

IO-Link P8S PLC Integration

IO-Link service data Add-On Instruction + process data parser function for Rockwell ControlLogix / CompactLogix (RSLogix5000 V16 or higher) PLC systems in combination with a EtherNet/IP IO-Link Master

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1. About this document

Please read this chapter carefully before working with this documentation and the PARKER IO-Link device.

1.1. Function of this document

These instructions have been designed for the technical personnel for the use of the IO-Link PLC blocks.

These instructions do not provide instructions for operating the machine, the system or the vehicle on which IO-Link devices are, or will be, integrated. Information on this is to be found in the appropriate operating instructions of the machine, the system or the vehicle.

1.2. Target group

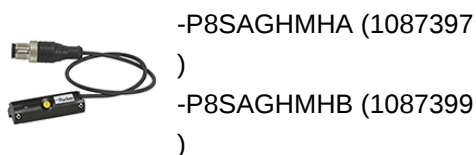
These instructions are addressed to programming engineers and the operators of machines and systems which are operated by one or several IO-Link devices. They also address people, who connect the IO-Link device via an IO-Link-Master-Gateway to a PLC-Control for data exchange.

1.3. Scope

These function blocks are device type-specific and only suitable for the following PARKER IO-Link devices.

Device family: Magnetic cylinder sensors

Device ID: 409856

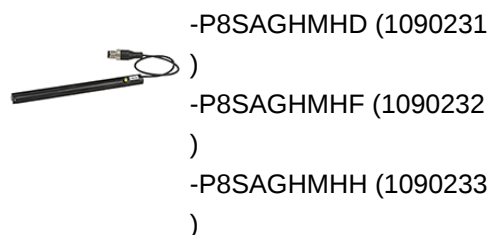


-P8SAGHMHA (1087397)

)

-P8SAGHMB (1087399)

)



-P8SAGHMHD (1090231)

)

-P8SAGMHF (1090232)

)

-P8SAGMHH (1090233)

)

The function block "FB_PARKER_P8S_EIP" interprets the call-up of the acyclic service data.

The function "F_PARKER_PDInParser_P8S" interprets the process data telegram sent from the IO-Link device.

The functionality of these PLC blocks depends on the IO-Link parameter set described by the IODD. This means, that these blocks also may be used for other PARKER devices (e.g. new device variants) with identical IO-Link parameter sets.

2. Service data function block

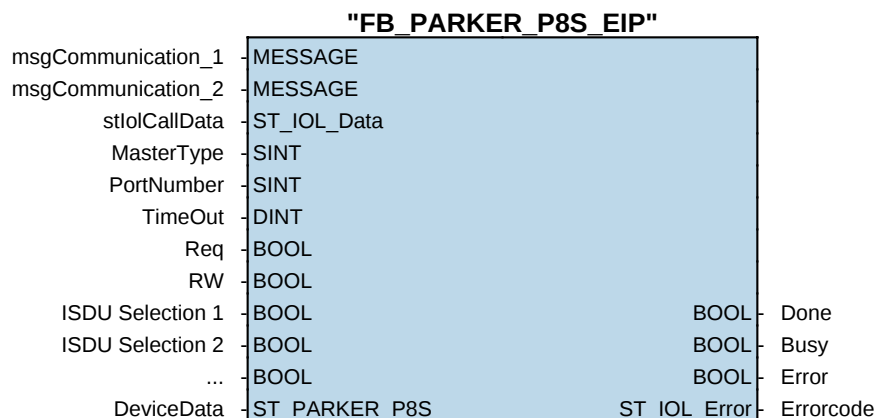
The function block "FB_PARKER_P8S_EIP" simplifies the usage of PARKER IO-Link devices on Rockwell ControlLogix / CompactLogix (RSLogix5000 V16 or higher) PLC controls. This FB supports IO-Link Masters which can be connected via EtherNet/IP to the PLC system.

The function block is device type-specific and thus only suitable for the appropriate PARKER IO-Link devices. The FB interprets the call-up of the acyclic service data between the PLC and the IO-Link device.

The IO-Link function block can only be used in combination with the listed helper functions / libraries.

2.1. Block specifications

Block name:	FB_PARKER_P8S_EIP
Version:	1.6
Used blocks:	FB_IOL_CALL_EIP
Used structures:	ST_PARKER_P8S ST_IOL_Error ST_IOL_Data
Call up:	Cyclic
Programming language:	Structured text (ST)
IODD:	Parker-Magnetic-Cylinder-Sensors-20171013-IODD1.1.xml (V1.3)



2.2. Method of function

The AOI (Add-On Instruction) uses the data structure "ST_PARKER_P8S". The PLC data structure (User-defined data type) contains the values of all IO-Link variables. Before you can use it, a parameter tag must be declared from this specific data type. This parameter must be connected to the AOI. Each IO-Link FB parameter has a data point representing it in this data structure. This data point will be actualized every time a read request was executed successfully.

The desired parameters can be selected via the input variables. Depending on the device definition, IO-Link parameters are read or writable. The input variable must be "RW" = FALSE to read a parameter. The value that should be written can be defined in the data structure (DeviceData), as soon

as the input parameter "RW" = TRUE. You start each transfer by calling up the "FB_PARKER_P8S_EIP" with a positive trigger at the "Req" input. As long as there is no valid answer the output "Busy" is TRUE. In the case that the chosen timeout period has elapsed a timeout error will be generated and the thread will be terminated. The "Done" = TRUE output shows that the transmission was successful. The outputs retain their states as long as there is no new positive trigger at the "Req" input again.

The AOI allows you to read or write multiple IO-Link parameters sequentially (multi-selection). Please note that it may happen, that a single parameter can not be written. The AOI aborts at this point and it is possible, that the IO-Link device contains an inconsistent set of parameters.

2.3. Behavior when error occurs

An error bit (Error) is set and an error code (Errorcode) generated, if there is a spurious input value or an incorrect input connection of the AOI. In this case, no further processing is carried out, until the input has been corrected.

2.4. EtherNet/IP MESSAGE-Box configuration

Because of dependencies in the communication between the PLC and the IO-Link Master only the following EtherNet/IP IO-Link Masters are supported:

- SICK IOLG2EI (MasterType = 0)
- Balluff BNI (MasterType = 0)
- Phoenix Axioline (MasterType = 1)
- Control IOLM (MasterType = 2)
- Rockwell 1743-4IOL (MasterType = 3)

Depending on the selected "MasterType" the Message-Box must be configured as follows.

SICK IOLG2EI / Balluff BNI (MasterType 0)	msgCommunication_1	msgCommunication_2
Message Type:	CIP Generic	CIP Generic
Service Type:	Custom	Custom
Service Code:	32 (Hex)	0
Class:	0	0
Instance:	0	0
Attribute:	0	0
Source Element:	stIolCallData.msgSource	stIolCallData.msgSource
Source Length:	1	0
Destination Element:	stIolCallData.msgDestination	stIolCallData.msgDestination
Path:	Path of the IO-Link Master	Path of the IO-Link Master

Phoenix Axioline (MasterType 1)	msgCommunication_1	msgCommunication_2
Message Type:	CIP Generic	CIP Generic

Service Type:	Custom	Custom
Service Code:	4B (Hex)	4C (Hex)
Class:	0	0
Instance:	0	0
Attribute:	0	0
Source Element:	stIolCallData.msgSource	stIolCallData.msgSource
Source Length:	1	1
Destination Element:	stIolCallData.msgDestination	stIolCallData.msgDestination
Path:	Path of the IO-Link Master	Path of the IO-Link Master

Control IOLM (MasterType 2)	msgCommunication_1	msgCommunication_2
Message Type:	CIP Generic	CIP Generic
Service Type:	Custom	Custom
Service Code:	4B (Hex)	0
Class:	0	0
Instance:	0	0
Attribute:	0	0
Source Element:	stIolCallData.msgSource	-
Source Length:	1	0
Destination Element:	stIolCallData.msgDestination	-
Path:	Path of the IO-Link Master	Path of the IO-Link Master

Rockwell 1743-4IOL (MasterType 3)	msgCommunication_1	msgCommunication_2
Message Type:	CIP Generic	CIP Generic
Service Type:	Custom	Custom
Service Code:	4B (Hex)	4C (Hex)
Class:	0	0
Instance:	0	0
Attribute:	0	0
Source Element:	stIolCallData.msgSource	stIolCallData.msgSource
Source Length:	1	1
Destination Element:	stIolCallData.msgDestination	stIolCallData.msgDestination
Path:	Path of the IO-Link Master	Path of the IO-Link Master

The "Source Element" and "Destination Element" parameters are defined by the variable that was connected to the AOI input stIolCallData.

2.5. Parameter

Parameter name	Declaration	Data type	Description
msgCommunication_1	IN_OUT	MESSAG E	EtherNet/IP communication parameters (see 2.4. EtherNet/IP MESSAGE-Box Configuration).
msgCommunication_2	IN_OUT	MESSAG E	EtherNet/IP communication parameters (see 2.4. EtherNet/IP MESSAGE-Box Configuration).

Parameter name	Declaration	Data type	Description
stIolCallData	IN_OUT	ST_IOL_Data	Communication data. This structure includes the Source and Destination Element to configure the Message-Box for the explicit EtherNet/IP communication.
MasterType	INPUT	SINT	Defines the type of the IO-Link Master. 0= SICK IOLG2EI Balluff BNI 1= Phoenix Axioline 2= Control IOLM 3= Rockwell 1743-4IOL 4..255= Reserved
PortNumber	INPUT	SINT	Number of the port where the IO-Link device is connected to the IO-Link Master 1..255: Port number
TimeOut	INPUT	DINT	Time, after a Timeout-Error is triggered.
Req	INPUT	BOOL	Positive trigger: Start data transfer
RW	INPUT	BOOL	Read or write the selected IO-Link parameter. FALSE: Read parameter TRUE: Write Parameter
VendorName	INPUT	BOOL	Selection of the IO-Link parameter "Vendor Name" ===== IO-Link parameter information ===== IO-Link Index: 16 Access: Read only
ProductName	INPUT	BOOL	Selection of the IO-Link parameter "Product Name" ===== IO-Link parameter information ===== IO-Link Index: 18 Access: Read only
VendorText	INPUT	BOOL	Selection of the IO-Link parameter "Vendor Text" ===== IO-Link parameter information ===== IO-Link Index: 17 Access: Read only
ProductID	INPUT	BOOL	Selection of the IO-Link parameter "Product ID" ===== IO-Link parameter information ===== IO-Link Index: 19 Access: Read only
ProductText	INPUT	BOOL	Selection of the IO-Link parameter "Product Text" ===== IO-Link parameter information ===== IO-Link Index: 20 Access: Read only
SerialNumber	INPUT	BOOL	Selection of the IO-Link parameter "Serial Number" ===== IO-Link parameter information ===== IO-Link Index: 21 Access: Read only

Parameter name	Declaration	Data type	Description
HWVersion	INPUT	BOOL	Selection of the IO-Link parameter "Hardware Version" ===== IO-Link parameter information ===== IO-Link Index: 22 Access: Read only
FWVersion	INPUT	BOOL	Selection of the IO-Link parameter "Firmware Version" ===== IO-Link parameter information ===== IO-Link Index: 23 Access: Read only
AppliName	INPUT	BOOL	Selection of the IO-Link parameter "Application Specific Tag" ===== IO-Link parameter information ===== IO-Link Index: 24 Access: Read/Write
SysCommand	INPUT	BOOL	Selection of the IO-Link parameter "Standard Command" ===== IO-Link parameter information ===== IO-Link Index: 2 Access: Write only Valid parameter values of the data structure (dec.): 160: Teach measuring range start 161: Teach measuring range end 162: Reset measuring range 163: Key Lock 164: Key Unlock
KeyLock	INPUT	BOOL	Selection of the IO-Link parameter "Key Lock" ===== IO-Link parameter information ===== IO-Link Index: 81 Access: Read/Write Valid parameter values of the data structure (dec.): 0: inactive 1: active
DeviceData	InOut	ST_PARKER_P8S	Reference to the PLC data type of the device. This data type contains the parameter values of the IO-Link device. If an IO-Link parameter should be read, the corresponding variable contains the parameter value. When writing an IO-Link parameter, the value of the corresponding variable must be set.
Done	OUTPUT	BOOL	Indicates whether data is valid.
Busy	OUTPUT	BOOL	Request in process. FALSE: Request is terminated TRUE: Request is being processed
Error	OUTPUT	BOOL	Error flag FALSE: No error TRUE: Error detected
Errorcode	OUTPUT	ST_IOL_Error	Error codes (see error description)

2.6. Error description

2.6.1. Error code (Errorcode)

The parameter "Errorcode" can be interpreted using the PLC data type ST_IOL_Error . This data type contains the following error information:

Parameter name	Data type	Description
nCommunicationError	DINT	Message communication error "EXERR" (high word) + "ERR" (low word) (see Rockwell help system about "Message (MSG)")
nBlockError	INT	PARKER AOI block errors
nIOLMError	INT	IO-Link Master error (see IO-Link specification) [not available using a CONTROL or RA IOLM]
nIOLError	INT	IO-Link error. Contains the IOL Error_Code the IOL Add_Error_Code (see IO-Link specification) and the device specific error codes [not available using a CONTROL or RA IOLM]
iISDUIndex	DINT	IO-Link Index (ISDU) to which the error code refers.

Error code (nBlockError)	Error code
0x0000	No error
0x0001	Reserved
0x0002	No parameter selected
0x0003	Selected parameter(s) not readable. There was at least one parameter selected with a write-only access (see Errorcode.iISDUIndex).
0x0004	Selected parameter(s) not writable. There was at least one parameter selected with read-only access (see Errorcode.iISDUIndex).
0x0005	At least one selected parameter, the input value is greater then the data type allows (see Errorcode.iISDUIndex).
0x0006	At least one selected parameter, the input value is lower than the data type allows (see Errorcode.iISDUIndex).
0x0007	Reserved
0x0008	Reserved
0x0009	Time out error occurred
0x000A	IO-Link device rejected the request (Control-Master error)
0x000B	IO-Link device did not respond (Control-Master error)
0x0100	(FB_IOL_CALL_EIP): 0 > IOL Index > 32767
0x0200	(FB_IOL_CALL_EIP): 0 > Data length > 232
0x0300	(FB_IOL_CALL_EIP): 0 > IOL Sub-Index > 255
0x0400	(FB_IOL_CALL_EIP): Invalid port number (PortNumber < 1)
0x0500	(FB_IOL_CALL_EIP): Invalid IO-Link device answer
0x0600	(FB_IOL_CALL_EIP): Master type is not supported
0x0700	(FB_IOL_CALL_EIP): Reserved
0x0800	(FB_IOL_CALL_EIP): Invalid time out time (TimeOut <= 0ms)
0x0900	(FB_IOL_CALL_EIP): Time out error occurred

Error code (nIOLMError)	Error code
0x0000	No error
0x0001 ... 0x06FF	Reserved / Master specific
0x7000	Unexpected Write request instead of read request / Invalid response PDU

Error code (nIOLMError)	Error code
0x7001	Decode error
0x7002	Port occupied by another task
0x7003 ... 0x7FFF	Reserved / Master specific
0x8001	IO-Link index > 32767
0x8002	Port address beyond defined maximum
0x8003	Port function not supported
0x8004 ... 0xFFFF	Reserved / Master specific

Error code (nIOLError)	Error code
0x0000	No error
0x1000	Master communication error
0x1100	ISDU time out / Device event error
0x5200	Device checksum error
0x5600	Device checksum error
0x5700	Master ISDU illegal service
0x5800	Device error: Byte length does not fit to the chosen parameter
0x8000	The requested service has been refused by the device application
0x8011	Read write access to a not existing Index
0x8012	Read write access to a not existing sub index
0x8020	Parameter is not accessible for a read or write service due to the current state in the device
0x8021	Parameter is not accessible for a read or write service due to an ongoing local operation at the device
0x8022	Parameter is not accessible for a read or write service due to an remote triggered state of the device application
0x8023	Write service tries to access a read-only parameter
0x8030	Write service to a parameter outside its permitted range of values
0x8031	Write service to a parameter above its specified value range
0x8032	Write service to a parameter below its specified value range
0x8033	Write service to a parameter above its specified length
0x8034	Write service to a parameter below its predefined length
0x8035	Write service with a command value not supported by the device application
0x8036	Write service with a command value calling a device function not available due to the current state
0x8040	The value via single parameter transfer collide with other actual parameter settings
0x8041	Inconsistent parameter set (at least an ISDU cannot be written)
0x8082	The read or write service is refused due to a temporarily unavailable application
0x8100	Unspecified
0x8101 ... 0x81FF	Device specific (see device description)

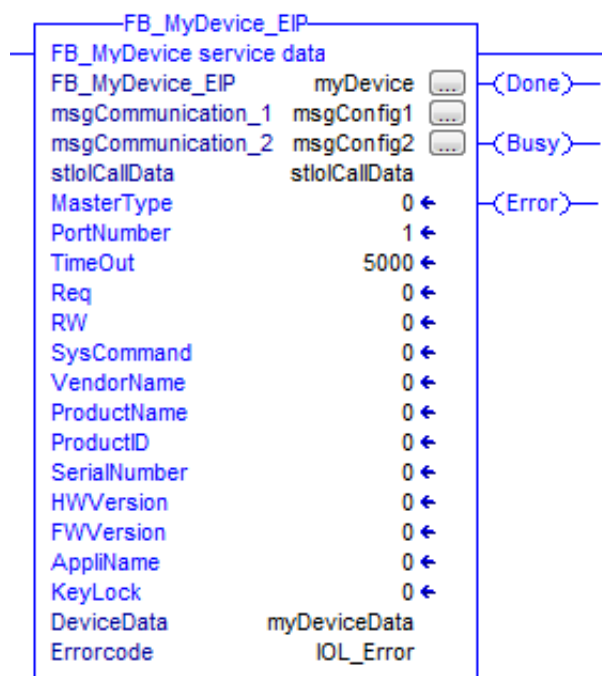
For additional information see the specification "IO-Link Communication" (www.IO-Link.com).

2.7. Including into the PLC project

The AOI "FB_PARKER_P8S_EIP" is part of the export file ".L5X". To get all relevant blocks into your PLC project, please import provided the .L5X file (File --> Import Component --> Add-On Instruction...).

Integration step by step:

- Download the ".L5X library file"
- Import the AOIs/data types into the PLC project (File --> Import Component --> Add-On Instruction...)
- Compiling the PLC project
- AOI call-up in the user program + AOI instance variable creation
- Create PLC tags for the following AOI inputs/outputs: msgCommunication_1 (MESSAGE), msgCommunication_2 (MESSAGE), stIolCallData (ST_IOL_Data), DeviceData (ST_PARKER_P8S)
- Message-Box configuration (see chapter: EtherNet/IP MESSAGE-Box Configuration)
- Select the IO-Link Master type (e.g. "0" for the SICK IOLGEI IO-Link Master)

**Attention!**

If several devices connect to the IO-Link Master, you can only exchange acyclic data (service data) with one device at the same time. Due this restriction, the service data communication AOIs must to be blocked against each other.

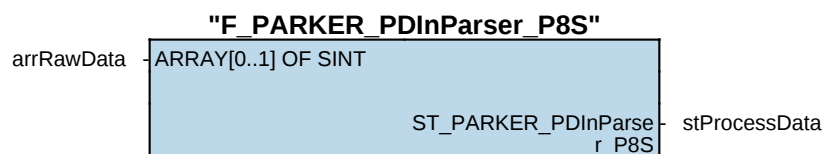
3. Process data parser function

The Add-On Instruction F_PARKER_PDInParser_P8S simplifies the interpretation of composed IO-Link process data. This data is provided as a data structure on the PLC side.

The Add-On Instruction is device type-specific and thus only suitable for the appropriated PARKER IO-Link devices.

3.1. Block specifications

Block name: F_PARKER_PDInParser_P8S
 Version: 1.6
 Used structures: ST_PARKER_PDInParser_P8S
 Programming language: Structured text (ST)
 IODD: Parker-Magnetic-Cylinder-Sensors-20171013-IODD1.1.xml (V1.3)



3.2. Parameter

Parameter name	Declaration	Data type	Description
arrRawData	IN_OUT	ARRAY[0..1] OF SINT	Raw process data of the IO-Link device. Please make sure that the byte order is not swapped. Please use the COP-Function to copy the corresponding process data area out of the input assembly of the IO-Link Master.
stProcessData	IN_OUT	ST_PARKER_PDInParser_P8S	Reference to a variable from the type ST_PARKER_PDInParser_P8S. The structure includes the disaggregated values of the process data.

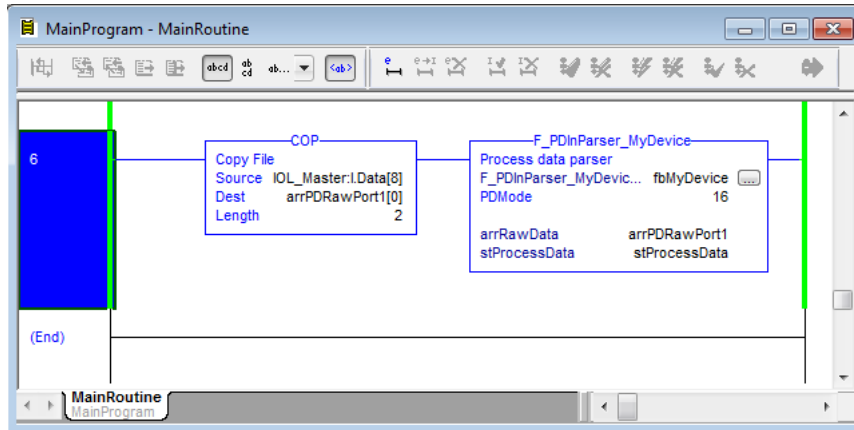
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Integration step by step:

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- Import the AOIs/data types into the PLC project (File --> Import Component --> Add-On Instruction...)
- Compiling the PLC project
- AOI call-up in the user program + AOI instance variable creation
- Create PLC tags for the following AOI IN_OUT parameter: arrRawData (ARRAY), stProcessData (ST_PARKER_PDInParser_P8S)

- Copy the corresponding process data area of the IO-Link Master, which includes the IO-Link process data of the device (COP-Function). The variable must be of the type ARRAY[0..1] OF SINT.
- Connect the raw data variable with the parameter "arrRawData"
- The interpreted process data are available in the structure stProcessData



The screenshot shows the Ladder Logic (LAD) editor for the 'MainRoutine' of a 'MainProgram'. A blue 'COP' block is connected to a 'Process data parser' block. The 'COP' block has parameters: Source (IOL_Master.I.Data[8]), Dest (arrPDRawPort1[0]), and Length (2). The 'Process data parser' block has parameters: F_PDInParser_MyDevice (fbMyDevice), PDMMode (16), arrRawData (arrPDRawPort1), and stProcessData (stProcessData). Below the LAD editor, the 'Controller Tags - test(controller)' window is open, showing a table of tags. The 'stProcessData' tag is expanded, showing its structure and values.

Name	Value	Style	Data Type
stProcessData	{ ... }		ST_PDInParser_MyDevice
stProcessData.Mode0	{ ... }		MyDevice_SwitchingOutput...
stProcessData.Mode16	{ ... }		MyDevice_MeasurementVal...
stProcessData.Mode16.SwitchingOutputQ	1	Decimal	BOOL
stProcessData.Mode16.QualityOfRunAlarm	1	Decimal	BOOL
stProcessData.Mode16.TeachSuccessful	1	Decimal	BOOL
stProcessData.Mode16.TeachBusy	0	Decimal	BOOL
stProcessData.Mode16.MeasurementValue	274	Decimal	INT



Please note!

The transmitted data of the IO-Link Master (Input Assembly) are master specific. The documentation of the IO-Link Master describes where you can find the data position of each IO-Link port in the input assembly.

Please do not change the origin byte order of the process data. This is possible with some IO-Link masters via web server (e.g. CONTROL IOL-M).