IO-Link interface description

1 General information

1.1 Document version

20230901 IO-Link Interface description (replaces earlier versions)

1.2 Valid for firmware version

2.04.10 and higher

2 Table of contents

3 The most important in brief

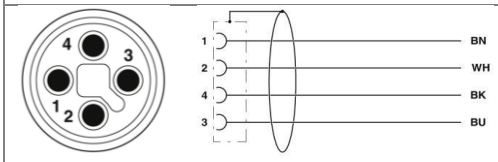
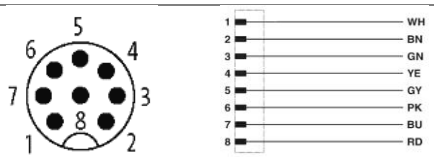
- The cylinder can be used with and without IO-Link
- The configuration data can be written via IO-Link, after which the cylinder can also be operated without IO-Link (via digital signals), but with the new configuration.
- If the IO-Link connection is active, an operating mode (Motion Mode) must be selected. In mode 0, the cylinder is not moved.
- The variables are stored in the IODD together with their description. The meaning of the variables can also be viewed without instructions via the IO-Link master.

IMPORTANT	
	The cyclic process data may be written during operation. The cylinder should be stopped for writing the remaining data. When writing the data, load shedding or even a restart of the device could occur.

IMPORTANT	
	Under no circumstances may the configuration variables be written to cyclically. Writing to these variables too frequently can damage the device. All important properties that must be controlled cyclically can be controlled via the cyclic process data.

IMPORTANT	
	In normal IO-Link operation, the current consumption remains well below 200mA, so all commercially available masters can provide the supply. However, if a large load is to be attached to one of the digital outputs (possible up to 250mA), then a master with a correspondingly higher output current must also be used.

4 Connection

Power	Signal
Plug M12x1, 4-pole T-coded according to EN 61076-2-11	**Plug M12x1, 8-pin** A-coded according to EN 61076-2-101 (Shielded cables are recommended)
	

Pin assignment Digital I/O

Pin	Farbe	Funktion	Pin	Farbe	Funktion
1	BN	Power voltage 24V-48V ± 15% (max. 10A) At 48V the use of a brake chopper is recommended.	**1**	WH	DO Ready / IO Link CQ
2	WH	Functional earth (FE)	**2**	BN	Logic voltage 24V ± 15% (max. 500mA)
3	BU	GND 0V	**3**	GN	DO is extended (optional)
4	BK	reserved, do not connect	**4**	YE	DO is retracted (optional)
			5	GY	DI Retract (optional)
			6	PK	DI Extend (optional)
			7	BU	GND 0V
			8	RD	DI Teach / Reset / Powerless

TABLE 1: CONNECTION

5 Process data structure

Process input data (Slave->Master):

Byte Nr.:	**0**	**1**	**2-5**	**6-9**	**10-13**
Variable:	State	Statusbits	Actual Position	Actual Speed	Actual Force
Datatype:	Uint8	Uint8	Float32	Float32	Float32
Details:	Chapter 8.1	Chapter 8.2	Chapter 8.3	Chapter 8.3	Chapter 8.3

TABLE 2: PROCESS INPUT DATA

Process output data (Master->Slave):

Bytenr.:	**0**	**1-4**	**5**	**6**	**7**
Variable:	Motion Mode	Target Position	Override 1	Override 2	Override 3
Datatype:	Uint8	Float32	Uint8	Uint8	Uint8
Details:	Chapter 7	Chapter 7.12	Chapter 7.7	Chapter 7.7	Chapter 7.7

TABLE 3: PROCESS OUTPUT DATA

Note	
	The above tables show the structure of the process data. The transmission sequence in the IO-Link telegram is shown in the table from left to right.

6 Referencing

After a restart (logic supply), the axis must first be referenced (home). There are three ways to do this:

- Reference run outwards direction: “Motion Mode” = 3, if not yet referenced
- Reference run inwards direction: “Motion Mode” = 4, if not yet referenced
- Direct referencing: “Motion Mode” = 7

The corresponding operating modes are described in the following chapter.

For referencing to be possible, both logic and power supply voltage must be available. This can be derived from the status byte "State" = 1 (Ready). If the axis was homed successfully, the “Homed” status bit changes to 1 (True).

If a reference run was not completed successfully, the axis must be reset with “Motion Mode” = 0 so that a new reference run can be started.

HINWEIS	
	A reference run with movement (“Motion Mode” = 3 or 4) can only be started if the axis is not yet referenced. This means that a reference run cannot be triggered a second time. If a successfully referenced axis is to be re-referenced with movement, the axis must be restarted (remove logic supply briefly) Direct referencing with «Motion Mode» = 7 can be repeated as often as desired

7 Description of the operating modes

The mode is selected via the cyclic process data with the variable “Motion Mode”.

7.1 UserMode_Off = 0

Power Supply of the Axis is cut off. If a command is triggered via the digital IO, it is immediately reset. No movement is executed.

7.2 UserMode_DIO = 1

The device can be controlled via the digital IO. The mode is essentially the same as operation without active IO-Link, but the variables can be read and written.

If no command level is present at the digital IOs, the device stops and remains in control at the current position. If coming from mode 0, the controller remains switched off.

This mode can also be seen as a stop-command in IO-Link mode.

7.3 UserMode_Teach = 2

The Axis is teached via a new learning run. First, the device travels in the direction corresponding to the “DirectionOfTravel” variable. Speed, acceleration, deceleration, and force of the learning run are set with the variables “Max. Speed Teach Mode”, “Max. Acceleration”, “Max. Deceleration” and “Max. Force”. If “Max. Force” = 0, the force is set using the force potentiometer.

A learning run can only be started when the device is in Idle status. From operation, the mode “UserMode_Off = 0” must be selected first.

7.4 UserMode_MoveOut = 3

A movement to the outer end position is triggered according to the “End Position Out” variable. Speed, acceleration, deceleration, and force of the movement are set with the variables “Max. Speed Out”, “Max. Acceleration”, “Max. Deceleration” and “Max. Force”. If “Max. Speed Out” = 0 or “Max. Force” = 0, the values are set using the speed or force potentiometers respectively.

If the axis is not yet referenced, homing is started in the outward direction. The reference speed is set using the variable «Max. Speed Teach Mode». The acceleration and the force of the reference run are set using the variables «Max. Acceleration" and "Max. Force» (deceleration is irrelevant). If «Max. Force» = 0, the force is selected using the force potentiometer.

7.5 UserMode_MoveIn = 4

A movement to the inner end position is triggered according to the “End Position In” variable. Speed, acceleration, deceleration, and force of the movement are set with the variables “Max. Speed In”, “Max. Acceleration”, “Max. Deceleration” and “Max. Force”. If “Max. Speed In” =0 or “Max. Force” = 0, the values are set using the speed or force potentiometers respectively.

If the axis is not yet referenced, homing is started in the inward direction. The reference speed is set using the variable «Max. Speed Teach Mode». The acceleration and the force of the reference run are set using the variables «Max. Acceleration" and "Max. Force» (deceleration is irrelevant). If «Max. Force» = 0, the force is selected using the force potentiometer.

7.6 UserMode_FreePos = 5

The target position is specified via the “Target Position” process variable. The axis follows this target position. Speed, acceleration, deceleration, and force of the movement are set with the variables “Max. Speed free positioning”, “Max. Acceleration”, “Max. Deceleration” and “Max. Force free positioning”. The target position must be between “End Position In” and “End Position Out”, otherwise no movement is performed and the “Warning active” bit (Table 6) and an IO-Link event (Table 8) are triggered.

HINWEIS	
	The target position “Target Position” must lie between the two end positions “End Position In” and “End Position Out”, otherwise no movement is started.

7.7 UserMode_FreePosPro = 6

Based on mode “UserMode_FreePos” = 5. In addition, the preconfigured values for speed, force and acceleration/deceleration can be scaled from 0% to 255% via the process variables “Override 1-3”.

HINWEIS	
	If “Override 1”, “Override 2” or “Override 3” = 0, no movement is executed with “Motion Mode” = 6

7.8 UserMode_HomeDirect = 7

With this mode, the axis can be referenced manually. The actual position is set equal to the “Target Position” process variable. The “Homed” status bit is set active.

Manual referencing can only be started if the device is in Ready or Active status (status byte = 1, 2) and in standstill. During operation, the mode "UserMode_Off" = 0 or "UserMode_Halt" = 1 must first be selected before manual referencing.

WICHTIG	
	When referencing manually, **it must be taken into consideration that the parameterized end positions (“End Position Out” and “End Position In”) are still approached when using User Mode 3 and 4**, as these end positions are not altered when referencing via Mode 7. These end positions may have to be adapted to the application to prevent unwanted behaviour

7.9 UserMode_PosSequence = 11 to 14

A positioning sequence is a preconfigured motion sequence that can be triggered with a simple command. Up to four sequences can be preconfigured in the parameters, which can then be triggered via User Mode 11 to 14.

Target Position (1)	rw	0.000	d	mm
Target Speed (1)	rw	0	d	mm/s
Target Acceleration (1)	rw	2	d	m/s²
Target Deceleration (1)	rw	2	d	m/s²
Target Positioning Time (1)	rw	0.000	d	ms
Target Positioning Force (1)	rw	400.00	d	N
Target Positioning Mode (1)	rw	Absolute	d	

FIGURE 1: POSITIONING SEQUENCES

The following applies:

Mode 11: Current actual position → Positioning Sequence 1
Mode 12: Current actual position → Positioning Sequence 2
Mode 13: Current actual position → Positioning Sequence 3
Mode 14: Current actual position → Positioning Sequence 4

The target position must be within a valid range (see chapter 6.7) and the target speed/acceleration/deceleration must not be 0. If the target positioning time is = 0, the target position is approached with the preconfigured values for speed/acceleration/deceleration. If the target positioning time > 0, the target speed is recalculated so that the movement (from the current position to the target position) is carried out within the preconfigured time. The target acceleration/deceleration parameters are used when calculating the path, and the target speed parameter serves as a limit value if the target positioning time cannot be reached (if, for example, the acceleration/deceleration selected was too small).

With "Target Positioning Mode" it is possible to choose between absolute and relative movement. The relative position always refers to the previously approached position.

Example for a movement sequence with Target Position = 50mm, Target Speed = 300mm/s, Target Acceleration/Deceleration = 2m/s^2, Target Positioning Time = 0:

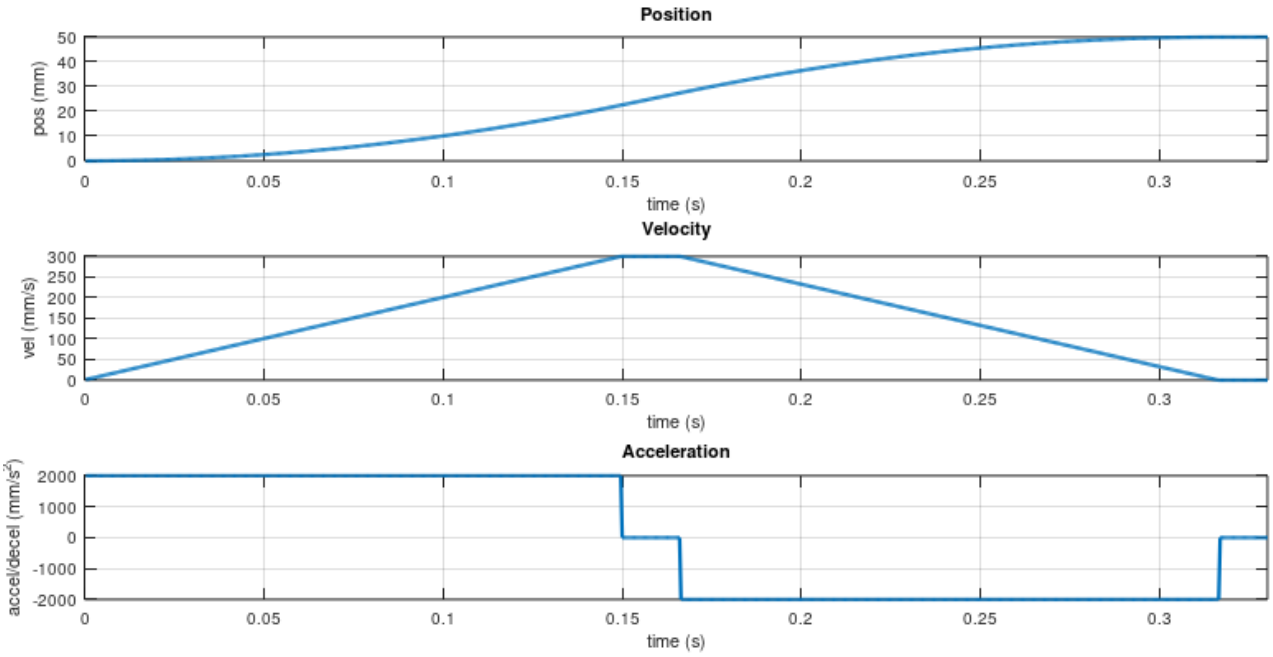


FIGURE 2: POSITIONING SEQUENCE EXAMPLE 1

Example for a movement sequence with Target Position = 50mm, Target Speed = 300mm/s, Target Acceleration/Deceleration = 2m/s^2, Target Positioning Time = 0.5s:

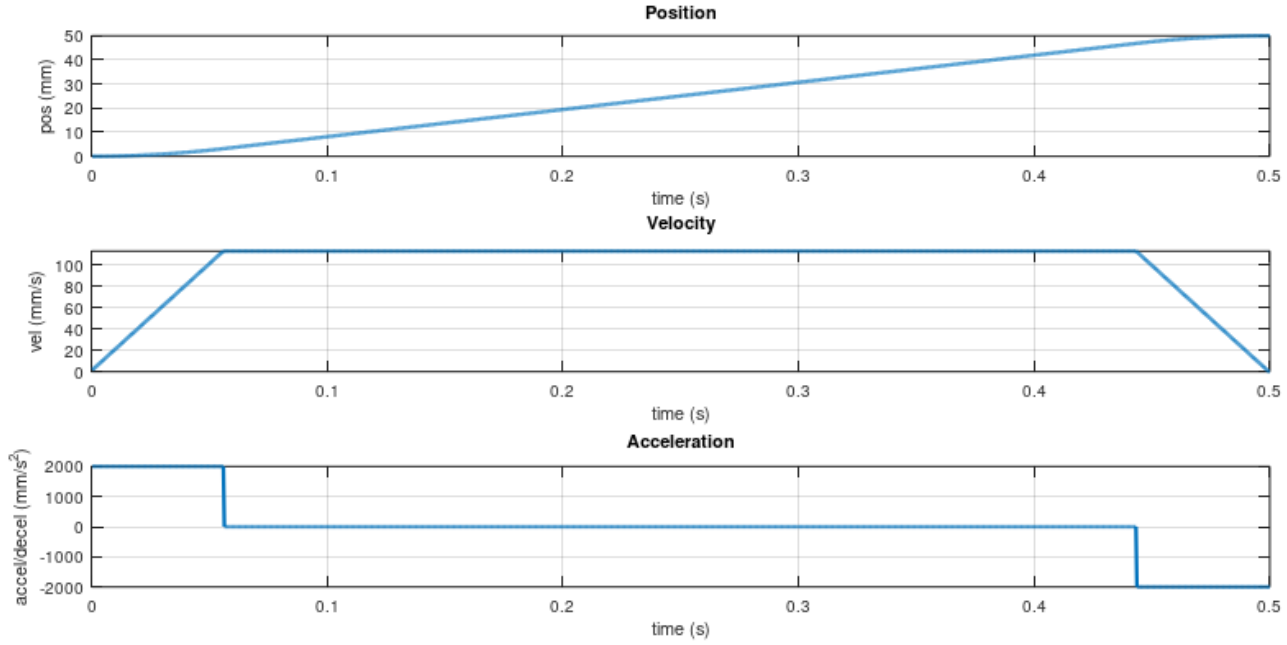


FIGURE 3: POSITIONING SEQUENCE EXAMPLE 2

7.10 UserMode_PressIn = 21 to 27

The Press In Mode uses the positioning sequences (see Chapter 6.9) to sequentially move to two pre-configured positions automatically. There are two variants:

- In mode 21 to 23, the first sequence is completed (i.e. with stop), then the second sequence is triggered.
- In modes 25 to 27 there is a smooth transition between the two sequences. If the target speed of the second sequence is lower than that of the first, the first position will be reached at the target speed of the second sequence. If the target speed of the second sequence is higher than that of the first sequence, the first position will be reached with the target speed of the first sequence

The following applies:

Mode 21 and 25: Current actual position → Sequence 1 → Sequence 2
Mode 22 and 26: Current actual position → Sequence 2 → Sequence 3
Mode 23 and 27: Current actual position → Sequence 3 → Sequence 4

HINWEIS	
	A target positioning time can also be configured for the press-in modes. In modes 25 to 27 (with a smooth transition) however, the cumulative time of both sequences can will be imprecise. It is recommended to select Target Positioning Time = 0 for these modes and to define the movement via Target Speed.

HINWEIS	
	If the current actual position of the cylinder lies between both target positions when starting a press-in mode via mode 25 to 27, the first position is ignored and the cylinder moves directly to position 2.

7.11 UserMode_Reset = 255

Serves to reset one (or more) present errors. The error state is acknowledged via rising edge of «Motion Mode» = 255.

7.12 Target Position, Override 1-3

The process variables "Target Position" and "Override 1-3" are updated on the axis with each process data cycle.

Name	Unit	Comment
Target Position	mm	
Override 1	%	Speed
Override 2	%	Force
Override 3	%	Acceleration/ Deceleration

TABLE 4: PROCESSVARIABLES TARGET VALUES

HINWEIS	
	Depending on the IO-Link master or PLC system, the byte order may have to be swapped when writing "Target Position". Attention: not the bit order, just the order of the four bytes

8 Feedback

The current values for position, speed and force are reported back directly via process variables.

8.1 Status byte

The status is reported back via a process byte with the following content:

Value	State	Meaning
0	Idle	Controller off, no power supply voltage detected
1	Ready	Controller off, power supply voltage detected and ready for enabling
2	Active	Controller on, in standstill or in movement
3	Error	Controller off, in Error
4	Teach	Controller on, teach run or home run in progress

TABLE 5: STATUSBYTE

8.2 Status bits

Further process data are available for evaluation; these are stored in the process data in the form of 8 status bits:

Value	State	Meaning
7	Tracking Error Tolerance Exceeded	Configured tracking error tolerance “Max. Tracking Error” is exceeded. This bit is set even if tracking error monitoring is deactivated (“Tracking Error Monitoring” = False).
6	Warning active	Temperature or voltage has exceeded the warning limit, invalid setpoint detected, teach or home run unsuccessful, or axis is in error
5	Motion command completed	Movement command finished successfully
4	Motion Mode active	Movement command in execution
3	Limit switch in	The position of the axis is located at “Pos. Sensor Signal In (limit switch)”, within the tolerance “Tolerance Position Sensor Signal In (Limit Switch)”
2	Limit switch out	The position of the axis is located at “Pos. Sensor Signal Out (limit switch)”, within the tolerance “Tolerance Position Sensor Signal Out (Limit Switch)”
1	Homed	The device is referenced
0	Ready	Power supply voltage detected, and the device is ready to accept a command. If no power supply is connected, this bit will stay False

TABLE 6: STATUSBITS

8.3 Actual Position, Actual Speed & Actual Force

The “Actual Position” process variable is returned in every operating state. The process variables “Actual Speed” and “Actual Force” are only returned when the controller is active.

Name	Unit
Actual Position	mm
Actual Speed	mm/s
Actual Force	N

TABLE 7: PROCESSVARIABLES ACTUAL VALUES

HINWEIS	
	Depending on the IO-Link master or PLC system, the byte order may have to be swapped when reading “Actual Position”, “- Speed” and “- Force”. Attention: not the bit order, just the order of the four bytes

HINWEIS	
	The “Actual Force” process variable is calculated using the motor current and is therefore only an estimate of the force currently acting on the axis. Due to friction effects, the actual acting force is expected to be smaller than the process data value

9 Notes on parameterization

The axis can be freely parameterized using the variables in Table 10. In the previous chapters, most of the parameters have been described in terms of the relevant modes (see chapter 7). Below are notes on other parameters.

9.1 Tracking Error

The tracking error monitoring compares the target value of the pathplanner and the actual value of the axis during a motion sequence. The error tolerance is set using the “Max. Tracking Error” variable. If the axis is in tracking error, it is **always reported back** using the status bit “Tracking Error Tolerance Exceeded”. If tracking error monitoring is switched on (“Tracking Error Monitoring” = True), in the event of a tracking error, the axis will go into error state (status byte = 3) and the axis will be switched off.

HINWEIS	
	If the axis goes into the error state due to a following error, this is **not** signaled by a flashing pattern on the red LED on the axis. In this case, all LEDs go out

HINWEIS	
	A typical application error when using the FreePosPro mode ("Motion Mode" = 6, see Chapter 7.7) is setting "Override 2" to 0 (target force). In this case, the "Tracking Error Tolerance Exceeded" process data bit reports a following error, even though no movement has yet been carried out

9.2 Control Mode

Special operating modes can be set using the “Control Mode (Bistable, Omnistable)” variable. Currently, only the modes “Omnistable” = 0 and “Bistable” = 1. These modes influence, among other, the function of Motion Mode 3 and 4 and are already documented in the operating instructions ***_Manual_CTL_EN).

HINWEIS	
	The “Bistable” mode is intended for applications in which the cylinder is controlled via digital in- and outputs (DIOs). For more information, refere to the corresponding operating instructions. If this mode is active, movements that are currently active can can only be aborted with “Motion Mode” = 0.

9.3 Reserved Parameters

Following parameters currently have no functionality and can be ignored:

- Reserved, Index 79

10 IO-Link Error Codes

The following error states can be read out via the IO-Link events:

Name	Code	Type
Undertemperature Micro Controller	6210	Error
Overtemperature Micro Controller	6211	Error
Undertemperature Controller Board	6212	Error
Overtemperature Controller Board	6213	Error
Undertemperature Encoder Board	6214	Error
Overtemperature Encoder Board	6215	Error
Overtemperature Power Stage Phase U	6216	Error
Overtemperature Power Stage Phase V	6217	Error
Overtemperature Power Stage Phase W	6218	Error
Overtemperature Motor Phase U	6219	Error
Overtemperature Motor Phase V	6220	Error
Overtemperature Motor Phase W	6221	Error
Controller Error (e.g. Overcurrent)	6222	Error
Internal Error	6223	Error
Tracking Error	6224	Error
Invalid Setpoints	6225	Warning
Primary supply voltage overrun	20752	Error
Primary supply voltage underrun	20753	Error
Secondary supply voltage fault (Port Class B)	20754	Error
Homing Failed	6226	Warning

TABLE 8: IO-LINK ERROR CODES

HINWEIS	
	How to read out the events depends on the respective IO-Link master. See the relevant manufacturer documentation.

10.1 Notes on IO-Link Error Codes

10.1.1 Overtemperature

Error codes **6210** to **6221** indicate thermal overload of the axis. For example, the axis was moving for too long with too much load. The axis may be driving against an end stop with high force or its movement is blocked (e.g. after incorrect referencing, etc.). See the data sheet for the permissible RMS loads for the respective axis type and spindle pitch.

10.1.2 Controller Error

Error code **6222** reports an error in the internal current-, speed- or position controller, for example if unexpectedly high currents occur.

10.1.3 Internal Error

Error Code **6223** reports an unexpected internal firmware error.

10.1.4 Tracking Error

Error code **6224** reports that the axis is in a following error. See chapter 9.1

10.1.5 Invalid Setpoints

Warning Code **6225** reports that the target position of a movement is not in a valid range (e.g. it is outside the configured end positions).

10.1.6 Homing Failed

Warning Code **6226** reports a power voltage drop during the teach or home run, or that the teach or home run could not be completed successfully because of some other issue. An unsuccessful teach or home run must be aborted with “Motion Mode” = 0 in order that a new attempt can be started

The following table was taken from the operating manual and supplemented with the corresponding IO-Link event codes. For remedies for the corresponding errors, see the operating instructions.

Blink / light pattern	Error Code	Possible cause	IO-Link error code
LED red lights constantly (after teach or reference run)	Voltage dip during teach or reference run, teach or reference run could not be completed	The power supply delivers less current than the actuator requires. Force setting too high.	6226
LED flashes red: 1x, Pause, 1x, ...	Power voltage too high	Overvoltage generated by braking loads	20754
LED flashes red: 2x, pause, 2x, ...	Temperature too high	Overload of the device	6210 - 6221
LED flashes red: 3x, pause, 3x, ...	Error current	Current internally too high	6222
LED flashes red: 4x, pause, 4x, ...	Internal error	Internal error	6223
LED flashes red: 5x, pause, 5x, ...	Signal voltage too high	- Overvoltage generated by braking loads - Overvoltage caused by another device in the 24V intermediate circuit	20752
LED flashes red: 6x, pause, 6x, ...	Signal voltage too low		20753

TABLE 9: ASSIGNMENT OF IO-LINK ERROR/EARNING CODES

11 Simple application examples

11.1 Approaching two taught-in end positions

This procedure corresponds to the use of the digital inputs and outputs. However, the wiring can be saved and everything can be controlled via the software.

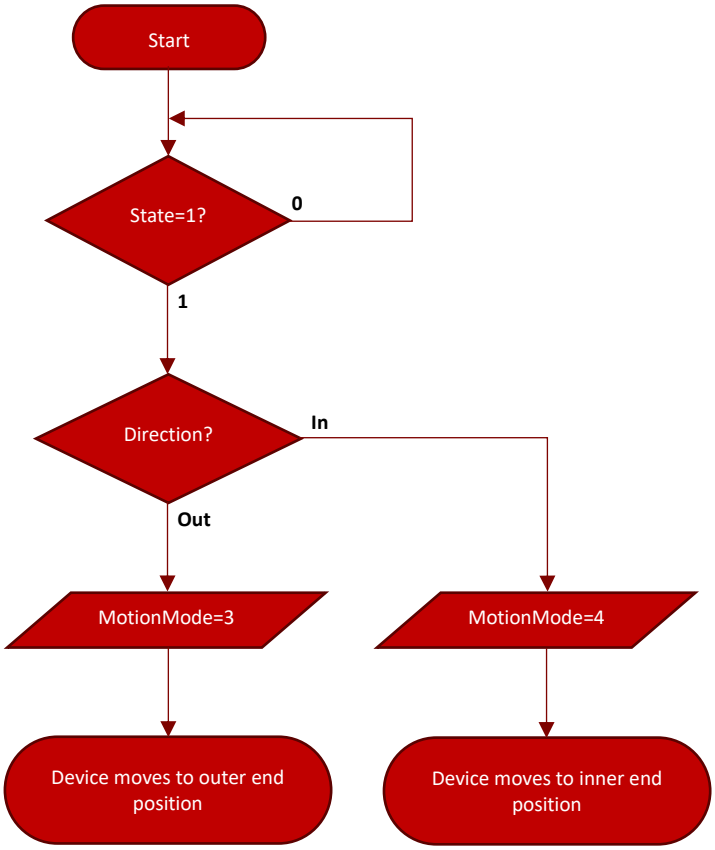


FIGURE 4: APPROACHING TWO TAUGHT IN END POSITIONS

The first movement is performed slowly to detect the end stop.

Afterwards, it is possible to switch back and forth between modes 3 and 4 as desired. A movement can also be stopped on the way by changing to mode 1 (position controller remains active) or mode 0 (position controller is deactivated).

11.2 Free positioning via cyclic data

Free positioning via the cyclic data can be set up as follows. As soon as the device is ready for operation (State=1 or Ready Bit=1), an end position can be approached. The device is then referenced and can be moved in free positioning mode.

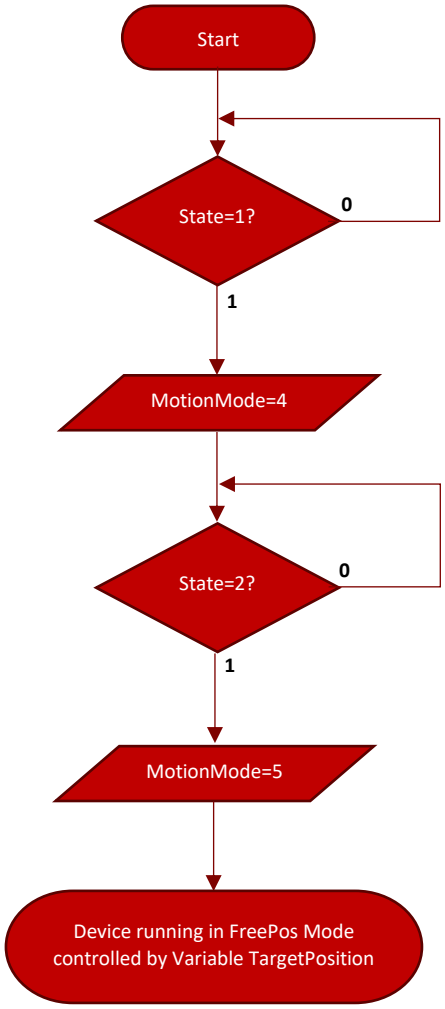


FIGURE 5: POSITIONING VIA CYCLICAL DATA

11.3 Teaching a new travel range

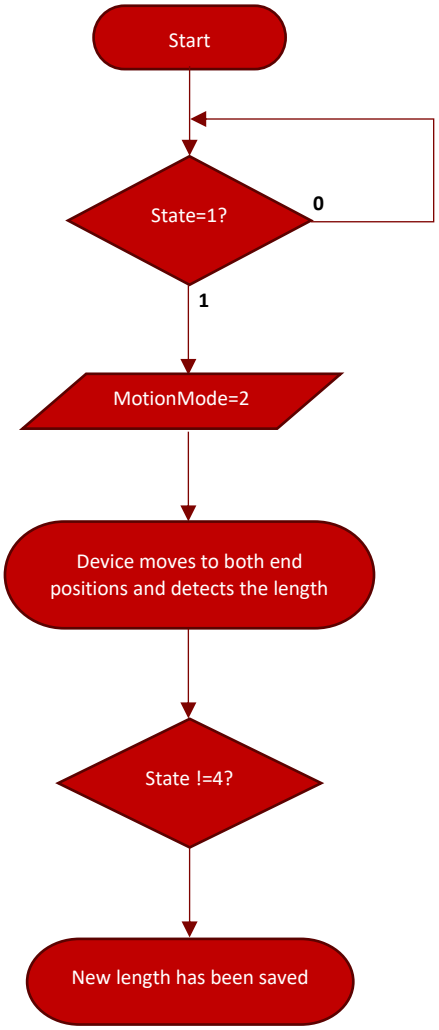


FIGURE 6: TEACHING A NEW TRAVEL RANGE

12 Variable list

12.1 configuration (read/write)

Name	Index	Datatype	Value Range	Unit	Single Values
Max. Speed In	64	Float32T	0 to 600	mm/s	
Max. Speed Out	65	Float32T	0 to 600	mm/s	
Max. Speed free Positioning	66	Float32T	1 to 600	mm/s	
Max. Force	67	Float32T	0 to 500	N	
Max. Acceleration	68	Float32T	0.01 to 20	mm/s^2	
Max. Deceleration	69	Float32T	0.01 to 20	mm/s^2	
Max. Tracking Error	70	Float32T	0.01 to 10000	mm	
Tracking Error Monitoring	71	Float32T			false (false), true (true)
Position Tolerance for Status Feedback	72	BooleanT	0.01 to 10000	mm	
Tolerance Position Sensor Signal Out (Limit Switch)	73	Float32T	0.01 to 10000	mm	
Tolerance Position Sensor Signal In (Limit Switch)	74	Float32T		mm	
End Position Out	75	Float32T		mm	
End Position In	76	Float32T		mm	
Pos. Sensor Signal Out (limit switch)	77	Float32T		mm	
Pos. Sensor Signal In (limit switch)	78	Float32T		mm	
Reserved	79	Float32T	0.1 to 10		
Max. Speed Teach Mode	80	Float32T	1 to 200	mm/s	
Rated Power Voltage	81	Float32T	24 to 48	V	
Control Mode (Bistable, Omnistable)	82	Float32T			Omnistable (0), Bistable (1), PWM Mode (2), DIO-Ramp (3), DIO-Press (4)
Direction of Travel	83	UIntegerT_8			extend (1), retract (0)
Max. Force free positioning	84	UIntegerT_8	0 to 500	N	
Target Position (1)	90	Float32T		mm	
Target Speed (1)	91	Float32T	0 to 600	mm/s	
Target Acceleration (1)	92	Float32T	0.01 to 20	mm/s^2	
Target Deceleration (1)	93	Float32T	0.01 to 20	mm/s^2	
Target Positioning Time (1)	94	Float32T	0 to 10000000	ms	
Target Position (2)	100	Float32T		mm	
Target Speed (2)	101	Float32T	0 to 600	mm/s	
Target Acceleration (2)	102	Float32T	0.01 to 20	mm/s^2	
Target Deceleration (2)	103	Float32T	0.01 to 20	mm/s^2	
Target Positioning Time (2)	104	Float32T	0 to 10000000	ms	
Target Position (3)	110	Float32T		mm	
Target Speed (3)	111	Float32T	0 to 600	mm/s	
Target Acceleration (3)	112	Float32T	0.01 to 20	mm/s^2	
Target Deceleration (3)	113	Float32T	0.01 to 20	mm/s^2	
Target Positioning Time (3)	114	Float32T	0 to 10000000	ms	
Target Position (4)	120	Float32T		mm	
Target Speed (4)	121	Float32T	0 to 600	mm/s	
Target Acceleration (4)	122	Float32T	0.01 to 20	mm/s^2	
Target Deceleration (4)	123	Float32T	0.01 to 20	mm/s^2	
Target Positioning Time (4)	124	Float32T	0 to 10000000	ms	
Target Positioning Force (1)	240	Float32T	0 to 500	N	

Target Positioning Force (2)	241	Float32T	0 to 500	N	
Target Positioning Force (3)	242	Float32T	0 to 500	N	
Target Positioning Force (4)	243	Float32T	0 to 500	N	
Target Positioning Mode (1)	244	UIntegerT_32			Absolute (0), Relative (1)
Target Positioning Mode (2)	245	UIntegerT_32			Absolute (0), Relative (1)
Target Positioning Mode (3)	246	UIntegerT_32			Absolute (0), Relative (1)
Target Positioning Mode (4)	247	UIntegerT_32			Absolute (0), Relative (1)

TABLE 10: READ/WRITE VARIABLES

HINWEIS	
	The “Value Range” in the table above applies to a spindle pitch of 10mm (type CTC-060-K10 or CTL-060-K10). For other types (e.g. CTC-060-K05) see the corresponding IODD. Current IODDs can be found online on the IODDfinder platform: IODDfinder (io-link.com)

HINWEIS	
	Detailed description of the parameters is in progress. The most important parameters are described in chapters 7, 8, 0

12.2 Diagnose (read only)

Name	Index	Datatype	Value Range	Single Values
Lubrication Countdown (in development)	140	Float32T		
Lifetime Countdown (in development)	141	Float32T		
Reserved	142	Float32T		
Temperature Board	143	Float32T		
Temperature Encoder	144	Float32T		
Temperature Power Unit	145	Float32T		
Reserved	146	Float32T		
Temperature Motor	147	Float32T		
Actual Tracking Error (in development)	148	Float32T		
Actual Control Voltage	149	Float32T		
Actual Power Intermediate Circuit Voltage	150	Float32T		
Reserved	151	Float32T		
Cycle Counter	152	IntegerT_32		
EEPROM Version	153	IntegerT_32		
Error counter for "Undervoltage Logic"	160	IntegerT_16		
Error counter for "Overvoltage Logic"	161	IntegerT_16		
Error counter for "Undervoltage Power"	162	IntegerT_16		
Error counter for "Overvoltage Power"	163	IntegerT_16		
Error counter for "Undertemperature Micro Controller"	164	IntegerT_16		
Error counter for "Overtemperature Micro Controller"	165	IntegerT_16		
Error counter for "Undertemperature Controller Board"	166	IntegerT_16		
Error counter for "Overtemperature Controller Board"	167	IntegerT_16		
Error counter for "Undertemperature Encoder Board"	168	IntegerT_16		

Error counter for "Overtemperature Encoder Board"	169	IntegerT_16		
Error counter for "Overtemperature Power Stage Phase U"	170	IntegerT_16		
Error counter for "Overtemperature Power Stage Phase V"	171	IntegerT_16		
Error counter for "Overtemperature Power Stage Phase W"	172	IntegerT_16		
Error counter for "Overtemperature Motor Phase U"	173	IntegerT_16		
Error counter for "Overtemperature Motor Phase V"	174	IntegerT_16		
Error counter for "Overtemperature Motor Phase W"	175	IntegerT_16		
Error Counter Controller Error	176	IntegerT_16		
Error Counter Internal Error	177	IntegerT_16		
Max. Temperature Controller Board	178	Float32T		
Max. Temperature Encoder	179	Float32T		
Max. Temperature Power Unit	180	Float32T		
Reserved	181	Float32T		
Max. Temperature Motor	182	Float32T		
Cycle Stamp Undervoltage Logic	183	IntegerT_32		
Cycle Stamp Overvoltage Logic	184	IntegerT_32		
Cycle Stamp Undervoltage Power	185	IntegerT_32		
Cycle Stamp Overvoltage Power	186	IntegerT_32		
Cycle Stamp Undertemperature Micro Controller	187	IntegerT_32		
Cycle Stamp Overtemperature Micro Controller	188	IntegerT_32		
Cycle Stamp Undertemperature Controller Board	189	IntegerT_32		
Cycle Stamp Overtemperature Controller Board	190	IntegerT_32		
Cycle Stamp Undertemperature Encoder Board	191	IntegerT_32		
Cycle Stamp Overtemperature Encoder Board	192	IntegerT_32		
Cycle Stamp Overtemperature Power Stage Phase U	193	IntegerT_32		
Cycle Stamp Overtemperature Power Stage Phase V	194	IntegerT_32		
Cycle Stamp Overtemperature Power Stage Phase W	195	IntegerT_32		
Cycle Stamp Overtemperature Motor Phase U	196	IntegerT_32		
Cycle Stamp Overtemperature Motor Phase V	197	IntegerT_32		
Cycle Stamp Overtemperature Motor Phase W	198	IntegerT_32		
Cycle Stamp Controller Error	199	IntegerT_32		
Cycle Stamp Internal Error	202	IntegerT_32		
Operating Hours	203	IntegerT_32		

TABLE 11: READ ONLY VARIABLES

13 Appendix

13.1 Firmware Version History

Version	Release date	Description of changes	Compatible IODD
2.01.01	03.05.2022	First Release	Cyltronic-CTC-060-***-20220322-IODD1.1
2.03.01	10.08.2022	New Features: - New Device ID (separate ID per spindle pitch) - Force in “free positioning mode” now defined via “Max. force free positioning” instead of “Max. force” and potentiometer Essential Bugfixes: - Improved saving of parameters - Behavior in UserModeOff improved (no more disturbances by DIOs) - Timing behavior in Basic Mode (Modes 0 and 1) improved - Quieter position controller	From Cyltronic-CTC-060-***-20220719-IODD1.1
2.03.03	30.08.2022	Essential Bugfixes: - Improved saving of parameters - Bugfix at transition between modes 2 and 5/6 to 3 and 4 - Bugfix when homing with DIOs	From Cyltronic-CTC-060-***-20220719-IODD1.1
2.04.07	07.02.2023	New Features: - Controller with Pathplaner - Tracking Error - UserMode 11-14 & 21-27: Positioning Sequences & Press-In Mode - UserMode 7: Manual Referencing - Compatible for CTL Essential Bugfixes: - Process variable Actual Force is now calculated through actual current instead of target current - Application Reset fixed for CTC K05 and for CTL K05/10 - Loss of Parameters fixed	From Cyltronic-CTC-060-***-20230207-IODD1.1
2.04.10	22.08.2023	Neue Features: - All target positions must lay within the parametrized end positions - Relative positioning sequences - Failed homing/teaching now triggers an IO-Link warning event as well as the "Warning active" bit - Errors reset through rising edge of Motion Mode = 255 Essential Bugfixes: - Fixed inconsistencies of State and Statusbits - Fixed undesired force peaks between changes of direction - Fixed issues during home/teach run when using very high or very low forces - Fixed undesired influence of DIO signals during IO-Link modes - Fixed REF-Led behavior after manually canceled home/teach run For details refer to Release-Notes FW V2.04.10	From Cyltronic-CT*-060-***-20230627-IODD1.1 (V2.04.01)

TABLE 12: FW HISTORY

13.2 IO-Link Interface Description History

Version	Description of changes
20230207	Initial document for History
20230405	- More detailed description of the operating modes with correspondingly relevant variables - Added general parameterization notes - Corrected indices in the variable list - Added units in variable list - Added IO-Link Error Codes - Added IO-Link interface description history
20230901	Revision for new FW V2.04.10. Changes in the following chapters: - New chapter 6: Referencing - New chapter 7.12 Target Position, Override 1-3 - 7.3 - 7.9, 7.11 - 8.1, 8.2, 8.3 - 9.3 - 10 - 12.1 - 13

TABLE 13: IO-LINK INTERFACE DESCRIPTION HISTORY

13.3 List of figures

13.4 List of tables