



## **PLC Integration LE3CLP\_2122**

**IO - Link service data function block + process data parser function for Siemens S7-1200 / S7 - 1500 (TIA - Portal V15.1 or higher) PLC systems in combination with a PROFIBUS / PROFINET 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\_LE3CLP\_2122" simplifies the usage of Leuze IO-Link devices on Siemens S7-1200/S7-1500 (TIA-Portal V15.1 or higher) PLC controls. This FB supports IO-Link Masters which can be connected via PROFIBUS / PROFINET 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

The module can be called as a single-instance.



Fig. 3.1: Example of module call with single instance

### 3.3 Configuration

Tab. 3.1: Parameter IN

Parameter	Data type	Description
Execute	Bool	Positive trigger: Start data transfer
RW	Bool	Read or write the selected IO-Link parameter. FALSE: Read parameter TRUE: Write Parameter
Port	Int	Number of the master port the IO-Link device is connected, starting with 1.
HwID	HW_IO	Hardware IO-Address of the IO-Link master
Cap	DInt	Client access point of the IO-Link function (IO-LinkMaster specific). Siemens: 227 Weidmüller: 227 Other manufacturers: 255
TimeOut	Time	Time, after a Timeout-Error is triggered.

Tab. 3.2: Parameter INOUT

Parameter	Data type	Description
DeviceData	Leuze_type_LE3CLP_2122	Sensor data

See structure description of Leuze\_type\_LE3CLP\_2122 in chapter 7.

Tab. 3.3: Parameter OUT

Parameter	Data type	Description
Done	Bool	Indicates whether data is valid.
Busy	Bool	Request in process. FALSE: Request is terminated TRUE: Request is being processed
Error	Bool	Error flag FALSE: No error TRUE: Error detected
ErrorCode	Leuze_type_lolError	Status of the function block
Diagnostics	LIOLink_typeDiagnostics	Detailed diagnostic information of the FB. See description of Siemens Library for IO-Link (LIOLink).

See structure description of Leuze\_type\_lolError in chapter 6.

## 3.4 Method of function

The function block uses the data structure "FB\_Leuze\_LE3CLP\_2122". 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 "RW" = FALSE to read parameter. The value that should be written can be defined in the data structure, as soon as the input parameter "RW" = TRUE. You start each transfer by calling up the "FB\_Leuze\_LE3CLP\_2122" with a positive trigger at the "Execute" 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 there states as long as there is no new positive trigger at the "Execute" input again.

The function block allows you to read or write multiple IO-Link parameters sequentially (multiselection). 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 (Error) is set and an error code (Leuze\_type\_lolError) 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\_LE3CLP\_2122" is a part of the TIA-Portal library. To get all relevant blocks into your PLC project, please open the library as a "global" library. Afterwards, the library elements can be copied into the currently opened project.

### Integration step by step:

- Downloading the library
- Open the library in the "global" library tab
- Including the blocks of the Leuze library into your project (code-blocks and data type)
- Compiling the PLC project

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 FC\_Leuze\_PD\_LE3CLP\_2122 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. Each sensor connected to Leuze IO-Link master has its own hardware ID. See Fig. 5.2.

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
HwID	INPUT	HW_IO	Hardware IO-Address of the IO-Link master (see HW-Configuration). For masters that do not use the Siemens PCT-Tool please use the HW IOAddress of the configured Master port.
RelByteOffset	INPUT	UINT	Relative start address of the IO-Link device on the IO-Link master port (see PCT-Tool -> Addresses -> Inputs Start). If the process date is mapped into a specified logical IO-Address, the relative byte offset = 0.
PDMode	INPUT	INT	Mode of the PD. User must select mode of PD according to the sensors settings.
ErrorCode	OUTPUT	WORD	Error code details see in the Siemens help system ("DPRD_DAT").
RET_VAL	OUTPUT	Leuze_type_PD_LE3CLP_2122	Reference to the instance of the data structure Leuze_type_PD_LE3CLP_2122. The structure includes the disaggregated values of the process data.

See structure description of Leuze\_type\_PD\_LE3CLP\_2122 in chapter 7.



Fig. 5.2: Hardware ID for sensors connected to Leuze MD798 IO-Link master

## 6 Error description

The parameter "ErrorCode" can be interpreted using the PLC data type Leuze\_type\_IolError. This data type contains the following error information:

Tab. 6.1: Leuze\_type\_IolError description

Parameter name	Data type	Description
ErrorCode.status	Word	16#0000–16#7FFF: Status of the FB, 16#8000–16#FFFF: Error codes
ErrorCode.iolMError	Word	IO-Link Master error (see IO-Link specification)
ErrorCode.iolError	Word	IO-Link error. Contains the IOL_Error_Code the IOL_Add_Error_Code (see IO-Link specification) and the device specific error codes
ErrorCode.isduIndex	Int	IO-Link Index (ISDU) to which the error code refers

Tab. 6.2: Error description for status

Error code (status)	Error description
0x0000	Operation completed, no warning and no further details
0x7000	No operation in progress (initial value)
0x7001	First call after input of a new command (rising edge on "execute")
0x7002	Subsequent cal
0x8001	Time out error occurred
0x8002	No parameter selected
0x8201	Unsupported port
0x8202	Unsupported index
0x8203	Unsupported subindex
0x8205	The length at the "writeLen" parameter does not match the data record that will be written
0x8401	The IO-Link master has reported an error code, see "diagnostics"
0x8402	Received data record does not match operation
0x8403	Operation could not be completed in the specified time
0x8600	Internal state machine has reached an undefined state
0x8601	System function WRREC reports an error, see "diagnostics"
0x8602	System function RDREC reports an error, see "diagnostics"

Tab. 6.3: Error description for ioLError

Error code (ioLError)	Error description
0x0000	No error
0x0001 ... 0x06FF	Reserved / Master specific
0x7000	Unexpected Write request instead of read request / Invalid response PDU
0x7001	Decode error
0x7002	Port occupied by another task
0x7003 ... 0x7FFF	Reserved / Master specific
0x8000	Timeout when IOL-Devices or IOL-Master port are busy
0x8001	IO-Link index > 32767
0x8002	Port address beyond defined maximum
0x8003	Port function not supported
0x8004	Reserved / Master specific
0x8005	Invalid length of the data that should be written (>232 / <1)
0x8006	Reserved / Master specific
0x8007	IO-Link subindex > 255
0x8008 ... 0x8051	Reserved / Master specific
0x8052	Error during acyclic data access (FB RDREC error)
0x8053	Error during acyclic data access (FB WRREC error)
0x8054 ... 0x8FFFF	Reserved / Master specific

For additional information see the technical specification "IO-Link Integration Part 1" ([www.profibus.com](http://www.profibus.com)).

Tab. 6.4: Error description for ioLError

Error code (ioLError)	Error description
0x0000	No error
0x1000	Master communication error
0x1100	ISDU time out / Device event error
0x5200	Device checksum error
0x5600	Device checksum error

Error code (IoError)	Error description
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](http://www.IO-Link.com)).

## 7 Data structures

Tab. 7.1: Leuze\_type\_ LE3CLP\_2122

Parameter name	Data type	Description
DeviceData.Selection.Commands.DeviceReset	Bool	[WRITE_ONLY] Device Reset
DeviceData.Selection.Commands.ApplicationReset	Bool	[WRITE_ONLY] Application Reset
DeviceData.Selection.Commands.RestoreFactorySettings	Bool	[WRITE_ONLY] Restore Factory Settings
DeviceData.Selection.Commands.ErrorConfirmationOr2WayTeachConfirmation	Bool	[WRITE_ONLY] Error Confirmation or 2-Way-Teach Confirmation
DeviceData.Selection.Commands.LightSwitching	Bool	[WRITE_ONLY] light switching
DeviceData.Selection.Commands.DarkSwitching	Bool	[WRITE_ONLY] dark switching
DeviceData.Selection.Commands.TimerOn	Bool	[WRITE_ONLY] Timer on
DeviceData.Selection.Commands.TimerOff	Bool	[WRITE_ONLY] Timer off
DeviceData.Selection.Commands.EnableConfigurationMode	Bool	[WRITE_ONLY] Enable Configuration Mode
DeviceData.Selection.Commands.RestoreFactoryDefaults	Bool	[WRITE_ONLY] Restore factory defaults
DeviceData.Selection.Commands.SaveCurrentParameters	Bool	[WRITE_ONLY] Save current parameters
DeviceData.Selection.Commands.EnableSensorMode	Bool	[WRITE_ONLY] Enable Sensor Mode
DeviceData.Selection.DirectParameters1.All	Bool	[READ_WRITE] all parameters of complex data type
DeviceData.Selection.DirectParameters1.Reserved_1	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.MasterCycleTime	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.MinCycleTime	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.MSequenceCapability	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.IoLinkId	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.ProcessDataInputLength	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.ProcessDataOutputLength	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.VendorId1	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.VendorId2	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.DeviceId1	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.DeviceId2	Bool	[READ_ONLY]

Parameter name	Data type	Description
DeviceData.Selection.DirectParameters1.DeviceId3	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.Reserved_13	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.Reserved_14	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.Reserved_15	Bool	[READ_ONLY]
DeviceData.Selection.DirectParameters1.StandardCommand	Bool	[WRITE_ONLY]
DeviceData.Selection.Dp.All	Bool	[READ_WRITE] all parameters of complex data type
DeviceData.Data.Commands.DeviceReset	UInt	[WRITE_ONLY] Device Reset
DeviceData.Data.Commands.ApplicationReset	UInt	[WRITE_ONLY] Application Reset
DeviceData.Data.Commands.RestoreFactorySettings	UInt	[WRITE_ONLY] Restore Factory Settings
DeviceData.Data.Commands.ErrorConfirmationOr2WayTeachConfirmation	UInt	[WRITE_ONLY] Error Confirmation or 2-Way-Teach Confirmation
DeviceData.Data.Commands.LightSwitching	UInt	[WRITE_ONLY] light switching
DeviceData.Data.Commands.DarkSwitching	UInt	[WRITE_ONLY] dark switching
DeviceData.Data.Commands.TimerOn	UInt	[WRITE_ONLY] Timer on
DeviceData.Data.Commands.TimerOff	UInt	[WRITE_ONLY] Timer off
DeviceData.Data.Commands.EnableConfigurationMode	UInt	[WRITE_ONLY] Enable Configuration Mode
DeviceData.Data.Commands.RestoreFactoryDefaults	UInt	[WRITE_ONLY] Restore factory defaults
DeviceData.Data.Commands.SaveCurrentParameters	UInt	[WRITE_ONLY] Save current parameters
DeviceData.Data.Commands.EnableSensorMode	UInt	[WRITE_ONLY] Enable Sensor Mode
DeviceData.Data.DirectParameters1.Reserved_1	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.MasterCycleTime	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.MinCycleTime	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.MSequenceCapability	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.IoLinkVersionId	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.ProcessDataInputLength	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.ProcessDataOutputLength	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.VendorId1	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.VendorId2	UInt	[READ_ONLY]

Parameter name	Data type	Description
DeviceData.Data.DirectParameters1.Deviceld1	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.Deviceld2	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.Deviceld3	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.Reserved_13	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.Reserved_14	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.Reserved_15	UInt	[READ_ONLY]
DeviceData.Data.DirectParameters1.StandardCommand	UInt	[WRITE_ONLY]
DeviceData.Data.Dp.Q2LogicFunction	UInt	[READ_WRITE] Inverted Switching Output, Switching Output or Warning Output
DeviceData.Data.Dp.DelayFunctionInternalDelayUnit	UInt	[READ_WRITE] Operating mode of the internal delay unit
DeviceData.Data.Dp.TimeBaseInternalDelayUnit	UInt	[READ_WRITE] 1ms, 10ms, 100ms, 1000ms
DeviceData.Data.Dp.MultiplicationFactorForTimeBaseInternalDelayUnit	UInt	[READ_WRITE] 1-15
DeviceData.Data.Dp.LightDarkSwitching	Bool	[READ_WRITE] Light/Dark Switching: adjusting the switching behavior of the switching output
DeviceData.Data.Dp.InternalDelayUnitBasedOnObject	Bool	[READ_WRITE] Enable Internal Delay Unit
DeviceData.Data.Dp.StatusCommand	Bool	[READ_ONLY] Value is re-read after new command. All status bits are valid after finished command.
DeviceData.Data.Dp.CommandAccepted	Bool	[READ_ONLY]
DeviceData.Data.Dp.TeachError	Bool	[READ_ONLY]
DeviceData.Data.Dp.LastValuesRestored	Bool	[READ_ONLY]
DeviceData.Data.Dp.ReceptionLevelTooHigh	Bool	[READ_ONLY]
DeviceData.Data.Dp.ReceptionLevelTooLow	Bool	[READ_ONLY]

Tab. 7.2: Leuze\_type\_PD\_LE3CLP\_2122

Parameter name	Data type	Description
FC_Leuze_PD_LE3CLP_2122.Q	Bool	
FC_Leuze_PD_LE3CLP_2122.Warning	Bool	



## 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
light switching			UIntegerT	161	W	light switching
dark switching			UIntegerT	162	W	dark switching
Timer on			UIntegerT	163	W	Timer on
Timer off			UIntegerT	164	W	Timer off
Enable Configuration Mode			UIntegerT	170	W	Enable Configuration Mode
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
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: light switching 162: dark switching 163: Timer on 164: Timer off 170: Enable Configuration Mode 172: Restore factory defaults 173: Save current parameters 174: Enable Sensor Mode
DP	1	0	RecordT		RW	
Q2 logic function	1	8	UIntegerT	0	RW	Inverted Switching Output, Switching Output or Warning Output  0: Inverted Switching Output 1: Switching Output 2: Warning 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
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

Parameter	Index	Subindex	Data type	Default	AR	Description
Status 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	2017-11-22
Device family	BR 3C
Device ID	2122
Device name	LE3C/LP
Device variants	Leuze electronic LE3C/LP (LE3C/LP)