Operator's Hardware Manual
ODS Compact-Line Sensor

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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

Important! Please read Appendix D when connecting a USB sensor to Windows (or uses a USB converter).

ODS sensors are optical distance measuring devices for non contact precision measurement of distance.
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 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 digital output signal is RS232, RS422 or USB 2.0 and the sensors measuring frequency is 1000 Hz. For sensors with RS232 there will also be an analog output signal (4-20mA or 1-9V).

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 upside 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 Specifications:

GENERAL MEASUREMENT DATA:

ODS 80

Measurement range	50 - - 100 mm
Digital output resolution (16 bit internal)	0.01 - - 0.02 mm
Linearity	± 0.04 mm
Reproducibility	± Resolution

ODS 155

Measurement range	50 - - 250 mm
Digital output resolution (16 bit internal)	0.01 - - 0.04 mm
Linearity	± 0.15 mm
Reproducibility	± Resolution

ODS 225

Measurement range	50 - - 500 mm
Digital output resolution (16 bit internal)	0.01 - - 0.40 mm
Linearity	± 0.70 mm
Reproducibility	± Resolution

USB 150

Measurement range	50 - - 250 mm
Digital output resolution (16 bit internal)	0.01 - - 0.04 mm
Linearity	± 0.15 mm
Reproducibility	± Resolution

ALL MODELS

Measuring frequency	1000 Hz
Temperature deviation	± 0.03% / ℃
Semiconductor laser IEC laser class 2	655 nm, < 1mW

ELECTRICAL DATA

USB

Supply voltage (supplied by USB)	5 VDC
Power consumption, max	< 0.75 W
Interface	USB

RS232 & RS422

Supply voltage	15-36 VDC
Power consumption, max	< 1.2 W

ALL

Connector	M8, USB micro B or Fixed cable
Baud rate can be set to either:	38400, 115200, 230400, 460800, 921600

PHYSICAL DATA

Dimensions	48 × 40 × 19.5 mm
Weight excl. Cable	App. 55 g
Housing	Aluminium / Glass Windows

ENVIRONMENT DATA

Operating Temperature	0 - +50℃
Storage temperature	-20 - +70℃
Humidity (non condensing)	max 90 % RH
Degree of protection	IEC IP65

1.3 Function of Light Indicator

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

Range indicator :

RED: Constant red light means:

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

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

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

1.4 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. 1.

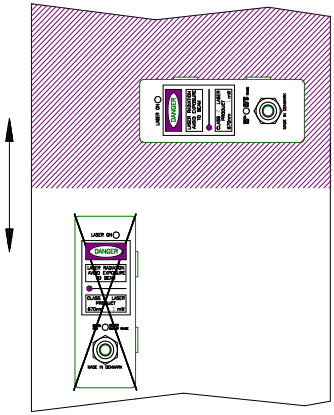


Fig. 1 Orientation of the Unit at Changes of Contrast.

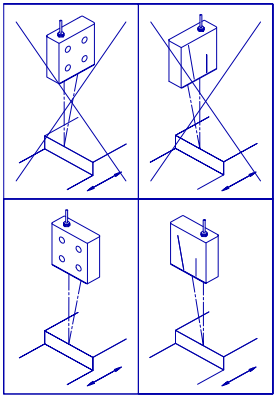


Fig. 2 Measurement on a Stepped Surface.

If the object in question has a stepped surface, the ODS should be mounted according to Fig. 2. Two of the four positions are correct, whereas the two marked with a cross should be avoided.

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

1.5 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.

1.6 Optimal Measuring Conditions

- The front glass must be kept clean.
- We recommend to warm up the sensor for at least 15 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. Also direct sun light should be avoid.

1.7 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 sensor.
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

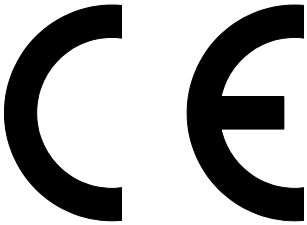


Fig. 3 CE-mark.

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 2 Ø 6.2 mm holes, placed on the front side of the sensor house. **IMPORTANT: Only the two mounting points below the sensor (standing 1,5 mm proud) must be in contact with the mounting bracket/protection house.**

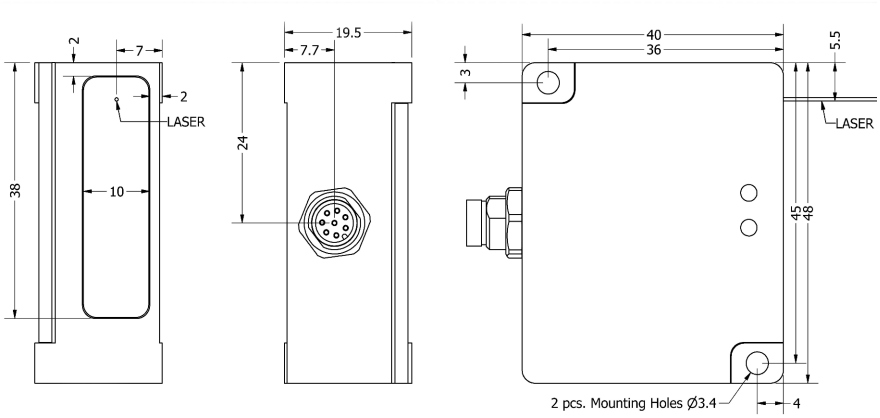


Fig. 4 Dimensions, Front, Rear & Upside (M8 connector).

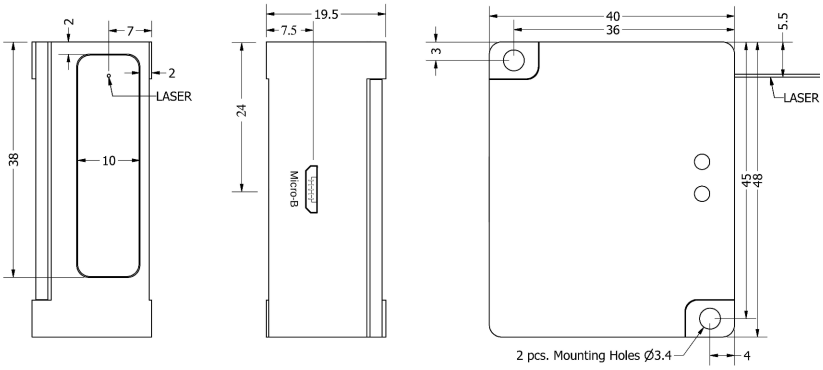


Fig. 5 Dimensions, Front, Rear & Upside (Micro-B Connection).

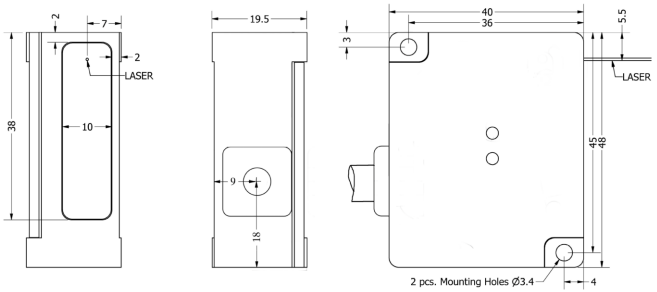


Fig. 6 Dimensions, Front, Rear & Upside (Cable Connection).

2.2 Cable Colours for Connector Models

ODS sensors can be delivered with a M8 Male connector, USB micro-B or Fixed cable.

The fixed 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

M8 Connector cable: M8x1 Female with 2 m cable with loose threads

DSE - USB model (M8 Male Connector and Fixed Cable)			
M8 pin number	Cable colours		Function
1	White		USB GND
2	Brown		NC
3	Green		NC
4	Yellow		NC
5	Grey		USB Vcc
6	Pink		NC
7	Blue		D +
8	Red		D -

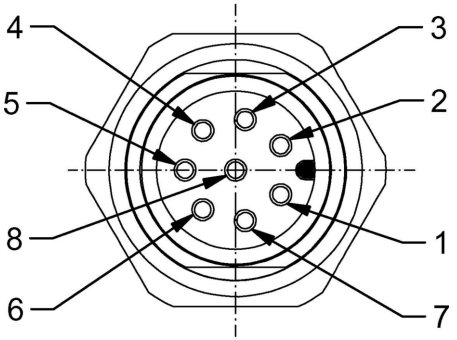


Fig. 7 Cable Colours and Pins for Models with M8 Male Connector.

DSE - RS232 model (M8 Male Connector and Fixed Cable)			
M8 pin number	Cable colours		Function
1	White		RS232 RX
2	Brown		RS232 TX
3	Green		NC
4	Yellow		NC
5	Grey		4-20 mA / 1-9 V signal
6	Pink		4-20 mA / 1-9 V GND
7	Blue		GND
8	Red		15-36 VDC supply

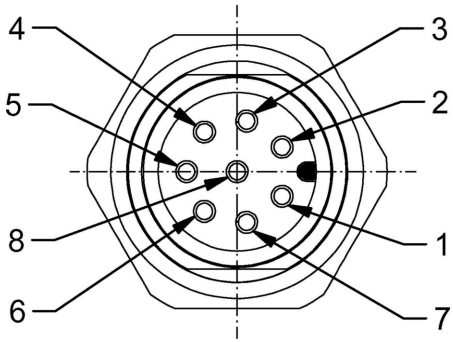


Fig. 8 Cable Colours and Pins for Models with M8 Male Connector.

DSE - RS422 model (M8 Male Connector and Fixed Cable)			
M8 pin number	Cable colours		Function
1	White		RS422 RX +
2	Brown		RS422 TX +
3	Green		NC
4	Yellow		NC
5	Grey		RS422 RX -
6	Pink		RS422 TX-
7	Blue		GND (+RS422 GND)
8	Red		15-36 VDC supply

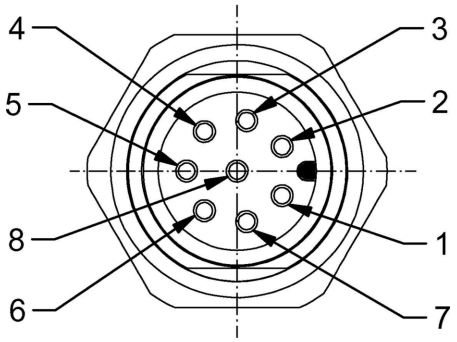


Fig. 9 Cable Colours and Pins for Models with M8 Male Connector.

3 OPERATION

3.1 Reading of Measuring Results

The serial data from the ODS are transferred asynchronously, and the data transfer rate is either 38400, 115200, 230400 or 460800, 921600 Baud.
In binary output mode 38400 will give out the full measurement speed (1000 Hz).
In ASCII mode 38400 Baud will reduce the measurement frequency to 333 Hz. In ASCII mode 115200 Baud a above will give out the full measurement speed.

4 SELECT PROGRAMMING MODES

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

4.1 Median Filter

In this setting one of 15 Group Seizes can be chosen; 3, 5, 7, 9, 11, 13 all the way up to 101. The filter ranks the values in the group, thus's in a sorted sequence value number 2, 3, 4, 5, 6 up to 50 will be the value outputted (converted).

4.2 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 20 is used the sensor the output rate will be 50 Hz.

4.3 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 consecutive zero values than specified by the zero suppression parameter a zero value will be output.

4.4 Level Mode

In this Mode the values are inverted. Output result will be 350 mm at short haul and 50 mm when measuring at its longest range.

4.5 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

A change of baud rate is not activated before the sensor is turned of and powered up again.
Baud rate can be either be 38400, 115200, 230400 or 460800, 921600 Baud.
In binary output mode 38400 will give out the full measurement speed (1000 Hz).
In ASCII mode 38400 Baud will reduce the measurement frequency to 333 Hz. The get full measurement output (1000 Hz) in ASCII mode the Baud rate has to be 115200 Baud or above.

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 analyzes without any Select filtering done and save the captured raw measuring data to a file on hard disk for further scrutinizing 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.

6 LASER 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.
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.
The hazard triangle shown in Fig.10 is also placed on the front of the sensor.

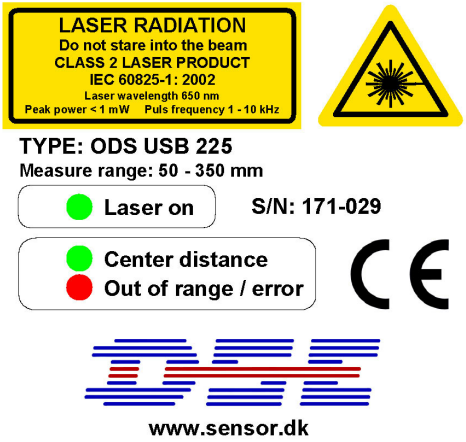


Fig. 13 Example of Label with Laser Warning.

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 - Binary Protocol

The result of each measurement is transmitted as a word, consisting of 2 bytes, MSB (Most Significant Byte), and LSB (Least Significant Byte), where the order of transmission is opposite, i.e. LSB is transmitted first. A measured distance, e.g. 224.67 mm is transmitted in hundredths of a mm, i.e. as the figure 22467 (decimal), converted to the hexadecimal value 57C3H. In the telegram,
the value will be transmitted as:

Byte No. n+1 Header 1 <AAH>
<LSB> = C3H followed by
<MSB> = 57H
Byte No. n+1 Header 1 <55H>

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

Byte No. n+1 Header 1 <AAH>
Byte No. n+2 Data byte 1 <LSB>
Byte No. n+3 Data byte 1 <MSB>
Byte No. n+4 Header 2 <55H>
Byte No. n+5 Data byte 2 <LSB>
Byte No. n+6 Data byte 2 <MSB>
Byte No. n+7 Header 3 <AAH>
Byte No. n+8 Data byte 3 <LSB>
Byte No. n+9 Data byte 3 <MSB>
etc.
The measuring results (header + 2 data bytes) will be transmitted with a frequency of 1000 Hz.

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.....97, 99 or 101.
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 101. 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.

Record layout:

Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB
Header	MSB	Header	LSB

Example:

255	0	255	4
255	0	255	100
255	0	255	99
255	0	255	16
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

The sensor settings can be updated by using a 4 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:

Word 1	MSB	LSB
Word 2	MSB	LSB
Word 3	MSB	LSB
Word 4	MSB	LSB
Word 5	MSB	LSB
Word 6	MSB	LSB
Word 7	MSB	LSB
Word 8	MSB	LSB
Word 9	MSB	LSB
Word 10	MSB	LSB
Word 11	MSB	LSB
Word 12	MSB	LSB
Word 13	MSB	LSB
Word 14	MSB	LSB
Word 15	MSB	LSB

Example:

Word 1	b#00000000	B#00000100=4
Word 2	0	100
Word 3	0	99
Word 4	0	16
Word 5	0	0
Word 6	0	0
Word 7	0	0
Word 8	0	0
Word 9	0	0
Word 10	0	0
Word 11	0	0
Word 12	0	0
Word 13	0	0
Word 14	0	0
Word 15	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: ASCII Mode

The sensor can be set to output data in ASCII format instead binary format. The sensor is default delivered in binary mode and to switch to ASCII mode the ASCII text “ASON” has to be transmitted to the sensor. To switch back to binary mode the text “ASOFF” has to be send to the sensor.

To achieve full measurement speed(1000 Hz) in ASCII mode the baud rate has to be 115200 baud or above. If the baud rate is 38400 the output frequency of the sensor will only be 333 Hz (This does only applies for ASCII mode. If the sensor is in Binary mode it will always give out full measurement frequency 1000 Hz).

Measurements Output Format in ASCII Mode:
The measurements are send as 5 digits in mm (for results less than 5 digits there is a leading zero) with point separator and with LF (Line feed) and CR (Carriage Return).

Example:

“1”; “0”; “3”; “.”; “4”; “3”; “LF; “CR”; “1”; “0”; “3”; “.”; “4”; “1”; “LF; “CR”; etc.

Equals: 103.43
103.41
099.41
088.52
000.00

ASCII Commands:

ASON : Starts ASCII Mode (the sensor will continue in ASCII mode also after it has been switch OFF and ON).

ASOFF : Stops ASCII Mode (the sensor will continue in Binary mode also after it has been switch OFF and ON).

RAVG + 4 digits :
Setup the running average filter. Has to be 0 or 2-1000.
If the wished filter size has less than 4 digits then preset zero values has to be used (example: RAVG0050).

Returns "RAVG OK" or "RAVG ERROR".

ZEROSP + 3 digits :

Setup Zero suppression. Has to be less than the RAVG value. If the wished filter size has less than 3 digits then leading zero has to be used (example: ZEROSP049).

Returns "ZEROSP OK" or "ZEROSP ERROR".

SIMAVG + 3 digits :

Setup Simple Average filter. Has to be 0 (=disabled) or 2-200. If the wished filter size has less than 3 digits then leading zero has to be used (example: SIMAVG005).

Returns "SIMAVG OK" eller "SIMAVG ERROR".

MEDIAN + 3 digits :

Setup Median filter. Only Odd numbers 3-101 or 0 (= disabled). If the wished filter size has less than 3 digits then leading zero has to be used (example: MEDIAN021).

Returns "MEDIAN OK" or "MEDIAN ERROR".

BAUD + 6 digits :

Setup Baud rate. Has to be: 038400, 11522, 230400, 460800, 921600. At 38400 Baud a leading zero has to be used. (example: BAUD038400).

Returns "BAUD OK" or "BAUD ERROR".

ODMON : Enable ON DEMAND Mode.

ODMOFF : Disable ON DEMAND Mode.

Q : Send one single measurement (works only if “ON DEMAND MODE” is enabled).

STATUS : Read out select settings + serial number.

Example:

SENSOR STATUS:

FIRMWARE VERS:	100.01
SERIAL NUMBER:	162002
RUNNING AVG:	50
ZERO SUPPRESSION:	49
SIMPLE AVG:	20
ON DEMAND MODE:	OFF
MEDIAN:	31
BAUD:	38400

APPENDIX D: 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.

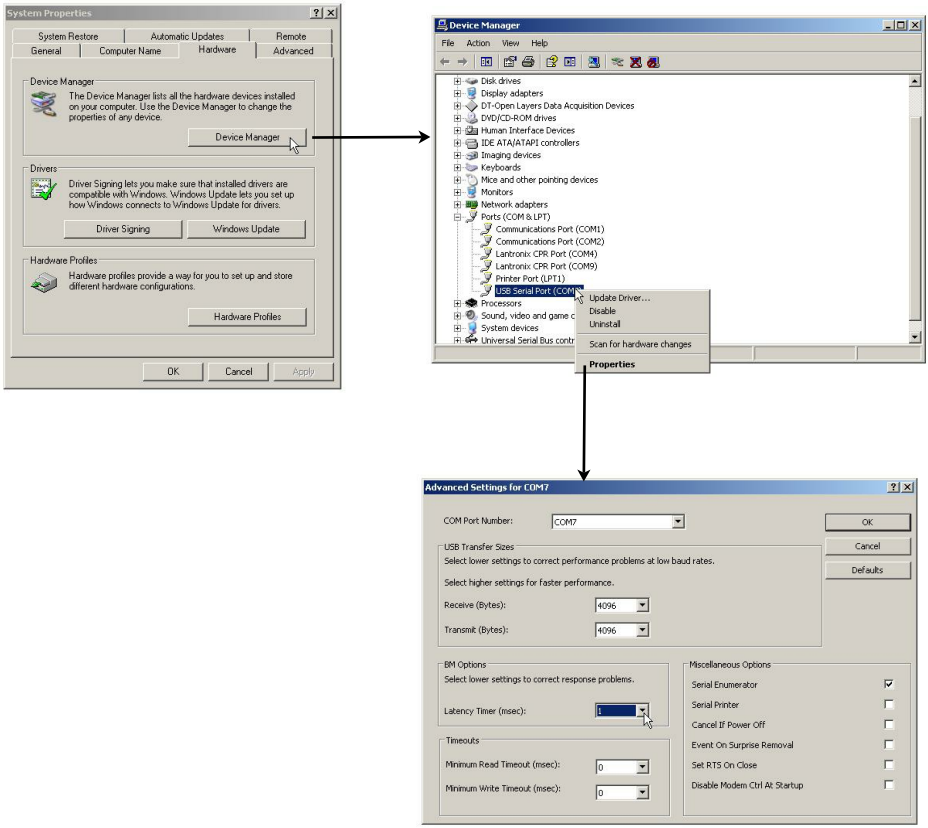
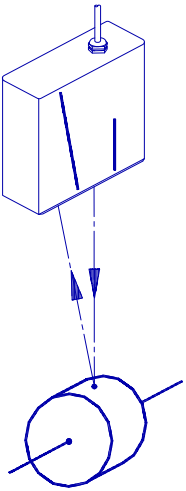
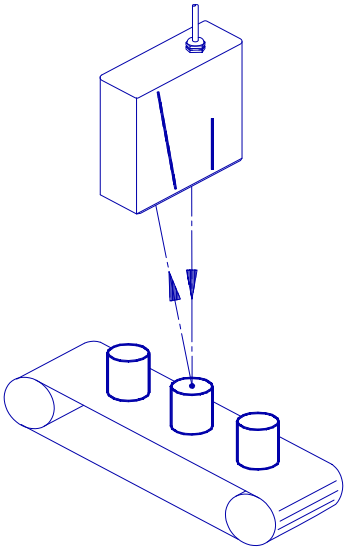


Fig. 14 Setting of Latency Timer.

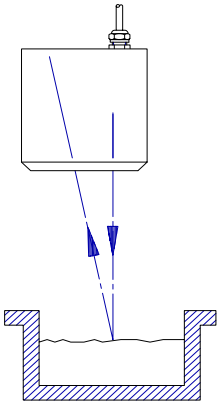
APPENDIX E: Applications



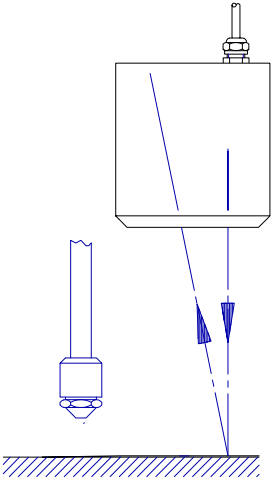
Measurement of throw and excentricity



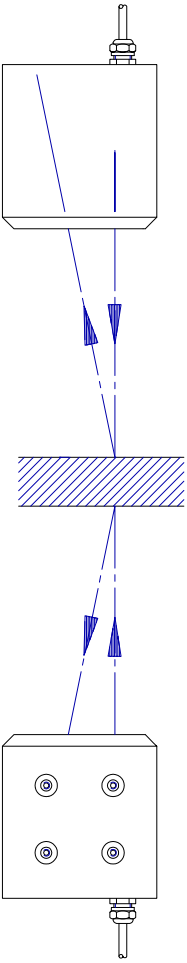
Control of vacuum or pressure in containers.



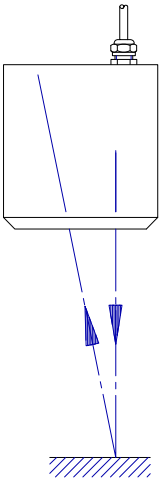
level control



measurement and control
of surface treatment



thickness measurement



distance measurement