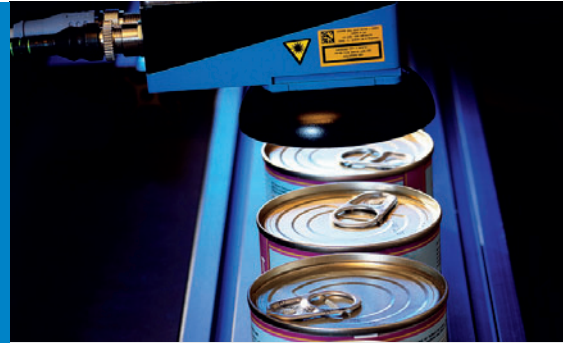


Inspector I10, I20, I40

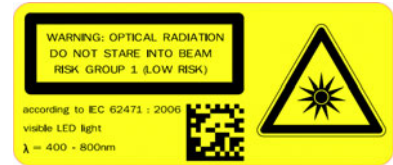
Vision Sensor



**VSPI-1R111 (I10 Standard), VSPI-1D111 (I10 Dome),
VSPI-2F111 (I20 Flex), VSPI-2D111 (I20 Dome),
VSPI-4F2111 (I40 Flex)**

WARNING

The Inspector is equipped with a LED illumination that must be considered as a lamp system of Risk Group 1 (low risk) according to IEC 62471:2006



WARNING: OPTICAL RADIATION DO NOT
STARE INTO BEAM

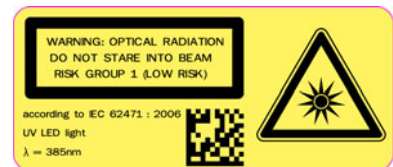
RISK GROUP 1 (LOW RISK) according to IEC
62471:2006

Visible LED light $\lambda = 400-800 \text{ nm}$

VSPI-2F121 (I20-UV Flex), VSPI-4F2311 (I40-LUT Flex)

WARNING

The Inspector is equipped with a LED illumination that must be considered as a lamp system of Risk Group 1 (low risk) according to IEC 62471:2006



WARNING: OPTICAL RADIATION DO NOT
STARE INTO BEAM

RISK GROUP 1 (LOW RISK) according to IEC
62471:2006

UV LED light $\lambda = 385 \text{ nm}$

VSPI-2F141 (I20-IR Flex), VSPI-4F2411 (I40-IR Flex)

NOTICE

The Inspector is equipped with an LED illumination that must be considered as a lamp system of Risk Group 0 / Free Group (exempt risk) according to IEC 62471:2006.



NOTICE: IR EMITTED FROM THIS
PRODUCT

RISK GROUP 0 (EXEMPT RISK) accord-
ing to IEC 62471:2006

IR LED light $\lambda = 850 \text{ nm}$

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The declarations of conformity and
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Internet at: **www.sick.com/Inspector**



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Introduction

About this manual

This manual is divided in the following main parts:

- Introduction – chapters 1–5.
- How To – chapters 6–20, including setup, installation and get started.
- User Interface – chapters 21–32, description of views, menus, toolbars etc.
- Appendices – chapters 33–40, including technical data, terminology and index.

1 Overview

The Inspectors, I10, I20 and I40 are a family of vision sensors intended for high-speed object inspection. With its robust object locator algorithm it is able to locate objects independently of their position, rotation and scale.

The Inspector is configured and monitored with SOPAS Inspector, an easy to use PC application. The Inspector can be connected to the PC using industrial Ethernet, which also enables it to be monitored over a network when operating.

The Inspector I10 is the base model, which can keep up to 16 different reference objects in memory at once, and switches between them using four digital inputs or object selection in SOPAS Inspector. For each object the Inspector can perform inspections of up to 32 different features simultaneously.

The Inspector I20 has a flexible lens concept which allows changing the lens to have a different working distance and field of view. It also has the following additional features:

- Outputs by logical expressions. The status of the outputs can be based on logical combinations of detailed inspections.
- Support for additional digital inputs and outputs through an external I/O extension box. This enables up to 16 additional outputs besides the three available on the I10, and 4 additional inputs for object selection.

The Inspector I40 has the same features as the I20, but also supports the following:

- Increased resolution to enable robust high-resolution inspections – 640x480 pixels (VGA) instead of 384x384.
- Pattern, an additional robust pattern matching inspection tool.
- Store Images to FTP, which allows storing inspected images remote from the Inspector to an FTP server.
- Possibility to control and read out results from the Inspector I40 using the EtherNet/IP standard.
- Extended number of reference objects from 16 to 32.

The Inspector is available in three different housings:

Standard	Fixed lens, white ring light.
Dome	Fixed lens, fixed white dome light suitable for inspecting glossy objects.
Flex	Exchangeable lens and front window. Front window can be replaced with color filters or white dome light.

	I10	I20	I40
Standard	X	-	-
Dome	X	X	-
Flex	-	X	X



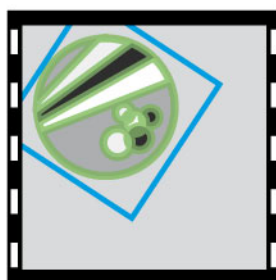
Figure – The Inspector Flex, Standard, and Dome.

1.1 Inspecting

The Inspector inspects objects in the following way:

- First, it locates the object in the view.
- After that, it inspects details on the object to find out whether the object is OK or not.

1. Locate



2. Inspect details

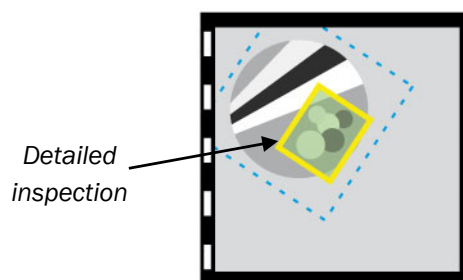


Figure – The Inspector first locates the object, and then inspects it.

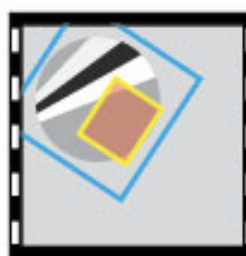
The Inspector will consider an object to be OK if it can be located, and if all detailed inspections pass. If one or more detailed inspection fails, the object will be considered faulty.

By default, the Inspector provides the inspection result by activating the outputs in the following way:

Output	Pin	Function LED	Activated when
Out1	4	Blue	Not located – The object was not located, or a detailed inspection was out of view.
Out2	6	Red	Detail failed – The object was located but at least one of the detailed inspections failed.
Out3	7	Green	All passed – The object was located and all detailed inspections passed as well.




All passed




Detail failed




Not located

Figure – The inspected object passed, failed and was not found.

The Inspector can be set up to just locate the object without making any additional inspections. This will be the case if you teach a new Inspector without using a PC.

Similarly, the Inspector can be set up to only inspect details, without locating any object. In this case, the Inspector will make the inspections in a fixed location in the view, and not necessarily on an object. This usually allows inspections at higher speeds, but the inspections are no longer location, rotation and scale invariant.

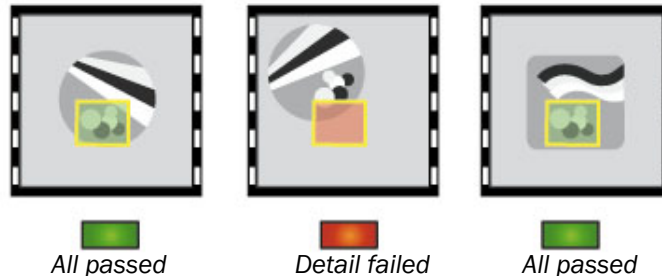


Figure – When the Inspector inspects without locating, the detailed inspections will always be performed at the same location in the field of view.

1.2 Teaching

Before the Inspector can inspect anything, it must be taught at least one reference object. There are two ways to teach the Inspector:

Using SOPAS Inspector

With SOPAS Inspector you can connect to an Inspector from a PC. You can then view images from the Inspector, teach new reference objects, add and modify detailed inspections, and change other settings in the Inspector.

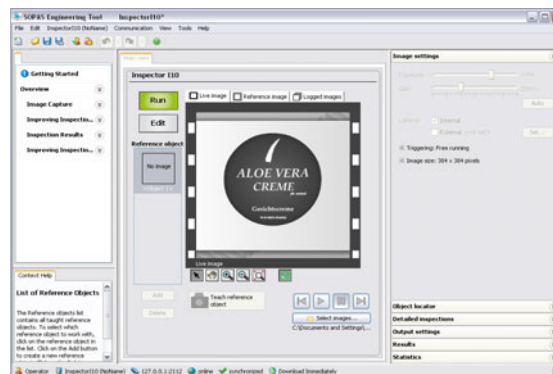


Figure – SOPAS Inspector main window.

Without PC

By default, the Inspector can also be taught by activating In2 for more than 3 seconds. The Inspector will then enter a “learning mode” during which you can adjust the focus and position the object. The Function LED can be used as a help when adjusting focus and positioning the object.

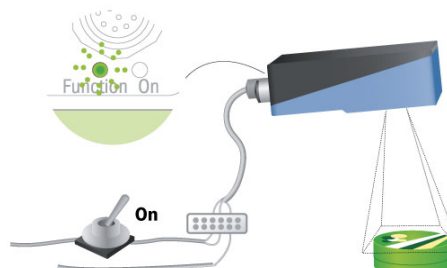


Figure – Teaching without using PC.

When In2 is then deactivated, the Inspector will learn everything within the field of view, and start inspecting. The result of the inspections will be either All passed if the object could be located, and Not located when it could not.

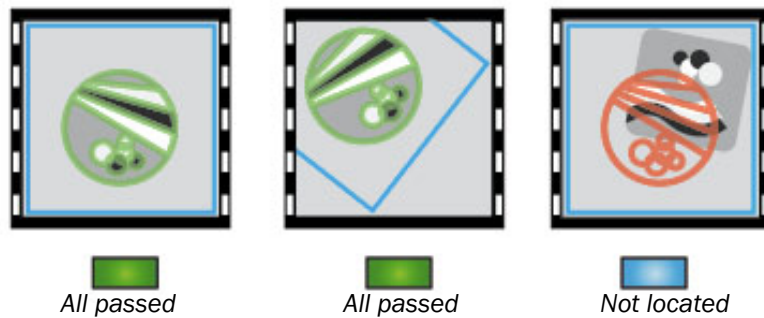


Figure – When teaching without PC, the Inspector will by default learn everything in the field of view.

If the Inspector has been configured previously, it will replace the reference object and learn the new object but keep the previous object locator settings (for example locator region size and rotation) and detailed inspection settings.

Note that the Inspector I40 can also be taught via EtherNet/IP.

2 Locating the Object

An object locator is used when teaching the Inspector which objects to inspect. A reference object cannot have more than one object locator.

During normal operation, the Inspector locates the object by searching for the contours of the taught object in the field of view. The contours that will be searched for are those inside the object locator region (the blue region in the figure). In SOPAS Inspector the used contours are outlined in green in the image to show where the object was located.

During normal operation, the Inspector locates the object by searching for the contours of it in the view. The contours that will be searched for are those inside the object locator region. In **SOPAS Inspector** the used contours are outlined in the image to show where the object was located.

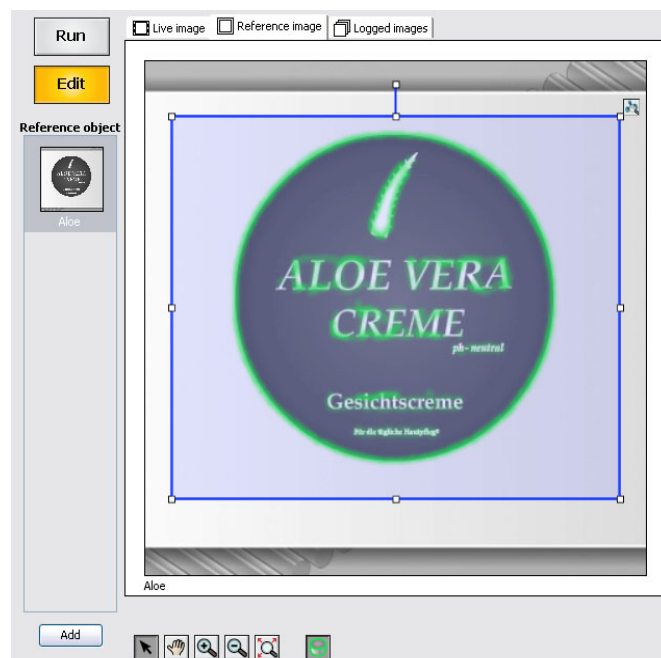


Figure – Object locator with the contours outlined.

2.1 Learned Contours

You can control which contours that should be used in the following ways:

- Adjust the amount of contours to learn with the **Edge strength** slider on the **Object locator** tab.
- Adjust the size, location, shape, and rotation of the object locator so that it covers the object properly. Use masks to mask out areas on the object locator.

Use the following rules of thumb to make the locating as accurate as possible:

- Highlight contours on the entire object, but avoid highlighted contours outside the object.
- Bright contours are more important than dim contours.
- It is not necessary to get bright contours everywhere on the important contours, the Inspector will probably be able to locate the object anyway.



OK

Enough amount of learned contours



Bad

Too few contours



Bad

Too many contours, as well as contours on the background

Note

The size and shape of the object locator region does not affect the speed of the inspections in Inspector I10/I20, however in Inspector I40 a smaller region will in most cases increase the speed. Adding masks to the object locator does not affect the inspection speed.

2.2 Match Settings

There are also a number of settings that affect how and when the Inspector should consider the object to be located when it is operating:

Match

The Match setting sets the required similarity between the taught contours and the found contours.

With a high Match setting, the Inspector will ignore objects that deviate from the reference object. With a lower Match setting, you can make the Inspector locate broken objects, which can then be disqualified by detailed inspections.

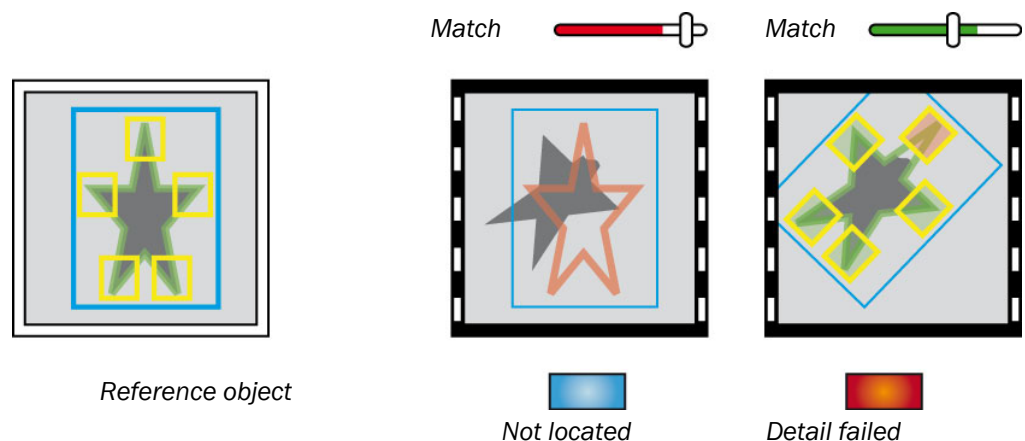


Figure – Using a lower Match setting will allow the Inspector to locate defect objects.

Rotation

The Rotation setting sets the rotational limit by which the objects can vary when compared with the reference object. Objects that appear with a rotation larger than this will not be located by the Inspector.

- If objects are never rotated, deselect Allow rotation to improve both accuracy and speed.
- If you are verifying that objects are not rotated more than a small amount, select Allow rotation and set the max rotation to a small amount.

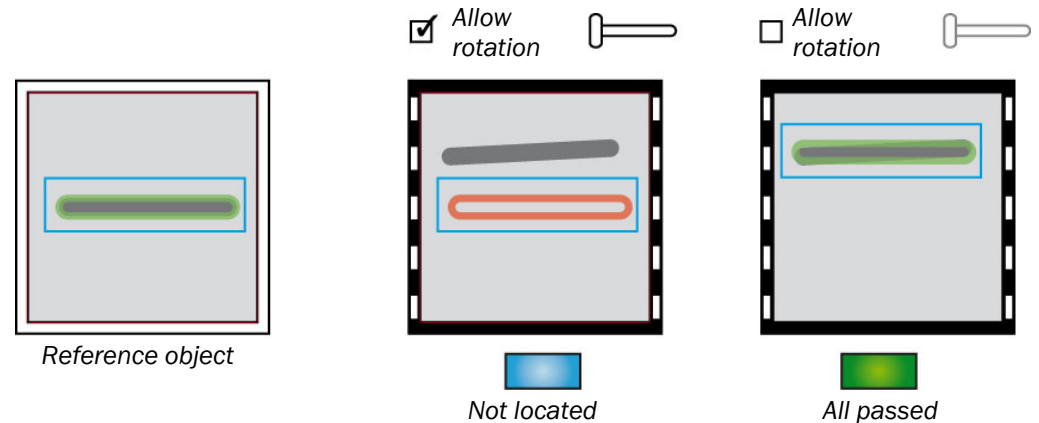


Figure – Allowing rotated objects but setting a small maximum rotation may cause objects that are only slightly rotated to be ignored. By not allowing rotation, the object may be located if the Match setting is not too high.

Location

By default, the Inspector will locate the object regardless of where in the field of view it is located, including edge objects – that is, objects partly outside the view.

You can specify a search region within which the object should be located. When using a search region, the Inspector will not locate edge objects.

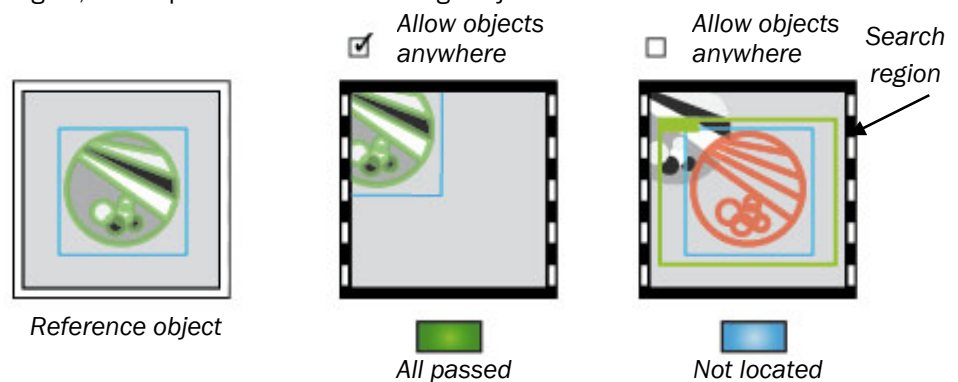


Figure – When allowing object to be located anywhere, edge objects may be located if the Match setting is not too high. Otherwise the object must be entirely within the search region to be located.

If the entire object must be within the field of view, deselect **Allow objects anywhere in image**. Otherwise edge objects will be located, as long as the match is above the threshold.

Note

If a detailed inspection is located partly outside the field of view, the Inspector will always report the object as Not located, even if the entire object is inside the field of view.

Scale

The Inspector is able to locate objects that are up to 20% larger or smaller than in the reference image. When a scaled object is located, any detailed inspections on the object will also be scaled accordingly.

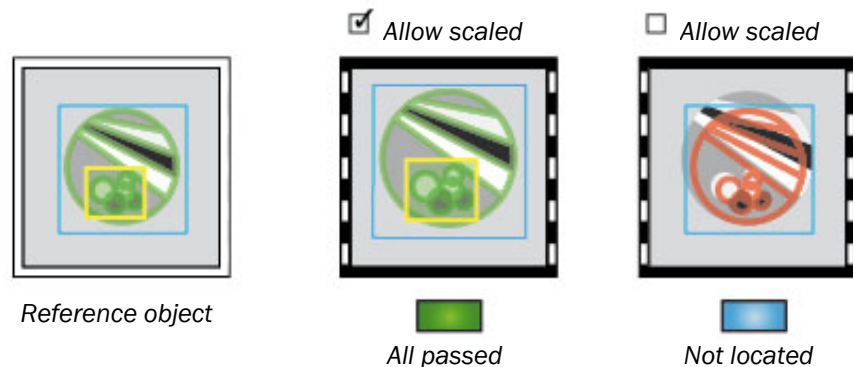


Figure – When locating scaled objects, detailed inspections will be scaled accordingly.

If objects are always of the same size and at the same distance from the Inspector, deselect **Allow scaled objects** to improve both robustness and speed.

3 Detailed Inspections

In addition to locating objects, the Inspector can also make up to 32 detailed inspections on the located object. The detailed inspections are only made if the object has been located.

The following types of detailed inspections are available:

- Pixel counter
- Edge pixel counter
- Contour
- Pattern (Inspector I40 only)

A detailed inspection can have the following results:

- Pass – detailed inspection passed
- Fail – detailed inspection failed

If a detailed inspection was located partly or completely outside the field of view, the Inspector will report the object as not located.

3.1 Pixel Counter

The Pixel counter counts the number of pixels within the inspection region that has an intensity (gray scale value) that is within a specified range. The location of these pixels is not considered, only the number of pixels.

When you adjust the intensity range, the pixels in the region that are within the range will be highlighted.

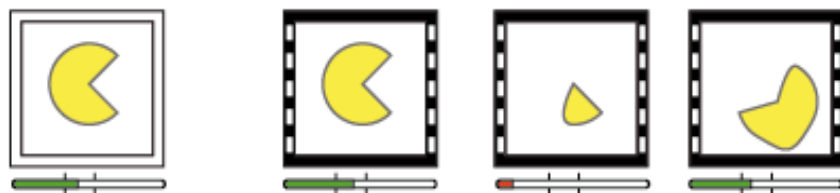


Figure – The pixel counter counts pixels of certain intensities, and compares this number with the **No. of pixels in range** settings. Where the pixels are located does not matter.

A Pixel counter can be useful for the following detailed inspections:

- Verifying the presence of a hole – there should be at least a certain number of dark pixels.
- Measuring the size of a groove – the number of dark pixels should be within a certain interval.

3.2 Edge Pixel Counter

The Edge pixel counter is similar to the Pixel counter, but this inspection type counts the number of edge pixels in the inspection region. The location of the edges is not considered, only the number of pixels.



Figure – The Edge pixel counter counts pixels that are edges and compares this number with the **No. of edge pixels** settings. Where the pixels are located does not matter.

The **Inspection edge strength** setting affects how much a pixel must differ from surrounding pixels in order to be an edge pixel. When you adjust this setting, the edge pixels within the region will be highlighted

Note

Please note that the **Inspection edge strength** setting is common for all Edge pixel counters and Contours in the reference object.

The Edge pixel counter can be useful for the following detailed inspections:

- Verifying the presence of a printed date – there should be at least a number of edge pixels.
- Verifying the presence of a hole (less sensitive to ambient light than the Pixel counter).

3.3 Contour

The Contour compares the contours in the region with the contours in the same region on the reference object. The better the two contours correspond, the greater is the matching score for the inspections.

Match The required similarity between the learned and the found contours. The setting is a value between 0 and 100%, where 100% means “perfect match”.

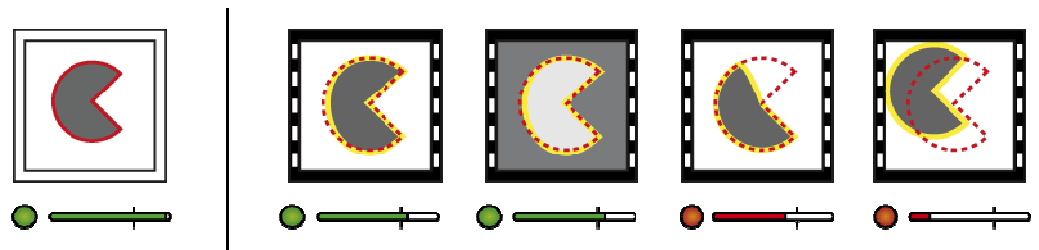


Figure – The Contour compares the contours in the region with the corresponding contours in the reference image. The location of the edge pixels is highly relevant.

If the contour on the inspected object is in a different location or rotation compared to the reference object, the match score will be reduced.

The **Inspection edge strength** setting affects how much a pixel must differ from surrounding pixels in order to be considered an edge pixel. When you adjust this setting, the edge pixels within the region will be highlighted.

Note

Please note that the **Inspection edge strength** setting is common for all Edge pixel counters and Contours in the reference object.

The Contour inspection works best on large or medium sized details with good contrast. For small or low-contrast details the Pattern inspection is recommended. The table in Section “3.4 Pattern” on page 14 lists other differences between the Contour and Pattern inspections.

The Contour inspection can be useful for:

- Verify that a large printed logo is not damaged.
- Verify that plastic parts on a belt have correct shape.
Since the Contour inspection ignores the contour polarity, the same inspection can handle both parts darker than the belt and brighter than the belt.

3.4 Pattern

The Pattern inspection is only available in the Inspector I40. It compares each pixel's value in the region with the corresponding pixel value in the reference image. The better the pixels correspond, the greater is the matching score for the inspection.

Match

The required similarity between the pixels and the reference. The setting is a value between 0 and 100%, where 100% means “perfect match”.

Position tolerance

The maximum positional offset between the pattern in the region and the reference image. The tolerance can be set from ± 0 to ± 4 pixels.

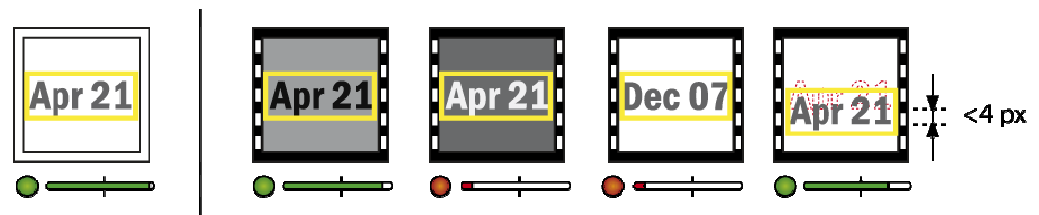


Figure – The Pattern inspection compares the pixel values of the region with the corresponding pixel values in the reference image.

The pixel-by-pixel comparison is computed using a method known as normalized cross-correlation. This method is very robust against global illumination changes. Such changes will therefore not affect the score.

The Contour inspection only considers the edge pixels, but in the Pattern inspection all pixels have the same importance. The score roughly corresponds to how many percent of the pixels in the region that match the pixels of the reference image. Consequently, a mismatch must cover a sufficiently large area of the region in order to be robustly detected. For small mismatches, ensure that the region is correspondingly small. Use several inspection regions if necessary.

In contrast to the Contour inspection, the Pattern inspection handles small variations in the position of the pattern to be inspected. Such variations may stem from imperfect match results of the Object locator or from physical variations between the objects to be inspected. The Pattern inspection searches for the position offset that gives the best match. When, for example, the search tolerance is set to ± 4 pixels, 9 positions in both x and y are tested. This means that $9 \times 9 = 81$ positions are evaluated in total.

Note that if a Pattern inspection is located near the edge of the field of view and the position tolerance is set so that the inspection could be located partly outside the field of view, the inspection result will always be Not located.

The following table summarizes the similarities and differences between the Contour and Pattern inspections:

	Contour	Pattern
Small variations in position	Affects score	Does not affect score
Medium variations in illumination	Does not affect score	Does not affect score
Object color variations on a fixed background	Does not affect score	Affects score
Handling of small details	Limited	Good
Handling of low-contrast details	Limited	Good
Speed	Slower	Faster

The Pattern inspection can be useful for:

- Verify that a printed logo of any size is not damaged.
- Verify the presence and printed ID of a mounted electronic component.

4 Results and Outputs

The Inspector provides the result of each inspection in the following ways:

- Inspector I10 has three built-in digital outputs (Out1, Out2, and Out3) that have fixed meanings.
- Inspector I20 and I40 has up to 19 digital outputs (3 built-in + 16 using I/O extension boxes). The result provided on each of the outputs is configurable, using Outputs by Logical Expressions.
- In addition, the Inspector I40 can use EtherNet/IP to report detailed inspection results.

For more information on how to use an I/O extension box with the Inspector, please refer to chapter 37 "Using the I/O extension box".

4.1 Built-in Digital Outputs

The following section describes the results of the inspections on the Inspector I10 and this is also the default setting for Inspector I20/I40:

Output	Pin	Function LED	Activated when
Out1	4	Blue	Not located – The object was not located, or a detailed inspection was out of view.
Out2	6	Red	Detail failed – The object was located but at least one of the detailed inspections failed.
Out3	7	Green	All passed – The object was located and all detailed inspections passed as well.

Note

The outputs are disabled by default when teaching the Inspector in **Edit** mode, but they can be manually enabled. When switching to **Run** mode, the outputs will be enabled automatically.

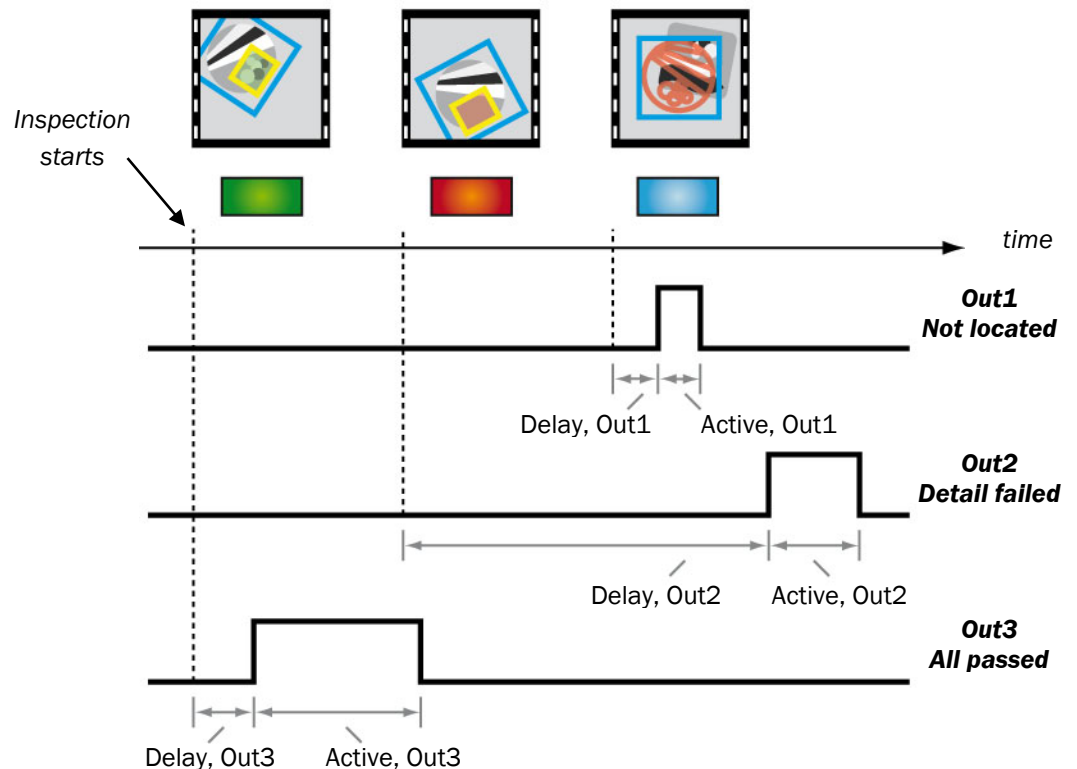


Figure – Results are provided on separate outputs, which can have separate delay and duration.

For each of the built-in output, you can specify:

- The *delay* from the start of an inspection to when the output is activated
- The *duration* – *active time* – of the output signal

Both the delay and the duration can be set to either a fixed time or a number of encoder pulses. If encoder pulses are used, an encoder should be connected to In4 on the Inspector.

The delay can also be set to **Minimum** – that is, as short as possible.

The duration can be set to **Hold until result changes**, in which case the output will be active until an inspection gives a different result than the one that is provided on the output.

If the duration is long enough to span over several inspections, the output signal will be prolonged each time the inspection result is the one provided on the output. This means that the result must be different for a number of successive inspections before the output is deactivated.

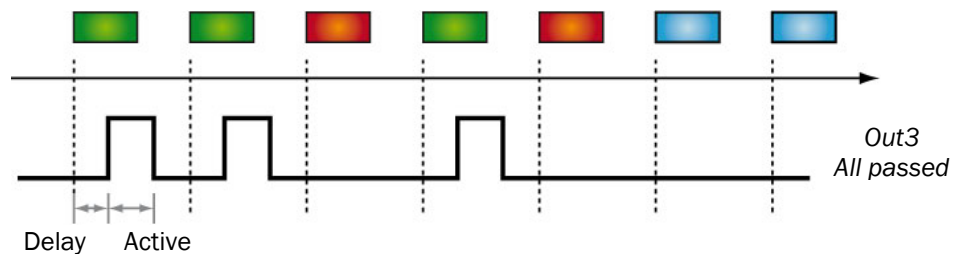
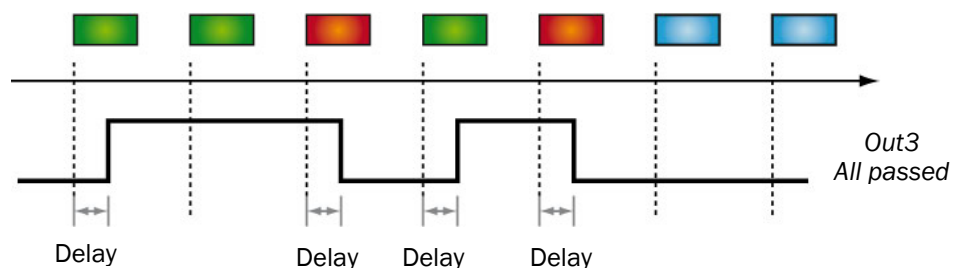
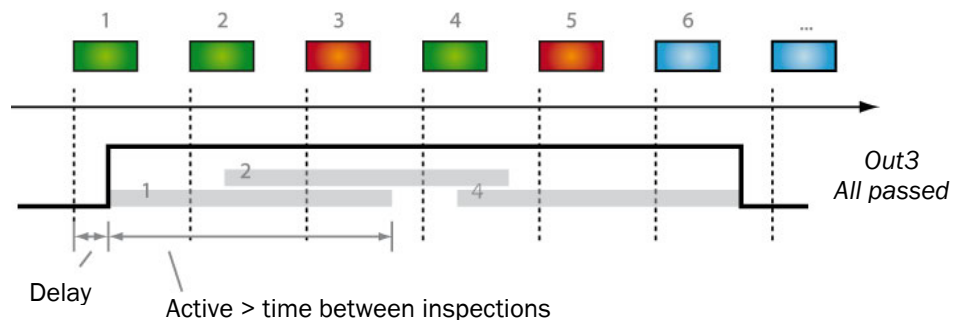
With a short active time**Hold until result changes****With a long active time**

Figure – Active time sets the duration of the output signal.

By default, the outputs will be +24 V when active and 0 V when inactive (active high). You can change this by selecting **Invert output signals** on the **Output settings** tab, in which case the outputs will be 0 V when active and +24 V when inactive (active low).

Minimum Delay Time

Since the delay time is counted from when an exposure is started, the output signals will always be slightly delayed — it will take a short time for the Inspector to capture and analyze the image.

The minimum delay time depends on several factors, for example the number of detailed inspections, and whether or not the Inspector should be looking for scaled or rotated objects.

The current minimum delay time is displayed below the image in the main view of **SOPAS Inspector**.

If you set a delay time in milliseconds that is shorter than the minimum delay time, the minimum delay will be used instead. Similarly, if you set the delay in a number of encoder pulses, and the Inspector receives this number of pulses in a shorter time than the minimum delay time, the output will be activated after the minimum delay time.

Note that the minimum delay time may change when you change the settings for the reference object. If the timing between the inspection and the result on the output is important, you should always set a fixed delay.

4.2 Results via EtherNet/IP

With the Inspector I40 you can retrieve inspection results via EtherNet/IP. The results are reported by the Inspector in an assembly with the following contents:

- Inspection ID - Sequence number identifying the inspection.
- Used reference object.
- Overall result - All passed, Not located, or Detail failed.
- Detailed results for the locator (if used) and each detailed inspection.
- Status information from the Inspector, for example the number of trigs that the Inspector has ignored (overtrig) and the number of images waiting to be stored to FTP.

With this information other devices (for example a PLC) can further evaluate the result of the inspection.

The results are available in the input assembly as soon as the inspection is finished. Any additional delays that are required must therefore be handled by the PLC.

EtherNet/IP cannot be used at the same time as an I/O extension box. The Inspector's 4 built-in inputs and 3 outputs can however be used while EtherNet/IP is activated.

5 Inputs

The Inspector has four inputs that can be used for the following purposes:

- Trigger inspections (In3)
- Encoder (In4)
- Teach reference object (In2)
- Select which reference object to use when inspecting

To use a digital input for triggering inspections, encoder input or teaching objects, connect the signal to its input on the Inspector and set the usage of the input in **SOPAS Inspector**. By default, In2 is already configured for teaching reference objects.

Any input that is not used for trig, encoder or teach signals can be used for reference object selection. For example, if an encoder is used, In4 should be set as encoder input but the remaining three inputs can be used for object selection, making it possible to select between up to eight objects with the inputs.

With an Inspector I20 or I40 you can connect an I/O extension box and select reference objects with those inputs instead of occupying the Inspector's built-in inputs.

On the Inspector I40 you can also trigger inspections, teach reference objects, and select reference object via EtherNet/IP. However, EtherNet/IP and I/O extension box cannot be used simultaneously.

5.1 Triggering Inspections

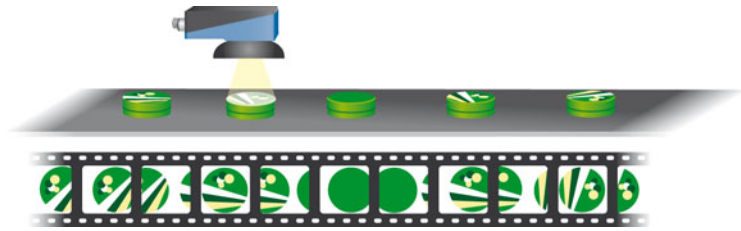
By default the Inspector will perform inspections at a constant rate, with the same time interval between the inspections.

You can also have the Inspector performing inspections when triggered by a signal, for example from a photoelectric switch. The Inspector will then make an inspection each time a pulse is received on In3, or for Inspector I40 when Trigger is set in the Output assembly via EtherNet/IP.

The Inspector will trigger inspections only when the active reference object has been set to use triggered instead of free-running. It is possible for the Inspector to have reference objects where image capturing should be free running for some and triggered for others.

Triggering the inspections has the following advantages:

- Higher inspection speed is possible, since you can ensure that an entire object is in the view for each inspection. In free-running mode, it may be necessary to make multiple inspections before the object can be properly located.
- Better accuracy of output signals, since the location of the object is well known when the inspection is made.

Free-running inspections

Multiple inspections may be required for each object, since it is not certain that the object is in view when inspected.

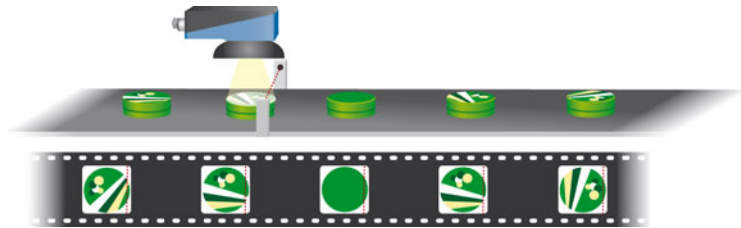
Triggered inspections

Figure – Inspecting in free-running and triggered mode respectively.

When using In3 for triggering the inspections, you can set a delay from when the trig pulse is received until the inspection is made. The delay can be set to either a fixed time or a number of encoder pulses. If encoder pulses are used, an encoder should be connected to In4 on the Inspector.

The highest rate at which the Inspector can receive trig pulses depends on several factors, for example the exposure time and the time it takes to produce the inspection result.

When triggering via EtherNet/IP, the minimum RPI for the communication channel will limit the triggering rate. The accuracy in timing of the triggered inspection may also be affected by jitter in the communication channel.

The current maximum trig rate — or maximum frame rate — is displayed below the image in the main view of **SOPAS Inspector**.

If the Inspector receives trig pulses at a higher rate — overtrig — the pulses that arrive before the minimum trig time has passed since the last inspection will be counted but ignored. If overtrig occurs the number of ignored trig pulses is shown in the statistics. The Inspector I40 can also notify about overtrig via EtherNet/IP.

Note

If In3 is defined to be used for triggering inspections, the Inspector will ignore any attempt to trigger via EtherNet/IP.

5.2 Using Encoder

An encoder can be used with the Inspector to more precisely control when inspections should be triggered and output should be activated, when inspecting moving objects.

An encoder is usually mounted on the conveyor belt, and sends a pulse every time the belt has moved a certain distance. When connected to an Inspector, the Inspector can for example start counting the pulses when an inspection is made, and activate the output when the object has moved the correct distance between the Inspector and an ejector, regardless of the speed of the conveyor belt.

The Inspector will use the encoder with a reference object when the trigger delay, output delay or output active time for that object is set to a number of pulses instead of milliseconds.

The maximum encoder frequency is 40kHz.

5.3 Teaching Reference Object

By default the Inspector can be taught by activating In2 for at least 3 seconds.

When In2 is then deactivated, the Inspector will capture a new reference image and learn the object from that image. If the Inspector has been configured previously, teaching again will not affect the shape or location of existing object locator and detailed inspections for the reference object.

Teaching with In2 is enabled by default, but can be disabled using **SOPAS Inspector**.

In the Inspector I40 teaching is also possible via EtherNet/IP.

Note

If In2 is defined to be used for teaching, the Inspector will ignore any attempt to teach via EtherNet/IP.

5.4 Selecting Reference Object

When the Inspector contains multiple reference objects, you can use the built-in inputs on the Inspector (or the inputs on an I/O extension box connected to an Inspector I20 or I40) to switch between the objects without using **SOPAS Inspector**. With the Inspector I40 you can also select reference objects via EtherNet/IP.

To use digital inputs for selecting the object to be used for inspections, you should first specify the following in **SOPAS Inspector**:

- The inputs to use for object selection.
- The reference object that should be selected by a certain combination of those inputs.

For example, if you have set up the following input selection:

Value	Reference object	In1	In2	In3	In4
0	Pencil	0	0	-	-
1	Bolt	1	0	-	-
2	<none>	0	1	-	-
3	Jar	1	1	-	-

As long as both In1 and In2 is low (0 V), the Pencil will be used, but as soon as In1 goes high (+24 V), the Bolt will be used instead.

When using external object selection, the inputs should remain in their active/inactive state during the entire time that the selected object should be used.

The time it takes to switch reference object depends on the number of inspections, inspection type, and sizes of the regions in the reference object. Typically it takes in the order of one second to switch reference object. For more information see section “12.2 Select Reference Object” on page 36.

With the Inspector I20 and I40, the digital inputs of the I/O extension box can be used for selection of reference objects. This way, In1–In4 are free to be used for example for encoder input or for triggering inspections.

How To

6 Setup for SOPAS and Inspector

SOPAS is the PC application used to control Inspector devices. SOPAS is available in two versions:

- SOPAS Inspector
- SOPAS Engineering Tool

SOPAS Inspector is only used with Inspector I10, Inspector I20, and Inspector I40 devices and only for one Inspector at a time. SOPAS Engineering Tool is used when simultaneously working with different SICK devices or multiple Inspectors. This manual only describes SOPAS Inspector, for information about SOPAS Engineering Tool, see help for Engineering Tool.

What's included

For information about what is included in the Inspector box, see section "33.8 What's included – Inspector I40" on page 87.

For a complete list of accessories for the Inspector, including cabling and external lightings, please visit www.sick.com.

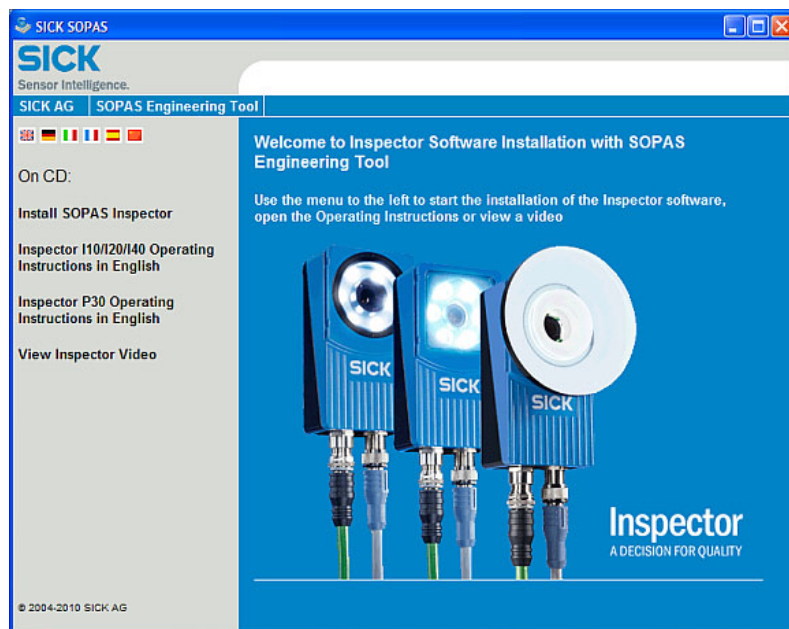
System Requirements

For system requirements, see section "33.9 System Requirements" on page 87.

6.1 Installation of SOPAS

Installing the SOPAS application:

1. Start your computer and insert the SOPAS Inspector CD into your CD drive. The following window is displayed:



2. If your CD does not automatically show this window, open the CD and open the file `welcome.html`.
3. Click on **Install SOPAS Inspector**. The installation program starts.
4. Follow the on screen instructions to complete the installation.

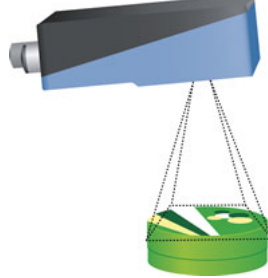
6.2 Connect the Inspector

Warning

Make sure that the loose ends of the I/O cable are separated before turning the device on.

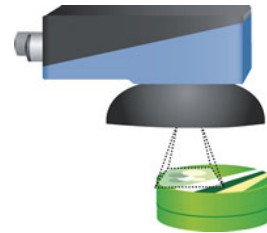
1. Mount the Inspector at an appropriate distance from the objects to be inspected.

Inspector with ring lighting



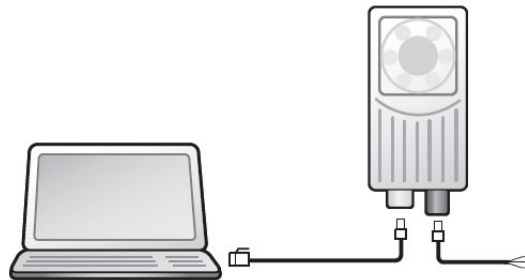
When using an Inspector with ring lighting, the Inspector may be mounted at a small angle to avoid too much reflexes.

Inspector with Dome lighting



When using an Inspector with Dome lighting, it should be aligned with the objects, with approximately 5 cm between object and the housing of the Inspector.

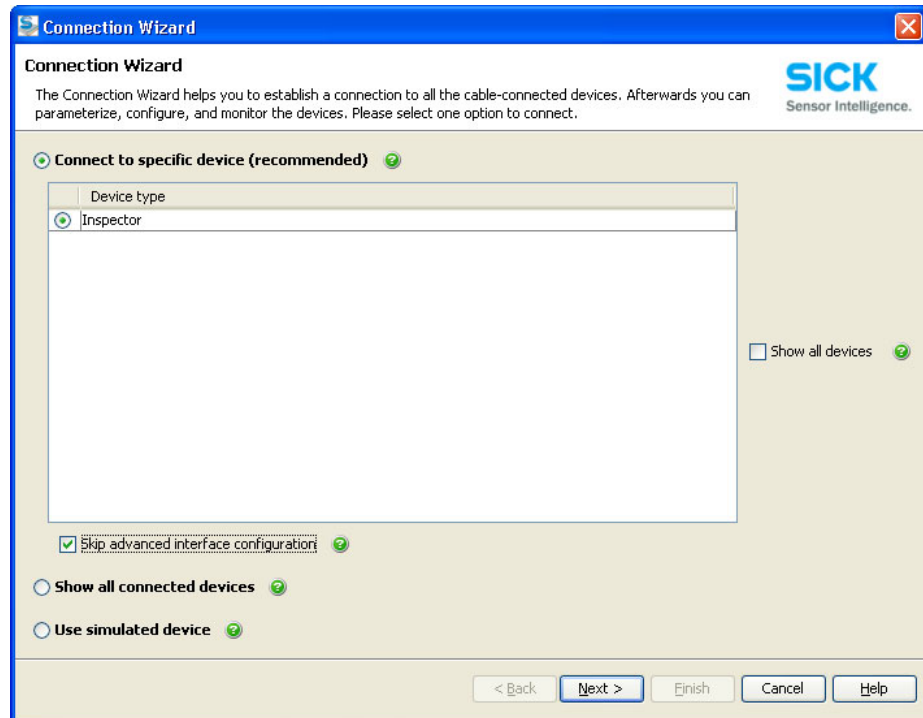
2. Connect the Ethernet connector on the Inspector to a network, or directly to an Ethernet connector on a PC.



3. If the input or output signals are used, or if an external lighting will be used, connect those devices to the Inspector's **Power** connector.
4. Connect the Inspector to a 24 V DC power supply.
5. Start the PC application **SOPAS Inspector** and follow the instructions in section "6.3 Connection Wizard" on page 22.

6.3 Connection Wizard

To connect to an Inspector using the **Connection Wizard**, choose **Connect to specific device** and select **Inspector** in the device type list. Then click **Next**.



SOPAS will now search for Inspectors that are connected to your computer:

- If there is only one Inspector connected, SOPAS will automatically try to connect to that Inspector and open the main window.
- If there are more than one Inspector connected, or if there was a problem connecting to the only connected Inspector, the **Found devices** page will be displayed.
- If the **Interface selection** page is displayed, click **Next** to go forward and to start searching for Inspectors.

The icons and colors in the list of found devices have the following meanings:

		The Inspector can be connected to.
		The Inspector is used by another user.
		The IP address of the Inspector must be changed before SOPAS can connect to the Inspector.

6.4 Synchronization

The PC application is automatically synchronized with the connected Inspector, which means that all device data are the same in the PC application and in the Inspector. If communication is lost or the PC application is in off line mode for some reason, select **Go Online** from the **Communication** menu.

7 Get Started

You teach the Inspector a reference object using the following steps:

1. Adjust focus and exposure.
2. Click **Teach reference object**.
3. If necessary, adjust the size and location of the object locator.
4. Add detailed inspection over the parts of the object to be inspected.
5. Test the inspection in the Live image and adjust the settings if necessary.
6. Set outputs.

When the inspections are accurate enough, switch to **Run** to put the Inspector in operation. You should save the settings in the Inspector's flash memory to assure that they will be remembered if the power should be disconnected.

7.1 Adjust Focus and Exposure

Place an object in front of the Inspector so that it is visible in the **Live image** tab.

Adjust the focus by turning the adjustment screw on the top of the Inspector using a 2 mm Hex key. Adjust the focus until the image looks focused.

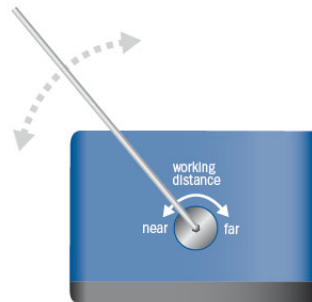


Figure – Adjust focus.

Adjust the **Exposure** setting until the image is bright and it is easy to distinguish between the object's detailed features and the background. If necessary, adjust the **Gain** setting to make the image brighter.

Click the **Auto** button if you want the Inspector to find suitable values for exposure and gain.

7.2 Teach a Reference Object

Click **Teach reference object** to use the object in the image as a reference object.

The Inspector will capture an image of the object to use for reference, and switch to displaying this image instead of the **Live image**. It also places an **Object locator region** (blue rectangle) in the image. The contours that the Inspector finds in this region will be highlighted. For more information about teaching, see section "1.2 Teaching" on page 8.

If the **Teach reference object** button says **Replace reference image** the current reference image will be replaced. To avoid replacing the current reference image, add a new reference object before teaching. For more information about working with multiple reference objects, see section "12 Work with Multiple Objects" on page 36.

7.3 Adjust Object Locator

If necessary, adjust the size and location of the Object locator region (blue rectangle) in the reference image.

Adjust the amount of highlighted contours by changing the **Edge strength** setting in the Object locator tab.

In most cases, you should make sure that most of the characteristic contours are highlighted but nothing is highlighted in the background or outside the object.

**OK**

Enough amount of learned contours

**Bad**

Too few contours

**Bad**

Too many contours, as well as contours on the background.

If it is difficult to make any highlights in the background disappear with the **Edge strength** setting, use the **Mask** tool to mask out areas of the region that lies outside the object.

Rules of thumb for settings:

- Bright contours are more important than dim contours.
- Avoid highlighting contours outside the object.
- It is not necessary to get bright contours everywhere on the important contours, the Inspector will probably be able to locate the object anyway.

7.4 Add Detailed Inspections

Place detailed inspections over features on the object to inspect in the reference image. There are four different types of detailed inspections, one of which is only available for the Inspector I40:



Pixel counter



Edge pixels counter



Contour



Pattern (Inspector I40 only)

For more information about inspections, see Chapter “3 Detailed Inspections” on page 12 and Chapter “24 Detailed Inspections Settings” on page 61.

7.5 Test the Settings

To test that the objects are properly located and inspected, switch to the **Live image** tab, place different objects in front of the Inspector, and view the results in the image and the **Results** tab.

You can change the settings in the **Object locator** and **Detailed inspections** tab while viewing the **Live image** and directly see the result of the changes. To move or resize any regions, switch to the **Reference image** tab.

7.6 Set Outputs

If necessary, set delays and active times for the output that you will use, see section "10 Setup Inspection Results" on page 31.

Note

When configuring the Inspector, the outputs are disabled by default. You can enable them in the **Edit** mode by doing the following:

Inspector I10 and I20 Click **Enable** below the image on the **Live image** tab.

Inspector I40 Choose **I/O Settings** from the **InspectorI40** menu and select **Enable built-in outputs in Edit mode** on the **I/O usage** tab.

When put in **Run** mode, outputs will automatically be enabled.

7.7 Switch to Run, or Add More Reference Objects

When the Inspector is properly inspecting the objects, put the Inspector in operation by switching to **Run** mode.

When switching to **Run**, you will be asked whether or not to save the settings permanently in the Inspector's flash memory. If you save the settings, the Inspector will continue to use this configuration if the power is disconnected and then re-connected again.

Add more reference objects to the Inspector by clicking the **Add** button under the **Reference objects** list. An empty reference object is then added to the list, and you can teach the Inspector a new object.

8 Capture Image

8.1 Adjust Focus

To adjust focus, place an object to inspect in front of the Inspector, so that it is visible in the **Live image** tab.

Adjust the focus by turning the adjustment screw on the top of the Inspector. Use the 2 mm Hex key that came with the Inspector. Look at the **Live image** tab and adjust until the image is focused.

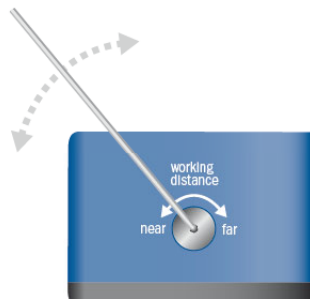


Figure – Adjust focus

8.2 Adjust Image Settings

Adjusting **Exposure** and **Gain** settings changes the image quality. To adjust exposure time and gain to good values, click on the **Auto** button. The **Auto** button adjustments will not change exposure time and gain continuously, only each time clicking on the **Auto** button.

8.2.1 Adjust Exposure

Exposure is the duration of the exposure, measured in milliseconds (ms).

Increasing the exposure time results in brighter images, but may also result in a lower frame rate.

If the object is moving and exposure time is too long, the image will be blurred, which may result in lower accuracy in the inspections. When a short exposure time is necessary because of object speed, there are two methods to make the image bright enough:

- Use external high-intensity lighting
- Increase the gain

To adjust exposure time, drag the **Exposure** slider on the **Image settings** tab.

8.2.2 Adjust Gain

The **Gain** setting is used for increasing the gain of an image after it has been captured. Increasing the gain may also increase the noise in the image and make it appear grainier.

To adjust gain, drag the **Gain** slider on the **Image settings** tab. Setting **Gain** to 100% means that the image will be unaffected. A higher value means that the image will be brighter.

8.3 Use Lighting

Inspector can be configured to use internal or external as well as both internal and external lighting.

Note

The internal and external light is active during the whole exposure time.

8.3.1 Use Internal Lighting

To turn on (or turn off) the built-in lighting in the Inspector select (or deselect) the **Internal** check box on the **Image Settings** tab.

8.3.2 Use External Lighting

Before the Inspector can use an external lighting, the type must be specified.

To use external lighting with the Inspector:

1. Select **External** on the **Image Settings** tab.
2. Choose the correct external light source from the list in the **Set external lighting** pop-up dialog box.
3. Click on the **OK** button

If a SICK ICL light source is used, the only configuration required is selecting the ICL-type in the list and all other settings will be configured automatically. Note that if the selected exposure time is longer than the maximum active time for the selected light source, then the exposure time is automatically adjusted to this limitation.

If a SICK light source used in combination with the VLR Triggerunit, the **Other - active low** choice shall be selected from the list.

Non-SICK External Light

If a non-SICK external light source is to be used, select **Other - active high** or **Other - active low** depending on the specifications of the external lighting. The option **Other - active high** is used for light sources that triggers on an active high signal (+5 V) and the option **Other - active low** is used for light sources that triggers on an active low signal (0 V). The signal is active during the whole exposure time, so adjust the **Exposure** setting to be lower than the maximum active time for the light source. If the external illumination has restriction of the duty cycle, the only way is to use an image trigger and adjust the trig rate so that the duty cycle of the light source is not exceeded.

Warning

Do not use longer exposure time than what the external light is designed for. See the technical data for the light source.

Do not use shorter cycle time (frame rate) than what the external light is designed for. See the technical data for the light source.

8.4 Triggering Image Capturing

The image capturing can be:

- **Free running**, capturing images as fast as the Inspector can. The frame rate is displayed in the main window.
- **Triggered**, capturing an image each time (with or without a delay) a trigger pulse is sent to In3 on the Inspector, or via EtherNet/IP on an Inspector I40.

To trigger image capturing with In3 on the Inspector:

1. Connect an image trigger to the Inspector, see section “14.1 Connect an Image Trigger” on page 39.
2. Select **Triggered by In3** on the **Image Settings** tab.
3. Choose **Rising edge** or **Falling edge** from the pop-up menu. (Rising edge: Signal level goes from 0 to +24 V, Falling edge: Signal level goes from +24 to 0 V.)
4. Enter a delay in milliseconds (ms) or in number of **pulses**. If **pulses** is selected, the input In4 must be activated in the **Input settings** dialog box.

To trigger image capturing via EtherNet/IP, please refer to section “15.3 Control the Inspector via EtherNet/IP” on page 43. When triggering via EtherNet/IP, the Inspector will capture the image without delay.

8.5 Adjust Image Size/Field of View

The image size is the size in pixels of the images captured by the Inspector. The image size can be changed by changing field of view.

Changing field of view will change the image size. Adjust the field of view so that the Inspector only captures images of the area in which the objects are expected to be found. The default field of view is the full area that the Inspector sees.

To change the field of view:

1. In the **Image Size** section of the **Image settings** tab, click on the **Change** button.
2. In the **Live image** tab, resize the gray rectangle **Valid FOV** (field of view) region with the handles. The **Minimum FOV** (red rectangle) depends on the object locator region and the detailed inspections, that all must be inside the field of view.



Figure – Reducing field of view

3. Click the **Resize** button. The Inspector will now use the new image size.

9 Improve Inspection Accuracy

There are a number of different ways to improve the accuracy (or robustness) of the inspections if the Inspector for example fails to locate correct objects, locates objects that are defect or has problems properly inspecting details on the objects.

9.1 Improve the Locating of Objects

If the Inspector has problems locating objects correctly, try the following:

Fine-tune the learned contours.

Change the **Edge strength** setting on the **Object locator** tab to adjust which contours that the Inspector uses for locating. Also see sections “2 Locating the Object” on page 8 and “7.3 Adjust Object Locator” on page 24.

Modify the size and shape of the object locator region.

Try to remove contours that are not distinguishing for the object, for example contours in the background. If there are no contours in the background, then it is good if the Object locator region (blue) covers the object with a margin.

Mask out difficult areas.

Areas that are known to vary between images, such as date codes or highly reflective areas, should be ignored in the object locator region. This is achieved by masking the area.

Deselect Allow rotation if possible.

If the objects are never rotated compared with the reference object, deselecting **Allow rotation** will avoid having the Inspector confusing rotated contours from the correct ones. In some applications this threshold can be used to discard objects with incorrect rotation.

Make sure that the Allow rotation is sufficiently high.

Objects that are rotated more than the **Allow rotation** setting will not be located at all.

Deselect Allow scaled objects if possible.

If the objects always appear at the same size as the reference object, deselecting **Allow scaled objects** will avoid having the Inspector confusing scaled contours from the correct ones.

Restrict Allow objects anywhere in image if possible.

If the objects will always be located in a certain part of the image, restricting the search region to this area will avoid having the Inspector confusing contours outside or partially outside this region from the correct ones.

Restrict the allowed region by deselecting **Allow objects anywhere in image**, and adjusting the **Search region** (green rectangle) in the image.

Adjust search method.

Switch to a faster search method for locating the objects, by changing the **Search method** setting (under **Advanced** on the **Object locator** tab).

Inspector I10/I20

The Inspector's **Search method** can be changed using one slider between **High accuracy** and **High speed**. Higher accuracy gives lower speed and higher speed gives lower accuracy.

Inspector I40

The Inspector's **Search method** can be changed using two sliders. One slider determines the trade-off between **High robustness** and **High speed**. The other slider determines the trade-off between **High accuracy** and **High speed**.

The one slider in Inspector I10/I20 is a combination of the two sliders in Inspector I40. Having both the **Robustness** and the **Accuracy** slider in **High speed** position in Inspector I40 corresponds to the **High speed** position of the one slider in Inspector I10/I20. Vice versa, having the two Inspector I40 sliders in **High robustness** and **High accuracy** position corresponds to the **High accuracy** position in Inspector I10/I20.

The term **High robustness** means that the object is located better in difficult images. This includes images that for example contain much background clutter, heavy shadows, small objects, low contrast, or much occlusion. For simple and clean scenes with large and high contrast objects it is typically sufficient to run at the High speed mode.

The term **High accuracy** relates to which sub-pixel precision the object is located. For simple pixel counting applications it may not be necessary to find the optimal sub-pixel position of the object. A fast coarse localization may then suffice. But for applications where the positioning of the detailed inspections needs to be precise, this slider should be set to high accuracy. An example of this may be an edge pixel counter positioned close to the object border in order to detect cracks in the object. It is then important that this edge pixel counter stays within the object in order to avoid counting the object edge as a crack.

9.2 Improve Detailed Inspections

If the Inspector has problems correctly inspecting details on objects after they have been located, try the following:

Adjust inspection settings

Try the following method to find proper settings for a detailed inspection:

1. Have the Inspector inspecting a number of acceptable objects, and note the result for the detailed inspection.
2. Do the same thing, using faulty objects instead, and note the result.
3. Set the **No. of pixels in range**, **No. of edge pixels** or **Match** setting so that the thresholds are halfway between the results for the acceptable and the faulty objects.

Modify the inspection regions

You can change the regions in the image on the **Reference image** tab:

- Move, resize and rotate an inspection region with the handles that appear on the region when selected.
- Change the shape of a region with the **Shape** buttons on the **Detailed inspections** tab.
- Mask out areas of the region with the **Mask tool**.

Note

After modifying a **Pixel counter** or an **Edge pixel counter**, you may have to adjust the setting for **No. of pixels in range** or **No. of edge pixels**.

Choose a different type of detailed inspection

Sometimes it may help to try a different inspection type. For example, using an **Edge pixel counter** instead of a **Pixel counter** may make the inspection more tolerant of ambient light. When choosing between the Contour and Pattern inspections the general recommendation is to test Pattern first. The Contour inspection can be advantageous for applications where the color of the object and/or the background changes but the contours remain unchanged.

Divide a detailed inspection into several smaller inspections

Sometimes one defect may even out another defect in an inspected region, for example ink smudges may compensate for missing print in a printed date. Using several smaller detailed inspections that cover the same area on the object can reduce the risk for this to happen.

9.3 Replace the Reference Image

Getting good images is often critical for correct inspections. To replace the reference image:

1. Place a good object in front of the Inspector.
2. Switch to **Edit** mode, and adjust the exposure and gain on the **Image settings** tab.
3. Click **Replace reference image** below the image on the **Live image** tab. The Inspector captures a new image of the object, and displays it on the **Reference image** tab.
4. If necessary, adjust the regions in the reference image so that they are located at the correct positions on the object.

9.4 Environmental Conditions

Try to improve the quality and reduce the variations in the images captured by the Inspector when inspecting.

- Shield out ambient light or use external lighting to reduce the variation in exposure caused by the ambient light.
- If the objects will be moving at high speed, shorten the exposure time, to avoid motion blur in the images. If this is difficult to do while maintaining a good image quality, consider adding external lighting.

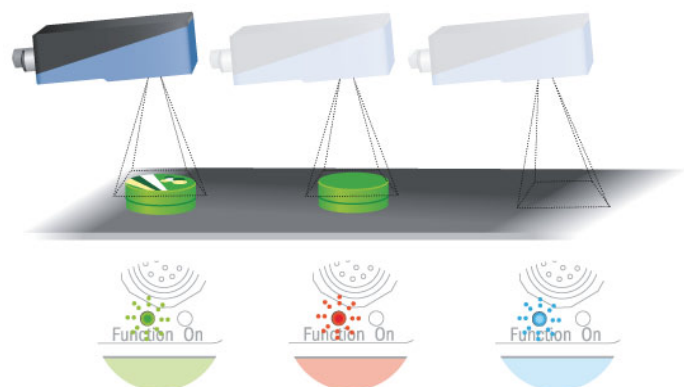
10 Setup Inspection Results

10.1 Activate Digital Outputs – Inspector I10

Each inspection made by the Inspector can activate any of the three built-in digital outputs Out1, Out2, or Out3 on the Inspector.

Which output that is activated in the Inspector I10 is determined by the inspection result:

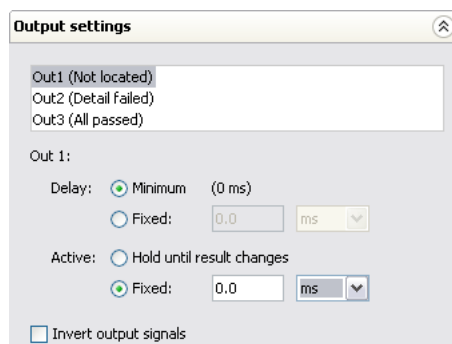
Output	Pin	LED color Function	Activated when
Out1	4	Blue	Not located – The object was not located, or a detailed inspection was out of view.
Out2	6	Red	Detail failed – The object was located but at least one of the detailed inspections failed.
Out3	7	Green	All passed – The object was located and all detailed inspections passed as well.



Function LED feed-back

Normally the output signal level is low (0 V) when inactive and high (+24 V) when active, that is active high, but signals can be inverted.

The inspection result output settings are configured in the **Outputs settings** tab.



Output settings tab Inspector I10

10.2 Activate Digital Outputs – Inspector I20/I40

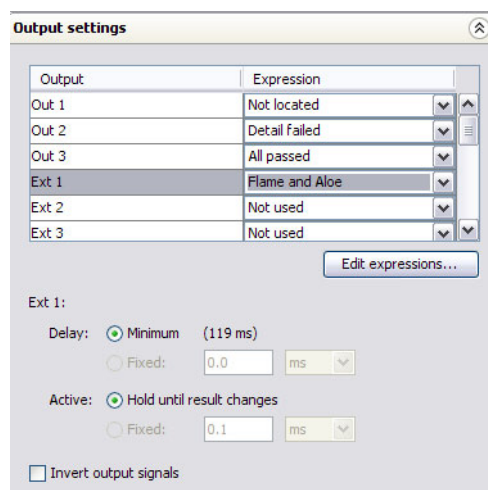
The result from each inspection made by the Inspector I20 I40 can be mapped to any of the built-in outputs, or to the outputs of a connected I/O extension box.

The default setting for the Inspector I20/I40 built-in outputs are the same as for the Inspector I10.

Output	Pin	LED color Function	Activated when
Out1	4	Blue	Not located – The object was not located, or a detailed inspection was out of view.
Out2	6	Red	Detail failed – The object was located but at least one of the detailed inspections failed.
Out3	7	Green	All passed – The object was located and all detailed inspections passed as well.

Normally the output signal level is low (0 V) when inactive and high (+24 V) when active, that is active high, but signals can be inverted.

The inspection result output settings are configured in the **Outputs settings** tab.



Output settings tab Inspector I20/I40 – I/O box enabled.

By clicking **Edit expressions** you can also define additional inspection results – for example if certain detailed inspections failed – which can then be mapped to digital outputs.

10.3 Set Output Delay

The delay is always counted from when the exposure of the image started. To set a delay on a built-in output:

1. Select the output in the list on the **Output settings** tab.
2. Set the output delay by selecting either:

Minimum The delay will be as short as possible – minimum delay time – which is the same as the time it takes the Inspector to make the inspection.
The time this takes depends on many settings in the current reference object, and is displayed below the image in the **Live image** and **Reference image** tabs.

Fixed Set the delay as a time (in milliseconds) or a number of encoder pulses.

When setting a delay in encoder pulses, the encoder should be connected to In4, and this input should be reserved as an encoder input. To do this, see section “14.2 Connect an Encoder” on page 40.

For more information about the **Delay** setting, see section “4 Results and Outputs” on page 15.

Notes

If you set the delay time to be shorter than the minimum delay time, a warning will be displayed and the minimum delay time will be used.

If the delay is set in encoder pulses, and the time these take when inspecting is shorter than the minimum delay time, the trig pulse is ignored. The number of ignored trig pulses is displayed in the Statistics tab, see section “19.2 Statistics” on page 52.

Output delay cannot be set for outputs on an I/O extension box.

10.4 Set Output Active Time

The active time is always counted from when the output signal is activated. To set the active time for a built-in output:

1. Select the output in the list on the **Output settings** tab.
2. Set the active time by selecting either:

Hold until result changes

The output will be active as long as the inspection result is the one that is put on that particular output.

Once the inspection result changes, the output will change. Note that the deactivation of the output will be after the output delay time.

Fixed Set the active time as a time (in milliseconds) or a number of encoder pulses.

For more information about the active time setting, see section “4 Results and Outputs” on page 15.

Note

Output delay cannot be set for outputs on an I/O extension box.

10.5 Invert Output Signals

Normally the output signal level is low (0 V) when inactive and high (+24 V) when active, that is active high. You can change this by selecting **Invert output signals** on the **Output settings** tab. When inverted, all output signals will be +24 V when inactive, and 0 V when active.

10.6 Disable and Enable Outputs

By default, the output signals are disabled when the Inspector is being configured in **Edit** mode. To activate the output signals in **Edit** mode, do the following:

Inspector I10/I20 Select **Enabled** below the image on the **Live image** tab.

Inspector I40 Choose **I/O Settings** from the **InspectorI40** menu and select **Enable built-in outputs in Edit mode** in the dialog box.

When switching to **Run** mode, the outputs will automatically be enabled.

10.7 Results via EtherNet/IP

To retrieve the inspection results from the Inspector I40 via EtherNet/IP, please refer to chapter "15 Use EtherNet/IP" on page 41.

11 Improve Inspection Speed

There is a number of ways to improve the inspection speed if it is not fast enough when inspecting at high speeds. When testing these adjustments, observe the improvement in the frame rate shown below the image.

11.1 Decrease Image Size

The image size is the size (in pixels) of the images captured by the Inspector. To adjust image size, see section "8.5 Adjust Image Size" on page 28.

11.2 Adjust Object Locator Settings

To improve inspection speed by adjusting **Object locator** settings, try the following:

Reducing Max Rotation.

Set **Allow rotation** to (slightly higher than) the largest rotation that the objects will ever appear, as compared with the reference object. This way, the Inspector will not spend time trying to find objects with larger rotations.

If the objects are never rotated compared with the reference object, deselect **Allow rotation**.

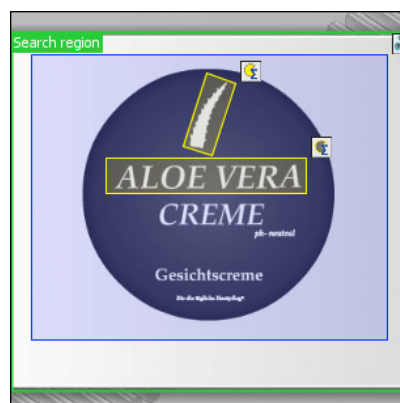
Not using Scaled Objects.

Deselect **Allow scaled objects** if the objects always appear with the same size as the reference object. This way, the Inspector will not spend time trying to find objects that are scaled.

Reducing the Search Region.

The search (object location) is sometimes faster for small search regions. To change the Search region:

1. Deselect **Allow objects anywhere in image**.
2. In the **Reference image** tab, resize the green search region with the handles.



Note

If no inspection regions are outside the search region, consider reducing the field of view instead of reducing the search region, see section “8.5. Adjust Image Size/Field of View” on page 28.

Note

The size and shape of the object locator region does not affect the speed of the inspections in Inspector I10/I20, however in Inspector I40 a smaller region will in most cases increase the speed. Adding masks to the object locator does not affect the inspection speed.

Adjust Search Method.

Switch to a faster search method for locating the objects, by changing the **Search method** setting (under **Advanced** on the **Object locator** tab).

For more information on how the **Search method** settings affect the robustness, accuracy, and speed of the object locator see the Adjust Search Method paragraph in section “9.1 Improve the Locating of Objects” on page 29.

11.3 Reduce Exposure Time

If the exposure time is a large part of the **Minimum delay** time, reducing the exposure time may be effective for increasing the speed.

To reduce the exposure time without making the image darker, try increasing the gain and/or adding external lighting.

11.4 Adjust Detailed Inspections Settings

To improve inspection speed by adjusting **Detailed inspections** settings, try the following:

Make the Inspection Regions Smaller.

The inspection is faster for small inspection regions.

Change Inspection Type.

In some cases it is possible to change to a faster inspection type. The relative speed of the inspection types are the following:

- Edge pixel counter – fastest
- Pixel counter – slightly slower
- Pattern – slower
- Contour – slowest

Reduce Position tolerance.

Reducing the position tolerance makes the Pattern inspection simpler and slightly faster.

11.5 Make it unnecessary to locate the object

Locating the object usually is what takes the longest time when inspecting. In most cases, the inspections can be sped up considerably by removing the **Object locator** region (blue) from the reference object.

Before the **Object locator** region can be removed, you should assure the following:

- The objects are always located at the same place in the images.
- The objects are not rotated or scaled compared with the reference object.

The first item can normally be assured by using an image trigger for capturing the images.

11.6 Avoid using external digital inputs or outputs

The communication with the I/O extension box will reduce the frame rate for the Inspector I20/I40. To optimize the use of the I/O extension box, enable only the functionality that is required for the application. For example, do not enable the inputs on the I/O box if only the outputs on the box are used.

12 Work with Multiple Objects

The Inspector can store up to 16 (32 in Inspector I40) different reference objects, making it easy to switch between different inspection tasks with different reference objects.

12.1 Teach Additional Objects

To teach an additional object:

1. Under the **Reference objects** list, click on the **Add** button. A new reference object is created. This new object is empty, without a reference image.
2. Place a new object in the Inspector's field of view.
3. Adjust image settings.
4. Click on the **Teach reference object** button. A new reference image is placed in the image container.
5. To change the name of the reference image, double-click on the name, and type a new name.
6. Add inspections and adjust settings.

For more information about image capturing and image settings, see sections "8 Capture Image" on page 26 and "22 Image Settings" on page 57.

12.2 Select Reference Object

The time it takes to switch reference object depends on the number of inspections, inspection type, and sizes of the regions in the reference object. Typically it takes in the order of one second to switch reference object. The following table gives some guidelines:

Reference object configuration	Typical time for reference object selection
Only locator	0.5s
Locator plus four Pixel Counter inspections	1s
Locator plus four Edge Pixel Counter inspections	1s
Locator plus four Contour inspections	2s
Locator plus four Pattern inspections	1s
Locator plus 32 Pixel Counter inspections	3.5s
Locator plus 32 Contour inspections	20s

12.2.1 Select Object from PC

To select which reference object to be used for the inspections/when inspecting:

1. Select Edit mode, by clicking on the **Edit** button.
2. In the **Reference objects** list, click on the desired reference object.
3. Click the **Run** button, to start the inspection.

12.2.2 Select Object with Inputs on the Inspector

To select which reference objects to use with the inputs on the Inspector, see section "14.4 Select Reference Objects with Inputs" on page 41.

12.2.3 Select Object with the I/O extension box

To select which reference object to use with the inputs on the I/O extension box, see section "28.2 I/O settings – Inspector I20" on page 70 or section "28.3 I/O Settings – Inspector I40" on page 71.

12.2.4 Select Object via EtherNet/IP

To select which reference objects to use via EtherNet/IP for the Inspector I40, see section "15.3 Control the Inspector via EtherNet/IP" on page 43.

12.3 Duplicate Reference Objects

To duplicate a reference object:

1. Right-click on source reference object and select **Copy to new reference object** from the pop-up menu.
2. The new reference object is placed at the end of the **Reference objects** list.

To change the name of the new reference image, double-click on the name, and type a new name.

12.4 Settings for Multiple Reference Objects

Some settings in SOPAS Inspector are unique for each reference object and some settings are common for all reference objects.

The settings made in the Configuration pane in the main view are unique for each reference object:

- Image settings
- Object Locator
- Detailed Inspections
- Output Settings

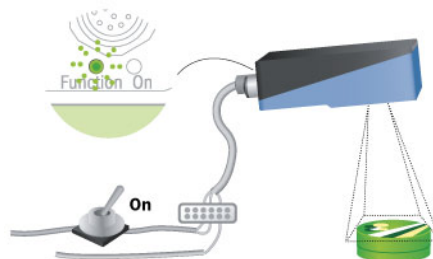
Other settings – made from the **Inspector** menu – are global and applies to all reference objects, for example:

- I/O settings
- Log settings
- Store images to FTP

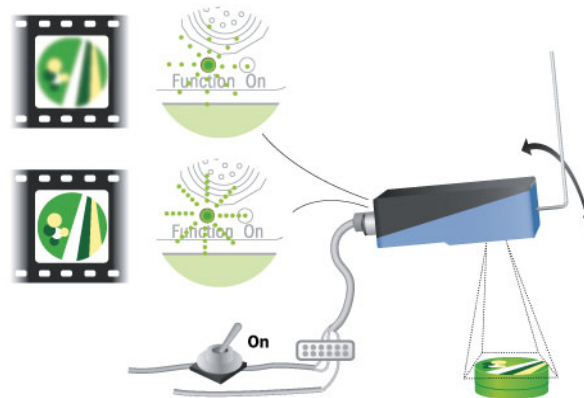
13 Teach Without PC

To teach a reference object using the digital input In2, without connecting the Inspector to a PC, do the following:

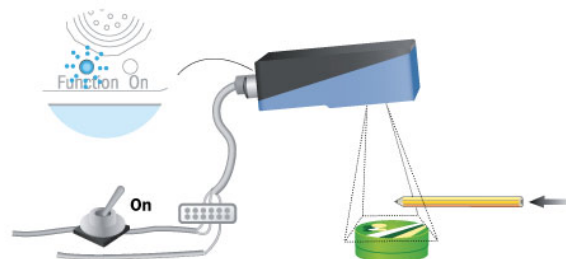
1. Make sure the Inspector is in **Run** mode. Place an object in front of the Inspector and connect In2 (pin 5, cable color is pink on DOL-1212 cables) to +24 V. After about 3 seconds, the Inspector will start capturing images and flash with the lighting, if used. Also, the **Function** LED will start flashing.



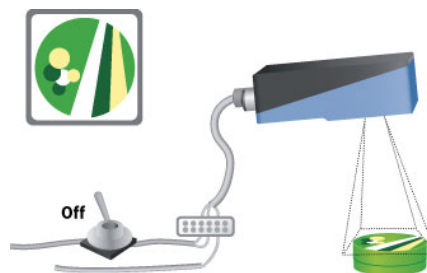
- Adjust focus by turning the focus screw. The frequency with which the **Function** LED is flashing indicates how focused the images are – the faster it flashes, the better the focus.



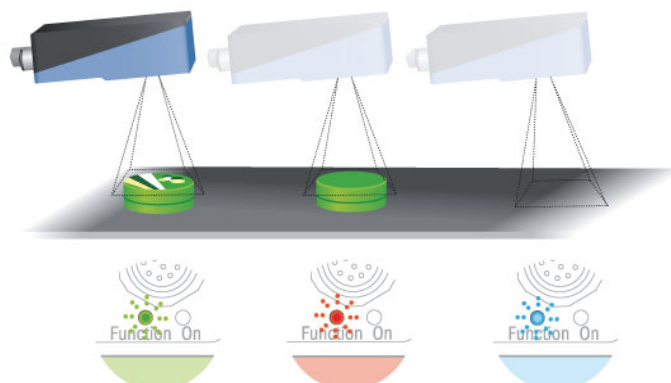
- Find the field of view (that is, the area covered in the captured image) by using a finger, a pen or similar. When the finger/pen enters the field of view, the color of the **Function** LED changes from green to blue. The LED color reacts on motion in the image. So ensure that the finger/pen is moving and that the rest of the scene is stationary.



- When done, disconnect In2 from the power. The Inspector will now use the most recent image as the reference image, and learn the contours of the object in view. All device data is saved in Flash memory. During the flash storage, the **Function** LED flashes white.



- The Inspector will then automatically switch to Run mode and start inspecting.



Teaching via EtherNet/IP on the Inspector I40 differs from teaching using In2 in the following ways:

- The reference object will be taught without the 3 seconds delay.
- Since the teach is made almost immediately, there is no delay for adjusting focus or field of view after being activated, and therefore no feedback on focus or moving objects in the field of view.

Notes

- If the Inspector already contains reference objects, using external teach will only replace the reference image for the active reference object and change the exposure settings (**Exposure** and **Gain**). The exposure settings can also be kept by enabling **Use current exposure** settings in the **I/O usage** tab in the **I/O Settings** dialog. Any modifications made to the reference object will remain, for example if the **Object locator** region has been resized, detailed inspections have been added, or settings have been changed.
- External teach using In2 is enabled by default, but can be disabled from the PC application. To disable or re-enable external teach, choose **Input settings** from the **InspectorI10** menu (**I/O Settings** for Inspector I20/I40), and change **Use external teaching (In2)** (**Enable external teaching...** for Inspector I40).
- To stop the Inspector from automatically adjusting the exposure settings when using external teach, open the PC application, choose **Input settings** from the **InspectorI10** menu (**I/O Settings** for Inspector I20 and I40), and select **Use current exposure settings** in the dialog box.

14 Use Digital Inputs

The Inspector has four built-in digital inputs that can be used for different purposes; see section “5 Inputs” on page 18. The input signals are shown in the figure.

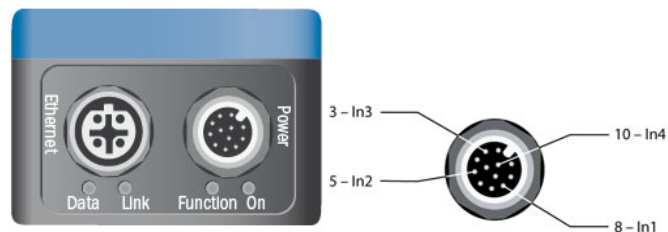


Figure – Input signals

14.1 Connect an Image Trigger

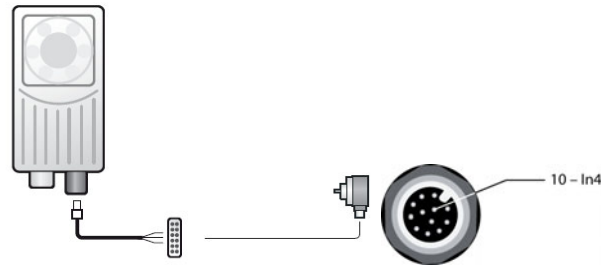
To use an external trigger for triggering the Inspector to capture the images, do the following:

1. Connect the image trigger to In3 (pin 3, cable color is white on DOL-1212 cables) on the Inspector.
2. Choose **Input settings** from the **InspectorI10** menu (**I/O Settings** for Inspector I20 and I40), and select **Use external image trigger (In3)** (**Enable external image trigger...** for Inspector I20 and I40).
3. Under **Triggering** in the **Image settings** tab, select **Triggered by In3**, and choose whether the images should be triggered on the **Rising edge** (from 0 V to +24 V) or on the **Falling edge** (from +24 V to 0 V).

You can also set a delay between the trigger pulse and when the image is captured, by specifying a delay time in milliseconds or number of encoder pulses.

Notes

- If there are multiple reference objects, you must choose **Triggered by In3** for each reference object for which images should be triggered. It is possible for the Inspector to have reference objects where image capturing should be free running for some and triggered for others.
- The image trigger and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.

14.2 Connect an Encoder

To use an encoder for controlling delay times for image triggering and/or output signals, do the following:

1. Connect the encoder to In4 (pin 10, cable color is violet on DOL-1212 cables) on the Inspector.
2. Choose **Input settings** from the **InspectorI10** menu (**I/O Settings** for Inspector I20 and I40), and select **Use encoder (In4)**.
3. Set the delays to be a number of encoder pulses:
 - Image capture delays are set on the **Image settings** tab for the reference object.
 - Output delays and active times are set on the **Output settings** tab, by first choosing the output in the list, and then setting the delay and/or active times in the **Fixed** fields.

Note

- The encoder and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.
- The maximum encoder frequency is 40kHz.

14.3 Use External Teach

To be able to teach reference objects without using a PC, do the following:

1. Connect the signal to use for teaching to In2 (pin 5, cable color is pink on DOL-1212 cables) on the Inspector. Make sure that the signal is inactive (0 V).
2. Choose **Input settings** from the **InspectorI10** menu (**I/O Settings** for Inspector I20 and I40), and select **Use external teach (In2)** (**Enable external teaching...** for Inspector I40). This is enabled by default.

For an instruction on how to actually teach the Inspector new reference objects, see section "13 Teach Without PC" on page 37.

Notes

- If the Inspector has multiple reference objects, make sure that the correct reference object is active before teaching.

14.4 Select Reference Objects with Inputs

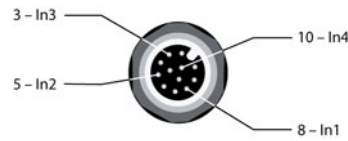


Figure – Signals used for selection

To be able to select objects with the inputs on the Inspector, you must first set up which combination of inputs that should select each object.

1. Select **Input settings** from the **InspectorI10** menu (**I/O Settings** for **Inspector I20** and **I40**), and select the **Use external object selection** (**Enable external object selection** available on the **I/O usage** tab for **Inspector I20** and on the **External object selection** tab for **Inspector I40**).
2. Select which input signals to be used for object selection. If an input is already used for image triggering, encoder or external teach, that input cannot be used for object selection and the check box for that input is therefore disabled.
3. Select which **Reference objects** to activate for each combination of inputs. The object is selected from the drop down menu. The **Inputs** number is the binary value with the selected input signals (In1 etc). The most significant binary digit is In1 (if used) or the one with the lowest number. The digit “0” means that the corresponding In-signal is active low and the digit “1” means that the corresponding In-signal active high.
4. Click **OK** when all settings are complete.

Important

- When selecting a reference object with the digital inputs, the input signal levels must be kept during the time that the reference object should be used. As soon as the input signal changes, another reference object will be selected instead.
- The device providing the signals and the Inspector should be connected to a common ground, to avoid problems with signals not being registered properly by the Inspector.
- When more than 16 reference objects are used for **Inspector I40**, an I/O extension box with 5 inputs or EtherNet/IP is required since the four built-in inputs can only address 16 reference objects.

15 Use EtherNet/IP

The Inspector I40 can be controlled and results can be read out using the EtherNet/IP standard.

15.1 Set Up the Connection

To set up the connection between the Inspector and a PLC and, do the following:

1. Configure the Inspector by teaching the reference objects and placing inspections.
2. Enable EtherNet/IP on the Inspector by choosing **I/O Settings** from the **InspectorI40** menu, and selecting **Enable external I/O... using EtherNet/IP**.
3. Click **Show input assembly mapping** and print out the input assembly mapping for the current configuration.
4. Switch the Inspector to **Run** mode.
5. Set up the communication on the PLC. For information on how to do this, please refer to the documentation for your PLC.
6. Use the printout of the input assembly mapping to map the data received from the Inspector on the PLC.

The Inspector has the following EtherNet/IP characteristics:

- **Device type:** Communication adapter
The Inspector relies on a Scanner device to set up the communication channel. The IP address of the Inspector can be found by choosing **Device Info** from the **InspectorI40** menu.
- **Assemblies:**

	Instance no.	Size	Comment
Output	100	4 bytes	Holds output from the PLC, which is input to the Inspector
Input	101	224 bytes	Holds input to the PLC, which is output from the Inspector
- **Minimum RPI:** > 16 ms.
When retrieving inspection results via EtherNet/IP, the time between two inspections should be at least twice the RPI (Requested Packet Interval) specified for the communication channel.
With the shortest possible RPI, the highest recommended inspection rate is therefore approximately 30 Hz.

The EDS file for the Inspector can be found in the **Documentation** folder on the **SOPAS Inspector CD**.

15.2 Retrieve Inspection Results

The Inspector I40 provides the result from the last inspection in an Input assembly containing the following information:

- Inspection ID, which is a sequence number that identifies the inspection made.
- Current reference object.
- The overall result (All passed, Detail failed, or Not located).
- If the object was located, the match score for the object locator and result for each inspection.
- Status information, such as if the Inspector is in teach mode, and number of images waiting to be stored to FTP.

You can view the structure of the input assembly for the current configuration by choosing **I/O Settings** from the **InspectorI40** menu, and clicking **Show input assembly mapping** in the **I/O Settings** dialog box.

General: - Inspection ID - Current reference object - Overall result - Status information
Locator: - Result (Located or not, Not used) - Match score - Rotation - Scale
Inspection 1: - Result (Pass, Fail, Not used) - Type
Inspection 32: - Result (Pass, Fail, Not used) - Type
Inspection 1: Score
Inspection 32: Score

Figure – Structure of the Input assembly

The input assembly is described in detail in section “38.1 Input Assembly” on page 96.

The inspection result is available when the Inspector has finished inspecting the image – that is, after the minimum delay time.

The status information may be updated independently from the inspection result, which means that the status flags tag may have changed value without there being a new inspection result in the assembly. To make sure that there is a new inspection result in the assembly, check whether the Inspection ID has changed value.

You can view the structure for the currently active reference object by choosing **I/O Settings** from the **InspectorI40** menu, and clicking **Show input assembly mapping** in the **I/O Settings** dialog box.

15.3 Control the Inspector via EtherNet/IP

The Inspector I40 has one Output assembly that can be used for controlling the Inspector in the following ways:

- Select reference object
- Teach reference objects
- Trigger inspections

The output assembly is described in detail in section 38.2 “Output Assembly”.

Select reference object

To enable reference object selection via EtherNet/IP, do the following:

1. Choose **I/O Settings** from the **InspectorI40** menu.
2. On the **External object selection** tab, select **Enable external object selection...using EtherNet/IP**.

To select which reference object the Inspector will use when inspecting, change the value of `Select reference object`. The value that corresponds to each reference object can be found in the following places:

- On the **External object selection** tab in the **I/O Settings** dialog box,
- In the input assembly mapping that can be shown (and printed) from the **I/O Settings** dialog box.

If the value in `Select reference object` does not correspond to any reference object, the Inspector will ignore the attempt to switch reference object.

The time it takes to switch reference object depends on the number of inspections, inspection type, and sizes of the regions in the reference object. Typically it takes in the order of one second to switch reference object. For more information see section “12.2 Select Reference Object” on page 36.

Teach reference object

To enable teaching via EtherNet/IP, do the following:

1. Choose **I/O Settings** from the **InspectorI40** menu.
2. On the **I/O usage** tab, select **Enable external teaching...using EtherNet/IP**.

To use EtherNet/IP for teaching a reference object without using a PC, set the value of `External teach` to 1.

Teaching via EtherNet/IP differs from teaching using In2 (as described in chapter 13 “Teach Without PC”) in the following ways:

- The reference object will be taught almost immediately, without a 3 seconds delay.
- Since the teach is made almost immediately, there is no delay for adjusting focus or field of view after being activated, and therefore no feedback on focus or moving objects in the field of view.
- If the exposure setting should be auto-adjusted when teaching, the Inspector needs to determine the best exposure setting before teaching, which may take a short while.

When a teach is activated, the Inspector will set the `In teach mode` flag in the Input assembly's `Status` tag. When the teach is made, the flag is reset to 0.

Notes

- If the Inspector has multiple reference objects, make sure that the correct reference object is active before teaching.
- To stop the Inspector from automatically adjusting the exposure settings when using external teach, choose **I/O Settings** from the **InspectorI40** menu, and select **Use current exposure settings** in the dialog box.

Trigger inspections

To enable triggering via EtherNet/IP, do the following:

1. Choose **I/O Settings** from the **InspectorI40** menu.
2. On the **I/O usage** tab, select **Enable external image trigger...using EtherNet/IP**.

To trigger an inspection via EtherNet/IP, set the value of **Trigger** to 1. The inspection is made immediately, without any delays.

The Inspector will make an inspection each time the value of **Trigger** is changed to 1 (similar to rising edge). To trigger the next inspection, you must first set the value to 0.

When triggering via EtherNet/IP, the time between two inspections should be at least 4 times the RPI. This means that the maximum triggering rate via EtherNet/IP is approximately 15 Hz.

16 Handle Device Data (Settings)

Device data is all settings and information that the Inspector needs to make inspections. The device data consists of:

- Settings for each reference object; image settings, object locator settings, detailed inspection settings and output settings.
- Reference images with object locator region and detailed inspection regions.

The image log and statistics are not included in the device data.

A device file is a file that contains device data and is mapped to a specific Inspector.

16.1 Save Device Data on the Inspector (in Flash)

To save all device data (settings) in the Inspectors Flash memory, select **Save Settings in Flash** from the **InspectorI10** (or **InspectorI20/InspectorI40**) menu. A progress bar is displayed during the process. The Inspector will stop inspecting until the Flash memory is updated.

Please note that it may take several minutes to save the settings in Flash. The more reference objects present the longer time it takes.

Settings that are saved in the Inspector's permanent (Flash) memory will be used when the Inspector starts again after a power loss. If you do not save the settings in the permanent memory, the changes you made will be lost if the power is disconnected.

16.2 Save Device Data on PC

Choosing **Save Device File as** from the **File** menu will save the Inspector's current device data to a new file on the PC. This file will contain all device data including the reference images and a reference to the Inspector used.

When opening a saved file, the PC application will try to connect to the Inspector for which the file was saved. All device files have the extension **SDV** (SOPAS Device File).

16.3 Use Saved Device Data on the Inspector

To use saved device data, choose **Open Device File** from the **File** menu and select the file (**SDV**). When opening a saved file, the PC application will try to connect to the Inspector for which the file was saved.

If you have unsaved changes in the Inspector, you will be asked if you want to save these before continuing.

If the Inspector, for which the file is saved, is found, then you can start using it.

If the Inspector is found but the device data differ between the Inspector and the file, then you are asked if you want to use the device data in the Inspector or from the file.

If the Inspector is not found, you will be asked if you want to use the Connection Wizard, to set up a connection with an Inspector.

16.4 Copying Device Data From one Inspector to Another

To copy device data from one Inspector (source) to another Inspector (target):

1. Connect to the source Inspector, by using **Connection Wizard**, see section “6.3 Connection Wizard” on page 22.
2. Save the device file, choosing **Save Device File as** from the **File** menu.
3. Connect to the target Inspector using the **Connection Wizard**.
4. Download the device data to the target Inspector, by using **Load Device Data to Device Wizard**, see below.

16.4.1 Load Device Data to Device Wizard

1. Choose **Load Device Data to Device** from the **Edit** menu. Click on the **Browse** button to browse for device files.
2. Select the device file and click **Open**.
3. The device data is transferred to the Inspector. Click **Finish**.

16.5 Restore Settings

It is possible to restore settings and return to the factory settings from the Inspectors Flash memory. All device data will be deleted. To restore settings:

1. Select **Restore settings** from the **InspectorI10** (or **InspectorI20/InspectorI40**) menu. A warning dialog box is displayed.
2. Click **Yes** to restore settings to factory settings. Or click **No** to cancel.

Note

The IP address of the Inspector will not be reset when restoring the settings.

17 Log and Save Images

17.1 Use Image Log

The Inspector saves up to 30 images in its memory. To view the logged images, click on the **Logged images** tab. To be able to log images at least one reference object has to have been taught.

Note:

The image log will not be displayed in SOPAS Inspector while the Inspector I40 is storing images to FTP.

Log Settings

To change which images the Inspector should log, choose **Log settings** from the **Inspector** menu.

For the Inspector I10 and I20 you can choose the following alternatives:

Log all images	Every inspected image
Log failed images only	Images where one or more detailed inspections failed (that is, were performed but did not pass). Images where no object was located are also logged, but only when the current reference object does not have any detailed inspections, or when the inspections are externally triggered.

For the Inspector I40 you can choose the following alternatives:

All	Every inspected image
Passed	Images where the object was located and all detailed inspections passed (if any). When the Inspector inspects without locator, images with all detailed inspections passed will be logged.
Located	Images where the object was located, regardless of whether any detailed inspection passed or failed. When the Inspector inspects without locator, no images will be logged.
Detailed failed	Images where one or more detailed inspections failed (that is, were performed but did not pass). When the Inspector is only locating without making detailed inspections, no images will be logged.
Failed (Not Located or Detail failed)	Images where either no object was located, or where one or more detailed inspections failed.

Save logged images to PC.

To save the log to the PC – all images and the results from the inspection – click **Save log**. The log is saved as an HTML file (**LogReport.html**) that can be viewed in any web browser. The images are saved in two folders together with the HTML file, one folder that contains the images without graphical feedback, and one folder that contains the same images but with the graphical feedback.

The images without graphical feedback can be used in the simulated device.

Update the image log.

While viewing the logged images, images that the Inspector adds to the log are *not* automatically added to the list on the **Logged images** tab. To update the displayed list of images with images added by the Inspector, click **Update log**.

When updating the log, the oldest images are removed from the list, keeping the maximum number of images at 30.

Clear the image log.

To remove all images from the image log, click on the **Clear log** button. The images are also removed from the Inspector.

17.2 Record Live Images to PC

To record images captured by the Inspector as files on the PC, choose **Record Live Images** from the **Inspector** menu.

After selecting a folder in which to save the images, a dialog box is displayed in which the number of recorded images is displayed.

To stop recording images, click **Stop recording** in the dialog box.

The images will be saved as separate files in the folder you selected. The images are saved in 8-bit gray scale BMP format.

Note

This saves only the images that are displayed in the **Live image** in the PC application, which is not necessarily every image that the Inspector captures.

17.3 Store Images to FTP

Setting up

To make the Inspector I40 store logged images to an FTP server, do the following:

1. Choose **Store Images to FTP** from the **InspectorI40** menu.
2. In the dialog box, select the **Store images** tab and enter the following:
 - Check **Enable FTP storage of logged images**.
 - Choose whether to automatically start storing images to FTP when in **Run** mode.
3. Next, select the **FTP settings** tab and enter the following information:
 - The IP address of the FTP server.
 - A user name and password for connecting to the FTP server.
 - The folder in which the images should be stored. This folder will be created on the FTP server if it does not already exist.
4. Click **Test connection** to test the connection to the FTP server. The Inspector will try to log in to the FTP server.

Once configured, the storing of images to the FTP server can be started and stopped from the **Live image** tab when the Inspector is switched to **Run** mode. Switching to **Edit** mode will pause the storing of images.

Note that only the captured images are stored on the FTP server – that is, no detailed inspection results or overlay graphics are stored, as in the image log on the Inspector.

Warn for unsent images

When the Inspector I40 is storing images to FTP it can queue up to 30 images in case that it should not be able to store images as fast as it is inspecting.

To make the Inspector signal on a digital output if the queue is getting full, select **Warn for unsent images** and choose which digital output to use for the warning. When used, the warning will be mapped to the same output regardless of which reference object is currently used. The Inspector will warn if there are more than 20 unsent images. The warning will be reset when there are less than 10 images in queue.

If the queue of unsent images becomes full, for instance if the FTP server is down, the oldest image in the queue will be replaced with the new image.

When using EtherNet/IP, the number of images currently waiting to be stored is available in the Input assembly.

Using the stored images

The images are stored on the FTP server as Windows bitmap files (BMP). The files are named in the following way:

`<Reference object>_<inspection ID>_<result>.bmp`

For example: `Aloe_00000147_pass.bmp`

Note that only the captured images will be saved, without any detailed result. To get the inspection result you can do the following:

1. Let an external device (for example a PLC) read the inspection results via EtherNet/IP and store the results. Use the inspection ID to combine the stored image with the inspection result.
2. Use SOPAS Inspector with a simulated device, and let the simulated device inspect the stored images. This way you can also get images with the inspections drawn in them, or use the images to adjust the configuration to make the inspections more robust.

18 Use the Simulated Device

SOPAS Inspector has a built in simulated device (emulates the real Inspector) that can be used to simulate and test new settings. The simulated device can be used as a test tool and can also be used to look at logged images afterwards, to improve settings. The simulated device gives the same result as with the Inspector.

18.1 Start the Simulated Device

There are two ways to start the simulated device:

- Starting the simulated device when already connected to an Inspector
- Starting the simulated device when starting SOPAS Inspector

18.1.1 Start the Simulated Device when Connected to an Inspector.

To start the simulated device when connected to an Inspector, select **Switch to Simulated Device** from the **Communication** menu.

18.1.2 Start the Simulated Device without PC application running.

To start the simulated device without PC application running:

1. Start the **SOPAS Inspector** application.
2. In the SOPAS welcome screen, select the **Connect to new device** option. Click on the **OK** button.
3. In the **Connection Wizard** dialog box, select the **Simulated device** option. Click on the **Next** button.



Ethernet connection



Simulated device

4. Select the **InspectorI10**, **InspectorI20** or **InspectorI40** device and click on the **Next** button. The simulated device is started.
5. Click **Finish** to start working with the simulated device.

18.2 Control the Simulated Device

The buttons in the bottom of the **Live image** tab controls the simulated device. These controls are only visible when using the simulated device.

The buttons are:



Run, loops over the images in the selected folder.



Pause, pauses on the current image.



Next image, steps to the next image and pauses.



Previous image, steps to the previous image and pauses.



Repeat, deselect to run through the images and stop at the last image. (Inspector I40 only)

With the Inspector I40, the filename of the currently displayed image is shown in the **Live image** tab.

18.3 Select Images to be used

To use saved images with the simulated device, the images must be in bitmap (BMP) file format (8 bit gray scale). Images saved to a PC using **Record Live Images** (Inspector menu), **Save Log** (on the **Logged images** tab), or **Store Images to FTP** (InspectorI40 menu) can be used.

If the resolution does not match the selected field of view:

- Large images will be truncated and the centered part of the image will be used.
- Small images will be centered in the field of view and filled with black outside the image.

To select which folder of images to be used by the simulated device:

1. Click on the **Select images...** button.
2. Select the image folder. Click on the **Open** button.
The folder path is displayed under the **Select images...** button.

For Inspector I10 and I20, the selected image folder must not contain more than 500 images, which is the limit for the simulated device. The Inspector I40 has no such limit.

18.4 Copy Device Data from the Simulated Device to an Inspector

If you have used the menu option **Switch to Simulated Device**, then you can copy device data from the simulated device to the Inspector, by selecting **Switch to Physical Device** from the **Communication** menu.

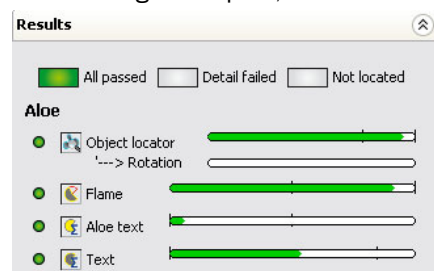
If you connected to the simulated device with the connection wizard, then you can copy device data by:

1. In the simulated device, select **Save Device File** from the **File** menu.
2. Connect to an Inspector by using **Connection Wizard**, see section “6.3 Connection Wizard” on page 22.
3. Load device data to device, see section “16.4.1 Load Device Data to Device Wizard” on page 45.

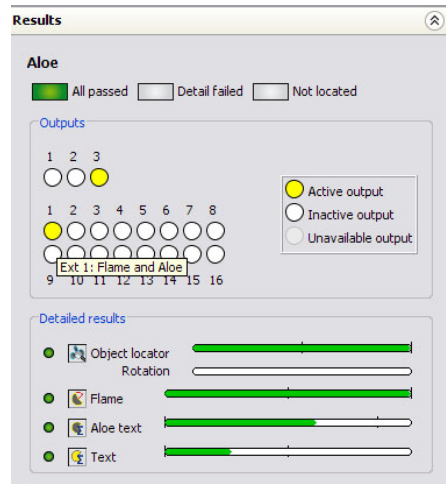
19 Use Results and Statistics

19.1 Results

The inspection result is displayed in the **Results** tab. As the Inspector I20/I40 has support for more digital outputs, the **Results** tab is extended with status for all available outputs.



Results tab for the Inspector I10



Results tab for the Inspector I20/I40

Output results

Three different results corresponding to the outputs:



Name of reference object

The name of the reference object is displayed above the results. Same name as in the Reference objects list.

Object locator, rotation

The vertical line in the **Objectlocator** bar corresponds to the Match setting in the **Object locator** tab. When the match score in the live image is higher than the threshold value, the bar is green (located) otherwise red (not located).

Inspection – Pixel counter

The two vertical lines in the **Pixel counter** inspection bar correspond to the **No. of pixels in range** setting in the **Detailed inspections** tab. When the match score in the live image is between the min and max values, the bar is green (All passed) otherwise red (Detail failed).

Inspection – Edge pixel counter

The two vertical lines in the **Edge pixel counter** inspection bar correspond to the **No. of edge pixels** setting in the **Detailed inspections** tab. When the match score in the live image is between the min and max values, the bar is green (All passed) otherwise red (Detail failed).

Inspection – Contour and Pattern

The vertical line in the **Contour and Pattern** inspection bar corresponds to the **Match** setting in the **Detailed inspections** tab. When the match score in the live image is higher than the threshold value, the bar is green (All passed) otherwise red (Detail failed).

Outputs (Inspector I20/I40)

For the Inspector I20/I40, the status of all available outputs is displayed in the Results tab. The top row contains the three outputs of the Inspector I20/I40, and the two bottom rows contain the outputs on the I/O extension box. If the mouse pointer is held above an output, the corresponding expression used for the output is displayed as a tooltip. The color of the output indicates the status:

Color	Status
Yellow	Active
White	Inactive
Gray	Not available

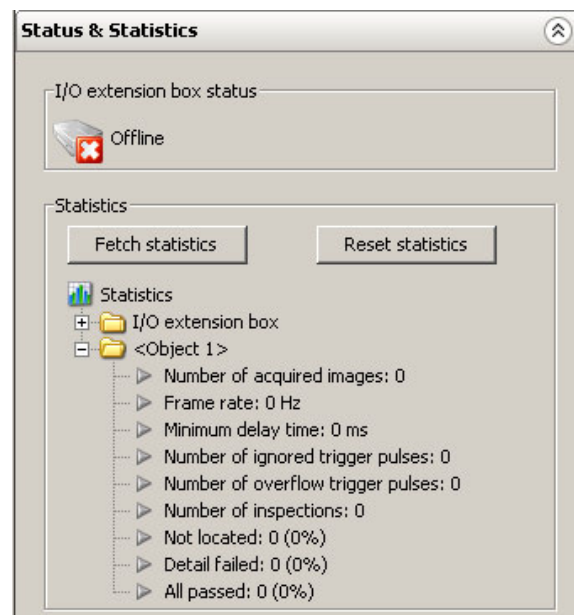
19.2 Statistics

Statistics are collected for each reference object used by the Inspector. The statistics are updated for the currently selected reference object, and all other reference objects are idle until selected. For the simulated device statistics are available only when using Inspector I40.

The statistics is started to be updated as soon as the selected reference object is being used for inspections.

Note

If any reference object settings are changed, then the statistics will be reset for that particular reference object. In the Inspector I40 the statistics can also be reset using a reset button in the Statistics tab.



To update the statistics, click on the **Fetch statistics** button.

The following statistics are collected for each reference object:

- **Number of acquired images.** Total number of captured images.
- **Frame rate.** The latest frame rate in Hertz (Hz). The same value as under the live image.
- **Minimum delay time.** The latest minimum delay time in milliseconds (ms). The same value as under the live image.
- **Number of ignored trigger pulses.** Losing trig pulses can happen if you are using an external image trigger (In3) and the inspected objects are moving too fast (too high speed on conveyor belt).
- **Number of overflow trigger pulses.** This can happen if there is a long distance between the image trigger and the Inspector (where the image is captured) and/or if there is a long distance between the Inspector and the rejecting device connected to the Inspectors output signals. As the Inspector needs to remember all objects in the queue, the queue can be too long if the inspected objects are moving too fast (too high speed on conveyor belt).
- **Number of inspections.** The number of detailed inspection regions (yellow regions) in the reference object. Object locator region and masks are not counted. This is a static value.
- **Not located.** The total number of captured images where the object was not located, or a detailed inspection was out of view. The result is also presented in percent of all captured images.
- **Failed (DetailFailed in I20/I40).** The total number of captured images where one or more detailed inspections failed. When the Inspector is only locating without making detailed inspections, no images will be counted. The result is also presented in percent of all captured images.

- **All passed.** (Inspector I20/I40 only). The total number of captured images where the object was located and all detailed inspections passed (if any). When the Inspector inspects without locator, images with all detailed inspections passed will be counted.

In Inspector I20/I40 any user defined expression (see section “25.2 Output settings – Inspector I20/I40”) mapped to the Inspector output will also be displayed under the Statistics tab.

Note

- For the simulated device statistics are only available for Inspector I40 and the only statistics available then are **Not Located**, **Detail Failed**, **All Passed**, and any user defined expressions mapped to an output.
- If using **Store Images to FTP** (see section “17.3 Store Images to FTP” on page 47) in the Inspector I40 statistics are also available for the **Number of stored images to FTP**, **Number of lost images**, and **Number of FTP retries**.

19.3 I/O extension box status

If the use of the I/O extension box is enabled, the current status of the communication with the I/O extension box is displayed on the Statistics tab. The field **I/O extension box status** shows if the I/O box is online or not.



I/O extension box is online



I/O extension box is offline

There is also a field in the statistics table showing the number of unanswered requests that have been sent to the I/O extension box. If this number is high, consider changing the communication mode for the I/O extension box. Please refer to section “37.3 Setup of the I/O extension box in the SOPAS Inspector application” on page 93 for details.

20 Manage Network Address

20.1 View Network Address

To view IP address:

1. Choose **Device info...** from the **InspectorI10** (or **InspectorI20/InspectorI40**) menu.
2. Select the **Network** tab. The IP address is displayed.

20.2 Change Network Address

To change the IP settings of an Inspector, for instance as a preparation before moving the Inspector to another network, do the following:

1. Open the **Connection Wizard** from the **Communication** menu in SOPAS Inspector.
2. Choose **Connect to specific device**, select **Inspector** in the device type list, and deselect **Skip advanced interface configuration**. Then click **Next**.
3. In the **Interface selection** page, click **Next**.
4. In the **Found devices** page, select the Inspector to configure and select to change the device IP settings **Manually**.
5. Change the IP configuration and click **OK**.

The wizard will now configure the Inspector with the new IP configuration and the **Found devices** page will after a while be shown again. If the task was only to change the IP address of the device, the connection flow can now be cancelled.

User Interface

21 Main View



Run/Edit Switch

Click on **Edit** to teach reference images, set up inspections, and to test. Click on **Run** to start real inspection. No settings can be changed in **Run** mode.

List of Reference Objects

The **Reference objects** list contains all taught reference objects. To select which reference object to work with, select **Edit** mode and click on the reference object in the list. Click on the **Add** button to create a new reference object. Click on the **Delete** button to remove the selected reference object.

21.1 Live Image Tab



Live Image

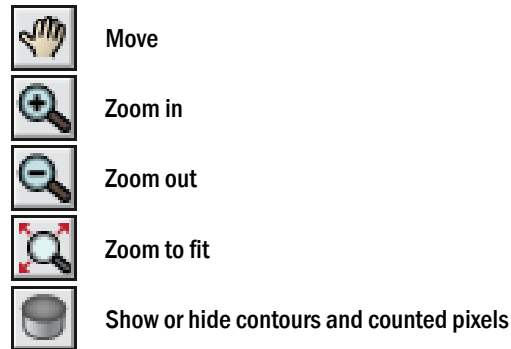
The **Live image** tab contains view control buttons, teach button and output selection. When clicking on the **Teach reference object** button, an image is captured and an **Object locator** region is placed in the new reference image.

View control buttons

The view control buttons consists of tools to work with regions and to set the view of the image. The buttons are:



Select regions

**Output selection radio buttons**

To stop the Inspector I10 or I20 from providing output signals (in **Edit** mode), click on **Disable**. To activate the output signals, click on **Enable**. In **Run** mode outputs are always enabled.

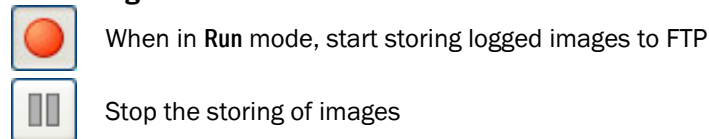
For Inspector I40, the built-in outputs can be activated and deactivated in **Edit** mode with the **Enable built-in outputs in Edit mode** in the **I/O Settings** dialog box. Outputs on an I/O extension box connected to the Inspector I40 will always be active.

Frame Rate and Minimum Delay time

Frame rate shows the number of inspections per second (in Hertz, Hz).

For triggered inspections, the frame rate is the minimum time between two frames. Trigger pulses that occur at a higher rate are discarded, and can be view in the **Status & Statistics** tab as **Number of ignored trigger pulses**.

The **Minimum delay time** is the shortest delay time on any output signal (in milliseconds, ms).

Store Images to FTP

Storing to FTP is always stopped when the Inspector I40 is in **Edit** mode.

The IP address of the used FTP server is displayed below the buttons.

The Inspector I40 can be set to start storing images to FTP automatically when in **Run** mode, by choosing this in the **Store Images to FTP** dialog box.

21.2 Live Image Tab – Simulated Device**Simulated Device Control Buttons**

The buttons in the bottom of the **Live image** tab controls the simulated device. These controls are only visible when using the simulated device.

The buttons are:

-  **Run**, loops over the images in the selected folder.
-  **Pause**, pauses on the current image.
-  **Next image**, steps to the next image and pauses.
-  **Previous image**, steps to the previous image and pauses.
-  **Repeat**, deselect to run through the images and stop at the last image. (Inspector I40 only)

With the Inspector I40, the filename of the currently displayed image is shown in the **Live image** tab.

21.3 Reference Image Tab



Reference Image

The **Reference image** tab contains tools to add an **Object locator** region and **Detailed inspections** to the selected reference image. The **Reference image** tab shows the reference image for the active reference object. A context menu is displayed when you right-click in the image or on a region.

View Control Buttons

For information about view control buttons see section “21.1 Live Image Tab” on page 53.

Object Locator Button

The **Object locator** tool can be used to select the part of the image that contains the reference object. Only one **Object locator** region can be used in each reference object. The **Mask** tool can be used to reshape the region. The object locator region can be changed in size, and rotated, by using the different handles. The object locator region is identified by blue region color and the symbol:



Pixel Counter Button

The **Pixel counter** inspection tool makes an inspection by counting the selected pixels on the inspected object and comparing this number with the **No. of pixels in range** interval setting in the **Detailed inspections** tab. The number of pixels on the reference object is only used to help specifying the **No. of pixels in range** interval setting. The **Mask** tool can be used to reshape the region. The inspection region can be changed in size, and rotated, by using the different handles. The inspection region is identified by yellow region color and the symbol:



For more information see section “3.1 Pixel Counter” on page 12.

Edge Pixel Counter Button

The **Edge pixel counter** inspection tool makes an inspection by counting the edge pixels on the reference object and comparing this number with the number of edge pixels on the inspected object. The **Mask tool** can be used to reshape the region. The inspection region can be changed in size, and rotated, by using the different handles. The inspection region is identified by yellow region color and the symbol:



For more information see section “3.2 Edge Pixel Counter” on page 13.

Contour Button

The **Contour** inspection tool makes an inspection by comparing the contour on the reference object with the contour on the inspected object. The **Mask tool** can be used to reshape the region. The inspection region can be changed in size, and rotated, by using the different handles. The inspection region is identified by yellow region color and the symbol:



For more information see section “3.3 Contour” on page 13.

Pattern Button (Inspector I40)

The **Pattern** inspection tool compares the pixel values of the inspection region with the reference object. The **Mask tool** can be used to reshape the region. The inspection region can be changed in size, and rotated, by using the different handles. The inspection region is identified by yellow region color and the symbol:



For more information see section “3.4 Pattern” on page 14.

Mask Tool Button

The **Mask tool**, makes it possible to reshape the **Object locator** region and **Detailed inspections**. To use the tool, first select the region that shall be masked, then click on the **Mask tool** button and draw a mask region. The mask region can be changed in size, and rotated, by using the different handles. Each **Object locator** region and **Detailed inspections** region can have up to ten mask regions attached to it.

**Shape Buttons**

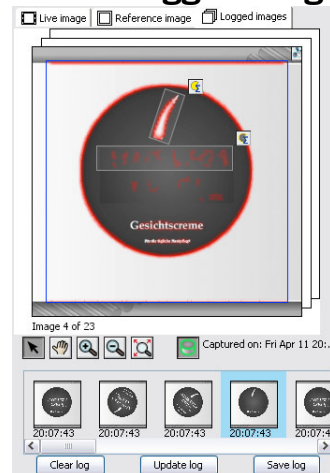
The selected **Region shape** button (rectangle or ellipse) determines which basic shape to use on the next region that is drawn. The shape setting affects all region tools; object locator, detailed inspections and masks. To change a current region, change shape in the **Object locator** tab or in the **Detailed inspections** tab.

Mask regions cannot be changed between rectangle and ellipse after they have been drawn. Delete the old one and draw a new with the correct shape.

**21.3.1 Frame Rate and Minimum Delay time**

For information about frame rate and minimum delay time, see section “21.1 Live Image Tab” on page 53.

21.4 Logged Images Tab



Logged Images

The logged image is the detailed view of the selected image in the image list. The corresponding **Object locator** and **Detailed inspections** graphical feedback are also displayed in the image.

Choose which images to log by choosing from **Log settings** from the **InspectorI10/Inspector I20/InspectorI40** menu.

When the Inspector I40 is storing images to FTP, the image log cannot be displayed.

List of logged images

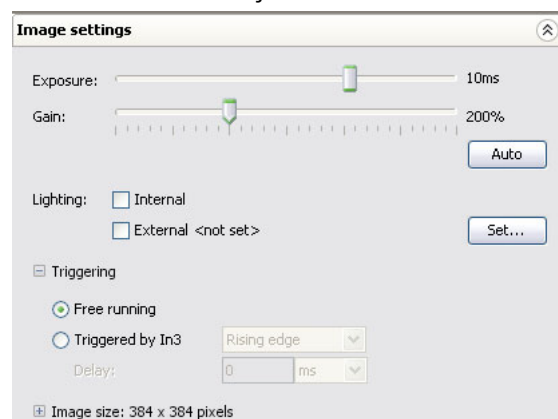
The list of logged images contains the 30 most recent logged images. To delete all images in the log, click on the **Clear log** button. To refresh the list, click on the **Update log** button. To save the images in the log to file, click on the **Save log** button.

22 Image Settings

Image Settings Tab

The **Image settings** tab contains image capturing settings; exposure, gain, lighting, triggering, and image size.

Select **Edit** mode before any settings can be changed. The displayed settings are for the selected reference object.



22.1 Image Quality

Adjusting **Exposure** and **Gain** settings changes the image quality. To adjust exposure time and gain to good values, click on the **Auto** button. The **Auto** button adjustments will not change exposure time and gain continuously, only each time clicking on the **Auto** button.

Exposure

Exposure is the duration of the exposure time, measured in milliseconds (ms). If the exposure time is too short, for the sensor to capture enough light, the image is underexposed. If there is too much light (the sensor is saturated) the image is overexposed. Increasing the exposure time results in brighter images, but may also result in lower frame rate.

The shortest exposure time is 0.025 ms (or 1/40.000 s) and the longest exposure time is 100 ms (or 1/10 s). The longest exposure time may be shorter if external lighting is used.

Gain

Gain is an electronic way to amplify the intensity values after the sensor has already been exposed. Increasing the gain results in brighter images, but may also increase the noise in the images. The image will appear grainier. The relative value for gain is displayed to the right of the Gain slider.

The lowest gain is 100% and the highest gain is 400%.

22.2 Lighting Options

The Inspector has a built-in lighting with LED's (Light Emitting Diodes).

There are four different combinations of how to use lighting:

- None, only ambient light is used, such as normal indoor light or sunlight
- Internal (or built-in) lighting
- External lighting
- Internal and external lighting

External Lighting

Before the Inspector can use an external lighting, the type must be specified. If a SICK external light source is used, the only thing to do is to select the right type and all other settings are automatic.

Using external lighting affects the shortest exposures time that can be used.

If a non-SICK external light source is to be used, see section "Non-SICK External Light" on page 27.

22.3 Image Triggering

The image capturing can be:

- **Free running**, capturing images as fast as possible
- **Triggered by In3**, capturing an image each time (with or without a delay) a trigger pulse is sent to In3 on the Inspector.
- **Triggered by EtherNet/IP**, capturing an image each time Trigger in the Output assembly is set to 1 (Inspector I40 only).

Triggered by In3

When the image capturing is triggered by In3, an image is captured each time a trigger pulse is sent to In3 on the Inspector.

The Inspector can trig on the pulses rising edge (from low to high) or falling edge (high to low), which can be selected from the pop-up menu.

Triggered by EtherNet/IP

When the image capturing is triggered via EtherNet/IP, an image is captured each time **Trigger** in the Inspector's Output assembly is set to 1.

Trigger must be set to 0 before the next image capturing can be triggered.

Delay

The **Delay** is the time from the trig pulse (rising or falling edge) until the image is captured. The delay is set in milliseconds (ms) or in number of pulses (encoder pulses).

22.4 Image Size

The **Image size** is controlled by the FOV (Field of View). To change the image size, click on the **Change** button to change the FOV.

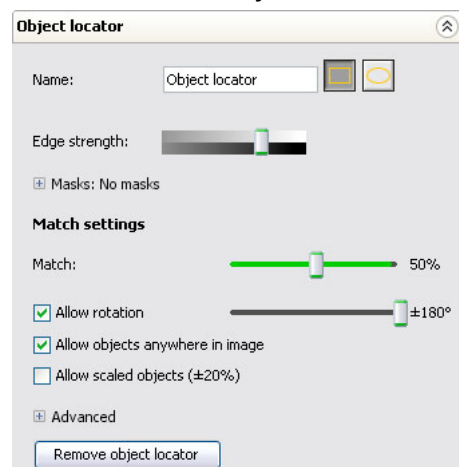
The FOV is changed by dragging the handles on the **Valid FOV** region (gray). The valid FOV will always include the object locator region and cannot be smaller than the **Minimum FOV** region (red). If the FOV is changed to a smaller area, it will change to **Invalid FOV** (red).

23 Object Locator Settings

Object Locator Tab

The **Object locator** tab contains settings for finding objects. To delete an **Object locator** region, click on the **Remove object locator** button.

Select **Edit** mode before any settings can be changed. The displayed settings are for the selected reference object.



Name of Object Locator Region

The name of the **Object locator** region is also displayed in the **Results** tab. Type in a new name in the field.

Shape of Region

The basic shape of an object locator region can be either a rectangle (rectangle icon) or an ellipse (ellipse icon). Clicking on the other shape button can change the basic shape.

Edge Strength

The **Edge strength** setting determines how much of the objects contour that are highlighted. In most cases, you should make sure that most of the characteristic contours in the object are highlighted but nothing is highlighted in the background or outside the object.

Use the **Mask tool** to mask out areas of the region that lie outside the object if it is difficult to make any highlights in the background disappear with the **Edge strength** setting.

For more information, see section “2 Locating the Object” on page 9.

Masks

The **Masks** list shows all mask regions (thin blue lines) that are attached to the **Object locator** region. To display the **Masks** list, click on the plus/expand button. To select a mask region in the reference image, click on the mask name (Mask 1 etc) in the list. The mask names cannot be changed.

23.1 Match Settings

The match settings consist of settings to control the accuracy in locating objects. The different settings are **Match**, **AllowRotation**, **Allow objects anywhere in image**, **Allow scaled objects**, and **Advanced** (that include **Search method**).



Match

The **Match** setting tells how well the located object must match. The match score can be set between 0% and 100%.

Move to the left (lower values) if the Inspector fails to locate objects, move to the right (higher values) if the Inspector claims to locate objects that are not the correct object.

Allow Rotation

The **Allow rotation** setting consists of a check box and a slider. If the check box is deselected, then the slider is inactivated. If the check box is selected, then the allowed rotation can be set between **None** and $\pm 180^\circ$.

Deselect the check box if the object always appears with the same rotation as in the reference image. This speeds up the inspections and makes it more robust.

If the objects appear with different rotations, make sure that the allowed angle is sufficiently high, since the Inspector will not locate objects that are rotated more than this setting.

Allow Objects Anywhere in Image

The **Allow objects anywhere in image** setting is used for telling where in the image to search for objects.

When selected, the Inspector will locate objects that are partially outside the image (although with a lower score).

When deselected, you can specify the region (**Search region** in green color) in which the objects are allowed. Objects located outside or partially outside this search region will not be located.

Allow Scaled Objects ($\pm 20\%$)

The **Allow scaled objects** setting is used when objects appear at different distance from the Inspector's lens.

Deselect if the inspected objects always have the same size in the image as the object in the reference image. This speeds up the inspections and makes it much more robust.

When selected, the Inspector will locate objects that are scaled up to $\pm 20\%$.

Advanced – Search Method

The **Advanced** setting contains the **Search method** slider (two sliders in Inspector I40). To display the advanced settings, click on the plus/expand button.

Inspector I10/I20

The Inspector's **Search method** can be changed using one slider between **High accuracy** and **High speed**. Higher accuracy gives lower speed and higher speed gives lower accuracy.

Inspector I40

The Inspector's **Search method** can be changed using two sliders. One slider determines the trade-off between **High robustness** and **High speed**. The other slider determines the trade-off between **High accuracy** and **High speed**.

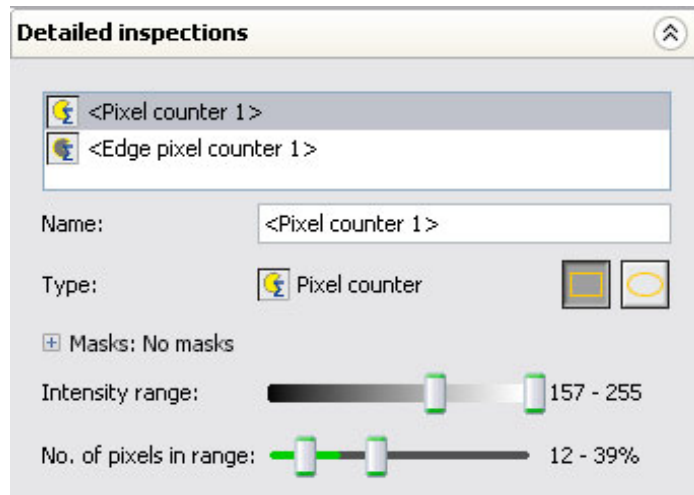
For more details see section "11.2 Adjust Object Locator Settings" on page 34.

24 Detailed Inspections Settings

Detailed Inspections Tab

The **Detailed inspections** tab lists all inspections for the selected reference object. The upper part of the tab is the same for all types of inspections, **Contour**, **Edge pixel counter**, **Pixel counter**, and **Pattern** (only Inspector I40). The lower part is different for all four inspection types in order to control the inspections behavior.

Select **Edit** mode before any settings can be changed. The displayed settings are for the selected reference object.



Detailed Inspection settings tab.

Detailed Inspections List

The detailed inspections list consists of all defined detailed inspections. To select a **Detailed inspection** region in the reference image, click on the inspection name in the list.

Name of Detailed Inspection

The name of the **Detailed inspection** is also displayed in the **Results** tab. Type in a new name in the field.

Inspection Type

The **Type** displays the name and the icon for the selected detailed inspection. The type can be **Contour**, **Edge pixel counter**, **Pixel counter**, or **Pattern** (only Inspector I40). The type cannot be changed, delete and draw a new detailed inspection to change detailed inspection type.

Shape of Region

The basic shape of a detailed inspection region can be either a rectangle (rectangle icon) or an ellipse (ellipse icon). Clicking on the other shape button can change the basic shape.

Masks

The **Masks** list shows all mask regions (thin yellow lines) that are attached to the detailed inspection region. To display the mask list, click on the plus/expand button. To select a mask region in the reference image, click on the mask name (Mask 1 etc) in the list. The mask names cannot be changed.

24.1 Pixel Counter Inspection



Intensity Range

The **Intensity range** specifies which pixels in the region that the Pixel counter should count. These pixels are highlighted (yellow) in the reference image. The interval is selected by the two sliders, that specify dark (left) upper limit and light (right) lower limit. The highlighted (yellow) area is those pixels that are in between the both sliders.

Number of Pixels in Range

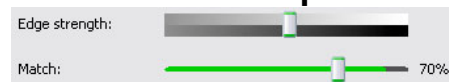
The setting tells in what interval the inspected detail must be.

For Inspector I10 and I20, the two sliders can be set between 0% and 100%, specifying the range in between. The percentage range refers to percentage of pixels within the pixel counter inspection region. Note that if the inspection region is changed the percentage will not automatically be changed.

The **Pixel counter** inspection tool makes an inspection by counting the highlighted (yellow) pixels on the inspected object and comparing this number with the **No. of pixels in range** interval setting.

For Inspector I40 the **No. of pixels in range** interval is specified as number of pixels within the inspection region. If the located object is scaled, the number of pixels is adjusted to be the number of matching pixels that should have been found if the located object had the same size as the reference object.

24.2 Contour Inspection



Edge Strength

The **Inspection edge strength** setting sets the minimal contrast required for a pixel to be marked as an edge.

Notes

- The **Inspection edge strength** setting affects all **Contour** and **Edge pixel counter** inspections.
- The **Inspection edge strength** setting for detailed inspections is different from **Edge strength** used in the **Object locator** tab.

Match

The **Match** setting tells how well the inspected object must match. The match score can be set between 0% and 100%.

Move to left (lower values) if the Inspector fails to inspect details, move to right (higher values) if the Inspector claims to approve detailed inspections that are not correct.

24.3 Edge Pixel Counter Inspection



Edge Strength

The **Inspection edge strength** setting sets the minimal contrast required for a pixel to be marked as an edge. These pixels are highlighted (yellow) in the reference image.

Notes

- The **Inspection edge strength** setting affects all **Contour** and **Edge pixel counter** inspections.
- The **Inspection edge strength** setting for detailed inspections is different from **Edge strength** used in the **Object locator** tab.

Number of Edge Pixels

The setting tells in what interval the inspected detail must be.

For Inspector I10 and I20, the two sliders can be set between 0% and 100%, specifying the range in between. The percentage range refers to percentage of pixels within the edge pixel counter inspection region. Note that if the inspection region is changed the percentage will not automatically be changed.

The Edge pixel counter counts pixels that are edges and compares this number with the **No. of edge pixels** settings. Where the pixels are located does not matter.

For Inspector I40, the **No. of edge pixels** interval is specified as number of pixels within the inspection region. If the located object is scaled, the number of pixels is adjusted to be the number of matching pixels that should have been found if the located object had the same size as the reference object.

24.4 Pattern Inspection



Position tolerance

The position tolerance specifies the maximum positional offset between the pattern in the region and the reference image. The tolerance can be set from ± 0 to ± 4 pixels.

Match

The **Match** threshold sets the required similarity between the pixels of the region and the reference image. The setting is a value between 0 and 100%, where 100% means “perfect match”.

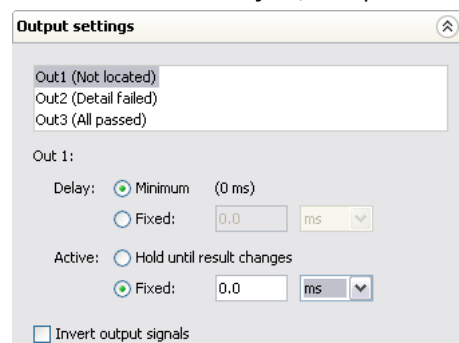
25 Output Settings

25.1 Output settings – Inspector I10

Output Settings Tab

The **Output settings** tab contains the detailed control of the output signals.

Select **Edit** mode before any settings can be changed. The displayed settings are for the selected reference object, except the **Invert output signals** setting.



List of Outputs

Each inspection made by the Inspector I10 activates one of the three outputs Out1, Out2, or Out3. Which output that is activated depends on the result:

Output	Pin	LED color Function	Activated when
Out1	4	Blue	Not located – The object was not located, or a detailed inspection was out of view.
Out2	6	Red	Detail failed – The object was located but at least one of the detailed inspections failed.
Out3	7	Green	All passed – The object was located and all detailed inspections passed as well.

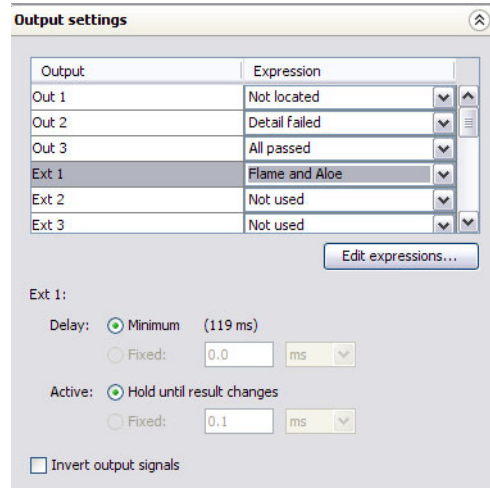
25.2 Output settings – Inspector I20/I40

Output Settings Tab

The **Output settings** tab contains the detailed control of the output signals.

Select **Edit** mode before any settings can be changed. The displayed settings are for the selected reference object, except the **Invert output signals** setting.

The outputs on the I/O extension box are enabled in the I/O settings dialog available on the **I/O settings** option on the **InspectorI20/InspectorI40** menu.



List of Outputs

All available outputs are shown in the list. The digital outputs on the Inspector I20/I40 are called Out1, Out2 and Out3. If the I/O extension box is used, the outputs on the I/O extension box are added to the list. The outputs on the I/O extension box are called Ext1, Ext2 etc.

Each output can be mapped to **All passed**, **Detail failed**, **Not Located**, or any user defined expression. In Inspector I40 a Store Images to FTP overflow warning signal can also be mapped to an output from the **Store Images to FTP** dialog box.

Outputs by Logical Expressions

The outputs of the Inspector I20/I40 can either be assigned the same result as in the Inspector I10 (this is the default configuration), or user defined expressions. The user defined expressions are created in the **Output Expression Editor**.

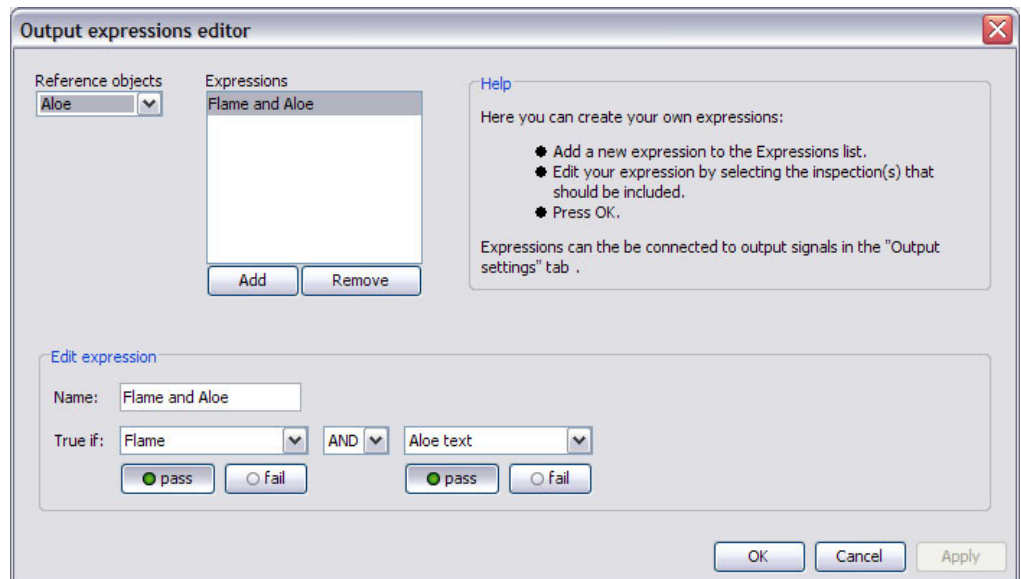
In the **Output settings** tab for the Inspector I20/I40, it is possible to define which expression that shall be used to control each output.

To select an expression for an output:

1. Click on the **Expression** column of the output to edit.
2. Choose the desired expression from the list.

Output Expression Editor

The **Output Expression Editor** is opened by clicking the button **Edit expressions...** in the **Output settings** tab. The editor is used to create and modify the expressions to use for the outputs. Each learned object can have up to 16 expressions. The three default expressions **Not located**, **Detail failed** and **All passed** are available for all objects, and they cannot be edited.



An expression is either the result of a single detailed inspection or a logical combination of two detailed inspections for a learned object. The inspections can be combined in two ways; logical AND, and logical OR. For each of the inspections, it is possible to specify if it shall pass or fail.

To create a new expression using the **Output Expressions Editor**:

1. Choose the learned object from the list.
2. Click on the **Add** button.
3. Enter a name for the new expression.
4. Choose the detailed inspection(s) to use for the expression, and specify if each inspection shall pass or fail by clicking the appropriate button.
5. Choose the logical operation to perform on the result(s).
6. Save the new expression by clicking **Apply**.

The field for logical operation has three possible states and the expression will be true if:

[empty] Only the first condition is fulfilled.

AND Both conditions are fulfilled.

OR At least one of the conditions is fulfilled.

The selected expression can be removed by clicking the button **Remove**.

Notes:

- If the removed expression is in use, the corresponding output will be set to **Not used**.
- If a detailed inspection that is used by an expression is removed, the corresponding expression will be modified. If the expression only contains the inspection that was removed, the expression will be removed, too.

25.3 Common settings for the outputs

The following settings are common for the internal outputs on all Inspector variants. If the I/O extension box is used together with the Inspector I20/I40, it will not be possible to change the settings **Delay time** and **Active time** for the outputs on the I/O extension box. For the I/O extension box, the delay time will always be set to **Minimum**, and the active time will always be set to **Hold until result changes**.

Settings for Selected Output in List

For each output signal, it is possible to individually specify:

- **Delay time.** Delay time is the time from start of exposure (when the image is captured) until a signal is sent.
- **Active time.** Active time is the length of the controlling pulse of the output signal.

Output Delay

Delay time can be set to **Minimum** or **Fixed**.

- | | |
|----------------|--|
| Minimum | The delay will be as short as possible – minimum delay time – which is the same as the time it takes the Inspector to make the inspection.

The time this takes depends on many settings in the current reference object, and is displayed below the image in the Live image and Reference image tabs. |
| Fixed | Set the delay as a time (in milliseconds) or a number of encoder pulses. |

Output Active Time

Active time can be set to **Hold until result changes** or **Fixed**.

- | | |
|----------------------------------|---|
| Hold until result changes | The output will be active as long as the inspection result is the one that is put on that particular output.

Once the inspection result changes, the output will change. Note that the deactivation of the output will be after the output delay time. |
| Fixed | Set the active time as a time (in milliseconds) or a number of encoder pulses, and choose the right type of delay from the popup menu to the right of the field. |

25.3.1 Invert Output Signals

Normally during the delay time the signal is low (0 V) on the output and during the active time the signal is high (+24 V) on the output. When **Invert output signals** is checked the signals are inverted, that is high signal (+24 V) during delay time and low signal (0 V) during active time.

Note

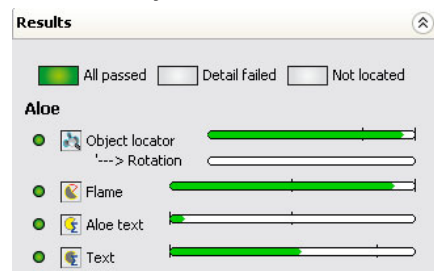
The selected **Invert output signals** setting is the same for all output signals. This setting will also apply to the outputs of the I/O extension box if this is used with the Inspector I20/I40.

26 Results

26.1 Results tab – Inspector I10

Results Tab

The inspection result is displayed in the **Results** tab. The result is displayed for the selected reference object.



Overall Result

Three different results corresponding to the outputs:

- Not located – Out1
- Detail failed – Out2
- All passed – Out3

Object Name

The name of the reference object is displayed above the results. Same name as in the **Reference objects** list.

Detailed Result

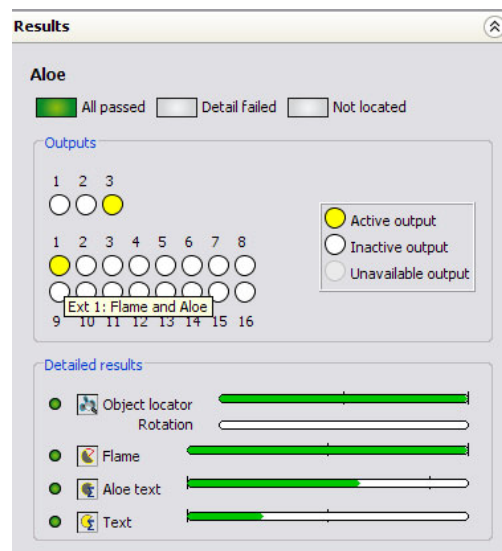
The vertical line in the **Locate object** bar corresponds to the **Match** setting in the **Object locator** tab. When the match score in the live image is higher than the threshold value, the bar is green (located) otherwise red (not located).

The vertical line(s) in the different inspection bars corresponds to settings **Match**, **No. of edge pixels** or **No. of pixels in range** in the **Detailed inspections** tab. When the bar is green the inspection is OK, otherwise red (inspection failed).

For more information see section “19.1 Results” on page 49.

26.2 Results tab – Inspector I20/I40

The inspection result is displayed in the **Results** tab. The result is displayed for the selected reference object.



Object Name

The name of the reference object is displayed above the results. Same name as in the **Reference objects** list.

Overall Result

Three different results depending on if the object is located or not and the result of the detailed inspections:



All passed



Detail failed



Not located

Outputs

The status of all available outputs is displayed in the **Outputs** field. The top row contains the three outputs of the Inspector I20/I40, and the two bottom rows contain the outputs on the I/O extension box. If the mouse pointer is held above an output, the corresponding expression used for the output is displayed as a tooltip.

The color of the output indicates the current status:

Color	Status
Yellow	Active
White	Inactive
Gray	Not available

Detailed Results

The vertical line in the **Locate object** bar corresponds to the **Match** setting in the **Object locator** tab. When the match score in the live image is higher than the threshold value, the bar is green (located) otherwise red (not located).

The vertical line(s) in the different inspection bars corresponds to settings **Match**, **No. of edge pixels** or **No. of pixels in range** in the **Detailed inspections** tab. When the bar is green the inspection is OK, otherwise red (inspection failed).

For more information see section “19.1 Results” on page 49.

27 Statistics

Statistics Tab

In the Statistics tab, inspection statistics are displayed. To view updated statistics click on the **Fetch statistics** button. For more information about statistics, see section “19.2 Statistics” on page 51.

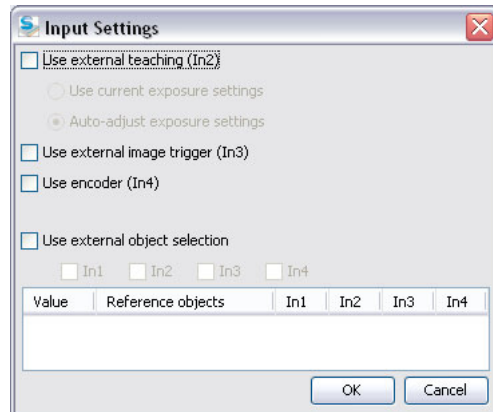
28 Input Settings

Note

The input settings are global and the current input settings apply to all reference objects. Input settings are not stored with the reference object.

28.1 Input settings – Inspector I10

To change input settings, select **Input settings** from the **InspectorI10** menu.



Use external teaching (In2)

The **Use external teach (In2)** setting is used to allow a teach of the Inspector without the need of a connected PC.

Select exposure settings with the radio buttons:

- Use current exposure settings
- Auto-adjust exposure settings (default)

Connect a push button or similar to In2 on the Inspector (pin 5 on the M12 connector marked **Power**, cable color is pink on DOL-1212 cables).

For more information see section “13 Teach Without PC” on page 37.

Use external image trigger (In3)

The **Use external image trigger (In3)** setting is used to control the image capturing. Use a photoelectric switch (or similar) to control when the Inspector should capture images to inspect. Set image trigger options in the **Image settings** tab.

Connect a photoelectric switch (or similar) to In3 on the Inspector (pin 3 on the M12 connector marked **Power**, cable color is white on DOL-1212 cables).

For more information see section “14.1 Connect an Image Trigger” on page 39.

Use encoder (In4)

The **Use encoder (In4)** setting is used to activate an encoder. Set encoder options in the **Output settings** tab.

Connect an encoder to In4 on the Inspector (pin 10 on the M12 connector marked **Power**, cable color is violet on DOL-1212 cables).

For more information see section “14.2 Connect an Encoder” on page 40.

Use external object selection

It is possible to select up to 16 different reference objects using the input signals on the Inspector. The number of selectable reference objects are depending on if the input signals are used for other purposes.

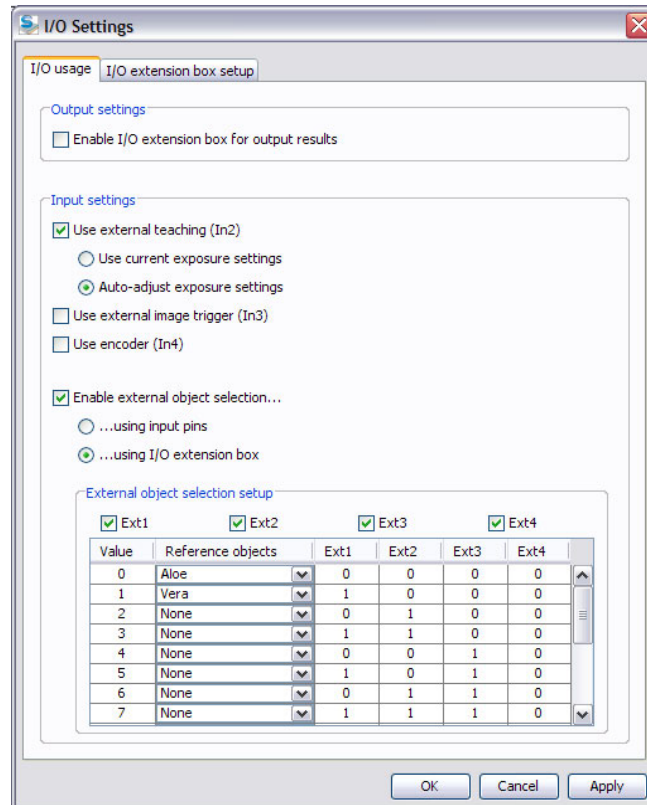
Connect a selector, PLC, or other device to pins 3 (In3), 5 (In2), 8 (In1), and/or 10 (In 4).

For more information see section “14.4 Select Reference Objects with Inputs” on page 41.

28.2 I/O settings – Inspector I20

The Inspector I20 can be used with its own inputs and outputs, with the I/O extension box, or with a combination of both. The I/O extension box supplies four digital inputs to be used for external object selection, and up to 16 digital outputs to be used for results from detailed inspections.

The configuration of the inputs and the use of the I/O extension box are controlled from the **I/O Settings** menu item on the **InspectorI20** menu.



Output Settings

The digital outputs on the Inspector I20 are always available. It is also possible to use the digital outputs of the I/O extension box for results from the detailed inspections.

Important

The I/O extension box must be configured before the digital outputs of the box can be used. This configuration is performed using the **I/O extension box setup** tab. Please refer to “37.3 Setup of the I/O extension box in the SOPAS Inspector” on page 93 for details about the configuration.

Input Settings

All digital inputs (In1, In2, In3 and In4) have the same meaning on the Inspector I20 as on the Inspector I10. Please refer to the section “28.1 Input settings – Inspector I10” on page 69 for details about these settings.

Enable external object selection

If the I/O extension box is used, the four digital inputs on the I/O extension box can be used for external object selection. This allows the possibility to externally select all 16 learned objects even when using the internal digital inputs of the Inspector I20, for instance for encoder or external image trig.

Select the digital inputs to use for external object selection using the radio buttons:

- ... using inputs pins
- ... using I/O extension box

External object selection setup

It is possible to select up to 16 different reference objects using the input signals on the Inspector. The number of selectable reference objects is depending on if the input signals are used for other purposes, and if the I/O extension box is used.

If the internal digital inputs are used, connect a selector, PLC, or other device to pins 3 (In3), 5 (In2), 8 (In1), and/or 10 (In 4). If the I/O extension box is used, the selector or PLC shall be connected to the pins of the I/O extension box.

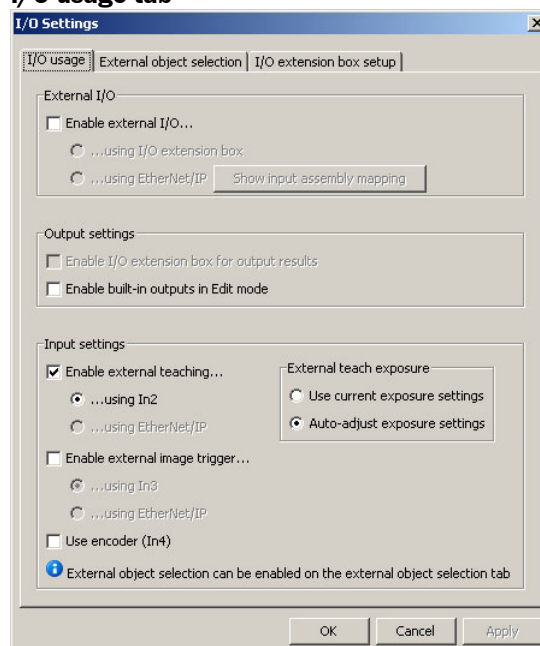
For more information see section “14.4 Select Reference Objects with Inputs” on page 41.

I/O extension box setup

The configuration of the I/O extension box is described in the appendix “37 Using the I/O extension box” on page 92.

28.3 I/O Settings – Inspector I40

To change the use of inputs and outputs, choose **I/O Settings** from the **InspectorI40** menu.

I/O usage tab**External I/O**

To use additional inputs and outputs beside the ones built-in, select **Enable external I/O...**, and use the radio buttons to specify whether an external **I/O extension box** or **EtherNet/IP** will be used.

When EtherNet/IP is used, click **Show input assembly mapping** to show the structure of the Input assembly for the currently active reference object.

Output settings

When using an I/O extension box, you can select to disable the outputs on the box, for example for performance reasons.

To have the Inspector to provide outputs on the built-in digital outputs in **Edit** mode, select **Enable built-in outputs in Edit mode**. To deactivate the built-in output signals, deselect **Enable built-in outputs in Edit mode**.

The digital outputs on the Inspector I40 are always available in **Run** mode.

Important

The I/O extension box must be configured before the digital outputs of the box can be used. This configuration is performed using the **I/O extension box setup** tab. Please refer to “37.3 Setup of the I/O extension box in the SOPAS Inspector application” on page 93 for details about the configuration.

Input settings

The built-in digital inputs (In1, In2, In3 and In4) are used for the same functions on the Inspector I40 as on the Inspector I10. Please refer to the section “28.1 Input settings – Inspector I10” on page 69 for details about these settings.

To use EtherNet/IP instead of the built-in inputs for activating external teach or triggering images, select **...using EtherNet/IP** instead of **...using In2/In3**.

External object selection tab

Value	Reference objects	In1	In2	In3	In4
0	None	0	-	0	-
1	None	1	-	0	-
2	None	0	-	1	-
3	None	1	-	1	-

To use inputs to select reference object to use for the inspections, select **Enable external object selection...** on the **External object selection** tab.

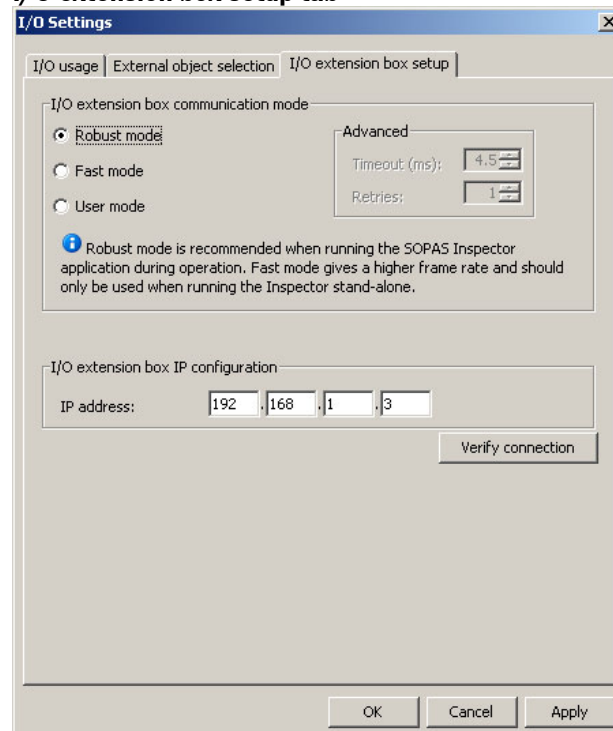
You can use either the Inspector's built-in inputs or external inputs - on the I/O extension box or via EtherNet/IP, depending on the setup.

With the built-in inputs it is possible to select up to 16 different reference objects. The actual number of selectable reference objects depends on if the input signals are used for other purposes.

To select more than 16 reference object, you must use either an I/O extension box with 5 inputs or EtherNet/IP.

If the built-in inputs are used, connect a selector, PLC, or other device to pins 3 (In3), 5 (In2), 8 (In1), and/or 10 (In 4) on the Inspector. If the I/O extension box is used, the selector or PLC shall be connected to the pins of the I/O extension box.

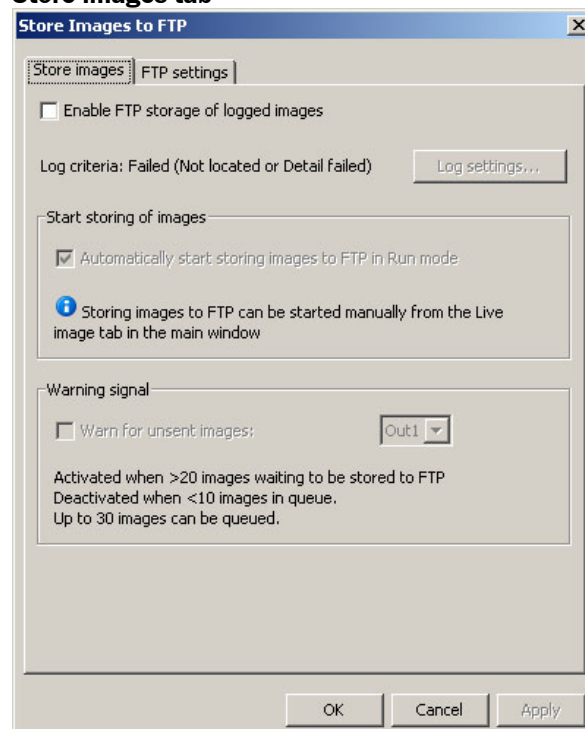
For more information see section “14.4 Select Reference Objects with Inputs” on page 41, or section “15.3 Control the Inspector via EtherNet/IP” on page 43.

I/O extension box setup tab

The configuration of the I/O extension box is described in the appendix “37 Using the I/O extension box” on page 92.

29 Store Images to FTP

The Inspector I40 can store inspected images to a remote FTP server while running. To store images to an FTP server, choose **Store Images to FTP** from the **InspectorI40** menu.

Store images tab

To start storing images to FTP, select **Enable FTP storage of logged images**. The type of images that the Inspector will store is displayed below this setting.

Clicking **Log settings...** will display the **Log settings** dialog box, in which you can change the type of images that will be stored (see section “30.2 Log Settings – Inspector I” on page 75.)

To automatically start storing images when the Inspector is switched to **Run**, select **Automatically start storing images to FTP in Run mode**. Storing can also be started and stopped in **Run** mode from the **Live image** tab.

To make the Inspector signal if there are too many images waiting to be stored, select **Warn for unsent images** and choose which digital output to use for the warning.

The polarity of the warning signal is always active high (+24 V) and is not affected by the **Invert output signals** setting in the **Output settings** tab.

FTP settings tab

The screenshot shows a dialog box titled "Store Images to FTP" with a close button (X) in the top right corner. Inside the dialog, there are two tabs: "Store images" and "FTP settings", with "FTP settings" being the active tab. The "FTP configuration" section contains four input fields: "FTP address:" with IP address components (192, 168, 1, 1), "Port:" with the value 21, "User name:" with the value "test", and "Password:" with masked characters "****". Below these fields is a "Test connection" button. The "File names and folder" section contains a text field "Store images in folder:" with the value "myfolder2". Below this field is a note: "(folder will be created in FTP root)". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Apply".

In the FTP settings tab the FTP configuration is setup:

FTP Address	The IP address of the FTP server.
Port	The port number of the FTP server.
User name	The user name for the FTP server.
Password	The password for the user of the FTP server.

The **Test connection** button will test if the FTP connection is working using the current settings.

It is also possible to name a folder where the images will be stored on the FTP server.

Note

The folder will always be created relative the user's FTP root. Only characters "A..Z", "a..z", and "0..9" are allowed in the folder name, that is hierarchical folder names cannot be used.

30 Log Settings

30.1 Log Settings – Inspector I10/I20

To change which type of images the Inspector should log, choose **Log settings** from the **Inspector** menu and select **Log all images** or **Log failed images only**.

Log all images	Every inspected image.
Log failed images only	Images where one or more detailed inspections failed (that is, were performed but did not pass). Images where no object was located are also logged, but only when the current reference object does not have any detailed inspections, or when the inspections are externally triggered. For instance, in free running mode and using a locator and detailed inspections images in the log will be images that are located and where a detailed inspection fails. But in triggered mode the log will also contain images where the locator fails.

30.2 Log Settings – Inspector I40

To change which type of images the Inspector should log, choose **Log settings** from the **InspectorI40** menu. The following options are available:

All	Every inspected image.
Passed	Images where the object was located and all detailed inspections passed (if any). When the Inspector inspects without locator, images with all detailed inspections passed will be logged.
Located	Images where the object was located, regardless of whether any detailed inspection passed or failed. When the Inspector inspects without locator, no images will be logged.
Detailed failed	Images where one or more detailed inspections failed (that is, were performed but did not pass). When the Inspector is only locating without making detailed inspections, no images will be logged.
Failed (Not Located or Detail failed)	Images where either no object was located, or where one or more detailed inspections failed.

31 Device Info

To see information about the current device, select **Device info** from the **Inspector** menu. The **Device info** dialog box is displayed, with two different tabs.

- General
- Network

General

Here you can see the following information about the device:

Name	The name of the current Inspector (device). The name can be changed. The name appears next to the Inspector menu and also in the Connection Wizard.
Serial no	The serial number of the current Inspector (device).

While connected to an Inspector I10 the following information is also available:

Application	Application Firmware version.
FPGA	FPGA Firmware version.
Monitor	Monitor Firmware version.

While connected to an Inspector I20/I40 this information is instead available in the **About Inspector** dialog box from the **Help** menu.

Save System Dump

To save the contents of the memory of the Inspector, click on the **Save system dump...** button. Select the directory where to save the dump. This is only used for support provided by SICK.

Network

Here you can see the following information about the network:

TCP/IP	The network configuration type; DHCP or Manually.
IP address	The IP address and port of the current Inspector (device).
Netmask	The netmask of the current Inspector (device).
Gateway	The gateway address for the network.
Network speed	The network speed for the current network connection.
MAC address	The MAC address or the Ethernet ID for the network card in the Inspector.

32 Menus and Tool bar

32.1 File Menu

New

The menu option **Connect to Device...** on the **New** submenu starts the Connection Wizard where it is possible to connect to a new Inspector device, for more information see “6.3 Connection Wizard” on page 22.

Open Device File

The menu option **Open Device File** opens a saved file. The PC application will try to connect to the Inspector for which the file was saved.

Save Device File

The menu option **Save Device File** saves the device data in the current file. For more information about device data, see section “16 Handle Device Data (Settings)” on page 44.

Save Device File As...

The menu option **Save Device File As** saves the device data in a file with a new name. For more information about device data, see section “16 Handle Device Data (Settings)” on page 44.

Close Device File

The menu option **Close Device File** closes the current file.

Exit

The menu option **Exit** closes the device file and exits the PC application.

32.2 Edit Menu

Undo/Redo

The **Undo** and the **Redo** menu options are not used in **SOPAS Inspector**.

Load Device Data to Device...

The **Load Device Data to Device...** menu option is used to load device data to an Inspector. For more information see section “16.4.1 Load Device Data to Device Wizard” on page 45.

32.3 Inspector Menu

This menu is named **InspectorI10**, **InspectorI20**, or **InspectorI40** in the **SOPAS Inspector** depending on the type of the Inspector that is currently used.

InspectorI10 (Bailey)
Run
Record Live Images
Input Settings...
Device Info...
Set Password...
Log Settings ▶
Save Settings in Flash
Restore Settings ▶

InspectorI20 (Gadget)
Run
Record Live Images
I/O Settings...
Output Expression Editor...
Device Info...
Set Password...
Log Settings ▶
Save Settings in Flash
Restore Settings ▶

InspectorI40 (Morse)
Run
Record Live Images
I/O Settings...
Output Expression Editor...
Device Info...
Set Password...
Log Settings...
Store Images to FTP...
Save Settings in Flash
Restore Settings ▶

Run

To switch the Inspector to **Run** mode:

1. Choose **Run** from the **Inspector** menu. A warning dialog box is displayed if any settings have been changed.
2. Click **Yes** to save the new settings in the Inspectors Flash memory. Click **No** to discard changes.

Edit

To switch the Inspector to **Edit** mode, choose **Edit** from the **Inspector** menu.

Record Live Images

To save a stream of live images to file on the disk drive on the PC:

1. Choose **Record live images** from the **Inspector** menu.
2. Select the directory where the images will be saved.
3. To stop saving images to file, click on the **Stop** button.
The images are saved as bitmap (BMP) files. The name of the files is numeric, starting on 0.

Input Settings (I10)

To view or change input settings, choose **Input settings** from the **Inspector** menu. For more information about Input settings, see section “28.1 Input settings – Inspector I10” on page 69.

I/O Settings (I20/I40)

To view or change input and output settings, choose **I/O settings** from the **Inspector** menu. For more information about input and output settings, see section “28.2 I/O settings – Inspector I20” on page 70 or section “28.3 I/O Settings – Inspector I40 on page 71.

Output Expression Editor (I20/I40)

The Output expression editor can be directly accessed from the **Output Expression Editor** item on the **Inspector** menu, see section “25.2 Output settings – Inspector I20/I40” on page 64.

Device Info

To see information about the current device, choose **Device info** from the **Inspector** menu. The **Device info** dialog box is displayed, with two different tabs.

- General
- Network

See Chapter “31 Device Info” on page 75 for more details.

Set Password

To change the current password in the Inspector for user level **Maintenance** (used for **Edit** mode), choose **Set Password** from the **Inspector** menu. The **Login** dialog box is displayed.

Enter current password (default password is **Inspector**). Select user level **Maintenance**. Enter new password and re-enter new password. Click **OK**.

To remove password protection of **Edit** mode (user level **Maintenance**), set the password to the default password **Inspector**.

For more information about user levels and password, see section “Login Device” on page 79.

Log Settings

To select which types of images that should be logged, choose **Log Settings** from the **Inspector** menu. The log settings are described in chapter “30 Log Settings” on page 75.

The 30 most recent images of the specified type are saved in the log. The images can be viewed in the **Logged images** tab.

Store images to FTP (I40)

To store inspected images to a remote FTP server, choose **Store images to FTP** from the **InspectorI40** menu. See Chapter “17 Log and Save Images” on page 45 for more information.

Save settings in Flash

To save all device data (settings) in the Inspector's Flash memory, choose **Save Settings in Flash** from the **Inspector** menu. A progress bar is displayed during the process. The Inspector will stop inspecting until the Flash memory is updated. For more information about device data (settings), see section “16 Handle Device Data (Settings)” on page 44.

Restore Settings

It is possible to restore settings and return to the factory settings from the Inspectors Flash memory. All device data will be deleted. To restore settings choose **Restore Settings** from the **Inspector** menu. For more information about device data (settings), see section “16 Handle Device Data (Settings)” on page 44.

32.4 Communication Menu

Connection Wizard

To use the **Connection Wizard**, see section “6.3 Connection Wizard” on page 22.

Go Online

The option **Go Online** establishes a communication with the Inspector and synchronizes device data. Synchronization means that the device data in the Inspector is the same as shown in the PC application.

Go Offline

The option **Go Offline** disconnects the connection to the Inspector. The Inspector will automatically enter **Run** mode. It is not possible to change settings during offline state.

Download all Parameters to Device

Download all Parameters to Device loads a device file to the connected Inspector. The Inspector is automatically synchronized with the PC application, so this option is normally never used.

Upload all Parameters from Device

Upload all Parameters from Device reads in all device data of the connected Inspector into an open device file. The Inspector is automatically synchronized with the PC application, so this option is normally never used.

Switch to Simulated Device

When you are connected to an Inspector it is possible to make an easy switch to the simulated device. To switch, choose **Switch to Simulated Device**. All device data is now copied from the Inspector to the simulated device. The settings can now be altered and tested without interfering with the production. When finished, choose **Switch to Physical Device**, to return to the Inspector. If the settings have been changed, choose if you want to use the new settings from the simulated device or the old settings in the Inspector.

Note

This option is only available if you are connected to a physical device (Inspector).

If you want to use images from the production in the simulated device, use the **Record Live Images** option from the **InspectorI10** (or **InspectorI20/InspectorI40**) menu, to record some images before you switch to simulated device. Alternatively, for Inspector I40, use the **Store Images to FTP** function to save inspected images from production that later can be used for the simulated device.

Switch to Physical Device

To return to the Inspector (physical device) from the simulated device, choose **Switch to Physical Device**.

Note

This option is only available if you were connected to a physical device (Inspector) and selected **Switch to Simulated Device**. The PC application will remember which Inspector you were connected to and try to reconnect.

32.5 View Menu**Context Help**

The **Context Help** is a context sensitive help referring to the current menu of the configuration bar in focus. It appears if activated on the left hand side in the PC application. If **How-to Help** is open **Context Help** appears on the bottom of the left part of the PC application.

How-to Help

The **How-to Help** gives specific information about the device. It appears if activated on the left hand side of the tool. If **Context Help** is open, **How-to Help** appears on the top of the left part of the PC application.

Configuration Bar

The **Configuration Bar** option shows or hides the different tabs (Image settings etc) on the right side of the window.

32.6 Tools Menu**Login Device**

There are two user levels for communication with the Inspector. Access and password can be set for each Inspector.

The following user levels are available:

- **Operator** – Machine operator (no password), default state and automatically used when entering **Run** mode.
- **Maintenance** – Maintenance staff (password possible), automatically used when entering **Edit** mode. When the default password (*Inspector*) is used, no password has to be entered when switching to **Edit** mode. If you want to protect the **Edit** mode with a password, choose **Set Password** from the **Inspector** menu, see section “32.3 Inspector Menu” on page 77.

Further alternative user levels are only intended for service purposes by SICK AG.

Logout Device

The **Logout Device** resets the user level to the lowest level: **Operator**.

Options

Language	Changes the language of the PC application. To make the change effective the PC application has to be restarted.
Unit System	The unit of shown values can be changed between metric , imperial (UK) and imperial (US) .
Reset button	The Reset button resets the tool (not the Inspector) to default settings.

32.7 Help Menu**Help**

The **Help** option opens the help system in a separate window.

Info

Info provides general information about the PC application.

About Inspector (Inspector I20/I40)

About Inspector provides general information about,

User Interface	User Interface version.
Application	Application Firmware version.
FPGA	FPGA Firmware version.
Monitor	Monitor Firmware version.

32.8 Tool Bar

Button	Name	Description
	Connect to Device...	Starts the Connection Wizard where it is possible to connect to a new Inspector device.
	Open Device File	The button Open Device File opens a saved file.
	Save Device File	The button Save Device File saves the parameter settings in the open file.
	Save Device File As	The button Save Device File As saves the parameter settings in a new file.
	Login Device	The button Login Device lets you change user level on the current Inspector.
	Logout Device	The button Logout Device resets the user level to the lowest level: Operator .
	Undo	Not used.
	Redo	Not used.
	Help	The button Help opens the help system in the default web browser.

32.9 Status bar

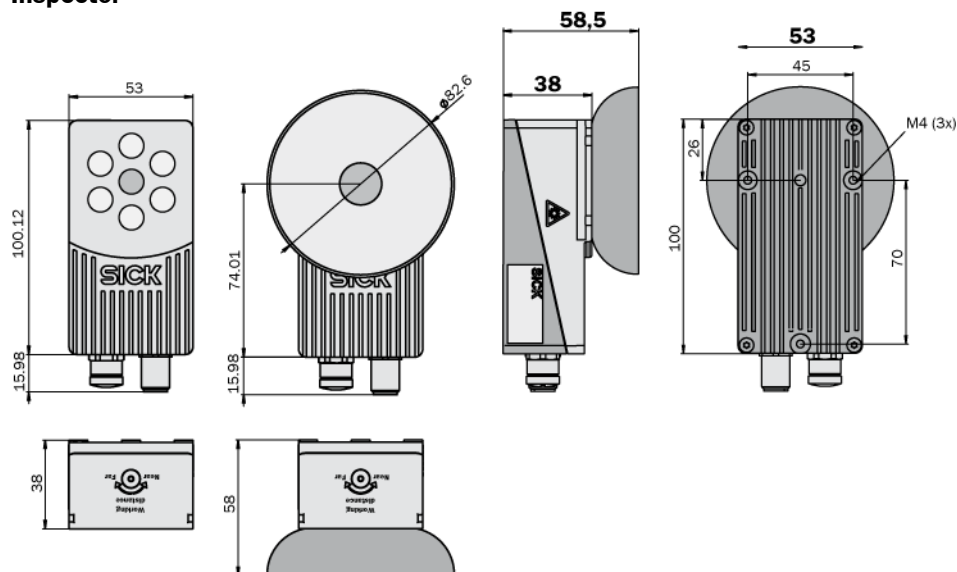
Item	Description
	The logged in user's User level.
	Type and name of the current Inspector.
	IP address and port number of the connected Inspector.
	Status (online/offline) of the device.
	Status (synchronized/not synchronized) of the Inspector. Always synchronized for the Inspector.
	Download mode (immediately/on demand). Always Download Immediately for the Inspector.
	Progress bar (save, upload or download)

Appendices

33 Technical Data

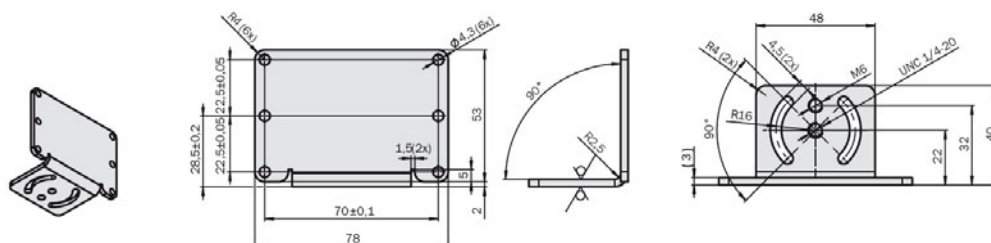
33.1 Drawings and Measurements

Inspector

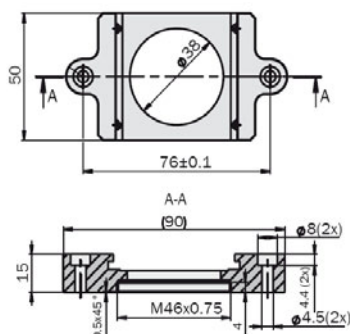


Brackets

Inspector angle bracket



Inspector light/filter adapter



33.3 LED description



Inspector – LED description			
LED	Mode	Color	Description
Data	All	Yellow	Ethernet Data
Link	All	Green	Ethernet Link
Function	Run/Edit	Blue	Not located
		Red	Detail failed
		Green	All passed
		Off	No inspection
	External teach	Flashing	Image focus. Higher frequency means better focus.
		Green	No motion in field of view
		Blue	Motion in field of view
		White	Device data is stored in Flash memory
	Anytime	Red, slow flashing	Fatal error
On	All	Green	Power On

33.4 Technical Specifications

		VSP1R111 - I10 Standard	VSP1D111 - I10 Dome	VSP12F111 - I20 Flex	VSP12D111 - I20 Dome	VSP12F121 - I20-UV Flex	VSP12F141 - I20-IR Flex	VSP14F2111 - I40 Flex	VSP14F2311 - I40-LUT Flex	VSP14F2411 - I40-IR Flex
Working distance	50 ... ∞ mm	x	x	x	x	x	x	x	x	x
Working distance, internal illumination	50 ... 200 mm	x		x		x	x	x	x	x
	50 mm		x		x					
Field of view, internal illumination	20x20 ... 72x72 mm ²	x		x		x	x			
	30x30 mm ²		x		x					
	22 x 15 ... 79x58 mm ²							x	x	x
Optics	Fixed	x	x		x					
	Exchangeable			x		x	x	x	x	x
Performance										
- Max	250 fps	x	x	x	x	x	x	x	x	x
- Typical	40 fps	x	x	x	x	x	x			
- Typical	50 fps							x	x	x

		VSP1R111 - I40 Standard	VSP1D111 - I40 Dome	VSP1-2F111 - I20 Flex	VSP1-2D111 - I20 Dome	VSP1-2F121 - I20-UV Flex	VSP1-2F141 - I20-IR Flex	VSP1-4F211 - I40 Flex	VSP1-4F231 - I40-LUT Flex	VSP1-4F241 - I40-IR Flex
Toolset	Object locator	x	x	x	x	x	x	x	x	x
	Pixel count, Edge pixel count, Contour	x	x	x	x	x	x	x	x	x
	Pattern							x	x	x
Number of inspections	32 regions	x	x	x	x	x	x	x	x	x
Reference images	16 objects	x	x	x	x	x	x			
	32 objects							x	x	x
Offline support	Emulator	x	x	x	x	x	x	x	x	x
Production control										
- Operator interface	SOPAS, Viewer	x	x	x	x	x	x	x	x	x
- Data store and retrieve	30 images device log	x	x	x	x	x	x	x	x	x
	Record images on PC	x	x	x	x	x	x	x	x	x
	Store images to FTP							x	x	x
- PLC communication	EtherNet/IP							x	x	x
- I/O Box extension	4x inputs for object selection			x	x	x	x			
	5x inputs for object selection							x	x	x
	16x outputs			x	x	x	x	x	x	x
Resolution	384×384 pixels	x	x	x	x	x	x			
	640×480 pixels							x	x	x
Light source	White ring light, 6x High-Power LEDs	x		x				x		
	White Dome light		x		x					
	UV ring light, 385 nm					x			x	
	IR ring light, 850 nm						x			x
LED class	Risk group 1 (low risk, IEC62471:2006)	x	x	x	x	x		x	x	
	Risk group 0 (low risk, IEC62471:2006)						x			x
Spectral response	Approx. 400 ... 750 nm	x	x	x	x			x	x	
	Near UV < 400 nm					x				
	Approx. 370 ... 900 nm						x			x
Supply voltage	24 VDC ±20%	x	x	x	x	x	x	x	x	x
- Ripple	< 5 Vpp	x	x	x	x	x	x	x	x	x
- Current consumption	< 450 mA, without load	x	x	x	x	x	x	x	x	x
Digital outputs	3 outputs 24 V (B-type)	x	x	x	x	x	x	x	x	x
- Output current	100 mA	x	x	x	x	x	x	x	x	x
- Default outputs	No object detect, all pass, any fail	x	x	x	x	x	x	x	x	x
- Configurable outputs	Output by logical expressions			x	x	x	x	x	x	x

		VSP1R1111 - I10 Standard	VSP1-1D1111 - I10 Dome	VSP1-2F1111 - I20 Flex	VSP1-2D1111 - I20 Dome	VSP1-2F1121 - I20-UV Flex	VSP1-2F1141 - I20-IR Flex	VSP1-4F2111 - I40 Flex	VSP1-4F2311 - I40-LUT Flex	VSP1-4F2411 - I40-IR Flex
	Store images to FTP overflow							x	x	x
Control of external light	5 V TTL	x	x	x	x	x	x	x	x	x
Digital inputs	4 inputs 24 V	x	x	x	x	x	x	x	x	x
- Configurable inputs	External trigger, encoder, external teach, reference object selection	x	x	x	x	x	x	x	x	x
- Max encoder frequency	40 kHz	x	x	x	x	x	x	x	x	x
Interface	100 Mb Ethernet	x	x	x	x	x	x	x	x	x
Ambient temperature (1)	Operation: 0 °C ... 45 °C	x	x	x	x	x	x	x	x	x
	Storage: -20 °C ... 70 °C	x	x	x	x	x	x	x	x	x
Housing material	Aluminum	x	x	x	x	x	x	x	x	x
- Window material	PMMA (plastic)	x	x	x	x		x	x		x
	Glass					x			x	
Weight	350 g	x		x		x	x	x	x	x
	400 g		x		x					
Enclosure rating	IP67	x	x	x	x	x	x	x	x	x
Mechanical shock load	EN 60068-2-27	x	x	x	x	x	x	x	x	x
Vibration load	EN 60068-2-6	x	x	x	x	x	x	x	x	x
Device specific accessories (2)										
- Lenses, focal length	4.3 mm			x		x	x			
	6 mm			x		x	x	x	x	x
	10 mm			x		x	x	x	x	x
	16 mm			x		x	x	x	x	x
- Glass front filters (3)	Red (> 588 nm)			x			x	x		x
	Green (544 ± 53 nm)			x				x		
	Blue (468 ± 62 nm)			x				x		
	IR (>730 nm)						x			x
- Dome	Optimal for 50 mm working distance			x			x	x		x
- I/O extension box	4 inputs, 8 outputs			x	x	x	x	x	x	x
- I/O module	2 extra digital inputs							x	x	x
	8 extra digital outputs			x	x	x	x	x	x	x
Viewer	Live image/log/statistics view and reference object change	x	x	x	x	x	x	x	x	x

(1) Rel. Humidity: 35 ... 85%, 95% at storage. (2) Full accessory list at www.sick.com.

(3) > 60% transmission.



33.5 Accessories Ordering information

Type	Order no.
Inspector angle bracket	2045167
Inspector light/filter adapter	2045397
Inspector universal adapter ¹	2045400
Universal arm ¹	2029022
Lens focal length 4.3 mm	2049491
Lens focal length 6mm	2049668
Lens focal length 8mm	2056692
Lens focal length 10mm	2049415
Lens focal length 16 mm	2049418
Inspector Flex Color filter, red	2050675
Inspector Flex Color filter, green	2050677
Inspector Flex Color filter, blue	2050676
Inspector Flex visible block filter (> 730 nm)	2061248
Inspector Flex Dome	2050678
I/O extension box (4 inputs, 8 outputs)	6037654
I/O module, 2 extra digital inputs	6039038
I/O module, 8 extra digital outputs	6037750
Front window, Inspector flex (glass)	2052266
Front window, Inspector flex (PMMA)	2050690
Tool, front window Inspector flex	2050703

¹Inspector universal adapter and Universal arm is used in combination and therefore must be ordered together.

For a complete list of accessories for the Inspector, including cabling and external lightings, please visit www.sick.com.

33.6 What's included – Inspector I10

The boxed version of the Inspector I10 includes:

- Inspector I10 (Standard or Dome)
- product installation CD including user documentation in PDF format
- printed Quickstart
- 2 mm hex key
- two focused stickers

Languages: English, French, Italian, German, Spanish, and Chinese (simplified).

33.7 What's included – Inspector I20

The boxed version of the Inspector I20 includes:

- Inspector I20 (Flex or Dome)
- product installation CD including user documentation in PDF format
- printed Quickstart
- 2 mm hex key
- Tool for exchange of lens (Flex only)
- two focused stickers

Languages: English, French, Italian, German, Spanish, and Chinese (simplified).

33.8 What's included – Inspector I40

The boxed version of the Inspector I40 includes:

- Inspector I40 Flex
- product installation CD including user documentation in PDF format
- printed Quickstart
- 2 mm hex key
- Tool for exchange of lens and color filters
- two focused stickers

Languages: English, French, Italian, German, Spanish, and Chinese (simplified).

33.9 System Requirements

Windows XP Professional (Service Pack 2), Windows Vista Business Edition (32/64bit) service pack 1, or Windows 7 (32/64bit)

Pentium III 550MHz or higher

For simulated device mode a Pentium 4 2.5GHz or higher should be used

512 MB of RAM (recommended 1024 MB)

1024 x 768 or higher screen resolution, minimum 256 colors (recommended 65536 colors)

CD-ROM drive

450 MB free hard disk space

Ethernet: 100MBit/s recommended

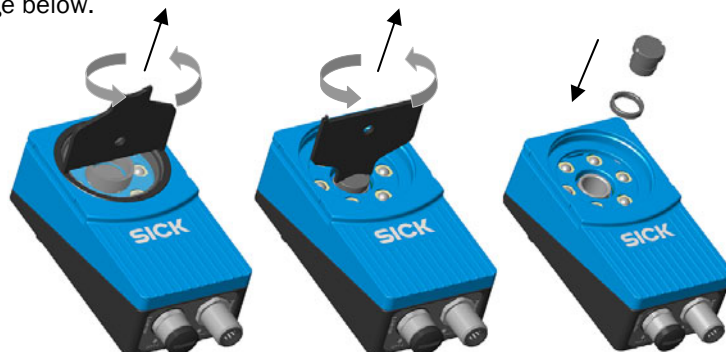
Recommended FTP servers to use with Store images to FTP: Filezilla, Microsoft IIS

34 Changing the lens

It is possible to change the lens on Inspectors with Flex housings (available for Inspector I20 and I40) in order to have a different working distance and field of view. A special tool is required to open the front window of the Flex housing, and to replace the standard lens. The tool is delivered in the Inspector Flex package.

To replace the standard lens of the Flex housing:

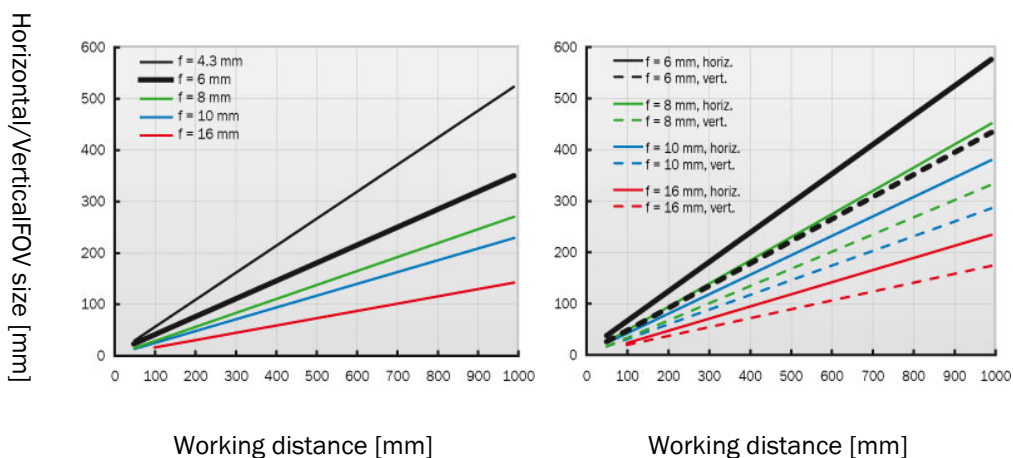
1. Open the front window of the Flex housing using the large end of the supplied tool. See the left image below.
2. Remove the standard lens by using the small end of the tool. See the middle image below.



3. Attach the new lens. Depending on the focal distance of the lens, and the working distance, one or more distance rings may be necessary. Refer to the table below for the correct number of distance rings to use.

Theoretical FOV size (384x384 pixels)

Theoretical FOV size (640x480 pixels)



Lens	Distance ring	Working distance
Focal length 16 mm	Black (3 mm) + Silver (1.5 mm)	100 mm – 140 mm
	Black (3 mm)	140 mm – 600 mm
	Silver (1.5 mm)	600 mm – ∞
Focal length 10 mm	Silver (1.5 mm)	50 mm – 120 mm
	None	120 mm – ∞
Focal length 8 mm	Silver (1.5 mm)	50 mm – ∞
Focal length 6 mm	None	50 mm – ∞
Focal length 4.3 mm	Black (3 mm)	50 mm – ∞

4. Attach the front window again to the Flex housing.

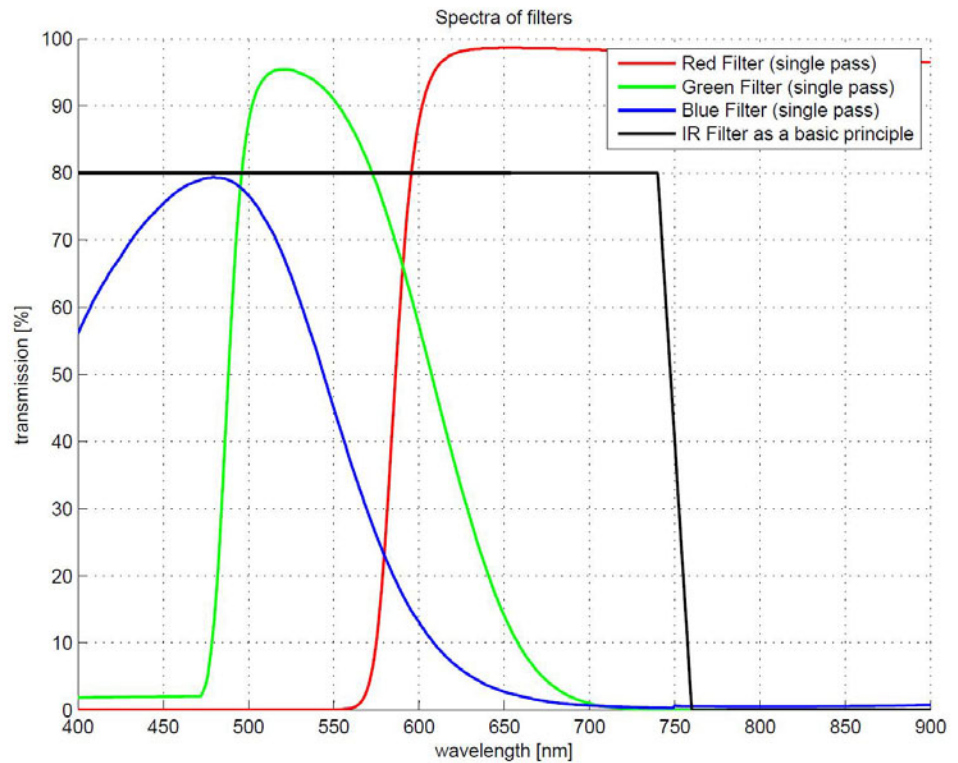
After replacement, both the lens and the front window must be securely fastened so that there is no risk of them falling off during operation.

Important:

- To keep IP 67 classification, open and close the front window only with the supplied tool. Make sure that the seal fits properly.
- To avoid damages, only Inspector accessory lenses offered by SICK must be used.
- Minimize the risk of getting dust into the device by changing the lenses in a dust-free environment. Do not keep the device without the front window. Wipe off the front window before you open it.

35 Mounting Color filter accessories

On Inspectors with Flex housings (available for Inspector I20 and I40) it is possible to replace the front window with a front glass filter accessory in order to handle multicolored objects. Available filters are red, green, and blue. Refer to the graph below for the transmission characteristics of the three different filters.



The right edge of the red filter is limited by the internal IR-filter of the Inspector.

The color filters can be used both with internal and external illumination. Please note that the transmission of the filters is only shown for single pass. For the internal illumination the overall transmission is lower because of the double passing.

A special tool is required to open the front window of the Flex housing and to mount the color filters. The tool is delivered in the Inspector Flex package.

To replace the front window with a front glass color filter:

1. Open the front window of the Flex housing using the large end of the supplied tool. See the left image below.



2. Attach the front glass color filter to the Flex housing by using the supplied tool.

After replacement, front glass color filter must be securely fastened so that there is no risk of them falling off during operation.

Important:

- To keep IP 67 classification, open and close the front window only with the supplied tool. Make sure that the seal fits properly.
 - To avoid damages, only Inspector Flex color filter accessories offered by SICK must be used.
 - Minimize the risk of getting dust into the device by changing the lenses in a dust-free environment. Do not keep the device without the front window. Wipe off the front window before you open it.
 - Note that the color filters are made of glass, whereas the standard front window is plastic.
-

36 Mounting the Dome accessory

On Inspectors with Flex housings (available for Inspector I20 and I40) it is possible to replace the front window with a Dome lighting. The Dome lighting diffuses the internal illumination in order to improve performance when working with glossy objects. This is the same Dome that is used in the Inspector I10 Dome and Inspector I20 Dome.

When using a Dome lighting, the following combination of lens and working distance is optimal:

Model (with Flex housing)	Lens	Working distance
Inspector I20	4.3mm	50mm
Inspector I40	6 mm	50mm

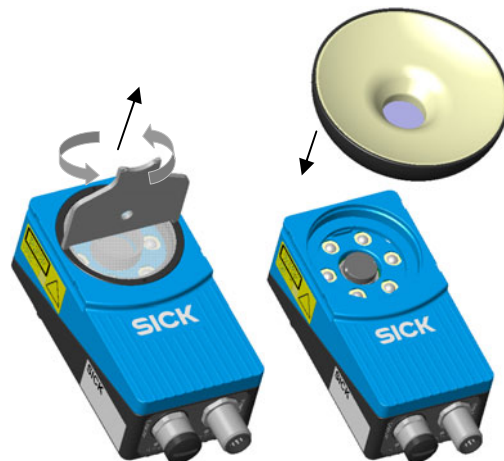
Depending on the object being inspected other working distances may also work well. For example objects with flat and less glossy surfaces could possibly be inspected at a larger distance.

Also narrower lenses can be used, for example using a 10mm lens for Inspector I40, with the effect that the FOV is correspondingly decreased.

A special tool is required to open the front window of the Inspector. The tool is delivered in the Inspector Flex package.

To replace the front window with the Dome:

1. Open the front window of the Flex housing using the large end of the supplied tool. See the left image below.



2. Attach the Dome to the Flex housing by hand.

After replacement, the Dome must be securely fastened so that there is no risk of it falling off during operation.

Important:

- To keep IP 67 classification, open and close the front window only with the supplied tool. Make sure that the seal fits properly.
- To avoid damages, only the Inspector Flex Dome accessory offered by SICK must be used.
- Minimize the risk of getting dust into the device by changing the lenses in a dust-free environment. Do not keep the device without the front window. Wipe off the front window before you open it.

37 Using the I/O extension box

The Inspector I20/I40 can be connected to an I/O extension box that increases the number of digital inputs and outputs. The I/O Extension box is available as an accessory from SICK, see “33.5 Accessories Ordering information” on page 86 for details. This section covers how the I/O extension box is connected to the Inspector I20/I40, and how it shall be configured.

The following basic steps are required to use the I/O extension box with the Inspector I20/I40. Details about the steps are found in the subsequent sections.

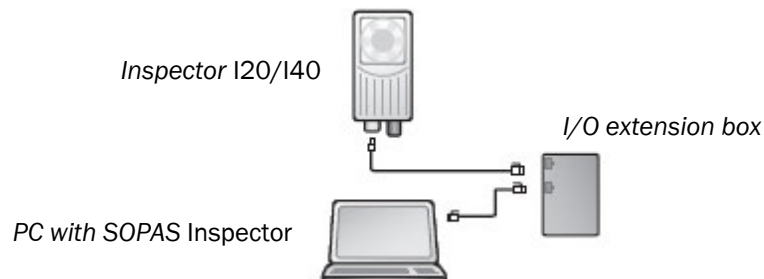
1. Connect the I/O extension box to the network.
2. Configure the IP address of the I/O extension box to match the settings of the network, and the Inspector I20/I40.
3. Enter the IP address of the I/O extension box in the **SOPAS Inspector** application.
4. Activate the inputs and/or outputs on the I/O extension box depending on the application.

Note

The SOPAS Inspector application should be closed or set to offline when the power to the I/O box is disconnected. The I/O extension box needs to be restarted if the IP address is changed or if the connections to the inputs and output on the box are changed.

37.1 Physical network connection

To minimize network latency, it is recommended that the I/O extension box is connected directly to the Inspector I20/I40. The I/O box has a network switch so that the PC running the **SOPAS Inspector** application can be connected via the I/O box.



37.2 Configuration of the IP address on the I/O extension box

This section briefly describes how to configure the I/O extension box for operation with the Inspector I20/I40. For details, please refer to the user manual delivered with the I/O extension box.

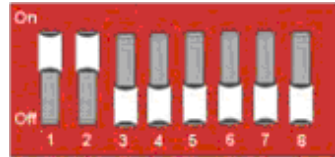
The IP address of the I/O extension box must be compatible with the addresses of the Inspector I20/I40 and of the PC. For details of how to set and view the address of the Inspector I20/I40, please refer to “20 Manage Network Address” on page 52.

The following is an example of how the IP addresses can be configured for the Inspector I20/I40, the I/O box and the PC.

Inspector I20/I40	I/O extension box	PC
192.168.1.110	192.168.1.3	192.168.1.30

Basic configuration of the IP address

The address selection switch on the I/O extension box configures the host part of the IP address, that is, the last of the four parts of the IP address. By default, the first three parts of the address (also known as the network address) are set to 192.168.1. If the switch is set to a value other than 0 (all switches set to **Off**) or 255 (all switches set to **On**), the I/O extension box will use the host part of the IP address assigned by the switch.

Example:

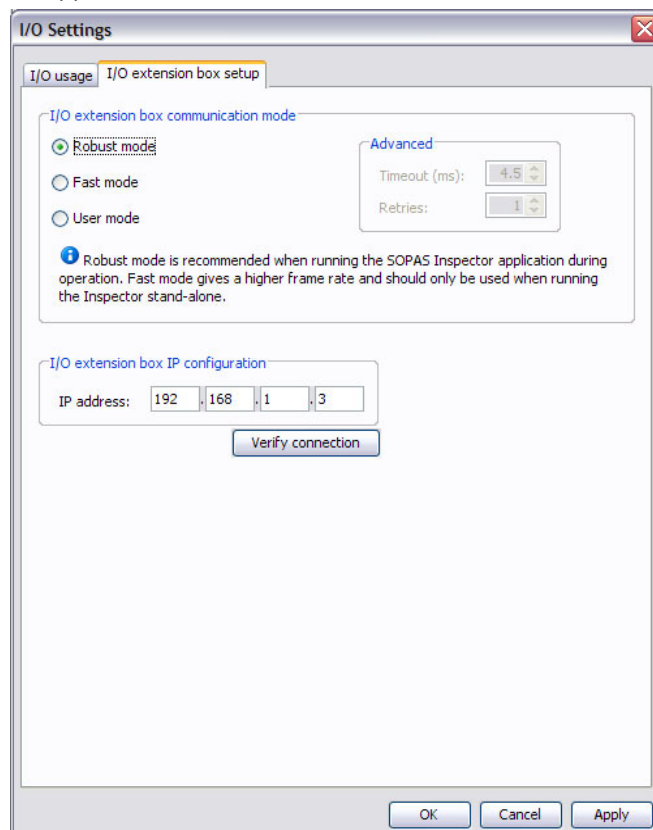
The setting above configures the I/O extension box to have a host ID of 3 corresponding to the binary value “00000011” where switch 1 is bit0 (LSB) and switch 8 is bit7 (MSB). The I/O box will then have an IP address of 192.168.1.3.

Advanced configuration of the IP address

If the network part of the IP address must be changed from the default 192.168.1 for the I/O extension box, the internal web server of the I/O extension box can be used. For details please refer to the manual delivered with the I/O extension box.

37.3 Setup of the I/O extension box in the SOPAS Inspector application

The communication with the I/O extension box is setup using the **I/O extension box setup** tab in the **I/O Settings** dialog available on the **InspectorI20/InspectorI40** menu in the **SOPAS Inspector** application.



Communication mode

It is possible to adjust the way that the Inspector I20/I40 is communicating with the I/O extension box. There are three modes available:

- **Robust mode.** This is the default communication mode, and it is the recommended one if the Inspector I20/I40 shall be connected to the **SOPAS Inspector** application during operation.
- **Fast mode.** This mode allows the Inspector I20/I40 to operate at a higher frame rate but there is a risk that some data in the communication with the I/O extension box is lost if there is high load on the network. This mode shall not be used if the Inspector I20/I40 is connected to the **SOPAS Inspector** application during operation.
- **User mode.** This is the advanced communication mode where it is possible to configure the number of retries that the Inspector I20/I40 shall perform, and the timeout for each retry. The timeout is the time (in milliseconds) that the Inspector I20/I40 is waiting for a reply from the I/O extension box for a request to set outputs or read inputs.

IP configuration

To be able to connect to the I/O extension box, the IP address of the I/O extension box must be specified in the **SOPAS Inspector** application.

To specify the IP address of the I/O extension box:

1. Enter the selected IP address of the I/O extension box in the four fields separated with dots.
2. Click **Apply** to store the settings.

Verify Connection

It is possible to verify that the connection to the I/O extension box can be established by clicking the **Verify connection** button. The **SOPAS Inspector** application will then try to connect to the I/O extension box, and a message will be displayed informing if the I/O extension box was found.

Note:

It is possible to configure the Inspector I20/I40 for use with the I/O extension box even when the I/O extension box is not available. As soon as the Inspector I20/I40 detects the I/O extension box on the network, it will connect to it and start using it as configured.

37.4 Enabling the I/O extension box

The use of the inputs and outputs on the I/O extension box is enabled on the **I/O usage** tab of the **I/O settings** dialog available on the **InspectorI20/InspectorI40** menu in the **SOPAS Inspector** application.

37.5 Input and output connections

When delivered, the I/O extension box contains four digital inputs and 8 digital outputs. The digital outputs can be expanded to 16, and in the Inspector I40 the digital inputs can also be extended to five.

Please refer to the manual delivered with the I/O extension box for details on how to connect the power supply to the box, and where to find the digital inputs and outputs.

37.5.1 Special conditions during startup

The following applies if the Inspector I20/I40 is configured to use the inputs of the I/O extension box for object selection:

If the I/O extension box is not available when the Inspector I20/I40 starts up, the Inspector I20/I40 will use the last reference object selected in the **SOPAS Inspector** application before saving to flash. Once the I/O extension box is available, the Inspector I20/I40 will read the inputs of the box, and select the corresponding reference object.

37.5.2 Connection to the I/O extension box lost during operation

If the connection to the I/O extension box is lost during operation, the last status of the inputs on the box will be used until the connection is re-established.

37.5.3 Object selection with I/O extension box

The status of the inputs on the I/O extension box is checked in the end of each inspection cycle. If the Inspector I20/I40 is configured to use external image trig, the status of the external inputs will only be checked when an image trig signal has been received.

37.5.4 Timing issues

The digital outputs on the I/O extension box shall be read at minimum delay time.

37.5.5 Use of the digital outputs for logic

The digital outputs on the I/O extension box are not guaranteed to be jitter-free. It is not recommended to use these outputs for direct control of other devices. The I/O extension box shall be connected to a PLC for process control.

37.5.6 Change of modules in the I/O extension box

The standard configuration of the I/O extension box contains 8 digital outputs and 4 digital inputs. In the Inspector I20/I40 It is possible to extend the box with an additional 8 digital outputs, that is, totally 16 digital outputs. This is done by connecting an additional I/O module (outputs) to the I/O extension box. The I/O module is available as an accessory from SICK, see section "33.5 Accessories Ordering information" on page 86 for details.

Further, in the Inspector I40 it is also possible to extend the number of digital inputs from 4 to 5. This is done by connecting another additional I/O module (inputs) to the I/O extension box. The I/O module is available as an accessory from SICK, see section "33.5 Accessories Ordering information" on page 86 for details.

Perform the following steps to connect and use more I/O modules:

1. Close the **SOPAS Inspector** application.
2. Disconnect the power from the I/O extension box.
3. Connect the additional I/O modules (inputs and/or outputs) to the I/O extension box. Please refer to the manual delivered with the I/O extension box for details.
4. Re-connect the power to the I/O extension box
5. Re-start the **SOPAS Inspector** application.

The additional digital outputs shall now be available in the **SOPAS Inspector** application.

37.6 Troubleshooting**37.6.1 The I/O LED flashes 10 times**

If the power to the I/O extension box has been disconnected for a longer period of time, the internal clock in the box will be reset. The I/O LED on the box will then flash 10 times in red. This is not a serious error, and the I/O extension box can still be used together with the Inspector I20/I40 without any problems.

Instructions on how to set the real-time clock in the I/O box can be found in the manual delivered with the I/O extension box.

37.6.2 No contact with the I/O extension box

Ensure that the network card on the PC has the same network address, for instance 192.168.1, as the I/O extension box. The host part of the IP address (that is the last number in the IP address) must not be the same as for the I/O extension box or the Inspector I20/I40.

There are two tools available in Windows to check the network connection and the IP settings:

- **Ping.** Open the command prompt, and type **ping** followed by the IP address of the I/O extension box. If the I/O extension box is available the following text will be displayed: **Reply from x.x.x.x** (where x.x.x.x is the IP address of the I/O extension box). If the I/O extension box could not be found an error message is displayed, for instance **Request timed out** or **Destination host unreachable**.

Example: ping 192.168.1.3

- **Ipconfig.** Open the command prompt and type **ipconfig**. The current status for the network cards on the PC will then be displayed. Ensure that the network settings are corresponding to the setting for the I/O extension box. The current IP address for the Inspector I20/I40 can be viewed by selecting **Device Info** from the **InspectorI20/InspectorI40** menu.

The web browser on the PC must be configured not to use a proxy when communicating with the web server in the I/O extension box.

37.6.3 High number of unanswered requests to the I/O extension box

The advanced communication mode, User mode, can be used to fine tune the communication with the I/O extension box. It is recommended to try to increase the timeout as a first step, and if this does not work, try to increase the number of retries. Increasing the number of retries will reduce the inspection speed.

If the problem persists even if the timeout and the number of retries have been increased, verify that the network topology does not block the use of UDP packets.

38 EtherNet/IP Reference

EtherNet/IP characteristics:

Vendor ID	808 (SICK)
Device type	12 (Communication adapter)
Product code	0x82
Product name	InspectorI40
Version	1.1
Minimum RPI	> 16 ms

The EDS file for the Inspector can be found in the **Documentation** folder on the **SOPAS Inspector** CD.

38.1 Input Assembly

The Input assembly contains the results from the last inspection made by the Inspector I40, together with current status information.

You can view the structure of the input assembly for the current configuration by choosing **I/O Settings** from the **InspectorI40** menu, and clicking **Show input assembly mapping** in the **I/O Settings** dialog box.

The values used in Current reference object for representing the reference objects can be found in the following places:

- On the **External object selection** tab in the **I/O Settings** dialog box.
- In the input assembly mapping that can be shown (and printed) from the **I/O Settings** dialog box.

Note that this value does not always follow the reference objects' order in the list in the main view.

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Instance ID: 101
Size: 224 bytes

Data	Type	Size	Offset (bytes)	Values
General				
Inspection ID	DINT	4	0	
Status	DINT	4	4	See Status flags
Number of ignored trigs	DINT	4	8	
Number of unsent images in queue	SINT	1	12	
Current reference object	SINT	1	13	0 ... 31: Reference object index 255: No reference objects
Overall result	SINT	1	14	0: Not located 1: Detail failed 2: All passed
Reserved	INT	1	15	
Locator				
Object locator result	SINT	1	16	0: Located 1: Not located 255: Locator not used
Object locator rotation enabled	SINT	1	17	0: Not enabled 1: Enable
Object locator scale enabled	SINT	1	18	0: Not enabled 1: Enable
Reserved	SINT	1	19	
Object locator match score	REAL	4	20	0 ... 100
Object locator estimated rotation	REAL	4	24	$-\pi/2 \dots \pi/2$
Object locator estimated scale	REAL	4	28	0.8 ... 1.2
Detailed inspection n (n = 1...32)		64	32	
Result	SINT	1	$32 + 2 \cdot (n-1)$	0: Fail 1: Pass 2: Outside field of view 255: Inspection not used
Inspection type	SINT	1	$33 + 2 \cdot (n-1)$	0: Contour 1: Pixel counter 2: Edge pixel counter 3: Pattern 255: Inspection not used
Scores for detailed inspection n (n = 1...32)		128	96	
Score	REAL	4	$96 + 4 \cdot (n-1)$	Contour: 0 ... 100 Pixel counter: No. of pixels in range Edge pixel counter: No. of edge pixels Pattern: 0 ... 100
Total size			224	

For example, if the used reference object has 5 detailed inspections, the Input assembly would contain the following values (among others):

- The result from the detailed inspection no. 5 is found at offset $32 + 2 \cdot (5-1) = 40$,
- The score from the detailed inspection no. 5 is found at offset $96 + 4 \cdot (5-1) = 112$.

- Since there is no detailed inspection no. 6, the byte at offset 42 ($32 + 2 \cdot (6-1)$) contains the value 255.
- The values at offset 116 ... 224 are undefined, since the inspections no. 6 ... 32 are not used.

Note

If the located object was scaled, the numbers of pixels in the `Score` for Edge pixel counters and Pixel counters have been compensated for the scaling. To get the actual number of pixels in the captured image, multiply this number by the value in `Object locator estimated scale`.

For example, if the located object have a size of 80% of the reference object, a `Score` value of 120 means that $120 \cdot 0,8 = 96$ pixels in the captured image had a gray scale value within the threshold.

Status Flags

Status flag	Bit	Values
Teaching	0	0: In Run mode 1: In teach mode
Reference object selection via EIP	1	0: Disabled 1: Enabled
External teach via EtherNet/IP	2	0: Disabled 1: Enabled
Trigger via EtherNet/IP	3	0: Disabled 1: Enabled
Reserved	4 ... 31	

38.2 Output Assembly

The Output assembly contains three parameters that are used for selecting reference object, trigger inspections and activate a (re-)teach of the currently selected reference object.

Note that if In2 is set to be used for external teach and/or In3 is set to be used for triggering, it is not possible to initiate the corresponding function via EtherNet/IP. The use of In2 and In3 can be changed by choosing **I/O settings** from the **InspectorI40** menu and selecting/deselecting the corresponding options.

When selecting reference object, the value that corresponds to each reference object can be found in the following places:

- On the **External object selection** tab in the **I/O Settings** dialog box,
- In the input assembly mapping that can be shown (and printed) from the **I/O Settings** dialog box.

Instance ID: 100
Size: 4 bytes

Data	Type	Offset (bytes)	Values
Select reference object	SINT	0	0-31: Selected reference object
External teach	SINT	1	1: Perform teach. Set to 0 before performing next teach.
Trigger	SINT	2	1: Trigger inspection. Set to 0 before triggering next inspection.
Reserved	SINT	3	

39 Terminology

Captured image	An image taken by the Inspector. A captured image can either be inspected (<i>live image</i>) or used as a <i>reference image</i> for a reference object.
Contour	Inspection that compares the contour in a region in a captured image, with the contour in the same region on the reference object.
Color filter accessory	An Inspector Flex accessory that replaces the front window of the Inspector Flex with a front glass color filter. Red, green, and blue filters are available.
Detailed inspections	Regions that are placed in the images, in which the Inspector will perform an analysis – compare contours or patterns, count pixels, or count edge pixels – after the object has been located. The user places inspections in the reference image to instruct the Inspector where to analyze, and the Inspector places the inspections in the captured images to show where the analysis was made.
Device data	Device data is all settings and information that the Inspector needs to make inspections. The device data consists of settings for each reference object (image settings, object locator settings, detailed inspections settings, output settings) and reference images with object locator region and detailed inspection regions.
Device file	A device file is a file that contains device data and is mapped to a specific Inspector.
Dome accessory	An Inspector Flex accessory that replaces the front window of the Inspector Flex. The Dome diffuses the internal illumination in order to be able to work with glossy objects.
Edge pixel counter	Inspection that counts the number of edge pixels in a region in a captured image.
Edge strength	The minimum difference in gray scale values between adjacent bright and dark areas that is required for the Inspector to consider there being an edge (or contour) between the areas.
EtherNet/IP	Ethernet Industrial Protocol. An open communications protocol designed for use in process control and other industrial automation applications. See ODVA (Open DeviceNet Vendor Association), http://www.odva.org , EtherNet/IP section.
Field of view	The area which is currently seen by the Inspector. The size of the field of view (measured in for example mm ²) depends on the working distance between the object and the Inspector. Adjusting the field of view will affect the image size.
FTP	File Transfer Protocol. A standard network protocol used to exchange and manipulate files over an Internet Protocol computer network. Specifically used in the Inspector to transfer and store Inspector image data on a PC.
I/O extension box	The Inspector I20/I40 can be connected to an I/O extension box in order to increase the number of digital inputs and outputs.
Image log	See logged image.
Image settings	The parameters that control the following: • The quality of the captured images (exposure, brightness, use of internal and external lighting) • When to capture images (free-running or triggered) • The size of the captured images
Image size	The size of the images captured by the Inspector in pixels. The image size can be changed by changing the field of view.

Inspect	This is what the Inspector does – it inspects objects and gives a pass/fail result for each inspected object. When the Inspector is inspecting an object, it uses one <i>object locator</i> and a number of <i>detailed inspections</i>.
Inspection tools	The tools that are used by the user to mark detailed inspection regions in the reference image. There are four inspection tools: • Contour tool • Pixel counter tool • Edge pixel counter tool • Pattern tool (only Inspector I40)
Live image	A captured image that is inspected by the Inspector.
Locate	This is what the Inspector does during inspection to identify and find the position of the object in a captured image.
Log settings	The criteria for which an image is saved in the image log of the inspector.
Logged image	A captured image that is saved in the image log in the Inspector. The image log can contain up to 30 images.
Mask	Areas of the basic shape of a region (can be rectangular or elliptical) that should not be included in that region. Only <i>object locators</i> and <i>detailed inspections</i> can have masks, not <i>search regions</i>.
Match	Object locators: The required similarity between the object in the image and the learned reference object. Contour and Pattern inspections: The required similarity between the edges/pattern in the inspection's region in the captured image, and the corresponding region in the reference image.
Match settings	Settings that affect when an object in a captured image is considered located.
Object	What the user wants the Inspector to inspect. An object can be an entire object (for example a blister pack, a ball bearing, or a bottle) or a detail on an object (a logotype, the cap on a bottle, or holes in a sheet of metal).
Object locator	The tool used for locating the object in the captured images. When teaching a reference object, the Inspector places an object locator covering most of the reference image. The Inspector will learn the contours of whatever is within the object locator region, and search for this shape in the captured images when inspecting.
Output active time	The time during which the output is set to active. Can be expressed as a time in milliseconds, or as a number of encoder pulses.
Output delay time	The time between capturing an image for inspection and setting the output to the result of the inspection. Can be expressed as a time in milliseconds, or as a number of encoder pulses.
Output polarity	The voltage level of the active and inactive states for the output signals. There are two different polarities available in the Inspector: Normal Active is +24 V, inactive is 0 V (active high) Inverted Active is 0 V, inactive is +24 V (active low)
Output settings	The parameters that control the delay and active time, and the polarity of the output signals.
Pattern	Inspection that compares the pixels of the inspection region with the corresponding pixels in the reference image using normalized cross-correlation.
Pixel counter	Inspection that counts the number of pixels in a region in a captured image that has gray scale values that are within a specified range.

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Reference image	Image of an object that is used when learning a reference object.
Reference object	An object that the Inspector has learned and uses as a “correct” object when inspecting.
Region	An area of the image that is marked with any of the Object locator or Inspection tools, or is created by default (search region). There are different types of regions used in and by the Inspector: • <i>Detailed inspections</i> are areas where the Inspector will compare contours or patterns, count pixels, or count edge pixels. • An <i>Object locator</i> region in a reference image contains the object that will be located when inspecting. • <i>Search region</i>.
RPI	Requested Packet Interval. The time interval between two packets of data sent over EtherNet/IP.
Search region	The region of the captured image in which the Inspector will try to locate the object.
Store Images to FTP	The Inspector I40 can store inspected images to a remote FTP server while running. In contrary to the record live images functionality every image that the inspector logs will be saved. Note that it is only the raw image that is saved on the FTP server – that is, no inspection results or overlay graphics are stored.
Teach	What the user does to make the Inspector learn a new <i>reference object</i> .

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