Your Global Automation Partner

TBEN-Lx-EN1 and FEN20-EN1 Spanner

User Manual

555Txxxxx v0.1 Preliminary 10/25/16

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Introduction

Purpose

The purpose of this document is to guide customers in installing and commissioning the TBEN-Lx-EN1 and FEN20-EN1 Ethernet spanners.

All respective Safety measures and accident protection guidelines must be considered carefully and without exception.

NFPA 79, State and Local code governing the installation of electrical devices and components take precedence over any circuit presented in this manual – circuits presented in this manual are for demonstrative purpose only.

Products Covered

TBEN-L4-EN1
TBEN-L5-EN1
FEN20-EN1

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General Technical Information

Safety

At the moment TURCK does not offer Ethernet Spanners for Safety applications.

Web Server Security

In the web server, a default-password is assigned in the TBEN-L-module for the administrator access (see also Change Admin Password (page 16)).

In order to make misuse by third parties more difficult, it can be necessary to change the password. This should be done in the context of the network security concept for the complete facility in which the modules are placed.

In order to disconnect a logged in user/PC with administrator rights from the web server, a logout is necessary. If the web browser is closed while the admin is logged in, the last active access is reactivated when opening the web server again from the same PC, which means, possibly with all administrator rights.

Ethernet Spanner General Information

- The Ethernet Spanner has 2 Ethernet ports that can be addressed individually.
- Data is exchanged via a 240 WORD (480 byte) data table.
- Spanner Port 1 supports Ethernet/IP and MODBUS/TCP, Spanner Port 2 supports Ethernet/IP and MODBUS/TCP and PROFINET.
- Direct connection of up to 16 digital inputs to the field bus
- Channel-related short-circuit diagnosis of inputs
- Ethernet-connection with two 4-pole, d-coded M12 x 1 connectors
- Rotary switch position settings only apply to port 1
- ACD is disabled on both ports
- LLDP is enabled on Port 2 only
- Port 2 IP address can only be setup via the web server
- Upgrades can only be performed via port 1

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TBEN-Lx-EN1 General Technical Information

Supply Voltage TBEN-Lx-EN1	
V1 (incl. electronics supply)	24 V DC
Permissible range	18 … 30 V DC
V2	24 V DC
Permissible range	18 … 30 V DC
Electrical isolation	galvanic isolation between V1 and V2
Connectors	
Ethernet	2 x M12-female (OUT), 4-pole, D-coded
PROFIBUS	1 x M12-male (IN), 5-pole, B-coded 1 x M12-female (OUT), 5-pole, B-coded
Power supply	7/8" connector, 4-/5-pole
Inputs	M12-connector, 5-pole
Isolation voltages	
V1 to V2	≥ 500 V AC
V1/V2 to field bus	≥ 500 V AC
Protocol properties	
Modbus TCP	
Address assignment	Static IP (rotary coding switch), BOOTP, DHCP
Supported Function Codes	FC3, FC4, FC16, FC23
Number of connections	8
EtherNet/IP™	
address assignment	according to EtherNet/IP™ standard
Quick Connect (QC)	< 150 ms
Number of connections	3
PROFINET	
Address assignment	DCP
MinCycleTime	1 ms

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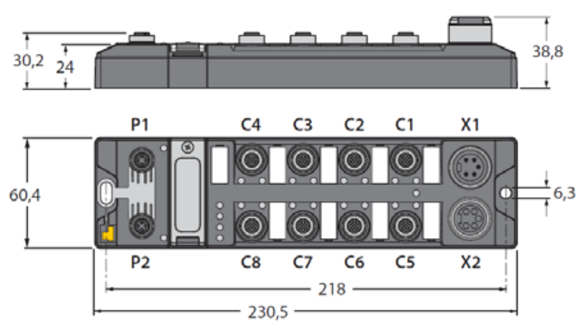
Diagnosis	according to PROFINET Alarm Handling
Topology detection	supported
Automatic address assignment	supported
Housing	Fibre-glass reinforced Polyamide (PA6-GF30)
Size	60.4 × 230.4 × 24 mm (B × L × H)
Window material	Lexan
Screw material	303 Stainless Steel
halogen-free	yes
Mounting	via 2 through-holes, Ø 6.3 mm
Mounting distance station to station	≥ 50 mm Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting). In case of low simultaneity factors and low ambient temperatures, mounting distances of < 50 mm may be possible.
Protection class	IP65/IP67/IP69K
Tests	
Vibration test	according to EN 60068-2-6/ IEC 68-2-47 Acceleration up to 20 g
Drop and topple	according to IEC 60068-2-31/ IEC 60068-2-32 1
Shock test	according to EN 60068-2-27
EMC	according to EN 61131-2
Temperature range	
– Operating temperature	- 40 °C to + 70 °C (- 40 °F to + 158 °F)
– Storage temperature	- 40 °C to + 70 °C (- 40 °F to + 158 °F)

TBEN-Lx-EN1 Dimensioned Drawing



FEN20-EN1 General Technical Information

FEN20-EN1	
Number of channels	8
Operating / load voltage	12...30 VDC
Operating current	100 mA
Electrical isolation	500V Galvanic I/O to Ethernet
Supply voltage	24 VDC
Power loss, typical	≤ 2.4 W
Voltage supply connection	screw terminals
Inputs	
Number of channels	8
Input voltage	24 VDC
Supply current	700 mA
Switching threshold	7V / 1.65mA
Low level signal voltage	< 7 VDC
High level signal voltage	7...30 VDC
Low level signal current	< 1.5 mA
High level signal current	> 2 mA
Input delay	2.5 ms
Max. input current	6 mA
System data	
Transmission rate	10/100 Mbps; Full/Half Duplex; Auto Negotiation; Auto Crossing
Addressing modes Ethernet:	via Software
Connection technology Ethernet	2 x RJ45 Sockets
Protocol detection	automatic
Web server	192.168.1.254 (Default)
Service Interface	Ethernet
Device Reset	via Push-button
Modbus TCP	
Addressing	Static IP, BOOTP, DHCP
Supported function codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of TCP connections	6
Input Data Size	max. 240 register
Input register start address	12288 (HEX 0x3000)
Output Data Size	max. 240 register
Output register start address	13312 (HEX 0x3400)

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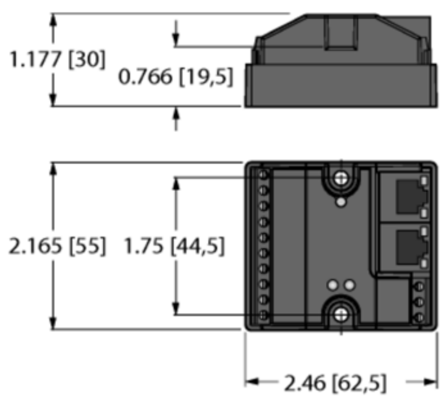
EtherNet/IP™	
Addressing	acc. to EtherNet/IP™ specification
Quick Connect (QC)	< 150 ms
Number of CIP connections	6

PROFINET	
Addressing	DCP
Conformance class	B (RT)
MinCycleTime	1 ms
Diagnostics	acc. to PROFINET alarm handling
Topology detection	supported
Automatic addressing	supported

Dimensions (W x L x H)	55 x 62.5 x 30mm
Housing material	Fiber-glass reinforced Polyamide (PA6-GF30)
Operating temperature	-40...70 °C
Storage temperature	-40...85 °C
Protection class	IP20
Approvals	CE, cULus

FEN20EN1 Dimensioned Drawing



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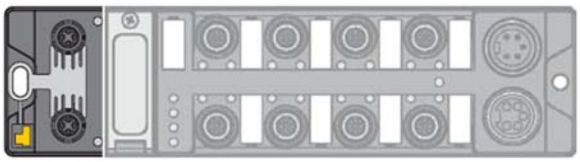
TBEN-Lx-EN1 Connection Options

Connection to Ethernet

The connection to Ethernet is realized via the integrated auto-crossing switch is done using two 4-pole, D-coded M12 x 1-Ethernet-connectors.

Ethernet M12 x 1



ETH1 (P1)

P1

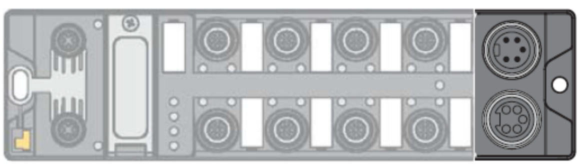
1 = TD +
2 = RD +
3 = TD –
4 = RD –

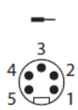
ETH2 (P2)

P2

1 = RD +
2 = TD +
3 = RD –
4 = TD –

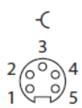
Supply voltage 7/8“, 5-pole





X1

1 = V2 (–)
2 = V1 (–)
3 = FE
4 = V1 (+)
5 = V2 (+)

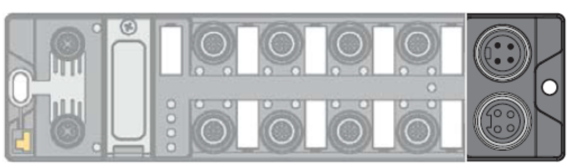


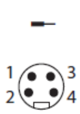
X2

X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

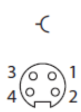
Supply voltage 7/8“, 4-pole





X1

1 = 24 VDC V2
2 = 24 VDC V1
3 = GND V1
4 = GND V2



X2

X1= voltage IN
X2 = voltage OUT for supplying the next node

V1 = supply voltage 1 (incl. supply of electronics)
V2 = supply voltage 2

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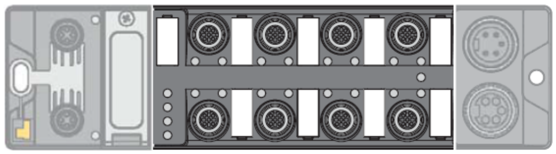
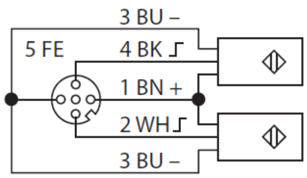
Inputs/outputs

The connection of sensors is realized via 8 M12 x 1-connectors.

Inputs/outputs M12 x 1





C0...C7 Input Pin assignments

Grounding the Station (FE)

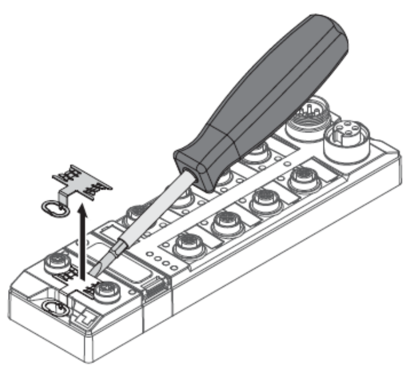
Metal clamp and metal ring are connected.

The mounting screw (3) through the station's mounting hole connects the shield of the fieldbus lines to the FE of power supply and sensors/actuators and the installation's reference potential.

If a common reference potential is not desirable, remove the metal clamp for decoupling and/or mounting the station by using a plastic screw.

Dismounting the metal clamp

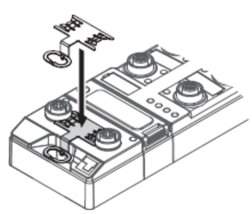
➤ Use a slim slotted screwdriver in order to lift up and remove the metal clamp.



Mounting the metal clamp

➤ Place the metal clamp between the fieldbus connectors by using a screwdriver in such way that the clamp contacts the metal housing of the connectors.

➥ The shielding of the fieldbus lines is now again connected to the metal clamp.



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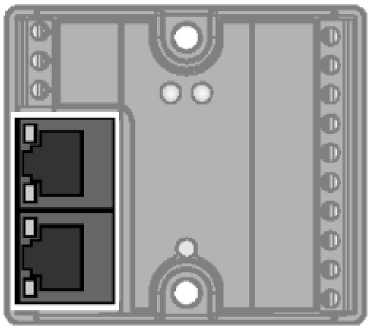
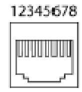
FEN20-EN1 Connection Options

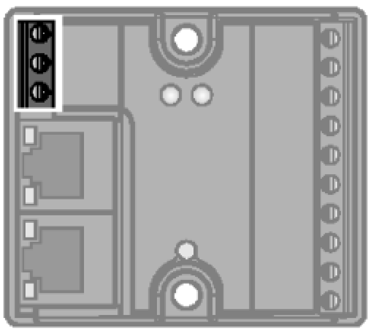
Terminal assignment



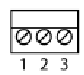
Ethernet



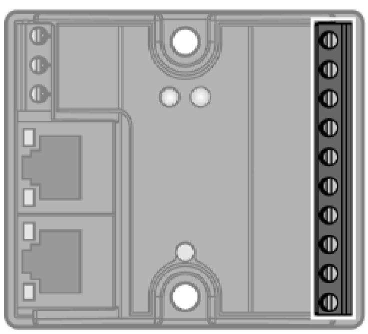
1 = TX +
2 = TX –
3 = RX +
4 = n.c.
5 = n.c.
6 = RX –
7 = n.c.
8 = n.c.



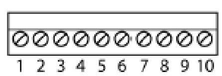
Power Supply



1 = ⏚
2 = V1 –
3 = V1 +



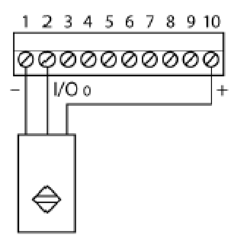
Input Channels



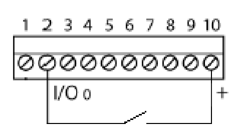
1 = V1 –
2 = I0
3 = I1
4 = I2
5 = I3
6 = I4
7 = I5
8 = I6
9 = I7
10 = V_{OUT}1 +

Pin 10 (VOUT1+) is powered by V+, Pin 1 V1- is common to V-.

3-wire



2-wire



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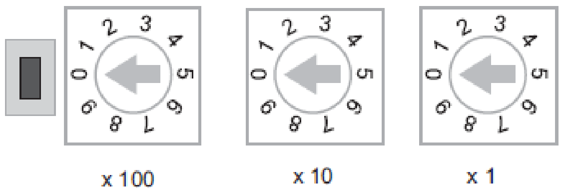
Spanner Setup and Addressing

TBEN-Lx-EN1 Address Mode Assignment

Setting the address mode is dome through 3 rotary coding-switches on the gateway.



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
900: F_Reset

ATTENTION!

Protective cover opened

Protection class IP65/IP67/IP69K not warranted

- Screw the protective cover over the rotary coding-switches firmly
- Check if seal of the protective cover is correctly placed

NOTE

After every change of the address-mode, a voltage reset must be done.

Mode: Static rotary

- switch position: **001 - 254**

When using the rotary-mode, the last byte of the station's IP address can be set via the rotary coding switches.

Addresses in the range from 0 to 255 can be allocated, whereas 1 is normally reserved for the default-gateway and 0 and 255 for broadcast messages in the subnet.

In TURCK devices, 0 is used to reset the device to the default IP address

NOTE

We therefore recommend addresses in the range of 2-254.

Mode: BootP (300)

- switch position: 300

Address setting is carried out by a BootP-server in the network after the start-up of the gateway.

NOTE

The IP address, as well as the default subnet mask assigned to the station by the BootP-server, are stored permanently in the station's EEPROM.

In case of switching the device to rotary- or PGM-mode, the settings carried out via BootP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

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Mode: DHCP (400)

- switch position: 400

Address setting is carried out by a DHCP-server in the network after the start-up of the gateway.

> **NOTE**
> The IP address, as well as the default subnet mask assigned to the station by the DHCP-server, are stored permanently in the station's EEPROM.
> In case of switching the device to rotary- or PGM-mode, the settings carried out via DHCP (IP address, subnet mask, etc) will be taken from the module's EEPROM.

DHCP supports three mechanisms for IP address allocation:

- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time, or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

Mode: PGM (500)

- switch position: 500

The PGM-mode enables access of the software I/O-ASSISTANT to the module's network settings.

> **NOTE**
> In the PGM-mode, all network settings (IP address, subnet mask, etc.) are send to the module's internal EEPROM and stored permanently.

Mode: PGM-DHCP (600)

- switch position: 600

The device sends DHCP-requests until a IP address is assigned (DHCP-server, PROFINET-controller).

The assigned IP-address is stored to the device and the DHCP-client is stopped.

Even after a restart of the device, the device sends no further DHCP-requests.

PROFINET

This mode assures a PROFINET-compliant operation of the modules.

> **NOTE**
> If a DHCP-server is used within the network, problems may occur during IP-assignment.
> In this case, both, the DHCP-server as well as the PROFINET-controller (via DCP), try an IP-address-assignment.

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Resetting the IP address, switch position ‘000’

With this setting the rotary coding-switches to "000" followed by a voltage reset, the module is set to the address 192.168.1.254 for IP-based services (seeDefault setting of the gateway (page 6-5)).

NOTE

Setting "000" is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

Default setting of the gateway

The stations' default-settings are as follows:

IP address	192.168.1.254
Subnet mask	255.255.255.0
default gateway	192.168.1.1

NOTE

The stations can be reset by the user to these default settings at any time.
To reset the module, set the 3 coding-switches on the gateway to "000" followed by a power-on reset.

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not warranted
- Screw the protective cover over the rotary coding-switches firmly
- Check if seal of the protective cover is correctly placed

Factory Rest (F_Reset), switch position ‘900’

F_Reset (Reset to factory setting)

switch position: 900

This mode sets all device-settings back to the default values and deletes all data in the device's internal flash.

NOTE

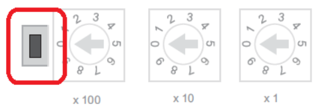
Setting 900 is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

ATTENTION!

Protective cover opened
Protection class IP65/IP67/IP69K not warranted
- Screw the protective cover over the rotary coding-switches firmly
- Check if seal of the protective cover is correctly placed

Set Button

The set button is placed to the left of the rotary coding switches under the cover on the device. Pushing this button causes a device re-start.



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FEN20-EN1 Address Mode Assignment

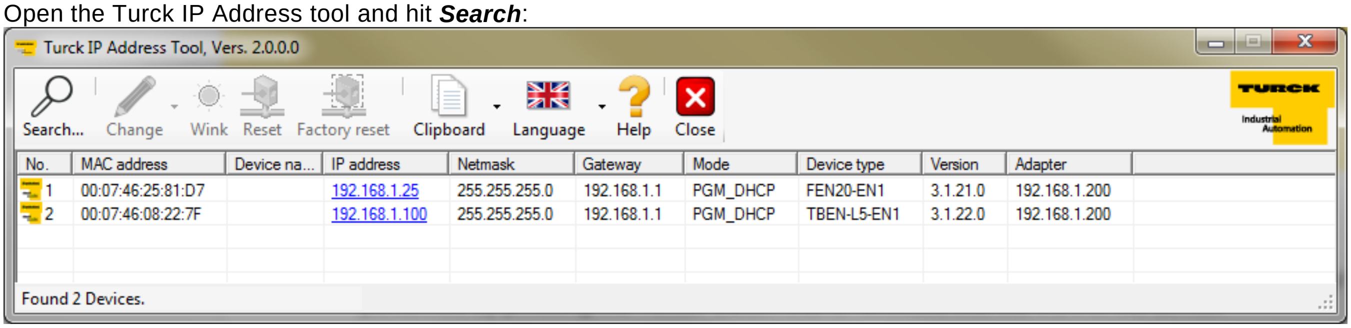
The FEN20-EN1 has no rotary switches and is permanently set to mode PGM-DHCP. A factory reset (F_Restet) can be performed by pressing the 'Reset' button that is recessed into the front of the device.

Assign the IP Address with Turck IP Address Tool (Port 1 only)

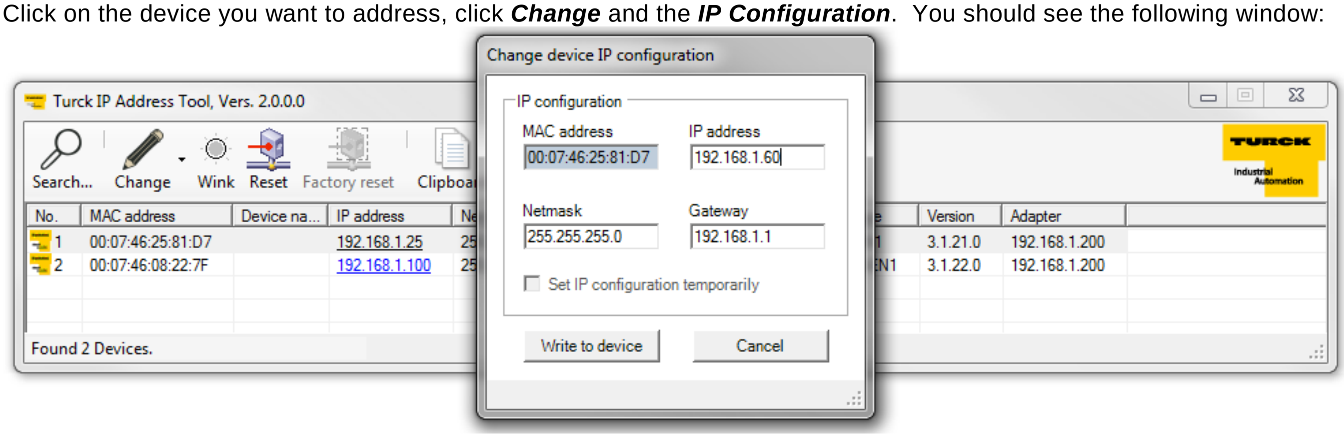
The Turck IP Address tool can be used to set the IP address of either the TBEN-Lx-EN1 or the FEN20-EN1 in rotary switch mode PGM (500) or PGM_DHCP (600). The tool can also be used to change the first 3 octets of the IP address as well as netmask and gateway in other rotary switch modes.

Note: For the TBEN-Lx-EN1 and the FEN20-EN1 Ethernet Spanners the Ethernet cable MUST be plugged into Port 1 for the Turck IP Address Tool to work correctly. The address of Port 2 CNANOT be set with Turck Address Tool, for users that need to assign IP addresses to ports 1 and 2 the Webserver is recommended and discussed in the following section.

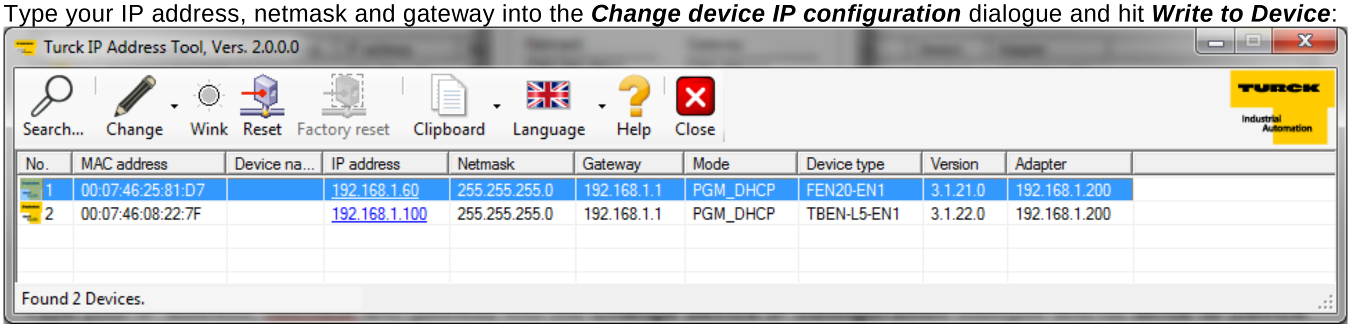
Open the Turck IP Address tool and hit ***Search***:



Click on the device you want to address, click ***Change*** and the ***IP Configuration***. You should see the following window:



Type your IP address, netmask and gateway into the ***Change device IP configuration*** dialogue and hit ***Write to Device***:

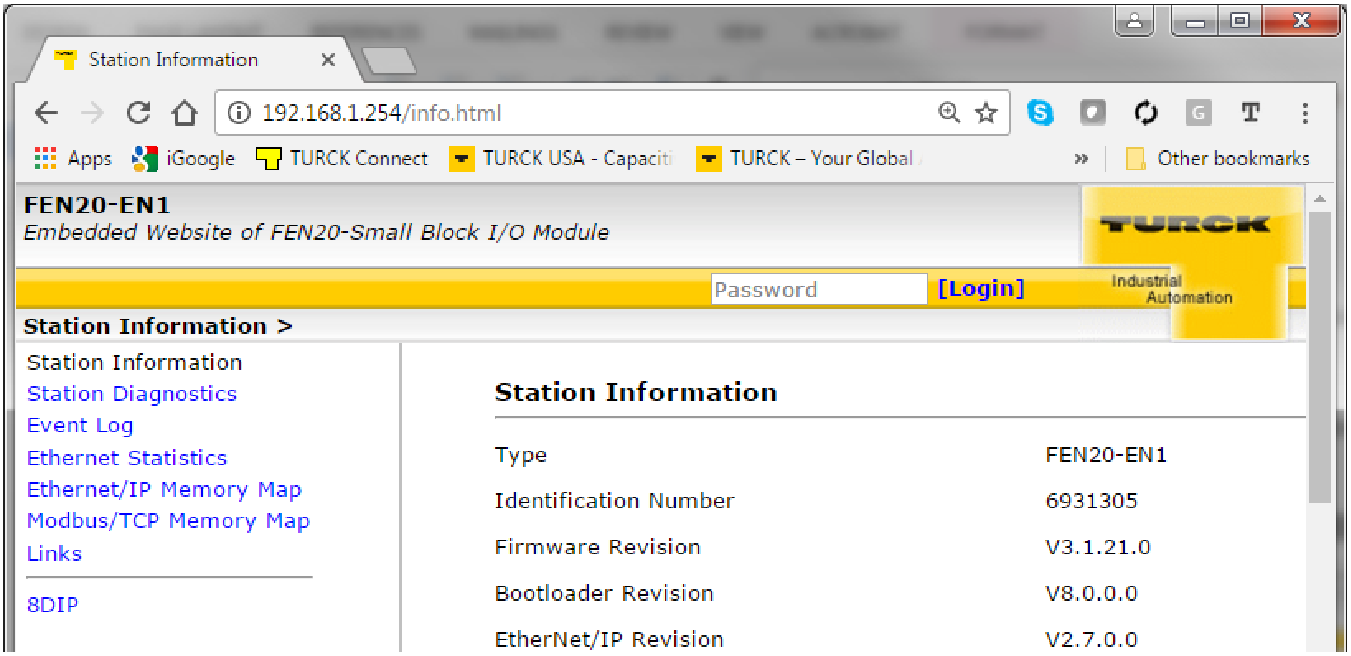


The IP address is now set. You can close the Turck IP Address Tool.

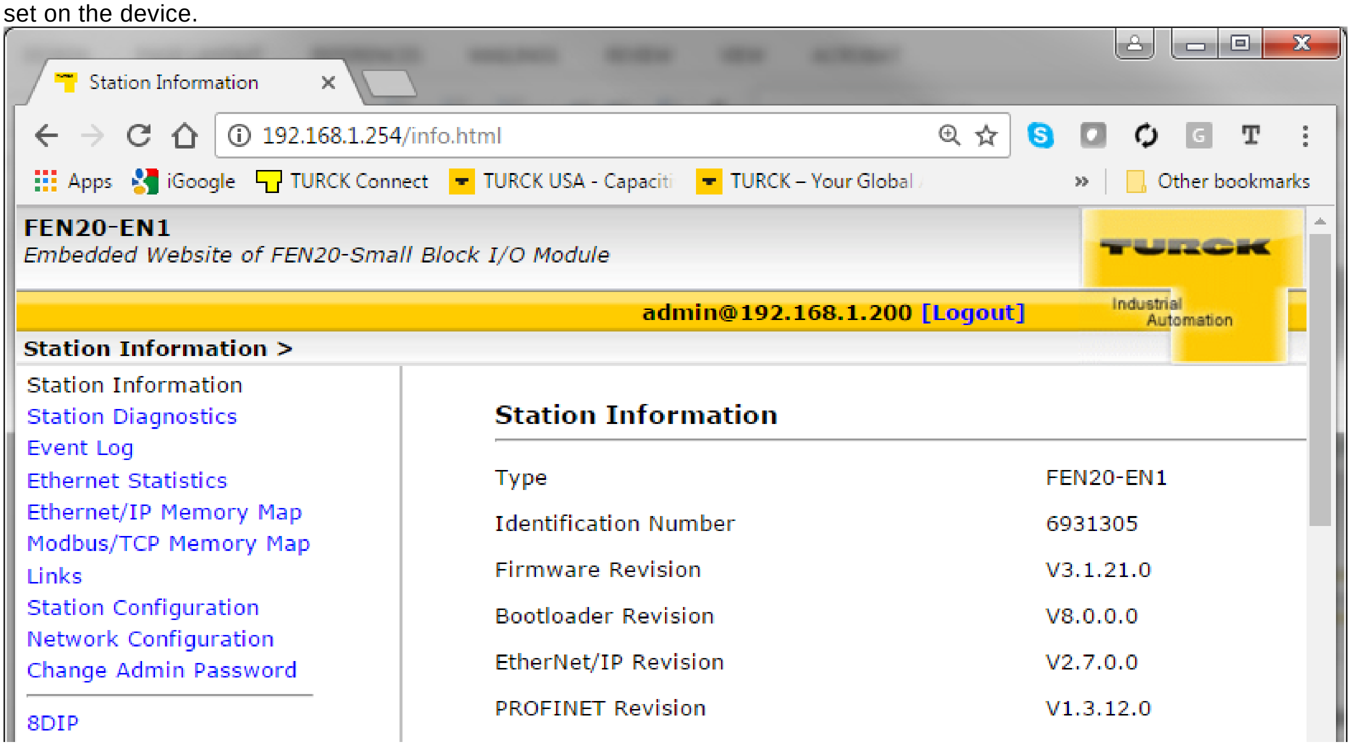
The Webserver

The Webserver of the TBEN-Lx-EN1 and the FEN20-EN1 can be used to set the IP address for Port 1 and 2 of the Ethernet Spanner, other functionalities of the webserver will be discussed in sections to follow.

Type the IP address of the device into your web browser, if the device is out of the box or has been reset to factory defaults the IP Address of both Port 1 and Port 2 is 192.168.1.254:

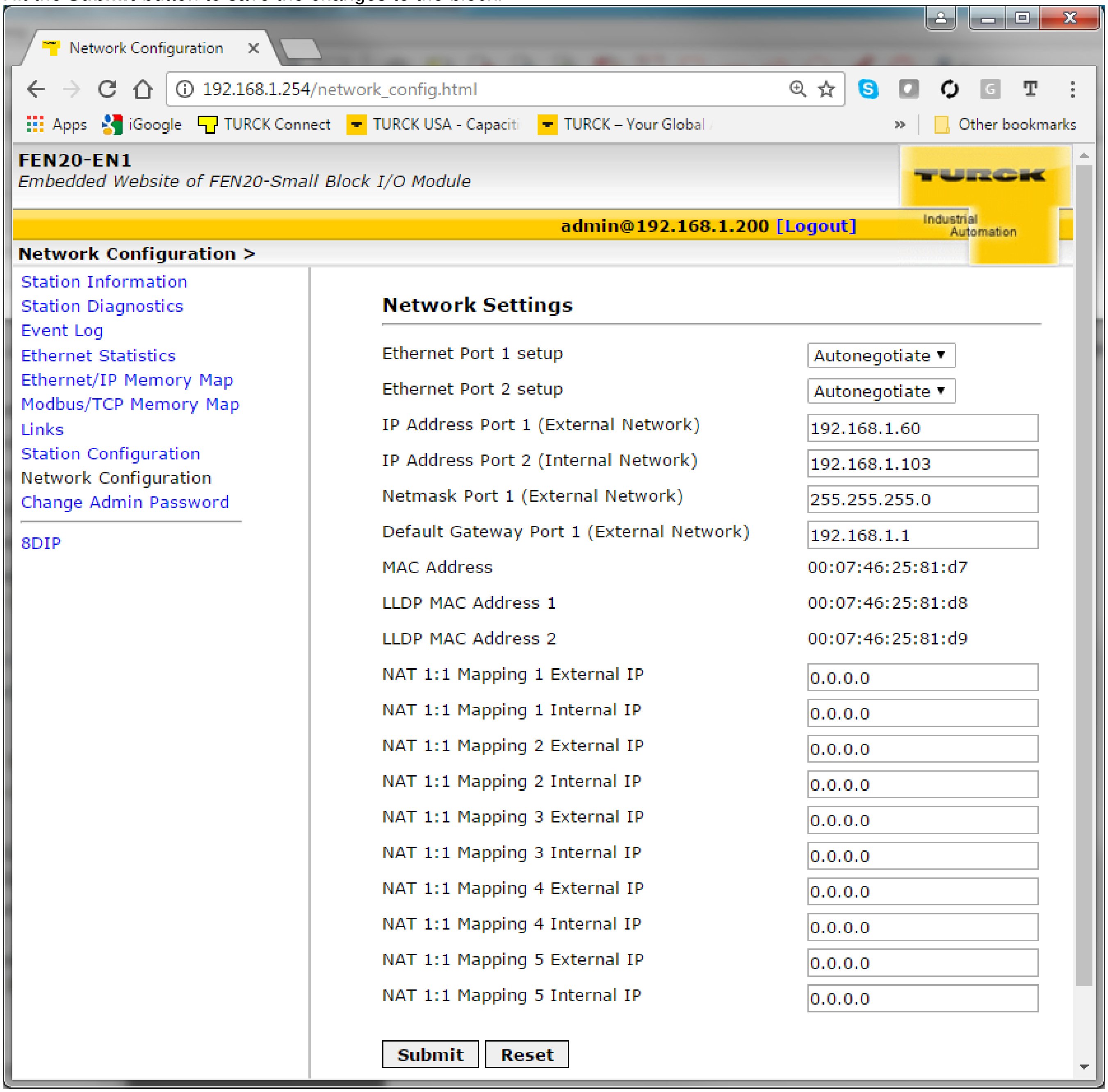


Log into the clock with the default Admin password – password. The password can be reset by performing a factory re-set on the device.

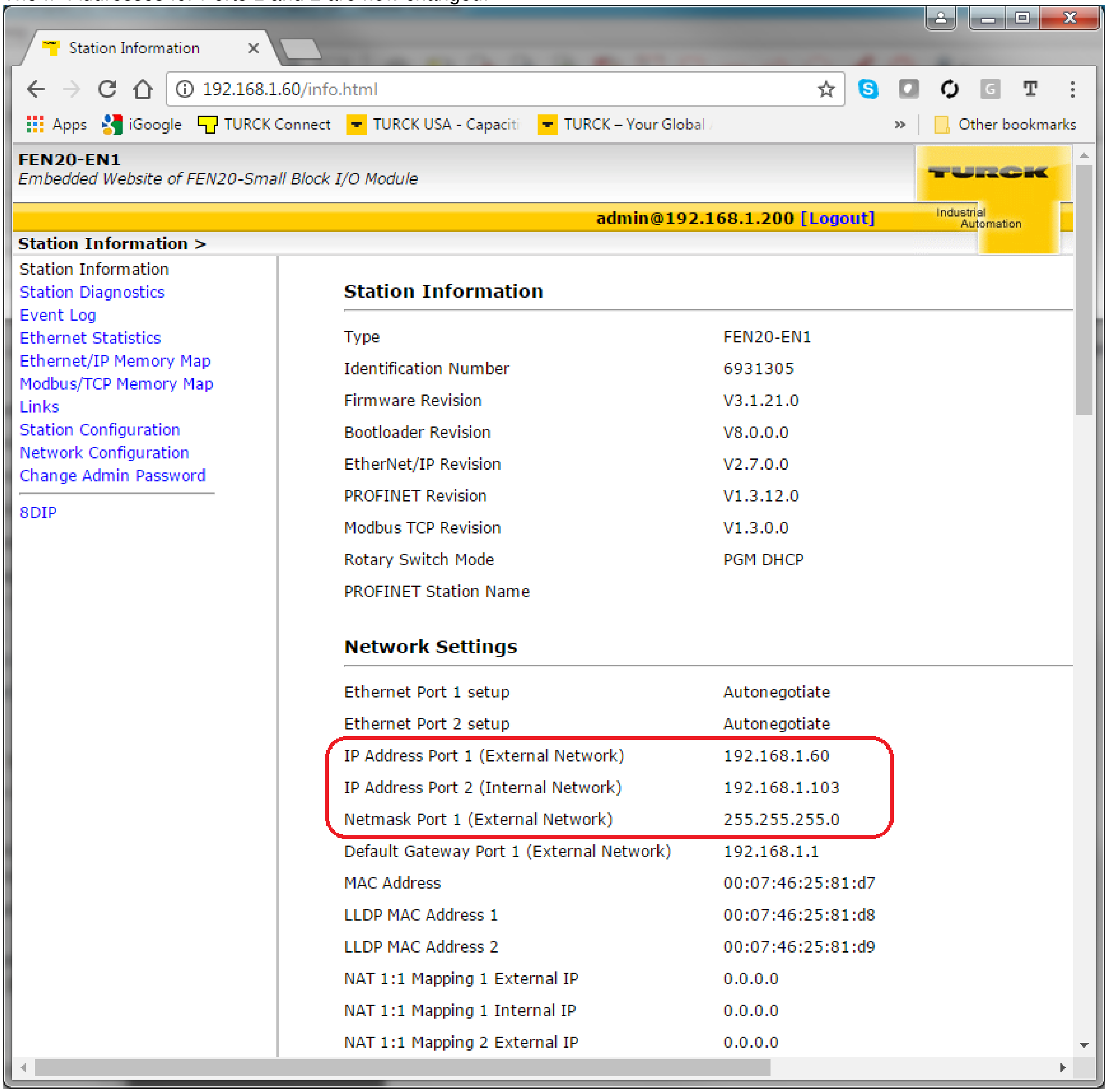


Use the hyperlinks on the left hand pane of the screen to go to the ***Network Configuration*** screen of the device. Here you can program the IP Address for Port 1 and Port 2.

Hit the ***Submit*** button to save the changes to the block:



The IP Addresses for Ports 1 and 2 are now changed:



The Webserver and Spanner Data Mapping

Spanner Data Mapping

The data map of the spanner can be seen on the **Station Information** page of the Webserver under the **Spanner Status** heading.

The data map consists of 240, 16-bit words. The status table for Port 1 shows the value of each word that is being written by the device that is mapped to Port 1, the status table for Port 2 shows the value of each word that is being written by the device that is mapped to Port 2.

Data from each port is loaded into the web page every time it is refreshed.

Spanner Status

Port 1 spanner data

Offset (d)	00	01	02	03	04	05	06	07	08	09
0	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
10	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
20	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
30	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
40	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
50	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
60	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
70	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
80	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
90	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
100	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
110	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
120	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
130	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
140	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
150	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
160	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
170	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
180	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
190	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
200	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
210	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
220	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
230	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000

Port 2 spanner data

Offset (d)	00	01	02	03	04	05	06	07	08	09
0	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
10	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
20	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
30	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
40	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
50	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
60	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
70	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
80	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
90	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
100	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
110	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
120	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
130	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
140	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
150	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
160	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
170	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
180	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
190	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
200	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
210	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
220	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
230	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000

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Data mapping of the Status and Input bits of the EN1 Spanner vary from protocol to protocol. The following mappings are for Ethernet/IP and Modbus/TCP, the same information can be added to a PROFINET project via GSDML file.

Modbus/TCP Status and Input mapping

8DIP (Input Data Mapping)			
Description	**Register**	**Bit Offset**	**Bit Length**
Channel 0 - Input value	0x0000 (0)	0	1
Channel 1 - Input value	0x0000 (0)	1	1
Channel 2 - Input value	0x0000 (0)	2	1
Channel 3 - Input value	0x0000 (0)	3	1
Channel 4 - Input value	0x0000 (0)	4	1
Channel 5 - Input value	0x0000 (0)	5	1
Channel 6 - Input value	0x0000 (0)	6	1
Channel 7 - Input value	0x0000 (0)	7	1
Station Status Word (Input Data Mapping)			
Description	**Register**	**Bit Offset**	**Bit Length**
Module Diagnostics Available	0x0001 (1)	0	1
Station Configuration Changed	0x0001 (1)	3	1
Overcurrent Isys	0x0001 (1)	5	1
Overvoltage Field Supply Ul	0x0001 (1)	6	1
Undervoltage Field Supply Ul	0x0001 (1)	7	1
Overvoltage Field Supply Usys	0x0001 (1)	8	1
Undervoltage Field Supply Usys	0x0001 (1)	9	1
Modulebus Communication Lost	0x0001 (1)	10	1
Modulebus Configuration Error	0x0001 (1)	11	1
INFO: Spanner connection established on Port 1	0x0001 (1)	12	1
INFO: Spanner connection established on Port 2	0x0001 (1)	13	1
Force Mode Enabled	0x0001 (1)	14	1

Ethernet/IP Status and Input Mapping

Station Status Word (Input Data Mapping)			
Description	**Word Offset**	**Bit Offset**	**Bit Length**
Module Diagnostics Available	0	0	1
Station Configuration Changed	0	3	1
Overcurrent Isys	0	5	1
Overvoltage Field Supply Ul	0	6	1
Undervoltage Field Supply Ul	0	7	1
Overvoltage Field Supply Usys	0	8	1
Undervoltage Field Supply Usys	0	9	1
Modulebus Communication Lost	0	10	1
Modulebus Configuration Error	0	11	1
INFO: Spanner connection established on Port 1	0	12	1
INFO: Spanner connection established on Port 2	0	13	1
Force Mode Enabled	0	14	1
8DIP (Input Data Mapping)			
Description	**Word Offset**	**Bit Offset**	**Bit Length**
Channel 0 - Input value	1	0	1
Channel 1 - Input value	1	1	1
Channel 2 - Input value	1	2	1
Channel 3 - Input value	1	3	1
Channel 4 - Input value	1	4	1
Channel 5 - Input value	1	5	1
Channel 6 - Input value	1	6	1
Channel 7 - Input value	1	7	1

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MODBUS/TCP General Description (Port 1 and/or Port 2)

Common Modbus description

NOTE

The following description of the Modbus protocol is taken from the Modbus Application Protocol Specification V1.1 of Modbus-IDA.

TECHNICAL BASICS

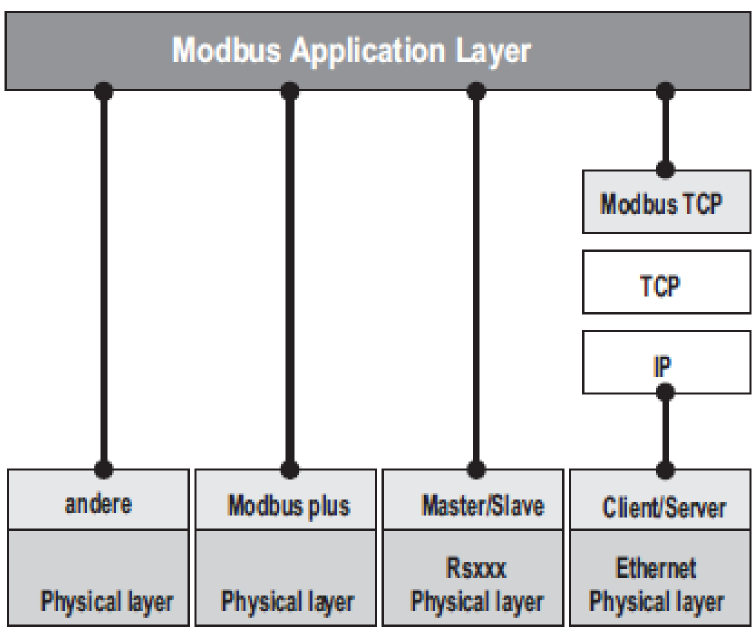
Modbus is an application layer messaging protocol, positioned at level 7 of the OSI model, that provides client/server communication between devices connected on different types of buses or networks.

The industry's serial de facto standard since 1979, Modbus continues to enable millions of automation devices to communicate. Today, support for the simple and elegant structure of Modbus continues to grow.

The Internet community can access Modbus at a reserved system port 502 on the TCP/IP stack.
Modbus is a request/reply protocol and offers services specified by function codes. Modbus function codes are elements of Modbus request/reply PDUs (Protocol Data Unit).

It is currently implemented using:
– TCP/IP over Ethernet. (that is used for the TBEN-L modules and described in the following)
– Asynchronous serial transmission over a variety of media (wire: RS232, RS422, RS485, optical: fiber, radio, etc.)
– Modbus PLUS, a high speed token passing network.

Schematic representation of the Modbus Communication Stack (according to Modbus Application Protocol Specification V1.1 of Modbus-IDA):



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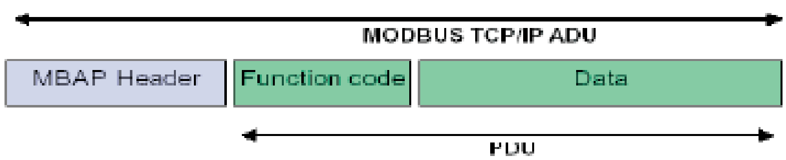
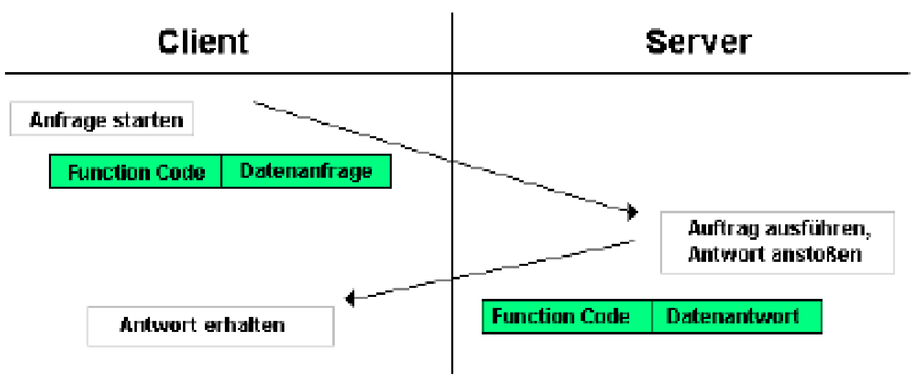
TECHNICAL BASICS

The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers.
The mapping of Modbus protocol on specific buses or network can introduce some additional fields on the application data unit (ADU).
The Modbus application data unit is built by the client that initiates a Modbus transaction.
The function code indicates to the server what kind of action to perform.
The Modbus application protocol establishes the format of a request initiated by a client.
The field function code of a Modbus data unit is coded in one byte. Valid codes are in the range of 1... 255 decimal (128 – 255 reserved for exception responses).
When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid.
Sub-function codes are added to some function codes to define multiple actions.



The data field of messages sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the data field.
The data field may be non-existent (= 0) in certain kinds of requests, in this case the server does not require any additional information. The function code alone specifies the action.
If no error occurs related to the Modbus function requested in a properly received Modbus ADU the data field of a response from a server to a client contains the data requested.



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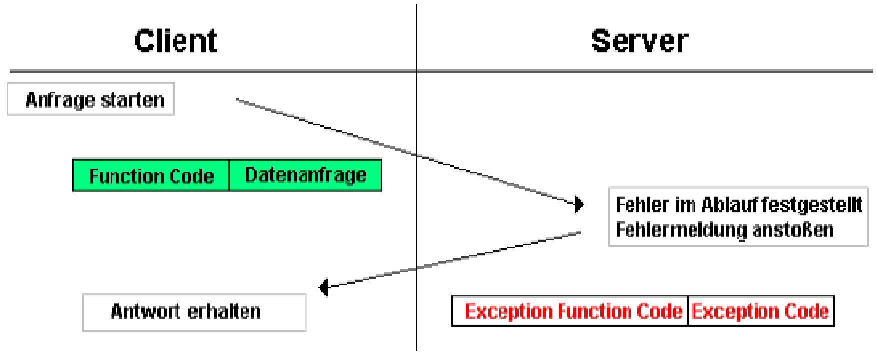
If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.



Data model

The data model distinguishes four basic data types:

Data Type	Object type	Access	Comment
Discrete Inputs	bit	Read	This type of data can be provided by an I/O system.
Coils	bit	Read-Write	This type of data can be alterable by an application program.
Input Registers	16 bit, (word)	Read	This type of data can be provided by an I/O system.
Holding Registers	16 bit, (word)	Read-Write	This type of data can be alterable by an application program.

TECHNICAL BASICS

For each of these basic data types, the protocol allows individual selection of 65536 data items, and the operations of read or write of those items are designed to span multiple consecutive data items up to a data size limit which is dependent on the transaction function code.
It's obvious that all the data handled via Modbus (bits, registers) must be located in device application memory.

Access to these data is done via defined access-addresses (see Modbus-registers (page 6-18)).

Implemented MODBUS Functions

The TBEN-Lx-EN1 and the FEN20-EN1 support the following functions for accessing process data, parameters, diagnostics and other services.

Function codes	
No.	**Function** Description
3	**Read Holding Registers**
	Serves for reading multiple output registers.
4	**Read Input Registers**
	Serves for reading multiple input registers.
6	**Write Single Register**
	Serves for writing a single output register.
16	**Write Multiple Registers**
	Serves for writing multiple output registers.
23	**Read/Write Multiple Registers**
	Reading and writing of multiple registers.

MODBUS/TCP EN1 Process Data Map – HEX (Decimal)

8DIP (Input Data Mapping)			
Description	**Register**	**Bit Offset**	**Bit Length**
Channel 0 - Input value	0x0000 (0)	0	1
Channel 1 - Input value	0x0000 (0)	1	1
Channel 2 - Input value	0x0000 (0)	2	1
Channel 3 - Input value	0x0000 (0)	3	1
Channel 4 - Input value	0x0000 (0)	4	1
Channel 5 - Input value	0x0000 (0)	5	1
Channel 6 - Input value	0x0000 (0)	6	1
Channel 7 - Input value	0x0000 (0)	7	1
Station Status Word (Input Data Mapping)			
Description	**Register**	**Bit Offset**	**Bit Length**
Module Diagnostics Available	0x0001 (1)	0	1
Station Configuration Changed	0x0001 (1)	3	1
Overcurrent Isys	0x0001 (1)	5	1
Overvoltage Field Supply UI	0x0001 (1)	6	1
Undervoltage Field Supply UI	0x0001 (1)	7	1
Overvoltage Field Supply Usys	0x0001 (1)	8	1
Undervoltage Field Supply Usys	0x0001 (1)	9	1
Modulebus Communication Lost	0x0001 (1)	10	1
Modulebus Configuration Error	0x0001 (1)	11	1
INFO: Spanner connection established on Port 1	0x0001 (1)	12	1
INFO: Spanner connection established on Port 2	0x0001 (1)	13	1
Force Mode Enabled	0x0001 (1)	14	1
Spanner Data			
Description	**Register**	**Bit Offset**	**Bit Length**
Spanner Data	0x3000 (12288)	0	up to 240 registers

Modbus/TCP Output Data Mapping

Spanner Data			
Description	**Register**	**Bit Offset**	**Bit Length**
Spanner Data	0x3400 (13312)	0	up to 240 registers

MODBUS/TCP All Registers

Address (hex.)	**Access A**	**Description**
0x0000 to 0x0000	ro	8 DIP - Input Data Mapping
0x0001 to 0x0001	ro	Station Status Word
0x3000 to 0x30EF	ro	packed process data of inputs (process data length of the modules
0x3400 to 0x34EF	rw	packed process data of outputs (process data length of the modules
0x1000 to 0x1006	ro	Station Identifier
0x100C	ro	Station status
0x1012	ro	process image length in bit for the intelligent output modules
0x1013	ro	process image length in bit for the intelligent input mod-ules
0x1017	ro	Register-mapping-revision (always 1, if not, mapping is incompatible with this description)
0x1020	ro	watchdog, actual time [ms]
0x1120	rw	watchdog predefined time [ms] (default: 0),
0x1130	rw	Modbus connection mode register
0x1131	rw	Modbus connection timeout in sec. (Def.: 0 = never),
0x113C to 0x113D	rw	Modbus parameter restore (reset of parameters to default values)
0x113E to 0x113F	rw	Modbus parameter save (permanent storing of parameters)

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Register 1130h: „Modbus-Connection-Mode“

This register defines the behavior of the Modbus connections:

Bit	Name – Description
15 to 2	reserved
1	**MB_ImmediateWritePermission**
	– **0**: With the first write access, a write authorization for the respective Modbus-connection is requested. If this request fails, an exception response with exception-code 01h is generated. If the request is accepted, the write access is executed and the write authorization remains active until the connection is closed. – **1**: The write authorization for the respective Modbus-connection is already opened during the establishment of the connection. The first Modbus-connection thus receives the write authorization, all following connections don't (only if bit 0 = 1).
0	**MB_OnlyOneWritePermission**
	– **0**: all Modbus-connections receive the write authorization – **1**: only one Modbus-connection can receive the write permission. A write permission is opened until a Disconnect. After the Disconnect the next connection which requests a write access receives the write authorization.

Register 1131h: „Modbus-Connection-Timeout“

This register defines after which time of inactivity a Modbus-connection is closed through a Disconnect.

Behavior of the BUS LED

In case of a Connection Timeout the BUS LED's behavior is as follows:

Connection-Timeout	BUS LED
Time elapsed	green, flashing

Register 0x113C and 0x113D: „Restore Modbus-Connection-Parameters"

Register 0x113C and 0x113D are used to reset the parameter-register 0x1120 and 0x1130 to 0x113B to default.

For this purpose, write 0x6C6F to register 0×113E. To activate the reset of the registers, write 0×6164 ("load") within 30 seconds in register 0×113D.

Both registers can also be written with one single request using the function codes FC16 and FC23.

The service resets the parameters without saving them. This can be achieved by using a following "save" service.

Register 0x113E and 0x113F: "Save Modbus-Connection-Parameters"

Registers 0x113E and 0x113F are used for permanent storing the parameters in registers 0x1120 and 0x1130 to 0x113B.

For this purpose, write 0x7361 to register 0×113E. To activate the saving of the registers, write 0×7665 ("save") within 30 seconds in register 0×113F.

Both registers can also be written with one single request using the function codes FC16 and FC23.

Error behavior (watchdog)

Behavior of outputs

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120

- watchdog = 0 ms (default)
  → outputs hold the momentary value
- watchdog > 0 ms
  → outputs switch to **0** after the watchdog time has expired (setting in register 0×1120).

NOTE
Setting the outputs to predefined substitute values is not possible in Modbus TCP. Eventually parameterized substitute values will not be used.

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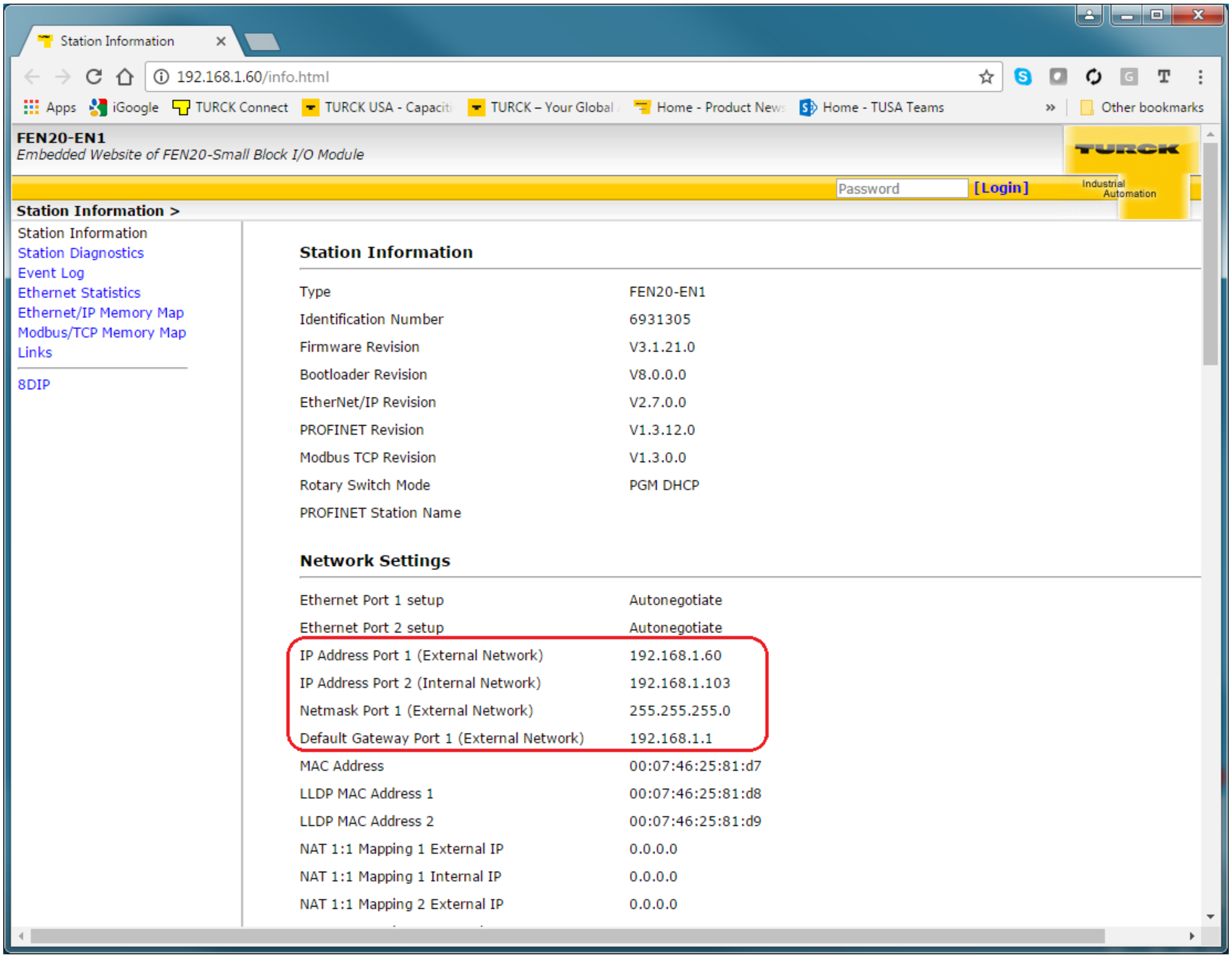
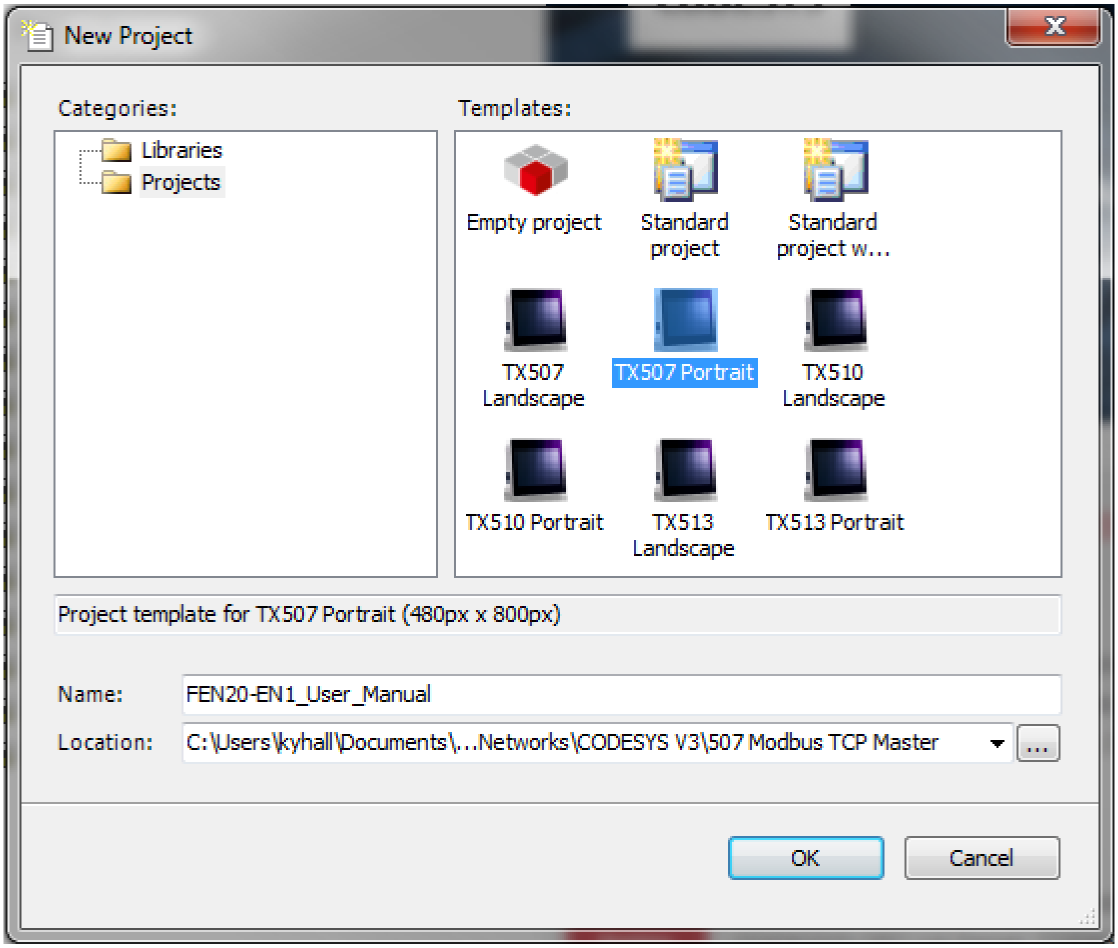
Mapping the FEN20-EN1 Spanner into a CoDeSys V3 Project via MODBUS/TCP

The FEN20-EN1 Spanner is addressed as follows via the Webserver



Create a TX507 Portrait Project in CODESYS V3.5 (CODESYS V3.5 SP 8 Patch 1)



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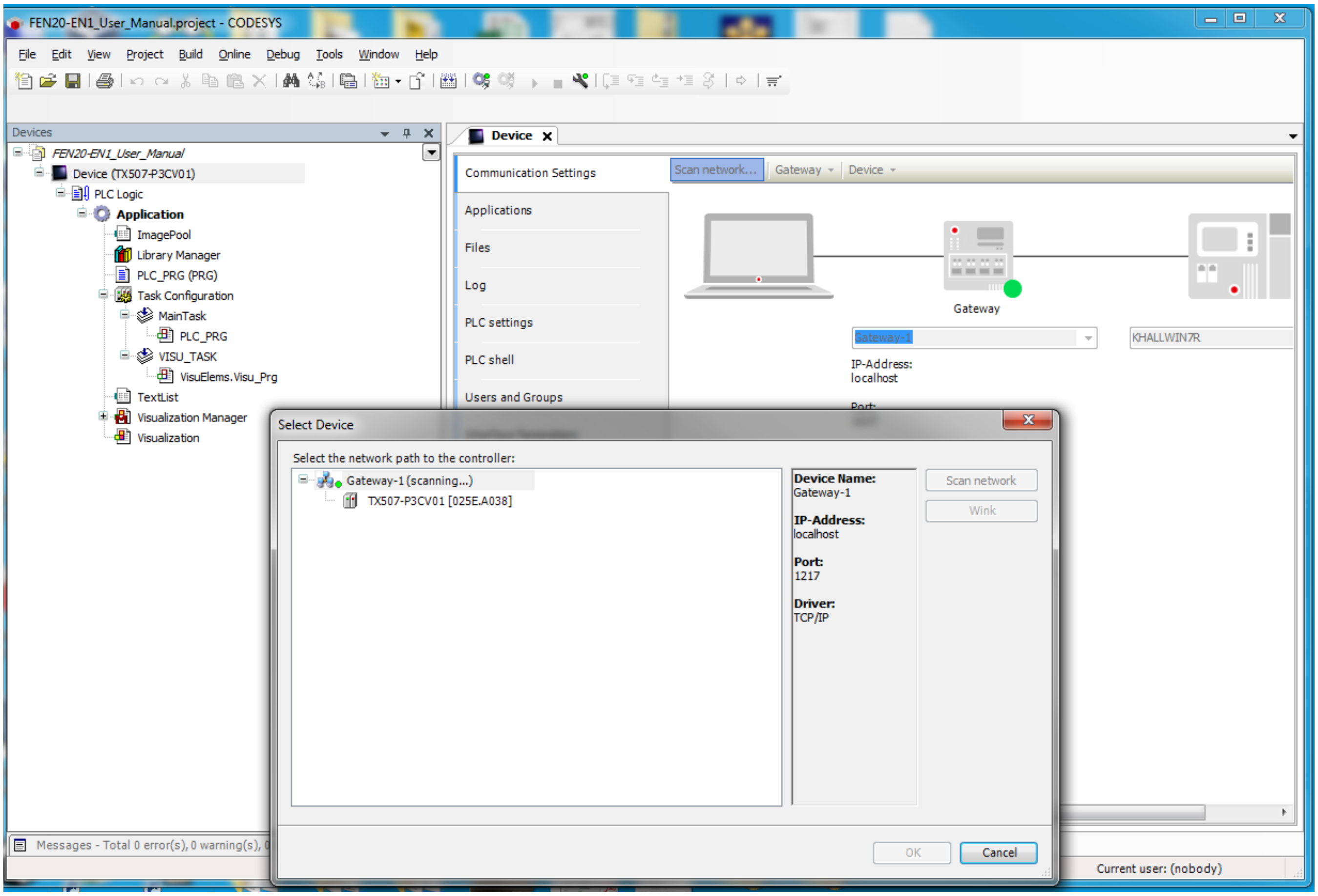
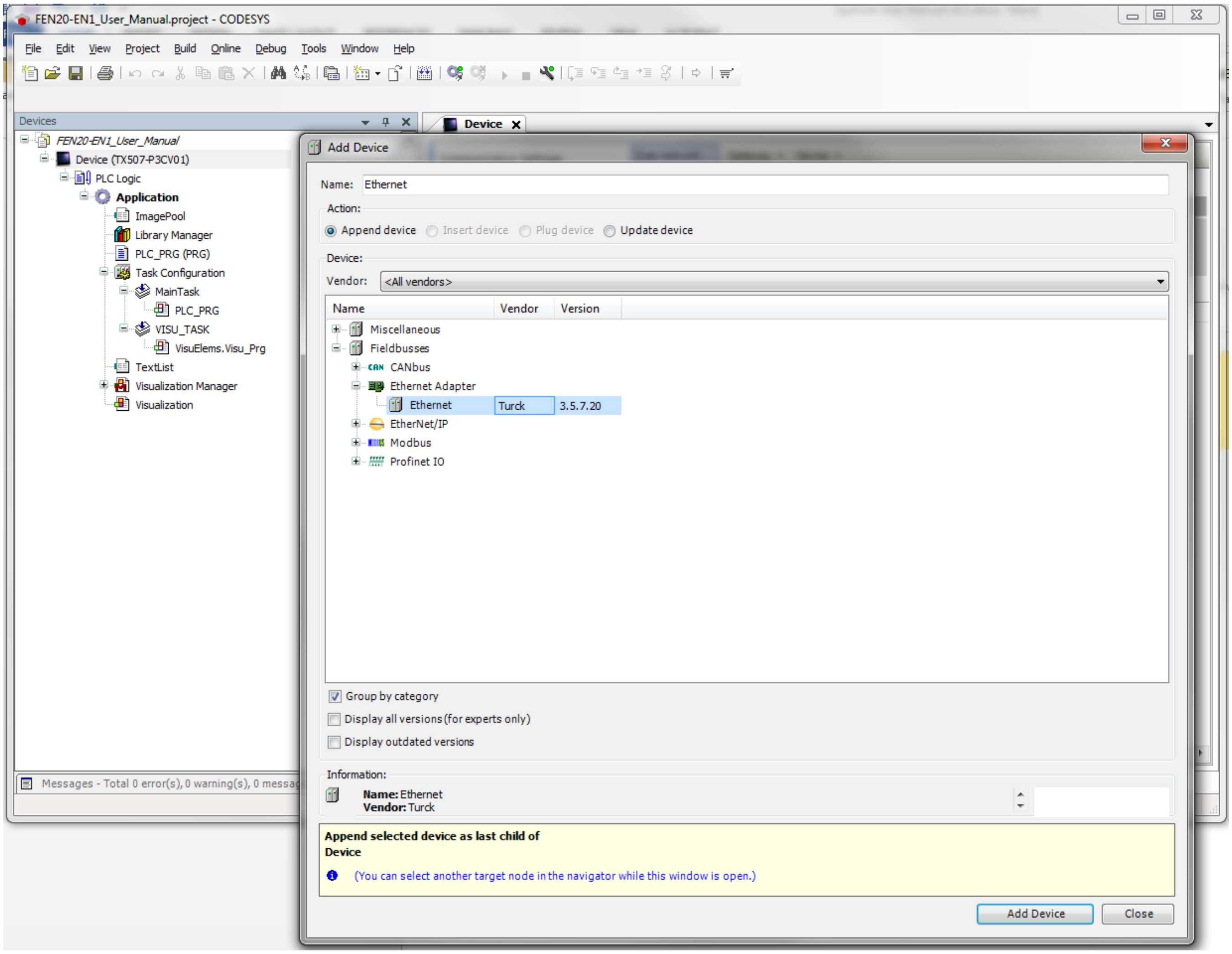
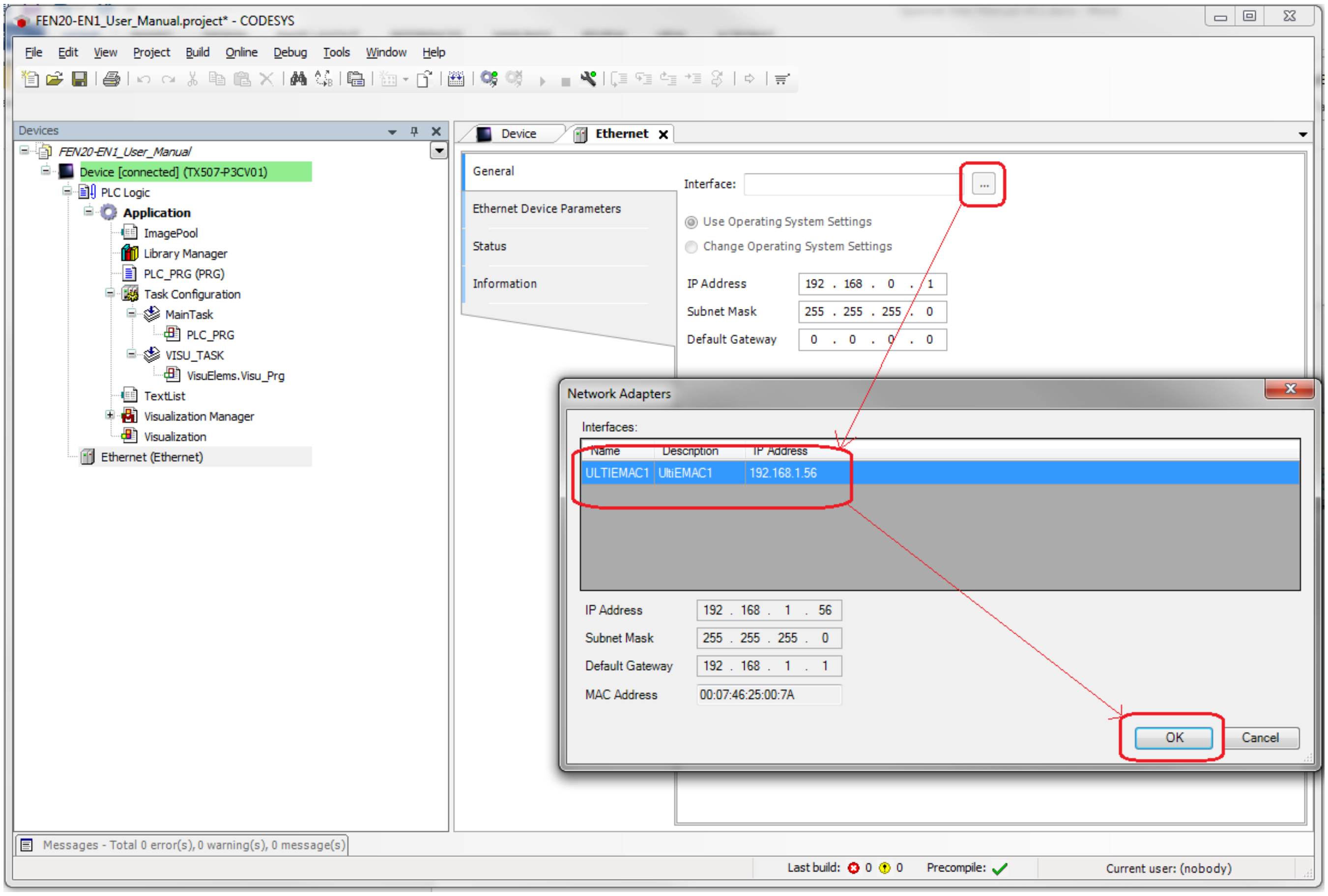
Scan the TX507 HMI into the CODESYS Project. For detailed instructions see the document BLxx-PG-EN-V3 MODBUS-TCP Master Start Up Guide v1.0.pdf

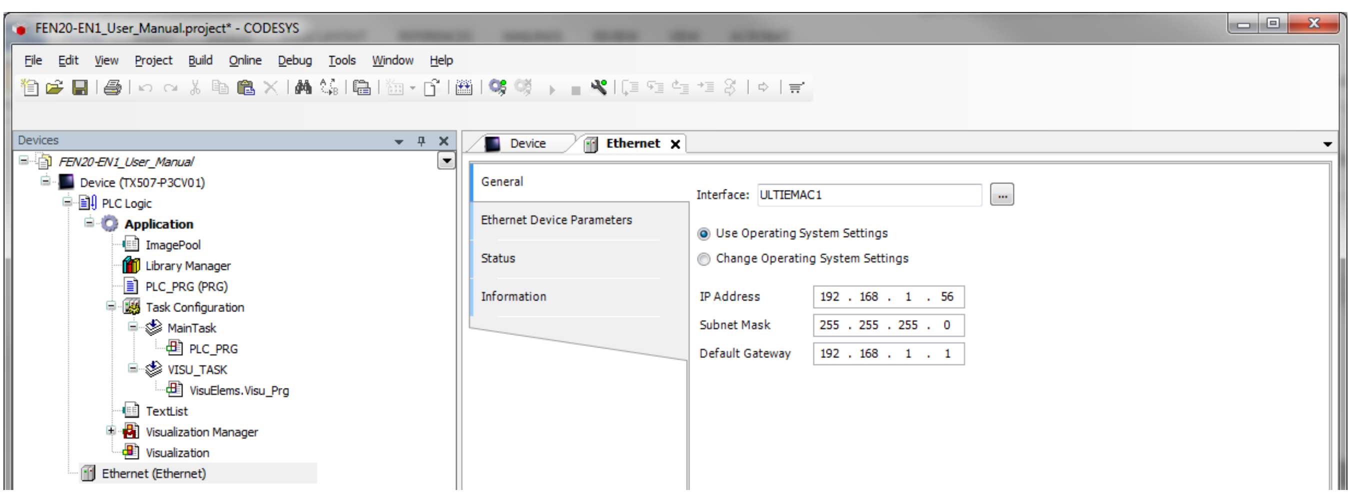


Right Click the ***Device*** and add an ***Ethernet Adapter*** Card (TURCK v3.5.7.20 or newer).

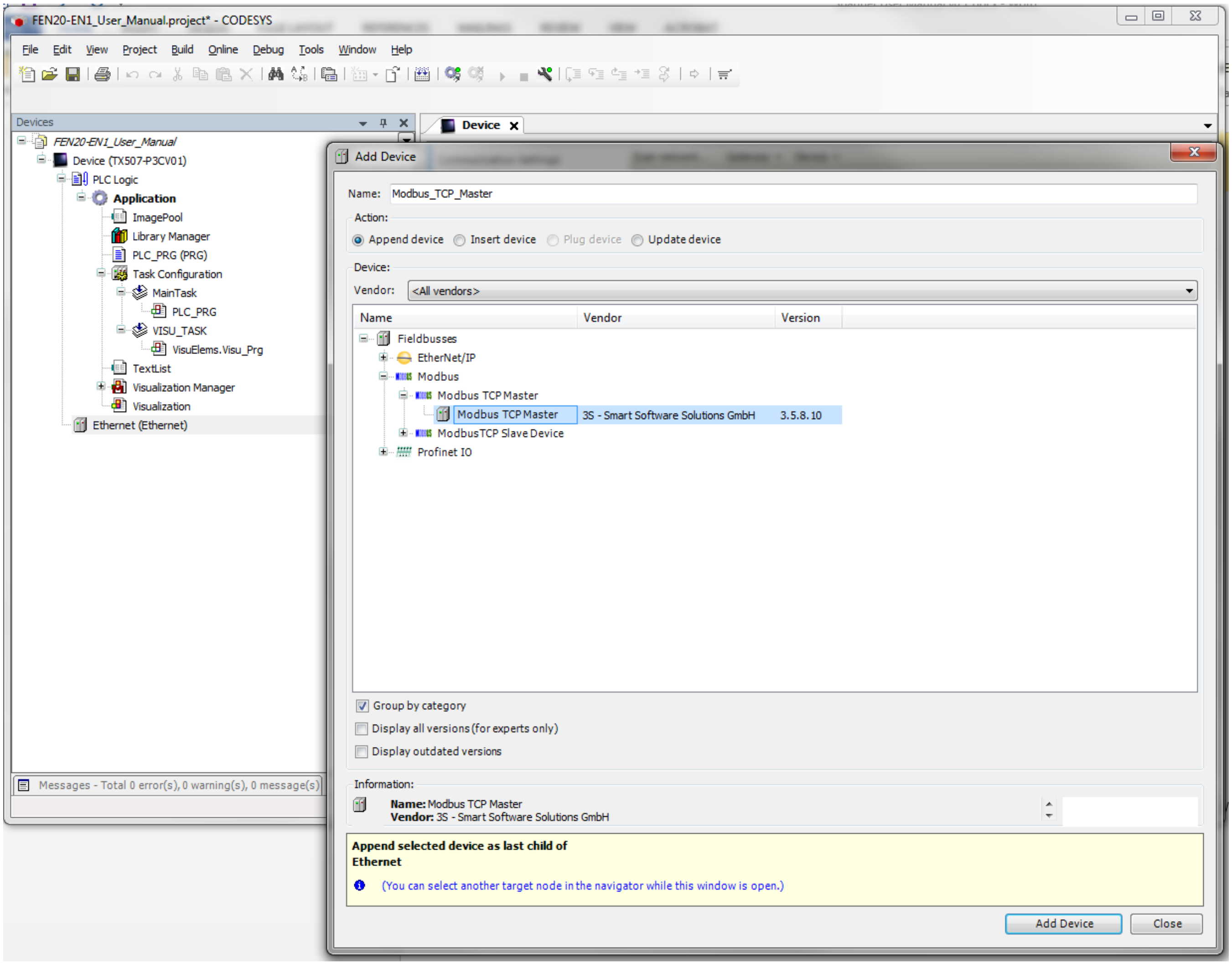


Double click on the ***Ethernet Adapter*** card. Click the Ellipsis to load the Ethernet IP Address information from the HMI. Click ***OK***.

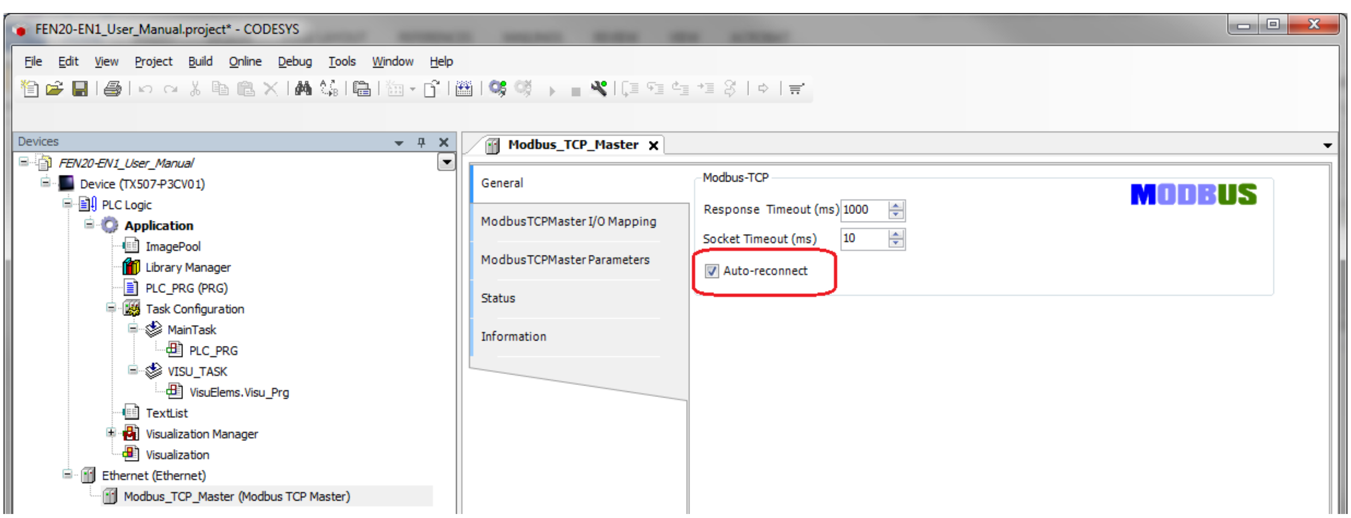




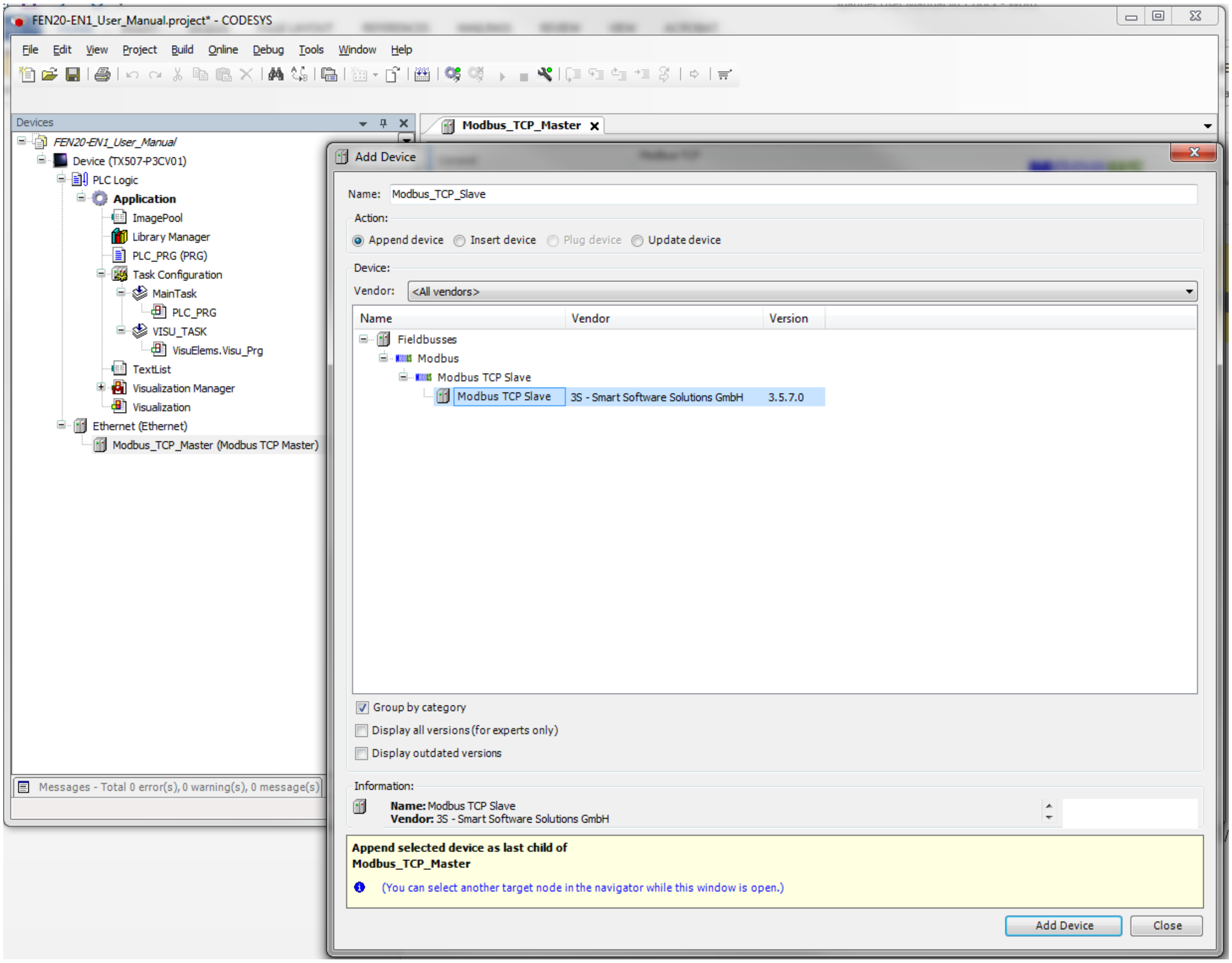
Right click the ***Ethernet Card***, click ***Add Device…*** and add a ***Modbus TCP Master***

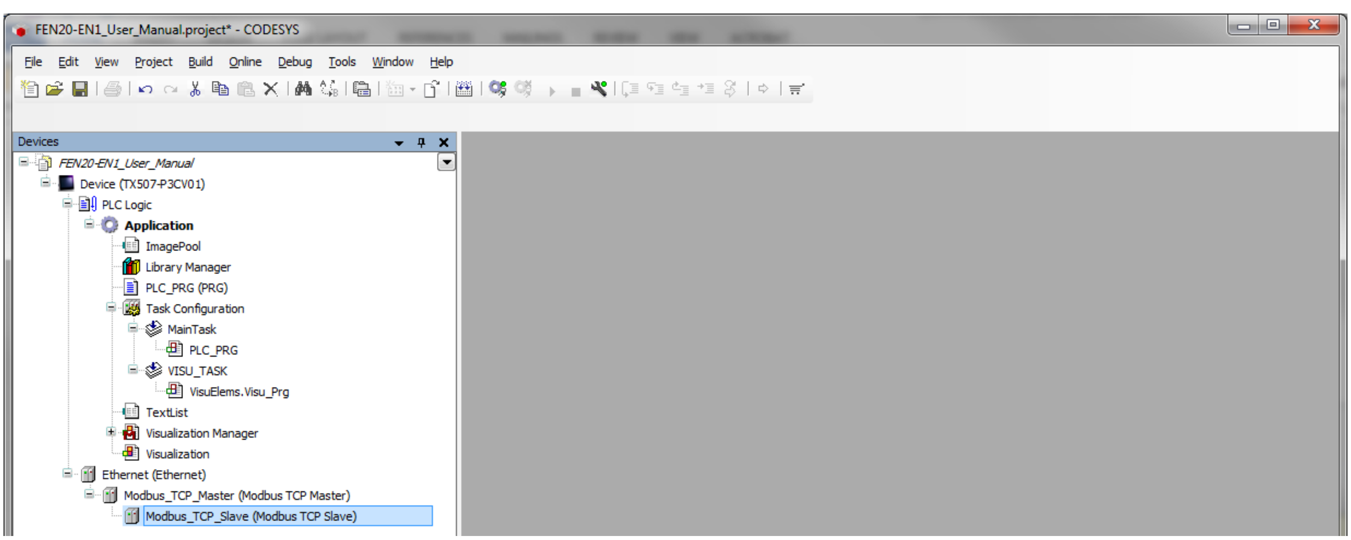


Once the ***Modbus_TCP_Master*** is added, double click on it and check the ***Auto-reconnect*** box

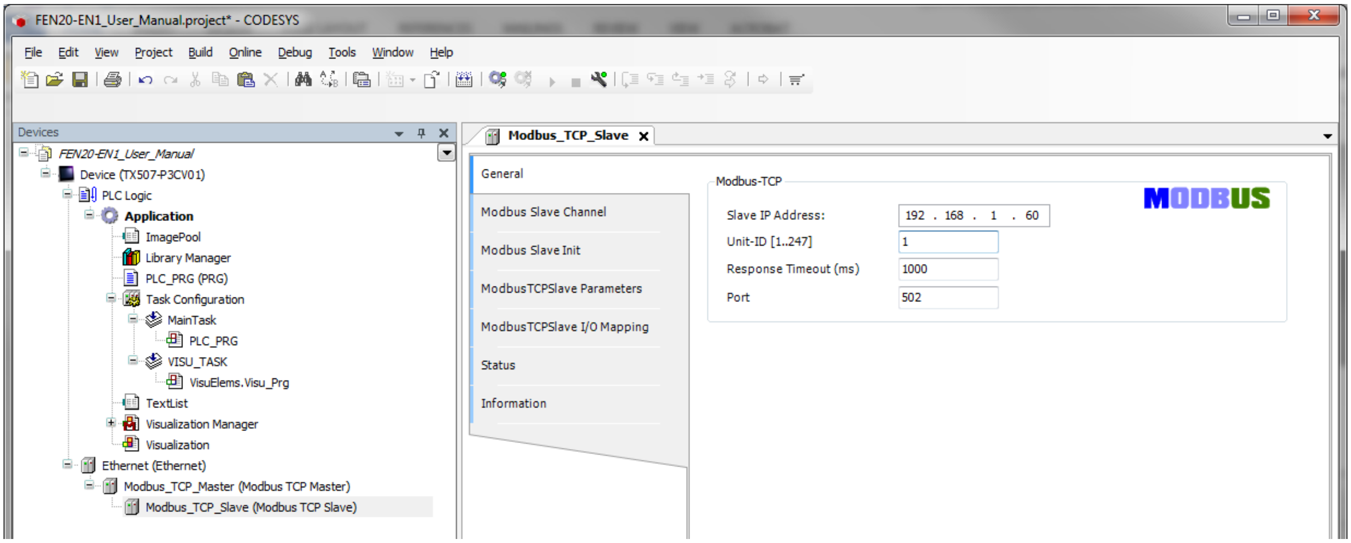


Right click the ***Modbus_TCP_Master***, click ***Add Device…*** and add a ***Modbus TCP Slave***

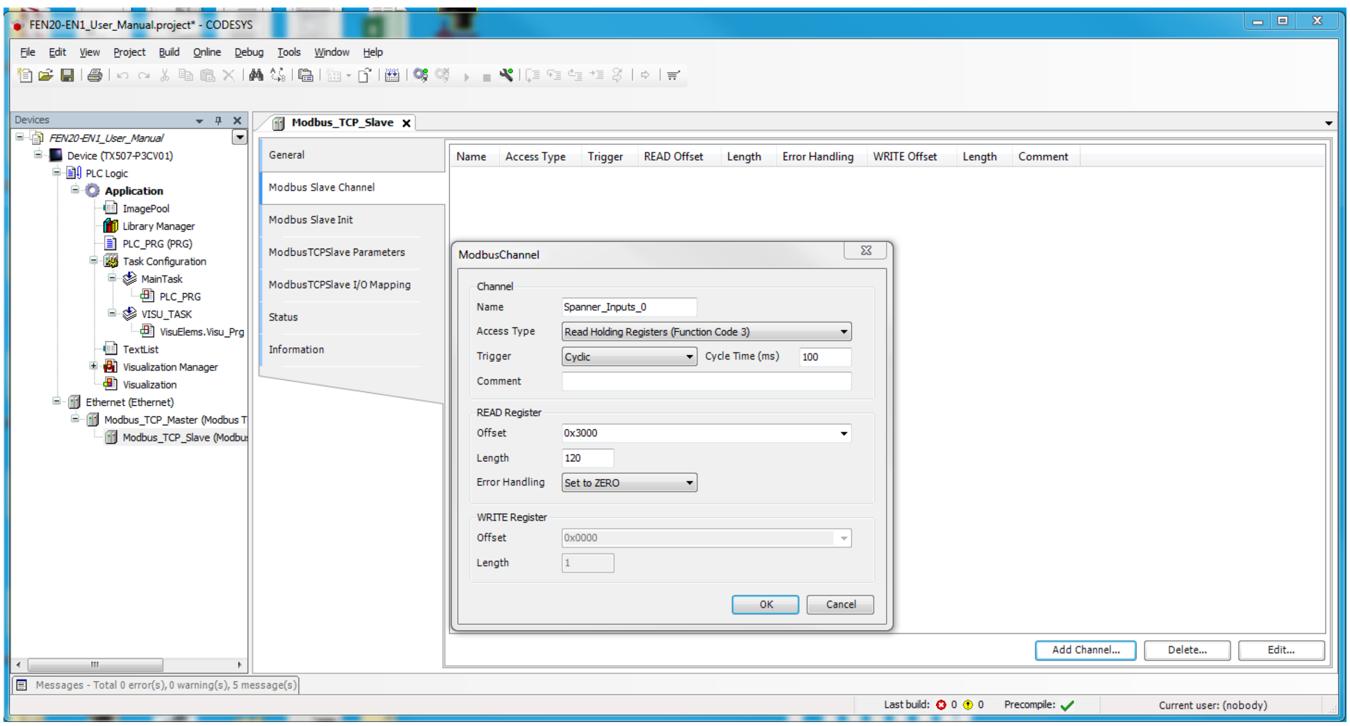




Double click on the ***ModbusTCP_Slave***, in the ***General*** tab enter the parameters below to map Port 1 of the FEN20-EN1 Spanner at IP Address 192.168.1.60



In the ***Modbus Slave Channel*** tab enter the parameters below to use all of the 240 I/O words in the FEN20-EN1.



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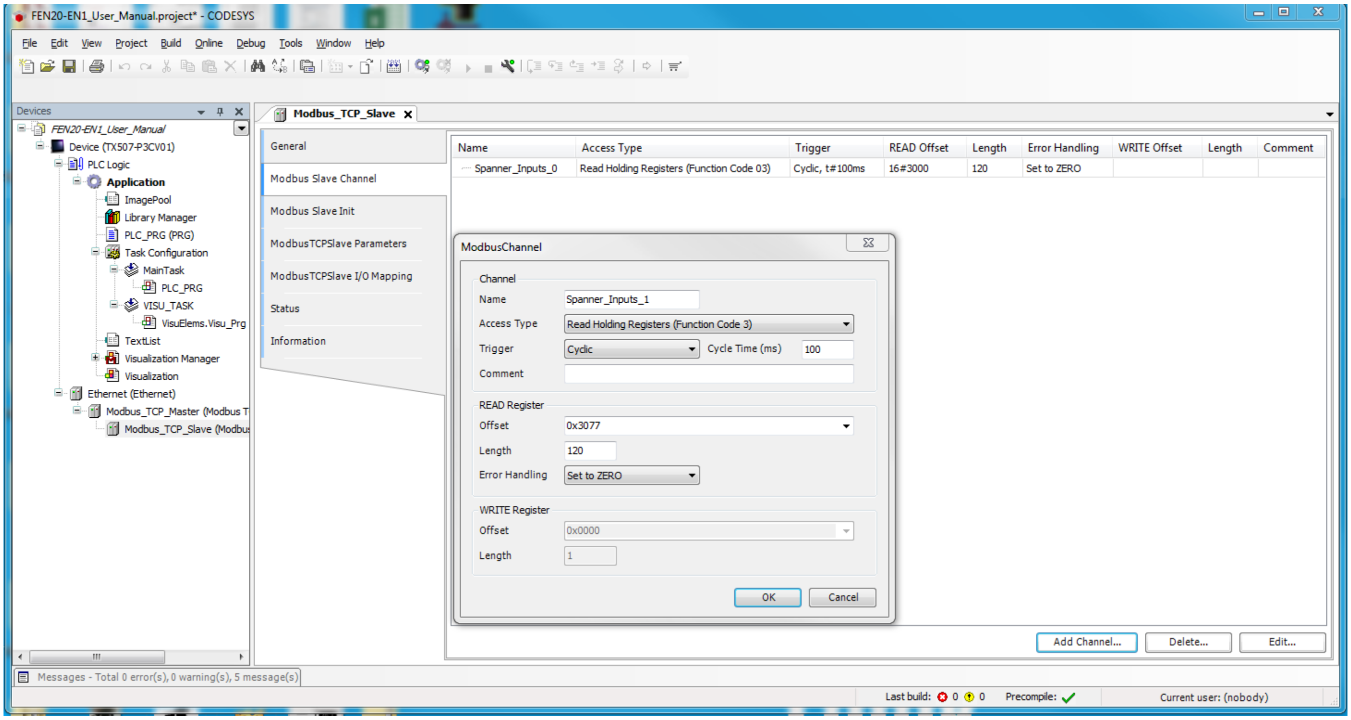
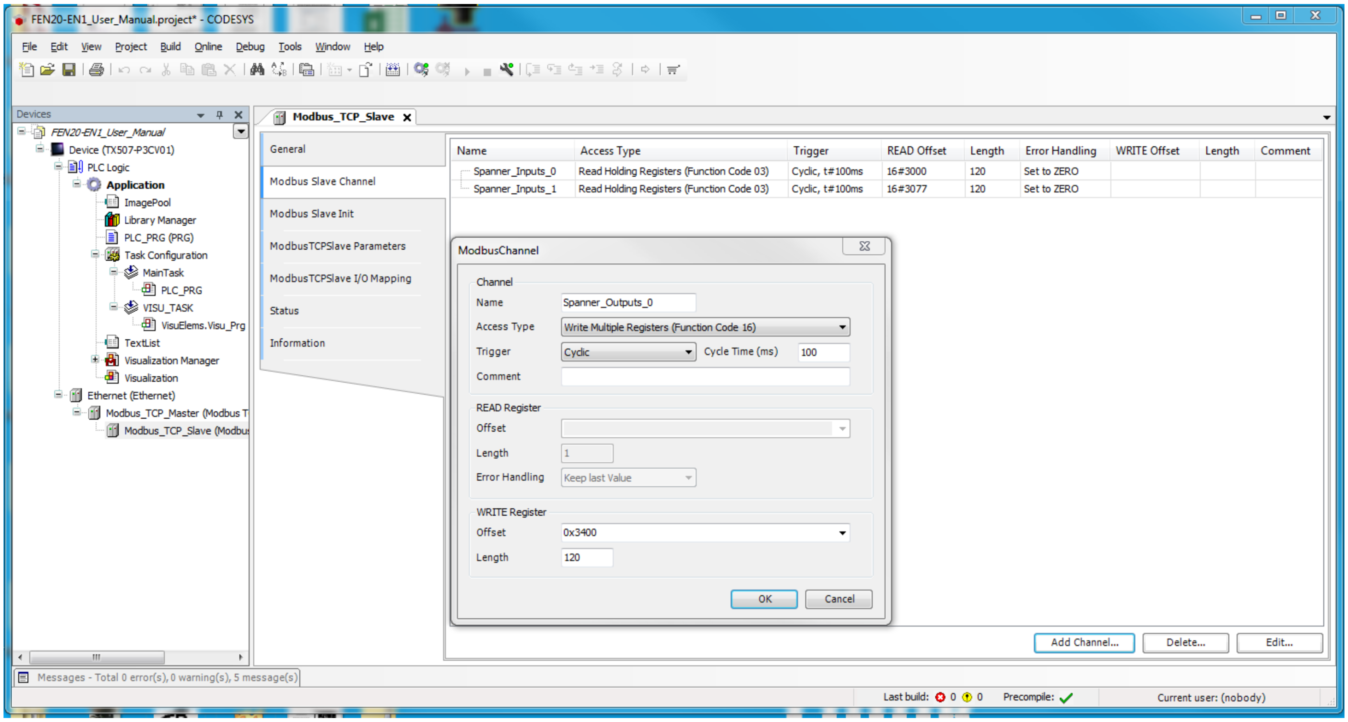
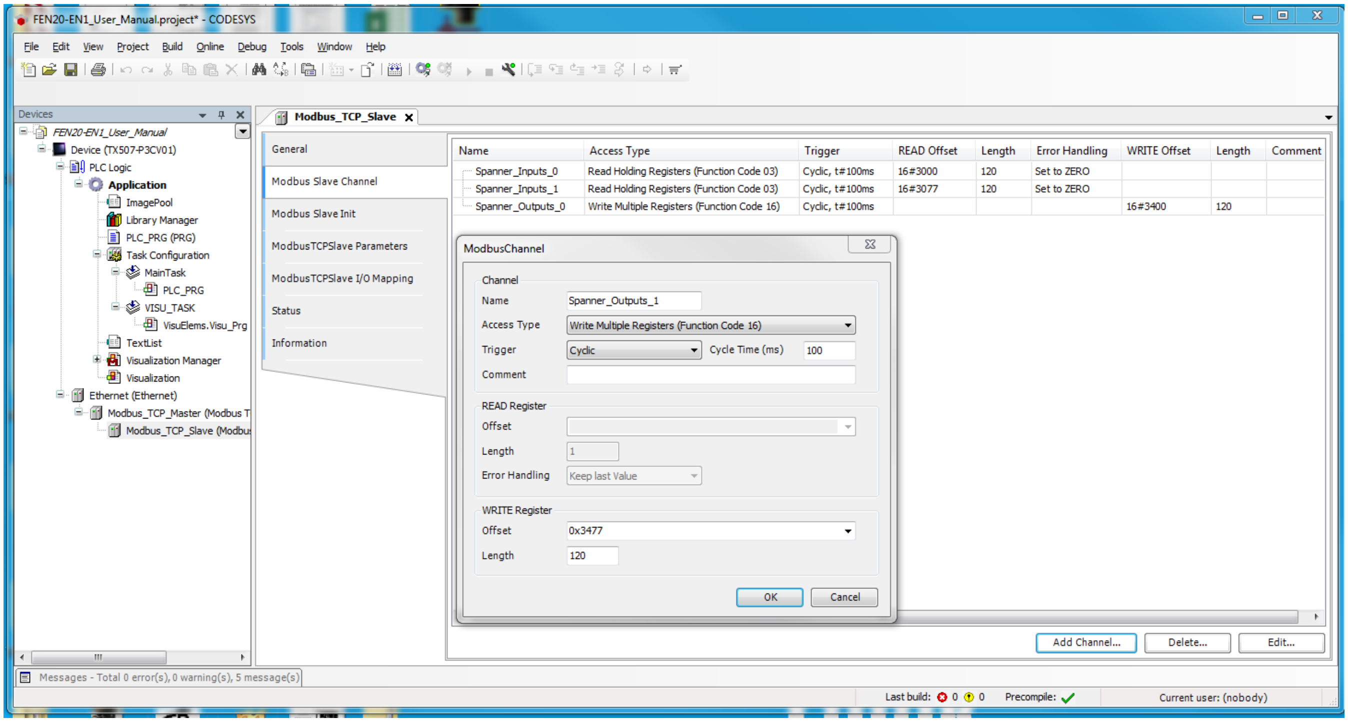
In the ***Modbus Slave Channel*** tab enter the parameters below to use all of the 240 I/O words in the FEN20-EN1.



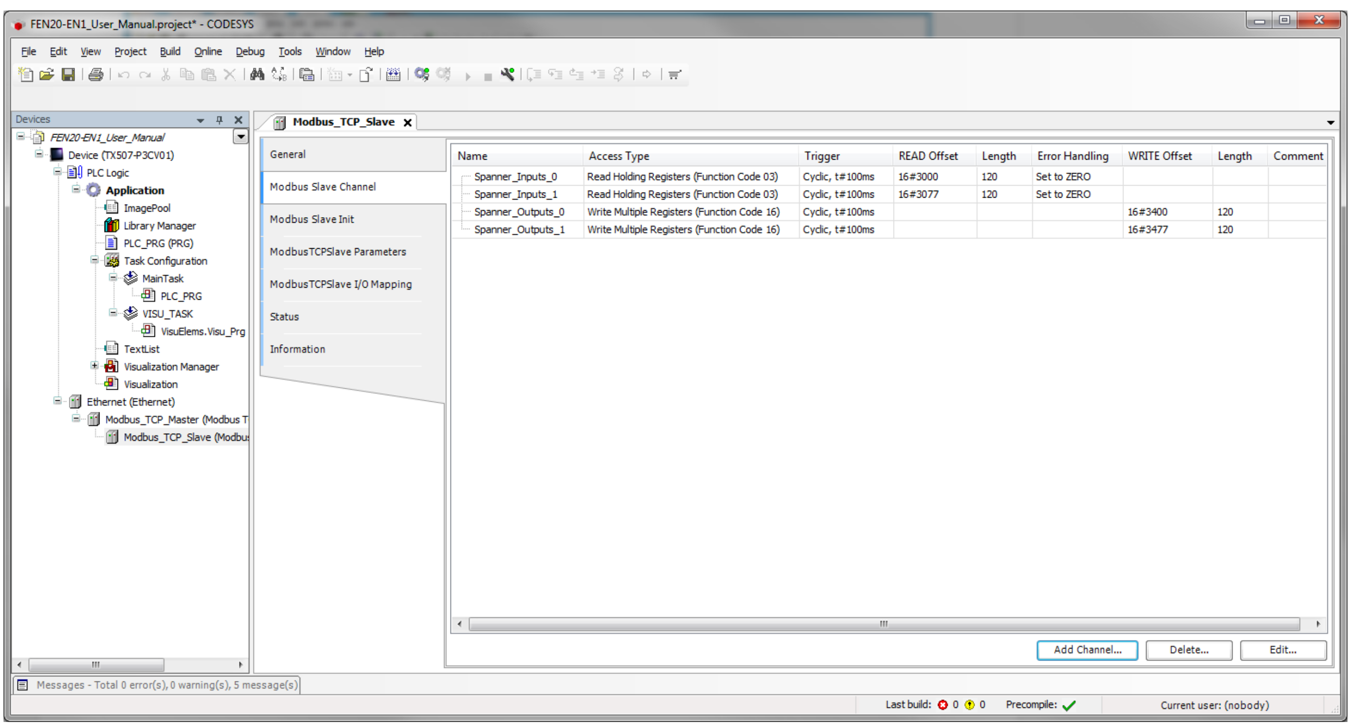
In the ***Modbus Slave Channel*** tab enter the parameters below to use all of the 240 I/O words in the FEN20-EN1.



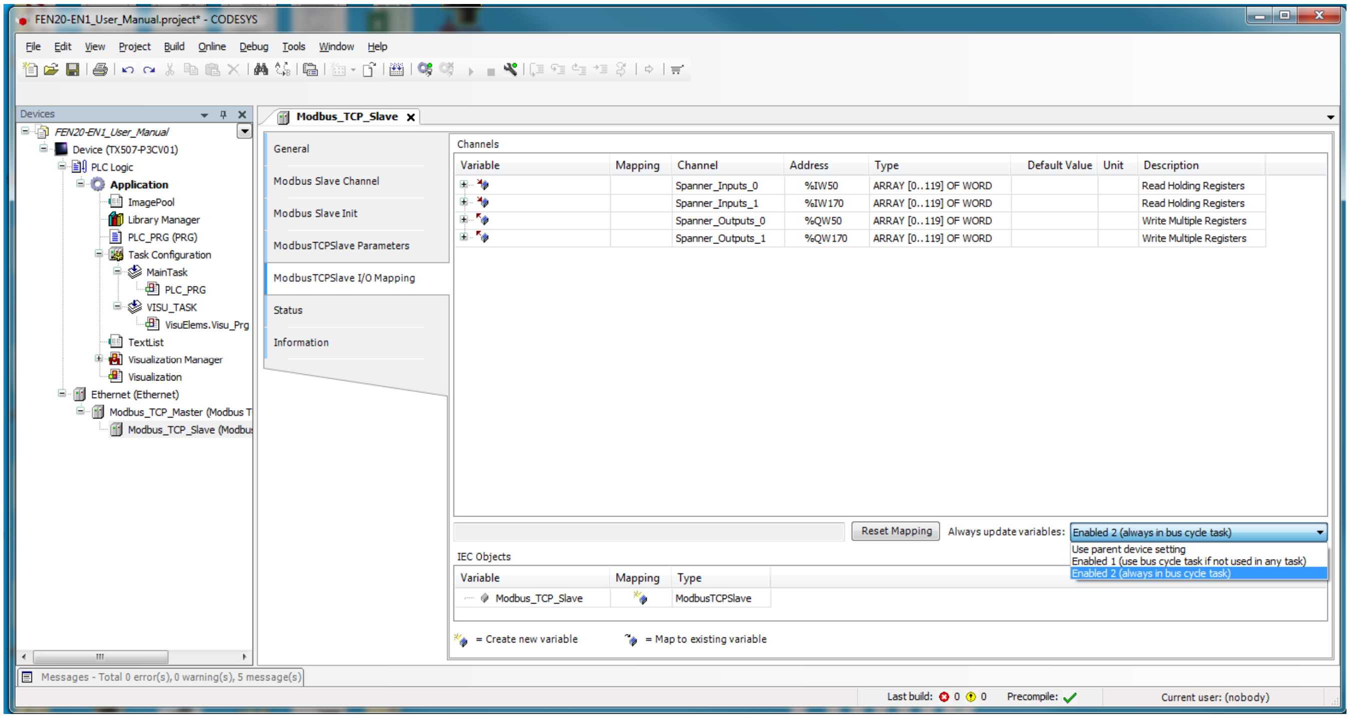
In the ***Modbus Slave Channel*** tab enter the parameters below to use all of the 240 I/O words in the FEN20-EN1.



The following Modbus Slave Channels should be set



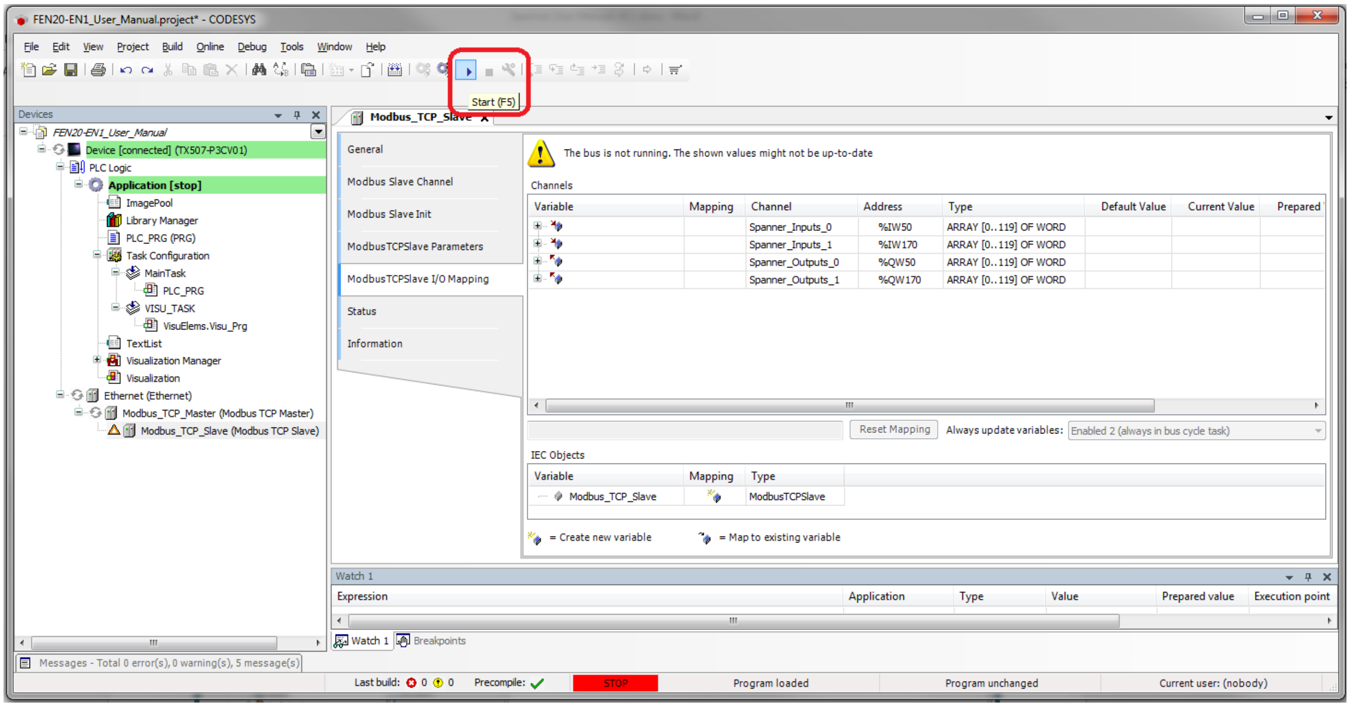
Under the ***ModbusTCPSlave I/O Mapping*** tab change the value of the ***Always Update Variables*** drop down box to ***Enabled 2 (Always in Bus Cycle)***



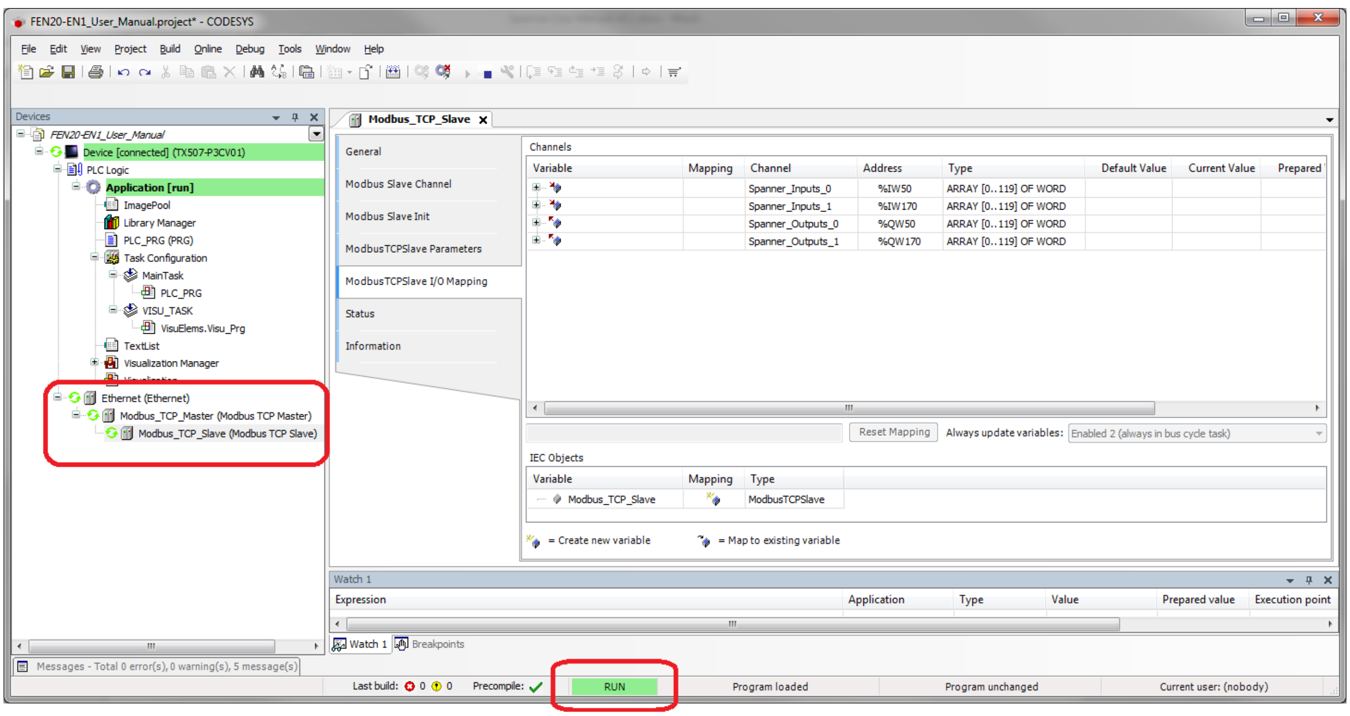
NOTE: The Modbus/TCP PLC may need to use "read/write multiple registers" (FC23) service code to read/write entire memory area starting with the first address of that area. It is up to the user to decide how many registers to read and write, but the read/write access may need to start with the beginning of the segment in order to achieve data transfer consistency between PLCs. It is up to the user to test data transfer consistency when multiple blocks of I/O data are read from and written to a single Spanner port.

Click ***Online -> Login*** and download the program to the TX507. Follow the prompts.

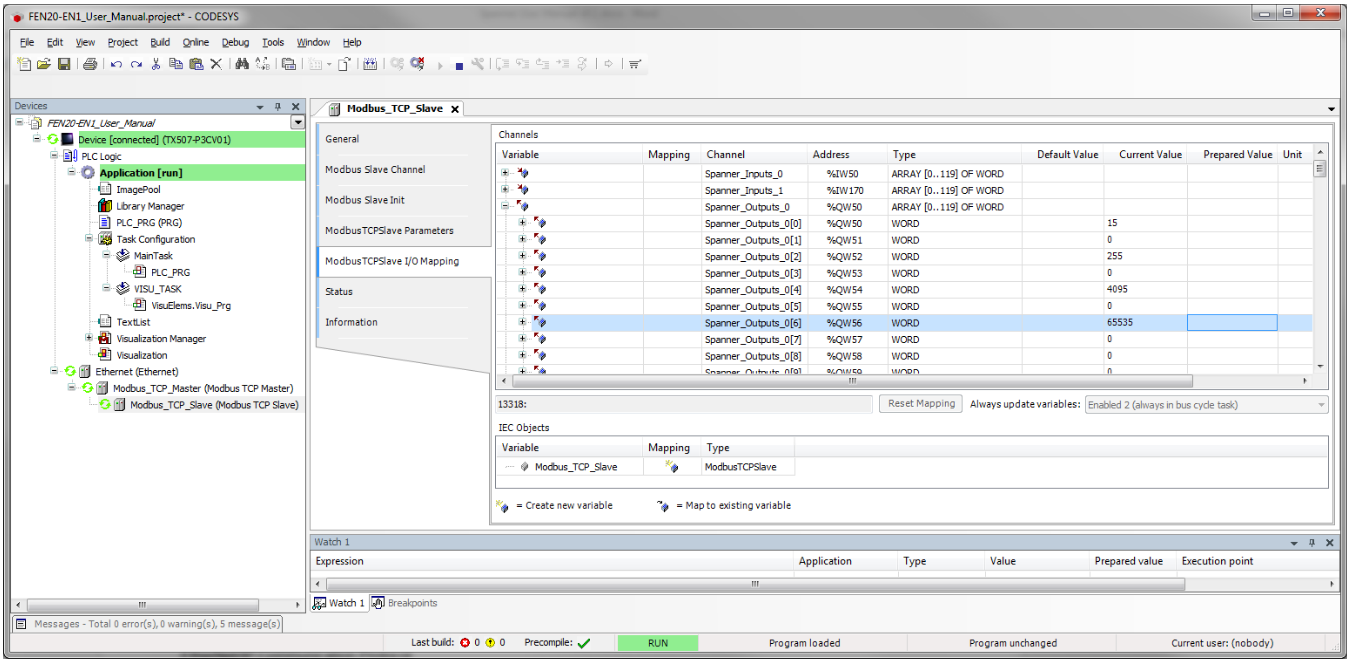
Click the ***Start*** button



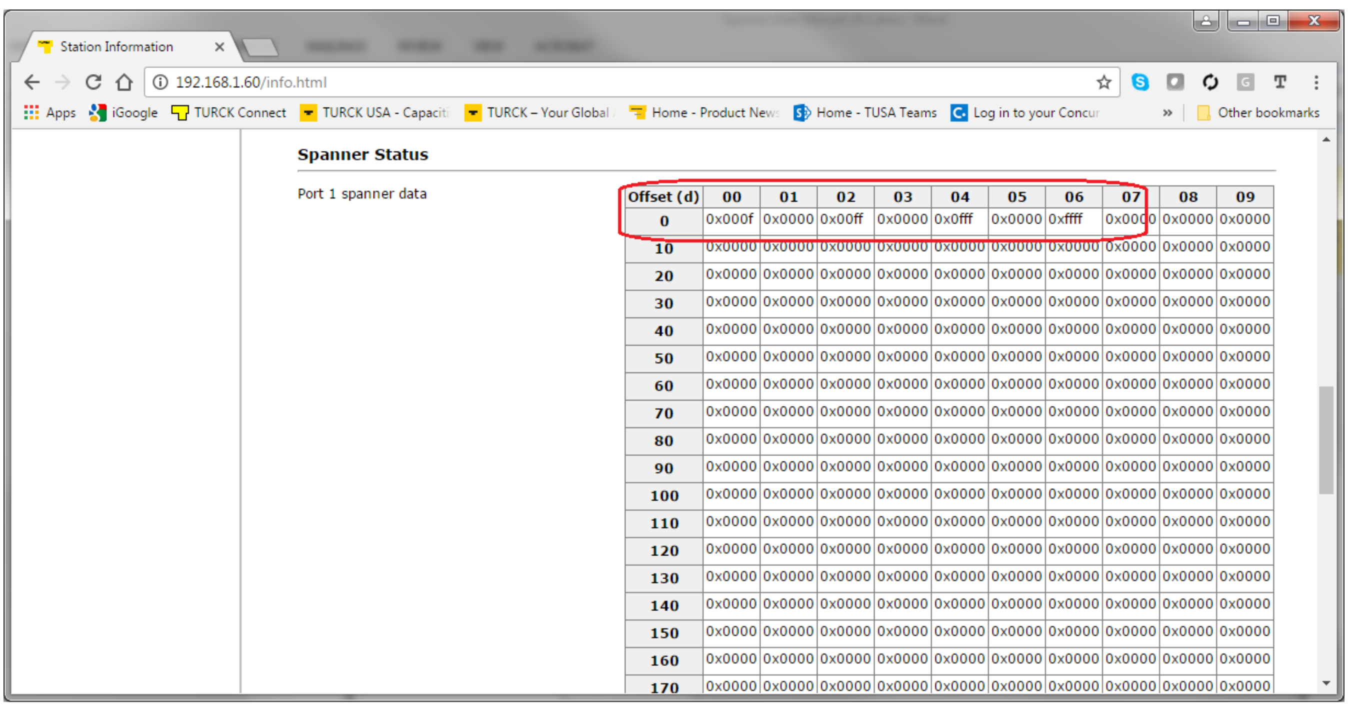
With the TX507 in run mode Port 1 of the Spanner is now being scanned



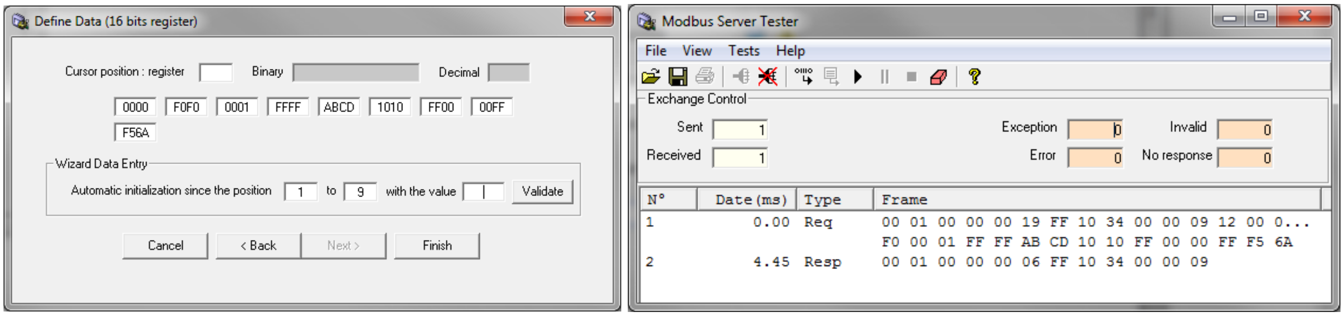
Writing values to the outputs (QWs) will be reflected in the Port 1 Spanner Data map in the Webserver. These values can also be read in as inputs by a device hooked to Port 2 of the Spanner.



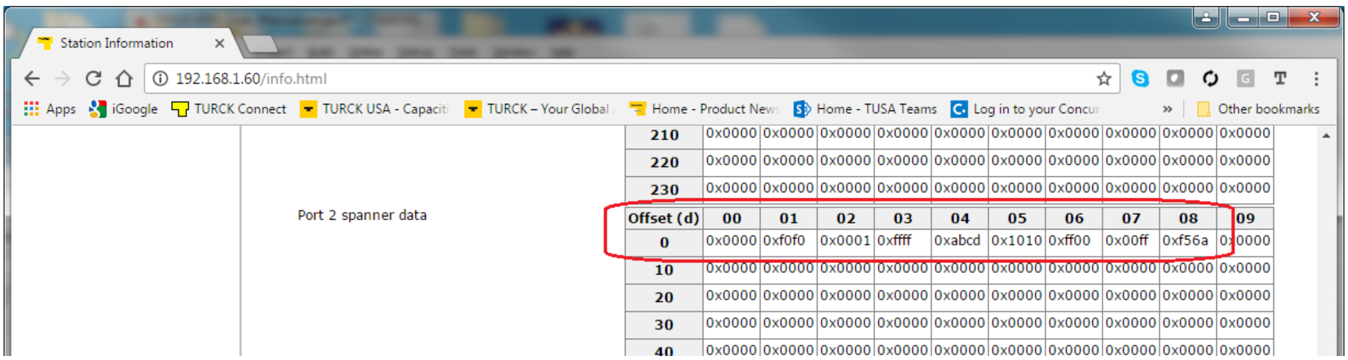
Corresponding Port 1 Spanner data reflected in the Web Server.



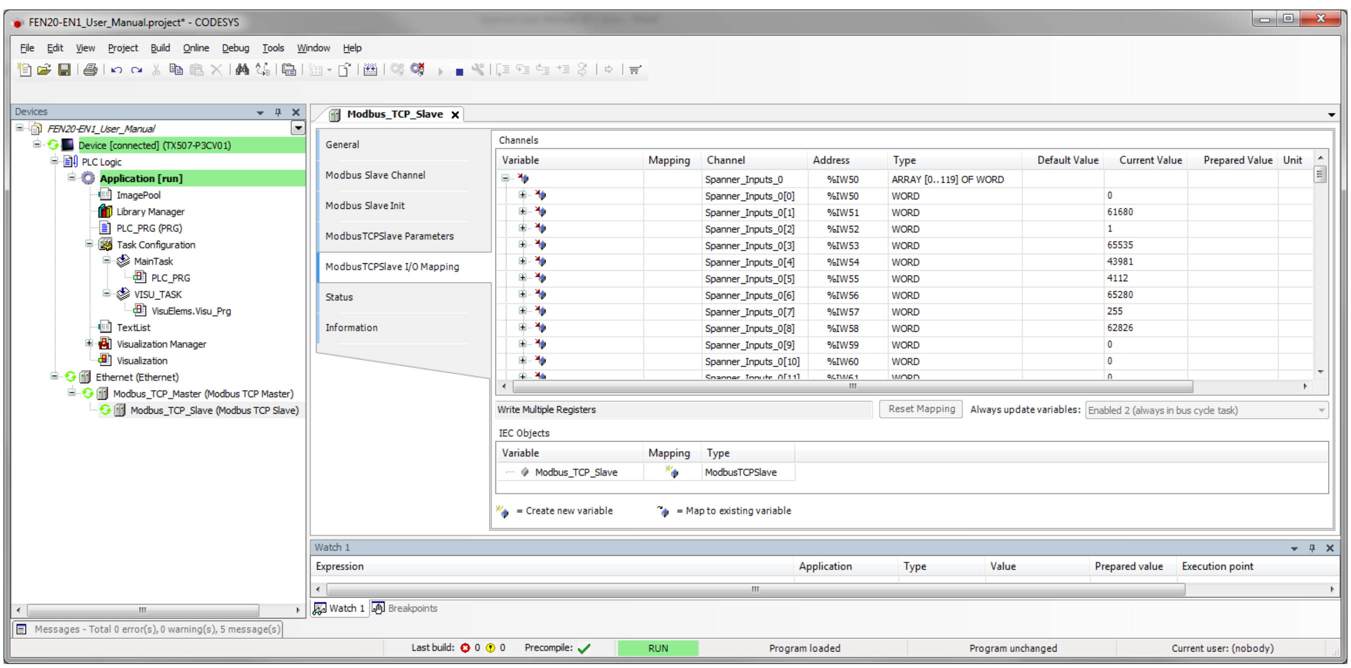
Input values (IWs) will be reflected in the Port 2 Spanner Data map in the Webserver. These values need to be written by a device connected to Port 2. Connecting the MODBUS Server Tester to Port 1 (192.168.1.103) and writing inputs 0-9 generates the following data words on Port 2 of the Spanner.



In the Webserver Port 2 Spanner Data



This data is now reflected in the Input words (IWs) of the TX507 CODESYS V3 HMI.



Ethernet/IP General Description (Port 1 and/or Port 2)

EtherNet/IP Communication Protocol

TECHNICAL BASICS

EtherNet/IP™ is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices. Communication between the nodes in the EtherNet/IP™ network can be carried out either via I/O Messages or Explicit Messages.

I/O Messages

I/O Messages serve to exchange high priority process and application data over the network. Communication between the slaves in the EtherNet/IP™ network is carried out according to the Server/Client Model,
which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit Messages

Explicit Messages are used to transmit low-priority configuration data, general management data or diagnostic data between two specific devices. This is a point-to-point connection in a Server/Client System that requires a request from a client always to be confirmed by a response from the server.

- Message Router Request
  Consists of a service code, path size value, a message router path and service data. An EPATH is used in the message router path to indicate the target object.
- Message Router Response
  Consists of a service field with the most significant bit set. This is an echo of the service code in the request message with the most significant bit set. A reserved byte follows the service code, which is followed by the General Status code.

Communication Profile for Ethernet/IP Spanner

The following EtherNet/IP™ communications types are supported:

- Unicast
- Multicast
- Cyclic Connection
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

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TECHNICAL BASICS

Unicast
A point-to-point connection that exists between two nodes only.

Multicast
A packet with a special destination address, which multiple nodes on the network may be willing to receive.

COS I/O Connection
COS (Change Of State) I/O Connections establish event-controlled connections. This means that the EtherNet/IP™ devices generate messages as soon as a change of status occurs.

Cyclic I/O Connection
Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

UCMM
The EtherNet/IP™ gateway offers the option of establishing explicit messaging via the UCMM port (Unconnected Message Manager Port).
UCMM-based explicit messaging is normally used for random, non-periodic requests.
It is not recommended for frequent messaging because the UCMM input queue in a product is typically limited to just a few messages. Once this limit is reached, subsequent requests are ignored and must be retried.

Connected Explicit Messaging
CIP is a connection-based system. For most communications between nodes, a connection is used.
A connection is a path or a virtual circuit between two or more end points in a system. The purpose is to transfer data in the most efficient manner possible.
The Connection ID is a number that is associated with a communication relationship. Receiving nodes decode this key to know whether they must accept the data or not.

Ethernet/IP Standard Classes

Class Code	Object name
01 (0x01)	Identity Object (0x01)
04 (0x04)	Assembly Object (0x04)
06 (0x06)	Connection Manager Object (0x06)
245 (0xF5)	TCP/IP Interface Object (0xF5)
246 (0xF6)	Ethernet Link Object (0xF6)

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Ethernet/IP EN1 Process Data Map

Connection	Assembly Instance	Size (in words)
Input	103	244
Output	104	244

Ethernet/IP Input Data Mapping

Station Status Word (Input Data Mapping)			
Description	**Word Offset**	**Bit Offset**	**Bit Length**
Module Diagnostics Available	0	0	1
Station Configuration Changed	0	3	1
Overcurrent Isys	0	5	1
Overvoltage Field Supply Ul	0	6	1
Undervoltage Field Supply Ul	0	7	1
Overvoltage Field Supply Usys	0	8	1
Undervoltage Field Supply Usys	0	9	1
Modulebus Communication Lost	0	10	1
Modulebus Configuration Error	0	11	1
INFO: Spanner connection established on Port 1	0	12	1
INFO: Spanner connection established on Port 2	0	13	1
Force Mode Enabled	0	14	1
8DIP (Input Data Mapping)			
Description	**Word Offset**	**Bit Offset**	**Bit Length**
Channel 0 - Input value	1	0	1
Channel 1 - Input value	1	1	1
Channel 2 - Input value	1	2	1
Channel 3 - Input value	1	3	1
Channel 4 - Input value	1	4	1
Channel 5 - Input value	1	5	1
Channel 6 - Input value	1	6	1
Channel 7 - Input value	1	7	1
Spanner Data			
Description	**Word Offset**	**Bit Offset**	**Bit Length**
Spanner Data	4	0	up to 240 words

Note – The Spanner data starts at word offset 4 for both the Input and Output I/O Data Map.

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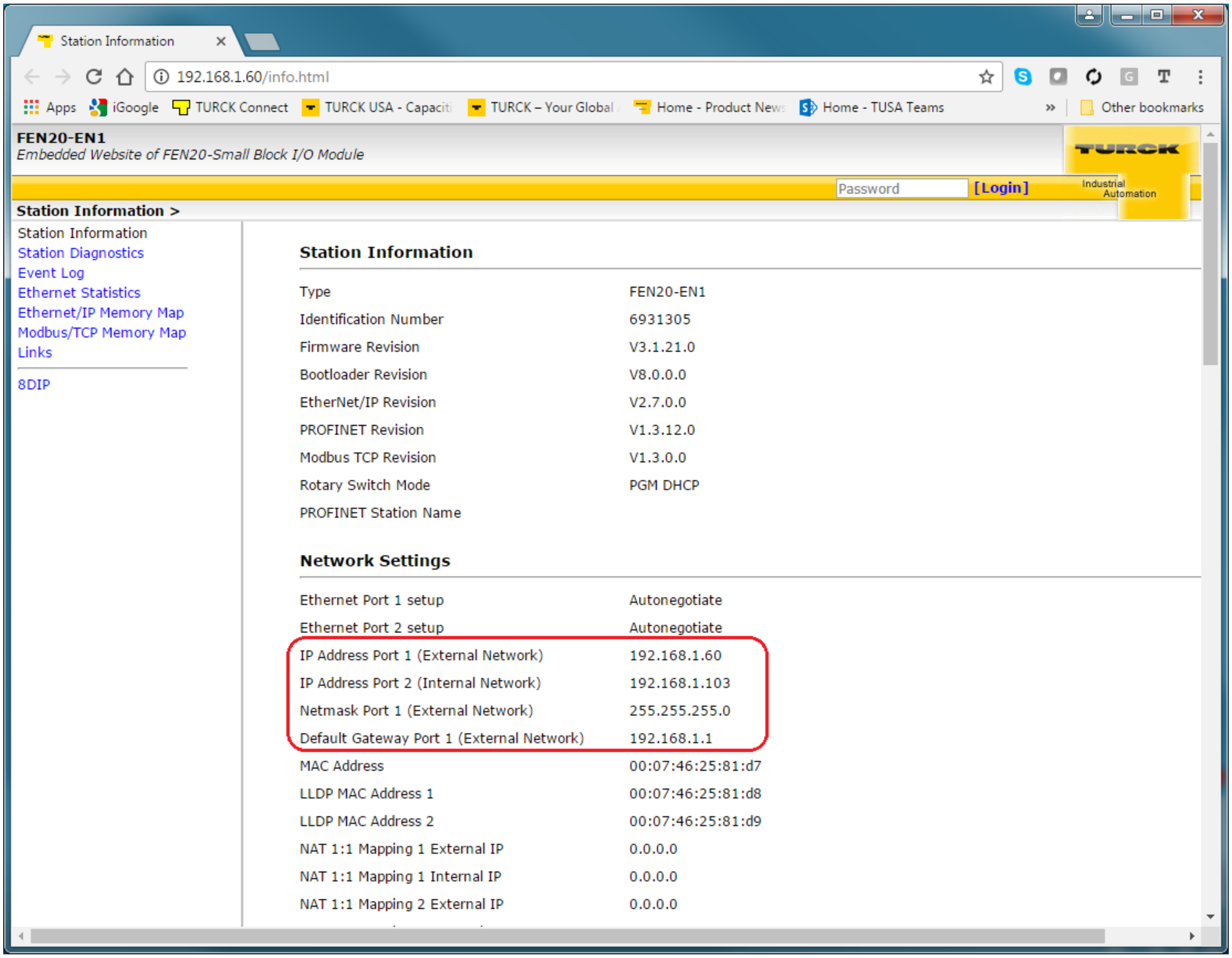
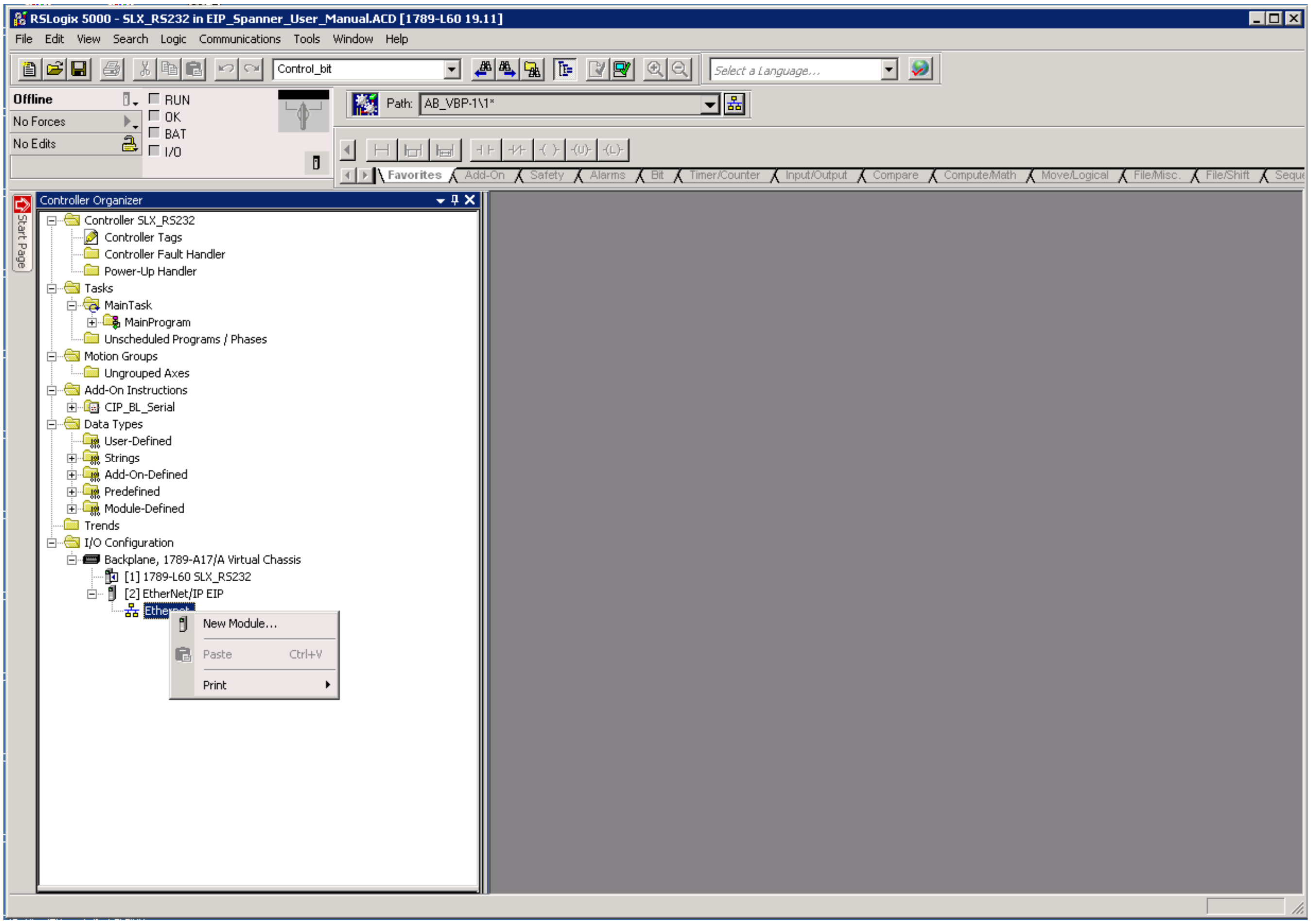
Mapping the FEN20-EN1 Spanner into a SoftLogix v19 project via Ethernet/IP w/ Generic Device

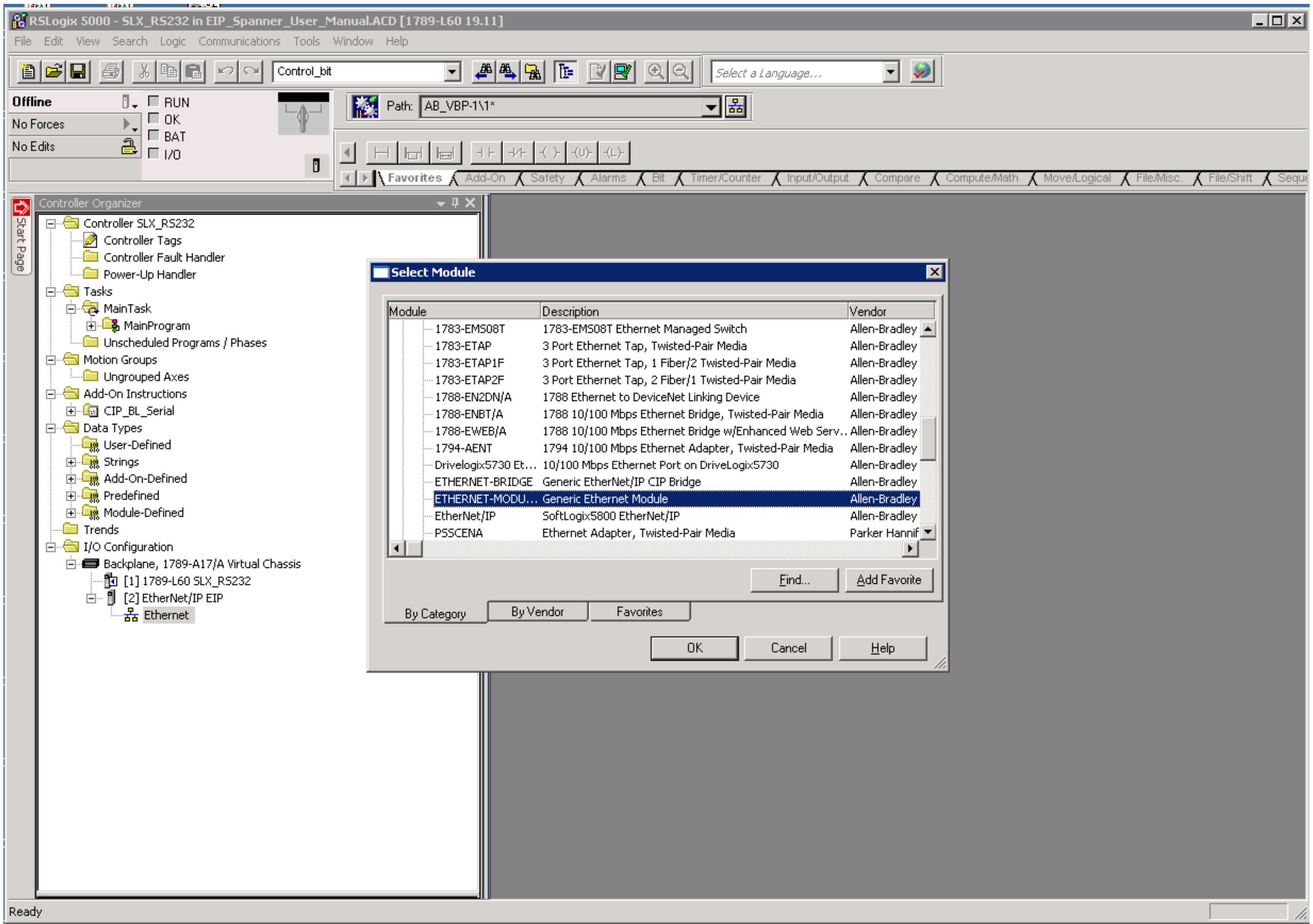
The FEN20-EN1 Spanner is addressed as follows via the Webserver



Create a SoftLogix v19 project and all your PLC. Right click on the Ethernet card and select ***New Module…***



Select ***Generic Ethernet Module*** and hit ***OK***



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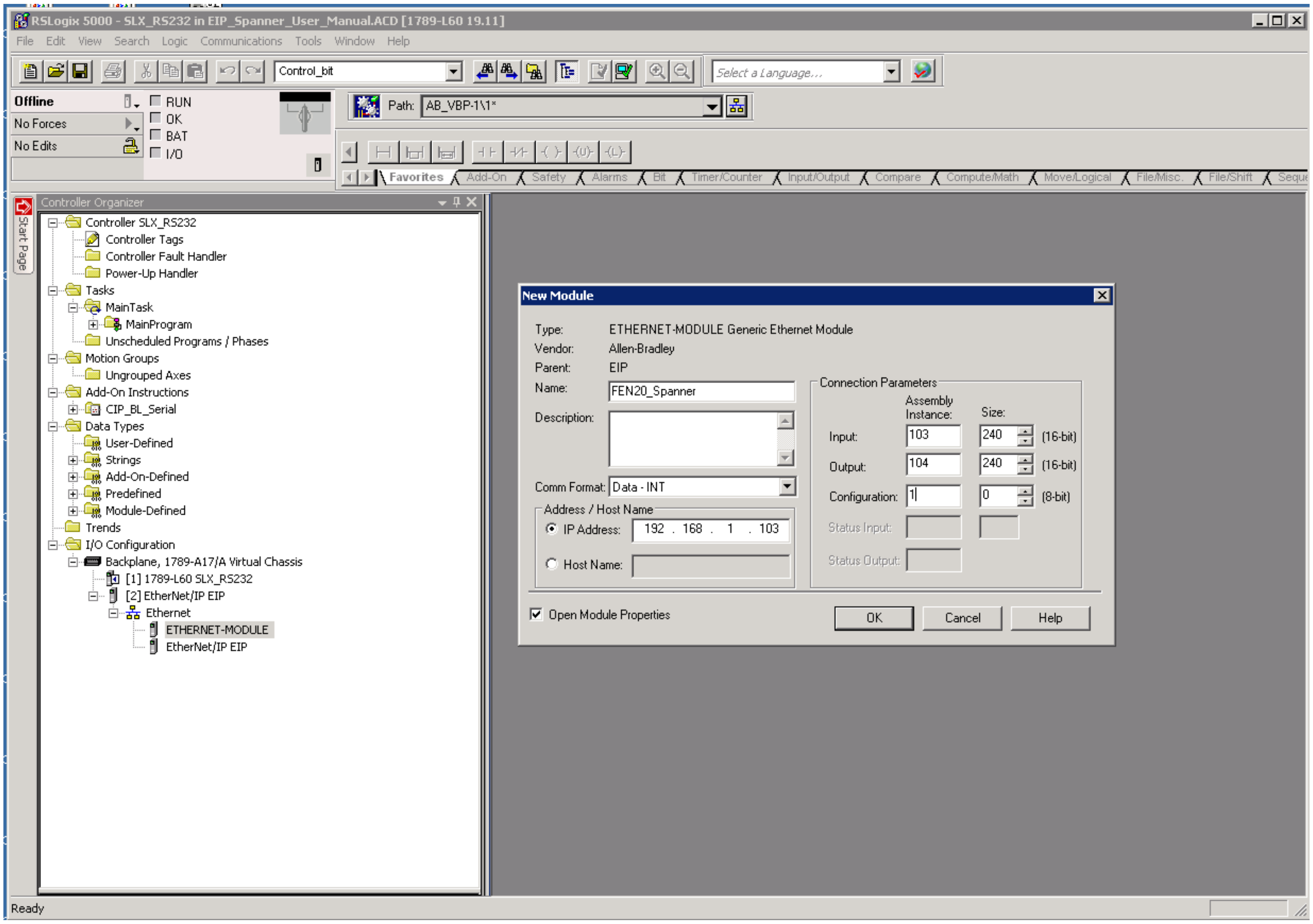
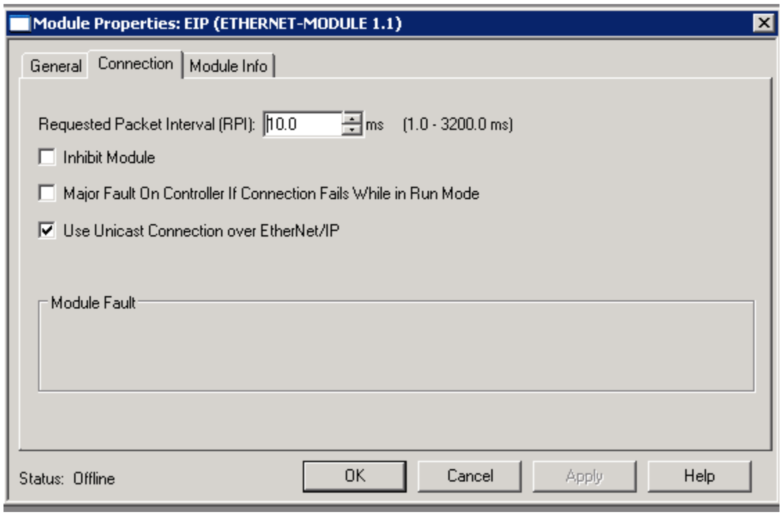
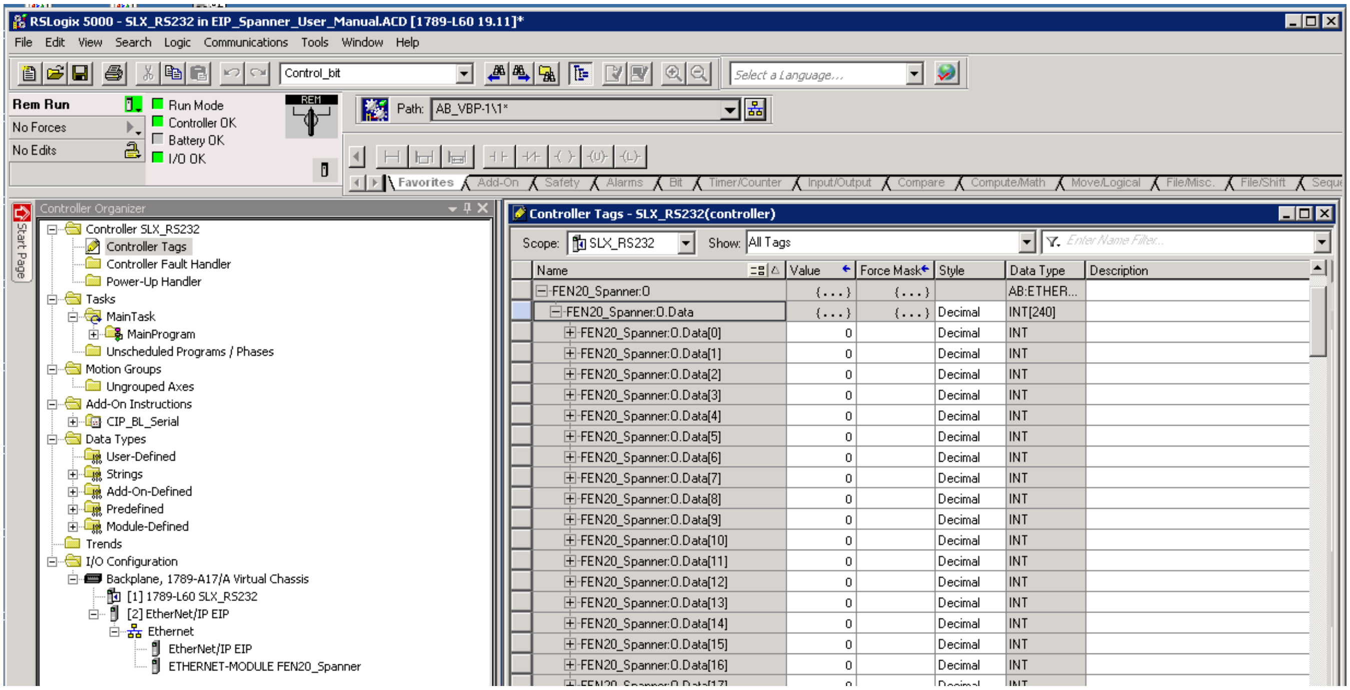
Name the Spanner in the ***Name*** field. For ***Comm Format*** select Data – INT. Enter the desired IP Address under ***IP Address*** (here we will map Ethernet/IP to Port 2 of the spanner). Enter the ***Connection parameters*** as pictured below and click OK.



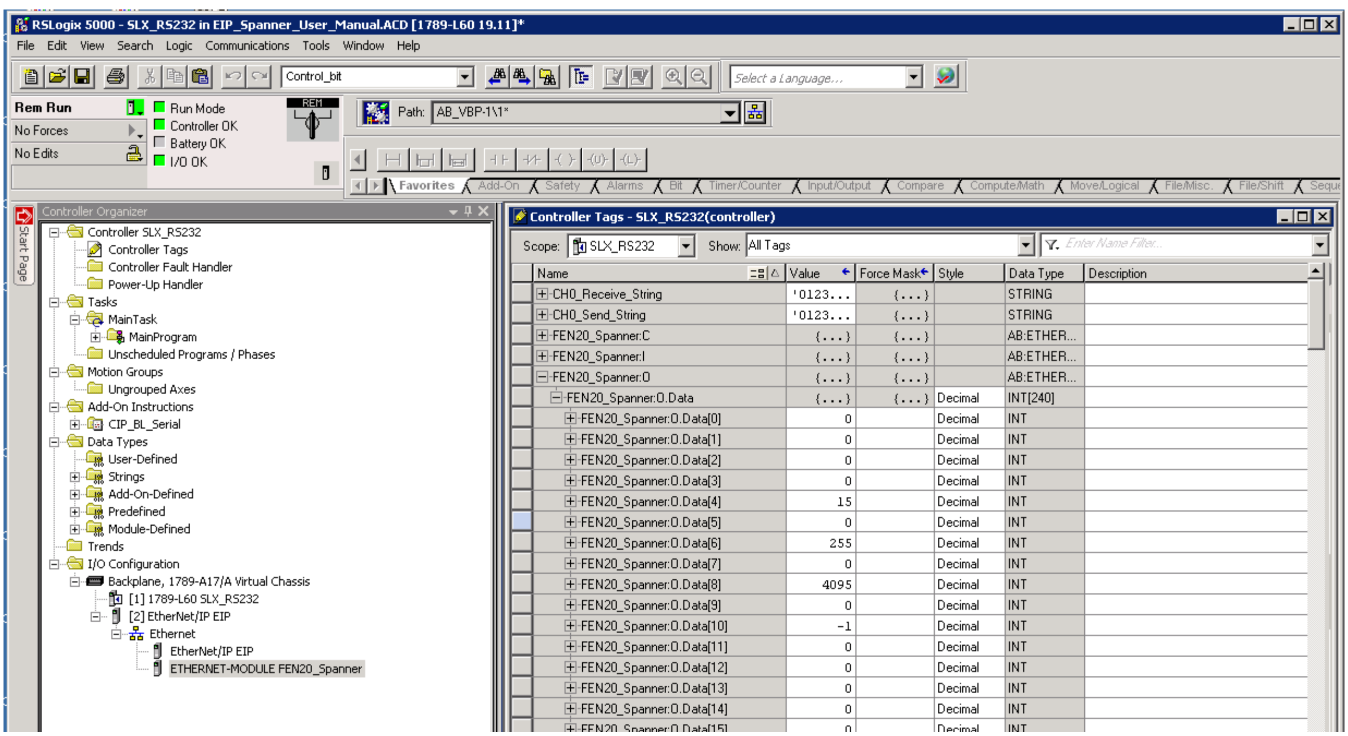
Set the desired RPI and check the ***Use Unicast Connection over Ethernet/IP*** check box. Click ***OK***.



Go ***Online*** and ***download*** the project. Put the PLC into ***Run*** mode.

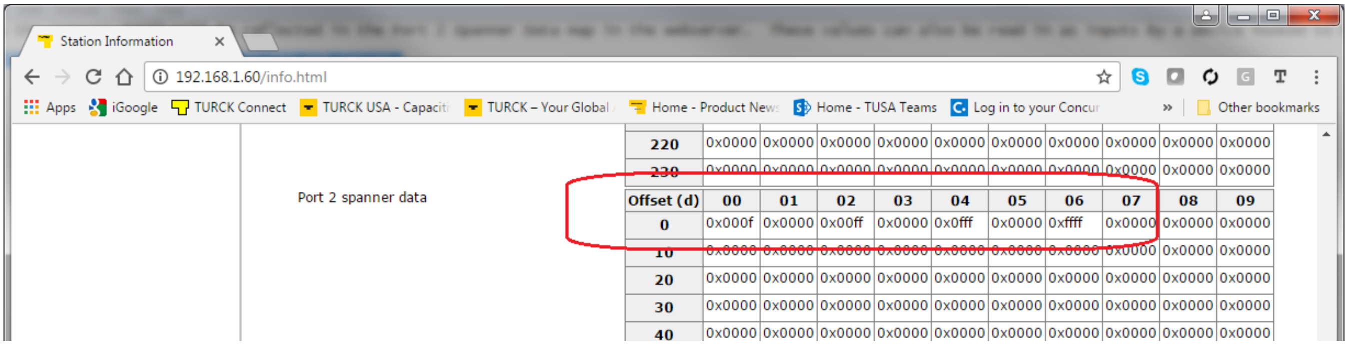


Writing values to the output data tags of the FEN20_Spanner module will be reflected in the Port 2 Spanner Data map in the Webserver. These values can also be read in as inputs by a device hooked to Port 1 of the Spanner.

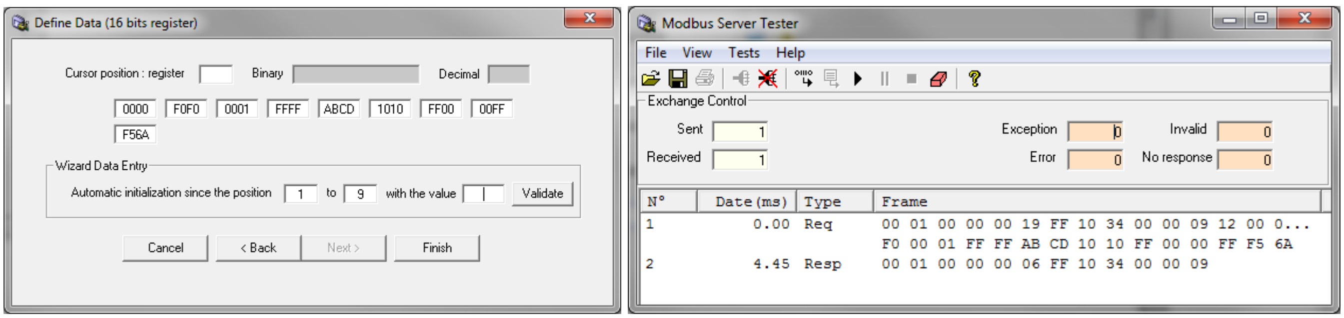


Note – Spanner Output data is offset by 4 words in the Ethernet/IP data mapping.

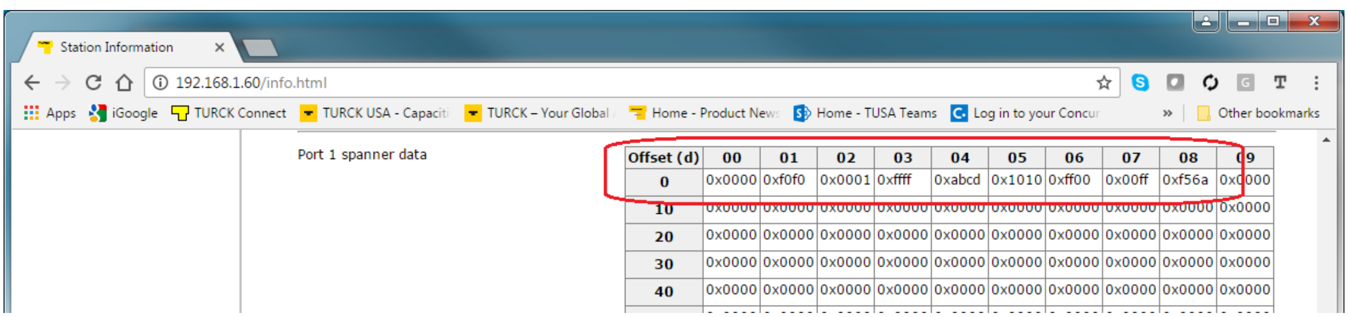
Port 2 Spanner data reflected in the Web Server.



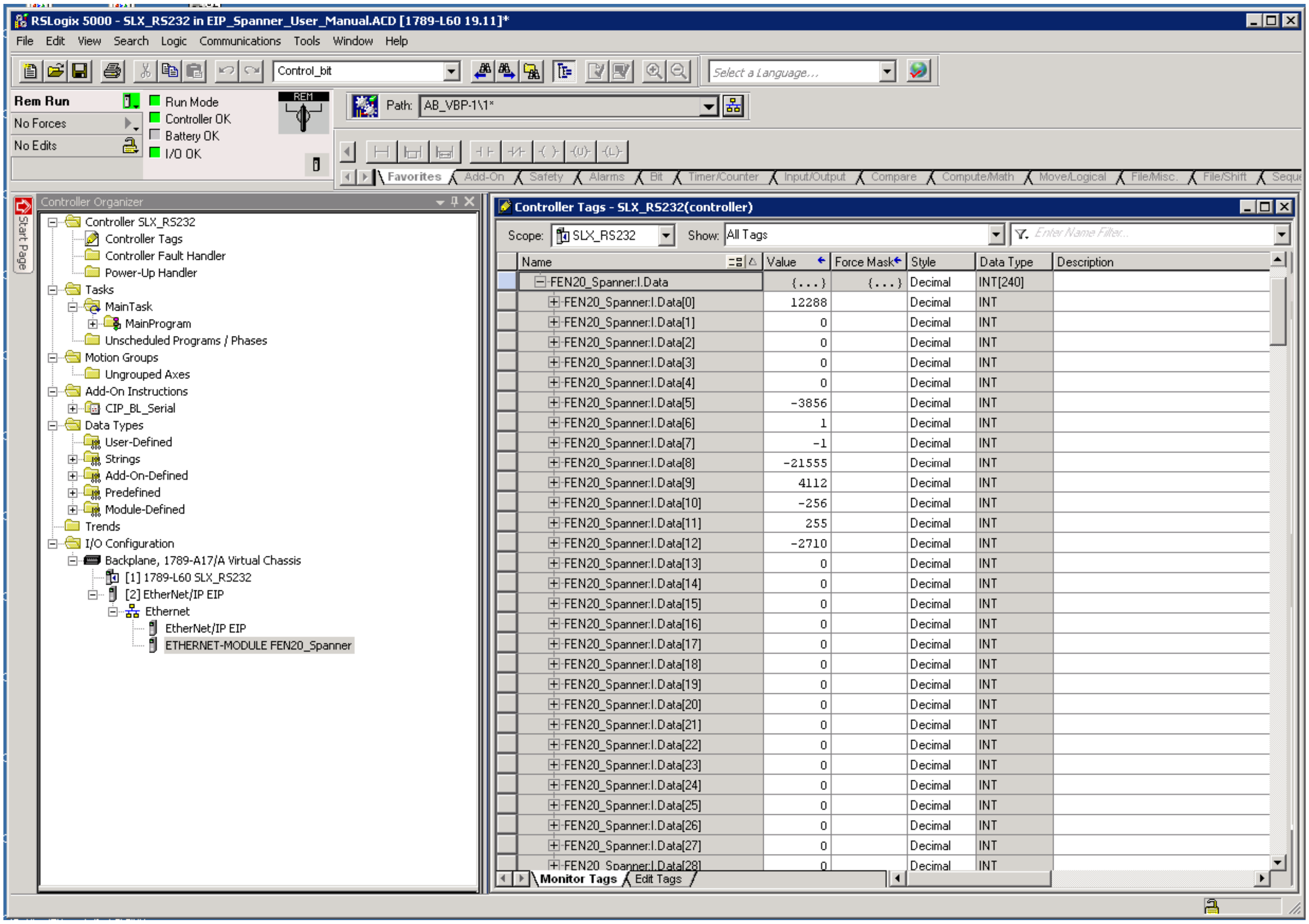
Input tag values will be reflected in the Port 1 Spanner Data map in the Webserver. These values need to be written by a device connected to Port 1. Connecting the MODBUS Server Tester to Port 1 (192.168.1.60) and writing inputs 0-9 generates the following data words on Port 1 of the Spanner.



In the Webserver Port 1 Spanner Data

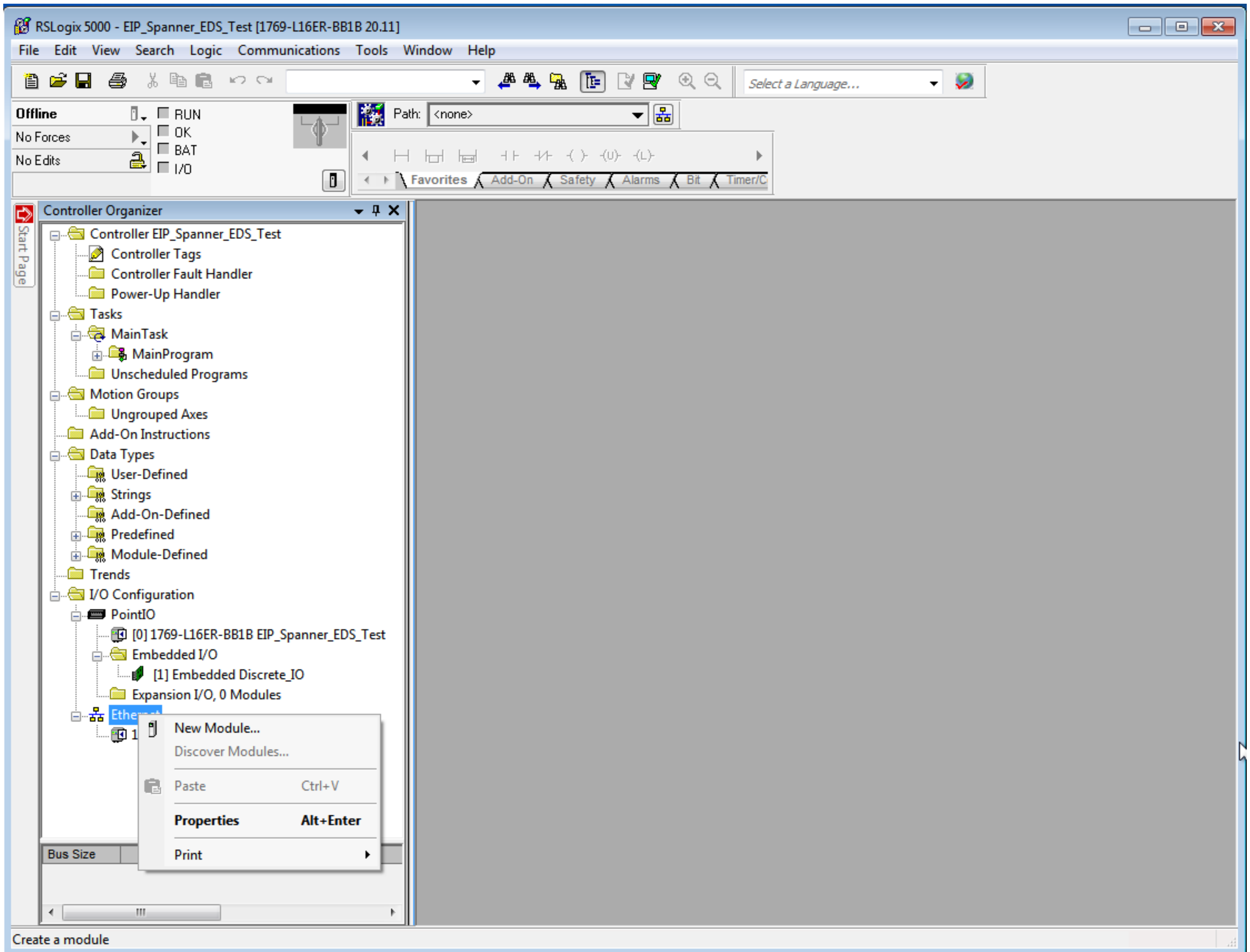


This data is now reflected in the Input tags of the Ethernet/IP PLC

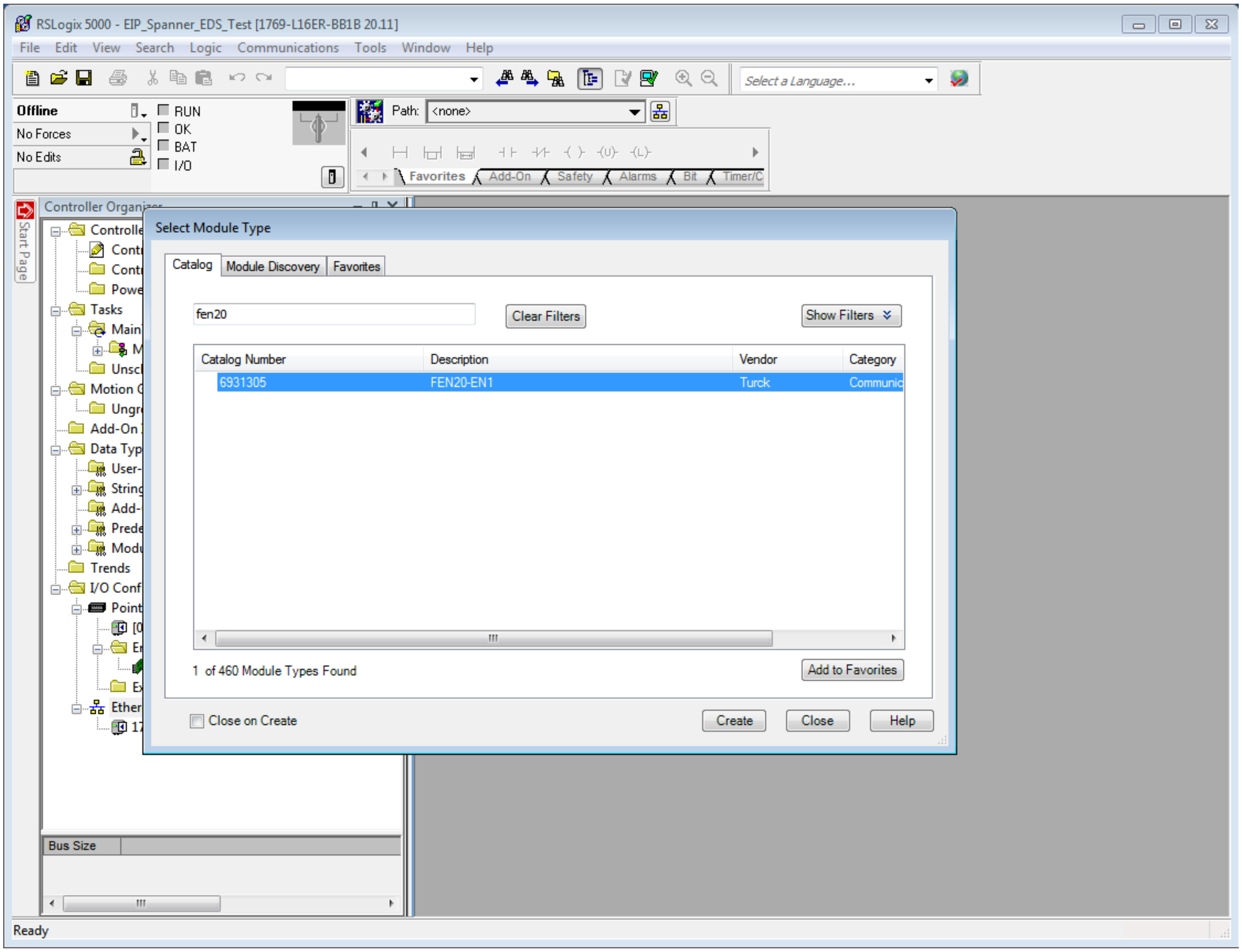


Mapping the FEN20-EN1 Spanner into a SoftLogix v20 and above project via Ethernet/IP w/ EDS File

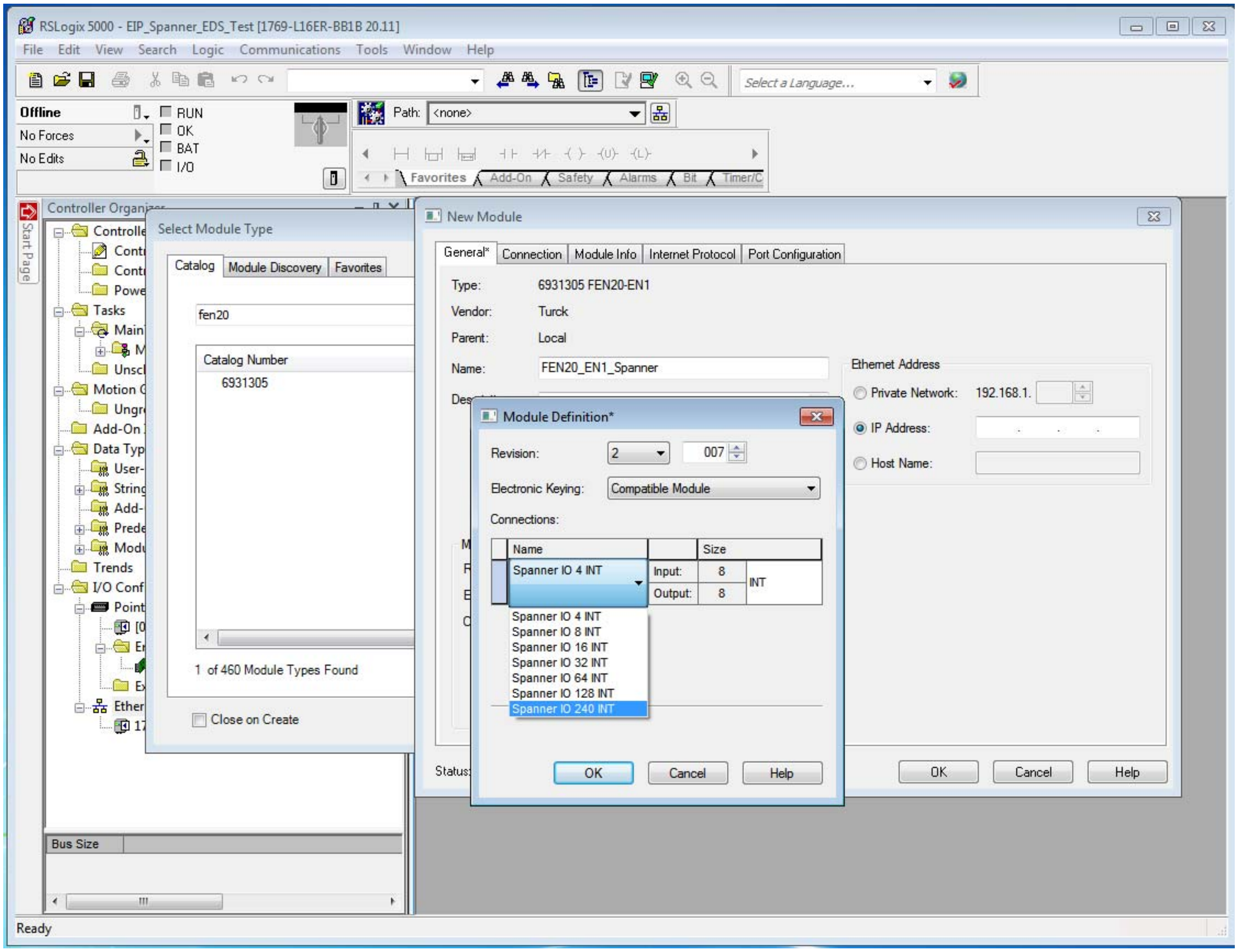
With the project open, select ***New Module***



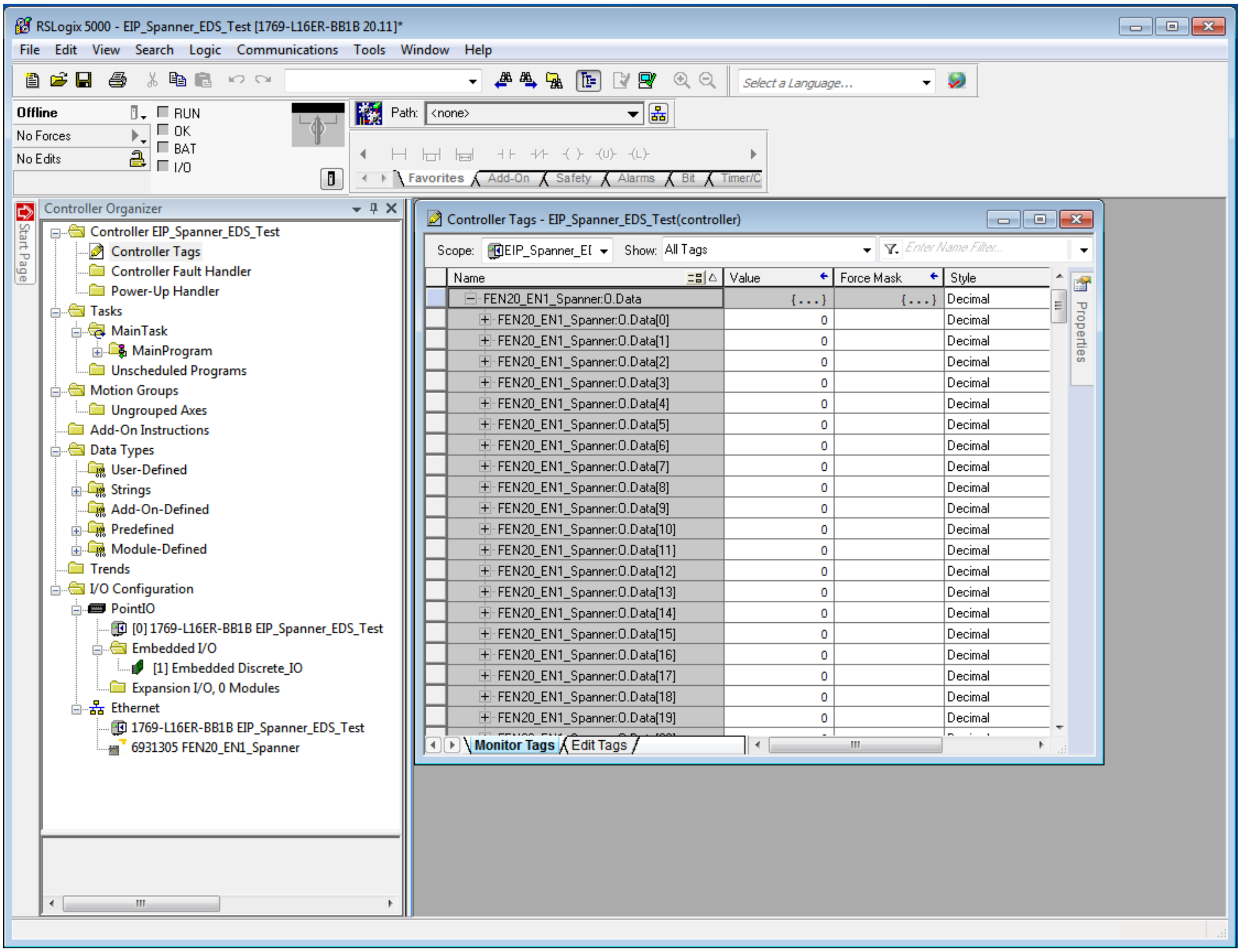
Select the ***FEN20-EN1***



Create a name. Select the number of 16 bit words to use with the Spanner, the recommended data size is INT. Add the IP address and click ***OK***.



The Spanner can now be used as in the sample above.



TECHNICAL BASICS

PROFINET is the innovative open standard for the implementation of end-to-end integrated automation solutions based on Industrial Ethernet. With PROFINET, simple distributed I/O and time-critical applications can be integrated into Ethernet communication just as well as distributed automation system on an automation component basis.

Distributed I/O with PROFINET IO

Distributed I/O is connected into communication through PROFINET IO. Here, the familiar I/O view of PROFIBUS is retained, in which the peripheral data from the field devices are periodically transmitted into the process model of the control system.

Device Model

PROFINET IO describes a device model oriented to the PROFIBUS framework, consisting of places of insertion (slots) and groups of I/O channels (sub slots). The technical characteristics of the field devices are described by the so-called GSD (General Station Description) on an XML basis.

Field bus integration

PROFINET offers a model for integration of existing field buses like PROFIBUS, AS-Interface, and INTERBUS.
This allows the construction of arbitrarily mixed systems consisting of fieldbus- and Ethernet-based segments. Thus a smooth technology transition is possible from fieldbus-based systems to PROFINET. The large number of fieldbus systems makes it necessary to support their simple integration into PROFINET for reasons of investment protection.
The integration is done with so-called "proxies". A proxy is a device which connects an underlying fieldbus with PROFINET. The proxy concept allows the device manufacturer, the plant and machine builder as well as the end user a high degree of investment protection.

Communications in PROFINET

Communications in PROFINET contain different levels of performance:
The non-time-critical transmission of parameters, configuration data, and switching information occurs in PROFINET in the standard channel based on UDP and IP. This establishes the basis for the connection of the automation level with other networks (MES, ERP).
For the transmission of time critical process data within the production facility, there is a Real-Time channel (RT) available.
For particularly challenging tasks, the hardware based communication channel Isochronous

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UDP/IP communication
For non-time-critical processes, PROFINET uses communications with the standard Ethernet mechanisms over UDP/IP which follow the international standard IEEE 802.3.
Similar to standard Ethernet, PROFINET field devices are addressed using a MAC and an IP address. In UDP/IP communications, different networks are recognized based on the IP address. Within a network, the MAC address is a unique criterion for the addressing of the target device. PROFINET field devices can be connected to the IT world without limitations. A prerequisite for this is that the corresponding services, for instance file transfer, must be implemented in the field device involved. This can differ from manufacturer to manufacturer.

Real-time communication (RT)
A data communication over the UDP/IP channel is provided with a certain amount of administrative and control information for addressing and flow control, all of which slows data traffic.
To enable Real-Time capability for cyclical data exchange, PROFINET abandons partially IP addressing and flow control over UDP for RT communications. The communication mechanisms of the Ethernet (Layer 2 of the ISO/OSI model) are very suitable for this. RT communications can always run in parallel with NRT communications.

The services of PROFINET IO
- Cyclic data exchange
  For the cyclic exchange of process signals and high-priority alarms, PROFINET IO uses the RT channel.
- Acyclic data exchange (record data)
  The reading and writing of information (read/write services) can be performed acyclically by the user. The following services run acyclically in PROFINET IO:
  - parameterization of individual submodules during system boot
  - reading of diagnostic information
  - reading of identification information according to the "Identification and Maintenance (I&M) functions"
  - reading of I/O data

Address assignment
In IP-based communications, all field devices are addressed by an IP address.
PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.
In the delivery state each device amongst others has a MAC address. This information is enough to assign each field device a unique name (appropriate to the installation).
Address assignment is performed in two steps:
- Assignment of a unique plant specific name to the field device.
- Assignment of the IP address by the IO-Controller before system boot based on the plant specific (unique) name.

PROFINET EN1 Process Data Map

The PROFINET process data map is defined in the PROFINET project by the GSDML file. Please download and install the appropriate GSDML file for the Spanner and PROFINT PLC you plan to use. GSDML files can be found at www.turck.com

Use of the GSDML file is demonstrated in the following section.

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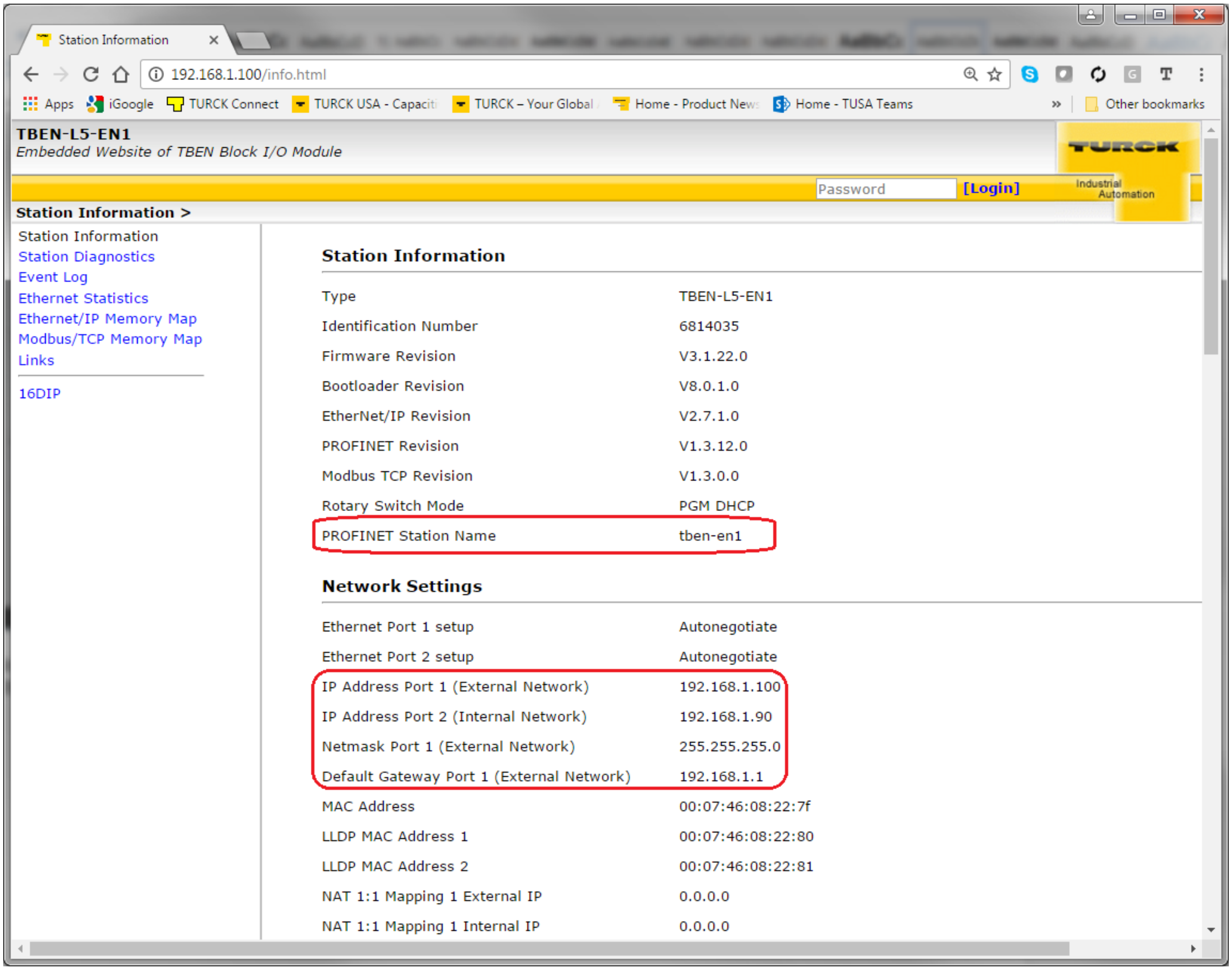
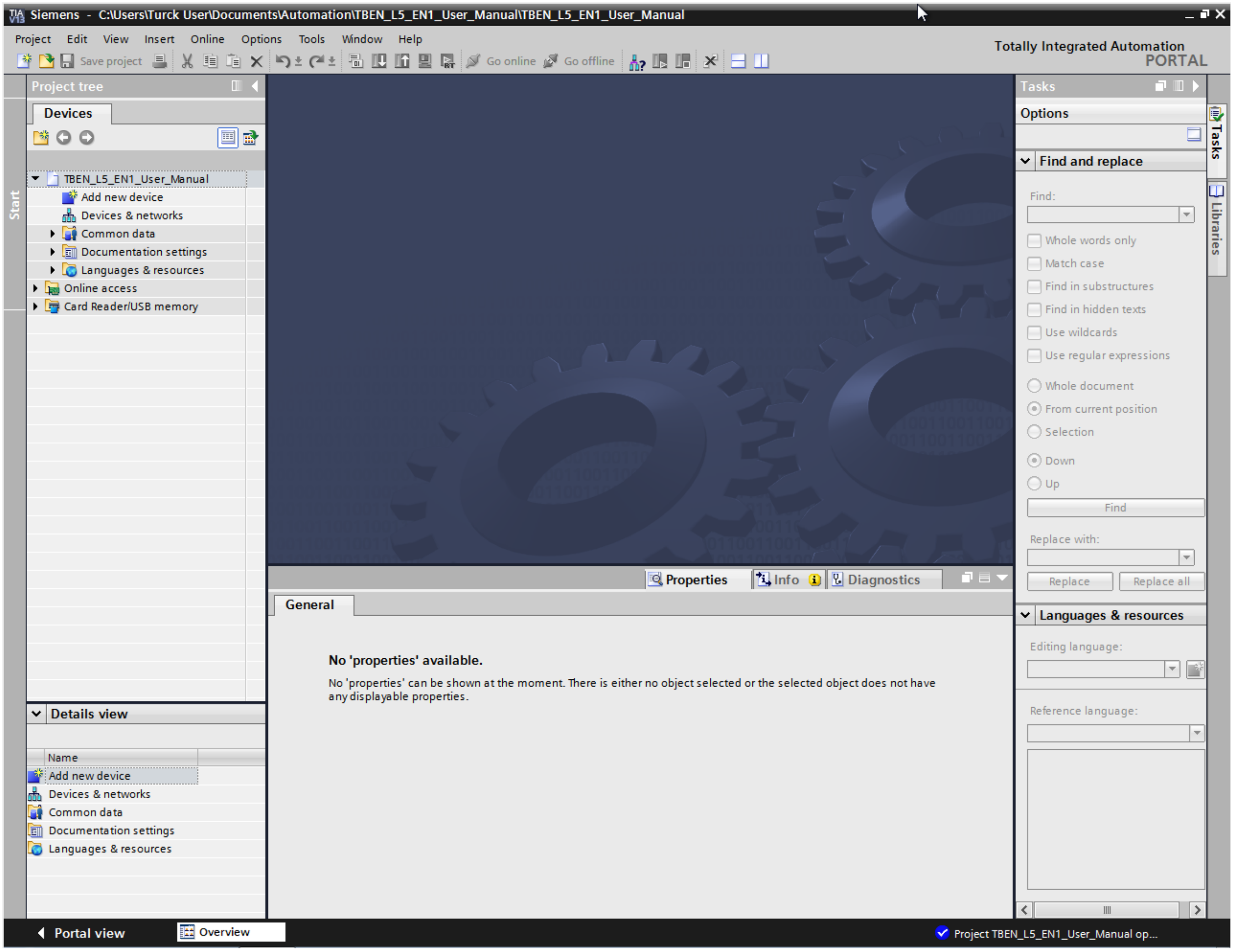
Mapping the TBEN-L5-EN1 Spanner into a TIA Portal v13 Project via PORFINET

The TBEN-L5-EN1 Spanner is addressed as follows via the Webserver



Create a project in TIA Portal



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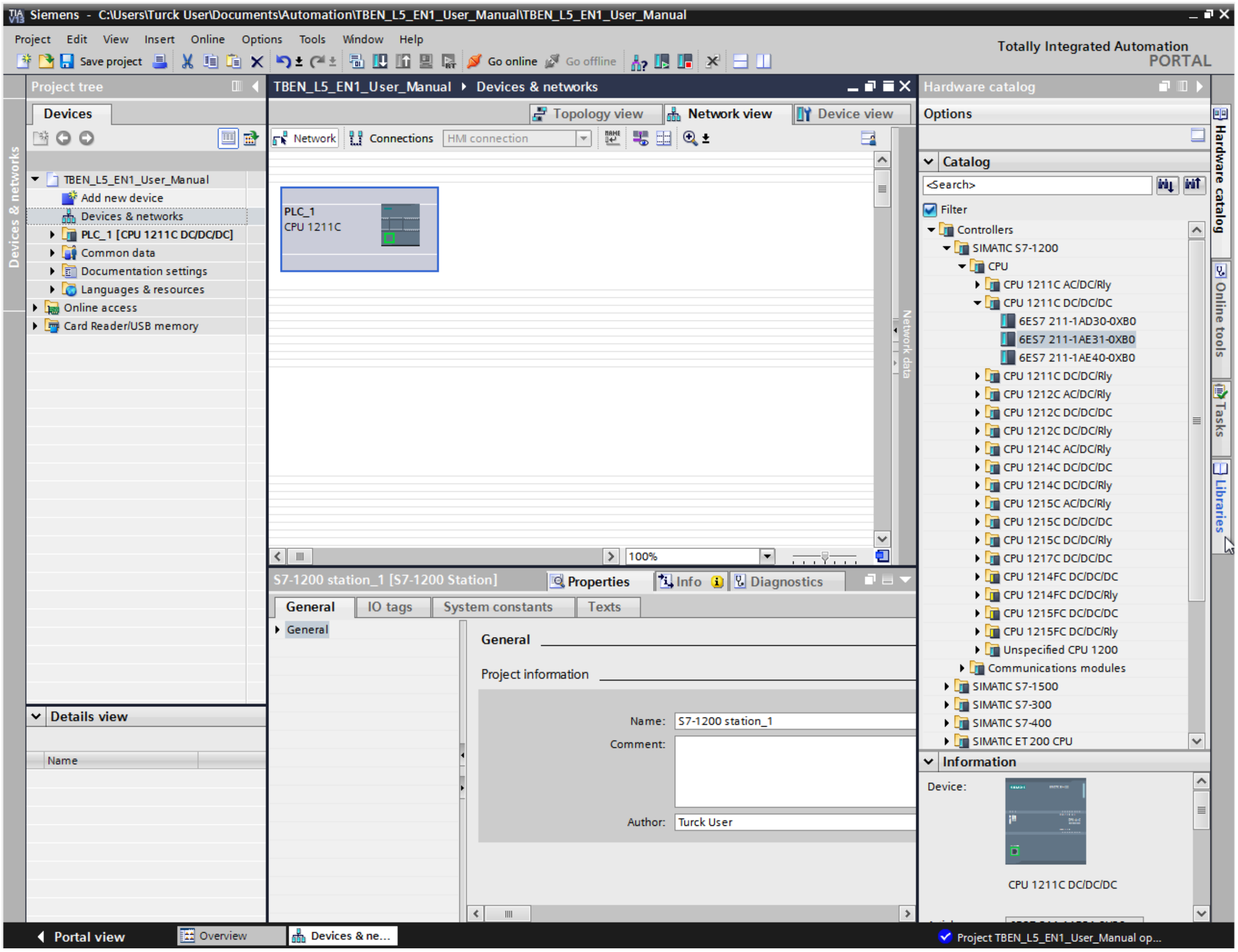
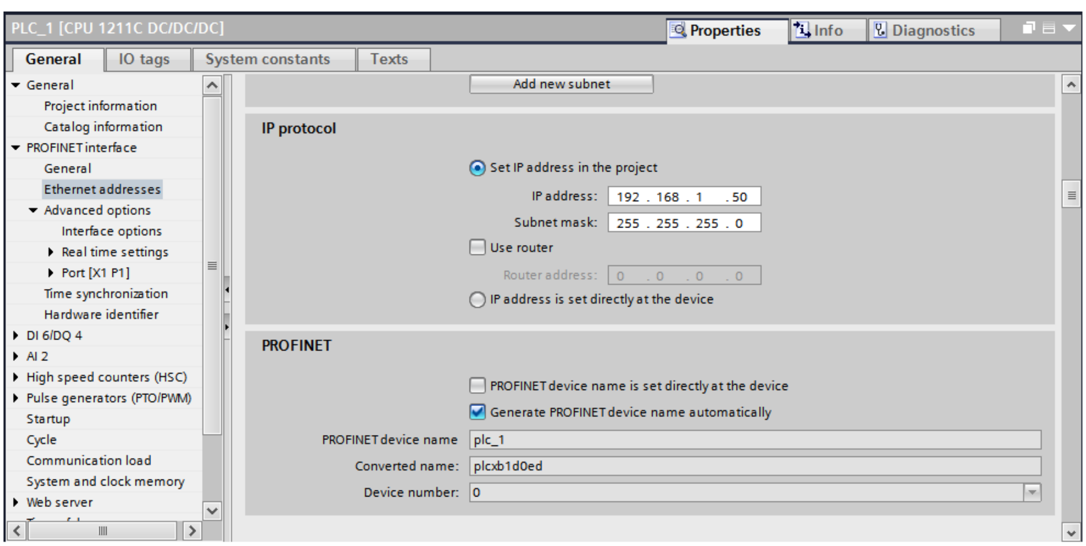
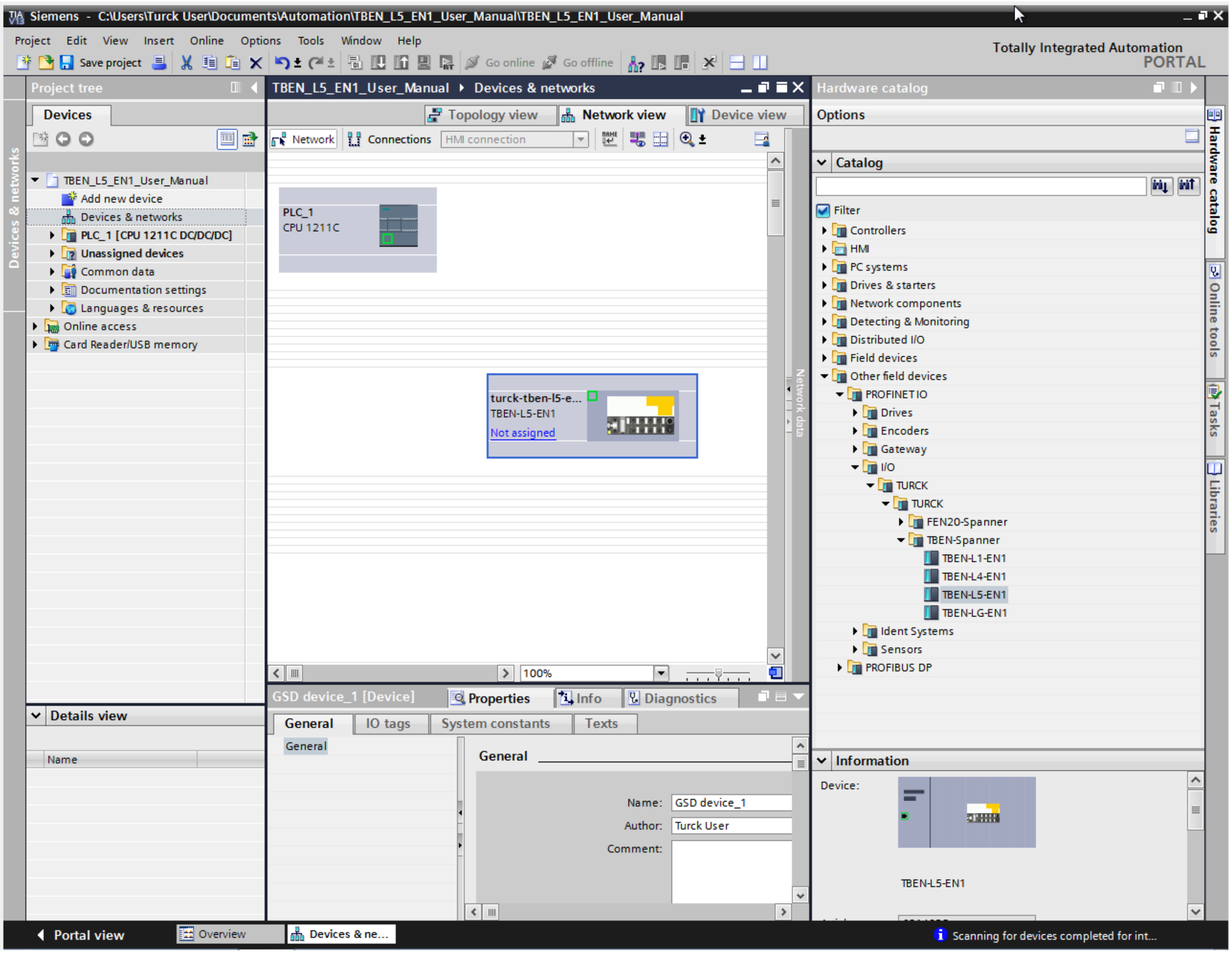
Use the ***Hardware Catalog*** to add a PLC to the project



Use the ***Properties*** -> ***PrROFINET Interface tab*** to assign the IP address and PROFINET device Name to the PLC



Use the ***Hardware Catalog*** to add a spanner to the project



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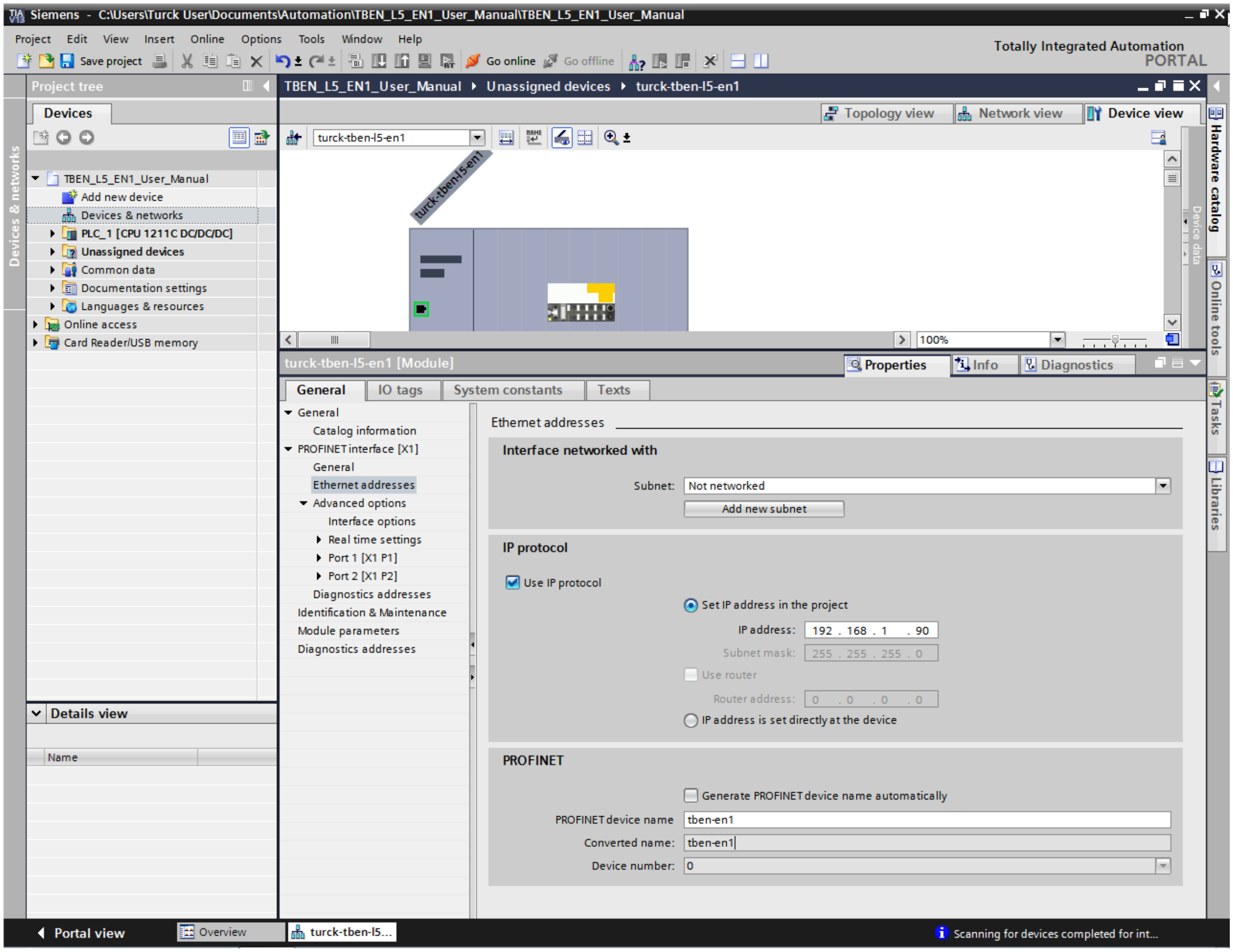
Use the ***Properties*** -> ***PROFINET Interface tab*** to assign the Spanner Port 2 IP address and PROFINET device Name to the Spanner



Note – PROFINET is supported on Port 2 only. If the PROFINET cable is hooked to Port 1 the Spanner will not respond to the PROFINET PLC.

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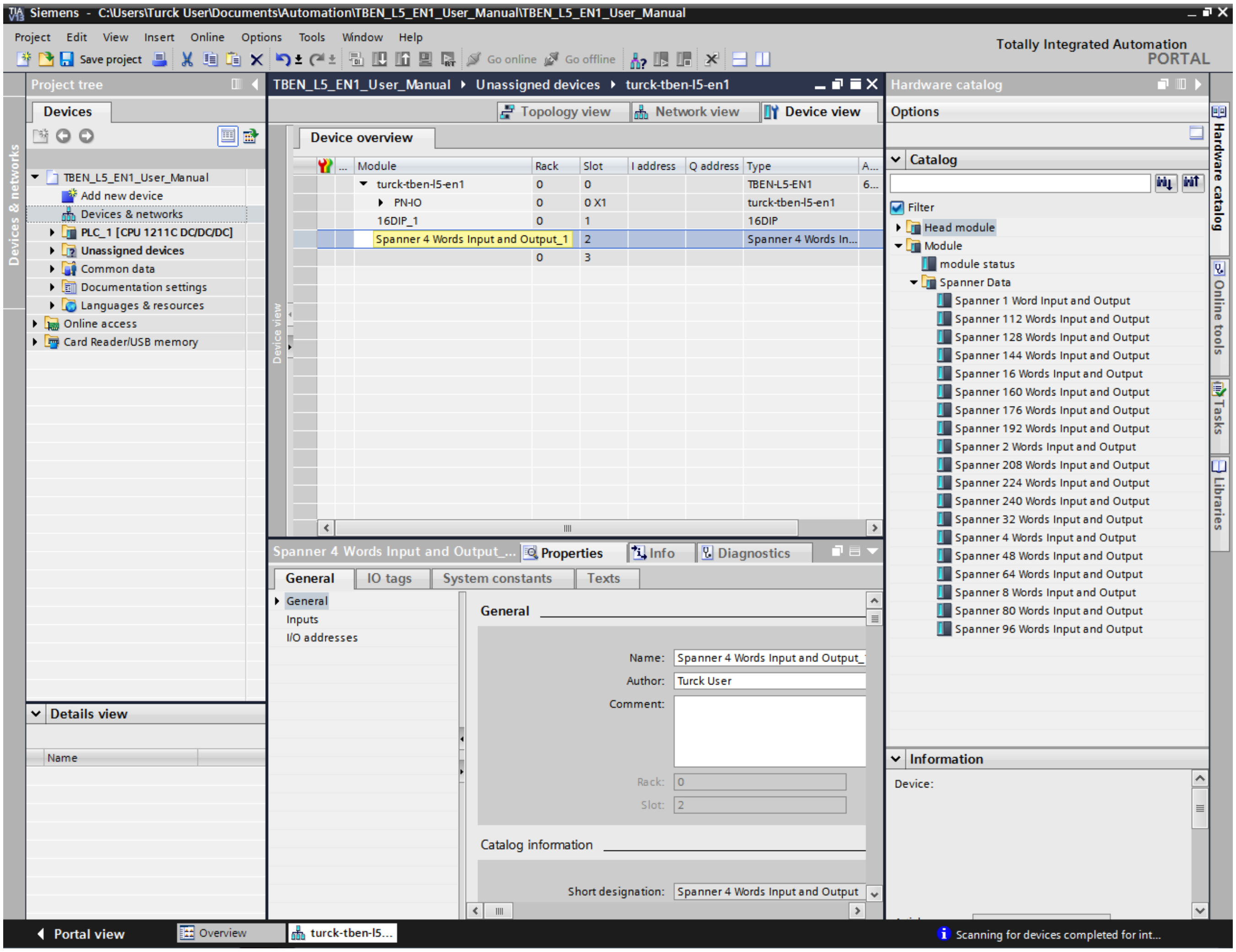
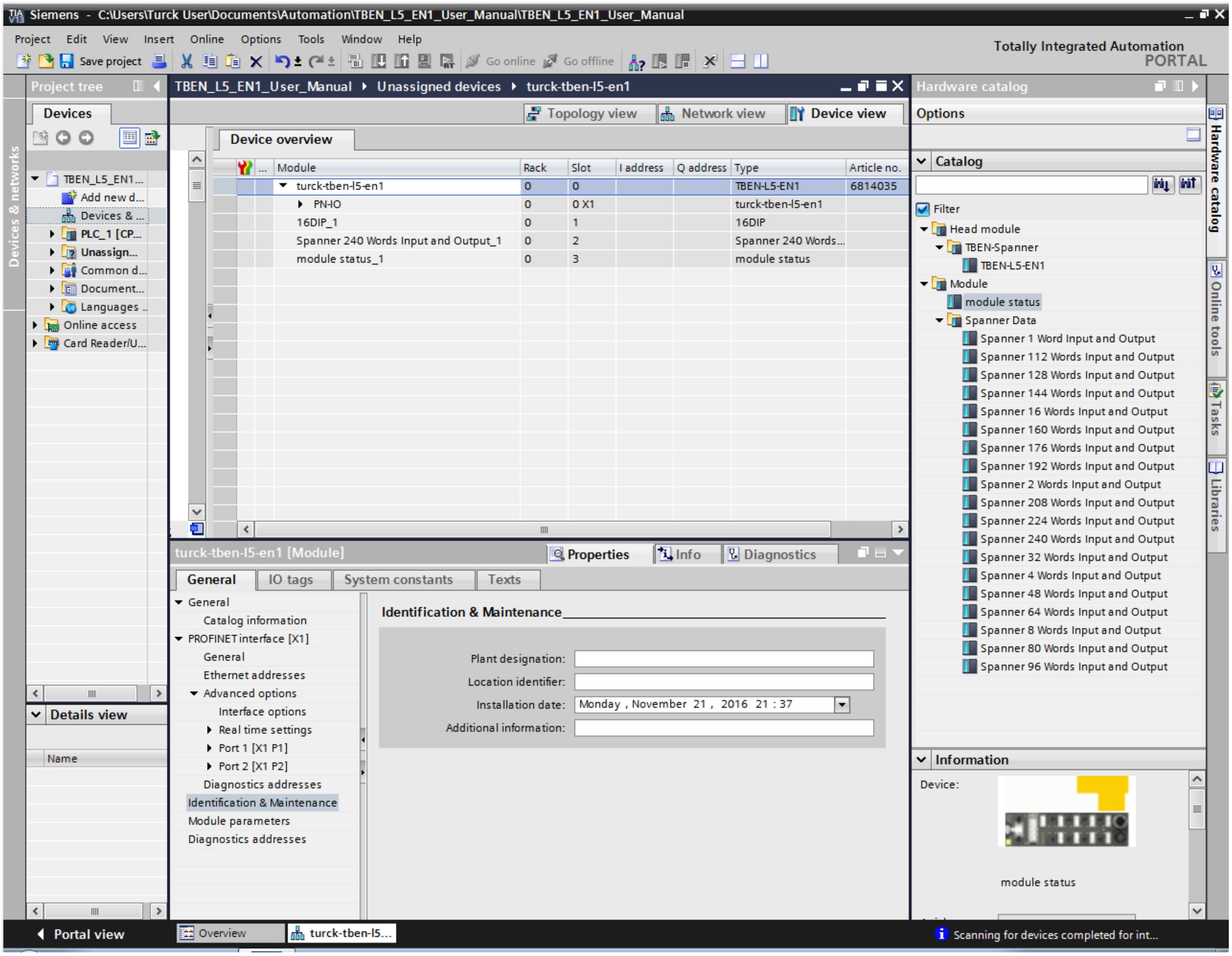
In the ***Device View*** use the ***Hardware Catalog*** to assign the number of I/O words used in the Spanner.



Note - the Spanner defaults to *Spanner 4 Words Input and Output*. This will have to be deleted to add a different amount of I/O Words.

The module now has 240 Words of Spanner I/O as well as the Module Status bits added.



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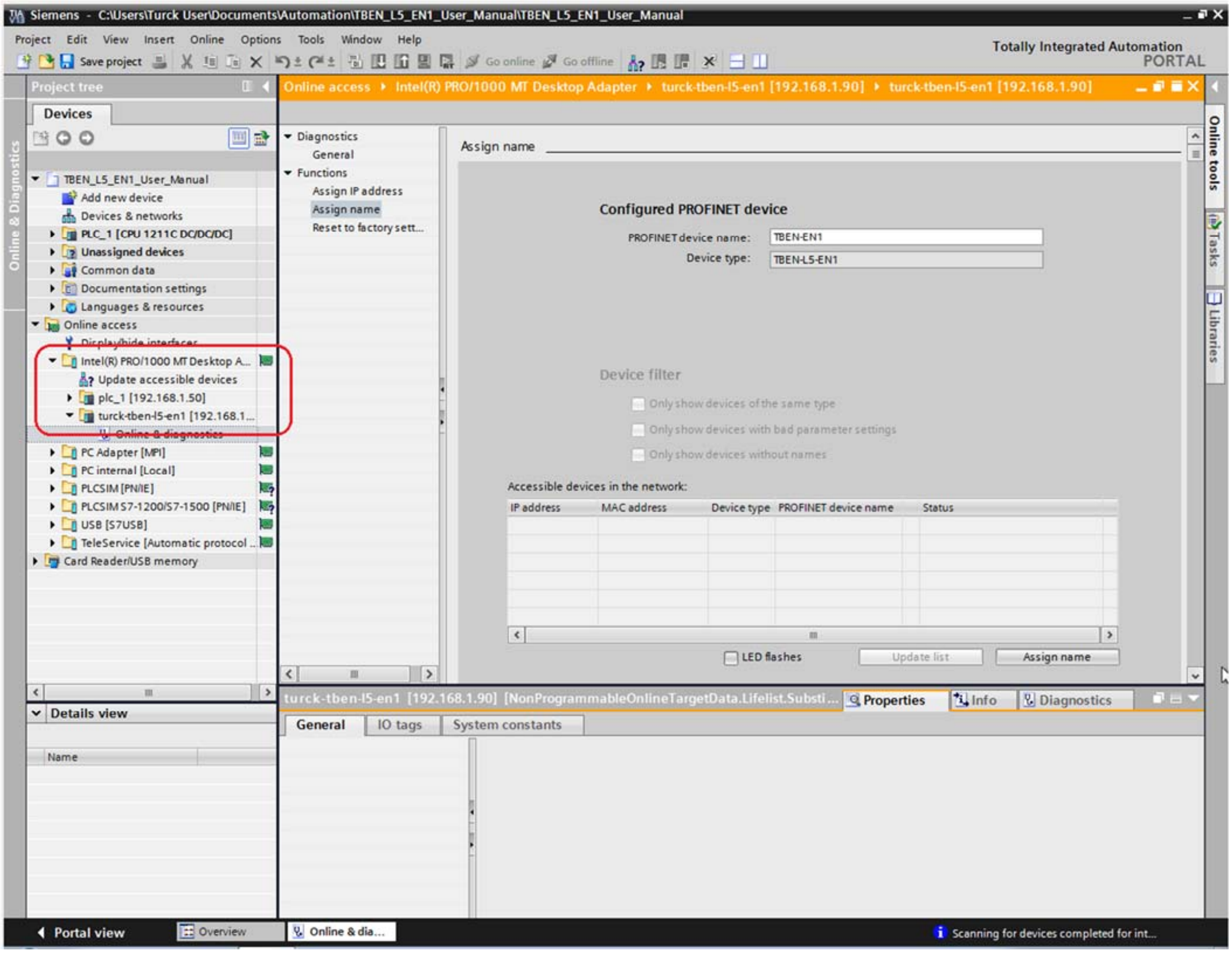
In the ***Project Tree***, open the ***Online Access*** Tab. Double click ***Update accessible devices*** and verify that the IP addresses and PROFINET names match in the connected devices.



Above you can see the PROFINET name of the TBEN-L5-EN1 does not match the name we programmed into the project, TBEN-EN1

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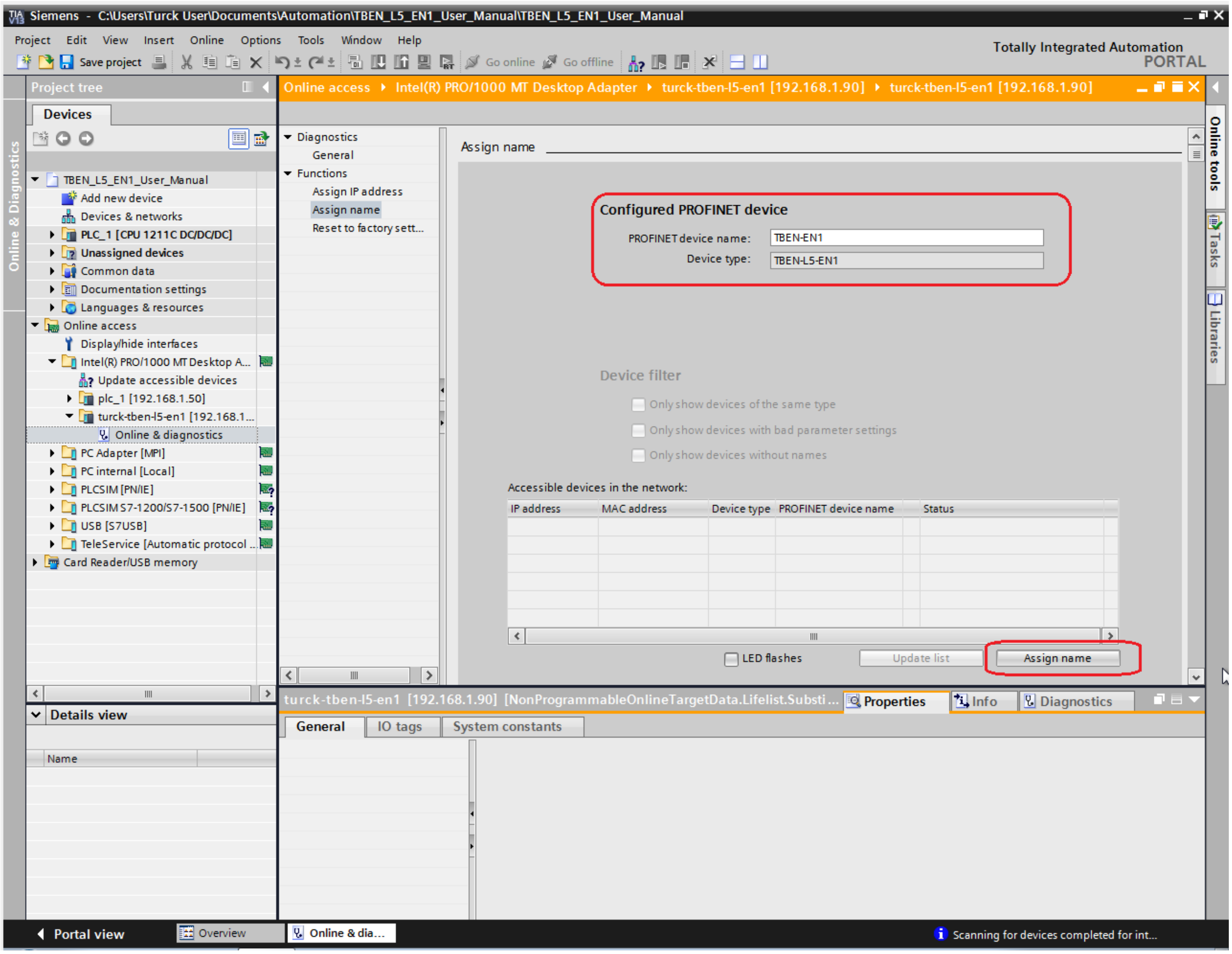
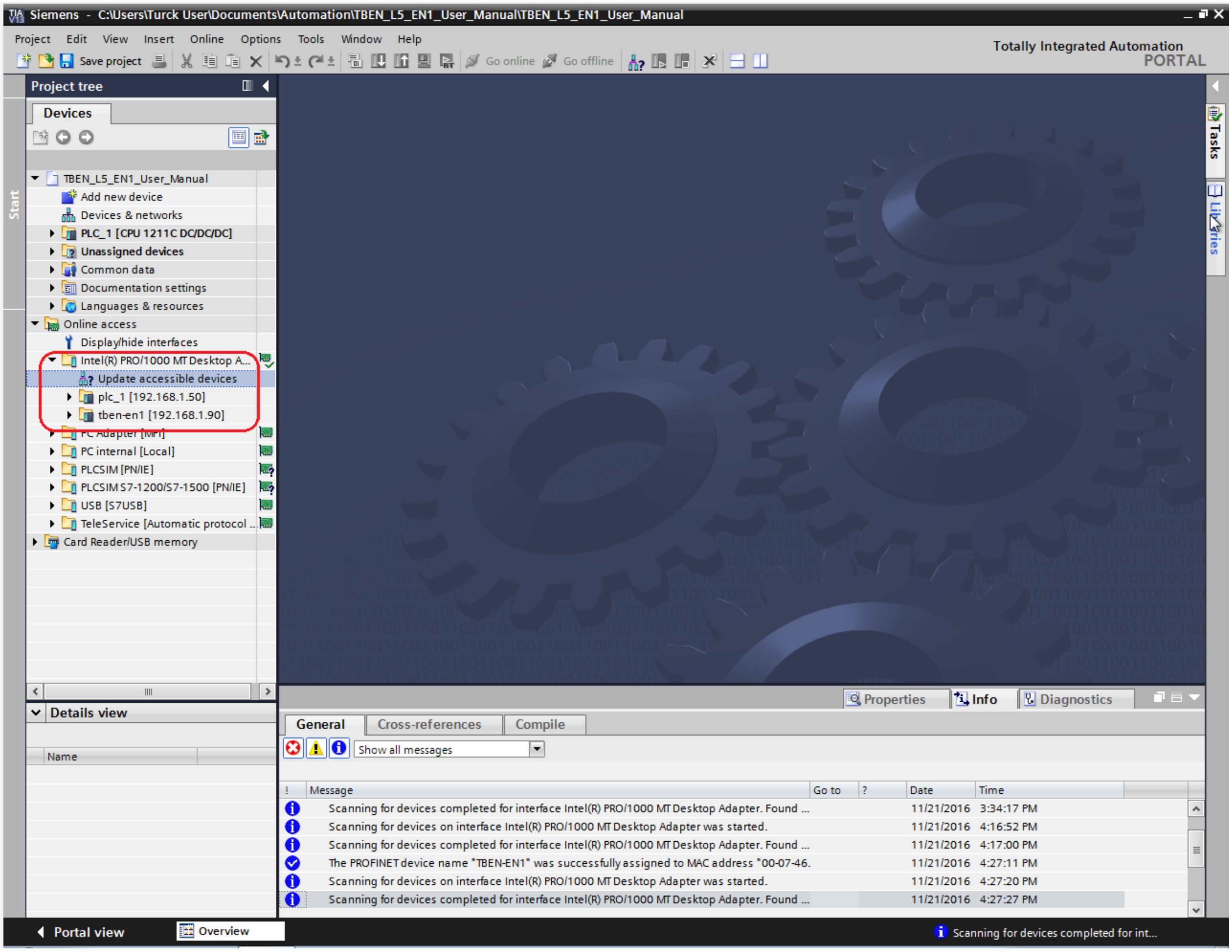
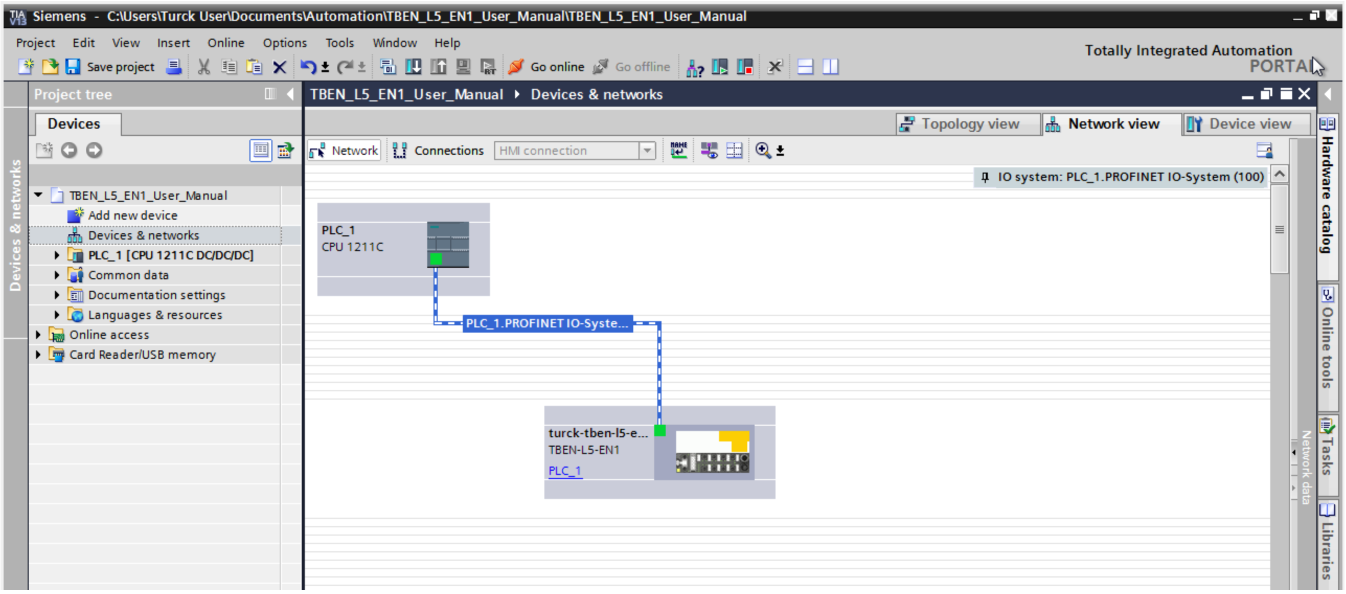
Re-assign the PROFINET name. In the ***Project Tree*** under the IP address 192.168.1.90 click ***Online and Diagnostics***. Go to the ***General tab*** -> ***Functions*** -> ***Assign Name*** and assign the correct PROFINET name to the Spanner.



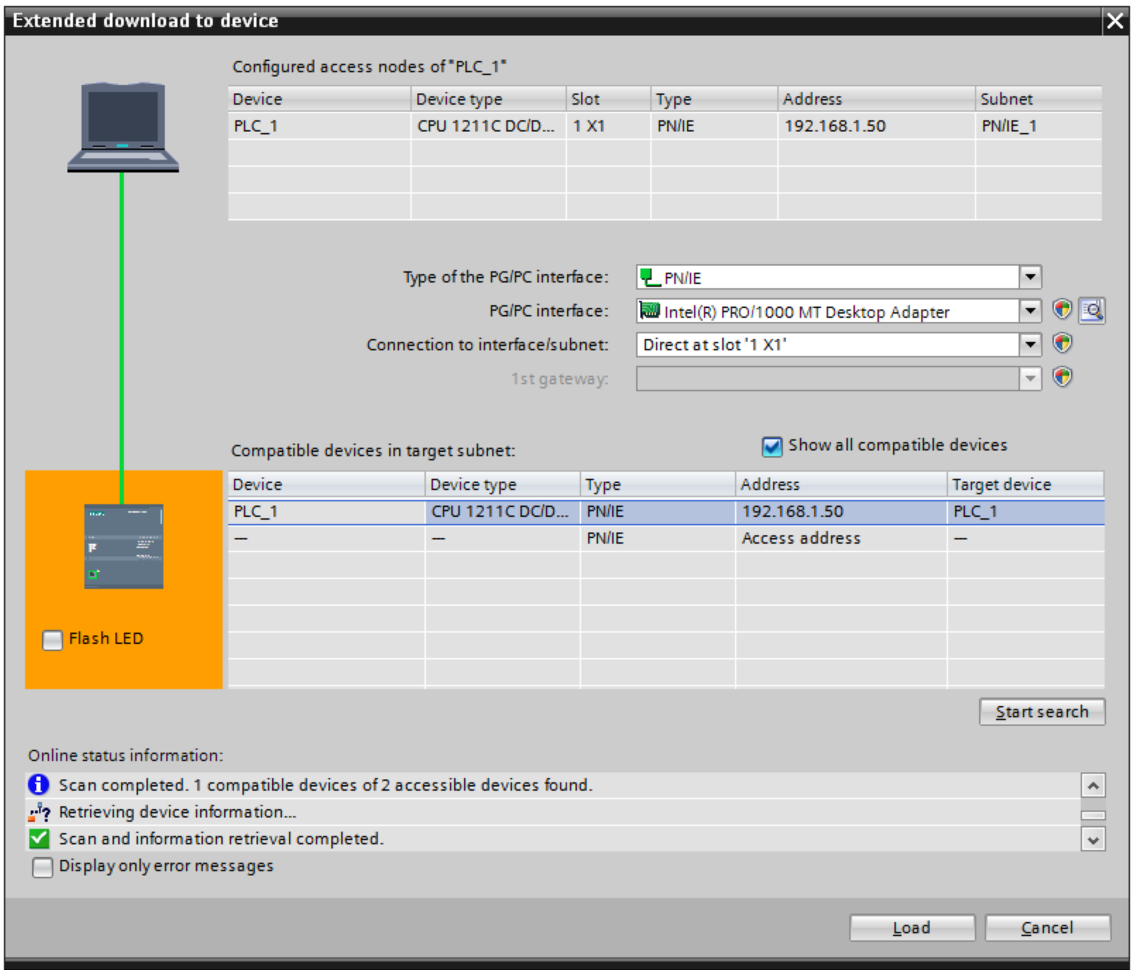
In the ***Project Tree***, double click on ***Update accessible devices*** and verify that the PROFINET name of the Spanner was changed.



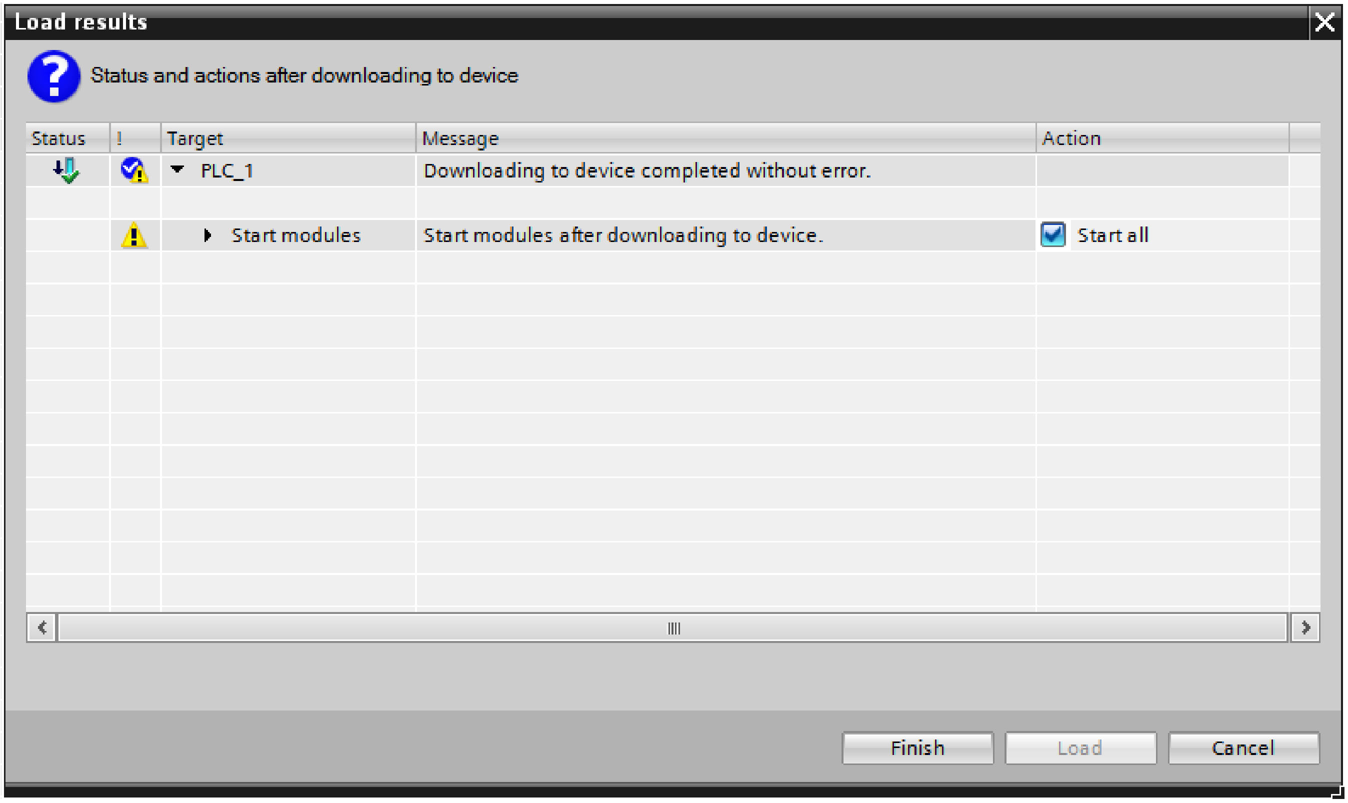
In the ***Network View*** make the network connection from the PLC to the Spanner.



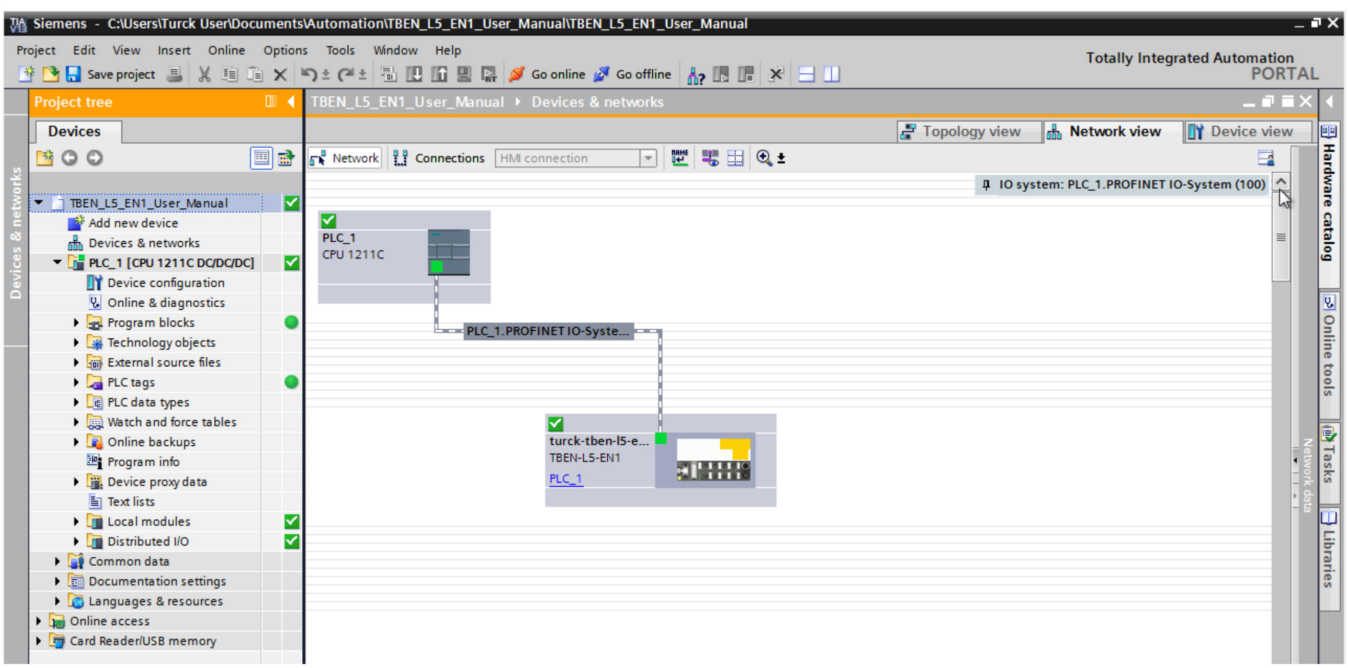
Click Online -> Download to Device. Select the correct PLC and click ***Load***.



Follow all Load prompts. Once the ***Load Results*** window is loaded check the ***Start All*** radio button and click ***Finish***.



Click ***Go Online***. The module is now connected to the PLC and the PLC is running.



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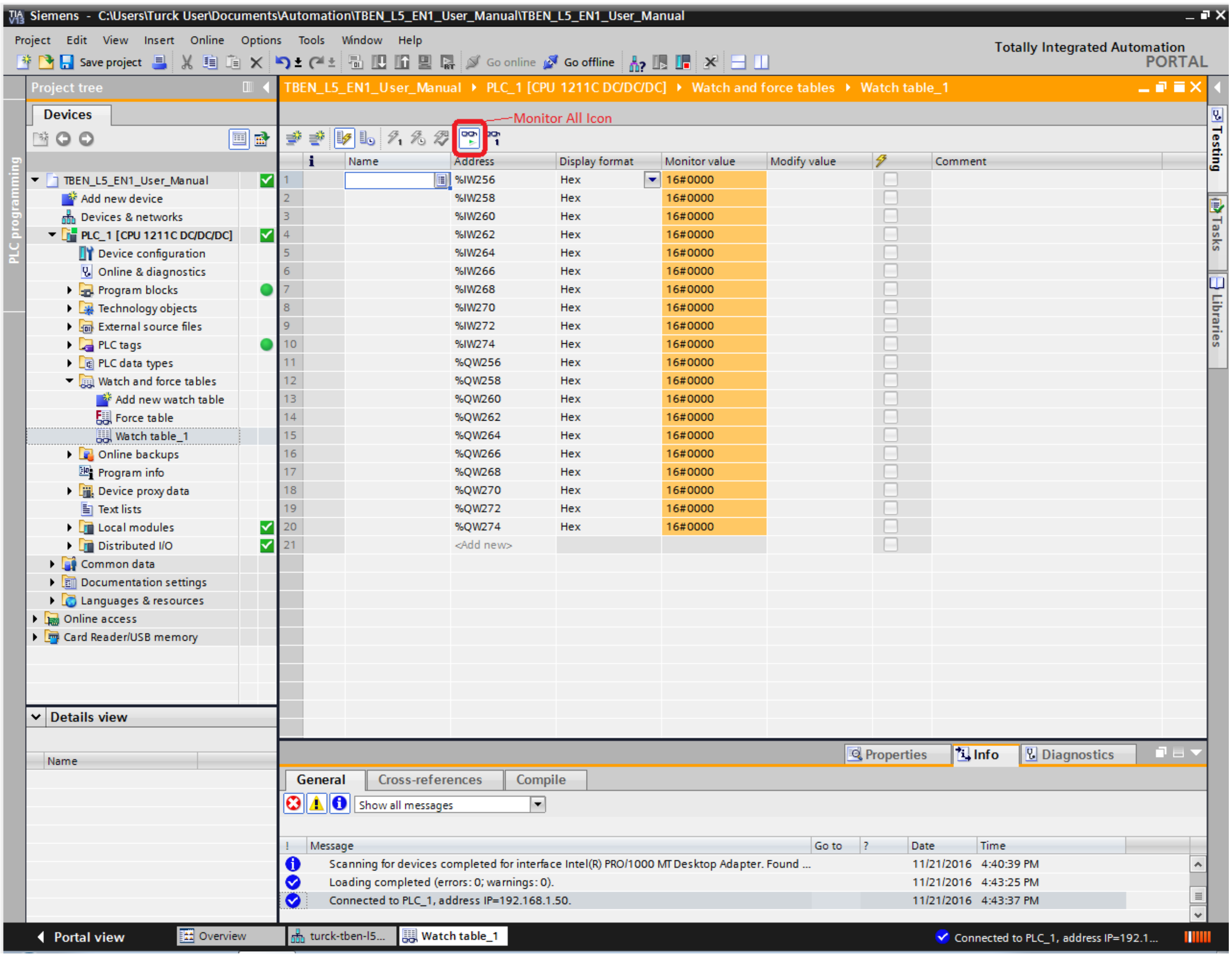
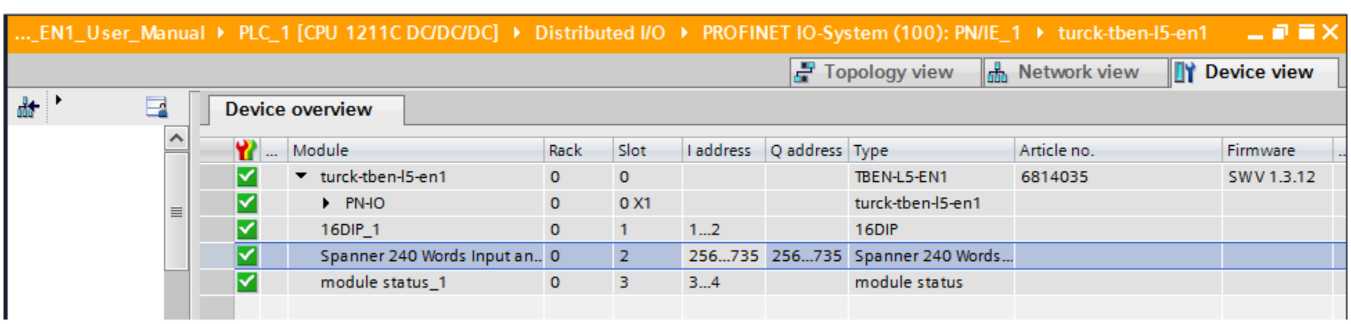
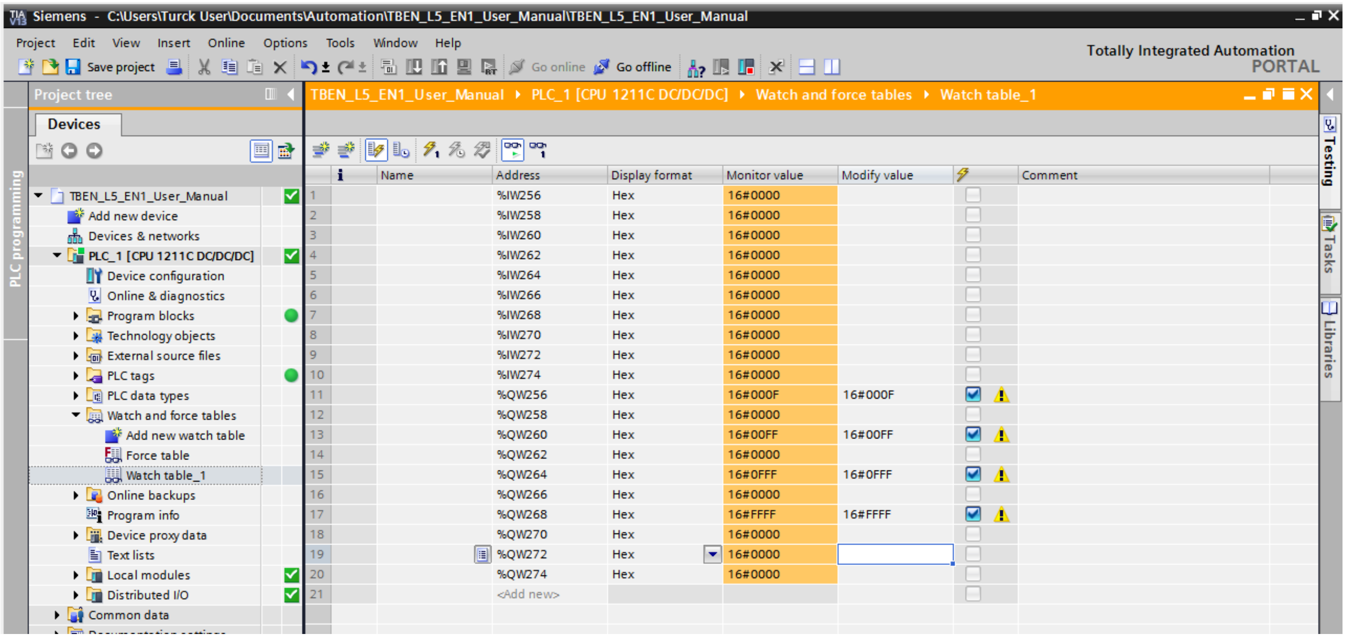
In the ***Project Tree***, *under* ***Watch and Force tables***, select ***Add New Watch Table***. Add I/O to the watch table. Click the ***Monitor All*** Icon to monitor the selected I/O



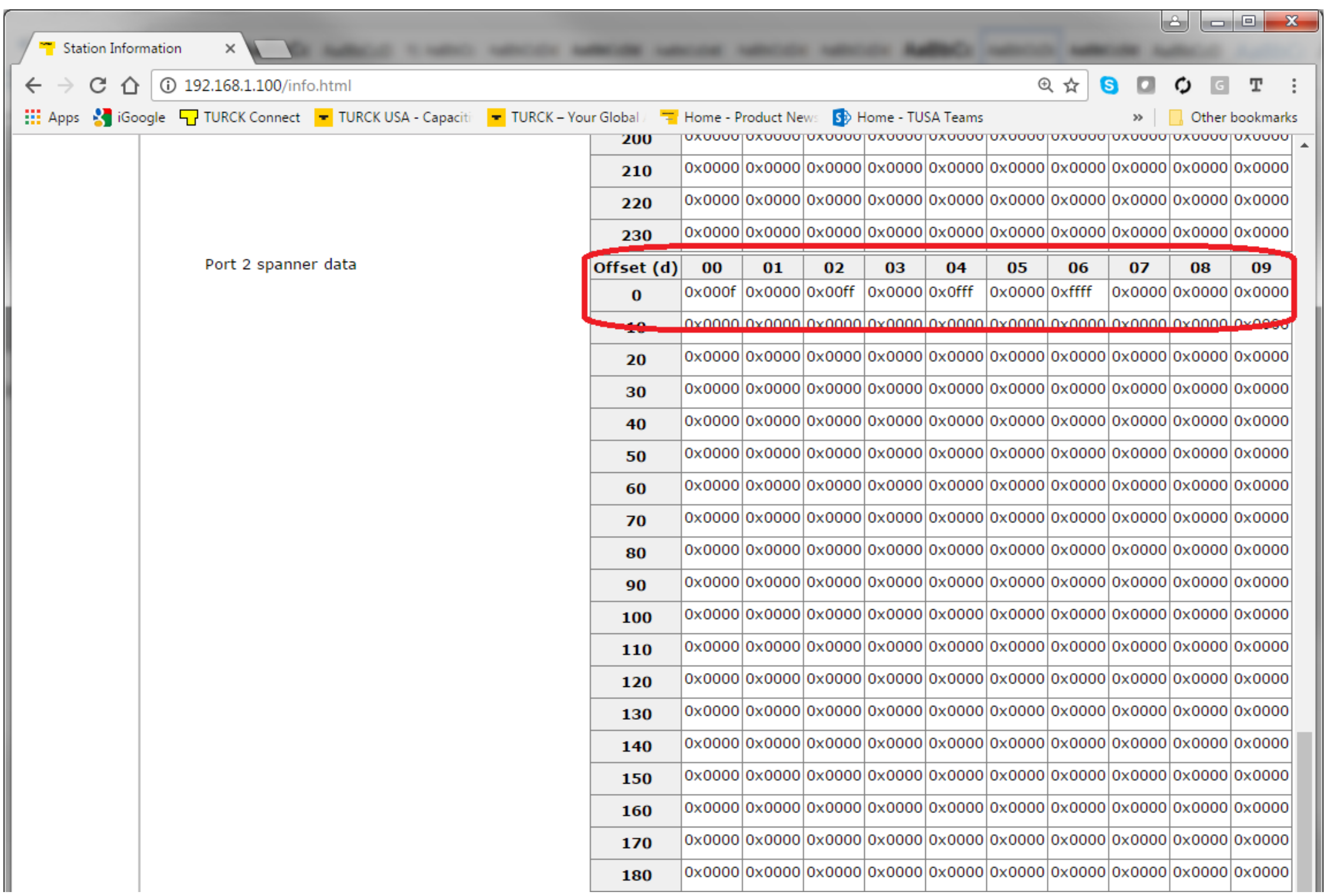
Note – Spanner I/O mapping can be found by selecting the Spanner from the ***Network*** view and going to the ***Device Data*** tab.



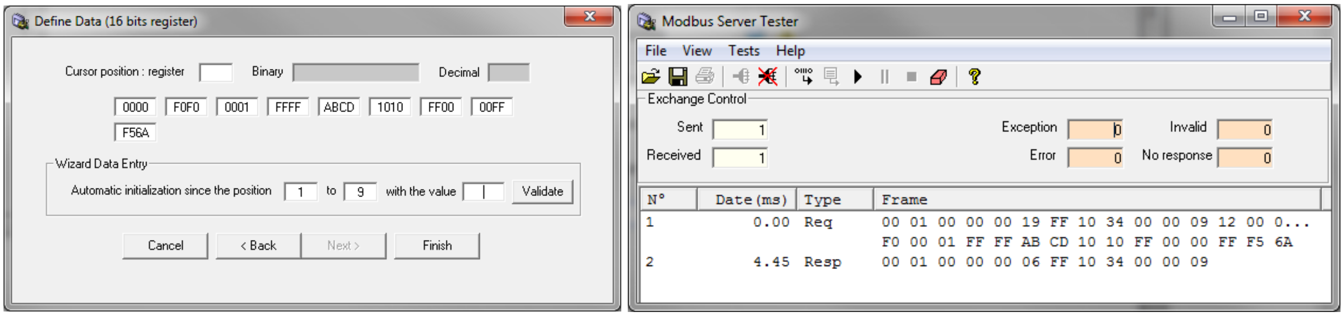
Writing values to the outputs (QWs) will be reflected in the Port 2 Spanner Data map in the Webserver. These values can also be read in as inputs by a device hooked to Port 1 of the Spanner.



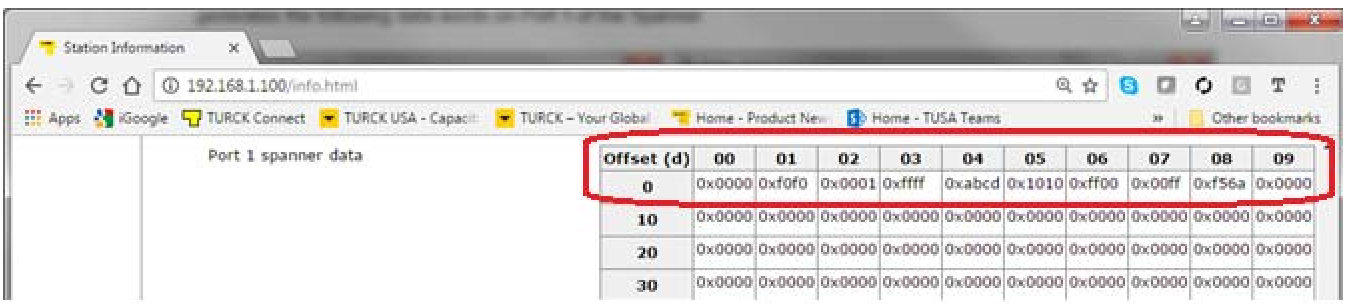
Corresponding Port 2 Spanner data reflected in the Web Server.



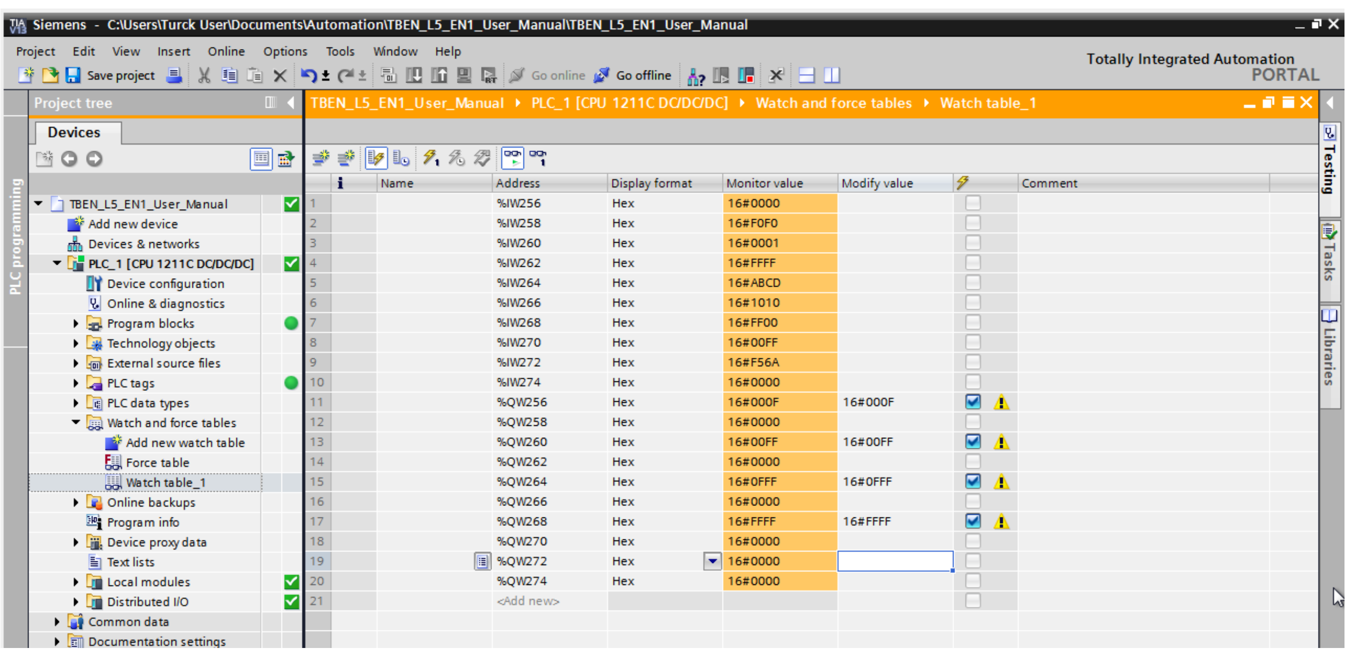
Input vales (IWs) will be reflected in the Port 1 Spanner Data map in the Webserver. These values need to be written by a device connected to Port 1. Connecting the MODBUS Server Tester to Port 1 (192.168.1.100) and writing inputs 0-9 generates the following data words on Port 1 of the Spanner.



In the Webserver Port 1 Spanner Data



This data is now reflected in the Input words (IWs) of the PROFINET PLC



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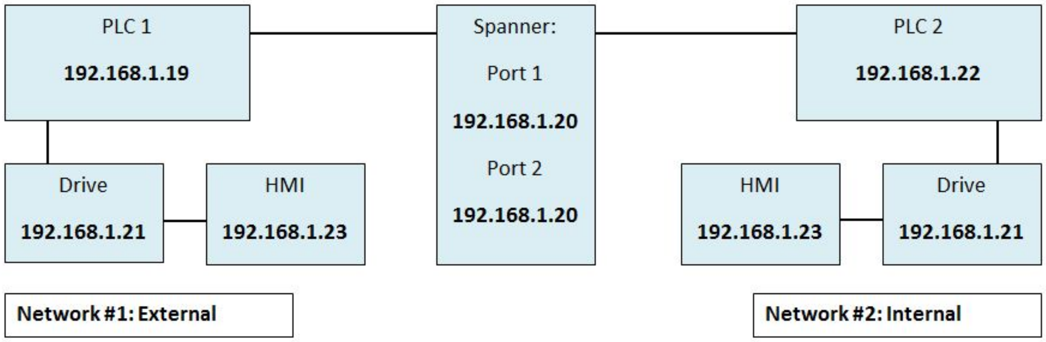
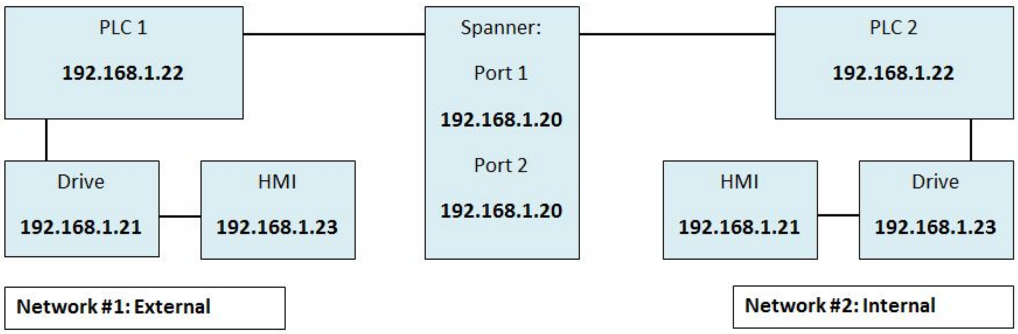
Spanner Mode

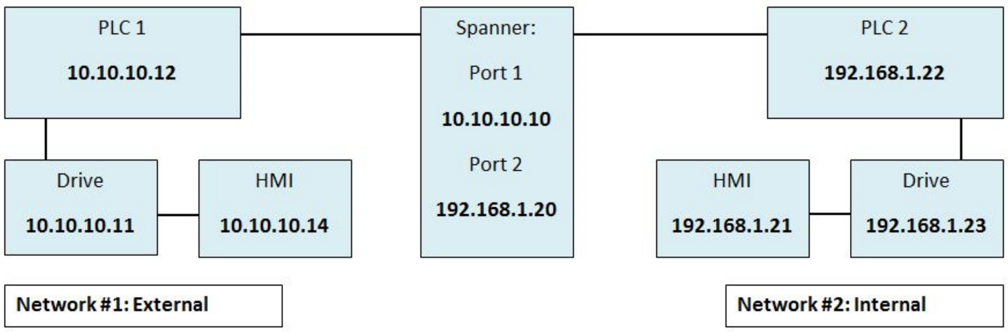
The spanner has multiple applications for spanning different networks. One application allows the user to view devices on a different network where under normal operations one would have conflicting IP address issues.



A second application for the spanner allows identical PLCs to exchange information.



A third application allows the user to connect two PLCs (with different subnets) without a router.



Setting the spanner to any of these configurations has been discussed by protocol in the preceding sections.

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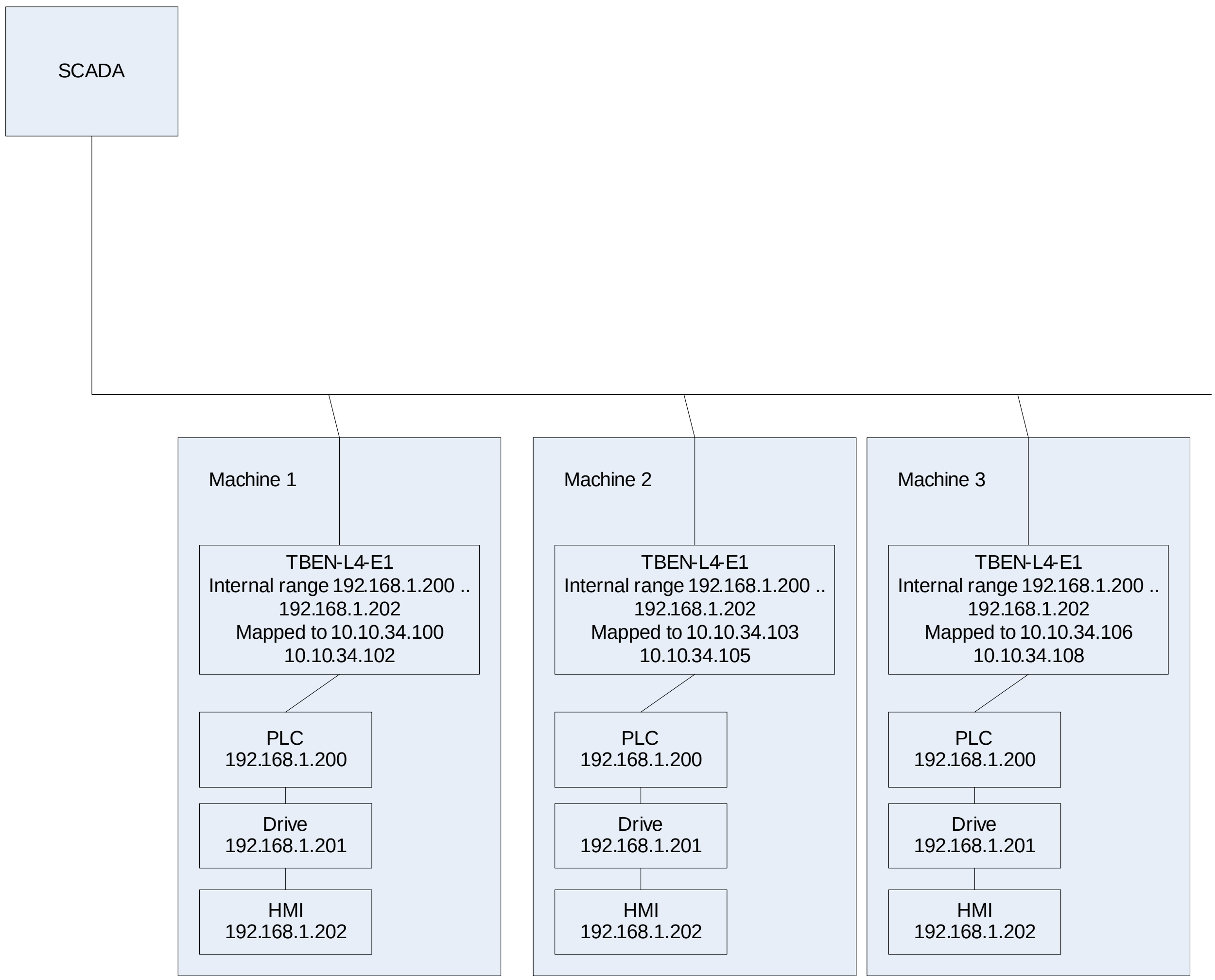
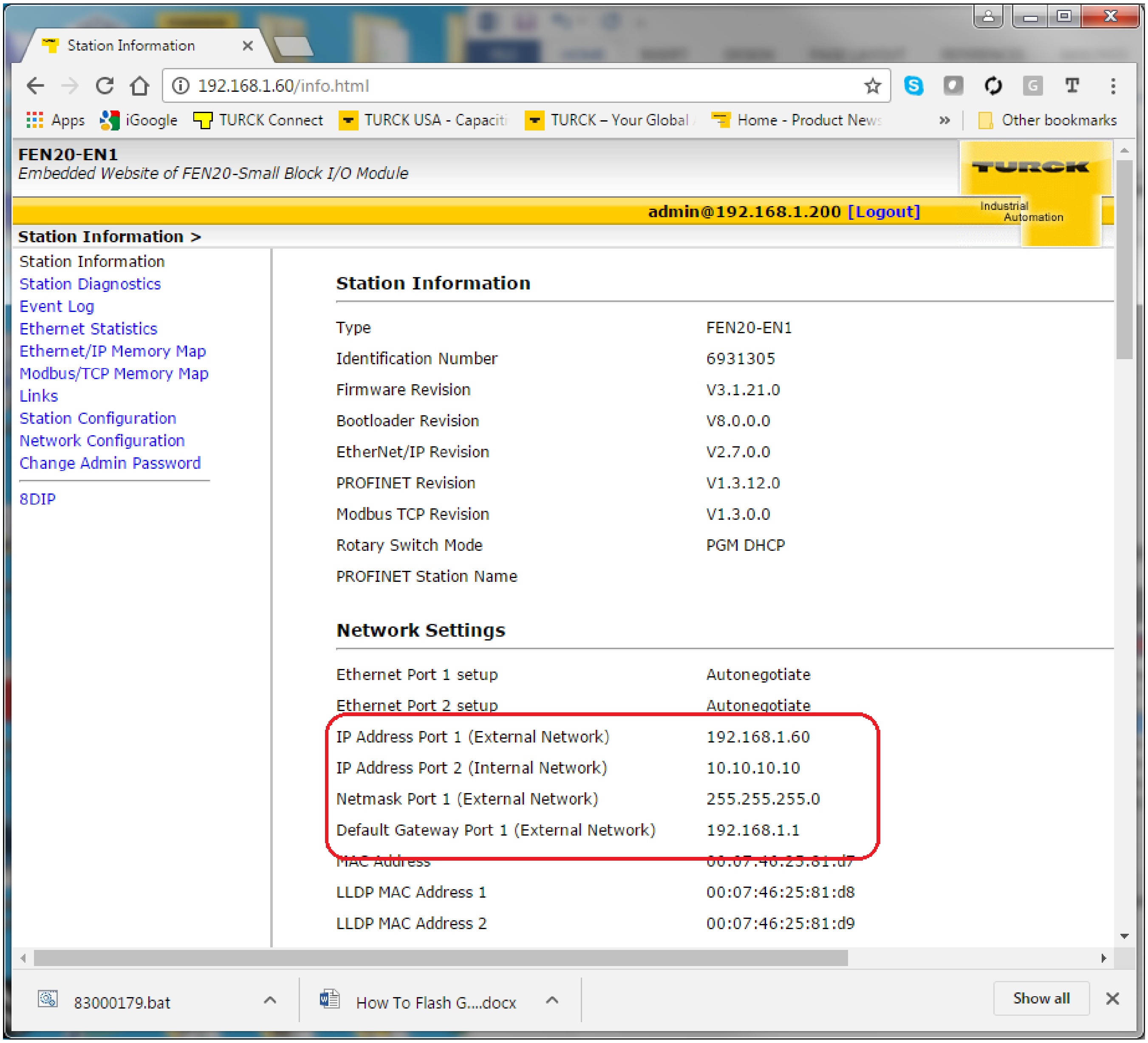
1:1 NAT Mode

In the 1:1 NAT Router a certain range of IP addresses of the internal network (Port 2) are mapped to a range of IP addresses on the external network (Port 1). This way we provide complete network isolation of the in-machine network and yet we allow a number of devices to be accessible outside of the machine (e.g PLC). The NAT device is protocol independent – it just moves IP frames between 2 networks modifying the IP header in some frames.

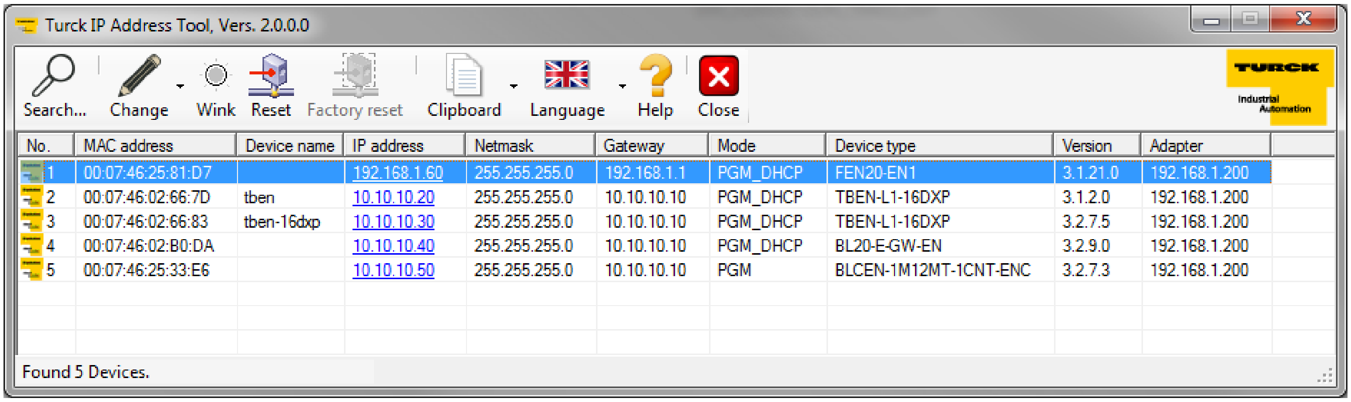


Configure the Spanner for 1:1 NAT Router Mode

Set up the IP Addresses for Port 1, Port 2 and the default gateway in the Spanner.



The following 4 I/O blocks will be mapped to the Spanner internal network. Note the default gateway of each device MSUT be the IP address of Port 2 (the internal port) of the Spanner.



No.	MAC address	Device name	IP address	Netmask	Gateway	Mode	Device type	Version	Adapter
1	00:07:46:25:81:D7		192.168.1.60	255.255.255.0	192.168.1.1	PGM_DHCP	FEN20-EN1	3.1.21.0	192.168.1.200
2	00:07:46:02:66:7D	tben	10.10.10.20	255.255.255.0	10.10.10.10	PGM_DHCP	TBEN-L1-16DXP	3.1.2.0	192.168.1.200
3	00:07:46:02:66:83	tben-16dxp	10.10.10.30	255.255.255.0	10.10.10.10	PGM_DHCP	TBEN-L1-16DXP	3.2.7.5	192.168.1.200
4	00:07:46:02:B0:DA		10.10.10.40	255.255.255.0	10.10.10.10	PGM_DHCP	BL20-E-GW-EN	3.2.9.0	192.168.1.200
5	00:07:46:25:33:E6		10.10.10.50	255.255.255.0	10.10.10.10	PGM	BLCEN-1M12MT-1CNT-ENC	3.2.7.3	192.168.1.200

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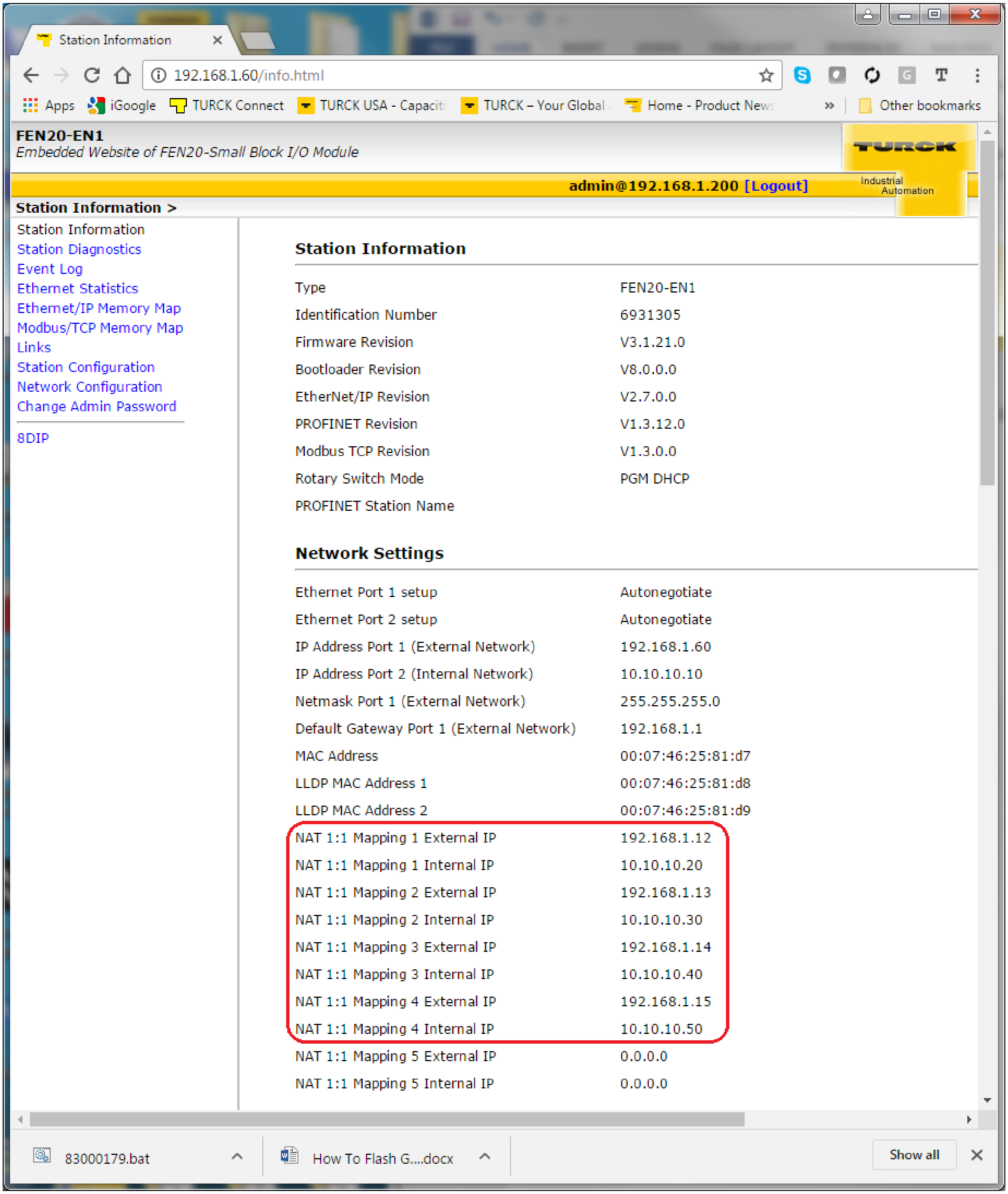
In the Spanner webpage, the blocks on the internal network are mapped to IP addresses on the external network. This is done by logging in as the admin and entering the mappings under ***Network Configuration***.



The stations now respond to requests from the external network. These stations can now be mapped into a PLC or SCADA on the external network.

```
Administrator: C:\Windows\system32\cmd.exe

Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\kyhall>ping 192.168.1.12

Pinging 192.168.1.12 with 32 bytes of data:
Reply from 192.168.1.12: bytes=32 time=4ms TTL=128
Reply from 192.168.1.12: bytes=32 time=2ms TTL=128
Reply from 192.168.1.12: bytes=32 time=2ms TTL=128
Reply from 192.168.1.12: bytes=32 time=2ms TTL=128

Ping statistics for 192.168.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 2ms

C:\Users\kyhall>ping 192.168.1.13

Pinging 192.168.1.13 with 32 bytes of data:
Reply from 192.168.1.13: bytes=32 time=4ms TTL=128
Reply from 192.168.1.13: bytes=32 time=2ms TTL=128
Reply from 192.168.1.13: bytes=32 time=2ms TTL=128
Reply from 192.168.1.13: bytes=32 time=2ms TTL=128

Ping statistics for 192.168.1.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 2ms

C:\Users\kyhall>ping 192.168.1.14

Pinging 192.168.1.14 with 32 bytes of data:
Reply from 192.168.1.14: bytes=32 time=4ms TTL=128
Reply from 192.168.1.14: bytes=32 time=2ms TTL=128
Reply from 192.168.1.14: bytes=32 time=2ms TTL=128
Reply from 192.168.1.14: bytes=32 time=2ms TTL=128

Ping statistics for 192.168.1.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 2ms

C:\Users\kyhall>ping 192.168.1.15

Pinging 192.168.1.15 with 32 bytes of data:
Reply from 192.168.1.15: bytes=32 time=4ms TTL=128
Reply from 192.168.1.15: bytes=32 time=2ms TTL=128
Reply from 192.168.1.15: bytes=32 time=2ms TTL=128
Reply from 192.168.1.15: bytes=32 time=2ms TTL=128

Ping statistics for 192.168.1.15:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 2ms

C:\Users\kyhall>_
```