

CaminaX[®]

BRIEF GUIDE

The Smart Vision System



This Brief Guide

- Objective** The objective of this brief guide is to enable you, as the user, to take the initial steps with Caminax[®]. You learn the basic operation of Caminax[®] enabling you to proceed into more complex topics.
More detailed information can be gained from the Caminax[®] *Reference Manual* and through user training.
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Info

www.caminax.com

Basic information

Basic information

What is Caminax[®]?

Caminax[®] is a complete real-time machine vision system for in-line quality control and gauging tasks.

Caminax[®] consists of the following components:

- Smart camera with an integrated processor
- Keypad
- Cables
- Break-Out Modules for cabinet integration (optional)

Caminax[®] is able to perform industrial inspection tasks using state-of-the-art machine vision technology.

Proper Use

Caminax[®] is used for real-time industrial testing and measuring tasks. The Caminax[®] process interface consists of digital in- and outputs. The inspection is started using a trigger signal coming from external devices. A camera image shown on a video display and a keypad are used as user interface. The inspection tasks are parameterized using the function Modules of the Caminax[®] software.

What are Tasks? What are Modules?

The whole testing sequence to be performed for the inspection of a certain product is called Task. The Task includes image taking and communication actions, too. A Caminax[®] Task is created by adding small functional units – so-called Modules – step by step. The Modules of a Task are executed sequentially in the inspection mode.

Every new Task consists of two basic Modules right from the start: The Image Module and the Result Module. These two Modules are needed for each possible Caminax[®] Task: The first one takes the image to be processed. A Task without image taking does not make sense since Caminax[®] is an image processing device. The Result Module is used to communicate the inspection results to external devices, e.g. a PLC. An interface to the outside world will always be necessary since Caminax[®] is a testing tool for automated fabrication. Application dependent adaptations are made by adding and configuring additional Modules.

List of Caminax[®] Modules

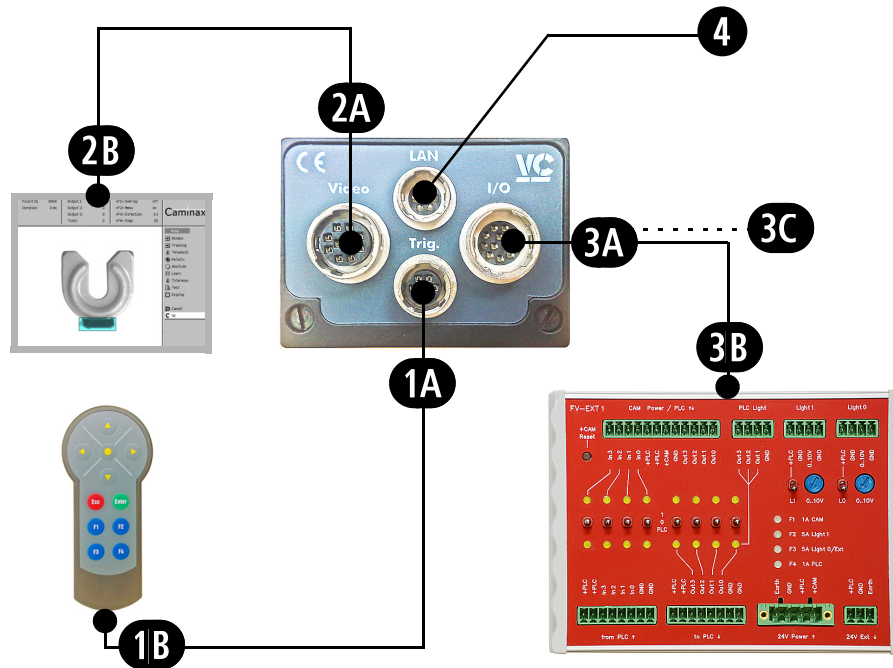
Module	Function
Image	Image capture, flash control and process synchronization
Result	Links the Results of the several Modules, sets digital outputs and time delays
Brightness	Determines and checks the mean image brightness
Area	Counts the number of pixels in an area (Pixel counting)
Color	Tests color in the testing area
Position	Detects the position of an edge and makes this value available to subsequent Modules as position reference
Points	Finds one or more object edges along a straightline or along a circle
Straightline	Tests the straightness and angle of a straightline
Circle	Tests the diameter and roundness of a circle
Vector	Calculates a vector from two points. The distance and angle are testing criteria.

Installing and starting the Caminax®

Basic information – Caminax®

Step 1: Connect Caminax®

Connect the components with the cables as shown:



Item	Connection / explanation
1A	Connector to the round plug of the keypad cable
1B	DB9 plug for the keypad
2A	Connector for the round plug of the SVGA cable
2B	DB15HD plug to connect a SVGA video display with 4:3 ratio
3A	Connector for the round plug of the Power/PLC cable
3B	Green flat plug to connect FV-EXT1 Break-Out Module
3C	Optional: 24 VDC power unit plug (black to GND 3 wires red/blue, red, gray/pink to +24 V)
4	Optional: Connector to the round plug of the LAN or RS232 (V.24) cable. The cable type depends on the Caminax® model used.

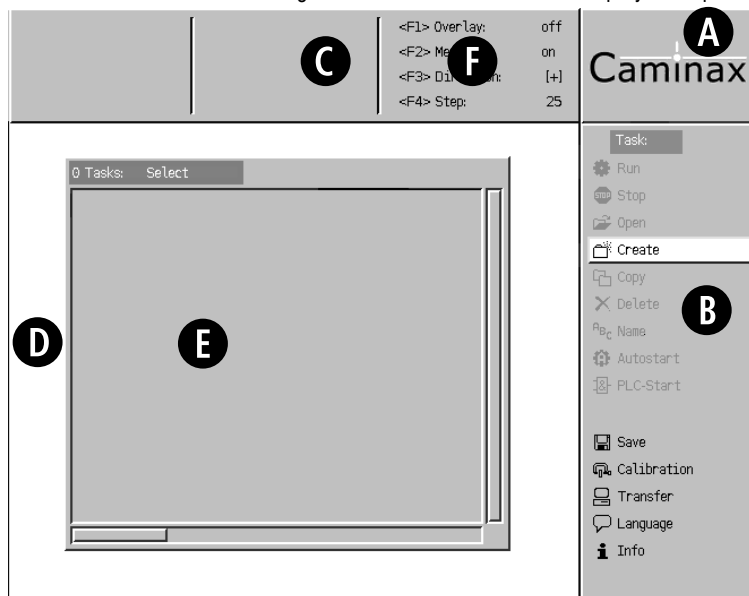
Step 2: Screw on the Lens

The optics are not part of Caminax[®]. The lens to be used depends mainly of the application. Please contact your Caminax[®] dealer. He will give you comprehensive advice on the choice of optics.

- 1 Remove the protective cap from the C-mount thread of the lens.
- 2 Screw the lens onto the C-mount thread of Caminax[®].
- 3 Remove the protective cap from the object-side of the lens.

Step 3: Start Caminax[®]

Caminax[®] shows the following user interface on the video display after power on.



A Caminax [®] logo	D Camera image area
B Menu area	E Task or Module list (Teach-In mode)
C Area for statistics	F Control values associated to keypad function keys F1 to F4

Using the Keypad

Using the Keypad

The keypad is the operator interface to Caminax®. All entries are made using the keypad keys. You navigate through the Caminax® system menu shown on the video display using the keypad. You also use it to set-up Tasks, Modules, Windows, texts and parameters.



Using the Navigation Keys

▲/▼ (arrow down/up)	Scroll vertically through the menus
	Scroll through the Task and Module lists
◀▶ (arrow left/right)	Step vertically through lists
	Step horizontally through lists
○ (Central key)	Change values of horizontal sliders
	Move Windows (Regions Of Interest, ROIs) vertically
○ (Central key)	Change the height of a Window (ROI)
	Change the width of a Window (ROI)
○ (Central key)	Step through the alphabet when entering text
	Set the Result logic for the outputs in the Result Module
○ (Central key)	Select elements from lists

Using Function Keys

Esc	Cancel input or selection
Enter	Confirm input or selection
F1	Show/hide overlays
F2	Show/hide the user interface
F3	Change the step direction when entering text
F4	Change the step width for numerical entries and Task (ROI) settings. Supported values are: 1 pixel (fine), 10 pixels (medium) and 25 pixels (coarse). The corresponding step widths for angles and directions are: 1/10° (fine), 1° (medium) and 2.5° (coarse).

Enter or Exit Sub-Menus

Select a Menu Item

Suppose you want to push the [Create] button.

- 1 Position the cursor with ▲/▼ onto the  Create button in menu area **B**.

The cursor is in the correct position when the [Create] button is highlighted.

- 2 Push Enter on the keypad.

Example: Cancel a previous action

Suppose you want to go back to the top menu.

- Push Esc on the keypad.

Interact with Dialogs

Example: Manage a YES / NO query

Suppose you want to push the [YES] button.

- 1 Position the cursor with onto the button.

The cursor is in the correct position when the [YES] button is highlighted.

- 2 Push **Enter** on the keypad.

Example: Confirmation dialog

In a confirmation dialog you only see the button.

- Push **Enter** on the keypad.

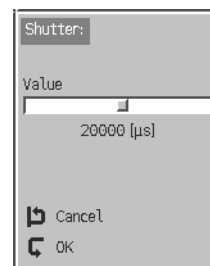
The dialog recognizes the confirmation and closes.

Set Values and Tolerances

Example: Set the Exposure Time

Suppose you want to change the exposure time in the Image Task. You've already entered the Shutter sub-menu.

- 1 Move the slider with .
- You see the value under the setting element.
You can change the step width with .
- 2 Push to select the button.
The button is selected as soon as it is highlighted.
- 3 Push **Enter** on the keypad.
The value chosen for the exposure time will be used from now on.



Set the Nominal Value and Tolerances

Step 1: Set the Nominal Value and Tolerances

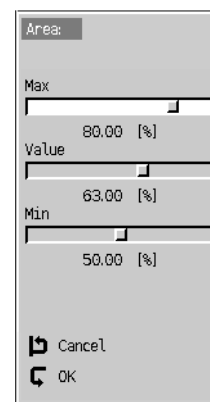
The nominal value, e.g. for an area, is set using the **Learn** function. Caminax will automatically set tolerances to default values when setting the nominal value.

- 1 Add the **Area** Module to your testing Task.
- 2 Enter the **Area** menu.
- 3 Push the button in the **Area** Module.
- 4 Confirm the following messages with **Enter**.
Caminax® saves the current value measured as nominal value, and sets the tolerances to default values.

You can change the values which were automatically pre-set by :

Step 2: Change the Nominal Value and Tolerances

- 1 Push the button in the **Area** Module.
- 2 Choose the **Value** slider with .
- 3 Change the nominal value by using the keys.
You can change the step size with .
- The numerical value is displayed right under the corresponding slider. The values for the lower and upper tolerance limits (Min/Max) will be adjusted automatically as soon as the nominal value is changed.
- 4 The **tolerances** are adjusted by choosing the corresponding slider using . The value itself is set with , again. The step width is set with right as before.
- 5 When all settings are done, push to select the button. The selected button is highlighted.
- 6 Push **Enter** on the keypad. The nominal value and its minimal and maximal tolerances are set. The **Area** Module is shown again.



Edit Characters

This function is used to change the Caminax® Task or Module names. The symbols of the Result logic in the Result Module are modified in the same way.

Example: Change a Task Name

- 1 Select **Task Name** in the Task menu.
- 2 Push **Enter** on the keypad.
The Task list appears.
- 3 Position the cursor onto the Task to be edited using the **▲/▼** keys.
- 4 Choose the letter to be edited with the help of the **◀/▶** keys.
- 5 Step through the alphabet with the **●** key located centrally on the keypad.
The order of appearance is: upper case letters, underscore, lower case letters, space, special characters, numbers.
Push **↻** on the keypad to change the step direction.
Push **Esc** on the keypad to abort.
- 6 Push **Enter** on the keypad to confirm the present names.

Set-Up Tasks, Modules and Windows

The following functions are available in the **Task** menu. You can navigate with ▲/▼ through the menu:

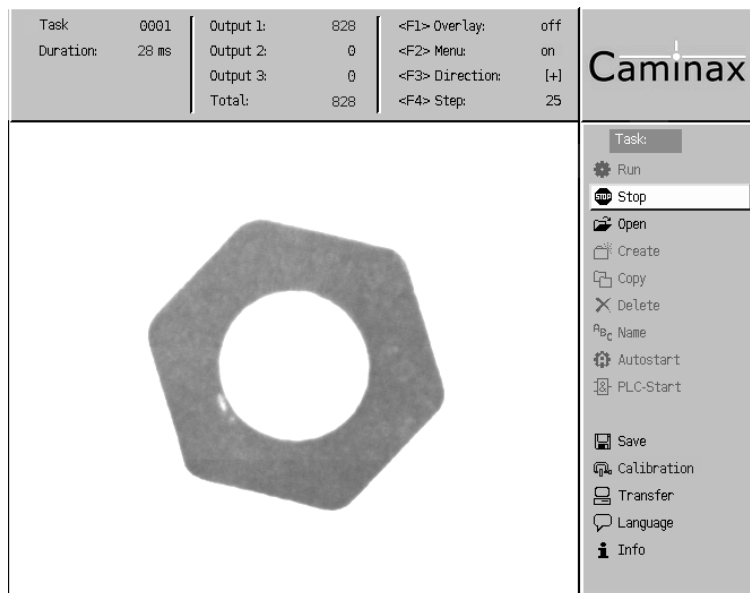
Run	Execute the selected Task
Stop	Stop the execution of the current Task
Open	Open a Task for editing
Create	Create a new Task
Copy	Copy a Task
Delete	Delete a Task
Name	Edit a Task name
Autostart	Define the Task to be automatically started on power-on.
PLC start	Control the execution of Tasks through digital inputs
Save	Save all settings and Tasks
Calibration	Global calibration for all Caminax [®] Tasks
Transfer	Data and image exchange between Caminax [®] and a PC
Language	Change the language of the user interface
Info	Show the Caminax [®] version information

Execute a Task

- 1 Position the cursor on **Task** →  with the keypad keys ▲/▼ then push **Enter** twice on the keypad.


Congratulations! You have just started executing a Task for the first time.

- 2 Place a hex nut as a testing object in the field of view of Caminax[®]. The nut should be illuminated by a bright backlight.
- 3 Adjust the lens. Turn the aperture ring of the lens to adapt the image brightness. The focus ring is used to adjust the image sharpness. Try to receive an image similar to the one shown below.



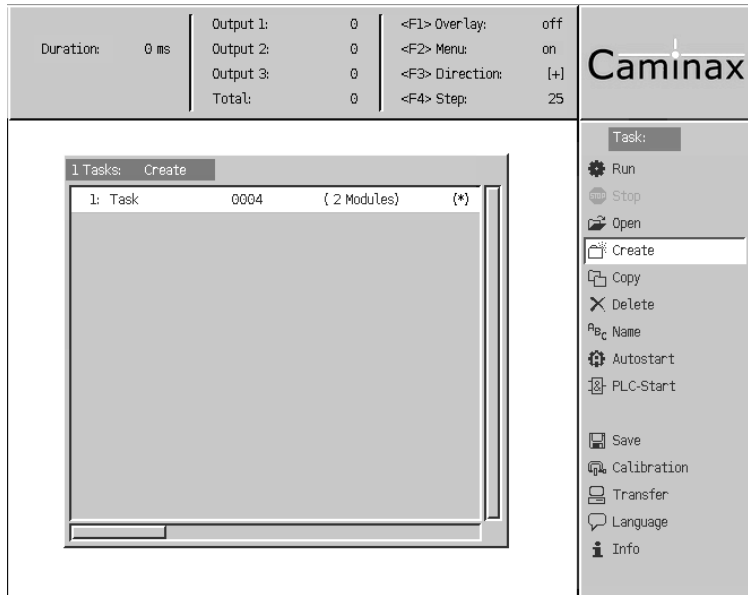
You see a picture of the nut on the screen. We use the nut as an example in this brief guide to show how easy it is to create testing Tasks with Caminax[®].

The image shows the object we are inspecting. It is the nut in our example. In the display area above the image, you see the time needed for the previous testing run (Duration) and the number of inspections performed so far (Total).



- 4 To stop the execution of the Task, position the cursor on **Task** →  with the keypad keys ▲/▼, then push **Enter** on the keypad.

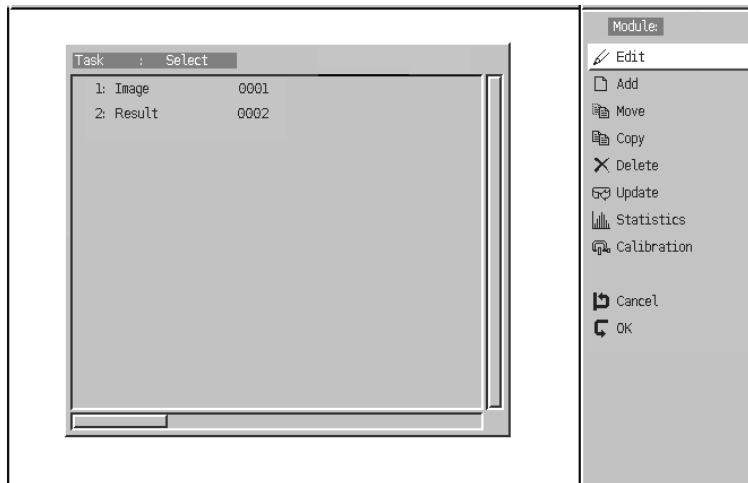
Insert and Edit Modules in a Task



- 1 Push Task →  Open
- Example:



The cursor jumps into the Task list.

- 2 Position the cursor with / onto the Task you want to open, then push Enter. You see the list of Modules used in the Task.

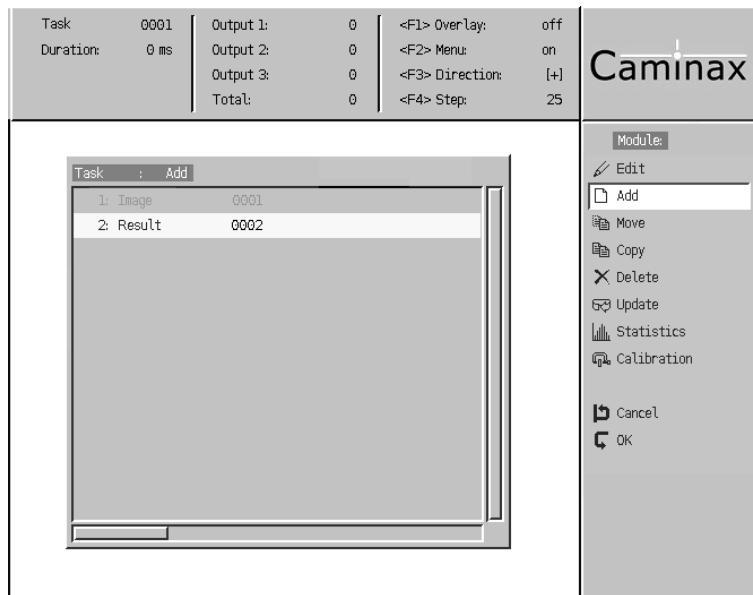


As every newly created Task, your Task already contains the **Image** and **Result** Modules. You can select from the following items using the / keypad keys.

Edit	Edit a Module to set parameters
Add	Add a new Module and edit it
Move	Cut a Module and paste it elsewhere
Copy	Duplicate a Module
Delete	Delete a Module
Update	Update a Task (All Modules are executed once)
Statistics	Reset the Task statistics
Calibration	Calibrate Caminax® for this Task
Cancel	Cancel changes and exit the menu
OK	Confirm changes and exit the menu

- 3 Push Module →  Add to insert a new Module.

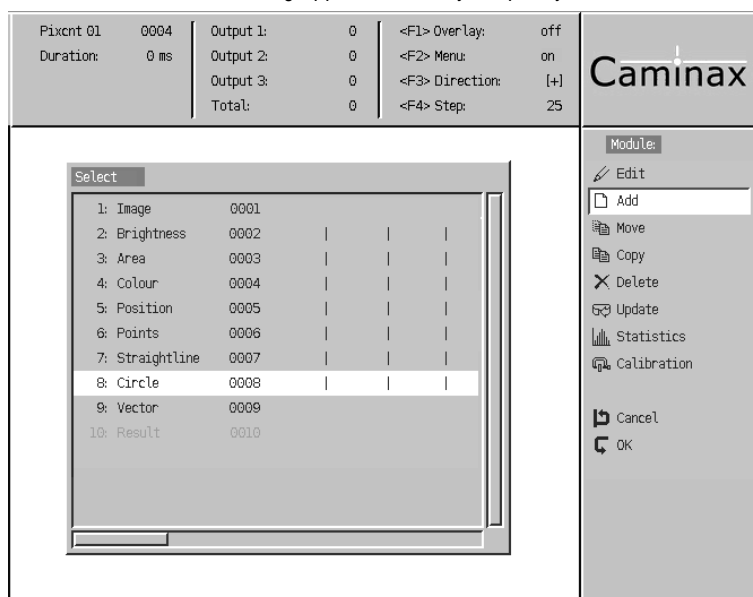
The cursor jumps into the Module list.



- 4 Move the cursor with ▲/▼ keys to select the item where you want to insert the new Module. The new Module is always inserted previous to the selected one.

The cursor is automatically positioned on **Result** in new Tasks since all new Modules are added between the two initial **Image** and **Result** Modules.

- 5 Push **Enter**. A selection dialog appears, where you specify the Module to be added.



- 6 Move the cursor with ▲/▼ onto the Module which you want to add, then push **Enter**. Now set-up the Module in according to your requirements.

The set-up of the Area Module is explained in detail in the section Example of a Testing Task (Page 14).

Window Configuration and Usage

What are Windows?

Windows are Regions Of Interest (ROIs) of the image in which Modules perform their machine vision functions. Modules using Windows are:

- Position Module (Edge detection)
- Points Module (Edge counter)
- Area Module (Pixel counter)
- Brightness Module

The Windows are visualized in the image while they are configured. Caminax® features the Window geometry adaptation suitable to a particular Task.


Area based Modules such as **Area**, **Brightness** and **Color** support Windows with various shapes. Turned rectangles, circles, rings, circle and ring segments are supported.

Edge based Modules such as **Position** and **Points**, support rectangular and ring shaped Windows, too. Additionally, their Windows specify a probe direction (search direction). This direction defines the search path for edge detection.

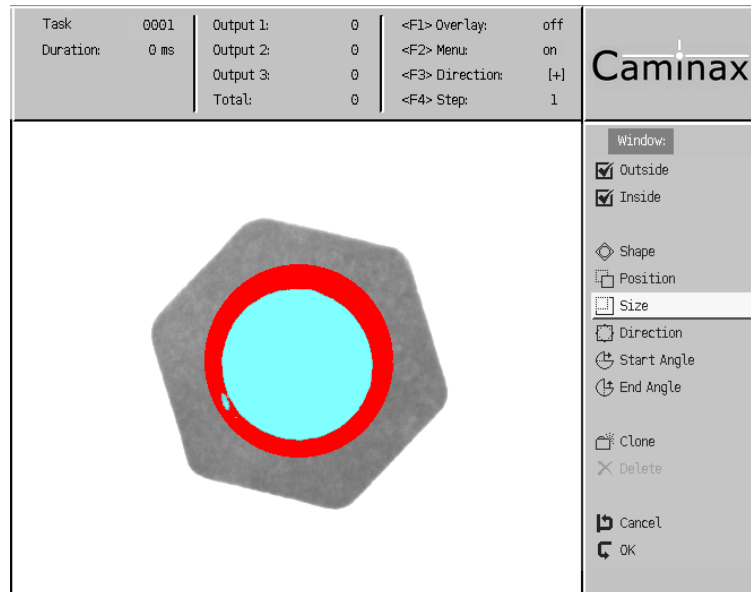
Multiple Windows in a Module



A Module may contain any number of Windows. You can create Windows one by one or as a group. The Window geometry can be configured individually for each Window. Changes can be performed on a single Window or collectively on a group of Windows.


Set-Up Windows

- We show the Window menu of the **Area** Module. Push the  Window button to activate the Window menu. The **Window** tool opens. When setting up the Window, Caminax® already performs the corresponding image processing Task of this Module, and displays the Result. Thus, the Window colors shown may vary depending on the Module's set-up.

The Window menu is shown below.



The **Window** menu items are selected using  / . The options available are:

Outside / Inside	Most settings apply on the whole Window. The whole Window is activated if both Outside and Inside are set. The size of just the outer or inner contour can be modified by activating only the corresponding check-box.
Shape	Toggle the shape of the Window between an ellipse and a rectangle. Push Shape , then toggle using the  key in the middle of the keypad. Push Enter if finished.

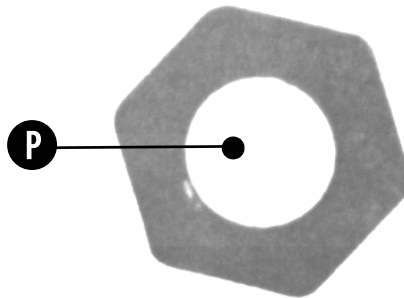
Position / Size	Set the location, define the size of the Window. Use the with the ▲/▼/◀/▶ keys. The step size is switched between 1, 10 and 25 pixels using the F4 key.
Direction	Rotates the Window using the ◀/▶ keys.
Start Angle / End Angle	These features apply to circular or elliptical Windows. A segment of the base geometry is specified. Change the start or end angle using the ◀/▶ keys.
Clone	Copy Windows
Delete	Delete Windows
Cancel	Cancel the changes and exit the <i>Window</i> tool
OK	Confirm changes and exit the <i>Window</i> tool

Some options are not available for all Module types.

Example of a Testing Task

The following sections use a hex nut as an example to show the simple creation of testing Tasks with Caminax®.

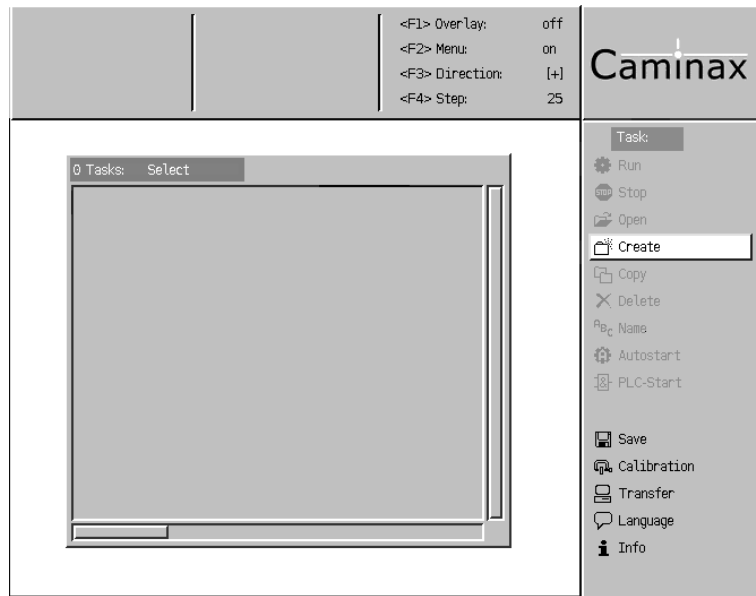
The task is to check if there is a hole in the nut (area **P** in the figure is bright) or not (the hole is dark). In the latter case, the nut is faulty. Caminax® should signal this state to a PLC with the help of the digital outputs.



- Solution Idea** We solve this testing task by checking the size of the bright area. A large amount of machine vision appliances are based on brightness checks in certain areas. Thus, this example shows a fundamental approach to visual inspection in industrial environments.
- Implementation** First of all, we create an empty Task. Then, we configure the Task by adding suitable Modules. Caminax® comes with a range of Modules. Each of them is made for a specific task. Then we start the inspection Task and integrate it into our production facilities:
- 1 **Empty Task** ... You create an empty Task. An empty Task already consists of Image and the Result Module.
→ Exercise Step 1: Create an Empty Task (Page 15)
 - 2 **Image** ... Caminax® captures an image of the nut.
→ Exercise step 2: Configure the Image Taking (Page 17)
 - 3 **Area** ... You add the Area Module and configure it. You define the area where you expect the hole of the nut.
4 → Exercise Step 3: Insert the Module »Area« (Page 20)
 - 5 **Result** ... You assign digital outputs to the inspection results.
6 → Exercise Step 4: Evaluation Set-Up (Page 25)
 - 7 **Run** ... Run your Task.
→ Exercise step 5: Run the Task (Page 30)
 - 8 **Integrate** ... Integrate the inspection into the process environment.
→ Exercise step 6: Exercise Step 6: Integration into the Process Environment (Page 31)

Exercise Step 1: Create an Empty Task

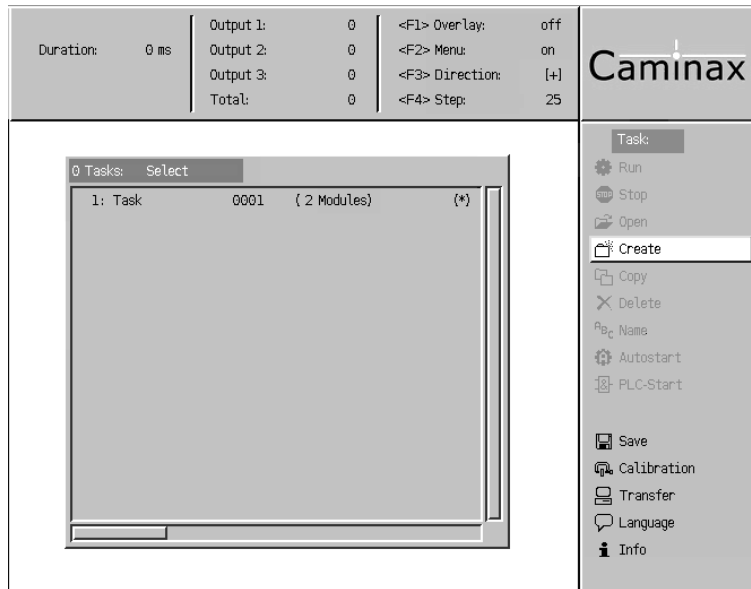
Prerequisite The Task menu shown below appears on the video display if Caminax® is powered-on for the first time. Some other screens may appear if Caminax® was used before. In this case, exit the Window or Module menus using Cancel or OK and go back to the Task menu. It does not matter if the Task list is not empty.



Create and Save a new Task

- 1 Position the cursor onto Task → Create with the ▲/▼ keypad keys, then push **Enter** on the keypad.

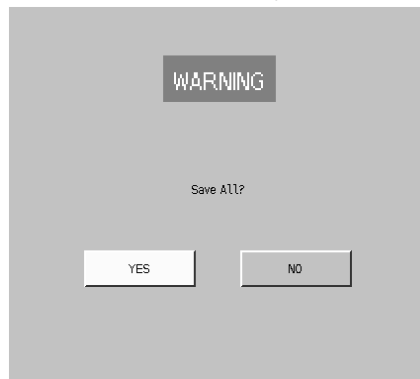
A new Task appears in the Task list.



- 2 Push Task → Save.

Attention: equipment could be damaged!
Caminax® must not be powered off while saving.

Caminax[®] queries whether you want to save all.



3 Push **YES**.

Caminax[®] replies with: All saved.



4 Push **OK**.

Finished. You have created and saved your first testing Task, now.

The **Save** function applies on all changes. All Tasks including their present configuration as well as statistics are saved power fail save in the Caminax[®] hardware.

The empty Task just created is already able to run since it is not completely empty, in fact. It already contains two Modules: An Image and a Result Module.

5 Continue with → Exercise step 2: Configure the Image Taking (Page 17).

Exercise step 2: Configure the Image Taking

Basic Information – »Image« Menu






Any machine vision Task starts with an image taking. Thus, we configure the image at first. This is done in the **Image** menu.

The **Image** menu has the following functions:

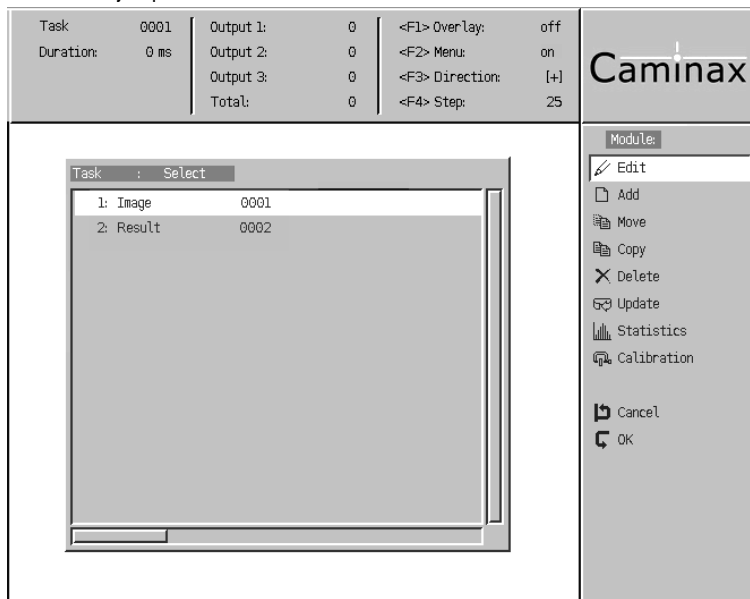
Demo Image Saved Image New Image	These buttons define the image source to be used. The Demo Image is not yet available. The Saved Image is an image taken by Caminax® which was saved before. New Image is the option to be chosen for inspection uses. Choose New Image.
Adjust	Toggle between live and the still images. It is a useful tool for setup. In the live mode, you see the effects of lens adjustments. The sharpness of the image will change if you turn the focus ring and the brightness will change if you turn the aperture ring. In the static mode, you can have a close look to what the camera sees. Maybe, there are some unexpected bright or dark areas which will disturb the inspection?
Flash	Enable / disable a flash light trigger signal. The output OUT1 is set during image exposure.
Exposure	Set the exposure time for the image taking.
Display	<input checked="" type="checkbox"/> : Enable display image update during measurements. <input type="checkbox"/> is less comfortable but faster. Choose <input checked="" type="checkbox"/> .
Trigger	<input checked="" type="checkbox"/> : Enable external trigger input from IN0 to start the Task. <input type="checkbox"/> : The Task is executed continuously. Choose <input type="checkbox"/> if no PLC or other triggering device is connected.
Test	Capture an image from the image source specified above and tests this Module.
Save Image	Save the present image on the internal flash card. This image can be re-loaded with the Saved Image option at a later time. You should save the current reference product when you set-up a new Task. This helps to analyze future changes of the testing equipment or of the product itself. In future, you will be able to compare the reference set-up image to the production images taken then.
Cancel	Cancel all changes and exit the menu.
OK	Confirm all changes and exit the menu.

Set Parameters for Image Taking

To enter the image Module from the Task list do the following:

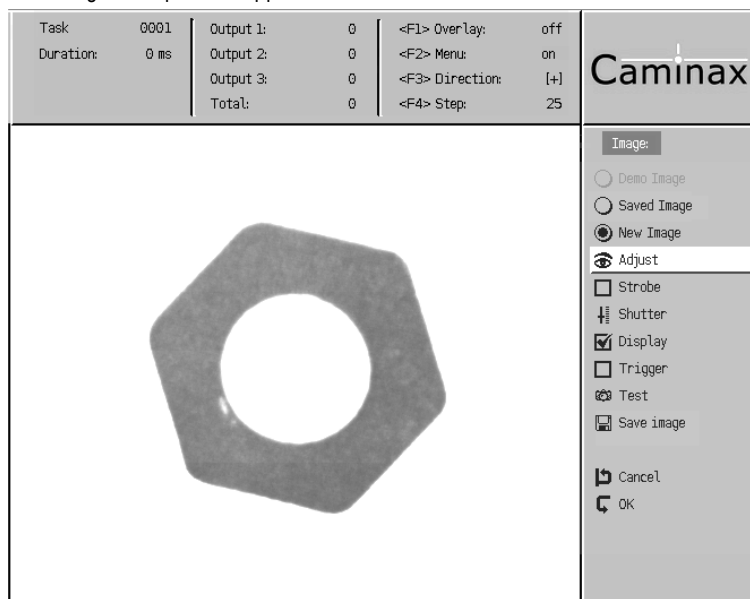
- 1 Position the cursor in the Module menu to the **Open** button by using / and push the **Enter** button.
- 2 If there is more than one Task: Select the Task to be edited using /.
- 3 Push the **Enter** button.
- 4 The Module list of the Task is shown. As any new Task, our empty Task already contains the **Image** and **Result** Modules.
- 5 Push Module → .

The cursor jumps into the Module list.





- Position the cursor with / onto the **Image** Module in the list, then push the **Enter** key on the keypad.

The Image set-up menu appears.





- Click Image → **New Image** .
- Push Image → **Adjust** , to adjust the position and illumination of the nut, then push Image → **Adjust** again.

- 9 Push Image →  Shutter, check and adjust the image brightness with ▲/▼, then push Enter.

The camera exposure time is set with  Shutter. A longer exposure time makes the image brighter. Consider that a long exposure time increases the Task processing time. Additionally, motion blur may occur with moving parts or vibration.

The effective lens aperture influences the image brightness, too. This aperture is set using the aperture ring of the lens. Consider that the depth of sharpness will decrease if you create brighter images with the help of the aperture ring settings.

Last, but not least the illumination brightness has a major impact on the image brightness and contrast.

- 10 Keep the **Flash** option switched off. We will use a permanently shining illumination in this example.
- 11 Keep the **Trigger** option switched off. The inspection Task will run continuously without an external input signal.
- 12 Push Image →  Test.
Caminax® captures a new image and keeps it in the memory as reference to set-up the rest of the testing Task.
- 13 Push Image →  OK.
You are back in the **Module** menu.
- 14 Continue as with → Exercise Step 3: Insert the Module »Area« (Page 20).

Exercise Step 3: Insert the Module »Area«

In our example, we will check the area of the nut's hole. We need a pixel counting function for that. This function is provided by the **Area** Module.


Basic information – Area menu

Basic Information - »Area« Menu

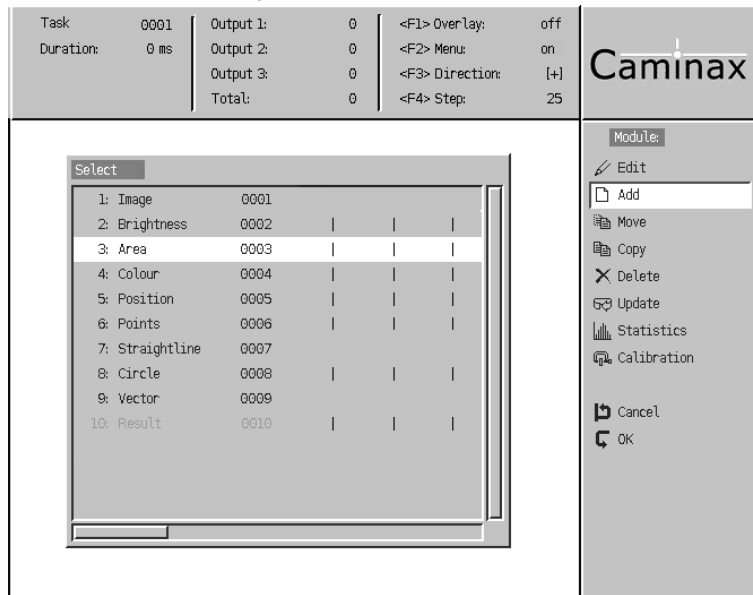
The **Area** Module has the following functions:

Window	Define one ore more Regions Of Interest (ROIs) within the camera image where this Module shall determine the size of an area with a certain brightness.
Tracking	The Window's X and Y positions may be shifted according to the object's position changes detected by preceding Modules. The area detection threshold may be adjusted according to the all-over image brightness, too. The prerequisite for that is, that this all-over brightness is detected previously in a suitable Module. The Tracking is not used in this exercise.
Threshold	The gray values stand for a certain image brightness. E.g., the gray value 0 represents the color black and the gray value 255 represents white. All the values in-between represent different types of gray. Lower values are darker and higher values are brighter. In the Threshold menu you define the interval of gray values to be used for pixel counting.
Relative / Absolute	Determine the way the tolerances are set. Relative defines that the area determined is tolerated as a percentage of the whole Window. Absolute means that the actual number of pixels within a certain range of gray values will be compared to the number determined with the reference object. Keep the Relative mode active in this exercise.
Learn	Execute the pixel counting with the present setting on the reference image. The resulting area is supposed to be GOOD. The tolerances are automatically pre-set in an interval around the GOOD value.
Tolerance	The automatically generated tolerances from Learn can be edited for fine tuning in the Tolerance function.
Test	Perform a test run of the Module with the current settings. The Module Results are shown on the display. The Results are made available to successive Modules.
Display	<input checked="" type="checkbox"/> : Enable the Result visualization of this Module while the inspection is running. <input type="checkbox"/> No Result visualization is shown from this menu. This option is chosen to speed up the Task execution. This option is also chosen for assisting Modules which should not attract the user's attention during inspection. Keep the Display <input checked="" type="checkbox"/> checked in this exercise.
Cancel	Cancel all changes and exit the menu
OK	Confirm all changes and exit the menu

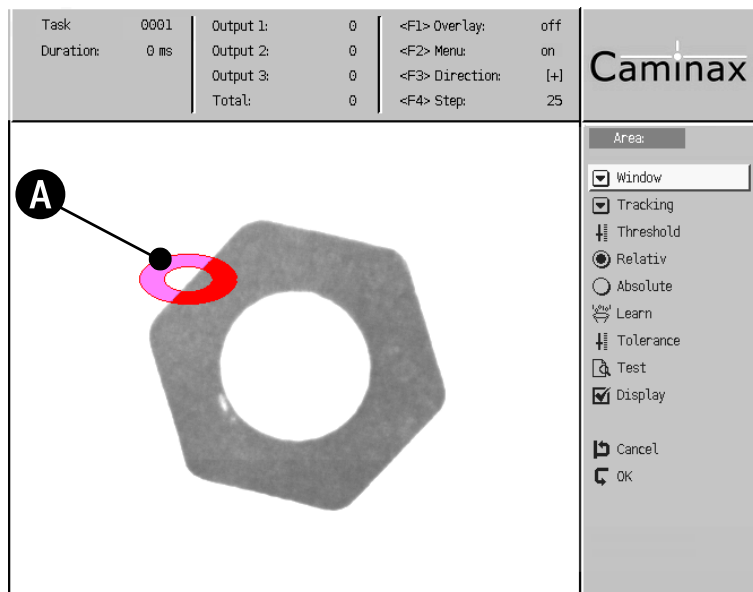
Step 3A: Insert the »Area« Module

- 1 Push **Module** →  **Add**.
The cursor jumps into the Module list.
- 2 Push **Enter**.

3 Select 3: Area in the dialog, then push Enter.



The Area set-up menu appears.



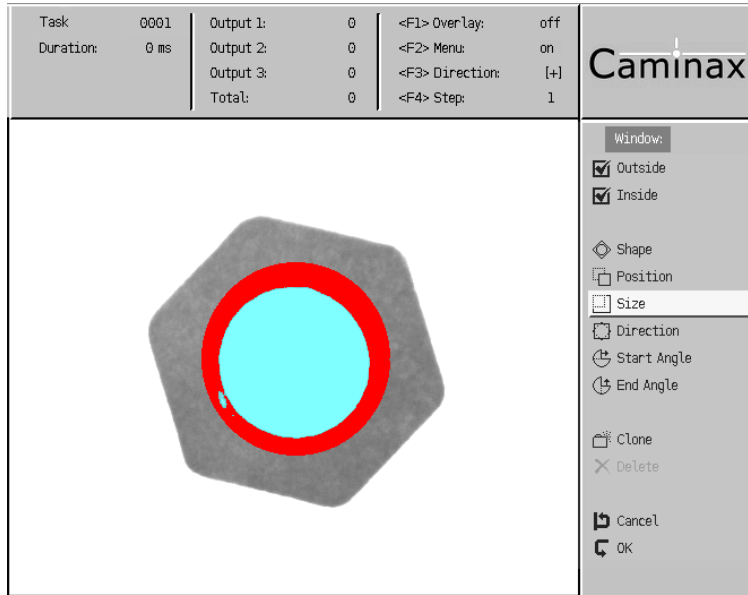
The figure shows the Window **A**, consisting of an outer and inner contour. You will adjust this Window in a suitable way in the next steps.

Step 3B: Position the Window

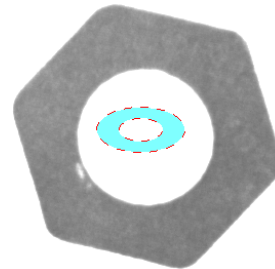
1 Push Area → Window

The **Window** tool opens. See Window Configuration and Usage (Page 12). The area used for pixel counting is colored and semitransparent. It is the area between the inner and outer Window contour.

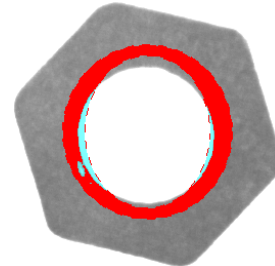
In our example we will position the ring into the middle of the hex nut hole. Then we will resize it in a way that the outer contour fully covers the hole. Finally, we scale the inner contour down to zero. Thus, we create a circle from the ring.



- 2 Push Window → , then position the Window with the keys approximately in the center of the hole under test, then push Enter. Change the step width with , as pleased. The present step size is shown in the display header: <F4> Step.



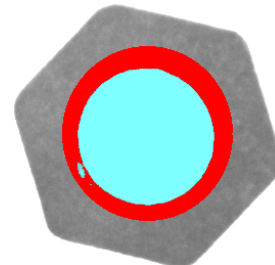
- 3 Push Window → , then enlarge the Window with the keys so that the outer contour covers the nut hole, then push Enter.
- 4 Push Window → Outside to keep just Inside checked.



- 5 Push Window → , then minimize the inner contour until it has vanished. Use the keys, then push Enter.

Select the step size 1 () to erase the inner contour completely. The circle creation does not work with other step sizes.

- 6 Push Window → . The **Window** tool closes, and Caminax® returns to the **Area** menu.



Step 3C: Set-Up the Tolerances of the Area Module

In our example, the **Area** Module should only count the bright pixels of the hole to be inspected. The dark pixels of the actual nut should not be counted.

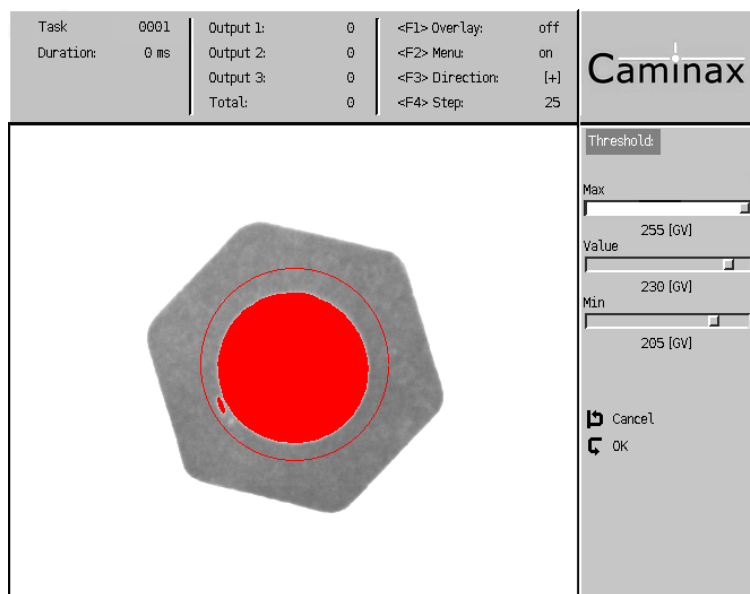
Caminax® counts medium gray pixels by default. In the following step, you will adjust the interval of gray values used for pixel counting in a way that Caminax® counts just bright pixels as they appear in the hole.

- 1 Push Area →  Threshold

Increase the Max-value until the entire hole appears colored. The color may change between red, green and yellow. This is not relevant, now. You will receive a completely colored hole with a Max-value less than 255 if the hole is just bright, but not completely white. No additional colored points should appear if you increase the Max-value to 255 in that case. Thus, you can keep the value of 255. 255 is always a good Max-value, if you want to count bright pixels. (By the way, 0 is always a good Min-value, if you want to count dark pixels.)


The Min-value is pre-set to 63. Thus, it is possible that some areas of the nut itself are colored, too. This is the case if the nut appears gray and not quite dark in the image. You can exclude these relatively bright areas on the nut from pixel counting. Just increase the Min-value until you see just the hole colored.

Now we have what we want:




The colored area covers just the hole. Thus, the hole size will be determined during inspection.

Push **Enter**.

- 2 In the next step we tell Caminax® that the present number of colored pixels is the expected one which should be treated as GOOD. Just push Area →  Learn, then confirm the messages with **Enter**.

The colored pixels are green, now. Caminax® uses the present number of pixels as reference from now on. The tolerances are automatically pre-set with values close to the reference value.

- 3 Push Area →  Tolerance, then reduce the Min-value and then increase the Max-value.

This increases the tolerance range related to the default settings created on **Learn**. This makes the system more robust. Just significant area changes will cause BAD sorting Results.

In the screenshot shown below, Caminax® detected bright pixels on 63% of the Window area. The tolerances have been adapted manually. Now, a bright area covering 50% to 80% of the Window area will provide a GOOD sorting Result. You will receive

another Value if you perform the exercise with your Caminax® since your camera

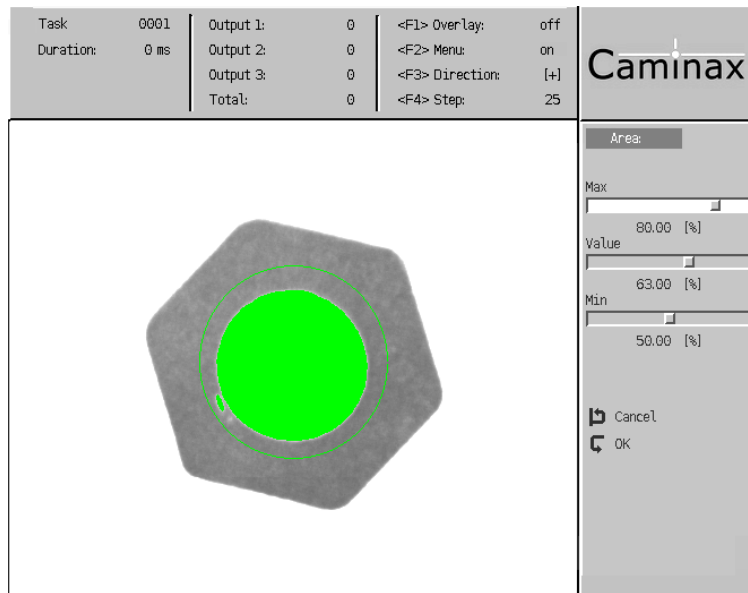

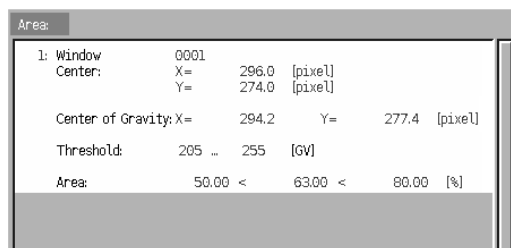


image and your Window will look different, too.

Push  OK

4 Push Area →  Test

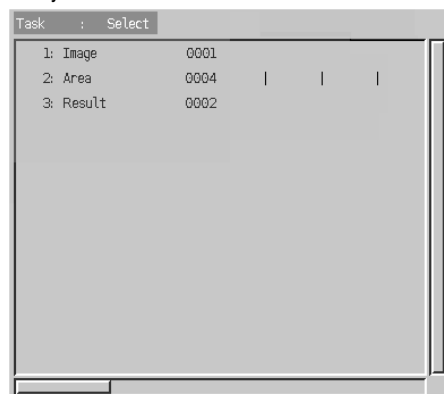
A Result screen opens. It shows the settings of the Area Module and the center of gravity of the area found.



Push Enter to close the Result screen.

5 Push Area →  OK

The newly added Area Module appears as a part of the Task. The Module list shows that your Task consists of three Modules.



6 Push Module →  OK

Caminax® saves the Module settings. The Task menu re-appears.

7 Continue with → Exercise Step 4: Evaluation Set-Up (Page 25).

Exercise Step 4: Evaluation Set-Up

Basic Information – Result Module

In our example, Caminax® will set a digital output depending on the Result of the **Area** Module. This is configured in the **Result** Module.

Every Task ends up with the **Result** Module. The **Result** Module configures the digital output states of the Caminax® hardware depending on the inspection results. Thus, the **Result** Module configures the interface to the outside world.

You can configure the usage of the outputs available according to your needs.

- Example 1: You configure the sorting outputs GOOD, BAD and REWORK.
- Example 2: You define logic conditions for WARNING and MACHINE STOP outputs. You specify output bit patterns for warning and intervention limits.
- Example 3: You define logic combinations to identify different product variants.

When do Modules return the Result BAD?

Modules return the Result BAD when their tolerances are exceeded.

Area	The pixel number in the Window is too high or too low
Brightness	The Window content is too bright or too dark
Position	No edge is found
Points	The number of edges is too high or too low
Circle	The tolerances for diameter or eccentricity are exceeded
Color	The color tolerance is exceeded
Straightline	The tolerances for straightness or angle are exceeded
Vector	The tolerances for distance or angle are exceeded

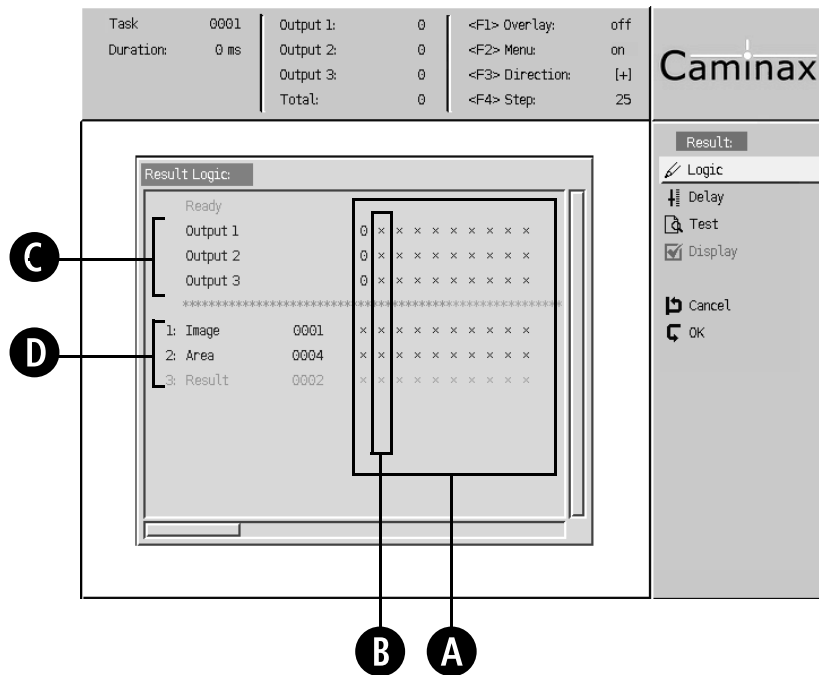
The Module's Result is indicated by the color of the testing Window.

Color	Result of Module
Green	Module is okay, the product checked is GOOD.
Yellow	Module is still okay, but close to the limit. The product is GOOD.
Red	Module is not okay, the product checked is BAD.

The **Result** menu features the following functions:

Logic	Set-Up the Result logic
Delay	Insert a time delay
Test	Test the Result logic
Display	Reserved
Cancel	Cancel changes and exit the Result menu
OK	Confirm changes and exit the Result menu

Basic Information
- Elements of the
Result Menu



The hardware outputs OUT1, OUT2 and OUT3 can be configured depending on the inspection results. The outputs are digital. They have two states: 0 (Low) and 1 (high). The output states are updated as soon as the inspection Task has finished. Caminax[®] indicates this using OUT0, the ready/busy signal.

The possible output states **C** for a certain Task are defined in the logic block **A**. The logic block consists of several logic units **B**. A logic unit defines an output state depending on certain Module Results **D**. Caminax[®] does not check if the output definitions of the logic units are non-contradictory. A well defined output is created anyway since Caminax[®] evaluates the logic units from the left to the right. The output of e.g. OUT2 will be 1 if the logic unit at the very right side configures it that way. All possible logic Modules closer to the left side assigning a 0 will have no influence in that case.

At the very left side of the logic block there is a logic unit which cannot be edited. It assigns the state 0 to all outputs (0), no matter what the Module outputs are (x). The logic units closer to the right side are pre-configured to keep the output states as they were defined earlier in the logic block (x). Thus, the outputs will be set to 0 if the Result Module keeps unchanged.

The hardware outputs are defined using the following states:

Description	
0	This logic unit sets the corresponding Caminax [®] output to 0 (LOW).
1	This logic unit sets the corresponding Caminax [®] output to 1 (HIGH).
x	This logic unit does not change the corresponding output state. The states defined on the left-hand side are used.

A conditions for the output of a logic block are defined in the lower part of that block. Here, the Modules of a Task are shown. You can assign the following symbols to each Module:





Result symbol	Description
+	Module must be GOOD.
-	Module must be BAD.
x	Module has no impact on the output state defined above.

If you assign the + or the – symbol to more than one Module all conditions have to be fulfilled at the same time to provoke an output state change. The output state will remain as it was defined closer to the left side of the logic box if just one Module Result is different to the specification in the logic unit.

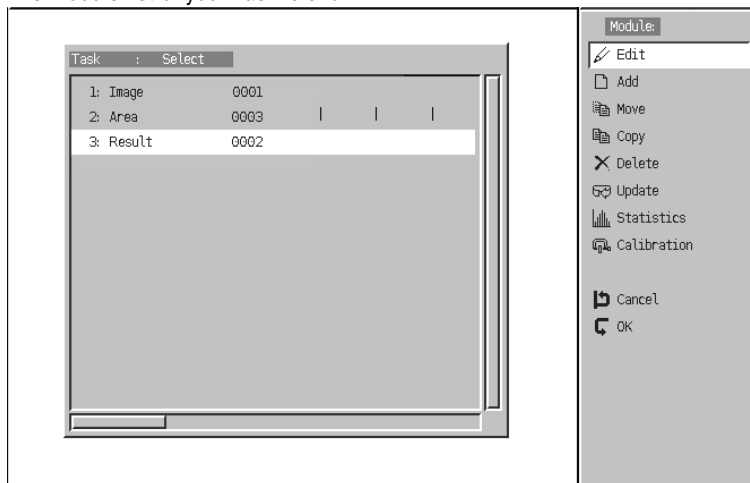
Output statistics in Caminax®: An internal counter is incremented by one each time a certain output is set. The counters for the three user-configurable outputs are shown at the top of the Caminax® screen.



Step 4A: Open the »Result« Module

Let's go on with the exercise. We are in the Task menu.

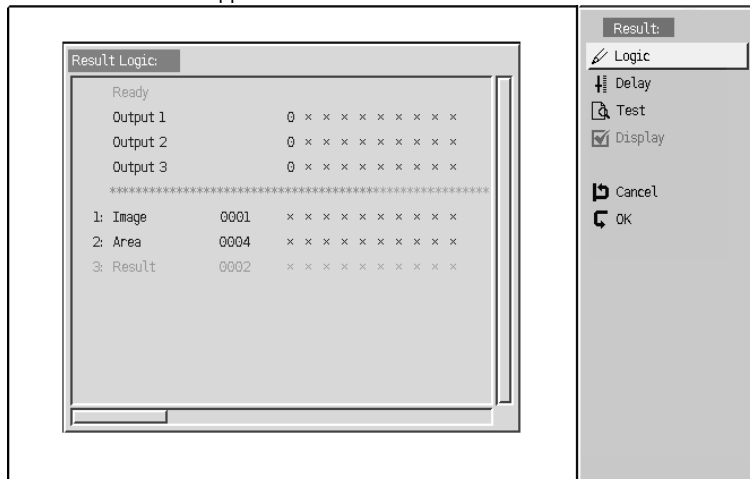
- 1 Push Task →  Open
- 2 Position the cursor with / onto your Task in the Task list, then push Enter.
- 3 Push Module →  Edit

The Module list of your Task is shown.



- 4 Position the cursor on 3:Result in the Module list using /. Confirm with Enter.

The Result menu for appears.



Step 4B: Set the Result Logic

The digital Caminax® outputs shall be set depending on the Area Module result. If the result is GOOD, we want to set OUT1 to 1. If the result is BAD, OUT2 will be set to 1, and OUT1 should stay at the 0 level.

Ready	Output 1	Output 2	Output 3
0	1	x	x
0	x	1	x
0	x	x	1

1: Image	0001	x	x	x	x	x	x	x
2: Area	0004	x	+	-	x	x	x	x
3: Result	0002	x	x	x	x	x	x	x

The table above shows a logical configuration which defines the behavior desired. In the first editable row on the left side **Area** is assigned to +. All other Modules have their default state x. This means that the output states are defined for the case that the Area Module returns GOOD. In that case, **Output 1** is set to 1. **Output 2** should be 0 in our example. We do not have to specify Output 2 explicitly in that row since all outputs are pre-set with 0. Correspondingly, it is sufficient to associate **Output 2 = 1** with **Area = -** in the next row.

- 1 Push **Result** → **Logic**.
- 2 Select the first editable column on the left side using .
- 3 Select **Output 1** using .
- 4 Push the key on the keypad until the 1 appears.
- 5 Select the **Area** Module with .
- 6 Push the key on the keypad until the + appears.
- 7 Go to the next row with .
- 8 Set **Output 2** to 1 and **Area** to - as described in above.
- 9 Push **Enter**.

Step 4C: Test the Result Module

- 1 Push **Result** → **Test**.
The present results of all Modules are shown. The associated output states defined in the logic block displayed, too.

Ready	Output 1	Output 2	Output 3
	1	0	0

1: Image	0001	Good
2: Area	0004	Good
3: Result	0002	Good


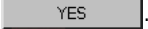
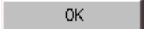
Push **Enter**.

- 2 Push **Result** → **OK**.
- 3 Push **Module** → **OK**.

The changes made are automatically used by Caminax® if a Task or Module is exited using the **OK** button. Still, they are not saved permanently on Caminax®. The power-fail save storage has to be performed by the user.

Step 4D: Save Task



Caution, equipment can be damaged!
Caminax[®] must not be switched off while saving.

- 1 Push Task → .
 - 2 Push .
 - 3 Confirm the message with .
- This action saves all Tasks and their settings power fail save.
- 4 Continue as with → Exercise step 5: Run the Task (Page 30).

Exercise step 5: Run the Task


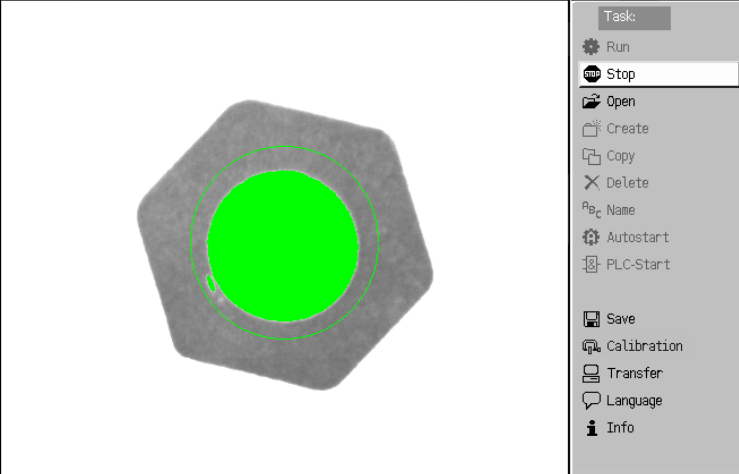
Let's get the previously defined Task running!

Run Task and
Check Result

- 1 Push Task →  Run
- 2 Position the cursor with / onto your Task in the Task list, then push Enter.

The execution of the Task starts.

Task	0001	Output 1:	902	<F1> Overlay:	off
Duration:	259 ms	Output 2:	0	<F2> Menu:	on
		Output 3:	0	<F3> Direction:	[+]
		Total:	902	<F4> Step:	25

Take a look at the statistics shown in the upper area of the Caminax[®] screen. Output 1 shows the number of GOOD counts, and Output 2 the number of BAD ones, respectively. We configured the outputs in this way for our testing Task.

- 3 Check the color of the testing Window.

Color	Result of Module
Green	Value is within the threshold.
Yellow	Value is within the threshold, but close to the limits. Warning.
Red	Value surpassed the threshold. Error.

Exercise Step 6: Integration into the Process Environment

The digital in-and outputs configured in the software have to be wired electrically, too. The Power/PLC cable provides the interfaces. The wiring is done easily when using the FV-EXT1 Break-Out Module. It has signal lamps to visualize the input and output states and provides switches to simulate PLC action.

One output is used to synchronize a flash lamp with the image taking in many cases. The other outputs are available to exchange sorting results with the machine control, e.g. a PLC.

One input is used to start the Caminax® testing Task in most applications. The other ones may be used to switch automatically between different testing Tasks.

Please refer to the Caminax® *Reference Manual* and the manual of the Break-Out Module for more detailed information.

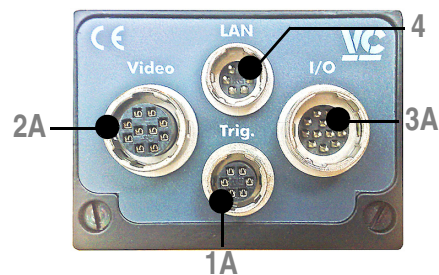
Technical Appendix

Technical Data

Type	612S	812 C (color)	632	680	1032	1080
	1200		3200	8000	3200	8000
Sensor	1/3"-Sony 640 x 480 Mono- chrome CCD	1/2"-Sony 782 x 582 Color CCD	1/3"-Sony 640 x 480 Monochrome CCD		1/3"-Sony 1024 x 768 Monochrome CCD	
Evaluation Area	588 x 476 Pixel		636 x 480 Pixel		952 x 768 Pixel	
Max. Frames per Second	25 Hz	10 Hz	52 Hz		20 Hz	
Exposure Time	25 µs up to 5 sec					
Processor	Texas Instruments DSP TMS320C6000 Series					
Memory Size RAM / Flash	16 MB / 2 MB	32 MB / 4 MB	32 MB / 4 MB		32 MB / 4 MB	
Memory Card	No	Yes	Yes		Yes	
Interfaces	RS-232	Ethernet 100 Mbit				
	Power supply 24 VDC ± 20%, max. 5.5 W					
	4 digital inputs, opto-decoupled					
	4 digital outputs, 400 mA, opto-decoupled					
	SVGA/Video					
	Keypad					
	Trigger					
	Flash					
Lens Adapter	C-Mount					
Operating Conditions	Max. 80% relative air humidity, -5°C ... 45°C (23°F ... 113°F)					
	Shock acceleration <70 g					
	Vibration <7 g (11-200 Hz)					
Dimensions	111 x 50 x 45 mm (without optics)					
Weight	Approx. 350 g					

Overview of Interfaces

Overview of
interfaces

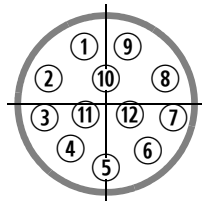
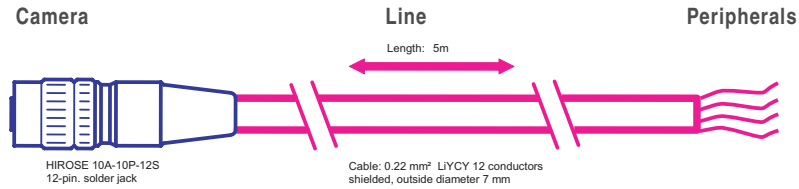


Plug	Sign on camera	Type of connector	Camera connector	Name of the cable / length	Outgoing cable connector	Function
1A	Trig.	6-pin Hirose	Socket	Keypad cable, 5 m	DB9	Keypad connector
2A	Video	10-pin Hirose	Socket	SVGA monitor cable, 5 m	DB15	SVGA video display connector
3A	I/O	12-pin Hirose	Plug	Power/PLC cable, 5 m	open	Power supply and PLC communication
Pos. 4 type-related (RS-232 or LAN)				order separately		
4	RS-232	6-pin Hirose	Plug	V24 (RS232) cable, 5 m	DB9	Serial data exchange
4	LAN	6-pin Hirose	Plug	LAN cable 5 m	RJ-45	Ethernet data exchange

Digital Interfaces

Pin assignment
»Power/PLC (I/O)«

For all Caminax® types



View of the solder side of the socket

open

Camera connector		Function	Peripherals	
Pin	Signal		Cable color	Pin
①	24 V IN PLC	Power supply digital outputs	red	—
②	24 V IN camera	Power supply camera	red/blue	—
③	Common GND IN for camera and PLC		black	—
④	IN1	Digital program selection	pink	—
⑤	OUT3	User configurable output	yellow	—
⑥	OUT2	User configurable output	green	—
⑦	OUT1	Flash output or user configurable output	brown	—
⑧	OUT0	Ready/busy signal	white	—
⑨	24 V IN PLC	Power supply digital outputs	grey/pink	—
⑩	IN3	Digital program selection	violet	—
⑪	IN2	Digital program selection	blue	—
⑫	IN0	Trigger or digital program selection	grey	—

All three 24 V wires have to be connected to operate Caminax® properly:

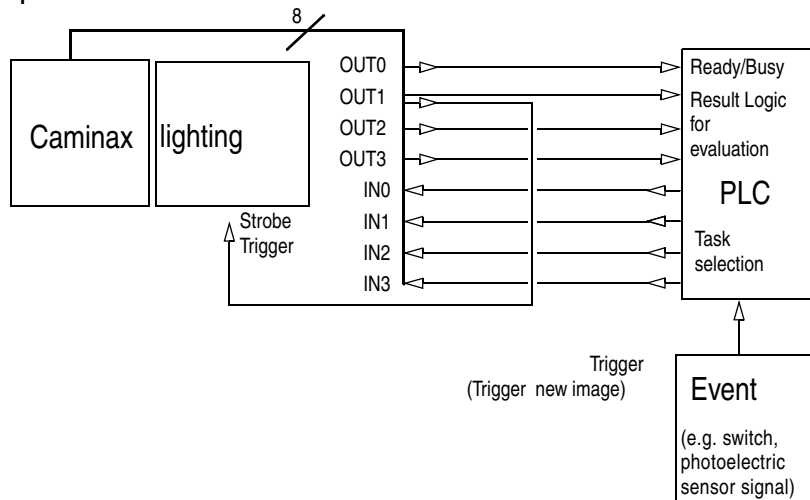
- red ① ... for PLC signals (24 V IN PLC)
- red/blue ② ... for camera (24 V IN camera)
- grey/pink ⑨ ... for PLC signals (24 V IN PLC)

Power Supply

A polarity reversal protection diode prevents damages from accidental polarity reversal of the power supply.

Using the Digital IOs

Example



Digital Inputs

CAUTION

Risk of destruction by overvoltage!
Voltages above 40 V can destroy the digital inputs and outputs.

Available Inputs

Caminax[®] has 4 digital inputs.

Input	Description
IN 0 [Trigger new image]	Input 0 has a double function. It is available for the digital selection of the Task by the PLC, and also reserved for the start signal (new image trigger signal).
IN 1, 2, 3	Available for the digital Task selection (PLC start).

Digital Inputs Usage

- You activate the new image trigger by switching it from LOW to HIGH.
- Please refer to the *Reference Manual* for changing the Task by external digital inputs.

Inputs - Technical Data

Parameter	Data
Operating Voltage	24 V, PLC compatible
Galvanic Isolation	Yes, optical de-coupled
Input Protection Circuit	Yes
Max. Input Current at 24 V	50 mA
Response Threshold (Input Detects HIGH)	8 V
Input current at response threshold	1 mA
Internal Signal Delay	Approx. 150 µs

Digital Outputs

CAUTION
Risk of destruction by overvoltage! Voltages above 40 V can destroy the digital inputs and outputs.

Available Outputs

Caminax[®] has 4 outputs.

Output	Description
OUT 0 [Ready]	Caminax [®] sets a this output high after having finished to process a Task. The signal is low while Caminax [®] is busy processing a Task.
OUT 1 [Flash]	Output 1 is reserved for a flash trigger signal set during image exposure if the flash mode is configured for image taking. The output usage is user defined if no flash is used.
OUT 2	The output usage is user defined.
OUT 3	The output usage is user defined.

Double Function of the Outputs

The outputs echo the inputs, if the inputs have been used successfully for a Task change. All outputs are set to 0 if the Task selected through an input code does not exist.

Outputs - Technical Data

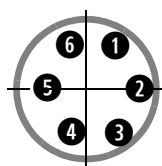
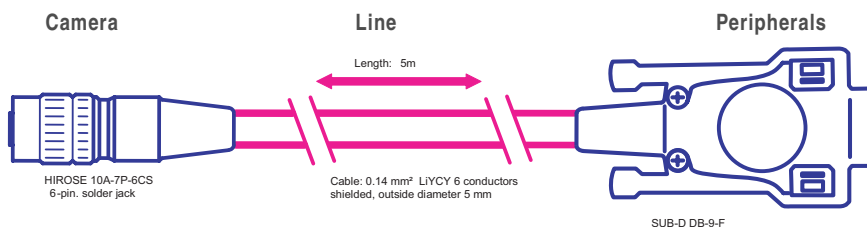
Parameter	Data
Operating Voltage	24 V
Galvanic Isolation	Yes, optical de-coupled
Current	150 mA per output (total 400 mA)
Switching Capacity	Maximum 3.6 W
Protection against Inductive Loads	Yes
Resistance when Switched On	< 0.6 Ohms

Keypad Connector

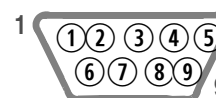
The pin assignment »Keypad (Trig.)« is depending on the Caminax[®] model used.

Pin Assignment »Keypad (Trig.)«

Caminax[®] 612 S and Caminax[®] 812C



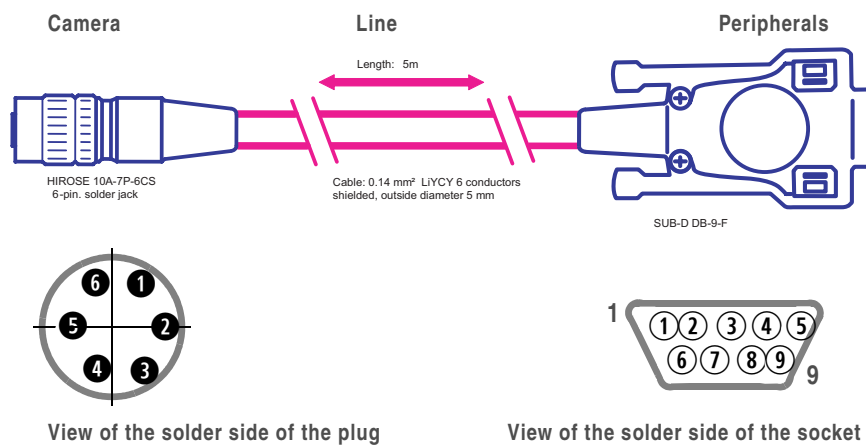
View of the solder side of the plug



View of the solder side of the socket

Camera Connector			Peripherals
Pin	Signal	Cable Color	Pin
①	Trigger IN –	Green	④
②	+5 V OUT	Brown	⑧
③	GND	White	⑤
④	Keypad IN	Pink	①
⑤	Trigger OUT	Gray	⑥
⑥	Trigger IN +	Yellow	⑨
nc	nc	nc	②
nc	nc	nc	③
nc	nc	nc	⑦

Caminax[®] 632 / 1032 and Caminax[®] 680 / 1080



Camera Connector			Peripherals
Pin	Signal	Cable Color	Pin
①	V24 TxD	Green	②
②	+5 V OUT	Brown	⑧
③	GND	White	⑤
④	V24 RxD	Pink	③
⑤	Trigger OUT	Gray	⑥
⑥	Trigger IN	Yellow	⑨
nc	nc	nc	①
nc	nc	nc	④
nc	nc	nc	⑦

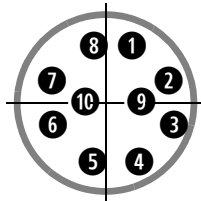
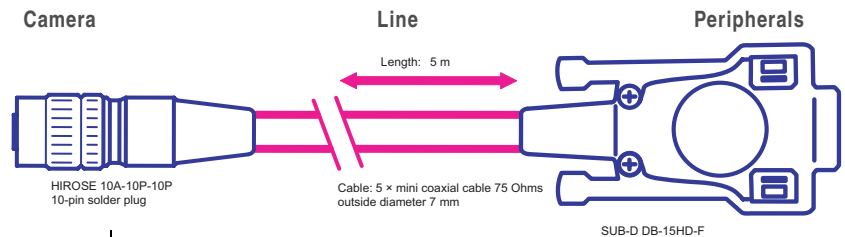
Keypad Usage

- Connect the keypad cable between the camera and keypad. Finished.

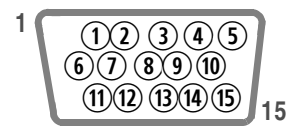
Video Output

Pin Assignment »SVGA Video«

For all Caminax® types



View of the solder side of the plug



View of the solder side of the socket

Camera Con- nector			Peripherals
Pin	Signal	Cable Color	Pin
①	Green GND	Green shielding	⑦
②	Green OUT	Green	②
③	Red GND	Red shielding	⑥
④	Red OUT	Red	①
⑤	Vertical sync. GND	Gray shielding	⑪
⑥	Vertical sync. OUT	Gray	⑭
⑦	Horizontal sync. GND	White shielding	⑩
⑧	Blue GND	Blue shielding	⑧
⑨	Blue OUT	Blue	③
⑩	Horizontal sync. OUT	White	⑬
nc	Monitor ID	nc	④
nc	nc	nc	⑤
nc	Encoding	nc	⑨
nc	Monitor ID	nc	⑫
nc	nc	nc	⑮

Video Output Usage

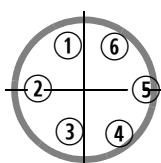
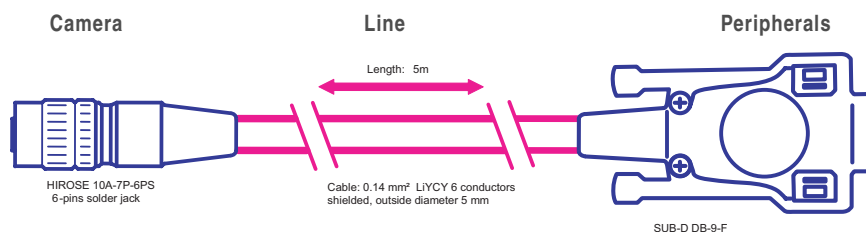
- Connect the SVGA cable between the camera and the cable of the video display. Finished.
- A video output cable with a DB15 plug instead of DB 15 socket is available optionally. This cable can be plugged into the video display directly.

V.24 or LAN Connector

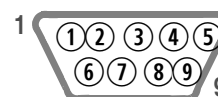
Depending on the Caminax[®] model a V.24 or LAN connector is available.

Pin Assignment
»RS-232 (V24)«

RS-232 (V.24) for Caminax[®] 612S



View of the solder side of the socket



View of the solder side of the socket

Camera Connector			Peripherals
Pin	Signal	Cable Color	Pin
①	RTS	Yellow	⑧
②	TxD	Brown	②
③	GND	Gray	⑤
④	nc	Pink	nc
⑤	CTS	Green	⑦
⑥	RxD	White	③
nc	DCD	nc	①
nc	DTR	nc	④
nc	DSR	nc	⑥
nc	RI	nc	⑨

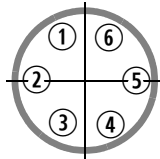
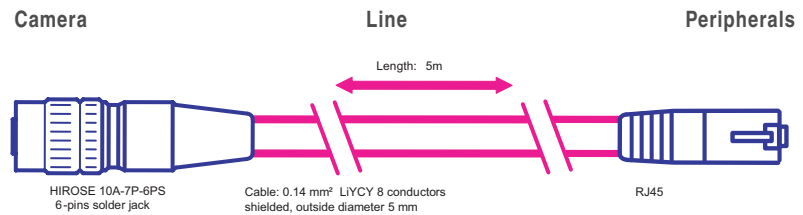
Serial Interface Usage

Refer to the *Reference Manual* for details.

- The RS 232 cable is available as an option.
- Uses of the cable:
 - Configuration exchange with a PC. All Tasks and their settings can be stored on a PC for backup. Caminax[®] configurations can be cloned by loading the configuration from the PC to back to other Caminax[®] cameras.
 - Reference image transfer between PC and Caminax[®]
 - RS 232 based Task selection.
- Connect the Hirose socket of the V24 cable to the camera, and the other end to the SUB-D socket on the PC.

Pin Assignment »LAN«
Cable

For all Caminax® models with LAN



View of the solder side of the socket



View of the front of the plug

Camera Connector			Peripherals
Pin	Signal	Cable Color	Pin
①	T-	Pink	②
②	T+	White/Pink	①
③	nc	nc	nc
④	nc	nc	nc
⑤	R-	Green	⑥
⑥	R+	White/Green	③
nc	nc	Blue	④
nc	nc	White/Blue	⑤
nc	nc	White/Brown	⑦
nc	nc	Brown	⑧

Ethernet Interface Usage

Refer to the *Reference Manual* for details.

- The LAN cable is available as an option.
- Uses of the cable:
 - Configuration exchange with a PC. All Tasks and their settings can be stored on a PC for backup. Caminax® configurations can be cloned by loading the configuration from the PC to back to other Caminax® cameras.
 - Reference image transfer between PC and Caminax®
 - Ethernet based Task selection.
- Connect the LAN cable to the Hirose socket on the camera, and the RJ45 plug on the other end to the internal network.
- A crossover adapter is needed for direct Caminax® - PC connection without Ethernet switch.

Housing Dimensions

- Dimensions 111 × 50 × 45 mm (without lens)

