Application Note

AS2100 Laser Distance Sensor

Getting started with EtherNet/IP™

V1.00

Abstract

This Application Note describes a simple example of use to get started with the EtherNet/IP™ interface of the Acuity AS2100 laser distance sensors.

This Application Note is provided as is without any warranty for any problems this sample may cause.

Table of Contents

1 Document scope

This document covers an Application Note written for the Acuity AS2100 Laser Distance Sensors with EtherNet/IP™ interface. The following topics are discussed:

- Safety instructions
- Application Note descriptions

2 Safety instructions

This Application Note is written for qualified system integrators to help doing an application specific sensor configuration.

Looking into the laser beam may be hazardous to the eyes.

- Do not look into the laser beam. Make sure the laser is aimed above or below eye level. (particularly with fixed installations, in machines, etc.).

Take precaution against electrostatic discharge (ESD) when the AS2100 laser distance sensors exchangeable cover is open.

- Generally the sensor with removed exchangeable cover is a sensitive device and can be damaged by electrostatic discharge.
- Only handle the device properly grounded and with care.
- No warranty will be granted on improper handling and / or ESD caused problems.

3 Introduction

3.1 Overview

This document contains a simple application of use to start with the EtherNet/IP™ interfaces of the Acuity AS2100 laser distance sensor. The simple example includes the relevant information and instructions to get started with the corresponding PLC and to handle the process data and the acyclic read / write services of the sensor.

This document describes a simple example of use to get started with the EtherNet/IP™ interface of the Acuity AS2100 laser distance sensor. All information and instructions necessary to understand this example of use and to run it on an Allen Bradley CompactLogix PLC are included.

The following functions are covered by this example:

- Process input / output data
  - Measurement Control – Start / Stop continuous distance measurement
  - Distance Integer / Distance Float – Distance data of the laser sensor
  - Distance Unit – Selected distance unit number for distance data
- Acyclic read / write services
  - Serial Number – Read serial number of laser sensor
  - Distance Unit – Read / Write distance unit number for distance data

Additionally, the following protocol specific features are covered too:

- Configuration / Change of IP address

For detail information about the laser sensor or the EtherNet/IP™ interface, please see the AS2100 Manual on the Acuity website (www.acuitylaser.com).

For questions, comments or technical support concerning this document please contact Acuity technical support. Please note, we are able to support you regarding our laser distance sensor but we only have limited support possibilities regarding the EtherNet/IP™ networks as well as for the used PLC's.

3.2 Prerequisites – Hardware & Software

The following hardware and software are used to create this example:

- PLC hardware: Allen Bradley CompactLogix 1769-L30ER
- PLC software: Studio 5000 Logix Designer V24 – Ensure the Logix Designer software is installed and running correctly.
- Sensor hardware: AS2100 laser distance sensor with correct assembled EtherNet/IP™ interface
- Sensor software: Only the EDS file of the AS2100 sensor. No additional sensor software.

Remark: The Logix Designer V24 is not the newest version, but for this simple example sufficient for the used basic functions. As additional information: Starting with the version V32, unsigned data types are now also supported.

Most Allen Bradly PLC's have a "RUN/REM/PROG" switch. For example, this switch must be set to PROG to load / program the PLC project onto the PLC.

The "RUN/REM/PROG" switch must be set to RUN to set the RUN flag in the Run/Idle header of the process data frames. Otherwise the output data will not be taken over in the AS2100 laser distance sensor and the safe values of the device are activated.

The "RUN/REM/PROG" switch must be set to RUN to set the RUN flag in the Run/Idle header of the process data frames. Otherwise the AS2100 laser distance sensor does not take over the output data and the safe values of the device are activated.

4 Description file (EDS)

First of all the EDS file of the laser distance sensor must be added / installed. This can be done over the Logix Designer software menu, Tools –› EDS Hardware Installation Tool. Then select the right EDS file path for the installation. See figure 1 and 2 for more details.

The latest EDS file for the Acuity AS2100 distance sensor with EtherNet/IP™ can be downloaded from www.acuitylaser.com.

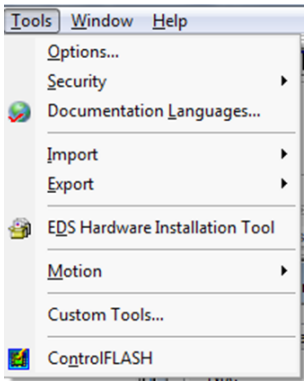

Figure 1: Studio 5000 software menu, Tools –› EDS Hardware Installation Tool.

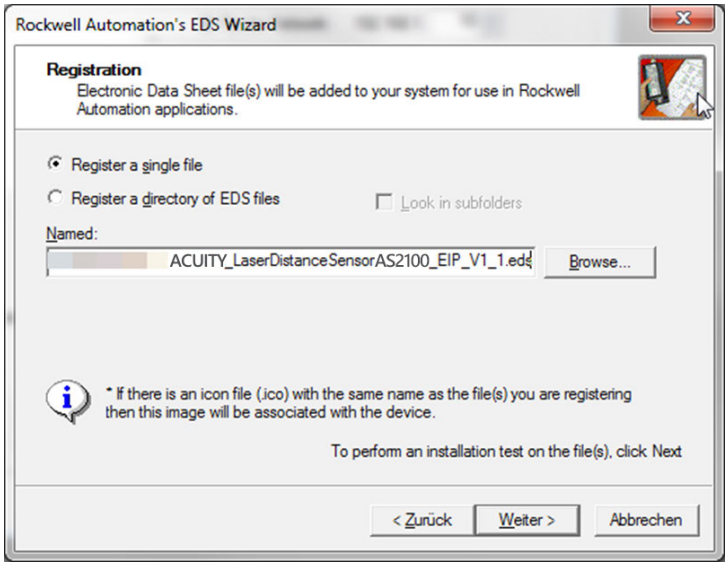

Figure 2: Rockwell Automation's EDS Wizard. Selection and installation of the EDS source file.

After this step the AS2100 Laser Distance Sensor will be available in the module catalog of the Logix Designer software as a EtherNet/IP™ module. For details see the next chapter 5.

5 Module configuration

5.1 New / Add module

The Laser Distance Sensor adapter device can now be added using the context menu entry New Module. Then the corresponding device can be selected and added to the network. For details see figure 3 and 4.

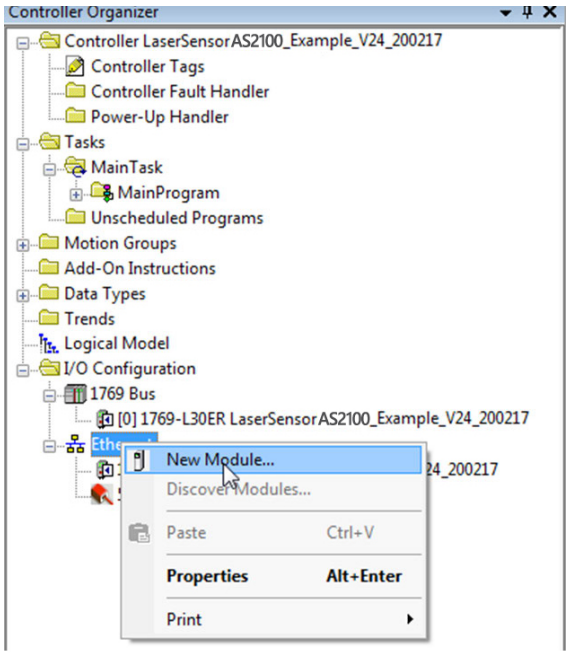

Figure 3: Controller Organizer – Context menu (right click) –› New Module... to add a new module to the network

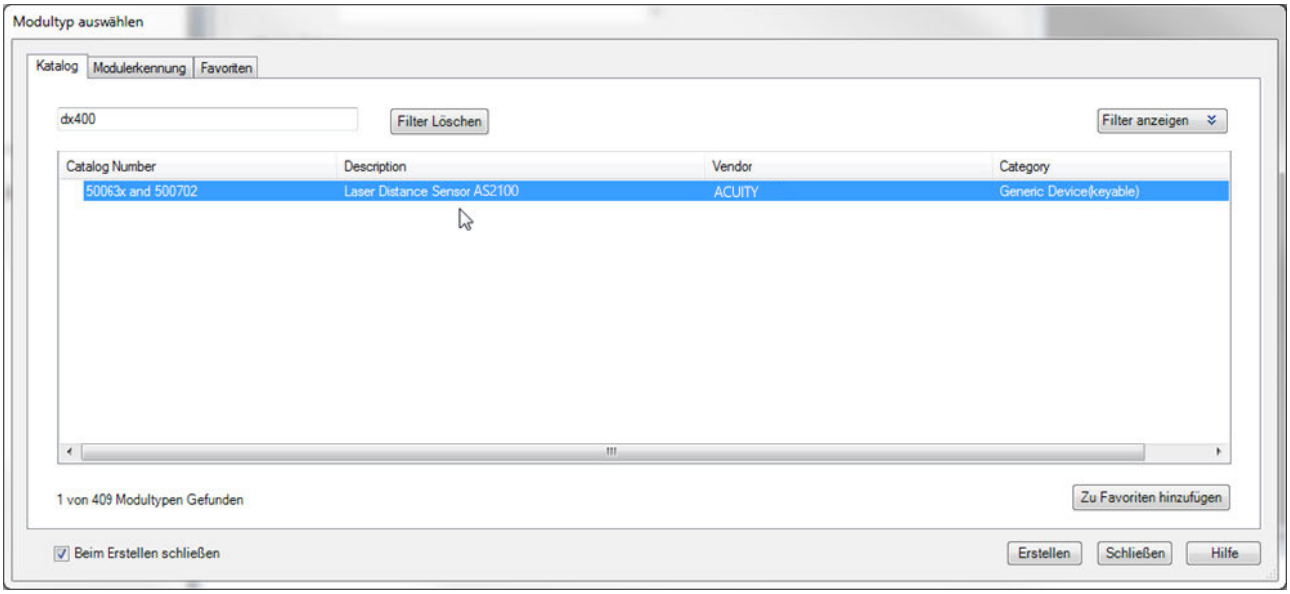

Figure 4: Module type selection – Select the corresponding module type, in this example "Laser Distance Sensor AS2100". Optional use the filter possibility to filter the available module types.

5.2 Connection configuration

The configuration of the connection type to "I/O Basic" is done in figure 5. This configuration allows the input and output (I/O) data exchange and handling.

Remark: Important differences between the connection types in the table below.

Connection types	Descriptions
I/O Basic	Allows the handling of input and output (I/O) data of the module.
Listen Only Basic	Allows a second connection (listen only) to an already existing connection.
Input Only Basic	Allows only the handling of the input data of the module.

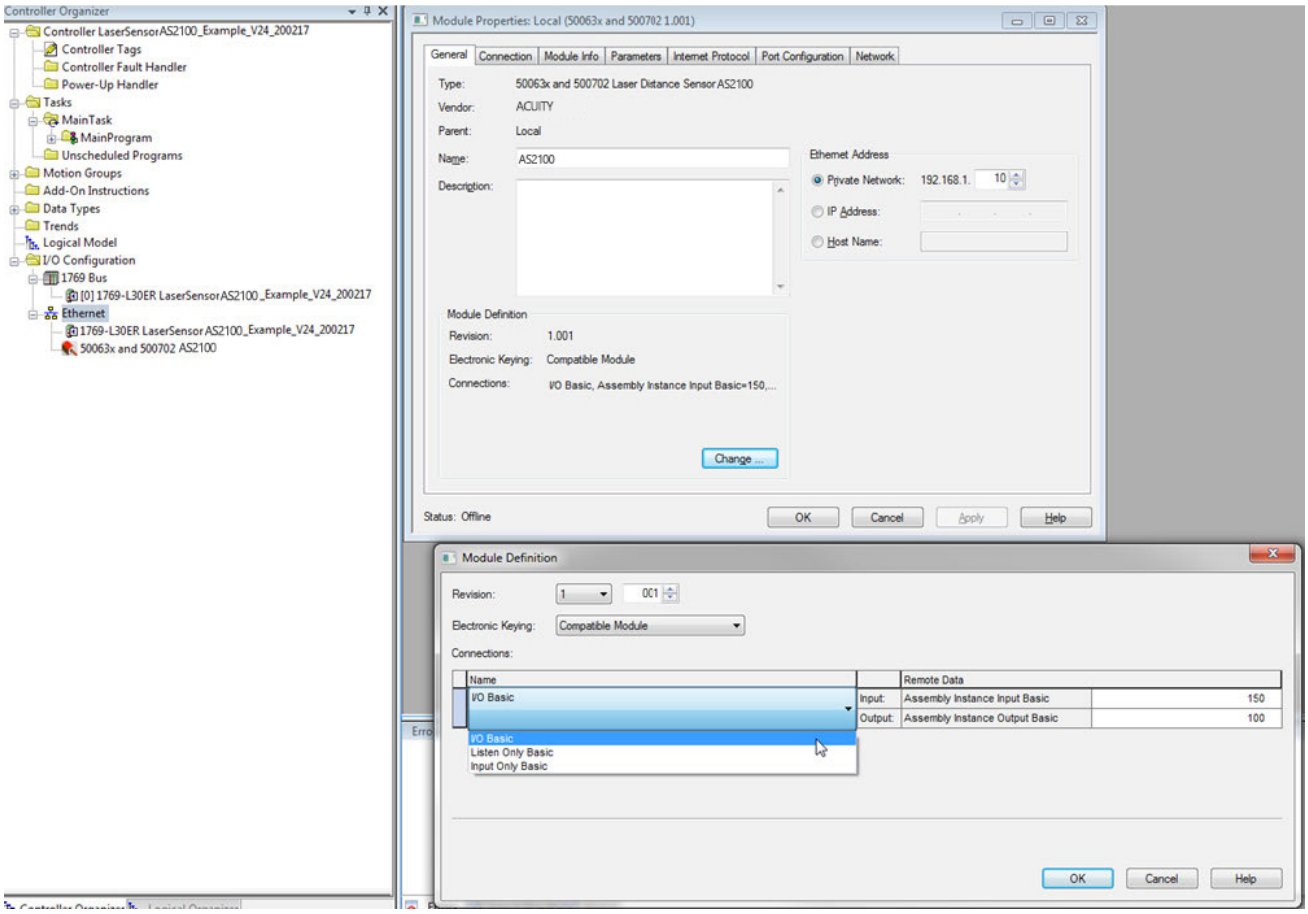

Figure 5: Module properties (General tab) – Change the connection type to “I/O Basic” (Exclusive-Owner connection). Module Properties –› General tab –› Change... button –› Selection of “I/O Basic”.

5.3 RPI configuration

The configuration of the process data interval time for the selected Laser Distance Sensor is available in the module properties configuration windows (see figure 6 for details). The interval time can be chosen between 1 ms and 100 ms (maximum).

Remark: The RPI value for older PLC systems is limited to a minimum of 2 ms.

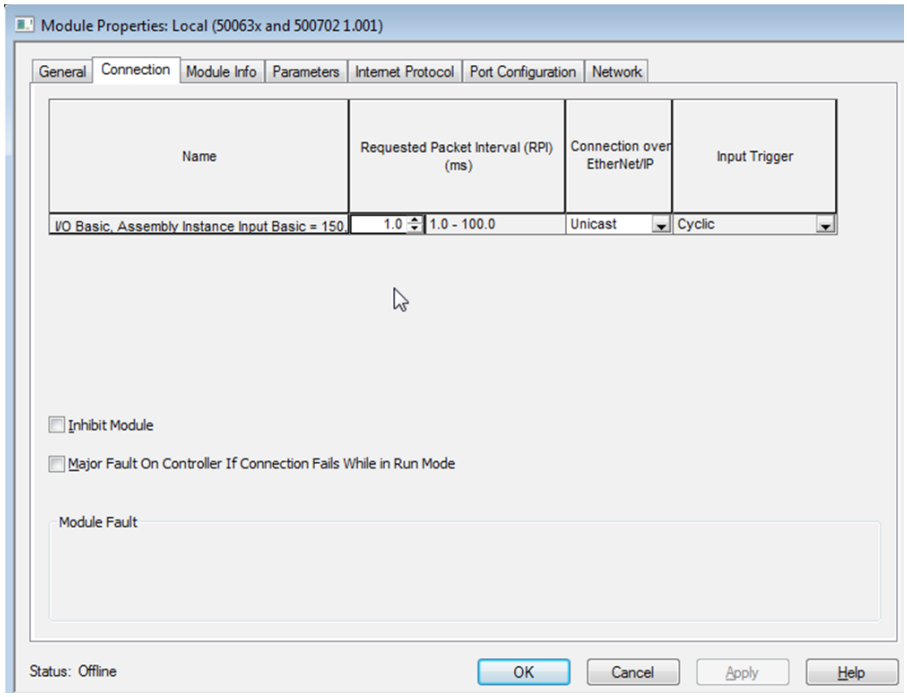

Figure 6: Module properties (Connection tab) – Change the Requested Packet Interval (RPI) of the cyclic process data. In this example: 1 ms.

6 Connection established

The establishment of a connection can be achieved by selecting the online mode. This can be done according the details in figure 7.

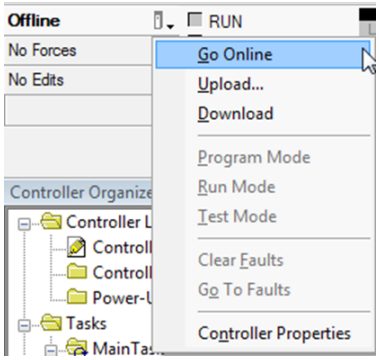

Figure 7: Connection establishment – Go Online to establish connection.

Once the connection is established, the status in the module properties window status bar at the bottom is switched to “Running”. The status in the status bar is marked in figure 8.

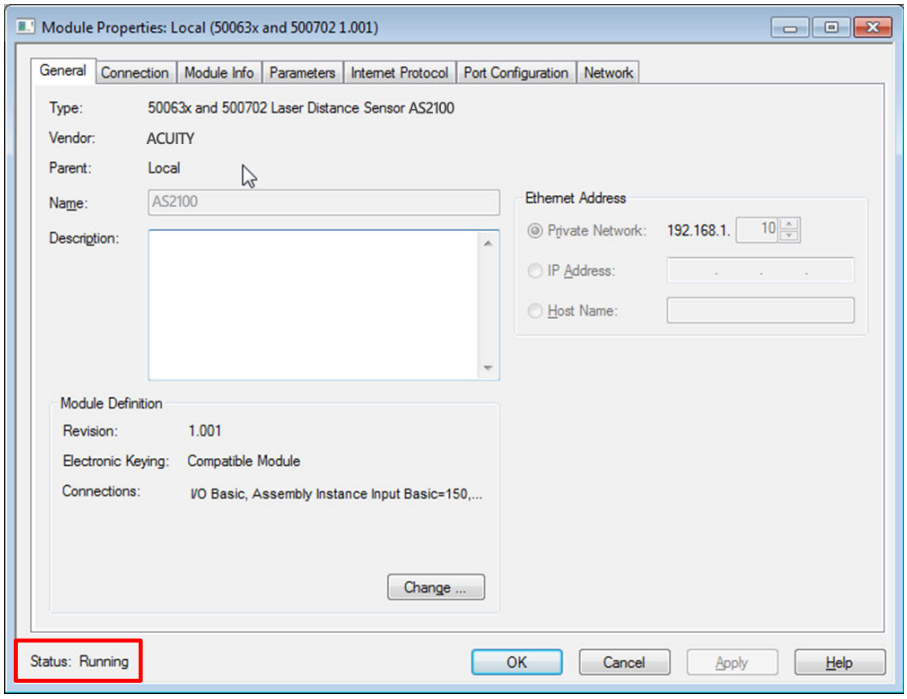

Figure 8: Module properties – Connection status: "Running" (for established connection)

7 Parameter

The parameter table in figure 9 is continuously updated with sensor data as soon as the connection is established (Online mode). This will be done automatically with the acyclic EtherNet/IP™ read services (Get_Attribute_Single). The parameter group selection offers the possibility to select all parameter or a desired parameter group only.

Remark: The selection of parameter groups is an unlocked feature of the AOP (AOP key in the EDS file). These parameter groups corresponds also to the AS2100 EtherNet/IP™ Manual.

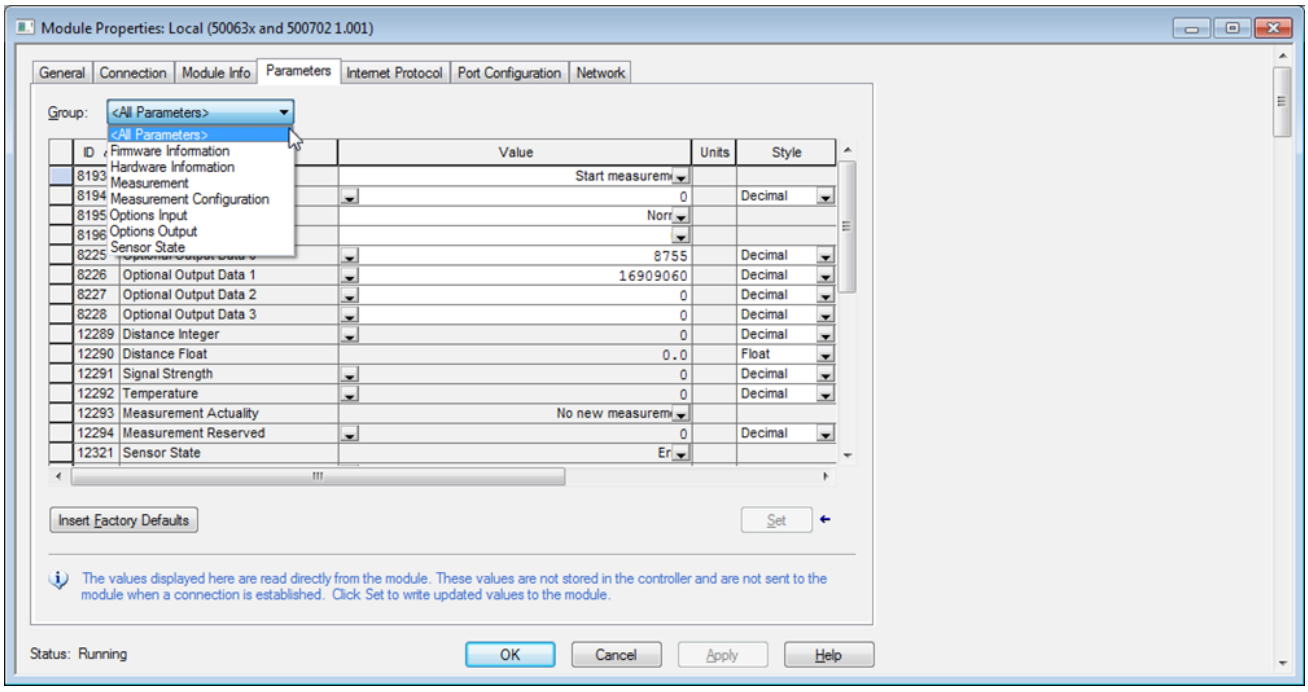

Figure 9: Module properties (Parameter tab) – Parameter view (from EDS file) with available parameter group selections.

8 Controller tags – Input / Output

The controller tags are generated automatically by adding the module (AS2100 device) to the network. At the same time, also the mapping of the device process data into the AS2100:I (Input) and AS2100:O Output) tags will be done. The available input tags are shown in figure 11 and the available output tags in figure 12.

Remark: The Add-On-Profile (AOP) key to unlock additional features is integrated in the EDS file of the Acuity laser sensor (see figure 10 for this information). No action needs to be taken.

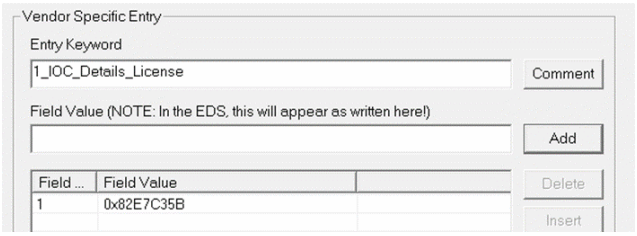

Figure 10: Add-On-Profile (AOP) Key / License in EDS file – Unlocks additional features e.g. showing real data types instead of an unspecific data array

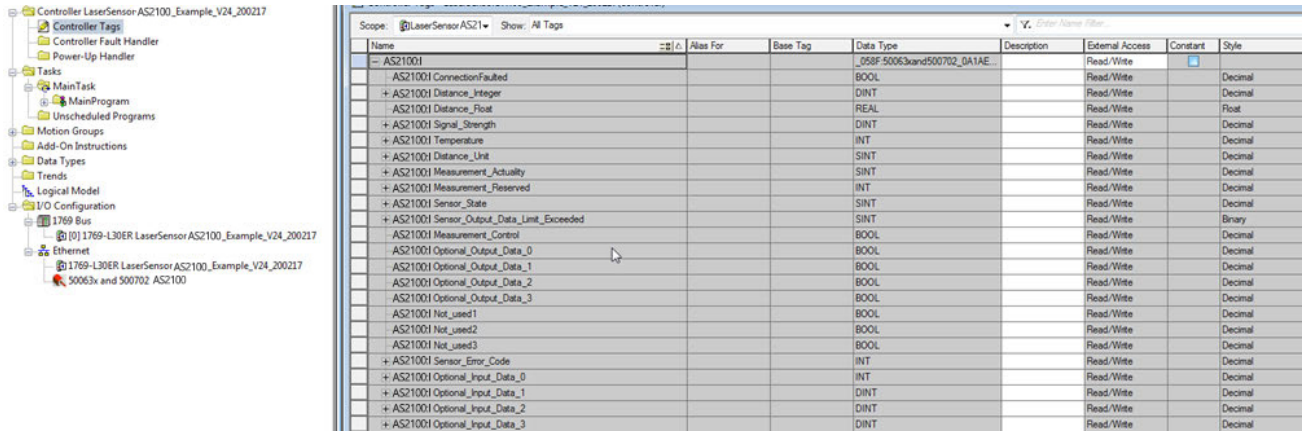

Figure 11: Controller tags – Available input tags according EDS file (Name, data type, etc.)

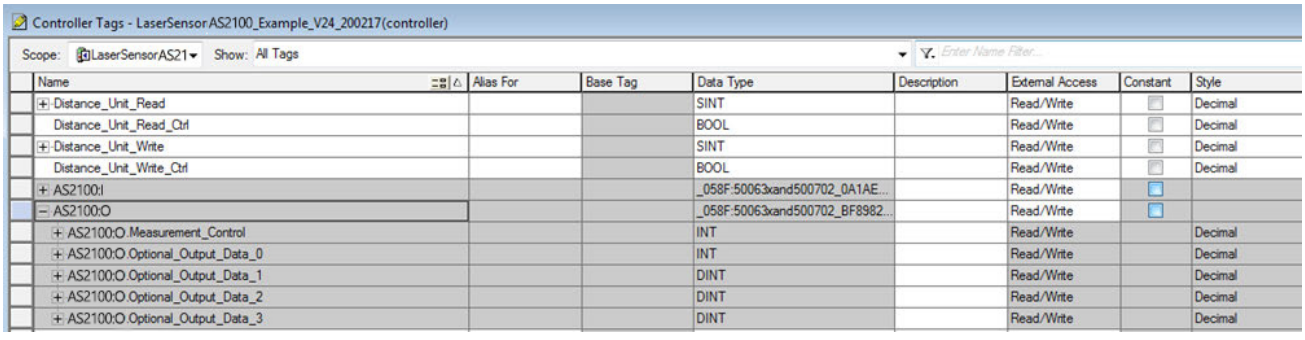

Figure 12: Controller tags – Available output tags according EDS file (Name, data type, etc.)

9 Controller tags – All

The controller tag list in figure 13 shows all available controller tags. This list contains the already mentioned automatically generated tags during the module adding process (see the previous chapter 8) and some other tags used for this example.

Since the used PLC system has no digital I/O, tags were used to trigger the corresponding services (see the tags Serial_Number_Read_Ctrl, Distance_Unit_Read_Ctrl and Distance_Unit_Write_Ctrl).

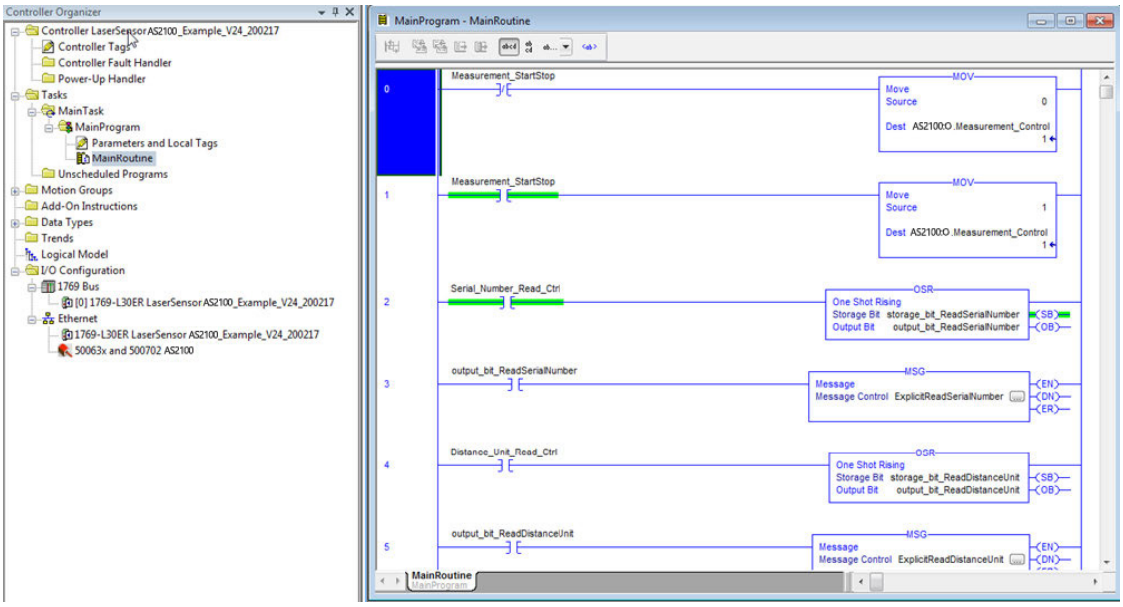

Figure 13: Controller tags – All available tags in the controller. In gray –› Automatically generated tags (AS2100:I, AS2100:O). In white –› Manually created tags (e.g. Distance_Unit_Read).

10 PLC application

10.1 Main routine

In the task tree the "MainRoutine" program can be found (see figure 14 for details). This main routine consists of different program segments (called "rugs") used for this EtherNet/IP™ example.

Remark: All these "rugs" are processed continuously with the maximum possible PLC processing time.

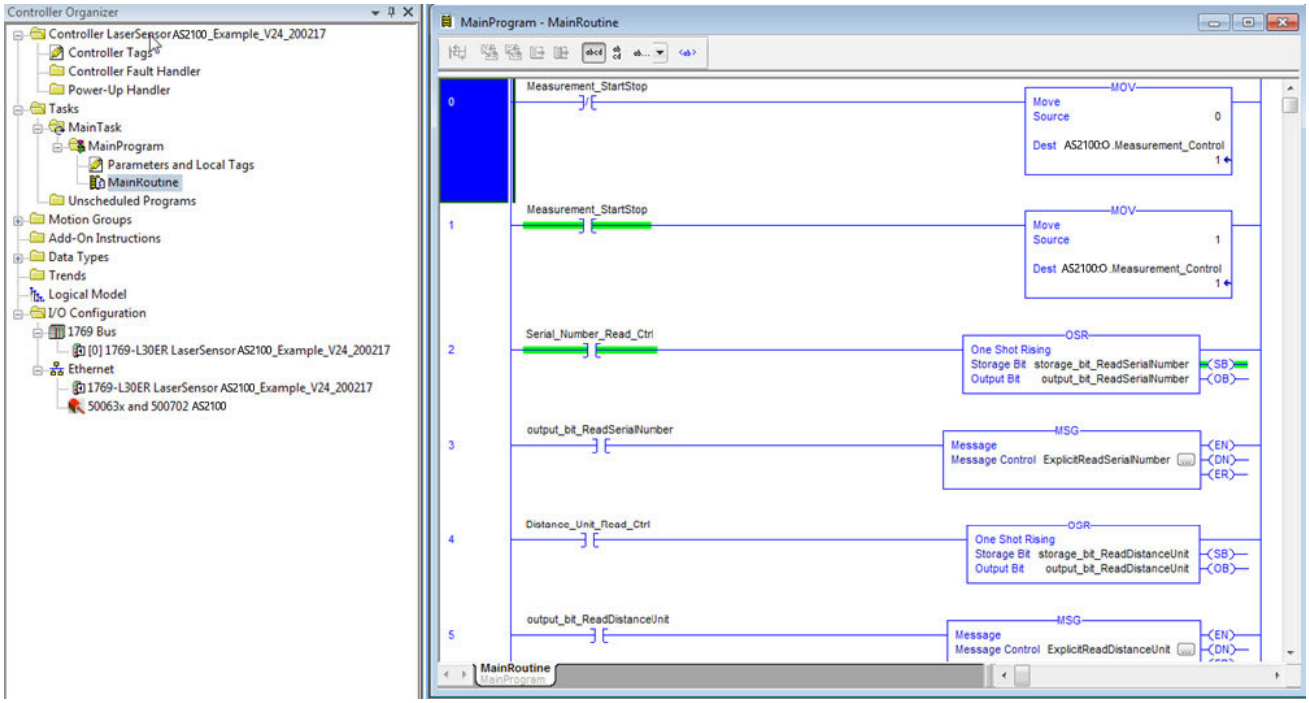

Figure 14: Main Program – Main Routine: View of the main program routines. PLC runs all program routines with max. possible cycle time.

10.2 Local tags

Local tags are temporary variable. In this example the local tags in figure 15 are used for triggering the acyclic services via OSR[1] blocks (for details see chapter 10.4.

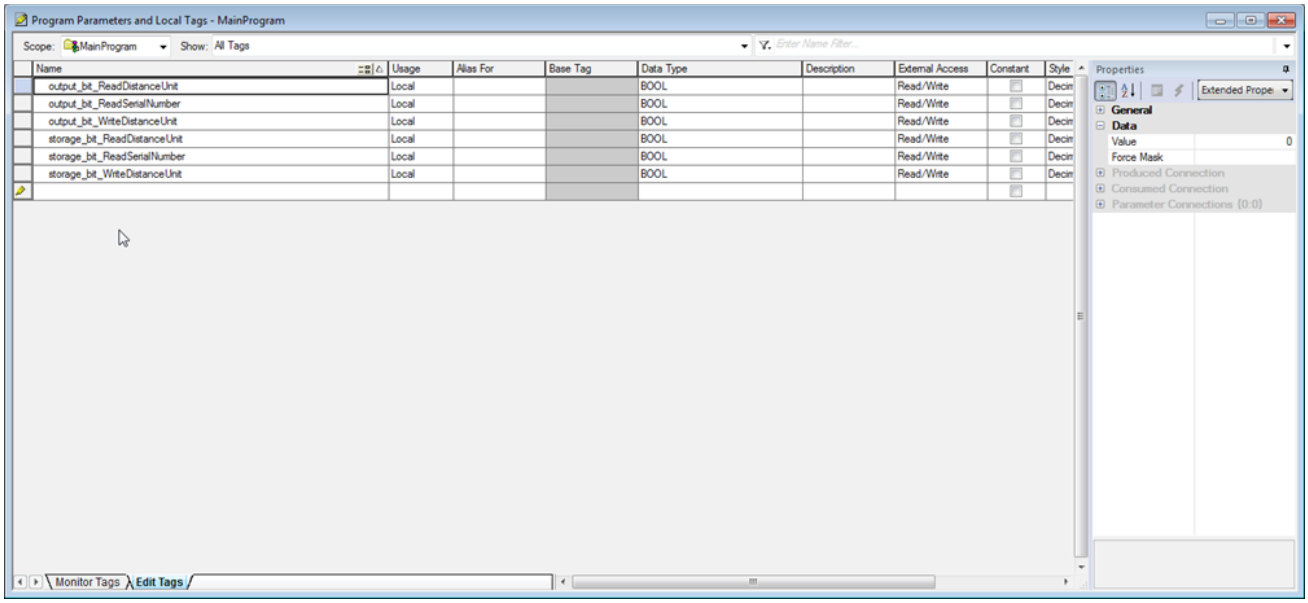

Figure 15: Main Program – List of local tags used in this example main program routines.

10.3 Measurement control

The "Measurement_Control", a part of the cyclic process output data, is used to start and stop the distance measurements of the laser distance sensor. In this example the "Measurement_Control" can be set to "1" or "0" with the associated controller tag. See figure 16 for the corresponding main routine 0 and 1.

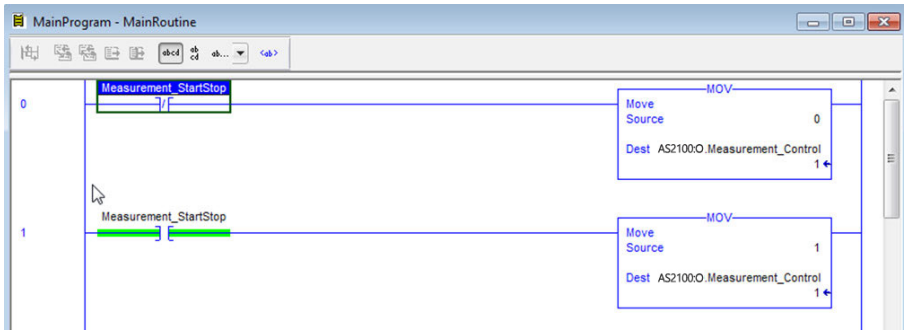

Figure 16: Main Program – Main Routine 0 & 1: Control of the process data output "Measurement Control" to start (1) / stop (0) distance measurements.

10.4 Acyclic read / write services

The acyclic read and write services are used to e.g. read device information and to configure the sensor. In this example the serial number and the distance unit are used to demonstrate the basic principle of reading or writing acyclic parameters. See chapter 10.4.3 to 10.4.5 for the corresponding routines.

10.4.1 Basic information (MSG messages)

The mentioned services can be programmed using the MSG instruction block. This block is available by default and no additions need to be added. Some selected information for the configuration of this block is shown in the table below. Detailed information can be found in the Rockwell documentation.

1 OSR (One Shot Rising) instruction: Detailed information for the OSR instruction can be found in the Rockwell documentation.

Message configuration	Descriptions
Message Type	CIP Generic as default.
Service Type	Service type e.g. “Get Attribute Single” for acyclic read service or “Set Attribute Single” for acyclic write service.
Class, Instance, Attribute	EtherNet/IP™ access information of the corresponding parameter. See the AS2100 EtherNet/IP™ for this information.
Error Code, Extended Error Code	In case of an error (.ER tag of the corresponding parameter is set, see figure 20 for details) the Error Code and Extended Error Code must be evaluated.
Timed Out	Not relevant.

In the figures 17, 18 and 19 the configurations used for the MSG instruction are shown (example to read out the serial number of the module).

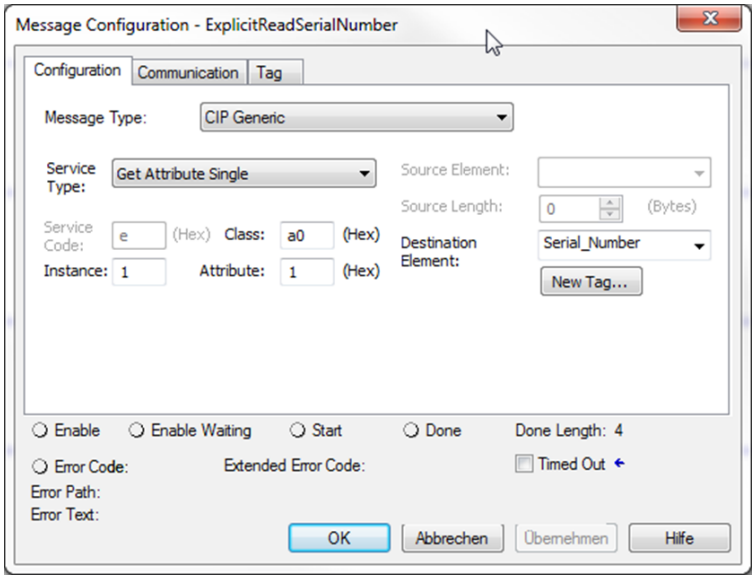

Figure 17: Message configuration (MSG) – Configuration tab: Configurations used to read the “Serial Number” (in this example).

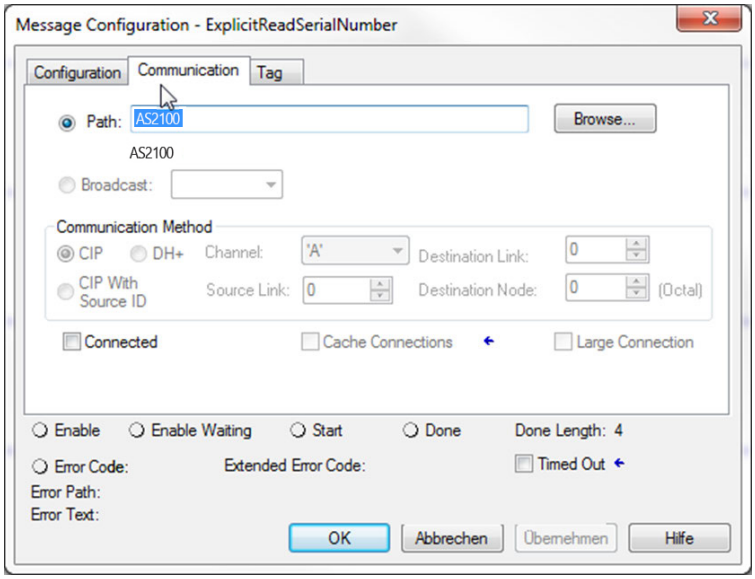

Figure 18: Message configuration (MSG) – Communication tab: Configurations used to read the “Serial Number” (in this example).

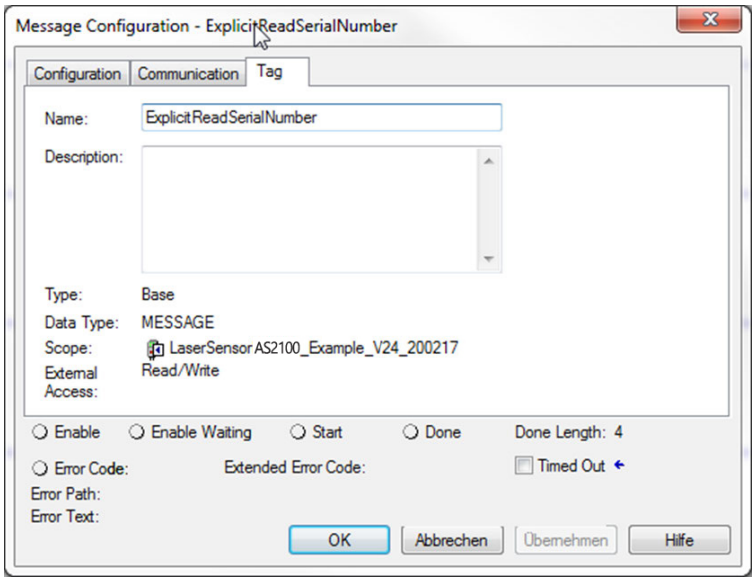

Figure 19: Message configuration (MSG) – Tag tab: No configuration used (in this example)

In of case of an error the Error Code and Extended Error Code in the .ER tag of the corresponding parameter must be evaluated. See figure 20 for more details.

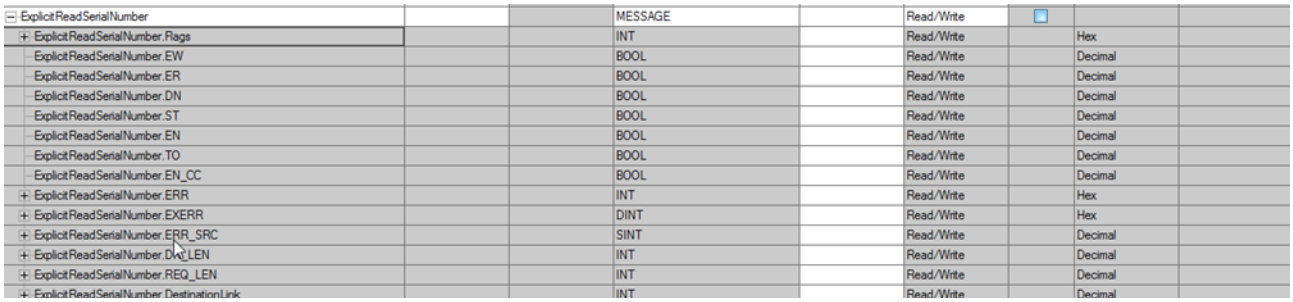

Figure 20: Message configuration (MSG) – .ER tag of SerialNumber: This tag will be set in an error condition / error case.

10.4.2 Parameter initialization

For EtherNet/IP™ no specific parameter initialization procedure is used during the establishment of the connection. Consequential all device parameters can be simple configured after the connection is established by using the acyclic read and write services (MSG blocks) at the system start or if needed at anytime during operation.

10.4.3 Serial number – Read

The routines in figure 21 show the acyclic read service (MSG) to read the serial number of the module. This read service can be triggered with the associated controller tag "Serial_Number_Read_Ctrl". So that this acyclic message instruction is only done once, the OSR (One Shot Rising) instruction block is used in addition.

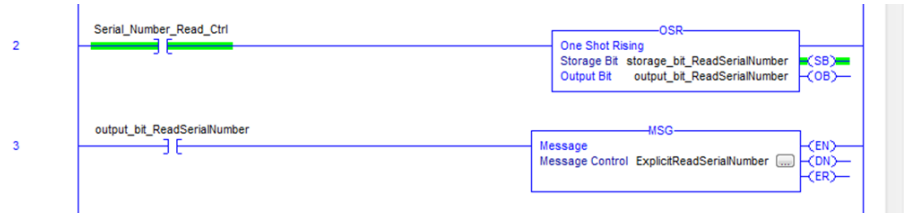

Figure 21: Main Program – Main Routine 2 & 3: Acyclic service (MSG) to read "Serial Number" of the device.

10.4.4 Distance unit – Read

The routines in figure 22 show the acyclic read service (MSG) to read the distance unit of the module. This read service can be triggered with the associated controller tag "Distance_Unit_Read_Ctrl". So that this acyclic message instruction is only done once, the OSR (One Shot Rising) instruction block is used in addition.

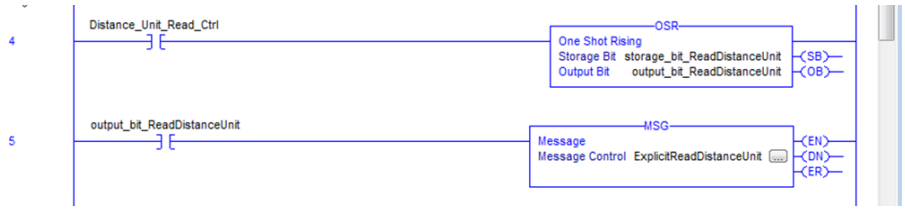

Figure 22: Main Program – Main Routine 4 & 5: Acyclic service (MSG) to read "Distance Unit" of the device.

10.4.5 Distance unit – Write

The routines in figure 23 show the acyclic write service (MSG) to write the distance unit of the module. This write service can be triggered with the associated controller tag "Distance_Unit_Write_Ctrl". So that this acyclic message instruction is only done once, the OSR (One Shot Rising) instruction block is used in addition.

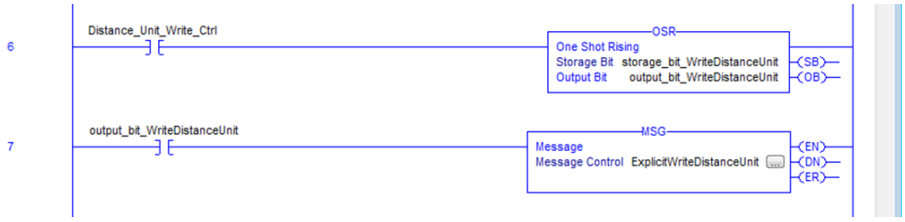

Figure 23: Main Program – Main Routine 6 & 7: Acyclic service (MSG) to write "Distance Unit" of the device.

10.5 Reset acyclic values

In this example the controller tags "Distance_Unit_Read" and "Serial_Number" (see chapter 9 for the controller tag list) can be cleared by the associated controller tag "Reset_Acyclic_Values". See figure 24 for the corresponding routines used to reset the acyclic values.

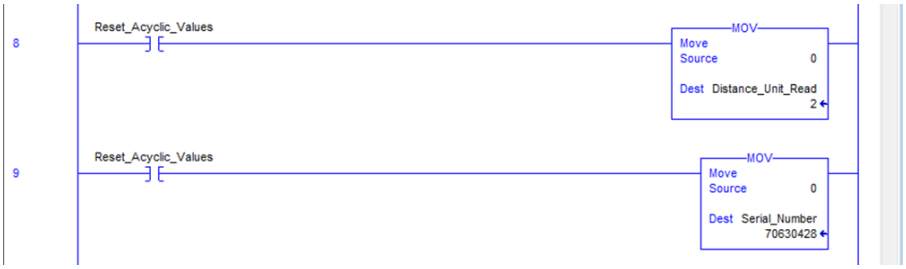

Figure 24: Main Program – Main Routine 8 & 9: Reset some controller tags used for acyclic read services.

11 IP parameter

There are various poss following possibilities IP parameter change

There are various possibilities to change the IP parameter of a selected module / device. See chapter 11.1 and 11.2 for details when using the Logix Designer software or the RSLinx tool.

Remark: In general the IP parameters are changed generically without exception with the acyclic service "Set Attribute Single" via the object 0xF5 / Instance 0x01 / Attribute 5.

11.1 Logix Designer

The IP parameter can be changed according figure 25 in the module properties. There will be a warning to indicate that the access to the device will be lost.

Remark: After the change of the IP parameter, the access to the device will then be lost because of different IP parameter in the PLC project and the device.

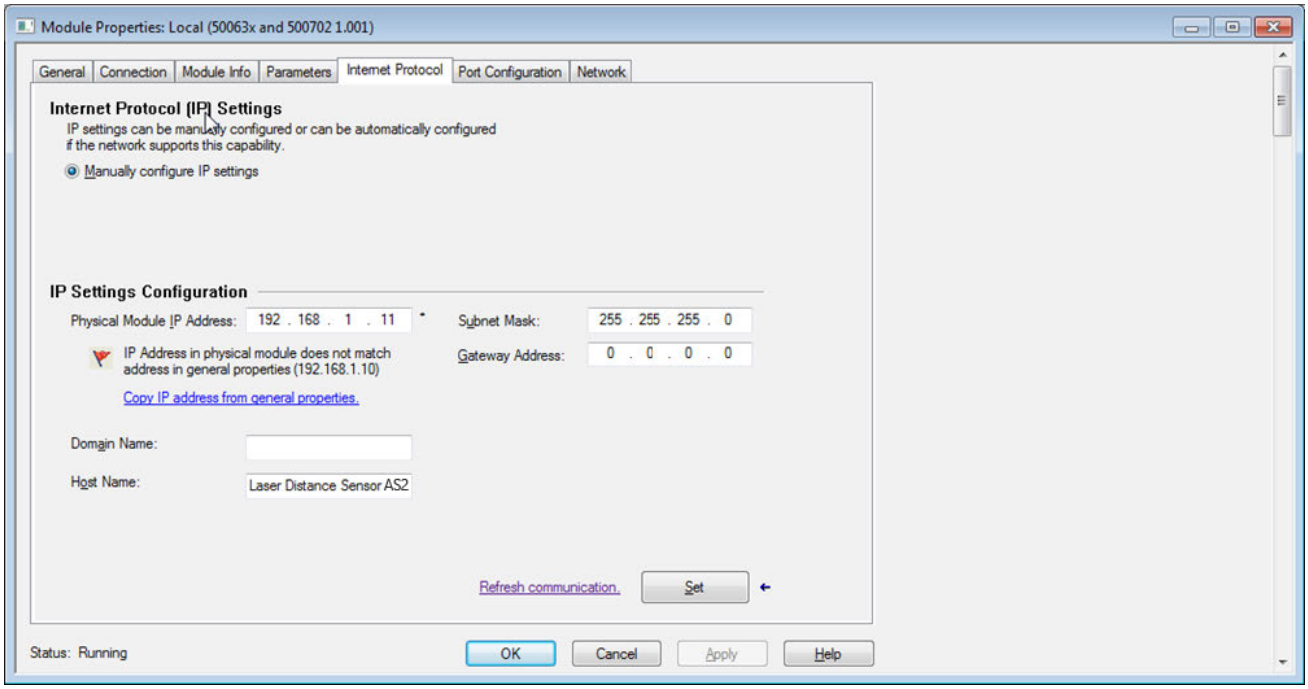

Figure 25: Module properties (Internet Protocol tab) – Possibility to change IP parameter (Address, subnet mask, etc). Warning: After change of IP address, no more access to the device possible.

11.2 RSLinx

The RSLinx tool is integrated in the Logix Designer software and basically required to connect to the PLC. This tool scans the network and shows all available devices (scanner and adapter). In figure 26 the scanned network with the Laser Distance Sensor and used PLC is shown.

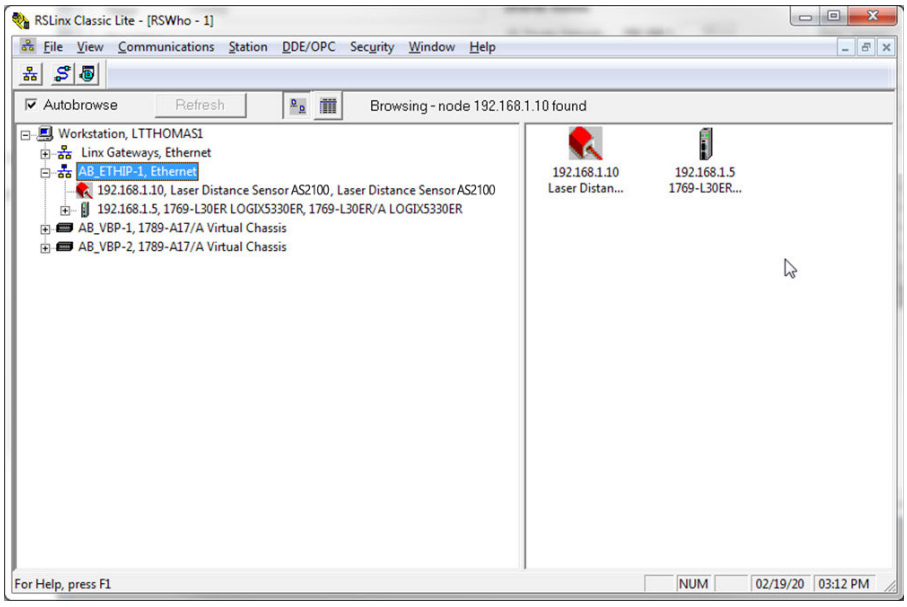

Figure 26: RSLinx Classic Lite tool (integrated in Logix Designer software) – Network scan: Display all available scanners and adapters.

The IP parameter can be simple changed with this tool. For details how to do this, see figure 27 and 28.

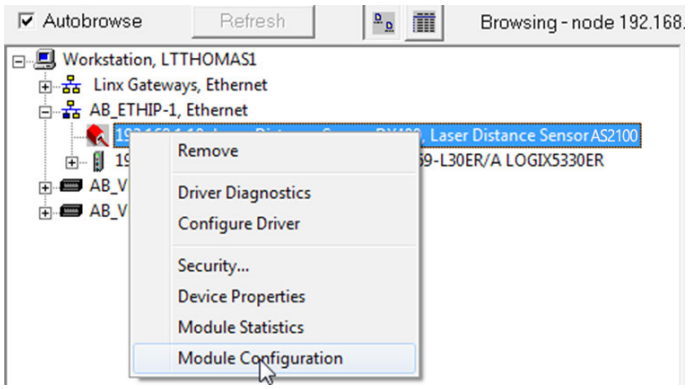

Figure 27: RSLinx Classic Lite tool – Context menu of the desired device –› Module Configuration: Module configuration window.

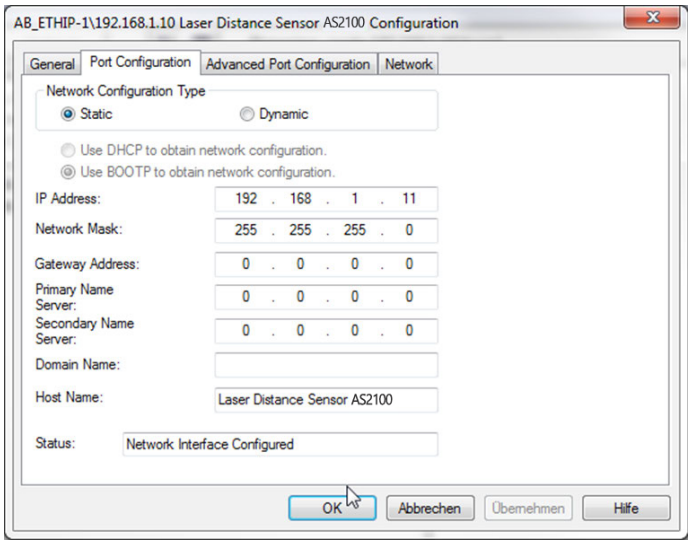

Figure 28: RSLinx Classic Lite tool – Module Configuration (Port Configuration tab): Change of IP parameters e.g. IP address.

After the IP parameter change (new IP: 192.168.1.11) of the selected device (see figure 28) the "old device" (old IP: 192.168.1.10) will be marked as no longer available. See figure 29 for details. At the same time the device with the new IP parameter (192.168.1.11) is now available in the network.

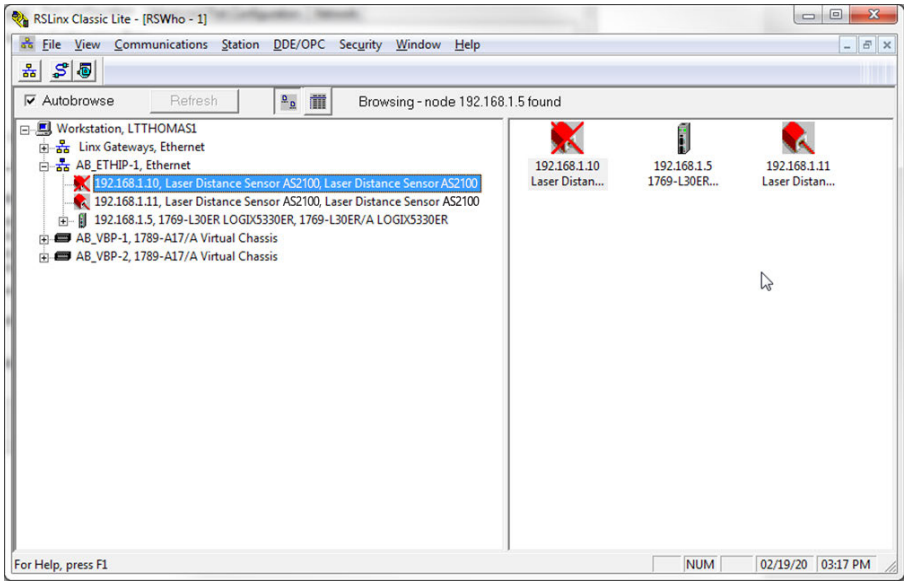

Figure 29: RSLinx Classic Lite tool – Network scan: Display all available and no longer available scanners and adapters.

In addition to the configuration of the IP parameter, the network configuration type can also be configured. Available network configuration types: Static, DHCP and BOOTP.

Remark: For the DHCP and BOOTP types a corresponding BOOTP / DHCP server is required for the assignment of the IP parameter. In figure 30 an example of the simple test tool from Rockwell "BOOTP/DHCP Server" (free-of-charge) is shown.

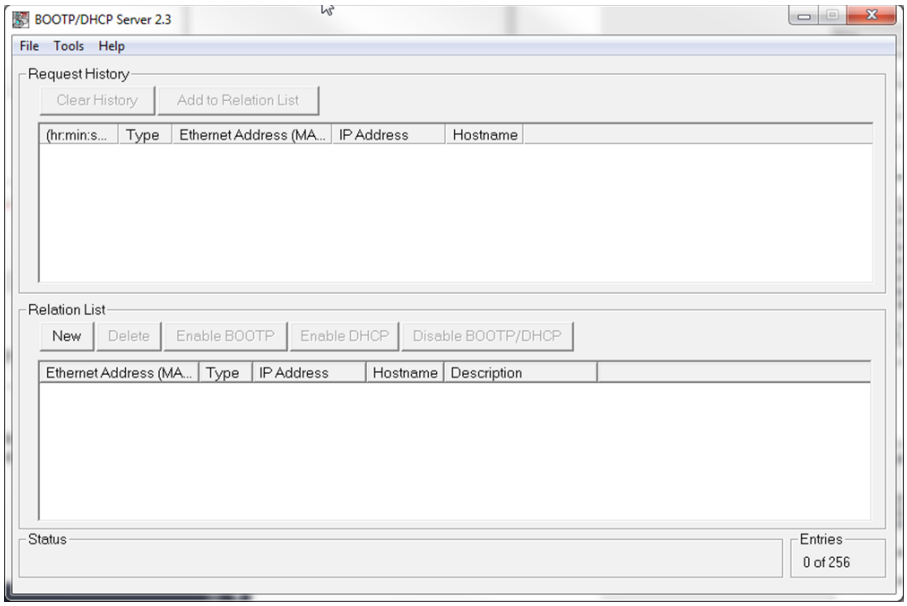

Figure 30: BOOTP/DHCP Server tool (Simple test tool from Rockwell) – BOOTP / DHCP server to assign IP addresses to devices on the network. Used for dynamic network configuration types (BOOTP, DHCP).

12 Glossary

AOP	Add On Profile key to unlock additional features (integrated in the EDS file).
BOOTP / DHCP	Different network configuration type: Bootstrap Protocol (BOOTP) and Dynamic Host Configuration Protocol (DHCP).
EDS	Electronic Data Sheet file. Describes the properties of an adapter or scanner device.
EtherNet/IP™	EtherNet/IP™ is one of the most popular Industrial Ethernet interfaces.
MOV	Move instruction to move a constant or the content of one memory location to another. Detailed information can be found in the Rockwell documentation.
MSG	Message instruction to use acyclic read or write services. Detailed information can be found in the Rockwell documentation.
OSR	One Shot Rising instruction to set or clear the output bit depending on the status of the storage bit. Detailed information can be found in the Rockwell documentation.
PLC	Programmable Logic Controller
Process data	Cyclic data communication of the Industrial Ethernet interfaces.
RPI	Requested Packet Interval. Cyclic process data exchange interval requested for a module / adapter.