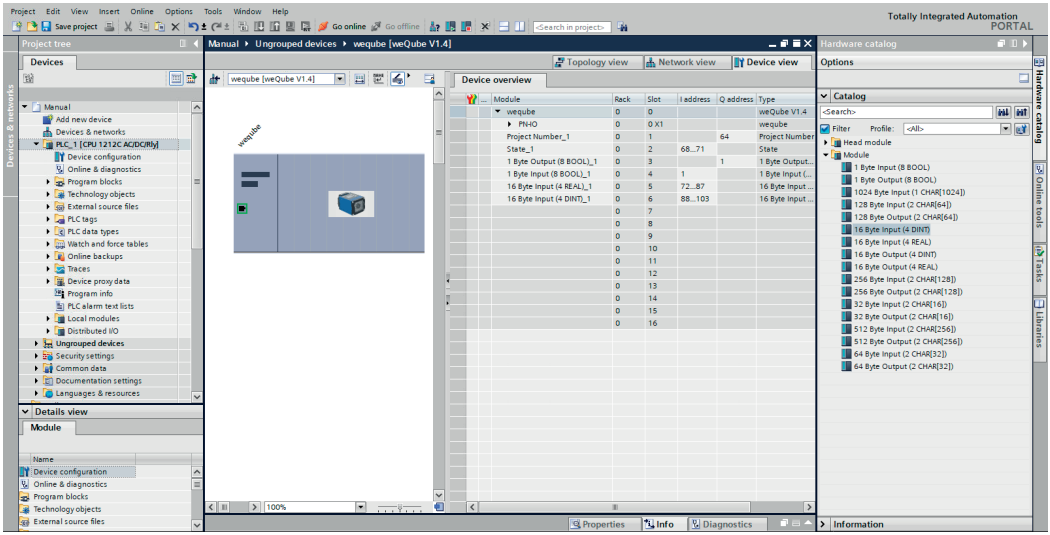


5.4 Configure Input and Output Data

Add the input and output slots according to the project configuration set in the software uniVision.

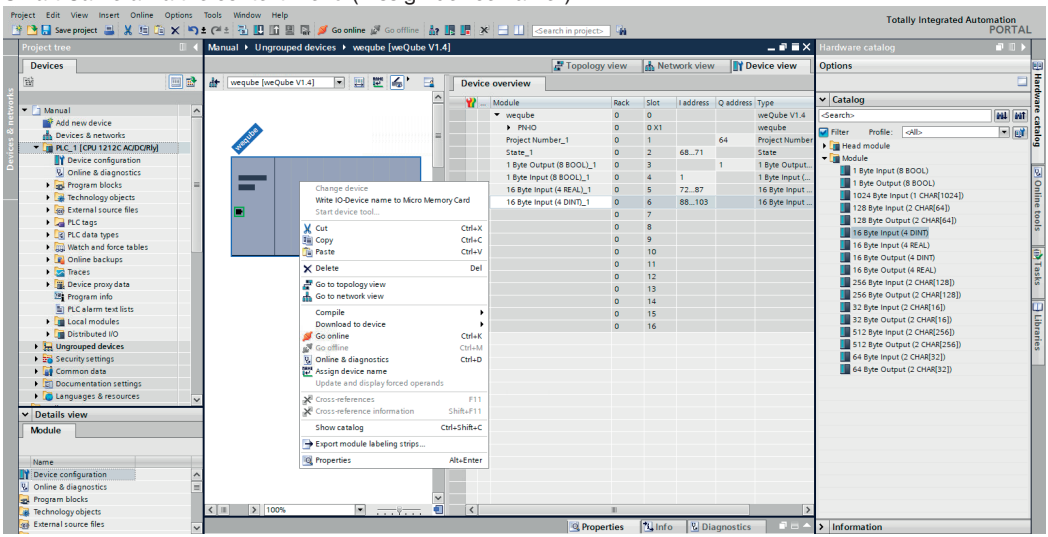
NOTE!
Slots 1 and 2 are fix. Slots 3 to 6 are adjustable.

The following example shows a 1 Byte Output (8 BOOL) at slot 3, a 1 Byte Input (8 BOOL) at slot 4, a 16 Bytes Input (4 REAL) at slot 5 and a 16 Bytes Input (4 DINT) at slot 6.

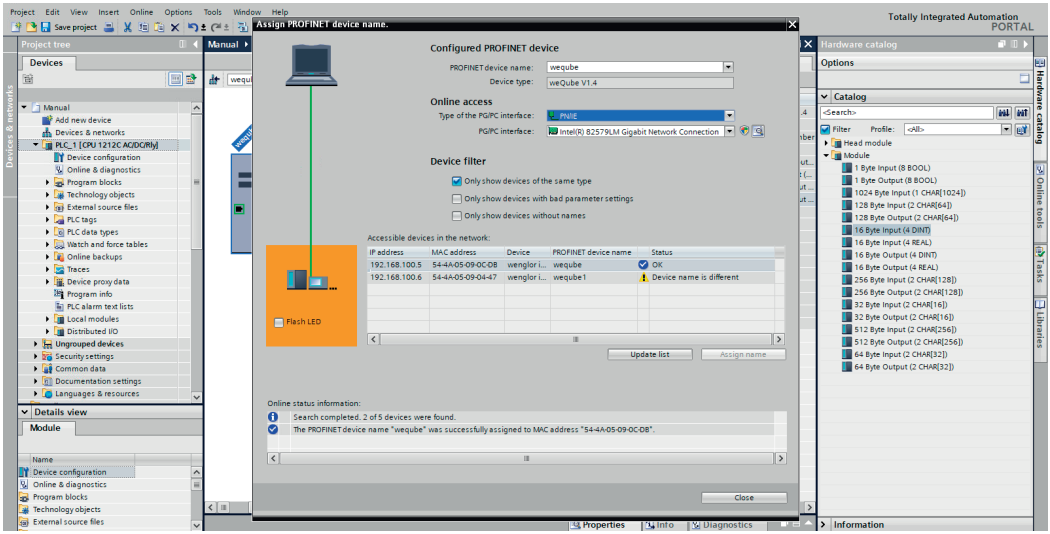


5.5 Download Configuration to PLC

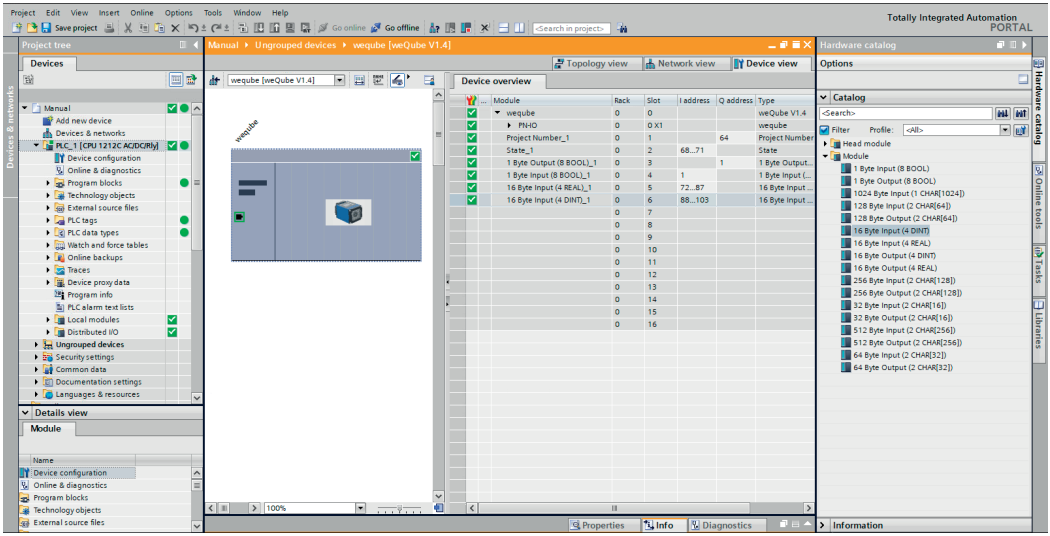
Download the configuration to the PLC. Then assign the network configuration and the device name to the Smart Camera via the context menu (“Assign device name”).



Click on “Update list” to see all Smart Cameras in the network. Select the correct Smart Camera, assign the name and close the window.



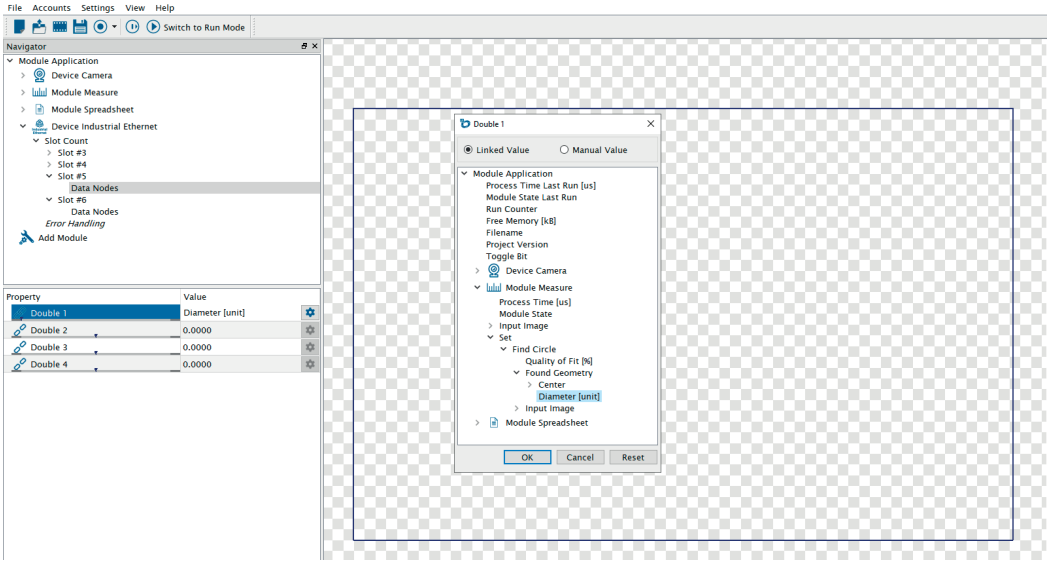
Click on “Go online”. Check the status in TIA Portal to analyze if the configurations of the PLC and the Smart Camera fit together.



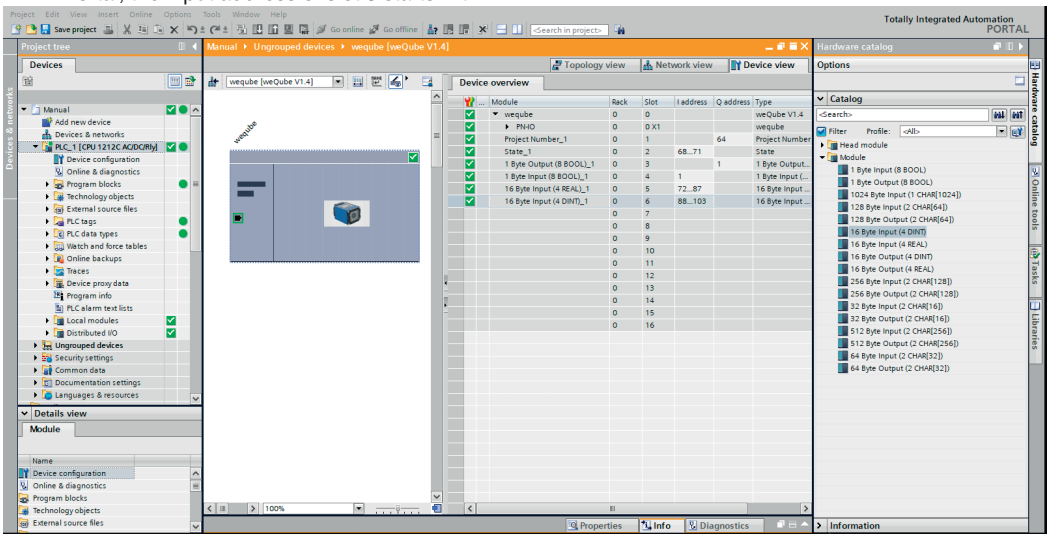
5.6 PLC Tags

Select PLC tags to add the input and output data to your PLC project.

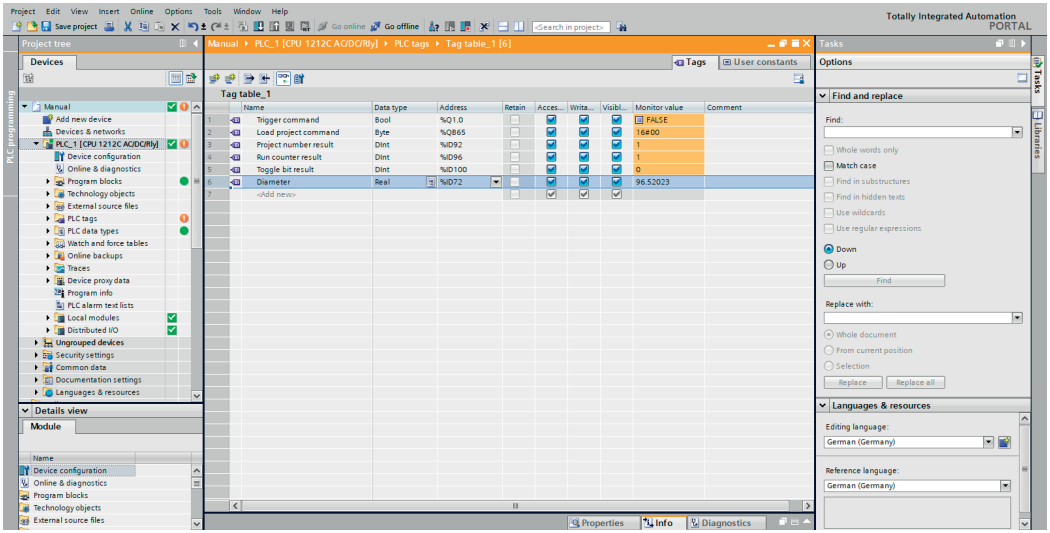
Example: The example shows the sending process of the Diameter in the Module Measure application as first REAL value of slot 5.



In TIA Portal, the input address of slot 5 starts with 72.



The correct input address must be set in the PLC tags in order to receive the diameter value.



NOTE!
Make sure to check the change of the toggle bit and/or the run counter in the last slot in order to check if all measurement results are already updated.

6. Sample PLC Program

The download area for the Smart Camera 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 weQube Smart Camera.

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. Open the associated uniVision project file in the Smart Camera, save it as a start-up project, and restart the Smart Camera. The following slot configuration is used in uniVision projects:
   - Slot 3: 1-byte output
   - Slot 4: 1-byte input
   - Slot 5: 16-byte input (4 REAL)
   - Slot 6: 16-byte input (4 DINT)

3. Open the sample PLC program, adjust the network configuration, and transfer the program to the PLC, or activate it on the PLC.