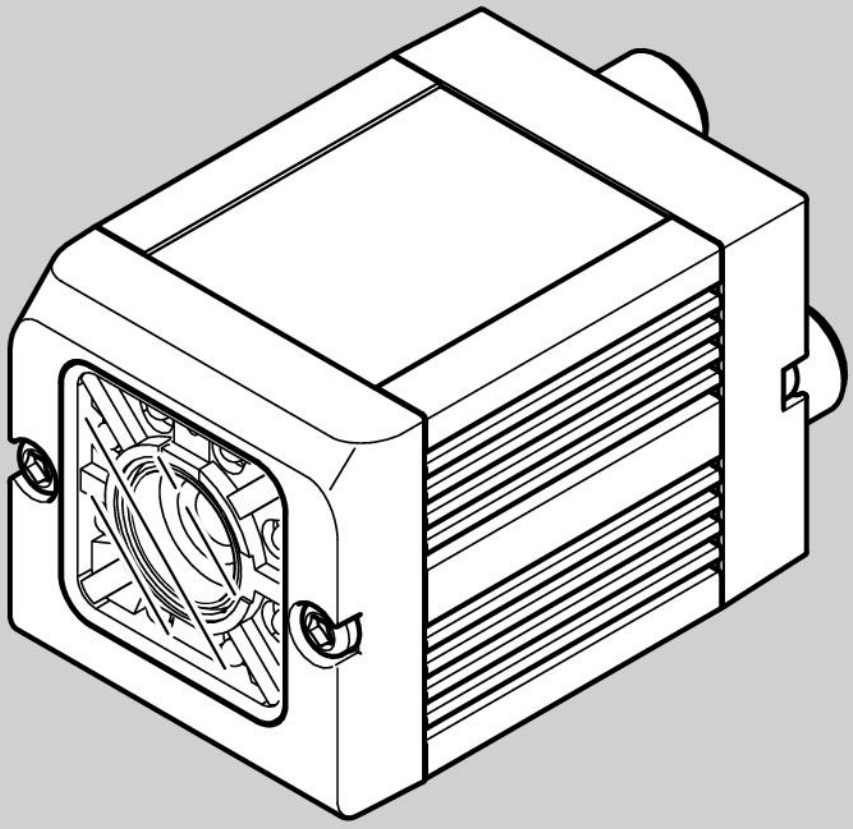
Vision sensor

SBSI-EN

FESTO

User manual



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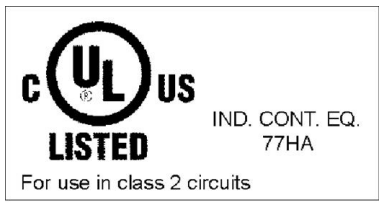
Festo AG & Co. KG

D-73726 Esslingen

Internet: http://www.festo.com

E-Mail: service_international@de.festo.com



For use in NFPA 79 Applications only

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1 General Information and Safety

1.1 Safety notes

Before starting the Vision Sensor, read these instructions carefully, ensure that you have understood them and comply with them at all times.
The Vision Sensor should only be connected by a qualified electrician.
Do not tamper with or make alterations on the unit!
The Vision Sensor is not a safety-critical component and its use is prohibited under conditions where the safety of persons may depend on its function.
The IP address set for the Vision Sensor should be marked on the enclosed label. After installation, stick the label on the sensor in a clearly visible position.
The IP address of the Vision Sensor must be used once only in any network.
For Use with any Listed (CYJV) cable assembly.

1.2 Components supplied

- Vision Sensor including integrated illumination.
- CD-ROM with Computer software and Operating instructions.
- Operating instructions, mounting clamp, Allen key, screwdriver, and protective cap for Ethernet plug.

1.3 Requirements for use

Configuration of the Vision Sensor requires a standard PC/Notebook (at least Pentium 4, 1GHz and 512 MB RAM, with Microsoft Windows XP SP3, Vista or Windows 7) with network connection or a network with TCP-IP protocol. We recommend a Pentium 4 Dual Core > 2GHz and 1GB RAM, for Windows Vista or Windows 7. We recommend a screen resolution of min. 1024 x 768 pixels. A basic knowledge of computers is also required. The Vision Sensor is supplied with the IP address 192.168.100.100 and a sub-net mask 255.255.255.0. The Vision Sensor is operated independently of a PC or PLC. A PC/notebook is only necessary for configuration of the Vision Sensor.

Attention must be paid to sufficient and constant object illumination to ensure reproducible results and avoid malfunction.

Reflections or varying incident light may affect detection results. If necessary, use an external light source and/or light-screening / shrouding devices to exclude incident light

2 Intended Use

2.1 Field of application

The Vision Sensor is an optical sensor and uses several evaluation methods according to the version: pattern recognition, contrast detection, grey level, contour detection, barcode or Data Matrix code reading. The product is designed for industrial use only. In residential areas possibly additional measures for noise suppression must be done.

Object:

The Vision Sensor precisely detects faulty parts, parts in the wrong place, at the wrong angle or in the wrong order or a combination of all of these. A total of five detectors are available for inspection tasks and interpretation: pattern recognition, contour detection, brightness, grey level and contrast detection. The Vision Sensor also offers alignment: it is thus now also possible to reliably detect those features which do not appear with repeated accuracy in the taught position. All interpretation is carried out relative to the actual position and angle of the part without having to define an independent characteristic for each possible position. This high capacity tool also enables you to solve demanding pick and place applications.

Code Reader:

Identification of products, components or packaging from printed or directly marked – punched or laser-etched – codes is common practice in many sectors of industry today. The Vision Code Reader immediately detects which part is in front of it: it can easily read numerous types of barcodes as well as printed and directly marked data matrix codes according to ECC 200 standard, and this on any base (metal, plastic, paper, glass). The sensor can even routinely decipher askew or warped codes or codes on convex, reflective or transparent surfaces. The Vision Code Reader assesses the quality of your printed or directly marked data matrix codes using standardised ISO and AIM quality parameters. This enables you to introduce early correctional measures and thus avoid rejects due to illegible codes.

The Vision Sensor range is an economic alternative to conventional image processing systems.

2.2 Functions overview

Characteristics Vision Sensor Object / Code Reader

Function	Object Std.	Code Reader Std.
Frames per second	50	50
Number of Jobs	8	8
Alignment	Contour only	
Number of detectors	32	2
- Pattern matching (X-, Y- translation)	X	
- Contour matching (X-, Y- translation and rotation)	X	
- Grey level	X	
- Contrast	X	
- Brightness	X	
- Data code		X
- Barcode		X
4 digital outputs, 2 inputs, PNP or NPN	X	X
Free definable digital In- / Outputs, PNP or NPN	2	2
Free shape of ROI	contour only	
Timeout, specified time response	X	X
Variable resolutions	X	X
Illumination quadrant controlled	X	X
Image recorder	X	X
Ethernet interface	X	X
RS422 / RS232 interface		X
EtherNet/IP interface	X	X
Sensor monitoring by Viewer, Job-Upload	X	X
R3 integrated 6 / 12	X / X	X / X

2.3 Sensor types

2.3.1 Object detection

Part no.	Type	Optics	Depth of focus	Internal illumination	min. operating distance / mm *1	min. Field of view mm x mm
R3 Standard White						
2942261	SBSI-Q-R3B-F6-W	6	Normal	White	6	5 x 4
2942262	SBSI-Q-R3B-F12-W	12	Normal	White	30	8 x 6
R3 Standard IR						
2942265	SBSI-Q-R3B-F6-NR *2	6	Normal	InfraRed	6	5 x 4
2942266	SBSI-Q-R3B-F12-NR *2	12	Normal	InfraRed	30	8 x 6

*1 For longer operating distances (from approx. 200 mm) external illumination may be necessary.

*2 External IR illumination is only possible with IR sensors or C-Mount sensors.

2.3.2 Code Reader

Part no.	Type	Optics	Depth of focus	Internal illumination	min. operating distance / mm *1	min. Field of view mm x mm
R3 Standard White						
2930232	SBSI-B-R3B-F6-W	6	Normal	White	6	5 x 4
2930233	SBSI-B-R3B-F12-W	12	Normal	White	30	8 x 6
2930242	SBSI-B-R3B-F6-W-D	6	Enhanced	White	6	5 x 4
2930243	SBSI-B-R3B-F12-W-D	12	Enhanced	White	30	8 x 6
R3 Standard Red						
2930234	SBSI-B-R3B-F6-R	6	Normal	Red	6	5 x 4
2930235	SBSI-B-R3B-F12-R	12	Normal	Red	30	8 x 6
2930236	SBSI-B-R3B-F6-R-D	6	Enhanced	Red	6	5 x 4
2930237	SBSI-B-R3B-F12-R-D	12	Enhanced	Red	30	8 x 6
R3 Standard IR						
2930238	SBSI-B-R3B-F6-NR *2	6	Normal	InfraRed	6	5 x 4
2930239	SBSI-B-R3B-F12-NR *2	12	Normal	InfraRed	30	8 x 6

Part no.	Type	Optics	Depth of focus	Internal illumination	min. operating distance / mm *1	min. Field of view mm x mm
2930240	SBSI-B-R3B-F6-NR-D *2	6	Enhanced	InfraRed	6	5 x 4
2930241	SBSI-B-R3B-F12-NR-D *2	12	Enhanced	InfraRed	30	8 x 6

*1 For longer operating distances (from approx. 200 mm) external illumination may be necessary.

*2 External IR illumination is only possible with IR sensors or C-Mount sensors.

2.4 Field of view / Depth of view

Field of view R3 6mm lens, internal

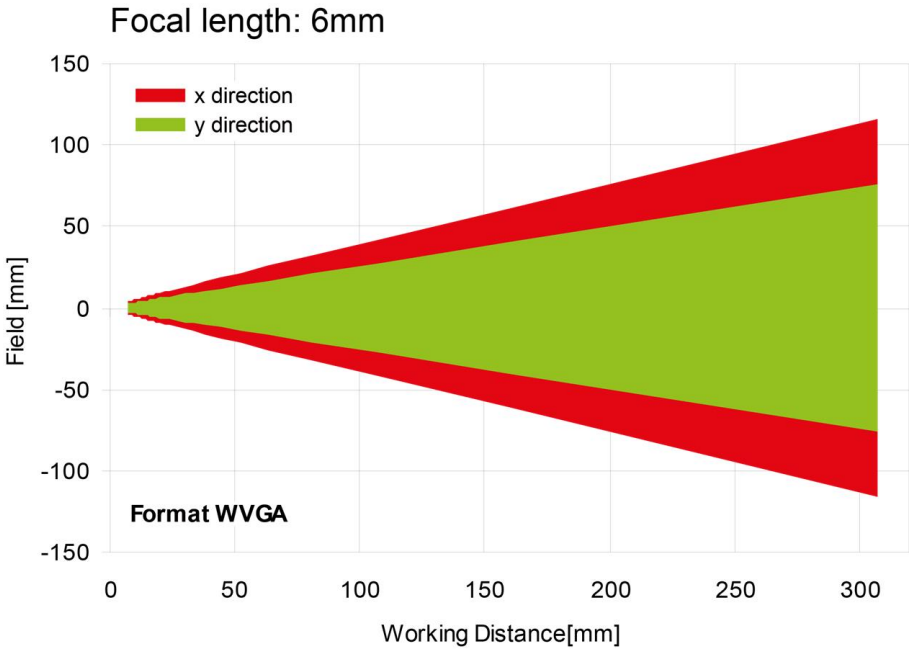


Fig. 1: Field of view R3 6mm lens, internal

Field of view R3 12mm lens, internal

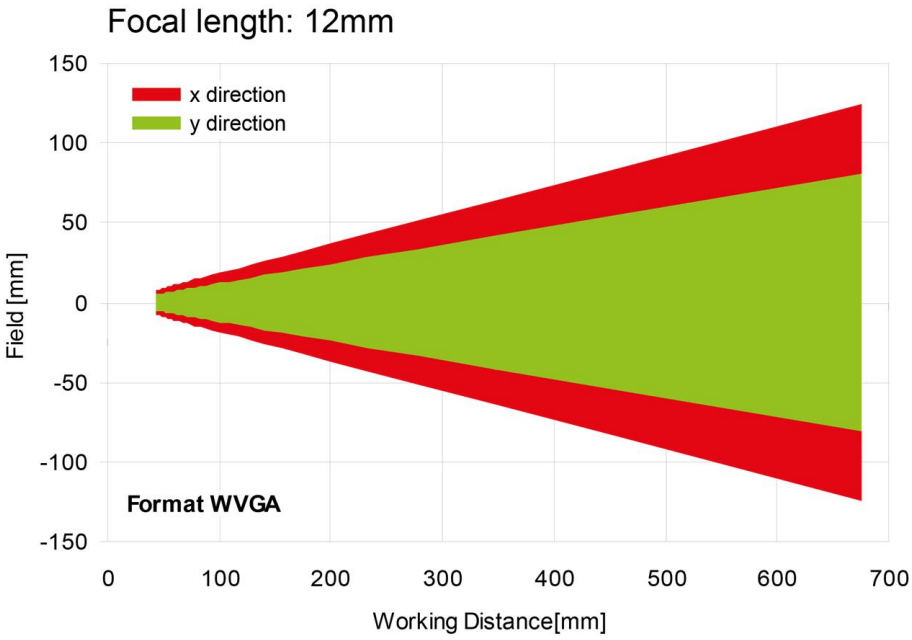


Fig. 2: Field of view R3 12mm lens, internal

Depth of view R3 6mm lens internal, normal

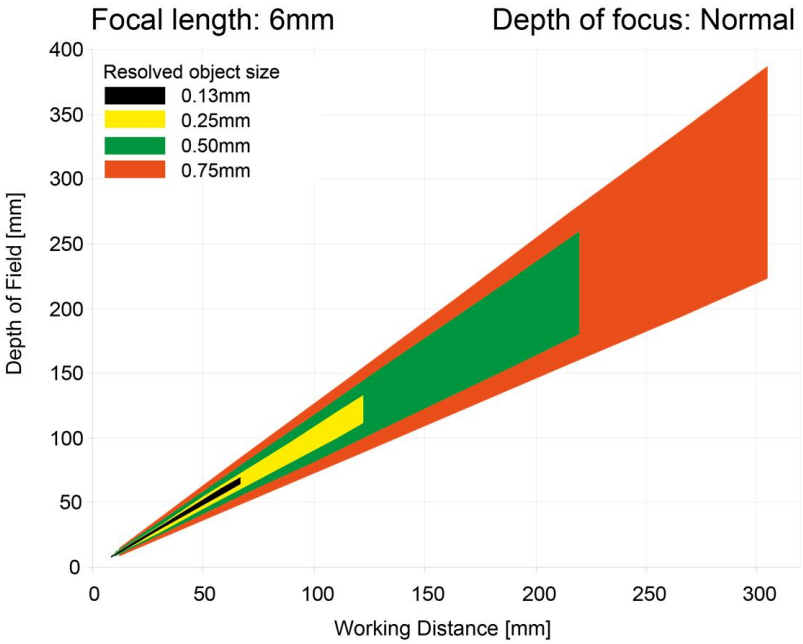


Fig. 3: Depth of view R3 6mm lens internal, normal

Depth of view R3 6mm lens internal, enhanced

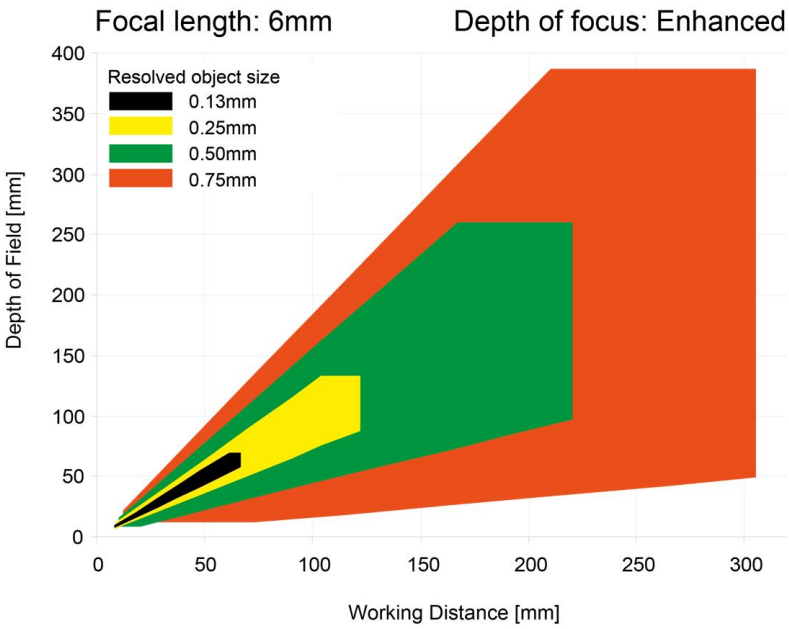


Fig. 4: Depth of view R3 6mm lens internal, enhanced

Depth of view R3 12mm lens internal, normal

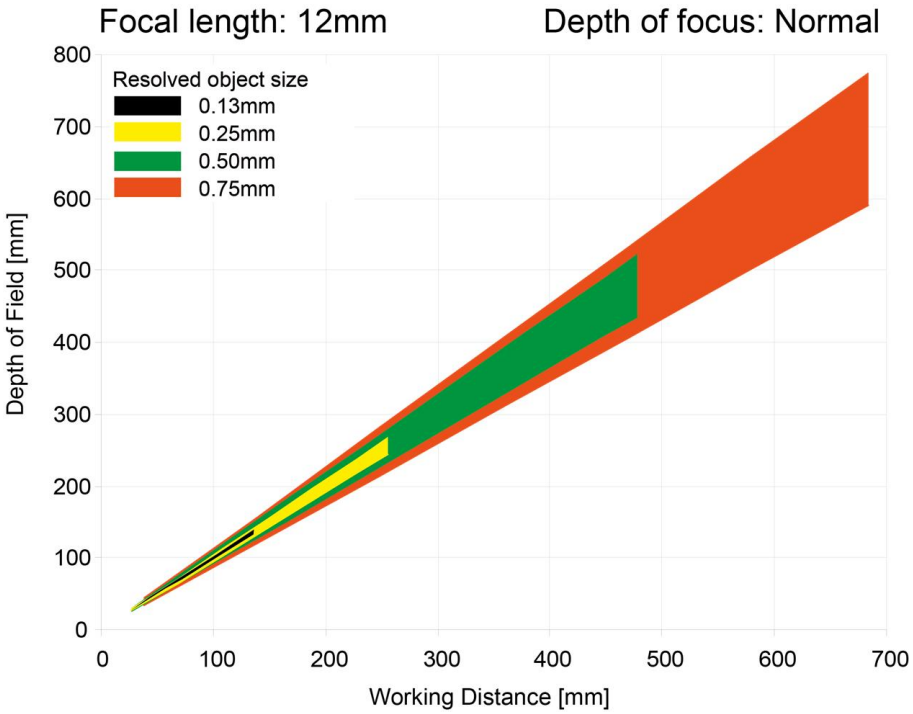


Fig. 5: Depth of view R3 12mm lens internal, normal

Depth of view R3 12mm lens internal, enhanced

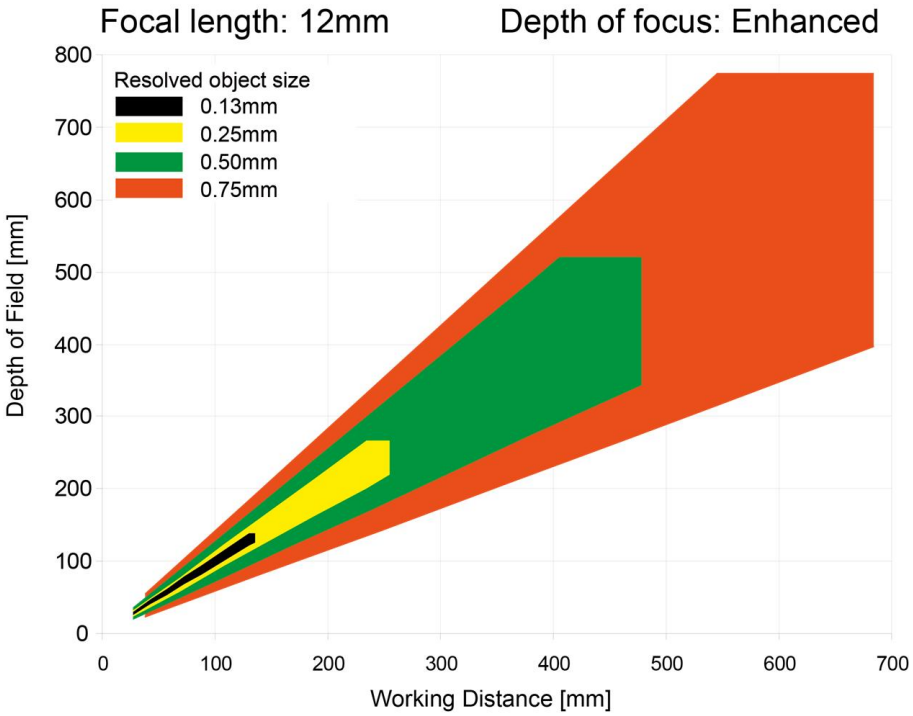


Fig. 6: Depth of view R3 12mm lens internal, enhanced

3 Installation

3.1 Mechanical Installation

To ensure maximum accuracy of detection, the Vision Sensor should be protected from vibration. Secure the supply and I/O cables with cable binders to prevent crushing or slipping.
Select a position for the Vision Sensor in which interfering factors such as slight differences in the position of the object or variations in illumination have little or no effect.
Screw the Vision Sensor onto the mounting clamp (supplied with the unit) and then onto a suitable object.
Use only the mounting clamp MK 45 (no. 543-11000) or the mounting hinge MG2A (no.543-11023).

3.1.1 Arrangement for dark-field illumination

For the prevention of direct reflections and accentuation of edges etc.

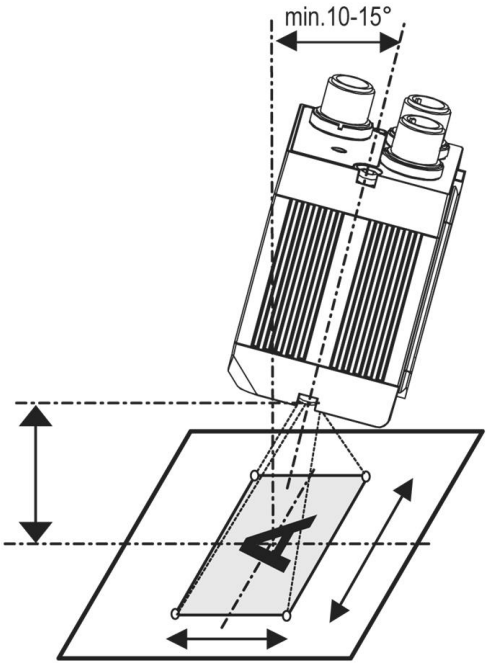


Fig. 7: Arrangement for dark-field illumination

3.1.2 Arrangement for bright-field illumination

For transmitted light/measuring tasks or for the accentuation of highly-reflective objects

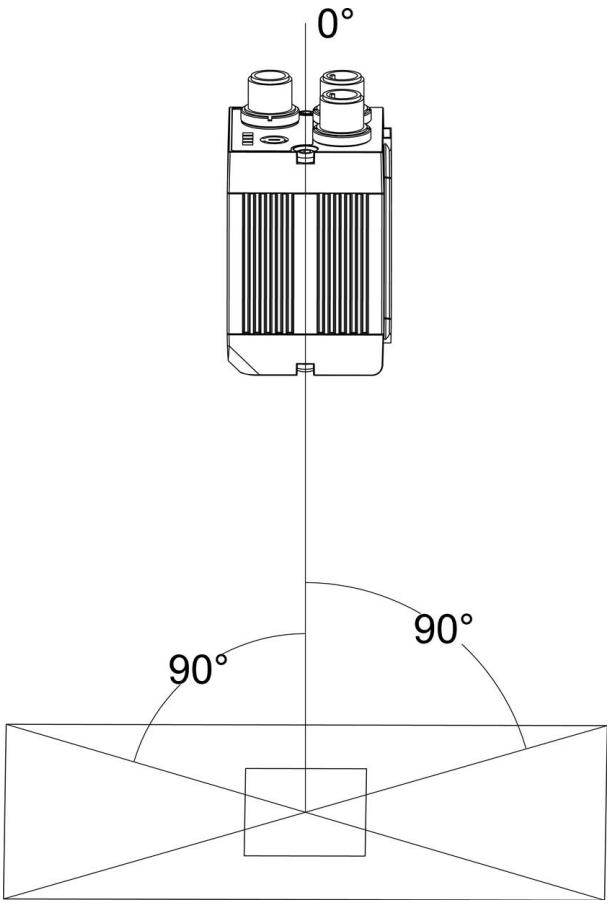


Fig. 8: Arrangement for bright-field illumination

Observe the object clearance given in the table Field of View / Working Distance.

To avoid interfering reflection from the detection object, align the Vision Sensor at an angle of approx. 10°- 15° with reference to the optical axis.

Fine adjustment

Important: Fine adjustment of the Vision Sensor should not be carried out until after electrical connection and start-up (PC software installation).

3.1.3 Alignment for a vertical illumination

In order to assure the absolutely vertical alignment of the Vision Sensor to the object surface, put a piece of reflective foil or a mirror on top of the object and start the Vision Sensor operating software. For an image that is continually updated, select trigger mode „free run ? “ and image update: „continuous ?“. Then align the sensor to the reflective surface / the mirror as vertical as possible until the integrated illumination LEDs are directly dazzling in the image of the user interface (Arrangement for bright-field illumination (Page 16)).

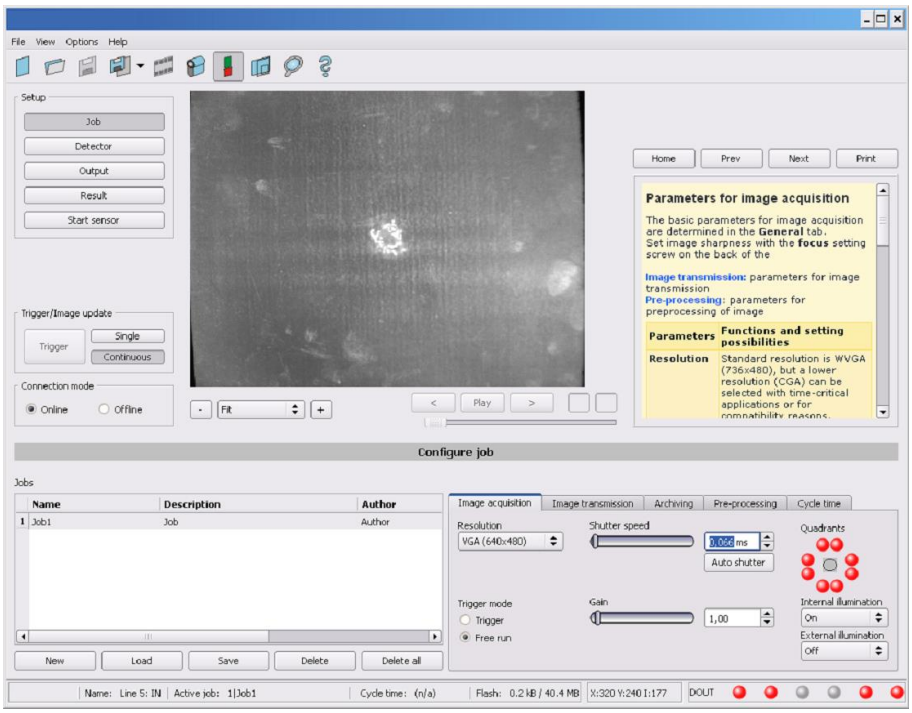


Fig. 9: Alignment for a vertical illumination

3.1.4 Assembly Vision Sensor - Mounting bracket SBAM-C6-CP

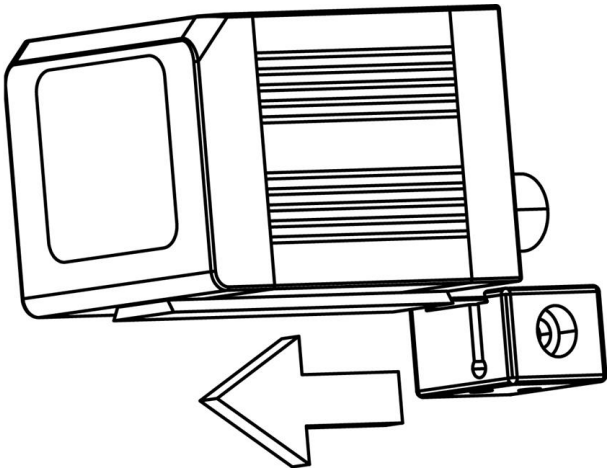


Fig. 10: Assembly Vision Sensor - Mounting bracket SBAM-C6-CP

For fixing the Vision Sensor on a fixing system / machine housing, slide the provided dovetail mounting bracket SBAM-C6-CP on the dovetail guide at the bottom side of the Vision Sensor and fix it at the desired position with the hexagon socket in the cross hole of the mounting bracket.

3.2 Electrical installation

The electrical installation of the Vision Sensor must be carried out by a qualified person. When installing the Vision Sensor, disconnect all electrical components from the power supply. When the unit is being used in a network, ensure that the network address (IP address) of the Vision Sensor set by the manufacturer at 192.168.100.100 is free and is not in use for any other unit connected to the system.

If necessary, re-set the IP address of the Vision Sensor as described in the section „Network settings“.

When the Vision Sensor is in use, the protective caps supplied must be pushed onto the M12 sockets (data and LAN) which are not in use. For error free operation the length of the connecting cables must not be longer than 30 m (except Ethernet cable). Failure to do this may cause malfunction.

3.2.1 Connection possibilities

For stand-alone operation (independent of PC /PLC) only connection 24 V DC is required afterstart-up.

For electrical installation, connect wires as follows:
***A: LED display**
***B: Focussing screw**
***C: 24 VDC, I/O- M12 connection socket**
***D: Data (RS422) M12 socket** (Version Code Reader only)
***E: LAN M12 connection socket**

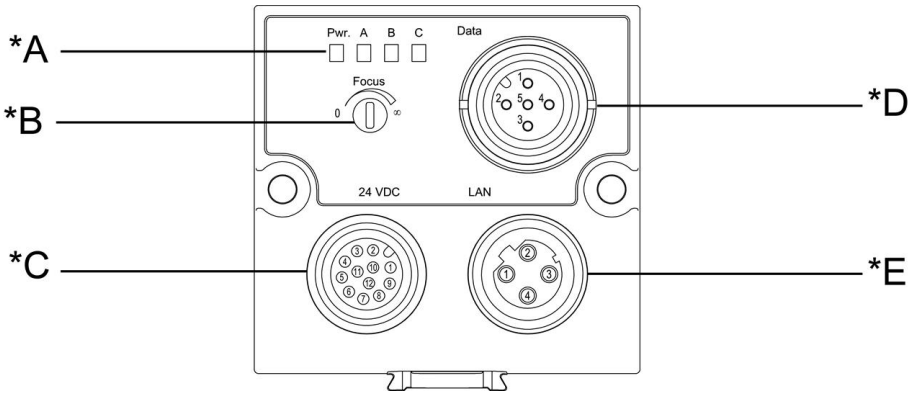


Fig. 11: Connectors Vision Sensor

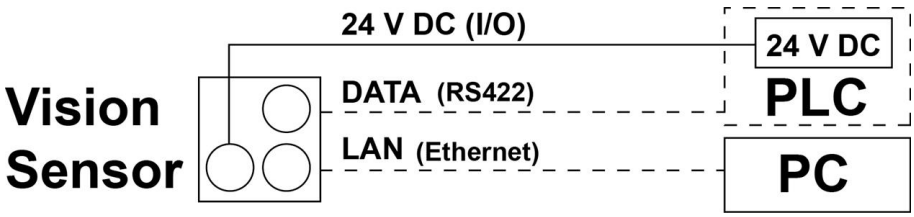


Fig. 12: Connection Vision Sensor

3.2.1.1 LED Display

Name	Colour	Meaning
Pwr.	green	Operating voltage
A	yellow	Result 1
B	yellow	Result 2
C	yellow	Result 3

All LED´s are set without taking into account any timing function (e.g. Trigger delay)

3.2.1.2 Focussing screw

Focussing screw to adjust focus.
Focus: Clockwise = higher distance
Counter Clockwise = lower distance

3.2.1.3 24 V DC Connection

M12 Connection socket for 24 V DC voltage supply and digital I/O.
For the exact plug connection see PIN assignment, connection 24 V DC

3.2.1.4 LAN Connection

M12 Connection socket for Ethernet connection.
For the exact plug connection see PIN assignment, connection LAN .
Use only the correct network cables.

3.2.1.4.1 Direct connection of the Vision Sensor to a PC (recommended)

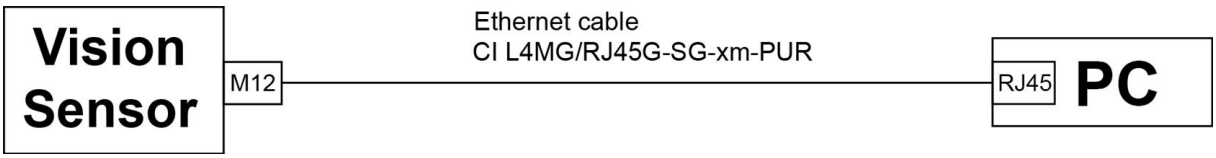


Fig. 13: Direct connection Vision Sensor <> PC

3.2.1.4.2 Connection of the Vision Sensor to a PC via a network:

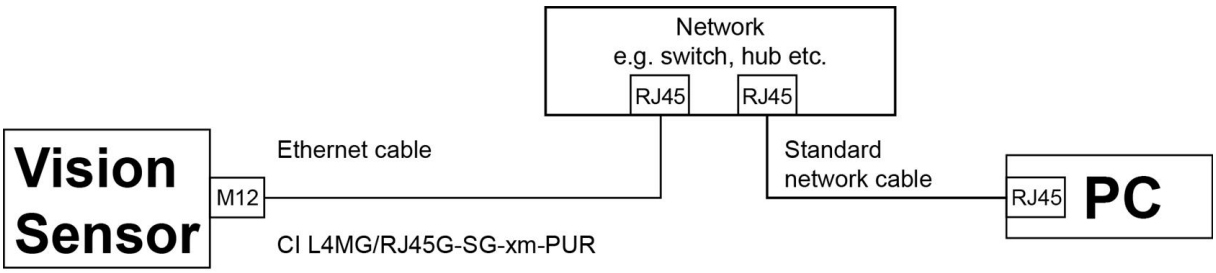


Fig. 14: Connection via a network

3.2.1.5 Data Connection

M12 Connection socket for DATA serial interface, RS422 / RS232.
s. PIN assignment DATA *A) (Page 21)

3.2.1.6 Plug connections

All pin assignments and signals are referring to the view from the sensor.

3.2.1.6.1 PIN assignment, connection 24 V DC

PIN	Colour	Use
1	BN	+ Ub (24V DC)
2	BU	GND
3	WH	IN (external trigger)
4	GN	READY *1
5 *2	PK	IN/OUT (encoder B+)
6 *2	YE	IN/OUT
7 *2	BK	IN/OUT, LED B*4
8 *2	GY	IN/OUT, LED C*4
9	RD	OUT (external illumination)
10	VT	IN (encoder A+)
11	GYPK	VALID *3
12	RDBU	OUT (ejector, max. 100mA), LED A*4

*1 Ready: Ready for next ext. trigger.
*2 Switchable input- output
*3 VALID: shows available results
*4 All LED´s are set without taking into account any timing function (e.g. Trigger delay)

For shielded cables use shield.

3.2.1.6.2 PIN assignment, connection LAN

(M12) 4 pin	Signal
1	TxD+
2	RxD+
3	TxD-
4	RxD-

3.2.1.6.3 PIN assignment DATA *A)

PIN	Colour	Use RS422	use RS232
1	brown	RxD+	Rx

2	white	RxD-	NC
3	blue	TxD+	NC
4	black	TxD-	Tx
5	grey	GND	GND

*A) Not with Object- Standard version

For shielded cables use shield.

3.2.1.7 Exemplary connection plan and software settings for the following setup:

- Power supply
- Trigger
- 1x digital output
- Encoder
- Ethernet to PC or PLC

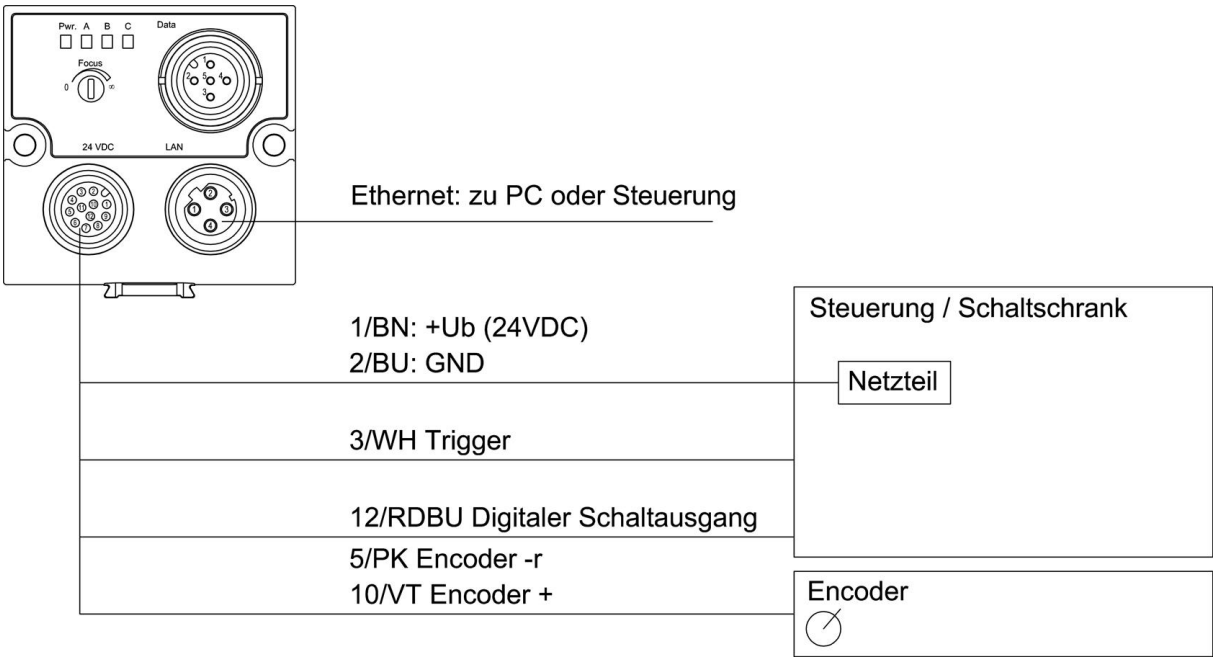


Fig. 15: Exemplary connection plan

3.2.1.8 Electrical connection supply voltage and shield

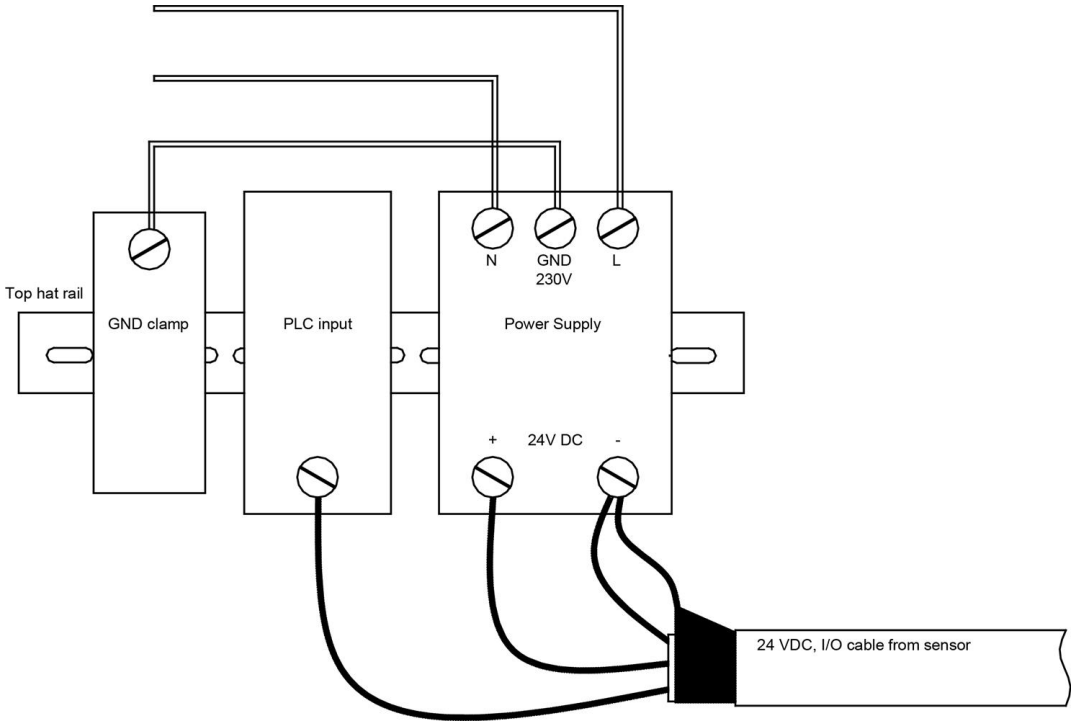


Fig. 16: Electrical connection, supply voltage 24VDC in cabinet with shield

3.2.1.9 Electrical connection PNP / NPN

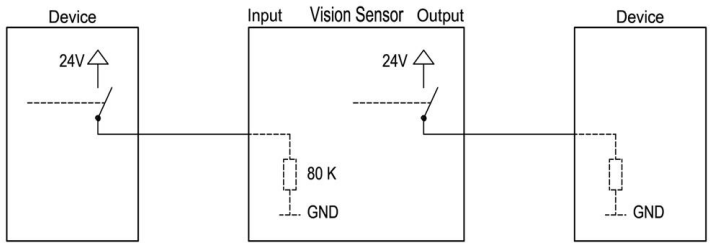


Fig. 17: Connection example Vision Sensor in PNP mode. In-/outputs switch to +24V

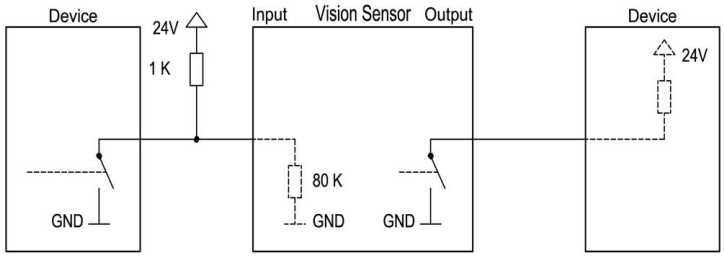


Fig. 18: Connection example Vision Sensor in NPN mode

As the inputs refer to ground, an additional pull-up resistor may be required in order to increase the input voltage to 24V when unswitched. The outputs switch to ground.

3.3 Network settings, Short reference

The following instructions indicate how to change the network configuration of the PC and the Vision Sensor. If incorrect settings are used, the network connections in the computer may be lost. To be on the safe side, note the former settings for later use if required.

Following this procedure, it may be necessary to re-start the system. In order to determine which IP addresses are allowed in your network or locally in your PC, and to carry out the necessary settings on your PC, contact the system administrator beforehand.

The illustrations, dialogues and menus originate from the operating system Microsoft WindowsXP™. The illustrations are similar in other operating systems.

3.3.1 Basic settings for PC and Vision Sensor

To configure the Vision Sensor with a PC it is essential that a network board and the TCP/IP LAN- connection is installed on the PC (This also applies when the PC is not connected to a network). The Vision Sensor supports the automatic recognition of the Ethernet transmission rate, but 100 MBit at the most.

The internet protocol IPv4 must be activated.

There are two alternatives to configure and parameterize the Vision Sensor.

See also chap. Network connection

1. Direct Connection

2. Network Connection

3.3.2 Direct Connection - Setting the IP Address of the PC

To connect the Vision Sensor to a PC via Ethernet the IP addresses of both devices have to correspond. The default IP of the Vision Sensor is 192.168.100.100 with Subnet mask = 255.255.255.0. To establish a direct connection, the PC must be set to a corresponding, fixed IP address like follows.

1. Click on Start / Control Panel / Network Connection / LAN Connection / Properties, the window "Local Area Connection Properties" opens.
2. In the list „This connection requires following elements“ select the option „Internet Protocol (TCP/IP)“ and then click the button „Properties“.
3. In the following window set the desired IP address of the PC and the sub-network data.
4. Confirm entries with OK

Example:

The Vision Sensor is pre-set to IP address 192.168.100.100 and subnet mask 255.255.255.0.
In this case, the IP address may be set to any value between 192.168.100.1 and 192.168.100.254, with a sub-net mask 255.255.255.0, with the exception of the sensor IP address (192.168.100.100).
To alter the sensor's IP address, see chap. Please do also not use the addresses .0 and .255 as these addresses are reserved for network infrastructure devices such as servers, gateways, etc.

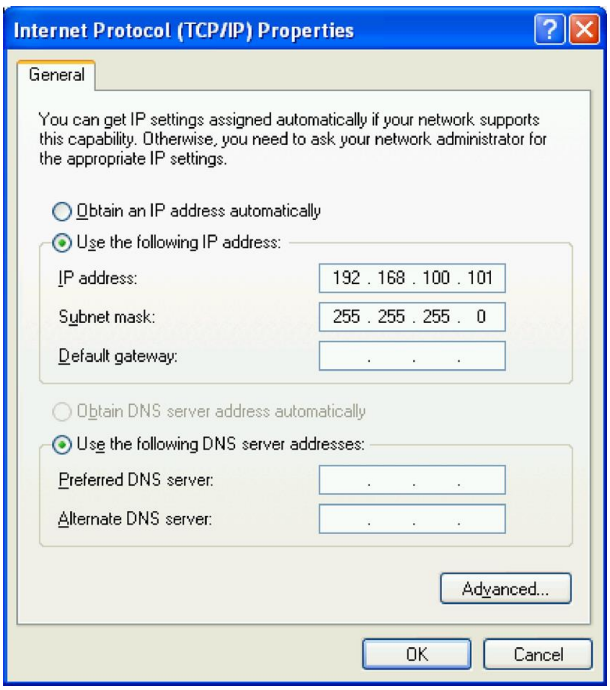


Fig. 19: PC IP Setup

3.3.3 Network Connection - Setting the IP address of the Vision Sensor

Before connecting the sensor in the network, check with the network administrator whether the sensor's address has already been assigned (default: 192.168.100.100 with subnet mask 255.255.255.0). This can otherwise cause network failure. The set IP address is to be noted on the enclosed label. The label is then to be stuck on the sensor in a clearly visible place after installation.

Network connection speed:

The sensor must only be operated with 100MBit/full-duplex when using VGA resolution (or higher) and Vision Sensor Visualisation Studio.

Sensor's IP still free:

Connect sensor to network and then set the sensor's IP to match the PC according to the administrator's specifications, as follows, beginning with 2.

Sensor IP already assigned:

1. First connect sensor and PC directly and set an authorised IP address in the sensor.
2. Connection via the network can then be carried out. First ensure electrical connection and installation of PC software has been completed. To set the IP address on the Vision Sensor, the following steps are to be carried out in the PC software:
    a. Start Vision Sensor Device Manager software
    b. Select the required Vision Sensor sensor from the active sensor list (single left mouse click)
    c. Set sensor's new IP address with the "Set" button. Follow the on screen prompts. The IP address is assigned by your system administrator. The PC's IP address is shown in the status bar under the buttons. (Please note some pc's have more than one Ethernet connection i.e. wireless and wired LAN connections
    d. When the new IP address has been set, Re-select the sensor and connect. Via Config or View

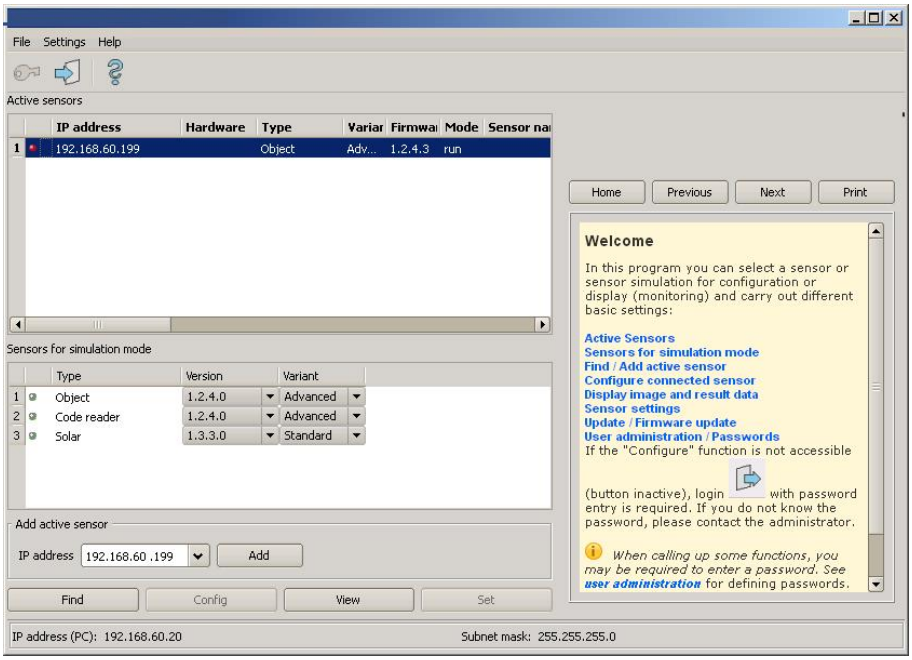


Fig. 20: Vision Sensor Device Manager

Modification of the standard gateway enables operation in different sub-networks. Only alter this setting after consultation with your network administrator. Automatic integration of a new computer or sensor in the existing network without manual configuration is possible through DHCP. Normally, automatic supply of IP address must only be set on the sensor, the client. When the sensor is started in the network, it can obtain the IP address, net mask and gateway from a DHCP server. Activation of DHCP mode is carried out via the "Set" button by activating the checkbox "DHCP". As one and the same Vision Sensor can thus have different IP addresses at different times, a sensor name must be attributed when activating the DHCP. Should several Vision Sensors be in one network, different names must be used.

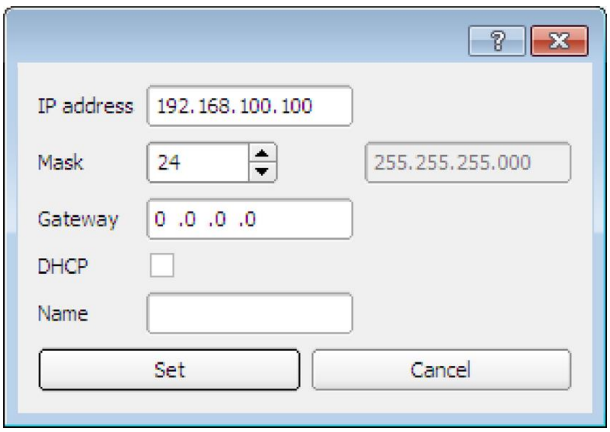


Fig. 21: Vision Sensor IP Setup

If a Vision Sensor with DHCP is switched on in a network without a DHCP server, the Vision Sensor automatically sets the IP address to 192.168.100.100. This can be the case, e.g. in the case of power/server failure or the restart of the system after shutdown as the DHCP server may boot slower than the Vision Sensor. Make sure that the Vision Sensor is only switched on when the DHCP server is available.

4 Vision Sensor – Operating- and configuration software

4.1 Vision Sensor – Operating- and configuration software - Overview

4.1.1 Structure of PC software

The PC software is organised into the following three sections:

- Vision Sensor – Operating- and configuration software – Short introduction (Page 29)
  For selection of a Vision Sensor sensor, or a sensor simulation model, for configuration with the "Vision Sensor Configuration Studio" tool or display (monitoring) with the "Vision Sensor Visualisation Studio" tool, or modification of different system settings such as IP addresses, firmware updates with the "Set" tool.
- **Vision Sensor Configuration Studio:**
  Complete set of functions to configure and test Vision Sensor for one or several inspection tasks (jobs) in six simple logical operating steps.
- **Vision Sensor Visualisation Studio:**
  For the display and monitoring of images and results from connected sensors, as well as job switch and job upload.

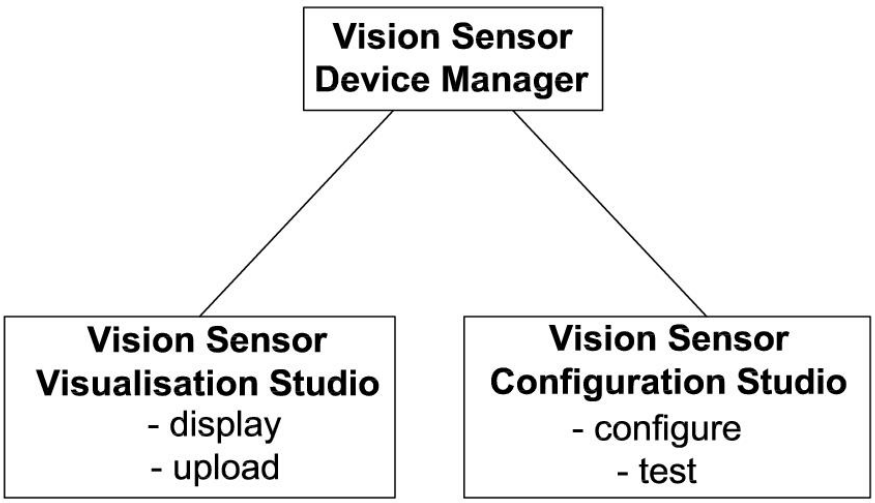


Fig. 22: Software structure

4.1.2 Context help

For all software functions a context sensitive help page is available and displayed as soon as a function is selected.

All available help pages can be viewed by pressing the Help- button („?“ symbol) or by double click to the online help window. There you also can do a keyword search. In comparison to the context help the size of this help window can be enlarged to view longer text more comfortable.

29.04.2014

4.2 Vision Sensor – Operating- and configuration software – Short introduction

(Example: Object sensor)

4.2.1 Vision Sensor, Short introduction, Starting the software

This short guide explains step by step the procedure for setting an example inspection task on the vision sensor

To start the Vision Sensor application click to the desktop icon "Vision Sensor“.

Fig. 23: Icon Vision Sensor

4.2.2 Vision Sensor Device Manager: Open sensors or sensor simulation / Passwords

In this program, you can select a sensor or a sensor simulation for configuration or display (monitoring) and carry out different basic settings.

Next topic: Vision Sensor Configuration Studio: Setting sensor, Job (Page 33)

Configuring or displaying sensors

In order to open a sensor for configuration or display, select with a single left mouse click the required sensor in the "Active sensors“ list, then click on the button "Config“ to start the "Vision Sensor Configuration Studio“ software, or on the button "View“ for the "Vision Sensor Visualisation Studio“ software.

Sensor simulation

To open a sensor for offline simulation, select the required sensor in the "Sensors for simulation mode“ list, then click on the button "Config“ to start the module "Vision Sensor Configuration Studio“. Vision Sensor Visualisation Studio is not available for the simulation mode as there is no device to send the images for display.

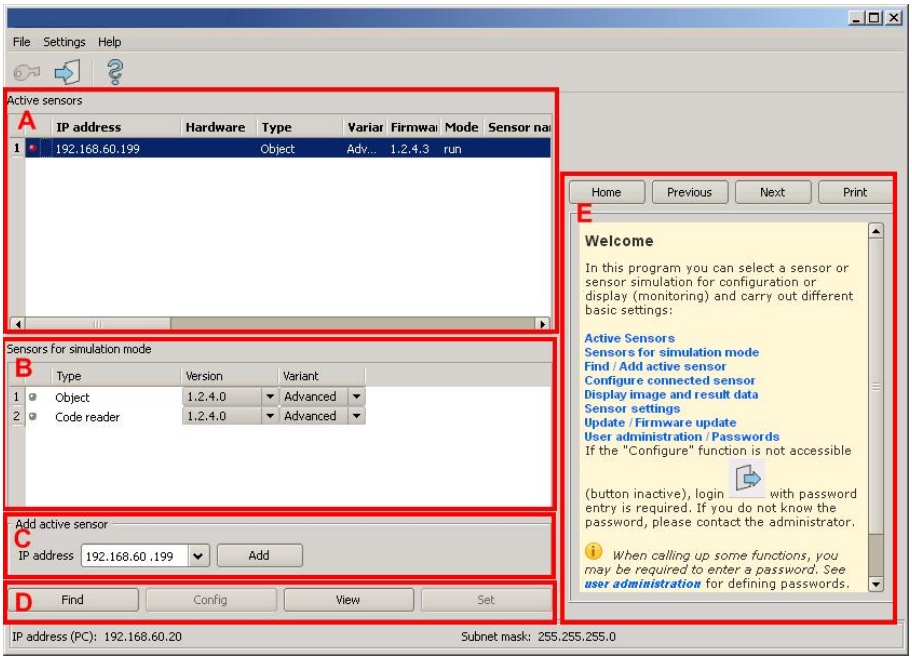


Fig. 24: Vision Sensor Device Manager Overview

A) Active sensors

This list displays all the Vision Sensors available on the network that can be controlled from the PC.

B) Sensors for simulation mode

All the sensors available for offline simulation are displayed here.

C) Add sensors via IP address

Sensors, which are not visible after starting the software or after clicking the "Find" button in Vision Sensor Device Manager, can be add manually with eheir IP address, if they are available in the network (e.g. after a gateway) and if the IP address is well-known. Via clicking the button "Add" such sensor con be found and are added to the list of active sensors, in order to edit them.

D) Functions

- **Find**

Activates another search procedure on the network to locate Vision Sensor products

- **Config**

Configures a connected sensor or a sensor simulation

- **View**

Displays image or result data from a connected sensor

- **Set**

Edits network settings such as the sensor's IP address etc.

E) Context help

Context sensitive help

4.2.3 Passwords

When first started-up after installation, password entry is completely deactivated and auto login is preset to administrator.

If parameter settings are to be protected from unauthorised access, passwords should be given for the "Admin“ and "User“ password levels, see below. This can be called up via the menu bar File / User administration or via the button with the key symbol in the toolbar.

Fig. 25: Password button

4.2.4 Password levels:

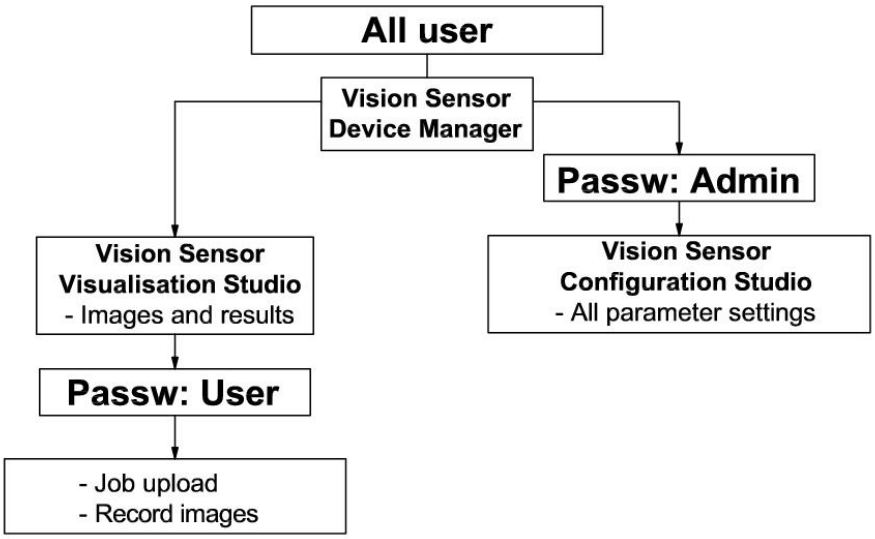


Fig. 26: Password levels

In order to be able to use the function "Config“ after the allocation of passwords, it is now necessary to login by clicking on the toolbar login button, and then entering the assigned password.

Fig. 27: Login button

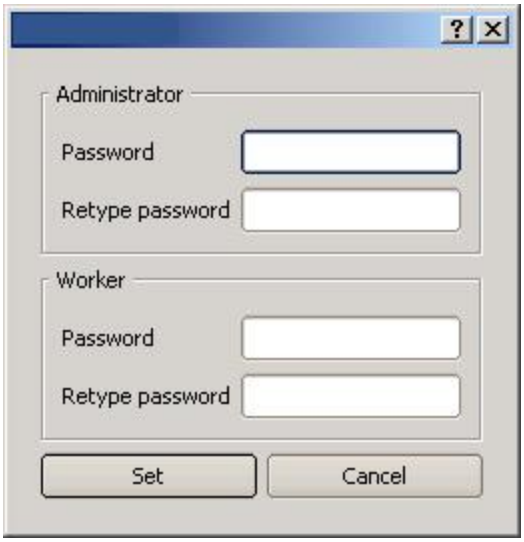


Fig. 28: Password input

Allocating an empty password means the password can be confirmed without any further entry. Activation of the "Deactivate password request“ checkbox, permanently deactivates password request.

If passwords have been assigned and then forgotten, it is possible to reset passwords to delivery status by reinstalling the software on the local PC.

4.3 Vision Sensor Configuration Studio: Setting sensor, Job

With this program, you can configure your Vision Sensor for one or several jobs in six simple logical operating steps.

Next topic: Alignment settings (Page 35)

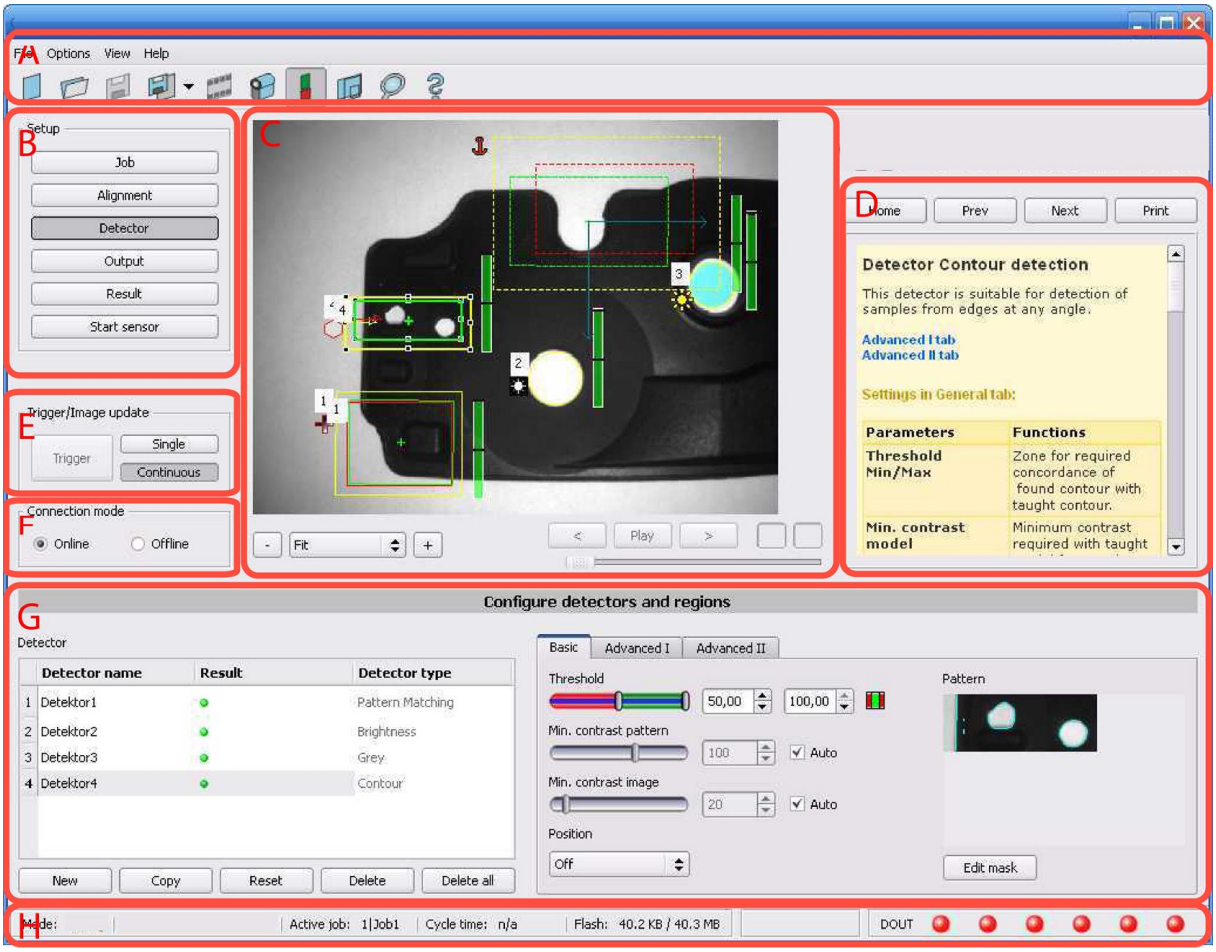


Fig. 29: Vision Sensor Configuration Studio

The fields are:

A) Menu and tool bar

B) Setup Navigation / Operating steps
See next chapter for description

C) Image
Image output with graphically adjustable operating and search zones as well as zoom function also filmstrip navigation when in simulation mode

D) Context
Context-sensitive online help, automatically updated for each action.

E) Image acquisition mode

Switch-over between continuous (free run) and single image mode with trigger input (either from sensor or via onscreen button)

F) Connection mode

Switch-over between online and offline mode (sensor present or simulation without sensor)

G) Job selection

Changing variable content relating to action in set-up navigation, for setting of associated parameters.

H) Status bar

Different status information including Mode / Name of Vision Sensor / Active job. In Run Mode: Cycle time / cursor x/y location and pixel intensity / individual I/O on /off indication (like configured in "Output/Digital output").

4.3.1 Job Setup

Configuring a job

To configure a job, edit the job entry in the "Select job" field or e.g. create a new job. Set global parameters here, such as shutter, exposure or the resolution which is valid for the entire job.

For Job- setup: in Setup/Job edit or generate a new job in field "Jobs".

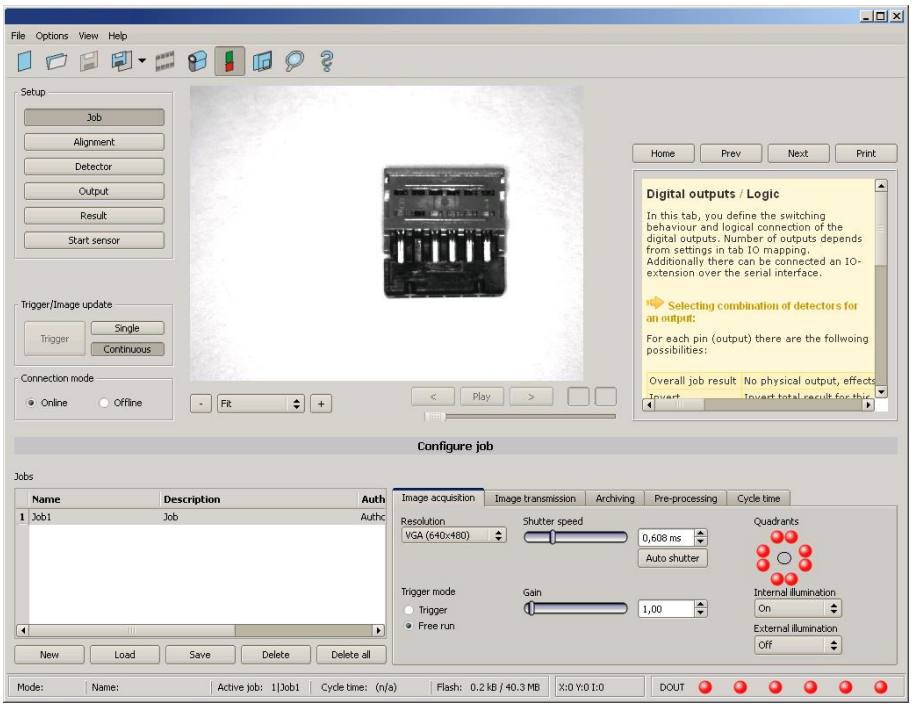


Fig. 30: Vision Sensor Configuration Studio Job

One job contains all settings and parameters necessary to perform a specific inspection task.

Jobs are created here, and several jobs can be stored in the Vision Sensor. All global settings, valid for each individual job, e.g. shutter, gain, illumination settings etc. are also carried out here.

- The following basic image settings should first be made to ensure a high-contrast and sharp image:
  * Image brightness: Set shutter or amplification, see Job/General
  * Image sharpness: Focus setting via the screw on the back of the Vision Sensor camera itself
- When delivered, the factory settings are trigger mode = "free run" (see Job/General) and image acquisition mode = "continuous" . A new image is continuously displayed for easier focus and brightness set up.
- The subsequent setting of alignment and detectors should preferably be carried out in single image mode, as all settings are then based on a master image and image collection is not continuously carried out.
- Alignment and multiple different detectors can subsequently be defined within one job to solve an inspection task.

4.3.2 Alignment settings

Alignment compensation can be necessary for objects whose position varies on the screen.

Next topic: Detector settings (Page 36)

Set the working zones on the parameter to be used for alignment tracking by adjusting the graphic frame to the appropriate position and size on the image.

The associated parameters are displayed on the bottom right-hand side and can also be adjusted there.

Alignment, when used, affects the positions of all the detectors subsequently defined in this job.

In this example, the outside contour is used for alignment and the plug can be found either by contour or by pattern matching. If the angular rotation of the object can vary also, the contour method must be used.

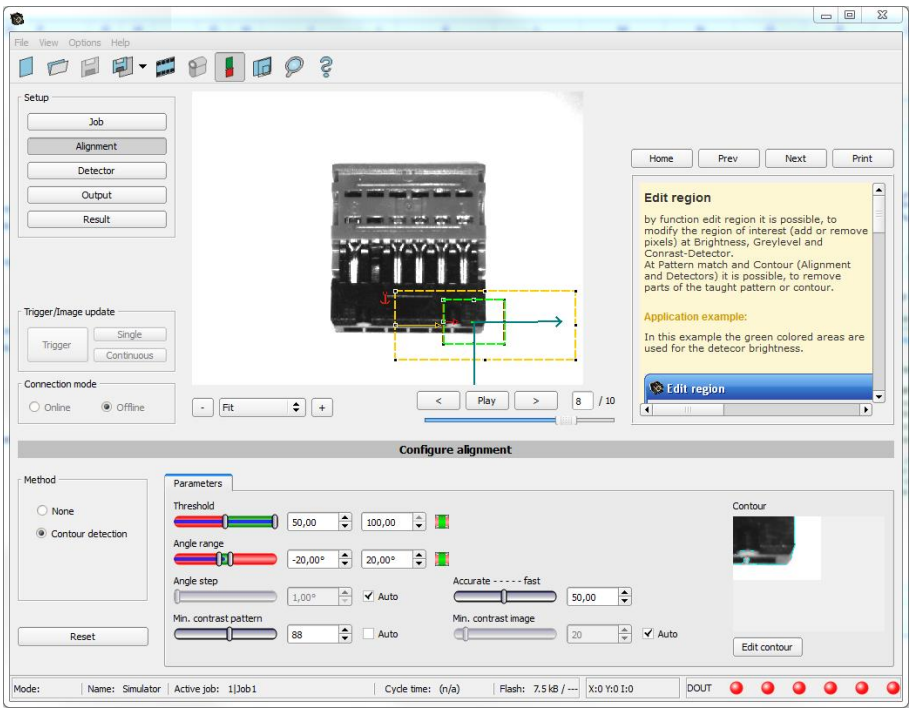


Fig. 31: Alignment

4.3.3 Detector settings

Different detectors can be selected and adjusted to solve an inspection task. First the required detector is selected in the dialog box shown below.

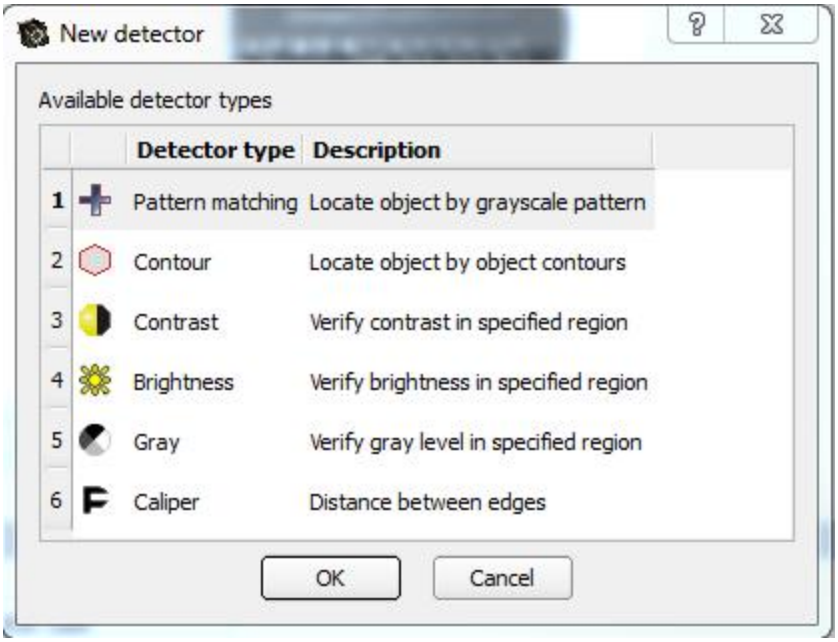


Fig. 32: Detector list, Object sensor

Then the working and search zones are graphically set on the screen. If “teach zones” (red outline) exist, they are taught immediately after completion of the settings. All the detectors defined in this job are shown in the bottom left-hand corner. The parameters of the currently selected detector are shown in the bottom right-hand corner and can be adjusted there.

If other parameters are to be checked on the same part, many other detectors can be created as described above by clicking on "New".

In the example two brightness detectors are defined to check the presence of metal contacts in a plastic connector housing.

Detector 1: contact found (brightness value is in defined range as the shiny metal contact is mounted) result positive.

Detector 2: contact not found (brightness value out of defined range, as only weak reflection from the black plastic housing background) result negative.

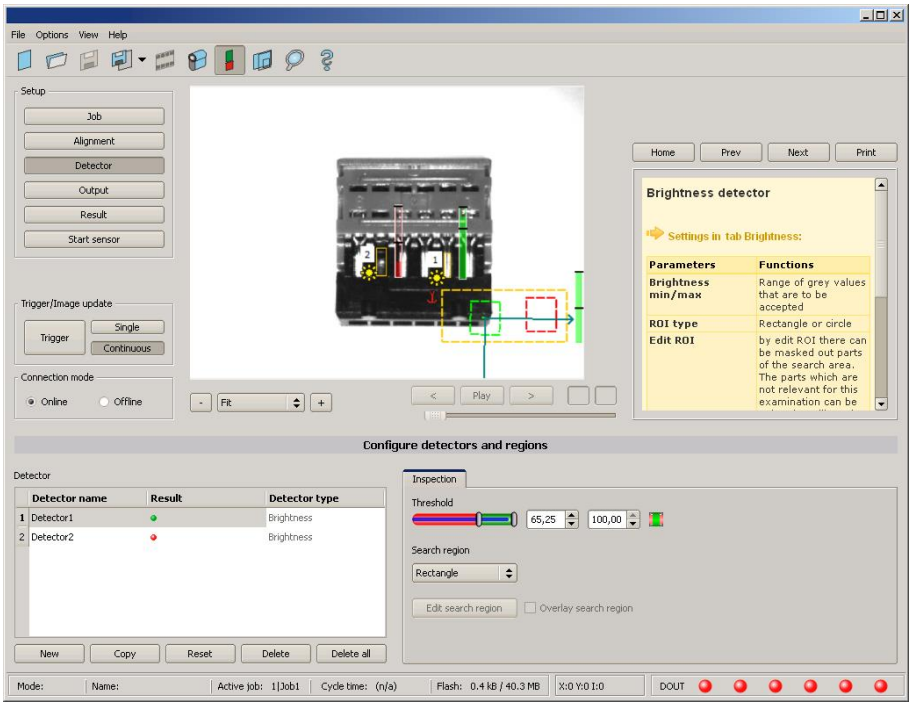


Fig. 33: Detector settings

4.3.4 Output, I/O and data output

The output module enables different settings of digital inputs/outputs and data output.

Select and activate the interfaces in the different tabs. Logically connect detector results and assign to the available I/O´s.

In order to enable the output of serial result data, select the required interface and compose data string.

Next topic:Result (Page 39)

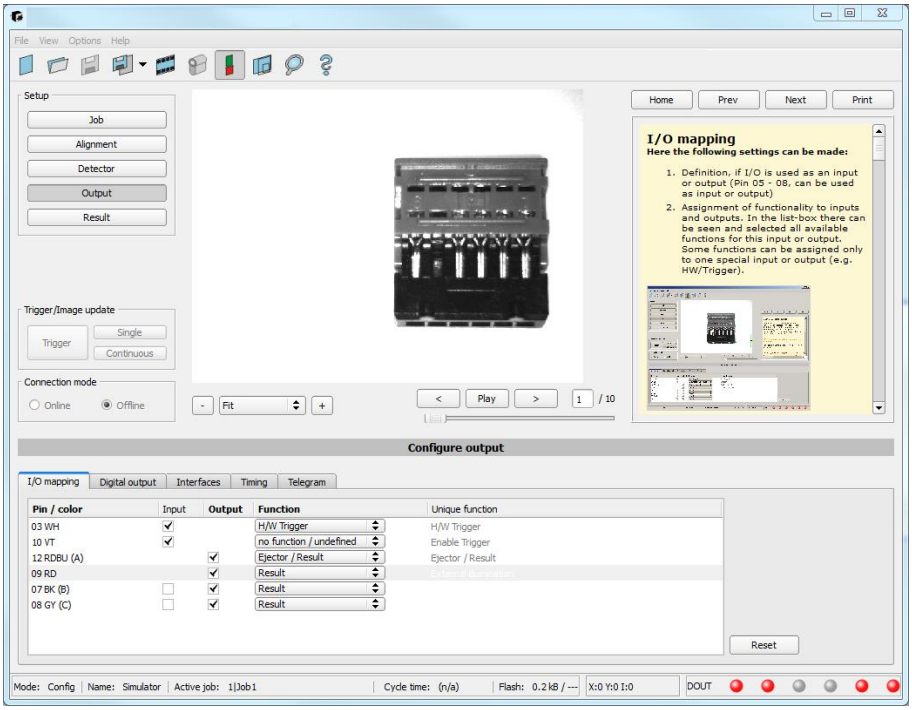


Fig. 34: Output, digital and data

Setting possibilities in the different tabs:

- **I/O mapping**
  Settings for the I/O Hardware configuration.
- **Digital Output**
  Selection of digital signal outputs and definition and assignment of logical connection using the Boolean results of all detectors. Definition of complex logic connections via table or via input of a logical formula.
  A different logical connection can be assigned to each available digital output.
- **Interfaces**
  Selection, setting and activation of the individual interfaces such as: programmable input IN2, RS422, I/O extension, Ethernet and Ethernet/IP
- **Timing**
  Setting of delay times: Trigger delay, result delay and duration of result
- **Telegram**
  Setting and preview of data output string via RS422 or Ethernet.
  Selection of: binary or ASCII protocol, header and/or trailer, standard contents and/or flexible, combinable, special individual data from the individual detectors.
  Any number of individual results from all the defined detectors can be freely arranged in an output string.

4.3.5 Result

With this function, an inspection is carried out on the PC for control purposes, using all the settings made. All the results are produced and displayed just as on the sensor. However e.g. execution times will not be updated as these values are only informative when implemented on the sensor itself. See next step: „Start Sensor“.

Next topic: Start sensor (Page 40)

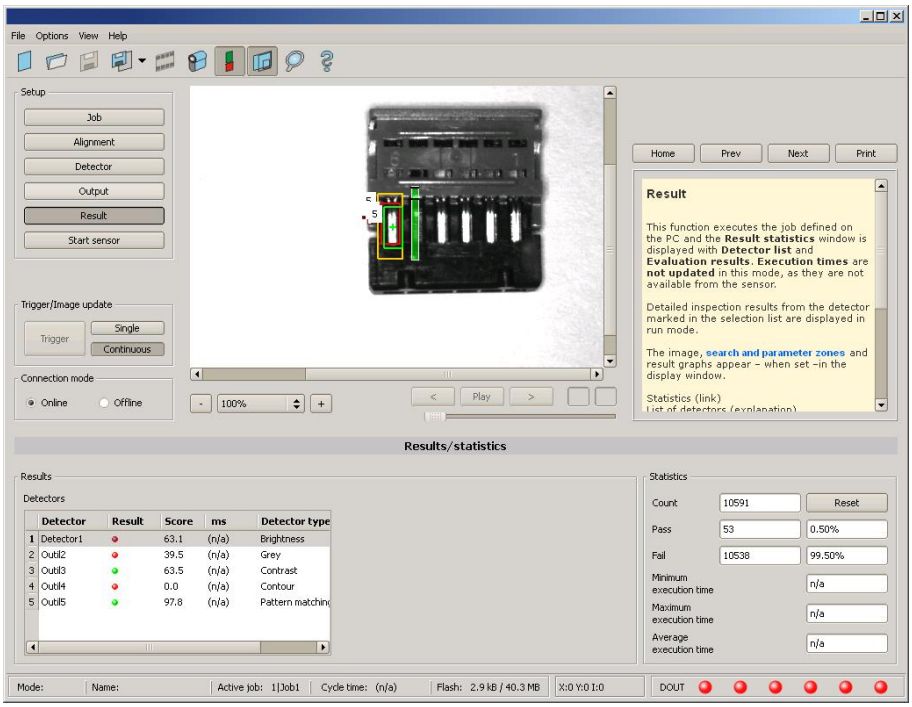


Fig. 35: Result display

4.3.6 Start sensor

When this function is activated, all settings are transferred to the sensor, stored in the flash memory and carried out in e.g. in free run or in triggered mode according to the settings made. All information in the list of detectors, result field or under „Statistics“ is updated here.

If using “triggered mode” then a trigger will be required from the external control system, alternatively a ‘software’ trigger can be sent using the Trigger button the left hand side of the image area.

Next topic: Vision Sensor Visualisation Studio, display images and results (Page 41)

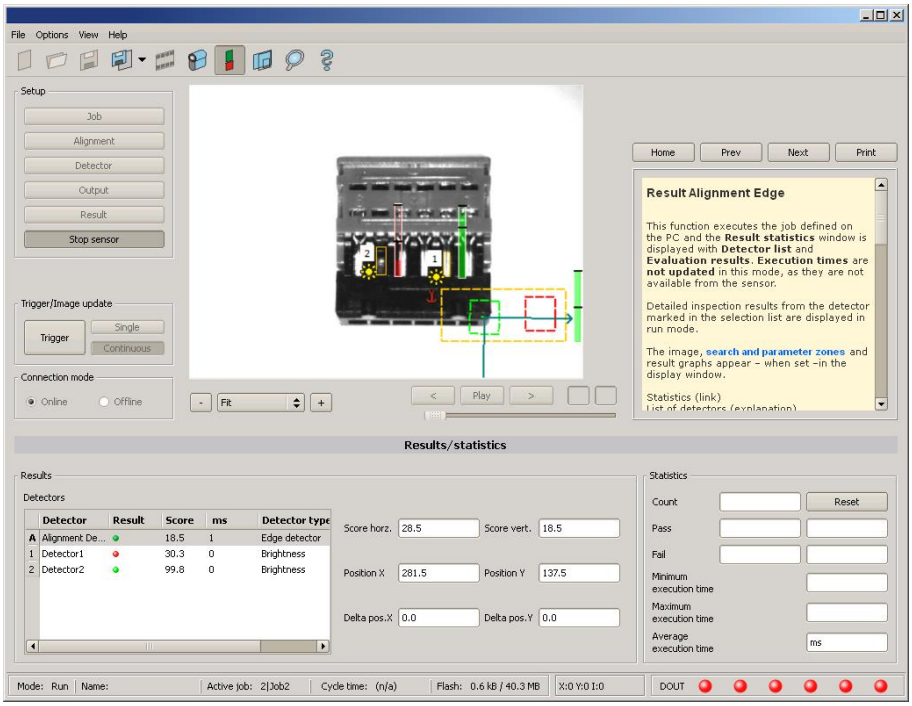


Fig. 36: Start sensor

4.4 Vision Sensor Visualisation Studio, display images and results

This program enables the monitoring/inspection of the connected sensor and the analysis of inspection results.

Click to the "**View"** button in the Vision Sensor Device Manager software to start the Vision Sensor Visualisation Studio module. (You can open multiple copies of this software if you are using multiple cameras on the system, however only one 'connection' is allowed to each Vision Sensor).

The current image is displayed with the drawings for alignment and the detectors (if „image transmission = active" is activated in the configuration module under Job/General).

The tab „**Result**" shows the individual detectors with their results and the overall result.
The tab „**Statistics**" shows further statistical results.
The "**Freeze image**" button enables result-controlled images (e.g.: bad part) to be kept on the display.
"**Zoom**" enlarges images.
With "**Archive images**", images and result data, as previously set under "File/Configure archiving", can be archived on the hard disk of a connected PC, with or without numerical result data.
With "**Rec. images**" the last 10 images can be retrieved from the Vision Sensor sensor.
In the tab „**Job**", it is possible to switch between jobs present on the sensor.
In the tab „**Upload**", further, previously defined jobs or whole job sets can be loaded from the Vision Sensor Visualisation Studio on to the sensor.

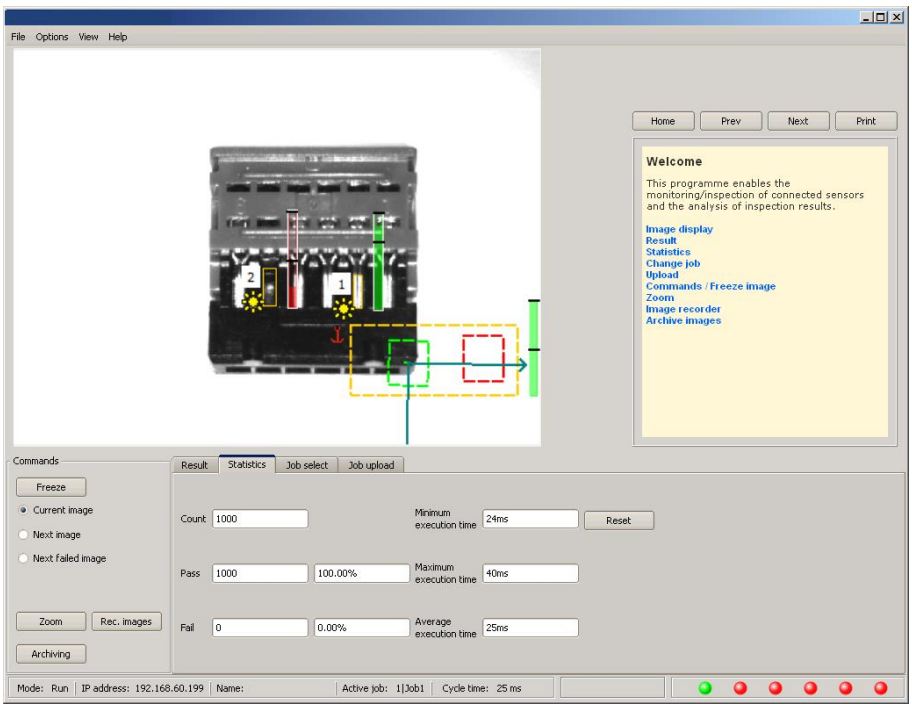


Fig. 37: Vision Sensor Visualisation Studio

4.5 Vision Sensor – Operating- and configuration software – Vision Sensor Device Manager, all functions

In this program you can select a sensor or sensor simulation for configuration or display (monitoring) and carry out different basic settings:

- Active sensors (Page 42)
- Sensors for simulation mode (Page 44)
- Find / Add active sensor (Page 44) active sensor
- Configuring a connected sensor (Page 45) connected sensor
- Display images and result data (Page 45) image and result data
- Sensor's network settings (Page 45)
- Update / Firmware update (Page 46) / Firmware update
- User administration / Passwords (Page 46) / Passwords (button with Key- symbol)

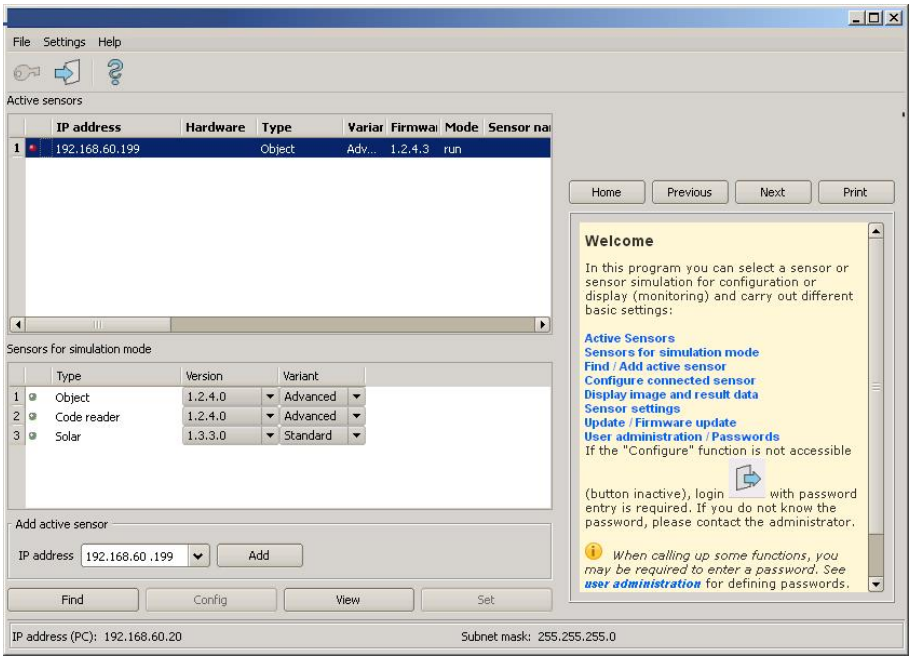


Fig. 38: Vision Sensor Device Manager

If the "Configure" function is not accessible (button inactive), login (button with door- / arrow- symbol) with password entry is required. If you do not know the password, please contact the administrator.

4.5.1 Active sensors

All sensors available on the connected network are displayed in the selection list Active sensors.

Configuring a connected sensor (Page 45) (call up Vision Sensor Configuration Studio)

Display images and result data (Page 45) (call up Vision Sensor Visualisation Studio)

Significance of parameters displayed

Parameter	Significance
IP address	Sensor´s IP address in the network
Hardware	Hardware (e.g. R3, ….)
Sensor type	Sensor type (Object-, Code reader)
Variant	Sensor- sub variant (e.g. Standard)
Version	Firmware version
Mode	Operating mode (Run, Config or Offline)
Sensor name	Name of sensor
Manufacturer	Name of manufacturer
Mac-Address	Sensor´s Mac address
Subnet mask	Sensor´s subnet mask
Gateway	Standard gateway
DHCP	DHCP active / inactive
Operating system	Type of operating system
Operating System Version	Version of operating system
Platform	z.B. Vision Sensor
Hardware version	Hardware version
RAM	RAM size
Flash	Flash size

If the "Configure" function is not accessible (button inactive, greyed out), login with password entry is required. If you do not know the password, please contact your site system administrator.

Information:

- If no entries are shown in the list, even though a sensor is connected, you can refresh the list with the "Find"-button or manually "Add" the IP address of the Vision Sensor product.
- If no sensor is connected, simulations of different sensor applications are available in the Sensors for simulation mode (Page 44) list such as 'Object' sensor.

Via the button “details” (at the right, upper corner of the parameter list of “Active Sensors”) a detailed list of all Vision Sensor parameters is accessible.

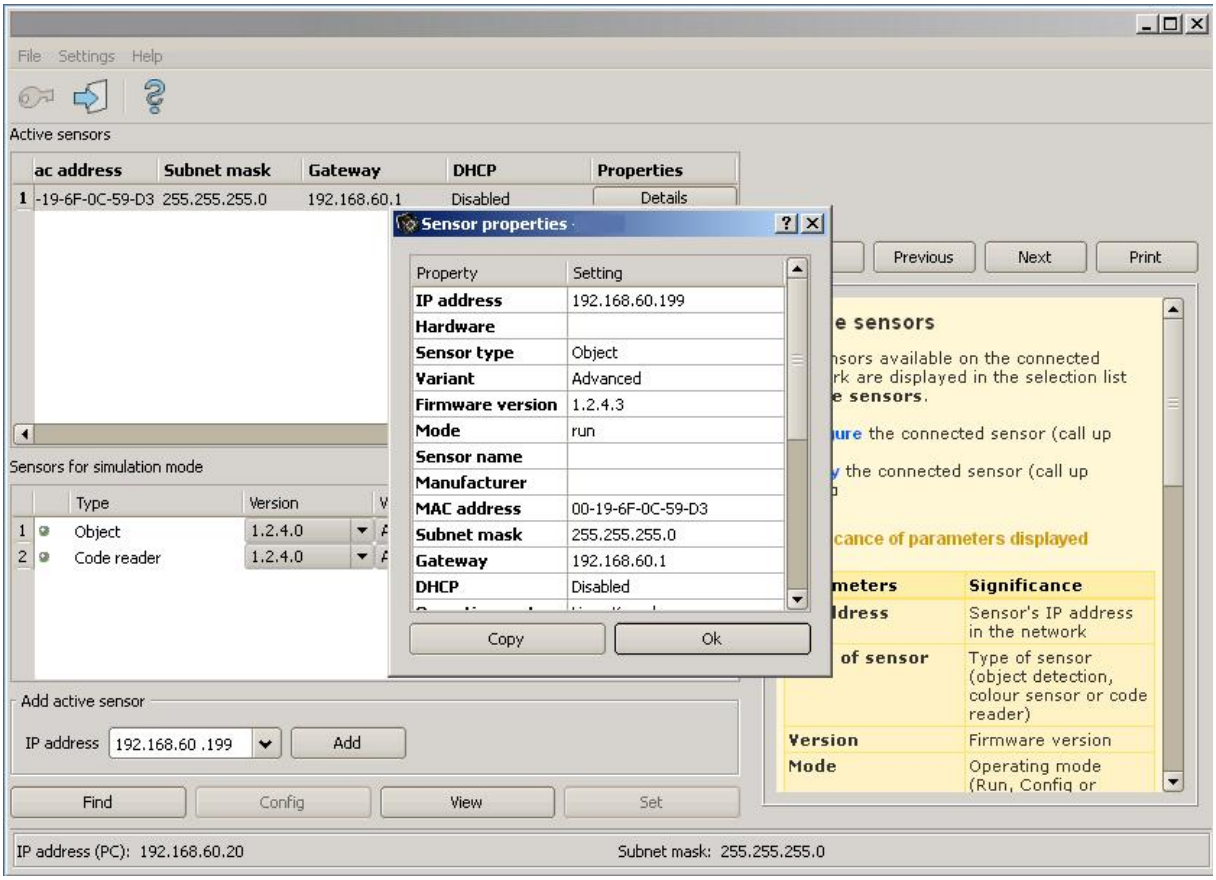


Fig. 39: Sensor properties

4.5.2 Sensors for simulation mode

In order to access the simulation mode, select the required sensor type with a double click and pressConfiguring a connected sensor (Page 45)button (call up Vision Sensor Configuration Studio).

Significance of parameters displayed

Parameter	Significance
Type	Sensor type (e.g. Object , Code reader ...)
Version	Firmware version
Variant	Sensor- sub variant (e.g. Standard …)

If the function „Config" is not accessible (button inactive) a Login (button with door / arrow symbol) with password input is necessary. If you do not know the password please contact your administrator.

4.5.3 Find / Add active sensor

If no sensors are shown in the list Active sensors, even though a sensor is connected, please follow these steps:

Find / search sensor:

To search for sensors which are connected directly to the PC, or which are available in the network, click button "Find". Basic understanding of PC networking is required.

Add active sensor:

If you know the IP-address of a sensor, please enter it into the field IP-address and click button "Add".

Now the sensor appears in the list and can be accessed for e.g. Config or View.

If the function "Config" is not accessible (button not active / greyed out) a Login with password input is necessary. If you do not know the password please contact your site systems administrator.

4.5.4 Configuring a connected sensor

Mark a sensor (simulation) in the list and click on the "Config" button.

The configuration program Vision Sensor Configuration Studio is called up and the jobs currently stored on the sensor are shown in the selection list.

When Vision Sensor Configuration Studio is called up, you may be required to enter a password. See User administration / Passwords (Page 46) for defining passwords.

s. chap Vision Sensor Configuration Studio Vision Sensor – Operating- and configuration software – Vision Sensor Configuration Studio, all functions

4.5.5 Display images and result data

Mark a sensor in the list and click on the "View" button.

The Vision Sensor Visualisation Studio program is opened up and images and measurement results from the active jobs are displayed on screen.

Information:

Calling up Vision Sensor Visualisation Studio does not affect operation of the selected sensor.

s. chap. Vision Sensor Visualisation Studio Vision Sensor – Operating- and configuration software – Vision Sensor Visualisation Studio, all functions

4.5.6 Sensor's network settings

You can change the network settings of the selected sensor with the Set button.

The IP address, subnet mask, standard gateway, DHCP and sensor name can be set here.

The PC's IP address and subnet mask are displayed below in the Vision Sensor Device Manager status bar.

The address structure must be correct in order to be able to connect the sensor to the PC. The sensor's IP address etc. can therefore be modified accordingly here if necessary.

Please contact your site administrator for the definition of network parameters. Further information on this subject can be found in the printed manual.

If "DHCP = active" is selected, a unique name must be given for the sensor as the IP address is newly assigned each time the sensor starts up and can thus change.

You require administrator authorisation for these functions (see user administration).

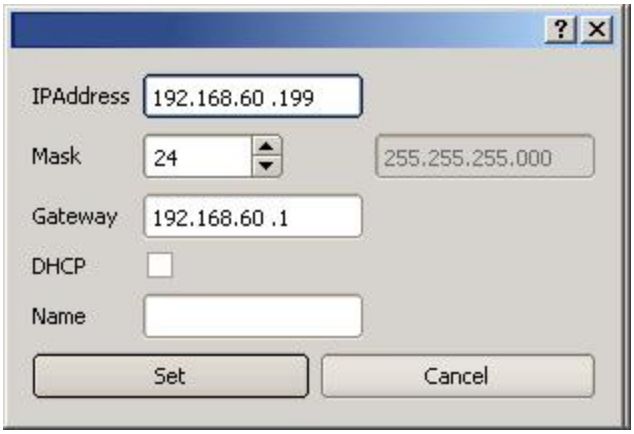


Fig. 40: Vision Sensor Device Manager, IP- Setup

s. chap. Network settings / Ethernet connection Network settings, Short reference and Network connection

4.5.7 Update / Firmware update

You can update the firmware of the selected sensor through the menu item File/Update.

The appropriate firmware update file must first have been obtained via download from www.festo.com. In the support portal search for "SBSI".

Select the appropriate firmware file in the file dialogue box that opens and follow the instructions.

Do not disconnect the power to the sensor during this process unless prompted by the onscreen instructions.

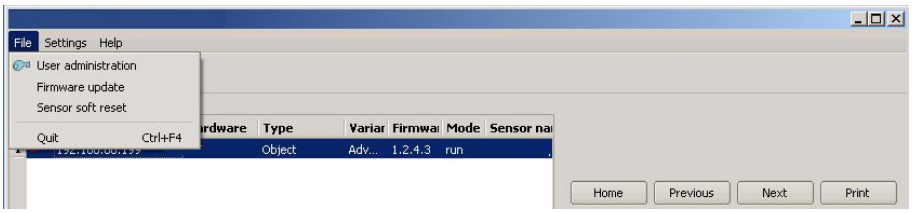


Fig. 41: Vision Sensor Device Manager, Firmware update

4.5.8 User administration / Passwords

The Vision Sensor configuration distinguishes between three user groups, which have different authorisations:

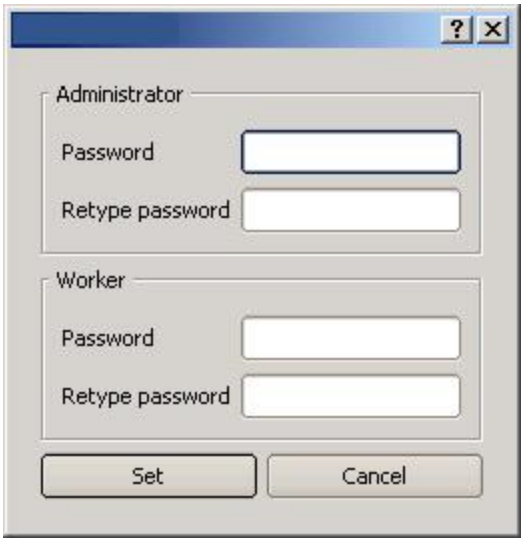


Fig. 42: Vision Sensor Device Manager, Password input

User	Vision Sensor Device Manager	Vision Sensor Configuration Studio	Vision Sensor Visualisation Studio
Administrator	all functions	all functions	all functions
Operator	all functions except - Config. - settings -update	none	all functions
User	all functions except - Config. - settings -update	none	only display of images, inspection results and statistics

After software installation, login is automatically carried-out when the application is called-up, without password request. No passwords are assigned.

Define passwords:

Select file user administration in the File menu or click on in the toolbar to assign passwords for the administrator and user categories. Once a password has been entered, a logout is automatically carried out, i.e. input of the new password is now necessary. Assigning an "empty" password, enables entry by simply confirming with OK.

Fig. 43: Password button

Login

Once passwords have been assigned and automatic logout has taken place, a login is required e.g. for sensor configuration. Click on in the tool bar to login and / or (after password entry) to deactivate password entry for the next session for the selected user group.

If the "deactivate password request" box is ticked, the password will not be requested when the application is next started.

Fig. 44: Login- button

4.6 Vision Sensor – Operating- and configuration software – Vision Sensor Configuration Studio, all functions

With this programme, you can configure your Vision Sensor for one or several jobs in six logical operating steps.

- Jobs (Inspection tasks) (Page 48)
- Alignment (Page 57)
- Detectors (Page 58)
- Output of inspection results (Page 94)
- Result (Page 110)
- Start sensor (Page 112)

Other program functions:

- Trigger settings (Page 113)
- Switching between online and offline mode (Page 114)
- Simulation of jobs (offline mode) (Page 114) using series of images.
- Creating filmstrips (Page 114) Image recording for analysis or simulation purposes. Use of Vision Sensor Configuration Studio may require password entry (administrator user group). See User administration / Passwords (Page 46)
- Image recorder (Page 122)

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

- Set to **free run** in "Job/Image acquisition"
- Set to **continuous** in "Trigger / collect image" User interface and operating procedure

4.6.1 Jobs (Inspection tasks)

A job contains all the settings and parameters required to carry out a certain inspection task.

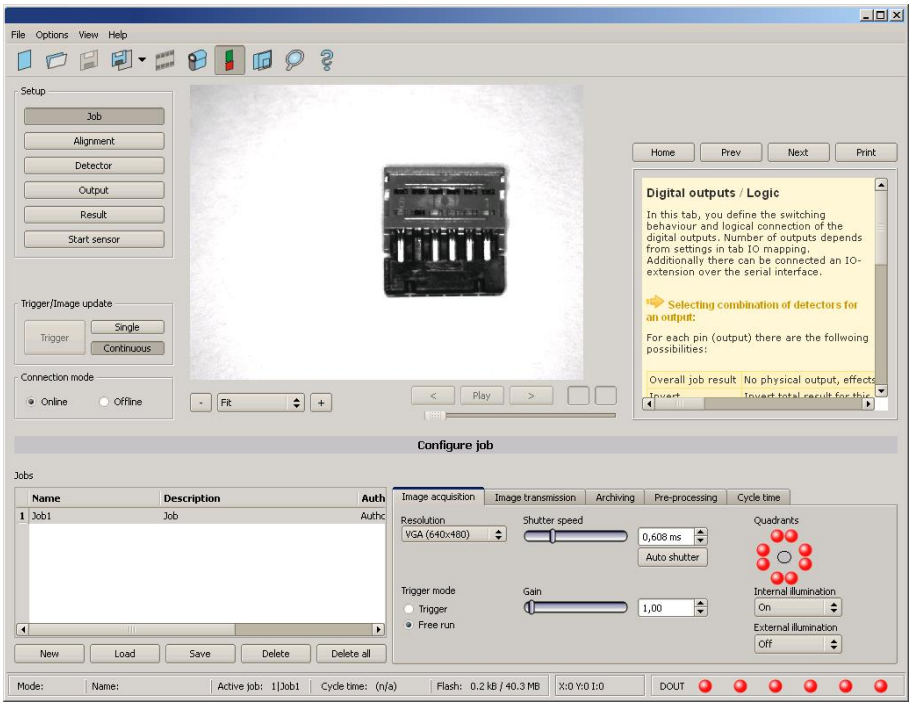


Fig. 45: Vision Sensor Configuration Studio Job

4.6.1.1 Creation, modification and administration of jobs

A selected job (marked in the list) can be modified by entering parameters in both tabs of the configuration window:

If there is no job entry in the list, you must create a new job first.

Creating a new job:

1. Click on the button "New" underneath the job selection list. A new job entry appears in the list.
2. Edit the entry with a double click on the respective line (Name, Description, Author):

Further functions:

Function	Description
New	Defines a new job
Load	Loads a job from the PC
Save	Saves the selected job on the PC
Delete	Deletes the selected job from the list
Delete all	Deletes all the jobs in the list

All the functions described can also be carried out using the File menu.

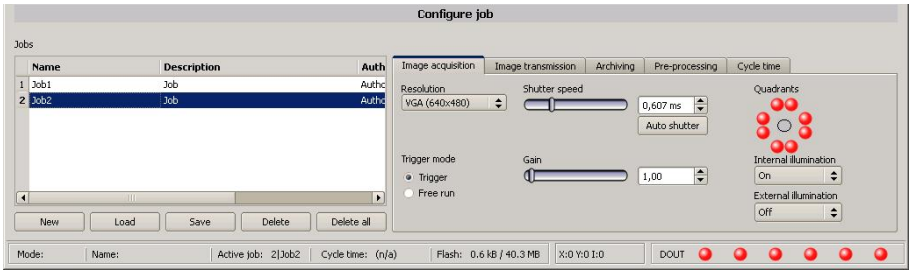


Fig. 46: Vision Sensor Configuration Studio Joblist

If the sensor's memory capacity is exhausted and no further jobs can be loaded on to the sensor, the colour of the remaining memory display in the status bar changes to red.

4.6.1.2 Loading and saving jobs and job sets

Jobs can be loaded and stored individually or as a whole set of jobs in a job set. If several jobs are stored on the sensor, they form a job set, which you can store as an XML file on your PC or on an external storage medium just like an individual job.

Next topic: Parameters for image acquisition (Page 51)

Saving a job / job set:

1. Select Save job as ... from the File menu.
2. Select Save job set as ... from the File menu.

Loading a job / job set:

1. Select Load job ... from the File menu.
2. Select Load job set ... from the File menu.
3. Activate the button "Start Sensor" to transfer jobs to the sensor.
   All the jobs stored on the sensor are deleted when a new job / job set is loaded !

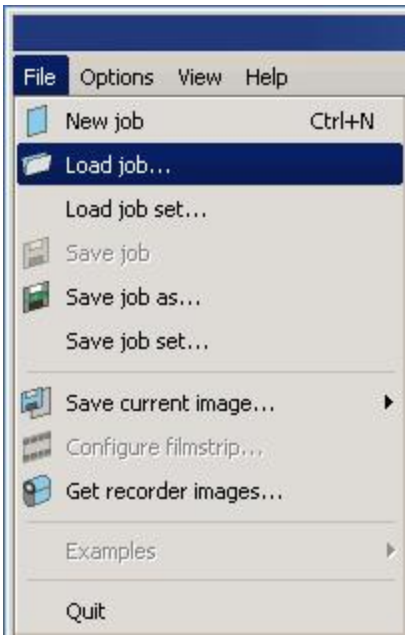


Fig. 47: Vision Sensor Configuration Studio, Load / save job

4.6.1.3 Parameters for image acquisition

The basic parameters for image acquisition are determined in the tab Image acquisition.

Next topic: Parameters for image transmission (Page 52)

Set image sharpness with the focus setting screw on the back of the Vision Sensor.

Parameters	**Functions and setting possibilities**
Resolution	Standard resolution is VGA (640x480), but a lower resolution (QVGA) can be selected with time-critical applications or for compatibility reasons. Available resolutions: R3: WVGA (736x480), VGA (640x480), QVGA (320x240), QQVGA (160x120) When the resolution is altered, all the detectors previously defined are deleted!
Zoom	Via the Zoom function different fields of view / image zones can be selected
Dynamic	Optimization of characteristics of image capturing: "Linear" means linear response curve(behaves like Vision Sensor-products with no dynamic image capturing), "High" means better graduation in bright areas of the image (avoids override).
Trigger mode	Select trigger mode (triggered or free run). In case of triggered mode trigger can be done by hardware-trigger (Pin 03 WH) or over one of the data interfaces. In free run the Vision Sensor continuously captures images and processes evaluations.
Shutter speed	Parameter for control of image brightness. Image brightness preferably should be set with “Shutter speed”, only in case that it´s not possible to achieve the required image brightness this way use the slider “Gain” (Default value of Gain = 1). With fast moving objects a high shutter value can cause blurring of the image. Exposure can be set automatically with the Auto-Shutter button. Maximum shutter value is 100ms. Maximum duration of internal illumination pulse is 8ms. Shutter timers longer than 8 ms just make sense, if internal and external illuminations are used.
Gain	Set image brightness preferably with shutter speed first, and only if necessary in a second step with gain. (Default value of Gain = 1).
Quadrants (illumination)	By click on the LED single quadrants of illumination can be switched off. This function may avoid reflections at low working distances.
Internal illumination	Switch internal illumination (on, off).
External illumination	Switch external illumination (on, off, permanent). External illumination is switched over Pin 09 RD.

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

- Set to **free run** under "Job/Image acquisition"
- Set to **continuous** under "Trigger / collect image"

4.6.1.4 Parameters for image transmission

Image transmission and/or the image recorder can be activated in the Image transmission tab.

Next topic: Parameters Archiving (Page 53)

Set image sharpness with the focus setting screw on the back of the Vision Sensor.

The symbol “exclamation mark” inside life picture means, that image display / transfer on PC is slower than image processing on Vision Sensor. Not all images are transferred and displayed on the PC. This may cause lost images during archiving. If this symbol occurs often, PC-programs running in background should be closed in order to improve PC performance.

Parameters	Functions and setting possibilities
Vision Sensor Visualisation Studio	Transmission of images to Vision Sensor Visualisation Studio can be switch on and off (Off increases the speed of Vision Sensor).
Image recorder	Storage of max. 10 images in the sensor's internal ring buffer. Setting possibilities via pop-up menu: off, bad images, all images
Ram disk	Storage of last image in ram memory, this image can be taken by a FTP-client. Ram disk Settings: Off, Any, Pass, Fail. The image is stored under name "image.bmp" in folder /tmp/results/ . Parameters for FTP-client: user "user", password "user" Example Windows Console: Microsoft Windows XP [Version 5.1.2600] (C) Copyright 1985-2001 Microsoft Corp. C:\>ftp 192.168.100.100 Verbindung mit 192.168.100.100 wurde hergestellt. 220 Welcome to Vision Sensor ftp-server! Benutzer (192.168.100.100:(none)): user 331 Please specify the password. Kennwort: user 230 Login successful. ftp> cd /tmp/results 250 Directory successfully changed. ftp> get image.bmp 200 PORT command successful. Consider using PASV. 150 Opening BINARY mode data connection for image.bmp (354358 bytes). 226 File send OK. FTP: 64d Bytes empfangen in 0,23Sekunden 1514,35KB/s ftp> Image is now in drive C of executing PC. If activated, results can be also received in the same way from file "results.csv".

Different types of archiving images

Access	Description	Max. number of	Image filter	Drawings

		images		
Image recorder in Vision Sensor (Ram)	Images stored in run-mode on Vision Sensor can be transferred by Vision Sensor Configuration Studio or Vision Sensor Visualisation Studio to a PC.	10	like pre-defined in settings "Filter"	no
Vision Sensor Visualisation Studio archiving / Vision Sensor Configuration Studio save image	Images transferred to Vision Sensor Visualisation Studio can be stored on hard disc of PC.	unlimited (Limit is size of hard disc in PC)	like pre-defined in settings "Filter"	selectable yes / no
Saving of filmstrips in Vision Sensor Configuration Studio	Current images from filmstrip can be saved as filmstrip (*.flm) or as bitmap (*.bmp) on hard disc of PC.	50	without filtering	no
Last image in Vision Sensor (Ram Disk)	Last image is stored in ram disk of Vision Sensor and can be taken by FTP from directory /tamp/results.	1	without filtering	no
Archiving of images via FTP or SMB	Archiving of images via FTP or SMB	unlimited (Limit is size of hard disc in PC)	selectable with / without filtering	no
Get Image Request	Last image from Vision Sensor by using GetImage command in a program of a PLC or PC.	unlimited (Limit is size of hard disc in PC)	like pre-defined in settings "Filter"	no

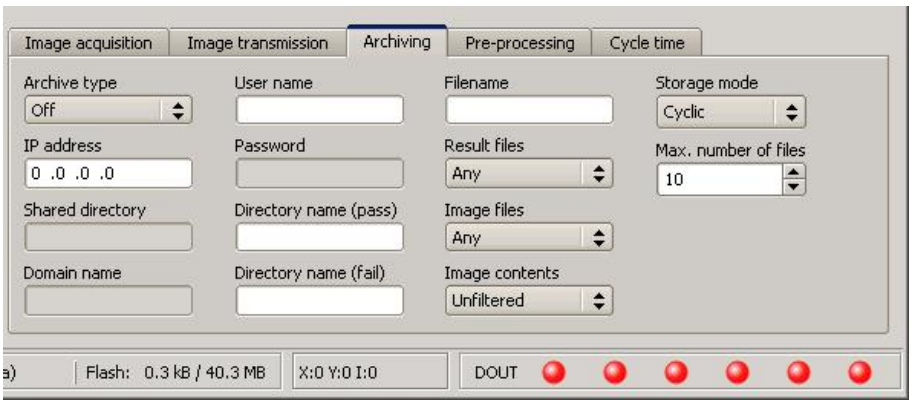


Fig. 48: Tab Job / Image transmission

4.6.1.5 Parameters Archiving

In tab Archiving the archiving of data can be defined.

Next topic: Filter for image improvement. (Page 55)

Parameters	Functions
Archive type	Off: no archiving, FTP: archiving to FTP server, SMB: archiving to a drive via SMB-service (Server Message Block) Attention: if archiving server is in different sub network set gateway first with Vision Sensor Device Manager.
IP Address	IP-Address of target server
Sharing name	Sharing name, specified in dialog "Advanced Sharing" in PC
Workgroup (Domainname)	Option ! , Workgoup / Domainname of server / client
User name	User name for FTP / SMB connection.
Password	Password for FTP / SMB connection.
Directory name (pass)	Directory for archiving of data of good parts (pass) (for C:\TESTPASS just enter TESTPASS)
Directory name (fail)	Directory for archiving of data of bad parts (fail) (for C:\TESTFAIL just enter TESTFAIL)
Filename	Filename for images and protocol file, this name is extended automatically by the image number (e.g. TESTFILE).
Image files	Activates archiving of images
Result files	If protocol file is active, there will be generated automatically a .csv file for each inspection (trigger). Contents of the file are specified in "Output / Telegram". Files will have increasing numbers.
Image contents	Possibility to select, whether images should be stored including the selected software filter or "raw" as taken from the camera.
Storage mode	Limit: after reaching maximum number of files transmission is stopped. Unlimited: files are stored, until target drive is full. Cyclic: after reaching maximum number of files the older files are replaced by the newer ones.
Max. number of files	Maximum number of file sets (image+protocol) which are allowed to be stored in the target directory.

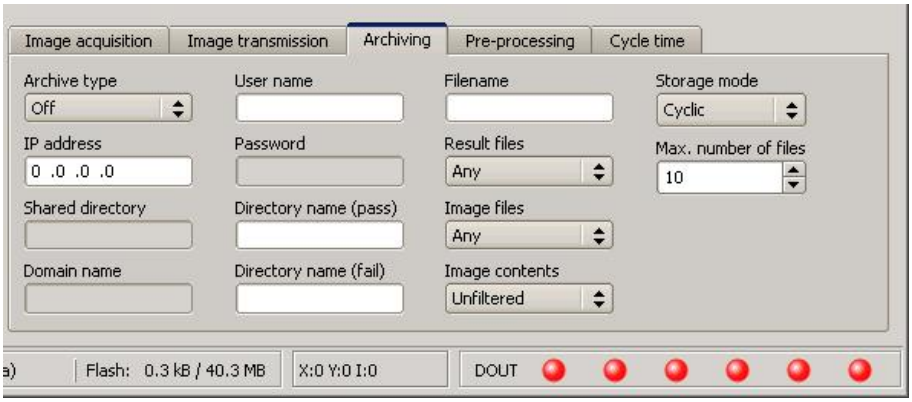


Fig. 49: Tab Job / Archiving

4.6.1.6 Filter for image improvement.

In tab Pro-processing you can filter the images taken by the sensor before analysis. Up to 5 filters can be used, which are processed in the selected sequence. All detectors (alignment and standard- detectors) will work with the pre-processed image (not with the original image)

Especially with morphological operations (Dilation and Erosion) can lead to improvements by combining them. E.g. by processing Erosion and Dilation one after another – or in reverse order.

Next topic:Parameters Cycle time (Page 56)

Example:- Black points in front of a bright background can be eliminated, if a sequence of dilation and erosion is processed.

The following filters are available for image improvement:

Filter type	Effect
Gauss	Reduction of disturbance, suppression of disturbing details and artefacts, smooth's edges
Erosion	Extension of dark zones, elimination of light pixels in dark zones, elimination of artefacts, division of bright objects. Each grey value is replaced by the minimum grey level found inside the filter mask (e.g. 3x3).
Dilation	Extension of light zones, elimination of dark pixels in light zones, elimination of artefacts, division of dark objects. Each grey value is replaced by the maximum grey level found inside the filter mask (e.g. 3x3).
Median	Reduction of disturbance, noise reduction
Mean	Reduction of disturbance
Range	Finds edges (starting with firmware 1.5.x.x)
Mirror	Vertical mirroring
Flip	Horizontal mirroring
Inversion	Inversion of image

The effect of an active filter is immediately visible in the image. The larger the filter core is selected, the stronger the effect of the filter. The filters are used in the order listed from top to bottom.

Configuring filters:

1. Select the filters in the required order, via the pop-up menus in the column Filter.
2. Enter the size of the filter core in the pop-up menu in the column Property. If the setting is Off, the respective filter is deactivated.

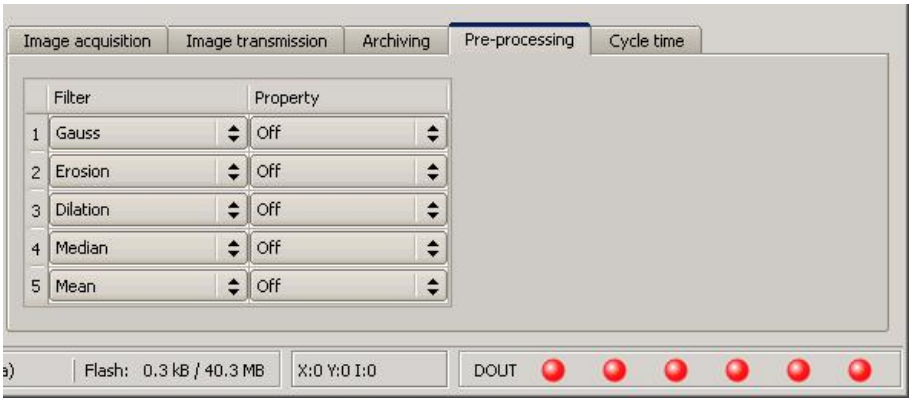


Fig. 50: Tab Job / Pre-processing

4.6.1.7 Parameters Cycle time

In tab Cycle time the timing conditions of the Vision Sensor can be defined.

Next topic:Alignment (Page 57)

Parameter	Function and possibilities
Max. cycle time	Parameter to control the minimum and maximum time of a cycle. Inside a cycle some images can be evaluated (in case of "Number of images (max)" > 1) Maximum processing time per image interrupts a job after a defined time. The result of a cycle after a timeout is always "not o.k". Maximum processing time should be selected higher than the time demand for one execution. The processing time is the time elapsed from trigger till the setting of the digital outputs. If this cycle time should be limited (e.g. if the machine cycle should not be exceeded) this function can be used. The result of all detectors which are not processed / finished after this processing time has elapsed are set to “failed”. As the currently processed detector will still be finished, please consider that the adjusted job time may not be met a 100% exactly, and it may last a few milliseconds longer till the job is interrupted. It´s recommended to test the real cycle time and to choose a value for this parameter which is a bit smaller / shorter.
Max. processing time per image	Maximum duration of one evaluation inside a cycle including image capturing.
Min. processing time per image	Minimum duration of one evaluation inside cycle including image capturing. Minimum processing time blocks trigger signals which are coming before the minimum processing time was reached.
Number of images (max.)	Maximum number of image capturings, which are processed after one trigger, if the stop criteria is not fulfilled. The stop criteria is the "Overall job result" (access via Output/Digital output)
LED-Power	This value is calculated automatically. Standard Value is 100%. LED-power may be reduced, if shutter time is quite long and minimum job time is quite short, because the recovery time for the LEDs may be to short in this case. To obtain 100% LED power,

	minimum job time should be factor 10 bigger than shutter time.
Auto	If "Auto" is selected the minimum cycle time is automatically adjusted in the way that the LED-power is 100%

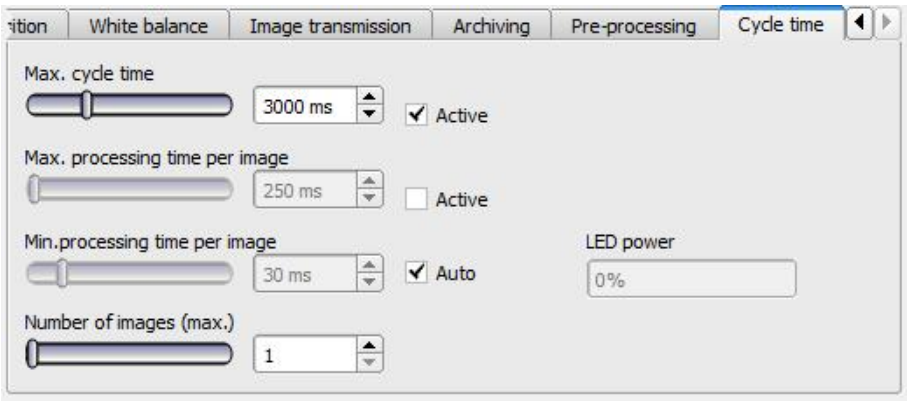


Fig. 51: Tab Job / Cycle time

4.6.2 Alignment

Alignment compensation can be necessary for objects or characteristics whose position varies in the image.

Mode of function of an alignment detector

An alignment detector is a tracking coordinate system, which is anchored to one selected characteristic. All subsequently defined detectors are aligned in relation to this coordinate system. Maximum one alignment detector can be defined for each job.

For information to the meaning and adjustment of the different frames see chap.

Search and parameter zones

As alignment requires an extra calculation step, it should only be used if required by the application.

4.6.2.1 Alignment Contour detection

This alignment detector is ideal for the detection of contours with edges at any angle.

4.6.2.1.1 Alignment detector Contour detection

Next Topic: Detectors (Page 58)

Settings in parameter tab:

Parameters	Functions and setting possibilities
Switching threshold	Zone for the required concordance of the found contour with the taught contour
Angular zone	Angular zone in which search is carried out

Increment (angle)	Increment in ° of the search across the selected angular zone (If the angular zone and increment are set to 0, the detector only searches for non-rotated objects)
Accurate - fast	Candidates with score less than indicated will already be rejected during search.
Min. contrast pattern	Minimum contrast required with taught model for an edge to be accepted as one.
Min. contrast image	Minimum contrast required in current image for an edge to be accepted as one.
Edit ROI	By edit ROI there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked.

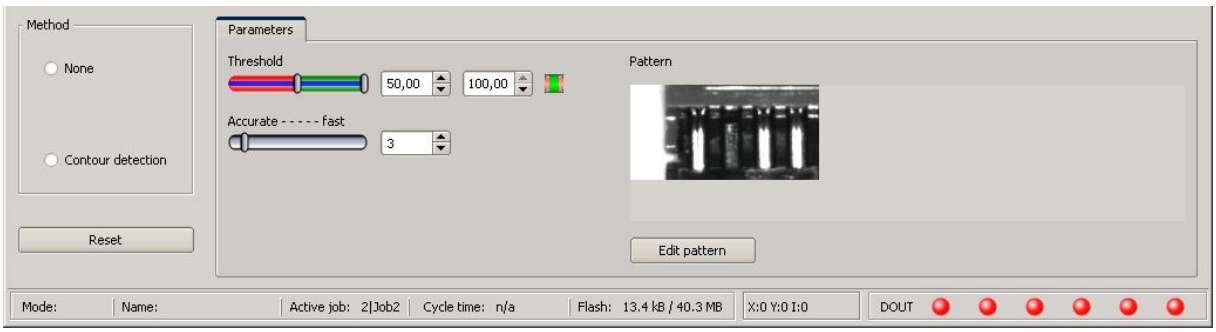


Fig. 52: Alignment detector, contour detector

4.6.3 Detectors

Each job contains one or several inspection steps (detectors), which you can define here.

With the very first selection of the step “Detector” a window with a list of all available detectors opens.

Drawings in the image (yellow, red frames etc.) can be activated or deactivated for any detector or category in the menu item "View/all drawings". With "View/drawings of current detector only", all drawings on the screen can be deactivated with the exception of the detector currently being processed.

Next topic: Creating and adjusting detectors (Page 59)

For information to the meaning and adjustment of the different frames see chap. Search and parameter zones

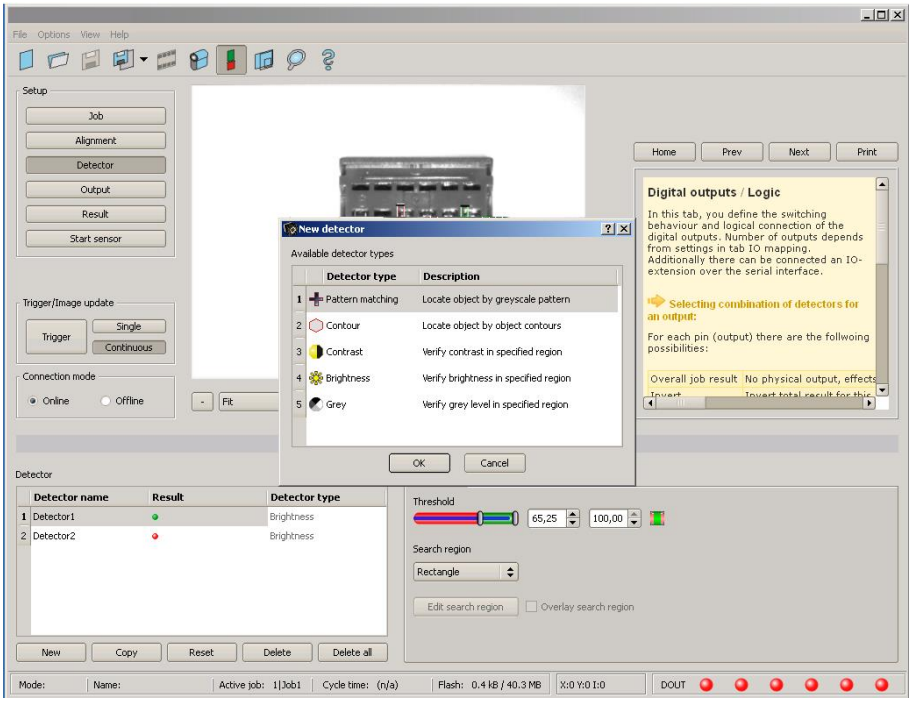


Fig. 53: Detector list for selection (here Object sensor)

4.6.3.1 Creating and adjusting detectors

Types of detector:

- Detector Pattern matching (Page 61)
- Detector Contour (Page 66)
- Contrast detector (Page 71)
- Brightness detector (Page 77)
- Grey detector (Page 74)
- Barcode detector. (Page 79)
- 2D Code detector (Page 86)

Create new detector:

1. Click on “New" button under the selection list in the configuration window and select the type of detector required. A new detector entry appears in the selection list.
2. Edit the name of the detector with a double click on "Name"

Configure detector:

1. Activate the detector in the selection list.
2. Graphically define the appropriate search and parameter zone on the image.
3. Configure the detector by entering/adjusting the parameters in the Parameters /General and if necessary Advanced tabs in the configuration window. Which tabs are shown depends on the type of detector selected.

Functions for administration of detectors:

Control panel	Functions
New	Adds new detector > dialogue box with above-mentioned detector selection list appears
Copy	Copies all parameters from one detector to one or several others. The parameter zones are not copied. All detectors must be from the same type. Copy process: Create all desired destination detectors; they must be of the same type as the source detector. Mark source detector in the list Click to button „copy“ A list occurs, mark all desired destination detectors. (To select several press “Ctrl” key) Click “Copy” to confirm
Reset	Resets parameters and search and parameter zones of selected detector to standard values
Delete	Deletes the selected detector
Delete all	Deletes all the detectors in the list

Information:

"Flash x.x/yyyy.y kB" appears in the bottom corner of the screen, indicating first the memory used by the current configuration x.x), and the memory available on the sensor (yyyy.y) in kB. Should the memory used exceed the available memory, this indicator switches to red as there is not enough space for the current settings on the sensor. In this case you can delete other jobs from the sensor before transfer.

Drawings in the image (yellow, red frames etc.) can be activated or deactivated for any detector or category in the menu item "View/all drawings". With "View/drawings of current detector only", all drawings on the screen can be deactivated with the exception of the detector currently being processed.

4.6.3.2 Selecting a suitable detector

Next topic: Detector Pattern matching (Page 61)

The following detectors are available in Vision Sensor Configuration Studio:

Object sensor

Type of detectors	Description
Pattern matching	Part detection using pattern matching, X- and Y- translational
Contour detection	Part detection using object contour, up to 360° rotation
Contrast	Evaluation of contrast in selected search zone
Brightness	Evaluation of brightness in selected search zone
Grey level	Evaluation of grey values in selected search zone

Code Reader

Type of detectors	Description
Barcode	Barcode reading 1D Codes (Code reader)
2D- Code	Data code reading 2D Codes (Code reader)

4.6.3.3 Detector Pattern matching

This detector is suitable for the detection of patterns of any shape, even without distinctive edges or contours.

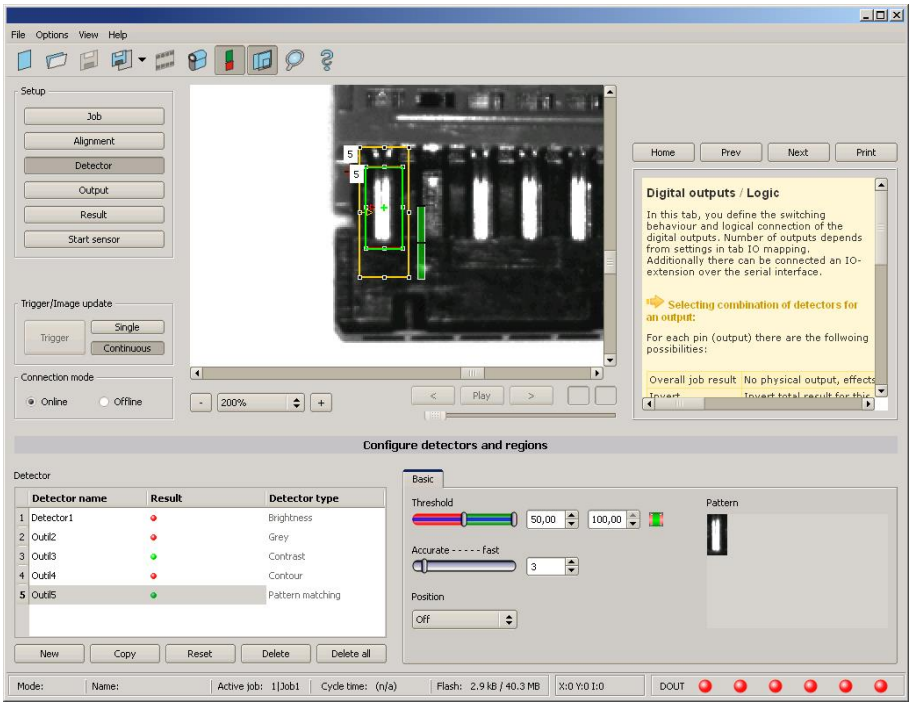


Fig. 54: Detector Pattern matching

Next topic: Detector Contour (Page 66)

Pattern matching application (Page 62)

4.6.3.3.1 Settings in tab Basic:

Parameters	Functions
Switching threshold min/max	Zone for the required concordance of the pattern found with the pattern taught.
Accurate - fast	Number of search levels / coarsening levels. 0 = automatic selection Higher value: faster = riskier (overlook candidates) Smaller value: slower = less risky (all candidates)
Position check	Checks whether the pattern found is in the right position. If position check is activated, the position frame is shown in blue (either rectangular or elliptic).

Pattern	Shows the taught pattern = contents of the red frame

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimisation Pattern matching:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary: Attention: The search area marks the area where the centre point of the pattern is searched!
- Reduce resolution to QVGA instead of VGA (Attention: Global parameter, affects all detectors!)
- Set "accurate – fast" to fast

Robust pattern detection:

- Search zone for position (yellow frame) sufficiently large?
- Reduce search levels
- Distinctive grey value pattern?, re-teach if necessary
- If found at wrong position: use distinct sample, re-teach if necessary

If, directly after teach, the found position (green frame) is not identical with teach area (red frame) the slider "Accurate – fast" should be set to "Accurate"

4.6.3.3.2 Pattern matching application

In this example a metal contact (left side) in a black plastic part is taught as pattern. It is detected with a high score value, as the metal contact is mounted. (Threshold near 100%)

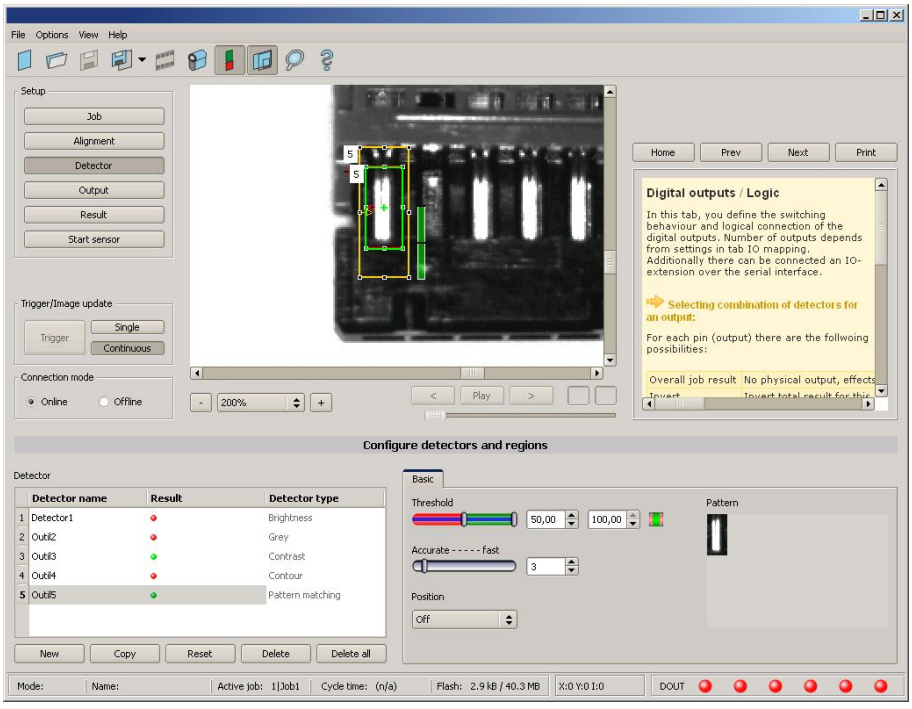


Fig. 55: Pattern matching, application example, positive result.

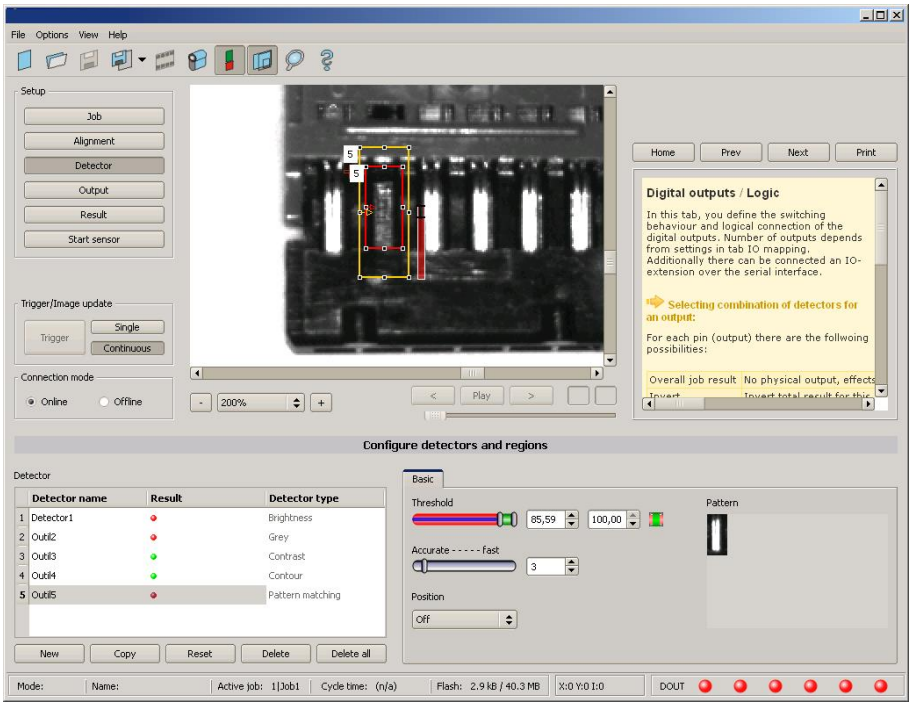


Fig. 56: Pattern matching, application example, negative result.

If the same pattern matching is performed at a position, where the metal contact searched for is not mounted, the score value does not reach the threshold and the result gets negative. With the function pattern matching the detection is made by the grey values of the pixels at the corresponding position in the image. As here the inner, shiny and therefore bright region does not exist, and instead of this the grey values of the pixels in the corresponding position do have lower (darker) values, the score value is significantly lower than with the contact mounted.

But, as also big regions of the search area are matching (the outer dark frame of the black plastic) the score value is not zero, but approx. 70%.

The settings in these examples are just made to illustrate the function of the detector pattern matching. In real operation these settings should be optimized further. (E.g. by smaller search and / or feature regions >> relevant pattern gets more significant, etc.)

By Teach the pattern inside the red frame gets stored in the sensor as reference pattern. Size and position of the reference pattern is defined by the red frame. In Run mode the Vision Sensor tries the find the best fit of the reference with any region in the image. Depending on the settings of the threshold the object / feature is detected or not. The function pattern matching does not work with rotated images; it´s tolerance is limited to an angle of approx. +/- 5°. Patterns with higher angular deviation are not detected. This behaviour can be used to detect if a part is in correct orientation in feeding application.

Example:

The following pattern was taught:

Fig. 57: Pattern, reference

With the following three examples, the object is detected with 100% concordance, as the taught pattern is exactly the same, even though it is in another place on the image.

Only offset in X or Y direction and not rotated.

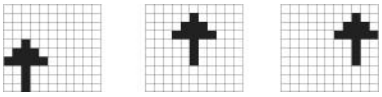


Fig. 58: Pattern, positive result

With the three now following examples in the second row, the object is also detected, but with less than 100% concordance, as it deviates from the taught pattern in some pixels. Good or bad results are supplied according to the setting of the threshold value (degree of concordance).

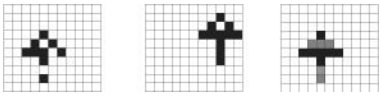


Fig. 59: Pattern, limit case

Pattern detection tolerates a ± 5 degree rotation. This means, the images in the bottom row were also detected, although the actual degree of concordance with the sample image is less than 100%, despite 100% pixel concordance.

Patterns with a larger degree of rotation are not detected.

This can be used as a function e.g. for detection of the correct alignment of parts on feeding units.

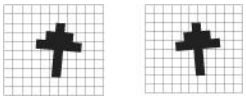


Fig. 60: Pattern, rotation

4.6.3.3.3 Function: Mask

With function „Mask“ the search region can be modified. Inside the search- and feature- areas of the different detectors regions can be included or excluded.

Application example:

In this example only the green marked regions inside the ROI of the brightness detector are relevant.

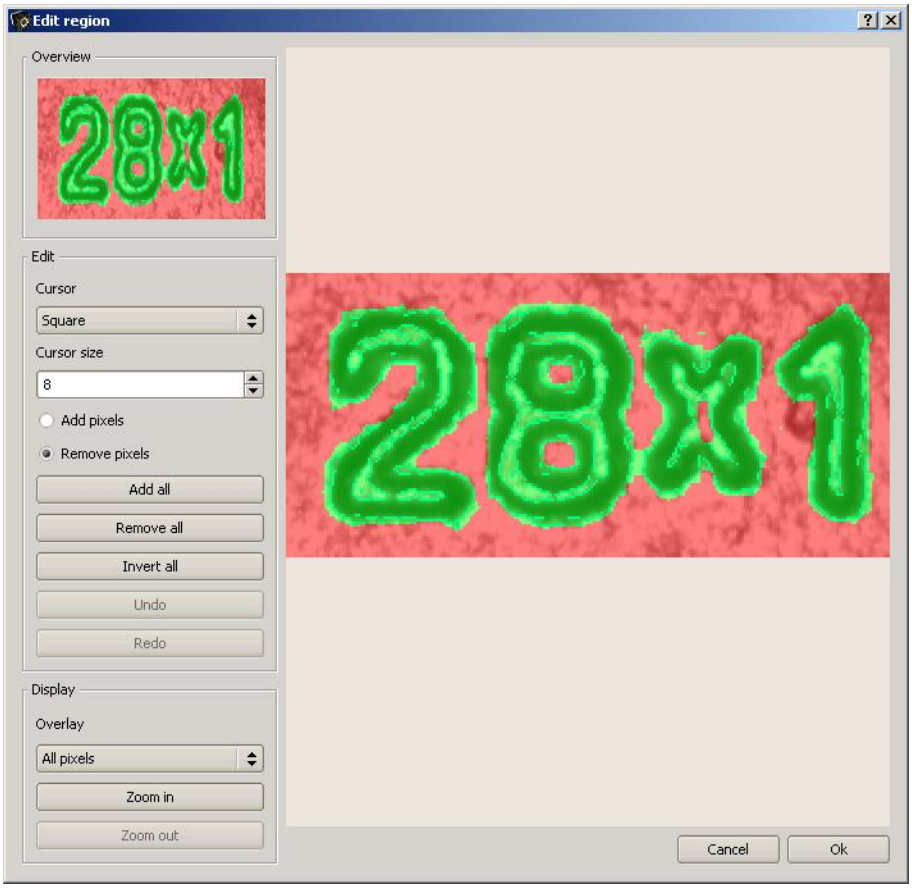


Fig. 61: Mask

Parameter	Function
Cursor (shape)	Changing shape of the cursors (Sqare, circle or line). With setting: "Cursor = Line" and pushed shift- key the angular position of the line changes in steps of 15°.
Cursor size	Changing size of the cursors
Add pixels / Remove pixels	Select if the cursor adds or removes pixels
Add all	Adds all pixels
Remove all	Removes all pixels
Undo	Undo function – last action
Redo	Redo function – for last undo action
Display	Select a display mode

By the flexible selection of cursor- shape and size, as well as if an action adds or removes pixels, complex geometric or free shaped search regions can be defined in a simple and quick manner. This regions are included = relevant (=green), or excluded (=red) in the search area.

To use the function „Mask" the following settings are necessary for the different detector types

Detector type	Necessary setting to use the function „Mask"
Pattern matching	Generally possible with „Edit pattern"
Contour	Generally possible with „Edit contour"
Contrast	Search region „Free shape"
Brightness	Search region „Free shape"
Grey	Search region „Free shape"

4.6.3.4 Detector Contour

This detector is suitable for detection of samples from edges at any angle.

Next Topic:Contrast detector (Page 71)

Settings in Scaling tab: (Page 69)

Settings in Angle tab: (Page 69)

Contour application: (Page 70)

Function: Mask (Page 64)

The contours of an object in the search area are taught and stored in the sensor. In Run mode the sensor searches the position of the best fit with the taught contour. If the fit is higher than the selected threshold the result is positive. The function contour detection can work incomplete 360° angular detection mode. So the object can be rotated in any angle. The angular settings must be set accordingly.

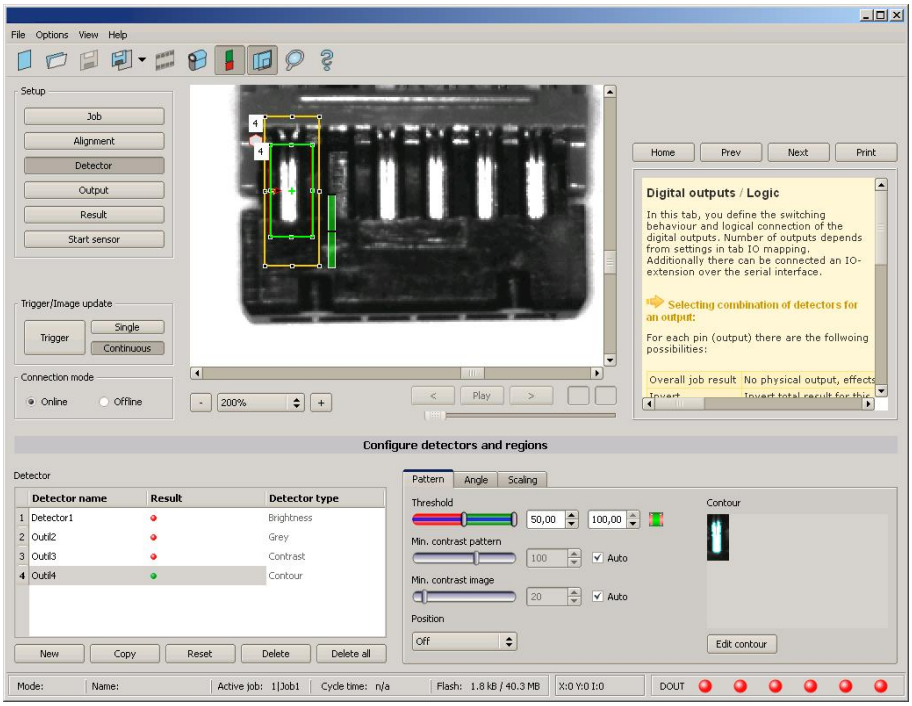


Fig. 62: Detector contour, tab pattern

The in the below, right corner in pale blue shown edges (high contrast changes in the image) have been identified and drawn because of the before made parameter settings. The found edges / contour can be influenced by changing these parameters, or by the function “Edit contour”. The Vision Sensor now searches this contour in the search area (yellow frame).

4.6.3.4.1 Settings in tab pattern:

Parameters	Functions
Threshold Min/Max	Zone for required concordance of found contour with taught contour.
Min. contrast pattern	Minimum contrast required with taught model for an edge to be detected as one.
Min. contrast image	Minimum contrast required in current image for an edge to be accepted as one.
Position check	Checks whether the sample found is in the right position. If position check is activated, the authorised zone for the position of the found parameter is shown in a blue frame (either rectangular or elliptic). The centre (green cross) of the parameter found must be situated inside the blue frame.
Pattern	Taught sample with display of the edges found
Edit contour	By edit contour there can be masked out parts of the search area. The parts which are not relevant for this examination can be painted out like using an eraser. Masks can also be inverted, means that parts which are interesting can be marked. S. also chap.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimisation:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary. Please note: The contour is found as long as the centre point of the pattern is inside the search area!
- Search zone for angle only as large as necessary
- Search zone for scale only as large as necessary
- Reduce resolution to CGA instead of VGA (Attention: Global parameter, affects all detectors!)
- Set "accurate – fast" to fast
- Increase value "Min. contrast pattern". Take care that the relevant contours are still visible in the display.
- Increase value "Min. contrast Image".
- Especially in case of alignment: Use alternate reference pattern. E.g. with higher contrast, that "Min. contrast pattern" and Min. contrast image" can be increased.

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Search zone for angle sufficiently large?
- Search zone for scale sufficiently large?
- Contrasts for model and image suitably set? (for model visible in sample)
- Set "accurate – fast" to accurate
- Are there some and overlapping objects in the image?
- Distinctive edges available?, re-teach if necessary
- "Min. contrast pattern" set to a suitable value? If in the taught pattern the relevant contour lines are not shown completely: decrease "Min. contrast pattern". If there are too many contour lines shown: increase "Min. contrast pattern".
- "Min. contrast image" set to a suitable value for the current image? If the current image(s) do have a higher / lower contrast than the taught reference image /pattern please increase / decrease the value of "Min. contrast image" accordingly.
- In the taught pattern the relevant contour lines are not shown completely: decrease "Min. contrast pattern". If there are too many contour lines shown: increase "Min. contrast pattern".
- If found at wrong position: use distinct sample, re-teach if necessary
- If the result value is fluctuating strongly from image to image? Take care that there are no "false edges" taught (edges because of shadows, or fragments of contours, which are not desired in the contour model): This can be achieved by increasing "Min. contrast pattern" or by eliminating those false edges by function "Edit contour".

4.6.3.4.2 Function: Edit contour

s. chap.: Detector Pattern matching Function: Mask

4.6.3.4.3 Settings in Angle tab:

Detector Contour (Page 66)

Settings in Scaling tab: (Page 69)

Contour application: (Page 70)

Function: Mask (Page 64)

Parameters	Functions
Angular zone	Angular zone in which search is carried out
Increment (angle)	Sensitivity of search throughout the selected angular zone in °
Accurate - fast	Candidates with score less than indicated will already be rejected during search. High value: early rejection = quicker = riskier Small value: late rejection = slower = less risky In case of false results this value can be decreased.

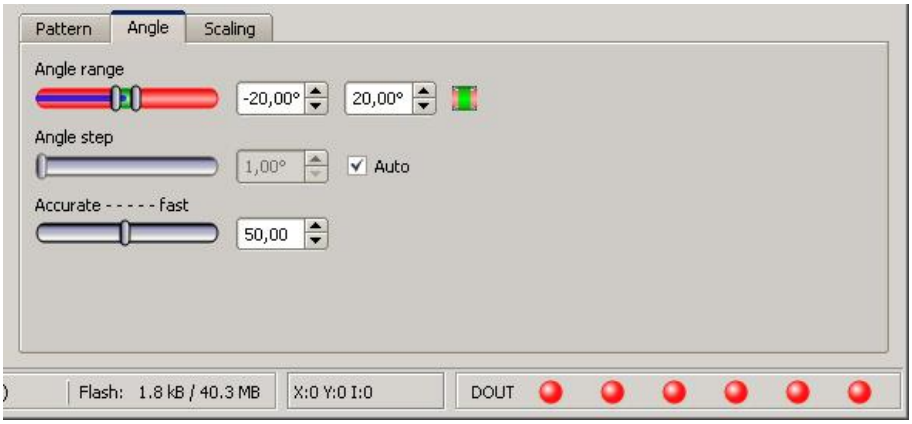


Fig. 63: Detector contour, tab angle

4.6.3.4.4 Settings in Scaling tab:

Detector Contour (Page 66)

Settings in Scaling tab: (Page 69)

Contour application: (Page 70)

Function: Mask (Page 64)

Parameters	Functions
Scale min/max	Detection also of enlarged or reduced objects in a given scale range

Increment scale	Sensitivity of search throughout the selected scale range
Accurate - fast	Number of search levels / Coarsening levels. 0 = automatic selection Higher value: faster = riskier (overlook candidates) Smaller value: slower = less risky (all candidates)

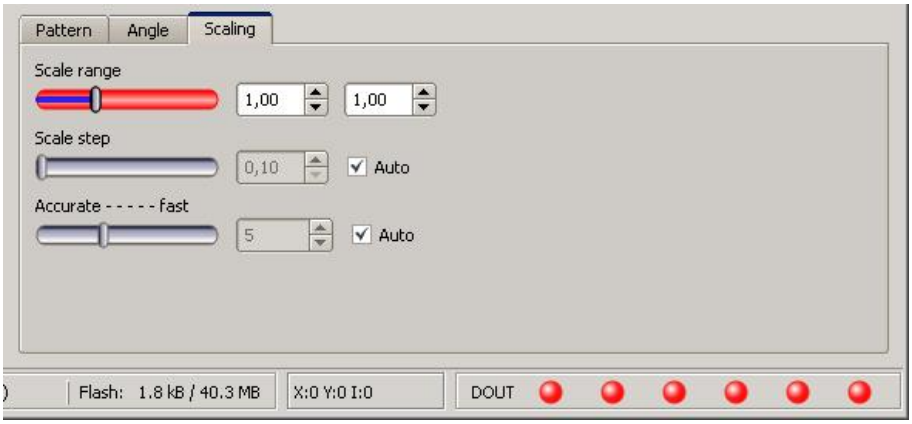


Fig. 64: Detector contour, Scaling tab

4.6.3.4.5 Contour application:

The visible edges / contour of metal contact mounted in a black plastic housing are taught as the reference contour. In this way the presence and the correct mounting of the contact is checked.

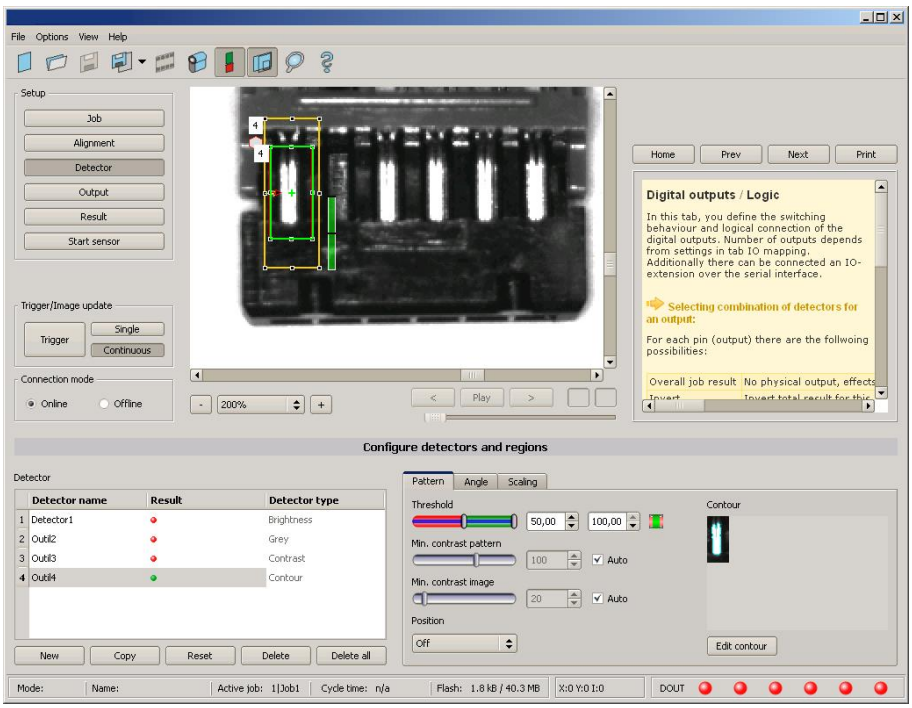


Fig. 65: Contour, application example, positive result

The found contour lines are displayed in the corner below right in pale blue. The contact is found reliably.

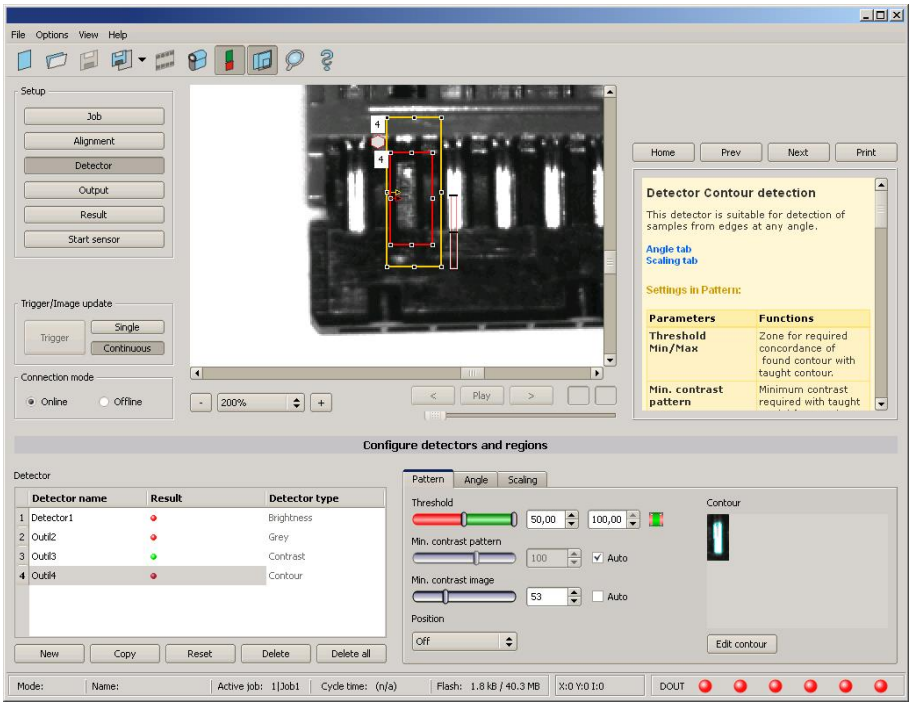


Fig. 66: Contour, application example, negative result

If now the same contour check is made at a position of the object where the metal contact is missing, the according edges / contour is not found. The detector gives a negative result.

4.6.3.5 Contrast detector

Next topic: Grey detector (Page 74)

Contrast application (Page 72)

This detector determines the contrast in the selected search area. Therefore all pixels inside the search area are evaluated with its grey value and the contrast value is calculated. If the contrast value is inside the limits set in parameter threshold the result is positive. The position of the single bright or dark pixels here is not relevant. The contrast is just depending on the bandwidth between darkest and brightest pixels and their quantity. Highest contrast value with 50% grey value “0” (= black) AND 50% grey value “255” (=white)

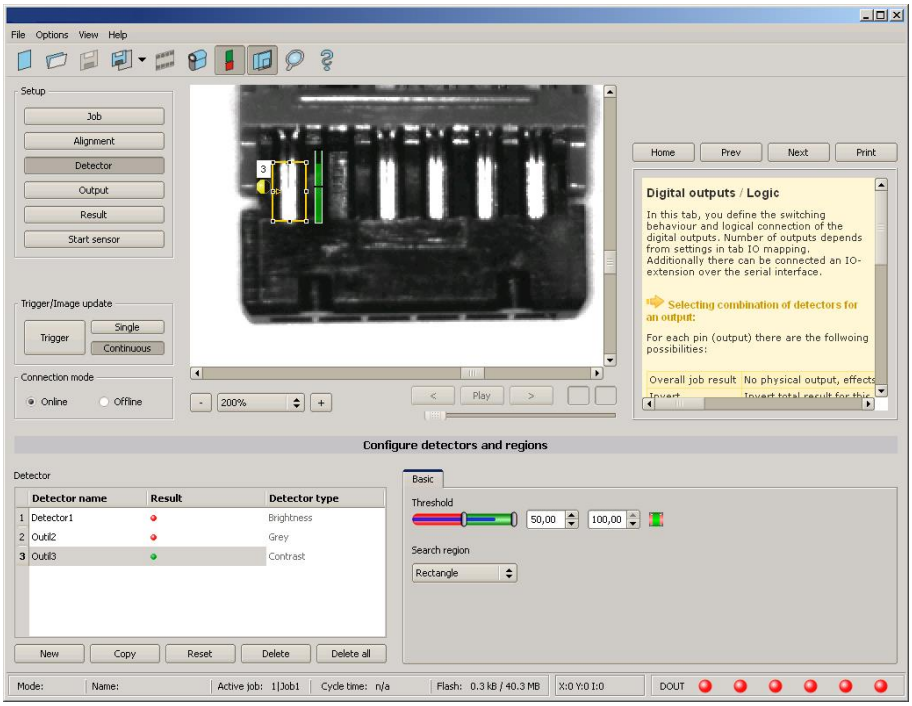


Fig. 67: Detector Contrast

Settings in tab Contrast:

Parameters	Functions
Threshold min/max	Range of contrast accepted.
Search region	Shape of search region can be set as Rectangle or Circle.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

4.6.3.5.1 Contrast application

Contrast detector (Page 71)

In the example the presence of a metal contact is checked with a contrast detector.

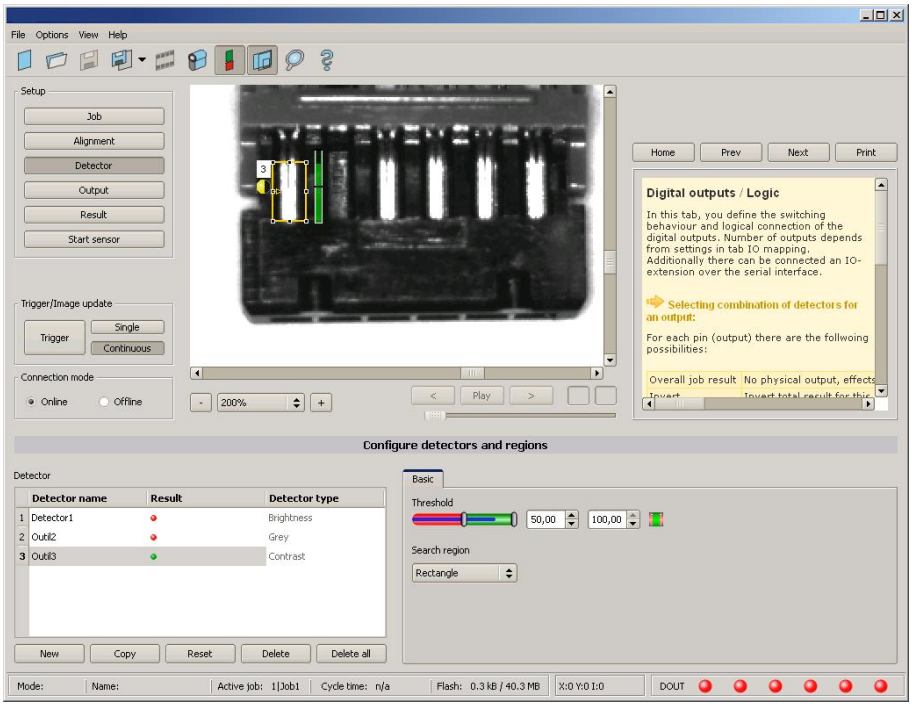


Fig. 68: Contrast, application example, positive result.

The presence of a shiny metal contact, in the middle of a surrounding black plastic housing, is checked with a contrast detector. As in this configuration contrast is pretty high the contrast detector delivers a high score, and in combination with alignment the whole job works reliably.

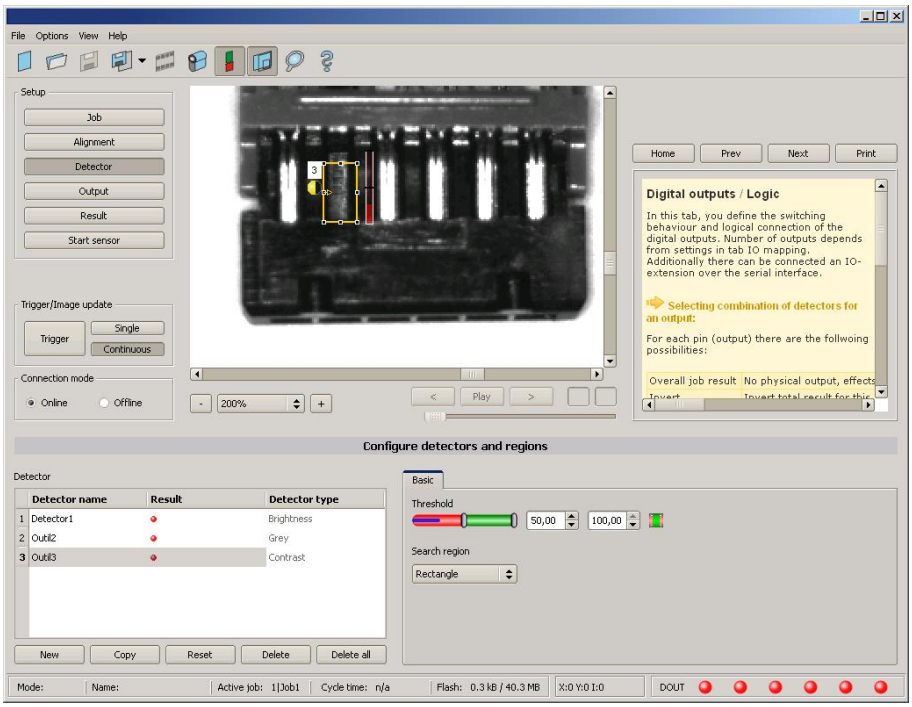


Fig. 69: Contrast, application example, negative result

If the same detector is placed now at a position where the metal contact is missing it leads to a negative result. As, between the black surrounding and the now visible black background of the contact, the contrast value here is low.

Function detector Contrast

The dark and the bright pixels are evaluated according to their amount and their intensity / brightness.

The position of the bright or dark pixels is not relevant.

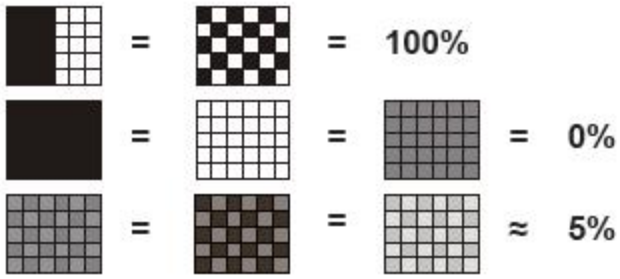


Fig. 70: Contrast examples

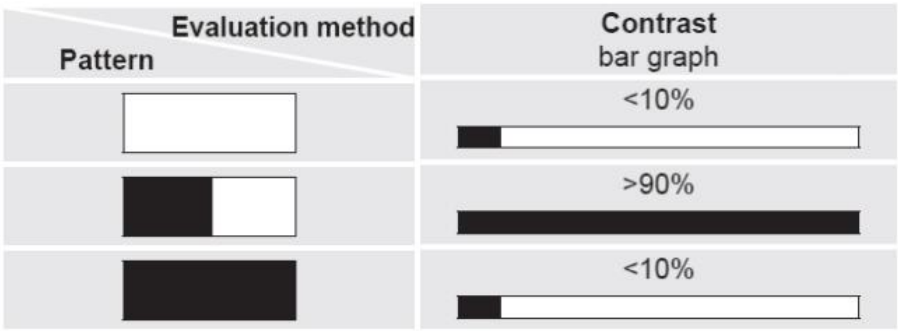


Fig. 71: Contrast explanation

4.6.3.6 Grey detector

Next topic. Brightness detector (Page 77)

Grey level application (Page 75)

At this detector in the first step the range of accepted grey values is defined by setting the two limit sliders of parameter “Grey level”.

In the second step the share of the search area (in %) which must be covered by pixels with the grey value inside the definition made in step 1, is defined with the parameter “Threshold” to achieve a positive result.

By the respective invert function all possible combinations can be defined, also those where the relevant grey values are only at the upper or lower border of the range of values. The position of the respective brought or dark pixels is not relevant.

With the parameter „Overlay“ pixels can be marked in a certain colour as an aid to select pixels / regions, which have a grey value inside (valid pixels), or outside (invalid pixels) the range set in „Grey level“. In this way pixels which are not covered with the settings / range of grey values can be detected very easily.

4.6.3.6.1 Settings in tab Grey:

Parameters	Functions
Grey level min/max	Range of grey values that are to be accepted
Threshold min/max	Percentage of the area, which must be in the selected grey value range
Search region	Shape of search region can be set as Rectangle or Circle.
Overlay	Selects which pixels are to be marked in colour on the screen as an adjustment aid. "None" = no marking, or “Valid pixels” or “Invalid pixels” are marked in the image.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

4.6.3.6.2 Grey level application

Grey detector (Page 74)

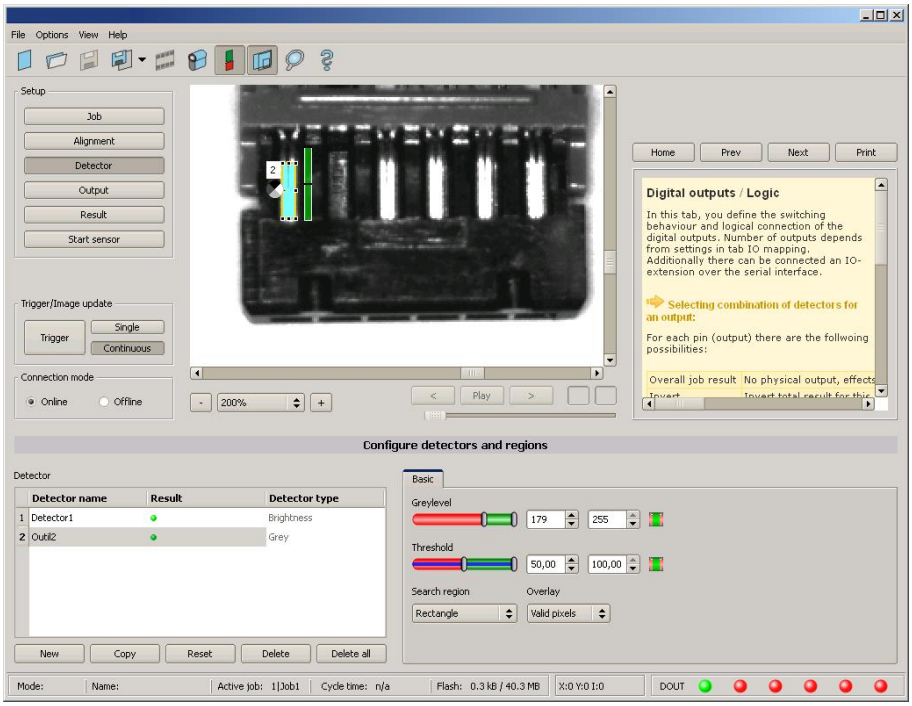


Fig. 72: Grey level, application example, positive result.

The contact is present in search area. Shiny metal contact shows grey values > 192, that means inside the limits of threshold = result positive.

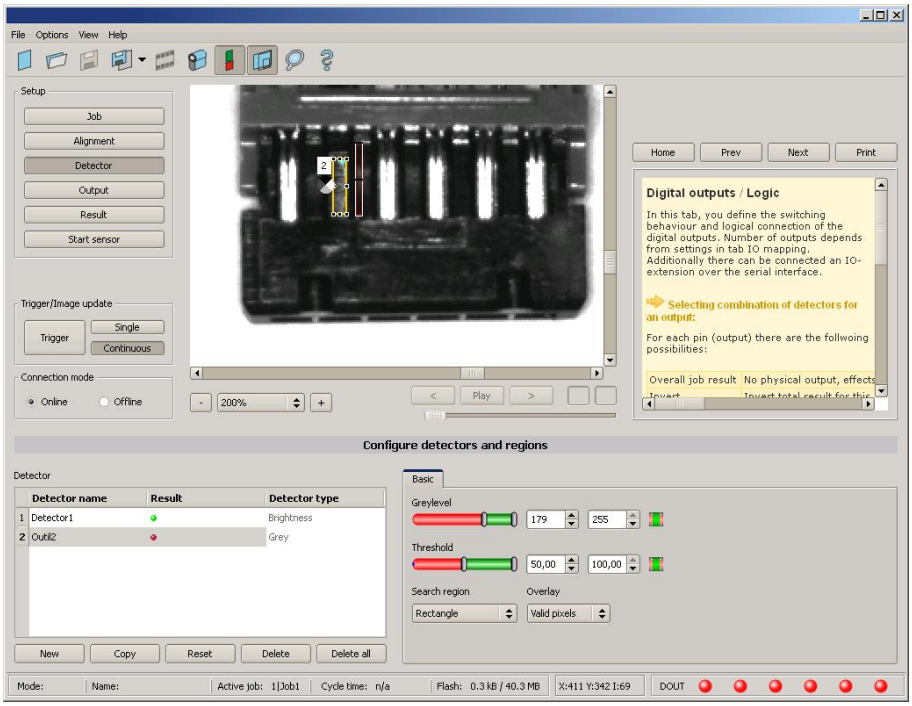


Fig. 73: Grey level, application example, negative result

Shiny metal contact is not present in the search area. That means average value of grey values in the search area is not inside the defined threshold limits. (Not inside grey value 192-255, but rather in range < 50). Result: negative = contact not found.

Aid to determine grey values:

By placing the cursor somewhere in the image the according X- and Y- coordinate and the grey value ("I" = Intensity) are displayed in the status line on the screen below in the next to last field at the right.

Function detector Grey level.

The authorised grey value range is defined by the two limits on the grey level slider.

All pixels within this grey value range and within the defined working zone (yellow frame) are added together. The proportion of the number of all the pixels in the working zone (yellow frame) and of the number of pixels in the authorised grey value range represents the result of this detector.

If this result is within the limits set on the switching threshold slider, the result is positive. The position of the grey value pixels on the screen is of no importance.

Example: (when the grey level slider is set to very dark values):

Both images produce exactly the same result with the grey level detector, as in each case 9 of the 25 pixels are detected as dark.

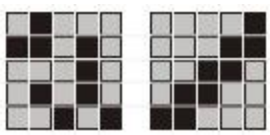


Fig. 74: Grey level, example 1

If the threshold value was set to 10 in this example, the following images would produce a positive result.

Fig. 75: Grey level, example 2

4.6.3.7 Brightness detector

Next topic: Barcode detector. (Page 79)

Brightness application (Page 77)

This detector determines the average value of the grey values in the search area. With the two limit sliders of the parameter „Threshold“ the valid range of the brightness mean value is defined.

As soon as the calculated average value is within these two limits the result is positive. The result value is standardized to %. The position of the bright or dark pixels is not relevant. If there are position deviations from check to check the alignment function must be used.

Settings in tab Brightness:

Parameters	Functions
Brightness min/max	Range of grey values that are to be accepted
Search region	Shape of search region can be set as Rectangle or Circle.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

4.6.3.7.1 Brightness application

The detector Brightness calculates the average value of the grey values of all pixels within the search area.

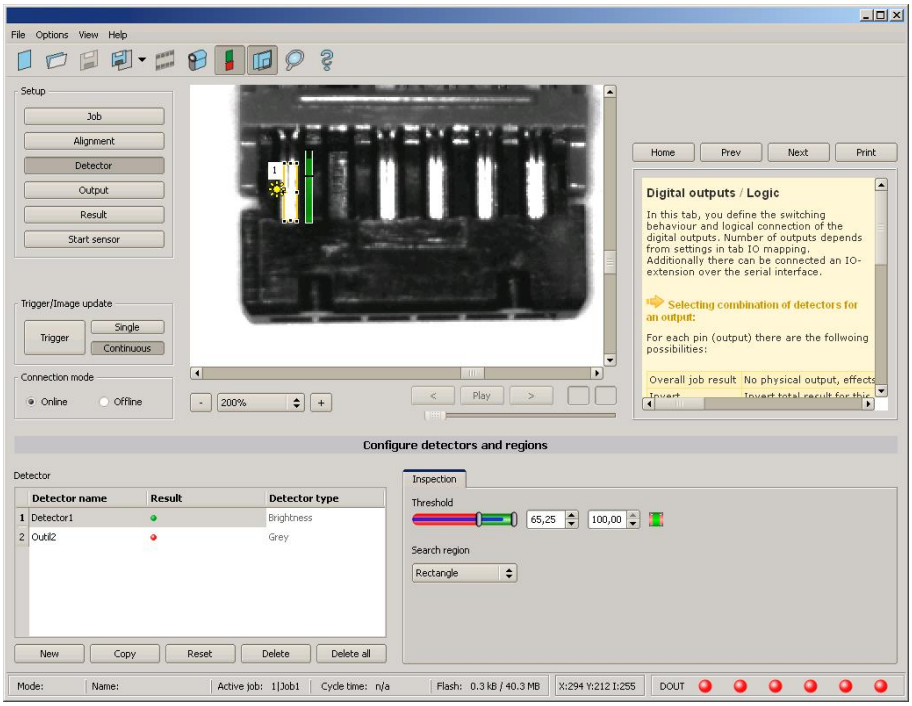


Fig. 76: Brightness, application example, positive result.

The contact is present within the position searched for; therefore the average value of the grey values in the search area has a high score (near 100%). That means the current value is within the requested threshold limits and the result is positive = contact present.

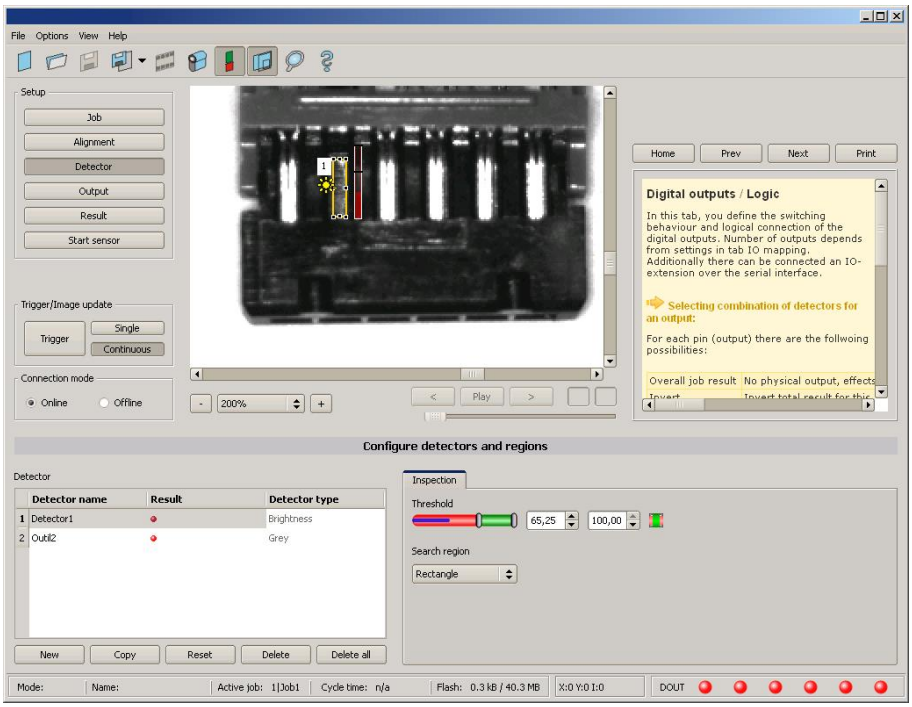


Fig. 77: Brightness, application example, negative result.

The contact is not present within the position searched for; therefore the average value of the grey values in the search area delivers a low score (near 0%). That means the current value is not within the requested threshold limits and the result is negative = contact not present.

Examples: Brightness value as average value of the grey values.

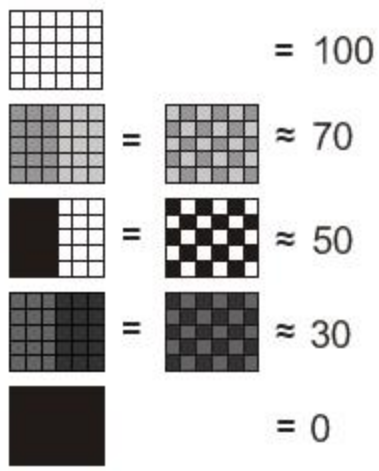


Fig. 78: Brightness, examples

4.6.3.8 Barcode detector.

Next topic: 2D Code detector (Page 86)

Barcode detector, tab Reference string (Page 80)

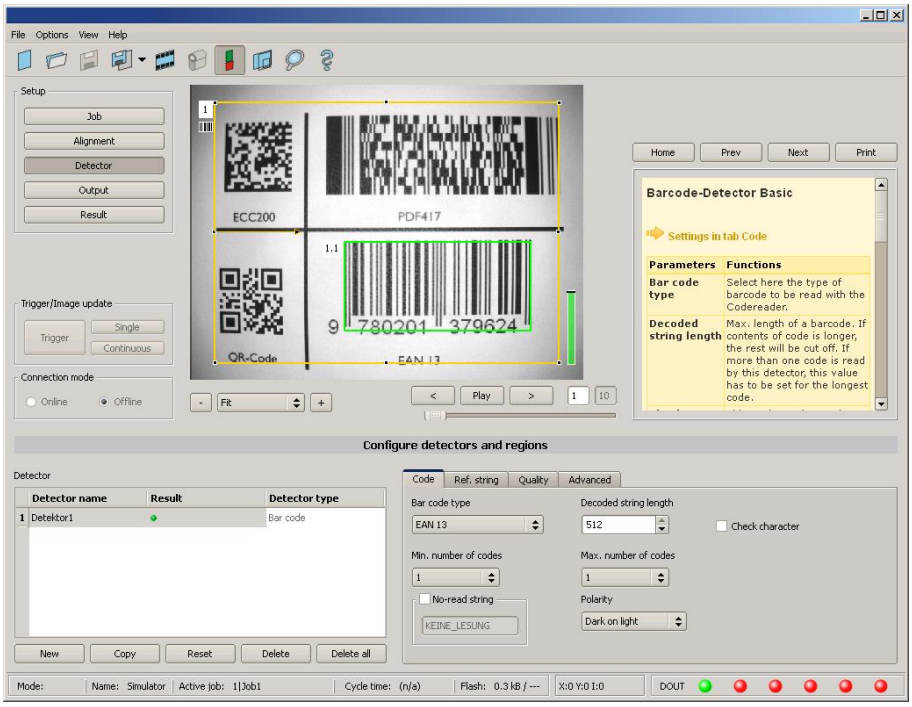


Fig. 79: Detector Barcode, tab Code

4.6.3.8.1 Barcode detector, tab Code

Settings in tab Code

Parameters	Functions
Bar code type	Select here the type of barcode to be read with the Code reader.
Decoded string length	Max. Length of a barcode. If contents of code are longer than this value, the rest will be cut off. If more than one code is read by this detector, this value has to be set for the longest code.
Check character	This setting activates the processing for a check character in case it is part of the code. Barcodes with check characters are e.g. Code 39, Codabar, 25 Industrial or 25 Interleaved. If this setting is not activated, the check character will be given out with the normal result string.
Min. number of codes	Minimum number of codes to be read inside the search area.
Max. number of codes	Maximum number of codes to be read inside the search area. If this value is set higher than necessary, the reading time may increase slightly.
No-read string	Specifies the text, which is given out over the interfaces in case of non successful reading.
Polarity	Specifies printing of code "black on white" or "white on black".

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimisation:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set? (for model visible in sample)
- Are thresholds set correctly?

4.6.3.8.2 Barcode detector, tab Reference string

Next topic: Barcode detector. (Page 79)

Barcode detector, tab Quality (Page 82)

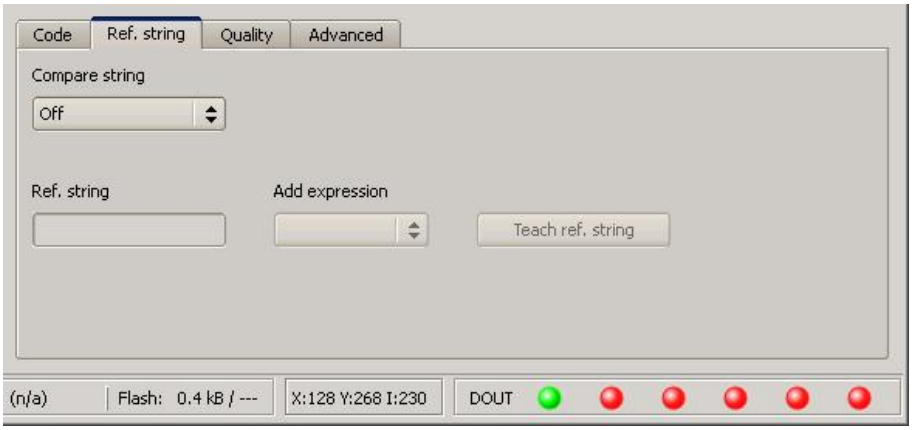


Fig. 80: Detector Barcode, tab Reference string

Settings in tab Reference String

Parameters	Functions
Compare string	Activates verification of contents of the result information. The verification is done by using of regular expressions.
Ref. string	This text or regular expression is taken for verification. Here can be entered characters or regular expressions.
Add expression	Opens a list with examples for regular expressions.
Teach ref. string	Reads the code under the code reader and takes the contents of this code as a reference string. This text can be changed later.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Examples for reference strings specified by regular expressions:

Reference string	Hit	Example for hit
123	String containing 123	01234
\A123	String beginning with 123	1234
123\Z	String ending by 123	0123
\A123\Z	String matching exactly 123	123
[123]	String containing one of the characters	33
[123]{2}	String containing sequence of the characters of length 2	23
[12]|[34]	String containing a character of one of both groups	4

Most important elements of regular expressions:

^ or \AMatches start of string

$ or \ZMatches end of string (a trailing newline is allowed)

.Matches any character except newline

[...]Matches any character listed in the brackets. If the first character is a '^', this matches any character except those in the list. You can use the '-' character as in '[A-Z0-9]' to select character ranges. Other characters lose their special meaning in brackets, except '\'.

*Allows 0 or more repetitions of preceding literal or group

+Allows 1 or more repetitions

?Allows 0 or 1 repetitions

{n,m}Allows n to m repetitions

{n}Allows exactly 'n' repetitions

|Separates alternative search expressions

4.6.3.8.3 Barcode detector, tab Quality

Barcode detector, tab Reference string (Page 80)

Barcode detector, tab Advanced (Page 84)

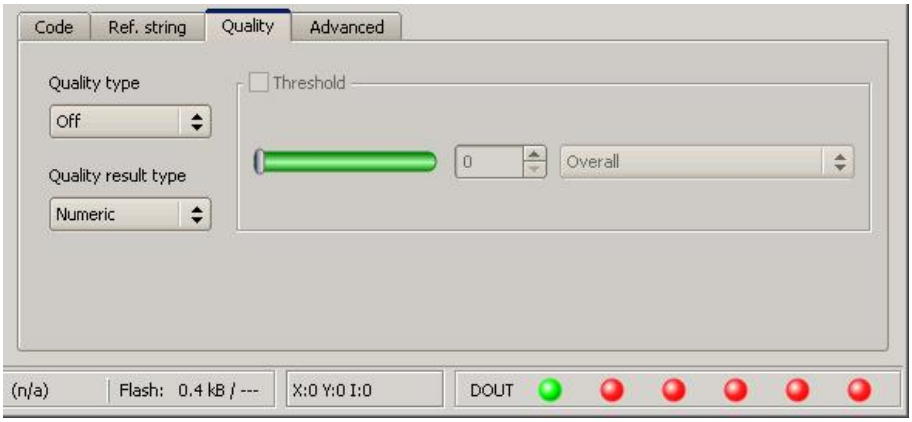


Fig. 81: Detector Barcode, tab Quality

Settings in tab Quality

Parameters	Functions
Quality param.	Evaluation of printing quality according to international standard ISO/IEC 15416. In order to achieve an evaluation according to the norm, there are defined minimum requirements for the size of the code inside the camera image (resolution) and mounting of camera and illumination. These requirements are specified inside the norm. For simple 1D Barcodes, the rating of printing quality is combined in a total of eight elements: Q1 Overall Q2 Decode Q3 Symbol Contrast Q4 Minimal Reflectance

	Q5 Minimal Edge contrast Q6 Modulation Q7 Defects Q8 Decodability "Overall" is rating the total quality, the further elements give information about possible reasons for a reduced quality. Inside ISO/IEC15416 there is a list with common defects and their influence to the single grades. The single quality grades are defined as follows: "Overall" is the minimum value of all other grades. "Decode" has value 4 when the code was read and value 0 when the code was not read. "Symbol contrast" is the difference between minimum and maximum reflexion value of greyscale, better contrast gives better grading. "Minimal reflectance" is set to 4 if the lowest reflectance value in the scan reflectance profile is lower or equal to 0.5 of the maximal reflectance value. Otherwise a value of 0 is assigned. "Edge contrast" is the contrast between any two adjacent elements, either bar-to-space or space-to-bar. The "minimal edge contrast" grades the minimum of the edge contrast values measured in the reflectance profile. "Modulation" indicates how strong the amplitudes of the bar code elements are. Big amplitudes make the assignment of the elements to bars or spaces more certain, resulting in a high modulation grade. "Defects" is a grading of reflectance irregularities found within elements and quiet zones. "Decodability" grade reflects deviations of the element widths from the nominal widths defined for the corresponding symbology. "Additional requirements" are bar code symbology specific requirements: mostly regarding the required quiet zones, but sometimes it can be also related to wide/narrow ratio, inter character gaps, guarding patterns or further symbology specific characteristics. For composite codes, the rating has 24 grades: OVERALL: Q1 Overall Q2 Overall Linear Q3 Overall Composite LINEAR: Q4 Decode Q5 Symbol Contrast Q6 Minimal Reflectance Q7 Minimal Edge contrast Q8 Modulation Q9 Defects Q10 Decodability Q11 Additional Requirements COMPOSITE: Q12 Decode Q13 Rap Overall COMPOSITE RAP: Q14 Contrast Q15 Minimal Reflectance Q16 Minimal Edge Contrast

	Q17 Modulation Q18 Defects Q19 Decodability Q20 Codeword Yield Q21 Unused Error Correction Q22 Modulation Q23 Decodability Q24 Defects The "overall" grade in the group OVERALL is the final symbol grade to be reported. It is just the lower from the other two in the group: "overall linear" and "overall composite", which are the overall grades of the linear and the composite sub symbols, respectively. The other two groups, "LINEAR" and "COMPOSITE", contain the corresponding individual grades for both sub symbols, and give information for possible causes for poor quality of the symbol. The grades in the "LINEAR" group correspond to those for the simple 1D bar code case, described above. The grades in the "COMPOSITE" group correspond to the grades for a PDF 417 data code symbol, where "rap overall" is called after the specific, so-called RAP, start/stop pattern of Composite symbols. Additionally, the sub group "COMPOSITE RAP" expands the individual grades for the reflectance profile of the RAP patterns. The RAP grades are consistent with the grades for the simple 1D bar code case explained above.
Quality type	There are existing two possibilities, to display quality parameters. Both are according to the norm. The grades can be given in values from A to F or from 4 to 0. A and 4 are the best possible grades. This setting determines how the grades should be displayed. It affects the display on screen as well as the output over the interfaces. The assignment is the following: ABCDF 43210

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

4.6.3.8.4 Barcode detector, tab Advanced

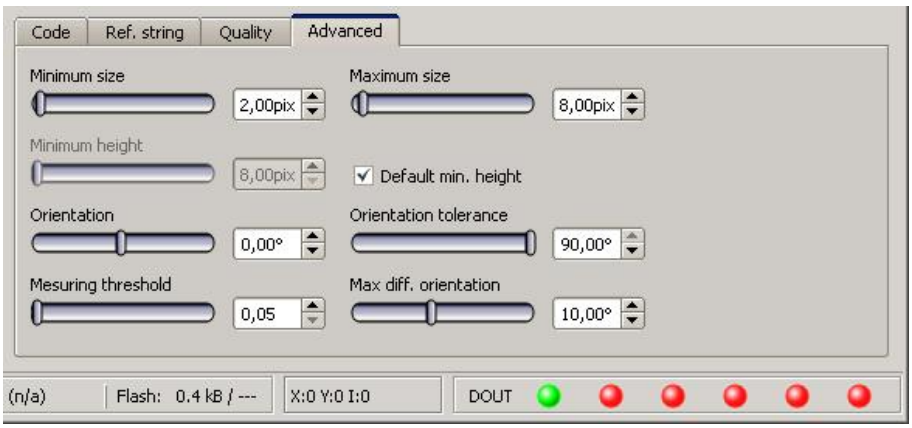


Fig. 82: Detector Barcode, tab Advanced

Settings in tab Advanced

Parameters	Functions
Minimum Size	Minimal size of bar code elements, i.e. the minimal width of bars and spaces. For small bar codes the value should be reduced to 1.5. In the case of huge bar codes the value should be increased, which results in a shorter execution time.
Maximum Size	Maximal size of bar code elements, i.e. the maximal width of bars and spaces. This value should be adequate low such that two neighbouring bar codes are not fused into a single one. On this other hand the value should be sufficiently high in order to find the complete bar code region.
Minimum height	Minimal bar code height. In the case of a bar code with a height of less than 16 pixels the respective height should be set by the user. Note, that the minimal value is 8 pixels. If the bar code is very high, i.e. 70 pixels and more, manually adjusting to the respective height can lead to a speed-up of the subsequent finding and reading operation.
Orientation	Expected bar code orientation. If the bar codes are expected to appear only in certain orientations in the processed images, one can reduce the orientation range adequately. This enables an early identification of false candidates and hence shorter execution times. This adjustment can be used for images with a lot of texture, which includes fragments tending to result in false bar code candidates.
Orientation tolerance	Orientation tolerance. See the explanation of 'orientation' parameter.
Measuring threshold	The bar-space-sequence of a bar code is determined with a scan line measuring the position of the edges. In the case of disturbances in the bar code region or a high noise level, this value should be increased.
Max. diff orientation	A potential bar code region contains bars, and hence edges, with a similar orientation. This value denotes the maximal difference in this orientation between adjacent pixels and is given in degree. If a bar code is of bad quality with jagged edges this parameter should be set to bigger values. If the bar code is of good it can be set to smaller values, thus reducing the number of potential but false bar code candidates.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

4.6.3.8.4.1 Optimisation:

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set? (for model visible in sample)
- Are thresholds set correctly?
- Code size sufficient in the field of view?
- Width of barcode line sufficient?

4.6.3.9 2D Code detector

4.6.3.9.1 2D Code detector, tab Code

Next topic:

2D Code detector, tab Ref. String (Page 87)

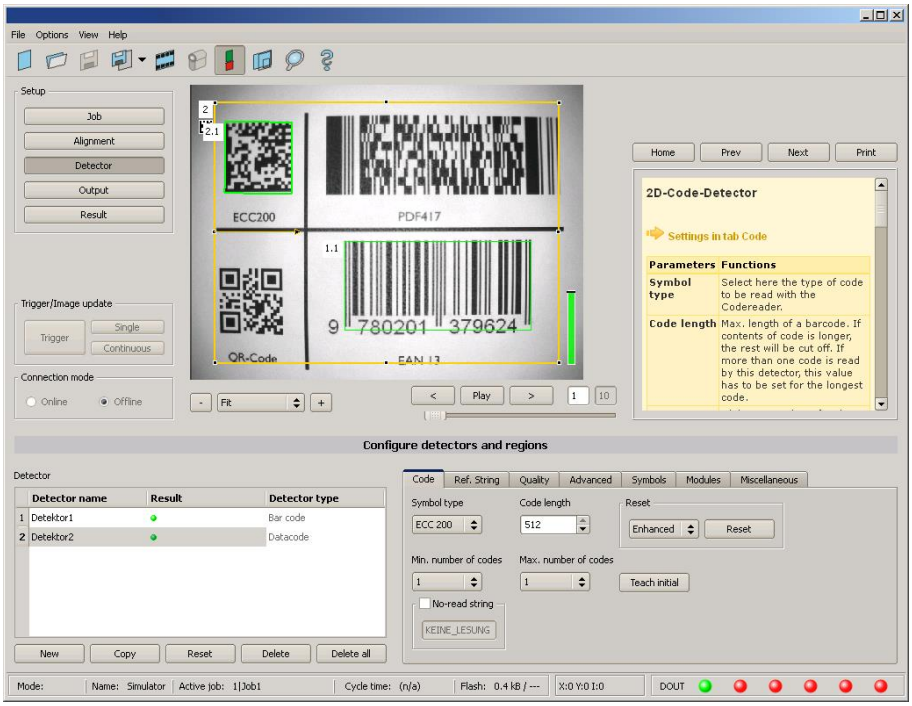


Fig. 83: Detector 2D Code, tab Code

Settings in tab Code

Parameters	Functions
Symbol type	Select here the type of code to be read with the Code reader.
Code length	Max. Length of a barcode. If the contents of code are longer, the rest will be cut off. If more than one code is read by this detector, this value has to be set for the longest code.
Min. number of codes	Minimum number of codes to be read inside the search area.
Max. number of codes	Maximum number of codes to be read inside the search area. If this value is set higher than necessary, the reading time may increase slightly.
Reset	Reset parameters are for setting the code reading parameters back to the default state before teaching. There can be selected "standard", "enhanced" and "maximum". "Standard" is setting the default parameters in a way that most of the codes can be read. If your code can not be read, please use setting "Enhanced". If the code still cannot be read, use setting

	"Maximum". Settings "Enhanced" and "Maximum" may increase the reading time. This reset function is only for resetting the detector parameters, not for resetting of other settings outside the detector (i.e. general settings like illumination, in-outputs, serial settings etc.). After resetting the parameters, there can be made an initial teach, again
Initial teach / Additive teach	Teach: the region of interest is searched for codes. If a code was found the parameters are set for this code. After successful teaching, the code will be marked with a green frame. After teaching a code the code reader will search in "run"-mode only for this type of code. Once teaching was done at least one time successful, this button is named "Teach additive". "Teach additive" is for extending the parameters either in order to read several different codes in one detector or in order to cover differences in printing quality.
No-read string	Specifies the text, sent out over the interfaces in case of non successful reading.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Optimisation

Execution speed:

- Search zone for position (yellow frame) only as large as necessary

Robust detection:

- Search zone for position (yellow frame) sufficiently large?
- Contrasts for model and image suitably set? (for model visible in sample
- Are thresholds set correctly?

4.6.3.9.2 2D Code detector, tab Ref. String

2D Code detector (Page 86)Barcode detector. (Page 79)

Barcode detector, tab Quality (Page 82)

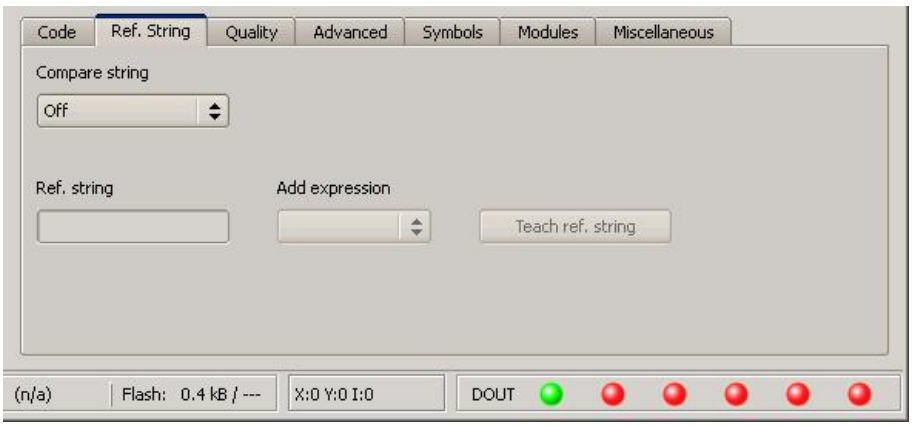


Fig. 84: Detector 2D Code, tab Ref. String

Settings in tab Reference String

Parameters	Functions
Compare string	Activates verification of contents of the result information. The verification is done by using of regular expressions.
Ref. string	This text or regular expression is taken for verification. Here can be entered characters or regular expressions.
Add expression	Opens a list with examples for regular expressions
Teach ref. string	Reads the code under the code reader and takes the contents of this code as a reference string. This text can be changed later.

For newly generated detectors, all parameters are preset as standard values, suitable for many applications.

Reference string	Hit	Example for hit
123	String containing 123	01234
\A123	String beginning with 123	1234
123\Z	String ending by 123	0123
\A123\Z	String matching exactly 123	123
[123]	String containing one of the characters	33
[123]{2}	String containing sequence of the characters of length 2	23
[12]|[34]	String containing a character of one of both groups	4

Most important elements of regular expressions:

^ or \AMatches start of string

$ or \ZMatches end of string (a trailing newline is allowed)

.Matches any character except newline

[...]Matches any character listed in the brackets. If the first character is a '^', this matches any character except those in the list. You can use the '-' character as in '[A-Z0-9]' to select character ranges. Other characters lose their special meaning in brackets, except '\'.

*Allows 0 or more repetitions of preceding literal or group

+Allows 1 or more repetitions

?Allows 0 or 1 repetitions

{n,m}Allows n to m repetitions

{n}Allows exactly n repetitions

|Separates alternative search expressions)

4.6.3.9.3 2D Code detector, tab Quality

2D Code detector, tab Ref. String (Page 87)

2D Code detector, tab Advanced (Page 90)

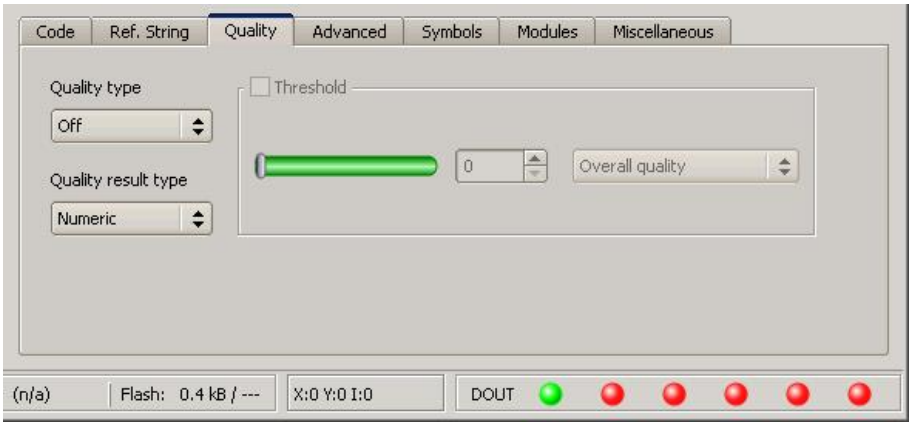


Fig. 85: Detector 2D Code, tab Quality

Settings in tab Quality

Parameters	Functions
Quality param.	Quality parameters are additional information for rating the printing quality of the code. There are two different standards: AIM DPM-1-2006 and ISO/IEC 15415. Quality parameters are eight single parameters, the definition of the respective elements is as follows: Q1 Overall quality Q2 Contrast Q3 Modulation Q4 Fixed pattern damage Q5 Decode Q6 Axial non-uniformity Q7 Grid non-uniformity Q8 Unused error correction Q9 Mean light The overall quality is the minimum of all individual grades. The contrast is the range between the minimal and the maximal pixel intensity in the data code domain, and a strong contrast results in a good grading. The modulation indicates how strong the amplitudes of the data code modules are. Big amplitudes make the assignment of the modules to black or white more certain, resulting in a high modulation grade. The fixed pattern of both ECC200 and QR Code is of high importance for detecting and decoding the codes. Degradation or damage of the fixed pattern, or the respective quiet zones, is assessed with the fixed pattern damage quality. The decode quality always takes the grade 4, meaning that the code could be decoded. Naturally, codes which cannot be decoded cannot be assessed concerning print quality either. Originally, data codes have squared modules, i.e. the width and height of the modules are

	the same. Due to a potentially oblique view of the camera onto the data code or a defective fabrication of the data code itself, the width to height ratio can be distorted. This deterioration results in a degraded axial non-uniformity. If apart from an affine distortion the data code is subject to perspective or any other distortions too this degrades the grid non-uniformity. As data codes are redundant codes, errors in the modules or code words can be corrected. The amount of error correcting capacities which is not already used by the present data code symbol is expressed in the unused error correction quality. In a way, this grade reflects the reliability of the decoding process. Note, that even codes with an unused error correction grading of 0, which could possibly mean a false decoding result, can be decoded in a reliable way, because the implemented decoding functionality is more sophisticated and robust compared to the reference decode algorithm proposed by the standard. In order to achieve an evaluation according to the norm, there are defined minimum requirements for the size of the code inside the camera image (resolution) and mounting of camera and illumination. These requirements are specified inside the norm. Quality parameters according to AIM DPM-1-2006 are a extension to ISO/IEC 15415 Standard, which define the requirements of the grey value conditions oft he image oft he data code, and so improves the reproducibility of the quality evaluation of different manufacturers. Quality parameters according to AIM consist of one value more than quality parameters according to ISO/IEC 15415. This value is called „Mean Light“. „Mean light“ is not a quality value of the code, it shows the quality of the image by calculating the average grey value of the bright data code modules. „Mean light“ can vary from 0.0 to 1.0. A image has the required grey value conditions if the „mean light“ value is between 70% and 86% (0.70 to 0.86).
Quality type	There are existing two possibilities, to display quality parameters. Both are according to the norm. The grades can be given in values from A to F or from 4 to 0. A and 4 are the best possible grades. This setting determines how the grades should be displayed. It affects the display on screen as well as the output over the interfaces. The assignment is the following: A B C D F 4 3 2 1 0

4.6.3.9.4 2D Code detector, tab Advanced

2D Code detector, tab Quality (Page 89)

2D Code detector, tab Symbols (Page 91)

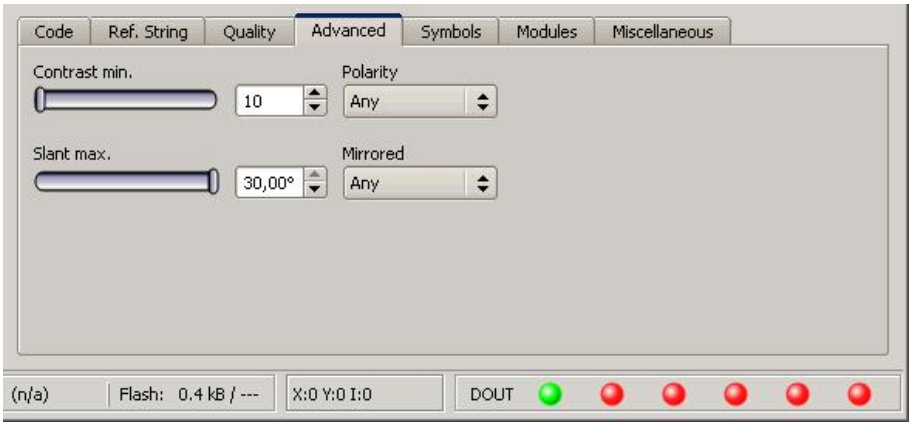


Fig. 86: Detector 2D Code, tab Advanced

Settings in tab Advanced

Parameters	Function
Contrast min.	Minimum contrast in grey values between bright and dark parts of the code, range (1...100).
Polarity	Possible restrictions concerning the polarity of the modules, i.e., if they are printed dark on a light background or vice versa.
Slant max.	Slant of the L-shaped finder pattern in radians. This is the difference between the angle of the 'L' and the right angle.
Mirrored	Describes whether the symbol is or may be mirrored (which is equivalent to swapping the rows and columns of the symbol). The function helps, if codes should be read through transparent parts like glass.

4.6.3.9.5 2D Code detector, tab Symbols

2D Code detector, tab Advanced (Page 90)

2D Code detector, tab Modules (Page 92)

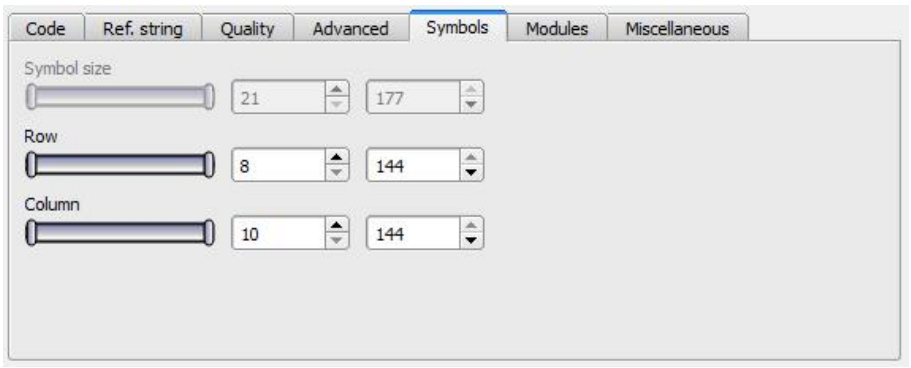


Fig. 87: Detector 2D Code, tab Symbols

Settings in tab Symbols

Parameters	Function

Symbol size	Only QR-Code: Size of symbol inside picture in pixel.
Row	Only ECC200 and PDF 417: Number of rows including finder pattern.
Column	Only ECC200 and PDF 417: Number of columns including finder pattern.

4.6.3.9.6 2D Code detector, tab Modules

2D Code detector, tab Symbols (Page 91)

2D Code detector, tab Miscellaneous (Page 92)

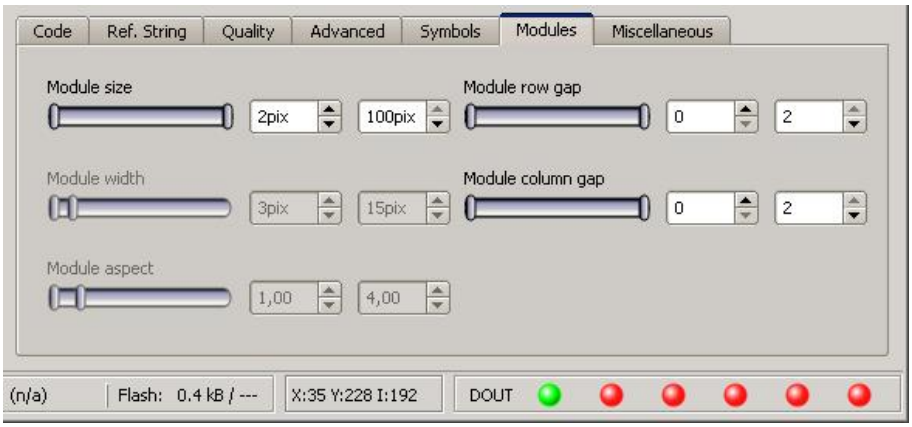


Fig. 88: Detector 2D Code, tab Modules

Settings in tab Modules

Parameters	Function
Module size	Size of modules in pixels.
Module width	Only PDF 417: width of modules inside picture in pixels.
Module aspect	Only PDF 417: minimum aspect of modules (rows compared to columns).
Module row gap	Only ECC200 and QR-Code: allowed gap between rows, i.e. at dot peened codes which have no full size modules.
Module column gap	Only ECC200 and QR-Code: allowed gap between columns.

4.6.3.9.7 2D Code detector, tab Miscellaneous

2D Code detector, tab Modules (Page 92)

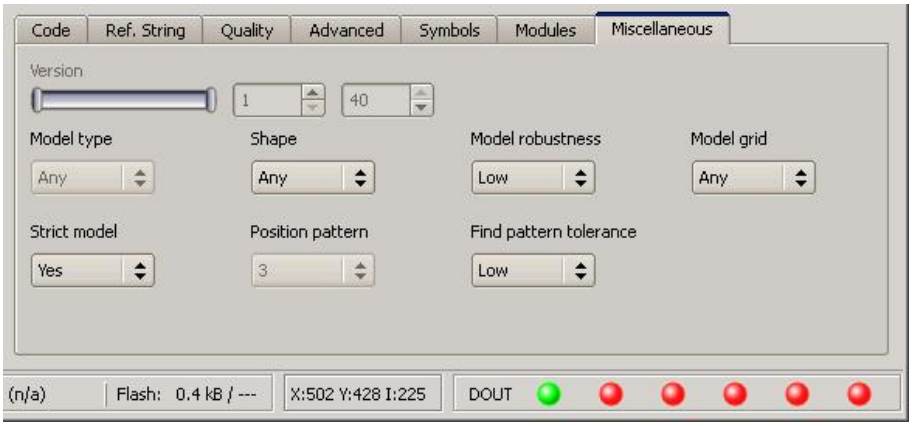


Fig. 89: Detector 2D Code, tab Miscellaneous

Settings in tab Miscellaneous

Parameters	Function
Version	Only QR-Code: Minimum symbol version to be read: [1. . . 40]
Model type	Only QR-Code: Type of the QR Code model specification: 1, 2, 0
Shape	Only ECC200 and QR-Code: Possible restrictions concerning the module shape (rectangle and/or square).
Model robustness	Robustness of the decoding of data codes with very small module sizes. Setting the parameter to 'high' increases the likelihood of being able to decode data codes with very small module sizes. Additionally, in that case the minimum module size should also be adapted accordingly, thus should be set to the expected minimum module size and width, respectively.
Model grid	Only ECC200: Describes whether the size of the modules may vary (in a specific range) or not. Dependent on the parameter different algorithms are used for the calculation of the module's centre positions. If it is set to 'fixed', an equidistant grid is used. Allowing a variable module size ('variable'), the grid is aligned only to the alternating side of the finder pattern. With 'any' both approaches are tested one after the other. Please note that the value of 'module_grid' is ignored if 'finder_pattern_tolerance' is set to 'high'. In this case an equidistant grid is assumed.
Strict model	Specifies, if the code parameters have to be meet completely or not. If this parameter is set to "Yes", all codes outside the parameter range will be ignored.
Position pattern	Only QR-Code: Number of position detection patterns that have to be visible for reading a code (2 or 3).
Find pattern tolerance	Only ECC200: Tolerance of the search with respect to a disturbed or missing finder pattern. The finder pattern includes the L-shaped side as well as the opposite alternating side. In one case ('low'), it is assumed that the finder pattern is present to a high degree and shows almost no disturbances. In the other case ('high'), the finder pattern may be heavily disturbed or missing completely without influencing the recognition and the reading of the symbol. Note, however, that in this mode the run-time may significantly increase.

4.6.4 Output of inspection results

Here you define the assignment and logical connection of the digital signal outputs as well as the interfaces and output data of your Vision Sensor.

I/O mapping (Page 94)

Output signals (Digital outputs / Logic) (Page 99)

Interfaces (Page 100)

Timing, Digital outputs (Page 101)

Telegram, Data output (Page 107)

4.6.4.1 I/O mapping

Here the following settings can be made:

1. Definition, if I/O is used as an input or output (Pin 05 - 08, can be used as input or output)
2. Assignment of functionality to inputs and outputs. In the list-box there can be seen and selected all available functions for this input or output. Some functions can be assigned only to one special input or output (e.g. HW/Trigger).

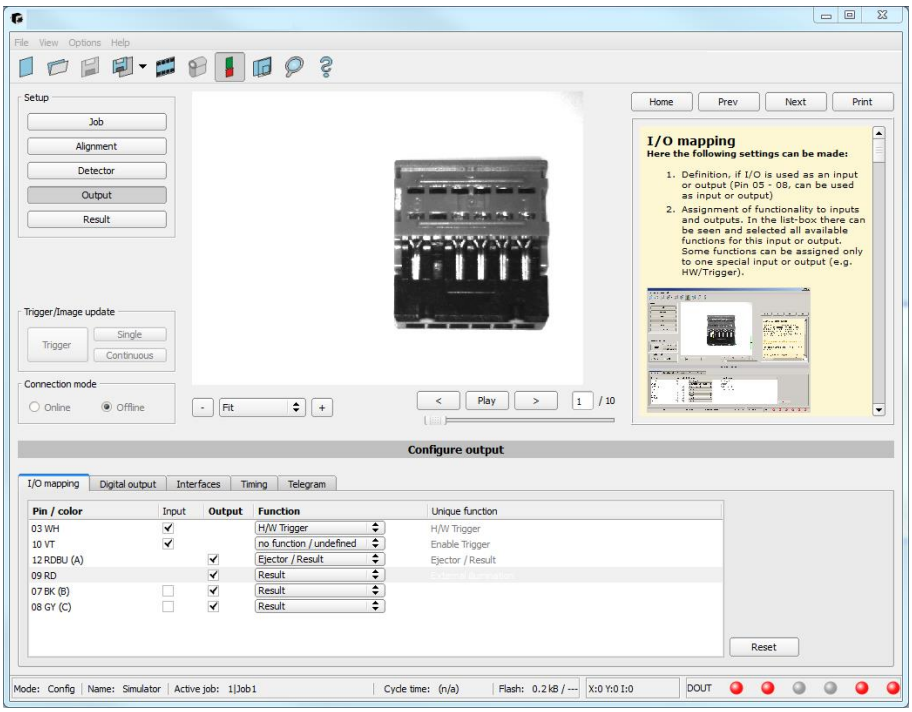


Fig. 90: Output, I/O Mapping

4.6.4.1.1 Functions of inputs

Function	Description
H/W Trigger	Hardware Trigger (only on pin 03 WH available)

Enable Trigger	Enable or disable trigger signals (input needs a minimum signal length of 2ms before raising trigger signal).
Job 1 … n	Job change by pulses on one input
Teach temp. / perm.	Teaching of all detectors and alignment. Rising edge on this input and trigger start teaching. Temporary: storage in RAM, permanent: storage in flash.
Job Pin 'X', binary coded	Job change by binary bit pattern. Up to 5 inputs can be used to select up to 32 jobs. PIN1 = LSB
No function, undefined	no function, not used

Functions which are used already are displayed in grey, because they cannot be used any more. All inputs need a minimum signal length of 2ms.

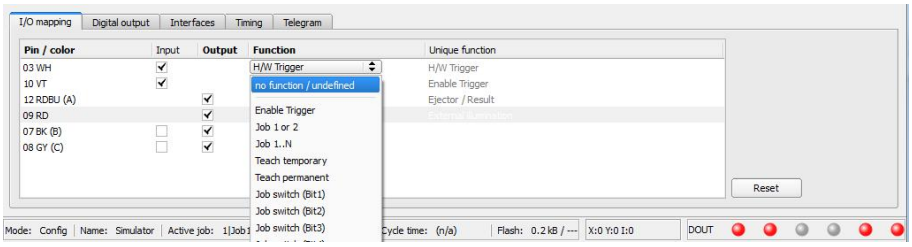


Fig. 91: Output, Inputs

4.6.4.1.1.1 Encoder Connection

If both tracks A+ ans B+ are used increasing or decreasing counting can be done / forward or backward movement of e.g. conveyor can be recognized.

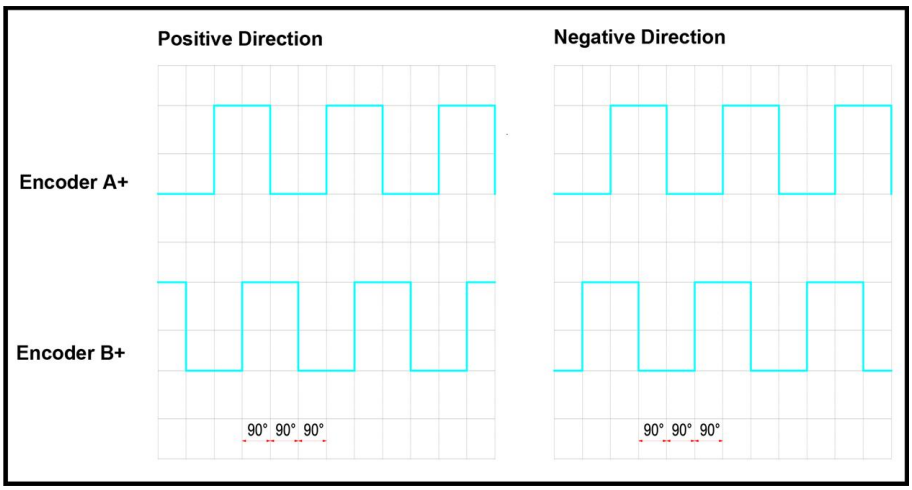


Fig. 92: Encoder connection A+ / B+

4.6.4.1.2 Functions of outputs

Function	Description
Ejector	Dedicated ejector output, maximum load 100mA (all other outputs 50 mA), only on pin 12 RDBU available. (corresponds LED "A")
Result	Result output, every result output can be covered with a detector result or a logical expression.
Acknowledge job change	Can be used to get a confirmation after successful job change via digital I/O („Job 1..n" or „Job Pin 'X', binary coded"). Rising edge indicates successful job change; high level is reset after 20ms. If job switch was not successful, signals remain low.
External illumination	If this setting is selected (via pin 09 RD available only), a external illumination can be connected / triggered
No function, undefined	no function, not used

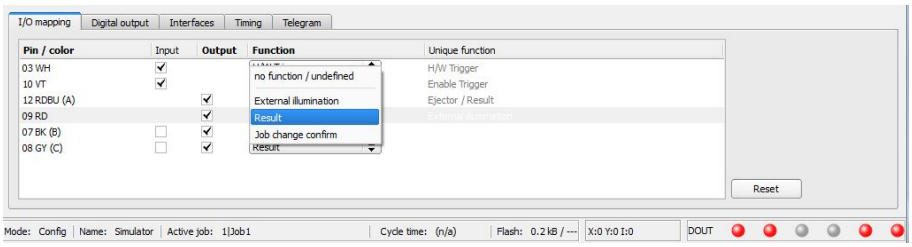


Fig. 93: Output, Outputs

There are 2 predefined outputs:

- Ready: indicates, that Sensor is ready to receive a trigger.
- Valid: indicated, that data on outputs are valid.

4.6.4.2 Functions of the programmable, digital inputs:

During operation with process control, the following cases can be carried out via the inputs:

- inactive
- enable/disable
- load Job (binary coded)
- load Job 1 ... n
- teach temporarily
- teach permanently

Description of different cases with a signal diagram.

4.6.4.2.1 Input: "Trigger enable"

For enable (high) or disable (low) of trigger input.

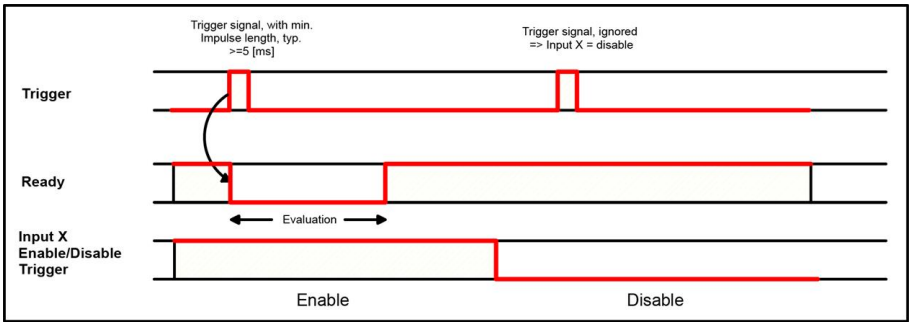


Fig. 94: Input timing, Trigger enable

4.6.4.2.2 Input: Job change binary or by function Job 1 or 2:

Job change binary over up to 5 inputs (Job 1- max. 31):

Possible only if Ready = high. As soon as the binary input signal change Ready is set to low.

Ready remains low until switch-over to the new job is done. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter "Ready" is set high again. During Job Change via binary inputs there must not be sent any trigger signal. The change of the logic levels of the according inputs must happen at the same time (during maximum 10ms all inputs must have a stable logic level)

Job change by function: Job 1 or 2:

Possible only if Ready = high. At the level change of the according input Ready is set low. Ready remains low till the job change is done. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter "Ready" is set high again. During Job Change over binary inputs there must not be sent any trigger signal. A high level causes evaluation according to job 2; a low level produces evaluation according to job 1.

Differences between binary switching and Job 1 or 2:

By usage of binary job switch the desired job number must be represented binary coded via the selected inputs. Therefore in this mode to switch between 2 jobs minimum 2 inputs are necessary.

In case of Job change Job 1 or 2 a high level cause's evaluation according to job 2, a low level produces evaluation according to job 1. In this way with only one input two the switching between two jobs can be done.

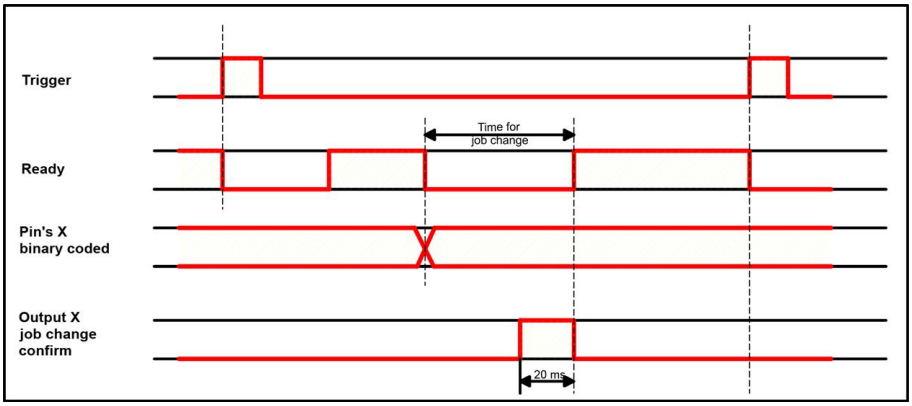


Fig. 95: Input timing, Job change via Binary / Job 1 or 2

4.6.4.2.3 Input: Job 1 ... n

For switching between jobs via impulses. Only possible when Ready = high. With the first impulse Ready is set to low. Impulses are counted until the first delay of >= 50ms and then switches to the appropriate job. Ready remains low until switch-over to the new job occurs. If the option “Job change confirm” is used, this signal occurs after the job change, and hereafter "Ready" is set high again. During Job Change over binary inputs there must not be sent any trigger signal. Pulse length for job change should be 5 ms pulse and 5 ms delay.

If possible job change should be made by binary coded signals like in fig. 2, this is the faster way.

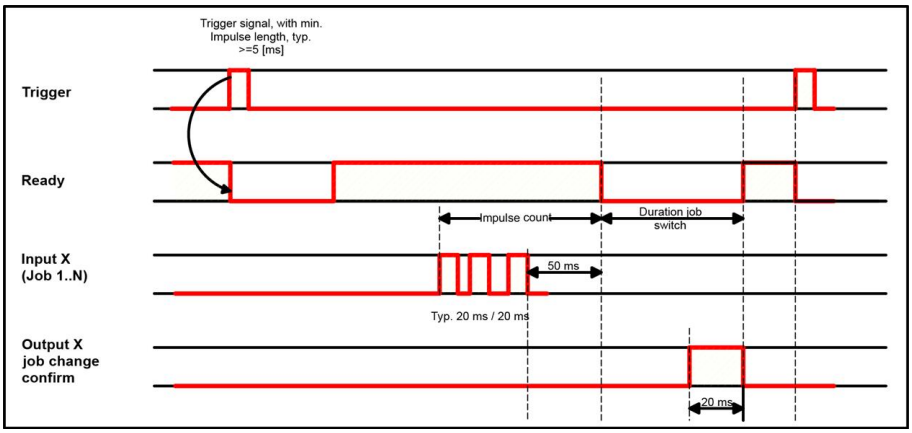


Fig. 96: Input timing, Job 1 ... n

Attention!

At Job switch please take care of the following:

- All Jobs must have the same setting for job change

- All Jobs must be in triggered mode

- Ready signal must be high when trigger sequence starts

4.6.4.2.4 Input: Teach temp. / perm.

For re-teaching samples of all detectors and if necessary alignment tracking of the current job. Only possible when Ready = high. A rising edge initiates teaching, during which a high level must exist at least until the next trigger, so that an image of an inspection part can be recorded in the correct position. Ready is set to low and remains low until teaching has been completed. Storage is either temporary (only in RAM), or permanent (in flash) according to the setting.

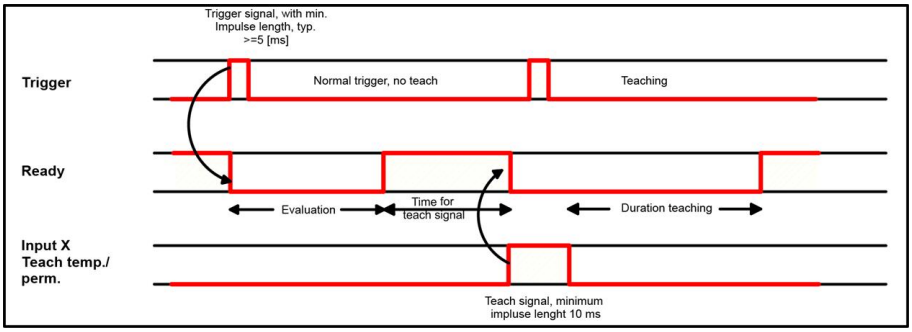


Fig. 97: Input timing, Teach

Attention!

The functions Job 1 or 2, Job 1 ... n or teach temp. /perm. can only be used in trigger mode

4.6.4.3 Output signals (Digital outputs / Logic)

In this tab, you define the switching behaviour and logical connection of the digital outputs. Number of outputs depends from settings in tab IO mapping.

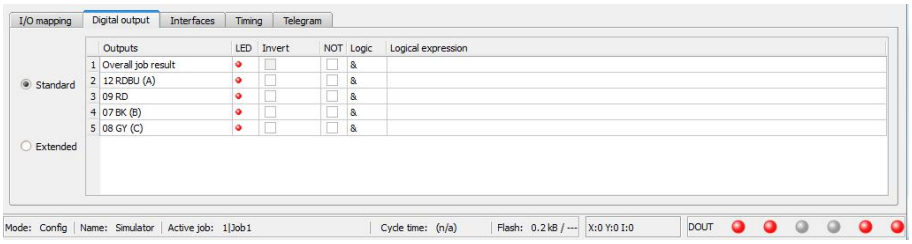


Fig. 98: Output, tab digital output

Description of different cases with a signal diagram.

For each pin (output) there are the following possibilities:

Parameter	Function
Overall job result	No physical output, effects recorder, statistics and archiving functions
Invert	Invert total result for this pin (output)
Mode	Standard: combine several detectors by logical expressions like AND (&) / OR (|) / NOT (!) to one logical expression. Advanced: Free edit of logical expression.
NOT	Select: operator NOT (!)
Logic	Select: operator AND (&) / OR (|)
D1 - D...	All active detectors are shown in this list depending from number of detectors. These can be assigned to the listed output. Each detector can be set to on, off and invert.
Logical Expression	Here is shown either the logical expression that was build automatically by using of standard mode or the logical expression can be entered free by using the advanced mode.

Defining logical connection:

Define the logical connection between the inspection results of the individual detectors and the status of the selected output. You have two input possibilities:

4.6.4.3.1 Logical connection – Standard mode

In standard mode, connection of detector inspection results with the selected output must be carried out using the option buttons operator and the checkboxes in the detector selection list. The result is displayed in the logical formulas window (cannot be edited).

Connecting results:

1. Select the logical operator to be used for connecting the detectors in the selection list, from the operator window.
2. Activate the detector in the selection list which is to contribute to the result (tick in the Active column).

By activation the "Inverted" column, you can individually invert the respective detector result.

The entry in the "Result" column alters accordingly.

Examples:

The detector results can only be connected by one logical operation, e.g.:

- (D1&D2&D3) or
- !((!D1)|D2|D3) etc.

(For more complex connections, please select Formula mode)

4.6.4.3.2 Logical connection – Formula mode

In formula mode, connection of detector inspection results with the selected output is defined by the direct input of a logical formula. The operators AND, OR and NOT and round brackets are available for this purpose.

Please use the following characters for the logical operators when editing the formula:

- "&" for AND
- "|" for OR ("AltCtrl" key and "<>" key)
- "!" for NOT

Examples:

Logical expressions of any complexity can be created, e.g.:

- (D1&D2)|(D3&D4)
- !((D1|D2)&(D3|D4))
- (D1|D2)&(D3|D4)&(D5|D6)

etc.

4.6.4.4 Interfaces

In this tab you select and activate the digital inputs/outputs used and the interfaces for data output:

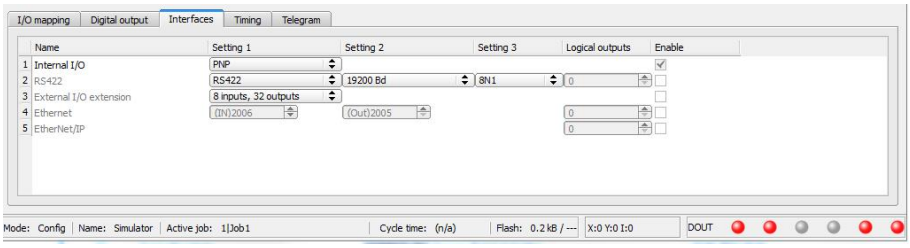


Fig. 99: Output, tab Interfaces

Parameters	Functions
Internal I/O	Selection of I/O-type: PNP or NPN
RS 422 (baud rate)	RS422 for data output with choice of data transmission rate
External I/O extension	Not available
Ethernet	Ethernet TCP/IP for data output. Sensor is a socket server. There are used two ports which can be defined by the user. Default is port 2006 (IN) for commands to sensor and port 2005 (OUT) for data transfer.
Ethernet/IP	Field bus Ethernet/IP for data output

For further informations see User manual, chapter "Communication"

Information

The outputs and interfaces can be separately activated or deactivated in the Active column.

Logical outputs:

By using the RS422, Ethernet and EtherNet/IP interface additional pure logic outputs can be defined, which just exist logically and can be communicated via one of these interfaces only.

Logical outputs can be assigned to an e.g. detector result or to a logic expression (formula).

4.6.4.5 Timing, Digital outputs

In this tab, you determine the time response of the selected signal output. If encoder was selected the delays are entered in encoder steps. Depending on the settings in the I/O configuration all following time delays are done in ms or in encoder steps.

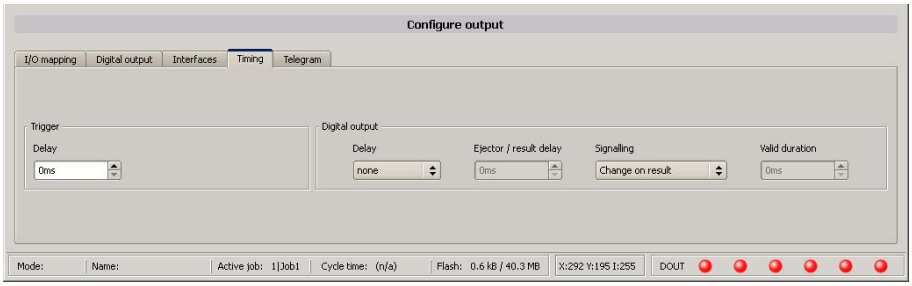


Fig. 100: Output, tab Timing

Parameters	Functions
Trigger delay	Time between trigger and start of image recording in ms
Digital outputs	All outputs can be delayed or only the ejector output.
Ejector	Time between trigger and connection of result level at the signal outputs. Includes evaluation time.
Reset signal	Determines, how to reset outputs.
Duration of result	Duration of result signal in ms

Attention:

At Job Change and change from Run- to Config Mode outputs will get the following states: Buffer of delayed outputs will be deleted.

Digital outputs:

Will be reset to default at change from "Run" to "Config". Defaults are set by flag "Invert" in output tab. "Invert" inverts the default setting and also the result.

Reset of digital outputs:

The reset of the result outputs can happen depending on different settings 7 events. This are:

- "Change on result" (default).
  The output changes its level according to the logical result when the next logical result is generated and valid. Typical use at controlling switch points e.g. in sorting applications.
- "Change on trigger"
  The output is set to "inactive" (in operating mode PNP = low) with the next trigger. Typical use at operation with a PLC.
- "Valid duration"
  The output changes back to inactive after the "Valid" duration time setting here in ms. typical use with e.g. pneumatic ejectors.

S. Vision Sensor Configuration Studio/Output/Timing/Signalling

READY AND VALID

- If Ready = high: Ready for next image / evaluation.
- If Valid = high: Results are valid at the outputs.

PNP or NPN operating mode.

All the described examples are in the operation mode „PNP". If the setting „NPN" is used, the examples are valid, but with inverted signal levels.

S. Vision Sensor Configuration Studio/Output/Interfaces/Internal I/O

4.6.4.5.1 The following cases for output timing are available:

4.6.4.5.1.1 Normal trigger, no delays:

Sequence: (Signalling here: Change in result)

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, and Valid = low
- After the Vision Sensor has evaluated the image and the results are valid the defined outputs change to the according logical states. Ready and Valid are set to high again. (ready for next task, outputs valid)

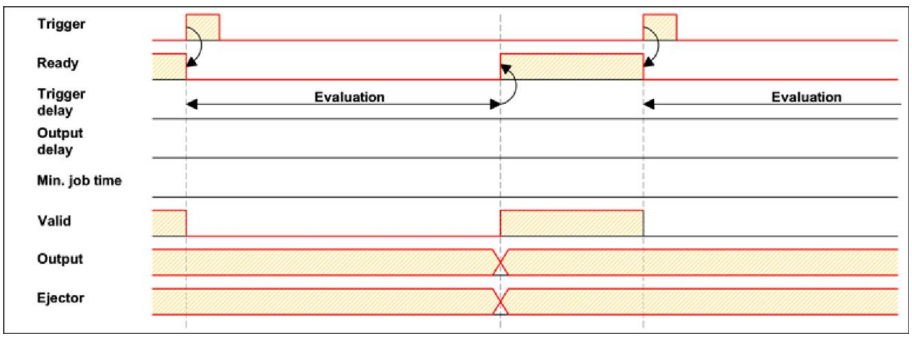


Fig. 101: Output timing, standard sequence at normal trigger

4.6.4.5.1.2 Trigger delay active

(Trigger delay concerns hardware trigger only)

This setting is used to delay the image capturing / start of evaluation against the real physical trigger, which was e.g. caused by a light barrier or by the PLC. With this function the fine tuning of the trigger point in time can be done without any change in mechanics or PLC programming.

Sequence:

Image is taken after the trigger delay time is elapsed. The cycle time is trigger delay time + evaluation time.

s. Vision Sensor Configuration Studio/Output/Timing/Trigger/Delay

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low, all defined result outputs = low (Signalling = Change on trigger)
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid the outputs change to the according logical levels. Ready and Valid are set to high again. (ready for next task, outputs valid)

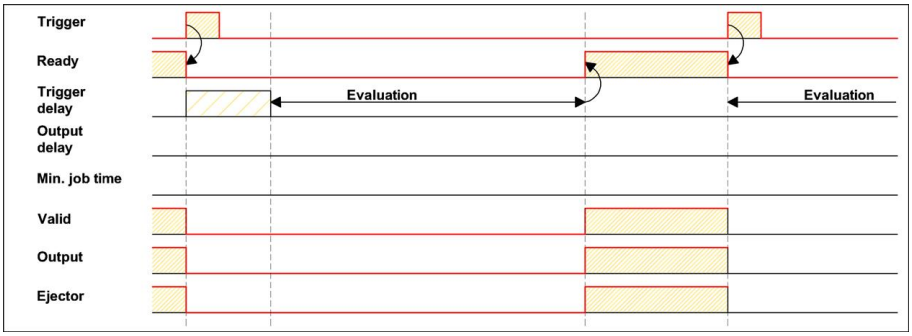


Fig. 102: Output timing, and Trigger delay

4.6.4.5.1.3 Trigger delay + Result delay (here: Ejector only):

(Trigger delay concerns hardware trigger only)

The result delay (if for all outputs or ejector only) is used to fine tune the ejector point in time, independent from evaluation time, as especially the evaluation time can have slight variations.

Sequence:

Image is taken after the trigger delay time is elapsed. Furthermore the Result delay is active, but in this example just for the ejector output (pin 12 RDBU)

For all defined result outputs, except the ejector output the cycle time is: Trigger delay time + evaluation time.

For the ejector output the cycle time is: Result delay only! (Counted from trigger, only make sense if longer than summation of above mentioned times!) s. Vision Sensor Configuration Studio/Output/Timing/Output/Delay.

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low, all defined result outputs = low. Except Ejector, as for this a fix result delay is defined.
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid the outputs change to the according logical levels. Ready and Valid are set to high again. (ready for next task, outputs valid)
- In this operation mode the Ejector output only is set after the Result delay is elapsed. In this example the Ejector output is also used with Result duration, therefore it´s reset after the Result duration time is elapsed.

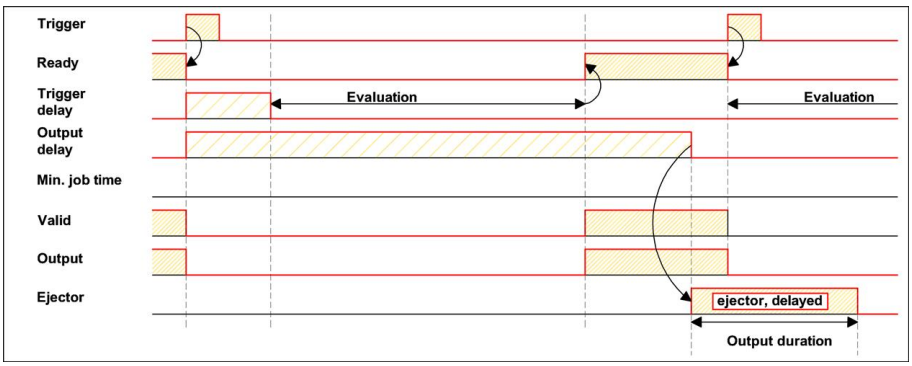


Fig. 103: Output timing, Result delay, ejector

4.6.4.5.1.4 Trigger delay + Result delay (here: all outputs):

(Trigger delay concerns hardware trigger only)

The result delay (if for all outputs or for ejector only) is used to fine tune the ejector point in time, independent from the evaluation time, as the evaluation time of the "job" can have slight variations.

Sequence:

Image is taken after the trigger delay time is elapsed. Furthermore the Result delay is active, in this example to ALL outputs.

For all defined outputs, the cycle time is: Result delay only! (Counted from trigger, only make sense if longer than summation of Trigger delay + Evaluation time) s. Vision Sensor Configuration Studio/Output/Timing/Output/Delay.

- Rising edge at Trigger input (Pin03 WH)
- Consequence of Trigger = high: Ready = low, Valid = low.
- Before the image for evaluation is taken, the adjusted Trigger delay time elapses.
- Now the evaluation starts. As soon as the results are valid, only the Ready signal is now directly set to high again (ready for next evaluation). Now the result delay time must elapse. After this has happened all defined outputs change to the according logical levels. Now also the Valid signal is reset to high level. (Valid = high: results / outputs valid. Signalling = Change on result)

In this operation mode the Ready signal only is reset to high level after Trigger delay + Evaluation time is elapsed. (Ready = high: Ready for next evaluation). This make sense as the Vision Sensor independent from the later setting of the other outputs, is now already available for the next evaluation task..

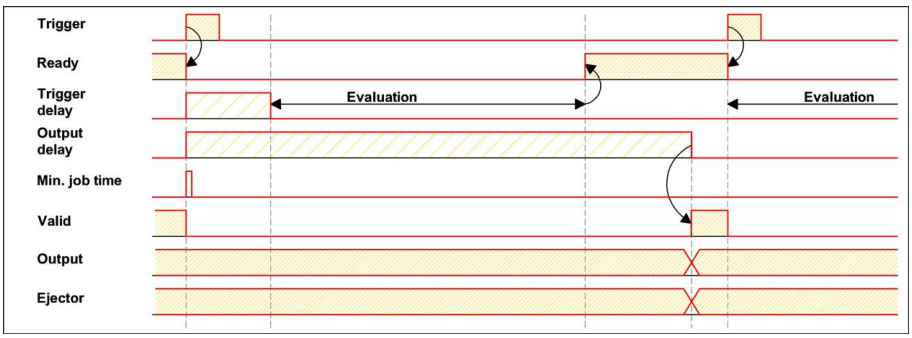


Fig. 104: Figure 142; Output timing, Result delay for all outputs.

4.6.4.5.1.5 Result duration active. (Here e.g. all outputs):

This timing setting is used to achieve a pulse at an output of defined length, for e.g. control of a pneumatic ejector in case of a bad part.

All defined result outputs are reset to low level (inactive in PNP operation) after the Result duration in ms is elapsed.

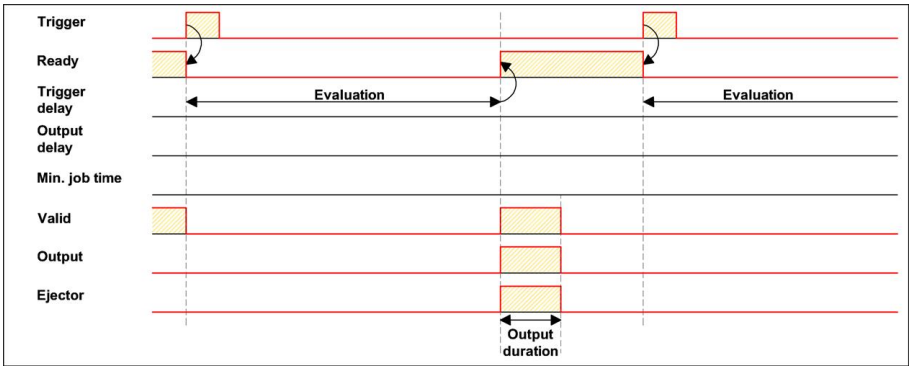


Fig. 105: Output timing, Result duration

4.6.4.5.1.6 Cycle time (Min, Max) active:

(Here: Signalling: Change on Trigger)

Parameter control for the minimum and maximum time for a job. Minimum job time blocks trigger signals which are coming in before the minimum job time was reached. (If during the Min Cycle time a further trigger is coming in it is ignored)

Maximum job time interrupts a job after a defined time. Job result after a timeout is "not o.k." Maximum job time should be selected higher than the time demand for one execution.

The Cycle time measures the time from Trigger till the setting of the outputs. If the cycle time should be limited, e.g. because of a machine cycle must not be exceeded, it should be set to an appropriate value. The result of all till this point of time not completely processed detectors is set to false. By selecting the Max. Cycle time please consider that this may not be 100% exact, as depending on the currently processed detector it´s possible that there will elapse a few more milliseconds the function can be stopped. It´s recommended to check this possible exceeding of the Cycle time in real operation and to decrease the value for the setting according to this offset.

Sequence:

All outputs and the signal „Valid“ (Outputs valid) are set directly after evaluation. But the signal „Ready“ (Ready for next evaluation) is set not until the Min Cycle time is elapsed. Therefore only from this point in time the next trigger will be accepted.

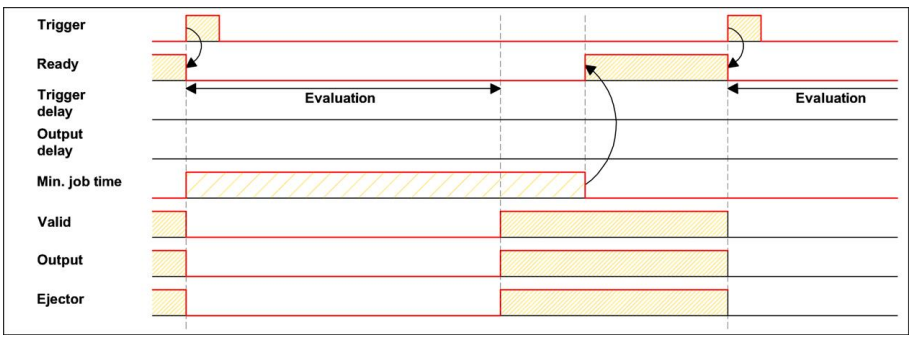


Fig. 106: Output timing, Cycle time

4.6.4.5.1.7 Multiple Result delay for Ejector

This mode of operation is used, if between trigger / evaluation for part A and it´s ejection is so much time / distance, that the Vision Sensor already has to check n (up to 20 parts possible) further parts which also has to be ejected later.

(Only available in mode: Vision Sensor Configuration Studio/Output/Timing/Delay: „Ejector only / Ejector- / result delay“

Here: Signalling = Result duration (alternatively also „Change on result“)

This function is limited on 20 parts between trigger and ejector.

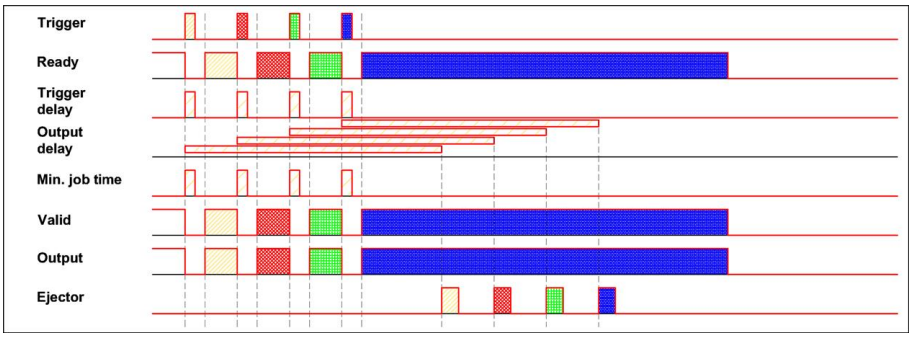


Fig. 107: Output timing, Multiple Result delay, ejector

4.6.4.6 Telegram, Data output

Serial Communication ASCII (Page 185)

Serial communication BINARY (Page 197)

EtherNet/IP Assembly Request (Page 212)

EtherNet/IP Assembly Response (Page 212)

Configuration of data output via serial interfaces RS 422 and Ethernet as well as for archiving in .csv. files. Here all settings can be done, which result data of the Vision Sensorshould be transferred via the before selected interface.

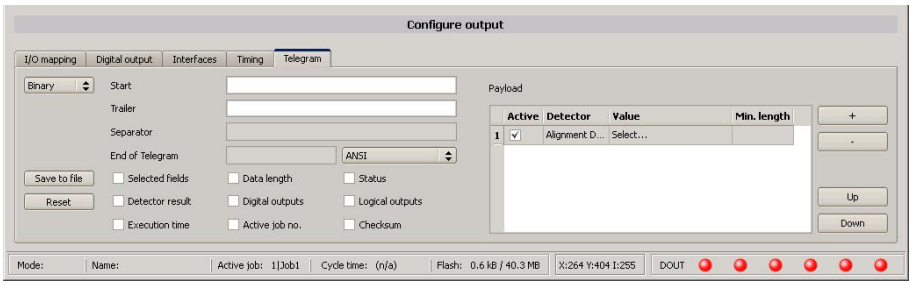


Fig. 108: Output, tab Telegram

Parameters	Functions

Binary / ASCII	Output data in Binary- (Hex) or ASCII- format.
Save to file	Exportation of file format with current results as .csv
Reset	Reset of all parameters in this tab

Standard contents of protocol

Often required standard contents can be added to the output string by simply filling them in, or activation via the checkbox.

Start	Characters which are inserted at the beginning of the payload data sting (Binary or ASCII)
Trailer	Characters which are inserted at the end of the payload data sting (Binary or ASCII)
Separator	Characters which are inserted behind each payload value (ASCII only)
End of telegram	Characters which are sent at the end of a response to a PC or PLC (Reaction to a command, not with payload data, in ASCII mode only, output selectable in ANSI or Hexa Decimal)
Selected fields	Shows which of the following checkboxes are activated.
.... further standard content, like e.g. "Selected fields, Data length" ff.	to data string: „Payload" Sequence: Selected fields, Data length, Status, Detector result, Digital outputs, Logical outputs, Execution time, Active job no., Checksum

Detector-specific individual results

First create a new entry by activating the "+" button.

Function of buttons

- "+": Insert new entry
- "-": Delete marked entry
- "Up", "Down": Displace marked entry

You can add detector-specific individual results to the data telegram in the required flexible order via the selection list: (adding new values via button "+")

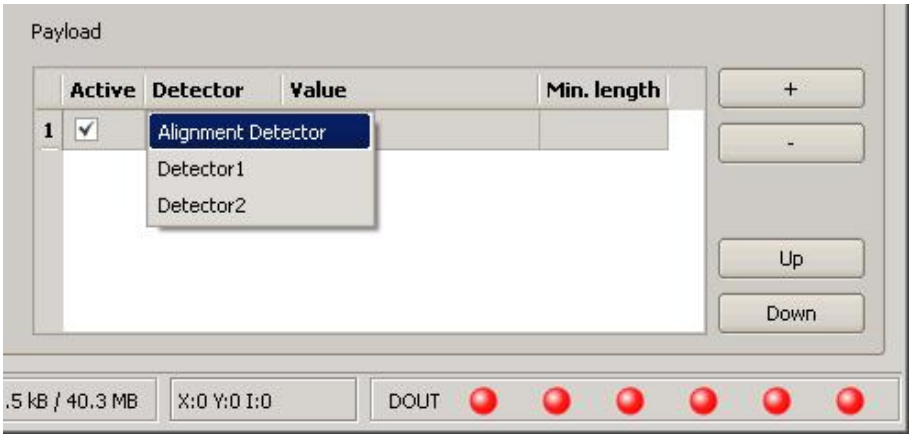


Fig. 109: Output, Detector specific payload

Column	Function
Active	Activates/deactivates the marked output value
Detector	Detector name (select from drop-down list)
Value	Available detector results (select from drop-down menu)
Min. length	Define the minimum length of the Value box; if the actual length is smaller than that specified, the box is filled with spaces (ASCII) or zeros (binary)

4.6.4.6.1 Possibilities of data output of Vision Sensor (s. also User manual, chap. Communication)

4.6.4.6.1.1 (Ethernet-) port 2005 / RS422

Numerical data, which has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

Ethernet: The sensor here is the (socket-) “server" and serves the Data via a „server-socket" interface. This is basically a “programming interface”. To read or process the Data a “socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

4.6.4.6.1.2 PC-Archiving (Vision Sensor Visualisation Studio)

Here images and numeric result data (in .csv. format) can be stored by “Vision Sensor Visualisation Studio” into a folder on the PC.

The configuration (folder, …) of this archiving function is done via “Vision Sensor Visualisation Studio”. (Menu: File/Result archiving, this is a pure PC- function)

4.6.4.6.1.3 Sensor- archiving (ftp, smb)

With this function images and numeric result data (in .csv format) can be stored actively by the sensor via ftp/smb. This kind of archiving is configured under „Job/Archiving", in this case:

a) With „ftp“ used: the senor is a „ftp client" and „writes“ the data to a „ftp server" folder on a drive which is available in the network. With Job/Start the sensor connects to the ftp-Server.

b) With „smb“ used: the sensor „writes“ the data direct in a folder in a network. With Job/Start the sensor connects/mounts with this folder.

4.6.4.6.1.4 Ram disk (in the sensor)

In the sensor the last image as well as the numeric data of the last evaluation, which has been configured under Output/Telegram, are stored (in a .csv file) in a Ram disc- folder under. „/tmp/results/".

This function is activated under „Job/Image transmission". To access this data an ftp- connection must be established actively to the sensor. Therefore an ftp client is necessary.

Attention

* The format of the .csv files is always the same (ftp, smb, ram-disk, Vision Sensor Visualisation Studio).

* The data are stored readable (by default separated by comma) into the .csv file.

* Only payload data which has been defined under (Output/Telegram) are transferred.

4.6.4.6.2 Communication settings

Communication	**Ethernet**	**RS422**
To Sensor, Command	Selectable in Tab: Protocol (Binary or ASCII)	
From Sensor, Data output	Selectable in Tab: Protocol (Binary or ASCII)	

Protocol settings

Parameters	**Functions**
Binary / ASCII	Output data in Binary- (Hex) or ASCII- format.
Save to file	Exportation of file format with current results as .csv
Reset	Reset of all parameters in this tab

Basics for establishing of a connection:

Vision Sensor is always tcp/ip (socket-) server.

Vision Sensor sensor opens always two (socket-) communication ports (default: 2005 + 2006).

- 2005 = Data port for sending of numerical results.
- 2006 = Command port for receiving of commands.

At a time only one (socket-) client (PC or PLC) can be connected to a port.

Recommendations:

Existing socket connections have only to be reconnected, if an error occurred (on ports 2005 + 2006)

(e.g.: PLC or client in stop mode or error mode, etc.). During normal operation there is no need to reconnect existing connections.

Ethernet data handling: Especially if several Vision Sensor are used Ethernet should be preferred.

4.6.5 Result

With this function the defined job is processed in the PC, and the “Results/statistics” window with the detector list and the evaluation results is displayed. The cycle times are not displayed in this mode as they are not available from the sensor.

In “Run” mode the results of the detector marked in the detector list are displayed. In the image window – if adjusted – the image, the search- and feature- frames, and the result- graphs are displayed

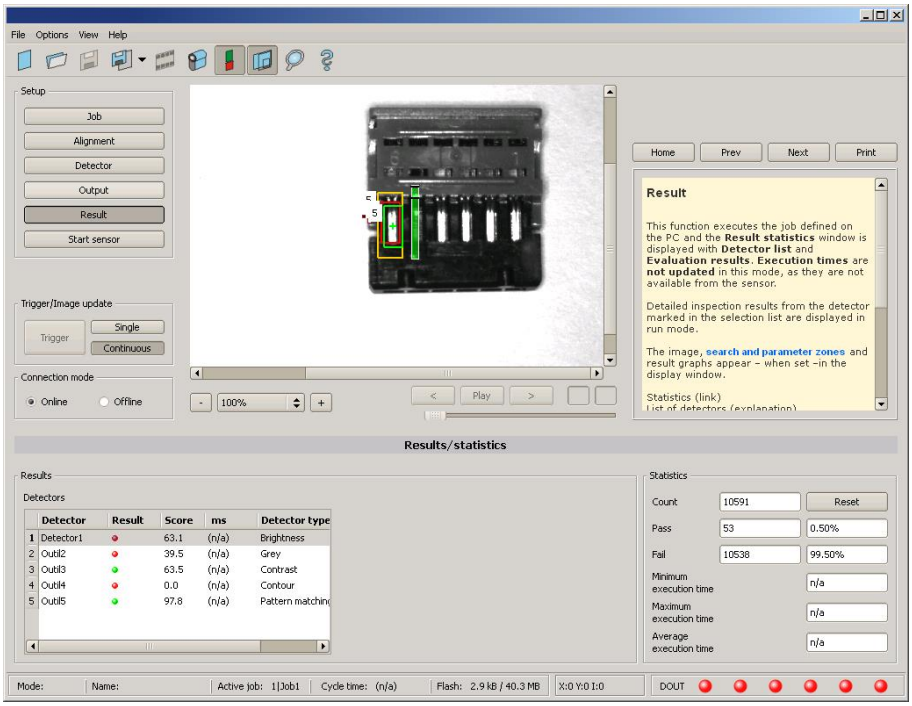


Fig. 110: Result

Param. results displayed	**Detector type**	**Function**
Result	all	Part / parameter detected (detected = green, not detected = red)
Score 1 .. n	all	Degree of concordance of pattern found with pattern taught
Execution time	all	Cycle time for an evaluation in ms
Position X, Position Y	Contour	Coordinates of parameter found (centre point)
Delta X, Delta Y	Contour	Deviation of coordinates found to taught position / through alignment
Position check	Contour	Position found within the defined position frame
Angle	Contour	Orientation (absolute angle) of parameter found
Delta angle	Contour	Angle deviation between parameter taught and parameter found
Scale	Contour	Scale of contour found in contrast to taught contour.

The displayed parameters vary depending on the selected detector type. To see the results of another detector mark it in the detector list. In module Vision Sensor Visualisation Studio numeric results, statistics and images with or without the selected frames can be archived.

4.6.6 Start sensor

This function sets the sensor to run mode and executes the job.

Image display (Page 121)

Result (Page 110)

Statistics (Page 125)

Starting execution of a job:

Click on the "Start Sensor" button.

The active (= marked in the selection list) job is transmitted to the sensor, stored in the sensor's non-volatile memory and started (run mode).

The parameters found are shown in the display window; the inspection results from the first detector or the detector selected in the selection list are shown in the configuration window along with statistical parameters.

Changing detector display:

To display the inspection results for another detector, mark it in the selection list or click on its graphic representation in the display window.

Quitting job execution:

Click on the "Stop Sensor" button. You are now back in configuration mode and can edit your job.

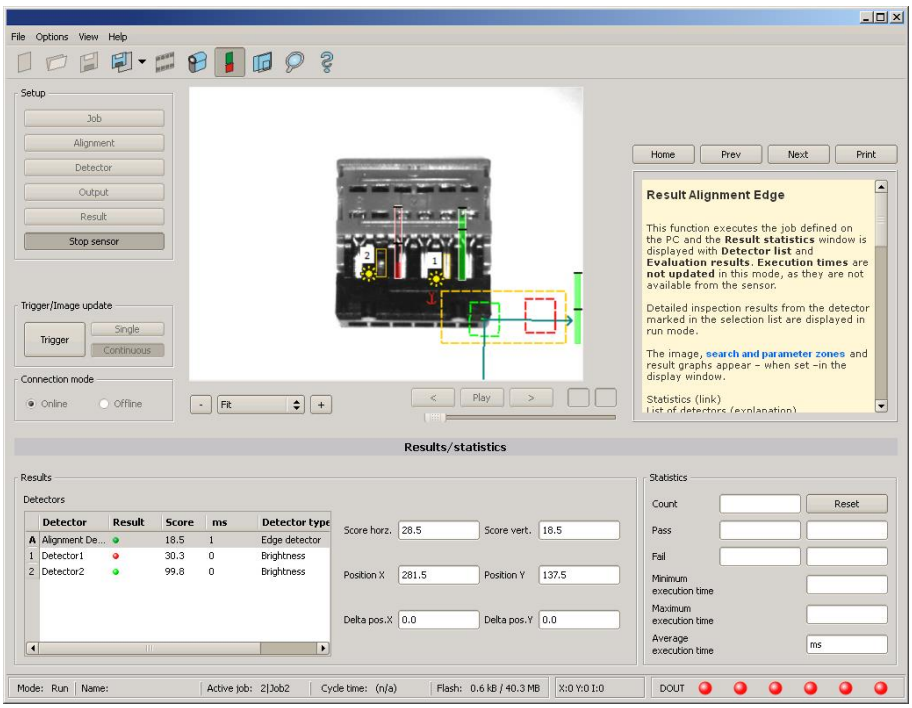


Fig. 111: Start sensor

4.6.7 Further topics of Vision Sensor Configuration Studio

4.6.7.1 Trigger settings

Select the required trigger mode in the job settings in the "General" tab:

Parameters	Functions
Triggered	Operation with external trigger, or trigger button in the interface
Free run	Operation with automatically running self-trigger; the sensor supplies images with the maximum possible frequency

Select the form in which the images are to be supplied by the sensor using the option buttons in the zone Trigger/Collect image:

Parameters	Functions
Single image	Recording of a single image, image recording occurs once when: 1. Trigger mode = triggered: First external trigger signal or with the trigger button on the interface 2. Trigger mode = free run: First click on the "Single image" button
Continuous	Continuous supply of images, image recording occurs continuously when: 1. Trigger mode = triggered: Each external trigger or with each click on the trigger button on the interface 2. Trigger mode = free run: Continuously through internal self-triggering with maximum frequency

When exposure time, amplification, illumination or resolution parameters are modified in the Job settings, a new image is automatically requested from the sensor.

To obtain a continuously updated live image even without trigger, carry out the following (if necessary temporary) settings:

- Set to free run under "Job/General"
- Set to continuous under "Trigger / Collect image"

4.6.7.2 Switching between online and offline mode

Two operating modes are available for sensor configuration and test run, which you can select in the Connection window.

- Online mode: Configuration with connected sensor.
- Offline mode: Simulation of a sensor with the help of images stored in film strips.

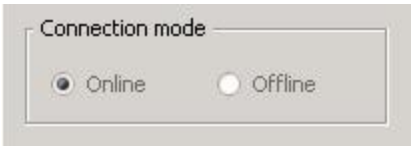


Fig. 112: Connection mode

When the sensor is connected, both modes are available; it is possible to switch between the two. If no sensor is available, it is only possible to work in offline mode, i.e. with sensor simulation.

4.6.7.3 Simulation of jobs (offline mode)

You can create and test your configuration without a sensor being connected using stored film strips (= series of images). Simulation can be worthwhile to prepare a configuration or to improve a configuration carried out online.

Displays in image window (Page 118)

Creating filmstrips (Page 114)

Information:

- Several films are available in Vision Sensor Configuration Studio when delivered.
- Further methods for image acquisition: Image recorder (Page 122)

4.6.7.4 Creating filmstrips

In configuration mode, images from the sensor are continuously loaded into the PC's RAM. After switching from online to offline mode, max. 30 images are available and can be stored as a series of images in a filmstrip file. Alternatively or in addition to the images stored on the sensor, you can load series of archived images or individual images on your PC or an external storage medium and combine them into new films.

When you mark an image in the list, it is displayed in small format in the preview window on the right.

4.6.7.4.1 Storing images from the sensor as filmstrips:

1. First connect the PC to the sensor and fill the memory with images in free run and collect image / continuous. (Mode of connection = online)
2. Select option button "offline" in the window mode of connection.
3. Select configure filmstrips in the File menu or click on the icon filmstrips in the toolbar. The images loaded from the sensor appear in the selection list that appears below:

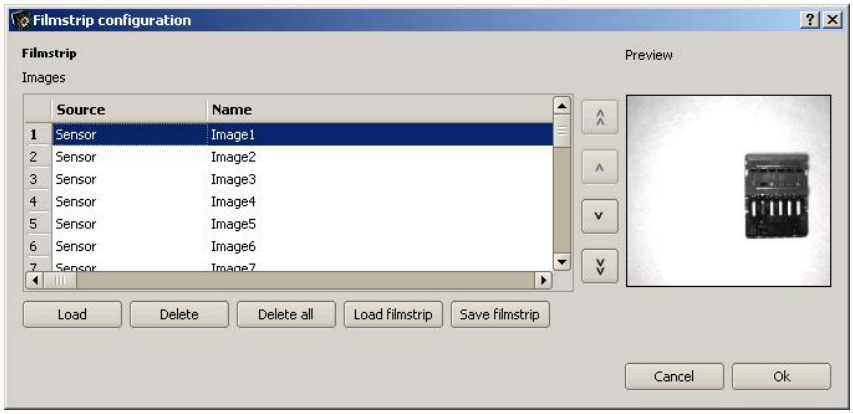


Fig. 113: Filmstrip

The images now can be examined; re-sorted or individual images can be deleted or added. The maximum number of images in a filmstrip is 30.

4. Click on Button "Save filmstrip" under the selection list.

All images in the list will be saved in a filmstrip file (extension .flm) in the order shown and are now available for future simulation.

4.6.7.4.2 Loading filmstrips and individual images from PC:

1. Select option button "Offline" in the window Mode of connection.
2. Select configure filmstrip in the File menu or click on the icon filmstrip in the tool bar.
3. Select a film file from the selection list and click on "Load filmstrip" button or load individual images from your PC or an external storage medium with the "Load image" button.

The loaded images are added to the selection list.

The type and memory location of the file is shown in the column source: filmstrips stored on the PC (Film), individual image stored on the PC (File), image in sensor memory (Sensor). After switching from online to offline mode all entries are Sensor.

4.6.7.4.3 Editing filmstrips:

You can create new films from the individual images in the selection list regardless of their source. The following functions are available for this purpose:

Button	Function
"<", "<<", ">", ">>"	Change order of images: The marked image is moved up/down one place or is moved to the end of the list.
Load image	Load further images from an external storage medium
Delete, Delete all	Delete image from the list/Delete all images from the list. (The images on the data carrier are not deleted here.)
Abort>	Quit the list without any modification
Import	Load all images into the film memory on the PC in the order shown. These are now available for display and analysis in offline mode.

Load / Save film strip	Load filmstrip from data carrier or save there

4.6.7.4.4 Displays in image window

4.6.7.4.4.1 Controlling image reproduction

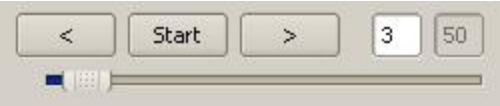


Fig. 114: Image reproduction

You can control the selection and reproduction of stored images using the "<" (back), Start / Stop and ">" (next) buttons as well as the slide bar underneath the display window. The image counter indicates the number of the current image as well as the number of images in the active filmstrip.

4.6.7.4.4.2 Image section and enlargement:

Fig. 115: Zoom

You can select the required image section using the buttons or drop-down menu under the display window

4.6.7.4.4.3 Graphical display of results

You can active or deactivate the following graphics in the View menu:

- Bar graph result: Displays the inspection result as a bar graph
- Drawings: Displays search, parameter and position frames detectors and alignment detectors
- Focussing aid: Displays image sharpness (see also Job settings)
- Enlarged display: Insertion of a separate enlarged display window, which can be adapted to the required scale using the adjustment handles at the corners of the frame

The module Vision Sensor Visualisation Studio offers a limited selection of these functions.

4.6.7.5 Image recorder

An image recorder is available in the Vision Sensor Configuration Studio and Vision Sensor Visualisation Studio programmes. When the recorder is activated, either all images or just error images are continuously loaded into the internal memory. This covers 10 images, the oldest images are in turn replaced (FIFO buffer). The recorded images can then be called-up and displayed with a PC, or stored on a PC or on an external storage medium, and are then available for analysis or simulation purposes in offline mode.

In the Vision Sensor Visualisation Studio program, you may be required to enter a password (if activated) to call up recorder images (User user group, see user administration).

Activating recorder:

Activate the recording function in the job settings in the Vision Sensor Configuration Studio programme (tab Image transmission). You can select whether all images or only error images are to be recorded in the pop-up list of Recorder parameters.

Selecting and recording images:

Select “Get images from sensor” from the File menu or click on the button "Rec.images" (only in Vision Sensor Visualisation Studio).

A display window appears in which you can load images stored in the sensor's RAM on to the PC and then examine and save them:

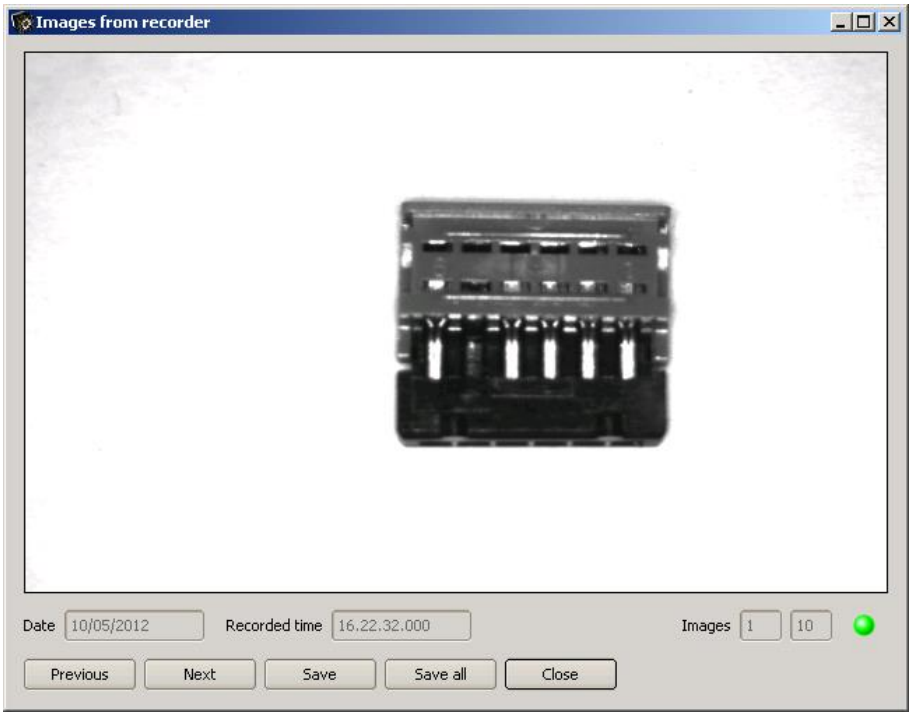


Fig. 116: Image recorder

Parameter	Function
Back	Displays the previous image
Next	Displays the next image
Save	Saves the image displayed on the PC or an external storage medium
Save all	Saves all images

Information:

- The running number of the selected image and the total number of images recorded on the sensor (max. 10) are displayed in the counter under the display window.
- During storage, the images are deposited in bitmap format (extension .bmp) with a resolution of 640 x 480 pixels (VGA).

- The inspection results associated with the images (OK or error) and the date are stored in the file name (format YYMMDD_running no._Pass/Fail.bmp, e.g. 090225_123456_Pass.bmp).
- If you want to record detailed inspection results with the images, use the function Archive in Vision Sensor Visualisation Studio.
- If you only want to record a single image with or without overlay, you can use the function save current image in the file menu, instead of using the recorder.
- Images will get a time stamp when loading them from Vision Sensor.
- Loading images from the sensor on to the PC deletes data on the sensor. If the recorder window is closed without images having been saved, they will also be deleted from the PC.
- Images are lost from the buffer in the event of a loss of power.

4.6.7.6 Displays in image window

4.6.7.6.1 Controlling image reproduction

Fig. 117: Image reproduction

You can control the selection and reproduction of stored images using the "<" (back), Start / Stop and ">" (next) buttons as well as the slide bar underneath the display window. The image counter indicates the number of the current image as well as the number of images in the active filmstrip.

4.6.7.6.2 Image section and enlargement:

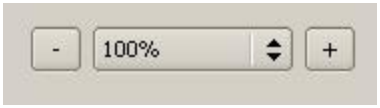


Fig. 118: Zoom

You can select the required image section using the buttons or drop-down menu under the display window

4.6.7.6.3 Graphical display of results

You can active or deactivate the following graphics in the View menu:

- Bar graph result: Displays the inspection result as a bar graph
- Drawings: Displays search, parameter and position frames detectors and alignment detectors
- Focussing aid: Displays image sharpness (see also Job settings)
- Enlarged display: Insertion of a separate enlarged display window, which can be adapted to the required scale using the adjustment handles at the corners of the frame

The module Vision Sensor Visualisation Studio offers a limited selection of these functions.

4.6.7.7 Search and parameter zones

You can define search and parameter zones in the configuration steps alignment and detectors. These are identified in the image window by different coloured frames.

Drawings in the screen (yellow, red frames etc.) can be activated or deactivated for any detector or category in the menu item "View/all drawings". With "View/drawings of current detector only", all drawings on the screen can be deactivated with the exception of the detector currently being processed.

4.6.7.7.1 Definition of search and parameter zones

When a new detector is created, a yellow frame is displayed, which defines the detector's search zone. The standard shape of the search zone is a rectangle; with contrast and grey level detectors, a circle can also be selected. The defined parameters (red frame) are found (green frame) provided its centre is within the search zone (yellow frame).

With pattern matching and contour detection detectors, there is also a parameter zone within the search zone which is represented by a red or green frame:

- Red frame = teach parameters
- Green frame = parameters found

If position control / check is defined, a blue frame appears also (either a rectangle, circle or ellipse).

If an alignment detector is defined, it's frame is shown in dotted yellow lines.

At the according upper left corner of each frame the number of the detector is shown.

4.6.7.7.2 Adapting search and parameter zones

The zones initially displayed in standard size and position can be selected / marked in the image or in the detector list and altered in size and position. Eight adjustment handles on the frame enable you to adapt the shape and size of the frame. Its position can be displaced by clicking anywhere inside the frame. The arrow at the side of the frame pointing to the centre can be used to change the rotational position of the frame.

The taught sample is represented in original size in the General or Parameters tab in the bottom, right-hand corner of the screen. Only the frame of the currently active detector, selected in the image or detector list, is shown with thick lines and adjustment handles, all other frames which are not selected are shown with thin or dotted lines (alignment detector).

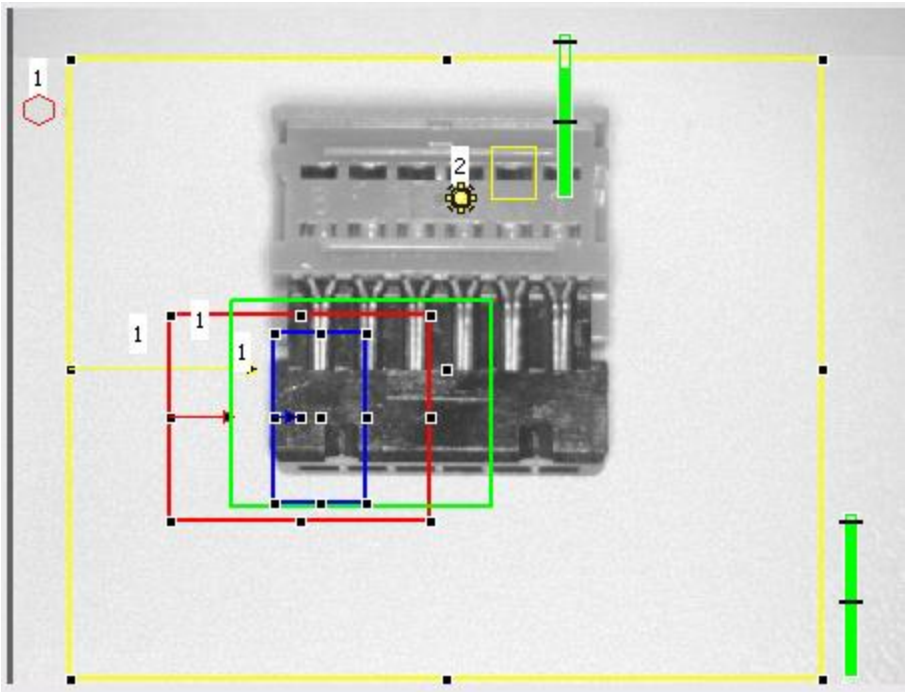


Fig. 119: Search- and feature frames

Information:

- For optimum detection, parameters must be distinct and not contain any variable parts, e.g. shadows.
- Significant contours, edges and contrast distinctions are of advantage.
- To reduce evaluation time, the search zone selected should not be unnecessarily large.

Result bar

On the right next to the search zone, the degree of concordance of the parameter searched for and found is displayed as a fixed result bar with a set threshold value:

- Green bar = The searched for parameter has been found and the pre-set threshold value of minimum concordance has been achieved.
- Red bar = The object could not be found with the required degree of concordance. The graphics displayed can be selected in the View menu.

4.7 Vision Sensor – Operating- and configuration software – Vision Sensor Visualisation Studio, all functions

This program enables the monitoring of the image from the camera and the inspection results.

Image display (Page 121)

Result (Page 125)

Statistics (Page 125)

Changing active job (Page 126)

Upload (Page 128)

Commands / Freeze image (Page 122)

Image recorder (Page 122)

Archiving test results and images (Page 124)

From this software ONLY monitoring and job change (loading of already defined jobs) can be done. It can be password protected so that you can only view (worker level), or view and load predefined jobs (Super-Vision Sensor level)

4.7.1 Image display

The graphical display of an image and the inspection results in the display window depend on the setting of the parameter Image transmission in job settings (Parameters for image transmission (Page 52) in Vision Sensor Configuration Studio) program:

- Image transmission active: The current image along with the frames for the defined search, parameter and position zones and parameters found are displayed.
- Image transmission inactive: Only the frames for the defined search, parameter and position zones and parameters found are displayed (current image is not displayed).

The degree of concordance between the parameter searched for and the parameter found appears to the right next to the search zone of the respective detector, in the form of a vertical result bar with a set threshold value:

- Green bar: The parameter searched for has been found and the pre-set threshold value for concordance has been reached.
- Red bar: The object could not be found with the required degree of concordance.

An exclamation mark in the top right hand corner of the live picture means, that image processing on PC is slower than image processing on Vision Sensor

. i.e. Not all images are transferred to PC.

This may cause lost images in images archiving. If this symbol occurs often, PC-programs running in background should be closed in order to improve PC performance.

You can configure the graphics of the inspection results in the View menu.

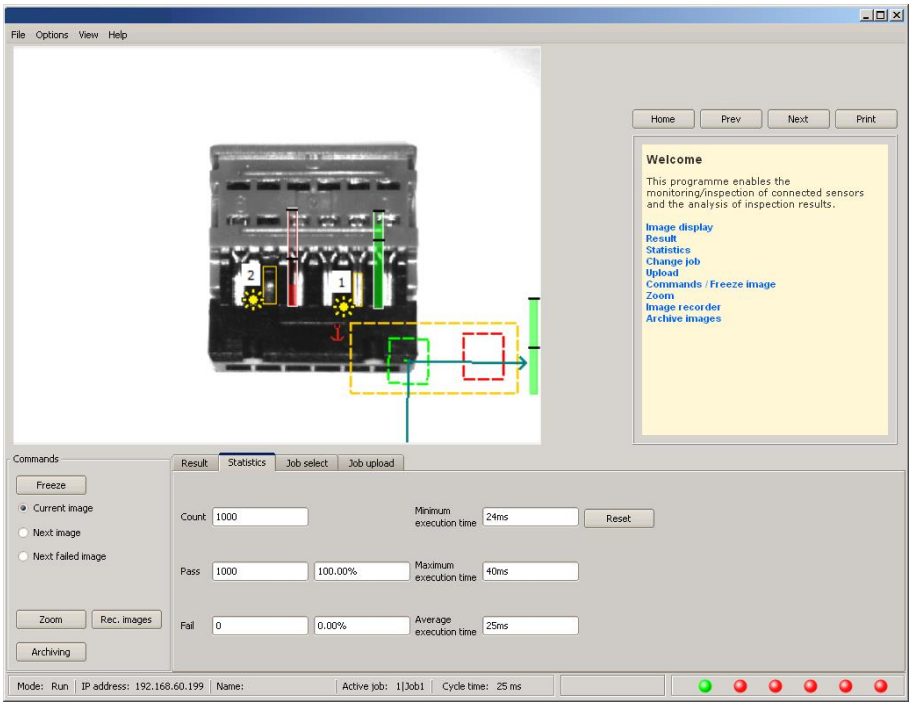


Fig. 120: Vision Sensor Visualisation Studio

Except the archiving all functions of Vision Sensor Visualisation Studio are available also in the module Vision Sensor Configuration Studio.

4.7.2 Commands / Freeze image

With the "Freeze image" button, you can request single images according to the type required (current image, next image, next failed image) and freeze them in the display window.

The required single image is displayed and the image counter stops at the corresponding image number.

Press "Continue" to end the frozen image state.

4.7.2.1 Zoom

With the button "Zoom" the image is opened in a new window with enlarged display.

4.7.3 Image recorder

An image recorder is available in the Vision Sensor Configuration Studio and Vision Sensor Visualisation Studio programmes. When the recorder is activated, either all images or just error images are continuously loaded into the internal memory. This covers 10 images, the oldest images are in turn replaced (FIFO buffer). The recorded images can then be called-up and displayed with a PC, or stored on a PC or on an external storage medium, and are then available for analysis or simulation purposes in offline mode.

In the Vision Sensor Visualisation Studio program, you may be required to enter a password (if activated) to call up recorder images (User user group, see user administration).

Activating recorder:

Activate the recording function in the job settings in the Vision Sensor Configuration Studio programme (tab Image transmission). You can select whether all images or only error images are to be recorded in the pop-up list of Recorder parameters.

Selecting and recording images:

Select “Get images from sensor” from the File menu or click on the button "Rec.images" (only in Vision Sensor Visualisation Studio).

A display window appears in which you can load images stored in the sensor's RAM on to the PC and then examine and save them:

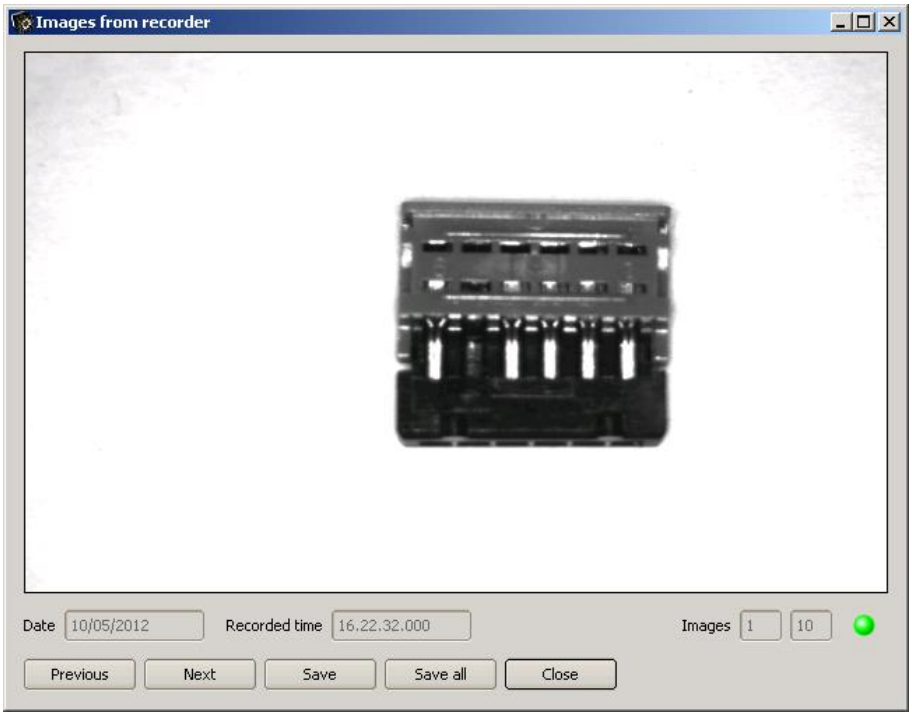


Fig. 121: Image recorder

Parameter	Function
Back	Displays the previous image
Next	Displays the next image
Save	Saves the image displayed on the PC or an external storage medium
Save all	Saves all images

Information:

- The running number of the selected image and the total number of images recorded on the sensor (max. 10) are displayed in the counter under the display window.
- During storage, the images are deposited in bitmap format (extension .bmp) with a resolution of 640 x 480 pixels (VGA).

- The inspection results associated with the images (OK or error) and the date are stored in the file name (format YYMMDD_running no._Pass/Fail.bmp, e.g. 090225_123456_Pass.bmp).
- If you want to record detailed inspection results with the images, use the function Archive in Vision Sensor Visualisation Studio.
- If you only want to record a single image with or without overlay, you can use the function save current image in the file menu, instead of using the recorder.
- Images will get a time stamp when loading them from Vision Sensor.
- Loading images from the sensor on to the PC deletes data on the sensor. If the recorder window is closed without images having been saved, they will also be deleted from the PC.
- Images are lost from the buffer in the event of a loss of power.

4.7.4 Archiving test results and images

You can archive images with and without graphics, and inspection results on to your PC or an external storage medium for analysis or simulation purposes (see Offline mode).

Access to this function may require password entry (User user group, see user administration).

Configuring archiving:

1. Select Configure archiving ... from the File menu.
   A dialogue box appears with the following options:

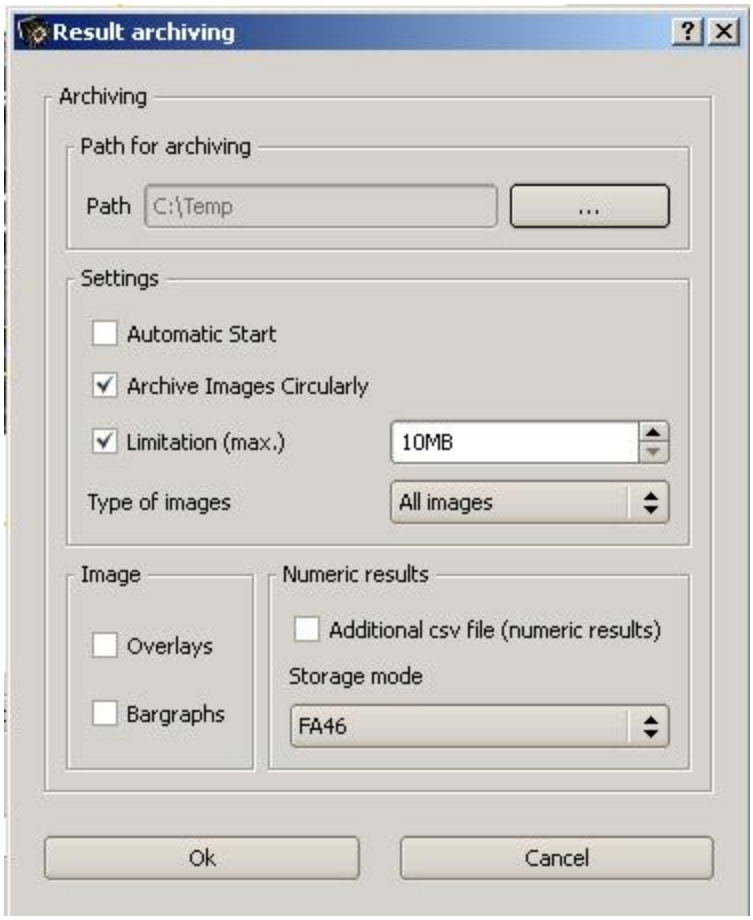


Fig. 122: Archiving configuration

Parameter	Function
Path for archiving	Directory in which archived file(s) are stored.
Settings, Automatic Start	Starts archiving automatically after start of Vision Sensor Visualisation Studio.
Settings, Archive image circularly	Activates cyclic overwriting of oldest images if limitation of storage is reached.
Settings, Limitation (max.)	In this drop-down menu it is possible to specify which images (all images or only good or bad images) are to be stored.
Type of images	Specifies, whether all, good or bad pictures have to be stored.
Graphics, Bar graph result	Choice of graphics to be archived in the image.
Numerical results	If "record with" is activated, numerical result data such as coordinate values etc. are archived in an additional .csv file.

2. Select the required options and confirm your choice with OK.

Start/end archiving:

Click on the button "Archive images" in the "Commands" filed to start or end the archiving function with the above mentioned settings. The name of the image file currently to be stored appears in the status bar. Archiving is carried out for as long as the button "Archive images" is pressed.

4.7.5 Statistics

Statistical data from the inspection process is displayed in the Statistics tab in run mode. The statistical data displayed is identical for all types of detectors:

Parameter	Function
All evaluations	Total number of inspections
Good parts	Number of inspections with result "OK"
Bad parts	Number of inspections with result "Error"
Min./max./mean execution time	Min./max./mean execution time for evaluation in ms

All statistic values can be reset to zero with the "Reset" button.

You can archive inspection results and statistical evaluations including selected graphics in the Vision Sensor Visualisation Studio program.

4.7.6 Result

This function executes the job defined on the PC and the Result statistics window is displayed with Detector list and Evaluation results. Execution times are not updated in this mode, as they are not

available from the sensor.

Detailed inspection results from the detector marked in the selection list are displayed in run mode.

The image, search and parameter zones and result graphs appear – when set – in the display window.

The parameters displayed vary according to the type of detector selected:

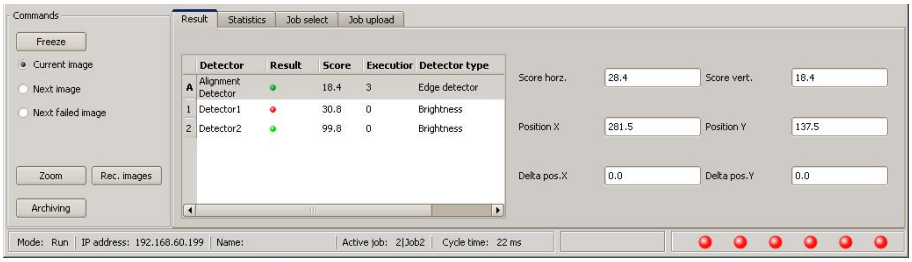


Fig. 123: Vision Sensor Visualisation Studio, Result

Param. results displayed	**Detector type**	**Function**
Result	all	Part / parameter detected (detected = green, not detected = red)
Score 1 .. n	all	Degree of concordance of pattern found with pattern taught
Execution time	all	Cycle time for an evaluation in ms
Position X, Position Y	Contour	Coordinates of parameter found (centre point)
Delta X, Delta Y	Contour	Deviation of coordinates found to taught position / through alignment
Position check	Contour	Position found within the defined position frame
Angle	Contour	Orientation (absolute angle) of parameter found
Delta angle	Contour	Angle deviation between parameter taught and parameter found
Scale	Contour	Scale of contour found in contrast to taught contour.

To show inspection results for another detector, mark it in the selection list.

You can archive inspection results and statistics including selected graphics in Vision Sensor Visualisation Studio.

4.7.7 Changing active job

In the Job tab, the jobs available on the sensor are displayed in the selection list. Here you can switch between different jobs stored on the sensor.

The use of functions which stop an active sensor may require password entry (User group user, see user administration).

Password levels

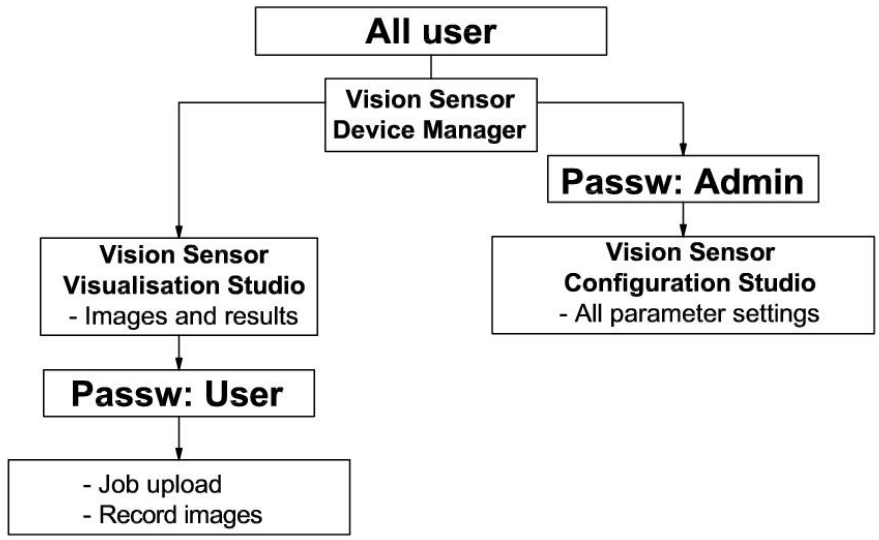


Fig. 124: Password levels

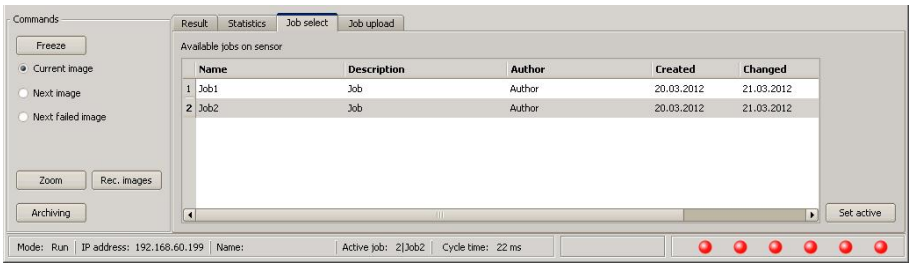


Fig. 125: Vision Sensor Visualisation Studio, Job select

Select a job from the list and activate it with the "Activated" button.

The previous job is deactivated; the selected job is now active.

Attention:

At Job Change and change from Run- to Config Mode outputs will get the following states:

- Buffer of delayed outputs will be deleted.
- Digital outputs: will be reset to default at change from "Run" to "Config". Defaults are set by flag "Invert" in output tab. "Invert" inverts the default setting and also the result.
- Ready and Valid: Ready and Valid show at Job change and at change of operation mode from Run to Config, that the Vision Sensor is not ready and that results are not valid. (Low level)

4.7.8 Upload

You can load new jobs or entire job sets from the PC to the sensor memory in the Upload tab. The available jobs and job sets are displayed in the selection list.

Jobs and job sets can be created in the Vision Sensor Configuration Studio program and stored there under File / Save Job / Save Jobset as .....

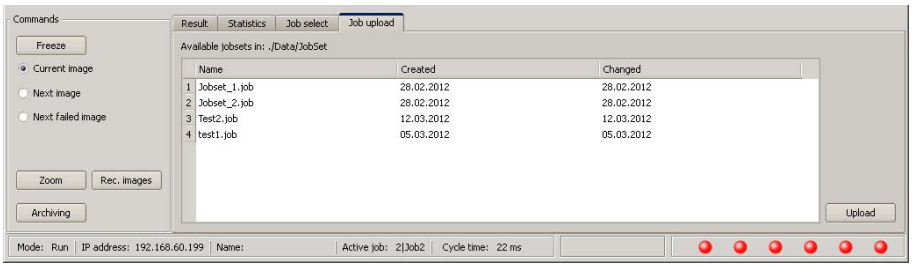


Fig. 126: Vision Sensor Visualisation Studio, Job set upload

Information:

- A job set consists of one or several jobs which are simultaneously stored in the sensor or on the hard disk.
- Use of functions which can stop the active sensor may require password entry (User user group, see user administration).
- Select a job or job set from the list and load it on to the sensor with the "Upload" button.
- This action deletes all jobs previously stored on the sensor!

5 Communication

5.1 Possibilities of image- / data transfer and archiving

The Vision Sensor is able to communicate and exchange data via different communication channels with a PLC or a PC. It´s possible to send data on request or cyclical from the Vision Sensor to a PLC/PC. But the PLC/PC can also actively communicate with the Vision Sensor, for e.g. only on demand / request to get result- or settings- data or to do a job switch.

The physically available communication interfaces are:

- Ethernet
- RS422

A complete overview about all available telegrams you find in chapter Serial Communication ASCII (Page 185) ff.

In the following pages the function and the according settings how to use the different possibilities to communicate with a Vision Sensor is illustrated in a few examples.

The following examples show how to work on the PC end with a Serial- and Ethernet- software- tool. Here the tool “Hercules” is used. This tool and the settings made here are examples for your PC- or PLC application, and all settings necessary you can see in these examples. If you also like to use the tool Hercules SETUP utility - produced by www.HW-group.com, you can download as freeware.

5.1.1 Ethernet, Port 2005 / 2006

Numerical data, which has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

The sensor here is the (socket-) “server" and serves the Data via a „server-socket" interface. This is basically a “programming interface”. To read or process the Data a “socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

Handling, settings

5.1.1.1 Ethernet example 1: Pure data output from Vision Sensor to PC / PLC

Step 1:

After the job with all necessary detectors, if so alignment is set up, here the Ethernet interface get´s activated and if necessary it´s parameter are set also.

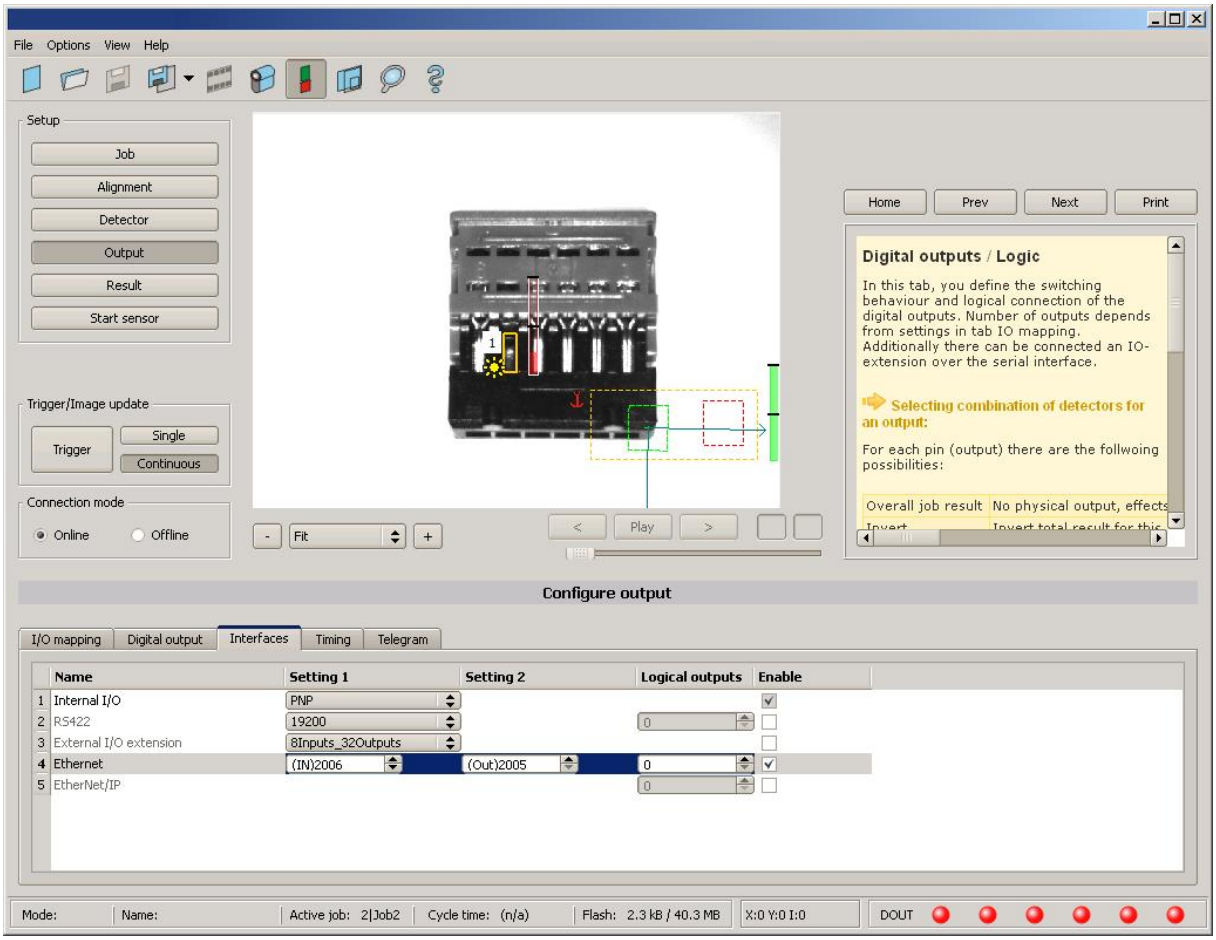


Fig. 127: Data output, Ethernet

In the example the Ethernet interface in the parameter field at the bottom in tab “interfaces” is activated by marking the checkbox. The default settings for input port (IN) = 2006 and output port (OUT) = 2005 remain as they are in this example. Of course here any other settings can be chosen to do a setup which fit to your network environment. If necessary please contact your network administrator.

Step 2:

In tab „Telegram“ the payload which should be transferred via Ethernet port 2005 are set up.

In this example it is:

- Start: „010“
- Overall result of detector 1
- Trailer: „xxx“
- As format „ASCII“ is defined, that makes traceability easier. The function with other payload data or in binary format works analogue to this example and to the here made settings.

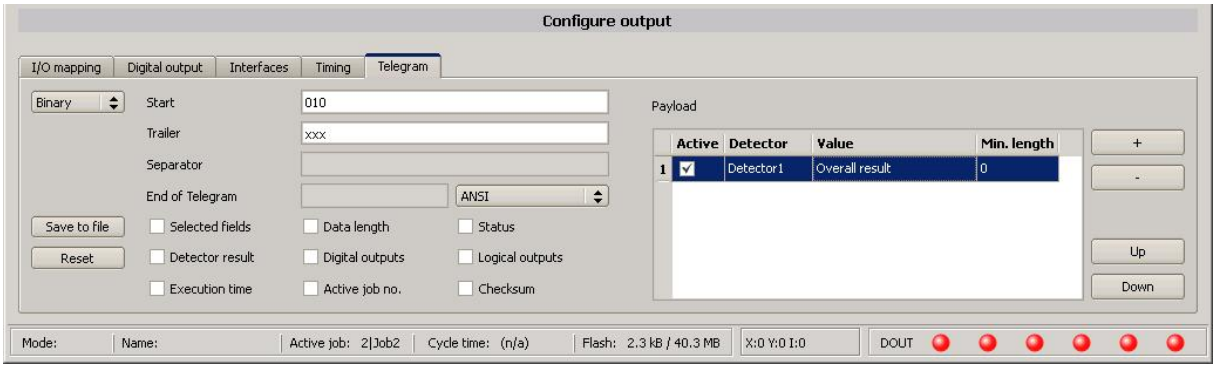


Fig. 128: Data output, configuration of output data

Step 3:

After starting the Ethernet tool „Hercules“ the tab „TCP-Client“ must be selected to communicate via Ethernet with the socket- server Vision Sensor.

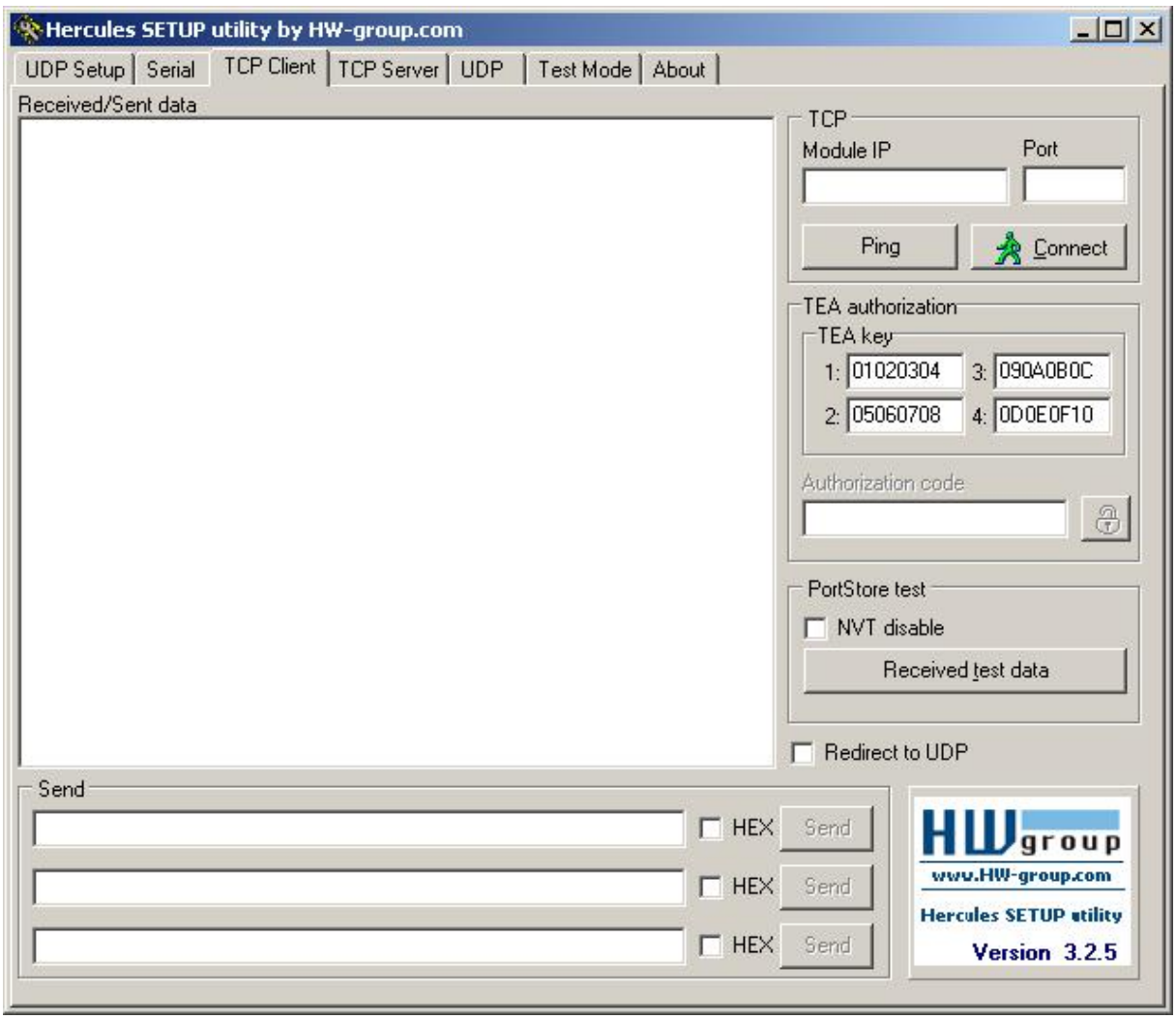


Fig. 129: Data output, Ethernet tool / 1

Here the IP address of the des Vision Sensor and the correct port number must be set up to receive data.

The IP address of the Vision Sensor you find in Vision Sensor Device Manager. Please look at the first line in the window „Active Sensors“ = 192.168.60.199

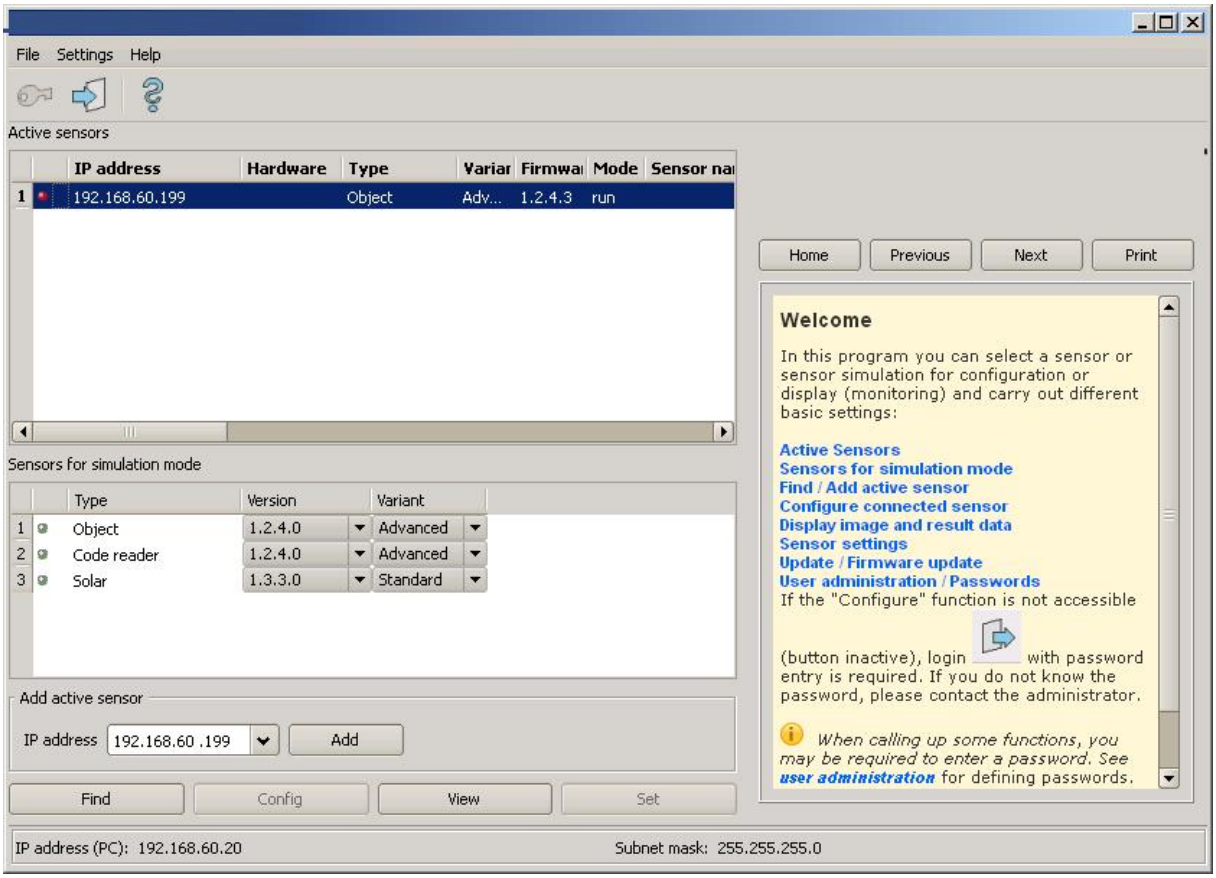


Fig. 130: Vision Sensor Device Manager, IP address ...

The port number for the output port was taken over from Step 1 with port 2005.

Step 4:

Therefore the following settings are made in Hercules: Module IP = 192.168.60.199, Port = 2005.

The rest of all settings remain on default. With a click to the button „Connect“ the connection to the Vision Sensor is established and shown in the main window in green letters.

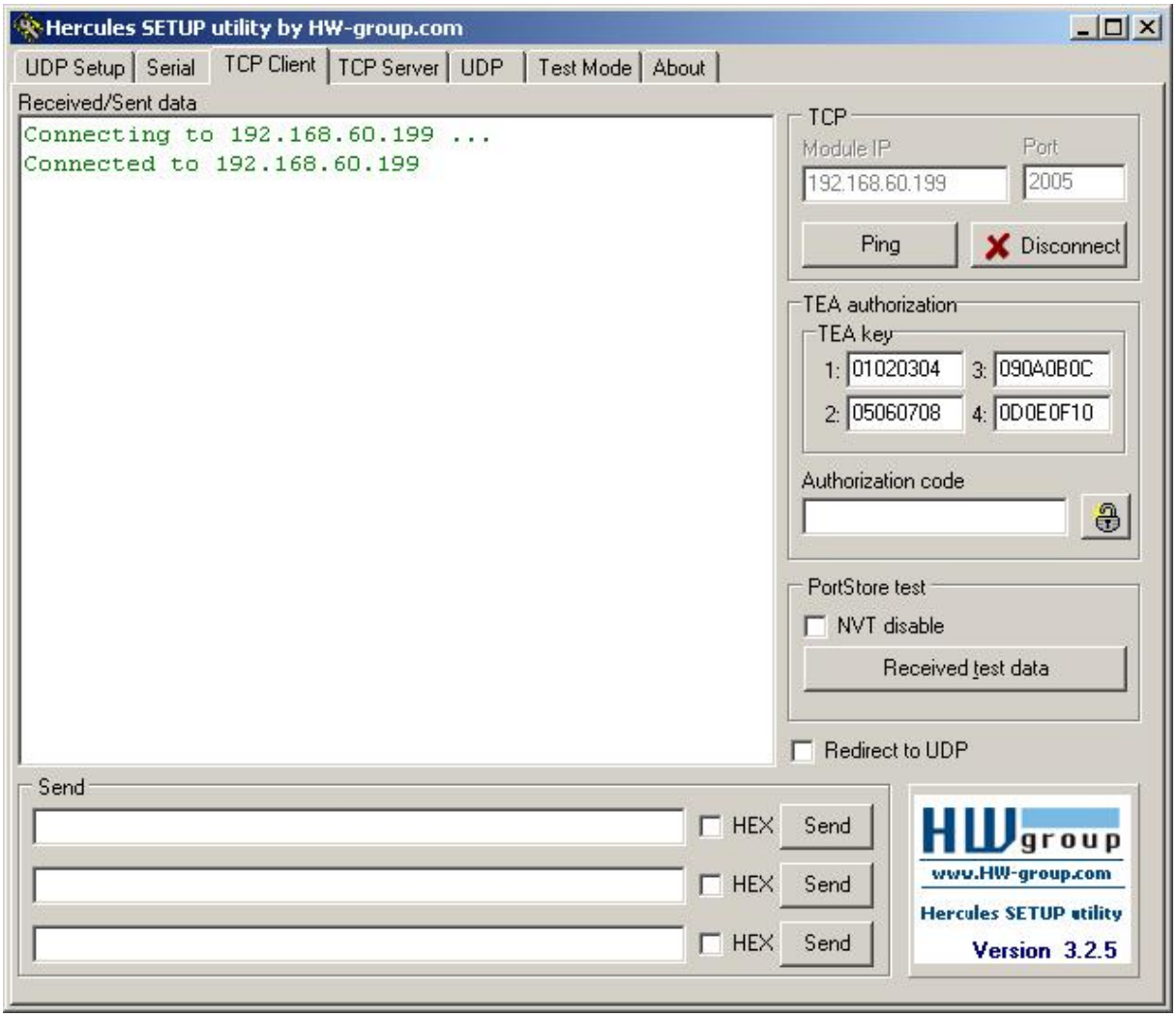


Fig. 131: Figure 168 Data output, Ethernet Tool / 2

Step 5:

The Vision Sensornow needs to be started form the PC application with „Start sensor“. (Later in autonomous operation the Vision Sensor directly starts after power on, and sends data, if configured this way).

In the example Trigger mode is “Continuous”, that means evaluation is done continuously and data is sent continuously too. All this data is visible in the main window of Hercules.

Fig. 132: Data output, Ethernet, Start sensor

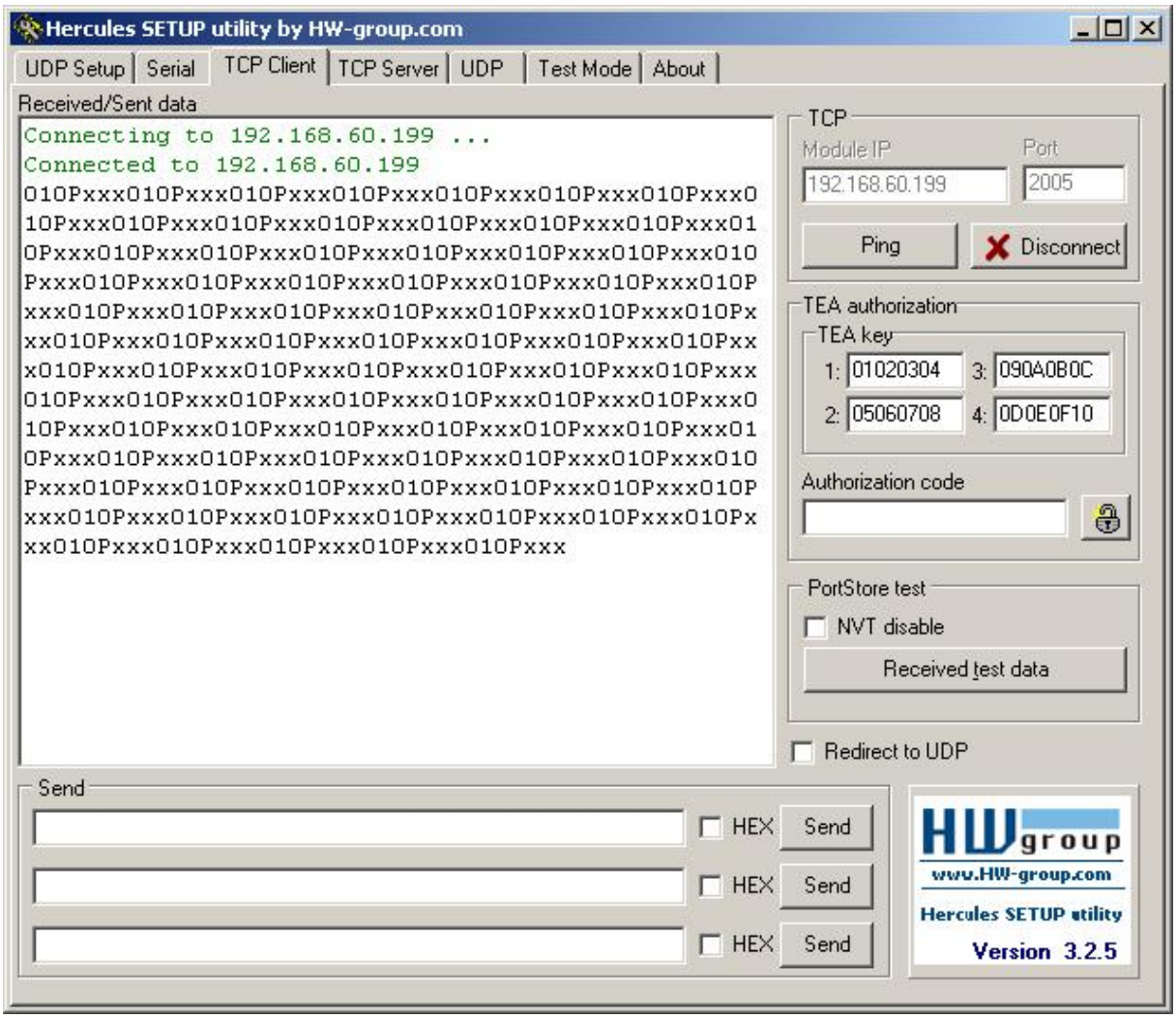


Fig. 133: Data output, Ethernet, Tool / 3

Then here visible data are displayed (as set up in „Output“):

- Start: „010“
- Overall result of detector 1 („P“ for positive, as result of detector Brightness is = “Pass”)
- Trailer: „xxx“

5.1.1.2 Ethernet example 2: commands (requests) from PC / PLC to Vision Sensor

With response / data output from Vision Sensor

Step 1

For better traceability in this example the triggered mode is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings remain the same like in example 1.

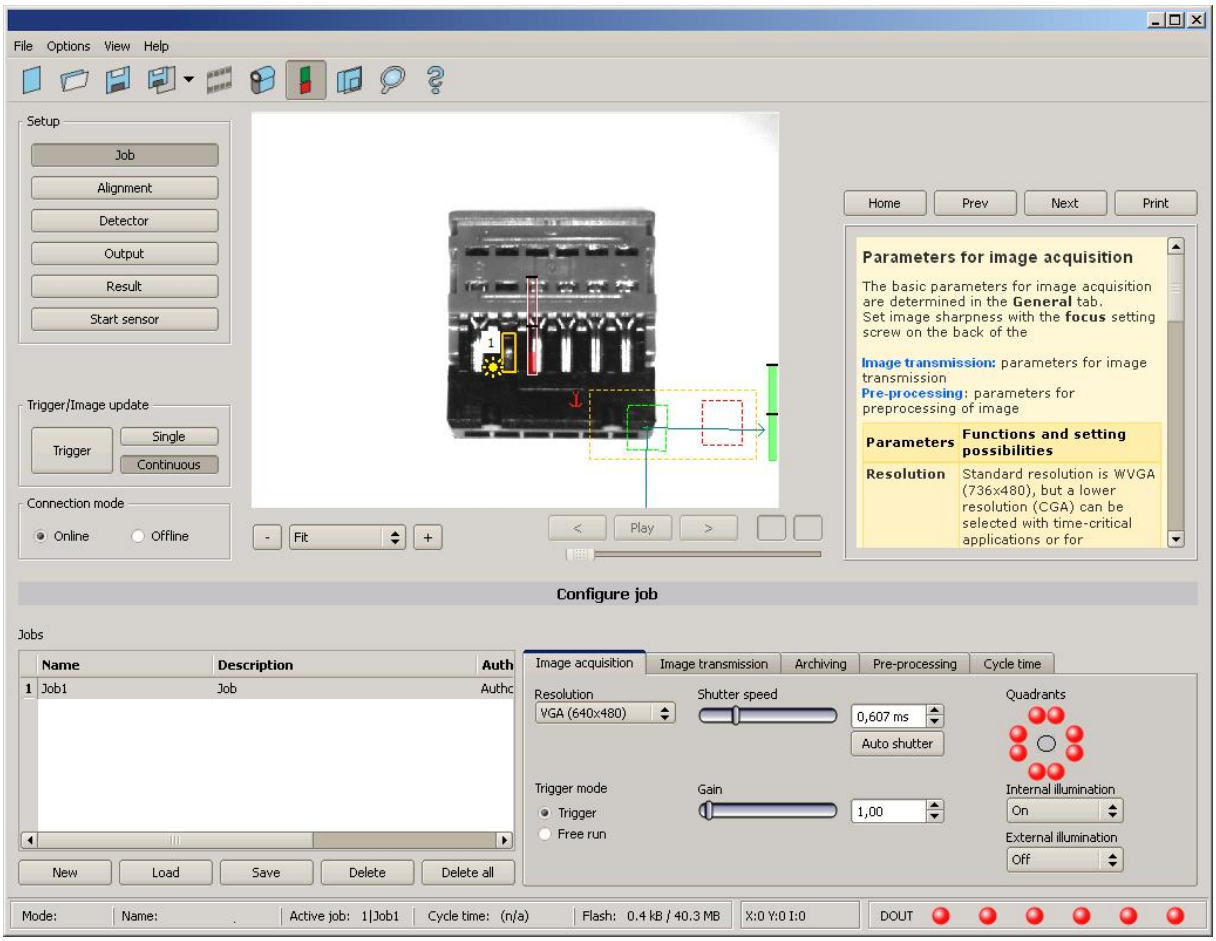


Fig. 134: Data output, Ethernet, Trigger

Step 2

To send commands / requests to the Vision Sensor, a second instance of Hercules is started. This time with Port 2006 as input port of the Vision Sensor, where it can receive commands. All telegrams

(commands and response strings) to and from the Vision Sensor you find in chap. Serial Communication ASCII ff...

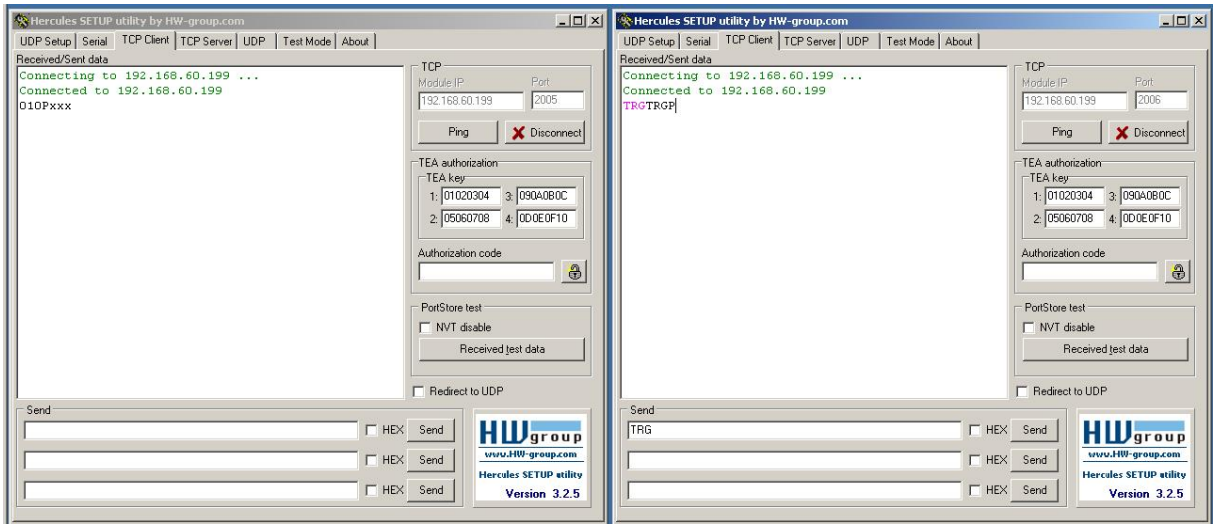


Fig. 135: Data output, Ethernet Tool / 4

In the window to the right the command "TRG" (for Trigger, command s. below, first line) was sent to the Vision Sensor, by a click to the according button "Send". This command is shown as soon as it´s sent in the main window in red letters.

The Vision Sensor responds via port 2006 as a acknowledge to the command with „TRG", and in this case with „P" for a positive result for detector 1, both in black letters, also in the right Hercules window.

In the left window the Vision Sensor sends via the output port 2005 the Output defined values „010Pxxx", like in example Ethernet 1. (Right window)

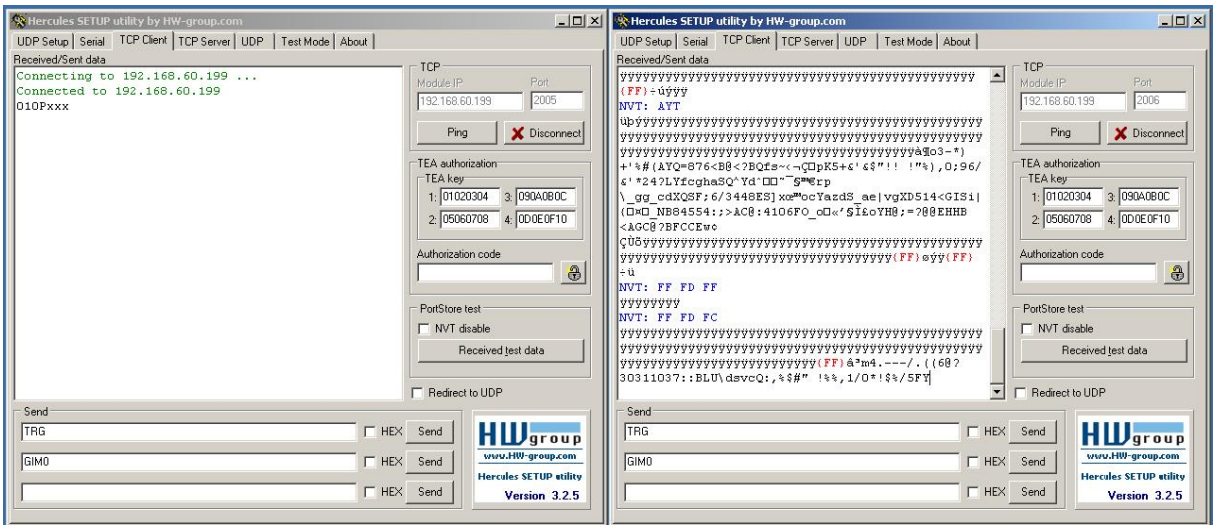


Fig. 136: Data output, Ethernet Tool / 5

In the example the command GIM0 (GetIMage0) was sent to the Vision Sensor. It responds with the binary image data which are shown in the right window. That means, the data output of the manually under

„Output“ defined payload data happened via port 2005. But the response to the request „GIM0“ was transferred via port 2006. This rule is valid for all payload- or response data.

Attention: to use the command GIMx the image recorder must be switched on.

5.1.1.2.1 Ethernet example 2.1 command job switch from PC/PLC to Vision Sensor

With response / data output from Vision Sensor

Step 1

For better traceability in this example the triggered mode and ASCII format is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings remain the same like in example 1.

For this example Job 1 was set up with the below visible data output:

- Start: „010“
- Trailer: „xxx“

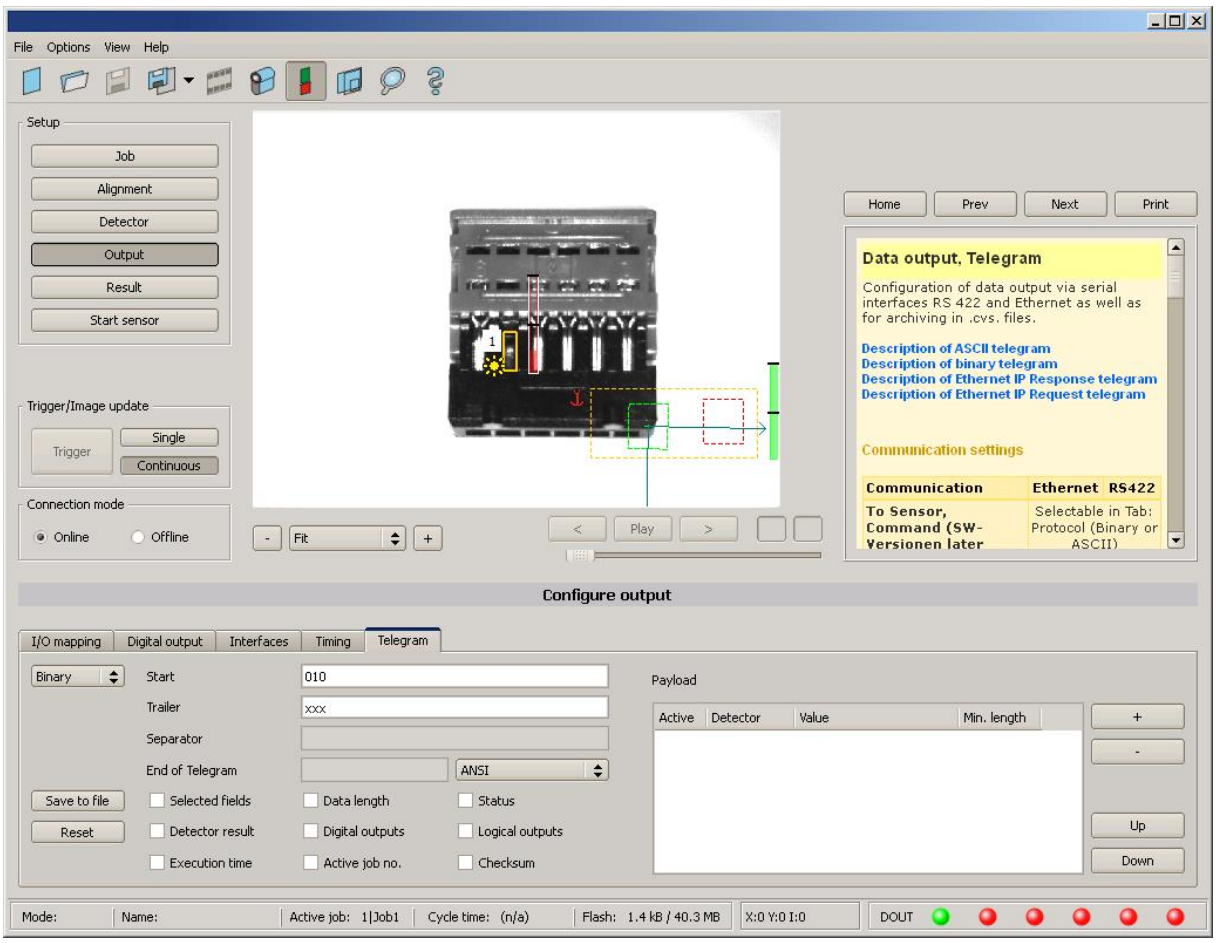


Fig. 137: Data output, Ethernet, Job switch Job 1

Job2 was set up with detector 1 and data output:

- Start: „020“
- Overall result of detector 1
- Trailer: „yyy“

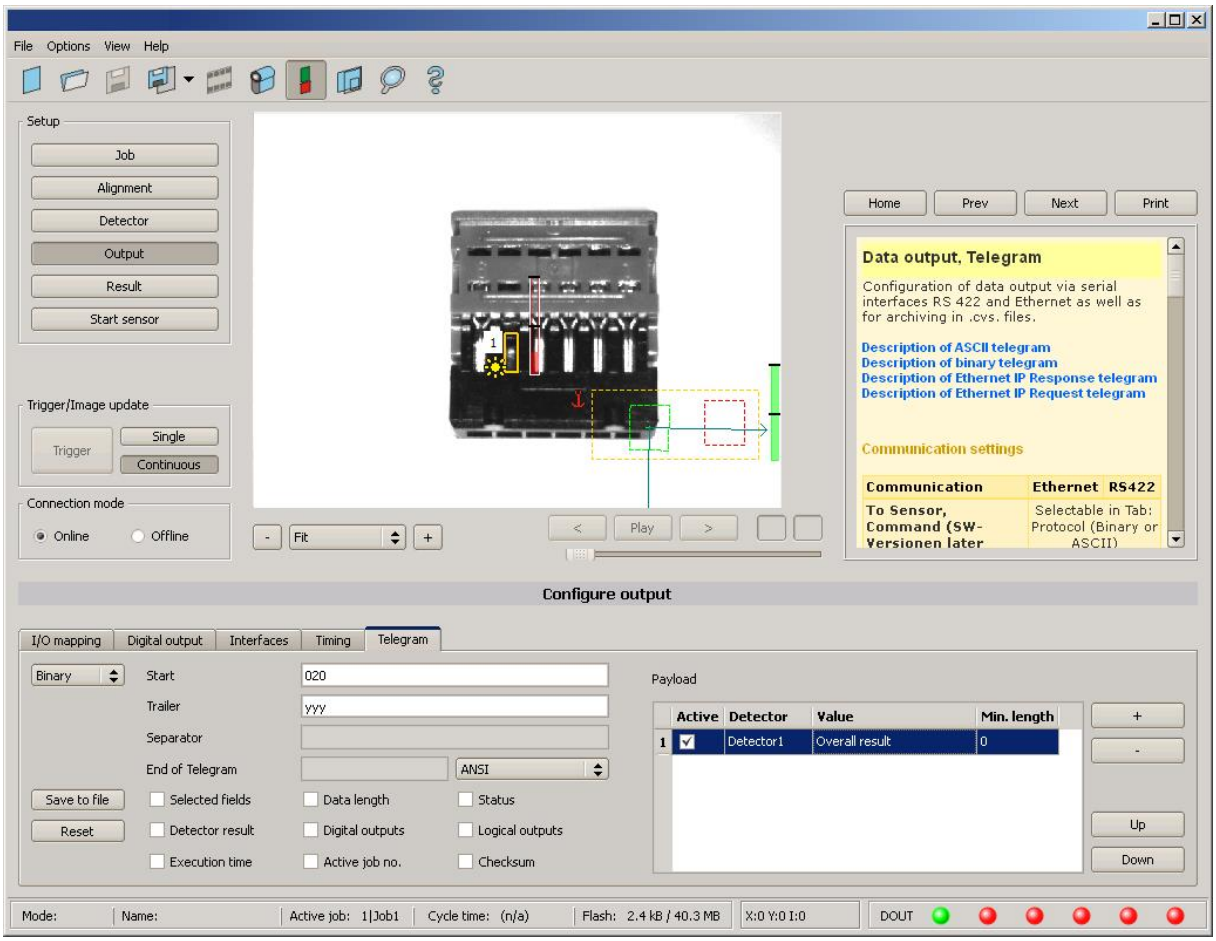


Fig. 138: Data output, Ethernet, Job switch, Job 2

Step 2

Here the application Hercules is started two times again. First with port 2005 (to receive results like defined under „Output“) and port 2006 (commands and response), as the input port of the Vision Sensor to receive commands.

All telegrams (commands and response strings) to and from Vision Sensor you find in chap. Serial Communication ASCII ff.

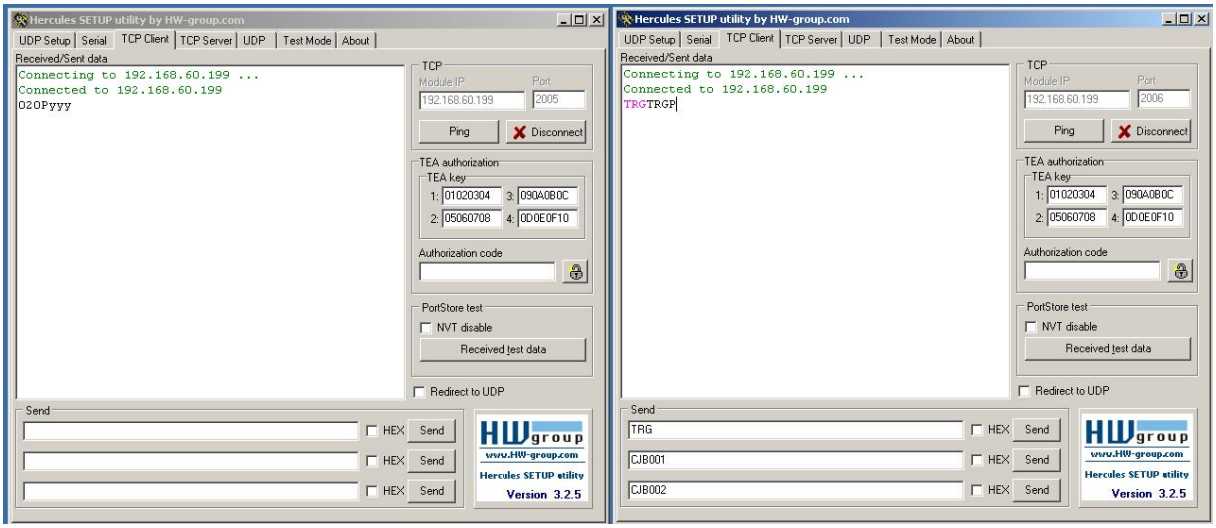


Fig. 139: Data output, Ethernet, Job switch, tool / 1

In the window to the right (port 2006) the command TRG (Trigger, s. below, first line "Send") was sent. This is displayed in the main window in red letters "TRG". The Vision Sensor responds with the acknowledge „TRGP" (repetition of the command „TRG" and „P" for positive)

In the window to the left (port 2005) the Vision Sensor, where currently Job2is active, sends the according result string which was defined under "Output" in Job 2 with „020Pyyy".

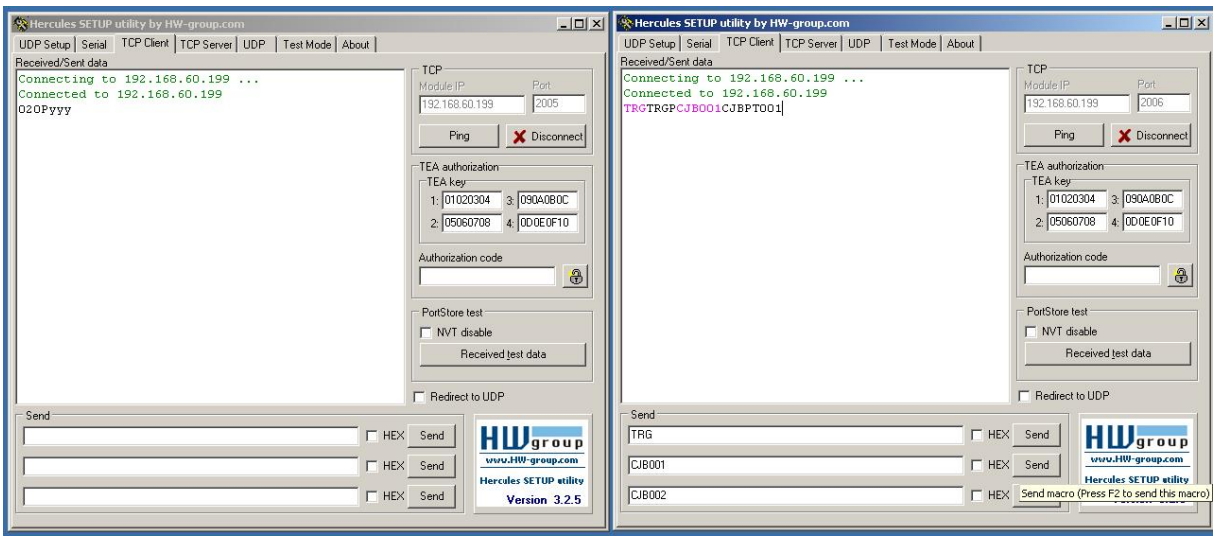


Fig. 140: Data output, Ethernet, Job switch, tool / 2

Now in the right window (port2006) the command CJB001 (ChangeJoB 001, 001 = Job Nr. 1, s. below, second line „Send") was sent. This is displayed in the main window in red letters "CJB001". The Vision Sensor responds with the acknowledge „CJBPT001" (repetition of command „CJB", „P" for positive, „T" = Triggered, "001" Job number to which was switched)

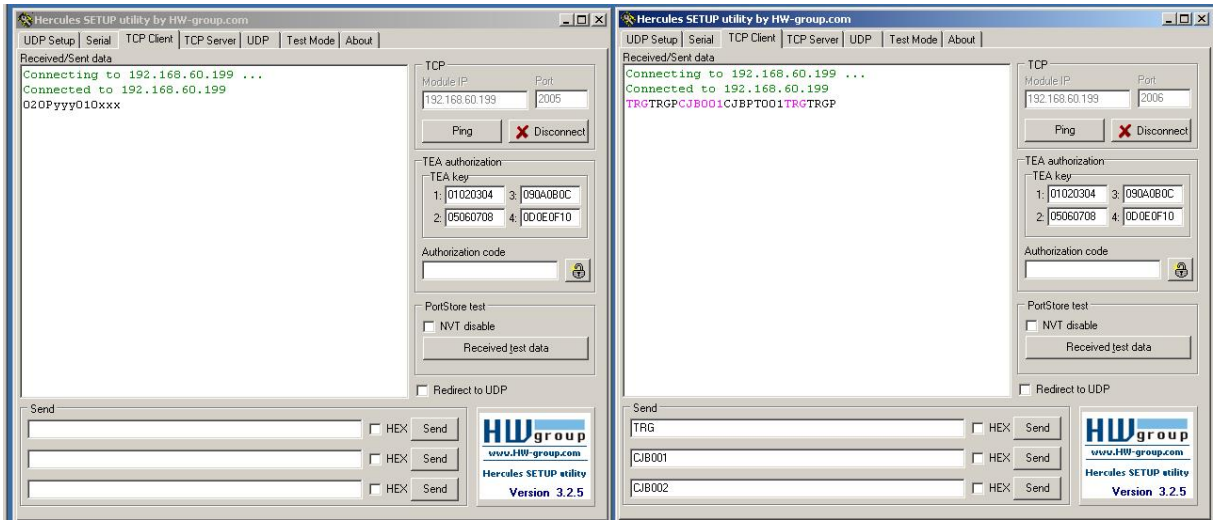


Fig. 141: Data output, Ethernet, Job switch, tool / 3

After the next Trigger command TRG (s. below third line „Send“) the command „TRG“ is displayed again in the main window in red letters. The Vision Sensor responds with „TRGP“ (repetition of command „TRG“ and „P“ for positive)

In the window left (port2005) the Vision Sensor, after switching to Job 1!, now the according result sting which was defined under Output in Job 1 with „010xxx“!

Function of the both Ethernet- ports for in- and output:

*A: Port 2005, only one direction: Sensor >> PC, all payload data, defined in „Output“

*B: Port 2006, both directions: Sensor <> PC, commands / requests to the Vision Sensor, with acknowledge, + all response data to the request (no payload data !)

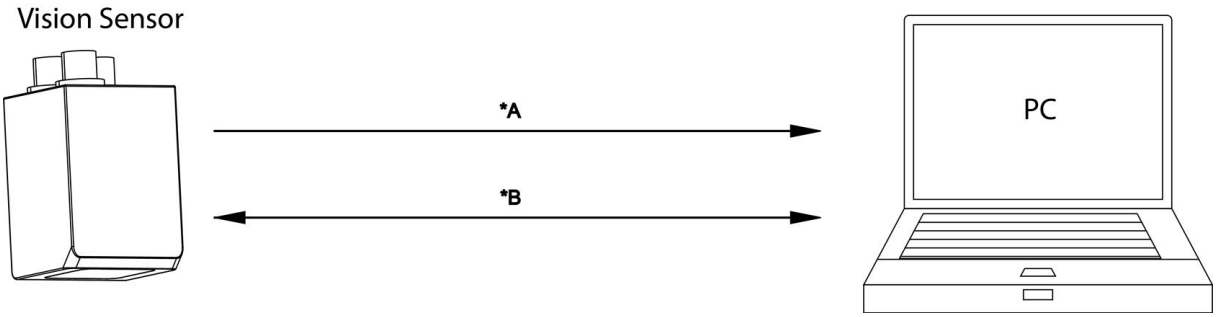


Fig. 142: Ethernet- ports

5.1.2 RS422

Numerical data that has been defined under Output/Telegram, now can be transferred in ASCII- or Binary- format.

Ethernet: The sensor here is the (socket-)“server" and serves the Data via a „server-socket" interface . This is basically a “program interface”. To read or process the Data a “socket client" (PC, PLC, ...) must establish a (socket-) connection (active) to the sensor.

Handling, settings

5.1.2.1 RS422 example 1: Data output from Vision Sensor to PC / PLC, and commands (requests) to the Vision Sensor

With response / Data output from Vision Sensor

Step 1:

After the job with all necessary detectors, if so alignment is set up, here the RS422 interface get´s activated and if necessary it´s parameter are set also.

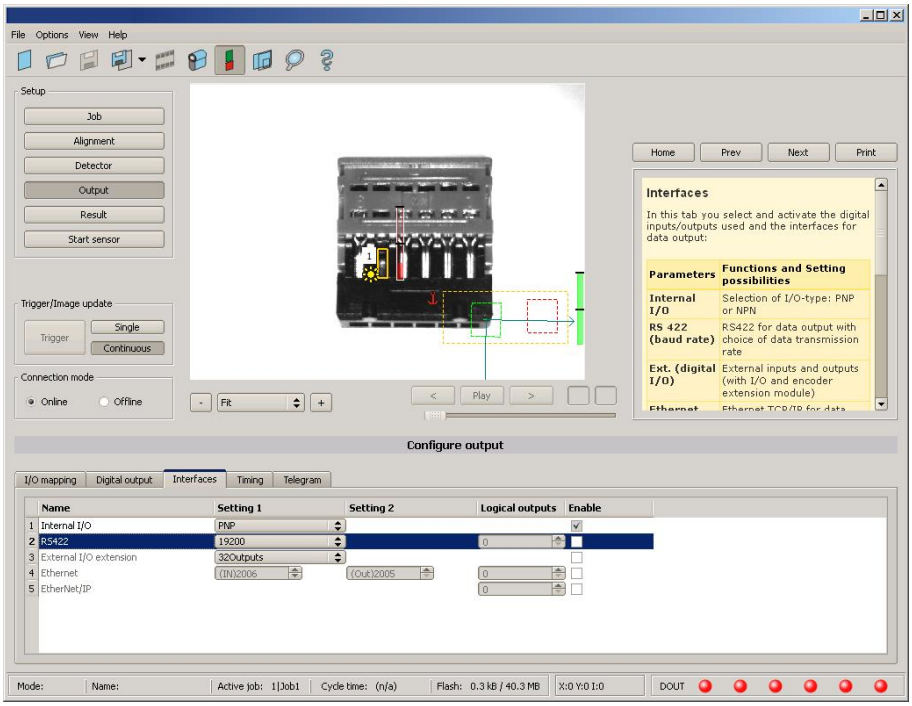


Fig. 143: Data output RS422

In the example the RS422 interface in the parameter area at the bottom in tab "Interfaces" get´s activated by marking the checkbox.

The default settings for Baud rate = 19200 and Logical outputs = 0 remain as they are. Here of course any other settings can be done which must have its corresponding setting at the other side (at the PC or PLC, whatever used)

Step 2:

In tab „Output" the payload data which shall be transferred via RS422 are defined.

In this example this is:

- Start: „010"
- Overall result of detector 1
- Trailer: „xxx"
- As format „ASCII" is defined, that makes traceability easier. The function with other payload data or in binary format works analogue to this example and to the here made settings.

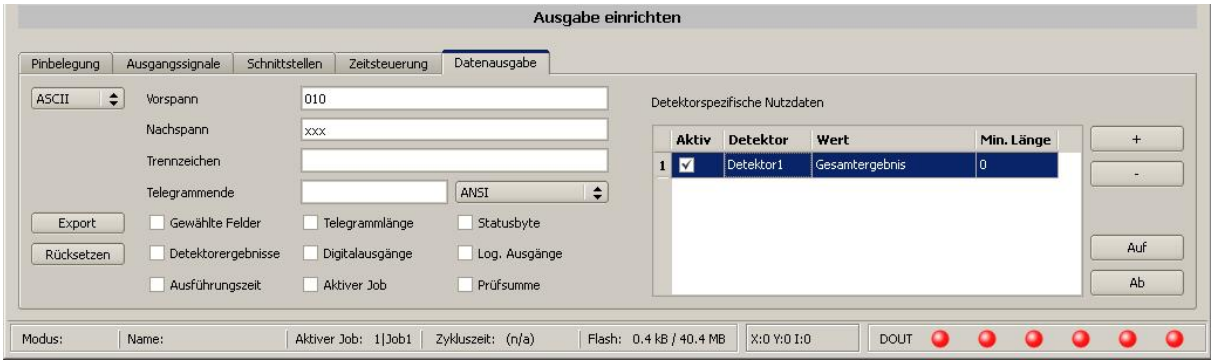


Fig. 144: Data output RS422, configuration of output data

Step 3:

The Vision Sensornow needs to be started form the PC application with „Start sensor“. (Later in autonomous operation the Vision Sensor directly starts after power on, and sends data, if configured this way).

In the example Trigger mode is continuous, that means evaluation is done continuously and data is sent continuously too. All this data is visible in the main window of Hercules.

Fig. 145: Start sensor

Step 4:

After start of Serial- tool Hercules, tab „Serial“ must be selected to communicate via RS422 with the socket server Vision Sensor.

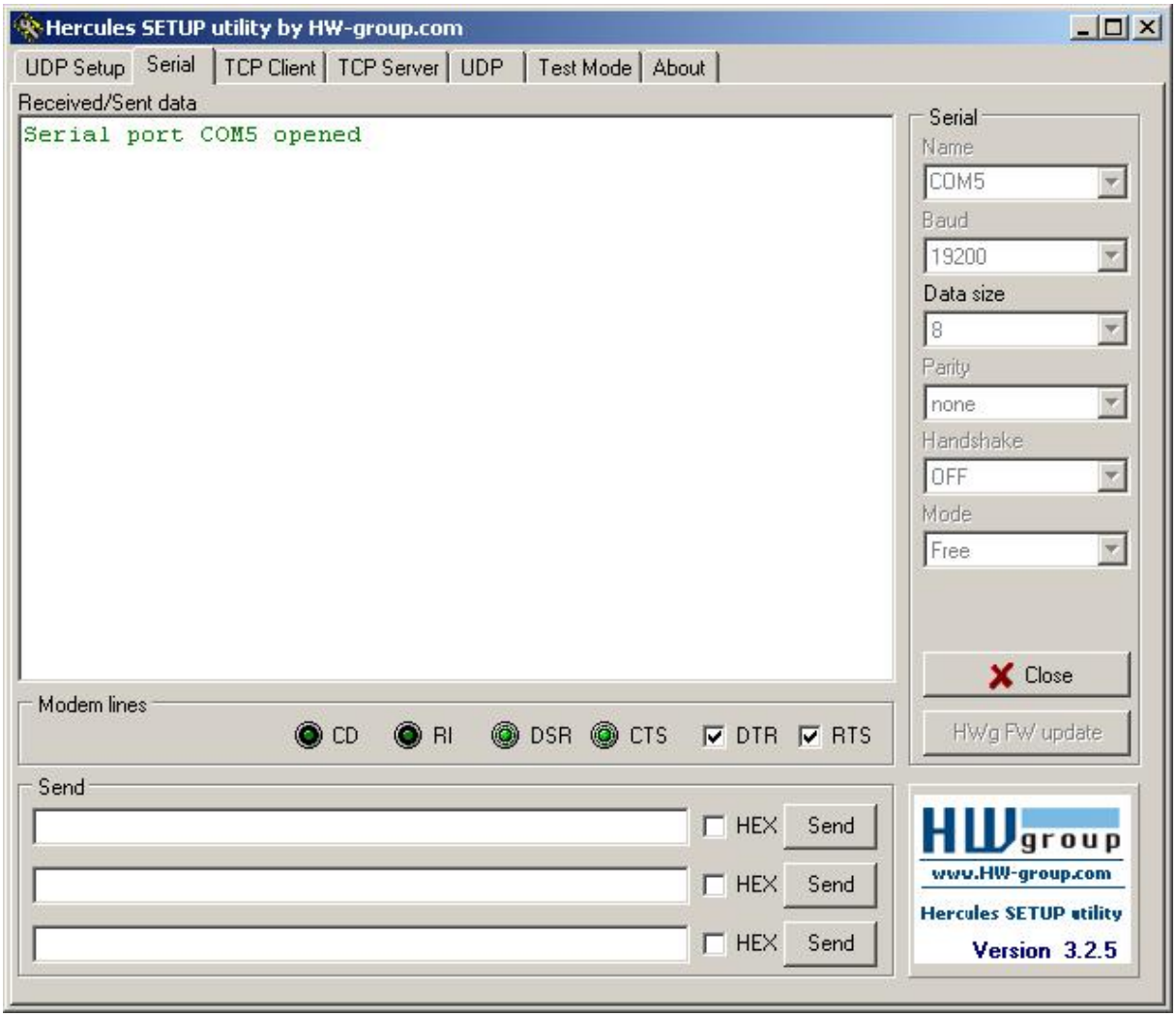


Fig. 146: Data output, RS422 tool / 1

Now the corresponding settings for baud rate like in Vision Sensor must be done. Also the correct serial port COMx must be set up her to receive data.

The baud rate you see in tab Output/Interfaces. The number of the serial COM port (COM x of the PC) you find out in Windows at: Start/Control Panel/Performance and Maintenance/System/Hardware/Device Manager, at Universal Serial Bus Controllers. (Here COM5).

The rest of the settings at the right are the default values of Hercules. „DTR“ and „RTS“ must be activated. With a click to the button „Connect“ the connection to the Vision Sensor is established and shown in the main window in green letters.

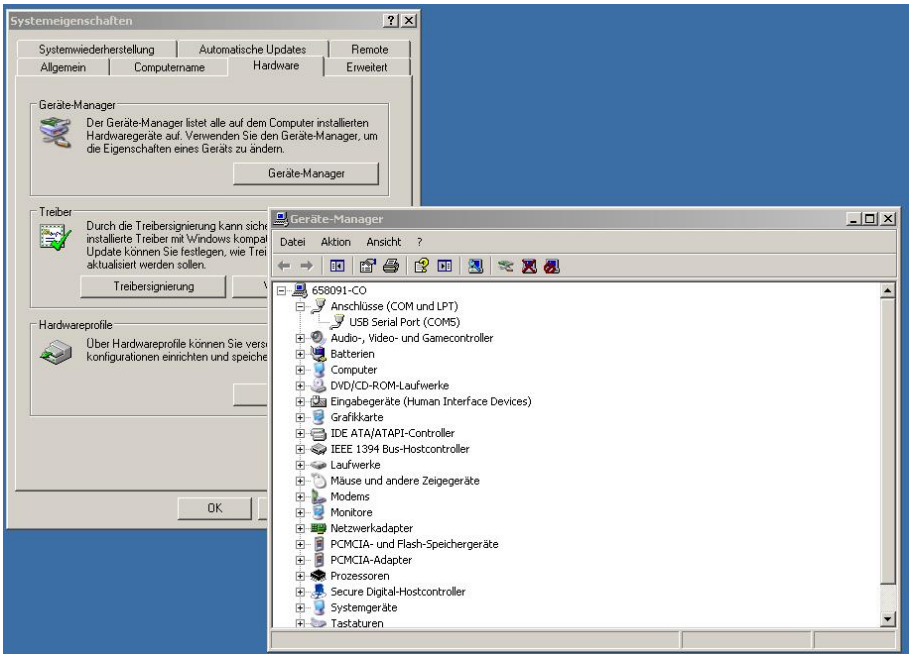


Fig. 147: Data output, RS422 COMx

Step 5:

With a click to button „Send“ the command „TRG“ is sent to the Vision Sensor. It responds with „TRG“, followed by „P“ for positive and the payload data „010Pxxx“.

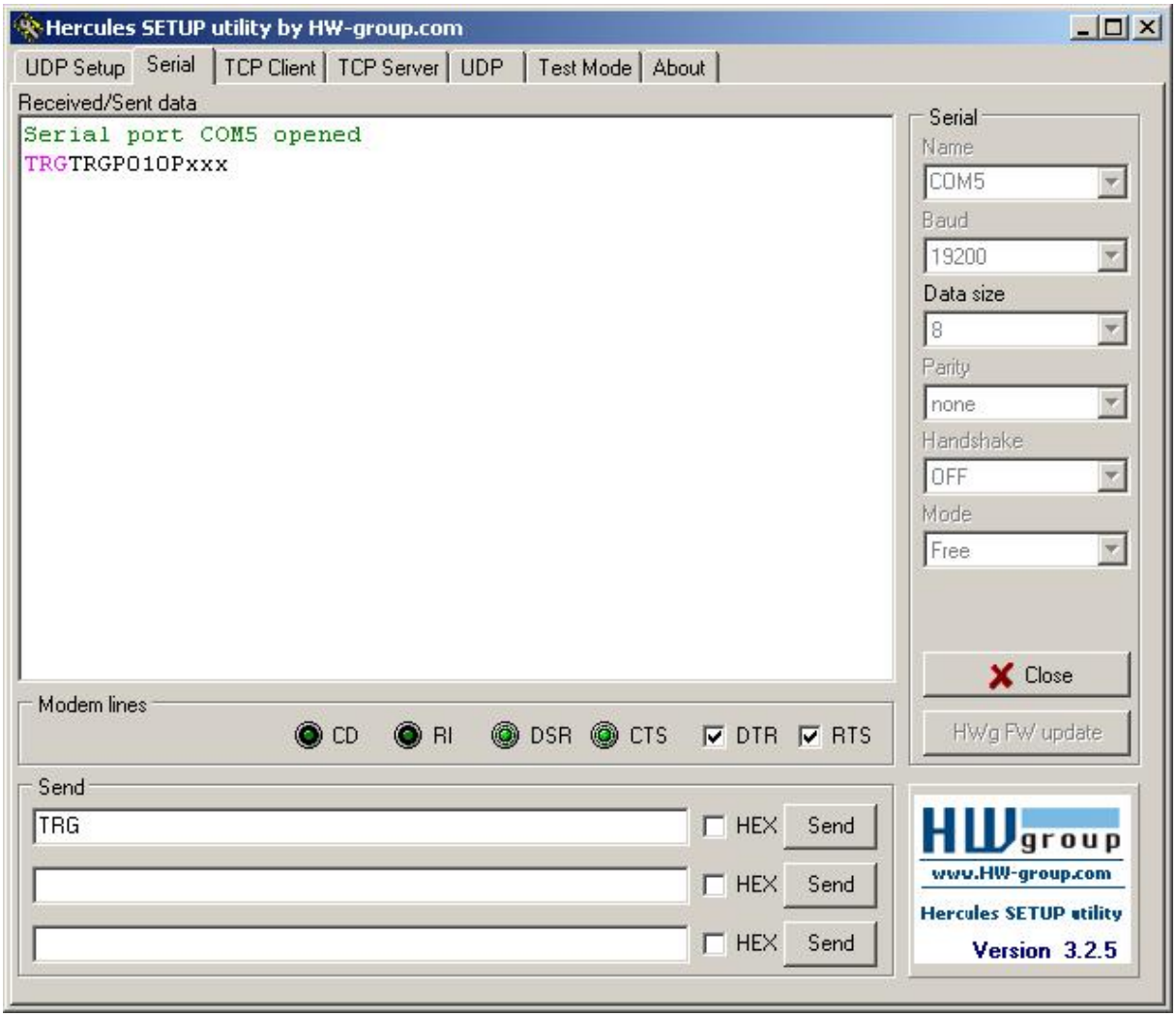


Fig. 148: Data output, RS422, tool / 2

Step 6:

In the following example the command „SST041000“ (SetShutterTemporary, 04 = number of letters of shutter value, 1000 = shutter value in microseconds) is sent and the Vision Sensor responds with SSTP (SetShutterTemporary, P = positive). All available telegrams you find in chap. Serial Communication ASCII ff. and are used in analogue way.

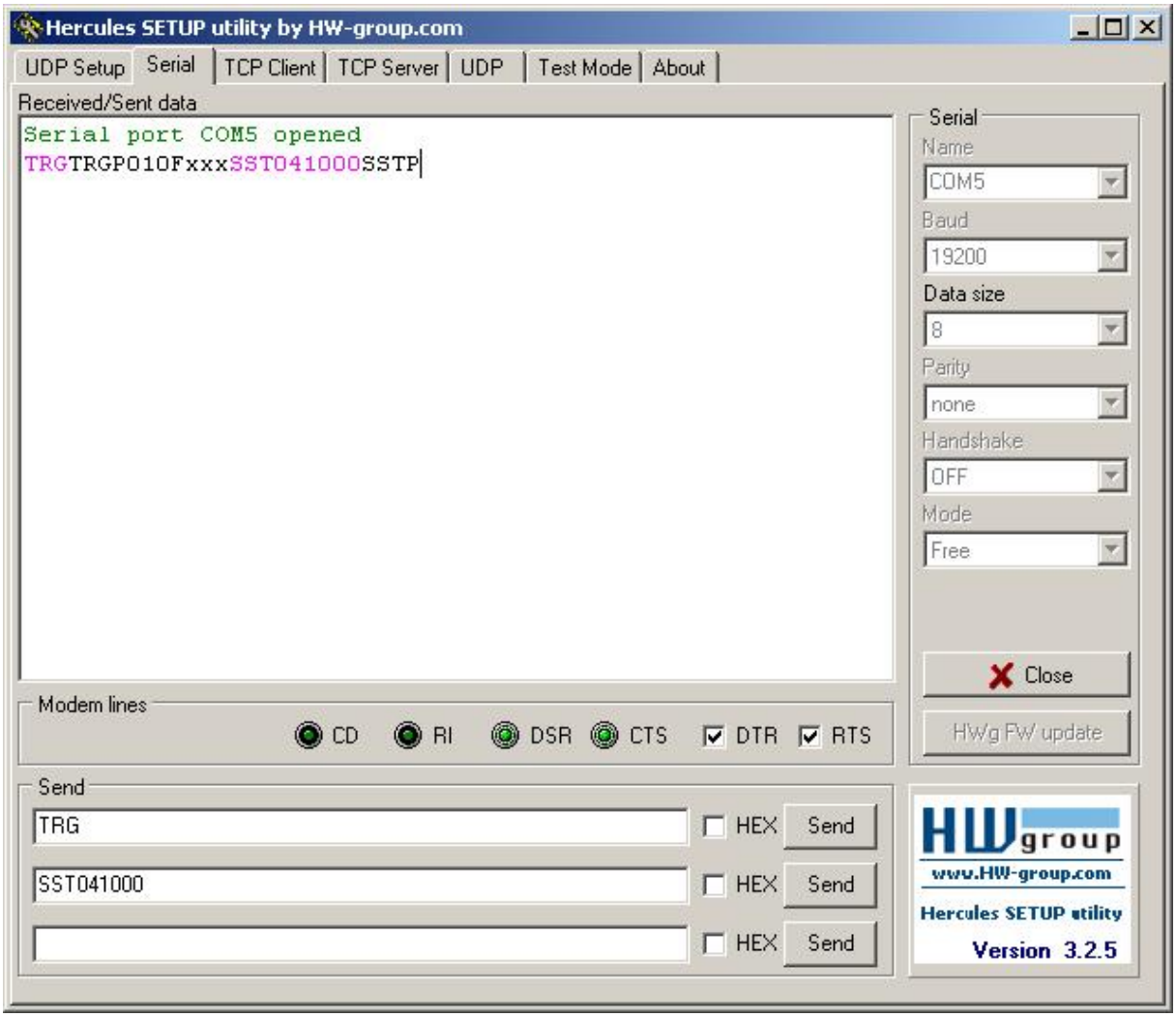


Fig. 149: Data output, RS422, tool / 3

5.1.2.1.1 RS422 example 1.1: command Job switch from PC / PLC to Vision Sensor

With response / data outputs from Vision Sensor

Step 1

Here the same setting for Job and Output are used as in „Ethernet Example 2.1“.

For better traceability in this example the triggered mode and ASCII format is used. That can be done as follows: Adjust Job/Image acquisition/Trigger mode = Trigger. All other settings remain the same like in example 1. In Output/Interfaces here the interface RS422 was activated.

For this example Job 1 was set up with the below visible data output:

- Start: „010“
- Trailer: „xxx“

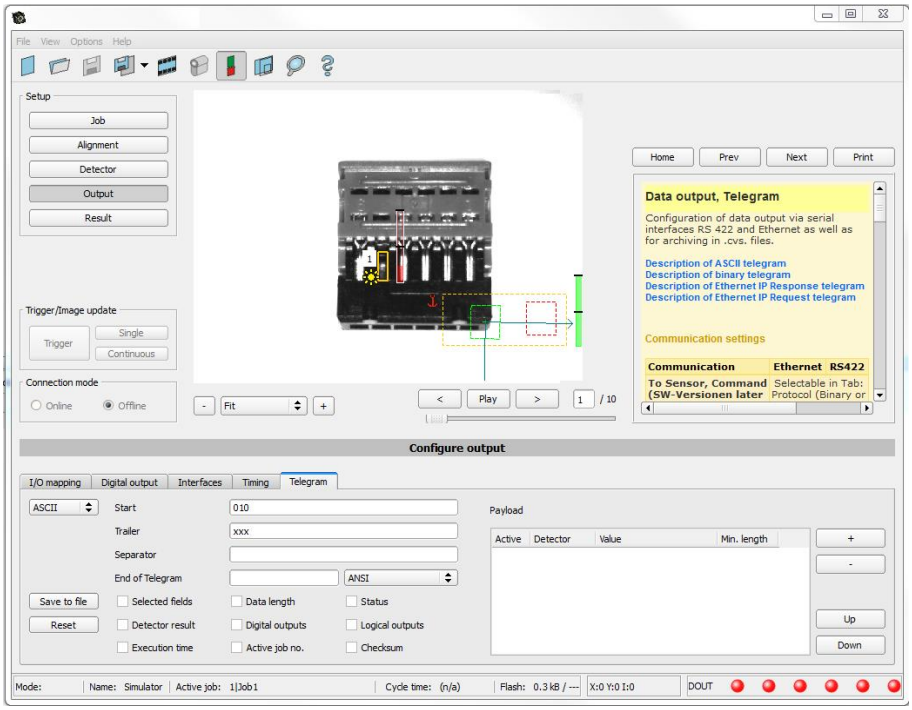


Fig. 150: Data output, RS422, Job switch, Job 1

Job2 was set up with detector 1 and data output:

- Start: „020“
- Overall result of detector 1
- Trailer: „yyy“

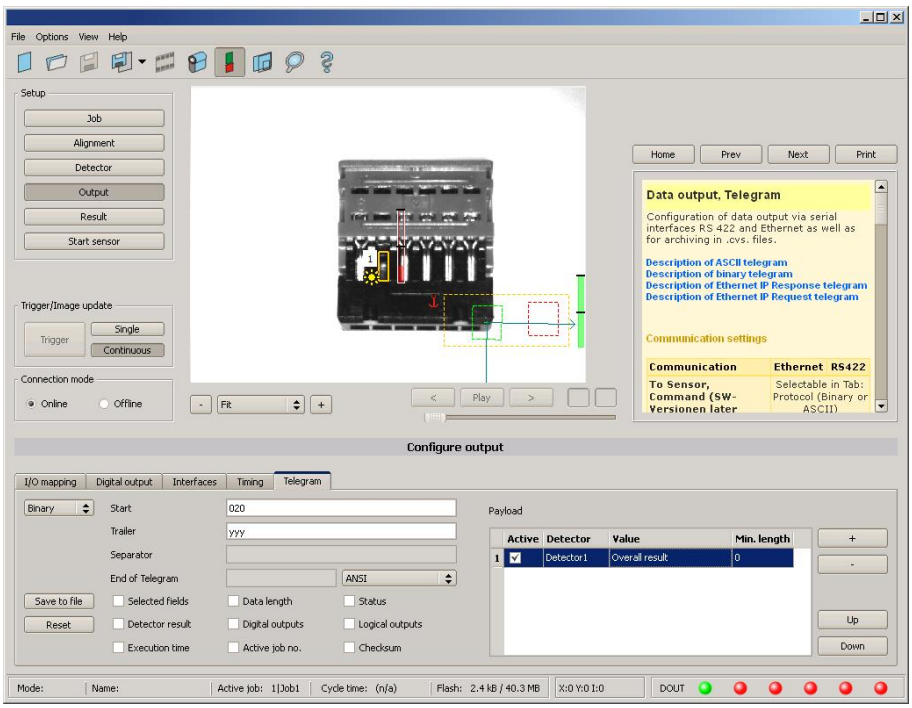


Fig. 151: Data output, RS422, Job switch, Job 2

Step 2

After start of Serial- tool Hercules, tab „Serial“ must be selected to communicate via RS422 with the socket server Vision Sensor.

Now the corresponding settings for baud rate like in Vision Sensor must be done. Also the correct serial port COMx must be set up here to receive data.

The baud rate you see in tab Output/Interfaces. The number of the serial COM port (COM x of the PC) you find out in Windows at: Start/Control Panel/Performance and Maintenance/System/Hardware/Device Manager, at Universal Serial Bus Controllers. (Here COM5).

The rest of the settings at the right are the default values of Hercules. „DTR“ and „RTS“ must be activated. With a click to the button „Connect“ the connection to the Vision Sensor is established and shown in the main window in green letters.

Step 3

With the command „TRG“ (Trigger, s. below, line 1, „Send“) an image acquisition and an evaluation was initiated. The Vision Sensor immediately responds with „TRGP“ („P“ for positive). Also, as in this moment Job1 is active, the result data string „010xxx“ is sent.

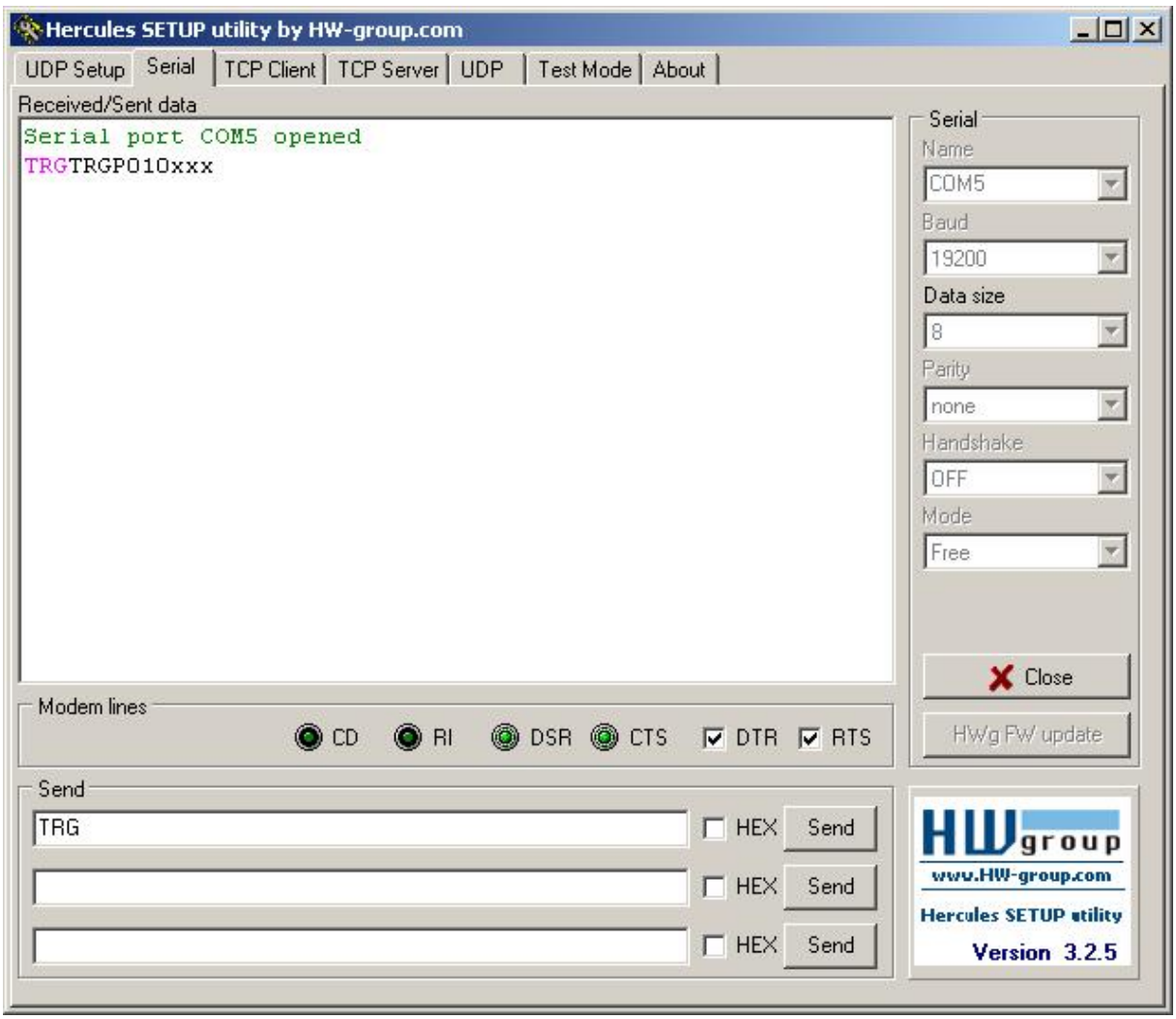


Fig. 152: Data output, RS422, Job switch tool / 1

Step 4

With the command „CJB002“ (ChangeJoB, Job Nr. 002, s. below line2, “Send“) the Vision Sensor now switches to Job 2.

The response: „CJBPT002“ (repetition of command „CJB“, „P“ for positive, „T“ = Triggered, 002 Job number switched to) is sent and displayed in main window.

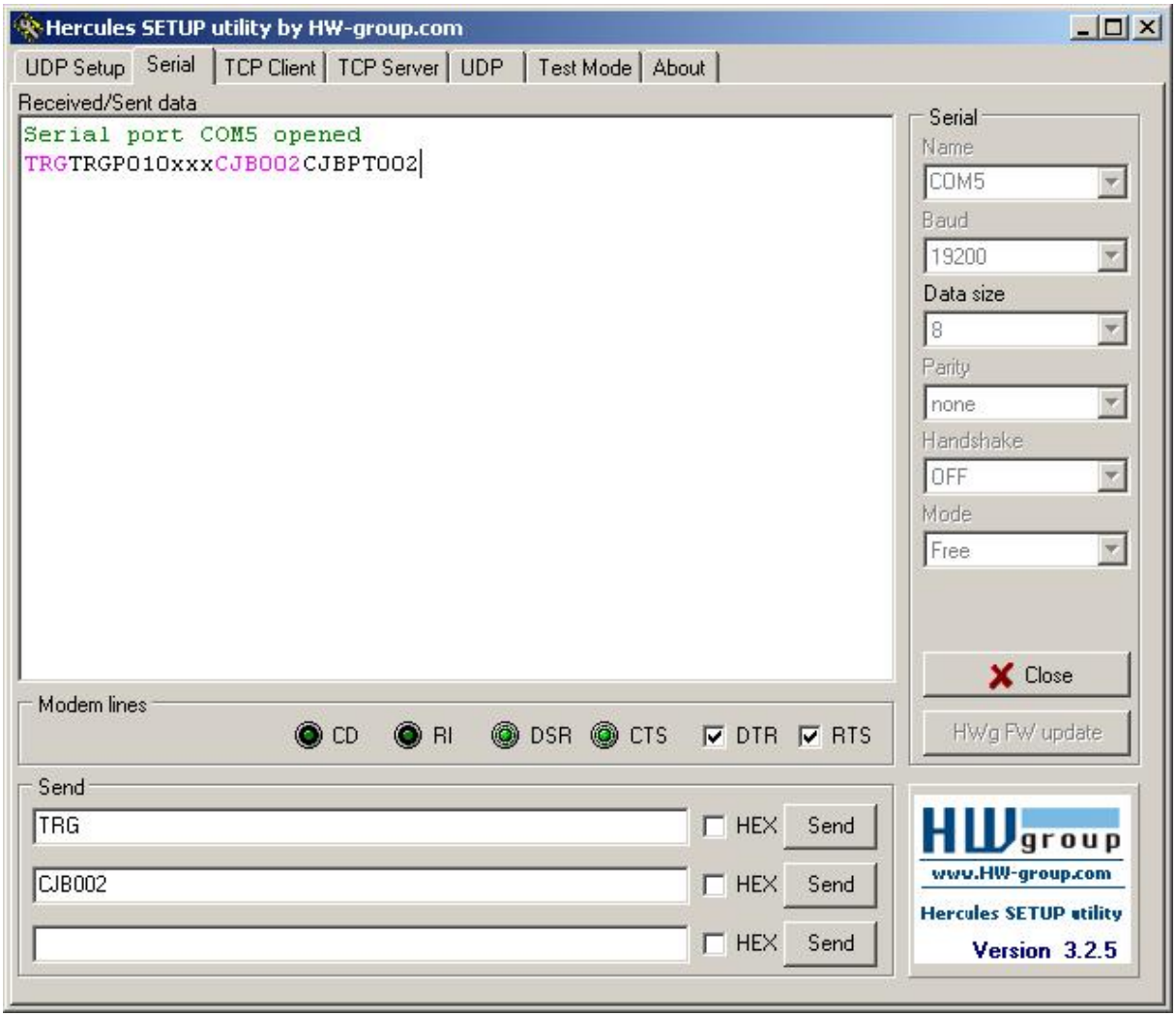


Fig. 153: Data output, RS422, Job switch tool / 2

Step 5

After the next Trigger command TRG (s. below line 1, „Send“) the command “TRG” the next evaluation is performed and the response „TRGP“ (repetition of command „TRG“ and „P“ for positive) is sent. Also, as now Job 2 is active, the result string „020Pyyy“ like in Job 2 defined is transmitted.

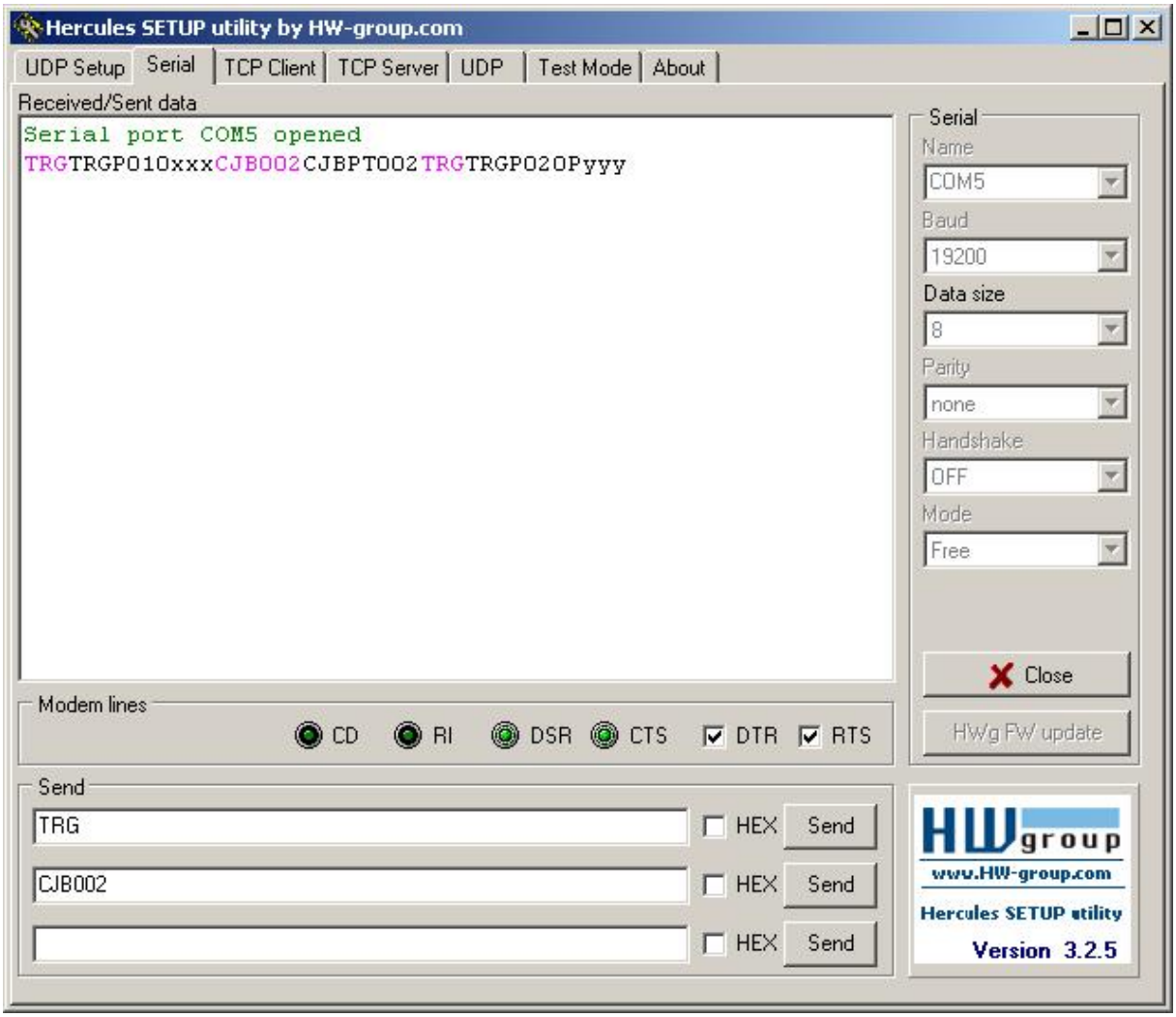


Fig. 154: Data output, RS422, Job switch tool / 3

5.1.3 PC- Archiving (Vision Sensor Visualisation Studio)

Via Vision Sensor Visualisation Studio images and numerical data (in .csv format) can be stored into a folder on the PC.

The setup (folder ...) is done via Vision Sensor Visualisation Studio in menu “File/Archiving”. This function is available on PC only.

Step 1:

Start Vision Sensor Visualisation Studio from Vision Sensor Device Manager, Click to button „View“

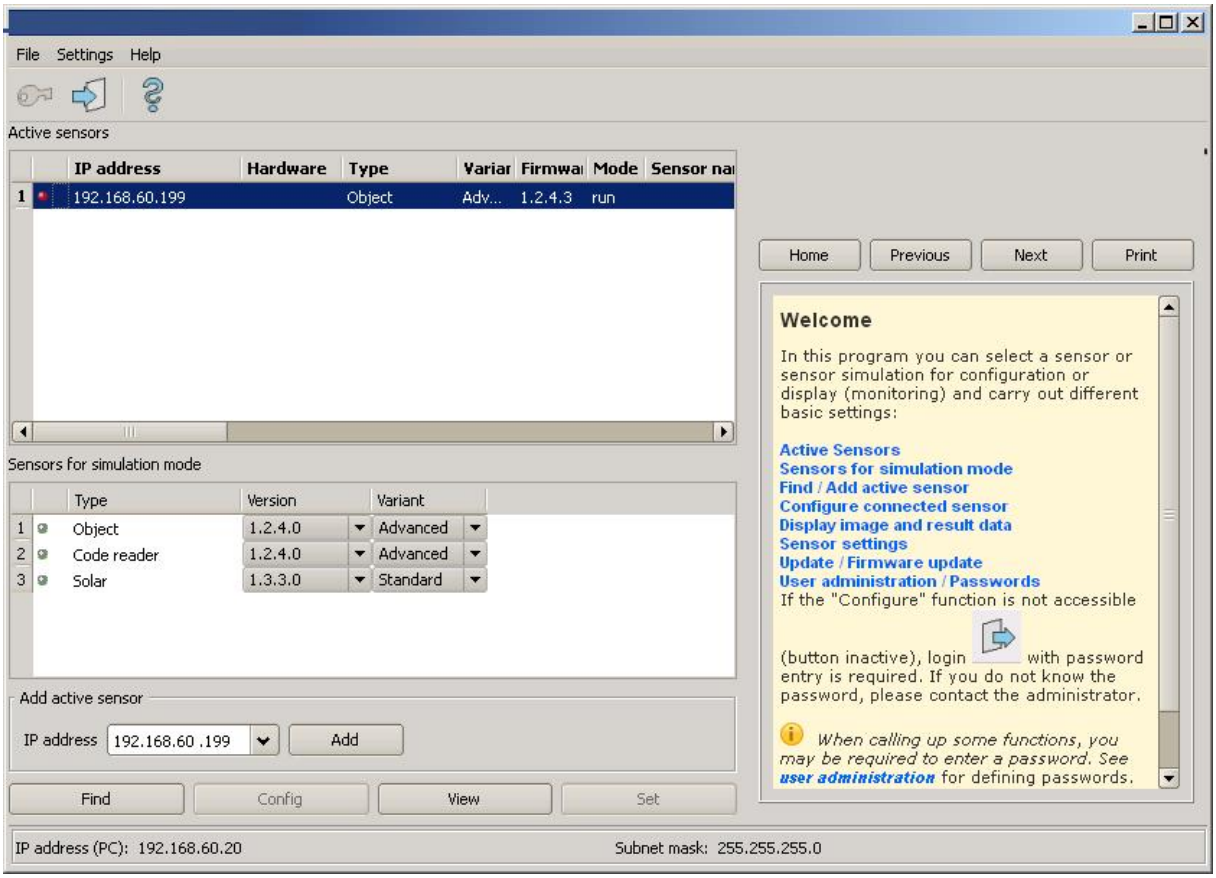


Fig. 155: Vision Sensor Device Manager

Vision Sensor Visualisation Studio is started

The conditions for a correct image display are the settings:

- Free run (set in Job/Image acquisition) or
- At least one trigger happened
- Image transmission active (set in Job/Image transmission)

Step 2

Select in menu: File/Archiving

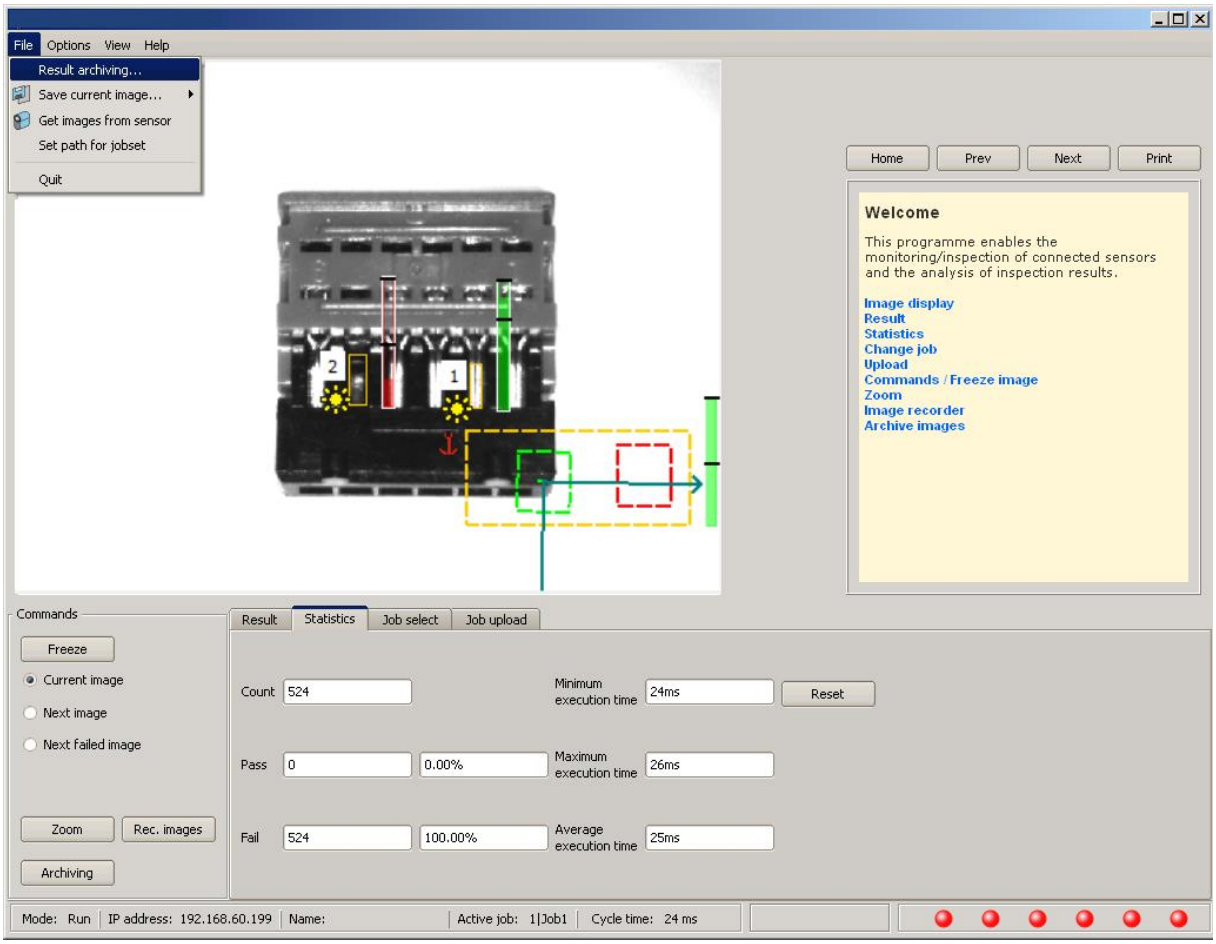


Fig. 156: Vision Sensor Visualisation Studio, Archiving

Now the following dialog box occurs to set up parameter for archiving.

Parameter	**Function**
Path for archiving	Directory in which archived file(s) are stored.
Settings, Automatic Start	Starts archiving automatically after start of Vision Sensor Visualisation Studio.
Settings, Archive image circularly	Activates cyclic overwriting of oldest images if limitation of storage is reached.
Settings, Limitation (max.)	In this drop-down menu it is possible to specify which images (all images or only good or bad images) are to be stored.
Type of images	Specifies, whether all, good or bad pictures have to be stored.
Graphics, Bar graph result	Choice of graphics to be archived in the image.
Numerical results	If "record with" is activated, numerical result data such as coordinate values etc. are archived in an additional .csv file.

Select the required options and confirm your choice with OK.

5.1.3.1 Start/end archiving:

Click on the button "Archive images" in the "Commands" filed to start or end the archiving function with the above mentioned settings. The name of the image file currently to be stored appears in the status bar. Archiving is carried out for as long as the button "Archive images" is pressed.

Fig. 157: Vision Sensor Visualisation Studio, Archiving configuration

5.1.4 Archiving via ftp or smb

With this function images and numeric result data (in .csv format) can be stored actively by the sensor via ftp/smb. This kind of archiving is configured under „Job/Archiving", in this case:

a. **With „ftp“ used**: the senor is a „ftp client" and „writes“ the data to a „ftp server" folder on a drive which is available in the network. With Job/Start the sensor connects to the ftp-Server.
b. **With „smb“ used**: the sensor „writes“ the data direct in a folder in a network. With Job/Start the sensor connects/mounts with this folder.

With this kind of data archiving in normal operation case no PC application like Vision Sensor Device Manager or Vision Sensor Configuration Studio is running, just a accordingly configured ftp- or smb- server.

5.1.4.1 Example: Archiving via ftp

In this example with the ftp- server freeware „Quick´n Easy FTP Server“ a ftp communication was established and image- and result data are stored on the hard disc of the PC.

In the ftp server with the account wizard a user account with the name „Vision Sensor_FTP was created. A password and a path for data storage have been specified, and upload and download are activated.

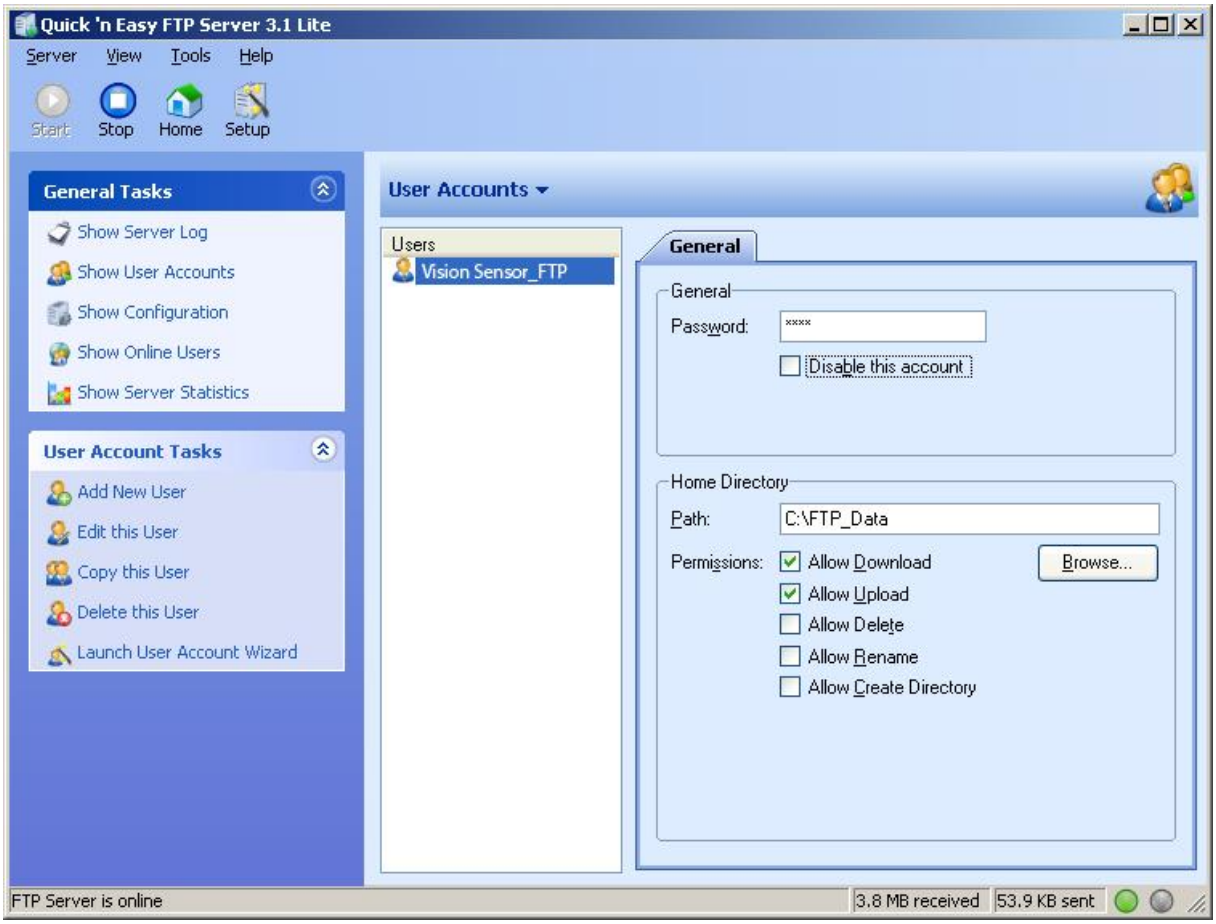


Fig. 158: FTP Server

In Vision Sensor Configuration Studio now at: Job/Archiving the according settings for the ftp server on the Vision Sensor must be done. This are:

- Archive type = FTP
- IP address = IP of the PC where the ftp server is running (IP address of PC connected you find in status line in Vision Sensor Device Manager in the corner left, below)
- User name = Name of the user account in the ftp server
- Password = in the ftp account used Password (option)

With this the for ftp communication according settings are done.

Also other settings like: Filename, Max. number of files, Storage mode ….. can be made here

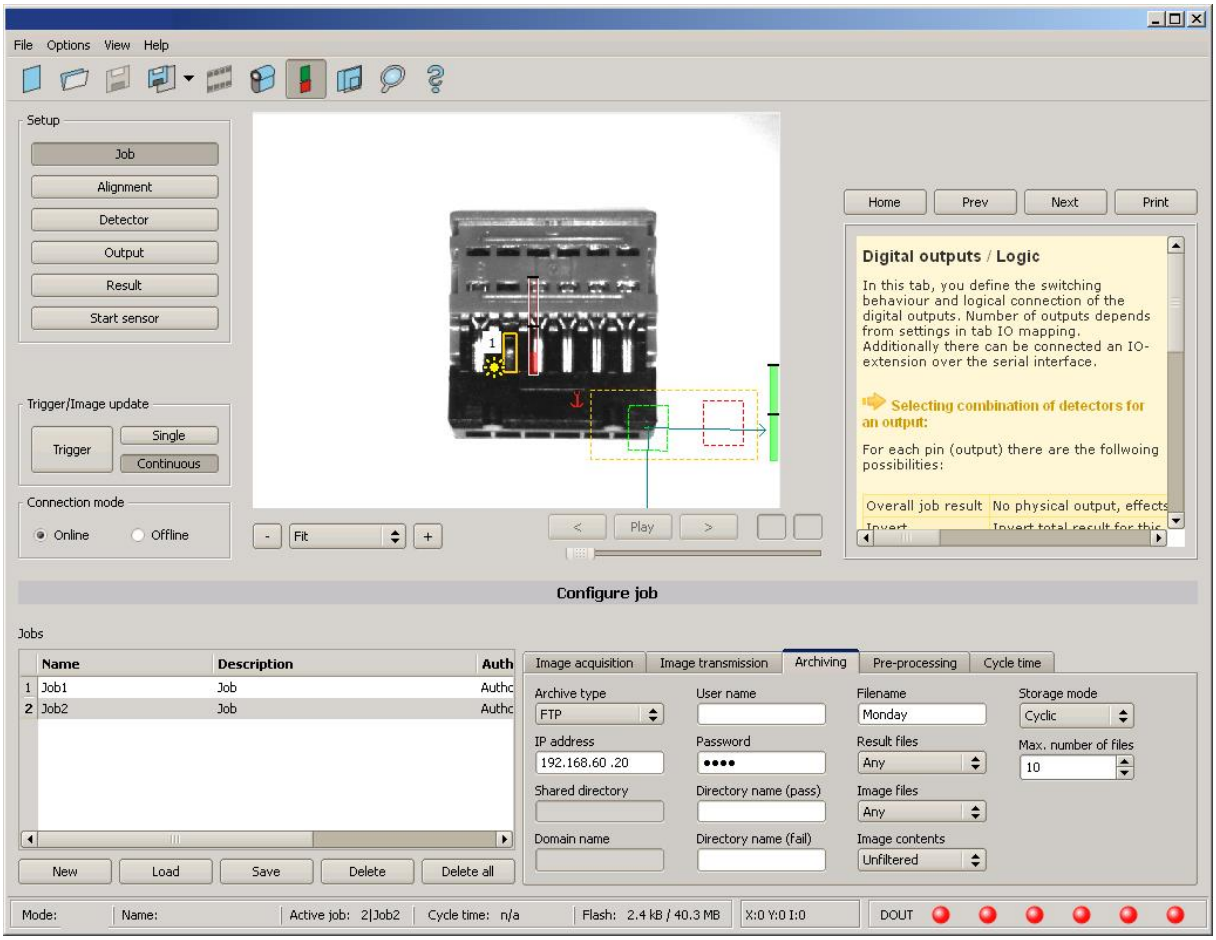


Fig. 159: FTP Server, settings in Vision Sensor Configuration Studio

As soon as this settings are done and transferred to the Vision Sensor (with „Start Sensor“), the image and result data are transferred and stored into the specified folder on the PC, without any of the applications Vision Sensor Device Manager, Vision Sensor Configuration Studio or Vision Sensor Visualisation Studio active.

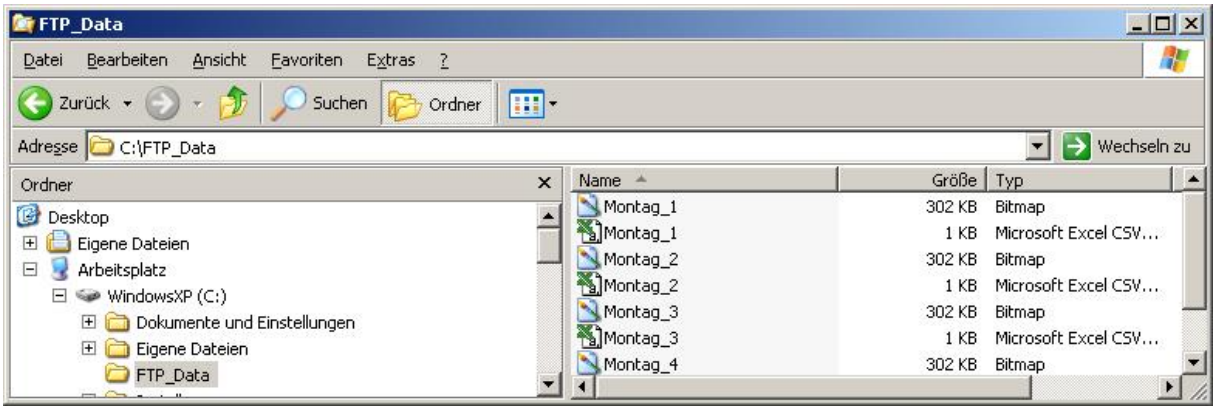


Fig. 160: Transferring files with FTP.

5.1.4.2 Example: Archiving via smb

The function via smb works analogue via a smb server, which must be set up in the according kind.

To archive data and / or images via SMB (Server message block), at the end of the PC a folder must be shared.

The following example shows the settings for archiving data via SMB exemplarily.

5.1.4.2.1 Settings for SMB on PC: Create folder and share it

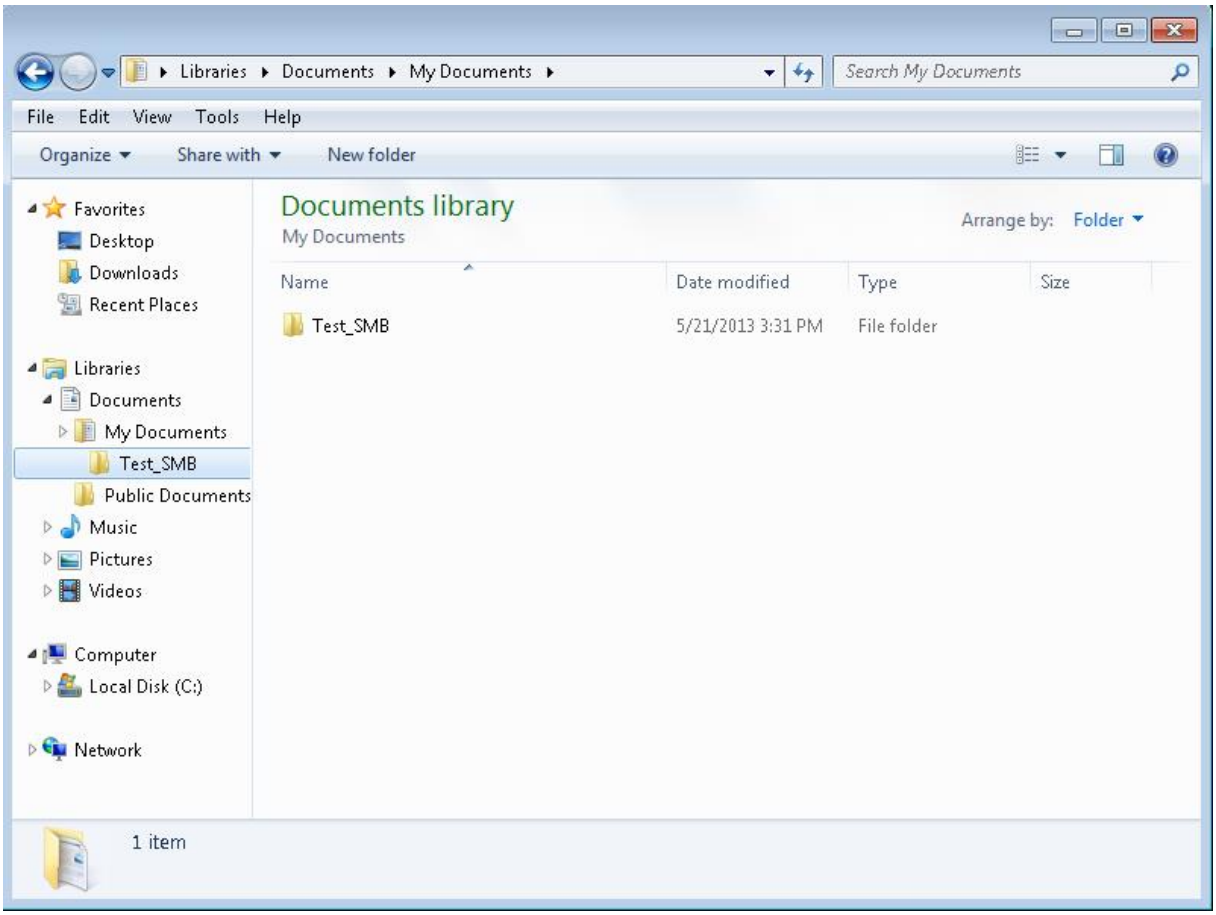


Fig. 161: Create folder to write data and / or images.

Via right- click to the folder (here „Test_SMB“), select „properties“.
In the following dialog „Test_SMB Properties“ select tab „Sharing” and open “Advnaced Sharing”.

Fig. 162: Sharing of folder > Advanced sharing.

In the dialog „Advanced Sharing“ activate „Share this folder“. As “Share name” the name of the folder “Test_SMB” is suggested. Here any other name can be set. In this example the suggested folder name is used.

Important: This “Share name” must be set later in the Vision Sensor- SMB- Interface!

With a click to „Permissions“ the following dialog appears.

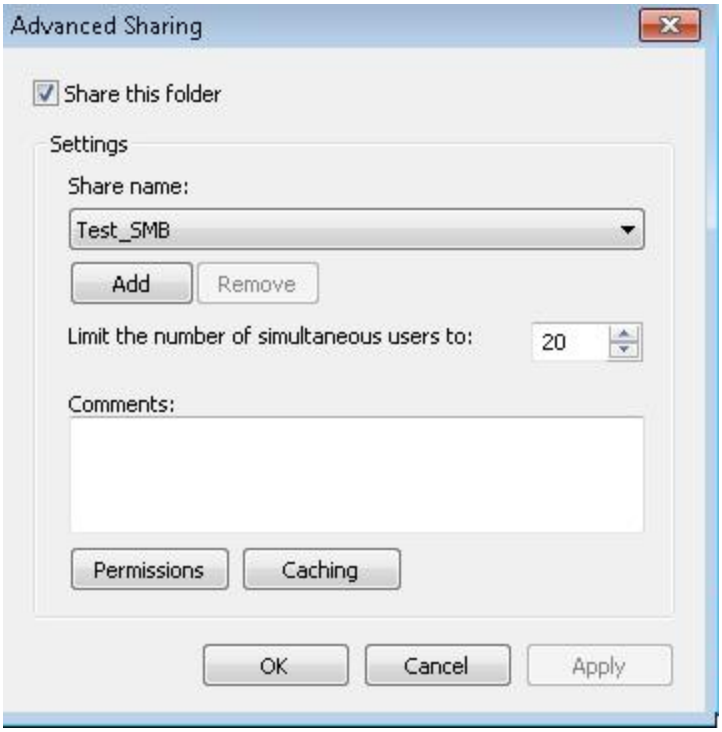


Fig. 163: Set Share name.

In the window „Permissions for Test_SMB",

either

Select user group "Everyone". With this choice everybody in the network has free access to the folder without any further login, and in the Vision Sensor- SMB – interface the fields: "User name" and "Password" remain empty.

or:

select a user (here „fsc"), (for which user name and password is known). User name and password are necessary later to be set in the Vision Sensor- SMB- Interface.

Activate „Full control",

and close the dialog with „Apply" and „OK".

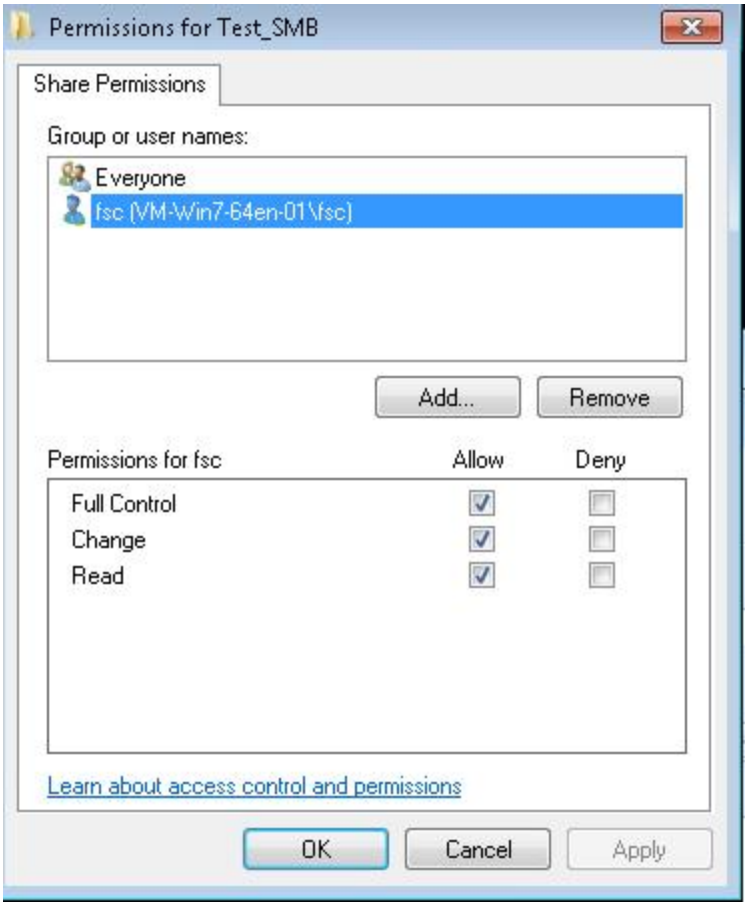


Fig. 164: Set permissions.

Now close the dialog „Advanced Sharing“ and „Test_SMB Properties“ with „Apply“ and „OK“ also.

The access for the here selected user to the selected folder on the PC now is set, and now the corresponding settings in the Vision Sensor- Interface „Vision Sensor Configuration Studio“ can be made.

5.1.4.2.2 Settings SMB Vision Sensor

Fig. 165: Settings in Vision Sensor- SMB- Interface

After starting Vision Sensor Configuration Studio, select select Job/Archiving/Archive type: „SMB”.

Do the follwing settings

• IP addresse: IP addresse of PC (this can be found with command „ipconfig“ via Start/run/cmd, s. following screenshot). In this example: 192.168.60.14

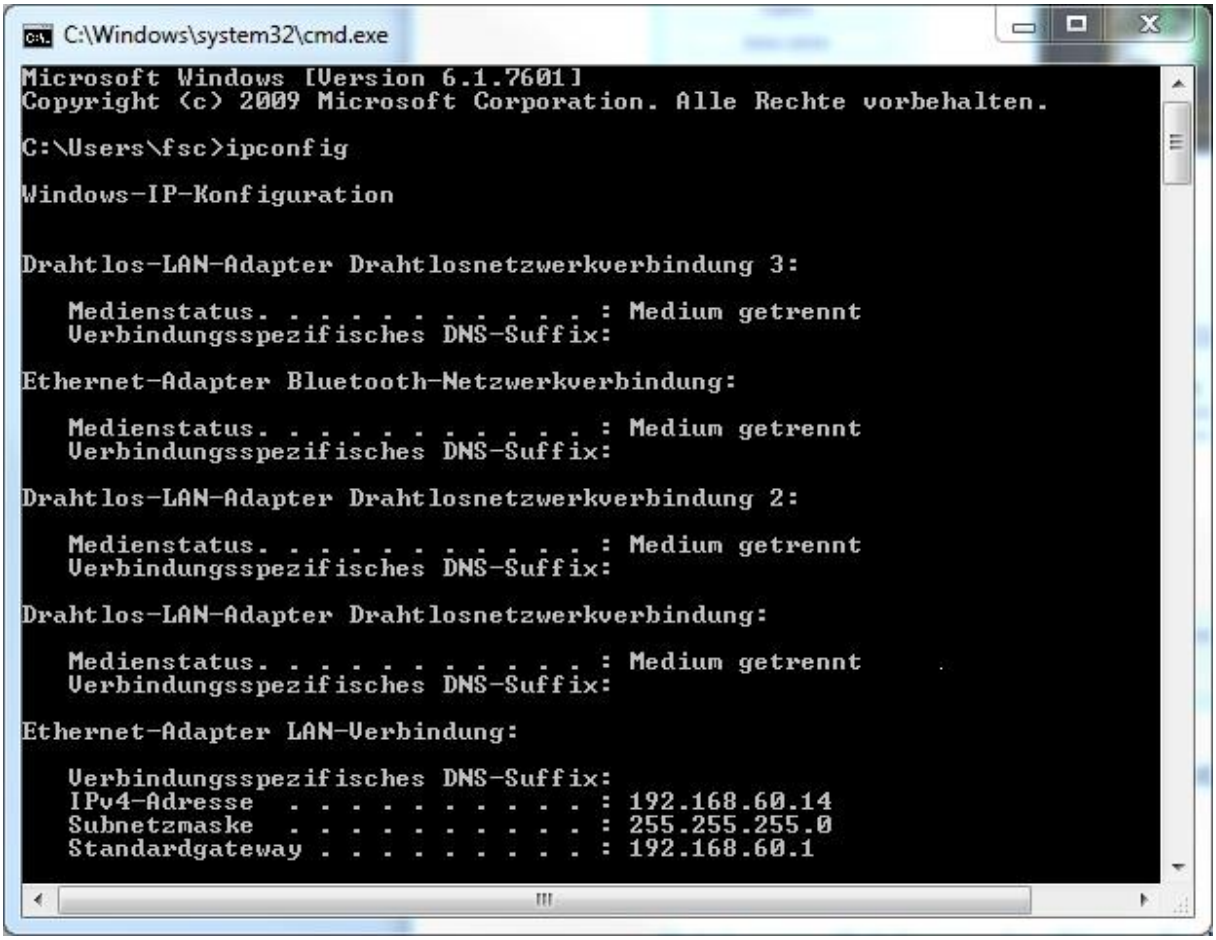


Fig. 166: IP- Adresse des PC via Start/Ausführen/cmd/ipconfig

• Share name: Here enter Share name like set in PC- dialog „Advanced Sharing“, Fig.3.

• Workgroup: Option! Name of workgroup.

• User name and Password: Depending on the selection made in dialog „Test_SMB Permissions“:

1. User group „Everyone“: User name and Password remain empty

2. Enter corresponding User name and (here in example User name: „fsc“)

• Directory name (Pass), Directory name (Fail): Chose a name for the folders in which in case of Pass- or Fail- parts the data and images should be archived. (These folders are crated below the shared folder (here: „Test_SMB“).

• Filename: Enter any filename.

• Result files: If protocol file is active, there will be generated automatically a .csv file for each inspection (trigger). Contents of the file is like specified in "Output / Telegram". Filename with incremented counter.

• Image contents: Possibility to select, whether images should be stored including the selected software filter or "raw" as taken from the camera.

• Storage mode: Limit: after reaching maximum number of files transmission is stopped. Unlimited: files are stored, until target drive is full. Cyclic: after reaching maximum number of files the older files are replaced by the newer ones.

• Max. number of files: Maximum number of filesets (image+ data) which are allowed to be stored in the target directory.

5.1.4.2.3 Archiving via SMB, output data

After starting of the sensor the images and data (as .csv- file), which has been defined under: Vision Sensor Configuration Studio/Output/Telegram are stored in the corresponding subfolder of the shared folder.

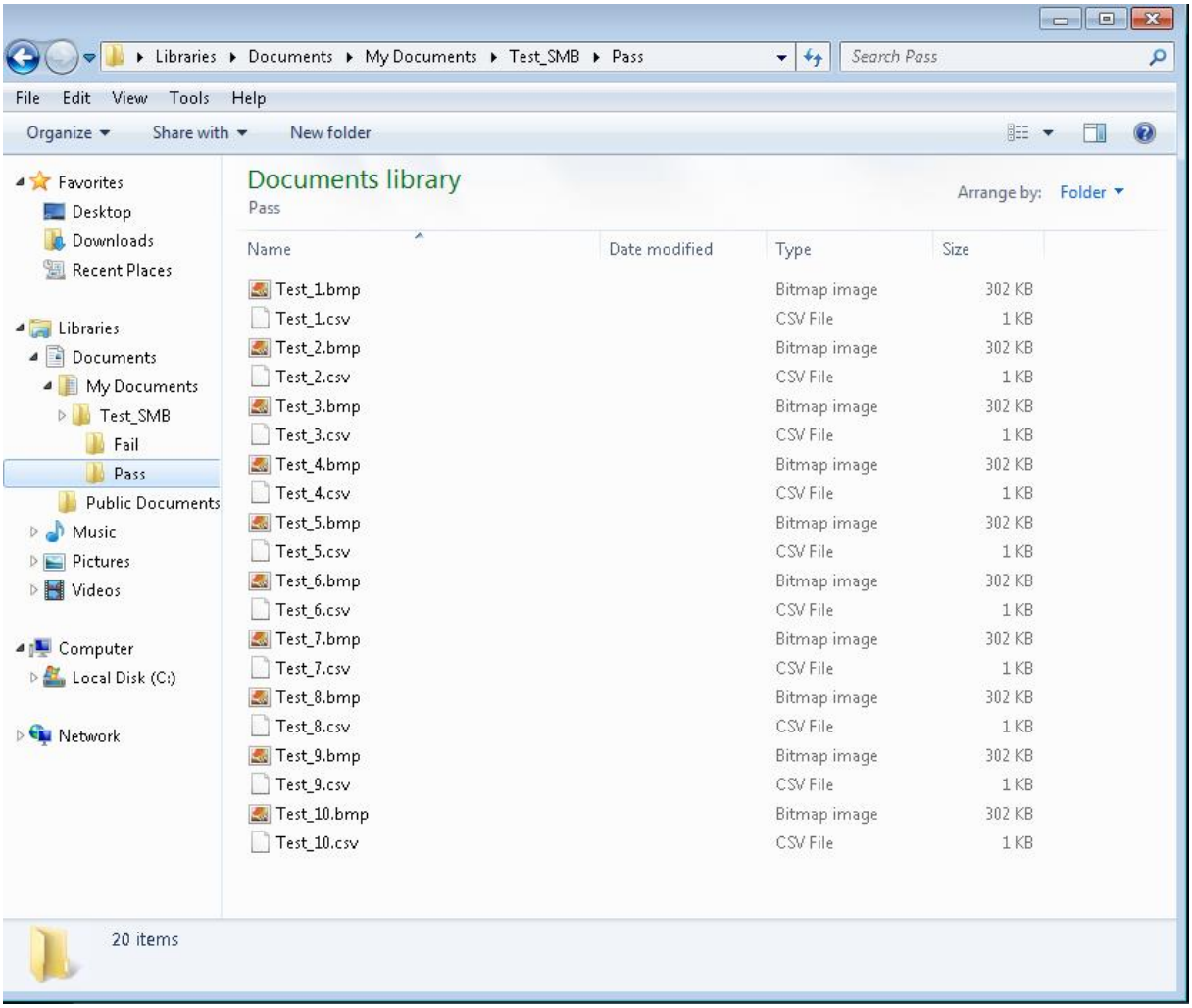


Fig. 167: Successful processed data and image archiving via SMB.

5.1.5 Ram disk (on the sensor)

If Ram disk is active, always the according last image and the numeric result data, which have been specified in: „Output/Telegram" (in format .csv) are stored on the sensor in the ram disk folder /tmp/results/.

This function is activated in „Job/Image transmission".

To access these data an ftp client connection must be established to the sensor.

If:

- Vision Sensor Configuration Studio/Job/Image transmission/Ram Disk is activated in the Vision Sensor always the last image (any, pass, failed parts) are stored. File: image.bmp in folder /tmp/results/
- Vision Sensor Configuration Studio/Output/Telegram data has been specified this are also stored in format .csv, on the Vision Sensor in folder „/tmp/results".

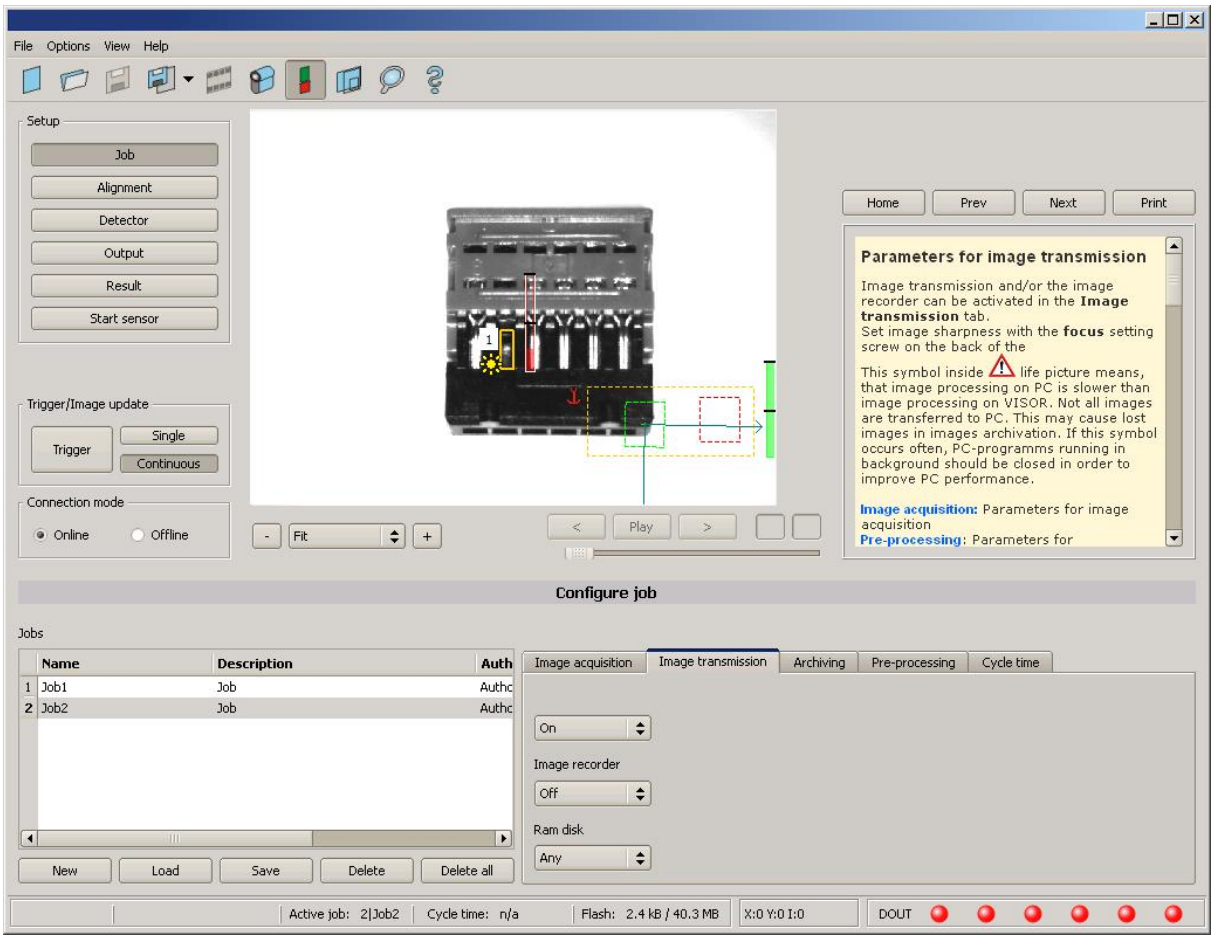


Fig. 168: Ram Disk

To access this data an ftp client connection like follows e.g. with Windows Explorer is established.

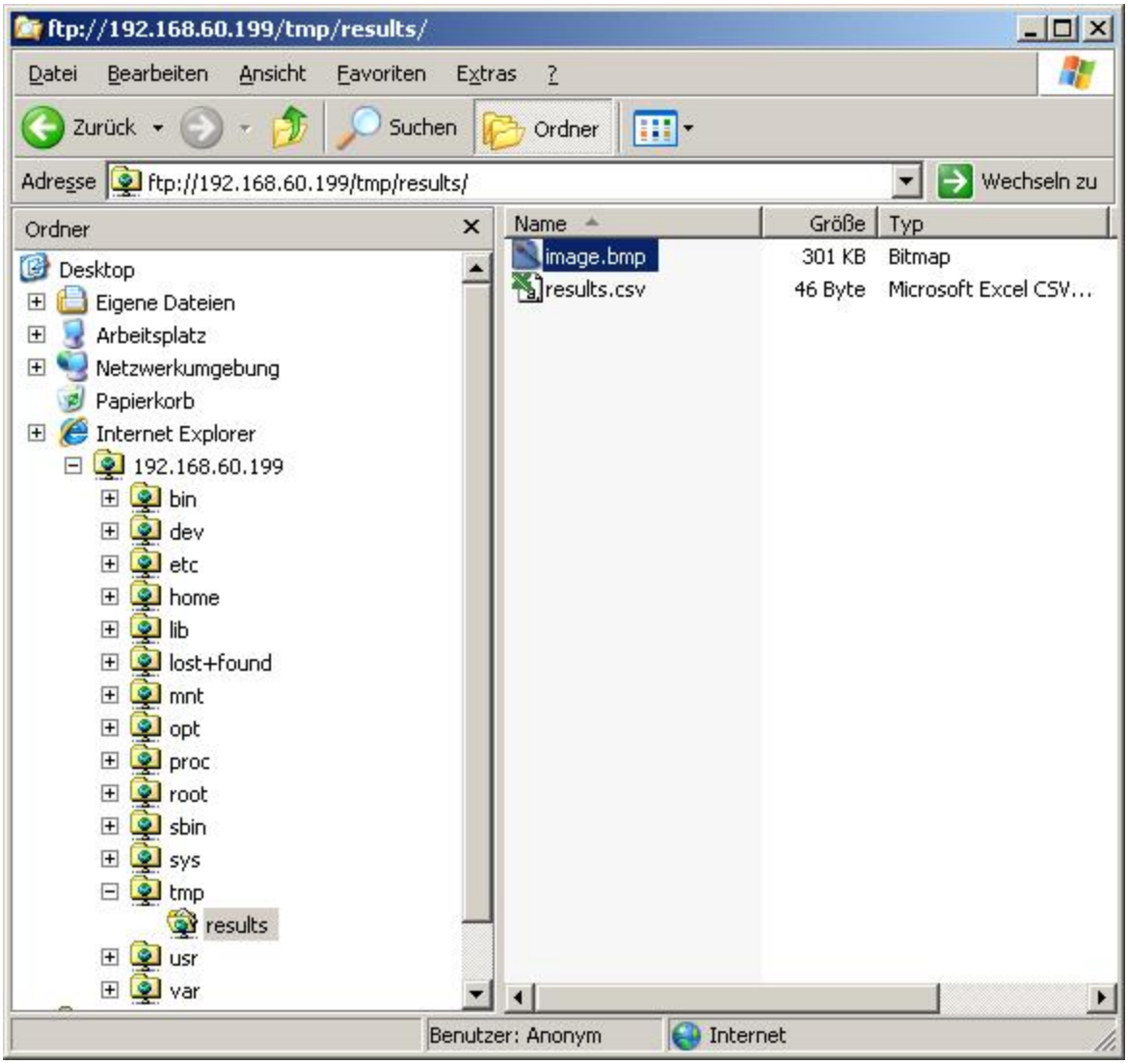


Fig. 169: Ram Disk Sensor via Explorer

A further possibility to access the data on the sensor e.g. is:

Use Windows command „cmd“ in Start/Run to open a DOS- window. Process the following commands.

The password in factory setting is „user“.

- First change to the folder on the PC where the data should be stored.
- is established.
- User name: user
- Password: user
- Go to folder: /tmp/results on the Vision Sensor.
- There are the both files: image.bmp and results.csv (if in Output/Telegram a data string was defined), as image and result data of the latest evaluation.
- With command „get image.bmp“, or. „get results.csv“ the files are copied to the selected folder on the PC

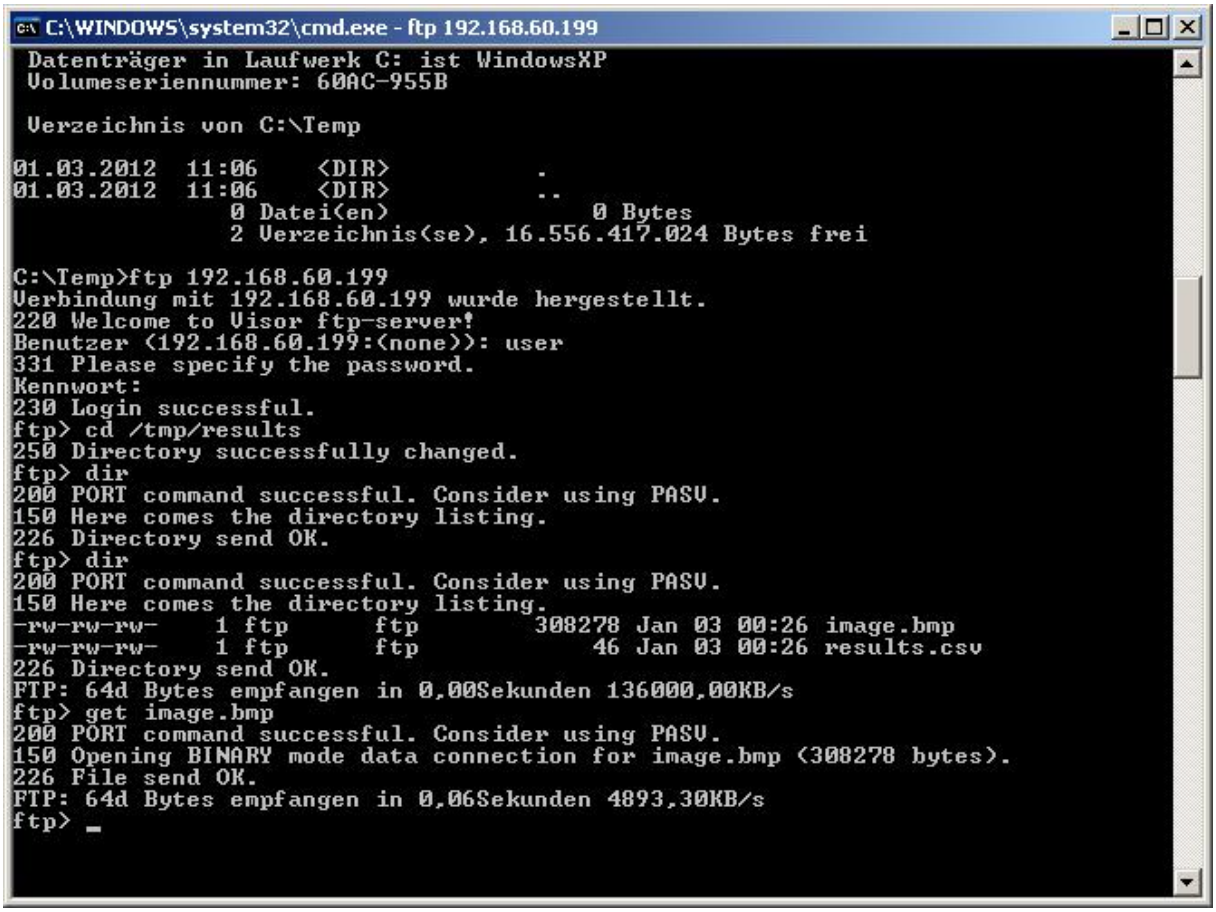


Fig. 170: Ram Disk via DOS

Attention:

* The format of all .csv files (ftp, smb, ram-disk, Vision Sensor Visualisation Studio) is always the same.

* The data is readable (by default divided with semicolon comma) stored into the .csv file.

* Only (payload) data, which have been defined under Output/Telegram are transmitted.

5.2 Backup

5.2.1 Backup creation

To save all setting of the sensor, which have been made to check one or some parts, please store all these settings with the command „Save job as ...“ or „Save job set ...“ in Vision Sensor Configuration Studio/File. With the commands „Load job ...“ or „Load job set ...“ these settings can be restored to the sensor later.

5.2.2 Exchange Vision Sensor

Before exchanging a sensor store all necessarily settings (as described in chap. Backup creation.) By exchanging one Vision Sensor against another please consider that the sensors are not calibrated optically or mechanically. That means the new sensor must be: installed mechanically and electrically like described in chap. Installation ff. And also must be optically focused and set up correctly to work in the network.

After this the in advance stored parameter settings can be restored from the PC to the sensor.

5.3 Job switch

5.3.1 Job switch via digital inputs

To switch between several jobs, which are already stored on the sensor, via digital inputs the following options are available:

S. also chap. ff., timing diagrams and comments

5.3.1.1 Job 1 or Job 2

To switch between Job1 and Job2 any input can be defined in Vision Sensor Configuration Studio/Output/I/O mapping with the function „Job 1 or 2“. After the according logical level is connected to this input Job 1 or Job 2 is processed Low = Job1, High = Job 2). S. also chap. I/O mapping (Page 94) / Function of inputs ff.

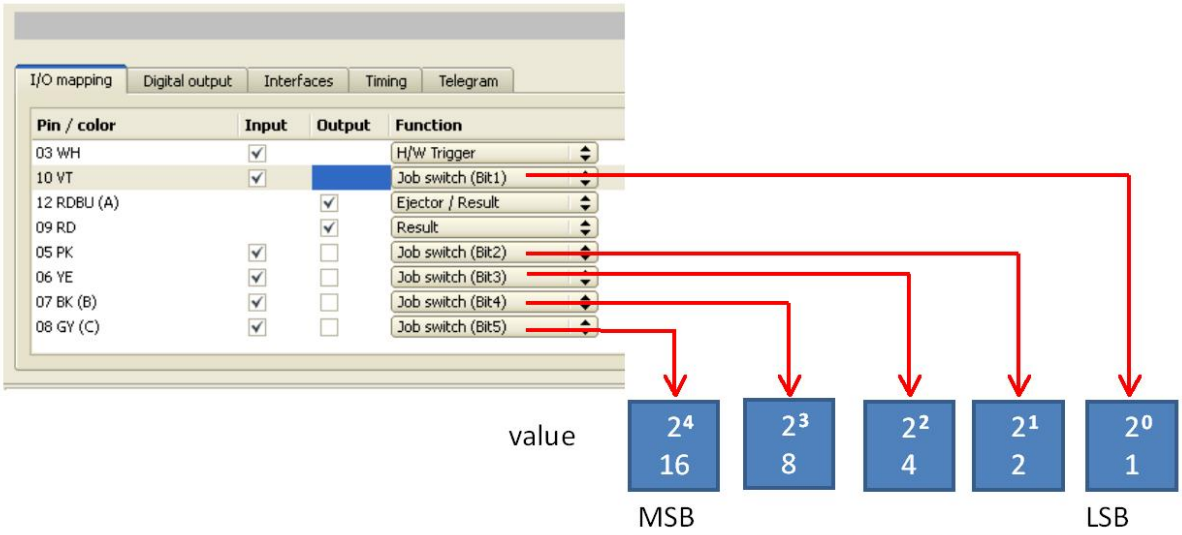
5.3.1.2 Job 1… 31 via binary bit pattern

To switch between up to 31 jobs by binary input pattern via the up to 5 digital inputs, all needed inputs in Vision Sensor Configuration Studio/Output/I/O mapping are set to the according function “Job switch (Bitx)”.

The in the following graphics shown binary input pattern then switch directly to the according job number. S. also chap. I/O mapping (Page 94) / Function of inputs ff.

Attention:

- Job switch starts / happens immediately after the input pattern has changed.
- The display of the active job changes with the first following trigger.
- The mapping of the I/O´s is not fixed. It´s depending on the settings in Vision Sensor Configuration Studio/Output/I/O mapping.
- The change of the logical level of all related inputs must happen at the same time.



e.g. Job No.	Output 5	Output 4	Output 3	Output 2	Output 1
1	false	false	false	false	true
2	false	false	false	true	false
6	false	false	true	true	false
13	false	true	true	false	true
31	true	true	true	true	true
No change	false	false	false	false	false

Fig. 171: Job- switch binary

5.3.1.3 Job 1..n via pulses

To switch between job´s with function "Job 1..n" any input can be set up with this function in Vision Sensor Configuration Studio/Output/I/O mapping. Only possible if Ready = High. After the last impulse (+50ms) Ready is set to low. Impulses are counted until the first delay of >= 50ms and then switches to the appropriate job. Ready remains low until switch-over to the new job occurs. If the option "Job change confirm" is used, this signal occurs after the job change, and hereafter Ready is set high again. During Job Change over binary inputs there must not be sent any trigger signal. Pulse length for job change should be 5 ms pulse and 5 ms delay. S. also chap. I/O mapping (Page 94) / Function of inputs ff.

If possible job change should be made by binary coded signals like in chap. Job 1… 31 via binary bit pattern, this is the faster way.

5.3.2 Job switch via Ethernet

s. chap. Ethernet example 2.1 command job switch from PC/PLC to Vision Sensor

5.3.3 Job switch via Serial

s. chap. RS422 example 1.1: command Job switch from PC / PLC to Vision Sensor

5.3.4 Job switch via Vision Sensor Visualisation Studio

In the application Vision Sensor Visualisation Studio a job switch can be made, or completely new job set´s can be uploaded.

In tab „Vision Sensor Visualisation Studio/Job“ on in the sensor stored jobs are displayed. If there is more than one job in the sensor memory, one of them can be marked in the job list, and activated with button “Set active”. S. also chap. Changing active job (Page 126)

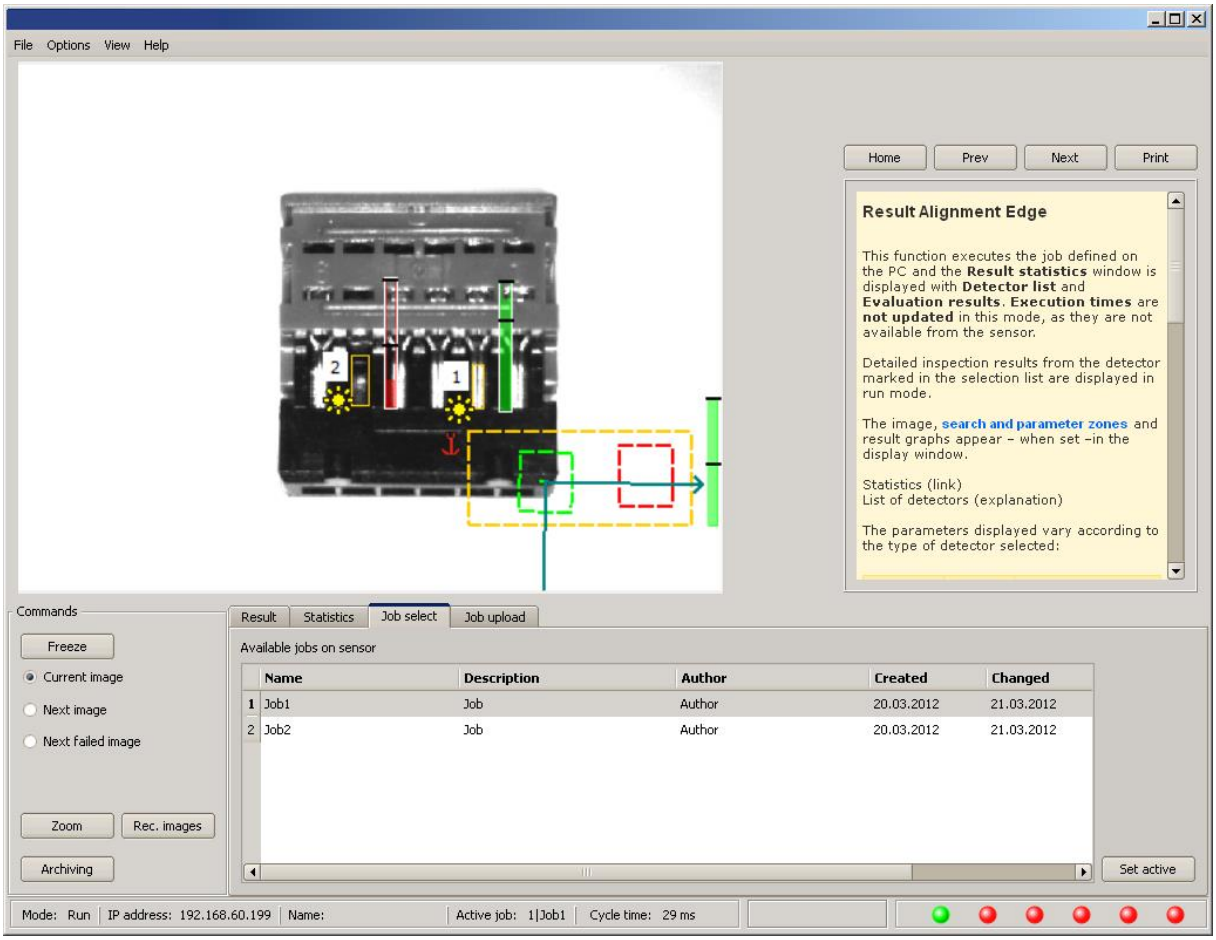


Fig. 172: Vision Sensor Visualisation Studio, Job switch

- In tab „Vision Sensor Visualisation Studio/Job upload“ all on PC available job set are displayed. This can be marked in the job list and uploaded to the sensor via the button „Upload“.

Attention:

By uploading a new job set all jobs in the sensor memory are deleted.

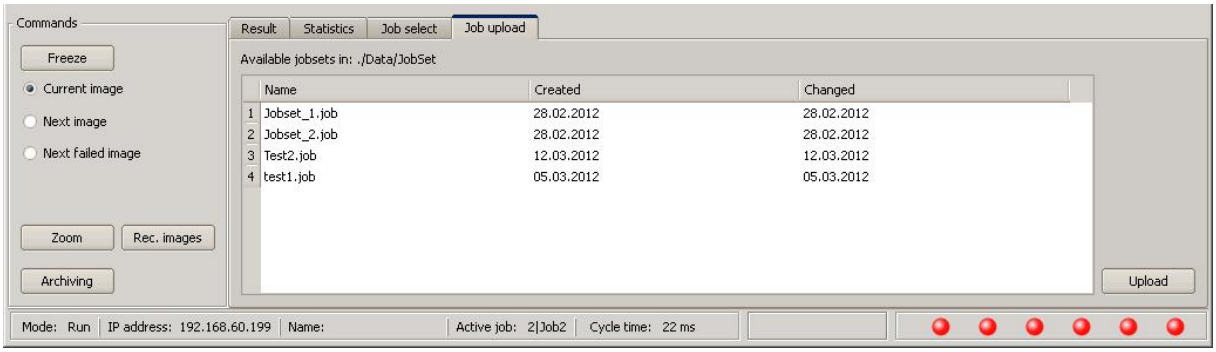


Fig. 173: Vision Sensor Visualisation Studio, Job upload

5.4 Network connection

5.4.1 Installation of Vision Sensor into a network / gateway

In Vision Sensor Device Manager/Active sensors, all Vision sensors, which are installed in the same network segment as the PC which runs Vision Sensor Device Manager are displayed as list. To update this list press the button „Find“, to see sensors which e.g. have been powered after Vision Sensor Device Manager was started.

For sensors, which are installed in the network, but are located in a different network segment via a gateway, please enter their IP address in the field „Add active sensor“ and press button „Add“. „

The according sensor now appears in the list „Active sensors“ and can be accessed now.

5.4.2 Proceeding/Troubleshooting - Direct Connection

Creating a functioning Ethernet connection between Vision Sensor and PC

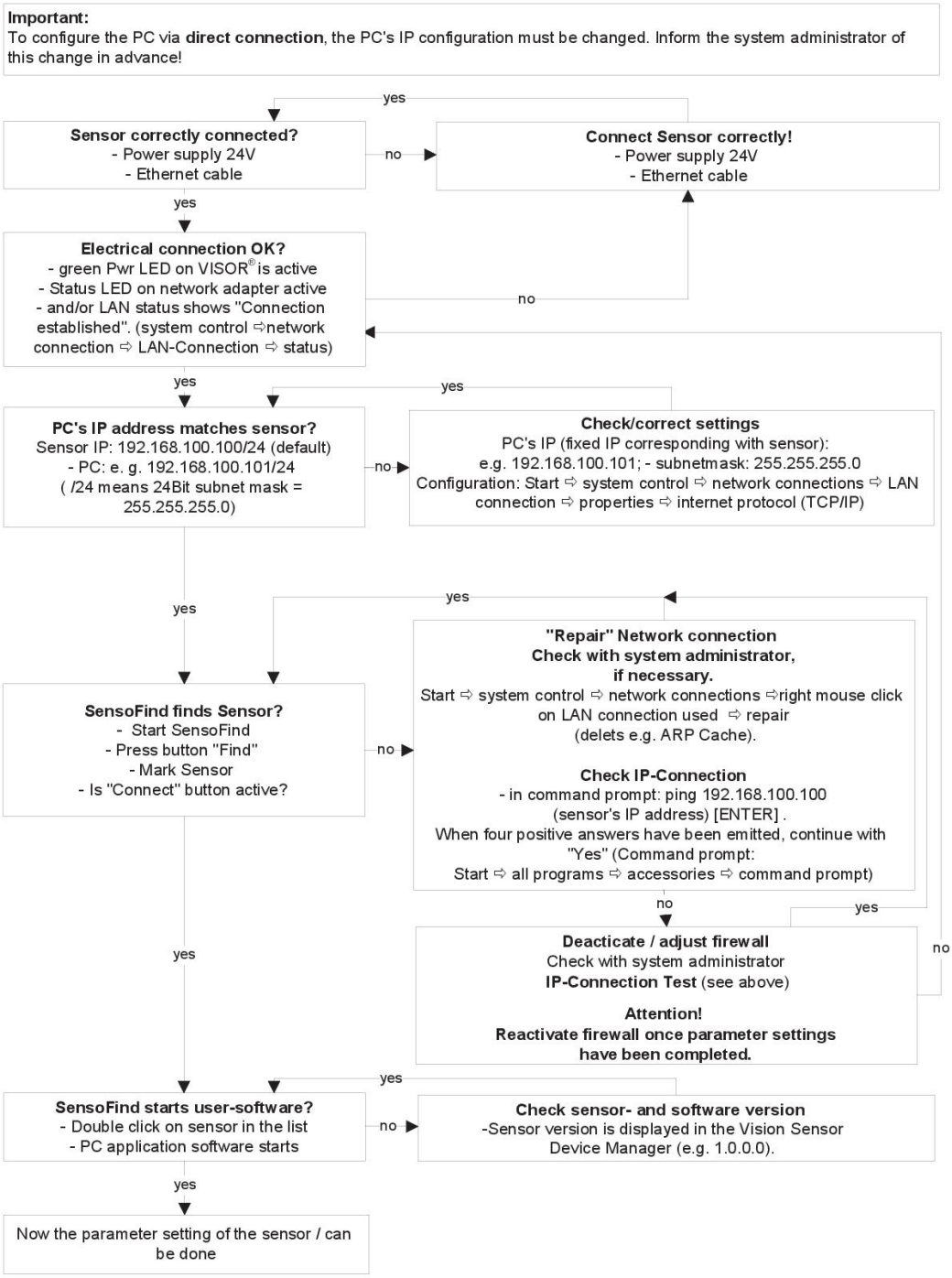


Fig. 174: Direct connection sensor / PC, proceeding / troubleshooting

5.4.3 Proceeding/Troubleshooting - Network Connection

Establishing an operational Ethernet connection between Vision Sensor and PC

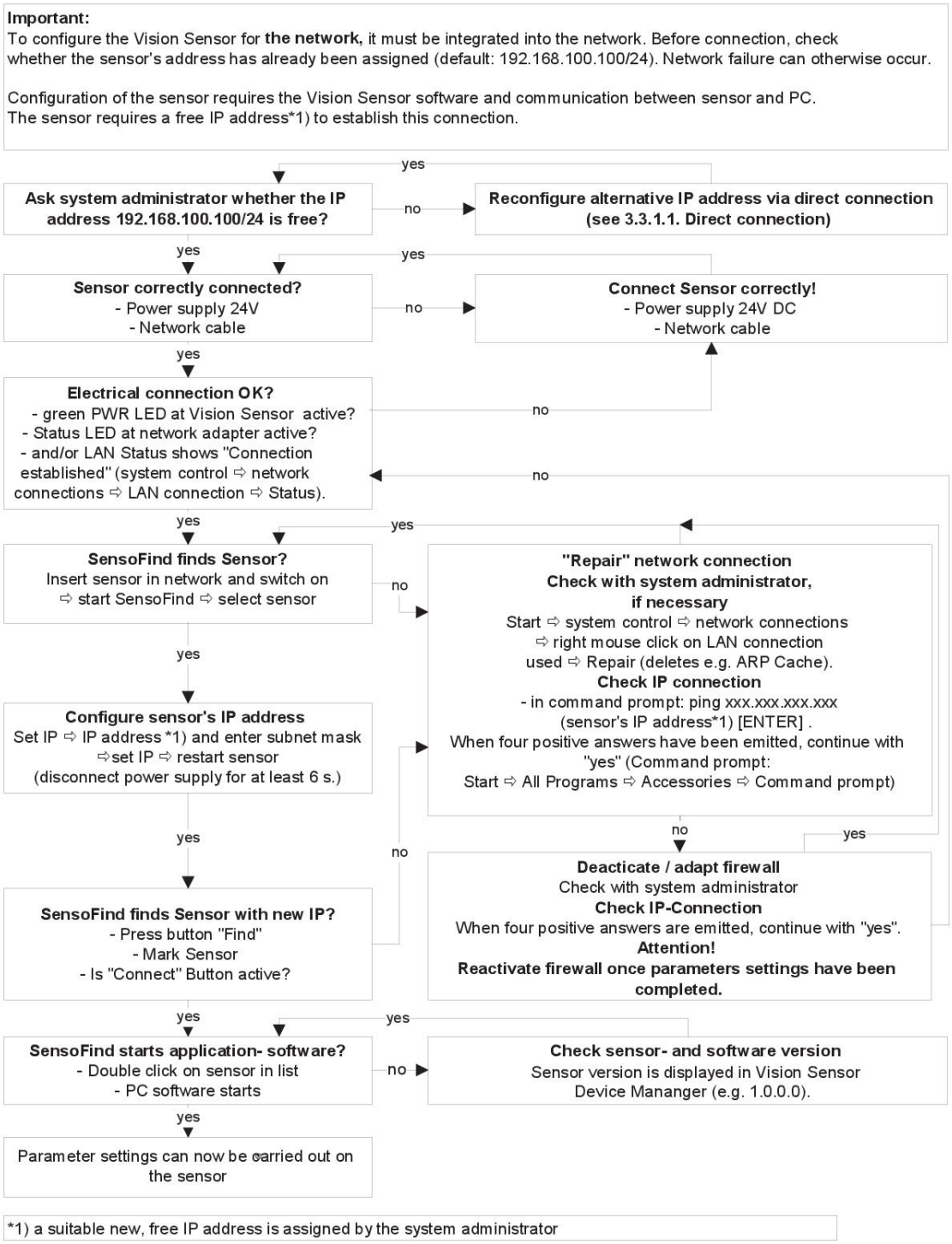


Fig. 175: Connection via network sensor / PC, proceeding / troubleshooting

5.4.4 Used Ethernet- Ports

If the Vision Sensor should be installed into a network, the following ports must be enabled, if so by the network administrator. This is necessary only in case that this specific ports have been locked e.g. in a company network by a firewall installed on a PC.

To communicate between a PC fur configuration and the Vision Sensor the following ports are used:

* Port 2000, TCP

* Port 2001, UDP Broadcast (to find sensors via Vision Sensor Device Manager)

* Port 2002, TCP

* Port 2003, TCP

* Port 2004, TCP

To communicate between PLC (PLC- PC also) and the Vision Sensor the following ports are used.

* Port 2005, TCP (Implicit results, that means, user configured result data)

* Port 2006, TCP (Explicit requests, e.g. trigger or job switch)

If the ports 2005 or 2006 are changed in Vision Sensor Configuration Studio, the according ports also must be enabled in the firewall by the administrator.

If the interface EtherNet/IP is used the following two ports must be enabled too.

* Port 2222, UDP (EtherNet/IP)

* Port 44818, TCP (EtherNet/IP)

5.4.5 Access to the Vision Sensor via network

Exemplary values for IP etc.

Access to Vision Sensor 1 from PC 1, if in same subnet.

- Via Vision Sensor Device Manager (/find)

Access to Vision Sensor 2 from PC1, if in different subnet.

Only if:

- Gateway is set correct in sensor 2 (here to 192.168.30.1) - and
- in Vision Sensor Device Manager via Add- IP- the sensor IP of sensor 2 is set correct

> now the Vision Sensor 2 appears in the list „Active Sensors“ in Vision Sensor Device Manager !

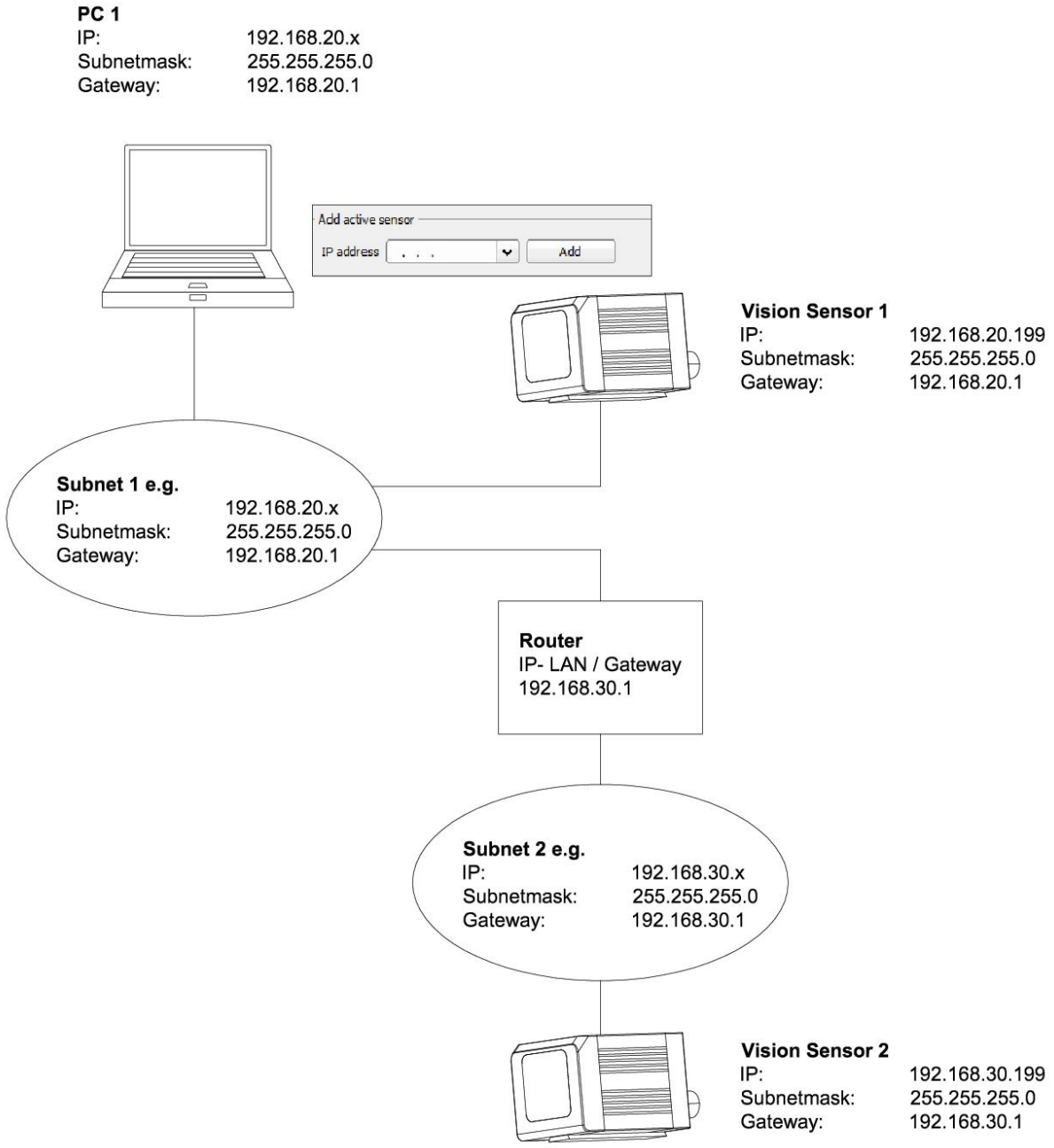


Fig. 176: Access to Vision Sensor via network, same or different subnet

5.4.6 Access to the Vision Sensor via Internet / World Wide Web

Exemplary values für IP etc.

Access from PC 1 (company network 1), via Word Wide Web, into company network 2 to Vision Sensor 1

- Add the IP- WAN of router 2 (company network 2) in PC1 (company network 1) in Vision Sensor Device Manager under „Add active sensor“ (here in example: 62.75.148.101)

In router 2 the ports which should be used by the sensor must be defined. (s. also chap. Used Ethernet-Ports (Page 171))

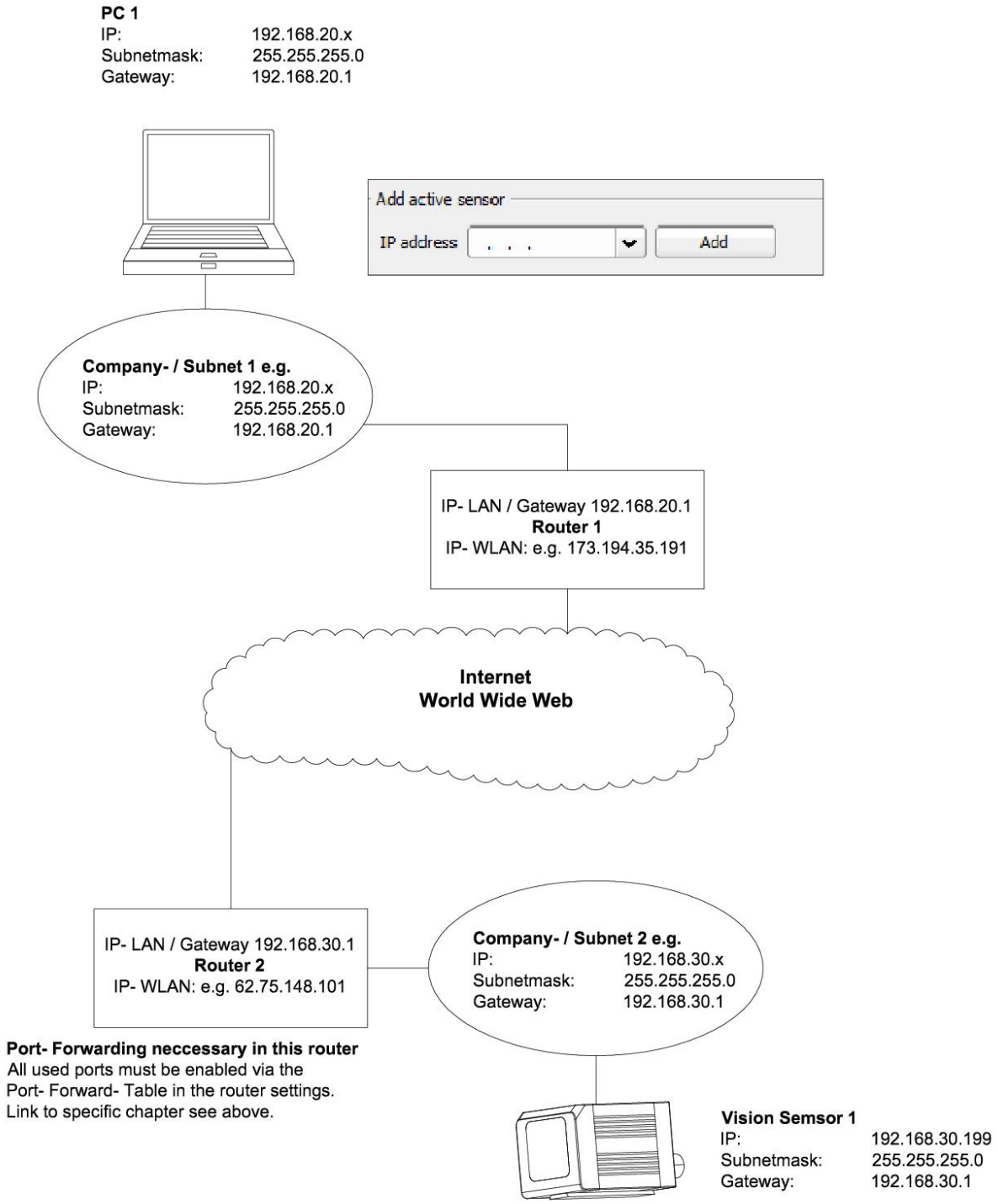


Fig. 177: Access to Vision Sensor via Internet / World Wide Web

5.5 Rescue

The utility „Rescue“ is used to reset Vision sensors, which no longer can be found by Vision Sensor Device Manager, to a default status to be able to be accessed via Vision Sensor Device Manager and Vision Sensor Configuration Studio again.

- Start Rescue (leave empty field „Mac address of Sensor“)
- Reset Vision Sensor, Power off/on or Vision Sensor Device Manager/File/Sensor soft reset (the Vision Sensor must be connected via Ethernet and be located in the same network as the PC)
- In the field below „Received Data“ now all settings of the Vision Sensor are displayed.

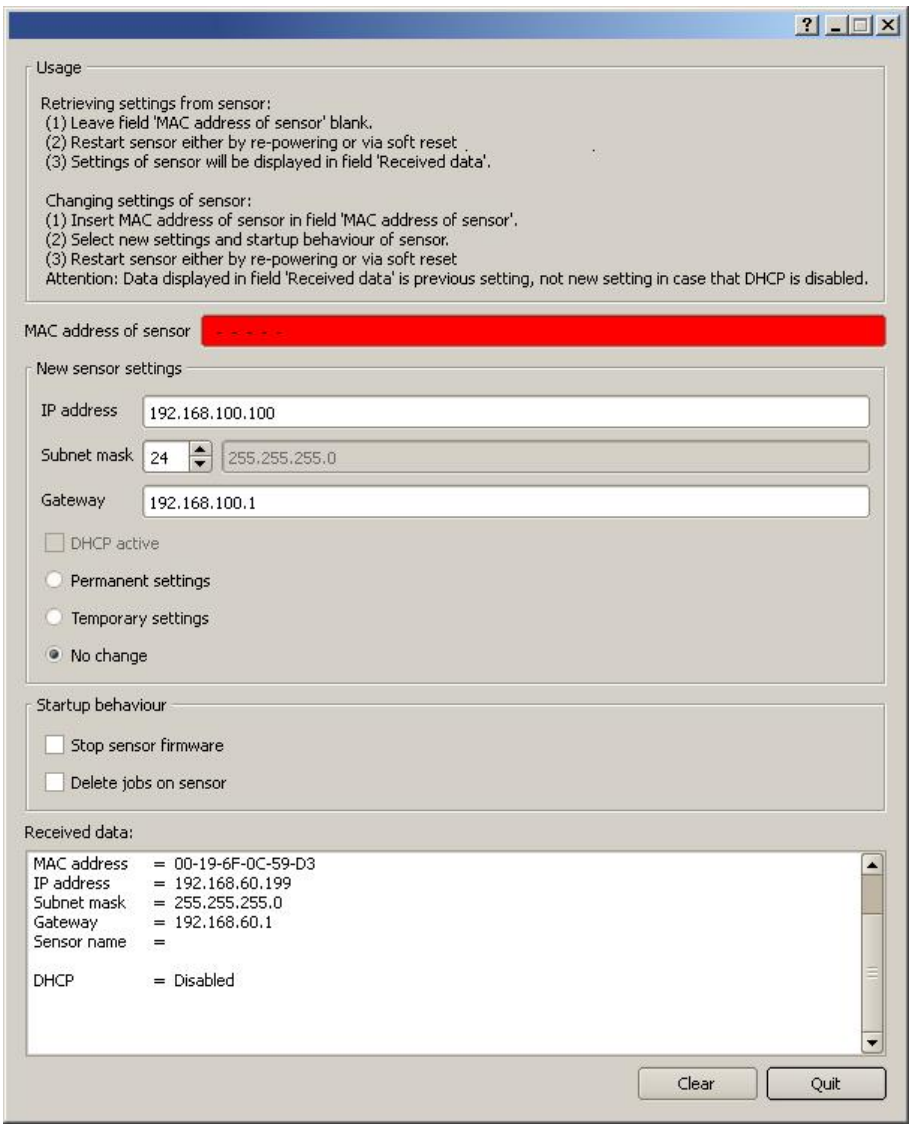


Fig. 178: Rescue /1

- Now the below shown Mac address can be entered into the field „Mac address of Sensor“.
- Into the lines below, all the network settings like, IP address, Subnet Mask etc., which the Vision Sensor should have after the next Restart (Power off/on), can be entered.
- Restart Vision Sensor.

Attention:

The after the next restart displayed data are the old ones as they are not refreshed by sensor restart.

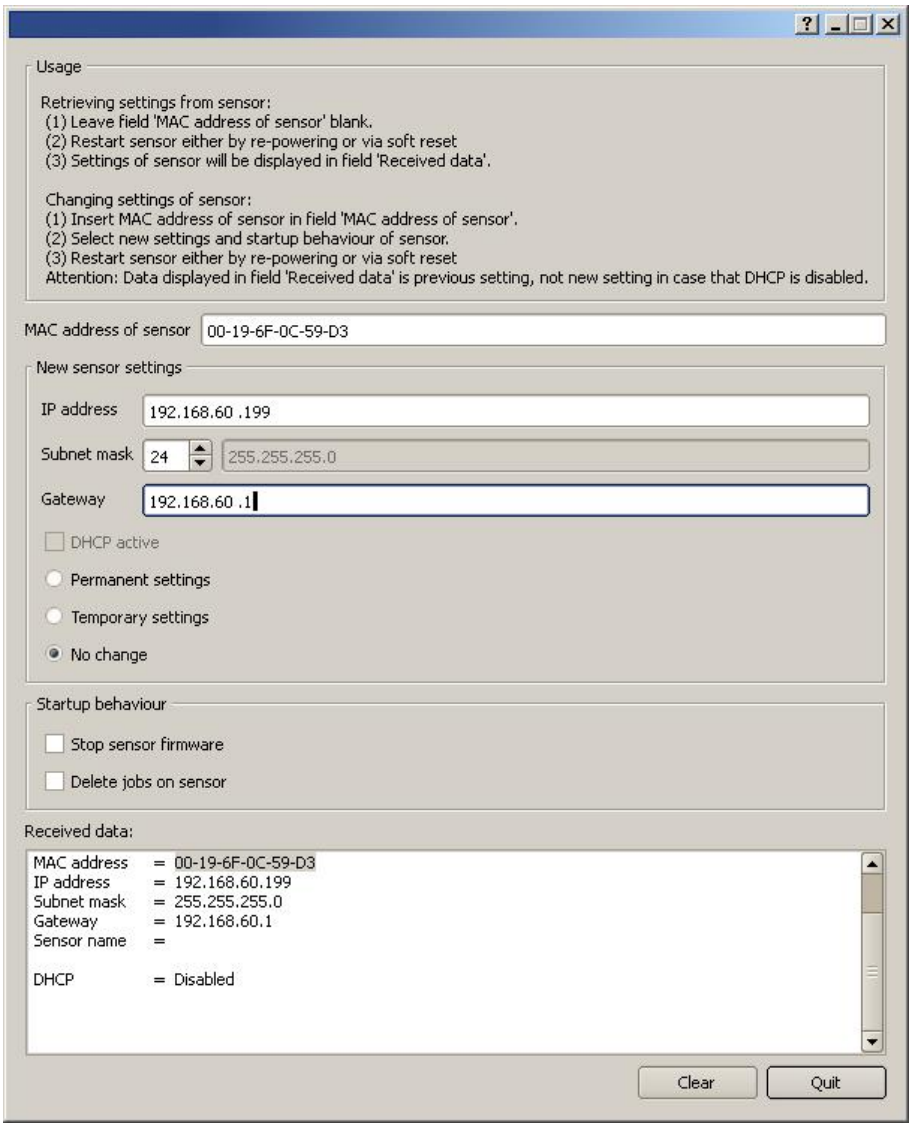


Fig. 179: Rescue / 2

6 Image settings and accessories

6.1 Good images

To achieve good images follow these steps:

- Align the sensor to the desired field of view. Take care for stable mounting.
- For high contrast images adjust angles and illumination like described in chap. The most important types of illumination are: Bright field, Dark field and Diffuse illumination..
- Adjust a sharp image with the focus screw at the backside of the sensor housing.
- Adjust the brightness of the image with the parameter “Shutter speed“ in Vision Sensor Configuration Studio/Job/Image acquisition. (Do not use parameter "Gain“, not until you are not able to achieve desired brightness via "Shutter speed“)

6.2 Environmental light, shrouding, IR- version

Mechanical shrouding

In most cases it´s much simpler and highly cost effective to protect the scene against disturbing light or sun beams, which e.g. shine temporary at a certain time of day or season from windows or roof lights, by mechanical shrouding like metal plates, than to create illumination conditions, e.g. by additional illumination which is strong enough not to be disturbed in any situation.

Version with Infrared illumination

A further elegant way to get independent from the environmental light is to use the according Vision Sensor version with Infrared illumination. Here the scene get´s illuminated with the built in powerful IR-illumination. The receiver is equipped with the according filter. That means the sensor works in a narrow range of this specific wavelength, and for that as far as possible with its own light only.

Another advantage of the infrared light is, that the light flashes are not visible and do not disturb any human workers which are near the plant.

6.3 External illumination

For the Vision Sensor a large range of accessories is available, which also covers a big range of external illuminations, which can be used additionally or instead of the internal illumination.

The both types SBAL-C6-A- xxx and SBAL-C6-R- xxx can be connected directly to the sensor.

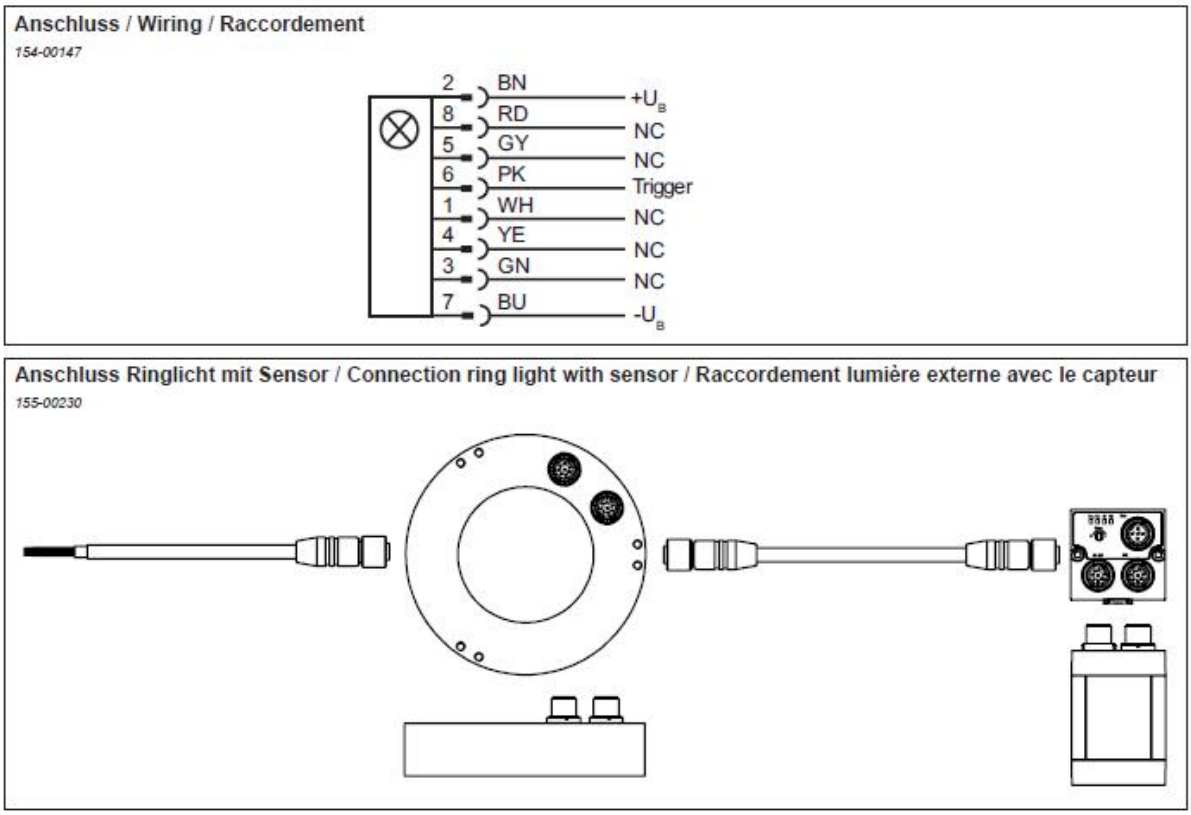


Fig. 180: Connection of external illumination SBAL-C6-A- xxx and SBAL-C6-R- xxx. All other listed types are connected to the Vision Sensor as follows.

6.4 The most important types of illumination are: Bright field, Dark field and Diffuse illumination.

6.4.1 Bright field illumination

Bright field internal / Bright field external

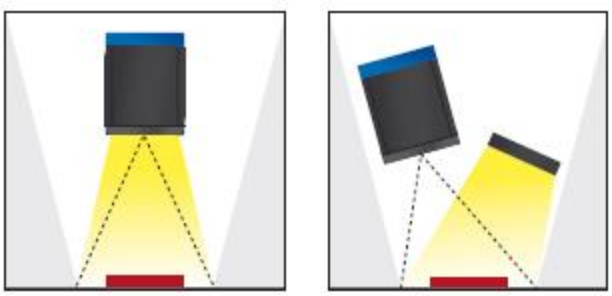


Fig. 181: Bright field illumination

With bright field lighting, the lighting, sensor and object are arranged so that the object's surface reflects the light directly into the sensor. The smooth surface of the object appears as a bright area and each indentation, bump or defect, such as e.g. scratches, are a dark edge.
Attention: With bright field lighting, the angle of alignment between the lighting, object and sensor and the object's surface is critical as direct reflection by the object's surface only works when the angle and surface characteristics (shiny, mat, oily ….) are constant!

With Bright field / With Dark field

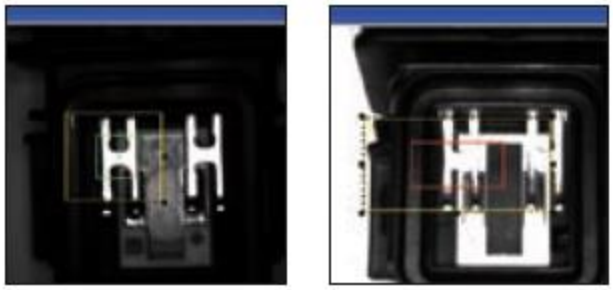


Fig. 182: Example Bright field illumination

By the direct reflection of the highly reflective (shiny) metal part, even before a white background, this is possible to be distinguished and recognized with Bright field illumination! With Dark field illumination it´s not possible to distinguish between shiny metal part and white background!

6.4.2 Dark field illumination

Dark field internal / Dark field external

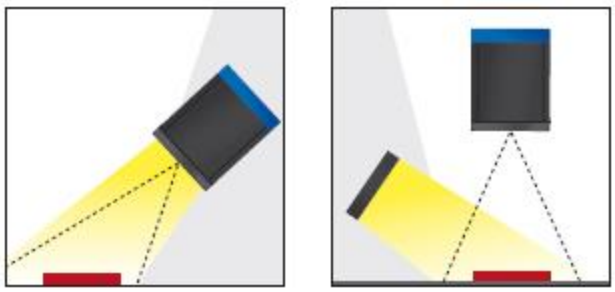


Fig. 183: Dark field illumination

With dark field illumination, the lighting, sensor and object are arranged so that the smooth surface of the object does not reflect the light directly into the sensor. Object edges (indentations and bumps) appear as bright areas, smooth object surfaces however are dark. This type of illumination functions with wide angle ranges and depends little on the object's surface.

With Bright field / With Dark field

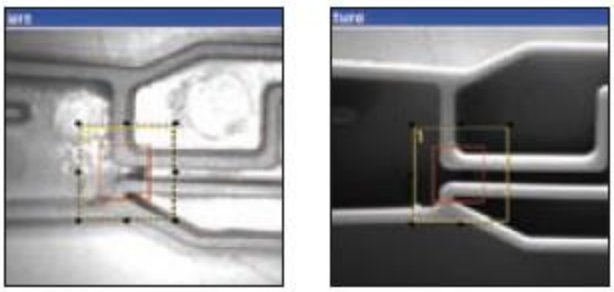


Fig. 184: Example, Dark field

Edges are clearly accentuated with Dark field illumination.

6.4.3 Diffuse illumination (external only)

Diffuse external

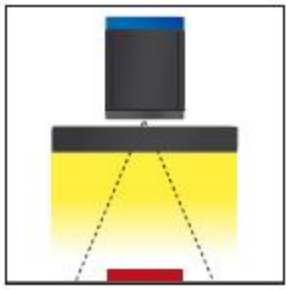


Fig. 185: Diffuse illumination

Diffuse lighting is used everywhere where highly-reflective, curved and above all irregularly-shaped object surfaces are concerned (e.g. aluminium foil on blister packs etc.). Such objects cannot be illuminated with spot-shaped lighting, but only with diffuse lighting (i.e. even lighting from all directions). Diffuse lighting is also known as "cloudy day" illumination, i.e. uniform light from behind the cover of clouds rather than from direct sunlight.

Spot illumination / Diffuse illumination

Fig. 186: Figure 218. Diffuse illumination

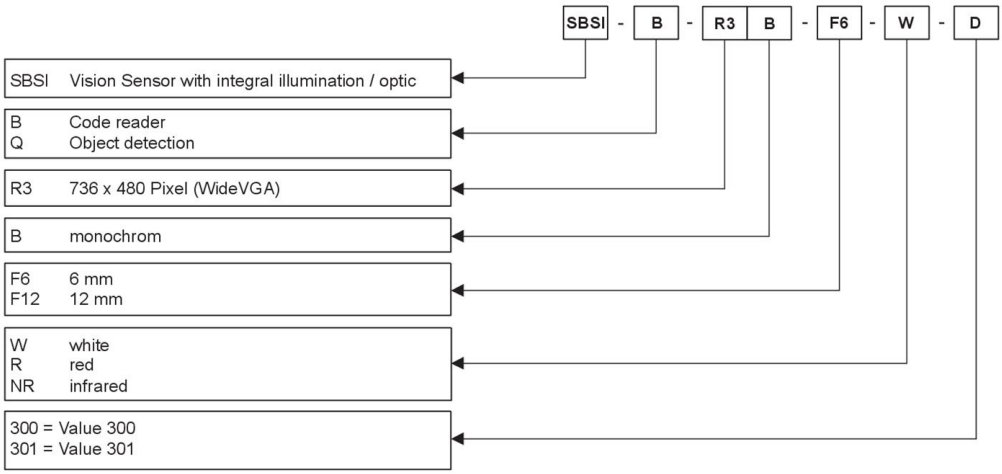
That means; clear homogeneous image with diffuse illumination! With any spot illumination the reflections of the aluminium foil from one part to another are always different.

7 Technical Data

Electrical data	
Operating voltage	U_B 24 V DC , -25% / + 10%
Residual ripple	< 5 Vss
Current consumption (no I/O)	≤ 200 mA
All inputs	PNP / NPN High > U_B - 1 V, Low < 3 V
Input resistance	> 20 kOhm
Encoder input	High > 4 V
Outputs	PNP / NPN
Maximum output current (per output)	50 mA, Ejector (Pin 12 / RDBU) 100 mA
Short-circuit protection (all outputs)	yes
Inductive load	typ.: Relays 17K / 2H, pneumatic valve 1.4K / 190mH
Protection against inverse polarity	yes
Interfaces Vision Sensor-XX-Standard	Ethernet (LAN)
Readiness delay	Typ. 13 s after power on
Optical data	
Number of pixels , chip size, pixel size Technology	Vision Sensor- R3...: 736 (H) x 480 (V), 1/3", 6,0 um square CMOS (mono)
Integrated scan illumination	8 LEDs
Integrated lens, focal length	6 or 12 mm, adjustable focus
Lens (adjustable to infinity) Min. scan distance Min. field of view X x Y	R3 | R3 6 | 12 6 | 30 5 x 4 | 8 x 6
Mechanical data	
Length x width x height	65 x 45 x 45 mm (without plug)
Weight	approx.160 g
Vibration / shock	EN 60947-5-2
Ambient operating temperature	0° C .... 50° C (80% humidity, non-condensing)

Storage temperature	-20° C ... 60° C (80% humidity, non-condensing)
Protective system	IP 67
Plug connection	24V DC and I/O M12 12-pin, LAN M12 4-pin, Data M12 5-pin
Housing material	aluminium, plastic
Function and characteristics	
Object detection	
Number of jobs / detectors	Vision Sensor-XX-Standard: 2 / 32
Evaluation modes	• alignment • contour match with/without position detection • pattern match with/without position detection • area test grey level • area test contrast • area test brightness • direction info, or coordinates for position detection • Caliper, distances between edges
Typical cycle time	typ. 20 ms pattern matching typ. 30 ms contour typ. 2 ms area test
Code Reader	
Number of jobs / detectors	Vision Sensor-XX-Standard: 8 / 1
Evaluation modes	• DataMatrix Code acc. ECC200 in any rotational position, square and Rectangular. • QR-Code, Model 1 and Model 2, Version 1 . . . 40 • Barcode Interleaved 2 of 5, Code 39, EAN13-Gruppe (EAN8, EAN13, UPC-A, UPC-E), EAN128 (Codes A, B, C) • position and size of field of view freely adjustable • logic operation of single configuration (AND, OR = sorting) • verify
Typical cycle time	40 ms one evaluation Coder reading

8 Type key


SBSI - B - R3 B - F6 - W - D
SBSI Vision Sensor with integral illumination / optic
B Code reader
Q Object detection
R3 736 x 480 Pixel (WideVGA)
B monochrom
F6 6 mm
F12 12 mm
W white
R red
NR infrared
300 = Value 300
301 = Value 301

9 Addendum

9.1 Telegram, Data output

The following telegrams are available

Serial Communication ASCII (Page 185)

Serial communication BINARY (Page 197)

EtherNet/IP Assembly Request (Page 212)

EtherNet/IP Assembly Response (Page 212)

9.1.1 Serial Communication ASCII

Data format of commands and data output

Communication settings

Communication	**Ethernet**	**RS422**
To Sensor, Command	**Selectable in Tab: Protocol (Binary or ASCII)**	
From Sensor, Data output	**Selectable in Tab: Protocol (Binary or ASCII)**	

Commands to sensor in ASCII

Trigger (ASCII) Request string to Sensor		
Byte no.	**ASCII contents**	**Significance**
1	**T**	**Trigger, (simple trigger without index, via port 2006)**
2	**R**	
3	**G**	
Trigger (ASCII) Response string from sensor		
Byte no.	**Contents**	**Significance**
1	**T**	**Trigger, (response to trigger without index, via port 2006. If defined: result date without index via port 2005)**
2	**R**	
3	**G**	
4	**P** **F**	**Pass** **Fail**
Additional information		
Accepted in run mode:	**Yes**	
Accepted in configuration mode:	**Yes**	
Accepted when Ready Low:	**No**	

Status of Ready signal during processing:	**Low**
End of telegram	max. 4 byte (option)

Extended Trigger (ASCII) Request string to Sensor		
Byte no.	ASCII contents	Significance
1	T	Extended Trigger, (trigger with index, for correlation of trigger to the corresponding result data, via port 2006)
2	R	
3	X	
4	x	Length of following data (n)
5	x	
6...n	x	Data
Extended Trigger (ASCII) Response string from sensor		
Byte no.	ASCII contents	Significance
1	T	Extended Trigger, (reponse to trigger with index and result data, via port 2006, for correlation of trigger to the corresponding result. Result data without index via port 2005 also)
2	R	
3	X	
4	P F	Pass Fail
5	x	Length of following data (n)
6	x	
7...n	x	Data of request command
n+1	x	C = Config R = Run
n+2	x	Length of following result data (m)
n+3	x	
n+4	x	
n+5	x	
n+6	x	
n+7	x	
n+8	x	
n+9	x	

n+9...m	x	Result data
m+1	x	End of telegram (option, max 4 byte)
m+2	x	
m+3	x	
m+4	x	
Additional information		
Accepted in run mode:		Yes
Accepted in configuration mode:		Yes
Accepted when Ready Low:		No
Status of Ready signal during processing:		Low
End of telegram		max. 4 byte (option)

Job change-over (ASCII) Request String to Sensor		
Byte no.	**ASCII contents**	**Significance**
1	**C**	**Change Job**
2	**J**	
3	**B**	
4	**X**	**Job number**
5	**X**	
6	**X**	
Job change-over (ASCII) Response String from Sensor		
Byte no.	**Contents**	**Significance**
1	**C**	**Change Job**
2	**J**	
3	**B**	
4	**P** **F**	**Pass** **Fail**
5	**T** **F**	**Triggered** **Free-run**

6	**X**	**Job number**
7	**X**	
8	**X**	
Additional information:		
Accepted in run mode:		**Yes**
Accepted in configuration mode:		**No**
Accepted when Ready Low:		**Yes**
Status of Ready signal during processing:		**Low**
End of telegram		max. 4 byte (option)

Set parameter (ASCII)		
Byte No.	**Contents**	**Significance**
1	**S**	**Set parameter**
2	**P**	
3	**P** **T**	**P Permanent** **T Temporary**
4	**X**	**Detector No.**
5	**X**	
6	**X**	
7	**X**	**Parameter No.** **101 = Reference string**
8	**X**	
9	**X**	
10	**X**	**Length of reference string in Bytes (n)**
11	**X**	
12	**X**	
13	**X**	
14	**X**	
15...n	**X**	**New reference string**
Set parameter (ASCII) Response string from Sensor		
Byte No.	**Contents ASCII**	**Significance**
1	**S**	**Set parameter**
2	**P**	
3	**P** **T**	**P Permanent** **T Temporary**

4	**P** **F**	**P Pass** **F Fail**
5	**S**	**Parameter of type STRG (String) was set**
6	**T**	
7	**R**	
8	**G**	
Additional information		
Accepted in run mode:		**Yes**
Accepted in configuration mode:		**No**
Accepted when Ready Low:		**Yes**
Status of Ready signal during processing:		**Low**
End of telegram		max. 4 byte (option)

Get parameter (ASCII)		
Byte No.	**Contents**	**Significance**
1	**G**	**Get parameter**
2	**P**	
3	**A**	
4	**X**	**Detector No.** **e.g. 001**
5	**X**	
6	**X**	
7	**X**	**Parameter No** **101 = Reference string**
8	**X**	
9	**X**	
Get parameter (ASCII) Response String from Sensor		
Byte No.	**Contents**	**Significance**
1	**G**	**Get parameter**
2	**P**	
3	**A**	
4	**P** **F**	**P Pass** **F Fail**
5	**S**	**Parameter of type STRG (String) was read**
6	**T**	

7	**R**	
8	**G**	
9	**X**	**Length of Reference strings (n)** **z.B. 00005**
10	**X**	
11	**X**	
12	**X**	
13	**X**	
14...n	**X**	**Reference string**
Additional information		
Accepted in run mode:		**Yes**
Accepted in configuration mode:		**No**
Accepted when Ready Low:		**Yes**
Status of Ready signal during processing:		**no change**
End of telegram		max. 4 byte (option)

Get image (ASCII)		
Byte No.	**Contents**	**Significance**
1	**G**	**Get image**
2	**I**	
3	**M**	
4	**X**	**0 – Last Image** **1 – Last Failed Image** **2 – Last Good Image**
Get image (ASCII) Response String from Sensor		
Byte No.	**Contents**	**Significance**
1	**G**	**Get image**
2	**I**	
3	**M**	
4	**P** **F**	**P Pass** **F Fail**
5	**X**	**Error type** **0 – Success,** **1 – Recorder Off** **2 – No Matching Image of requested type**

6	**X**	**Image type** **0 - greyscale** 1 – COLOR_BAYER_GB 2 – COLOR_BAYER_GR 3 – COLOR_BAYER_BG 4 – COLOR_BAYER_RG At conversion of the image from Bayer into RGB, the appropriate image type must be considered. Bei Konvertierung des Farb Bildes von Bayer in RGB, muss der entsprechende Bild Typ berücksichtigt werden.
7	**X**	**Image result** **0 - good image** **1 - failed image**
8	**X**	**No of rows** **e.g. 0480 / 0200**
9	**X**	
10	**X**	
11	**X**	
12	**X**	**No of columns** **e.g. 0640 / 0320**
13	**X**	
14	**X**	
15	**X**	
16...n	**X**	**Binary image data (rows * columns)**
Additional information		
Accepted in run mode:		**Yes**
Accepted in configuration mode:		**No**
Accepted when Ready Low:		**Yes**
Status of Ready signal during processing:		**pulled low**
End of telegram		max. 4 byte (option)

Set Shutter (ASCII)		
Byte No.	**Contents**	**Significance**
1	**S**	**Set Shutter in active Job**
2	**S**	
3	**P** **T**	**Permanent** **Temporary**

4	**X**	**Number of chars of shutter value, e.g. 04**
5	**X**	
6	**X**	**New shutter value in microseconds, e.g. 8000 = 8 ms**
7	**X**	
8	**X**	
9	**X**	
Set Shutter (ASCII) Response String from Sensor		
Byte No.	**Contents**	**Significance**
1	**S**	**Set Shutter**
2	**S**	
3	**P** **T**	**Permanent** **Temporary**
4	**P** **F**	**P Pass** **F Fail**
Additional information		
Accepted in run mode:		**Yes**
Accepted in configuration mode:		**No**
Accepted when Ready Low:		**Yes**
Status of Ready signal during processing:		**pulled low**
End of telegram		max. 4 byte (option)

Set ROI (ASCII)		
Byte No.	**Contents**	**Significance**
1	**S**	**Set ROI** **SRP00000490010002001600000012000000** **080000000400000080000** **Length49, Detector=1,yellow ROI, rectangle, centre X=160, centre Y=120, half width= 80, half height=40**
2	**R**	
3	**P** **T**	**Permanent** **Temporary**
4-11	**X**	**ROI Info length in bytes from Byte 4 to end** **e.g. 00000049**

12	X	Detector No. e.g. 001
13	X	
14	X	
15	X	ROI Index = 00 for yellow ROI
16	X	
17	X	ROI shape 01=circle / 02=rectangle / 03=ellipse e.g. 02 for rectangle
18	X	
19-26	X	centre X (in pixels * 1000), e.g. 160 pixels = 00160000
27-34	X	centre Y (in pixels * 1000), e.g. 120 pixels = 00120000
35-42	X	half width / X-radius (in pixels * 1000), e.g. 80 Pixel = 0008000
43-50	X	half height / Y-radius (in pixels * 1000), e.g. 40 Pixel = 0004000
51-58	X	Angle (not at circle / ellipse) (in ° * 1000), e.g. 180° = 0018000
Set ROI (ASCII) Response String from Sensor		
Byte No.	**Contents**	**Significance**
1	S	Set ROI
2	R	
3	P T	Permanent Temporary
4	P F	P Pass F Fail
Additional information		
Accepted in run mode:		Yes
Accepted in configuration mode:		No
Accepted when Ready Low:		Yes
Status of Ready signal during processing:		pulled low
End of telegram		max. 4 byte (option)

Get ROI (ASCII)		
Byte No.	**Contents**	**Significance**

1	G	Get ROI e.g. GRI00100
2	R	
3	I	
4	X	Detector No. e.g. 001
5	X	
6	X	
7	X	ROI Index = 00 for yellow ROI
8	X	
Get ROI (ASCII) Response String from Sensor		
Byte No.	Contents	Significance
1	G	Get ROI
2	R	
3	I	
4	P F	P Pass F Fail
5	X	ROI Info length in bytes from Byte 5 to end
6	X	
7	X	Detector No.
8	X	
9	X	
10	X	ROI Index = 00 for yellow ROI
11	X	
12	X	ROI shape 01=circle / 02=rectangle / 03=ellipse
13	X	
14-21	X	centre X (in pixels * 1000)
22-29	X	centre Y (in pixels * 1000)
30-37	X	X-radius (in pixels * 1000)
38-45	X	Y-radius (in pixels * 1000)
46-53	X	Angle (not at circle / ellipse) (in ° * 1000)
Additional information		
Accepted in run mode:		Yes
Accepted in configuration mode:		No
Accepted when Ready Low:		Yes

Status of Ready signal during processing:	**pulled low**
End of telegram	max. 4 byte (option)

Data output in ASCII

Dynamically composed from user settings in the software
<START> (((<OPTIONAL FIELDS> <SEPARATOR> <PAYLOAD>))) <CHKSUM> <TRAILER>
Output data (ASCII), dynamically composed from user settings in the software

Name	Number of bytes	ASCII contents / example	Significance /Comments
Header	1 - max. 8	User defined, max. 8 characters	Start string (Header)
Separator	1 - 5	User defined, max. 5 characters (per separator)	Separator from: “after first optional field“, or „after first detector spec. date“
Selected Fields	16	1 Byte per field	by this field output of all active checkboxes "byte-wise" can be activated - Output order is from left to right and from top to down. - For each checkbox there is one byte beginning with LSB = low significant bit. - Checkbox "Selected fields" is not part of the output! P = logical output set F = logical output not set 0 = logical output not active
Data length	n	One byte per figure of decimal number e.g. 102 „1“; „0“; „2“	Length of telegram in bytes
Status	3	“110” triggered mode or “101” free-run mode	
Detector result	n	Byte 1 = AND conjunction of all detectors Byte 2 = Boolean result of alignment	

		Byte 3 = global result of the active job **Following Bytes: number of detectors** **Following Bytes: Detector results, "P" = Pass, "F" = Fail, last byte is first detector** **Length: 4 Byte + 1 Byte per each used detector**	
Digital outputs	**n**	**First Bytes: number of active outputs** **Following Bytes: digital outputs**	**P = logical output set** **F = logical output not set** **0 = logical output not active**
Logical outputs	**n**	**First Bytes: number of active logical outputs** **Following Bytes:- logical outputs**	**Example: 18 logical outputs are configured, but only output1,2 and 9 are linked to functions (are active):** **3PP000000P** **2 bytes number of active outputs, all results bit-coded ...** **In this example there are needed 2 bytes because of output 9....** **P = logical output set** **F = logical output not set** **0 = logical output not active**
Total exec. time	**n**		**Current (job) cycle time in [ms]**
Active job no.	**1-3**		**Active job no. (1..255)**
<<Detector specific>>			
Detector result	**1**	**P = Pass** **F = Fail**	**Boolean detector result**
Score value 1 .. n	**1-3**		**Score (0..100%)**
Execution time	**n**		**Execution time of individual detector in [msec].**

Position X 1 .. n	**n**	**e.g.: X = 180 (pix) = (in ASCII) "180000" = 6 Byte**	**Position found X (x-coordinate). [1/1000]**
Position Y 1 .. n	**n**		**Position found Y (y-coordinate). [1/1000]**
DeltaPos X	**n**		**Delta position X between object taught and object found [1/1000]**
DeltaPos Y	**n**		**Delta position X between object taught and object found [1/1000]**
Angle	**n**		**Orientation of object found (0°..360°) [1/1000)**
Delta Angle	**n**		**Angle between object taught and object found (0°..360°) [1/1000]**
Scaling	**n**		**Only with contour (0.5..2) [1/1000]**
String	**1...n**	**Maximum length 127!!**	**Contents of Code, depending from code string length may change, if a fix string length is needed, parameters minimum string length (detector specific data output) and maximum string length (detector parameters) have to be used.**
String length	**n**		**Length of Code in Bytes**
Truncated	**1**	**F = Code complete, P = Code truncated**	**Code truncated**
Checksum	**3**		**XOR checksum of all bytes in telegram**
Trailer	**1 - max. 8**	**User defined, max. 8 characters**	**End of string (Trailer)**

All detector-specific data with decimal places are transmitted as whole numbers (multiplied by 1000) and must therefore be divided by 1000 after receipt of data.

9.1.2 Serial communication BINARY

Data format of commands and data output

Communication settings

Communication	**Ethernet**	**RS422**
To Sensor, Command	**Selectable in Tab: Protocol (Binary or ASCII)**	
From Sensor, Data output	**Selectable in Tab: Protocol (Binary or ASCII)**	

Commands to sensor in BINARY

Trigger (Binary) Request string to sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x05	
5	Unsigned Char	0x01	Trigger command, (simple trigger without index, via port 2006)
Trigger (Binary) Answer string from sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x07	
5	Unsigned Char	0x01	Trigger command, (response to trigger without index, via port 2006. If defined: result data without index via port 2005)
6	Unsigned Short	0x00	Error code, 0 = Pass, 1 = Fail
7		0xXX	
Additional information			
Accepted in run mode:			Yes
Accepted in configuration mode:			Yes
Accepted when Ready Low:			No
Status of Ready signal during processing:			Low

Extended Trigger (Binary) Request string to sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	Unsigned Int	0x00	Length of telegram
2		0x00	

3		**0x00**	
4		**0x05**	
5	**Unsigned Char**	**0x013**	**Extended Trigger command, (trigger with index for correlation of trigger to the correponding result data, via port 2006)**
6	Unsigned Char	0xXX	Length of following data (n)
7...n	Unsigned Char	0xXX	Data
Extended Trigger (Binary) Answer string from sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x07**	
5	**Unsigned Char**	**0x013**	**Extended Trigger command, (response to trigger with index and result data, via port 2006, for correlation of trigger to corresponding result, Result data without index, via port 2005 also)**
6	**Unsigned Short**	**0x00**	**Error code** **0 = Pass** **1 = Fail**
7		**0xXX**	
8	Unsigned Char	0xXX	Length of following data (n)
9...n	Unsigned Char	0xXX	Data of request command
n+1	Unsigned Char []	0xXX	Operating mode 0 = Config Mode 1 = Run Mode
n+2	Unsigned Int	0xXX	Length of following result data (m)
n+3		0xXX	
n+4		0xXX	
n+5		0xXX	
n+6	Unsigned Int []	0xXX	Result data
n+7		0xXX	
n+8		0xXX	
n+9...m		0xXX	
Additional information			
Accepted in run mode:			**Yes**
Accepted in configuration			**Yes**

mode:			
Accepted when Ready Low:			**No**
Status of Ready signal during processing:			**Low**
Job change-over (Binary) Request string to sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x06**	
5	**Unsigned Char**	**0x02**	**Job change-over command**
6	**Unsigned Char**	**0xXX**	**Job no, XX = 1- n**
Job change-over (binary) Answer string from sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x09**	
5	**Unsigned Char**	**0x02**	**Job change-over command**
6	**Unsigned Short**	**0x00**	**Error code, 0 = Pass, 1 = Fail**
7		**0xXX**	
8	**Unsigned Char**	**0xXX**	**Trigger mode** **0 = triggered** **1 = free-run**
9	**Unsigned Char**	**0xXX**	**Job no, XX = 1- n**
Additional information			
Accepted in run mode:			**Yes**
Accepted in configuration mode:			**No**
Accepted when Ready Low:			**Yes**

Status of Ready signal during processing:	**Low**

Set parameter (Binary) Request string to Sensor			
Byte no.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram = 9 Bytes + length of string (n)**
2		**0x00**	
3		**0x00**	
4		**0xn**	
5	**Unsigned Char**	**0x05** **0x06**	**Command set parameter permanent** **Command set parameter temporary**
6	**Unsigned Char**	**0xXX**	**Detector no., XX = 1- n**
7	**Unsigned Char**	**0x65**	**Command: Set reference string*1), see below !**
8	**Unsigned Short**	**0x00**	**Length new reference string (n)**
9		**0x0n**	
10..n	**Unsigned Char**	**0xn**	**Reference string**
Set parameter (Binary) Response string from Sensor (may be 4-5 Seconds delayed)			
Byte no.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x08**	
5	**Unsigned Char**	**0x05** **0x06**	**ID set reference string permanent** **ID set reference string temporary**
6	**Unsigned Short**	**0xXX**	**Error Code 00 00 = Pass** **Error Code 00 01 = Fail**
7		**0xXX**	
8	**Unsigned Char**	**0x0A**	**Parameter type string**
Additional information			
Accepted in run mode:			**Yes**
Accepted in configuration mode:			**No**
Accepted when Ready Low:			**Yes**
Status of Ready signal during processing:			**Low**

***1) Byte No. 7: Command: set reference string:**

Detector	Function	Command	Length of following data
Alignment Contour	Threshold Min Threshold Max	1 2	4 4
Pattern matching	Threshold Min Threshold Max	1 2	4 4
Contour	Threshold Min Threshold Max	1 2	4 4
Grey Level	Threshold Min Threshold Max GreyMin GreyMax	1 2 101 102	4 4 4 4
Contrast	Threshold Min Threshold Max	1 2	4 4
Barcode	Reference String	101	n
Datacode	Reference String	101	n

Get parameter (Binary) Request string to Sensor			
Byte no.	Data type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x07	
5	Unsigned Char	0x0A	Command get parameter
6	Unsigned Char	0xn	Detector no., XX = 1- n
7	Unsigned Char	0x65	Command: Set reference string*1), see below !
Get Parameter (Binary) Response string from Sensor (may be 4-5 Seconds delayed)			
Byte no.	Data type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram = 10 Bytes + Length of string (n)
2		0x00	
3		0x00	
4		0x0n	
5	Unsigned Char	0x0A	ID get parameter
6	Unsigned Short	0xXX	Error Code 00 00 = Pass Error Code 00 01 = Fail

7		0xXX	
8	Unsigned Char	0x0A	Parameter type string
9	Unsigned Short	0x00	Length of parameter (n)
10		0x0n	
11..n	Unsigned Char	0xn	Reference string
Additional information			
Accepted in run mode:			Yes
Accepted in configuration mode:			No
Accepted when Ready Low:			Yes
Status of Ready signal during processing:			No change

*1) Byte No. 7: Command: set reference string:

Detector	Function	Command	Length of following data
Alignment Contour	Threshold Min Threshold Max	1 2	4 4
Pattern matching	Threshold Min Threshold Max	1 2	4 4
Contour	Threshold Min Threshold Max	1 2	4 4
Grey Level	Threshold Min Threshold Max GreyMin GreyMax	1 2 101 102	4 4 4 4
Contrast	Threshold Min Threshold Max	1 2	4 4
Barcode	Reference String	101	n
Datacode	Reference String	101	n

Get image (Binary) Request string to Sensor			
Byte No.	Data type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x06	

5	**Unsigned Char**	**0x03**	**Get image**
6	**Unsigned Char**	**0xXX**	**0 – Last Image** **1 – Last Failed Image** **2 – Last Good Image**
Get image (Binary) Response String from Sensor			
Byte No.	**Data type**	**Contents**	**Significance**
1	**Unsigned Int**	**0xXX**	**Length of telegram** **e.g. 00 04 B0 0D**
2		**0xXX**	
3		**0xXX**	
4		**0xXX**	
5	**Unsigned Char**	**0x03**	**Response ID Get image**
6	**Unsigned short**	**0xXX**	**Error code** **00 00 – Success,** **00 01 – Recorder Off** **00 02 – No Matching Image of requested type**
7		**0xXX**	
8	**Unsigned Char**	**0xXX**	**Image type** **0 - greyscale** 1 – COLOR_BAYER_GB 2 – COLOR_BAYER_GR 3 – COLOR_BAYER_BG 4 – COLOR_BAYER_RG At conversion of the image from Bayer into RGB, the appropriate image type must be considered. Bei Konvertierung des Farb Bildes von Bayer in RGB, muss der entsprechende Bild Typ berücksichtigt werden.
9	**Unsigned Char**	**0xXX**	**Image result** **00 - good image** **01 - failed image**
10	**Unsigned short**	**0xXX**	**No of rows** **e.g. 01 E0**
11		**0xXX**	
12	**Unsigned short**	**0xXX**	**No of columns** **e.g. 02 80**
13		**0xXX**	
14...n	**Unsigned Char**	**0xXX**	**Binary image data (rows * columns)**
Additional information			
Accepted in run mode:			**Yes**

Accepted in configuration mode:	**No**
Accepted when Ready Low:	**Yes**
Status of Ready signal during processing:	**Pulled low**

Set Shutter (Binary) Request string to Sensor			
Byte No.	**Data Type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x09**	
5	**Unsigned Char**	**0x0E** **0x0F**	**Command set shutter temporary** **Command set shutter permanent**
6	**Unsigned Int**	**0xXX**	**Shutter value (in microseconds)**
7		**0xXX**	
8		**0xXX**	
9		**0xXX**	
Set Shutter (Binary) Response String from Sensor			
Byte No.	**Data Type**	**Contents**	**Significance**
1	**Unsigned Int**	**0x00**	**Length of telegram**
2		**0x00**	
3		**0x00**	
4		**0x07**	
5	**Unsigned Char**	**0x0E** **0x0F**	**ID set shutter temporary** **ID set shutter permanent**
6	**Unsigned Short**	**0x00**	**Error Code 00 00 = Pass** **Error Code 00 01 = Fail**
7	**0xXX**		
Additional information			
Accepted in run mode:			**Yes**
Accepted in configuration mode:			**No**
Accepted when Ready Low:			**Yes**
Status of Ready signal during processing:			**Pulled Low**

Set ROI (Binary) Request string to Sensor			
Byte No.	**Data Type**	**Contents**	**Significance**
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x32	
5	Unsigned Char	0x10 0x11	Command set ROI temporary Command set ROI permanent
6	Unsigned Int	0xXX	ROI Info Length in Bytes from Byte 6 to end
7		0xXX	
8		0xXX	
9		0xXX	
10	Unsigned Char	0xXX	Detector No.
11	Unsigned Char	0x00	ROI Index = 00 = yellow ROI
12	Unsigned Char	0xXX	ROI shape 01=circle / 02=rectangle / 03=ellipse
13	Unsigned Int	0xXX	ROI Parameter: centre X (in Pixels * 1000)
14		0xXX	
15		0xXX	
16		0xXX	
17	Unsigned Int	0xXX	ROI Parameter: centre Y (in Pixels * 1000)
18		0xXX	
19		0xXX	
20		0xXX	
21	Unsigned Int	0xXX	ROI Parameter: width / radius X (in Pixels* 1000)
22		0xXX	
23		0xXX	
24		0xXX	
25	Unsigned Int	0xXX	Only ellipse / rectangle: ROI Parameter: width / radius Y (in Pixels* 1000)
26		0xXX	
27		0xXX	
28		0xXX	

29	Unsigned Int	0xXX	Only ellipse / rectangle: ROI Parameter: Angle in ° (in ° * 1000)
30		0xXX	
31		0xXX	
32		0xXX	
Set ROI (Binary) Response String from Sensor			
Byte No.	Data Type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x07	
5	Unsigned Char	0x10 0x11	ID set ROI temporary ID set ROI permanent
6	Unsigned Short	0x00	Error Code 00 00 = Pass Error Code 00 01 = Fail
7		0xXX	
Additional information			
Accepted in run mode:			Yes
Accepted in configuration mode:			No
Accepted when Ready Low:			Yes
Status of Ready signal during processing:			Pulled Low

Get ROI (Binary) Request string to Sensor			
Byte No.	Data Type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x09	
5	Unsigned Char	0x12	Command get ROI
6	Unsigned Char	0xXX	Detector No.
7	Unsigned Char	0xXX	ROI Index = 00 = yellow ROI
Get ROI (Binary) Response String from Sensor			

Byte No.	Data Type	Contents	Significance
1	Unsigned Int	0x00	Length of telegram
2		0x00	
3		0x00	
4		0x34	
5	Unsigned Char	0x12	ID get ROI
6	Unsigned Short	0x00	Error Code 00 00 = Pass Error Code 00 01 = Fail
7		0xXX	
8	Unsigned Int	0xXX	ROI Info Length in Bytes from Byte 8 to end
9		0xXX	
10		0xXX	
11		0xXX	
12	Unsigned Char	0xXX	Detector No.
13	Unsigned Char	0x00	ROI Index = 00 = yellow ROI
14	Unsigned Char	0xXX	ROI shape 01=circle / 02=rectangle / 03=ellipse
15	Unsigned Int	0xXX	ROI Parameter: centre X (in Pixels * 1000)
16		0xXX	
17		0xXX	
18		0xXX	
19	Unsigned Int	0xXX	ROI Parameter: centre Y (in Pixels * 1000)
20		0xXX	
21		0xXX	
22		0xXX	
23	Unsigned Int	0xXX	ROI Parameter: width / radius X (in Pixels* 1000)
24		0xXX	
25		0xXX	
26		0xXX	
27	Unsigned Int	0xXX	Only ellipse / rectangle: ROI Parameter: width / radius Y (in Pixels* 1000)

28		0xXX	
29		0xXX	
30		0xXX	
31	Unsigned Int	0xXX	Only ellipse / rectangle: ROI Parameter: Angle in ° (in ° * 1000)
32		0xXX	
33		0xXX	
34		0xXX	
Additional information			
Accepted in run mode:			Yes
Accepted in configuration mode:			No
Accepted when Ready Low:			Yes
Status of Ready signal during processing:			Pulled Low

Data output from sensor in BINARY

dynamically composed from user settings in the software

Main string structure:<START> <OPTIONAL FIELDS> <PAYLOAD> <CHKSUM> <TRAILER>

Output data (BINARY), dynamically composed from user settings in the software			
Name	Number of bytes	Binary contents / Example	Significance /Comments
Start	1 - max. 8	User defined, max. 8 Bytes	Start string (Header)
Selected fields	2 (Word)	1 Bit per field	By this field output of all active checkboxes "bit-wise" (in 2Bytes!) can be activated - Output order is from left to right and from top to down. - For each checkbox there is one bit (high/low) beginning with LSB = low significant bit. - Checkbox "Selected fields" is not part of the output!
Data length	2 (Word)	e.g. 0x00, 0x02 = length = 2 Byte	Length of telegram in Bytes
Status	2 (Word)	e.g. 0x00, 0x06 (triggered) e.g. 0x00,	Byte1: 00000xxx Bit0 = 1 = <Free-run> Bit1 = 1 = <triggered> Bit2 = <Op.mode> (1=run/0=config)

		0x05 (free-run)	Byte2 (reserved), always 0x00
Detector result	4..n	e.g.. 0x05 (Bit1+3=5) 0x00 (two bytes number of detectors) 0x01 0x01 (Detector result D1)	Byte 1 Bit1 (LSB) = global job result (1 = Pass, 0 = Fail) Bit2 = Boolean result, alignment only, alignment inactive = true Bit3 = AND conjunction of all detectors of the active job Byte 2 and 3 two byes for the number of detectors inside job (without alignment) Byte 4 - n 1 Byte per each block of 8 used detectors e.g.: Bit1(LSB) = Detector 1, Bit2 = Det. 2, ...
Digital outputs	n	Byte 1 and 2: number of active outputs Bytes 3 ... n: outputs, bit-coded	Results of all digital outputs (bit-coded)
Logical outputs	n	Byte 1 ... n number of active logical outputs Byte n ... m all active logical outputs, bit-coded	Example: 18 logical outputs are configured, but only output1,2 and 9 are linked to functions (are active): 000, 003, 003, 001 2 bytes number of active outputs, all results bit-coded ... In this example there are needed 2 bytes because of output 9.... 1. result byte = 00000011 (log. output 1+2) 2. result byte = 00000001 (log. output 9)
Total exec. time	4 (Integer)		Current (job) cycle time in [ms]
Active job no.	1		Active Job no. (1..255)
<<Detector specific>>			
Detector result	1	(1 = Pass, 0 = Fail)	Boolean detector result
Score value 1 .. n	4		Score (0..100%)

Execution time	**4**		**Execution time of individual detector in [msec].**
Position X1 .. n	**4**		**Position found X (x-coordinate). [1/1000]**
Position Y1 .. n	**4**		**Position found Y (y-coordinate). [1/1000]**
DeltaPos X	**4**		**Delta Position X between object taught and object found [1/1000]**
DeltaPos Y	**4**		**Delta Position X between object taught and object found [1/1000]**
Angle	**4**		**Orientation of object found (0°..360°) [1/1000)**
Delta Angle	**4**		**Angle between object taught and object found (0°..360°) [1/1000]**
Scaling	**4**		**Only with contour (0.5..2) [1/1000]**
String	**1...n**	**Maximum length 127!!**	**Contents of Code, depending from code string length may change, if a fix string length is needed, parameters minimum string length (detector specific data output) and maximum string length (detector parameters) have to be used.**
String length	**4**		**Length of Code in Bytes**
Truncated	**1**	**0x00 = Code complete, 0x01 = Code truncated**	**Code truncated**
Checksum	**1**		**XOR-checksum of all bytes in telegram**
Trailer	**1 - max. 8**		**End of string (Trailer)**

All detector-specific data with decimal places are transmitted as whole numbers (multiplied by 1000) and must therefore be divided by 1000 after receipt of data.

Values are transferred in format "Big-endian". (there are two different architectures for handling memory storage. They are called Big Endian and Little Endian and refer to the order in which the bytes are stored in memory, in the case of the Vision Sensor architecture the data is stored Big End In first)

Example: "Score" Value (Binary protocol)

In Vision Sensor Configuration Studio/Vision Sensor Visualisation Studio "Score" = 35 is displayed.

Over Ethernet there will be received the following four bytes: 000,000,139,115

Formula for recalculating: (HiWordByte*256 + HiLowByte) *65536 + HiByte*256 + LoByte = Value

Because Big-endian (from Sensor) is sent calculation goes as following:
000 = HiWordByte, 000 = HiLowByte, 139 = HiByte, 115 = LoByte

(0*256 + 0) * 65536 + (139 * 256) + 115 = 35699 / 1000 = 35,699 (real score value)

Angles or other negative values are transferred in two's complement.

9.1.3 EtherNet/IP Assembly Request

Communication Settings

Description:	Response returned from sensor to PLC
Class:	Class 1
nAssemblyInstance	101
nType	AssemblyProducing
nLength (bytes)	444
szAssemblyName	AssemblyResponse

Assembly request

Position	Size (bytes)	Member	Data type	Description
0	2	unKey	U16	request key, e.g. a request counter
2	2	unId	U16	request ID, e.g. for requests "trigger", "change job"
4	2	unNumChar	U16	no. of valid char parameters
6	2	unNumInt	U16	no. of valid int parameters
8	256	pcValueChar[RQST_ NUM_CHAR]	I8	char parameters for request, member may only hold one string
264	80	pnValueInt[RQST_ NUM_INT]	I32	int parameters for request

9.1.4 EtherNet/IP Assembly Response

Communication-Settings

Description:	Request posted to sensor from PLC
Class:	Class 1

nAssemblyInstance	100
nType	AssemblyConsuming
nLength (bytes)	344
szAssemblyName	AssemblyRequest

Assembly response

Position	Size (bytes)	Member	Data type	Description
0	4	unFault	U32	member is standard in Rockwell RSLogix
4	2	unKey	U16	request key is returned in response
6	2	unId	U16	request ID is returned in response
8	2	unError	U16	error code of response
10	2	unNumChar	U16	no. of valid char parameters
12	2	unNumInt	U16	no. of valid int parameters
14	2	ucAlignmentDummy	U8	
16	16	pcValueChar[RPNS_NUM_CHAR]	I8	char parameters for response, member may only hold one string
32	16	pnValueInt[RPNS_NUM_INT]	U32	int parameters for response
48	4	unImageCount	U32	no. of last processed image.
52	4	unExecutionTime	U32	execution time in msec of last processed image.
56	4	pucStatus[RPNS_IMPL_NUM_ BYTE_STATUS]	U8	status information, including operation mode
60	2	unActiveJob	U16	active job
62	2	ucAlignmentDummy	U8	
64	2	unNumDigital	U16	no. of valid digital outputs
66	2	unNumLogic	U16	no. of valid logic outputs
68	2	unNumDetector	U16	no. of valid logic outputs
70	2	unNumBool	U16	no. of valid boolean parameters
72	2	unNumString	U16	no. of strings included in pcValueChar
74	2	unNumInt	U16	no. of valid int parameters
76	4	pucDigital[RPNS_IMPL_NUM_	U8	digital outputs (bitwise)

		BYTE_DIGITAL]		
80	8	pucLogic[RPNS_IMPL_NUM_ BYTE_LOGIC]	U8	logic outputs (bitwise)
88	4	pucDetector[RPNS_IMPL_NUM_ BYTE_DETECTOR]	U8	detector results (bitwise), formerly stored in pucValueBool
92	4	pucBool[RPNS_IMPL_NUM_ BYTE_BOOL]	U8	boolean results (bitwise) as configured in HMI (listbox)
96	16	punStringLength[RPNS_IMPL_ NUM_STRING]	U16	lengths of strings included in pcValueChar
112	2	pucStringTruncated[RPNS_IMPL_ NUM_BYTE_STRING_ TRUNCATED]	U8	indicates for each string whether it has been truncated (bitwise)
114	2	ucAlignmentDummy	U8	
116	128	pcString[RPNS_IMPL_NUM_ BYTE_STRING]	I8	char result as configured in HMI (listbox), member may hold multiple strings
244	200	pnInt[RPNS_IMPL_NUM_INT]	U32	int results as configured in HMI (listbox)

9.2 Starting Vision Sensor Visualisation Studio or Vision Sensor Configuration Studio via Autostart

To start Vision Sensor Visualisation Studio or Vision Sensor Configuration Studio via Autostart please select in: Vision Sensor Device Manager/File/Auto start file, the module to autostart and save it.

After selecting the module to start and the user level, with "Save" store the Autostart- file in folder ..\Windows\Start Menu\Programs (exact path depends on Windows installation)

9.3 Care and maintainance

9.3.1 Cleaning

The Vision Sensor is to be cleaned with a clean, dry cloth.

Dirt on the front panel is to be cleaned with a soft cloth and a small amount of plastic cleaner if necessary.

Attention

Never use aggressive detergents such as solvents or benzine.

Never use sharp objects. Do not scratch!

9.3.2 Transport, packaging, storage

Always check the delivery contents immediately after receipt to ensure they are complete and that they have not been damaged during transport. In the event of transport damage, the carrier must be informed. When returning the sensor, always ensure that it is sent in sufficiently protective packaging.

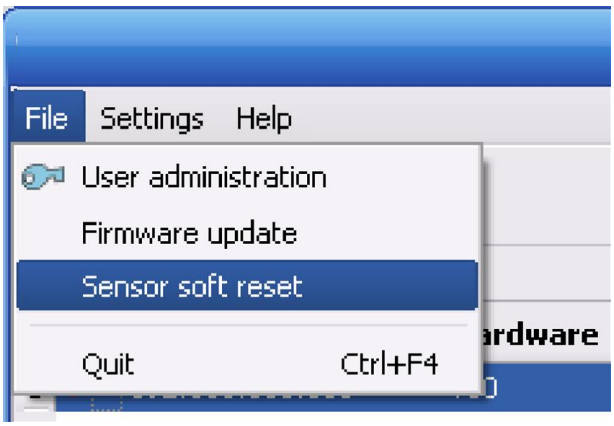
Information
Complaints must be made as soon as a defect is detected. Claims can only be lodged within the applicable time limits.

9.3.3 Waste disposal

Electronic components are subject to special waste regulations and may only be disposed of by specialist waste disposal firms.

9.3.4 Softreset

Start Vision Sensor Device Manager. Select the sensor you wish to restart from the list and select „Sensor soft reset“ under Menu / File.



9.3.5 Sensor Firmware Update Vision Sensor

Firmware update is to be carried out as follows:

Start Vision Sensor Device Manager. Select the sensor you wish to update from the list and select “Update” under Menu / File.

For update, you require an VIS file which matches your sensor type and contains the latest software version for the sensor. The VIS file for the respective latest sensor version can be found on the support web page of the manufacturer. Please ensure you have the correct file before beginning the update. Updates can only be made in the user group “Administrator”.
Check that no other programmes have access to the sensor before beginning update, then follow the instructions of the update routine.

Warning
Close all programmes that communicate with the sensor before update. Active communication with the sensor during update can delete the firmware and render it necessary to return the sensor to the manufacturer! Save configurations before update. They can then be reloaded later.

Once update has been completed, you will be requested to restart the sensor and Vision Sensor Device Manager.
After restart, you will see that the sensor is listed with a new version number in the sensor list.