



<AutomationML/>

**The Glue for Seamless
Automation Engineering**

**Application Recommendation Extension:
IO-Link for Automation Project
Configuration**

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1 Introduction

A very frequently occurring task within the planning process of production and automation systems is the exchange of automation project configuration information of automation system devices between ECAD and PLC systems. To avoid multiple engineering in the participating systems ECAD and PLC systems need an interface for sharing this information.

In case of beginning engineering in the ECAD tool certain rules must be observed to get the hardware information in the correct location in the PLC tool. In case of beginning engineering in the PLC tool non placed functions must be placed and operated in the ECAD tool.

The application recommendation "Automation Project Configuration" describes these workflows and the method of hardware configuration modelling using AutomationML and refers in several items to bus types. Because not all existing and upcoming bus types can be described in the application recommendation "Automation Project Configuration" the specific extensions of each bus type shall be described in a separate bus specific specification.

This application recommendation describes the specific extensions for the IO-Link communication system, which is point-to-point extension of field busses.

1.1 Basics

The data exchange format AutomationML which is standardising in the IEC 62714 standard is a neutral, free, and XML-based data format. It has been developed in order to support the data exchange between engineering tools in a heterogeneous engineering tool landscape.

Due to the different aspects of AutomationML the IEC 62714 consists of different parts.

Table 1 – Overview of AutomationML parts

Part / Document Identifier	Title	Description
Part 1 / WP Arch, V 2.0.0	Architecture and general requirements	This part specifies the general AutomationML architecture, the modelling of the engineering data, classes, instances, relations, references, hierarchies, basic AutomationML libraries and extended AutomationML concepts.
Part 2 / WP Lib V 2.0.0	Role class libraries	This part specifies additional AutomationML libraries.
Whitepaper / WP Comm V 1.0.0	Communication	This Whitepaper describes the modelling of Communication mechanisms in AutomationML
Whitepaper / WP eClass V 2.0.0	AutomationML and eCl@ss integration	This Whitepaper describes the integration of eCl@ss in AutomationML
Best Practice Recommendation / BPR MlingExp V 1.0.0	Multilingual expressions in AutomationML	This Whitepaper describes the handling of different texts for different languages in AutomationML
Best Practice Recommendation / BPR RefDes V 1.0.0	Modelling of Reference Designations	This Whitepaper describes the handling of reference designations following IEC 81346-1:2009-07 within AutomationML

1.2 References

The following documents are referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Extensible Markup Language (XML) 1.0:2004, W3C Recommendation (available at <<http://www.w3.org/TR/2004/REC-xml-20040204/>>)

IEC 62424:2008, Representation of process control engineering - Requests in P&I diagrams and data exchange between P&ID tools and PCE-CAE tools

Whitepaper AutomationML Part 1 – AutomationML Architecture, November 2018

Whitepaper AutomationML Part 2 – AutomationML Role Libraries, October 2014

Whitepaper AutomationML – AutomationML Communication, September 2014

Whitepaper AutomationML – AutomationML and eCI@ss Integration, November 2021

Best Practice Recommendation Multilingual expressions in AutomationML, March 2017

Best Practice Recommendation Modelling of Reference Designations, September 2017

Application Recommendation Automation Project Configuration, June 2021

IO-Link Interface and System Specification Version 1.1.3 June 2019

2 General notes regarding exchange of Automation Project Configuration data

The AutomationML export of Automation Project Configuration data is based on the application recommendation "Automation Project Configuration". This recommendation only describes extensions, additional definitions or not needed objects from AR APC. Extensions are realized by derivation from abstract base class extension defined by AR APC.

3 Modelling of IO-Link in Automation Project Configuration data with AutomationML

3.1 Subnet

A “**Subnet**” is not supported for this type of serial communication system.

3.2 DeviceItemIOLinkMaster

A “**DeviceItemIOLinkMaster**” is defined in AR APC as DeviceItem. An IO-Link Master is defined by the characteristic to have 2..n CommunicationPortIOLinks in relation of data exchange for operation mode.

A “**DeviceItemIOLinkMaster**” is derived from the abstract RoleClass “DeviceItemBusExtension” according AR APC.

Table 2 – Definition DeviceItemIOLinkMaster

Role class name	DeviceItemIOLinkMaster
Description	See AR APC V 1.3.0
Parent Class	AutomationProjectConfigurationRoleClassLib/DeviceItemBusExtension
Path for Element reference	AutomationProjectConfigurationIOLinkRoleClassLib/DeviceItemIOLinkMaster

3.3 DeviceItemIOLinkDevice

A “**DeviceItemIOLinkDevice**” is defined in AR APC as DeviceItem. An IO-Link-Device is defined by the characteristic to have exactly one CommunicationPortIOLink.

A “**DeviceItemIOLinkDevice**” is derived from the abstract RoleClass “DeviceItemBusExtension” according AR APC.

Table 3 – Definition DeviceItemIOLinkDevice

Role class name	DeviceItemIOLinkDevice
Description	See AR APC V 1.3.0
Parent Class	AutomationProjectConfigurationRoleClassLib/DeviceItemBusExtension
Path for Element reference	AutomationProjectConfigurationIOLinkRoleClassLib/DeviceItemIOLinkDevice

Note:

The VendorID, DeviceID, DeviceVariant and RevisionID are defined in the attribute “TypeIdentifier” of the DeviceItem using a leading “IODD:”. VendorID and DeviceID are mandatory, DeviceVariant and RevisionID are optional, see examples below.

Examples:

TypeIdentifier = “IODD:VendorID/DeviceID/DeviceVariant/RevisionID”

TypeIdentifier = “IODD:VendorID/DeviceID/DeviceVariant”

TypeIdentifier = “IODD:VendorID/DeviceID//RevisionID”

TypeIdentifier = “IODD:VendorID/DeviceID”

3.4 Node

A “**Node**” is not supported for this type of serial communication system.

3.5 CommunicationInterface

A “**CommunicationInterface**” is defined in AR APC.

The attribute “Type” shall have the value “IO-Link”

3.6 CommunicationPort

A “**CommunicationPort**” is defined in AR APC.

A DeviceItemIOLinkMaster can have 2..n Ports in relation of data exchange for operation mode, a DeviceItemIOLinkDevice shall have exactly one Port.

3.7 CommunicationPortIOLink

A “**CommunicationPortIOLink**” is derived from an “AutomationMLBaseRole”. It contains the following additional attributes:

Table 4 – Definition CommunicationPortIOLink

Role class name	CommunicationPortIOLink	
Description	A CommunicationPortIOLink is used to define additionally IO-Link bus specific attributes for the CommunicationPort <i>Note: CommunicationPortIOLink shall only be used for CommunicationPort objects.</i>	
Parent Class	AutomationMLBaseRole	
Path for Element reference	AutomationProjectConfigurationIOLinkRoleClassLib/CommunicationPortIOLink	
Attributes	"PortMode" (AttributeDataType="xs:string")	The attribute "PortMode" shall define the operating mode of the port. The attribute shall contain one of the values "IOL_MANUAL", "IOL_AUTOSTART", "DEACTIVATED", "DI_C/Q" or "DO_C/Q" according to IO-Link specification. This attribute is optional and only used on IO-Link Master. The default value is "DEACTIVATED".
	"ConfigurationWithPDCT" (AttributeDataType="xs:boolean")	The attribute "ConfigurationWithPDCT" shall define if the configuration uses a port configuration tool according to IO-Link specification. This attribute is optional and only used on IO-Link Master. The default value is "true".
	"ValidationAndBackup" (AttributeDataType="xs:int")	The attribute "ValidationAndBackup" shall define the inspection backup level according to IO-Link specification. This element contains the InspectionLevel to be performed by the Device and the Backup/Restore behavior: 0: No Device check 1: Type compatible Device V1.0 2: Type compatible Device V1.1 3: Type compatible Device V1.1, Backup + Restore 4: Type compatible Device V1.1, Restore 5 to 255: Reserved This attribute is optional and only used on an IO-Link Master.
	"PortCycleTime" (AttributeDataType="xs:int")	The attribute "PortCycleTime" shall define the PortCycleTime expected by the SMI client according to IO-Link specification. This attribute is optional.
	"VendorID" (AttributeDataType="xs:int")	The attribute "VendorID" shall define the VendorID from the connected DeviceItemIOLinkDevice according to IO-Link specification. This attribute is mandatory for an IO-Link Master if the "PortMode" is "IOL_MANUAL".
	"DeviceID" (AttributeDataType="xs:int")	The attribute "DeviceID" shall define the DeviceID from the connected DeviceItemIOLinkDevice according to IO-Link specification. This attribute is mandatory for an IO-Link Master if the "PortMode" is "IOL_MANUAL".
	"PDInLength" (AttributeDataType="xs:int")	The attribute "PDInLength" shall define the length of the input in bytes according to the PDInlength of the IO-Link specification. This attribute is optional and only used on IO-Link Master.
	"PDInBitLength" (AttributeData Type="xs:unsignedInt")	The attribute "PDInBitLength" shall define the length of the input in bits when the length is less than 16 bits according to the length section in ProcessDataIn of the IO-Link specification. If the attribute PDInBitLength is present the attribute "PDInLength" can be

		ignored. The range of allowed values is 0..15. The attribute is optional and only used on IO-Link masters.
	"PDOOutLength" (AttributeDataType="xs:int")	The attribute "PDOOutLength" shall define the length of the output in bytes according to the PDOOutLength of the IO-Link specification. This attribute is optional and only used on IO-Link Master.
	"POutBitLength" (AttributeData Type="xs: unsignedInt")	The attribute "PDOOutBitLength" shall define the length of the output in bits when the length is less than 16 bits according to the length section in ProcessDataOut of the IO-Link specification. If the attribute PDOOutBitLength is present the attribute "PDOOutLength" can be ignored. The range of allowed values is 0..15. The attribute is optional and only used on IO-Link masters.
	"PDInAddress" (AttributeDataType="xs:int")	The attribute "PDInAddress" shall define the start address of the input area according to the PDInAddress of the IO-Link specification. This attribute is optional and only used on IO-Link Master.
	"PDInBitOffset" (AttributeData Type="xs: unsignedInt")	The attribute "PDInBitOffset" defines the bit offset within the PDInAddress. The range of allowed values is 0..7. The default value is "0". The attribute is optional and only used on IO-Link masters.
	"PDOOutAddress" (AttributeDataType="xs:int")	The attribute "PDOOutAddress" shall define the start address of the output area according to the PDOOutAddress of the IO-Link specification. This attribute is optional and only used on IO-Link Master.
	"PDOOutBitOffset" (AttributeData Type="xs: unsignedInt")	The attribute "PDOOutBitOffset" defines the bit offset within the PDOOutAddress. The range of allowed values is 0..7. The default value is "0". The attribute is optional and only used on IO-Link masters.
	"DeviceAlias" (AttributeDataType="xs:string")	The attribute "DeviceAlias" shall define a user configurable name to address the specific Device by this name. This attribute is optional.