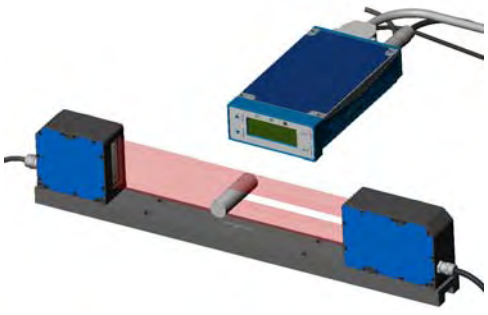
SENSORS & SYSTEMS

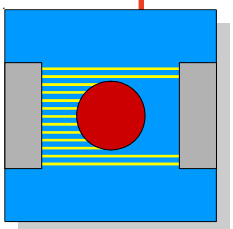
Authority in Displacement Measuring

MICRO-EPSILON

INSTRUCTION MANUAL

MICRO EPSILON





Non-Contacting
Optical Micrometer

Instruction Manual

optoCONTROL 2600

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Certified in compliance with DIN EN ISO 9001: 2008

Contents

1. Safety

The operation of the system requires knowledge of the operating manual.

1.1 Symbols Used

The following symbols are used in this instruction manual:

WARNING! - potentially dangerous situation

IMPORTANT! - useful tips and information

1.2 Warnings

- Caution - use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

The optoCONTROL 2600 uses a LED light source and is classified in **Laser Class 1**.

- **Avoid shock and knocks on the light source/receiver and the controller.**
  > Damage to light source/receiver or the controller.

- **Supply voltage must not exceed specified limits**
  > Damage to light source/receiver or the controller.

- **Power supply and the display/output device must be connected according to the safety regulations for electrical operating equipment.**
  > Risk of injury.
  > Damage to 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 measurements.

IMPORTANT!

Wipe off fingerprints on protective windows immediately.

- Do not touch the **protective windows** of the light source and receiver with the fingers. Wipe off any fingerprints immediately.
  > Inaccurate, erroneous measurements.

- The connectors on the **light source** or **receiver** must not be plugged or unplugged with the electronics switched on.
  > Damage to light source/receiver or the controller.

- Protect **cables** from damage.
  > Failure of the measurement device.

- Avoid permanent action of **dust** or **splashed water** on the measurement channel. Blow off or use protective housing.
  > Damage to light source/receiver or the controller.

1.3 Notes on CE Identification

The following apply to the optoCONTROL2600 Measurement System:

EMC-Regulations 2004/108/EC

Products which bear the CE mark fulfill the requirements of the EMC-Regulations 2004/108/EC „Electromagnetic Compatibility“ and the harmonized European standards (EN) listed in it. The EU declaration of conformity is kept available for the responsible authorities according to the EU Directive, Article 10 at

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The measurement system is designed for applications in the industrial field and fulfills the requirements according to the standards

- EN 61326-1:2006-10
- EN 61000-6-2:2006-03
- DIN EN 55011:2007-11 (Group 1, Class B)

The measurement system fulfills the requirements when the guidelines described in the operating manual are observed during installation and operation.

1.4 Proper Use

- The optoCONTROL 2600 is designed for use in industrial areas.
- It is used
  - displacement, distance, edge and offset measurement,
  - edge crack testing,
  - position acquisition of components or machine parts.
- The measuring system may only be operated within the limits specified in the technical data.
- The system should only be used in such a way that in case of malfunctions or failure personnel or machinery are not endanged.
- Additional precautions for safety and damage prevention must be taken for safety-related applications.

1.5 Proper Environment

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

- 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.

- Operating temperature: 0 - 50 °C (with free air circulation)

  Relative humidity: up to 95 % RH, non condensing

- Ambient pressure: Atmospheric pressure

- Vibration:
  According to IEC 60068-2-6 (light source only / receiver)

- Mechanical shock:
  According to IEC 60068-2-29 (light source only / receiver)

- EMC:
  Conforming to EN 61326-1:2006-10, EN 61000-6-2:2006-03
  DIN EN 55011:2007-11 (Group 1, Class B)

- Storage temperature: -20 bis +70 °C (-4 up to +158 °F)

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

IMPORTANT!
The protection class is restricted to water (no drilling emulsions, etc.)!

Avoid quick changes between hot and cold!

Use a protective housing if the effects of water are continuous.

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. Functioning 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.

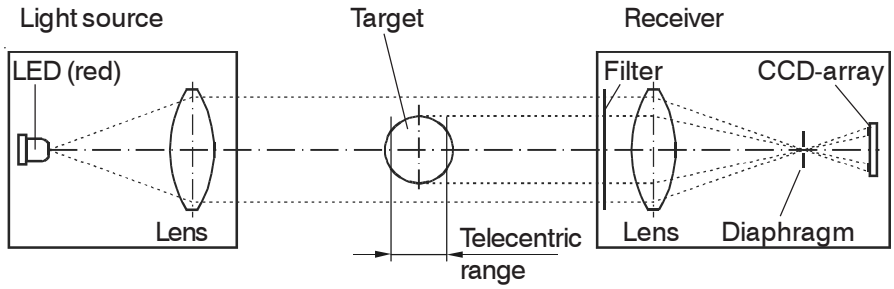


Fig. 3.1: Measuring principle

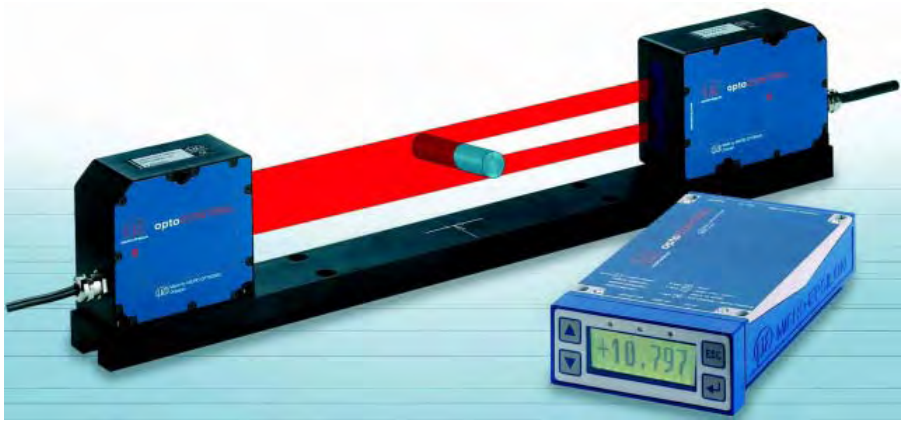
3.2 Structure of a Complete Measurement System

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.



A measurement system consists of:
- light source,
- receiver,
- controller.

Fig. 3.2: Measurement system ODC2600-40

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. 3.3).

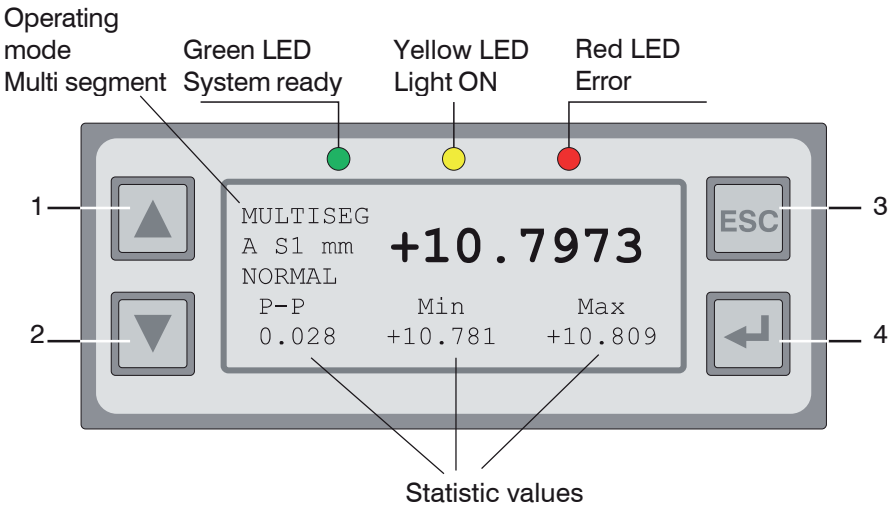


Fig. 3.3: Keypad and display on the front panel of the controller

The following functions are assigned to the keypad in Fig. 3.3:

(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).

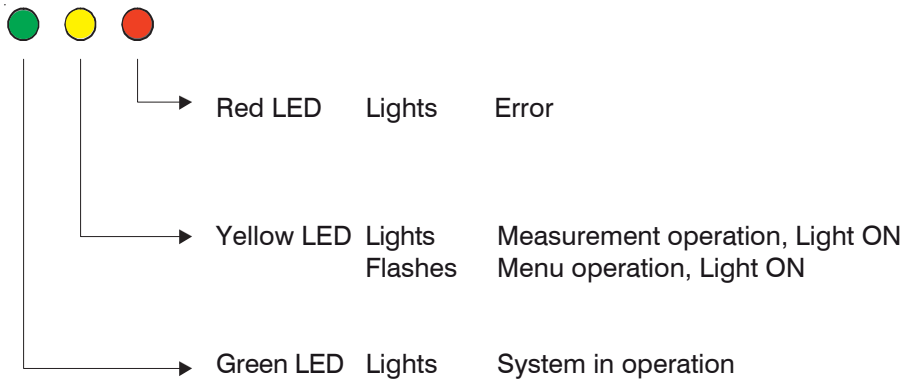


Fig. 3.4: LEDs on the front panel of the controller

3.3.2 Rear View of the Controller

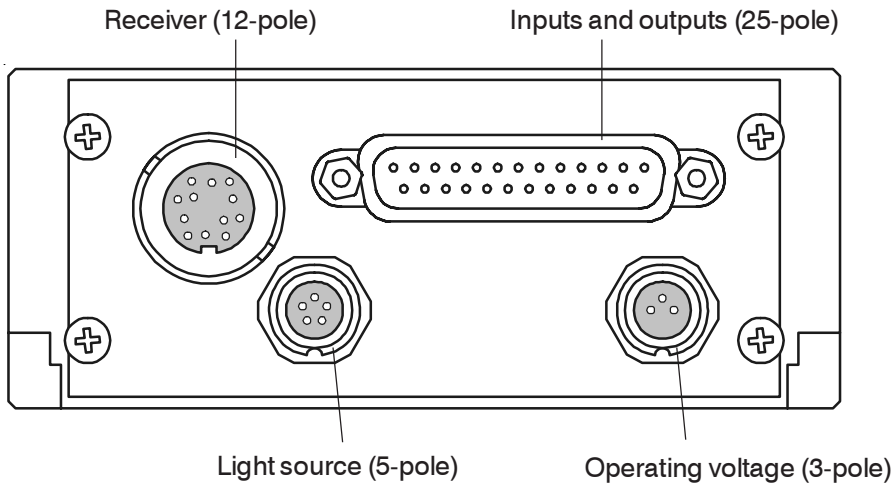


Fig. 3.5: Connectors on the rear side of the controller

3.4 Operating Modes

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

IMPORTANT!

Factory setting:
Position edge
bright - dark

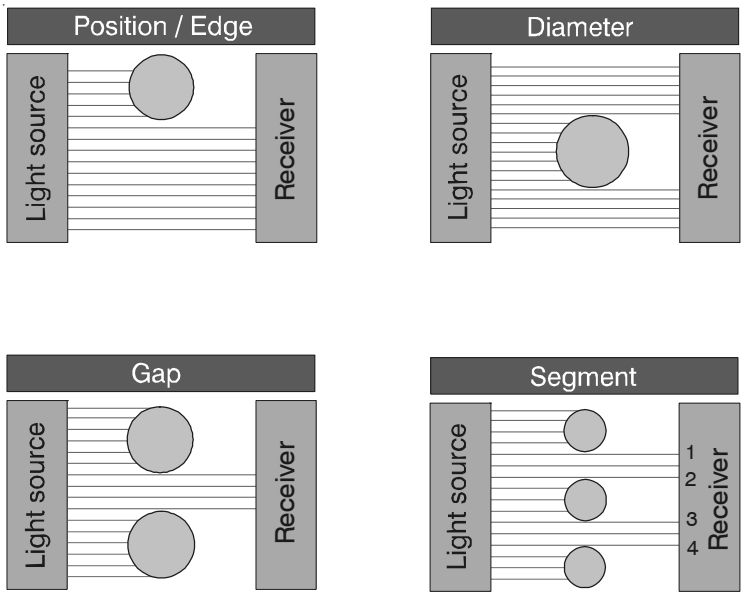


Fig. 3.6: Methods of operation

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	ODC 2600 Option 209
Measurement range		40 mm	
Measuring rate (sample rate)		2.3 kHz	
Smallest measurable diameter or gap		0.3 mm	
Distance of light source - receiver (free space)		300 (± 50) mm	400 (± 50) mm
Working distance (target - receiver)		150 (± 5) mm	200 (± 5) mm
Linearity (3 σ) [1]		< ± 3 µm	
Resolution [2]		0.1 µm	
Repeatability [1 4]		± 0.1 µm	± 1.5 µm
Light source		LED (red)	
Analog output (voltage)		0 to 10 VDC, range ± 10 VDC, selectable	
Digital output		RS232 (Standard): max. 115.2 kBaud or RS422: max. 691.2 kBaud	
Switching outputs		Error, 2x tolerance limit, 2x warning level, max. 30 VDC; 100 mA	
Operating temperature		0 ... 50 °C (+32 ... +122 °F)	
Storage temperature		-20 ... 70 °C (-4 ... +158 °F)	
Cable length		Standard: 2 m	
(controller - light source and controller - receiver)		Extension: 3 or 8 m	
Operating voltage		+24 VDC ± 15 %, < 1 A	
Protection class		IP 64 (light source, receiver)	
		IP 40 (controller)	
Measurement programs		Edge bright - dark	
		Edge dark - bright	
		Diameter	
		Gap	
		Segment	
		Multi-segment	
		4 user programs (can be edited)	
Dimensions L x B x H (in mm)	Light source	87 x 80 x 45	
	Receiver	116 x 80 x 45	
	Controller (without connector)	191 x 110 x 45	
	Mounting rail (for light source and receiver)	510 x 45 x 20	610 x 45 x 20
Vibration [3]		acc. DIN EN 60068-2-6	
		2 g / 20 ... 500 Hz	
Shock [3]		acc. DIN EN 60068-2-29	
		15 g / 6 ms	
Weight	Controller	1000 g	
	Light source	450 g	
	Receiver	800 g	
	Mounting rail	900 g	1100 g

Model	ODC 2600	ODC 2600 Option 209
Displays	LCD display (measured value, maximum, minimum, peak to peak)	
	Measurements displayed in mm or inch, selectable	
	Menu language in German or English, selectable	
	3 x LED (power on, light on, error)	
Inputs	Zero point (Zero), reset („*Triggermode*“)	
	Synchronization, opto coupler $I_{max.}$ = 15 mA	
	Light on/off (can be turned off via menu), trigger („*Triggermode*“)	
Synchronal signal output	HIGH = 3.3 V, FPGA	
Accessories (optional)	Cable extensions for light source and receiver (3 m or 8 m)	
	Power supply cable (3 m or 10 m)	
	Signal output cable (signal and switching outputs): - only analog (3 m) - analog (3 m) + RS232 (3 m) - analog (3 m) + RS422 (10 m)	

The data shown are for a constant room temperature of 20 °C, after a warm-up time of 30 min.

1) Edge measurement without averaging, operating distance 150 ± 5 mm (Option 209: 200 mm ± 5 mm)
2) Display resolution at the digital display:
   - Resolution digital output 0.6 µm;
   - Resolution analog output 1.2 µm /analog coefficient 1,
   - Resolution analog output 0.3 µm /analog coefficient 4.

The gain of the analog output can be increased to a max. of 10 V/10 mm respectively ±10 V/20 mm (analog coefficient 4) then 0.3 µm resolution.
3) Data apply to sensor unit.
4) Measured with static noise over 3 min.

3.6 Block Diagram

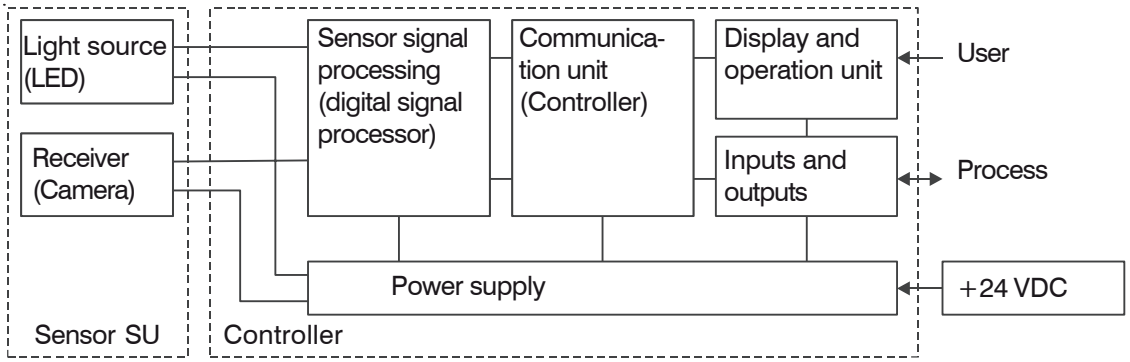


Fig. 3.7: Block diagram of the ODC 2600 Measuring System

3.7 Analog Output

Output voltage (without offset):	0 ... 10 VDC
Max. output range (with offset, factor):	-10.0 VDC ... +10.0 VDC
Output span(100% of measurement range):	Uout 10.0 V
Output voltage (with error indication):	-10.04 V ... +10.04 VDC
Internal resistance:	100 ohm
Minimum load resistance:	1 kohm
Recommended load resistance:	1 Mohm
Maximum capacitive load:	47 nF

See also Chap. 6.4

3.8 Input Zero point / RESET

IMPORTANT!

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

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 Chap. 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 zeroes.

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

IMPORTANT!

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

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.

3.9 Synchronisation

If two or more optoCONTROL 2600s are operated on the same target, they can be synchronized to one another, see also Chap. 6.5.
As master, controller 1 then synchronizes controller 2.
All synchronization signals are electrically isolated by optocouplers.

3.10 Error Output

IMPORTANT!

The error output is provided on the 25-pole connector:
Pin 1: Error output
Pin 2: GND

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.

See Chap. 5.6 for more details.

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.

IMPORTANT!

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 intire measurement range is defaulted at 50 %.

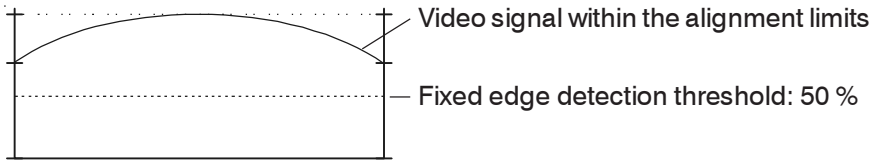


Fig. 3.8: Video image with fixed edge detection threshold

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 Chapter 11.3.3, “1B10 – Selection of the edge detection threshold”).

A very high edge detection threshold will require a dynamic curved edge detection threshold. This can be set by activating the “1B20 – Light comparison” menu item.

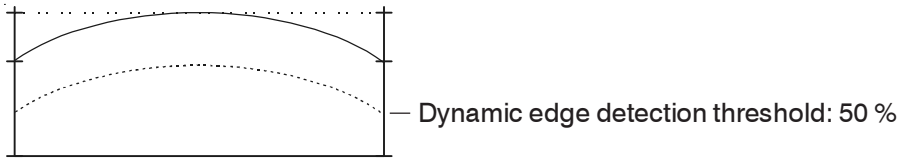


Fig. 3.9: Video image with dynamic edge detection threshold

The determined dynamic edge detection threshold is permanentely 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 comparison” deletes the saved dynamic edge detection threshold but not the threshold value.

To return to the default settings you can use menu item “1A00 – Delete the user-defined options and measurement program data”.

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

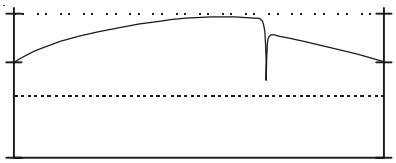


Fig. 3.10: Display image of the video signal, shown for the first threshold of 50 %
Measurement object: Glass edge, 0.5 mm

Fig. 3.10 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.

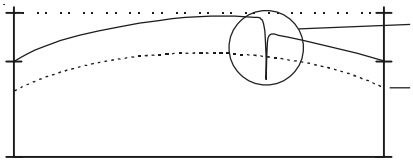


Fig. 3.11: Display image of the video signal with a dynamic threshold
Measurement object: Glass edge, 0.5 mm thick

4. Delivery

4.1 Supplied Items

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 Instruction manual

Carefully remove the components of the measuring system from the packaging and ensure furthermore that the goods are forwarded in such a way that no damage will occur.

Check the delivery for completeness and shipping damage immediately after unpacking.

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

4.2 Storage

- Storage temperature: -20 to +70 °C
- Humidity: Up to 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. Kinks in the cables must always be avoided.

IMPORTANT!

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

> Inaccurate, erroneous measuring values

IMPORTANT!

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

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

5. Mounting the Sensor Unit

The sensor unit, consisting of the light source, receiver and mounting rail, is pre-assembled and pinned together (see Fig. 5.1).

The mounting rail must mounted such 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.

Minimum cable bending radius

Light source	flexible: 35 mm	fixed: 23 mm
Receiver	flexible: 49 mm	fixed: 33 mm

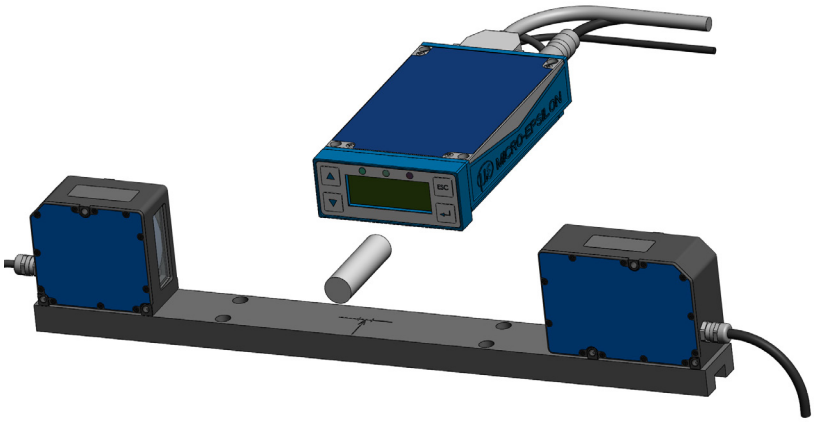


Fig. 5.1: Mounted sensor unit with controller

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

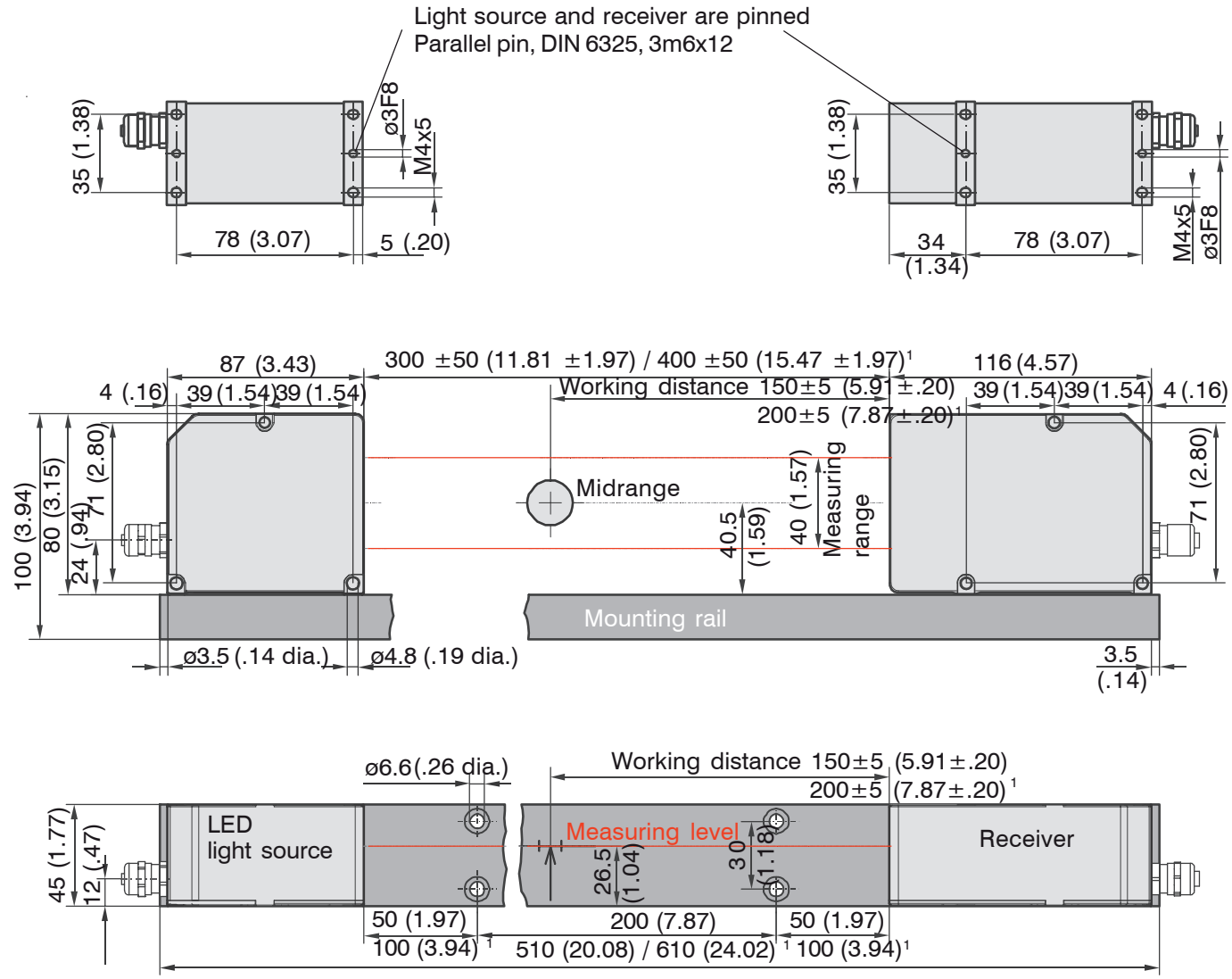


Fig. 5.2: Dimensional drawing of the sensor unit with mounting rail, dimensions in mm (inches), not to scale

1) Applies only for option 209.

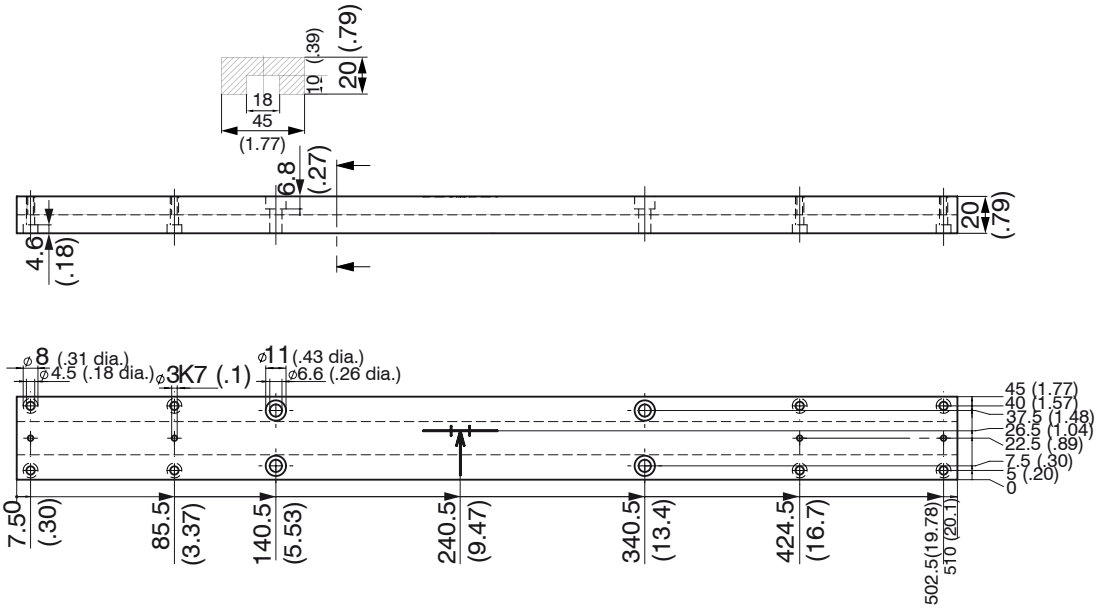


Fig. 5.3: Dimensional drawing of the mounting rail

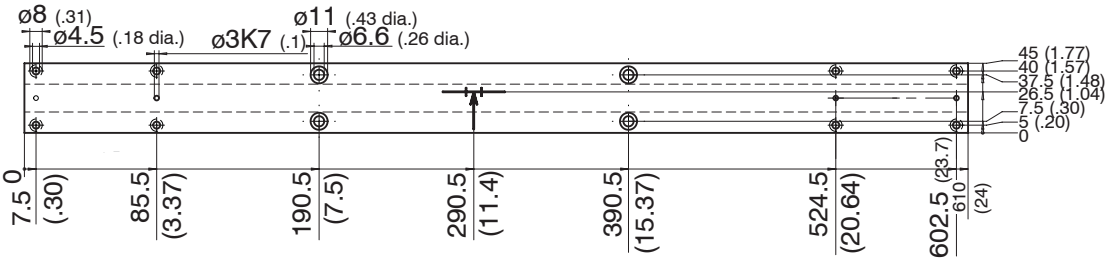


Fig. 5.4: Dimensional drawing of the mounting rail, option 209

Dimensions in mm (inches), not to scale

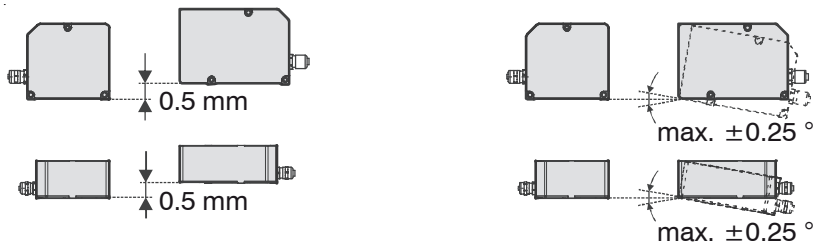
IMPORTANT!

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. 5.5: Permissible adjustment error

Connect light source and receiver with the controller.

Use the video signal (see Chap. 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.

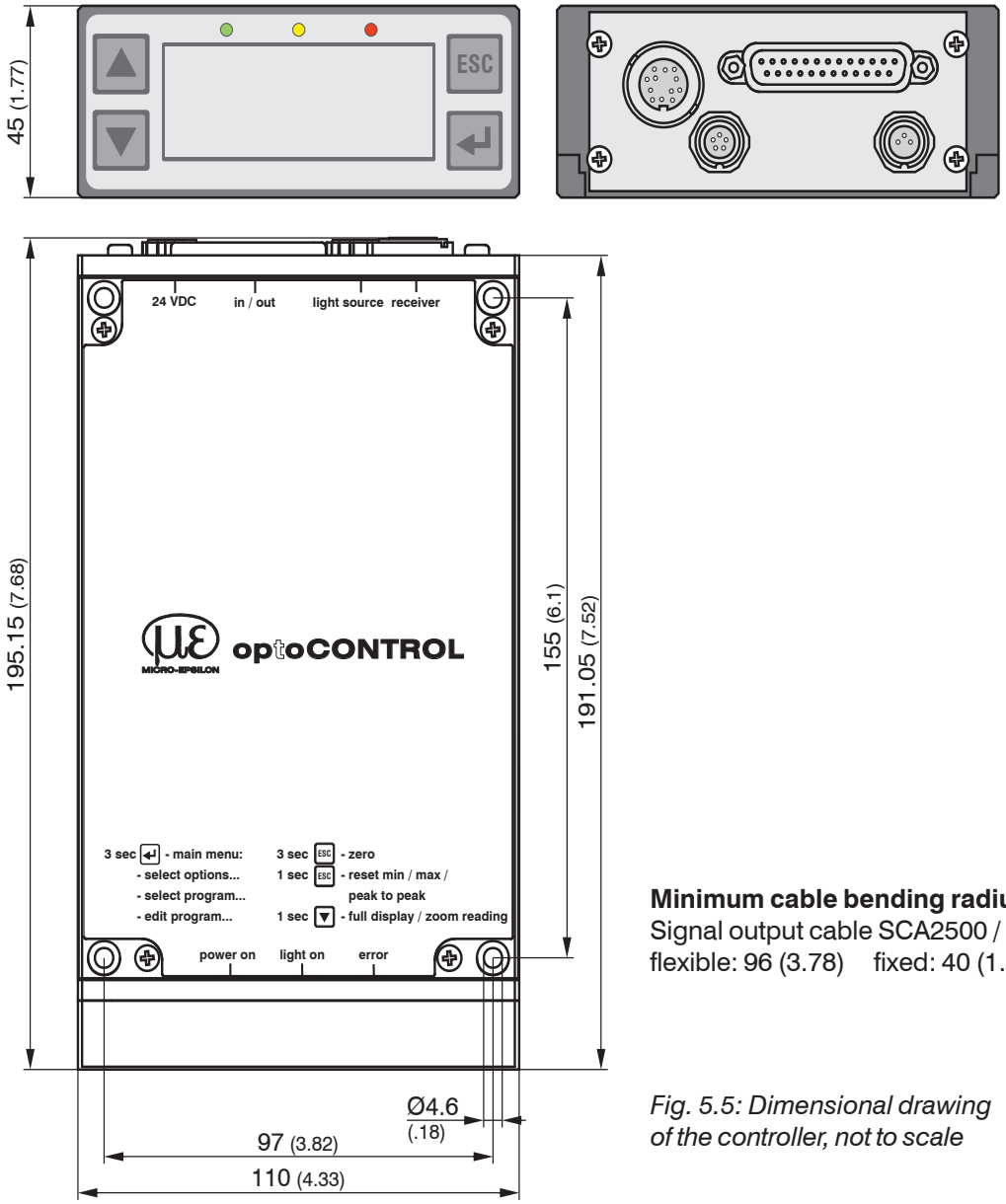


Fig. 5.5: Dimensional drawing of the controller, not to scale

IMPORTANT!

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

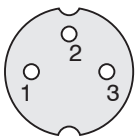
Minimum cable bending radius
Signal output cable SCA2500 / SCD2500
flexible: 96 (3.78) fixed: 40 (1.57)

5.4 Supply Voltage

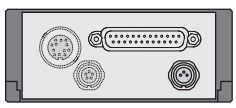
The operating voltage is preferably connected via a screened two-core cable, e.g. via the Supply Cable PC2500-3. Route the cable screen to a potential equalization terminal in the vicinity of the power supply unit. The controller contains a inverse-polarity protection. Please use the power supply unit for measurement instruments only and not for drive units or similar sources of pulse interference at the same time.

Pin No.	Signal	Conductor coloring PC2500, (old version)
1	GND supply voltage	black (blue or brown)
2	N.C.	---
3	+24 VDC (±15 %), <1 A	red (white)
Housing	Cable screen	tin-plated

Tab. 5.1: Pin assignment (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

For connecting an analog terminal device use either the analog connecting cable from the accessories or your own screened cable.

When using the connecting cable SCA2500 (see Accessories), 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. 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.

IMPORTANT!

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.

Pin No.	Signal	Signal type / connector type	Core colors or pole no SCA2500 or SCD2500 Signal, Output Cable
1	Error output (Signal)	Switching output	red
14	Error output (GND)	Switching output	blue
2	Upper tolerance limit (Signal)	Switching output	violet
15	Upper/lower tolerance limit (GND)	Switching output (common connection)	black and brown
3	Lower tolerance limit (Signal)	Switching output	white
16	Upper warning limit (Signal)	Switching output	pink
4	Upper/lower warning limit (GND)	Switching output (common connection)	grey and grey/pink
17	Lower warning limit (Signal)	Switching output	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 switch. input	
20	RS422 Receive (positive)	Optocoupler input (positive)	green, Pin 1 (HD-SUB 15) [1]
7	RS422 Receive (inverted)	Optocoupler input (negative)	yellow, Pin 2 (HD-SUB 15) [1]
8	RS422 Send (inverted)	Serial output (negative Imp.)	brown, Pin 4 (HD-SUB 15) [1]
21	RS422 Send (positive)	Serial output (positive 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	Synchronsization output (+) [1]	Digital output (SYNC)	
11	Synchronsization output (-)	Reference potential (DGND)	
24	Synchronsization input(+) [2]	Optocoupler input (positive)	
12	Synchronsization input (-)	Optocoupler input (negative)	
25	Analog output (AGND)	Reference potential for analog signal	Innener screen (thin cable)
13	Analog output (Signal)	Analog signal (voltage)	green

Tab. 5.2: 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 operating voltage.
- DGND and AGND are internally electrically connected, but isolated from the minus pole (GND) of the 24 V operating voltage.

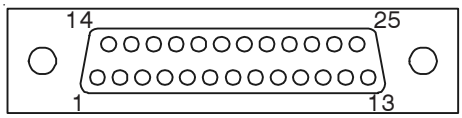


Fig. 5.6: 25-pole. Sub-D male cable connector, view on solder pin side

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 operating voltage or another external auxiliary voltage are provided (see circuit diagram). The switching outputs are protected against overload and reverse connection.
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 operating voltage.

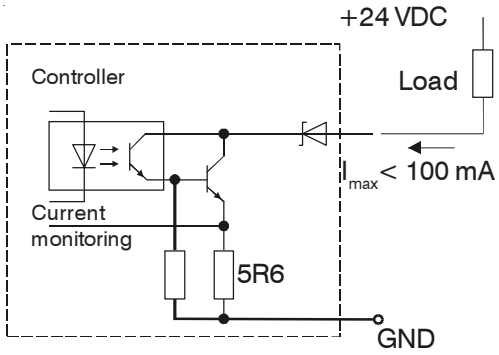


Fig. 5.7a: Circuit diagram for switching output, with external load (e.g. pull-up resistor), see table 5.2 for pin assignment.

Test of the switching outputs
The error and limit outputs can be tested in the service menu, see Chap. 11.3.4. 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 "aktive". Press the "ESC" key to abort the sequence without saving. Then the outputs are deactivated.

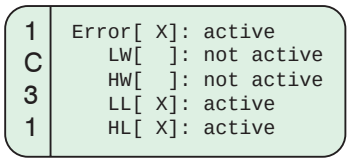


Fig. 5.7b: Test of the switching outputs

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 operating voltage.

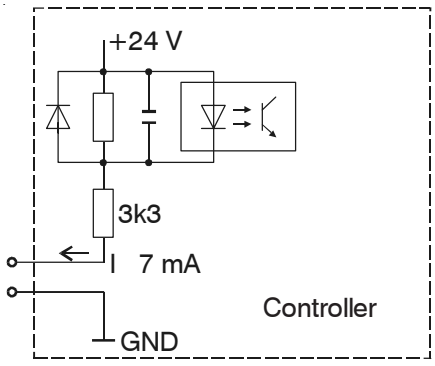


Fig. 5.8: Basic circuit for switching inputs

5.8 Synchronal Signal Input

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

R_{ext} $(U_{HIGH} - U_F - (I_{LED} * 100\ Ohm)) / I_{LED}$

Example: U_{HIGH} 3.3 V
I_{LED} 15 mA
U_F 1 V
R_{ext} 53.3 Ohm, so 56 Ohm

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

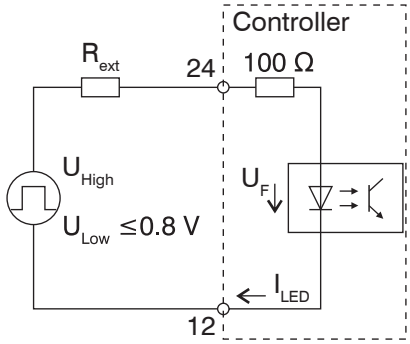


Fig. 5.9: Circuit synchronal signal input, 25-pol. Sub-D

6. Operation

6.1 Putting into Operation

Before the system is put into operation, the light source and receiver must be connected to the controller (refer to Fig. 3.5 for the connector arrangement) and all connectors secured with the screw connections.

Switch on downstream computers.

Switch on the 24 VDC operating 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.

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

WARNING!

During the operation, i.e. with the operating voltage switched on, the light source and receiver must not be unplugged.

6.2 Menu Structure

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

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, threshold adjustment)
- Service menu

Select measurement program:
- Edge bright - dark
- Edge dark - bright
- Diameter / width
- Gap
- Segment and Multi-segment
- User-defined programs (four max.)

Edit measurement program
- Select segments
  (only for Segment and Multi-segment 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 modus

IMPORTANT!

For stable measurements the system needs a warm-up period of 30 minutes.

6.3 Operating the System

6.3.1 Key Functions

The following functions are assigned to the keypad in Fig. 3.3:

▲ ▼	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	+13.2345
	Full Display: Indication of the momentary value, peak-peak value (P-P), minimum and maximum, measurement programs, limits, measurement modus	MULTISEG UT A S1 mm +13.2345 NORMAL P-P Min Max 0.0032 +13.2320 +13.2352
Menu mode Yellow light emitting diode flashes.	**Menu Display:** Display of the menu number (left), menu name and any settings parameters.	3 2 1 0 offset Display +00.0000 mm

IMPORTANT!

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

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.

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 number 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 operating 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:

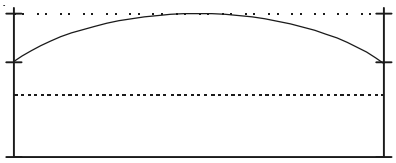


Fig. 6.1: Video signal (correct).

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:

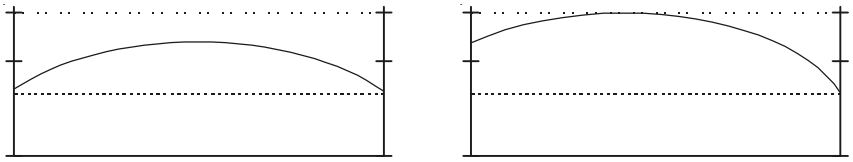


Fig. 6.2: Video signal (maladjusted)

An optimum video signal, as in Fig. 6.1, should be able to be obtained by appropriately moving and tilting the light source and receiver within the permitted tolerances (see Fig. 5.4). 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.

IMPORTANT!

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).

6.3.5 Options

The set parameters apply independently of the selected measurement program. The standard options can be found in the annex under "Option data".
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 Tab. 6.1).

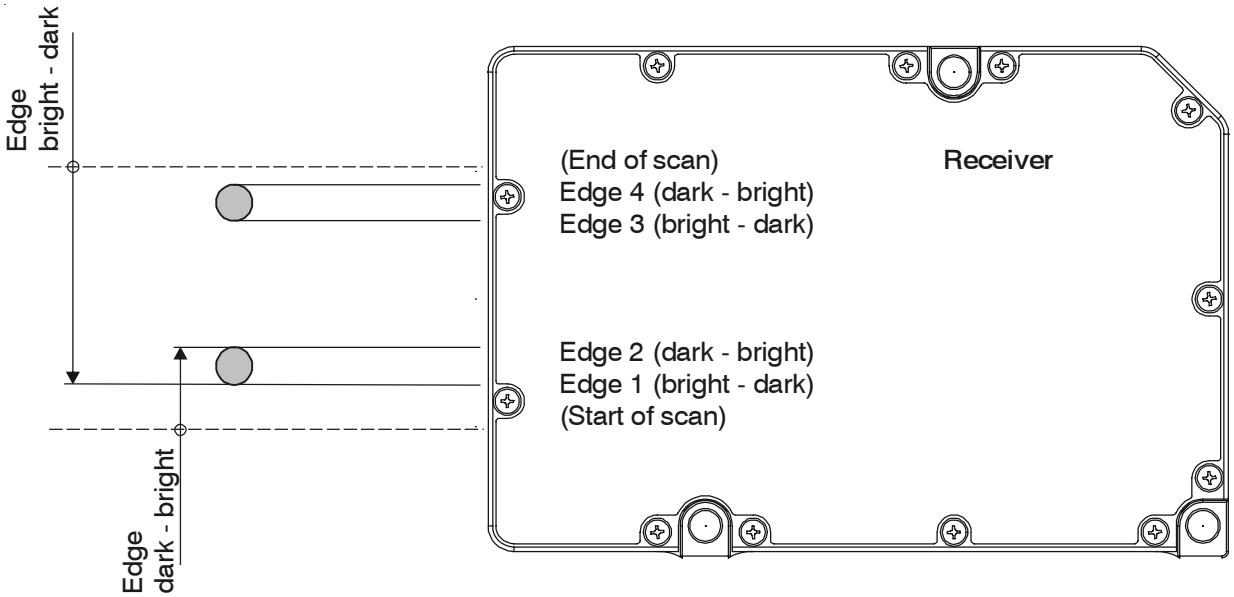


Fig. 6.3: Definition of terms for measurement program edge

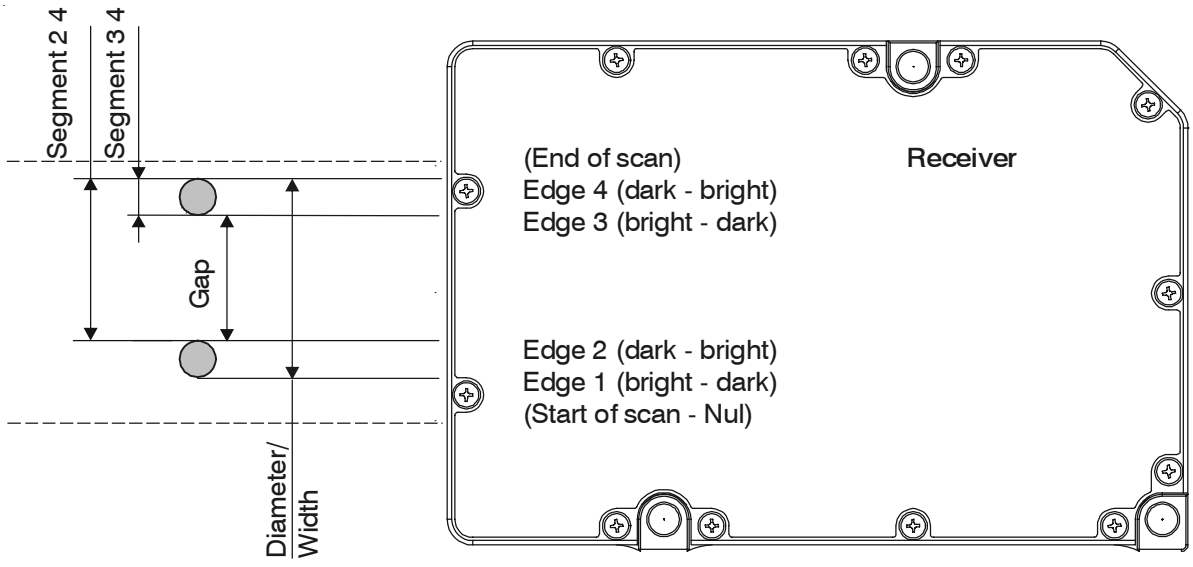
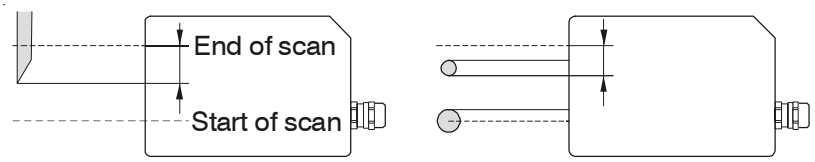
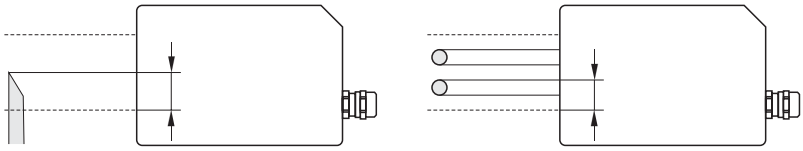


Fig. 6.4: Definition of terms for measurement programs segment, gap, diameter and width

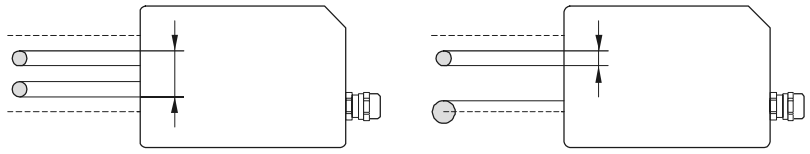
Edge bright - dark (EDGEHL)
Factory setting.
Measurement between first bright-dark edge and end of scan.



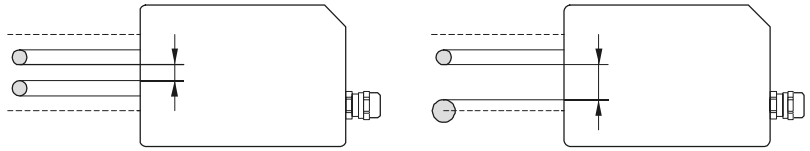
Edge dark - bright (EDGELH)
Measurement between start of scan and first dark-bright edge.



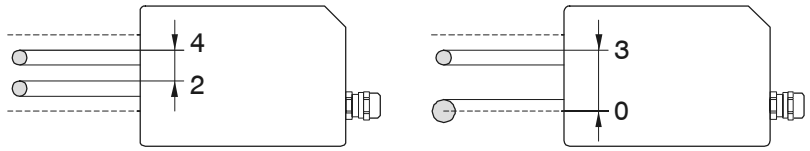
Diameter/width: (DIA)
Measurement between the first bright-dark edge and last dark-bright edge.



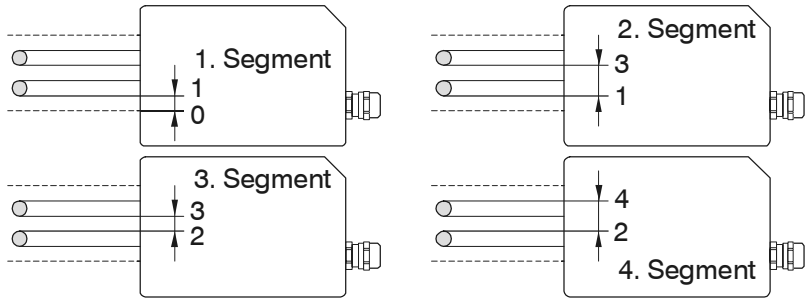
Gap: (GAP)
Measurement between first dark-bright edge and the following edge.



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!



Tab. 6.1: Measurement programs (standard programs).
See Chap. 11.3.5 for further details.

6.3.7 Edit Measurement Program (user-specific programs)

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

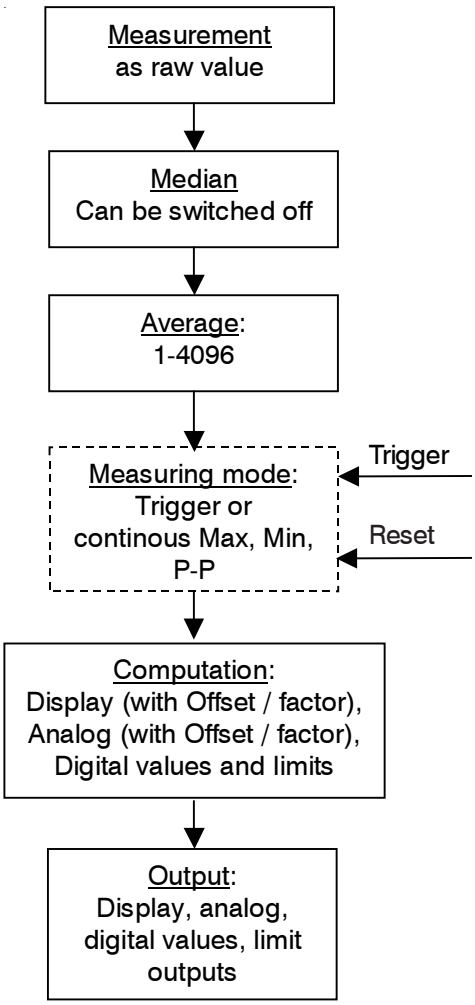


Fig. 6.4: Measurement flow

IMPORTANT!

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.

Note: 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.

Note: In the operating menu "Options" you will find in Menu 1900 "Clear user data options + program" which, after a confirmation query (1910) clears all user-specific 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).

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.

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.

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

IMPORTANT!

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.

IMPORTANT!

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

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 user-specific names. Each measurement program can save its own master value.

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).

For the long-term saving of the single-point calibration, also after the operating 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.

IMPORTANT!

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

IMPORTANT!

Mastering and resetting are only possible together with the target.

IMPORTANT!

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.

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.
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.

IMPORTANT!
In the “Multi-segment” measurement program the analog output remains switched off at 0 V.

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“.

IMPORTANT!
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 7.000 mm
d_l 8.005 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”).

Abbrev.	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

Tab. 6.2: 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 11.3.6.

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 11.3.6.

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 6.3. The selection is made in the operating menu (see Chap. 11.3.7).

Measurement mode	Remarks	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

Tab. 6.3: 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

Tab. 6.4: 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.

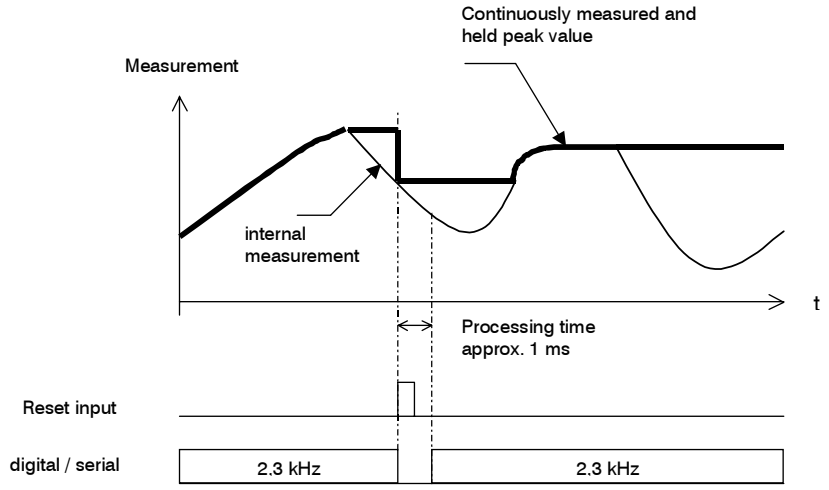
The entered limits always relate to the measurement signal which is present after the trigger mode evaluation. The trigger and reset pulses can also be controlled via the serial interface. The normal measurement mode is set with the following values:

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

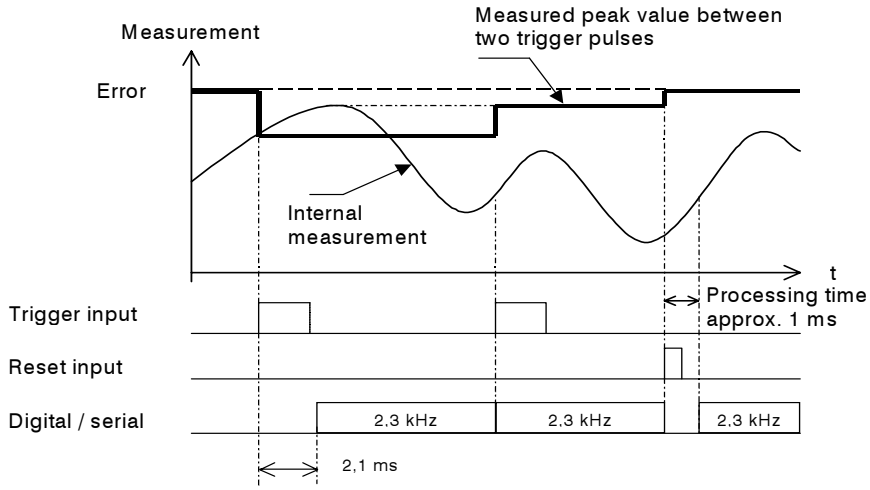
Tab. 6.5: Settings for the measurement mode selection "NORMAL"

IMPORTANT!

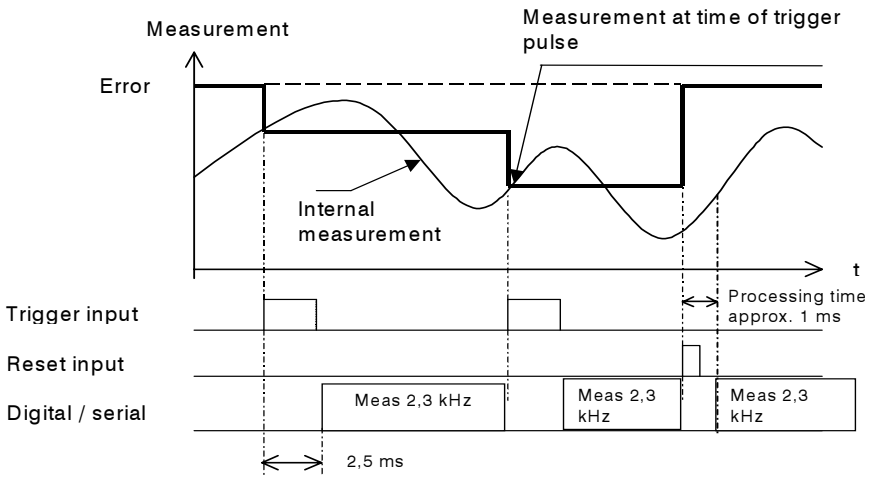
If the optoCONTROL is in the trigger mode, then the light source cannot be switched off!



Example:
Maximum, continuous



Example:
Maximum, triggered



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:

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

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:

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

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.

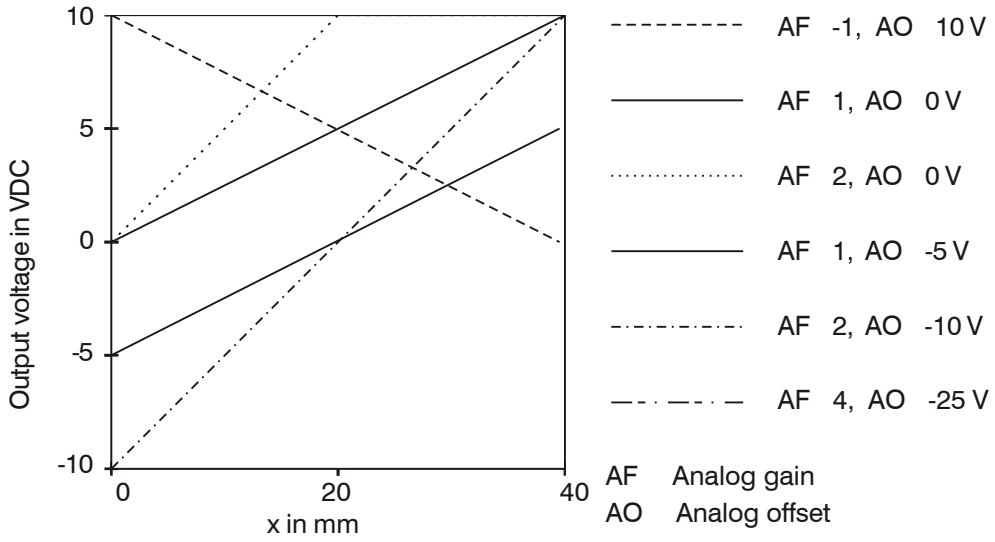


Fig. 6.5: Analog scaling of output characteristics

IMPORTANT!

Zero-setting (see Chap. 6.3.7.1) and mastering (see Chap. 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.

IMPORTANT!

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

Notes:

With input resistances less then 1MOhm 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.

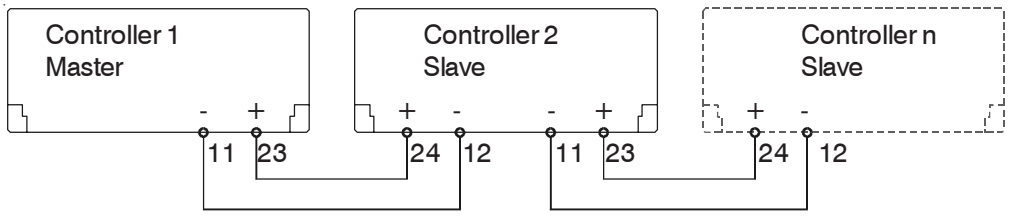
6.4.3 Error Handling

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. Screened leads are preferred for the synchronization.



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

Fig. 6.6: Synchronization of controllers

The synchronizing signal of the optoCONTROL2600 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 optoCONTROL2600 only. The synchronal 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.

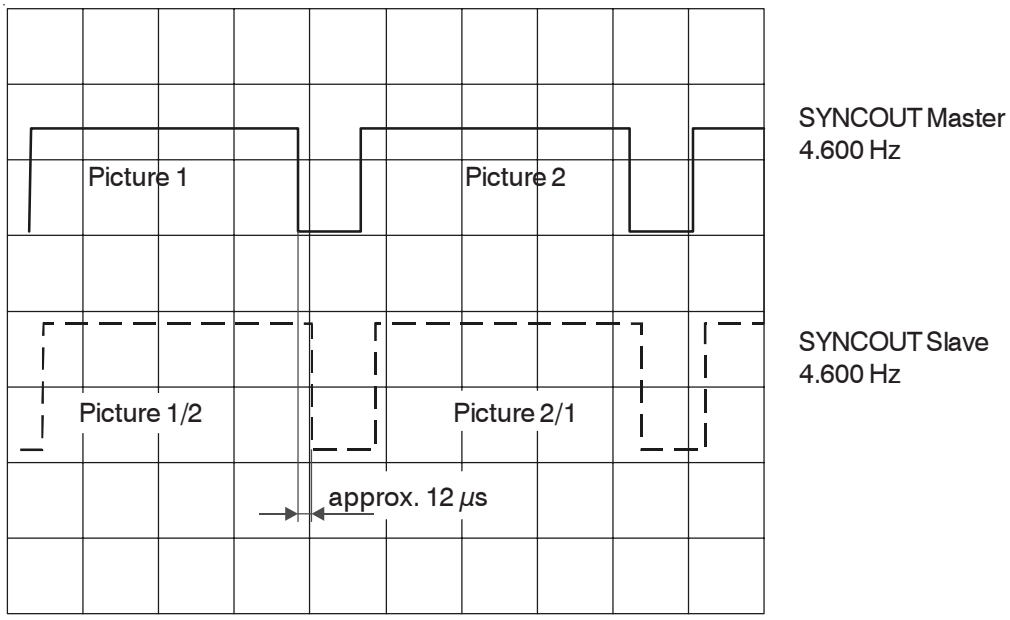


Fig. 6.7: Time offset through synchronizing signal

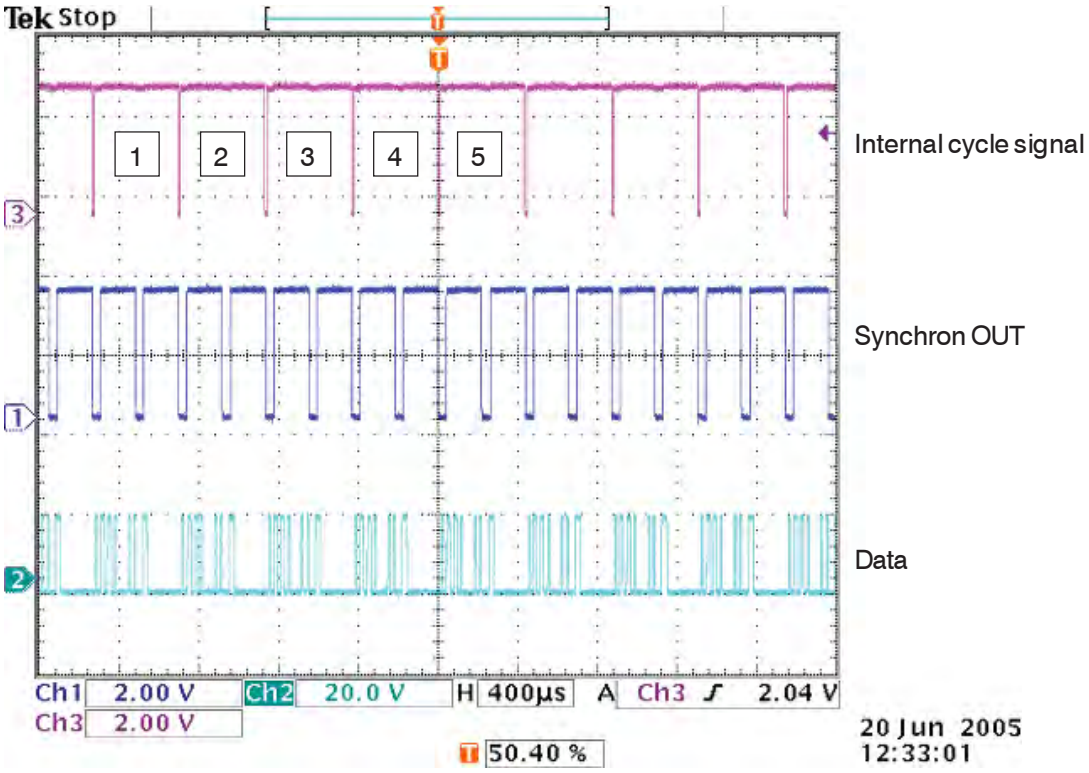


Fig. 6.8: Time response controller

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 Table 6.6:

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)

Tab. 6.6: Baud rates and measuring rates

RS232
Baud rate: 9.6 to 115.2 kBaud, selectable via menu "**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,2)

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. 6.9: 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. 6.10: Reception

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

Tab. 6.7: Measurement allocation for "Multi-segment" operating mode

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

Fig. 6.11: Result of conversion (digital value DV)

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

MW (mm)	DW * 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. 6.12: Structure of a 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.

Note: The controller processes the data in the “*Little Endian Format*”.

Example:
The 32-bit command word “INFO” 0x 0000 2011 has two contents:
First part 0x2011 : Command 16 bit variable in the controller
Second part 0x0000 : Length 16 bit variable in the controller

Important:
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

Note: Byte-by-byte reading and out from left to right.

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.

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 from 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 "Trigger mode": 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

Tab. 6.8: Overview of the ODC 2500 commands

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 eror+ 4 bytes errorcode
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

ArticleNumber:	'98765432'	ASCII - 8 Byte
SerialNumber:	' 1234567'	ASCII - 8 Byte
Option:	'000 '	ASCII - 8 Byte
Messbereich [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

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

Stop-Kommando

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

Note: "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.

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	0x02	0x00	0x0002A001	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

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
"0"	"D"	"C"	"1"	0x3143444F	
0x23	0xA0	0x03	0x00	0x0003A023	Without error
0x00	0x00	0x00	0x00	0x00000000	Error code

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.

Note: 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

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

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

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

Respose:

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 %
Reserve2	Binary - 0x0000	
Active Interface	Binary - 0x0001	RS232
RS232 Baudr ate	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

MICRO-EPSILON

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 Type	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 char	8	20 ... 90	20 ... 90 %
Contrast	Binary unsigned char	8	0 ... 100	0 ... 100 %

Tab. 6.9: Option data record

Description	Format Type	Bits	Valid values	Remark
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 transmission	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.	

Tab. 6.9: Option data record (continued)

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

Important: If an error occurs, the data is not accepted!

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 code:
0x00000006 Flash - access error

Read measurement program data

Name: RD MPR RAM
Description: With this command the currently valid measurement program data is read out of the main memory.

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	
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	Binär - 0x0000	
Measurement mode	Binär - 0x0000	NORMAL
Median	Binär - 0x0003	over 3 values
Number of averages	Binär - 0x0001	1
Reserve 2	Binär - 0x0000	
Measurement program	Binär - 0x0001	Edge HL
Number of segments	Binär - 0x0001	Edge HL, LH, Diameter, Gap
Front edge for Segmentt 1+2	Binär - 0x0000	
Front edge for Segmentt 3+4	Binär - 0x0000	
Reserve 4	Binär - 0x0000	
Reserve 5	Binär - 0x0000	
Rear edge for Segment 1+2	Binär - 0x0000	
Rear edge for Segment 3+4	Binär - 0x0000	
Reserve 7	Binär - 0x0000	
Reserve 8	Binär - 0x0000	
Place-holder	Binär - 0x0000...0xFFFF	
Master value	Binär - 0x00000000	0.0 mm

Tab. 6.10: Measurement program data

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	0x0F	0x00	0x000F2028

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 iare 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

Tab. 6.11: Measurement program data record

Description	Format Type	Bits	Valid values	Remark
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 for 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		
Reserve	Binary unsigned short	16	0 ... 80 0 ... 80	
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		
Reserve	Binary unsigned short	16	0 ... 80 0 ... 80	
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

Tab. 6.11: 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

Possible errors:

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

Important: If an error occurs, the data is not accepted!

Save measurement program data

Name: SAVE MPR RAM TO FLASH
Beschreibung: 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	Erro code

Possible errors:
0x00000006 Flash - access error

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

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Bemerkung
"O"	"D"	"C"	"1"	0x3143444F	
0x2B	0xA0	0x03	0x00	0x0003A02B	ohne Fehler
0x00	0x00	0x00	0x00	0x00000000	Fehlercode

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

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

Note: 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

Activating light reference tuning

Name: SET LIGHT REFERENCE TUNING
Description: Activates light reference tuning, detection and use of a flexible 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

Note: This command corresponds to the menu "1B20 - Light Reference Tuning"

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Bemerkung
"O"	"D"	"C"	"1"	0x3143444F	
0x2D	0xA0	0x03	0x00	0x0003A02D	ohne Fehler
0x00	0x00	0x00	0x00	0x00000000	Fehlercode

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

Reset 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
0x2E	0x20	0x00	0x00	0x0000202E

Note: This command corresponds to the menu "1B30 - Reset Light Reference Tuning"

Response:

Byte 1	Byte 2	Byte 3	Byte 4	hex	Bemerkung
"O"	"D"	"C"	"1"	0x3143444F	
0x2E	0xA0	0x03	0x00	0x0003A02E	ohne Fehler
0x00	0x00	0x00	0x00	0x00000000	Fehlercode

6.4.4 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 2500 operates internally in **five 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) are carried out.

5. **Output**: Output via the analog and digital interfaces, activation of limit switching functions.

Each cycle takes about 435 µs (1 / measuring rate).

After five 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 Tab. 6.12). 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

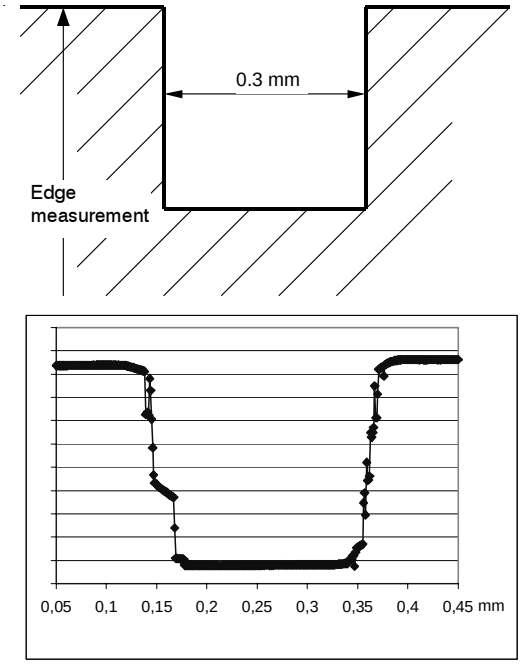
Tab. 6.12: Internal cycles in the ODC controller

6.8 Error Effects

6.8.1 Error Effects on the Light Beam

Edge changes cause, as can be seen in the above illustration, 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 feely select between which edges the measurement is to be taken.



Edge change (recess in target object)

Output signal of the ODC2600

Region with measurement errors approx. 0.05 mm wide.

Fig. 6.13: 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.

IMPORTANT!

Avoid direct irradiation of extraneous light into the receiving area.

6.8.3 Contamination

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.

For cleaning the protective windows a clean, soft, lint-free cloth and pure alcohol (isopropanol) should be used. Never use normal window cleaning products.

In dusty ambient conditions the receiver and the laser should be continuously subjected to clean (free of dust and oil) compressed air using a normal commercial nozzle.

IMPORTANT!

Use a clean, soft, lint-free cloth and pure alcohol (isopropanol) for cleaning the protective windows. Never use normal window cleaning agents.

6.8.4 Transparent Target Objects

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" on Chap. 11.3.3, “1B10 – Selection of the edge detection threshold”.

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 also Chap. 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.

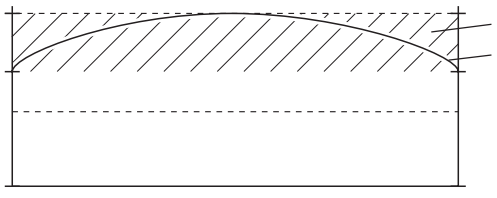
Use the video signal, see menu "Video, 1B00" to evaluate the light intensity. Without a measurement object the video signal should be arranged within the marked area.

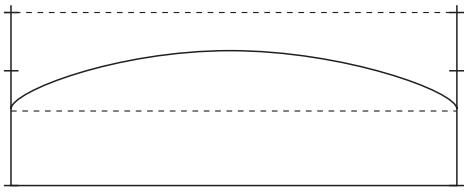
Check wether the intensity is reduced by
- pollution,
- incorrect adjustment of the light source and receiver (for free arrangement without mounting rails).

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:

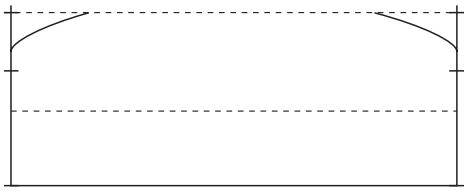




Video signal too low

Fixed threshold for edge detection

Increase the light intensity



Video signal too high

Decrease light intensity

The following steps are recommended:

1. Exit the menu "Video". Press the key "ESC".
2. Press the arrow key ▼ (Down). The "service" menu appears as the last item in the options menu..
3. Press the key ↵ twice to adjust the light intensity.
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. The adjustment may be repeated several times until the video curve shows the desired result.

7a. Confirm and save your settings with ↵.

7b. 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.

```
1
C          Art, Vers.
1     Boot: STD  1004
1     ARM : STD  1014
      DSP : TLZ  1016
```

Press the ↵ or „ESC“ key to leave the menu..

7. Accessories

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

- **PS2010** Power supply unit 24 VDC (for mounting on DIN top-hat rails)
- **PC2500-3** or -10 Power supply cable, 3 or 10 m long
- **CE1800-3** or -8 Sensor cable extension 3 m or 8 m for receiver
- **CE2500-3** or -8 Sensor cable extension 3 m or 8 m for light source
- **SCA2500-3**, Signal output cable 3 m for analog and switching outputs
- **SCD2500-3/10/ RS422**, Signal output cable 3 m for analog and switching outputs and 10 m long for RS422
- **SCD2500-3/3/ RS232**, Signal output cable 3 m for analog and switching outputs and 3 m long for RS232
- **SCD2500-x/CSP**, Power output cable to connect a CSP2800 universal controller
- **IF2008** Interface Card for maximum of four channels RS422, PCI bus

8. Warranty

All components of the device have been checked and tested for perfect function in the factory.

In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON Eltrotec GmbH.

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

This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties. No other claims, except as warranted, are accepted. The terms of the purchasing contract apply in full.

MICRO-EPSILON Eltrotec GmbH will specifically not be responsible for eventual consequential damages.

MICRO-EPSILON Eltrotec GmbH always strives to supply the customers with the finest and most advanced equipment. Development and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved.

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

IMPORTANT!

The housing of the receiver and laser may only be opened by the manufacturer.

For repairs and service the sensor must always be sent to the manufacturer.

9. Service, Repair

In the event of a defect in the controller, light source, receiver or the sensor cable, the whole system must be sent back for repair or replacement.

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

MICRO-EPSILON Eltrotec GmbH
Heinkelstraße 2
73066 Uhingen / Germany

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

10. Decommissioning, Disposal

- Disconnect the power supply and output cable on the controller.
- Disconnect the sensor cable between light source, receiver and controller.

The optoCONTROL2600 is produced according to the directive 2011/65/EU (“RoHS“).

The disposal is done according to the legal regulations (see directive 2002/96/EC).

11. Annex

11.1 Factory settings

			On delivery	Customer
1000	Optionen			
	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 programafter Power ON		Standard edge bright - dark	

11.2 Interface and Software Support

An ODC2600 controller is connected to the IF2008A PCI interface card from MICRO-EPSILON Eltrotec GmbH via the SCD2500-3/IF2008 signal and output cable to the socket X1 (Sensor 1).

A second ODC2600 can be plugged to the X2 socket (Sensor 3).
For the connection of more than two ODC2600 sensors to one IF2008 you require a Y adapter cable from MICRO-EPSILON Eltrotec GmbH.

The interface parameters on the ODC2600 must be set to the active RS422 interface and the following standard settings made:
Baud rate: 691200 Baud
Data format: 8 data bits, no parity, 1 stop bit (8,N,1)

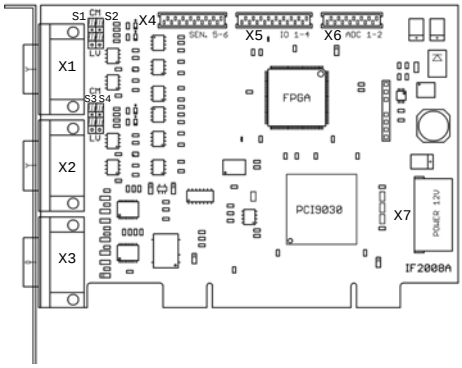


Fig. 11.1: View IF2008A

IMPORTANT!

IF2008A requires on X7 an external supply voltage through PC

The designations "Sensors 1 and 3" refer to the terminology of the driver software "**MEDAQlib** " and the measurement acquisition software "**ICONNECT**" from Micro-Epsilon Eltrotec GmbH.

The Micro-Epsilon Eltrotec GmbH Data Acquisition Library offers you a high level interface library to access the micrometer from your Windows application in combination with
- IF2008A PCI interface card and SCD2500-3/IF2008 cable into an existing or a customized PC software. Or
- RS422/USB converter (optional accessory) and a suitable PC1700-x/USB/IND cable

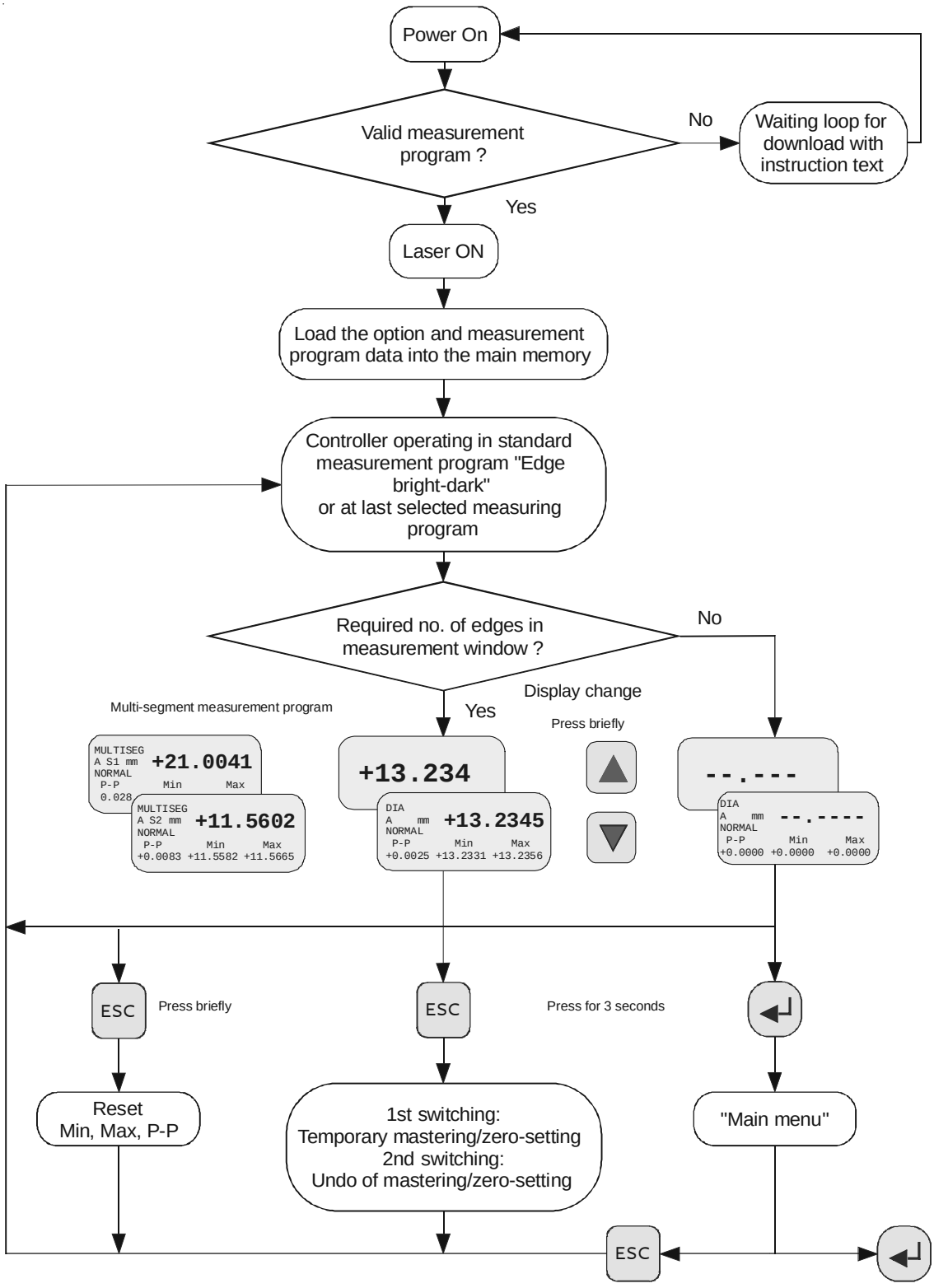
You need no knowledge about the sensor protocol to communicate with the individual sensors. The individual commands and parameters for the sensor to be addressed will be set with abstract functions. MEDAQLib translates the abstract functions in comprehensible instructions for the sensor.

MEDAQLib
- is a DLL/LIB usable for C, C++, VB, Delphi and many other Windows programming languages,
- supports functions to talk to the sensor
- hides the details on how to talk to the communication interface (RS232, RS422, USB, TCP)
- hides the details of the sensor protocoll
- converts the incoming data to „expected data values“
- provides a consistent programming interface for all Micro-Epsilon Eltrotec GmbH sensors
- provides many programming examples many different programming languages
- the interface is documented in a large *.pdf file

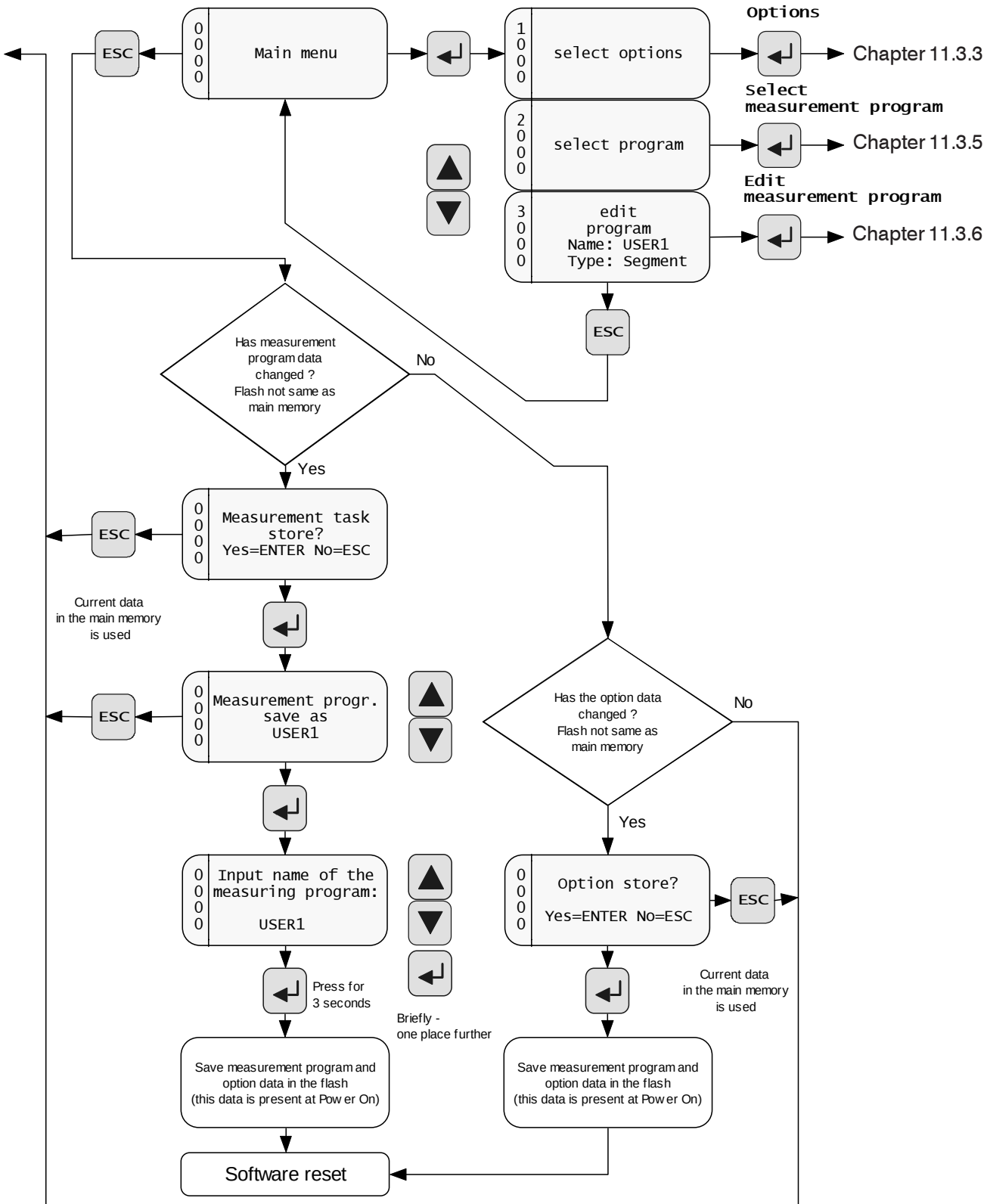
You will find the latest MEDAQLib version at:
www.micro-epsilon.com/download or
www.micro-epsilon.com/link/software/medaqlib

11.3 Operating Menu

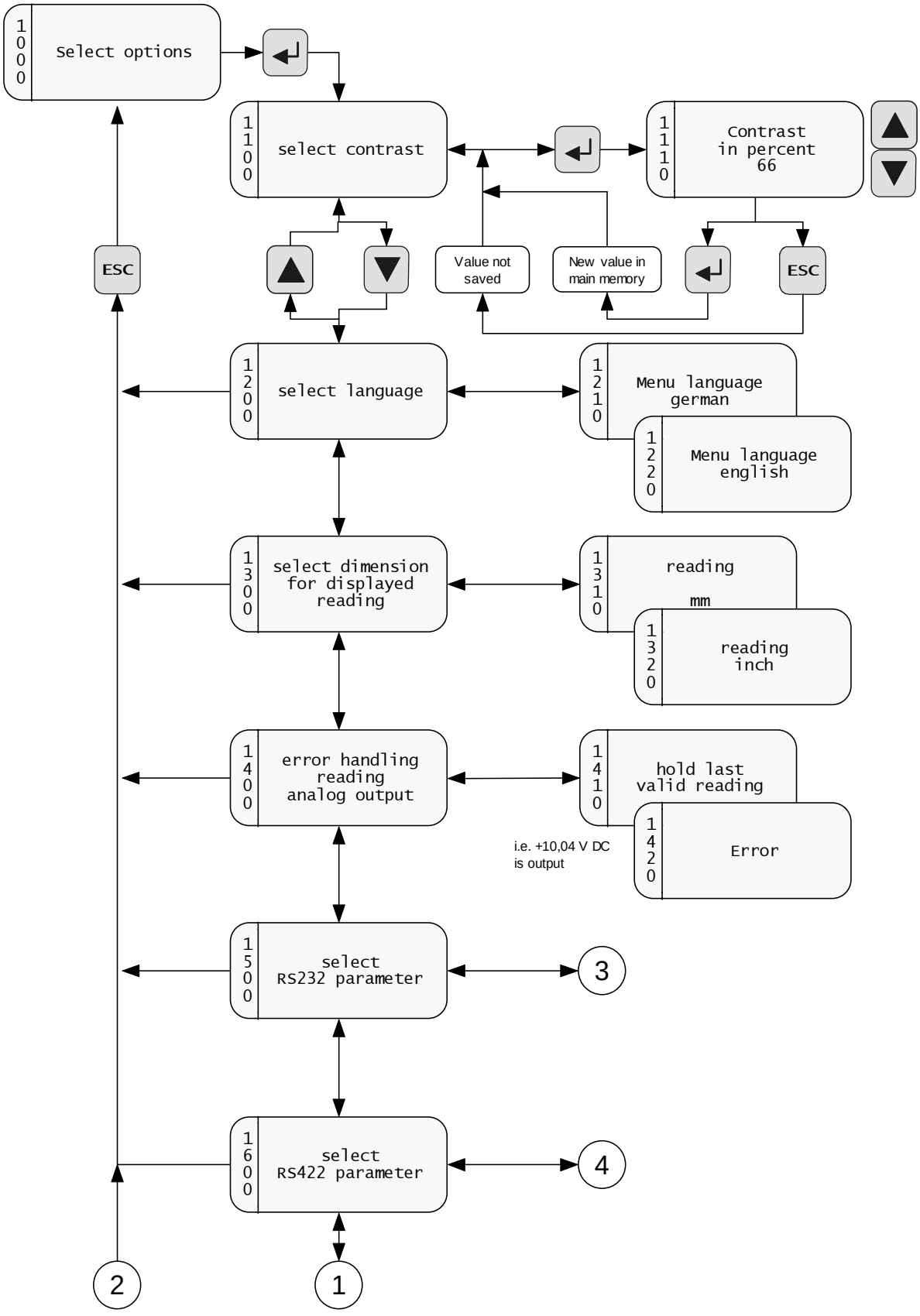
11.3.1 Initialization and Operation in the Measurement mode



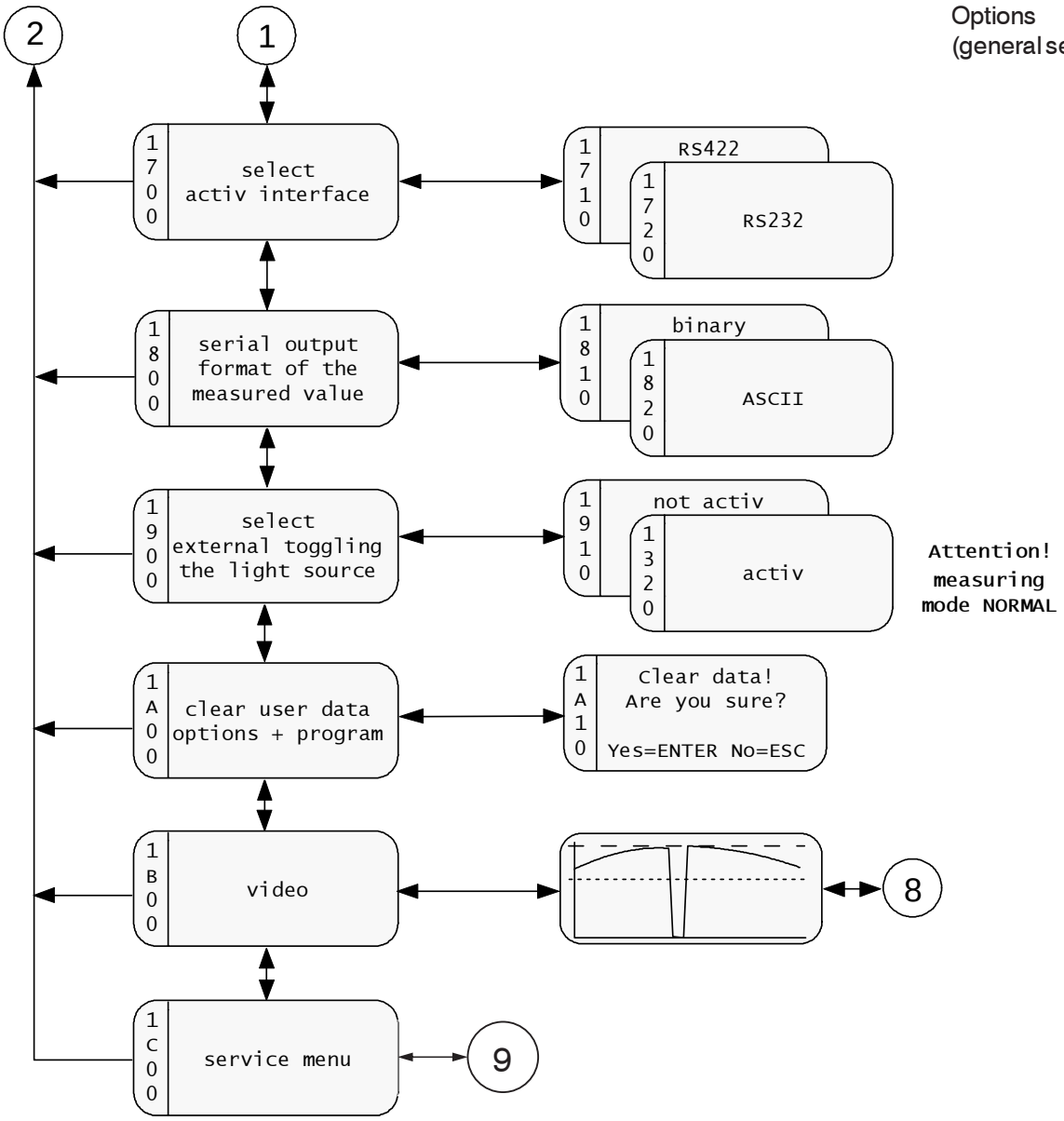
11.3.2 Dialog and Procedure for Saving



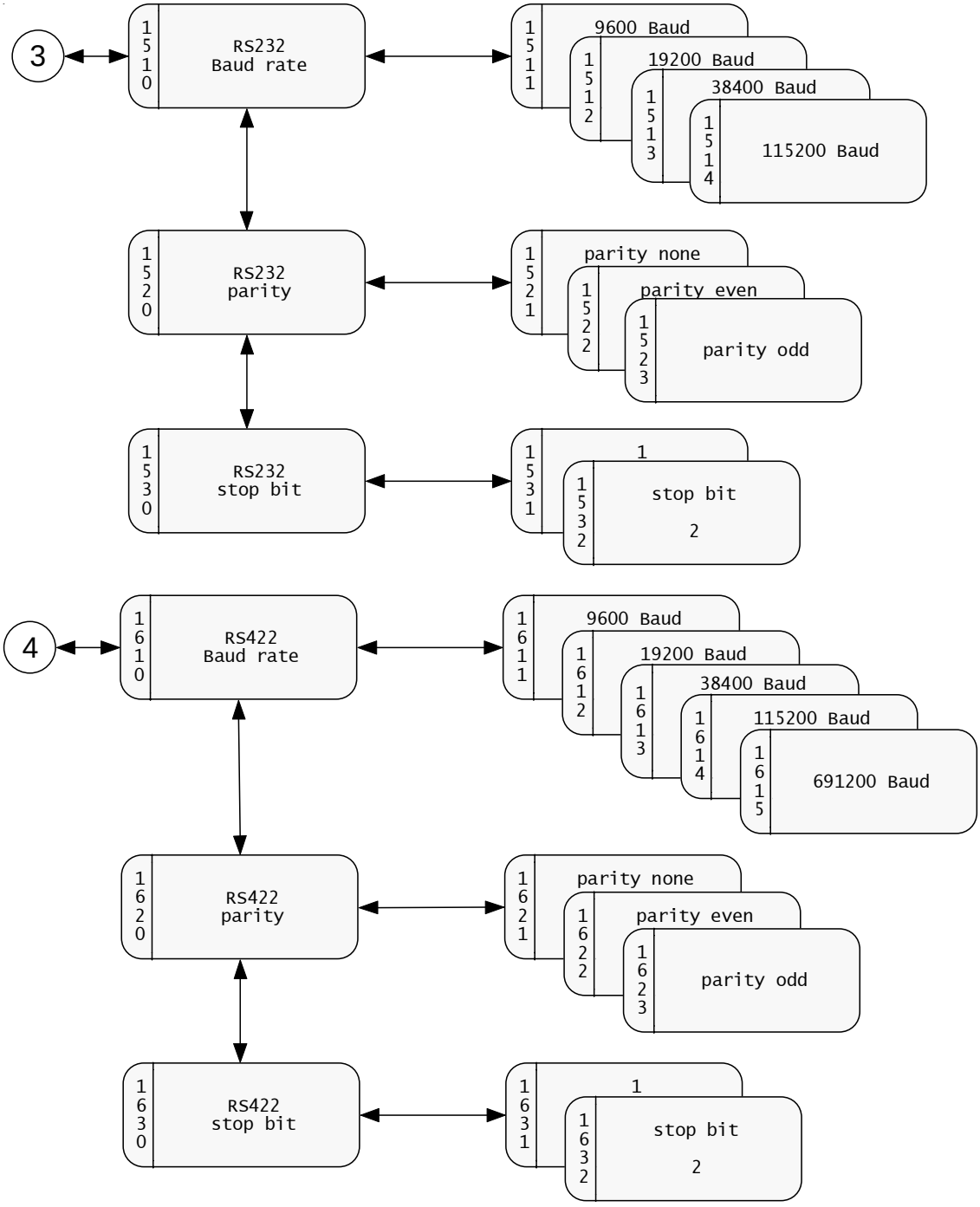
11.3.3 Options (general settings)



Options
(general settings, continued)

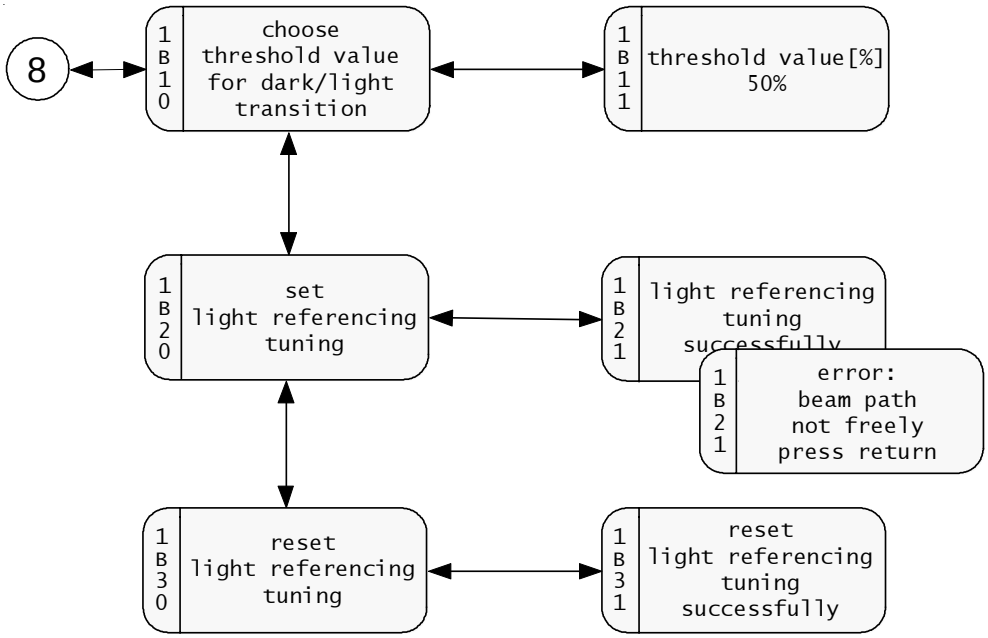


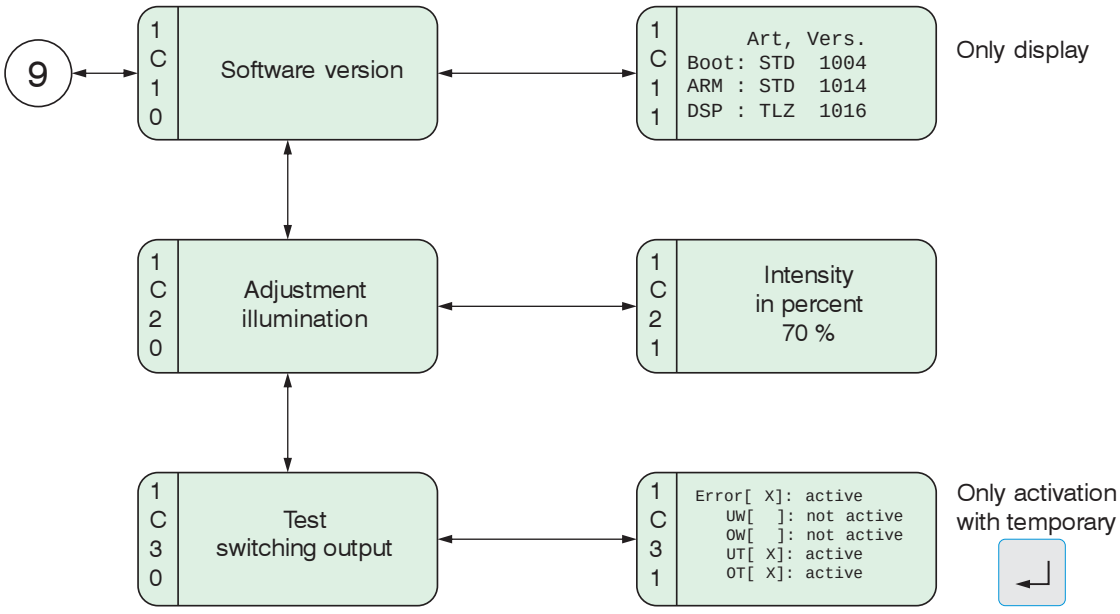
11.3.4 Options (interface)



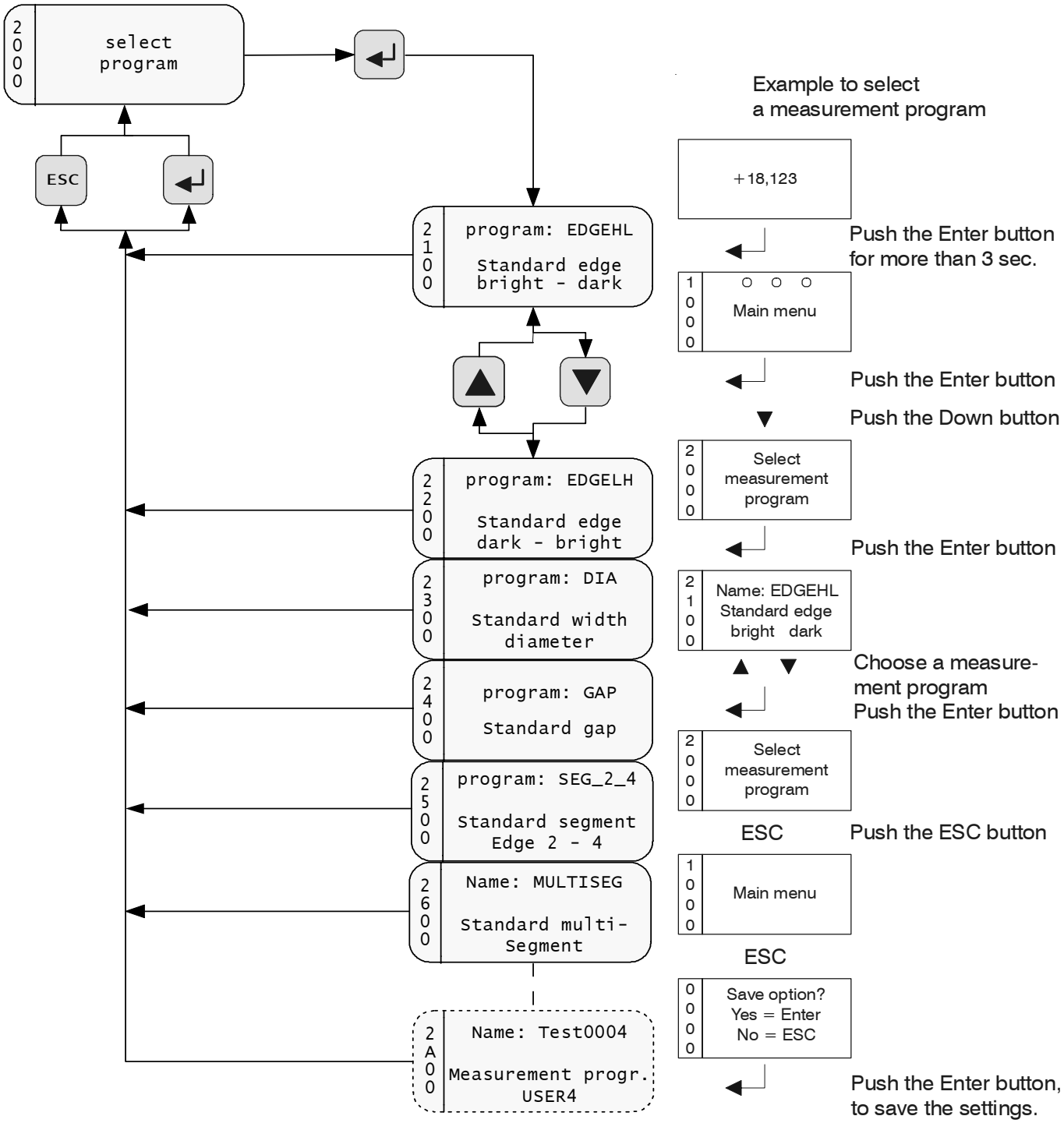
The parameters which can be selected in the options are read out of the option data in the main memory and written back. The user can decide only on quitting the main menu whether the parameters are to be written into the flash memory. The data is then also present after Power ON.

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


8
1B10
choose threshold value for dark/light transition
1B11
threshold value[%]
50%
1B20
set light referencing tuning
1B21
light referencing tuning successfully
1B21
error: beam path not freely press return
1B30
reset light referencing tuning
1B31
reset light referencing tuning successfully

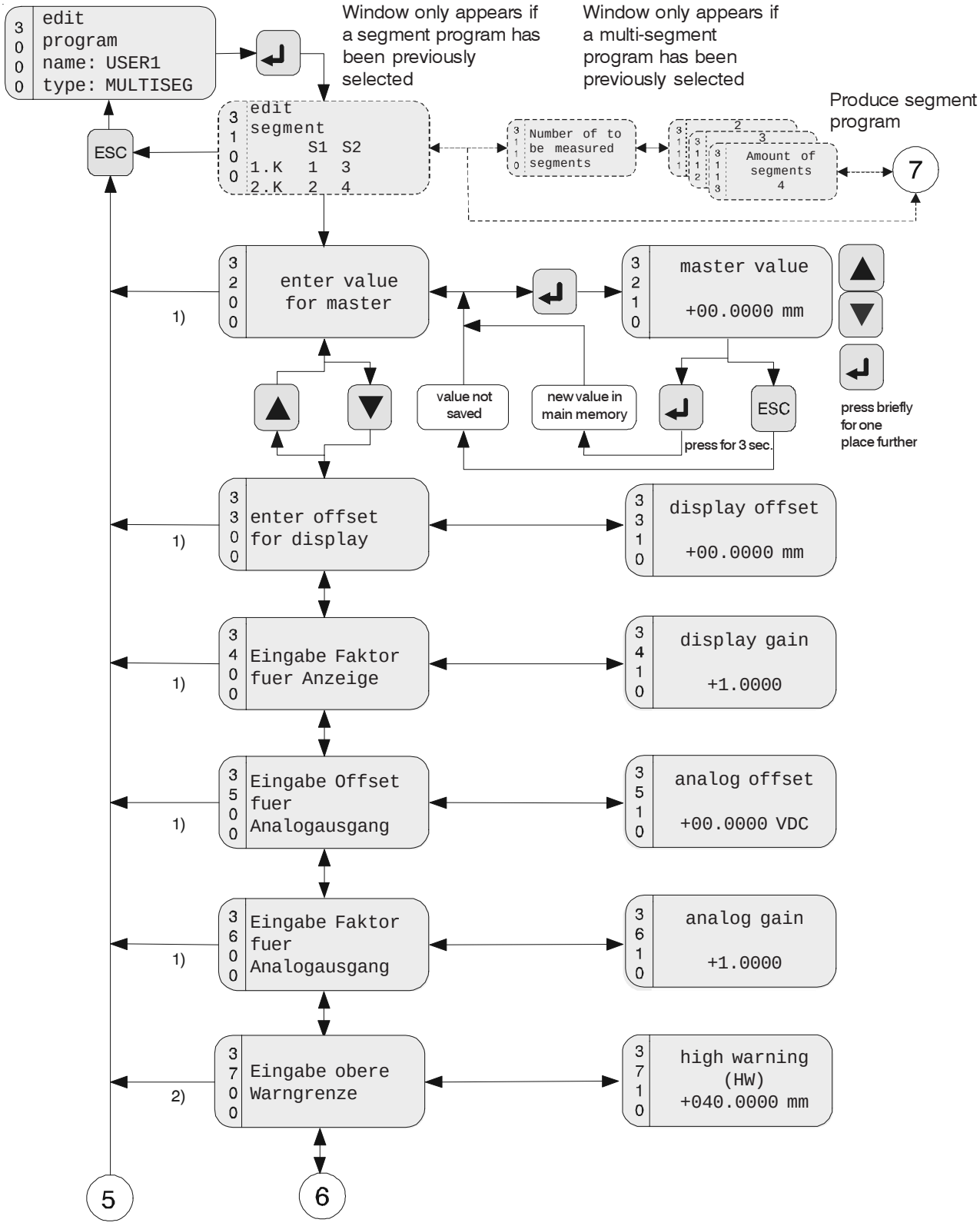

9
1C10
Software version
1C11
Art, Vers.
Boot: STD 1004
ARM : STD 1014
DSP : TLZ 1016
Only display
1C20
Adjustment illumination
1C21
Intensity in percent
70 %
1C30
Test switching output
1C31
Error[X]: active
UW[ ]: not active
OW[ ]: not active
UT[X]: active
OT[X]: active
Only activation with temporary

11.3.5 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

11.3.6 Editing the Measurement Program

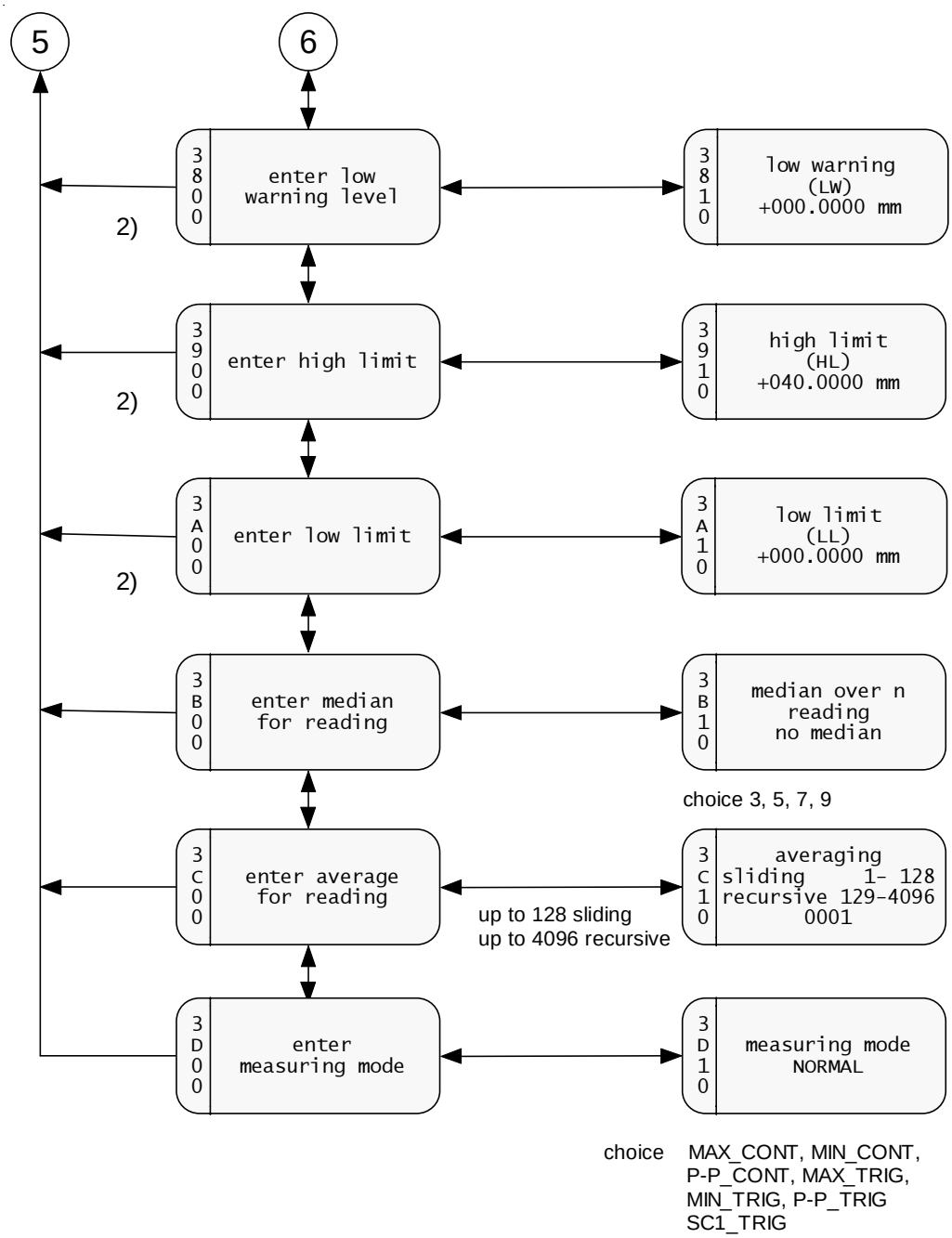


The program selected before is template for editing.

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.

Editing the measurement program (continued)

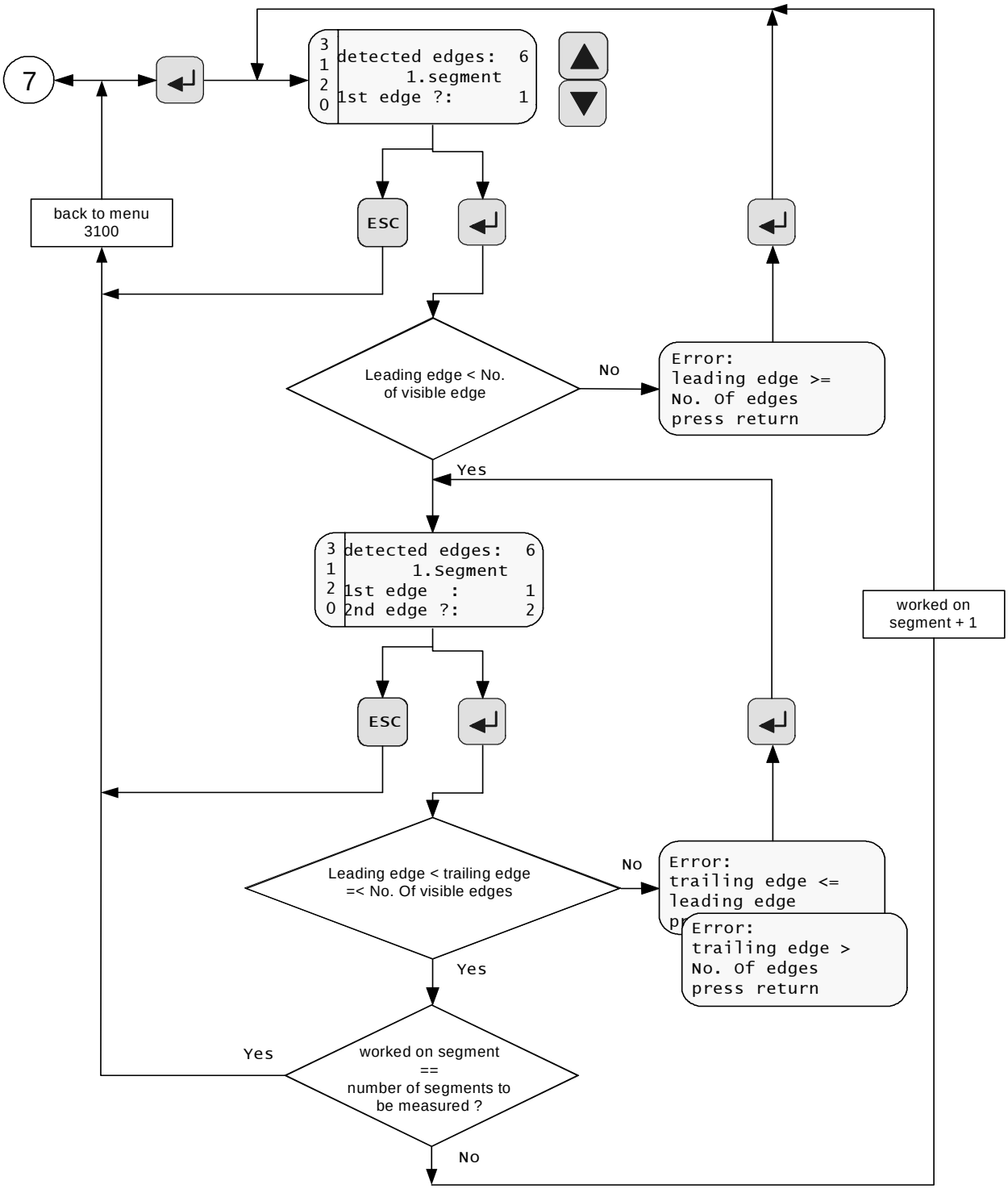


IMPORTANT

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.

Producing a Segment Program

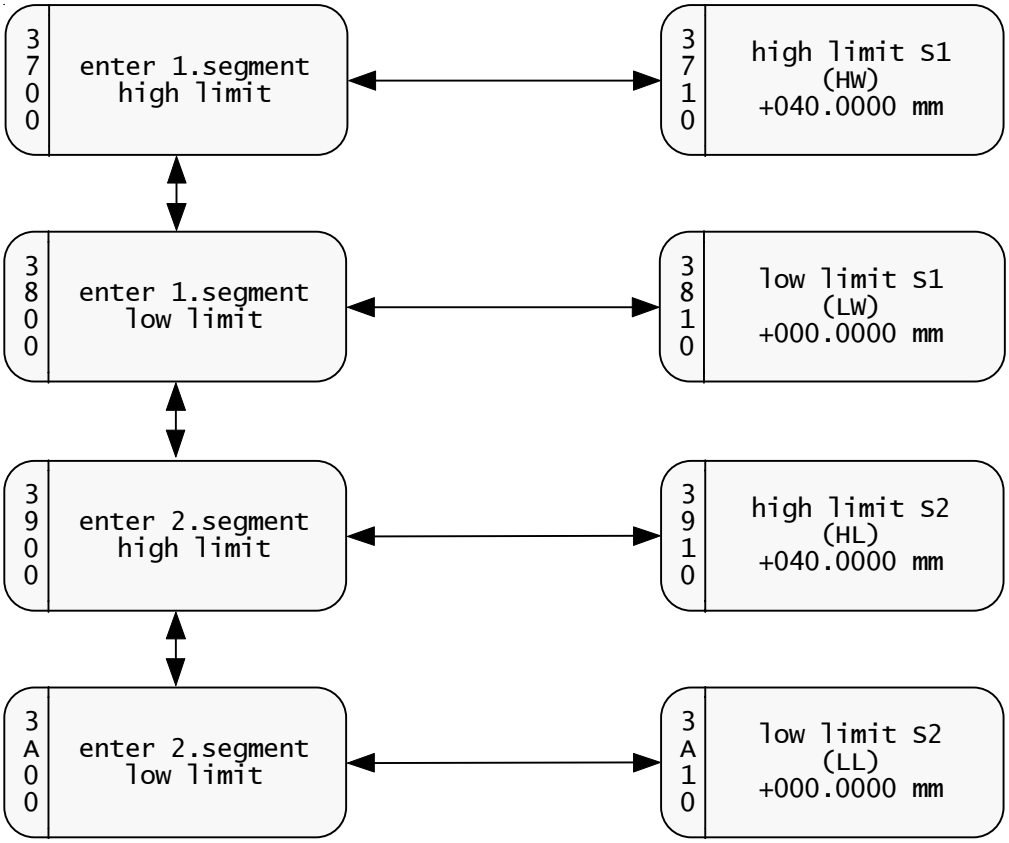


The front edge can also be set equal to zero; then measurement takes place from the zero-point of the receiver.

11.3.7 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, 1st segment
Lower warning level	Lower limit, 1st segment
Higher tolerance limit	Higher limit, 2nd segment
Lower tolerance limit	Lower limit, 2nd segment



11.4 Standard Measurement Program Data for ODC2600-40

			Standard						User			
			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	EDGELH	D A	GAP	SEG_2_4	MULT SEG				
	Segment		1	1	1	1	1	x				
	1	Leading edge						1				
		Trailing edge						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		+1 000	+1 000	+1 000	+1 000	+1 000	+1 000				
	Analog offset		+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC	+00 000 VDC				
	Analog gain		+1 000	+1 000	+1 000	+1 000	+1 000	+1 000				
	Higher warning level (higher WL 1st segment)		+040 000 mm	+040 000 mm	+040 000 mm	+040 000 mm	+040 000 mm	+040 000 mm				
	Lower warning level (lower WL 1st segment)		+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)		+040 000 mm	+040 000 mm	+040 000 mm	+040 000 mm	+040 000 mm	+040 000 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				

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