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IO-Link

This document reflects the Novotechnik sensor protocol implementation of the standard IO-Link protocol. A basic knowledge of the IO-link interface is required for a proper understanding of this document. Most of the definitions made are according to the IO-Link Standard specifications. For making use of all the features that these specifications offer, a knowledge about them is absolutely necessary. The linear sensors supports the IO-Link Smart Sensor Profile specifications (Edition 2011) according IEC 61131-9.

The IO-Link interface is a point-to-point connection based on a UART protocol with 24 V pulse modulation. Data is exchanged cyclically between the IO-Link Master and the IO-Link device using the IO-Link protocol. The protocol contains process data and also requested additional data for state determination or configuration.

1 IODD Files

For integration in a common IO-Link projecting tool, IO Device Description (*.IODD) files are provided. These files can be downloaded from the Novotechnik Web Site, see Downloads/Operating manuals where also this document can be found.

⇒ IODD see file *Product series_IODD_model.zip*

2 Device specification

Specification	IO-Link Description	Value
Transfer rate	COM3	230.4 kBaud
Minimum cycle time of device	Min cycle time	0x0A (1 ms)
Frame specification - Number of preoperate data required - Number of operate data required - Enhanced parameters	M-sequence capability: - Preoperate M-sequence type - Operate M-sequence type - ISDU supported	0x2B Type_1_V Type_2_V Supported
IO-Link protocol version	Revision ID	0x11 (Version 1.1)
Number of process data (PD) from device to master	ProcessDataIn	See chapter 3, table "Device ID and ProcessDataIn"
Number of process data (PD) from master to device	ProcessDataOut	0x00 (0 bit)
Manufacturer ID	Vendor ID	0x030B (779)
Device identification	Device ID	See chapter 3, table "Device ID and ProcessDataIn"
Transfer times		
Process data cycle with master V1.0	Number of PD x master cycle time = 2 x 1 ms = 2 ms	
Process data cycle with master V1.1	Master cycle time = 1 ms	

3 Process data

The process data are transmitted cyclically. The sensor outputs a signed integer value via the IO-Link interface, e.g.: 32 bits = position or 48 bits = 32 bits position and 16 bits speed

The absolute position relates to the factory default null point.

Resolution of position data: 1 or 5 µm
 Resolution of speed data: 0.1 or 0.5 mm/s

The factory default null point can be shifted via the parameter "Null point offset".

The validity of the process data 0xF000 FF10 ... 0x7FFF FFF0 is confirmed by a PD Valid Information (process data valid). In case of an error, if no position marker or magnet can be detected, the error value 0x7FFF FFFC is put out and the data is labeled as invalid (PD Invalid Bit).

Hint: The IO-Link functionality PD Invalid Bit is handled differently by different IO-Link masters (refer to the manual for the respective master).

Product series	Device ID	Process Data In	
TF1	0x000834 (002100)	0x04	1x 4 byte position
	0x00083E (002110)	0x06	1x 4 byte position + 1x 2 byte speed
TP1/TH1	0x00044C (001100)	0x04	1x 4 byte position
	0x000456 (001110)	0x06	1x 4 byte position + 1x 2 byte speed
	0x0004B0 (001200)	0x08	2x 4 byte position
	0x0004C4 (001220)	0x0C	2x 4 byte position + 2x 2 byte speed
	0x000514 (001300)	0x0C	3x 4 byte position

Table: Device ID and ProcessDataIn

4 Parameter Data

Device parameters are exchanged non-cyclically and on request of the IO-Link master. Parameter values can be written into the sensor (Write) or device states can be read out of the sensor (Read) by means of the "On-Request Data Objects".

4.1 Identification data

Index	Sub-index	Parameter	Access	Default value
0x0010	0	Vendor name	Read only	Novotechnik Messwertaufnehmer OHG
0x0011	0	Vendor Text	Read only	www.novotechnik.de
0x0012	0	Product name	Read only	z.B. / e.g. TH1-0100-102-A11-107
0x0013	0	Product ID	Read only	TH1/TP1/TF1- P 1x position code A11/A31 TH1/TP1/TF1- PV 1x position + speed code A12/A32 Only TP1/TH1 series: TH1/TP1- 2P 2x position code A13/A33 TH1/TP1- 2PV 2x position + speed code A14/A34 TH1/TP1- 3P 3x position code A15/A35
0x0014	0	Product text	Read only	TP1/TH1 series: Magnetostrictive Transducer TF1 series: Inductive Transducer
0x0015	0	Serial number	Read only	see product label B/N xxxxxx or S/N xxxxxxxx
0x0016	0	Hardware revision	Read only	TP1/TH1 series: HW xx.xx TF1 series: xxxxxxxx-xx
0x0017	0	Firmware revision	Read only	TP1/TH1 series: FW xx.xx TF1 series: Vxx.xx.xx

4.2 Device parameter data

Index	Sub-index	Parameter	Access	Default value	Parameter management
0x000C	0	Device Access Locks	Read/Write	0 (not locked)	Yes
0x000D	0	Profile Characteristics	Read only	0x00 01 80 00 80 02 80 03	No
0x000E	0	PD Input Descriptor	Read only	Code A11/A31: 0x03 20 00 Code A12/A32: 0x03 30 00 Only TP1/TH1 series: Code A13/A33: 0x03 40 00 Code A14/A34: 0x03 60 00 Code A15/A35: 0x03 60 00	No
0x0018	0	Application Specific Tag	Read/Write	***	Yes
0x0040	0	Null point offset	Read/Write	0	Yes
0x0041	0	Averaging	Read/Write	0 (not activated)	Yes *
0x0043	0	Resolution	Read/Write	(resolution position, see ordering code)	Yes *
0x0044	0	Mode	Read/Write	(configuration, default see ordering code)	Yes **
0x0050	0	Position 1	Read only	(actual position value 1, 32 bits)	No
0x0051	0	Speed 1	Read only	(actual speed value 1, 16 bits)	No
0x0052	0	Position 2	Read only	Only TP1/TH1 series: (actual position value 2, 32 bits)	No
0x0053	0	Speed 2	Read only	Only TP1/TH1 series: (actual speed value 2, 16 bits)	No
0x0054	0	Temperatur	Read only	(actual chip temperature in °C, 16 bits)	No
0x0055	0	Position 3	Read only	Only TP1/TH1 series: (actual position value 3, 32 bits)	No

Index	Sub-index	Parameter	Access	Default value	Parameter management
0x0060	0	Measuring range	Read only	(measuring length, see ordering code)	No
0x0061	0	Measurement resolution	Read only	1 [µm]	No

*) changeable during operation.

Only TP1/TH1 series: Process data are invalid until renewed output of valid process data after 10 ms

**) changeable during operation but only effective after Power Off / Power On

4.2.1 Device Access Locks

With this parameter, it is possible to active or deactivate the function of the parameter manager.

In order to lock the parameter manager, bit #1 of the 2 byte value must be set to "1" (locked), to unlock bit #1 is set to "0".

4.2.2 Profile Characteristics

This parameter indicates which profile is supported by the IO-Link device.

The sensor supports the Smart Sensor Profile:

Profile Identifier -> DeviceProfileID: 0x0001 "Smart Sensor Profile"
 Profile Identifier -> FunctionClassID: 0x8000 "Device Identification"
 Profile Identifier -> FunctionClassID: 0x8002 "ProcessDataVariable"
 Profile Identifier -> FunctionClassID: 0x8003 "Sensor Diagnosis"

4.2.3 PD Input Descriptor

This parameter describes the composition of the process data variables used. The sensor processes the process data variable as follows:

0x000E Subindex 0:

0x03 -> Data type = IntegerT

0x20 -> Data size = 32 bits

0x00 -> Offset = 0 bit

0x30 -> Data size = 48 bits

Only TP1/TH1 series:

0x40 -> Data size = 64 bits

0x60 -> Data size = 96 bits

4.2.4 Application Specific Tag

This parameter makes it possible to assign the IO-Link device an arbitrary, 32-byte string. This can only be used by the customer for application-specific identification and applied in the parameter manager. The entire object is accessed via subindex 0.

4.2.5 Null point offset

Same as process data value, this parameter is a signed **32-bits** decimal value.

The null point offset can be done without magnet or position marker. The value is added to the factory default null point as a simple offset: maximum value corresponding sensor length.

Access takes place via subindex 0.

4.2.6 Averaging

The behavior of the output filter can be adjusted for smoothing the signal noise of the output signal. This allows to achieve a better repeatability.

0 without moving average

1 (or 2, 3, 4, 5) moving average across 2 (or 4, 8, 16, 32) values

4.2.7 Resolution

The setting of the resolution can be changed (see IODD: 0 = 1 µm, 1 = 5 µm). When changing the resolution of the position signal from 1 to 5 µm, the resolution of the speed signal changes from 0.1 to 0.5 mm/s and vice versa.

4.2.8 Mode

The ordered product model can be configured regarding number of position markers and measured variables:

mode 0 = 1x position

mode 1 = 1x position + 1x speed

Only TP1/TH1 series:

mode 2 = 2x position

mode 3 = 2x position + 2x speed

mode 4 = 3x position

4.2.9 Error Messages while Parametrization

The following IO-Link error messages are stored if parametrization fails:

Error code	Error Message
0x8011	Index not available
0x8012	Subindex not available
0x8020	Service temporarily not available
0x8023	Index not writable
0x8030	Parameter value out of range

5 Events: Warnings and Errors

When an event occurs, the sensor sets the so-called "Event Flag". During an event is read by the master, no parameter data can be exchanged

Code	Characterist.	Description
0x8C10 0x8C30	Warning	Magnet or position marker is below (range overrun) above (range underrun) of the defined working range
0x8C20	Error	Magnet or position marker is missing
0x4210	Error	Internal temperature overrun
0x5000	Error	Internal system failure
0x8CA0	Error	Storage failure

6 Storage of Parameter Data

The device parameters that have been set by the configuration tool and IODD are stored non-volatile. They can be changed and stored again in the sensor any time via the configuration tool or by the PLC. The device acknowledges any change of the parameters to the master.

7 Factory Reset

Resetting to factory default settings is done with command 0x80 in index 0x0002 subindex 00.

8 Document Changes

Revision	Changes	Date	Who
V00	First edition	27.07.20	VM/mm