

ODS Black-Line Sensors

**Short Stand-off Models:
ODS 205/ODS 230/ODS 280/ODS 330/
ODS 445**

**Long Stand-off Models:
ODS 455/ODS 510/ODS 550/ODS 650/
ODS 775**

**All in HT / VHT & VVHT form.
and as Select-2 & -10 Models**



OPERATOR'S HARDWARE MANUAL

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NOTE

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

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1 GENERAL INFORMATION

1.1 Description

ODS sensors are optical distance measuring devices for non contact precision measurement of distance or thickness, width and difference.

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 collimated laser beam forms a spot on the measuring target / 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 or RS422 serial output or USB / Ethernet interface, provides the distance to the object with a frequency of either 2000Hz or 10000Hz or according to Select programming. At the same time one analog output deliver the measured distance, either as a 4-20mA current loop or as a 1-9V signal. The output options must be decided at time of ordering.

An ODS unit (except if it is ordered with USB / Ethernet serial interface) is prepared for measurement of thickness, since 2 units of the same type (same measuring range, same nominal resolution, same measuring frequency and same serial interface) connected to each other automatically will function as one measuring system in which the output signal is an expression of the thickness variation.

The ODS has a special built-in feature for measuring thickness of partly transparent objects, e.g. paper, wood, plastic, etc. 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.

The ODS is easy to mount correctly, since a light emitting diode on the top 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.

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1.2 High Temperature

ODS Black-Line sensors can be specified to measure on target materials up to 1000°C as HT models or up to 1300°C as VHT models using **Red Diodes**.

When VVHT is specified a **Blue Diode** is used and the target temperature can reach far above 1500°C.

It is important to stress, that the HT specification only concerns the target temperature. Maximum sensor environment temperature is 45°C.

The HT specification can also be necessary when there is a risk of harmful false light as is the case with bright sunlight, both direct and reflected.

1.3 Sensors with Ethernet Interface

ODS sensors With Ethernet are equipped with Lantronix xPico device server module.

Manuals for xPico module and software can be downloaded from www.lantronix.com. Sensors are delivered with static IP address, see sensor label. It can be changed with the software "Deviceinstaller", see user guide "xPico_UG.pdf".

Use "CPRmanager" to configure a virtual COM port for application software.

It is not possibly to use sensors in thickness mode with Ethernet interface

1.4 Sensors with USB Interface

ODS sensors with USB interface use standard FTDI interface circuit. When sensor is connected to a PC it will automatic configure a virtual COM port for use in application software. In Windows it is necessary to change the standard setting for latency timer for the actual COM port. Change from 16 ms to 1 ms to avoid communication errors. See appendix E on page 34.

Sensor need to be provided with power from separate supply.

USB interface is powered from USB host so it will work even if the sensor turned off.


It is not possibly to use sensors in thickness mode with USB interface.

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1.5 Function of Light Indicators.

LASER RADIATION
 Do not stare into the beam
CLASS 2 LASER PRODUCT
 IEC 60825-1: 2002
 Laser wavelength 650 nm
 Peak power < 1 mW Pulse frequency 1 - 10 kHz

M12 x 1 connector	
Function	Pin
22 - 36 V +	9
22 - 36 V GND	2
RS232 - RX	11
RS232 - RX GND	12
RS232 - TX	1
RS232 - TX GND	3
Sync. output	7
Sync. input	10
4 - 20 mA output	8
4 - 20 mA GND	5
Laser interlock	4
Measurement on	6


 Danish Sensor Engineering
 Columbusvej 3 - DK-2860 Søborg
 Denmark


CE

Measure range: 400 - 1150 mm
 TYPE: ODS 775 / Select - 2
 S/N: 141-037

Complies with 21CFR1040 with deviations
 pursuant to Laser Notice 50
 Made in Denmark July 2014

● Temperatur warning
● Center distance
● Out of range / error

● Laser on



LASER ON: Green light indicates that the laser is on.

RED:

Constant red light means:

1. The measuring object is outside the range in which the sensor can detect an object, or
2. The reflect ability of the measuring object is so poor that the sensor cannot detect the light reflected from the object.

GREEN:

Constant green light means that the object is positioned at the reference distance, 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:

Intermittent/flashing orange tells that the environment temperature is too high.

See 3.2 on page 22 how to read the internal sensor temperature over the serial interface.

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1.6 Common Specifications

GENERAL MEASUREMENT DATA:

Nominal Digital Output Resolution (18 bit internal)	0.01 mm
Analog Conversion	14 bit DAC
Measuring Frequency Select-2	2000 Hz
Measuring Frequency Select-10	10000 Hz
Measuring Frequency (thickness, object opaque)	Full frequency
Frequency (thickness, object semi-transparent)	Half frequency
Temperature Deviation	$\pm 1.5\mu, \pm 2\mu, \pm 2.5\mu,$ $\pm 5\mu, \pm 10\mu / ^\circ\text{C}$
Semiconductor laser IEC laser class 2 650 nm,	1 mW
Semiconductor laser IEC laser class 3R 650 nm,	< 5 mW
VVHT spec.: A Blue diode IEC laser class 2 405 nm,	1mW

ELECTRICAL DATA

Supply Voltage (max ripple 5 %)	22 - 36 VDC
Power Consumption,	max 4.5 W
Serial Interface	RS232, RS422, USB or Ethernet
Baud rate can be set to either:	38400, 115200, 23400 or 460800 kbit/s
Select-10 requires RS 422 interface running at 460800 kbit/s	
Current Loop Output	4 - 20 mA
Voltage Output: (Optional alternative to current output)	1 - 9 V

PHYSICAL DATA

Dimensions	120 × 95 × 30 mm
Weight excl. Cable	App. 390 g
Male Connector	M12x1 (A coding)
Housing	Aluminium

ENVIRONMENT DATA

Operating Temperature	0 - +45 °C
Storage Temperature	-20 - +70 °C
Humidity (non condensing)	max 90 % RH
Degree of Protection	IEC IP65
When a cable is ordered with the sensor please see Appendix C.	

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RS232 and RS422 Output:

The serial data from the ODS are transferred asynchronously, and the data transfer rate is either 38400, 115200, 230400, 460800 kbit/s depending on the model and Select setting.

Unless otherwise specified in the purchase order the default setting will correspond to the sample rate of 2 kHz or 10 kHz.

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.

Ethernet or USB output:

If COM port emulation is used the protocol is identical.

Ethernet Interface:

Ethernet 10Base-T or 100Base-TX (Auto-sensing)

Protocols: TCP/IP, UDP/IP, ARP, Telnet, ICMP, SNMP, DHCP, BOOTP, TFTP, AutoIP and HTTP.

Cable / M12 plug for connection.

USB Interface:

USB 2 and mini B connector in sensor.

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Dimensions:

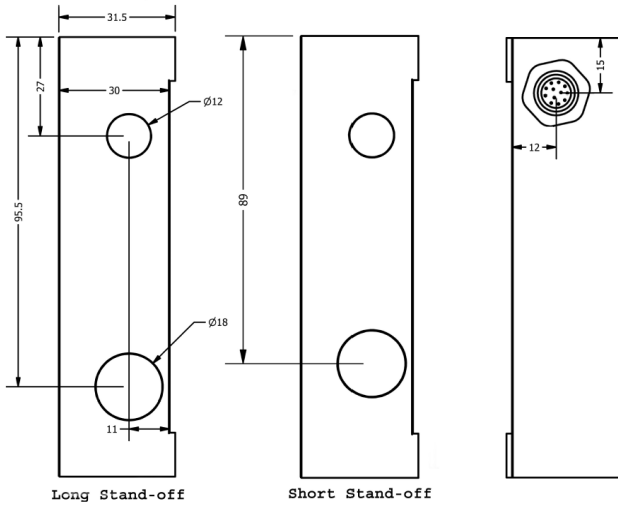


Figure 1. ODS Black-Line Front and Back View

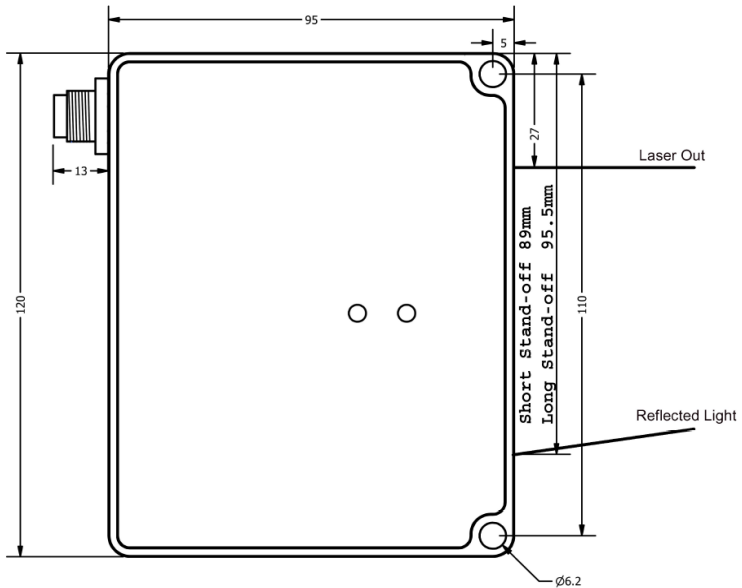


Figure 2. ODS Black-Line Top View

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1.7 Sensor Specific Specifications

Short Stand-off Models:

ODS 205

Distance to centre of measuring range	205 mm
Measuring range	180 - 230 mm
<i>Digital output:</i>	
Resolution*	0.01 mm
Reproducibility*	± 0.01 mm
Linearity*	± 0.04 % of
	50 mm = ± 0.02 mm
Size of light spot	Ø 0.5 mm

ODS 230

Distance to centre of measuring range	230 mm
Measuring range	180 - 280 mm
<i>Digital output:</i>	
Resolution*	0.01 mm
Reproducibility*	± 0.01 mm
Linearity*	± 0.03 % of
	100 mm = ± 0.03 mm
Size of light spot	Ø 0.6 mm

ODS 280

Distance to centre of measuring range	280 mm
Measuring range	180 - 380 mm
<i>Digital output:</i>	
Resolution*	0.02 mm
Reproducibility*	± 0.02 mm
Linearity*	± 0.03 % of
	200 mm = ± 0.06 mm
Size of light spot	Ø 0.7 mm

ODS 330

Distance to centre of measuring range	330 mm
Measuring range	180 - 480 mm
<i>Digital output:</i>	
Resolution*	0.03 mm
Reproducibility*	± 0.03 mm
Linearity*	± 0.03 % of
	300 mm = ± 0.09 mm
Size of light spot	Ø 0.8 mm

ODS 445

Distance to centre of measuring range	450 mm
Measuring range	200 - 700 mm
<i>Digital output:</i>	
Resolution*	0,07 mm
Reproducibility*	± 0.07 mm
Linearity*	± 0.03% of
	500 mm = ± 0.16 mm
Size of light spot	Ø 0.9 mm

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Long Stand-off Models:

ODS 455	
Distance to centre of measuring range	450 mm
Measuring range	400 - 500 mm
<i>Digital output:</i>	
Resolution at short range* app.=	2-STD 0.01 mm
Resolution at long range* app.=	2-STD 0.02 mm
Linearity*	± 0.04 mm
Size of light spot	Ø 0.6 mm
ODS 510	
Distance to centre of measuring range	500 mm
Measuring range	400 - 600 mm
<i>Digital output:</i>	
Resolution at short range* app.=	2-STD 0.01 mm
Resolution at long range* app.=	2-STD 0.02 mm
Linearity*	± 0.06 mm
Size of light spot	Ø 0.7 mm
ODS 550	
Distance to centre of measuring range	550 mm
Measuring range	400 - 700 mm
<i>Digital output:</i>	
Resolution at short range* app.=	2-STD 0.01 mm
Resolution at long range* app.=	2-STD 0.03 mm
Linearity*	± 0.09 mm
Size of light spot	Ø 1 mm
ODS 650	
Distance to centre of measuring range	650 mm
Measuring range	400 - 900 mm
<i>Digital output:</i>	
Resolution at short range* app.=	2-STD 0.02 mm
Resolution at long range* app.=	2-STD 0.04 mm
Linearity*	± 0.11 mm
Size of light spot	Ø 0 1.5 mm
ODS 775	
Distance to centre of measuring range	775 mm
Measuring range	400 - 1150 mm
<i>Digital output:</i>	
Resolution at short range* app.=	2-STD 0.03 mm
Resolution at long range* app.=	2-STD 0.1 mm
Linearity*	± 0.25 mm
Size of light spot	Ø 2 mm

*) Referring to static un-averaged measurements on white paper

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1.6 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. 3.

If the object in question has a stepped surface, the ODS should be mounted according to Fig. 4. Two of the four positions are correct, whereas the two

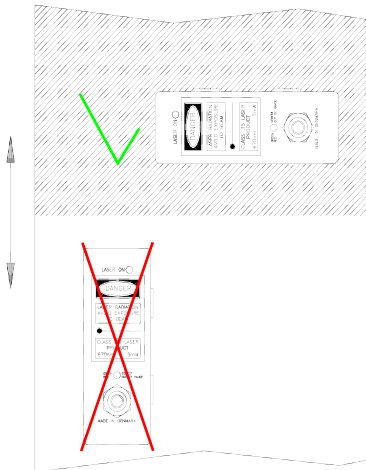


Figure 3. Orientation of the unit at changes of contrast

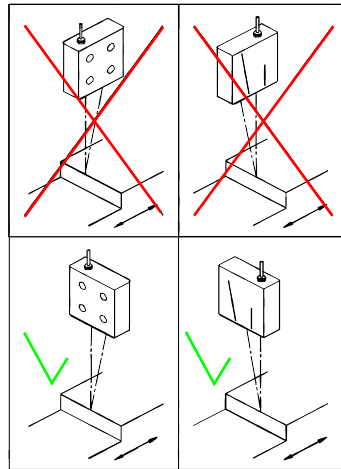


Figure 4 .Measurement on a stepped

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.

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1.7 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.

1.8 Optimal Measuring Conditions

The front glass must be kept clean.

The unit should be allowed to warm up for at least 20 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.

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1.9 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,

Emission EN 61000 - 6 - 3 : 2007

Immunity EN 61000 - 6 - 2 : 2005

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

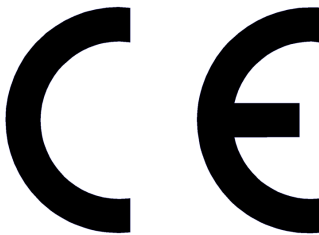


Figure 5. CE mark

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2 INSTALLATION

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 two Ø6.2 mm holes, placed on the front side of the sensor house. **IMPORTANT:** Only the two mounting points below the sensor (1.5 mm high foot) must be in contact with the mounting bracket/protection house. 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 sensor 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 center of the measuring range.

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2.2 Mounting for Thickness Measurement

For direct measurement of thickness two ODS units (***must be the same type***) are used, see Fig. 6.

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 two 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 wire 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.

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.

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Fig. 5 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.

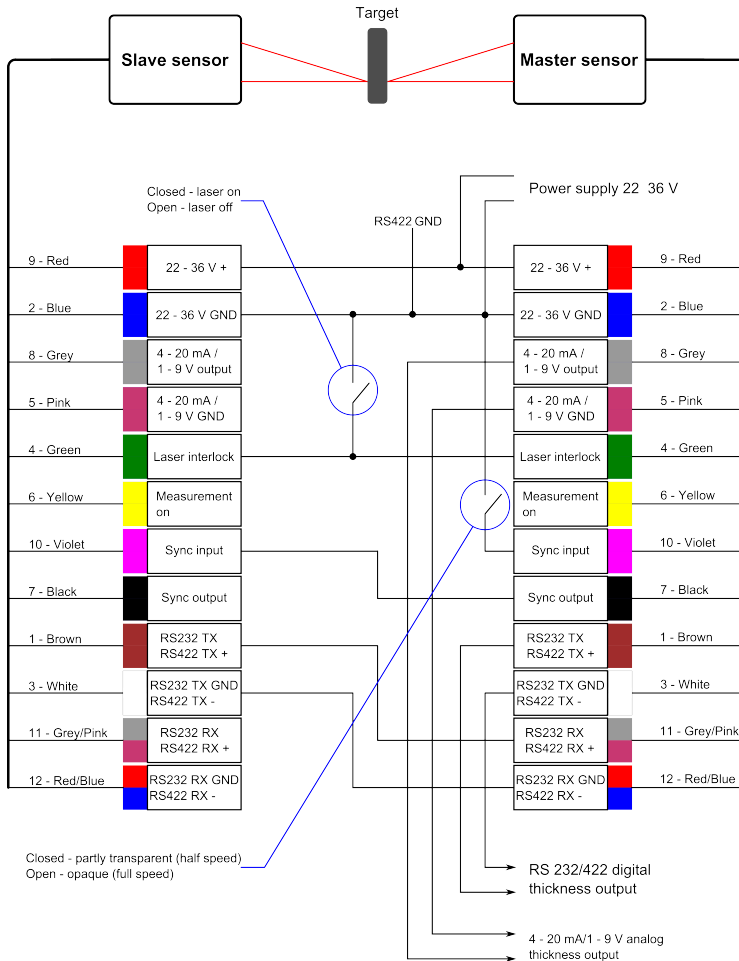


Fig. 6 Connections for thickness measurement

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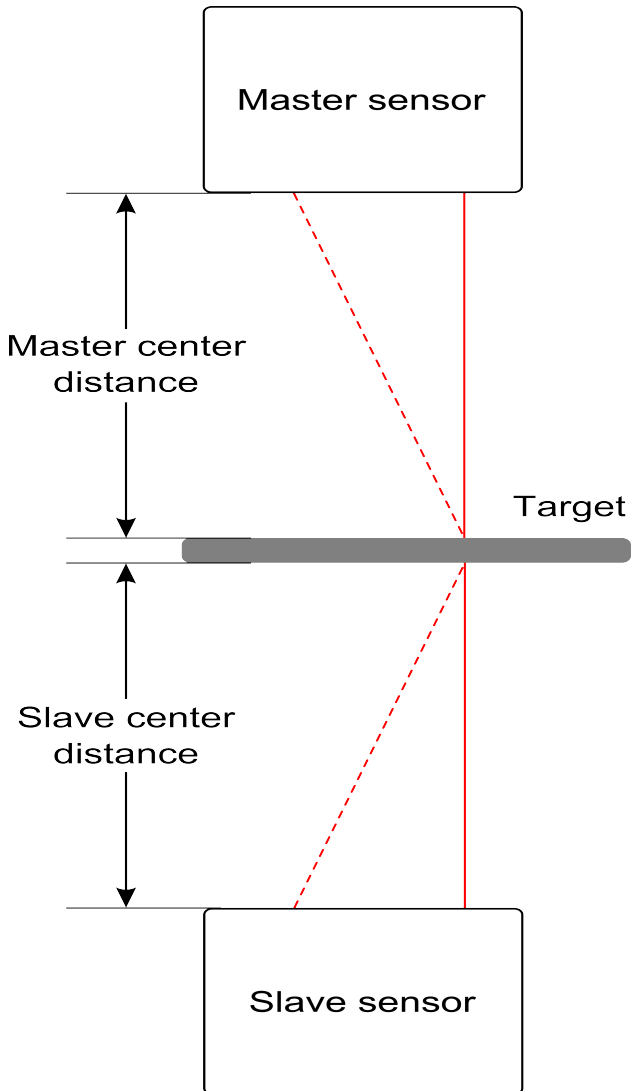


Figure 7. Sensors mounted for thickness measurement.

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2.3 Terminals (For cable colours please see Appendix C.)

INPUT:

PIN 9	22-36 V	DC Supply voltage.
PIN 2	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. If RS422 is used the RS422 GND of the converter should be connected to Supply voltage ground.
PIN 4	Laser Interlock	Safety wire. The wire must be connected to ground during normal operation. If not grounded, the laser will switch off.
PIN 10	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.
PIN 11	RS232 RX RS422 RX+	Serial digital input for use in thickness applications or programming Select Mode and Parameters. When not used this wire should be left not connected.
PIN 12	RS232 RX GND RS422 RX-	Reference for the RX-digital input. When not used, this wire should be left not connected or (for RS232) be connected to GND Supply (PIN 2).

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OUTPUT:

PIN 6	"Measuring on"	Output signal < 3 V : Object not detected (corresponding to 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 (PIN 2) via a 10 kΩ resistor (minimum) - also when signal is not used in application.
PIN 8	Analog Output	Signal for distance or thickness. <i>Models with Current output:</i> Current signal 4-20mA. Load range (resistance): 0-300 Ω. When not used in application the wire should be connected to analog ground (pink wire). <i>Models with Voltage output:</i> Voltage signal 1-9V. Load range (resistance): Minimum 10kΩ. When not used in application the wire should be connected to analog ground (pink wire) via 10kΩ.
PIN 5	Analog GND	Reference for the analog output This wire should not be connected to supply voltage ground (PIN 2).
PIN 7	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.
PIN 1	RS232 TX or RS422 TX+	Serial digital output for use in distance and thickness measurement applications. This wire should be left not connected when not used in application.
PIN 3	RS232 TX GND or RS422 TX-	Digital Reference (ground) or RS422 TX-. When not used in application, this wire when should be left not connected or (for RS232) connected to supply voltage ground (PIN 2).

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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 connector containing a number of pins, and the guide lines described in section 2.3 should be followed. The shield of the connector/cable is internally connected to the housing, and the two mounting holes on the front of the sensor therefore have the same potential as the shield.

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.

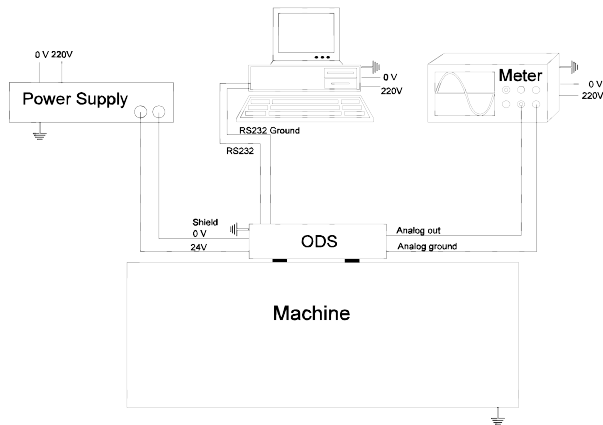


Figure 8

The machine or table, where the sensor is mounted should be connected to the housing or the shield of the sensor. Fig. 8 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

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3 OPERATION**3.1 Reading of Measuring Results****3.1.1 Distance Measurement****4 - 20 mA Output** (Default analog signal)

	ODS 205	ODS 230	ODS 280	ODS 330	ODS 445
4 mA	180 mm	180 mm	180 mm	180 mm	180 mm
12 mA	205 mm	230 mm	280 mm	330 mm	450 mm
20 mA	230 mm	280 mm	380 mm	480 m	700 mm

	ODS 455	ODS 510	ODS 550	ODS 650	ODS 775
4 mA	400 mm	400 mm	400 mm	400 mm	400 mm
12 mA	450 mm	500 mm	550 mm	650 mm	775 mm
20 mA	500 mm	600 mm	700 mm	900 m	1150 mm

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

ODS 205 ODS 455	ODS 230 ODS 510	ODS 280 ODS 550	ODS 330 ODS 650	ODS 445 ODS 775
6,25 mm	12,5 mm	18,75 mm	31,25 mm	46,87 mm

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

1 - 9 V Output (Alternative to 4-20 mA when ordered)

	ODS 205	ODS 230	ODS 280	ODS 330	ODS 445
1 V	180 mm	180 mm	180 mm	180 mm	180 mm
5 V	205 mm	230 mm	280 mm	330 mm	450 mm
9 V	230 mm	280 mm	380 mm	480 m	700 mm

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	ODS 455	ODS 510	ODS 550	ODS 650	ODS 775
1 V	400 mm	400 mm	400 mm	400 mm	400 mm
5 V	450 mm	500 mm	550 mm	650 mm	775 mm
9 V	500 mm	600 mm	700 mm	900 m	1150 mm

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

ODS 205 ODS 455	ODS 230 ODS 510	ODS 280 ODS 550	ODS 330 ODS 650	ODS 445 ODS 775
12,5 mm	25,0 mm	37,5 mm	62,5 mm	93,75 mm

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

3.1.2 Thickness Measurement

4 - 20 mA output (Default analog signal)

The centre of the measuring range corresponds to 12.00 mA.

	ODS 205 ODS 455	ODS 230 ODS 510	ODS 280 ODS 550	ODS 330 ODS 650	ODS 445 ODS 775
4 mA	- 50 mm	-100 mm	-150 mm	-250 mm	-375 mm
20 mA	+50 mm	+100 mm	+150 mm	+250 mm	+375 mm

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

1 - 9 V Output (Alternative to 4-20 mA when ordered)

The centre of the measuring range corresponds to 5.00 V.

	ODS 205 ODS 455	ODS 230 ODS 510	ODS 280 ODS 550	ODS 330 ODS 650	ODS 445 ODS 775
1 V	- 50 mm	-100 mm	-150 mm	-250 mm	-375 mm
9 V	+50 mm	+100 mm	+150 mm	+250 mm	+375 mm

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

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3.2 Reading of Internal Sensor Temperature

For an ODS sensor it will be possible to monitor the internal temperature. By sending a sequence of 3 bytes equal to "22", "44" and "66" over the serial interface, the sensor is instructed to substitute the distance value by a temperature code "11" followed by a second telegram giving the temperature value in 1/10 of °C. When measuring thickness the 3 byte sequence (22,44,66) must be send to the Slave sensor, and then the temperature code will be "12" followed by the Master temperature in a 2ND telegram and the Slave temperature in a 3RD telegram. An example of such a data stream for a thickness measurement at app. 110 mm and temperatures of 34,8 and 34,6°C could be:11025 1; 110252; 12; 348; 346; 110243;..

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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 what sequence in which they are implemented, and this corresponds to the order in which they appear 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. 70000 to 120000 for an ODS 120 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 120 will be increased from the mentioned 120000 (120 mm) to 240000 (240 mm) by down scaling the output data from the sensor by 2 / to half the actually measured seize before they are output.

When an 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 120 will output values between 120000 and 170000 representing a measured difference between 0 and +/- 100 mm. The range 70000 -120000 being the negative domain (when the Master measures a shorter distance than the Slave) and 120000 to 170000 the positive domain. Remember that the data values must be scaled up by 2 in order to have the distance difference in 1/1000 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, thus in a sorted sequence value number 2, 3, 4, 5, 6 up to 15 will be the value outputted (converted).

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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 size 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 1 and 999. It is recommended to use maximum zero suppression. If a data stream contain more 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 120 would consequently output result ranging from 170000 at short haul to 70000 when measuring at its longest range.

4.6 Sample-Hold Mode

In this Mode the latest valid measurement data will be output and any occurring zeros will be replaced with the latest valid measurement value until a new non zero measurement result is detected. Light Intensity Codes as well as zero values will never be output after the first valid measurement data has occurred.

5 SELECT SENSOR SETTINGS

5.1 Baud Rate Settings

Unless otherwise ordered, an ODS sensor will be delivered in the Baud rate setting for a serial output rate corresponding to the sampling rate. The Baud rate can be reset to a 38400 kbit/s giving an output rate of 1 kHz, or other Baud rates lower than the one required for the sampling/measuring rate. A change of Baud rate is not implemented before the sensor is turned off and powered up again.

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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 application give to many zero measuring results, it will be constructive to make an analyse 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 Error Code from Slave Sensor (Serial Interface)

If the serial connection between the Slave sensor and its Master do not operate/function correctly, the Master sensor will output an error code "9".

This code is enabled and disabled along with the above mentioned light intensity codes.

5.4 Advanced Sensor Settings

The DSP firmware in the ODS sensor is highly developed for giving the best possible distance estimates, and as far as possible only output values if they can be considered 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 algorithms 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 and e-mailed to DSE, it can determined if a change of sensor setting can positively influence the results of a given application.

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6 CAUTION

For safety reasons, install the ODS in a location where the laser beam will not enter someone's eyes directly or 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.

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



Class 2 Red Diode Caution



Class 3R Red Diode Caution



Class 3B Red Diode Caution



Class 2 Blue Diode Caution



Class 3R Blue Diode Caution

Figure 9. The caution tags must always be legible.

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.

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APPENDIX A - PROTOCOL

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 these 3 bytes.

Byte1 : consists of 6 header bits and the 2 least significant bits of the measurement result bit 0 and 1, i.e. Byte1 = hhhhhhddB
where h is a header bit and d is data bit.

The header bits will alternate between 101010B and 010101B.

Byte 2 : consists of data bit 2-9.

Byte 3 : is the 8 most significant bits in the result bit 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 01111001-11000000-01B. 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 header 101010 + data bit 0 and 1 LSB

Byte No. n+2 Byte2 data bit 2-9

Byte No. n+3 Byte3 data bit 10-17 MSB

Byte No. n+4 Byte1 header 010101 + data bit 0 and 1 LSB

Byte No. n+5 Byte2 data bit 2-9

Byte No. n+6 Byte3 data bit 10-17 MSB

Byte No. n+7 Byte1 header 101010 + data bit 0 and 1 LSB

Byte No. n+8 Byte2 data bit 2-9

Byte No. n+9 Byte3 data bit 10-17 MSB

etc.

The measuring results (3 bytes) will be transmitted with a frequency of 1000, 2000 or 10000 Hz dependent on sensor model and the Select setting chosen by the user.

When measuring thickness the sensors must always be synchronized and output at the Baud rate corresponding to the full measuring frequency.

See section 2.2 on page 14 for more about thickness measurement.

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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 halved and the speed of the data transmission will also be reduced using the full speed Baud rate.

If no object is detected by the sensor, an error code will be output. 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 <00H>. 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 end user 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 followed after a short pause by a single byte code/command. Sending 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, where after measuring is resumed.

<i>The first word:</i>	consists of flags/toggle bits: 1=ON or 0=OFF.
<i>The second word:</i>	is the size of the Running Average Filter: A number between 2 and 1000.
<i>The third word:</i>	is maximum number of zero values suppressed in the above Filter: 0 to 999
<i>The forth word:</i>	is Baud Rate: LSB is set to 8,16, 24, 32 or 40.
<i>The fifth word:</i>	is the size of the Median Filter: 1, 3, 5, 7.....27, 29 or 31.
<i>The sixth word:</i>	is the size of the Simple Average Filter: A number between 2 and 200.

If the filter are not used the corresponding word shall be zero. 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.

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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:

Baud rate 38400 corresponds to the code 8. Baud rate 115200 corresponds to the code 16. Baud rate 230400 corresponds to the code 24. Baud rate of 460800 corresponds to the code 32, and Baud rate 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 31. 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 Average 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 values in the group at all. Do

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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.

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
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 5 byte command code to stop the measuring operation followed by a single byte code/command.

Sending 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.

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Record layout:

Example:

Word 1	MSB	Header	LSB	255	0	255	4
Word 2	MSB	Header	LSB	255	0	255	100
Word 3	MSB	Header	LSB	255	0	255	99
Word 4	MSB	Header	LSB	255	0	255	16
Word 5	MSB	Header	LSB	0	0	0	0
Word 6	MSB	Header	LSB	0	0	0	0
Word 7	MSB	Header	LSB	0	0	0	0
Word 8	MSB	Header	LSB	0	0	0	0
Word 9	MSB	Header	LSB	0	0	0	0
Word 10	MSB	Header	LSB	0	0	0	0
Word 11	MSB	Header	LSB	0	0	0	0
Word 12	MSB	Header	LSB	0	0	0	0
Word 13	MSB	Header	LSB	0	0	0	0
Word 14	MSB	Header	LSB	0	0	0	0
Word 15	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.

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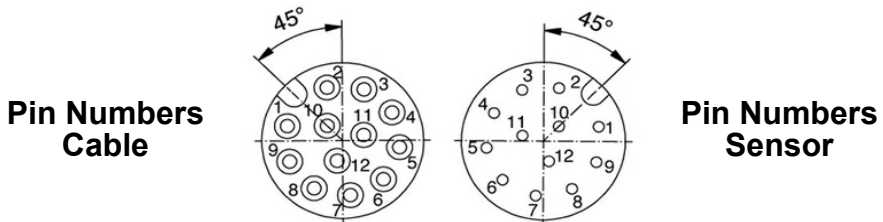
APPENDIX C: PIN Connector & Cable Colours

ODS sensors are delivered with a Male connector, and a cable is only delivered if ordered so. If a cable is ordered it will be configured as follows:

Cable Dimension	Ø 6 mm
Type of Cable	6 × 2 × 0.14 mm ² shielded
Standard Cable Length	2 m or 10 m
Connector M12x1 Female with loose threads.	

Pin No.	Cable Colour	Function
9	Red	22-36 VDC Supply
2	Blue	GND Supply
11	Grey/Pink	RS232 RX or RS422 RX+
12	Red/Blue	RS232 GND or RS422 RX-
1	Brown	RS232 TX or RS422 TX+
3	White	RS232 GND or RS422 TX-
7	Black	Sync. Output
10	Violet	Sync. Input
8	Grey	4-20mA or 1-9V Signal
5	Pink	4-20mA or 1-9V GND
4	Green	Laser On
6	Yellow	Measurement On

Wires not used should be insulated.



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APPENDIX D - 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 RS422/485 COM port:

From Sensor	To:	D-connector	D-connector
		RS422/485	RS232
Brown wire (RS232 TX or RS422/385 TX+)		Pin 3	Pin 2
White wire (RS232 GND or RS422/385 TX-)		Pin 4	Pin 5
Grey/rose wire (RS232 RX or RS422/385 RX+)		Pin 2	Pin 3
Red/blue wire (RS232 GND or RS422/385 RX-)		Pin 1	Pin 5
Blue wire (RS422/485 GND = power GND)		Pin 5	0

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 RS422/485 COM port:

From Sensor	To:	D-connector	D-connector
		RS422/485	RS232
Brown wire (RS232 TX or RS422/385 TX+)		Pin 3	Pin 3
White wire (RS232 GND or RS422/385 TX-)		Pin 16	Pin 7
Grey/rose wire (RS232 RX or RS422/385 RX+)		Pin 2	Pin 2
Red/blue wire (RS232 GND or RS422/385 RX-)		Pin 14	Pin 7
Blue wire (RS422/485 GND = power GND)		Pin 5	0

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

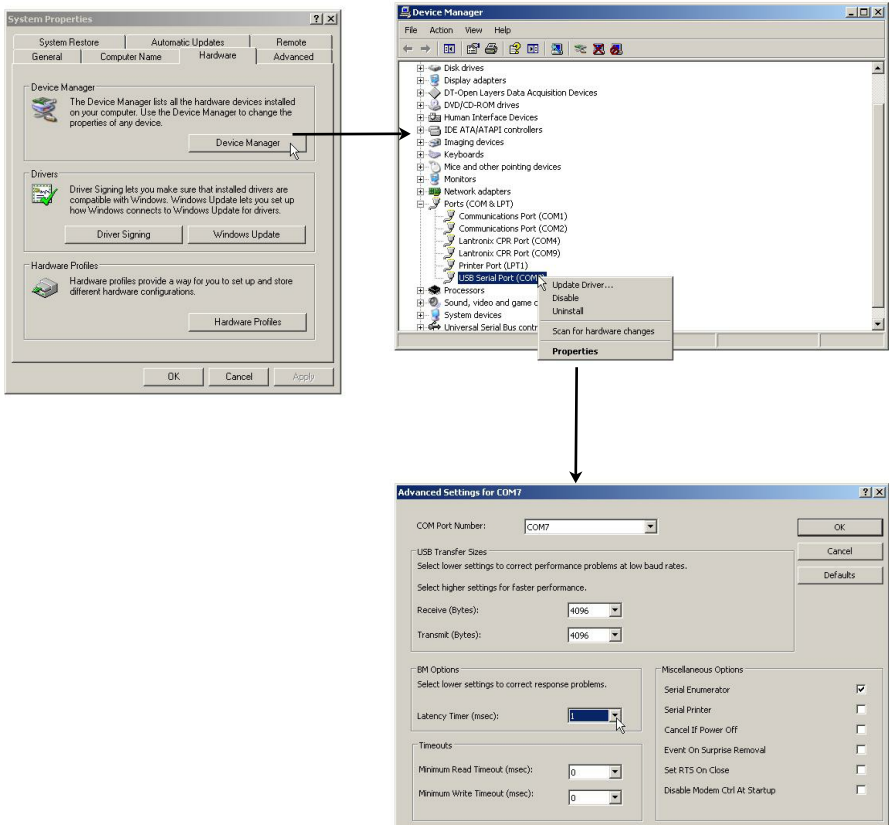
If RS422 is used the RS422 GND of the converter should be connected to GND Supply (Blue wire).

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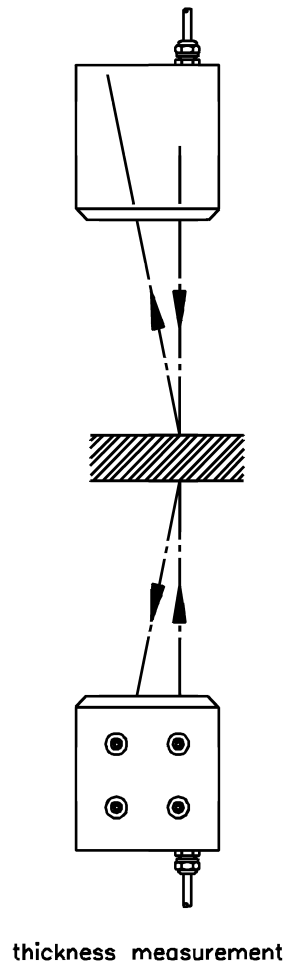
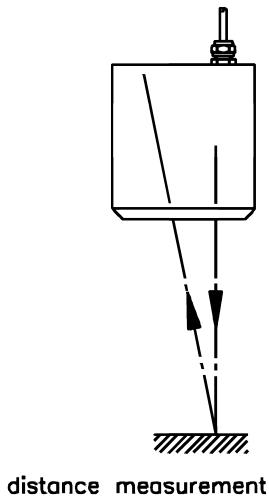
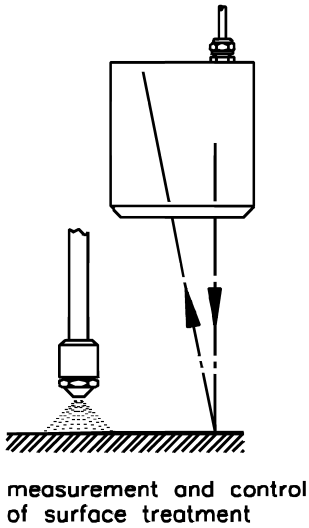
APPENDIX E - Windows Set-up with USB Sensor or Converter.

When a USB sensor or converter is connected to a Windows computer it will automatic configure a USB serial Port(ComX) for use in application software.

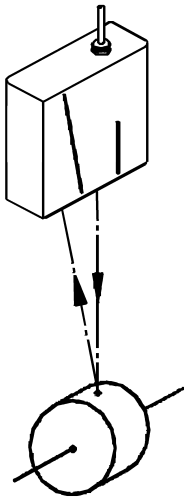
The “Latency Timer” in the USB serial Port(ComX) shall be set to 1 ms (the default value is 16 ms), see screen shot below. If the “Latency Timer” is not set to 1 ms the data flow will be chopped up causing error saving data and select programming the sensor (please note that some USB converters do not have a “Latency Timer” option).



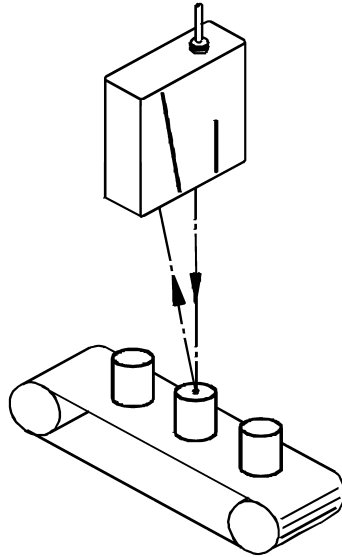
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Applications

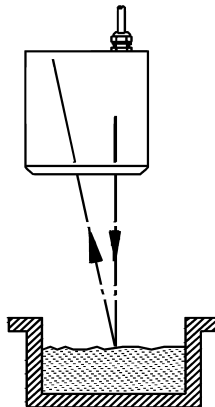
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Measurement of throw
and excentricity



Control of vacuum or
pressure in containers.



level control