User Manual

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1. General

The magnetostrictive displacement transducers are designed for direct connection to the EtherCAT industrial Ethernet system. Use of the CANopen over EtherCAT message (CoE) enables parameters and diagnostic data to be handled as usual in the case of CANopen.

The EtherCAT specifications can be obtained from the EtherCAT Technology Group ETG (www.ethercat.org).

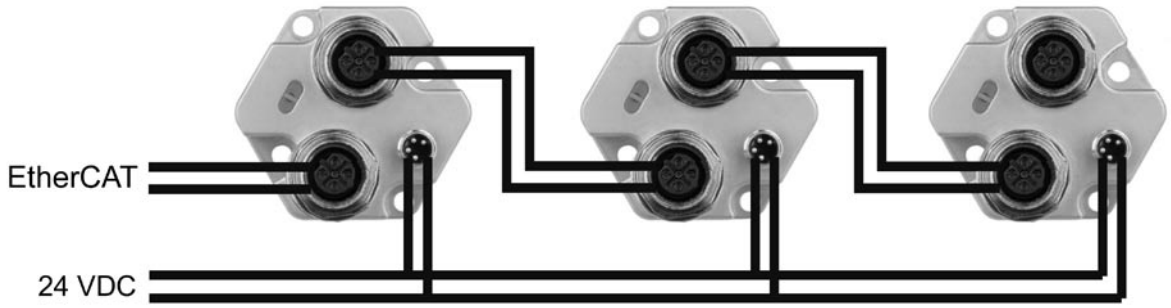
2. Installation instructions

2.1 Connection via M12/M8 connector

The " ...M01" type Magnosens displacement transducers have separate connectors for the supply and the EtherCAT system.

Device connectors:	- M12x4 D-coded socket:	Bus in
	- M12x4 D-coded socket:	Bus out
	- M8x4 pins:	24 V voltage supply

In and out are marked on the device.



(See data sheet 11791 for connector assignment)

2.2 EtherCAT wiring

The physical characteristics of the interface are based on the 100BASE-TX Ethernet standard in accordance with ISO/ I EC 8802-3.

As a result of this:

- The EtherCAT cable must at least meet the requirements according to CAT5.

- The max. cable length between two subscribers may be 100 m.

- Setting the baud rate is not possible/necessary.

In the case of EtherCAT, the network topology normally has a linear structure. However, tree structures or branch-off lines may also be implemented by means of bus modules with an integrated switch port.

In contrast to the EDP networks which are usual today, hubs are not permissible, and a standard switch is only permitted directly to the rear of the master (the first subscriber must then possess a MAC address).

For wiring purposes, we recommend pre-assembled data cables with M12 connectors moulded on at both ends. These can be ordered from us in various lengths (see data sheet 11791).

Terminating resistors are not necessary.

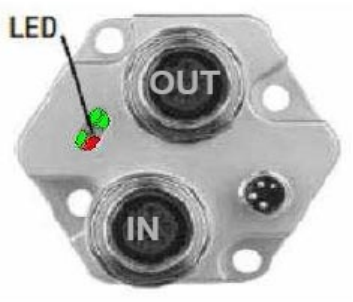
2.3 Addressing

Manually setting the subscriber address is not necessary. It is assigned automatically by the EtherCAT master in accordance with the physical sequence in the bus.

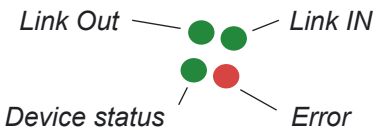
2.4 Status LEDs

Four LEDs are housed behind the inspection port in the displacement transducer's connecting cap. These have the following meanings:

	Status	Meaning
Link IN **Link OUT**	on off flashing	No link Link Data traffic
Device status	on flashing (1s) flashing (2s) off	Init Pre-operational safe-operational Operational
Error	on off flashing	Magnet missing No error Supply voltage not o.k.



LED arrangement



2.5 XML file

An XML file is supplied on a CD-ROM to integrate the displacement transducer into a project planning tool. This describes the features of the EtherCAT subscriber in the standardised XML format.

After integrating the XML file into the project planning tool (e.g. TwinCAT System Manager from Beckhoff), the displacement transducer can be integrated off-line into the bus. However, access to the parameters and diagnostic information (CANopen over EtherCAT) is only possible after reading these out (online) from the displacement transducer. See Chapter 5.

3. Process data exchange

The displacement transducer transmits 10 bytes of input data in a process data object (PDO). These include:

- 2 bytes of status information
- 4 bytes of position data
- 4 bytes of speed data

The output data definition (mapping) cannot be changed.

Data format

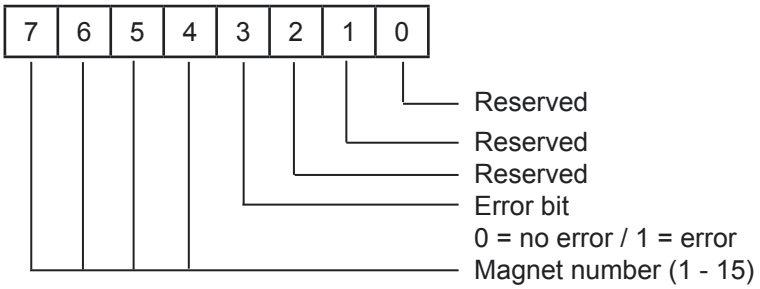
Byte 0								Byte 1							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
16 bit status															

Byte 2								Byte 3								Byte 4								Byte 5							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
32 bit position																															

Byte 6								Byte 7								Byte 8								Byte 9							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
32 bit speed																															

The position and the speed value are depicted in Intel format (Little Endian).

Status byte



Position

The displacement transducer's resolution (µm per step) and measurement direction (descending or ascending signal) can be changed via the CoE parameters 2009_h and $200A_h$. Failsafe storage of the modified parameters is carried out via the CoE parameter $200C_h$. See Chapters 4.3.10 and 4.3.13.

Speed

The speed unit is mm/step. It cannot be changed. The speed is depicted with a prefix, i.e. magnet movement from the sensor head towards the end of the rod results in a positive speed value, movement from the end of the rod to the sensor head results in a negative speed value.

4. Programming and diagnosis (CANopen over EtherCAT)

4.1 Overview of the object directory

Index	Object	Name	Data type	Access
Communication Profile Area				
1000_h	VAR	Device type	Unsigned32	ro
1001_h	VAR	Error register	Unsigned8	ro
1008_h	VAR	Manufacturer device name	String	ro
1009_h	VAR	Manufacturer hardware version	String	ro
$100A_h$	VAR	Manufacturer software version	String	ro
1018_h	RECORD	Identity object		ro
1A00	RECORD	TxPDO1		ro
1C00	RECORD	Sync Manager Communication Type		ro
1C12	RECORD	Sync Manager RxPDO Assign		rw
1C13	RECORD	Sync Manager TxPDO Assign		rw
Manufacturer Specific Profile Area				
2000	VAR	Manufactured Date	String	ro
2001	VAR	Sensor Serial Number	Unsigned32	ro
2002	VAR	Sensor Length	Unsigned32	ro
2003	VAR	Number of Magnets	Unsigned32	ro
2004	VAR	Sensor Status Bits	Unsigned32	ro
2005	VAR	Missing Magnet Status	Unsigned32	ro
2006	VAR	Suppley Voltage	Real32	ro
2007	VAR	Threshhold Voltage	Real32	ro
2008	VAR	SE Threshhold Voltage	Real32	ro
2009	VAR	Sensor Resolution	Unsigned32	rw
200A	VAR	Measuring Direction Reversed	Unsigned32	rw
200B	VAR	Prediction Buffer Size	Unsigned32	rw
200C	VAR	Save Configuration	Unsigned32	rw
200D	VAR	Noise Window	Unsigned32	rw
200E	VAR	Velocity Window	Unsigned32	rw
200F	VAR	Enable Smart Missing Magnet Detection	Unsigned32	rw
3101	RECORD	Inputs		ro
Standardised Device Profile Area				
6000_h	VAR	Operating parameters	Unsigned16	ro
6001_h	VAR	Measuring units per revolution	Unsigned32	ro
6002_h	VAR	Total measuring range in measuring units	Unsigned32	ro

4.2 Communication parameters

4.2.1 Object 1000_h - Device type

Index	Sub	Name	Data type	Access	Range/Value	Default
1000_h	00	Device type	Unsigned32	ro	0xA0196	

4.2.2 Object 1001_h - Error register

Index	Sub	Name	Data type	Access	Range/Value	Default
1001_h	00	Error register	Unsigned8	ro		

Not currently used.

4.2.3 Object 1008_h - Manufacturer device name

Index	Sub	Name	Data type	Access	Range/Value	Default
1008_h	00	Manufacturer device name	String	ro	TWK-Magnosens MxK	

4.2.4 Object 1009_h - Manufacturer hardware version

Index	Sub	Name	Data type	Access	Range/Value	Default
1009_h	00	Manufacturer hardware version	String	ro		

Contains the current manufacturer hardware version e.g.: “1”

4.2.5 Object $100A_h$ - Manufacturer software version

Index	Sub	Name	Data type	Access	Range/Value	Default
$100A_h$	00	Manufacturer software version	String	ro		

Contains the current manufacturer software version e.g.: “1.19”

4.2.6 Object 1018_h - Identity object

Index	Sub	Name	Data type	Access	Range/Value	Default
1018_h	00	Largest supported subindex	Unsigned8	ro	4	
	01	Manufacturer ID	Unsigned32	ro	0x10D	
	02	Product ID	Unsigned32	ro	0x7000	
	03	Revision No.	Unsigned32	ro	XXXX XXXX	
	04	Serial No.	Unsigned32	ro	XXXX XXXX	

4.2.7 Object $1A00_h$ - Transmit PDO mapping

Index	Sub	Name	Data type	Access	Range/Value	Default
$1A00_h$	00	Largest supported subindex	Unsigned8	ro	3	
	01	PDO mapping first object	Unsigned32	ro	0x31010110	
	02	PDO mapping second object	Unsigned32	ro	0x31010220	
	03	PDO mapping third object	Unsigned32	ro	0x31010320	

The object $1A00_h$ determines the content of the process data message.

4.2.8 Object $1C00_h$ - Sync manager communication type

Index	Sub	Name	Data type	Access	Range/Value	Default
$1A00_h$	00	Largest supported subindex	Unsigned8	ro	4	
	01	Communication Type Sync Manager 1	Unsigned8	ro	1	
	02	Communication Type Sync Manager 2	Unsigned8	ro	2	
	03	Communication Type Sync Manager 3	Unsigned8	ro	3	
	04	Communication Type Sync Manager 4	Unsigned8	ro	0	

Sync Manager Communication Types:

0 unused
1 mailbox receive (master to slave)
2 mailbox send (slave to master)
3 process data output
4 process data input

4.2.9 Object $1C12_h$ - Sync manager channel 2 (process data output)

Index	Sub	Name	Data type	Access	Range/Value	Default
$1C12_h$	00	Number of RxPDOs	Unsigned8	ro	0	
	01	PDO mapping first object	Unsigned32	rw		

The displacement transducer does not receive any process data from the master.

4.2.10 Object $1C13_h$ - Sync manager channel 3 (process data input)

Index	Sub	Name	Data type	Access	Range/Value	Default
$1C13_h$	00	Number of TxPDOs	Unsigned8	ro	1	
	01	PDO mapping first object	Unsigned32	rw	$1A00_h$	

4.3 Manufacturer-specific parameters

4.3.1 Object 2000_h - Manufactured date

Index	Sub	Name	Data type	Access	Range/Value	Default
2000_h	00	Manufactured Date	String	ro	yyyy/mm/dd	

4.3.2 Object 2001_h - Sensor serial number

Index	Sub	Name	Data type	Access	Range/Value	Default
2001_h	00	Sensor Serial Number	Unsigned32	ro	xxxxxxxx	

4.3.3 Object 2002_h - Sensor length

Index	Sub	Name	Data type	Access	Range/Value	Default
2002_h	00	Sensor Length	Unsigned32	ro	xxxxxxxx	

Measurement range of the displacement transducer in mm.

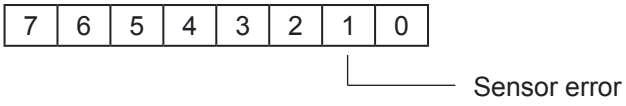
4.3.4 Object 2003_h - Number of magnets

Index	Sub	Name	Data type	Access	Range/Value	Default
2003_h	00	Number Of Magnets	Unsigned16	ro	xxxx	

Number of magnets which are supported.

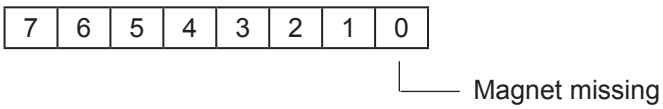
4.3.5 Object 2004_h - Sensor status bits

Index	Sub	Name	Data type	Access	Range/Value	Default
2004_h	00	Sensor Status Bits	Unsigned16	ro		



4.3.6 Object 2005_h - Missing magnet status

Index	Sub	Name	Data type	Access	Range/Value	Default
2005_h	00	Missing Magnet Status	Unsigned16	ro		



4.3.7 Object 2006_h – Supply voltage

Index	Sub	Name	Data type	Access	Range/Value	Default
2006_h	00	Supply Voltage	Real32	ro		

Display of the current supply voltage.

4.3.8 Object 2007_h - Threshold voltage

Index	Sub	Name	Data type	Access	Range/Value	Default
2007_h	00	Threshold Voltage	Real32	ro		

4.3.9 Object 2008_h - SE threshold voltage

Index	Sub	Name	Data type	Access	Range/Value	Default
2008_h	00	SE Threshold Voltage	Real32	ro		

4.3.10 Object 2009_h - Sensor resolution

Index	Sub	Name	Data type	Access	Range/Value	Default
2009_h	00	Sensor Resolution	Unsigned16	rw	1 ... 65535	

This parameter can be used to set the displacement transducer's resolution in µm. E.g. a value of 10 results in a resolution of 10 µm per step.

4.3.11 Object $200A_h$ - Measuring direction reversed

Index	Sub	Name	Data type	Access	Range/Value	Default
$200A_h$	00	Measuring Direction Reversed	Unsigned32	rw	0,1	

Measuring direction setting: 0 = ascending signal from the sensor head to the end of the rod
1 = descending signal from the sensor head to the end of the rod

4.3.12 Object $200B_h$ - Prediction buffer size

Index	Sub	Name	Data type	Access	Range/Value	Default
$200B_h$	00	Prediction Buffer Size	Unsigned32	rw	0 ... 65535	15

Setting this buffer establishes mean value formation. Based on the values stored in the buffer, this provides a prediction of the measured value until a new, true (measured) value is received. The pre-set value of 15 has proved practicable here. Attention: A high value influences the displacement transducer's reaction time.

4.3.13 Object $200C_h$ - Save configuration

Index	Sub	Name	Data type	Access	Range/Value	Default
$200C_h$	00	Save Configuration	Unsigned32	rw	0,1	

Writing a 1 into this parameter leads to the parameters' being saved in the failsafe EEPROM. After saving, the transducer resets the value to 0.

4.3.14 Object $200D_h$ - Noise window

Index	Sub	Name	Data type	Access	Range/Value	Default
$200D_h$	00	Noise Window	Unsigned32	rw		0

For multi-magnet measurement only.

If a value greater than 0 is entered here, a missing position ring is not reported in the status byte but by means of an abrupt change in this magnet's actual value by the value which has been entered. Also see 4.3.16.

4.3.15 Object $200E_h$ - Velocity window

Index	Sub	Name	Data type	Access	Range/Value	Default
$200E_h$	00	Velocity Window	Unsigned32	rw		2

Determines the time basis for speed recording.

4.3.16 Object $200F_h$ - Enable smart missing magnet detection

Index	Sub	Name	Data type	Access	Range/Value	Default
$200F_h$	00	Enable Smart Missing Magnet Detection	Unsigned32	rw	0,1	0

For multi-magnet measurement only.

Enabling this function prevents the position value from drifting to the next available magnet in the event of magnet loss. If a value is entered in object $200D_h$, the position value for the lost magnet jumps by this value; otherwise, it remains set to the last valid position value.

4.3.17 Objekt 3101_h - Inputs

Index	Sub	Name	Data type	Access	Range/Value	Default
3101_h	00	Largest supported subindex	Unsigned8	ro	3	
	01	Status 1	Unsigned16	ro		
	02	Position 1	Unsigned32	ro		
	03	Velocity 1	Unsigned32	ro		

4.4 Standardised device parameters

4.4.1 Object 6000_h - Operating parameters

Index	Sub	Name	Data type	Access	Range/Value	Default
6000_h	00	Operating parameters	Unsigned16	ro		0

Not currently used.

4.4.2 Object 6001_h - Measuring units per revolution

Index	Sub	Name	Data type	Access	Range/Value	Default
6001_h	00	Measuring units per revolution	Unsigned32	ro		

Display of the set resolution in µm.

4.4.3 Object 6002_h – Total measuring range

Index	Sub	Name	Data type	Access	Range/Value	Default
6002_h	00	Total measuring range	Unsigned64	ro		

Display of the total number of steps (measuring range of the displacement transducer / set resolution).

5. TwinCAT system manager

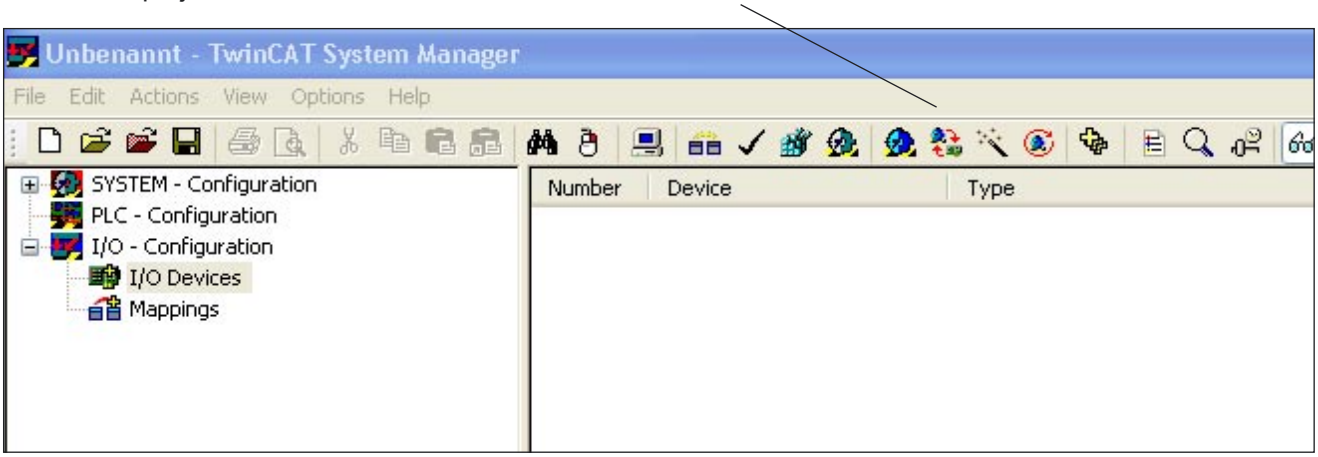
5.1 Installation of the XML file

- Copy the enclosed XML file to the **..\Twincat\Io\Ethercat** directory
- Start the TwinCAT system manager

5.2 Online commissioning

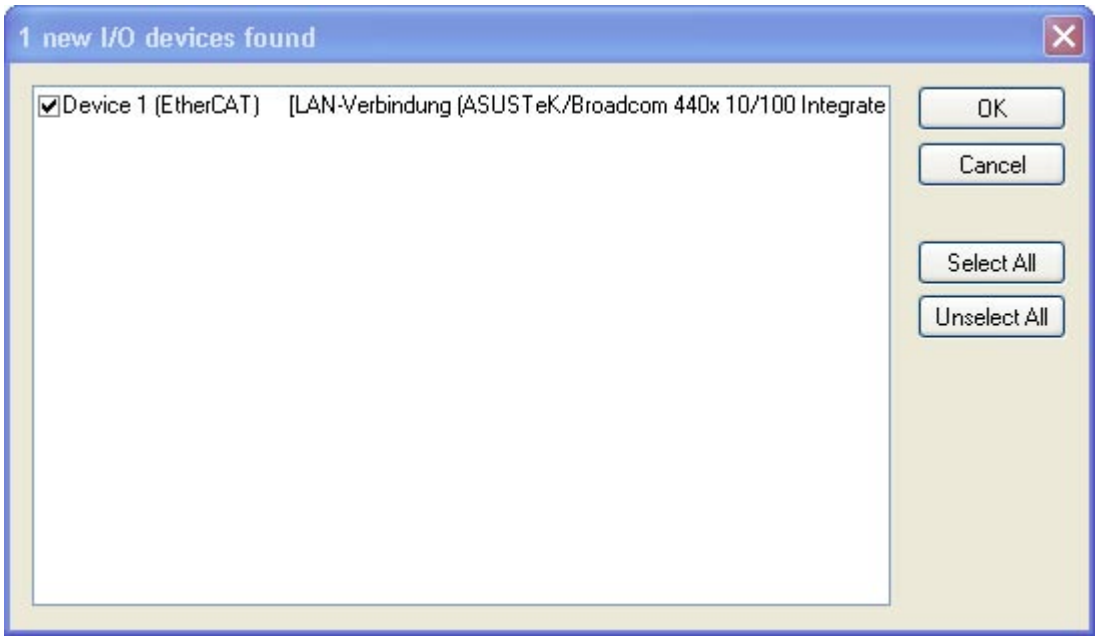
If the system is connected and capable of running, reading-in the bus structure online is the simplest option. This procedure is described here.

Create a new project, mark “I/O devices” and click onto the “wand”.

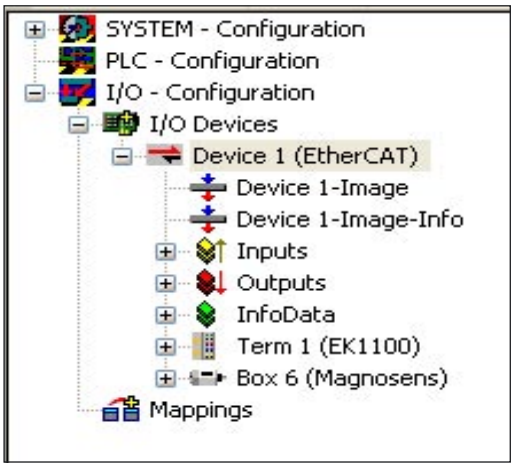


Confirm the following note with OK.

TwinCAT should then locate your network card. Confirm this with OK.

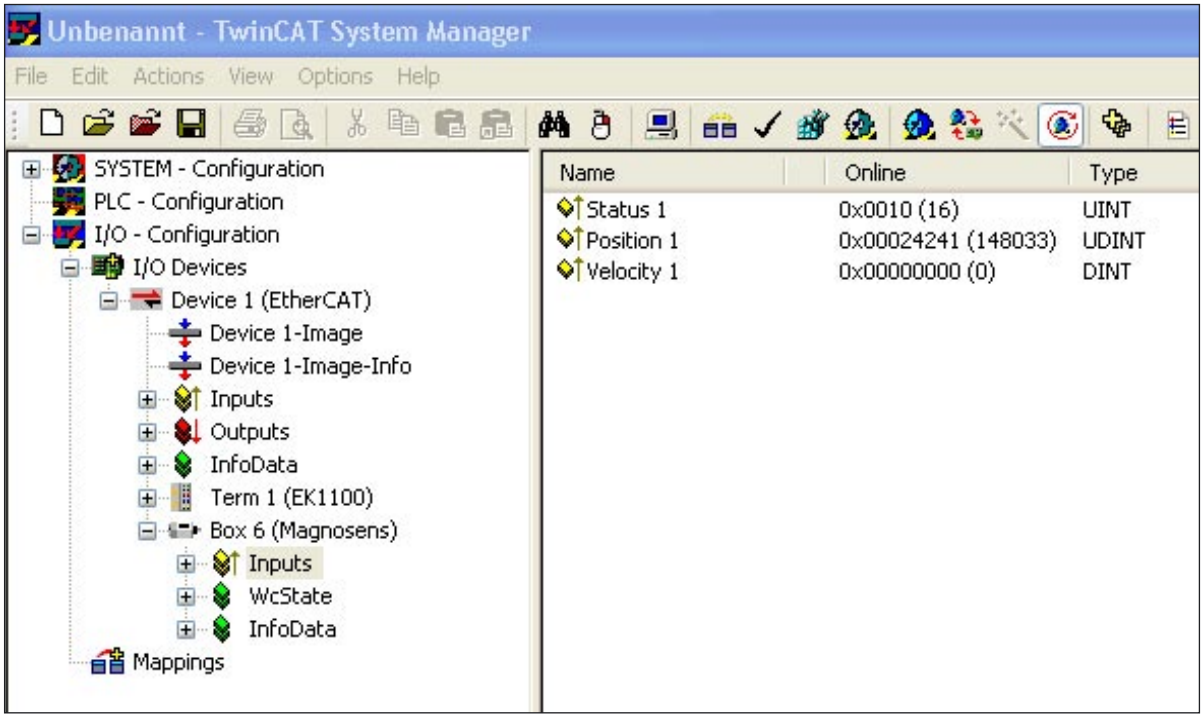


After confirming the following dialogue with “Yes”, all connected devices should be located. In this case, the EtherCAT master (device 1), a Beckhoff bus terminal with I/O modules and the TWK displacement transducer (Magnosens).

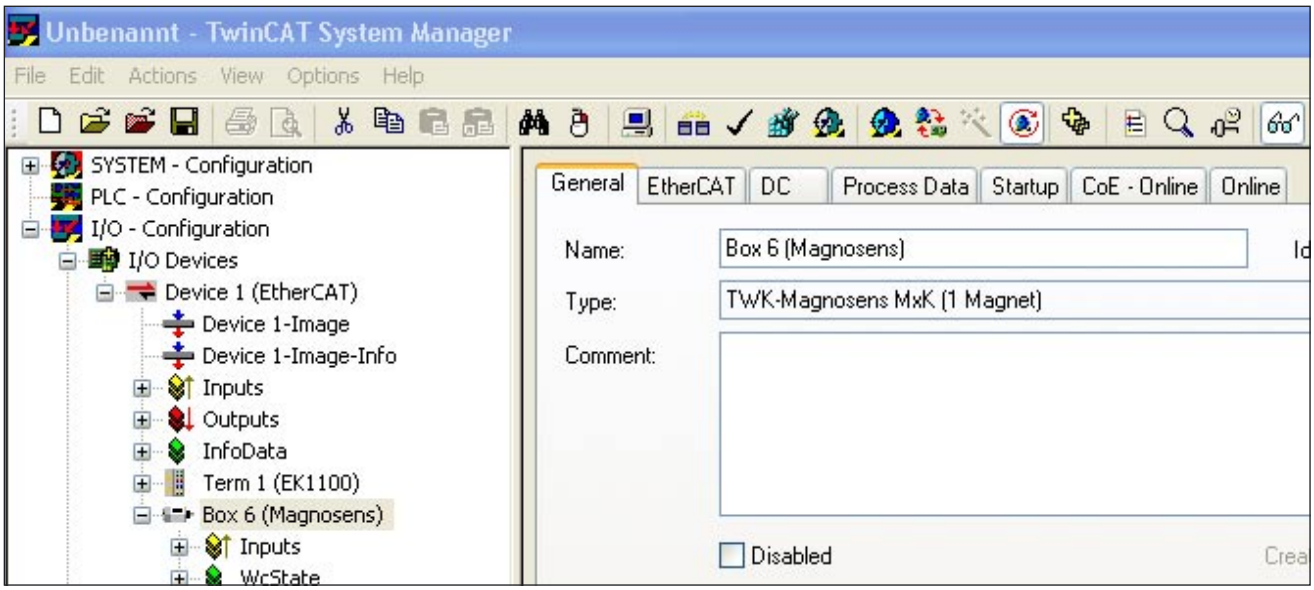


If the so-called free run is now also activated, the I/O data are exchanged in the acyclical data traffic and can be monitored in the TwinCAT.

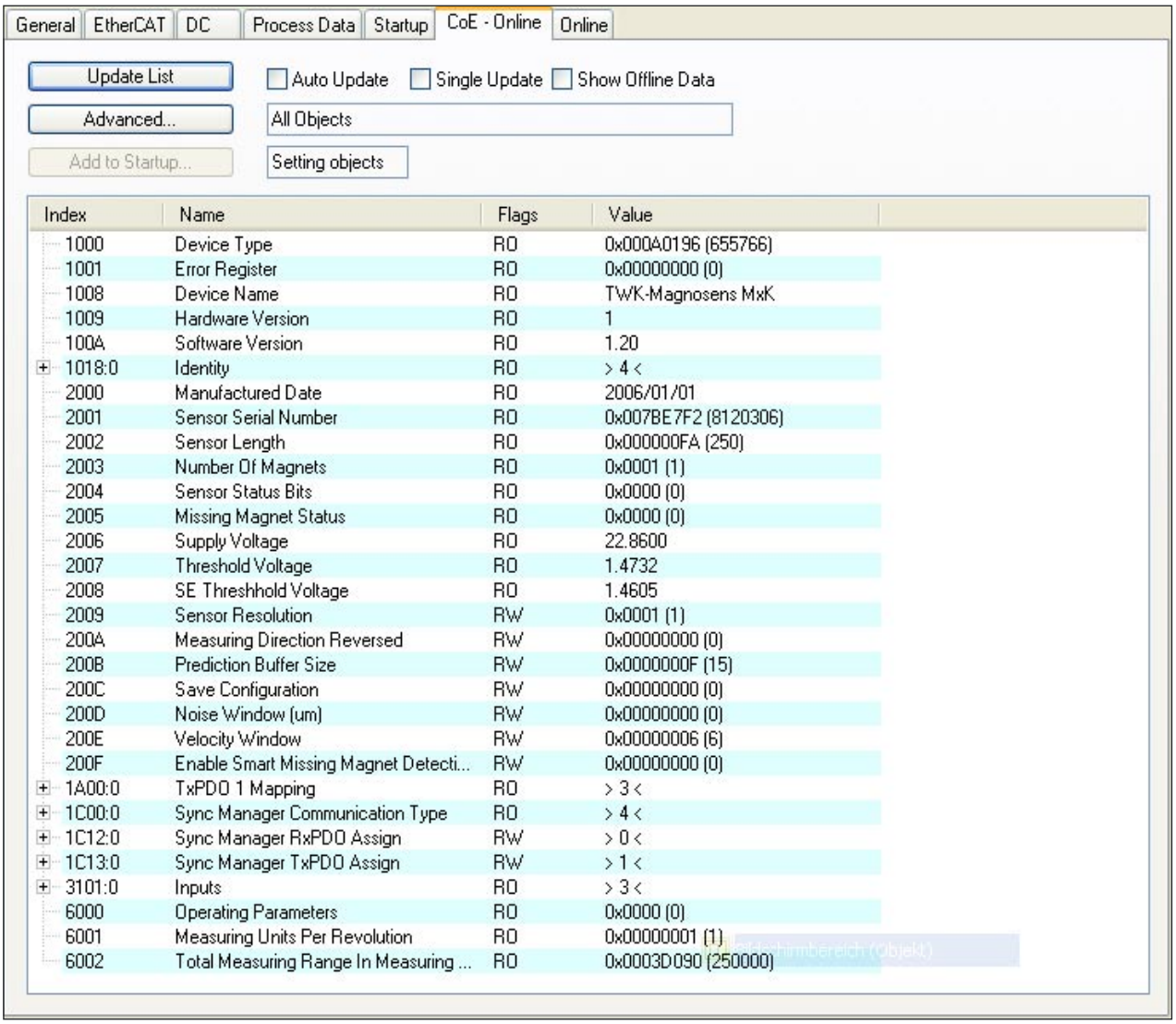
Clicking onto the Magnosens “Inputs” displays the displacement transducer’s input data.



If you click onto the Magnosens itself instead, the following screen's register takes you to the displacement transducer's configuration and parameterisation.



The CoE online register accesses the parameter and diagnostic data. All parameters identified with "RW" can be changed. The description of the parameters can be found in Chapter 4. Do not forget to subsequently save the parameters in a failsafe manner via parameter 200C$_h$.



Index	Name	Flags	Value
1000	Device Type	RO	0x000A0196 (655766)
1001	Error Register	RO	0x00000000 (0)
1008	Device Name	RO	TWK-Magnosens MxK
1009	Hardware Version	RO	1
100A	Software Version	RO	1.20
1018:0	Identity	RO	> 4 <
2000	Manufactured Date	RO	2006/01/01
2001	Sensor Serial Number	RO	0x007BE7F2 (8120306)
2002	Sensor Length	RO	0x000000FA (250)
2003	Number Of Magnets	RO	0x0001 (1)
2004	Sensor Status Bits	RO	0x0000 (0)
2005	Missing Magnet Status	RO	0x0000 (0)
2006	Supply Voltage	RO	22.8600
2007	Threshold Voltage	RO	1.4732
2008	SE Threshhold Voltage	RO	1.4605
2009	Sensor Resolution	RW	0x0001 (1)
200A	Measuring Direction Reversed	RW	0x00000000 (0)
200B	Prediction Buffer Size	RW	0x0000000F (15)
200C	Save Configuration	RW	0x00000000 (0)
200D	Noise Window (um)	RW	0x00000000 (0)
200E	Velocity Window	RW	0x00000006 (6)
200F	Enable Smart Missing Magnet Detecti...	RW	0x00000000 (0)
1A00:0	TxPDO 1 Mapping	RO	> 3 <
1C00:0	Sync Manager Communication Type	RO	> 4 <
1C12:0	Sync Manager RxPDO Assign	RW	> 0 <
1C13:0	Sync Manager TxPDO Assign	RW	> 1 <
3101:0	Inputs	RO	> 3 <
6000	Operating Parameters	RO	0x0000 (0)
6001	Measuring Units Per Revolution	RO	0x00000001 (1)
6002	Total Measuring Range In Measuring ...	RO	0x0003D090 (250000)