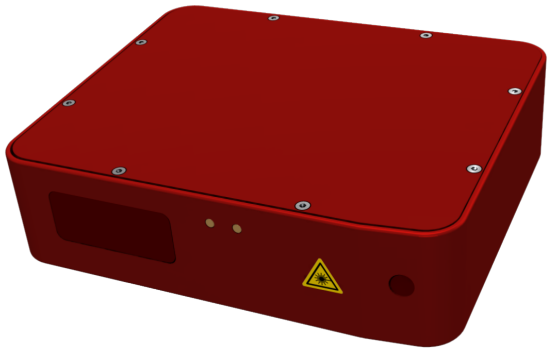
Operator's Hardware Manual

ODS Red-Line Sensors

ODS 505 / ODS 500-1100 / ODS 925 / ODS 1150 / ODS 1950 / ODS 1400 / ODS 3000

All in HT / VHT & VVHT Form and as Select-2 & -10 Models



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OPERATOR'S HARDWARE MANUAL

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NOTE

Read chapter 6: CAUTION before applying power to the sensor

OPERATOR'S HARDWARE MANUAL

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.

1.2 High Temperature

ODS Black-Line sensors can be specified to measure on target materials up to 1000ºC as HT models or up to 1300ºC as VHT models using Red Diodes.
When VVHT is specified a Blue Diode is used and the target temperature can reach far above 1500ºC.
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.

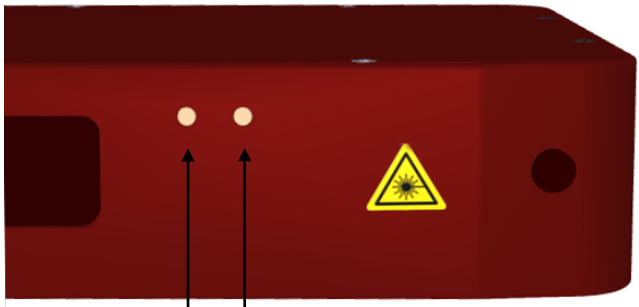
1.3 Sensors with Ethernet Interface

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 39.
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.

1.5 Function of Light Indicators.



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 to high. Se 3.2 on page 23 how to read the internal sensor temperature over the serial interface.

1.6 Common Specifications

GENERAL MEASUREMENT DATA:

Measuring Frequency Select-1	1000 Hz
Measuring Frequency Select-2	2000 Hz
Measuring Frequency Select-10	10000 Hz
Temperature Deviation	± 0.03 % of F.S./°C
Semiconductor Red IEC Laser Class 2 (1 & 2 kHz)	650 nm,1 mW
VVHT spec.: Blue IEC Laser Class 2	405 nm, 1mW
Size of Light Spot	App. Ø 1-5 mm

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 bit/s
Select-10 requires RS422 interface running at:	460800 bit/s
Current loop output	4 - 20 mA
Voltage output: (Optional alternative to Current Output)	1 - 9 V

PHYSICAL DATA

Dimensions	255 × 70 × 205 mm
Weight excl. Cable	App. 4.5 kg
Male Connector	M12x1 (A coding)
Housing	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

When a cable is ordered with the sensor please see Appendix C.

RS232 and RS422 Output:

The serial data from the ODS are transferred asynchronously, and the data transfer rate is either 38400, 115200, 230400, 460800 bit/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.

Dimensions:

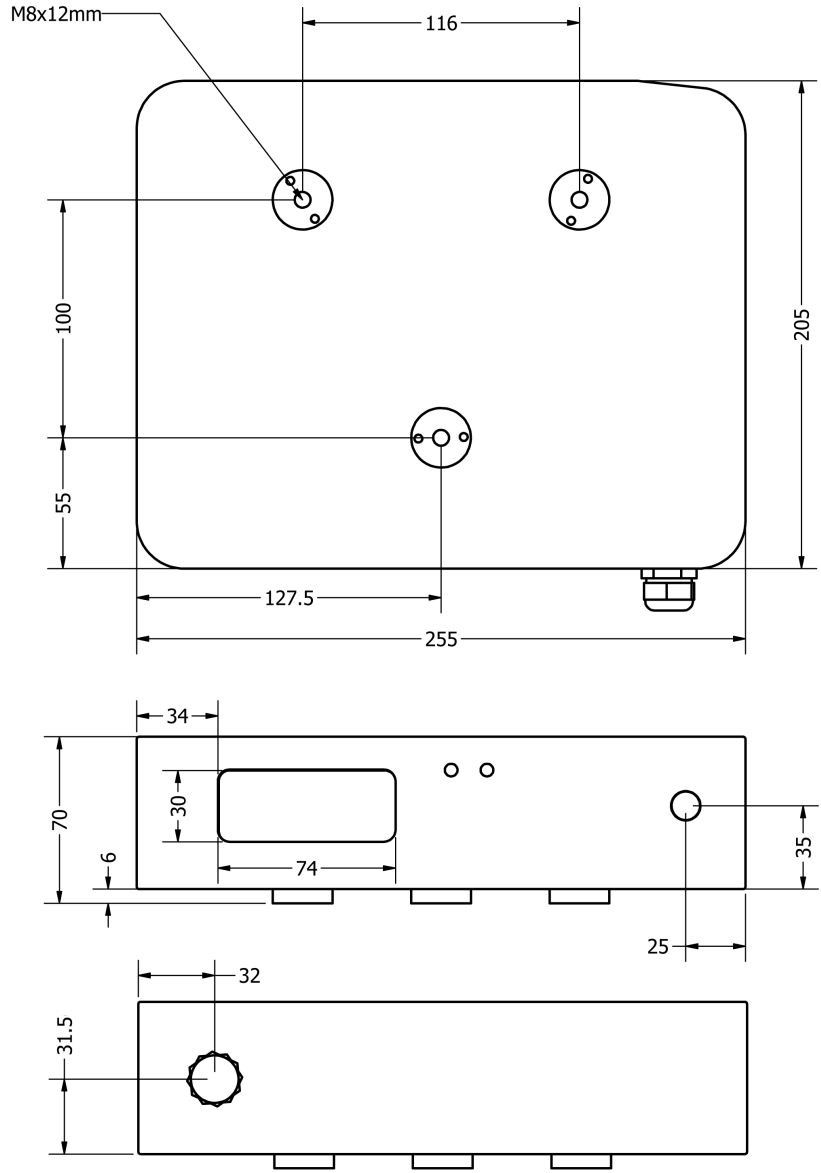


Figure 1. Dimensions, bottom, front and rear.

1.7 Sensor specific specifications

ODS 505

Distance to centre of measuring range	500 mm
Measuring range	180 - 230 mm
Resolution*	0.01 mm
Reproducibility*	± 0.01 mm
Linearity*	± 0.05 mm
Size of light spot	Ø 1.0 mm
Full Scale = 100 mm	

ODS 500

Distance to centre of measuring range	500 mm
Measuring range	400 - 600 mm
Resolution*	0.05 mm
Reproducibility*	± 0.05 mm
Linearity*	± 0.10 mm
Size of light spot	Ø 2-3 mm
Full Scale = 200 mm	

ODS 700

Distance to centre of measuring range	700 mm
Measuring range	600 - 800 mm
Resolution*	0.05 mm
Reproducibility*	± 0.05 mm
Linearity*	± 0.10 mm
Size of light spot	Ø 2-3 mm
Full Scale = 200 mm	

ODS 950

Distance to centre of measuring range	950 mm
Measuring range	850 - 1050 mm
Resolution*	0.05 mm
Reproducibility*	± 0.05 mm
Linearity*	± 0.10 mm
Size of light spot	Ø 2-3 mm
Full Scale = 200 mm	

ODS 1100

Distance to centre of measuring range	450 mm
Measuring range	1000 - 1200 mm
Resolution*	0,05 mm
Reproducibility*	± 0.5 mm
Linearity*	± 0.10 mm
Size of light spot	Ø 2-3 mm
Full Scale = 200 mm	

ODS 925

Distance to centre of measuring range	925 mm
Measuring range	600 - 1250 mm
Resolution*	0.10 mm
Reproducibility*	± 0.1 mm
Linearity*	± 0.3 mm
Size of light spot	Ø 4 mm
Full Scale = 650 mm	

ODS 1150

Distance to centre of measuring range	1150 mm
Measuring range	700 - 1600 mm
Resolution*	0.10 mm
Reproducibility*	± 0.1 mm
Linearity*	± 0.4 mm
Size of light spot	Ø 4 mm
Full Scale = 900 mm	

ODS 1950

Distance to centre of measuring range	1950 mm
Measuring range	1500 - 2400 mm
Resolution*	0.2 mm
Reproducibility*	± 0.2 mm
Linearity*	± 0.5 mm
Size of light spot	Ø 5.0 mm
Full Scale = 900 mm	

ODS 1400

Distance to centre of measuring range	1400 mm
Measuring range	700 - 2100 mm
Resolution*	0.3 mm
Reproducibility*	± 0.3 mm
Linearity*	± 0.7 mm
Size of light spot	Ø 5.0 mm
Full Scale = 1400 mm	

ODS 3000

Distance to centre of measuring range	3000 mm
Measuring range	2000 - 4000 mm
Resolution*	0.5 mm
Reproducibility*	± 0.5 mm
Linearity*	± 1.0 mm
Size of light spot	Ø 5.0 mm
Full Scale = 2000 mm	

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

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 figure 2.

If the object in question has a stepped surface, the ODS should be mounted according to figure 3. Two of the four positions are correct, whereas the two

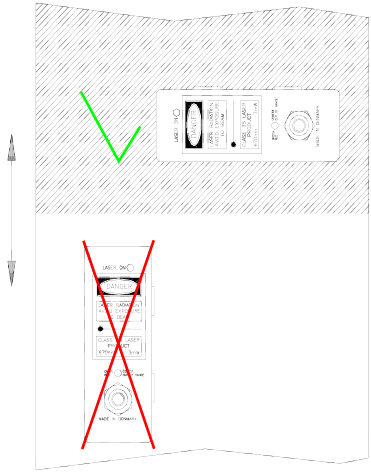


Figure 2. Orientation of the unit at changes of contrast.

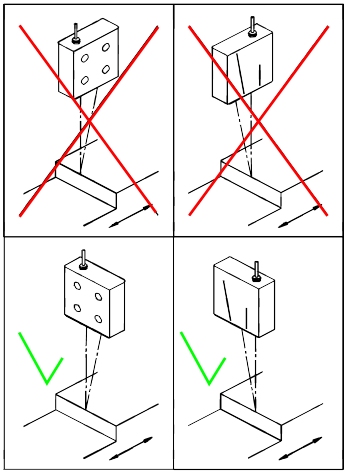


Figure 3. Measurement on a stepped object.

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.

1.7 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.

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

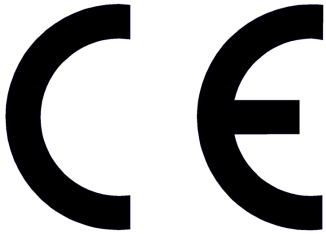


Figure 4. CE mark.

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 3 M8 holes, placed on the bottom side of the sensor house. See figure 1 on page 7.

IMPORTANT: Only these 3 mounting points must be in contact with the mounting bracket.

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.

2.2 Mounting for Thickness Measurement

For direct measurement of thickness two ODS units (***must be the same type)*** are used, see Figure 5.
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.

Figure 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.

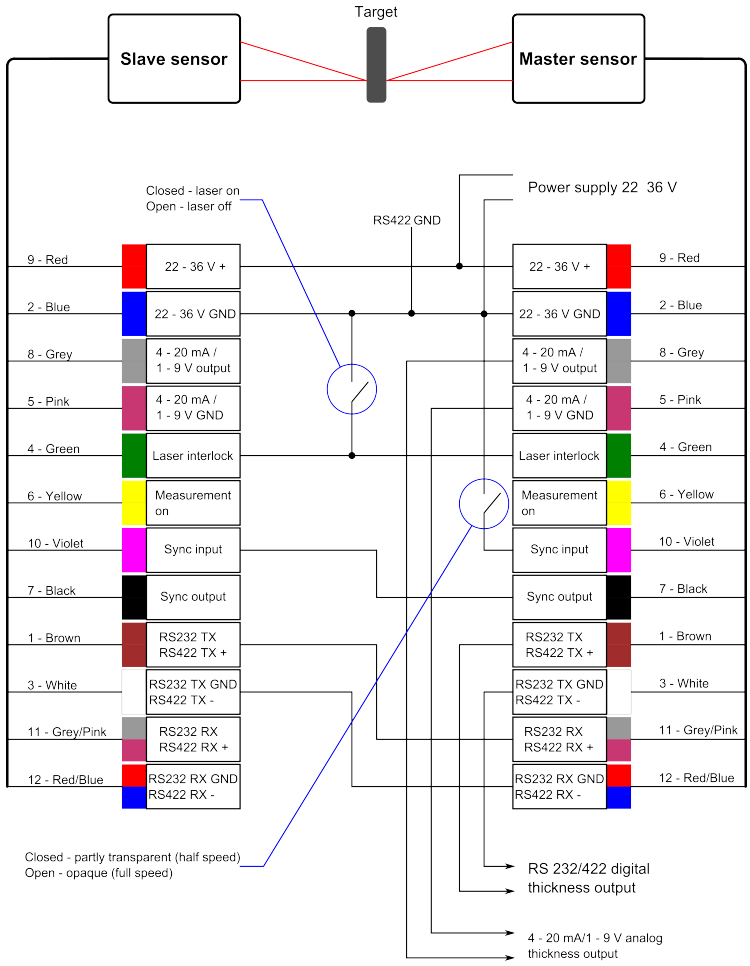


Figure 5. Connections for thickness measurement.

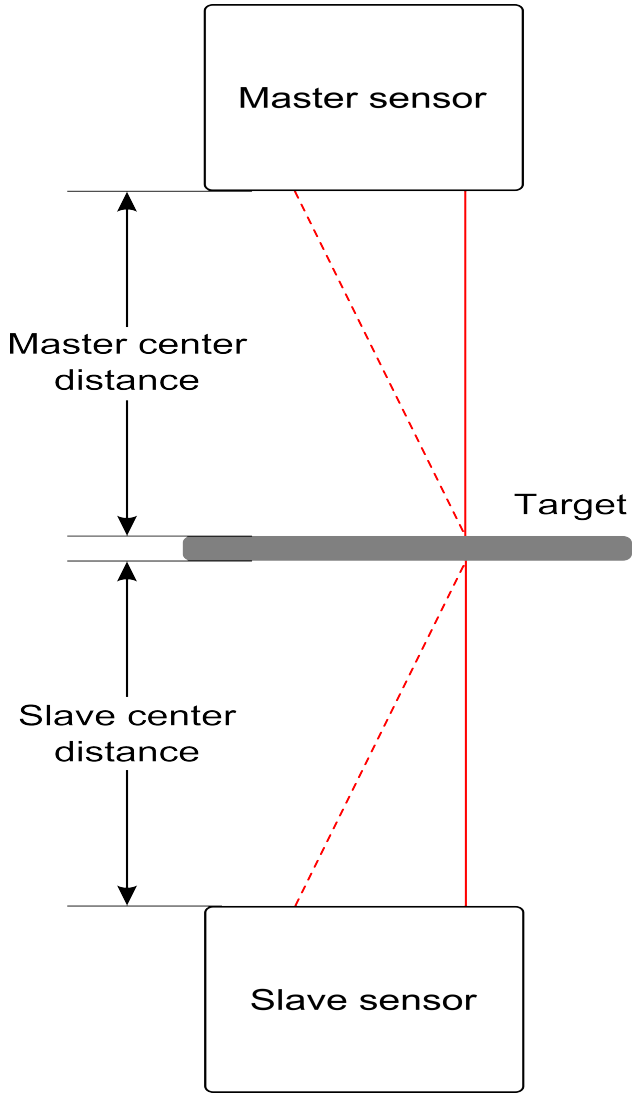


Figure 6. Sensors mounted for thickness measurement.

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).

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. *Models with Current output:* 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). *Models with Voltage output:* 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).

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.

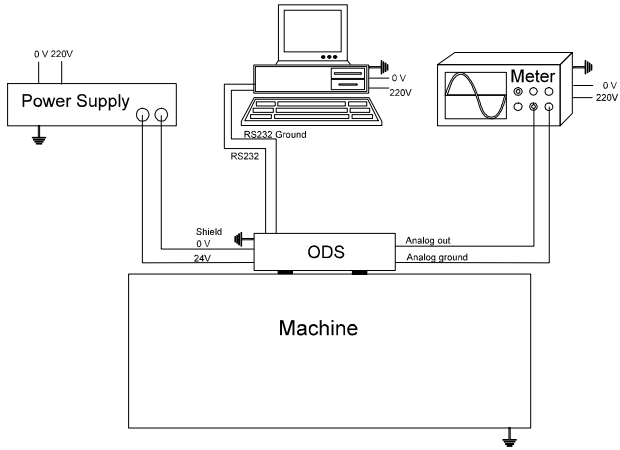


Figure 7. Grounding.

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. Figure 7 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

4 - 20 mA Output: *(Default analog signal)*

	ODS 505	ODS 500-1100	ODS 925	ODS 1150
4 mA	450 mm	-100 mm	600 mm	700 mm
12 mA	500 mm	500/700/950/1100 mm	925 mm	1150 mm
20 mA	550 mm	100 mm	1250 mm	1600 mm

	ODS 1950	ODS 1400	ODS 3000
4 mA	1500 mm	700 mm	2000 mm
12 mA	1950 mm	1400 mm	3000 mm
20 mA	2400 mm	2100 mm	4000 mm

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

ODS 505	ODS 500-1100	ODS 925	ODS 1150	ODS 1950	ODS 1400	ODS 3000
6,25 mm	12,5 mm	40,6 mm	56,3 mm	56,3 mm	87,5 mm	125 mm

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

	ODS 505	ODS 500-1100	ODS 925	ODS 1150
1 V	450 mm	-100 mm	600 mm	700 mm
5 V	500 mm	500/700/950/1100 mm	925 mm	1150 mm
9 V	550 mm	100 mm	1250 mm	1600 m

	ODS 1950	ODS 1400	ODS 3000
1 V	1500 mm	700 mm	2000 mm
5 V	1950 mm	1400 mm	3000 mm
9 V	2400 mm	2100 mm	4000 mm

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

ODS 505	ODS 500-1100	ODS 925	ODS 1150	ODS 1950	ODS 1400	ODS 3000
12,5 mm	25 mm	81,3 mm	112,5 mm	112,5 mm	175 mm	250 mm

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

RS232, RS422, USB and Ethernet:

(serial protocol, see page 6 for specification).

Please notice that an ODS 200 nominal output range convention has been specified for models ODS 500, 700, 950 and 1100 i.e. the values are between 10000 and 30000. For the ODS 505 the output varies between 10000 and 20000, all in hundredth of millimetres.

	ODS 505	ODS 500-1100	ODS 925	ODS 1150
Distance	450 mm	400/600/ 850/1100 mm	600 mm	700 mm
Output	10000	10000	6000	7000
Distance	550 mm	600/800/ 1050/ 1200 mm	1250 mm	1600 mm
Output	20000	30000	12500	16000

	ODS 1950	ODS 1400	ODS 3000
Distance	1500 mm	700 mm	2000 mm
Output	15000	7000	20000
Distance	2400 mm	2100 mm	4000 mm
Output	24000	21000	40000

3.1.2 Thickness Measurement

4 - 20 mA Output: *(Default analog signal)*

The centre of the measuring range corresponds to 12.00 mA.

	ODS 505	ODS 500-1100	ODS 925	ODS 1150
4 mA	-50 mm	-100 mm	-325 mm	-450 mm
20 mA	+50 mm	+100 mm	+325 mm	+450 m

	ODS 1950	ODS 1400	ODS 3000
4 mA	-450 mm	-700 mm	-1000 mm
20 mA	+450 mm	+700 mm	+1000 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 505	ODS 500-1100	ODS 925	ODS 1150
1 V	-50 mm	-100 mm	-325 mm	-450 mm
9 V	+50 mm	+100 mm	+325 mm	+450 m

	ODS 1950	ODS 1400	ODS 3000
1 V	-450 mm	-700 mm	-1000 mm
9 V	+450 mm	+700 mm	+1000 mm

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

RS232, RS422, USB or Ethernet Output: *(Serial Protocol)*

The ODS sensor chosen to be the Master sensor will utilize the digital distance data received from the Slave sensor together with its own distance data in a formula that looks as follows:

"Output value from Master" = 3 C " Centre-distance of sensor type"
- "Distance value from Slave" - "Distance value in Master"

This means, that two ODS sensors connected to measure thickness, will give the correct digital thickness value (only) when they are mounted with a distance between them of exactly 3 times the centre distance of the sensor type in question. In most applications one would chose to mount the sensors with a distance between them that differs from the above mentioned. As a result, the digital output will then not be the actual thickness, but a relative value, in the same manner as the analog signals are. In order to calculate the actual thickness in this situation it is necessary to correct the output value from the Master sensor by adding the following constant value C:

C = "Distance between Slave and Master" - 3 C" Centre-distance"

In most practical circumstances the easiest way, and the most precise way, is to let the sensors determine the value and constant C by measuring on any object of known thickness i.e. a "Calibration cube":

C = "Thickness of Calibration cube" - "Output value from the Master"

In this way thickness measurement can always be performed as long as the surfaces of both sides of the object are within the measurement range of the relevant ODS sensor. The thickness of the actual object being measured on is then the sum of the output value from the Master and the correction factor C. The constant C can be positive as well as negative.

When two ODS sensors are connected for thickness measurement, the variation in thickness values are restricted to be within the numerical domain of the ODS sensor used. For an ODS 1150 the digital domain is 7000 to 16000 catering for a thickness variation of 900 mm in tenths of a mm. The reason for restricting the output in this way is to keep the same high resolution on the analog output channels for thickness measurement as when the sensors are used for measuring distance.

In Extended Thickness Mode the allowed variation in thickness is doubled at the expense of a halved resolution witch offers an alternative to a couple of sensors with a larger measuring range.

The automatic thickness measuring functionality of the ODS sensors are restricted to sensors having the same digital output value domain. Let say one is an ODS 500 and the other is an ODS 1100. As they both have output values that varies from 10000 to 30000 (measuring range being 200 mm centred around a distance from the sensor front of 500 mm respectively 1100 mm). This digital domain also applies to the original ODS 200 with a centre distance of 200 mm and the ODS 700 with a centre distance of 700 mm, and they can thus all be connected for thickness measuring. The only other sensor types with a common digital domain are the ODS 1150 and ODS 1950 with a measuring range of 900 mm.

Again it has to be remembered, that not only do this feature need a common digital output domain, the target surfaces have to be within the measurement ranges of the sensors on either side at all time to give a measuring result.

The relationship between output value and actual thickness is the following:

Change in output value	ODS 505	ODS 500-1100	ODS 925	ODS 1150
from minimum	10000	10000	6500	7000
to maximum	20000	30000	12500	16000
equals a thickness variation of	+100 mm	+200 mm	+650 mm	+900 mm

Change in output value	ODS 1950	ODS 1400	ODS 3000
from minimum	15000	7000	20000
to maximum	24000	21000	40000
equals a thickness variation of	+900 mm	+1400 mm	+2000 mm

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;..

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).

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 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 1150 would consequently output result ranging from 16000 at short haul to 7000 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 bit/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 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 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.

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.
All ODS Red-Line sensor models are manufactured in the same house, and are provided with a laser light indicator on the front of the sensor.
The hazard triangle shown in Fig. 9 is also placed on the front of the sensor.
The yellow laser class labels shown in fig. 10,11,12, 13 & 14, and the Product Information label as seen in Figure 15. are placed on the back side of the ODS sensor. Laser class 3R models also have an aperture label (emission indicator) fig. 9, on the front of the sensor between the laser aperture and the hazard triangle.

Fig.8. Aperture label.

Fig.9. Caution tag.

Fig.10. Class 2 red diode caution.

Fig.11. Class 3R red diode caution.

Fig.12. Class 3B red diode caution.

Fig.13. Class 2 blue diode caution.

Fig.14. Class 3R blue diode caution.

The caution tags must always be legible.

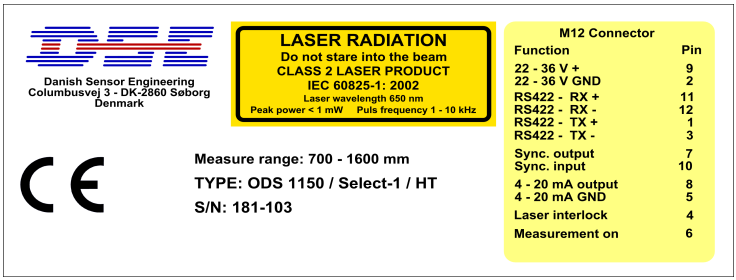


Figure 15. Example of a product identification label.

Laser Class 3B have in US specification additional safety features in addition to the mentioned emission indicator, interlock connector and aperture label, a key witch is supplied with the sensor, and a beam stop is placed on the front of the sensor.
Users of these sensors are advised to wear protection goggles/eyewear.

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

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 consist of header bits that will alternate between 55H and AAH.
Byte 2 consists of data LSB
Byte 3 consists of data MSB

A measured distance, e.g. 2246.7 mm, in case of an ODS 1950 or ODS 3000, is transmitted in tenths 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,

<Byte1> = 55H
<Byte2> = C3H
<Byte3> = 57H

A sequence of telegrams will look as follows,

Byte No. n+1 Byte1 Header 1 <55H>
Byte No. n+2 Byte2 Databyte 1 <LSB>
Byte No. n+3 Byte3 Databyte 1 <MSB>
Byte No. n+4 Byte1 Header 2 <AAH>
Byte No. n+5 Byte2 Databyte 2 <LSB>
Byte No. n+6 Byte3 Databyte 2 <MSB>
Byte No. n+7 Byte1 Header 1 <55H>
Byte No. n+8 Byte2 Databyte 3 <LSB>
Byte No. n+9 Byte3 Databyte 3 <MSB>

etc.

The measuring results (header+2 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 15 for more about thickness measurement.

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.

The first word:	consists of flags/toggle 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 8,16, 24, 32 or 40.
The fifth word:	is the size of the Median Filter: 1, 3, 5, 7.....27, 29 or 31.
The sixth word:	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.

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

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.

	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.

APPENDIX C: PIN Connector & Cable Colours

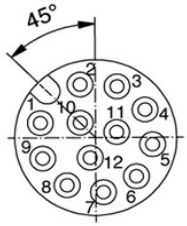
ODS sensors are delivered with a Male connector and a cable. The cable will be configured as follows:

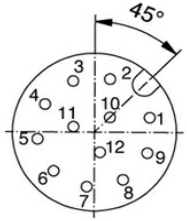
Cable Dimension	Ø 6 mm
Type of Cable	6 × 2 × 0.14 mm^2 shielded
Standard Cable Length	2 m or 10 m
Connector	M12x1 Female with loose threads.

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.

Pin Numbers Cable





Pin Numbers Sensor

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 COM port:

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

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

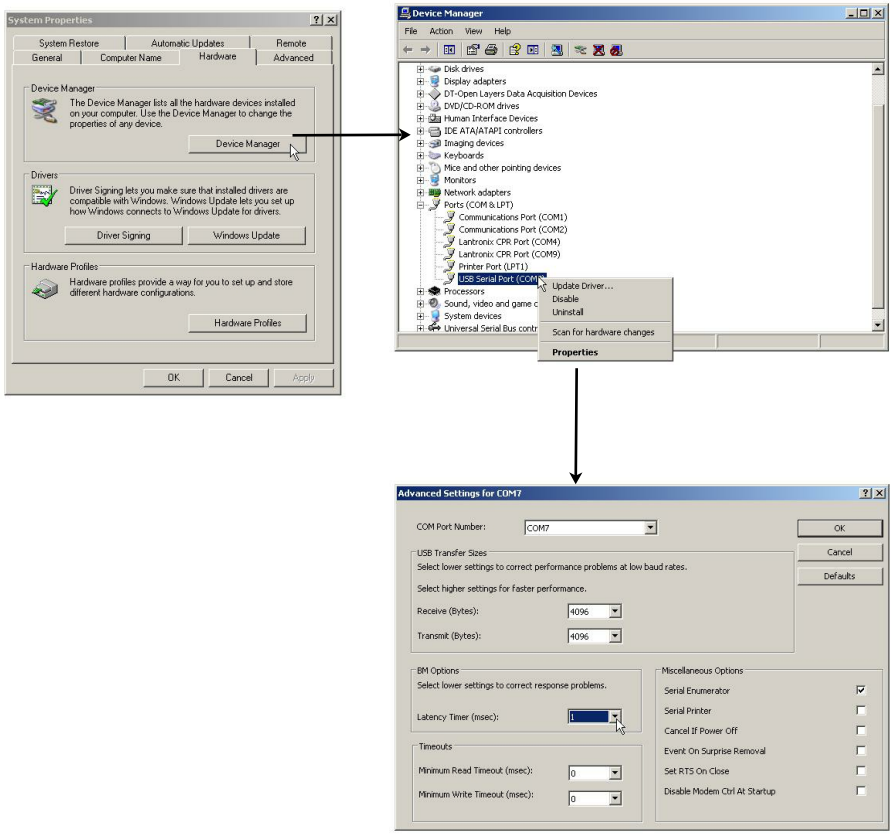
When the sensor is equipped with an RS422 serial interface it is necessary to consult the COM port specifications in order to verify the above suggestion.

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

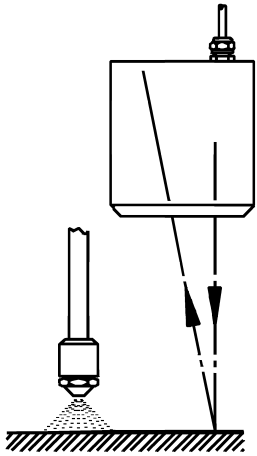
APPENDIX E - Windows Set-up with USB Sensor or Converter.

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.

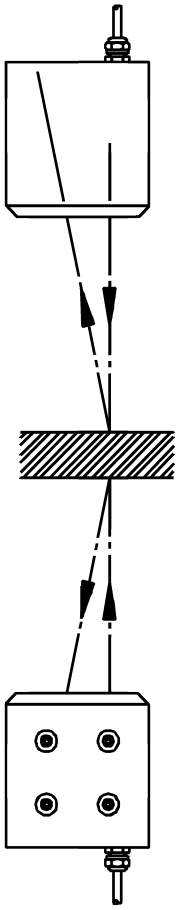
The "Latency Timer" in the USB serial Port(ComX) shall be set to 1 ms (the default value is 16 ms), see screen shot below. If the "Latency Timer" is not set to 1 ms the data flow will be chopped up causing error saving data and select programming the sensor (please note that some USB converters do not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



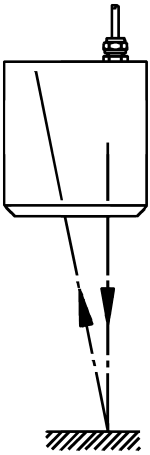
Applications



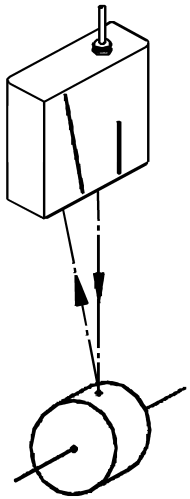
measurement and control
of surface treatment



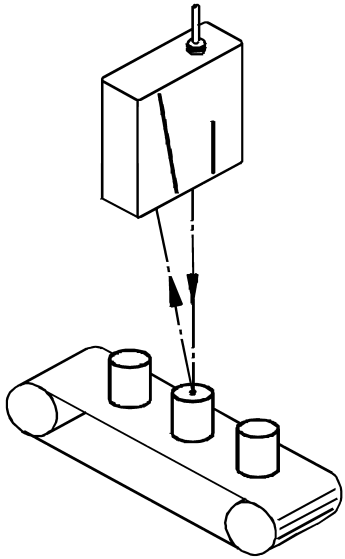
thickness measurement



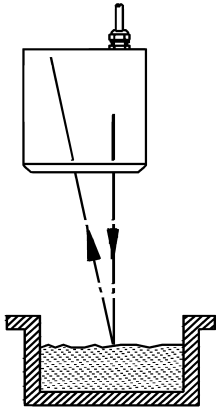
distance measurement



Measurement of throw and excentricity



Control of vacuum or pressure in containers.



level control