MICRO-EPSILON

EtherCAT documentation

confocalDT IFD2410
confocalDT IFD2411
confocalDT IFD2415

PRELIMINARY VERSION

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1. EtherCAT-Documentation

1.1 Generally

EtherCAT® is, from the Ethernet viewpoint, a single, large Ethernet station that transmits and receives Ethernet telegrams. Such an EtherCAT system consists of an EtherCAT master and up to 65535 EtherCAT slaves.

Master and slaves communicate via a standard Ethernet wiring. On-the-fly processing hardware is used in each slave. The incoming Ethernet frames are directly processed by the hardware. Relevant data are extracted or added from the frame. The frame is then sent on to the next EtherCAT® slave device. The completely processed frame is sent back from the last slave device. Various protocols can be used in the application level. CANopen over EtherCAT technology (CoE) is supported here. In the CANopen protocol, an object tree with Service Data Objects (SDO) and Process Data Objects (PDO) is used to manage the data. Further information can be obtained from ® Technology Group (www.ethercat.org) or Beckhoff GmbH, (www.beckhoff.com).

1.2 Introduction

1.2.1 Structure of EtherCAT®-Frames

The transfer of data occurs in Ethernet frames with a special Ether type (0x88A4). Such an EtherCAT® frame consists of one or several EtherCAT® telegrams, each of which is addressed to individual slaves / storage areas. The telegrams are either transmitted directly in the data area of the Ethernet frame or in the data area of the UDP datagram. An EtherCAT® telegram consists of an EtherCAT® header, the data area and the work counter (WC). The work counter is incremented by each addressed EtherCAT® slave that exchanged the corresponding data.

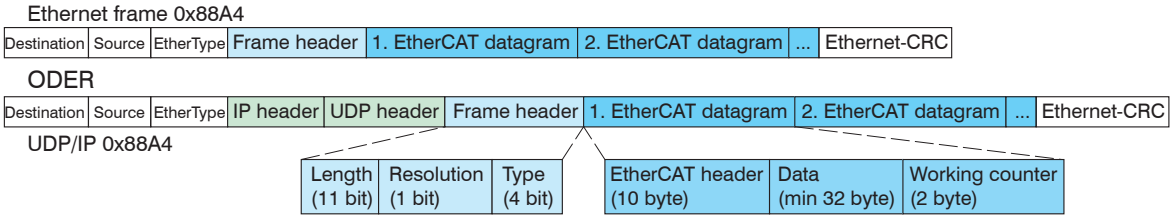


Fig. 1 Setup of EtherCAT frames

1.2.2 EtherCAT® Services

EtherCAT® services specify the reading and writing of data in the physical memory of the slave hardware. The following EtherCAT® services are supported by the slave hardware:

- APRD (Auto-Increment Physical Read, reading of a physical area with auto-increment addressing)
- APWR (Auto-Increment Physical Write, writing of a physical area with auto-increment addressing)
- APRW (Auto-Increment Physical Read Write, reading and writing of a physical area with auto-increment addressing)
- FPRD (Configured Address Read, reading of a physical area with fixed addressing)
- FPWR (Configured Address Write, writing of a physical area with fixed addressing)
- FPRW (Configured Address Read Write, reading and writing of a physical area with fixed addressing)
- BRD (Broadcast Read, broadcast-reading of a physical area for all slaves)
- BWR (Broadcast Write, broadcast-writing of a physical area for all slaves)
- LRD (Logical Read, reading of a logical storage area)
- LWR (Logical Write, writing of a logical storage area)
- LRW (Logical Read Write, reading and writing of a logical storage area)
- ARMW (Auto-Increment Physical Read Multiple Write, reading of a physical area with auto-increment addressing, multiple writing)
- FRMW (Configured Address Read Multiple Write, reading of a physical area with fixed addressing, multiple writing)

1.2.3 Addressing and FMMUs

In order to address a slave in the EtherCAT® system, various methods from the master can be used. The confocalDT IFD241x supports as full slave:

- Position addressing
  The slave device is addressed via its physical position in the EtherCAT® segment.
  The services used for this are APRD, APWR, APRW.
- Node addressing
  The slave device is addressed via a configured node address, which was assigned by the master during the commissioning phase. The services used for this are FPRD, FPWR and FPRW.
- Logical addressing
  The slaves are not addressed individually; instead, a segment of the segment-wide logical 4-GB address is addressed. This segment can be used by a number of slaves.
  The services used for this are LRD, LWR and LRW.

The local assignment of physical slave memory addresses and logical segment-wide addresses is implemented via the field bus Memory Management Units (FMMUs). The slave FMMUs are configured by the master. The FMMU configuration contains a start address of the physical memory in the slave, a logical start address in the global address space, length and type of the data, as well as the direction (input or output) of the process data.

1.2.4 Sync Manager

Sync Managers serve the data consistency during the data exchange between EtherCAT® master and slaves. Each Sync Manager channel defines an area of the application memory. The confocalDT IFD241x has four channels:

- Sync manager channel 0: Sync manager 0 is used for mailbox write transfers (mailbox from master to slave).
- Sync manager channel 1: Sync manager 1 is used for mailbox read transfers (mailbox from slave to master).
- Sync manager channel 2: Sync manager 2 is normally used for process output data. Is not used in the IFD241x.
- Sync manager channel 3: Sync manager 3 is used for process input data. It contains the Tx PDOs that are specified by the PDO assignment object 0x1C13 (hex.).

1.2.5 EtherCAT State Machine

The EtherCAT® state machine is implemented in each EtherCAT®. Immediately after switching on the confocalDT IFD241x, the state machine is in the "Initialization" state. In this state, the master has access to the DLL information register of the slave hardware. The mailbox is not yet initialized, i.e. communication with the application (controller software) is not yet possible. During the transition to the pre-operational state, the Sync Manager channels are configured for the mailbox communication. In the „Pre-Operational“ state, communication via the mailbox is possible, and it can access the object directory and its objects. In this state, no process data communication occurs. During the transition to the „Safe-Operational“ state, the process-data mapping, the Sync Manager channel of the process inputs and the corresponding FMMU are configured by the master. Mailbox communication continues to be possible in the „Safe-Operational“ state. The process data communication runs for the inputs. The outputs are in the „safe“ state. In the „Operational“ state, process data communication runs for the inputs as well as the outputs.

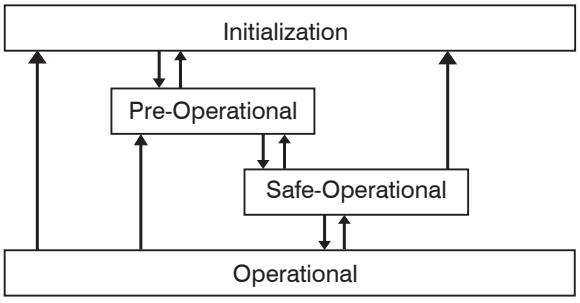


Fig. 2 EtherCAT State Machine

1.2.6 CANopen over EtherCAT

The application level communication protocol in EtherCAT is based on the communication profile CANopen DS 301 and is designated either as “CANopen over EtherCAT” or CoE. The protocol specifies the object directory in the IFD241x, as well as the communication objects for the exchange of process data and acyclic messages. The IFD241x uses the following message types:

- Process Data Object (PDO). The PDO is used for the cyclic I/O communication, i.e. for process data.
- Service Data Object (SDO). The SDO is used for acyclic data transmission.

The object directory is described in the chapter CoE Object Directory.

1.2.7 Process Data PDO Mapping

Process Data Objects (PDOs) are used for the exchange of time-critical process data between master and slaves. Tx PDOs are used to transfer data from the slave to the master (inputs). Rx PDOs are used to transfer data from the master to the slave (outputs); this concept is not used in the confocalDT IFD241x. The PDO mapping defines which application objects (measurement data) are transmitted into a PDO.

The confocalDT IFD241x lets the user choose from a selection of Tx PDO mapping objects, 1.3.1.7.

In EtherCAT the PDOs are transported in objects of the Sync Manager channel. The IFD241x uses the Sync Manager channel SM3 for input data (Tx data). The PDO assignments of the Sync Manager can only be changed in the “Pre-Operational” state.

Note: Subindex 0h of the object 0x1A00 contains the number of valid entries within the mapping report. This number also represents the number of application variables (parameters) that should be transmitted/received with the corresponding PDO. The subindices from 1h up to the number of objects contain information about the depicted application variables. The mapping values in the CANopen objects are coded in hexadecimal form.
The following table contains an example of the entry structure of the PDO mapping:

MSB					LSB
31	16	15	8	7	0
Index e.g. 0x6000 (16 bit)		Sub-index e.g. 0x01		Object length in bits, e.g. 20h = 32 bits	

Fig. 3 Entry structure of the PDO mapping, example

1.2.8 Service Data SDO Service

Service data objects (SDOs) are mainly used for the transmission of non-time-critical data, for example parameter values.

EtherCAT specifications

- SDO services make possible the read/write access to entries in the CoE object directory of the device.
- SDO information services make it possible to read the object directory itself and to access the properties of the objects.

All parameters of the measuring device can be read or changed in this way, and measurements can be transmitted. A desired parameter is addressed via index and subindex within the object directory.

1.3 CoE – Object Directory

The CoE object directory (CANopen over EtherCAT) contains all the configuration data of the IFD241x. The objects in CoE object directory can be accessed using the SDO services. Each object is addressed using a 16-bit index.

1.3.1 Communication-Specific Standard Objects

1.3.1.1 Overview

Index (h)	Name	Description
1000	Device type	Device type
1008	Device name	Manufacturer device name
1009	Hardware version	Hardware version
100A	Software version	Software version
1018	Identity	Device identification
10F8	Timestamp	EtherCAT stack predefined object, not to be confused with the timestamp of the process data.
1A00 ... 1B5B		TxPDO Mapping PDO mapping objects may contain merged process data (mappable objects - process data).
1C00	Sync. manager type	Synch. manager type
1C12	RxPDO assign	Is not used with IFD241x.
1C13	TxPDO assign	TxPDO assign
1C32	Sync manager output parameter	Synchronous mode parameter (DC)
1C33	Sync manager input parameter	

Fig. 4 Overview of standard objects

1.3.1.2 Object 1001h: Device Type

1000	VAR	Device type	0x00000000	Unsigned32	ro

Provides information about the used device profile and the device type.

1.3.1.3 Object 1008h: Manufacturer Device Name

1008	VAR	Device name	IFC24xx	Visible String	ro

1.3.1.4 Object 1009h: Hardware Version

1009	VAR	Hardware version	xx	Visible String	ro

1.3.1.5 Object 100Ah: Software Version

100A	VAR	Software version	xxx.xxx	Visible String	ro

1.3.1.6 Object 1018h: Device Identification

1018	RECORD	Identity			
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Vendor ID	0x00000607	Unsigned32	ro
2	VAR	Product code	0x0024E555	Unsigned32	ro
3	VAR	Revision	0x00010000	Unsigned32	ro
4	VAR	Serial number	0x009A4435	Unsigned32	ro

The product code identifies an EtherCAT device in the network. This identification is composed of vendor ID, product code and revision. Serial number contains the serial number of the IFD241x

1.3.1.7 TxPDO Mapping IFD2410, 2411

0x1A00	Ch01Dist1 TxPDOMap OV1			
	:001 0x6000:001 Ch01Dist1_OV00			
0x1A01	Ch01Dist1 TxPDOMap OV2			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01		
0x1A02	Ch01Dist1 TxPDOMap OV4			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01	:003 0x6000:003 Ch01Dist1_OV02	:004 0x6000:004 Ch01Dist1_OV03
0x1A03	Ch01Dist1 TxPDOMap OV8			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01	:003 0x6000:003 Ch01Dist1_OV02	:004 0x6000:004 Ch01Dist1_OV03
	:005 0x6000:005 Ch01Dist1_OV04	:006 0x6000:006 Ch01Dist1_OV05	:007 0x6000:007 Ch01Dist1_OV06	:008 0x6000:008 Ch01Dist1_OV07

Fig. 5 Mapping for distance value DIST1

0x1A10	Ch01Dist2 TxPDOMap OV1			
	:001 0x6001:001 Ch01Dist2_OV00			
0x1A11	Ch01Dist2 TxPDOMap OV2			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01		
0x1A12	Ch01Dist2 TxPDOMap OV4			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01	:003 0x6001:003 Ch01Dist2_OV02	:004 0x6001:004 Ch01Dist2_OV03
0x1A13	Ch01Dist2 TxPDOMap OV8			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01	:003 0x6001:003 Ch01Dist2_OV02	:004 0x6001:004 Ch01Dist2_OV03
	:005 0x6001:005 Ch01Dist2_OV04	:006 0x6001:006 Ch01Dist2_OV05	:007 0x6001:007 Ch01Dist2_OV06	:008 0x6001:008 Ch01Dist2_OV07

Fig. 6 Mapping for distance value DIST2

0x1A30	Ch01Intensity1 TxPDOMap OV1			
	:001 0x6010:001 Ch01Intensity1_OV00			
0x1A31	Ch01Intensity1 TxPDOMap OV2			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01		
0x1A32	Ch01Intensity1 TxPDOMap OV4			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01	:003 0x6010:003 Ch01Intensity1_OV02	:004 0x6010:004 Ch01Intensity1_OV03
0x1A33	Ch01Intensity1 TxPDOMap OV8			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01	:003 0x6010:003 Ch01Intensity1_OV02	:004 0x6010:004 Ch01Intensity1_OV03
	:005 0x6010:005 Ch01Intensity1_OV04	:006 0x6010:006 Ch01Intensity1_OV05	:007 0x6010:007 Ch01Intensity1_OV06	:008 0x6010:008 Ch01Intensity1_OV07

Fig. 7 Mapping for Intensity 1 of DIST1

0x1A40	Ch01Intensity2 TxPDOMap OV1			
	:001 0x6011:001 Ch01Intensity2_OV00			
0x1A41	Ch01Intensity2 TxPDOMap OV2			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01		
0x1A42	Ch01Intensity2 TxPDOMap OV4			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01	:003 0x6011:003 Ch01Intensity2_OV02	:004 0x6011:004 Ch01Intensity2_OV03
0x1A43	Ch01Intensity2 TxPDOMap OV8			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01	:003 0x6011:003 Ch01Intensity2_OV02	:004 0x6011:004 Ch01Intensity2_OV03
	:005 0x6011:005 Ch01Intensity2_OV04	:006 0x6011:006 Ch01Intensity2_OV05	:007 0x6011:007 Ch01Intensity2_OV06	:008 0x6011:008 Ch01Intensity2_OV07

Fig. 8 Mapping for Intensity 2 of DIST2

0x1A80	Ch01Shutter TxPDOMap OV1			
	:001 0x6030:001 Ch01Shutter_OV00			
0x1A81	Ch01Shutter TxPDOMap OV2			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01		
0x1A82	Ch01Shutter TxPDOMap OV4			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01	:003 0x6030:003 Ch01Shutter_OV02	:004 0x6030:004 Ch01Shutter_OV03
0x1A83	Ch01Shutter TxPDOMap OV8			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01	:003 0x6030:003 Ch01Shutter_OV02	:004 0x6030:004 Ch01Shutter_OV03
	:005 0x6030:005 Ch01Shutter_OV04	:006 0x6030:006 Ch01Shutter_OV05	:007 0x6030:007 Ch01Shutter_OV06	:008 0x6030:008 Ch01Shutter_OV07

Fig. 9 Mapping for exposure time

0x1AC0	Ch01Encoder TxPDOMap OV1			
	:001 0x6050:001 Encoder1_OV00	:002 0x6051:001 Encoder2_OV00	:003 0x6052:001 Encoder3_OV00	
0x1AC1	Ch01Encoder TxPDOMap OV2			
	:001 0x6050:001 Encoder1_OV00	:003 0x6051:001 Encoder2_OV00	:005 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:004 0x6051:002 Encoder2_OV01	:006 0x6052:002 Encoder3_OV01	
0x1AC2	Ch01Encoder TxPDOMap OV4			
	:001 0x6050:001 Encoder1_OV00	:005 0x6051:001 Encoder2_OV00	:009 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:006 0x6051:002 Encoder2_OV01	:010 0x6052:002 Encoder3_OV01	
	:003 0x6050:003 Encoder1_OV02	:007 0x6051:003 Encoder2_OV02	:011 0x6052:003 Encoder3_OV02	
	:004 0x6050:004 Encoder1_OV03	:008 0x6051:004 Encoder2_OV03	:012 0x6052:004 Encoder3_OV03	
0x1AC3	Ch01Encoder TxPDOMap OV8			
	:001 0x6050:001 Encoder1_OV00	:009 0x6051:001 Encoder2_OV00	:017 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:010 0x6051:002 Encoder2_OV01	:018 0x6052:002Encoder3_OV01	
	:003 0x6050:003 Encoder1_OV02	:011 0x6051:003 Encoder2_OV02	:019 0x6052:003 Encoder3_OV02	
	:004 0x6050:004 Encoder1_OV03	:012 0x6051:004 Encoder2_OV03	:020 0x6052:004 Encoder3_OV03	
	:005 0x6050:005 Encoder1_OV04	:013 0x6051:005 Encoder2_OV04	:021 0x6052:005 Encoder3_OV04	
	:006 0x6050:006 Encoder1_OV05	:014 0x6051:006 Encoder2_OV05	:022 0x6052:006 Encoder3_OV05	
	:007 0x6050:007 Encoder1_OV06	:015 0x6051:007 Encoder2_OV06	:023 0x6052:007 Encoder3_OV06	
	:008 0x6050:008 Encoder1_OV07	:016 0x6051:008 Encoder2_OV07	:024 0x6052:008 Encoder3_OV07	

Fig. 10 Mapping for Encoders 1 to 3

0x1AE0	Counter TxPDOMap OV1			
	:001 0x7000:001 Counter_OV00			
0x1AE1	Counter TxPDOMap OV2			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01		
0x1AE2	Counter TxPDOMap OV4			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01	:003 0x7000:003 Counter_OV02	:004 0x7000:004 Counter_OV03
0x1AE3	Counter TxPDOMap OV8			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01	:003 0x7000:003 Counter_OV02	:004 0x7000:004 Counter_OV03
	:005 0x7000:005 Counter_OV04	:006 0x7000:006 Counter_OV05	:007 0x7000:007 Counter_OV06	:008 0x7000:008 Counter_OV07

Fig. 11 Mapping for the measured value counter

0x1AE8	Time stamp TxPDOMap OV1			
	:001 0x7001:001 Time stamp_OV00			
0x1AE9	Time stamp TxPDOMap OV2			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01		
0x1AEA	Time stamp TxPDOMap OV4			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01	:003 0x7001:003 Time stamp_OV02	:004 0x7001:004 Time stamp_OV03
0x1AEB	Time stamp TxPDOMap OV8			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01	:003 0x7001:003 Time stamp_OV02	:004 0x7001:004 Time stamp_OV03
	:005 0x7001:005 Time stamp_OV04	:006 0x7001:006 Time stamp_OV05	:007 0x7001:007 Time stamp_OV06	:008 0x7001:008 Time stamp_OV07

Fig. 12 Mapping for time information

0x1AF0	Frequency TxPDOMap OV1			
	:001 0x7002:001 Frequency_OV00			
0x1AF1	Frequency TxPDOMap OV2			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01		
0x1AF2	Frequency TxPDOMap OV4			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01	:003 0x7002:003 Frequency_OV02	:004 0x7002:004 Frequency_OV03
0x1AF3	Frequency TxPDOMap OV8			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01	:003 0x7002:003 Frequency_OV02	:004 0x7002:004 Frequency_OV03
	:005 0x7002:005 Frequency_OV04	:006 0x7002:006 Frequency_OV05	:007 0x7002:007 Frequency_OV06	:008 0x7002:008 Frequency_OV07

Fig. 13 Mapping for measurement frequency

0x1B00	User calc output 01 TxPDOMap OV1			
	:001 0x7C00:001 User calc 01_OV00			
0x1B01	User calc output 01 TxPDOMap OV2			
	:001 0x7C00:001 User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01		
0x1B02	User calc output 01 TxPDOMap OV4			
	:001 0x7C00:001User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01	:003 0x7C00:003 User calc 01_OV02	:004 0x7C00:004 User calc 01_OV03
0x1B03	User calc output 01 TxPDOMap OV8			
	:001 0x7C00:001 User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01	:003 0x7C00:003 User calc 01_OV02	:004 0x7C00:004 User calc 01_OV03
	:005 0x7C00:005 User calc 01_OV04	:006 0x7C00:006 User calc 01_OV05	:007 0x7C00:007 User calc 01_OV06	:008 0x7C00:008 User calc 01_OV07

Fig. 14 Mapping for calculation program 1

0x1B08	User calc output 02 TxPDOMap OV1			
	:001 0x7C01:001 User calc 02_OV00			
0x1B09	User calc output 02 TxPDOMap OV2			
	:001 0x7C01:001 User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01		
0x1B0A	User calc output 02 TxPDOMap OV4			
	:001 0x7C01:001User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01	:003 0x7C01:003 User calc 02_OV02	:004 0x7C01:004 User calc 02_OV03
0x1B0B	User calc output 02 TxPDOMap OV8			
	:001 0x7C01:001 User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01	:003 0x7C01:003 User calc 02_OV02	:004 0x7C01:004 User calc 02_OV03
	:005 0x7C01:005 User calc 02_OV04	:006 0x7C01:006 User calc 02_OV05	:007 0x7C01:007 User calc 02_OV06	:008 0x7C01:008 User calc 02_OV07

Fig. 15 Mapping for calculation program 2

0x1B10	User calc output 03 TxPDOMap OV1			
	:001 0x7C02:001 User calc 03_OV00			
0x1B11	User calc output 03 TxPDOMap OV2			
	:001 0x7C02:001 User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01		
0x1B12	User calc output 03 TxPDOMap OV4			
	:001 0x7C02:001User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01	:003 0x7C02:003 User calc 03_OV02	:004 0x7C02:004 User calc 03_OV03
0x1B13	User calc output 03 TxPDOMap OV8			
	:001 0x7C02:001 User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01	:003 0x7C02:003 User calc 03_OV02	:004 0x7C02:004 User calc 03_OV03
	:005 0x7C02:005 User calc 03_OV04	:006 0x7C02:006 User calc 03_OV05	:007 0x7C02:007 User calc 03_OV06	:008 0x7C02:008 User calc 03_OV07

Fig. 16 Mapping for calculation program 3

0x1B18	User calc output 04 TxPDOMap OV1			
	:001 0x7C03:001 User calc 04_OV00			
0x1B19	User calc output 04 TxPDOMap OV2			
	:001 0x7C03:001 User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01		
0x1B1A	User calc output 04 TxPDOMap OV4			
	:001 0x7C03:001User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01	:003 0x7C03:003 User calc 04_OV02	:004 0x7C03:004 User calc 04_OV03
0x1B1B	User calc output 04 TxPDOMap OV8			
	:001 0x7C03:001 User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01	:003 0x7C03:003 User calc 04_OV02	:004 0x7C03:004 User calc 04_OV03
	:005 0x7C03:005 User calc 04_OV04	:006 0x7C03:006 User calc 04_OV05	:007 0x7C03:007 User calc 04_OV06	:008 0x7C03:008 User calc 04_OV07

Fig. 17 Mapping for calculation program 4

0x1B20	User calc output 05 TxPDOMap OV1			
	:001 0x7C04:001 User calc 05_OV00			
0x1B21	User calc output 05 TxPDOMap OV2			
	:001 0x7C04:001 User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01		
0x1B22	User calc output 05 TxPDOMap OV4			
	:001 0x7C04:001User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01	:003 0x7C04:003 User calc 05_OV02	:004 0x7C04:004 User calc 05_OV03
0x1B23	User calc output 05 TxPDOMap OV8			
	:001 0x7C04:001 User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01	:003 0x7C04:003 User calc 05_OV02	:004 0x7C04:004 User calc 05_OV03
	:005 0x7C04:005 User calc 05_OV04	:006 0x7C04:006 User calc 05_OV05	:007 0x7C04:007 User calc 05_OV06	:008 0x7C04:008 User calc 05_OV07

Fig. 18 Mapping for calculation program 5

0x1B28	User calc output 06 and 07 TxPDOMap OV1			
	:001 0x7C05:001 User calc 06_OV00			
	:002 0x7C06:001 User calc 07_OV00			
0x1B29	User calc output 06 and 07 TxPDOMap OV2			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01		
	:003 0x7C06:001 User calc 07_OV00	:004 0x7C06:002 User calc 07_OV01		
0x1B2A	User calc output 06 and 07 TxPDOMap OV4			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01	:003 0x7C05:003 User calc 06_OV02	:004 0x7C05:004 User calc 06_OV03
	:005 0x7C06:001 User calc 07_OV00	:006 0x7C06:002 User calc 07_OV01	:007 0x7C06:003 User calc 07_OV02	:008 0x7C06:004 User calc 07_OV03
0x1B2B	User calc output 06 and 07 TxPDOMap OV8			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01	:003 0x7C05:003 User calc 06_OV02	:004 0x7C05:004 User calc 06_OV03
	:005 0x7C05:005 User calc 06_OV04	:006 0x7C05:006 User calc 06_OV05	:007 0x7C05:007 User calc 06_OV06	:008 0x7C05:008 User calc 06_OV07
	:009 0x7C06:001 User calc 07_OV00	:010 0x7C06:002 User calc 07_OV01	:011 0x7C06:003 User calc 07_OV02	:012 0x7C06:004 User calc 07_OV03
	:013 0x7C06:005 User calc 07_OV04	:014 0x7C06:006 User calc 07_OV05	:015 0x7C06:007 User calc 07_OV06	:016 0x7C06:008 User calc 07_OV07

Fig. 19 Mapping for calculation programs 6 and 7

0x1B30	User calc output 08 and 09 TxPDOMap OV1			
	:001 0x7C07:001 User calc 08_OV00			
	:002 0x7C08:001 User calc 09_OV00			
0x1B31	User calc output 08 and 09 TxPDOMap OV2			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01		
	:003 0x7C08:001 User calc 09_OV00	:004 0x7C08:002 User calc 09_OV01		
0x1B32	User calc output 08 and 09 TxPDOMap OV4			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01	:003 0x7C07:003 User calc 08_OV02	:004 0x7C07:004 User calc 08_OV03
	:005 0x7C08:001 User calc 09_OV00	:006 0x7C08:002 User calc 09_OV01	:007 0x7C08:003 User calc 09_OV02	:008 0x7C08:004 User calc 09_OV03
0x1B33	User calc output 08 and 09 TxPDOMap OV8			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01	:003 0x7C07:003 User calc 08_OV02	:004 0x7C07:004 User calc 08_OV03
	:005 0x7C07:005 User calc 08_OV04	:006 0x7C07:006 User calc 08_OV05	:007 0x7C07:007 User calc 08_OV06	:008 0x7C07:008 User calc 08_OV07
	:009 0x7C08:001 User calc 09_OV00	:010 0x7C08:002 User calc 09_OV01	:011 0x7C08:003 User calc 09_OV02	:012 0x7C08:004 User calc 09_OV03
	:013 0x7C08:005 User calc 09_OV04	:014 0x7C08:006 User calc 09_OV05	:015 0x7C08:007 User calc 09_OV06	:016 0x7C08:008 User calc 09_OV07

Fig. 20 Mapping for calculation programs 8 and 9

0x1B38	User calc output 10 and 11 TxPDOMap OV1			
	:001 0x7C09:001 User calc 10_OV00			
	:002 0x7C0A:001 User calc 11_OV00			
0x1B39	User calc output 10 and 11 TxPDOMap OV2			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01		
	:003 0x7C0A:001 User calc 11_OV00	:004 0x7C0A:002 User calc 11_OV01		
0x1B3A	User calc output 10 and 11 TxPDOMap OV4			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01	:003 0x7C09:003 User calc 10_OV02	:004 0x7C09:004 User calc 10_OV03
	:005 0x7C0A:001 User calc 11_OV00	:006 0x7C0A:002 User calc 11_OV01	:007 0x7C0A:003 User calc 11_OV02	:008 0x7C0A:004 User calc 11_OV03
0x1B3B	User calc output 10 and 11 TxPDOMap OV8			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01	:003 0x7C09:003 User calc 10_OV02	:004 0x7C09:004 User calc 10_OV03
	:005 0x7C09:005 User calc 10_OV004	:006 0x7C09:006 User calc 10_OV05	:007 0x7C09:007 User calc 10_OV06	:008 0x7C09:008 User calc 10_OV07
	:009 0x7C0A:001 User calc 11_OV00	:010 0x7C0A:002 User calc 11_OV01	:011 0x7C0A:003 User calc 11_OV02	:012 0x7C0A:004 User calc 11_OV03
	:013 0x7C0A:005 User calc 11_OV04	:014 0x7C0A:006 User calc 11_OV05	:015 0x7C0A:007 User calc 11_OV06	:016 0x7C0A:008 User calc 11_OV07

Fig. 21 Mapping for calculation programs 10 and 11

0x1B40	User calc output 12 and 13 TxPDOMap OV1			
	:001 0x7C0B:001 User calc 12_OV00			
	:002 0x7C0C:001 User calc 13_OV00			
0x1B41	User calc output 12 and 13 TxPDOMap OV2			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01		
	:003 0x7C0C:001 User calc 13_OV00	:004 0x7C0C:002 User calc 13_OV01		
0x1B42	User calc output 12 and 13 TxPDOMap OV4			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01	:003 0x7C0B:003 User calc 12_OV02	:004 0x7C0B:004 User calc 12_OV03
	:005 0x7C0C:001 User calc 13_OV00	:006 0x7C0C:002 User calc 13_OV01	:007 0x7C0C:003 User calc 13_OV02	:008 0x7C0C:004 User calc 13_OV03
0x1B43	User calc output 12 and 13 TxPDOMap OV8			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01	:003 0x7C0B:003 User calc 12_OV02	:004 0x7C0B:004 User calc 12_OV03
	:005 0x7C0B:005 User calc 12_OV004	:006 0x7C0B:006 User calc 12_OV05	:007 0x7C0B:007 User calc 12_OV06	:008 0x7C0B:008 User calc 12_OV07
	:009 0x7C0C:001 User calc 13_OV00	:010 0x7C0C:002 User calc 13_OV01	:011 0x7C0C:003 User calc 13_OV02	:012 0x7C0C:004 User calc 13_OV03
	:013 0x7C0C:005 User calc 13_OV04	:014 0x7C0C:006 User calc 13_OV05	:015 0x7C0C:007 User calc 13_OV06	:016 0x7C0C:008 User calc 13_OV07

Fig. 22 Mapping for calculation programs 12 and 13

0x1B48	User calc output 14 and 15 TxPDOMap OV1			
	:001 0x7C0D:001 User calc 14_OV00			
	:002 0x7C0E:001 User calc 15_OV00			
0x1B49	User calc output 14 and 15 TxPDOMap OV2			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01		
	:003 0x7C0E:001 User calc 15_OV00	:004 0x7C0E:002 User calc 15_OV01		
0x1B4A	User calc output 14 and 15 TxPDOMap OV4			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01	:003 0x7C0D:003 User calc 14_OV02	:004 0x7C0D:004 User calc 14_OV03
	:005 0x7C0E:001 User calc 15_OV00	:006 0x7C0E:002 User calc 15_OV01	:007 0x7C0E:003 User calc 15_OV02	:008 0x7C0E:004 User calc 15_OV03
0x1B4B	User calc output 14 and 15 TxPDOMap OV8			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01	:003 0x7C0D:003 User calc 14_OV02	:004 0x7C0D:004 User calc 14_OV03
	:005 0x7C0D:005User calc 14_OV004	:006 0x7C0D:006 User calc 14_OV05	:007 0x7C0D:007 User calc 14_OV06	:008 0x7C0D:008 User calc 14_OV07
	:009 0x7C0E:001 User calc 15_OV00	:010 0x7C0E:002 User calc 15_OV01	:011 0x7C0E:003 User calc 15_OV02	:012 0x7C0E:004User calc 15_OV03
	:013 0x7C0E:005 User calc 15_OV04	:014 0x7C0E:006 User calc 15_OV05	:015 0x7C0E:007 User calc 15_OV06	:016 0x7C0E:008 User calc 15_OV07

Fig. 23 Mapping for calculation programs 14 and 15

0x1B50	User calc output 16 and 17 TxPDOMap OV1			
	:001 0x7C0F:001 User calc 16_OV00			
	:002 0x7C10:001 User calc 17_OV00			
0x1B51	User calc output 16 and 17 TxPDOMap OV2			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01		
	:003 0x7C10:001 User calc 17_OV00	:004 0x7C10:002 User calc 17_OV01		
0x1B52	User calc output 16 and 17 TxPDOMap OV4			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01	:003 0x7C0F:003 User calc 16_OV02	:004 0x7C0F:004 User calc 16_OV03
	:005 0x7C10:001 User calc 17_OV00	:006 0x7C10:002 User calc 17_OV01	:007 0x7C10:003 User calc 17_OV02	:008 0x7C10:004 User calc 17_OV03
0x1B53	User calc output 16 and 17 TxPDOMap OV8			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01	:003 0x7C0F:003 User calc 16_OV02	:004 0x7C0F:004 User calc 16_OV03
	:005 0x7C0F:005User calc 16_OV004	:006 0x7C0F:006 User calc 16_OV05	:007 0x7C0F:007 User calc 16_OV06	:008 0x7C0F:008 User calc 16_OV07
	:009 0x7C10:001 User calc 17_OV00	:010 0x7C10:002 User calc 17_OV01	:011 0x7C10:003 User calc 17_OV02	:012 0x7C10:004User calc 17_OV03
	:013 0x7C10:005 User calc 17_OV04	:014 0x7C10:006 User calc 17_OV05	:015 0x7C10:007 User calc 17_OV06	:016 0x7C10:008 User calc 17_OV07

Fig. 24 Mapping for calculation programs 16 and 17

0x1B58	User calc output 18 and 19 TxPDOMap OV1			
	:001 0x7C11:001 User calc 18_OV00			
	:002			
	0x7C12:001 User calc 19_OV00			
0x1B59	User calc output 18 and 19 TxPDOMap OV2			
	:001 0x7C11:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01		
	:003 0x7C12:001 User calc 19_OV00	:004 0x7C12:002 User calc 19_OV01		
0x1B5A	User calc output 18 and 17 TxPDOMap OV4			
	:001 0x7C11:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01	:003 0x7C11:003 User calc 18_OV02	:004 0x7C11:004 User calc 16_OV03
	:005 0x7C12:001 User calc 19_OV00	:006 0x7C12:002 User calc 19_OV01	:007 0x7C12:003 User calc 19_OV02	:008 0x7C12:004 User calc 17_OV03
0x1B5B	User calc output 18 and 17 TxPDOMap OV8			
	:001 0x7C11F:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01	:003 0x7C11:003 User calc 18_OV02	:004 0x7C11:004 User calc 18_OV03
	:005 0x7C11:005User calc 18_OV004	:006 0x7C11:006 User calc 18_OV05	:007 0x7C11:007 User calc 18_OV06	:008 0x7C11:008 User calc 18_OV07
	:009 0x7C12:001 User calc 19_OV00	:010 0x7C12:002 User calc 19_OV01	:011 0x7C12:003 User calc 19_OV02	:012 0x7C12:004User calc 19_OV03
	:013 0x7C12:005 User calc 19_OV04	:014 0x7C12:006 User calc 19_OV05	:015 0x7C12:007 User calc 19_OV06	:016 0x7C12:008 User calc 19_OV07

Fig. 25 Mapping for calculation programs 18 and 19

1.3.1.8 TxPDO Mapping IFD2415

0x1A00	Ch01Dist1 TxPDOMap OV1			
	:001 0x6000:001 Ch01Dist1_OV00			
0x1A01	Ch01Dist1 TxPDOMap OV2			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01		
0x1A02	Ch01Dist1 TxPDOMap OV4			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01	:003 0x6000:003 Ch01Dist1_OV02	:004 0x6000:004 Ch01Dist1_OV03
0x1A03	Ch01Dist1 TxPDOMap OV8			
	:001 0x6000:001 Ch01Dist1_OV00	:002 0x6000:002 Ch01Dist1_OV01	:003 0x6000:003 Ch01Dist1_OV02	:004 0x6000:004 Ch01Dist1_OV03
	:005 0x6000:005 Ch01Dist1_OV04	:006 0x6000:006 Ch01Dist1_OV05	:007 0x6000:007 Ch01Dist1_OV06	:008 0x6000:008 Ch01Dist1_OV07

Fig. 26 Mapping for distance value DIST1

0x1A10	Ch01Dist2 TxPDOMap OV1			
	:001 0x6001:001 Ch01Dist2_OV00			
0x1A11	Ch01Dist2 TxPDOMap OV2			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01		
0x1A12	Ch01Dist2 TxPDOMap OV4			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01	:003 0x6001:003 Ch01Dist2_OV02	:004 0x6001:004 Ch01Dist2_OV03
0x1A13	Ch01Dist2 TxPDOMap OV8			
	:001 0x6001:001 Ch01Dist2_OV00	:002 0x6001:002 Ch01Dist2_OV01	:003 0x6001:003 Ch01Dist2_OV02	:004 0x6001:004 Ch01Dist2_OV03
	:005 0x6001:005 Ch01Dist2_OV04	:006 0x6001:006 Ch01Dist2_OV05	:007 0x6001:007 Ch01Dist2_OV06	:008 0x6001:008 Ch01Dist2_OV07

Fig. 27 Mapping for distance value DIST2

0x1A20	Ch01Dist3 to Dist6 TxPDOMap OV1			
	:001 0x6002:001 Ch01Dist3_OV00	:002 0x6003:001 Ch01Dist4_OV00	:003 0x6004:001 Ch01Dist5_OV00	:004 0x6005:001 Ch01Dist6_OV00
0x1A21	Ch01Dist3 bis Dist6 TxPDOMap OV2			
	:001 0x6002:001 Ch01Dist3_OV00	:003 0x6003:001 Ch01Dist4_OV00	:005 0x6004:001 Ch01Dist5_OV00	:007 0x6005:001 Ch01Dist6_OV00
	:002 0x6002:002 Ch01Dist3_OV01	:004 0x6003:002 Ch01Dist4_OV01	:006 0x6004:002 Ch01Dist5_OV01	:008 0x6005:002 Ch01Dist6_OV01
0x1A22	Ch01Dist3 bis Dist6 TxPDOMap OV4			
	:001 0x6002:001 Ch01Dist3_OV00	:005 0x6003:001 Ch01Dist4_OV00	:009 0x6004:001 Ch01Dist5_OV00	:013 0x6005:001 Ch01Dist6_OV00
	:002 0x6002:002 Ch01Dist3_OV01	:006 0x6003:002 Ch01Dist4_OV01	:010 0x6004:002 Ch01Dist5_OV01	:014 0x6005:002 Ch01Dist6_OV01
	:003 0x6002:003 Ch01Dist3_OV02	:007 0x6003:003 Ch01Dist4_OV02	:011 0x6004:003 Ch01Dist5_OV02	:015 0x6005:003 Ch01Dist6_OV02
	:004 0x6002:004 Ch01Dist3_OV03	:008 0x6003:004 Ch01Dist4_OV03	:012 0x6004:004 Ch01Dist5_OV03	:016 0x6005:004 Ch01Dist6_OV03
0x1A23	Ch01Dist3 to Dist6 TxPDOMap OV8			
	:001 0x6002:001 Ch01Dist3_OV00	:009 0x6003:001 Ch01Dist4_OV00	:017 0x6004:001 Ch01Dist5_OV00	:025 0x6005:001 Ch01Dist6_OV00
	:002 0x6002:002 Ch01Dist3_OV01	:010 0x6003:002 Ch01Dist4_OV01	:018 0x6004:002 Ch01Dist5_OV01	:026 0x6005:002 Ch01Dist6_OV01
	:003 0x6002:003 Ch01Dist3_OV02	:011 0x6003:003 Ch01Dist4_OV02	:019 0x6004:003 Ch01Dist5_OV02	:027 0x6005:003 Ch01Dist6_OV02
	:004 0x6002:004 Ch01Dist3_OV03	:012 0x6003:004 Ch01Dist4_OV03	:020 0x6004:004 Ch01Dist5_OV03	:028 0x6005:004 Ch01Dist6_OV03
	:005 0x6002:005 Ch01Dist3_OV04	:013 0x6003:005 Ch01Dist4_OV04	:021 0x6004:005 Ch01Dist5_OV04	:029 0x6005:005 Ch01Dist6_OV04
	:006 0x6002:006 Ch01Dist3_OV05	:014 0x6003:006 Ch01Dist4_OV05	:022 0x6004:006 Ch01Dist5_OV05	:030 0x6005:006 Ch01Dist6_OV05
	:007 0x6002:007 Ch01Dist3_OV06	:015 0x6003:007 Ch01Dist4_OV06	:023 0x6004:007 Ch01Dist5_OV06	:031 0x6005:007 Ch01Dist6_OV06
	:008 0x6002:008 Ch01Dist3_OV07	:016 0x6003:008 Ch01Dist4_OV07	:024 0x6004:008 Ch01Dist5_OV07	:032 0x6005:008 Ch01Dist6_OV07

Fig. 28 Mapping for distance values DIST3 to DIST6

0x1A30	Ch01Intensity1 TxPDOMap OV1			
	:001 0x6010:001 Ch01Intensity1_OV00			
0x1A31	Ch01Intensity1 TxPDOMap OV2			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01		
0x1A32	Ch01Intensity1 TxPDOMap OV4			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01	:003 0x6010:003 Ch01Intensity1_OV02	:004 0x6010:004 Ch01Intensity1_OV03
0x1A33	Ch01Intensity1 TxPDOMap OV8			
	:001 0x6010:001 Ch01Intensity1_OV00	:002 0x6010:002 Ch01Intensity1_OV01	:003 0x6010:003 Ch01Intensity1_OV02	:004 0x6010:004 Ch01Intensity1_OV03
	:005 0x6010:005 Ch01Intensity1_OV04	:006 0x6010:006 Ch01Intensity1_OV05	:007 0x6010:007 Ch01Intensity1_OV06	:008 0x6010:008 Ch01Intensity1_OV07

Fig. 29 Mapping for Intensity 1 of DIST1

0x1A40	Ch01Intensity2 TxPDOMap OV1			
	:001 0x6011:001 Ch01Intensity2_OV00			
0x1A41	Ch01Intensity2 TxPDOMap OV2			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01		
0x1A42	Ch01Intensity2 TxPDOMap OV4			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01	:003 0x6011:003 Ch01Intensity2_OV02	:004 0x6011:004 Ch01Intensity2_OV03
0x1A43	Ch01Intensity2 TxPDOMap OV8			
	:001 0x6011:001 Ch01Intensity2_OV00	:002 0x6011:002 Ch01Intensity2_OV01	:003 0x6011:003 Ch01Intensity2_OV02	:004 0x6011:004 Ch01Intensity2_OV03
	:005 0x6011:005 Ch01Intensity2_OV04	:006 0x6011:006 Ch01Intensity2_OV05	:007 0x6011:007 Ch01Intensity2_OV06	:008 0x6011:008 Ch01Intensity2_OV07

Fig. 30 Mapping for Intensity 2 of DIST2

0x1A50	Channel 1 intensity 3 bis 6 TxPDOMap OV1			
	:001 0x6012:001 Intensity3_OV00	:002 0x6013:001 Intensity4_OV00	:003 0x6014:001 Intensity5_OV00	:004 0x6015:001 Intensity6_OV00
0x1A51	Channel 1 intensity 3 bis 6 OV2			
	:001 0x6012:001 Intensity3_OV00	:003 0x6013:001 Intensity4_OV00	:005 0x6014:001 Intensity5_OV00	:007 0x6015:001 Intensity6_OV00
	:002 0x6012:002 Intensity3_OV01	:004 0x6013:002 Intensity4_OV01	:006 0x6014:002 Intensity5_OV01	:008 0x6015:002 Intensity6_OV01
0x1A52	Channel 1 intensity 3 bis 6 OV4			
	:001 0x6012:001 Intensity3_OV00	:005 0x6013:001 Intensity4_OV00	:009 0x6014:001 Intensity5_OV00	:013 0x6015:001 Intensity6_OV00
	:002 0x6012:002 Intensity3_OV01	:006 0x6013:002 Intensity4_OV01	:010 0x6014:002 Intensity5_OV01	:014 0x6015:002 Intensity6_OV01
	:003 0x6012:003 Intensity3_OV02	:007 0x6013:003 Intensity4_OV02	:011 0x6014:003 Intensity5_OV02	:015 0x6015:003 Intensity6_OV02
	:004 0x6012:004 Intensity3_OV03	:008 0x6013:004 Intensity4_OV03	:012 0x6014:004 Intensity5_OV03	:016 0x6015:004 Intensity6_OV03
0x1A53	Channel 1 intensity 3 bis 6 OV8			
	:001 0x6012:001 Intensity3_OV00	:009 0x6013:001 Intensity4_OV00	:017 0x6014:001 Intensity5_OV00	:025 0x6015:001 Intensity6_OV00
	:002 0x6012:002 Intensity3_OV01	:010 0x6013:002 Intensity4_OV01	:018 0x6014:002 Intensity5_OV01	:026 0x6015:002 Intensity6_OV01
	:003 0x6012:003 Intensity3_OV02	:011 0x6013:003 Intensity4_OV02	:019 0x6014:003 Intensity5_OV02	:027 0x6015:003 Intensity6_OV02
	:004 0x6012:004 Intensity3_OV03	:012 0x6013:004 Intensity4_OV03	:020 0x6014:004 Intensity5_OV03	:028 0x6015:004 Intensity6_OV03
	:005 0x6012:005 Intensity3_OV04	:013 0x6013:005 Intensity4_OV04	:021 0x6014:005 Intensity5_OV04	:029 0x6015:005 Intensity6_OV04
	:006 0x6012:006 Intensity3_OV05	:014 0x6013:006 Intensity4_OV05	:022 0x6014:006 Intensity5_OV05	:030 0x6015:006 Intensity6_OV05
	:007 0x6012:007 Intensity3_OV06	:015 0x6013:007 Intensity4_OV06	:023 0x6014:007 Intensity5_OV06	:031 0x6015:007 Intensity6_OV06
	:008 0x6012:008 Intensity3_OV07	:016 0x6013:008 Intensity4_OV07	:024 0x6014:008 Intensity5_OV07	:032 0x6015:008 Intensity6_OV07

Fig. 31 Mapping for Intensities 3 to 6 from DIST3 up to DIST6

0x1A80	Ch01Shutter TxPDOMap OV1			
	:001 0x6030:001 Ch01Shutter_OV00			
0x1A81	Ch01Shutter TxPDOMap OV2			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01		
0x1A82	Ch01Shutter TxPDOMap OV4			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01	:003 0x6030:003 Ch01Shutter_OV02	:004 0x6030:004 Ch01Shutter_OV03
0x1A83	Ch01Shutter TxPDOMap OV8			
	:001 0x6030:001 Ch01Shutter_OV00	:002 0x6030:002 Ch01Shutter_OV01	:003 0x6030:003 Ch01Shutter_OV02	:004 0x6030:004 Ch01Shutter_OV03
	:005 0x6030:005 Ch01Shutter_OV04	:006 0x6030:006 Ch01Shutter_OV05	:007 0x6030:007 Ch01Shutter_OV06	:008 0x6030:008 Ch01Shutter_OV07

Fig. 32 Mapping for exposure time

0x1A90	CH01 Peak symmetry 1 TxPDOMap OV1			
	:001 0x6060:001 Peak sym 1_OV00			
0x1A91	CH01 Peak symmetry 1 TxPDOMap OV2			
	:001 0x6060:001 Peak sym 1_OV00	:002 0x6060:002 Peak sym 1_OV01		
0x1A92	CH01 Peak symmetry 1 TxPDOMap OV4			
	:001 0x6060:001Peak sym 1_OV00	:002 0x6060:002 Peak sym 1_OV01	:003 0x6060:003 Peak sym 1_OV02	:004 0x6060:004 Peak sym 1_OV03
0x1A93	CH01 Peak symmetry 1 TxPDOMap OV8			
	:001 0x6060:001 Peak sym 1_OV00	:002 0x6060:002 Peak sym 1_OV01	:003 0x6060:003 Peak sym 1_OV02	:004 0x6060:004 Peak sym 1_OV03
	:005 0x6060:005 Peak sym 1_OV04	:006 0x6060:006 Peak sym 1_OV05	:007 0x6060:007 Peak sym 1_OV06	:008 0x6060:008 Peak sym 1_OV07

Fig. 33 Mapping for peak symmetry 1

0x1AA0	CH01 Peak symmetry 2 TxPDOMap OV1			
	:001 0x6061:001 Peak sym 2_OV00			
0x1AA1	CH01 Peak symmetry 2 TxPDOMap OV2			
	:001 0x6061:001 Peak sym 2_OV00	:002 0x6061:002 Peak sym 2_OV01		
0x1AA2	CH01 Peak symmetry 2 TxPDOMap OV4			
	:001 0x6061:001Peak sym 2_OV00	:002 0x6061:002 Peak sym 2_OV01	:003 0x6061:003 Peak sym 2_OV02	:004 0x6061:004 Peak sym 2_OV03
0x1AA3	CH01 Peak symmetry 2 TxPDOMap OV8			
	:001 0x6061:001 Peak sym 2_OV00	:002 0x6061:002 Peak sym 2_OV01	:003 0x6061:003 Peak sym 2_OV02	:004 0x6061:004 Peak sym 2_OV03
	:005 0x6061:005 Peak sym 2_OV04	:006 0x6061:006 Peak sym 2_OV05	:007 0x6061:007 Peak sym 2_OV06	:008 0x6061:008 Peak sym 2_OV07

Fig. 34 Mapping for peak symmetry 2

0x1AB0	CH01 Peak symmetry 3 bis 6 TxPDOMap OV1			
	:001 0x6062:001 Peak sym 3_OV00	:002 0x6063:001 Peak sym 4_OV00	:003 0x6064:001 Peak sym 5_OV00	:004 0x6065:001 Peak sym 6_OV00
0x1AB1	CH01 Peak symmetry 3 bis 6 OV2			
	:001 0x6062:001 Peak sym 3_OV00	:003 0x6063:001 Peak sym 4_OV00	:005 0x6064:001 IPeak sym 5_OV00	:007 0x6065:001 Peak sym 6_OV00
	:002 0x6062:002 Peak sym 3_OV01	:004 0x6063:002 Peak sym 4_OV01	:006 0x6064:002 IPeak sym 5_OV01	:008 0x6065:002 Peak sym 6_OV01
0x1AB2	CH01 Peak symmetry 3 bis 6 OV4			
	:001 0x6062:001 Peak sym 3_OV00	:005 0x6063:001 Peak sym 4_OV00	:009 0x6064:001 Peak sym 5_OV00	:013 0x6065:001 Peak sym 6_OV00
	:002 0x6062:002 Peak sym 3_OV01	:006 0x6063:002 Peak sym 4_OV01	:010 0x6064:002 Peak sym 5_OV01	:014 0x6065:002 Peak sym 6_OV01
	:003 0x6062:003 Peak sym 3_OV02	:007 0x6063:003 Peak sym 4_OV02	:011 0x6064:003 Peak sym 5_OV02	:015 0x6065:003 Peak sym 6_OV02
	:004 0x6062:004 Peak sym 3_OV03	:008 0x6063:004 Peak sym 4_OV03	:012 0x6064:004 Peak sym 5_OV03	:016 0x6065:004 Peak sym 6_OV03
0x1AB3	CH01 Peak symmetry 3 bis 6 OV8			
	:001 0x6062:001 Peak sym 3_OV00	:009 0x6063:001 Peak sym 4_OV00	:017 0x6064:001 Peak sym 5_OV00	:025 0x6065:001 Peak sym 6_OV00
	:002 0x6062:002 Peak sym 3_OV01	:010 0x6063:002 Peak sym 4_OV01	:018 0x6064:002 Peak sym 5_OV01	:026 0x6065:002 Peak sym 6_OV01
	:003 0x6062:003 Peak sym 3_OV02	:011 0x6063:003 Peak sym 4_OV02	:019 0x6064:003 Peak sym 5_OV02	:027 0x6065:003 Peak sym 6_OV02
	:004 0x6062:004 Peak sym 3_OV03	:012 0x6063:004 Peak sym 4_OV03	:020 0x6064:004 Peak sym 5_OV03	:028 0x6065:004 Peak sym 6_OV03
	:005 0x6062:005 Peak sym 3_OV04	:013 0x6063:005 Peak sym 4_OV04	:021 0x6064:005 Peak sym 5_OV04	:029 0x6065:005 Peak sym 6_OV04
	:006 0x6062:006 Peak sym 3_OV05	:014 0x6063:006 Peak sym 4_OV05	:022 0x6064:006 Peak sym 5_OV05	:030 0x6065:006 Peak sym 6_OV05
	:007 0x6062:007 Peak sym 3_OV06	:015 0x6063:007 Peak sym 4_OV06	:023 0x6064:007 Peak sym 5_OV06	:031 0x6065:007 Peak sym 6_OV06
	:008 0x6062:008 Peak sym 3_OV07	:016 0x6063:008 Peak sym 4_OV07	:024 0x6064:008 Peak sym 5_OV07	:032 0x6065:008 Peak sym 6_OV07

Fig. 35 Mapping for peak symmetries 3 to 6

0x1AC0	Ch01Encoder TxPDOMap OV1			
	:001 0x6050:001 Encoder1_OV00	:002 0x6051:001 Encoder2_OV00	:003 0x6052:001 Encoder3_OV00	
0x1AC1	Ch01Encoder TxPDOMap OV2			
	:001 0x6050:001 Encoder1_OV00	:003 0x6051:001 Encoder2_OV00	:005 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:004 0x6051:002 Encoder2_OV01	:006 0x6052:002 Encoder3_OV01	
0x1AC2	Ch01Encoder TxPDOMap OV4			
	:001 0x6050:001 Encoder1_OV00	:005 0x6051:001 Encoder2_OV00	:009 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:006 0x6051:002 Encoder2_OV01	:010 0x6052:002 Encoder3_OV01	
	:003 0x6050:003 Encoder1_OV02	:007 0x6051:003 Encoder2_OV02	:011 0x6052:003 Encoder3_OV02	
	:004 0x6050:004 Encoder1_OV03	:008 0x6051:004 Encoder2_OV03	:012 0x6052:004 Encoder3_OV03	
0x1AC3	Ch01Encoder TxPDOMap OV8			
	:001 0x6050:001 Encoder1_OV00	:009 0x6051:001 Encoder2_OV00	:017 0x6052:001 Encoder3_OV00	
	:002 0x6050:002 Encoder1_OV01	:010 0x6051:002 Encoder2_OV01	:018 0x6052:002Encoder3_OV01	
	:003 0x6050:003 Encoder1_OV02	:011 0x6051:003 Encoder2_OV02	:019 0x6052:003 Encoder3_OV02	
	:004 0x6050:004 Encoder1_OV03	:012 0x6051:004 Encoder2_OV03	:020 0x6052:004 Encoder3_OV03	
	:005 0x6050:005 Encoder1_OV04	:013 0x6051:005 Encoder2_OV04	:021 0x6052:005 Encoder3_OV04	
	:006 0x6050:006 Encoder1_OV05	:014 0x6051:006 Encoder2_OV05	:022 0x6052:006 Encoder3_OV05	
	:007 0x6050:007 Encoder1_OV06	:015 0x6051:007 Encoder2_OV06	:023 0x6052:007 Encoder3_OV06	
	:008 0x6050:008 Encoder1_OV07	:016 0x6051:008 Encoder2_OV07	:024 0x6052:008 Encoder3_OV07	

Fig. 36 Mapping for Encoders 1 to 3

0x1AE0	Counter TxPDOMap OV1			
	:001 0x7000:001 Counter_OV00			
0x1AE1	Counter TxPDOMap OV2			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01		
0x1AE2	Counter TxPDOMap OV4			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01	:003 0x7000:003 Counter_OV02	:004 0x7000:004 Counter_OV03
0x1AE3	Counter TxPDOMap OV8			
	:001 0x7000:001 Counter_OV00	:002 0x7000:002 Counter_OV01	:003 0x7000:003 Counter_OV02	:004 0x7000:004 Counter_OV03
	:005 0x7000:005 Counter_OV04	:006 0x7000:006 Counter_OV05	:007 0x7000:007 Counter_OV06	:008 0x7000:008 Counter_OV07

Fig. 37 Mapping for the measured value counter

0x1AE8	Time stamp TxPDOMap OV1			
	:001 0x7001:001 Time stamp_OV00			
0x1AE9	Time stamp TxPDOMap OV2			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01		
0x1AEA	Time stamp TxPDOMap OV4			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01	:003 0x7001:003 Time stamp_OV02	:004 0x7001:004 Time stamp_OV03
0x1AEB	Time stamp TxPDOMap OV8			
	:001 0x7001:001 Time stamp_OV00	:002 0x7001:002 Time stamp_OV01	:003 0x7001:003 Time stamp_OV02	:004 0x7001:004 Time stamp_OV03
	:005 0x7001:005 Time stamp_OV04	:006 0x7001:006 Time stamp_OV05	:007 0x7001:007 Time stamp_OV06	:008 0x7001:008 Time stamp_OV07

Fig. 38 Mapping for time information

0x1AF0	Frequency TxPDOMap OV1			
	:001 0x7002:001 Frequency_OV00			
0x1AF1	Frequency TxPDOMap OV2			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01		
0x1AF2	Frequency TxPDOMap OV4			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01	:003 0x7002:003 Frequency_OV02	:004 0x7002:004 Frequency_OV03
0x1AF3	Frequency TxPDOMap OV8			
	:001 0x7002:001 Frequency_OV00	:002 0x7002:002 Frequency_OV01	:003 0x7002:003 Frequency_OV02	:004 0x7002:004 Frequency_OV03
	:005 0x7002:005 Frequency_OV04	:006 0x7002:006 Frequency_OV05	:007 0x7002:007 Frequency_OV06	:008 0x7002:008 Frequency_OV07

Fig. 39 Mapping for measurement frequency

0x1B00	User calc output 01 TxPDOMap OV1			
	:001 0x7C00:001 User calc 01_OV00			
0x1B01	User calc output 01 TxPDOMap OV2			
	:001 0x7C00:001 User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01		
0x1B02	User calc output 01 TxPDOMap OV4			
	:001 0x7C00:001User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01	:003 0x7C00:003 User calc 01_OV02	:004 0x7C00:004 User calc 01_OV03
0x1B03	User calc output 01 TxPDOMap OV8			
	:001 0x7C00:001 User calc 01_OV00	:002 0x7C00:002 User calc 01_OV01	:003 0x7C00:003 User calc 01_OV02	:004 0x7C00:004 User calc 01_OV03
	:005 0x7C00:005 User calc 01_OV04	:006 0x7C00:006 User calc 01_OV05	:007 0x7C00:007 User calc 01_OV06	:008 0x7C00:008 User calc 01_OV07

Fig. 40 Mapping for calculation program 1

0x1B08	User calc output 02 TxPDOMap OV1			
	:001 0x7C01:001 User calc 02_OV00			
0x1B09	User calc output 02 TxPDOMap OV2			
	:001 0x7C01:001 User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01		
0x1B0A	User calc output 02 TxPDOMap OV4			
	:001 0x7C01:001User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01	:003 0x7C01:003 User calc 02_OV02	:004 0x7C01:004 User calc 02_OV03
0x1B0B	User calc output 02 TxPDOMap OV8			
	:001 0x7C01:001 User calc 02_OV00	:002 0x7C01:002 User calc 02_OV01	:003 0x7C01:003 User calc 02_OV02	:004 0x7C01:004 User calc 02_OV03
	:005 0x7C01:005 User calc 02_OV04	:006 0x7C01:006 User calc 02_OV05	:007 0x7C01:007 User calc 02_OV06	:008 0x7C01:008 User calc 02_OV07

Fig. 41 Mapping for calculation program 2

0x1B10	User calc output 03 TxPDOMap OV1			
	:001 0x7C02:001 User calc 03_OV00			
0x1B11	User calc output 03 TxPDOMap OV2			
	:001 0x7C02:001 User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01		
0x1B12	User calc output 03 TxPDOMap OV4			
	:001 0x7C02:001User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01	:003 0x7C02:003 User calc 03_OV02	:004 0x7C02:004 User calc 03_OV03
0x1B13	User calc output 03 TxPDOMap OV8			
	:001 0x7C02:001 User calc 03_OV00	:002 0x7C02:002 User calc 03_OV01	:003 0x7C02:003 User calc 03_OV02	:004 0x7C02:004 User calc 03_OV03
	:005 0x7C02:005 User calc 03_OV04	:006 0x7C02:006 User calc 03_OV05	:007 0x7C02:007 User calc 03_OV06	:008 0x7C02:008 User calc 03_OV07

Fig. 42 Mapping for calculation program 3

0x1B18	User calc output 04 TxPDOMap OV1			
	:001 0x7C03:001 User calc 04_OV00			
0x1B19	User calc output 04 TxPDOMap OV2			
	:001 0x7C03:001 User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01		
0x1B1A	User calc output 04 TxPDOMap OV4			
	:001 0x7C03:001User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01	:003 0x7C03:003 User calc 04_OV02	:004 0x7C03:004 User calc 04_OV03
0x1B1B	User calc output 04 TxPDOMap OV8			
	:001 0x7C03:001 User calc 04_OV00	:002 0x7C03:002 User calc 04_OV01	:003 0x7C03:003 User calc 04_OV02	:004 0x7C03:004 User calc 04_OV03
	:005 0x7C03:005 User calc 04_OV04	:006 0x7C03:006 User calc 04_OV05	:007 0x7C03:007 User calc 04_OV06	:008 0x7C03:008 User calc 04_OV07

Fig. 43 Mapping for calculation program 4

0x1B20	User calc output 05 TxPDOMap OV1			
	:001 0x7C04:001 User calc 05_OV00			
0x1B21	User calc output 05 TxPDOMap OV2			
	:001 0x7C04:001 User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01		
0x1B22	User calc output 05 TxPDOMap OV4			
	:001 0x7C04:001User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01	:003 0x7C04:003 User calc 05_OV02	:004 0x7C04:004 User calc 05_OV03
0x1B23	User calc output 05 TxPDOMap OV8			
	:001 0x7C04:001 User calc 05_OV00	:002 0x7C04:002 User calc 05_OV01	:003 0x7C04:003 User calc 05_OV02	:004 0x7C04:004 User calc 05_OV03
	:005 0x7C04:005 User calc 05_OV04	:006 0x7C04:006 User calc 05_OV05	:007 0x7C04:007 User calc 05_OV06	:008 0x7C04:008 User calc 05_OV07

Fig. 44 Mapping for calculation program 5

0x1B28	User calc output 06 and 07 TxPDOMap OV1			
	:001 0x7C05:001 User calc 06_OV00			
	:002 0x7C06:001 User calc 07_OV00			
0x1B29	User calc output 06 and 07 TxPDOMap OV2			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01		
	:003 0x7C06:001 User calc 07_OV00	:004 0x7C06:002 User calc 07_OV01		
0x1B2A	User calc output 06 and 07 TxPDOMap OV4			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01	:003 0x7C05:003 User calc 06_OV02	:004 0x7C05:004 User calc 06_OV03
	:005 0x7C06:001 User calc 07_OV00	:006 0x7C06:002 User calc 07_OV01	:007 0x7C06:003 User calc 07_OV02	:008 0x7C06:004 User calc 07_OV03
0x1B2B	User calc output 06 and 07 TxPDOMap OV8			
	:001 0x7C05:001 User calc 06_OV00	:002 0x7C05:002 User calc 06_OV01	:003 0x7C05:003 User calc 06_OV02	:004 0x7C05:004 User calc 06_OV03
	:005 0x7C05:005 User calc 06_OV04	:006 0x7C05:006 User calc 06_OV05	:007 0x7C05:007 User calc 06_OV06	:008 0x7C05:008 User calc 06_OV07
	:009 0x7C06:001 User calc 07_OV00	:010 0x7C06:002 User calc 07_OV01	:011 0x7C06:003 User calc 07_OV02	:012 0x7C06:004 User calc 07_OV03
	:013 0x7C06:005 User calc 07_OV04	:014 0x7C06:006 User calc 07_OV05	:015 0x7C06:007 User calc 07_OV06	:016 0x7C06:008 User calc 07_OV07

Fig. 45 Mapping for calculation programs 6 and 7

0x1B30	User calc output 08 and 09 TxPDOMap OV1			
	:001 0x7C07:001 User calc 08_OV00			
	:002 0x7C08:001 User calc 09_OV00			
0x1B31	User calc output 08 and 09 TxPDOMap OV2			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01		
	:003 0x7C08:001 User calc 09_OV00	:004 0x7C08:002 User calc 09_OV01		
0x1B32	User calc output 08 and 09 TxPDOMap OV4			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01	:003 0x7C07:003 User calc 08_OV02	:004 0x7C07:004 User calc 08_OV03
	:005 0x7C08:001 User calc 09_OV00	:006 0x7C08:002 User calc 09_OV01	:007 0x7C08:003 User calc 09_OV02	:008 0x7C08:004 User calc 09_OV03
0x1B33	User calc output 08 and 09 TxPDOMap OV8			
	:001 0x7C07:001 User calc 08_OV00	:002 0x7C07:002 User calc 08_OV01	:003 0x7C07:003 User calc 08_OV02	:004 0x7C07:004 User calc 08_OV03
	:005 0x7C07:005 User calc 08_OV04	:006 0x7C07:006 User calc 08_OV05	:007 0x7C07:007 User calc 08_OV06	:008 0x7C07:008 User calc 08_OV07
	:009 0x7C08:001 User calc 09_OV00	:010 0x7C08:002 User calc 09_OV01	:011 0x7C08:003 User calc 09_OV02	:012 0x7C08:004 User calc 09_OV03
	:013 0x7C08:005 User calc 09_OV04	:014 0x7C08:006 User calc 09_OV05	:015 0x7C08:007 User calc 09_OV06	:016 0x7C08:008 User calc 09_OV07

Fig. 46 Mapping for calculation programs 8 and 9

0x1B38	User calc output 10 and 11 TxPDOMap OV1			
	:001 0x7C09:001 User calc 10_OV00			
	:002 0x7C0A:001 User calc 11_OV00			
0x1B39	User calc output 10 and 11 TxPDOMap OV2			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01		
	:003 0x7C0A:001 User calc 11_OV00	:004 0x7C0A:002 User calc 11_OV01		
0x1B3A	User calc output 10 and 11 TxPDOMap OV4			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01	:003 0x7C09:003 User calc 10_OV02	:004 0x7C09:004 User calc 10_OV03
	:005 0x7C0A:001 User calc 11_OV00	:006 0x7C0A:002 User calc 11_OV01	:007 0x7C0A:003 User calc 11_OV02	:008 0x7C0A:004 User calc 11_OV03
0x1B3B	User calc output 10 and 11 TxPDOMap OV8			
	:001 0x7C09:001 User calc 10_OV00	:002 0x7C09:002 User calc 10_OV01	:003 0x7C09:003 User calc 10_OV02	:004 0x7C09:004 User calc 10_OV03
	:005 0x7C09:005 User calc 10_OV004	:006 0x7C09:006 User calc 10_OV05	:007 0x7C09:007 User calc 10_OV06	:008 0x7C09:008 User calc 10_OV07
	:009 0x7C0A:001 User calc 11_OV00	:010 0x7C0A:002 User calc 11_OV01	:011 0x7C0A:003 User calc 11_OV02	:012 0x7C0A:004 User calc 11_OV03
	:013 0x7C0A:005 User calc 11_OV04	:014 0x7C0A:006 User calc 11_OV05	:015 0x7C0A:007 User calc 11_OV06	:016 0x7C0A:008 User calc 11_OV07

Fig. 47 Mapping for calculation programs 10 and 11

0x1B40	User calc output 12 and 13 TxPDOMap OV1			
	:001 0x7C0B:001 User calc 12_OV00			
	:002 0x7C0C:001 User calc 13_OV00			
0x1B41	User calc output 12 and 13 TxPDOMap OV2			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01		
	:003 0x7C0C:001 User calc 13_OV00	:004 0x7C0C:002 User calc 13_OV01		
0x1B42	User calc output 12 and 13 TxPDOMap OV4			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01	:003 0x7C0B:003 User calc 12_OV02	:004 0x7C0B:004 User calc 12_OV03
	:005 0x7C0C:001 User calc 13_OV00	:006 0x7C0C:002 User calc 13_OV01	:007 0x7C0C:003 User calc 13_OV02	:008 0x7C0C:004 User calc 13_OV03
0x1B43	User calc output 12 and 13 TxPDOMap OV8			
	:001 0x7C0B:001 User calc 12_OV00	:002 0x7C0B:002 User calc 12_OV01	:003 0x7C0B:003 User calc 12_OV02	:004 0x7C0B:004 User calc 12_OV03
	:005 0x7C0B:005 User calc 12_OV004	:006 0x7C0B:006 User calc 12_OV05	:007 0x7C0B:007 User calc 12_OV06	:008 0x7C0B:008 User calc 12_OV07
	:009 0x7C0C:001 User calc 13_OV00	:010 0x7C0C:002 User calc 13_OV01	:011 0x7C0C:003 User calc 13_OV02	:012 0x7C0C:004 User calc 13_OV03
	:013 0x7C0C:005 User calc 13_OV04	:014 0x7C0C:006 User calc 13_OV05	:015 0x7C0C:007 User calc 13_OV06	:016 0x7C0C:008 User calc 13_OV07

Fig. 48 Mapping for calculation programs 12 and 13

0x1B48	User calc output 14 and 15 TxPDOMap OV1			
	:001 0x7C0D:001 User calc 14_OV00			
	:002 0x7C0E:001 User calc 15_OV00			
0x1B49	User calc output 14 and 15 TxPDOMap OV2			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01		
	:003 0x7C0E:001 User calc 15_OV00	:004 0x7C0E:002 User calc 15_OV01		
0x1B4A	User calc output 14 and 15 TxPDOMap OV4			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01	:003 0x7C0D:003 User calc 14_OV02	:004 0x7C0D:004 User calc 14_OV03
	:005 0x7C0E:001 User calc 15_OV00	:006 0x7C0E:002 User calc 15_OV01	:007 0x7C0E:003 User calc 15_OV02	:008 0x7C0E:004 User calc 15_OV03
0x1B4B	User calc output 14 and 15 TxPDOMap OV8			
	:001 0x7C0D:001 User calc 14_OV00	:002 0x7C0D:002 User calc 14_OV01	:003 0x7C0D:003 User calc 14_OV02	:004 0x7C0D:004 User calc 14_OV03
	:005 0x7C0D:005User calc 14_OV004	:006 0x7C0D:006 User calc 14_OV05	:007 0x7C0D:007 User calc 14_OV06	:008 0x7C0D:008 User calc 14_OV07
	:009 0x7C0E:001 User calc 15_OV00	:010 0x7C0E:002 User calc 15_OV01	:011 0x7C0E:003 User calc 15_OV02	:012 0x7C0E:004User calc 15_OV03
	:013 0x7C0E:005 User calc 15_OV04	:014 0x7C0E:006 User calc 15_OV05	:015 0x7C0E:007 User calc 15_OV06	:016 0x7C0E:008 User calc 15_OV07

Fig. 49 Mapping for calculation programs 14 and 15

0x1B50	User calc output 16 and 17 TxPDOMap OV1			
	:001 0x7C0F:001 User calc 16_OV00			
	:002 0x7C10:001 User calc 17_OV00			
0x1B51	User calc output 16 and 17 TxPDOMap OV2			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01		
	:003 0x7C10:001 User calc 17_OV00	:004 0x7C10:002 User calc 17_OV01		
0x1B52	User calc output 16 and 17 TxPDOMap OV4			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01	:003 0x7C0F:003 User calc 16_OV02	:004 0x7C0F:004 User calc 16_OV03
	:005 0x7C10:001 User calc 17_OV00	:006 0x7C10:002 User calc 17_OV01	:007 0x7C10:003 User calc 17_OV02	:008 0x7C10:004 User calc 17_OV03
0x1B53	User calc output 16 and 17 TxPDOMap OV8			
	:001 0x7C0F:001 User calc 16_OV00	:002 0x7C0F:002 User calc 16_OV01	:003 0x7C0F:003 User calc 16_OV02	:004 0x7C0F:004 User calc 16_OV03
	:005 0x7C0F:005User calc 16_OV004	:006 0x7C0F:006 User calc 16_OV05	:007 0x7C0F:007 User calc 16_OV06	:008 0x7C0F:008 User calc 16_OV07
	:009 0x7C10:001 User calc 17_OV00	:010 0x7C10:002 User calc 17_OV01	:011 0x7C10:003 User calc 17_OV02	:012 0x7C10:004User calc 17_OV03
	:013 0x7C10:005 User calc 17_OV04	:014 0x7C10:006 User calc 17_OV05	:015 0x7C10:007 User calc 17_OV06	:016 0x7C10:008 User calc 17_OV07

Fig. 50 Mapping for calculation programs 16 and 17

0x1B58	User calc output 18 and 19 TxPDOMap OV1			
	:001 0x7C11:001 User calc 18_OV00			
	:002 0x7C12:001 User calc 19_OV00			
0x1B59	User calc output 18 and 19 TxPDOMap OV2			
	:001 0x7C11:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01		
	:003 0x7C12:001 User calc 19_OV00	:004 0x7C12:002 User calc 19_OV01		
0x1B5A	User calc output 18 and 17 TxPDOMap OV4			
	:001 0x7C11:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01	:003 0x7C11:003 User calc 18_OV02	:004 0x7C11:004 User calc 16_OV03
	:005 0x7C12:001 User calc 19_OV00	:006 0x7C12:002 User calc 19_OV01	:007 0x7C12:003 User calc 19_OV02	:008 0x7C12:004 User calc 17_OV03
0x1B5B	User calc output 18 and 17 TxPDOMap OV8			
	:001 0x7C11F:001 User calc 18_OV00	:002 0x7C11:002 User calc 18_OV01	:003 0x7C11:003 User calc 18_OV02	:004 0x7C11:004 User calc 18_OV03
	:005 0x7C11:005User calc 18_OV004	:006 0x7C11:006 User calc 18_OV05	:007 0x7C11:007 User calc 18_OV06	:008 0x7C11:008 User calc 18_OV07
	:009 0x7C12:001 User calc 19_OV00	:010 0x7C12:002 User calc 19_OV01	:011 0x7C12:003 User calc 19_OV02	:012 0x7C12:004User calc 19_OV03
	:013 0x7C12:005 User calc 19_OV04	:014 0x7C12:006 User calc 19_OV05	:015 0x7C12:007 User calc 19_OV06	:016 0x7C12:008 User calc 19_OV07

Fig. 51 Mapping for calculation programs 18 and 19

1.3.1.9 Example of TxPDO-Mapping

In object 0x1C13 is selected which PDOs are transferred. The PDO mapping objects are selected. The selection process takes place before switching from PreOP to SafeOP mode.

Example 1: Startup procedure to output distance 1 from channel 1 (01DIST1):

- Distance 1 is output in 0x6000. In order to transfer 0x6000 in the PDO, the PDO mapping object 0x1A00 must be selected in 0x1C13.

Object	Value	Description
0x1C13:00	0x00	clear sm pdos (0x1C13)
0x1C13:01	0x1A00	download pdo 0x1C13:01 index
0x1C13:00	0x01	download pdo 0x1C13 count

Example 2: Startup procedure to output distance 1, the exposure time and the encoder.

- Distance 1 is output in 0x6000. In order to transfer 0x6000 in the PDO, the PDO mapping object 0x1A00 must be selected in 0x1C13.
- Shutter is output in 0x6030. In order to transfer 0x6030 in the PDO, the PDO mapping object 0x1A80 must be selected in 0x1C13.
- Encoder 1 is output in 0x6050, Encoder 2 in 0x6051 and Encoder 3 in 0x6052. The four process data are merged in 0x1AC0 and must be selected in 0x1C13 for transfer in the PDO.

Object	Value	Description
0x1C13:00	0x00	clear sm pdos (0x1C13)
0x1C13:01	0x1A00	download pdo 0x1C13:01 index
0x1C13:02	0x1A80	download pdo 0x1C13:02 index
0x1C13:03	0x1AC0	download pdo 0x1C13:03 index
0x1C13:00	0x03 (3)	download pdo 0x1C13 count

1.3.1.10 Object 1C00h: Synchronous Manager Type

1C00	RECORD	Sync manager type			ro
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Sync manager 1	0x01	Unsigned8	ro
2	VAR	Sync manager 2	0x02	Unsigned8	ro
3	VAR	Sync manager 3	0x03	Unsigned8	ro
4	VAR	Sync manager 4	0x04	Unsigned8	ro

1.3.1.11 Object 1C12h: RxPDO Assign

1C12	ARRAY	RxPDO-Assign			rw
Subindices					
0	VAR	Number of entries	0	Unsigned8	ro

No RxPDOs can be selected because none are present. The object is implemented as a dummy to enable the EtherCAT master to set the RxPDOs to 0.

1.3.1.12 Object 1C13h: TxPDO Assign

1C13	ARRAY	TxPDO-Assign			rw
Subindices					
0	VAR	Number of entries	n	Unsigned8	rw
1	VAR	Subindex 001	0x1A00	Unsigned16	rw
2	VAR	Subindex 002		Unsigned16	rw
..					
n	VAR	Subindex n	-	Unsigned16	rw

Object for selecting the PDOs (TxPDO maps), 8.3.1.7.

1.3.1.13 Object 1C32h: Synchronization Manager Input Parameters

see description of input parameters, see Chap. 1.3.1.14.

1.3.1.14 Object 1C33h: Synchronization Manager Input Parameters

1C33	RECORD	SM input parameter			ro
Subindices					
0	VAR	Number of entries	9	Unsigned8	ro
1	VAR	Synchronization type	x	Unsigned16	ro
2	VAR	Cycle time	x	Unsigned32	ro
4	VAR	Synchronization types supported	0x4007	Unsigned16	ro
5	VAR	Minimum cycle time	1250000	Unsigned32	ro
6	VAR	Calc and copy time	x	Unsigned32	ro
8	VAR	Get cycle time	x	Unsigned16	rw
9	VAR	Delay time	x	Unsigned32	ro
0C	VAR	Cycle time too small counter	x	Unsigned16	ro
20	VAR	Sync error	x	BOOL	ro

- Synchronization Type: currently specified synchronization, Fig. 52
- Cycle Time: currently specified cycle time in ns
  - Free run: the cycle time derived from the measuring rate,
  - SM2, SM3: the cycle time derived from the measuring rate,
  - Sync0 synchronization, the Sync0 cycle time set by the master.
- Supported synchronization types:
  - Freerun, SM2 / SM3 and Sync0 synchronization
- Minimum cycle time: The minimum cycle time is derived from the maximum measuring rate and is 125 µs for the IFD2410 or IFD2411 and 40 µs for the IFD2415.
- Calc and Copy Time: The Calc and Copy time is the time after the input latch (input data are available in the slave) until the input data is copied into the Sync-Manager-3 area (transfer of the data to Industrial Ethernet). The Calc and Copy Time from 0x1C33 is only calculated if the Distributed Clocks are enabled. The value is recalculated each time it is read. Since the sensor does not have output data, the Calc and copy time of 0x1C32 always returns 0.
- Delay time: The delay time is the hardware-related delay until the input latch is reached.

The delay time from 0x1C33 is only calculated if the Distributed Clocks are activated. The value is recalculated each time it is read. Since the sensor does not have output data, the Delay time from 0x1C32 always returns 0.

- Cycle Time Too Small Counter: This counter is incremented if the cycle time is too low, so that the input data could not be provided for the next SM event.

- Sync Error
  - 0: No errors.
  - 1: A synchronization error occurred. The Cycle Time Too Small Counter has been incremented.

The set synchronization depends on the combination of 0x1C33:001 and 0x1C32:001. The synchronization changes during a transition from the PreOP state to the SafeOP state. If the combination is invalid, an error message is displayed when the state is changed. Process data communication will then not be possible.

0x1C32 Synchronization Type	0x1C33 Synchronization Type	Synchronization
0x00	0x00	Free Run
0x01	0x22	SM2
0xyy	0x01	SM3
0x02	0x02	Sync0

Fig. 52 Example of synchronization

An activation of the Distributed Clocks does not automatically change the Sync0 mode. The synchronization can only be changed by writing the objects 0x1C32 and 0x1C33.

1.3.2 Manufacturer Specific Objects

1.3.2.1 Overview

Index (h)	Name	IFD2410	IFD2411	IFD2415	Description
3001	User level	•	•	•	Login, logout, change Pass word
3005	Controller information	•	•	•	Information on IFD241x (others)
3011	Correction ch 1	•	•	•	Dark correction
3020	Basicsettings	•	•	•	Load, save, factory settings
3021	Preset settings	•	•	•	
3022	Measurement settings	•	•	•	Measurement setting
303F	Sensor error	•	•	•	Error IFD241x channel 1
3101	Reset	•	•	•	Reboot IFD241x
3105	Factory reset	•	•	•	Factory settings
3107	Counter reset	•	•	•	Counter reset
3133	LED on/off ch 1	•	•	•	LED light source channel 1
3150	Sensor ch 1	•	•	•	Information IFD241x channel 1
3152	Select sensor		•		Sensor selection
3153	Sensor table		•		Sensor table
3156	Multilayer options ch 1	•	•	•	
3161	Peak position ch 1	•	•	•	Peak selection channel 1
3162	Peak options ch 1	•	•	•	Peak options channel 1
31B0	Digital interfaces	•	•	•	Digital interfaces
31B1	Enable output	•	•	•	Interface selection
31B2	Outhold	•	•	•	Error handling
31B3	Outreduce settings	•	•	•	Data reduction
31D0	Analog output	•	•	•	Analog output, scaling
31F3	Switching output 1	•		•	Switching output 1/2
31F4	Switching output 2	•		•	
31F5	RS422 output	•	•	•	Data output with RS422
3250	Shutter mode ch 1	•	•	•	Exposure mode channel 1
3251	Measuring rate	•	•	•	Measuring rate
34A0	Keylock	•	•	•	Lock button on the IFD241x
35A0	Encoder	•	•	•	Encoder settings
35B0	Trigger settings	•	•	•	Trigger settings
35B1	Synchronization	•	•	•	Synchronization, terminating resistance
3711	Range of interest ch 1	•	•	•	Masks the evaluation range
3800	Material info and edit	•	•	•	Material information
3802	Material table edit	•	•	•	Edit material table
3803	Material table	•	•	•	Existing materials in the material table
3804	Material selection ch 1	•	•	•	Select Material
Index (h)	**Name**	**IFD2410**	**IFD2411**	**IFD2415**	**Description**
39FF-3A09	Mastering y	•	•	•	Master value, mastering
3A10-3A12	Statistic y	•	•	•	Statistics
3C00-3C09	Comp y ch 1	•	•	•	Measured value calculation Channel 1
3CBF	Sys signals	•	•	•	
3E00	User calc	•	•	•	

i Invalid entries when reading and writing manufacturer-specific objects can result in errors. These errors are described in the SDO abort codes, see Chap. 8.5. If an error occurs while writing a value, you may be able to retrieve error details in object 303F.

1.3.2.2 Object 3001h: User Level

3001	RECORD	User level			
Subindices					
0	VAR	Number of entries	7	Unsigned8	ro
1	VAR	Actual user	x	Unsigned8	ro
2	VAR	Login		Visible string	wo
3	VAR	Logout	FALSE	BOOL	rw
4	VAR	User level when restarting	x	Unsigned8	rw
5	VAR	Password old		Visible string	wo
6	VAR	Password new		Visible string	wo
7	VAR	Password repeat		Visible string	wo

For more information, please refer to the Login section, 6.6.4.

Actual user, Default user:

0 - User

1 - Professional

Modifying the user level will change the access rights for objects. Once you log out, RW objects change to read-only (= ro), and write-only objects (=wo) are no longer available.

For changing the password, the three password fields Old, New and Repeat must be described in the specified sequence. The maximum password length is 31 characters.

1.3.2.3 Object 3005h: Information IFD241x (others)

3005	RECORD	Controller Info			ro
Subindices					
0	VAR	Number of entries	8	Unsigned8	ro
1	VAR	Name	IFC24xx,	Visible String	ro
5	VAR	Serial No	xxxxxxxx	Visible String	ro
6	VAR	Option No	xxx	Visible String	ro
8	VAR	Article No	xxxxxxx	Visible String	ro

Further details can be found in the section Controller Information, A 5.3.1.2.

1.3.2.4 Object 3011h: Correction, Channel 1

3011	RECORD	Correction channel 1			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	Dark correction start	FALSE	BOOL	wo
3	VAR	Dark correction state	x	Unsigned32	ro

Writing 1 (True) to subindex 1 triggers a dark correction. Sub-index 3 displays the state of the correction; valid values include:

- 0: no correction active
- 1: correction active
- 100: error during the correction process

Once correction has been initiated, the status changes from 0 to 1. If no error occurs, the status changes back to 0 when correction is completed. No settings may be changed while a correction is active.

For more information, please refer to the Dark Correction section, A 5.3.4.3,

1.3.2.5 Object 3020h: Load, Save, Factory Settings

3020	RECORD	Basic settings			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	READ		BOOL	wo
2	VAR	STORE		BOOL	wo
3	VAR	SETDEFAULT		BOOL	wo

- READ: Loads the last saved basic settings
- STORE: Stores the current settings
- SETDEFAULT: Resets the basic settings to factory defaults

1.3.2.6 Object 3021h: Preset

3021	RECORD	Preset			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	Mode	x	Unsigned8	rw
2	VAR	List		Visual string	ro
3	VAR	Named read		Visual string	wo

Mode:

- 0 – STATIC
- 1 – BALANCED
- 2 – DYNAMIC

Further details can be found in the section Measurement Setting, 1.3.2.7.

1.3.2.7 Object 3022h: Measurement Settings

3022	RECORD	Measurement settings			ro
Subindices					
0	VAR	Number of entries	7	Unsigned8	
1	VAR	Current		Visual string	ro
2	VAR	Named read		Visual string	wo
3	VAR	Named store		Visual string	wo
4	VAR	Named delete		Visual string	wo
5	VAR	Initial meassettings		Visual string	rw
6	VAR	List		Visual string	ro
7	VAR	Set default		BOOL	wo

- Current: Current measurement settings (MEASSETTINGS CURRENT)
- Named read: Loads a measurement setting from the `List`/sub-index 6 (MEASSETTINGS READ)
- Named store: Stores the current measurement setting. You can assign a name or number (MEASSETTINGS STORE)
- Named delete: Deletes a measurement setting from the `List`/sub-index 6 (MEASSETTINGS DELETE)
- Initial meassettings: Measurement setting that is initially loaded during a reset of IFD241x (MEASSETTINGS INITIAL)
- List: List with stored measurement settings (MEASSETTINGS LIST)
- Set default: corresponds to the SETDEFAULT MEASSETTINGS command

For more information, please refer to the Measurement Settings section, A 5.3.8.6.

1.3.2.8 Object 303Fh: Error IFD241x

303F	RECORD	Sensor error			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Error number	x	Unsigned16	ro
2	VAR	Error description	x	Visible String	ro

For more information, please refer to the Error Messages section.

- Sensor error number: Outputs the error during communication
- Sensor error description: Error as plain text

1.3.2.9 Object 3101h: Reset

3101	VAR	Reset	FALSE	BOOL	rw

The IFD241x is restarted.

1.3.2.10 Object 3105h: Factory Settings

3105	VAR	Factory reset		BOOL	wo

Reset to factory defaults. Corresponds to the SETDEFAULT ALL command.

1.3.2.11 Object 3107h: Counter Reset

3107	RECORD	Counter reset			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Reset timestamp		BOOL	wo
2	VAR	Reset counter		BOOL	wo

Setting sub-index 1 to 1 will reset the time stamp (0x7001). Setting sub-index 2 to 1 will reset the measured value counter (0x7000).

1.3.2.12 Object 3133h: LED Light Source Channel 1

3133	RECORD	LED on/off ch1			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	LED on/off	x	BOOL	rw
2	VAR	LED source	x	Unsigned8	rw

LED on/off:

- 0 – Off
- 1 – On

Allows you to turn on or off the LED light source and corresponds to the LED command.

1.3.2.13 Object 3150h: Information IFD241x Channel 1

3150	RECORD	Sensor ch1			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	Sensor info	IFS24xx-xx	Visible String	ro
2	VAR	Sensor range	xx.xxxxxx	FLOAT32	ro
3	VAR	Sensor serial No	xxxxxxxx	Visible String	ro

For more information, please refer to the Sensor section, A 5.3.4.

1.3.2.14 Object 3152h: Sensor Selection Channel 1

Object is valid for the IFD2411.

3152	RECORD	Select sensor ch1			ro
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Select sensor		Unsigned8	rw
2	VAR	Sensor name	IFS24xx-xx	Visible String	ro
3	VAR	Measuring range	xx.xxxxxx	FLOAT32	ro
4	VAR	Sensor serial no.	xxxxxxxx	Visible String	ro

For more information, please refer to the Sensor section, A 5.3.4.

1.3.2.15 Object 3153h: Sensor Table

Object is valid for the IFD2411.

3153	RECORD	Select table ch1			ro
Subindices					
0	VAR	Number of entries	6	Unsigned8	ro
1	VAR	Position		Unsigned8	rw
2	VAR	Get next position		BOOL	ro
3	VAR	Get previous position		BOOL	ro
4	VAR	Sensor name	IFS24xx-xx	Visible String	ro
5	VAR	Measuring range	xx.xxxxxx	FLOAT32	ro
6	VAR	Sensor serial no.	xxxxxxxx	Visible String	ro

1.3.2.16 Object 3156h: Multilayer Options for Channel 1

3156	RECORD	Multilayer options ch1			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Peak count		Unsigned32	rw
2	VAR	Disable refractivity correction	FALSE	BOOL	rw

Includes the options for thickness and multilayer measurements.
Subindex 1 is equivalent to the PEAKCOUNT command.
Subindex 2 is equivalent to the REFRACCORR command.

Disable refractivity correction: Disables the refractive index correction

1.3.2.17 Object 3161h: Peak Selection Channel 1

3161	VAR	Peak position	0	Unsigned8	rw

Use this command to define the peaks that are evaluated in the distance/thickness measurement mode.

Standard: first peak / first and second peak

In order to receive transparent measuring results, the standard setting should only be changed where absolutely required.

0	first and last peak
1	second-last and last peak
2	first and second peak
3	highest and second-highest peak

1.3.2.18 Object 3162h: Peak Options Channel 1

3162	RECORD	Peak options ch1			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Min threshold		FLOAT32	rw
2	VAR	Peak modulation		FLOAT32	rw

Min threshold: Peak detection threshold, corresponds to the MIN_THRESHOLD command.

1.3.2.19 Object 31B0h: Digital Interfaces

31B0	RECORD	Digital interfaces			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
2	VAR	RS422 baud rate	x	Unsigned32	rw

Subindex 2 is equivalent to the BAUDRATE command. You can only select from the predefined baud rates.

RS422 baud rate: 9600, 115200, 230400, 460800, 691200, 921600, 1500000, 2000000, 3500000, 4000000

1.3.2.20 Object 31B1h: Select Interface

31B1	RECORD	Enable output			ro
Subindices					
0	VAR	Number of entries	5	Unsigned8	ro
1	VAR	RS422	x	BOOL	rw
3	VAR	Analog out		BOOL	rw
4	VAR	Switching outputs		BOOL	rw
5	VAR	Industrial Ethernet		BOOL	rw

Corresponds to the OUTPUT command. Parallel output of measured values via the respective interface can be switched on and off.

1.3.2.21 Object 31B2h: Error Handling

31B2	RECORD	Outhold			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Error handling type		Unsigned8	rw
2	VAR	Error handling values		Unsigned32	rw

1.3.2.22 Object 31B3h: Data Reduction

31B3	RECORD	Outreduce settings			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
2	VAR	Reduction analog		BOOL	rw
3	VAR	Reduction RS422		BOOL	rw
4	VAR	Reduction factor		Unsigned32	rw

1.3.2.23 Object 31D0h: Analog Output

31D0	RECORD	Analog output			ro
Subindices					
0	VAR	Number of entries	55	Unsigned8	ro
1	VAR	Analog output	x	Unsigned8	rw
2	VAR	Analog signal	x	Visible String	rw
4	VAR	Type of scaling	x	Unsigned8	rw
5	VAR	Two-point-scaling start	x.x	FLOAT32	rw
6	VAR	Two-point-scaling end	x.x	FLOAT32	rw
50	VAR	Available signals part 0		Visible String	ro
51	VAR	Available signals part 1		Visible String	ro
52	VAR	Available signals part 2		Visible String	ro
53	VAR	Available signals part 3		Visible String	ro
54	VAR	Available signals part 4		Visible String	ro
55	VAR	Available signals part 5		Visible String	ro

For more information, please refer to the Analog output section, A 5.3.15.

Analog output:

- 0 - Voltage 0 … 5 V
- 1 - Voltage 0 … 10 V
- 7 - Current 4 … 20 mA

Signal: Data can only be selected in accordance with the selected measuring program. For distance measurements, only distance 1 can be selected.

You can, for example, select 01DIST1. `Available signals` lists the available signals.

Type of scaling:

- 0 - Default scaling
- 1 - Two-point scaling

1.3.2.24 Object 31F3h: Switching Output 1

Object is valid for IFD2410/2415.

31F3	RECORD	Switching output			ro
Subindices					
0	VAR	Number of entries	55	Unsigned8	ro
1	VAR	Output level		Unsigned8	rw
2	VAR	Error out		Unsigned8	rw
3	VAR	Limit signal		Visible String	rw
5	VAR	Lower limit value		FLOAT32	rw
6	VAR	Upper limit value		FLOAT32	rw
7	VAR	Compare to		Unsigned8	rw
8	VAR	Error hysteresis		FLOAT32	rw
50	VAR	Available signals part 0		Visible String	ro
51	VAR	Available signals part 1		Visible String	ro
52	VAR	Available signals part 2		Visible String	ro
53	VAR	Available signals part 3		Visible String	ro
54	VAR	Available signals part 4		Visible String	ro
55	VAR	Available signals part 5		Visible String	ro

For more information, please refer to the Switching Output section A 5.3.14.

Output level:

0 - PNP
1 - NPN
2 - Push-pull
3 - Push-pull negated

Error out:

1 - 01ER1
2 - 01ER2
3 - 01ER12
4 - 02ER1
5 - 02ER2
6 - 02ER12
7 - 0102ER12
8 - ERRORLIMIT

Use `Limit signal` to select a measured value signal that will be used for the comparison.

`Available signals` contains a list of the available signals.

Compare to:

1 - Lower
2 - Upper
3 - Both

Object 31F4h includes the settings for switching output 2.

1.3.2.25 Object 31F5h: RS422 Output

31F5	RECORD	RS422 output			ro
Subindices					
0	VAR	Number of entries	93	Unsigned8	ro
1	VAR	RS422 add output signal		Unsigned8	rw
2	VAR	RS422 remove output signal		Unsigned8	rw
3	VAR	RS422 reset output signals		Visible String	rw
50	VAR	RS422 available signals part 0		FLOAT32	ro
51	VAR	RS422 available signals part 1		FLOAT32	ro
...					
63	VAR	RS422 available signals part 12		FLOAT32	
81	VAR	Outputinfo RS422 part 0		Visible String	ro
82	VAR	Outputinfo RS422 part 1		Visible String	ro
...					
93	VAR	Outputinfo RS422 part 12		Visible String	ro

1.3.2.26 Object 3250h: Exposure Mode Channel 1

3250	RECORD	Shutter mode ch1			
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Shutter mode	x	Unsigned8	rw
3	VAR	Shutter time 1	x.xx	FLOAT32	rw
4	VAR	Shutter time 2	x.xx	FLOAT32	rw

For more information, please refer to the Exposure Mode section, 6.2.5 and the Exposure Time section, A 5.3.9.6.

Shutter mode:

1 - Measurement mode
2 - Manual mode
3 - Two-time mode alternating
4 - Two-time mode automatic

Object 3250h includes the exposure settings for channel 2.

1.3.2.27 Object 3251h: Measuring Rate

3251	RECORD	Measuring rate		FLOAT32	rw

Further details can be found in the section Measuring Rate, A 5.3.9.5.

1.3.2.28 Object 34A0h: Keylock

34A0	RECORD	Keylock			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Mode	0	Unsigned8	rw
2	VAR	Key lock countdown [min]	0	Unsigned8	rw

Mode:

0 - Inactive
1 - Active
2 - Automatic mode / Active after delay

1.3.2.29 Object 35A0h: Encoder

Encoder 2/3 is possible with IFD2410/2415.

35A0	RECORD	RS422 output			ro
Subindices					
0	VAR	Number of entries	17	Unsigned8	ro
1	VAR	Encoder 1 reference signal		Unsigned8	rw
2	VAR	Encoder 1 interpolation		Unsigned8	rw
3	VAR	Encoder 1 initial value		Unsigned32	rw
4	VAR	Encoder 1 maximum value		Unsigned32	rw
5	VAR	Encoder 1 set value		BOOL	wo
6	VAR	Encoder 2 reference signal		Unsigned8	rw
7	VAR	Encoder 2 interpolation		Unsigned8	rw
8	VAR	Encoder 2 initial value		Unsigned32	rw
9	VAR	Encoder 2 maximum value		Unsigned32	rw
10	VAR	Encoder 2 set value		BOOL	wo
11	VAR	Encoder 3 reference signal		Unsigned8	rw
12	VAR	Encoder 3 interpolation		Unsigned8	rw
13	VAR	Encoder 3 initial value		Unsigned32	rw
14	VAR	Encoder 3 maximum value		Unsigned32	rw
15	VAR	Encoder 3 set value		BOOL	wo
16	VAR	Set encoder		Unsigned8	wo
17	VAR	Reset encoder		Unsigned8	wo

For more information, please refer to the Encoder Inputs, 6.1.2 section and the Encoders, A 5.3.6 section.

Encoder reference signal:

0 - None, the encoder's reference marker has no effect

1 - One, specified once

3 - Ever, specified for all markers

Encoder interpolation:

1 - Single interpolation

2 - Dual interpolation

3 - Quadruple interpolation

Encoder initial value:

0 … 2^{32}-1

Encoder maximal value:

0 … 2^{32}-1

1.3.2.30 Object 35B0 Triggering

35B0	RECORD	Triggering			ro
Subindices					
0	VAR	Number of entries	11	Unsigned8	ro
1	VAR	Trigger at		Unsigned8	rw
2	VAR	Trigger source		Unsigned8	rw
3	VAR	Trigger mode		Unsigned8	rw
4	VAR	Trigger level		Unsigned8	rw
5	VAR	Trigger count type		Unsigned8	rw
6	VAR	Trigger count value		Unsigned16	rw
7	VAR	Trigger software		BOOL	ro
8	VAR	Trigger encoder minimum		Unsigned32	rw
9	VAR	Trigger encoder maximum		Unsigned32	rw
10	VAR	Trigger encoder step size		Unsigned32	rw
11	VAR	MFI level		Unsigned8	rw

1.3.2.31 Object 35B1 Synchronization

35B1	RECORD	Synchronization			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Sync mode		Unsigned8	rw
2	VAR	Termination		BOOL	rw

1.3.2.32 Object 3711h: Masking the Evaluation Range for Channel 1

3711	RECORD	Range of interest ch1			
Subindices					
0	VAR	Number of entries	12	Unsigned8	ro
11	VAR	Range of interest start	x	Unsigned16	rw
12	VAR	Range of interest end	x	Unsigned16	rw

For more information, please refer to the section on masking the evaluation range, 6.2.4, A 5.3.9.7.

1.3.2.33 Object 3800h: Material Information

3800	RECORD	Material info and edit			
Subindices					
0	VAR	Number of entries	7	Unsigned8	ro
1	VAR	Name	xxxxx	Visible String	rw
2	VAR	Description	xxxxxx	Visible String	rw
3	VAR	Type of refraction	xx	Unsigned8	rw
4	VAR	nd value	x.xxxx	FLOAT32	rw
5	VAR	nF value	x.xxxx	FLOAT32	rw
6	VAR	nC value	x.xxxx	FLOAT32	rw
7	VAR	Abbe number	x.xxxx	FLOAT32	rw

For more information, please refer to the Material Database section, see Chap. 6.2.8, A 5.3.10.

Material name: Currently selected material for a thickness measurement

Material description: Description of the currently selected material

nd, nf and nC: Refractive index of the currently selected material at 587 nm, 486 nm and 656 nm

Abbe number: Abbe number for the currently selected material

The current material can be edited in Expert mode. Specified settings are stored immediately.

1.3.2.34 Object 3802h: Edit Material Table

3802	RECORD	Material table edit			
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Material delete	x	Visible String	wo
2	VAR	Reset materials	x	BOOL	wo
3	VAR	New material	x	BOOL	wo
4	VAR	Select material for edit		Visible String	rw

Material delete: Specify the name of a material to be deleted from the material table

Reset materials: Resets the material table to the factory settings

New material: Creates a new material in the material table. The newly created material (“NewMaterial”) is edited in object 3800h “Material info”.

Sub-index 4 selects the material that is to be edited in object 0x3800.

1.3.2.35 Object 3803h: Existing Materials

3803	RECORD	Material table			
Subindices					
0	VAR	Number of entries	5	Unsigned8	ro
1	VAR	Existing materials part 0		Visible String	ro
2	VAR	Existing materials part 1		Visible String	ro
3	VAR	Existing materials part 2		Visible String	ro
4	VAR	Existing materials part 3		Visible String	ro
5	VAR	Existing materials part 4		Visible String	ro

Provides a list of all available materials.

1.3.2.36 Object 3804h: Select Material for Channel 1

3804	RECORD	Material selection ch1			
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Material 1	xx	Visible String	rw

1.3.2.37 Object 3A00h: Mastering, Zeroing

3A00	RECORD	Master 1			
Subindices					
0	VAR	Number of entries	55	Unsigned8	ro
1	VAR	Enable	xx	BOOL	rw
2	VAR	Signal	xx	Visible String	rw
4	VAR	Set/reset	xx	BOOL	rw
5	VAR	Value	xx	FLOAT32	rw
50	VAR	Available signals part 0		Visible String	ro
51	VAR	Available signals part 1		Visible String	ro
52	VAR	Available signals part 2		Visible String	ro
53	VAR	Available signals part 3		Visible String	ro
54	VAR	Available signals part 4		Visible String	ro
55	VAR	Available signals part 5		Visible String	ro

Mastering or zeroing a signal; there are 10 of these objects (3A00h and 3A09). The sub-index 2 specifies which signal is to be mastered. Subindex 4 corresponds to the MASTER command.

1.3.2.38 Object 3A10h: Statistics

3A10	RECORD	Statistic 1			
Subindices					
0	VAR	Number of entries	55	Unsigned8	ro
1	VAR	Enable		BOOL	rw
2	VAR	Signal		Visible String	rw
4	VAR	Infinite		BOOL	rw
5	VAR	Depth		Unsigned16	rw
6	VAR	Reset		BOOL	wo
50	VAR	Available signals part 0		Visible String	
51	VAR	Available signals part 1		Visible String	
52	VAR	Available signals part 2		Visible String	
53	VAR	Available signals part 3		Visible String	
54	VAR	Available signals part 4		Visible String	
55	VAR	Available signals part 5		Visible String	

The objects 3A10h to 3A12h generate 3 statistics signals.

Sub-index 50 ... 55 corresponds to the META_STATISTICSIGNAL command.

Subindex 6 corresponds to the STATISTIC command.

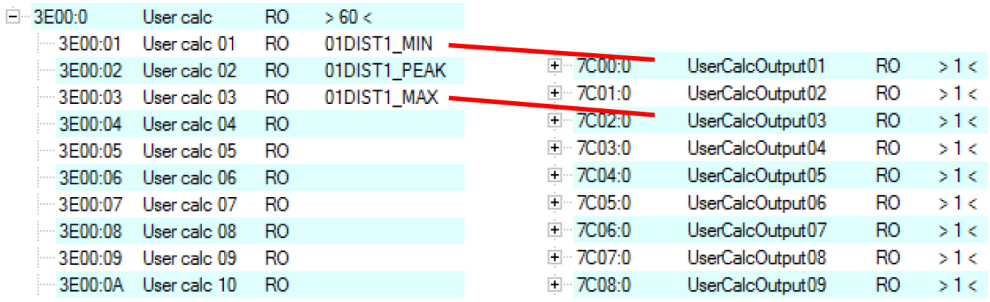
3 signals are generated for each activated statistics object. These signals are listed in object 0x3E00. The statistics function can also be applied to a user signal.

Example: You want distance 1 (channel 1) to output the minimum and the maximum measured values using all previous distance values.

Activating a statistics object
3A10:01(Enable) to TRUE. Distance 1 (01DIST1) is selected as signal by default. If you would like to display statistics for a different signal, you will need to select the required signal in sub-index 2.

- Settings for all previous distance values
  3A10:04 (Infinite) to True (STATISTICSIGNAL – INFINITE)

Assignment of user defined signal to PDO
The newly created signal names are listed in object 0x3E00h:



The minimum distance is output in 0x7C00h and the maximum distance is output in 0x7C02h.

PDO Select
UserCalcOutput01 - 0x7C00h is selected with object 1B00h and 0x7C02h is output with object 1B10hSo

1B00	UserCalc01 TxPDOMap	
	UserCalcOutput01	0x7C00
1B08	UserCalc02 TxPDOMap	
	UserCalcOutput02	0x7C01
1B10	UserCalc03 TxPDOMap	
	UserCalcOutput03	0x7C02

Extract from TxPDO Mapping, see Chap. 8.3.1.7

Before PreOp to SafeOp must be selected in 0x1C13h, 0x1B00h and 0x1B10h:

0x00 (0)1B00	clear sm pdos (0x1C13)
0x1B00 (6912)	download pdo 0x1C13:01 index
0x1B10 (6928)	download pdo 0x1C13:02 index
0x02 (2)	download pdo 0x1C13 count

1.3.2.39 Object 3C00h: Measured Value Calculation Channel 1

3C00	RECORD	Comp y ch1			
Subindices					
0	VAR	Number of entries	55	Unsigned8	ro
1	VAR	Type		Unsigned8	rw
2	VAR	Name1		Visible String	rw
4	VAR	Signal1		Visible String	rw
5	VAR	Signal2		Visible String	rw
13	VAR	Factor1		FLOAT32	rw
14	VAR	Factor2		FLOAT32	rw
17	VAR	Offset		FLOAT32	rw
18	VAR	Parameter		Unsigned32	rw
50	VAR	Available signals part 0		Visible String	ro
51	VAR	Available signals part 1		Visible String	ro
52	VAR	Available signals part 2		Visible String	ro
53	VAR	Available signals part 3		Visible String	ro
54	VAR	Available signals part 4		Visible String	ro
55	VAR	Available signals part 5		Visible String	ro

The Objects 3C00h to 3C09h generate 10 calculation modules for channel 1.

Type:

1 - Moving average (MOVING)
2 - Recursive average (RECURSIVE)
3 - Median (MEDIAN)
4 - Calc / Calculation of two signals (CALC)

As soon as the type is changed, default settings are loaded for the selected type. You can only select signals from the corresponding channel.

Depending on the type, all other object entries have different meanings:

- Moving average (MOVING):

4	Signal1	Signal which should be applied to the filter (default 01DIST1)
18	Param1	Averaging number (default: 2)

Value range for Param1: 2|4|8|16|32|64|128|256|512|1024|2048|4096

- Recursive average (RECURSIVE):

4	Signal1	Signal which should be applied to the filter (default 01DIST1)
18	Param1	Averaging number (default: 2)

Value range for Param1: 2 ... 32000

- Median (MEDIAN)

4	Signal1	Signal which should be applied to the filter (default 01DIST1)
18	Param1	Averaging number (default: 3)

Value range for Param1: 3|5|7|9

- Calc / Calculation of two signals (CALC)

2	Name	Name of the generated signal
4	Signal1	(default ch x: 01DIST1)
5	Signal2	(default ch x: 01DIST2)
13	Factor1	(default chx/sys: -1.0)
14	Factor2	(default chx/sys: 1.0)
18	Offset	(default chx/sys: 0.0)

(<factor1> * <signal1>) + (<factor2> * <signal2>) + <offset>

Value range for offset (mm): -2147.0 ... 2147.0

i The object index determines the order of processing and corresponds to the parameter `ID` of the ASCII command.

Example: Signal 01DIST1 is to be filtered using a median filter and an average value filter. The sequence is first median

filter, then average value filter.

0x2C00:

1	Type	3 (Median)
4	Signal1	01DIST1
18	Param1	<averaging number>

0x2C01:

1	Type	2 (recursive average)
4	Signal1	01DIST1
18	Param1	<averaging number>

Filters can also be applied to user signals.

1.3.2.40 Objekt 3CBFh: Sys Signals

3CBF	RECORD	Sys signals			
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Range lower		FLOAT32	rw
2	VAR	Range upper		FLOAT32	rw

References the SYSSIGNALRANGE command.

1.3.2.41 Object 3E00: User Signals

3E00	RECORD	User calc			
Subindices					
0	VAR	Number of entries	19	Unsigned8	ro
1	VAR	User calc 01		Visible String	ro
2	VAR	User calc 02		Visible String	ro
...					
13_{hex}	VAR	User calc 18		Visible String	ro

Names of the user signals that are output in the 0x7C0xh objects. The sequence specifies the order of the PDO data. The PDOs are selected via the 0x1B0xh objects.

1.4 Mappable Objects - Process Data

Displays all individually available process data.

The objects 0x60xx, 0x700x and 0x7Cxx are structured as follows:

[INDEX]	[NAME]			
0	Subindex 0		Uint8	Read
1	Subindex 1		[DATENTYP]	READ

Objects 0x60xx: Process data for channel 1.

Objects 0x700x: System process data (process data that are not available per channel).

Objects 0x7Cxx: Calculated process data.

i The process data for the objects are not yet available after switching on. Only a successful state change from PreOP to SafeOP makes the process data available which were selected through object 0x1C13h or the mapping objects for the PDO output. If the state changes from SafeOP to OP, all previously selected process data are still available.

1.4.1 Object 6000, 6001: Distance Value

6000	RECORD	Channel 1 Distance 1			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Channel 1 distance 1_OV00		Unsigned32	ro
2		Channel 1 distance 1_OV01		Unsigned32	ro
3		Channel 1 distance 1_OV02		Unsigned32	ro
4		Channel 1 distance 1_OV03		Unsigned32	ro
5		Channel 1 distance 1_OV04		Unsigned32	ro
6		Channel 1 distance 1_OV05		Unsigned32	ro
7		Channel 1 distance 1_OV06		Unsigned32	ro
8		Channel 1 distance 1_OV07		Unsigned32	ro

Object 0x6001 contains the value for the second distance value Distance 2 (DIST2).

For the IFD2415, there are the additional objects for further distance values

- 0x6002 contains Distance 3 (DIST3),
- 0x6003 contains Distance 4 (DIST4),
- 0x6004 contains Distance 5 (DIST5) and
- 0x6005 contains Distance 6 (DIST6).

1.4.2 Object 6010, 6011: Intensity

6010	RECORD	Channel 1 Intensity 1			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Channel 1 intensity 1_OV00		Unsigned32	ro
2		Channel 1 intensity 1_OV01		Unsigned32	ro
3		Channel 1 intensity 1_OV02		Unsigned32	ro
4		Channel 1 intensity 1_OV03		Unsigned32	ro
5		Channel 1 intensity 1_OV04		Unsigned32	ro
6		Channel 1 intensity 1_OV05		Unsigned32	ro
7		Channel 1 intensity 1_OV06		Unsigned32	ro
8		Channel 1 intensity 1_OV07		Unsigned32	ro

Object 0x6011 contains the value for the second intensity value Intensity 2 of DIST2.

For the IFD2415, there are the additional objects for further intensity values

- 0x6012 contains Intensity 3 (DIST3),
- 0x6013 contains Intensity 4 (DIST4),
- 0x6014 contains Intensity 5 (DIST5) and
- 0x6015 contains Intensity 6 (DIST6).

1.4.3 Object 6030: Exposure Time

6030	RECORD	Channel 1 Shutter			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Channel 1 shutter_OV00		Unsigned32	ro
2		Channel 1 shutter_OV01		Unsigned32	ro
3		Channel 1 shutter_OV02		Unsigned32	ro
4		Channel 1 shutter_OV03		Unsigned32	ro
5		Channel 1 shutter_OV04		Unsigned32	ro
6		Channel 1 shutter_OV05		Unsigned32	ro
7		Channel 1 shutter_OV06		Unsigned32	ro
8		Channel 1 shutter_OV07		Unsigned32	ro

1.4.4 Object 6050, 6051, 6052: Encoder

6050	RECORD	Channel 1 Encoder 1			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Channel 1 encoder 1_OV00		Unsigned32	ro
2		Channel 1 encoder 1_OV01		Unsigned32	ro
3		Channel 1 encoder 1_OV02		Unsigned32	ro
4		Channel 1 encoder 1_OV03		Unsigned32	ro
5		Channel 1 encoder 1_OV04		Unsigned32	ro
6		Channel 1 encoder 1_OV05		Unsigned32	ro
7		Channel 1 encoder 1_OV06		Unsigned32	ro
8		Channel 1 encoder 1_OV07		Unsigned32	ro

The object 0x6051 contains the values for Encoder 2.

The object 0x6052 contains the values for Encoder 3.

1.4.5 Object 6060: Peak Symmetry

The object is valid for the IFD2415.

6060	RECORD	Channel 1 Peak Symmetry			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Channel 1 peak symmetry 1_OV00		Unsigned32	ro
2		Channel 1 peak symmetry 1_OV01		Unsigned32	ro
3		Channel 1 peak symmetry 1_OV02		Unsigned32	ro
4		Channel 1 peak symmetry 1_OV03		Unsigned32	ro
5		Channel 1 peak symmetry 1_OV04		Unsigned32	ro
6		Channel 1 peak symmetry 1_OV05		Unsigned32	ro
7		Channel 1 peak symmetry 1_OV06		Unsigned32	ro
8		Channel 1 peak symmetry 1_OV07		Unsigned32	ro

The object 0x6060 contains the peak symmetry of DIST1.

The following objects container other symmetry values

- 0x6061 contains Peak symmetry 2 (DIST2),
- 0x6062 contains Peak symmetry 3 (DIST3),
- 0x6063 contains Peak symmetry 4 (DIST4),
- 0x6064 contains Peak symmetry 5 (DIST5),
- 0x6065 contains Peak symmetry 6 (DIST6),

1.4.6 Object 7000: Measured Value Counter

7000	RECORD	Counter			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Counter_OV00		Unsigned32	ro
2		Counter_OV01		Unsigned32	ro
3		Counter_OV02		Unsigned32	ro
4		Counter_OV03		Unsigned32	ro
5		Counter_OV04		Unsigned32	ro
6		Counter_OV05		Unsigned32	ro
7		Counter_OV06		Unsigned32	ro
8		Counter_OV07		Unsigned32	ro

1.4.7 Object 7001: Time Stamp

7001	RECORD	Time stamp			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Time stamp_OV00		Unsigned32	ro
2		Time stamp_OV01		Unsigned32	ro
3		Time stamp_OV02		Unsigned32	ro
4		Time stamp_OV03		Unsigned32	ro
5		Time stamp_OV04		Unsigned32	ro
6		Time stamp_OV05		Unsigned32	ro
7		Time stamp_OV06		Unsigned32	ro
8		Time stamp_OV07		Unsigned32	ro

1.4.8 Object 7002: Measuring Rate

7002	RECORD	Frequency			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		Frequency_OV00		Unsigned32	ro
2		Frequency_OV01		Unsigned32	ro
3		Frequency_OV02		Unsigned32	ro
4		Frequency_OV03		Unsigned32	ro
5		Frequency_OV04		Unsigned32	ro
6		Frequency_OV05		Unsigned32	ro
7		Frequency_OV06		Unsigned32	ro
8		Frequency_OV07		Unsigned32	ro

1.4.9 Object 7C00: Calculated Process Data

7C00	RECORD	User calc output			
Subindices					
0		Number of entries	8	Unsigned8	ro
1		User calc output 01_OV00		Unsigned32	ro
2		User calc output 01_OV01		Unsigned32	ro
3		User calc output 01_OV02		Unsigned32	ro
4		User calc output 01_OV03		Unsigned32	ro
5		User calc output 01_OV04		Unsigned32	ro
6		User calc output 01_OV05		Unsigned32	ro
7		User calc output 01_OV06		Unsigned32	ro
8		User calc output 01_OV07		Unsigned32	ro

Other process data contain the following objects:

0x7C01 User calc output 02	0x7C02 User calc output 03	0x7C03 User calc output 04
0x7C04 User calc output 05	0x7C05 User calc output 06	0x7C06 User calc output 07
0x7C07 User calc output 08	0x7C08 User calc output 09	0x7C09 User calc output 10
0x7C0A User calc output 11	0x7C0B User calc output 12	0x7C0C User calc output 13
0x7C0D User calc output 14	0x7C0E User calc output 15	0x7C0F User calc output 16
0x7C10 User calc output 17	0x7C11 User calc output 18	0x7C12 User calc output 19

1.5 Error Codes for SDO Services

In case of a negative evaluation of a SDO requirement, a corresponding error code is output in “Abort SDO Transfer Protocol“.

Error code hexadecimal	Meaning
0503 0000	Toggle-Bit has not changed.
0504 0000	SDO protocol timeout expired
0504 0001	Invalid command registered
0504 0005	Not enough memory
0601 0000	Access to object (parameter) not supported.
0601 0001	Attempt to write to a “read-only parameter“
0601 0002	Attempt to write to a “read-only parameter“
0602 0000	Object (parameter) is not listed in the object directory.
0604 0041	Object (parameter) is not mappable on PDO.
0604 0042	Number or length of objects to be transmitted exceeds PDO length.
0604 0043	General parameters incompatibility
0604 0047	General internal device incompatibility
0606 0000	Access denied due to hardware error
0607 0010	False data type or length of service parameter is incorrect.
0607 0012	False data type or length of service parameter is too large.
0607 0013	False data type or length of service parameter is too small.
0609 0011	Subindex does not exist
0609 0030	Invalid value of parameter (only for write access)
0609 0031	Value of the parameter too large
0609 0032	Value of the parameter too small
0609 0036	Maximum value falls below minimum value.
0800 0000	General error
0800 0020	Data can not be transmitted or saved in application.
0800 0021	Data can not be transmitted or saved in application due to local control unit.
0800 0022	Data can not be transmitted or saved in application due to device status.
0800 0023	Dynamic generation of object directory failed or no object directory is available

1.6 Oversampling

In operation without oversampling, the last accumulated measured value data set is transferred to the EtherCAT master with each fieldbus cycle, see Chap. 8.3.1.7. Therefore, for long fieldbus cycle periods many data records with measured values are not available. Configurable oversampling ensures that all (or selected) measured value data records are gathered and transmitted together to the master during the next fieldbus cycle.

The oversampling factor specifies how many samples per bus cycle are transmitted. For example, an oversampling factor of 2 means that 2 samples are transferred per bus cycle.

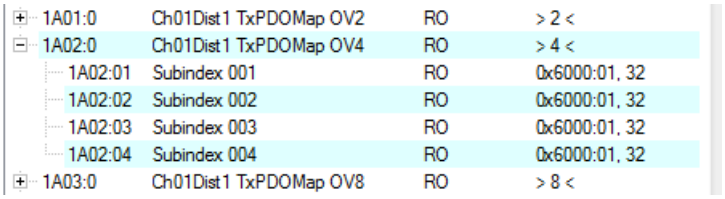
With TxPDO Mapping, the base index of the PDO mapping objects is included with the oversampling factor 1. Use the following list to determine the index for selecting a different oversampling factor:

- Base index + 1: Oversampling factor 2
- Base index + 2: Oversampling factor 4
- Base index + 3: Oversampling factor 8

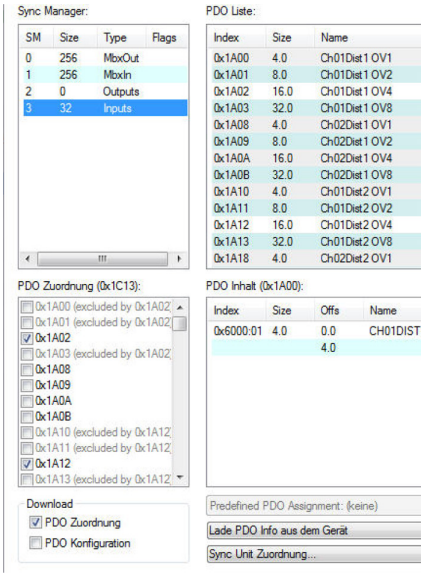
You can only select mapping objects with the same oversampling factor in 0x1C13h.

Example:

- The fieldbus/EtherCAT master operates at a cycle time of 1 ms because the higher-level PLC works with a cycle time of 1 ms. This means that every 1 ms, an EtherCAT frame is sent to the IFD241x to pick up process data. If the measurement frequency in the IFD241x is set to 4 kHz, you need to specify an oversampling of 4.
- Startup procedure to output distance 1 for channel 1 (01DIST1) and distance 2 for channel 1 (01DIST2) with an oversampling factor of 4.
  - Distance 1 for channel 1 is output in object 6000h. In order to transfer this object in the PDO, the PDO mapping object 0x1A00 must be selected in object 0x1C13:01h. However, 0x1A02 (base index 0x1A00 + 2) must be selected for the 4-fold oversampling.

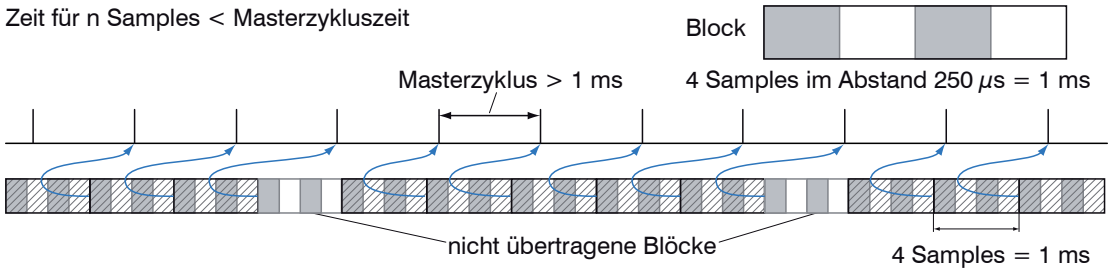


  - Distance 2 for channel 1 is output in object 6001h. In order to transfer this object in the PDO, the PDO mapping object 0x1A10 must be selected in object 0x1C13:02h. However, 0x1A12 (base index 0x1A10 + 2) must be selected for the 4-fold oversampling.

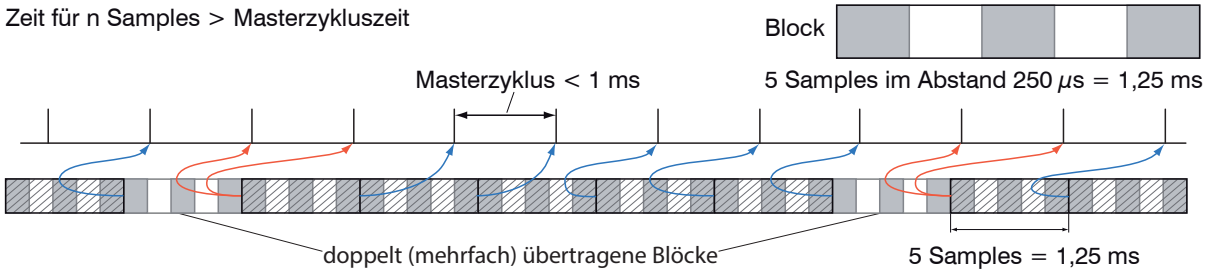


To ensure that no samples are lost due to the asynchronous nature between the master cycle and slave cycle, the master cycle time should always be less than the time for building a block from n samples.

An entire block with the specified samples is only made available to the EtherCAT side after all specified samples have been written to the block. If the time for filling a block is less than the master cycle time, individual blocks are not transferred. It can indeed happen that the next block is already being filled with samples before the previously filled block is picked up in a master cycle.



But if you select a number of samples sufficiently large so that the time for filling a block is greater than the master cycle time, each block will be picked up in a master cycle. Individual blocks (and therefore samples), however, will be transferred two or more times. This can be detected on the master side by transferring the timestamp or counter (see object 0x7000).



1.7 Calculation

1.7.1 Setting a Filter

The function for an average or median filter has been explained, see Chap. 8.3.2.39.

1.7.2 Thickness Calculation

Sequence for outputting a thickness (distance 1 to distance 2) in the PDO:

Steps 1 and 2 are not required when using the `Single side thickness` preset. To activate this preset, `Single side thickness` must be written to object 3022:01h, see Chap. 8.3.2.7. Please note that this also modifies other settings.

Step 1: Set the number of expected peaks to 2.

2156:0	Multilayer options ch 1	RO	> 2 <
2156:01	Peak count	RW	0x02 (2)
2156:02	Disable refractivity correction	RW	FALSE

Step 2: Set up the calculation for object 2C00:
Set sub-index 1 to 4h. The name for the generated signal is `THICK12`.
Formula for the calculation: THICK12 = -1.0 x 01DIST1 + 1.0 x 01DIST2 + 0.0
The factors and the offset must be defined accordingly:

2C00:0	Comp 1 ch1	RO	> 25 <
2C00:01	Type	RW	0x0004 (4)
2C00:02	Name	RW	THICK12
2C00:03	Signal1	RW	01DIST1
2C00:04	Signal2	RW	01DIST2
2C00:0D	Factor1	RW	-1.000000 (-1.000000e+000)
2C00:0E	Factor2	RW	1.000000 (1.000000e+000)
2C00:17	Offset	RW	0.000000 (0.000000e+000)
2C00:18	Param1	RW	0x00000000 (0)

Step 3: Assigning a user-defined signal to a PDO
2E00h now includes the new signal name (all user-defined signals are displayed starting with sub-index 1).

2E00:0	User calc	RO	> 40 <
2E00:01	User calc 01	RO	THICK12
2E00:02	User calc 02	RO	
2E00:03	User calc 03	RO	
2E00:04	User calc 04	RO	
2E00:05	User calc 05	RO	
2E00:06	User calc 06	RO	
2E00:07	User calc 07	RO	
2E00:08	User calc 08	RO	
2E00:09	User calc 09	RO	
2E00:0A	User calc 10	RO	

7C00:0	UserCalcOutput01	RO	> 1 <
7C01:0	UserCalcOutput02	RO	> 1 <
7C02:0	UserCalcOutput03	RO	> 1 <
7C03:0	UserCalcOutput04	RO	> 1 <
7C04:0	UserCalcOutput05	RO	> 1 <
7C05:0	UserCalcOutput06	RO	> 1 <
7C06:0	UserCalcOutput07	RO	> 1 <
7C07:0	UserCalcOutput08	RO	> 1 <
7C08:0	UserCalcOutput09	RO	> 1 <
7C09:0	UserCalcOutput10	RO	> 1 <

Step 4: Select the PDO.
UserCalcOutput01 – 0x7C00h is selected with 0x1B00h:

1B00	**UserCalc01 TxPDOMap**
	UserCalcOutput01 0x7C00

Before PreOp is changed to SafeOp, the following must be selected in 0x1C13h and 0x1B00h:

0x1C13:00	0x00 (0)	clear sm pdos (0x1C13)
0x1C13:01	0x1B00 (6912)	download pdo 0x1C13:01 index
0x1C13:00	0x01 (1)	download pdo 0x1C13 count

1.8 Operational Modes

1.8.1 Free Run

There is no synchronization between sensor and EtherCAT master. The PDOs are updated based on the internal measuring rate. The measuring rate is set using object 0x3251h. PDO frames may be lost or duplicated. A gapless transmission of the PDO frames to the EtherCAT master is only given if oversampling and measuring rate are in the right relation to the bus cycle, see Chap. 8.6. You can use the measured value counter in 0x7000h or 0x1AE0h to ensure that no measured values are evaluated twice due to the lack of synchronization.

1.8.2 Distributed Clocks SYNC0 Synchronization

There is a synchronization between IFD241x and EtherCAT master via the Sync0 cycle time. An update of the PDOs is done based on the Sync0 cycle time, which replaces the internal measuring rate. In this mode, an EtherCAT master can synchronize the measurement acquisition for the EtherCAT cycle time and the measurement acquisition of multiple systems.

Note that although the measurements in the IFD241x are synchronized to the Sync0 cycle time, the transmission of the values to the EtherCAT master is again asynchronous with the bus cycle. Synchronous transmission of the values to the EtherCAT master is only given if oversampling and Sync0 cycle time are in the right relation to the bus cycle, see Chap. 8.6.

The ESI-XML file includes predefined SYNC0 cycle times. However, any cycle time between

- 10000000 ns and 125000 ns for the IFD2410 and IFD2411
- 10000000 ns and 50000 ns for the IFD2415

can be set.

1.8.3 SM2/SM3 Synchronization

The sensor supplies current data to the EtherCAT master with every SM2 or SM3 event. Please note that the data of the PDOs are updated with the internal measuring rate independent of the bus cycle. This can cause PDO frames to be lost or duplicated. A gapless transmission of the PDO frames to the EtherCAT master is only given if oversampling and measuring rate are in the right relation to the bus cycle, see Chap. 8.6.

1.9 Update

To update the firmware of the IFD241x, two options are available:

- Update via EoE (Ethernet over EtherCAT) or Telnet
- Update via FoE (File Access over EtherCAT)

1.9.1 Update via FoE

Via FoE it is possible to perform an update of the IFD241x. For this purpose, a *.mef file is transferred to the sensor via FoE. The name and password of the file are as follows:

Name: `confocalDT241x.mef`

Password: `0x00000000`

The IFD241x checks the beginning of the file during transmission. If the file is not in the correct format, the IFD241x will abort the transfer. After the file has been completely transferred, the IFD241x automatically starts the update, which disconnects the EtherCAT master.

1.9.2 Update via EoE

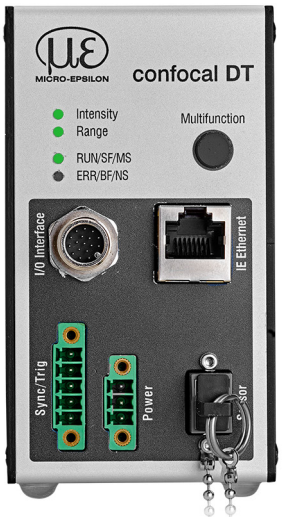
An update is performed via a *.meu file. The firmware update tool `Update_Sensor.exe` is required for this.

The current firmware is available at www.micro-epsilon.de/service/download/software.

To execute an update, you have to check Ethernet in the firmware update tool and enter the IP address, which you have configured via the EtherCAT master. With `Refresh` you can check if the sensor can be found on this IP address. Then select the *.meu file via "..." and confirm with Send update. First, the update is transmitted to the IFD241x. After transmission has been completed, the installation will start automatically. Do not disconnect the IFD241x controller from the power supply. After the installation is complete, the message `All updates successful` is displayed. The IFD241x is ready for operation again.

1.10 Meaning of LEDs in EtherCAT Operation

LED	Color	Status	Meaning
RUN	Green	Off	Slave is in the "Init" status
	Green	flashes evenly	Slave is in the "Pre-Operational" status
	Green	flashes briefly	Slave is in the "Safe-Operational" status
	Green	flashes quickly	Slave is in the "initialization" or "bootstrap" status
	Green	lights up	Slave is in the "Operational" status
ERR	Red	Off	No error
	Red	flashes evenly	Invalid configuration
	Red	flashes briefly	Unwanted status change
	Red	flashes twice	Timeout of the Application watchdog
	Red	flickers	Boot error
	Red	lights up	Timeout of the PDI watchdog



1.11 EtherCAT Configuration with the Beckhoff TwinCAT© Manager

For example the Beckhoff TwinCAT Manager can be used as EtherCAT Master on the PC.

The device description files (EtherCAT®-Slave Information) can be found online at www.micro-epsilon.com/download/software/.

- `Micro-Epsilon_IFC241x.xml` for IFD2411
- `Micro-Epsilon_IFD241x.xml` for IFD2410/2415

➨ Copy the device description file to the directory `C:\TwinCAT\3.1\Config\Io\EtherCAT` before the measuring device can be configured via EtherCAT®.

➨ Delete any existing older files.

EtherCAT®-Slave information files are XML files, which specify the characteristics of the Slave device for the EtherCAT® Master and contain information on the supported communication objects.

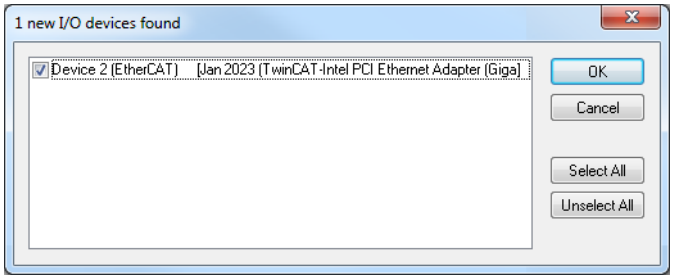
➨ Restart the TwinCAT manager after the copy operation.

Searching for a device:

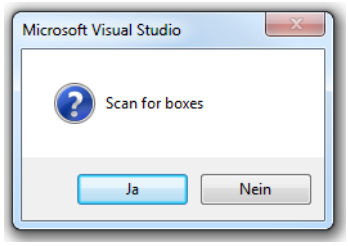
➨ Select the `I/O Devices` tab and then select `Scan`.

➨ Confirm with `OK`.

➨ Select a network card at which EtherCAT® slaves are to be searched for.



➨ Confirm with `OK`.

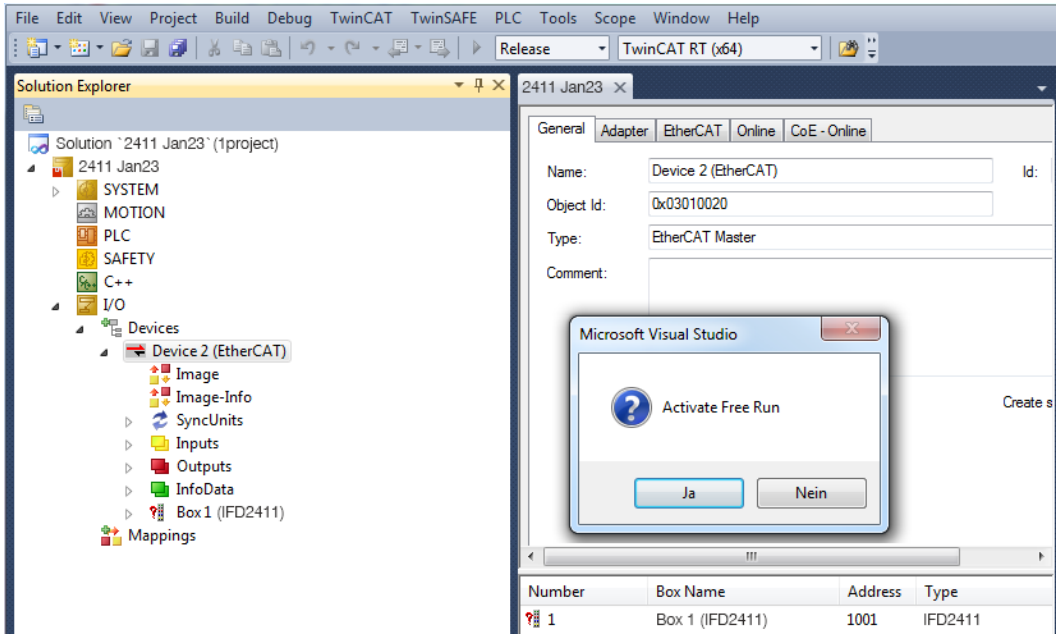


The "`Scan for boxes`" window appears (EtherCAT® slaves).

➨ Confirm with `Yes`.

The IFD241x is now included in a list.

➨ Now confirm the `Activate Free Run` window with `Yes`.

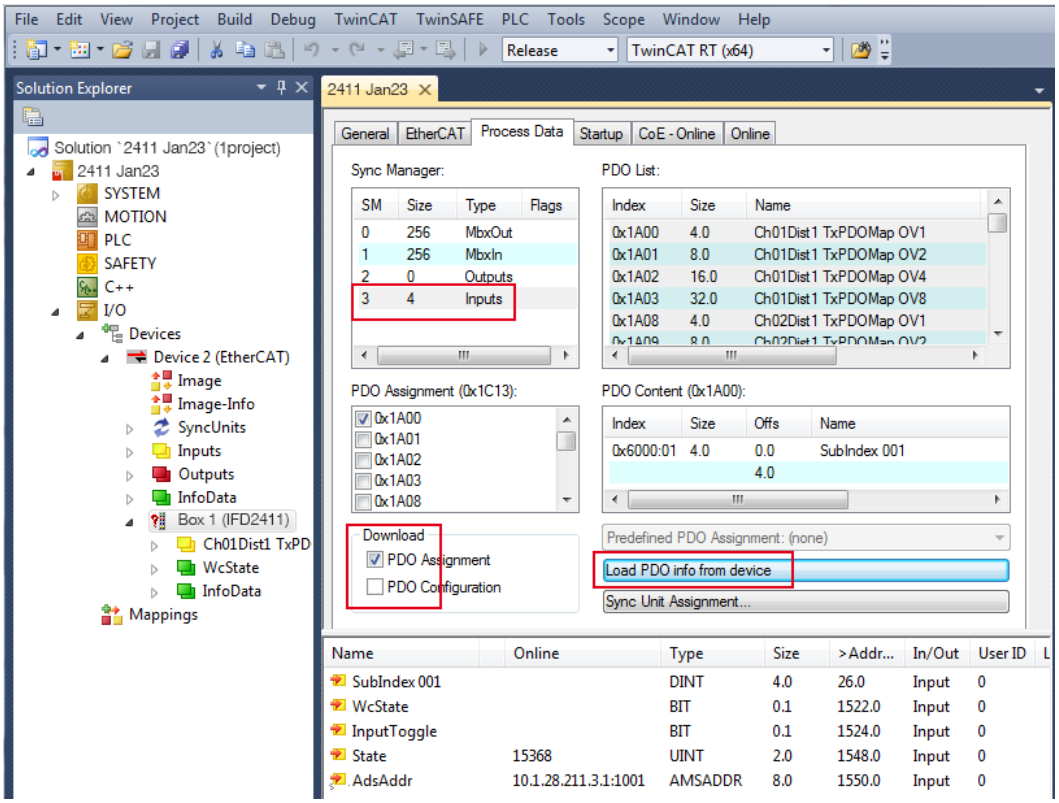


The current status should be at least `PREOP`, `SAFEOP` or `OP` on the `Online` page.

In the event that ERR PREOP appears in `Current Status`, the cause is reported in the message window. This is the case if the PDO mapping settings in IFD241x are different from the settings in the ESI file (device description file).

In the delivery state of the measuring device, only one measurement value (distance 1) is set as output variable (both in the IFD241x and in the ESI file).

You can select other data in the Process Data tab.

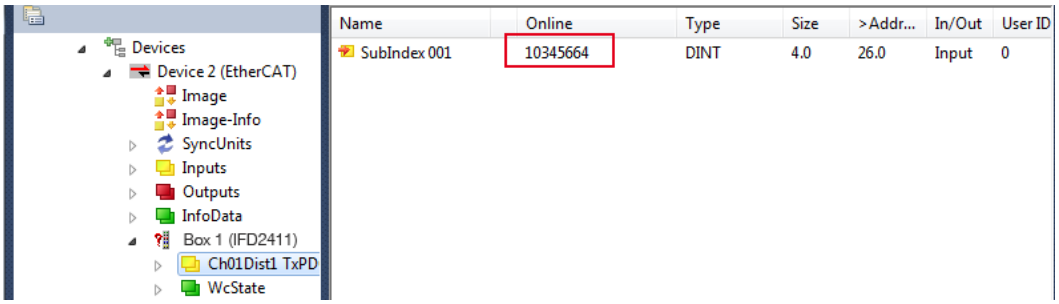


The scope of the provided process data and the assignment of the SyncManager may be viewed now.

➡ From the `TwinCAT` menu select the `Restart TwinCAT (Config Mode)` tab.

The configuration is now complete.

In `SAFEOP` and `OP` status, the selected measurement values are transferred as process data.



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