EtherCAT Interface

Description

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SIOS Interferometer EtherCat-Interface

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Version		
1.0	22.01.21	Complete rewrite
1.1	16.02.21	Update
1.2	03.03.21	Update
1.3	16.12.21	Update
1.4	21.08.25	Extension PDO (sin/cos, Inclination, fast error status), OD AUX sections, Extension: SIOS Interferometer II
1.5	19.09.25	IFM ready status added

Intended use

The SIOS EtherCAT interface is made for accessing a SIOS interferometer as a slave device in an EtherCAT field bus environment.

Depending on the configuration of the interferometer device it provides:

- Interferometric displacement values from up to 4 channels, also processed as angles and straightness, depending on the application and configuration of the measurement
- Lateral displacement values for adjustment purposes
- Environmental values (air and material temperature, air pressure, humidity)
- Signal quality information
- Status information
- Configuration data
- The interferometric displacement values and the lateral displacement values are provided as PDO data and can be transmitted with a maximum clock rate of at least 5 kHz.

The EtherCAT distributed clock can trigger the measurement values, so in this case they are in phase with values from other EtherCAT slaves. A free running mode is also possible, if measurement value timing is not important.

Besides reading out data the following data can be set from the EtherCat master and the following actions can be triggered:

- At the reference point of the measurement the interferometer can be set to zero and all error states can be cleared
- The environment values can be set to the external measured values instead of using the interferometer sensors

The typical application is the integration of the interferometer in a larger environment with moving stages and other measurement systems.

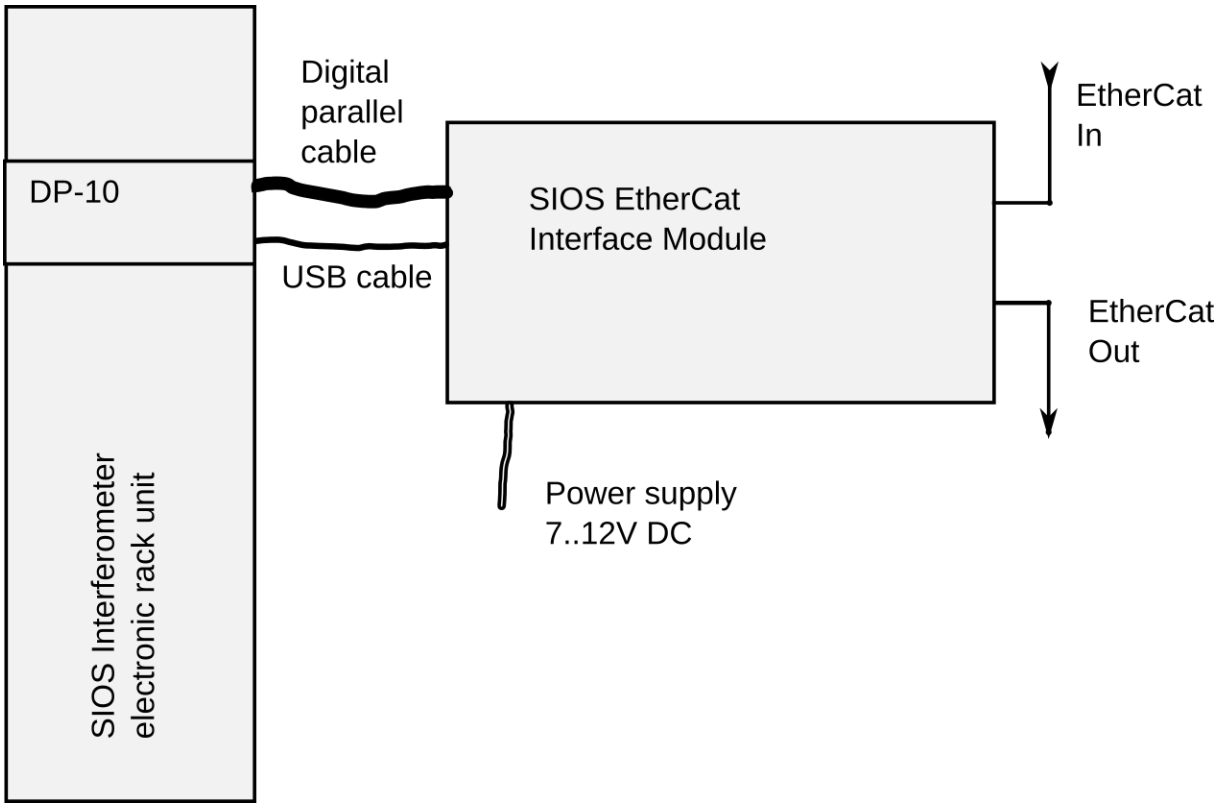
Installation procedure

The EtherCat interface module is an external box which has to be connected to the SIOS interferometer rack electronic via USB and via the digital parallel interface. To use the distributed EtherCat clock as sampling clock for the interferometer values, the EtherCat interface of the interferometer electronic must be equipped with a DP-10 interface module which provides the digital parallel interface as well as an USB interface. Usually the default RE-10 USB interface module of an interferometer can be replaced by a DP-10 module if it's not yet installed there.

To use the interface in datasource USB mode, the USB interface of a RE-10 module is sufficient. For parallel datasource mode, the parallel interface of DP-10 module is needed.

DP-10 module, which provides the necessary interfaces must be installed in the interferometer

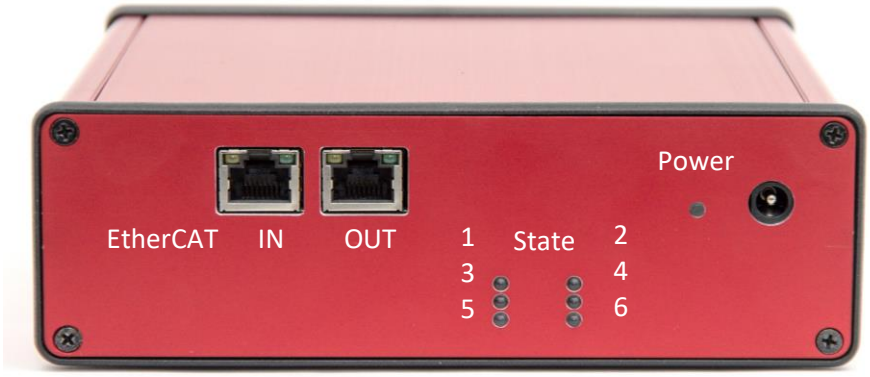
The DP10 card must be configured in mode 1 (external address, external clock). The resolution should be set to default 0.07725nm (Lamda/8192) or must be adjusted according to the application.



Wiring of the EtherCat module

Connectors and indicators

The EtherCAT IN/OUT connectors as well as the power jack are located at the front panel of the device. The status LEDs indicate the EtherCAT device state.



Device connectors and state LEDs (front panel)

EtherCAT state LEDs

The following table shows the meaning of the EtherCAT state LEDs.

1	OP-OK (green)	Lights up green when the device is in "OP" state. It flashes green if there is no USB connection to the interferometer. In the case of flashing, EtherCAT is in „OP“ state and length data from parallel interface is valid but not the data transferred via USB interface (configurations and environment data).
2	NO OP (red)	Lights up red when the device is not in "OP" state.
3	INIT	Lights up orange when the device is in "INIT" state.
4	PRE OP	Lights up orange when the device is in "PRE-OP" state.
5	SAFE OP	Lights up orange when the device is in "SAFE OP" state.
6	OP	Lights up orange when the device is in "OP" state.

USB and parallel interface (rear panel)

The connections for the interferometer are located on the rear panel. The parallel interface and the USB interface need to be connected to the corresponding connections of the DP10 card. The Parallel interface cable must be as short as possible. It is recommended to have a maximum length of 1m. The green „Connection ready“ LED flashes after boot time (approx. 30 seconds) of the device. In case it does not, please check USB connection to the DP10 interface card.

Related documentation

The majority of the flags and symbolic constants used in this document are derived from the USB API of the interferometer. They are defined in the siosifmdef.h file of the siosifm.dll API.

Please refer to the API-interface description of the siosifm.dll.

The application of the interferometer itself, the adjustment procedure as well as the using of the interferometer is described in the manual of the interferometer device.

Interface extension II

With the extension 09/2025 the EtherCAT product code remains “0” and the revision now is “2”. New type name is “SIOS Interferometer II” with hardware version “0x5031”.

The following changes are made:

Fast status transmission	The PDO status at 0x6001-4 has the additional flag 0x0004 which originates from the fast DP10 interface error signal (the other status bits come from usb interface)

Sync time measurement	The sync timing value on the length count of channel 4 can now be enabled and disabled with the data source selection 0x8004.7
Sin and cos PDO signals	The sin/cos signals (detector signal) are now included in PDO data and read out from DP10 parallel interface (0x6001.4/5 – 0x6004.4/5)
Signal quality PDO	Signal Quality is transmitted as PDO (0x6001.6-0x6004.6)
Zeroing with channel mask	Writing the Zero Command “1” to 0x8008.1 zeros all interferometer channels. Now the command “2” can be used to zero the channels that are selected with the mask at 0x8008.2
Additional values	For additional values like laser power new Aux interfaces at 0x901A / 0x901B are available

Descripion of the EtherCAT Interface Objects

Input Data (Send PDO)

Index	Object	SI	DataType	Name	R/W	Description
0x6001	RECORD			Channel1		
		01	UNSIGNED16	Status_1	r	Statusflags
		02	INTEGER64	Length Count_1	r	Length Count
		03	REAL64	Length Real_1	r	0x6001.2 * 0x9000.8 + 0x9000.9
		04	UNSIGNED16	Sin	r	0x800
		05	UNSIGNED16	Cos	r	0x800
		06	UNSIGNED8	SignalQuality	r	Spiegelt 0x9004.1
		07	UNSIGNED8	Reserved	r	0
0x6002	RECORD			Channel2		
		01	UNSIGNED16	Status_2	r	Statusflags

		02	INTEGER64	Length Count_2	r	Length Count
		03	REAL64	Length Real_2	r	0x6002.2 * 0x9001.8 + 0x9001.9
		04	UNSIGNED16	Sin	r	0x800
		05	UNSIGNED16	Cos	r	0x800
		06	UNSIGNED8	SignalQuality	r	Spiegelt 0x9004.3
		07	UNSIGNED8	Reserved	r	0
0x6003	RECORD			Channel3		
		01	UNSIGNED16	Status_3	r	Statusflags
		02	INTEGER64	Length Count_3	r	Length Count
		03	REAL64	Length Real_3	r	0x6003.2 * 0x9002.8 + 0x9002.9
		04	UNSIGNED16	Sin	r	0x800
		05	UNSIGNED16	Cos	r	0x800
		06	UNSIGNED8	SignalQuality	r	Spiegelt 0x9004.5
		07	UNSIGNED8	Reserved	r	0
0x6004	RECORD			Channel4		
		01	UNSIGNED16	Status_4	r	0
		02	INTEGER64	Length Count_4	r	Length Count
		03	REAL64	Length Real_4	r	0x6004.2 * 0x9003.8 + 0x9003.9
		04	UNSIGNED16	Sin	r	0x800
		05	UNSIGNED16	Cos	r	0x800
		06	UNSIGNED8	SignalQuality	r	Spiegelt 0x9004.7
		07	UNSIGNED8	Reserved	r	0
0x6005	RECORD			Adjustment aid 1		
		01	DWORD	Flags_1	r	0

		02	INTEGER16	PsdX_1	r	PsdX Value
		03	INTEGER16	PsdY_1	r	PsdY Value
		04	UNSIGNED16	PsdSum_1	r	Psd Sum
0x6006	RECORD			Adjustment aid 2		
		01	DWORD	Flags_2	r	0
		02	INTEGER16	PsdX_2	r	PsdX
		03	INTEGER16	PsdY_2	r	PsdY
		04	UNSIGNED16	PsdSum_2	r	Psd Sum
0x6007	RECORD			Inclination		
		01	DWORD32	Flags	r	0
		02	INTEGER32	Inclination A	r	0
		03	INTEGER32	Inclination B	r	0
		04	REAL64	Inclination	r	0

Length (displacement) values

The records 0x6001-0x6004 contain the interferometric displacement values and related status information. Each record has the data of one channel, up to four interferometer channels are supported.

An interferometer measures the displacement values as “fringe counts” and interpolated results between the full fringes. The “count” value combines these into one data word. To get the displacement in nanometers the count value must be multiplied with a factor which is derived from the current laser wavelength and the device depended interpolation depth. The laser wavelength in air depends on the environment values and, therefore, changes frequently.

The factor is provided in the 0x900x.8 field and recalculated every time if new environment values are available.

The 0x600x.3 field provides the calculated length based on the current conversation factor.

However, for some short-term measurements it may be beneficial to acquire all data with the same conversation factor. Simply, read out the factor from 0x900x.8 at the begin of the measurement and use the count values for each channel to calculate the length:

length = 0x900x.8 x 0x600x.2

Statusflags (6001.01 – 6004.01, IfmStatus)

Flag	Value	Description
IFM_STATUS_BEAMBREAK_QUADRANT	0x0001	miscount detected: the interferometer counter has detected an invalid jump over more than one quadrants
IFM_STATUS_BEAMBREAK_LEVEL	0x0002	the signal amplitude is lower than a given threashold so that miscounts are likely
	0x0004	DP10 signal indicates beam status error (fast status)
	0x0008	IFM not ready (DP10 interface connection broken or test pattern/counter mode at 0x8004.07 selected)
IFM_STATUS_LASER_STABLE	0x0010	the laser(s) is(are) stable (only in systems with stabilized lasers)
IFM_STATUS_LASER_WAS_UNSTABLE	0x0020	since last IfmSetZero the laser was at least one time unstable

Adjustment aid 0x6005, 0x6006

To track lateral movements of the reflector, the interferometer may be equipped with a lateral sensor, typical a PSD (position sensitive diode). PsdX and PsdY give the lateral misalignment against the laser beam as unit less numbers. These values are also transmitted as PDO for a maximum of 2 PSD units in the objects 0x6005 and 0x6006. PsdSum is an expression for the laser intensity at the PSD. If PsdSum is below a defined level, PsdX and PsdY are not valid. Typically, the PSD values are used as zero-point detectors for aligning the reflector or the movement axis to the laser beam. The sensitivity depends also on the distance between reflector and interferometer head, so that a defined characteristic between the PSD values and the real lateral displacement is not trustworthy. But in some interferometer heads a camera instead a PSD is used as a sensor for the straightness. In this case, the PSD values from the interface represent valid lateral displacement values and PsdNorm from the “Calculation Factors” record contains a normalizing factor from these values to µm. If PsdNorm is not valid, it is set to 0 or 1.

The Flags at 0x6005.1 and 0x6006.1 are 1 if the PSD unit is present and 0 if not.

Inclination 0x6007

The interferometer can be equipped with 2 inclination sensors. The Flags at 0x6007.1 indicate the presence and measuring of the sensors.

Mask	Value	Description
0x0000000000010000	1 – present 0 – not present	Indicates the presence of inclination sensors.
0x00000000000000FF	Measure value counter of sensor A	This 8-Bit counter is incremented with each measured value of sensor A.
0x000000000000FF00	Measure value counter of sensor B	This 8-Bit counter is incremented with each measured value of sensor B.

The Inclination A/B raw sensor values at 0x6007.2 and 0x6007.3 are in radians x 16777216. The resulting inclination value at 0x6007.4 is in milliradians.

Configuration Data

Index	Object	SI	DataType	Name	R/W	Beschreibung
0x8000	RECORD			Environment Settings Ch1		
		01	UNSIGNED8	Flags	rw	see below
		02	REAL64	Temperature	rw	
		03	REAL64	Airpressure	rw	
		04	REAL64	Humidity	rw	
0x8001	RECORD			Environment Settings Ch2		
		01	UNSIGNED8	Flags	rw	see below
		02	REAL64	Temperature	rw	
		03	REAL64	Airpressure	rw	
		04	REAL64	Humidity	rw	
0x8002	RECORD			Environment Settings Ch3		
		01	UNSIGNED8	Flags	rw	see below

		02	REAL64	Temperature	rw	
		03	REAL64	Airpressure	rw	
		04	REAL64	Humidity	rw	
0x8003	RECORD			Environment Settings Ch4		
		01	UNSIGNED8	Flags	rw	see below
		02	REAL64	Temperature	rw	
		03	REAL64	Airpressure	rw	
		04	REAL64	Humidity	rw	
0x8004	RECORD			Configuration Settings		
		01	UNSIGNED32	Measurement flags	rw	
		02	REAL64	SampleRate	rw	
		03	Unsigned16	Motor speed forward	rw	
		04	Unsigned16	Motor speed backwards	rw	
		05	DWORD	Reserved1	rw	
		06	DWORD	Reserved2	rw	
		07	UNSIGNED8	Data source	rw	
0x8005	RECORD			Length Preset		
		01		reserved		
		02	REAL64	Preset Channel_1	rw	Not for DP10 par. interface
		03	REAL64	Preset Channel_2	rw	Not for DP10 par. interface
		04	REAL64	Preset Channel_3	rw	Not for DP10 par. interface
		05	REAL64	Preset Channel_4	rw	Not for DP10 par. interface
0x8006	RECORD			Deadpath		
		01		reserved	ro	

		02	REAL64	Deadpath Channel_1	rw	Unit is mm.
		03	REAL64	Deadpath Channel_2	rw	Unit is mm.
		04	REAL64	Deadpath Channel_3	rw	Unit is mm.
		05	REAL64	Deadpath Channel_4	rw	Unit is mm.
0x8008	RECORD			Command		
		01	DWORD	Code	rw	
		02	DWORD	Parameter1	rw	
		03	DWORD	Parameter2	rw	
		04	REAL64	Parameter3	rw	
		05	UNSIGNED8	Status	r	
		06	DWORD	Return code	r	
		07	REAL64	Return value	r	
0x8009	RECORD			MOD		
		01	BOOLEAN	Status Channel_1	rw	
		02	BOOLEAN	Status Channel_2	rw	
		03	BOOLEAN	Status Channel_3	rw	
		04	BOOLEAN	Status Channel_4	rw	
0x800A	RECORD			AGC		
		01	BOOLEAN	Status Channel_1	rw	
		02	BOOLEAN	Status Channel_2	rw	
		03	BOOLEAN	Status Channel_3	rw	
		04	BOOLEAN	Status Channel_4	rw	

The configuration data objects in the 0x8xxx range are intended to use for configuration and control purposes. The majority of them are writable. After writing over EtherCat, the mailbox will be processed and the appropriate status objects are updated.

Environment Settings Flags 0x8000 – 0x8003 (following the API function IfmManualEnvironment)

To each interferometer channel belongs a set of environment values: a temperature [°C], a air pressure [Pa] and humidity value [%]. These values are normally measured with the environmental sensors of the interferometer and assigned to the different channels according the configuration stored in the interferometer.

For application with external sensors or without the usage of the interferometer own sensors the environment values for each channel can be set by writing the value to the related object.

The flags words on (0x8000-0x8003).1 must also be set with an according value to tell the system which values to use:

Flag	Value	Description
IFM_ENVIR_MANUAL_T	0x0002	the temperature was set manually
IFM_ENVIR_MANUAL_H	0x0004	the humidity was set manually
IFM_ENVIR_MANUAL_P	0x0008	the air pressure was set manually

For example, if temperature, pressure and humidity should be set manually, write the according values to the respective objects and write 0x000E (=14 decimal) to the flags.

Configuration Settings (0x8004)

The configuration settings block is used to configure some behavior of the measurement process.

Measurement flags

(reserved for later use**)**

Sample rate

In DC (distributed clock) synchronized mode the interferometer length values are read out from the interferometer according the EtherCat clock. So, the sample rate is given by the DC.

With USB data source mode (0x8004.07 = 3) in this field a sample rate can be written, in which the interferometer length values are read out from the interferometer and actualized in the EtherCat interface. Values from 0.1 to 100 Hz are possible.

Motor speed forwards/backwards

Some systems are equipped with a motor, for instance to mechanical probing a device. Typical systems are the probe systems LM-10 and LM-50 or the medical tonometer test

system PT. Over the interface the motor can be driven to attach or release the probing system and the velocities can be configured in these fields.

Data source (0x8004.7)

0 = data source is the parallel interface with length count values

1 = data source is parallel interface with fixed test pattern values

2 = data source is internal test counter that is incremented with EtherCAT sync clock

3 = data source is the USB interface

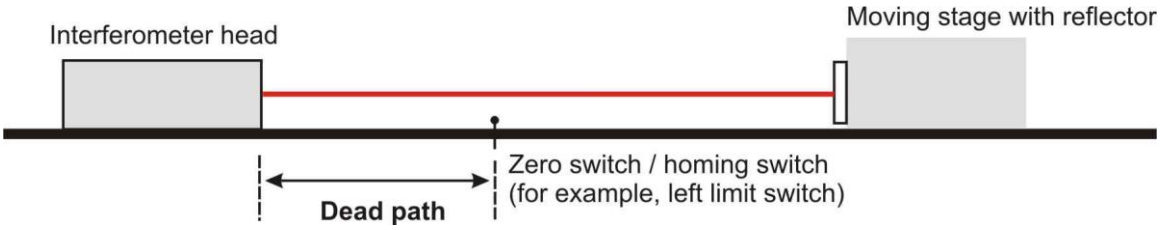
4 = sync clock time counter on channel 4. Channels 1-3 with normal length count values

Preset and Deadpath (0x8005 and 0x8006)

In these objects for each interferometer channel a preset and deadpath value can be configured. The values will be applied with the “Set to Zero” command (see below).

The preset value is an offset at the position where the interferometer is set to zero. With the current version this value is supported as this value has no effect at the counts of the digital interface of the DP10 card.

The deadpath is the distance from the interferometer head to the zero point of the measurement and not directly visible in the measurement values. It influences the environmental value correction. Due to changes in environment values the laser wavelength as the primary etalon for the interferometer measurements changes. Not only the inclination value is affected also the defined zero point for the last “set to zero” operation is drifting. To correct this zero-point drift the deadpath is required.



Command (0x8008)

The interface in object 0x8008 is used to transmit commands to the interferometer. Writing a command code to 0x8008.1 with the optional parameters in 0x8008.2-4 triggers the processing of the given command.

During the processing the status in 0x8009.5 is 1 (busy), after processing it returns to zero and optional results are filled in 0x8008.6-7.

The following commands are defined:

Command Code	Parameter	Return	Description

1	-	-	SetToZero (all channels)
2	*Parameter1:* 0x01 – Channel 1 0x02 – Channel 2 0x04 – Channel 3 0x08 – Channel 4	-	SetToZero (with channel selection mask)
10	*Parameter1:* 1 – Beambreak threshold (0x901A.01 Aux1) *Parameter2:* new value	-	Set AUX configuration value

MOD/AGC (0x8009,0x800A)

Each interferometer channel has a signal control (automatic gain control, AGC) and often a so-called signal modulator (MOD). The modulator produces a vibration of about 500 -1000 Hz and an amplitude of 320 – 1000nm to let the AGC work. For details, please see the documentation of the interferometer.

The objects 0x8009 und 0x800A switches the MOD and AGC of the respective interferometer channel on (writing 1) and off (writing 0).

Information Data

Index	Object	SI	DataType	Name	R/W	Description
0x9000	RECORD			Environment Ch1		
		01	UNSIGNED16	Temperature Flags	r	see below
		02	REAL64	Temperature	r	
		03	UNSIGNED16	Air pressure Flags	r	see below
		04	UNSIGNED16	Humidity Flags	r	see below
		05	REAL64	Air pressure	r	
		06	REAL64	Humidity	r	

		07	REAL64	Laser wavelength	r	632.825705
		08	REAL64	Length coefficient	r	4.828076971e-03
		09	REAL64	Deadpath coefficient	r	
0x9001	RECORD			Environment Ch2		
		01	UNSIGNED16	Temperature Flags	r	see below
		02	REAL64	Temperature	r	
		03	UNSIGNED16	Air pressure Flags	r	see below
		04	UNSIGNED16	Humidity Flags	r	see below
		05	REAL64	Air pressure	r	
		06	REAL64	Humidity	r	
		07	REAL64	Laser wavelength	r	632.825705
		08	REAL64	Length coefficient	r	4.828076971e-03
		09	REAL64	Deadpath coefficient	r	
0x9002	RECORD			Environment Ch3		
		01	UNSIGNED16	Temperature Flags	r	see below
		02	REAL64	Temperature	r	
		03	UNSIGNED16	Air pressure Flags	r	see below
		04	UNSIGNED16	Humidity Flags	r	see below
		05	REAL64	Air pressure	r	
		06	REAL64	Humidity	r	
		07	REAL64	Laser wavelength	r	632.825705
		08	REAL64	Length coefficient	r	4.828076971e-03
		09	REAL64	Deadpath coefficient	r	
0x9003	RECORD			Environment Ch4		
		01	UNSIGNED16	Temperature Flags	r	see below

		02	REAL64	Temperature	r	
		03	UNSIGNED16	Air pressure Flags	r	see below
		04	UNSIGNED16	Humidity Flags	r	see below
		05	REAL64	Air pressure	r	
		06	REAL64	Humidity	r	
		07	REAL64	Laser wavelength	r	632.825705
		08	REAL64	Length coefficient	r	4.828076971e-03
		09	REAL64	Deadpath coefficient	r	

The information object block is divided into four parts:

1. Information belonging to a measurement channel 0x9000 – 0x9003
2. Signal quality information 0x9004
3. Information about environment sensors 0x9005 – 0x9006
4. Global information about the device and it's configuration 0x9010
5. Auxiliary data at 0x901A and 0x901B

Measurement channel information 0x9000 - 0x9003

These objects describe the measurement channels and mainly the environment data and resulting coefficients.

As described also earlier in this document an interferometer uses the laser light wavelength as etalon for the length measurement. And in air this wavelength depends on the temperature, air pressure and humidity. Normally, these environment values are measured and assigned to an interferometer channel. Which sensor belongs to which channel is defined in the internal device configuration. The LengthCoefficient is the Laserwavelength divided by the ResolutionDivider at 0x9010. The ResolutionDivider is part of the DP10 configuration and must be set on the card according to the application.

Temperature, air pressure and humidity

Environment values which are used to calculate the reference coefficients for this channel.

Temperature, Airpressure, Humidity Flags (IfmTemperatureFlags, IfmAirpressureFlags, IfmHumidityFlags)

IFM_ENVIRFLAG_SENSORMASK	0x00FF	in these bits the sensor number is coded, where the value was measured
IFM_ENVIRFLAG_MEASURED	0x0100	the value was measured; otherwise it's a default value
IFM_ENVIRFLAG_CURRENT	0x0200	the value was measured with the last data set (in a typical configuration it's not older than 4 secs)
IFM_ENVIRFLAG_MANUAL	0x0400	value was given manually per writing values in one of the related 0x800x objects

Wavelength

The laser wavelength in air which results from the laser vacuum wavelength and the environment values.

Length coefficient, deadpath coefficient

These are the coefficients which are used to calculate a length in nanometers from the fringe count values, following this equation.

`Length_nm = deadpath_coefficient + length_coefficient x counter`
The counter can be read from 0x600x.2 and the result also directly from 0x600x.3.

Signal quality information (0x9004)

Index	Object	SI	DataType	Name	R/W	Description
0x9004	RECORD			Signal Quality		
		01	UNSIGNED8	Quality 1	r	
		02	UNSIGNED8	Flags 1	r	0
		03	UNSIGNED8	Quality 2	r	
		04	UNSIGNED8	Flags 2	r	0
		05	UNSIGNED8	Quality 3	r	
		06	UNSIGNED8	Flags 3	r	0
		07	UNSIGNED8	Quality 4	r	

Index	Object	SI	DataType	Name	R/W	Description
		08	UNSIGNED8	Flags 4	r	0

For each channel exists a signal quality value from 0 to 100 (percent). Typical values for valid measurements ranges between 30 and 99%. As higher the value as better is the signal quality and as lower is the noise. A value of 100% means that the signal is too strong and the amplifiers are likely in saturation.

The flags are for future enhancements only and have no meaning at the moment.

Environment sensors and their flags (0x9005-0x9006)

Index	Object	SI	DataType	Name	R/W	Description
0x9005	RECORD			Environment Sensor Values		
		01		reserved		
		02	REAL64	Value	r	
		03	REAL64	Value	r	
		04	REAL64	Value	r	
		05	REAL64	Value	r	
		06	REAL64	Value	r	
		07	REAL64	Value	r	
		08	REAL64	Value	r	
		09	REAL64	Value	r	
		0A	REAL64	Value	r	
		0B	REAL64	Value	r	
		0C	REAL64	Value	r	
		0D	REAL64	Value	r	
		0E	REAL64	Value	r	
		0F	REAL64	Value	r	

Index	Object	SI	DataType	Name	R/W	Description
		10	REAL64	Value	r	
		11	REAL64	Value	r	
		12	REAL64	Value	r	
		13	REAL64	Value	r	
		14	REAL64	Value	r	
		15	REAL64	Value	r	
		16	REAL64	Value	r	
		17	REAL64	Value	r	
		18	REAL64	Value	r	
		19	REAL64	Value	r	
		1A	REAL64	Value	r	
		1B	REAL64	Value	r	
		1C	REAL64	Value	r	
		1D	REAL64	Value	r	
		1E	REAL64	Value	r	
		1F	REAL64	Value	r	
		20	REAL64	Value	r	
		21	REAL64	Value	r	
0x9006	RECORD			Environment Sensor Flags		
		01		reserved		
		02	DWORD	Flags	r	
		03	DWORD	Flags	r	
		04	DWORD	Flags	r	
		05	DWORD	Flags	r	

Index	Object	SI	DataType	Name	R/W	Description
		06	DWORD	Flags	r	
		07	DWORD	Flags	r	
		08	DWORD	Flags	r	
		09	DWORD	Flags	r	
		0A	DWORD	Flags	r	
		0B	DWORD	Flags	r	
		0C	DWORD	Flags	r	
		0D	DWORD	Flags	r	
		0E	DWORD	Flags	r	
		0F	DWORD	Flags	r	
		10	DWORD	Flags	r	
		11	DWORD	Flags	r	
		12	DWORD	Flags	r	
		13	DWORD	Flags	r	
		14	DWORD	Flags	r	
		15	DWORD	Flags	r	
		16	DWORD	Flags	r	
		17	DWORD	Flags	r	
		18	DWORD	Flags	r	
		19	DWORD	Flags	r	
		1A	DWORD	Flags	r	
		1B	DWORD	Flags	r	
		1C	DWORD	Flags	r	
		1D	DWORD	Flags	r	
		1E	DWORD	Flags	r	

Index	Object	SI	DataType	Name	R/W	Description
		1F	DWORD	Flags	r	
		20	DWORD	Flags	r	
		21	DWORD	Flags	r	

Environment Sensor Flags

Flag	Value	Description
IFM_ENVIR_VALID	0x0100	the sensor value was at least one time measured
IFM_ENVIR_CURRENT	0x0200	the sensor value was measured recently, the value is current or up-to-date
IFM_ENVIR_SENSOR_TEMP	0x10	Sensor Type
IFM_ENVIR_SENSOR_HUMIDITY	0x20	Sensor Type
IFM_ENVIR_SENSOR_AIRPRESSURE	0x30	Sensor Type
IFM_ENVIR_SENSOR_TEMP_MATERIAL	0x40	
IFM_ENVIR_SENSOR_TEMP_AUX	0x50	
IFM_ENVIR_CHANNEL1	0x01	Belongs to channel 1
IFM_ENVIR_CHANNEL2	0x02	
IFM_ENVIR_CHANNEL3	0x04	
IFM_ENVIR_CHANNEL4	0x08	
IFM_ENVIR_EDLEN	0x80	Is used for calculation of the reference coefficients (so called Edlen correction). If not set on a temperature sensor,it’s likely a material sensor

This list contains the values of all environment sensors which are connected to the system. Which meaning a value has, can be seen in the related flag word.

Common device information (0x9010)

Index	Object	SI	DataType	Name	R/W	Description
0x9010	RECORD			Fixed settings		
		01	UNSIGNED8	Channel count	r	1-4
		02	UNSIGNED64	Serial number string	r	
		03	DWORD	Serial number	r	USB serial number
		04	REAL64	Straightness Factor	r	38
		05	REAL64	Base distance 1-2	r	Read from interferometer.
		06	REAL64	Base distance 2-3	r	Read from interferometer.
		07	REAL64	PsdNorm	r	1
		08	INTEGER64	Resolution Divider	r	1-65535
		09	INTEGER8	Interferometer Factor	r	2
		0A	UNSIGNED32	Device Configuration	r	See below.
		0B	UNSIGNED32	FPGA_SW_Version	r	0x50220601

Channel count, Base distance and straightness factor

A SIOS interferometer can have up to 4 channels. The configuration of multiple channels depends on the application. But usually beam 1-3 points to the same target with a defined distance (base distance in 0x9010.5 and 0x9010.6) and the displacement difference are used to calculate the yaw and pitch angle. Channel 4 is often a straightness channel which means that the displacement of this channel must be multiplied by the straightness factor in 0x9010.4 to get the lateral displacement (straightness of an axis).

Serial number and serial number string

The serial number is the USB serial number which is used by PC programs to identify the device.

The serial number string is the serial number from the label on the backside of the device.

Both items are totally different and have no connection.

PSDNorm

Usually the optional lateral sensors from 0x6005 are zero-point sensors with no unit to measure the lateral displacement. In this case, this item is 1 or 0.

There are some devices with measure able lateral sensors. In this case this item holds the conversation coefficient from the digit in 0x6005 to nm.

Resolution divider, interferometer factor

To calculate the displacement from the laser wavelength the optical principle of the interferometer (interferometer factor) and the interpolation depth (resolution divider) must be known. Both affects the length coefficient and deadpath coefficient in 0x9000 - 0x9003.

Device configuration

This is a flag field which describes which functional groups or options are available in the device.

IFM_OPTION_CHANNEL1 0x0001

Channel 1 is present

IFM_OPTION_CHANNEL2 0x0002

Channel 2 is present

IFM_OPTION_CHANNEL3 0x0004

Channel 3 is present

IFM_OPTION_CHANNEL4 0x0008

Channel 4 is present

IFM_OPTION_PSD 0x0010

The device has a PSD

IFM_OPTION_STRAIGHTNESS_4 0x0020

The fourth channel is optical straightness

IFM_OPTION_STRAIGHTNESS_XY 0x0040

The straightness information is delivered in the PSD XY values. This is usually the case if the sensor head has a camera instead of the PSD, like in the SP5000C5-2D

FPGA_SW_Version

This is a combined number which shows the version numbers of different internal modules.

Auxiliary device information (0x901A, 0x901B)

Depending on the application, additional data may be provided in the following sections.

Index	Object	SI	DataType	Name	R/W	Description
0x901A	RECORD			Aux Integer Data		

Index	Object	SI	DataType	Name	R/W	Description
		1	INTEGER32	Aux1	r	0
		2	INTEGER32	Aux2	r	0
		3	INTEGER32	Aux3	r	0
		4	INTEGER32	Aux4	r	0
		5	INTEGER32	Aux5	r	0
		6	INTEGER32	Aux6	r	0
		7	INTEGER32	Aux7	r	0
		8	INTEGER32	Aux8	r	0
		9	INTEGER32	Aux9	r	0
		10	INTEGER32	Aux10	r	0
0x901B	RECORD			Aux Float Data		
		1	REAL64	Aux1	r	0
		2	REAL64	Aux2	r	0
		3	REAL64	Aux3	r	0
		4	REAL64	Aux4	r	0
		5	REAL64	Aux5	r	0
		6	REAL64	Aux6	r	0
		7	REAL64	Aux7	r	0
		8	REAL64	Aux8	r	0
		9	REAL64	Aux9	r	0
		10	REAL64	Aux10	r	0

Integration in TwinCat

The SIOS EtherCat module has been tested with Beckhoff TwinCAT 3.1.4024.11.

To use the module with TwinCat, copy the XML-Interface description of the module to C:\TwinCAT\3.1\Config\Io\EtherCAT.

A following scan of the EtherCat bus will recognize the SIOS module under the name “SIOS interferometer”. To use it, the appropriate links of the process data have to be done, following the TwinCAT documentation.