3D INSPECTION MACHINE

RF096.2D-100/410-305 Series

User's manual

Contents

2

1. Safety precautions

- Use supply voltage and interfaces indicated in the machine specifications.
- In connection/disconnection of cables, the machine power must be switched off.
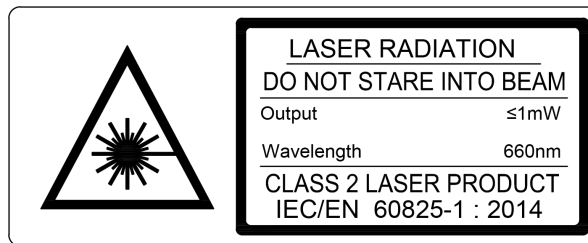- Do not use the machine in locations close to powerful light sources.

2. CE compliance

The machine has been developed for use in industry and meets the requirements of the following Directives:

- EU directive 2014/30/EU. Electromagnetic compatibility (EMC).
- EU directive 2011/65/EU, "RoHS" category 9.

3. Laser safety

The machine makes use of an c.w. 660 nm wavelength semiconductor laser. Maximum output power is 1 mW. The machine belongs to the 2 laser safety class according to IEC/EN 60825-1:2014. The following warning label is placed on the housing:

```
┌────────────────────────────────────┐
│  ⚠    LASER RADIATION              │
│      DO NOT STARE INTO BEAM        │
│      Output            ≤1mW         │
│      Wavelength        660nm        │
│      CLASS 2 LASER PRODUCT          │
│      IEC/EN  60825-1 : 2014         │
└────────────────────────────────────┘
```

The following safety measures should be taken while operating the machine:

- Do not target the laser beam to humans.
- Do not disassemble the laser sensor.
- Avoid staring into the laser beam.

4. General information

The machine is designed for non-contact measurement of geometric parameters of steel band rims used in the tire industry. Measurement method: laser scanning.

5. Basic technical data

Parameter	Value
ID measuring range, mm	100…410
Rim height range, mm	70…305
Measured parameters	average, maximum and minimum diameter; roundness (all in programmable positions along the workpiece height); height; width and angle of chamfers
Measurement error, mm	±0.05
Light source	red semiconductor laser, 660 nm wavelength
Laser safety class	2M (IEC60825-1)
Interface	Ethernet and PROFINET
Power supply, V	220
Measurement time, s	<20
Weight, kg	47

Note: Machine parameters can be changed for a specific task.

6. Example of item designation when ordering

RF096.2D-Dmin/Dmax-L

Symbol	Description
Dmin/Dmax	ID measuring range, mm.
L	Measured hole depth, mm.

Example: RF096.2D-100/410-305 - 3D Inspection Machine, ID measuring range - 100...410 mm, measured hole depth - up to 305 mm.

7. Structure and operating principle

4

The operation of the machine is based on the principle of scanning the inner surface of the hole with a rotating 2D triangulation laser sensor RF627 Series. Overall dimensions of the laser sensor:
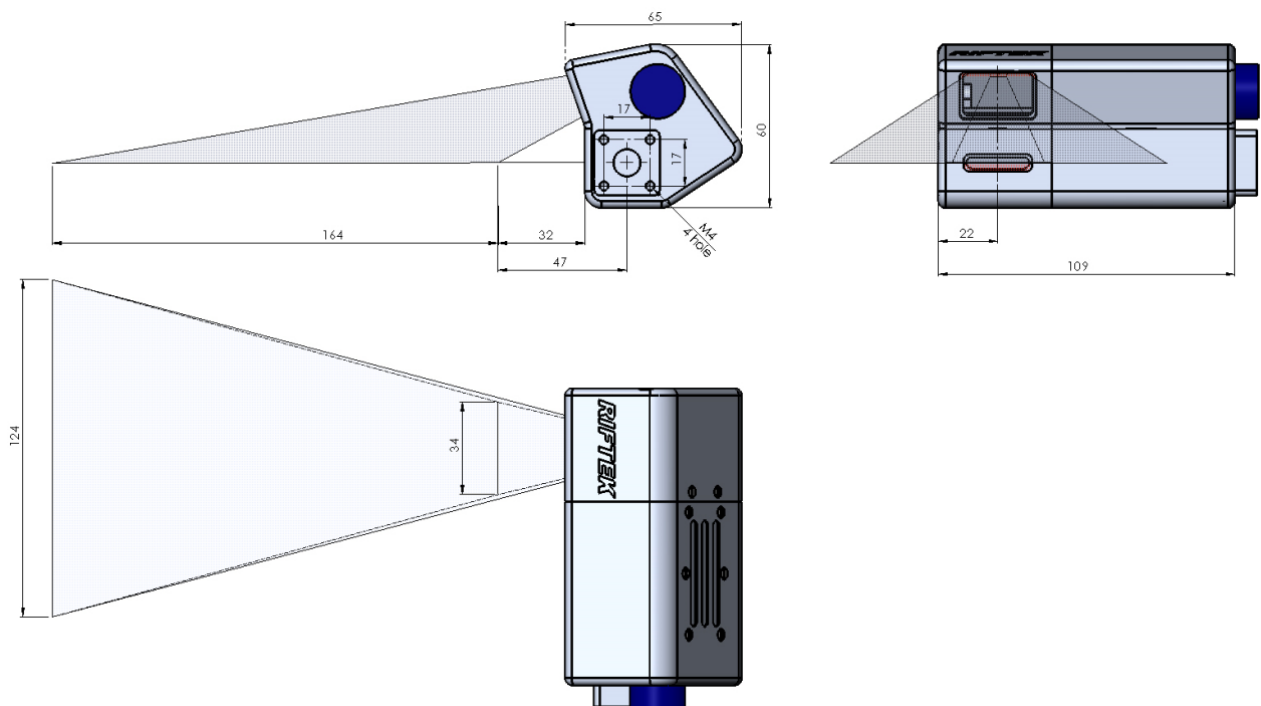
The machine contains a main frame on which the linear movement system, the controller and the interface module are installed. The linear movement system carries the rotation module on which the 2D laser sensor is mounted. On the back of the machine, there are three connectors for connecting power and interfaces, as well as a power button.
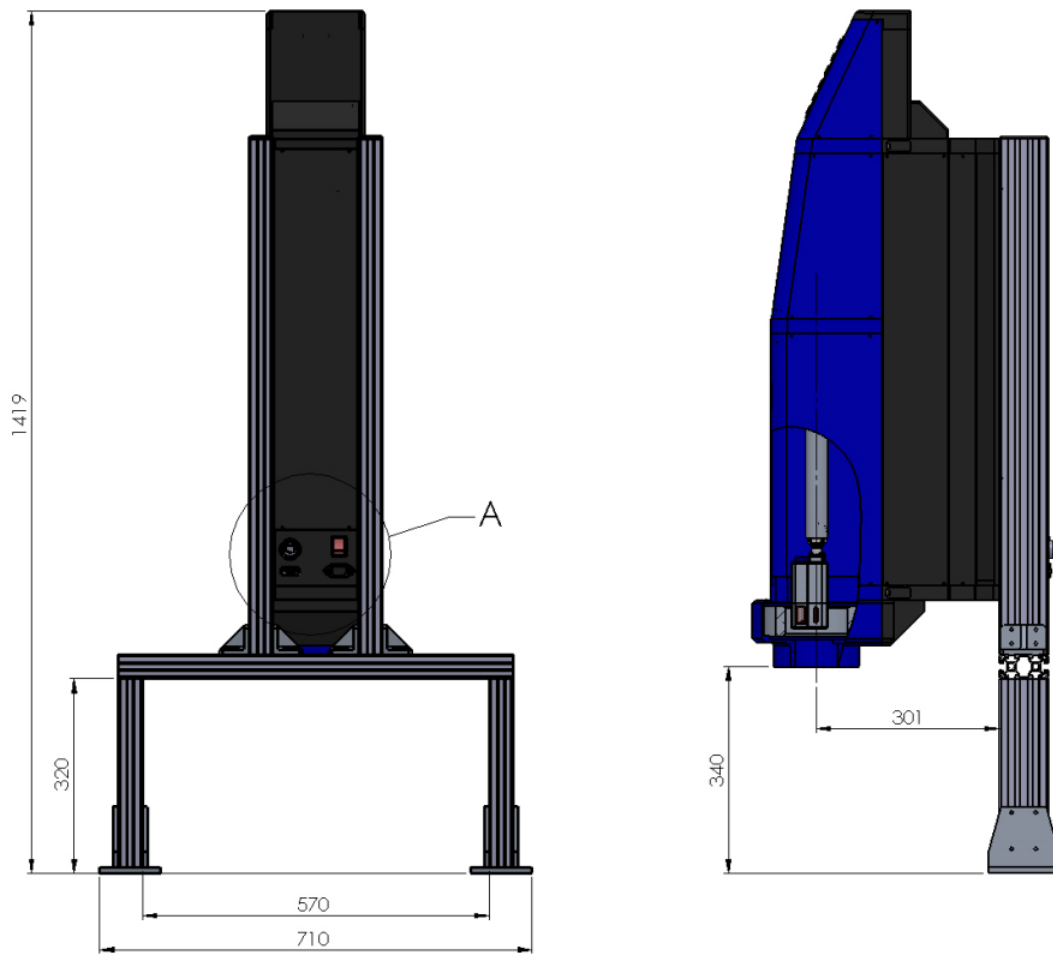
The machine operates as follows.

The part to be measured is installed on the same axis with the sensor rotation system. At the command of the external controller, the laser sensor moves into the measured hole. The sensor starts rotating and scans the inner surface of the part. The controller transmits the polar coordinates of the surface (distance from the axis of rotation measured by the sensor and the corresponding angle of rotation) to the computer to calculate the required geometric parameters. The results are transmitted to the external controller via PROFINET.

Video demonstration: https://youtu.be/gfMf7hBrpqU

8. Connection

- Connect the machine to the computer.
- Connect the power cable to the machine.
- Connect the machine to 24V DC by using the special power cable.

The block diagram is shown below. In this diagram, the I-7580 module is the PROFINET IO device, and the PLC is the S7-1200 controller from Siemens. The configuration is carried out using the "Step 7 V11" software from Siemens.
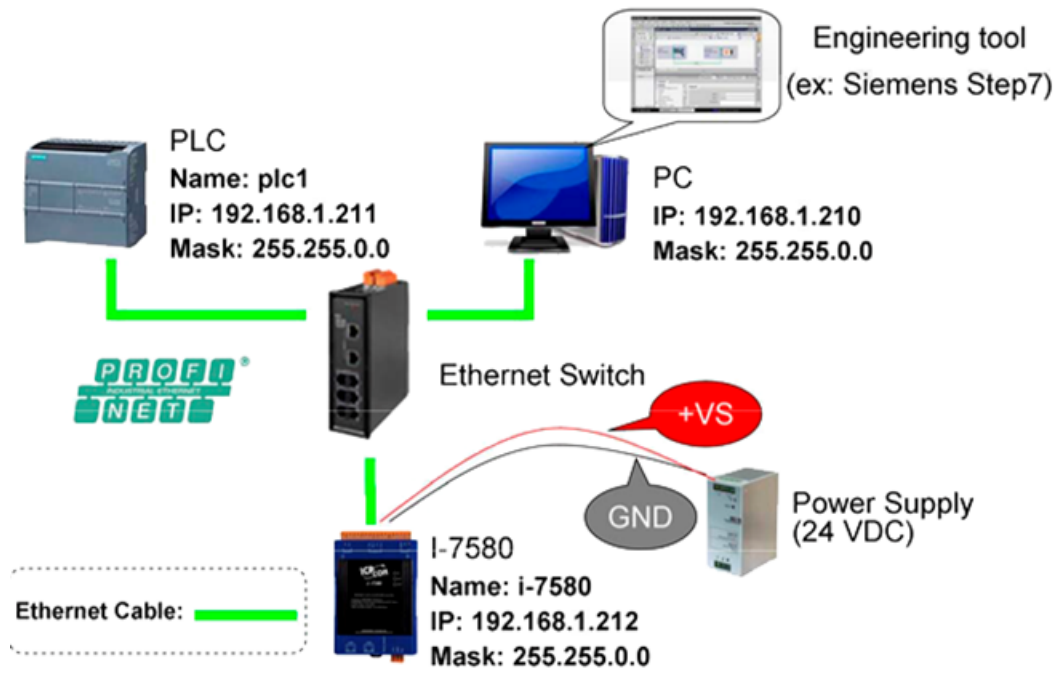
9.   Network configuration

Configure the network as shown below:

PC	PLC	I-7580
–	Device name: PLC_1	Device name: i-7580
IP: 192.168.1.210	IP: 192.168.6.211	IP: 192.168.1.212
Mask: 255.255.0.0	Mask: 255.255.0.0	Mask: 255.255.0.0

9.1.   PC

1. Select **Start Menu** > **Control Panel** > **Network and Sharing Center**. (For Windows 8 and higher, search for **Control Panel**, and select **Network and Internet**).
2. Click **Change adapter settings**.
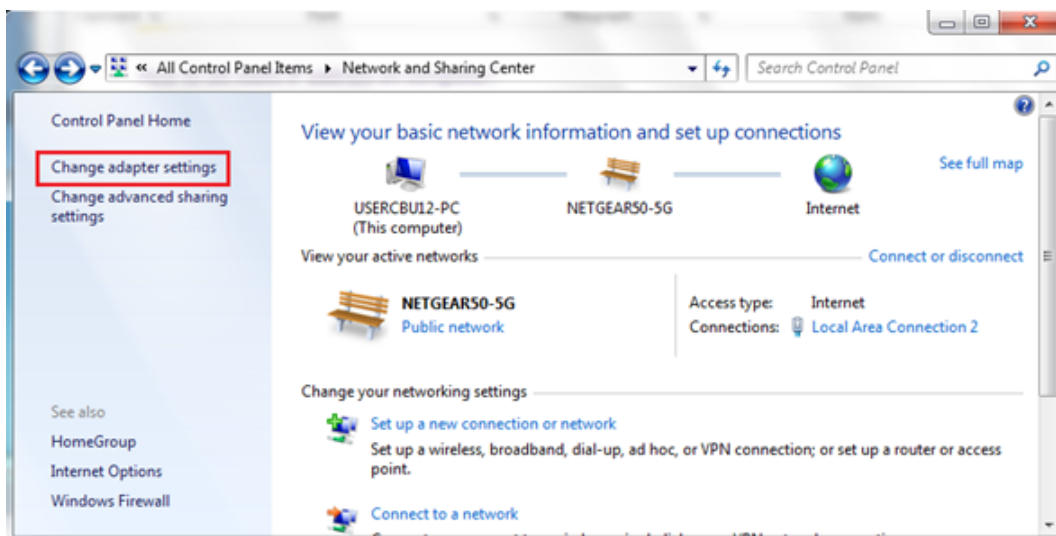
3. Right-click on **Local Area Connection** and select **Properties**.
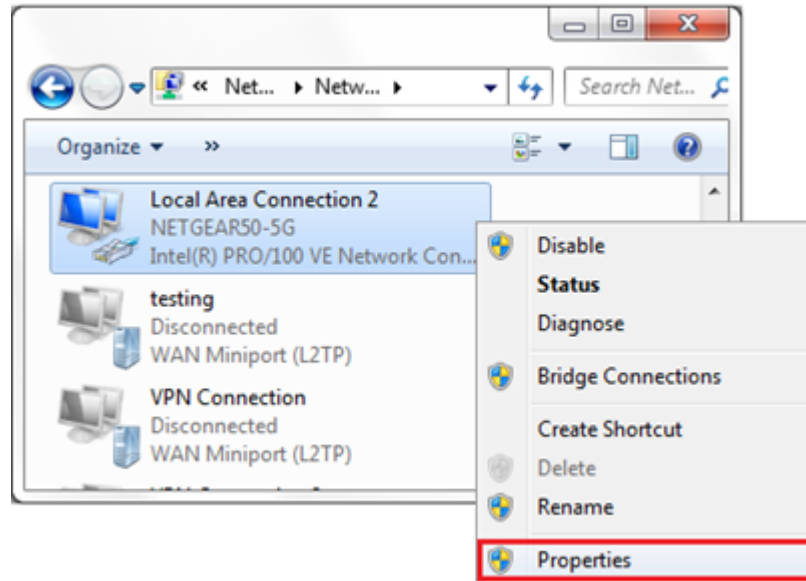
4. Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
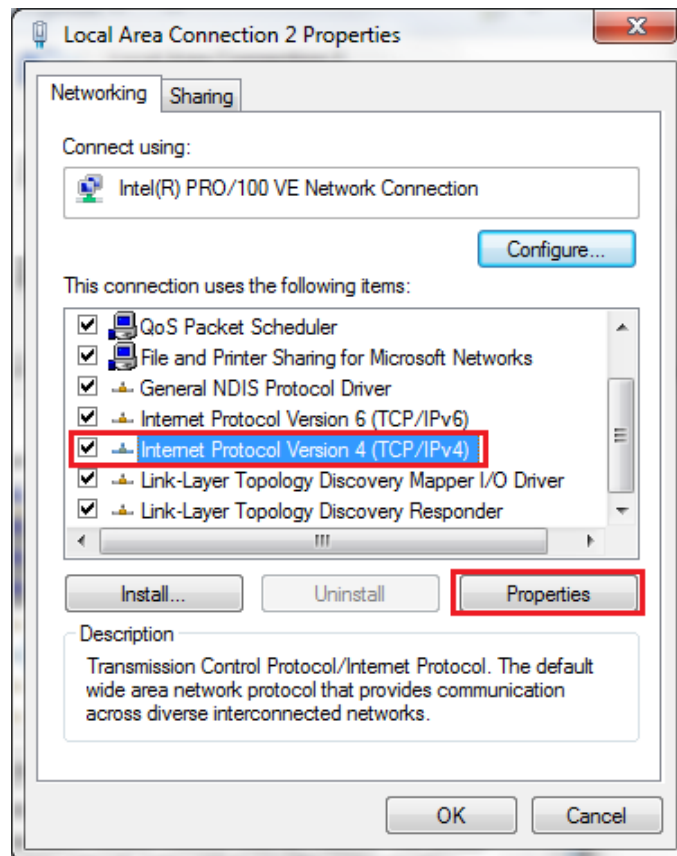
5. Select **Use the following IP address** and enter the IP address, Subnet mask, Default gateway and DNS server.

Click **OK** and close the **Local Area Connection Properties** window.
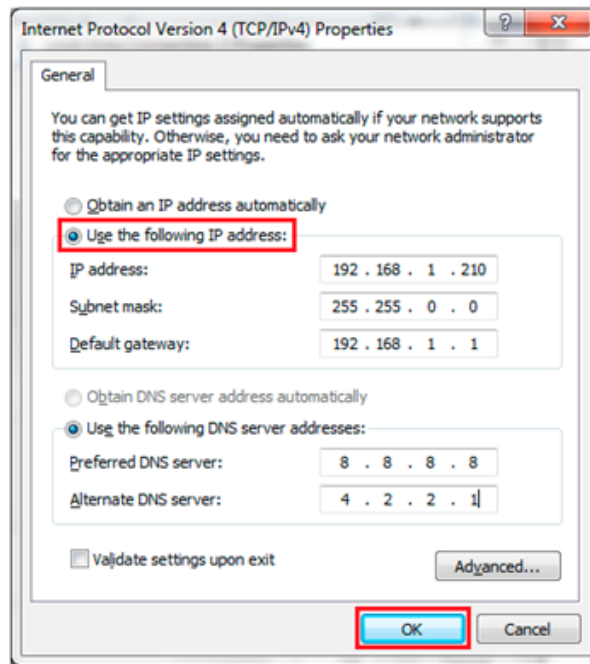
9.2. PLC

1. Double-click the **TIA** icon to start the **Step 7 V11** software.

2. Click **Project view**.
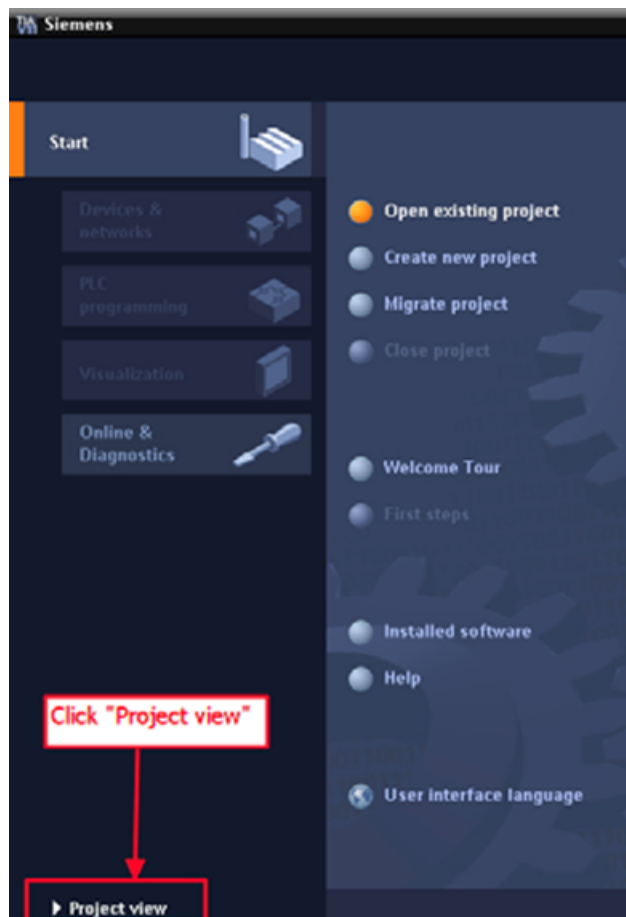
3. Search for accessible devices.
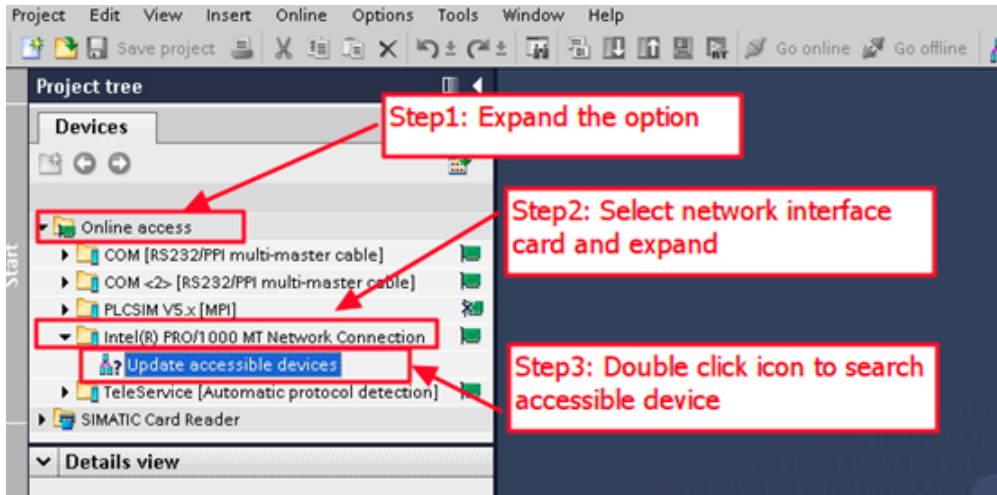
4. Select **PLC** and click the **Online & diagnostics** button.
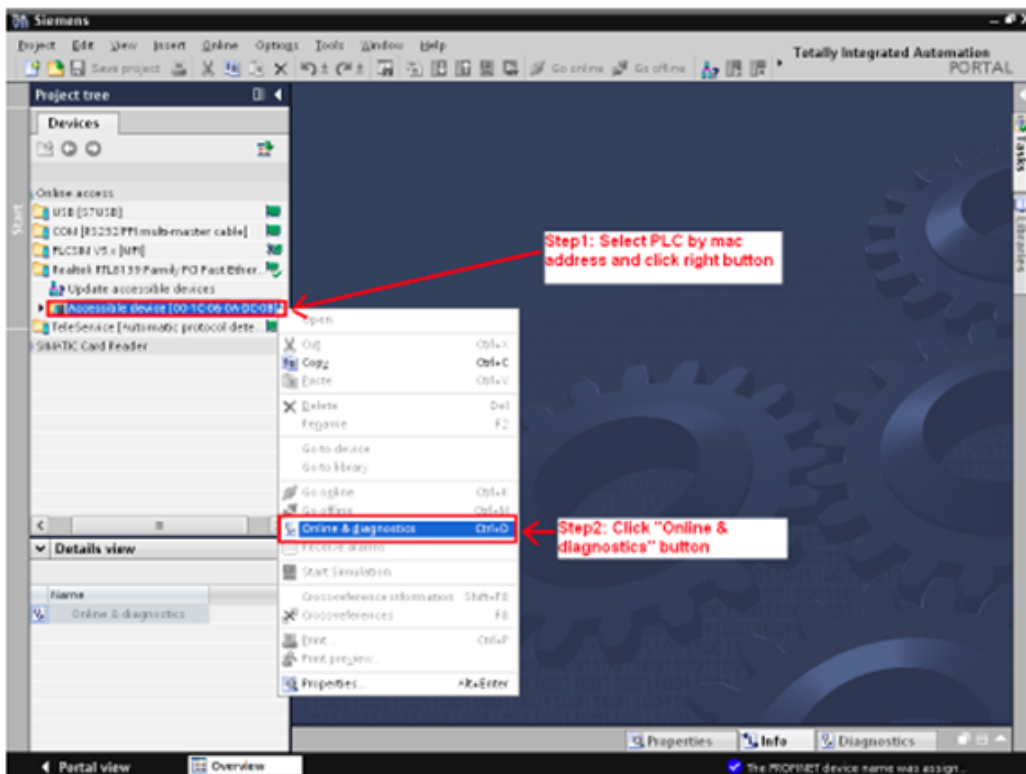
5. Set the IP address and the subnet mask.
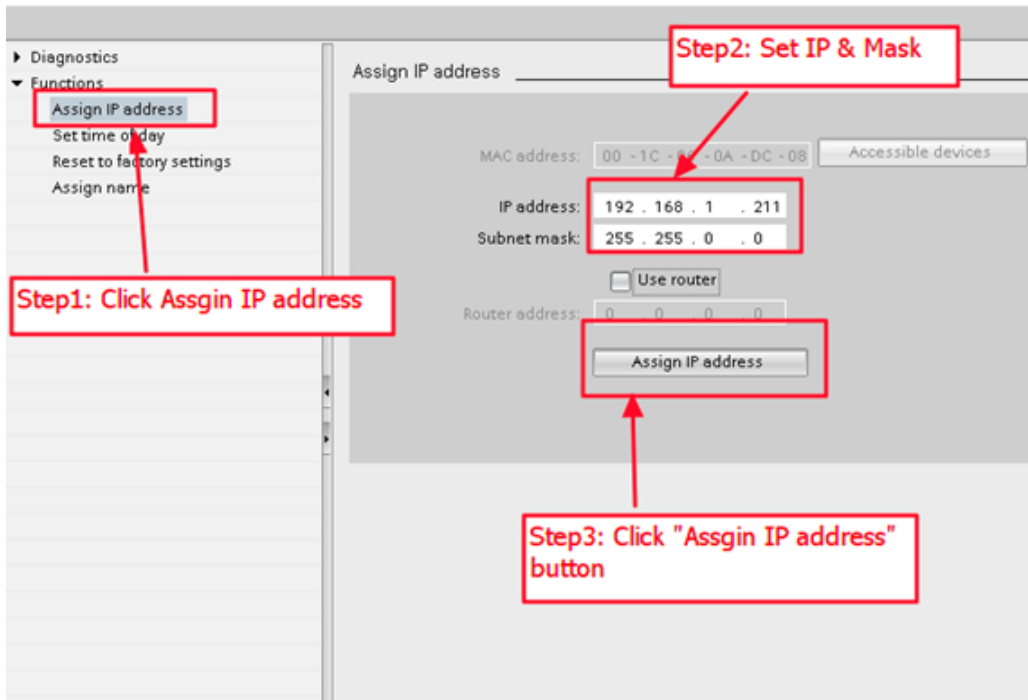
6. Set the device name.
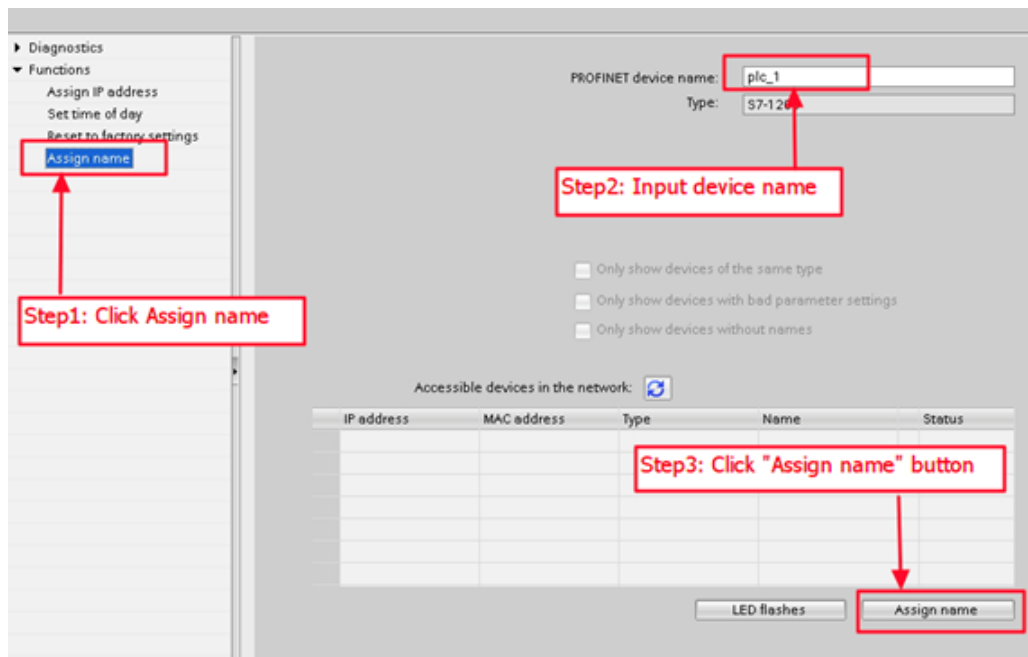
9.3. I-7580

1. Search for accessible devices.
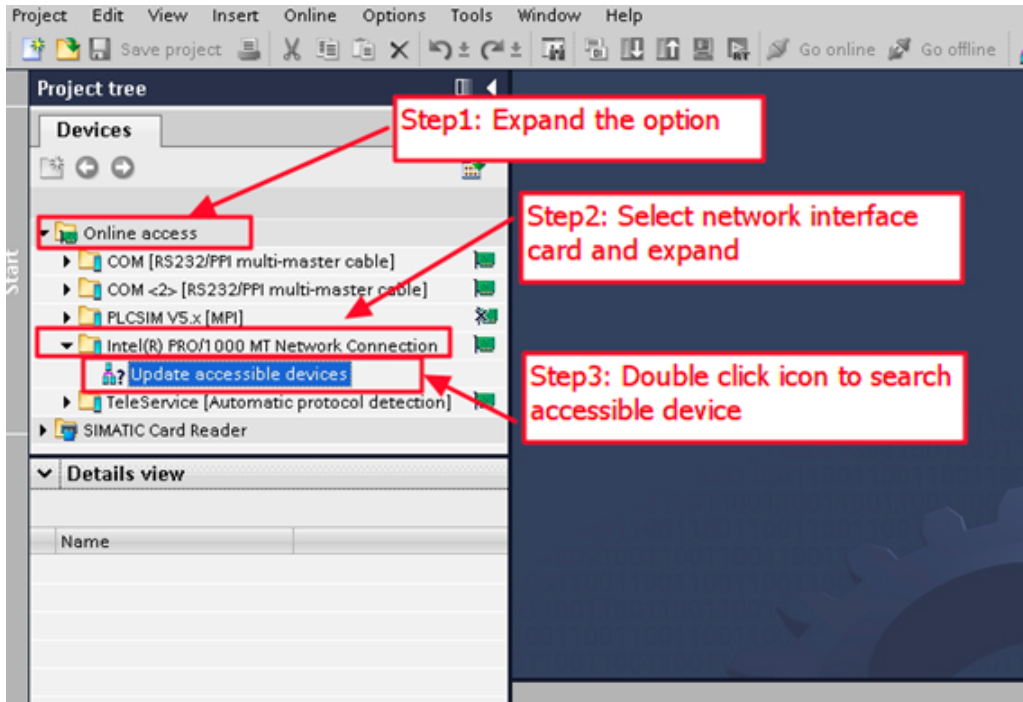
2. Select the I-7580 module and click the **Online & diagnostics** button.
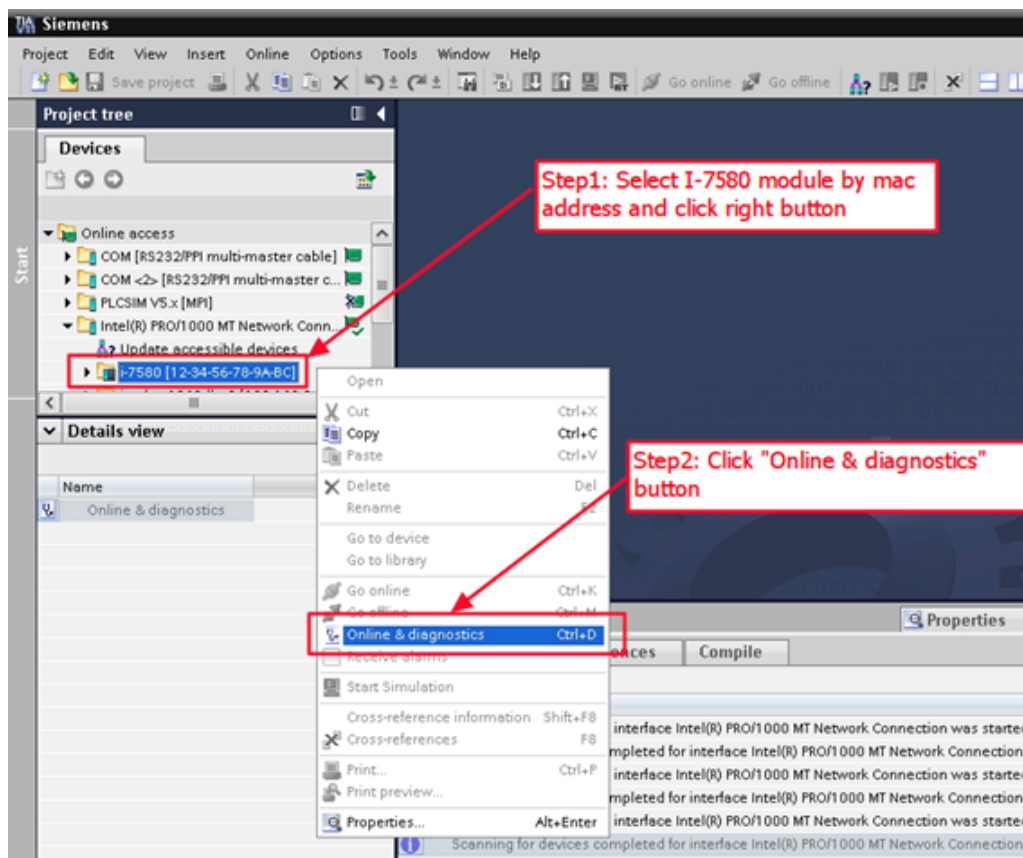
3. Set the IP address and the subnet mask.
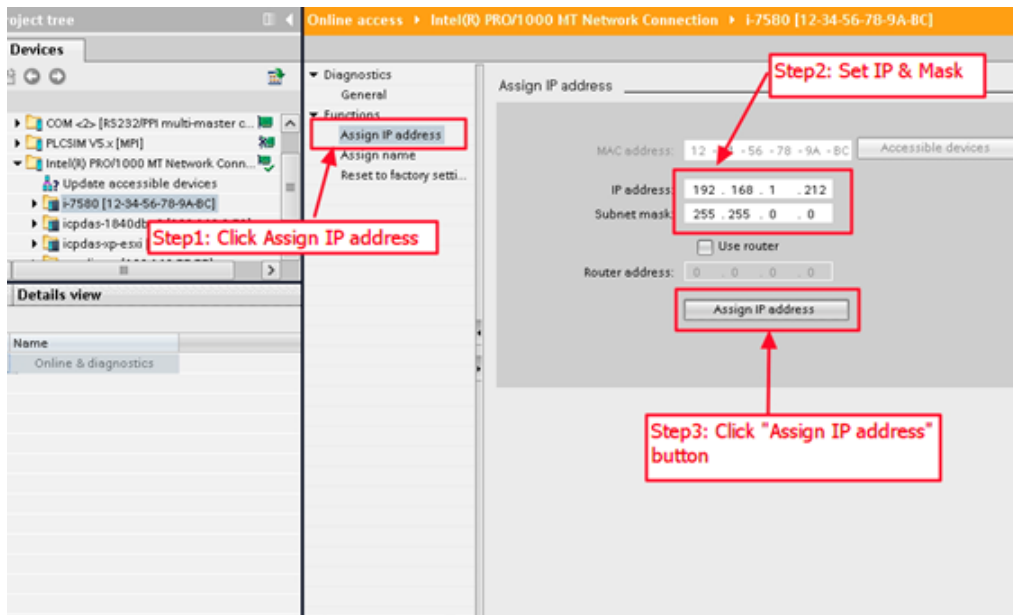
4. Set the device name.
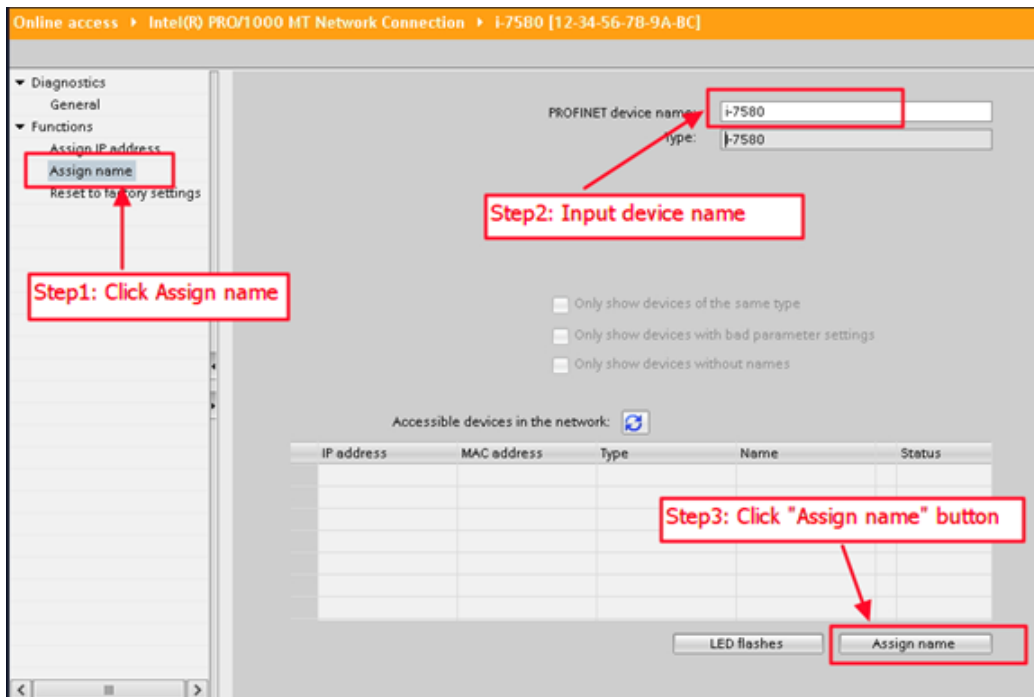
10.   GSD import

Please follow the steps to import the GSD file:

Step 1: Get the GSD file

The GSD file can be downloaded from the FTP site:
ftp://ftp.icpdas.com/pub/cd/fieldbus_cd/profinet/converter/i-7580/gsd/

Step 2: Import the GSD file

1. Double-click the **TIA** icon to start the **Step 7 V11** software.

2. Click **Project view**.
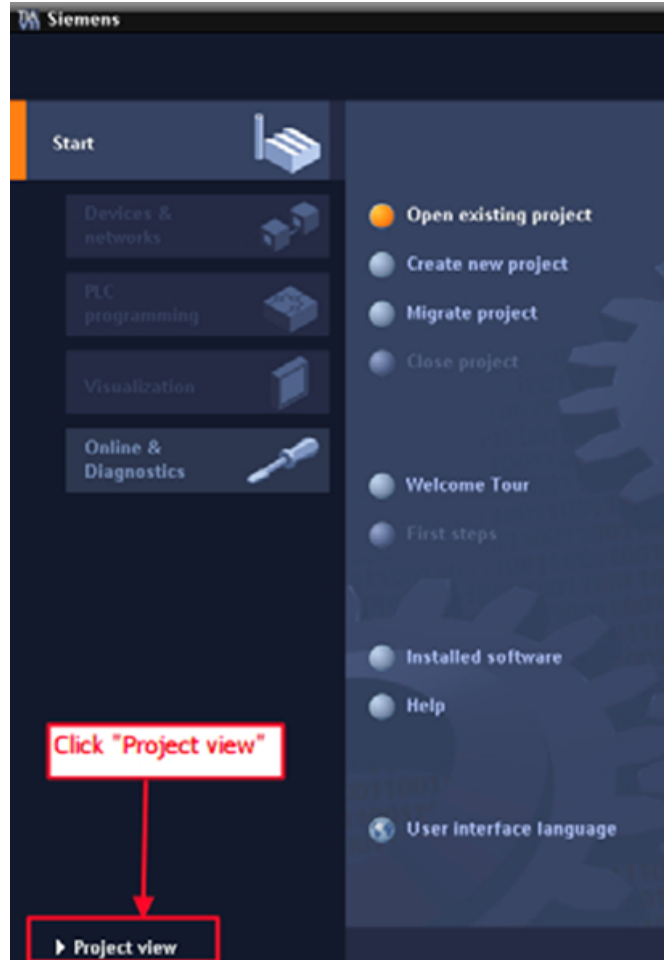
3. Select **Menu > Options > Install general station description file (GSD)**.
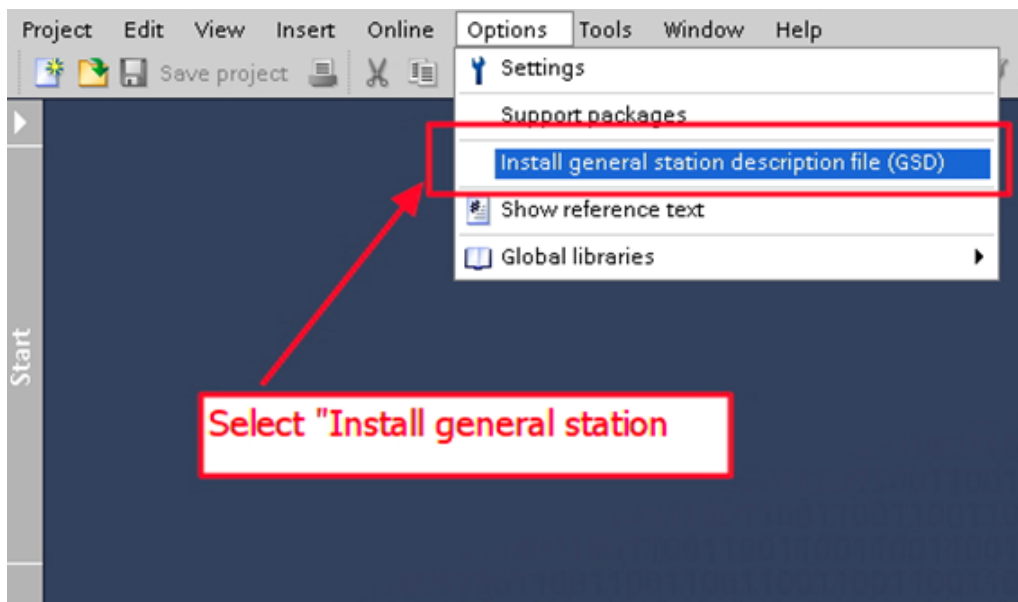
4. Select and install the GSD file.
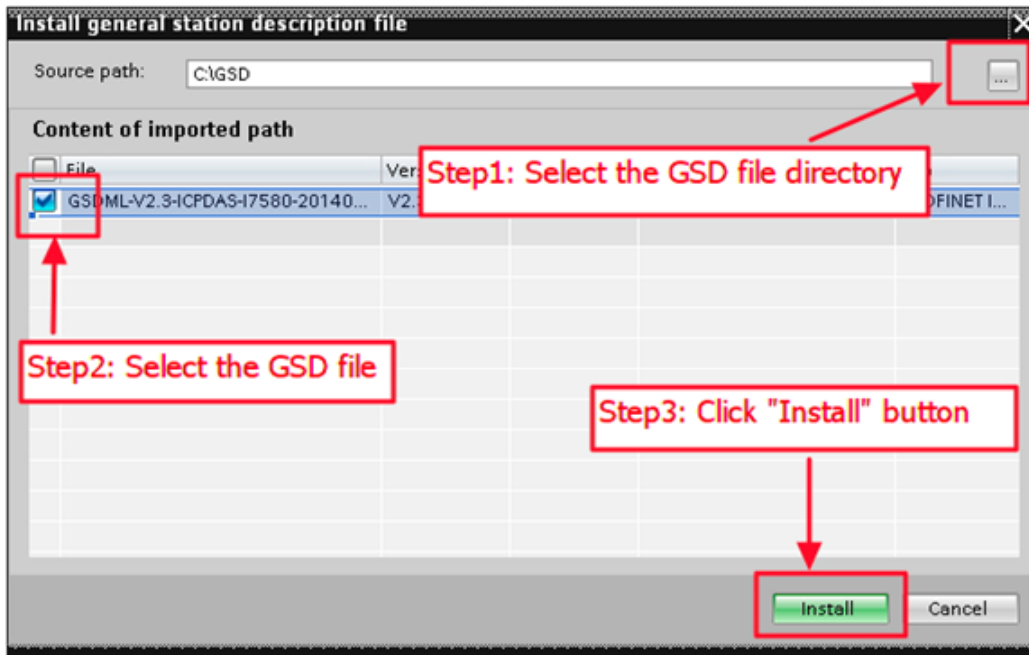
11. Project setup

Please follow the steps to set up the project:

Step 1: Create the project

1. Double-click the **TIA** icon to start the **Step 7 V11** software.

2. Create the project.
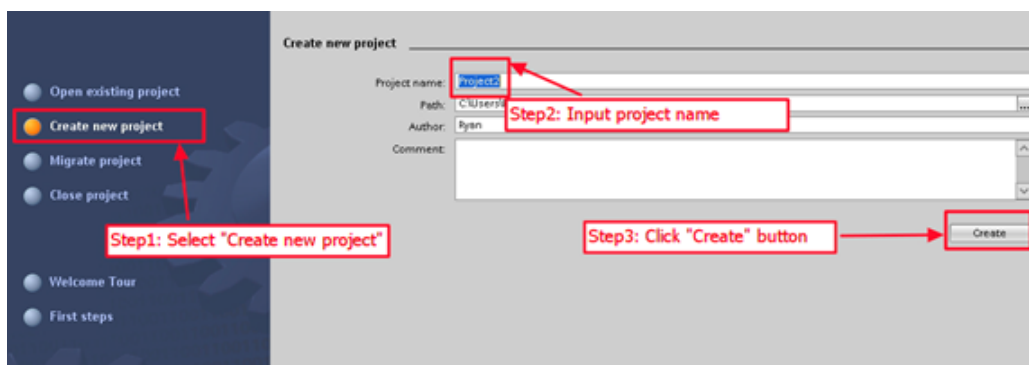
Step 2: Project configuration

1. Add the PLC device.
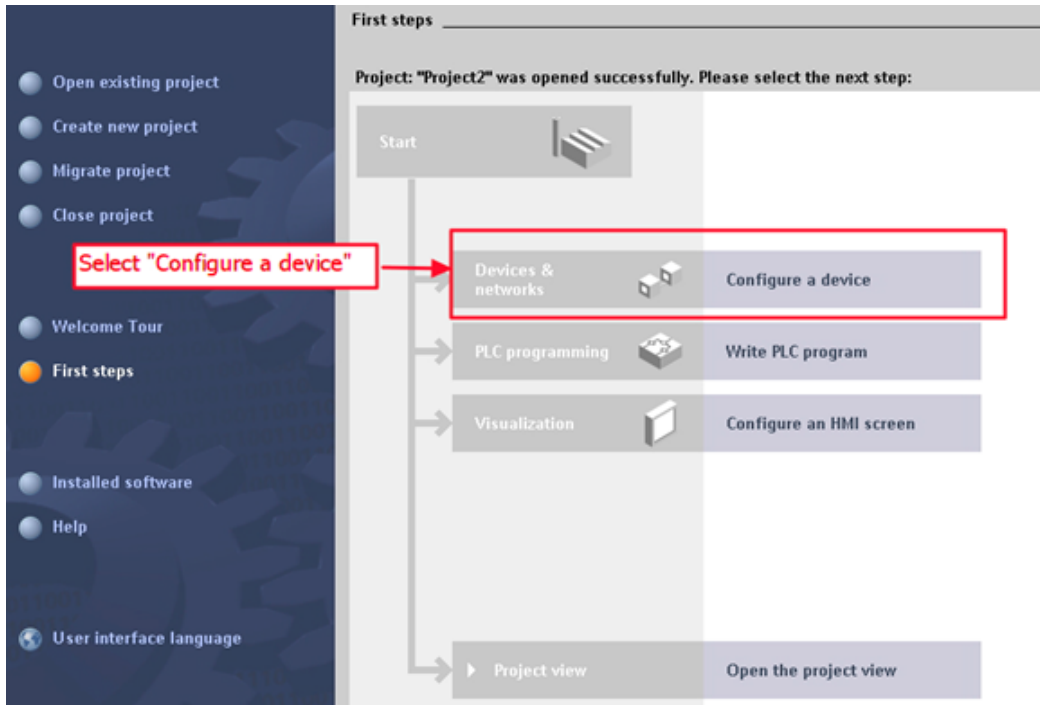
2. Select **Add new device**.

3. Set the PLC name as «PLC_1».

Step1: Select "Properties"

Step2: Select "General"

Step3: Input device name

16
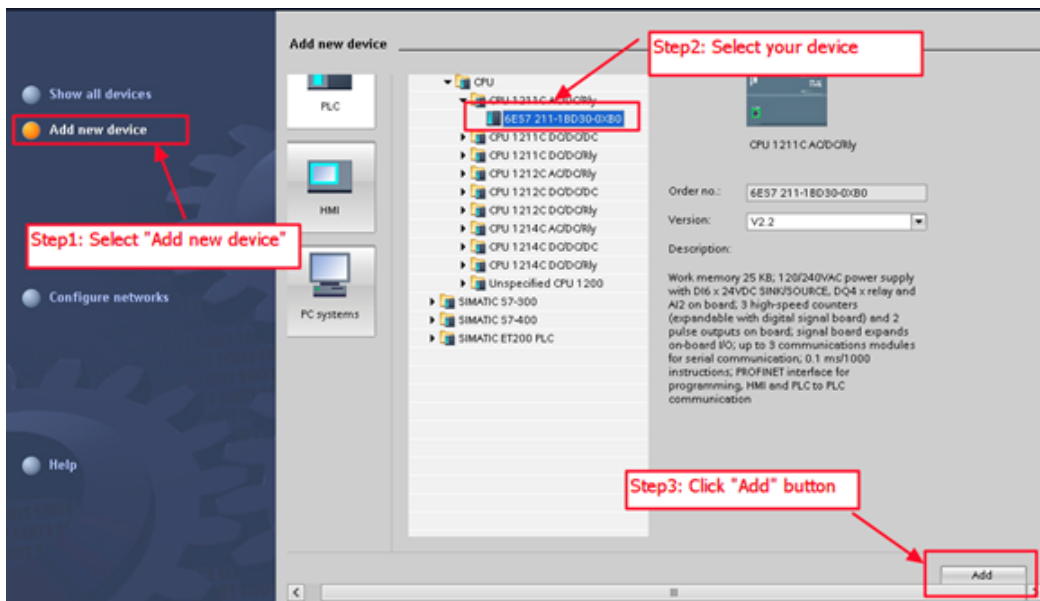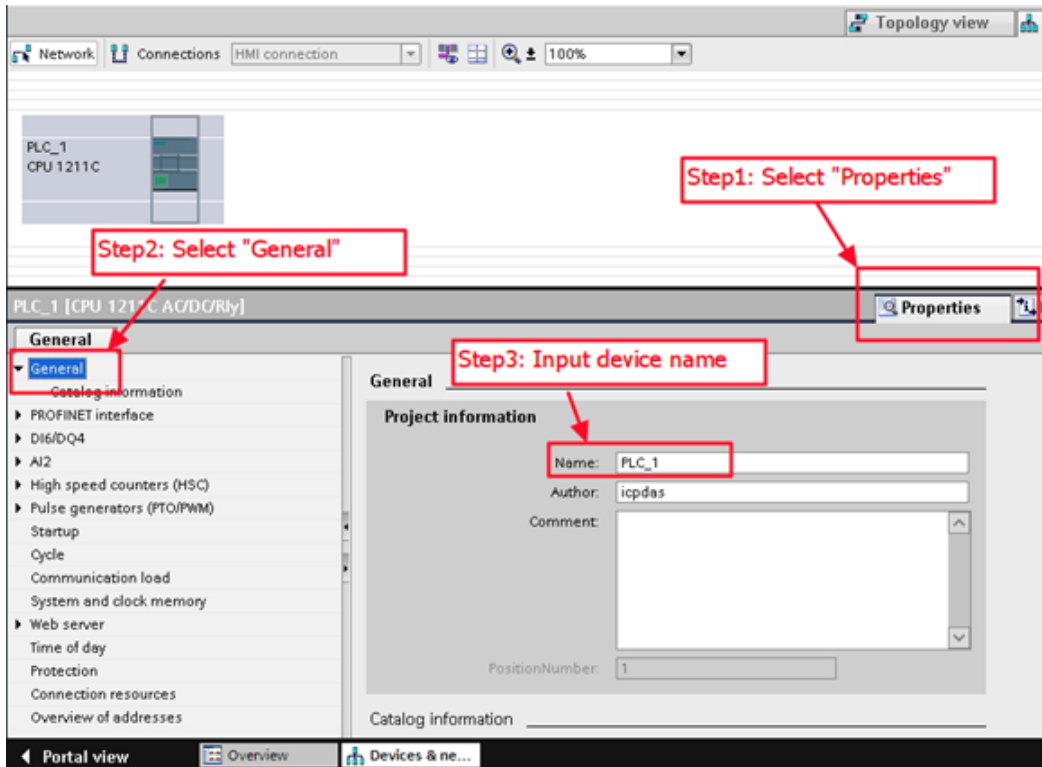
4. Set the IP address and the subnet mask for PLC and add the new subnet.

Step1: Select "PROFINET interface" -> "Ethernet addresses"

Step2: Click "Add new subnet" button

Step3: Set IP & Mask

5. Add the I-7580 module.
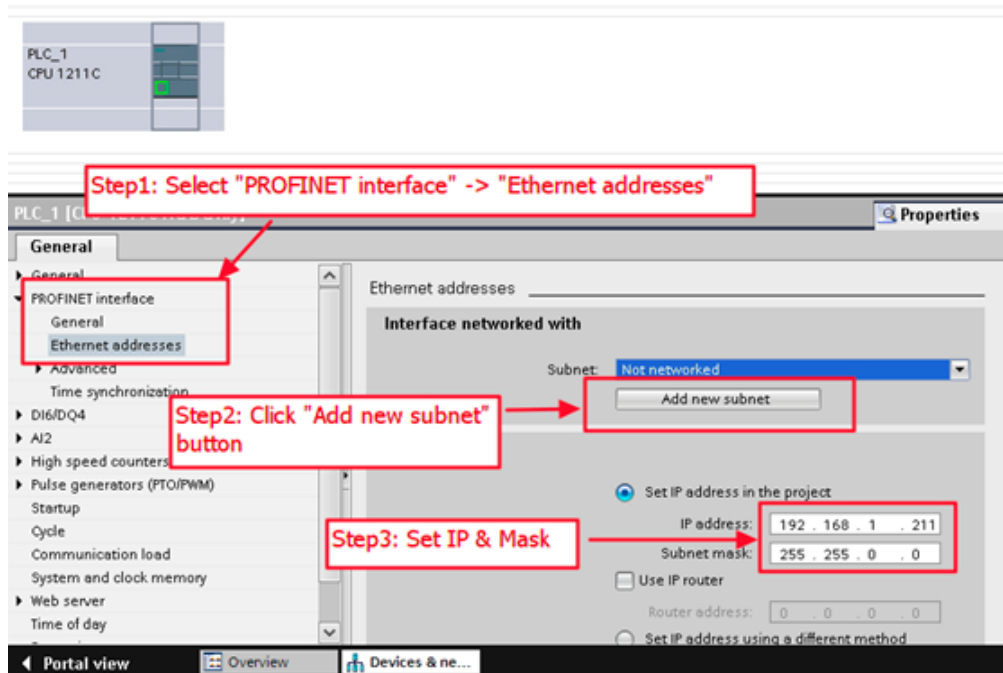
Double click I-7580 icon to add this device
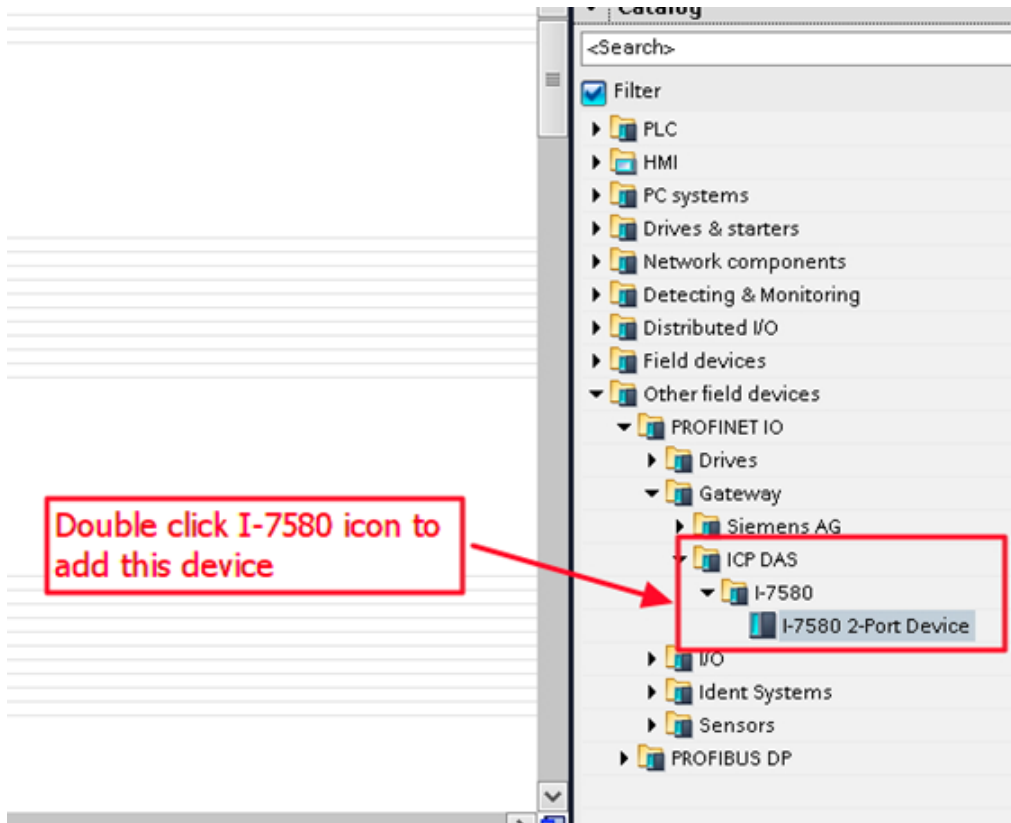
6. Select the PROFINET interface.

Step1: Click "Not assigned"

Step2: Select "PLC_1.PROFINET interface_1"
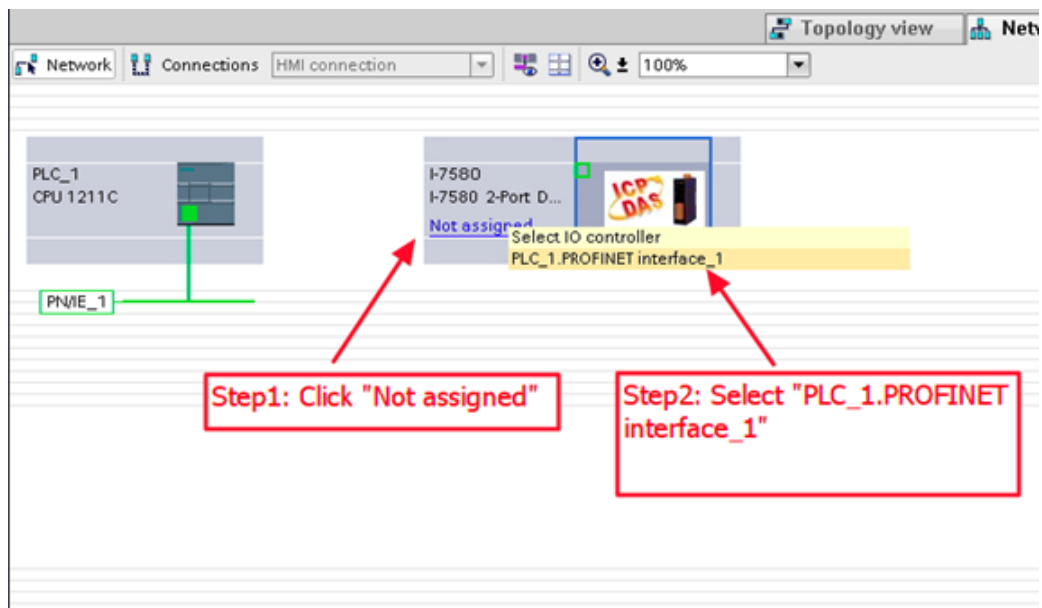
7. Set the device name as «I-7580».

Step1: Click I-7580 icon

Step2: Select "General"

Step3: Input device name
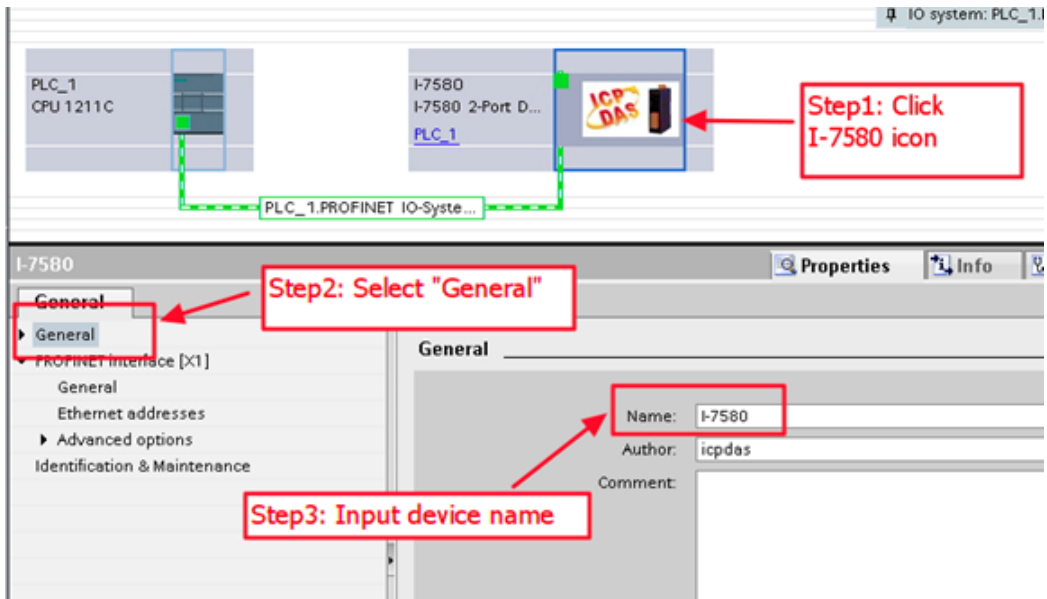
8. Set the IP address for the I-7580 module.

Step1: Select "PROFINET interface" -> "Ethernet addresses"

Step2: Input IP address
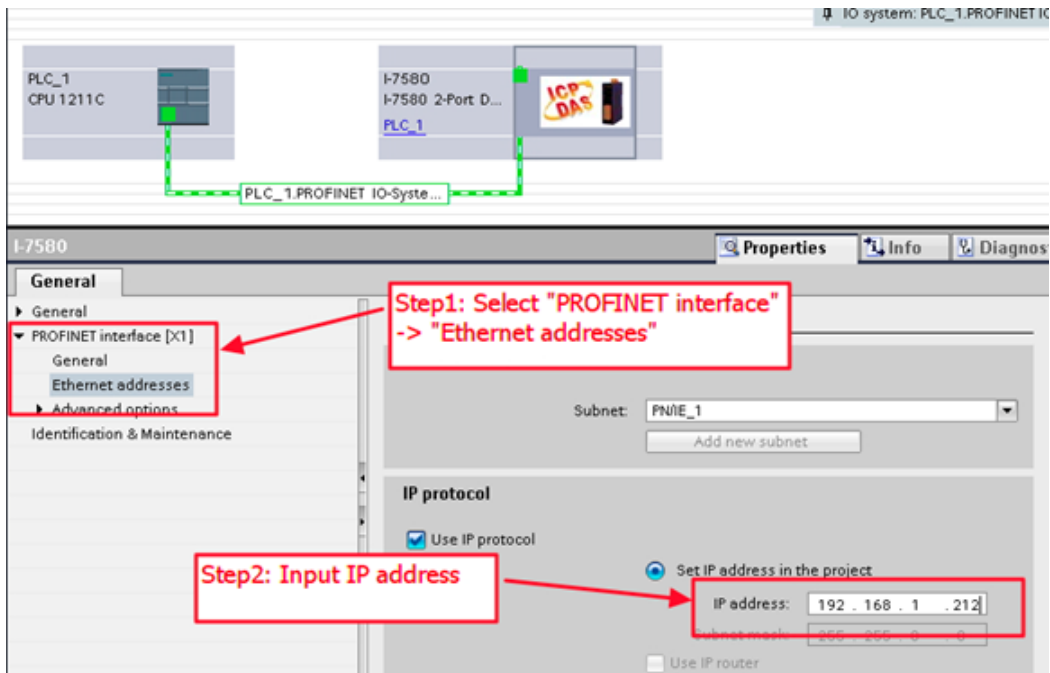
9. Set the module type for the I-7580 module.

Step1: Select "Device view"

Step2: Select module type and double click this icon to add module
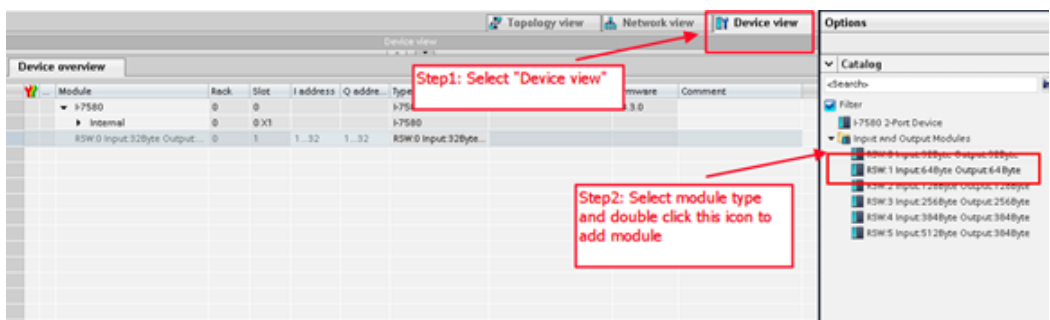
10. Set parameters for the I-7580 module.
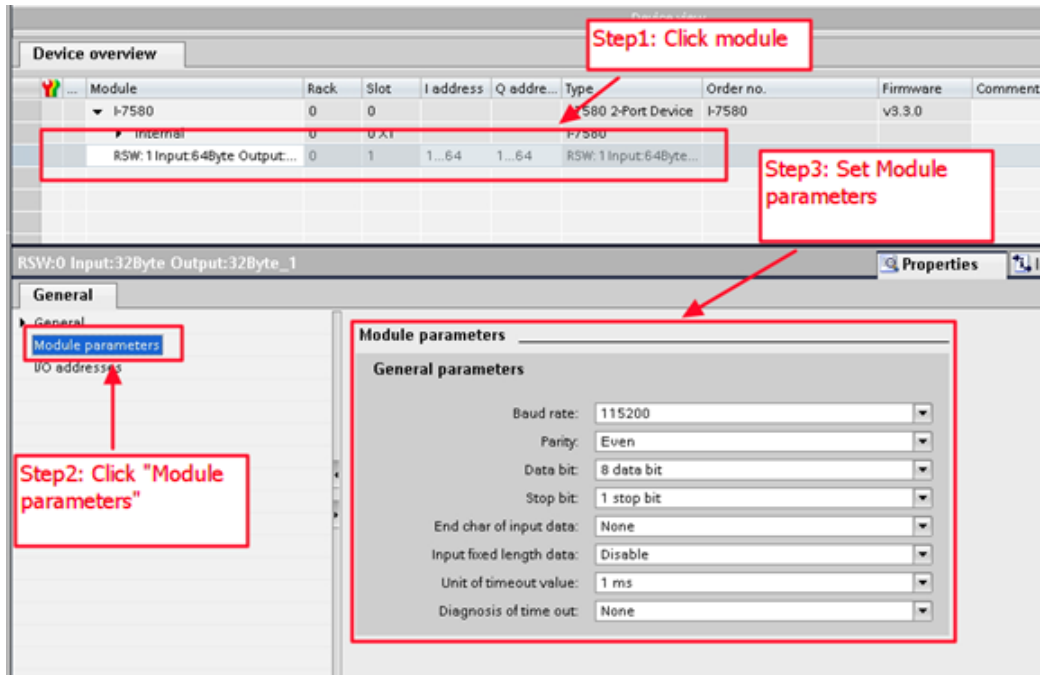
11. Compile and download to the device.

Click "Load" button

Step1: Select "Start all"

Step2: Click "Finish" button

PLC_1
CPU 1211C

I-7580
I-7580 2-Port D...
PLC_1

PN/IE_1

Network data

Properties | Info

General | Cross-references | Compile

!	Message	Date	Ti
✓	Project S7-1200_I-7580_001 opened.		1
ℹ	▼ Start downloading to device.		1
ℹ	▼ PLC_1		1
✓	▼ Hardware configuration		1
✓	Hardware configuration was loaded successfully.		1
ℹ	The software has not been loaded, because it is up-to-date.		1
✓	Connected to PLC_1, Address IP=192.168.6.211.		1
✓	Connection to PLC_1 terminated.		1
✓	Connected to PLC_1, Address IP=192.168.6.211.		1
✓	Connection to PLC_1 terminated.		1
✓	Loading completed (errors: 0; warnings: 0).		1

Download completed and no error

12. Communication

12.1. Communication sequence

The I-7580 module contains 4 buffers:
- PROFINET IO device input buffer.
- PROFINET IO device output buffer.
- COM port input buffer.
- COM port output buffer.

The PROFINET IO controller contains 2 buffers:
- PROFINET IO controller input buffer.
- PROFINET IO controller output buffer.

In the I-7580 module, data is transferred from the COM port input buffer to the PROFINET IO device output buffer, and from the PROFINET IO device input buffer to the COM port output buffer. The data flow is illustrated below.
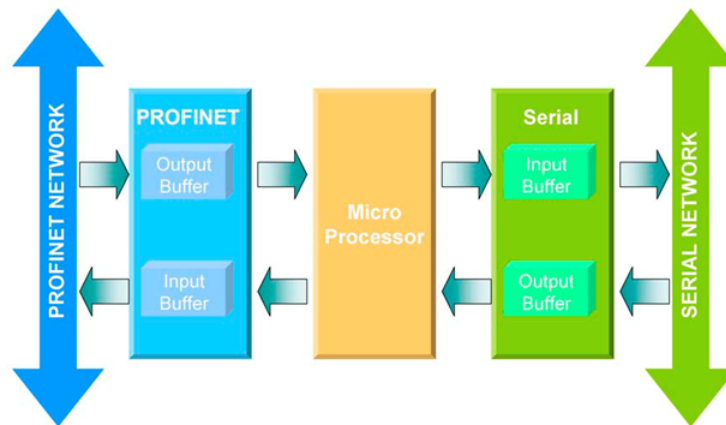
During each message cycle, the PROFINET IO controller writes the content of its output buffer to the PROFINET IO device input buffer and reads the content of the PROFINET IO device output buffer to its input buffer. The exchange cycle is taking place even though the content of the PROFINET IO controller and PROFINET IO device output buffer has not changed. The data flow between the PROFINET IO controller and the I-7580 module is shown below.
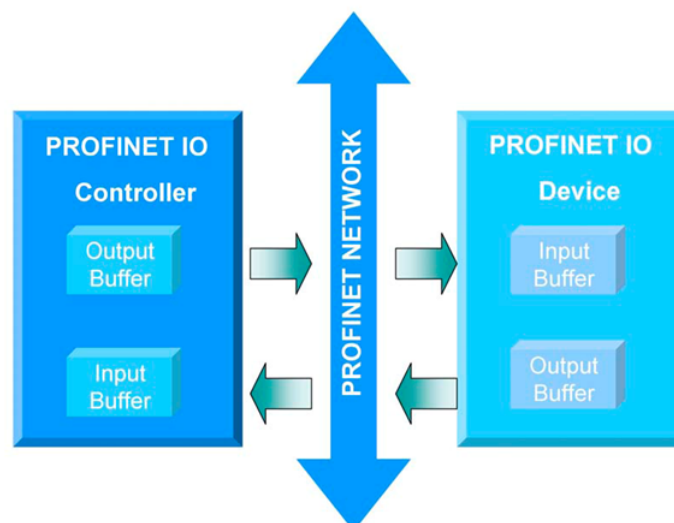
12.2. PROFINET Input Data Area

The maximum input data length of I-7580 is 512 bytes. The first 8 bytes of the received input data are reserved for the communication status. The remaining data in the input data area represents the data packet received from the serial network. The 9th byte therefore shows the first byte of the received serial data.

Byte	Data	Description
0	0x00	I-7580 does not transmit I/O data.
	0x01	I-7580 transmits data to the COM port.
	0x02	I-7580 receives data from the COM port.
1	Error State	Bit 0: Output FIFO overflow Bit 1 : Input FIFO overflow Bit 2 : Output Data loss Bit 3 : Input Data loss Bit 4 : Input Data overflow
2	Length	Received data length (High byte)
3		Received data length (Low byte)
4	Input	Received data count (High byte)
5	Count	Received data count (Low byte)
6	Output	Transmitted data count (High byte)
7	Count	Transmitted data count (Low byte)
8～511	Data	Receive data from the COM port

The I-7580 module has three modes to identify data from two batches of data packet. These modes are: (1) Interval time, (2) Fixed data length, and (3) End character of data.

12.2.1. "Interval time" mode

If the time between two consecutive bytes exceeds the timeout value, the module transfers the data from the COM port input buffer to the PROFINET IO device output buffer. The default timeout value is set to the duration needed to send one data byte. That means if after a time period of one byte no additional data arrives, then the data that is already in the COM port input buffer will be regarded as a data packet.

The interval time between messages arriving at the COM port must be greater than 2 milliseconds.

12.2.2. "Fixed data length" mode

The converter counts the number of bytes arriving at the COM port. If the specified amount of data has entered the serial input buffer, the content is removed from the input buffer and transferred to the PROFINET IO device output buffer. The last string will only be send after a transmit time of three bytes has elapsed. To use this feature, you need to set the "Input fixed length data" parameter to "Enable". The data length has to be defined in bytes 5-6 of the PROFINET output data area (please refer to section "PROFINET Output Data Area").

Fixed Length : 5 (byte 5, 6 of PROFINET output data area)

String arriving at the Com Port:

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D |

String Count : **3**

String 1: | 01 | 02 | 03 | 04 | 05 |

String 2: | 06 | 07 | 08 | 09 | 0A |

String 3: | 0B | 0C | 0D |

String 3 will only be send after a transmit time of three bytes has elapsed.

12.2.3. "End character" mode

As soon as the converter detects the end characters of the incoming serial data stream, it removes the data from the serial receive buffer and transfers it to the PROFINET IO device output buffer of the converter.

If the time interval between two consecutive bytes is longer than the time needed to transmit three bytes, then the module treats this situation as an end of a string.

To use this feature, the "End char of input data" parameter must not be set to "None".

Example 1:
The end character : CR(0x0D)

String arriving at the Com Port:

| 01 | 02 | 0D | 03 | 0D | 04 | 05 | 06 | 07 | 0D |

String Count : **3**

String 1: | 01 | 02 |

String 2: | 03 |

String 3: | 04 | 05 | 06 | 07 |

Example 2:
The end character : CR(0x0D)

Time interval between two consecutive bytes is longer than the time needed to transmit three bytes

String arriving at the Com Port:

| 01 | 02 | | | 03 | 04 | 0D | 05 | 06 | 07 | 08 | 0D |

String Count : **3**

String 1: | 01 | 02 |

String 2: | 03 | 04 |

String 3: | 05 | 06 | 07 | 08 |

12.3. PROFINET Output Data Area

The maximum output data length of I-7580 is 384 bytes. The first 8 bytes are needed to set the communication behavior of the converter.

Byte	Data	Description
1	0〜255	Data output command.
2	0x01	Control bit – clear all diagnostic messages.
	0x02	Control bit – clear Received data count.
	0x04	Control bit – clear Transmitted data count.
3	Length	Output data length (High byte).
4		Output data length (Low byte).

5	Length	Fixed data length (High byte).
6		Fixed data length (Low byte).
7	0~255	Interval time between the two batches of the data.
8	0~255	Timeout value.
9~384	Data	Output data to COM port.

12.3.1.   Data output command (byte 1)

The PROFINET IO Controller is cyclically polling the I-7580 module. The PROFINET IO Controller sends data from its output buffer to the input buffer of the converter. If no new data is put on the PROFINET IO Controller output buffer, the PROFINET IO Controller sends the same data in each polling cycle. Therefore, it is necessary for the converter to detect whether the data arriving at its PROFINET IO device input buffer has already been sent before or is new. The converter recognizes a new data packet when the value of the first byte differs from the previous data packet. A change of the first byte results in an immediate output of the newly arrived data (at the PROFINET IO device input buffer) to the serial COM port.

When the user wants to send a new data packet to the converter, the user should increase progressively the first byte (ex: 0->1, 1->2, 2->3, …, 255->0), and the converter will send the new data packet to the serial COM port. If the user changes the first byte but doesn't increase progressively it (ex: 0->2, 1->3, 2->5), the converter will send a diagnostic message "Output data - data loss". This message informs the user that the PROFINET data may be loss.

> **ATTENTION!**
> The converter will send no data to the connected serial devices if the content of the first byte of two consecutive PROFINET messages is identical. Even if the remaining bytes differ, no message will be forwarded to the COM port. The converter detects a new data packet only by checking the first byte.

12.3.2.   Control bit (byte 2)

Bit 0: When this bit is set, all diagnostic messages sent by the I-7580 module will be cleared.

Bit 1: When this bit is set, the I-7580 module sets the **Received data count** to zero (please refer to section "PROFINET Input Data Area").

Bit 2: When this bit is set, the I-7580 module sets the **Transmitted data count** to zero (please refer to section "PROFINET Input Data Area").

Bit 3~7: The remaining bits have to be set to zero.

12.3.3.   Output data length (byte 3, byte 4)

The default value for the output data length is 0. It has to be set for every single output command, otherwise no data will be sent to the COM port.

These two bytes determine the number of bytes copied from the I-7580 PROFINET IO device input buffer to the COM port output buffer. This means that regardless of the data length sent by the master, only the number of bytes specified in the third byte will be forwarded to the COM port.

12.3.4. Fixed data length (byte 5, byte 6)

These two bytes determine the length of the response data string. The converter waits until the data arriving at the COM port buffer has reached the specified length.

To use this feature, the "Input fixed length data" parameter has to be set to "Enable".

12.3.5. Interval time (byte 7)

This byte can increase the interval time between two batches of the data packet. It means the converter can delay the data output from PROFINET to the COM port.

Example: Interval time – 15 ms.
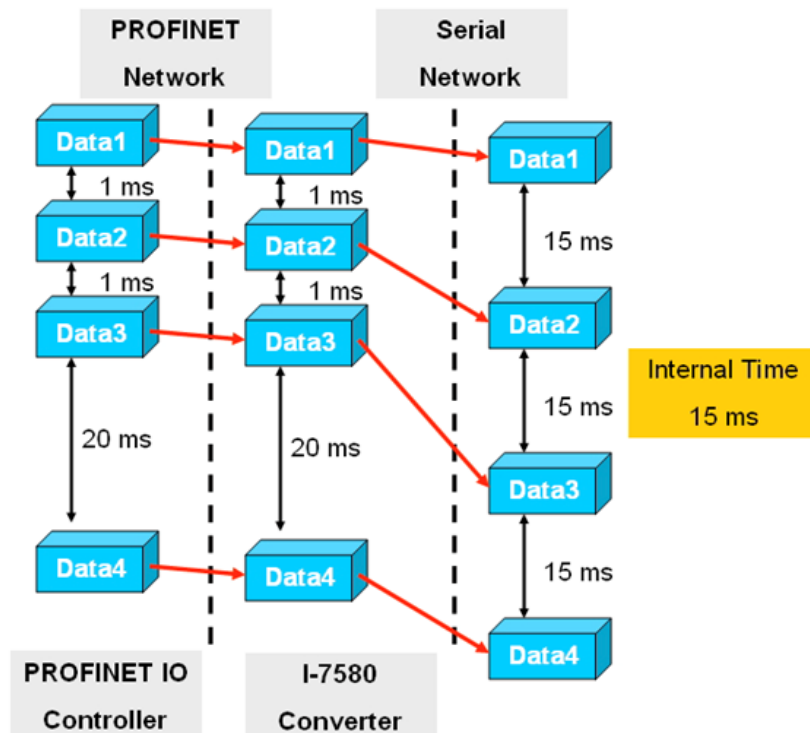
12.3.6. Timeout value (byte 8)

The timeout is only relevant for the communication between the I-7580 converter and the serial network. The converter receives the response of the device at the COM port as a continuous data stream. A silent interval in the data stream exceeding the timeout value signals the converter the end of the message and forwards this message to its PROFINET IO device output buffer.

Valid values for the timeout: 0 to 255.

The value "0" represents the minimum value which equals the transmission time of one byte [(start bit+data bit+parity bit+stop bit)/Baudrate].

The value "1" assigns a timeout value of either 1 or 10 milliseconds depending on the chosen unit (1 or 10 ms).

The value "255" represents either 255 milliseconds (time unit: 1 ms) or 2550 milliseconds (time unit: 10 ms).

This byte specifies the timeout for the data stream of the serial response. If the multiply responses are expected for every request sent by the converter, then the timeout applies to all these messages.

12.4. Communication between PLC and Machine

12.4.1. Protocol description

The **I-7580 Transport Protocol** version 1.1.0 (hereinafter referred to as the protocol) is intended for transferring arbitrary data through the PROFINET IO Device/Slave interface converter to RS-232/422/485. The protocol has a minimum number of overhead bytes (10 bytes) added to the transmitted data in each packet.

12.4.2. Protocol parameters

Protocol parameters are shown in the table:

Parameter	Value
Packet loss handling	The sender resends packets as needed, providing data redundancy.
Maximum data packet size	376 bytes (366 data bytes and 10 overhead bytes).
Maximum size of logically related data for transmission	4 153 343 bytes.

12.4.3. Data exchange principle

The protocol defines only one type of **DATA** packets – packets for data transmission. The principle of data exchange using the protocol: the data array for transmission is divided into sections of a fixed length (366 bytes), with the exception of the last section containing the remaining data. The data of each section is packed into a packet (10 overhead bytes are added to the data). Formed packets with a maximum size of 376 bytes are sequentially sent through the serial port to the converter. After receiving the packet, the receiving side copies the data contained in this packet into the buffer. To ensure reliable data delivery, the sender can resend packets.The sender determines how many times to resend a packet. The figure below shows the principle of data exchange using the I-7580 Transport Protocol version 1.1.0.
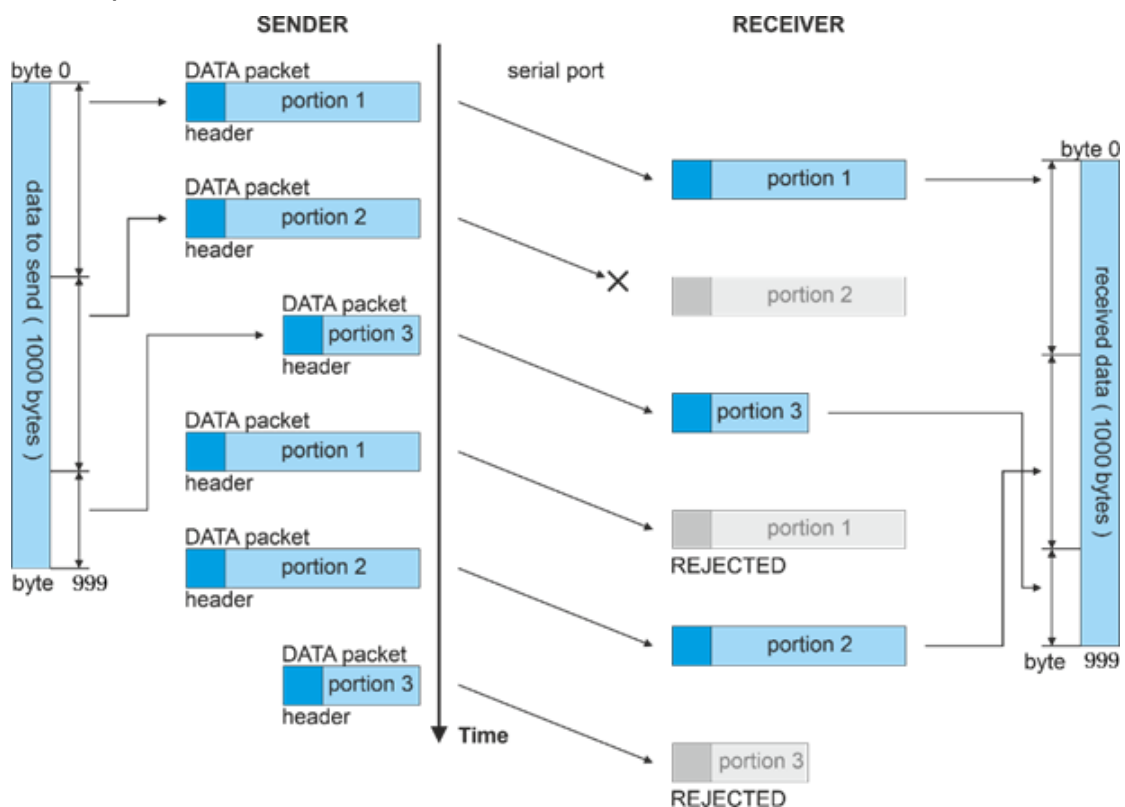
The figure shows a simple example of sending data. In this example, the size is 1000 bytes. According to the protocol specification, the maximum size of a transmitted packet is 376 bytes (366 data bytes and 10 overhead bytes). In this example, the amount of data will be divided into three chunks of 366 bytes and 268 bytes for the last chunk. **The data is divided into chunks sequentially, starting from the first byte (meaning a continuous one-dimensional byte array).** For each chunk of data, the **DATA** packets are formed containing overhead data (header) of 10 bytes. Packets are sequentially sent to the recipient.

As can be seen from the figure, a **DATA** packet with the first chunk of data is sent first. Then a second **DATA** packet is sent. Suppose the second packet was lost, then the next packet received by the receiver contains the third chunk of data. After receiving the **DATA** packet with the third chunk of data, the data has not yet been collected. To ensure reliable delivery, the sender resends the packets. Let's assume that the number of repeat dispatches is set to two. After sending the third packet, the sender resends the packets starting with the first one. The **DATA** packet with the first chunk of data will be rejected by the receiver as it has already been received. The resent **DATA** packet with the second chunk of data will be successfully processed by the receiver. After that, the data will be considered accepted and all subsequent packets with this data will be rejected.

12.4.4. DATA packet format

DATA packets have a maximum length of 376 bytes and are intended for data transfer. Packets have the following format.

Byte #	0	1	2	3	4	5	6	7	8	9	10	...	N
hex field	0xAA	0xA0 | buffer_ID	logic_port	packet_ID		max_packet_ID		packet_size		CRC	data[0]		data[n]

DATA packet fields:

Field	Value	Size	Description
Start byte	0xAA	1 byte	The start byte has a fixed value and is intended to identify DATA packets in the serial port buffer.
Header	0xA0	1 byte	The packet header occupies the first 4 bits of the second byte of the packet. It has a fixed value.
buffer_ID	from 0 (0x00) to 15 (0x0F)	1 byte	Data buffer identifier. It occupies the last 4 bits of the second byte of the packet. The data buffer identifier value is formed as follows: all logically related data (for example, a data structure) is sequentially marked with the data buffer number from 0 (0x00) to 15 (0x0F). After identifier 15 (0x0F), numbering starts over (0x00).
packet_ID (big endian)	from 0 (0x0000) to 4095 (0x0FFF)	1 byte	Packet identifier. The sent data is divided into packets, each of which is sequentially assigned its own identifier from 0 (0x0000) to 4095 (0x0FFF). The identifier value is sent in big endian format.
max_packet_ID (big endian)	from 0 (0x0000) to 4095 (0x0FFF)	1 byte	Maximum packet ID for the data to be sent (last packet ID). If the data size is less than 366 bytes, then all data will be sent in one packet. Therefore, the packet_ID and max_packet_ID fields will be the same and equal to 0 (0x0FFF). The identifier value is sent in big endian format.
packet_size (big endian)	from 11 to 376		Packet size. It can take values from 11 (0x000B is the minimum packet size) to 376 (0x0178 is the maximum packet size). The packet size is transmitted in big endian format.

CRC			Header checksum. It is the least significant byte of the sum of the first 9 bytes of the DATA packet: CRC = (uint8_t)(byte0 + byte1 + byte2 + byte3 + byte4+ byte5 + byte6 + byte7 + byte8 + byte9)
data[n]	Any		Transmitted data. The maximum size of data included in a packet is 366 bytes.

12.4.5. DATA packet payload from PLC to Machine

Payload in the data[n] field of the DATA packet from the controller (PLC) to the converter.

Command name	Type	Size	Description
Calibration Start	BOOL	1 byte	Start the machine calibration process.
Zero Positioning Start	BOOL	1 byte	Return the machine to its starting position.
Measuring Start	BOOL	1 byte	Start measurement.
Abort Measuremet	BOOL	1 byte	Abort measurement.
Fault Reset	BOOL	1 byte	Reset error.
New Data Transfer	BOOL	1 byte	Presence of new data from the controller.
Scan Length	REAL	4 bytes	Scan length.
Calibration Diameter	REAL	4 bytes	Calibration ring diameter.

The software installed on the computer controls the movement system depending on the received commands from the PLC. When receiving commands:

- «Calibration Start» – The software sets the "Calibration running" flag to "TRUE" in the output data packet and starts the machine calibration process. The laser sensor starts rotating and goes into the calibration ring. Then the machine calibration process starts. Upon successful completion of the calibration process, the "Calibration running" flag is set to "FALSE", and the value of the "Calibration completed" flag is set to "TRUE". In cases where the machine failed to successfully complete the calibration process, the "Calibration running" flag is set to "FALSE" and the "Calibration error" flag is set to "TRUE".

- «Zero Positioning Start» – The software starts moving the measurement system to the starting (zero) position and sets the "Zero Positioning running" flag to "TRUE" in the output packet. Upon successful completion of the moving process, the "Zero Positioning running" flag is cleared, and the value of the "Zero Positioning completed" flag is set to "TRUE" in the output packet. In cases where the machine failed to successfully complete the moving process, the "Zero Positioning running" flag is set to "FALSE" and the "Zero positioning error" flag is set to "TRUE" in the output packet.

- «Measuring Start» – The software starts the measurement process and sets the "Measuring Running" flag to "TRUE" in the output packet. The laser sensor starts rotating and goes into the ring, scanning the inner surface and chamfers. Upon completion of the measurement process, the movement system with the laser sensor goes back to the starting (zero) position, while in the output packet the "Measuring Running" flag is set to "FALSE", the "Measuring completed" flag is set to "TRUE", and the returned variables with measured diameters, width and chamfer angles are populated with the corresponding values. In cases where the machine failed to successfully complete the measurement process, or the measurement process was forcibly interrupted by the "Abort Measurement" command from the PLC, the "Measuring Running" flag is set to "FALSE", while the "Measuring error" flag and the "Measuring aborted" flag are set to "TRUE" in the output packet.

28

- «New Data Transfer» – The software writes new incoming data to the machine memory. For this purpose, the values of the «Scan Length» and «Calibration Diameter» variables are read from the input packet from the PLC and saved to PC's non-volatile memory. After that, the "Data Transfer Read" flag is set to "TRUE" in the output packet, indicating that the data transferred from the controller has been successfully read and saved.
- «Fault Reset» – The software sets the "FALSE" values for all error flags and the machine returns to the starting (zero) position.

In cases where the machine diagnosed a technical breakdown or malfunction while executing one of the received commands from the controller, the software sets the "System Fault Condition" flag to "TRUE", indicating that the machine is out of order and requires operator intervention.

12.4.6. DATA packet payload from Machine to PLC

Payload in the data[n] field of the **DATA** packet from the converter to the controller (PLC):

Command name	Type	Size	Description
Calibration running	BOOL	1 byte	Calibration is in progress.
Calibration completed	BOOL	1 byte	Calibration is completed.
Calibration error	BOOL	1 byte	Calibration error.
Zero Positioning Running	BOOL	1 byte	Returning to the starting position.
Zero Positioning Completed	BOOL	1 byte	Machine is in the starting position.
Zero Positioning Error	BOOL	1 byte	Zero positioning error.
Measuring Running	BOOL	1 byte	Measurement is in progress.
Measuring Error	BOOL	1 byte	Measurement error.
Measuring Completed	BOOL	1 byte	Measurement is completed.
Measuring Aborted	BOOL	1 byte	Measurement is aborted.
System Fault Condition	BOOL	1 byte	Machine is out of order.
Data Transfer Read	BOOL	1 byte	Data transmitted from the controller has been read.
Measurements by Height (Nh)	UINT	4 bytes	Number of measurements by height.
Measurement Height	REAL - ARRAY[Nh]	4 bytes	Height at which the measurement was taken.
Diameter	REAL - ARRAY[Nh]	4 bytes	Diameter value.
Circularity	REAL - ARRAY[Nh]	4 bytes	Circularity value.
Measurements by Angle (Na)	REAL - ARRAY[Nh]	4 bytes	Number of measurements by angle.
Measurement Angle	REAL - ARRAY[Nh]	4 bytes	Angle at which the measurement was taken.
Top Chamber Width	REAL - ARRAY[Nh]	4 bytes	Top chamfer width.
Bottom Chamber Width	REAL - ARRAY[Nh]	4 bytes	Bottom chamfer width.
Top Chamber Angle	REAL - ARRAY[Nh]	4 bytes	Top chamfer angle.
Bottom Chamber Angle	REAL - ARRAY[Nh]	4 bytes	Bottom chamfer angle.
Height Measured Part	REAL - ARRAY[Nh]	4 bytes	Part height.
Diameter Min	REAL	4 bytes	Minimum diameter.
Diameter Max	REAL	4 bytes	Maximum diameter.

Diameter Average	REAL	4 bytes	Average diameter.
Chamber Width Min	REAL	4 bytes	Minimum chamfer width.
Chamber Width Max	REAL	4 bytes	Maximum chamfer width.
Chamber Width Average	REAL	4 bytes	Average chamfer width.
Circularity Min	REAL	4 bytes	Minimum circularity.
Circularity Max	REAL	4 bytes	Maximum circularity.
Circularity Average	REAL	4 bytes	Average circularity.
Chamber Angle Min	REAL	4 bytes	Minimum chamfer angle.
Chamber Angle Max	REAL	4 bytes	Maximum chamfer angle.
Chamber Angle Average	REAL	4 bytes	Average chamfer angle.

12.5. Diagnostic messages

The I-7580 module has two types of diagnostic messages: "Output Data Error" and "Input Data Error".

Type	Description
Output Data Error	FIFO overflow.
	Data loss.
Input Data Error	FIFO overflow.

12.5.1. Output Data Error

1. When the PROFINET network speed is higher than the serial network speed and the PROFINET IO controller continuously transmits data to the I-7580 module, the output buffer of the I-7580 module will overflow, and the I-7580 module will send a diagnostic message "Output Data Error – FIFO overflow".
2. When the I-7580 module receives the data output command (first byte of the output data area, please refer to section "PROFINET Output Data Area") from the PROFINET IO controller and the command is not increased continuously (for example: 0->1, 1->2 ... 254->255, 255->0), the I-7580 module will send a diagnostic message "Output Data Error – Data loss" to the PROFINET IO controller.

12.5.2. Input Data Error

1. When the serial network speed is higher than the PROFINET network speed and the serial device continuously transmits data to the I-7580 module, the input buffer of the I-7580 module will overflow, and the I-7580 module will send a diagnostic message "Input Data Error – FIFO overflow".
2. When the I-7580 module cannot receive data in time from the COM port, it will send a diagnostic message "Input Data Error – Data loss". Please refer to section "PROFINET Input Data Area".
3. The maximum input data length for the COM port of the I-7580 module is 506 bytes. When the COM port of the I-7580 module receives data larger than 506 bytes, it will send a diagnostic message "Input Data Error – Data overflow".

13. Intended use

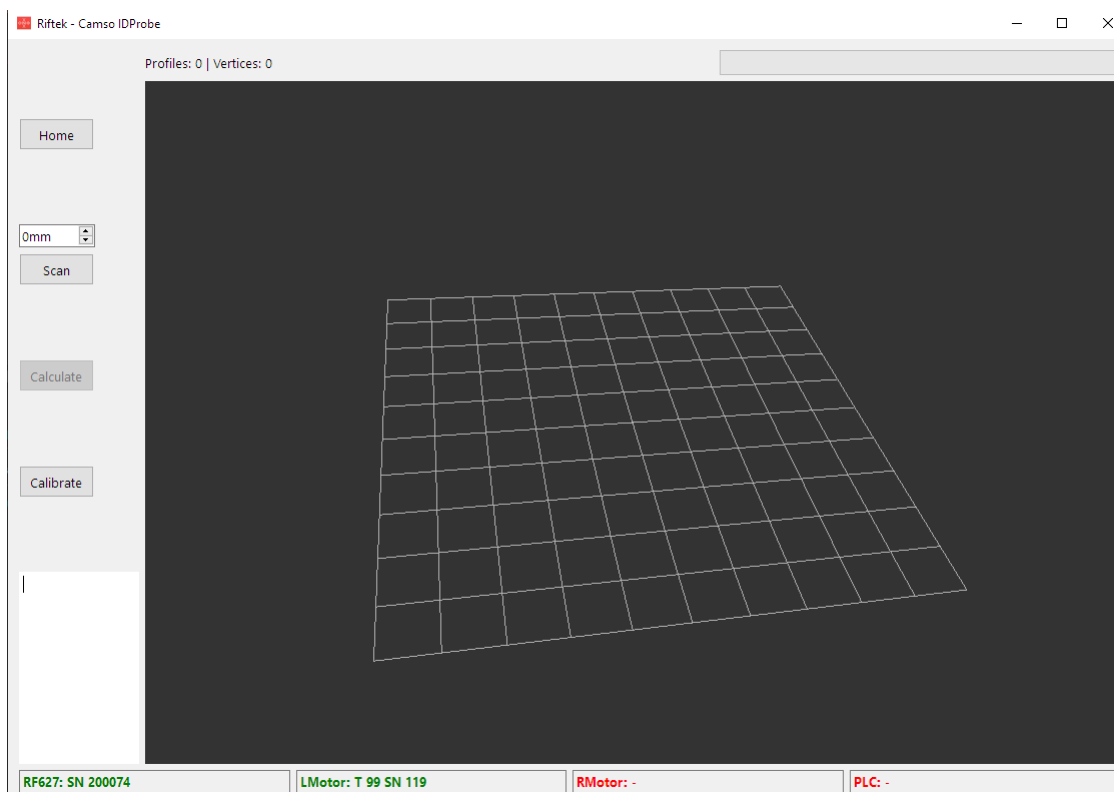## 13.1. Preparation for use

Install the machine on the conveyor in accordance with the connecting dimensions:
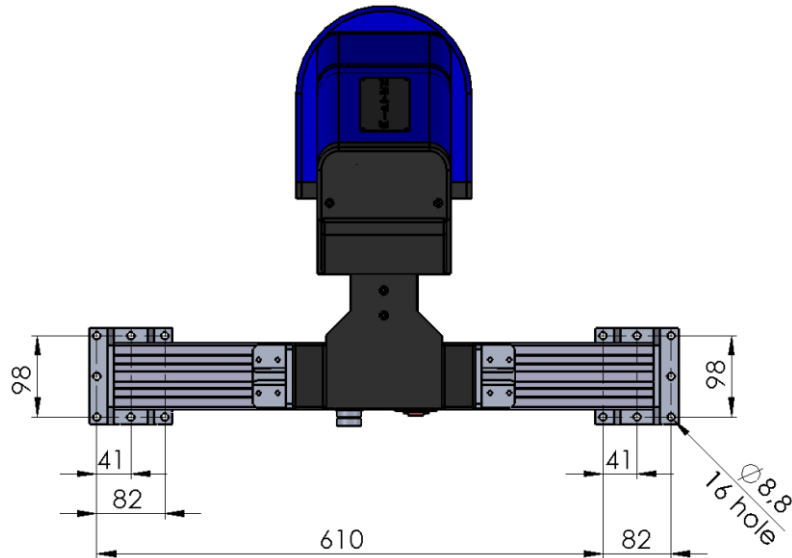
- Check the cables.
- Make sure that the network settings are correct.
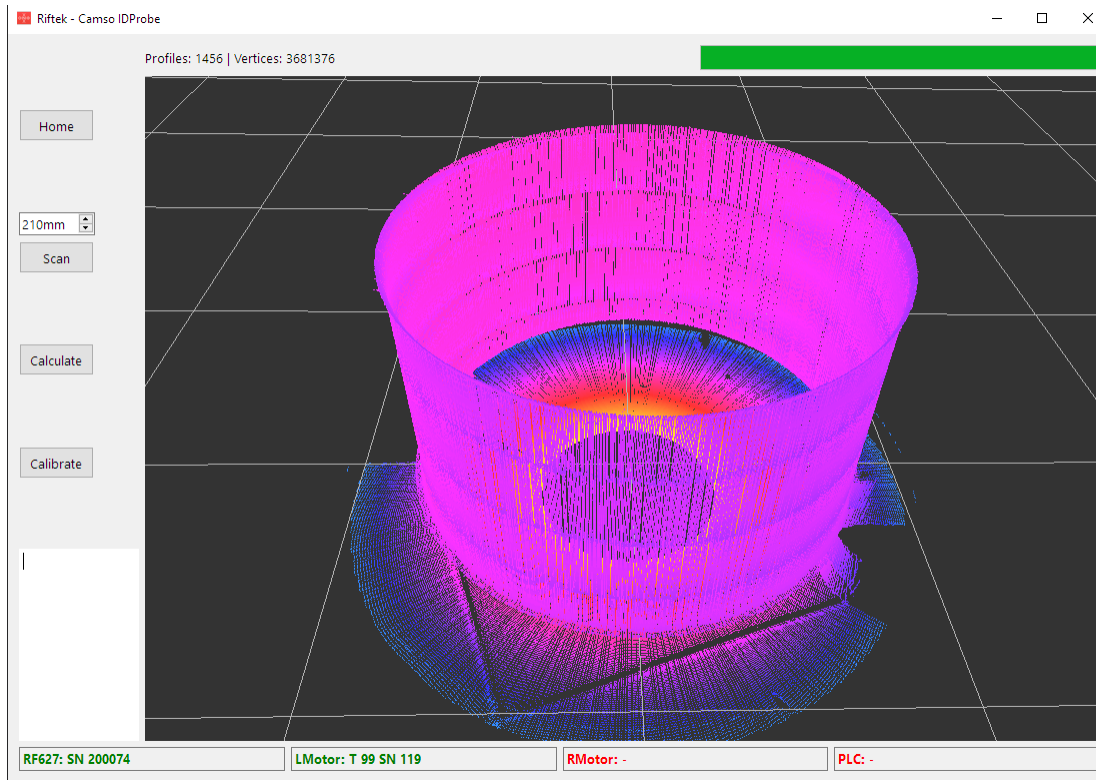- Turn on the machine.

13.2. Testing

The RF Camso IDProbe software is used to test the machine. After starting the software, the main window appears:

Set the scanning height in mm. Start the measurement process by clicking the **Scan** button.

Upon completion of the scanning process, a 3D model of the object will appear on the screen:

To calculate the parameters, click the **Calculate** button. The results are saved to a file. An example of results:

	A	C	D	E	F	G
1	**Position from bottom**	**Diameter**	**Circularity**			
2	22,58	612,27	0,99		Dimeter:	
3	27,58	612,18	1,07		Avg =	612,0844
4	32,58	612,20	1,04		Min =	611,868
5	37,58	612,18	0,96		Max =	612,274
6	42,58	612,10	0,97			
7	47,58	612,13	0,94		Circularity:	
8	52,58	612,18	0,86		Avg =	0,943939
9	57,58	612,22	0,91		Min =	0,832314
10	62,58	612,27	0,84		Max =	1,10023
11	67,58	612,23	0,85			
12	72,58	612,18	0,87			
13	77,58	612,16	0,83			
14	82,58	612,15	0,86			
15	87,58	612,13	0,86			
16	92,58	612,05	0,93			
17	97,58	612,03	0,85			
18	102,58	612,06	0,85			
19	107,58	612,09	0,92			
20	112,58	612,12	0,92			
21	117,58	612,07	0,92			
22	122,58	612,01	0,90			
23	127,58	611,98	0,91			
24	132,58	611,97	0,94			
25	137,58	611,95	0,97			
26	142,58	611,87	1,03			
27	147,58	611,87	0,97			
28	152,58	611,92	0,96			
29	157,58	611,97	1,03			
30	162,58	612,07	0,99			
31	167,58	612,01	1,00			
32	172,58	612,01	1,04			
33	177,58	612,04	1,06			
34	182,58	612,06	1,10			
35						

Diameter|Circularity   Chamfer|Height

13.3. Measurements

Run the sequence of commands described in section "Communication between PLC and Machine".

14. Technical support

Technical assistance related to incorrect operation of the machine and to problems with the software is free. Requests for technical assistance should be addressed at support@riftek.com.

15. Warranty policy

Warranty assurance for the 3D Inspection Machine RF096.2D-100/410-305 Series - 24 months from the date of putting in operation; warranty shelf-life - 12 months.

16. Revisions

Date	Version	Description
20.11.2020	1.0.0	Starting document.