MICRO-EPSILON

Operating Instructions

IF2035-EIP

Interface Module

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Contents

1. Safety

System operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in these operating instructions.

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation that may result in property damage if not avoided.
➔	Indicates a user action.
i	Indicates a tip for users.
`Measurement`	Indicates hardware or a software button/menu.

1.2 Warnings

⚠ CAUTION

Connect the power supply and the display/output device according to the safety regulations for electrical equipment.
> Risk of injury
> Damage to or destruction of the interface module

NOTICE

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

Avoid shocks and impacts to the interface module.
> Damage to or destruction of the interface module

1.3 Notes on CE Marking

The following apply to the IF2035-EIP interface module:
- EU Directive 2014/30/EU
- EU Directive 2011/65/EU

Products which carry the CE mark satisfy the requirements of the EU directives cited and the relevant applicable harmonized European standards (EN). The interface module is designed for use in industrial environments.

The EU Declaration of Conformity and the technical documentation are available to the responsible authorities according to the EU Directives.

1.4 Intended Use

- The IF2035-EIP interface module is designed for use in industrial and laboratory applications. It is used to convert the internal MICRO-EPSILON sensor protocol (RS485, RS422) to EtherNet/IP.
- The IF2035-EIP must only be operated within the limits specified in the technical data, see Chap. 2.2.
- The IF2035-EIP must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class: IP20
- Temperature range
  - Operation: 0 ... +50 °C (+32 ... +122 °F)
  - Storage: -20 ... +70 °C (-4 ... +158 °F)
- Humidity: 5 - 95% (non-condensing)
- Ambient pressure: Atmospheric pressure

2. Functional Principle, Technical Data

2.1 Functional Principle

The IF2035-EIP interface module is used to convert the internal Micro-Epsilon sensor protocol (RS485 or RS422) to EtherNet/IP.

Features:

- LED status display
- EtherNet/IP interface
- Housing for top-hat rail

2.2 Technical Data

Model		IF2035-EtherCAT	IF2035-PROFINET	IF2035-EIP
Speed [1]		0.25 ms	1 ms, 0.5 ms (IRT)	1 ms
Supply voltage		9 ... 36 VDC		
Power consumption		approx. 1.25 W with 24 VDC (without sensor)		
Digital interface		RS422, RS485 (with Micro-Epsilon specific data protocol), baud rate 9600 baud ... 4 MBaud, EtherCAT	RS422, RS485 (with Micro-Epsilon specific data protocol), baud rate 9600 baud ... 4 MBaud, PROFINET	RS422, RS485 (with Micro-Epsilon specific data protocol), baud rate 9600 baud ... 4 MBaud, EtherNet/IP
Digital output		Digital output synchronization (TTL, HTL) for RS422 sensors		
Connection		2 x RJ45 for fieldbus, 4 screw terminals for sensor connection and power supply		
Mounting		DIN rail 35 mm		
Temperature range	Storage	-20 ... 70°C		
	Operation	0 ... 50 °C		
Humidity		5 % RH ... 95 % RH (non condensing)		

1 corresponds to the minimum cycle time

Model		IF2035-EtherCAT	IF2035-PROFINET	IF2035-EIP
Shock (DIN EN 60068-2-27)		5 g, 6 ms, 1000 shocks, 3 axes in 2 directions each		
Vibration (DIN EN 60068-2-6)		2 g, sinusoidal excitation with 50 ... 2000 Hz, 10 cycles, 3 axes		
Protection class (DIN EN 60529)		IP20		
Compatibility	RS485	inertialSENSOR: ACC5703, INC5701; capaNCDT 6120; induSENSOR MSC7401, MSC7602, MSC7802, DTD		
	RS422	optoNCDT 1220, 1320, 1420, 1900, 2300; confocalDT 242x, 246x; interferoMETER IMS5400-TH, IMS5400-DS, IMS5600-DS; colorCONTROL ACS7000, MFAx; optoCONTROL 2520; 2700 optoNCDT ILR2250		
Control and indicator elements		4 status LEDs (System, Status, RUN, ERR)	4 status LEDs (System, Status, COM0, COM1)	4 status-LEDs (System, Status, NS, MS)
Special features [2]		EtherCAT compliant 2.3.0.0 / Software integration in PLC: ESI file	Certification: PNIO V2.43 / Software integration in PLC: GSDML file	Certification: CT-19.1 / Software integration in PLC: EDS file
Weight		approx. 120 g		

2 available for download on Micro-Epsilon website

3. Delivery

3.1 Unpacking, Included in Delivery

1 IF2035-EIP interface module
1 Assembly Instructions

➡ Carefully remove the components of the interface module from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.

➡ After unpacking, check immediately for completeness and transport damage.

➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

3.2 Download

EDS file, available at https://www.micro-epsilon.de/service/download/

3.3 Storage

Temperature range storage:	-20 ... +70 °C (-4 ... +158 °F)
Humidity:	5 - 95% (non-condensing)

4. Installation and Assembly

Ensure careful handling during installation and operation.

4.1 Installation of the Interface Module

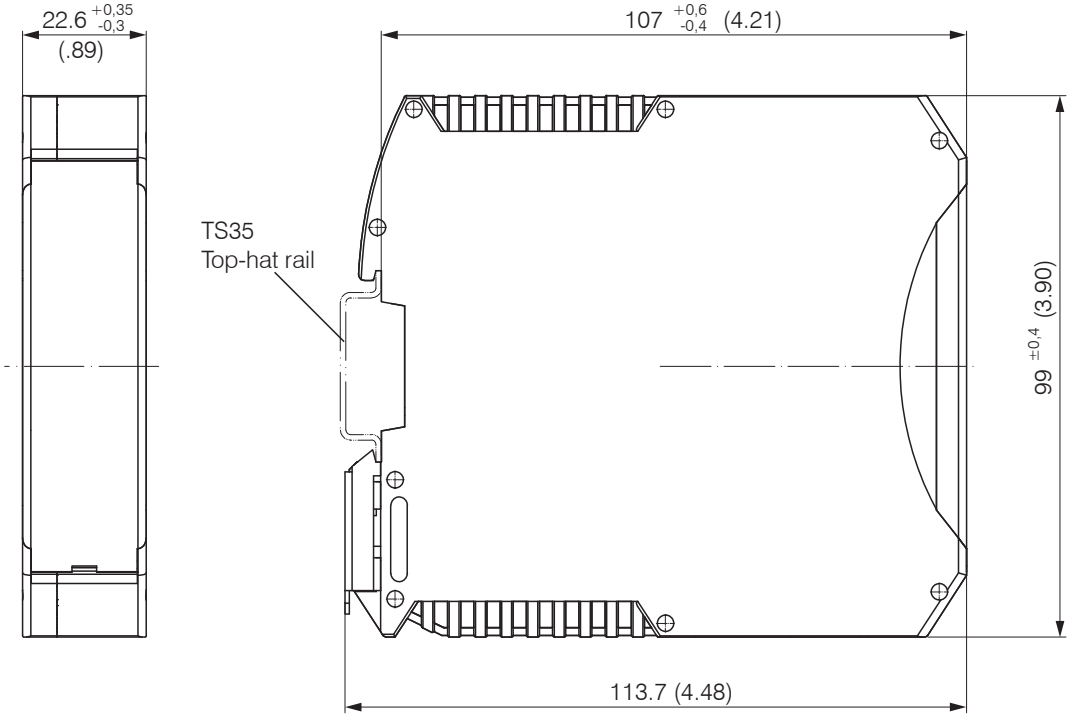


Fig. 1 IF2035-EIP dimensional drawing, dimensions in mm (inches)

4.2 Pin Assignment

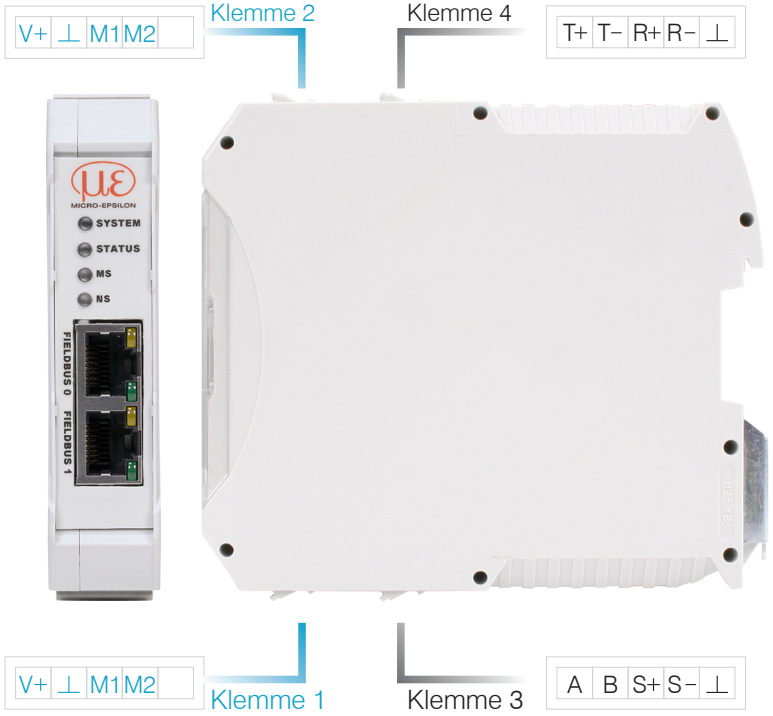


Fig. 2 Interface module terminals

Terminal 1 and 2	
V+	Supply voltage [2]
⊥	Ground for supply voltage
M1, M2	Multifunction input 1/2 sensor
Terminal 1 and 2 connections daisy-chained	

Terminal 4	
T+	RS422 Tx+
T-	RS422 Tx-
R+	RS422 Rx+
R-	RS422 Rx-
⊥	Ground [1] e.g., for RS422 shield connection

Terminal 3	
A	RS485 A
B	RS485 B
S+	Synchronization output +
S-	Synchronization output -
⊥	Ground [1] e.g., for RS485 shield connection

1) Internally connected to supply ground

2) If the distance between IF2035-EIP and the sensor/controller is long, a separate supply for the sensor/controller may be advisable.

4.2.1 Supply Voltage

The supply voltage is daisy-chained from the supply port (terminal 1) to the sensor port (terminal 2), i.e., the supply voltage must match that of the sensor. Positive voltage must be between 9 V and 36 V.

➡ Connect the inputs V+ and ⊥ on terminal 1 to a voltage supply. Maximum cable length 3 m.

The voltage supply must match that of the connected sensor, because the voltage is internally daisy-chained.

MICRO-EPSILON recommends using the optionally available power supply PS2020, input 100 - 240 VAC, output 24 VDC/2.5 A, see Chap. A 1.

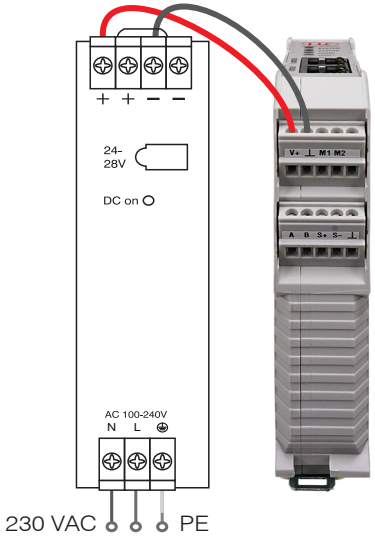


Fig. 3 Interface module with optional PS2020 power supply

If the distance between IF2035-EIP and the connected sensor/controller is long, Micro-Epsilon recommends that a separate supply be used for the sensor/controller.

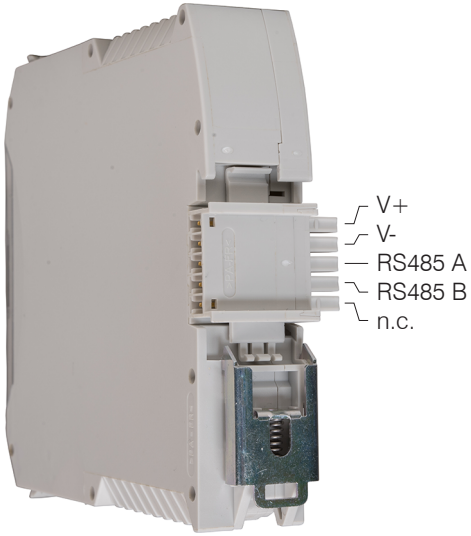
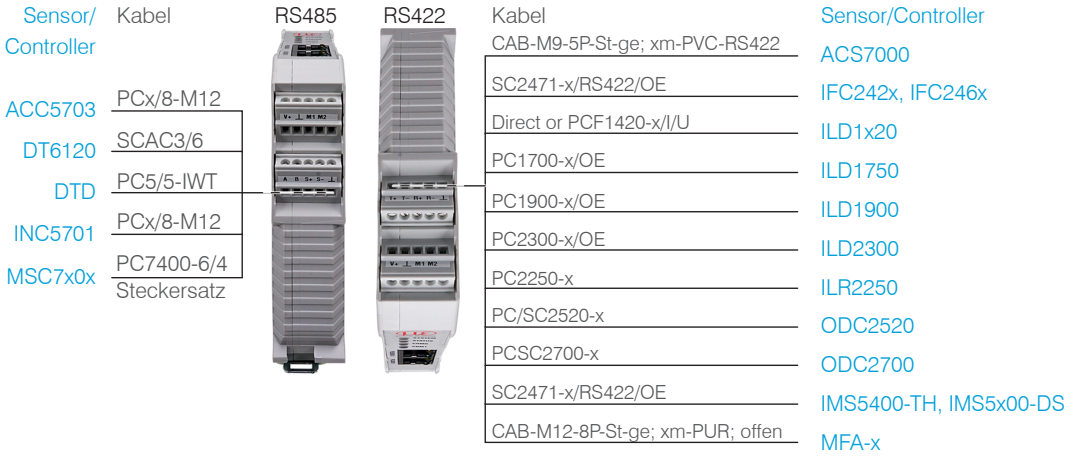


Fig. 4 Optional supply voltage wiring at rear of terminal

4.2.2 Connection Options



The length of the cable between IF2035-EIP and sensor/controller is 10 m at most. Because of the PCx/8-M12 cable, the sensor supply for ACC5703 and INC5701 sensors is possible only via the IF2035-EIP.

Fig. 5 Connection examples for IF2035-EIP

Fig. 6 Connection of an MSC7602 with MSC7602 connector kit

IF2035-EIP	Sensor/Controller
RS422	
T+ T - R+ R -	R+ R - T+ T -
⊥	Cable shield
RS485	
A B	A B
⊥	Cable shield

Fig. 7 Wiring regulation for connections with RS485 or RS422

4.2.4 Cable Termination at Interface

Ensure correct cable termination for an RS485 bus or RS422 bus!

We recommend a 120 Ohm terminating resistor between the signal lines at both the bus start and end. IF2035-EIP works as a master for both interfaces; internally, a 120 Ohm terminating resistor has already been permanently incorporated. The IF2035-EIP should be at the bus start.

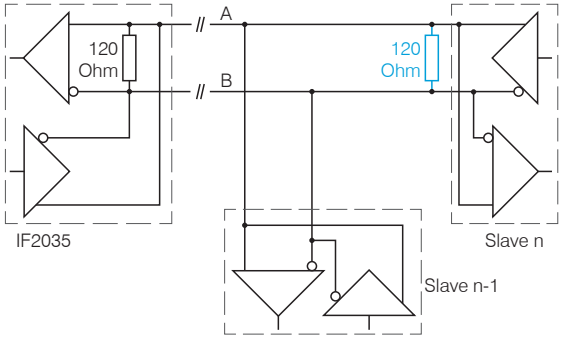


Fig. 8 Cable termination RS485, n = max. 16 slaves

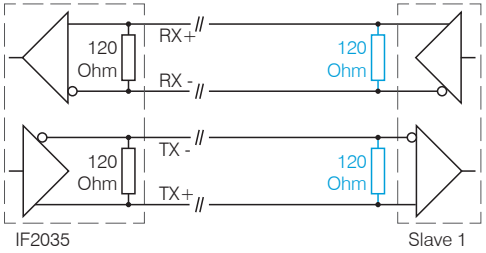


Fig. 9 Cable termination RS422

4.3 Fieldbus Cabling

During cabling, channel 0 of the scanner is connected to a port of adapter 1 (slave device).

The second port of the adapter 1 is connected to the port of the next adapter, etc. One port of the last adapter and channel 1 of the master device (scanner) remain unused.

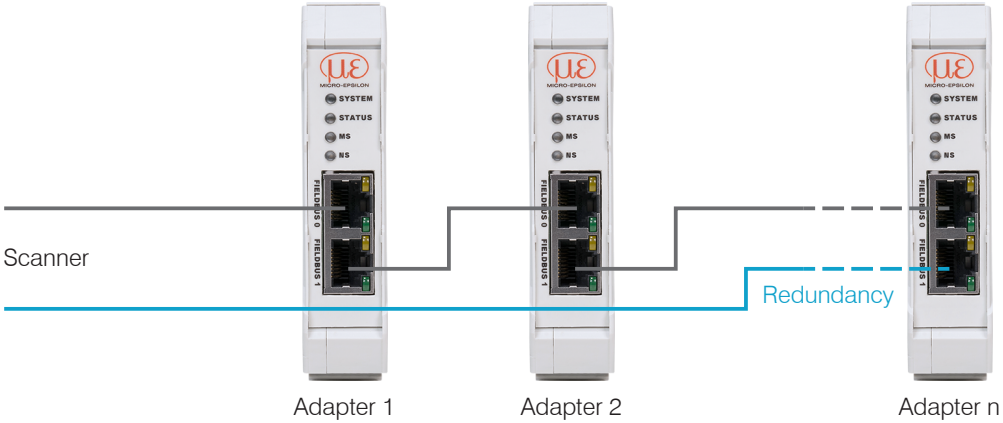


Fig. 10 Cabling in the EtherNet/IP network

Optional: IF2035-EIP can participate in a device level ring as a ring node and thereby reduce the threat of failures through redundant cabling.

5. Commissioning

5.1 Configuring the Sensors

The sensor used must be correctly configured to work with the IF2035. Micro-Epsilon recommends that the sensor's base configuration be set by using its web interface. The configuration can later also be adjusted via fieldbus.
Please refer to the operating instructions of the corresponding sensor for detailed information on configuring the sensor.

5.2 Baud Rate and Sensor Interface

IF2035-EIP must be set for the interface used and the sensor's baud rate.

Sensor/Controller	Baud rate [Baud]	RS485	RS422
ACC5703	230400	•	
ACS7000	230400		•
DT6120	230400	•	
DTD	256000	•	
IFC242x, IFC246x	115200		•
ILD1220, ILD1320	921600		•
ILD1420	921600		•
ILD1750, ILD1900	921600		•

Sensor/Controller	Baud rate [Baud]	RS485	RS422
ILD2300	921600 [1]		•
ILR2250	115200		•
IMS5400-TH, IMS5x00-DS	115000		•
INC5701	230400	•	
MFAx	115200		•
MSC7401, MSC7x02	256000	•	
ODC2520	115200		•
ODC2700	921600		•

Fig. 11 Baud rate (factory setting) of the sensors or controllers to be connected

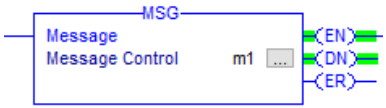
The baud rate and sensor interface are transferred with Class 0xA0 (Object), see Chap. 5.4.

1) The ILD2300 is set for 691.2 kBaud ex factory. Increase the baud rate to 921.6 kBaud in the sensor.

5.2.1 Option 1: MSG Command

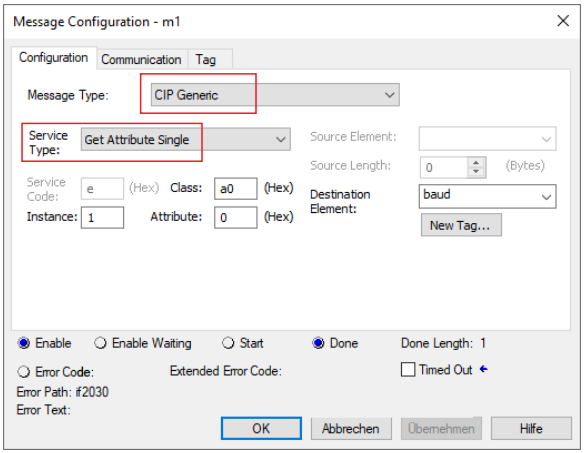
An MSG command is configured as follows:

➡ Click the button ... .

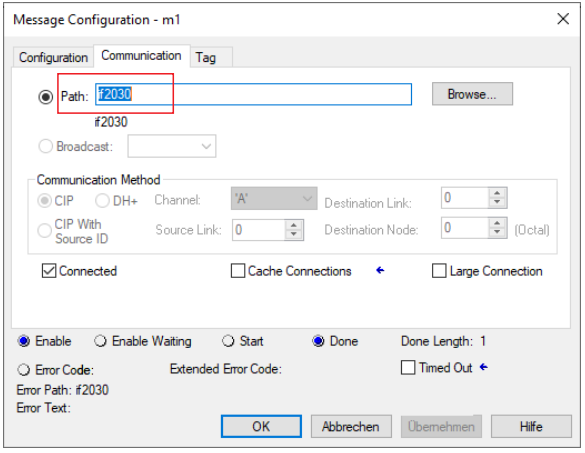


➡ Click the `Configuration` tab and set type `CIP Generic` as `Message Type`.

The following `Service Types` are possible:
- Get Attribute Single or
- Set Attribute Single.

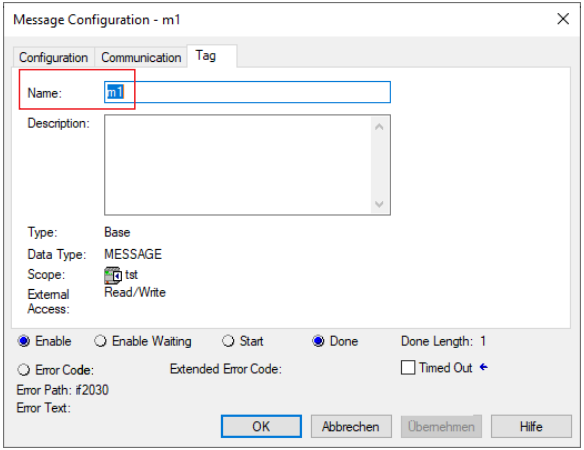


➡ Click the `Communication` tab and select the target device using the `Browse` button in the `Path` field.



➡ Click the `Tag` tab and assign an element name in the `Name` field.

Nothing needs to be set here. The Message Configuration dialog is only available if a tag of type `Message` had been previously entered in the MSG element. In the example above, `m1` was chosen for this purpose.



5.2.2 Option 2: External Software

IF2035-EIP can also be configured beyond the PLC (e.g., with a software tool) by using EtherNet/IP Explicit Messaging.

The software used for this purpose must support the following services:

- 0x0E – Get Attribute Single as well as
- 0x10 – Set Attribute Single.

5.3 Data Format

All configuration parameters and data are transmitted in Little Endian format.

Sensors/controllers with RS422: cyclical data are decoded, i.e., a 4th byte is added to the 3 bytes and then transmitted. The sensor signals selected for transfer and their sequence are available on the sensor's web interface.

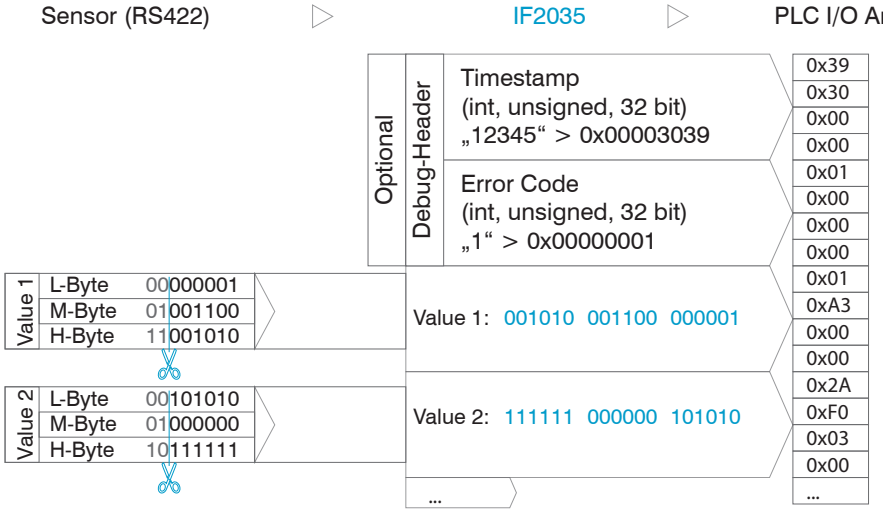


Fig. 12 Interpretation of RS422 sensor data in IF2035-EIP

Sensors/controllers with RS485: cyclical data are transmitted via the fieldbus without change, i.e., as a binary block as described and supplied by the sensor. Please refer to the sensor's operating instructions for the data set structure.

5.4 Class Directory

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x80	1	0	Uint8	RW	Select sensor	✓		Address of currently selected sensor
	1	1	Uint8[32]	R	Sensor addresses	✓		Shows address list of available sensors
0x90	0		Uint32[64]	R	Device error log	✓	✓	Reads out the last 32 error codes with time stamp
0xA0	1	0	Uint32	RW	Baudrate	✓	✓	IF2035 baud rate
		1	Uint8	RW	Minimum cycle time	✓	✓	Minimum time for one communication cycle in ms, cycle time = 0: use estimated time
		3	Uint8	RW	Sensor interface	✓	✓	0: RS485 (ME bus), 1: Reserved, 2: RS422 with 3 byte 3: RS422 with variable byte
		4	Uint8	W	Reset device config	✓	✓	One byte deletes settings from flash, settings are included in RAM until restart
		5	Uint8	W	Reset sensor config	✓		One byte deletes settings from flash, settings are included in RAM until restart
		6	Uint8	W	Reset device	✓	✓	One byte performs reset
		7	Uint8	RW	enable/disable HTTL Sync	✓	✓	0: Disable HTTL synchronization 1: Enable HTTL synchronization
		8	Uint8	RW	Enable/disable cyclic measurement command		✓	Enables/disables sending the cyclic measurement command “OUTPUT RS422” if no data are received. Modification only in special cases, where multiple output interfaces selected on the sensor.
		9	Uint8	RW	Enable/disable ME-Bus compatibility check	✓		Enable/disable ME-Bus article number checking, if Article number checking is enabled only
		10	Uint8	RW	Reset debug header error	✓	✓	Resets the error stored in debug header

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0310	1				Device Info	✓		Read out the block of the current sensor
		0	Uint8	R	Number of objects			
		1	Uint8	R	Block version			Block version
		2	Uint8	R	Endianness			Endian
		3	Uint16	R	Software version			Software version
		4	Int32	R	Article number			Part number
		5	Int32	R	Option			Option
		6	Int32	R	Batch number			Batch number
		7	Int32	R	Serial number			Serial number
		8	Uint8	R	Change index			Change index
		9	Uint8	R	Calibration day			Day of calibration
		10	Uint8	R	Calibration month			Month of calibration
		11	Uint8	R	Calibration year			Year of calibration
		12	Uint16	R	Calibration software version			Version of calibration software
		13	Uint16	R	Test software version			
		14	Uint8	R	Test hour			
		15	Uint8	R	Test day			
		16	Uint8	R	Test month			
		17	Uint8	R	Test year			
		18	Int32	R	Article number circuit board			
		19	Int32	R	Serial number circuit board			
		20	Uint8[32]	R	Name			
		21	Uint8	R	sensor/channel count			
		22	Uint8	R	protocol block count			
		23	Uint8[164]	R	protocol blocks			

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0313	1				Diagnostic block	✓		RS485 bus diagnostic block (if available)
		0	Uint8		Number of objects			
		1	Uint8	RW	Page index to read			Specifying an index lets you scroll through existing pages
		2	Uint8	R	Number of pages			
		3	Uint8	R	Diagnose Type			
		4	Uint8[235]	R	String Page			Diagnostic message

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0320	1				Sensor block	✓		Request sensor information
		0	Uint8	R	Number of objects			
		1	Uint8	RW	block index offset			The offset lets you scroll through existing sensor blocks [0 - 0x1F]
		2	Uint8	RW	page index to read			Specifying an index lets you scroll through existing pages
		3	Uint8	R	number of pages			Max. number of pages
		4	Uint8	R	measurement unit			Signal unit
		5	Int32	R	article number			Part number
		6	Int32	R	Option			Option
		7	Int32	R	Batch number			Batch number
		8	Int32	R	serial number			Serial number
		9	Float	R	Nominal measuring range			Nominal measuring range
		10	Float	R	Nominal offset			Nominal offset
		11	Float	R	current measuring range			Actual measuring range
		12	Float	R	current offset			Actual offset
		13	Uint8[32]	R	Target material			Target material
		14	Uint8[32]	R	Sensor/channel name			Sensor/channel name
		15	uint8	R	extension length			Length of block extension
		16	uint8[138]	R	extension			

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0390	1				Parameter Info	✓		Request configuration parameters, e.g., sensor exposure time, request via subindex 1, configure interface with Class 0x2510 through 0x2540
		0	Uint8	R	Number of objects			
		1	Uint16	RW	Parameter ID			Please refer to the sensor documentation for available parameter IDs and their types
		2	Uint8[14]	R	Name			
		3	Uint8[8]	R	Unit			
		4	Uint8[8]	R	Type			

0x0410	1				Float parameter	✓		Read or write float parameter
		0	Uint8		Number of objects			
		1	Uint16	RW	Parameter ID			Please refer to the sensor documentation for available parameter IDs and their types
		2	Uint8	RW	Reserved			
		3	Float	RW	Value			Value
		4	Uint8[14]	R	Name			Designation
		5	Uint8[8]	R	Unit			Unit as a string
		6	Float	R	Min			
		7	Float	R	Max			

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0411	1				Int Parameter	✓		Read or write integer parameter
		0	Uint8		NrOfObjects			
		1	Uint16	RW	Parameter ID			Please refer to the sensor documentation for available parameter IDs and their types
		2	Uint8	RW	Reserved			
		3	Int32	RW	Value			Value
		4	Uint8[14]	R	Name			Designation
		5	Uint8[8]	R	Unit			Unit as a string
		6	Int32	R	Min			
		7	Int32	R	Max			

0x0412	1				Uint Parameter	✓		Read or write unsigned integer parameter
		0	Uint8		NrOfObjects			
		1	Uint16	RW	Parameter ID			Please refer to the sensor documentation for available parameter IDs and their types
		2	Uint8	RW	Reserved			
		3	Uint32	RW	Value			Value
		4	Uint8[14]	R	Name			Designation
		5	Uint8[8]	R	Unit			Unit as a string
		6	Uint32	R	Min			
		7	Uint32	R	Max			

Class	Instance	Attribute	Data type		Name	RS485	RS422	Description
0x0413	1				String Parameter	✓		Read or write string parameter
		0	Uint8		NrOfObjects			
		1	Uint16	RW	Parameter ID			Please refer to the sensor documentation for available parameter IDs and their types
		2	Uint8	RW	Reserved			
		3	Uint8[246]	RW	Value			Value
		4	Uint8[14]	R	Name			Designation
0x0430	1				RS422 ASCII Access		✓	RS422 commando
		1	Uint8[128]	RW	Send Cmd			Buffer for a 128-character ASCII command, termination with '\n' or 0x0A
		2	Uint8[896]	R	Cmd Answer			Answer from sensor without shortening, e.g., Line feed; if buffer overflows, e.g., PRINT ALL, answer is truncated

If time synchronization has been enabled on the scanner (SPS), a synchronized signal can be tapped at the S+/S- terminal. Signal timing can be configured by using Class 0x43, Instance 1, Attribute 768 (0x300).

	Parameter	**Unit**	**Default**	**Min**	**Max**	**Comments**
Byte 0 - 3	Sync Intervall	ns	500,000,000	10,000	500,000,000	Synchronization interval 10 µs ... 500 ms
Byte 4 - 7	Sync Offset	ns	0	0	Sync Interval -1	
Byte 8 - 11	Res. Sync Interval	ns	500,000,000	10,000	500,000,000	
Byte 11 - 15	Res. Sync Offset	ns	150	0	Res. Sync Interval - 1	|Sync Offset – Res. Sync Offset| > 150
Byte 16 - 19	Pulse Length	µs	4	1	500	Pulse length < min (SyncOffset, Res.Sync Offset)

Changes only take effect after IF2035-EIP has been restarted.
Please use Class 0xA0, Instance 1, Attribute 7 to configure the level (TTL/HTL).

6. Disclaimer

All components of the device have been checked and tested for functionality in the factory. However, should any defects occur despite careful quality control, these shall be reported immediately to MICRO-EPSILON or to your distributor / retailer.

MICRO-EPSILON undertakes no liability whatsoever for damage, loss or costs caused by or related in any way to the product, in particular consequential damage, e.g., due to

- non-observance of these instructions/this manual,
- improper use or improper handling (in particular due to improper installation, commissioning, operation and maintenance) of the product,
- repairs or modifications by third parties,
- the use of force or other handling by unqualified persons.

This limitation of liability also applies to defects resulting from normal wear and tear (e.g., to wearing parts) and in the event of non-compliance with the specified maintenance intervals (if applicable). MICRO-EPSILON is exclusively responsible for repairs. It is not permitted to make unauthorized structural and / or technical modifications or alterations to the product. In the interest of further development, MICRO-EPSILON reserves the right to modify the design.

In addition, the General Terms of Business of MICRO-EPSILON shall apply, which can be accessed under Legal details | Micro-Epsilon https://www.micro-epsilon.com/impressum/.

For translations into other languages, the German version shall prevail.

7. Service, Repair

If the interface module is defective, please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire system to

MICRO-EPSILON MESSTECHNIK
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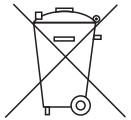
8. Decommissioning, Disposal

In order to avoid the release of environmentally harmful substances and to ensure the reuse of valuable raw materials, we draw your attention to the following regulations and obligations:

- Remove all cables from the sensor and/or controller.
- Dispose of the sensor and/or the controller, 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.
- You are obliged to comply with all relevant national laws and regulations.

For Germany / the EU, the following (disposal) instructions apply in particular:

- Waste equipment marked with a crossed garbage can must not be disposed of with normal industrial waste (e.g. residual waste can or the yellow recycling bin) and must be disposed of separately. This avoids hazards to the environment due to incorrect disposal and ensures proper recycling of the old appliances.



- A list of national laws and contacts in the EU member states can be found at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en. Here you can inform yourself about the respective national collection and return points.
- Old devices can also be returned for disposal to MICRO-EPSILON at the address given in the imprint at https://www.micro-epsilon.de/impressum/.
- We would like to point out that you are responsible for deleting the measurement-specific and personal data on the old devices to be disposed of.
- Under the registration number WEEE-Reg.-Nr. DE28605721, we are registered at the foundation Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg, as a manufacturer of electrical and/or electronic equipment.

Appendix

A 1 Optional Accessories

PS2020

Power supply; installation of top-hat rail,
2.5 A, input 100 - 240 VAC,
output 24 VDC/2.5 A, installation type;
installation on symmetrical standard rail
35 mm x 7.5 mm, DIN 50022

A 2 Factory Settings

Baud rate	921600 Baud
cycleMinTime	0 (= IF2035 calculates cycle time)
SensorInterface	RS422 with 3 byte
HTTL	OFF

A 3 Sensor Values, Data Format, Conversion

A 3.1 General

The sensors or controllers do not solely output distance values. The overview below describes the conversion during output of distance values. Please refer to the corresponding operating instructions for detailed information on conversion when additional values are output.

A 3.2 ACC5703

Baud rate 230400 b/s RS485 half duplex Max. sampling rate 1 kHz: measurements with variable number ex factory scaled to ±2 g, Little Endian

Bus address 126

Byte Data	Meaning	Data format
Data[0]	Status byte (contains error flags, normally 0x00)	8 bit
Data[1] ... Data[4]	Measured value counter [bit 0:31]	Uint 32 bit
Data[5]	Number of measured values in this package = 3*x mit x [1 ... 19]	8 bit
Data[6]	Padding-Byte	8 bit
Data[7]	Padding-Byte	8 bit
Data[8]	Measuring value 1 x-axis [bit 0:7]	Float 32 bit
Data[9]	Measuring value 1 x-axis [bit 8:15]	
Data[10]	Measuring value 1 x-axis [bit 16:23]	
Data[11]	Measuring value 1 x-axis [bit 24:31]	
...	...	
Data[n] n=8+(4*Data [5]/3)	Measuring value 1 x-axis [bit 0:7]	Float 32 bit
Data[n+1]	Measuring value 1 x-axis [bit 8:15]	
Data[n+2]	Measuring value 1 x-axis [bit 16:23]	
Data[n+3]	Measuring value 1 x-axis [bit 24:31]	
...	...	...
Data[n+m] m=4*Data[5]/3	Measuring value 1 z-axis [bit 0:7]	Float 32 bit
Data[n+m+1]	Measuring value 1 z-axis [bit 8:15]	
Data[n+m+2]	Measuring value 1 z-axis [bit 16:23]	
Data[n+m+2]	Measuring value 1 z-axis [bit 24:31]	

Please refer to the operating instructions for the acceleration sensor for more information.

The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--inertialSENSOR-ACC5703--en.pdf

Fig. 14 Encoding of Measured Data in the Transmission Protocol, ACC5703

A 3.3 ACS7000

RS422	Measuring rate 250 Hz ex factory, all color values and color distances. Up to 32 output values can be transmitted at the same time.
Baud rate	115200 b/s

ACS7000 supplies 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

Group	Name	Index	Raw		Scaled			
			Min	Max	Min	Max	Formula	Unit
Status	Framerate	1	2500	250000	20,00	2000,00	10 ^ 6/(x*12,5*2 ^ 4)*1000	Hz
	Shutter	2	2500	250000	20,00	2000,00	x*12,5*2 ^ 4)/10 ^ 9	µs
	TempDetector	3	-1024	1023	-256,00	255,75	x/4	°C
	TempLightSrc	4	-1024	1023	-256,00	255,75	x/4	°C
LightSensor	Red	5	0	65535	0,00	100,00	x/65536*100	%
	Green	6	0	65535	0,00	100,00	x/65536*100	%
	Blue	7	0	65535	0,00	100,00	x/65536*100	%
	Brightness	8	0	65535	0,00	100,00	x/65536*100	%
Status	Counter	9	0	262143	0	262143	x	-
	Timestamp	10	0	262143	0,00	67,11	x*256/100000	s
Color	XYZ	11-13	0	131072	0,00	256,00	x/512	-
	RGB	14-16	0	131072	0,00	256,00	x/512	-
	LAB	17-19	-131072	131071	-256,00	256,00	x/512	-
	LUV	20-22	-131072	131071	-256,00	256,00	x/512	-
	LCH (L/C)	23-24	-131072	131071	-256,00	256,00	x/512	-
	LCH (H)	25	0	131071	0,00	256,00	x/512	°
	LAB99	26-28	-131072	131071	-256,00	256,00	x/512	-
	LCH99 (L/C)	29-30	-131072	131071	-256,00	256,00	x/512	-
	LCH99 (H)	31	0	184320	0,00	360,00	x/512	°

Group	Name	Index	Raw		Scaled			
			Min	Max	Min	Max	Formula	Unit
Status	Error	32	0	262143	0	262143	x	-
Distance	1_1/2/3	33-35	NA	-				
	…	36-77						
	16_1/2/3	78-80		-				
	Min_1/2/3	81-83	-131072	131071	-256,00	256,00	x/512	-
	DetectedID	84	0	16	0	16	-	-
	MinDistID	85	0	16	0	16	-	-

Fig. 15 Overview of output data via RS422

Please refer to the operating instructions for the color measuring system colorCONTROL ACS7000 for more information, especially about possible output values. The current version is available at:

https://www.micro-epsilon.com/download/manuals/man--colorCONTROL-ACS7000--en.pdf

A 3.4 DT6120

Baud rate	230400 b/s	RS485 half duplex	Measurements ex factory scaled to sensor measuring range, Little Endian
Bus address	126		

Measuring data consist of a counter, the packet length m and the measurements. The packet length m determines how many measurements are transmitted. The packet length m is the number of measurements that have been queried by the electronic system since the last time measuring data were queried, but is limited to the most recent 20 measurements. The first measurement in the data [] package is the oldest value queried, the last one is the most recently queried value.

Byte Data	Meaning	Data format
Data[0]	Counter [7:0]	unsigned short
Data[1]	Counter [15:8]	
Data[2]	Packet length m [7:0]	unsigned char
Data[3]	Filler byte [7:0]	unsigned char
Data[4]	Measuring value 1 [7:0]	signed integer
Data[5]	Measuring value 1 [15:8]	
Data[6]	Measuring value 1 [23:16]	
Data[7]	Measuring value 1 [31:24]	
	. . .	
Data[..]	Measuring value m [7:0]	signed integer
Data[..]	Measuring value m [15:8]	
Data[..]	Measuring value m [23:16]	
Data[..]	Measuring value m [31:24]	

Scaling of measurements

BY default, 24-bit measurements are transmitted.
The following equivalences therfore apply:

0x0 = 0 % of the sensor measuring range

0xF00000 = 100 % of the sensor measuring range

If the sensor is outside the measuring range, accordingly larger measurements are output.

Fig. 16 Encoding of Measured Data in the Transmission Protocol, DT6120

Please refer to the operating instructions for the capacitive displacement measuring system for more information. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--capaNCDT-6110-6120IP--en.pdf

A 3.5 IFC2421, IFC2422, IFC2451, IFC2461, IFC2471

RS422	Up to 32 output values can be transmitted at the same time. The data are configured or selected via ASCII commands or via the web interface.
Baud rate	115200 b/s ex factory

Ex factory, the controller is set for the `Distance measurement` measuring program. Please refer to the associated operating instructions for descriptions of additional measuring programs. IFC24xx supplies 3 bytes per value at the output. These bytes are coded by the IF2035/-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in µm using the following formula:

$$x = \frac{(d_{OUT} - 98232) * MR}{65536}$$

x	=	Displacement / Thickness in mm
d_{OUT}	=	digital output value
MR	=	Measuring range in mm
131000	=	Midrange for the displacement measurement

Please refer to the operating instructions for the confocal distance measuring system
- confocalDT 2421/2422
- confocalDT 2451/2461/2471

for more information, especially about possible output values.

The current version is available at:

https://www.micro-epsilon.com/download/manuals/man--confocalDT-2421-2422--en.pdf

https://www.micro-epsilon.de/download/manuals/man--confocalDT-2451-2461-2471--en.pdf

A 3.6 ILD1220, ILD1320, ILD1420

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	921600 baud ex factory

The sensor can continue to supply measurements to the RS422 output even while the sensor is communicating.

The digital measurements are output at the sensor as unsigned digital values (raw values). The sensors supply 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in µm using the following formula:

Value	Variables	Value range	Formula
Distance [1]	x = digital value	[0; <643] SMR reserve [643; 64877] Measuring range [>64877; 65520] EMR reserve	$d\ [\mathrm{mm}] = \frac{1}{100}\left(\frac{102}{65520}\,x - 1\right) * MR\ [\mathrm{mm}]$
	MR = measuring range [mm]	{10/25/50/100/200/500}	
	d = distance [mm]	[-0.01MR; 1.01MR]	

Fig. 17 Calculation of distance value from the digital value, ILD1220/1320/1420

Please refer to the operating instructions for the laser-optical displacement sensors optoNCDT 1220/1320/1420 for more information, especially about possible output values. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-1220--en.pdf

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-1320--en.pdf

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-1420--en.pdf

1) Distance value without the Master function.

A 3.7 ILD1750

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	921600 baud ex factory

i The sensor can continue to supply measurements to the RS422 output even while the sensor is communicating.

The digital measurements are output at the sensor as unsigned digital values (raw values). The sensors supply 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in µm using the following formula:

Value	Variables	Value range	Formula
Distance	x = digital value	[0; 230604]	$d\ [\text{mm}] = \frac{x - 98232}{65536} * MR\ [\text{mm}]$
	MR = measuring range [mm]	{2/10/20/50/100/200/500/750}	
	d = distance [mm]	without Mastern [-0.01MR; 1.01MR]	
		with Mastern [-2MR; 2MR]	

Fig. 18 Calculation of distance value from the digital value, ILD1750

Please refer to the operating instructions for the laser-optical displacement sensors optoNCDT 1750 for more information, especially about possible output values. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-1750--en.pdf

A 3.8 ILD1900

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	921600 baud ex factory

i The sensor can continue to supply measurements to the RS422 output even while the sensor is communicating.

The digital measurements are output at the sensor as unsigned digital values (raw values). The sensors supply 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in µm using the following formula:

Value	Variables	Value range	Formula
Distance	x = digital value	[0; 230604]	$d\ [\text{mm}] = \frac{x - 98232}{65536} * MR\ [\text{mm}]$
	MR = measuring range [mm]	{2/10/25/50/100/200/500}	
	d = distance [mm]	without Mastern [-0.01MR; 1.01MR]	
		with Mastern [-2MR; 2MR]	

Fig. 19 Calculation of distance value from the digital value, ILD1900

Please refer to the operating instructions for the laser-optical displacement sensors optoNCDT 1900 for more information, especially about possible output values. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-1900--en.pdf

A 3.9 ILD2300

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	691200 baud ex factory [1]

i The sensor can continue to supply measurements to the RS422 output even while the sensor is communicating.

The digital measurements are output at the sensor as unsigned digital values (raw values). 16 Bit per value are transmitted. The sensors supply 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in mm using the following formula:

Value	Variables	Value range	Formula
Distance	x = digital value	[0; <643] SMR reserve [643; 64877] Measuring range [>64877; 65520] EMR reserve	$d\ [\mathrm{mm}] = \frac{1}{100}\left(\frac{102}{65520}\,x - 1\right) * MR\ [\mathrm{mm}]$
	MR = measuring range [mm]	{10/25/50/100/200/500}	
	d = distance [mm]	[-0.01MR; 1.01MR]	

Fig. 20 Calculation of distance value from the digital value, ILD2300

Please refer to the operating instructions for the laser-optical displacement sensors optoNCDT 2300 for more information, especially about possible output values. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--optoNCDT-2300--en.pdf

1) When delivered, ILD2300 is set for 691.2 kBaud. Increase the baud rate to 921.6 kBaud in the sensor.

A 3.10 ILR2250

RS422 The data are configured or selected via ASCII commands or via the web interface.

Baud rate 115200 b/s ex factory

i The sensor can continue to supply measured values to the RS422 output even while the sensor is communicating.

28 bits each output value are transmitted via RS422. Each data frame consists of the timestamp in ms and the distance in 1/10 mm, followed by a footer byte.

- The sensor sends data in big endian format.
- Each value is transmitted in 4 bytes; the lower 7 bits are used for the data.
- The IF2035-EIP extracts the distance value from the data frame and deletes the flag bits.
- The 4*7 bits are combined into a 28 bit value.
- The IF2035-EIP sends data in little endian format.

Distance value in millimeter:

The user or a PLC must divide the transmitted value by 10 to obtain distance values with a resolution of 0.1 mm.

A 3.11 INC5701

Baud rate 230400 b/s RS485 half duplex max. sampling rate 250 Hz, ex factory INC5701D, Little Endian
Bus address 126

Byte	Meaning	Data format
Data[0]	Status byte (contains error flags, normaly 0x00)	8 bit
Data[1]	Long term values counter [bit 0:7]	Uint 32 bit
Data[2]	Long term values counter [bit 8:15]	
Data[3]	Long term values counter [bit 16:23]	
Data[4]	Long term values counter [bit 24:31]	
Data[5]	Number of measured values in this package	8 bit
Data[6]	Padding byte	8 bit
Data[7]	Padding byte	8 bit
Data[8]	Measured value 1 [bit 0:7]	Float 32 bit
Data[9]	Measured value 1 [bit 8:15]	
Data[10]	Measured value 1 [bit 16:23]	
Data[11]	Measured value 1 [bit 24:31]	
Data[12]	Measured value 2 [bit 0:7]	Float 32 bit
Data[13]	Measured value 2 [bit 8:15]	
Data[14]	Measured value 2 [bit 16:23]	
Data[15]	Measured value 2 [bit 24:31]	

Fig. 21 Encoding of Measured Data in the Transmission Protocol, INC5701S

Byte Data	Meaning	Data format
Data[0]	Status byte (contains error flags, normally 0x00)	8 bit
Data[1] ... Data[4]	Measured value counter [bit 0:31]	Uint 32 bit
Data[5]	Number of measured values in this package	8 bit
Data[6], Data[7]	Padding-Byte	8 bit
Data[8]	Measuring value 1 LP [1] [bit 0:7]	Float 32 bit
Data[9]	Measuring value 1 LP [1] [bit 8:15]	
Data[10]	Measuring value 1 LP [1] [bit 16:23]	
Data[11]	Measuring value 1 LP [1] [bit 24:31]	
Data[12]	Measuring value 2 LP [1] [bit 0:7]	
Data[13]	Measuring value 2 LP [1] [bit 8:15]	
Data[14]	Measuring value 2 LP [1] [bit 16:23]	
Data[15]	Measuring value 2 LP [1] [bit 24:31]	
...	...	...
Data[n] n=8+(4*Data [5])	Measuring value 2 SF [2] [bit 0:7]	Float 32 bit
Data[n + 1]	Measuring value 2 SF [2] [bit 8:15]	
Data[n + 2]	Measuring value 2 SF [2] [bit 16:23]	
Data[n + 3]	Measuring value 2 SF [2] [bit 24:31]	
Data[n + 4]	Measuring value 2 SF [2] [bit 24:31]	
Data[n + 5]	Measuring value 2 SF [2] [bit 24:31]	
...	...	

Fig. 22 Encoding of Measured Data in the Transmission Protocol, INC5701D

1) LP = Low pass filter 2) SF = SensorFUSION filter

Please refer to the operating instructions for the inclination sensor for more information. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--inertial-SENSOR-INC5701--en.pdf

The measurement data consits of one status byte, measured values counter, number of measured values, and the measured data. The measured values counter increases continuously with each sampled value. It represents the number of measured values transmitted in this package (floats). The first measurement value in the Data [] package is the oldest measured value. A measured value is represented as 4-byte float data type in the unit angular degrees [°].

A 3.12 DTD, MSC7401, MSC7602, MSC7802

Baud rate 256000 baud ex factory, [9600 ... 256000] RS485 half duplex Measurements ex factory scaled to analog value, Little Endian

Bus address 126 [2 ... 126]

Sequence for a measurement value request:

Send	0x10	0x7E [1]	0x01 [2]	0x4C	0xCB [3]	0x16									
Receive	0x68	0x0B	0x0B	0x68	0x01 [2]	0x7E [1]	0x08	0xAE	0x47	0x61	0x3F	0x00	0x00	0x00	0x00
	0x1C [4]	0x16													

Result	Description	Format	Example
	Unscaled value	Bytes 8 - 11: 4 Bytes, float, Little-Endian	0x3F6147AE (float) = 0.88 V
	Scaled value	Bytes 12 - 15: 4 Bytes, float, Little-Endian	If this value is 0, the controller was not set up. Otherwise, the digital counterpart of the analog output will be sent according the setting you have done in the controller before.
	Maximum speed for data transmission (1x send + 1x receive): ~3 ms @ 256.000 Baud		

1) DA: 126
2) SA: 1
3) CH: Checksum Send: Bytes 2 - 4
4) CH: Checksum Receive: Bytes 5 - 15

Fig. 23 Encoding of Measured Data in the Transmission Protocol, MSC7602

Please refer to the operating instructions for the inductive displacement measuring system for more information.
The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--induSENSOR-MSC7xxx--en.pdf

A 3.13 ODC2520

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	115200 Baud ex factory

Ex factory, the controller outputs the measurements in the `Edge light-dark` measuring program to the web diagram, i.e., output must be redirected to the RS422 interface.
The ODC2520 supplies 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.
The linearized measuring values can be converted in µm using the following formula:

$$x\,[\mu m] = d_{OUT} - 131000$$

x = Measuring value (edge position, difference, center axis) in µm

d_{OUT} = digital output value; $d_{OUT} \geq 262072$ are error values

Fig. 24 Calculation of edge position from the digital value, ODC2520

Please refer to the operating instructions for the laser micrometer optoCONTROL 2520 for more information. The current version is available at:

https://www.micro-epsilon.de/download/manuals/man--optoCONTROL-2520--en.pdf

A 3.14 ODC2700

RS422	The data are configured or selected via ASCII commands or via the web interface.
Baud rate	921600 Baud ex factory

Ex factory, the controller outputs the measurements in the `Strip edge` preset to the web diagram, i.e., output must be redirected to the RS422 interface.
The ODC2700 supplies 3 bytes per value at the output. These bytes are coded by the IF2035-EIP into 4 bytes, see Chap. 5.3.

The linearized measuring values can be converted in µm using the following formula:

$$x\ [\text{mm}] = \frac{d_{OUT}}{100000}$$

x = Measuring value (1st edge starting with SMR) in mm

d_{OUT} = digital output value

Fig. 25 Calculation of edge position from the digital value, ODC2700

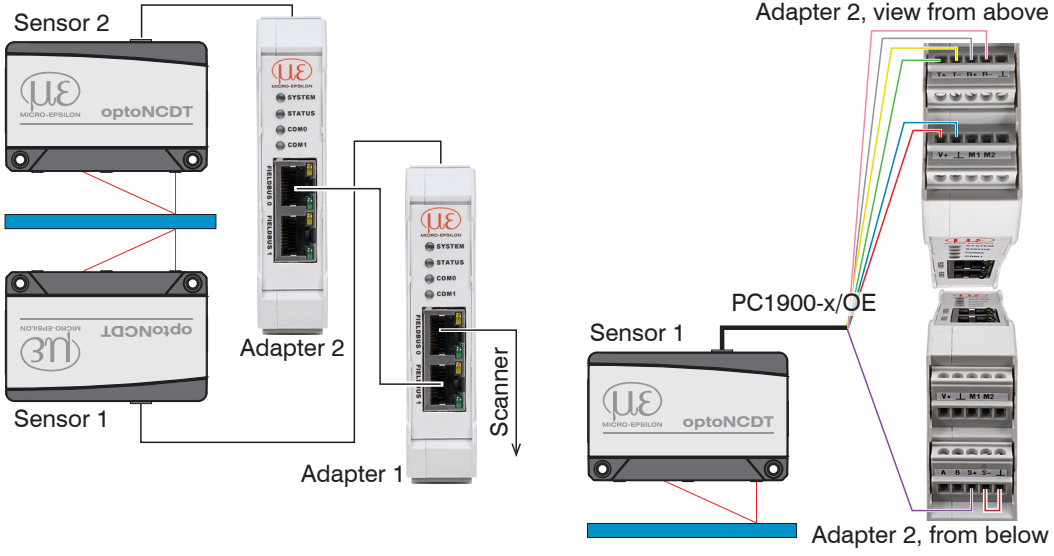
Please refer to the operating instructions for the laser micrometer optoCONTROL 2700 for more information. The current version is available at:

https://www.micro-epsilon.com/download-file/manuals/man--optoCONTROL-2700--en.pdf

A 4 Synchronization ILD1900, Examples

The settings for synchronizing two ILD1900 series sensors with each other are shown below. They are synchronized using the multi-function input of ILD1900, pin 13 of the 17-pole male connector.

Type		Used for
Simultaneous synchronization	Both sensors measure in the same cycle	Differential measurement (thickness, height difference) of opaque measuring objects.
Alternating synchronization	Both sensors measure alternatively Output rate ≤ measuring rate / 2	Thickness measurement of translucent measuring objects or differential measurement at points very close to each other. Alternating synchronization forces alternating laser switch-on/-off so that the two sensors do not interfere with each other optically.



Signal Sensor	Wire color PC1900-x/OE
V+	Red
GND	Blue
Multifunction input	Violet
Tx +	Gray
Tx -	Pink
Rx +	Green
Rx -	Yellow

Fig. 26 Measuring system structure and wiring for synchronization

Example 1: Simultaneous synchronization, measuring rate 1 kHz

Pulsing of adapters 1 and 2 (IF2035-EIP)				Hex value
Byte 0 – 3	Sync Interval	ns	1,000,000	0x000F4240
Byte 4 – 7	Sync Offset	ns	0	0x00000000
Byte 8 – 11	Res. Sync Interval	ns	500,000	0X0007A120
Byte 11 – 15	Res. Sync Offset	ns	150	0x00000096
Byte 16 – 19	Pulse Length	µs	499	0x000001F3

Hex value to both adapters: 0x40420F00 00000000 20A10700 96000000 F3010000

Example 2: Alternating synchronization, measuring rate 2 kHz

Pulsing of adapter 1 (IF2035-EIP)				Hex value
Byte 0 – 3	Sync Interval	ns	500,000	0X0007A120
Byte 4 – 7	Sync Offset	ns	0	0x00000000
Byte 8 – 11	Res. Sync Interval	ns	250,001	0X0003D091
Byte 11 – 15	Res. Sync Offset	ns	150	0x00000096
Byte 16 – 19	Pulse Length	µs	250	0x000000FA

Hex value to adapter 1: 0x20A10700 00000000 91D00300 96000000 FA000000

Pulsing of adapter 2 (IF2035-EIP)				Hex value
Byte 0 – 3	Sync Interval	ns	500,000	0X0007A120
Byte 4 – 7	Sync Offset	ns	250,000	0X0003D090
Byte 8 – 11	Res. Sync Interval	ns	250,001	0X0003D091
Byte 11 – 15	Res. Sync Offset	ns	150	0x00000096
Byte 16 – 19	Pulse Length	µs	250	0x000000FA

Hex value to adapter 2: 0x20A10700 90D00300 91D00300 96000000 FA000000

i Micro-Epsilon recommends that measuring rate and `Slave` operating mode be programmed in advance in each of the sensors.

Both sensors work as slaves and are synchronized by their corresponding scanner via an external signal. For correct synchronization, pulse length and pulse pause must maintain a 1:1 ratio.

In example 2, alternating synchronization is achieved by adapter 2. For each measurement, it starts the measurement in sensor 2 shifted by half a synchronization period.

The synchronization signal is timed by using Class 0x43, Instance 1, Attribute 300.

The level (TTL/HTL) is configured by using Class 0xA0, Instance 1, Attribute 7.

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