Operator's Hardware Manual
ODS Black-Line Sensors
ODS 20.5
ODS 115
ODS 150
ODS 200
ODS 260
ODS 450
ODS 750
Select - 2, - 5 & - 10 (kHz) Models:

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4105-185.dse

NOTE

Read chapter 6: LASER CAUTION
before applying power to the sensor

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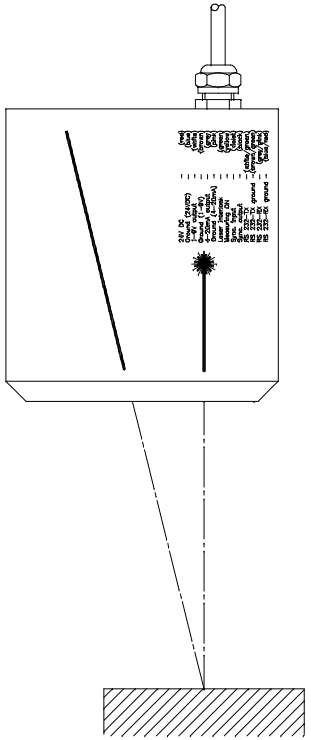


Fig.1 Distance measurement

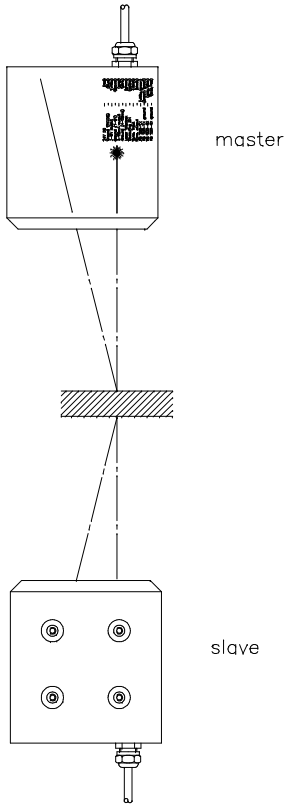


Fig. 2 Thickness measurement

1 GENERAL INFORMATION

1.1 Description

ODS sensors are optical distance measuring devices for non contact precision measurement of distance (1 unit - Fig. 1) or thickness, width and difference (2 units - Fig 2).

The SELECT functionality, programming the sensor Modes and Settings, is described in chapter 4 & 5, and is further elaborated on in a separate Supplement in connection with the ODS-Explorer software.

The ODS is a compact unit in which optics, sensor, and signal processing electronics are all integrated. The distance to an object is detected by means of the triangulation principle. A focused laser beam forms a spot on the measuring object. The image of the spot is reflected onto a position detector, a CCD camera, and the ODS converts this position into the distance to the object by advanced mathematical procedures.

The output signal is provided in 2 different manners. One digital output, an RS232, RS422 or Ethernet serial output, provides the distance to the object with a frequency of (1000 option), 2000 (default if not specified in the order), 5.000 or 10.000 Hz acording to Model and the setting of the baud rate parameter. At the same time one analog outputs deliver the measured distance, as either a 1 - 9 V signal or as a 4 - 20 mA current loop (default in not specified in the order). The **ODS Select-2 Model** samples at **2.000 Hz. The ODS Select-5, Model at 5.000 Hz, and the ODS Select-10 Model at 10.000 Hz.**

An ODS unit is prepared for measurement of thickness, since 2 units of the same type connected to each other can be automatically set to function as one measuring system in which the output signal is an expression of the thickness.

The ODS has a special built-in feature for measuring thickness of partly transparent objects, e.g. paper, wood, plastic, etc. The two ODS units will not disturb each other with light from one sensor into the other due to the built-in synchronization in which one sensor is on while the other is off.

Automatic adjustment of the light intensity permits measurement on a wide variety of different surfaces. The ODS can measure on most surfaces from white to black and all colours in between.

Even though the sensor is constructed to measure on diffusely reflecting surfaces, many shiny surfaces can be measured too.

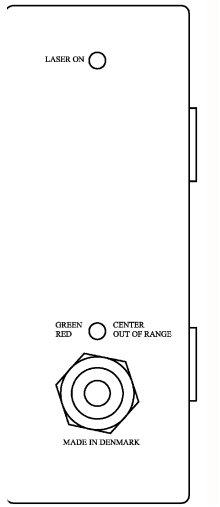


Fig. 3 Light indicators for laser (emission) on and measurement at centre or out of range

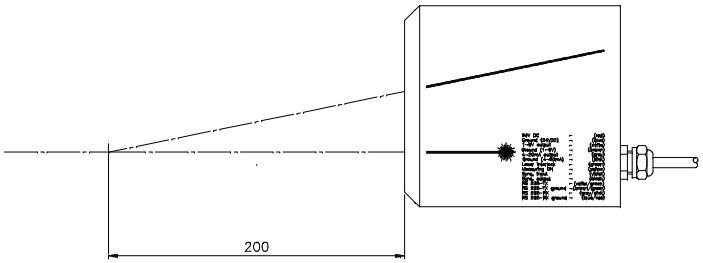


Fig. 4 Reference distance for ODS 200.

ODS is easy to mount correctly, since a twin colour light emitting diode on the back of the sensor indicates, when the object is outside the range in which it can be detected, and when the object is at the centre of the measuring range. Furthermore, the measuring spot is visible.

1.2 Function of Light Indicators (Fig. 3)

Laser on (1):
Constant red light means that the laser is on.

Range indicator (2):

RED: Constant red light means either,

1. The measuring object is outside the range in which the ODS can detect an object, or

2. The reflectability of the measuring object is so poor that the ODS cannot detect the light reflected from the object.

GREEN: Constant green light means that the object is positioned at the reference distance (see Fig. 4), i.e. at the centre of the working range of the sensor.

NO LIGHT: If the sensor is turned on, and the indicator diode is neither red nor green, this means that the object is within the measuring range of the sensor but not exactly at the reference distance.

ORANGE: If an intermittant/flashing orange light turns on, it tells that the internal sensor temperature has reached approximately 50°C, corrosponding to an environment temperature of 40°C. This is an early warning signal.

1.3 Common specifications

GENERAL MEASUREMENT DATA:

Measuring frequency Select-2	2000 Hz
Measuring frequency Select-5	5000 Hz
Measuring frequency Select-10	10000 Hz
Measuring frequency (thickness, object opaque)	Full frequency
Measuring frequency (thickness, obj. semi-transparent)	Half frequency
Temperature deviation	± 0.03 % of F.S./°C
Semiconductor laser IEC laser class 2	655 nm, maximum 1 mW
Semiconductor laser IEC laser class 3R	655 nm, maximum 5 mW
optional	Other spot sizes & laser class 3B on special order

F.S. = Full Scale (= measuring range)

ELECTRICAL DATA

Supply voltage (max ripple 5 %)	22-36 V DC ± 10 %
Power consumption, max	4.5 W
Serial interface **)	RS232, RS422 or Ethernet
Baud rate *)	38400, 115200, 230400, 460800
Voltage output **OR**	1 - 9 V
Current loop output	4 - 20 mA

*) Select-2 provides a choise between 38400 (1 kHz) & 115200 (2 kHz)
*) Select-5 provides a choise between 38400,115200 & 230400 (5 kHz)
*) Select-10 have a choise of 38400,115200,230400 & 460800(10 kHz)
*) The output rate can be further reduced by using the Simple average filter
**)The Ethernet option can only be used for distance/Level measurement

PHYSICAL DATA

Dimensions	136 × 146 × 50 mm
Dimensions of ODS 20.5	136 × 138 × 50 mm
Weight excl. cable	App. 1.6 kg
Cable dimension	Ø 8 mm
Type of cable	7 × 2 × 0.14 mm^2 shielded
Cable length	2.5 m
Housing	steel/aluminium/glass

ENVIRONMENT DATA

Operating Temperature	0 - +45 °C
Storage temperature	-20 - +70 °C
Humidity (non condensing)	max 90 % RH
Degree of protection	IEC IP65

1.4 Sensor specific specifications

ODS 20.5

Distance to centre of measuring range	20.5 mm
Measuring range	16 - 25 mm
Digital output:	
Resolution*	0.8 µm
Reproducibility*	± 0.8 µm
Linearity*	± 0.05 % of 9 mm =± 4.5 µm
Analog outputs:	
Resolution*	0.8 µm
Reproducibility*	± 0.8 µm
Linearity*	± 0.08 % of 9 mm = ± 7.2 µm
Size of light spot	Ø 0.1 mm
Laser protection class	IEC 2

*) Referring to static unaveraged measurements on white paper

ODS 115

Distance to centre of measuring range	115 mm
Measuring range	100 - 130 mm
Resolution*	2 µm
Reproducibility*	± 2 µm
Linearity*	± 0.1 % of 30 mm = ± 30 µm
Size of light spot	Ø 1 mm
Laser protection class	2 kHz & 5 kHz IEC 2; 10 kHz IEC 3R

ODS 150

Distance to centre of measuring range	150 mm
Measuring range	100 - 200 mm
Digital output:	
Resolution*	10 µm
Reproducibility*	± 10 µm
Linearity*	± 0.05 % of 100 mm = ± 50 µm
Analog outputs:	
Resolution*	10 µm
Reproducibility*	10 µm
Linearity*	± 0.08 % of 100 mm = ± 80 µm
Size of light spot	Ø 1 mm
Laser protection class	2 kHz & 5 kHz IEC 2; 10 kHz IEC 3R

ODS 200

Distance to centre of measuring range	200 mm
Measuring range	100 - 300 mm
Resolution*	0.05 mm
Reproducibility*	± 0.05 mm
Linearity*	± 0.1 % of 200 mm = ± 0.1 mm
Size of light spot	Ø 2 mm
Laser protection class	2 kHz IEC 2; 5 & 10 kHz IEC 3R

*) Referring to staticunaveraged measurements on white paper

ODS 260

Distance to centre of measuring range	260 mm
Measuring range	110 - 410 mm
Resolution*	0.08 mm
Reproducibility*	± 0.08 mm
Linearity*	± 0.07 % of 300 mm = ± 0.20 mm
Size of light spot	Ø 2 mm
Laser protection class	2 kHz IEC 2; 5 & 10 kHz IEC 3R

ODS 450

Distance to centre of measuring range	450 mm
Measuring range	200 - 700 mm
Resolution*	0,1 mm
Reproducibility*	± 0.1 mm
Linearity*	± 0.05 % of 500 mm = ± 0.3 mm
Size of light spot	Ø 2 mm
Laser protection class	2 kHz IEC 2; 5 & 10 kHz IEC 3R

ODS 750

Distance to centre of measuring range	750 mm
Measuring range	400 - 1100 mm
Resolution*	0,5 mm
Reproducibility*	± 0.5 mm
Linearity*	± 0.1 % of 700 mm = ± 0.7 mm
Size of light spot	Ø 3 mm
Laser protection class	2 kHz IEC 2; 5 & 10 kHz IEC 3R

*) Referring to static unaveraged measurements on white paper

1.5 Limiting Factors

It may be difficult or impossible to measure on strongly reflecting surfaces, since even very small angular deviations may reflect the light past the sensor. Thus, the adjustment of the ODS must be made very carefully.

Structural changes and strong colour/contrast changes may result in smaller measuring errors. These can be minimized, if measurements are always performed in the same structural direction, and if measurements at strong contrast changes are performed with the ODS set up as shown in Fig. 5.

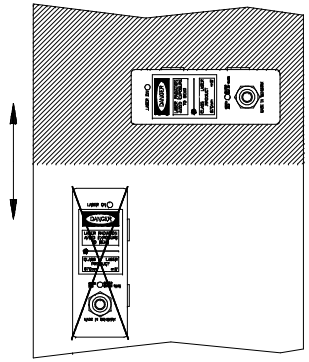


Fig. 5 Orientation of the unit at changes of contrast

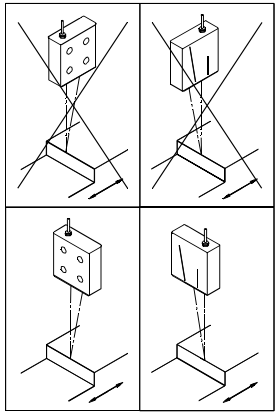


Fig. 6 Measurement on a stepped surface

If the object in question has a stepped surface, the ODS should be mounted according to Fig. 6. Two of the four positions are correct, whereas the two marked with a cross should be avoided.

A very bright surrounding light may influence the measurement, especially if the light shines directly into the front glass of the ODS. In most cases, the automatic compensation for external light and the spectral front glass will prevent such disturbances.

1.6 Maintenance

The ODS is made to withstand industrial environments.

The front glass must be kept free from dirt and oil film to avoid measuring errors.

Cleaning of the front glass is best done with non-flaky paper or with a soft cloth.

In very dusty environments it is recommended to install an air nozzle with clean, dry air to keep the front glass clean.

1.7 Optimal Measuring Conditions

- The front glass must be kept clean.
- The unit should be allowed to warm up for at least 30 min.
- The surrounding temperature should be constant.
- Lighting from the surroundings should be constant and light bulbs close to the set-up should be avoided.

1.8 EMC-Directive

From January 1st, 1996, all products that can emit or can be influenced by emitted electromagnetic radiation must comply with the EMC-directive. In practice, this includes all electrical or electronic products, and therefore also the ODS.
This means that a number of EU-harmonized standards must be met, and the manufacturer must mark his products with the CE-mark.

The ODS has been developed and manufactured to meet the EMC directive specified in the two generic standards,

EN 50081-1	Emission
EN 50082-1	Immunity

and accordance with the EMC-directive has been established using the method described in the directive 89/336/EEC article 10, part 1.

Fig. 7 CE-mark

During the EMC-tests, the sensor was mounted and connected as close to a real life situation as possible. In order to have the same conditions, all terminals should be connected as described in section 2.3 in this manual. Also the guide - lines regarding correct grounding of the sensor described in section 2.4 should be followed.

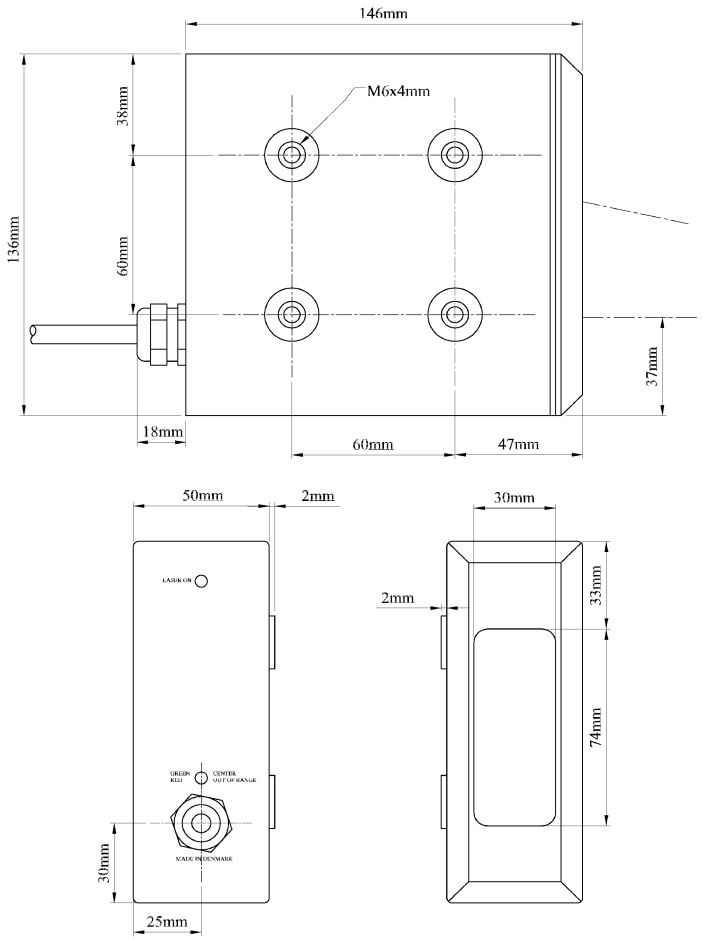


Fig. 8 Right hand side & Fig. 9 Front and Rear

2 INSTALTION

WARNING!
Be sure that the power is off when connecting/disconnecting the sensor.

Before power on, be sure that the laser beam will not enter people's eyes, neither directly nor from a reflecting surface, e.g. a mirror.

2.1 Mounting for Distance Measurement

The ODS is mounted by means of four M6 holes, placed on the right hand side of the unit (Fig. 8 and Fig. 9). The thread depth of each mounting hole is 6 mm.

If the ODS is mounted on a plane surface, it is recommended to use all 4 mounting holes. Only 3 mounting holes should be used in the case of a non-plane mounting surface in order to avoid distortion of the housing which could cause a reduction of the measuring accuracy.

On its left hand side, the ODS has two red guide lines, one for the direction of the visible laser beam and one for the direction of the reflected light entering the position detector from an object positioned 200 mm from the front glass.

A correct mounting is most easily made when the ODS is switched on, since the LED indicator can be used for the adjustment.

At first, the position is roughly adjusted, until the LED indicator switches from red to no light. Now, the ODS has detected the object. After this, the distance between the sensor and the object is adjusted, until the LED indicator turns green; this means that the object is situated at the centre of the measuring range.

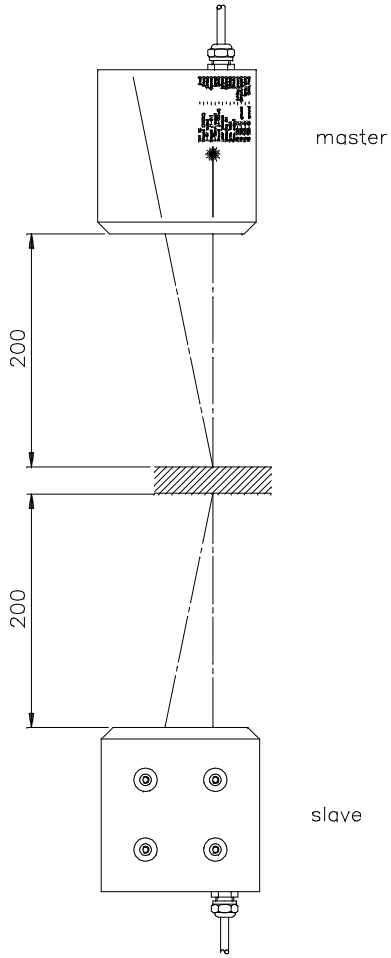


Fig. 10 Mounting for thickness measurement.
(Measures in mm) Example: ODS 200

2.2 Mounting for Thickness Measurement

For direct measurement of thickness, 2 ODS units (***must be the same type)*** are used, see Fig. 10.

The two units are mounted **laterally reversed** on each side of the object and are adjusted separately, without being interconnected, so that they are operating as distance measuring units at the centre of their measuring range (see section 2.1: Mounting for Distance Measurement).

The mounting of the two units must assure that these cannot be moved in relation to each other and also that the object under normal operating conditions will always remain within the measuring range.

To perform a correct thickness measurement it is very important that the two sensors measure along the exact same line.

Alignment of the two sensors can be made very easily by means of the visible measuring spot. Turn OFF the slave sensor, while the master sensor is ON. Now adjust the position of the master, until the measuring spot hits the centre of the corresponding laser beam blocking device on the slave. The hole can be seen through the red front glass.

The slave is adjusted correspondingly. After the coarse adjustment, a fine adjustment may be necessary, i.e. the adjustment procedure should be repeated at least once.

To form a thickness measuring unit, 2 ODS units are connected electrically. An ODS sensor can be used as a single distance measuring device, as a master sensor, or as a slave sensor.

The TX output from the "slave" sensor is connected to the RX input on the "master" sensor. The corresponding TX-ground and RX-ground must also be connected. The result of the thickness measurement is taken from the output signals of the "master" sensor.

In order to accomplish correct thickness measurements, the sync output from the "master" must be connected to the sync input on the "slave", ensuring synchronization between measuring telegrams.

Furthermore, when measuring partly transparent objects, two sensors can measure alternating, if the sync input of the "master" is connected to ground. Thus, the two sensors will not disturb each other, emitting light through the object and into the other sensor but work at half speed.

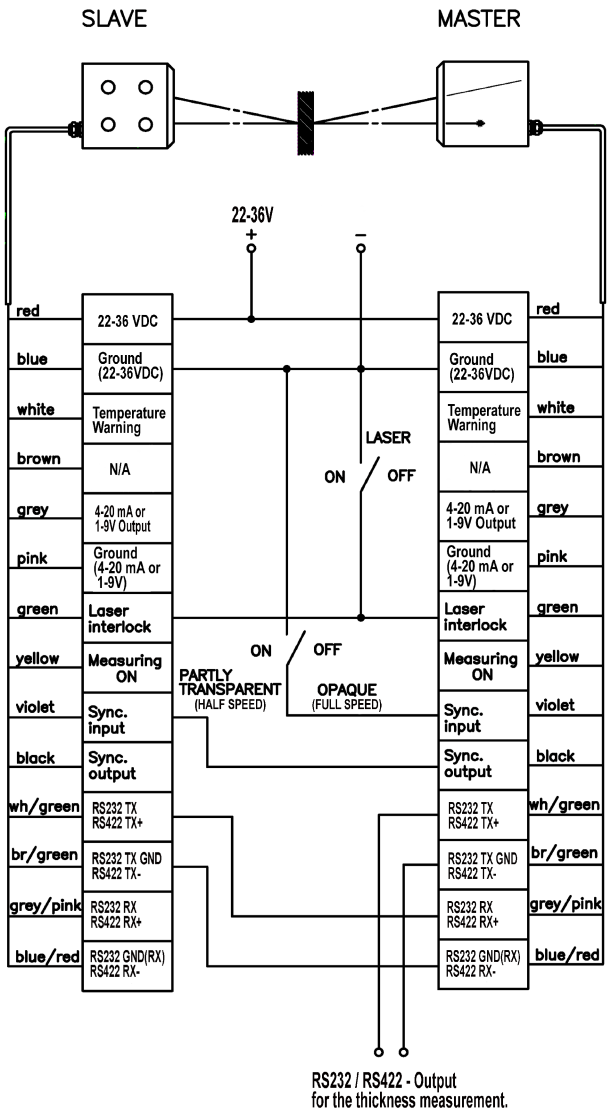


Fig. 11 Connections for thickness measurement

The LED indicator on the "slave" sensor indicates the ***distance*** from "slave" to object, whereas the LED indicator on the "master" sensor indicates whether or not the measured ***thickness*** is within the range.

Fig. 11 shows the necessary connections when measuring thickness with two ODS units. In addition, the voltage output, the current output, and the measuring ON signal from the slave can be used to tell about the ***distance*** from the slave to the object, whereas the voltage output, the current output, and the measuring ON signal from the master is directly related to the ***thickness*** measurement.

2.3 Terminals / Wire

INPUT:		
RED	22 - 36 V DC	Supply voltage.
BLUE	Ground	Supply voltage ground. The housing is connected to the outer cable shield. Maximum voltage difference between ground and housing is limited to ± 15 V by an internal voltage crossbar. Except for short spikes, voltage higher than ± 15 V will damage the sensor.
GREEN	Laser interlock	Safety wire. The wire must be connected to ground during normal operation. If not grounded, the laser will switch off. Allow app. 4 seconds before measuring data is available when reconnecting this wire to ground.
VIOLET	Sync. input	Signal for synchronous connections between master and slave. The terminal has three modes: If the wire is left open (not connected) the sensor will be working in standard distance sensing mode or be working as a master. If the wire is connected to the Sync Output wire from another sensor the sensor will work as a slave at the master frequency. If the wire is connected to ground (blue wire) the sensor will operate at half measuring frequency. This applies for both distance and thickness applications.

GREY/ ROSE	RX-digital input (signal) or RX+ when RS422 or Ethernet	Serial digital input for use in thickness applications or programming Select Mode and Parameters. When not used this wire should be left not connected.
RED/ BLUE	RX-digital input (ground) or RX- when RS422 or Ethernet	Reference for the RX-digital input. When not used, this wire should be left not connected or (for RS232) be connected to supply voltage ground (blue wire).
OUTPUT:		
YELLOW	"Measuring on"	Output signal < 3 V : Object not detected (corresponding to constant red light in LED indicator). Output signal > 10 V : Object detected (corresponding to LED indicator switched off or green). The wire should always be connected to ground (blue wire) via a 10 kΩ resistor (minimum) - also when signal is not used in application.
WHITE	Temperature early warning	The output should always be connected to ground (blue wire) via a 20 kΩ resistor (minimum). If the temperature inside the sensor is less than 50 °C, the signal level will be above 4 V, otherwise it will be less than 1 V. The output is protected against short-circuit to ground.
BROWN	N/A	Reserved for works use.

GREY	Analog current output (signal) (Optional 1-9V)	Signal for distance or thickness. The measuring range is 4 - 20 mA. Load range (resistance) : 0-300 Ω The wire should be connected to ground (pink wire), when not used in application. When Voltage signal is ordered instead of current signal, this wire is used for the 1-9V. In this case the output should be connected to Voltage Ground (Pink wire) via a 10 kΩ resistor (minimum).
PINK	Analog current output (ground)	Reference for the analog current output. This wire should **not** be connected to supply voltage ground (blue wire). Also used if 1-9V is ordered instead of 4-20 mA signal.
BLACK	Sync. output	Signal for synchronous connection between master and slave in thickness applications. The signal can also be used to synchronize other events in a complex process. A measurement starts at the positive flank of the square signal. This wire should be left not connected when not used in application.
WHITE/ GREEN	TX-digital output (signal) or TX+ when RS422	Serial digital output for use in distance and thickness measurement applications. This wire should be left not connected when not used in application.
BROWN/ GREEN	TX-digital output (ground) or TX - when RS422	Reference for the TX-digital output. When not used in application, this wire should be left not connected or (for RS232) be connected to supply voltage ground (blue wire).

Wires that are not used (connected) must be separately insulated.

2.4 Correct Grounding

To avoid introducing noise in the measurements, it is important that the sensor is mounted correctly. The sensor is equipped with a cable, containing a number of wires, and the guide lines described in section 2.3 should be followed.

The shield of the cable is internally connected to the housing, and the four mounting holes on the right hand side of the sensor therefore have the same potential as the shield.

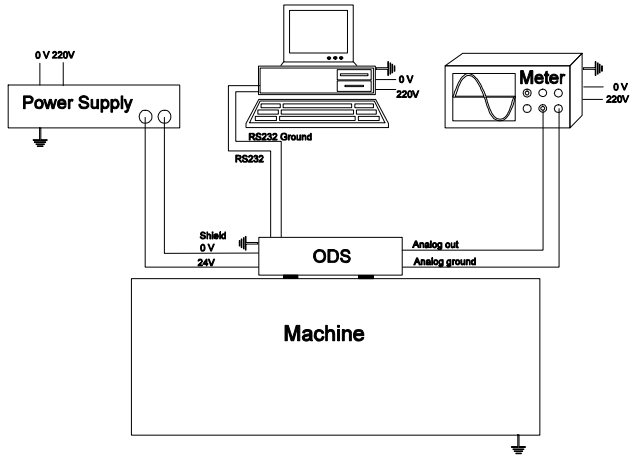


Fig. 12. Setup with all components connected to the same Protective ground.

It is necessary to distinguish between ground and outer cable shield. The ground in the sensor should be connected to 0 V on the power supply. The machine or table, where the sensor is mounted should be connected to the housing or the shield of the sensor. Fig 12 shows a schematic diagram of the optimal setup, where all components has been connected to the same protective ground.

All signal wires should be shielded all the way from the sensor to other equipment.

3 OPERATION

3.1 Reading of Measuring Results

3.1.1 Distance measurement

1 - 9 V output

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
1 V ~	16 mm	100 mm	100 mm	100 mm	110 mm	200 mm	400 mm
5 V ~	20,5 mm	115 mm	150 mm	200 mm	260 mm	450 mm	750 mm
9 V ~	25 mm	130 mm	200 mm	300 mm	410 mm	700 mm	1100 mm

A change in output voltage of 1 V corresponds to a distance change of

ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
1.125 mm	3.75 mm	12.5 mm	25 mm	37.5 mm	62.5 mm	87.5 mm

If no object is detected by the sensor, the voltage output will be < 0.5 V.

4 - 20 mA output

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
4 mA ~	16 mm	100 mm	100 mm	100 mm	110 mm	200 mm	400 mm
12 mA ~	20.5 mm	115 mm	150 mm	200 mm	260 mm	450 mm	750 mm
20 mA ~	25 mm	130 mm	200 mm	300 mm	410 mm	700 mm	1100 mm

A change in output current of 1 mA corresponds to a distance change of

ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
0.5625 mm	1.875 mm	6.25 mm	12.5 mm	18.75 mm	31.25 mm	43.75 mm

If no object is detected by the sensor, the current output will be < 1 mA.

RS232 output (serial protocol)

The serial data from the ODS are transferred asynchronously, and the data transfer rate is either 38,400 or 115200 or 230400 or 460800 Baud dependent on ODS sensor model and the Select setting. Unless otherwise specified in the purchase order the default setting will corrospond to the sampling rate of the sensor model.

The data format is,
- 1 start bit
- 8 data bits
- 2 stop bits

No parity will be used.
Logic levels according to CCITT V.28.
The protocol can be found in Appendix A.

3.1.2 Thickness measurement

1 - 9 V output

The centre of the measuring range corresponds to 5.00 V.

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
1 V ~	-4.5 mm	-15 mm	-50 mm	-100 mm	-150 mm	-250 mm	-350 mm
9 V ~	+4.5 mm	+15 mm	+50 mm	+100 mm	+150 mm	+250 mm	+350 mm

referred to a reference thickness with the two sensors mounted so that the master sensor voltage output is 5.00 V.

4 - 20 mA output

The centre of the measuring range corresponds to 12.00 mA.

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
4 mA ~	-4.5 mm	-15 mm	-50 mm	-100 mm	-150 mm	-250 mm	-350 mm
20 mA ~	+4.5 mm	+15 mm	+50 mm	+100 mm	+150 mm	+250 mm	+350mm

referred to a reference thickness with the two sensors mounted so that the master sensor current output supplies 12.00 mA.

RS232 output (serial protocol)

The centre of the measuring range corresponds to

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
showing	205000	115,000	150,000	20000	26000	4500	7500
i.e.	20.5 mm	115 mm	150 mm	200 mm	260 mm	450 mm	750 mm

The value will decrease to

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
showing	160 ,000	100,000	100,000	10000	11000	2000	4000
i.e.	16 mm	100 mm	100 mm	100 mm	110 mm	200 mm	400 mm
if the thickness of the object is reduced by							
	4.5 mm	15 mm	50 mm	100 mm	150 mm	250 mm	350 mm

The value will increase to

	ODS 20.5	ODS 115	ODS 150	ODS 200	ODS 260	ODS 450	ODS 750
showing	250000	130,000	200,000	30000	41000	7000	11000
i.e.	25 mm	130 mm	200 mm	300 mm	410 mm	700 mm	1100 mm
if the thickness of the object is increased by							
	4.5 mm	15 mm	50 mm	100 mm	150 mm	250 mm	350 mm

4 SELECT PROGRAMMING MODES

The Select functionality consists of a number of modes and filter settings described below. Most of the settings can be combined and it is therefore important to know that the sequence in wich they are implementet, and this corresponds to the order in wich they apear here below.

4.1 Thickness Mode / Extended T M / Difference Mode

The ODS sensor is in Thickness Mode as default setting. This enables a (Master) ODS sensor automatically to turn into a Thickness measuring System when a compatible (same measuring frequency and nominal output format) (Slave) ODS sensor is connected to its Serial Input. The 3 Modes are mutually exclusive.

In order always to have correctly calibrated analog signals, the nominal digital output regime in Thickness Mode is restricted to the relevant distance data of the ODS sensor type in question, i.e. 10000 to 30000 for an ODS 200 sensor. In certain Thickness applications this will restrict the thickness variation, that is possible to measure. By using Extended Thickness Mode the output range of an ODS 200 will be increased from the mentioned 20000 (200 mm) to 40000 (400 mm) by down scaling the output data from the sensor by 2 / to half the actually measured seize before they are output.

When ODS (Master) sensor is programmed to be in Difference Mode it will subtract a distance value from a connected (Slave) sensor from its own distance value before it is output. A (Master) sensor in Difference Mode will always use/be in the Extended Mode described above, i.e. an ODS 200 will output values between 10000 and 300000 representing a measured difference between 0 and +/- 200 mm. The range 10000 - 20000 being the negative domain (when the Master measures a shorter distance than the Slave) and 20000 to 30000 the possitive domain. Remember that the data values must be scaled up bu 2 in order to have the distance difference in 1/100 mm.

4.2 Median Filter

In this setting one of 15 Group Seizes can be chosen; 3, 5, 7, 9, 11, 13 all the way up to 31. The filter ranks the values in the group, thuss in a sorted sequence value number 2, 3, 4, 5, 6 up to 15 will be the value outputted (converted).

4.3 Simple Average Filter

In this setting every new non zero value is averaged over an interval given by compression factor. If all values in the interval are zero a zero value will be output.

It is important to note that only one averaged value will be output, and therefore the output frequency will be reduced according to the compression factor. If a compression factor 10 is used on a 2 kHz sensor the output rate will be 200 Hz.

4.4 Running Average Filter

In this setting a group of measuring values are being averaged on the fly after the zero values has been suppressed/discarded in the calculation of the running average.

The seize of the group can be chosen from 2 to 1000 measuring points, and the maximum number of zero values to be ignored in the calculation can be chosen between 1and 999. It is recomended to use maximum zero suppression. If a data stream contain more consequetive zero values than specified by the zero suppression parameter a zero value will be output.

4.5 Level Mode

In this Mode the values are inverted. An ODS 200 would consequently output result ranging from 30000 at short haul to 10000 when measuring at its longest range.

4.6 Sample-Hold Mode

In this Mode the latest valid measuremet data will be output and any occuring zeros will be replaced with the latest valid measurement value untill a new non zero measurement result is detected. Ligth Intensity Codes as well as zero values will never be output after the first valid measurement data has occured.

5 SELECT SENSOR SETTINGS

5.1 Baud Rate Settings

Unless otherwise ordered an ODS sensor will be delivered in the lowest baud rate setting e.g. 38400 coresponding to a serial output rate of 1 kHz. A 2 kHz sensor can be reset to a 115200 baud rate giving an output rate equal to the measuring rate (and output frequency of the analog signals). Baud Rates of 230400 (5 kHz) and 460800 (10 kHz) requires a RS422(485) type serial interface. 5 and 10 kHz sensors will output at a 2½ kHz frequency when the baud rate is set to 115200. A change of baud rate is not implemented before the is turned of and powered up again.

5.2 Light Intensity Code Setting

"Zero" measurements are default an integer value less than 9. The sensor can be reset to output zero values instead of the Codes. Neither information type is output when Sample-Hold is enabled.

If a measuring applcation give to many zero measuring results, it will be constructive to make an analyzis without any Select filtering done and save the captured raw measuring data to a file on hard disk for further scrutinising or to be e-mailed to DSE.

The Light Intensity Codes can be explained as follows:

6: Too little light returned or there is no target at all.
5: Too much light returned/blinding or false light.
4: False light or an undefined spot recorded.
0/1/2: A target is observed but outside the measuring range.

5.3 Advanced Sensor Settings

The DSP firmware inthe ODS sensor is is highly developed for giving the best possible distance estimates, and as far as possible only output values if they can beconsidered to be correct values.
The control of the light intensity is also highly developed to give the best measuring results under general circumstances.

Under exceptional measuring conditions a change of measuring algoritms or parameters can make it possible to obtain measuring data, where this is not possible with a standard sensor.
If measuring difficulties are documented in the form of raw data files e-mailed to DSE, it can determined if a change of sensor setting can positively influence the results of a given application.

6 LASER CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
For safety reasons, install the ODS in a location where the laser beam will not enter someone's eyes directly or be reflected from a shiny surface.
Do not install the sensor in a location, where the laser beam can enter someone's eyes due to the passage or disappearance of the object being measured. Use e.g. a screen to stop the leaking of the laser beam.
Provide security installations as stated in relevant regulations so that the

laser beam will not go into someone's eyes, and also post a warning in the laser area.

All ODS Black-Line sensor models are manufactured in the same house, and are provided with light indicator on the back side as shown in Fig. 3. The hazard triangel shown in Fig. 13 is placed on the top of the sensor close to the front end. The yellow laser class labels shown in Fig. 14 & 15,16, 17 & 18, and the Product Information label Fig. 19. is placed on the left side of the ODS sensor (oposite the mounting holes). Laser class 3R models also have a an aperture label (emission indicator) on the top of the sensor between the front and the hazard triangel. The caution tags must always be legible.

Fig. 13 Caution tags

Fig. 14 Class 2 caution tag

Fig. 15 Class 3R caution tag

Fig. 16 Class 3B caution tag

Fig. 17 Class 2 for Blue diode

Fig. 18 Class 3R Blue diode

On all models the laser light can be controlled by an Laser InterLock wire (Green).

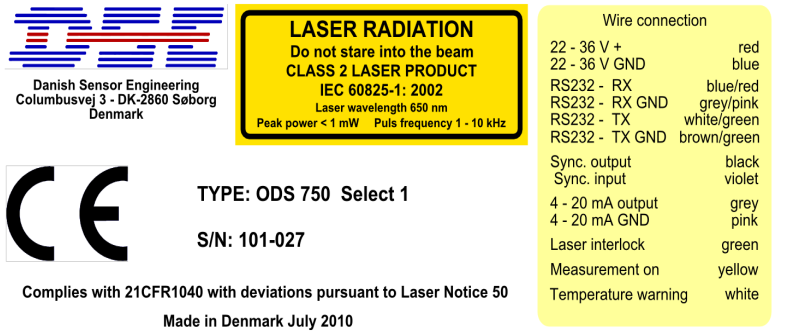


Fig. 19 Example of a Product Identification Label

Laser class 3B models for the USA market have additional safety features in addition to the mentioned emission indicater, interlock connector and aperture label, a key switch is supplied with the sensor, and a beam stop is placed on the front of the sensor as shown in Fig. 20.

Users of these sensors are advised to wear protection goggles/eyewear.

Fig. 20 Attenuator

7 SERVICE

All servicing of this instrument is done by the manufacturer.

Opening of the sensor will not only cause annulment of the warranty but will *also corrupt measurement performance*.

APPENDIX A - PROTOCOL

A.1 ODS 20.5, ODS 115 and ODS 150

The result of each measurement is transmitted as a 24 bit word, consisting of 3 bytes, below called Byte1, Byte2, and Byte3. One telegram is made of the 3 bytes.

Byte1 consists of 6 header bits and the 2 least significant bits of the measurement result, i.e. Byte1 = hhhhhhddB
where h is a header bit and d is a data bit.
The header bits will alternate between 101010B and 010101B.

Byte2 consists of data bit Nos. 2-9, whereas Byte 3 is the 8 most significant bits in the result, i.e. bits Nos. 10-17.
A measured distance, e.g. 124.673 mm, is transmitted in µm, i.e. as the figure 124673 (decimal), converted to the hexadecimal value 1E701H or binary 011110011100000001B. In the telegram, the value will be transmitted as,

<Byte1> = 10101001B = A9H
<Byte2> = 11000000B = C0H
<Byte3> = 01111001B = 79H

where the first set of header bits has been used.

A sequence of telegrams will look as follows,

Byte No. n+1 Byte1
Byte No. n+2 Byte2
Byte No. n+3 Byte3
Byte No. n+4 Byte1
Byte No. n+5 Byte2
Byte No. n+6 Byte3
Byte No. n+7 Byte1
Byte No. n+8 Byte2
Byte No. n+9 Byte3
etc.

The measuring results (3 bytes) will be transmitted with a frequency of 1000 Hz, 2000 Hz/(2500 in case of an 5 kHz model) or 5000 Hz dependent on sensor model and the Select setting chosen by the user.
When measuring thickness the sensors must always be syncronized and output at the baudrate corresponding to the full measuring frequency. This entails that 5 kHz sensors must be ordered with RS422 serial interface. In the special thickness measurement application on semi transparent materials, where the sync. input of the master sensor is connected to ground, the measuring frequency is halfed and the speed of the data transmission will also be reduced using the full speed Baudrate.
If no object is detected by the sensor, an error code will be output. This is the default setting in Select-2 and Select-5 sensors. The codes are integers between 0 and 9. With this Select setting Bit 2 i Word 1 OFF/"0". Originally if no object is detected by the sensor, both <LSB> and <MSB> will be transmitted as <ooH>. When the sensor

is Select programmed with Bit 2 in Word 1 set (ON/"1") the error code will be replaced with only zero values.

A.2 ODS 200, ODS 260, ODS 450 and ODS 750

The result of each measurement is transmitted as a word, consisting of 2 bytes, MSB (Most Significant Byte), and LSB (Least Significant Byte), where the order of transmission is opposite, i.e. LSB is transmitted first.

A measured distance, e.g. 224.67 mm, is transmitted in hundredths of a mm, i.e. as the figure 22467 (decimal), converted to the hexadecimal value 57C3H. In the telegram, the value will be transmitted as,

<LSB> = C3Hfollowed by
<MSB> = 57H

Data are transferred as telegrams, each consisting of 3 bytes: 1 header byte and 2 data bytes. The header byte will alternate between <AAH> and <55H>. A sequence of telegrams will look as follows,

Byte No. n+1 Header 1 <AAH>
Byte No. n+2 Data byte 1 <LSB>
Byte No. n+3 Data byte 1 <MSB>
Byte No. n+4 Header 2 <55H>
Byte No. n+5 Data byte 2 <LSB>
Byte No. n+6 Data byte 2 <MSB>
Byte No. n+7 Header 3 <AAH>
Byte No. n+8 Data byte 3 <LSB>
Byte No. n+9 Data byte 3 <MSB>
etc.

The measuring results (3 bytes) will be transmitted with a frequency of 1000 Hz, 2000 Hz/(2500 in case of an 5 kHz model) or 5000 Hz dependent on sensor model and the Select setting chosen by the user.

When measuring thickness the sensors must always be syncronized and output at the baudrate corresponding to the full measuring frequency. This entails that 5 kHz sensors must be ordered with RS422 serial interface. In the special thickness measurement application on semi transparent materials, where the sync. input of the master sensor is connected to ground, the measuring frequency is halfed and the speed of the data transmission will also be reduced using the full speed Baudrate.

If no object is detected by the sensor, an error code will be output. This is the default setting in Select-2 and Select-5 sensors. The codes are integers between 0 and 9. With this Select setting Bit 2 i Word 1 OFF/"0". Originally if no object is detected by

the sensor, both <LSB> and <MSB> will be transmitted as <ooH>. When the sensor is Select programmed with Bit 2 in Word 1 set (ON/"1") the error code will be replaced with only zero values.

APPENDIX B – Telegrams for programming sensor settings

In most enduser applications sensor settings will remain unchanged year after year, once they have been determined and programmed into the sensor. Under these circumstances, it is by far the easiest way to use the **ODS-Explorer.exe** program. Often Machine builders will however want to implement facilities for reconfiguring sensor settings in their application program in order to cater for different customer needs.

The sensor settings can be interrogated or updated by using a 4 byte command code to stop the measuring operation folowed after a short pause by a single byte code/command.

Sendig decimal 23, 103, 204, 18 and thereafter 77 the sensor will send back 15 parameters consisting of 2 byte words. <MSB> and <LSB>, i.e. a string of 30 bytes followed by a single byte reading 111, whereafter measuring is resumed.

The first word consists of flags/toggel bits: 1=ON or 0=OFF:
The second word is the size of the Running Average Filter: A number between 2 and 1000.
The third word is maximum number of zero values suppressed in the above Filter: 0 to 999.
The forth word is Baud Rate: LSB is set to 8 (default), 16, 24, 32 or 40.
The fifth word is the size of the Median Filter: 1, 3, 5, 7, 11, 9, 11, 13 or 15 enables.
The sixth word is the size of the Simple Average Filter: A number between 2 and 200.
Zero values disables the filter in question.
The remaining 9 words are reserved for factory use only. All 22 bytes are zero's or have undefined values unless otherwise instructed by DSE.

Re. 1 word:

Bit 0: Is set for enabling Extended Thickness Mode.
Bit 1: Is set for enabling Level Mode.
Bit 2: Is set for outputting "0" instead of an error code (default).
Bit 3: Is set for enabling Sample-Hold Mode.
Bit 4: Is set for enabling Difference Mode.
Bit 5 to 15 are reserved for factory use only, and must be zero unless otherwise instructed by DSE.

Re. 2. word: The Running Average Filter size parameter determines how many measurement values are used for calculating the running average. A zero value disables the filter functionality.

Re. 3 word: The maximum number of zero-measurements that will be disregarded when calculating the running average value. It is recommended that this parameter is set to be the Group size minus 1.

Re. 4. word: Baudrate 38400 corresponds to the code 8. Baudrate 115200 corresponds to the code 16. Baudrate 230400 corresponds to the code 24. Baudrate of 460800 corresponds to the code 32, and Baudrate of 921600 corresponds to the code 40.

Re. 5. word: The Median Mode size parameter can be set to uneven numbers of measuring points between 3 and 15. If the parameter is set to zero the median filter is disabled. In this Mode, the "middle value" of a sorted list of measurement values is output. If the median filter size is set to 5 and the latest 5 measuring result was: 11510, 11012, 11859, 11200 and 10905 the sorted list will be 10905-11012-11200-11510-11859 and the Median value is 11200 i.e. the value to be outputted in this measuring / output cycle.

Re. 6. word: The Simple Avarage Filter parameter, the Compression Factor, is an integer between 2 and 200, determines how many measurement values are used for calculating ONE (Simple Average) value, that replaces ALL the measuring values used in the calculation. Maximum zero suppression is used,i.e. a zero value only appears when there has been no zero values in the group at all. Do observe, that the output rate is reduced according to the compression factor.

The example below show a sensor setting with error code removed and Group size set to 100 and zero suppression to 99 with a Baud rate of 115200.

	Record layout:			Example:
Word 1	MSB	LSB	b#00000000	b#00000100 = 4
Word 2	MSB	LSB	0	100
Word 3	MSB	LSB	0	99
Word 4	MSB	LSB	0	16
Word 5	MSB	LSB	0	0
Word 6	MSB	LSB	0	0
Word 7	MSB	LSB	0	0
Word 8	MSB	LSB	0	0
Word 9	MSB	LSB	0	0
Word 10	MSB	LSB	0	0
Word 11	MSB	LSB	0	0
Word 12	MSB	LSB	0	0
Word 13	MSB	LSB	0	0
Word 14	MSB	LSB	0	0
Word 15	MSB	LSB	0	0

The sensor settings can be updated by using a 4 byte command code to stop the measuring operation folowed by a single byte code/command. Sendig decimal 23, 103, 204, 18 and 7 the sensor will wait for receiving the above-mentioned 30 bytes, but with each individual byte

lead by an editing byte/ header byte being either decimal 255 or 0. 255 instructs a replacement with the following byte, and 0 instructs the present information/setting to remain.

Record layout: Example:

Header	MSB	Header	LSB		255	0	255	4
Header	MSB	Header	LSB		255	0	255	100
Header	MSB	Header	LSB		255	0	255	99
Header	MSB	Header	LSB		255	0	255	16
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0
Header	MSB	Header	LSB		0	0	0	0

If only the two Group Mode Parameters, Group Size and Zero Filtering needs to be changed to, lets say, 20 and 19 respectively, the 65 byte string should read in decimal notation as:

23, 103, 204, 18,7;
0, 0, 0, 0;
255, 0, 255, 20;
255, 0, 255, 19;
0, 0, 0, 0;
0, 0, 0, 0:
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0;
0, 0, 0, 0:
0, 0, 0, 0;
0, 0, 0, 0;

As soon as the sensor receives the 65 bytes, it will output a byte equal to 111, and then returns to measuring mode again, and outputs 3 byte telegrams. Please remember, that a change of Baud rate will first be activated when the sensor has been turned off and is powered up again.

APPENDIX C: SUB-D Connectors

ODS sensors are delivered without a connector.

Be sure that the power to the ODS sensor is ***switched OFF*** when connecting or disconnecting the sensor to your PC.

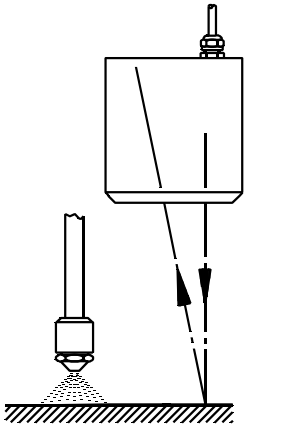
If the COM port is a 9-pole D-connector, the following connections will apply when it is a serial RS232 or most probably if it is a RS 422/485 COM port:

From Sensor	To D-connector	To D-connector
	RS 422/485	RS 232
White/Green wire (RS 232 TX or RS 422/485 TX +)	Pin 3	Pin 2
Brown/Green wire (RS 232 Ground or RS 422/485 TX -)	Pin 4	Pin 5
Grey/Rose wire (RS 232 RX or RS 422/485 RX +)	Pin 2	Pin 3
Red/Blue wire (RS 232 Ground or RS 422/485 RX -)	Pin 1	Pin 5
Blue wire (RS 422/485 Ground = Power Ground)	Pin 5	-

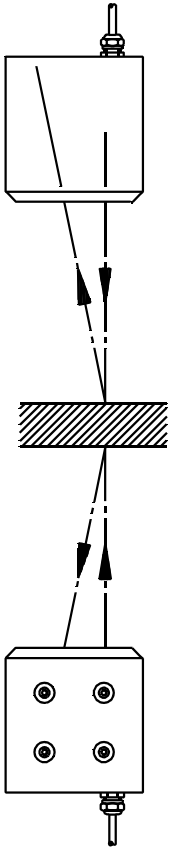
If the COM port is a 25-pole D-connector, the following connections will apply when it is a serial RS232 or most probably if it is a RS 422/485 COM port:

From Sensor	To D-connector	To D-connector
	RS 422/485	RS 232
White/Green wire (RS 232 TX or RS 422/485 TX +)	Pin 3	Pin 3
Brown/Green wire (RS 232 Ground or RS 422/485 TX -)	Pin 16	Pin 7
Grey/Rose wire (RS 232 RX or RS 422/485 RX +)	Pin 2	Pin 2
Red/Blue wire (RS 232 Ground or RS 422/485 RX -)	Pin 14	Pin 7
Blue wire (RS 422/485 Ground = Power Ground)	Pin 5	-

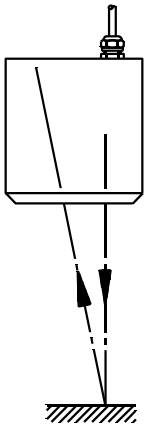
When the sensor is equipped with an RS422 serial interface it is necesarry to consult the COM port specifications in order to verify the above suggestion.



measurement and control
of surface treatment

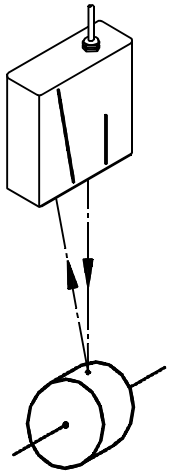


thickness measurement

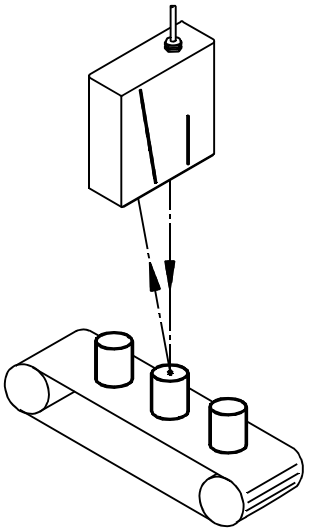


distance measurement

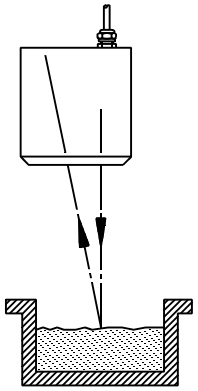
Fig. 23 Applications



Measurement of throw
and excentricity



Control of vacuum or
pressure in containers.



level control

Fig. 24 Applications