MICRO-EPSILON

Operating Instructions

Dual Processing Unit

ILD1x20
ILD1750
ILD1900
ILD2300

ODC2520

IFC24xx
(current models in the catalog)

Controllers for sensors of class ILD1x20, ILD1750, ILD1900, ILD2300, ODC2520, IFC24xx (current models in the catalog)

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1 Safety

1.1 Symbols used

System operation assumes knowledge of the operating instructions.

The following symbols are used in these operating instructions:

⚠ CAUTION	Indicates a 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 according to the regulations for electrical equipment.

- Risk of injury
- Damage to or destruction of the controller

NOTICE

The supply voltage must not exceed the specified limits.

- Damage to or destruction of the controller

Avoid shocks and impacts to the controller.

- Damage to or destruction of the controller

1.3 Notes on product marking

1.3.1 CE marking

The following apply to the product:

- Directive 2014/30/EU ("EMC")
- Directive 2011/65/EU ("RoHS")

Products which carry the CE marking satisfy the requirements of the EU Directives cited and the relevant applicable harmonized European standards (EN).

The product is designed for use in industrial and laboratory environments.

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

1.3.2 UKCA marking

The following apply to the product:

- SI 2016 No. 1091 ("EMC")
- SI 2012 No. 3032 („RoHS")

Products which carry the UKCA marking satisfy the requirements of the directives cited and the relevant applicable harmonized standards.

The product is designed for use in industrial and laboratory environments.

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

1.4 Intended use

The controller is designed for use in industrial and laboratory applications.

The controller is used for

- calculating two digital input signals, for example for thickness measurement
- filtering measurement values

The controller may only be operated within the values specified in the technical data, see Chap. 2.2.

The controller 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 of the controller.

Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper environment

Protection class:	IP40
Temperature range:	
- Operation	0 ... 50 °C
- Storage:	0 ... 50 °C
Humidity:	5 % RH ... 95 % RH (non-condensing)
Ambient pressure:	Atmospheric pressure

i The protection class is limited to water (no penetrating liquids, detergents, or similar aggressive media).

2 Functional principle, technical data

2.1 Functional principle

The controller is used to process two digital input signals.

Features:

- Processing of two input signals, switchable between sensor and encoder
- Programmable via Ethernet (websites)
- Semi-automatic sensor detection for Micro-Epsilon sensors with a digital output
- Triggering
- Ethernet interface with TCP and UDP protocol
- Three filter algorithms: median, mean, recursive
- USB interface
- D/A conversion of the digital measurement values, output via current and voltage output

The controller is installed in a stable aluminum housing.

Two digital sensors can be directly connected at the controller via RS422. All sensors known to the controller can be mixed in any desired manner, e.g. an ODC2520 with an ILD2300. Both sensors are synchronized via the controller; the controller is the master. If both sensors at least have the same measuring rate, they can be operated normally. If the sensors do not have the same measuring rate, they can still be operated with the setting `SYNC = NONE`. If the measuring rates are not the same and in the event of `SYNC <> NONE`, the error message E76 is output.

All inputs and outputs on the controller are parameterized via a web interface.

An internal time base makes it possible to calculate measurement results with different measuring frequencies.

2.2 Technical data

Model		Dual Processing Unit
Supply voltage		13 ... 30 VDC
Max. current consumption		200 mA
Signal input		2x RS422 for sensor or encoder 2x HTL/TTL (switchable) for trigger and master
Digital interface		1x Ethernet (TCP/UDP) 1x USB
Analog output		1x current output per connected sensor (4 - 20 mA) 1x voltage output per connected sensor (0 - 5 V, 0 - 10 V, ±5 V, ±10 V)
Switching output		2x HTL
Connection		1x RJ45 for Ethernet 1x USB 2x 15-pin Sub-D socket for RS422 1x pluggable pin strip 16-pin for power supply, laser on/off, trigger, analog output
Mounting		Desktop housing, optional mounting via holding clamp (available as accessory)
Temperature range	Storage	0 ... 50 °C
	Operation	5 ... 50 °C
Shock (DIN EN 60068-2-6)		5 g, 6 ms, 1000 shocks, 3 axes in 2 directions each
Vibration (DIN EN 60068-2-27)		2 g, sinusoidal excitation with 50 ... 2000 Hz, 10 cycles, 3 axes
Protection class (DIN EN 60529)		IP40
Material		Aluminum housing

Model	Dual Processing Unit
Weight	approx. 210 g
Control and indicator elements	Status LED for controller/sensor connection, Ethernet; web interface for setup and extended functions: Filter, Zero, Mastering
Measuring programs	Distance 1, distance 2, step, thickness/diameter
Compatibility	optoNCDT: ILD1420, ILD1900, ILD2300; optoCONTROL: ODC2520; confocalDT: IFD241x, IFC2411, IFC242x, IFC2465, IFC2466

3 Delivery

3.1 Unpacking, included in delivery

- 1 controller
- 1 setup guide
- 1 16-pin socket strip (cable terminal) with latching function of the type Weidmüller B2CF 3.50/16/180 SN BK BX

► Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.
► Check the delivery for completeness and shipping damage immediately after unpacking.
► If there is damage or parts are missing, immediately contact the manufacturer or supplier.

Optional accessories are listed in the appendix.

3.2 Storage

Temperature range:	0 ... 50 °C
Humidity:	5 % RH ... 95 % RH (non-condensing)

4 Installation and assembly

4.1 Assembling the controller

Note	Ensure careful handling during installation and operation.

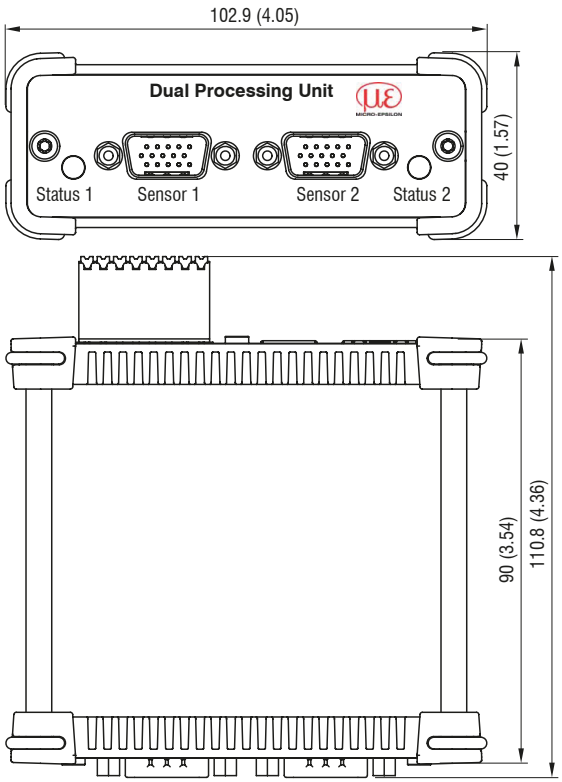


Fig. 4.1: Dimensional drawing of the Dual Processing Unit, dimensions in mm

4.2 Electrical connections, LEDs

Pin	Sensor signal	Encoder signal
1	RS422 TxD-	A-
2	RS422 TxD+	A+
3	RS422 RxD-	B-
4	RS422 RxD+	B+
5	GND	GND
6	RS422 TRG+	R+
7	RS422 TRG-	R-
8	n. c.	+5 VDC
9	Power supply +24 V via power connection	n. c.
10	Power supply +24 V via power connection	n. c.
11	Multi-function output TTL or HTL compatible	n. c.
12	Laser ON HTL compatible	n. c.
13	Switching input 1 HTL	n. c.
14	Switching input 2 HTL	n. c.
15	GND	n. c.

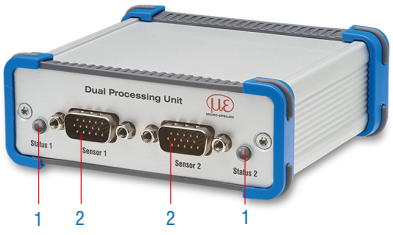


Fig. 4.1: Pin assignment for sensor connections (2), sensor 1 or sensor 2, encoder 1 or encoder 2

LED	Description
Off	No sensor connected
Green	Sensor in measuring mode and within measuring range
Red	Sensor in measuring mode and outside of measuring range
Orange flashing	Sensor is being scanned.
Orange	CHANNELMODE = ENCODER

Fig. 4.2: Description of LEDs (1) for sensor 1 or sensor 2

Pin	Name	Signal
1	24 VDC	Power
2	GND	GND
3	TRG IN	Trigger in
4	MF IN	Multi-function input
5	OUT S1	Switching output 1
6	Laser	Laser
7	OUT S2	Switching output 2
8	GND	GND
9	OUT V1	Measurement value, voltage 1
10	GNDA	Analog GND 1
11	OUT I1	Measurement value, current 1
12	Shield	Shield
13	OUT V2	Measurement value, voltage 2
14	GNDA	Analog GND 2
15	OUT I2	Measurement value, current 2
16	Shield	Shield

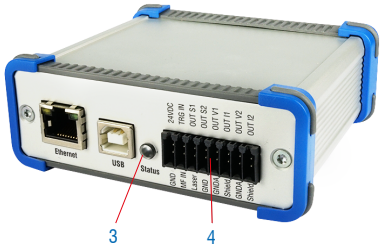


Fig. 4.3: Pin assignment pin header 16-pin (4), Weidmüller (B2CF)

LED **Color**	Description
Off	No power supply (power OFF)
Green	Power ON, data output to USB interface disabled or data output to USB interface enabled and data traffic error-free
Orange	Power ON, data output to USB interface enabled, data traffic faulty or interrupted
Red	Power ON, data output to USB interface enabled, USB cable not connected or connection interrupted

Fig. 4.4: Description of LEDs for power and USB status (3)

4.3 Switching on the laser

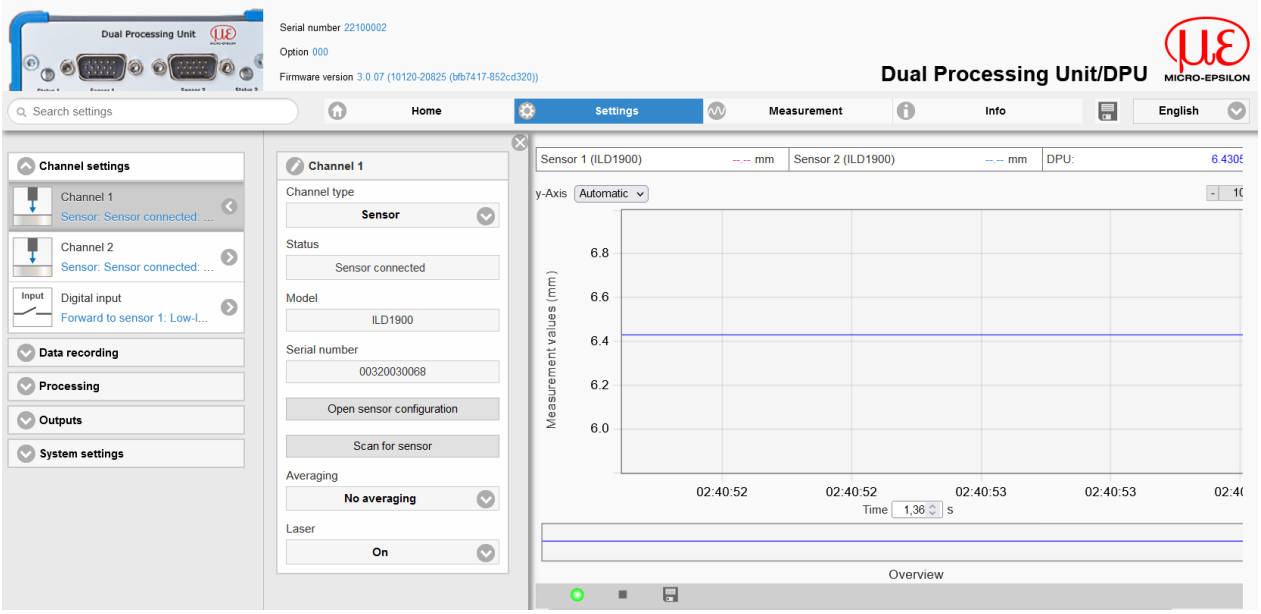


Fig. 4.2: View for Settings - Channel settings - Sensor 1/2 - Laser

The measuring laser at the sensor is switched on via an optocoupler input. This is advantageous when it comes to switching the sensor off for maintenance work or the like. A switching transistor with an open collector (for example in an octocoupler) as well as a relay contact are suitable for switching.

► Connect pin 6 `Laser` to pin 8 `GND` via a bridge.

i	The laser remains switched off if pin 6 is not connected to pin 8 in an electrically conductive manner.

5 Operation

5.1 Getting ready for operation

- Mount the controller as per the setup guide.
- Connect the controller to the following display or monitoring units and to the power supply in accordance with the connection instructions.

After the supply voltage is switched on, the controller runs through an initialization sequence and then transitions to the `Measurement` mode.

Laser operation at optical sensors is only displayed at the sensor by means of an LED.

- If no measurement values appear, check whether the sensors are switched on and there is a target in the measuring range of the sensor.

5.2 Installing the USB Driver

You can find the current Dual Processing Unit / C-Box WinUSB driver at:

https://www.micro-epsilon.com/industry-sensors/interfaces/dual-processing-unit/

- Connect the controller to the USB port on your computer.
- Connect the controller to the power supply.
- Open the Windows control panel.
- Go to Device Manager.

A device (unknown device) is displayed with a question mark.

- Click the right mouse button.

A menu will open.

- Select `Properties`.
- Select `Update driver`.
- Go to the folder with the downloaded Win USB drivers.
- Confirm with `OK`.
- Wait until installation is complete.

When you have completed installation properly, you will find the controller in the device manager.

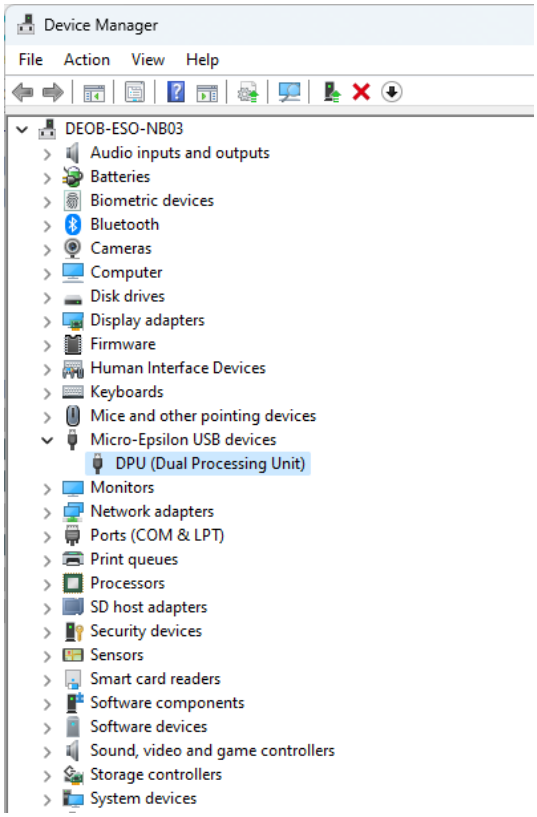


Fig. 5.1: Device manager view

5.3 Software update

i The software can only be updated via USB.

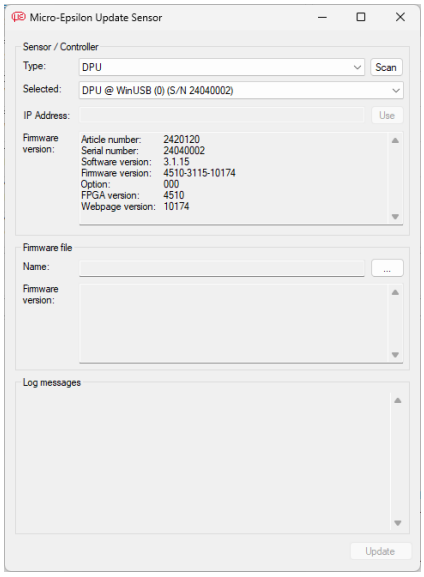


Fig. 5.2: View of Micro-Epsilon sensor update

- Load the firmware update file `Update_Sensor.exe` from the MICRO-EPSILON homepage , see Chap. 5.2.
- Unzip the files. The file `Update_Sensor.exe` and the firmware file `DPU_V...meu` are unzipped.
- Launch the installation program `Update_Sensor.exe` with a double-click.
- Search for the controller under `Type`.
  If a controller is found, the article number, serial number, firmware versions, etc., are shown in the window.

- Select the update file (.meu file) under `Firmware file`.
  Information about the firmware is shown in the file.
- Start installation by clicking on `Update`.
  The update is performed.
- Wait until installation is complete.
- After installation is complete, confirm by clicking on `OK`.

5.4 Control via Ethernet

5.4.1 Requirements

Dynamic websites that contain the current controller and peripheral settings are generated in the controller. Operation is only possible while there is an Ethernet connection to the controller.

You will need a web browser (e.g. Mozilla Firefox, Microsoft Edge or Google Chrome) on a PC with a network connection. Decide whether to connect the controller to a network or directly to a PC.

As standard, the controller is shipped with the permanent IP address 169.254.168.150. If you do not want a static IP address, you can enable DHCP (Dynamic Host Configuration Protocol) as the automatically assigned IP address. The controller is thus assigned an IP address by your DHCP server.

If you have set your browser such that it accesses the Internet via a proxy server, in browser settings please add the controller IP address to the IP addresses that should not be routed via the proxy server, see Chap. 5.4.3.

Parameter	Description
Address type	Static IP address (default) or dynamic IP address (DHCP)
IP address	Static controller IP address (only active if no DHCP has been selected)
Gateway	Gateway to other subnets
Subnet mask	Subnet mask of the IP subnet

Fig. 5.1: Basic Ethernet Settings

5.4.2 Direct link to PC

The IP address of the DPU must be known for displaying the websites.

In the delivery state, it is 169.254.168.150.

- Connect the controller to a PC via an Ethernet direct connection (LAN). Use a LAN cable with RJ-45 plugs for this purpose.
- Launch a web browser and enter the URL http://169.254.168.150 in the address bar.

The website of the DPU is then displayed in the browser.

If you cannot remember the IP address of the DPU or if you have configured the use of a dynamic IP address (DHCP) on the DPU, launch the `sensorTOOL` program.

You can find this program online at https://www.micro-epsilon.com/fileadmin/download/software/sensorTool.exe.

- Select `Interfaces` in the `Sensor group` drop-down menu and select `DPU` in the `Sensor type` drop-down menu.
- Click on the `Sensor` button.
- Now select the desired controller from the list.
- Click on the `Open Website` button to show the sensor website.

Interactive websites for setting the controller and peripherals will now appear in the web browser.

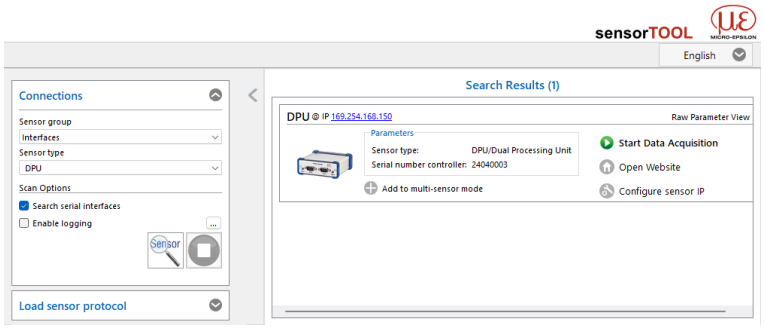
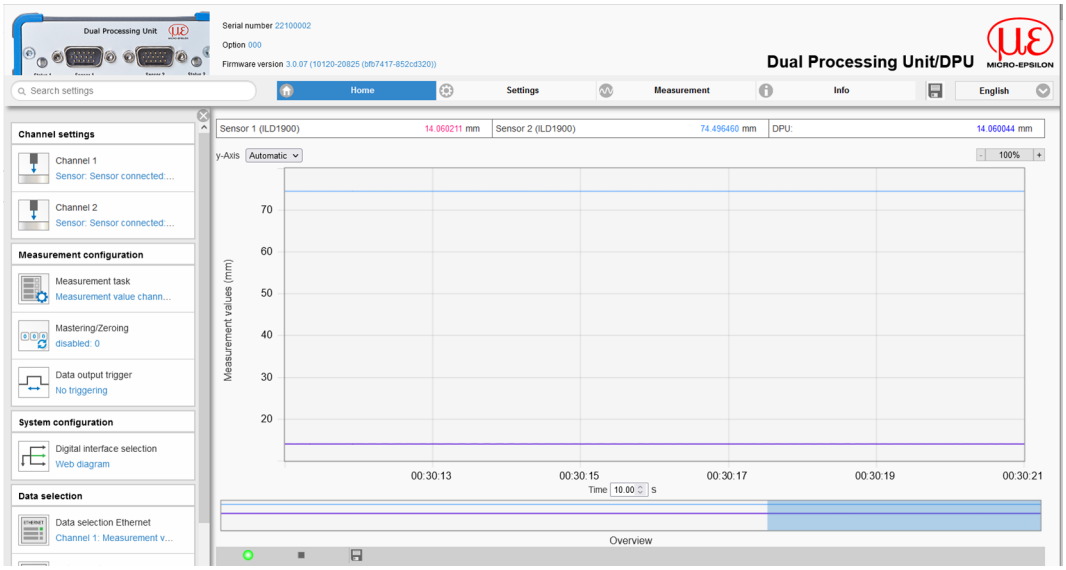


Fig. 5.3: sensorTOOL auxiliary program for sensor search

5.4.3 Access via Ethernet

► Launch the sensor web interface.

Interactive websites for configuring the controller will now appear in the web browser. The controller is active and delivers measurement values.



Horizontal navigation includes the following functions:

- The search function allows you to access functions and parameters while saving you time.
- `Home`. The web interface automatically starts in this view with a measurement chart, channel settings, measurement configuration and system configuration.
- `Settings`. This menu contains all sensor parameters.
- `Measurement`. Shows the currently recorded data.
- `Info`. Contains information on the sensor, including the serial number and software version.

Fig. 5.2: Start page after calling up the web interface

Parallel operation via the web browser and ASCII commands is possible; the last setting applies. Do not forget to save it.

i The web interface only receives modified settings via ASCII commands after the website is reloaded.

5.4.4 Measurement value display with web browser

► Switch to the `Measurement` tab to configure the measurement value display.

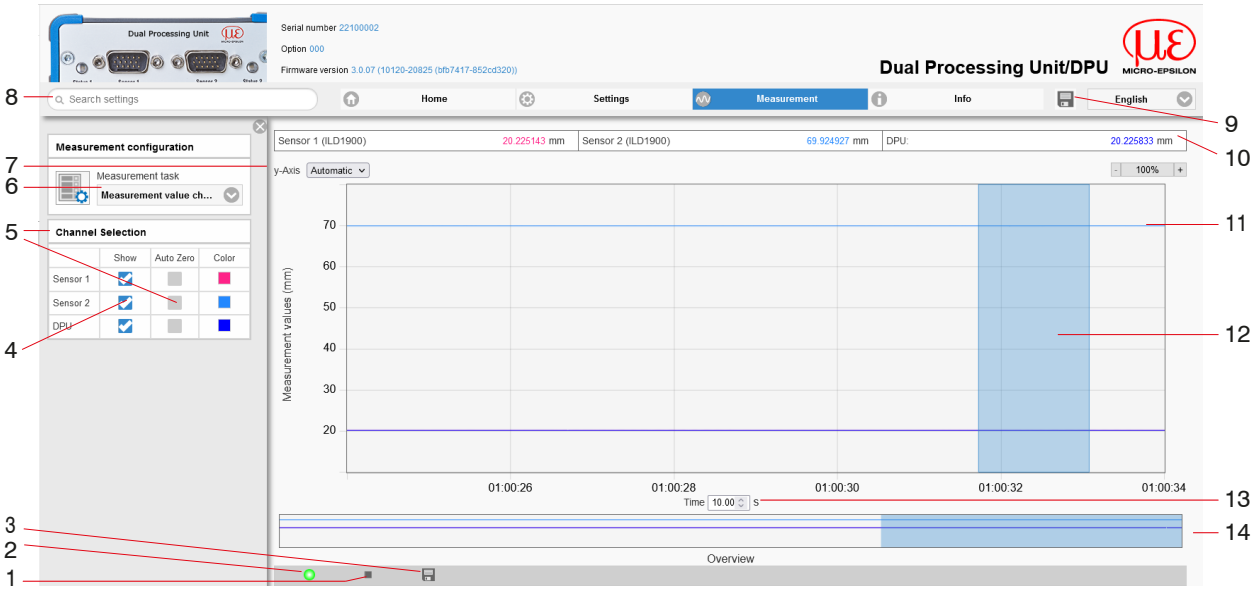


Fig. 5.4: Display of the measuring or computing result

The website for displaying measurement values includes the following functions:

1 Buttons for controlling a measurement with the functions `Start`, `Pause` and `Stop`.
- `Stop` halts the diagram; data selection and the zoom function are still possible.
- `Start` begins the measurement display.

2 Status display:
- Green: OK, diagram started
- Gray: Diagram stopped

3 When the diagram is stopped, the displayed measurement curves can be saved in CSV format (timestamp and measurement values) using the `Save` button. This will open the Windows selection dialog for file name and save location.

4 You can select which channels to display in the diagram using the checkboxes in `Channel Selection` > `Show`.
You can also change the line color for the channel by clicking on `Color`.

5 You can only set the selected channel to zero in the diagram using the selection checkboxes `Channel Selection` > `Auto Zero`. This setting has no effect on the controller or connected sensors.

6 You can select the measurement task in the `Measurement task` drop-down menu in the `Measurement configuration` section.

7 Scaling the measurement value axis (y-axis) of the graph:
- `Automatic` = Automatic scaling
- `Manual` = Manual scaling

8 The search function allows you to access functions and parameters while saving you time.

9 By clicking on the `Save` button, the current configuration can be saved in the DPU so that it is available again after a reboot.

10 The current measurement values are displayed in the text boxes above the graph.

11 Mouseover function. When you move the mouse over the graph, a tooltip appears with the associated measurement value.

12 A region can be selected in the measurement value display by pressing and holding the left mouse button. The selection is marked in light blue. When you release the mouse button again, the measurement value display is zoomed onto this region.

13 The value range of the x-axis can be defined using an input field under the time axis.

14 Scaling the x-axis: The diagram shown above can be enlarged (zoomed) using the two sliders on the left and right in the bottom overall signal. The overall signal can also be moved to the side using the mouse in the center of the zoom window (arrow cross).

If the language was set to `German`, the measurement values are saved with a comma as the decimal separator, whereas a decimal point is used if `English`, etc., is selected.

i Only a limited number of recorded measurement values can be saved (approx. 50,000). If more measurement values are recorded, the oldest measurement values are deleted.

5.5 Programming via ASCII commands

As an additional feature, you can configure the controller via an ASCII interface, physically RS422. For this purpose, the controller must be connected to a serial RS422 interface by means of a suitable interface converter or by means of a plug-in card to a PC/PLC.

Note	Observe the correct RS422 basic setting in the programs used.

After establishing the connection, you can transmit the commands from the appendix via a terminal program to the controller.

5.6 Time response, measurement value flow

The controller requires 5 cycles without triggering to process the controller values.

The cycle time depends on the controller setting and the value range extends from 0.4 to 80 kHz.

6 Setting controller parameters

6.1 Preparations for the setting options

You can configure the controller in various ways:

- By web browser via the web interface.
- With ASCII command set and terminal program via RS422.

> i If you do not permanently save the programming in the sensor, the settings will be lost after the sensor is switched off.

Configuration via the web interface is described below:

6.2 Overview of parameters

Inputs	Sensor 1, sensor 2, digital input
Data recording	Measurement task, measuring rate, error handling
Processing	Filter/averaging, mastering/zeroing, two-point mastering, trigger mode, synchronization, output data rate
Outputs	Selection of digital interface, Ethernet data selection, USB data selection, Ethernet settings, USB settings, digital outputs, analog output 1, analog output 2
System settings	Language & unit, save settings, load settings, manage settings on PC, reset

6.3 Channel Settings

6.3.1 Channel type

Each channel can be configured for either sensors or encoders.

6.3.2 Channel 1, channel 2 - sensor

► Switch to the `Settings` > `Channel settings` > `Channel 1, Channel 2` menu.

Depending on the sensor types connected, sensor-specific channel settings apply to channel 1 and channel 2.

Channel 1, channel 2	Channel type	*Off /***Sensor***/ encoder*	*Selection of connected sensor. Sensors of series ILD1x20, ILD1750, ILD1900, ILD2300, ODC2520, IFC24xx (current models in the catalog) are supported. However, the digital interface must be enabled for this purpose. If no sensor is listed, you can search for sensors.*
	Status	Sensor connected	
	Model	e.g. ILD1900	
	Serial number	e.g. 00320030068	
		Open sensor configuration	
		Searching for a Sensor	
	Measurement value averaging	*No averaging*	
		Moving average	*Number of values for moving average*
			2, 4, 8, 16, 32, 64, 128, 256, 512
		Recursive average	*Number of values for recursive average*
			Possible values for filter in the DPU: 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768
		Median filter	*Number of values for median filter*
			3, 5, 7, 9
	Measurement task	*Measurement task not supported / EDGEHL (edge light-dark) / EDGELH (edge dark-light) / DIA (diameter) / GAP (gap)*	
	Laser[1]	*On, off*	*Software is used to switch the laser light source at the sensor on or off.*

Fig. 6.1: View for channel 1, channel 2 - sensor

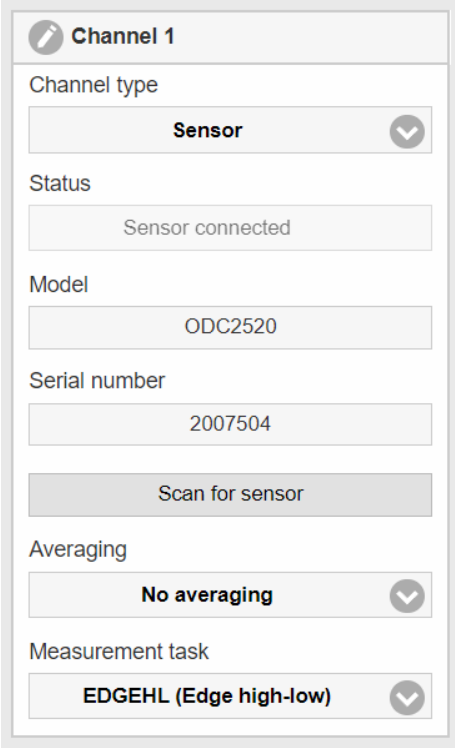


Fig. 6.1: View for menu for channel 1, channel 2 - sensor

Filter / Averaging in the Sensor or Controller

There are several filter types for the measurement values. Filtering prevents noise in the measurement signal, thus ensuring a better resolution. The number of measurement values on which the filter acts is set via the filter width.

Moving Average

The arithmetic average M_{mov} is calculated and output for a series of consecutive measured values according to the selectable filter width N. Each new measured value is added, and the first (oldest) value is removed from the averaging (from the window).

[1] Functionality not valid for ODC1520

$M_{mov} = \frac{\sum_{k=1}^{N} MW(k)}{N}$	*MW* = measured value
	N = averaging value
	k = continuous index (in the window)
	M_{mov} = average value or output value

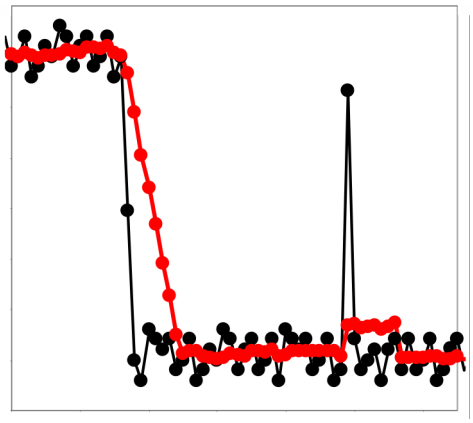
This produces short settling times in case of measurement jumps.

Example: N = 4

... 0, 1, [2, 2, 1, 3] ... 1, 2, [2, 1, 3, 4] Measured values

$\frac{2, 2, 1, 3}{4} = M_{mov}(n)$ $\frac{2, 1, 3, 4}{4} = M_{mov}(n+1)$ Output value

Note	For the moving average, only powers of 2 are permitted for the averaging number *N*. The highest averaging value is 4096.



Application tips

- Smoothing of measured values
- In contrast to recursive averaging, the effect can be finely controlled.
- With uniform noise of the measured values without spikes
- In the case of a slightly rough surface whose roughness is to be eliminated.
- Also suitable for measured value jumps with relatively short settling times

Signal without averaging

Signal with averaging

Fig. 6.2: Moving average, N = 8

Recursive average

Each new measured value *MW*(n) is weighted and added to (n-1) times the previous average value.

Formula:

$$M_{rec}(n) = \frac{MW_{(n)} + (N\text{-}1) \times M_{rek\ (n-1)}}{N}$$

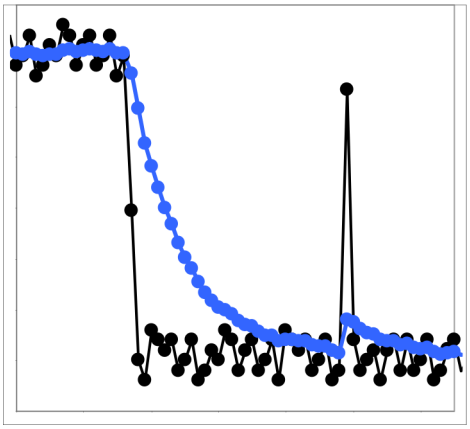
N = averaging number, *N* = 1 ... 32767

n = measured value index

MW = measurement value

M_{rec} = average or output value

Recursive averaging allows for very strong smoothing of the measurements, however it requires long response times for measurement jumps. The recursive average value shows low-pass behavior.



Application tips

- Permits a high degree of smoothing of the measured values. Long settling times in the case of measured value jumps (low-pass behavior).
- High degree of smoothing for noise without strong spikes
- To especially smooth signal noise for static measurements
- To eliminate the roughness when performing dynamic measurements on rough target surfaces, e.g., roughness of paper.
- To eliminate structures, e.g., parts with uniform groove structures, knurled turned parts or coarsely milled parts
- Unsuitable for highly dynamic measurements

—— Signal without averaging
—— Signal with averaging

Fig. 6.3: Recursive average, N = 8

Median

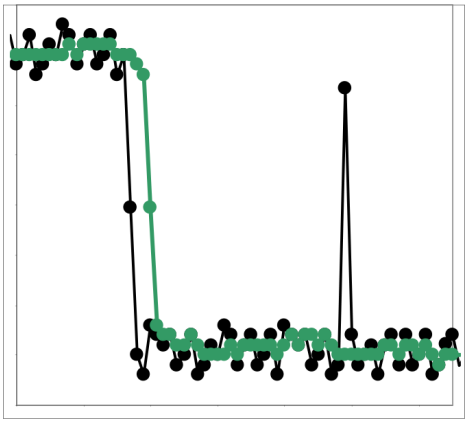
A median value is formed from a preselected number of measured values.

When creating a median value for the sensor, incoming measured values are sorted after each measurement. Then the average value is provided as the median value.

3, 5, 7 or 9 readings are taken into account. This means that individual interference pulses can be suppressed. However, smoothing of the measurement curves is not very strong.

Example: Median value from five readings

... 0 1 2 4 5 1 3 → Sorted measurements: 1 2 3 4 5 $\text{Median}_{(n)} = 3$
... 1 2 4 5 1 3 5 → Sorted measurements: 1 3 4 5 5 $\text{Median}_{(n+1)} = 4$



Application tips

- The measured value curve is not smoothed to a great extent; it primarily eliminates spikes
- Suppresses individual interference pulses
- In short, strong signal peaks (spikes)
- Also suitable for edge jumps (only minor influence)
- To eliminate dirt or roughness in a rough, dusty or dirty environment
- Further averaging can be used after the median filter

—— Signal without averaging
—— Signal with averaging

Fig. 6.4: Median, N = 7

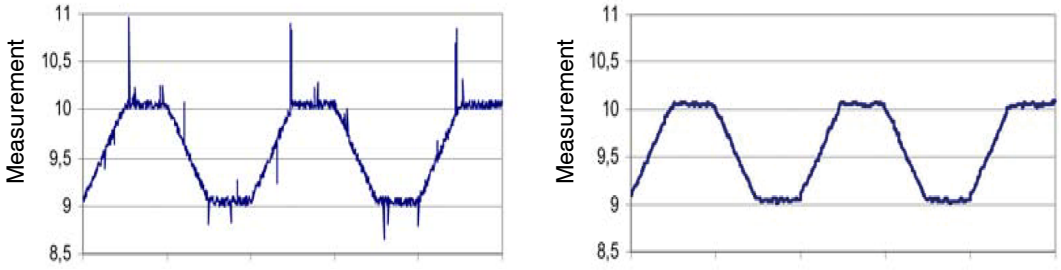


Fig. 6.2: Signal Curve – Profile without Median (Left), with Median N = 9 (Right)

6.3.3 Channel 1, channel 2 - encoder

► Switch to the `Settings` > `Channel settings` > `Channel 1, Channel 2` menu.

Depending on the sensor types connected, sensor-specific channel settings apply to channel 1 and channel 2.

Channel 1, channel 2	Channel type	*Off / sensor /* **encoder**	Set the channel type (sensor, encoder, off) and – depending on the selected type – the associated settings.
	Interpolation depth	*Counter / 1 / 2 / 3 / 4*	
	Counting direction	*Forwards / backwards*	
	Encoder preselect	*0 / 1 / 2 / 3 / 4 ...*	
		Set encoder preselect	
		Reset encoder preselect	
	Encoder reference	*None / One / Ever / Limit*	
	Latch source	*None / Timer / Trigger Input / MF input / Sensor: Measurement value / First reference / Second reference / Every reference*	

Fig. 6.5: View for channel 1, channel 2 - encoder

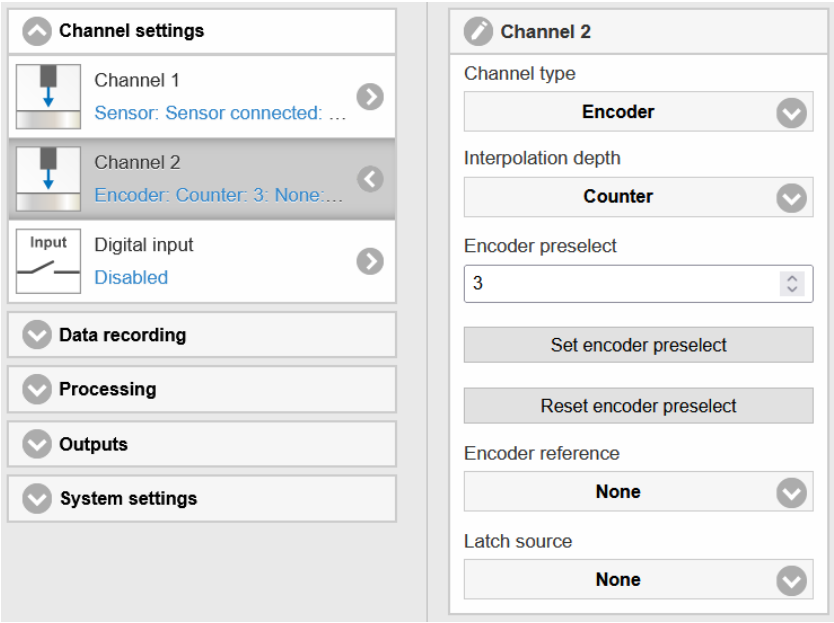


Fig. 6.3: Dual Processing Unit - channel 1, 2 - encoder

6.3.4 Digital input

► Switch to the `Settings` > `Channel settings` > `Digital input` menu.

Selecting the function of the multi-function input

Digital Input	Function	*Disabled*	*The multi-function input has no function.*
		Master DPU measurement value	*The multi-function input is the master pulse input for the DPU.* **Attention:** *The mastering must be active for this function (see Processing → Mastering/Zeroing).*
		Forward to sensor 1	*Multi-function input is forwarded to the corresponding input of the connected sensor 1.*
		Forward to sensor 2	*Multi-function input is forwarded to the corresponding input of the connected sensor 2.*
		Forward to sensor 1 and 2	*Multi-function input is forwarded to the corresponding inputs of the connected sensors 1 and 2.*
		Reset statistical values	Resets the statistical values (minimum, maximum, peak-to-peak) calculated by the DPU.
	Logic for digital input	*High-level logic / Low-level logic*	*Settings, see Trigger Mode chapter or Synchronization chapter.*

6.4 Data recording

6.4.1 Measurement task

► Switch to the `Settings` > `Data recording` > `Measurement task` menu.

The measurement task determines which value (possibly still mastered or filtered) is output as the DPU measurement value.

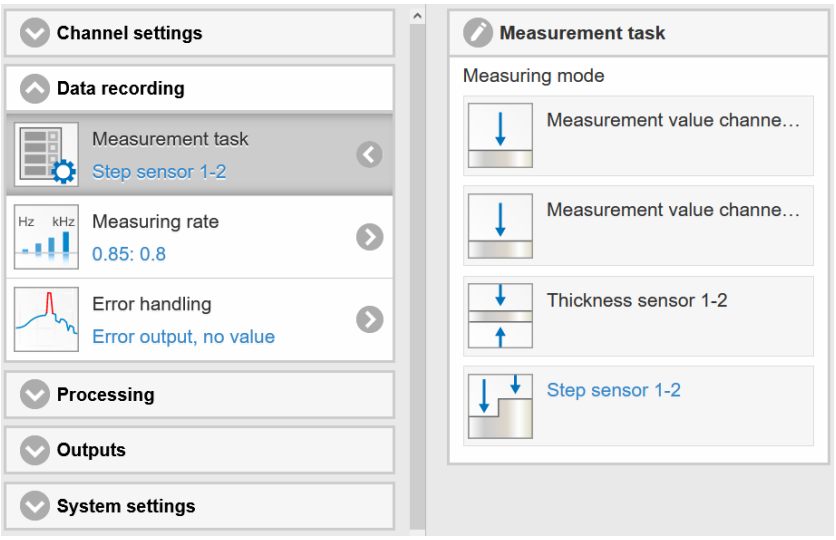


Fig. 6.4: View for measurement task - measuring mode

Measurement task	Measuring mode	*Measurement value, channel 1*	*Measurement value of the sensor connected to channel 1, 2.*
		Measurement value, channel 2	
		Thickness sensor 1-2	*Forms the difference from the two distance values of the sensors 1/2 in direct or diffuse reflection, during two-sided distance measurement, and outputs the result as a thickness value.*
		Step sensor 1-2	*Forms the difference from the two distance values of the sensors 1/2 in direct or diffuse reflection, during one-sided distance measurement, and outputs the result as a height value.*

i The selected measuring mode is also the default measuring mode at the start, provided that it was saved.

6.4.2 Measuring rate

► Switch to the `Settings` > `Data recording` > `Measuring rate` menu.

Measuring Rate	Measuring rate (kHz)	*0.1 ... 100 kHz*	*If synchronization is switched off, the measuring rate can be freely set. Value range: from 0.1 to 100 kHz. Otherwise, the possible measuring rates are specified by the connected sensors/controllers. You can find the measuring rates in the operating instructions for the connected sensors and controllers.*
	Data rate web diagram (kHz)	*Value*	---

i The data is transmitted at a lower data rate via the web diagram interface. At higher measuring rates, this means that fewer measurement values are displayed or stored in the web diagram.

You can find the measuring rates in the operating instructions for the connected sensors and controllers.

6.4.3 Error handling

► Switch to the `Settings` > `Data recording` > `Error handling` menu.

Error Handling	Error handling in the event of no valid measurement value	*Error output, no measurement value*		*If no valid measurement value can be determined, an error value is output. If this prevents further processing, the last valid measurement value can alternatively be held for a given number of measurement cycles, i.e. output repeatedly.*
		Hold last valid value	*Value*	
		Hold last valid value indefinitely		

6.5 Processing

6.5.1 Filter / averaging

► Switch to the `Processing` > `Filter/averaging` menu.

There are three filter algorithms: median, moving average, recursive average

You can find more information on the various types of filter here: , see Chap. 6.3.2.

Filter/averaging	Measurement value averaging	*No averaging*	
	Number of values for moving average	*Moving average*	*2 / 4 / 8 / 16 / 32 / 64 / 128 / 256 / 512 / 1024 / 2048*
	Number of values for recursive average	*Recursive average*	*2 / 4 / 8 / 16 / 32 / 64 / 128 / 256 / 512 / 1024 / 2048 / 4096 / 8192 / 16384 / 32768*
	Number of values for median filter	*Median filter*	*3 / 5 / 7 / 9 / 11 / 13*

There are two DPU filters (DPUFILTER1, DPUFILTER2) and per channel two sensor filters (SENSOR1FILTER1, SENSOR1FILTER2, SENSOR2FILTER1, SENSOR2FILTER2). You can use either the DPU filters or the sensor filters.

Mixed operation is not possible. The DPU filters affect the calculated DPU value, while the sensor filters affect the measurement values provided by the sensors (i.e. generally the distance values). Each of these six filters currently supports the three filter types: moving average, arithmetic average and median.

There are several filter types for the measurement values. Filtering prevents noise in the measurement signal, thus ensuring a better resolution. The number of measurement values on which the filter acts is set via the filter width.

Moving average

The arithmetic average value M_{mov} is formed via the selectable filter width N of successive measurement values and then output. Each new measurement value is added on, and the first (oldest) measurement value is removed from the averaging.

Recursive average

Each new measurement value MW(n) is weighted and added to (n-1) times the previous average value.

Median

The median is formed from a preselected filter width N of measurement values. For this purpose, the incoming measurement values are resorted after every measurement. The middle value is then output as the median. If an even number is selected for the filter width N, the two middle values are added up and divided by two.

6.5.2 Mastering / zeroing

► Switch to the `Settings` > `Processing` > `Mastering/Zeroing` menu.

Mastering/zeroing	Mastering is	*inactive*		
		active		
	Master value (mm)	*Value*	*Set master value*	*Triggers zeroing or mastering Value range for mastering: from -1024 to 1024 mm*
			Reset master value	*Reverses the zeroing or mastering*

6.5.3 Two-point mastering

► Switch to the `Settings` > `Processing` > `2-point mastering` menu.

Two-Point Mastering	Two-point mastering is		*Two-point mastering is used to correct the slope and offset of the output signal using any two points. Only values of between -1024 and 1024 mm are permissible. Two-point mastering makes it possible to achieve a linear signal curve within the defined limit values at the Ethernet output. The correction only affects the measurement value of the DPU in the selected measurement task. The raw data of the individual sensors and the analog outputs remains unaffected.*
	Inactive / active / inactive (offset value set at 2)		
	Offset value 1 (mm)	*Value*	
	Set offset value 1		
	Offset value 2 (mm)	*Value*	
	Set offset value 2		
	Reset offset values		

6.5.4 Data output trigger

► Switch to the `Settings` > `Processing` > `Data output trigger` menu.

Data Output Trigger	Selected mode	*No triggering / level triggering / edge triggering / software triggering*

Level triggering

Measurement values are output continuously as long as the selected level applies. The data output then stops. Triggering can be set to level high / level low.

Edge triggering

After the trigger event, the sensor outputs the previously set number of measurement values or starts continuous output of measurement values. Triggering can be set to rising edge / falling edge.

Software triggering

Output of measurement values is started as soon as a software command is triggered. The trigger time is defined less precisely. After the trigger event, the sensor outputs the previously set number of measurement values or starts continuous output of measurement values.

Active logic level *The logic level defines the threshold at which the trigger switches over:*

Low-level logic (LLL) *≤ 0.7 V: Level Low; ≥ 2.2 V: Level High*

High-level logic (HLL) *≤ 3.0 V: Level Low; ≥ 8.0 V: Level High*

Number of measurement values:

1...16382: Number of measurement values to be output after a trigger event

16383: Start of infinite output of measurement values after a trigger event

0: Stops the trigger and ends the infinite output of measurement values

i Data output trigger: During all measurement tasks, it must be ensured that the combination of level or edge triggering and external synchronization is not possible.

6.5.5 Synchronization

► Switch to the `Settings` > `Processing` > `Synchronization` menu.

Synchronization	Synchronization	*No synchronization / Internal synchronization / Channel 1: Sensor / Channel 2: Sensor*	
		External synchronization	*Low-level logic*
	Logic for external synchronization		*High-level logic*

All sensors can be synchronized from the controller. Synchronization between sensors of the same type is thus no longer necessary. Sensors with different measuring ranges from the same series can be synchronized.

The controller functions as the master; the sensors function as the slave. This eliminates the slight time difference between measurement values of individual sensors. The controller reacts exclusively to the edge of a synchronization signal.

No synchronization *Synchronization switched off. The measuring rate can be freely set. Value range: from 0.1 to 100 kHz.*

Internal synchronization *The time base is the DPU.*

External synchronization *The synchronization signal is generated by an external signal source, e.g. function generator.*

Low-level logic (LLL) *≤ 0.7 V: Trigger inactive; ≥ 2.2 V: Trigger active*

High-level logic (HLL) *≤ 3.0 V: Trigger inactive; ≥ 8.0 V: Trigger active*

Channel <n>: Sensor *If a sensor is connected to channel <n>, the sensor value thereof is used as a latch source for an encoder.*

Channel <n>: encoder *If an encoder is connected to channel <n>, the encoder synchronizes the DPU processing. Trigger increment defines the number of encoder changes after which the processing is triggered in each case. The encoder value must be between the minimum and the maximum. Output begins after the start value (if set) is passed. If the signal "Sensor <n> error output 1" is also output at the digital output, a signal is output for the duration of pulse width µs when the increment is reached.*

i Synchronization: External synchronization is not possible if edge or level triggering is active.

6.5.6 Output data rate

► Switch to the `Settings` > `Processing` > `Output data rate` menu.

Output Data Rate	Output every ... measured value	*Value*
	Reducing applies for following interfaces	*Analog*
		Ethernet
		USB

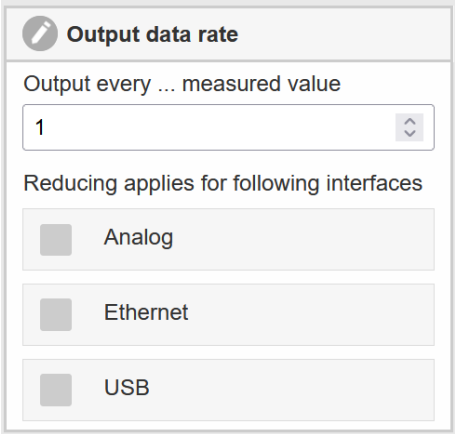


Fig. 6.5: View for processing - Output data rate, analog example

Reducing the output rate means that only every nth measurement value is output. The other measurement values are discarded. Any desired averaging over n values must be set specially.

6.6 Outputs

6.6.1 Digital interface selection

► Switch to the `Settings` > `Outputs` > `Digital interface selection` menu.

Digital Interface Selection	Interface for data output	*Disabled*	*No measurement values are output via the digital interface.*
		Ethernet	*Ethernet allows for fast data transmission not in real time (packet-based data transfer). The measuring device can be configured via the web interface or using ASCII commands via a terminal program.*
		Web diagram	*The recorded measurement values are shown in the diagram on the website.*
		USB	*The USB interface provides a lower data rate for transmitting measurement value data. Configuration takes place via ASCII commands.*

i The Ethernet interface is recommended for outputting measurement values with a subsequent analysis without direct process control. If output of measurement values in real time is required for process control, the analog interfaces should be used.

6.6.2 Ethernet data selection

Switch to the `Settings` > `Outputs` > `Data selection Ethernet` menu.

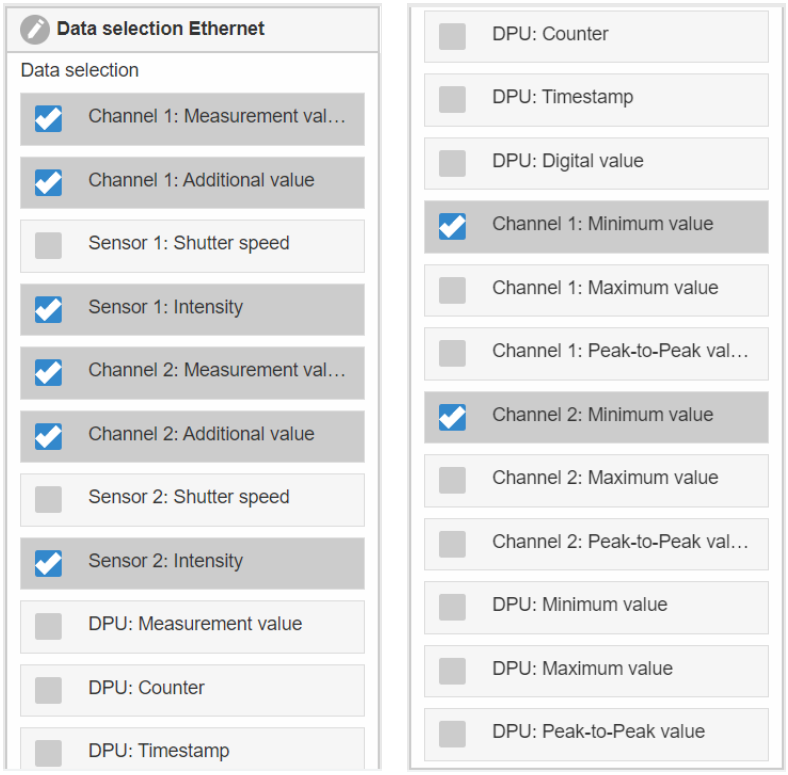


Fig. 6.6: Ethernet data selection menu view

> i It is not possible to display and store the additional values in the web diagram. Please use sensorTOOL for this. You can find sensorTOOL on the Micro-Epsilon website at https://www.micro-epsilon.com/industry-sensors/interfaces/dual-processing-unit/.

The data required for further processing can be selected from the total available data. This data is then output in a fixed order successively. Information on the data format, output sequence and other explanations are given in the corresponding chapters of these operating instructions.

6.6.3 USB data selection

Switch to the `Settings` > `Outputs` > `Data selection USB` menu.

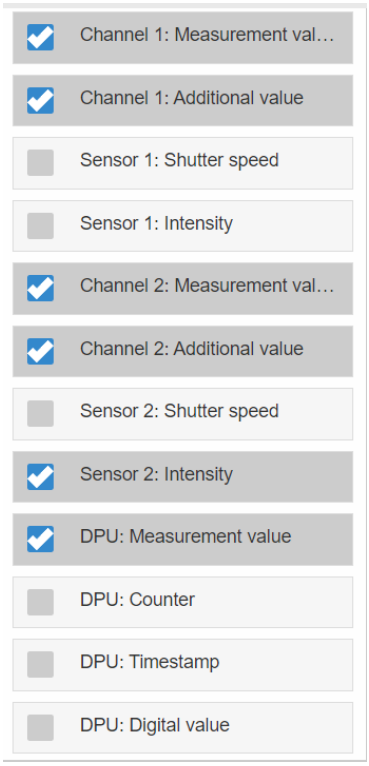


Fig. 6.7: USB data selection menu view

i It is not possible to display and store the additional values in the web diagram. Please use sensorTOOL for this. You can find sensorTOOL on the Micro-Epsilon website at https://www.micro-epsilon.com/industry-sensors/interfaces/dual-processing-unit/.

The data required for further processing can be selected from the total available data. This data is then output in a fixed order successively. Information on the data format, output sequence and other explanations are given in the corresponding chapters of these operating instructions.

6.6.4 Ethernet settings

Switch to the `Settings` > `Outputs` > `Ethernet settings` menu.

Ethernet Settings	Address type	*Static IP address*	Adopt IP settings
		Dynamic (DHCP)	
	IP address	*Value*	
	Netmask	*255.255.0.0*	
	Gateway	*169.254.1.1*	
	Transmission type	*Inactive*	
		Server/TCP	*Data port: Value*
		Client/UDP	*Server address: Value*
			Data port: Value
	Frames per measurement packet	*Automatic*	
		Manual	

Settings for the Ethernet interface, transmission type and measurement packet size. The DPU can send the measurement values to a measurement value server (transmission type: Client/UDP) or provide the measurement values themselves as a server (transmission type: Server/TCP). In this case, a program you have created yourself can be used as the client, for example. Information on the data format can be found in the corresponding chapters of these operating instruc-

tions. It is possible to set the maximum number of measurement value frames in the measurement packet. The number can also be automatically determined.

6.6.5 USB settings

Switch to the `Settings` > `Outputs` > `USB settings` menu.

USB Settings	*Default scaling*	*In default scaling, the entire measuring range of the sensor/controller is output.*
	Two-point scaling	*Two-point scaling requires specifying the start and end of the range.* *Value range: from -1024 to 1024 mm.* *The minimum value must be less than the maximum value.*

6.6.6 Digital outputs

Switch to the `Settings` > `Outputs` > `Digital outputs` menu.

Digital Outputs	*Error output 1*	*Selection, see below*
	Lower limit value	*Value*
	Upper limit value	*Value*
	Error output 2	*Selection, see below*
	Lower limit value	*Value*
Upper limit value	*Value*	

i The channel mode can restrict the selectable values!

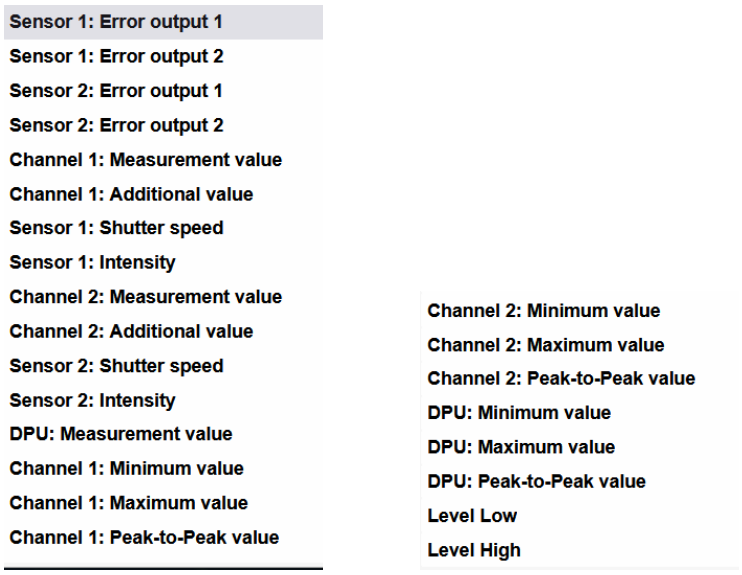


Fig. 6.8: Selecting the function of the error outputs

The result of the range check of the selected value is output. The valid value range is set by the upper and lower limit value.

Sensor x: Error output y

The value of the selected error output of the selected sensor is output.

Level low

The level at the error output is always low.

Level High

The level at the error output is always high.

6.6.7 Analog output 1, analog output 2

Switch to the `Settings` > `Outputs` > `Analog output 1 / 2` menu.

Analog output 1, analog output 2	*Output range*	*Inactive 0 V ... 5 V, 0 V ... 10 V, -5 V ... 5 V, -10 V ... 10 V, 4 mA ... 20 mA*	*Specification of analog output, current or voltage with selectable value range.*
	Output signal	*Fixed output value, channel 1: Measurement value, channel 1: Additional value, sensor 1: Shutter speed, sensor 1: Intensity, channel 2: Measurement value, channel 2: Additional value, sensor 2: Shutter speed, sensor 2: Intensity, DPU: Measurement value, channel 1: Peak-to-peak value, channel 2: Peak-to-peak value, DPU: Peak-to-peak value*	*Depending on the channel mode, the data source may be a sensor signal, the measurement value of the DPU, a statistical value or a fixed value within the output range.*
	Scaling	*Default scaling*	*In default scaling, the entire measuring range of the sensor/controller is output.*
		Two-point scaling	*Two-point scaling requires specifying the start and end of the range.*

6.7 System Settings

6.7.1 Language & unit

The web interface supports the units mm and inches in the measurement result display.

German, English, Chinese, Japanese and Korean are possible as languages for the web interface.

► Switch to the `Settings` > `System settings` > `Language & Unit` tab.

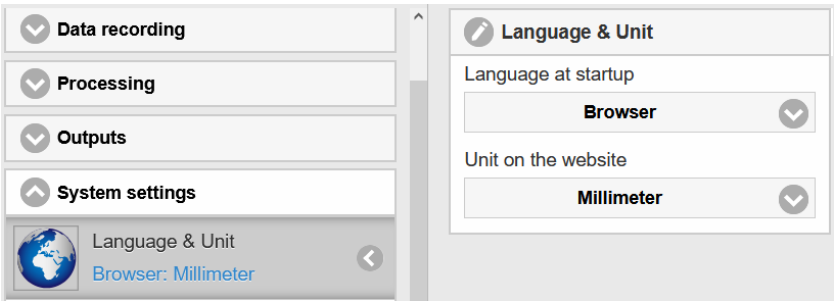


Fig. 6.6: Language & unit menu view

Language & Unit	Language during loading	*Browser, English, German, Chinese, Japanese, Korean*	*Defines the language used when the website is loading.*
	Unit on the website	*Millimeters, inches*	*Defines the unit of measurement used in the measurement value display.*

i This unit of measurement has no influence on the sensor itself.

Menu bar language settings

► Change the language settings in the menu bar.

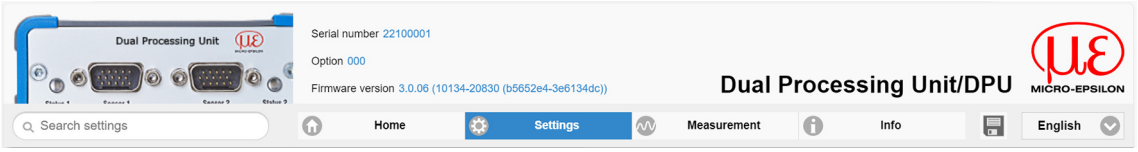


Fig. 6.7: Language settings menu

`German`, `English`, `Chinese`, `Japanese` and `Korean` are possible as languages for the web interface.

> i This language setting is not saved in the DPU. After the website is reloaded, the setting is saved under `Language at startup`.

6.7.2 Saving settings

► Switch to the `Settings` > `System settings` > `Save settings` tab.

All settings on the controller can be permanently saved in user programs, i.e. so-called setups.

This may be settings of the connected sensors or controllers.

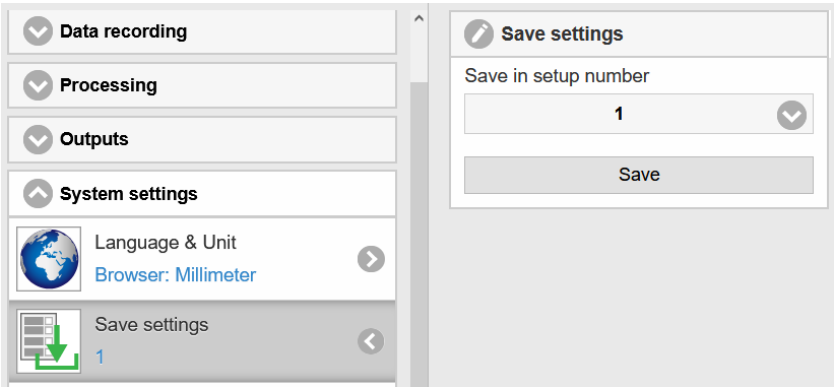


Fig. 6.8: Save settings menu view

Up to 8 setups are available.

► Apply the desired settings and confirm with `Save`.

The settings are now saved in the selected setup file.

> i After programming, save all settings under a setup no. (1 / 2 / 3 ... 8) permanently in the controller so that they are available again when you next switch on the controller.

6.7.3 Loading settings

► Switch to the `Settings` > `System settings` > `Load settings` menu.

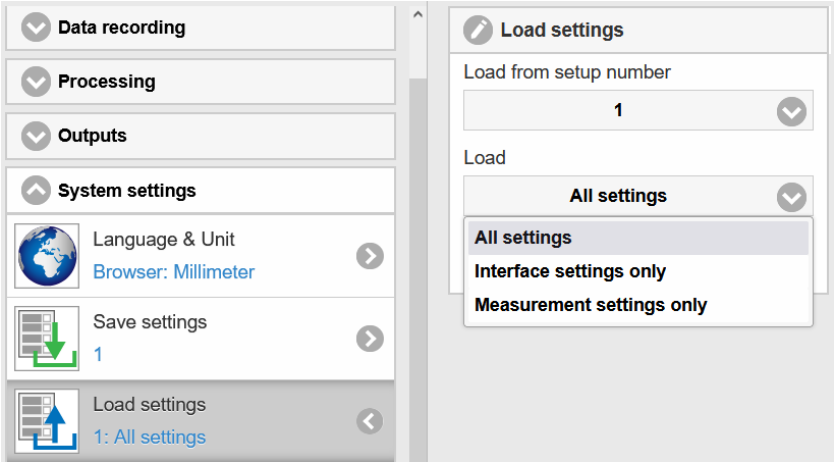


Fig. 6.9: Load settings view

Load settings	Load from setup number	*1, 2 ... 8*	*Click on the button to load the settings of the selected setup.*
	Load	*All settings,*	
		Only interface settings	
		Only measurement settings	

Click on the `Load` button.

The settings of the selected setup have now been loaded.

6.7.4 Managing settings

► Switch to the `Settings` > `System settings` > `Manage settings` tab.

This menu allows you to save a backup copy of the controller settings on your PC/Notebook or to read saved controller settings back into the controller.

i For security reasons, save the settings in the controller before exporting or importing the files.

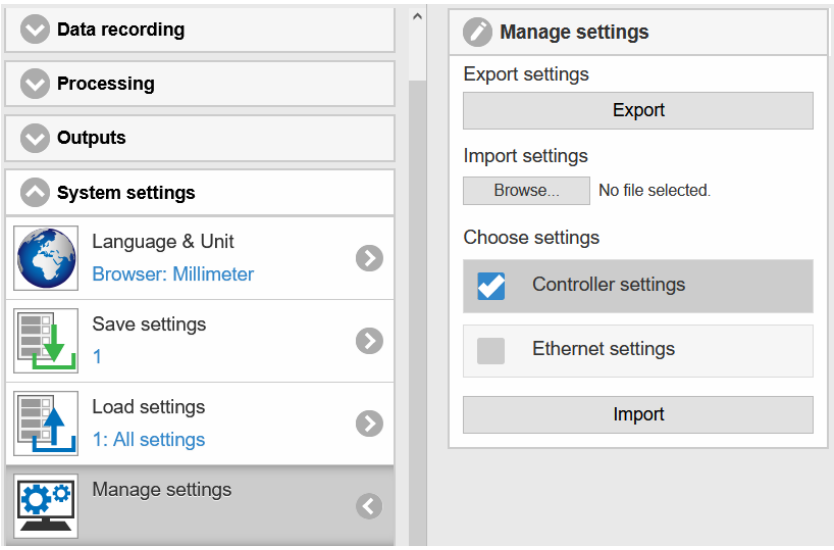


Fig. 6.10: Manage settings view

Export settings

► Apply the desired settings and confirm with `Export`.

A dialog allowing you to save the file opens.

Click on the `Save file` button.

All controller settings are saved in a file.

Import settings

► Select the appropriate settings under `Choose settings`

Managing Settings	Choose settings	*Controller settings*
		Ethernet settings

Fig. 6.9: Choose settings selection

Click on the `Browse` button.

Select a suitable setting file in the `Open file` dialog.

The controller settings are read from the file and sent to the controller.

i Only suitable settings are imported.

6.7.5 Resetting

► Switch to the `Settings` > `System settings` > `Reset` tab.

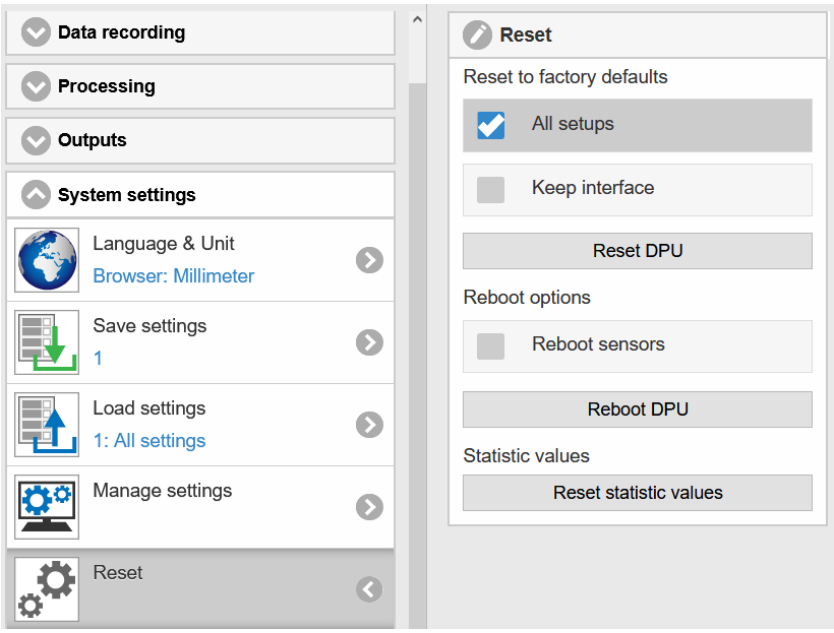


Fig. 6.11: Reset menu view

Resetting	*Reset to factory defaults*	*The DPU is reset to the factory settings. All setups are deleted and the default parameters are loaded.*	
		All setups	*If selected, all setups are returned to factory settings, otherwise only the current setup is.*
		Keep interface	*The settings for language, password and Ethernet remain unchanged.*
		Click on the `Reset DPU` button.	
	Reboot options	Reboot sensors	*The DPU is rebooted. The measurement is interrupted, unsaved changes are lost.*
		Click on the `Reboot sensors` button.	
	Statistical values	Click on the `Reset statistic values` button.	*Resets all saved statistical values to zero.*

7 Software Support with MEDAQLib

MEDAQLib offers you a documented driver DLL. This allows you to integrate sensors from Micro-Epsilon in conjunction with a converter or interface module into existing or customer-specific PC software.

MEDAQLib

- contains a DLL, which can be imported into C, C++, VB, Delphi and many additional programs,
- takes care of data conversion for you,
- works independently of the type of interface used,
- is characterized by identical functions for communication (commands),
- provides a consistent transmission format for all Micro-Epsilon sensors.

For C/C++ programmers, MEDAQLib contains an additional header file and a library file.

- You can download the MEDAQLIb installation files via https://www.micro-epsilon.com/link/software/medaqlib.
- For further information on MEDAQLIb, please visithttps://www.micro-epsilon.com/service/software-sensorintegration/medaqlib.

8 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/legal-details/.

9 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.com/legal-details.

- 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.

10 Service, repair

In the event of a controller defect:

- If possible, save the current settings in a parameter set, see Chap. 6.7.2 to reload them into the controller after the repair.
- Please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire measuring system 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
E-Mail: info@micro-epsilon.com
www.micro-epsilon.com/contact/worldwide/
Web: https://www.micro-epsilon.com

11 Optional accessories

Cable terminal suitable for

- single-stranded/fine-stranded conductor, cross-section = 0.08 ... 1.5 mm²
- fine-stranded conductor (with ferrule with/without plastic collar), cross-section = 0.25 ... 1 mm²

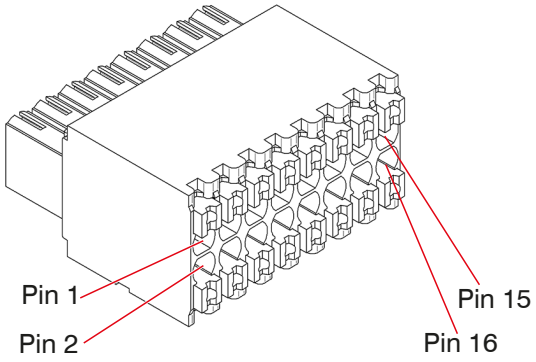


Fig. 11.1: Pin assignment for 16-pin cable terminal

Fasten the cable terminal in a vise, if possible.

1. Press the orange-colored clamping lever inwards.
2. Insert the connection wire into the terminal.
3. Now release the operating opening again.

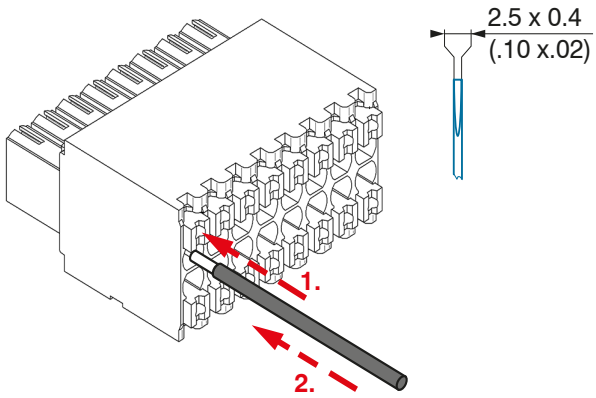


Fig. 11.2: Work steps for wiring the cable terminal

i Please use a screwdriver with a maximum blade width of 2.5 x 0.4 mm.

Interface and supply cable for connecting an ILD23xx to the Dual Processing Unit, cable length x = 3, 6, 9 or 25 m

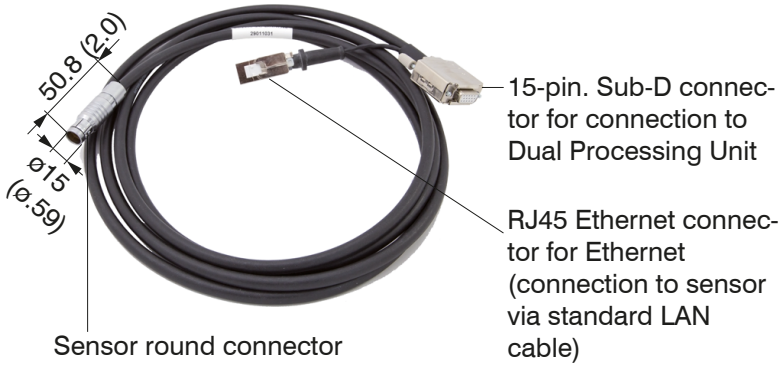


Fig. 11.3: PC2300-3/C-Box/RJ45 Supply and Interface Cable

The RJ45 Ethernet socket can be used to apply settings on the sensor via the web interface or via ASCII communication.

Interface and supply cable for connecting an ILD1420 to the Dual Processing Unit, cable length x = 3, 6, 9 or 10 m

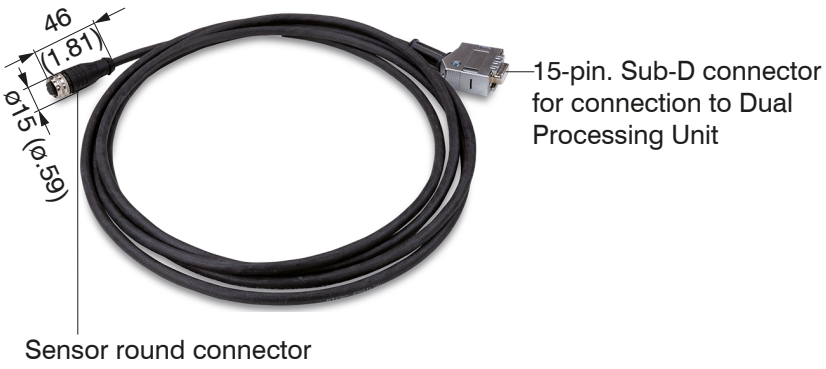


Fig. 11.4: PCF1420-x/C-Box Supply and Interface Cable

Interface and supply cable for connecting an ILD1750 to the Dual Processing Unit, cable length x = 3, 6, or 9 m

Fig. 11.5: PC1750-x/C-Box Supply and Interface Cable

Interface and supply cable for connecting an ILD1900 to the Dual Processing Unit, cable length x = 3, 6, 9 or 15 m, 15-pin Sub-D plug

Fig. 11.6: PC1900-x/C-Box Supply and Interface Cable

12 ASCII communication

12.1 General

The ASCII commands can be sent to the sensor/controller via the RS422 or Ethernet (port 23) interfaces. All commands, inputs and error reports are in English. A command always consists of the command name and zero or several parameters that are separated with a space and end in LF. If spaces are used in parameters, the parameter must be placed in quotation marks, e.g. “Password with space”.

Example: Switching on output via RS422

OUTPUT RS422 <Enter>

Reference	<Enter>	Must contain LF, but can also be CR LF
Explanation	<LF>	Line feed (hex 0A)
	<CR>	Carriage return (hex 0D)
	<Enter>	Hex 0A or hex 0D0A, depending on system

The currently set parameter value is reset if a command is invoked without parameters.

The output format is:

<Command name> <Parameter1> [<Parameter2> […]]

The response can be used again without changes as a command for setting the password. Optional parameters are only returned as well if this is necessary.

(“->”) returned. In the event of an error, an error message beginning withExx, where xx stands for a unique error number, comes before the prompt. Moreover, instead of error messages, warning messages (“Wxx”) may be output. Warnings are structured analogously to error messages. Warnings do not prevent commands from being executed.

12.2 Data protocol

All values to be output at the same time are combined into a frame for transmission. The measurement values are transmitted via TCP/IP with 32 bits and USB with a maximum of 18 data bits.

Example of a measurement value frame:

- Sensor 1: Value
- Sensor 1: Intensity
- Sensor 1: Shutter
- Sensor 1: Reflectivity
- Sensor 2: Value
- Sensor 2: Intensity
- Sensor 2: Shutter
- Sensor 2: Reflectivity
- DPU: Value
- DPU: Counter
- DPU: Timestamp
- DPU: Digital

During Ethernet transmission, a header and then a sequence of measurement value frames are transmitted for each packet.

The header consists of:

- Preamble (32 bits): MEAS
- Article no. (32 bits)
- Serial no. (32 bits)
- Flags1 (32 bits), see Fig. 12.1
- Flags2 (32 bits), see Fig. 12.2, currently without function

- Bytes per frame (16 bits) / number of frames in the packet (16 bits)
- Frame counter (32 bits)

The measurement value frames in the packet are always complete. Therefore, a frame cannot be divided between multiple packets. Each frame consists of its selected measurement values (up to 12). Each measurement value in turn has 32 bits.

The valid value ranges for sensor and DPU are as follows:

- Via USB:
  - Sensor measurement values and additional values dependent on the sensor, see also the operating instructions for the connected sensors.
  - DPU measurement values from 0 .. 131071, from 262073 … 262143 (18 bits) error values
  - DPU counter from 0 .. 262143 (18 bits)
  - DPU timestamp from 0 .. 262143 (18 bits)
  - DPU digital from 0 .. 262143 (18 bits)
- Via TCP/IP (Ethernet):
  - Sensor measurement values and additional values dependent on the sensor, see also the operating instructions for the connected sensors.

    However, an additional hi byte (0x00) is transmitted in order to comply with the 32 bits.
  - DPU measurement values from INT_MIN (-2147483648) to INT_MAX (2147483647)-11, INT_MAX-10 to INT_MAX are error values
  - DPU counter from INT_MIN to INT_MAX
  - DPU box timestamp from INT_MIN to INT_MAX
  - DPU box digital from INT_MIN to INT_MAX

Flag 1 bits	Description		Flag 1 bits	Description
0	Channel 1: Measurement value		13	Channel 1: Maximum value
1	Channel 1: Additional value		14	Channel 1: Peak-to-peak value
2	Channel 1 shutter speed		15	Channel 2: Minimum value
3	Channel 1: Intensity		16	Channel 2: Maximum value
4	Channel 2: Measurement value		17	Channel 2: Peak-to-peak value
5	Channel 2: Additional value		18	DPU: Minimum value
6	Channel 2: Shutter speed		19	DPU: Maximum value
7	Channel 2: Intensity		20	DPU: Peak-to-peak value
8	DPU: Measurement value		21 - 28	Reserved
9	DPU: Measurement value counter		29	Overflow
10	DPU: Timestamp		30 - 31	10 (fixed, controller type)
11	DPU: Digital value			
12	Channel 1: Minimum value			

Fig. 12.1: Description of flags 1 (Ethernet)

Flags 2 bits	Description
0 to 31	0

Fig. 12.2: Description of flags 2 (Ethernet)

Value	Interface	Value range
Sensor 1 value, Sensor 2 value, DPU value	USB	0 ... 262072
	Ethernet -INT_MAX ... INT_MAX-11	-2147483647 ... 2147483636
DPU counter, DPU timestamp, DPU digital	USB	0 ... 262143
	Ethernet: -INT_MAX ... INT_MAX	-2147483647 ... 2147483647

Fig. 12.3: Valid value ranges (raw values)

Value	Interface	Value range
Sensor 1 value, Sensor 2 value, DPU value	USB	262073 ... 262143
	Ethernet: INT_MAX -10 ... INT_MAX	2147483637 ... 2147483647

Fig. 12.4: Error ranges (raw values)

Value	Interface	Calculation	Unit
DPU value	USB		[mm]
	$\text{Value} = \frac{\text{Digital * (DPU Range Max - DPU Range Min)}}{131072.04} + \text{DPU Range Min}$		
	Ethernet	$\text{Value} = \frac{\text{Digital}}{1.0e+006}$	[mm]
DPU timestamp	USB	$\text{Value} = \frac{\text{Digital (Linksshift um 8 bits)}}{1.0e+006}$	[s]
	Ethernet	$\text{Value} = \frac{\text{Digital (unsigned int)}}{1.0e+006}$	[s]
DPU counter	USB	Digital	None
	Ethernet	Digital (unsigned int)	None
DPU digital	, see Fig. 12.6		

Fig. 12.5: Calculating the values

DPU digital		
Bits	**Description**	
0	Trigger IN (TRG IN)	Pin header input
1	Multi-function input (MF IN)	Pin header input
2	Laser_ON	Pin header input
3	Switching output S1 (OUT S1)	Pin header output
4	Switching output S1 (OUT S2)	Pin header output
5	Multi-function output	Sensor 1 output
6	Laser ON	Sensor 1 output
7	Switching input 1	Sensor 1 input
8	Switching input 2	Sensor 1 input
9	Multi-function output	Sensor 1 output

DPU digital		
10	Laser ON	Sensor 2 output
11	Switching input 1	Sensor 2 input
12	Switching input 2	Sensor 2 input
13 to 15 (or 31)	Reserved (0)	

Fig. 12.6: Description of DPU digital

During a reboot or after a configuration change at the DPU, the DPU initializes the sensors and the measurement starts again.

12.3 General commands

12.3.1 Calling up controller information

`GETINFO`

Outputs information to the sensor.

```
Name: DPU
Serial: 14310011
Option: 000
Article: 2420072
MAC-Address: 00-0C-12-02-04-41
FPGA-Version: 11
Web-Version: 8152
Version: 0.9.5
```

Fig. 12.1: Calling up controller information

12.3.2 Searching for a Sensor

`SCAN1`

The controller searches for sensors connected to the sensor 1 connection. The command SCAN2 prompts the controller to search for sensors connected to the sensor 2 connection.

12.3.3 Calling up sensor information

`GETINFO1`

- GETINFO1 Provides information about the sensor connected at the sensor 1 connection.

Example

Example of a response if an ILD2300 [2] is connected:
-> GETINFO1
Name: ILD2300
Serial: 11020009
Option: 001
Article: 2418004
MAC address: 00-0C-12-01-06-08
Version: 004.093.087.02
Measuring range: 20 mm
...
Image type: User
->

If the sensor was not detected at the DPU, an error “E39 no sensor found” is output.

[2] Similar for the other supported sensors.

- GETINFO2: The command GETINFO2 provides information about the sensor connected at the sensor 2 connection.

12.3.4 Reading out all settings

```
PRINT [ALL]
```

- PRINT is used to output all query commands, line preceded by a response with command name.
- ALL: Provides additional information.

12.3.5 Language settings

```
LANGUAGE BROWSER | ENGLISH | GERMAN | CHINESE | JAPANESE | KOREAN
```

Defines the language in which the web interface is shown after (re)loading.

- BROWSER: Language of browser
- GERMAN: The language is German
- ENGLISH: The language is English
- CHINESE: The language is Chinese
- JAPANESE: The language is Japanese
- KOREAN: The language is Korean

Factory setting: BROWSER

12.3.6 Synchronization

```
SYNC NONE | INTERNAL | EXTERNAL | CHANNEL<n> [LLL | HLL]
```

- NONE: Sensors are not synchronized, the controller runs at its own pace and takes currently available sensor values.
- INTERNAL: The controller generates a sync pulse
- EXTERNAL: External sync pulse is looped through to the sensors
  - In the case of external triggering, it is still possible to switch between low-level logic (LLL) and high-level logic (HLL).
  - Low-level logic (0 ... 0.7 to 2.8 ... 30)
  - High-level logic (0 ... 3 to 8 ... 30)

    HLL of the digital input TRIG IN at the controller, only taken into account for SYNC EXTERNAL.
- CHANNEL<n>

  In the case of CHANNEL<n> == ENCODER, an encoder is the trigger. In the case of CHANNELMODE<n> == SENSOR, a sensor value is the trigger and is used as a latch source for an encoder.

Factory setting: INTERNAL

12.3.7 Booting the controller

```
RESET [ALL]
```

- RESET: The controller is rebooted.
- ALL: The sensors are also rebooted.

12.3.8 Sending a command to the sensor

```
TUNNEL<n> <command for sensor n>
```

The command is enclosed in quotation marks and sent by the DPU with a <CRLF> to the connected sensor at the sensor 1 connection <n> (n = 1, 2). The response from the sensor is packed in quotation marks and sent back.

If no sensor has been recognized in the DPU, an error message is returned.

12.4 Triggering

12.4.1 Trigger mode

```
TRIGGER NONE | EDGE | PULSE | SOFTWARE
```

Selection of the trigger mode.

- NONE: No triggering
- EDGE: Edge triggering via TRG-IN (output of measurement values depending on the TRIGGERCOUNT)
- PULSE: Gate triggering via TRG-IN (continuous output of measurement values, if TRG-IN is active)
- SOFTWARE: Triggering via the command TRIGGERSW, see Chap. 12.4.4, (output of measurement values depending on the TRIGGERCOUNT, see Chap. 12.4.3).

Factory setting: NONE

12.4.2 Trigger Level

```
TRIGGERLEVEL HIGH|LOW LLL | HLL
```

Defines the active logic level and the switching threshold for the trigger input.

- HIGH | LOW: active logic level
  - HIGH: Rising edge
  - LOW: Falling edge
- LLL|HLL: Switching threshold
  - LLL = Low-level logic ==> LO = 0..0.7 volts, HI = 8..30 volts
  - HLL = High-level logic ==> LO = 0..3 volts, HI = 8..30 volts

Factory setting: HIGH LLL

12.4.3 Number of measurement values to be output

```
TRIGGERCOUNT 0 | 1... 16382 |INFINITE |16383
```

Defines the number of values that are output during a trigger event.

- 1...16382: Number of values that are output during every trigger event.
- INFINITE | 16383: Starts continuous output of measurement values after a trigger event.
- 0: Stops continuous output of measurement values after a trigger event.

Factory setting: 1

12.4.4 Software trigger

```
TRIGGERSW
```

Generates a software trigger pulse when trigger is set to SOFTWARE.

If SOFTWARE is not selected in the trigger selection, see Chap. 12.4.1, the error message “E43 triggermode SOFTWARE disabled” is output.

If the command is sent again during continuous output of measurement values (TRIGGERCOUNT = 16383), the output of measurement values is ended.

12.5 Data Output via Digital Interfaces

12.5.1 Ethernet settings

```
IPCONFIG DHCP | STATIC [<IP address> [<Netmask> [<Gateway>]]]
```

Defines the settings for the Ethernet interface.

- DHCP: IP address and gateway are automatically queried via DHCP. If no DHCP server is available, a link-local address is searched for.

- STATIC: Setting an IP address, netmask and gateway (format: xxx.xxx.xxx.xxx)

If the IP address, netmask and/or gateway are not specified, their values remain unchanged.

Factory setting: STATIC 169.254.168.150 255.255.0.0 169.254 1.1

12.5.2 Setting for Ethernet measurement value transmission

```
MEASTRANSFER NONE
MEASTRANSFER SERVER/TCP <port>
MEASTRANSFER CLIENT/UDP <IP> <port>
```

Settings for Ethernet data transfer mode

- The port is freely selectable between 1024 and 65535.

Factory setting: SERVER/TCP 1024

12.6 Parameter management, load/save settings

12.6.1 Saving parameters

```
STORE 1|2|3|4|5|6|7|8
```

- STORE: Save the current parameters under the specified number in the flash drive. When rebooting the controller, the last saved dataset is always loaded.

12.6.2 Loading parameters

```
READ ALL | DEVICE | MEAS 1|2|3|4|5|6|7|8
```

Reads the parameters under the specified number from the flash drive. In addition, the scope of the data to be loaded must be specified:

- ALL: All parameters are loaded.
- DEVICE: Only the device basic settings are loaded (interface parameters).
- MEAS: Only the measurement settings are loaded (all properties for the measurement).

12.6.3 Reset factory settings

```
SETDEFAULT [ALL] [NODEVICE]
```

Resets the controller to factory settings.

- ALL: All setups are deleted and the default parameters are loaded, otherwise only the current setup is deleted.
- NODEVICE: The IP address settings are temporarily maintained.

12.6.4 Resetting the statistics

```
RESETSTATISTIC
```

Resets the statistics (all current min, max and peak-to-peak values)

Can also be triggered by MFIN, see MFIFUNC chapter, see Chap. 12.9.8.

12.7 Measurement

12.7.1 Selection of measuring mode

```
MEASMODE SENSOR1VALUE|SENSOR2VALUE|SENSOR12THICK|SENSOR12STEP
```

Defines the measuring mode.

The DPUVALUE results from the transfer of a sensor value or from the calculation of a thickness or step. If an encoder value is used in one of these calculations, an error message “E80 channel is not in sensor mode” is generated.

- SENSOR1VALUE: Measurement value from sensor 1
- SENSOR2VALUE: Measurement value from sensor 2
- SENSOR12THICK: The measurement values from sensor 1 and sensor 2 are subtracted from the measuring range and both results are added together. If mastering is active, both values are subtracted from the internal mastering offset.
- SENSOR12STEP: Difference of measurement value of sensor 1 minus measurement value of sensor 2

Factory setting: SENSOR1VALUE

12.7.2 Setting the measuring rate

```
MEASRATE x.xxx
```

Specifies the measuring rate (frequency) in kHz with three decimal places.

Only measuring rates supported by the sensors are allowed. If synchronization is disabled, values of between 0.1 and 100.000 are allowed.

12.7.3 Outputting temperature signals

```
GETTEMP<n>
```

If an ILD2300 is connected at the channel n and it outputs a temperature signal, this temperature signal is read out from the incoming data stream and returned scaled to °C with one decimal place.

12.7.4 Sensor measurement value averaging

```
AVERAGE<n> NONE | MOVING | RECURSIVE | MEDIAN [<Averaging depth>]
```

Averaging in the sensors. The average value always affects all distance and difference values to be output.

- NONE: Measurement value averaging inactive.
- MOVING: Moving average [3]
- RECURSIVE: Recursive average [1]
- MEDIAN: Median [1]

The command AVERAGE2 NONE | MOVING | RECURSIVE | MEDIAN [<Averaging depth>] sets the averaging for the sensor connected to the sensor 2 connection.

An error message “E39 no sensor found” appears in the event of CHANNELMODE<n> == ENCODER

Factory setting: NONE

12.7.5 Mastering / zeroing

```
MASTERMV NONE | MASTER <Master value>
```

Mastering the ControllerVALUE

- NONE: Ends the mastering
- MASTER: Sets the current measurement value as the master value
  - Master value in millimeters (min: -1024.0 mm, max: 1024.0 mm)

Factory setting: NONE

12.7.6 Two-point mastering

```
DIGITALSCALE<n> MASTER <value>|NONE
```

Two-point mastering is used to correct the slope and offset of the output signal using any two points. The value range for <value> is set between -1024 and 1024 mm. Two-point mastering makes it possible to achieve a linear signal curve within the defined limit values at the Ethernet and USB outputs. The correction only affects the measurement value of the DPU in the selected measurement task. The raw data of the individual sensors and the analog outputs remains unaffected. Once one of the two DIGITALSCALE<n> has been set to NONE, two-point scaling no longer takes place.

[3] Only values also supported by the sensor are possible.

12.7.7 Switch of Measurement Value Display

```
UNIT|INCH
```

Switch of measurement value display only on the websites

12.8 Switching the laser on / off

```
LASERPOW1 OFF | ON
```

Switch the laser cable on or off.

If the laser is enabled by a short-circuit bridge between Laser-ON and GND, it can be switched using the command LASERPOW1 OFF/ON. The command LASERPOW2 works in a similar way and is used for the sensor connected at the sensor 2 connection.

12.9 Data Output

12.9.1 Selection of digital output

```
OUTPUT NONE | ETHERNET | HTTP ETHERNET | USB
```

Enables the data output at the desired interface.

- NONE: No output of measurement values
- ETHERNET: Output of measurement values via Ethernet
- HTTP: Output of measurement values via the controller website
- USB: Output of measurement values via USB

Factory setting: HTTP

12.9.2 Selection of interface for reduced data output

```
OUTREDUCE <Output reduction> ([ANALOG] [USB] [ETHERNET])|NONE
```

Defines the interface via which the output of measurement values is reduced by transferring only every nth measurement value.

- NONE: No data output reduction
- ANALOG: Reduced data output via ANALOG
- ETHERNET: Reduced data output via ETHERNET
- USB: Reduced data output via USB
- 1: Outputs each measurement value.
- 1 ... 3000000: Outputs every nth measurement value

Factory setting: 1 NONE

12.9.3 Scaling output values

```
OUTSCALE_USB STANDARD|(TWOPOINT <Minimum measurement value> <Maximum measurement value>)
```

Setting the DPUVALUE scaling via USB

The default scaling is for distance/step 0 to MR (Sensor1) and for thickness measurement 0 to MR (sensor1) + MR (Sensor2) (MR = measuring range).

The minimum and maximum measurement value must be given in millimeters. The available output range of the USB output is then spread between the minimum and maximum measurement value. The minimum and maximum measurement value must be between -1024.0 and 1024.0 mm with four decimal places.

The max. value must be greater than the min. value

Factory setting: DEFAULT

12.9.4 Error handling

```
OUTHOLD NONE|0|<number>
```

Defines the behavior for the output of measurement values in the event of an error, but only for the controller.

- NONE: No holding time, error values are output
- 0: Holds the last measurement value indefinitely
- Number:
  Holds the last measurement value for a maximum of <n> measuring cycles with errors, then error values are output.

Factory setting: NONE

12.9.5 Data selection for USB

```
OUT_USB NONE|([CHANNEL1VALUE] [CHANNEL1ADDITIONAL] [SENSOR1SHUTTER] [SENSOR1INTENSITY]
[CHANNEL2VALUE] [SENSOR2ADDITIONAL] [SENSOR2SHUTTER] [SENSOR2INTENSITY] [DPUVALUE] [DPU-
COUNTER] [DPUTIMESTAMP] [DPUDIGITALIO] [CHANNEL1STATMIN] [CHANNEL1STATMAX] [CHANNEL1STAT-
PEAK] [CHANNEL2STATMIN] [CHANNEL2STATMAX) [CHANNEL2STATPEAK] [DPUSTATMIN] [DPUSTATMAX]
[DPUSTATPEAK])
```

Setting for specifying which values are to be output via USB.

- NONE: No output via USB
- CHANNEL1VALUE: Channel 1 measurement value
- CHANNEL1ADDITIONAL: Channel 1 additional value
- SENSOR1SHUTTER: Sensor 1: Shutter speed
- SENSOR1INTENSITY: Sensor 1: Intensity
- CHANNEL2VALUE: Channel 2: Measurement value
- SENSOR2ADDITIONAL: Channel 2: Additional value
- SENSOR2SHUTTER: Sensor 2: Shutter speed
- SENSOR2INTENSITY: Sensor 2: Intensity
- DPUVALUE: DPU: Measurement value
- DPUCOUNTER: DPU: Counter value
- DPUTIMESTAMP: DPU: Timestamp
- DPUDIGITALIO: DPU: Digital inputs/outputs
- CHANNEL1STATMIN: Channel 1: Minimum value
- CHANNEL1STATMAX: Channel 1: Maximum value
- CHANNEL1STATPEAK: Channel 1: Peak-to-peak value
- CHANNEL2STATMIN: Channel 2: Minimum value
- CHANNEL2STATMAX: Channel 2: Maximum value
- CHANNEL2STATPEAK: Channel 2: Peak-to-peak value
- DPUSTATMIN: DPU: Minimum value
- DPUSTATMAX: DPU: Maximum value
- DPUSTATPEAK: DPU: Peak-to-peak value

Factory setting: SENSOR1VALUE

12.9.6 Data selection for Ethernet

```
OUT_ETH NONE|([CHANNEL1VALUE] [CHANNEL1ADDITIONAL] [SENSOR1SHUTTER] [SENSOR1INTENSITY]
[CHANNEL2VALUE] [SENSOR2ADDITIONAL] [SENSOR2SHUTTER] [SENSOR2INTENSITY] [DPUVALUE] [DPU-
COUNTER] [DPUTIMESTAMP] [DPUDIGITALIO] [CHANNEL1STATMIN] [CHANNEL1STATMAX] [CHANNEL1STAT-
PEAK] [CHANNEL2STATMIN] [CHANNEL2STATMAX) [CHANNEL2STATPEAK] [DPUSTATMIN] [DPUSTATMAX]
[DPUSTATPEAK])
```

Setting for specifying which values are to be output via Ethernet53.

Factory setting: SENSOR1VALUE

12.9.7 Information about signals set

`GETOUTINFO_USB`

Identical to query using OUT_USB, i.e. can only query, but not change. Useful due to compatibility with other sensors/ devices.

`GETOUTINFO_ETH`

Identical to query using OUT_ETH, i.e. can only query, but not change. Useful due to compatibility with other sensors/ devices.

12.9.8 Function selection MFI input

`MFIFUNC NONE|MASTER|SENSOR1|SENSOR2|SENSOR12|RESETSTATISTIC|LLL|HLL`

Explanation , see Chap. 6.3.4

- NONE: Disabled
- MASTER: Master DPU measurement value
- SENSOR1: Forward to sensor 1
- SENSOR2: Forward to sensor 2
- SENSOR12: Forward to sensor 1 and 2
- RESETSTATISTIC: Reset statistical values
- LLL: Low-level logic
  HLL: High-level logic

12.9.9 Digital error outputs

Switching outputs, can output 0 or 1.

`ERROROUT<n> <errorOutNames>`

with`<errorOutNames>=SENSOR1ERROROUT1|SENSOR1ERROROUT2|SENSOR2ERROROUT1|SENSOR2ERROROUT2|CHANNEL1VALUE|CHANNEL1ADDITIONAL|SENSOR1INTENSITY|SENSOR1SHUTTER|CHANNEL2VALUE|CHANNEL2ADDITIONAL|SENSOR2INTENSITY|SENSOR2SHUTTER|CHANNEL1STATMIN|CHANNEL1STATMAX|CHANNEL1STATPEAK|CHANNEL2STATMIN|CHANNEL2STATMAX|CHANNEL2STATPEAK|DPUVALUE|DPUSTATMIN|DPUSTATMAX|DPUSTATPEAK|LOW|HIGH`

In CHANNELMODE SENSOR, the status of the digital sensor output is forwarded directly in the event of SENSOR1ERROROUT1|SENSOR1ERROROUT2|SENSOR2ERROROUT1|SENSOR2ERROROUT2.

In CHANNELMODE ENCODER, a brief HIGH signal is output if ENCSTEPSIZE is reached in the event of SENSOR1ERROROUT1|SENSOR2ERROROUT1. The duration can be changed using ENCTRIGGERPULSEWIDTH.

A value range check is carried out according to the ERRORLIMIT in the event of CHANNEL1VALUE|CHANNEL1ADDITIONAL|SENSORINTENSITY|SENSOR1SHUTTER|CHANNEL2VALUE|CHANNEL2ADDITIONAL|SENSOR2INTENSITY|SENSOR2SHUTTER|CHANNEL1STATMIN|CHANNEL1STATMAX|CHANNEL1STATPEAK|CHANNEL2STATMIN|CHANNEL2STATMAX|CHANNEL2STATPEAK|DPUVALUE|DPUSTATMIN|DPUSTATMAX.

With LOW|HIGH, the output is permanently set to LOW or HIGH.

12.9.10 Limit value testing

`ERRORLIMIT<n> <Lower limit value><Upper limit value>`

Parameters for DPU limit value testing.

Depending on the signal set for ERROROUT<n>, different value ranges and units apply for the ERRORLIMIT parameters: mm (sensor values)

- CHANNEL1VALUE|CHANNEL2VALUE: 0 .. UINT32_MAX (encoder values)
- SENSOR1INTENSITY|SENSOR2INTENSITY: 0.0000 .. 100.0000 %
- SENSOR1SHUTTER|SENSOR2SHUTTER: 0.0000 .. 4000.0000 µs

- SENSOR1ERROROUT1|SENSOR1ERROROUT2|SENSOR2ERROROUT1|SENSOR2ERROROUT2|LOW|HIGH: No value range, no unit, since ERRORLIMIT is ignored here.

12.9.11 Analog output

```
ANALOGOUT<n> <analogOutNames>
```

with `analogOutNames=CHANNEL1VALUE|CHANNEL1ADDITIONAL|SENSOR1INTENSITY|SENSOR1SHUTTER|CHANNEL2VALUE|CHANNEL2ADDITIONAL|SENSOR2INTENSITY|SENSOR2SHUTTER|CHANNEL1STATPEAK|CHANNEL2STATPEAK|DPUVALUE|DPUSTATPEAK|FIXED<value>`

In the case of CHANNELMODE<n>==ENCODER, a set CHANNEL<n>VALUE is output as the error voltage.

12.9.12 Selection of the output range for the analog output

```
ANALOGRANGE<n> 0-5V|0-10V|-10-10V|4-20mA
```

Defines the output range for the analog output.

- 0 ... 5 V: Measurement value is specified in the range of 0 - 5 V.
- 0 ... 10 V: Measurement value is specified in the range of 0 - 10 V.
- -10 ... -10 V: Measurement value is specified in the range of -10 - 10 V.
- 4 ... -20 mA: Measurement value is specified in the range of 0 – 20 V.

12.9.13 Scaling the analog output

```
ANALOGSCALE<n> STANDARD|(TWOPOINT <Minimum measurement value><Maximum measurement value>)
```

When using default scaling, the entire measuring range of the sensor/controller is output.

Two-point scaling requires specifying the start and end of the range.

> i The default scaling is for distances -MR/2 ... MR/2, for thickness measurements 0 ... 2 MR (MR = measuring range), for intensity 0 ... 100 %.

12.10 Encoder Settings

12.10.1 General

All of the following encoder parameters can always be set. They are only used for CHANNELMODE<n> == ENCODER.

12.10.2 Encoder interpolation mode

```
ENCINTERPOL<n> COUNTER|1|2|4 (n = 1,2)
```

Setting the interpolation depth of the relevant encoder input.

- COUNTER: Normal counting operation
- 1, 2, 4: Interpolation stage (single, double, quadruple evaluation)

12.10.3 Encoder reference track

```
ENCREF<n> NONE|ONE|EVER|LIMIT
```

Setting the effect of the encoder reference track

- NONE: Reference mark of the encoder has no effect.
- ONE: Setting once. The encoder value, see ENCVALUEn, is adopted when the reference mark is reached for the first time.
- EVER: Setting at all marks. The encoder value, see ENCVALUEn, is adopted every time the reference mark is reached.
- LIMIT: The encoder is limited between 0 and the encoder value, see ENCVALUEn.

When the limit is exceeded, the value is set to the opposite value (forward encoder value ≥ 0, backward 0 ≥ encoder value)

12.10.4 Encoder Start Value

`ENCPRESETVALUE<n> <uint32>`

The command defines the encoder start value. The encoder value can be between 0 and 4294967295 (UINT_MAX).

12.10.5 Loading the encoder start value

`ENCLOADPRESET<n>`

Loads the value previously agreed via ENCPRESETVALUE, see Chap. 12.10.4 to the corresponding encoder.

12.10.6 Encoder counting direction

`ENCDIR<n> NORMAL|REVERSE`

Defines the encoder counting direction.

12.10.7 Resetting the reference marks

`ENCENABLEREF<n>`

Resets reference mark detection, see ENCREFn.

12.10.8 Resetting the encoder

`ENCCLEAR<n>`

Resets the encoder value to 0 in the specified encoder. ENCPRESETVALUE<n> is not changed in the process.

12.10.9 Querying the encoder value

`ENCGETVALUE<n> [LATCH]`

Reads out current encoder value asynchronously. The return value can be between 0 and 4294967295 (UINT_MAX).

12.10.10 Querying the reference counter

`ENCGETREF<n>`

Queries the current reference counter value. Possible results:

- NONE: Reference mark has not been crossed since the last reset.
- FIRST: The reference mark has been crossed once.
- SECOND: The reference mark has been crossed multiple times.

12.10.11 Encoder acquisition source

`ENCLATCHSRC<n> TIMER|SENSOR|MFIN|TRGIN|FIRSTREF|SECONDREF|ANYREF|NONE/ENCSTEPSIZE x`

n = 1, 2

There are only 2 possible encoder channels.

Selects the source with which the encoder is written to the latch register for continuous recording. The value can be read out from this register using ENCGETVALUE.

Possible parameters:

- NONE: Encoder is never latched (default value).
- TIMER: Encoder is recorded in sync with a timer.
- SENSOR: Encoder is recorded in sync with the measurement value frames of the sensor at the other channel.

- TRGIN: Trigger input: Encoder is recorded on the rising edge of a trigger input.
- MFIN: Encoder is recorded on the rising edge of a multi-function input.
- ENCSTEPSIZE: Latching with every xth step
- FIRSTREF, SECONDREF, ANYREF: Encoder is latched when the first, second or every reference mark is reached.

Default: NONE

12.11 Encoder as Trigger

12.11.1 Number of triggers

`ENCTRIGGERSTEPSIZE<n> 1..UINT32_MAX`

After <value> increments in each case, the DPU triggers processing again.

Default: 1

12.11.2 Minimum trigger value

`ENCTRIGGERMIN<n> 0..UINT32_MAX`

Only above <value> is output. For linear axes.

Default: 0

Error message if the minimum trigger value is greater than or equal to the maximum trigger value.

12.11.3 Maximum trigger value

`ENCTRIGGERMAX<n> 0..UINT32_MAX`

Only below <value> is output. For linear axes.

Default: 0

Error message if the minimum trigger value is greater than or equal to the maximum trigger value.

12.11.4 Trigger start value

`ENCTRIGGERSTART<n> 0..UINT32_MAX|NONE`

Output is started after this start position is passed.

Default: NONE: Start value inactive, output is started immediately.

12.11.5 Trigger pulse width

`ENCTRIGGERPULSEWIDTH<n> 1..UINT16_MAX`

Input of pulse duration in µs at the digital error output in CHANNELMODE<n> ENCODER and ERROROUT<n> SENSOR<n> SENSOR<n>ERROROUT1 when the encoder has reached the number of steps in ENCTRIGGERSTEPSIZE<n>.

Default: 1 µs

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