Instruction Manual

IF1032/ETH

Interface Module

Contents

Appendix

1. Safety

The handling of the system assumes knowledge of the instruction manual.

1.1 Symbols Used

The following symbols are used in the instruction manual.

⚠ CAUTION   Indicates a hazardous situation which, if not avoided, may result in minor or moderate injuries.

NOTICE   Indicates a situation which, if not avoided, may lead to property damage.

➡   Indicates a user action.

i   Indicates a user tip.

`Measure`   Indicates a hardware or a button/menu in the software.

1.2 Warnings

⚠ CAUTION   Connect the power supply and the display / output device in accordance with the safety regulations for electrical equipment.
> Danger of injury

> Damage to or destruction of the interface module

NOTICE   The power supply must not exceed the specified limits.
> Damage to or destruction of the interface module

Avoid shock and vibration to the interface module.
> Damage to or destruction of the interface module

Avoid continuous exposure to fluids on the interface module.
> Damage to or destruction of the interface module

1.3 Notes on CE Identification

The following applies to the interface module IF1032/ETH:
- EU directive 2004/108/EC [1]
- EU directive 2011/65/EC, "RoHS" category 11

Products which carry the CE mark satisfy the requirements of the quoted directives and the European standards (EN) listed therein. The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg / Germany

The interface module IF1032/ETH is designed for use in industry and satisfies the requirements.

1) EMC

1.4 Proper Use

- The interface module IF1032/ETH is designed for use in industrial and laboratory areas. It is used to convert the MICRO-EPSILON internal sensor protocol (RS485) to Ethernet or EtherCAT.
- The interface module may only be operated within the limits specified in the technical data, see Chap. 2.2.
- Use the IF1032/ETH in such a way that in case of malfunctions or failure personnel or machinery are not endangered.
- Take additional precautions for safety and damage prevention for safety-related applications.

1.5   Proper Environment

- Protection class: IP 40
- Operating temperature: 0 ... +60 ℃ (+32 ... +140 °F)
- Storage temperature: -10 ... +75 ℃ (+14 ... +167 °F)
- Humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure

2. Functional Principle, Technical Data

2.1 Functional Principle

The IF1032/ETH interface module is used for conversion of the MICRO-EPSILON internal sensor protocol (RS485) to Ethernet or EtherCAT. The IF1032/ETH interface module also has three analog inputs (2 x 0 -10 V voltage, 1 x 4 - 20 mA current) which can be used to convert the measuring values from analog sensors to Ethernet/EtherCAT.

Features:
- Automatic detection of MICRO-EPSILON sensors which support the MICRO-EPSILON internal sensor protocol via RS485
- Alternatively three analog inputs with configurable sampling frequency from 2 Sps – 4 kSps and trigger function
- Ethernet interface
- EtherCAT interface

2.2   Technical Data

Model	IF1032/ETH
Power supply	+5 ... +36 V
Power consumption (without sensor)	approx. 1.2 W
Inputs	RS485 (ME protocol) 3 analog inputs (2 x voltage, 1 x current) Trigger input (only for analog inputs)
Outputs	Ethernet, EtherCAT, Sync output (only EtherCAT)
Analog inputs	Measuring range	2 x 0 - 10 V voltage (max. 20 V!); 1 x 4 - 20 mA current (max. 30 mA!)
Resolution	14 Bit
Linearity	±0.1 %
Sampling rate	2 Sps - 4 kSps
Temperature stability	30 ppm
RS485 interface	Baud rate: 9200 - 6250000 Only sensors with ME sensor protocol
EtherCAT	min. cycle time approx. 500 µs
Operating temperature	0 ... +60 °C (+32 ... +140 °F)
Storage temperature	-10 ... +75 °C (+14 ... +167 °F)
Protection class	IP 40

3. Delivery

3.1 Unpacking

1   IF1032/ETH interface module

1   Ethernet cable, 3 m long

1   Instruction Manual

1   CD with measurement tool MEDAQ-LIB (Ethernet), SensorFinder, ESI-File (EtherCAT)

2   Terminal blocks

➡ Check for completeness and shipping damage immediately after unpacking.

➡ In case of damage or missing parts, please contact the manufacturer or supplier.

3.2 Storage

Storage temperature: -10 ... +75 °C (+14 ... +167 °F)

Humidity: 5 - 95 % (non-condensing)

4.   Installation and Mounting

ⅈ   Pay attention to careful handling during mounting and operation.

4.1   Mounting the Interface Module
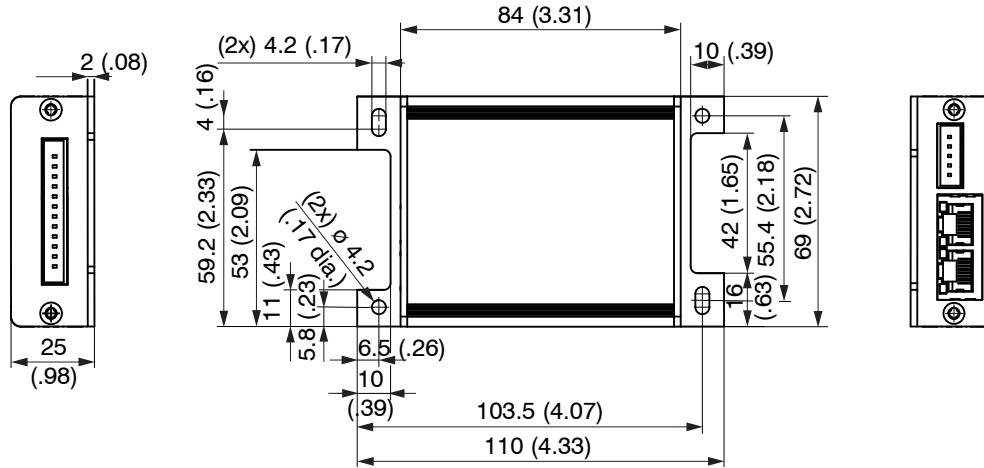
Fig. 1 Dimensional drawing IF1032/ETH, dimensions in mm, not to scale

4.2 Pin Assignment Inputs and Outputs

➡️ Connect the inputs V+ and GND to a power supply.

The power supply must correspond to that of the connected sensor as it is internally looped through to the sensor.

MICRO-EPSILON recommends the use of the optionally available power supply PS2020 or the plug-in power supply PS2401 for the interface module, see Fig. 2., input 100 - 240 VAC, output 24 VDC/2.5 A, see Chap. A 1.
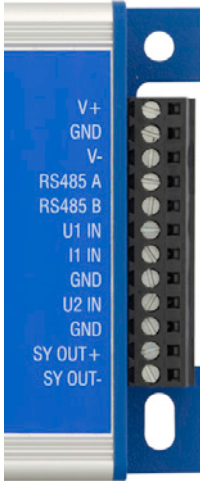
Fig. 2 Interface module with optional power supply PS2020

Supply socket (left)	
V+	Positive power supply (5 - 36 V)
GND	Power supply ground
V-	Negative power supply (if required by sensor)
TRG IN+	Trigger input + (LVDS signal, max. 3.3 V, only for analog inputs)
TRG IN-	Trigger input - (LVDS signal, max. 3.3 V, only for analog inputs)

Sensor socket (right)	
V+	Positive power supply for sensor (looped through)
GND	Power supply ground for sensor (looped through)
V-	Negative power supply for sensor (looped through)
RS485 A	RS485 sensor interface (only ME sensor protocol)
RS485 B	RS485 sensor interface (only ME sensor protocol)
U1 IN	Voltage input 1 for AD converter (0 - 10 V) (= CH1)
I1 IN	Current input 1 for AD converter (4 - 20 mA) (= CH3)
GND 1	Ground for voltage-, current input
U2 IN	Voltage input 2 for AD converter (0 - 10 V) (= CH2)
GND 2	Ground for voltage, current input
SY OUT+	Synchronisation output + (= EtherCAT distributed clocks, LVDS signal)
SY OUT -	Synchronisation output - (= EtherCAT distributed clocks, LVDS signal)

4.4 Power Supply

The power supply is looped through from the supply socket to the sensor socket, i.e. the power supply must match that of the sensor. The positive voltage must be between 5 V and 36 V. The negative supply voltage is not needed by the IF1032/ETH, but is only looped through for the sensor in case this needs an additional negative voltage.

4.5 RS485 Interface

i   Look for a RS485 bus to a correct line termination!

We recommend a termination resistance of 120 Ohm between RS485 A and RS485 B both at the bus start and end. The IF1032/ETH is a RS485 master; internally a termination resistance of 120 Ohm is permanently attached. The IF1032/ETH should be at the bus start. In short RS485 lines (< 5 m) or low baud rates can usually be waived on a termination resistance at the end of the bus.

5. Operation

5.1 Configuring Sensor Interface

Either a sensor supporting the ME sensor protocol can be connected via RS485 or alternatively the analog inputs of the interface module can be used.

For this it is necessary to select the appropriate sensor port in the interface module using the web interface (alternatively via Ethernet commands or using CoE for EtherCAT).

For RS485, the baud rate and address of the sensor must also be set. All characteristics of the sensor (e.g. name, measuring range, possible filter types, ...) are then automatically retrieved from the sensor.

If the analog inputs are selected as sensor interface, the measuring range, offset and the unit per input can be defined in the web interface for the scaling of the measuring values. Thus, only changes the scaling of the measuring values; the actual input voltage range and/or input current range does not change as a result.

5.2 Changing Data Rate

Any sampling frequency between 2 Sps and 4 kSps can be set for the analogue inputs.

Use the web interface or the appropriate Ethernet command for this.

If a sensor is connected via RS485, the possible data rates are dependent on the connected sensor.
➡ Write the required data rate for this, e.g. in the web interface.

After confirmation, the nearest possible data rate is set in the sensor and displayed in the web interface.

5.3 Ethernet/EtherCAT Switching

Switching between Ethernet and EtherCAT can either be performed using the hardware switch, see Fig. 3, or by software.
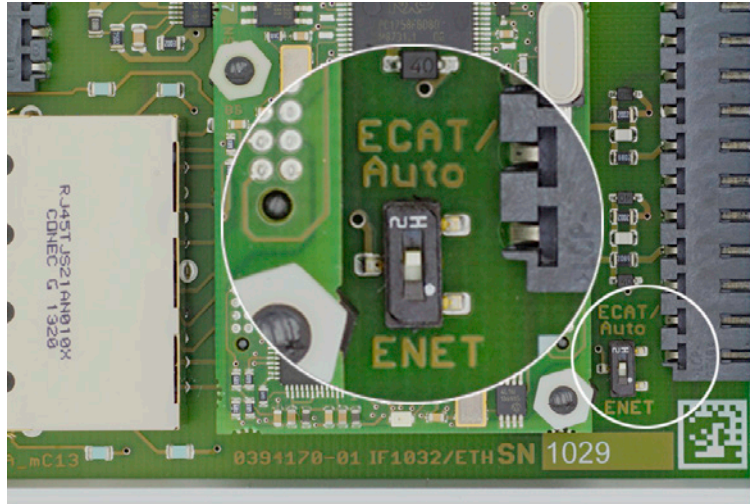
Fig. 3 Switch for changing the interface

If the switch is in the `Ethernet` position, the Ethernet interface is always active irrespective of the software setting. If the switch is in the `ECAT/Auto` position, the interface set by the software is active. Any change of the interface does not come into effect until after restart of the interface module.

5.4   Trigger Input

The trigger input is only for the analog inputs of the IF1032/ETH. If the sensor to be connected has a trigger input itself, this must be used.

Use an LVDS signal with max. 3.3 V for the trigger input.

➡   Activate the trigger mode and set a data rate which is larger than the maximum trigger frequency.

There are three possible settings for the trigger input:

Trigger mode 1 (rising edge)

A measuring value is sent for each rising edge at the trigger input. The specified data rate must be greater than the maximum trigger frequency. If triggering is faster than the specified data rate, separate measuring values are sent duplicated as new measuring values of the AD converter are not yet present internally.

Trigger mode 2 (high level)

The measuring values are sent with the specified data rate while a logical High level is present at the trigger input.

Trigger mode 3 (gate rising edge)

With the first rising edge at the trigger input, the interface module starts sending the measuring values with the specified data rate; it stops sending measuring values with the second rising edge and so on …

i   If a sensor is connected via RS485, the trigger input of the sensor (if present) must be used.

The supported trigger modes are dependent on the sensor.

5.5 Measuring Value Averaging

5.5.1 Introduction

The measuring value averaging is performed before the output of the measuring values via the Ethernet interfaces. The averaging types are dependent on the connected sensor. Not all sensors support every averaging type.

Due to the measuring value averaging, the resolution is improved, individual interference points are hidden or the measurement result is "smoothed".

ⅈ The linearity is not influenced by averaging. The averaging has no influence on the data rate.

The interface module is shipped from the factory without averaging.

5.5.2 Moving Average

The selected number N of successive measuring values (window width) is used to generate the arithmetic average M_{gl} on the basis of the following formula:

$$M_{gl} = \frac{\sum\limits_{k=1}^{N} MV(k)}{N}$$

MW = Measuring value
N = Number
k = Running index
M_{gl} = Averaging value

Fig. 4 Formula for moving average

Mode

Each new measuring value is added and the first (oldest) measuring value from the averaging process is taken out again.

Example with N = 7:

.... 0 1 $\boxed{2\ 3\ 4\ 5\ 6\ 7\ 8}$ gets to $\dfrac{2+3+4+5+6+7+8}{7}$ averaging value n

.... 1 2 $\boxed{3\ 4\ 5\ 6\ 7\ 8\ 9}$ gets to $\dfrac{3+4+5+6+7+8+9}{7}$ averaging value n +1

5.5.3 Arithmetic Average

The definable number N for successive measuring values is used to calculate the arithmetic average M.

Mode

Measuring values are collected and the average is calculated from these. This method results in a reduction of the occurring quantity of data because an average is only output after every Nth measuring value.

Example with N = 3:

.... 0 1 $\boxed{2\ 3\ 4}$ ...   gets to $\dfrac{2+3+4}{3}$ averaging value n

.... 3 4 $\boxed{5\ 6\ 7}$ ...   gets to $\dfrac{5+6+7}{3}$ averaging value n + 1

5.5.4 Median

A median value is formed from a preselected number of measurements.

The incoming measuring values are also sorted again after each measurement. Afterwards, the average is output as the median.

If an even number is selected for the averaging number N, the two middle measuring values are added and divided by two.

Example with N = 7:

... 2 4 $\boxed{0\ 1\ 2\ 4\ 5\ 1\ 3}$ Sorted measuring value 0 1 1 $\boxed{2}$ 3 4 5 Median $_n$ = 2

... 4 0 $\boxed{1\ 2\ 4\ 5\ 1\ 3\ 4}$ Sorted measuring value 1 1 2 $\boxed{3}$ 4 4 5 Median $_{n+1}$ = 3

$\mathbf{i}$ Variable average, arithmetic average and median are available for the analog inputs. If a sensor is connected via RS485, the available averaging types are dependent on whether they are supported by the respective sensor.

5.6 Synchronisation Output (only EtherCAT)

The Distributed Clocks Signal which can be transferred via EtherCAT is output at the outputs. This is an LVDS signal.

6. Ethernet Interface

You can readout the measuring values in digital form via the Ethernet interface.

For this purpose, use the web interface or a special program. MICRO-EPSILON supports you by the driver MEDAQLib, containing all commands for IF1032/ETH. You will find more details on the enclosed CD or on the Internet: www.micro-epsilon.de/software "Standard applications > MEDAQlib".

6.1 Hardware, Interface

➡ Connect the IF1032/ETH to an available Ethernet interface at the PC. Use a crossover cable.

Ethernet connection

Fig. 5 Ethernet connection for a LAN or Crossover cable

For a connection with the capaNCDT 6200 you will require a defined IP address of the network interface card inside the PC.

➡ Change to `Control Panel\Network Connections`.

➡ Set up a new LAN connection, if applicable. For more information, contact your network administrator.
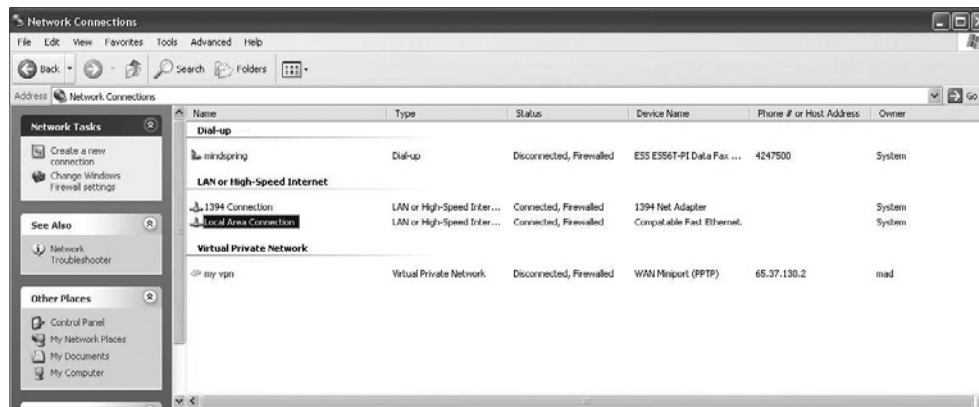
Fig. 6 LAN connection of a PC

➡️   Define the following address in the properties of the LAN connection:

IP address: 169.254.168.1

Subnet mask: 255.255.0.0
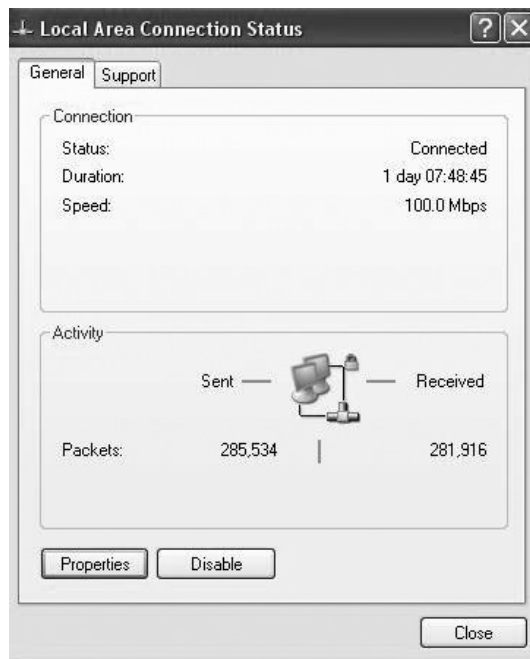
Select `Properties`.
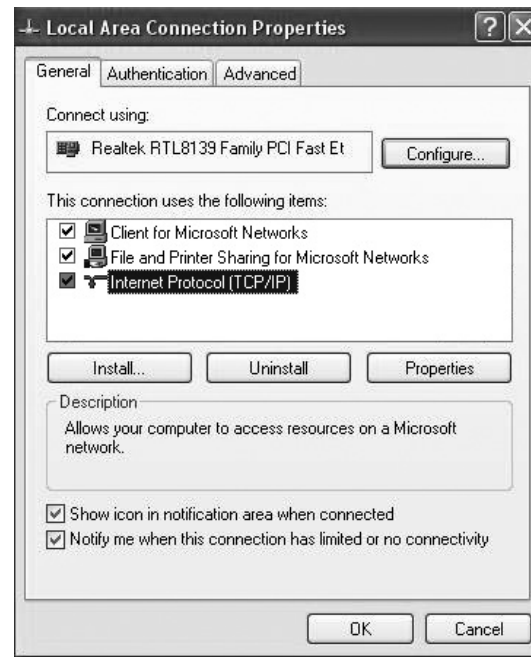
Select `Internet Protocol (TCP/IP) > Properties.`
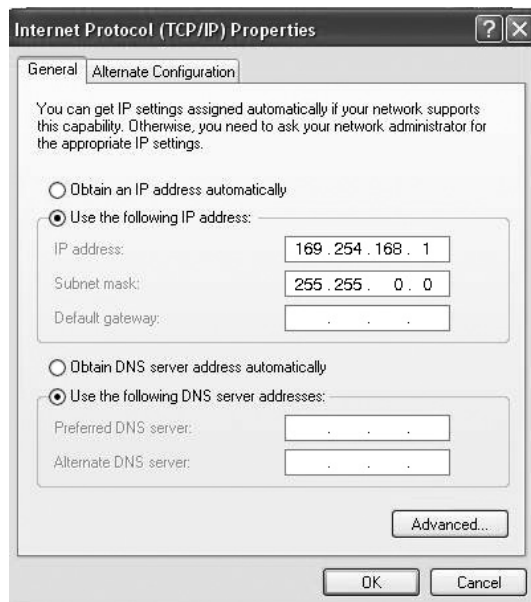
By default, the IP address of the interface module is set to 169.254.168.150. Communication with the controller is done on the data port 10001 for measurement transmission. A command port (Telnet, port 23) is used for sensor commands.

The IP settings and the data port can be changed at any time:
- by using the web browser. Enter the current IP address into the address bar. Go to the `Settings > Digital Interfaces > Ethernet settings` menu to set a new IP address, activate DHCP or change the port.
- by using software commands, see Chap. 6.3.
- by using the `SensorFinder` software.

If you activate DHCP, access to the interface module via a DHCP host name is possible. The host name contains the device name and serial number. Structure: NAME_SN (e.g. IF1032_1001).

The interface module supports UPnP. If you use an operational system with activated UPnP client e.g. standard with Windows 7, the controller is listed in the explorer as a device automatically. This is helpful, if you do not know the IP address of the interface module.

6.2 Data Format of Measuring Values

All measuring values recorded at a time are combined into a measuring value frame (One measuring value per channel).

Several measuring value frames are combined to a measuring value block and then transmitted together with a header as a TCP packet.

All measuring values and the header are transmitted in little-endian format.

Contents	Size	Description
Preamble	32 bit	„MEAS" as ASCII text
Article number	32 bit	Order number of sensor as int
Serial number	32 bit	Serial number of sensor as int
Channels (Bit field)	64 bit	Bit field, which channel available. Two bits per channel are used. „00"= channel is not available; „01"= channel available and transmission as ‚int'. „10" = channel available and transmission as ‚uint'; „11" = channel available and transmission as ‚Float'. The lowest channel is on the low-order bit ->Thereby determining the number of channels N is possible.
Status	32 bit	Not used for analog inputs, otherwise depending on the connected sensor.
Frame number M / bytes per frame	16 bit / 16 bit	One frame = one measuring value per channel
Measuring value counter	32 bit	Measuring value counter (of 1. frame)
Measuring value frame 1 [number channels N]	N * 32 bit	Measuring values of all channels, starting with the lowest channel number
Measuring value frame 2 [number channels N]	N * 32 bit	„
....	...	...
Measuring value M [number channels N]	N * 32 Bit	„

All measuring values are transmitted as Int32, Uint32 or Float depending on the connected sensor.

Scaling of measuring values:

The measuring value is transmitted as Int32 or UInt32, then the formula is:

$$\text{Measuring value} = \frac{(\text{Digital value (Int32/Uint32)} - \text{DataRangeMin}) * \text{Measuring range}}{\text{DataRangeMax} - \text{DataRangeMin}} + \text{Offset}$$

The measuring value is transmitted as Float, then the formula is:

$$\text{Measuring value} = \text{Digital value (Float)}$$

The unit of the measuring value and the parameter measuring range, Offset, DataRangeMin, DataRangeMax can be accessed for each channel via the sensor commands $CHI and $MDF.

Example: Measuring range = 500, Offset = 20, DataRangeMin = 0, DataRangeMax = 16777215

Unit = μm

Digital value = 2523552

$$\text{Measuring value} = \frac{(2523552 - 0) \times 500}{1677215 - 0} + 50 = 95.21 \; \mu m$$

By default, the measuring values are continuously output with the set data rate via the data port.

However, there is also a trigger mode, wherein individual measuring values can be queried, see Chap. 6.3.2.

6.2.1 Settings for Analog Inputs

Operating Modes:
- Continuous transmission with fixed data rate
- Trigger mode (hardware trigger input), see Chap. 5.4.

Data rate:

It is possible to adjust different data rates between 2.0 Sa/s and 4 kSa/s. The data rate applies to all channels.

6.2.2 Settings for Sensors via RS485

Depending on the sensor.

6.3 Commands

All commands are transmitted via port 23 (Telnet). Each command starts with a $ character. The interface module ignores all characters, which are transmitted before the $ character.

The interface module immediately returns all transmitted characters back as echo.

Commands are transmitted in ASCII format.

A time out is reached approximately 10 seconds after the last character input.

Channel numbers are separated by a comma, channel number and a parameter belonging to the channel by a colon.

Several successive different parameters (for the command STS and VER) are separated by a semicolon.

Commands always have to end with <CR> or <CRLF>.

6.3.1 Data Rate (STI = Set Sample Time)

Changes the sample time in μs (respectively sample rate) for all channels, which are used to transmit the measuring values. The requested sample time in μs is sent to the controller. Because any sample time is not possible, the controller replies with the next available sampletime in μs. This is active from then.

	STI = Set Sample Time
Command	$STIn<CR> Example: $STI1200<CR>
Response	$STIn,mOK<CRLF> Example: $STI1200,960OK<CRLF>
Index	n = designated new sample time in μs (TARGET)
	m = new sample time in μs (ACTUAL)
Possible sample times	
	* depending on the sensor
Request the sample time	
Command	$STI?<CR>
Response	$STI?nOK<CRLF>

6.3.2   Trigger Mode (TRG)

There are possible settings regarding the trigger input, see Chap. 5.4.

The available trigger modes are dependent on the connected sensor. If the trigger mode is turned off, the IF1032/ETH will send measuring values without interruption with the adjusted data rate.I

	TRG
Command	$TRGn<CR>
Response	$TRGnOK<CRLF>
Index	n = 0: Continuous transmission (default setting)
	n = 1: Trigger mode 1 (rising edge)
	n = 2: Trigger mode 2 (high level)
	n = 3: Trigger mode 3 (gate rising edge)
	? = Request trigger mode
Request trigger mode	
Command	$TRG?<CR>
Response	$TRG?nOK<CRLF>

6.3.3   Filter, Averaging Type (AVT = Averaging Type)

Mode of measurement averaging. The available averaging types are depending on the connected sensor.

	AVT
Command	$AVTn<CR>
Response	$AVTnOK<CRLF>
Index	n = 0: No averaging (default setting)
	n = 1: Moving average
	n = 2: Arithmetic average (outputs only each nth measuring value)
	n = 3: Median
	? = Request averaging type
Request averaging type	
Command	$AVT?<CR>
Response	$AVT?nOK<CRLF>

6.3.4 Filter, Averaging Number (AVN = Averaging Number)

Number of measuring values used to calculate the average. The available averaging numbers are depending on the connected sensor.

	AVN
Command	$AVNn<CR>
Response	$AVNnOK<CRLF>
Index	n = depending on sensor
	? = Request averaging number
Request averaging number	
Command	$AVN?<CR>
Response	$AVN?nOK<CRLF>

6.3.5 Channel Status (CHS = Channel Status)

Specifies in increasing order which channels are available in the controller (0 = no channel available, 1 = channel available).

	CHS
Command	$CHS<CR>
Response	$CHS1,0,0,1OK<CRLF> (Example: Channel 1,3,4 available)

6.3.6 Status (STS)

Reads all settings at once.

The individual parameters are separated by a semicolon. The structure of the respective responses corresponds to those of the individual requests.

	STS
Command	$STS<CR>
Response	$STSSTIn;AVTn;AVNn;CHS…;TRG.OK<CRLF>

6.3.7 Version (VER)

Requests the current software version including date.

	VER
Command	$VER<CR>
Response	$VERIF1032;V1.2a;8010078<CRLF>

6.3.8 Ethernet Settings (IPS = IP-Settings)

Changes the IP settings of the interface module.

	IPS
Command	$IPSm,<IPAddress>,<SubnetAddress>,<GatewayAddress><CRLF>
Example	$IPS0,169.254.168.150,255.255.0.0,169.254.168.1<CRLF>
Response	$IPSm,<IPAddess>,<SubnetAddress>,<GatewayAddress>OK<CRLF>
Index	m = 0: static IP address m = 1: activates DHCP* * If DHCP is active, no IP subnet- and gateway address has to be transmitted.
Request settings	
Command	$IPS?
Response	$IPS? m,<IPAddress>,<SubnetAddress>,<GatewayAddress>OK<CRLF>

6.3.9 Query Data Port (GDP = Get Data Port)

Queries the port number of the data port.

Command	$GDP<CRLF>
Response	$GDP<Portnummer>OK<CRLF> Bsp: $GDP10001OK<CRLF>

6.3.10 Set Data Port (SDP = Set Data Port)

Sets the port number of the data port. Range: 1024 ...65535.

Command	$SDP<Portnumber><CRLF> Example: $SDP10001OK<CRLF>
Response	$SDP<Portnumber>OK<CRLF>

6.3.11 Change between Ethernet and EtherCAT (IFC = Interface)

Command switches between Ethernet and EtherCAT interface. Effective only, if the switch `Ethernet/ EtherCAT` is in the position `ECAT/AUTO`. Otherwise the Ethernet interface is always active. The new interface is activated after a restart of the controller.

	IFC
Command	$IFCm<CRLF> Example: $IFC1<CLRF>
Response	$IFCmOK<CRLF>
Index	m = 0: Ethernet m = 1: EtherCAT
Request	
Command	$IFC?
Response	$IFC?mOK<CLRF>

6.3.12   Access Channel Information (CHI = Channel info)

Reads channel-specific information (e.g. measuring range of sensor).

Command	$CHIm<CR>
Response	$CHIm:ANO...,NAM...,SNO...,OFS...,RNG...,UNT...,DTY...OK<CRLF>
Index	m (channel number): 1 - 8 ANO = Article number NAM = Name SNO = Serial number OFS = Measuring range offset RNG = Measuring range UNT = Unit of measuring range (e.g. μm) DTY = Data type of measuring value (0 = no measuring value, 1 = int, 2 = unit, 3 = float)

6.3.13   Access Controller Information (COI = Controller info)

Reads information of the connected controller (e.g. serial number).

Command	$COI<CR>
Response	$COIANO...,NAM...,SNO...,OPT...,VER...OK<CRLF>
Index	ANO = Article number NAM = Name SNO = Serial number OPT = Option VER = Firmware version

6.3.14   Login for Web Interface (LGI = Login)

Changes the user level for the web interface to `professional`.

Command	$LGI<Password><CR>
Response	$LGI<Password><OK>CRLF
Index	Password = Password of the device. When delivered, no password is assigned. The field can remain empty.

6.3.15 Logout for Web Interface (LGO = Logout)

Changes the user level for the web interface to `user`.

Command	$LGO<CR>
Response	$LGOOK<CRLF>

6.3.16 Change Password (PWD = Password)

Changes the password of the device (required for the web interface and the SensorFinder).

Command	$PWD<oldpassword>,<newpassword>,<newpassword><CR>
Response	$PWD<oldpassword>,<newpassword>,<newpassword>OK<CRLF> A password can be from 0-16 characters and must only contain letters and numbers. When delivered, no password is assigned. The field can remain empty/blank.

6.3.17 Change Language for the Web Interface (LNG = Language)

Changes the language of the web interface.

Command	$LNGn<CR>
Response	$LNGnOK<CRLF>
Index	0 = System 1 = English 2 = German

6.3.18 Measuring Values Data Format (MDF = Measured Data Format)

Requests the measuring value data format (DataRangeMin/DataRangeMax) is needed for scaling the measuring values.

Command	$MDFm<CR>
Response	$MDFm<DataRangeMin>, <DataRangeMax><CRLF>
Index	m (channel number 1 ... 8)

6.3.19   Set Sensor Interface (SIF = Sensor Interface)

Selects the sensor interface of the module.

Command	$SIFm<CR>
Response	$SIFmOK<CRLF>
Parameter	m = 0; Analog m = 1; not assigned currently m = 2; not assigned currently m = 3; RS485
Request	$SIF?
Response example	$SIF?1OK<CRLF>

6.3.20   Sensor Baud Rate (SBR = Sensor Baud Rate)

Changes the Baud Rate of the RS485 interface.

Problem: You do not know which baud rate the sensor supports, so the „desired" baud rate is set to the interface module; the closest possible baud rate comes as answer.

Command	$SBR<value><CR>
Response	$SBR900000, 921600OK<CRLF> (A set baud rate of 900000 was written here, the sensor supports 9216000 as the next possible baud rate.)
Value range	9200 - 6250000
Request	$SBR?<CR>
Response example	$SBR?9216000OK<CRLF>

6.3.21   Sensor Address (SAD = Sensor Address)

Changes the address used to communicate with the RS485.

Command	$SAD1:<value><CR>
Response	$SAD1:<value>OK<CRLF>
Value range	2 - 126
Request	$SAD1?<CR>
Response example	$SAD1?120OK<CRLF>

6.3.22   Analog Range (ARA)

Sets the measuring range of the analog inputs. This changes only the scaling, not the actual input range.

Command	$ARAm:<value><CR>
Response	$ARAm:<value>OK<CRLF>
Parameter	m = 1,2,3 (channel)
Value range	0 ... 10 000 000
Request	$ARAm?<CR>
Response example	$ARA1?1000OK<CRLF>

6.3.23   Sensor Search (SSE)

Automatically searches common baud rates for sensors. If a sensor was found, the sensor baud rate and the sensor address are automatically stored in the IF1032.

i   Make sure only 1 sensor is connected as the search for the sensor happens by means of a broadcast command.

Command	$SSE<CR>
Response	$SSEOK<CRLF>

6.3.24 Analog Offset (AOF)

Sets the measuring range offset of the analog inputs. This only changes the scaling, not the actual input range.

Command	$AOFm:<value><CR>
Response	$AOFm:<value>OK<CRLF>
Parameter	m = 1,2,3 (channel)
Value range	0 ... 10 000 000
Request	$AOFm?<CR>
Response example	$AOF1?1000OK<CRLF>

6.3.25 Analog Unit (AUN)

Sets the unit of the analog inputs. This only changes the scaling, not the actual input range.

Command	$AUNm:n<CR>
Response	$AUNm:nOK<CRLF>
Parameter	m = 1,2,3 (channel) n = unit 0 = m, 1 = mm, 2 = μm, 3 = V, 4 = digit, 5 = mA
Request	$AUNm?<CR>
Response	$AUNm?nOK<CRLF>

6.3.26 Analog Math Function (AMF)

Analog outputs of the IF1032 can be reckoned up here and the result is output via channel 4. Units of the inputs are not considered.

Command	$AMF<Offset>,<Factor1>,<Factor2>,<Factor3><CRLF>
Response	$AMF<Offset>,<Factor1>,<Factor2>,<Factor3>OK<CRLF>
Parameter	Offset, Factor 1, Factor 2, Factor 3 = float, with this factor the respective analog output is multiplied
Example	$AMF100,1.25,-2,0<CR> (sets a math function with offset 100, analog channel 1 is multiplied with factor 1.25, analog channel with -2 and the total is output
Request	$AMF?<CR>
Delete math function	$AMF0<CR><

6.3.27 Default Messages

- Unknown command: (ECHO) + $UNKNOWN COMMAND<CRLF>
- Wrong parameter after command: (ECHO) + $WRONG PARAMETER<CRLF>
- Timeout (approximately 10 s after last input) (ECHO) + $TIMEOUT<CRLF>
- Wrong password: $WRONG PASSWORD<CRLF>

6.4 Operation Using Ethernet

Dynamic web pages are generated in the interface module which contain the current settings of the interface module and the peripherals. Operation is only possible while there is an Ethernet connection to the interface module.
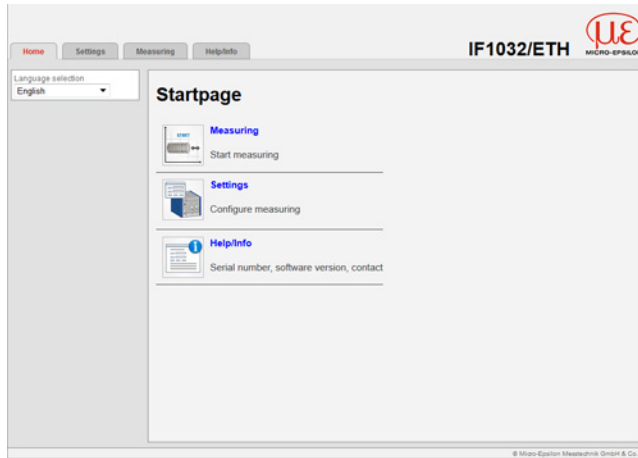
6.4.1 Requirements

You need a web browser with HTML5 support (e.g. Mozilla Firefox ≥ 3.5 or Internet Explorer ≥ 10) on a PC with network connection. To support a basic first commissioning of the interface module, the interface module is set to a direct connection.

If you have configured your browser to access the internet via a proxy server, in the browser settings you will need to add the IP address of the controller to the list of addresses which should not be routed through the proxy server. The MAC address of the unit can be found on the nameplate of the controller.

Javascript" must be enabled in the browser so that measurement results can be displayed graphically.

Direct connection to PC, controller with static IP (factory setting)		Network
PC with static IP	PC with DHCP	Interface module with dynamic IP, PC with DHCP
➡ Connect the interface module to a PC using a direct Ethernet connection. Use a LAN cable with RJ-45 connectors.		➡ Connect the interface module to a switch using a direct Ethernet connection (LAN). Use a LAN cable with RJ-45 connectors.
➡ Now start the SensorFinder program. You will find this program on the provided CD. ➡ Click the button `Start Sensor Scan`. Select the designated interface module from the list. In order to change the address settings, click the button `Open IP-Config`. • Address type: static IP address • IP address: 169.254.168.150 [1] • Subnet mask: 255.255.0.0 ➡ Click the button `Transfer IP Settings to Sensor` to transmit the changes to the interface module. ➡ Click the button `Open Web Interface` to connect the interface module with your default browser. 1) Requires that the LAN connection on the PC uses, for example, the following IP address: 169.254.168.1.	Wait until Windows has established a network connection (connection with limited connectivity). ➡ Now start the Sensor-Finder program. You will find this program on the provided CD. ➡ Klicken Sie auf die Schaltfläche `Start Sensor Scan`. Select the designated interface module from the list. ➡ Click the button `Open Web Interface` to connect the interface module to your default browser.	➡ Enter the interface module in the DHCP / register the interface module in your IT department. The interface module gets assigned an IP address from your DHCP server. You can check this IP address with the SensorFinder program. ➡ Start the SensorFinder program. You will find this program on the delivered CD. ➡ Click the button `Start Sensor Scan`. Select the designated interface module from the list. ➡ Click the button `Open Web Interface` to connect the interface module with your standard browser. Alternatively: If DHCP is used and the DHCP server is linked to the DNS server, access to the controller via a host name of the structure "IF1032_<serial_number>" is possible. ➡ Start the web browser on your PC. To achieve an interface module with the serial number "01234567", type in the address bar on your browser „IF1032_01234567".
Interactive web pages for setting the interface module and peripherals are now shown in the web browser.		

6.4.2   Access via Web Interface

Use the upper navigation bar to access additional features (e. g. settings).

All settings on the web page are applied immediately in the controller after pressing the `Submit` button.

Fig. 7 First interactive web page after calling the IP address

Parallel operation with web interface and Telnet commands is possible; the last setting applies.

The appearance of the web pages may vary depending on functions and peripherals. Each page contains parameter descriptions and tips to configure the interface module.

6.5   Firmware Update

The controller has a firmware update function. We recommend to always use the latest firmware version. You can find the latest firmware version on our website and it can be installed with the attached Firmware Update Tool.

6.6 Operating Menu, Set Interface Module Parameter

6.6.1 Preliminary Notes to the Settings

You can program the IF1032/ETH at the same time in two different ways:
- Using a web browser via the sensor web interface
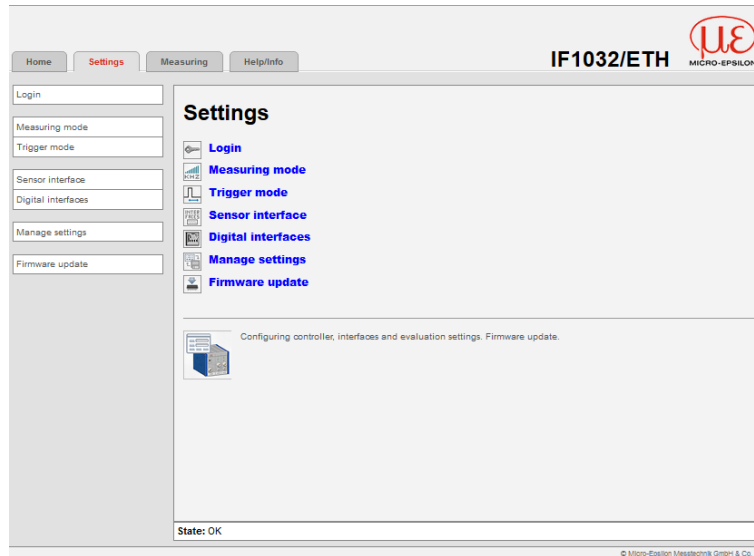- With ASCII command set and terminal program via Ethernet (Telnet).

Fig. 8 Web page Settings

6.6.2   Menu Settings

6.6.2.1   Login, Changing User Level

Assigning passwords prevents unauthorized changes to interface module settings. Password protection is not enabled as a factory setting. After the interface module has been configured, you should enable password protection.

i   A firmware update will not change the custom password.

User can do the following:

	User	Professional
Password required	no	yes
View settings	yes	yes
Change settings, change password	no	yes
Start measuring	yes	yes
Scaling graphs	yes	yes

Fig. 9 Permissions within the user hierarchy

Login		
Logged in as	User	
Password		Submit

Enter the password into the `Password` box and click `Submit` to confirm.

To change to user mode, click the `Logoff` button.

Fig. 10 Changing to professional level

Fields with a grey background require a selection.

Value Fields with a dark border require the specification of a value.

In `professional` mode, you can use the change password features to assign a custom password.

Password	Value	All passwords are case-sensitive. Numbers are allowed, but special characters are not permitted
User level at restart	User / Professional	Defines the user level that is enabled when the sensor starts the next time. MICRO-EPSILON recommend to select User level.

With the first-time assignment of a password the `Old Password` field remains free.

6.6.2.2 Measuring Mode

The adjustable filter are depending on the connected sensor respectively controller.

Data rate	Value	Instructs the controller about the frequency, with which data are output via the Ethernet interface.
Filter type	Moving average, Arithmetic mean, Median, Off	Designation of averaging type. Averaging number indicates, about how many current measuring values should be averaged in the controller, before a new measuring value is output.
Filter width	2, 3, 4, 5, 6, 7, 8	

It is recommended to use averaging for statical measuring or slowly changing measuring values.

A number of data rates are available for the controller to record measurement values. The same data rate applies to all channels, and channel data rates are synchronised. The smaller the data rate, the lower the measurement signal noise. While this results in a better resolution, the bandwidth of the measurement signal decreases.

A number of filter types for measurement values are available. Filtering lowers the noise of the measurement signal, which results in a better resolution. Filter width is used to specify the number of measurement values to which the filter applies.

6.6.2.3 Trigger Mode

The adjustable trigger modes are depending on the connected sensor respectively controller.

This menu item determines the trigger behavior. The triggering is released by an external electrical signal, see Chap. 4.2.

If the trigger mode is turned off, the IF1032/ETH will send measuring values without interruption with the adjusted data rate.

Trigger mode	Rising edge	*A measuring value is output per edge.*
	High level	*Level triggering. Measuring value output, as long as the level is active.*
	Gate rising edge	*Starts respectively stops the measuring value output alternatively.*
	Off	*Controller sends measuring values continuously.*

6.6.2.4 Sensor Interface

Fig. 11 Web page Settings / Sensor interface

(grey box)	Fields with a grey background require a selection.
Value	Fields with a dark border require the specification of a value.

Sensor interface	Analog	Settings analog	Analog channel	1, 2, 3
			Measuring range analog channel	*Value*
			Offset analog channel	*Value*
			Unit analog channel	*m, mm, µm, V, digit, mA, °C*
		Math function	Offset	*Value*
			+ (Factor 1 * Channel 1)	*Value*
			+ (Factor 2 * Channel 2)	*Value*
			+ (Factor 3 * Channel 3)	*Value*
	RS485	Settings RS485	Sensor baud rate	*Value*
			Sensor address	*Value*
		Search sensor		

RS485 and analog inputs are available as sensor interface. Depending on the use the corresponding unused setting is grayed out.

If the RS485 interface is selected, then baud rate and address of the sensor must be set. If the analog inputs are selected, the analog measuring values can be scaled for the diagram with the help of measuring range, offset and unit.

Fields with a grey background require a selection.

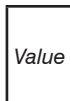*Value* Fields with a dark border require the specification of a value.

i Thereby only the diagram's scaling changes, the actual input voltage range and input current range remains unchanged.

Get measu-ring range and offset for	Analog channel 1, 2, 3	Measuring range analog channel 1, 2, 3	Start	*Value*	*m, mm, μm, V, digit, mA, °C*
			End		
		Voltage analog channel 1, 2, 3	Distance correlates to	*Value*	

For the calculation of the measuring range and offset of the analogue channels please select at first the analogue channel and subsequently enter the start of measuring range and the end of measuring range, the desired unit and the according voltage and current values and click on the Compute button.

i The calculated measuring range/offset doesn't necessarily correspond to the real measuring range/off-set of the sensor. It's just for the correct scaling of the measurement value.

By clicking the button Submit of the corresponding analog channel, the values are transferred to the controller.

6.6.2.5   Digital Interfaces

Ethernet settings	IP settings	Address type	Static IP address / DHCP	*Values for IP address / Gateway / Subnet mask. Only with static IP address*
		IP address	*Value*	
		Subnet mask	*Value*	
		Default gateway	*Value*	
		DHCP Host Name	*Value*	
	Port settings	Data port	*Value*	
		MAC address	*Value*	
		UUID	*Value*	

Use this mask to modify IP settings for the controller. You can specify a static IP address or enable DHCP.

If DHCP is enabled, the controller can be reached within the network via its DHCP host name. This consists of name and serial number and cannot be changed.

For DHCP the controller's MAC address might need to be shared for the network.

Any modified IP settings are active immediately, and the user might be required to enter the new IP address in the browser to enable the web interface to be launched.

The data port that is used to transmit the measurement values can also be changed.

Ethernet/ EtherCAT	Operating mode after start	Ethernet / EtherCAT

User may toggle between Ethernet and EtherCAT mode via the software. After the setting is changed, the controller needs to be restarted to activate the other interface.

Please note that the software toggle feature is only enabled if the hardware switch for interface selection is in the ECAT/Auto position, see Chap. 7.2. If it's in the Ethernet position, only the Ethernet interface will be enabled.

Only switch to EtherCAT mode if the appropriate hardware is available. The web interface cannot be launched in EtherCAT mode.

6.6.2.6 Manage Settings

i Make sure that Java is enabled on your computer.
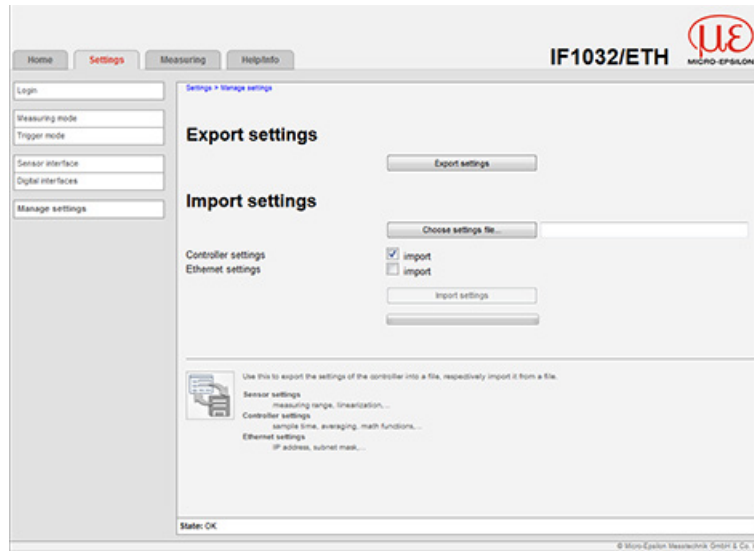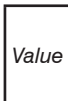
Fig. 12 Web page Manage settings

	Fields with a grey background require a selection.
Value	Fields with a dark border require the specification of a value.

Use this to export the settings of the controller into a file, respectively import it from a file.

6.6.3 Menu Measuring
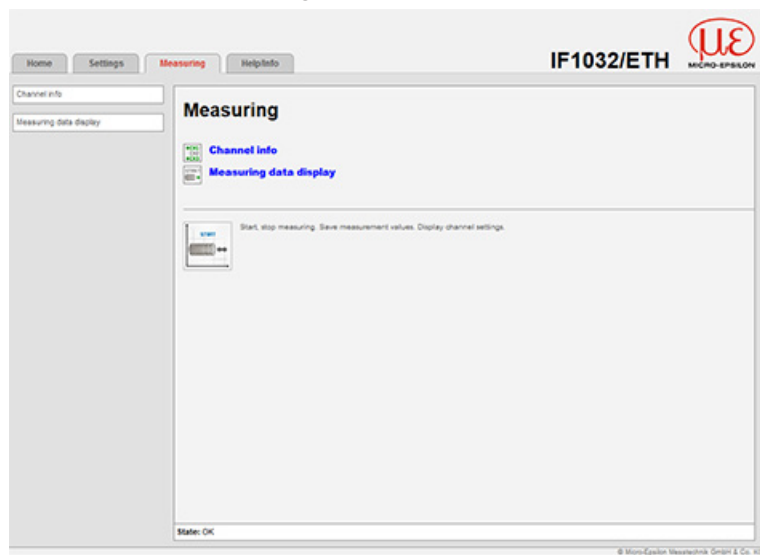
Fig. 13 Web page Menu Measuring

In this menu, measurements can be started and stopped, as measuring values can be saved and channel settings can be displayed.

6.6.3.1 Channel Info

Channel info	Data channel	1, 2, 3, 4		*Summary of all channel-dependent controller settings. No changes can be made here.*
	State	active, -		
	Measuring range	*Value*	*m, mm, µm, V, digit, mA, °C*	
	Offset	*Value*	*m, mm, µm, V, digit, mA, °C*	

6.6.3.2 Measuring Data Display

Fig. 14 Web page measuring data display

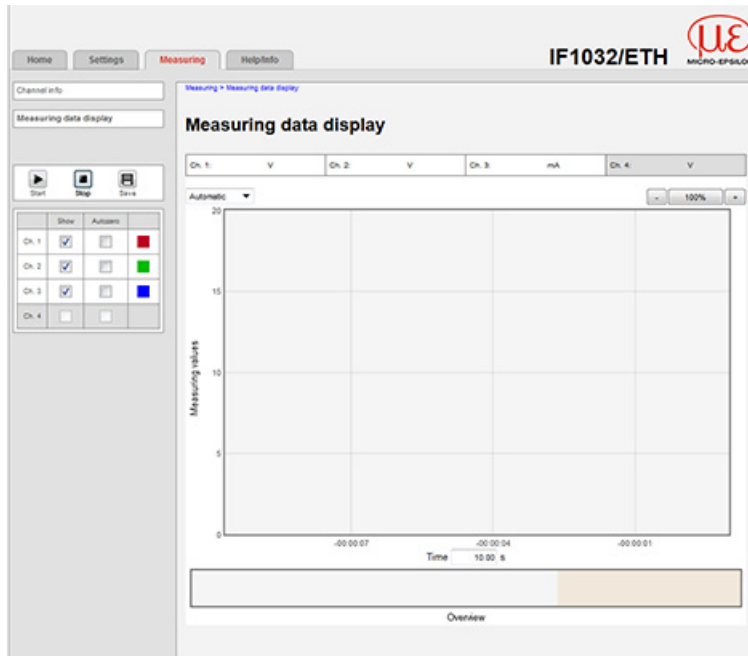| Start, Stop	Use these buttons to start or stop the display of measured data.
Save	Stores the measured values after the measurement was stopped. The measured values are stored with a dot as decimal mark if the language is set to English, otherwise a comma is used. **i** Only a limited number of measured values can be stored (about 50,000). The oldest values will be overwritten when more values are captured.
Show	Specifies which channels are displayed in the diagram.
Autozero	Sets the selected channel to zero, e.g. for performing differential measurements.
Measuring data display	The measuring data display consists of two parts. The lower part (Overview) shows the last 30 seconds of the measurement. The dark-shaded area defines the view (the time period) of the upper diagram. This area can be moved or resized by using the mouse with left button down. The upper diagram can be resized in the same way. The + and - buttons change the view in fixed steps. The text field Time shows the current displayed time period. It also allows to manually change this period. The view can be reset to default settings with a double click into the upper diagram or a click onto the %-button. The y-axis can be scaled manually or automatically. **i** During a continuous display the shown time period is limited to 10 seconds. When moving the view during continuous display the diagram stops. The incoming data will be buffered. Moving the view to the right hand end of the lower diagram or resetting the view forces the diagram to start continuous display again. Always at least one channel must be chosen for display!

6.6.4 Menu Help, Info

This page contains information such as the sensors serial and version numbers, channel names and serial numbers of the used channels.

Fig. 15 Web page Help/Info

7. EtherCAT Interface

7.1 Introduction

The EtherCAT interface allows a fast transfer of measuring values. The interface module supports CANopen over EtherCAT (CoE).

Service Data Objects SDO: All parameters of the interface module can thus be read or modified.

Process Data Objects PDO: A PDO telegram is used for real-time transmission of measuring values. Individual objects are not addressed. The content of the previously selected data is transmitted.

The displacement values are transmitted as 32 bit Float values.

7.2 Change Interface

You cannot change directly to the EtherCAT interface through the web interface or command.

Restart your interface module to do this.

i Also keep in mind that the setting of the EtherCAT switch is in the correct position, see Fig. 16.
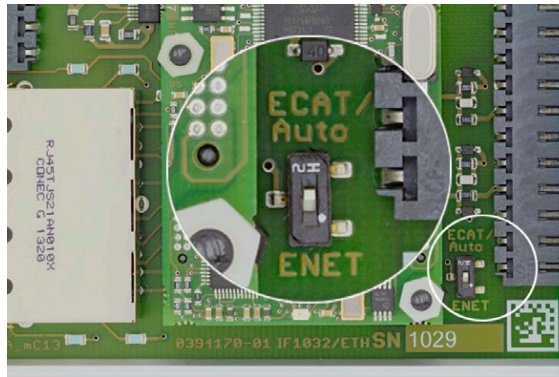
Switch position	Declaration
Ethernet	Independent of software adjustment, the Ethernet interface is always active.
ECAT/Auto	Interface is active which is adjusted via web interface or command.

Fig. 16 Switch to change the interface

A change back from the EtherCAT interface to Ethernet is possible using the hardware switch on the interface module or via the appropriate CoE object. In both cases, a restart of the interface module is required afterwards.

An ESI file is included for the integration of the EtherCAT interface, e.g. in TwinCAT.

Further details can be found in the Appendix, see Chap. A 1.

8.   Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON.

This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

No other claims, except as warranted, are accepted.

MICRO-EPSILON will specifically not be responsible for eventual consequential damage. The terms of the purchasing contract apply in full.

MICRO-EPSILON always strives to supply the customers with the finest and most advanced equipment.

Development and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved.

For translations in other languages, the data and statements in the German language operation manual are to be taken as authoritative.

9.   Service, Repair

In the event of a defect on the interface module, please send us the device for repair or exchange.

In the case of faults the cause of which is not clearly identifiable, the whole measuring system must be sent back to:

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Str. 15
94496 Ortenburg / Germany

Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de
www.micro-epsilon.com

10. Decommissioning, Disposal

➡ Disconnect all cables on interface module.

Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

Appendix

A 1   Accessories

PS2020

Power supply; DIN rail mounting, 2.5 A, input 100 - 240 V AC, output 24 V DC / 2.5 A, installation type; mounting on symmetrical standard rail 35 mm x 7.5 mm, DIN 50022

PS2401

Plug-in power supply; 1 A, input 100 - 240 V AC, output 24 V DC / 1 A; with 1.8 m integrated cable

A 2   EtherCAT Documentation

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 subsequently forwarded 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).

A 2.1   Preamble

A 2.1.1   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.
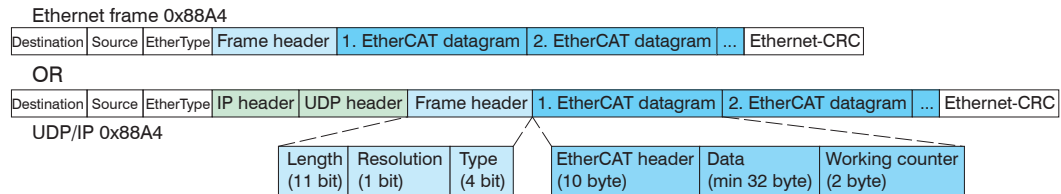

Fig. 17 Setup of EtherCAT frames

A 2.1.2 EtherCAT® Services

In EtherCAT® services for the reading and writing of data are specified in the physical memory of the slave hardware. The following EtherCAT® services are supported by the slave hardware:
- APRD (Autoincrement physical read, Reading of a physical area with auto-increment addressing)
- APWR (Autoincrement physical write, Writing of a physical area with auto-increment addressing)
- APRW (Autoincrement 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)
- RW (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)

A 2.1.3 Addressing and FMMUs

In order to address a slave in the EtherCAT® system, various methods from the master can be used. The IF1032/ETH 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 configuration of the slave FMMUs is implemented 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 data, as well as the direction (input or output) of the process data.

A 2.1.4   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 IF1032/ETH 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 usually used for process output data. Not used in the sensor.
- 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.).

A 2.1.5   EtherCAT State Machine

The EtherCAT® state machine is implemented in each EtherCAT®. Directly after switching on the IF1032/ETH, 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 (sensor software) is not possible yet. 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.
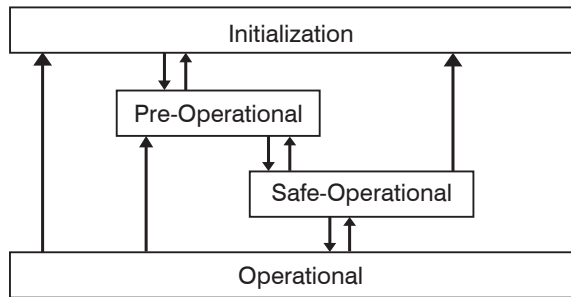

Fig. 18 EtherCAT State Machine

A 2.1.6   CANopen via 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 sensor, as well as the communication objects for the exchange of process data and acyclic messages. The sensor uses the following message types:
  - Process Data Object (PDO). The PDO is used for the cyclic I/O communication, therefore 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, see Chap. A 2.2.

A 2.1.7   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 for the transmission of data from the slaves to the master (inputs), Rx PDOs are used to transmit data from the master to the slaves (outputs); not used in the IF1032/ETH. The PDO mapping defines which application objects (measurement data) are transmitted into a PDO. The IF1032/ETH has a Tx PDO for the measuring data. The following measurements are available as process data:
  - Counter   Measurement counter (32 bit)
  - Channel 1   Displacement channel 1
  - Channel 2   Displacement channel 2
  - Channel 3   Displacement channel 3
  - Channel 4   Displacement channel 4
  - Channel 5   Displacement channel 5
  - Channel 6   Displacement channel 6
  - Channel 7   Displacement channel 7
  - Channel 8   Displacement channel 8

A 2.1.8   Service Data SDO Service

Service Data Objects (SDOs) are primarily used for the transmission of data that are not time critical, e.g. parameter values. EtherCAT specifies the SDO services as well as the SDO information services: SDO services enable 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 or measurements can be transmitted. A desired parameter is addressed via index and subindex within the object directory.

A 2.2 CoE – Object Directory

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

A 2.2.1 Communication Specific Standard Objects (CiA DS-301)

Overview

Index (h)	Name	Description
1000	Device type	Device type
1001	Error register	Error register
1008	Device name	Device name
1009	Hardware version	Hardware version
100A	Software version	Software version
1018	Identity	Device identification
1A00	TxPDO Mapping	TxPDO Mapping
1C00	Sync. manager type	Sync. manager type
1C13	TxPDO assign	TxPDO assign

Object 1000h: Device type

1000	VAR	Device type	0x00200000	Unsigned32	ro

Provides information about the used device profile and device type.

Object 1001h: Error register

1001	VAR	Error register	0x00	Unsigned8	ro

Object 1008h: Manufacturer device name

1008	VAR	Device name	IF1032/ETH	Visible String	ro

Object 1009h: Hardware version

1009	VAR	Hardware version	V x.xxx	Visible String	ro

Object 100Ah: Software version

100A	VAR	Software version	V x.xxx	Visible String	ro

Object 1018h: Device identification

1018	RECORD	Identity			

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Vendor ID	0x0000065E	Unsigned32	ro
2	VAR	Product code	0x003EDE73	Unsigned32	ro
3	VAR	Revision	0x00010000	Unsigned32	ro
4	VAR	Serial number	0x009A4435	Unsigned32	ro

The article number is deposit in the product code, the sensor's serial number.

Object 1A00h: TxPDO mapping

1A00	RECORD	TxPDO mapping			
Subindices					
0	VAR	Number of entries	10	Unsigned8	ro
1	VAR	Subindex 001	0x0000:00	Unsigned32	ro
2	VAR	Subindex 002	0x6020:03	Unsigned32	ro
3	VAR	Subindex 003	0x6020:08	Unsigned32	ro
3	VAR	Subindex 004	0x6020:09	Unsigned32	ro
4	VAR	Subindex 005	0x6020:0A	Unsigned32	ro
6	VAR	Subindex 006	0x6020:0B	Unsigned32	ro
7	VAR	Subindex 007	0x6020:0C	Unsigned32	ro
8	VAR	Subindex 008	0x6020:0D	Unsigned32	ro
9	VAR	Subindex 009	0x6020:0E	Unsigned32	ro
10	VAR	Subindex 0010	0x6020:0F	Unsigned32	ro

Object 1C13h: TxPDO assign

1C13	RECORD	TxPDO assign			
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Subindex 001	0x1A00	Unsigned16	ro

A 2.2.2   Manufacturer Specific Objects

Overview

Index (h)	Name	Description
2010	Controller Info	Controller-Information
2020	Channel 1 Info	Information and settings of channel 1
2021	Channel 2 Info	Information and settings of channel 2
2022	Channel 3 Info	Information and settings of channel 3
2023	Channel 4 Info	Information and settings of channel 4
2024	Channel 5 Info	Information and settings of channel 5
2025	Channel 6 Info	Information and settings of channel 6
2026	Channel 7 Info	Information and settings of channel 7
2027	Channel 8 Info	Information and settings of channel 8
2060	Controller Settings	Controller settings
2100	Controller Interface	Ethernet/EtherCAT settings
2110	Sensor Interface	Sensor interface settings
2200	Commands	Commands
6020	Measuring values	Measuring values

Object 2010h: Controller information

2010	RECORD	Controller Info			ro

Subindices

0	VAR	Number of entries	5	Unsigned8	ro
1	VAR	Name	DT6530	Visible String	ro
2	VAR	Serial No	xxxxxxxx	Unsigned32	ro
3	VAR	Article No	xxxxxxx	Unsigned32	ro
4	VAR	Option No	xxx	Unsigned32	ro
5	VAR	Software version	xxx	Visible String	ro

Object 2020h: Channel information

2020	RECORD	Channel 1 Info			ro

Subindices

0	VAR	Number of entries	8	Unsigned8	ro
1	VAR	Name	DL6500	Visible String	ro
2	VAR	Serial No	xxxxxxxx	Unsigned32	ro
5	VAR	Status	Active	Enum	ro
6	VAR	Offset	0	Float	ro
7	VAR	Range	100	Float	ro
8	VAR	Unit	μm	Enum	ro

The structure of objects 2021h to 2027h corresponds to the object 2020h.

Object 2060h: Controller settings

2060	RECORD	Controller Settings			ro

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Samplerate	2083.3 Hz	Float	rw
2	VAR	Averaging type	Off	Enum	rw
3	VAR	Averaging number	2	Unsigned32	rw
4	VAR	Trigger	Off	Enum	rw

Object 2100h: Controller interface

2100	RECORD	Controller Interface			ro

Subindices

0	VAR	Number of entries	7	Unsigned8	ro
1	VAR	Ethernet/EtherCAT	EtherCAT	Enum	rw
3	VAR	Ethernet Address type	Static	Enum	rw
4	VAR	Ethernet IPAddress	169.254.168.150	Visible String	rw
5	VAR	Ethernet Subnet	255.255.0.0	Visible String	rw
6	VAR	Ethernet Gateway	169.254.168.1	Visible String	rw
7	VAR	Ethernet Dataport	10001	Unsigned16	rw

Object 2110h: Sensor interface

2110	RECORD	Sensor Interface			ro

Subindices

0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	Sensor Interface	RS485	Enum	rw
2	VAR	RS485 Baud rate	115200	Unsigned32	rw
3	VAR	RS485 Address	126	Unsigned8	rw

Object 2200h: Commands

2200	RECORD	Commands			ro

Subindices

0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Command	AVT1	Visible String	rw
2	VAR	Command Response	AVT1OK	Visible String	ro

Optional commands can be transmitted with the object 2200h to the interface module, e.g. the math functions as those are not defined in the CoE objects.

Object 6020h: Measuring values

6020	RECORD	Measuring values			ro

Subindices

0	VAR	Number of entries	15	Unsigned8	ro
3	VAR	Counter	xxxx	Unsigned32	ro
8	VAR	Channel 1	xxxx	Float	ro
9	VAR	Channel 2	xxxx	Float	ro
10	VAR	Channel 3	xxxx	Float	ro
11	VAR	Channel 4	xxxx	Float	ro
12	VAR	Channel 5	xxxx	Float	ro
13	VAR	Channel 6	xxxx	Float	ro
14	VAR	Channel 7	xxxx	Float	ro
15	VAR	Channel 8	xxxx	Float	ro

A 2.3   Measurement Data Format

The measuring values are transmitted as Float.

The unit can be read from the channel info objects 2020h to 2027h (Range and Unit).

A 2.4   EtherCAT Configuration with the Beckhoff TwinCAT©-Manager

For example the Beckhoff TwinCAT Manager can be used as EtherCAT master.

▶ Copy the device description file (EtherCAT®-Slave information) `Micro-Epsilon.xml` from the included CD in the directory \\TwinCAT\IO\EtherCAT (for TwinCAT V2.xx) or \\TwinCAT\3.1\Config\IO\EtherCAT (for TwinCAT V3.xx) before the measuring device can be configured via EtherCAT®.

EtherCAT® slave information files are XML files, which specify the characteristics of the slave device for the EtherCAT® master and contain information to the supported communication objects.

▶ Restart the TwinCAT-Manager after copying.

Searching for a device:

▶ Select the tab `I/O Devices,` then `Scan`.

▶ Confirm with `Yes.`
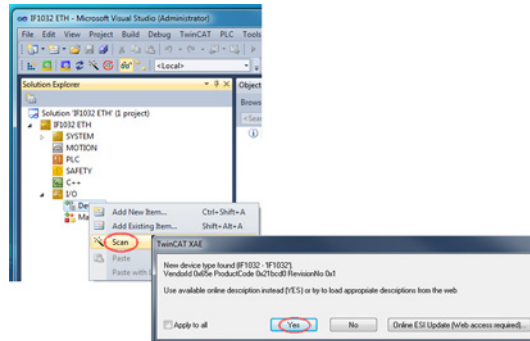
▶ Select a network card, where to look for EtherCAT® slaves.
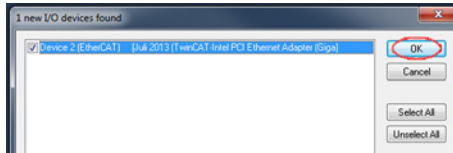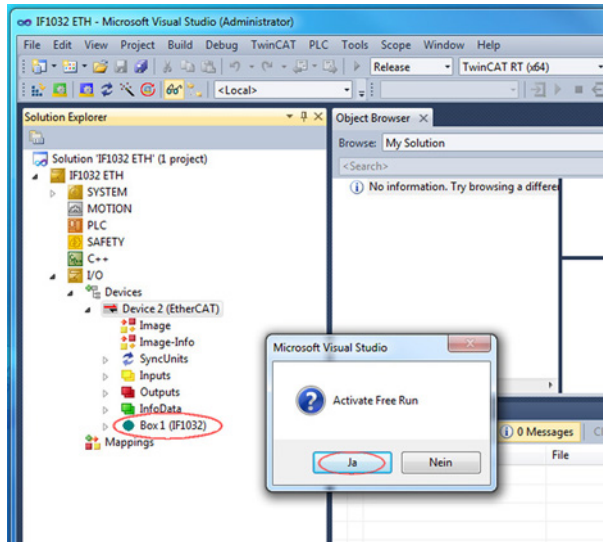
➡ Confirm with `OK`.

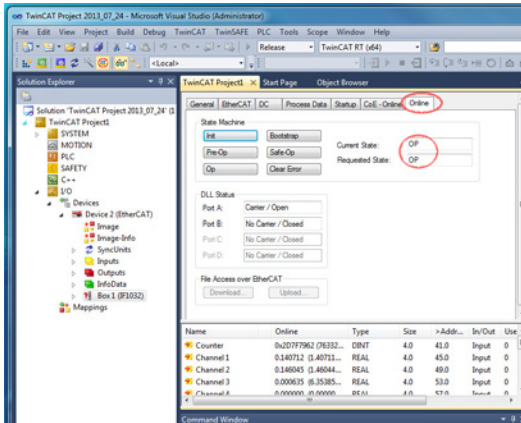The window `Scan for boxes` (EtherCAT® slaves) appears.
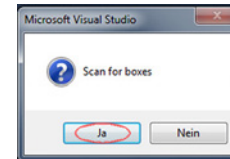
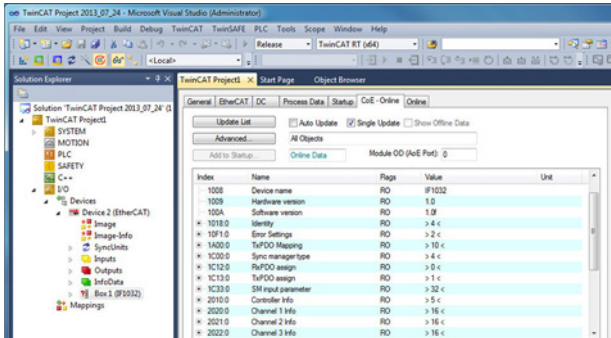➡ Confirm with `Ja/Yes`.

The IF1032/ETH is now shown in a list.

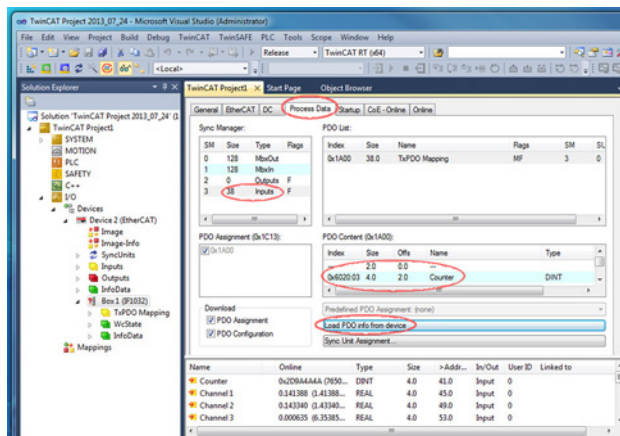➡ Now confirm the window `Activate Free Run` with `Ja/Yes`.

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

Example for a complete object directory (subject to change without prior notice).

On the `Process Data` side the PDO allocations can be read from the device.

The selected measuring values are transmitted as process data in the status `SAFEOP` and `OP`.

Name	Online	Type	Size	>Addr...	In/Out	User ID	Linked to
Counter	0x2D9A4A4A (7650...	DINT	4.0	41.0	Input	0	
Channel 1	0.141388 (1.41388...	REAL	4.0	45.0	Input	0	
Channel 2	0.143340 (1.43340...	REAL	4.0	49.0	Input	0	
Channel 3	0.000635 (6.35385...	REAL	4.0	53.0	Input	0	