



PLC Integration of PRK3CT3LP_2114

IO-Link service data function block + process data parser function for Beckhoff (TwinCAT 3.x) PLC systems in combination with a EtherCAT IO-Link Master

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1 Legal information

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2 About this document

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

2.1 Purpose of use

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

These instructions are intended to provide support during the commissioning of a Leuze IO-Link sensor using standard software from Siemens. The described module is part of this standard software.

2.2 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.

3 General use of function block

3.1 Short description

The function block "FB_Leuze_IOL_ PRK3CT3LP_2114" simplifies the usage of Leuze IO-Link devices on Beckhoff (TwinCAT 3.x) PLC controls. This FB supports IO-Link Masters which can be connected via EtherCAT to the PLC system.

The function block is device type-specific and thus only suitable for the appropriate Leuze 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.

3.2 Calling and designation



Fig. 3.1: Example of module call

3.3 Configuration

Tab. 3.1: Parameter IN

Parameter	Data type	Description
bExecute	Bool	Positive trigger: Start data transfer
bRW	Bool	Read or write the selected IO-Link parameter. FALSE: Read parameter TRUE: Write Parameter
nPort	T_AmsPort	Port number of the ADS device.
sNetId	T_AmsNetID	String containing the AMS network identifier of the target device to which the ADS command is directed. Beckhoff EL6224/EP6224: AoeNetId of the IO-Link Master
nIdxGroup	UDInt	Index group number.
tTimeOut	Time	Time, after a Timeout-Error is triggered.

Tab. 3.2: Parameter INOUT

Parameter	Data type	Description
stDeviceData	ST_Leuze_IOL_ PRK3CT3LP_2114	Sensor data

See structure description of ST_Leuze_IOL_ PRK3CT3LP_2114 in chapter 7.

Tab. 3.3: Parameter OUT

Parameter	Data type	Description
bDone	Bool	Indicates whether data is valid.

Parameter	Data type	Description
bBusy	Bool	Request in process. FALSE: Request is terminated TRUE: Request is being processed
bError	Bool	Error flag FALSE: No error TRUE: Error detected
stErrorCode	ST_Leuze_IOL_Error	Status of the function block

See structure description of ST_Leuze_IOL_Error in chapter 6.

3.4 Method of function

The function block uses the data structure "ST_Leuze_IOL_ PRK3CT3LP_2114". The PLC data structure contains the values of all IO-Link variables. Before you can use it, the structure must be instantiated by a data block. 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 "bRW" = FALSE to read parameter. The value that should be written can be defined in the data structure, as soon as the input parameter "bRW" = TRUE. You start each transfer by calling up the "FB_Leuze_IOL_ PRK3CT3LP_2114" with a positive trigger at the "bExecute" input. As long as there is no valid answer the output "bBusy" 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 "bDone" = TRUE output shows that the transmission was successful. The outputs retain there states as long as there is no new positive trigger at the "bExecute" input again.

The function block 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 function block aborts at this point and it is possible, that the IO-Link device contains an inconsistent set of parameters.

3.5 Behavior when error occurs

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

4 Integration into the PLC project

The function block "FB_Leuze_IOL_ PRK3CT3LP_2114" is a part of the TwinCAT V3.x library. The library can be installed by using the Library Repository. Afterwards the library can be added to your project (References --> Add library...).

Integration step by step:

- Download the library
- Open the Library repository in Library Manager tab in Beckhoff TwinCAT
- Click Install... and select downloaded library
- Open Add library in Library Manager tab
- Find installed library under Leuze electronic GmbH + Co. KG

NOTICE	
	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 blocks must to be blocked against each other.

5 Process data parser function

The function `F_Leuze_PD_PRK3CT3LP_2114` simplifies the interpretation of composed IO-Link process data. This data is provided as a data structure on the PLC side. Some sensors supports different process data output. User must select mode of PD according to the sensors settings.

The function is device type-specific and thus only suitable for the appropriated Leuze IO-Link devices.

5.1 Calling and designation



Fig. 5.1: Example of process data parsing function call

5.2 Configuration

Tab. 5.1: Parameters

Parameter name	Declaration	Data type	Description
aProcessData	INPUT	ARRAY OF BYTE	Raw process data of the IO-Link device.
nPDMode	INPUT	INT	Mode of the PD. User must select mode of PD according to the sensors settings.
bError	OUTPUT	BOOL	Error flag FALSE: No error TRUE: Error detected
F_Leuze_PD_PRK3CT3LP_2114	OUTPUT	ST_Leuze_PD_PRK3CT3LP_2114	Reference to the instance of the data structure ST_Leuze_PD_PRK3CT3LP_2114. The structure includes the disaggregated values of the process data.

See structure description of `ST_Leuze_PD_PRK3CT3LP_2114` in chapter 7.

6 Error description

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

Tab. 6.1: ST_Leuze_IOL_Error description

Parameter name	Data type	Description
ErrorStatus.nBlockError	WORD	Error number representing FB where error occurred
ErrorStatus.nAdsReadError	UDINT	ADS read error code
ErrorStatus.nAdsWriteError	UDINT	ADS write error code
ErrorStatus.nIndex	INT	IO-Link index to which the error code refers
ErrorStatus.nSubIndex	INT	IO-Link sub-index to which the error code refers

Tab. 6.2: Error description for nBlockError

Error code (nBlockError)	Error description
0x0000	No error
0x8001	Time out error occurred
0x8002	No parameter selected
0x8003	Error in FB_Leuze_IOL_AdsReadWrite block

For additional information see the Beckhoff ADS Return Codes (<https://infosys.beckhoff.com>).

7 Data structures

Tab. 7.1: ST_Leuze_IOL_PRK3CT3LP_2114

Parameter name	Data type	Description
stDeviceData.stSelection.stCommands.bDeviceReset	BOOL	[WRITE_ONLY] Device Reset
stDeviceData.stSelection.stCommands.bApplicationReset	BOOL	[WRITE_ONLY] Application Reset
stDeviceData.stSelection.stCommands.bRestoreFactorySettings	BOOL	[WRITE_ONLY] Restore Factory Settings
stDeviceData.stSelection.stCommands.bErrorConfirmationOr2WayTeachConfirmation	BOOL	[WRITE_ONLY] Error Confirmation or 2-Way-Teach Confirmation
stDeviceData.stSelection.stCommands.bHighSensitiveTeachFullBottle	BOOL	[WRITE_ONLY] High Sensitive Teach (full bottle)
stDeviceData.stSelection.stCommands.bSensitiveTeachEmptyBottle	BOOL	[WRITE_ONLY] Sensitive Teach (empty bottle)
stDeviceData.stSelection.stCommands.bEnableConfigurationMode	BOOL	[WRITE_ONLY] Enable Configuration Mode
stDeviceData.stSelection.stCommands.bReloadLastTeachWorking	BOOL	[WRITE_ONLY] Reload last Teach (WORKING)
stDeviceData.stSelection.stCommands.bRestoreFactoryDefaults	BOOL	[WRITE_ONLY] Restore factory defaults
stDeviceData.stSelection.stCommands.bSaveCurrentParameters	BOOL	[WRITE_ONLY] Save current parameters
stDeviceData.stSelection.stCommands.bEnableSensorMode	BOOL	[WRITE_ONLY] Enable Sensor Mode
stDeviceData.stSelection.stCommands.bEnableAdcSignalProcessDataOutput	BOOL	[WRITE_ONLY] Enable ADC Signal Process Data Output
stDeviceData.stSelection.bStandardCommand	BOOL	[WRITE_ONLY]
stDeviceData.stSelection.stDirectParameters1.bAll	BOOL	[READ_WRITE] all parameters of complex data type
stDeviceData.stSelection.stDirectParameters1.bReserved_1	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bMasterCycleTime	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bMinCycleTime	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bMSequenceCapability	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bIoLinkVersionId	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bProcessDataInputLength	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bProcessDataOutputLength	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bVendorId1	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bVendorId2	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bDeviceId1	BOOL	[READ_ONLY]

Parameter name	Data type	Description
stDeviceData.stSelection.stDirectParameters1.bDeviceId2	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bDeviceId3	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bReserved_13	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bReserved_14	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDirectParameters1.bReserved_15	BOOL	[READ_ONLY]
stDeviceData.stSelection.stDp.bAll	BOOL	[READ_WRITE] all parameters of complex data type
stDeviceData.stData.stCommands.nDeviceReset	UINT	[WRITE_ONLY] Device Reset
stDeviceData.stData.stCommands.nApplicationReset	UINT	[WRITE_ONLY] Application Reset
stDeviceData.stData.stCommands.nRestoreFactorySettings	UINT	[WRITE_ONLY] Restore Factory Settings
stDeviceData.stData.stCommands.nErrorConfirmationOr2WayTeachConfirmation	UINT	[WRITE_ONLY] Error Confirmation or 2-Way-Teach Confirmation
stDeviceData.stData.stCommands.nHighSensitiveTeachFullBottle	UINT	[WRITE_ONLY] High Sensitive Teach (full bottle)
stDeviceData.stData.stCommands.nSensitiveTeachEmptyBottle	UINT	[WRITE_ONLY] Sensitive Teach (empty bottle)
stDeviceData.stData.stCommands.nEnableConfigurationMode	UINT	[WRITE_ONLY] Enable Configuration Mode
stDeviceData.stData.stCommands.nReloadLastTeachWorking	UINT	[WRITE_ONLY] Reload last Teach (WORKING)
stDeviceData.stData.stCommands.nRestoreFactoryDefaults	UINT	[WRITE_ONLY] Restore factory defaults
stDeviceData.stData.stCommands.nSaveCurrentParameters	UINT	[WRITE_ONLY] Save current parameters
stDeviceData.stData.stCommands.nEnableSensorMode	UINT	[WRITE_ONLY] Enable Sensor Mode
stDeviceData.stData.stCommands.nEnableAdcSignalProcessDataOutput	UINT	[WRITE_ONLY] Enable ADC Signal Process Data Output
stDeviceData.stData.nStandardCommand	UINT	[WRITE_ONLY]
stDeviceData.stData.stDirectParameters1.nReserved_1	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nMasterCycleTime	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nMinCycleTime	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nMSequenceCapability	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nIoLinkVersionId	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nProcessDataInputLength	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nProcessDataOutputLength	UINT	[READ_ONLY]

Parameter name	Data type	Description
stDeviceData.stData.stDirectParameters1.nVendorId1	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nVendorId2	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nDeviceld1	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nDeviceld2	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nDeviceld3	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nReserved_13	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nReserved_14	UINT	[READ_ONLY]
stDeviceData.stData.stDirectParameters1.nReserved_15	UINT	[READ_ONLY]
stDeviceData.stData.stDp.nOffLimit	UINT	[READ_WRITE] Off Limit
stDeviceData.stData.stDp.nOnLimit	UINT	[READ_WRITE] On Limit
stDeviceData.stData.stDp.bKeyLock	BOOL	[READ_WRITE] Key Lock; IO-Link Parameter overrides IN2 Input/PD
stDeviceData.stData.stDp.nQ2LogicFunction	UINT	[READ_WRITE]
stDeviceData.stData.stDp.nDelayFunctionInternalDelayUnit	UINT	[READ_WRITE] Operating mode of the internal delay unit
stDeviceData.stData.stDp.nTimeBaseInternalDelayUnit	UINT	[READ_WRITE] 1ms, 10ms, 100ms, 1000ms
stDeviceData.stData.stDp.nMultiplicationFactorForTimeBaseInternalDelayUnit	UINT	[READ_WRITE] 1-15
stDeviceData.stData.stDp.bEasyTune	BOOL	[READ_WRITE] Enable EasyTune
stDeviceData.stData.stDp.bLightDarkSwitching	BOOL	[READ_WRITE] Light/Dark Switching: adjusting the switching behavior of the switching output
stDeviceData.stData.stDp.bInternalDelayUnitBasedOnObject	BOOL	[READ_WRITE] Enable Internal Delay Unit
stDeviceData.stData.stDp.nTeachValue2	UINT	[READ_WRITE]
stDeviceData.stData.stDp.nPdiContent	UINT	[READ_ONLY]
stDeviceData.stData.stDp.bStatusTeachCommand	BOOL	[READ_ONLY] Value is re-read after new command. All status bits are valid after finished command.
stDeviceData.stData.stDp.bCommandAccepted	BOOL	[READ_ONLY]
stDeviceData.stData.stDp.bTeachError	BOOL	[READ_ONLY]
stDeviceData.stData.stDp.bLastValuesRestored	BOOL	[READ_ONLY]
stDeviceData.stData.stDp.bReceptionLevelTooHigh	BOOL	[READ_ONLY]

Parameter name	Data type	Description
stDeviceData.stData.stDp.bReceptionLevelTooLow	BOOL	[READ_ONLY]

Tab. 7.2: ST_Leuze_PD_PRK3CT3LP_2114

Parameter name	Data type	Description
ST_Leuze_PD_PRK3CT3LP_2114.stMode_0.cQ	BOOL	
ST_Leuze_PD_PRK3CT3LP_2114.stMode_0.bWarning	BOOL	
ST_Leuze_PD_PRK3CT3LP_2114.stMode_0.bStatus	BOOL	
ST_Leuze_PD_PRK3CT3LP_2114.stMode_1.cQ	BOOL	
ST_Leuze_PD_PRK3CT3LP_2114.stMode_1.nReceivedSignal	UINT	

8 Parameter descriptions

Tab. 8.1: IODD parameter descriptions

(AR - Access Rights, R - Read only, W - Write only, RW - Read and Write, NS - Not specified)

Parameter	Index	Subindex	Data type	Default	AR	Description
Commands			RecordT		W	
Device Reset			UIntegerT	128	W	Device Reset
Application Reset			UIntegerT	129	W	Application Reset
Restore Factory Settings			UIntegerT	130	W	Restore Factory Settings
Error Confirmation or 2-Way-Teach Confirmation			UIntegerT	160	W	Error Confirmation or 2-Way-Teach Confirmation
High Sensitive Teach (full bottle)			UIntegerT	161	W	High Sensitive Teach (full bottle)
Sensitive Teach (empty bottle)			UIntegerT	162	W	Sensitive Teach (empty bottle)
Enable Configuration Mode			UIntegerT	170	W	Enable Configuration Mode
Reload last Teach (WORKING)			UIntegerT	171	W	Reload last Teach (WORKING)
Restore factory defaults			UIntegerT	172	W	Restore factory defaults
Save current parameters			UIntegerT	173	W	Save current parameters
Enable Sensor Mode			UIntegerT	174	W	Enable Sensor Mode
Enable ADC Signal Process Data Output			UIntegerT	191	W	Enable ADC Signal Process Data Output
Direct Parameters 1	0	0	RecordT		RW	
Reserved	0	1	UIntegerT		R	
Master Cycle Time	0	2	UIntegerT	0	R	
Min Cycle Time	0	3	UIntegerT	23	R	
M-Sequence Capability	0	4	UIntegerT	0	R	
IO-Link Version ID	0	5	UIntegerT	17	R	
Process Data Input Length	0	6	UIntegerT	72	R	
Process Data Output Length	0	7	UIntegerT	1	R	
Vendor ID 1	0	8	UIntegerT	1	R	
Vendor ID 2	0	9	UIntegerT	82	R	
Device ID 1	0	10	UIntegerT	0	R	

Parameter	Index	Subindex	Data type	Default	AR	Description
Device ID 2	0	11	UIntegerT	16	R	
Device ID 3	0	12	UIntegerT	2	R	
Reserved	0	13	UIntegerT		R	
Reserved	0	14	UIntegerT		R	
Reserved	0	15	UIntegerT		R	
Standard Command	0	16	UIntegerT		W	(0 ... 63): Reserved 128: Device Reset 129: Application Reset 130: Restore Factory Settings (131 ... 159): Reserved 160: Error Confirmation or 2-Way-Teach Confirmation 161: High Sensitive Teach (full bottle) 162: Sensitive Teach (empty bottle) 170: Enable Configuration Mode 171: Reload last Teach (WORKING) 172: Restore factory defaults 173: Save current parameters 174: Enable Sensor Mode 191: Enable ADC Signal Process Data Output
DP	1	0	RecordT		RW	
Off Limit	1	2	UIntegerT		RW	Off Limit
On Limit	1	3	UIntegerT		RW	On Limit
Key Lock	1	6	BooleanT	1	RW	Key Lock; IO-Link Parameter overrides IN2 Input/PD False: Disabled True: Enabled
Q2 logic function	1	8	UIntegerT	0	RW	0: Inverted Switching Output 1: Switching Output
Delay Function (internal delay unit)	1	10	UIntegerT	1	RW	Operating mode of the internal delay unit 0: On delay 1: Off delay 2: pulse stretching 3: pulse suppression
Time base (internal delay unit)	1	11	UIntegerT	1	RW	1ms, 10ms, 100ms, 1000ms 0: 1ms 1: 10ms 2: 100ms 3: 1000ms
Multiplication factor for time base (internal delay unit)	1	12	UIntegerT	1	RW	1-15
EasyTune	1	16	BooleanT		RW	Enable EasyTune False: Disabled True: Enabled

Parameter	Index	Subindex	Data type	Default	AR	Description
Light/Dark Switching	1	18	BooleanT	0	RW	Light/Dark Switching: adjusting the switching behavior of the switching output False: light switching True: dark switching
Internal Delay Unit (based on object)	1	20	BooleanT	0	RW	Enable Internal Delay Unit False: Disabled True: Enabled
Teach Value 2	1	25	UIntegerT		RW	
PDI Content	1	26	UIntegerT	0	R	0: Switching Signal and Status 1: Analog ADC value and Switching Signal
Status Teach/Command	1	32	BooleanT	0	R	Value is re-read after new command. All status bits are valid after finished command. False: finished True: running
Command accepted	1	33	BooleanT	0	R	False: no True: yes
Teach Error	1	36	BooleanT	0	R	False: no True: yes
Last values restored	1	37	BooleanT	0	R	False: no True: yes
Reception level too high	1	38	BooleanT	0	R	False: no True: yes
Reception level too low	1	39	BooleanT	0	R	False: no True: yes

9 Technical specifications

9.1 General data

Tab. 9.1: Sensor and IODD version

IODD version	V1.1
IODD release date	2016-7-22
Device family	BR 3C
Device ID	2114
Device name	PRK3C.T3/LP
Device variants	PRK3C IO-Link (PRK3C.T3/LP)