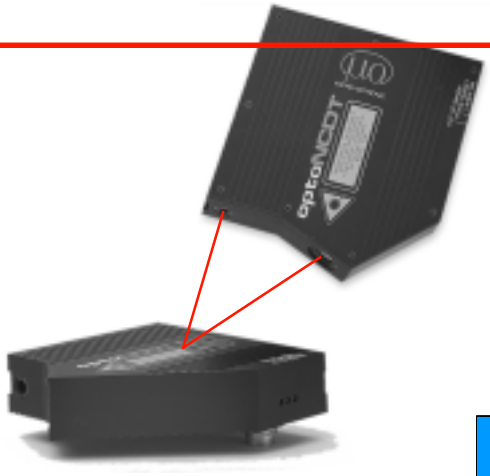
SENSORS & SYSTEMS

Authority in Displacement Measurement

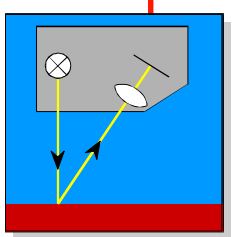
MICRO-EPSILON

INSTRUCTION MANUAL

MICRO EPSILON



Intelligent
Laser-Optical
Displacement
Measurement



Instruction Manual

optoNCDT 2000

MICRO-EPSILON

Contents

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1. Safety

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

1.1 Symbols Used

The following symbols are used in this instruction manual:

DANGER! - imminent danger

WARNING! - potentially dangerous situation

IMPORTANT! - useful tips and information

1.2 Warnings

- Avoid **banging** and **knocking** the sensor and the electronics

  ⇨ Damage to or destruction of the sensor and/or the electronics

- **The power supply** may not exceed the specified limits

  ⇨ Damage to or destruction of the electronics and/or the sensor

- **Power supply** and the **display-/output** device must be connected in accordance with the safety regulations for electrical equipment

  ⇨ Danger of injury
  ⇨ Damage to or destruction of the sensor and/or the electronics

- Protect the **sensor cable** against damage
  ⇨ Destruction of the sensor
  ⇨ failure of the measuring device

- Avoid continuous exposure to **spray** on the sensors and the electronics

  ⇨ Damage to or destruction of the sensor and/or the electronics

1.3 Notes on CE Identification

The following applies to the measuring system series 2000:

EC regulation 89/336/EEC

Products which carry the CE mark satisfy the requirements of the EC regulation EC 89/336/EEC 'Electromagnetic Compatibility' and the European standards (EN) listed therein.
The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

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The system is designed for use in industry and to satisfy the requirements of the standards

- EN 50 081-2 Spurious emission
- EN 50 082-2 Resistance to disturbance

The systems satisfy the requirements if they comply with the regulations described in the operating manual for installation and operation.

The system has been tested according to the following EMC standards:

EN 55 011

Emission of electromagnetic fields	Group1 / Class B
Spurious emission over mains cable	Group1 / Class B

EN 50 082-2

ESD (air and contact discharge)	EN 61000-4-2	Criterion B
Transient disturbance variables (burst)	prEN 61000-4-4	Criterion B
Magnetic fields	EN 61000-4-8	Criterion A
Line-bound disturbance variables	ENV 50141	Criterion A
Electromagnetic RF field	ENV 50140	Criterion A

1.4 Proper Use

- The series 2000 measuring system is designed for use in industrial areas.
- It is used
  - for measuring distance, thickness and displacement
  - to detect the position of components or machine parts
- The measuring system may only be operated within the limits specified in the technical data (chap. 3.1.2).
- 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 sensor and electronics: IP 64 (Only with sensor cable connected)
- Lenses are excluded from protection class. Contamination of the lenses leads to impairment or failure of the function.
- Operating temperature: 0 to +40 °C (+32 to +104 °F)
- Storage temperature: -20 to +70 °C (-4 to +158 °F)
- Humidity: 5 - 95 % (no condensation)
- Pressure: atmospheric pressure
- Vibration: acc. to IEC 68-2-6
- Mechanical schock: acc. to IEC 68-2-27
- EMC: acc. EN 50 081-2 Spurious emission
  EN 50 082-2 Resistance to disturbance

IMPORTANT!

The protection class is limited to water (no penetrating liquids or similar)

Use protective housing if exposed continuously to spray!

2. Laser Class

The ILD 2000-5, 10, 20, 40, 100, and 200 sensors operate with a semiconductor laser with a wavelength of 670 nm (visible/red).

The maximum optical output is 1 mW.

The sensors are classified in laser class 2 (Class II)**.**

During operation of the sensors ILD 2000 the pertinent regulations acc. to EN 60825-1 on “radiation safety of laser equipment” and the German accident prevention regulations for “laser radiation” (VBG 93) must be fully observed at all times.

– As a precaution laser operation must be signalled by means of an audible or optical warning signal.

The following warning label is attached to the cover of the sensor housing:

– Laser operation is indicated by LED (see chap. 7.3).

- Although the laser output is low. Looking directly into the laser beam must be avoided. Due to the visible light beam eye protection is ensured by the natural blink reflex.

The housing of the optical sensors ILD 2000 may only be opened by authorised persons.

For repair and service purposes the sensors must always be sent to the manufacturer.

IMPORTANT!

Opening of the secured housing screws by third parties will void any warranty claim.

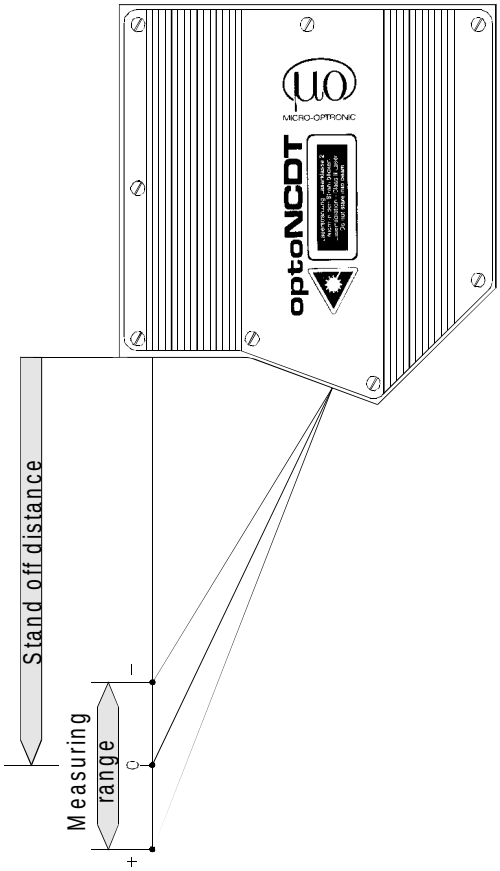
3. Functional Principle, Technical Data

3.1 Position Sensor ILD 2000

3.1.1 Short Description

The sensor type ILD 2000 uses the principle of optical triangulation, i.e. a visible, modulated point of light is projected onto the target surface.

Depending on the distance the diffuse fraction of the reflection of this point of light is then focussed on, to a position sensitive element (CCD-array) by the receiving lens, which is arranged at a certain angle with respect to the optical axis of the laser beam.



From the CCD signal the intensity of the diffuse reflection is determined in real time. This enables the sensor to compensate intensity fluctuations still during processing of a measured-value, which it does in a very wide reflection factor range (from almost complete absorption to almost total reflection).

The early digitisation of the signal ensures a high immunity to interference. Furthermore signal processing by an integral micro-processor makes it possible to adapt the sensor for difficult material surfaces by way of the digital interface. This means that a high linearity is achieved even with material surfaces with little reflection (e.g. black rubber ±0.03% FSO [1]). Output of the measured value is in analog voltage (±5V) and digital (RS485/ 687.5 kBaud) formats at the same time.

LEDs on the sensor indicate an “Out of Range” condition (measuring range exceeded), a “Poor Target” condition (the object cannot be measured due to insufficient reflection), and laser-ON/OFF.

1) Full Scale Output

3.1.2 Technical Data

Modell ILD 2000 -	5	10	20
Measuring range	± 2.5 mm (±0.10)	± 5 mm (±0.20)	± 10 mm (±0.39)
Stand off distance (=midrange)	58 mm (2.28)	58 mm (2.28)	61 mm (2.40)
Non-Linearity 0.03 % FSO (typical)	± 1.5 µm [±0.06]	±3 µm [±0.12]	± 6 µm [±0,24]
Resolution 0.005 % FSO	0,25 µm [0.01]	0,5 µm [0.02]	1 µm [0.04]
Temperature stability [1] of zero 0.002 % FSO/K	± 0.1 µm / K [±0.004 mils/K]	± 0.2 µm / K [±0.008 mils/K]	± 0.4 µm / K [±0.016 mils/K]
Long-term stability [2] ±0.02 % FSO/month (typical)	± 1 µm/mon. [±0.04 mils/mon.]	± 2 µm/mon. [±0.08 mils/mon.]	± 4 µm/mon. [±0.16 mils/mon.]
Light source	Semiconductor laser 670 nm (red) / 1 mW (laser class 2)		
Light spot size (eliptical) SMR EMR	50/95 µm [1.97/3.74] 260/300 µm [10.2/11.8]	40/60 µm [1.57/2.36] 480/860 µm [18.9/33.9]	48/80 µm [1.89/3.15] 930/1630 µm [36.6/64.2]
Angle of spread	39.2 °	39.2 °	39.2 °
Sampling rate	10 kHz		
Angle error at ±30° tilting about the X - or Y-axis	typ. ± 0.5 %		
Angle error at ±15° tilting about the X - or Y-axis	typ. ± 0.14 %		
Permissible incident light directly illuminating a diffusely reflecting target	30 000 l x		
Protection class	IP 64 (with cable connected)		
Electromagnetic Compatibility EMC	acc. EN 50 081-2 and EN 50 082-2		
Operating temperature range	0 °C ... 40 °C (+32 ... +104 °F), with free air circulation		
Storage temperature range	-20 °C ... 70 °C (-4 ... +158 °F)		
Output analog digital	± 5 V /RL > 1 KOhm, Ri = 250 Ohm RS485 / 687.5 kBaud, 16 Bit		
Power supply through accessory power supply unit PS 2000-24 or Interface-cards IFPS 2001 / 2002	4 supply voltages required + 5 Vdc / 500 mA, + 12 Vdc / 250 mA - 12 Vdc / 120 mA, + 24 Vdc / 30 mA		
Weight	500 g (282 dram)		

Legend:

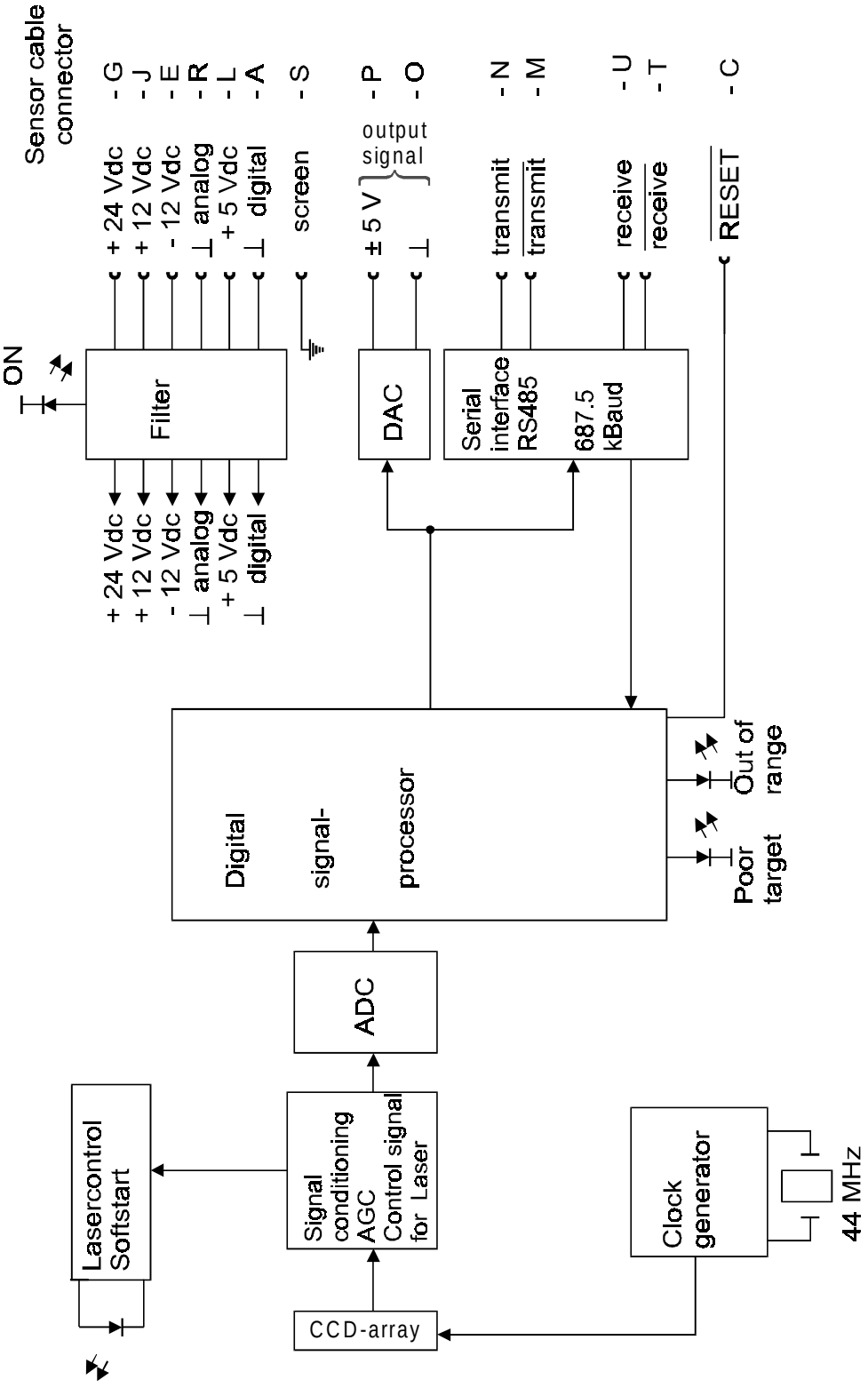
mm / µm
(inches)
[mils]

The specified data apply for a diffusely reflecting matt white ceramic target
1) applies for fixing by the top dovetail guide
2) at 20 °C constant, sensor permanently in operation

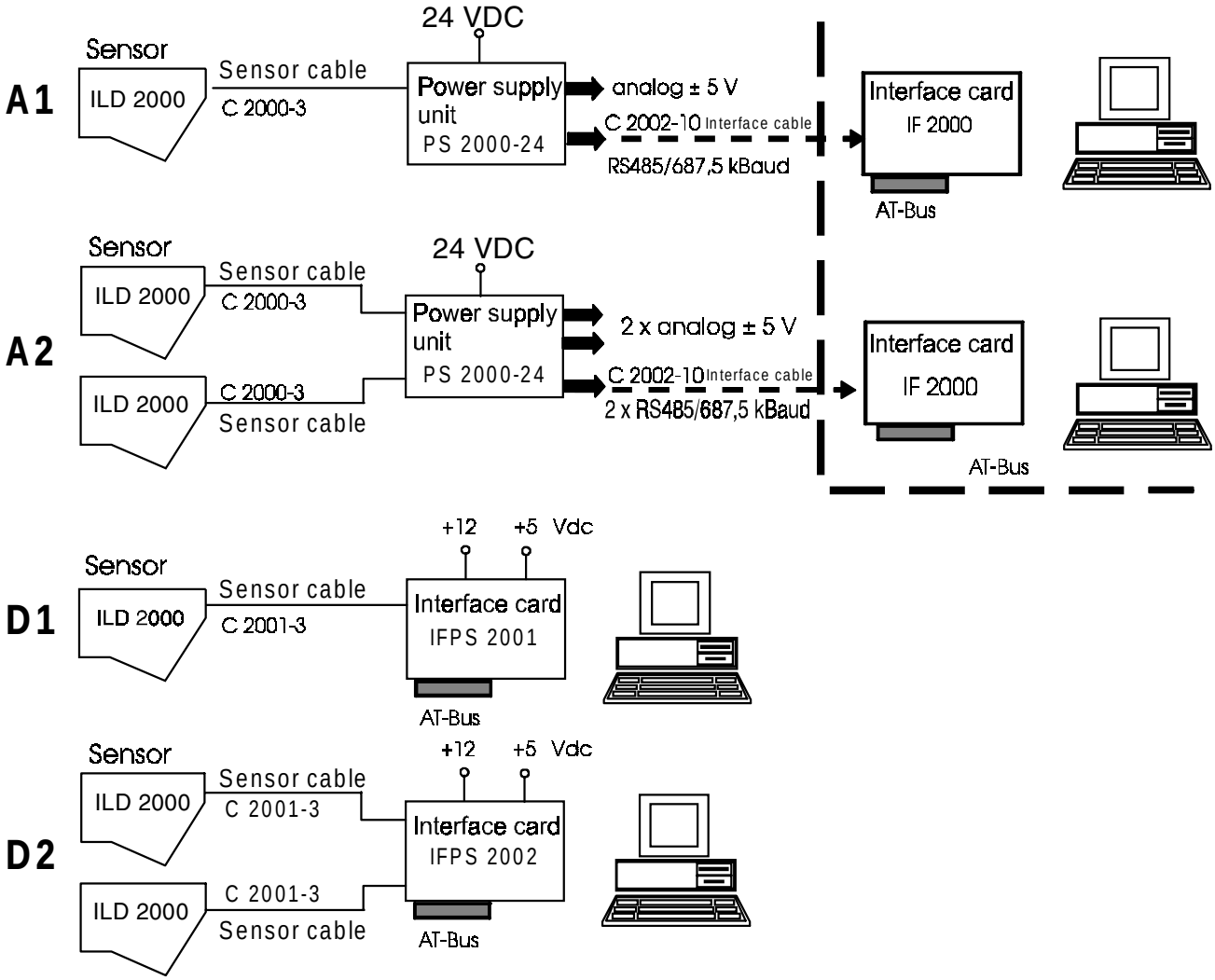
Modell ILD 2000 -	**40**	**100**	**200**
Measuring range	±20 mm (±0.79)	± 50 mm (±1.97)	± 100 mm (±3.94)
Stand off distance (=midrange)	195 mm (7.68)	159 mm (6.26)	228 mm (8.98)
Non-Linearity 0.03 % FSO (typical)	± 12 µm [±0.47]	30 µm [±1.18]	± 60 µm [±2.36]
Resolution 0.005 % FSO	2,5 µm [0.10]	5 µm [0.20]	10 µm [0.39]
Temperature stability [1] of zero 0.002 % FSO/K	± 2 µm / K [±0.08 mils/K]	± 2 µm / K [±0.08 mils/K]	±4 µm / K [±0.16 mils/K]
Long-term stability [2] ±0.02 % FSO/month (typical)	± 10 µm/mon. [±0.39 mils/mon.]	± 20 µm/mon. [±0.79 mils/mon.]	± 40 µm/mon. [±1.57 mils/mon.]
Light source	Semiconductor laser 670 nm (red) / 1 mW (laser class 2)		
Light spot size (eliptical) SMR EMR	0.13/0.23 mm [5.1/9.1] 0.43/0.88 mm [16.9/34.6]	0.19/0.35 mm [7.5/13.8] 1.95/3.80 mm [76.8/149.6]	1.29/2.27 mm [50.8/89.4] 1.46/2.58 mm [57.5/101.6]
Angle of spread	29.3 °	22.4 °	19 °
Sampling rate	10 kHz		
Angle error at ±30° tilting about the X - or Y-axis	typ. ± 0.5 %		
Angle error at ±15° tilting about the X - or Y-axis	typ. ± 0.14 %		
Permissible incident light directly illuminating a diffusely reflecting target	30 000 l x		
Protection class	IP 64 (with cable connected)		
Electromagnetic Compatibility EMC	acc. EN 50 081-2 and EN 50 082-2		
Operating temperature range	0 °C ... 40 °C (+32 ... +104 °F), with free air circulation		
Storage temperature range	-20 °C ... 70 °C (-4 ... 158 °F)		
Output analog digital	± 5 V /RL > 1 KOhm, Ri = 250 Ohm RS485 / 687.5 kBaud, 16 Bit		
Power supply through accessory power supply unit PS 2000-24 or Interface-cards IFPS 2001 / 2002	4 supply voltages required + 5 Vdc / 500 mA, + 12 Vdc / 250 mA - 12 Vdc / 120 mA, + 24 Vdc / 30 mA		
Weight	950 g (536 dram)	600 g (338 dram)	

FSO = Full Scale Output
SMR = start of measuring range
EMR = end of measuring range

3.1.3 Block Diagram ILD 2000



3.1.4 Structure of the Measuring System Options



3.2 Power Supply Unit PS 2000-24

3.2.1 Short Description

The PS 2000-24 power supply unit provides the necessary power to operate max. of 2 sensors of type ILD 2000.

The output signals are provided as voltages in the range ± 5V at the two sockets (analog 1 resp. analog 2).

With the C2002-10 interface cable the digital output can be connected to the IF-2000 interface card in the computer over a standard distance of 10 m (32.81 ft).

3.2.2 Technical Data

IMPORTANT!

To compensate switch-on peaks the 24 VDC power supply must be designed for a current consumption of 2 A.

- **Primary voltages**

  +24 VDC (-15/+20 %)
  Current consumption
  with one sensor: 500 mA (continuos operation)
  with two sensors: 1 A (continuos operation)

- **Secondary voltages (stabilised)**

  + 5 Vdc / 1 A
  + 12 Vdc / 500 mA
  - 12 Vdc / 250 mA
  + 24 Vdc / 60 mA

IMPORTANT!

Voltages for different cable lengths must be set by the manufacturer.

Standard:
The secondary voltages are set for 2 sensors each with a C2000-3 3 m (9.84 ft) sensor cable (A longer cable is possible as an option).

- **Type of protection:** IP50

- **Temperature range:** Operation 0...40 °C (+32...+104 °F) free air circulation
  Storage: -20...70 °C (-4...+158 °F)

- **Weight:** 950 g (536 dr)

- **Analog voltage output:**
  2 x socket, type Binder
  - passive low pass 2nd order / f_g = 100 kHz
  ± 5 V dc (R_i = 250 Ohm, error at R_L = 1 MOhm:
  1.3 mV/ at the end of the measuring range)

- **Interface output:**
  2 x RS485/687.5 kBaud
  (HD subminiature 15-pin socket)

Standard:
Adjusted for 10 m interface cable length (differing lengths on request)

- **Interface and software-RESET optically isolated**

- **Standard version with error output (see fig. 3.1)**

- **Option with synchronisation of 2 sensors (without error output)**
  is intended for operation without IF 2000 interface card. If a interface card IF2000 is connected: operate it only in mode "unsynchronisiert". Otherwise failure of the connected sensors through interference of the sync pulse are possible.

- **Error output at the power supply unit**
  max. voltage: 30 VDC
  max. current: 100 mA

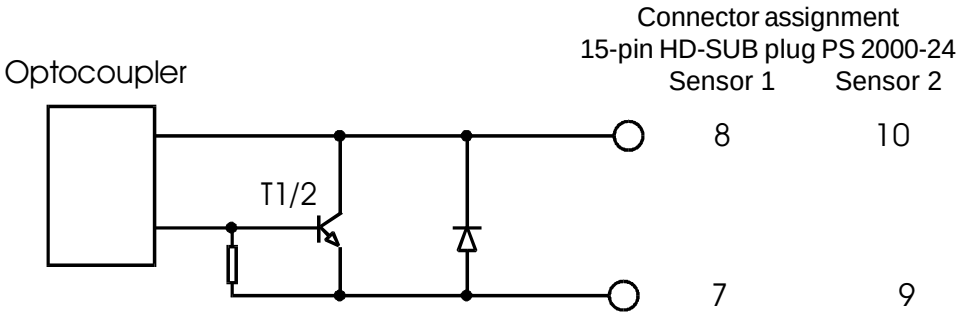
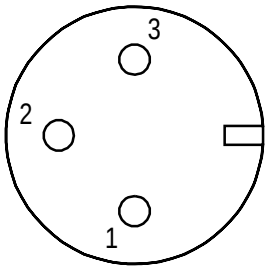


Fig. 3.1: Error output at the power supply unit

1.	No error	⇨ T closed (locked)
2.	Error	⇨ T open (conducting)
3.	No sensor connected	⇨ Not defined

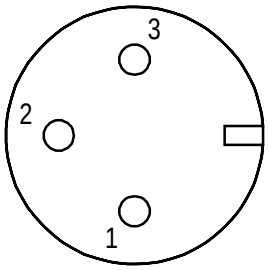
3.2.3 Sockets for Power Supply and Analog Output

Power supply



Pin	3	+ 24 V
	1	GND
	2	NC

Analog output



Pin	2	Signal
	1	GND
	3	NC

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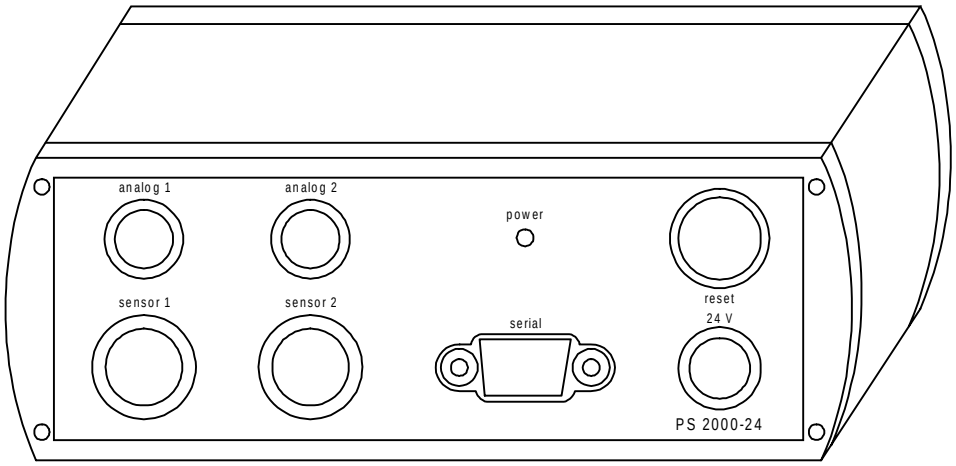
3.2.4 Front View - PS 2000



Legend:

mm
(inches)

Dimensions: 172 (6.77) x 55 (2.17) x 141 (5.55) (width x height x depth)

3.3 Interface Cards
IF 2000, IFPS 2001, IFPS 2002

3.3.1 Short Description

The interface cards provide the RS485/687.5 kBaud interface to a PC-AT (286...Pentium). They require a 16 bit AT-bus slot.

The type IF2000 requires the space of 1 PC bus slot.

The types IFPS-2001 and IFPS-2002 require two slots due to the height of the integrated sensor power supply.

For setting address, interrupt, synchronisation, start of measurement, and additional information for interface cards with serial number S/N 0396 or higher (or a later than month/year 03.96) the enclosed special “description interface cards optoNCDT series 2000” must be observed.

Interface card - IF 2000

This card has **2 RS485/687.5 kBaud interfaces**. It can only be connected to the PS 2000power supply unit through the C2002-10 interface cable. It has **no integrated power supply**.

It is designed for the following applications:

- Larger distances between sensor and computer
- The power supply of the PC does not have sufficient capacity to supply the sensors, too.
- The analog signal is needed as well as the digital output.

It is possible to synchronise the two sensors, and to trigger the measured value transfer.

Interface card - IFPS 2001

This card provides **1 interface** RS485/687.5 kBaud. It includes an **integral power supply** for the operation of one sensor ILD 2000. Sensor and card are connected by the C2001-3 sensor cable [1]. Triggering is possible. The demo-software supplied or the program modules switch the power supply, and thus the sensor, on or off, and also enable data transfer.

Interface card - IFPS 2002

The 2-channel interface card has the same function as IFPS2001, but it has an additional RS485/687.5 kBaud interface and power supply for a **second sensor**. It is possible to synchronise the two sensors, and to trigger the measured value transfer.

1) Length: 3 m (9.84 ft) up to 8 m (26.25 ft) is possible

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3.3.2 Technical Data of the Interface Cards

Model	IF 2000	IFPS 2001	IFPS 2002
Dimensions	155x114x14 mm (6.10x4.49x0.55 in) (corresponds with the depth of 1 PC slot) + 1 slot for trigger	337x114x33 mm (13.27x4.49x1.30 in) (corresponds with the depth of 2 PC slots) + 1 slot for trigger	337x114x33 mm (corresponds with the depth of 2 PC slots) + 1 slot for trigger
Weight	150 g (85 dr)	450 g (254 dr)	500 g (282 dr)
Interface	2 x RS 485 / 687.5 kBaud, 16 bit	1 x RS 485 / 687.5 kBaud, 16 bit	2 x RS 485 / 687.5 kBaud, 16 bit
Power requirement	5 V DC / 0.5 A	5 V DC / 0.5 A + 12 V DC / 1.5 A	5 V DC / 0.5 A + 12 V DC / 3 A
Power supply for sensors ILD 2000	Not included	For one sensor ILD 2000 from 12 V DC from the PC: + 5 V DC + 12 V DC Output - 12 V DC voltages [1] + 24 V DC	For two sensors ILD 2000 from 12 V DC from the PC: + 5 V DC + 12 V DC Output - 12 V DC voltages [1] + 24 V DC
RESET	Possible through software	Possible through software	Possible through software
Plug connectors	1 x HD-subminiature 15-pin connector f. interface to sensor, 1 x HD-subminiature 9-pin connector f. trigger input (extra slot)	1 x HD-subminiature 15-pin connector f. interface to sensor, 1 x HD-subminiature 9-pin connector f. trigger input (extra slot)	1 x HD-subminiature 15-pin connector f. interface to sensor, 1 x HD-subminiature 9-pin connector f. trigger input (extra slot)
Synchronisation of 2 sensors	Possible	Not necessary	Possible
Trigger input	TTL signal, optically decoupled, pin 3 = GND, pin 8 = trigger impulse (LH edge)		
Interrupt	/IRQ: 5, 10, 11,12,15 selectable with J2 ... 6, maskable		

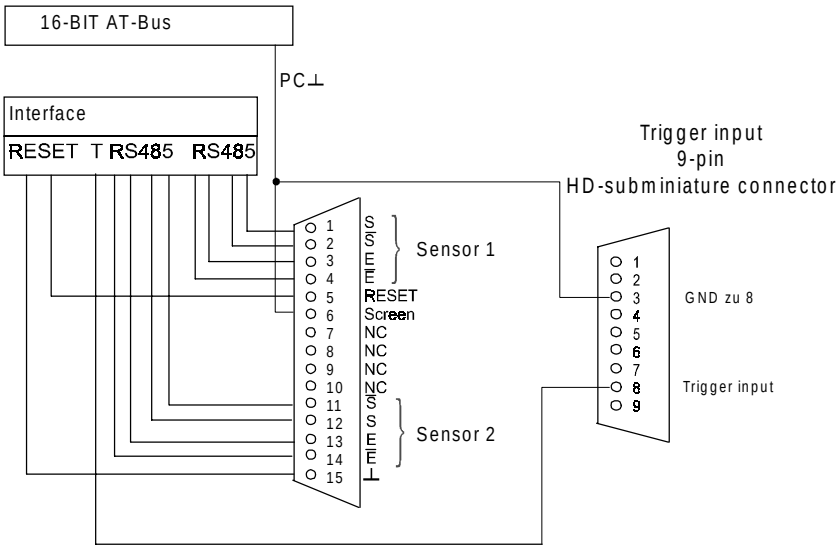
IMPORTANT!

Voltages for different sensor cable lengths must be set by the manufacturer.

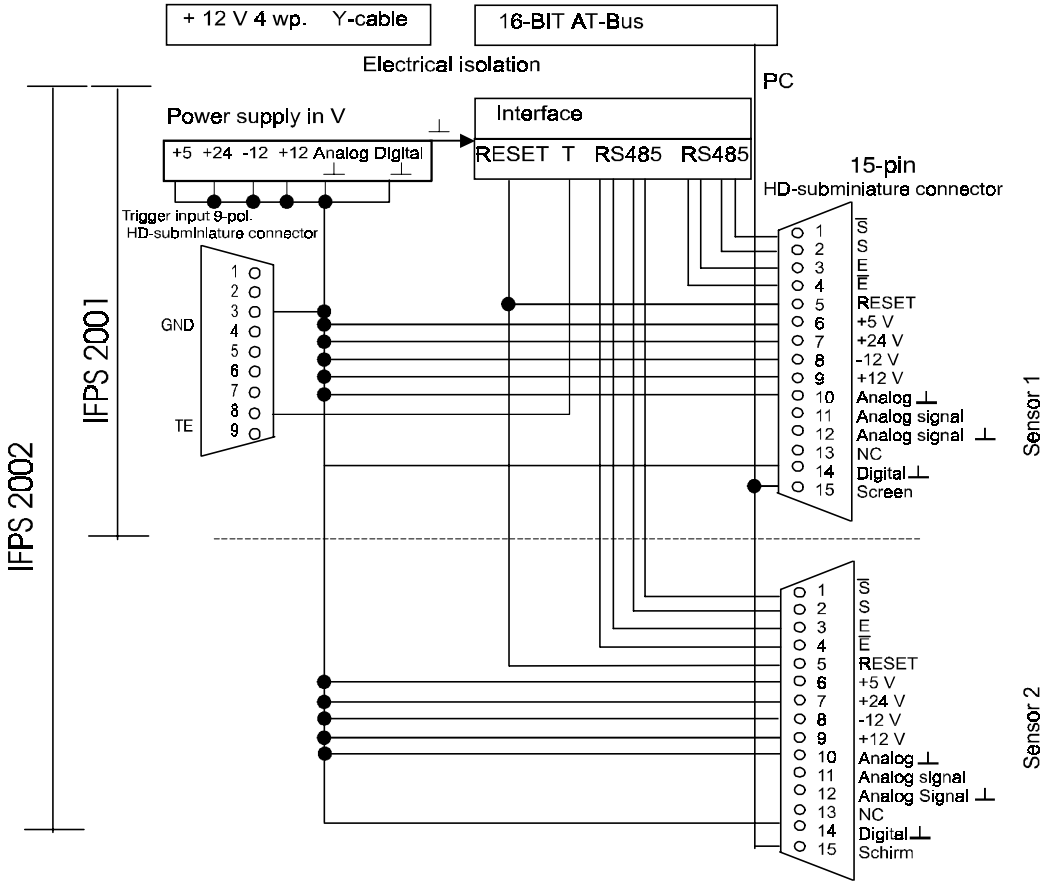
1) In the standard version the output voltages are set for 3 m (9.84 ft) sensor cable length each (C 2001-3).

3.3.3 Block Diagrams of the Interface Cards

Interface card IF 2000



Interface cards IFPS 2001/2002



3.4 Software Modules

File name	Designation (C++)	Description	Comment
reset.c	void reset (void)		The system always sets the initialisation condition loaded last
mittlung.c	unsigned mittlungszahl_aendern_1 (unsigned parameter) unsigned mittlungszahl_aendern_2 (unsigned parameter) unsigned mittlungszahl_speichern _1 (unsigned parameter) unsigned mittlungszahl_speichern _2 (unsigned parameter)	• IP number of averagings for the recursive mean value of the sensor Value range 1 ... 65535 • OP communication Bit 0 without error 0 with error 1	Modification of the averaging number in the sensor. The changed averaging number is stored in the RAM of the sensor. The old averaging number in the RAM is deleted by power-off or RESET. Storing of the averaging number in the EEPROM of the sensor. The current averaging number in the RAM of the sensor is transferred to the EEPROM. With RESET or after activation of the operating voltage the averaging number in the EEPROM is loaded into the RAM of the sensor.
empfang.c	unsigned messenp_1 (void) unsigned messenp_2 (void)	• OP: 16 bit measured value (without sign) Value range 0 ... 62258	With this program module a measured value can be taken over after internal status bit interrogation.
	unsigned status (void)	• OP: Status byte Bit 0 transmitter = 0 transmission possible 1 transmission not possible Bit 1 receiver K1 = 0 no new measured value 1 new measured value Bit 2 receiver K2 = as above (K1)	This program module is called up by the previous module. However, it may also be called up individually.
	unsigned s1_prozess (unsigned far * messwerte unsigned anzahl unsigned ausblenden)	• IPd: Pointer to storage address for measured value field start (32 bit) • IP: Measured value number Value range: 1 ... 32000 • IPd: Delay time (32 bit) Number of measured values that should not be taken over between two measured values. Value range 0 ... 65535 • OP: Communication Bit 0 without error 0 with error 1	Continuous measured value acquisition sensor 1
	unsigned s2_prozess (unsigned far * messwerte unsigned anzahl unsigned ausblenden)		Continuous measured value acquisition sensor 2
	unsigned prozess (unsigned far * messwerte 1 unsigned far * messwerte 2 unsigned anzahl unsigned ausblenden)		Two-point measurement continuous sensor 1 and sensor 2
spannung.c	void spannung_ein (void) void spannung_aus (void)	• IP: Control word Initialisation to polling or interrupt, no RESET	Activation of operating voltage. Deactivation of operating voltage (only effective for interface cards IFPS 2001/2002)
initial.c	port initialisierung (unsigned port betrieb)	• IP: Control word Bit 0 Operating mode Bit 1 RESET (with fixed time constant) Bit 2 operating voltage • OP: Communication Bit 0: Error	1. If a sensor is connected, the unused channel is initialised in the same operating mode, i.e. the respective unused interrupt source is also enabled in interrupt operation (but level inactive). 2. Possible errors in communication are mentioned in section 7.3. 3. Operating voltage off or on is only effective for interface cards IFPS 2001/2002.

3.4.1 Explanation of Terms

Knr. Sensor + no.

IP Input parameters, each 16 bit wide.
(these parameters are transferred to the respective program module by the higher-level program that is generated by the user).

IPd Same as IP, but 32 bit each.

OP Output parameters, each 16 bit wide
(these parameters are transferred to the higher-level program by the program module)

3.4.2 Basic Initialisation of the Sensor

(programmed by the manufacturer)

If a sensor is connected and switched on, it has the following basic status:

- Number of measured values (averaging) 1
- Linearisation table (either reference “matt white” or taught for a customer-specific target).

3.4.3 Programming Language

The programming language is > >C+ + < <
Program modules are available in source code.

3.4.4 Address Assignment and Data Transfer

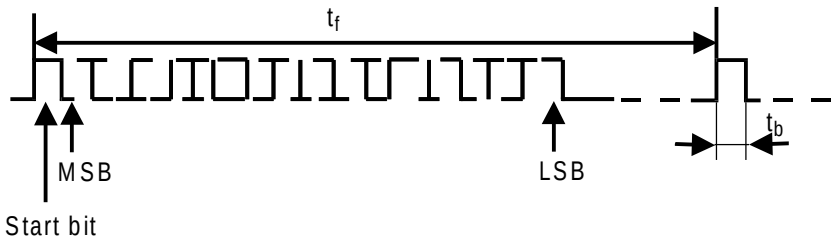
(for interface programming by the user)

Please refer to the "appendix" for more detailed information on the interface.

3.4.5 Data Format

asynchronous 16 bit 1 start bit no parity	tf: 100 µs data word sequence (10 kHz) tb = 1.45 µs data bit width Data rate 687.5 kBaud Driver and receiver are LTC 485 Driver and receiver are designed separately with twisted 2-wire cable

MSB = bit 15
LSB = bit 0

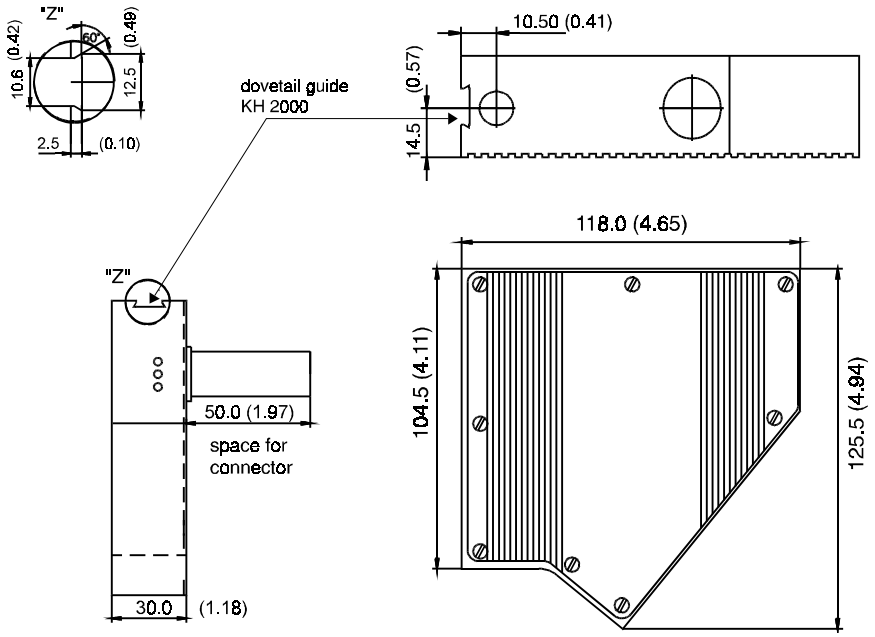


4. Installation

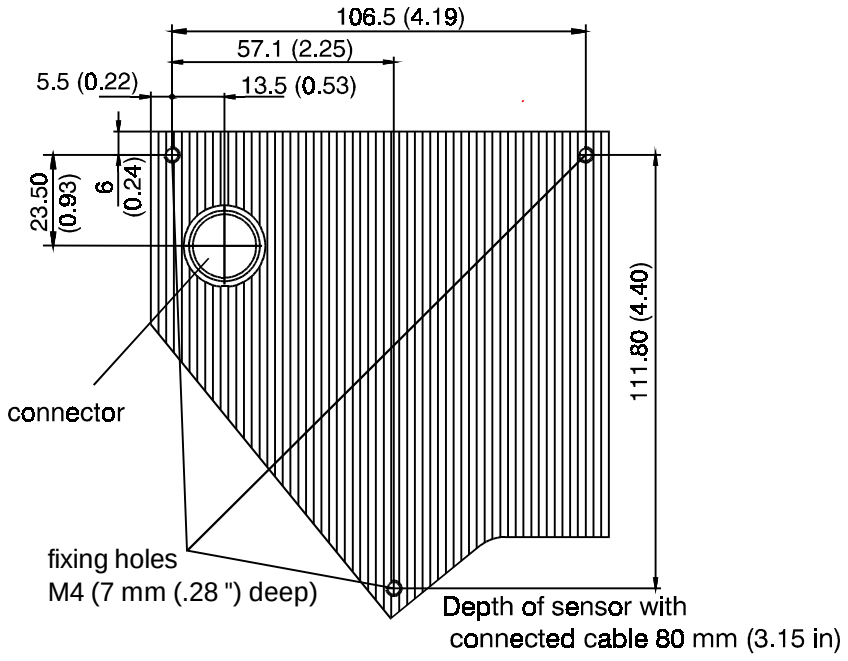
4.1 Mounting Options and Dimensions Models ILD 2000-5, 10 or 20

Ranges 5, 10, 20 mm (0.20, 0.39, 0.79)

Legend:
mm
(inches)



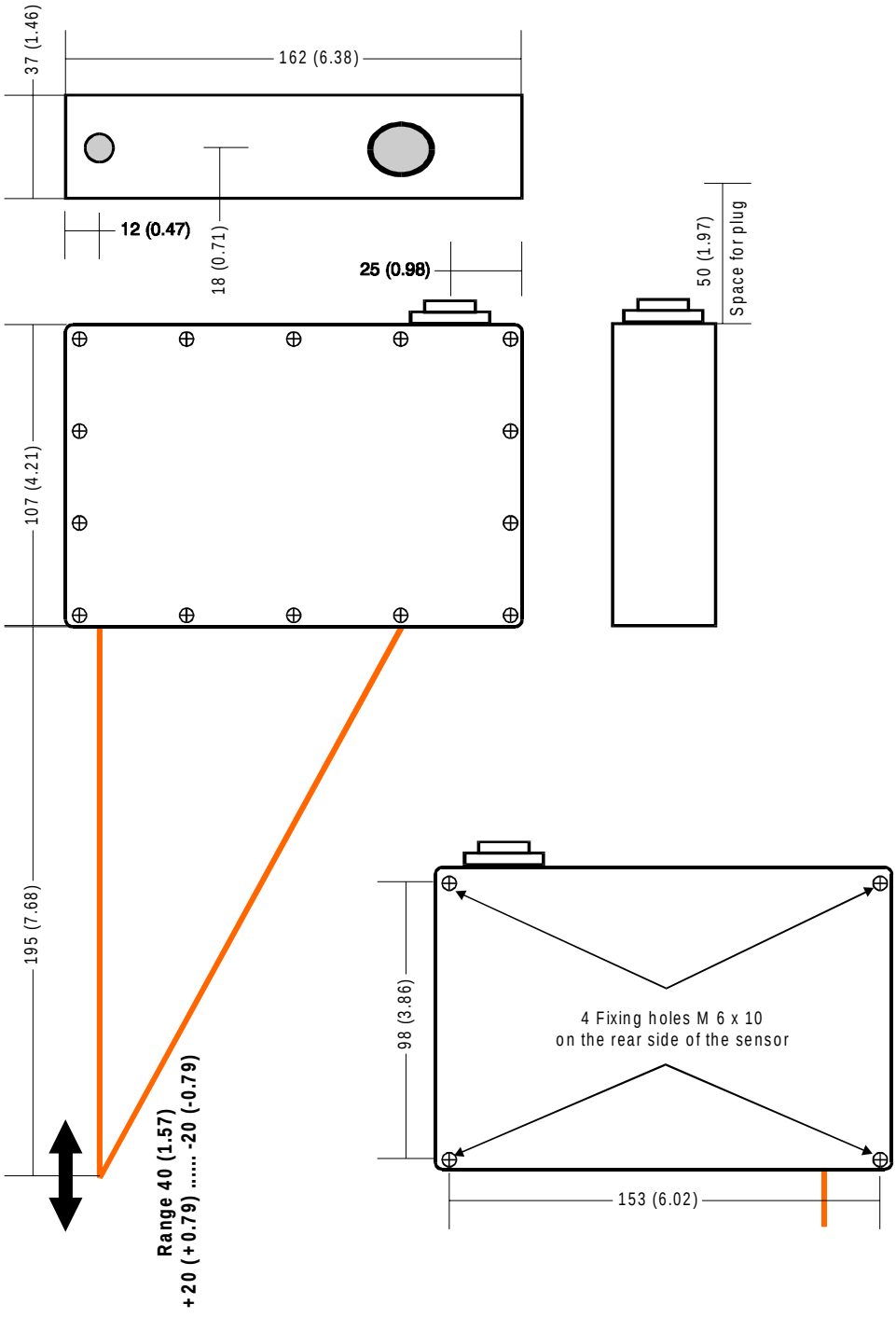
Pic. 4.1: Mounting with the KH 2000 dovetail clamp (available as an accessory)



Pic. 4.2: Mounting with M4 screws

4.2 Mounting Options and Dimensions Model ILD 2000-40

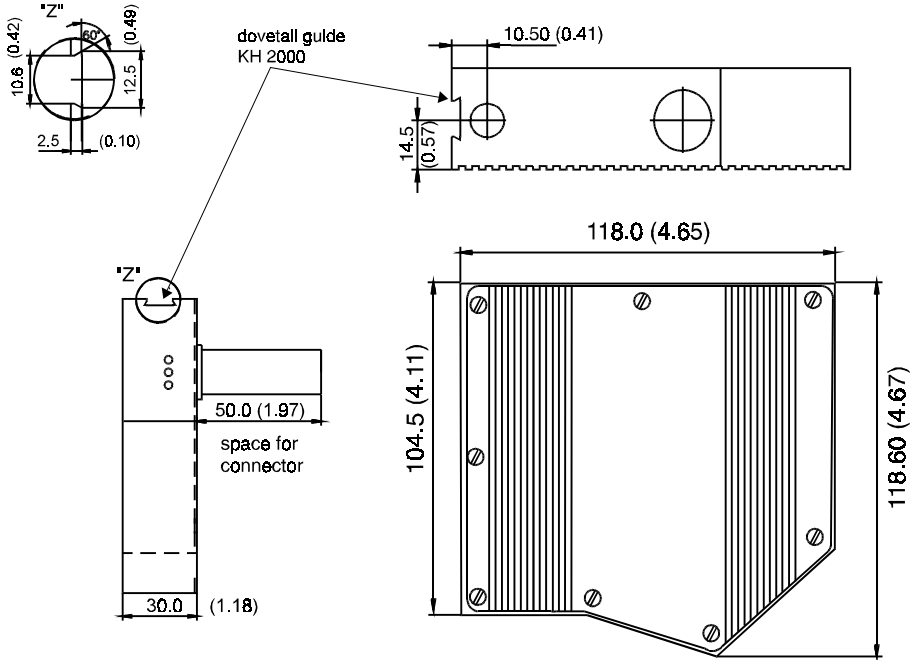
Range 40 mm (1.57)



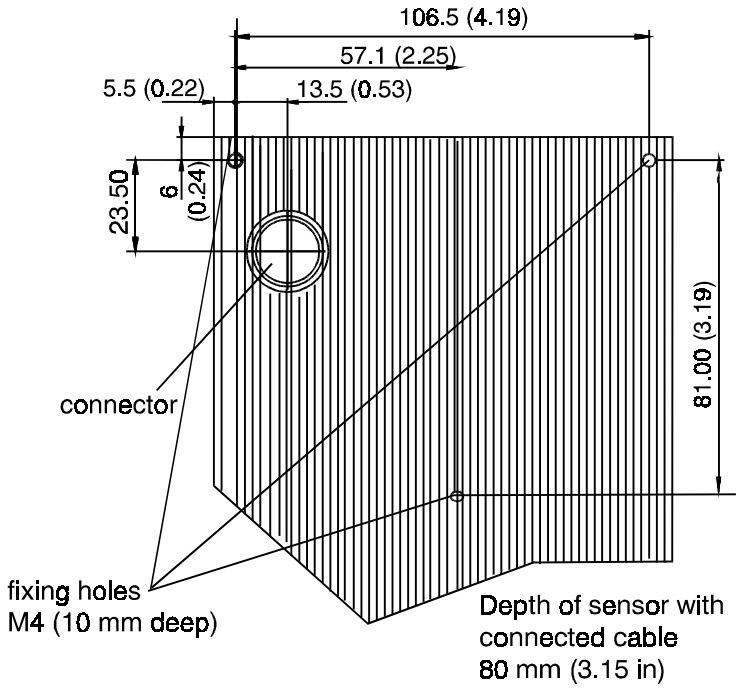
4.3 Mounting Options and Dimensions Models ILD 2000-100 or 200

Ranges 100, 200 mm (3.94, 7.87)

Legend:
mm
(inches)



Pic. 4.3: Mounting with the KH 2000 dovetail clamp (available as an accessory)

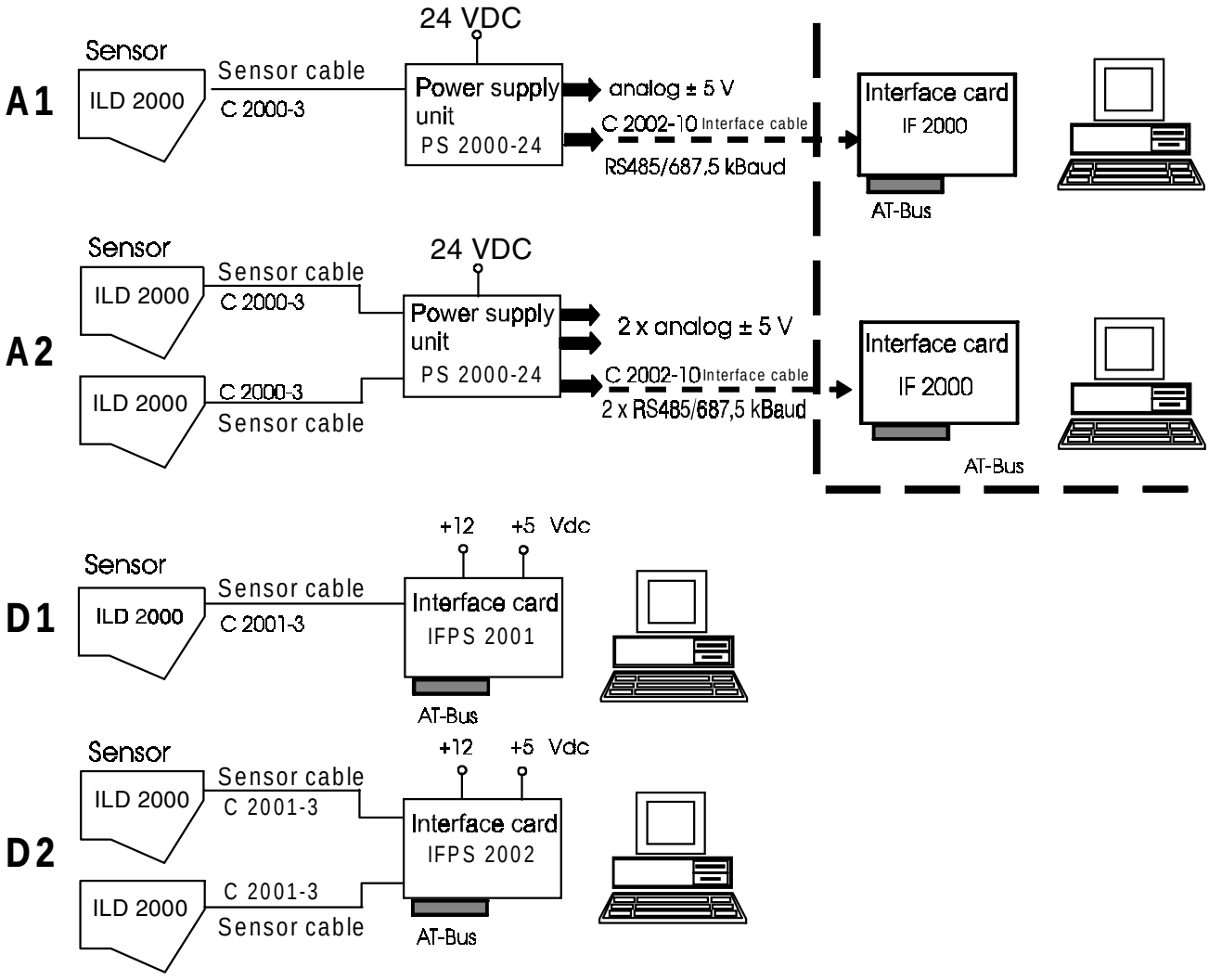


Pic. 4.4: Mounting with M4 screws

5. Commissioning

5.1 System Configurations

Configure the system components as shown in fig. 5.1 .



5.2 Measuring Setup and Commissioning

5.2.1 Getting Ready for Operation

<table>
<tr><th colspan="3">Configuration ILD 2000 with</th></tr>
<tr><td>PS 2000-24
Analog output
A1 or A2</td><td>IF 2000 and PS 2000
Serial output RS485/687.5 kBaud
A1 or A2</td><td>IFPS 2001 or IFPS 2002

D1 or D2</td></tr>
<tr><td colspan="3">• Install the sensor ILD 2000 using one of the mounting options (chapter 4)!
The standard temperature compensation is valid for installation using the top dovetail guide.

• The distance between sensor and measuring object must lie within the specified range.
In order to keep the specified accuracy - position the measuring object normally (90°) to the optical axis of the laser.</td></tr>
<tr><td colspan="2">• The ventilation slots in housing of the power supply unit must be free.</td><td>• Plug the power supply adapter cable (4-pin) into the interface card.

• Insert the interface card into the PC. The PC must be switched off.
(Requires an AT-bus slot
IEEE P 996 16 bit).</td></tr>
<tr><td colspan="2">• Insert the interface card into the PC. The PC must be switched off.
(Requires an AT-bus slot IEEE P 996 16 bit).

! The interface requires
5 V / 0.5 A from the computer

• Connect IF2000 and PS2000-24 using C2002-10 interface cable</td><td>! The interface requires
5 V / 0.5 A and 12 V / 1.5 A (1-channel)
5 V / 0.5 A and 12 V / 3 A (2-channel)
from the computer

• Connect the power supply adapter cable to the power supply unit of the PC (connection with Y-cable is possible after separation).

• Connect IFPS-2001/2002 and ILD2000 using C2001-3 sensor cable</td></tr>
</table>

IMPORTANT!

When commissioning please observe the notes on the laser class in chap. 2.

5.2.2 Hardware Commissioning

C o n f i g u r a t i o n ILD 2000 with		
PS 2000-24 **Analog output** **Configuration** **A1 or A2**	**IF 2000 and PS 2000-24** **Serial output RS485/687.5 kBaud** **Configuration** **A1 or A2**	**IFPS 2001 or IFPS 2002** **Configuration** **D1 or D2**
• This sequence applies to the operation of one or two sensors • Switch on: PS 2000-24 or PS 2000-24 and PC or only PC - The green LED* lights up = LASER ON • Ready for measuring after 20 minutes warm-up time • The sensor supplies measured values in standard setting without averaging. The linearisation table for the respective measuring range is for "matt white ceramic target" or taught in for customer-specific material.		
• At the analog output of the power supply unit the measuring signal is available in a voltage range of ± 5 V.		

Error messages chapter 7.3.

5.2.3 Starting the Demo-Software

Configuration ILD 2000 with		
PS 2000-24 **Analog output** **A1 or A2**	**IF 2000 and PS 2000-24** **Serial output RS485/687.5 kBaud** **A1 or A2**	**IFPS 2001 or IFPS 2002** **D1 or D2**
• Insert the demo disk into the 3.5" floppy drive • Enter (in DOS): A: ILD_INST [ENTER] • The WINDEMO demo-software will be installed automatically. • Start the program in WINDOWS (window "ILD 2000")		

6. Instructions for Operating

6.1 Reflection Factor of the Target Surface

In principle the sensor evaluates the diffuse part of the reflected laser light (fig.6.1). A statement concerning a minimum reflectance is difficult to make, because even a small diffuse fraction can be evaluated from highly reflecting surfaces. This is done by determining the intensity of the diffuse reflection from the CCD array signal in real time and subsequent compensation for intensity fluctuations. To use the sensor on transparent or reflective objects, manufacturer pre-testing is necessary.

6.2 Error Influences

Colour differences
Because of intensity compensation, colour difference of targets affect the measuring result of the ILD2000 only slightly. However, such colour differences are often combined with different penetration depths of the laser light into the material. Different penetration depths then result in apparent changes of the measuring spot size.

Therefore colour differences in combination with changes of penetration depth may lead to measuring errors. This fact also affects the linearity behaviour of the sensor, if it has been adapted for white, diffusely reflecting reference material, and is then used to measure black material (chapter 8, fig. 8.2, curve •).

If, however, the sensor is optimised for the black material, a clearly improved linearity behaviour is achieved again (chapter 8, fig. 8.2, curve x).

Temperature influences
An integral temperature sensor measures the internal housing temperature of the sensor and at the same time compensates for temperature fluctuations in the measured value.

When the sensor is commissioned a warm-up time of at least 20 minutes is required to achieve uniform temperature distribution in the sensor.

If measurement is performed in the micron accuracy range, the effect of temperature fluctuations on the sensor holder must be considered. Temperature compensation is optimized for mounting the sensor topside by using the dovetail clamp.

Due to the damping effect of the heat capacity of the sensor sudden temperature changes are only measured with delay.

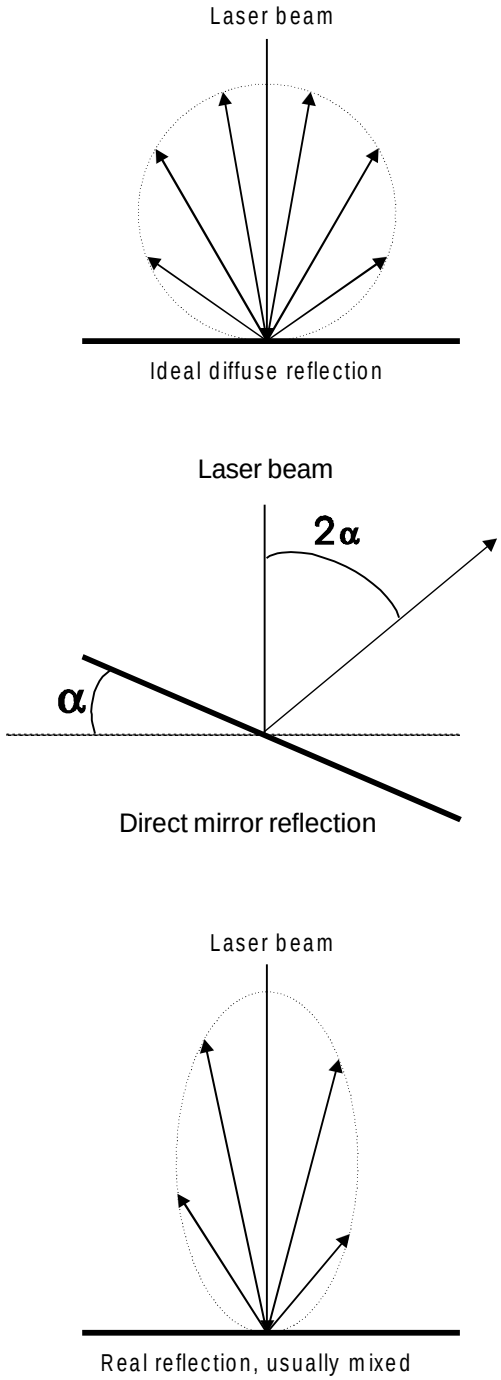


Fig. 6.1: Reflection Factor of the Target Surface

Mechanical vibration
If the sensor should be used for resolutions in the µm to sub-µm range, special care must be taken to ensure stable and vibration-free mounting of sensor and target.

Surface roughness
In case of traversing measurements surface roughnesses of 5 µm and more lead to an apparent distance change (also-called surface noise). However, they can be dampened by averaging (chapter 6.3).

Influence of external light
Due to the narrow-band optical filters that are used diffusely reflecting targets can even be measured when in direct sunlight.

Angle influence
Tilt angles of the target both around the X and the Y axes of less than 5 ° only have a disturbing effect with surfaces which are highly reflecting.

Tilt angles between 5 ° and 15 ° lead to an apparent distance change of approx. 0.1° of the measuring range (fig. 6.2).

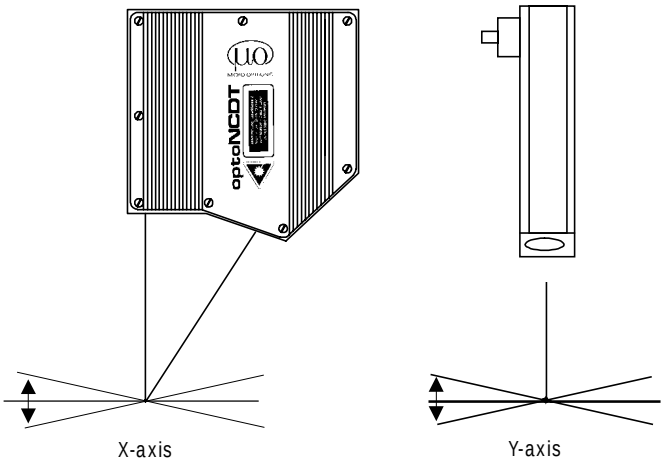


Fig. 6.2: Angle influence

Tilt angles between 15 ° and 30 ° lead to an apparent distance change of approx. 0.5 ° of the measuring range.

These influences must be considered especially when scanning structured surfaces. In principle the angle behaviour in triangulation also depends on the reflectivity of the target.

Angle	X-axis %	Y-axis %
5 °	0.04	0.03
15 °	0.12	0.1
30 °	0.5	0.5

Optimising the measuring accuracy by means of special sensor arrangement

- In case of rolled or polished metals that are moved past the sensor the sensor plane must be arranged in the direction of the rolling or grinding marks.

The same arrangement must be used for colour strips (fig. 6.3).

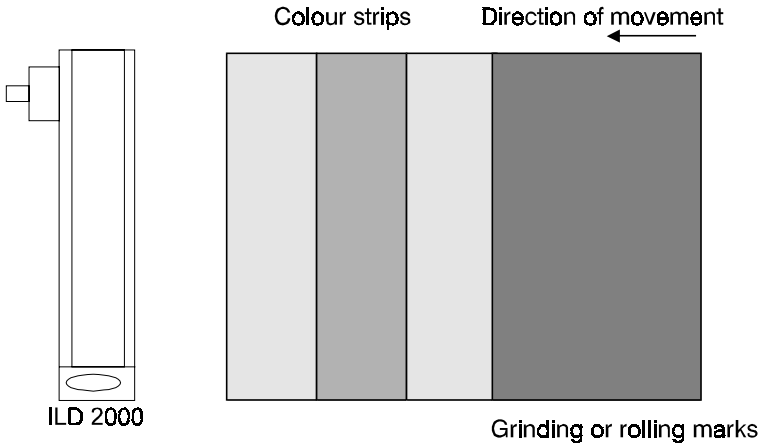


Fig. 6.3: Sensor arrangement in case of ground or striped surfaces

- In case of bore holes, blind holes, and edges in the surface of moving targets the sensor must be arranged in such a way that the edges do not obscure the laser spot (fig. 6.4).

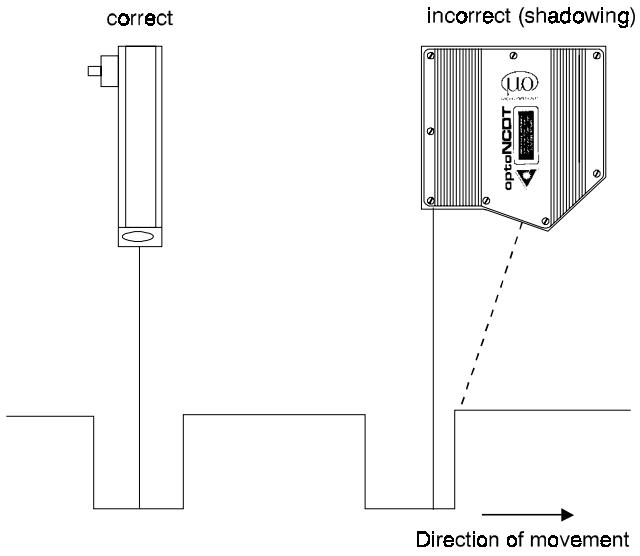


Fig. 6.4: Sensor arrangement for holes and ridges

6.3 Averaging

In the standard setting the sensor is set to the mean value of 1, i.e. without averaging. If averaging becomes necessary because of the surface properties of the target (surface noise due to structure caused by grinding, high-precision cutting, etc.), a distinction must be made between operation with analog output and digital interface.

Operation with analog output - Configuration A1 or A2 (see chap. 5.1)

1. The number of the values to be averaged is already given in the order and is set in the factory.

2. The sensor is sent to the manufacturer for reprogramming.

Operation with serial interface - Configuration D1 or D2 with interface card (see chap. 5.1)

The user can change the number of values any time by means of software modules (chap. 3.4).

The mean value is a recursive mean value, and it is generated according to the following formula:

$$\overline{X}_i = \frac{X_i + (n-1)\,\overline{X}_{i-1}}{n}$$

n (number of averagings) = 1 ... 65535

6.4 Use of the Protective Housing

The SGH protective housing is designed to be used especially if the sensor operates in a dirty environment. It is available as an accessory.

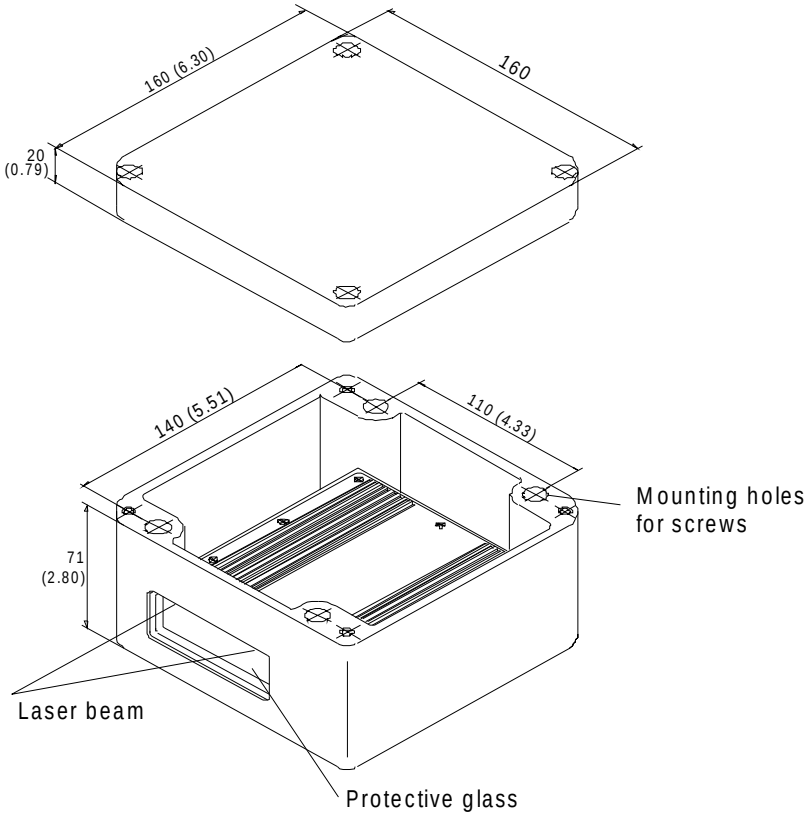


Fig. 6.5: SGH Protective housing

If these protective housings are used, the linearity of the sensors in the complete system may deteriorate. For the sole purpose of protection against mechanical damage a simple protective shield with sufficiently large opening is therefore more advantageous.

The protective housing is offered in two versions:

-SGH 2000.01	with the protective window blown clean, and
-SGH 2000	with the protective window not blown clean (with outlet connection).

The SGH 2000-40(B) protective housing is used for the ILD 2000-40 sensor. The following guidelines must be observed if the sensors are operated in a protective housing:

1. In a closed protective housing sensors may only be operated with compressed-air flowing.

Legend:
mm
(inches)

IMPORTANT!

You will find more details about the protective housing in chap. 10.2.

2. The requirements for compressed-air are:
   - Temperature at the inlet < 25°C
   - Flow rate > 200 l/min.
   - Pressure < 10 bar (nominal pressure 2 bar)
   - The compressed-air must be free of oil and water residues. It is recommended to use two oil separators in series arrangement.

3. The maximum ambient temperature within the protective housing is 40°C. This temperature only applies in case of thermally insulated installation of the protective housing.

4. For higher ambient temperatures it is recommended to use an additional water-cooled carrier and cover plates outside the protective housing.

5. No direct heat radiation (including sunlight!) on the protective housing. In case of direct heat radiation additional thermal protective shields must be installed.

6. Installation of the sensors in the protective housings should be performed by the manufacturer, because especially in case of short measurement ranges (≤ 40 mm) the protective window must be included in the calibration.

7. It is recommended that the protective window is cleaned from time to time with a soft alcohol-soaked cloth or cotton pad.

Scope of delivery of the protective housing:

The rotatable plug-nipple glands type LCN-1/4-PK-6 (FESTO) for the compressed-air tubes and the distance sleeves and the countersunk screws for sensor fastening are included in the delivery of the protective housing.

6.5 Cleaning the Lenses

The laser optical system may only be cleaned by blowing it out with suitable compressed-air (e.g. rubber-ball blower or compressed-air can).

If dirt deposits have accumulated that cannot be removed with compressed-air, the sensor must be sent to the manufacturer for cleaning and inspection.

The receiver optical system may also be cleaned with an antistatic optics brush. Do not use antistatic cloth or spectacles cleaning cloth.

Tightly adhering impurities (e.g. finger prints) can be removed with high-percentage alcohol (propanol or optics cleaner) and a lint-free lens-cleaning paper or an optics cleaning cloth (from the optics or photo shop).

Please note that the types of protection mentioned in the technical data do not apply to the optical components.

IMPORTANT!

If the sensors are operated in an **oil-laden environment**, we urgently recommend the use of a **protective housing** (see chap. 6.4).

6.6 Cleaning the Protective Glasses

The protective glasses of the laser and receiver optics have coated surfaces.

Clean the protective glasses with high-percentage alcohol (propanol or optics cleaner) and a lint-free lens-cleaning paper or an optics cleaning cloth (from the optics or photo shop).

Do not use antistatic cloth or spectacles cleaning cloth. Protective glasses can be changed by the manufacturer only.

7. Measured Value Output

7.1 Analog

After the sensor has been commissioned (chap. 5.2) the displacement signal is available as an analog voltage value in the range of ± 5 V (standard).

- The sensor output may only be loaded with R_L = 1 kOhm.

- At the output of the PS 2000 power supply unit this analog signal is still filtered by a 100 kHz low-pass.

- The output has an internal resistance of R_i = 250 Ohm.

- With a load resistance of R_L = 1 MOhm the error is 1.3mV at the end of the measuring range.

7.2 Digital

After the sensor has been commissioned (chapter 5.2) the averaged value in the

value range 0 ... 65535 (16 bit) is available at the output of the serial interface.

0 … 1637 - Measured value out of measuring range[1]
1638 … 63896 - Measured value in the measuring range
63897 … 65534 - Measured value out of measuring range[1]
65535 > > Poor Target < < - No measuring range

The interface hardware corresponds with the standard for RS485. The interface has been tested with a data rate of 687.5 kBaud for a distance of 13 m (3 m sensor - power supply unit + 10 m power supply unit - PC-card). Greater lengths must first be tested by the manufacturer.

1) Both measured values no longer correspond with the specification of the sensor. They are used for adjustment, so that the measured value can be slightly exceeded in up and down direction.

7.3 Signal Output

Description	LED on the laser	Analog output	Serial interface
Laser in operation	green >>LASER ON/OFF<<	---	---
Target does not reflect sufficiently Penetration depth of the laser point too deep - corona formation too great	red>>POOR TARGET<<	output > +5.26 V [1] or last valid measured value	output 65535
Target still in detection range but slightly beyond of meas. range	red>>OUT OF RANGE<<	output -5.26 ... -5.00 or +5.00 ... +5.26 V	output 0 ... 1637 or 63897 ... 65534
No target available	red>>POOR TARGET<< red>>OUT OF RANGE<<	output > +5.26 V [1] or last valid measured value	output 65535

1) +5.26 V appears if there is no target within the measuring range when the sensor is switched on.

8. Examples of Measuring Results

8.1 Linearity Behaviour

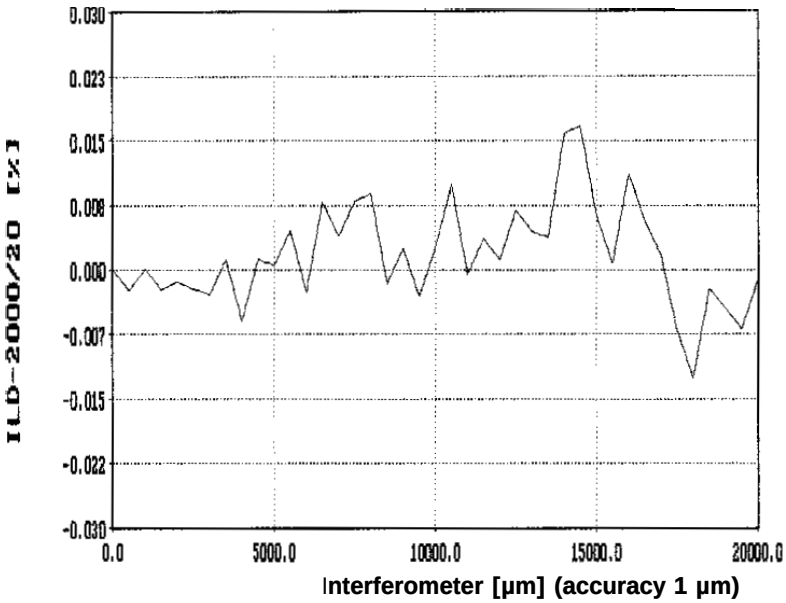


Fig. 8.1: Reference target "matt white paper"

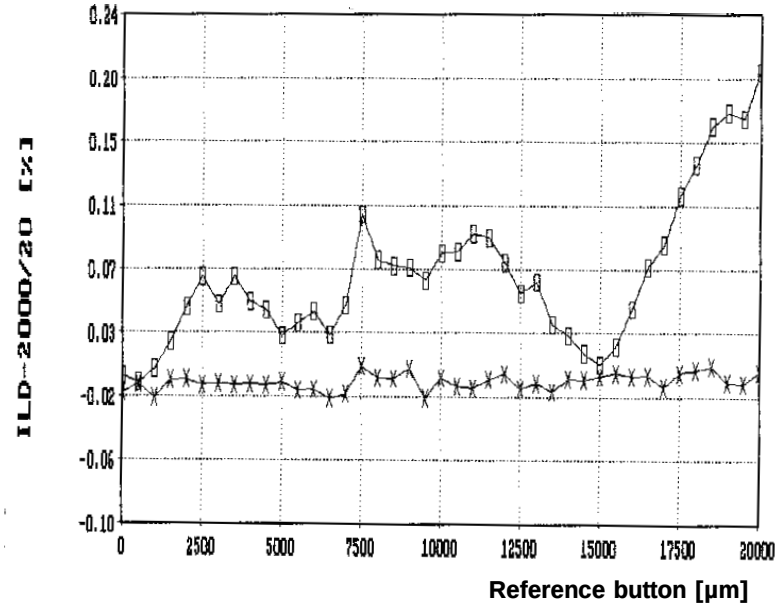


Fig. 8.2: Target "matt black paper" at different calibration

Legend:

- • Calibration against white paper, measurement against black paper
- x Calibration and measurement against black paper

8.2 Noise

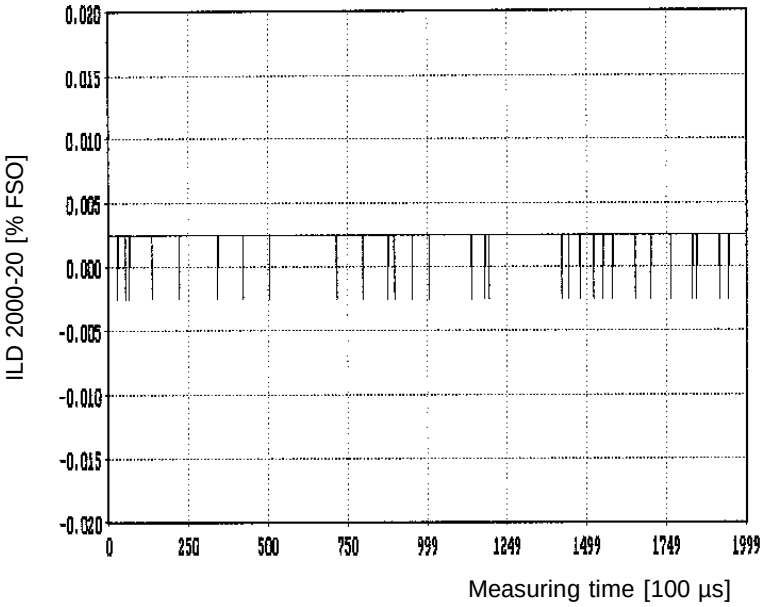


Fig. 8.3: Reference target "matt white paper" without averaging

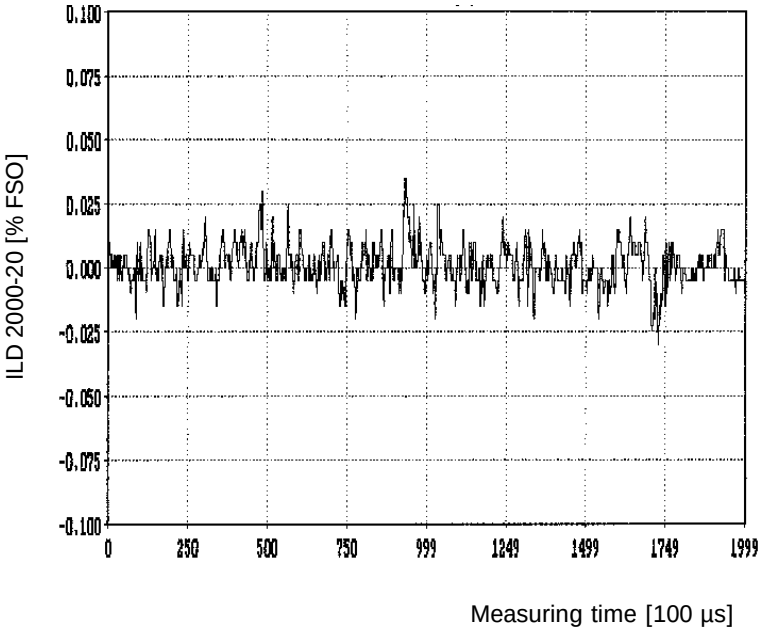


Fig. 8.4: Reference target "matt white paper" with strong air circulation between target and sensor without averaging value formation

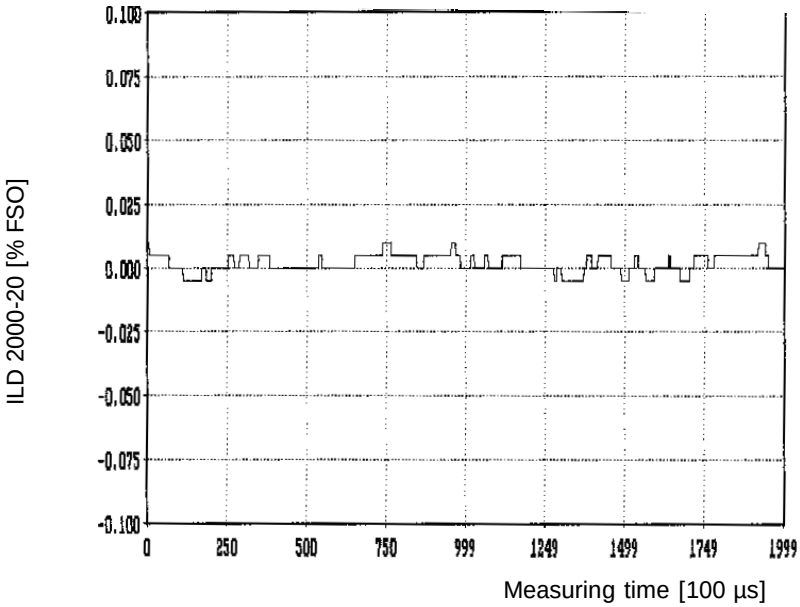


Fig. 8.5: Reference target "matt white paper" with strong air circulation between target and sensor averaged over 10 values

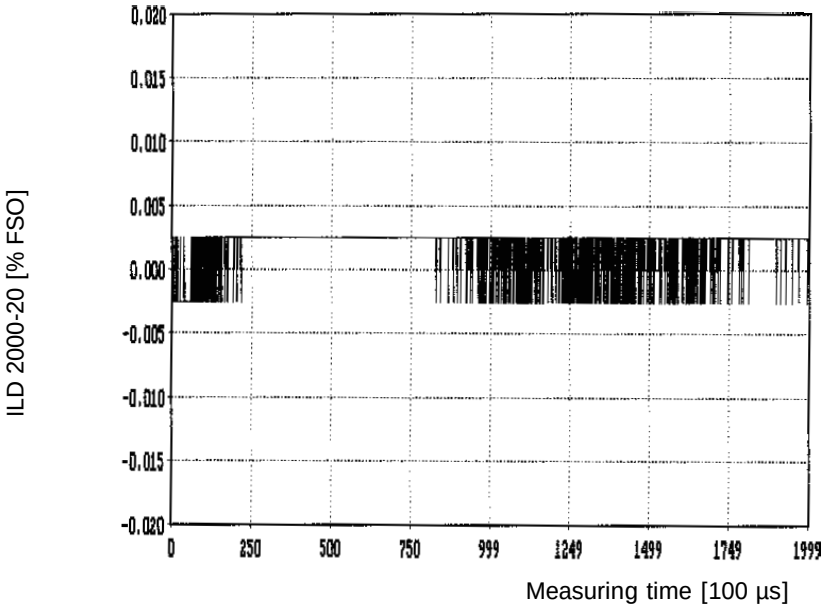


Fig. 8.6: Reference target "black rubber"

9. Warranty

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

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

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

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

No other claims, except as warranteed, are accepted. The terms of the purchasing contract apply in full.

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

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

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

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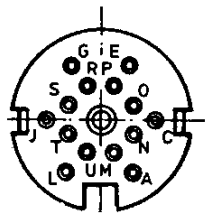
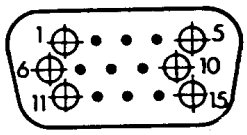
10. Appendix

10.1 Connector Pin Assignment

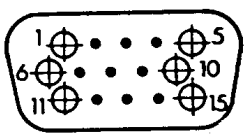
10.1.1 Round Connector on the Sensor or PS 2000-24 Power Supply Unit

Contact arrangement	Pin	Assignment on sensor	Assignment on power supply unit
Connector Binder series 723 14-pin View of solder side	A	ground digital	ground digital
	C	RESET	RESET
	E	-12 V	-12 V
	G	+24 V	+24 V
	J	+12 V	+12 V
	L	+5 V	+5 V
	M	$\overline{\text{transmitter}}$	$\overline{\text{receiver}}$
	N	transmitter	receiver
	O	ground analog output	ground analog input
	P	analog output (R_L > 1K)	analog input
	R	analog ground	analog ground
	S	screen	screen
	T	$\overline{\text{receiver}}$	$\overline{\text{transmitter}}$
	U	receiver	transmitter

10.1.2 Interface Connector on the PS 2000-24 Power Supply Unit or on the IF 2000 Interface Card

Contact arrangement	Pin	Assignment on power supply unit	Interface card IF 2000
Socket SERIES HD-subminiature 15-pin View: solder side  	1	receiver 1	transmitter 1
	2	$\overline{\text{receiver 1}}$	$\overline{\text{transmitter 1}}$
	3	transmitter 1	receiver 1
	4	$\overline{\text{transmitter 1}}$	$\overline{\text{receiver 1}}$
	5	RESET	RESET
	6	screen	screen
	7	emitter 1	not used
	8	collector 1	not used
	9	emitter 2	not used
	10	collector 2	not used
	11	receiver 2	transmitter 2
	12	$\overline{\text{receiver 2}}$	$\overline{\text{transmitter 2}}$
	13	transmitter 2	receiver 2
	14	$\overline{\text{transmitter 2}}$	$\overline{\text{receiver 2}}$
	15	RESET	RESET

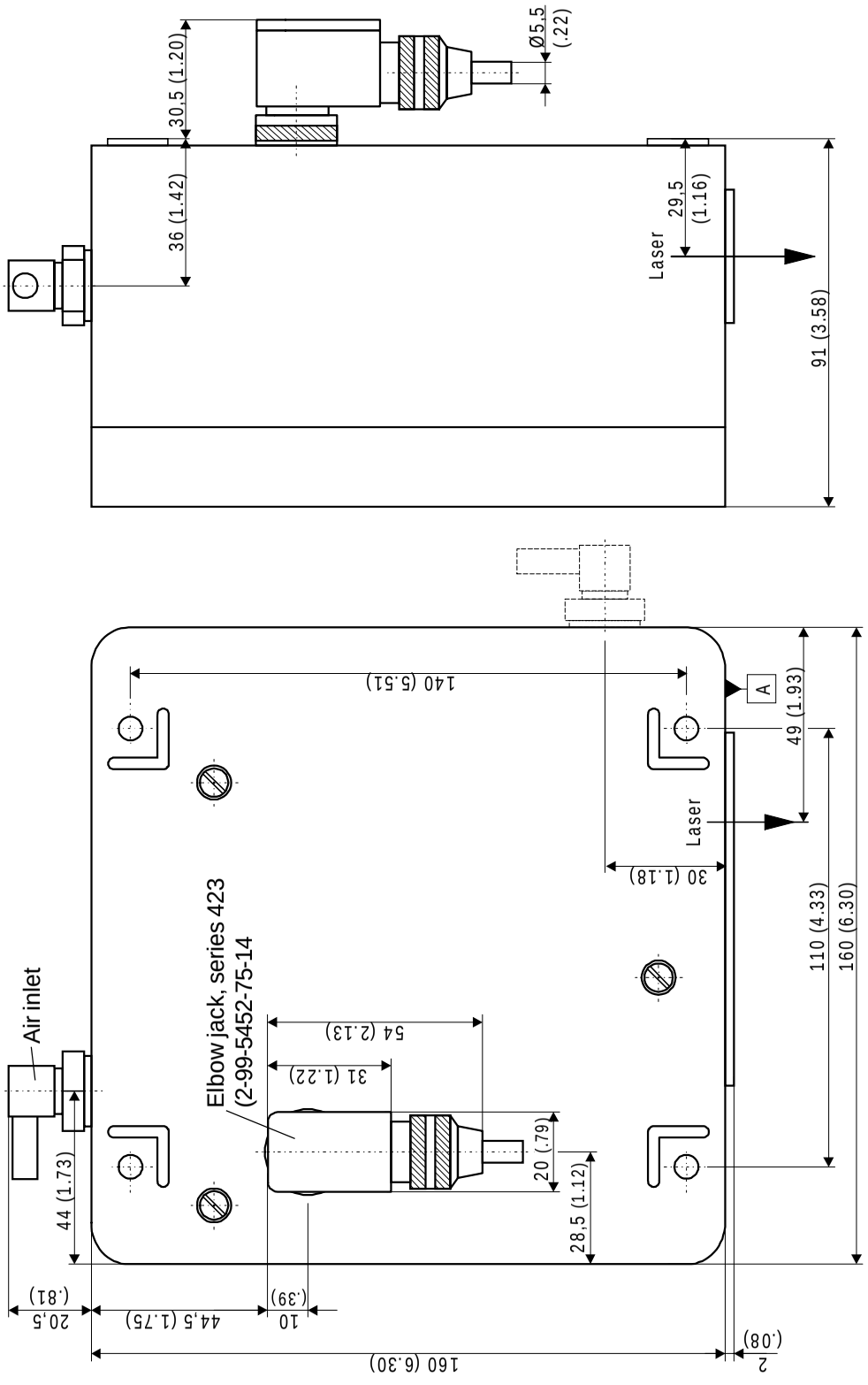
10.1.3 Sensor Connector on the IFPS-2001 or 2002 Interface Card

Contact arrangement	Pin	Assignment
Plug Series HD-subminiature 15-pin View:: solder side  	1	$\overline{\text{transmitter}}$
	2	transmitter
	3	receiver
	4	$\overline{\text{receiver}}$
	5	RESET
	6	+5 Vdc
	7	+24 Vdc
	8	-12 Vdc
	9	+12 Vdc
	10	analog ground
	11	analog input
	12	analog input ground
	13	not used
	14	digital ground
	15	screen

MICRO-EPSILON

10.2 Drawing of SGH2000 Protective Housing

(Not to scale)



Legend:
mm
(inches)

Sensor	Distance / mm (") A - Midrange
ILD 2000-5	27,5 (1.08)
ILD 2000-10	27,5 (1.08)
ILD 2000-20	30,5 (1.20)
ILD 2000-100	128,4 (5.06)
ILD 2000-200	197,4 (7.77)