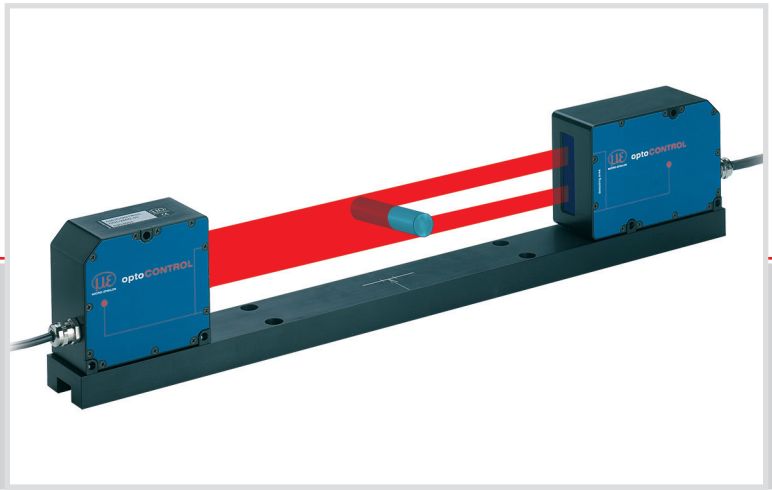
MICRO-EPSILON



Operating Instructions

optoCONTROL 2600

ODC 2600-40
ODC 2600-40(209)

Laser micrometer

MICRO-EPSILON
Eltrotec GmbH
Manfred-Wörner-Straße 101

73037 Göppingen / Germany

Tel. +49 (0) 7161 / 98872-300
Fax +49 (0) 7161 / 98872-303
eltrotec@micro-epsilon.com
www.micro-epsilon.com

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, could result in death or serious injury.
NOTICE	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
➪	Indicates a user action.
i	Indicates a tip for users.
Measure	Indicates hardware or a 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 light source/receiver or the controller

NOTICE

Avoid shocks and impacts to the light source/receiver and the controller.

> Damage to or destruction of the light source/receiver or the controller

Protect the cables against damage.

> Failure of the measuring device

The supply voltage must not exceed the specified limits.

> Damage to or destruction of the light source/receiver or the controller

Avoid damage (scratches) to the protective windows of the light source and receiver through unsuitable cleaning-methods or cleaning solvents.

> Inaccurate, erroneous measuring values

Do not touch the protective windows of light source and receiver with the fingers. Wipe off any fingerprints immediately.

> Inaccurate, erroneous measuring values

Avoid constant exposure of the measuring channel to dust or splashes of water. Blow off or use protective housing.

> Damage to or destruction of the light source/receiver or the controller

Avoid exposure of light source/receiver or controller to aggressive media (detergents, cooling emulsions).

> Damage to or destruction of the light source/receiver or the controller

1.3 Notes on CE Marking

The following apply to the optoCONTROL 2600:

- 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 measuring system 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 optoCONTROL 2600 is designed for use in industrial and laboratory applications. It is used for
  - measuring displacement, distance, edge and offset
  - edge crack testing
  - position acquisition of components or machine parts
- The system must only be operated within the limits specified in the technical data, see 3.5.
- The system 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 system.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class:
  - Light source/receiver: IP64 (applies with connected cable)
  - Controller: IP40

i The protection class is restricted to water (no drilling emulsions, cleaning solvents etc.).
Avoid quick changes between hot and cold.
Use a protective housing if the effects of water are continuous.

- The level of protection does not apply to the optical paths during operation, because if they become contaminated, the function is impaired or fails completely.
- Temperature range:
  - Operation: 0 ... +50 °C (+32 ... +122 °F) with free air-circulation
  - Storage: -20 ... +70 °C (-4 ... +158 °F)
- Humidity: Up to 5 - 95 % RH (non-condensing)
- Ambient pressure: Atmospheric pressure
- Vibration: According to IEC 60068-2-6 (light source only/ receiver)
- Shock: According to IEC 60068-2-27 (light source only/ receiver)

i Only use screened leads or the original cable from the range of accessories for connecting a power supply unit and for the outputs!

2. Light Source

The light source of the optoCONTROL 2600 is a high performance red LED.

LED light sources are not classified according to the laser standard.

On the controller a yellow LED (“Light On”) signals by its illumination that radiation is being emitted from the optical opening of the light source.

3. Functional Principle, Technical Data

3.1 Measurement Principle

optoCONTROL is a measurement system with an integral high resolution line-scan camera for the measurement of geometrical quantities.

The light source illuminates the target from the rear.

In the receiver there is a telecentric objective lens which provides an image of the same size in the so-called telecentric range, producing constant accuracy.

The advantages of the telecentric lens lie in free positioning of the target within a large range (± 5 mm) and the relatively high tolerance to contamination and extraneous light.

The line scan camera in the receiver measures the projected outer contour of the target with high accuracy.

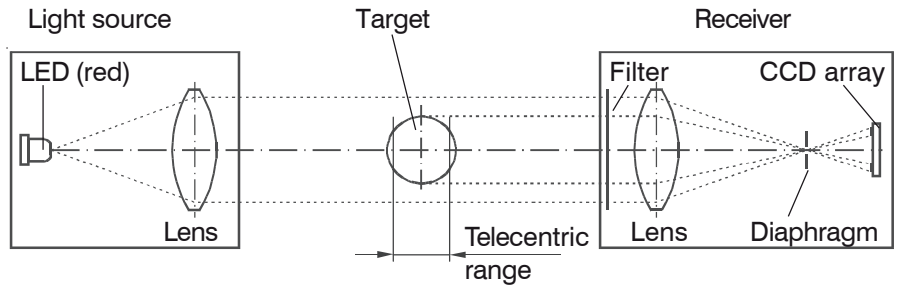


Fig. 1 Measuring principle

3.2 Structure of a Complete Measurement System

A measurement system consists of:

- light source,
- receiver,
- controller.

optoCONTROL consists of a sensor unit SU and a controller CU.

The sensor unit incorporates a LED light source and a receiver with a line scan camera which are mounted on the mounting rail enclosed with the supplied items.

The sensor unit is controlled and evaluated by an intelligent controller with graphical display for operation and measurement indication.

The data obtained with the various selectable measurement programs is output via analog and digital interfaces.

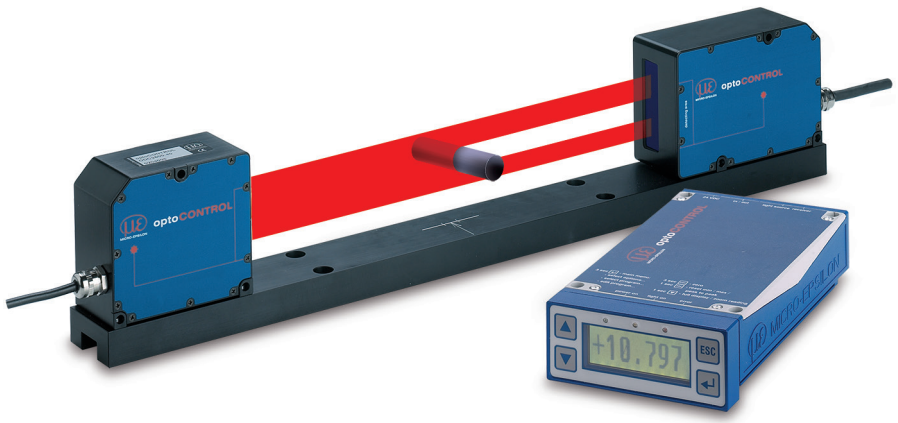


Fig. 2 Measurement system ODC2600-40, complete

3.3 Controller

3.3.1 Front View of the Controller

The interactive operation is supported by an LC graphical display with illuminated screen. The controller is operated with the four keys on the front panel, see Fig. 3.

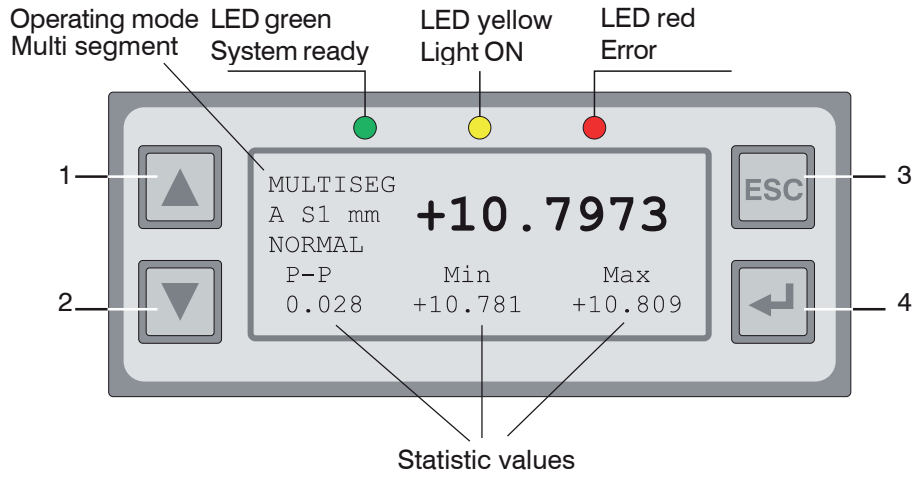


Fig. 3 Keypad and display on the front panel of the controller

The following functions are assigned to the keypad, see Fig. 3:

(1), (2) Up/down movement in menus,

Value input: (1) greater, (2) smaller

(3) Quitting a menu point, change to the next higher hierarchical level

(4) Entry into the selected menu point, confirmation of entry (By long press switches the input values are taken over.)

Below the operating mode (e.g. DIA, EDGE) A for absolute or R for relative measurement is displayed.

- In the `Multisegment` operating mode (MULTISEG) the code for the selected segment also appears (S1 or S2).

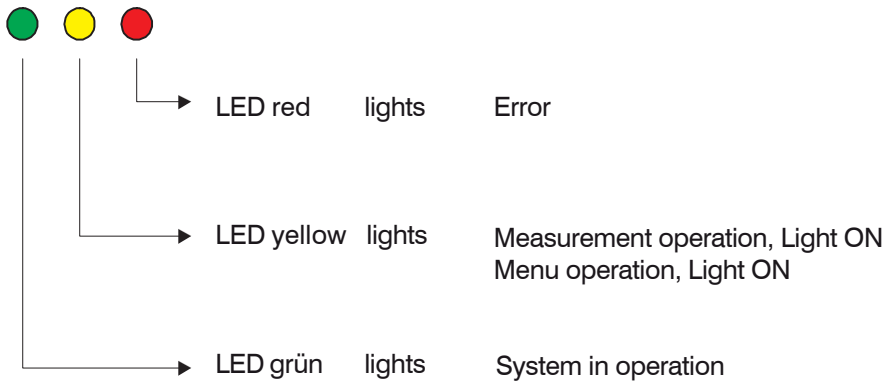


Fig. 4 LEDs on the front panel of the controller

3.3.2 Rear View of the Controller

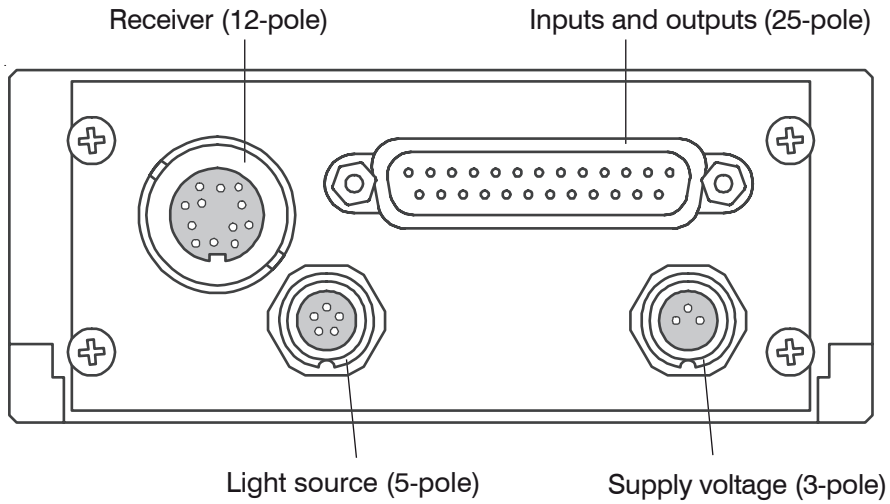


Fig. 5 Connection on the rear side of the controller

3.4 Operating Modes

The following operating modes are selectable via a menu-assisted selection (measurement program, see 6.3.6):

- Position of an edge (bright/dark or dark/bright)
- Diameter of a target
- Gap between two targets
- Distance between two selectable edges (segment)
- Serial measurement of up to four freely selectable segments (multi-segment) via the digital output (e.g. segments 1 - 4 and 2 - 3)

i Factory setting:
Position edge bright - dark

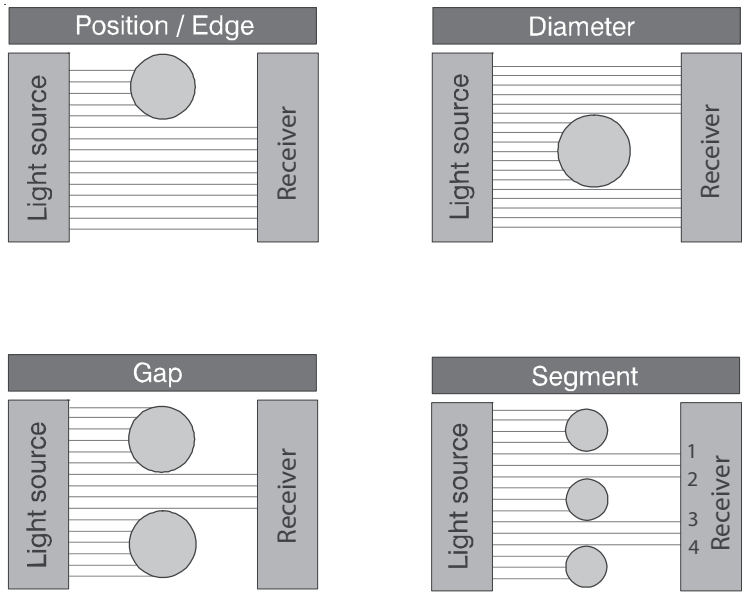


Fig. 6 Methods of operation

For each measurement program 2 limits and 2 warning levels can be programmed. For the `Multi-segment` program only 2 limits per segment 1 and segment 2 can be programmed.

Potentially measured segments 3 and 4 are not monitored.

Application-specific measurement programs can also be generated by menu.

3.5 Technical Data

Model		ODC 2600-40	ODC 2600-40(209)
Measuring range		40 mm	
Min. target size		0.3 mm	
Distance light source - receiver (free space) [1]		300 (±50) mm	400 (±50) mm
Measuring distance (target - receiver)		150 (±5) mm	200 (±5) mm
Measuring rate		2.3 kHz	
Resolution [1]		0.1 µm	
Linearity [2]		< ±3 µm	
Repeatability [2 3]		≤ ±1 µm	≤ ±1.5 µm
Light source		red LED 625 nm	
Analog output		0 to 10 VDC, ±10 VDC, selectable	
Digital interface		RS232 (115.2 kBaud); RS422 (691.2 kBaud)	
Switching output		Error, 4 x limit values; max. 30 V DC ≤ 100 mA	
Signal input		Zero setting/reset; trigger/light (on/off); synchronization	
Digital output		Synchronization [4]	
Connection	Receiver	integrated cable, length 2 m 12-pole	
	Light source	integrated cable, length 2 m, 5-pole	
	Controller	Receiver: 12-pole M8 socket; Light source: 5-pole socket for light source Supply: 3-pole socket; signal: 25-pole SUB-D socket	
Mounting		Mounting rail (see accessories), mounting holes	
Temperature range	Storage	-20 °C … +70 °C (non-condensing)	
	Operation	0 °C ... +50 °C (non-condensing)	
Supply voltage		+24 VDC (±15 %)	
Max. current consumption		< 1 A	
Shock (DIN EN 60068-2-27)		15 g / 6 ms	
Vibration (DIN EN 60068-2-6)		2 g / 20 … 500 Hz	
Protection class (DIN-EN 60529)	Receiver/Light source	IP64	
	Controller	IP40	
Material	Receiver/Light source	Aluminum housing	
Weight	Light source	450 g	
	Receiver	800 g	
	Controller	1200 g	
	Mounting rail	900 g	1100 g
Measuring programs		Edge light-dark; Edge dark-light; (Outside) diameter/width Gap/(inside diameter) Any segment edge	
Control and display elements		LCD display (value, maximum, minimum, peak-to-peak) Measurement chart in mm / inch, selectable; Menu language in German / English, selectable 3x LED (power on, light on, error)	
Features		4 editable user programs	

The specified data apply for a consistent room temperature of 20 °C, after a warm-up time of 30 min.

1) Resolution of the digital display (resolution of digital output 0.6 µm)

2) Measured with 3 sigma; edge measurement without averaging, working distance 150±5 mm, option 209: 200 mm ± 5 mm

3) Measured with static noise over 3 min.

4) Only for synchronization of two or more optoCONTROL 2600 models

3.6 Block Diagram

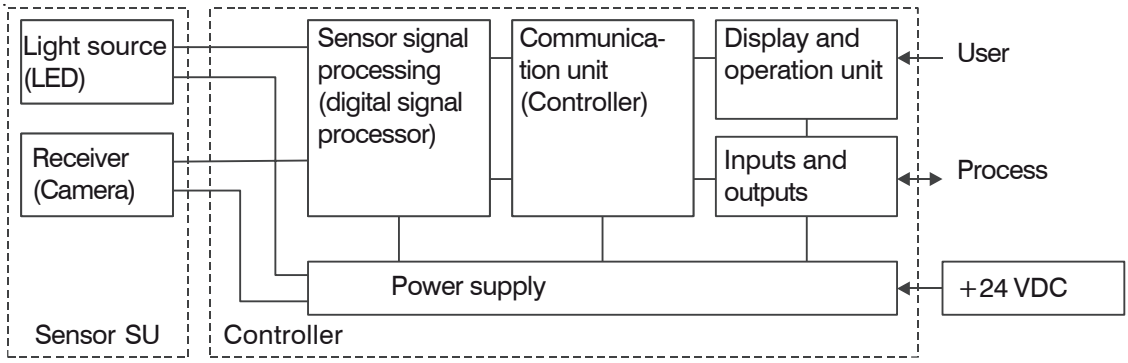


Fig. 7 Block diagram of the ODC 2600 measuring system

3.7 Analog Output

Output voltage (without offset)	0 ... +10 V DC
Max. output range (with offset, factor)	-10.0 V ... +10.0 V DC
Output span (100 % of measurement range)	U_{OUT} 10.0 V DC
Output voltage (with error indication)	-10.04 V ... +10.04 V DC
Internal resistance	100 Ohm
Minimum load resistance	1 kOhm
Recommended load resistance	1 MOhm
Maximum capacitive load, see 6.4	47 nF

3.8 Input Zero Point / RESET

By briefly connecting (0.5 to 3 s) together the inputs “Zero point” (Signal and GND) during measurement, the measurement is set to the default master value, see 6.3.7.2. If a master value has not yet been entered, the measurement is set to 00.000 during zero setting.

If the zero point input is activated for between 3 and 6 s (closed), resetting occurs to the measurement without masters or zeros. Pulses which are shorter than 0.5 s or longer than 6 s are not processed.

The zero point input is only active in the normal measurement mode with valid measurements. In the `TRIGGER` measurement mode this input is used as `RESET` and therefore no zero setting is possible.

In the `Multi-segment` operating mode and with erroneous measurements, no zero setting is possible. The input `Zero point` affects the display and the analog output only. The digital output is not affected.

i Zero-setting input on the 25-pole connector:
Pin 5: Signal
Pin 18: GND

i The zero point input only affects the display and the analog output. The digital output is not affected.

3.9 Synchronization

If two or more optoCONTROL 2600s are operated on the same target, they can be synchronized to one another, see 6.5.

As master, controller 1 then synchronizes controller 2.

All synchronization signals are electrically isolated by optocouplers.

3.10 Error Output

If an error is detected by the measurement system (e.g. no target present, too much extraneous light, etc.), then the switching output `Error` becomes conducting.

The error output always refers to the unaveraged measurements (at a rate of 2.3 kHz).

The red light emitting diode (Error LED) also indicates the error.

For more details, see 5.6.

i The error output is provided on the 25-pole connector.
Pin 1: Error output
Pin 14: GND

3.11 Light Source Control and Trigger Input

In the menu `options` you can also activate the switching input for the external light source control `light source off`. The light source is then active (light on) when the input is short-circuited.

In the triggered measurement mode, see 6.3.7.8, this input is used as a trigger input. The light source can not then be switched off externally.

Activating the switch input for the light source controller automatically switches the system to normal operation (untriggered). This has a higher priority than triggering.

The system is delivered with the input not activated, meaning that nothing has to be connected to the 25-pole D Sub to put the system into operation.

i The activation of the input as light source control resets to normal operation.
The light source control has a maximum switching frequency of 10 Hz.

3.12 Edge Detection Threshold for Transparent Measurement Objects

The system's fixed edge detection threshold of the video signal across the entire measurement range is defaulted at 50 %.

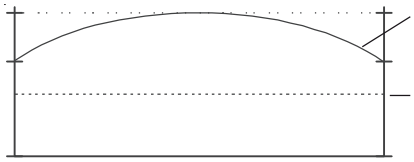


Fig. 8 Video image with fixed edge detection threshold

i There must be no light threshold when measuring object in the beam path.

In the case of highly transparent objects only a very small amount of the light will be blocked. If the edge detection threshold is set too low the measurement object will not be detected. The edge detection threshold can be adjusted to any setting between 20 % and 90 % in 1 % increments, see A 5.4, menu item `1B10 - Choose threshold value for dark/light transition`.

A very high edge detection threshold will require a dynamic curved edge detection threshold. This can be set by activating the `1B20 - Set light referencing tuning` menu item.

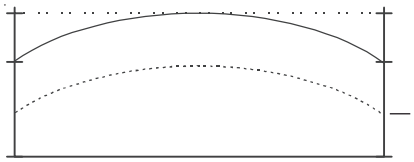


Fig. 9 Video image with dynamic edge detection threshold

The determined dynamic edge detection threshold is permanently saved (no loss at power down). However, it may be necessary to teach in a new light threshold if the light conditions have changed.
Menu item `1B30 – Reset light referencing tuning` deletes the saved dynamic edge detection threshold but not the threshold value.

To return to the default settings you can use menu item `1A00 – Clear user data options program`.

i Restoration of the delivery state deletes all individual measuring programs.

An example for the measurement of transparent measurement objects is shown in the following two illustrations.

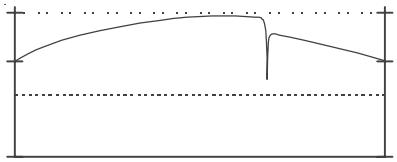


Fig. 10 Display image of the video signal, shown for the first threshold of 50 %

Measurement object: Glass edge, 0.5 mm

The figure, see Fig. 10, shows with the default conditions with a fixed threshold of 50 % the measurement object would not be detected. By increasing the edge detection threshold and carrying out a light comparison the measurement object can be detected by the sensor and the selected position or geometry then measured.

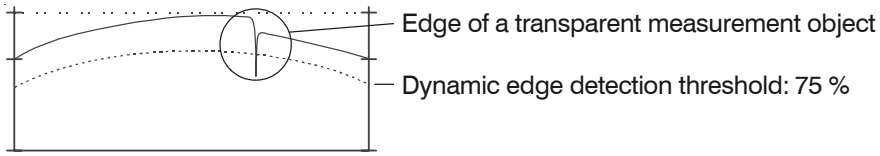


Fig. 11 Display image of the video signal with a dynamic threshold

Measurement object: Glass edge, 0.5 mm thick

4. Delivery

4.1 Unpacking, Included in Delivery

1 Controller

1 Light source

1 Receiver

1 Mounting rail with mounting screws for light source and receiver

1 25-pole Sub-D plug

1 3-pole circular plug

1 Operating Instructions

➪ 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 will occur.

i Do not touch the optical windows. Dirt on the optical window will eventually affect the functionality.

➪ 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.

4.2 Storage

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

5. Installation and Mounting

5.1 Precautions

No sharp-edged or heavy object should be allowed to affect the cable. The connecting cables from the light source and receiver are compatible with use as trailing cables.

NOTICE

Avoid kinks in the cables.

> Failure of measuring device

5.2 Mounting the Sensor Unit

The sensor unit, consisting of the light source, receiver and mounting rail, is pre-assembled and pinned together, see Fig. 12.

➥ Mount the mounting rail in such a way that it is not distorted.

A horizontal measurement arrangement reduces contamination on the optical parts and should therefore be preferred.

If the individual components are mounted separately, the locating pins should remain in the mounting rail. For mounting, either the supplied mounting screws or other suitable M4 screws should be used. Please note the thread depth of 5 mm in both components. To bolt on the individual components, the three through holes of 4.8 mm dia. in each component can also be used.

NOTICE

Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted.

> Inaccurate, erroneous measuring values

i Do not touch the optical windows. Contamination on the optical windows impairs correct functioning.

i The light source and receiver are assigned to their particular controller through the serial number and must not be interchanged.

Minimum cable bending radius

Light source	flexible: 35 mm (1.38)	fixed: 23 (.91)
Receiver	flexible: 49 mm (1.93)	fixed: 33 (1.30)

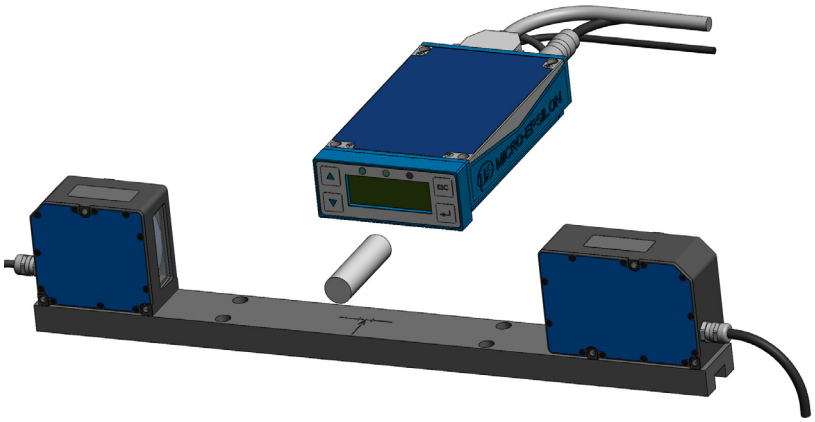


Fig. 12 Mounted sensor unit with controller

i The light source and receiver are screwed and pinned to the mounting rail and can be removed.

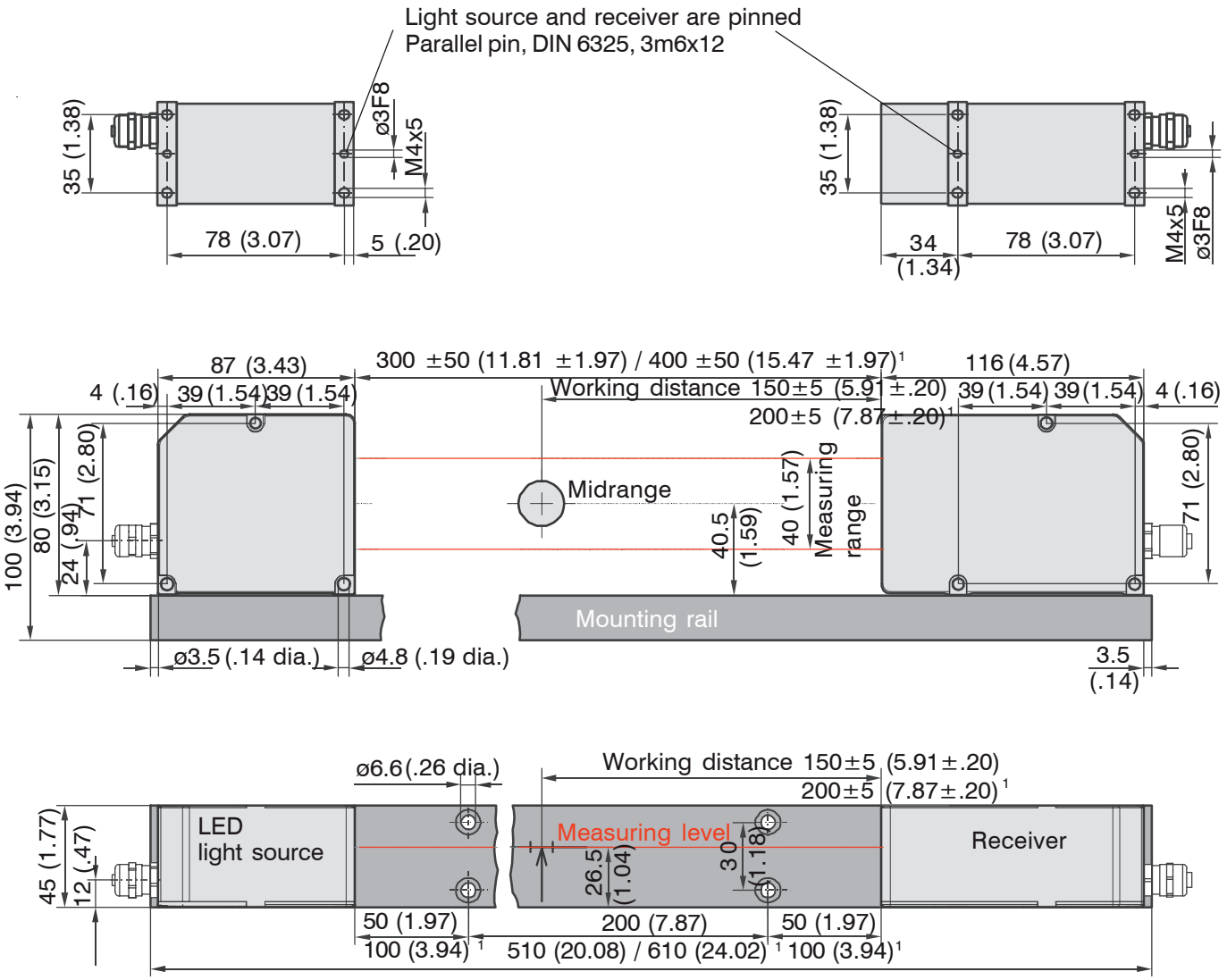


Fig. 13 Dimensional drawing of the sensor unit with mounting rail

1) Applies only for option 209.

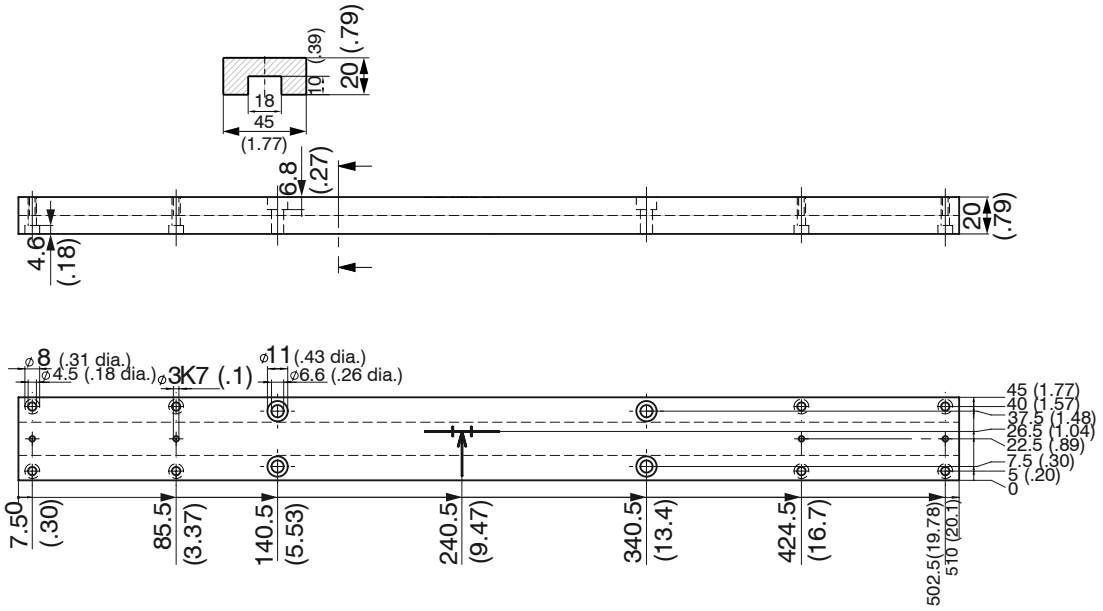


Fig. 14 Dimensional drawing of the mounting rail

Dimensions in mm (inches)

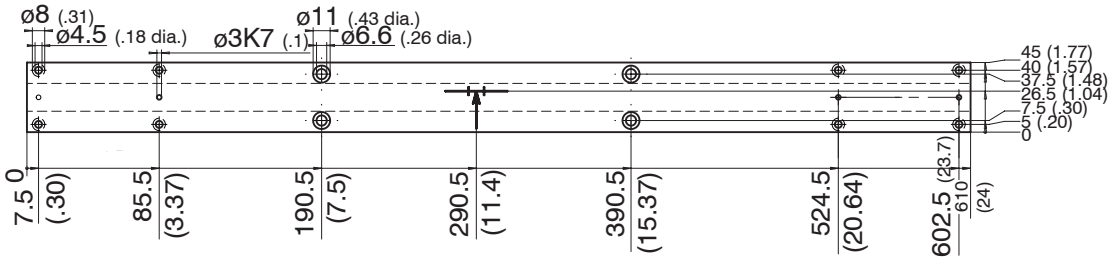


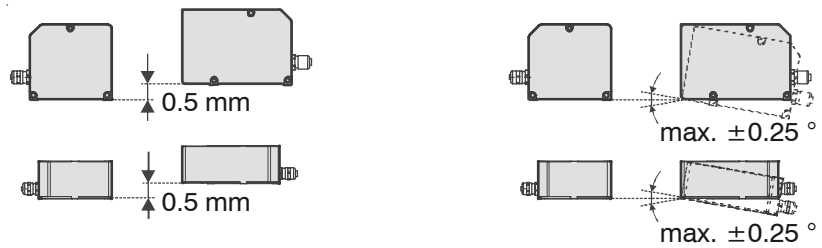
Fig. 15 Dimensional drawing of the mounting rail, option 209

Dimensions in mm (inches)

i The light source and receiver must be aligned with one another using the video signal.

When the sensor components, light source and receiver, are mounted freely, initially exact alignment of the housing edges with respect to one another should be ensured. The housing
edges must lie within one plane.
The angular deviation may be up to 0.25 °. For alignment try squares or rails are suitable aids.

Tolerances for maximum moving and tilting of the light source and receiver during installation and mounting. The following illustrations show the permissible error range:



Offset: Maximum 0.5 mm Tilt: Maximum 0.25 °

Fig. 16 Permissible adjustment error

➡ Connect light source and receiver with the controller.

Use the video signal, see 6.3.4, for accurate adjustment of the light source and receiver.

5.3 Mounting the Controller

The controller should be mounted with four M4 screws (not included in the supplied items) on a flat mounting plate. The controller can be mounted in any orientation.

Pay attention to sufficient space for connectors and cables.

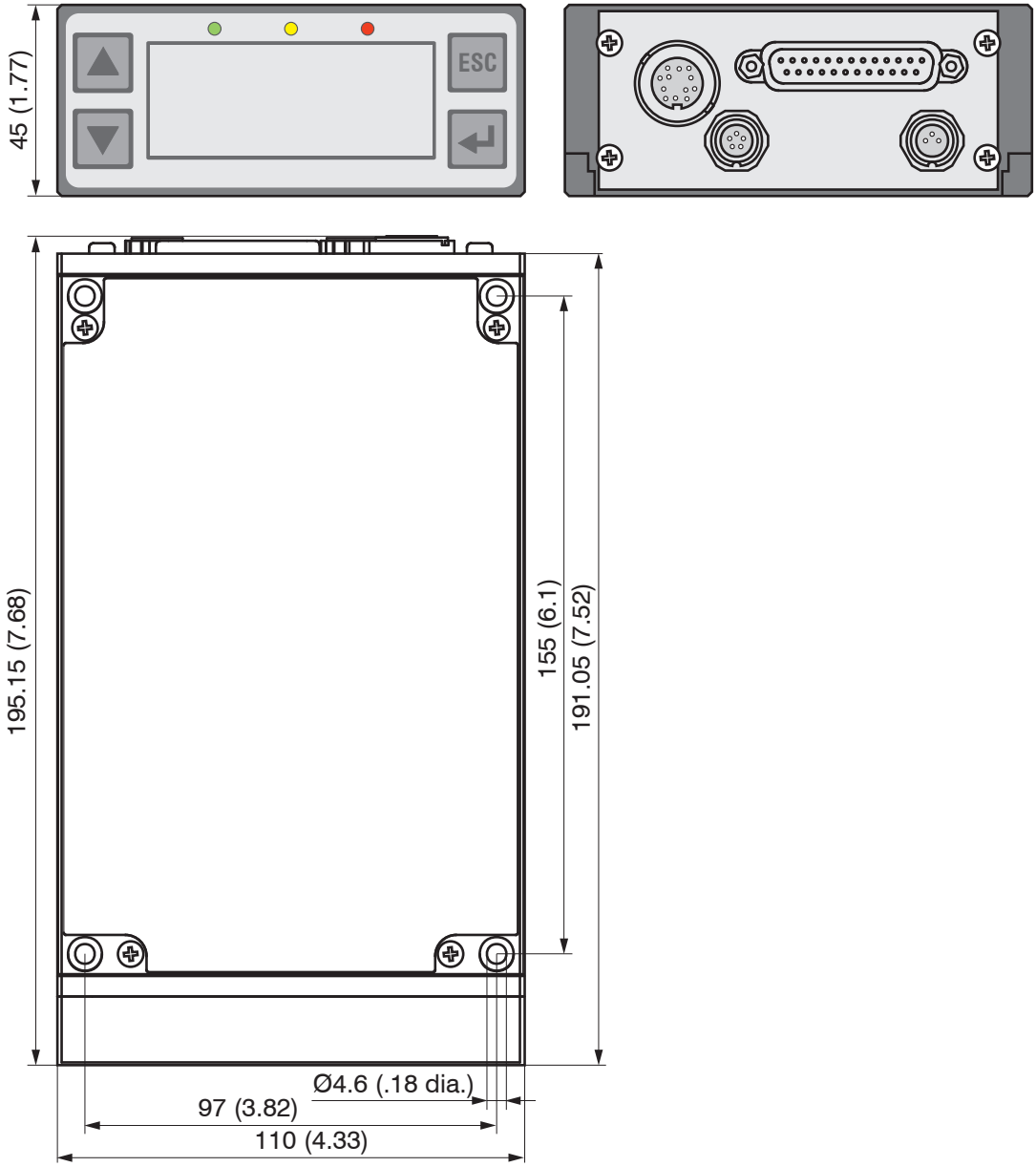


Fig. 17 Dimensional drawing controller

Dimensions in mm (inches)

The light source and receiver are assigned to their particular controller through the serial number and must not to be endangered.

Minimum cable bending radius

Signal output cable SCA2500 respectively SCD2500
Flexible: 96 mm Fixed: 40 mm

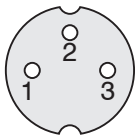
5.4 Power Supply

The supply voltage is preferably connected via a screened two-core cable, e.g. via the supply cable PC2500-3. Route the cable screen to a potential equalization terminal in the vicinity of the power supply unit. The supply voltage of ODC2600 devices is internally protected against reverse polarity.

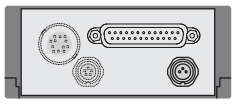
i Please use the power supply unit for measurement instruments only and not for drive units or similar sources of pulse interference at the same time.

Pin	Signal	Conductor coloring PC2500, old version in ( )
1	GND supply voltage	Brown (black or blue)
2	N.C.	----
3	+24 VDC (±15 %), <1 A	White (red)
Housing	Cable screen	Tin-plated

Fig. 18 Pin assignment, round connector (type Binder), 3-pole



3-pole male cable connector, view on solder pin side



Minimum bending radiuses of the connecting cables are 20 mm.

5.5 Connecting an Analog Terminal Device

i For connecting an analog terminal device use either the analog connecting cable SCA2500-x, SCD2500-3/10/RS422 or SCD2500-3/3/RS232, see A 1, or your own screened cable.

When using the connecting cable SCA2500-x, see A 1, the outer screen must be connected to the receiver screen (e.g. plug housing).

The inner screen acts as the signal return conductor (analog ground AGND) and must be connected to the receiver ground. This screen should not have any connection to the housing screen (plug housing).

When using your own cable, a single-core screened cable is recommended, the screen of which is used as the signal return conductor (analog ground AGND). This screen must not have any connection to the housing screen (plug housing) and the receiver screen.

i In the case of interference try connecting the outer screen to the receiver screen with a ceramic capacitor of 10 to 100 nF or not connecting it at all.

A capacitor of up to 47 nF can be wired in parallel to the input of the evaluation device to counter any high frequencies and pulse-shaped parasitic interference on the analog signal.

Route the analog connecting cable according to the general applicable rules in measurement engineering, i.e. for example, not directly next to pulse-loaded lines, best in a separate cable duct.

Pin	Signal	Signal type / connector type	Core colors or pole no. SCA2500 or SCD2500 Signal and Output Cable
1	Error output (Signal)	Switching output (Open Collector)	red
14	Error output (GND)	Switching output	blue
2	Upper tolerance limit (Signal)	Switching output (Open Collector)	violet
15	Upper/lower tolerance limit	Switching output	black and brown
3	Lower tolerance limit (Signal)	Switching output (Open Collector)	white
16	Upper warning limit (Signal)	Switching output (Open Collector)	pink
4	Upper/lower warning limit (GND)	Switching output (common connection)	gray and gray/pink
17	Lower warning limit (Signal)	Switching output (Open Collector)	red/blue
5	Zero point (Signal) [3]	Switching input (ZERO)	
18	Zero point (GND)	Reference potential for ZERO	
6	Light source OFF (Signal) [4]	Switching input for LED	
19	Light source OFF (GND)	Reference potential for switching input	
20	RS422 Receive (negative)	Optocoupler - input (negative)	green, Pin 1 (HD-SUB 15) [1]
7	RS422 Receive (positive)	Optocoupler - input (positive)	yellow, Pin 2 (HD-SUB 15) [1]
8	RS422 Send (positive)	Serial output (positive Imp.)	brown, Pin 4 (HD-SUB 15) [1]
21	RS422 Send (negative)	Serial output (negative Imp.)	white, Pin 3 (HD-SUB 15) [1]
9	RS232 Receive (RxD)	Serial input (RS232)	green, Pin 3 (DB9F) [2]
22	RS232 DGND	Reference potential for RS232	brown, Pin 5 (DB9F) [2]
10	RS232 Send (TxD)	Serial output (RS232)	yellow, Pin 2 (DB9F) [2]
23	Synchronization output (+) [1]	Digital signal output (SYNC)	
11	Synchronization output (-) [1]	Reference potential (DGND)	
24	Synchronization output (+) [2]	Optocoupler - input (positive)	
12	Synchronization output (-)	Optocoupler - input (negative)	
25	Analog output (AGND)	Reference potential for analog signal	Inner screen (thin cable)
13	Analog output (Signal)	Analog signal (voltage)	green

Fig. 19 Sub-D connector, 25-pole

1) For SCD2500-3/10/RS422 only
2) For SCD2500-3/3/RS232 only
3) In trigger mode used as reset input
4) In trigger mode used as trigger input

Comment:

- All GDN signals are connected internally with one another and with the minus pole (GND) of the 24 V supply voltage.
- DGND and AGND are internally electrically connected, but isolated from the minus pole (GND) of the 24 V supply voltage.

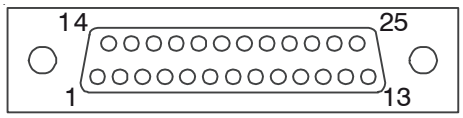


Fig. 20 25-pole Sub-D male cable connector, view on solder pin side

5.6 Switching Outputs

Error output, upper tolerance limit, lower tolerance limit, upper warning limit, lower warning limit

All switching outputs have the same internal circuit (open collector). In the active state the associated output transistor conducts to GND. For obtaining logical signal levels, external pull-up resistors to the 24 VDC supply voltage or another external auxiliary voltage are provided (see circuit diagram). The switching outputs are protected against overload and reverse connection.

i When connecting inductive loads (e.g. relays), always fit freewheel diodes across the load!

All GND signals are connected together internally and to the minus pole (GND) of the 24 V supply voltage.

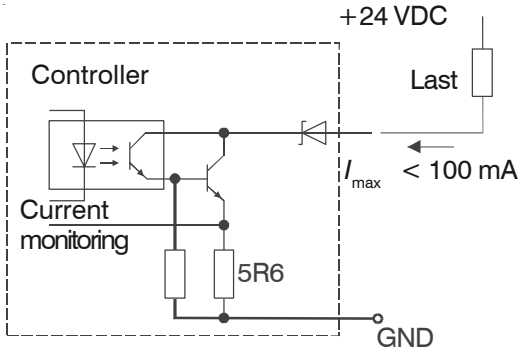


Fig. 21 Circuit diagram for switching output, with external load (e.g. pull-up resistor), see Fig. 19 (pin assignment)

Test of the Switching Outputs

The error and limit outputs can be tested in the service menu, see A 5.4.

The cursor can be moved with `Up/Down` key. Press the `Enter` key to alternately set or reset the output. A conductive output (ON) is shown with a [`X`] and the comment `active`. Press the `ESC` key to abort the sequence without saving. Then the outputs are deactivated.

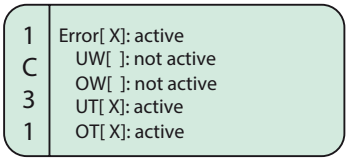


Fig. 22 Test of the switching outputs

5.7 Switching Inputs

Light source off, Zero-point inputs are, for example, connected through relay contacts or transistors (optocouplers).

Activate the light source switch-off in the relevant menu!

All GND signals are connected together internally and with the minus pole (GND) of the 24 V supply voltage.

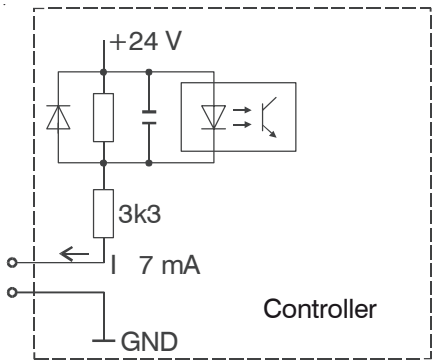


Fig. 23 Basic circuit for switching inputs

5.8 Synchronal Signal Input

The input is triggered by a further controller or another device.

R_{ext} (V_{HIGH} - V_F - (I_{LED} * 100 Ohm)) / I_{LED}

Example
V_{HIGH} = 3.3 V
I_{LED} = 15 mA
V_F = 1 V
R_{ext} = 53.3 Ohm, also 56 Ohm

All GND signals are connected together internally and with the minus pole (GND) of the 24 V supply voltage.

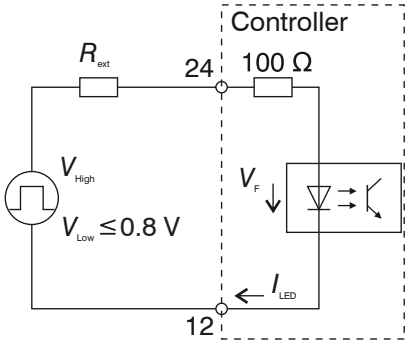


Fig. 24 Circuit synchronal signal input, 25-pol. Sub-D

6. Operation

6.1 Initial Operation

- Connect the light source and receiver to the controller before the system is put into operation, see Fig. 5, and fix all connectors secured with the screw connections.
- Turn on on downstream computers.
- Switch on the 24 V DC supply voltage at the controller.

As delivered, the measurement system is programmed to the standard setting of “Edge bright - dark”. If there is no target in the beam path, then the red LED (Error) lights.

i Observe a warm-up period of 30 minutes.

NOTICE

During the operation, i.e. with the supply voltage switched on, the light source and receiver must not be unplugged.
> Risk of damage to light source / receiver or the controller

6.2 Menu Structure

A detailed representation of the operating concept can be found in the annex, see A 5.

Select options	Contrast
	Language
	Measurement unit (mm or inch)
	Error handling (analog output)
	Interface parameters (active interface, RS232 or RS422)
	External light control (LED On/Off)
	Clear user data
	Video (for adjustment, light reference tuning and threshold adjustment)
	Service menu
Select measurement program:	Edge bright - dark
	Edge dark - bright
	Diameter / width
	Gap
	Segment and multisegment
	User-defined programs (four max.)
Edit measurement program	Master value
	Select segments (only for segment and multisegment measurement programs)
	Offset / gain, separately for display and analog output
	Upper tolerance limit / lower tolerance limit
	Upper warning level / lower warning level
	Median
	Averaging
	Measurement mode

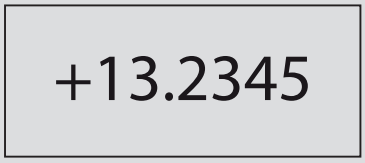
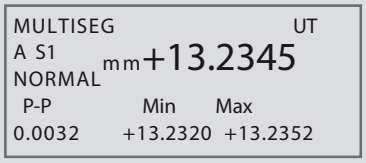
6.3 Operation

6.3.1 Key Functions

The following functions are assigned to the keypad, see Fig. 3:

▲	▼		Up/down movement in the menus, display selection Value input: ▲ higher, ▼ lower
ESC			Quits a menu point, changes to the next higher hierarchical level, display reset, zero setting, masters
↵			Enters the selected menu point, confirmation of entry (by long press switches the input values are taken over.)

6.3.2 Display

Measurement Mode Yellow light emitting diode is continuously lit. The keys ▼ and ▲ toggle in the measurement mode between the two types of display and the multisegment program between the measurements for the 1st and 2nd segment. Below the operating mode (e.g. DIA) A for absolute or R for relative measurement is displayed.	**Zoom Reading:** Large indication of the momentary value	
	Full Display: Indication of the momentary value, peak-peak value (P-P), minimum and maximum, measurement programs, limits, measurement mode	
Menu mode Yellow light emitting diode flashes	**Menu Display:** Display of the menu number (left), menu name and any settings parameters	

The display does not show the measurement at the full measuring frequency, but averaged over 766 measurements (display frequency about 3 Hz) unless the number of averages is set higher than 766.

To monitor all measurements, the display can be selected to „small“ with the key ▲ or ▼ Full Display). Then MIN, MAX and Peak to Peak (P-P) can be observed at the full measuring frequency. If the formation of the average was activated with > 1, the display refers to the averaged values.

The display of Min, Max and Peak-to-peak can be reset by pressing briefly on the ESC key. There is no automatic reset after a certain time.

i If the unit for the measurement display is selected as inches (in), then the decimal point is displaced behind the 1st place.

6.3.3 Main Menu

By pressing the ↵ key for 3 s you quit the measurement mode and access the main menu. The yellow light emitting diode flashes while you are in the setup menu.

By pressing the ↵ key again you access in turn the submenus. In the left part of the display field the associated menu numbers appears. The main menu has the number 0000.

The ↵ key takes you progressively deeper into the menu and the ESC key brings you back up the menu hierarchy.

The parameters selectable in the options are read out of the option data of the main memory and written to it again. The operator can decide only on leaving the main menu whether the parameters are to be stored or not. Then the data is retained even after the supply voltage is switched on again.

6.3.4 Adjustment with the Video Signal

To simplify the adjustment of the light source and receiver with separate mounting of the individual components, the display on the controller can show the video signal of the receiver. This reproduces the brightness trace over the receiver array.

From the main menu, access to the menu `Select options` is obtained by pressing the key ↵ again.

After entry (key ↵) into this menu, repeated pressing of the key `s` (Up) brings you to the menu point `Video`.

After renewed confirmation with ↵, the video signal appears on the display similar to the following picture:

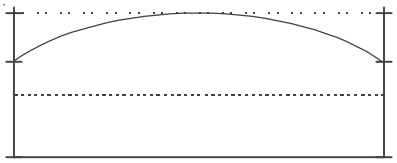


Fig. 25 Video signal (correct)

This picture appears with a sensor unit which is very well adjusted. If you now hold a target object between the light source and the receiver, then its shadow becomes visible through a fall in the video signal.

The following picture appears, for example, with a poorly adjusted sensor unit:

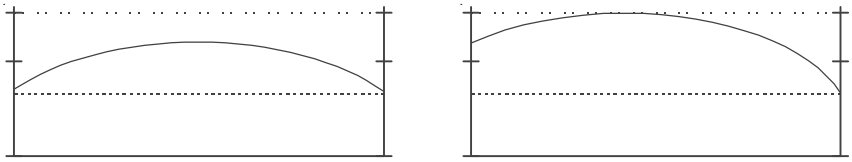


Fig. 26 Video signal (maladjusted)

i If after a lengthy period of operation the video signal no longer reaches the maximum value, it may be due to contamination.
In this case clean the protective windows with a lint-free cloth and some alcohol (isopropanol).

An optimum video signal, see Fig. 25, should be able to be obtained by appropriately moving and tilting the light source and receiver within the permitted tolerances, see Fig. 16. The curve should be at a maximum and should be symmetrical.

Return to the measurement mode is obtained by pressing the `ESC` key a number of times.

6.3.5 Options

The set parameters apply independently of the selected measurement program, see Fig. 29. You will find the standard option in the Appendix under `Option data`, see A 5.5.

The option data in the main memory are used for the measurement mode. This means that even after quitting the main menu and responding negative to saving the data, the newly selected option data are valid until the measurement system is switched off. If no changes are made at all, then no query for saving is presented on quitting the main menu.

The currently set parameters appear first during selection in the individual menus.

6.3.6 Select Measurement Program

The six standard measurement programs cannot be modified. They can be used though as templates for your own user-defined measurement programs. First, select a suitable standard program, see Fig. 29.

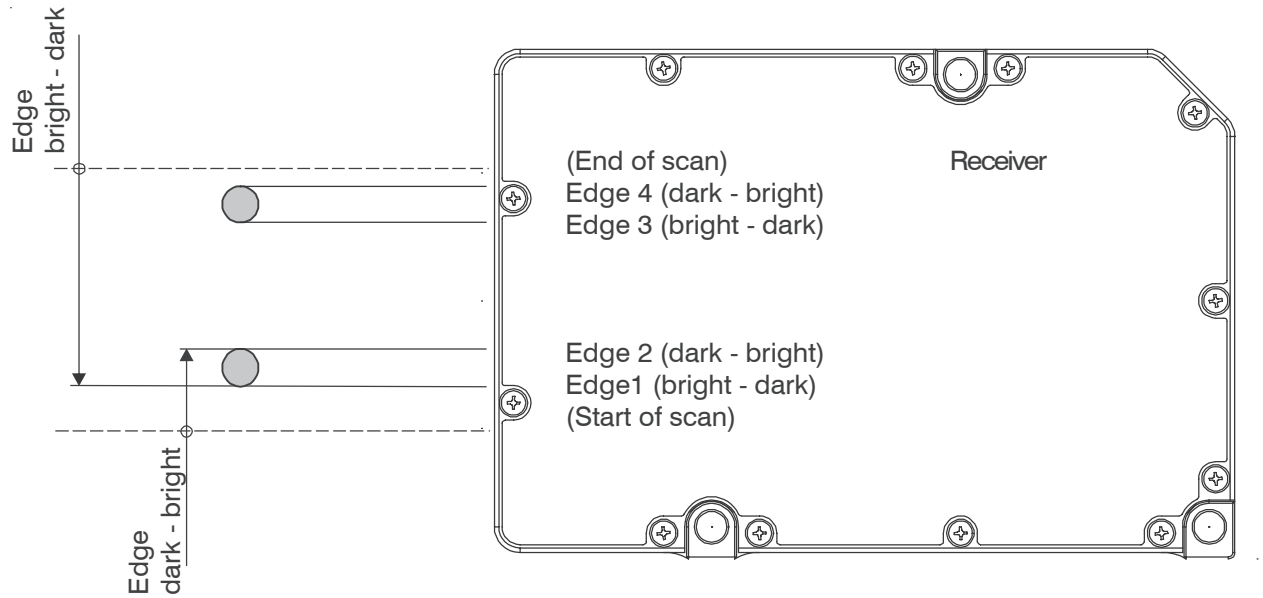


Fig. 27 Definition of terms for measurement program edge

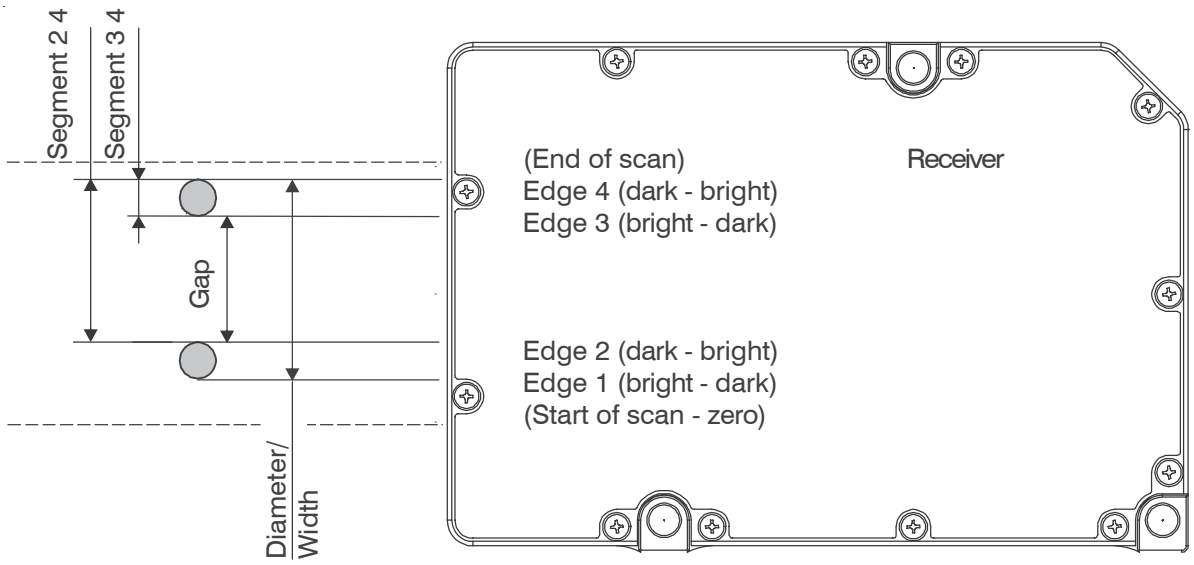


Fig. 28 Definition of terms for measurement programs segment, gap, diameter and width

Edge bright - dark (EDGEHL)
Factory setting.
Measurement between first bright-dark edge and end of scan.

Edge dark - bright (EDGELH)
Measurement between start of scan and first dark-bright edge.

Diameter/width: (DIA)
Measurement between the first bright-dark edge and last dark-bright edge.

Gap: (GAP)
Measurement between first dark-bright edge and the following edge.

Segment: (SEG 2 4)
Measurement between any 2 (from a max. of 80) selectable edges, also possible from zero.

Multi-segment: (MULTISEG)
Measurement of up to 4 selectable segments. Serial output of measurements via the digital output.
No analog output!

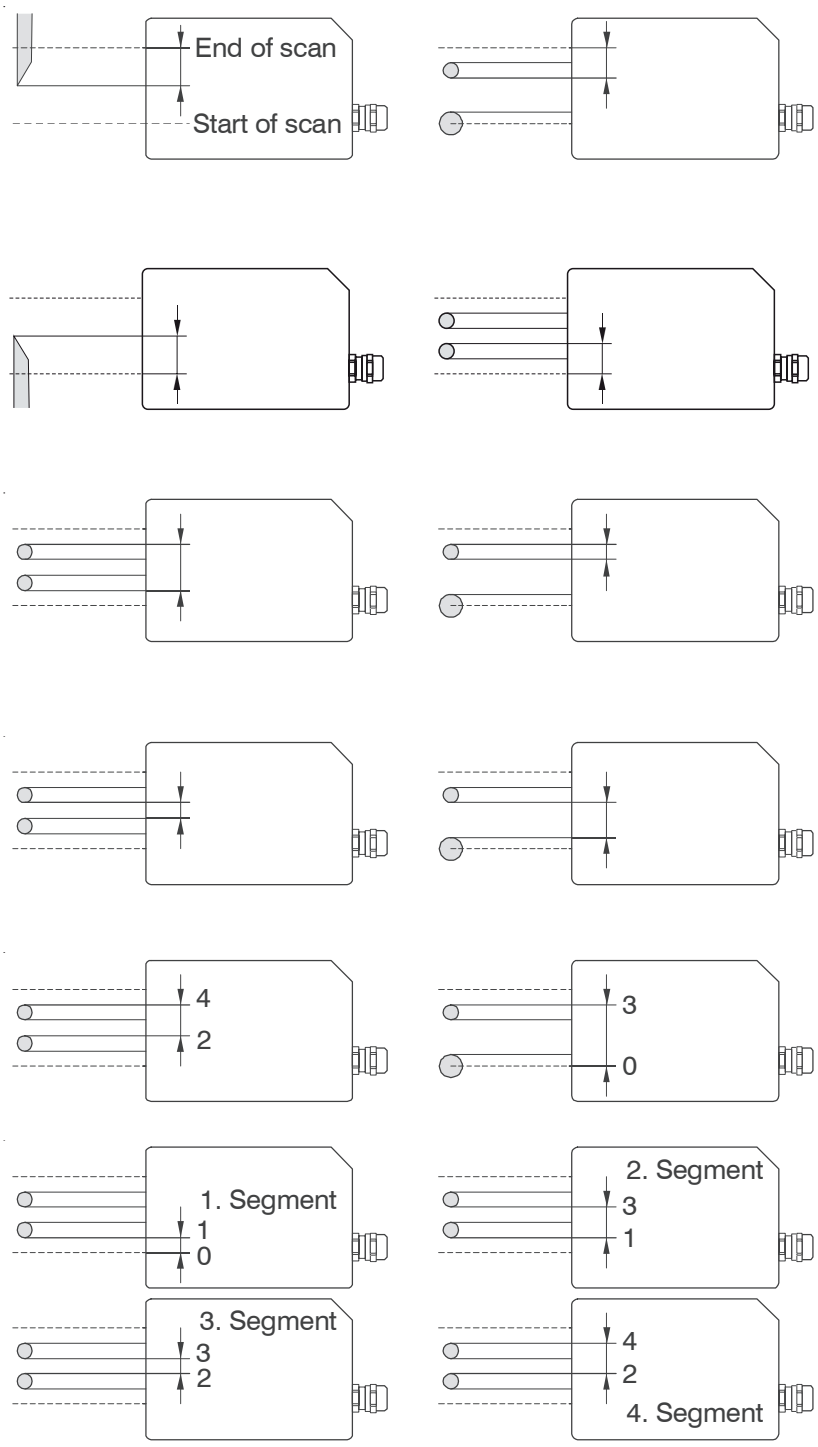


Fig. 29 Measurement programs (standard programs)

6.3.7 Edit Measurement Program (User-specific Programs)

Here, you can carry out user-specific adjustments to the previously selected measurement program.

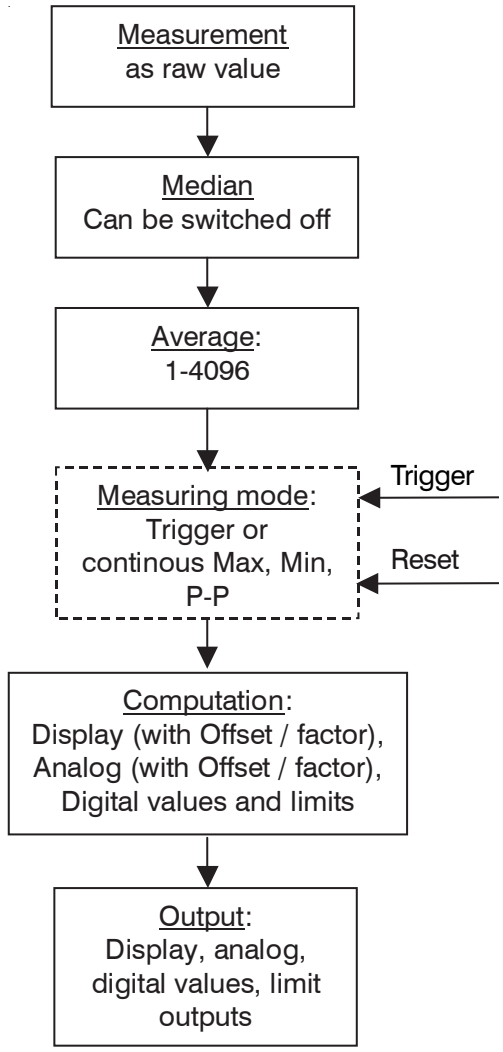


Fig. 30 Measurement flow

i The trigger only functions when the external light source control is not active.

During selection, the measurement program which is entered in the option data in the main memory is always first displayed. If parameters have been changed, then you can decide whether these settings are to be retained also after switch-off. Then you must save a user-specific program under a new, freely selected name. This is then automatically activated during switch-on. `USER1` or the last user-specified name used appears as a suggestion. These can be overwritten so that the user-specific program can be edited and saved again and again.

If you respond negatively with `ESC` to the query “Measurement task store?”, the changes made only remain active until the device is not switched off.

i The measurement program name must be regarded as a comment and not as a search criterion, i.e. multiple use of the same name is not evaluated but is not permissible.

Up to four user-specific programs are possible. User-specific programs already saved can be called up and activated under `Select program`.

After saving (or responding negatively with `ESC`), you are again returned to the measurement mode. The measurement program name appears in the measurement display mode `Full Display` for checking in the display.

i In the operating menu Options you will find in Menu 1900 “Clear user data options + program” which, after a confirmation query (1910) clears all userspecific programs in the block.

The six standard programs cannot be modified.

6.3.7.1 Zero-Setting Function

By pressing the key ESC for 3 s or during the measurement, the measurement is set to 0.000 if no master value has been saved in the measurement program (e.g. in the factory setting). After zero-setting an R for relative measurement is displayed in the Full Display below the operating mode (e.g. DIA).

i For zero-setting after concluding mastering, the master value must be set again to 00.000.
Zero-setting is not available in the Multi-segment measurement program.

Zero setting leads to temporary offset values for the display and the analog output. Pressing the ESC key again for 3 s clears the temporary offset values for the display and the analog output. For this however, a valid measurement must be located in the display (not --.---). At this point the ESC key, on being pressed for 3 s, takes on as an exception a toggling function between “normal” (absolute) and “zeroed” (relative) measurements.

i Zero-setting is restricted to the display and the analog output.
The digital value is not affected.

If the temporary offset values are needed after switch-off, you must move to the main menu (3 s ↵) and leave it again straight away (with ESC). You are then asked whether you would like to save (all changes) and must now save a user-specific program with name.

i For stable measurements observe a warm-up period of 30 minutes.

Different offset values for the display and the analog output can be entered via the menu function.

6.3.7.2 Mastering

Mastering enables balancing the display and analog values to a reference part (master) as single-point calibration.

The known value of the master (reference value) is entered via the menu points `Edit program > Enter value for master` and saved under one of the new userspecific names. Each measurement program can save its own master value.

i Mastering and resetting are only possible together with the target.

In the measurement mode the master is placed in the beam and the key `ESC` is pressed for three seconds. The display shows the value of the master. For resetting the `ESC` key is again pressed during the measurement for three seconds. For this however a valid measurement must be located in the display (not —,—).

After mastering an `R` for relative measurement is displayed in the `Full Display` below the operating mode (e.g. DIA).

i The master function is restricted to the display and the analog output. The digital output is not affected.
Mastering is not available in the `Multi-segment` measurement program.

For the long-term saving of the single-point calibration, also after the supply voltage is switched off, enter briefly into the menu `Main menu` and quit it again with `ESC`. You are then requested to save. You can use the same user-specific name as used for entering the master value.

For zero-setting after conclusion of mastering, the master value must be set again to 00.000.

With zero-setting or mastering via the external input by joining the connections Signal (5) and GND (18) together there are two possibilities:

- short pulse (0.5 to 3 s duration): Zero-setting (or mastering) when a valid measurement is present and no master value is saved in the measurement program.
- long pulse (3.0 to 6 s duration): Resetting of the master or zero-setting process.

Pulses which are shorter than 0.5 s or longer than 6 s are not processed.

The duration of the zero-setting (mastering) depends on the selected average.

With averaging over 128 values the process takes about 1 to 2 s and over 4096 values it can take up to 1 minute. Settling to the final value can be observed on the analog output and on the display.

6.3.7.3 Measurement Programs Segment and Multi-Segment

If the measurement program `Segment` (and `Multi-segment`) is selected, then you can choose the edges between which the distance is to be measured. Whereas with the normal Segment measurement program the distance of any two selectable edges is found and output, with the `Multi-segment` measurement program the measurements of up to four different segments are output consecutively. Here, the measurement output is only possible via a digital interface. The analog output remains switched off at 0 V. The measurement of the segments occurs simultaneously, but the output serially via the digital interface.

i In the `Multi-segment` measurement program the analog output remains switched off at 0 V.

Up to 80 edges on the measurement object can be used to program the segments. Use the command `SWITCH EDGE` (see page 43) to change between the segments.

6.3.7.4 Display Scaling

The display values can be changed by the parameters Gain and Offset.

Corrected value	Display value * Display gain - Display offset

You can, for example, add a constant value (offset displacement) or influence the slope of a characteristic by a gain.

Entry occurs via `Main menu > Edit program > Enter offset for display` or `Enter gain for display`.

i The function `Display scaling` is not available in the `Multi-segment` measurement program.

Entry of a gain should occur before any mastering or zero-setting, whereas the offset can be modified after mastering or zero-setting.

To displace the display value add the desired displacement to the displayed displacement and enter the new value at `Display offset`.

In addition a two-point calibration can be carried out. For the two-point calibration it is best to use two reference pieces which correspond to the smallest and largest expected measurements.

t_l true measurement (set value), largest dimension

t_s true measurement (set value), smallest dimension

d_l Display value (actual value), largest dimension

d_s Display value (actual value), smallest dimension

Display gain	$\frac{t_l - t_s}{d_l - d_s}$
Display offset	t_l - Display gain * d_l

Example:

t_l 8.000 mm

t_s 8.005 mm

d_l 7.000 mm

d_s 7.003 mm

Display gain: 0.99800
Display offset: +0,0110 mm

The menu points `Enter offset` and `Enter gain` are not available in the `Multi-segment` measurement program.

The settings `Offset` and `Gain` for the display or the analog output have no effect on the digital value.

6.3.7.5 Limit Monitoring

The controller can compare the measurement with four different limits.

Therefore, thresholds can be monitored, impermissible tolerances detected and sorting criteria realized.

The reference value is always the averaged measurement.
Exception: If 1 is selected for “No. of readings for forming average”, each measurement is a reference value.

The detected upper and lower limit violations activate the associated switching output at the full measuring rate of 2.3 kHz.

In addition, they are shown in the display (top right-hand corner in the `Full display`).

Abbreviation	Standard	Multi-segment
HW	Higher warning level	Higher limit 1st segment
LW	Lower warning level	Lower limit 1st segment
HL	Higher tolerance limit	Higher limit 2nd segment
LL	Lower tolerance limit	Lower limit 2nd segment

Fig. 31 Limit allocation

Remark:
The limit output of the `Multi-segment` measurement program differs from the other standard programs. For the segment 1 + 2 one upper and one lower limit can be defined.

6.3.7.6 Averaging

In the measurement system averaging can take place over a selectable number of consecutive measurements. Here, the sliding average is used with a number from 1 to 128 and the recursive average from 129 to 4096. The setting of the averaging number is described in Chapter Editing the Measurement Program, see A 5.6.

6.3.7.7 Median Filter

The median filter over n measurements selects in each case the mean value from the n values and eliminates the odd “runaway” value.

Any additionally set averaging occurs after the median filter.

The setting of the filter sizes 3, 5, 7 or 9 and switching off the filter are described in Chapter Editing the Measurement Program, see A 5.6.

6.3.7.8 Measurement Modes

The ODC 2600-40 measurement system can be operated in various measurement modes.

Apart from the normal mode, measurements can be held and peak values can be measured continuously and triggered.

The possible measurement modes are summarized in Table, see Fig. 32.

The selection is made in the operating menu, see A 5.7.

Measurement mode	Remark	Name in display
Normal	Continuous measurement output-standard setting	NORMAL
Maximum value, continuous	Output of the max. value in continuous measurement operation, value is held until change or reset pulse occurs. No evaluation of a trigger pulse.	MAX CONT
Minimum value, continuous	Output of the min. value in continuous measurement operation, value is held until change or reset pulse occurs. No evaluation of a trigger pulse.	MIN CONT
Peak to peak, continuous	Output of the P-P value in continuous measurement operation, value is held until change or reset pulse occurs. No evaluation of a trigger pulse.	P-P CONT
Maximum value, triggered	Output of the max. value found between two trigger pulses (corresponds to sampling period). The value is held on the output until the next trigger pulse or reset pulse.	MAX TRIG
Minimum value, triggered	Output of the min. value found between two trigger pulses (corresponds to sampling period). The value is held on the output until the next trigger pulse or reset pulse.	MIN TRIG
Peak to peak, triggered	Output of the P-P value found between two trigger pulses (corresponds to sampling period). The value is held on the output until the next trigger pulse or reset pulse.	P-P TRIG
Momentary value, triggered	Output of the momentary value valid at the time of the trigger pulse. The value is held on the output until the next trigger pulse or reset pulse.	SC1 TRIG

Fig. 32 Measurement modes of the optoCONTROL 2600-40

Two external inputs are required to realize the trigger measurement modes.

This means that the external inputs `External light source control` (LIGHT ON/ OFF) and `Zero/Master` dynamically change functions to `Trigger` and `Reset`.

The following settings are needed for this:

Data	Menu point	Setting
Options	1900: External switching of light source	not active
Measurement program	3D00: Select measurement mode	MAX CONT, MIN CONT, P-P CONT, MAX TRIG, MIN TRIG, SC1 TRIG

Fig. 33 Settings for the measurement mode selection

The activation of the external light source control has higher priority compared to the setting of a trigger mode. This means that with the activation of the external light source control in the options data, no trigger mode can be set for the selected measurement program or a trigger mode already set is rendered ineffective and the `NORMAL` measurement mode is set automatically.

The entered limits always relate to the measurement signal which is present after the trigger mode evaluation. The trigger and reset pulses can also be controlled via the serial interface. The `NORMAL` measurement mode is set with the following values:

Data	Menu point	Setting
Options	1800: External switching of light source	not active or active
Measurement program	3D00: Select measurement mode	NORMAL

Fig. 34 Settings for the measurement mode selection

i If the optoCONTROL 2600 is in the trigger mode, then the light source cannot be switched off!

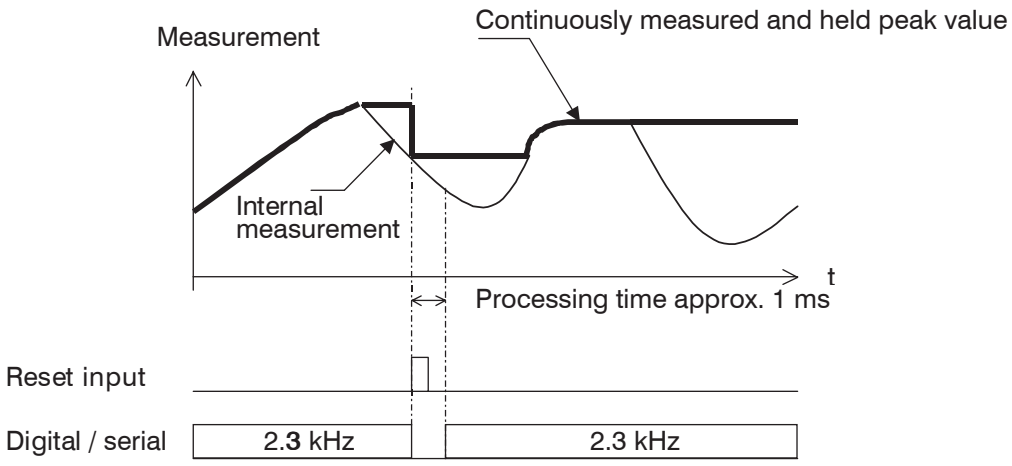


Fig. 35 Measurement mode, example Maximum continuous

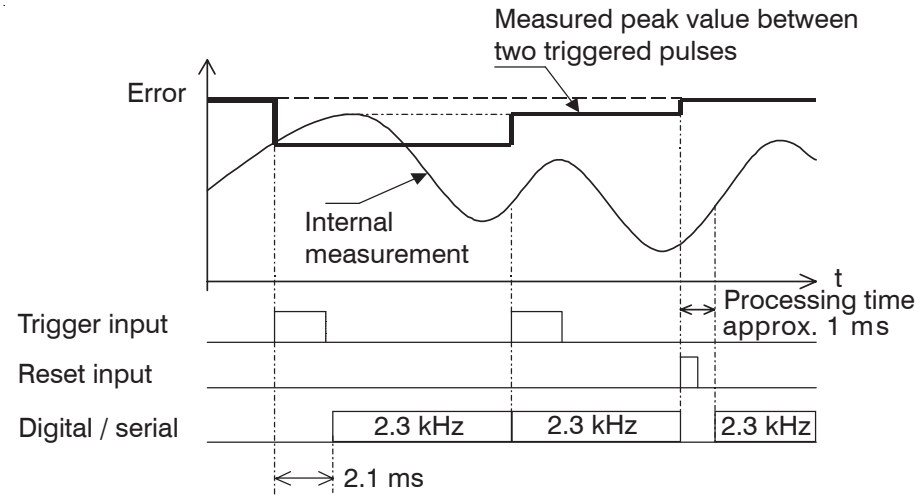


Fig. 36 Measurement mode, example Maximum triggered

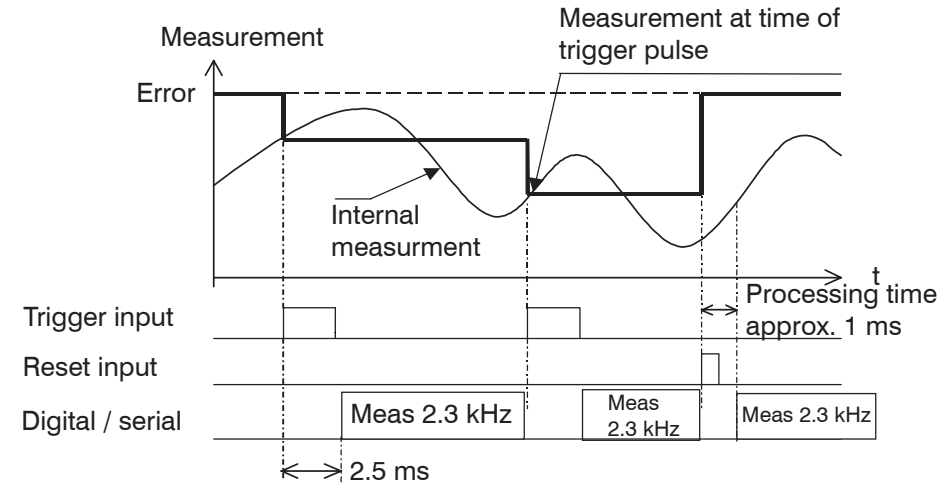


Fig. 37 Measurement mode, example Momentary value triggered

6.4 Analog Output

6.4.1 Setup

Setup occurs specific to the measurement program in the menu `Edit program: > Enter gain for analog output` or `Enter gain for analog output`.

6.4.2 Measurement Conversion

The measurement value (MV) is calculated from the analog output voltage as follows:

$$MV\ (mm) = \frac{4.0}{\text{Analog gain}} \left(V_{OUT} - \text{Analog offset}\right)$$

Value ranges

Analog offset: -50.0000 V ... +50.0000 V

Analog gain: -4.00000 ... +4.00000

The analog output voltage to be expected for a certain measurement value can be calculated from the following formula:

$$V_{OUT}\ (V) = \frac{MV\ (mm)}{4.0} * \text{Analog gain} + \text{Analog offset}$$

With the two quantities, analog gain and analog offset, you can produce all the arising linear output characteristics as shown in the following graph. This is particularly interesting for adaptation to evaluation equipment with lower resolution or lower voltage span on the input. In this respect, the above formula is changed according to the analog gain.

Then it is possible, for example, to extend a measurement span of 10 mm to a voltage span of 10 V; the analog gain in this case is +4.0.

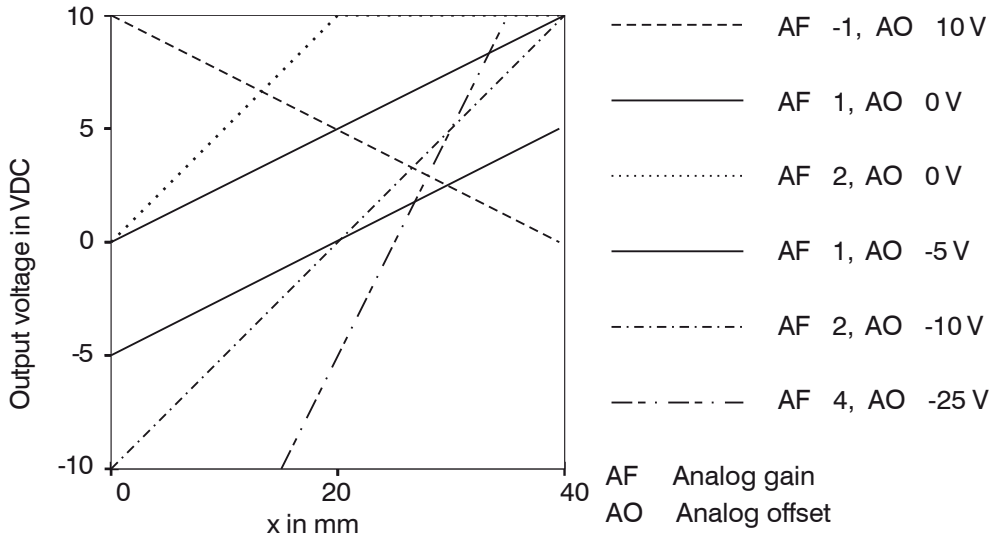


Fig. 38 Analog scaling of output characteristics

i Zero-setting, see 6.3.7.1 and mastering, see 6.3.7.2 also affect the analog output. It should therefore be carried out before the analog gain is changed.

The output voltage has an overrun respectively underrun of 20 mV (0.068 mm). This means it can exceed resp. undercut the zero point and the full scale (+10 VDC) by 20 mV in each case.

In the above example with AG 2 and AO 0 V the output voltage from an edge position x > 20 mm is limited to 10.02 V. With x > 40,.... mm the error value of 10.04 V then appears.

If negative output voltages disturb, an analog offset of -20 mV (-0.020 V) can be entered.

With `Error` in the standard setting, a voltage of +10.04 V is output.

Notes:

With input resistances less then 1 MOhm on the evaluation device, you must allow for a voltage division with the internal resistance of the analog output of 100 ohm.

You can, however, also scale the analog output via the menu `Edit program` as has been described under `Display scaling` for the display.

For an internal resistance of, for example, 100 kohm a correction factor of 1.001 (+ 1 per thousand) arises and with 10 kohm the factor is already 1.010 (+ 1 %). From this you can estimate whether your application requires a correction.

The settings `Offset` and `Gain` for the display and the analog output have no effect on the digital value.

The analog output remains switched off at 0 V in the `Multi-segment` measurement program.

6.4.3 Error Handling

In the menu `Select options` you can decide under the point `Error handling, analog output` whether with a possible error (e.g. no target in the measurement range) the last valid measurement is retained or the voltage 10.04 VDC is output.

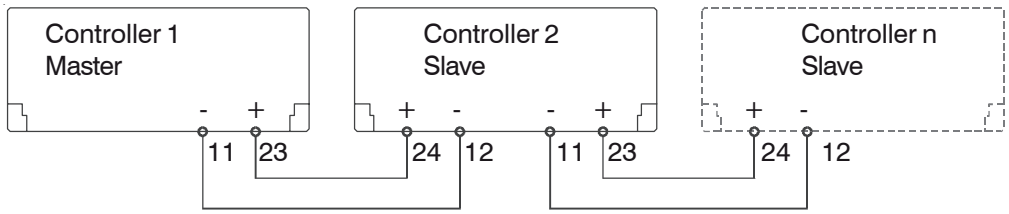
This option is then also valid for the display, i.e. either the last valid measurement or ---.--- is displayed.

6.5 Synchronization of optoCONTROLs

Connect the synchronizing signal output (Signal +) of controller 1 with the synchronizing signal input (Signal +) of controller 2 and proceed similarly with the minus pole.

Further systems can be added by cascading.

Prefer screened leads for the synchronization.



Inputs and outputs on the 25-pol. Sub-D connector

Fig. 39 Synchronization of controllers

The synchronizing signal of the optoCONTROL 2600 has the double frequency of the measuring rate. I.e. pictures from the CCD array are read in twice and than are averaged.

Measuring rate: 2.300 Hz
Synchron signal: 4.600 Hz

The synchronizing signal should be used for synchronization of two or more optoCONTROL 2600 only. The synchron signal output is not designed for synchronization or triggering external measurement devices (PC boards).

The time offset between the synchronizing signals of master and slave is about 12 µs.

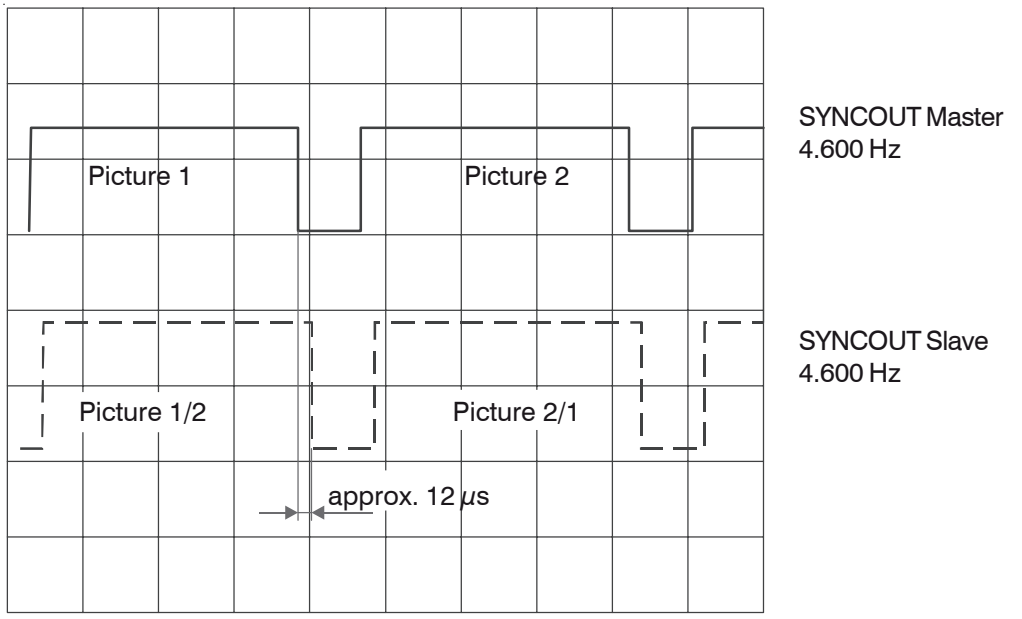


Fig. 40 Time offset through synchronizing signal

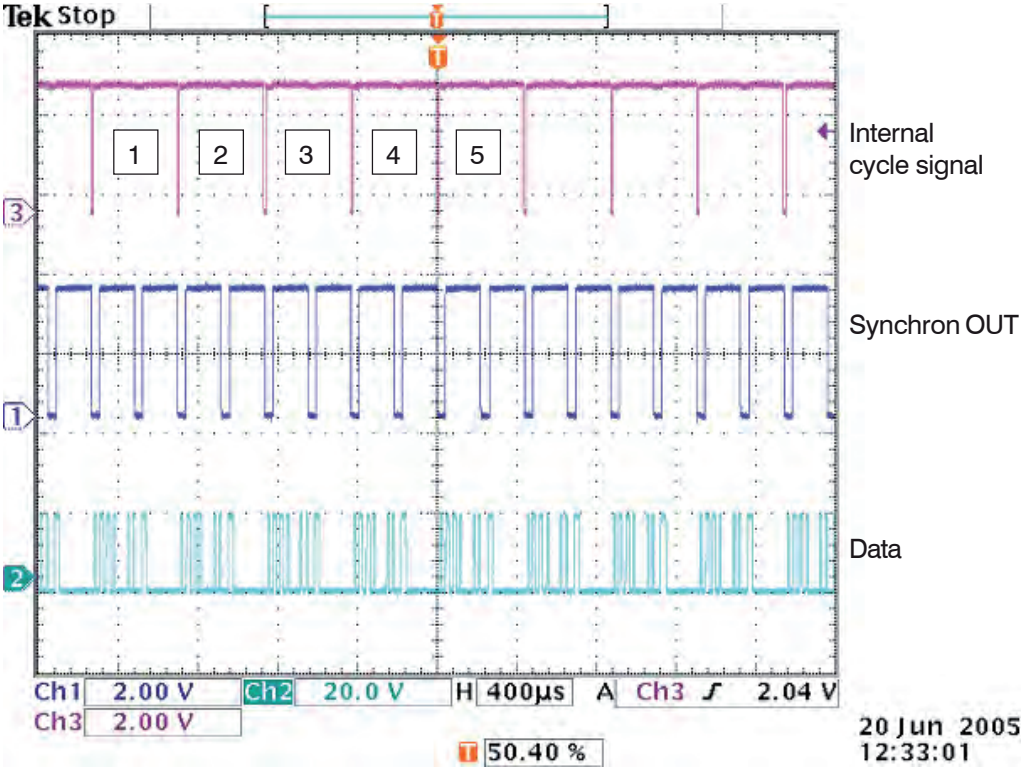


Fig. 41 Time response controller

1	Integration
2	Reading
3	Computation
4	Controlling
5	Output

6.6 Digital Interfaces

6.6.1 Interface Parameters

Factory setting: RS232, 115.2 kBaud

Only one digital interface is available (RS422 or RS232). It is activated by selecting in the menu `Select options > Select active interface` and configured in the menu `Select RS232 parameters` (or RS422).

The data word (one measurement) is composed of three consecutive bytes (L-byte, M-byte, H-byte).

The maximum measuring rate of the measurement system is only obtained with a baud rate of 115.2 kBaud or higher. With slower data transfer measurements are omitted.

The relationship between the selected baud rate and the measuring rate is illustrated in following table, see Fig. 42:

Baud rate (kBaud)			Measuring rate (measurements/second)
	RS232	RS422	
691.2		x	2300 (each measurement)
115.2	x		
38.4	x	x	766 (each 3rd measurement)
19.2	x	x	383 (each 6th measurement)
9.6	x	x	255 (each 9th measurement)

Fig. 42 Baud rates and measuring rates

RS232	
Baud rate:	9.6 to 115.2 kBaud, selectable via menü `RS232 baud rate`
Data format:	8 data bits, parity selectable, 1 or 2 stop bits, adjustable via menu `Select RS232 parameter`, (standard: 8, N, 2)
RS422	
Baud rate:	9.6 to 691.2 kBaud, selectable via menu `RS422 baud rate`
Data format	8 data bits, parity selectable, 1 or 2 stop bits adjustable via menu `Select RS422 parameter`, (standard: 8, N, 1)

6.6.2 Serial Measurement Output

The serial output format of the measurement can be set in the options data menu. The options are `Binary` and `ASCII`.

ASCII format
Twelve characters are always output as a minimum with the first five figures as standard corresponding to the digital value of the measurement and being continuously output.

In the `Multi-segment` program a further 5 figures are needed for each further segment.

Figures 1 - 5 are occupied with 0 ... 65535. For the computation formula of the measurement, see `Binary measurement output`.

Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	0x09	Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	0x09
Measurement value (1. segment)					<Tab>	2. segment					<Tab>
Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	0x09	Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	0x0D
3. segment					<Tab>	4. segment					<CR>

The measured values are separated with a tab character (0x09).

Finally a <CR> („carriage return“, 0D) is attached to the string.

Binary format
Data conversion

Start	0	0	6 Bit (D5...D0)	Stop	Start	0	1	6 Bit (D11...D6)	Stop	Start	1	0	6 Bit (My...D12)	Stop

Fig. 43 Transmission format of a data word (example)

L-Byte	0	0	D5	D4	D3	D2	D1	D0
M-Byte	0	1	D11	D10	D9	D8	D7	D6
H-Byte	1	0	My	Mx	D15	D14	D13	D12

Fig. 44 Reception

	My	Mx
Seg. 1	0	0
Seg. 2	0	1
Seg. 3	1	0
Seg. 4	1	1

Fig. 45 Measurement allocation for `Multi-segment` *operating mode*

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

Fig. 46 Result of conversion (digital value DW)

The following formula is used for the conversion of the digital values (DV) to the measurement values (MV in mm):

MV (mm) DV * 40.824 / 65519 - 0.4204872

The settings `Offset` and `Gain` for the display or the analog output have no effect on the digital value.

With errors a digital value of ≥ 65520 is output.

Error messages during measurement output:

65521 No edge
65522 At the beginning of the picture
65523 At the end of the picture
65524 Dark - bright edge
65525 Bright - dark edge
65526 Min. number of edges
65527 Max. number of edges
65528 Invalid measuring program
65529 Segment 1st edge > 2nd edge
65530 Segment number of edges < last edge
65531 Invalid working distance
65533 Laser off
65534 Invalid float
65535 DMA setup error

6.6.3 Control Commands

Control commands are used for controlling the operation of the controller. The control commands for the sensor consist of command data which is interchanged in both directions. Each command data packet consists of an integer multiple of 32-bit words.

Since most serial interfaces use an 8-bit data format, four consecutive bytes are combined to form a 32-bit word. Each command has a header of two 32-bit words followed by the command and any further data (where required).

Byte 1	Byte 2	Byte 3	Byte 4
Header			
ID			
Command			
Data 1			
Data (n)			

Fig. 47 Structure of the command packet

The first word contains the header for identifying a connection to the sensor. The second word ID is used for identifying the sender. The third word is the actual command, whereby the upper two bits in Byte 2 are always `0`.

When the sensor receives a command, it is answered in that the command is returned with the MSB in Byte 2 set to `1`. If the sensor finds an error in executing the command, the second highest bit in Byte 2 is also set to `1`. When the sensor responds to a command, no header is sent.

i The controller processes the data in the Little Endian Format.

Example:

The 32-bit command word `INFO` 0x0000 2011 has two contents:

First part	0x2011: Command	16 bit variable in the controller
Second part	0x0000: Length	16 bit variable in the controller

Remark: The prefix 0x is the code for numbers in the hexadecimal format.

In the following commands the representation is given in the transmission sequence (Bytes 1 - 4) on the serial interface.

i The length figure from the PC gives the number of the following 32-bit words. In contrast, the controller of the ODC2500 sends a length figure corresponding to the number of 32-bit words in the complete data packet.

Consequently, the following 32-bit word must be transmitted sequentially over the interface:

0x11 0x20 0x00 0x00

i Byte-by-byte reading and out from left to right!

Hexcode	Name	Interpretation
0x00002001	RESET	Reset and reboot
0x00002011	INFO	Information command (indicates sensor data)
0x00002021	STOP	Terminate measurement output
0x00002022	START	Permanent measurement output
0x00012023	CHOOSE MP	Change the current measurement program
0x00022024	SWITCH EDGE	Change the edges to be measured in the segment measurement program
0x00002025	RD OPT RAM	Read the option data to the main memory
0x00002026	RD MPR RAM	Read the measurement program data from the main memory
0x000B2027	WR OPT TO RAM	Write the option data to the main memory
0x000F2028	WR MPR TO RAM	Write the measurement program data to the main memory
0x00002029	SAVE OPT RAM TO FLASH	Save the option data from the main memory to the flash memory
0x0000202A	SAVE MPR RAM TO FLASH	Save the measurement program data from the main memory to the flash memory
0x0000202B	TRIGGERMODE RESET	In the measurement mode “Trigger mode”: reset active, reset of the output values
0x0000202C	TRIGGERMODE TRIGGER	In the measurement mode “Triggermode”: trigger active, activate output
0x0000202D	SET_LIGHT_REFERENCE_TUNING	Activates the light reference tuning, detection of a flexible threshold value for dark/light transition
0x0000202E	RESET_LIGHT_REFERENCE_TUNING	Activates a fixed threshold value for dark/light transition
0x00002033	RD MINMAX	Read out the min/max values
0x00002034	RD MINMAX RESET	Read out the min/max values with reset

Fig. 48 Overview of the optoCONTROL 2600 commands

6.6.3.1 Information Command

Name `INFO`

Description: After the command response, sensor data are sent in the ASCII format.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x11	0x20	0x00	0x00	0x00002011

Response with error:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x11	0xE0	0x03	0x00	0x0003E011	With error + 4 bytes error code
0x06	0x00	0x00	0x00	0x00000006	Error code

0x00000006 Flash access error

Response without error:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x11	0xA0	0x10	0x00	0x0010A011	without error

i In byte 3 the length of the whole following data packet is:

Decimal	Hexadecimal	Binary/dual
16	0x10	00010000

ArticleNumber:	‘98765432‘	ASCII - 8 Byte
SerialNumber:	‘1234567‘	ASCII - 8 Byte
Option:	‘000 ‘	ASCII - 8 Byte
Measurement range (mm):	40	Binary - 0x28000000
Reserve:		Binary - 0xDE83EB3D
SoftArtBoot:	‘Std ‘	ASCII - 4 Byte
SoftArtArm:	‘Std ‘	ASCII - 4 Byte
SoftArtDSP:	‘Std ‘	ASCII - 4 Byte
SoftVersionBoot:	1003	Binary - 0xEB030000
SoftVersionARM:	1006	Binary - 0xEE030000
SoftVersionDSP:	1002	Binary - 0xEA030000

i If you add up all the bytes of the responses described in the operating instructions, you get 64 bytes → 512 bits / 32 bits = 16; i.e. 16 32-bit words.

6.6.3.2 Start Command

Name `START`

Description: Starts the permanent measurement output of the sensor.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x22	0x20	0x00	0x00	0x00002022

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x22	0xA0	0x03	0x00	0x0003A022	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.3 Stop Command

Name `STOP`

Description: Stops the permanent measurement output from the sensor.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x21	0x20	0x00	0x00	0x00002021

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x21	0xA0	0x03	0x00	0x0003A021	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

i `Start` is on when the sensor is switched on. The command `Stop` is volatile and is lost when the voltage supply is switched off or the Reset command is sent.

6.6.3.4 Reset Command

Name `RESET`

Description: The sensor executes a software reset. This corresponds to switching the sensor off and then on again.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x01	0x20	0x00	0x00	0x00002001

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x01	0xA0	0x03	0x00	0x0003A001	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.5 Change the Measurement Program

Name `CHOOSE MP`

Description: The sensor changes the current measurement program.

This corresponds to selecting the measurement program via the display without the options of saving, i.e. after switching the sensor off and on the last saved measurement program is loaded.

Command:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
„+“	„+“	„+“	0x0D	0x0D2B2B2B	
“O“	“D“	“C“	“1“	0x3143444F	
0x23	0x20	0x01	0x00	0x00012023	Command, following lenght (32 bit words)
0x02	0x00	0x00	0x00	0x00000002	0 ... EDGEHL 1 ... EDGELH 2 ... DIA 3 ... GAP 4 ... SEG 2 4 5 ... MULTISEG 6 ... USER1 7 ... USER2 8 ... USER3 9 ... USER4

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x23	0xA0	0x03	0x00	0x0003A023	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.6 Change Edges (Segment and Multi-segment Programs)

Name `Switch EDGE`

Description: If a Segment or a Multi-segment program is active on the sensor,then the edges to be measured are refreshed.

After Power OFF the data last transmitted is lost.

i Legal values for segment numbers 0 ... 80.

Command:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
„+“	„+“	„+“	0x0d	0x0D2B2B2B	
“O“	“D“	“C“	“1“	0x3143444F	
0x24	0x20	0x04	0x00	0x00042024	Command, following length (32 bit words)
0x01	0x03	0x00	0x00	0x00000301	Front edge Segment 1: 1 Segment 2: 3
0x07	0x05	0x00	0x00	0x00000507	Rear edge Segment 1: 7 Segment 2: 5
0x02	0x04	0x00	0x00	0x00000402	Front edge Segment 3: 2 Segment 4: 4
0x08	0x06	0x00	0x00	0x00000608	Rear edge Segment 3: 8 Segment 4: 6

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x24	0xA0	0x03	0x00	0x0003A024	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.7 Read out min/max Values

Name `RD MINMAX`

Description: After the command response the min/max values are transmitted in the range 0...65519.

Command:

Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x33	0x20	0x00	0x00	0x00002033

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x33	0xA0	0x04	0x00	0x0004A033	Without error
0x33	0xE0	0x03	0x00	0x0003E033	Error + 4 bytes error code

Min [0...65519]: Binary - 0x00008B3E

Max [0...65519]: Binary - 0x00008B4B

Min/Max[mm] Min/Max[0...65519] * 40.824 / 65519 - 0.4204872

6.6.3.8 Read out min/max Values Followed by Reset

Name `RD MINMAX RESET`

Description: After the command response the min/max values are transmitted in the range 0 ... 65519.
Then the min/max content is set to zero.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x34	0x20	0x00	0x00	0x00002034

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x34	0xA0	0x04	0x00	0x0004A034	Without error
0x34	0xE0	0x03	0x00	0x0003E034	Error + 4 bytes error code

Min [0...65519]: Binary - 0x00008B3E

Max [0...65519]: Binary - 0x00008B4B

Min/Max[mm] Min/Max[0...65519] * 40.824 / 65519 - 0.4204872

6.6.3.9 Read Option Data

Name `RD OPT RAM`

Description: With this command the currently valid option data is read out from the main memory.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x25	0x20	0x00	0x00	0x00002025

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x25	0xA0	0x0D	0x00	0x000DA025	Without error
0x25	0xE0	0x03	0x00	0x0003E025	Error + 4 bytes error code

Measurement program number	Binary - 0x0000	Std. - Measurement program EDGEHL
Language	Binary - 0x0001	English
Displayed measurement unit	Binary - 0x0000	mm
Error handling, analog	Binary - 0x0000	Error output
Serial output format	Binary - 0x0000	Binary
External light control	Binary - 0x0000	Not active
Light intensity	Binary - 0x0032	50 %
Threshold value for dark/light transition / Contrast	Binary - 0x3232	50 % / 50%
Reserve 2	Binary - 0x0000	
Active interface	Binary - 0x0001	RS232
RS232 Baud rate	Binary - 0x0001C200	115200 Bd
RS232 Parity	Binary - 0x0000	None
RS232 Stop bits	Binary - 0x0002	2
RS232 TimeOut Transmit	Binary - 0x0001	No effect
RS232 TimeOUT Receive	Binary - 0x0001	No effect
RS422 Baud rate	Binary - 0x000A8C00	691200 Bd
RS422 Parity	Binary - 0x0000	None
RS422 Stop bits	Binary - 0x0002	2
RS422 TimeOut Transmit	Binary - 0x0001	No effect
RS422 TimeOUT Receive	Binary - 0x0001	No effect

6.6.3.10 Write Option Data

Name `WR OPT TO RAM`

Description: With this command option data is written from the receive buffer to the main memory. The validity of the data is checked while this occurs. If incorrect data is found or a different error arises, the data is not accepted into the main memory.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x27	0x20	0x0B	0x00	0x000B2027

Description	Format Typ	Bits	Valid Values	Remark
Measurement program number	Binary unsigned short	16	0...5, Standard 6...9, User - if available in flash memory	6 - USER1 ... 9 - USER4
Language	Binary unsigned short	16	0, 1	0 ... German 1 ... English
Displayed measurement unit	Binary unsigned short	16	0, 1	0 ... mm 1 ... inch
Error handling display + analog output	Binary unsigned short	16	0, 1	0 ... Error output : -- , --- 10,04 V 1 ... retain last value
Serial output format	Binary unsigned short	16	0, 1	0 ... binary 1 ... ASCII
External switching of the light source	Binary unsigned short	16	0, 1	0 ... not active 1 ... active
Light intensity	Binary unsigned short	16	No effect. The factory data are accepted.	
Threshold value for dark/ light transition	Binary unsigned short	8	20 ... 90	20 ... 90 %
Contrast	Binary unsigned short	8	0 ... 100	0 ... 100 %
Reserve 2	Binary unsigned short	16		
Active serial interface	Binary unsigned short	16	0, 1	0 ... RS422 1 ... RS232
RS232 Baud rate	Binary integer	32	9600, 19200 38400, 115200	
RS232 Parity	Binary unsigned short	16	0, 1, 2	0 ... No 1 ... Even 2 ... Odd
RS232 Stop bits	Binary unsigned short	16	1, 2	
RS232 Timeout transmission	Binary unsigned short	16	No effect The factory data is accepted.	
RS232 Timeout receipt	Binary unsigned short	16	No effect The factory data is accepted.	

RS422 Baud rate	Binary integer	32	9600, 19200 38400, 115200, 691200	
RS422 Parity	Binary unsigned short	16	0, 1, 2	0 ... No 1 ... Even 2 ... Odd
RS422 Stop bits	Binary unsigned short	16	1, 2	
RS422 Timeout transmis-sion	Binary unsigned short	16	No effect The factory data is accepted.	
RS422 Timeout receipt	Binary unsigned short	16	No effect The factory data is accepted.	

Fig. 49 Option data record

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x27	0xA0	0x03	0x00	0x0003A027	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

Possible error codes:
0x00000004 Too much data received
0x0000000A Error on writing to the RAM
0x0000000B Incorrect data transmitted, see `Valid values`
0x0000000C Incorrect measurement program number

NOTICE

Avoid error!
> Data are not accepted!

6.6.3.11 Save Option Data

Name `SAVE OPT RAM TO FLASH`

Description: With this command the currently valid option data is written from the main memory to the flash memory.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x29	0x20	0x00	0x00	0x00002029

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x29	0xA0	0x03	0x00	0x0003A029	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

Possible error coder:
0x00000006 Flash access error

6.6.3.12 Read Measurement Program Data

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x26	0x20	0x00	0x00	0x00002026

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x26	0xA0	0x16	0x00	0x0003A026	Without error
0x26	0xE0	0x03	0x00	0x0003E026	Error + 4 bytes error code

Measurement program number	Binary - 0x0007	USER2-Measurement program
Measurement program name	ASCII - 0x45	„E“
	0x44	„D“
	0x47	„G“
	0x45	„E“
	0x48	„H“
	0x4C	„L“
	0x55	„U“
	0x00	ZERO
Place-holder	Binary - 0x0000...0xFFFF	
Analog offset	Binary - 0x00000000	0.0 VDC
Analog gain	Binary - 0x3F800000	1.0
Display offset	Binary - 0x00000000	0.0 mm
Display gain	Binary - 0x3F800000	1.0
Upper limit	Binary - 0x42200000	40.0 mm
Lower limit	Binary - 0x00000000	0.0 mm
Upper warning	Binary - 0x42200000	40.0 mm
Lower warning	Binary - 0x00000000	0.0 mm
Reserve 1	Binary - 0x0000	
Measurement mode	Binary - 0x0000	NORMAL
Median	Binary - 0x0003	over 3 values
Number of averages	Binary - 0x0001	1
Reserve 2	Binary - 0x0000	
Measurement program	Binary - 0x0001	Edge HL
Number of segments	Binary - 0x0001	Edge HL, LH, Diameter, Gap
Front edge for Segment 1+2	Binary - 0x0000	
Front edge for Segment 3+4	Binary - 0x0000	
Reserve 4	Binary - 0x0000	
Reserve 5	Binary - 0x0000	
Rear edge for Segment 1+2	Binary - 0x0000	
Rear edge for Segment 3+4	Binary - 0x0000	
Reserve 7	Binary - 0x0000	
Reserve 8	Binary - 0x0000	
Place-holder	Binary - 0x0000...0xFFFF	
Master value	Binary - 0x00000000	0,0 mm

Fig. 50 Measurement program data

6.6.3.13 Write Measurement Program Data

Name `WR MPR TO RAM`

Description: With this command measurement program data is written from the receive buffer to the main memory. The validity of the data is checked while this occurs. If incorrect data is found or a different error arises, the data is not accepted into the main memory.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x28	0x20	0x14	0x00	0x00142028

Description	**Format Type**	**Bits**	**Valid values**	**Remark**
Measurement program number	Binary unsigned short	16	6 ... 9	6 - USER1 9 - USER4
Measurement program name	ASCII char	8x8	“A“ - “Z“, “ “, “ “, “0“ - “9“	Only uppercase letters. The last space characters are deleted. Space characters between the letters are replaced by “ “ (“underscore”).
Place-holder	Binary unsigned short	16		
Analog offset	Binary float	32	-10.000 ... +10.000	Entry is made in [VDC]
Analog gain	Binary float	32	-4.0000 ... +4.0000	
Display offset	Binary float	32	-99.999 ... +99.999	Entry is made in mm
Display gain	Binary float	32	-2.000 ... +2.000	
Upper limit	Binary float	32	-168,876 ...+168,876	
Lower limit	Binary float	32		
Upper warning	Binary float	32		
Lower warning	Binary float	32		
Reserve	Binary unsigned short	16	No effect. The factory data are accepted.	
Measurement mode	Binary unsigned short	16	0, 1, 2, 3, 4, 5, 6, 7	0... NORMAL 1 ... MAX CONT 2 ... MIN CONT 3 ... P-P CONT 4 ... MAX TRIG 5 ... MIN TRIG 6 ... P-P TRIG 7 ... SC1 TRIG

Median	Binary unsigned short	16	0, 3, 5, 7, 9	0 ... no Median 3, 5, 7, 9 Median over n values
Average	Binary unsigned short	16	1 ... 4096	1 ... 128 sliding 129 ... 4096 recursive
Reserve	Binary unsigned short	16	No effect The factory data is accepted.	
Measurement program	Binary unsigned short	16	1 ... 6	1 ... EDGEHL 2 ... EDGELH 3 ... DIA 4 ... GAP 5 ... SEG 2 4 6 ... 2-SEG
Number of segments	Binary unsigned short	16	1, 2, 3, 4	1 ... EDGEHL, EDGELH, DIA, GAP, SEG 2 4 2 ... 4 bei MULTISEG
Front edge segment 1 + 2 1. Segment 2. Segment	Binary unsigned short Low-Byte High-Byte	16	0 ... 80 0 ... 80	Example: front edge 1. Seg. = 2 front edge 2. Seg. = 4 = 0x0402 hex (= 1026 decimal)
Front edge Segment 3+4	Binary unsigned short	16	0 ... 80 0 ... 80	
Reserve	Binary unsigned short	16		
Reserve	Binary unsigned short	16		
Rear edge Segment 1 + 2 1. Segment 2. Segment	Binary unsigned short Low-Byte High-Byte	16	0 ... 80 0 ... 80	Example: rear edge 1. Seg. = 8 rear edge 2. Seg. = 7 = 0x0807 hex (= 1800 decimal)
Rear edge Segment 3+4	Binary unsigned short	16	0 ... 80 0 ... 80	
Reserve	Binary unsigned short	16		
Reserve	Binary unsigned short	16		
Place-holder	Binary unsigned short	16	No effect. The factory data are accepted.	
Master value	Binary float	32	-40.000 ... +40.000	Entry is made in mm

Fig. 51 Measurement program data record

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x28	0xA0	0x03	0x00	0x0003A028	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

NOTICE

Avoid error!

> Data are not accepted!

Possible errors:
0x00000004 Too much data received
0x0000000A Error on writing to the RAM
0x0000000B Incorrect data transmitted, see `Valid values`

6.6.3.14 Save Measurement Program Data

Name `SAVE MPR RAM TO FLASH`

Description: With this command the currently valid measurement program data is written from the main memory to the flash memory.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x2A	0x20	0x00	0x00	0x0000202A

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x2A	0xA0	0x03	0x00	0x0003A02A	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

Possible errors:
0x00000006 Flash - access error

6.6.3.15 Resetting the Output Values in the Trigger Measurement Mode

Name `TRIGGERMODE RESET`

Description: Resets the output values in the Trigger measurement mode

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x2B	0x20	0x00	0x00	0x0000202B

i This command corresponds to the external reset input in the Trigger measurement mode.

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x2B	0xA0	0x03	0x00	0x0003A02B	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.16 Activating the Output in the Trigger Measurement Mode

Name `TRIGGERMODE TRIGGER`

Description: Activates the output in the trigger measurement mode

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x2C	0x20	0x00	0x00	0x0000202C

i This command corresponds to the external trigger input in the trigger measurement mode.

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x2C	0xA0	0x03	0x00	0x0003A02C	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.3.17 Activating the Light Reference Tuning

Name `SET LIGHT REFERENCE TUNING`

Description: Activates the output in the trigger measurement mode.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x2D	0x20	0x00	0x00	0x0000202D

i This command corresponds to the menu „1B20 - Light reference tuning“.

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x2D	0xA0	0x03	0x00	0x0003A02D	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

Possible errors:
0x0000000D Unsuccessful Light reference tuning, optical path not free

6.6.3.18 Reset the Light Reference Tuning

Name RESET LIGHT REFERENCE TUNING

Description: Erasures the flexible threshold value for dark/light transition, use of a fixed threshold value for dark/light transition.

Command:				
Byte 1	Byte 2	Byte 3	Byte 4	hex
„+“	„+“	„+“	0x0D	0x0D2B2B2B
“O“	“D“	“C“	“1“	0x3143444F
0x2D	0x20	0x00	0x00	0x0000202D

i This command corresponds to the menu “1B30 - Reset Light Reference Tuning“.

Response:					
Byte 1	Byte 2	Byte 3	Byte 4	hex	Remark
“O“	“D“	“C“	“1“	0x3143444F	
0x2E	0xA0	0x03	0x00	0x0003A02E	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

6.6.4 Error Responses

0x04	Too much data received
0x06	Flash access error
0x0a	Error on writing to the RAM
0x0b	Incorrect data transmitted, see, ‘Valid values’
0x0c	Incorrect measurement program number
0x01	Error destination, if µC has to send information or data an error message is returned e.g. passing data to the DSP were aborted
0x02	Error source, error during data fetching
0x03	Error length, stated length in the parameter > buffer size receiver
0x05	Not used
0x07	Error erase flash
0x08	Error flash sector, during writing or deletion of the flash
0x09	Error video, video can not be fetched by the DSP

6.7 Timing

The controller in the ODC 2600 operates internally in 5 cycles:

1. Integration: Gathering of the incoming light in the receiver (measurement).
2. Reading in: Conversion and saving of the light signals as digital values.
3. Computation: Measurement determination in the DSP (digital signal processor).
4. Controlling: Transfer of the measurements to the output controller where statistical computations (Segment, Min, Max, PtP, Limits, Zero-setting)
5. Output: Output via the analog and digital interfaces, activation of limit switching functions.

Each cycle takes about 435 µs (1 / measuring rate). After 5 cycles in each case the measured value N is available on the output. The delay between the input reaction and output signal is 2175 µs. The processing of the cycles occurs sequentially in time and parallel in space, see Fig. 52. After a further 435 µs the next measurement N + 1 is present on the output.

One output cycle is added for each segment in `Multi-segment` mode. This reduces the measuring rate.

Cycle	1.	2.	3.	4.	5.	Time (µs)
Integration (measurement)	N	N+1	N+2	N+3	N+4	435
Reading in	N-1	N	N+1	N+2	N+3	870
Computation	N-2	N-1	N	N+1	N+2	1305
Controlling	N-3	N-2	N-1	N	N+1	1740
Output	N-4	N-3	N-2	N-1	N	2175

Fig. 52 Internal cycles in the ODC controller

6.8 Error Effects

6.8.1 Error Effects on the Light Beam

Edge changes cause, as can be seen in the illustration, see Fig. 53, measurement errors over a width of approx. 0.05 mm.

Therefore measurements should not be carried out in the immediate vicinity of a sudden change (e.g. recesses, shoulders, etc.).

If edges, which are not used in the measurement process, protrude into the light beam, then they should be taken into account during the editing of the measurement program (masked out). To do this, use the program `Segment`. Then you can freely select between which edges the measurement is to be taken.

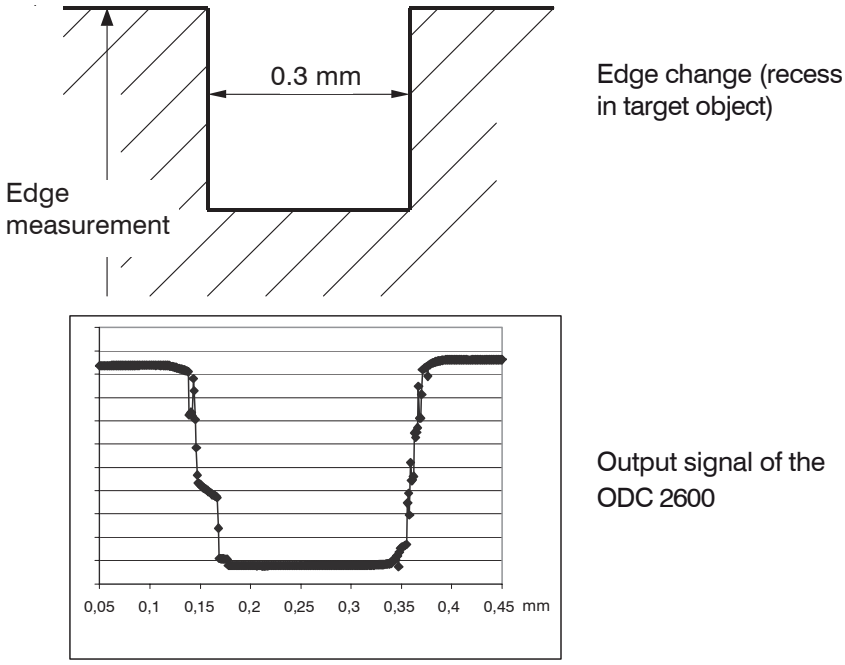


Fig. 53 Effects on the light beam due to edge changes

6.8.2 Extraneous Light

The telecentric objective lens in the receiver only allows beams onto the CCD array which are precisely parallel to the optical axis.

Such a beam can be generated by a self-illuminated measurement object or by the directed reflection of extraneous light on shiny target objects.

The video signal image on the display can be used for observation.

The red filter in the receiver blocks radiation below 610 nm wavelength (visible light).

The direct irradiation from primary light sources, such as for example, reflector lamps or sunlight, onto the receiver and the target should be avoided.

NOTICE

Avoid direct irradiation of ambient light in the receiving area.

> Measurement error or measurement is not possible

6.8.3 Contamination

NOTICE

Dust deposits in the measurement channel (receiver and light source), particularly on the target, should be avoided. Where possible, the horizontal measurement arrangement should be preferred.

> Measurement error or edge error

i Use a clean soft, lint-free cloth or lens cleaning paper and pure alcohol (isopropanol) for cleaning the protective window!
Do not use commercial glass cleaner or cleansing agents!

➪ Subject to clean compressed air using a normal commercial nozzle the receiver and the laser continuously in dusty ambient conditions (free of dust and oil).

6.8.4 Transparent Target Objects

i With application on transparent materials (e.g. edges of clear films and plates or transparent round material - glass tubes), MICRO-EPSILON Eltrotec GmbH recommends that tests are first carried out.

➪ Use the menu `Video`, see A 5.3

It is likely that transparent target objects (e.g. glass rods or tubes) shade the light beam at the outer edges, but allow it to pass to the receiver on the inside. Therefore, the video signal image on the display should be observed. For transparent target objects the program `Diameter (DIA)` should be preferably selected, because in this case the first and last edges are used for the measurement of the distance.

Diffusely transparent material can be measured, see 3.12.

6.8.5 Reduced Light Intensity

The brightness of the light source may decrease caused by aging or thermal effects. Readjust the light intensity in case of a failure only.

The intensity is set correct with the factory setting.

Use the video signal, see menu `Video, 1B00` to evaluate the light intensity. Without a measurement object the video signal should be arranged within the marked area.

- Check whether the intensity is reduced by
  - pollution,
  - incorrect adjustment of the light source and receiver (for free arrangement without mounting rails).
- Clean the windows or adjust the light source and the receiver again.

Similarly, avoid ambient light into the receiver, which can increase the video signal.

The following pictures show three possible states, see Fig. 54:

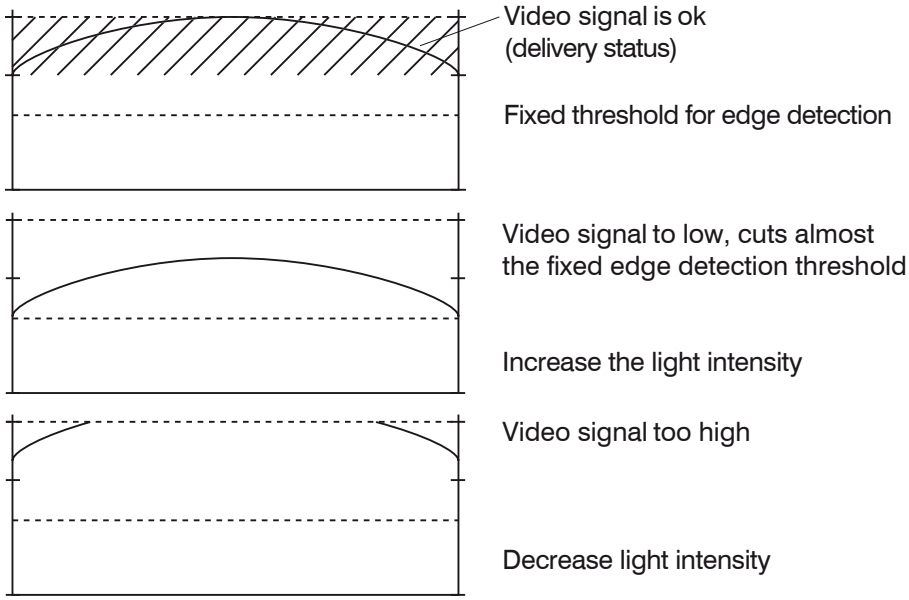


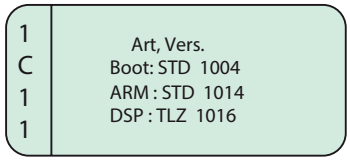
Fig. 54 Different states of the video signal

The following steps are recommended:

1	Exit the menu `Video`. Press the key `ESC`.
2	Press the arrow key ▼ (Down). The `service` menu (1C00) appears as the last item in the `Options` menu.
3	Press the key ↵ twice (arrow key ▼) to adjust the `light intensity` (1C20) menu.
4	Use the arrow keys to change the light intensity in percent, see menu 1C21. Confirm with ↵.
5	Then it is essential to control the video signal.
6	Repeat the adjustment several times until the video curve shows the desired result.
7	Confirm and save your settings with ↵.
8	If you confirm your settings with `ESC`, the light intensity is volatile and will be lost, if you power down the system.

6.9 Show Software Version

Retrieve the current firmware version in the `Service` menu.



➥ Press the ↵ or `ESC` key to leave the menu.

7. 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.

8. Service, Repair

In the event of a defect in the controller, light source, receiver or the sensor cable please send us the affected parts for repair or exchange.

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

MICRO-EPSILON Eltrotec GmbH
Manfred-Wörner-Straße 101
73037 Göppingen / Germany
Tel. +49 (0) 7161 / 98872-300
Fax +49 (0) 7161 / 98872-303
eltrotec@micro-epsilon.com
www.micro-epsilon.com

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.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

The following accessory parts are optionally available for the optoCONTROL 2600 from MICRO-EPSILON Eltrotec GmbH:

Name	Description	Item number
PS2020 Power supply 24 V	Input 100 - 240 VAC; output 24 VDC / 3.3 A, installation type; mounting onto symmetrical standard rail; 35 mm x 7.5 mm, DIN 50022	2420062
PS2031 Power supply 24 V / 2.5 A	Power supply unit universal 100-240 V/24V/ 1A; 2m-PVC; terminal-2P-BU-ge; with additional UK and USA plug	2420096
PC2500-3	Power supply cable, 3 m long, open	2901123
PC2500-10	Power supply cable, 10 m long, open	2901124
SCA2500-3	Signal output cable analog, 3 m	2901120
SCA2500-10	Signal output cable analog, 10 m	2901215
SCD2500-3/3/RS232 Signal output cable with RS232, 3 m long	Digital and analog output cable with additional wiring for the RS232 interface	2901121
SCD2500-3/10/RS422 Output cable with RS422 interface	3 m long component cable with open ends for the analog output and the switching outputs, 10 m long component cable with 15-pole connector for use with the serial RS422 interface, possible use with IF2004 interface card	2901122
IF2008/PCIE	RS422 interface / up to 4 MBaud; for PC with PCIe interface, PCIe x1 interface Rev1.0 FIFO for 4096 data bytes (depending on the sensor log), incl. interface driver for Windows 10 for 1 to 4 laser-optical ODC2600 sensors	2213032
IF2008E expansion board RS422/analog/PCI	2 digital RS422 signals, 2 analog signals and 8 I/O signals; 6 digital signals in total when used with IF2008/PCIE, 2 encoders, 2 analog signals and 8 I/O signals; FIFO data memory, synchronous data acquisition	2213018
SCD2500-3/RS422 Output cable 3 m with open ends	3 m long cable with open ends for use with the serial RS422 interface, possible use with the IF2001/USB converter from RS422 to USB or converter for RS422/USB ILD sensors, industrial-grade; for ODC2600 sensors	29011111
CE1800-3 Sensor cable extension, 3 m long	Sensor cable extension for camera, 3 m long for the 2600 sensors	2901057

Name	Description	Item number
CE2500-3 Sensor cable extension for light source, 3 m long	Sensor cable extension for light source, 3 m	2901118
CE1800-8 Sensor cable extension, 8 m long	Sensor cable extension for camera, 8 m long	2901058
CE2500-8 Sensor cable extension for light source, 8 m long	Sensor cable extension for light source, 8 m long	2901119
IF2004/USB	4-channel RS422/USB converter	2213024
IF2001/USB 1-channel RS422/ USB converter	IF2001/USB converter RS422 to USB	2213025
IF2008-Y adapter cable	Adapter cable, Y type, 100 mm long	2901528
SCD2500-3/IF2008 interface cable	Output cable 3 m long, in addition with 15-pole plug; to be used with IF2008/PCIE card	2901561
SCD2500-8/IF2008 interface cable	Output cable 8 m long, in addition with 15-pole plug; to be used with IF2008/PCIE card via RS422	2901563
SCD2500-3/CSP	Connection cable, 3 m long, with straight plugs, for an ODC2500 or ODC2600 micrometer to the CSP2008 universal controller	2901504
SCD2500-10/CSP	Connection cable for an optical ODC2500-35 or ODC2600 micrometer to the CSP2008 universal controller; 10 m long, with straight plug	2901505

A 2 Factory Setting

			On delivery	Customer
1000	Options			
	Contrast %		50	
	Threshold value for dark/light transition %		50	
	Menu language		English	
	Unit measurement display		mm	
	Analog output and display for error		Error	
	RS232			
		Baudrate	115.200	
		Parity	none	
		Stop bits	2	
	External switching of the light source		not active	
2000	Measurement program after Power ON		Standard edge bright - dark	

A 3 Other Pin Assignments

A 3.1 Cables for Analog Terminal Devices

Pin	Signal	Signal type / connector type	Core colors in the SCA2500-x Signal and Output Cable
1	Error output (signal)	Switching output (open collector)	red
14	Error output (GND)	Switching output	blue
2	Upper tolerance limit (signal)	Switching output (open collector)	purple
15	Upper/ lower tolerance limit (GND)	Switching output (common connection)	black and brown
3	Lower tolerance limit (signal)	Switching output (open collector)	white
16	Upper warning limit (signal)	Switching output (open collector)	pink
4	Upper/ lower warning limit (GND)	Switching output (common connection)	gray and gray / pink
17	Lower warning limit (signal)	Switching output (open collector)	red / blue
25	Analog output (AGND)	Reference potential for analog signal	Inner shield (thin cable)
13	Analog output (Signal)	Analog signal (voltage)	green

Fig. 55 Pin assignment, standard analog output cable

Pin	Signal	Signal type or connector type	Core color in the signal and output cable CA2500-x(01)
1	Error output (signal)	Switching output	red
14	Error output (GND)	Switching output	blue
5	Zero setting (signal)	Switching input	white
18	Zero setting (GND)	Switching input	gray-pink
6	Input laser OFF (signal)	Switching input	pink
19	Input laser OFF (GND)	Switching input	black
11	Sync signal output (-)	Potential (DGND)	gray
23	Sync signal output (+)	Digital output (SYNC)	purple
12	Sync signal input (-)	Optocoupler input (-)	brown
24	Sync signal input (+)	Optocoupler input (+)	red-blue
13	Analog output (Signal)	Signal (voltage)	green (inside)
25	Analog output (AGND)	Potential (AGND)	Inner shield

Fig. 56 Pin assignment, optional SCA2500-x(01) signal and output cable

A 3.2 Cable for RS232 and RS422

25-pin.	Signal	9-pin	Braids
1	Error output (signal)		red
14	Error output (GND)		blue
2	Upper tolerance limit (signal)		purple
15	Upper/lower tolerance (GND)		black and brown
3	Lower tolerance limit (signal)		white
16	Upper warning limit (signal)		pink
4	Upper/lower warning limit (GND)		gray and gray / pink
17	Low warninging limit (signal)		red / blue
9	RS232 reception (RxD)	3	
22	RS232 DGND	5	
10	RS232 transmission (TxD)	2	
25	Analog output (AGND)		black (inner conductor)
13	Analog output (signal)		green
			black (outer shield on 25-pin connector housing)

Fig. 57 SCD2500-x/3/RS232 pin assignment

25-pin	Signal	15-pin	Braids
1	Error output (signal)		red
14	Error output (GND)		blue
2	Upper tolerance limit (signal)		purple
15	Upper/lower tolerance (GND)		black and brown
3	Lower tolerance limit (signal)		white
16	Upper warning limit (signal)		pink
4	Upper/lower warning limit (GND)		gray and gray / pink
17	Lower warning limit (signal)		red / blue
20	RS422 reception (negated)	1	
7	RS422 reception (positive)	2	
8	RS422 transmission (positive)	4	
21	RS422 transmission (inverted)	3	
25	Analog output (AGND)		black (inner conductor)
13	Analog output (signal)		green
			black (outer screen on connector housing 25-pin)

Fig. 58 Pin assignment SCD2500-x/3/RS422

A 3.3 Interface Card IF2008/PCIE

The IF2008/PCIE interface card enables synchronous acquisition of up to four digital sensor signals and two encoders.

The ODC 2600 controller is connected to the IF2008/PCIE interface card from MICRO-EPSILON Eltrotec GmbH, see A 1, via the SCD2500-x/IF2008 signal output cable on the upper socket (sensor 1).
You can connect a second ODC 2600 to the X2 socket (sensor 3).
You require an IF2008-Y adapter cable from MICRO-EPSILON Eltrotec GmbH, see A 1, to connect more than two ODC 2600 sensors to an IF2008/PCIE.

The interface parameters at the ODC 2600 must be set to the active RS422 interface and the following default settings:
Baud rate: 691200 Baud
Data format: 8 data bits, no parity, 1 stop bit (8, N, 1)

i IF2008/PCIE requires an X7 supply via PC.

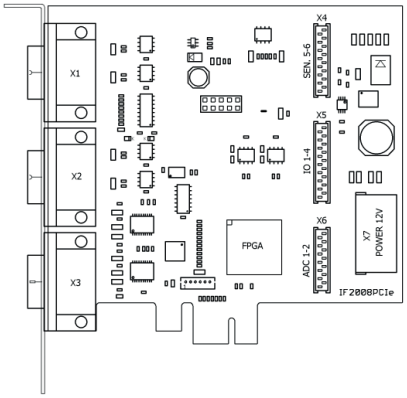


Fig. 59 View IF2008/PCIE

➡ Turn on downstream computers first and then the controller.

All inputs are isolated via optocouplers on the ODC 2600 controller as well as on the IF2008/PCIE interface card.

The designations `Sensor 1 and 3` refer to the terminology of the MEDAQlib, see A 1, driver software and the ICONNECT data acquisition software from MICRO-EPSILON Eltrotec GmbH.

For further information, please refer to the documentation about IF2008/PCIE, ICONNECT and MEDAQlib from MICRO-EPSILON Eltrotec GmbH.

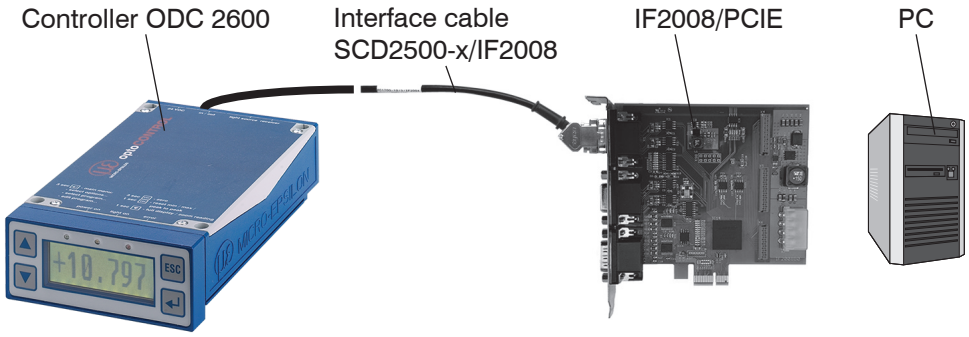


Fig. 60 System design for the operation of the IF2008/PCIE interface card

	Pin to controller (HD-Sub 25)		IF2008/PCIE interface card Socket X1 (or X2)	15-pin Sub-D, IF2008	
Controller ODC 1	7		Sensor 1 (3) TxD+	2	
	20		Sensor 1 (3) TxD-	1	
	8		Sensor 1 (3) RxD+	4	
	21		Sensor 1 (3) RxD-	3	
	24		Sync In+	6	
	12		GND	15	IF2008/PCIE, X1 and X2, 15-pin. Sub-D
			NC	7	
			NC	8	
			NC	9	
			NC	10	
Controller ODC 2	7		Sensor 2 (4) TxD+	2	
	20		Sensor 2 (4) TxD-	1	
	8		Sensor 2 (4) RxD+	4	
	21		Sensor 2 (4) RxD-	3	
	24		Sync In+	6	
	12		GND	15	

Fig. 61 Pin assignment RS422 between IF2008/PCIE and ODC2600

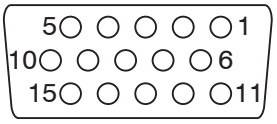


Fig. 62 15-pin. HD subminiature connector, view on solder pin side of cable connector

25-pin. Sub-D	Signal	15-pin. Sub-D	Braids
1	Error output (Signal)		red
14	Error output (GND)		blue
2	Upper tolerance limit (signal)		purple
15	Upper/ lower tolerance limit (GND)		black and brown
3	Lower tolerance limit (signal)		white
16	Upper warning limit (signal)		pink
4	Upper/ lower warning limit (GND)		gray and gray / pink
17	Lower warning limit (signal)		red / blue
20	RS422 reception (negat-ed)	1	
7	RS422 reception (positive)	2	
8	RS422 transmission (positive)	4	
21	RS422 transmission (negated)	3	
24	Sync signal input (+)	6	
12	Sync signal input (-)	15	
25	Analog output (AGND)		black (inner conductor)
13	Analog output (signal)		green
			black (outer shield on 25-pin housing)

Fig. 63 Pin assignment SCD2500-x/IF2008 (15-pin)

A 4 Software Support with MEDAQlib

MEDAQLib is a documented driver DLL. This allows you to integrate the micrometer into existing or customer-specific PC software.

Possible connections:

- with the 4-channel IF2004/USB converter from RS422 to USB and the SCD2500-3/10/RS422 or SCD2500-3/RS422 connection cables or
- with the single-channel IF2001/USB converter from RS422 to USB and the SCD2500-3/RS422 connection cable or
- with the IF2008/PCIE PCI interface card and the SCD2500-x/IF2008 connection cable

You need no knowledge about the sensor protocol to communicate with the individual sensors. The individual commands and parameters for the sensor to be addressed will be set with abstract functions. MEDAQLib translates the abstract functions in comprehensible instructions for the sensor.

MEDAQLib

- contains a DLL, which can be imported into C, C++, VB, Delphi and many additional programs,
- makes data conversion for you,
- works independent of the used interface type,
- features by identical functions for the communication (commands),
- provides a consistent transmission format for all MICRO-EPSILON Eltrotec GmbH sensors.

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

You will find the latest driver / program routine including documentation at:

www.micro-epsilon.com/service/download

www.micro-epsilon.de/link/software/medaqlib

A 5 Operating Menu

A 5.1 Initialization and Operation in the Measurement Mode

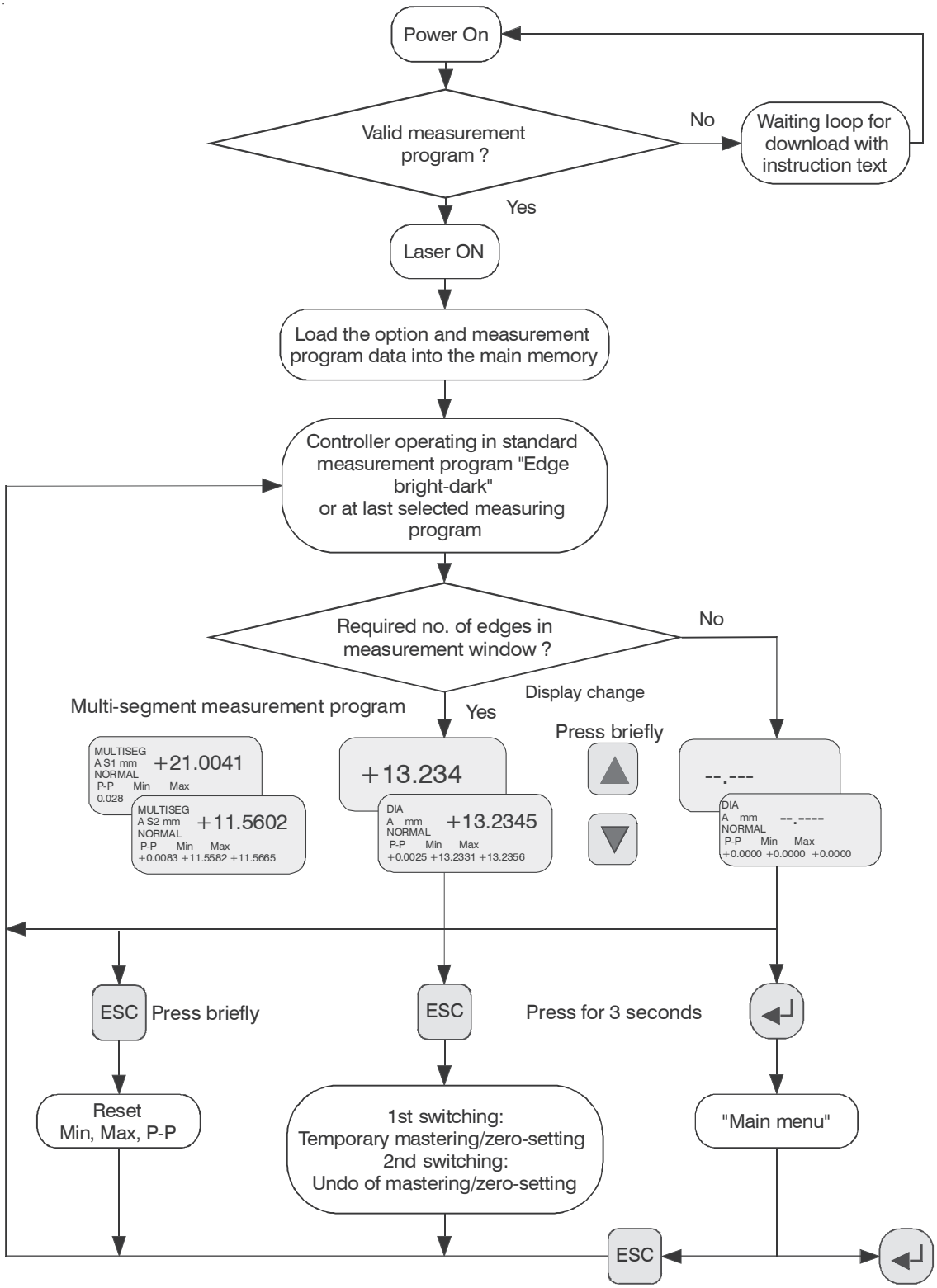


Fig. 64 Operating Menu `Initialization and Operation in the Measurement Mode`

A 5.2 Dialog and Procedure for Saving

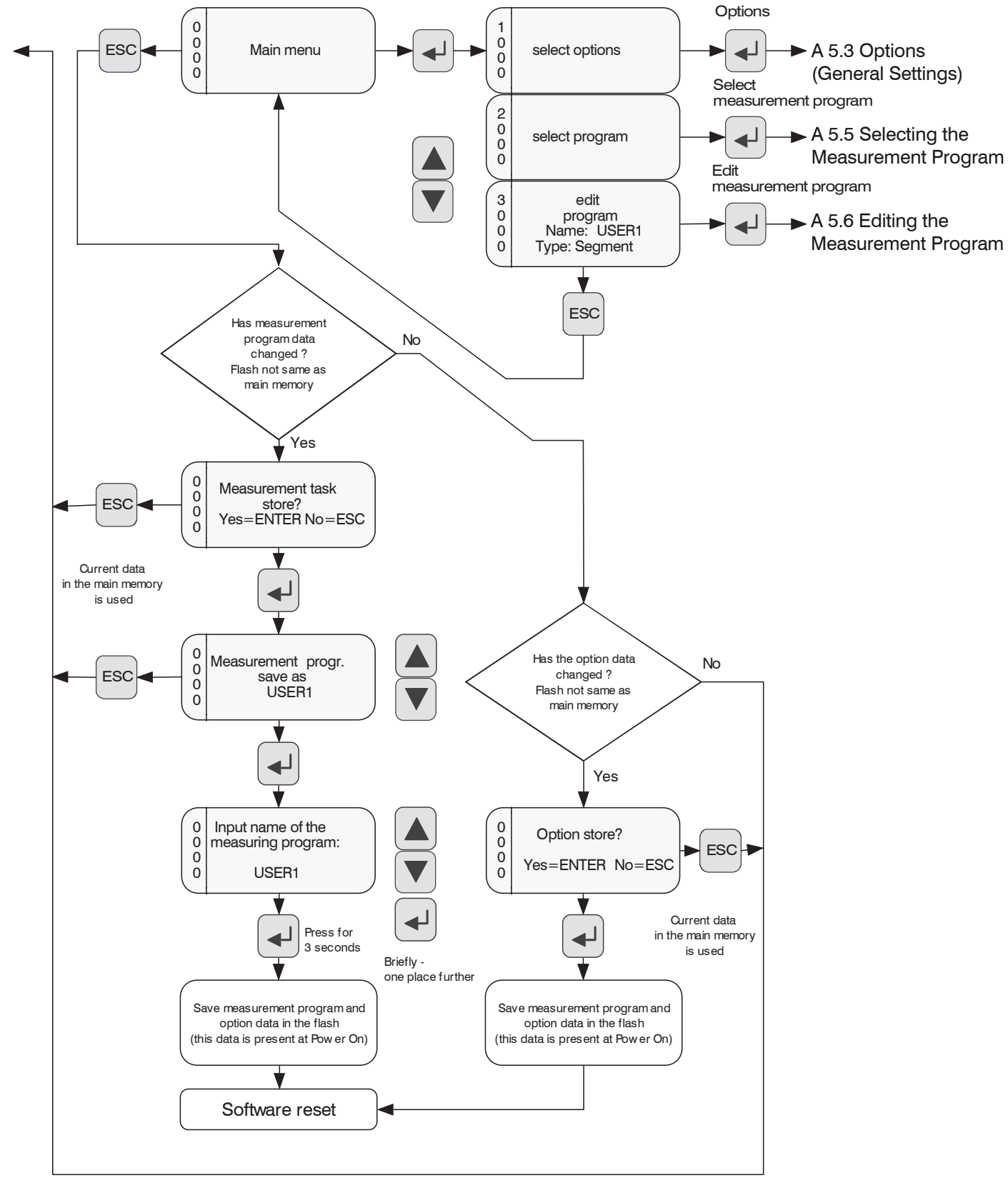


Fig. 65 Operating Menu `Dialog and Procedure for Saving`

A 5.3 Options (General Settings)

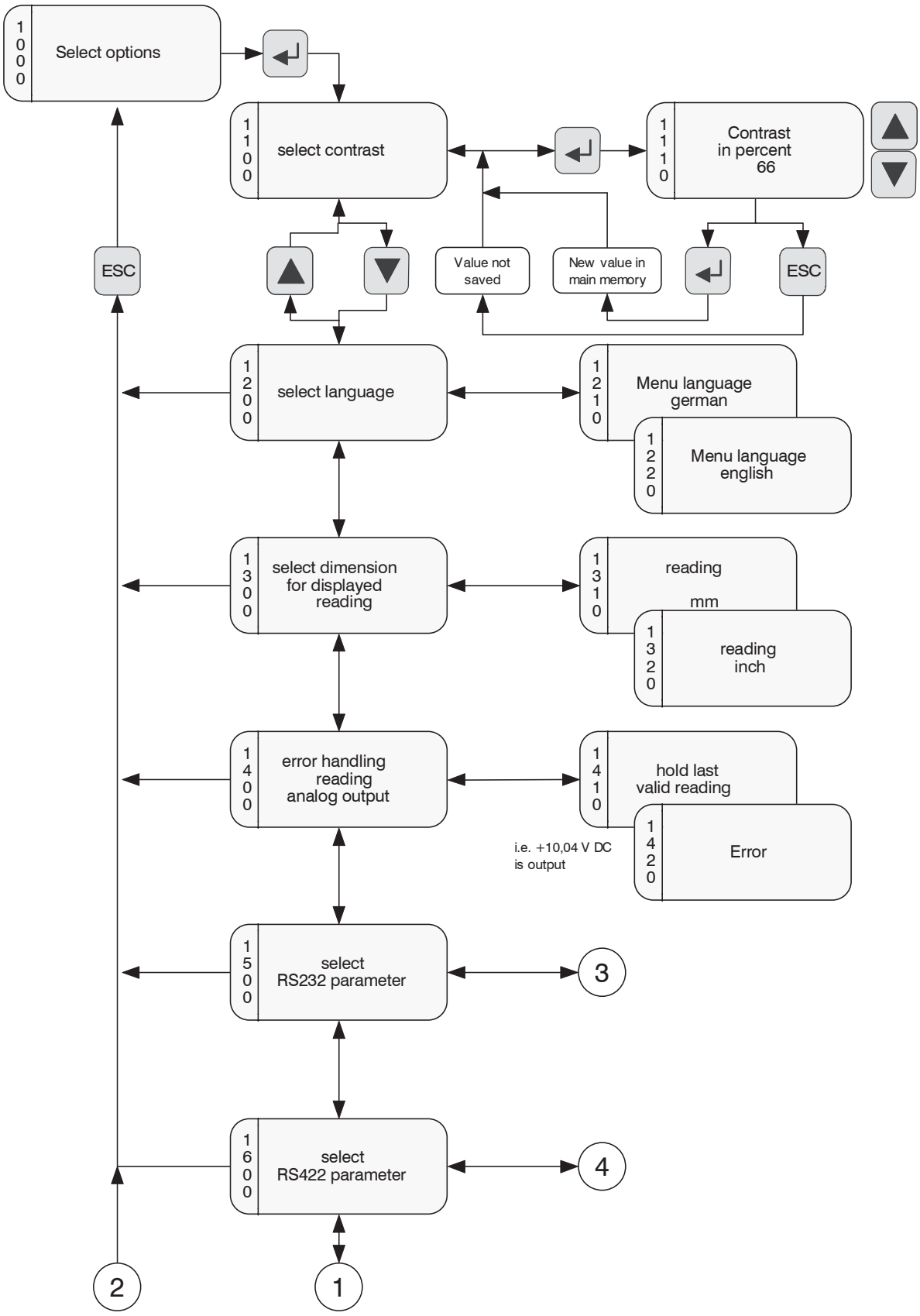


Fig. 66 Operating Menu `Options (General Settings)`

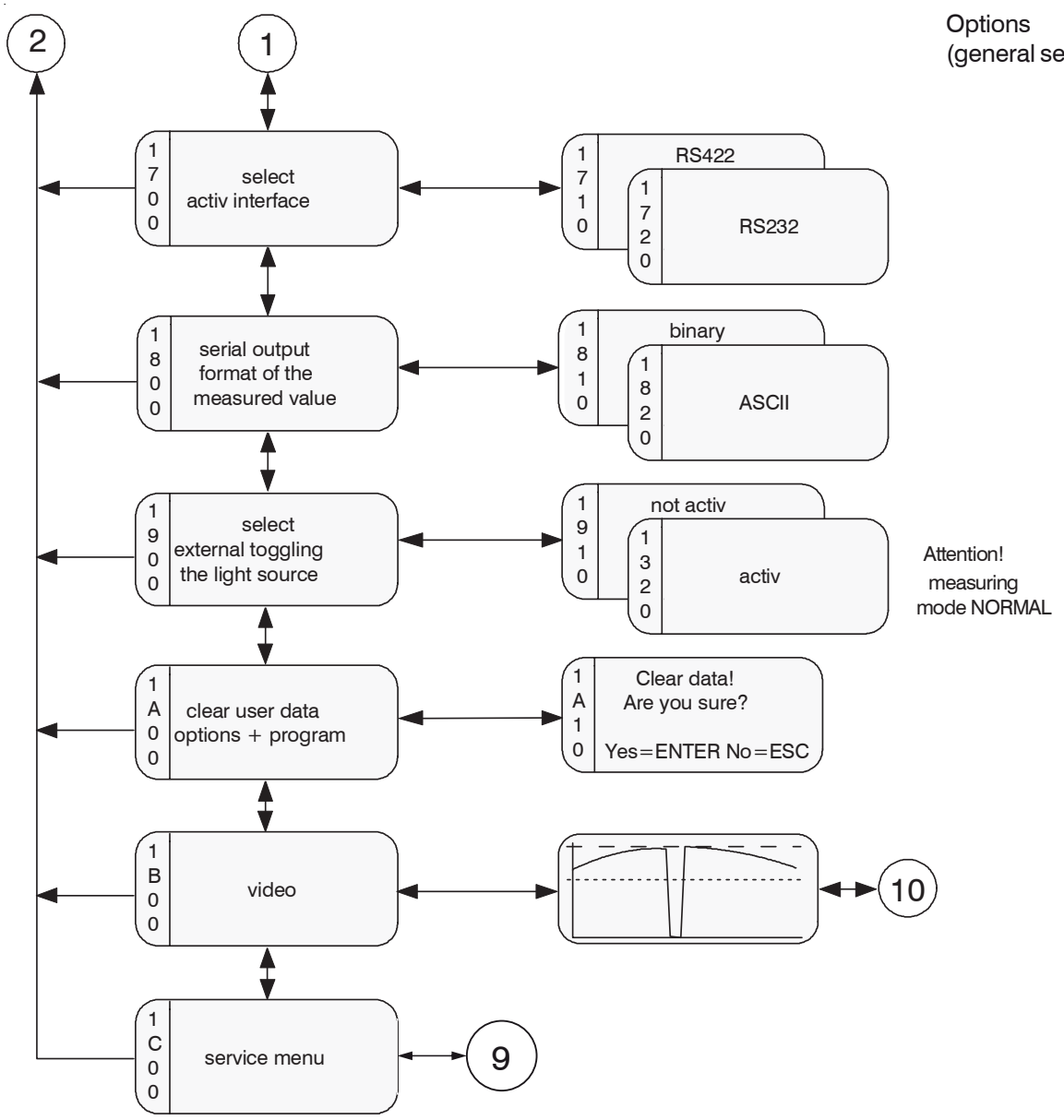


Fig. 67 Operating Menu `Options (General Settings)`*, part 2*

A 5.4 Options (Interface)

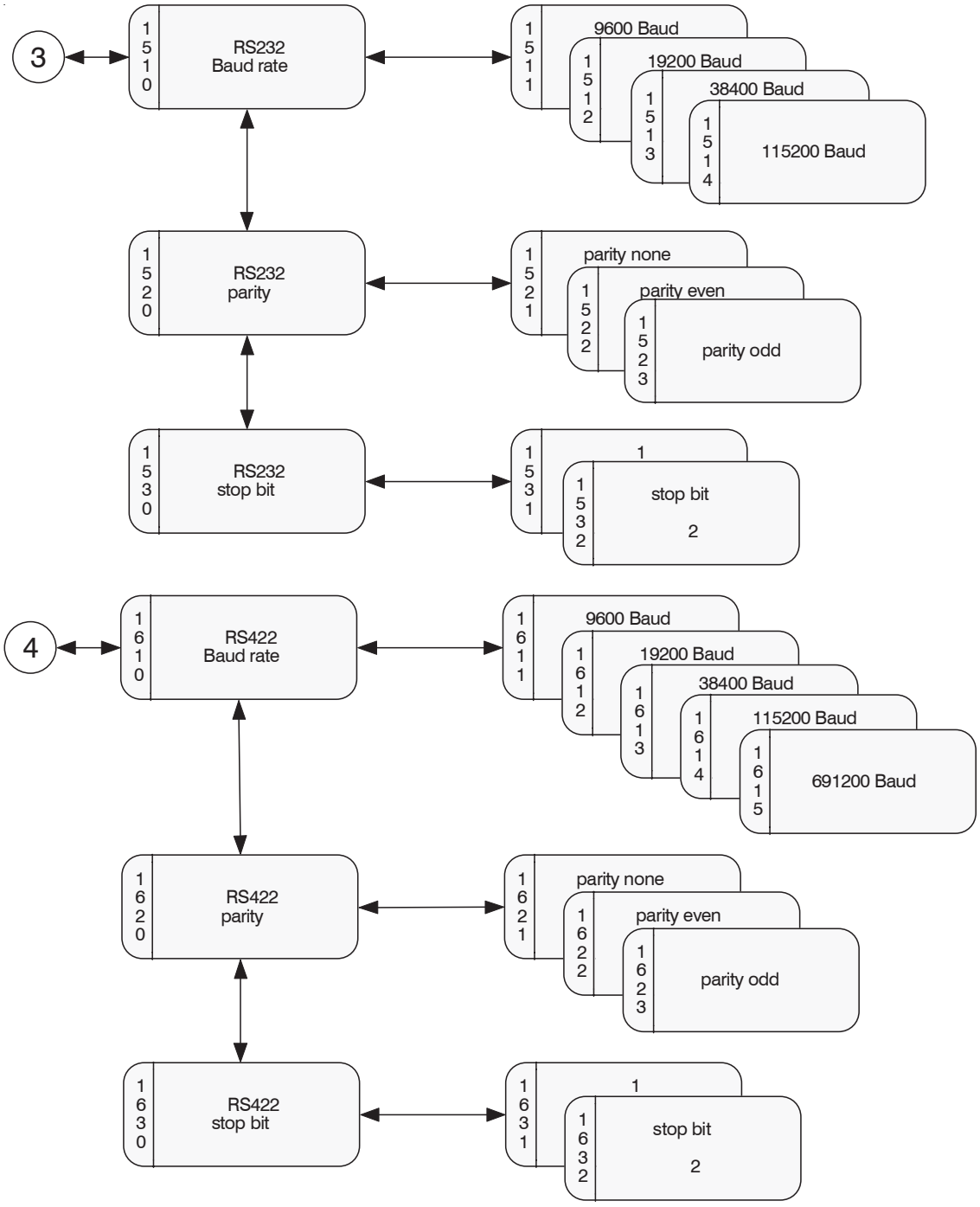
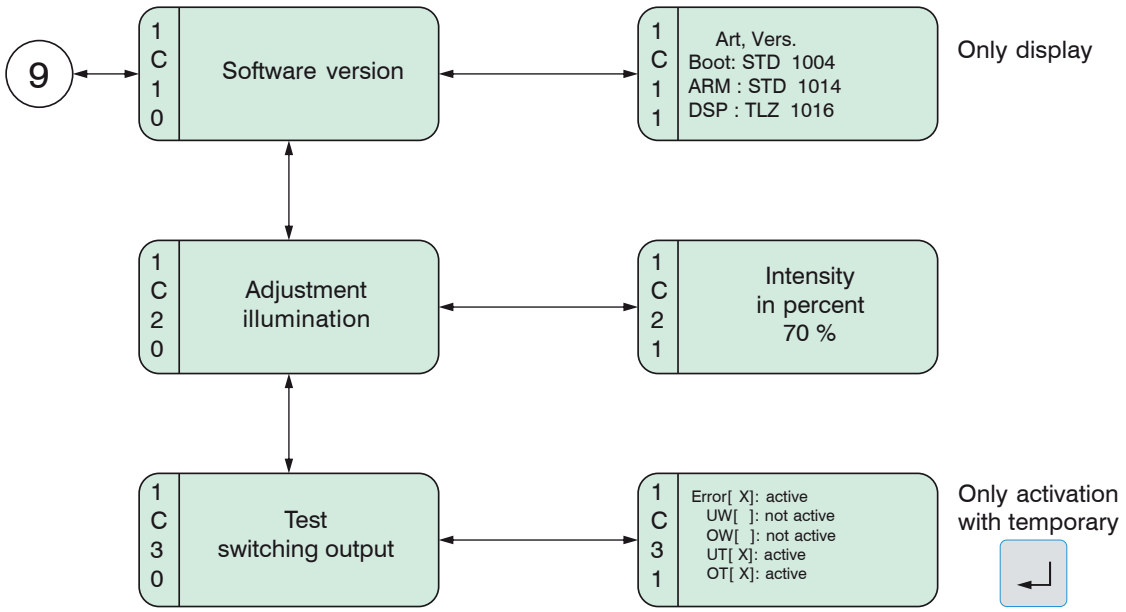


Fig. 68 Operating Menu `Options (Interface)`

The parameters which can be selected in the options are read out of the option data in the main memory and written back. The user can decide only on quitting the main menu whether the parameters are to be written into the flash memory. The data is then also present after `Power ON`.

The option data located in the main memory is used for the measurement mode.

The currently set parameter appears first during selection.



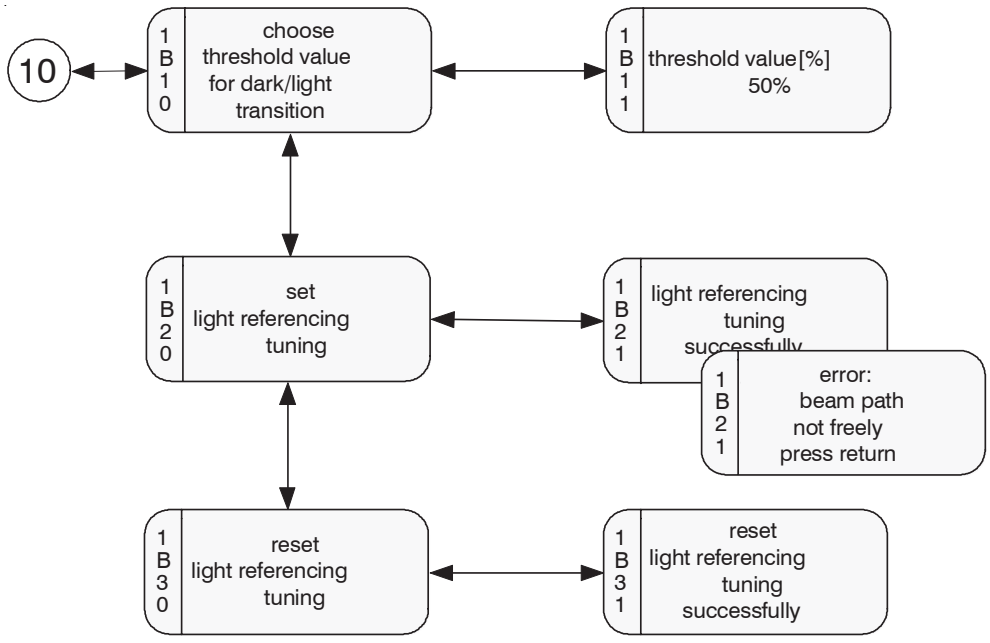


Fig. 69 Operating Menu `Options (Interface)`, part 2

A 5.5 Selecting the Measurement Program

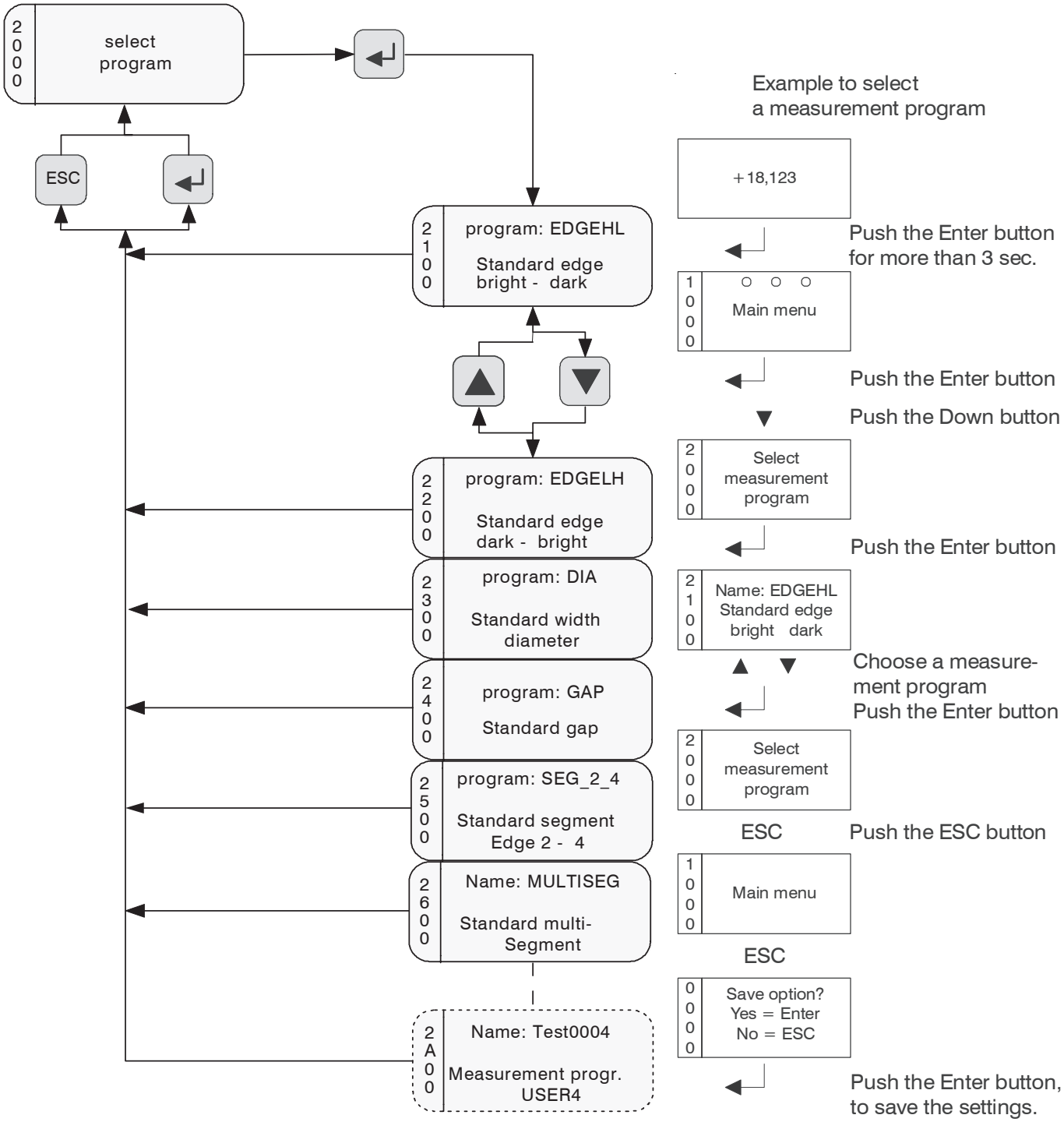


Fig. 70 Operating `Selecting the Measurement Program`

The parameters which can be selected in the options are read out of the option data in the main memory and written back. The user can decide only on quitting the main menu whether the parameters are to be written into the flash memory. The data is then also present after `Power ON`.

The option data located in the main memory is used for the measurement mode. The currently set parameter appears first during selection.

A maximum of four user programs can be saved. They can be overwritten.

The factory setting for the measurement program is the standard light-dark edge.

Measurement program: 2100

Program name: EDGEHL

A 5.6 Editing the Measurement Program

The program selected before is template for editing.

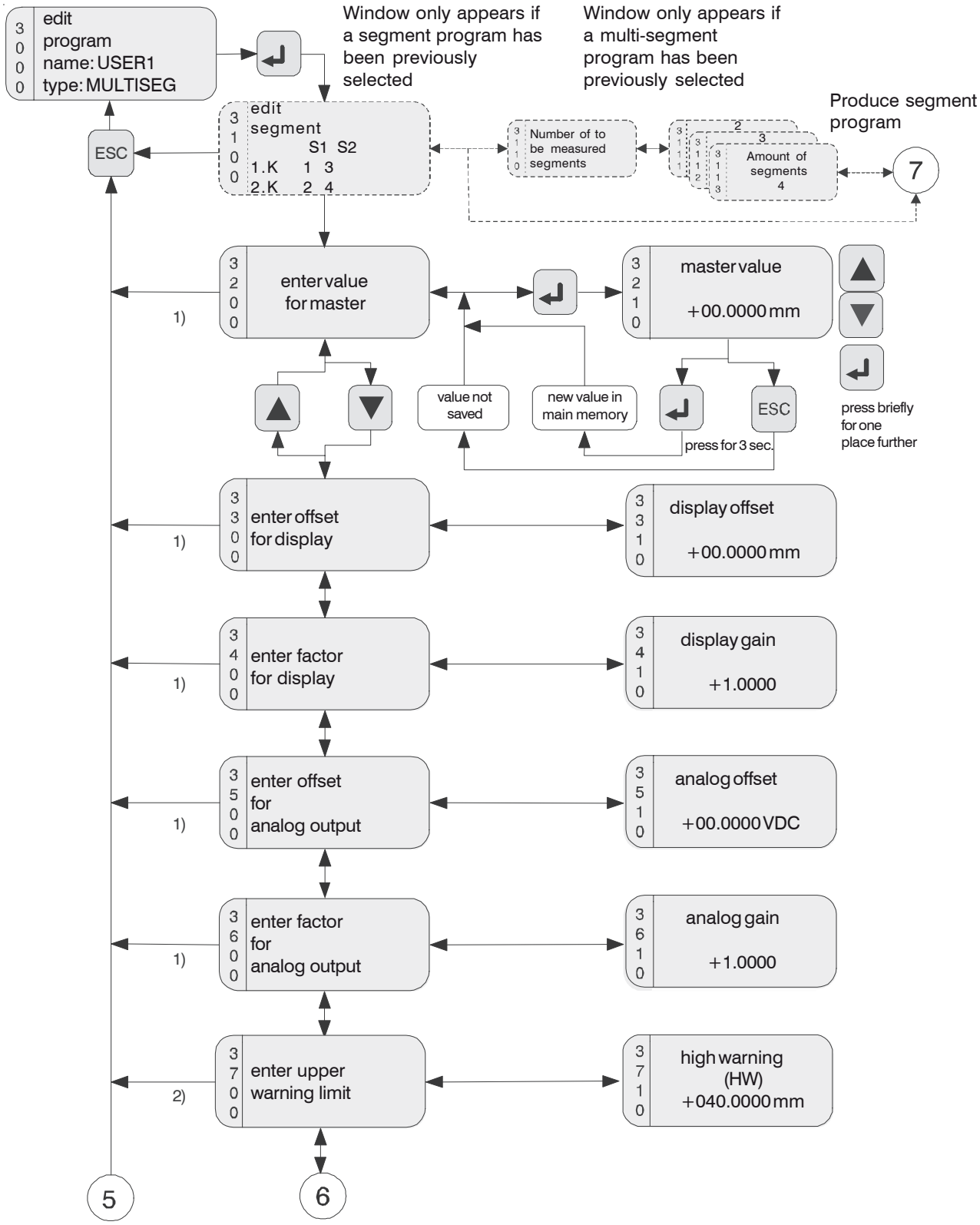


Fig. 71 Operating menu `Editing the Measurement Program`

1) These menu points cannot be selected and processed with the `Multi-segment` measurement program, because their contents are not used. Analog output = 0 VDC.
The function zero-setting / mastering cannot be executed.

2) The limit output of the `Multi-segment` measurement program differs from the other standard programs. For the segment 1 + 2 one upper and one lower limit can be defined.

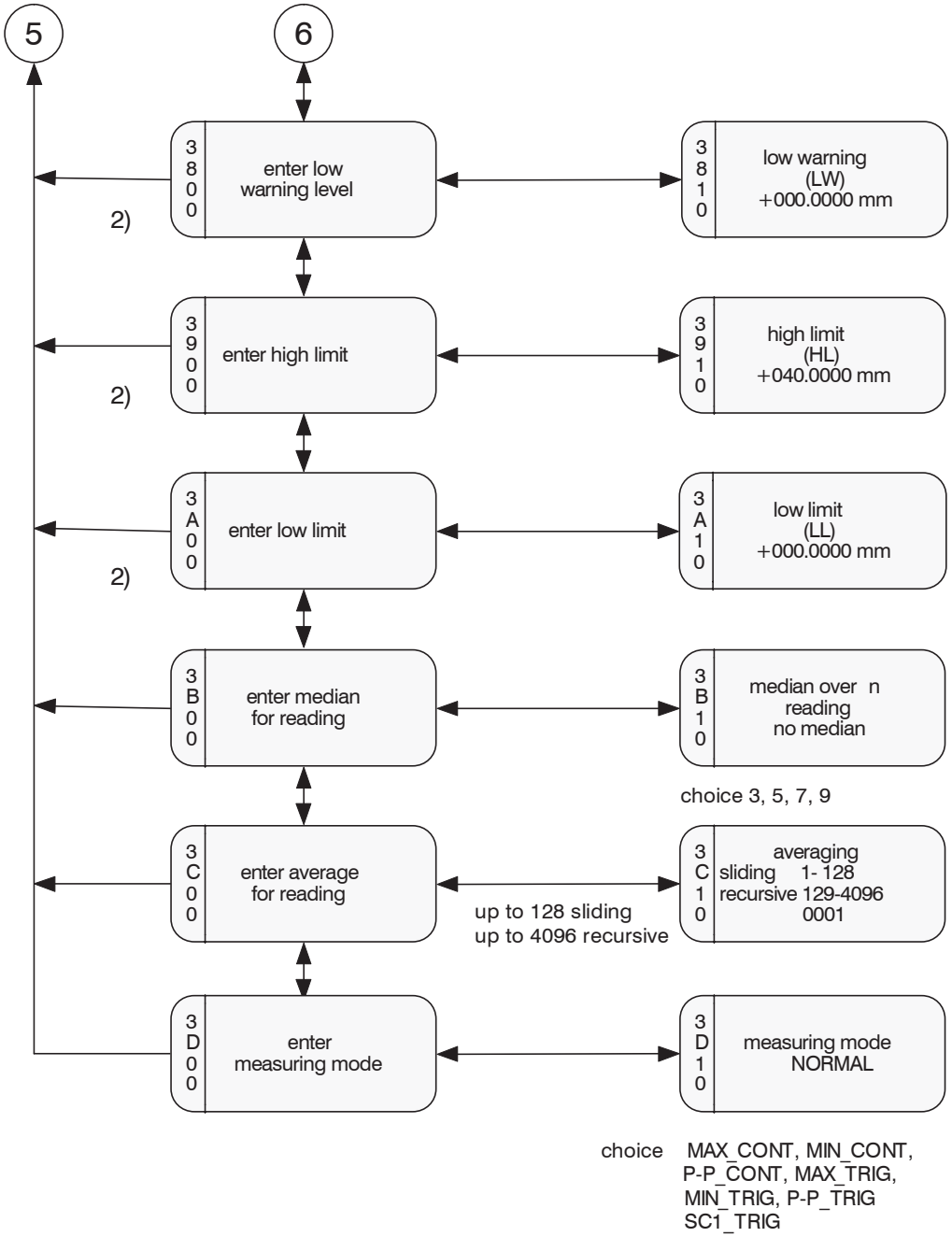


Fig. 72 Operating menu `Editing the Measurement Program`, part 2

i The measuring mode cannot be voted for respect, if light control is active.
Measuring mode = NORMAL

2) The limit output of the `Multi-segment` measurement program differs from the other standard programs. For the segment 1 + 2 one upper and one lower limit can be defined.

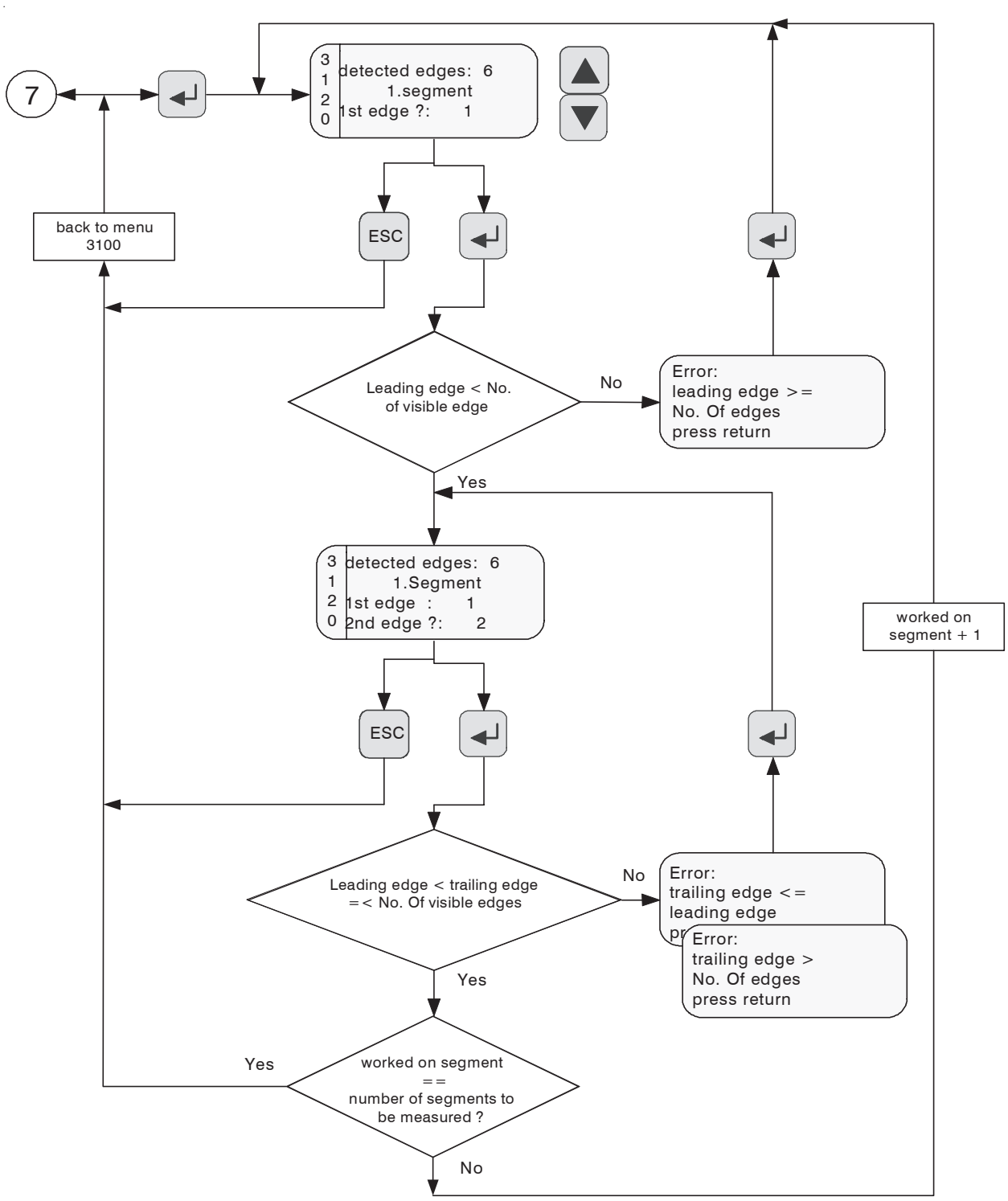


Fig. 73 Operating menu `Editing the Measurement Program`, part 3

The leading edge can also be set = 0; then the measurement is taken from the zero point of the receiver.

A 5.7 Limits with the Multi-segment Measurement

The limit output of the `Multi-segment` measurement program differs from the other standard programs. For the segment 1+ 2 one upper and one lower limit can be defined.

Standard	Multi-segment
Higher warning level	Higher limit, 1 st segment
Lower warning level	Lower limit, 1 st segment
Higher tolerance limit	Higher limit, 2 nd segment
Lower tolerance limit	Lower limit, 2 nd segment

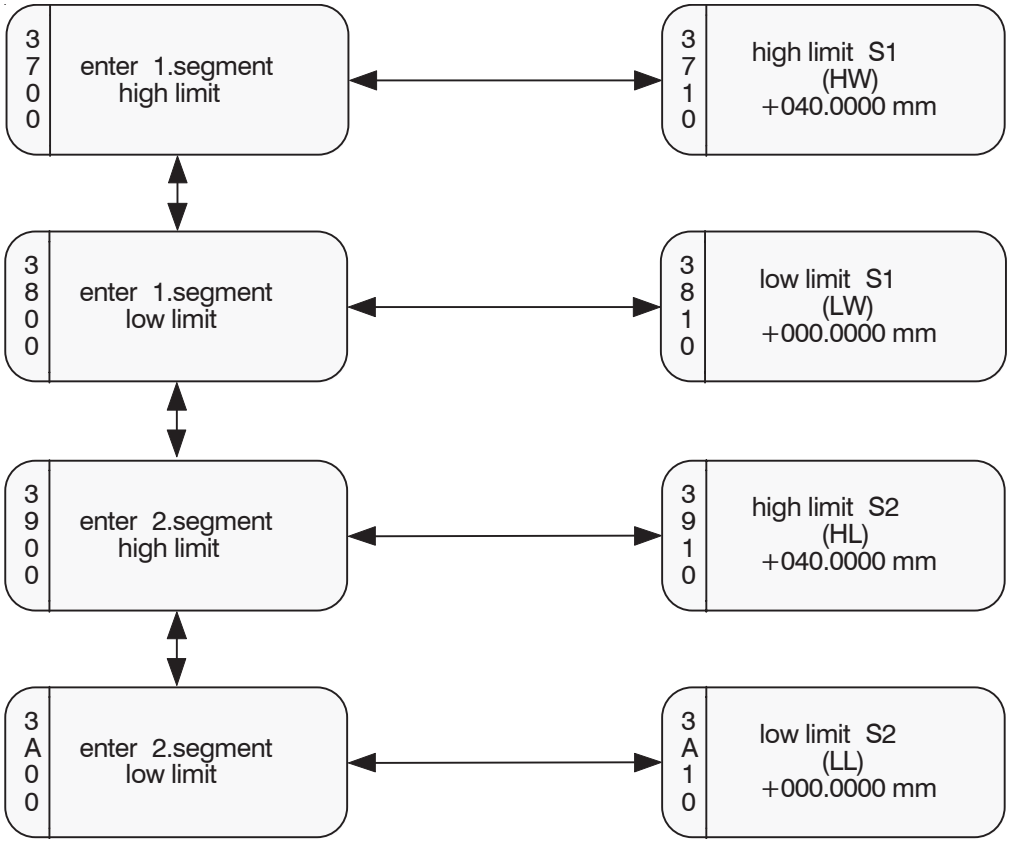


Fig. 74 Operating menu `Limits with the Multi-segment Measurement`

A 6 Standard Measurement Program Data for ODC2600-40

			Standard						User			
Measurement program data			Bright - dark	Dark - bright	Width diameter	Gap	Segment 2 - 4	Multi-seg-ment	USER1 User -defined	USER2 User -defined	USER3 User -defined	USER4 User -defined
3000	Measurement program data											
	Name		EDGEHL	EDGEHL	DA	GAP	SEG_2_4	MULT SEG				
	Segment		1	1	1	1	1	x				
	1	Leading edge					1	1				
		Trailing edge					2	2				
	2	Leading edge						3				
		Trailing edge						4				
	3	Leading edge						5				
		Trailing edge						6				
	4	Leading edge						7				
		Trailing edge						8				
	Master value		+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm				
	Display offset		+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm				
	Display gain		+1000	+1000	+1000	+1000	+1000	+1000				
	Analog offset		+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC				
	Analog gain		+1000	+1000	+1000	+1000	+1000	+1000				
	Higher warning level (higher WL 1st segm)		+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm				
	Lower warning level (lower WL 1st segm)		+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm				
	Higher tolerance limit (higher WL 2nd segment)		+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm	+040 0000 mm				
	Lower tolerance limit (lower WL 2nd segment)		+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm	+000 0000 mm				
	Median		None	None	None	None	None	None				
	No of measurements for average		1	1	1	1	1	1				
	Measurement mode		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL				

MICRO-EPSILON Eltrotec GmbH
Manfred-Wörner-Straße 101 · 73037 Göppingen / Germany
Tel. +49 (0) 7161 / 98872-300 · Fax +49 (0) 7161 / 98872-303
eltrotec@micro-epsilon.com · www.micro-epsilon.com
Your local contact: www.micro-epsilon.com/contact/worldwide/

X9751125-B072102HDR