

# **BALLUFF**

*sensors worldwide*

**IO-Link Device  
Add-On Instruction  
User Guide**

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## 1.0 Scope

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- 1.1 This User Guide describes the installation, use and maintenance of the Add-On Instruction (AOI) software module for Balluff IO-Link Devices. This software module is designed for use with RSLogix5000.
- 1.2 Prerequisite; set-up of IO-Link Master AOI, using IO-Link Master AOI User Guide.

## 2.0 Products

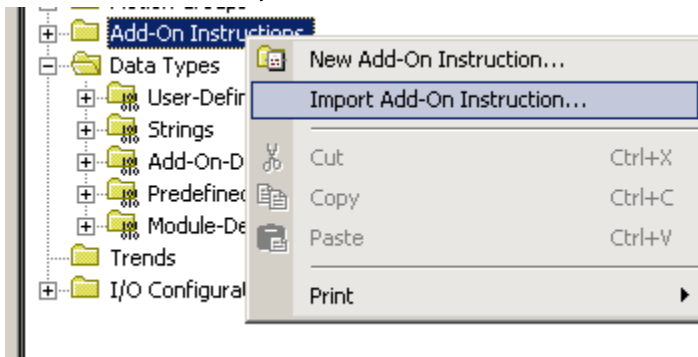
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- 2.1 This guide was developed for use in conjunction with the AOI software module for Balluff's IO-Link Master device. This software module is available for download at the web site [www.Balluff.com/AOI](http://www.Balluff.com/AOI).
- 2.2 The Balluff AOI software module was developed for use with a Balluff IO-Link Device in conjunction with the Balluff EtherNet/IP Connectivity block BNI EIP-502-105-Z015 (hardware version 4.0, firmware version 2.7). Although this Add-On Instruction User Guide covers many Balluff IO-Link devices, each device has a unique AOI software module.
- 2.3 For the development of this software module and hardware configuration, the following system components were used and validated:
  - 2.3.1 RSLogix5000, version 18.01 (or later)
  - 2.3.2 Rockwell 1756-L63 controller

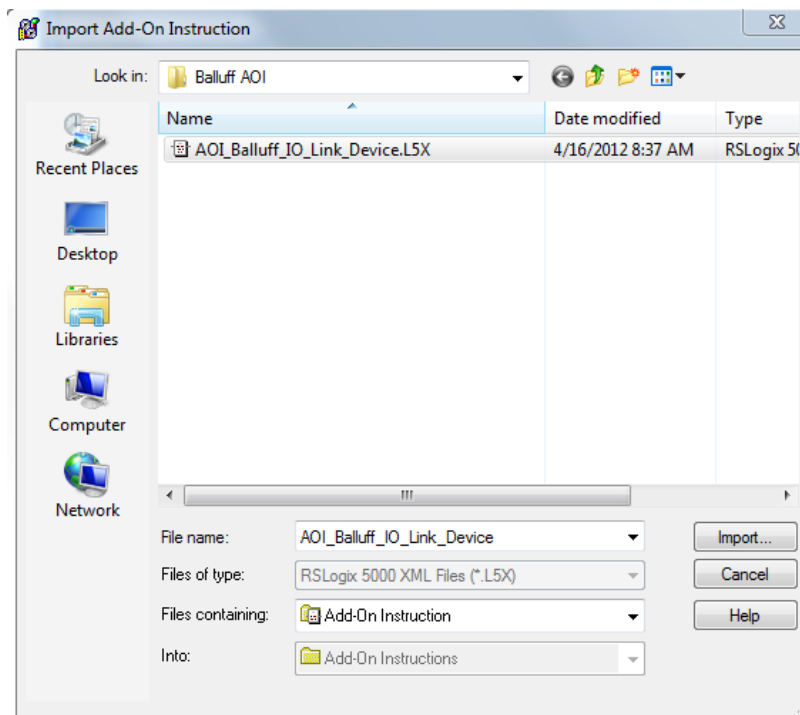
## 3.0 Instructions

- 3.1 This section describes the process for installing and using the AOI module. This is a three-step process that must be followed sequentially: complete the configuration of Balluff BNI EIP-502-105-Z015 module with its associated AOI; import AOI module along with all associated UDTs; and create new ladder logic with AOI modules. In addition, some Balluff IO-Link devices may require additional logic for configuring the hardware for application-specific features. This configuration process is described in section 3.3 below.
- 3.2 Configuration of Balluff BNI EIP-502-105-Z015 module and associated AOI
  - 3.2.1 Follow the User Guide for the IO-Link Master AOI, which can be found at [www.Balluff.com/AOI](http://www.Balluff.com/AOI). This step of configuring the IO-Link Master must be completed before any of the following steps, including hardware configuration of an IO-Link device, can be initiated.
- 3.3 Hardware configuration of the Balluff IO-Link device.
  - 3.3.1 Some devices include application-specific features that must be configured using explicit messages. If this hardware configuration is required based on requirements of both the device and the application, please refer to the reference Balluff Tech Note.
- 3.4 Import Balluff IO-Link Device AOI

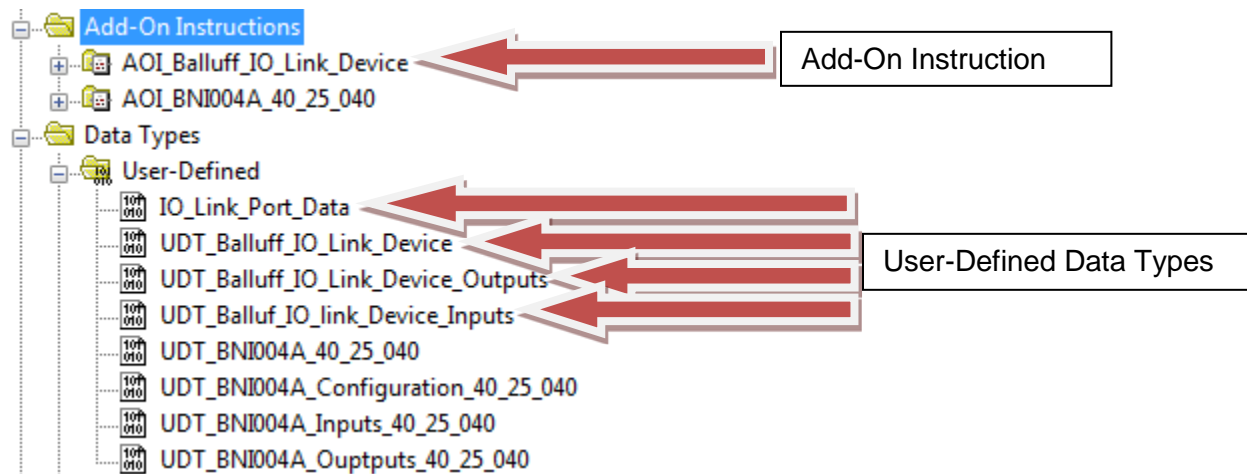
- 3.4.1 Right click on the Add-On Instructions element of the Controller Organizer to view a menu that includes "Import Add-On Instruction..." as shown below:



3.4.2 Locate your folder containing the downloaded Balluff AOI modules, highlight .L5X file and click *Import...*

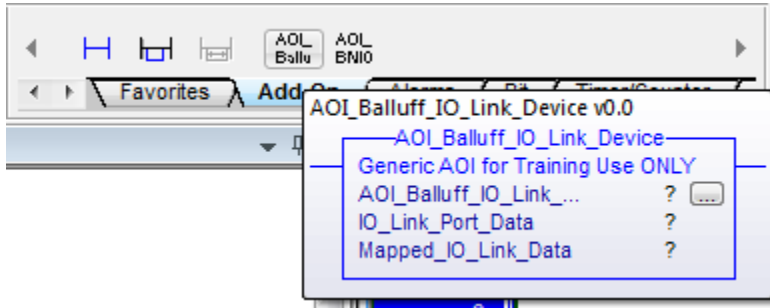


3.4.3 If the operation is successful, all UDTs associated with the AOI module will be imported into the project along with the AOI. This can be verified by checking the User-Defined element under Data Types in the Controller Organizer.

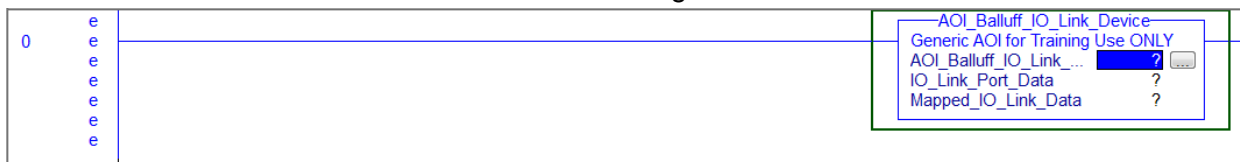


### 3.5 Create logic using RSLogix5000

3.5.1 Once an AOI has been imported, it can be used in the same manner as other ladder instructions. A new Element Group tab will be displayed in RSLogix5000's Language Element toolbar. This is shown here with the hover window information displayed:

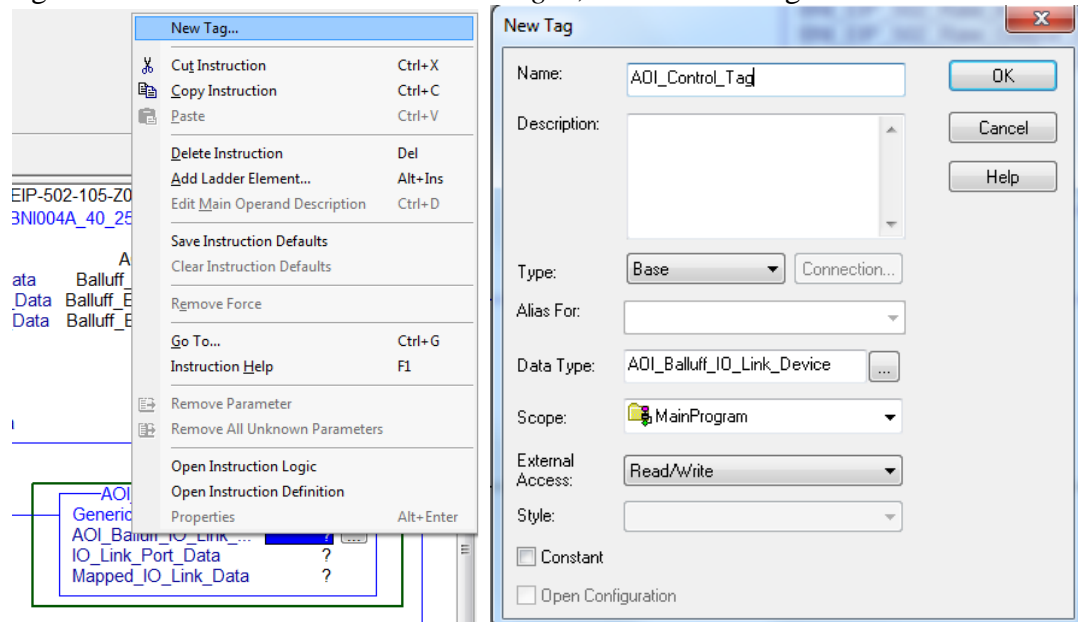


The AOI module can now be added to a rung of ladder:

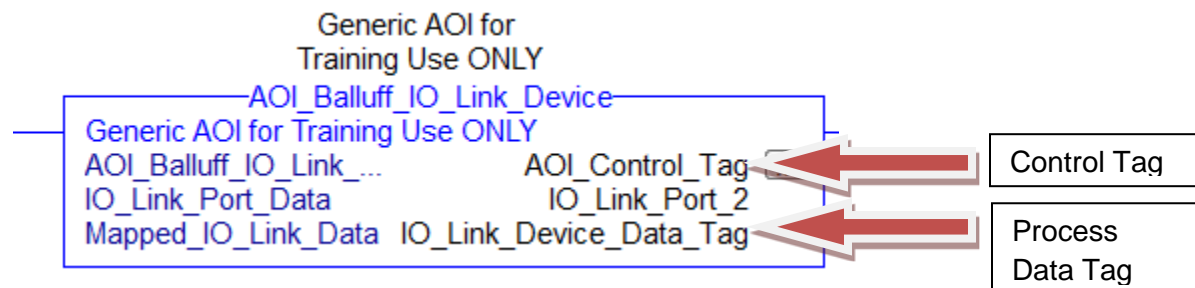


3.5.2 All parameters must be defined with tags of valid data type as defined by the AOI module. The user should create each Tag Name relevant to the user's project.

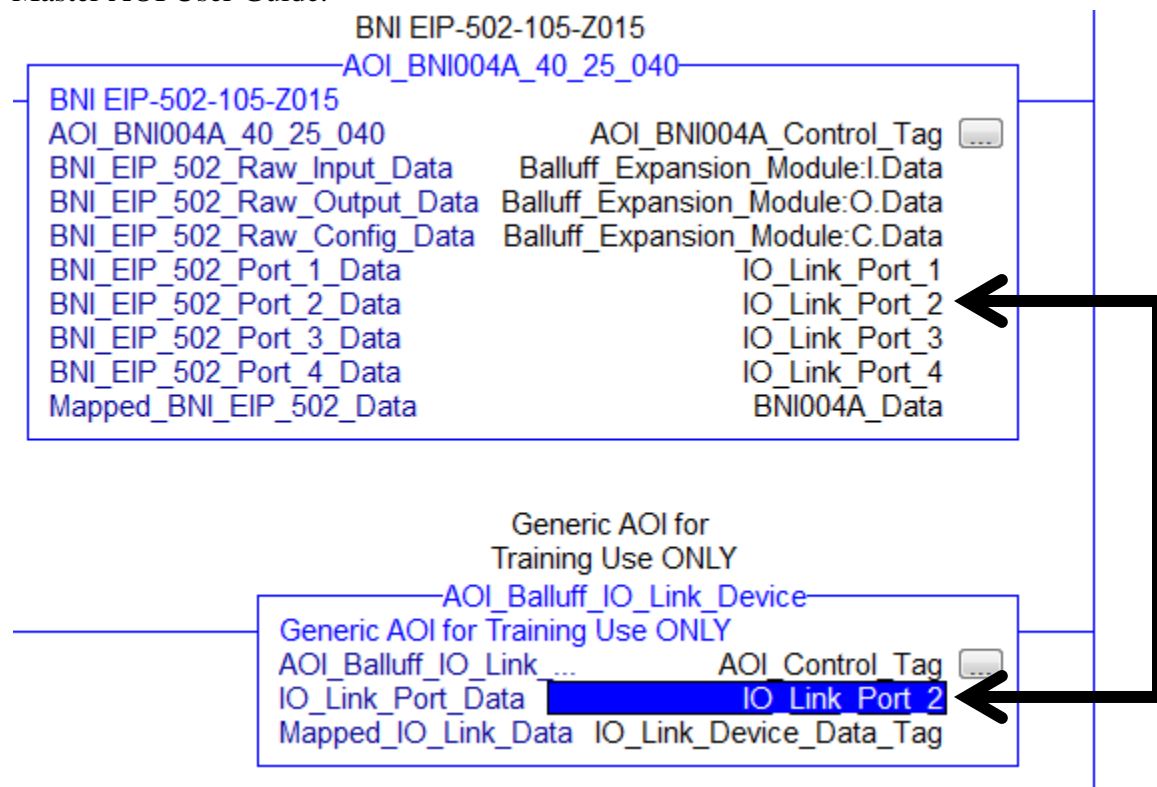
3.5.2.1 There are only two tags that must be created; first the AOI Control Tag this is the first tag location on the AOI. To guarantee that the new tag uses the correct data type, simply right click on the "?" and choose *New Tag...*, then create a tag name.



- 3.5.2.2 Second the IO-Link Device Data Tag, this the last tag location on the AOI. This tag contains the defined IO-Link Devices Process Data. This is the tag that will contain the data specific to the device for use in the logic of the project. For more information on what data is included in this tag, please refer to Section 4 which describes each UDT.



- 3.5.2.3 Finally, drag the corresponding IO-Link Port Tag from the IO-Link Master AOI to the *IO\_Link\_Port\_Data* tag location; this is the middle tag location. Also see; IO-Link Master AOI User Guide.



## 4.0 User-Defined Data Type (UDT)

- 4.1 The User-Defined Data Type for the Add-On Instruction defines the interface for the AOI and the user's project. The highest level UDT is usually comprised of two sub-UDT components: Input (I) and Output (O). However, Input-only devices will not typically include an Output UDT. One additional UDT is defined, IO\_Link\_Port\_Data, for integrating data through configured IO-Link ports.
- 4.2 The highest level UDT consists of the two sub-UDT.

Name:




UDT\_Balluff\_IO\_Link\_Device

Description:

Balluff IO-link IO Map

Members:

Data Type Size: 24 byte(s)

	Name	Data Type	Style
	I	UDT_Balluff_IO_link_Device_Inputs	
	O	UDT_Balluff_IO_Link_Device_Outputs	
			



- 4.3 The Input UDT consists of all inputs associated with the Balluff IO-Link Device. Each Balluff IO-Link Device Input UDT will contain the Input Data for that unique device. The definition of most input elements can be found in the corresponding IO-Link Devices User Manual, which can be located at the Balluff website ([www.balluff.com](http://www.balluff.com)) or by contacting Balluff Technical Support([technical.support@balluff.com](mailto:technical.support@balluff.com)). The IO-Link Diagnostic elements are not included in the device manuals, but are included in this section.

Name:

Description: 

Balluff IO-Link  
Device Input Map

Members: Data Type Size: 20 byte(s)

	Name	Data Type	Style	Description
<input type="checkbox"/>	Input_0_0	BOOL	Decimal	
<input type="checkbox"/>	Input_0_1	BOOL	Decimal	
<input type="checkbox"/>	Input_1_0	BOOL	Decimal	
<input type="checkbox"/>	Input_1_1	BOOL	Decimal	

- 4.3.1 **Note:** There are IO-Link Diagnostic elements that are common to all Input UDTs, they are defines as follows:

Device_OK	BOOL
Mismatch_Fault	BOOL
Comm_Fault	BOOL
Validation_Failed	BOOL
Event_1_Error_Code	SINT
Event_1_Add_Code_1	SINT
Event_1_Add_Code_2	SINT
Event_2_Error_Code	SINT
Event_2_Add_Code_1	SINT
Event_2_Add_Code_2	SINT
Event_3_Error_Code	SINT
Event_3_Add_Code_1	SINT
Event_3_Add_Code_2	SINT

- 4.3.2
- 4.3.2.1 *Device\_OK*: Diagnostic bit; when high (1), represents that the corresponding IO-Link Port on the EtherNet/IP Master Module (BNI004A) is set-up as IO-Link, there is an IO-Link device connected to the port, and that the connected device matches the correct Vendor and Device ID Number associated with the IO-Link Device AOI.
- 4.3.2.2 *Mismatch\_Fault*: Diagnostic bit; when high (1), represents that the corresponding IO-Link Port on the EtherNet/IP Master Module (BNI004A) is set-up as IO-Link, there is an IO-Link device connected to the port, **but** that the connected device **does not** matches the correct Vendor and Device ID Number associated with the IO-Link Device AOI.
- 4.3.2.3 *Comm\_Fault*: Diagnostic bit; when high (1), represents that the corresponding IO-Link Port on the EtherNet/IP Master Module (BNI004A) is set-up as IO-Link, but there is not

an IO-Link device connected to the port. This fault is usually associated with a short or opens on the cable between the IO-Link port and the IO-Link Device.

4.3.2.4 *Validation\_Error*: when high (1), represents a validation error associated with an incorrect Vendor or Device ID number. Consult the IO-Link Master AOI User Guide for more information

4.3.2.5 *Event\_Error\_Code* and *Additional\_Code*; when a fault occurs, these elements will contain the error code and additional data that defines the fault. The definition of each error code and additional code can be found in the corresponding devices User Manual, which can be located at the Balluff website ([www.balluff.com](http://www.balluff.com)) or by contacting Balluff Technical Support ([technical.support@balluff.com](mailto:technical.support@balluff.com)).

4.4 The Output UDT consists of all outputs associated with the Balluff IO-Link Device. Each Balluff IO-Link Device Output UDT will contain the Output Data for that unique device, unless it is an Input-only device. The definition of each element can be found in the corresponding devices User Manual, which can be located at the Balluff website ([www.balluff.com](http://www.balluff.com)) or by contacting Balluff Technical Support ([technical.support@balluff.com](mailto:technical.support@balluff.com)).

Name:

Description: 

Balluff IO-Link  
Device Output Map

Members: Data Type Size: 4 byte(s)

	Name	Data Type	Style	Desc
<input checked="" type="checkbox"/>	Output_0_0	BOOL	Decimal	
<input type="checkbox"/>	Output_0_1	BOOL	Decimal	
<input type="checkbox"/>	Output_1_0	BOOL	Decimal	
<input type="checkbox"/>	Output_1_1	BOOL	Decimal	

- 4.5 The IO\_Link\_Port\_Data UDT consists of the 48 input bytes (SINTs) and 48 output bytes (SINTs) that the IO-Link master allocates to each port. Under normal operating conditions, the user will not be aware of any data being passed through this UDT. The AOI automates the parsing of the data for each port and allows the user to access the data directly without mapping each of the four port's data into the master's single data buffer. This UDT is used for both the IO-Link master AOI as well as each IO-Link slave AOI. The master and slave must share the same tag name for the corresponding port. Refer to page 7 (3.4.3.3) for a visual representation.

Name:

Description:

Members: Data Type Size: 96 byte(s)

	Name	Data Type	Style	Description	External Access
	Inputs	SINT[48]	Decimal		Read/Write
	Outputs	SINT[48]	Decimal		Read/Write
10 <sup>0</sup> 010					

- 4.5.1 Inputs – this 48-byte SINT array contains all raw input data values being passed from the IO-Link slave device input array to the master device input array.
- 4.5.2 Outputs – this 48-byte SINT array contain all raw output data values being passed from the IO-Link slave device output array to the master device output array.

## 5.0 Software Validation

5.1 If the preceding instructions (4.0 Instructions) have been successfully completed, the software module will be integrated into the RSLogix5000 project and it will be ready to use. The user will be able to verify proper operation of the AOI by monitoring the transition of a controller-scoped tag and its corresponding real world device. This section describes a sampling technique that will verify the proper operation of one input bit.

5.2 This example describes how to validate the transition of a controller-scoped input tag.

5.2.1 This example uses the Device\_OK bit although any input bit will suffice. The key point of this example is to ensure that the AOI bit corresponding to the selected input bit follows it. After physically connecting the IO-Link device to the master on a port that is configured for IO-Link Mode (Port LED is solid green), the Device\_OK bit should transition to ON or “high” as shown here:

Scope: AOIs_3_11_12 Show: All Tags							
Name	Value	Force Mask	Style	Data Type	Description		
IO_Link_Device_Data_Tag	{...}	{...}		UDT_Balluff_IO_...	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I	{...}	{...}		UDT_Balluff_IO_...	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Device_OK	1		Decimal	BOOL	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Mismatch_Fault	0		Decimal	BOOL	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Comm_Fault	0		Decimal	BOOL	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Validation_Failed	0		Decimal	BOOL	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_1_Error_Code	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_1_Add_Code_1	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_1_Add_Code_2	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_2_Error_Code	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_2_Add_Code_1	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_2_Add_Code_2	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_3_Error_Code	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_3_Add_Code_1	0		Decimal	SINT	Balluff IO-Link IO ...		
IO_Link_Device_Data_Tag.I.Event_3_Add_Code_2	0		Decimal	SINT	Balluff IO-Link IO ...		
IOLink_Master_16:C	{...}	{...}		AB:ETHERNET_...			
IOLink_Master_16:I	{...}	{...}		AB:ETHERNET_...			
IOLink_Master_16:O	{...}	{...}		AB:ETHERNET_...			
Port1_Data	{...}	{...}		IO_Link_Port_Data			
Port2_Data	{...}	{...}		IO_Link_Port_Data			
Port3_Data	{...}	{...}		IO_Link_Port_Data			
Port4_Data	{...}	{...}		IO_Link_Port_Data			

Note that when the IO-Link cable connecting the device to the IO-Link master is disconnected, this Device\_OK bit should transition to OFF or “low”.

5.2.2 While the IO-Link device is properly connected to the IO-Link master, this bit (IO\_Link\_Device\_Data\_Tag.I.Device\_OK) should be ON or “high”. If this is not the case, please refer to Section 6.0 Troubleshooting.

## 6.0 Troubleshooting Tips

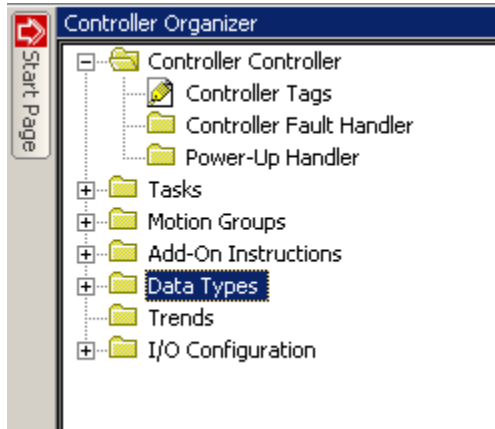
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- 6.1 If the user does not obtain the correct data in the defined user tags, please ensure that the following match those described in this User Guide:
  - 6.1.1 Hardware System layout – system must consist of the following:
    - 6.1.1.1 Rockwell Automation Logix processor
    - 6.1.1.2 Rockwell Logix EtherNet/IP network bridge
    - 6.1.1.3 ODVA-compliant EtherNet/IP physical media
  - 6.1.2 Software configurations – RSLogix5000 version 18.01 or higher must be used with this Add-On Instruction
  - 6.1.3 Revision levels
- 6.2 Verify the correct LED states; on the IO-Link Port of the EtherNet/IP Master Module (BNI004A), the LED should be solid GREEN, while the IO-Link LED on the IO-Link device should flash.
- 6.3 If the IO-Link Port of the EtherNet/IP Master Module (BNI004A) has a flashing GREEN LED, then the IO-Link device is not connected properly. Please ensure that the cable is not broken and both ends are connected securely.
- 6.4 If the IO-Link Port of the EtherNet/IP Master Module (BNI004A) is OFF, then the Port is not configured for IO-Link mode. Please refer to the BNI004A AOI User Guide for guidance on configuring this port for IO-Link mode.
- 6.5 If the system still does not respond properly, please contact the Balluff Technical Support Group at [technicalsupport@balluff.com](mailto:technicalsupport@balluff.com).

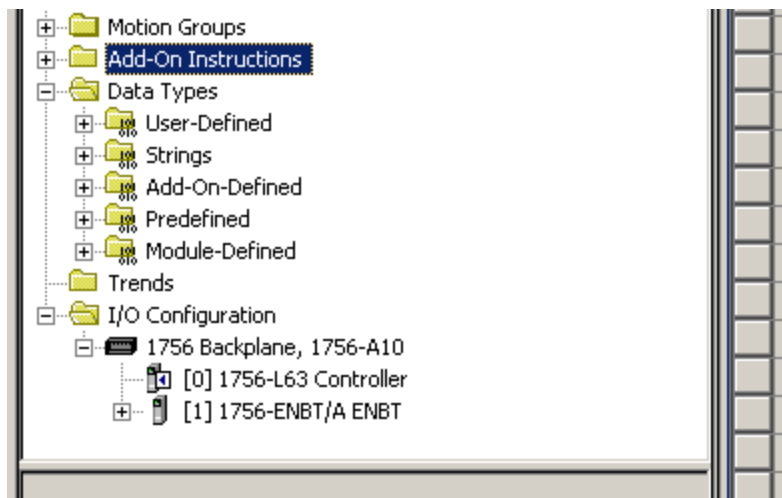
## 7.0 Definitions

7.1 The following terms are used in this guide with these definitions:

7.1.1 Controller Organizer – the area of RSLogix5000 where all project components can be accessed. If this toolbar is not visible, it can be opened by pressing Alt+0.



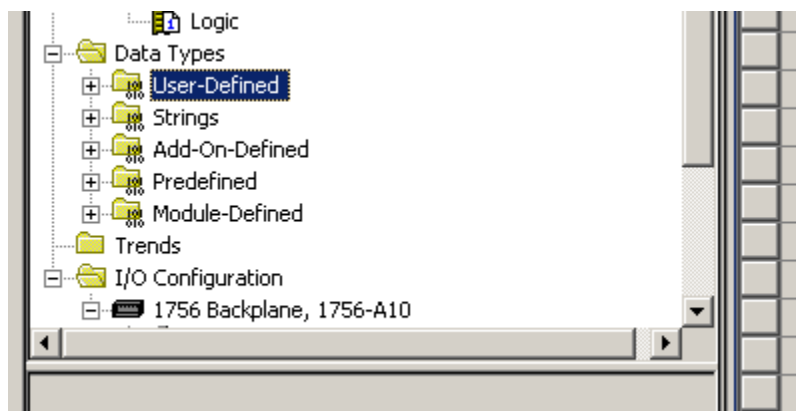
7.1.2 AOI – Add On Instruction – reusable software module created with RSLogix5000. Balluff's AOI modules are composed of UDTs and associated logic to implement control algorithms. This module is hardware specific. All AOI modules contained in a project will be located in the Controller Organizer as shown below:



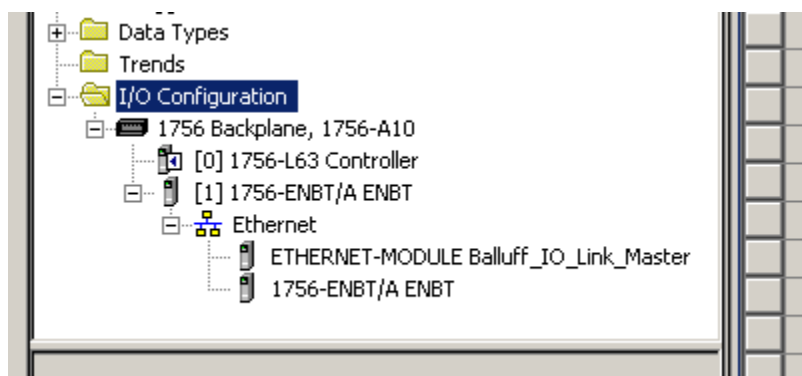
7.1.3 Controller scoped tag – a tag of any valid data type that is available to all programs within a project and must be used uniformly throughout the entire project.

7.1.4 AOI Parameter – a tag of any valid data type that is created during the definition of the AOI module and is isolated to that AOI. Its scope is limited to the each discrete use of AOI function.

- 7.1.5 UDT – User Defined Data Type – reusable software module created with RSLogix5000. Balluff’s UDTs define the input and output tag names to be used when implementing our AOI modules. A UDT can be composed of any combination of standard Data Types defined by RSLogix5000 or other UDTs. All UDTs contained in a project will be located in the Controller Organizer as shown below:



- 7.1.6 I/O Configuration Tree – the area of RSLogix5000 where all physical, or “real world”, Inputs and Outputs associated with the controller are defined. One example of an I/O Configuration Tree is shown below:



- 7.1.7 EDS – Electronic Data Sheet – software configuration file that defines how a hardware product will communicate with the network master using EtherNet/IP. The format and content of an EDS is defined by ODVA, the controlling organization for EtherNet/IP specifications.

## 8.0 Related Documents

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- 8.1 The following Balluff documents support the release of this User Guide and its related software module. Each of these documents can be obtained by contacting Balluff Technical Support at [technical.support@balluff.com](mailto:technical.support@balluff.com)
- 8.1.1 IO-Link Master AOI User Guide
  - 8.1.2 Balluff device-specific hardware User Guides
  - 8.1.3 Using Explicit Messages to Configure IO-Link Devices Tech Note

## 9.0 References

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- 9.1 None