



OPTIPACT

**Optical length and velocity sensor
with two orthogonal measurement axes**

OPT- S 1 N 0 0 4 0 0 4- 0 0 4 1 0- 1 2- a 0 P b- A 0 0 0
OPT- F 1 N 0 0 1 0 0 1- 0 0 1 1 0- 1 2- a 0 P b- A 0 0 0
OPT- M 1 N 0 0 2 0 0 2- 0 1 8 0 3- 1 2- a 0 P 1- A 0 0 0

Manual

Imprint

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Specifications are subject to change without notice

Technical specifications, which are described in this manual, are subject to change due to our permanent strive to improve our products.

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Safety Instructions

Definitions and symbols



Danger denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.



Caution denotes an important information. It indicates a situation which can result in a loss or degradation of signal or service.



Warning denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the device. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

Safety and intended use in brief



Before powering-up the system, check all of the electrical connections. Connections not properly made can cause the system to function incorrectly. Faulty connections can result in severe injury to personnel, and material damage to equipment. Do not exceed the maximum supply voltage of 5 V or 30 V, dependent on model.



Do not stare intentionally into the LED's beam. Although the human eye is normally sufficiently protected by its own eyelid winking reflex, this natural reflex may be impaired by medication, alcohol and drugs. Although the product can be operated without taking special safety precautions, one should refrain from looking directly into the LED beam.

Safety Instructions	3
Definitions and symbols	3
Safety and intended use in brief	3
Product details	6
Technical data	6
Variants of types	6
Sensor Properties	7
Optics and Illumination	7
Mechanical data	7
Electrical data	8
Scope of delivery	9
OPTIPACT S1/F1 at a glance	10
OPTIPACT M1 at a glance	11
Putting into operation	12
Storage	12
Mounting Situation	13
Pin Assignment	15
Incremental Interface	16
Systematic Error and Working Distance	18
Normal Operation of OPTIPACT	19
Diagnostic LEDs	20
Handling the OPTIPACT with the Graphical User Interface "Sensor Configurator"	21
1 Introduction	21
Before you start	21
Purpose	21
System requirements	21
Communication between OPTIPACT und PC	21
Software Installation and Start up	22
Send and Receive - Proper handling of the RS232	23
2 Functions	24
Type Label	24
General	25
Camera	26
Piece goods	28
Filter	30
Pixel Cam	31
Online Parameter	32
3 Hints and Application Notes	34
Hint 1: Mathematical Definition of the Filters	34
Hint 2: Configuration of OPTIPACT with the Hyperterminal	34
Hint 3: Cleaning the Optical window	35

Application 1: Flying Saw.....	36
Application 2: Measurement of Extremely Dark Materials.....	39
Application 3: Measuring Shiny Surfaces	42
Technical Documents.....	43
Dimensioned Drawings OPTIPACT S1 and F1.....	43
Dimensioned Drawings OPTIPACT M1	44

Product details

The sensor OPTIPACT bases on a contactless, optical measuring principle. The built-in digital camera closely observes the surface of an object and analyzes its lateral movement. The sensor measures the relative displacement of the surface in two orthogonal axes. The incremental interface and SSI respectively are integrated into the housing. Information about velocity of the object measured can be deduced from the length measurement.

The working distance between OPTIPACT and the measurement surface can vary in any way that complies with specifications.

The illumination of the measurement surface is achieved by a LED emitting visible, red light, ensuring safety of operation both for the user and for OPTIPACT's lifespan.

Technical data

Variants of types

This manual covers all variants of the sensors OPTIPACT S1, F1 and M1

OPT - S1N004004 - 00410 - 12 - a 0 P b - A000
 OPT - F1N001001 - 00110 - 12 - a 0 P b - A000
 OPT - M1N002002 - 01803 - 12 - a 0 P 1 - A000

Meaning of the variables a and b:

- a Incremental interface
 - 0 = none
 - 1 = RS 422 compatible
 - 2 = Push-Pull (Voltage level = + U_b)
 - 3 = TTL

- b Voltage supply
 - 1 = 10 to 30 V
 - 2 = 5 V

Sensor Properties

Type of Sensor	OPT-F1	OPT-S1	OPT-M1
Velocity measurement range (v_{max})	up to 1 m/s	up to 4 m/s	up to 2,5 m/s
Measurement Uncertainty	< 1 %	< 1 %	< 0,5 %
Resolution (Optics)	15 μ m	65 μ m	30 μ m
Resolution (Output)	Typically 100 μ m Resolution tunable		

Optics and Illumination

Type of Sensor	OPT-F1	OPT-S1	OPT-M1
Distance to object	15,5 mm	40 mm	180 mm
Distance Deviation	± 10 %	± 10 %	± 3 %
Measurement Spot Size	< 4 mm ² (2 mm x 2 mm)	< 64 mm ² (8 mm x 8 mm)	< 25 mm ² (5 mm x 5 mm)
Illumination	red LED		

Mechanical data

Type of Sensor	OPT-F1	OPT-S1	OPT-M1
Housing	Aluminim		
Shock resistance (EN 60068-2-27)	≤ 25 g (Half sine, 6 ms) (*)		
Permanent shock (EN 60028-2-29)	≤ 10 g (Half sine, 16 ms) (*)		
Vibration (EN 60068-2-6)	≤ 1 g (5 Hz ... 200 Hz, Sine) (*)		
Weight (standard version)	Approx.. 250 g		Approx. 3,5 kg
Mounting	M4		M6

(*) corresponding to class 3M5 (EN 60721-3-3: compliant to applications associated with significant vibrations, e.g. caused by machines or vehicles, or shocks with high density of energy, e.g. caused by heavy machines or conveyor belts)

Electrical data

Sensor type	OPT-F1	OPT-S1	OPT-M1
Supply voltage (*)	5 V or 10 - 30 V DC		10 – 30 V DC
Max. Power Consumption	2,5 Watts		4 Watts
EMC	Emitted interference: EN 61000-6-4		
	Noise immunity: EN 61000-6-2		
Interfaces	Incremental-Interface, RS232 (**)		
Transmission Rate Incremental Interface	Usage of one axis: up to 41 kHz Usage of two axes: up to 20,5 kHz		
Electrical lifetime	> 10 ⁵ h		

(*) Supply voltage according to EN 50 178 (safety extra-low voltage).

(**) Usage of RS232 interface is only possible when sensor is connected to the software "Sensor Configurator"

Scope of delivery

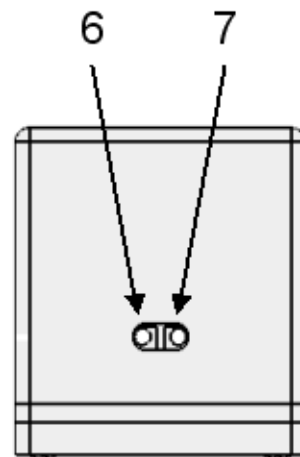
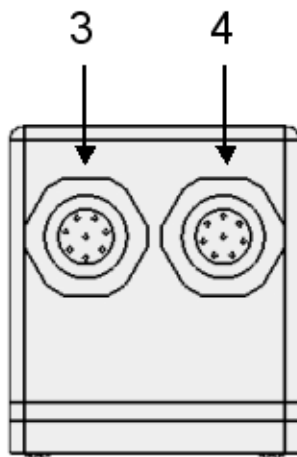
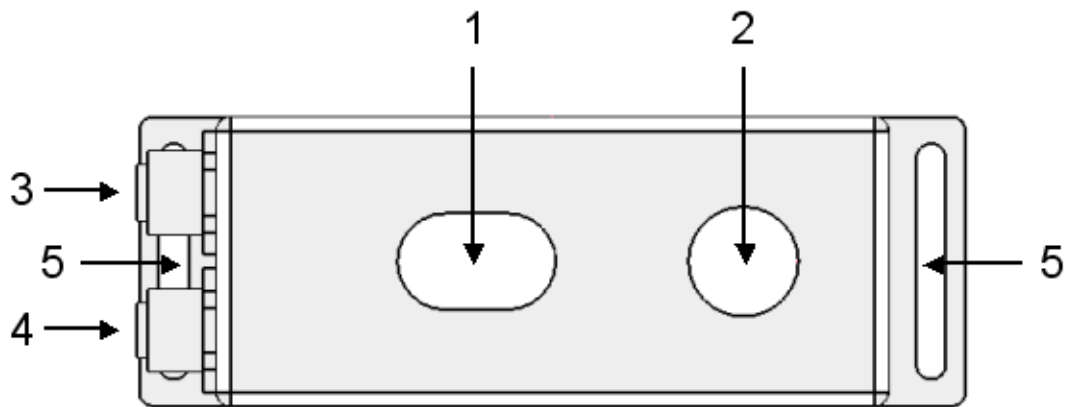
The delivery contains:

- 1 OPTIPACT
- This manual

 **CAUTION**

- Please verify that the content of your delivery is complete.
- Check the content for damages caused by transport.
- Make sure that the type key on your device matches that one on your delivery note or invoice.

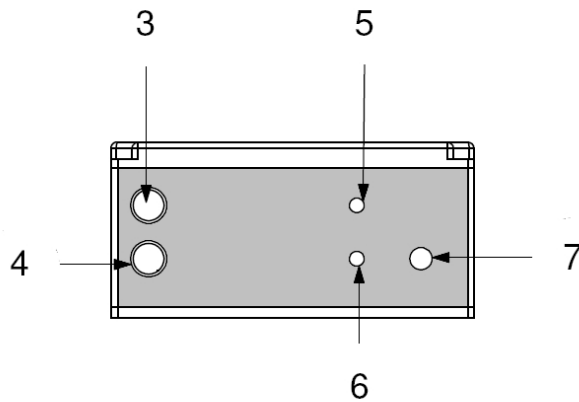
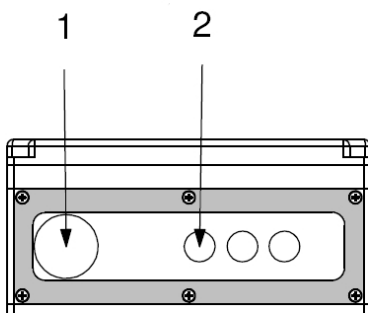
OPTIPACT S1/F1 at a glance



- 1 = LED-Illumination
- 2 = Optics of camera
- 3 = M12-Female, 8 contacts
- 4 = M12-Male, 8 contacts

- 5 = Slotted holes for mounting
- 6 = green LED to indicate operating state
- 7 = red LED to indicate operating state

OPTIPACT M1 at a glance



- 1 = Optics of camera
- 2 = LED-Illumination
- 3 = M12-Connector male, 8 pins
- 4 = M12-Connector female, 8 pins

- 5 = green LED to indicate operating state
- 6 = red LED to indicate operating state
- 7 = Venting plug

Putting into operation

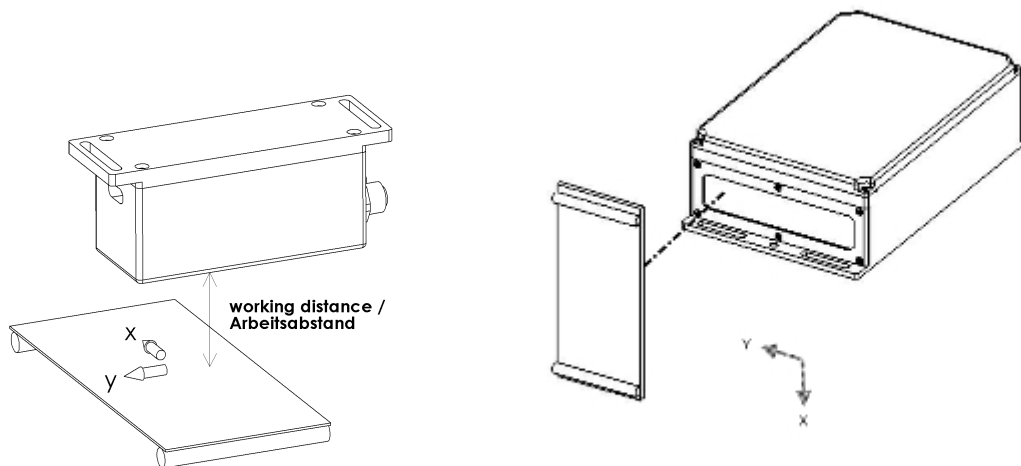
Storage

The storage temperature is -20 to $+60$ °C at humidity less than 80 %. The optimum storage conditions are in dry rooms with a storage temperature of $+10$ to $+30$ °C.

A fast changeover between hot and cold temperatures may cause condensation (water

drops) to form on internal or external surfaces of the device. Therefore the device should be slowly adjusted to its environmental conditions before start-up.

Mounting Situation



The drawing shows the measurement setup. For OPTIPACT S1 and F1 (left) and OPTIPACT M1 (right). Please note the reference points for the working distance and the orientation of the sensor relative to the direction of movement along the axes shown in the drawing.

The front surface of OPTIPACT must run parallel to the surface of the measurement object, to minimize the angel-caused alignment error.

The slotted holes in the base plate allow flexible adjustment of the sensor with M4-screws.

The nominal working distance between object and aluminium front of the sensor should be kept as constant as possible. Measuring glossy or polished surfaces could make a different mounting

necessary. Please refer to Example of Application No. 3 on page 37.

The measurement spot below the camera optic depends on the type of sensor:

OPT-S1	OPT-F1	OPT-M1
8 x 8 mm ²	2 x 2 mm ²	5 x 5 mm ²

The measurement object should be completely covered by the measurement spot.

If the measurement direction follows the X-axis it is recommended to mount the sensor as illustrated in the figure above.

 **WARNING**

Before powering-up the system, check all of the electrical connections. Connections not properly made can cause the system to function incorrectly. Faulty connections can result in severe injury to personnel, and material damage to equipment. Do not exceed the maximum supply voltage of 5 V or 30 V, dependent on model.

 **CAUTION**

Route the connecting cable to OPTIPACT at a considerable distance or completely separated from AC power cables with their associated noise. For reliable data transfer, completely shielded cables must be used, and good grounding must be provided.

OPTIPACT should not be used as a handhold or as a step. Avoid mechanical loads on the housing.

 **WARNING**

Do not stare intentionally into the LED's beam. Although the human eye is normally sufficiently protected by its own eyelid winking reflex, this natural reflex may be impaired by medication, alcohol and drugs.

Although the product can be operated without taking special safety precautions, one should refrain from looking directly into the LED beam.

 **CAUTION**

During operation the space between the object's surface and OPTIPACT's optical window must not be obstructed. Otherwise the intended mode of operation is not assured.

Pin Assignment

OPT - S1N004004 - 00410 - 12 - a 0 P b - A000
 OPT - F1N001001 - 00110 - 12 - a 0 P b - A000
 OPT - M1N002002 - 01803 - 12 - a 0 P 1 - A000

Voltage Supply U_b regarding to variable „b“ in the type key :

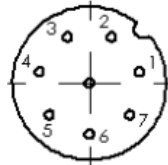
- b=1: 10 ... 30 V
- b=2: 5 V

8 pin male M12 connector

Pin Number	Signal
1	X_A
2	/X_A
3	X_B
4	/X_B
5	+ U_{b_Ext}
6	Gnd_Ext
7	RS232 Rx
8	RS232 Tx

External view:

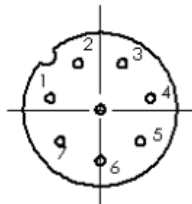
Stecker
Male Connector



8 pin female M12 connector

Pin Number	Signal
1	Y_A
2	/Y_A
3	Y_B
4	/Y_B
5	Digital Input 1
6	Gnd_Ext
7	Digital Output 1
8	Digital Output 2

Dose
Female Connector

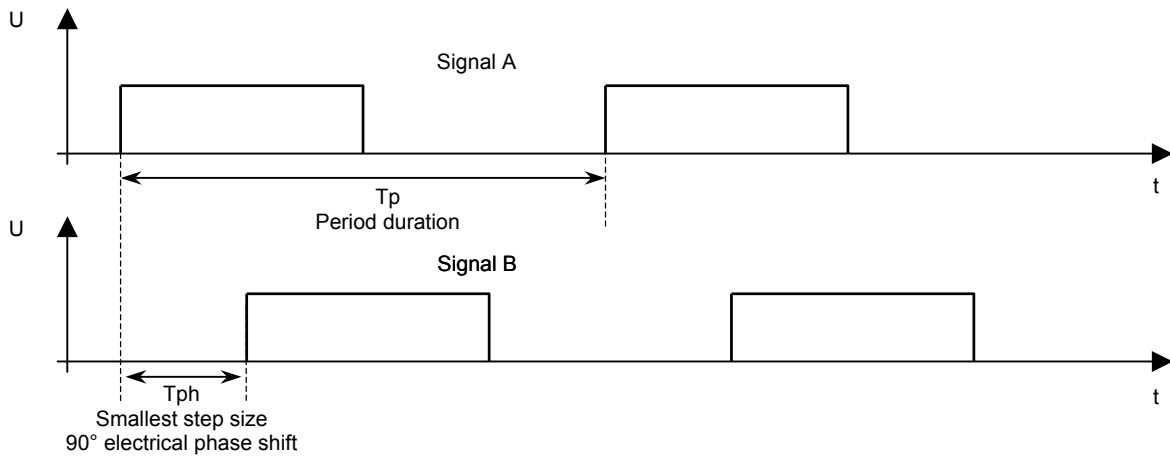


Incremental Interface

The incremental interface can be used to transmit the displacement information. Incremental length information is provided by a quadrature signal pair consisting of two square pulses, shifted in phase to each other by 90°. The direction of the movement can be deduced from the order in which the signal

edges appear. In the example below an edge from signal B follows an edge from signal A with a phase shift of 90°. If the measurement object turns over to the other direction an edge of signal A will follow an edge of signal B.

Signal diagram



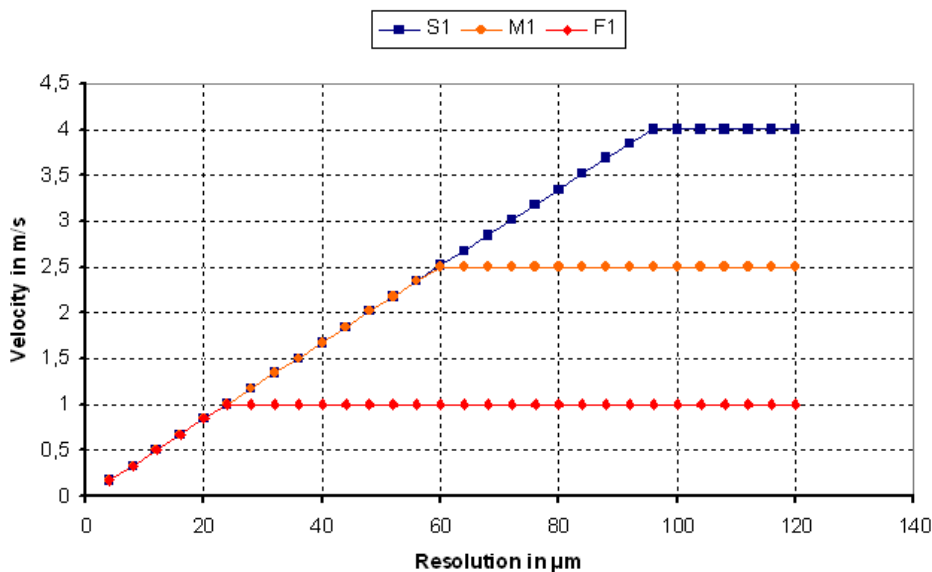
Signal A: Square signal A, incremental signal
Signal B: Square signal B, incremental signal

T_p : Period duration
 T_{ph} : 90° electrical phase shift

Electrical data

Sensortyp	OPT-F1	OPT-S1	OPT-M1
Maximum output frequency	1D: up to 41 kHz at 4x edge count 2D: up to 20.5 kHz per measurement axis at 4x edge count		
Velocity measurement range	Please refer to the figure below		
Line Driver			
Maximum output current	Max. 25 mA		
Push-Pull Ausführung			
Maximum Output Current	Max. 25 mA		
Maximum Output Voltage	Operating Voltage		
Short-circuit proof	Signal output against each other and to ground		

Maximum Velocity Measurable as Dependency of Resolution



If the finest resolution of sensor is chosen, the maximum velocity in the application has to be noticed, as the figure shows: Measuring the

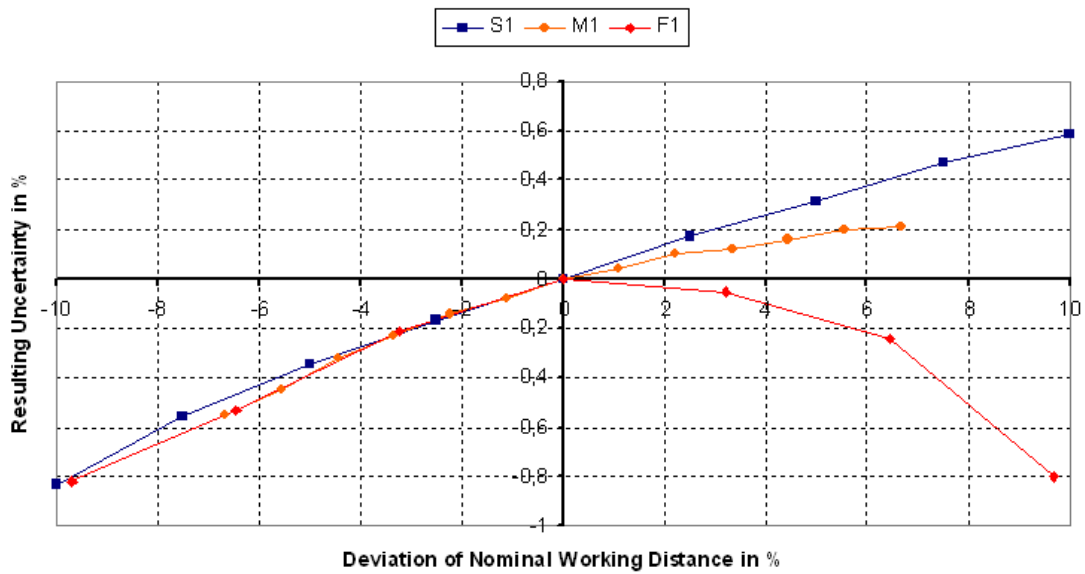
maximum velocity of the sensor's specification is not possible with its finest resolution. The graph is based on 4 times edge count.

Systematic Error and Working Distance

A big influence on the stated measurement uncertainty has the deviation of distance between object to be measured and Sensor. This is because of unevenness or flatter of

the material. Keeping the working distance constantly minimizes the deviation's influence on the measuring uncertainty.

Measuring Uncertainty at Variation of Working Distance



Normal Operation of OPTIPACT

Apply voltage to OPTIPACT. After 3 seconds it is operational, and provides length information at the incremental interface. This applies also to the initial operation. In the delivery status the

device is ready to measure with its factory settings. During normal operation, OPTIPACT's green LED shows constant light, while its red LED is off.

 **WARNING**

Do not stare intentionally into the LED's beam. Although the human eye is normally sufficiently protected by its own eyelid winking reflex, this natural reflex may be impaired by medication, alcohol and drugs.

Although the product can be operated without taking special safety precautions, one should refrain from looking directly into the LED beam.

 **CAUTION**

During operation the space between the object's surface and OPTIPACT's optical window must not be obstructed. Otherwise the intended mode of operation is not assured.

 **DANGER**

If you have configured the OPTIPACT-Sensor incorrectly and machines are connected, there may

be situations that can result in physical injury or death. First, read this introduction carefully.

 **CAUTION**

Avoid touching the optical window. There is a special anti-finger-print coating on it; nevertheless dirt or a grease film, causing optical losses and blurring, decreases the quality of measurements.

 **CAUTION**

Avoid direct sunlight falling onto the measured surface or into the camera lens. OPTIPACT is able to give trouble-free measurements with extrinsic illumination additional to the built-in LED, but direct sunlight could decrease the required contrast.

Diagnostic LEDs

The red and the green LED indicate the operating state of OPTIPACT. The different states of a LED are on, off and blinking. The following table explains the different operating states.

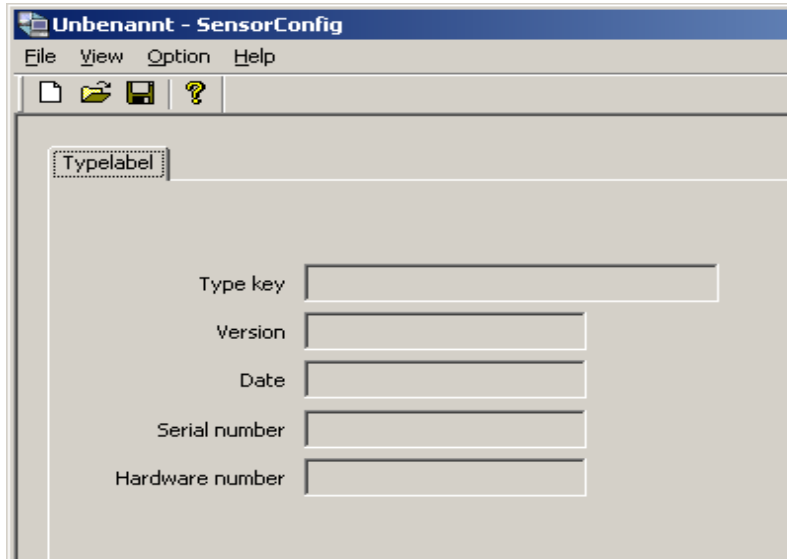
General meaning of diagnostic LEDs

Green LED	Red LED	Meaning
On		Measurement mode
Blinking		Configuration mode
Off		No supply voltage
	On	Inability of measurement probable
	Blinking	Restricted measurement ability
	Off	Normal operation

Meaning of diagnostic LEDs in detail

Green LED	Red LED	Meaning
On	Off	Measurement mode, all parameters operating within specification.
Blinking	Off	Configuration mode
Off	Off	No supply voltage
On	Blinking 2x	Measurement mode. Restricted measurement ability. Image quality operating aside the defined range of parameter warning. Preventive maintenance recommended.
On	Blinking 3x	Digital filter indicates sporadic drop outs.
On	Blinking 4x	More than one indicator signals restricted measurement ability.
Blinking	Blinking	Verification mode, transmission of test data without relationship to movement of measurement object.
Off	Blinking	Transmission of image data
On	On	Measurement mode. Inability of measurement probable. One or more parameters operating aside the defined range of parameter alarm.
Blinking	On	System error in configuration mode.
Off	On	System error in measurement mode.

Handling the OPTIPACT with the Graphical User Interface “Sensor Configurator”



1 Introduction

Before you start...

This manual contains important hints how to configure the OPTIPACT with the help of the software „Sensor Configurator“. It shows how to configure the OPTIPACT for your application. Please read this instruction carefully before you start.

Purpose

The sensor configuration is a program with graphical user interface that can operate and configure the OPTIPACT – sensor from the company INTACTON. Besides the configuration of incremental-resolution or number of saved pictures per second, you can use the software to check the measurement possibility in different applications or show/check a length's progress. The software Sensor Configurator can be used with every sensor from the product family of INTACTON. This document is an instruction guide to use the Sensor Configurator with OPTIPACT-Sensor from the company INTACTON.

System requirements

To use the Sensor Configurator, you will need a PC with Windows Vista, 2000 or XP. To communicate with the OPTIPACT, you will also need an RS232 connection with the PC. This can be done with a standard PC interface or an USB-RS232 converter. The transfer rate (Baud rate) for the interface is 19.2kbps.

Communication between OPTIPACT und PC

To configure the OPTIPACT-Sensor with the Sensor Configurator, there must be a RS232-Connection between Sensor and PC. The Sensor also needs external supply voltage. Wire the OPTIPACT with the RS232-connection as follows:

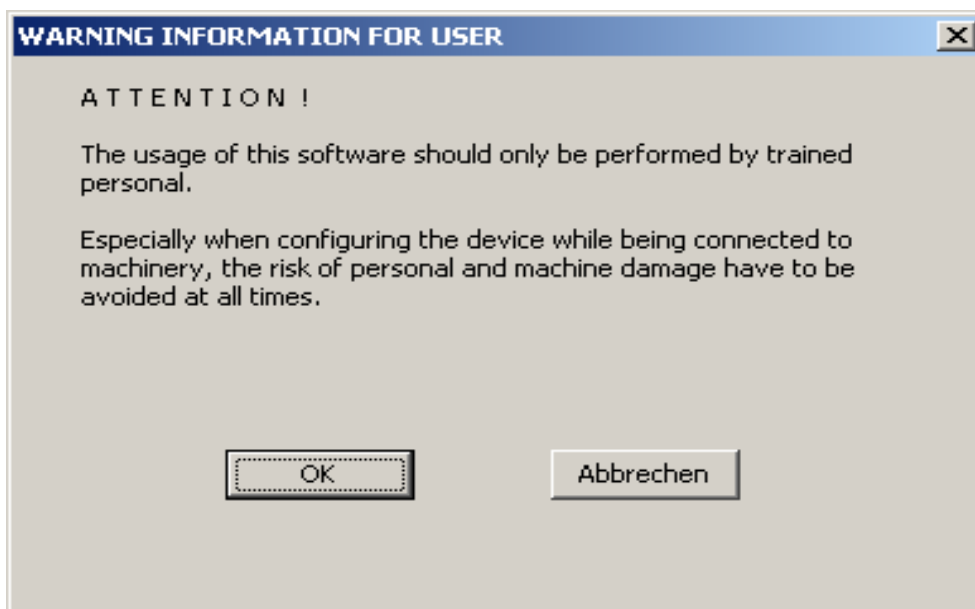
INTACTON

FRABA

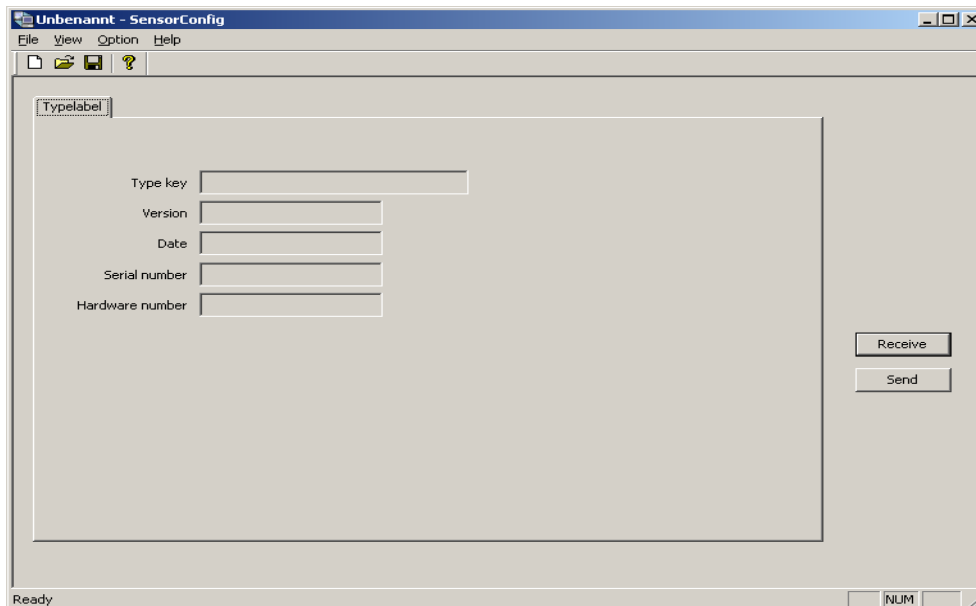
8 pol. Plug male OPTIPACT Pin Number	9 pol. D-Sub female PC Pin Number
6	5
7	3
8	2

Software Installation and Start up

It must be ensured that you have sufficient system rights to install software. The sensor Configurator is available as a zip file for free download available at www.intacton.com. Download the file and then start Sensor_Configurator_VXX.exe. Follow the instructions of the installer. After successful installation, the program generates a single contribution 'Sensor Config' in your start menu. At the start of the program, the following warning is shown:

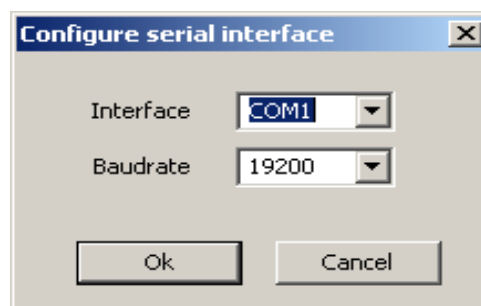


The program reminds you that only trained personnel should operate the software. Improper configuration of sensors, particularly if the Sensor is directly connected with machines, may result in situations where bodily injury or death may occur. After confirming with "OK" is the startup screen of the software:



First, select Options→Serial Interface“, to configure the RS232-connection.

Then, choose your Interface. The baud rate for all OPTIPACT sensors is at 19200 bps.



Confirm with "OK" and press "Receive" on the right side of the screen. If all the settings are correct, the software will now be receiving all relevant data from the sensor and writing them in the text fields of the start screen. The connection to the sensor has now been established and the software is ready to measure.

Send and Receive - Proper handling of the RS232

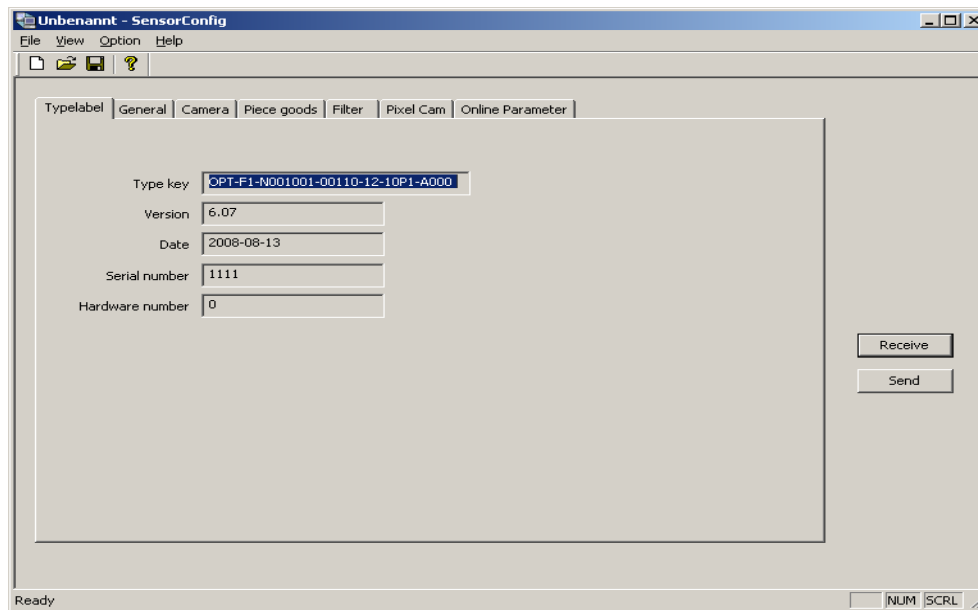
All settings must be confirmed by clicking "Send" on the right side. Only after pushing this button they will be effective in the sensor. The two LEDs on the sensor show whether the OPTIPACT is in configuration or measurement mode. When the green LED permanently lights, the OPTIPACT is in measurement mode. If the green LED is flashing, the OPTIPACT is in configuration mode. If the red LED is flashing, the OPTIPACT is in PixelCam mode. For other combinations, please refer to the OPTIPACT data sheet. Please consider: Increments will never be generated if:

- The sensor is in configuration mode
- The PixelCam is active
- The Send- or Receive button is pushed

2 Functions

Type Label

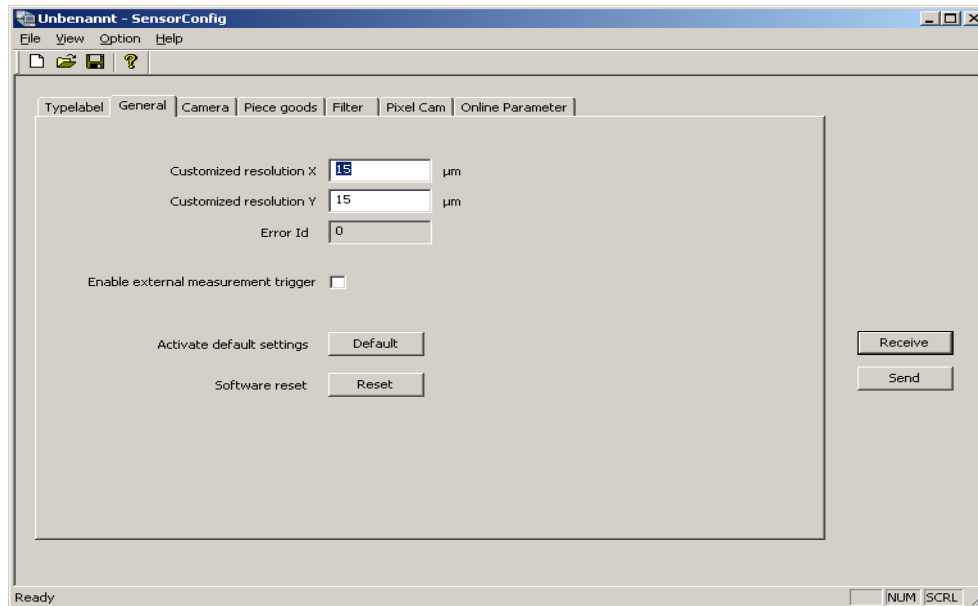
In the Typelabel tab, you cannot change the function. You will be shown only information about the connected sensor.



- **Type Key** of the Sensor. Besides the sensor type (S1, F1, M1), you see further information such as levels of output signals etc. The structure of the type key is documented in the OPTIPACT data sheet.
- **Version** shows the state of internal sensor software.
- **Date** documented the date on which the sensor passed the quality control at INTACTON GmbH.
- **Serial Number** is the serial number of the unit. This should be used to support requests.
- **Hardware Number** is an internal index.

General

The general function allows the setting of incremental resolution. In addition, the software can be reset to its original settings.



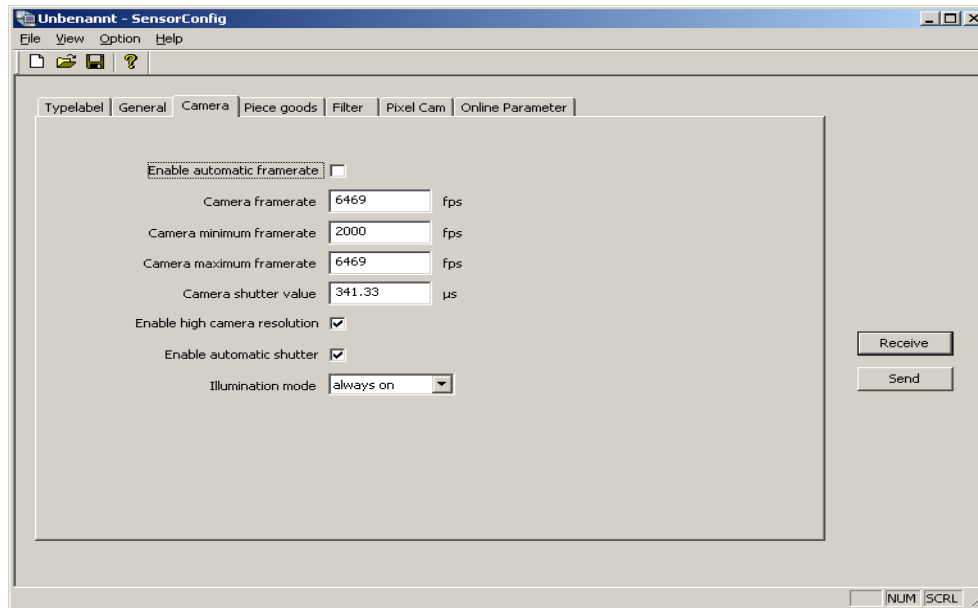
OPTIPACT sensors have an area camera that allows for measurement in two axes. The incremental resolution can be defined and/or set for both axes independently. The input is referenced to a 4x counting of the incremental signal (i.e. on track A and B falling and rising flanks are counted). If for example a distance resolution of 100µm per increment should be set, the value 100 has to be entered in the X or Y field. For a 2x measurement the value 50 has to be entered to get a 100µm per increment. For a 1x (1 period) measurement, its the value is 25.

$$E = \frac{1}{4} \cdot 100 \cdot G$$

- **Customized Resolution X:** Setting the resolution for measuring the X direction
- **Customized Resolution Y:** Setting the resolution for measuring the Y direction
- **Error ID:** If a serious system failure occurs as a result of damage to the sensor, a number is written in this field which characterized the errors.
- **Enable external measurement trigger:** OPTIPACT sensors have a digital input on which the start of a measurement can be triggered. The field must be enabled if this input is used. The input level of the trigger signal must be equal to its supply voltage.
- **Activate Default settings:** OPTIPACT is set in default settings.
- **Software reset:** Restart the internal OPTIPACT software.

Camera

The camera-function allows all settings that are relevant for the internal digital camera.



Comments on the framerate parameters

The number of digital camera images per second is the frame rate. A number value between 2000 (minimum frame rate) and 6469 (maximum frame rate) can be set. OPTIPACT sensors determine the distance moving by comparing successively recorded images, hence the frame rate varies directly with the maximum measurement speed. To set a right frame rate, the following relationships are important:

1. **The less camera images recorded in a second (small frame rates), the more time the camera has for exposure of each image. The more images per second the camera takes up (high frame rates), the less time the camera has for exposure of each image.**
2. **With the maximum frame rate, the sensor can measure with maximum speed (4 m/s for OPTIPACT-S1). With half of the maximum frame rate, the OPTIPACT can measure half of the maximum speed.**

$$v_{\text{detectable}} = \frac{\text{Framerate that is set}}{6469} \cdot v_{\text{max}}$$

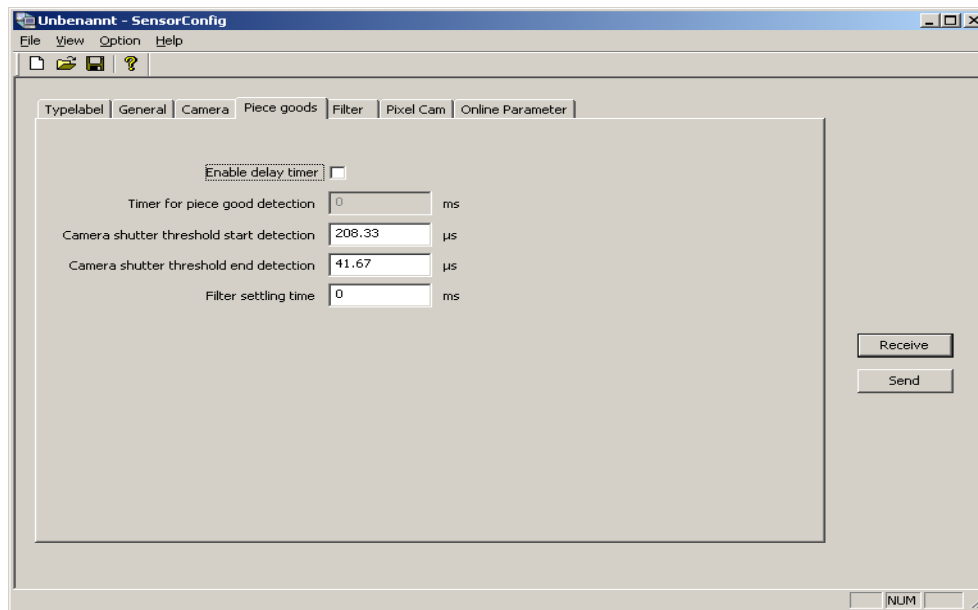
For dark materials with low-light return (see shutter value), possible smaller frame rates are more practical because there is more time per picture that is exposed, which creates a better measurement environment

– (of course taking into the maximum speed in the application). Please see the chapter application examples.

- **Enable automatic frame rate:** By default, the hook in this field is not set. The frame rate is set to the maximum value of 6469 fps. Changes in this field should be done only in exceptional cases and after consultation with INTACTON. One for all measurements fixed frame rate is recommended.
- **Camera Frame rate:** The number of recorded images per second
- **Camera minimum frame rate & Camera maximum frame rate:** These fields are effective if “Enable automatic frame rate” is hooked. They give the minimal and maximal limit by which the the frame rate can move.
- **Camera Shutter Value:** The shutter value represents the exposure time per image. The value in this field is the maximal limit of the value, the sensor can take. The default value is the maximum value of 341.66 μ s. The clock cycle is 314.66 μ s = 24 Mhz = 8192.
- **Enable high camera resolution:** The resolution of the camera can be set in this field . The camera should be used in the highest resolution, the hook should be set.
- **Enable automatic shutter:** For the most application automatic regulation of the shutter value is used. In comparison to the frame rate the shutter value changes rapidly for the whole measurement
- **Illumination Mode:** The illumination can be set to be always on or pulsed.

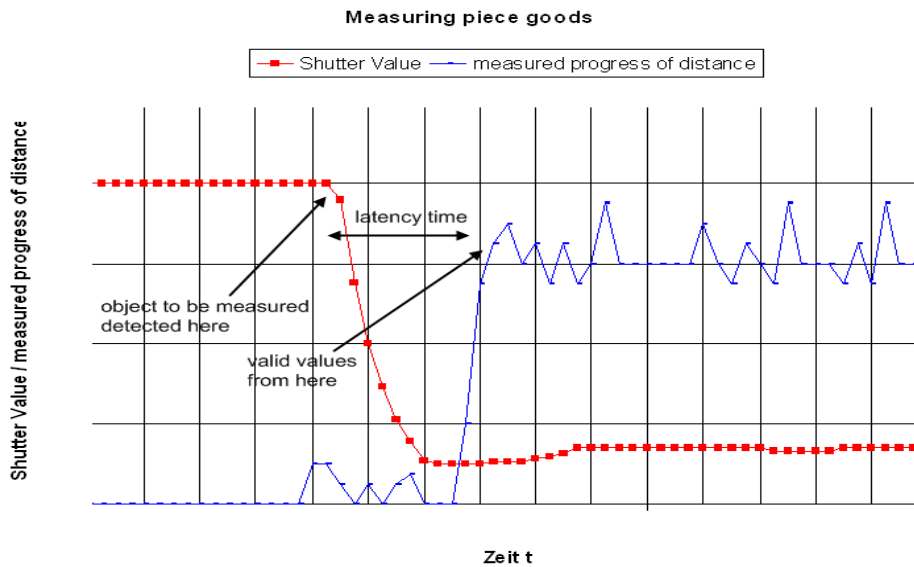
Piece goods¹

The 'Piece goods' tab allows you to measure the length of single parts.



Between physical detection of a single piece (Board of wood, Steel Rail,..) from the OPTIPACT and the real output of length, there is a time delay labeled as latency time in the following picture.

¹ Please contact INTACTON for support if you want to do a piece good measurement

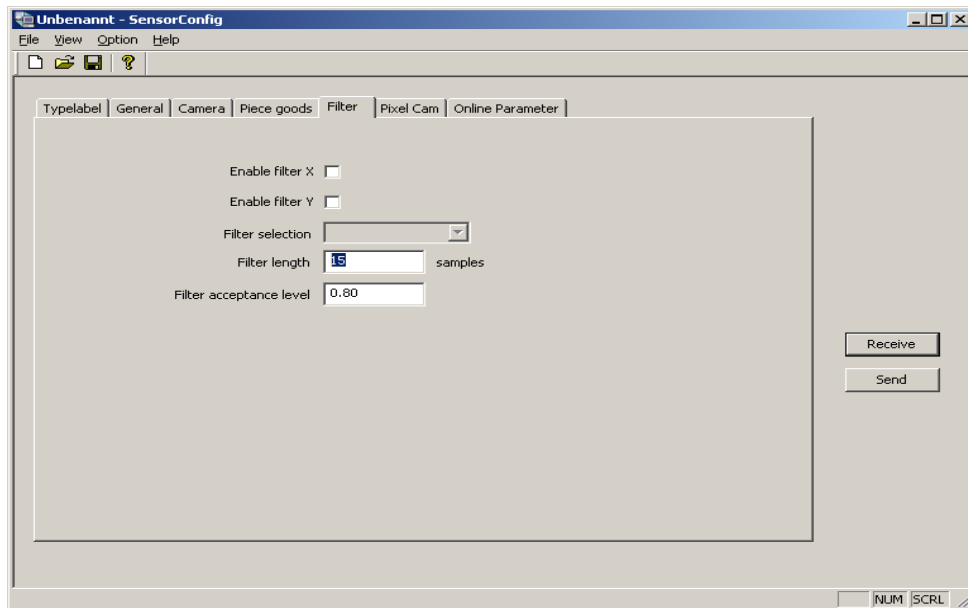


The Measurement can be suspended for the duration of this latency time (Delay Timer Δt , s.u.). The OPTIPACT sensor uses for this the internal light regulation as the trigger and so you can get a trigger signal for the start of the measurement. The condition for a good measurement is knowledge of the exact process speed. These should be constant during the beginning of the measurement. Then the lost beginning length can be compensated with the time delay t with the sum delay $t \cdot v$ (v = process speed) in the PLC. The end of the object is detected by the OPTIPACT without any latency.

- **Enable delay timer:** For detection of piece goods, the hook has to be set. By going under the set threshold level "Threshold start detection" the OPTIPACT waits for the Timer for piece good detection and then starts its measurement .
- **Camera shutter threshold start detection:** Here you set the shutter value that defines the start of the delay timer.
- **Camera shutter threshold end detection:** Marks the end of a piece good measurement and prepares the sensor for the next measurement.
- **Filter Setting Time:** By activating a filter as well as piece good measurement, this time enables the sensor to fill the filter selected with measurement values. 20ms is recommended.

Filter

OPTIPACT gives you the option to filter the output signal, therefore you have different kind of filters. The filtering can be used to filter the peaks to smoothen the signal.

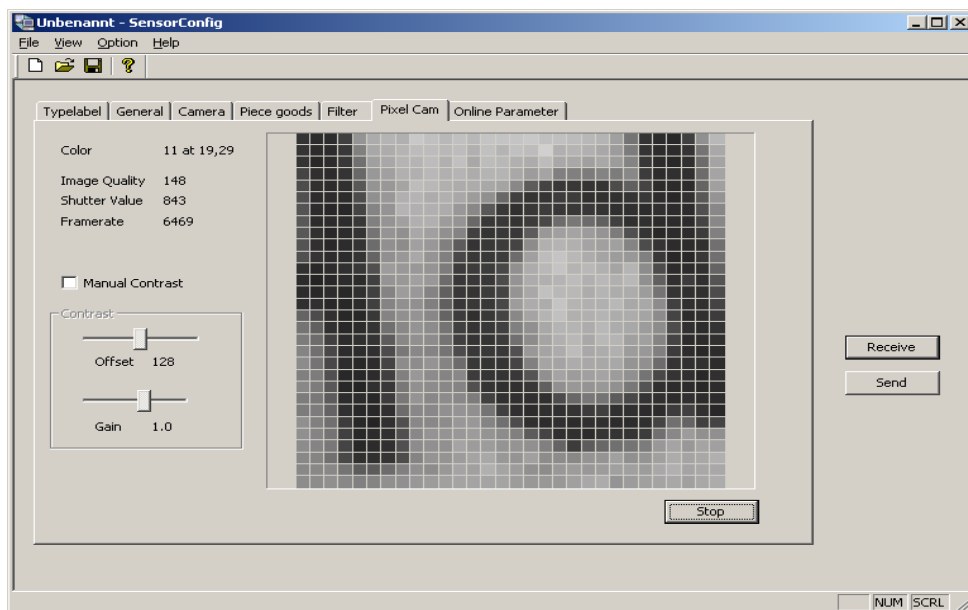


- **Enable Filter X:** Activate the filter for the X axis measurement
- **Enable Filter Y:** Activate the filter for the Y axis measurement
- **Filter Selection²:** You can choose between 2 different filters: Moving Average Filter and Median Filter. You can find the mathematical definition under Chapter 3 in ApplicationNotes and Tips.
- **Filter length:** Gives the number of samples used for the filtering and the length of the window for filtering. If you activate the median filter, the value has to be an odd integer.
- **Filter acceptance level:** This filter will be active if the difference between the current measurement and the past value is bigger than this factor value.

² The filter function can be activated only over the serial terminal (see chapter 3) and is not part of the sensor configurator

Pixel Cam

OPTIPACT allows you to see the pictures of the internal digital camera. Here you can judge the quality of the measurement in the static mode, without material movement.



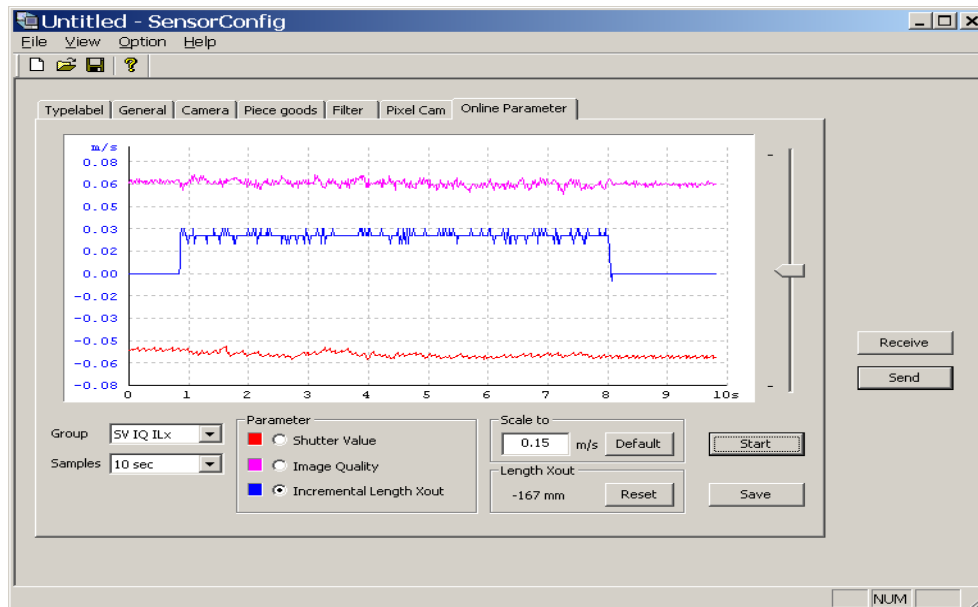
Here you can prove if...

- Working distance is correct
- The OPTIPACT can see the measuring material/surface
- If the reflected light is high enough for The OPTIPACT
- If the conditions are good for a dynamic length measurement

The above points are conditions for a good quality measurement. Please see these values in the sensor configurator on the top left side.

Parameter	Wertebereich Value	Bedeutung Description
Color	0-63	Brightness without unit for every pixel. Shows the value of this pixel on which the cursor is pointing. In pictures with a high contrast, you will find dark and light pixels in the same picture. This shows a high image quality.
Image Quality	0-169	Value for the number of structures in a picture, that the OPTIPACT can detect. Empirically, a good reproducible measurement can be done by a value greater than 65.
Shutter Value	0-8192	This is the shutter value in clock cycles(clock rate: 24Mhz). Every value below 8192 is a valid value. If the value is exactly 8192, meausrement failure may occur.
Frame rate	2000-6469	Number of saved pictures per second. In the standard settings this value is set to 6469.

Online Parameter



These functions assist in substantial diagnosis- and measurement capabilities

The Measurement window above shows the time line of three signals you can display. Different combinations of signals can be displayed and chosen on the bottom left scroll down menu, under group.

Initials	Description
SV	Shutter Value
IQ	Image Quality
ILx	Incremental Length X, measured increments of the X-Axis
ILy	Incremental Length Y, measured increments of the Y-Axis
Flx	Filter Input X: unfiltered signal on the X-axis
Fly	Filter Input Y: unfiltered signal on the Y-axis
FOx	Filter Output X: filtered signal on the X-axis
FOy	Filter Output Y: filtered signal on the Y-axis
FR	Frame rate
ALx	Absolute Length X: Output of the internal OPTIPACT counter for pattern detection ³
SPD	Status Pattern Detection

In the samples field, you can set the timeline or the length of the sample period. It is used to scale the Y-axis flexibly because the different signals have a different value ranges. For more effective useage of the Online Parameter function is shown in the Chapter Application note and tips.

After the measurement is done you can save the measurement with the “stop” button as a .csv file and later export in excel for further analysis.

³ This Funktion „Pattern Detection“ must be set in the Serial Terminal and is not part of the actual Software Configu

3 Hints and Application Notes

Hint 1: Mathematical Definition of the Filters

n is the number of samples of the filter.

Equation for one moving average output.

$$\bar{x}_k = \frac{1}{n} \sum_{i=k-n+1}^k x_i$$

Equation for the output of the median filter value string with n input samples

$$\tilde{x} = \begin{cases} x_{\frac{n+1}{2}} & n \text{ is odd} \\ \frac{1}{2} \left(x_{\frac{n}{2}} + x_{\frac{n}{2}+1} \right) & n \text{ is even} \end{cases}$$

Hint 2: Configuration of OPTIPACT with the Hyperterminal

Besides the configuration of OPTIPACT sensors with the graphical user interface the sensors can also be configured by a terminal program. You open this by clicking on Options→Terminal. If connection to OPTIPACT is established correctly, a click on “Return” delivers the text: “OPT>”. During the configuration with the terminal OPTIPACT is not able to measure. The connection to the terminal has to be terminated by the “exit” –command. A “?” can be added to any command to see the actual settings. Example: “sres x?” delivers the actual resolution for the X-axis.

"exit "	Leave configuration mode and start normal measurement mode
"getsviq"	Get actual Shutter Value (SV) and Image Quality (IQ)
"help"	List commands and command descriptions
"*idn"	Report electronic type label
"rcp"	Report current parameters
"error"	Show last occurred system error
"sres"	Set resolution dependant on axis in [µm] Syntax: sres [x y] [value]

"highres"	Set optical resolution of the sensor Syntax: highres [0 = low, 1 = high]
"imode"	Set illumination mode Syntax: imode [0 = pulsed, 1 = constant]
"sfauto"	Set frame rate mode Syntax: sfauto [0 = choose frame rate manually, 1 = automatic frame rate control]
"sfr"	Set frame rate when using manual frame rate mode in [Hz] Syntax: sfr [value]
"filter"	Switch for digital filter Syntax: filter [x y] [0 = off, 1 = on]
"fselect"	Choose a digital filter Syntax: fselect [1 = moving average filter, 2 = median filter]
"fl"	Set filter length in [samples] Syntax: fl [value]
"fthres "	Set quotient of filter threshold Syntax: fthres [numerator] [denominator]
"svlow"	Set lower threshold for parameter warning of image intensity in [digits] Syntax: svlow [value]
"svup"	Set upper threshold for parameter warning of image intensity in [digits] Syntax: svup [value]
"iqup"	Set upper threshold for parameter warning of image quality in [digits] Syntax: iqup [value]
"iqlow"	Set lower threshold for parameter warning of image quality in [digits] Syntax: iqlow [value]
"enable"	Enable switch for X- and Y-axis Syntax: enable [x y] [0 = off, 1 = on]
"trigger"	Enable switch for external measurement trigger Syntax: trigger [0 = off, 1 = on]

Hint 3: Cleaning the Optical window

To obtain best results, it is recommended to clean the optical window occasionally. Dust and larger dirt particles can usually be removed using pressurized, oil-free gas (filtered dry nitrogen). If further cleaning is needed, the drag method of cleaning can be used to remove fingerprints or other contaminants. In the drag method, lint-free lens tissue saturated with reagent-grade isopropyl alcohol or reagent-grade acetone is slowly dragged across the optical window. If done correctly, the solvent will evaporate uniformly without leaving streaks or spots.



Follow the safety instructions of the vendor of isopropyl alcohol or acetone when using these chemicals.

Application 1: Flying Saw

Task: The OPTIPACT F1 synchronize the cutting process of a flying saw in the production of Paper tubes

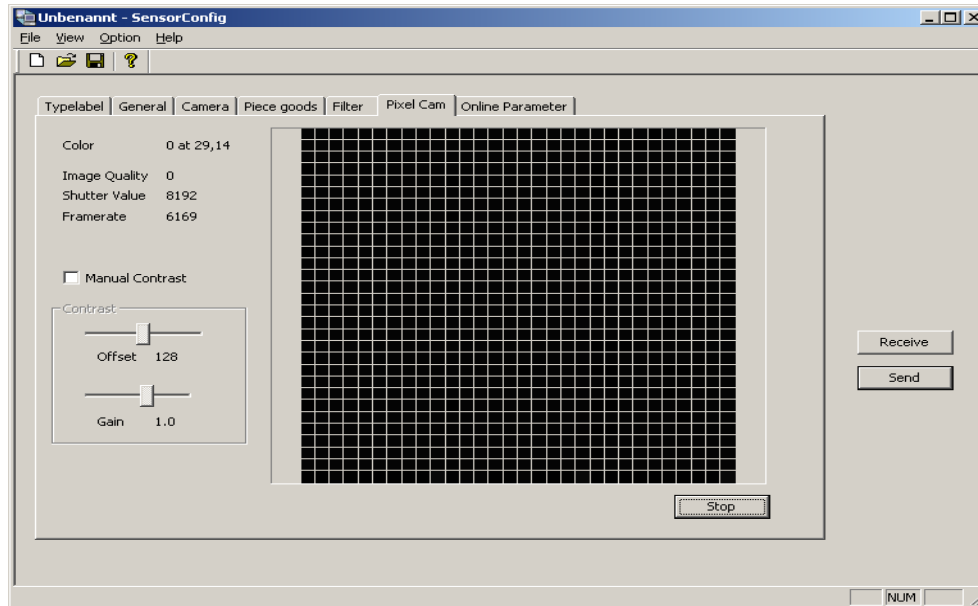
Before getting started, the following must be in place:

1. The sensor has to be mounted in the specified distance from the object
2. With help of the sensor configurator, the OPTIPACT can be setup for the application
3. This sensor has to be connected to the PLC to synchronize the speed of the saw with the speed of the raw materials

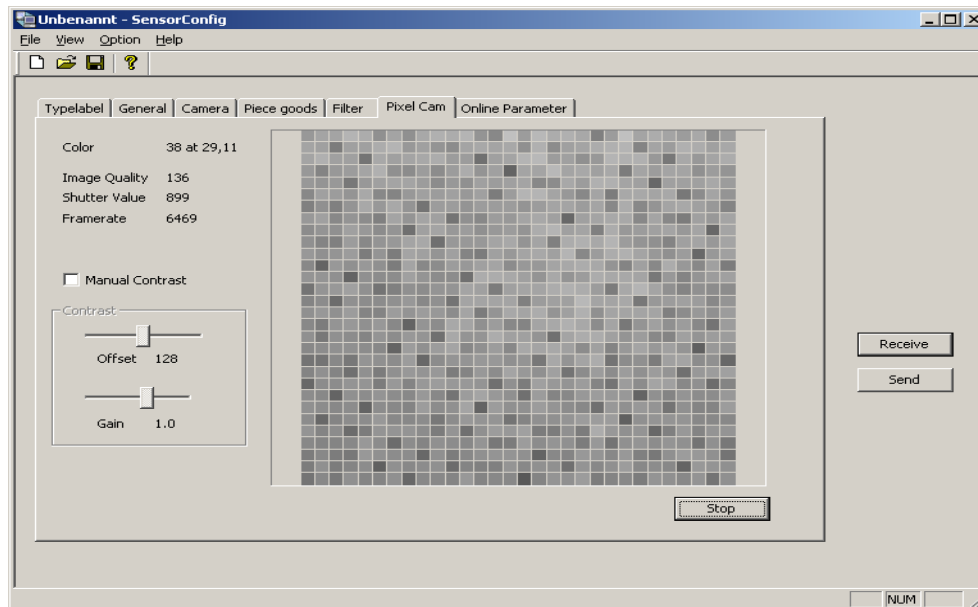
After the installation of the sensor in the machine the sensor configurator can be started. The general function allows you to set the incremental resolution (here: 100 micro meter). With the camera function, you should do the following:

- **Enable automatic frame rate:** no
- **Camera Frame rate:** 6469
- **Camera minimum Frame rate** und **Camera maximum frame rate:** 2000 / 6469
- **Camera Shutter Value:** 8192
- **Enable high camera resolution:** yes
- **Enable automatic shutter:** yes
- **Illumination Mode:** always on

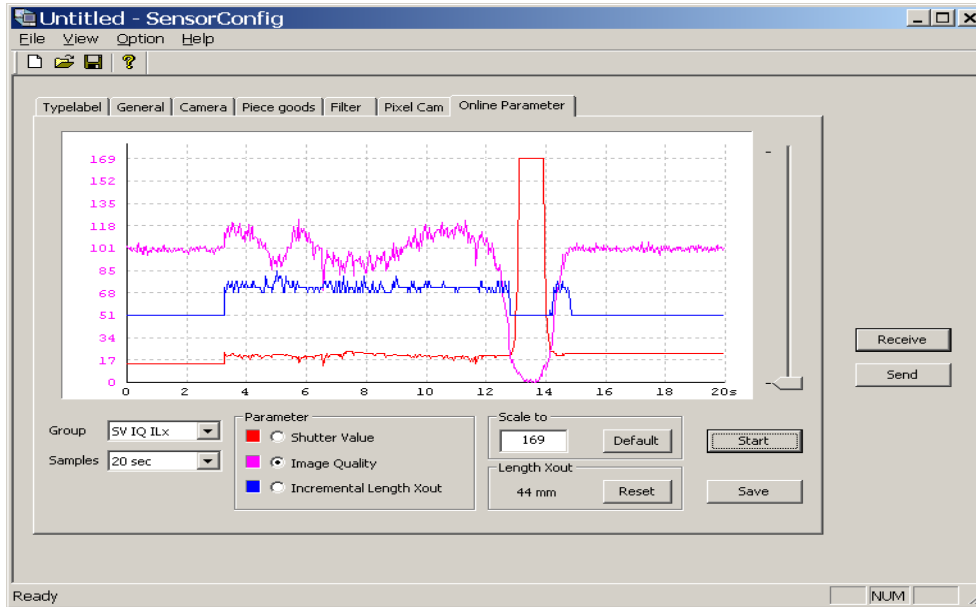
In this application, there is no piece good measurement. Initially we do not need to use the filter. Now, use the Pixel-Cam function to see the raw data of the digital camera. It delivers important diagnostic information in the static measurement mode. Take for example the following picture:



The complete black camera picture indicates that the distance between the sensor and measurement object is incorrect. The shutter value is at its maximum 8192, the image quality is near 0. Through manual adjustments of the distance and simultaneously looking at the pixel cam, you can adjust the measurement situation. The sensor should be fixed at the point where the image quality is maximum. A perfect measurement environment is shown in the following picture:



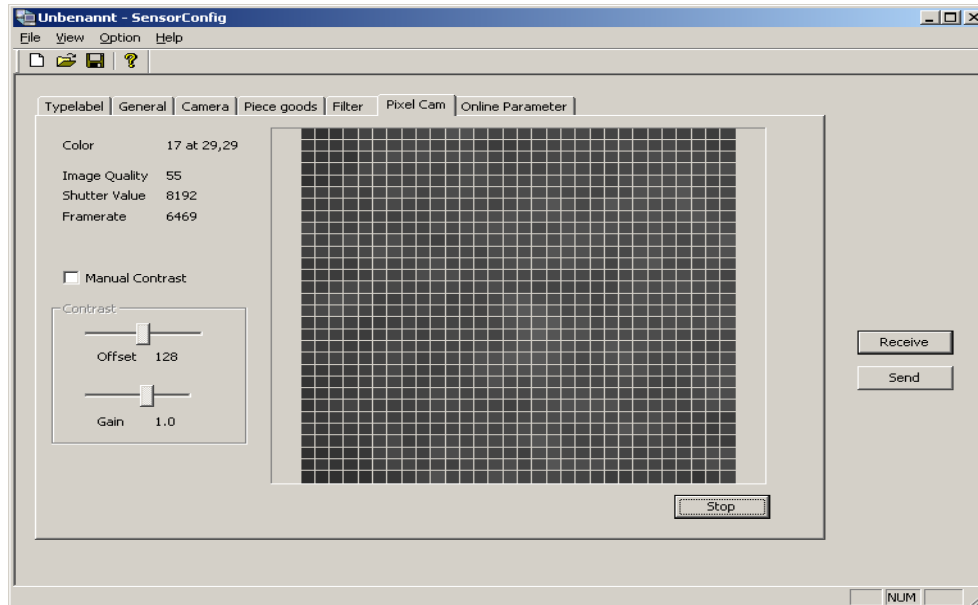
The image quality is an important basis of judgment if the measurement possibility is well over 100. The shutter value, as a value smaller than 1000, is absolutely in the valid area. Now, you can start the dynamic measurement. With this you can control time the working distance for the second. The fluctuation of the surface is too much for example: if the material is shaking the OPTIPACT will see a blurred picture. The value of the image quality will drop at the same time the Shutter Value increases. The picture illustrates this scenario.



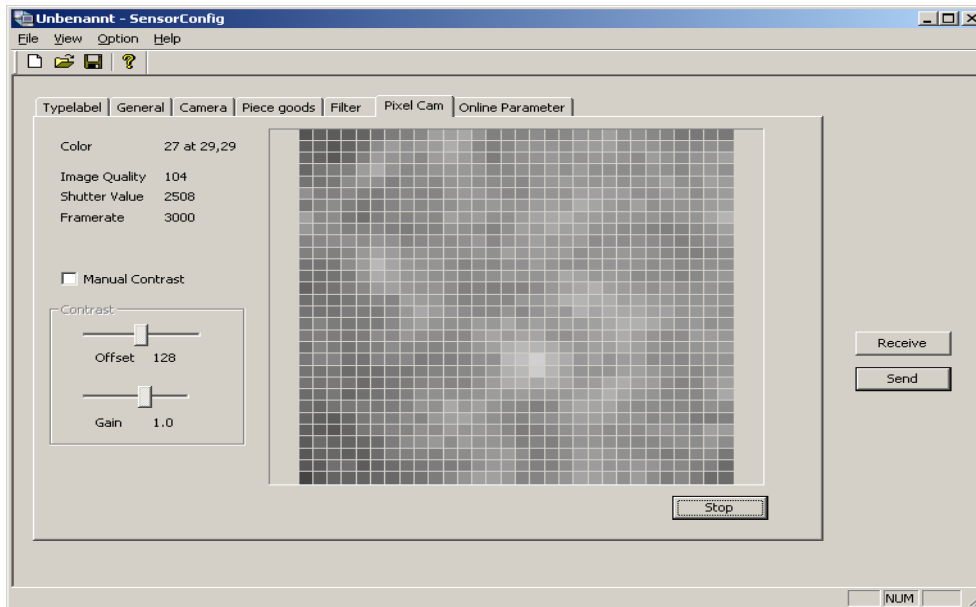
The described distance variation is shown by the loss of image quality at the pink curve. At the same time, the shutter value increases to its maximum and the sensor will not capture the object. In the distance curve (blue) you can see a dip. The application must have the distance between sensor and material be as constant as possible. For roll goods, you can measure directly over the roll. Please see the datasheet for the different telecentrics ranges of our sensors. For good measurement, the IQ must be greater than 65 for the entire measurement duration. If you do not have significant drops in your increment curve, the measurement is valid. Now you can connect the OPTIPACT to the PLC.

Application 2: Measurement of Extremely Dark Materials

For installation of OPTIPACT for measurement of materials with very dark surfaces, the amount of light reflected from the material might not be adequate for the sensor. Indicators are at a max shutter value of 8192, nevertheless the image quality is in a valid area. The following picture shows such a situation:



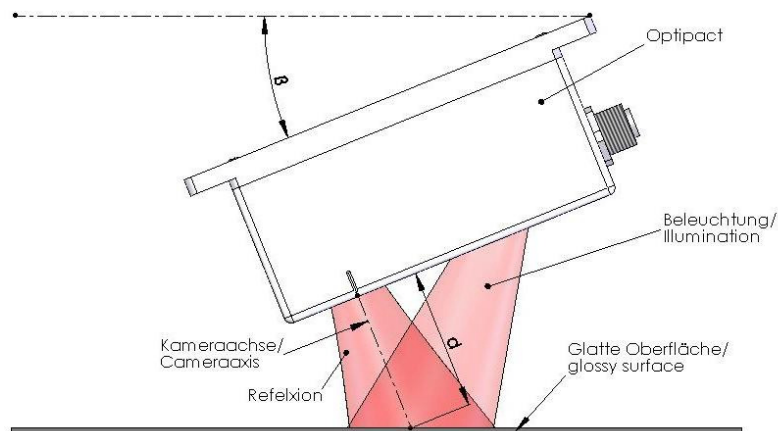
The image quality has a value of 55, which is in the low range. The shutter value has reached its max. As mentioned earlier, try to get a shutter value lower than 8192 and an IQ value greater than 65. Apparently the sensor sees structure, but unfortunately it cannot be exposed thoroughly enough for doing a good measurement. By decreasing the frame rate you can get the following situation:



The picture is much better than the previous situation. The shutter value is in a good area around 2500. The image Quality has doubled. Here, you have a valid measurement environment. Consider the comments on the parameter Framerate” in the chapter “Camera”.

Application 3: Measuring Shiny Surfaces

Illuminating rough surfaces like abrasive paper or textiles leads to a reflection of the light into all solid angles: The reflection is diffuse. In this environment OPTIPACT's camera usually is getting enough light to a valid measurement. If now a shiny, glossy surface like plastics is illuminated, the reflection is no longer diffuse. The input angle of the light beam is equal to the output angle. OPTIPACT's camera only gets back a small amount of the light reflected so that a valid measurement is not possible. In such cases, the sensor must be mounted in an inclined position, as the picture shows. :

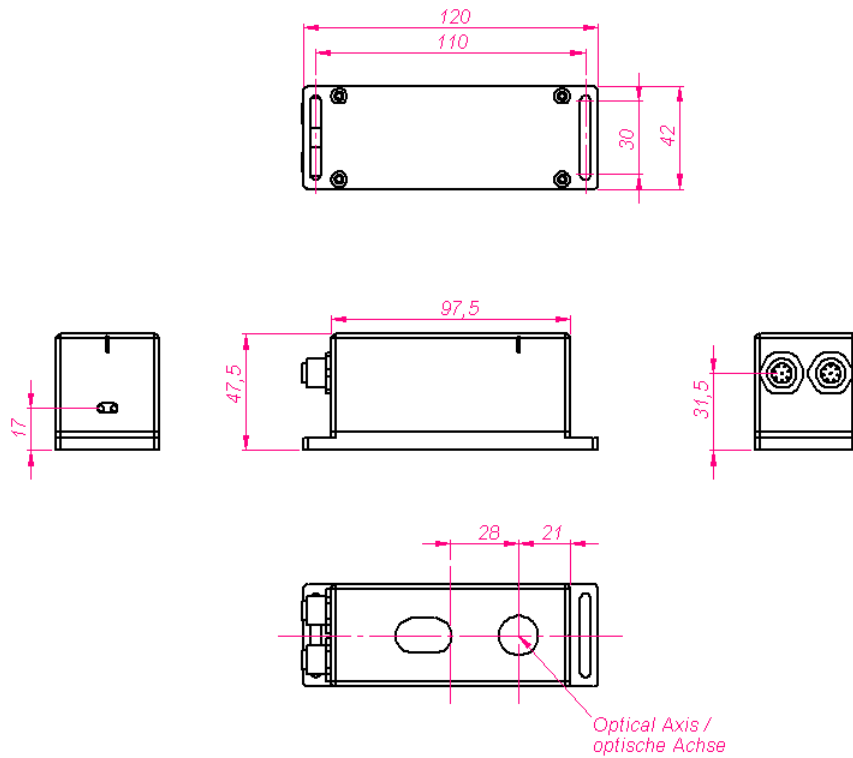


The following settings for the angle β apply: OPT-S1: 22°, OPT-F1: 33°, OPT-M1: 6°. Please note that the working distance has to be set up as shown in the picture. Furthermore OPTIPACT sensors have to recognize surface structures in order to be fully functional. Therefore exceedingly smooth surfaces cannot be detected by the sensor types S1, F1 and M1.

Technical Documents

Dimensioned Drawings OPTIPACT S1 and F1

All dimensions specified in mm. Tolerances according to DIN ISO 2768-1 -f.



Dimensioned Drawings OPTIPACT M1

All dimensions specified in mm. Tolerances according to DIN ISO 2768-1 –f.

