Panasonic

P400MA

User's Manual

for Vision P400 V4.1

Panasonic

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Please direct support matters and technical questions to your local Panasonic representative.

Important Information

Please read the following information **before** you begin with the installation or operation!

◆NOTES

- **Use only products (cameras and camera cables) offered by Panasonic for specific use with the Imagechecker P400MA. The use of any other products will negate the warranty for the entire system since third-party components can damage the P400MA. In this case, Panasonic will not assume liability for the proper functioning of the P400MA.**
- **Under no circumstance should you ever disassemble the P400MA or change the system's factory settings unless you are specifically asked to do so in this manual. Any tampering will negate the warranty for the entire system since such changes may damage the P400MA. In this case, Panasonic will not assume liability for the proper functioning of the P400MA.**
- **The P400MA is a precision device and should under no circumstance be exposed to shocks or vibrations.**
- **The P400MA is neither waterproof, dustproof nor rustproof. Consequently, it is absolutely necessary to install the Imagechecker in a dry, clean environment.**
- **Protect the P400MA from exposure to direct sunlight and explosive or corrosive gases.**
- **Disconnect the power supply before connecting or disconnecting any connectors to or from the P400MA.**
- **Never apply force to any P400MA connectors or cables. Do not bend the cables. The connections should never be unplugged by pulling on the cable. Always hold the connector by the plug when unplugging any component from the Imagechecker.**
- **NEVER touch an exposed connector contact after unplugging a connector from the P400MA, and ensure that no fluids/chemicals come into contact with the contacts.**
- **Leave ample space around the P400MA so that heat generated during operation can be dissipated by the ventilators.**
- **Please ensure that the ventilators function properly.**
- **Guard against unintended data loss by maintaining data protection in a safe location.**
- **Ensure that the power supply is disconnected while you work on the equipment.**
- **Avoid discharges of static energy.**

- **Use the components only within the humidity and temperature ranges specified.**
- **Take care to keep dust accumulation to a minimum since dust may impair the functioning of the components.**
- **Do NOT clean the components with solvents or aggressive cleansers. These substances can destroy equipment parts and damage the paint.**

Important Symbols

One or more of the following symbols may be used in this documentation:

Warning!
The warning triangle indicates especially important safety instructions. If they are not adhered to, the results could be fatal or critical injury.

◆CAUTION

Indicates that you should proceed with caution. Failure to do so may result in injury or significant damage to instruments or their contents, e.g. data.

◆NOTE

Contains important additional information.

◆EXAMPLE

Contains an illustrative example of the previous text section.

◆Procedure

Indicates that a step-by-step procedure follows.

◆REFERENCE

Indicates where you can find additional information on the subject at hand.

◆KEYPOINTS

Summarizes key points in a concise manner.

◆SHORTCUTS

Provides helpful keyboard shortcuts.

◆EXPLANATION

Provides brief explanation of a function, e.g. why or when you should use it.

☛ next page

Indicates that the text will be continued on the next page.

This documentation uses the following conventions to indicate elements from the user interface or the keyboard:

"Data Field"	Data field entries and option names are rendered in quotation marks.
[Button]	Buttons are indicated by square brackets.
<Key>	Keys are indicated by pointed brackets.

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Chapter 1

System Description

1.1 Introduction

This page provides you with an overview of all the major P400MA components and optional accessories. These components will be described in more detail in the sections to follow.

Equipment/Accessories	Order number
Controller set: • P400MA controller • Mouse • Windows XP (multi language: Czech, Dutch, English, French, German, Italian, Spanish, Simplified Chinese, Swedish) • Flash drive (see software)	ANPMA 4311V1 (Multi language version with frame grabber for parallel and serial grabbing, digital I/O board ANPC 850V3D and 7 PCI slots)
Software • Vision P400 V4.x • flash drive "Vision P400 License" with software license and system recovery	Optional, without device: ANPC 74400DD / ANPC 74400ED Vision P400 version 4.x. Bundle license (English/German)
Mouse (PS/2)	ANPS 836D
Keyboard (PS/2)	ANPC 835ED (English) ANPC 835DD (German) ANPC 835FD (French)
Camera	ANPC 831D (Progressive and partial Scan, 636 x 480 pixel) ANPC 834D (Progressive and partial Scan, 1380 x 1035 pixel) ANPC 836D (Double-speed and partial Scan, 636 x 480 pixel) ANPC 837D (Double-speed and partial Scan, 1024 x 768 pixel)
Frame grabber	ANPC 802D (2 cameras parallel or 4 cameras serial)
ICH P400 flash trigger connection unit (optional, not for use with digital I/O board ANPC 850V3D)	ANPC 8101D
ICH P400 digital I/O board with 16 inputs/outputs	ANPC 850V3D
Camera cables	ANPC 87103D (3m, only for ANPC 831D/834D/836D/837D) ANPC 87105D (5.47yd, only for ANPC 831D/834D/836D/837D) ANPC 87110D (10m, only for ANPC 831D/834D/836D/837D) ANPC 87115D (16.40yd, only for ANPC 831D/834D/836D/837D)
Mounting bars for floor mounting	ANMPM 8018
Mounting bars for wall mounting	ANPMA 8019
3V battery	ANPS 8610D
Fan	ANPMA 8608
Connector for 24 Volt connection	ANPMA 8609
Laboratory socket for ANPC 831D/834D	ANPC 8311D
Laboratory socket for ANPC 836D/837D	ANPC 8361D
Serial programming cable for ANPC 831D/834D	ANPC 8300D

Equipment/Accessories	Order number
ICH P400MA hard disk (2,5") without software , 40GB (24/7)	ANPMA 861
CompactFlash card 2GB	ANPMA 862
USB flash drive 2GB	ANPMA 866
External power supply (100-240VAC IN, 50-60Hz, 24DC OUT, 5.0A)	HSA 120S24

1.2 Industrial PC

The Industrial PC P400MA (called Imagechecker hereafter) was developed especially for use in demanding industrial environments. The Imagechecker provides ultimate convenience as a result of:

- 24V DC power supply (ATX functionality of the internal power supply)
- Bootable via flash drive
- Backup and recovery functionality via flash drive and network
- Compact size
- Ready for operation

The device has CE marking and conforms to the requirements listed in part 15 of FCC (subpart B, class A).

According to the EMC directive, the device is compliant with the following norms:

- EN 55022 class A
- EN 61000-4-2: 2001
- EN 61000-4-3: 2006
- EN 61000-4-4: 2004
- EN 61000-4-5: 2006
- EN 61000-4-6: 2007
- EN 61000-6-2: 2005

Danger of radio interferences!
The Imagechecker is an appliance of class A. The Imagechecker is designed for industrial use only. This appliance may cause radio interferences if installed in a residential area. If you are using the Imagechecker in a residential area, you are obliged to take suitable precautions against radio interference and to pay for the cost involved.

All connected cables must be shielded. The camera and power supply cables must be equipped with ferrite core (impedance: ca. 141/241Ohm at 25/100MHz).

◆NOTES

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- **Reorient or relocate the receiving antenna.**
- **Increase the separation between the equipment and receiver.**
- **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.**
- **Consult the dealer or an experienced radio/T.V. technician for help.**

Panasonic Electric Works Europe AG is not responsible for any radio television interference caused by unauthorized modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Panasonic Electric Works Europe AG. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user. The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

1.2.1 Specifications

Industrial PC	
Casing	Powder-coated galvanized steel case with ground connection
Dimensions	Width: 206mm Height: 113mm (with feet) Depth: 219mm (without protruding connectors)
Mounting (option)	• Floor mounting rails • Wall mounting rails
Power supply	Mini ITX 160 Watt (ATX functionality) 24V DC input voltage
Ventilation	Axial DC fan Y.S. TECH FD124020HB Max. air flow (CFM) 7.5
Battery	CR2032 lithium button cell 3V
CPU	Intel Celeron M440, 1,86GHz with active cooling
RAM	1GB DDR2 SDRAM (max. 4GB)
Chip set	Intel 82945GM
Graphics	Intel GMA 950 up to 224MB shared memory
BIOS	(Phoenix-AWARD-BIOS), P400MA-1-01/08
Ethernet	Intel 82562ET 10/100 Base TX Ethernet Marvell 88E8053 PCIe Gigabit
Connections	4 x USB 2.0 PS/2 for mouse and keyboard 1 x Firewire IEEE 1394 2 x RS232
Hard disk (HDD)	40GB S-ATA, 2,5", for 24/7 operation
CompactFlash card	2GB TRS Star CompactFlash card (with operating system and Vision P400)
USB flash drive	2GB with software license and system recovery
Digital I/O board (ANPC 850V3D)	16 opto-isolated inputs 16 outputs, PhotoMOS relays, short-circuit protected, bipolar 1 flash output 1 start input
Frame grabber (ANPC 802D)	4 cameras serial or 2 cameras parallel
Mouse	3-button mouse, IBM-compatible (right-handed), PS/2
Operating system	Windows XP Embedded OEM version
Image-processing software	Vision P400
Weight (industrial PC)	3,0kg
Packaging	Width: 35cm Height: 30cm Depth: 34cm Weight: 3.3kg (device incl. packaging)
Protection class	IP20

Industrial PC	
Environmental requirements	
Current consumption	approx. 72 Watt when 4 cameras are used (24V DC/3A)
Storage temperature	-20°C to 60°C (no ice, no condensation)
Operational temperature	41.00°F to 104.00°F (no ice, no condensation)
Ambient humidity (operation)	20% - 80% non-condensing
Ambient humidity (storage)	5% - 92% non-condensing
Vibration resistance	5 to 9Hz, fixed amplitude of 3.5mm, 1 minute cycle 9 to 150Hz, constant acceleration from 9.8m/s^2, 10 minute on 3 axes
Shock resistance:	98m/s^2, 4 times on 3 axes

◆NOTE

Specifications are subject to change without notice.

1.2.2 Digital I/O Board

The digital I/O board ANPC 850V3D has 16 digital inputs and outputs (see page 11) each and can be used to control a flash (see page 32). The digital outputs are equipped with short-circuit protected PhotoMos relays to protect against overload. It is possible to connect further peripheral devices (see page 13).

Details on pin 11 (start signal)

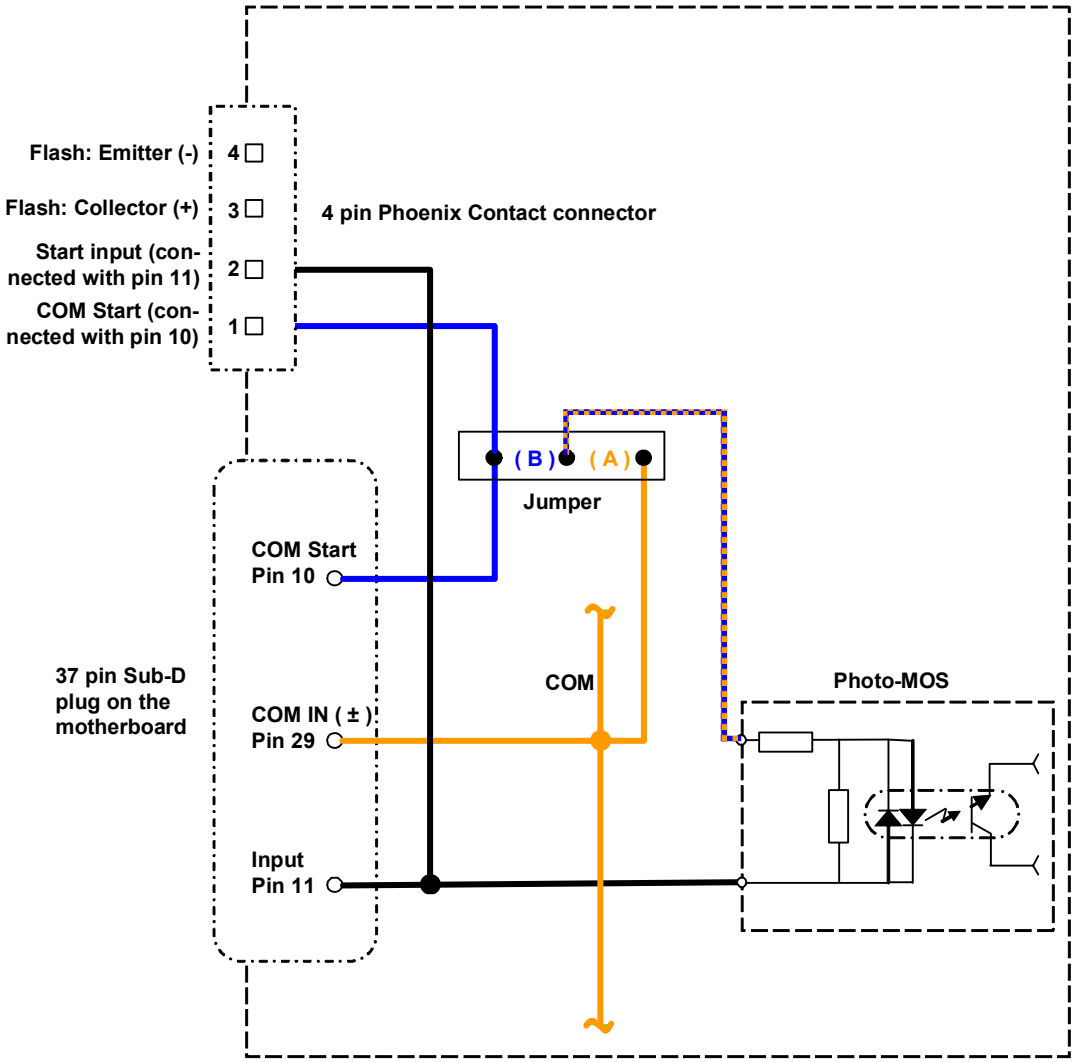
By default, the output signal at pin 11 (start) uses pin 29 as a common ground with input signals at pins 12 to 14 and pins 30 to 30, see figure. By using a jumper you can separate the ground for pin 11 from the common ground at pin 29 and move it to a separate contact at pin 10.

There are two reasons to do this:

1. You can use a sensor with an NPN output to trigger the start signal. At the same time, you can use the other pins to connect a PLC with PNP outputs.
2. You can connect the start signal wire directly to the Phoenix connector without having to change the Sub-D plug.

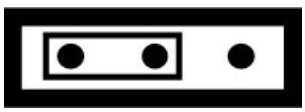
◆NOTES

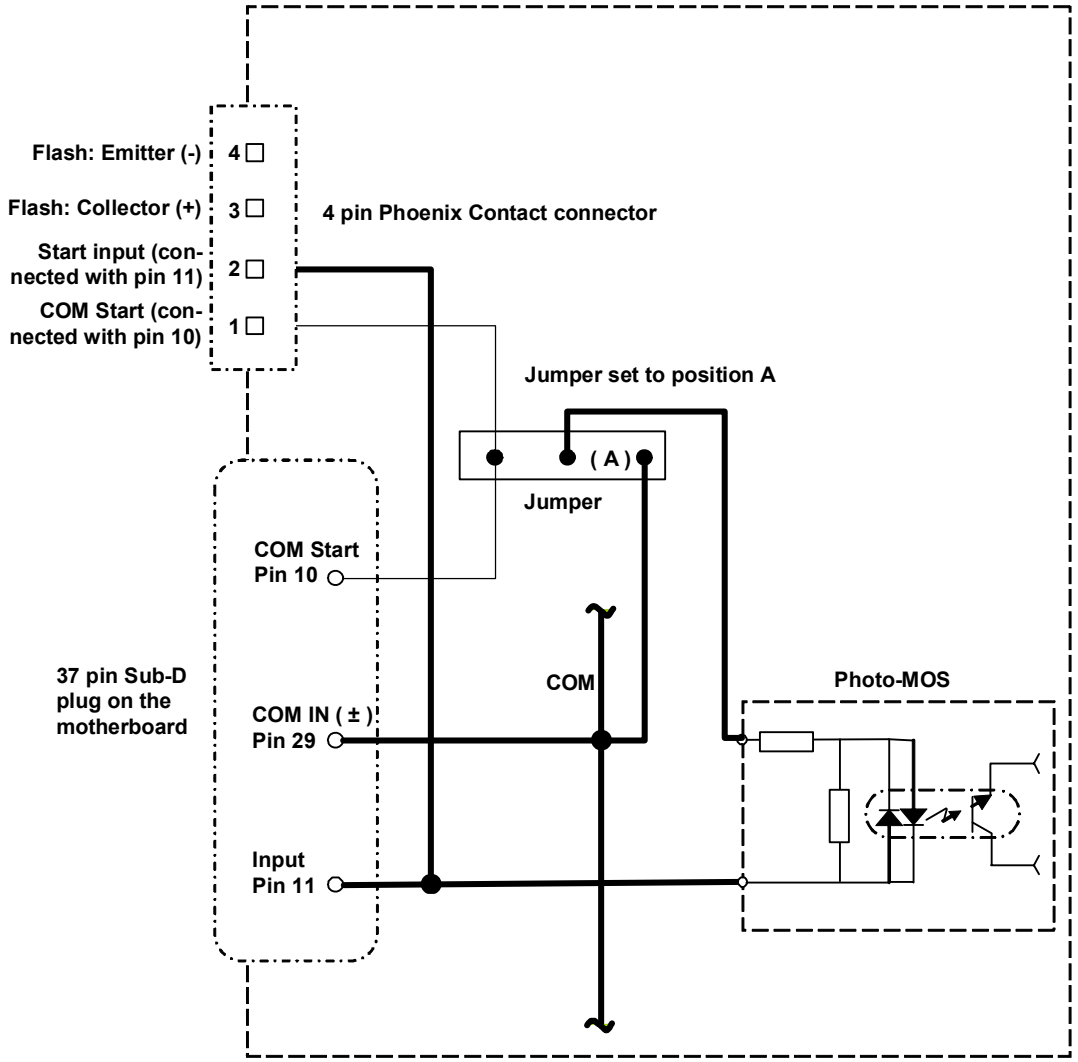
- **The signal pin 2 of the 4-pin Phoenix Contact plug is hardwired with pin 11 of the 37-pin Sub-D plug of the board.**
- **The ground terminal of the 4-pin Phoenix Contact plug is hardwired with pin 10 of the 37-pin Sub-D plug of the board.**



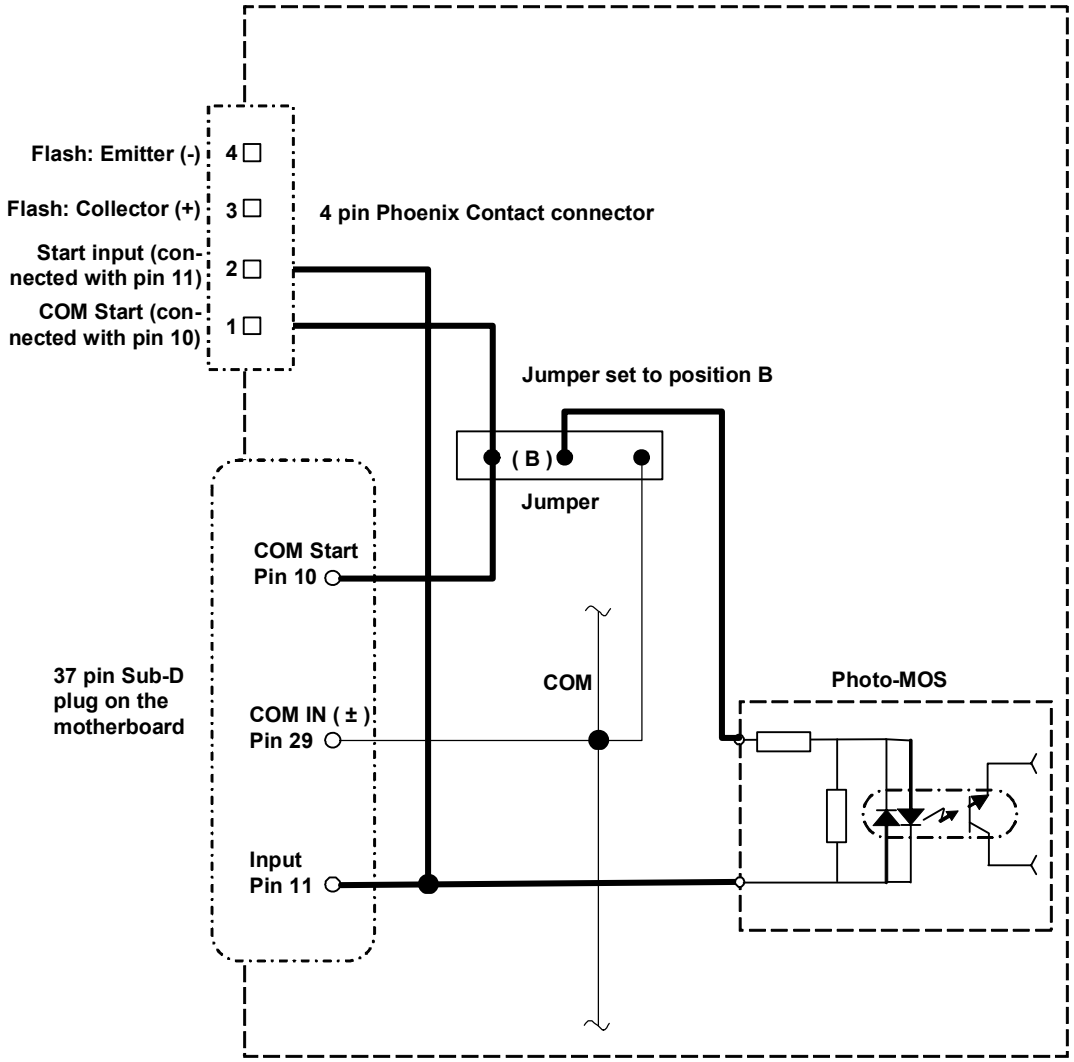
Wiring diagram for using the jumper on ANPC 850V3D

Using the jumper

Jumper position	Functionality
Position A (factory setting)	The start signal must be connected to pin 37 of the 37-pin Sub-D plug of the board. • The start signal at pin 11 of the 37-pin Sub-D plug uses COM pin 29 as a common COM wire together with pins 12 to 14 and 30 to 33. • The contacts pin 10 of the 37-pin Sub-D plug and pin 1 of the 4-pin Phoenix Contact plug have no functionality.
Position B 	• Pin 11 of the 37-pin Sub-D plug now has a separate COM wire at pin 10. • In addition, you can transmit the start signal separately at the 4-pin Phoenix Contact connector and the pins 1 and 2.



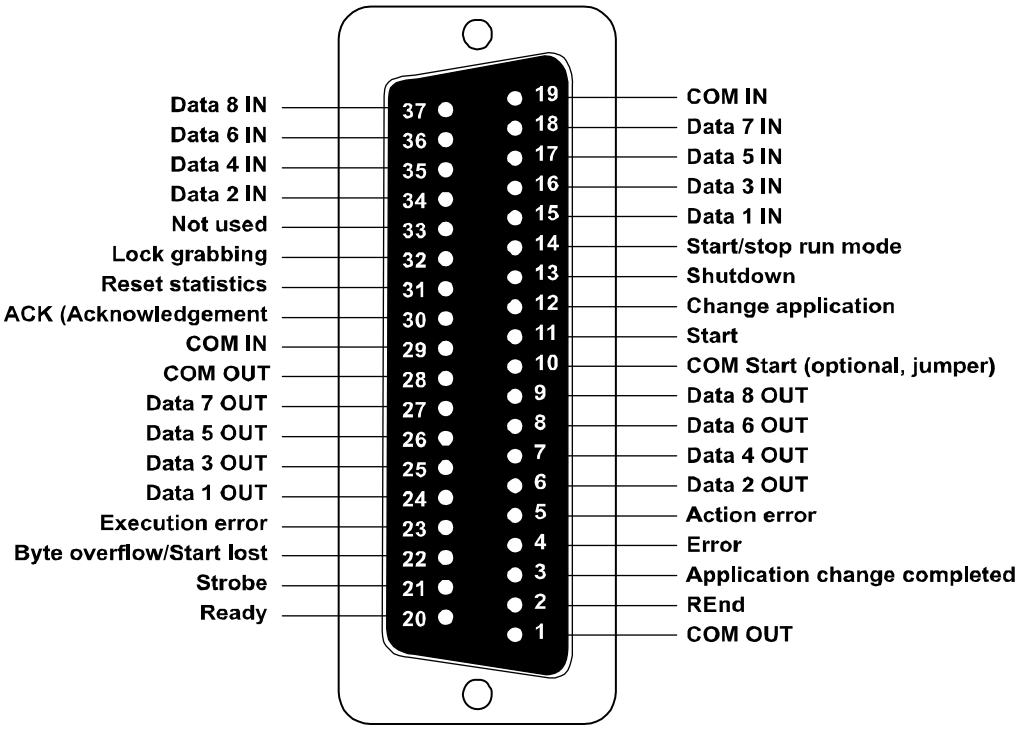
Wiring diagram showing the factory setting (jumper at position A)



Wiring diagram when jumper is at position B

1.2.2.1 ANPC 850V3D

The figures below show the pin assignment of the digital I/O board ANPC 850V3D when you look at the Imagechecker.



Female sub-D connection on the P400MA board (top view)

Inputs of the digital I/O board ANPC 850V3D

Inputs (16 Signals)			
Pin No.	**Pin for COM**	**Functionality**	
11	29 (Default. Alternatively, pin 10 can be defined as an individual ground terminal by changing the jumper setting (see page 7))	Start: starts the application Please refer to the information on wiring the optional ground terminal! Identical with Phoenix contact pin 2 (see page 7)	
30	29	ACK: response of external device	
12		Change application	
31		Reset statistics	
13		Shut down	
32		Lock grabbing (see page 126)	
14		Start/Stop run mode	
33		Not used	
15	19	Data 1	8 bit data input of the application or execution group number. Input of 0000 0000 means selecting application No. 1 or execution group 0.
34		Data 2	
16		Data 3	
35		Data 4	
17		Data 5	
36		Data 6	
18		Data 7	
37		Data 8	

Outputs of the digital I/O board ANPC 850V3D

Outputs (16 Signals)			
Pin No.	**Pin for COM**	**Functionality**	
20	1	PCReady: next application start possible	
2		REnd: Read image end	
21		Strobe: indicates output data available	
3		Application change completed	
22		Error due to byte overflow / lost start	
4		Error	
23		Execution error	
5		Action error	
24	28	Data 1	8 bit data output
6		Data 2	
25		Data 3	
7		Data 4	
26		Data 5	
8		Data 6	
27		Data 7	
9		Data 8	

Pin assignment of the Phoenix Contact connector

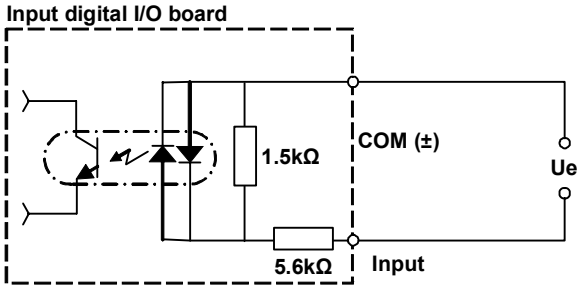
Pin No.	Functionality
1	Individual ground terminal for start signal (same potential as pin 10 at the Sub-D plug). **Note:** By default, this terminal is NOT active. Please refer to the details about this terminal (see page 7)!
2	Start signal (same potential as pin 11 at the Sub-D plug) **Note:** By default, this terminal is NOT active. Please refer to the details about this terminal (see page 7)!
3	Flash emitter (see page 32)
4	Flash collector (see page 32)

1.2.2.2 Connect Peripheral Devices to ANPC 850V3D

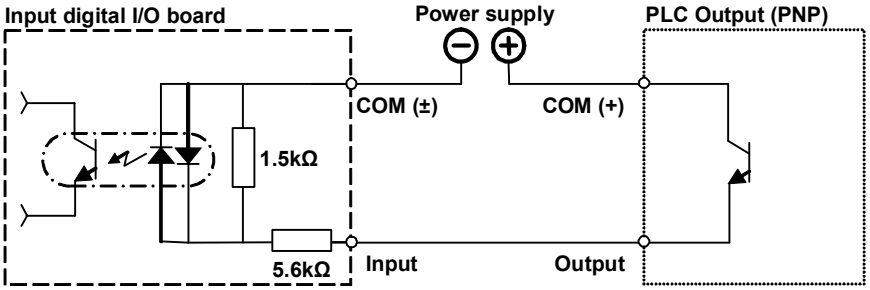
Please note the following specifications for the input and output circuit:

Input circuit

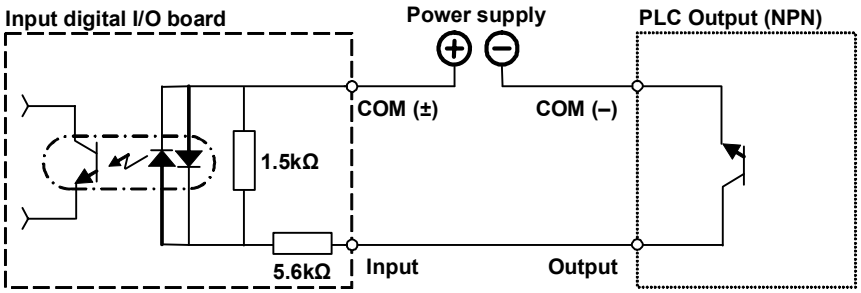
Voltage range Ue	State
0V up to 4V	OFF
12V up to 24V	ON (rated input voltage)
Min. 9.6V to max. 26.4V	ON (operating voltage)
More than 26.4V	Not permissible! Danger of destruction!



Input circuit principle



Circuit diagram with PNP connection

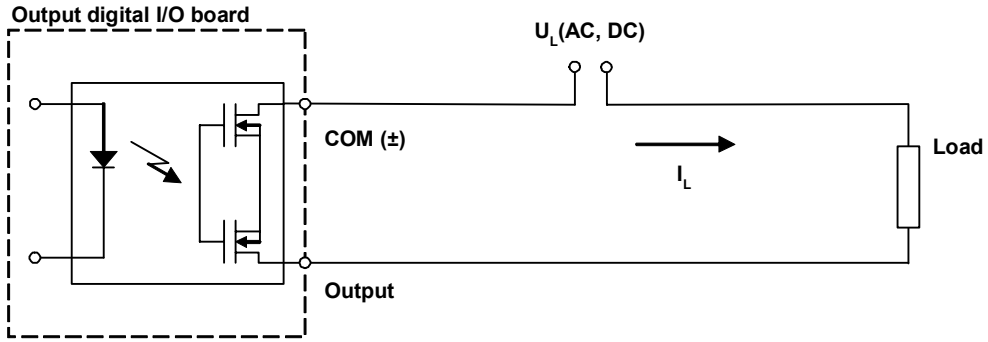


Circuit diagram with NPN connection

Danger of damage to the equipment!
Applying more than 26.4V to the inputs may destroy them!

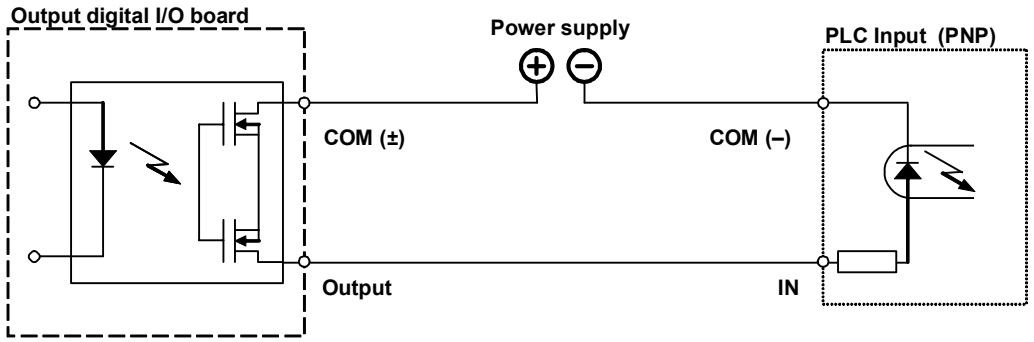
Output circuit

Important: The description of the PhotoMos output circuit is valid for all output signals. For reasons of speed, the flash signal will be output via a special PhotoMOS output with a rise time of 2µs. Please note the following specifications for the output circuit:

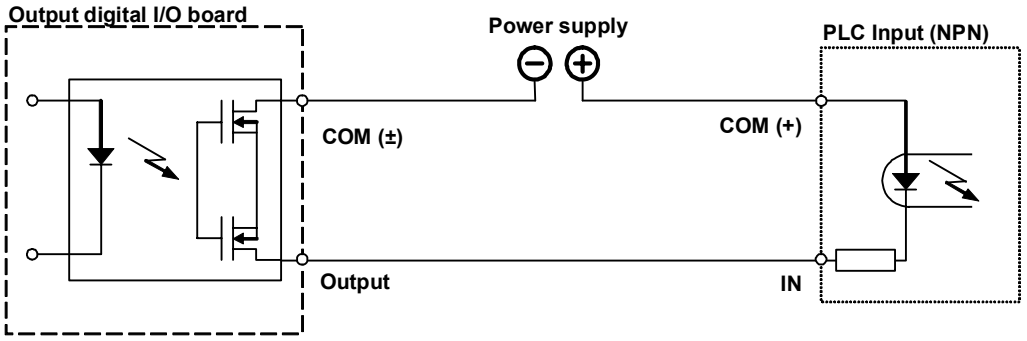


PhotoMOS output circuit principle

Specification	I_L	V_L
Maximum load	100mA	24V DC



Connecting a PLC with PNP inputs



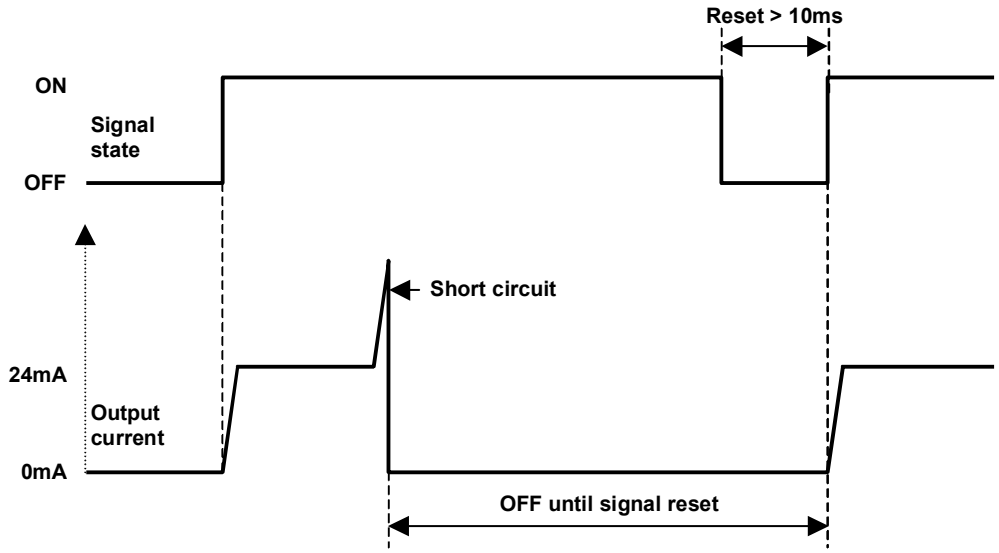
Connecting a PLC with NPN inputs

Danger of damage to the equipment!
Do not connect circuits with more than 26.4V (AC or DC)!
When you apply more than 100mA to the outputs, they may be destroyed due to overheating!

Short-circuit protection of the outputs

After a short circuit with a load of more than 160mA the inputs automatically switch to the state "OFF". It is absolutely necessary to find and correct the cause of the short circuit!

The output is ready for operation again when you have reset the signal for at least 10ms.



Short-circuit protection of the outputs

1.2.3 Operating System

The operating system is Windows XP Embedded. The C: drive with the pre-installed operating system and the Vision P400 software is on the CompactFlash Card (2GB). The D: drive is the hard disk with a maximal storage capacity of 40GB.

The following languages are installed:

- German
- English
- French
- Italian
- Dutch
- Swedish

- Spanish
- Czech
- Simplified Chinese

Menus and dialog windows will be displayed in the language you have selected.

1.2.3.1 Write Protection

The operating system Windows XP Embedded uses a sophisticated write protection to prevent users from inadvertently changing the system settings.

File-Based Write Filter (FBWF)

Windows XP Embedded supports the "File-Based Write Filter" (FBWF). With FBWF it is possible to protect the complete operating system against changes so that it cannot be corrupted by accident. All changes to files or to the settings of the operating system are saved temporarily in the RAM and will be lost when you switch off the system.

However, it is possible to exclude parts of the operating system from the write protection. This means you can give write access to individual files or folders.

The following Imagechecker folders grant the user write access by default:

- C:\Temp
- D: drive (to save permanent data)
- C:\SysFiles
- Some log and temporary files of the operating system

◆NOTES

- **The C: drive with the pre-installed operating system and the Vision P400 software is on the CompactFlash Card (2GB).**
- **The D: drive is the hard disk with a maximal storage capacity of 40GB.**

Registry Filter

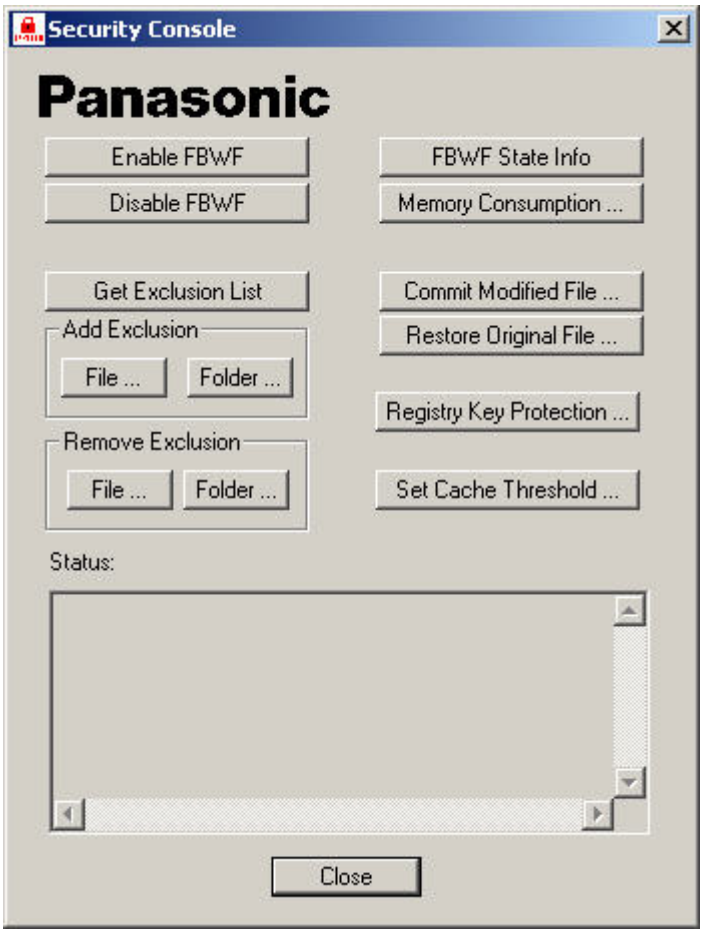
Windows XP Embedded supports the "Registry Filter". Together with the file-based write filter the registry filter allows you to save changes to individual registry keys permanently. This means you can save Vision P400 settings stored in the registry file permanently.

◆NOTES

- **The parts of the registry file used for storing the Vision P400 settings are excluded from the write protection.**
- **Use the tool Security Console (see page 18) if you want to save settings in the registry file permanently or if you wish to switch the write protection on or off.**

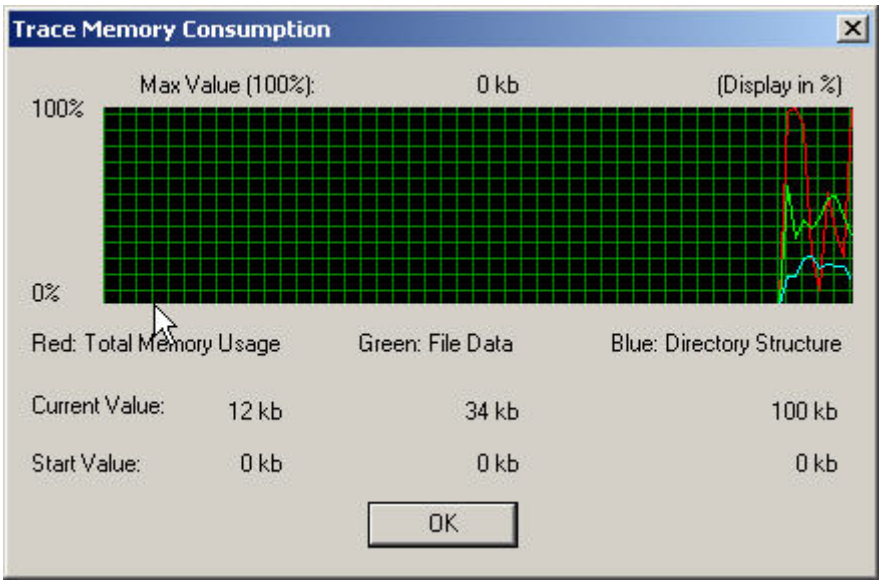
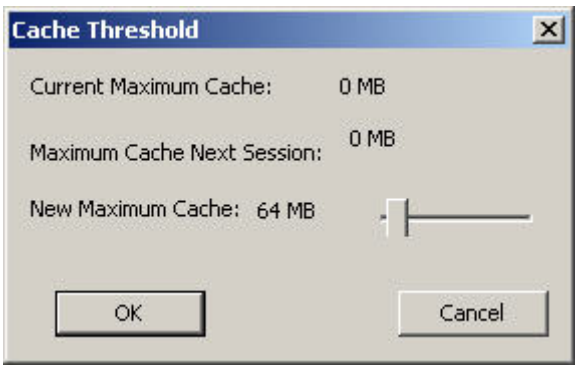
1.2.3.2 Changing the Write Protection with Panasonic Security Console

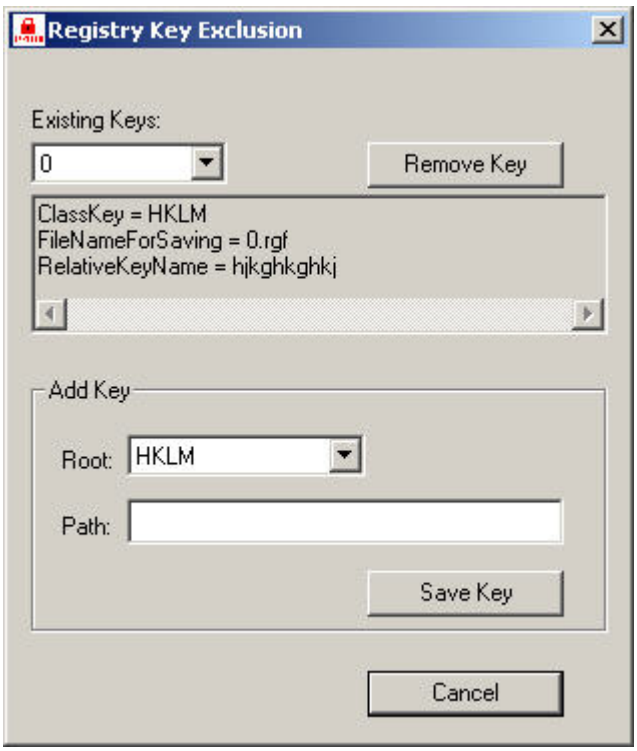
Use the tool Security Console if you want to save settings in the registry file permanently or if you wish to switch the write protection on or off.



Security Console start-up screen

Button	Available functionality
Enable FBWF	Switches on the "File-Based Write Filter" (FBWF) (see page 17). This activates the write protection of the operating system. You need to restart the system to apply the change. **Please note: By default the write protection is OFF.**
Disable FBWF	Switches off the FBWF. This deactivates the write protection of the operating system. You need to restart the system to apply the change.
FBWF State Info	Informs you about the current state of the system, e.g. whether the FBWF is switched on or off.

Button	Available functionality
Memory Consumption	Allows you to track the RAM memory consumption of the FBWF. All system changes are written to the cache (see below) for temporary storage. When data is written continuously to a write-protected area, you may run out of memory. In this case it is necessary to transfer data to an area that is not write-protected, e.g. drive D:. Use the button [Memory Consumption] to see how much memory has been used so far: 
Add Exclusion **Remove Exclusion**	Use this button to define which files and/or folders should be excluded from the write protection. You can add or remove exclusions. You can select whether you want to exclude individual files are complete folders from the write protection.
Get Exclusion List	This function gives you an overview which files and folders have been excluded from the write protection in the current session and which changes have already been made for the next session.
Commit Modified File	Use this button to transfer changed files into the protected area without having to restart the system.
Restore Original File	Use this button to reset a changed file to its original state without having to restart the system.
Set Cache Threshold	Use this button to access the dialog box where you can set how much cache memory should be available to save system changes. The cache memory is located in the system RAM and cannot be used for other software applications. The default setting is 64MB, which should be sufficient for most applications. 

Button	Available functionality
Registry Key Protection	Not only can you exclude files and folders from the write protection, but also complete paths in the registry file. This is necessary if you want to be able to save system changes permanently. Use this function to modify the registry settings individually to suit your requirements:  The items excluded from the write protection are also managed by the registry file. To exclude a path from the write protection, set the root and path under "Root" and "Path" and select the button [Save Key]. With [Remove Key] you remove the selected exclusion.

1.2.4 Time Response of the System

The operating system is not truly a real-time operating system. Therefore, other programs running simultaneously with Vision P400 on the Imagechecker and mouse/keyboard actions may influence the time response of your image processing application.

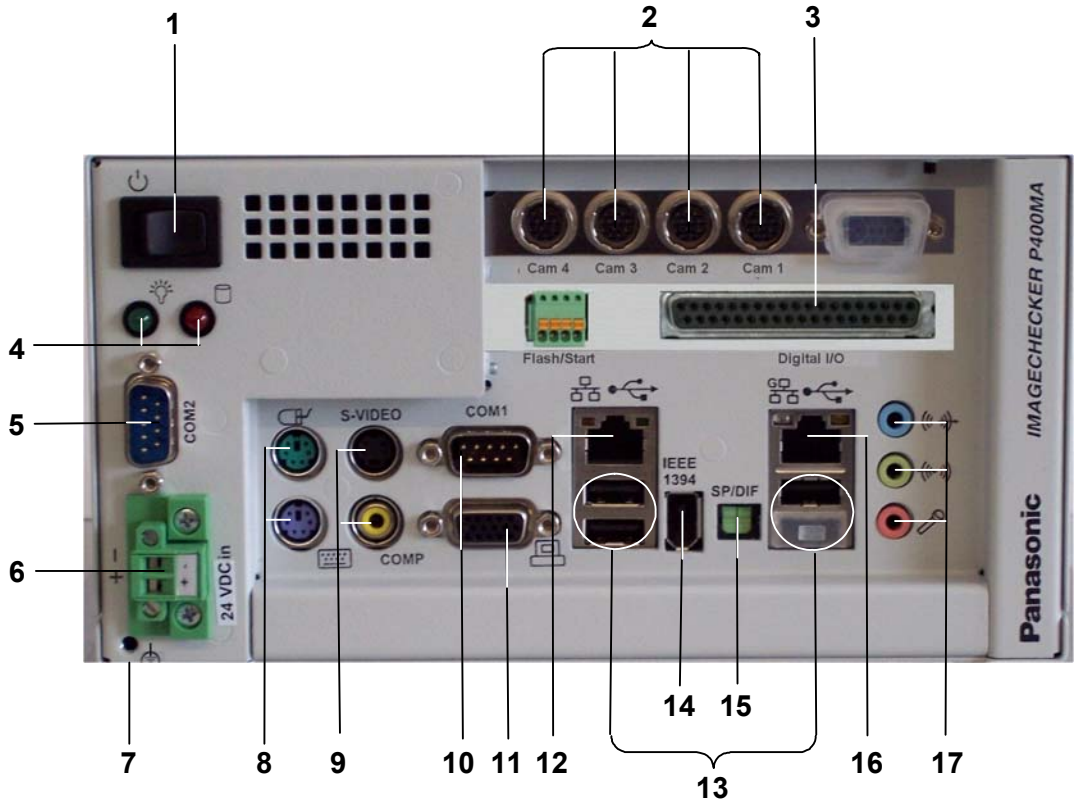
As a result, please make sure that the image processing during operation in run mode is not affected by such actions. We recommend unplugging the mouse and the keyboard when in run mode. This will help prevent unauthorized or accidental interference with the process.

The system performance also depends on the selected display. Updating (see page 127) parameters such as camera image, checker shape, spreadsheet etc. needs time and may effect the overall performance of the system. Updating all display parameters is possible when there is sufficient time available for the testing of a particular object. In addition, it takes processing time to compress the camera images.

◆NOTES

- **To ensure maximal system performance for the image processing task, all screensaver options are deactivated when the software is started. They will be reactivated automatically when you exit Vision P400.**
- **Please note that the power scheme options in the control panel may also have a negative effect on the time response. This is why the option "Power Scheme" is set to "Presentation". The options "Switch off monitor", "Switch off hard disk", "Standby" and "Hibernation" are deactivated.**

1.2.5 Description of the Casing



Connections in the front panel of the P400MA

1	Button to: • Switch on (press lightly once), • Shut down (press lightly once) and • Switch off (press and hold until the device switches off)
2	Frame grabber ANPC 802D with 4 camera connectors (camera 1 to 4 from right to left)
3	Digital I/O board ANPC 850V3D
4	LEDs: red HDD, green power
5	COM2 (9-pin sub-D plug connection)
6	24VDC IN female connector (suitable plug ANPMA 8609)
7	Ground (female screw for M4, max. length 6mm)
8	PS/2 connector for keyboard and mouse
9	S-VIDEO and Video Composite (not necessary for working with Vision P400)
10	COM1 (9-pin sub-D plug connection)
11	VGA monitor
12	LAN 10/100 Base TX Ethernet, RJ-45
13	4 x USB 2.0 ports
14	LAN Gigabit Ethernet RJ-45 (via PCIe)
15	IEEE 1394 Firewire connection (not necessary for working with Vision P400)
16	SP/DIF, digital audio format (not necessary for working with Vision P400)
17	Connectors for microphone and loudspeakers (not necessary for working with Vision P400)

Important Information

Please read the following information **before** you begin with the installation or operation!

◆NOTES

- **Use only products (cameras and camera cables) offered by Panasonic for specific use with the Imagechecker P400MA. The use of any other products will negate the warranty for the entire system since third-party components can damage the P400MA. In this case, Panasonic will not assume liability for the proper functioning of the P400MA.**
- **Under no circumstance should you ever disassemble the P400MA or change the system's factory settings unless you are specifically asked to do so in this manual. Any tampering will negate the warranty for the entire system since such changes may damage the P400MA. In this case, Panasonic will not assume liability for the proper functioning of the P400MA.**
- **The P400MA is a precision device and should under no circumstance be exposed to shocks or vibrations.**
- **The P400MA is neither waterproof, dustproof nor rustproof. Consequently, it is absolutely necessary to install the Imagechecker in a dry, clean environment.**
- **Protect the P400MA from exposure to direct sunlight and explosive or corrosive gases.**
- **Disconnect the power supply before connecting or disconnecting any connectors to or from the P400MA.**
- **Never apply force to any P400MA connectors or cables. Do not bend the cables. The connections should never be unplugged by pulling on the cable. Always hold the connector by the plug when unplugging any component from the Imagechecker.**
- **NEVER touch an exposed connector contact after unplugging a connector from the P400MA, and ensure that no fluids/chemicals come into contact with the contacts.**
- **Leave ample space around the P400MA so that heat generated during operation can be dissipated by the ventilators.**
- **Please ensure that the ventilators function properly.**
- **Guard against unintended data loss by maintaining data protection in a safe location.**
- **Ensure that the power supply is disconnected while you work on the equipment.**
- **Avoid discharges of static energy.**
- **Use the components only within the humidity and temperature ranges specified.**

- **Take care to keep dust accumulation to a minimum since dust may impair the functioning of the components.**
- **Do NOT clean the components with solvents or aggressive cleansers. These substances can destroy equipment parts and damage the paint.**

1.2.6 Dimensions

The Imagechecker is suitable for floor as well as wall mounting.

The angle bracket are optional:

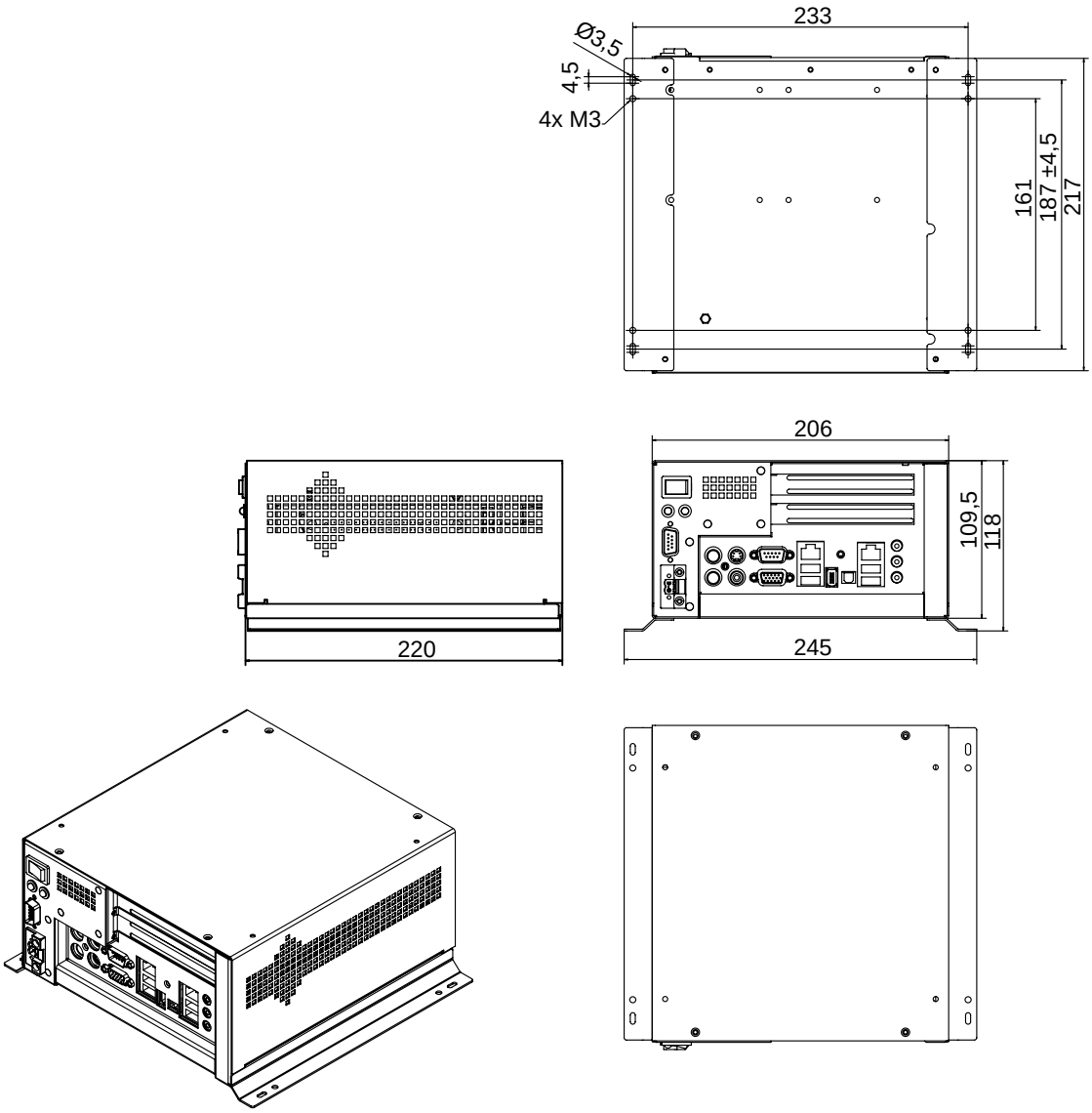
- Floor mounting rails: ANPMA 8018
- Wall mounting rails: ANPMA 8019

◆**NOTE**

Please take care to leave enough space between ventilations slots and mounting area (approx. 20mm) to prevent the Imagechecker from overheating.

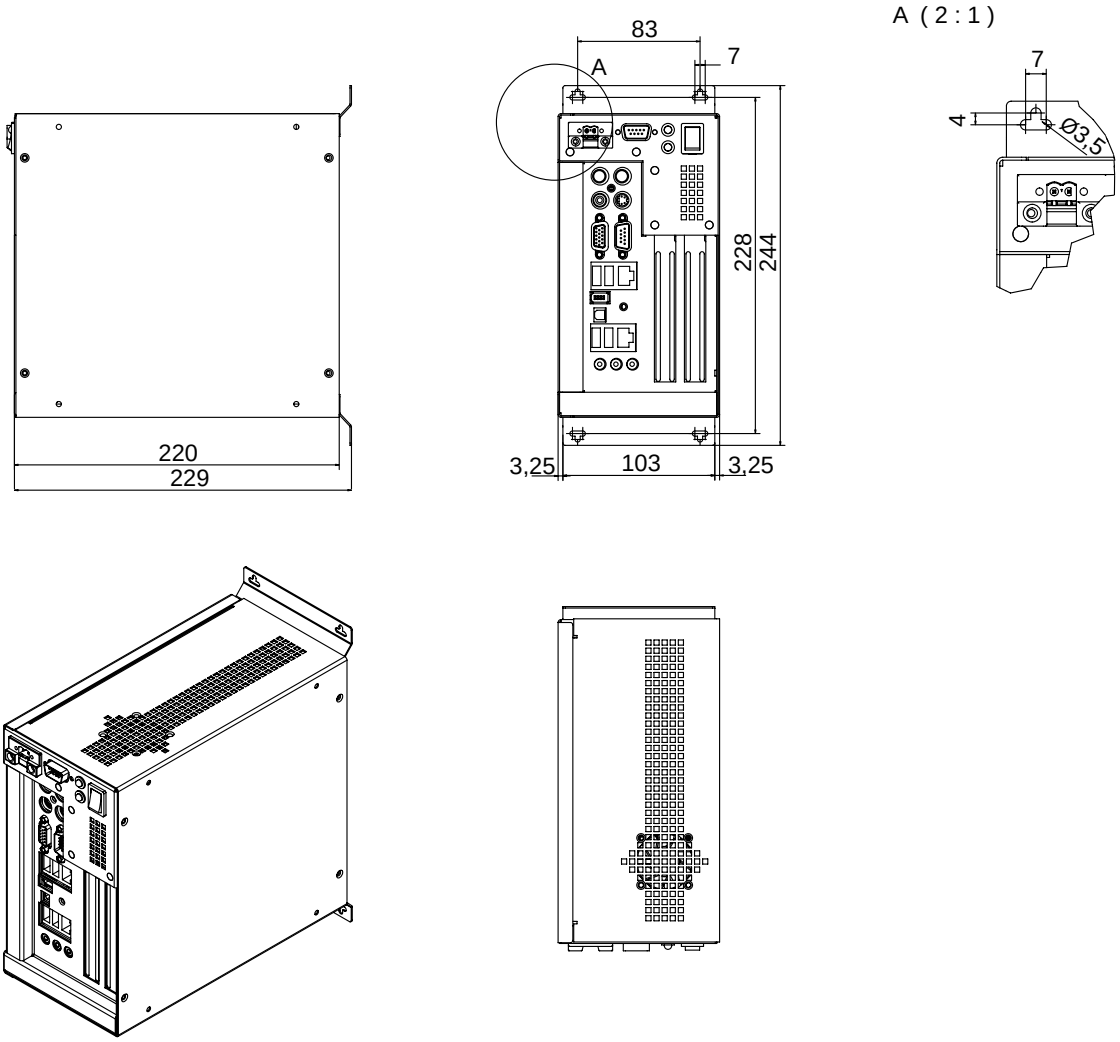
The dimensions are in mm.

1.2.6.1 Floor Mounting



Floor mounting of the P400MA

1.2.6.2 Wall Mounting



Wall mounting of the P400MA

1.3 Frame Grabber

The frame grabber ANPC 802D is available for parallel and serial operation with the PC Imagechecker P400MA.

The Imagechecker offers one PCI slot for one frame grabber. You can connect a maximum of 4 cameras for serial image grabbing and a maximum of 2 cameras for parallel image grabbing. Use the table below to find out about possible combinations of frame grabber and cameras.

Frame grabber ANPC 802D with serial grabbing

Camera ANPC xxxD	Standard image format in pixels	Max. No. of cameras	Camera cable ANPC xxxxxD
831	636 x 480	4	87103 87105 87110 87115
834	1380 x 1035	4	87103 87105 87110 87115
836	636 x 480	4	87103 87105 87110 87115
837	1024 x 768	4	87103 87105 87110 87115

Frame grabber ANPC 802D with parallel grabbing

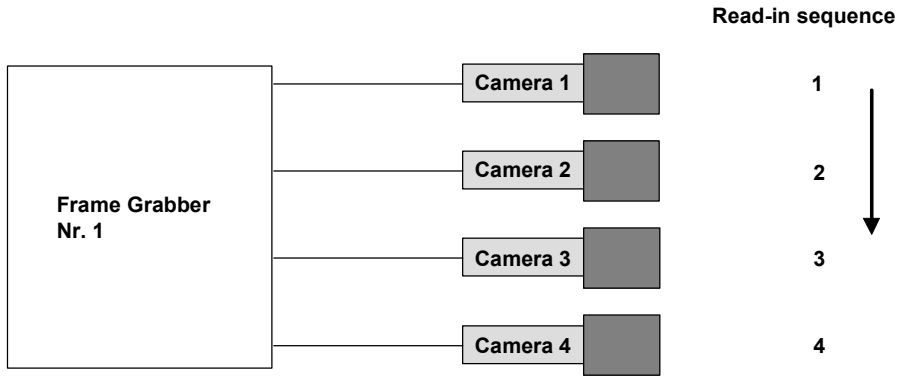
Camera ANPC xxxD	Standard image format in pixels	Max. No. of cameras	Camera cable ANPC xxxxxD
831	636 x 480	2	87103 87105 87110 87115
834	1380 x 1035	2	87103 87105 87110 87115
836	636 x 480	2	87103 87105 87110 87115
837	1024 x 768	2	87103 87105 87110 87115

◆NOTES

- **You can install cameras of one type only.**
- **You can only switch from one application to another application if both applications use the same configuration of cameras and frame grabbers.**
- **The mode selected for the camera and processing also applies to the frame grabber. That means you need to set all cameras used in an application to the same mode (parallel, serial, partial scan, shutter and flash mode).**

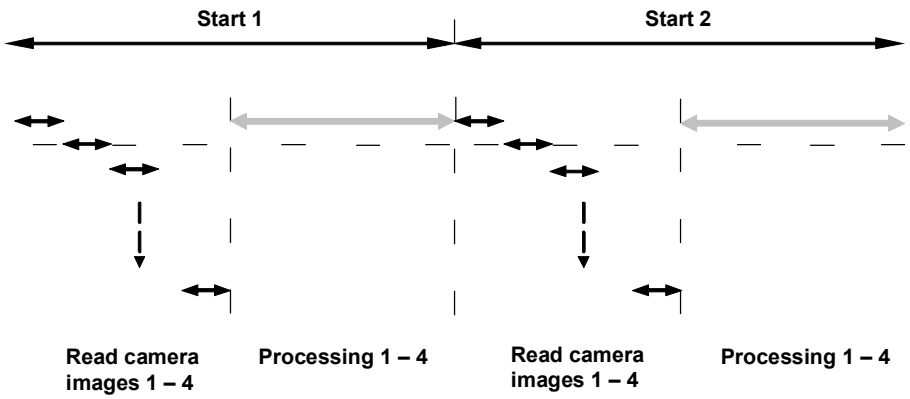
1.3.1 Serial Operation

The Imagechecker is equipped with a frame grabber, where you can connect up to a maximum of 4 cameras. The images of the 4 cameras will be read serially into the main memory via a multiplexer.



Serial read-in of images

In the example below, the cameras 1 to 4 are read into the Imagechecker's main memory and processed.



Serial image read-in and sequential processing

1.3.1.1 Grab Image Time

The total time needed for image grabbing depends on the selected shutter speed ($t_{shutter}$), the image transfer time ($t_{transfer}$), and the number of cameras connected (n). It is calculated as follows:

$t = (t_{shutter} + t_{transfer}) * n$

For the duration of the image transfer $t_{transfer}$ refer to the corresponding camera description.

◆EXAMPLE

With 4 cameras of type ANPC 831D in serial operation, the maximal grabbing time is:

$t_{shutter}$ = 2ms; $t_{transfer}$ = 35ms; n =4

(2ms + 35ms) * 4 = 148ms

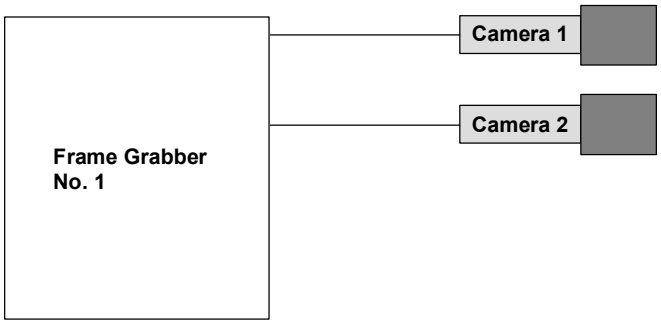
1.3.1.2 Displaying the Camera Image in Serial Operation

The screen always displays the image recorded by the camera selected. Vision P400 updates the display when the images have been grabbed from the cameras, the images have been processed by the image-processing algorithms, the spreadsheet has been updated, and the results have been output to the interfaces. If Vision P400 grabs multiple images in serial operation, it consequently takes longer to update the image display.

When you are in live image mode, the image display of the currently selected camera is updated.

1.3.2 Parallel Operation

The Imagechecker is equipped with a frame grabber, where you can connect up to a maximum of 2 cameras for parallel operation. The images of the 2 cameras of the frame grabber are transferred to the Imagechecker memory in parallel operation.



Parallel grabbing of images

1.3.2.1 Grab Image Time

The images of all connected cameras are grabbed simultaneously. How long it takes depends on the selected shutter speed. The total time needed for image grabbing is calculated as follows:

Camera type	Formula
ANPC 831D (see page 43)	$t = 35ms + t_{shutter}$
ANPC 834D (see page 49)	$t = 91ms + t_{shutter}$
ANPC 836D (see page 54)	$t = 18ms + t_{shutter}$
ANPC 837D (see page 61)	$t = 35ms + t_{shutter}$

1.3.2.2 Displaying the Camera Image in Parallel Operation

The screen always displays the image recorded by the camera selected. Vision P400 updates the display when the images have been grabbed from the cameras, the images have been processed by the image-processing algorithms, the spreadsheet has been updated, and the results have been output to the interfaces.

When you are in live image mode, the image display of the currently selected camera is updated.

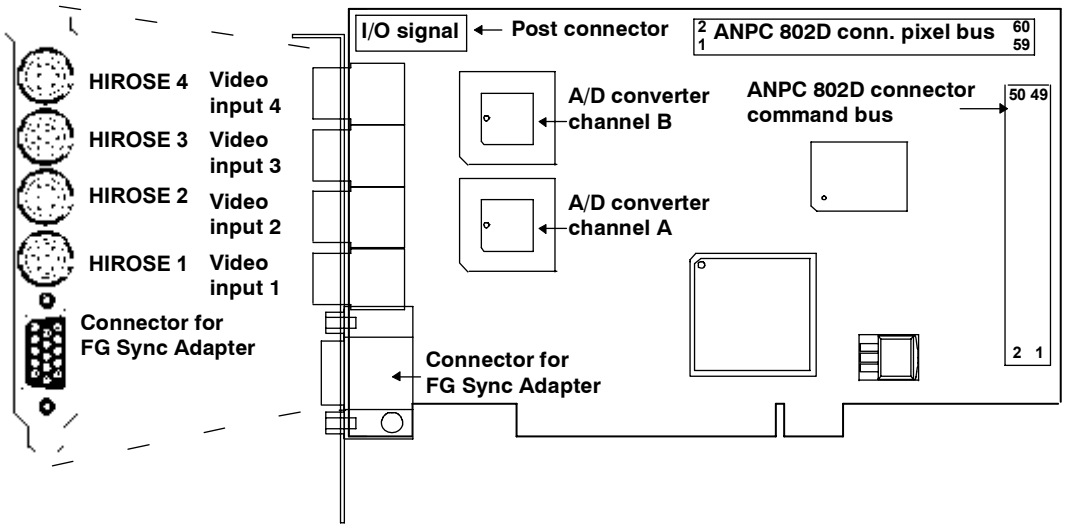
1.3.3 Camera Connection to the Frame Grabber

The frame grabber ANPC 802D may be used for **parallel** and for **serial** image grabbing.

It is absolutely necessary to connect the cameras beginning from plug 1 (the plug at the bottom). If you use the frame grabber for serial grabbing, you may use the video inputs 1 to 4. For parallel grabbing, use the video inputs 1 and 2 only.

◆NOTE

The camera connector is of the type HIROSE HR 10A-10R-12S. There is no use for the FG Sync. Adapter with the P400MA.



Camera connection to the ANPC 802D

◆NOTE

If you wish to grab the images in serial operation, activate the option "Grab always serial" on the "Frame Grabber" (see page 140) page under System Settings → Vision P400 Settings**.**

1.3.4 Specifications

ANPC 802D (4 cameras serial / 2 cameras parallel)	
Bus interface	PCI, DMA image transmission
Rate of transmission	Maximal 132MB/s
Synchronization	For flash and camera

1.4 Working with a Flash

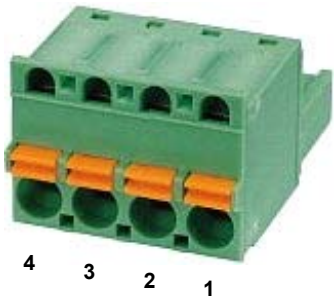
Depending on the digital I/O board installed, the flash signal is output via the parallel outputs or via a special connector (optional). There are different possibilities of connecting and controlling a flash, depending on whether you have installed a digital I/O board or not. The table gives an overview of the machine vision system P400, P400S, and P400MA:

Device	Parallel I/O board	Connecting a flash
P400	---	at the 15-pin sub-D plug connector
P400	ANPC 850D	at the 15-pin sub-D plug connector
P400	ANPC 850V2D	at the 37-pin sub-D plug connector
P400	ANPC 850V3D	at the 4-pin plug (see page 32)
P400S	---	at the 37-pin sub-D plug connector
P400S	ANPS 850D	at the 37-pin sub-D plug connector
P400MA	ANPC 850V3D	at the 4-pin plug (see page 32)
P400MA	---	at the 15-pin sub-D plug connector (ANPC 8101D, optional)

1.4.1 P400MA with ANPC 850V3D

Depending on the I/O board installed, the flash signal is output via the digital outputs or via a special connector. To output the flash signal make sure to connect the Flash Controller to the 4 pin Phoenix Contact plug as follows:

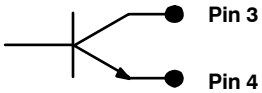
Slot bracket (top view)



4-pin Phoenix Contact plug

Pin	Signal
1	Optional start signal (see page 11)
2	Individual ground (GND) for start signal

3	Flash (+) (collector)
4	COM (-) (emitter)



Circuit diagram

Plug specifications

Maximum current	50mA
Variable current	5,0V up to 24,0V
Maximum reverse voltage	7.0V

◆NOTES

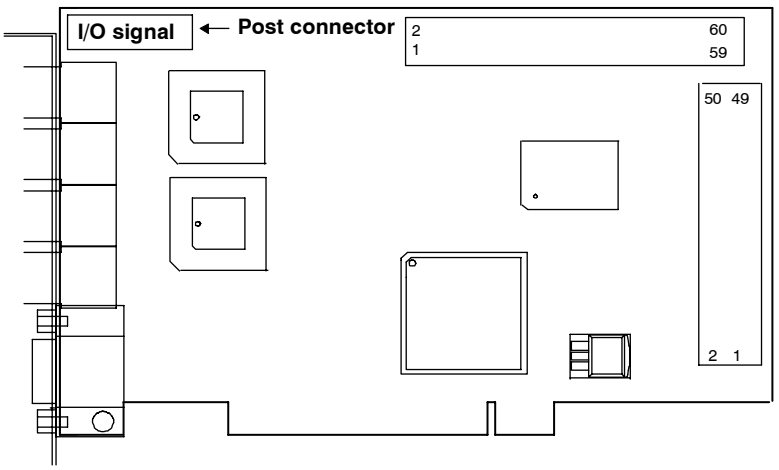
- **When there is a digital I/O board installed, please note the pin assignment for the other outputs (see page 11).**
- **Please refer to the notes on connecting peripheral devices (see page 13).**

1.4.2 P400 without Digital I/O Board / with ANPC 850D

If you have no digital I/O board installed, you can connect a flash to the output signal I/O of the frame grabber by proceeding as follows:

◆Procedure

1. **Plug the ICH P400 Flashtrigger Unit in the 16-pin post connector of the frame grabber**

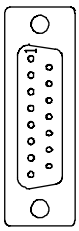


This way you activate the slot for the Flashlight Controller at the back of the Imagechecker.

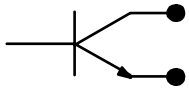
2. **Connect the Flashtrigger Unit to the lower PCI slot of the riser card.**

3. Plug the Flashlight Controller in the 15-pin slot of the ICH P400 Flashtrigger Unit at the back of the Imagechecker

The flashtrigger signal is taken from the 15-pin Sub-D plug at pins 10 and 11. The output transistor is of the type NPN. Pin 10 works as the collector and pin 11 as the emitter of the transistor.



Pin	Signal
1	NC
2	NC
...	...
10	COM (+) (collector)
11	SG (-) (emitter)
12	NC
13	NC
14	NC
15	NC



Pin 10 (+) 5 - 24V DC (max. 30mA)

Pin 11 GND

◆NOTE

The frame grabber only sends a flash trigger signal if the option "Send Flash Signal" is activated in the frame grabber's property page (see page 265).

1.5 Software for Industrial Image Processing

The Vision P400 V4.0 software is multi-lingual. It supports English, German, and French.

The following camera types are supported:

- ANPC 831D
- ANPC 834D
- ANPC 836D
- ANPC 837D

If you wish to use the old camera types (ANPC 830D, ANPC 832D, ANPC 833D), please contact your local Panasonic Electric Works branch.

The installation procedure is described in detail elsewhere (see page 76).

◆**NOTE**

To upgrade version 3.x or older versions to version 4.0, you need to buy a new license file!

1.5.1 Vision P400 Demo Version

For testing and demonstration purposes, there is a demo version available on the CD-ROM. You can download the latest demo version from our internet page at http://www.panasonic-electric-works.com.

The demo version lets you simulate different applications of Vision P400. With the help of sample bitmaps you can test the functions and features of Vision P400. However, for reasons of software protection, it is not possible to use the demo version with a frame grabber. Every 5 minutes a message is displayed reminding you that the current version of Vision P400 is the demo version.

1.5.2 Software Protection

From version 1.4x onwards Panasonic has protected the library of image-processing algorithms. Using hardware information, Panasonic has created the license file “license.dat" in the installation subfolder \license. This file ensures that you can run the software only on the Imagechecker that has been delivered by Panasonic and not on any other PC. This does not affect the demo version of Vision P400, which can be run and installed on any PC.

A backup copy of the license file will be stored with Panasonic as well as your local PEW branches. In addition, a time-limited license is also available for the current month at Panasonic and the local PEW branches in case you need to compensate the loss of a license file temporarily.

Please also refer to the information on how to address software protection issues after reformatting the hard disk.

Chapter 2

Camera Specifications

2.1 Introduction

This chapter deals with the four different types of cameras available for the Imagecheckers P400 and P400S. You will find information on how to connect a camera to the Imagechecker as well as a detailed description of each camera type.

You will find the following information:

- available camera modes (progressive scan, partial scan)
- how to use a flash
- hardware-related camera data (gain setting, pin assignments, dimensions)
- tables with specifications.

Please read the information on the four camera types and their configuration carefully. The right camera choice optimizes results in processing speed and image resolution.

2.1.1 Camera Types

There are four types of cameras available for the Imagechecker: ANPC 831D, ANPC 834D, ANPC 836D, and ANPC 837D. Choose the camera and the scanning format depending on the intended usage. Please note that as far as image grabbing is concerned, the Imagechecker works either only in serial or only in parallel mode. Depending on the requirements of your application, set the mode accordingly in Vision P400.

◆NOTES

- **For lens selection tables, please turn to our homepage: http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls**
  Select your camera type by clicking one of the tabs at the bottom.
- **With version 4.0 of Vision P400, the old camera types ANPC 830/832/833 are no longer supported. Version 3.2 supports the old camera types to a certain degree. If you urgently need an old camera type for your application, please contact your local Panasonic branch.**
- **You can use cameras only of the same type. It is not possible to connect cameras of different types to the frame grabber or to use different camera types within one application.**

Camera type	Standard image format in pixels	Usage
ANPC 831D (see page 42)	636 x 480	Full resolution in vertical direction Shutter: 1/15 to 1/10000 second
ANPC 834D (see page 48)	1380 x 1035	Full resolution in vertical direction Shutter: 1/16 to 1/8000 second
ANPC 836D (see page 54)	636 x 480	Full resolution in vertical direction Shutter: 1/125 to 1/10000 second

Camera type	Standard image format in pixels	Usage
ANPC 837D (see page 61)	1024 x 768	Full resolution in vertical direction Shutter: 1/125 to 1/10000 second

There are different scanning formats available (partial 1/2, 1/3, and 1/6) to reduce the time for image grabbing. The correct scanning format considerably reduces the image-grabbing time for oblong objects. With the scanning formats only a certain part of the image (e.g. line 120 - 360) will be read.

Another possibility to reduce the image-grabbing time is the binning mode. This mode, however, is only available for the cameras ANPC 836D and ANPC 837D. In binning mode an odd and an even line of the camera image are combined into one line by compression. This reduces the resolution by half. The combined lines are doubled again for monitor display and internal calculations. This means you can carry out position and rotation adjustment as well as angle calculation as usual. There are several image formats available in binning mode.

Camera type	Available scanning formats			Formats available in binning mode
	Partial 1/2	**Partial 1/3**	**Partial 1/6**	
ANPC 831D	636 x 240 pixel	636 x 160 pixel	636 x 80 pixel	Mode not available
ANPC 834D	1380 x 510 pixel	1380 x 340 pixel	1380 x 170 pixel	Mode not available
ANPC 836D	636 x 240 pixel	636 x 148 pixel	636 x 102 pixel	636 x 480 pixel 636 x 308 pixel 636 x 212 pixel 636 x 116 pixel
ANPC 837D	1024 x 354 pixel	1024 x 220 pixel	1024 x 152 pixel	1024 x 640 pixel 1024 x 316 pixel 1024 x 116 pixel

2.1.2 Connecting Cameras to the Imagechecker

To hook up a camera, connect it to the frame grabber camera connector via the camera cable. Please read the notes below prior to operating any of the cameras.

◆NOTES

- **Do NOT touch the CCD chip; irreparable damage may result.**
- **Recordings may be slightly distorted if the CCD chip is improperly positioned. Re-adjust the camera as needed.**
- **Do not touch the camera lens. Cover it when not in use.**
- **Place the protective cover on the camera whenever the camera is not in place.**
- **Protect the camera from excessive humidity and dust. It must be covered and wrapped, especially when there is risk of exposure to condensation.**
- **Protect the camera against shocks or vibrations.**

2.1.3 Combining Frame Grabbers and Camera Types

Use the tables below to find out about the possible combinations of the different cameras with frame grabber ANPC 802D. The tables also inform you about the camera cables available and whether you need an FG Sync. Adapter.

◆**NOTE**

The tables below provide the maximal number of cameras you can connect to the P400 Imagechecker. The Imagecheckers P400S and P400MA use the following maximal number of cameras independent of the camera type:
- maximal 4 cameras with serial grabbing
- maximal 2 cameras with parallel grabbing.

Frame grabber ANPC 802D with serial grabbing

Camera ANPC xxxD	Standard image format in pixels	Max. No. of cameras		Camera cable ANPC xxxxD	FG sync. adapter (FG sync)
		Max. per grabber	Max. No. of cameras		
831	636 x 480	4	12 (3 frame grabbers + FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers) ANPC 8104D (3 frame grabbers)
834	1380 x 1035	4	6 (2 frame grabbers + FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers)
836	636 x 480	4	12 (2 frame grabbers + FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers) ANPC 8104D (3 frame grabbers)
837	1024 x 768	4	12 (2 frame grabbers + FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers) ANPC 8104D (3 frame grabbers)

Frame grabber ANPC 802D with parallel grabbing

Camera ANPC xxxD	Standard image format in pixels	Max. No. of cameras		Camera cable ANPC xxxxD	FG sync. adapter (FG sync)
		Max. per grabber	Max. No. of cameras		
831	636 x 480	2	6 (FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers) ANPC 8104D (3 frame grabbers)
834	1380 x 1035	2	4 (FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers)
836	636 x 480	2	3 (FG sync)	87103 87105 87110 87115	ANPC 8103D (2 frame grabbers)
837	1024 x 768	2	2	87103 87105 87110 87115	Not required

2.2 ANPC 831D

Camera ANPC 831D produces images with a format of 636 x 480 pixels and uses the "progressive scan" technology. With this technology, all lines of the CCD chip are exposed at the same time and then transferred one after the other to the frame grabber.

There are different scanning formats available (partial 1/2, 1/3, and 1/6) to reduce the time for image grabbing. The correct scanning format considerably reduces the image-grabbing time for oblong objects. You need to carry out two steps to use the scanning formats: configure (see page 69) the camera and create the application in Vision P400 with the correct camera format (see page 259).

◆**NOTE**

For lens selection tables, please turn to our homepage:
http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls
Select your camera type by clicking one of the tabs at the bottom.

2.2.1 Operation Modes

You can use camera ANPC 831D both for serial and parallel image grabbing, see table (see page 40):

- serial operation with 4 to max. 12 cameras (you will need 3 frame grabbers) or
- parallel operation with 2 to max. 6 cameras (you will need 3 frame grabbers).

◆**NOTE**

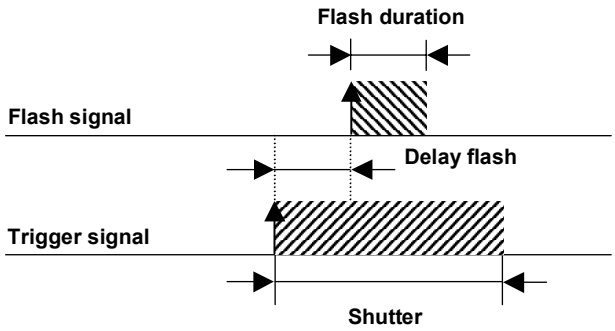
If you want to grab the images in serial mode, select the "Grab Always Serial" option on the "Frame Grabber" tab (see page 140) under System Settings → Vision P400 Settings**.**

2.2.2 Full Frame Shutter Mode

The camera ANPC 831D works in full frame shutter mode. This mode is suitable for inspecting moving objects. Immediately after the Imagechecker receives the start signal, the image is grabbed without any observable time delay (t_{delay} < ca. 1ms). This mode also offers a synchronous flash trigger to allow for more efficient lighting.

The following diagram explains with an example the temporal connection between the flash signal and the trigger IN signal of the camera. You can set the delay for the flash signal and the trigger IN signal on the frame grabber's property page under **Camera** → **Properties** on the "Frame Grabber" tab. You can set a delay for the flash or for the camera. This way it is possible to trigger the flash during the shutter opening time or to trigger the shutter during the flash time.

Set the flash time at the flash according to your application's requirements. Please remember that depending on the flash used there may be hardware-related delays.



Sample time diagram for flash signal and shutter of camera ANPC 831D

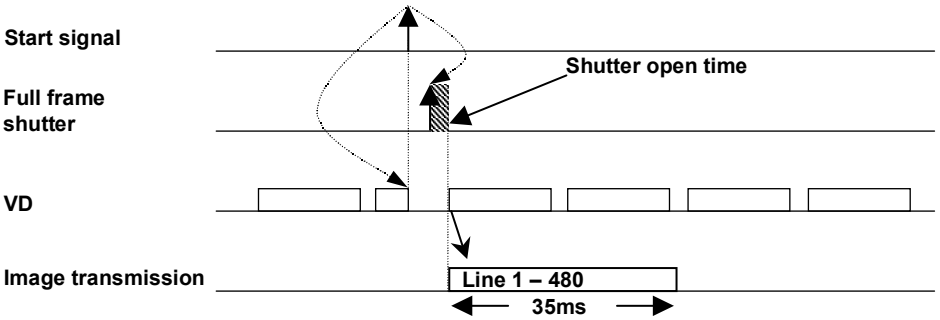
◆NOTE

Please read the manufacturer's instructions for your flash.

2.2.3 Time Diagram for Image Grabbing

With a shutter speed of 1/10,000s it takes about 35ms to read the image. If you set (see page 264) a different shutter speed, add the appropriate value to obtain the time needed for image reading.

The time diagram below illustrates the time sequence of start signal, shutter open time (exposure) and image transmission to the frame grabber.



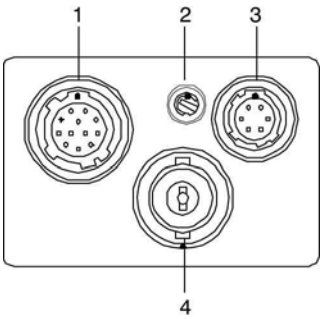
Time diagram for image grabbing with ANPC 831D

Formula: Grab image = approximately $t_{transfer}$ + $t_{shutter}$

Image format	$t_{transfer}$
Full image	35ms
Partial 1/2	21ms
Partial 1/3	16ms
Partial 1/6	10ms

2.2.4 Camera Settings

The camera is delivered with the correct settings for optimum operation. If necessary, you can modify the settings via the integrated serial RS232 interface and a programming cable (order number ANPC 8300D (see page 615)) using the program "Vision Camera Configurator" (see page 69). You can increase the video signal input (+15dB) with the “Gain” screw, for example if you are working in a badly-lit environment.



1	12-pin HIROSE connector for the frame grabber connection
2	Gain potentiometer to regulate image brightness
3	6-pin HIROSE connector for the serial programming cable (RS232)
4	BNC connection for video

Connections at the back of camera ANPC 831D

The shutter speeds are controlled by the pulse length of the camera trigger (start signal for the frame grabber to read the image) Set the shutter speeds with the Vision P400 software. Use **Camera → Properties** and go to the property page "Camera" (see page 262). The following shutter speeds are available: 1/15; 1/30; 1/60; 1/125; 1/250; 1/500; 1/1,000; 1/2,000; 1/4,000; 1/10,000 second.

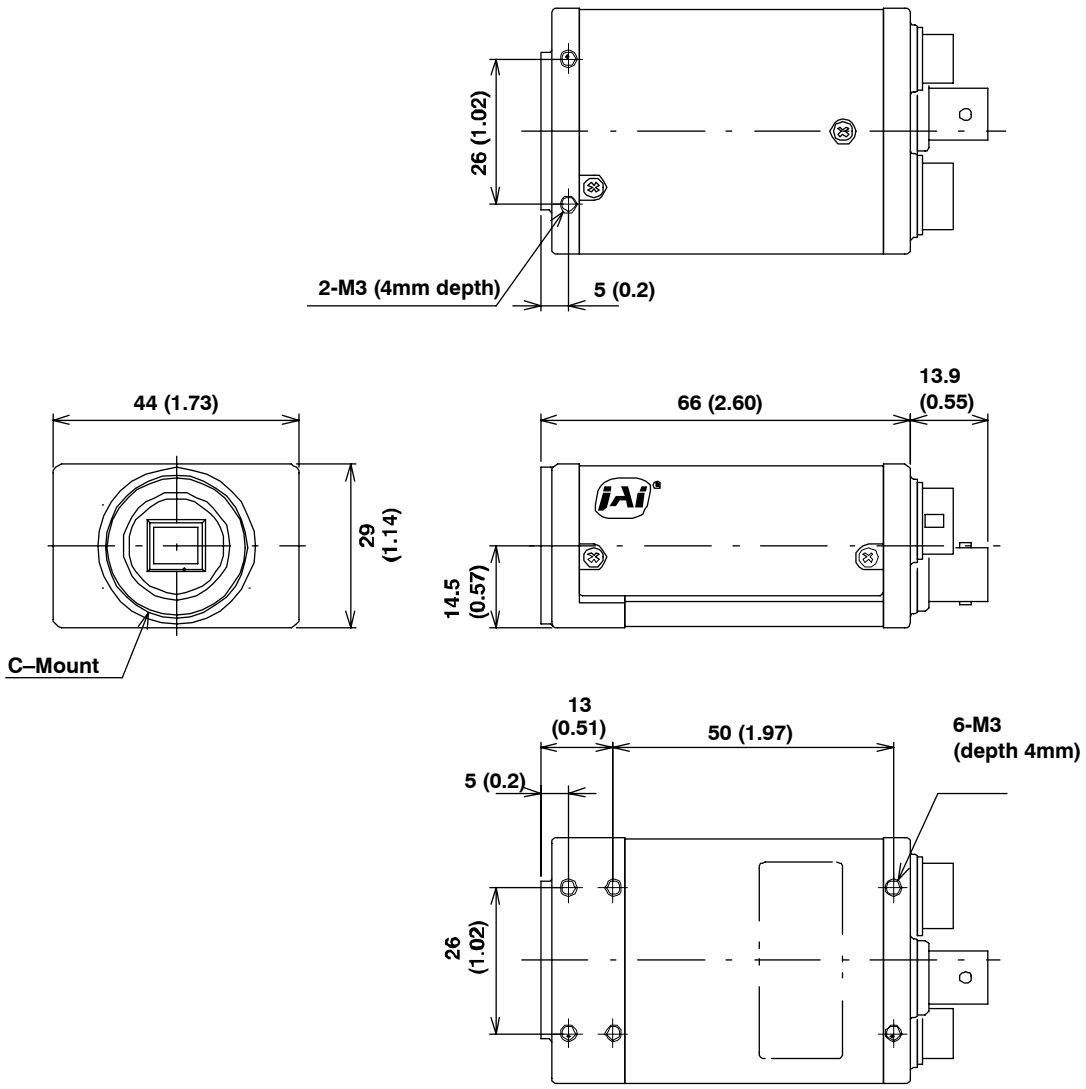
2.2.5 Pin Assignment

The 12 pins of the camera connector are assigned as shown below:

Pin	Frame shutter
1	GND
2	+12V DC IN
3	Video OUT GND
4	Video OUT signal
5	GND
6	HD IN signal
7	VD IN signal (not used)
8	GND
9	Not connected
10	Not connected
11	Trigger IN signal
12	GND

Pin assignment ANPC 831D

2.2.6 Dimensions



Dimensions in mm (inch)

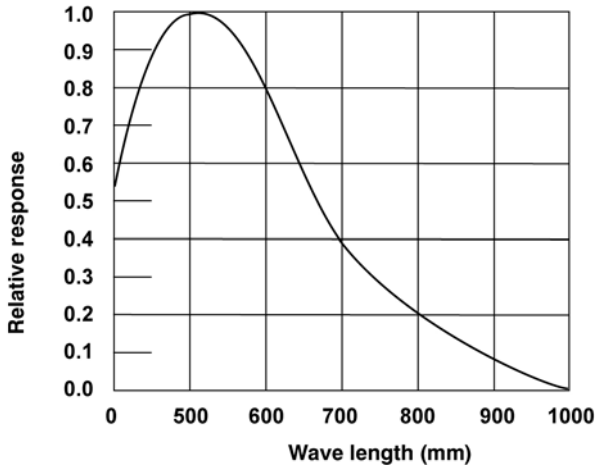
Dimensions for camera ANPC831D

Danger of damage to the camera!
Make sure when mounting the camera to use Phillips screws not longer than 4mm or 0.16 inch.

2.2.7 Specifications

Progressive scan camera ANPC 831D	
Recording system	Progressive 525 lines 30 frames/second
CCD sensor	Monochrome 1/3" IT CCD
Sensing area	4.9mm (h) x 3.7mm (v)
Effective pixels	659 (h) x 494 (v)
Pixels in video output	648 (h) x 492 (v)
Pixel size	7.4µm (h) x 7.4µm (v)
Resolution horizontal	480 TV lines
Sensitivity on sensor	0.05 Lux, maximal gain, 50% Video
S/N ratio	> 56dB
Video output	Composite VS signal, 1.0Vpp, 75 ohm, DC coupled
Gamma correction	0.45 or 1.0
Gain range	Manual - Automatic to +15dB
Accumulation	Frame (progressive scan)
Synchronization system	Int, X-tal, Ext HD/VD or random trigger
HD sync input/output	4 Vpp, 75 ohm
Trigger input	4 Vpp, 75 ohm
WEN output (write enable)	4 Vpp, 75 ohm
EEN output (exposure enable)	4 Vpp, 75 ohm
Pixel clock output	4 Vpp, 75 ohm
Shutter speeds	1/15, 1/30, 1/50, 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000s
Pulse width control	1.5 H to 1000H
Start/Stop	1/30, 1/10000s
Long time exposure	1 frame to infinite (recommendation)
Programmable exposure	0.5H to 1023.5H
Frame delay readout	Time from PWC trigger input to external VD input
Functions controlled by RS232	Scanning format, trigger mode, shutter speeds, trigger/WEN polarity, accumulation, shutter mode, programmable exposure, AGC level, white clip, setup, manual gain, AGC/manual gain, internal/potentiometer gain set, gamma, pixel clock, commands, and internal adjustments
Functions controlled by internal DIP switches	VD input/output, HD input/output, HD, VD and 75 ohm termination on/off
Operational temperature	23.00°F up to +113.00°F
Ambient humidity	20% - 80% non-condensing
Storage temperature/humidity	-25°C to 60°C/20% - 80%
Power supply	12V DC ±10%, 1.8W max.
Lens mount	C mount
Dimensions	29 x 44 x 66mm (length x width x height)
Weight	5.29oz

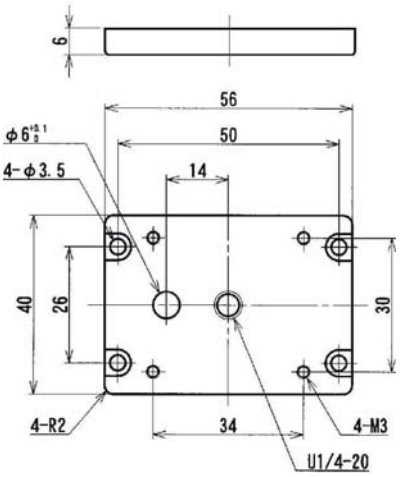
2.2.8 Spectral Response



Spectral response of camera ANPC 831D

2.2.9 Laboratory Socket

To attach the camera ANPC 831D to a pole or staff, please use the laboratory socket (order number ANPC 8311). The socket is not provided with the camera and needs to be ordered separately.



Dimensions for laboratory socket ANPC 8311 for camera ANPC 831D

Danger of damage to the camera!
Make sure when mounting the camera to use Phillips screws not longer than 5mm or 0.2 inch.

2.3 ANPC 834D

Camera ANPC 834D produces images with a format of 1380 x 1035 pixels and uses the "progressive scan" technology. With this technology, all lines of the CCD chip are exposed at the same time and then transferred one after the other to the frame grabber.

There are different scanning formats available (partial 1/2, 1/3, and 1/6) to reduce the time for image grabbing. The correct scanning format considerably reduces the image-grabbing time for oblong objects. You need to carry out two steps to use the scanning formats: configure (see page 69) the camera and create the application in Vision P400 with the correct camera format (see page 259).

◆**NOTE**

For lens selection tables, please turn to our homepage:
http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls
Select your camera type by clicking one of the tabs at the bottom.

2.3.1 Operation Modes

You can use camera ANPC 834D both for serial and parallel image grabbing, see table (see page 40):

- serial operation with 4 to max. 6 cameras (you will need 2 frame grabbers) or
- parallel operation with 2 to max. 4 cameras (you will need 2 frame grabbers).

◆**NOTE**

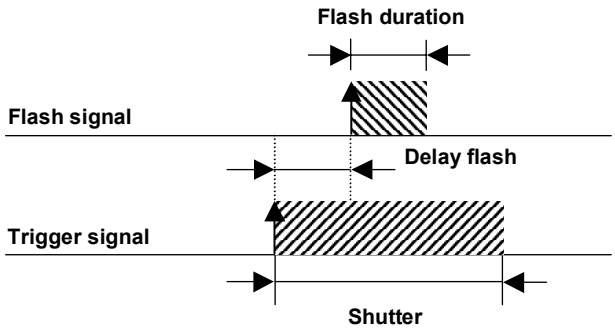
If you want to grab the images in serial mode, select the "Grab Always Serial" option on the "Frame Grabber" tab (see page 140) under System Settings → Vision P400 Settings**.**

2.3.2 Full Frame Shutter Mode

The full frame shutter mode is generally selected to inspect moving objects. Immediately after the Imagechecker receives the start signal, the image is grabbed without any observable time delay (t_{delay} < ca. 1ms). This mode also offers a synchronous flash trigger to allow for more efficient lighting.

The following diagram explains with an example the temporal connection between the flash signal and the trigger IN signal of the camera. You can set the delay for the flash signal and the trigger IN signal on the frame grabber's property page under **Camera** → **Properties** on the "Frame Grabber" tab. You can set a delay for the flash or for the camera. This way it is possible to trigger the flash during the shutter opening time or to trigger the shutter during the flash time.

Set the flash time at the flash according to your application's requirements. Please remember that depending on the flash used there may be hardware-related delays.



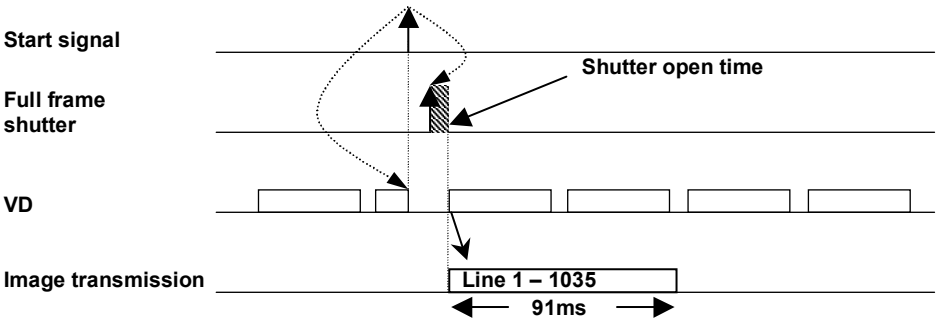
Sample time diagram for flash signal and shutter of camera ANPC 834D

◆**NOTE**

Please read the manufacturer's instructions for your flash.

2.3.3 Time Diagram for Image Grabbing

With a shutter speed of 1/8,000s it takes about 91ms to read the image. If you set (see page 264) a different shutter speed, add the appropriate value to obtain the time needed for image reading.



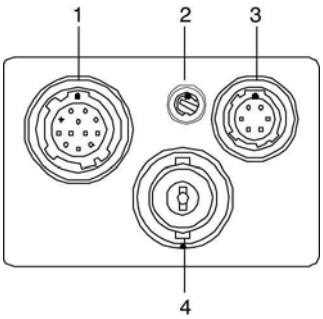
Time diagram for image grabbing with ANPC 834D

Formula: Grab image = approximately $t_{transfer}$ + $t_{shutter}$

Image format	$t_{transfer}$
Full image	91ms
Partial 1/2	54ms
Partial 1/3	39ms
Partial 1/6	24ms

2.3.4 Camera Settings

The camera is delivered with the correct settings for optimum operation. If necessary, you can modify the settings via the integrated serial RS232 interface and a programming cable (order number ANPC 8300D (see page 615)) using the program "Vision Camera Configurator" (see page 69). You can increase the video signal input (+15dB) with the “Gain” screw, for example if you are working in a badly-lit environment.



1	12-pin HIROSE connector for the frame grabber connection
2	Gain potentiometer to regulate image brightness
3	6-pin HIROSE connector for the serial programming cable (RS232)
4	BNC connection for video

Connections at the back of camera ANPC 834D

The shutter speeds are controlled by the pulse length of the camera trigger (start signal for the frame grabber to read the image) Set the shutter speeds with the Vision P400 software. Use **Camera → Properties** and go to the property page "Camera" (see page 262). The following shutter speeds are available: 1/16; 1/30; 1/60; 1/125; 1/250; 1/500; 1/1,000; 1/2,000; 1/4,000; 1/8,000 second.

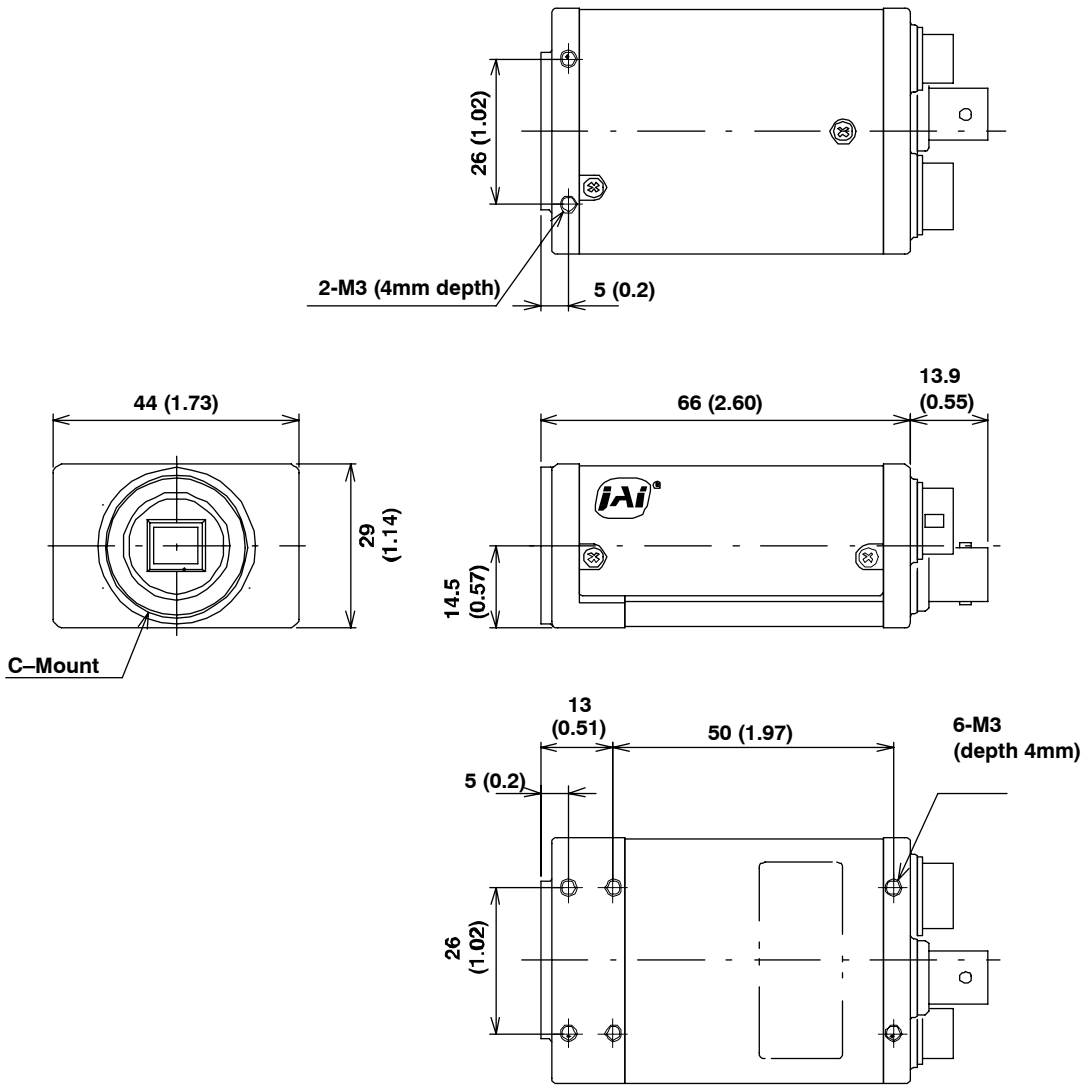
2.3.5 Pin Assignment

The 12 pins of the camera connector are assigned as shown below:

Pin	Frame shutter
1	GND
2	+12V DC IN
3	GND
4	Video OUT
5	GND
6	Ext. HD IN signal
7	VD IN signal (not used)
8	GND
9	Not connected
10	Not connected
11	Trigger IN signal
12	GND

Pin assignment ANPC 834D

2.3.6 Dimensions



Dimensions in mm (inch)

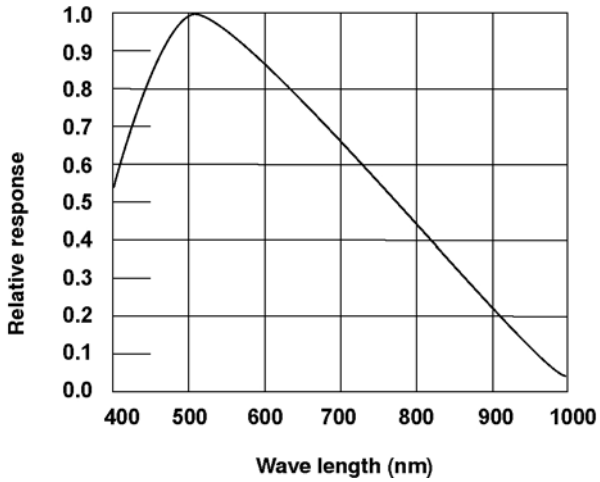
Dimensions for camera ANPC 834D

Danger of damage to the camera!
Make sure when mounting the camera to use Phillips screws not longer than 4mm or 0.16 inch.

2.3.7 Specifications

Progressive scan camera ANPC 834D	
Recording system	Progressive 1068 lines 11.2 frames/second
CD sensor	Monochrome 1/2" IT CCD
Pixel clock	20.00MHz
Line frequency	11.962kHz (1672 pixel clock/line)
Sensing area	6,42mm (h) x 4,81mm (v)
Effective pixels	1392 (h) x 1040 (v)
Pixels in video output	1380 (h) x 1035 (v)
Pixel size	4.65µm (h) x 4.65µm (v)
Resolution horizontal	1000 TV lines
Sensitivity on sensor	0.3 Lux, maximal gain, 50% Video
S/N ratio	> 50dB
Video output	Composite VS signal, 1.0 Vpp, 75 ohm, DC coupled
Gamma correction	0.45 or 1.0
Gain range	Manual -3 to +12dB, automatic 0 to +12dB
Accumulation	Frame (progressive scan)
Synchronization system	Int, X-tal, Ext HD/VD or random trigger
HD sync input/output	4 Vpp, 75 ohm
Trigger input	4 Vpp, 75 ohm
WEN output (write enable)	4 Vpp, 75 ohm
EEN output (exposure enable)	4 Vpp, 75 ohm
Pixel clock output	4 Vpp, 75 ohm
Shutter speeds	1/16, 1/30, 1/50, 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000
Pulse width control	1.3H to 2000H
Start/Stop	1/30, 1/10000s
Long time exposure	<2s (interval between ext. VD)
Programmable exposure	1.3H to 1023.5H in 1H steps
Frame delay readout	Time from PWC trigger input to external VD input
Functions controlled by RS232	Scanning format, trigger mode, shutter speeds, trigger/WEN polarity, accumulation, shutter mode, programmable exposure, AGC level, white clip, setup, manual gain, AGC/manual gain, internal/potentiometer gain set, gamma, pixel clock, commands, and internal adjustments
Communication baud rate	9600bps
Functions controlled by internal DIP switches	VD input/output, HD input/output, HD, VD and 75 ohm termination on/off
Operational temperature	0°C up to +40°C
Ambient humidity	50% – 70% non-condensing
Storage temperature/humidity	-30°C to 60°C/25% - 90% non condensating
Power supply	12V DC →10%, 1.8W max.
Lens mount	C mount
Dimensions	29 x 44 x 66mm (length x width x height)
Weight	150g

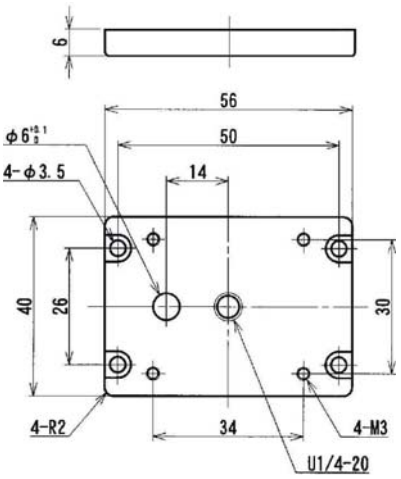
2.3.8 Spectral Response



Spectral response of camera ANPC 834D

2.3.9 Laboratory Socket

To attach the camera ANPC834D to a pole or staff, please use the laboratory socket (order number ANPC8311). The socket is not provided with the camera and needs to be ordered separately.



Dimensions for laboratory socket ANPC8311 for camera ANPC834D

Danger of damage to the camera!
Make sure when mounting the camera to use screws not longer than 5mm or 0.2 inch.

2.4 ANPC 836D

Camera ANPC 836D produces images with a format of 636 x 480 pixels and uses the "double-speed progressive scan" technology. With this technology, all lines of the CCD chip are exposed at the same time and then transferred one after the other to the frame grabber. This shutter mode is also called full frame shutter mode.

The image-grabbing time is shorter compared with cameras using the "progressive scan" technology (e.g. ANPC 831D). However, you can connect only 3 cameras with parallel grabbing because more cameras would exceed the capacity of the PCI bus and lead to errors in the camera image.

There are different scanning formats available (partial 1/2, 1/3, and 1/6) to reduce the time for image grabbing. The correct scanning format considerably reduces the image-grabbing time for oblong objects. With the scanning formats only a certain part of the image (e.g. line 120 - 360) will be read.

Another possibility to reduce the image-grabbing time is the binning mode. In binning mode an odd and an even line of the camera image are combined into one line by compression. This reduces the resolution by half. There are several image formats available in binning mode.

◆**NOTE**

For lens selection tables, please turn to our homepage:
http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls
Select your camera type by clicking one of the tabs at the bottom.

2.4.1 Operation Modes

You can use camera ANPC 836D both for serial and parallel image grabbing, see table (see page 40):

- serial operation with 4 (P400S) to max. 12 cameras (P400, you will need 3 frame grabbers) or
- parallel operation with 2 (P400S) to max. 3 cameras (P400, you will need 2 frame grabber).

◆**NOTE**

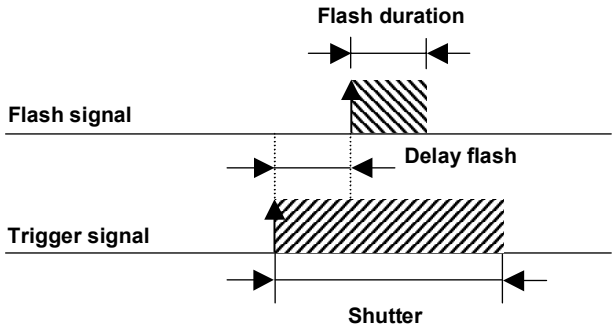
If you want to grab the images in serial mode, select the "Grab Always Serial" option on the "Frame Grabber" tab (see page 140) under System Settings → Vision P400 Settings**.**

2.4.2 Full Frame Shutter Mode

The full frame shutter mode is generally selected to inspect moving objects. Immediately after the P400 receives the start signal, the image is grabbed without any observable time delay (t_{delay} < ca. 1ms). This mode also offers a synchronous flash trigger to allow for more efficient lighting.

The following diagram explains with an example the temporal connection between the flash signal and the trigger IN signal of the camera. You can set the delay for the flash signal and the trigger IN signal on the frame grabber's property page under **Camera** → **Properties** on the "Frame Grabber" tab. You can set a delay for the flash or for the camera. This way it is possible to trigger the flash during the shutter opening time or to trigger the shutter during the flash time.

Set the flash time at the flash according to your application's requirements. Please remember that depending on the flash used there may be hardware-related delays.



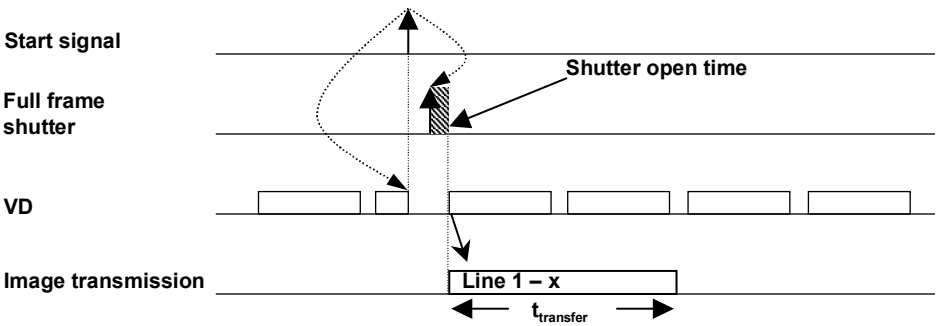
Sample time diagram for flash signal and shutter of camera ANPC 836D

◆NOTE

Please read the manufacturer's instructions for your flash.

2.4.3 Time Diagram for Image Grabbing

With a shutter speed of 1/10000s it takes about 18ms to read in a full image. If you set (see page 264) a different shutter speed, add the appropriate value to the image transfer time $t_{transfer}$ to obtain the time needed for image reading.



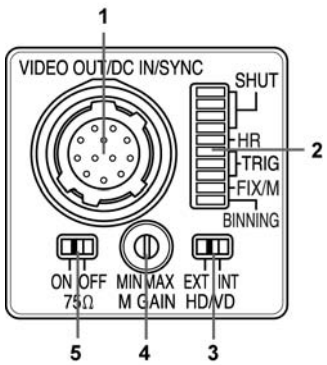
Time diagram for image grabbing with ANPC 836D

Formula: Grab image = approximately $t_{transfer} + t_{shutter}$

Image format	$t_{transfer}$
Full image	18ms
Partial 1/2	10ms
Partial 1/3	8ms
Partial 1/6	6ms
Binning 636 x 480	10ms
Binning 636 x 308	8ms
Binning 636 x 212	6ms
Binning 636 x 116	5ms

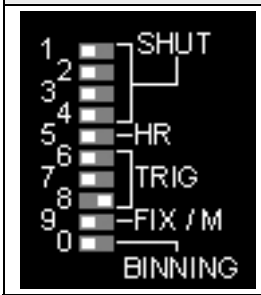
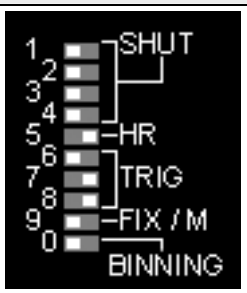
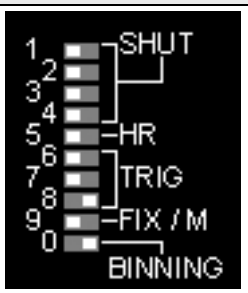
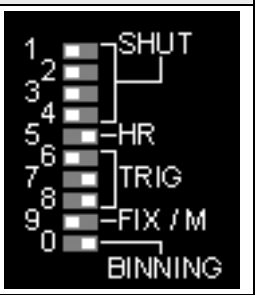
2.4.4 Camera Settings

The camera is delivered with the correct settings for optimum operation.



1	12-pin HIROSE connector for the frame grabber connection
2	DIP switch, for setting options see below. Number 9 controls the gain setting and is set by default to M = Manual.
3	Switch for input/output of HD/VD signal. Setting = EXT
4	Gain potentiometer to regulate image brightness
5	75Ω termination switch Setting = ON

The table below lists the different setting options of the DIP switches in the different camera operation modes.

Full frame mode	Partial scan mode	Full frame mode with binning	Partial scan mode with binning
			

When you create a new application (see page 260), you select the camera type together with the image format and mode.

The shutter speeds are controlled by the pulse length of the camera trigger (start signal for the frame grabber to read the image). Set the shutter speeds with the Vision P400 software. Select

Camera → Properties and go to the "Camera" property page (see page 262). The following shutter speeds are available: 1/125; 1/250; 1/500; 1/1000; 1/2000; 1/4000; 1/10000 second.

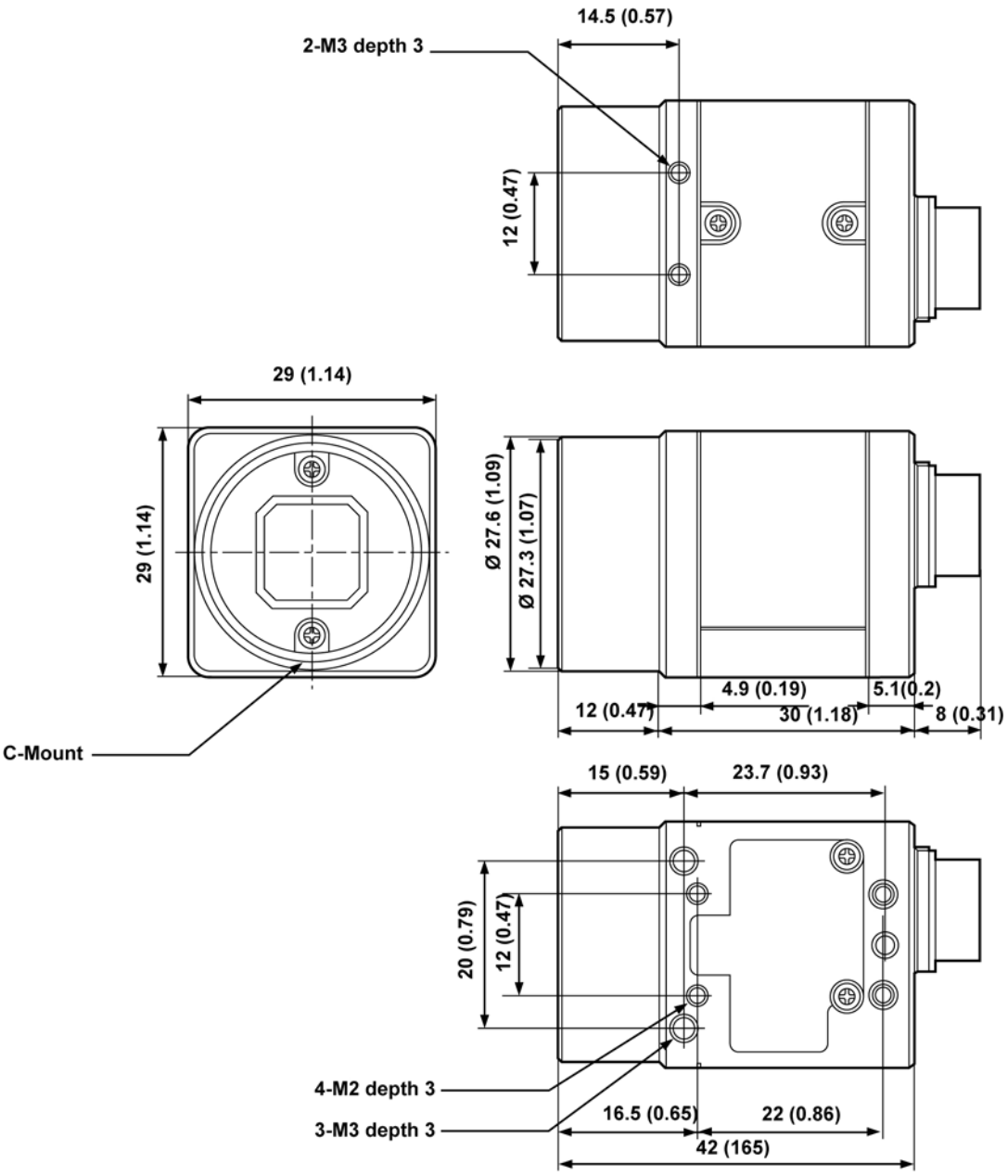
2.4.5 Pin Assignment

The 12 pins of the camera connector are assigned as shown below:

Pin	Frame shutter
1	GND
2	+12V DC IN
3	Video OUT GND
4	Video OUT signal
5	HD GND
6	Ext. HD IN signal
7	VD IN signal
8	Not connected
9	Not connected
10	WEN OUT signal
11	Trigger IN signal
12	GND

Pin assignment ANPC 836D

2.4.6 Dimensions



Unit: mm (inches)

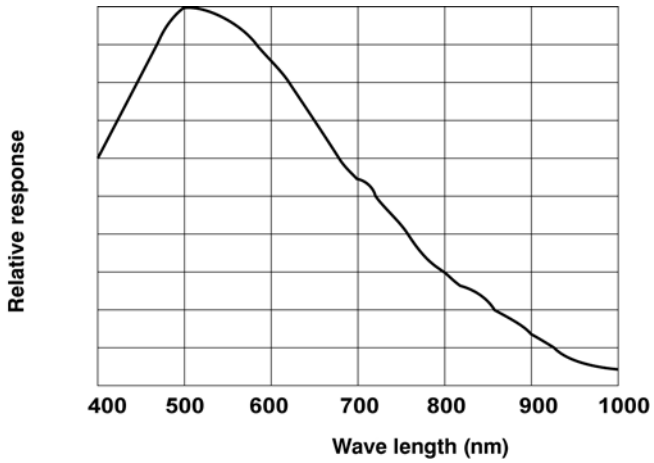
Dimensions for camera ANPC 836D

Danger of damage to the camera!
Make sure when mounting the camera to use Phillips screws not longer than 3mm or 0.12 inch.

2.4.7 Specifications

Progressive scan camera ANPC 836D	
CCD sensor	Monochrome 1/3" IT PS CCD
Pixel clock	24.5454MHz
Line frequency	31.468kHz
Video signal frequency	59.94Hz/119.88Hz (normal mode/binning mode)
Chip size	5,84mm x 4.94mm (v)
Pixel size	7.4µm (h) x 7.4µm (v)
Effective pixels	659 (h) x 494 (v)
Pixel in the image area of Vision P400	636 (h) x 480 (v)
Resolution horizontal	500 TV lines
Minimal light intensity	1 Lux (with maximal gain and F1.4)
S/N ratio	58dB
Gain	Fixed or set manually
Gamma correction	1.0 (fix)
Video output	Composite VS signal, 1.0 Vpp, 75 ohm, sync. negative
Accumulation	Frame (progressive scan)
Synchronization system	Int/Ext, HD/VD or random trigger
Shutter speeds	1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000
Vibration resistance	10G (20 to 200Hz)
Maximal vibration	70G
MTBF	88,044 hours (about 10 years)
Functions controlled by DIP switches	Shutter speed, high-rate scanning, trigger mode, gain, binning mode, EXT/INT sync., termination
Operational conditions (temperature/humidity)	-5°C to +45°C/20% to 80% non condensating
Storage conditions (temperature/humidity)	-30°C to 60°C/20% to 95% non condensating
Power supply	+12V DC +/- 10%, 1.8W max.
Lens mount	C mount
Dimensions	29 x 29 x 42mm (length x width x height)
Weight	50g

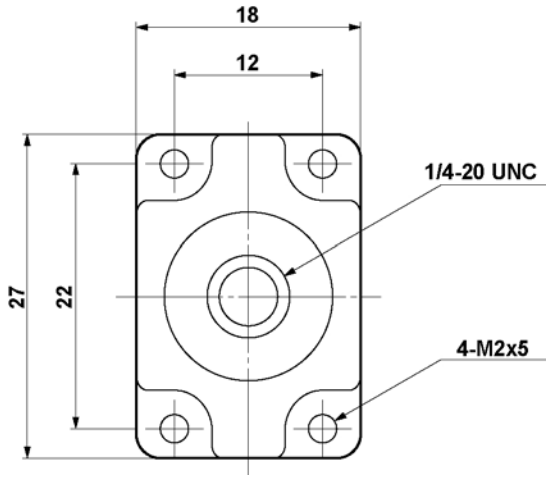
2.4.8 Spectral Response



Spectral response of camera ANPC 836D

2.4.9 Laboratory Socket

To attach the camera ANPC 836D to a pole or staff, please use the laboratory socket (order number ANPC8361). The socket is not provided with the camera and needs to be ordered separately.



Dimensions for laboratory socket ANPC 8361 for camera ANPC 836D

Danger of damage to the camera!
Make sure when mounting the camera to use screws not longer than 4mm or 0.16 inch.

2.5 ANPC 837D

Camera ANPC 837D produces images with a format of 1024 x 768 pixels and uses the "double-speed progressive scan" technology. With this technology, all lines of the CCD chip are exposed at the same time and then transferred one after the other to the frame grabber. This shutter mode is also called full frame shutter mode.

The image-grabbing time is shorter compared with cameras using the "progressive scan" technology (e.g. ANPC 831D). However, you can connect only 2 cameras with parallel grabbing because more cameras would exceed the capacity of the PCI bus and lead to errors in the camera image.

There are different scanning formats available (partial 1/2, 1/3, and 1/6) to reduce the time for image grabbing. The correct scanning format considerably reduces the image-grabbing time for oblong objects. With the scanning formats only a certain part of the image (e.g. line 192 - 546) will be read.

Another possibility to reduce the image-grabbing time is the binning mode. In binning mode an odd and an even line of the camera image are combined into one line by compression. This reduces the resolution by half. There are several image formats available in binning mode.

◆NOTE

For lens selection tables, please turn to our homepage:
http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls
Select your camera type by clicking one of the tabs at the bottom.

2.5.1 Operation Modes

You can use camera ANPC 837D both for serial and parallel image grabbing, see table (see page 40):

- serial operation with 4 (P400S) to max. 12 cameras (P400, you will need 3 frame grabbers) or
- parallel operation with 2 (P400S) to max. 2 cameras (P400, you will need 1 frame grabber).

◆NOTE

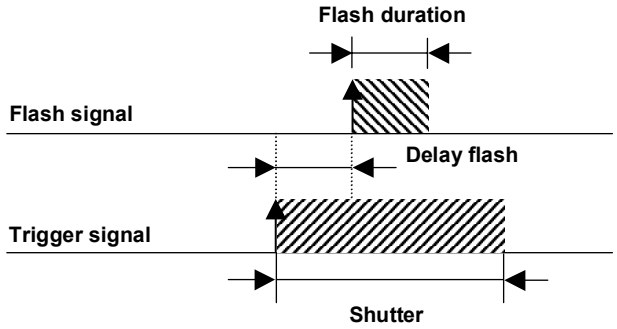
If you want to grab the images in serial mode, select the "Grab Always Serial" option on the "Frame Grabber" tab (see page 140) under System Settings → Vision P400 Settings**.**

2.5.2 Full Frame Shutter Mode

The full frame shutter mode is generally selected to inspect moving objects. Immediately after the Imagechecker receives the start signal, the image is grabbed without any observable time delay (t_{delay} < ca. 1ms). This mode also offers a synchronous flash trigger to allow for more efficient lighting.

The following diagram explains with an example the temporal connection between the flash signal and the trigger IN signal of the camera. You can set the delay for the flash signal and the trigger IN signal on the frame grabber's property page under **Camera → Properties** on the "Frame Grabber" tab. You can set a delay for the flash or for the camera. This way it is possible to trigger the flash during the shutter opening time or to trigger the shutter during the flash time.

Set the flash time at the flash according to your application's requirements. Please remember that depending on the flash used there may be hardware-related delays.



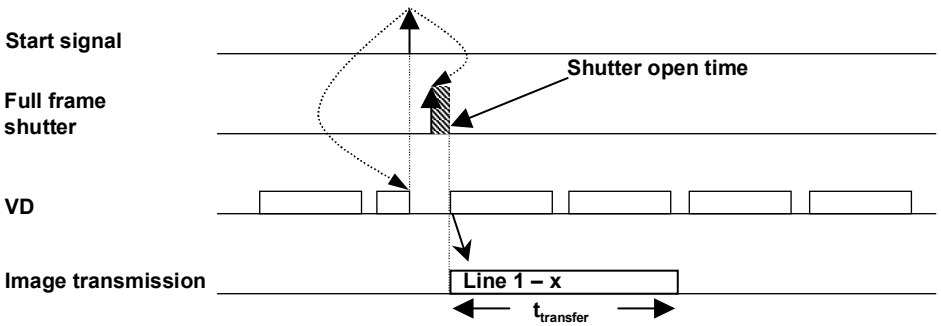
Sample time diagram for flash signal and shutter of camera ANPC 837D

◆ **NOTE**

Please read the manufacturer's instructions for your flash.

2.5.3 Time Diagram for Image Grabbing

With a shutter speed of 1/10000s it takes about 36ms to read in a full image. If you set (see page 264) a different shutter speed, add the appropriate value to the image transfer time $t_{transfer}$ to obtain the time needed for image reading.



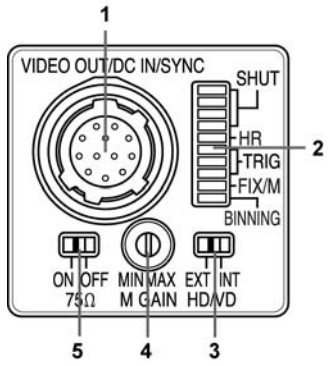
Time diagram for image grabbing with ANPC 837D

Formula: Grab image = approximately $t_{transfer} + t_{shutter}$

Image format	$t_{transfer}$
Full image	36ms
Partial (354 lines)	19ms
Partial (220 lines)	13ms
Partial (152 lines)	10ms
Binning (640 lines)	19ms
Binning (316 lines)	11ms
Binning (116 lines)	7ms

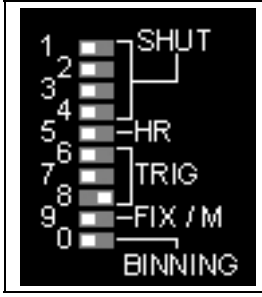
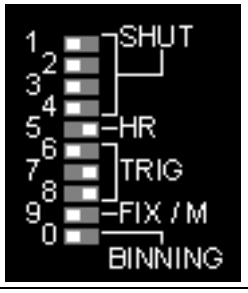
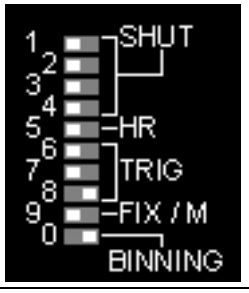
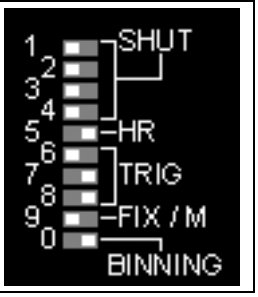
2.5.4 Camera Settings

The camera is delivered with the correct settings for optimum operation.



1	12-pin HIROSE connector for the frame grabber connection
2	DIP switch, for setting options see below. Number 9 controls the gain setting and is set by default to M = Manual.
3	Switch for input/output of HD/VD signal. Setting = EXT
4	Gain potentiometer to regulate image brightness
5	75Ω termination switch Setting = ON

The table below lists the different setting options of the DIP switches in the different camera operation modes.

Full frame mode	Partial scan mode	Full frame mode with binning	Partial scan mode with binning
			

When you create a new application (see page 260), you select the camera type together with the image format and mode.

The shutter speeds are controlled by the pulse length of the camera trigger (start signal for the frame grabber to read the image). Set the shutter speeds with the Vision P400 software. Select **Camera** → **Properties** and go to the "Camera" property page (see page 262). The following shutter speeds are available: 1/125; 1/250; 1/500; 1/1000; 1/2000; 1/4000; 1/10000 second.

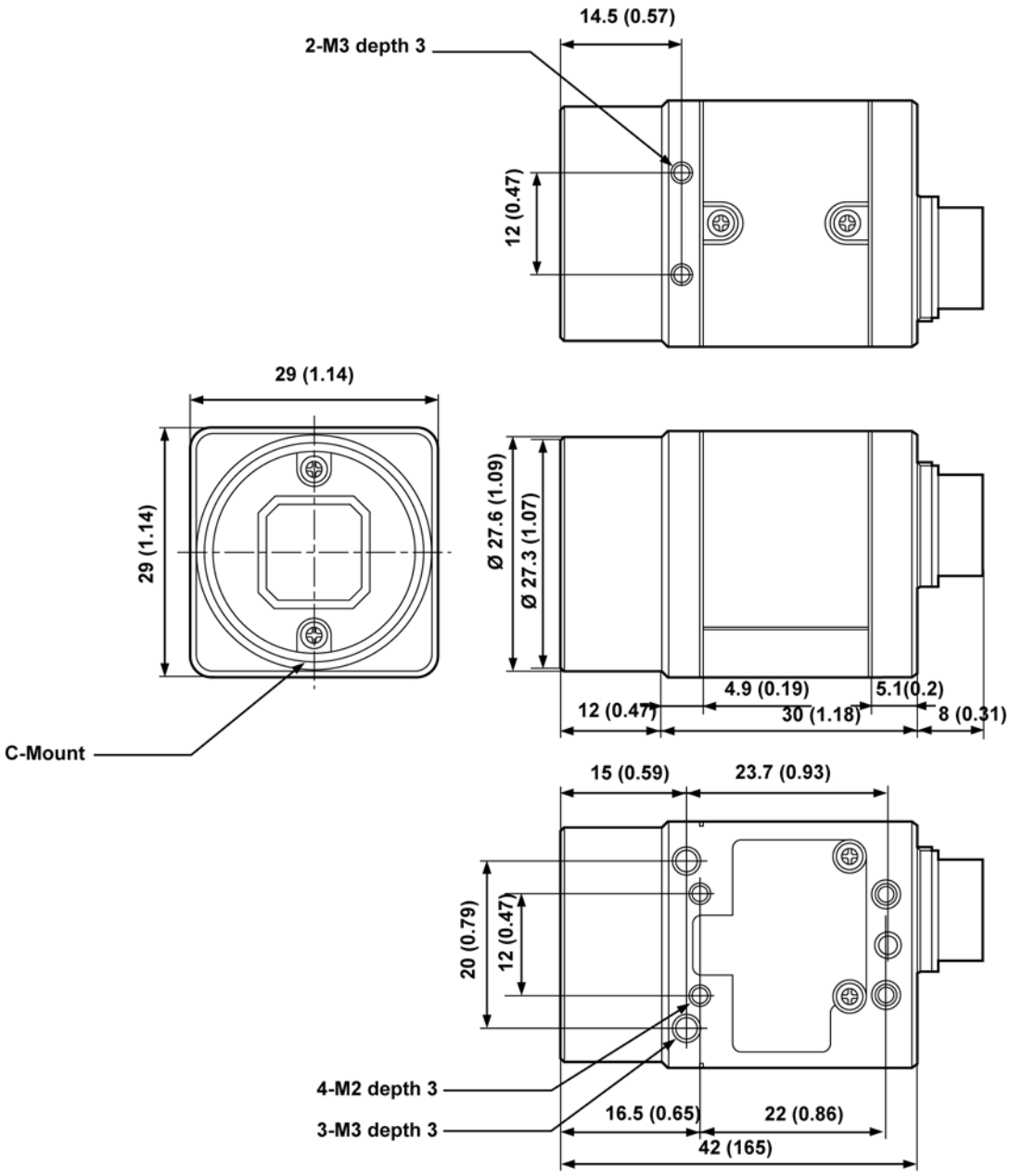
2.5.5 Pin Assignment

The 12 pins of the camera connector are assigned as shown below:

Pin	Frame shutter
1	GND
2	+12V DC IN
3	Video OUT GND
4	Video OUT signal
5	HD IN GND
6	Ext. HD IN signal
7	VD IN signal
8	Not connected
9	Not connected
10	WEN OUT signal
11	Trigger IN signal
12	GND

Pin assignment ANPC 837D

2.5.6 Dimensions



Unit: mm (inches)

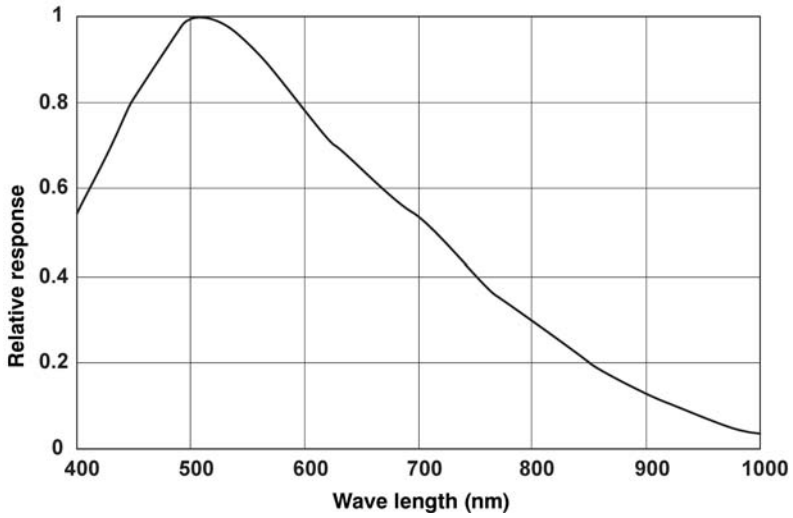
Dimensions for camera ANPC 837D

Danger of damage to the camera!
Make sure when mounting the camera to use Phillips screws not longer than 3mm or 0.12 inch.

2.5.7 Specifications

Progressive scan camera ANPC 837D	
CCD sensor	1/3" IT PS CCD
Pixel clock	29.5MHz
Line frequency	23.23kHz
Video signal frequency	29.2Hz/58.4Hz (normal mode/binning mode)
Chip size	5,80mm (h) x 4,92mm (v)
Pixel size	4.65µm (h) x 4.65µm (v)
Effective pixels	1034 (h) x 779 (v)
Pixel in the image area of Vision P400	1024 (h) x 768 (v)
Resolution horizontal	800 TV lines
Minimal light intensity	1 Lux (with maximal gain and F1.8)
S/N ratio	> 56dB
Gain	Fixed or set manually
Gamma correction	1 (fix)
Video output	Composite VS signal, 1.0 Vpp, 75 ohm, sync. negative
Accumulation	Frame (progressive scan)
Synchronization system	Int/Ext, HD/VD or random trigger
Shutter speeds	1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000
Vibration resistance	10G (20 to 200Hz)
Maximal vibration	70G
MTBF	88,044 hours (about 10 years)
Functions controlled by DIP switches	Shutter speed, high-rate scanning, trigger mode, gain, binning mode, EXT/INT sync., termination
Operational conditions (temperature/humidity)	-5°C to +45°C/20% to 80% non condensating
Storage conditions (temperature/humidity)	-30°C to 60°C/20% to 95% non condensating
Power supply	+12VDC +/- 10%, 2.0W max.
Lens mount	C mount
Dimensions	29 x 29 x 42mm (length x width x height)
Weight	50g

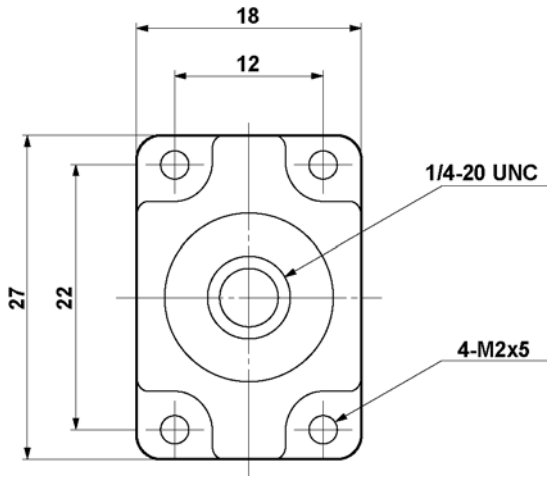
2.5.8 Spectral Response



Spectral response of camera ANPC 837D

2.5.9 Laboratory Socket

To attach the camera ANPC 837D to a pole or staff, please use the laboratory socket (order number ANPC8361). The socket is not provided with the camera and needs to be ordered separately.



Dimensions for laboratory socket ANPC 8361 for camera ANPC 837D

Danger of damage to the camera!
Make sure when mounting the camera to use screws not longer than 4mm or 0.16 inch.

2.6 Camera Cables

The camera cables come in four standard sizes:

Order number camera	Camera cables available
ANPC 831D	ANPC 87103D (3m)
ANPC 834D	ANPC 87105D (5m)
ANPC 836D	ANPC 87110D (10m)
ANPC 837D	ANPC 87115D (15m)

◆**NOTE**

Strong electric or magnetic fields in the immediate surrounding of the camera cables may cause interference with the image transmission. Please keep the cables away from such fields.

2.7 Camera Configuration

In order to be able to use the different camera resolutions of camera ANPC831D/ANPC 834D two steps are necessary: One, you need to make the right settings in Vision P400 when selecting the camera. Two, you need to configure the firmware of the selected camera. For easy configuration and for new cameras when you connect them for the first time, please use the "Vision Camera Configurator" program.

This program has been installed on your system together with the Vision P400 software. The Vision Camera Configurator is supported by Win 2000 and Win XP.

To establish the connection to the camera you need the serial programming cable which you can order from your local Panasonic branch (order number ANPC 8300D).

Configure New Cameras with the Correct Settings for Vision P400

◆Procedure

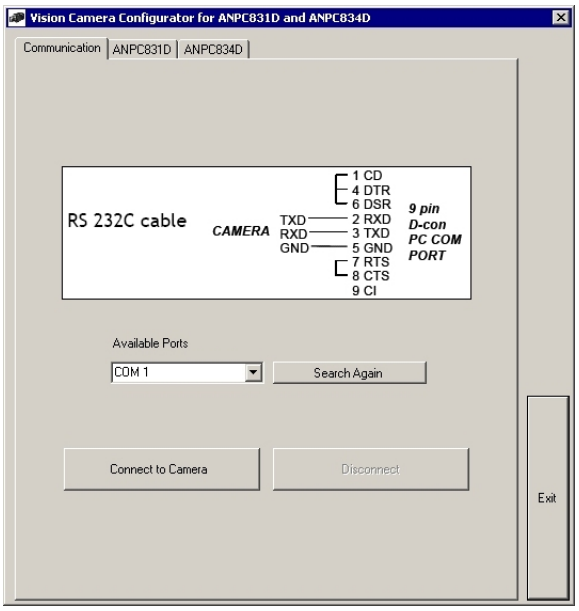
1. **Connect the camera to the PC**

   Please use the serial programming cable ANPC 8300D. Connect the 6-pin Hirose connector to the camera and the 9-pin sub-D plug to a free COM port.

2. **Start the PC**

3. **Start the Vision Camera Configurator**

4. **In the startup screen select the port of the serial interface you wish to use for the communication**

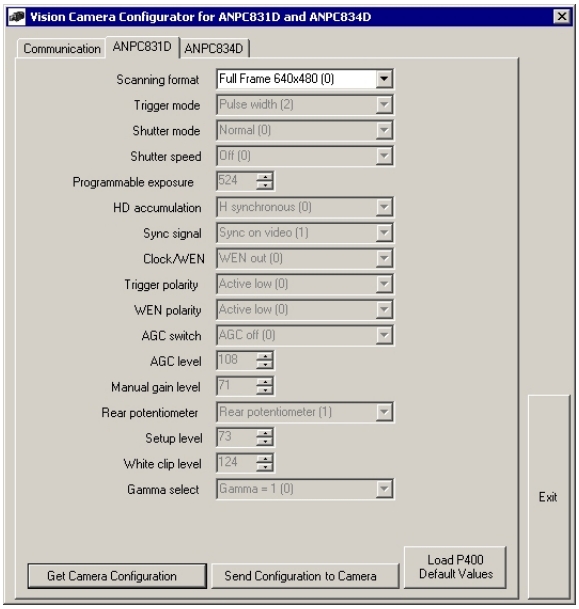


   Use the [Search again] button to let the P400 search for the port.

5. **Establish the connection to the camera with the [Connect to camera] button**

   When the camera connection is established, the parameter page of the camera is

displayed automatically. Two camera types are supported: ANPC 831D and ANPC 834D.



You see the current camera settings and you may change the image format under "Scanning format". The scanning format must be the same as the one you have selected in Vision P400 when you created the application (see page 259).

6. **To configure the camera select [Load P400 Default Values]**

   This commands loads the predefined standard values for the camera.

7. **To transfer the settings to the camera select [Send Configuration to Camera]**

   The command "Get Camera Configuration" respectively "Send Configuration to Camera" reads the current parameter values from the camera respectively sends the parameter values to the camera.

8. **End the connection with "Disconnect"**

◆**NOTE**

At the moment it is not possible to change any other parameter except "Scanning format" because the other modes are not supported by Vision P400.

Chapter 3

Installation

3.1 Important Information

Please read the following information **before** you begin with the installation or operation!

◆NOTES

- **Use only products (cameras and camera cables) offered by PEWEU for specific use with the Imagechecker. The use of any other products will negate the warranty for the entire system since third-party components can damage the Imagechecker. In this case, PEWEU will not assume liability for the proper functioning of the Imagechecker.**
- **Under no circumstance should you ever disassemble the Imagechecker or change the system's factory settings unless you are specifically asked to do so in this manual. Any tampering will negate the warranty for the entire system since such changes may damage the Imagechecker. In this case, PEWEU will not assume liability for the proper functioning of the Imagechecker.**
- **The Imagechecker is a precision device and should under no circumstance be exposed to shocks or vibrations.**
- **The Imagechecker is neither waterproof, dustproof nor rustproof. Consequently, it is absolutely necessary to install the P400 in a dry, clean environment.**
- **Protect the Imagechecker from exposure to direct sunlight and explosive or corrosive gases.**
- **Disconnect the power supply before connecting or disconnecting any connectors to or from the Imagechecker.**
- **Never apply force to any Imagechecker connectors or cables. Do not bend the cables. The connections should never be unplugged by pulling on the cable. Always hold the connector by the plug when unplugging any component from the Imagechecker.**
- **NEVER touch an exposed connector contact after unplugging a connector from the Imagechecker, and ensure that no fluids/chemicals come into contact with the contacts.**
- **Leave ample space around the Imagechecker so that heat generated during operation can be dissipated by the ventilators.**
- **Please ensure that the ventilators function properly.**
- **Clean or change the dust filter regularly (if there is one). Warm air cannot pass readily through a dirty filter, which, in turn, may lead to damage from overheating.**
- **Guard against unintended data loss by maintaining data protection in a safe location.**
- **Ensure that the power supply is disconnected while you work on the equipment.**

- **Avoid discharges of static energy.**
- **Use the components only within the humidity and temperature ranges specified.**
- **Take care to keep dust accumulation to a minimum since dust may impair the functioning of the components.**
- **Do NOT clean the components with solvents or aggressive cleansers. These substances can destroy equipment parts and damage the paint.**

3.2 Unpacking the P400MA

As you unpack your P400MA, please check the package contents to make sure nothing is missing.

◆NOTES

- **Be careful! The P400MA weighs approx. 3kg.**
- **Mount the device on the floor or at the wall according to the description. Make sure to leave enough space between ventilation slots and mounting areas. Or place the equipment on a strong, firm base (space requirements: 0.3m x 0.3m).**

◆Procedure

1. **Remove the box containing the accessories and periphery from the package**
2. **Using both hands, lift the P400MA out of the package**
3. **Check package contents to make sure nothing is missing**

Product	Description	Amount
Industrial PC	P400MA by Panasonic Electric Works Europe AG	1
Periphery	IBM-compatible mouse, 3 buttons	1
Connector	Connector for serial and parallel interface	1
Flash drive/CD-ROM	Vision P400 installation CD Flash drive with system recovery and license file DSM manual with driver CD (CPU board)	1 1 1

4. **Check to see that the ventilation slots are unobstructed**
5. **Check again to ensure that there is sufficient space (minimum 0.3m x 0.3m)**

3.3 Connecting the P400MA

◆Procedure

1. **Check the power input of the power supply (24V DC/3A)**

   For operating the P400MA you need a current consumption of 24V DC/3A.

2. **Ground the Imagechecker casing**

   Use the tap hole at the front intended for grounding (M4).

3. **Connect the power supply to the two-pin connector**

4. **Connect the monitor, the mouse, and the keyboard**

   The mouse and the keyboard are connected at the PS/2 connectors at the front: the monitor is connected to the 15-pin Sub-D plug (use the designated tap holes at the bottom resp. back of the device). Be careful! Do not connect the monitor to the frame grabber!.

5. **Connect the cameras, interface and network cables**

6. **Switch the device ON**

   The green LED at the front will light up and indicate proper operation. The red LED will flash and indicate operation of the hard disk. The computer will boot up the operating system.

3.4 Software Installation

Vision P400 is available in different editions. The following editions are available in English, French, or German:

- Vision P400 Version 4.0
- Vision P400 V4.0 Demo Version (free of charge)

3.4.1 New Installation of Vision P400 Edition "4.0 Full Version"

The system comes readily installed with the following components:

- Current (see page 35) version of Vision P400
- Operating system Windows XP Embedded
- Necessary drivers
- Vision Camera Control software
- Security Console (EnhancedWriteFilter) software
- Vision P400 software license (file: "license.dat"))

It is necessary to perform a new installation when:

- You have deleted the software by accident
- A hardware failure has occurred

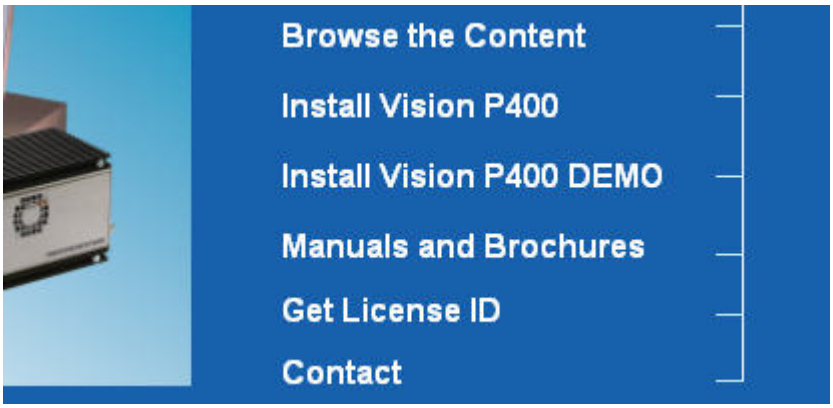
To install Vision P400 again, use the flash drive (see page 83) you have received.

◆Procedure

1. **Insert the flash drive in a free USB port**

The auto start menu of the flash drive is displayed. Select "Start my P400MA Recovery System".

2. **Select "Install Vision P400" from the following menu**



This triggers the installation routine of the Vision P400 software. Follow the instructions on the screen and restart the system when you are finished.

3. **Install the license file**

When you have received a new license file (see page 78) per mail: After installing Vision P400, copy the license file into the folder \<installation folder>\license on your Imagechecker.

3.4.2 Applying for a New License

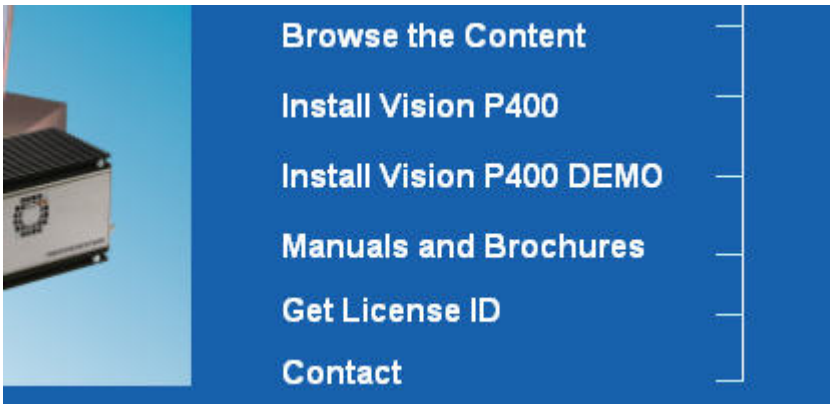
◆Procedure

1. **Insert the flash drive in a free USB port**

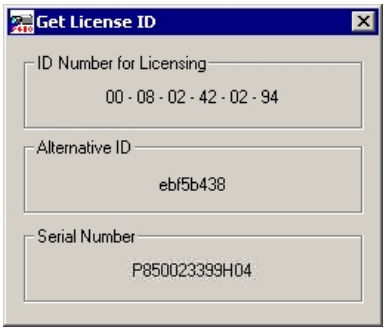
   The auto start menu of the flash drive is displayed.

2. **Select "Start my P400MA Recovery System"**

3. **Select "Get License ID" from the following menu**



A window appears displaying the license ID. In addition, a second field displays an alternative ID. Use the alternative ID in case the primary license ID is not displayed.



4. **Write down the number displayed under "ID Number for Licensing" or, if nothing is displayed there, the number under "Alternative ID"**
5. **To close the window click the cross in the top right corner**
6. **Write down the serial number of your Imagechecker**

   The serial number can be found on the product label on the casing.
7. **Inform your local Panasonic Electric Works branch that you need a new license file**

   Tell them the license ID you have written down and the serial number.
8. **Carry out the new installation of Vision P400**

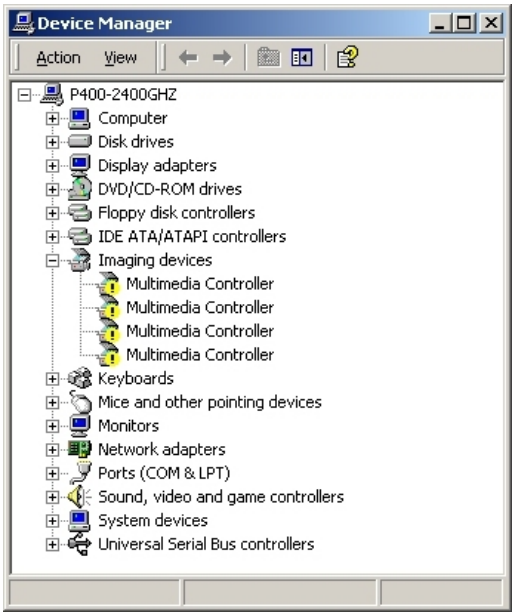
   Follow the procedure for new installations.
9. **When you have received the new license file, install it**

   When you have received the new license file per mail: After installing Vision P400, copy the file into the folder \<installation folder>\license on your Imagechecker.

3.5 Driver Installation

Inside the Imagecheckers P400, P400S, and P400MA there is one or (for the P400) up to three frame grabbers of type ANPC 802D controlling the image capture and a digital I/O board (ANPC 850V2D for P400, ANPS 850D for P400S, ANPC 850V3 for P400MA) for digital data output. All devices need the appropriate drivers for correct operation. The Imagecheckers are shipped with the drivers for one of the devices listed above installed.

If you install additional or new devices (like for example another frame grabber) or if you change slots, it is necessary to install the drivers for these devices manually. The image below shows a typical configuration of the Imagechecker P400 with three frame grabbers and a digital I/O board of type ANPC 850V2D.



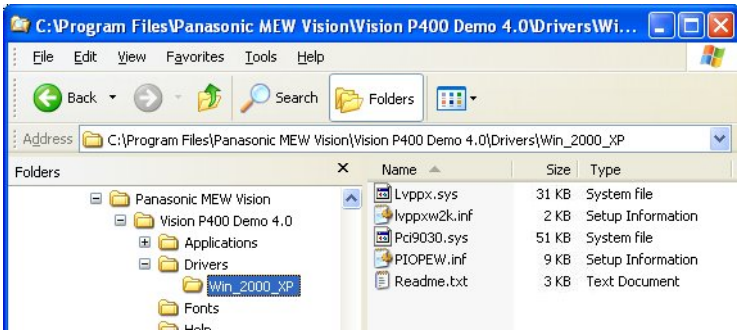
Yellow symbols indicate not fully installed devices in the Device Manager

Yellow circles with exclamation marks appear in the Windows Device Manager next to devices which have not been installed completely. The four devices listed under "Imaging devices" are 3 frame grabber and the digital I/O board ANPC 850V2D, as used by the Imagechecker P400. If a different digital I/O board is installed (ANPC 850V3 or ANPS850D), it will be listed here.

The table below shows how frame grabbers and digital I/O boards are displayed and which .INF and .SYS files they require.

Device type (Imaging devices)	**ANPS 850D (I/O P400S)**	**ANPC 850V2D (I/O P400)**	**ANPC 850V3D (I/O P400MA/P400)**	**ANPC802D (frame grabber, all devices)**
Displayed as	Multimedia Controller	Multimedia Controller	Panasonic Digital IO ANPC850V3D	Multimedia Controller
.INF file	lvppxw2k.inf	lvppxw2k.inf	PIOPEW.inf	lvppxw2k.inf
.SYS file	lvppx.sys	lvppx.sys	PCI9030.sys	lvppx.sys

Both .INF and .SYS files can be found in the installation folder of Vision P400.

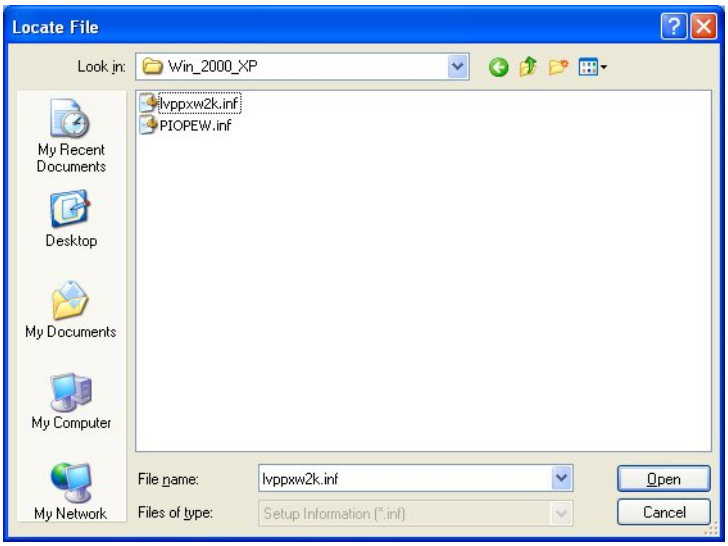


To install the driver "lvppx.sys", proceed as follows:

◆Procedure

1. **Open the Windows Device Manager**
2. **Double-click the device you wish to install**
3. **Select the tab "Driver"**
4. **Select [Update Driver ...]**
5. **Select [Install from a list or specific location]**
6. **Click [Don't search, I will choose the driver to install] and select the suitable file in the folder "Drivers" shown above**

   The frame grabbers and the digital I/O boards ANPC 850V2D/ANPS 850V2D use the same driver "lvppx.sys". The digital I/O board ANPC 850V3D uses the driver "piopew.sys".



7. **Select the corresponding .INF file and click [Open]**

   This file contains all information needed to install the driver. The driver installation is

carried out. In some cases there may be another prompt asking you to select the actual driver file. Next, in the installation folder open the file with the extension .SYS.

The drivers for all other PC devices like graphic boards, Ethernet, etc. are installed with the setup from the recovery CD. If the necessity for an update of the driver arises, please contact your local Panasonic branch.

3.6 System Backup and Recovery

You have several possibilities to use the recovery software on the flash drive:

- Start recovery from flash drive (see page 89)
- Create and save a backup copy of the current system:
  - on the flash drive (see page 83)
  - on the network (see page 87)
- Restore system from backup copy
  - from the flash drive (see page 83)
  - from the network (see page 87)
- Burn system backup on CD (see page 83, see page 87)

Required settings in "Recovery_Settings.ini"

In order to be able to use all possibilities, please make the following settings in the file "Recovery_Settings.ini". You find this file in the main folder of the flash drive.

[NetShare]	• Share=\\computer name\path password /user:domain\username Here you define the network path for reading or writing system backups. Enter the name of the computer, the path, the user name, and the password.
[FileName]	• NameForRecovery=VisionP400MAMasterImage.wim Name of the master image. Please do not change as this may make it impossible to use the function to restore the original system state. • NameForBackupMemStick=BackupVisionP400Image.wim Name of the backup file for reading from or writing to the flash drive. • NameForBackupNetwork=BackupVisionP400image.wim Name of the backup file for reading from or writing to the network.

3.6.1 Using the Flash Drive

Use the flash drive you have received to back up and restore the system as follows:

◆**NOTE**

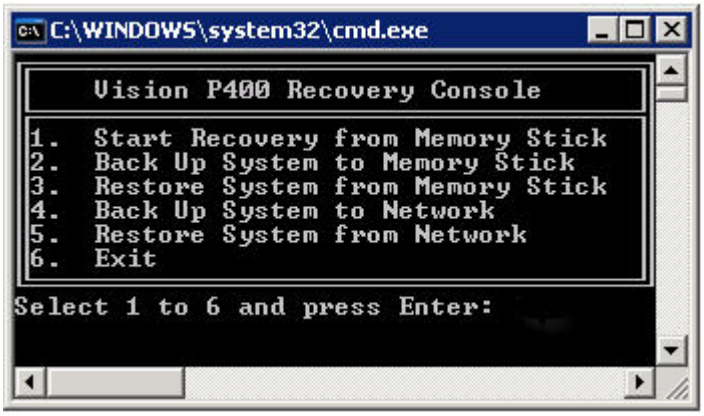
Please note that you need to make certain settings in the file "Recovery_Settings.ini" (see page 83) before you can back up or restore the system.

Back up the system

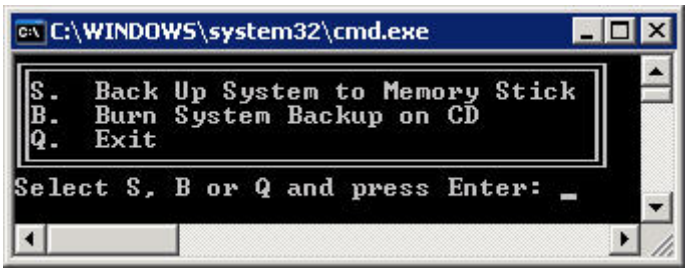
◆**Procedure**

1. **Insert the flash drive in a free USB port**

2. **Start the system and wait until the system has booted from the flash drive**



3. **Type "2" <Enter>**



4. **Type "S" <Enter>**

   The backup process should take 10 to 20 minutes to complete. When the backup process has finished, you will find the backup copy "BackupVisionP400image.wim" in the corresponding folder on the flash drive. The backup copy comprises the complete contents of the device. You can burn the system backup on CD if you have connected a CD recorder.

5. **Type "B" <Enter> to burn the backup copy on the CD**

6. **Follow the instructions on the screen**

   With the help of your backup CD you can restore the system as it was when you created the backup CD.

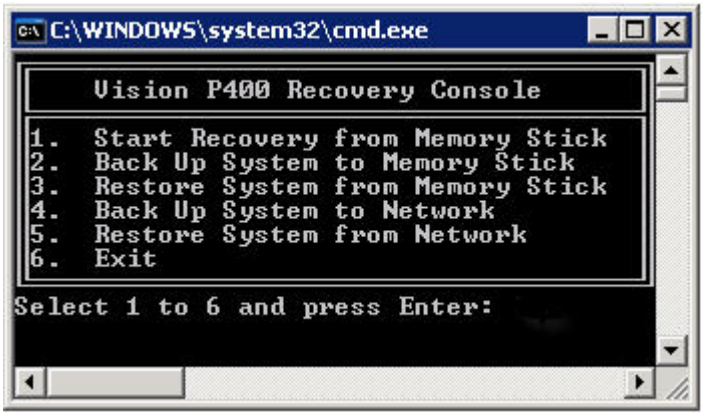
7. **When you have completed the backup, remove the flash drive and restart the Imagechecker**

Restore the system

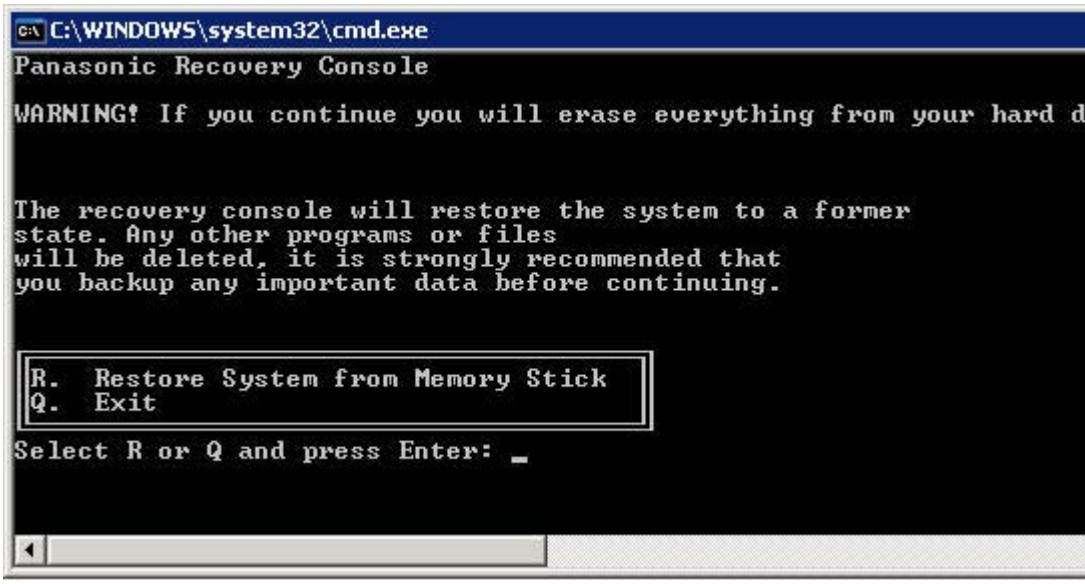
◆Procedure

1. **Insert the flash drive in a free USB port**

2. **Start the system and wait until the system has booted from the flash drive**



3. **Type "3" <Enter>**



4. **Type "R" <Enter>**

   The restore process should take 10 to 20 minutes to complete. After you have completed the restore process, the Imagechecker is in the same state as it was when you created the backup. All data or settings changed afterwards will be lost.

5. **When you have completed the backup, remove the flash drive and restart the Imagechecker**

3.6.2 Installing a Slot Card

It is only necessary to replace the frame grabber (ANPC 802D) or the digital I/O board (ANPC 853V3D) in the rare event that a hardware failure occurs. These boards are pre-installed in the Imagechecker P400MA.

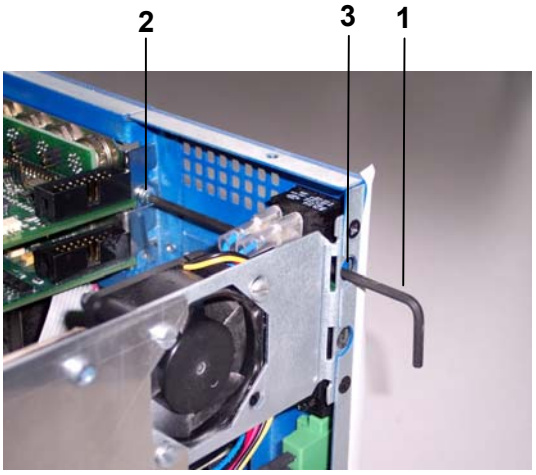
It is possible to replace the pre-installed digital I/O board with your own board.

◆Procedure

1. **Pull the mains cable and disconnect the power supply**
2. **Unscrew the four screws of the top cover and pull the cover up to open the casing**

3. **Open the slot card holder of the board**

   Use the hex wrench you have received (1, accessories) to open the recessed-head screw (2) at the slot card holder inside the Imagechecker. Insert the hex wrench through one of the slotted side holes in the casing (3).



4. **Remove the old card from the slots of the PCI riser card**
5. **Insert the new card into the free slot of the PCI riser card**
6. **Re-fasten the screw of the slot card holder to the Imagechecker casing**

   Use the hex wrench you have received (accessories) to fasten the screw. Insert the hex wrench through one of the slotted side holes in the casing.

7. **Close the Imagechecker casing and fasten it with the four recessed-head screws**

3.6.3 Using the Network

Use the network to back up and restore the system as follows:

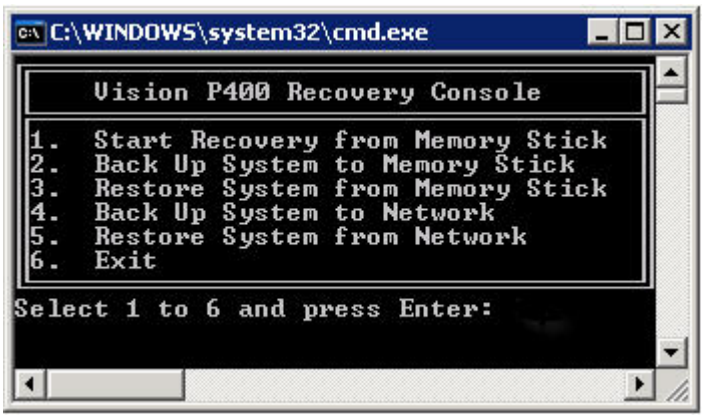
◆NOTE

Please note that you need to make certain settings in the file "Recovery_Settings.ini" (see page 83) before you can back up or restore the system.

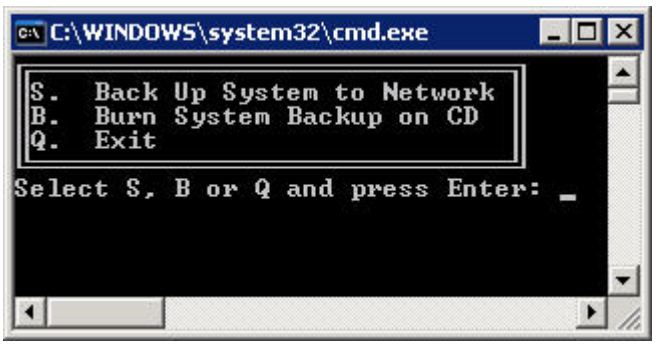
Back up the system

◆Procedure

1. **Insert the flash drive in a free USB port**
2. **Start the system and wait until the system has booted from the flash drive**



3. **Type "4" <Enter>**



4. **Type "S" <Enter>**

The backup process should take 10 to 20 minutes to complete. When the backup process has finished, you will find the backup copy called "BackupVisionP400image.wim" in the corresponding folder on the network. The backup copy comprises the complete contents of the device. You can burn the system backup on CD if you have connected a CD recorder.

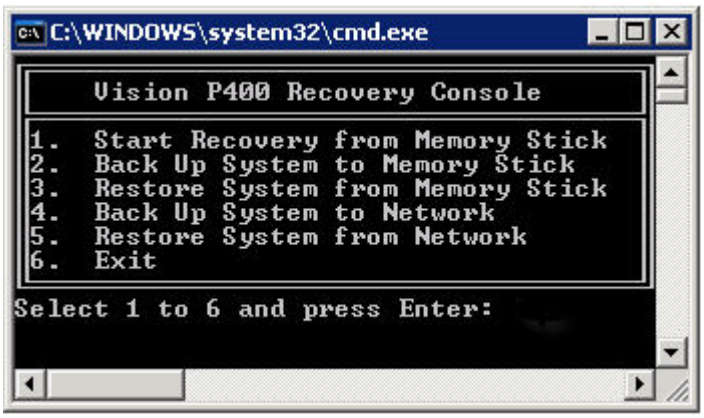
5. **Type "B" <Enter> to burn the backup copy on the CD**
6. **Follow the instructions on the screen**

   With the help of your backup CD you can restore the system as it was when you created the backup CD.
7. **When you have completed the backup, remove the flash drive and restart the Imagechecker**

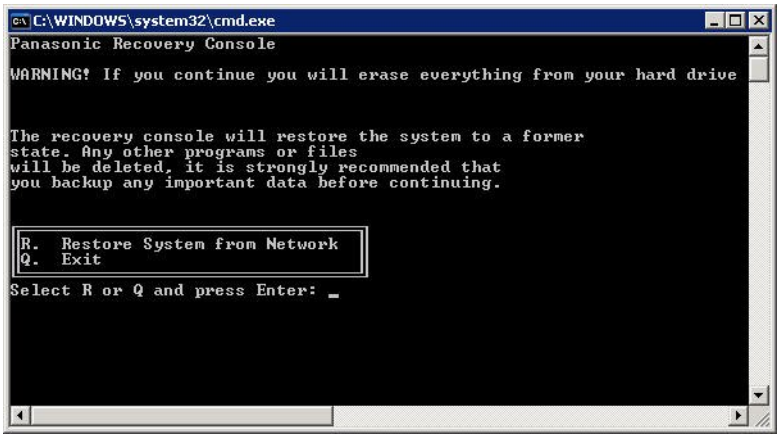
Restore the system

◆Procedure

1. **Insert the flash drive in a free USB port**
2. **Start the system and wait until the system has booted from the flash drive**



3. **Type "5" <Enter>**



4. **Type "R" <Enter>**

   The restore process should take 10 to 20 minutes to complete. After you have completed the restore process, the Imagechecker is in the same state as it was when you created the backup. All data or settings changed afterwards will be lost.

5. **When you have completed the backup, remove the flash drive and restart the Imagechecker**

3.6.4 Recover the Original State of the System

Before you reset your system to the original state, please carry out the following steps to back up important information from you current system:

Procedure

1. **Create a backup copy of the file "license.dat"**

   There is a backup copy on the USB flash drive.

2. **Create backup copies of all your applications and data files with inspection results**

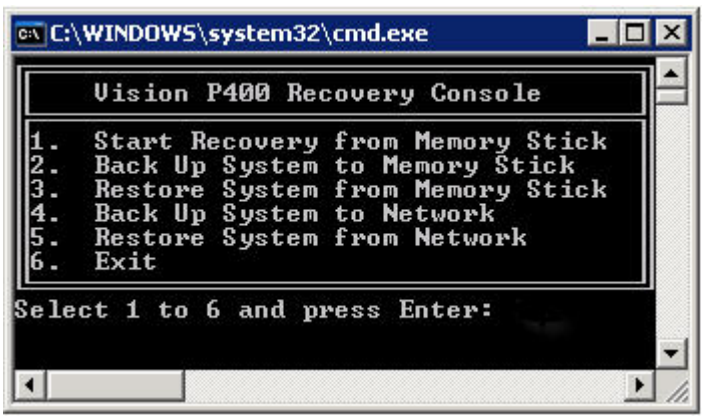
   These files may be overwritten when you use the recovery files.

3. **Save all your favorites, user layouts, network IP addresses, and user-specific files**

To recover the original system from the flash drive you have received from us, please proceed as follows.

Procedure

1. **Insert the flash drive in a free USB port**
2. **Start the system and wait until the system has booted from the flash drive**



3. **Type "1" <Enter>**

4. **Type "R" <Enter>**
5. **Follow the instructions on the screen**

   This process should take 10 to 20 minutes to complete.
6. **When you have completed the backup, remove the flash drive and restart the Imagechecker**
7. **After restarting log on as administrator (no password)**

   At first boot, you are prompted for your Microsoft Product ID.
8. **Enter the user name, company name, and Vision P400 serial number**

   You find the serial number on the Panasonic product label on the hardware casing.
9. **Configure the network adapter, if necessary**
10. **Copy the license file "license.dat" into the subfolder "license" of the Vision P400 installation folder**

    The installation path is usually C:\Program Files\Panasonic MEW Vision\Vision P400.
11. **Restore all files you have backed up previously**

3.7 Assign a Password for Windows

If you wish to start the Imagechecker and/or Vision P400 automatically, you need to assign a Windows password in order to be able to activate the corresponding settings (see page 145) for Vision P400. You need to specify a user name and a password at login.

To assign a Windows password, please proceed as follows.

◆Procedure

1. **Press <Ctrl>+<Alt>+<Del>**
2. **Select the [Change Password...] button**
3. **Enter a password under "New Password"**

   Make sure the "User Name" is the same as entered in Vision P400.
4. **Enter the same password under "Confirm Password"**
5. **Select [OK]**

3.8 Maintaining the Imagechecker

Aside from cleaning the device and replacing or cleaning the dust filter, the Imagechecker is maintenance-free. Consequently, you should never open the Imagechecker.

Ensure that the PC has ample space for ventilation in both front and back. Heat build-up can destroy the electronic components.

If a dust filter is installed, check the extent of dust contamination regularly. If it is dirty, please clean or exchange it.

◆**NOTES**

- **Use only slightly moistened towels or a dry, soft brush to clean the Imagechecker.**
- **Never apply aggressive cleansers, alcohol or other chemical substances since these may damage the parts.**
- **Protect the Imagechecker from exposure to direct sunlight and humidity.**

3.9 Resolving Problems

If your Imagechecker should ever cease to function, please check all plug connections first, then check the software configuration. If you cannot find the reason for the problem there, **do NOT open the device** and do not attempt to repair anything inside the Imagechecker.

3.9.1 Radio Interference

The Imagechecker generates and utilizes signals in the frequency range of radio and television. If the Imagechecker is not installed and operated in accordance with the instructions, interference in the reception of radio services may result or the Imagechecker itself may be impaired as a result of interference from external signals.

There can be no guarantee that interference with reception or operations are ruled out entirely with proper installation and operation. If the Imagechecker creates interference with your television or radio reception or if it is itself disturbed by these, verify the cause and effect by briefly turning off the systems and then attempt to rectify the interference with one of the following measures.

◆Procedure

1. **Change the orientation or placement of the receiving antenna of the radio or television affected**
2. **Increase the physical distance between the Imagechecker and the radio or television receiver**
3. **Hook the Imagechecker to a power circuit separate from the radio or television receiver**

If none of these measures are successful please ask your local Matsushita Electric Works branch or a qualified radio and television technician.

◆NOTES

- **Please ensure that the Imagechecker is operated exclusively with the cables provided or with shielded data cables.**
- **Unauthorized tampering with the Imagechecker or the equipment will invalidate the warranty!**

3.10 Environmental Protection

◆NOTES

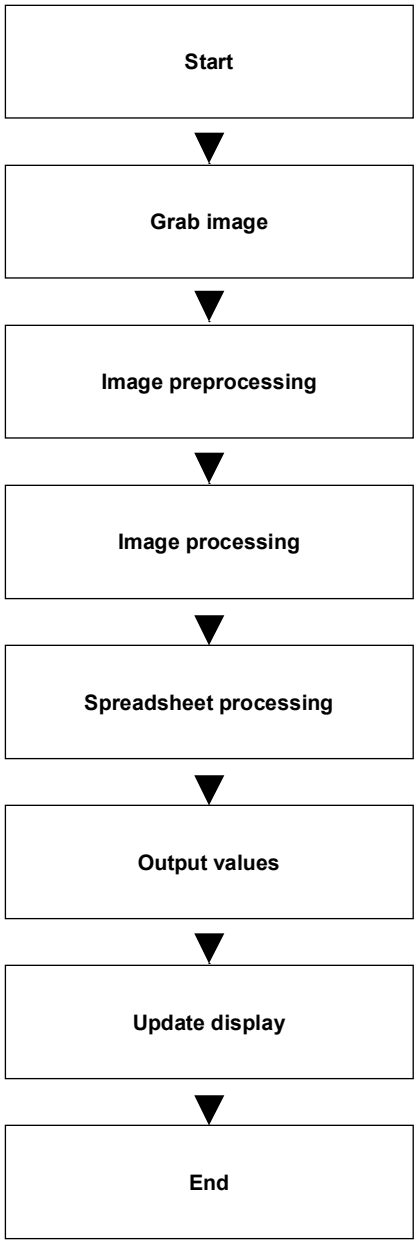
- **Please disconnect the Imagechecker from the electrical outlet when it is not in use for an extended period of time (e.g. vacation, etc.).**
- **Turn off the Imagechecker when not in use (e.g. upon completion of the work with the Imagechecker).**
- **For proper disposal, please turn to your local or municipal waste management or the appropriate community institution. The equipment casing is made of nearly 100% galvanized steel.**
- **Beware! The Imagechecker contains batteries. Danger of explosion in the event of improper handling! Replace the batteries only with batteries of the same type. Dispose of used batteries properly in the designated battery recycling containers at your local waste management department or recycling center.**

Chapter 4

Imagechecker in Operation

4.1 Introduction to Image Processing

The whole procedure of image processing consists of several steps. A normal image processing sequence is as follows:



Flow diagram image processing

The speed of image processing depends on how long it takes the system to carry out the individual steps.

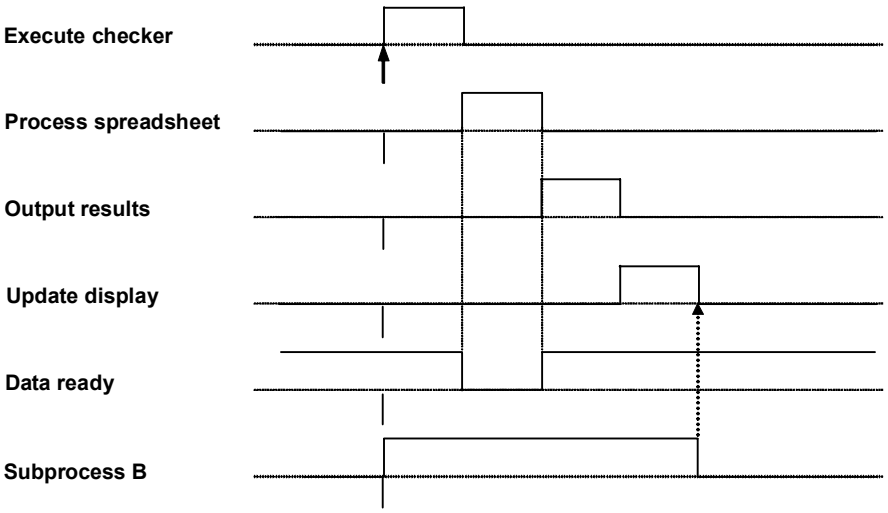
4.2 Serial Image Processing

Image processing can be divided into two subprocesses:

A = Grab image
B = Checking and Result Processing

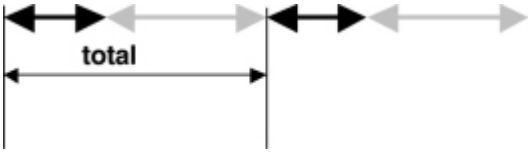
Image processing as two subprocesses

1. Subprocess A = grab image
   The time needed to process the grab image depends on the image data speed of transmission from camera to frame grabber and from the frame grabber to the Imagechecker's main memory.
2. Subprocess B = checking and results processing
   The time needed to test the image preprocessing and image processing routines, the subsequent processing of the results gained from the image processing as well as the data output to the monitor or individual interfaces depends on the specific application. It consists of:
   - execute image preprocessing and image processing routines (checker)
   - process spreadsheet
     continue processing checker results in statistics, formulas, calibration, etc.
   - output results
     transmit output values to interfaces
   - update GUI
     represents the time needed to update the screen display. It consists of:
     - display camera image
     - update spreadsheet
     - update checker results
     - update execution time (see page 249)



Time diagram for the control signals for subprocess B

Serial processing means executing the subprocesses one after the other in sequence. In serial image processing, the sum of the subprocesses equals the total duration of the complete process:

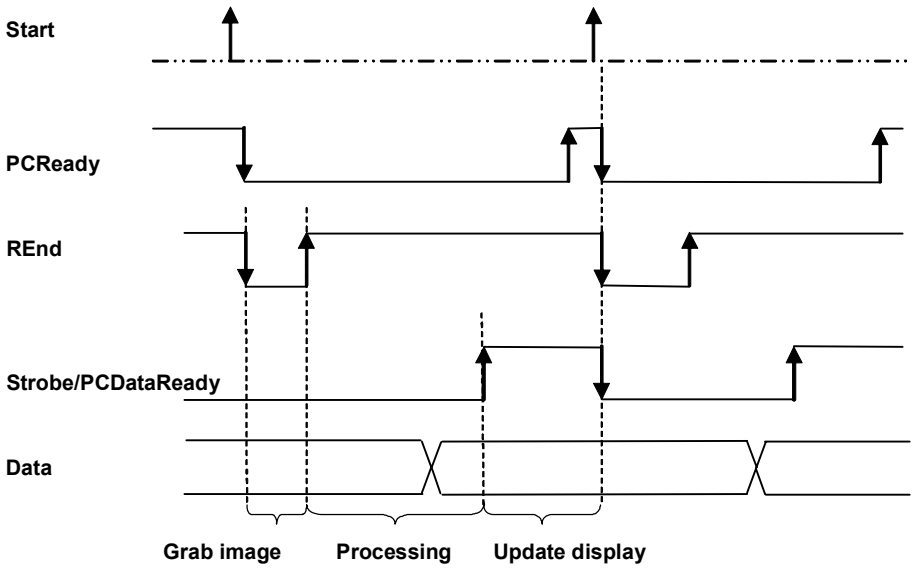


4.3 Control Signals and Time Response

During the image processing, the following control signals may be sent to the interfaces:

1. REnd
   indicates when image grabbing begins and ends
2. PCReady
   indicates when the system is ready for the next start
3. Strobe/PCDataReady
   a signal indicates at the serial port (PCDataReady) when the system has finished calculating the results of a new image.

The figure below shows the time diagram for serial processing of control signals.



Time diagram for control signals

◆NOTE

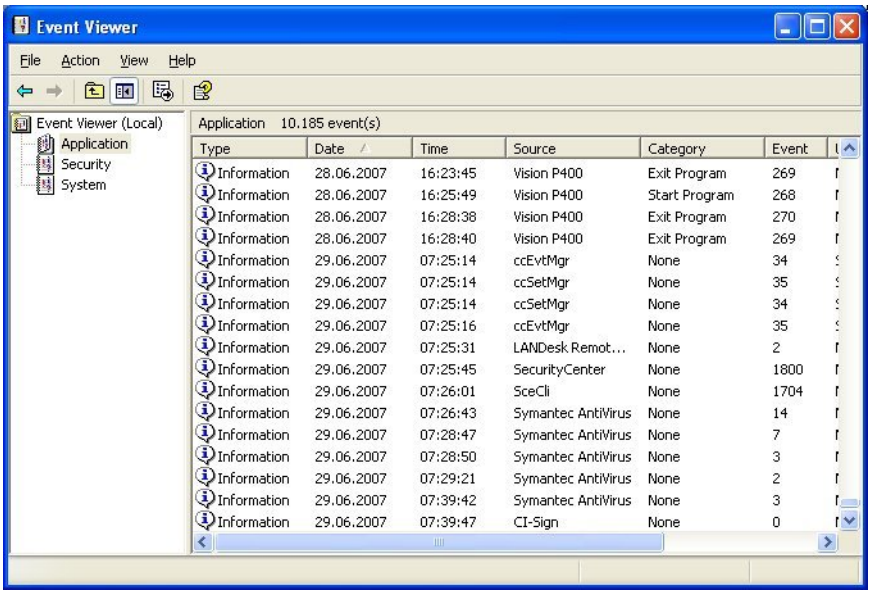
The diagram shows the typical course of signals at the digital I/O board ANPC 850V3 when data is transferred without handshake. For information on the timing of the older digital I/O boards ANPC 850 and ANPC 850V2 please consult your local dealer.

4.4 Event Logging

Vision P400 writes entries into the system's event log file. The event log may be helpful in tracing problems when working with Vision P400.

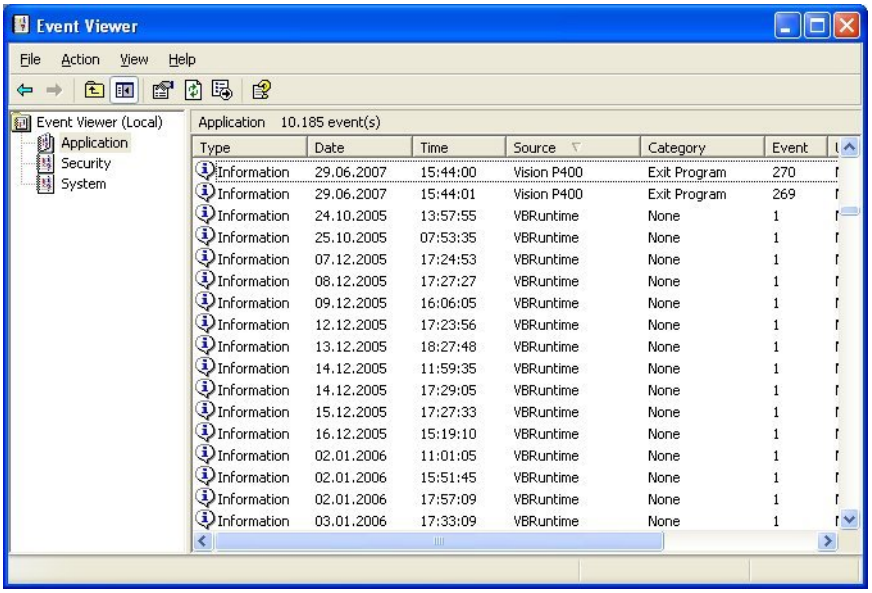
◆Procedure

1. **Start → Settings → System Settings**
2. **Select "Administration" or**
3. **Select "Event Logging"**



You can sort the display by source and thus list for example all events caused by Vision P400.

4. **Click column header "Source"**



5. **Double-click on an entry to see details about the logged event**

   The event information is kept until you manually delete it.

The table lists the entries that may appear in the event log file.

Event	Entry
Start/Stop	The Vision P400 started. The Vision P400 Demo started. Vision P400 - manual exit. Vision P400 - Exit by OLE interface. Vision P400 - Exit by serial interface. Vision P400 - Exit by parallel interface. Exit Vision P400. Exit Vision P400 Demo.
System shutdown	Vision P400 Shutdown the computer.
Client services	Vision P400 is started by an OLE client. Vision P400 - Register COM Server. Vision P400 - Unregister COM Server.
Errors	Vision P400 was started twice. Vision P400 Fatal Error: %1.

Chapter 5

User Interface

5.1 Introduction

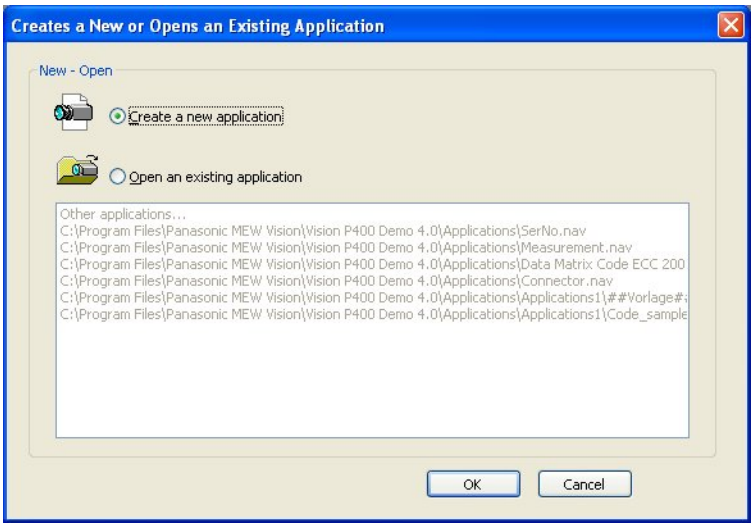
Start up Vision P400 under Windows with a double-click on the Vision P400 icon. First, the opening screen below will appear.

Which screen appears next depends on the settings you have made on the "Application" (see page 145) property page under **System Settings** → **Vision P400 Settings**:

Selected setting under "Application to Start With"	Details
None	You start the program with an empty window (see page 105).
Show Vision P400 startup dialog	You choose whether you create a new application or open (see page 104) an existing one.
Load last open application	The selected application will be loaded (see page 106).
Load the following application	

5.1.1 Program Start with Startup Dialog

When you have activated the "Show Vision P400 startup dialog" option on the "Application" (see page 137) property page in the Vision P400 settings on the **System Settings** menu, the following dialog appears after starting the program:

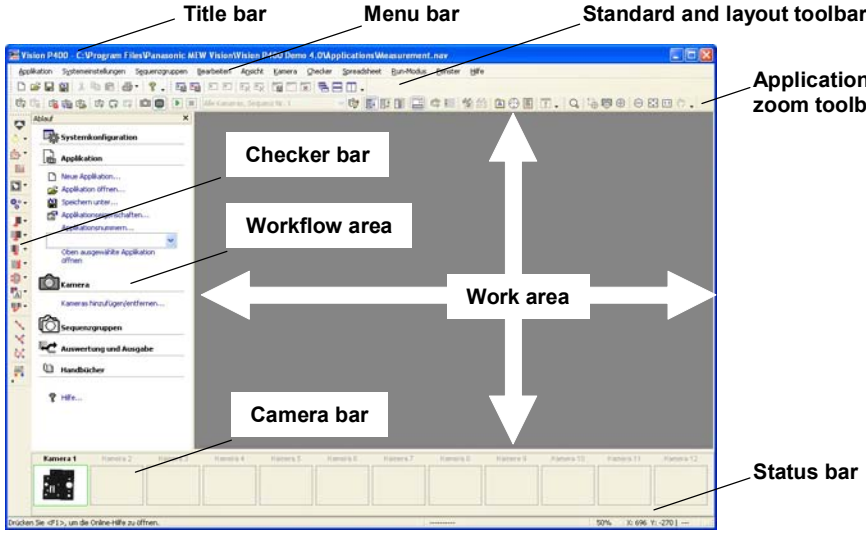


Dialog after starting Vision P400

You choose whether you create a new application or open an existing one. The recently opened applications are listed in the dialog box. As soon as you have selected "Open an existing application", the window is activated and you can select an application from the list and start it with [OK].

5.1.2 Starting the Program without Selecting an Application

If you start Vision P400 without having selected an application, the following screen is displayed:



Screen after starting Vision P400

The **title bar** shows the "Vision P400" program name and the three Windows icons, which you can use to minimize the Vision P400 window to icon size, enlarge it to full screen or close the window.

The second bar is called the **menu bar**. It contains all the main menus. You will find a detailed description of each main menu and its submenus under the respective chapter/section heading.

The **standard toolbars** are situated directly beneath the menu bar. You can conveniently access frequently used submenus or procedures by clicking on the icon.

Select the checker type you wish to create from the **checker bar** located to the far left. As soon as you have selected a checker, a pop-up menu opens up next to it showing the shapes available for it. You can use it to assign the checker its search/template area, such as a rectangle.

At the left-hand margin of the work area you will find the **workflow window**. Here you see all the operations needed to create a simple application, set out step by step. When you click on a heading highlighted in bold, additional steps are displayed which open up when you click on the relevant dialog box.

The large empty space is the **work area.** This is were you see the camera window(s) and edit all dialog boxes of Vision P400. Additional windows show for example the camera image, the spreadsheet, the error log, the font viewer, digital I/O monitor, etc.

In the bottom part of the screen you see the **camera bar**, which is an aid to navigation especially in applications with multiple cameras.

The **status bar** at the bottom of the window shows error messages, icon names, the status of the execution group controller, the mouse cursor position and the gray-value at the mouse cursor.

◆**NOTE**

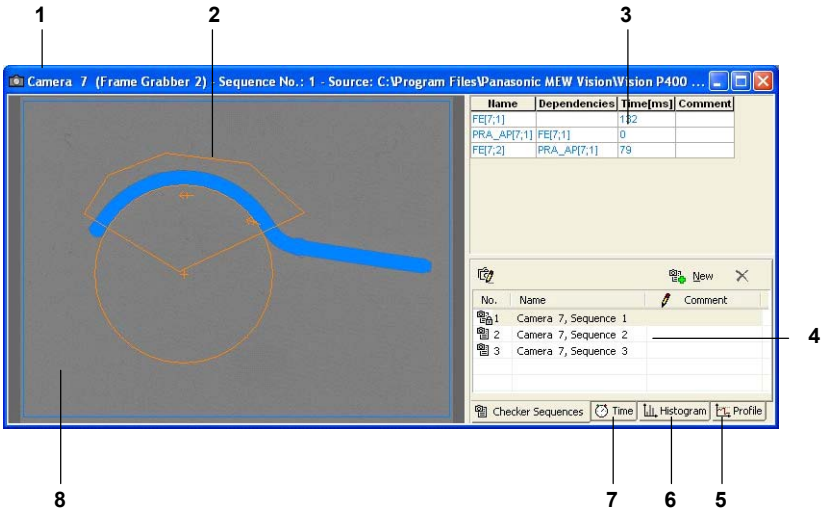
Depending on the work mode you are in, the various menus/icons will be activated. Active menus and icons are shown on the screen in bold face/color. You will not be able to call up the inactive menus or icons shown in light gray.

5.1.3 Camera Window after Loading an Application

When you have loaded an application (**Application** → **New/Open**) and selected a camera **(Camera** → **Add/Remove Camera(s)**), the system may display a screen similar to the one below. What will be displayed depends largely on the settings you have made in the **View** (see page 222) menu.

The title bar of the camera window provides the following information (see figure below):

- number of the current camera
- number of the frame grabber
- number of current checker sequence
- source information (i.e. camera or location and file name if you are working with a bitmap)



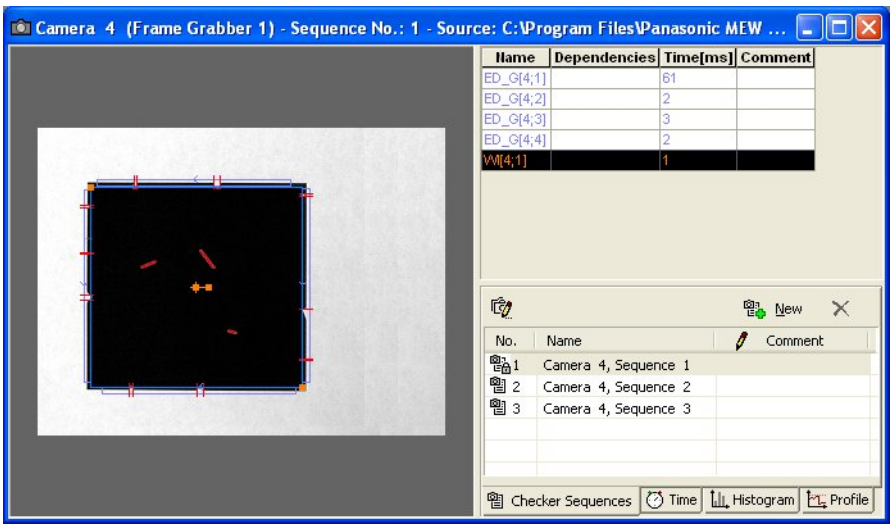
Camera window

1	Title bar
2	Checker shape
3	Sequence
4	List of checker sequences
5	"Profile" tool for image analysis
6	"Histogram" tool for image analysis
7	Information on checker sequence processing time
8	Camera window (work area)

In the camera window the camera image is shown at the left. This is where the user defines the different checkers (see page 225). The graphical results of image preprocessing and processing are displayed if you have activated this option. Change the size and the position of the camera window with the mouse. With large images, use the scroll bars to see different parts of the image.

The right-hand window pane contains four tabs:

- Checker sequences
- Time
- Histogram
- Profile



Camera window with 4 checker sequences

The right-hand camera window pane containing the checker sequence can be hidden (see page 224).

Checker sequences

This tab page shows the created checker sequences in the bottom half and the checkers relating to the selected sequence in the top half. By default, every camera works with a checker sequence. If you are working with execution groups, you can move from one sequence to the next by a mouse-click.

Whenever you create a new checker, the checker is added to the end of the table. The table lists the checkers in the order of their execution, as well as showing additional information - see table.

Column title	Description
Name	This column informs you about the checker name. For each checker name there is an abbreviation (see page 115).

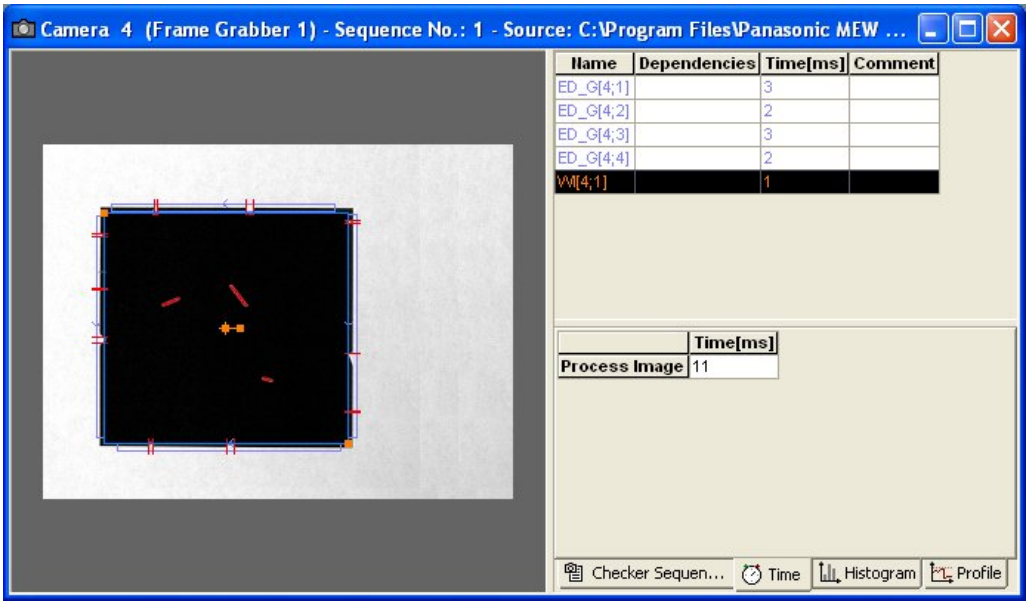
Column title	Description
Dependencies	This columns informs you about the dependencies between the different checkers. Here you see if a position and rotation adjustment uses the coordinates of a checker which needs to be executed first or if a checker needs the coordinates from another checker. The checker providing the coordinates for another checker must be **above** the dependent checker in the sequence.
Time (ms)	The time columns lists the processing time for each individual checker.
Comment	This column displays the user-defined text which has been entered under **Checker** → **Properties** on the "General" page in the "Comment" field. Use this field to write down the checker's specific function for this application.

◆**NOTE**

It is not possible to create a dependency on the checker(s) belonging to another sequence or camera.

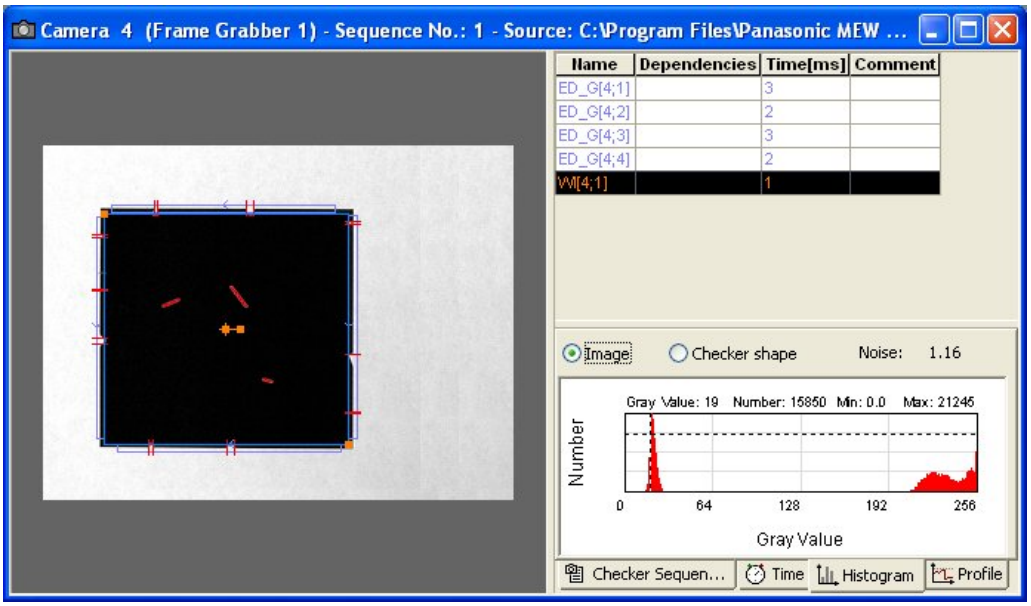
Time

When you select this tab, the execution time for the current selected checker sequence is displayed in the bottom half of the page.



Histogram

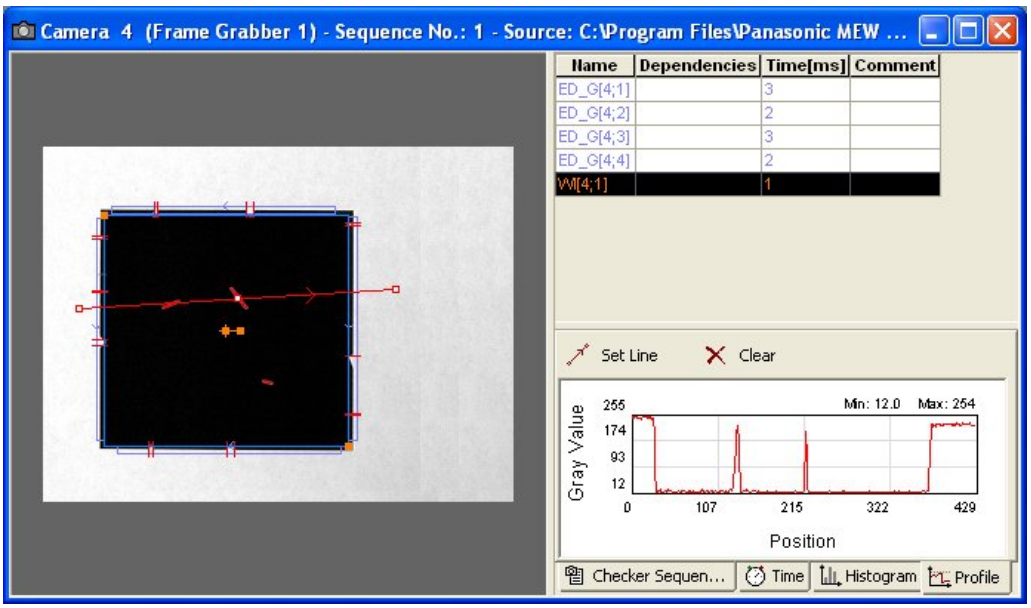
When you select this tab, a histogram is displayed in the bottom half of the page. You can choose whether the histogram is displayed in the gray-value curve in the camera image or in the current selected checker shape. The red curve indicates how many pixels have which gray value. By moving the vertical dashed line in the histogram you can read off the number of pixels for each gray value. In the example below, 15850 pixels have the gray value 19. The highest number of pixels (21245) is at a gray value of around 20.



Histogram function in the camera window

Profile

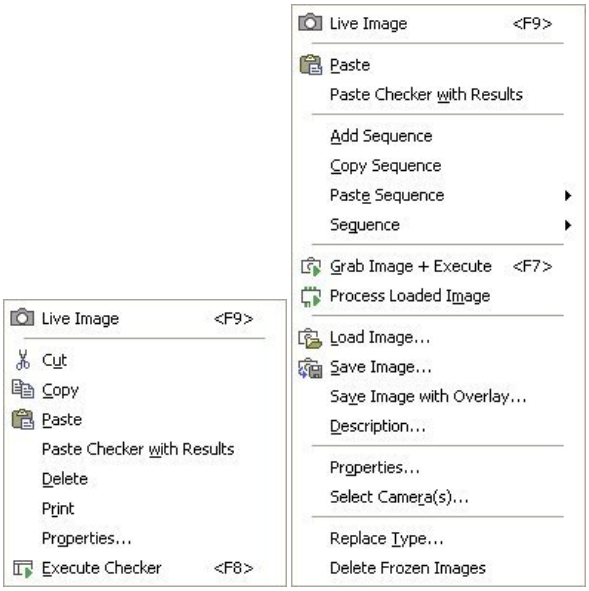
When you select this tab, you can view a gray value profile along a freely selectable line in the bottom half of the window. Choose "Set Line" and then click the mouse to set the start and end points respectively of the line in the camera image.



Profile line for image analysis in the camera window

5.1.4 Checker Options

When you click the right mouse button in the camera window or beneath the checker sequence, the system displays a pop-up menu. The pop-up menu contains different options depending on whether you selected a checker in the camera window or from the sequence.



Mouse menu options when a checker has been selected / when no checker has been selected

The options are in alphabetical order.

Menu option	Functionality
Add / Remove	Adds a new camera to the application or removes the camera providing the image for the currently active window from the application. You cannot remove the camera if checker results from this camera have been inserted into the spreadsheet.
Add sequence	Adds an empty checker sequence in the "Sequence Controller" window.
Append with results	Pastes a checker sequence from the clipboard. You can either paste it as a "New" sequence in the "Sequence Controller" window or "Append" it to the current checker sequence (Notes). Checker results you have inserted into the spreadsheet will also be pasted. However, formulas using the pasted checker results will not be pasted.
Copy	Copies the selected checker from the checker sequence. Use this option and then "Paste" or "Paste Checker with Results" to add a copy of the checker to the end of the sequence.
Copy sequence	Copies a complete checker sequence to the clipboard. When you copy a sequence, all dependencies remain intact, e.g. if checker 2 depends on checker 1 and if checkers 3 and 4 are copies of checker 1 and 2, then checker 4 depends on checker 3.
Cut	Deletes a checker from the checker sequence. Use this option if you wish to move a checker to the end of the sequence with cut and paste.
Delete	Deletes a checker from the checker sequence.
Delete sequence	Deletes the selected checker sequence. This option is not available when you have selected the first checker sequence. It cannot be deleted.
Execute checker <F8>	Use this option to execute the selected checker and to open the "Result" page of the property page.
Live image/memory image	Switches from the memory to the live image of the camera and back.

Menu option	Functionality
Paste	Pastes the checker from the clipboard to the end of the checker sequence. Checker results you have inserted into the spreadsheet will NOT be pasted.
Paste checker with results	Pastes the checker from the clipboard to the end of the checker sequence. Checker results you have inserted into the spreadsheet will also be pasted. However, formulas using the pasted checker results will not be pasted.
Paste sequence	Pastes a checker sequence from the clipboard. You can either paste it as a "New" sequence in the "Sequence Controller" window or "Append" it to the current checker sequence (Notes). Checker results you have inserted into the spreadsheet will NOT be pasted.
Print	Prints all data or parameters set under **Checker → Properties.**
Process image <F7>	The camera takes a new image and the checker sequence is executed. Other cameras and their checker sequences are ignored.
Properties	When you have selected a checker: Opens the property window of that checker. When no checker is selected: Opens the property window of the camera.

◆NOTES

- **If you select "Paste Checker with Results", the checker results in the spreadsheet are copied as well. However, the formulas using the checker results are not copied. This means that you have to edit formulas manually that are supposed to use the copied checker results.**
- **Checker sequences can be linked to indicators via the spreadsheet. If you copy such a checker sequence and use the option "Append with Results", the indicator is copied as well. That means the copied indicator will be linked to the copied spreadsheet result.**
- **Checkers and/or sequences can also be copied to other cameras or applications.**

5.2 Menu Bar

You find the complete set of main menus available in Vision P400 in the menu bar.

Menu	Description
Application	• Create, manage and document applications • Start application • Assign colors
System Settings	• Assign passwords • Make, save or restore general Vision P400 settings • Configure handling of errors and warning messages during operation and in run mode • Assign application numbers • Make settings for the interfaces
Execution Groups	• Set up groups with various checker sequences of various cameras
Edit	• Cut, copy, paste, and delete elements such as checkers and indicators
View	• Set which elements (toolbars, additional windows, font viewers, error log, etc.) to display on screen
Camera	• Add, remove and manage cameras • Load and save images • Set slice level • Replace camera type
Checker	• Create, modify and execute image processing routines • Create object shapes • Create indicators
Spreadsheet	• Process Spreadsheet
Run mode	• Start and stop run mode
Window	• Bring window on screen on top or put in background • Define window layout
Help	• Call up online help and view installation information like Vision P400 version number, serial number, etc.

Place the mouse on one of the main menus and click to open the submenu desired. Active menus are shown in bold face/color, inactive menus are shaded light gray. You may call up menus only when they are active.

This manual contains a chapter for each main menu item. The respective submenus are described in detail in the corresponding chapter.

5.3 Standard Toolbars

Directly under the menu bar there are four standard toolbars on two lines, which you can hide, move, or replace by your own custom toolbars (see page 231).

When you point your mouse at an icon, a short description of the icon's function, i.e. the tool tip, appears next to the icon. At the same time, the status bar displays a description.

"Standard" toolbar at top left

	New Application (see page 124)
	Open Application (see page 124)
	Save Application (see page 125)
	Save Application under Different Name (see page 125)
	Cut selected element
	Copy selected element
	Paste selected element
	Print (see page 131)
	Information about Vision P400 (see page 596)

"Layout" toolbar at top right

	Save Run Mode Layout (see page 226)
	Save Setup Mode Layout (see page 226)
	Load Run Mode Layout (see page 226)
	Load Setup Mode Layout (see page 226)
	Delete Run Mode Layout (see page 226)
	Delete Setup Mode Layout (see page 226)
	Save Custom User Layout (see page 155)
	Load Custom User Layout (see page 155)
	Reset User Layout to Default (see page 155)
	Cascade (see page 594)
	Tile Windows Vertically (see page 594)
	Tile Windows Horizontally (see page 594)

"Application" toolbar at bottom left

	Start/Execute Application (see page 126)		Show Execution Group Controller (see page 200)
	Stop: Repetitive Start (see page 126)		Show Workflow Window (see page 254)
	Lock grabbing (see page 126)		Show Log Execution (see page 255)
	Save current camera image (see page 269)		Show Spreadsheet Controller (see page 237)
	Load Image (see page 269)		Show Camera Bar (see page 253)
	Grab Image + Execute (see page 268)		Switch to next camera window (see page 594)
	Process Loaded Image (see page 268)		View spreadsheet (see page 236)
	Execute Checker (see page 498)		Show a Monitor Window for the Interfaces (see page 186)
	Gray-value live image (see page 223)		View parallel interface monitor (see page 188)
	Gray-value memory image (see page 223)		Font Viewer (see page 246)
	Run Mode (see page 590)		Execution Times (see page 127)
	Setup Mode (see page 590)		Error logging window (see page 248)
No. 0: All Cameras, Sequence No. 1 List box for selection of Execution Groups (see page 195)			Execute program (see page 145)

"Zoom" toolbar at bottom right

	Magnifying Glass (see page 118)
	Zoom in selection (see page 118)
	Zoom in checker (see page 118)
	Zoom in (see page 118)
	Zoom out (see page 118)
	Customize (see page 118)
1:1	1:1 view (see page 118)
	Hand tool (see page 118)

◆**NOTE**

The hand tool and the related mouse wheel controlled functions are only available when the image is larger than the main window.

5.4 Checker and Shape Bar

The checker bar is situated to the far left. It contains icons to create and edit checkers, indicators and image adjustment routines. To select a checker type, click the corresponding icon. The icon meanings, from top to bottom, are listed below:

	Camera Slice Level (see page 271)		Difference (DI) (see page 397)
	Exposure Adjustment (EA) (see page 320)		Contour Matching (CM) (see page 409)
	Position and Rotation Adjustment (PRA) (see page 322)		Optical Character Recognition (OCR) (see page 430)
	Object Shape (OS) (see page 334)		Code Reader Checker (CR) (see page 455)
	Window (WI) (see page 353)		Geometry Point-Point (G_PP) (see page 467)
	Feature Extraction (FE) (see page 356)		Geometry Point-Line (G_PL) (see page 469)
	Edge Detection Binary (ED_B) (see page 371)		Geometry Line-Line (G_LL) (see page 471)
	Edge Detection Gray Value (ED_G) (see page 381)		Indicator (see page 477)
	Edge Detection Gray Value Projection (ED_GP) (see page 390)		

When you guide your mouse to the icon, the icon description (tool tip) will appear. The abbreviations (e.g. WI for Windows Checker) shown will help you identify the respective checker type in the sequence list and the spreadsheet later.

When you click on a checker icon, a pop-up menu opens up next to it in which you can select the shape of the checker. After selecting a checker type (e.g. Window Checker), you can assign the checker area a shape (e.g. a rectangle) by clicking on one of the available icons: Only the areas possible for the checker are offered for selection.

General checker shapes		**Edge-detection checker shapes**	
	Rectangle		Rectangle with scanning direction
	Ellipse/Circle		Ellipse/Circle with scanning direction
	Polygon		Line with scanning direction
	Doughnut (segment)		Doughnut (segment) with search direction
	Object Shape		

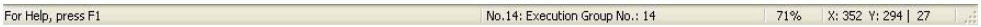
For the contour matching checker you can set not only shape and size of the checker, but also of the search area (see page 409). Using edge detection allows you to select the search direction. Follow the direction of the arrow (see page 377).

If you select "Object Shape" as the check area, a dialog box opens up in which you need to select the object shape you want to use.

5.5 Status Bar

Messages in the status bar are aimed to help and support you in your work with Vision P400. It may show one of the following status messages:

- Help on icons and menu options
- Error messages
- Execution group with which the application was last run
- Zoom factor
- Mouse position
- Gray value at mouse position



Status Bar

5.6 Function Keys and Shortcuts

You can access some important functions by pressing a function key.

Key	Functionality	Accessible from where?
F1	Open the online help	Vision P400 main window
F3	Loads the next image in the demo version	
F5	Execute the application	
F6	Stop repetitive start	
F7	Read and process image of the currently active camera	
F8	Execute the checker	
F9	Switch from live to memory image and vice versa	
F10	Jump with the cursor to the menu bar	
<Ctrl>+L	Switches to setup mode	
<Ctrl>+N	Creates a new application	
<Ctrl>+O	Opens an existing application	
<Ctrl>+P	Prints the current application settings	
<Ctrl>+R	Switches from setup to run mode	
<Ctrl>+S	Saves the current application	
<Ctrl>+<F6>	Switches to the next camera image	
<Ctrl>+<Alt>+<F12>	Opens the execution log window	
<Ctrl> + selecting a checker shape	Without pressing <Ctrl> you need to click exactly the edge of the shape or the moving point of the shape. • To select a checker, you can also click somewhere inside the checker shape. • If the checker is already selected, clicking the checker again will let you move the checker.	
Double-click in the camera window	Activates the hand tool so that you can move the image within the window. With this tool you can seize the image and move it with the mouse. A second double-click deactivates the hand tool.	
<Ctrl>+ double-clicking a checker	Opens the property window and executes the checker	Sequence
<Ctrl>+<↑>	Selects the first checker in the sequence	
<Ctrl>+<↓>	Selects the last checker in the sequence	
<Ctrl> + dragging a spreadsheet row into the "String Reference" column	The result of this column will be used as a string reference for the corresponding OCR checker or code reader (without <Ctrl> the spreadsheet row will be moved)	Spreadsheet
<Shift> + selecting a checker in the sequence	Selects the search area of the checker (without <Shift> the template area will be selected)	Contour matching checker
<Ctrl> + dragging a result value to the field "X /Y Position" under "Position Settings"	Inserts automatically the X and Y coordinates	Indicator

5.7 Zoom Functions

The zoom functions offer a range of options for enlarging, reducing or adjusting the image or segments of it, or moving the zoomed segment around. The maximum reduction when zooming out is 13%, and the maximum enlargement when zooming in is 1000%.

Toolbar with zoom functions.

This toolbar includes icons to run eight different functions:

Icon	Functionality
Magnifying glass	Temporarily enlarge a small segment of the image. When you have activated this zoom function, the cursor appears in the form of the selected icon. Clicking the left mouse button zooms into the image area underneath the magnifying glass. You can also move the magnifying glass around the image by clicking and holding down the mouse button and dragging the mouse. The magnifying glass zoom remains active as you do so. While you are viewing the zoomed image segment, at the right beneath the round magnification window you see the coordinates of the pixel in the middle of the magnifying glass area and the pixel's gray value. To quit the zoom function, click on the icon again, press <Esc> or click the right mouse button.
Zoom in selection	Zoom into a selected area When you have activated this zoom function, the cursor appears in the form of the selected icon. Left-click to set the start point of the zoom area, then click and drag the mouse to expand the rectangular zoomed area. The portion of the image inside the rectangle is enlarged as soon as you release the left mouse button. The function is then automatically deactivated.
Zoom in checker	Enlarge a selected checker shape With this function you can zoom into a selected checker. To do so, click with the mouse on the checker shape. The image is then enlarged so that the checker shape fills the main window. The function is then automatically deactivated.
Zoom in	Enlarge the entire image (up to 1000%) With this function you enlarge the image by zooming into its center point. The function is automatically deactivated after one zoom. You can also enlarge the image by turning the mouse wheel or by pressing the <+> key on the keyboard number pad.
Zoom out	Reduce the entire image (down to 13%) With this function you reduce the size of the image by zooming away from its center point. The function is automatically deactivated after one zoom. You can also reduce the image size by turning the mouse wheel or by pressing the <-> key on the keyboard number pad.
Customize	Adjust the height or width of the image to the size of the main window without distorting the image itself.
1:1 view	The image is displayed on a 1:1 scale, meaning one camera pixel corresponds to one pixel on screen.

Icon	Functionality
Hand tool	Move the image around the main window When you have activated this zoom function, the cursor appears in the form of the selected icon. You activate this zoom function by clicking on the icon or by double-clicking inside the image. When you press and hold down the left mouse button, the hand icon forms a gripping shape and you can move the image in the desired direction by dragging the mouse. To quit the zoom function, click on the icon again, double-click in the image, press <Esc> or click the right mouse button. You can also use the mouse wheel to move the image around: • To move it horizontally, press <Ctrl> and turn the mouse wheel • To move it vertically, press <Shift> and turn the mouse wheel

◆**NOTE**

The hand tool and the related mouse wheel controlled functions are only available when the image is larger than the main window.

Chapter 6

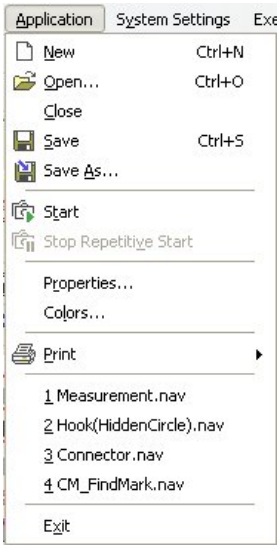
Application

6.1 What's an Application?

An application is a checking task with all the associated settings which specify the checking task in more detail. This includes:

- Checker definitions
- Camera definitions
- Spreadsheet settings
- The data transmitted via the interfaces

You can create an application, save it under a name of your choice, print it out, number it or assign certain properties to it. There are submenus available under **Application** for all these tasks.



Application menu

Basically, an application should include the following steps:

1. Create a new application
2. Camera selection and settings
3. Image **pre**processing and image processing routines
4. Spreadsheet definition (calibration, value ranges, output to interfaces, calculations)
5. Configure the data transfer via the interface(s)
6. Comment the application for documentation purposes

◆NOTES

- **The Workflow Window (see page 254) displays the steps required to configure Vision P400 and create an application. By default, the window is at**

the left between the checker bar and the main window with the camera image.

- **The properties of an interface, such as the Baud rate of the serial RS232 port or the signals transmitted via an interface, are not specific to any single application. They always apply to all Vision P400 applications. By contrast, the data to be transferred via an interface must be configured separately for each application.**

6.2 Submenus

The submenus in the **Application** menu will be described in the following sections.

6.2.1 New

You can create a new application with **Application** → **New**. With each new application, a new spreadsheet is created. Any other open application will be closed automatically.

Before you start defining the checkers, you need to assign one or more cameras to the application. When you create a new application, the dialog box (see page 260) for assigning cameras appears automatically. You can also use this dialog box later to add more cameras (**Camera** → **Add/Remove Camera(s).....**).

6.2.2 Open

With **Application** → **Open**, you can open an existing application along with all its accessory components, such as:

- Camera selection and settings
- Creation of image **pre**processing and image processing routines (checkers, object shapes)
- spreadsheet settings (calibration, value ranges, output to interfaces, calculations)
- Application description

When the application your are opening has been created with an older version of the Vision P400 software, Vision P400 creates a backup copy of the application. When you are in setup mode, Vision P400 displays a message with the name of the backup copy, unless:

- You have opened the file via an OLE client or
- You have activated the parameter "Activate Run Mode at Startup" on the "Application" page under **System Settings** → **Vision P400 Settings**.

6.2.3 Close

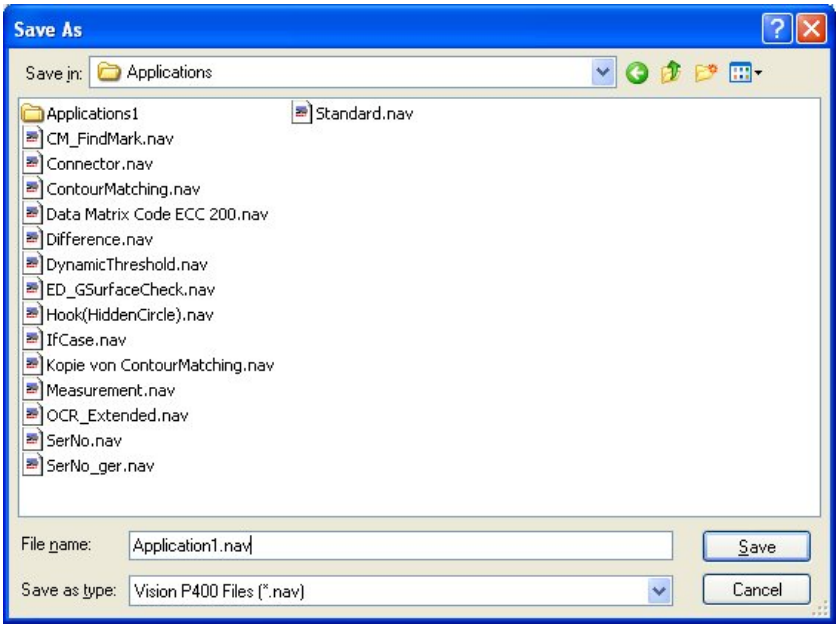
With **Application** → **Close**, you can close an open application along with all its accessory components.

6.2.4 Save

With **Application** → **Save** you save an application. If the access to this function is protected by a password (see page 134), the following window appears:

Enter password

Enter the password. If you save a new application for the first time, the following window appears:



"Save as" dialog box

The system suggests an application name, which you can overwrite. When the application is write-protected, Vision P400 opens the "Save As..." dialog box automatically. You can save the application under the previous name. Simply confirm the two prompts asking whether you wish to overwrite the file.

6.2.5 Save As

With **Application** → **Save As...** you can save a new application under any name. If you have previously saved the application, you can save an application with **Application** → **Save As...** again under a new name. In doing so, you will create a second copy with another name, since the application saved previously will remain unchanged under the original name.

The access to **Save As...** can be protected by a password (see page 134).

6.2.6 Start

With **Application** → **Start** you can execute an application in order to test it or to end an application's interrupt (see next section). This "Start" refers to the complete application; which may consist of several cameras. Please remember that if you have activated the execution group function (see page 200), this may influence the way in which an application is executed.

This function may also be called up with , the 1st icon in the standard tool bar, or by pressing <F5>.

◆**NOTE**

When you select Application → Start**, the displayed camera image will be replaced by the current image.**

This is especially important when your PC is configured to start up the image processing system automatically after being switched on. This may be necessary during setup, when you have made several test runs with the application and the conveyor belt has moved the test objects out of the camera range.

Click to use the last image saved in the camera's memory; and then execute the application as usual.

◆**NOTE**

When starting an application via an interface, you use the interface to specify whether to include a new camera image or use the last camera image in the memory. This means that in this case the icon setting (Lock Grabbing) is ignored. Inputs via the interfaces always have a higher priority than inputs on the user interface.

6.2.7 Stop: Repetitive Start

With **Application** → **Stop Repetitive Start** you can interrupt the repeated start of an application without exiting run mode. Then you can, for example, modify your production line and then continue image processing with **Application** → **Start** even if the run mode start/stop is protected with a password that is unknown to you.

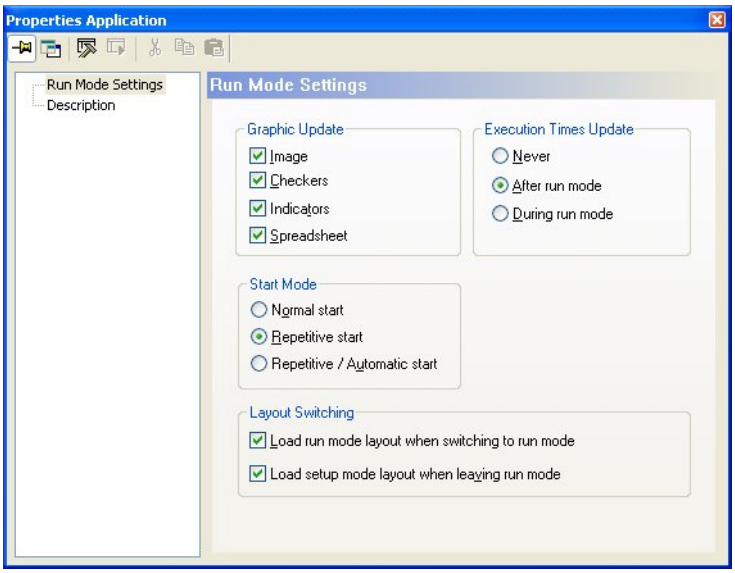
You may also stop and restart executing the application with or <F6> and or <F5>.

6.2.8 Properties

With **Application** → **Properties** you open the property page of an application. You may also specify general settings under "General" and enter a comment or description on the "Description" page.

6.2.8.1 Run Mode Settings

On the "Run Mode Settings" property page you specify which data to update on screen during operation, i.e. in run mode. Here you also select the start and processing mode, and whether the user interface layout is changed when switching from setup to run mode (and vice versa).



Application properties - "Run Mode Settings" property page

Graphic update

The parameters in this box determine the screen display. Activate the corresponding option to see the camera image, the checkers, the indicators or the spreadsheet updated after every application start.

Updating the screen display in general is quite time-consuming. Please allow extra time for it so that you have sufficient time left for the execution of your checking task.

You should test to see how much time you will need for updating the checkers and indicators. With extremely fast check sequences, you may want to skip screen updating completely.

◆NOTE

The settings described above refer to the screen display only. For image processing and output to interfaces the system will always use current data, even if the screen displays old results.

Execution times update

The information on the time needed for execution is displayed in a special window (see page 249). You can choose between no display, during, or after run mode. The window with the execution times opens up automatically in run mode when you have activated "After run mode" or "During run mode". If the window is covered by other windows, you can move it to the front by clicking on the icon.

Start mode

The following start modes are available:

Start mode	Explanation
Normal start	Starts up image processing with every external start signal (e.g. <F5>) or from an interface
Repetitive start	Repeats the image processing from the first start signal a.s.a.p. With the 2nd start signal you stop Vision P400, with the 3rd you start it again etc.
Repetitive / Automatic start	Starts and repeats the image processing after starting the run mode a.s.a.p. With the 2nd start signal you stop Vision P400, with the 3rd you start it again etc.

Layout switching

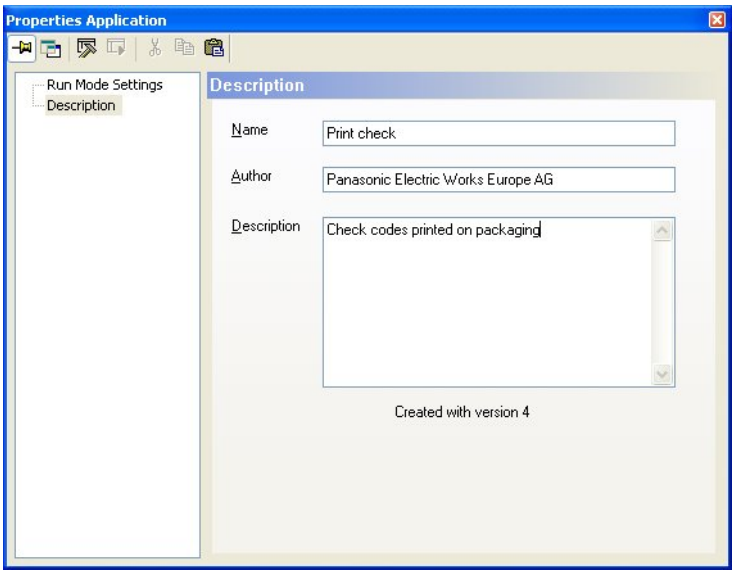
You can configure a custom user interface layout (see page 226) for run and setup mode and save it with the application. Activate the relevant option when you want to load the associated layout on switching to run mode and back to setup mode.

◆**NOTE**

You can also activate these options when the corresponding user interface layout does not exist. In such cases loading of the layout on switching mode is ignored and a warning is written to the error log file.

6.2.8.2 Description

On the “Description” page, you may enter an application name, the staff member’s name as well as a description of the application for documentation purposes.



Application properties “Description” page

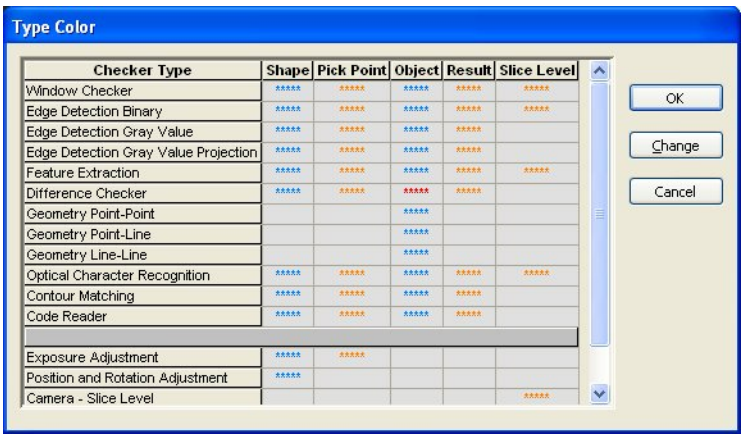
6.2.9 Colors

With **Application → Colors...** you can adjust the color of the different checkers and the slice levels according to your needs.

◆Procedure

1. **Application → Colors...**

   You will see a complete list of all checkers available and the camera slice level:



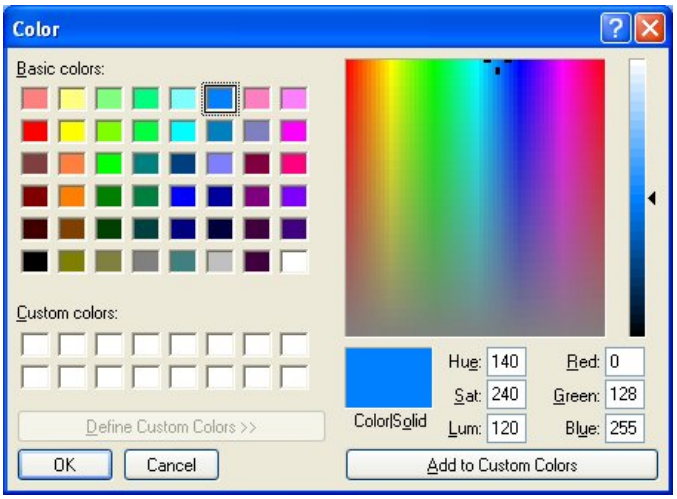
Column	Explanation
Checker Type	Type of checker
Shape	Color of the borders of the checker shape
Pick Point	Color of the center, start, and end point of the shape (select the shape by clicking the pick point)
Object	Color to fill objects found
Result	Color of the cross in the middle of objects found or color of an edge found
Slice Level	Color to mark the customized slice level

2. **Select ***** of the checker in the list (e.g. "Pick Point")**

   The ***** (asterisks) in the list show the selected color.

3. **Click [Change] or double-click on *****

   The color selection dialog appears.



4. **Click the left mouse button on a basic color or on any of the colors on the right**
5. **Use the arrow on the far right to adjust the color brightness**
6. **Click [OK]**

◆**NOTE**

When a checker uses an object shape, the shape is displayed in the pick point color of the checker when the checker is selected.

6.2.10 Print

With **Application** → **Print** you can print the application components listed below to the printers installed:

- **Checker Parameter...**
  prints from the current camera sequence all checker parameters and settings previously defined for documentation purposes in the checker property page **(Checker** → **Properties**).
- **Spreadsheet...**
  prints the current contents of the spreadsheet complete with formulas and objects for data transfer. This option is active only when you are working in spreadsheet mode.
- **Sequence...**
  prints all checker sequences and the text you entered on the "General" (see page 287) page in the checker properties. A checker sequence describes the image processing routines selected in the order of execution along with the dependencies as defined. Several checker sequences are only available if you have activated the execution group controller (see page 195).
- **Image...**
  prints the current image along with a description and the date.
- **Properties...**
  prints the application properties as well as the general settings for Last Display Update (see page 127) as configured under **Application** → **Properties**.

6.2.11 Recent Files

This option shows you a listing of the applications last opened. To open any of these applications, click on it. You can delete (see page 145) the list of recently used applications by selecting [Delete recent file list] under **System Settings** → **Vision P400 Settings** → **Extras**.

6.2.12 Exit

With **Application** → **Exit** you exit the Vision P400 session.

Chapter 7

System Settings

7.1 Password

With **System Settings → Password** you can assign a password to Vision P400. Once you have assigned a password to an application, the following functions are protected:

- Saving application edits (even under another name)
- Changing application numbers
- Changing Vision P400 settings
- Starting and stopping the run mode
- Saving changes to the interface parameters
- Changing settings under "Error Handling"

◆Procedure

1. **System Settings → Password**

   If you have not assigned a password yet, proceed to step 3.

2. **If you have already assigned a password for Vision P400, enter it under "Current Password"**
3. **Enter your new password under "New Password"**

   If you make no entry, the access to Vision P400 is not protected.

4. **Enter your password again under "Confirm New Password"**
5. **Click [OK]**

◆NOTES

- **If you have activated the "Activate Run Mode at startup" option on the "Application" page under** System Settings → Vision P400 Settings**, the system ignores the password when you switch to run mode.**
- **With Windows XP/Windows 2000, you have to differentiate between capitalized and non-capitalized letters even as you enter a password.**

- **Please note that the Windows XP/Windows 2000 password and the password for Vision P400 are two separate passwords.**
- **When you use an OLE client to control Vision P400, Vision P400 ignores password settings for all functions controlled by the OLE client. If you wish to protect your application, please implement the password in the OLE client.**

7.2 Spreadsheet Password

Use this option to set a password for locking the spreadsheet. If you do not define a password, the spreadsheet can be locked/unlocked by any user.

◆Procedure

1. **System Settings → Spreadsheet Password...**

   If you have not assigned a password yet, proceed to step 3.

2. **If you have already assigned a password to the spreadsheet, enter it under "Current Password"**
3. **Enter your new password under "New Password"**

   If you make no entry, the access to locking/unlocking the spreadsheet is not protected.

4. **Enter your password again under "Confirm New Password"**
5. **Click OK**

◆NOTE

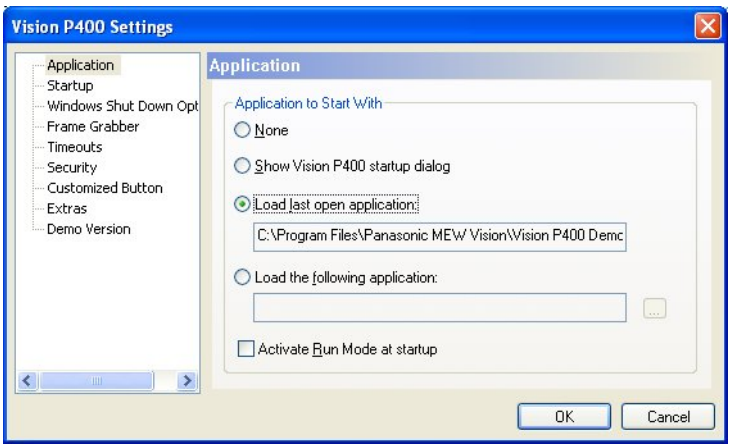
This password only applies to locking/unlocking the spreadsheet. The application is protected by a dedicated password (see page 134).

7.3 Vision P400 Settings

With **System Settings** → **Vision P400 Settings** you determine the behavior of Vision P400 independent of an application, for example what should happen with Vision P400 when you start or exit Windows XP/Windows 2000. Please note that if there is a password for Vision P400, you can only save changes to the settings if you have entered the password correctly when the dialog box was opened.

7.3.1 Application

With these options you determine the application which will be loaded after you have started Vision P400. Choose whether you wish to switch to run mode automatically after the selected application has been loaded.



Vision P400 settings for applications

Options	Description
None	No application is loaded
Show Vision P400 startup dialog	When you switch on the P400 a dialog box (see page 104) is displayed with the choice between creating a new application and opening an existing application.
Load last open application	The application used last is loaded automatically
Load the following application	The selected application is loaded automatically when the system is started
Activate Run Mode at startup	Run mode is activated automatically when the application is loaded

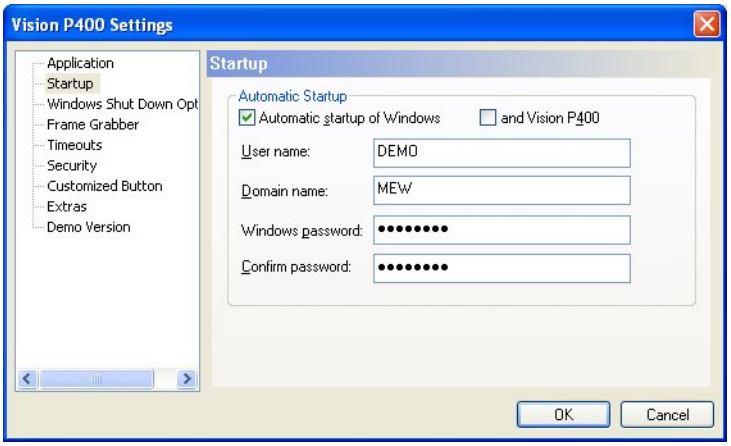
7.3.2 Automatic Startup

Use these options to start Windows XP/Windows 2000 and/or Vision P400 automatically after the PC Imagechecker has been switched on. You need to specify a user name, the domain, and a password at login.

◆NOTES

- **You have to define a Windows NT password (see page 91) before you can configure automatic startup. It is possible to leave the password field empty under Windows XP.**
- **The password for the Windows XP/Windows 2000 login will be saved unencrypted in the registry file! This means everybody logging in on the PC can read it.**
- **If you do not belong to a domain, you must leave the "Domain Name:" field empty.**

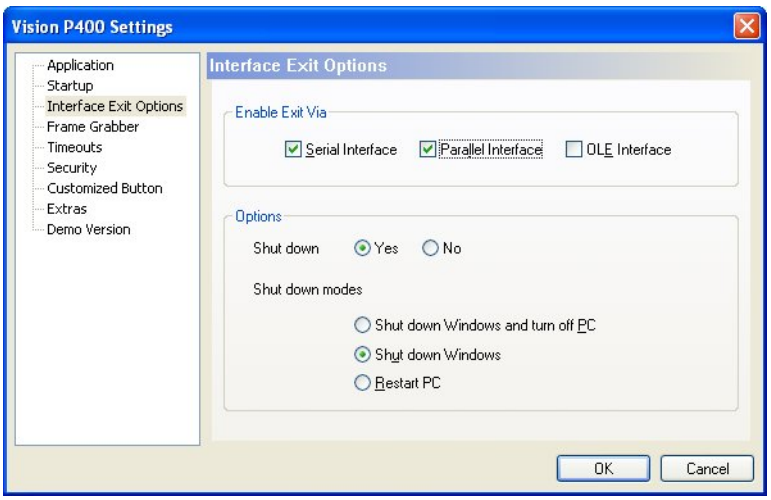
When you activate the option "and Vision P400", both Windows XP/Windows 2000 and Vision P400 will be started automatically after the PC Imagechecker has been switched on.



Vision P400 settings for automatic startup

7.3.3 Interface Exit Options

Use the dialog box "Interface Exit Options" to specify how you want to exit Vision P400 and whether Windows shuts down automatically.



Vision P400 shutdown settings

You can exit Vision P400 via the selected interfaces. If an interface has not been selected, signals coming from this interface will be ignored and a warning appears in the error log. The table below lists the options available:

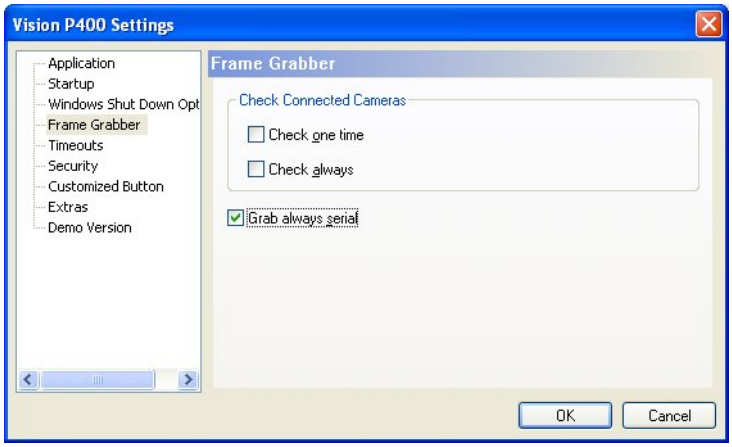
Settings	Description
Enable exit via	You can select one or more interfaces to exit Vision P400: • Serial interface • Parallel interface • OLE interface
Shut down	Select whether you want to trigger one of the "Shut down modes" listed below after you exit Vision P400 or not.
Shut down Windows and turn off PC	Use this option to shut down Windows and switch the PC off. This feature is not supported by the P400S hardware.
Shut down Windows	Windows will be shut down when you exit Vision P400 manually or send a corresponding signal via one of the interfaces (serial, parallel, OLE).
Restart PC	This option executes an automatic restart of the system including Windows.

◆NOTE

With the parallel interface, you need to apply the shutdown signal followed by a start signal to initiate the shutdown if you are still using the interface board "ME81".

7.3.4 Frame Grabber

Use these options to determine the method for detecting cameras and for grabbing images.



Vision P400 frame grabber settings

Check Connected Cameras

When you start Vision P400 there are two ways of detecting cameras:

Option	Functionality
Check one time	This option corresponds to the button [Check Connected Cameras Now] in the camera selection dialog box (see page 259). Next you need to exit and restart Vision P400 manually. The option will be deactivated after the next start.
Check always	With this option the system checks the number of cameras attached every time you start Vision P400. As it takes some time to check the cameras, you do not need this option if you start Vision P400 and the number and type of the connected cameras has not changed since the last session. Please note that in some cases this option may lead to faulty camera images.

When none of the two options is activated, Vision P400 uses the camera data saved with the last session.

◆NOTES

- **Every time when you add or remove a camera, you need to activate the option "Check One Time" or select the button [Check Connected Cameras Now], then exit and restart Vision P400. Otherwise Vision P400 will continue to work with the camera data from the last session, which will be incorrect, however.**
- **You can select either "Check One Time" or "Check Always" or none of the two options.**
- **When a camera provides only black images it is possible that this camera has been removed from the application since the last start of Vision P400, but neither the option "Check One Time" nor the button [Check Connected Cameras Now] have been used.**

Grab Always Serial

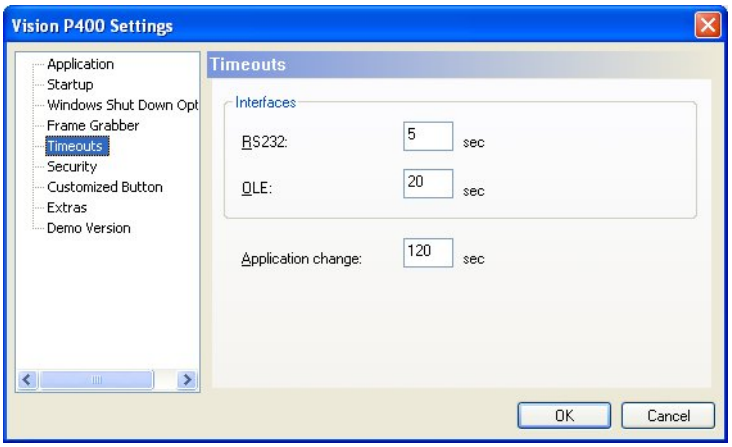
Select this option if you are using a parallel frame grabber, but wish to grab the images serially. The parallel frame grabber will work like serial frame grabbers.

◆NOTE

This option is only displayed if you are working with parallel frame grabbers.

7.3.5 Timeouts

Here you can define which timeouts (in seconds) will be used in Vision P400.



Vision P400 timeout settings

RS232 Interface

When you transfer data or signals to the RS232 interface, the interface has to respond within the time span entered here. If the transfer is not completed by then, an interface error occurs. The minimum timeout is five seconds.

◆NOTE

The timeout is only used if you have set the option "Flow Control" to "Hardware" on the RS232 property page.

OLE Interface

When you transfer data, images, or signals to an OLE client, the OLE client has to respond within the time span entered here. If the transfer is not completed by then, an interface error occurs. The minimum timeout is five seconds.

◆NOTES

- **All data and images have to be transferred in the time span entered here. Even if the data transfer is completed earlier, the time saved is not available for transferring images.**
- **The transfer of data, images, or signals from Vision P400 to an OLE client is synchronous. This means that Vision P400 waits for the client to acknowledge each transfer. This is why timeouts are often caused by the client not acknowledging the transfer on time.**

Application Change

An application change triggered by the interface has to be completed in the time span entered here. If the application change is not completed by then, an error signal is output. As it is not possible to terminate the application change, the process will be completed. However, after the process is complete, the currently loaded application will be closed so that no application is open in Vision P400.

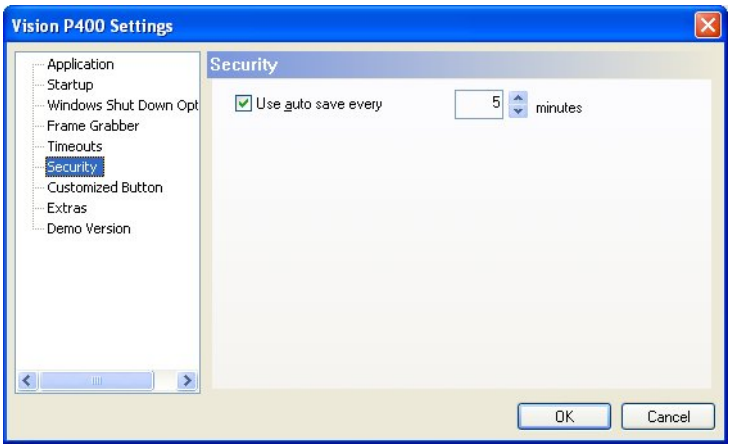
If an error signal is output, the Ready signal remains OFF until a correct application changes has been performed.

◆NOTE

The timeout is also valid if an OLE client opens a new application in setup mode. This means that if the application cannot be opened in the time span entered here, the (synchronous) command to open the application returns an error message. As it is not possible to terminate the process of opening the application, the process will be completed. However, after the process is complete, the currently loaded application will be closed so that no application is open in Vision P400.

7.3.6 Security

If you activate this option, Vision P400 creates a backup copy in the application folder every n minutes, with n = figure entered as time interval. The default setting is 5 minutes and can be increased in 1-minute steps. This function only works in setup mode, it is switched off during run mode.



Vision P400 security settings

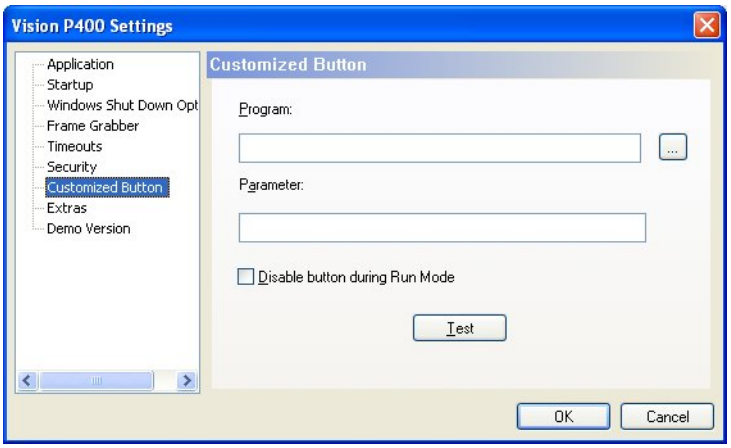
When you start Vision P400, the system checks whether there is a backup copy. If Vision P400 detects a backup copy, it displays a message asking whether the backup copy should be loaded. If you select "No", the file will be deleted.

◆**NOTE**

The backup copy is called "~autoSave.sav". In order to be able to open it in Vision P400, rename the file and change the extension from *.sav to *.nav. This also prevents Vision P400 from displaying the message that a backup copy exists.

7.3.7 Customized Button

Use this option to define which program will be executed when you click . You can enter any program here.



Configuration dialog box for the customized button

◆Procedure

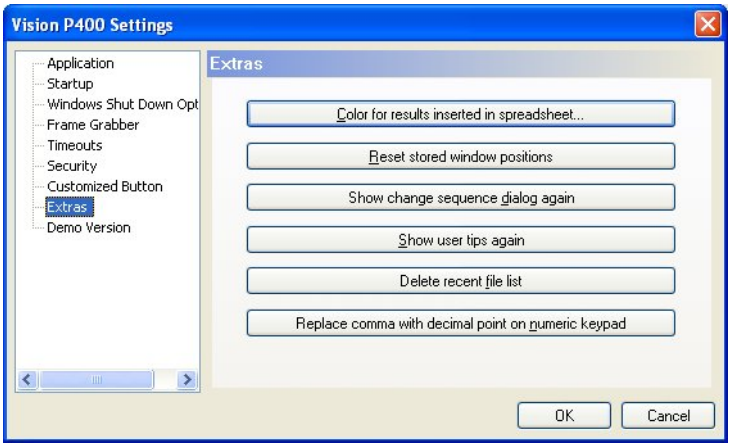
1. **Under "Program" you enter the program path**

   or

   Click [...] to select the path with the explorer
2. **Under "Parameter" you can enter program parameters, if required**
3. **Select "Disable button during Run Mode" if you want to deactivate the button in run mode**
4. **Use [Test] to check whether the button works as intended**

7.3.8 Extras

This tab contains some additional functions which make it easier to use Vision P400.



Vision P400 settings under "Extras"

Color for results inserted in spreadsheet

Vision P400 indicates which checker results on the "Result" page have already been inserted in the spreadsheet by displaying them with a special background color. Use this option to change the background color.

◆NOTE

The selected background color is a default setting in Vision P400 and valid for all applications.

When you click this button, the dialog box for selecting a color (see page 129) is displayed. The default background color appears in the top and bottom right field of the dialog box under "User-Defined Colors". Select one of these fields if you wish to return to the default background color.

Reset stored window positions

Both the main screen and the windows displaying the checker properties can be moved and resized, as desired. When you exit Vision P400, the system stores the position of the windows. In some cases, for example when you change the screen resolution, it is possible that a window is moved out of the visible area and can no longer be accessed. If this happens, use this button to return all windows to their default position.

Show change sequence dialog again

If you are using execution groups, it may occur that checkers are displayed in the camera window which do not belong to the checker sequence currently selected. When you then click on one of these "non-belonging" checkers in the camera window, the "Change Sequence" dialog box appears by default, asking whether you want to switch to the sequence to which the selected checker belongs. You can disable this dialog box. Click the "Show change sequence dialog again" button to re-enable it.

Show user tips again

There are information dialog boxes in Vision P400, which automatically display useful user tips after the installation, e.g. the dialog box with the information on the currently supported cameras that appears when you start Vision P400. Every information dialog can be deactivated by selecting "Show information on startup" so that it will not be displayed the next time. If you select this function, all information dialog boxes which you have deactivated will be displayed again.

Delete recent file list

With this button you delete the list of recently used files. Note that you can only delete the current list status: When you open or save an application after clicking the "Delete recent file list" button, it is entered in the list of recent files.

Replace comma with decimal point on numeric keypad

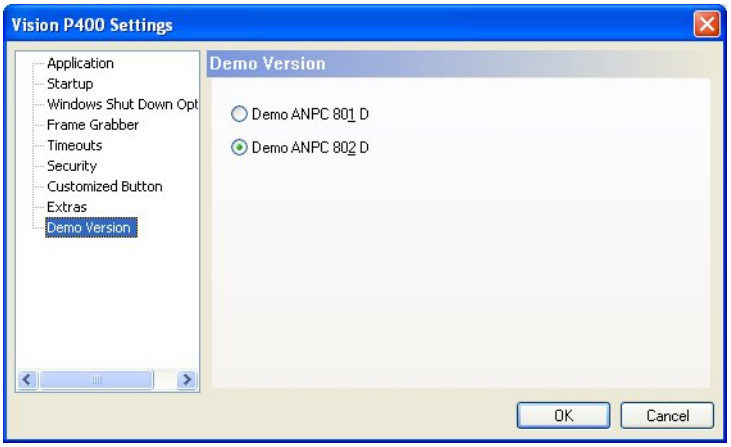
With this button you replace the comma in your keyboard number pad with a decimal point. This helps you input decimal values on the spreadsheet. When you click the button the label changes to "Replace decimal point with comma on numeric keypad", enabling you to reset the key assignment to its original status.

◆**NOTE**

When you have clicked this button you must exit Vision P400 and restart your computer for the new setting to take effect.

7.3.9 Demo Version

This property page only appears in the demo version of Vision P400. Here you can select which frame grabber you wish to emulate in the demo version.



Vision P400 demo version settings

Select "Demo ANPC 801D" for serial and "Demo ANPC 802D" for parallel image grabbing. The demo version supports camera models ANPC 831D, ANPC 834D, ANPC 836D and ANPC 837D.

◆**NOTE**

If you have changed the demo version settings, you need to restart Vision P400.

7.4 Save Settings to File

When you select this command, a dialog box opens up in which you can assign a file name. Then all settings not specific to an application but globally applicable throughout the Vision P400 system are saved to a file of type *.reg.

The following settings are saved:

- the settings for the Vision P400 interfaces;
- the settings for the Frame Grabber, in particular the connected cameras;
- the settings for Vision P400 error handling;
- the settings for Vision P400 timeouts;
- the settings to start and end Vision P400 and to activate and quit run mode, such as the name of the application to be loaded when Vision P400 starts up,
- the assignment of application names to the application numbers used on an interface-controlled application change; and
- Vision P400 internal settings.

With this function you can easily transfer the Vision P400 settings to a different computer by copying the file to the target computer and loading it there by way of the "Restore Settings from File" command.

◆**NOTE**

You cannot edit the *.reg file you create by way of the "Save Settings to File" command, so as to prevent important Vision P400 settings from being unintentionally discarded and Vision P400 from being prevented from running correctly when you read in the file.

7.5 Restore Settings from File

When you select this command, a dialog box opens up in which you can select a file of type *.reg (see page 148). In files of this type all settings are stored which are not application-specific but globally applicable throughout the Vision P400 system.

◆NOTES

- **When you run the "Restore Settings from" command, the settings stored in this file overwrite the current Vision P400 settings on the computer on which you are running the command.**
- **When you run the "Restore Settings from File" command, Vision P400 is automatically terminated and you must restart the program.**

7.6 Error Handling

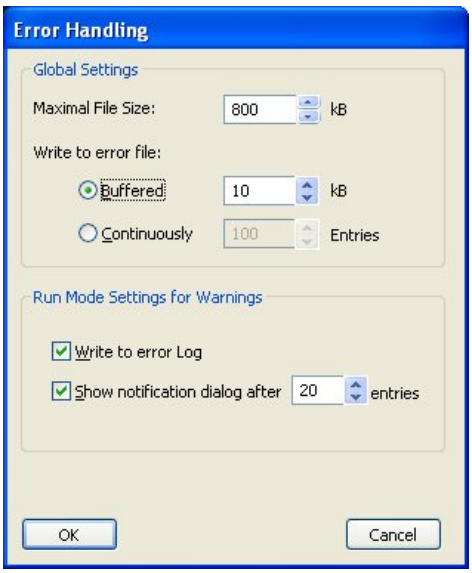
In Vision P400, there are different types of errors (see page 611). The settings in the menu **Error Handling** are only valid for warnings.

You will receive a warning if a **calculation error** occurs in the **spreadsheet** or when **executing individual checkers**. The calculation of a checker fails, for example, if the dependencies could not be established or if an algorithm did not find any objects for evaluation. A spreadsheet calculation error occurs, for example, if the system tries to divide a result by zero.

As a rule, warnings do not influence the operation of the system, apart from the time needed to write the warning into the file “error.txt” and into the "Error Logging" window (this option can be switched off in run mode). In the "Error Logging" window (see page 248) you can see all warnings displayed while the program is running. You can only view the file “error.txt” after you have exited the program.

If the number of warnings exceeds a user-definable limit, you can configure an appropriate message that will appear on your screen.

In **Error Handling** → **Error Handling** you define Vision P400's response to warning errors. The access to this function can be protected by a password (see page 134).



"Error Handling" dialog box

7.6.1 Global Settings

The error file "error.txt" is not created new every time Vision P400 starts up; the existing file is opened and new entries are appended at the end. To prevent the error file from becoming too large, use "Maximal File Size" to limit the size of the file. Every time it starts up, Vision P400 checks whether the size of the error file has exceeded the permitted maximum. If the error file has exceeded the permitted maximum size, Vision P400 creates a maximum of one copy of the error file "error.txt" under the name "error.txt.bak" (if a file with this name already exists it is overwritten) and deletes the content of the "error.txt" file.

You can also specify when error entries are written to the error file "error.txt" (see page 152). If you select "Buffered", warnings are not written to the file directly, but are stored in a buffer in the memory. The size of the buffer is defined by the figure selected in the right field. When you leave Vision P400, the system writes the contents of the buffer into the error file “error.txt”.

When you select "Continuously", all warnings are directly written into the error file. The number of entries is limited by the figure selected in the input box at the right.

◆NOTES

- **If unexpected (see page 605) or fatal errors (see page 606) occur, the system automatically uses "Continuous" mode, meaning all such errors are written immediately to the error file. In this case, possible limits set for the file size will be ignored.**
- **Writing into the error file influences the time response of your application. We therefore recommend that you use the setting "Buffered".**

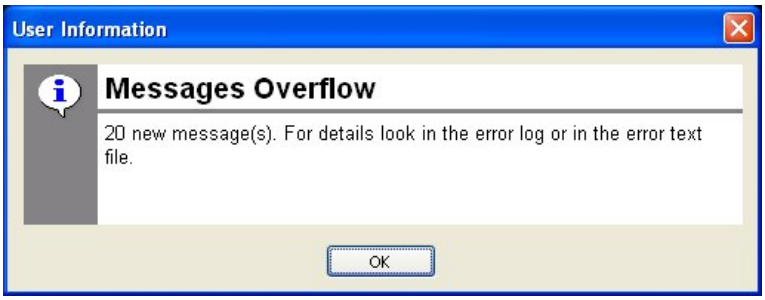
7.6.2 Run Mode Settings for Warnings

In run mode there are two additional possibilities to deal with warnings:

If you activate the parameter "Write to Error Log" with a mouse click, the system will write warnings not only into the file “error.txt”, but also into the "Error Logging" window of the application. This setting is only valid for run mode. In setup mode, all warnings are always displayed in the "Error Logging" window. You can empty the error log with **Error Handling → Clear Error Log** or the <Del> key.

With "Show Notification Dialog after <n> Entries" you define a limit for warnings. If the number of warnings reaches this limit, a window appears with an appropriate message. This setting is only valid for run mode. In setup mode, there is no notification window.

Here the maximum number of warnings to ignore has been set to "20".



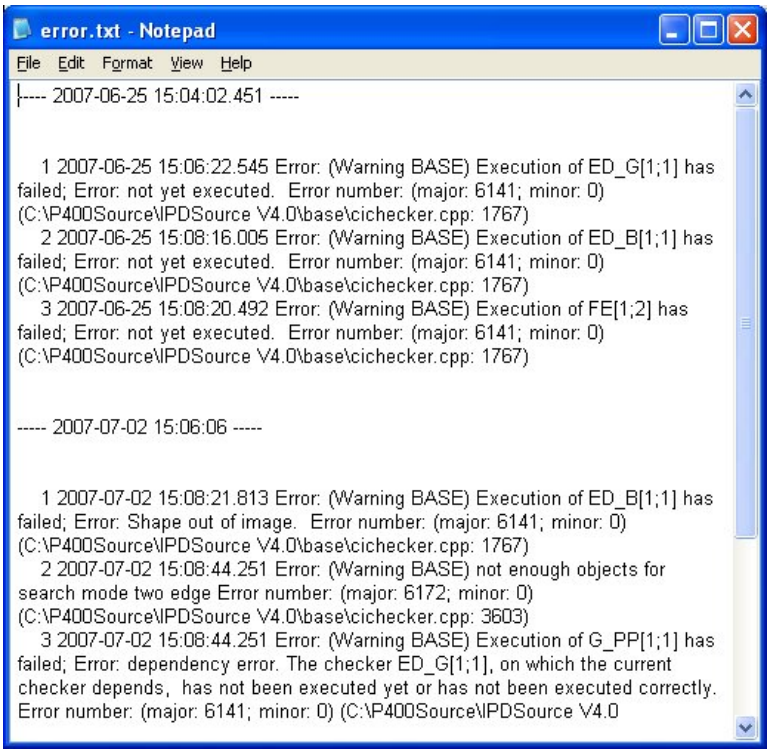
Ignore warnings (limit)

This configuration option is useful during the installation phase. It makes it easier to find problems that occur only sporadically while the system is in operation.

7.6.3 Error file "error.txt"

In the installation folder (e.g. C:\Program Files\Panasonic MEW Vision\Vision P400 4.0) you will find the "error.txt" file. This file contains error descriptions (see page 610) which help you to analyze the errors that have occurred.

Every time the program starts up a new section with the current date and time is created at the end of the file. Each error or warning is written in a new line.



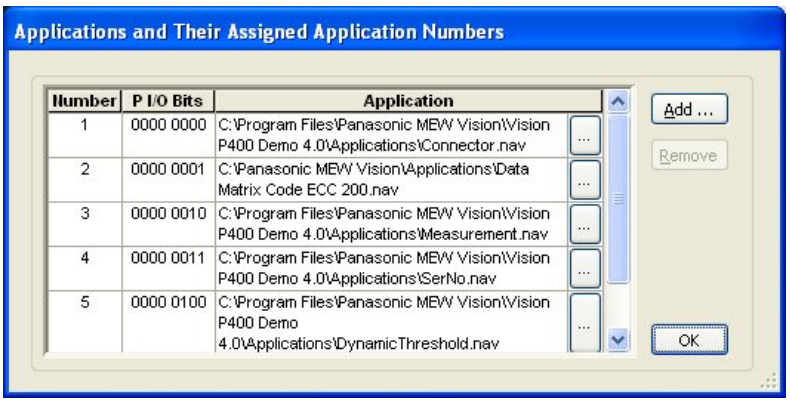
Extract from an “error.txt” file

7.7 Application Numbers

With **System Settings → Application Numbers** you can number any application saved. Initially, Vision P400 will assign the numbers automatically when you add a new application to the list. Please note that if there is a password for Vision P400, you need the password to modify the application numbers. Viewing is possible without password. Use the application numbers (see page 167) to switch from one application to another (see page 181).

◆NOTE

The time needed for an application switch depends on the size of the applications. That means, depending on the number of cameras and checkers and depending on the display settings it may take longer to complete an application switch. If your application is time-sensitive, we recommend doing test runs to find out how long it takes to switch applications.



Numbering applications

You can overwrite the existing application number with a new number. Click in the column labeled "Number" and type in a new number. The table will be updated when you move the cursor out of the cell.

◆NOTE

If you enter a number already assigned to another application, Vision P400 will not accept the change.

You insert an application by clicking [Add]. Depending on whether you have selected a row when you add an application, Vision P400 inserts the application below the selected row or at the beginning of the list. Delete an assigned application number by selecting the corresponding row and clicking [Remove]. Alternatively, press <Del> or Backspace.

If you wish to change the application assigned to a number, click [...] and select an application in the dialog box.

The column "P I/O Bits" (see page 181) shows the pattern of bits you need to send to the parallel interface in order to perform an switch to the application with this number.

◆**NOTES**

- **The P I/O bit pattern is always the application number minus 1, e.g. for application number 1 the P I/O bit pattern is 0000 0000.**
- **You can assign application numbers up to 9999. However, changing to an application with an application number higher than 256 is only possible via the serial or the OLE interface.**

7.8 User Interface Layout

In Vision P400 you can customize the appearance of your user interface in layouts. In this, a distinction is made between

- layouts with non-application-specific settings which are used when no application, or no layout saved in the application, is loaded, and
- layouts with application-specific settings which are saved with the respective application.

Name	Layout type	Which data are stored in it?	Icons and commands in Vision P400
User Interface Layout (see page 155)	non-application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows	Save with Load with Delete with System Settings → **User Interface Layout** → Save as/Load/Reset User Layout
Start Layout (see page 226)	application-specific	• Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Automatically configured and saved (see page 226) by Vision P400
Setup Mode Layout (see page 226)	application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Save with Load with Delete with View → Application Layouts → Save/Load/Delete Setup Mode Layout
Run Mode Layout (see page 226)	application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Save with Load with Delete with View → Application Layouts → Save/Load/Delete Run Mode Layout

With "User Interface Layout" you define **independently of the specific application** how the Vision P400 user interface is to look when no application, or no layout saved in the application, is loaded.

When you select **System Settings → User Interface Layout → Save as User Layout** or click on the icon, the current appearance and position of the toolbars, the menu bar and the dockable windows is saved (see page 231). The position and size of the camera windows and

of the spreadsheet are not saved, because those settings are **application-specific**, and are saved along with the application.

With **System Settings** → **User Interface Layout** → **Reset to Default Layout** or by clicking the icon you can restore the Vision P400 default settings at any time.

◆**NOTES**

- **Whenever you have changed the layout of the user interface, you must save your changes explicitly by choosing** System Settings → User Interface Layout → Save as User Layout**, otherwise they will be lost the next time Vision P400 starts up.**
- **When you have selected** System Settings → User Interface Layout → Reset to Default Layout**, you must restart Vision P400 for the default setting to be applied.**
- **When an application is loaded, the settings made here are normally overwritten by one of the layouts stored in the application. Whether this happens, and with which layout from the application, depends on the application settings (see page 226).**

7.9 Interfaces

In Vision P400 you can output data at three different interfaces:

- Serial I/O (see page 158)
- Parallel Interface (see page 173)
- OLE (see page 185)

All settings you make under **Interfaces** are globally applicable to every loaded application. When you leave Vision P400, you need to save the interface settings if you wish to use them in the next session. Saving the interface settings is protected by password (see page 134), if you have defined a password under **System Settings → Password**.

Sending Signals

On the interfaces' property pages you select a) whether the interface will be used (serial and parallel interface only) and b) which signals will be sent by Vision P400. If you mark the box with a mouse click, the signal will be sent. Activate the sending of signal with a mouse click.

Signal	Meaning
REnd	REnd (read end) signifies that the image has been read-in. This means the next image can be captured, or the next object placed before the camera lens.
PCReady	Signals that Vision P400 is ready to continue the application, a new start signal will be accepted.
PCDataReady	Signals that the current results are available.
Application change completed	Sends a signal when the application has been changed successfully.
Start Lost	Signals that a start signal was sent to Vision P400 before the PCReady signal was given and that the start signal has been ignored. With the parallel interface, the signal "Byte Overflow" can be transferred instead.

The following signals are selected indirectly:

Signal	Meaning
PCReady OFF	Vision P400 is busy, all input commands will be ignored. This signal will be sent if you have activated PCReady signal on the property page of the interface.
PCDataReady OFF	Indicates that the data from the last execution are no longer valid. This signal is sent if you have checked PCDataReady.
Error	Signals that an error has occurred.

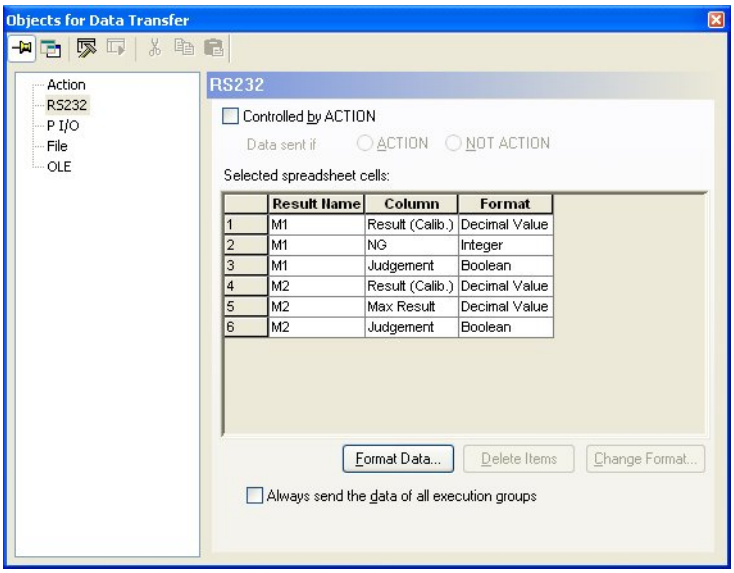
Vision P400 will automatically recognize free interfaces. For example, if you have connected the mouse to the serial interface COM2, Vision P400 proposes the COM1 interface, which is free and can be used for transfer purposes.

Transfer Sequence

The transfer sequence depends on the sequence order in which you have assigned spreadsheet results to the interface, i.e. either by drag & drop or via the right mouse button. If you use drag & drop to select spreadsheet data for output to the RS232 interface, for example, the selected spreadsheet cell will be marked in the color of the interface. The data are transmitted automatically after the application has run. The user can change the transfer

sequence by changing the sequence on the RS232C page in the "Objects for Data Transfer" (see page 546) window.

Open the "Objects for Data Transfer" dialog window with the sequence, for example for the serial interface, with a click on the RS232 symbol to the left of the spreadsheet.



Sequence of the RS232 interface

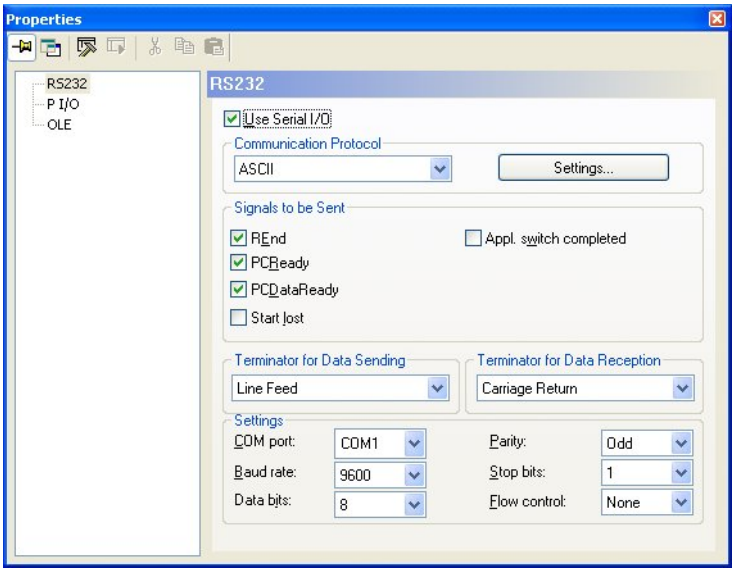
◆**NOTE**

In communication over the interfaces, interface errors may occur in run mode. You can fix interface errors (see page 607) without exiting Vision P400.

7.9.1 RS232

All results marked in the spreadsheet and all the signals selected in the interface property page will be transferred via the serial interface (RS232C) automatically after Vision P400 has finished processing the image and calculating the spreadsheet results.

Choose **System Settings** → **Interfaces** → **RS232...** to open the following property page:



Property page of RS232 interface in ASCII protocol mode

Use Serial I/O

When the check box "Use Serial I/O" is deselected, Vision P400 does not use the serial interface. It is possible to configure data for transfer to the serial interface, but Vision P400 will not send data or signals when in run mode.

◆NOTE

When you have changed the setting for this parameter, you need to exit and restart Vision P400 in order for the changes to take effect.

Communication Protocol

Here you define which communication protocol Vision P400 is to use for the data and signals. The following protocols are supported:

Protocol	PLC Type
ASCII (see page 160)	All PLC types which support this protocol
MEWTOCOL (see page 163)	FP series from Panasonic Electric Works

The options on the property page of the serial interface and in the dialog box opened by the [Settings...] button change according to which communication protocol you selected.

Terminator for Data Sending

Every time Vision P400 sends data to an external device, the terminator will be added at the end of the data package. In the "MEWTOCOL" communication protocol this option cannot be changed, and is fixed as "CR" (Carriage Return).

Terminator for Data Reception

The terminator for receiving data is needed whenever external devices send data to Vision P400. Here you set the code which indicates that the data have been transferred completely and that this is the end of the reception. If there is no terminator, Vision P400 is not able to interpret the signals it has received. In the "MEWTOCOL" communication protocol this option cannot be changed, and is fixed as "CR" (Carriage Return).

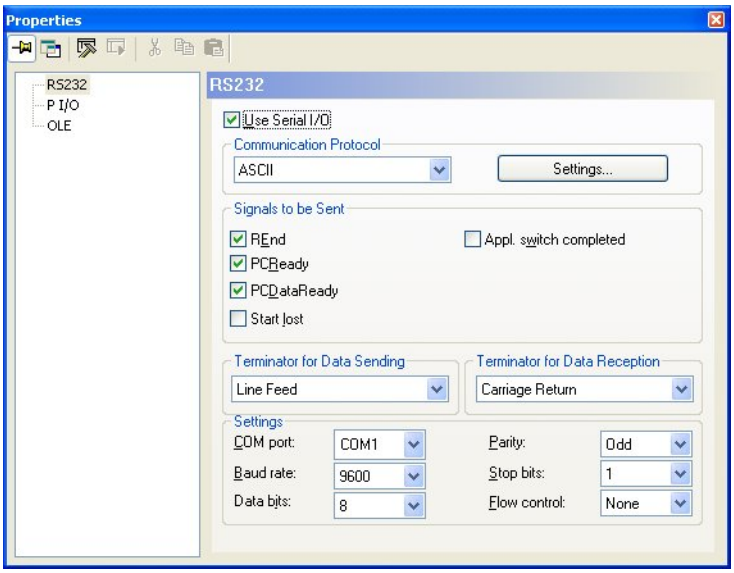
Settings

The adequate **baud rate** depends on the PC hardware.

Feature	Settings
Baud rate	75; 110; 134.5; 150; 300; 600; 1200; 1800; 2400; 4800; 7200; 9600; 14400; 19200; 38400; 56K; 57600; 115200
Data bits	5;6;7;8
Parity	No, Odd, Even
Stop bits	1; 1.5; 2
Flow control	Select • "None" if you do not need a handshake at all. • "Xon/Xoff" if the handshake is defined via the software. • "Hardware" if handshake is performed by wiring.

7.9.1.1 ASCII Communication Protocol

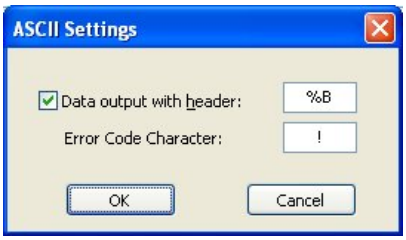
If you select "ASCII" under "Communication Protocol", the property page for the serial interface looks like this:



"RS232" property page for ASCII as communication protocol

Settings

When you choose [Settings] a dialog box opens up. In it, you can set the data header and a flag to mark data errors.



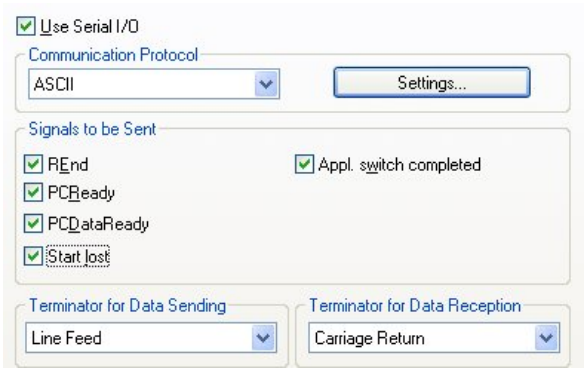
"ASCII Settings" dialog box

The following options are available:

Option	Description
Data output with header	user-definable one-digit code which precedes spreadsheet data in the data packages to send
Error code character	user-definable one-digit error code which is used for errors (see page 611) occurring during the spreadsheet calculation

Signals to Be Sent

Here you define which signals are to be transmitted. In the "ASCII" communication protocol the following signals are available.



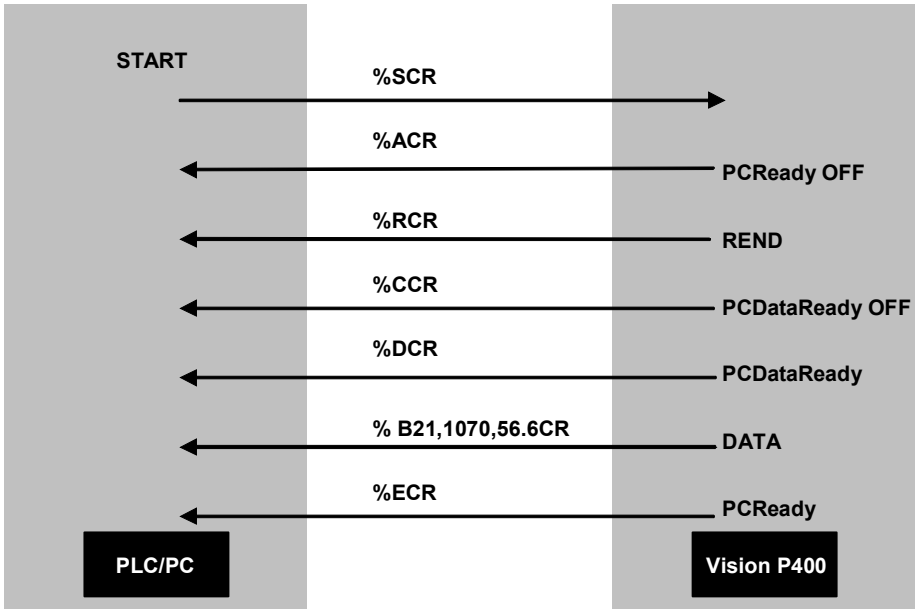
Signal	Activate Sending in the RS232 Property Page?
REnd	Yes
PCReady	Yes
PCDataReady	Yes
Start Lost	Yes
Application change completed	Yes
Error	Is always sent automatically
Execution error	Whenever errors (see page 611) occur when making calculations on the spreadsheet, the user-defined single-digit error code you specify in the "ASCII Settings" dialog box ([Settings...] button) is transmitted.
Action Error	Always sent, as defined on the "Action" (see page 565) property page.

Data output from Vision P400 to PLC/PC

◆**EXAMPLE**

Vision P400 automatically outputs the values marked in the spreadsheet. The example uses the default signals to be sent, e.g. %B as the header for spreadsheet data output.

	Result Name	Result (Calib.)	Judgement	Scans
Results	Start			
	M1	1070	OK	21
	M2	56.6	OK	21
	End			



Vision P400 sets the **PCDataReady** signal before it sends data to the PLC. As long as **PCDataReadyOFF** is not sent, the data from the last scan remain valid and can be requested by the PLC or PC. **PCDataReadyOFF** can only be sent if you have executed one scan and the **PCDataReady** signal has been set once.

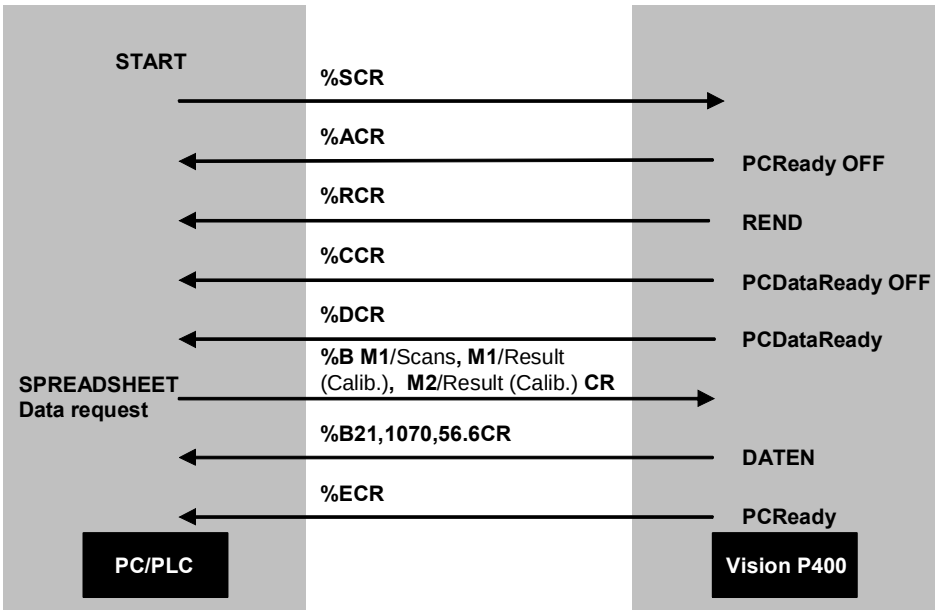
Data request from PLC/PC to Vision P400

◆**EXAMPLE**

You request data directly from a spreadsheet with a PC/PLC, i.e. Vision P400 should send the number of scans and the calibrated result from the first spreadsheet row and the calibrated result from the second row via the interface to the PC/PLC.

	Result Name	Result (Calib.)	Judgement	Scans
Results	Start			
	M1	1070	OK	21
	M2	56.6	OK	21
	End			

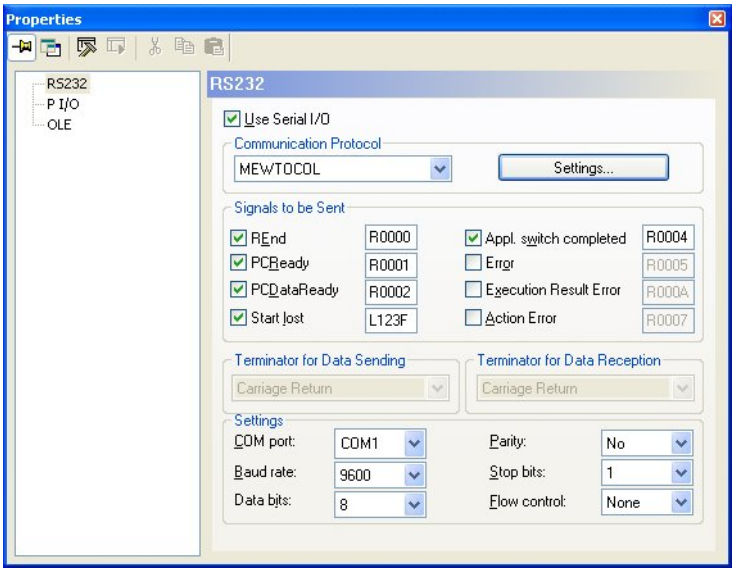
The data protocol for the data request would then look like this:



Vision P400 sets the **PCDataReady** signal before it sends data to the PLC. As long as **PCDataReadyOFF** is not sent, the data from the last scan remain valid and can be requested by the PLC or PC. **PCDataReadyOFF** can only be sent if you have executed one scan and the **PCDataReady** signal has been set once.

7.9.1.2 MEWTOCOL Communication Protocol

If you select "MEWTOCOL" under "Communication Protocol", the property page for the serial interface looks like this:

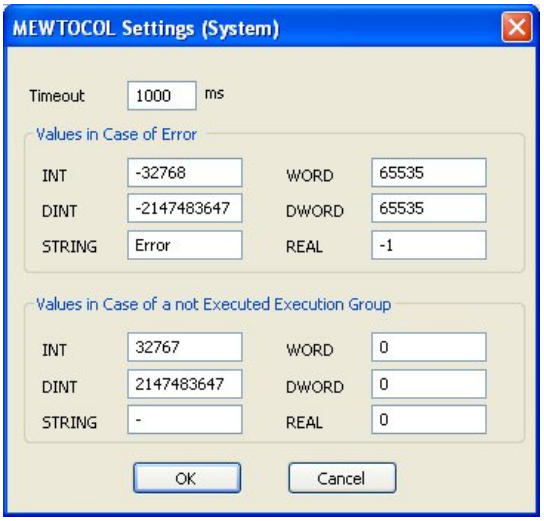


"RS232" property page for MEWTOCOL as communication protocol

MEWTOCOL is a communication protocol which enables communication between P400/P400S and a PLC of the FP series from Panasonic Electric Works. This means the scan results (calculation and evaluation data) can be written to PLC registers (DT, FL, L). You can also write signals (such as PCReady) to an output (Y), an internal flag (R) or a communication flag (L).

Settings

When you choose [Settings] a dialog box opens up. Here you set the values to be transmitted in certain situations as defaults.



"MEWTOCOL Settings (System)" dialog box

The following options are available:

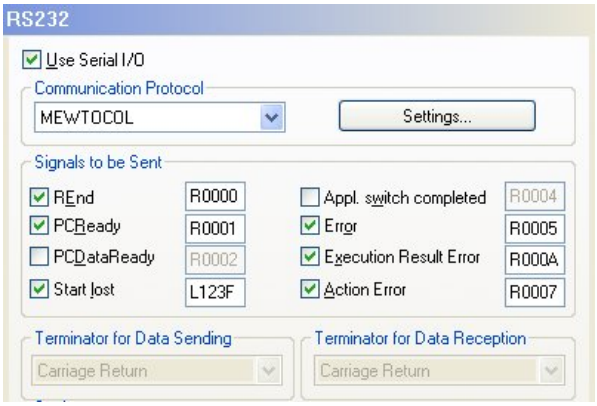
Option	Description
Timeout	Time within which a reply is expected from the PLC to transmitted data or signals.
Values in Case of Error	Values transmitted in case of an execution result error (see page 611)
Values in Case of a not Executed Execution Group	Values transmitted when an execution group was not executed (see note)

◆**NOTES**

- **The values under "Values in Case of a not Executed Execution Group" are only transmitted if you have activated the "Always send the data of all execution groups" option in the "Objects for Data Transfer" (see page 541) window.**
- **It is advisable to use the value range limit in place of the zero.**

Signals to Be Sent

Here you define which signals are sent and the address to which the value is to be transmitted. If signals are not selected the address field is grayed out.



Signal	Activate Sending in the RS232 Property Page?
REnd	Yes and define flag/output/address
PCReady	Yes and define flag/output/address
PCDataReady	Yes and define flag/output/address
Start Lost	Yes and define flag/output/address
Application change completed	Yes and define flag/output/address
Error	Yes and define flag/output/address
Execution error	Whenever errors (see page 611) occur when making calculations on the spreadsheet, or the checker whose result is to be transmitted cannot be executed or calculated, the user-defined value you specify in the "MEWTOCOL Settings" dialog box ([Settings...] button) is transmitted. An execution result error can occur, for example, when an Integer type result is to be transmitted but the result value exceeds the value range specified for integers.
Action Error	According to the setting on the "Action" (see page 565) property page and the settings made here, this signal is transmitted or not.

When you have activated a signal for output, you can change the destination address for the signal. The address for the signals is composed of the memory area and the memory address. You can set internal flags (R), outputs (Y) or communication flags (L) for the memory area. The memory address is subdivided into a decimal and a hexadecimal portion. For the first three characters decimal figures can be set; the fourth character is the hexadecimal number 0-F. For the relevant settings for data transfer refer to the table (see page 167).

◆NOTE

The number of outputs, internal flags and communication flags depends on the connected PLC. For the "MEWTOCOL" communication protocol the terminators for sending and receiving data are preset and cannot be changed.

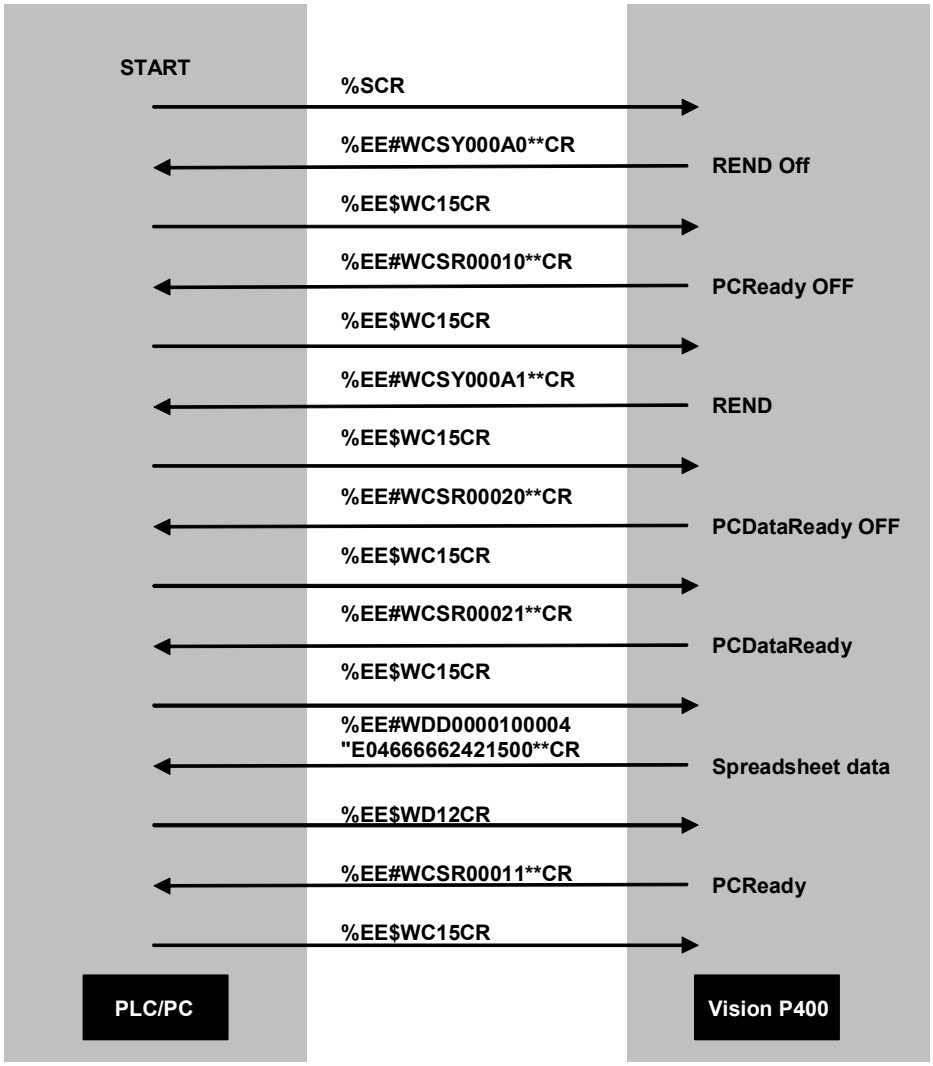
Data output from Vision P400 to PLC/PC

◆**EXAMPLE**

Vision P400 automatically outputs the values marked in the spreadsheet. Also, the REnd, PCReady and PCDataReady signals in the property page of the RS232 interface are activated and are likewise output.

	Result Name	Result (Calib.)	Judgement	Scans
Results	Start			
	M1	1070	OK	21
	M2	56.6	OK	21
	End			

The data protocol would then look like this:



7.9.1.3 Signal Codes for Data Transfer

Below, you find a list with all signal codes which can be exchanged between the Imagechecker (ICH) and the PLC/PC or other peripheral devices. Depending on the direction of communication, the same or differing signal codes are used for the two communication protocols ASCII and MEWTOCOL.

- In the PLC/PC → Imagechecker communication direction ASCII and MEWTOCOL use the **same** signal codes.
- In the Imagechecker → PLC/PC communication direction ASCII and MEWTOCOL use **different** signal codes.

◆**NOTE**

The terminators for sending and receiving data are user-definable (see page 158) when you are using the "ASCII" communication protocol. For the "MEWTOCOL" communication protocol the codes are fixed.

Signal codes for the PLC/PC → Imagechecker communication direction

◆**EXAMPLE**

Request of a single data string: **%*dCR**
Request of several data strings: **%*d,d,dCR**

%	Flag for start of transmission
*	to be replaced by a signal code
d	to be replaced by a data string
CR	indicates the end of communication

Example output: %RCR, %ACR,%ECR,%DCR and %TCR

Signal name	Signal	ASCII	Description
Start	S	53h	Start signal executes the application. With start mode = "Repetitive Start" and "Repetitive / Automatic Start" the start signal works as a start/stop signal (see page 127). Example: %SCR Start signal executes execution group Example: %S010CR (starts execution group No. 10)
Start without grabbing a new image	SN		Start signal executes the application without grabbing a new image Example 1: %SNCR Example 2: %SN010CR (starts execution group No. 10) Using the command **SN** has the same functionality as sending the signal "Lock Grabbing" (see page 126) over the parallel interface.
Start/Stop run mode	K	4Bh	Start/Stop Run Mode **Note:** **This signal is the only signal that Vision P400 processes in setup mode. Please take care not to send the signal by accident. If you do, Vision P400 switches to run mode while you may still want to edit your application.**
Spreadsheet data request	B	42h	Spreadsheet Data Request Example: %BM1/Result,M2/JudgementCR (spreadsheet cell defined by <result name>/<column heading>)
Change the limit values of a spreadsheet row	T... U/L	54h	Change value of upper/lower limit (U/L) in a row Example: %TM1/L/1000CR (the new lower limit for row with result name "M1" is 1000, see figure below) **Note:** **Do not forget to enter the decimal point. Vision P400 does not accept a comma!**
Change an OCR reference value on the spreadsheet	F	46h	Change the reference value for OCR results on the spreadsheet Example: %FM3/ABCDCR (M3 is a user-defined result name in the spreadsheet, see figure below)

Signal name	Signal	ASCII	Description
Change multiple OCR reference values on the spreadsheet	G	47h	Change multiple OCR reference values for OCR results on the spreadsheet Example: %GO1/ABC,O2/CDECR changes the reference values of rows O1 and O2 to ABC and CDE respectively (spreadsheet cell defined by <result name>/<new reference value>).
Reset spreadsheet statistics	H	48h	Reset statistics of the spreadsheet: Example: %HCR (the spreadsheet statistics and the number of scans are reset. This happens AFTER the next start signal.)
Change application	X	58h	Change Application Example: %X002CR (change to application No. 2)
Exit	Q	51h	Exit Vision P400 and automatically shut down Windows where appropriate (depending on the setting (see page 145)) Example: %QCR

This figure shows the spreadsheet according to the signal code description.

	Result Name	Result (Calib.)	String Reference	Lower Limit	Upper Limit	Judgement	Scans
Results	Start						
	M1	1070		0	5500	OK	15
	M2	56.6		0	60	OK	15
	M3	CODE	CODE			OK	15
	End						

Signal codes for the Imagechecker → PLC/PC communication direction

Signal name	Description	ASCII protocol	MEWTOCOL protocol
PCReady	System ready for next task	E (45h)	The register configured under "Signals to be sent" is set.
PCReadyOFF	All entered commands are ignored	A (41h)	The register configured under "Signals to be sent" is reset.
Run mode started/stopped	Confirmation that Vision P400 has started or stopped run mode	K (4Bh)	When transfer of PCReady, REnd or PCDataReady is active, no additional %KCR is sent. If those signals are inactive, a %KCR is sent.
REnd	Read image end	R (52h)	The register configured under "Signals to be sent" is set.
REndOff	Image grab signal reset ended		The register configured under "Signals to be sent" is reset.
PCDataReady	Result data is available.	D (44h)	The register configured under "Signals to be sent" is set.
PCDataReadyOFF	No result data available	C (43h)	The register configured under "Signals to be sent" is reset.
Spreadsheet data output	Output of the contents of the selected or requested spreadsheet cells	B (42h) (changeable)	• With automatic data output the MEWTOCOL protocol is used. • The response to an external data request is as in the ASCII protocol
Reference value for OCR result has been changed in the spreadsheet	Confirmation that the OCR reference value has been changed	F (46h)	As in ASCII protocol: %FCR

Signal name	Description	ASCII protocol	MEWTOCOL protocol
Multiple reference values for OCR results have been changed in the spreadsheet	Confirmation that the OCR reference values have been changed	G (47h)	As in ASCII protocol: %GCR
Change notify	Confirmation of change of upper/lower limit	T (54h)	As in ASCII protocol: %TCR
Spreadsheet statistics reset	Confirmation of statistics reset	H (48h)	As in ASCII protocol: %HCR
Start lost	A start signal was sent to Vision P400, but the system was not ready for another start signal.	L (4Ch)	The register configured under "Signals to be sent" is set.
Application change completed	Confirmation that Vision P400 has loaded the desired application	X (58h)	The register configured under "Signals to be sent" is set.
Quit	Close Vision P400 and, depending on the presetting, shut down Windows.	Q (51h)	As in ASCII protocol: %QCR

Error Messages to RS232

Signal	Description	ASCII	MEWTOCOL
Z	Unregistered data error: Example: %ZCR means application does not exist.	5A	The register configured under "Signals to be sent" for "Execution Result Error" is set.
! (variable)	Execution Result Error (see page 611), e.g. data error on spreadsheet: Example: %B 33 , ! , 1 , ! , 0CR **Note:** **The character indicating execution result errors is user-definable (see page 158) on the property page of the serial interface.**	21h	The register configured under "Signals to be sent" for "Execution Result Error" is set. In place of the erroneous value, the value set under "Values in Case of Error" is transmitted.
?	Error message: Example: %?CR This error can be caused by all unknown commands, by an action error or by an erroneous signal from the PLC.	3Fh	The register configured under "Signals to be sent" for "Error" or "Action Error" is set.

◆**NOTES**

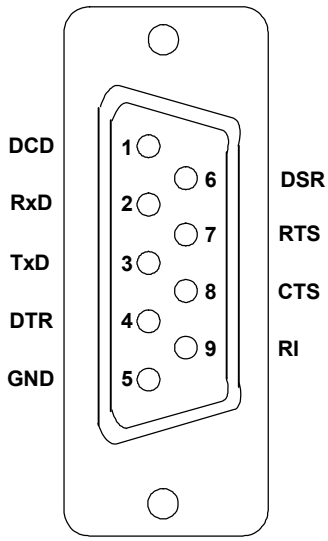
- **All signals listed above, except %K (Start/Stop run mode) are only accepted or sent if two conditions are met:**
  - **The Imagechecker signal PCReady is ON.**
  - **The system is in run mode.**
- **The time needed for an application switch depends on the size of the applications. That means, depending on the number of cameras and checkers and depending on the display settings it may take longer to complete an application switch. If your application is time-sensitive, we**

recommend doing test runs to find out how long it takes to switch applications.

- **If you want to view the input signals coming in via the serial interface, we recommend using the Microsoft "Hyperterminal" program or the interface monitor (see page 186) built-in to Vision P400.**
- **When you change the application, the old application is saved implicitly unless it has been write-protected. In this case Vision P400 does not save the application but rather writes a warning into the error log if you have activated the option "Write to Error Log" under Error Handling (see page 151).**
- **If you send a start signal via the serial interface with an execution group number although the "Allow group switching" option is not activated, the group number is ignored and Vision P400 executes the whole application.**
- **If the "Allow group switching" option is activated and you send a start signal with an execution group number that does not exist, the start signal is ignored. The "Start Lost" signal is sent to all interfaces and "Start Signal Lost" is written into the error log file.**
- **The execution group number sent together with the start signal must be either exactly three or four digits long. If the number has less digits, the execution group number must be sent with leading zeros.**

7.9.1.4 Pin Assignment and Pin Connection

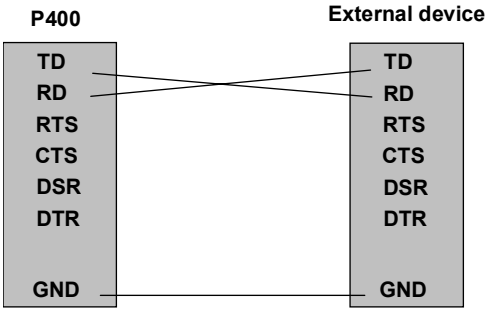
The following sections explain how to connect the Imagechecker correctly to an external device depending on the settings of the "Handshake" parameter. The PC Imagechecker has a 9-pin male connector.



Pin assignment of the 9-pin male RS232 port on the Imagechecker

Parameter "Flow Control" = None

The figure below illustrates how to use a Sub-D plug to make a simple three-wire connection between the P400 and an external device.



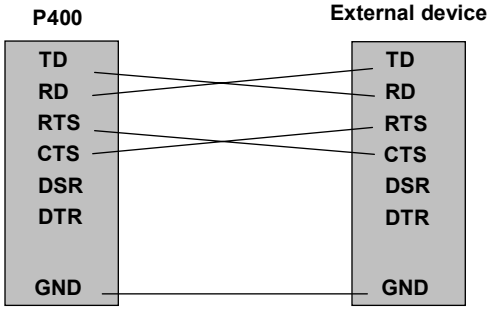
Most simple connection via the serial interface

Parameter "Flow Control" = Xon / Xoff

To improve the data transfer, a three-wire-connection is often used together with the XON/XOFF protocol. When the receiver is ready to accept data, it sends the signal XON (this usually corresponds to code DC1 = ASCII code 11h). As long as the receiver is still busy processing data, it sends the signal XOFF (code DC3 = ASCII code 13h). Please note that this connection method only works when you set the parameter "Flow Control" to "Xon / Xoff" and when the external device actively supports the XON/XOFF protocol.

Parameter "Flow Control" = Hardware

Another way to improve the data transfer is to set the devices to perform a hardware handshake. This does not only mean a connection of data lines (depending on the configuration the lines are crossed or not), but also to connect the pins RTS and CTS. CTS (CLEAR TO SEND) is used by the external device to indicate that it is ready to receive data. Usually the external device sends this signal as a reaction to receiving the signal REQUEST TO SEND from the P400. Data transfer only takes place when both RTS and CTS are active (low).



Connection with handshake

◆**NOTE**

The hardware handshake uses the timeouts you set in the Vision P400 settings on the "Timeouts (see page 141) property page. If you are using MEWTOCOL as the communication protocol, the Handshake timeout and the MEWTOCOL timeout are added together.

7.9.2 Parallel I/O

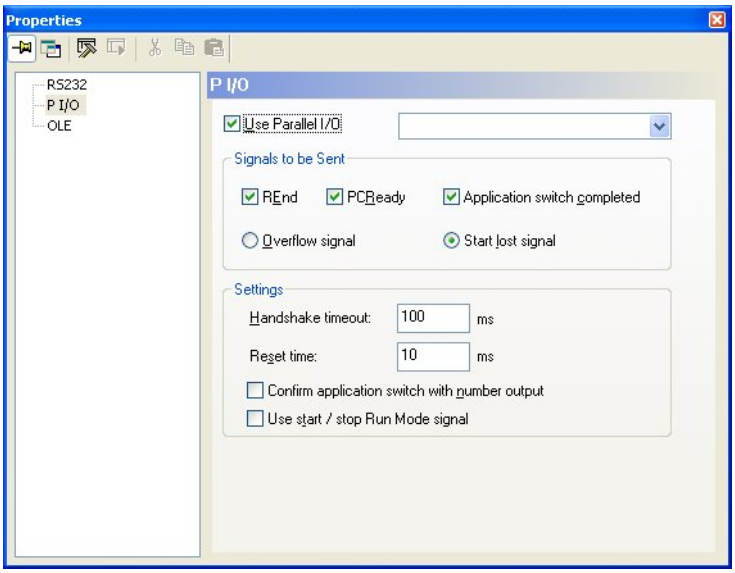
Vision P400 supports the following digital I/O boards:

- For P400: ANPC 850V2D (from Vision P400 V3.0) and ANPC 850D
- For P400S: ANPS 850D
- For P400MA: ANPC 850V3D

The I/O boards differ where it comes to connecting and controlling the flash as well as the timing of some signals.

The parallel interface provides 16 input/output channels which are opto-isolated.

All selected numeric spreadsheet data as well as several control and warning signals are transmitted. In addition to this, you can switch from one application to another via the digital I/O.



Property page of the parallel interface

Use parallel I/O

When the check box "Use Parallel I/O" is deselected, Vision P400 does not use the parallel interface. It is possible to configure data for transfer to the parallel interface, but Vision P400 will not send data or signals when in run mode.

◆NOTE

When you have changed the setting for this parameter, you need to exit and restart Vision P400 in order for the changes to take effect.

Signals to be sent

Signal	Activate sending in the P I/O property page?
REnd	Yes

Signal	Activate sending in the P I/O property page?
PCReady	Yes
Application change completed	Yes
Start lost/Overflow	Yes, select the signal to be sent with a mouse click

Settings

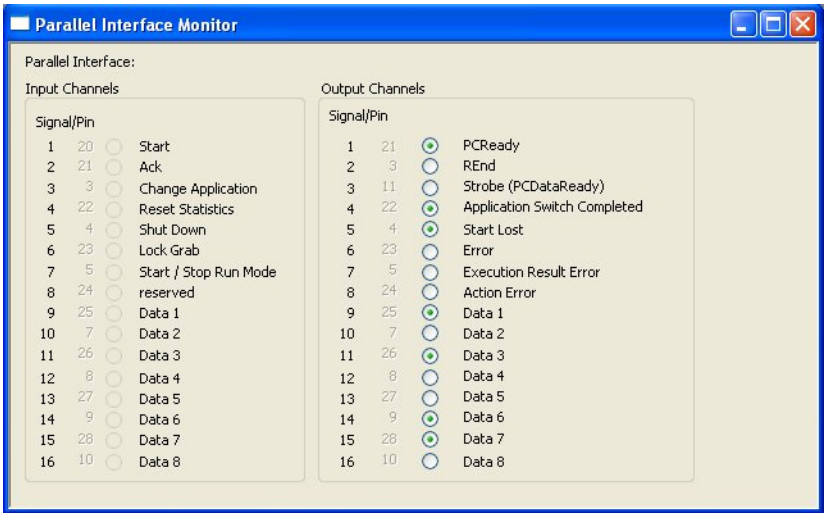
Setting option	Functionality
Timeout for handshake	Time for timeout in handshake communication (see page 179)
Reset time	Time for resetting the Strobe signal (see page 177)
Confirm application switch with number output	After Vision P400 has switched to another application, the number of the new application is output as binary data. After the next start signal the output signals are reset.
Use start / stop run mode signal	When you activate this option, Vision P400 uses the next start signal to switch from setup to run mode or vice versa. (When using the digital I/O board ANPC 850D you also need to send the application change signal = Pin 12).

◆NOTE

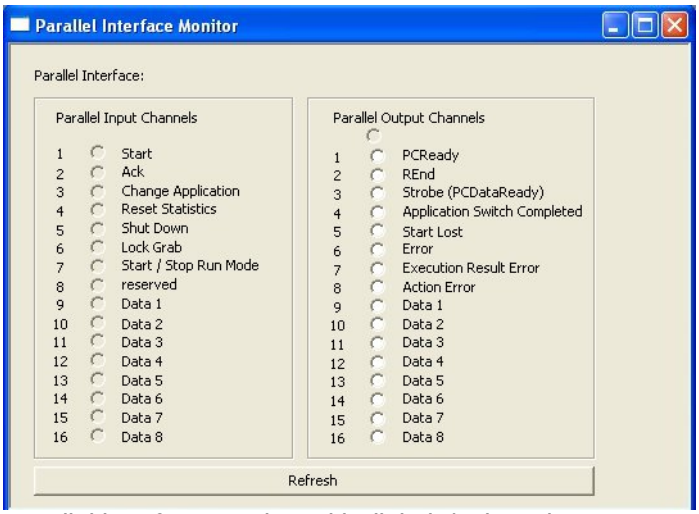
When you have selected the start mode "Repetitive Start" or "Repetitive / Automatic Start" for this application (see page 127), you stop Vision P400 by setting the start signal and start it again with the next start signal.

7.9.2.1 Available Input and Output Signals

The input and output signals are displayed in the "Parallel Interface Monitor" window, which varies according to the installed interface board. To open the interface monitor choose **View → Parallel Interface Monitor** or click the icon.



Parallel interface monitor with digital I/O board ANPC 850V2D and ANPS 850D



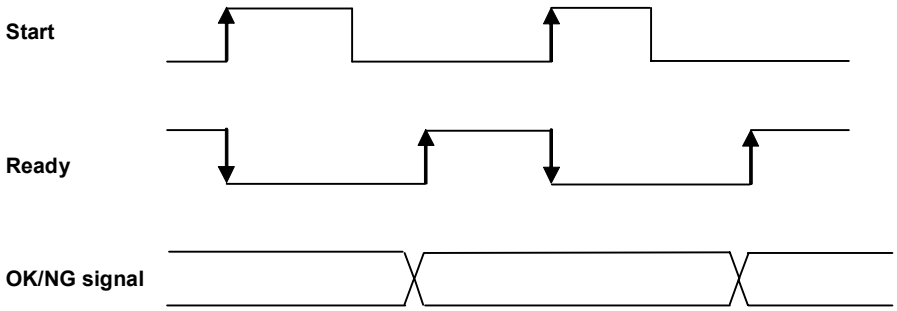
Parallel interface monitor with digital I/O board ANPC 850D

◆NOTES

- **You can set all output signals in setup mode with the Monitor: Parallel Interface" option for test purposes.**
- **Only for the digital I/O board ANPC 850D installed in the PC Imagechecker: To display the current status of the input channels, either select the button [Refresh] or send an interrupt signal via "Start" or "Change Application".**

7.9.2.2 Starting the Image Processing

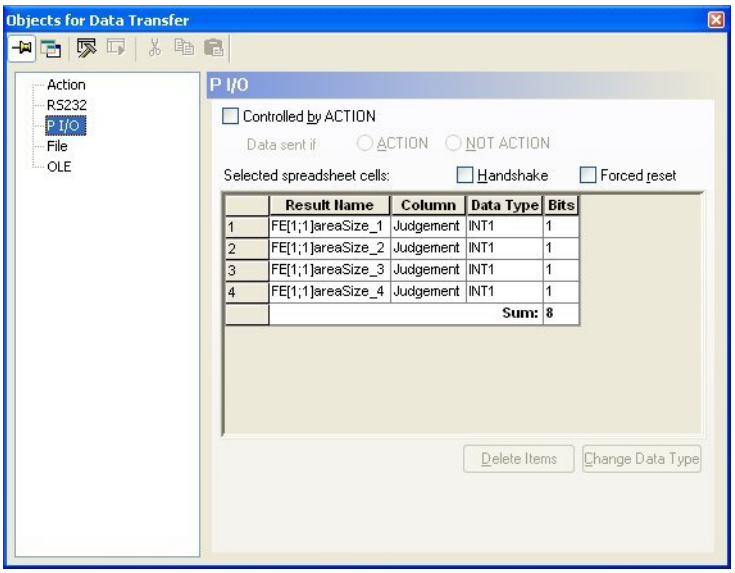
The image processing is started with a rising edge at the start signal. The Ready signal goes OFF. When the processing is completed, the Ready signal goes ON again.



Time diagram when starting the Imagechecker

7.9.2.3 Set the Transfer Mode

When transferring data volumes up to 1 byte, in the "Objects for Data Transfer" window you can choose between transfer with handshake (see page 179) and without handshake (see page 177). The data volume is displayed in the window on the last row of the table next to "Sum:".



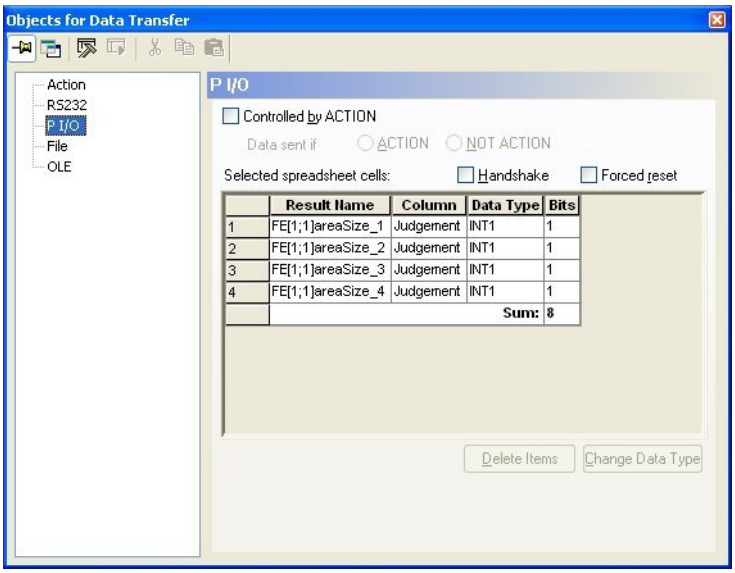
Data output with less than 1 byte

Data transfer with handshake has the advantage that the transfer of each byte of data will be confirmed with an acknowledge signal by the receiving station, thus ensuring a safe data transfer.

If you are not using execution groups, and transfer more than 8 bits of data, transfer is automatically performed with handshake.
When using execution groups (see page 184) it is usually not possible to determine beforehand how much data will be transferred. In this case it is up to the user to determine the transfer mode.

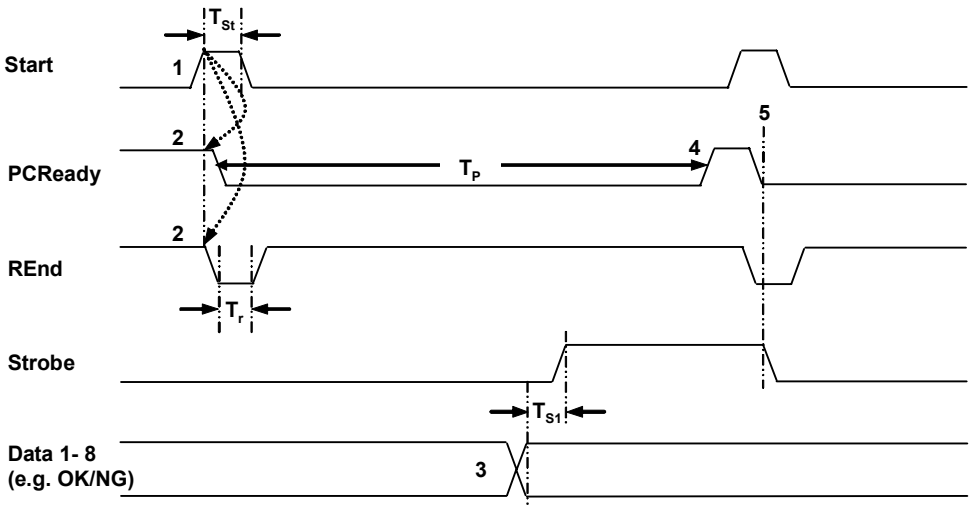
No Handshake

You do not need to use a handshake if the amount of data to be transferred is 1 byte or less and if you prefer a simple communication protocol. Deactivate the option "Handshake" on the "P I/O" page of the "Objects for Data Transfer" window.



Transferring data without handshake

When the system has calculated the results of the new image and the data is ready at the D registers for output, the Strobe signal goes ON to inform the peripheral device that it can read the data from the D registers now.



Time diagram for data output without handshake

T_{St} Minimum length of the start signal (about 1ms)

T_p Processing time (time it takes to execute the whole application)

T_r Time needed for image grabbing (depends on the camera type)

System time between ACK ON and the reset of the Strobe signal (ca. 300 - 400µs).

T_{S1} System time between data output and setting the Strobe signal

1 The system start is triggered: The start signal is about 1ms long. The Imagechecker will only accept the start signal when it is ready, i.e. when the PCReady signal is ON. If the Imagechecker receives a start signal while PCReady is OFF, the "Start lost" signal is output (depending on the parameter settings).

2 The falling edge of PCReady indicates that the application has been started. The falling edge of REnd indicates that the Imagechecker is grabbing and transferring the image to the main memory.

3 When the image-checking results have been calculated, the spreadsheet including all formulas is updated. Then the data selected for output are output via the interfaces. This is indicated by the Strobe signal (PCDataReady).

4 When the application has been executed and the monitor display has been updated, PCReady is set to ON again. Now you can start the application again.

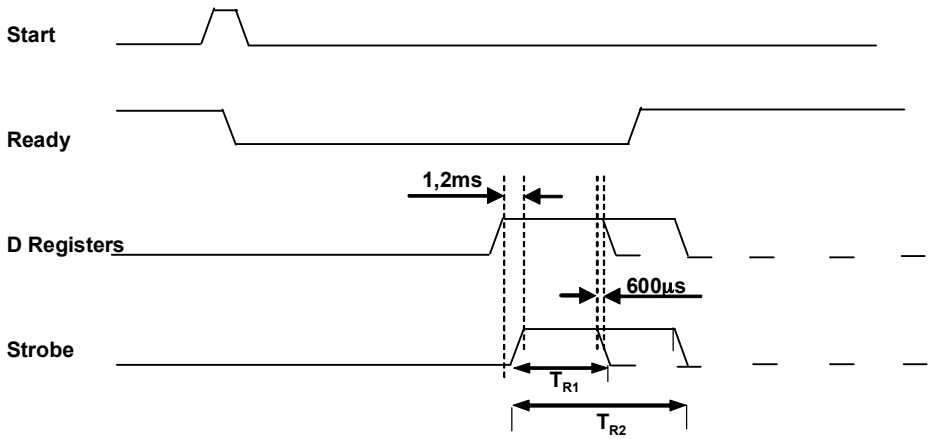
5 At the next start signal, the Strobe signal will be reset together with PCReady.

Forced reset

You can extend the duration of the signal switch by activating the parameter "Forced Reset" and by entering the desired time span under **System Settings → Interfaces → Parallel I/O** in the field "Reset Time". The Strobe signal and the D registers will be reset after the time you have entered.

The status of the D registers does not change until the next process.

1. Strobe is set after output of the data byte
2. Data and Strobe are automatically reset after the defined reset time Tr 10 ... 10000ms
3. Reset of the data byte after Tr



Reset Strobe signal after reset time

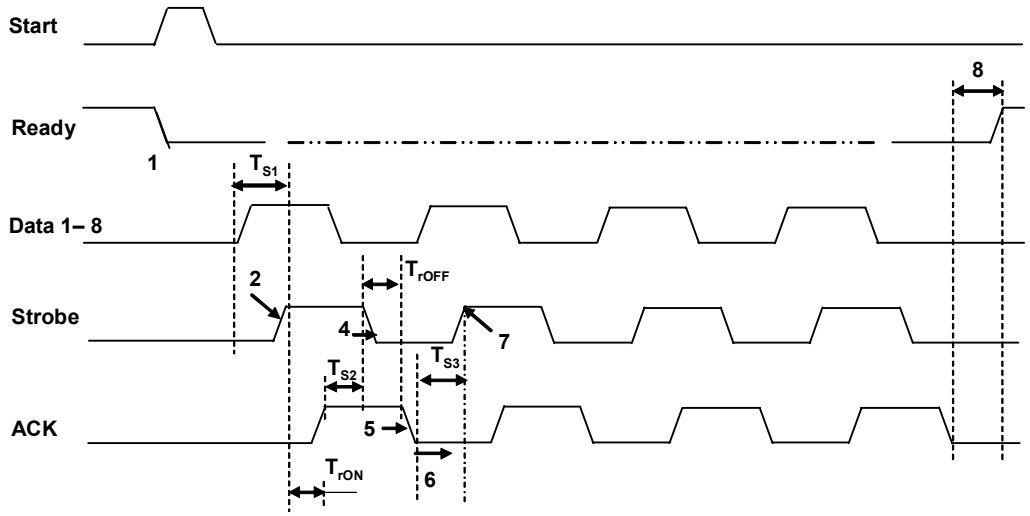
T_{R1}: Reset time 1. In this example, the Strobe signal and the D registers will be reset after T_{R1} and before the Ready signal.

T_{R2}: Reset time 2 (only for digital I/O board ANPC 850D). In this example the reset time is very long. The Strobe signal and the D registers will be reset after T_{R2} and after the Ready signal. If you have set a reset time longer than the data output of the next application start, an error messages appears.

Handshake

When you transfer data of more than 1 byte, you must perform the data transfer with handshake. When you transfer data of less than 1 byte, you may choose whether to perform the data transfer with handshake or not.

Data transfer with handshake has the advantage that the transfer of each byte of data will be confirmed with an acknowledge signal by the receiving station, thus ensuring a safe data transfer.



Time diagram - handshake

T_{S1}	System time between data output ON (D1 - D8) and rising edge of the Strobe signal (1.2ms).
T_{rON}	Time between Strobe ON and the rising edge of the ACK signal.
T_{S2}	System time between ACK ON and the reset of the Strobe signal (ca. 160µs).
T_{rOFF}	Time between Strobe OFF and the falling edge of the ACK signal.
T_{S3}	Time between ACK OFF and the rising edge of the Strobe signal (3ms).
Start	The P400 reacts to a rising edge and does not need an impulse.
Byte xx	With a 16-bit value, byte 1 is the lower and byte 2 the higher byte.
1	The data (D1 - D8) are output to the parallel interface.
2	Once the output of the first byte has been started, Strobe switches from OFF to ON within 1.2ms (T_{S1}).

3 After the PLC has received the Strobe signal, it sets the ACK signal to ON $_{(TrON)}$.

4 When the ACK signal goes ON:

- The Imagechecker checks whether the ACK signal has been reset within the time span set for handshake timeout (parameter in Vision P400, $_{TrOFF}$< = handshake timeout). If the ACK signal does not occur on time, Vision P400 outputs an interface error. In addition, the ERROR signal is switched ON.
- The Strobe signal is set to OFF automatically.

5 After the Strobe signal has gone OFF, the PLC sets the ACK signal to OFF $_{(TrOFF)}$.

6 When the ACK signal goes OFF:

- The Imagechecker checks whether the ACK signal has been reset within the time span set for handshake timeout (parameter in Vision P400, $_{TrOFF}$< = handshake timeout).

7 When ACK is OFF and T_{S3} has elapsed, the Imagechecker outputs the next byte and sets the Strobe signal to ON.

8 When the last byte has been output and its reception has been confirmed with the ACK signal, all data signals will be set to 0 by Vision P400.

9 When all bytes have been output, the P400 needs some time for postprocessing (depending on the application settings, for example to update the user interface) and then sets the Ready signal to ON.

◆**NOTES**

- **The internal timer function of the Imagechecker has a resolution of 10ms.**
- **In handshake mode, make sure that the strobe signal from Vision P400 is acknowledged with an ACK signal from the other device.**
- **The confirmation from the ACK signal has to be applied to the output channel for at least 1ms!**
- **The ACK signal needs to be reset within the time set in "Handshake Timeout" (property page Parallel I/O (see page 173)) after the Strobe signal has been reset by Vision P400.**

7.9.2.4 Transfer of Spreadsheet Data

Spreadsheet data are transferred byte by byte via 8 data channels. Both numerical and Boolean data are transferred in the same sequence as they appear in the "Objects for Data Transfer" window of the parallel interface.

Numerical data	Measurement results, statistical data and results from calculations Data types: INT8 = 1 byte; INT16 = 2 byte; IEEE float = 4 byte
Boolean data	OK/NG judgements, Boolean formula results Data types: INT1 = 1 bit (8 Boolean data = 1 byte)

The number of bytes to be output depends on the number of data.

◆EXAMPLE

Output of 19 Boolean values, 2 INT16 and 1 INT8 and 1 IEEE:

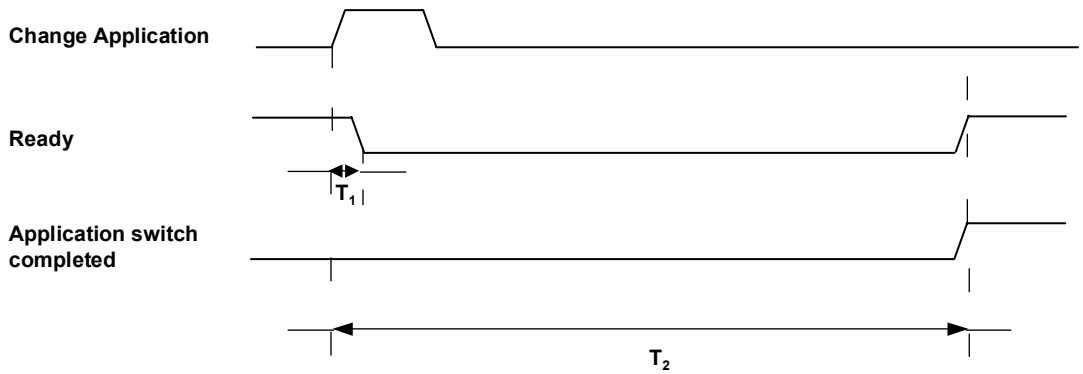
Byte 1 = bit 0 ... 7	8 x INT1
Byte 2 = bit 8 ... 15	8 x INT1
Byte 3 = bit 16 ... 18	3 x INT1 (bit 19 - 23 is equal to 0)
Byte 4 and 5 = -222	1 x INT16
Byte 6 = 199	1 x INT8
Byte 7 and 8 = 55353	1 x INT16
Byte 9 to 12 = 123,456	1 x IEEE

◆NOTES

- **Optimize the speed of the data transmission by putting the Boolean data before the numerical data in the spreadsheet (8 Boolean data = 1 byte).**
- **Before data can be output, they have a data type (see page 538) assigned automatically (1 to 4 bytes). If the value to be transferred exceeds the possible maximal value of the selected data type, a byte overflow error will be output.**
- **If a data bit has the logical state ON, the output transistor is switched through. This means there is no voltage on the output.**
- **As the number of channels for data transfer is limited, determine under** System Settings → Interfaces → Parallel I/O **whether output channel 5 should be used to indicate a byte overflow or Start Lost (see page 173).**

7.9.2.5 Change Application

You can use the parallel interface to switch from one application to another. The number of the application is transferred via the input channels 1 - 8. Send the application number and execute the application switch by sending the signal "Change Application".



Time diagram for the application change

T_1: Setting of the Ready signal: ON -> OFF
The Ready signal is turned OFF ca. 2 to 10ms after the "Change Application" signal.

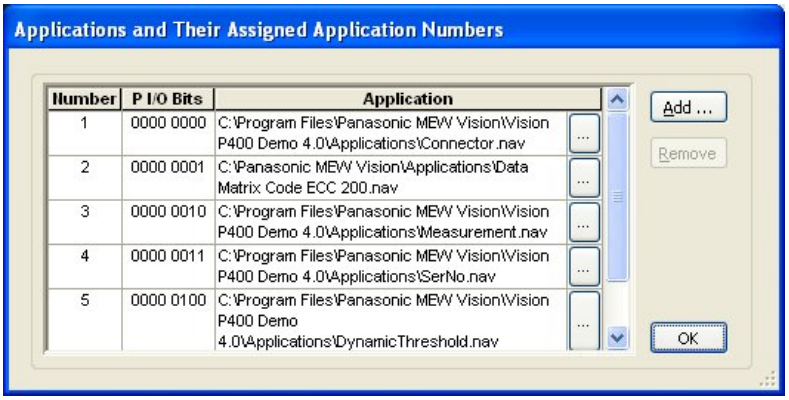
T_2: Setting of the "Application switch completed" signal: OFF -> ON
After the "Change Application" signal the "Application switch completed" signal is set to ON. The next Start signal or "Change Application" signal resets the "Application switch completed" signal.

◆**NOTES**

- **The time needed for an application change (T_2) depends on the size of your applications, in particular**
  a) on the checkers used and
  b) on the number of cameras.
  For time-critical applications perform test runs to determine the time needed for an application change.
- **When you change the application, the old application is saved implicitly unless it has been write-protected. In this case Vision P400 does not save the application but rather writes a warning into the error log if you have activated the option "Write to Error Log" under Error Handling (see page 151).**
- **Under certain conditions it is possible to execute an application change even if the Ready signal is OFF. This is for example possible if no application has been loaded after the program start and a timeout has occurred. In this case Vision P400 performs the application change even if the Ready signal has been turned OFF by the timeout.**

Sending application numbers via the parallel interface

Choose **System Settings** → **Application Numbers** to open the dialog box below. Here you may assign numbers to your applications. The entry in the column "P I/O Bits" shows you the binary signal that needs to be applied to the parallel interface in order to switch to that application.



Assigning numbers to applications for application changes via the interface

◆**NOTE**

The P I/O bit pattern is always the application number minus 1, e.g. for application number 1 the P I/O bit pattern is 0000 0000.

Confirm application switch with number output

When you activate the option "Confirm application switch with number output" at the bottom of the property page of the parallel interface, Vision P400 outputs the number you have sent to the parallel interface after the application switch has been completed successfully.

7.9.2.6 Start/Stop Run Mode

When you activate the check box "Use start / stop run mode signal", you can send a command to the parallel interface to switch from setup to run mode. Set the signal "Start/Stop Run Mode" (pin 7).

If you are using the digital I/O board ANPC 850D, you also need to set the signal "Application change completed" (pin 3) for confirmation.

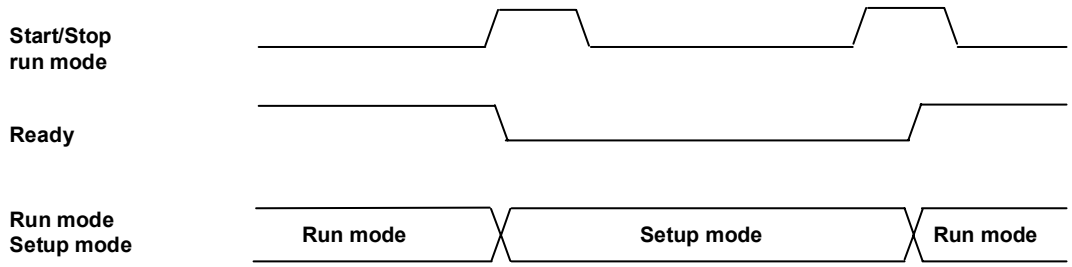
◆**NOTE**

Please note the following when you are using the signal "Start/Stop Run Mode": The signal "Start/Stop Run Mode" is the only signal that Vision P400 processes in setup mode. For this reason, in setup mode take care not to send the signal by accident. If you send the signal, Vision P400 switches to run mode while you may still want to edit your application.

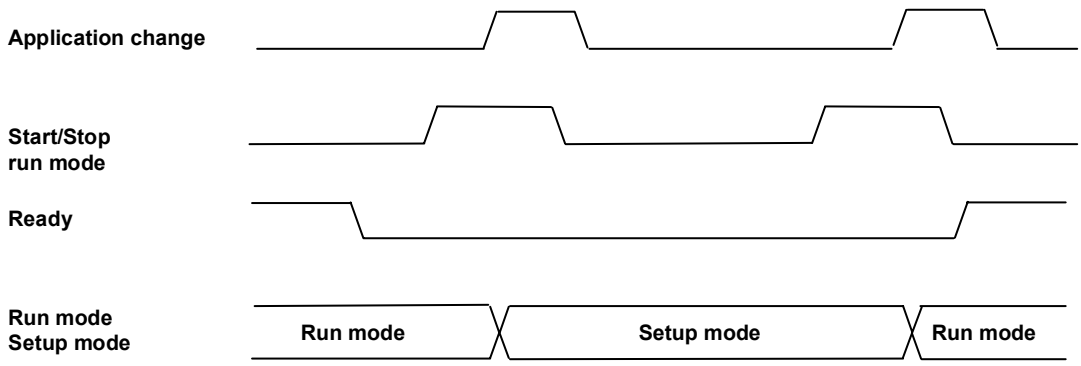
You can prevent an accidental switch from setup to run mode by activating the "Use start / stop Run Mode signal" checkbox only when you have finished setting up your application(s). Vision P400 ignores the signal to start or stop run mode if the check box is not activated.

Time diagrams to start/stop run mode

The diagrams show the timing of the different digital I/O boards available when you switch from run mode to setup mode.



Time diagram for ANPC 850V2D and ANPS 850D when starting/stopping run mode



Time diagram for ANPC 850D when starting/stopping run mode

◆**NOTE**

Please note the special behavior of digital I/O board ANPC 850D: When Vision P400 is in run mode, the program reacts as follows when it receives the signal "Change Application":

- **The signal "Start / Stop Run Mode" is set: Vision P400 switches to setup mode.**
- **The signal "Start / Stop Run Mode" is not set: Vision P400 changes the application.**

7.9.2.7 Executing an Execution Group

The number for the execution group is transferred as a binary signal (decimal values 0 - 255) via input channels 1 - 8. Send the binary signal corresponding to the number via the input channel along with a start signal. Then the application is executed with the relevant execution group.

The table below shows some examples of binary data for execution groups.

Execution group number	Signal to P I/O
0 (All Cameras, Sequence No. 1)	0000 0000
1	0000 0001
2	0000 0010
5	0000 0101

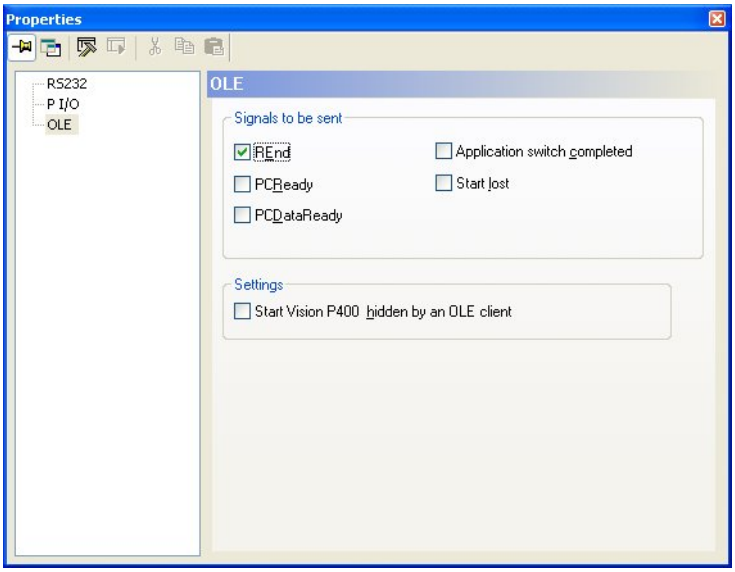
◆**NOTES**

- **If you send a start signal with an execution group number that does not exist, the start signal is ignored. The "Start Lost" signal is sent to all interfaces and "Start Signal Lost" is written into the error log file.**
- **If you send a start signal together with an execution group number via the interface although the "Allow group switching" option under** Execution Groups → Properties **is not activated, Vision P400 ignores the group number**

and executes precisely the execution group configured in the "Use always this group" (see page 195) pick list.

7.9.3 OLE

Vision P400 can be used as an OLE Automation Server. The ActiveX Control "VisionP400DataControl" is registered automatically during the installation so that you can access the interface. The methods, properties, and events of ActiveX Control "VisionP400DataControl" are described in the document "VisionP400ActiveXControl.doc", which is stored in the installation folder. Sample programs for using ActiveX Control can be found in the subfolder \Demo Clients in the installation folder.



Property page of the OLE interface

Signals to Be Sent

Signal	Definition VISIONP400_SIG_	Activate Sending on the Property Page?
REnd	PCREND[OFF]	Yes
PCReady	PCREADY[OFF]	Yes
PCDataReady	PCDATAREADY[OFF]	Yes
Application change completed	CHANGE_NOTIFY	Yes
Start Lost*	START_LOST	Yes
Action Error	ACTION_ERROR	As defined on the property page "Action" (see page 565)
PCError	PCERROR	Is always sent automatically
Start and stop run mode	START_RUNMODE STOP_RUNMODE	Is always sent automatically Is always sent automatically

*When you use a client and startApplication() to start Vision P400 and the start has failed, the signal "Start Lost" is not sent to the client. Instead, startApplication() returns FALSE.

Start Vision P400 Hidden by an OLE Client

When you start Vision P400 via an OLE client and you have activated this option, the program will start without window and flash screen. This means you can only access Vision P400 via the client.

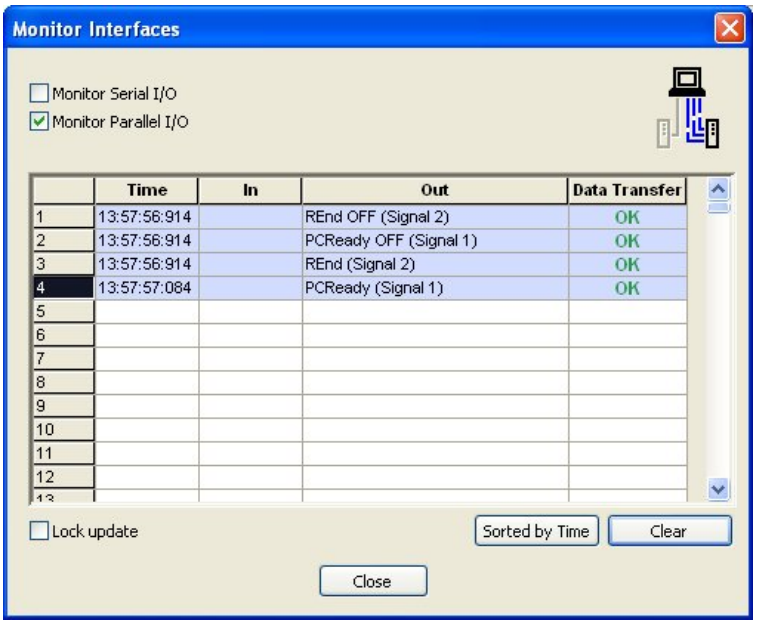
◆NOTES

- **When you try to exit Vision P400 with at least one OLE client still connected, a message appears asking whether you want to exit Vision P400 nevertheless. If you confirm with "Yes", Vision P400 closes the connection to each OLE client.**
- **If you exit Vision P400 via an OLE client and there is no other OLE client connected, Vision P400 will be exited without requesting confirmation from the user.**

7.9.4 Monitor Interfaces

With the **System Settings → Interfaces → Monitor Interfaces** or **View → Monitor Interfaces** command you open the "Monitor Interfaces" window. Here you can see the signals and/or data which are sent or received via the parallel or the serial interface. The signals and/or data are displayed in a buffered table with four columns. The buffer can store up to 500 entries. This means the entries at the beginning of the table will be overwritten when the table is full.

The currently last entry has a black mark in the first column. Data with light blue shading are transferred with handshake (see page 179).



The table columns display the following content:

First column	Time	In	Out	Data transfer
Line number. The last entry is marked in black.	Time when the signals and/or data have been sent or received	Received signals and/or data	Sent signals and/or data	OK = Data transfer has been successful NG = Error during data transfer. Please check the connected peripheral device.

How the signals and/or data in the columns "In" and "Out" will be displayed depends on which interface you have selected:

Serial interface	Parallel interface
The columns display exactly the characters that have been sent or received. Please note that the separation characters (see page 549) for sent data are user-definable. Non-printing characters like "\t" cannot be displayed correctly on the monitor, but will be sent as a normal character string.	Data: the bit pattern that has been sent or received Signals: name of the signal

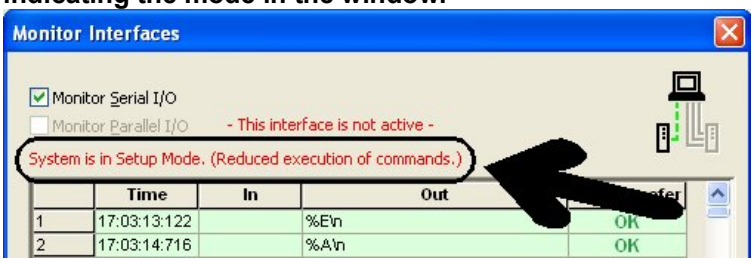
You can make the following settings in the window:

Option	Functionality
Monitor serial/digital I/O	Select whether you wish to see the data communication of the serial or parallel interface.
Lock update	When you activate this check box, no entries will be added even if Vision P400 sends or receives signals and/or data. Activate this check box when you wish to examine old entries in the table without having to fear they will be overwritten by new entries.
Sorted by time	As the monitoring function is buffered it may happen that older entries are listed before newer entries in the table. Click the [Sorted by Time] button to sort the table entries so that the oldest entries are displayed at the top and the newest at the bottom of the table.
Clear	Use this button to delete all entries from the table.

Please note the following when you work with interface monitoring:

◆NOTES

- **Vision P400 only sends and receives signals and data in run modus. As long as you are in setup mode (icon is active) no new signals or data are displayed. If the system is in setup mode, you see a red message text indicating the mode in the window.**



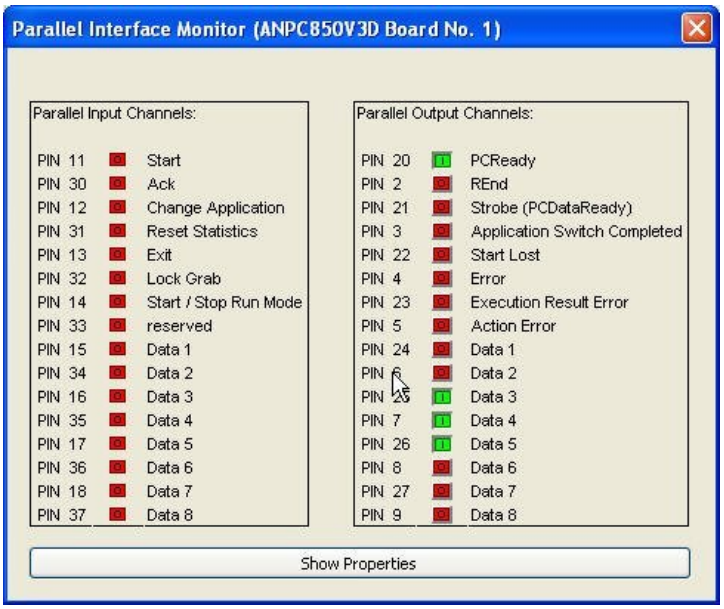
- **Signals and/or data are only recorded when the "Monitor Interfaces" window is open. When you close and re-open the window, the monitoring is started again, i.e. the table is empty again.**

- **When you switch from the serial to the parallel interface (or vice versa), the monitoring is started again (Vision P400 deletes all entries in the table).**
- **If the data transferred or received are too long to fit in the table, click into the cell with the left mouse button. Then the data will be displayed as a tool tip.**

7.9.5 Parallel Interface Monitor

With the command **System Settings → Interfaces → Monitor: Parallel Interface** or **View → Monitor: Parallel Interface** command or by clicking the icon, you can monitor the line states of the parallel interface and the communication with a remote station

- in run mode and
- make changes in setup mode for testing purposes.



Parallel interface monitor (with digital I/O board ANPC 850V2D)

For each input and output signal, the monitor displays the pin number where the signal will be output or received as well as the status and the signal name. The pin number for the signal depends on the type of digital I/O board (see page 11) you are using.

In the "Parallel Input Channels" column, you can supervise the input status, e.g. whether or not the starting signal originates as it should from a peripheral device connected to the parallel interface.

In the "Parallel Output Channels" column, you can edit the signals on the output channels in setup mode and thus test the output devices. In run mode, you can only supervise the output status with the digital I/O monitor.

This function is especially valuable when you need to check the communication in handshake mode (see page 179).

◆NOTES

- **The display is updated with every change of a signal.**
- **We recommend switching off the parallel interface monitor when you are in run mode. Otherwise, it may effect the time response of the system negatively.**
- **If you have activated (see page 173) the option "Start lost signal" under** System Settings → Interfaces → Parallel I/O**, the text for "Byte overflow" changes to "Start lost" (and vice versa).**
- **When you have deactivated the sending of a signal on the property page of the parallel interface, e.g. the PCReady signal, the name of the signal is grayed out on the parallel interface monitor. To open the property sheet use** System Settings → Interfaces → Parallel I/O **or click the button [Show Properties].**

7.10 Language

With **System Settings** → **Language** you can define which of the available languages you want to use.

When you have changed the language setting, you need to restart Vision P400 to see the menu in the selected language.

◆**NOTES**

- **The languages are always listed in the language configured for your operating system. This is not necessarily the same language as is currently being used for Vision P400.**
- **The language currently being used by Vision P400 is flagged in the language list by a black dot. As any change of language selection only takes effect the next time Vision P400 is started up, the language used the next time Vision P400 is started up is additionally flagged in the list by a white dot with a black surround, if it differs from the language currently being used.**

Chapter 8

Execution Groups

8.1 What Are Execution Groups?

An execution group is a group of one or more checker sequences (see page 106). Execution groups offer you the opportunity to divide your application into logical subsidiary tasks.

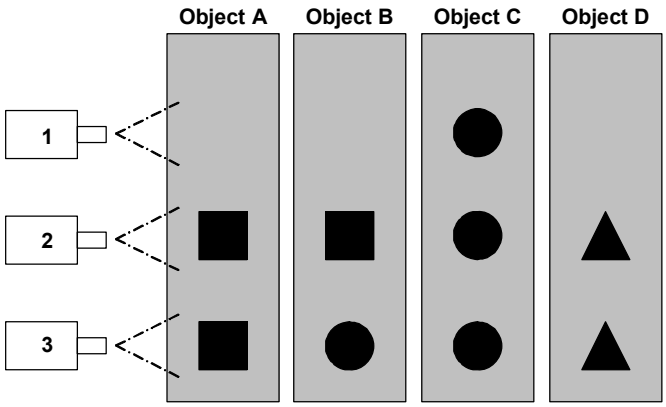
You can perform many checking tasks without using execution groups. So first try to create the application directly, without configuring custom execution groups, and start the application. When you do so, the system works in the background with internal, predefined execution groups. Any application created by this simple method can be subsequently expanded as needed, and organized into user-defined sequences and execution groups.

For more complex checking tasks, you can subdivide your application into logical subsidiary tasks performed in single checker sequences which can be grouped according to your requirements and executed together. Execution groups are useful, for example when:

- You have to perform different, rapidly changing checking tasks, such as when tasks vary from picture to picture.
  If each task has different application properties, you must carry out an application change (serial (see page 167)or parallel (see page 181)). This takes considerably more time however.
- You wish to save processing time, e.g. by only executing those checker or checker sequences you really need.
- You want to carry out more detailed checks dependent on the initial check results, and use IfCase formulas (see page 575) for the purpose.

◆EXAMPLE

The application uses three cameras. On every start signal the application checks different objects containing three differently shaped parts in varying composition. For this you need three different checker sequences (triangle, square, circle) for each camera. Camera 1 only checks the circle however, meaning it only needs one checker sequence.



Set up the following checker sequences in the camera window checker sequence for the three cameras:

Camera 1	Sequence 1	Circle
Camera 2	Sequence 1	Square
	Sequence 2	Circle
	Sequence 3	Triangle
Camera 3	Sequence 1	Square
	Sequence 2	Circle
	Sequence 3	Triangle

From the object-specific checker sequences create execution groups (see page 203) to check objects A to D:

	Object A	**Object B**	**Object C**	**Object D**
Execution group	Group No. 13	Group No. 14	Group No. 15	Group No. 16
Included sequences	**Camera 2,** sequence 1	**Camera 2,** sequence 1	**Camera 1,** sequence 1	**Camera 2,** sequence 3
	Camera 3, sequence 1	**Camera 3,** sequence 2	**Camera 2,** sequence 2	**Camera 3,** sequence 3
			Camera 3, sequence 2	

Then you activate use of execution groups under "Execution Group Properties" (see page 195) with the "Allow group switching" option. Now you can use the various execution groups to check the different objects. To check object C, for example, you run execution group 15.

◆**NOTE**

You can run the execution groups manually by starting the application (see page 126). In run mode you can run the execution groups via the following interfaces: parallel, serial, and OLE.

8.2 Execution Group Types and Their Differences

Vision P400 features three types of execution groups, differentiated by their numbers:

- 1 System-internal execution group (group 0)
- 12 Predefined execution groups (group 1 to 12)
- 243 User-specific execution groups (group 13 to 255)

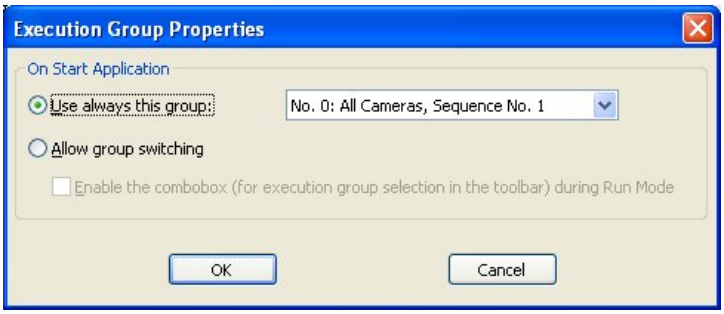
Execution group	Type	Contents
Execution group 0	system-internal	Sequence number 1 of all connected cameras (for each connected camera the system defines one sequence number 1)
Execution group 1 to 12 icon	predefined, not deletable	Sequence no. 1 of camera <Number of camera> For each connected camera the system defines one sequence (no. 1, icon) and one execution group, which contains precisely that sequence (icon). The group number corresponds to the number of the camera.
Execution group 13 to 255 icon	user-defined	Any number of sequences of up to 12 cameras, but each sequence only once per execution group.

◆**NOTE**

- **The system is set by default to run (see page 195) the system-internal execution group 0 in response to a start signal. This means you can operate the system with all cameras without having to create your own sequences or execution groups.**
- **Because you can only edit the system-internal predefined sequences and execution groups but not delete them, the icons are displayed with a padlock.**
- **User-defined objects - that is, the sequences with a number greater than 1 and the execution groups 13 to 255 - are identifiable by their "unlocked" icons or .**
- **You can assign each execution group an individual shutter speed for capturing the image (not available for execution groups that are triggered by IfCase formulas).**

8.3 Properties and Usage

In this dialog box you configure how you want to use execution groups.



Default for execution group properties

Use always this group

If the "Use always this group" option is activated, in setup and run modes the execution group selected from the list box to the right of it is always used. By default it is "No. 0: All Cameras, Sequence No. 1". On every start signal the execution group configured here is executed and the execution group list box on the toolbar is grayed out. Commands to change execution group are ignored.

◆NOTE

- **If you have activated the "Use always this group" option, it is not possible to switch to a different execution group. On every start signal via the interfaces the execution group configured here is executed, even if the command contains a different execution group number.**

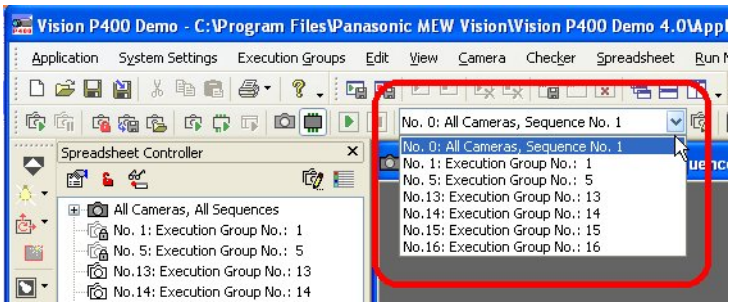
Allow group switching

With this option you activate the possibility to switch to another execution group and thus also to use your own execution groups. Execution group switching occurs

- in setup mode via the list box on the "Application" (see page 113) toolbar and
- during run mode via the interfaces or via the list box on the "Application" toolbar, if you have activated the "Enable the combobox (for execution group selection in the toolbar) during Run Mode" option.

Enable the combobox (for execution group selection in the toolbar) during Run Mode

If you check this checkbox, the toolbar list box for the execution groups is also available in run mode, so you can select and run a different execution group without quitting run mode.

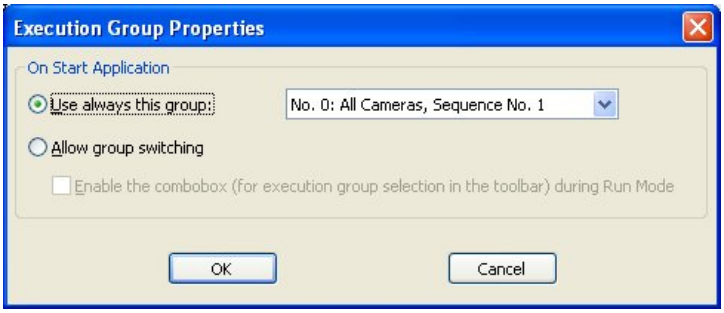


◆**NOTE**

Execution of the execution groups depends on the mode **(see page 197) you are in and on the** settings **you make here in the "Execution Group Properties".**

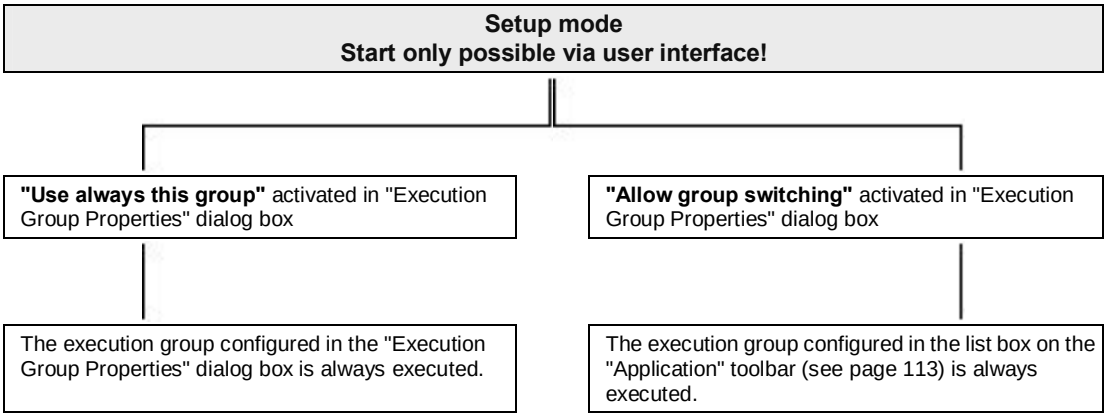
8.4 Executing an Execution Group

Execution of the execution groups depends on the **mode** you are in and on the **settings** you made on execution group property page (see page 195) under **Execution Groups → Execution Groups Properties...**.

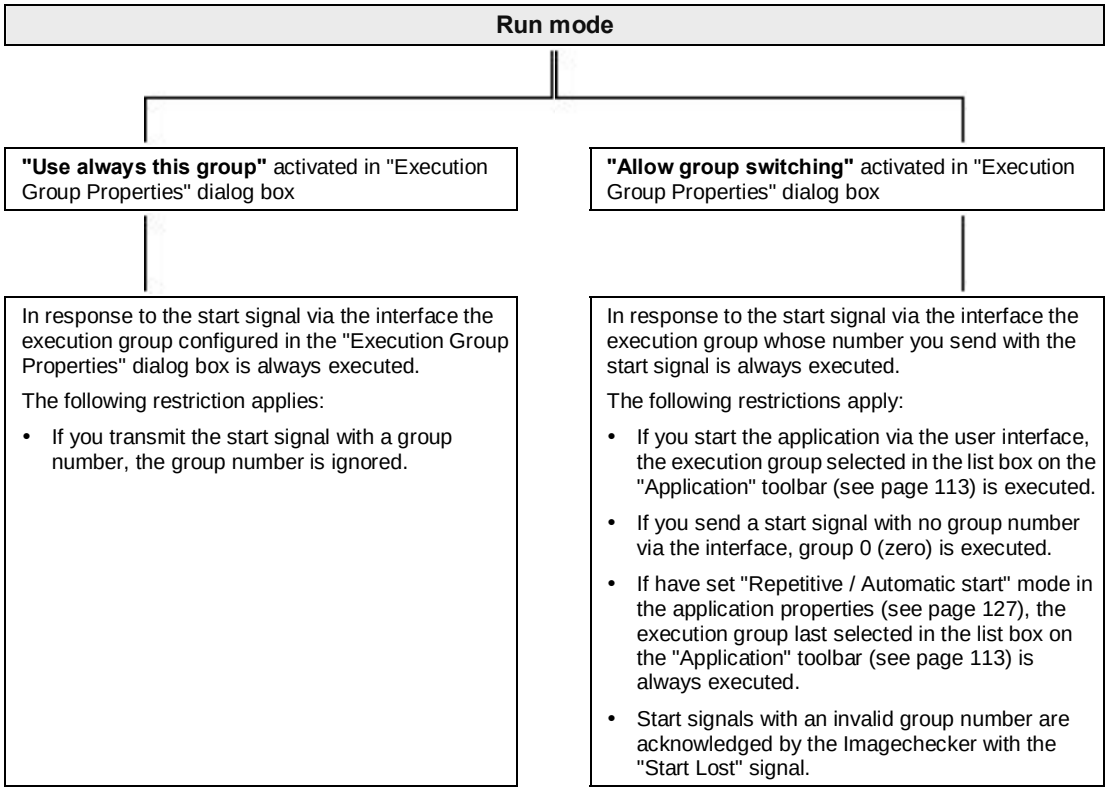


Default for execution group properties

In setup mode



In run mode



The execution group status is displayed in the bottom right corner of the status bar. Every time the application starts up you can see there which execution group has been executed.

8.5 Result Output

Vision P400 only outputs those results which could be calculated.

Checker results can be calculated if:

- The checker is used in any of the sequences belonging to the executed execution group(s).

Formula results can be calculated if:

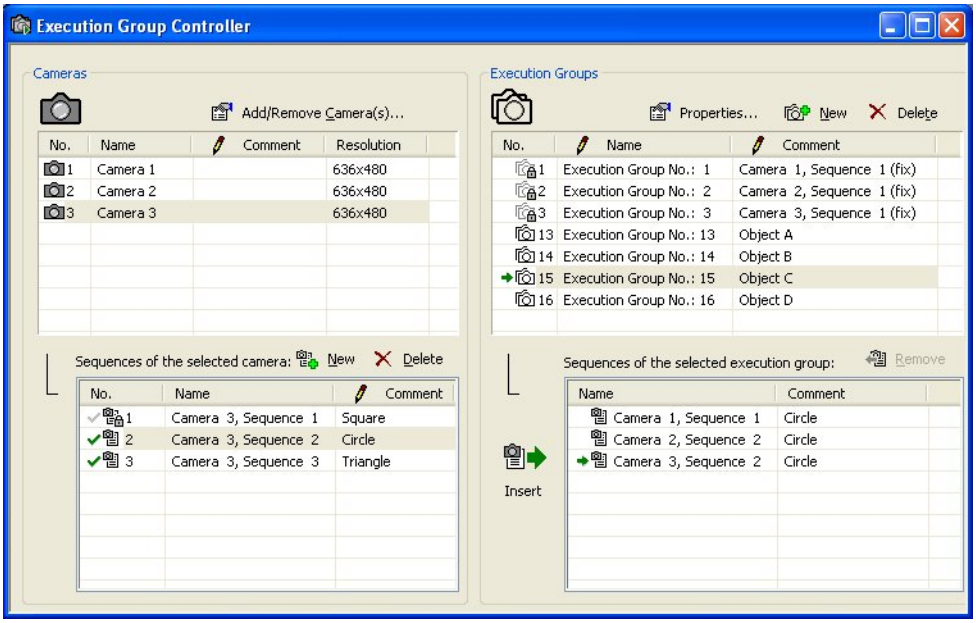
- All checkers used in the formula can be calculated
- All formulas used in the formula can be calculated
- The formula does not use any checkers or other formulas (e.g. formulas which only contain the value "TRUE" or which contain a fixed numeric value)
- The formula is a global formula.

◆NOTES

- **Enter all checker results you wish to send to an interface in the window "Objects for Data Transfer". Please note that only the results which could be calculated can be sent to the interface.**
- **When you use IfCase formulas to execute execution groups conditionally, it is not possible to know beforehand which results will be output when the application is executed. Therefore, we recommend including the number of execution groups which are triggered by IfCase formulas in the result output. This will make it easier to identify and interpret the data output. This option is available for the file and OLE interfaces (see page 560).**

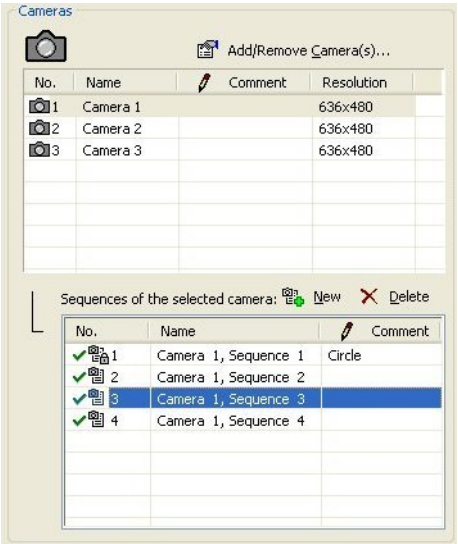
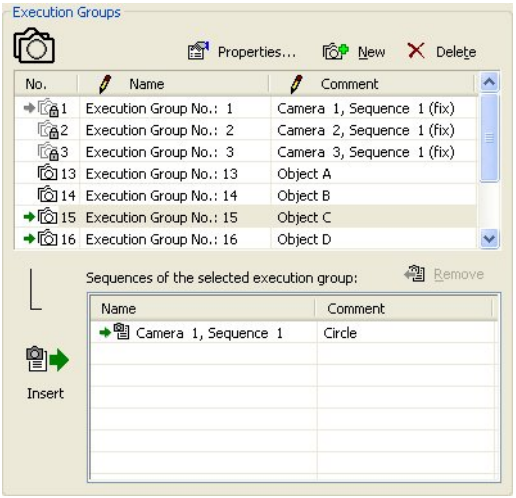
8.6 Execution Group Controller

The Execution Group Controller lists all execution groups with their assigned camera(s) and sequence(s). You manage all execution groups in a single window, accessed by the command **Execution Groups → Execution Group Controller** or **View → Execution Group Controller** or by clicking the icon.



Execution Group Controller

The Execution Group Controller window is divided into four sections. On the left is the camera pane and on the right the execution group pane. At the top you see the available cameras (on the left) and execution groups (on the right), and at the bottom the associated checker sequences.

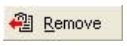
Camera pane (left)	Execution group pane (right)
	
• At the top left you see the list of connected cameras. • At the bottom left you see the sequences belonging to the camera selected above. In front of the sequences used in an execution group there is a ✔. Unused sequences are marked by a ⏻. • The first sequence of each camera is predefined and cannot be deleted. It is identifiable by the icon with the padlock. The other sequences with the icon cannot be deleted. When deleted, the sequence is deleted together with all included checkers (see note).	• At the top right you see the execution groups. • The predefined execution groups 1 to 12 are identifiable by the icon with the padlock. You cannot add or remove sequences to or from predefined groups. • You can add and remove any sequences to and from the user-defined execution groups 13 to max. 255 (icon). • You can edit the names and commentaries of all execution groups. • If there is a green arrow in front of an execution group, this signifies that the sequence selected in the bottom left half of the window is used in this execution group. • At the bottom right you see the sequences belonging to the camera sequence selected above. The sequence selected in the bottom left half of the window is marked by a green arrow. • You can assign a shutter speed to each execution group. You can use the shutter speed set in the camera properties or set an individual shutter speed. The individual shutter time will not be used when the execution group is triggered by an ifCase formula (see page 575). In this case, the image has already been captured.

Available options

Each window pane contains its own specific options.

Options in the left-hand pane	Explanation
Add/Remove Camera(s)...	Opens the dialog box to add or remove cameras (see page 259).
New Add New Sequence	Adds a new sequence to the camera. You set the checkers by copying them in the camera image from other sequences or setting new ones (double-click on the sequence in the Spreadsheet Controller to jump directly to the sequence).

Options in the left-hand pane	Explanation
 Delete sequence	This option is active only if you have selected a sequence. Deletes the selected sequence from the application. Note that this also deletes the checkers included in the sequence! If checker results of the selected sequence are entered on the spreadsheet, you contain a warning.

Options in the right-hand pane	Explanation
 Properties	Opens the "Execution Group Properties" (see page 195) dialog box. In it, you can select a specific execution group for application startup or activate group switching.
 Add a new execution group	Adds a new execution group. The new execution group automatically contains the next free group number, which also appears in the name. You can rename the execution group at any time.
 Delete Execution Group	This option is only active if you have selected a deletable execution group (execution groups 1 - 12 are predefined and cannot be deleted). Deletes the selected execution group from the application.
 Insert Sequence into Group	This option is active only if you have selected a sequence at the left. You can add each sequence only once to an execution group, otherwise a warning message appears. Inserts the selected sequence into the execution group selected at the top right.
 Remove Sequence from Group	This option is active only if you have selected a sequence in an execution group at the right. Removes the selected sequence from the execution group selected at the top right. The sequence and the checkers included in it are retained.

◆NOTES

- **The icon indicates that you can make entries in this column. Double-click to open the comment or name field for editing.**
- **Note the difference between deleting and removing! Deleting a sequence on the left in the Execution Group Controller - that is, from the list of checker sequences belonging to the camera selected above - also deletes the included checkers! Removing a sequence from an execution group at the right in the Execution Group Controller leaves the sequence and the included checkers in place.**
- **Sequences cannot be deleted if they belong to an execution group or if they are number 1 (predefined sequence).**

8.6.1 Create a User-Defined Execution Group

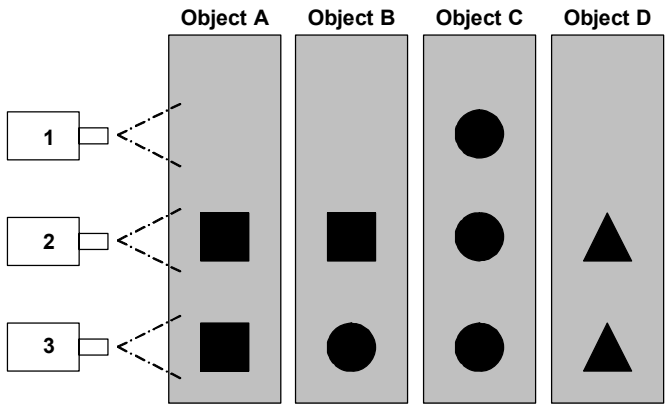
You can define (see page 203) up to 243 execution groups (a total of 255 execution groups minus 12 predefined execution groups). To create an execution group, select one or more checker sequences of one or more cameras to compile a custom grouping of your checking tasks.

Each execution group is assigned a unique number by the system as well as a name which you can change at any time. Applying the start signal followed by the number of the execution group results in only the checker sequence(s) of the corresponding execution group being processed.

How to create execution groups is demonstrated on the basis of an example.

◆EXAMPLE

The application uses three cameras. On every start signal the application checks different objects containing three differently shaped parts in varying composition. For this you need three different checker sequences (triangle, square, circle) for each camera. Camera 1 only checks the circle however, meaning it only needs one checker sequence.



Set up the following checker sequences in the camera window checker sequence for the three cameras:

Camera 1	Sequence 1	Circle
Camera 2	Sequence 1	Square
	Sequence 2	Circle
	Sequence 3	Triangle
Camera 3	Sequence 1	Square
	Sequence 2	Circle
	Sequence 3	Triangle

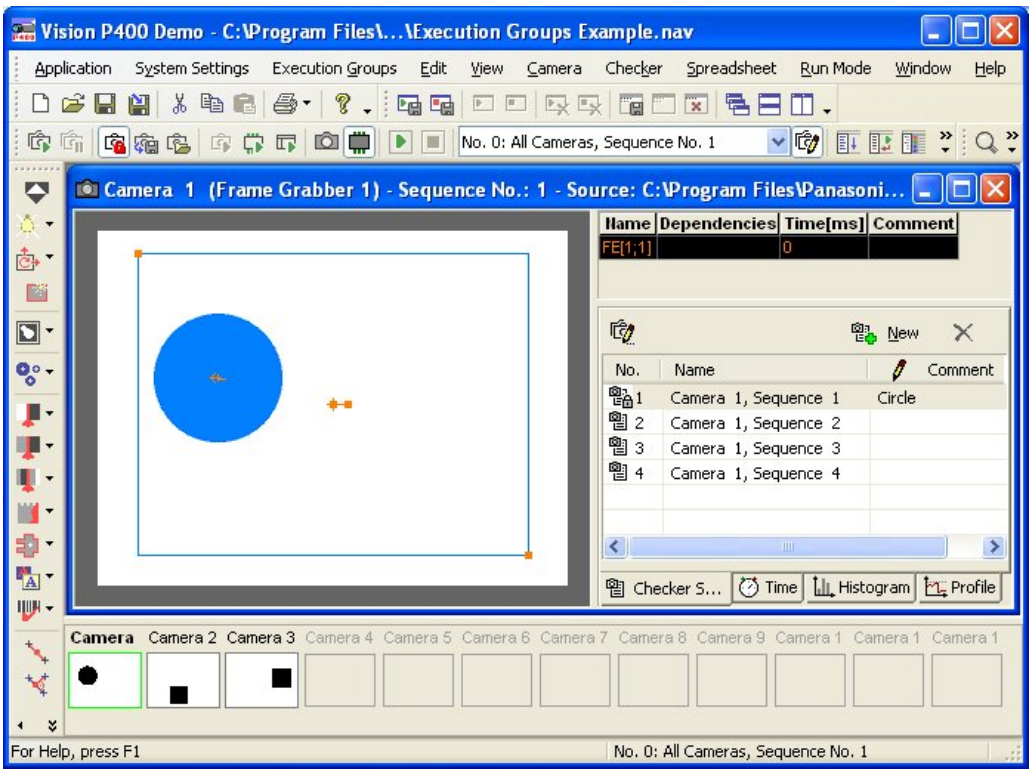
From the object-specific checker sequences create execution groups (see page 203) to check objects A to D:

	Object A	Object B	Object C	Object D
Execution group	Group No. 13	Group No. 14	Group No. 15	Group No. 16
Included sequences	**Camera 2,** sequence 1	**Camera 2,** sequence 1	**Camera 1,** sequence 1	**Camera 2,** sequence 3
	Camera 3, sequence 1	**Camera 3,** sequence 2	**Camera 2,** sequence 2	**Camera 3,** sequence 3
			Camera 3, sequence 2	

The procedure shows how to create execution group 13 for checking of object A.

Procedure

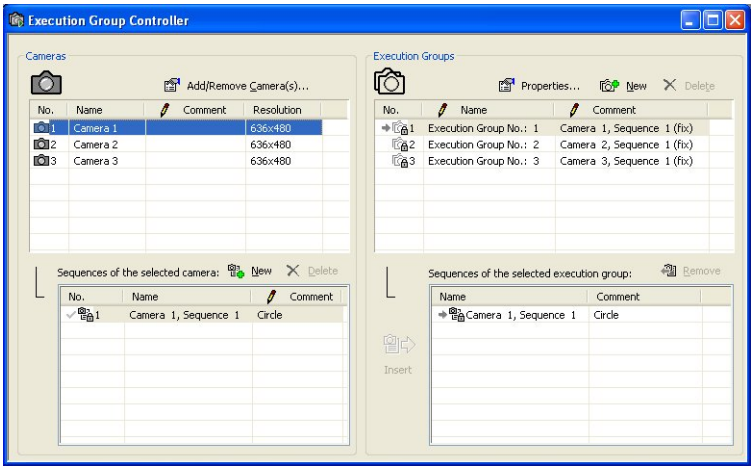
1. **Create a new application**
2. **Add Three Cameras**
3. **For each camera set up the corresponding number of checker sequences with checkers and with comments**



Next the checker sequences are compiled into execution groups according to the objects being checked.

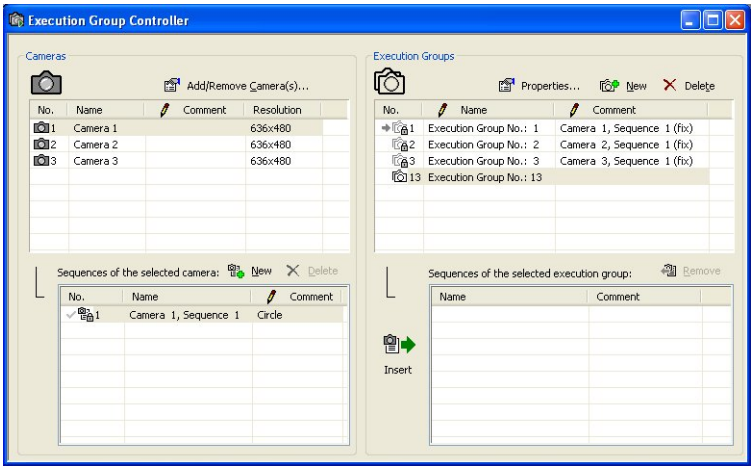
4. **Execution Groups → Execution Group Controller**

The Execution Group Controller is displayed. It shows the three cameras and the three predefined execution groups. Camera 1 is selected at the top left. At the bottom left you see the sequence 1 created for camera 1 with the comment "Circle".



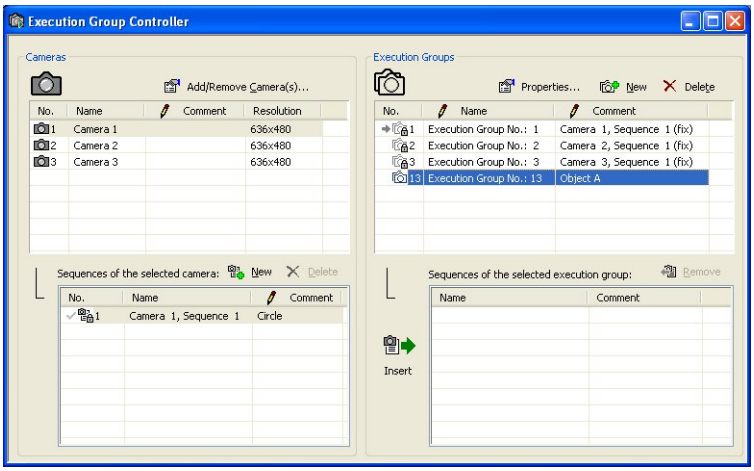
5. At the top right under "Execution Groups" select

The group list includes a new execution group which is assigned the lowest unused sequence number - that is, 13.



6. Click to select new execution group

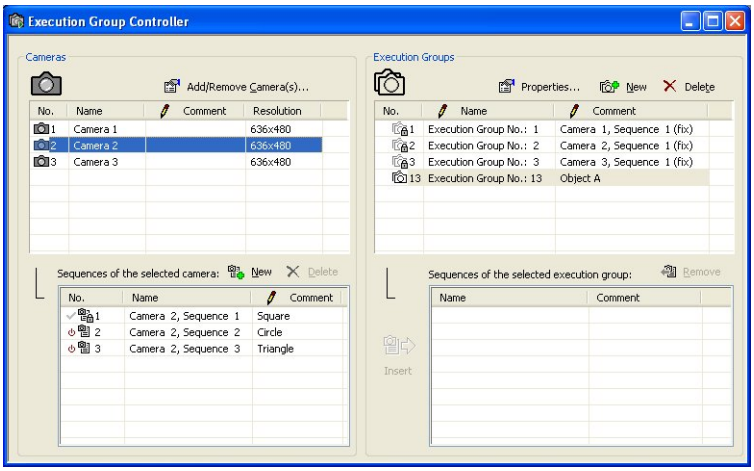
Double-click on the execution group name to rename it. You can also edit the entry in the Comments column. In this example, "Object A" was entered in the Comments field by way of a double-click in order to provide clearer differentiation between the execution groups.



For object A the execution group needs sequence 1 of camera 2 and sequence 1 of camera 3.

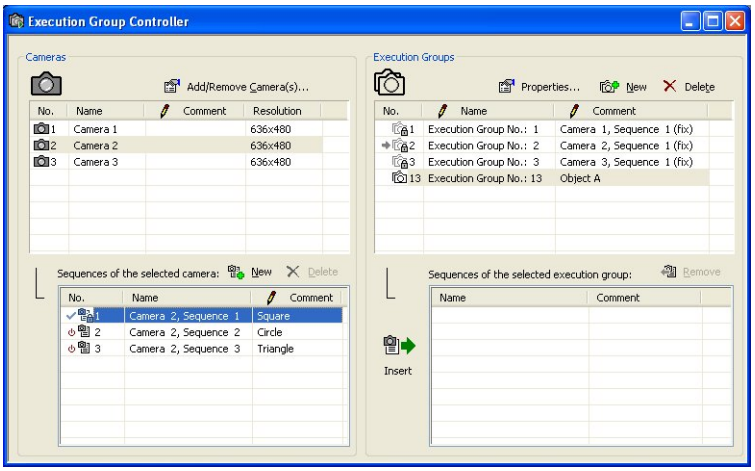
7. At left under "Camera" select camera 2

To now add sequences to the new execution group, first select the camera whose checker sequence you want to assign to the group.



8. Select sequence 1 at the bottom left in the list of checker sequences

In front of the sequences already in use in an execution group there is a ✔.
Sequences not yet used in any execution group are marked by a ⏻.

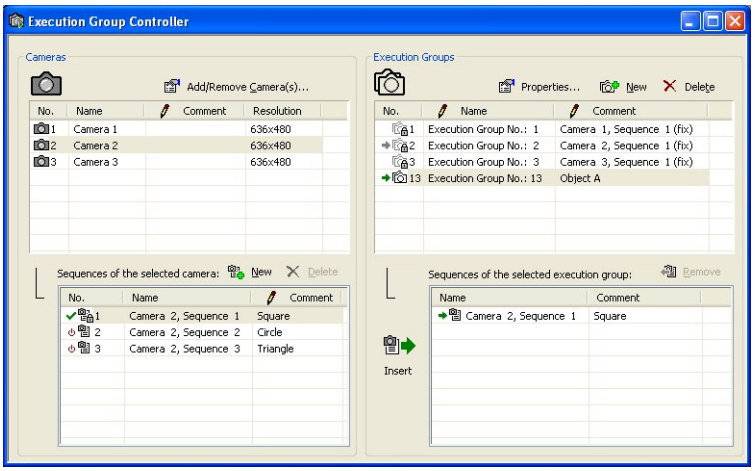


9. **Select**

   or

   use drag & drop to select from the left-hand half or the checker sequence and drag into the camera window

   The selected sequence then appears in the execution group and is marked by a green arrow ➔. At the top right, the arrow indicates the execution groups in which the selected sequence is used.



10. **Repeat the last three steps for sequence 1 of camera 3**

8.6.2 Adding Sequences to a User-Defined Execution Group

You can add more sequences to an existing execution group any time. Either use the execution group controller as for creating user-defined execution groups (see page 203) or drag & drop the sequence from the list of checker sequences to the right of the camera window.

◆NOTE

You can use as many sequences as you like from up to 12 cameras. However, every sequence can only be used ONCE within an execution group.

In the example we will add sequence 1 from camera 1 to execution group 16.

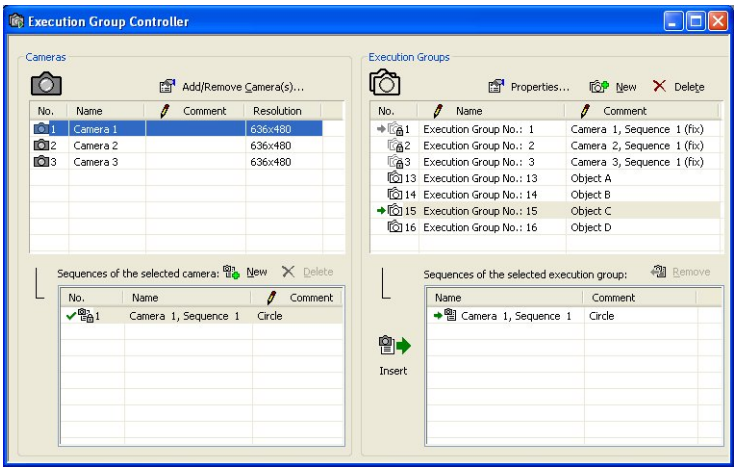
Adding sequences with the execution group controller

◆Procedure

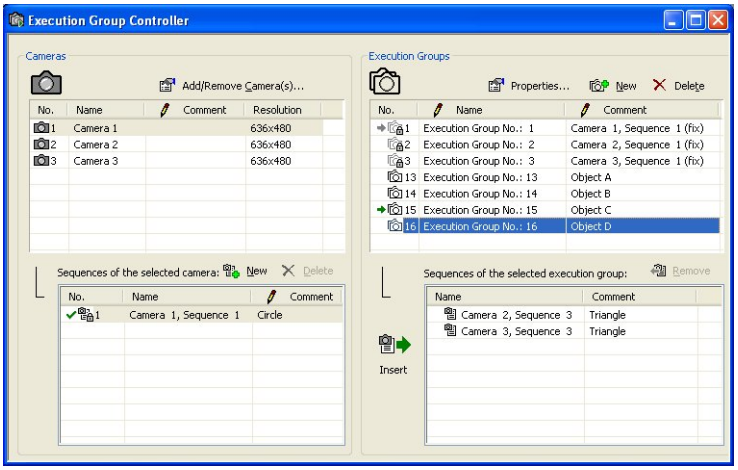
1. **Execution Groups → Execution Group Controller**

   The Execution Group Controller is displayed.

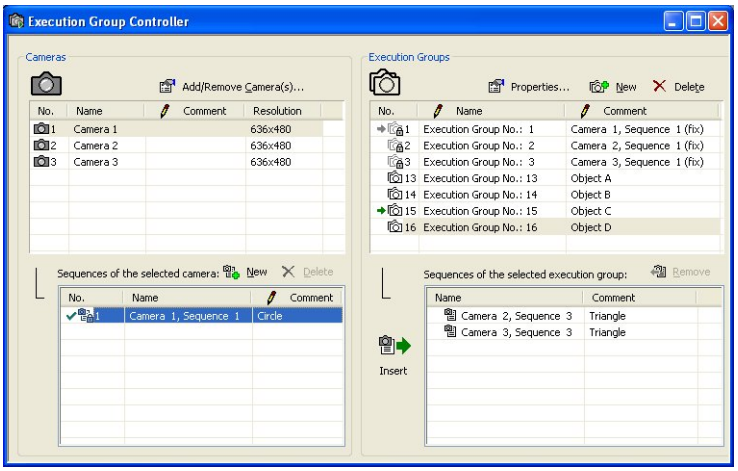
2. **In the top left half of the window, select camera 1**



3. **In the top right half of the window, select execution group 16**

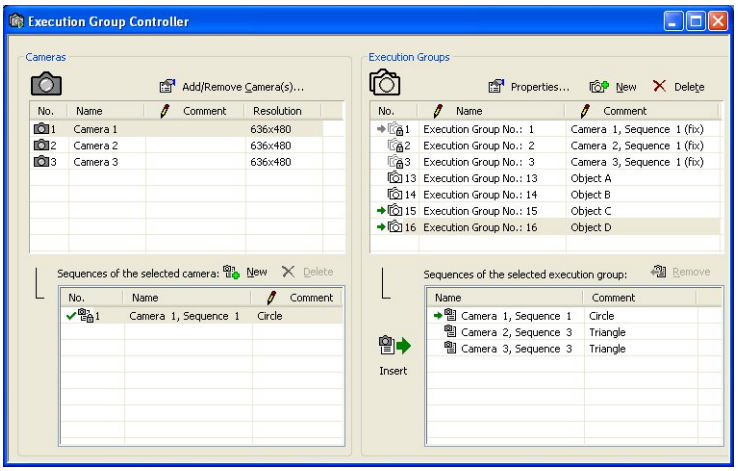


4. **In the bottom left half of the window, select the required sequence**



5. **Click**

Now sequence 1 from camera 1 is displayed on the right under execution group 16. The green arrow mark helps you to identify it quickly. At the top right, the arrow indicates all the execution groups using this sequence. At the bottom right, the arrow indicates where the sequence is located in the execution group.



Adding sequences with drag & drop from the camera window

You can also add sequences to the execution group by dragging & dropping sequences from the camera window into the execution group controller.

◆Procedure

1. **Execution Groups → Execution Group Controller**

   The Execution Group Controller is displayed.

2. **In the top left half of the execution group controller, select the camera from which you want to drag the sequence.**

3. **In the top right half of the execution group controller, select the execution group you want to expand**

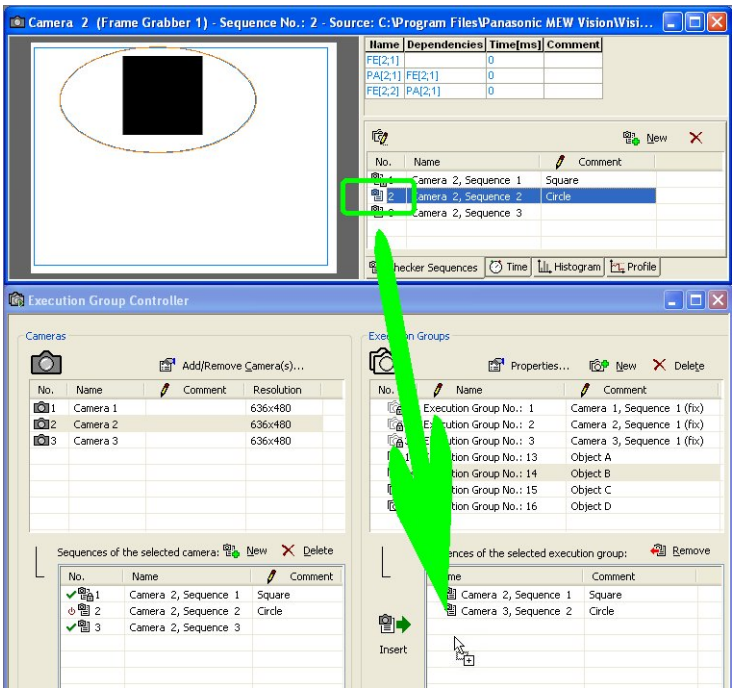
   In the example we add sequence 2 from camera 2 to execution group 14.

4. **In the camera window, select the sequence with a left mouse click and hold the mouse button down**

   If you move the mouse and the cursor looks like ⃠, you have got the sequence in a firm hold.

5. **Drag the sequence to the right bottom half of the execution group controller**

   The cursor changes to look like when you are moving it to an area where you may drop the sequence.



◆NOTE

The drag & drop function only works as expected when you have selected the same camera in the execution group controller and in the camera window from which you try to drag the sequence.

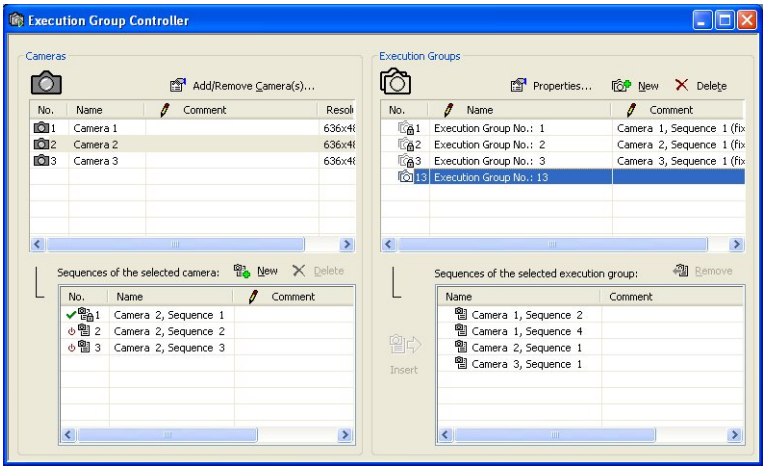
8.6.3 Remove a Sequence from a User-Defined Execution Group

◆Procedure

1. **Execution Groups → Execution Group Controller**

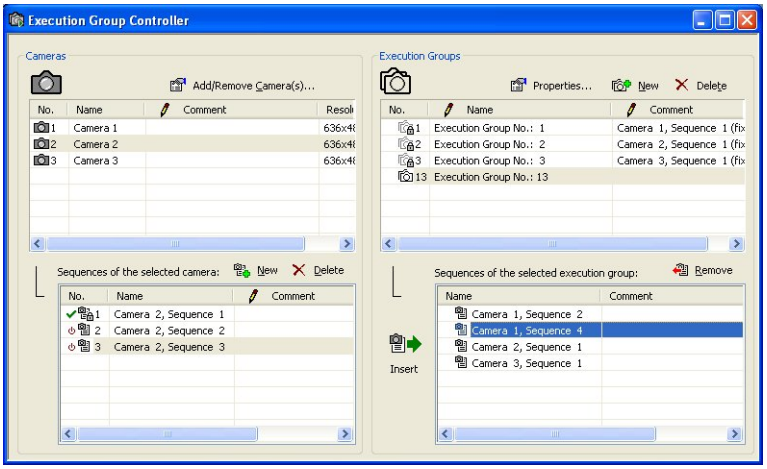
   The execution group controller is displayed. The example shows how to remove sequence 4 from camera 1 from the execution group 13.

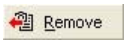
2. **In the top right half of the window, select execution group 13**



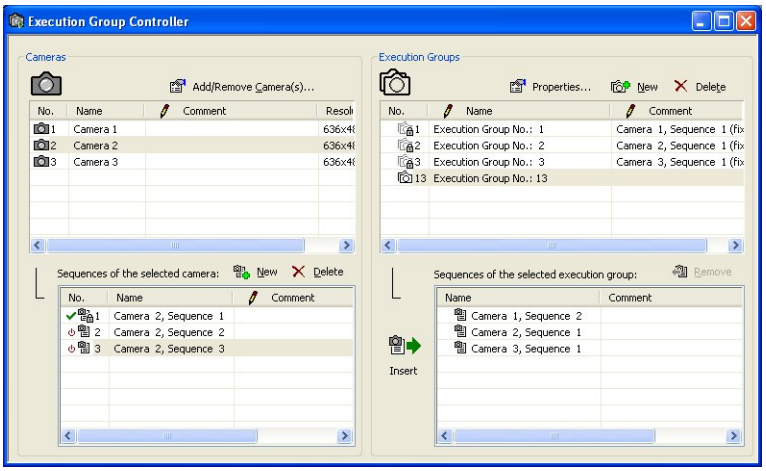
Below, you see all sequences belonging to this execution group.

3. **In the bottom right half of the window, select "Camera 1, Sequence 4"**



4. **Click** 

A message appears, asking for confirmation. If you select [Yes], the sequence will be removed from the execution group.

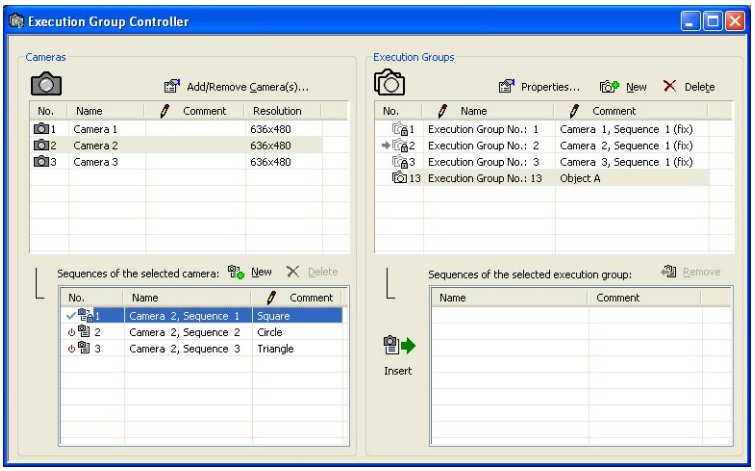


8.6.4 Delete a User-Defined Execution Group

◆Procedure

1. **Execution Groups → Execution Group Controller**

   The execution group controller is displayed (e.g. Execution Group No.: 13; Object A).

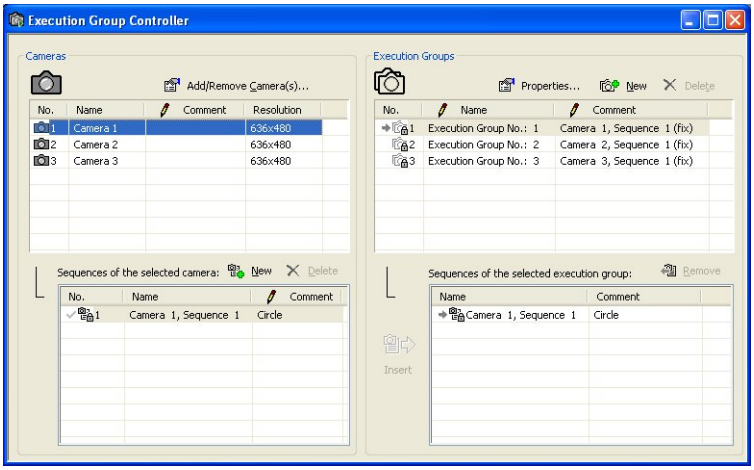


2. **In the top right half of the execution group controller, select the execution group you want to delete**
3. **Click**

   or press

   <Del>

A message appears, asking for confirmation. If you select [Yes], the sequence will be removed from the execution group.



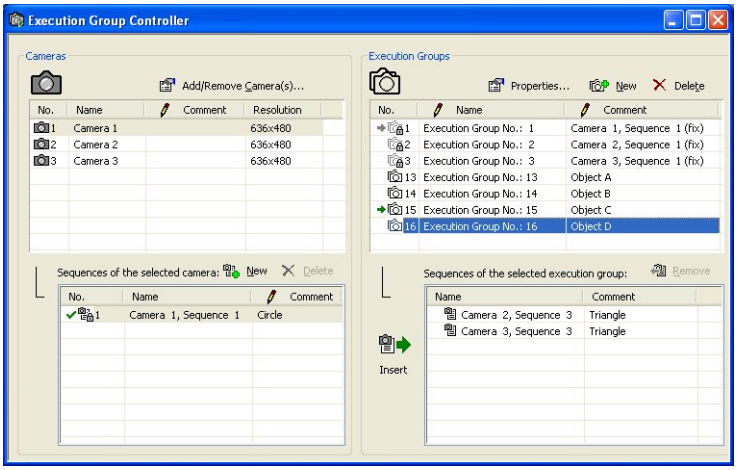
8.6.5 Change an Execution Group Number or Name

◆Procedure

1. **Execution Groups → Execution Group Controller**

   The execution group controller is displayed.

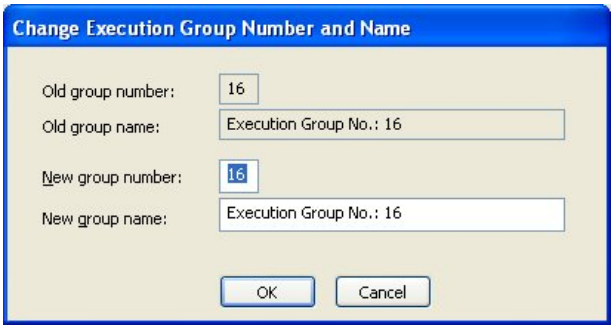
2. **With the right mouse button, select the execution group to which you wish to assign a new number**



   The context-sensitive pop-up menu appears.

3. **Select "Change Group Number ..."**

The following dialog box appears:



4. **Enter the new execution group number**
5. **Change the name, if required**

   The original execution group name also contains the execution group number. If you assign a new number to the execution group, it may be confusing later if you do not modify the name accordingly.
6. **Click [OK]**

◆NOTE

You can change the name of an execution group any time by double-clicking the name field, entering a new name and confirming with <Enter>.

8.7 Reading Images

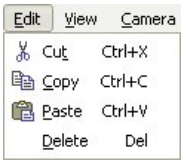
Vision P400 always grabs the images of all cameras connected to the system but only processes those with a sequence entry in the execution group being executed. You will find the relevant settings on the "Frame Grabber" tab (see page 140) under **System Settings** → **Vision P400 Settings**.

Chapter 9

Edit

9.1 Introduction

In the main menu **Edit** you will find several submenus which you can use to cut, paste, copy, insert and delete previously selected checkers and parameters:



Submenus in the "Edit" menu

◆**NOTE**

These submenus are not available in run mode.

All options available from the menu are accessible from the work area via the pop-up menu. Depending on whether or not you have selected an object, the pop-up menu contains different options (see page 110).

9.2 Submenus

The submenus in the **Edit** menu will be described in the following sections.

9.2.1 Cut

With **Edit** → **Cut** you can cut out a selected text or a checker either to delete it or to re-insert it somewhere else with **Edit** → **Paste**.

The cut item will be deposited into the buffer until you cut or copy another item. Once an item is cut, you may re-insert it repeatedly, as needed.

9.2.2 Copy

With **Edit** → **Cut** you can cut a selected text or checker in order to re-insert it somewhere else with **Edit** → **Paste**.

The item copied will remain in the buffer (clipboard) until you copy or cut out another item. So once an item has been copied you can re-insert it repeatedly with **Edit** → **Paste.**

9.2.3 Paste

With **Edit** → **Paste** you can re-insert an item that has previously been either copied or cut.

◆**NOTE**

Initially, the pasted shape of a checker lies exactly on top of the original checker. Select the center point of the shape, hold down the mouse button and drag it to the desired location. The pasted checker will be added to the end of the sequence.

An item copied or cut will remain in the buffer until you cut or copy another item. In other words, once cut or copied, you can re-insert the item repeatedly at other locations with **Edit**→ **Paste**.

9.2.4 Delete

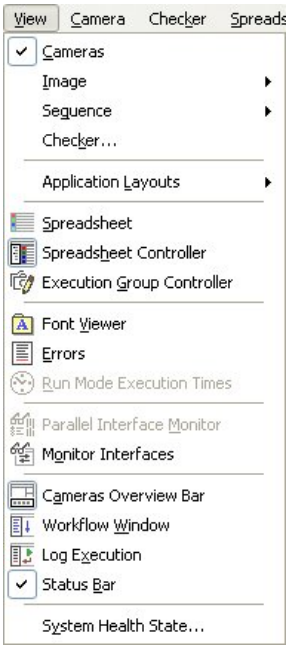
With **Edit** → **Delete** you can delete the item you have selected. Unlike cut or copied items, a deleted item is not deposited in the buffer. As such, it cannot be re-inserted.

Chapter 10

View

10.1 Introduction

The **View** submenus allow you to configure which components will appear on the screen display in the camera window (see the following sections):



Submenus in the "View" menu

With the exception of the "System Health State...", "Checker...", "Sequence", "Image", “Tool Bars...” and “Colors...” options, all submenu options work just like on/off toggle switches. If a submenu option is marked with a check mark, the corresponding item (e.g. the status bar) will be shown on the screen.

10.2 Submenus

The submenus in the **View** menu will be described in the following sections.

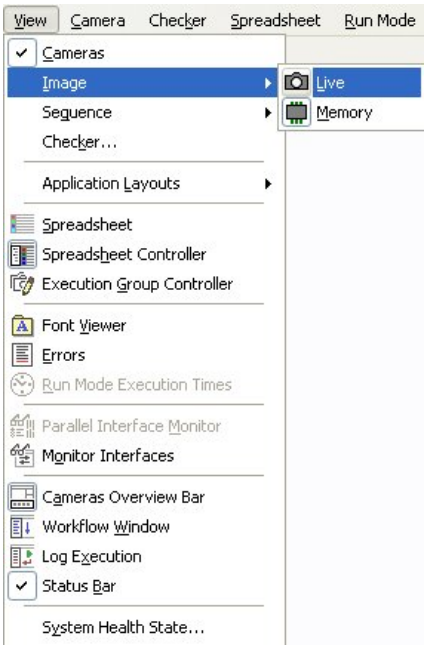
10.2.1 Cameras

With **View** → **Cameras** you can switch on/off the camera image(s) and the associated checker sequence(s). If you have connected multiple cameras, you can switch between the individual cameras using camera bar (see page 253) or the **Window** menu, or by clicking on .

10.2.2 Image

With **View** → **Image** → **Live/Memory** or the <F9> key, you can switch back and forth between memory and live image. You can also use the corresponding icons.

- Live image
- Memory image

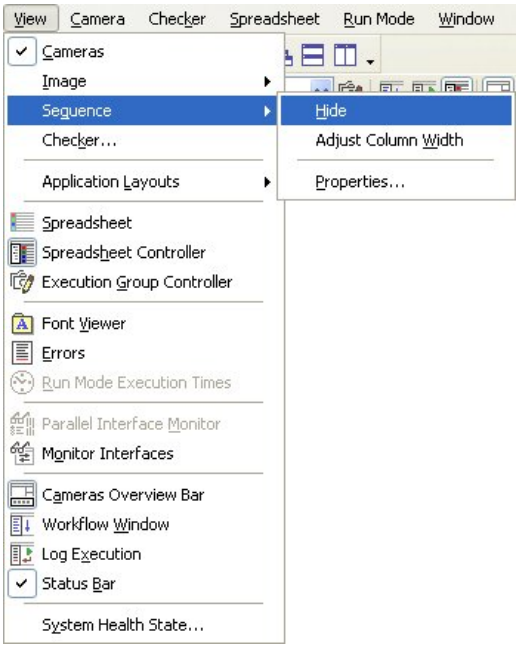


Select live or memory image display

We recommend using the live image for image adjustments and the memory image when creating new checkers.

10.2.3 Sequence

You find the following display options in the submenu **Sequence**.



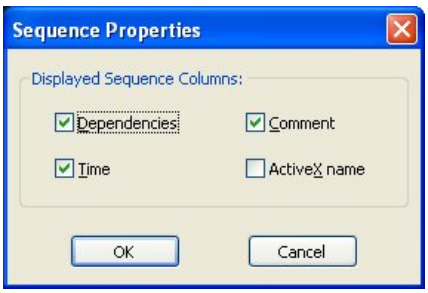
Submenus under "Sequence" in the View menu

With **View → Sequence → Hide/Show** you can switch on/off the checker sequence displayed to the right of the camera image.

With **View → Sequence → Adjust Column Width** you can make the longest entry in a column determine the column width in the sequence.

With **View → Sequence → Properties...** you can define which columns will be displayed in the checker sequence.

When you select this option, the following dialog box appears:



Sequence columns available for display

◆NOTE

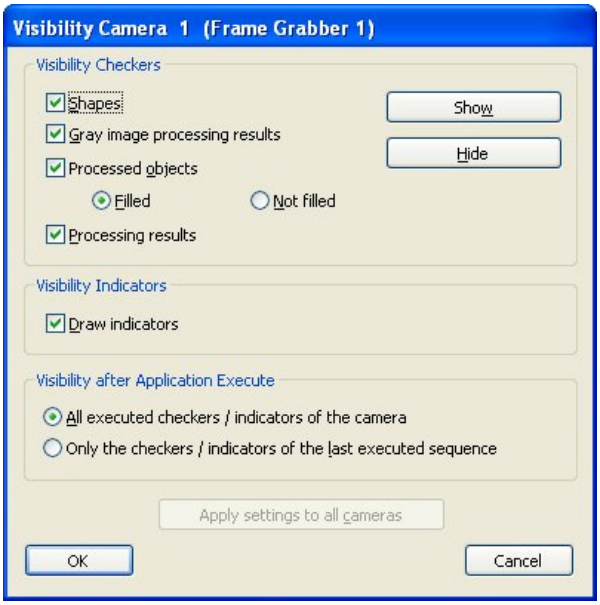
Please note that it is not possible to hide the column "Name". By default, the column "ActiveX Name" is hidden.

10.2.4 Checker

You can configure the visibility and mode of display of checkers and indicators in Vision P400 as you need. The settings you make here apply to the camera indicated on the dialog box title bar at the top.

You can also make custom settings on the "Visibility" (see page 305) property page for each checker, object shape or indicator.

Under **View → Checker...** you enter the camera-specific settings for the visibility of checkers and indicators:



Define visibility for all checkers and indicators of a camera

Parameter	Explanation	Condition
Shapes	Switch checker shapes on/off	Only checkers
Gray image processing results	Show/hide gray image processing results	Only checkers
Processed objects	Show/hide the objects computed in image processing and display in this way: • **Filled:** Processed objects are displayed in the color (see page 129) selected by the user. • **Not filled:** Processed objects are not filled, only the borders are visible.	Only checkers

Parameter	Explanation	Condition
Processing results	Switch image processing results on/off	Only checkers
Draw indicators	Show/hide indicators	Only indicators
All executed checkers/indicators of a camera	All checkers and indicators of one camera processed during the last execution of the application are displayed. This includes checkers from ALL sequences which have been used for calculating the IfCase formula.	Only if you are using IfCase formulas
Only the checkers / indicators of the last executed sequence	Displays only the checkers and indicators of the sequence executed last when calculating the IfCase formula.	No condition

The following buttons are available:

Button	Explanation
Show	All parameters relating to the display of the current element are activated. The setting determining whether processed objects are filled or not filled does not change.
Hide	All parameters relating to the display of the current element are activated. The setting determining whether processed objects are filled or not filled does not change.
Apply settings to all cameras	With this button the settings of the current camera are applied to all other cameras.

◆**NOTE**

For run mode you can disable display of all checkers, object shapes and indicators entirely. To do so, activate the relevant "Graphic Update" parameters on the "Run Mode Settings" property page under Application → Properties**. The properties of the application have priority over the settings you make here or on the "Visibility" property page.**

10.2.5 Application Layouts

In Vision P400 you can customize the appearance of your user interface in layouts. In this, a distinction is made between

- layouts with non-application-specific settings which are used when no application, or no layout saved in the application, is loaded, and
- layouts with application-specific settings which are saved with the respective application.

Name	Layout type	Which data are stored in it?	Icons and commands in Vision P400
User Interface Layout (see page 155)	non-application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows	Save with Load with Delete with System Settings → **User Interface Layout** → Save as/Load/Reset User Layout
Start Layout (see page 226)	application-specific	• Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Automatically configured and saved (see page 226) by Vision P400
Setup Mode Layout (see page 226)	application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Save with Load with Delete with View → Application Layouts → Save/Load/Delete Setup Mode Layout
Run Mode Layout (see page 226)	application-specific	• Position and appearance of menu bar • Position and appearance of toolbars • Position and appearance of dockable windows • Position and size of camera windows • Position and size of spreadsheet	Save with Load with Delete with View → Application Layouts → Save/Load/Delete Run Mode Layout

In "Application Layouts" a distinction is made between the start layout (see below), the setup mode layout and the run mode layout. All layouts include **application-specific** settings for the user interface adapt to the specific mode. So it is advisable in run mode, in which no settings can be made anyway, to hide the toolbar and checker bar so as to make more space for the windows with camera images and execution times etc.

Start Layout

The start layout of an application is configured implicitly by Vision P400 with the application, and determines the appearance of the Vision P400 user interface when you load an application in setup mode. As the start layout contains no information on the Vision P400 toolbar and menu bar, their settings remain unchanged. In run mode the start layout is used whenever an application change takes place and no run mode layout is stored in the newly loaded application.

The appearance of the start layout depends on the time of saving:

- In setup mode the start layout is generated from the layout of the user interface at the time the application was saved.

- In run mode, the application is automatically saved when you quit run mode. The start layout is generated from the layout of the user interface at the time setup mode was quit.

◆NOTE

Before switching to run mode, configure the layout so that you can work with it the next time the program starts up, because this layout is implicitly saved as the start layout of this application when you exit run mode, provided you do not then save the application again in setup mode.

The following user interface elements are stored in the various layouts:

	Start layout	Setup mode layout	Run mode layout
Position and appearance of menu bar	No	Yes	Yes
Position and appearance of toolbars	No	Yes	Yes
Position and appearance of dockable windows	Yes	Yes	Yes
Position and size of camera windows	Yes	Yes	Yes
Position and size of spreadsheet	Yes	Yes	Yes

Saving Application Layouts

The procedure describes how to create and save a run mode layout.

◆Procedure

1. **Open required windows**

   Configure your layout the way you want it for run mode. Open and position all necessary windows, such as for the camera(s), spreadsheet, workflow, execution log, etc.

2. **Adapt window position and size**

3. **Hide unwanted toolbars**

   You can hide unwanted toolbars to create more space on screen. In run mode most toolbars are not needed, or have no effect.

4. **Save your finished layout with**

   or by choosing

   View → Application Layouts → Run Mode Layout → Save Layout

5. **Select**

   or choose

   Application → Save

If you do not save the application, you will not be able to load the layout the next time the program starts. Repeat the procedure if you want to configure a setup mode layout.

Loading Application Layouts

In setup mode you can load your own custom-defined setup or run mode layout at any time.

Procedure

1. **Select to load the run mode layout or for the setup mode layout**

   or choose

   View → Application Layouts → Run/Setup Mode Layout → Load Layout

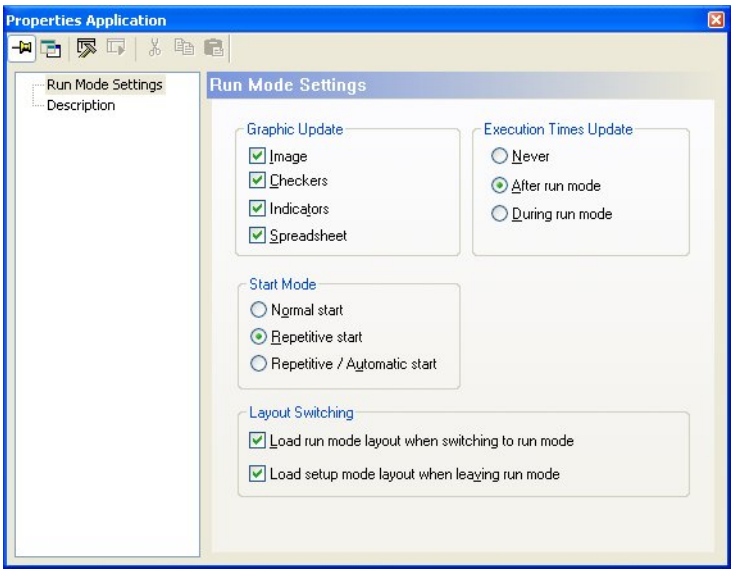
   All windows are restored to the sizes and positions you saved as the layout for this application.

Automatic Loading of Layouts on Mode Switching

When you switch from setup to run mode or back again, you can have Vision P400 load the run or setup mode layout.

Procedure

1. **Application → Properties**
2. **If not yet visible, select "Run Mode Settings" property page**
3. **Under "Layout Switching" activate the desired parameter**



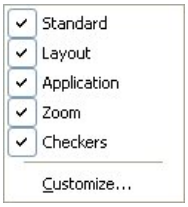
4. **Application → Save**

◆NOTES

- **You can also activate the options under "Layout Switching" when you did not create the layout concerned. In such cases loading of the layout on switching mode is ignored and a warning is written to the error log file.**
- **If you have not checked the "Load setup mode layout when leaving run mode" checkbox or the layout does not exist, the start layout is loaded when you quit run mode.**

10.2.5.1 Showing and Hiding Toolbars

By default, the five Vision P400 toolbars are docked beneath the menu bar, and feature all available icons. Because most icons are grayed out in run mode, it is advisable in run mode to hide the toolbars and checker bars so as to make more space for the windows with camera images and execution times etc. Alternatively, you can also create your own custom toolbar (see page 233) containing only the icons available in run mode, which takes up less space and can be positioned wherever you like (see page 231).



List of available standard toolbars

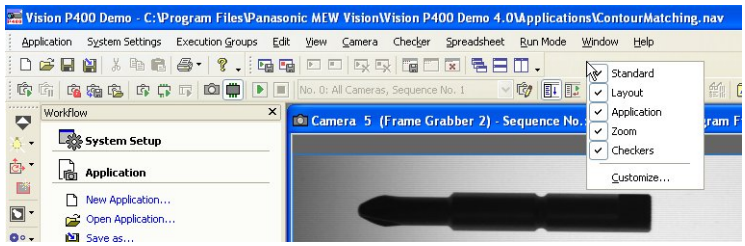
Hiding Toolbars

To hide unwanted toolbars:

◆Procedure

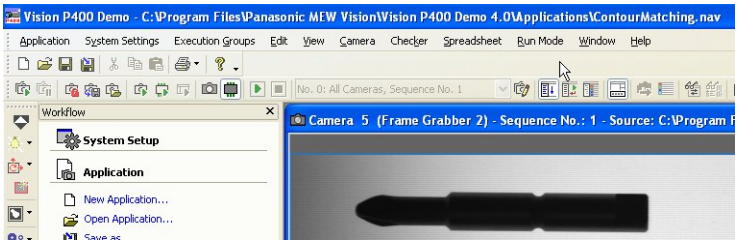
1. **Right-click in the free gray area next to or beneath the menu bar or a toolbar**

   A pop-up menu appears containing the five toolbars. In this example the "Layout" toolbar is to be hidden.



2. **Left-click to select "Layout"**

The selected toolbar is hidden and the pop-up menu closed.



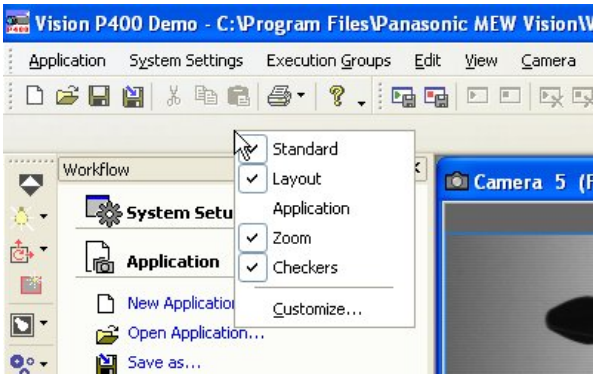
Showing Toolbars

To redisplay hidden or unintentionally closed toolbars:

Procedure

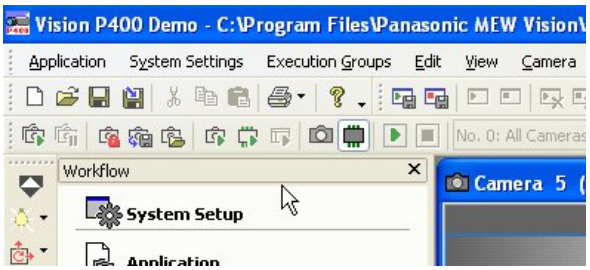
1. **Right-click in the free gray area next to or beneath a toolbar**

   A pop-up menu appears containing the five toolbars. Currently visible toolbars are indicated by a check mark in front of the name. There is no checkbox for hidden toolbars. In the example the hidden "Application" toolbar is to be restored to view.



2. **Left-click to select "Application"**

   The selected toolbar is redisplayed and the pop-up menu closed.



10.2.5.2 Customizing and Positioning Toolbars

By default, the five Vision P400 toolbars are docked beneath the menu bar, and feature all available icons. Each toolbar can be detached from its docked position and positioned as a floating box at a different position on the screen.

◆Procedure

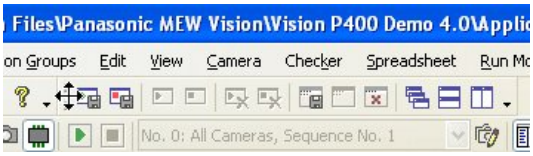
1. **Point the cursor to the start of the toolbar**

   Each toolbar starts at the left with a vertical dotted line. This line also acts as a separator between adjacent toolbars.

   The cursor shape changes to ✥.

2. **Press and hold down the left mouse button**

   This detaches the toolbar from its anchorage.

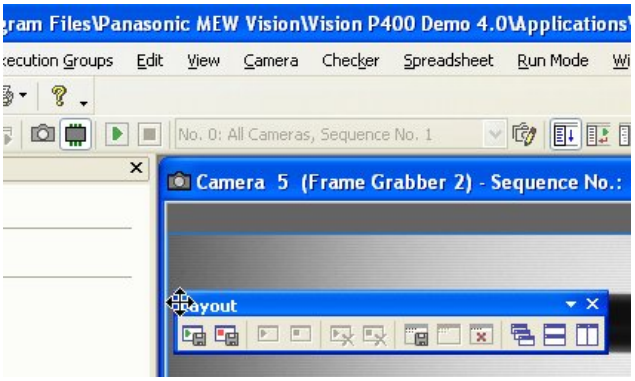


3. **Drag the toolbar to where you want it in the window**

   When you move the cursor along the window margin, Vision P400 tries to dock the toolbar there. When you move the cursor to the middle of the window, the toolbar is displayed on screen in a separate, floating toolbar box when you release the mouse button. In this case the "Layout" toolbar is to be placed in a dedicated box

4. **Move the cursor into the middle of the window**

5. **Release the mouse button**

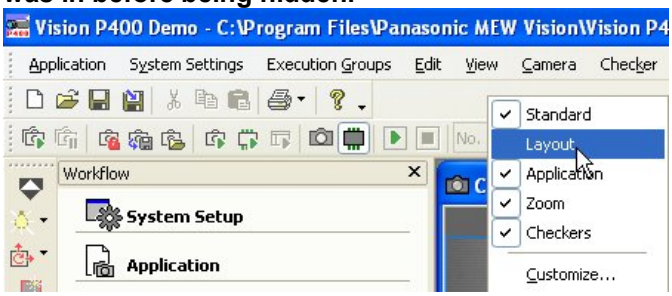


   The layout toolbar box can be moved at any time.

◆NOTES

- **When you close a toolbar box, you hide the toolbar. It is not reset to its original position. To redisplay the toolbar, right-click in the gray area where the toolbar was previously positioned. All available toolbars are displayed, with the currently visible ones indicated by a check mark. Select the toolbar you want to redisplay by left-clicking on it and it reappears at the position it**

was in before being hidden.



- **You can save the customized user interface as your layout and load it when required. You can also save different layouts with more or fewer toolbars for setup and run mode with the application (see page 226) and load the relevant layout automatically on switching mode (see page 226).**

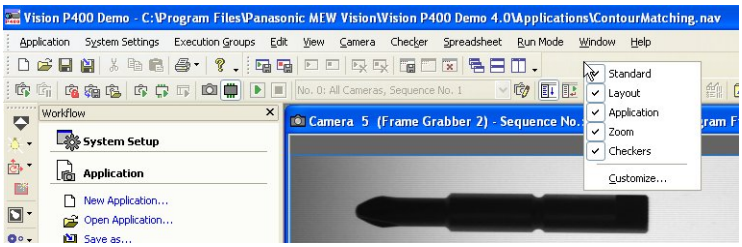
10.2.5.3 Customizing and Positioning Toolbars

By default, the five Vision P400 toolbars feature all available icons. You can create your own custom toolbars featuring the icons you need most frequently. A custom toolbar is a good idea in run mode, for example, because only a small number of icons can be used in that mode while most are grayed out.

◆Procedure

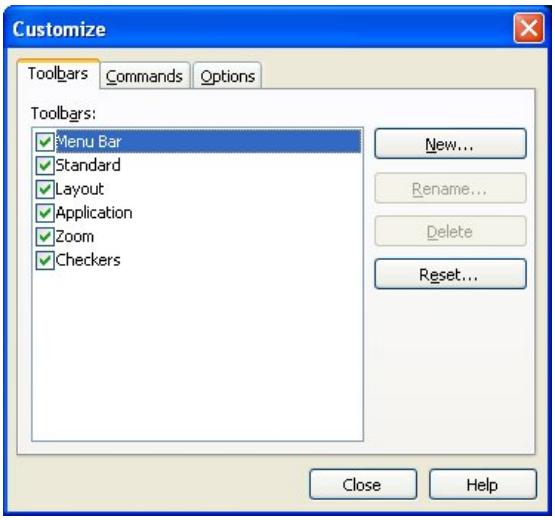
1. **Right-click in the free gray area next to or beneath the menu bar or a toolbar**

   A pop-up menu appears containing the five toolbars.



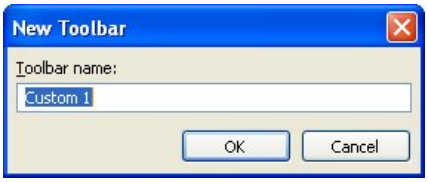
2. **Click on "Customize..."**

   The following dialog box appears:



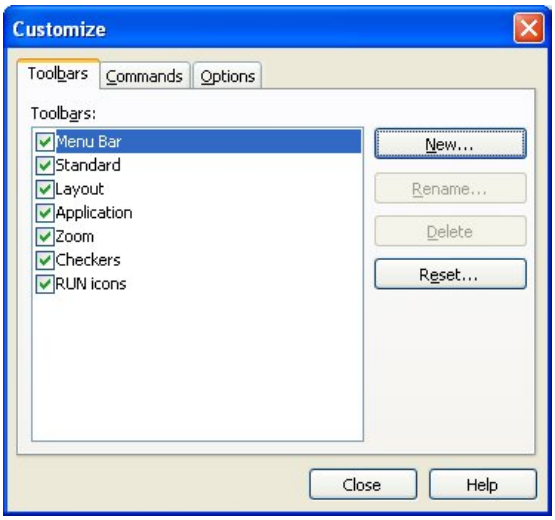
3. Click on [New]

The following dialog box appears:

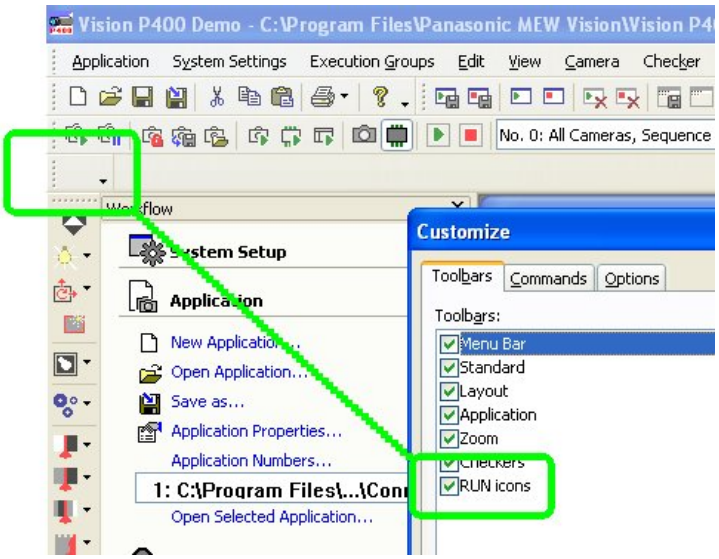


4. Enter a name for the toolbar and click [OK]

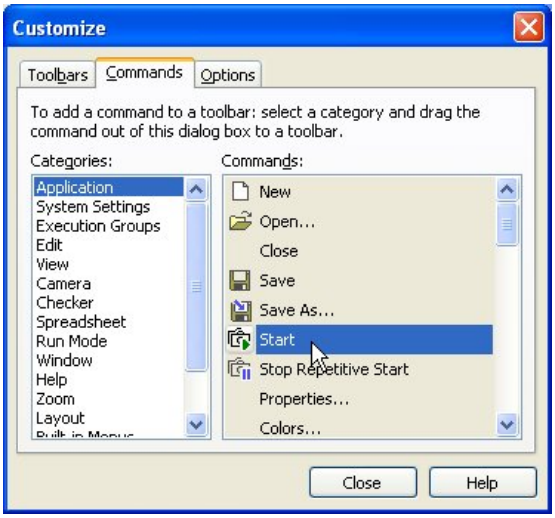
Give your toolbar a descriptive name; in the example it is "RUN". The new toolbar appears at the end of the toolbar list.



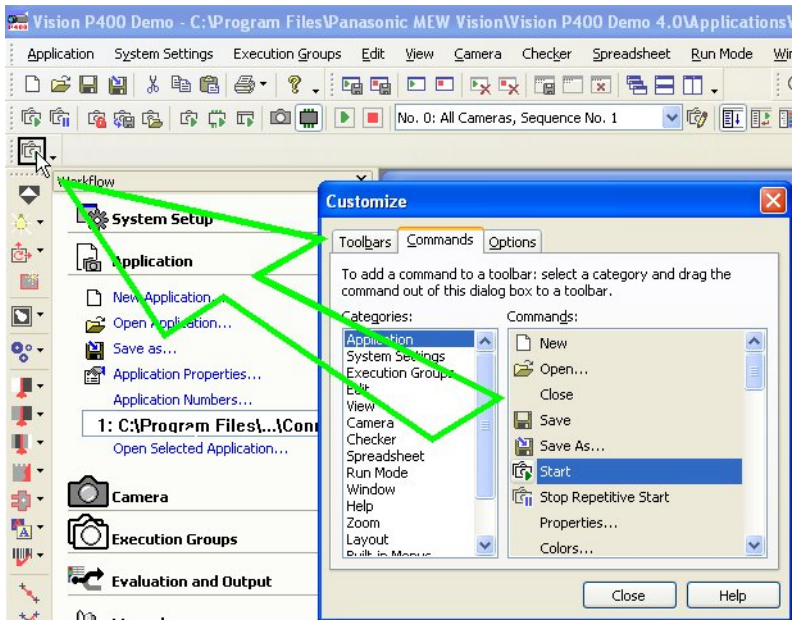
At the same time, a new, empty bar is displayed at the top underneath the standard toolbars.



5. **In the "Customize" window select the "Commands" tab**
6. **Left-click on the "Start" icon and hold the mouse button down**



7. **Drag the icon onto the empty toolbar and release the mouse button**



8. **Drag & drop all the command icons you want to use onto the toolbar**
9. **Click on [Close]**

Icons for commands which are not currently available are grayed out as usual (in the example the icons for "Stop: Repetitive Start" and switching to setup mode, as we are in setup mode).

10. **Position the finished toolbar**

User-defined toolbars can be docked onto the window margin or onto other toolbars just like standard toolbars, or can be positioned as separate floating boxes. The toolbar name is displayed on the title bar of floating toolbar boxes.

◆**NOTE**

You can save the customized user interface as your layout and load it when required. You can also save different layouts with more or fewer toolbars for setup and run mode with the application (see page 226) and load the relevant layout automatically on switching mode (see page 226).

10.2.6 Spreadsheet

With **View** → **Spreadsheet** or by clicking you can switch the spreadsheet window on/off.

10.2.7 Spreadsheet Controller

The "Spreadsheet Controller" window allows you to view only selected checker results and formulas in the spreadsheet and the "Objects for Data Transfer" window.

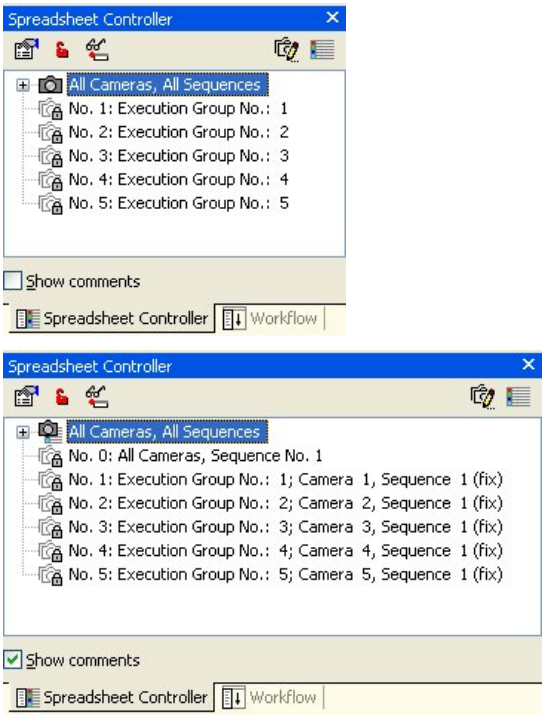
If you are not using execution groups

Depending on the item you have selected, the spreadsheet and the "Objects for Data Transfer" window display formulas and checker results from

- the whole application (all cameras, all sequences) or
- a selected camera with its sequences or
- one specific sequence of a camera

To open the Spreadsheet Controller choose **View** → **Spreadsheet Controller** or click on the icon. The window is displayed at the left as a separate tab page in the area with the workflow window. The Spreadsheet Controller is a useful tool for navigation and for reducing the display down to the data of a camera, sequence or execution group. You can use this function as follows:

- Restrict (see page 240) the spreadsheet display to the results of the selected sequence/execution group
- Restrict (see page 242) the display in the "Objects for Data Transfer" window to the results of the selected sequence/execution group
- Camera Window Switching (see page 244)



Spreadsheet Controller without execution groups: At top normal display; at bottom with comments

If you are using execution groups

When you work with execution groups, there are additional items available:

- all cameras with sequence number 1 (corresponds to executing the application in run mode without execution groups)
- user-defined execution groups with one or more cameras and sequences

The following rules apply for the display of checkers and formulas:

- A checker result is displayed if its checker belongs to the entry selected in the spreadsheet controller.
- A formula (exception: IfCase formulas) is displayed if
  - all the checker results used in this formula belong to the entry selected in the spreadsheet controller.
  - all the formula results used in this formula belong to the entry selected in the spreadsheet controller.
  - the formula is independent of checker results, e.g. it only contains the value "TRUE".
  - it is a global formula (see page 583).
- An IfCase formula is displayed if at least one result used in the formula belongs to the entry selected in the spreadsheet controller.

◆EXAMPLE

A formula uses the results of a feature extraction checker from camera 8, sequence 1 and a binary edge detector from camera 9, sequence 2. The formula is displayed when you select one of the following entries in the "Spreadsheet Controller" window:

- All Cameras, All Sequences (= whole application) or
- the user-defined execution group 13 containing both camera 8, sequence 1 and camera 9, sequence 2

The formula WILL NOT be displayed with any of the following selections in the "Spreadsheet Controller" window:

- the predefined execution group No. 8 (because one checker is part of a sequence which does not belong to the execution group for camera 8)
- the predefined execution group No. 9 (because one checker is part of a sequence which does not belong to the execution group for camera 2)
- any user-defined execution group which contains only one of the cameras or sequences
- "Exec. grp. num. 0: All Cameras, Sequence No. 1" because a sequence with number 2 is used

An exemption to this rule are formulas containing no checker, e.g. a global formula or a formula containing only the value TRUE.

The display rules for the spreadsheet are also valid for the "Objects for Data Transfer" window: Vision P400 only lists checker and formula results which are executed with the execution group and are selected for data transfer to the interface. If you select another camera or execution group in the spreadsheet controller, the display changes.

◆NOTES

- **The selection you have made in the spreadsheet controller to limit the spreadsheet display will not be saved when you save the application.**
- **If you have hidden spreadsheet rows, you can temporarily display them again by clicking on the icon in the Spreadsheet Controller. Then the icon is displayed on the spreadsheet to the left of the actually hidden but temporarily visible rows.**

	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	FE[1;1]areaSize_1	4253	0	4253	OK
	FE[1;1]gravity_X_Coordinate_1	422.45	0	422.45	OK
	FE[1;1]gravity_Y_Coordinate_1	235.03	0	235.03	OK
	FE[1;1]angle_1	1.08	0	1.08	OK
	End				

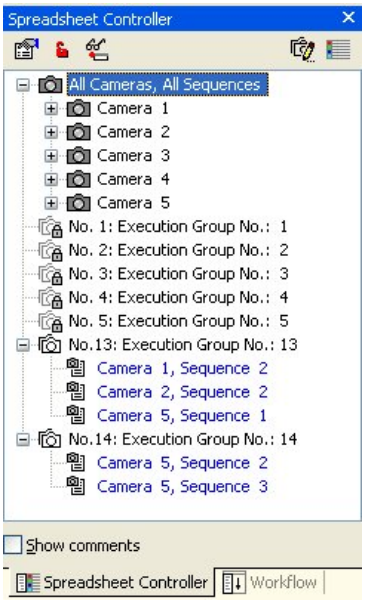
10.2.7.1 Restricting Spreadsheet View

If you have connected a lot of cameras and the spreadsheet contains a large number of checker results, it will become less clearly readable. Clicking on an execution group with the spreadsheet open results in only the spreadsheet rows containing the results of checkers from this execution group being displayed. All other rows are hidden.

◆Procedure

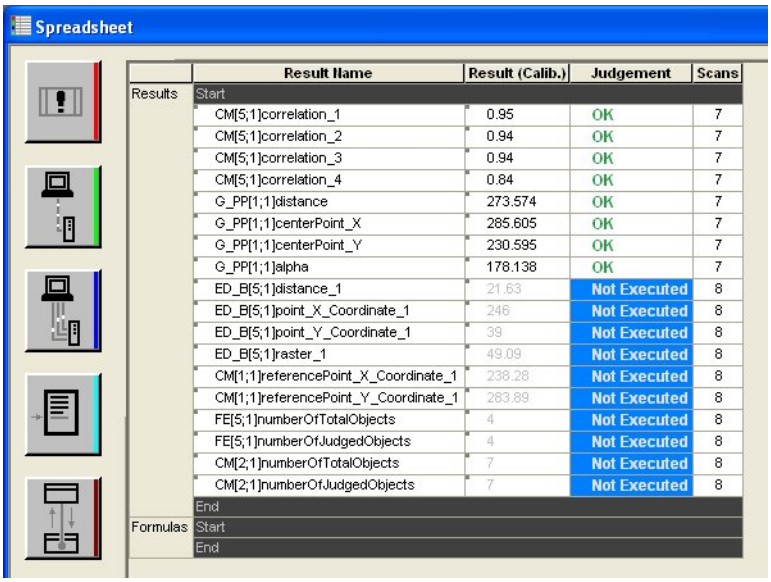
1. **Choose** View → Spreadsheet Controller **or click on**

   The Spreadsheet Controller window opens up, or if already open is placed in the foreground.



2. **Click on "All Cameras, All Sequences"**

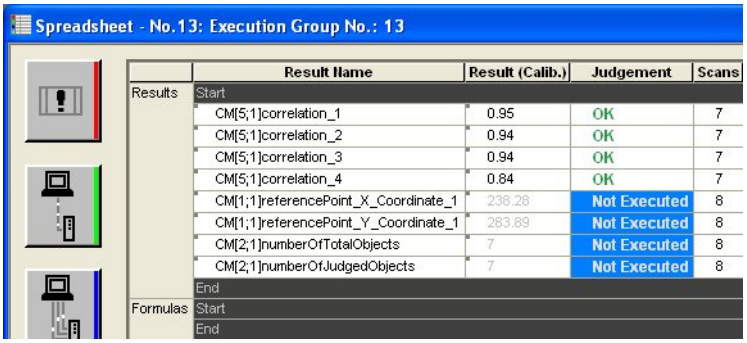
   The spreadsheet shows all inserted results. Results of checkers not executed on the last startup because they belong to a different execution group are marked in blue. Next the view is to be restricted to all results of execution group 13.



	Result Name	Result (Calib.)	Judgement	Scans
Results	Start			
	CM[5;1]correlation_1	0.95	OK	7
	CM[5;1]correlation_2	0.94	OK	7
	CM[5;1]correlation_3	0.94	OK	7
	CM[5;1]correlation_4	0.84	OK	7
	G_PP[1;1]distance	273.574	OK	7
	G_PP[1;1]centerPoint_X	285.605	OK	7
	G_PP[1;1]centerPoint_Y	230.595	OK	7
	G_PP[1;1]alpha	178.138	OK	7
	ED_B[5;1]distance_1	21.63	Not Executed	8
	ED_B[5;1]point_X_Coordinate_1	246	Not Executed	8
	ED_B[5;1]point_Y_Coordinate_1	39	Not Executed	8
	ED_B[5;1]raster_1	49.09	Not Executed	8
	CM[1;1]referencePoint_X_Coordinate_1	238.28	Not Executed	8
	CM[1;1]referencePoint_Y_Coordinate_1	283.89	Not Executed	8
	FE[5;1]numberOfTotalObjects	4	Not Executed	8
	FE[5;1]numberOfJudgedObjects	4	Not Executed	8
	CM[2;1]numberOfTotalObjects	7	Not Executed	8
	CM[2;1]numberOfJudgedObjects	7	Not Executed	8
	End			
Formulas	Start			
	End			

3. Select group number 13

The spreadsheet then only shows the results relating to the checkers from execution group 13. The restriction to execution group 13 is also indicated on the spreadsheet title bar.



	Result Name	Result (Calib.)	Judgement	Scans
Results	Start			
	CM[5;1]correlation_1	0.95	OK	7
	CM[5;1]correlation_2	0.94	OK	7
	CM[5;1]correlation_3	0.94	OK	7
	CM[5;1]correlation_4	0.84	OK	7
	CM[1;1]referencePoint_X_Coordinate_1	238.28	Not Executed	8
	CM[1;1]referencePoint_Y_Coordinate_1	283.89	Not Executed	8
	CM[2;1]numberOfTotalObjects	7	Not Executed	8
	CM[2;1]numberOfJudgedObjects	7	Not Executed	8
	End			
Formulas	Start			
	End			

◆NOTES

- **The selection you have made in the spreadsheet controller to limit the spreadsheet display will not be saved when you save the application.**
- **If you have hidden spreadsheet rows, you can temporarily display them again by clicking on the icon in the Spreadsheet Controller. Then the icon is displayed on the spreadsheet to the left of the actually hidden but temporarily visible rows.**

	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	FE[1;1]areaSize_1	4253	0	4253	OK
	FE[1;1]gravity_X_Coordinate_1	422.45	0	422.45	OK
	FE[1;1]gravity_Y_Coordinate_1	235.03	0	235.03	OK
	FE[1;1]angle_1	1.08	0	1.08	OK
	End				

10.2.7.2 Restricting View of Output Data

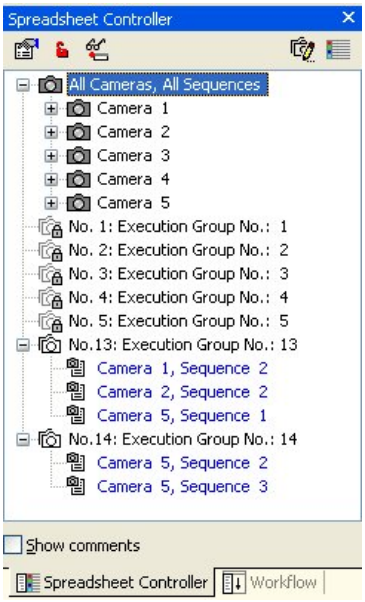
The "Objects for Data Transfer" window can only display a certain number of results at once. When you have opened the "Objects for Data Transfer" window and click on an execution group in the Spreadsheet Controller, only the results relating to checkers from that execution group are displayed. All other results are hidden.

Procedure

1. **Choose** View → Spreadsheet Controller **or click on**

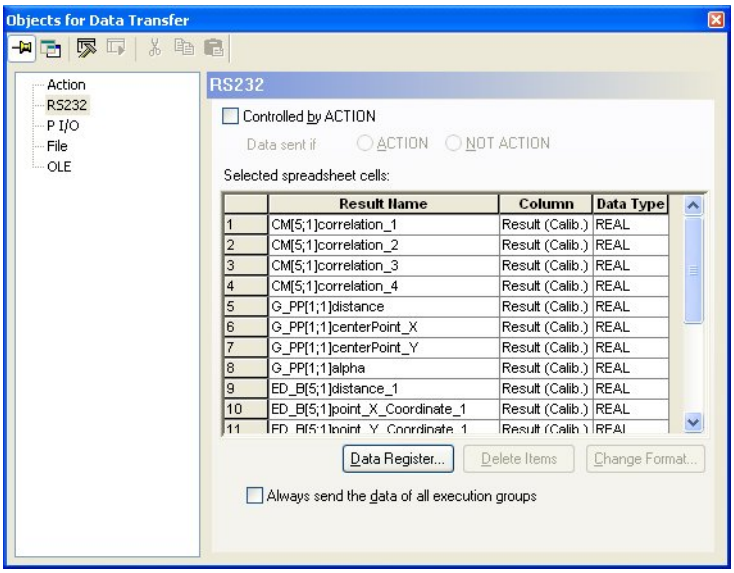
   The Spreadsheet Controller window opens up, or if already open is placed in the foreground.

2. **Click on "All Cameras, All Sequences"**

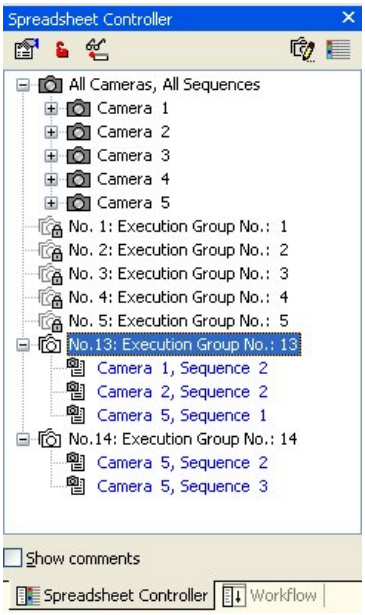


3. **Click**

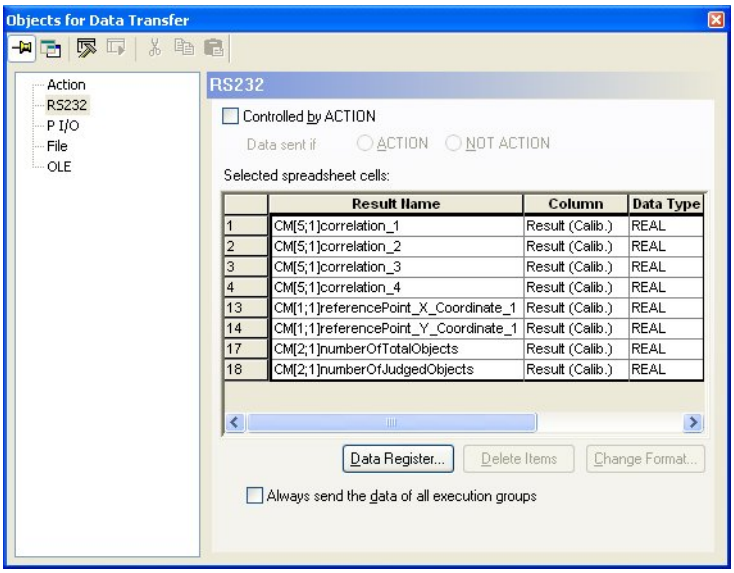
   The "Objects for Data Transfer" window displays all results to be output via the RS232 interface. Next the view is to be restricted to all results of execution group 13.



4. Select group number 13



The window then only shows the results relating to the checkers from execution group 13.



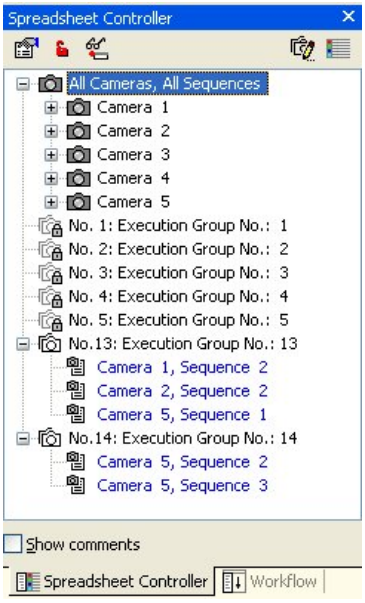
10.2.7.3 Camera Window Switching

With the Spreadsheet Controller you can quickly switch from one camera window to the next via the sequences.

Procedure

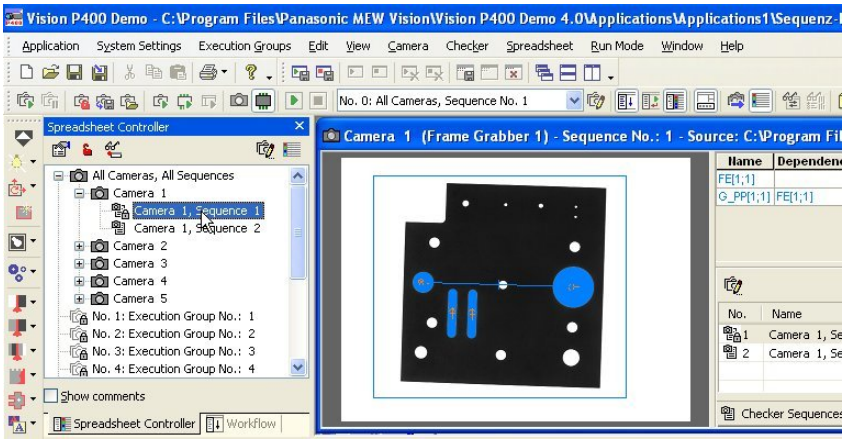
1. View → Spreadsheet Controller **or click**

   The Spreadsheet Controller window opens up, or if already open is placed in the foreground. First the image of camera 1 is to be displayed.



2. **Click on "All Cameras, All Sequences"**
3. **Select camera 1**
4. **Double-click on a sequence**

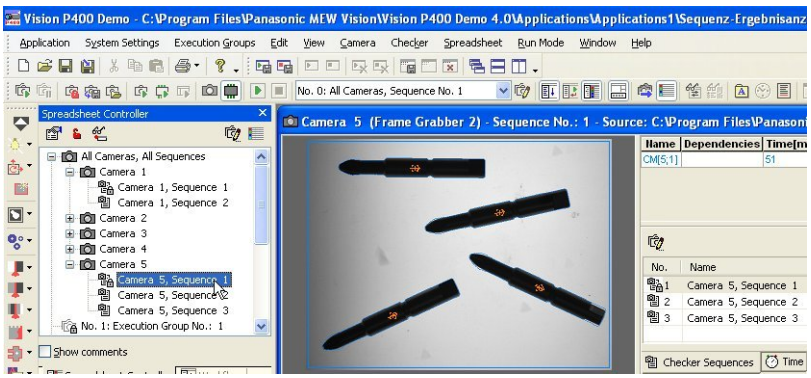
   The camera window jumps to the image of the selected camera. In the example sequence 1 of camera 1 is displayed.



   Now you want to switch to camera 5.

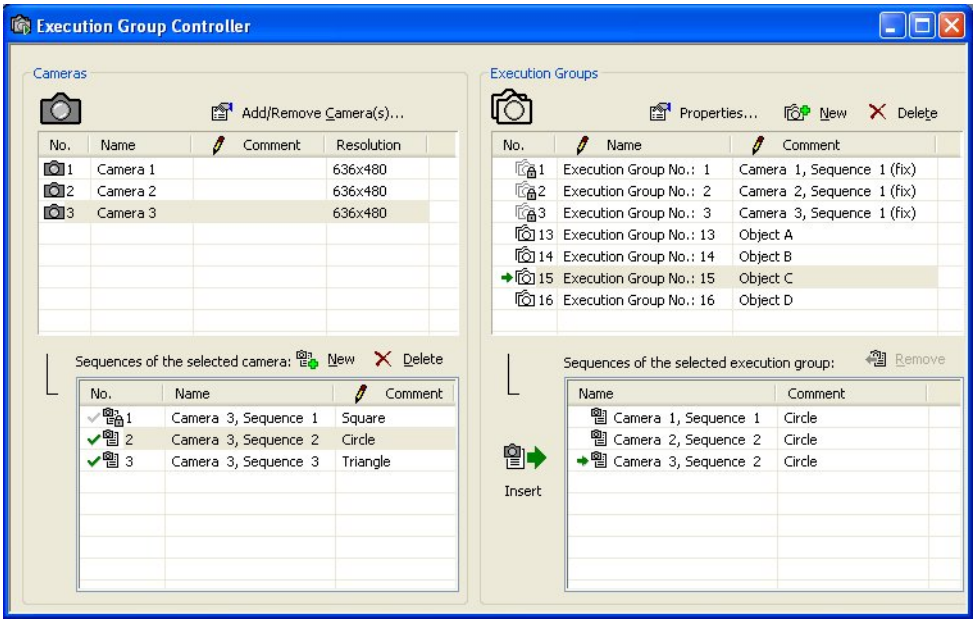
5. **Select camera 5**
6. **Double-click on a sequence**

   In the example sequence 1 of camera 5 is displayed.



10.2.8 Execution Group Controller

The Execution Group Controller (see page 200) lists all execution groups with their assigned camera(s) and sequence(s).



Execution Group Controller

There are two categories of execution groups:

- Predefined execution groups (see page 194), e.g.: Group number 1 includes "Camera 1, Sequence no. 1", group number 2 includes "Camera 2, Sequence no. 1" etc., up to 12, if you are using 12 cameras in the application
- User-defined execution groups (see page 194) (group 13 to 255) which you can create (see page 203) or expand (see page 208) yourself.

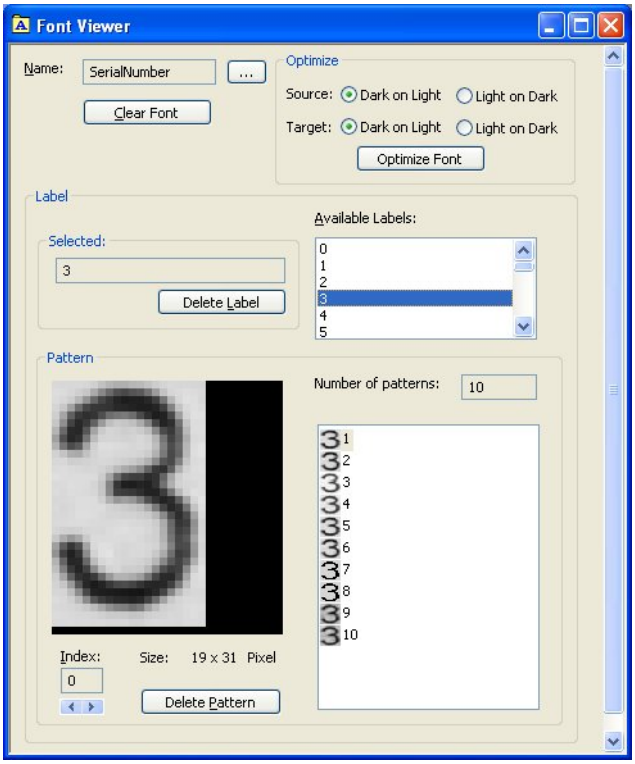
10.2.9 Font Viewer

With **View** → **Font Viewer** or by clicking you switch the font viewer window on/off. The font viewer is a tool for viewing and editing existing fonts. You can either

- view or delete individual patterns,
- view or delete all patterns for a label, or
- view or delete a complete font.

When you select this option, the window below appears. When you have selected a font, you find all the labels belonging to that font and the different patterns that have been registered for a particular label.

The figure below shows a font called “Credit_card” and the label “3” with different patterns.



"Font Viewer" window

Name

This field displays the name of the selected font. Click ... to select another font. Use the [Clear Font] button to delete the currently selected font.

Label

In this part of the window you select the label you wish to view. On the right side you find a list of available labels. Click on any label to display the registered pattern(s). Use the [Delete Label] button to delete the selected labels together with all their patterns.

Pattern

In this part of the window you select the pattern you wish to view. On the right side you find a list of registered patterns for the selected label. Selecting a pattern displays this particular pattern in an enlarged version on the left side of the window. You can select a pattern either by clicking on it in the "Number of Patterns" list or by using the arrow buttons of the index counter at the bottom of the window.

Use the [Delete Pattern] button to delete the currently selected pattern. When you delete the last pattern of a label, the label is deleted, too.

◆**NOTE**

If you have defined an OCR checker so that it uses a font (see page 433), the classifier is recalculated every time you add or delete a pattern to the font.

Optimize

Use this part of the window to optimize the font. Under "Source" and "Target" select the type of font, then select [Optimize Font]. Vision P400 saves the optimized font in a new file. Depending on the selection you made under "Target", the file name is different. XXX_Opt_Dl.nft when you have selected the option "Dark on Light" under "Target" or XXX_Opt_Ld.nft when you have selected the option "Light on Dark" under "Target". Next, turn to the property page "General" of the OCR checker and use [Set Font] to assign the optimized font to the checker.

10.2.10 Errors

Use **View** → **Errors** or click to switch on/off the "Error Logging" window. Depending on your configuration of the error handling (see page 150), this window lists all errors and warnings which have occurred during the operation of Vision P400.

Error Logging

Count	Time	Level	Class	Error	Descr
1	03. July 2007 09:43:41	Warning	GUI	0	The file C:\Program Files\Panasonic MEW Vision\Vision P400 Demo 4 not a valid Vision P400 application file!
2	03. July 2007 09:43:47	Warning	GUI	0	The file C:\Program Files\Panasonic MEW Vision\Vision P400 Demo 4 not a valid Vision P400 application file!
3	03. July 2007 09:48:12	Warning	BASE	6141	Execution of FE[5;1] has failed; Error: not yet executed.
4	03. July 2007 10:42:52	Warning	BASE	6141	Execution of FE[1;1] has failed; Error: not yet executed.
5	03. July 2007 10:43:05	Warning	BASE	6141	Execution of CM[2;1] has failed; Error: not yet executed.
6	03. July 2007 10:43:26	Warning	BASE	6141	Execution of ED_G[4;1] has failed; Error: not yet executed.
7	03. July 2007 10:44:04	Warning	BASE	6141	Execution of FE[5;1] has failed; Error: not yet executed.
8	03. July 2007 10:44:08	Warning	BASE	6141	Execution of FE[5;1] has failed; Error: not yet executed.
9	03. July 2007 10:44:56	Warning	BASE	6163	no object after selection
10	03. July 2007 10:44:56	Warning	BASE	6141	Execution of G_PP[1;1] has failed; Error: dependency error. The che has not been executed yet or has not been executed correctly.
11	03. July 2007 10:44:56	Warning	BASE	6172	not enough objects for search mode two edge
12	03. July 2007 10:45:03	Warning	BASE	6163	no object after selection
13	03. July 2007 10:45:03	Warning	BASE	6141	Execution of G_PP[1;1] has failed; Error: dependency error. The che has not been executed yet or has not been executed correctly.
14	03. July 2007 10:45:03	Warning	BASE	6172	not enough objects for search mode two edge
15	03. July 2007 10:45:10	Warning	BASE	6141	Execution of FE[5;1] has failed; Error: not yet executed.
16	03. July 2007 10:45:12	Warning	BASE	6163	no object after selection
17	03. July 2007 10:45:12	Warning	BASE	6141	Execution of G_PP[1;1] has failed; Error: dependency error. The che

Error logging window

Column	Explanation
Count	Running numbers for errors
Time	Time and date
Level	Error types: Warning/fatal error Warning: e.g. dependency error Fatal error: e.g. hardware defect
Class	Where in the software did the error occur
Error	Error number
Description	Error description

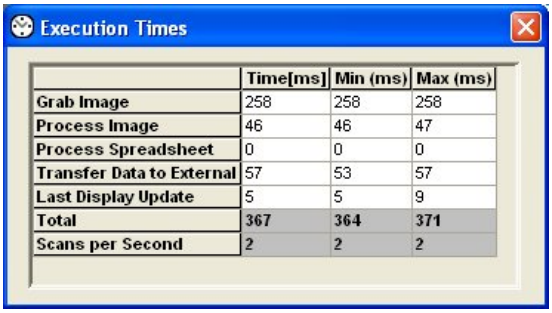
In addition, you can save this information in the file "error.txt" (see page 610). This file is located in the Vision P400 installation folder (e.g. C:\Program Files\Panasonic MEW Vision\Vision P400).

◆NOTES

- **The content of the file "error.txt" is deleted with every start of the program. If you need the contents of this file, you should rename the file prior to starting Vision P400 again.**
- **If you need support, copy the file "error.txt". Print out the file and fax it to Panasonic Electric Works Europe AG together with the form for user feedback (see page 613).**
- **When the "Error Logging" window is displayed and active on the screen, you can delete its content by choosing** System Settings → Error Handling → Clear Error Log **or by pressing the <Del> key.**

10.2.11 Run Mode Execution Times

With **View → Run Mode Execution Times** or by clicking you can show/hide the window with the execution times in Run mode. When the execution times are displayed depends on the settings in the application properties (see page 127).



	Time[ms]	Min (ms)	Max (ms)
Grab Image	258	258	258
Process Image	46	46	47
Process Spreadsheet	0	0	0
Transfer Data to External	57	53	57
Last Display Update	5	5	9
Total	367	364	371
Scans per Second	2	2	2

Execution times

The window contains the times of the last application execution as well as the shortest and longest execution time. The time displayed in "Total" is the sum of the times recorded for one test and sums up the time needed for processing the image, the spreadsheet, for transferring data and for updating the display. "Scans per second" gives the number of complete tests which can be carried out in one second. This value may be "< 1" if a single test takes more than one second.

◆NOTE

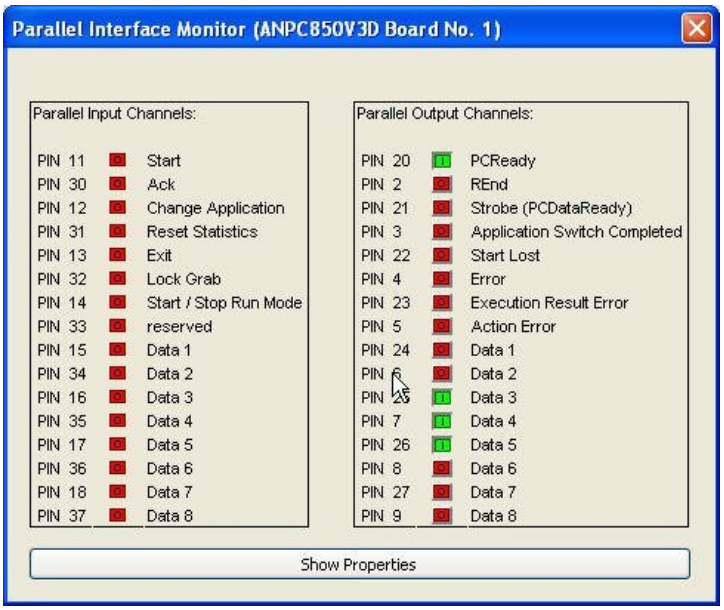
The demo version of Vision P400 does not use cameras, but loads the images as a file. Consequently, the times displayed under "Grab Image" are not measured, but computed by Vision P400 to give you the most accurate possible idea of how long image grabbing would take when using cameras. But do please note that

these computed times may differ from the time measured when using real cameras. If you want to know the precise times for execution of an application, you must determine them with the release version of Vision P400.

10.2.12 Parallel Interface Monitor

With the command **System Settings → Interfaces → Monitor: Parallel Interface** or **View → Monitor: Parallel Interface** command or by clicking the icon, you can monitor the line states of the parallel interface and the communication with a remote station

- in run mode and
- make changes in setup mode for testing purposes.



Parallel interface monitor (with digital I/O board ANPC 850V2D)

For each input and output signal, the monitor displays the pin number where the signal will be output or received as well as the status and the signal name. The pin number for the signal depends on the type of digital I/O board (see page 11) you are using.

In the "Parallel Input Channels" column, you can supervise the input status, e.g. whether or not the starting signal originates as it should from a peripheral device connected to the parallel interface.

In the "Parallel Output Channels" column, you can edit the signals on the output channels in setup mode and thus test the output devices. In run mode, you can only supervise the output status with the digital I/O monitor.

This function is especially valuable when you need to check the communication in handshake mode (see page 179).

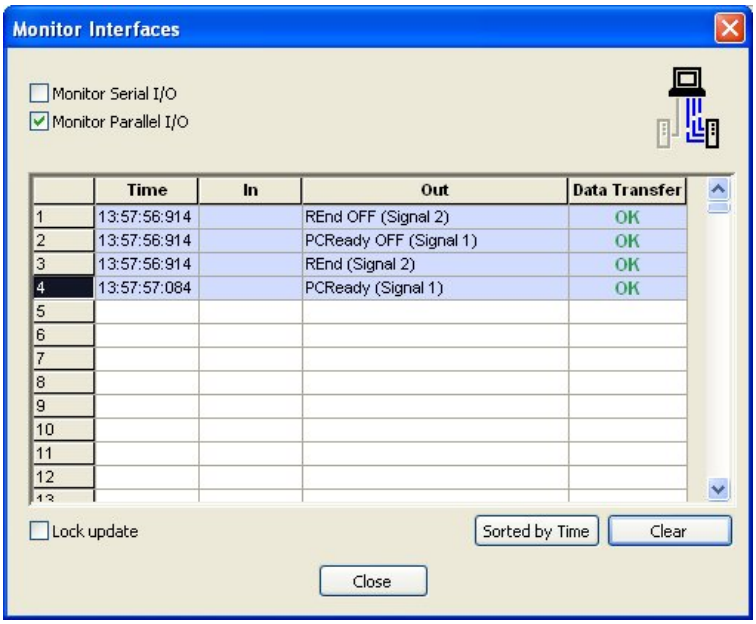
◆NOTES

- **The display is updated with every change of a signal.**
- **We recommend switching off the parallel interface monitor when you are in run mode. Otherwise, it may effect the time response of the system negatively.**
- **If you have activated (see page 173) the option "Start lost signal" under** System Settings → Interfaces → Parallel I/O**, the text for "Byte overflow" changes to "Start lost" (and vice versa).**
- **When you have deactivated the sending of a signal on the property page of the parallel interface, e.g. the PCReady signal, the name of the signal is grayed out on the parallel interface monitor. To open the property sheet use** System Settings → Interfaces → Parallel I/O **or click the button [Show Properties].**

10.2.13 Monitor Interfaces

With the **System Settings → Interfaces → Monitor Interfaces** or **View → Monitor Interfaces** command you open the "Monitor Interfaces" window. Here you can see the signals and/or data which are sent or received via the parallel or the serial interface. The signals and/or data are displayed in a buffered table with four columns. The buffer can store up to 500 entries. This means the entries at the beginning of the table will be overwritten when the table is full.

The currently last entry has a black mark in the first column. Data with light blue shading are transferred with handshake (see page 179).



The table columns display the following content:

First column	Time	In	Out	Data transfer
Line number. The last entry is marked in black.	Time when the signals and/or data have been sent or received	Received signals and/or data	Sent signals and/or data	OK = Data transfer has been successful NG = Error during data transfer. Please check the connected peripheral device.

How the signals and/or data in the columns "In" and "Out" will be displayed depends on which interface you have selected:

Serial interface	Parallel interface
The columns display exactly the characters that have been sent or received. Please note that the separation characters (see page 549) for sent data are user-definable. Non-printing characters like "\t" cannot be displayed correctly on the monitor, but will be sent as a normal character string.	Data: the bit pattern that has been sent or received Signals: name of the signal

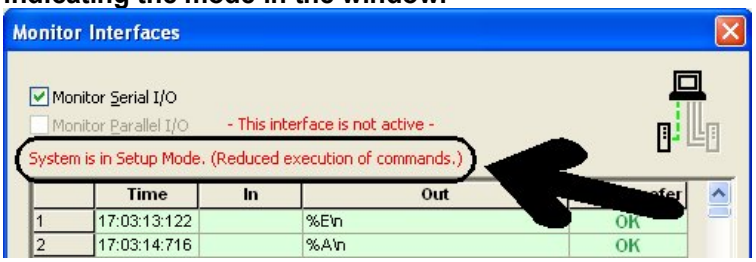
You can make the following settings in the window:

Option	Functionality
Monitor serial/digital I/O	Select whether you wish to see the data communication of the serial or parallel interface.
Lock update	When you activate this check box, no entries will be added even if Vision P400 sends or receives signals and/or data. Activate this check box when you wish to examine old entries in the table without having to fear they will be overwritten by new entries.
Sorted by time	As the monitoring function is buffered it may happen that older entries are listed before newer entries in the table. Click the [Sorted by Time] button to sort the table entries so that the oldest entries are displayed at the top and the newest at the bottom of the table.
Clear	Use this button to delete all entries from the table.

Please note the following when you work with interface monitoring:

◆NOTES

- **Vision P400 only sends and receives signals and data in run modus. As long as you are in setup mode (icon is active) no new signals or data are displayed. If the system is in setup mode, you see a red message text indicating the mode in the window.**



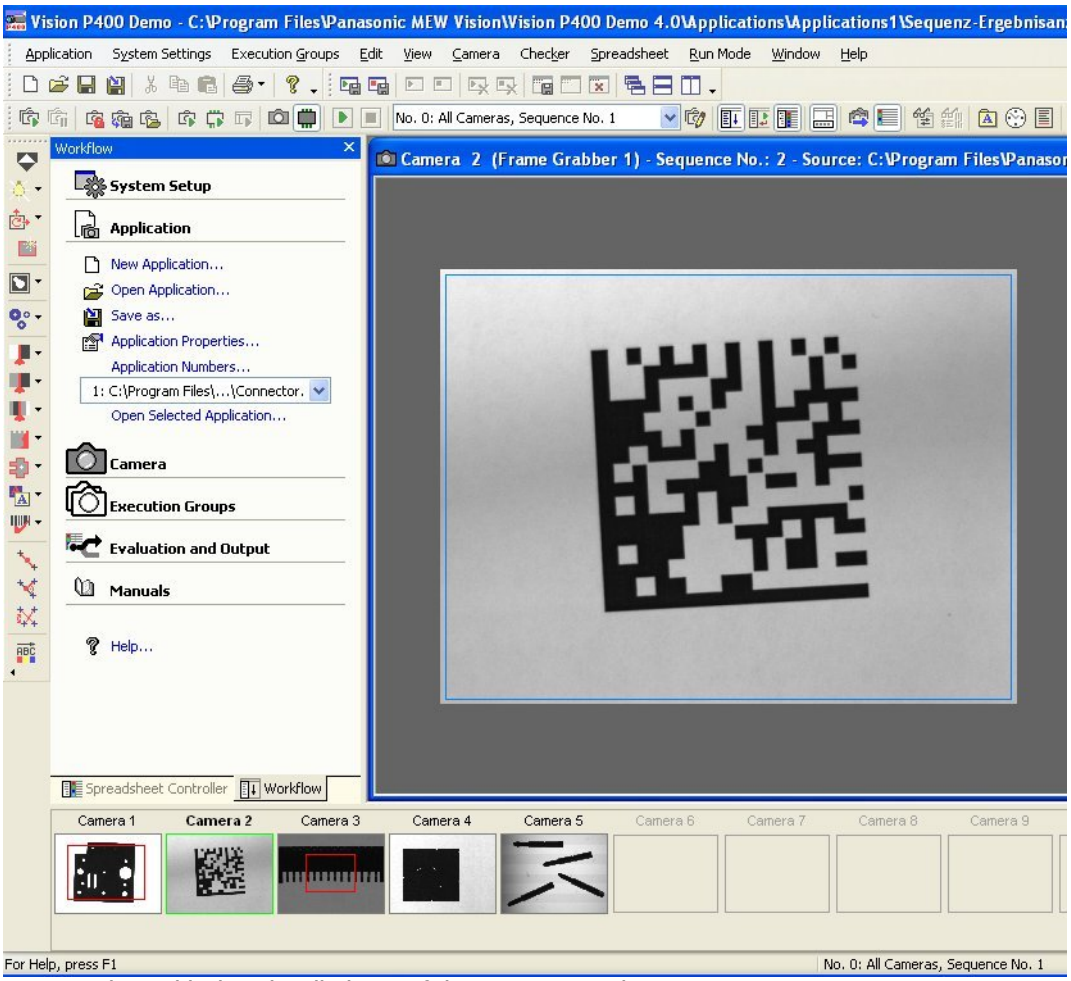
- **Signals and/or data are only recorded when the "Monitor Interfaces" window is open. When you close and re-open the window, the monitoring is started again, i.e. the table is empty again.**

- **When you switch from the serial to the parallel interface (or vice versa), the monitoring is started again (Vision P400 deletes all entries in the table).**
- **If the data transferred or received are too long to fit in the table, click into the cell with the left mouse button. Then the data will be displayed as a tool tip.**

10.2.14 Camera Bar

The camera bar shows thumbnail images from all connected cameras in ascending order. The camera bar is started by default with Vision P400 and docked in a fixed position at the bottom of the screen above the status bar. You can show and hide the camera bar as required by choosing **View** → **Camera Bar** or by clicking on the icon.

Click on the next thumbnail view to switch from one camera to the next. The image from the current selected camera is displayed in large format in the main window and its thumbnail is framed in green. If the camera image is larger than the window, such as because you have used a zoom function, a red segment marker in the thumbnail indicates the area of the image currently on display in the main window. You also see the red segment marker on the thumbnails which are currently not selected.



Camera bar with thumbnail views of the 5 connected cameras

You can alter the height of the camera bar. Position the cursor on the border between the main window and the camera bar until the cursor turns into ⇳. If you now press and hold down the left mouse button, you can enlarge or reduce the bar. The thumbnails are displayed correspondingly smaller or larger.

10.2.15 Workflow Window

The workflow window displays the steps required to configure Vision P400 and to create and launch an application. By default, the window is at the left between the checker bar and the main window with the camera image.

The menu items in the workflow window are arranged so that you can locate the key steps in configuring an application quickly and easily.

All functions in the workflow window are also available in the submenus on the main menu bar or on the toolbars.

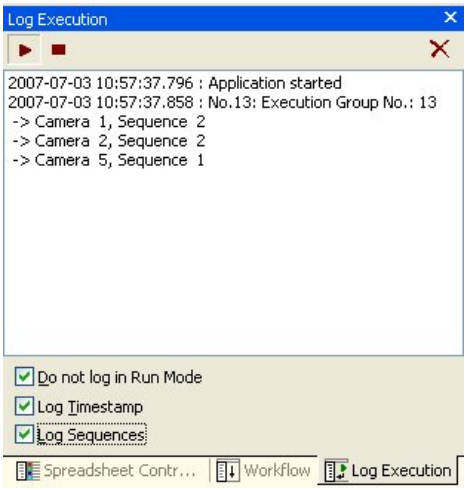
Workflow Window

◆NOTE

You can assign applications numbers (see page 153). You can select all applications which you have assigned a number by way of the list box and open them with "Open Selected Application".

10.2.16 Log Execution

With **View** → **Log Execution** or by clicking you can create an additional "Log Execution" tab in the workflow window. The execution log records information including when an application was started, which execution group was executed with which checker sequences in the process, and which IfCase formula activated which execution group to execute.



Example of an execution log

The following options are available:

Setting Option	Functionality
Do not log in Run Mode	The log is only kept in setup mode.
Log Timestamp	The date and time of the application execution are logged
Log Sequences	If you activate this option, apart from the number of the executed execution group the camera and sequence numbers are also displayed. That is helpful when you are working with IfCase formulas.

10.2.17 Status Bar

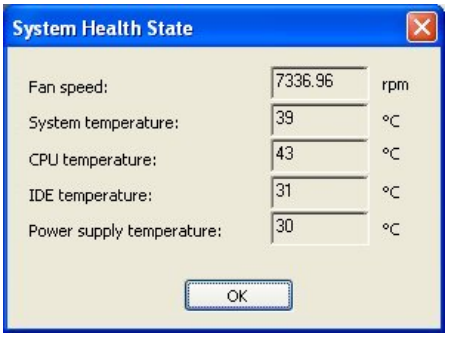
With **View** → **Status Bar**, you can choose whether to show/hide (see page 116) the status bar (see page 105).

10.2.18 System Health State

Use **View** → **System Health State** to display the following system parameters:

- fan speed,
- system temperature,
- CPU temperature,
- IDE temperature, and
- temperature of the power supply.

It depends on your hardware and software configuration of Vision P400 whether respectively which parameters can be displayed.



Displaying the system health state

Chapter 11

Camera

11.1 Introduction

You can use the frame grabber ANPC 802D in two different operating modes with Vision P400: serial and parallel. Please refer to the table for possible combinations (see page 40).

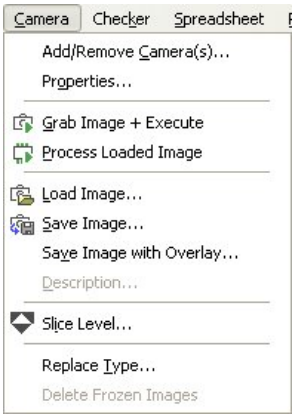
- ANPC 831D (see page 42)
- ANPC 834D (see page 48)
- ANPC 836D (see page 54)
- ANPC 837D (see page 61)

With Vision P400, you can control up to 3 frame grabber boards with the corresponding number of cameras.

◆NOTES

- **Each application works with one type of camera only. Please refer to the table (see page 40) to find out how many cameras you can connect in serial or parallel operating mode to the frame grabber.**
- **Use** System Settings → Vision P400 Settings → Frame Grabber **to define how Vision P400 should detect cameras (see page 145).**

How you connect and control a flash depends on the type of digital I/O board you are using.



Submenus of the "Camera" menu

11.2 Submenus

The submenus in the **Camera** menu will be described in the following sections.

11.2.1 Add / Remove

With **Camera** → **Add/Remove Camera(s)** you open a dialog box showing all cameras known to Vision P400. Depending on whether you create a new application or modify an existing application by adding or removing cameras, the dialog box will look slightly different:

- If you are creating a new application or have not added any cameras yet, you first select the camera type and the image format.
- When you have already added at least one camera to the application (which means that you have already determined the camera type for the application), you see the selected camera type and the image format displayed here.

◆**NOTES**

- **The layout of the camera selection dialog box depends on the number of frame grabbers you are using and whether you work with serial or parallel image grabbing.**
- **Each application works with one single camera type only. Once the camera type has been selected, it can only be changed if you remove all cameras from the application first. Alternatively, create a new application if you wish to work with a different camera type.**
- **With existing applications it is possible to add and remove cameras in one step.**

Button [Check Connected Cameras Now]

Normally Vision P400 does not check every time you start the program which cameras are connected. Instead, Vision P400 lists all cameras in the camera selection dialog box which are known from the last session. Only if there are no cameras known does Vision P400 search for cameras in order to be able to list them in the camera selection dialog box.

◆**EXAMPLE**

The system cannot detect by itself whether for example camera 1 has been removed and camera 2 has been added since the last program start. Vision P400 will continue to offer camera 1, while camera 2 will not be listed as connected.

By selecting [Check Connected Cameras Now] you make sure that when you start Vision P400 next, the system ignores all the information about connected cameras and actually checks which cameras are currently connected to the system. When you start Vision P400 again, the program checks for connected cameras. For the example given above it would mean that Vision P400 no longer lists camera 1, but camera 2.

◆NOTES

- **When you select [Check Connected Cameras Now], you need to confirm that you wish to exit Vision P400 now. Restart Vision P400 manually.**
- **If you change the camera configuration, you must select [Check Connected Cameras Now] and restart Vision P400 to display the new configuration in the camera selection dialog box.**
- **When a camera provides only black images it is possible that this camera has been removed from the application since the last start of Vision P400 without the "Check One Time" option (**System Settings → Vision P400 Settings**, "Frame Grabber" property page) or the [Check Connected Cameras Now] button having been activated.**
- **When you are creating a new application, the first connected camera is preselected in the dialog box. If you want to close the dialog box without adding the preselected camera, use the [Do Not Select] button.**

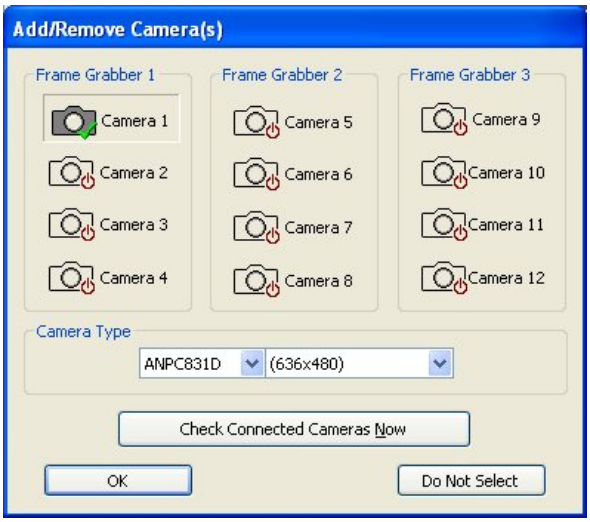
11.2.1.1 When Creating a New Application

When you create an application or when you have removed all cameras from an application, you select the camera type and the image format as well as the number of connected cameras.

◆Procedure

1. **Select one or more cameras by clicking the corresponding button**

   The first known camera is already selected for you.



2. **In the "Camera Type" list box select the connected type**

   The list boxes for selecting the camera type and the image format will only be displayed if you create a new application or if you have not defined the camera type yet.

3. **Select the correct image format on the right**
4. **Click [OK]**

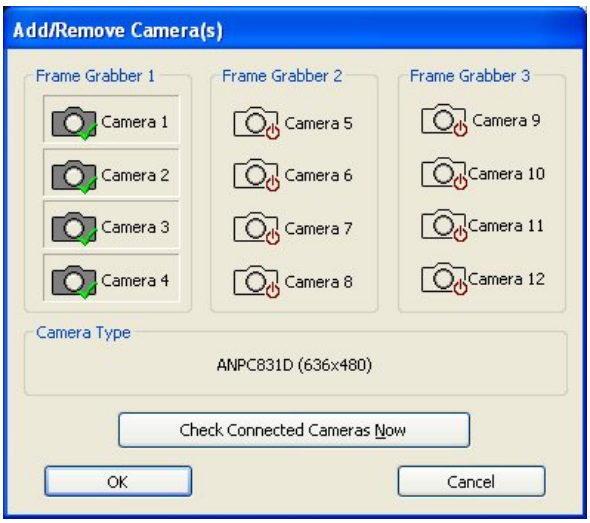
   The image format must agree with the format you have selected in the camera configuration (see page 69) or set by the DIP switches (see page 56) on the camera. Whether you need to use the camera configuration or the DIP switches depends on the type of camera.

11.2.1.2 When Modifying an Existing Application

With existing applications, you can add more cameras of the same type and with the same image format at any time:

◆Procedure

1. **Select one or more cameras by clicking the corresponding button**



   In the figure above you can see all the cameras known to Vision P400. If a camera is grayed out it means that it is available on the frame grabber(s) used, but it is not yet known to Vision P400. These cameras cannot be selected.

◆NOTE

Each application works with one single camera type only. The camera type cannot be changed later. If you wish to use a different camera type or image format, you need either to create a new application or remove all cameras from the application.

11.2.1.3 Removing Cameras from an Application

You can remove cameras from an existing application at any time:

Procedure

1. **Camera → Add/Remove Camera(s)**
2. **Remove one or more cameras by clicking the corresponding button**
3. **Click [OK]**

   Vision P400 asks you to confirm for each camera you have selected before whether you really wish to remove it from the application.
4. **Select [Yes] to confirm**

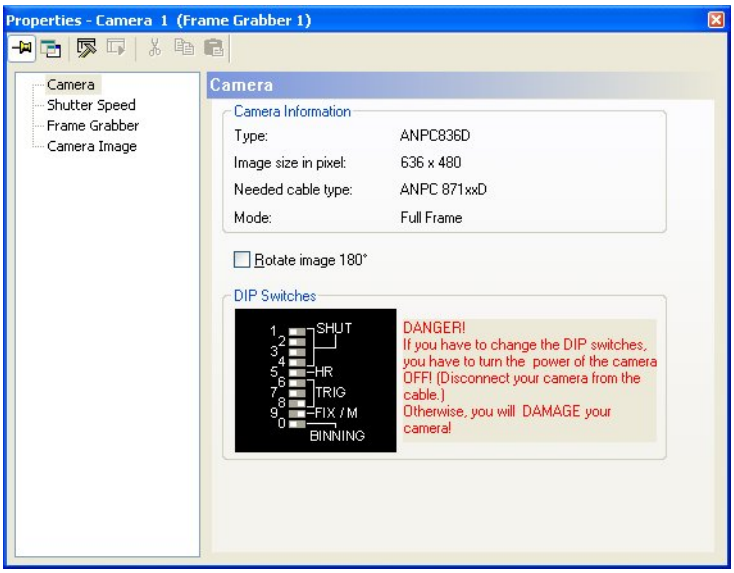
   If you confirm, the camera will be removed from the application.

11.2.2 Properties

With **Camera → Properties...** you open the property page of a camera. There are four pages: "Camera", "Shutter Speed", "Frame Grabber" and "Image".

11.2.2.1 Camera

On the page "Camera" you see the camera type and operation mode which has been selected for the current application.



Camera properties, "Camera" page

Type

Shows the camera type you have selected.

Image size in pixel

Shows the size of the camera image in pixels (width x height).

Needed cable type

Shows the type of cable required for the currently selected camera type.

Mode

Shows the operating mode of the camera. The following operation modes are available:

Operation mode	Description
Full frame	The image comprises the maximal view range of the camera.
Partial scan	The image comprises a part of the camera's view range. The camera transfers only a certain number of lines to the image memory.
Binning	The binning mode is available only for cameras ANPC (see page 54) 836D (see page 54) and ANPC (see page 61) 837D (see page 61). The binning mode is combined with one of the two other modes. In binning mode an odd and an even line of the camera image are combined into one line by compression. This reduces the resolution by half. Consequently, the image capture time is reduced. **Note:** **The image lines will be doubled again for monitor display and the calculation of the checkers. This means you can carry out position and rotation adjustment as well as angle calculation as usual.**

Rotate image 180°

If you activate this option, the camera image will be rotated by 180° degree after grabbing. Please note that it takes some processing time to rotate the image. The time needed for rotating the image depends on the size of the image and needs to be added to the time for image grabbing.

DIP switches

If you are using camera ANPC 836D or ANPC 837D, you set the operation mode via the DIP switches (see page 56). The picture shows how you need to set the DIP switches on the back of the camera for the currently selected camera type and image format so that the camera provides a good image.

Danger of damage to the camera!
Disconnect the camera cable before you change the setting of the DIP switches. Leaving the camera connected while you set the DIP switches may destroy the camera!

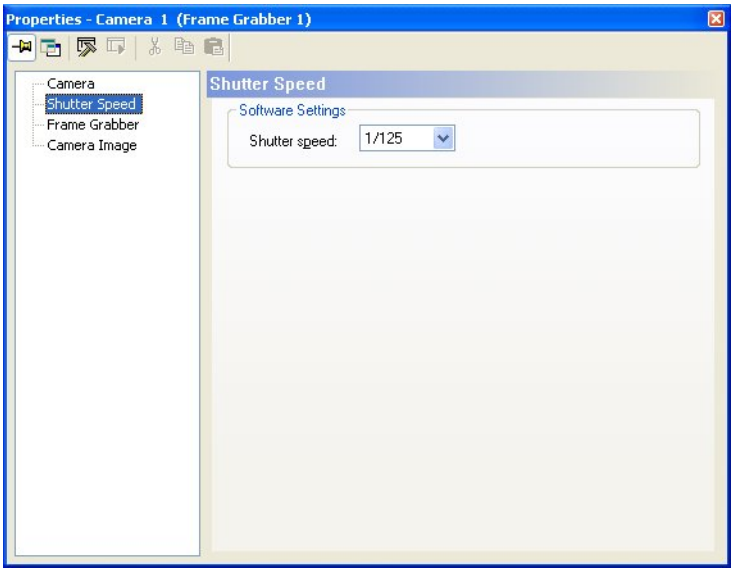
◆**NOTE**

The camera settings on the hardware and in the software have to be consistent. In case of trouble see the table below to diagnose possible causes.

Event	Hardware / Camera Setting	Software Setting
Unsynchronized image	Selected camera resolution is not consistent with setting in Vision P400. The camera type set in the software is not the same as the camera type connected.	Selected camera resolution is not consistent with the camera setting.
Unsynchronized image	More than one frame grabber installed, but no FG Sync. Adapter.	
No flash signal	The Flash Trigger Unit has not been connected to the master frame grabber.	The option "Send Flash Signal" on the property page "Frame Grabber" (see page 265) has not been activated.
The camera is not recognized when you start Vision P400	The camera configuration has been changed	Select **Camera → Add/Remove Camera(s)** and then click the [Check Connected Cameras Now] button
The camera image is black	The camera configuration has been changed: You have disconnected a camera from the system.	Select **Camera → Add/Remove Camera(s)** and then click the [Check Connected Cameras Now] button
The camera image is black	The camera configuration is correct.	The preset shutter speed is too short. Change the setting on the "Shutter Speed" property page. The aperture of the camera is closed.

11.2.2.2 Shutter Speed

You can make the following settings on the "Shutter Speed" property page:



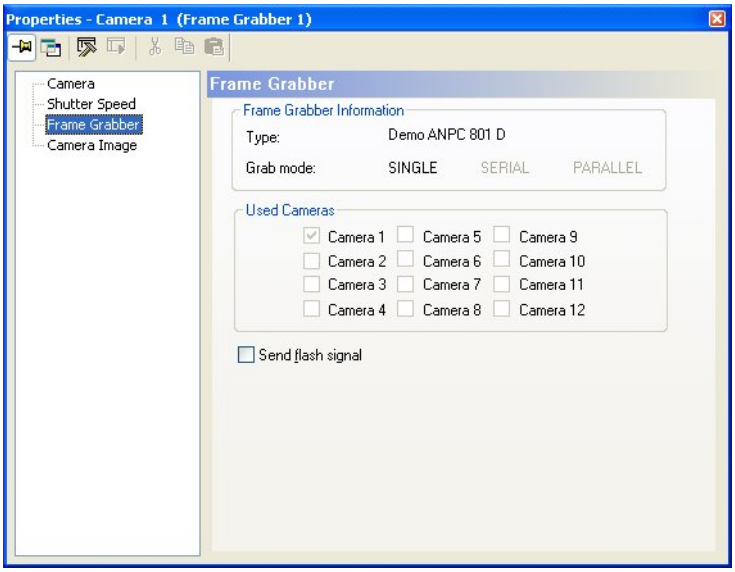
Camera properties, "Shutter Speed" page

Software Settings

"Shutter speed": In this field you enter the opening time for the shutter.

11.2.2.3 Frame Grabber

On the page “Frame Grabber” you can see information on the frame grabber.



Frame grabber property page

Type

The system detects the frame grabber type automatically and displays the appropriate number.

Grab Mode

Shows which grab mode has been selected for the current application.

Grab Mode	Explanation
Single	Displays when only one camera is used by the application.
Serial	Displays when the application uses more than one camera and works with one or more frame grabbers of type ANPC 802D.
Parallel	Displays when the application uses more than one camera and works with one or more frame grabbers of type ANPC 802D.

Used Cameras

Shows which cameras are used in the application.

Send Flash Signal

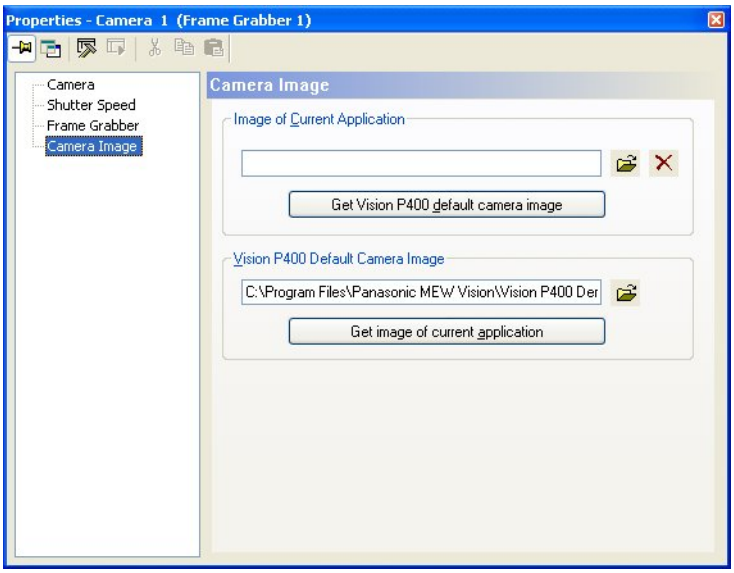
If this option is activated (default: OFF), Vision P400 sends a signal to the connected flash. You can set a delay for the camera or for the flash, if required. Vision P400 calculates the delay time and displays it grayed out.

Option	Setting	Explanation
Delay mode	No delay	Flash signal is sent without delay.
	Camera is delayed	The camera shutter is triggered with delay.
	Flash is delayed	Flash signal is sent with delay

Option	Setting	Explanation
Rows	<Numeric>	Enter the number of image rows to be read before Vision P400 triggers the camera shutter or the flash.
Delay time (µs)	Cannot be edited	Vision P400 calculates the delay time from the number of (image) rows you have entered.

11.2.2.4 Image

The "Image" property page is only visible in the demo version. Here you can select a bitmap file, which will be used as the camera image.



Camera properties, "Image" page

Image of current application

In the Vision P400 demo version you can select a bitmap file for each camera in an application, to be used as the image. The name of this file is stored in the application, but the file itself is not. This means you can use different images in different applications for the same camera.

◆NOTE

Use relative path names if you also want to run the application on a different computer. For the "Image of Current Application" field a relative path name is initially relative to the folder in which the application is saved. If it has not yet been saved, or if the specified image is not found there, the entered path name relative to the installation folder of your Vision P400 demo version is interpreted second. The absolute path name currently being used is displayed as a tool tip.

◆EXAMPLE

Application location: C:\Program Files\Panasonic MEW Vision\Applications
Location of Vision P400 demo version: C:\Program Files\Panasonic MEW Vision\Vision P400 Demo 4.0

The entry "Speicherchip1.bmp" in the "Image of Current Application" field signifies that the "Speicherchip1.bmp" file must be either in the folder C:\Program Files\Panasonic MEW Vision\Applications or in the folder C:\Program Files\Panasonic MEW Vision\Vision P400 Demo 4.0. If the file is in both folders, the one from the application folder C:\Program Files\Panasonic MEW Vision\Applications is used.

As well as the method of selecting a bitmap by the browse function with , you can also drag & drop a bitmap from the Explorer into the camera window. If you press <Shift> at the same time, the bitmap from the Explorer is saved as the camera image for the current application.

Click on the button to delete the entry under "Image of Current Application". The associated file is not deleted. If you have not selected a file - meaning the input box is empty - the bitmap file you selected under "Vision P400 Default Camera Image" is used as the camera image.

Vision P400 default camera image

Here you can select a bitmap file, which will be used as the predefined default camera image. The predefined image of a camera applies to all applications, and is used whenever no file is selected under "Image of Current Application" or the selected file does not exist. Here, too, you can use relative path names.

◆NOTE

As opposed to the relative path names under "Image of Current Application", relative path names here are only ever interpreted relative to the installation folder of your Vision P400 demo version. The absolute path name currently being used is displayed as a tool tip.

As well as the method of selecting a bitmap by the browse function with , you can also drag & drop a bitmap from the Explorer into the camera window. If you press <Ctrl> at the same time, the bitmap from the Explorer will be entered here as the predefined default Vision P400 camera image.

Get Vision P400 default camera image

If you click on this button, the bitmap file entered under "Vision P400 Default Camera Image" is applied as the image for the current application, meaning it is entered under "Image of Current Application".

Get image of current application

If you click on this button, the bitmap file entered under "Image of Current Application" is applied as the predefined image for all applications of Vision P400, meaning it is entered under "Vision P400 Default Camera Image". In this, please note that for the camera image of the current application relative path names are always relative to the installation folder of your Vision P400

demo version. That means that you can only import an image with a relative path name from "Image of Current Application" if the file to which it links is also in the installation folder of your Vision P400 demo version.

◆NOTES

- **When you select a new bitmap, the new image is only displayed after the next grab image command (press <F7> to grab and process an image or <F5> to execute the application). Note that for bitmaps which have not been created by Vision P400 certain restrictions (see page 269) apply.**
- **If a file name is entered under "Image of Current Application" and the file exists, it is used; otherwise the file entered under "Vision P400 Default Camera Image" is used.**
- **If no file name is entered under "Image of Current Application", the file entered under "Vision P400 Default Camera Image" is used.**
- **If the file under "Vision P400 Default Camera Image" does not exist, a black image is output labeled "Error".**
- **Please note that the file name entered under "Vision P400 Default Camera Image" is not stored in the application, but is computer-specific. So if you run an application on a different computer than the one on which you created it, and you have not defined a camera-specific image under "Image of Current Application", the image specified on the execution computer under "Vision P400 Default Camera Image" is used for the camera.**

11.2.3 Grab Image + Execute

With **Camera → Grab Image + Execute** or by clicking you load the current camera image and execute all checkers which have been assigned to the image.

◆NOTE

When you select Camera → Grab Image + Execute**, the loaded image will be replaced by the current image, unless the function "Lock Grabbing" (see page 126) has been activated.**

11.2.4 Process Loaded Image

With **Camera → Process Loaded Image** or by clicking you test all defined checkers on an image loaded (see page 269) from a storage device or your hard disk.

This gives you the opportunity for a test run of the checkers on a predefined image.

11.2.5 Load Image

With **Camera → Load Image** you can load an image which has been saved by Vision P400 in bitmap format (.BMP) without overlay (see page 270). Images in the following formats can also be loaded: .PNG, .TIFF, .GIF, .JPG, .PCX.

This way you have an opportunity to test checkers on a test image rather than a live image or just to display the image on the screen. If you have saved a description with the image (see page 269), it will be displayed together with the image. This option only exists for images in bitmap format.

If the image you wish to load is bigger than the image format of the currently active camera type, the areas beyond the valid image size will be cut. If the image is smaller, the areas which are not covered by the loaded image are filled with black.

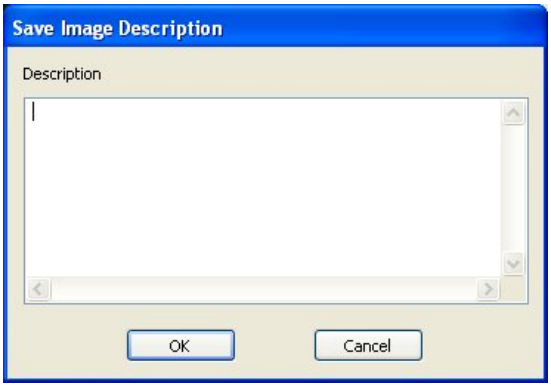
You can also load an image with drag & drop: Select the bitmap file in the Windows Explorer, drag it to Vision P400 and drop it in the camera window. If you work with the demo version and press <Ctrl> when you drop the image, the dragged image will be saved as the predefined camera image (see page 262). This is the same option as "Vision P400 Default Camera Image" on the property page "Camera Image " (**Camera → Properties**).

◆NOTES

- **To load a bitmap image, you need to switch the display to memory image with** View → Image → Memory**. You cannot load a bitmap in live mode.**
- **Loading a bitmap image will activate lock grabbing (i.e. the function usually executed by clicking). This way the loaded image will not be overwritten by the new camera image. However, lock grabbing will not be activated when you drag & drop a bitmap from the Windows Explorer.**
- **When you wish to use a bitmap which has not been created by Vision P400, make sure that it uses a color table which maps the pixel values 0...255 to the RGB colors (0,0,0)...(255,255,255). For more information on bitmaps, please see http://msdn.microsoft.com/library/default.asp?url=/library/en-us/gdi/bitmaps_85ke.asp.**
- **Note that file formats such as .PNG or .JPG contain compressed image data which may produce unexpected results during analysis.**

11.2.6 Save Image

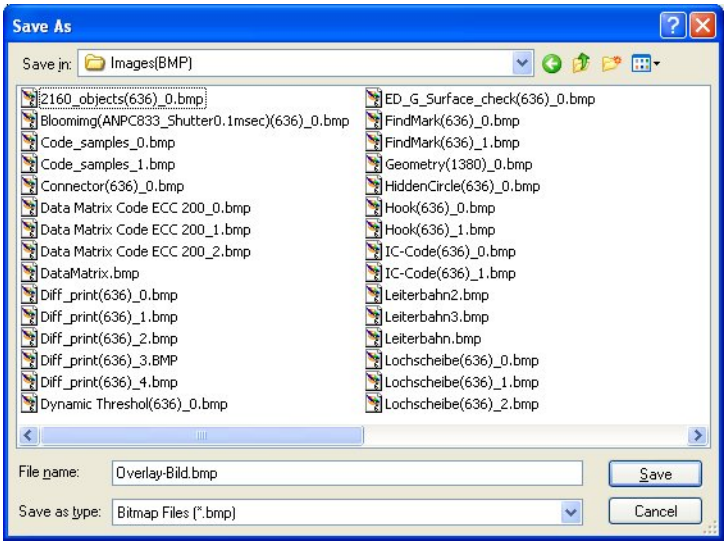
With **Camera → Save Image** or by clicking on you can save the current camera image shown on screen in .BMP, .PNG or .TIF format. You can save an image description along with the image in bitmap format.



Enter description of the image to be saved

11.2.7 Save Image with Overlay

Choose **Camera** → **Save Image with Overlay...** to save the current image on the monitor including all the checker shapes, indicators and results. The following file formats are available: .BMP, .PNG, .TIF, .GIF, .JPG and .PCX.



Save camera image together with checker shapes and results

◆**NOTE**

The saved image can be used for documentation purposes. However, images with overlay cannot be loaded and displayed in Vision P400.

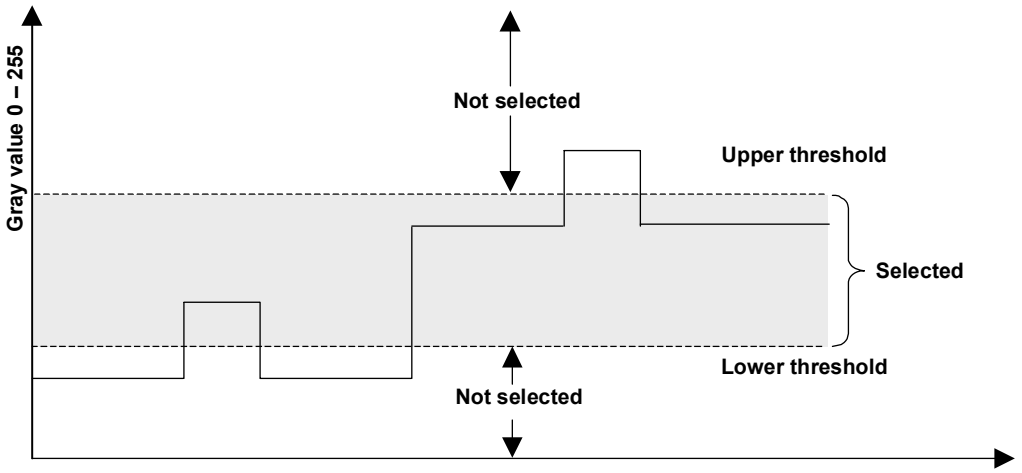
11.2.8 Description

This option displays the image description of a bitmap image. It is only active when you have loaded a bitmap image that has a description.

11.2.9 Slice Level

With **Camera** → **Slice Level** or by clicking you set the slice level according to which the gray-value image in the memory will be transformed into a binary image.

In other words, the slice level serves as a binary threshold. Generally, pixels in between the lower and the upper threshold are part of an object, the others are not.



Upper/lower binary threshold for the slice level

On the screen display, all pixels lying in between the upper and lower threshold are marked in the color (see page 129) selected for the checker's slice level. In the checker description, these pixels are called "Selected". Pixels found beyond the threshold are called "Not Selected".

We differentiate between the camera slice level and the customized slice level. The camera slice level is a global setting, which you configure in this option either manually or automatically by setting the value suggested by Vision P400. The customized slice level, on the other hand, is a special setting for each checker. Set the customized slice level in the "Algorithm" page of each checker.

If a customized slice level has been set, it will be used for binarisation within a shape. If not, the system uses the camera slice level for binarisation.

The slice levels can be adjusted to temporarily changing light conditions by using an exposure adjustment checker (see procedures below).

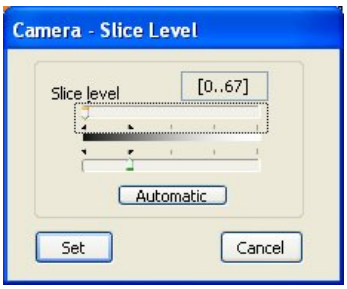
11.2.9.1 Setting the Slice Level Manually

Set the camera slice level manually and see how this effects the objects detected in the camera window.

Procedure

1. **Camera → Slice Level**

   The "Camera - Slice Level" window appears.



2. **Click on the slider**

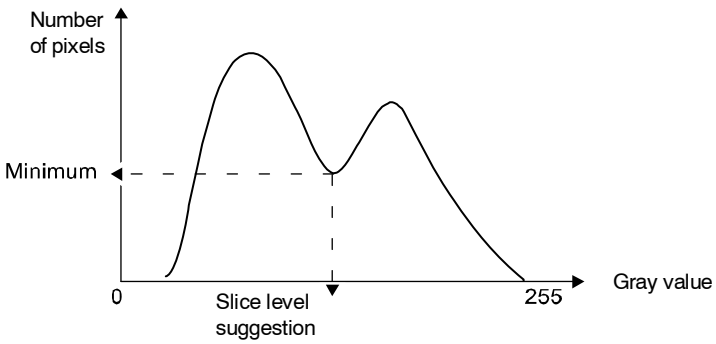
   Set the lower slice level with the first slider and the upper one with the second slider.

3. **Hold the mouse button and move the slider**

   Use the keys <PgUp>/<PgDn> to change the position of a slider by +/– 1. Watch the camera window to see the effect of your settings on the detection of objects in the camera window.

11.2.9.2 Setting the Slice Level Automatically

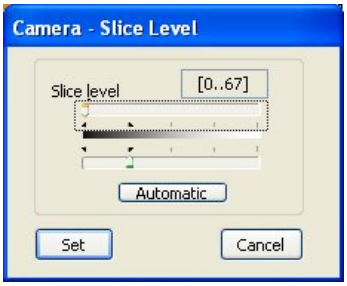
When you use this function, Vision P400 creates a gray-value histogram within the camera image. Then Vision P400 calculates the binary threshold with the help of the minimum's position in the histogram. Please note that the value displayed here is only a suggestion for setting the slice level. This value will not be recalculated when the system executes the checkers.



Slice level - automatic setting

◆Procedure

1. **Camera → Slice Level**



2. **Click [Automatic]**

   Vision P400 suggests a slice level value.

3. **Click [OK]**

   The value suggested by Vision P400 is set as the camera slice level.

◆NOTES

- **If a checker depends on a position and rotation adjustment, the customized slice level applies to the adjusted shape. If you want the slice level to apply to the original shape, you need to delete the dependency of the position and rotation adjustment before setting the customized slice level. After determining the slice level, re-create the dependency relationship.**
- **If a checker depends on an exposure adjustment, this is taken into account when you set a customized slice level.**

11.2.10 Replace Type

Use this option when you wish to switch from the old to the new camera types with your image-processing system.

When you select this option, Vision P400 displays a warning message with items you need to check before changing the camera type.

- Check the camera settings (see page 262)
- Check whether the checkers can stay at the positions where you set them for the old camera types and modify their size and/or position, if necessary.

When you select "Yes" to change the camera type, Vision P400 proceeds as follows:

1. Vision P400 automatically saves the original application under a new name. The layout of the file name is as follows: <original name>_BCR.nav
2. Vision P400 displays a dialog box in which you select the new camera type and confirm with [OK]
3. Vision P400 replaces the old camera types with the new ones

4. Vision P400 saves the application under the original name Now the new camera types are supported
5. Vision P400 is closed automatically

Start the program again.

11.2.11 Delete Frozen Images

With this command you delete NG images from the image memory, when the action (see page 565) has been triggered on the Spreadsheet. The action enables you to hold NG images in run mode on screen, such as when specific errors occur or a specific number of errors has been reached for example. On switching from run to setup mode you can save the displayed NG image. When you then switch back to run mode, the first or last NG image is displayed, depending on the setting.

◆**NOTE**

This command is also available by way of the pop-up menu in the image.

Chapter 12

Checkers

12.1 What is a Checker?

Checkers are flexible image processing tools that group several image processing algorithms together and execute them. They either

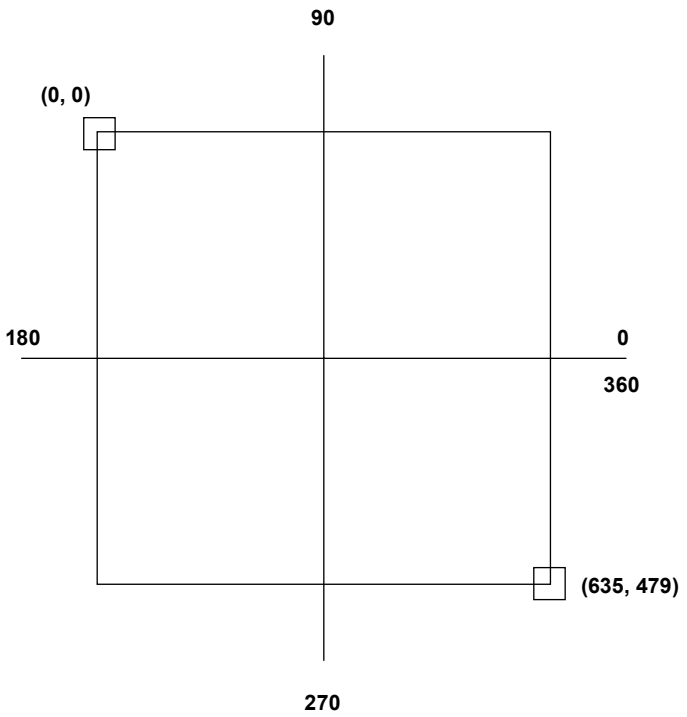
- work directly on an image area or
- deduce results from the findings of other checker results.

One checker that works directly on an image area is the feature extraction checker. It calculates certain object features in an image, such as the object's size, etc.

The second type of checkers to work with the results of other checkers, are the position and rotation adjustment checkers and the geometry checkers. Position and rotation adjustment checkers are used to reposition an image area which is being worked on by a checker based on the results of another checker (see page 322). A geometry checker calculates, for example, the distance between two points calculated by another checker.

The unit for checker results concerning point coordinates, length, distance, or area size are all in **pixels**. All checker results concerning angles use **degrees** as a unit.

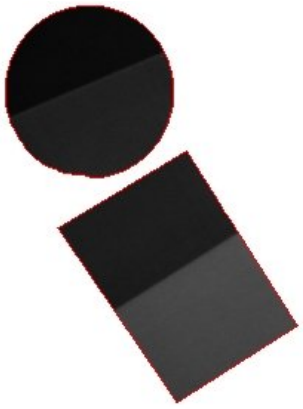
The following system of coordinates applies for all coordinates and angles in Vision P400:

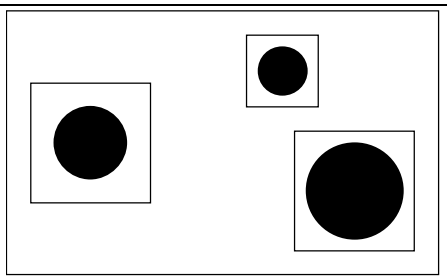


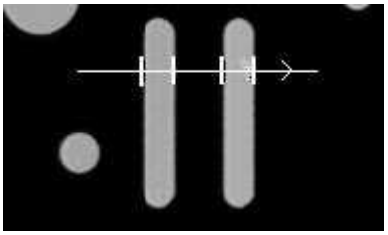
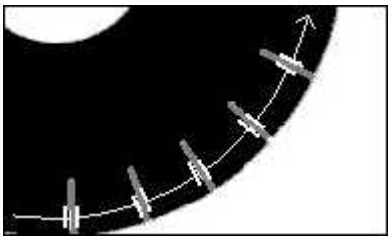
System of coordinates in Vision P400

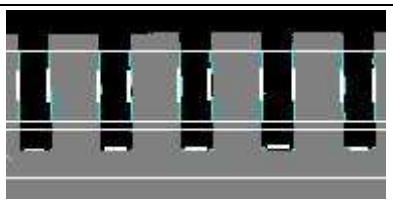
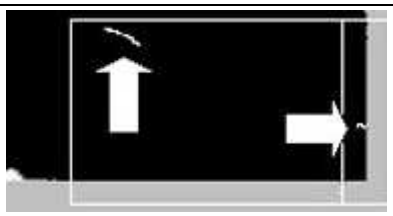
12.1.1 Available Checker Types and Usage

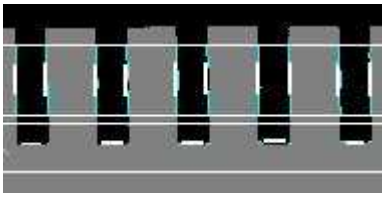
This section contains an overview of the available checkers and their typical usage.

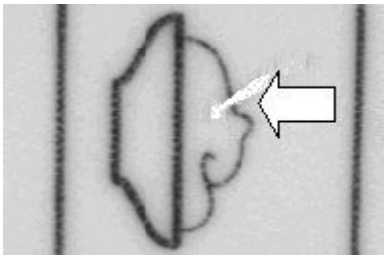
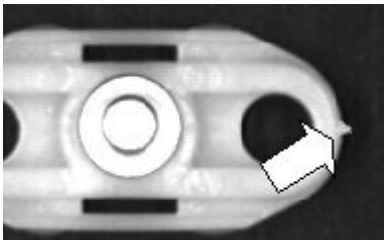
Object Shape (OS)		
Algorithm	Interlinking of the result objects of different checkers to form an inspection area	Morphological filter Object filter Quantity operations
Usage	Calculation of the inspection area for objects with complex or variable contours	
Example	Combination of various located objects to form a checker shape.	

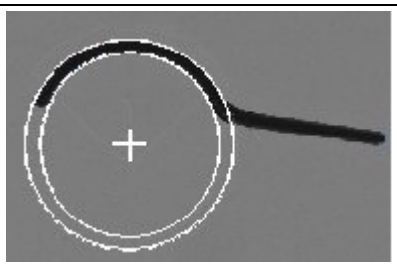
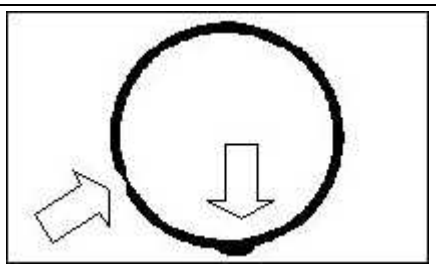
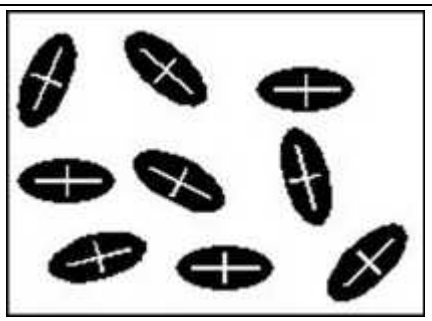
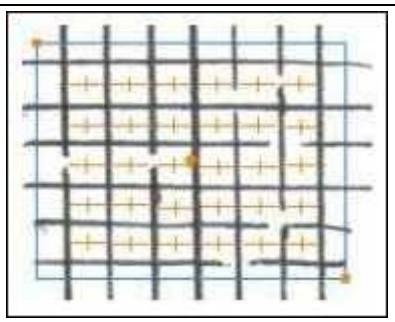
Window (WI)		
Algorithm	Binary, pixel-counting	Gray-value filter Morphological filter Object filter
Usage	Presence check Area calculation Surface inspection	
Example	Holes present = OK Surface = OK	

Edge Detection Binary (ED_B)		
Algorithm	Binary (with pixel accuracy)	Gray-value filter Morphological filter Object filter
Usage	Fast measurement of length/distance Fast angle measurement	
Example	Width of groove = OK	
	Slots cut properly = OK	

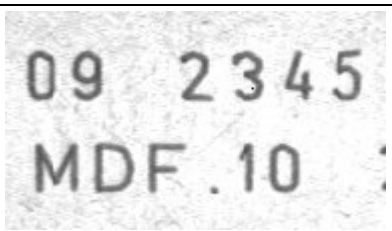
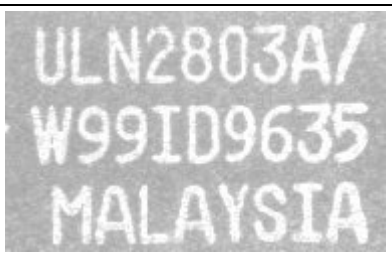
Edge Detection Gray Value (ED_G)		
Algorithm	Gray Value (accurate to sub-pixel level, based on the Sobel filter)	Noise reduction Smoothing Size Direction-sensitive
Usage	Measurement of length/distance Angle measurement Coplanarity check Surface inspection Fractured edges	
Example	Distances/orientation and coplanarity of the plug pins = OK	
	Scratches in the surface, fractured edges = NG	

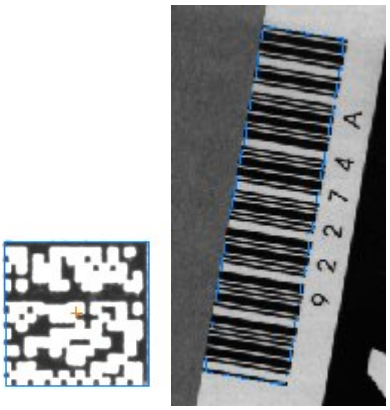
Edge Detection Gray Value Projection (ED_GP)		
Algorithm	Gray Value (accurate to sub-pixel level, based on gray value projection)	Noise reduction Smoothing Size Direction-sensitive
Usage	Very fast measurement of length/distance of edges and edge pairs	
Example	Distances/orientation of the plug pins = OK	
	Edge measurement within a ring segment	

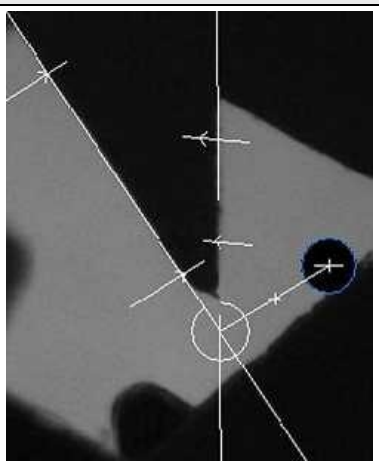
Difference (DI)		
Algorithm	Image pattern subtraction Pattern matching (with subpixel accuracy) Gray-value differential Binary object detection	Morphological filter Object filter Sorting
Usage	Print check Punch check Quality check of injection-molded parts (completeness, ridges)	
Example	Print = NG	
	Ridge near the gate mark	

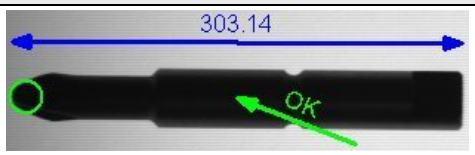
Feature Extraction (FE)		
Algorithm	Binary	Gray-value filter Morphological filter Object filter Sorting
Usage	Object count Position check Roundness check Presence check Thickness check	
Example	Bending radius and center position = OK	
	Checking minimal and maximal thickness of joint ring = NG	
	Check position (angle, X- and Y-coordinate) of 9 objects	
	Checking white squares in a dark grid	

Contour Matching (CM)		
Algorithm	Contour-based pattern matching	
Usage	Presence check Counting of objects Very stable position and orientation recognition	
Example	Position and rotation detection when • object sizes vary • the illumination is likely to change	
	• objects can be hidden or covered partially	

Optical Character Recognition (OCR)		
Algorithm	Segmentation by binary and size data Classifier, gray-value and binary properties	Gray-value filter Morphological filter Object filter Sorting
Usage	Read and verify: • Plain writing • Laser print Object recognition	
Example	Laser print on a box = OK	
	Read ID code of an IC Distinguish labels	

Code Reader (CR)		
Algorithm	Detect and read 1D and 2D codes	
Usage	Reading labels or codes to identify parts	
Example	Read data matrix code ECC200 or bar code Code 39	

Geometry Checker (G_PP, G_PL, G_LL)		
Algorithm	Geometrical calculation of: • Point-to-point distance • Point-to-line distance • Intersection of two lines • Angle between two lines	
Usage	Measure punched parts Measure modules and components	
Example	Measure tooth flanks	

Indicator		
Usage	Presentation of inspection results: • Display of check values • Display of lines, rectangles, ellipses, circles,... • Display of bitmaps • Display of judgement results	

12.1.2 Gray-Value and Binary Checker

With checkers that work directly on the image, we distinguish between gray-value checkers and binary checkers.

Gray-value checkers work on the original gray-value image, while binary checkers work on a binary image, a derivative of the gray-value image. The image area worked on is called the shape. All checker operations (except for the difference checker and the contour matching

checker) are executed exclusively within the range of the shape and do not extend to the overall input image. This results in significant gains in the processing speed.

In order to derive the binary image for the binary checker from the original gray-value image, binarisation thresholds have to be used. Use either a **global threshold** (see page 271) by clicking on or a customized, **checker-specific** threshold for individual checkers. Here you can choose between a static or a dynamic slice level in the checker's property page.

Global means that the slice level is valid for all binary checkers within the checker sequences of the selected camera unless the checkers have been assigned a customized slice level.

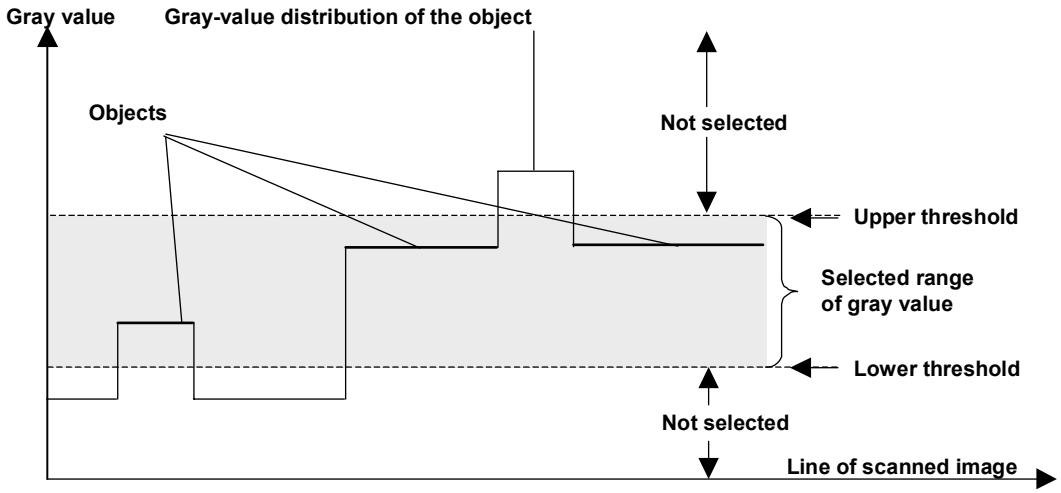
Customized means that the slice level is valid only for the checker as you define the slice level in the checker's property page.

12.1.3 Template

On this page, you may enter templates (image sections) needed as a reference for checkers.

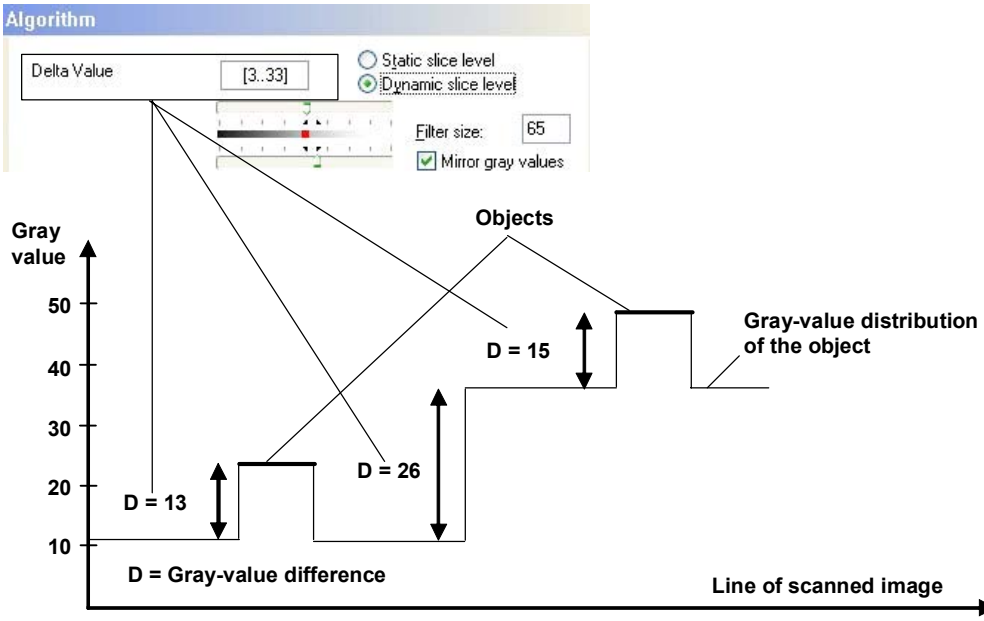
12.1.4 Checker-Specific Slice Levels

With a **static slice level**, all the gray-value image areas whose values fall within the range of the binarisation slice levels are marked. These areas are called **objects**



Static slice levels

With **dynamic thresholding**, the average gray value is calculated in the environment of the pixel. The environment is defined by the filter size. The dynamic slice level is the difference between the gray value of the current pixel and the mean value of the surrounding pixels within the filter area (valid for all binary checkers as well as window and feature extraction checkers, see next paragraph). The image areas in the gray-value image whose difference (the delta value) falls within the pre-set range, are then marked. These areas are called objects, too. They appear in the color (see page 129) you have defined for the slice level. Whereas a static slice level searches for pixels lying in a certain range of gray values, a dynamic slice level searches for a certain difference in the gray values compared to the environment.



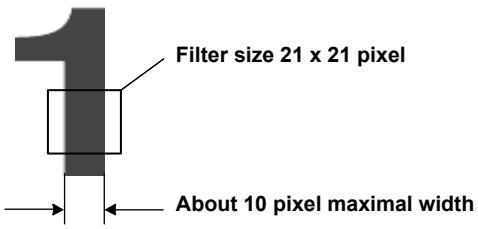
Dynamic thresholding

Filter Size

The "Filter Size" is set to 65x65 by default, but only one axis is displayed on the screen. The filter should be at least twice as big as the maximal size of the target object is on the X-axis and Y-axis.

◆**EXAMPLE**

If the figure is about 10 pixels wide, the filter width should be at least 21 pixels wide.



◆**NOTES**

- **Use the mouse to measure the size of an object. Simply position the cursor on the beginning and the end of the object and subtract the coordinates displayed in the status bar from each other.**
- **Use the mouse to determine the gray value of a pixel. Simply position the cursor on the pixel, and the gray value is displayed in the bottom right corner of the status bar.**

- **The way objects are generated depends not only on the slice level setting. Filters also influence object generation.**

Mirror gray values

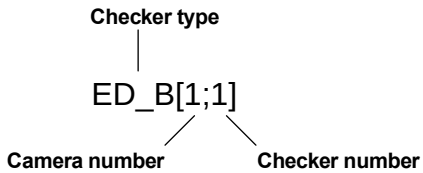
To calculate the dynamic slice level it is necessary to smooth the image. To calculate the smoothing on the margins of the checker shape, gray values outside of the checker shape are also used. Normally in smoothing, the gray values of the image are simply applied at this point for calculation purposes. This can produce unforeseeable effects however, especially at the image edge or in images with strong contrasts. That is why there is the possibility to mirror the gray values inside the checker shape for smoothing of the image edge to the outside.

12.1.5 Checker Label

For ready identification, each checker has been assigned an exclusive label that is used throughout Vision P400. The user cannot change this checker label. It is made up of:

- Checker type,
- Camera number, and
- checker number

The serial number always relates to the checker type. Camera numbers and checker numbers are counted from one (1), meaning the first checker of each type is assigned the number 1. An example is the first checker for binary edge detection which is configured for camera number 1. The following label is generated for this checker:



Explanation of checker label

Element type	Name	Abbreviation	Icon
Checker	Exposure Adjustment	EA	
	Position Adjustment	PA	
	Position and Rotation Adjustment Line-Point	PRA_LP	
	Position and Rotation Adjustment Angle-Point	PRA_AP	
	Position and Rotation Adjustment Two Points	PRA_2P	
	Position and Rotation Adjustment Three Points	PRA_3P	
	Window Checker	WI	
	Feature Extraction	FE	
	Edge Detection Binary	ED_B	
	Edge Detection Gray Value	ED_G	

Element type	Name	Abbreviation	Icon
	Difference Checker	DI	
	Contour Matching	CM	
	Optical Character Recognition	OCR	
	Code Reader	CR	
	Geometry Point Line	G_PL	
	Geometry Point Point	G_PP	
	Geometry Line Line	G_LL	
Object Shape	Object Shape	OS	
Indicator	Indicator	IN	

12.1.6 Property Sheet

The checker properties are defined in the so-called property page. It is made up of the following pages:

- General
- Algorithm
- Image Filters
- Object Filters
- Shape
- Dependencies
- Judgement
- Result
- Adjustment
- Visibility
- Adjustment Width
- Template
- Parameters
- Customize
- Character Separation
- Model
- Model Parameters
- Template Area
- Code Model Parameter

However, not every one of these pages is available for every checker. The “Template” page, for example, is available for the difference checker only.

The sections below describe which properties specifically may be entered on which page. You will also learn about the dialog elements and parameters common to many checkers.

12.1.6.1 Icons

When you open a checker’s property page, the following icons appear at the top of the property page window:

Stay visible	Cut selection
Make transparent	Copy selection
Apply	Paste selection
Execute Checker	

The icon is always active by default when you open the property page. It allows you to open a second property page if you wish to transfer the results from a different checker via drag & drop. This is useful, for example, when you need the coordinates from an edge detection checker for a position adjustment. If the property pages are concealing the camera image, but you want to keep it on view, click to make the checker property pages transparent.

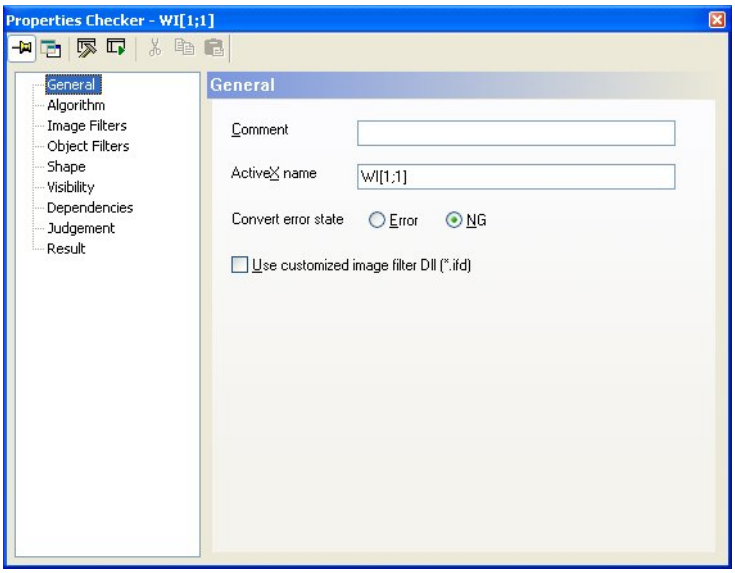
When you click , you confirm all the changes you have made on that page and apply them to the checker.

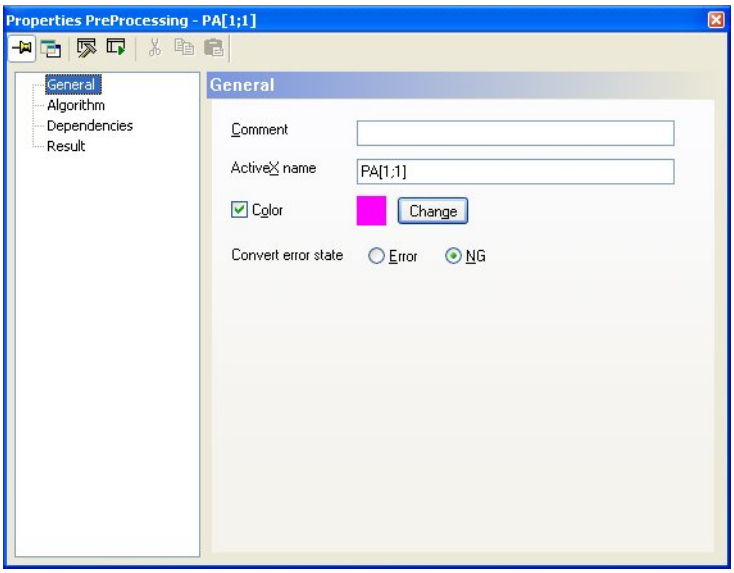
Click to execute a checker. The program automatically puts the “Result” page in front.

With the standard icons , and you can cut or copy previously selected items such as checkers, results, parameters, etc. to the buffer and paste them to a different position.

12.1.6.2 General

On this page, you have the opportunity to enter a **comment** about each checker. This comment appears in the sequence.





"General" page of a window checker and a position adjustment checker

ActiveX name

You need the ActiveX name of a checker if you wish to read or modify the checker's parameters via an ActiveX client. The ActiveX client can only access the checker via its ActiveX name. The ActiveX name is defined by Vision P400 when you create the checker. You can modify the name when you have set the checker.

Color

For position and rotation adjustment checkers, you may also change the **color** in which the checkers providing the reference values for the adjustment are displayed. The **color** is used both in the sequence list and in the camera image.

Convert error state

In some instances, it makes sense to treat an error as an NG judgement so that an application is executed completely. For example, a formula contains the result of a feature extraction checker. If the checker does not find an object, it generates an error for the whole formula. If you know that this can happen, but still wish to execute the formula, you need to convert the error to an NG signal. In this case, select "NG", and the formula will be executed even if the feature extraction checker does not find an object.

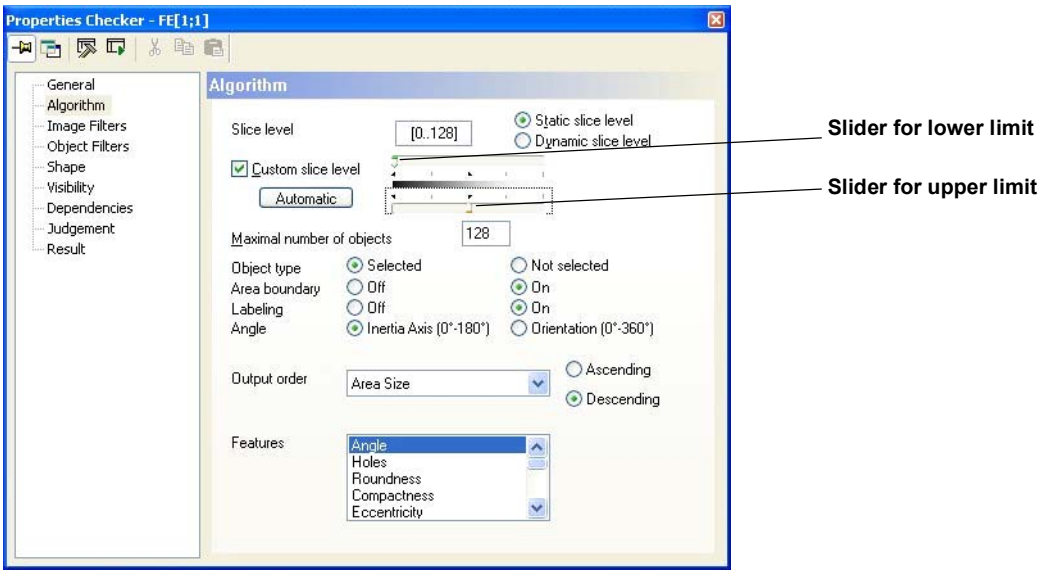
Use customized image filter Dll (*.ifd)

Depending on the checker type Vision P400 offers a range of gray-value and/or binary image filters. The filters are designed to yield an optimum result for most applications. If the standard filters are not sufficient for an optimum result, enter a specially designed Dll here (the file extension "ifd" stands for "Image Filter Dll"). If you enter a name here, Vision P400 does not use the standard filters, but uses the filters from the Dll.

Please contact the technical support if you have an application that cannot be handled satisfactorily by the standard filters in Vision P400. The support staff will advise you on how the image-processing algorithms can be modified and will supply you with an extended library of filters specially designed for your application.

12.1.6.3 Algorithm

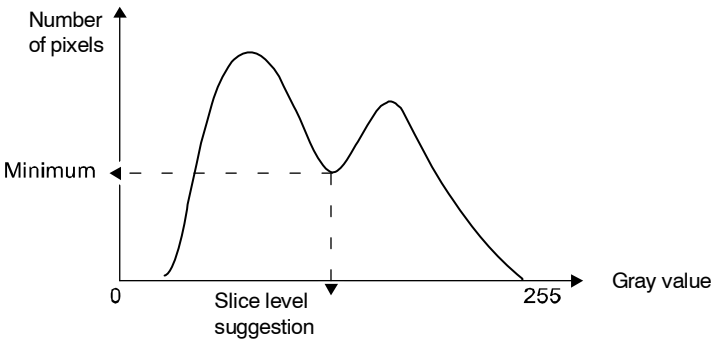
This is where you define the custom slice levels for individual checkers. By default, the static camera slice level is active. However, it is also possible to use a dynamic or a custom slice level. Activate the corresponding box and use the first slide to set the lower and the second slide for the upper limit.



"Algorithm" page of a feature extraction checker

You will obtain a rough setting by dragging (hold down mouse button while moving left/right) both sliders. You can fine-tune the setting one degree at a time by clicking at a slider or using the cursor keys. The area selected between the two sliders is marked in blue.

Click [Automatic] to have Vision P400 calculate a threshold value. This is done with the help of the gray-value histogram and the position of the minima in this histogram. Please note that this value is only a suggestion to help you set the slice level. It will not be recalculated when you execute the checker.



Custom slice level - automatic calculation

For binary checkers we define with the means of static and dynamic slice levels whether objects are selected (within the slice level limits (see page 271) or not selected (not within the slice level limits (see page 283).

12.1.6.4 Image Filters

Vision P400 differentiates between image and object filters (see page 301). Each filter type has its own property page. There are two types of image filters: gray-value filters and binary filters.

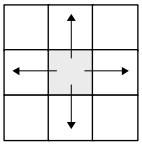
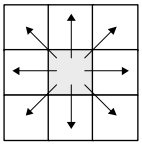
- Gray-value filters are used for preprocessing the gray-value image before thresholding.
- Binary filters are executed after thresholding. They work on the objects detected by the thresholding.

The filters are executed in the following order:

1. Gray-value image filters
2. Thresholding with regards to the setting under "Object Type"
3. Binary image filters
4. Object Filters

The filters, which can be selected on the page "Image Filters" or "Object Filters", will be used within one checker shape only. The gray-value image and binary image filters available for a checker are listed in the checker description. The filter settings are only valid for the checker for which they were set.

The following gray-value image filters are available (in alphabetic order):

Filter name	Parameters and other available settings	Description
Anisotropic Diffusion	Mode: Method according to Weickert, Perona-Malik or parabolic Contrast: 0.0 - 100.0 Theta: 0.0 - 3.0 Iterations: 1 - 30	The filter performs an anisotropic diffusion of the image based on the Perona and Malik model. This process is also termed non-linear isotropic diffusion. The object of anisotropic diffusion is to eliminate wide-area image disturbances such as noise without blurring image edges. The distinction between edges and areas is made by the slice level defined as "contrast" for the size of the gray value difference between adjacent pixels.
Anisotropic Smoothing	Smoothing Grade: 50 - 100 Iterations: 1 - 30 Neighborhood: 4, 8  4-fold neighboring relationship  8-fold neighboring relationship	Smooth an image by edge-preserving anisotropic diffusion. The anisotropic smoothing filter carries out an iterative, anisotropic smoothing process on the mathematical basis of physical diffusion. In analogy to the physical diffusion process describing the concentration balance between molecules dependent on the density gradient, the diffusion filter carries out a smoothing of the gray values dependent on the local gray-value gradients. For iterative calculation of the gray value of a pixel the gray-value differences in the 4-fold or 8-fold neighboring relationship, respectively, are used. "Smoothing Grade" increases the smoothing effect but blurs the edges a little more (values from 80 to 90 percent are typical). The parameter "Iterations" determines the number of iterations (typically 3 to 7).

Filter name	Parameters and other available settings	Description
Closing Shape	Filter Size: 3 - 511 Shape: "octagon", "rhombus"	Perform a gray-value closing with a selected mask. The gray-value closing shape applies a gray-value closing to the input image with the structuring element of the selected "Shape". The mask's offset values are 0 and its horizontal and vertical size is defined by "Filter Size". The setting "octagon" for "Shape" uses an equilateral octagonal mask which is a suitable approximation for a circular structure. The setting "rhombus" for "Shape" uses a rhombic mask. For border treatment the gray values are reflected at the image borders.
Coherence Enhancing	Sigma: 0.0 - 1.0 Rho: 0.0 - 30.0 Theta: 0.1 - 0.5 Iterations: 1 - 500	The filter carries out an anisotropic diffusion on the image aimed at enhancing the coherence of the structures in the image - that means in particular diffusively joining interrupted image edges without smudging them perpendicular to the edge direction.
Corner Detection Filter	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11 Variance: 0 - 0.3	Searching corners in images. The corner detection filter extracts gray-value corners in an image. The bigger the filter size, the more pronounced the corners appear. The higher the variance value, the fewer corner points will be detected.
Dilation Rectangle	Rectangle Width: 3 - 511 Rectangle Height: 3 - 511	Determine the maximal gray value within a rectangle. The gray-value dilation rectangle calculates the maximal gray value of the input image within a rectangular mask (defined by "Rectangle Width" and "Rectangle Height") for each pixel. For border treatment the gray values are reflected at the image borders.
Dot Print Enhancement	Dot Size: 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23 Dot Filter Type: "dark, "light", "all" Emphasize Contrast: -1, 1, 2	Enhance circular dots in an image. The dot print enhancement filter enhances circular dots of diameter "Dot Size" in the input image. Hence, the dot print enhancement filter is especially suited for the segmentation of dot prints, e.g., in OCR applications. The enhancement is performed by using matched filters with filter masks that are tuned for a particular dot size. The "Dot Filter Type" selects whether dark, light, or all dots in the image should be enhanced. The parameter "Enhance Contrast" can be used either to increase the contrast of the output image (Enhance Contrast > 0) or to dampen the values in extremely bright areas that would be cut off otherwise (Enhance Contrast = -1).
Emphasize	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11 Emphasize Contrast: 0 - 100	Enhance contrast of the image. The emphasize filter emphasizes high-frequency areas of the image (edges and corners). The resulting images appears sharper. "Emphasize Contrast" serves as measurement of the increase in contrast. The division frequency is determined via the size of the filter matrix: The larger the matrix, the lower the division frequency. For border treatment the gray values are reflected at the image borders.
Erosion Rectangle	Rectangle Width: 3 - 511 Rectangle Height: 3 - 511	Determine the minimal gray value within a rectangle. The gray-value erosion rectangle calculates the minimal gray value of the input image within a rectangular mask of size (defined by "Rectangle Width" and "Rectangle Height") for each pixel. For border treatment the gray values are reflected at the image borders.

Filter name	Parameters and other available settings	Description
Gauss	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11	Smooth using discrete Gauss functions. The Gauss filter smoothes images using the discrete Gaussian function. The smoothing effect increases when you increase the filter size. For border treatment the gray values are reflected at the image borders.
Gray Closing Rectangle	Rectangle Width: 3 - 15 Rectangle Height: 3 - 15 (only odd values are permitted)	The filter performs a gray value closing with a rectangular mask (defined by "Rectangle Width" and "Rectangle Height"). For border treatment the gray values are reflected at the image borders.
Gray Opening Rectangle	Rectangle Width: 3 - 15 Rectangle Height: 3 - 15 (only odd values are permitted)	The filter performs a gray value opening with a rectangular mask (defined by "Rectangle Width" and "Rectangle Height"). For border treatment the gray values are reflected at the image borders.
Gray Skeleton		Thinning of gray-value images. The gray skeleton filter applies a gray-value thinning operation to the input image. Figuratively, the gray value "mountain range" is reduced to its ridge lines by setting the gray value of "hillsides" to the gray value at the corresponding valley bottom. The resulting ridge lines are at most two pixels wide. This operator is especially useful for thinning edge images. The filter preserves the contours.
Invert Image		Invert an image. The operator inverts the gray values of an image.
Isotropic Diffusion	Iterations: 0 - 500 Sigma: 0.1 - 50.0	The filter carries out an isotropic diffusion of the image. This corresponds to a folding of the image matrix with a Gaussian mask with standard deviation Sigma. If the "Iterations" parameter is 0, a fold of this kind is explicitly carried out.
Mean	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11	Smooth by averaging. The mean filter carries out a linear smoothing with the gray values of the input image. The filter matrix consists of ones (evaluated equally) and has the selected filter size. The result of the convolution is divided by the filter size. For border treatment the gray values are reflected at the image borders.
Mean Curvature Flow	Sigma: 0.0 - 1.0 Theta: 0.1 - 0.5 Iterations: 1 - 500	The filter produces a smoothing of the image toward the image edges - that is, along the level lines. The edges of the image do not blur in the process. In order to define the edge directions in a more stable way, particularly where input data is subject to noise, an additional isotropic smoothing operation can be inserted prior to calculation of the gray value gradients. The "Sigma" parameter determines the amount of this smoothing as the standard deviation of the associated Gaussian kernel.

Filter name	Parameters and other available settings	Description
Median Rectangle / Circle	Filter Size: 1 - 101 Border Treatment: "continued", "cyclic", "mirrored"	Median filtering with different rank masks. The median filter carries out a non-linear smoothing of the gray values of the input image with different rank masks. The filter uses a circular resp. rectangular mask. Several border treatments can be chosen for filtering: • "continued": Continuation of edge pixels • "cyclic": Cyclic continuation of image edges • "mirrored": Reflection of pixels at the image edges The circular / rectangular mask is put over the image to be filtered in such a way that the center of the mask touches all pixels of the objects once. For each of these pixels all neighboring pixels covered by the mask are sorted in an ascending sequence according to their gray values. Thus, each of the sorted gray-value sequences contains exactly as many gray values as the mask has pixels. From these sequences the median is selected and entered as resulting gray value at the corresponding output image.
Opening Shape	Filter Size: 3 - 511 Shape: "octagon", "rhombus"	Perform a gray-value opening with a selected mask. The gray-value opening shape applies a gray-value opening to the input image with the structuring element of the selected "Shape". The mask's offset values are 0 and its horizontal and vertical size is defined by "Filter Size". The setting "octagon" for "Shape" uses an equilateral octagonal mask which is a suitable approximation for a circular structure. The setting "rhombus" for "Shape" uses a rhombic mask. For border treatment the gray values are reflected at the image borders.
Shock Filter	Mode: Laplace, Canny Sigma: 0.0 - 5.0 Theta: 0.1 - 0.7 Iterations: 1 - 100	Filter to sharpen the focus of image edges.
Sigma	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11 Difference: 0 - 255	Non-linear smoothing with the sigma filter. The sigma filter carries out a non-linear smoothing of the gray values of the input image. All pixels are checked in a rectangular window (defined by "Filter Size"). All pixels of the window which differ from the current pixel by less than "Difference" are used for calculating the new pixel. The new pixel is the average of the chosen pixels. If all differences are larger than "Difference", the gray value is adapted unchanged.
Sobel	Filter Size: 3x3, 5x5, 7x7, 9x9, 11x11	Detect edges (amplitude) using the Sobel operator. The sobel filter calculates the first derivative of the image and is used as an edge detector.

For details on the effects of the parameters please refer to the relevant literature or consult Technical Support.

The following binary image filters are available (in alphabetic order):

Filter name	Parameters and other available settings	Function
Area Boundary	Ignore touching objects: True / False	Ignores objects touching the edge of the shape. This filter is used to decide whether an object touching the checker shape should be processed or not. If "Ignore Touching Objects" is set to "True", an object may touch the shape. If the parameter is set to "False", the object to be checked may not touch the shape.
Binary Skeleton		Compute the skeleton of a region. Binary Skeleton computes the skeleton of the input regions.
Closing	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	Close an object with a circular structuring element. Closing smoothes the object boundaries. It closes holes within an object which are smaller than the circular structuring element of radius "Filter Radius".
Closing - Opening	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	A closing followed by an opening.
Closing (horizontal)	Filter Width: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Close a region with a rectangular structuring element, in this special case a horizontal line. Closing (horizontal) performs a dilation followed by an erosion on the input object. The size of the rectangular structuring element is determined by the parameters "Filter Width". As is the case for all closing variants, object boundaries are smoothed and holes within an object which are smaller than the rectangular structuring element are closed.
Closing (vertical)	Filter Height: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Close a region with a rectangular structuring element, in this special case a vertical line (see Closing (horizontal)).
Combine Dot Prints	Dot Size: 1 - 100	This special filter is used to combine dots extracted with the gray-value filter "Dot Print Enhancement" to the dot print characters.
Dilation Circle	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	Dilate an object with a circular structuring element. Dilation circle results in enlarged objects, smoothed object boundaries. The holes smaller than the circular mask in the interior of the objects are closed.
Dilation Rectangle	Filter Height: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110 Filter Width: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Dilate an object with a rectangular structuring element. Dilation circle results in enlarged objects, smoothed object boundaries. The holes smaller than the circular mask in the interior of the objects are closed.
Erosion Circle	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	Erode an object with a circular structuring element. Erosion circle results in reduced regions, smoothed object boundaries. The objects smaller than the circular mask are eliminated.
Erosion Rectangle	Filter Height: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110 Filter Width: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Erode an object with a rectangular structuring element. Erosion circle results in reduced regions, smoothed object boundaries. The objects smaller than the rectangular mask are eliminated.

Invert objects	Invert Objects: True / False	Use this toggle switch to turn objects into background and vice versa. As opposed to the option "Object Type - Selected/Not Selected" on the "Algorithm" page, this function is performed after the gray-image filters and the morphological operations.
Opening	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	Open an object with a circular structuring element. Opening serves to eliminate small objects (smaller than the circular structuring element) and to smooth the boundaries of an object.
Opening - Closing	Filter Radius: 1.5 / 2.5 / 3.5 / 4.5 / 5.5 / 7.5 / 9.5 / 12.5 / 15.5 / 19.5 / 25.5 / 33.5 / 45.5 / 60.5 / 110.5	An opening followed by a closing.
Opening (horizontal)	Filter Width: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Open a region with a rectangular structuring element, in this special case a horizontal line (see Opening (vertical)).
Opening (vertical)	Filter Height: 1 / 2 / 3 / 4 / 5 / 7 / 9 / 12 / 15 / 19 / 25 / 33 / 45 / 60 / 110	Open a region with a rectangular structuring element, in this special case a vertical line. Opening (vertical) performs an erosion followed by a dilation on the input object. The size of the structuring element is determined by the parameters "Filter Height". As is the case for all opening variants, larger structures are preserved, while small regions like lines or points are eliminated.

◆**NOTE**

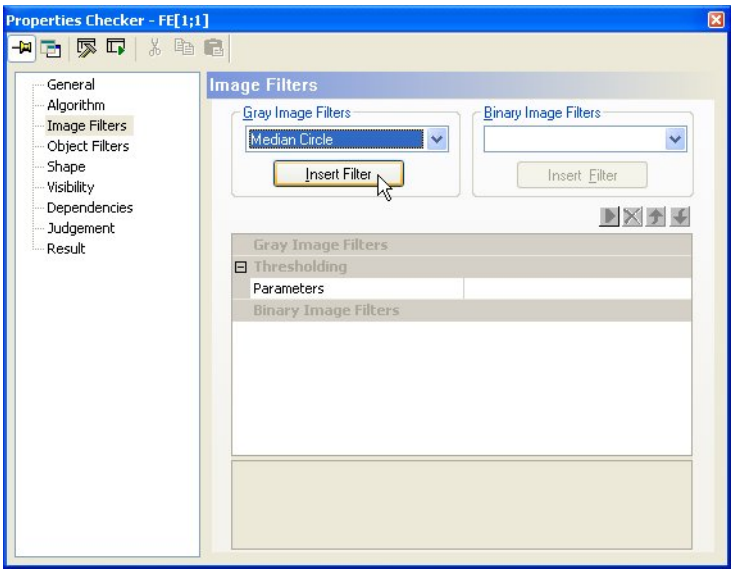
The gray-image and binary filters are described in detail in the standard literature on image processing (see page 621).

Selecting Image Filters

If you wish to select gray-image or binary filters, please proceed as follows:

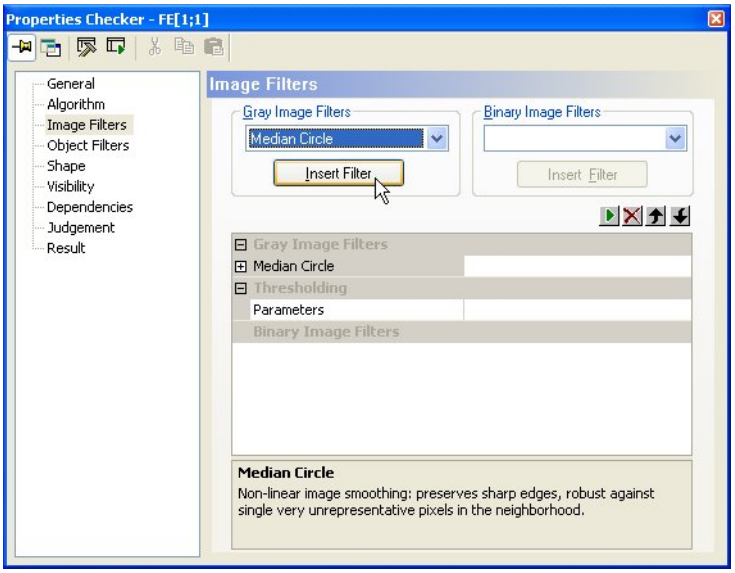
◆**Procedure**

1. **Under "Gray Image Filters" select the filter you wish to insert into the filter list**



2. Select the [Insert Filter] button

The selected filter is added at the end of the list. The [Insert Filter] button is active only if you have selected a filter.



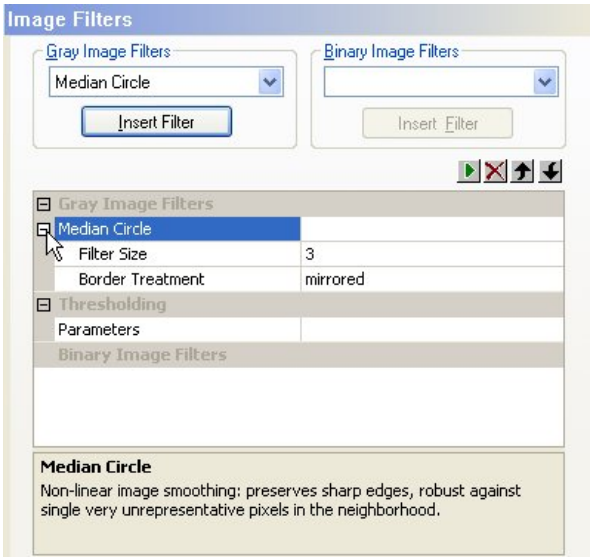
You can add as many filters as you like. It is also possible to add the same filter several times. All filters in the list are executed one after the other, beginning at the top of the list. If a list is empty, it means that the filter type is not executed on the image.

Changing a Parameter Setting

For most of the image filters there are one or more parameters to set. To change a default parameter setting, please proceed as follows:

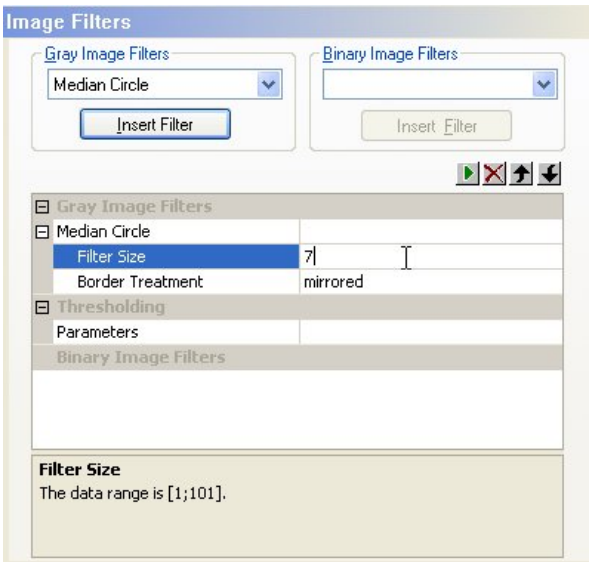
Procedure

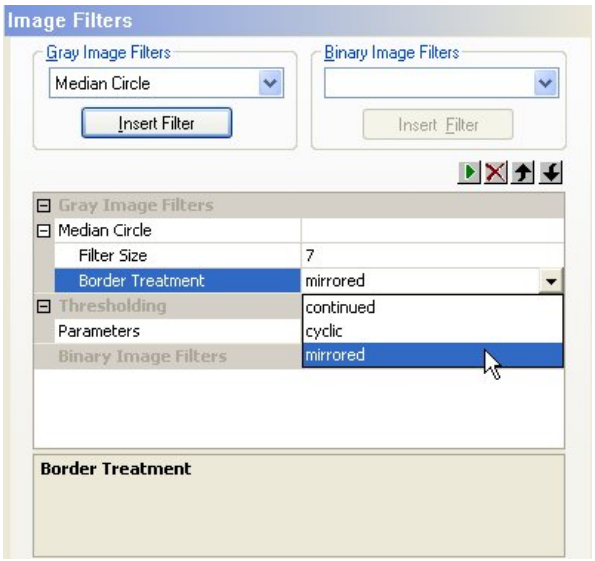
1. **Click the "+" sign next to the filter name to display the parameter list**



2. **To change the setting click right of the parameter name**

   Either you can edit the parameter setting directly or you can select an entry from the list box displayed. If you can edit the setting directly, a box below displays the valid range of setting values.





Testing the Set Filters

You can test the filters you have set directly on the current camera image. Please proceed as follows:

◆Procedure

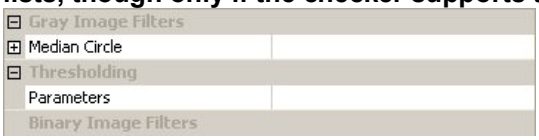
1. **Select the first filter in the list with a left mouse click**
2. **Click to execute the filter on the camera image**

   The symbol is active only if you have selected a filter. Vision P400 executes the filter, displays the filter results in the checker shape, and selects the next filter in the list.
3. **Keep clicking until you have tested all filters**

◆NOTES

- **If you do not select the first filter but a filter further down the list and click , Vision P400 executes the selected filter and all the filters up to that point in the list. Vision P400 displays the filter results and selects the next filter.**
- **The thresholding parameters can only be set on the "Algorithm" page. In order to be able to test the effects of the thresholding together with the image filters, you will find the non-editable entry "Thresholding" with the subentry "Parameters" in the list between the gray value and binary filter**

lists, though only if the checker supports thresholding.



- **If a checker depends on an exposure or a position and rotation adjustment, these will be taken into consideration during testing. If that is undesirable, you should delete these dependencies before testing the filters and re-install them again afterwards.**

Deleting a Filter

If you wish to delete a filter from the list, please proceed as follows:

◆Procedure

1. **Select the filter to be deleted from the filter list**
2. **Click to delete the filter**

   The symbol is active only if you have selected a filter.

Moving a Filter

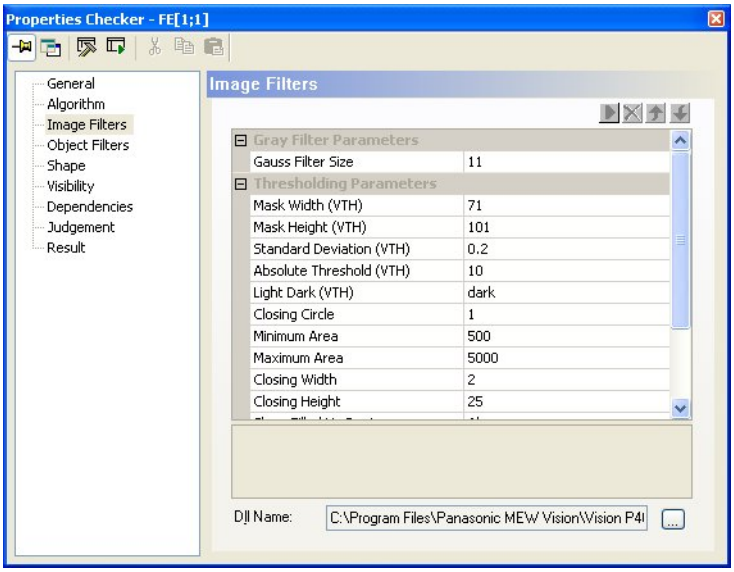
◆Procedure

1. **Select the filter you wish to move**
2. **Click or to move the filter one position up respectively down the list**

   The symbols are active only if you have selected a filter.

Using a Customized Image Filter File

If you have selected the option "Use Customized Image Filter Dll (*.ifd)", the property page "Image Filters" looks as shown below:



*"Image Filters" page with selected *.ifd file*

Under "Dll Name" select the image filter file you wish to use. Vision P400 checks whether the selected file is a valid *.ifd file.

If you work with a customized image filter, the standard Vision P400 gray-image and binary-image filters are not available. You can only use the filters from the image filter file. If the image filter file does not contain any gray-image filters, it is not possible to use a gray-image filter.

However, this is different for thresholding: If the image filter file contains thresholding algorithms, you can only use the file-specific thresholding. However, if the image filter file does not contain any thresholding functions, you may use the default Vision P400 thresholding functionality from the "Algorithm" page.

If the image filter file contains editable parameters, these will be listed. To change a parameter setting, please proceed as described above.

If you are using a customized image filter file, you neither delete nor move a filter. However, it is possible to test the parameters and their settings. Please proceed as described under "Testing the Set Filters".

In order to test the parameters step by step, Vision P400 displays a non-editable entry "No Parameters" under "Gray Filter Parameters", if there are no parameters to be set. This also goes for the thresholding and the binary filter parameters.

If there is no entry under "Gray Filter Parameters" or "Binary Filter Parameters", not even the entry "No Parameters", then the selected image filter file does not provide any filters of that type.

◆NOTES

- **If you have activated the option "Use Customized Image Filter Dll (*.ifd)" on the "General" page and you have not selected an image filter file or an invalid file, there is no entry in "Dll Name" and the checker generates an error upon execution.**

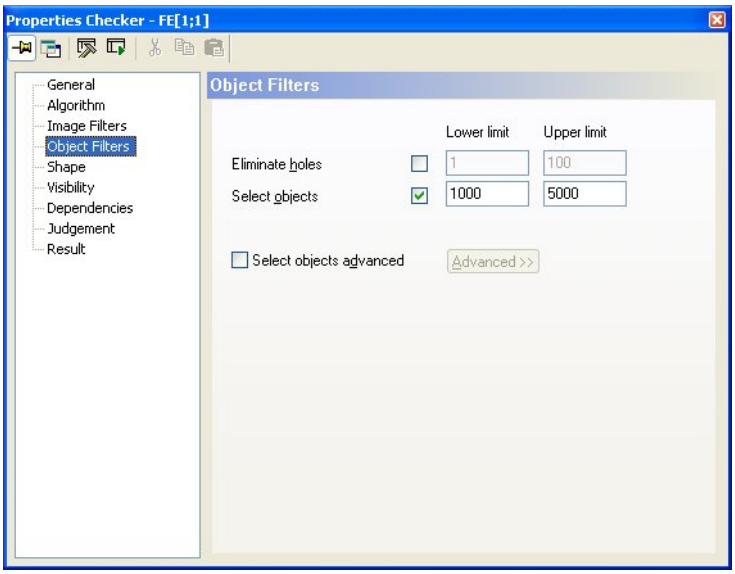
- **The functionality of the filter parameters depends on the selected image filter file and cannot be described here.**

12.1.6.5 Object Filters

The following object filters are available after the binary filter operations:

- **Eliminate Holes**
  A hole is defined as an image area which is fully enclosed by one and the same object and which is not part of that object. In the case of a light object, a hole would be dark and vice versa. Whether a given hole should be closed or not depends on the size (pixel count). You need to enter a lower and an upper limit (inclusive) for the hole size in the columns "Lower Limit" and "Upper Limit". The default is 1 to 100. The maximum limit depends on the connected camera.
- **Select Objects**
  With this filter, the objects can be selected by size as measured in pixels. As with the suppression of holes, a lower and an upper limit (inclusive) has to be defined. This time, however, the object's size is the relevant criterion. The maximal limit depends on the camera.
- **Select Separated Objects** (only for the OCR checker)
  When you are working with character separation in the OCR checker, this object filter is applied to the objects found after character separation. That is to say, the objects are first selected unseparated, then character separation is carried out and then the object filter is applied.

With the feature extraction checker it is also possible to fine-tune the selection of objects with a formula (see page 367).



"Object Filters" page of a feature extraction checker

12.1.6.6 Shape

On this page, you may modify the checker shapes which have been entered interactively with the mouse during the creation of the checker (see page 312). The following shapes are available:

- Rectangle
- Ellipse
- Polygon
- Doughnut
- Rectangle -> (only edge detection)
- Ellipse -> (only edge detection)
- Line -> (only edge detection)
- Doughnut-> (only edge detection gray value projection)

An ellipse may be transformed into a circle by selecting “Circle” in the field "Type". The transformation occurs in maintaining the top left point and by using the length of the ellipse’s conjugate axis (shortest axis) for the circle diameter.

In reverse, a circle can be transformed into an ellipse by clicking on “Ellipse”. The parameters of the circle will be maintained. The difference between a circle and an ellipse that looks like a circle only becomes apparent when the shape coordinates are altered: With the ellipse, the main and conjugate axes may be modified independently of each other. With the circle, both axes are of the same length and will consequently be altered simultaneously.

A line -> may be modified into either a horizontal or a vertical line. To this end, the line’s projections onto the image edges will be used and shifted in such a way that the starting point of the line is maintained. The reverse is also possible. While the line type is changed, the parameters remain unchanged.

With edge detectors with line -> or rectangle -> as shape, the shape’s orientation may be set in the "Angle" field. With edge detectors with the shape ellipse ->, the scanning direction may be selected either "clockwise" or "counterclockwise" in the "Scanning Direction" field.

The following tables list the parameters which describe a shape:

Polygon (Closed Progression)

Parameter	Meaning
Type	Type of shape (polygon)
Center point	Coordinates of the center point
Point	List of polygon-supporting points

Rectangle

Parameter	Meaning
Type	Type of shape
Center point	Coordinates of the center point
Starting point	Coordinates of the upper left point of the rectangle
End point	Coordinates of the lower right point of the rectangle

Ellipse

Parameter	Meaning
Type	Type of shape

Parameter	Meaning
Center point	Coordinates of the center point
Top left point	Coordinates of the upper left point of the enclosing rectangle
Bottom right point	Coordinates of the lower right point of the enclosing rectangle

Doughnut

Parameter	Meaning
Type	Type of shape
Center point	Coordinates of the center point
Outer circle edge point	Left upper corner of the enclosing rectangle of the outer circle
Inner circle edge point	Left upper corner of the enclosing rectangle of the inner circle
Starting point	Coordinates of the starting point of the doughnut section on the outer circle
End point	Coordinates of the end point of the doughnut section on the outer circle

Rectangle ->

Parameter	Meaning
Type	Type of shape
Center point	Coordinates of the center point
Starting point	Coordinates of the upper left point of the enclosing rectangle
End point	Coordinates of the lower right point of the enclosing rectangle
Angle	Scanning direction for the edge detectors

Ellipse-> (Elliptic Arc)

Parameter	Meaning
Type	Type of shape
Center point	Coordinates of the center point
Top left point	Coordinates of the upper left point of the enclosing rectangle
Bottom right point	Coordinates of the lower right point of the enclosing rectangle
Starting point	Coordinates of the starting point of the elliptic arc
End point	Coordinates of the end point of the elliptic arc
Scanning direction	Scanning direction for the edge detectors (clockwise, counterclockwise)

Line->

Parameter	Meaning
Type	Type of shape (line, horizontal line, vertical line)
Center point	Coordinates of the center point
Starting point	Coordinates of the starting point of the line
End point	Coordinates of the end point of the line
Angle	Orientation of the line

Doughnut->

Parameter	Meaning
Type	Type of shape
Center point	Coordinates of the center point
Outer circle edge point	Left upper corner of the enclosing rectangle of the outer circle
Inner circle edge point	Left upper corner of the enclosing rectangle of the inner circle
Starting point	Coordinates of the starting point of the doughnut section on the outer circle
End point	Coordinates of the end point of the doughnut section on the outer circle
Scanning direction	Scanning direction for the edge detectors (clockwise, counterclockwise)

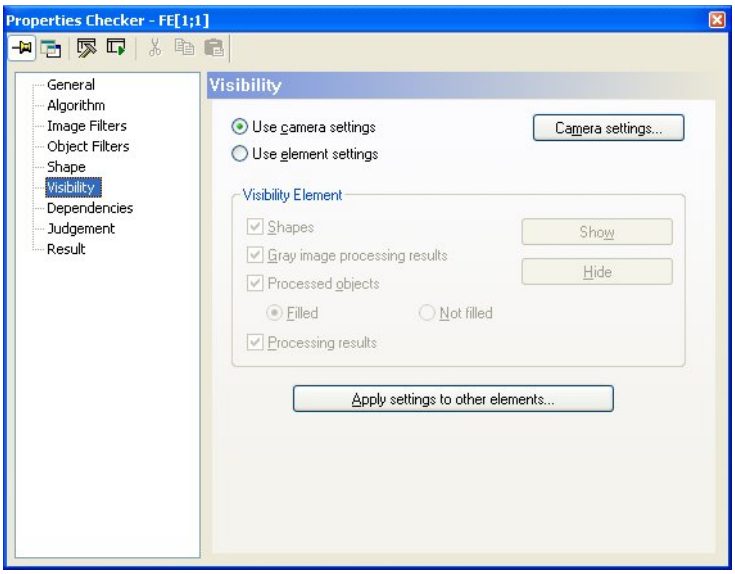
◆NOTES

- **All coordinates must fall within the image range. The image range depends on the camera used. All angles (see page 276) must be within the range of 0 – 360 degrees.**
- **When you change the parameters in such a way that parts of the shape come to lie outside the image area, Vision P400 will only accept your changes if you have activated the option "Allow positions outside the image area".**

12.1.6.7 Visibility

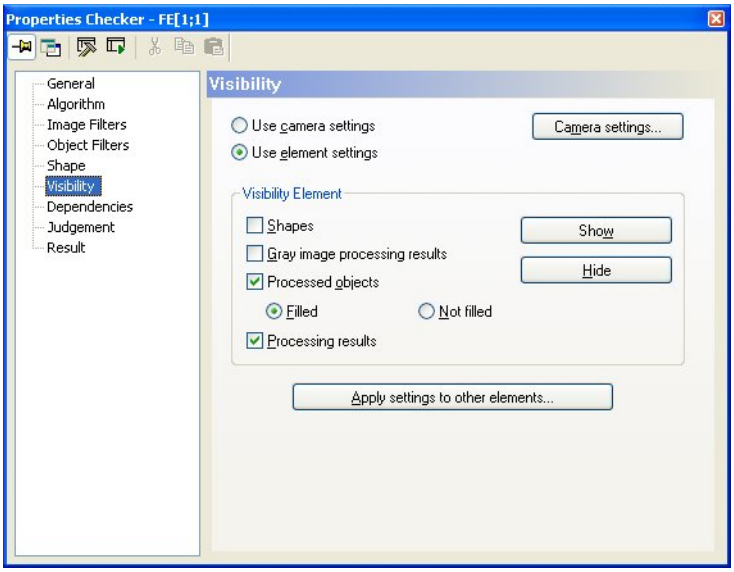
On the "Visibility" property page you customize the mode of display for elements such as checkers, object shapes and indicators. As a rule, the visibility settings you make under **View → Checker...** apply to all elements of the current camera (see page 225). They can differ from the camera settings in order to alter the on-screen visibility for certain elements such as checkers and indicators, such as if the screen view threatens to become unclear when there are large number of elements.

As long as an element uses the camera-specific settings the "Use camera settings" option is active. You can view these settings by clicking the "Camera Settings" button. Any change to the camera settings applies to all checkers, object shapes and indicators for which the "Use camera settings" option is active.



Default settings for the visibility of an element

To vary the settings from the camera settings, choose the "Use element settings" option. This makes the previously grayed out parameters available.



Element-specific visibility settings

You can switch the following parameters on or off:

Parameter	Explanation
Shapes	Switch checker shapes on/off
Gray image processing results	Show/hide gray image processing results
Processed objects	Show/hide the objects computed in image processing: • **Filled:** Processed objects are displayed in the color (see page 129) selected by the user. • **Not filled:** Processed objects are not filled, only the borders are visible.
Processing results	Switch image processing results on/off
Draw (only for geometry checkers, object shapes and indicators)	Show/hide element

The following buttons are available:

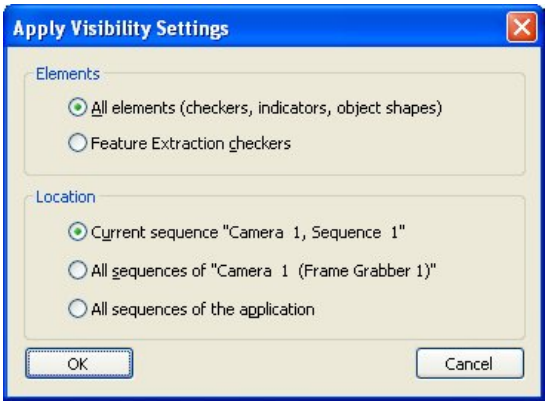
Button	Explanation
Camera settings	Opens the dialog box with the camera settings (see page 225). The camera settings apply to all checkers, object shapes and indicators for which the "Use camera settings" option is active.
Show	All parameters relating to the display of the current element are activated. The setting determining whether processed objects are filled or not filled does not change.
Hide	All parameters relating to the display of the current element are deactivated. The setting determining whether processed objects are filled or not filled does not change.
Apply settings to other elements	When you click this button, a dialog box opens up with which you can transfer the setting of the element you are currently working on to other elements. This means that when you have changed the visibility settings of a feature extraction checker, you can also apply the new settings to other feature extraction checkers or to other elements (see below).

◆NOTES

- **For geometry checkers, object shapes and indicators there is only the "Draw" parameter. It defines whether the element is displayed or not.**
- **Note that the element you selected in the checker sequence window is always displayed on screen, even when the selected visibility settings dictate that it should be hidden.**
- **For run mode you can disable display of all checkers, object shapes and indicators entirely. To do so, activate the relevant "Graphic Update" parameters on the "Run Mode Settings" property page under** Application → Properties**. The properties of the application have priority over the settings you make on the "Visibility" property page.**

Apply settings to other checkers

With this button you open a dialog box with which you can apply the setting of the element you are currently working on to all other elements or to elements of the same type.



Transferring visibility settings of a feature extraction checker

Under "Elements" you specify whether all elements (checkers, indicators and object shapes) or only the elements of the same type (indicated dynamically in the dialog box) are to adopt the settings.

Under "Location" you specify the areas of the application for which the elements selected above are to adopt the visibility settings. The displayed parameters change according to the situation from which you opened the dialog box.

Parameter as in image	Explanation
Current sequence "Camera 1, Sequence 1"	The first parameter offers you the current checker sequence as the application area.
All sequences of "Camera 1 (Frame Grabber 1)"	The second parameter offers you all sequences of the camera to which the current element belongs as the application area.
All sequences of the application	The new visibility settings are applied to the entire application - meaning all checker sequences of all cameras.

When applying the settings of an element to other elements, you should note the following points:

Selected settings	Transfer from -> to	Effect
"Use camera settings" is activated	Irrelevant	Only this parameter is activated on the target element; all other settings remain unchanged
"Use element settings" is activated and additional parameters have been individually set	Checker -> Checker	Settings are applied 1:1
	Checker -> Geometry checker, object shape or indicator	Depends on the setting of the "Processing results" parameter. If it is active, "Draw" is also activated.
	Geometry checker, object shape or indicator -> Checker	Depends on the setting of the "Draw" parameter. When it is activated, the effect is the same as clicking the [Show] button - that is, all visibility settings are activated. When it is deactivated, the effect is the same as clicking the [Hide] button - that is, all visibility settings are deactivated.
	Geometry checker, object shape or indicator -> Geometry checker, object shape or indicator	The setting for "Draw" is applied.

12.1.6.8 Dependencies

You may enter a checker's dependencies on this page. It may be dependent on exactly one position and rotation adjustment. The checker providing the position and rotation adjustment must be above the dependent checker in the sequence list. When you install that dependency, the "Position and Rotation" window will give you a choice of all those adjustments which satisfy this condition, i.e. which appear in the sequence list before the dependent checker.

If the checker uses binarisation slice levels, you may define one exposure adjustment each for the upper and lower slice levels. This is done in the fields "Lower Exposure" and "Upper Exposure". Again, you will only be able to choose from exposure checkers on the sequence list above the dependent checker.

12.1.6.9 Judgement

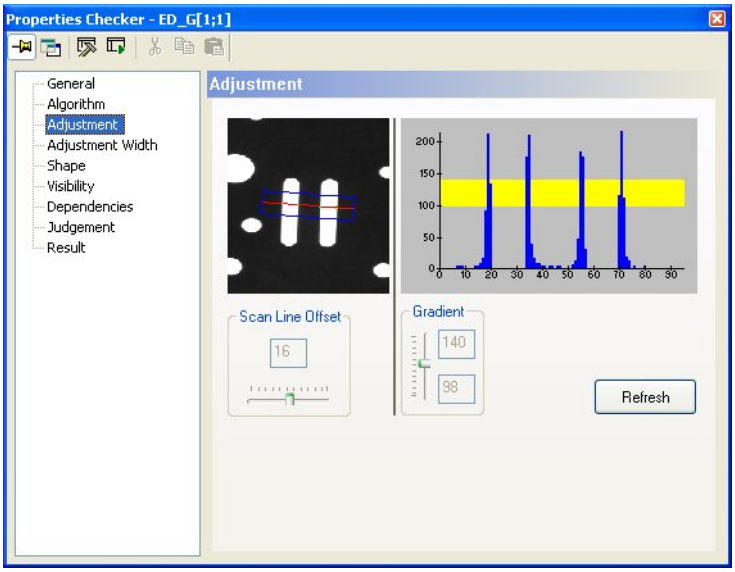
The judgement indicates whether the checker's calculations have been judged as good (OK) or not (NG). From all the checker results exactly one result is selected and used for the judgement. The judgement is considered good when the result chosen falls within the pre-set range of limits. When a checker is judged as NG, the checker shape will be displayed with red-white dotted lines.

The checker's result to be used for the judgement is determined by a pre-set process that cannot be modified by the user.

Frequently, the judgement is defined as the number of objects worked on. As such, the judgements can be used for ready identification of missing or additional unwanted objects.

12.1.6.10 Adjustment

The "Adjustment" page contains help suggestions for the adjustment of checker parameters. With an edge-detection gray-value checker, for example, the course of the gradient amount is represented as an intersection line in the image. Consequently, the optimal gradient value for the detection of a gray-value edge is readily determined.



"Adjustment" page of a gray-value edge detector

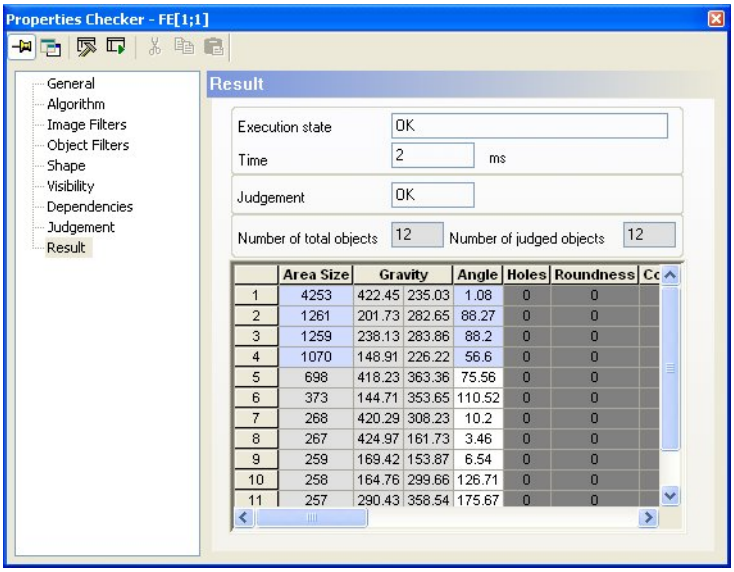
12.1.6.11 Template

On this page, you may enter templates (image sections) needed as a reference for checkers.

12.1.6.12 Result

This page lists checker results. These results may refer to the entire checker shape (e.g. window checker) or to individual objects in the shape (e.g. feature extraction checker). With the latter, a list is generated containing the object-specific results for each object evaluated.

Besides the checker results, this page usually also displays the **execution state**, the **time**, and the **judgement**.



"Result" page of a feature extraction checker

If the execution state is OK, this means that the checker calculation has been successful. All other entries in the field "Execution State" indicate that there is an error (see "Error Log" (see page 248)) or they give a status message (see page 611) for your information.

Highlighting results in the camera image

When you click a result from the list, the corresponding object is highlighted in the camera image. With the keys at the bottom you can leave the highlighting as it is or highlight different results:

Key	Highlighted result
Spacebar	The result selected with the left mouse button is highlighted as long as you hold down the key.
Up arrow	The result above the result selected with the left mouse button is highlighted as long as you hold down the key.
Arrow left	The result left of the result you have selected with a left mouse click will be highlighted as long as you press this key.
Down arrow	The result below the result selected with the left mouse button is highlighted as long as you hold down the key.
Arrow right	The result right of the result you have selected with a left mouse click will be highlighted as long as you press this key.

Only the results within the current displayed image segment are highlighted in the camera image. If a result is outside the segment, but still within the camera image (such as because only part of the complete image is visible after zooming), you can move the current image segment so that the result is positioned in the middle of it. To do so, double-click on the result.

If the result is outside the camera image (this is often the case with indicators), it is usually not possible to move the current image segment so that the result is positioned in the middle of it. In this case a warning message appears on the screen.

When you have inserted a result into the spreadsheet, it is color-highlighted in the checker result list. The default color is a light blue. You can change (see page 145) this default under

Application → **Vision P400 settings** → **Tools** with the [Color for results inserted in spreadsheet] button.

When you want to quickly locate a result already inserted into a spreadsheet, select the result, right-click and choose "Show in the Spreadsheet".

◆NOTE

The result must be selected uniquely, meaning only a single color-highlighted result can be selected.

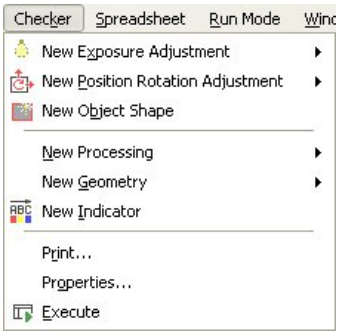
When you select the "Show in the Spreadsheet" function the following happens:

- The spreadsheet is displayed.
- The Spreadsheet Controller is displayed in the workflow window
- Even hidden rows are displayed on the spreadsheet.
- The current spreadsheet row selection is deleted.
- The spreadsheet row belonging to the result is selected and scrolled into the visible area of the spreadsheet.

12.2 Submenus

With the **Checker** submenus you create checkers for image adjustment and checking, object shapes and indicators.

From the checkers you select a type, a shape and where appropriate a search area. When you have selected a checker, indicator or object shape in the camera image, you can execute the object or view or print the properties on screen.



"Checker" submenus

Checkers are used either for image PRE-adjustment or for actual checking:

Area of use	Available checkers	Functionality
Adjustments	Exposure Adjustment	Compensating for fluctuations in brightness
	Position adjustment Position and rotation adjustment by: • line-point • angle-point • two points • three points	Position adjustment and/or rotation of a checker shape
	Object Shape	Create a user-defined static or dynamic checker shape based on results of a feature extraction checker
Image processing	Inspection Checkers: • Window Checker • Feature Extraction • Edge Detection Binary • Gray-value edge detection checker • Edge detection with gray value projection • Difference Checker • Contour Matching • OCR Checker • Code Reader	Checker for the actual image processing

Area of use	Available checkers	Functionality
	Geometric checkers: • Point-point • Point-line • Line-line	Calculate results based on results of other checkers
	Indicator	Highlight results on screen using geometric figures, images or texts (also result-dependent)

Below you will find procedures describing how to create checkers with the toolbar and how to rotate checker shapes.

12.2.1 Creating Checkers of Different Shapes

With "simple" shapes like rectangle and line, you only need two left mouse clicks to define the checker shape. The first mouse click sets the start point, the second the end point.

For more complex shapes like polygon, doughnut, or ellipse with direction, the procedures for defining the checker shape are more complicated, see below.

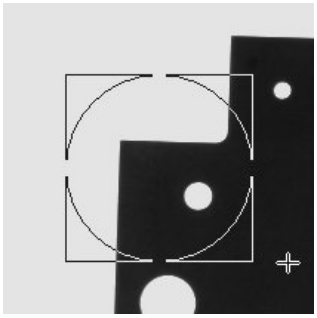
◆NOTE

You can cancel setting a checker shape any time by pressing <Esc>.

12.2.1.1 Doughnut Shapes

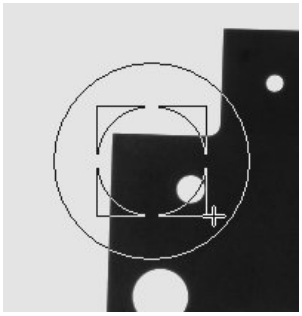
◆Procedure

1. **Click a checker type available for doughnut shapes, e.g. feature extraction**
2. **Click the checker shape doughnut**
3. **Click the left mouse button within the image area to define the start point**
4. **Move the mouse to determine the size of the first circle**



5. **Click the left mouse button to close the first circle**

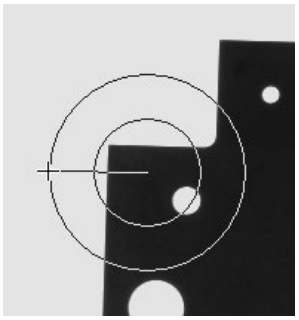
6. **Move the mouse either towards the center of the first circle or outwards to determine the size of the second circle**



7. **Click the left mouse button to close the second circle**
8. **If you want to use the entire doughnut as the search area, right-click to quit defining the shape**

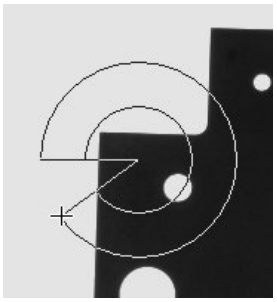
   or

   If you only want to use a segment of the doughnut as the search area, left-click to define the start point of the search area

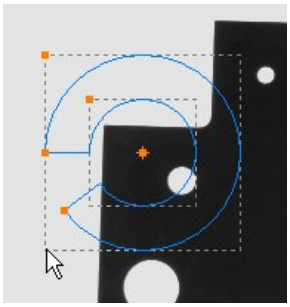


   Vision P400 always scans clockwise. Independent of whether you move the mouse clockwise or anti-clockwise to set the end point, the scanning area will always be the section between the start point you have just clicked and the end point.

9. **Left mouse click on the end point of the scanning area**



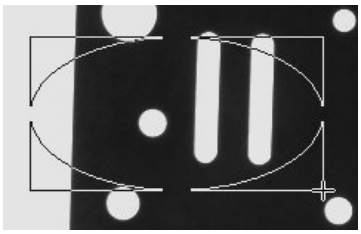
Vision P400 displays the doughnut (ring segment) selected as the search area in the color you chose for this checker type. You also see the rectangles surrounding the doughnut (ring segment) with dashed lines.



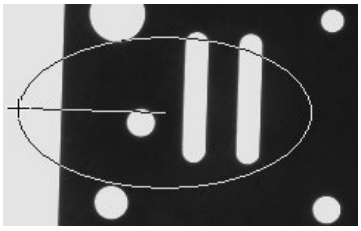
12.2.1.2 Elliptic Shapes for Edge Detection

Procedure

1. **Click a checker type available for elliptic shapes, e.g. binary edge detection**
2. **Click the checker shape ellipse with scanning direction**
3. **Click the left mouse button within the image area to define the start point**
4. **Move the mouse to determine the size of the ellipse**

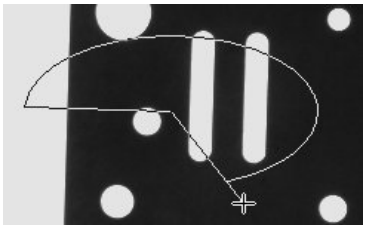


5. **Left mouse click to set the ellipse size**
6. **Click the left mouse button on the start point of the scanning area**



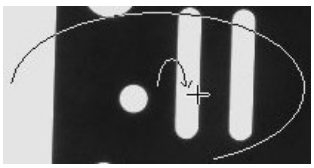
7. **If you wish to use the whole ellipse as the scanning area, click the right mouse button and continue with step 9**

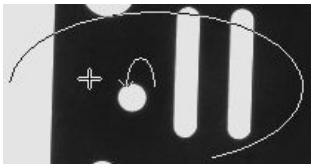
8. **Left mouse click on the end point of the scanning area**



Vision P400 always scans clockwise. Independent of whether you move the mouse clockwise or anti-clockwise to set the end point, the scanning area will always be the section between the start point you have just clicked and the end point. Next, you need to set the scanning direction of the elliptic arc.

9. **Move the mouse to the right to scan clockwise for edges or to the left to scan anti-clockwise**

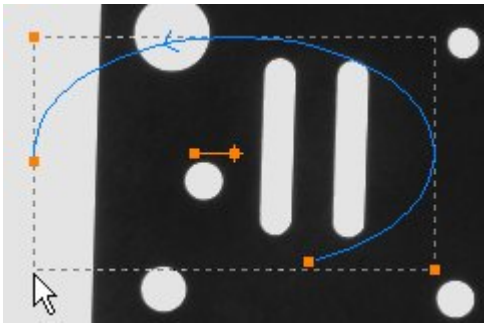




The curved arrow originating from the center point of the ellipse indicates the search direction.

10. **Click the left mouse button to finish setting the shape**

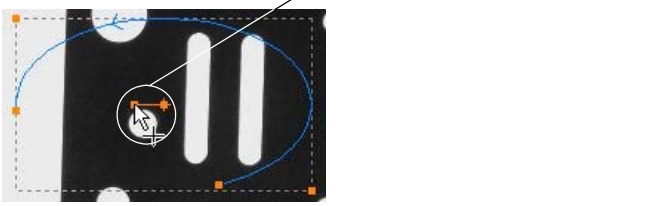
The elliptic arc defined by start and end point is displayed in the color you have selected for this checker type. Note the arrow head on the checker line indicating the scanning direction (anti-clockwise in this example):



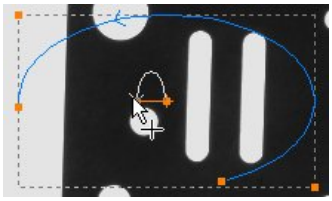
Change Scanning Direction

Procedure

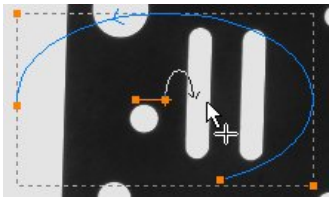
1. **Select the grip point of the checker**



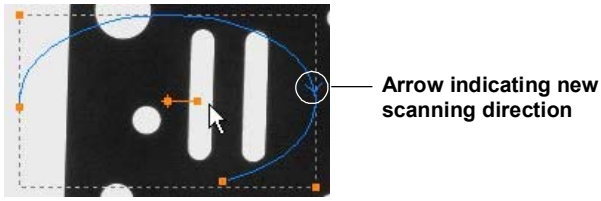
2. **Move the mouse so that the arrow indicating the scanning direction appears**



3. **Move the mouse to the other side of the center point to change the scanning direction**



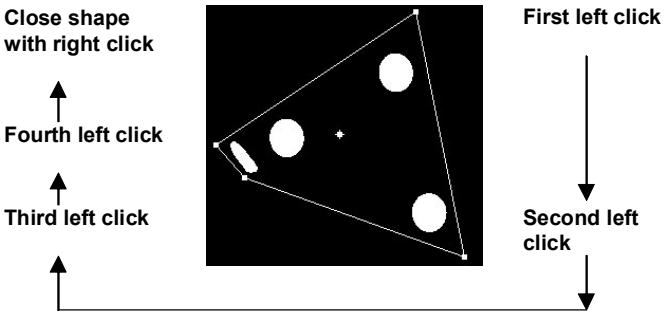
4. **Click the left mouse button to set the new scanning direction**



12.2.1.3 Polygon Shapes

Procedure

1. **Click a checker type available for polygon shapes, e.g. feature extraction**
2. **Click the checker shape polygon**
3. **Click the left mouse button to define the start point**
4. **Click the left mouse button as many times as you need to surround the check area**
5. **Close the polygon shape with a right mouse button click**



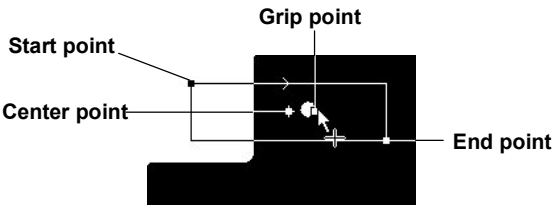
12.2.2 Rotating a Checker Shape

Procedure

1. **Select the checker shape you wish to rotate**

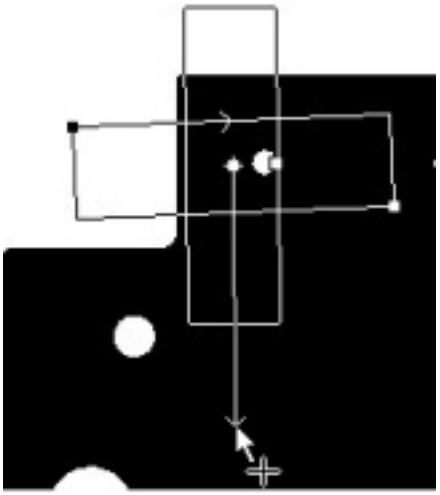
   The checker is highlighted. The start, end, center and the grip point appear as little squares; the center point is additionally marked by a cross.

2. **Position the cursor on the grip point and hold the left mouse button down**

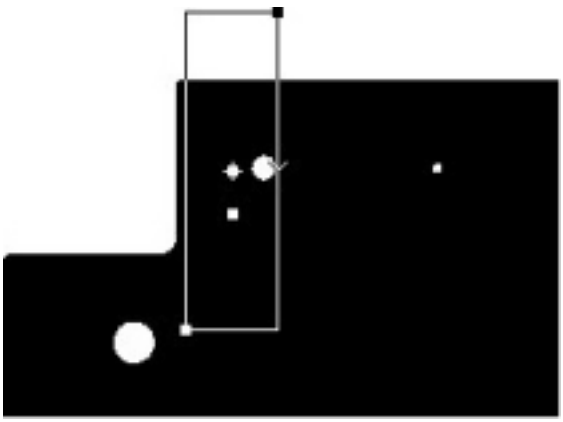


3. **Move the cursor to rotate the checker into the desired position**

A white arrow appears to help you find the right direction and angle.



4. **Release the left mouse button when the checker shape has reached the desired position**



◆NOTE

If a checker shape does not rotate as desired, the reason is that the checker shape is moved outside of the image area by the rotation. In this case, activate the "Allow positions outside the image area" option on the "Shape" property page of the checker and then rotate the shape you want.

12.3 Exposure Adjustment Checker

If you use a binary checker, the custom slice level can be adjusted for each new image using an exposure adjustment checker. The exposure adjustment checker calculates the average value of all gray values of the shape and subtracts it from a reference value.

The result (difference) will be added to the current slice level. This is how changes in the light intensity can be compensated for.

12.3.1 Algorithm

Enter the reference value in the field "Reference Brightness". This value is subtracted from the current value. The difference can be modified further with the "Coefficient of delta correction" parameter. The percentage differential value determined is applied. For example, if you enter 200 as the parameter the difference is doubled. If you enter 50, the difference is halved.

◆**NOTE**

It is not possible to enter the parameter “Reference Brightness” directly. When you click [Update Reference Value] on the "Result" page, the currently measured average brightness becomes the reference brightness.

The following parameters are available:

Parameter	Permissible value range
Reference brightness	0 ... 255
Coefficient of delta correction	0 ... 200

12.3.2 Shape

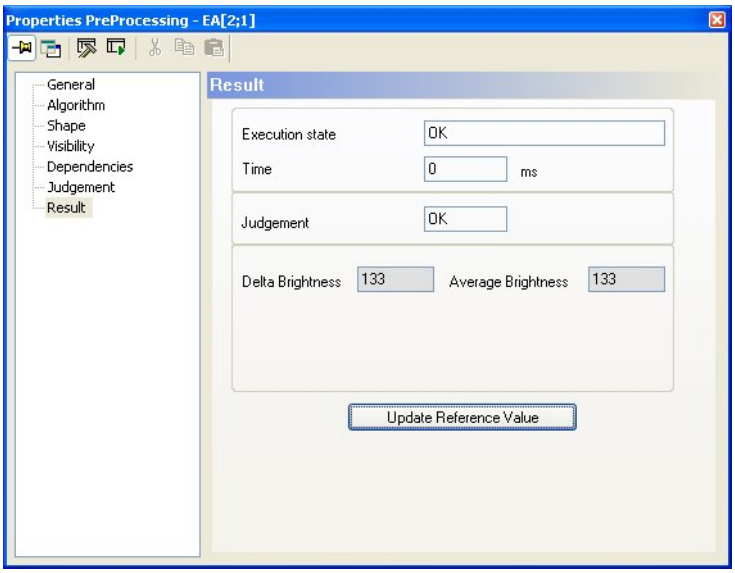
You can choose between four different shapes for exposure adjustment checkers:

- Rectangle
- Ellipse
- Polygon
- Doughnut
- Object Shape

12.3.3 Result

The value in the field "Delta Brightness" is the difference between the average brightness and the reference value. This difference has not been modified by the coefficient of delta correction. The value in the field "Average Brightness" is the average of all gray values of the selected shape.

Click [Update Reference Value] to adopt the current average brightness as displayed in the “Result” page as the reference value. Now, when you click the “Algorithm” page, you will find this value in the field "Reference Brightness". Making the current average brightness the reference value means that the "Delta Brightness" becomes zero, and the value displayed on the “Result” page is changed.

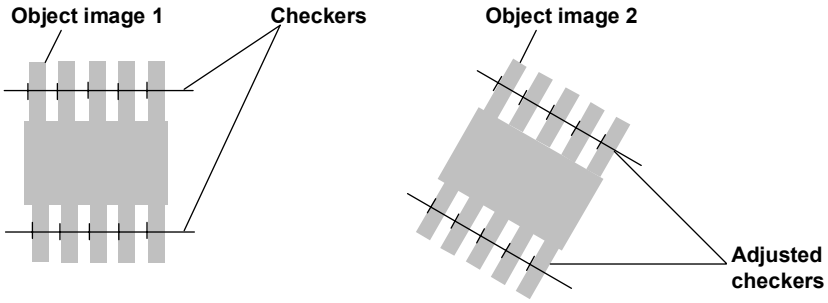


“Result” page of an exposure adjustment checker

12.4 Position and Rotation Adjustment Checkers

Position and Rotation Adjustment Checkers (PosRot checker) are used if the shape's position has to be adjusted to the current position of the object to be checked.

This is necessary if the position (x; y; α) of the object to be checked is different from the template position of the checker. In such a case, the checkers have to be adjusted to the new object position. The example below shows how checkers measure the distance between IC pins. As the chips may come to lie in a different position under the camera, the checkers (in this case edge detectors) need to be moved and rotated to fit the new position.



Position and rotation adjustment

There are five types of position and rotation adjustment checkers:

- Position Adjustment (PA)
- Position and Rotation Adjustment Line-Point (PRA_LP)
- Position and Rotation Adjustment Angle-Point (PRA_AP)
- Position and Rotation Adjustment Two Points (PRA_2P)
- Position and Rotation Adjustment Three Points (PRA_3P)
  (the abbreviations in brackets are used in Vision P400 for the preprocessing checkers)

In this section you find a general description which applies to all position and rotation adjustment checkers.

◆**NOTE**

A checker which uses a dynamic object shape as its shape cannot use position and rotation adjustment.

12.4.1 Reference Value

Position and rotation adjustment checkers do not calculate results from the shape to be checked but use results from other checkers to obtain the necessary correction value. In order to do so, the user assigns a checker whose results will be used as reference value. Which values are used for reference and on which checker the PosRot checker will depend is defined on the "Dependencies" page of the PosRot checker.

You can remove a checker value you inserted in the "Dependencies" property page by right-clicking on the value you want to remove and choosing "Remove" from the pop-up menu.

Highlighting results in the camera image

When you click on a result from the list on the property page, the object concerned is highlighted in the camera image. With the keys at the bottom you can leave the highlighting as it is or highlight different results:

Key	Highlighted result
Spacebar	The result selected with the left mouse button is highlighted as long as you hold down the key.
Up arrow	The result above the result selected with the left mouse button is highlighted as long as you hold down the key.
Down arrow	The result below the result selected with the left mouse button is highlighted as long as you hold down the key.

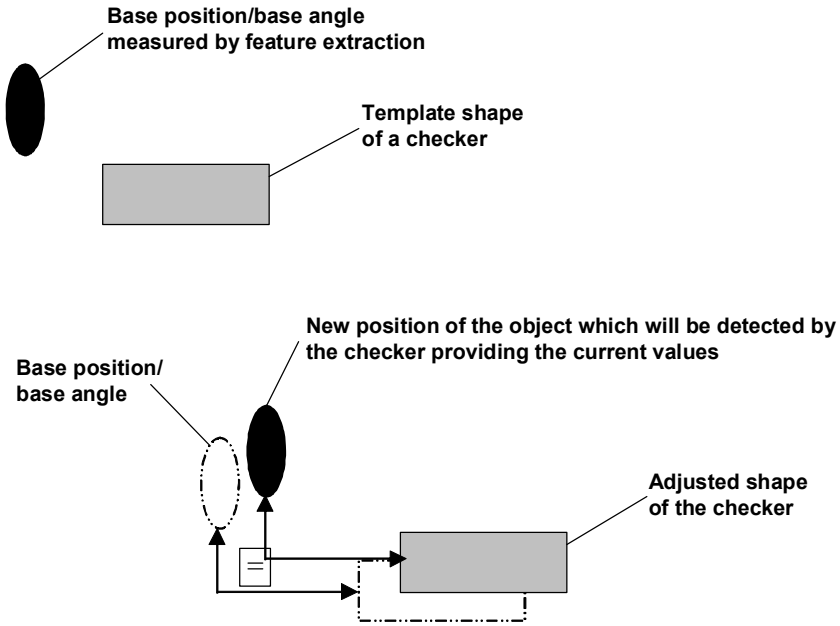
Only the results within the current displayed image segment are highlighted in the camera image. If a result is outside the segment (such as because only part of the complete image is visible after zooming) you can move the current image segment so that the result is positioned in the middle of it. To do so, double-click on the result.

12.4.2 Current Value

You find the current value of a checker serving as a reference value for a PosRot checker in the column headed "Current Value" on the “Dependencies” page.

12.4.3 Base Values

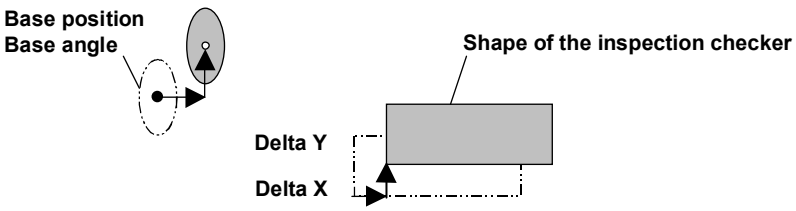
The values base position/base angle define the point of origin of the adjustment. They are calculated from the reference values and appear on the "Algorithm" page once you have executed the checker. All correction values refer to the base position/base angle:



Base position and angle for position and rotation adjustment

12.4.4 Correction Value

All position and rotation adjustment checkers provide correction values for all the dependent checkers so that the shape's position can be adjusted. Up to three adjustment values are calculated, depending on the type of position and rotation adjustment: **Delta X, Delta Y** and the **Delta angle**.



Correction value for position and rotation adjustment

A change of the angle will be adjusted if you selected the adequate position and rotation adjustment type.

The correction values (delta values) are obtained from the base and the current values. Correction values are always whole numbers, as checker shapes can be adjusted only with pixel accuracy.

The following checkers provide reference values for a position and rotation adjustment and can be used as reference checkers in the dependency list of a PosRot checker:

Checkers	Reference value
Edge Detection Binary (ED_B)	Point, angle
Edge Detection Gray Value (ED_G)	Point, angle (correction is not executed with subpixel values)
Edge Detection Gray Value Projection (ED_GP)	point, 2nd point (in "execution mode" = "edge pair")
Difference (DI)	Point, angle of the pattern matching on the "Results" page
Feature Extraction (FE)	Gravity, angle, smallest rectangle rotated, circumcircle, hidden circle (result values should refer to the same real object)
Contour Matching (CM)	Point, reference point, angle
Code Reader (CR)	Point
Geometry Point-Point (G_PP)	Gravity, angle ALPHA
Geometry Point-Line (G_PL)	Foot point
Geometry Line-Line (G_LL)	Intersection point, angles ALPHA and BETA

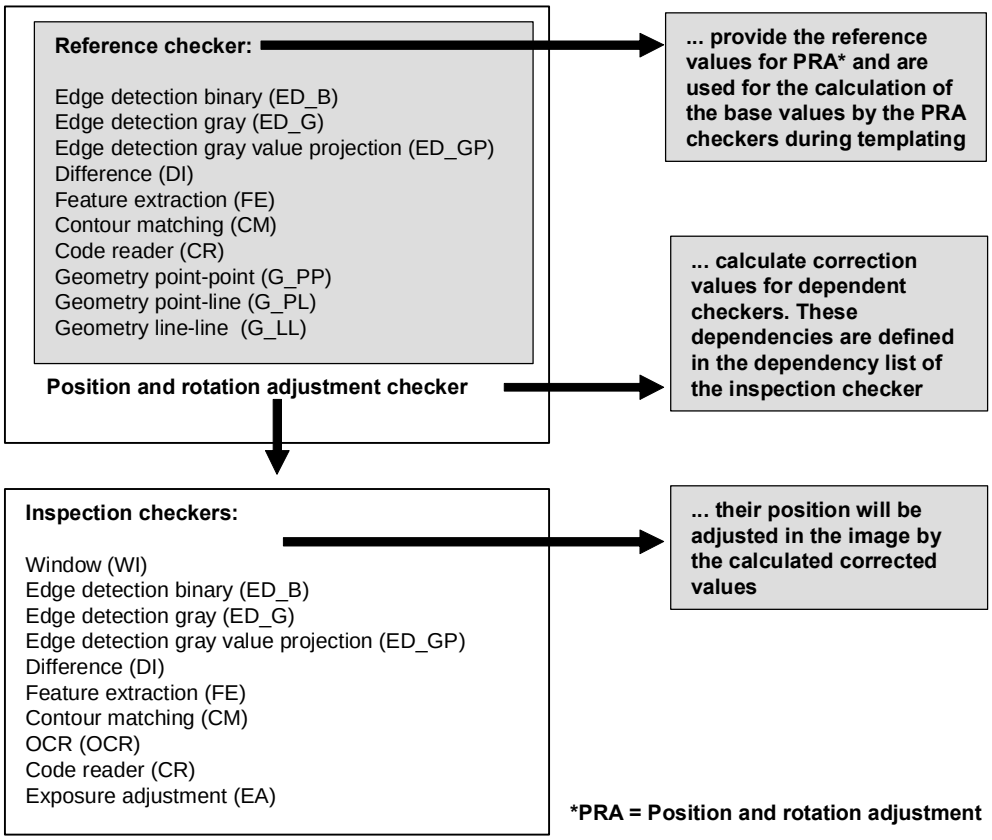
Checkers and checker results which do not appear in the table above cannot be entered into the dependency list, i.e. other checkers cannot be used to determine reference values for a position and rotation adjustment.

◆**NOTE**

The center of motion and the direction can be provided by several checkers but should refer to one and the same real object.

12.4.5 Dependency of a Shape Position

The diagram shows what each type of checker/preprocessing checker is used for.



Usage of position and rotation adjustment checkers

When establishing dependencies, take into account that:

- **Reference checker**
  provide the values during "teaching" Vision P400 the point of origin of the adjustment. These values are used to calculate the base values x_0, y_0 and α_0 during teaching and are updated with every inspection.
- **Position and rotation adjustment checker**
  calculate and save the base values during "teaching" Vision P400 the point and angle of origin of the adjustment. With every inspection they use the current and the base values to calculate the correction values Δx, Δy and $\Delta\alpha$.
- **Adjustment values Δ x, Δ y and $\Delta\alpha$**
  are added to the base values and the shape will be moved to the right position.

Enter the results of the reference checker on which the PosRot checker depends into the "Dependencies" page of the PosRot checker. Transfer the results via drag & drop from the "Result" page of the reference checker.

When entering the checker results into the table, reference and current values are the same. The values will differ only after the checker has been executed. Current values will be used as

new reference values in the column "Reference Value" when you click [Copy Current Values]. This will also make Vision P400 recalculate the base values.

Always click [Copy Current Values] if

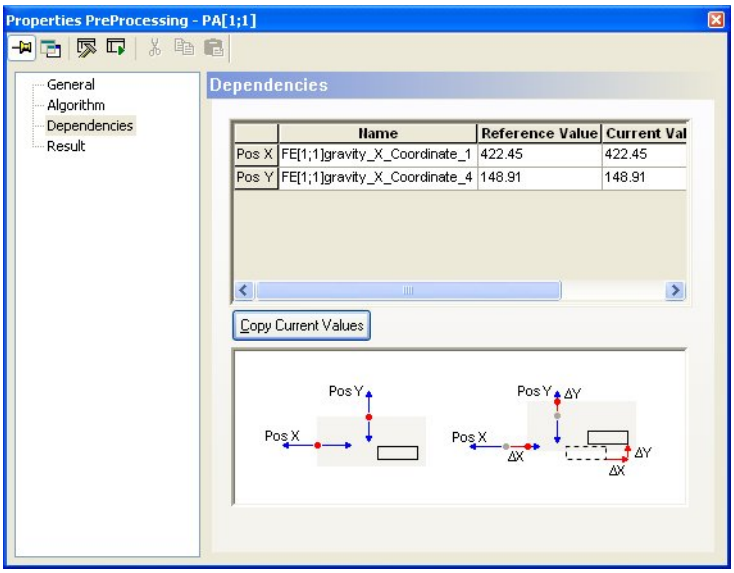
- you have already executed the checkers and add a new checker afterwards or
- the position of one of the checkers depending on a position and rotation adjustment has been changed.

◆NOTES

- **If you set a position and rotation adjustment checker, we recommend saving the image as a bitmap. When you need to add checkers later, use the saved bitmap image to define the checkers and their dependency from the position and rotation adjustment.**
- **Copying the current values and recalculating the base values does not mean the checker will be executed.**
- **Not all checker results can be entered into the dependency list.**
- **A PosRot Checker cannot be executed if a checker it depends on has not been executed. As a result, the checkers depending on the PosRot checker will not be executed, either.**
- **If you use the results of a feature extraction checker, for example, make sure that you always use the same object for the dependencies. You have to make sure that the sequence of the objects in the result list is correct either by using the option "Output Order" on the "Algorithm" page or by using filters.**
- **When you have carried out a position and rotation adjustment at least once, i.e. the position of the checkers depending on the PosRot checker has been adjusted accordingly, it is not sufficient to click [Copy Current Values] when you need to set new checkers. The values for the position / rotation adjustment have been updated, but the checkers set before still depend on the original base values and need to be adjusted manually. Otherwise, they will not be positioned correctly when you execute the application again. Only after the manual adjustment can you set new checkers.**

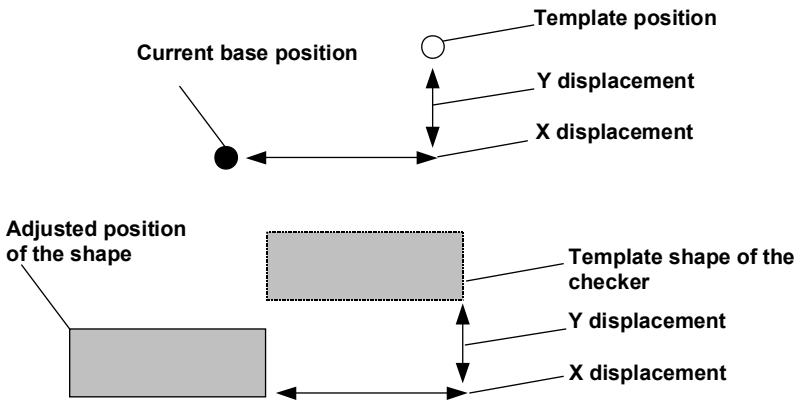
12.4.6 Position Adjustment Checker

Reference checker	Reference value	Base value	Result
ED_B, ED_G, ED_GP **FE** **DI** **CM** **CL** **G_PP, G_PL, G_LL**	X-coordinate Pos X and / or Y-coordinate Pos Y	The reference value in the dependency list and the base value of a position adjustment checker are identical	Current and delta values for X-coordinate Y-coordinate



"Dependencies" page of a position adjustment checker

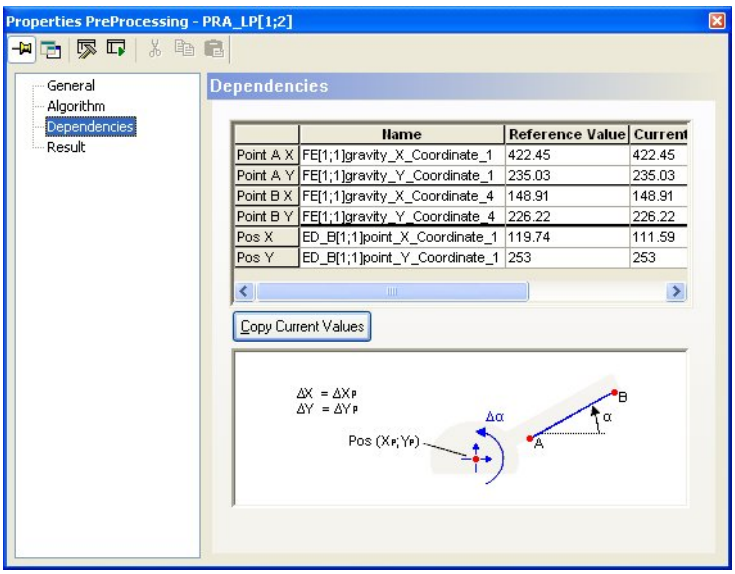
By clicking on the checkbox in the "Use" column, you delete the corresponding row. This way it is possible to execute the position adjustment in one direction only. You can replace a row by dragging & dropping a new result from an inspection checker's "Result" page.



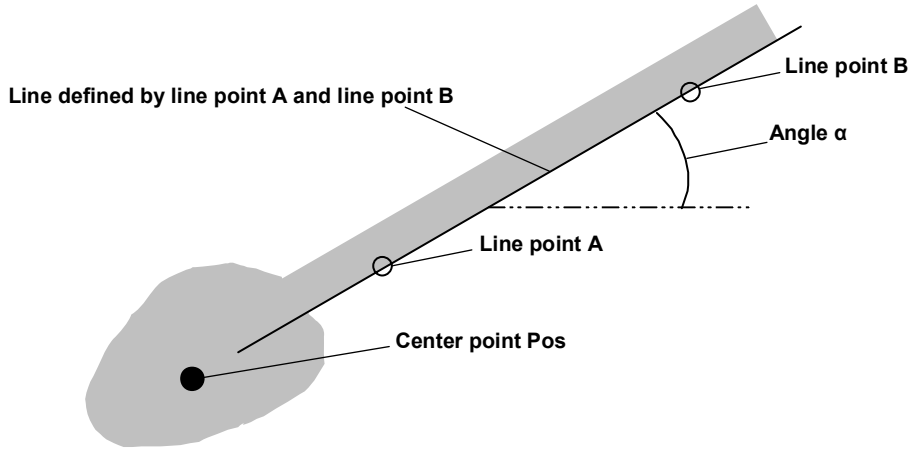
Position adjustment

12.4.7 Position and Rotation Adjustment Line-Point

Reference checker	Reference value	Base value	Result
ED_B, ED_G, ED_GP **FE** **DI** **CM** **CL** **G_PP, G_PL, G_LL**	Center point Pos (center of motion and point of origin of the displacement) Points defining the line: line point A line point B	Center point Pos Angle α is the angle between the horizontal line and the line defined by line point A and line point B	Current and delta values for: X-coordinate Y-coordinate Angle



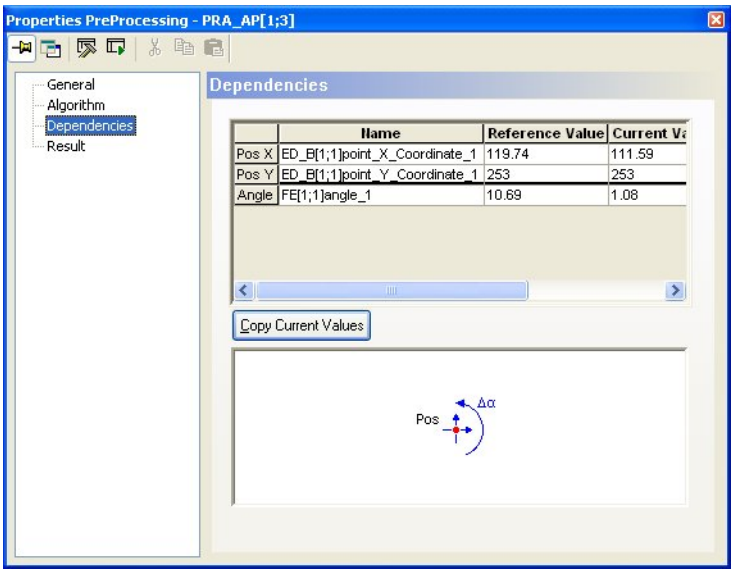
"Dependencies" page of a position and rotation adjustment line-point checker



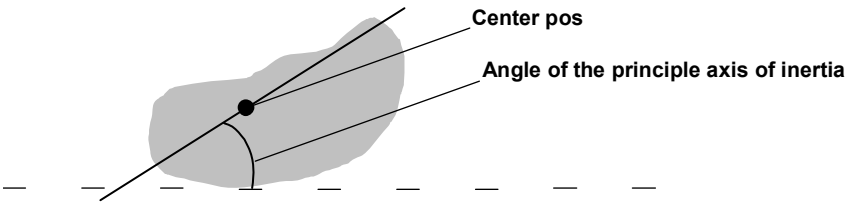
Example for position and rotation adjustment line-point

12.4.8 Position and Rotation Adjustment Angle-Point

Reference checker	Reference value	Base value	Result
ED_B, ED_G, ED_GP **FE** **DI** **CM** **CL** **G_PP, G_PL, G_LL**	Center point Pos Angle α of the object position provided by a feature extraction or edge detection checker, for example	The reference values in the dependency list and the base values are identical for position and rotation adjustment	Current and delta values for: X-coordinate Y-coordinate Angle



"Dependencies" page of a position and rotation adjustment line-point checker



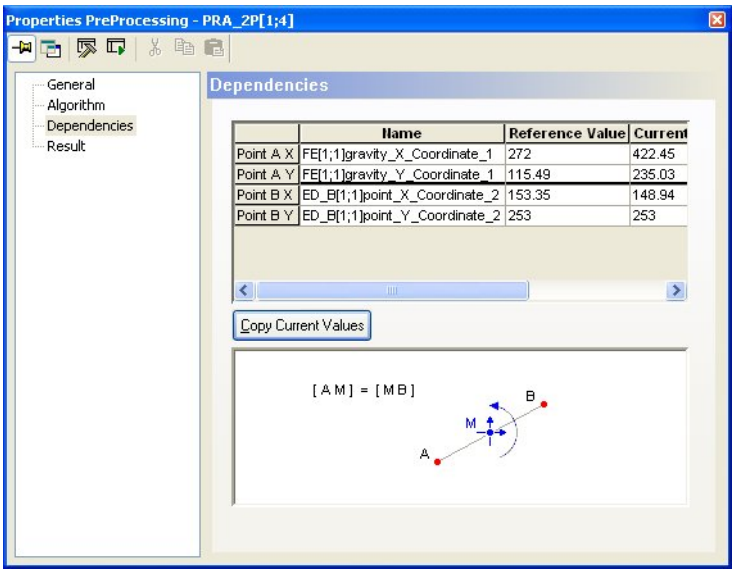
Example for position and rotation adjustment angle-point

◆**NOTE**

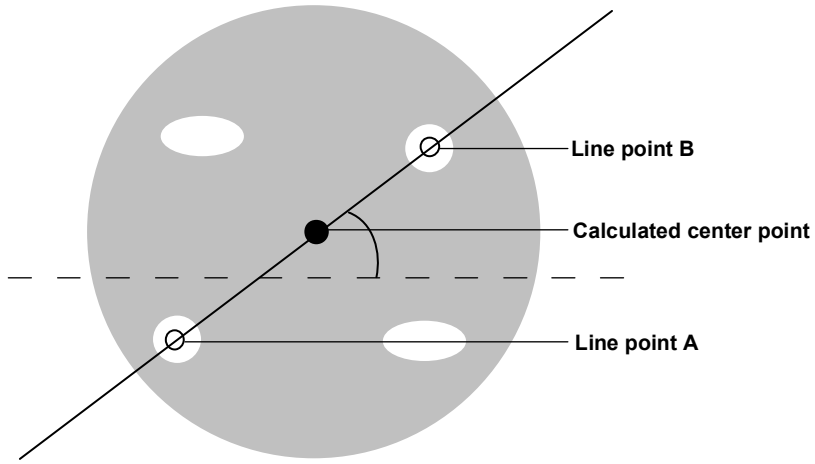
The reference angle entered under "Angle" can be in the range of 0° to 180° or 0° to 360°. This depends on the angle result from the reference checker used for the position and rotation adjustment. The PRA_AP checker determines the valid angle range automatically from the reference checker result to calculate the correction angle.

12.4.9 Position and Rotation Adjustment Two Points

Reference checker	Reference value	Base value	Result
ED_B, ED_G, ED_GP **FE** **DI** **CM** **CL** **G_PP, G_PL, G_LL**	Points defining the line: line point A line point B	Center: center point M of the straight line which is defined by the line points Angle α between the horizontal line and the line defined by line point 1 and line point 2	Current and delta values for: X-coordinate Y-coordinate Angle



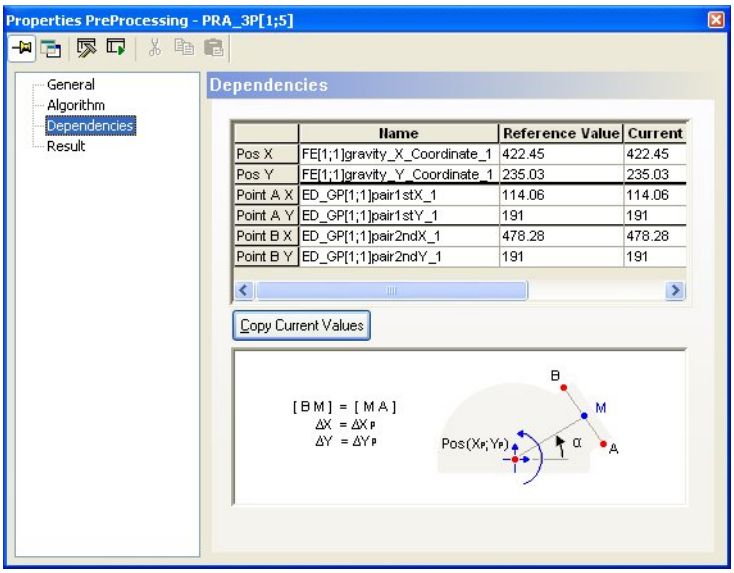
"Dependencies" page of a position and rotation adjustment two points checker



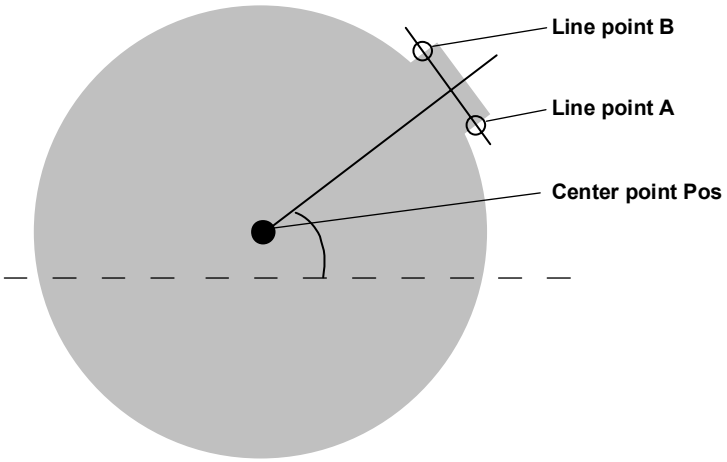
Example for position and rotation adjustment two points

12.4.10 Position and Rotation Adjustment Three Points

Reference checker	Reference value	Base value	Result
ED_B, ED_G, ED_GP **FE** **DI** **CM** **CL** **G_PP** **G_PL** **G_LL**	Center point Pos Points defining the line: line point A line point B	Center point Pos Angle α between the line defined by the line points and the horizontal line Vision P400 calculates the center point of the line defined by line point A and line point B. The center point and the point Pos define another line. The angle of this line in relation to the horizontal line is the base angle (angle: α).	Current and delta values for: X-coordinate Y-coordinate Angle



"Dependencies" page of a position and rotation adjustment three points checker



Example for position and rotation adjustment three points

12.4.11 Algorithm

On the "Algorithm" page of the position and rotation adjustment checker Vision P400 displays the base values (see page 324) after the first execution of the checker.

12.4.12 Result

The following results can be obtained from a position and rotation adjustment checker:

- Current Position X
- Current Position Y
- Current Angle (not position adjustment checker)
- Delta X
- Delta Y
- Delta Angle (not position adjustment checker)

Delta values are correction values (see page 324) and are calculated with the base value and the current value.

12.5 Object Shape

In many inspections it is sufficient to use a predefined, unchanging area which can be moved around the image with a position adjustment. For check areas of constantly changing shape and/or size (such as bread rolls), or for complex check areas (such as conductor tracks) that is not possible, or only with great effort. For these cases you can use the object shape. The function defines a check area using pre-calculated objects and then analyzes this area precisely.

Four steps are necessary for this:

1. Determine the objects which define the check area. This is done using feature extraction checkers.
2. Define the check area from those objects. You use the object shape for this.
3. Assign the check area to other checkers, such as a feature extraction checker.
4. Execute the actual inspection

How you use the object shape is explained on the basis of two different examples.

- Object shapes for amorphous objects (see page 340) by bread rolls which are to be examined for burnt areas
- Object shapes for complex objects (see page 346) by conductor tracks which are to be examined for defects

The following checkers can use an object shape as a shape:

Exposure Adjustment (EA) (see page 320)

Window (WI) (see page 353)

Feature Extraction (FE) (see page 356)

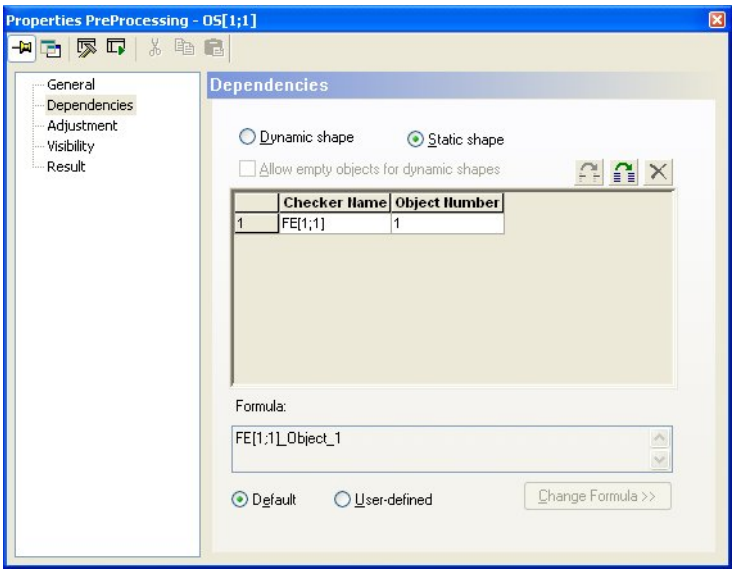
Optical Character Recognition (see page 430)

Code Reader Checker (CR) (see page 455)

◆**NOTE**

The object shape must be positioned in the checker sequence BEFORE the inspection checker which is to use the object shape as a shape.

12.5.1 Dependencies



"Dependencies" property page to calculate the object shape

There are basically two cases in which you can use an object shape:

1. The shape of the check area changes on every check. In this case you need a dynamic shape.
2. The shape of the check area remains the same, but it is so complex that it can only be created with great effort (such as using a polygon), or it consists of multiple unconnected areas, or it contains "holes". In this case you need a static shape.

Dynamic shape

When you select a "Dynamic shape", the check area is calculated on every check from the objects you dragged into the list of dependencies. This means that the check area changes as soon as one of the objects used for its calculation changes.

◆NOTE

Checkers which use a dynamic object shape cannot be adjusted with a position adjustment. By contrast, position adjustment is possible for checkers which use a static object shape.

Since the check area is always calculated from the current objects, it may occur that one of the objects is empty or does not exist in the current check. For this case it is advisable to activate the "Allow empty objects for dynamic shapes" option. Then empty or non-existent objects are ignored in calculation of the check area and the check area is calculated only from the other objects. If you have not activated "Allow empty objects for dynamic shapes", the check area is not calculated when one of the objects is empty or does not exist, and the object shape returns a dependency error as the result.

Static shape

If you choose "Static shape" the check area is calculated at the following points in time:

- When you first activate the "Static shape" option button
- When you add a new object to the dependencies list or
- When you select one of the two icons (see below).

The check area is not recalculated on every check. This means the static object shape enables you to calculate a complex check area once in advance and then reuse it for every check. Static object shapes can also be adjusted in the image with a position adjustment.

Available buttons

Button	Functionality
	Only available when you have activated "Static shape" and the object list contains at least one object. This updates the selected object, meaning you recalculate the static check area with the updated object.
	Only available when you have activated "Static shape" and the object list contains multiple objects. This updates all objects, meaning you recalculate the static check area with the updated objects.
	Deletes the selected object from the dependencies list. Alternatively, you can also right-click on the object you want to delete and from the pop-up menu choose "Delete". A static check area is recalculated in this case.

Highlighting results in the camera image

When you click on a result from the list on the property page, the object concerned is highlighted in the camera image. With the keys at the bottom you can leave the highlighting as it is or highlight different results:

Key	Highlighted result
Spacebar	The result selected with the left mouse button is highlighted as long as you hold down the key.
Up arrow	The result above the result selected with the left mouse button is highlighted as long as you hold down the key.
Down arrow	The result below the result selected with the left mouse button is highlighted as long as you hold down the key.

Only the results within the current displayed image segment are highlighted in the camera image. If a result is outside the segment (such as because only part of the complete image is visible after zooming) you can move the current image segment so that the result is positioned in the middle of it. To do so, double-click on the result.

There are two ways of displaying an object used in an object shape:

1. The object is displayed as it exists currently in the checker from which it originates.
2. The object is displayed as it is stored in the object shape.

These two displays modes of the object shape usually do not match.

- For the dynamic object shape option 1 is the standard view, as in it the current object from the checker is always used.
- For the static object shape option 2 is the standard view, as in it the object from the

shape is always used.

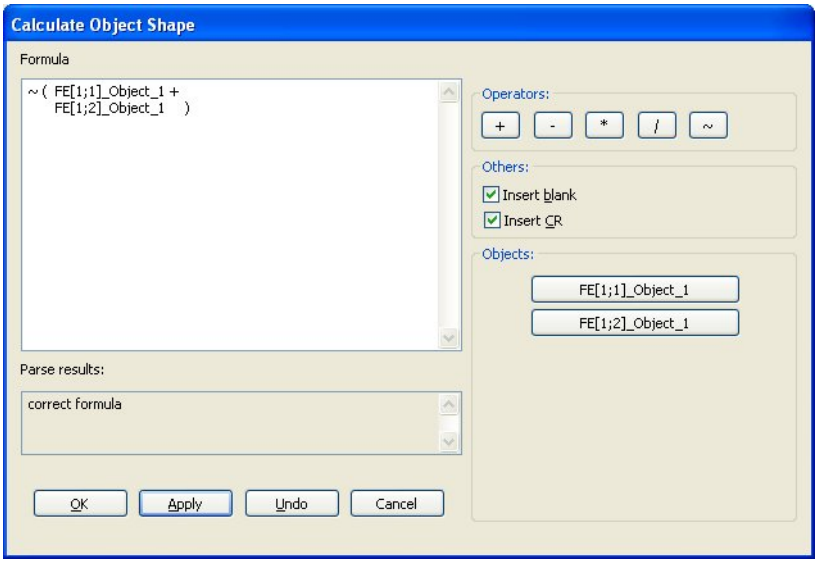
The <Ctrl> key can be used to switch display mode.

Type of object shape	When <Ctrl> is not pressed	When <Ctrl> is pressed
Dynamic shape	The current shape of the result in the checker is displayed.	The shape of the result which the object had when the result was inserted into the object list is displayed.
Static shape	The shape of the result which the object had when the result was inserted into the object list, or on the last update of the object, is displayed.	The current shape of the result in the checker is displayed.

The "Formula" field contains the formula used to calculate the check area from the objects. The default uses the combination of all objects in the object list. The combination of objects is indicated in the formula by "+". If you select "User-defined", you can enter your own custom formula (see page 337). To do so, open the Formula Editor by clicking the [Change Formula >>] button.

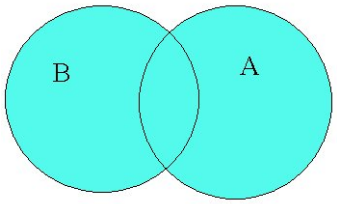
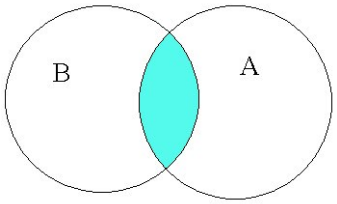
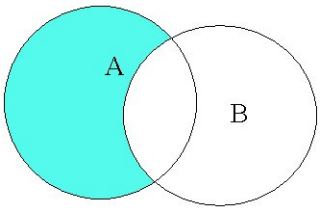
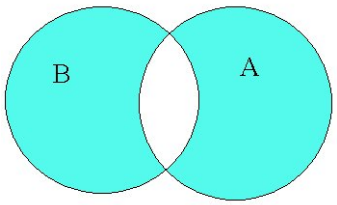
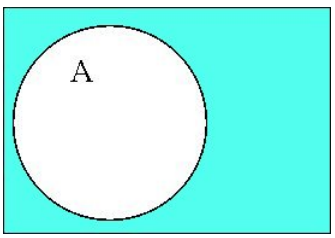
12.5.1.1 Formula Editor to Calculate the Object Shape

This formula calculates the complement of two objects.



Formula Editor to calculate the object shape

All objects in the object list can be interlinked by way of the operators and brackets. You can use each object as often as you want. The following operators are available:

Symbol	Operator	Example
+	Combination	A+B 
*	Intersection	A*B 
-	difference	A-B 
/	Symmetric difference	A/B 
~	Complement of the object for the complete image	~A 

The examples in the table are merely representative; more than two objects can also be interlinked. If there are more objects available than can be displayed in the Formula Editor, use the << and >> buttons to display the previous and next objects. To check the formula click on the [Apply] button (Formula Editor remains open) or click [OK] (Formula Editor is closed).

You can insert operators and object names as follows into the formula:

- Select the relevant buttons at the right
- Type the formula directly into the input box

If you are creating the formula using the buttons and have checked the "Insert blank" checkbox, a blank is inserted into the formula before the button text is inserted. With "Insert CR" a carriage return is inserted after each object.

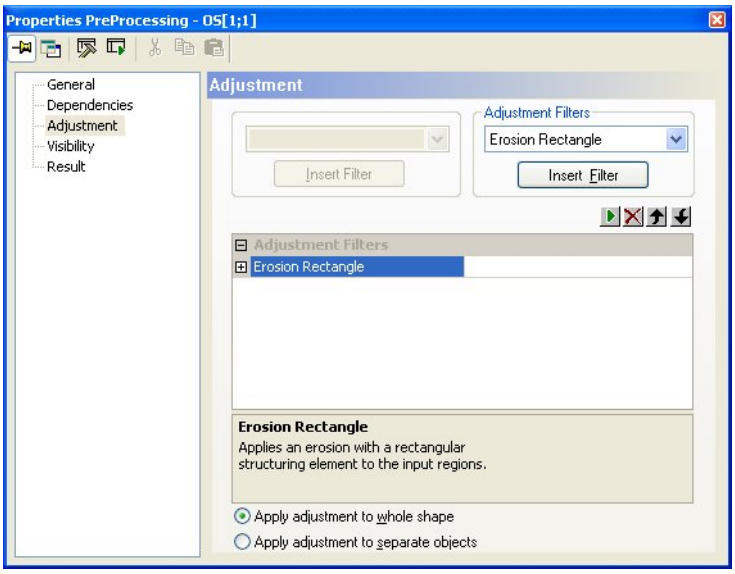
◆NOTE

If you clear everything from the formula input box or do not enter anything in the first place, the system automatically uses the combination of all objects in the object list.

Button	Description
OK	Use this button to save all changes and close the formula editor. Please note that this is only possible if the entered formula is correct. Otherwise you will get a warning message.
Apply	Use this button to accept all changes to the formula. The editor window stays open. Please note that this is only possible if the entered formula is correct. Otherwise you will get a warning message.
Undo	Use this button to undo all changes which you have made since you have last clicked [Apply].
Cancel	Use this button to leave the formula editor without saving any of the changes made since you have last clicked [Apply].

12.5.2 Adjustment

With the filters you enter on the "Adjustment" property page you can modify the check area you are calculating. These filters corresponds to the binary image filters (see page 290).



"Adjustment" property page to modify an object shape

In use of the adjustment filters you have two options for influencing the order of the individual steps when calculating objects:

- If you choose "Apply adjustment to whole shape", the object shape is calculated in this order:

  1 Calculate the check area based on the formula entered under "Dependencies"

  2 Apply the filter to the calculated check area

- If you choose "Apply adjustment to separate objects", the object shape is calculated in this order:

  1 Apply the filter of each individual object

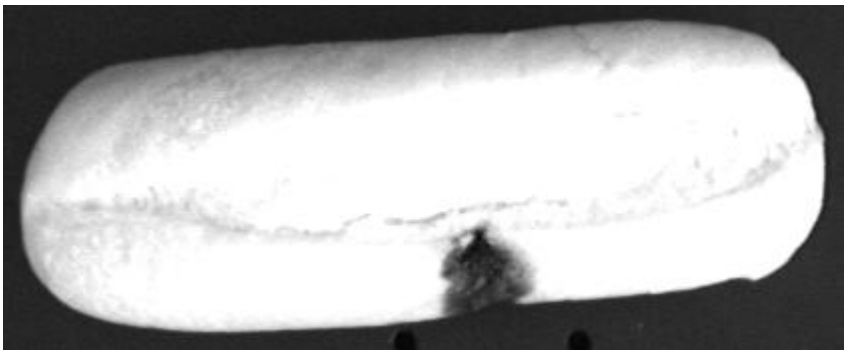
  2 Calculate the check area based on the formula entered under "Dependencies"

◆**NOTE**

It makes no difference whether you use "Apply adjustment to separate objects" or edit the objects first through the filters of the feature extraction checker. There is only a difference when you use the same objects in different object shapes: If you edit the objects with feature extraction checker filters, the edited objects are used in all object shapes. But if you use the adjustment filters of the object shape, you can edit the objects in every object shape with different filters.

12.5.3 Example with an Amorphous Object

The bread roll in the example image is to be examined for burnt areas (black staining). The shape of the roll may be different in every check.



Identifying the roll

First you must find the roll.

Procedure

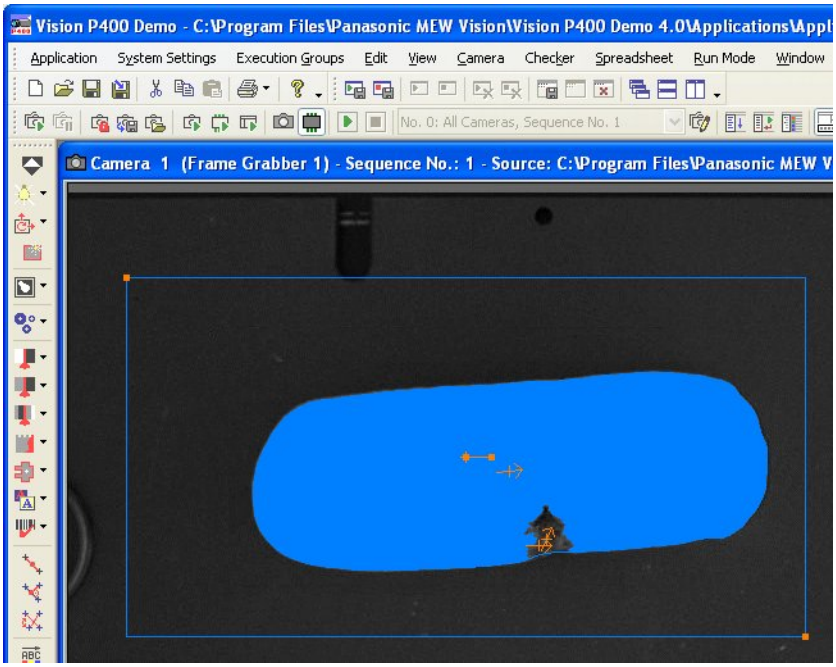
1. **Click on**

on the checker bar

   This creates a feature extraction checker with a rectangular check area.

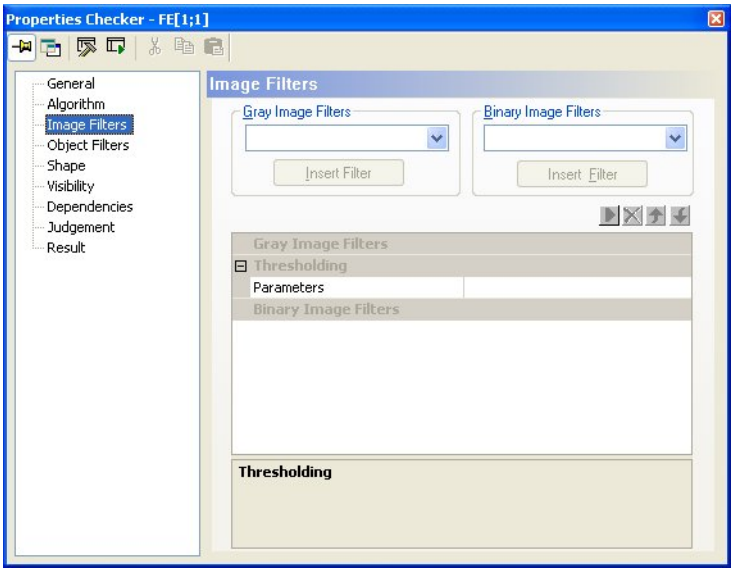
2. **Drag the check area over the roll so the roll is fully inside it**

3. **Execute the checker with**



The burnt spot is currently not part of the object found - the bread roll. It must, however, be added to the object using a filter so that it later belongs to the check area and can be assessed. To do this use a binary closing filter, to be found on the "Image Filters" (see page 290) property page of the feature extraction checker. Alternatively, you can also use the unfiltered object in the object shape and configure the closing filter on the "Adjustment" property page of the object shape.

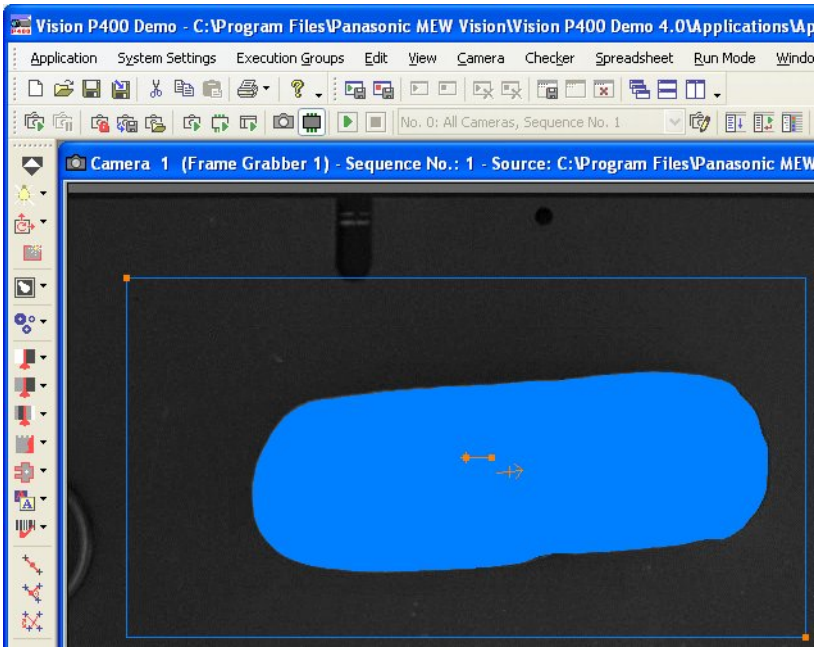
4. **Select the "Image Filters" property page of the feature extraction checker**



5. **Under "Binary Image Filters" in the list box select "Closing"**
6. **Click on [Insert Filter]**
7. **Double-click on "Closing" to set the filter radius**
8. **In the "Filter Radius" list box select the setting "60.5"**

   You can test the effects of the filter with the configured parameters in the camera image by clicking the icon.
9. **Execute the checker with**

Now an area corresponding to the shape of the bread roll is marked out.



Define the complete roll as the check area for the object shape

As the bread roll is to be examined for defects, the complete roll with no burn marks must be defined as a check area.

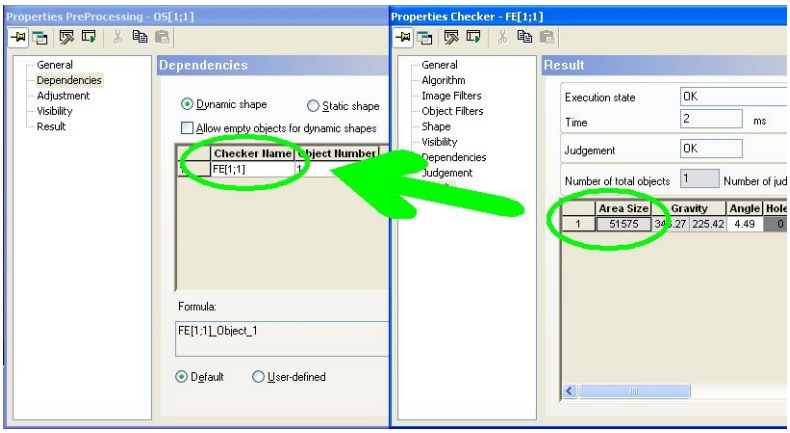
◆Procedure

1. **Click on on the checker bar**

   The properties window of the object shape opens up on the "Dependencies" page. The object shape enables the irregular roll shape to be defined as a dynamic shape for the feature extraction checker which is to check the roll for burnt spots.

2. **Open the Properties window of the feature extraction checker**
3. **Click on the "Result" property page**

4. **Drag the result with the mouse from the result series belonging to the selected object into the dependencies list of the object shape**



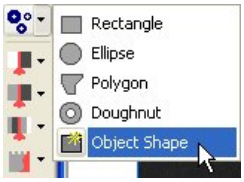
◆NOTE

Make sure the "Dynamic shape" option is activated on the "Dependencies" page of the object shape. Only then will the check area be recalculated on every check and adjust to the current shape of the roll.

Assign the object shape check area for the actual check

In the last step you assign the check area you identified by way of the feature extraction and object shape to another feature extraction checker which examines the roll for burnt spots.

◆Procedure

1. **Click on** 

on the checker bar

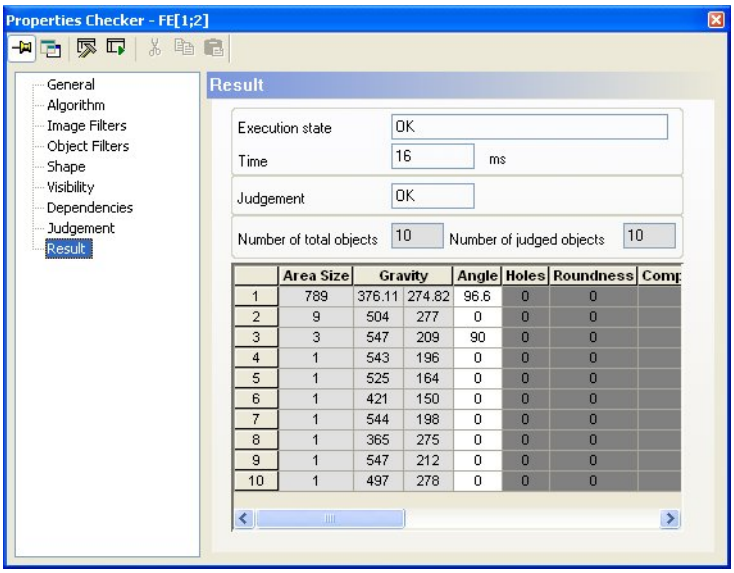
   When you click on a checker on the checker bar, the shapes available for that checker are displayed on a submenu. If you have not yet created an object shape, the "Object Shape" option is grayed out.

2. **Click on "Object Shape"**

   The "Object Shape Checker" window appears.

3. **Confirm OF(1;1) with [OK]**
4. **Execute the checker with**

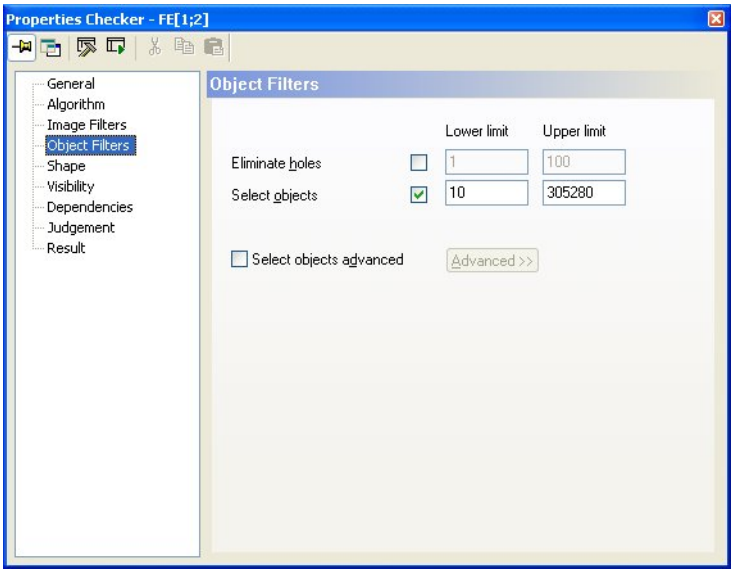
   On the result page all nonconformance to the complete (ideal) bread roll is listed. Based on the results under "Area size", "real" and "unreal" defects can be distinguished.



	Area Size	Gravity		Angle	Holes	Roundness	Comp
1	789	376.11	274.82	96.6	0	0	
2	9	504	277	0	0	0	
3	3	547	209	90	0	0	
4	1	543	196	0	0	0	
5	1	525	164	0	0	0	
6	1	421	150	0	0	0	
7	1	544	198	0	0	0	
8	1	365	275	0	0	0	
9	1	547	212	0	0	0	
10	1	497	278	0	0	0	

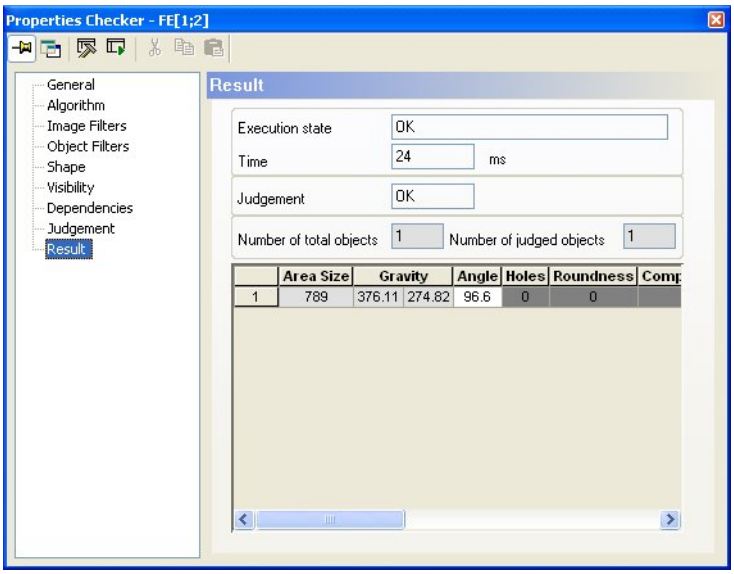
   So as to only find "real" defects, set the limit values on the "Object Filters" property page

5. **Click on "Object Filters"**
6. **Activate "Select Objects"**
7. **In "Lower limit" enter a value above the largest "unreal" defect**



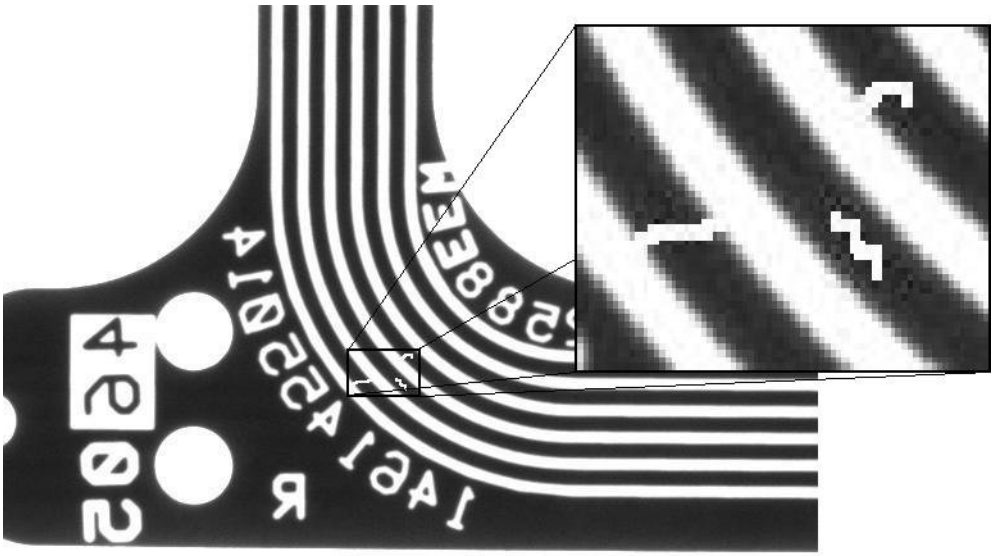
8. **Execute the checker with**

   Now only the burn mark is detected as a defect.



12.5.4 Example with a Complex Static Object

The conductor tracks in the example image are to be examined for cracks, fractures or other defects. The check area remains the same in every check (static object shape). It is possible to check the conductor tracks with the aid of polygons, but it is very involved. You would have to create a separate checker for each track. It is easier to calculate the check area for all conductor tracks with one object shape.



Identify the conductor tracks

First you must find the conductor tracks as objects. To do so, use an image with defect-free conductor tracks.

Procedure

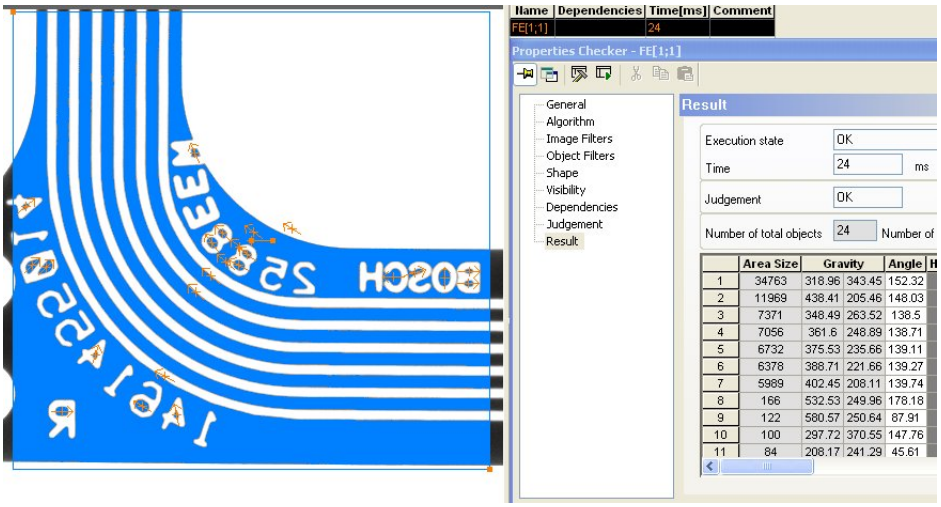
1. **Click on**

on the checker bar

   This creates a feature extraction checker with a rectangular check area.

2. **Drag the check area over the conductor tracks so the conductor tracks are fully inside it**

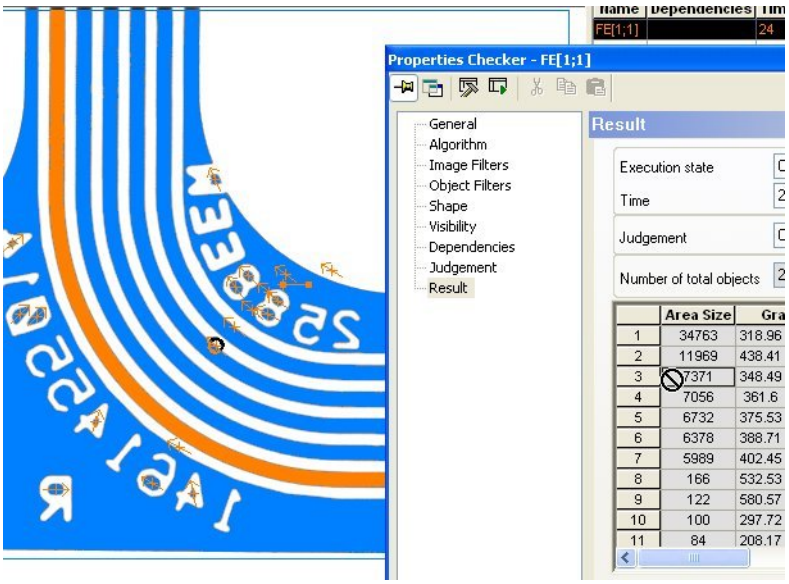
3. **Execute the checker with**



With the default settings of the feature extraction checker other objects are found in addition to the conductor tracks. You have two options to use only the conductor tracks for the check area:

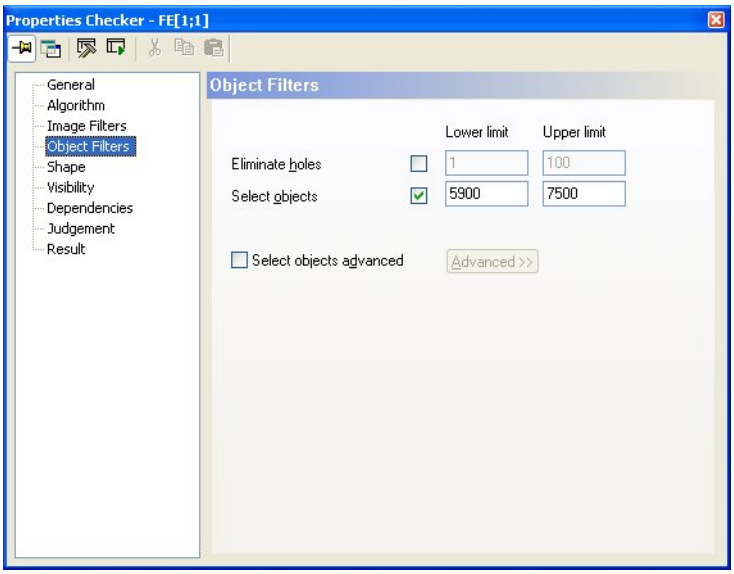
1. You use only the objects which represent conductor tracks
2. You exclude all objects which are not conductor tracks.

The example shows how you can apply the second option. The objects are sorted in descending order of area size. Clicking on the individual results highlights the associated object in the camera image (orange by default).



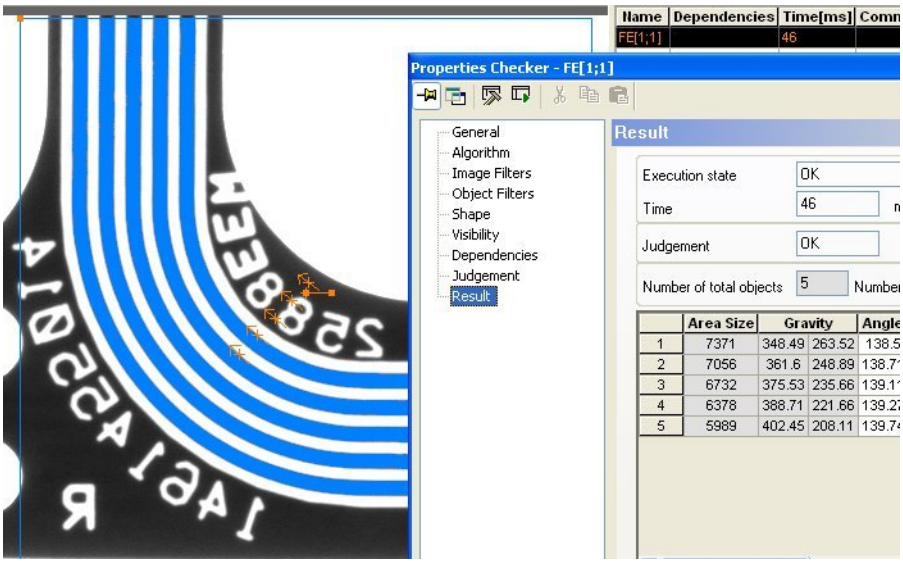
When you click on the objects in the result list in succession, you find that the conductor tracks have an object size of between around 5900 and 7500. With this data you can use an object filter (see page 301) to separate the conductor tracks from the other objects.

4. **Click on the "Object Filters" property page**
5. **Activate "Select Objects"**
6. **In the "Lower limit" field enter 5900**
7. **In the "Upper limit" field enter 7500**



8. **Execute the checker with**

   Now only the conductor tracks are found.



Define the defect-free conductor tracks as the check area for the object shape

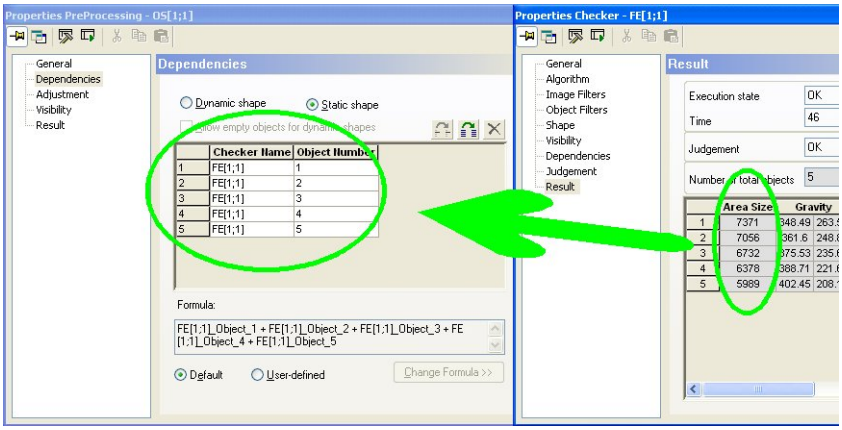
As the conductor tracks are to be examined for defects, the defect-free conductor tracks must be defined as a check area.

◆Procedure

1. **Click on** **on the checker bar**

   The properties window of the object shape opens up on the "Dependencies" page.
2. **Activate "Static shape"**
3. **Open the Properties window of the feature extraction checker**
4. **Click on the "Result" property page**
5. **For each track drag a result with the mouse into the dependencies list of the object shape**

It is not possible to transfer more than one result at once into the dependencies list.



If multiple objects are entered in the dependencies list of an object shape, the combination of the areas of the individual objects is used as the check area by default. This is indicated by the fact that in the formula field all entered objects are linked by a "+" (for combination) and that the "Default" option is activated.

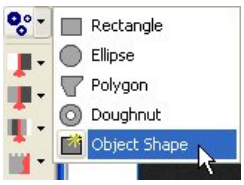
NOTE

Make sure the "Static shape" option is activated on the "Dependencies" page of the object shape. As a result the check area is calculated once when you apply the settings with or switch to another property page. The check area is not recalculated during the check. In this way you can calculate complex check areas such as the conductor tracks in advance and reuse them over and over.

Assign the object shape check area for the actual check

In the last step you assign the check area you identified by way of the feature extraction and object shape to another feature extraction checker which examines the conductor tracks for cracks, fractures or other defects.

Procedure

1. **Click on** 

on the checker bar

   When you click on a checker on the checker bar, the shapes available for that checker are displayed on a submenu. If you have not yet created an object shape, the "Object Shape" option is grayed out.

2. **Click on "Object Shape"**

The "Object Shape Checker" window appears.

3. **Confirm OF(1;1) with [OK]**

   To find defects on the conductor tracks a number of other settings are required.

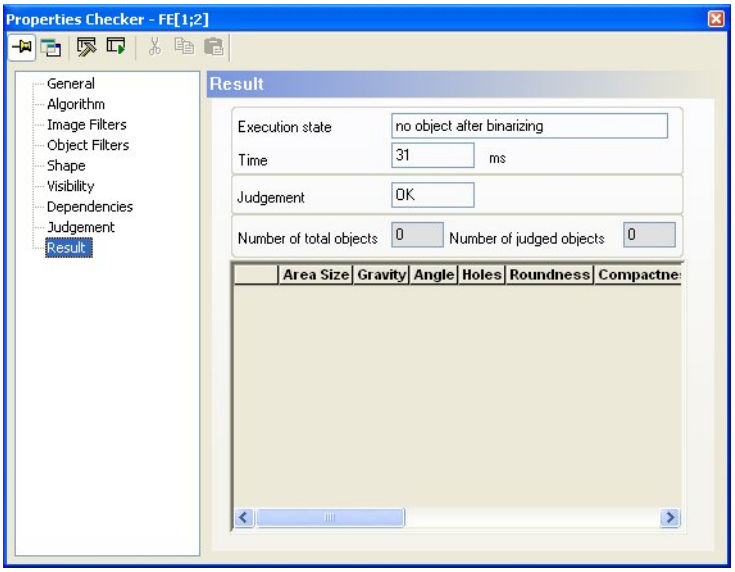
4. **Click on the "Algorithm" property page**

5. **Under "Object type" choose "Not selected"**

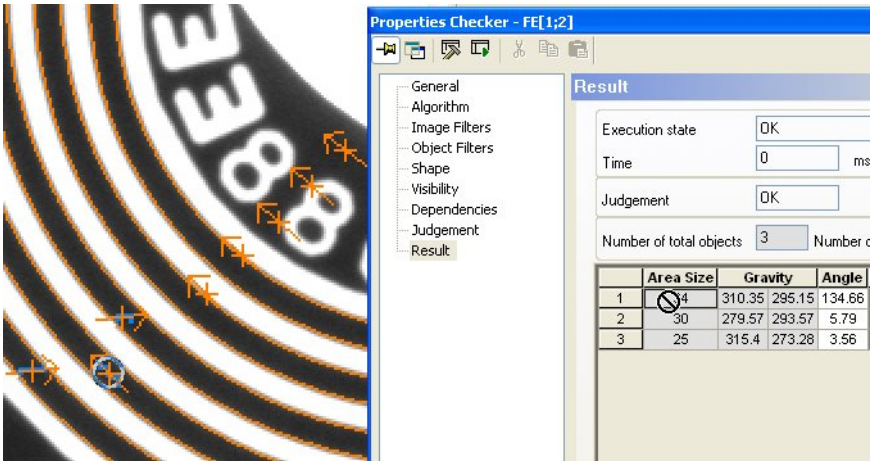
   Consequently the feature extraction checker returns all conductor track nonconformance as its result.

6. **Execute the checker with**

   If the conductor tracks are defect-free the feature extraction checker returns no results.



If the conductor tracks have cracks or fractures, the feature extraction checker finds objects.



◆**NOTE**

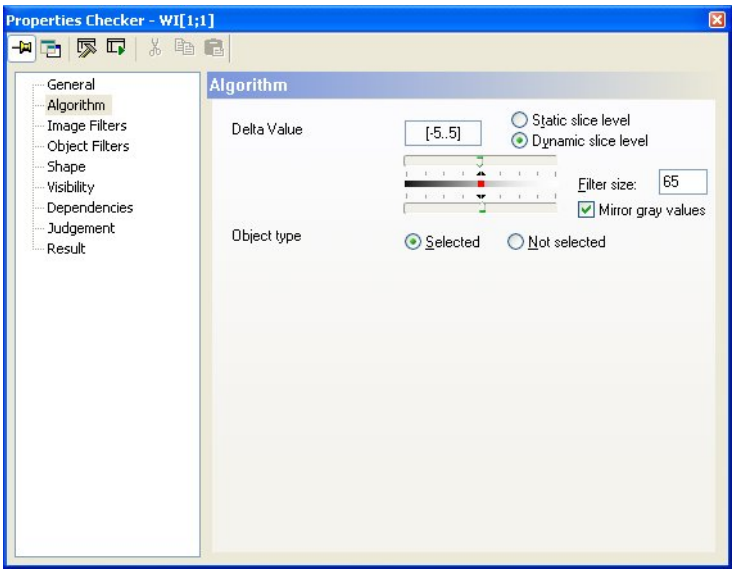
Checkers which use a dynamic object shape cannot be adjusted with a position adjustment. By contrast, position adjustment is possible for checkers which use a static object shape.

12.6 Window Checker

The window checker works in the binary image and counts the pixels selected or not selected within its shape.

12.6.1 Algorithm

For binarisation, you have the choice of either a static or dynamic slice level. You may set the slice levels with the two sliders (see page 289).



"Algorithm" page of a window checker

In the output image, all pixels with a gray value within the range of the thresholding (inclusive) will be marked with the color specified. These pixels will be considered “selected”.

Use exposure adjustments to adjust the slice levels to time-variable illumination conditions.

With a **static slice level**, all the gray-value image areas whose values fall within the range of the thresholding are marked. You can set the static slice level value either with the camera slice level in the **Camera** menu or with the customized slice level on the checker's property page (see page 289).

With a **dynamic slice level**, the mean of the gray values in the environment of the current pixel is calculated. The environment is defined by the filter size. The dynamic slice level value refers to the difference between the gray value of the current pixel and the mean value of the surrounding pixels. Vision P400 marks all objects with a difference within the specified limits (see page 283).

Object Type

Here you determine which pixels will define an object. If you choose "Selected", the objects will be generated from the pixels whose gray value falls within the specified binarisation range. If you choose "Not Selected", the objects will be generated from the pixels of which the gray value falls outside the specified range.

Mirror gray values

To calculate the dynamic slice level it is necessary to smooth the image. To calculate the smoothing on the margins of the checker shape, gray values outside of the checker shape are also used. Normally in smoothing, the gray values of the image are simply applied at this point for calculation purposes. This can produce unforeseeable effects however, especially at the image edge or in images with strong contrasts. That is why there is the possibility to mirror the gray values inside the checker shape for smoothing of the image edge to the outside.

◆**NOTE**

This option is only available when you have activated the "Dynamic Slice Level" option.

12.6.2 Image/Object Filters

All image (see page 290) and object filters (see page 301) are available.

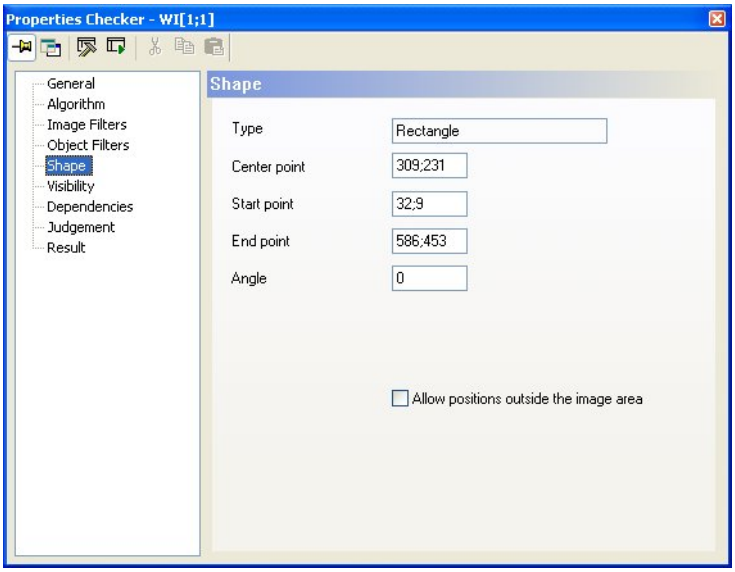
12.6.3 Result

"Area Size" describes the number of pixels counted. The OK or NG judgement refers to the values entered for "Area size: Lower/Upper limit" on the "Judgement" property page.

12.6.4 Shape

Four different shapes are available for a window checker:

- Rectangle
- Ellipse (Circle)
- Polygon
- Doughnut
- Object Shape



"Shape" page of a window checker

◆NOTES

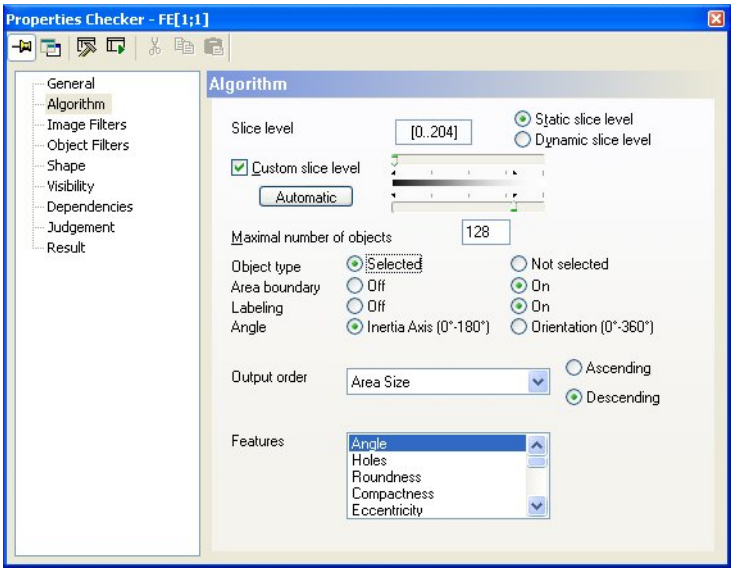
- **All coordinates must fall within the image range. The image range depends on the camera used. All angles (see page 276) must be within the range of 0 – 360 degrees.**
- **When you change the parameters in such a way that parts of the shape come to lie outside the image area, Vision P400 will only accept your changes if you have activated the option "Allow positions outside the image area".**

12.7 Feature Extraction Checker

The feature extraction checker calculates the features of those objects which remain after binarisation and filtering with binary filters.

12.7.1 Algorithm

For binarisation, you have the choice of either a static or dynamic slice level. You may set the slice levels with the two sliders. The first slider regulates the lower limit and the second slider regulates the upper limit. All the pixels whose values fall within the range (inclusive) of the binarisation slice levels will be marked in the color specified for that slice level. These pixels will be considered "selected" (see page 283).



"Algorithm" page of a feature extraction checker

Slice level

Use exposure adjustments to adjust the slice levels to time-variable illumination conditions.

With a **static slice level**, all image areas of the gray-value image are marked which fall within the range of the slice levels. For the static slice level, you may use either the camera slice level (see page 271) or the customized slice level.

With a **dynamic slice level**, the mean of the gray values in the environment of the current pixel is calculated. The environment is defined by the filter size. The dynamic slice level value refers to the difference between the gray value of the current pixel and the mean value of the surrounding pixels. If a difference falls within the specified range, the pixel is marked in the gray-value image in the color specified.

Maximal number of objects

Use this parameter to limit the number of objects to be processed. You may process a maximum of 32767 objects. When there are more objects than the maximal number, Vision

P400 only calculates and displays the features of the set number of objects in the order specified under "Output Order" on the "Algorithm" page and ignores the rest.

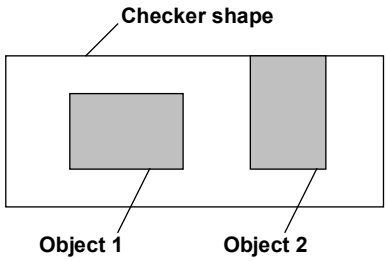
The selected objects will be subjected to binary filter operations and their number will be limited especially by the size limits to which all objects must conform.

Object type

Here you determine which pixels will define an object. If you choose "Selected", the objects will be generated from the pixels whose gray value falls within the specified binarisation range. If you choose "Not Selected", the objects will be generated from the pixels of which the gray value falls outside the specified range.

Area boundary

Use this parameter to define whether or not an object to be processed will be allowed to touch the shape. If "Area Boundary" is set to OFF, an object to be processed will not be permitted to touch the shape. If the parameter is set to "ON", the object to be processed will be permitted to touch the shape.

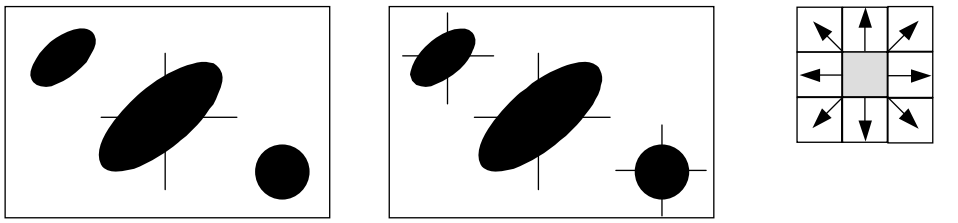


Parameter "Area Boundary"

With "Area Boundary" set to "ON", object 1 and object 2 would be processed. With "Area Boundary" "OFF", only object 1 would be processed since object 2 touches the shape.

Labeling

If "Labeling" is "OFF", all pixels within the selected range will be gathered into an object. If, however, "Labeling" is "ON", only pixels linked to one another within the 8-fold neighboring relationship will be gathered into one object.



Parameter "Labeling"

As shown in the example, the three black objects are treated as one object with "Labeling" = "OFF". Vision P400 calculates the center of gravity for this object as well as the features selected on the "Algorithm" page. With "Labeling" = "ON", the objects are treated as three separate objects. Vision P400 then calculates the center of gravity and the selected features for each of the three objects individually.

Angle (for each object)

Use this parameter to control whether Vision P400 should output the angle between the inertia axis and a virtual horizontal line (0° to 180°) or whether Vision P400 should determine the object orientation (0° to 360°) by taking into the account the center of gravity.

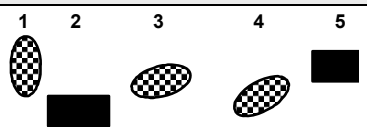
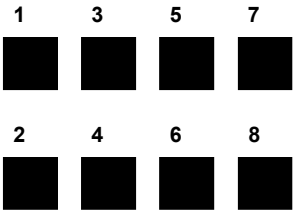
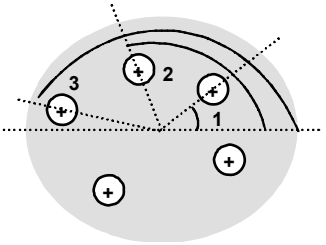
Parameter values

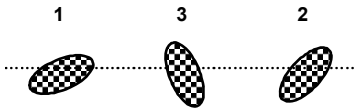
The following parameter values are valid for the "Algorithm" page of the feature extraction checker:

Parameter	Permissible value range
Selected range	-254 ... 254
Maximal number of objects	1 ... 32767
Object type	Selected / Not selected
Area boundary	ON / OFF
Labeling	ON / OFF
Angle (for each object)	Inertia axis (0°-180°): angle between the inertia axis and a virtual horizontal line
	Orientation (0°-360°): angle between the inertia axis and a virtual horizontal line taking into account the center of gravity

12.7.1.1 Output Order

This parameter determines the sequence order in which the objects will appear in the results list. There is no default output order. Depending on which object features are calculated, you can display the objects according to different criteria in ascending or descending order. One typical sorting criteria for objects is an ascending output order sorted by size or coordinates. Further possibilities of sorting the output are:

Setting	Way of sorting the output	Example
Character mode	If the objects form a rough line, they will be output as you would read a text, i.e. they will be sorted from top left to bottom right ("ascending") or from bottom right to top left ("descending"). Vision P400 uses the object's point of gravity for sorting.	
Column-by-column	If the objects form a rough column, they will be sorted in columns from top left to bottom right ("ascending") or from bottom right to top left ("descending"). Vision P400 uses the object's point of gravity for sorting.	
Circular order	If several objects are situated in a roughly circular fashion around the center of the checker shape, the output order is determined by the angle between the virtual line from the object's point of gravity to the checker's center point and a virtual horizontal line.	

Setting	Way of sorting the output	Example
Angle	The objects will be sorted by their angle to a virtual horizontal line.	

The system always calculates an object's area size, the coordinates of its center of gravity and the location of its principal axis of inertia:

- **Area size**
  Area size of the object in pixels
- **Center of gravity**
  coordinates of the object found

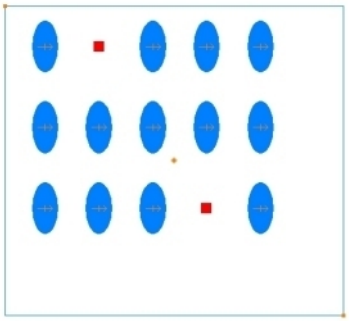
Output order "List"

The output order "List" helps you to determine whether an object is at the position where you expect it to be or not. First, you need to teach Vision P400 a list of objects which are all correctly positioned. The position of the object in this list is equal to the number of the object in the result list of the checker.

◆NOTE

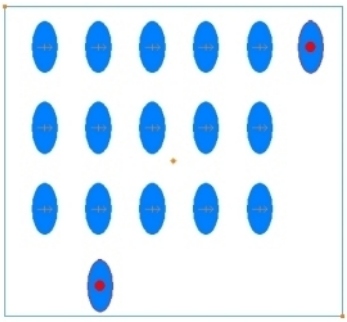
If you want to use the output order "List", the checker cannot depend on a position and rotation adjustment checker.

When you execute the checker, Vision P400 compares the position of all objects detected with the positions of the objects taught in the list. When an object cannot be detected, its object number appears read in the result list of the checker. All object features are displayed as "-". In the checker shape, Vision P400 indicates with a red square the position of an object that should have been there but could not be detected.



	Area Size	Gravity		Angle	Holes	Roundness	Co
1	2613	399.21	309.45	0	0	2.408	
2	-	-	-	-	-	-	
3	2613	241.21	308.45	0	0	2.408	
4	2613	166.21	302.45	0	0	2.408	
5	2613	83.21	296.45	0	0	2.408	
6	2613	392.21	184.45	0	0	2.408	
7	2613	317.21	183.45	0	0	2.408	
8	2613	240.21	182.45	0	0	2.408	
9	2613	169.21	181.45	0	0	2.408	
10	2613	87.21	184.45	0	0	2.408	
11	2613	399.21	73.45	0	0	2.408	

If the checker detects additional objects, i.e. objects not included in the taught list, the new objects are added to the end of the result list of the checker. The object number of the first of these objects is the number of objects in the object list plus 1. In the checker shape an additionally found object is marked by a red circle and red border.



	Area Size	Gravity		Angle	Holes	Roundness	Co
8	2613	240.21	182.45	0	0	2.408	
9	2613	169.21	181.45	0	0	2.408	
10	2613	87.21	184.45	0	0	2.408	
11	2613	399.21	73.45	0	0	2.408	
12	2613	325.21	73.45	0	0	2.408	
13	2613	244.21	74.45	0	0	2.408	
14	2613	168.21	75.45	0	0	2.408	
15	2613	88.21	73.45	0	0	2.408	
16	2613	473.21	73.45	0	0	2.408	
17	2613	240.21	411.45	0	0	2.408	

When you create the list of objects, Vision P400 enters the object coordinates from the list automatically into the spreadsheet. For the lower respectively upper limit Vision P400 uses the coordinates minus/plus 10 pixel. You can modify these limits in the spreadsheet according to your requirements. When you execute the checker, Vision P400 relates a detected object to an object from the list if the object coordinates are within the limits entered in the spreadsheet.

The list of objects is not updated automatically. If you wish to add an object to or delete an object from the list, select the [Update List] button to update both the list of objects and the spreadsheet.

If an object cannot be detected, its coordinates will be judged with "Forced NG" in the spreadsheet. In the example Vision P400 could not detect object 2. The result cells for the coordinates are empty, the judgement is "Forced NG".

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	MG[1;1]Schwerpkt_X_Koord_1	399.21	399.21	389.21	409.21	OK
	MG[1;1]Schwerpkt_Y_Koord_1	309.45	309.45	299.45	319.45	OK
	MG[1;1]Schwerpkt_X_Koord_2			308.21	328.21	Forced NG
	MG[1;1]Schwerpkt_Y_Koord_2			300.45	320.45	Forced NG
	MG[1;1]Schwerpkt_X_Koord_3	241.21	241.21	231.21	251.21	OK
	MG[1;1]Schwerpkt_Y_Koord_3	308.45	308.45	298.45	318.45	OK

Example with spreadsheet results when you use output order "List"

If you have selected results from an object to be output to an interface and Vision P400 has been unable to find the object, Vision P400 will output an error. The judgement output will be NG.

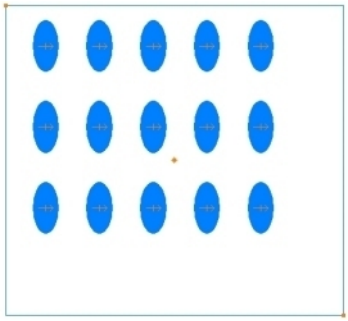
Creating the output order "List"

This is how you create the output order "List" to check the correct position of objects. Use a Boolean formula to check at one glance whether all objects from the list are detected at the expected position. Please proceed as follows:

◆Procedure

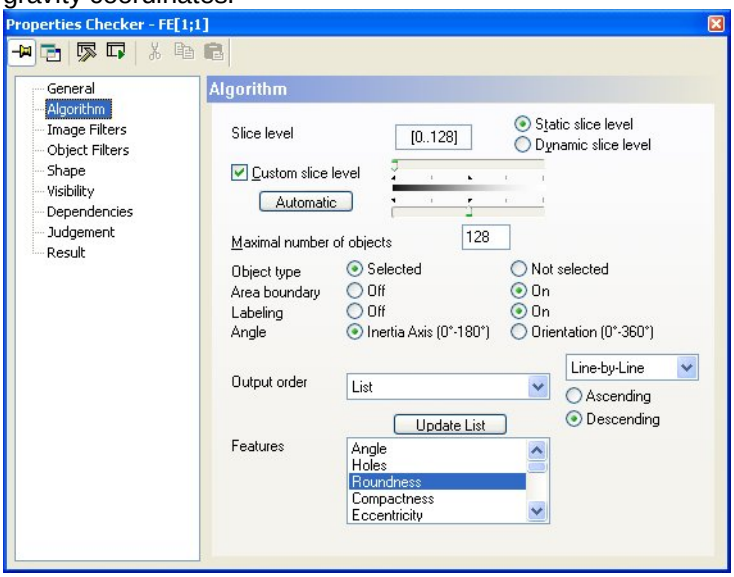
1. **Grab an image where all objects of which you wish to check the position are positioned correctly.**

   Set the checker so that all objects are inside the shape.



2. **On the "Algorithm" page, select output order "List"**
3. **In the pull-down list to the right of "Output Order" select the sorting order for entering the objects into the list**

   Please note that the sorting order selected here only influences the order in which objects are entered into the list of objects. If you select "Line-by-line" and "Descending" as the sort order, for example, the objects are inserted in descending order into the object list. The positions of the objects are always checked by way of the coordinates; the feature extraction checker always checks them using the gravity coordinates.



   For the sort order of the object list the same orders are available as for the output order (except for the "List" order).

4. **Open the spreadsheet if you need to modify the upper and lower limits for the coordinates**

   By default, Vision P400 uses the coordinates minus/plus 10 pixel for the lower respectively upper limit.

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	MG[1;1]Schwerpkt_X_Koord_1	399.21	399.21	389.21	409.21	OK
	MG[1;1]Schwerpkt_Y_Koord_1	309.45	309.45	299.45	319.45	OK
	MG[1;1]Schwerpkt_X_Koord_2	318.21	318.21	308.21	328.21	OK
	MG[1;1]Schwerpkt_Y_Koord_2	310.45	310.45	300.45	320.45	OK
	MG[1;1]Schwerpkt_X_Koord_3	241.21	241.21	231.21	251.21	OK
	MG[1;1]Schwerpkt_Y_Koord_3	308.45	308.45	298.45	318.45	OK

The coordinates in the spreadsheet will be judged OK if the object is detected at the expected position. If an object has not been found, the judgement is "Forced NG" and the result fields are empty.

5. **Create a Boolean formula with** Spreadsheet → Insert Formula → Boolean
6. **Open the formula by double-clicking in the name cell**
7. **Activate "Insert always" next to the operator "&"**
8. **In the spreadsheet column "Judgement" select the first result from the object list with a left mouse click**
9. **Press <Shift> key and hold the key down**
10. **In the "Judgement" column, select the last result of the object list with a left mouse click**
11. **Transfer results to the formula editor with drag & drop**
12. **Release left mouse button, then release <Shift> key**
13. **Click [Apply]**
14. **Click [OK] to save the formula and to close the formula editor**

    The formula will be judged OK when all objects are detected at the expected position. It will be NG if at least one object has not been detected.

If you also wish to find out whether more than the expected number of objects have been detected, insert the checker result "Number of Judged Objects" into the spreadsheet and set its upper and lower limits to the expected number of objects. Create a Boolean formula for this result or add the result to the formula created above.

"Number of Judged Objects" is the number of objects in the result list of the checker. It also contains the not detected objects. Consequently, if the "Number of Judged Objects" is bigger than the number of objects in the object list, Vision P400 has detected additional objects.

"Number of Total Objects" is the number of detected objects in the current image. Please note that this figure does not indicate whether all objects have been detected at the expected position. For example, if Vision P400 detects an object at a position that differs from the expected position, the result "Number of Total Objects" equals the number of expected objects. Nevertheless, the checker result is not as it should be, because one object is positioned incorrectly. The result "Number of Judged Objects" gives a better indication, because it will be increased by 1 compared to the number of expected objects because the "empty" result entry for the object detected at a different position will be included.

◆**NOTE**

If you have created formulas based on the output order "List" and if you have updated the object list later with the [Update List] button because objects have

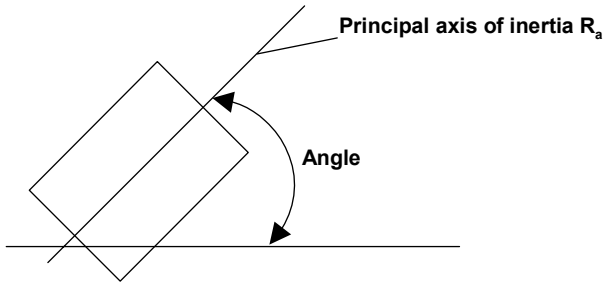
been added or deleted, the formulas are NOT updated automatically. Please modify the formulas manually. Vision P400 will remind you with a message.

12.7.1.2 Features

Use this parameter to select additional object features to be calculated. These are:

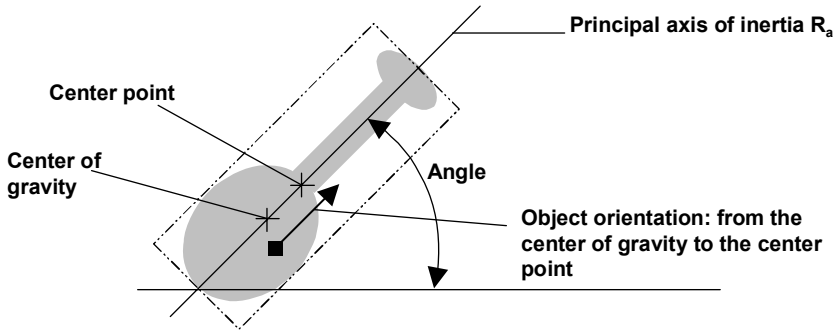
Angle

This is the **angle** of the principal inertia axis R_a to a virtual horizontal line. The result is in the range between 0° and 180°.



Angle and principal axis of inertia R_a

With **angle** and **orientation** Vision P400 calculates the angle and orientation of the principal inertia axis R_a to a virtual horizontal line. The result is in the range between 0° and 360°.



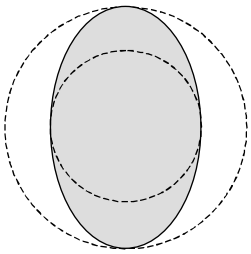
Angle and orientation of the principle axis of inertia R_a

Holes

Refers to the number of holes in the object.

Roundness

Roundness is the ratio of the smallest circumference to the greatest inner circle of an object. Roundness in the case of a circle without holes is = 1. If an object contains holes or if it is not a circle, roundness is > 1. If you select this feature, you can choose between "Ascending" and "Descending" in addition to "Output Order".



Calculate the roundness of an object

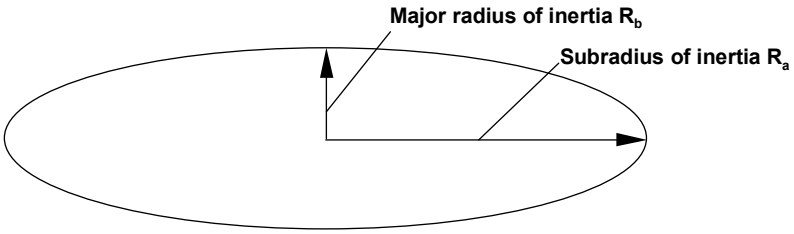
Compactness

If L is the length of the contour and F is the area of an object, then compactness is defined as:

$$Kompaktheit = \frac{L^2}{4F\pi}$$

Eccentricity

Eccentricity refers to the ratio of R_a to R_b, that is to say in the case of an object with equal inertial radii such as a circle or a square = 1, otherwise > 1.



Calculate eccentricity

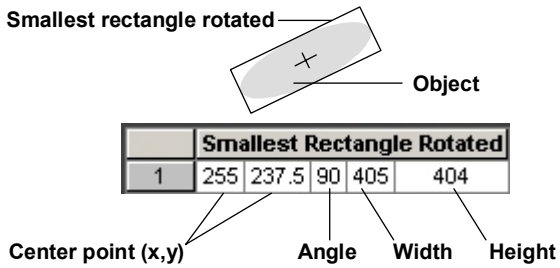
Major radius of inertia

The major radius of inertia is R_a.

Smallest rectangle rotated

The smallest comprising rectangle, that is to say the coordinates of its center point, its width, its length and the orientation of its principal axis are output. The rectangle does not have to be parallel to the coordinate axes.

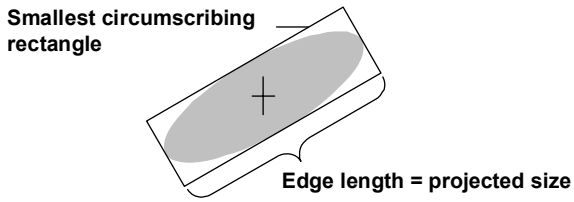
The width of the rectangle is the edge length of the longer edge, the height is the length of the shorter edge. Accordingly, the width is always bigger than or equal to the height. The orientation is determined by the direction of the longer edge and will be output in the range of 0 to 180 degrees.



Calculate the smallest rectangle rotated

Projected size

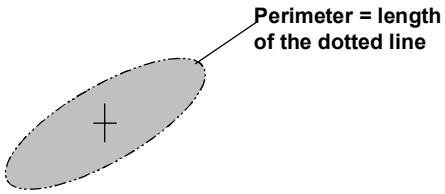
The projected size is defined by the length of the edge of that rectangle which the object circumscribes Vision P400 calculates the length of the edges of the smallest circumscribing rectangle parallel to the axis. The width is the length of the edge parallel to the X-axis, the height the length of the edge parallel to the Y-axis. The first result column outputs the length in X direction, the second column the length in Y direction.



Calculate the projected size with the help of the smallest circumscribing rectangle

Perimeter

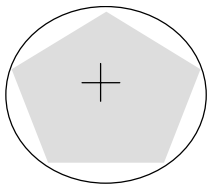
The perimeter is the circumference of an object expressed in pixels



Calculate the perimeter

Circumcircle

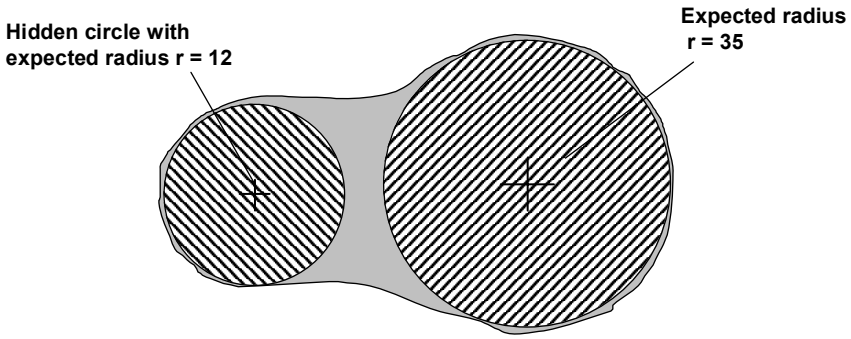
The coordinates of its center point and its radius are displayed.



Calculate the circumcircle

Hidden circle

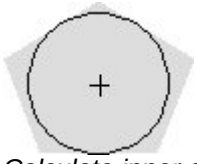
With this option you can detect circles which are partially hidden. This may be useful in determining the radius of rounded edges or bent components, for instance. As a result you obtain the circle which fits best into the rounded contour of the object. If there are several circles possible, the circle with the radius closest to what has been entered under "Expected Radius" will be listed on the "Result" page (center point coordinates and radius). The field "Expected Radius" only appears after you have selected "Hidden Circle" from the "Features" selection box on the "Algorithm" page.



Possible hidden-circle results depending on the expected radius

Inner circle

The coordinates of its center point and its radius are displayed.



Calculate inner circle

Rectangularity

To determine rectangularity, a rectangle is first identified which has the same first and second moments as the input region. Calculation of the rectangularity is based solely on the area of the difference between the identified rectangle and the input region scaled to the area of the rectangle. In the case of perfect rectangles the result is 1. The less the object is like a rectangle, the lower is the result value.

The table shows an example. The first and second moments (arrows) are identical in both objects.

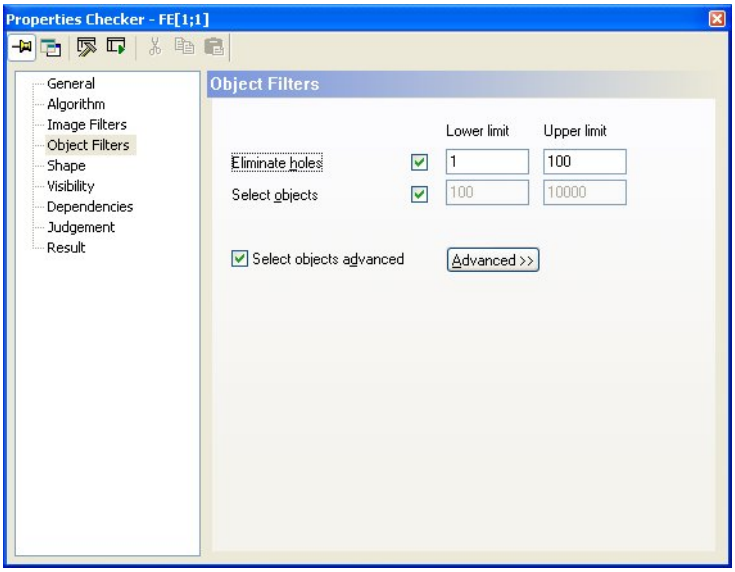
	Result < 1 Difference area between the object being checked (circle) and the identified rectangle
	Result = 1 No difference between the object being checked (rectangle) and the identified rectangle

12.7.2 Image Filters

All image filters (see page 290) are available.

12.7.3 Object Filters

You can fine-tune the filter conditions for objects with the help of a formula. To do so, check the "Select objects advanced" checkbox to enable the [Advanced >>] button. Click this button to open the formula editor.



"Object Filters" page of a feature extraction checker

12.7.3.1 Formula-based Object Selection

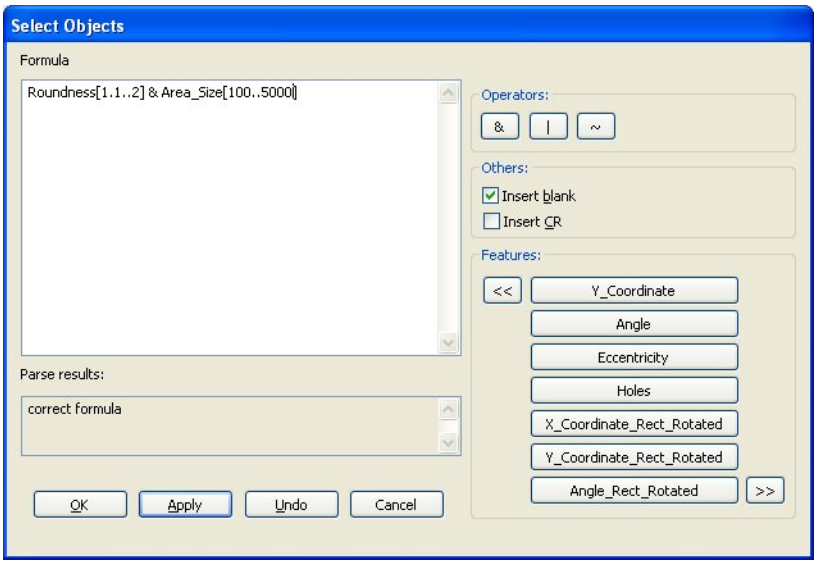
You can define conditions to fine-tune object selection. The conditions are based on the calculated features and operators. Enter a range for every feature.

Operator	Symbol
AND	&
OR	|
NOT	~

Which features are available depends on the selection you have made under "Features" on the "Algorithm" page. If there are more features available than can be displayed in the formula editor, use the buttons << and >> to display the previous/next feature. The filter selects objects within ranges. You specify the range as <feature name>[<lower limit>..<upper limit>]. To check the consistency of the formula click the [Apply] button (further information (see page 572) on using the formula editor).

◆EXAMPLE

You wish to use only objects for feature extraction with a roundness between 1.1 and 2 and an area size of 100 to 5000 pixels. Your formula should read as follows:



12.7.4 Judgement

The criterion for the judgement is the number of objects for which the features have been calculated. This must be within the limits of "Number of judged objects: Lower limit" and "Number of judged objects: Upper limit" (inclusive) for the judgement to be OK. You can enter a valid range limit from 0 to 32767. The default settings are 0 and 128.

12.7.5 Shape

Four different shapes are valid for use with a feature extraction checker:

- Rectangle
- Ellipse (Circle)
- Polygon
- Doughnut
- Object Shape

12.7.6 Result

The result list displays the features calculated for each object processed. The objects are listed in the order specified in the parameter "Output Order". Features which have not been calculated appear in the list, but are displayed with a dark gray background.

In addition, the field "Number of Judged Objects" states the number of objects for which features have been calculated. Number of "Total Objects" states the number of remaining objects after applying the limit set in parameter "Maximal Number of Objects".

Left-click on a feature in the result list to highlight the object to which it belongs in the camera window. If the object is large enough, the object is highlighted. Small objects are often too small be clearly discernible, despite highlighting. Consequently, small objects themselves are not highlighted, but a circle is drawn around the center of gravity of the object. This circle is also drawn on large objects if their center of gravity is outside of the object, to enable the link to be made between the center of gravity and the object.

When you click on a result in the "Smallest Rectangle Rotated", "Circumcircle", "Hidden Circle" or "Inner Circle" columns this result is additionally highlighted.

Feature	Contents of the result column(s)
Area size	Area size in pixel
Center of gravity	1. X Coordinate 2. Y Coordinate
Angle	Angles in degree
Holes	No. of holes
Roundness	1 for a perfect circle, otherwise > 1.
Compactness	1 for a perfect circle, otherwise > 1.
Eccentricity	Major radius of inertia divided by its subradius (1: circle/square, else > 1)
Major radius of inertia	Radius
Smallest rectangle rotated	1. X coordinate of the center point 2. Y coordinate of the center point 3. Angle of the principle axis of inertia in degrees 4. Width of the smallest rectangle rotated 5. Height of the smallest rectangle rotated
Projected size	1. Surrounding rectangle parallel to the coordinate axes: length of X part 2. Surrounding rectangle parallel to the coordinate axes: length of Y part
Perimeter	Perimeter in pixel
Circumcircle	1. X coordinate of the center point 2. Y coordinate of the center point 3. Radius
Hidden circle	1. X coordinate of the center point 2. Y coordinate of the center point 3. Radius
Inner circle	1. X coordinate of the center point 2. Y coordinate of the center point 3. Radius
Rectangularity	1 for a perfect rectangle, otherwise < 1.

◆**NOTE**

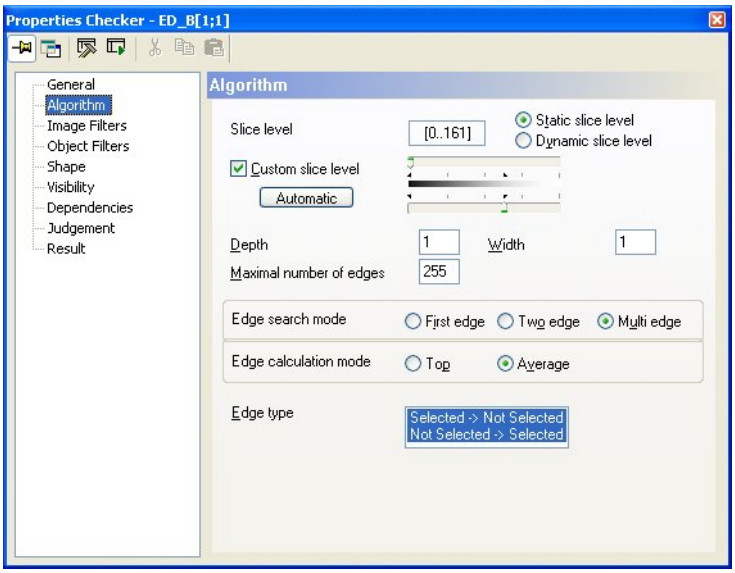
If you are not sure what the value in the result column refers to, select a result with the mouse and wait until the tool tip is displayed.

12.8 Binary Edge Detection Checker

The binary edge detection checker searches for the edges in a binary image.

12.8.1 Algorithm

You may use either static or dynamic thresholding (see page 283) for binarisation.



"Algorithm" page of a gray-value edge detector

With a **static slice level**, all the gray-scale image pixels whose values fall within the range of the binarisation slice levels are marked. You can set the static slice level value either with the camera slice level in the **Camera** menu or with the customized slice level (see page 289).

With a **dynamic slice level**, the mean of the gray values in the environment of the current pixel is calculated. The environment is defined by the filter size. The dynamic slice level value refers to the difference between the gray value of the current pixel and the mean value. If a difference falls within the specified range (see page 283), the pixel is marked in the gray-value image..

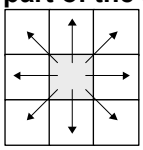
You may set the slice levels with the two sliders (see page 289). The first slider regulates the lower limit and the second slider regulates the upper limit. In the output image, all pixels whose values fall within the range of the thresholding (inclusive) will be marked with the color specified for that slice level under **Application** → **Colors**. These pixels will be considered **selected**.

Slice level values can be adjusted to different light conditions by means of exposure adjustments.

When you use the shape rectangle with scanning direction, you may also select the edge calculation mode. You may combine the edge search modes "First Edge", "Two Edge" or "Multi Edge" with the edge calculation modes "Top Edge" and "Average Edge". When you select search mode "Two Edge", the calculation mode "MinMax" is also available. Altogether there are seven search mode variations available to you.

◆**NOTE**

All pixels which satisfy the specified search criteria and can be accessed via the 8-fold neighboring relationship even across several neighbors are considered part of the same edge.

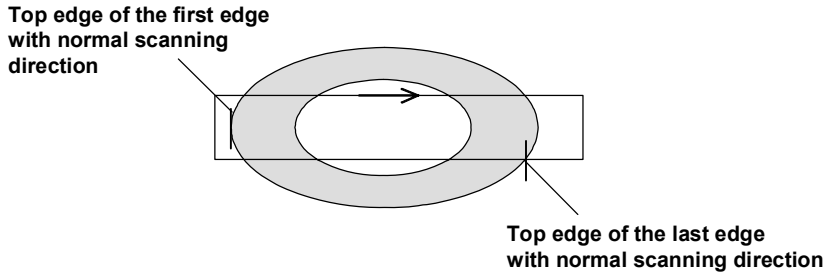


The edge search modes work as follows:

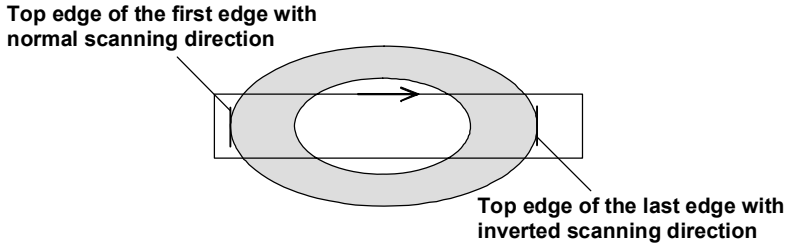
- **First Edge**
  traces only the first edge in the scanning direction. The distance previously put out in the results for each edge is used to determine the first edge. It is always the edge with the lowest distance value (see page 377).
- **Two Edge**
  traces the first and last edge in the scanning direction.
- **Multi Edge**
  traces all edges in the scanning direction and outputs them in the order in which they appear in the scanning direction.

"Top Edge", "Average Edge" and "MinMax" define how the representative of an edge is to be determined. They are edge calculation modes.

- **Top Edge**
  means that the first pixel in the scanning direction which is associated with an edge is chosen as the representative for that edge.
- **Average Edge**
  means that, with the help of a regression straight line, the position of the representative is calculated from the position of all pixels belonging to an edge.
- **MinMax**
  means that of all edge representatives only the first and the last are used. The last edge is the edge found first when you inverse the scanning direction. This calculation mode is only available for the rectangle shape with scanning direction and when you select the "Two Edge" search mode.



Search mode "Two Edge" with calculation mode "Top Edge"

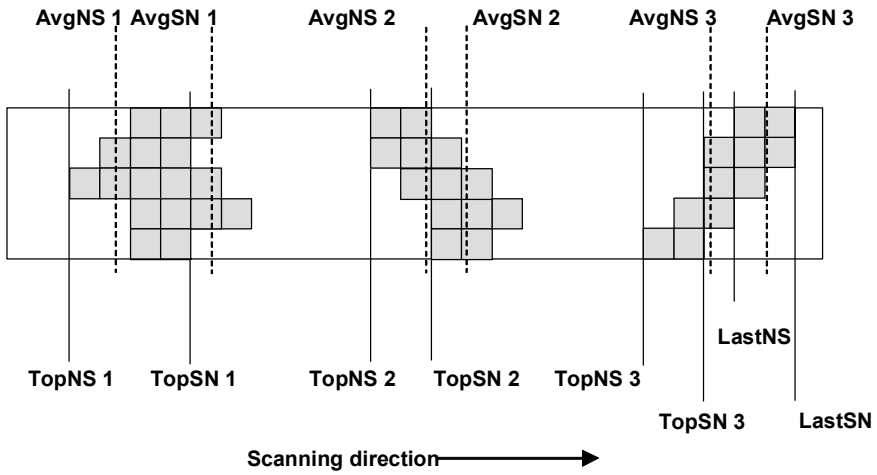


Search mode "Two Edge" with calculation mode "MinMax"

With every search mode you define whether Selected -> Not Selected (SN) transitions and/or Not Selected -> Selected (NS) transitions should be found. You can select both SN **and** NS transitions when you have selected the search mode "Two Edge" or "Multi Edge".

Pixels will belong to an edge only if one of the transitions defined can be found. The system always selects the pixel on the selected side of the transition.

In the figure below, all edges that can be found are drawn in for the three dark objects. "Top Edges" are represented by continuous lines, "Average Edges" by dotted lines. The edges are numbered in sequence following by the scanning direction and are identified with S/N in correspondence with their transition.



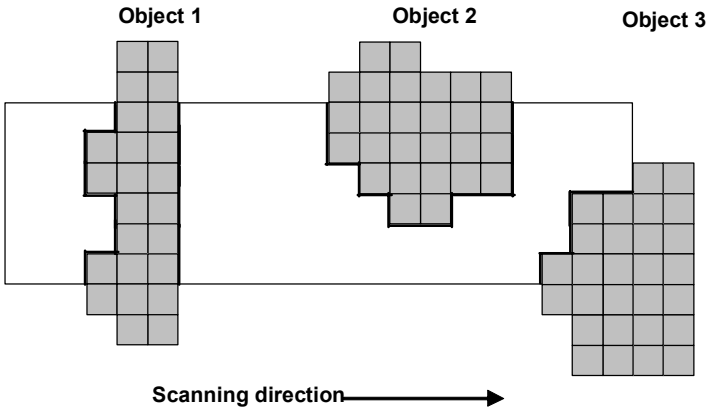
Search modes "Top Edge" and "Average Edge"

The table below lists what edges can be found with what settings as per the preceding example:

Edge search/ calculation mode	NS transitions	SN transitions	NS and SN transitions
Top edge/first edge	TopNS 1	TopSN 1	Not permissible
Top edge/two edge	TopNS 1 and TopNS 3	TopSN 1 and TopSN 3	TopNS 1 and TopSN 3
Top edge/multi edge	TopNS 1 to TopNS 3	TopSN 1 to TopSN 3	All top transitions
Average edge/first edge	AvgNS 1	AvgSN 1	Not permissible
Average edge/two edge	AvgNS 1 and AvgNS 3	AvgSN 1 and AvgSN 3	AvgNS 1 and AvgSN 3
Average edge/multi edge	AvgNS 1 to AvgNS 3	AvgSN 1 to AvgSN 3	All avg transitions
MinMax/two edge	TopNS 1 and LastNS	TopSN1 and LastSN	TopNS1 and LastSN

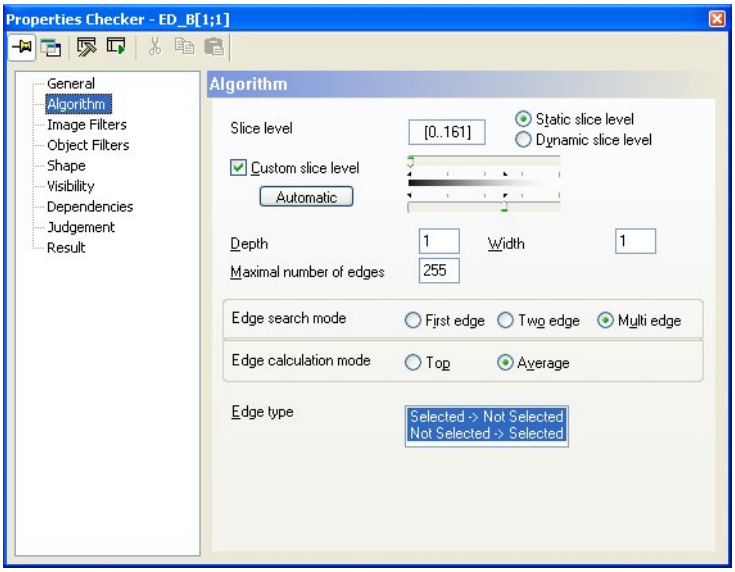
◆NOTE

If you use a rectangle as a shape for a checker, an edge will be found only if it crosses each of the two sides running parallel to the scanning direction but none of the other sides.



In the figure above, only the edges of object 1 will be found. The checker is improperly positioned to detect the edges of objects 2 and 3 since they do not satisfy the requirement just described. What is more, the fact that the edges of object 2 and 3 cross the checker shape on only one side may even have a negative effect on the edge calculation of object 1! This is why you should take special care to position the shape when defining an edge detection checker with a rectangle shape.

Aside from the type of edge transition, additional parameters may be defined to narrow the search. "Maximal Number of Edges" will limit the number of edges to be processed. This option is available only in Multi Edge. In "First Edge" this parameter is limited to 1, in "Two Edge" it is limited to 2. If more edges are found than defined in "Maximal Number of Edges", they will be processed in the order of the scanning direction up to the number specified by "Maximal Number of Edges" and their results displayed.



"Algorithm" page of a gray-value edge detector

A maximum of 255 edges may be processed. If more than 255 edges are found in a given shape, an error message will appear and none of the edges will be processed.

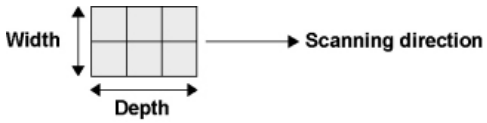
With the parameters "Depth" and "Width" it is possible to more narrowly define which pixels are to be considered edge pixels.

- **Depth**
  refers to the depth of the object in scanning direction. If a transition occurs, the entry in "Depth" determines how many pixels deep (in scanning direction) the object which caused the transition needs to be in order to be treated as an object.
- **Width**
  refers to the width of an object (orthogonal to the scanning direction). This means that with the shapes line and circular arc, width always equals 1 since a line/ circular arc has no width.

Basically, the parameters of depth and width mean that a model is generated which corresponds to the depth and width specified. A transition is accepted as an edge point only if a model position exists which contains the point of transition and if all the pixels which are covered by the model are part of the object which caused the transition.

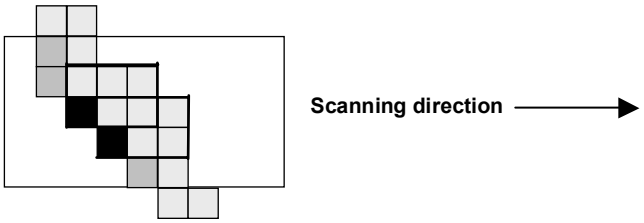
◆EXAMPLE

"Depth" = 3 and "Width" = 2 generate the following model:

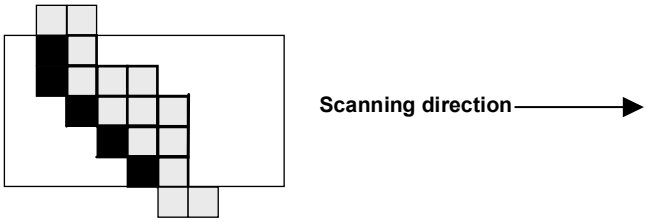


If this model is applied to the two light-gray objects in the figure below, only the black pixels will be detected as edge points. This is because the layer of the model shown

(outlined in bold, black lines) containing the potential edge points is the only part to meet the edge's requirement of "Width" = 3 and "Depth" = 2.



If, however, you were to set "Depth" = 2, all points marked in gray would be accepted as edge points since with regard to these points the model would be considered within the bounds of the object.



In summary, the six edge search modes permit the following parameter values:

Search mode	Shapes			Transitions		
	Line	Ellipse	Rectangle	SN	NS	SN and NS
Top edge/first edge	Yes	Yes	Yes	Yes	Yes	No
Top edge/two edge	Yes	Yes	Yes	Yes	Yes	Yes
Top edge/multi edge	Yes	Yes	Yes	Yes	Yes	Yes
Average edge/first edge	No	No	Yes	Yes	Yes	No
Average edge/two edge	No	No	Yes	Yes	Yes	Yes
Average edge/multi edge	No	No	Yes	Yes	Yes	Yes
MinMax/two edge	No	No	Yes	Yes	Yes	Yes

Search mode	Number of edges	Depth*	Width*	
			Rectangle	Line/Ellipse
Top edge/first edge	1	1...999	1...999	1
Top edge/multi edge	1...128	1...999	1...999	1
Average edge/first edge	1	1...999	1...999	1
Average edge/multi edge	1...128	1...999	1...999	1

* The upper limit for this value also depends on the image format of the camera and the checker size.

◆NOTES

- **If the sides of a rectangle shape are not parallel to the sides of the image, then the model created in defining the depth and width must also be rotated. The resulting discretionary effects may mean that the rotated model is not**

positioned entirely within the object, even if one would expect it. As a consequence, anticipated edge points will not be accepted and unanticipated edge points will be accepted. If that happens, please enlarge or reduce the shape accordingly.

- **If the values "Depth" and "Width" are greater than the current length or width of the shape, then no object will be found. In that case, the message "No object" will be displayed in the field "Execution State" upon execution of the checker.**

12.8.2 Image/Object Filters

All image (see page 290) and object filters (see page 301) are available. The gray-value filters will be used prior to binarisation, all others will be used afterwards.

12.8.3 Shapes and Scanning Directions

With edge detection checkers, three different types of shape are available:

- Line with scanning direction
- Ellipse with scanning direction
- Rectangle with scanning direction

For each shape, you can determine one of the following scanning directions:

Shape	Scanning directions
Line	1 scanning direction: from start to end point
Ellipse	2 scanning directions: clockwise or counterclockwise
Rectangle	1 scanning direction: from the start to the end page

Determining the scanning directions is part of defining the checker.

◆NOTE

In contrast to all other checkers, the rectangle can be oriented in any direction when used in edge detection. Its sides do not have to be parallel to the image sides.

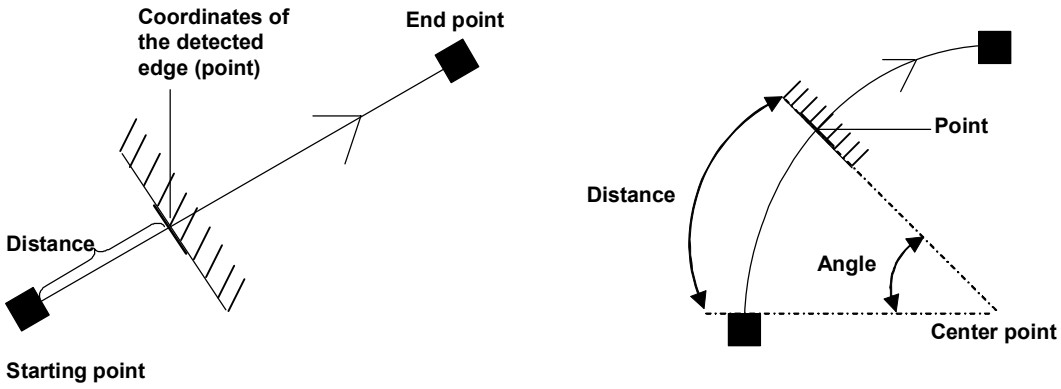
12.8.4 Result

The following table shows which results can be obtained from which shape, search and calculation mode.

Shape	Edge search mode	Edge calculation mode	Result			
			Distance to point or line	Coordinates of edge representative	Angle	Raster

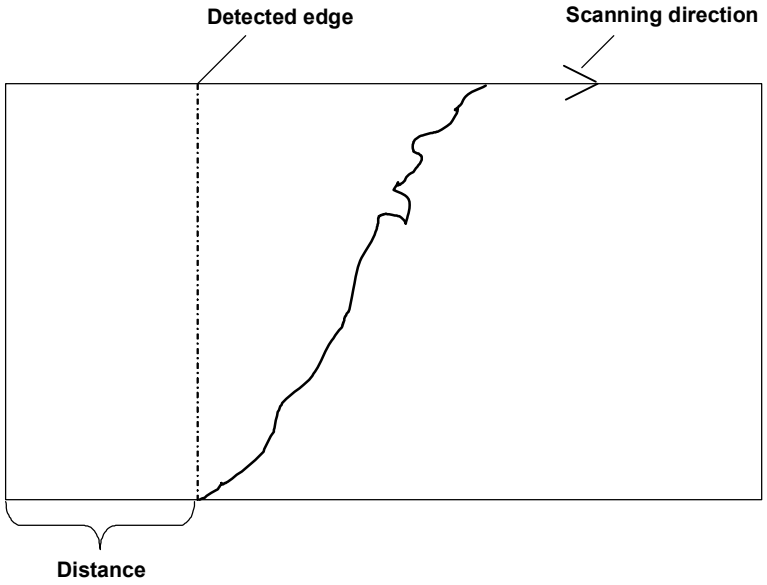
Shape	Edge search mode	Edge calculation mode	Result			
			Distance to point or line	Coordinates of edge representative	Angle	Raster
Line->	1. First edge	---	Yes	Yes	No	---
	Two edge	---	Yes	Yes	No	Yes
	Multi edge	---	Yes	Yes	No	Yes
Ellipse ->	1. First edge	---	Yes	Yes	Yes	---
	Two edge	---	Yes	Yes	Yes	Yes
	Multi edge	---	Yes	Yes	Yes	Yes
Rectangle ->	1. First edge	1. Point	Yes	Yes	No	---
		Average	Yes	Yes	Yes	---
	Two edge	1. Point	Yes	Yes	No	Yes
		Average	Yes	Yes	Yes	Yes
		MinMax	Yes	Yes	No	Yes
	Multi edge	1. Point	Yes	Yes	No	Yes
		Average	Yes	Yes	Yes	Yes

The **"distance"** output here will also be used to determine the first edge. It is always that edge whose representative is closest in distance to the reference point (starting point) or the reference line. In case of two edge representatives of equal minimal distance, it is not defined which of the two is to be considered first.



Distance with line-> and ellipse->

With **"Top Edge"**, the edge representative is the first pixel in the scanning direction to satisfy the search criteria. Due to the binarisation process, this pixel inevitably lies on the not-selected side of a transition and since its coordinates "Point" will be used as edge coordinates, it follows that the edge will always fall in the not-selected area.

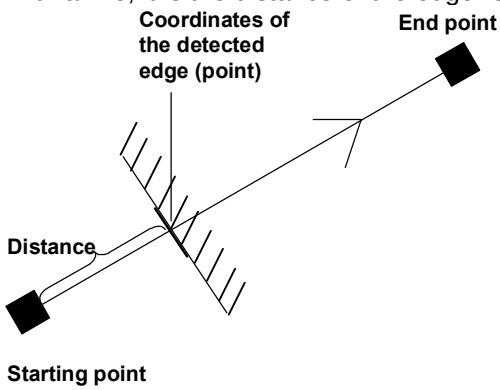


Distance with calculation mode "Top Edge"

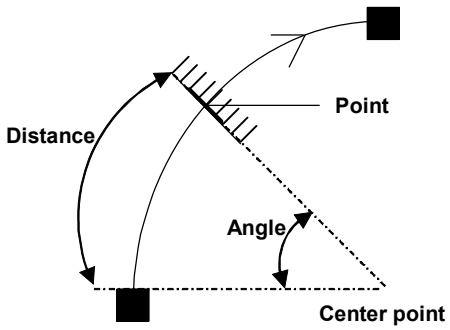
With **"Average Edge"**, a regression line is calculated from the x- and y-coordinates. The edge representative is then calculated with the help of these regression lines on the center line of the shape type rectangle. All edge representatives of the Average Edge thus lie on the center line of the shape (rectangle). The coordinates will always be indicated by two decimals.

The distance output is determined in a different manner for each of the three shape types:

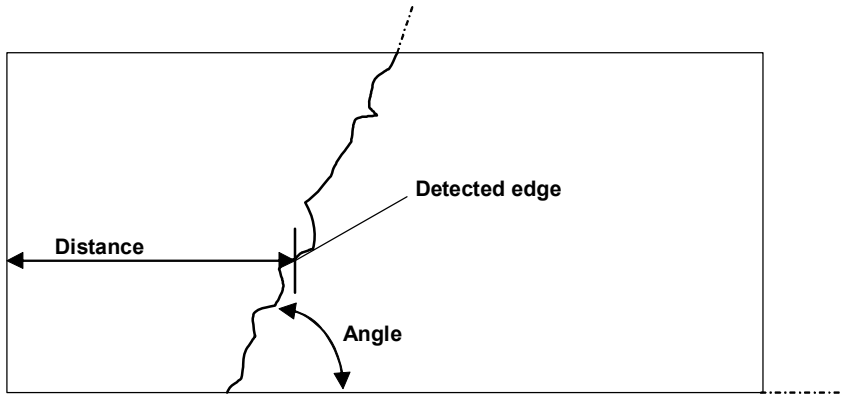
- With a line, it is the distance of the edge representative to the starting point of the line.



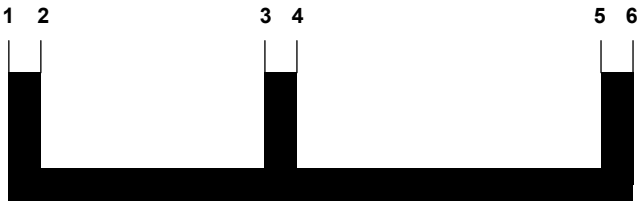
- With an ellipse it is the length of the elliptic arc from the starting point to the edge representative. With the circular arc, the opening angle of the circle segment between the beginning of the arc and the edge point found on the arc is indicated in Angle.



- With rectangle, the direction of the edge is indicated in **"Angle"**. The angle determines the orientation of the straight line which was gained by means of linear regression from the coordinates forming the edge point. Please note that the angle refers to the coordinate system of the image and not to the checker shape.



The result **"Raster"** always is the distance between one edge and the next edge. In the example below, the raster result would be the distance between edge 1 and 2, between edge 2 and 3, etc. The raster result for the last edge is always "0".

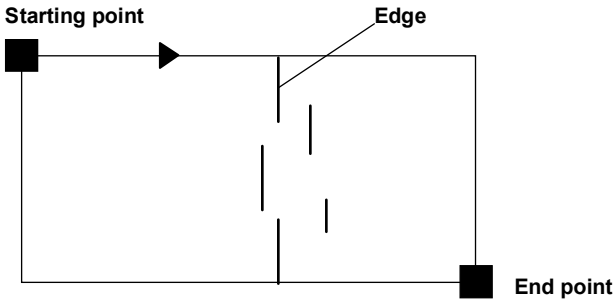


The **"Number of Judged Edges"** is used for the judgement. OK means that this number falls within the specified lower and upper limits (inclusive). If not, the judgement will read NG (not good).

The field **"Number of Total Edges"** informs you about how many edges have been found altogether.

12.9 Gray-Value Edge Detection Checker

The gray-value edge detection checker finds edges in the gray-value image. A maximum of 255 edges is processed for calculating the results.



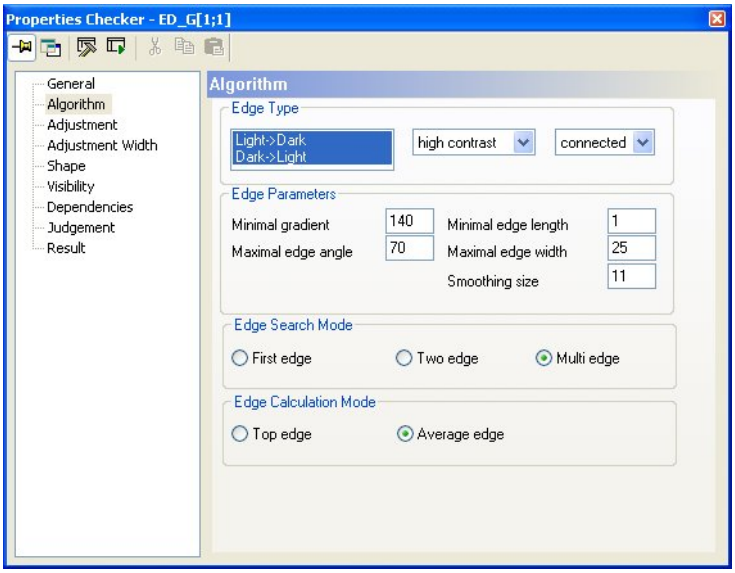
How gray-value edge detection works

12.9.1 Algorithm

The “Algorithm” page contains four groups with different parameters for defining the checker.

- Edge type
- Edge parameters
- Edge search mode
- Edge calculation mode (only if the checker shape is a rectangle)

As with binary edge detection, all checker shapes work with two edge types.



“Algorithm” page of a gray-value edge detector

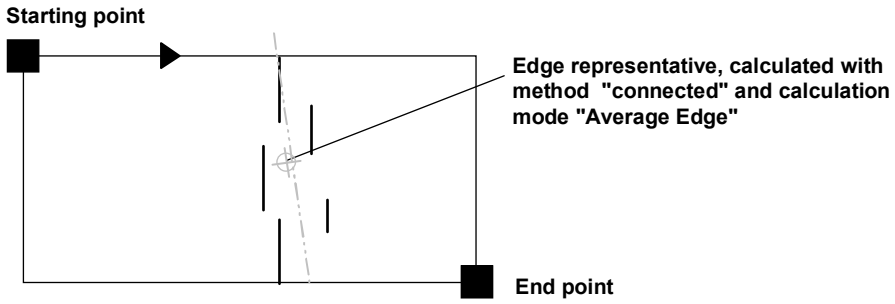
12.9.1.1 Edge Type

Here you define which type of edges you wish to detect (Light to Dark or Dark to Light). The pull-down list on the right defines the contrast properties of the edge. If your image has a high contrast, as is usually the case with back-light applications, choose high contrast. Then the system uses a standard algorithm for calculating the edge representatives. When the image is noisy or very noisy, the system uses smoothing algorithms to maintain a high level of accuracy in spite of difficult processing conditions.

◆NOTES

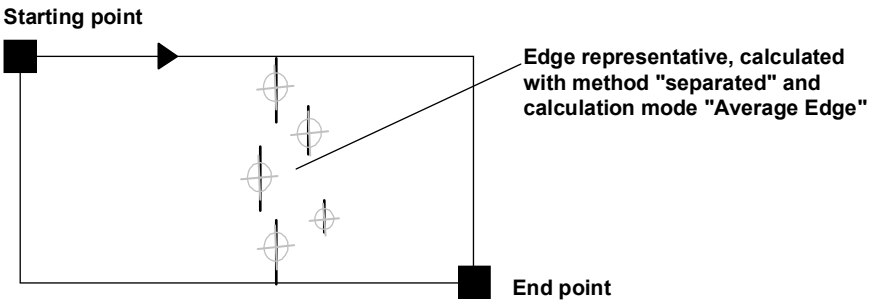
- **Please keep in mind that using smoothing algorithms will slow down the inspection.**
- **Please note that if you wish to search with "Edge Search Mode" = "First Edge", you need to define the edge type to be detected first. If you leave both edge types selected, you will get a warning message when you try to select "First Edge".**

If you use the rectangle shape, a second pull-down list appears on the right side of the page. Here you select whether you wish to use the method separated or connected. When you use connected, all edge representatives detected within a certain image area will be combined to form an edge, e.g. for calculating the regression line. This way you obtain exactly one edge representative. The angle of the fitted line is displayed as the angle of the edge.



Gray-value edge detection with method "connected"

When you use separated as the edge detection method, every single detected edge will be used as an edge representative.



Gray-value edge detection with method "separated"

12.9.1.2 Edge Parameters

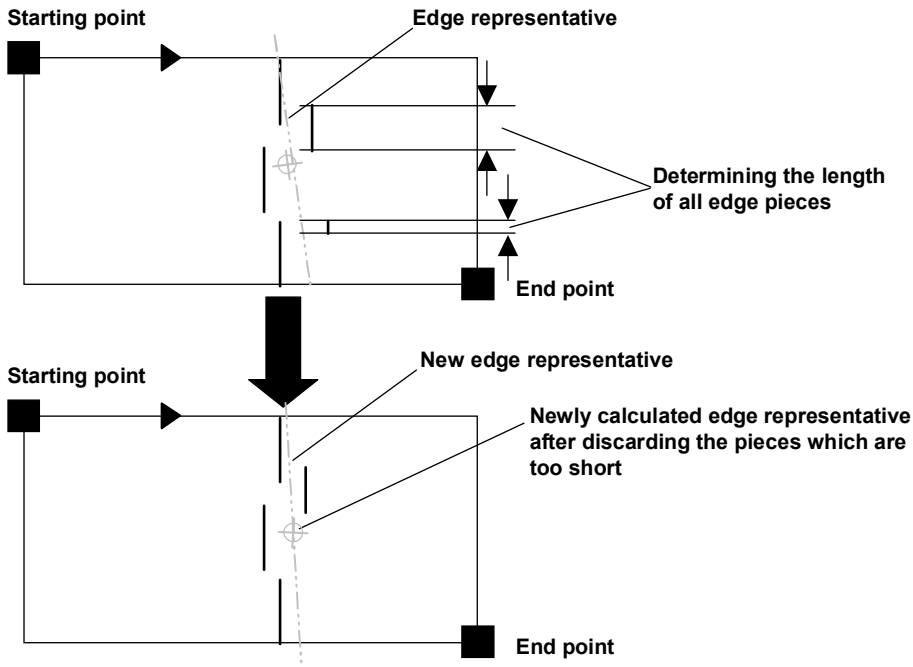
With this parameter group you determine the minimal gradient. If you are using the rectangle shape, more parameter fields appear on your screen, depending on the method selected before.

- **Minimal Gradient**
  defines how high the edge gradient (gray-value difference between a pixel and its neighbors) needs to be at a given pixel in order for it to be accepted as an edge point (see page 385). The minimal gradient is automatically calculated in a first step. The default value displayed on the "Adjustment" property page is about two thirds of the maximal gradient detected in the checker area. You can adjust the minimal gradient on the "Adjustment" (see page 385) page.

◆NOTES

The minimal gradient should be at least ten. With gradients any smaller than this, the edge points will vanish in the image noise.

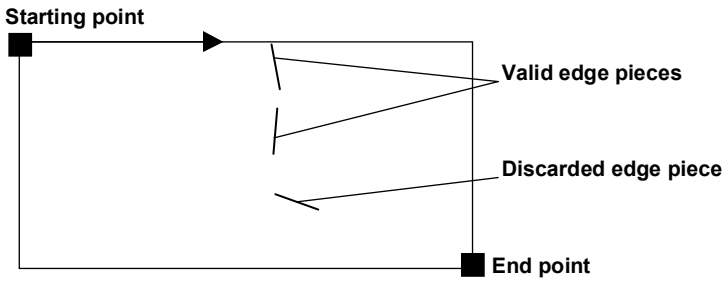
- **Minimal Edge Length**
  defines the minimal length which an edge piece must have in order to be considered in the calculation of the edge representative.



If an edge piece is shorter than the specified minimal edge length, the piece will be discarded. This way it is possible to eliminate runaways as shown in the figure above. The remaining edge calculations will be executed based on this preprocessing.

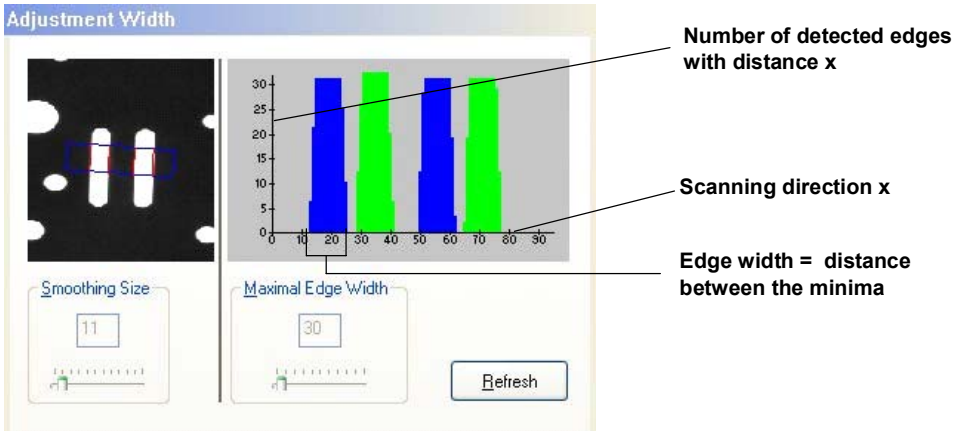
- **Maximal Edge Angle**
  indicates how large the angle between an edge piece and the reference line may be in

order for the piece to be used in calculating the edge representatives. If the angle is exceeded, the edge pieces will be discarded. The default setting is 70°.



Adjustable Edge Parameters for Rectangle Shape and Method "Connected"

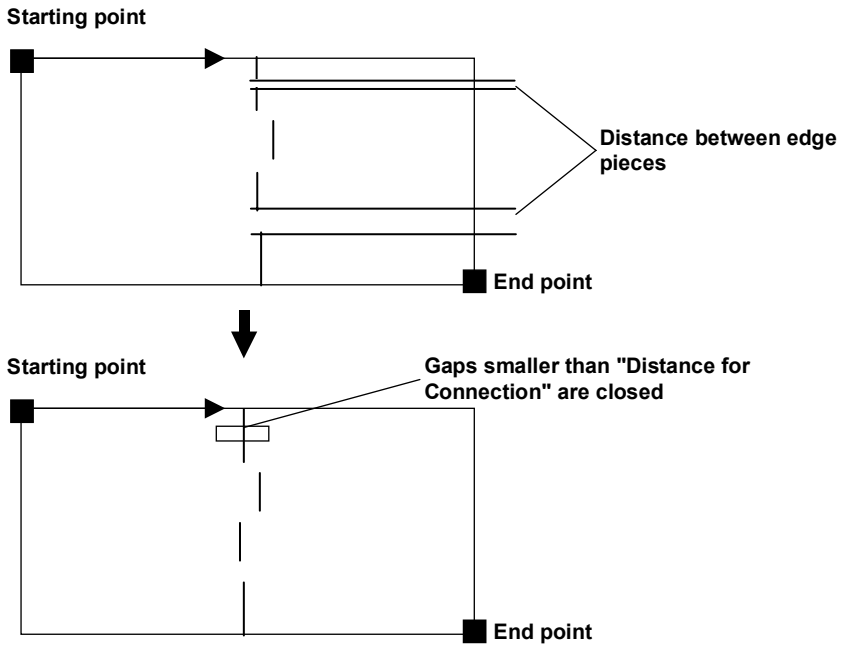
- **Maximal Edge Width**
  shows the setting you have made on the page "Adjustment Width" (see page 388). There you find all gray-value edges marked in color (dark-to-light edges are marked blue, light-to-dark edges in green). An edge is considered valid if the distance between two minima in the histogram is smaller than the value under "Maximal Edge Width". If the distance is higher, the edge is discarded as too indistinct and too blurred.



- **Smoothing Size**
  shows the setting you made on the "Adjustment Width" (see page 388) property page. The default is 11.

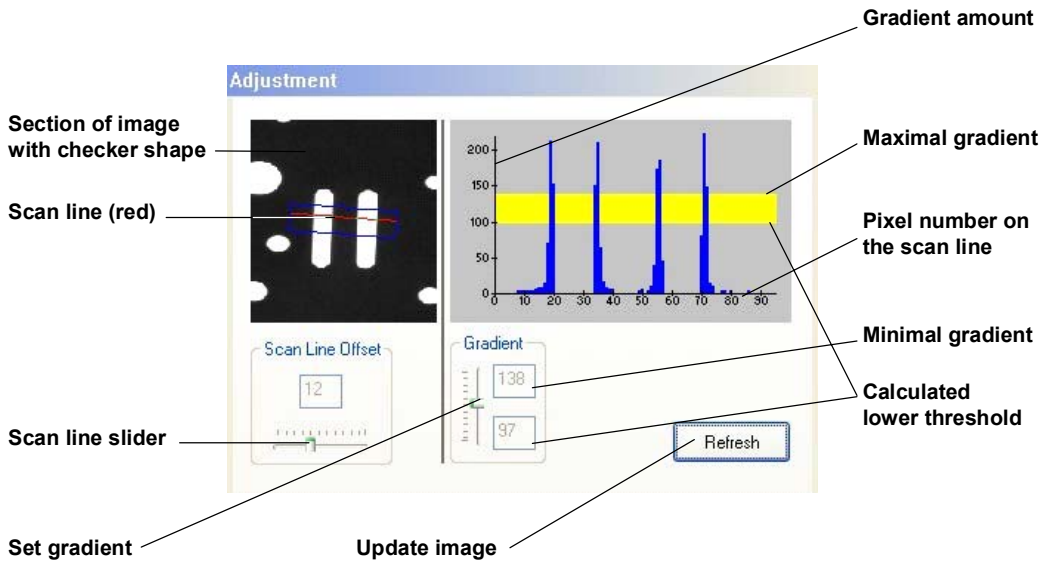
Adjustable Edge Parameters for Rectangle Shape and Method "Separated"

- **Distance for Connection**
  indicates how large the distance between two edge pieces may be so that the system closes the gap automatically.



12.9.2 Adjustment

Below, you will find assistance with the settings for the parameter "Minimal Gradient" from the “Algorithm” page.



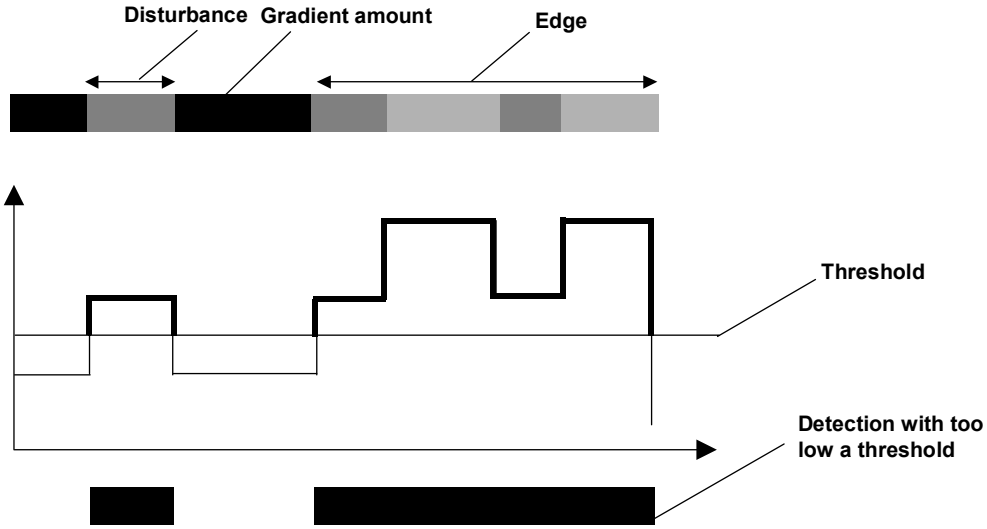
“Adjustment” page of a gray-value edge detector

The gradient amount is calculated along the scan line and shown in blue in the display. The gradient amount is the gray-value difference between a pixel and its neighbors.

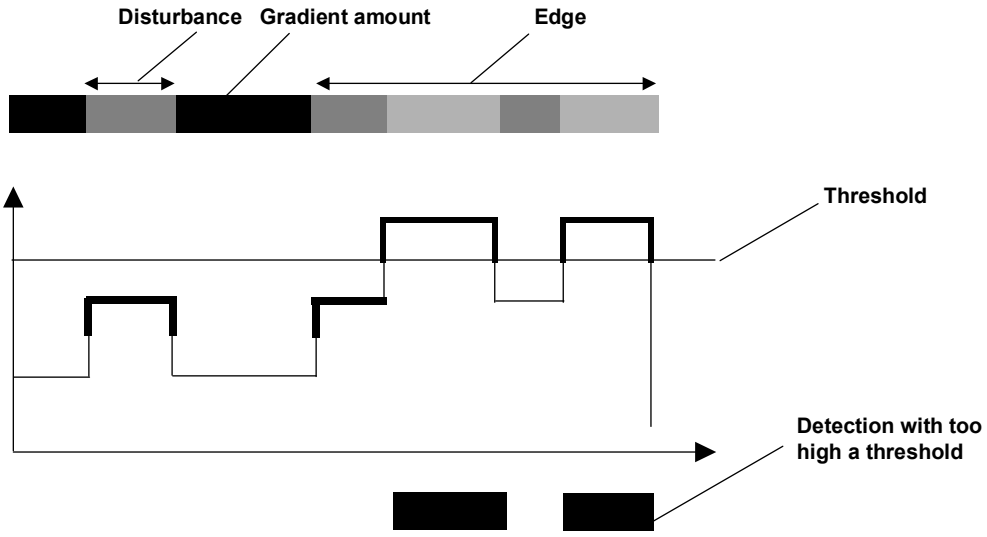
The thresholding process is described in more detail in the drawings below. It is assumed that the edge takes up the right half of the drawing. Moreover, it is assumed that the average gray values on the right side are part of the edge, while the ones to the left represent a disturbance.

If, as is common practice, only one threshold is used, it often turns out that this threshold is only capable of detecting the entire edge plus the disturbances or else merely a portion of the edge.

The example serves to demonstrate this case and illustrates the result in the two figures below.



Edge detection using too low a threshold



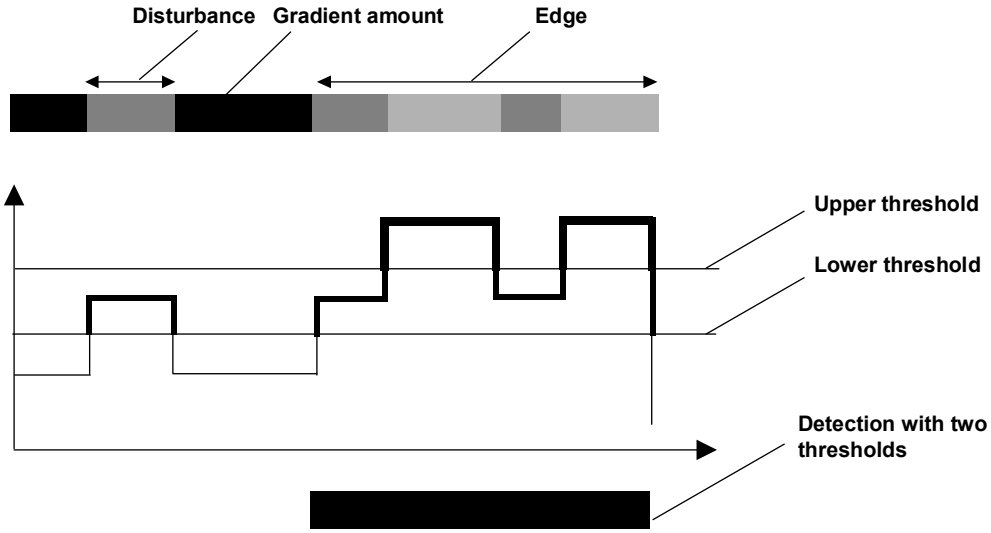
Edge detection using too high a threshold

The process in use in Vision P400 utilizes two thresholds (yellow area on the "Adjustment" page), whereby the lower is implicitly calculated from the upper. In the first step, it marks all pixels as edge points which are equal to or greater than the upper threshold. These pixels are called starting points. In the second step, all the neighboring pixels of the starting points which lie above the lower threshold are added in. Next, all pixels above the lower threshold which are

neighbors of the previously added pixels are added and so on. This process is continued until no more pixels can be added.

The process detects an edge whenever at least one edge point lies above the upper threshold with some tolerance: Gaps in the edge may be filled if its pixels lie above the lower threshold. Disturbances with pixels which exceed the lower, but not the higher threshold will not be detected, however.

The result of this process is illustrated in the figure below.



Edge detection with two thresholds

The “Adjustment” page is structured in accordance with the process in use. In the upper left hand corner you see an image segment with the selected shape. With the shapes Line and Elliptical Arc, the edge gradients are calculated along the shape and displayed in the diagram at the right of the page. With the rectangle shape, the gradients are calculated along a line within the shape. The line’s orientation corresponds to the orientation of the shape. The line position within the shape can be changed by means of the slider "Scan Line Offset". The gradient diagram on the page corresponds to the diagrams in the example above.

The parameter "Minimal Gradient" represents the upper threshold in the process used.

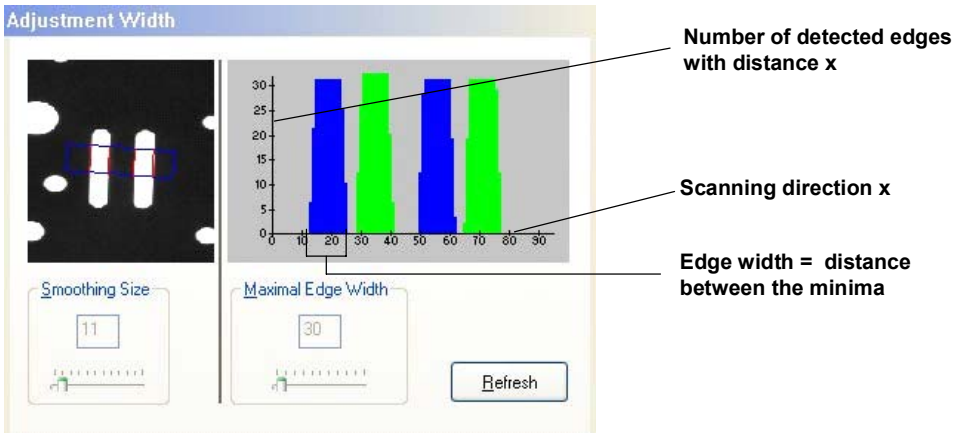
It may be changed with the slider Gradient. Its value is displayed in the upper window of the slider. In the lower window you will find the implicitly calculated lower threshold. The area between the lower threshold and the minimal gradient is marked in the diagram to the right of the page.

An edge is detected when the gradient amount lies at least one edge point above the upper threshold, i.e. above the value in "Minimal Gradient". Within the diagram, this means that at least one point of the diagram must protrude beyond the marked area. All the pixels above the lower threshold and which are associated with the starting points will be adjoined. In figure 10, these are all the pixels which protrude into the marked area and which are neighbors to one of the pixels protruding from the marked area.

The edge points detected are illustrated in the image segment of the “Adjustment” page.

12.9.3 Adjustment Width

This page is only active when you use a gray-value checker with a rectangle shape and the method "Connected". It assists you in determining the correct settings for the parameters "Maximal Edge Width" and "Smoothing Size" on the "Algorithm" page.



"Adjustment Width" page of a gray-value edge detector

The histogram evaluates the checker shape column by column, that means vertically to the scanning direction. It is the sum of all detected edges. The histogram is calculated with a smoothing algorithm and depicts all gray-value edges in color (transitions from dark to light in blue, transition from light to dark in green).

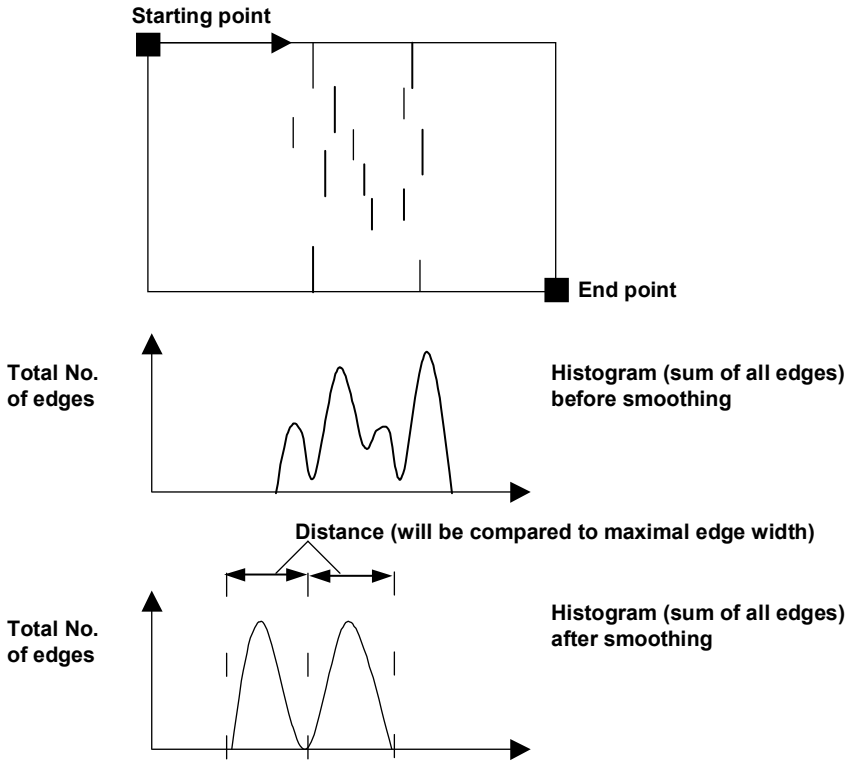
The histogram shown above is optimum as it shows very distinct minima and maxima. The distances between the minima are smaller than the value under "Maximal Edge Width" so that each transition is considered an edge.

Maximal Edge Width

Use the slider "Maximal Edge Width" to determine the maximal distance between two minima in the histogram. All minima which are further apart than this value are not considered an edge because it is concluded that the edge is too blurred and indistinct.

Smoothing Size

"Smoothing Size" determines the setting for the histogram smoothing. Use the slider to determine the right smoothing factor. Changing the smoothing factor may result in a histogram with more or fewer minima, or minima that have been moved. The smoothing size selected should be set in such a manner that each edge has a maximum or two minima, respectively.



Histogram before and after smoothing

12.9.4 Shapes and Scanning Directions

Please read the description under binary edge detection (see page 377).

12.9.5 Result

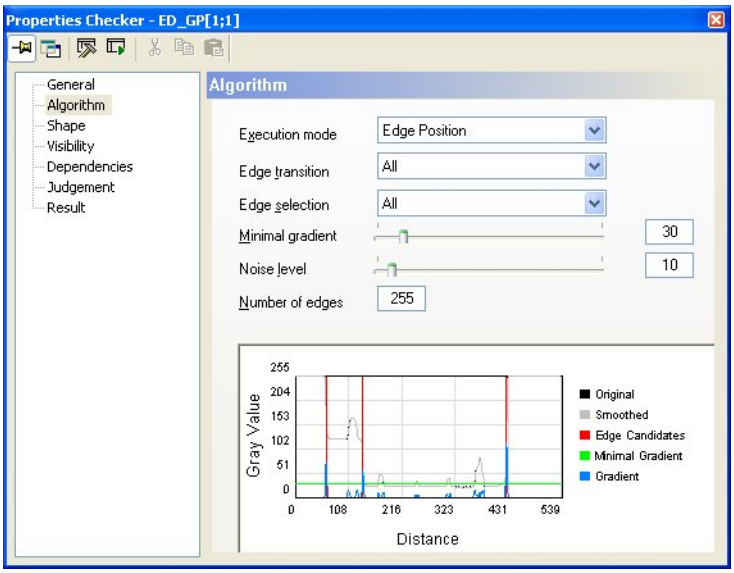
The results (see page 377) of gray-value edge detection correspond to those of the binary edge detection.

12.10 Edge Detection Checker with Gray Value Projection

The gray-value projection edge detection checker finds edges in the gray-value image. The system calculates the positions of a maximum of 255 edges.

12.10.1 Algorithm

The "Algorithm" property page contains six parameters by which you define the edge search.



"Algorithm" property page of a checker for gray value edge detection by projection

Execution mode

The list box offers two setting options:

- **Edge position:** If you choose this option, all edges found are processed individually and their edge positions determined.
- **Edge pair:** If you choose this option, the edges found are always grouped in pairs. If only one edge is found no pair can be formed, so no result is delivered. If there is an odd number of edges the last edge is not processed.

Edge transition

Here you define which type of edges you wish to detect (Light to Dark or Dark to Light). The list box offers three setting options:

- Dark to light
- Light to dark
- All transitions (from light to dark and from dark to light)

Edge selection

Here you specify which of the edge(s) found is to be processed. The list box offers five setting options:

- **All:** All edges are processed and included in the result list.
- **First:** Only the first edge found is included.
- **Last:** Only the last edge found is processed and delivered as the result.
- **First - Last:** The first and last edges found are processed and delivered as the result.
- **Maximal gradient:** The edge with the largest gradient is output.

Minimal gradient

The minimal gradient defines how high the edge gradient (gray-value difference between a pixel and its neighbors) needs to be at a given pixel in order for it to be accepted as an edge point (see page 385). The minimal gradient is automatically calculated in a first step. The default is 30. If you enter a different value manually, or move the slider, you will see the effect in the gray-value diagram. The minimal gradient is displayed there in green.

NOTE

The minimal gradient should be at least ten. With gradients any smaller than this, the edge points will vanish in the image noise.

Noise level

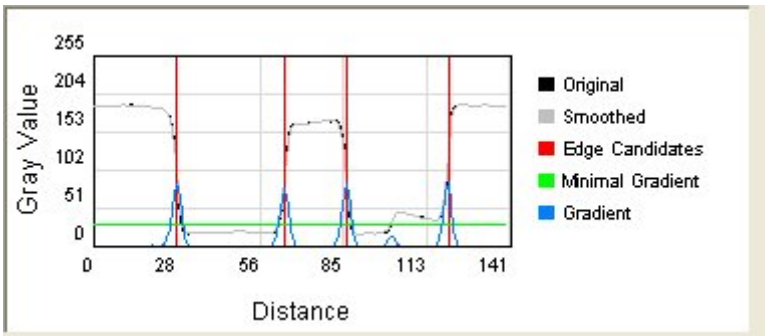
With this value you define the smoothing grade. If the image is very noisy, you can counteract it with a higher value so as to still attain good results. The better the contrast in the image, the lower you can set this parameter value. If you enter a different value manually, or move the slider, you will see the effect in the gray-value diagram. The smoothed edge is displayed there in gray.

Number of edges

Here you specify how many edges as a maximum are to be processed. The default is 255.

Gray value diagram

5 lines in this diagram deliver various items of data from the edge finder.



- **Original:** This line shows the gray value characteristic along the checker from the start point. The start point is always on the left-hand side of the diagram.
- **Smoothed:** This line shows the characteristic of the smoothed gray value along the checker from the start point. The start point is always on the left-hand side of the diagram. The line characteristic is dependent on the preset noise level (see above).
- **Edge candidates:** These vertical lines show the positions at which edges are found with the current minimal gradient setting.
- **Minimal gradient:** The horizontal line shows the current value of the minimal gradient.
- **Gradient:** This line shows the gradient characteristic along the checker from the start point. The start point is always on the left-hand side of the diagram.

12.10.2 Shapes and Scanning Directions

For the edge detection checker with gray value projection, four different shapes are permitted, as opposed to the other edge detection checkers which only permit three:

- Line with scanning direction from start to end point
- Circle with scanning direction clockwise or counterclockwise (ellipse not possible here)
- Rectangle with scanning direction from start to end point
- Doughnut with scanning direction clockwise or counterclockwise

You define the scanning direction when configuring the checker (see page 313).

12.10.3 Result

The following tables explain which results are delivered by which edge search and calculation modes.

12.10.3.1 "Edge Pair" Execution Mode

The following figures display results in execution mode "Edge Pair" and the objects they refer to.

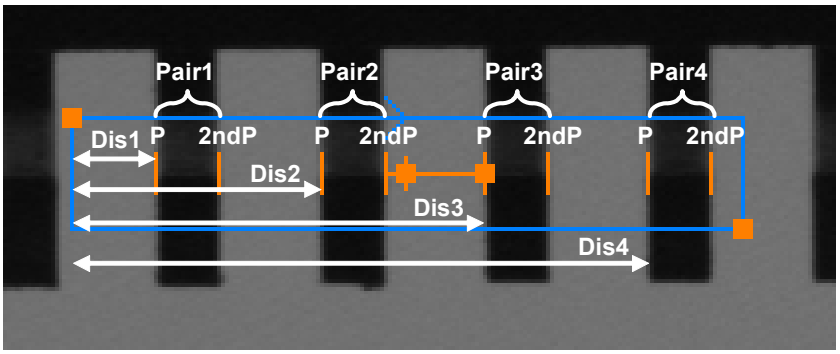
Distance, Point, 2nd Point

Total number of edges 4 Number of judged edges 4

	Distance	Point		2nd Point		Gradient	Gradient 2nd P
1	12.86	167.86	262	183.54	262	-55.05	57.15
2	54.44	209.43	262	224.9	262	-56.31	55.68
3	95.13	250.12	262	265.89	262	-55.05	56.36
4	136.83	291.83	262	307.31	262	-56.3	57.44

Distance, Point, 2nd Point

- Pair = Edge pair
- Dis = Distance (distance between the shape and the first point of an edge)
- P = Point (first point of an edge)
- 2ndP = Second point (of an edge pair)

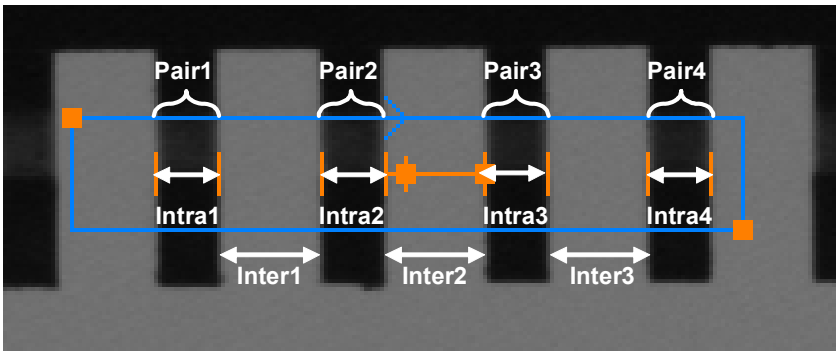


Intra Distance, Inter Distance

Total number of edges 4 Number of judged edges 4

	Point		2nd Point			Intra Distance	Inter Distance
1	1	167.86	262	183.54	262	-5	15.68	25.9
2	5	209.43	262	224.9	262	-5	15.47	25.22
3	9	250.12	262	265.89	262	-5	15.76	25.94
4	1	291.83	262	307.31	262	-5	15.48	0

- Pair = Edge pair
- Intra = Intra distance (distance between the first and the second point of an edge)
- Inter = Inter distance (distance between the first and the second edge pair)

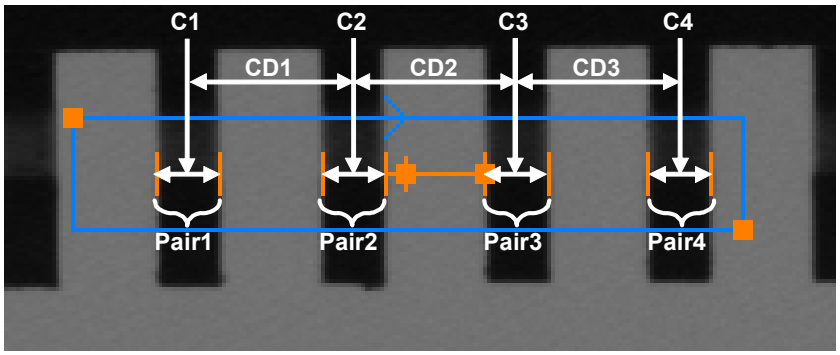


Center, Center's Distance

Total number of edges 4 Number of judged edges 4

	Point		2nd Point			Center		Center's Distanc
1	1	167.86	262	183.54	262	-512	175.7	262	41.47
2	5	209.43	262	224.9	262	-512	217.17	262	40.84
3	3	250.12	262	265.89	262	-512	258.01	262	41.56
4	1	291.83	262	307.31	262	-512	299.57	262	0

- Pair = Edge pair
- C = Center (Center point between the first and second point of an edge)
- CD = Center's distance (distance between the center points of two edges)



Which results will be output depends on the setting of option "Edge selection".

Result	Setting under "Edge Selection"		
	All	First	Last
Distance	Yes	Yes	Yes
Point	Yes	Yes	Yes
2. Point	Yes	Yes	Yes
Gradient	Yes	Yes	Yes
Gradient 2nd Point	Yes	Yes	Yes
Intra Distance	Yes	Yes	Yes
Inter Distance	Yes	0	0
Center	Yes	Yes	Yes
Center's Distance	Yes	0	0

As with "Edge Selection" = "First" or "Last" only one edge is calculated, no inter distance or distance to the center can be determined. So 0 is output for these results.

12.10.3.2 "Edge Position" Execution Mode

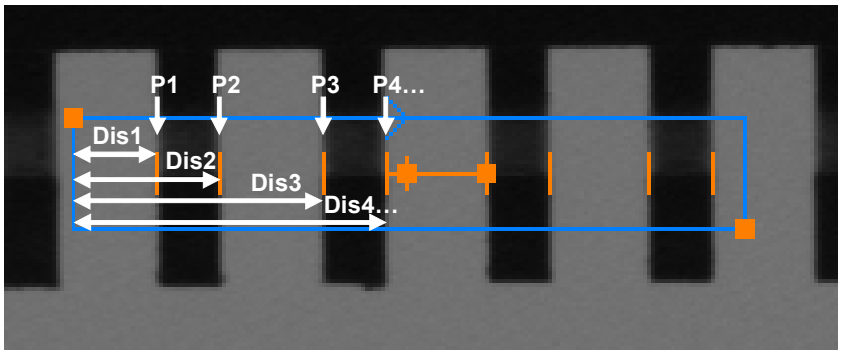
The following figures display results in execution mode "Edge Position" and the objects they refer to.

Distance, Point

Total number of edges 8 Number of judged edges 8

	Distance	Point	2n		Gradient	Gra	Int	Inter Distance
1	12.86	167.86	262	-	-55.05	-	-	15.68
2	28.54	183.54	262	-	57.15	-	-	25.9
3	54.43	209.43	262	-	-56.31	-	-	15.47
4	69.9	224.9	262	-	55.68	-	-	25.22
5	95.12	250.12	262	-	-55.05	-	-	15.76
6	110.89	265.89	262	-	56.36	-	-	25.94
7	136.83	291.83	262	-	-56.3	-	-	15.48
8	152.31	307.31	262	-	57.44	-	-	0

- P1 - Px = Point 1 to point x (row number in the table)
- Dis1 Disx = Distance (distance from the shape to edge point x)

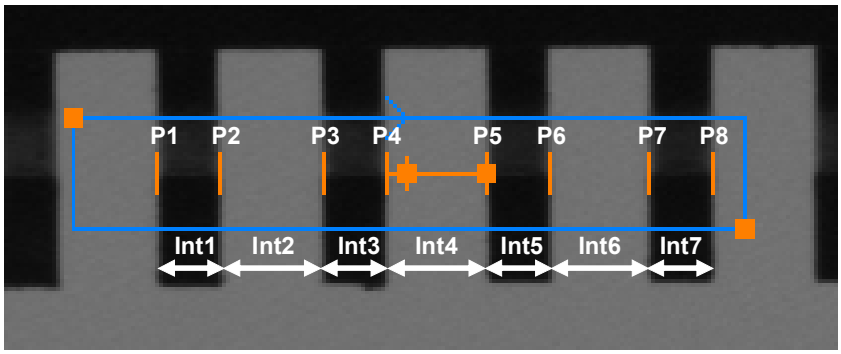


Inter Distance

Total number of edges 8 Number of judged edges 8

	Distance	Point	2n		Gradient	Gra	Int	Inter Distance
1	12.86	167.86	262	-	-55.05	-	-	15.68
2	28.54	183.54	262	-	57.15	-	-	25.9
3	54.43	209.43	262	-	-56.31	-	-	15.47
4	69.9	224.9	262	-	55.68	-	-	25.22
5	95.12	250.12	262	-	-55.05	-	-	15.76
6	110.89	265.89	262	-	56.36	-	-	25.94
7	136.83	291.83	262	-	-56.3	-	-	15.48
8	152.31	307.31	262	-	57.44	-	-	0

- P = Edge point
- Int = Inter distance (from one edge point to the next)



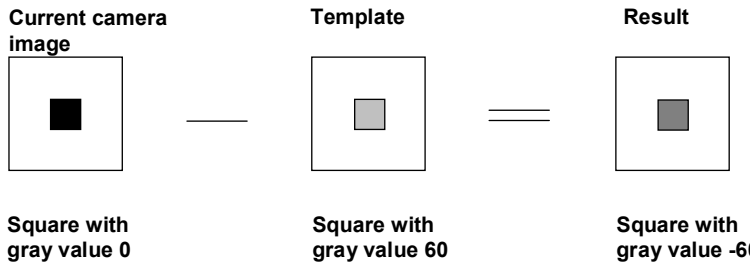
Which results will be output depends on the setting of option "Edge selection".

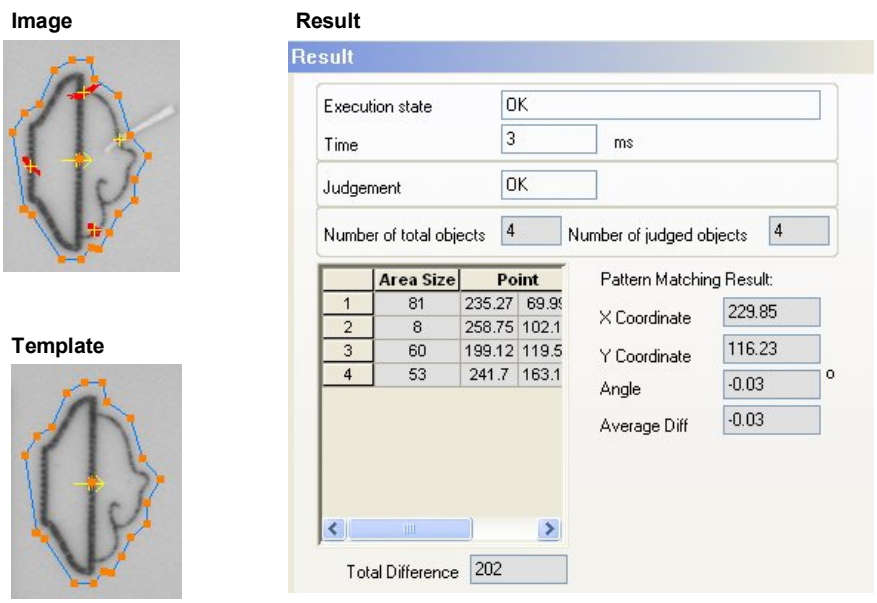
Result	Setting under "Edge Selection"				
	All	**First**	**Last**	**First - Last**	**Max. Gradient**
Distance	Yes	Yes	Yes	Yes	Yes
Point	Yes	Yes	Yes	Yes	Yes
2. Point	No	No	No	No	No
Gradient	Yes	Yes	Yes	Yes	Yes
Gradient 2nd Point	No	No	No	No	No
Intra Distance	No	No	No	No	No
Inter Distance	Yes	0	0	Yes	0
Center	No	No	No	No	No
Center's Distance	No	No	No	No	No

As with "Edge Selection" = "First", "Last", or "Maximum Gradient" only one edge is calculated, no inter distance can be determined. So 0 is output for this result.

12.11 Difference Checker

The difference checker determines the difference between the template just read in and the saved gray-value image by means of image subtraction. The image subtraction result is the difference of the gray values at each pixel:



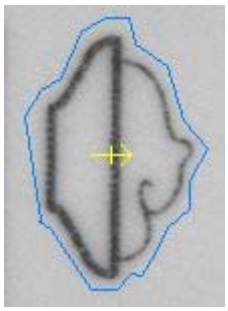


The resulting image is subjected to a type of binarisation, i.e. the thresholding. You may modify the thresholding result with the binary filter. The resulting features of the objects remaining will be calculated.

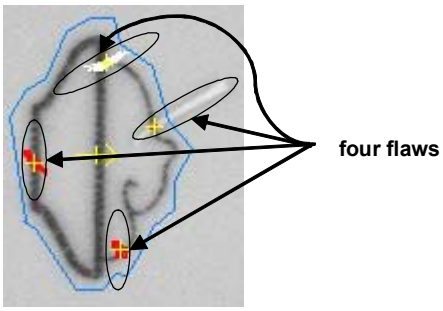
Typical application examples for the difference checker are:

- Flaw detection with cast or molded parts
- Print inspection
- Inspection of punched or stamped parts

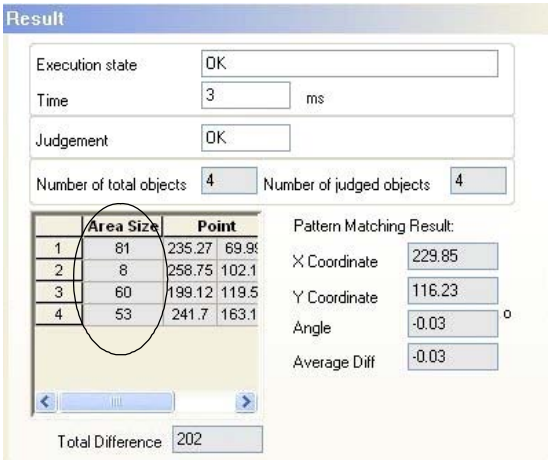
◆EXAMPLE



Print = OK



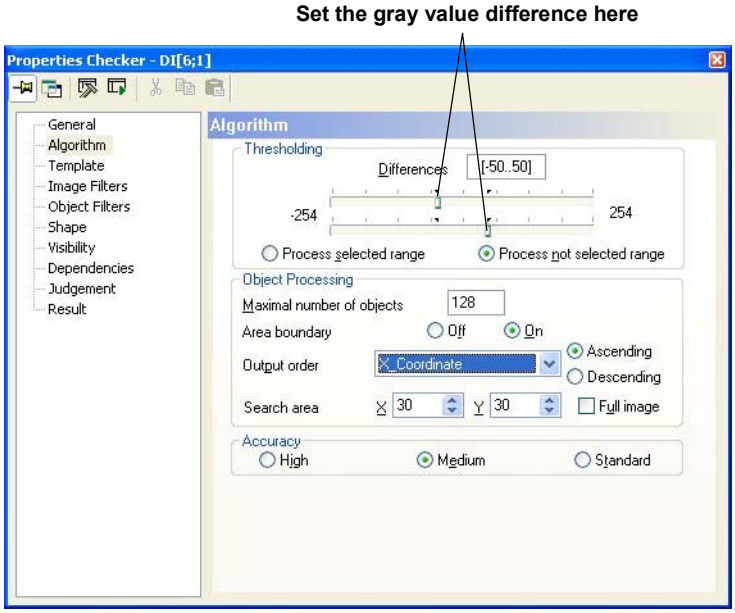
Print = NG



The difference checker displays the size and position of the defects and the total difference in pixels.

12.11.1 Algorithm

The "Algorithm" page contains parameters for "Thresholding", "Object Processing", and "Accuracy". Use these parameters to perform the flaw detection with an optimum of accuracy.

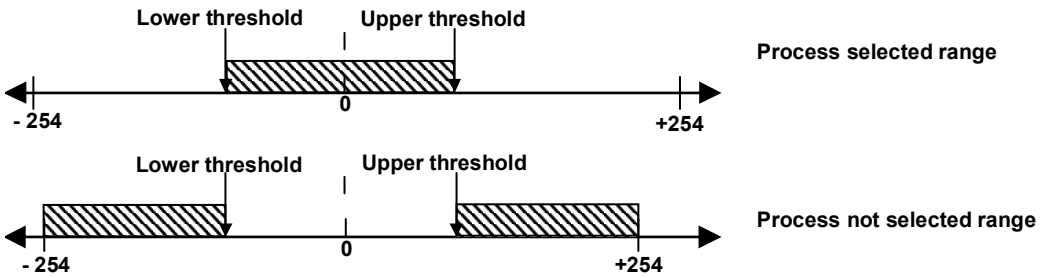


"Algorithm" page of a difference checker with threshold setting

Thresholding

This is where you set the binarisation thresholds, which determine the range of valid differences. Use the sliders (see page 283) to define the thresholds. You may set the difference range anywhere between -254 and +254. When you have selected "Process selected range", the differences within the range of the threshold values (inclusive) determine the objects to be processed. When you select "Process not selected range", the differences outside the selected range are the objects.

In the figure below, the range of differences to be used for the objects is marked in seriph.



Object range with parameter "Process (Not) Selected Range"

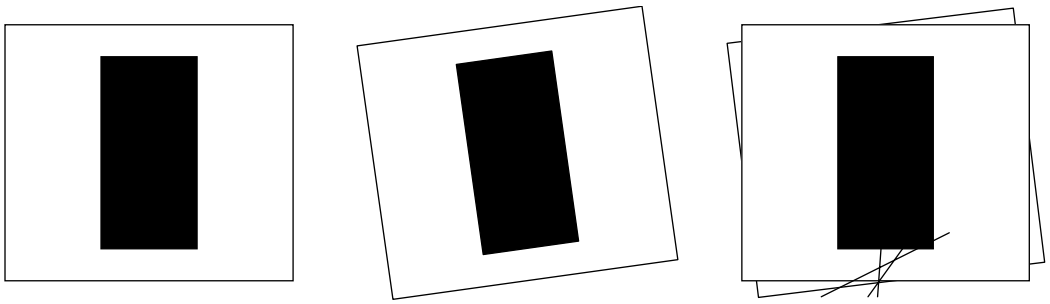
Object Processing

Parameter	Permissible value range	Additional information
Differences	-254 ... 254	
Thresholding	Selected / Not selected	
Maximal number	1 ... 32767	"Maximal Number" (see page 356) limits the number of objects to be processed.
Area boundary	ON / OFF	"Area Boundary" defines whether or not an object to be processed may touch the shape. If you set the parameter OFF, then the objects to be processed may not touch the shape. If you select "ON" (see page 356), touching will be permitted.
Output order		"Output Order" determines the sequence order in which the checker results are displayed. There is no default output order. You may choose between displaying results sorted by size or by coordinates, compare the table for Feature Extraction (see page 356).
Search area	X: 0 ... 1296* Y: 0 ... 1026* Full image	This option is not available if the difference checker depends on a position and rotation adjustment checker. It defines the area where Vision P400 should carry out the template matching in order to find a matching candidate.

*Depends on the selected camera type.

Accuracy

When the difference checker depends on a position and rotation adjustment, **pseudo differences** may occur at the edges of objects.



Template **Current (rotated) image** **Pseudo differences**

Pseudo differences

These differences occur not because of real differences between the two images, but because of inaccurate positioning of the template and the current image. Pseudo differences occur to a greater or lesser extent depending on the quality of the position and rotation adjustment process.

The algorithms calculating the position and rotation adjustment offer an accuracy of 1 pixel (x/y) or 0.1 degree, respectively. The accuracy of the algorithms further depends on the inspected object's properties (edges, holes, etc.), which may vary minimally. However, in reality changes in an object's position and rotation happen in the subpixel range.

The accuracy parameters "High", "Medium", and "Standard" let you determine whether pseudo differences will influence the image processing to a lesser or greater extent. Please note that setting a high accuracy factor slows down the algorithms. The following parameter settings are available:

- **High**
  With this setting Vision P400 positions the template in the image with the help of a pattern matching process working with subpixel accuracy. This helps to keep the number of pseudo differences at the object edges as low as possible.

The pattern matching process automatically searches a matching candidate within a range of +/- 75 pixels (X,Y) around the template shape.

If you need to perform a rotation adjustment of more than 1.5° degrees, it is necessary to create rotated templates in the expected rotation range. Please note that the settings under "Template Rotation" will influence the accuracy of the pattern matching process, the memory size needed to store the rotated templates, and the speed of the image checking.

◆NOTES

- **Avoid wasting memory space for rotated templates by setting the angle range in "Min Angle" and "Max Angle" as narrow as possible.**
- **If you expect an object to be misplaced by more than +/- 30 pixels (in x- and/or y-coordinates), use a larger search area or a position and rotation adjustment.**
- **The quality of the matching process deteriorates if the objects contain only white and black pixels but no gray values, or if the objects have no significant structure or texture in either x- or y-direction.**
- **If the image to be checked differs considerably from the template, the pattern matching process may not be successful. In this case, the x- and y-coordinates are usually zero.**

- **Medium**
  This setting works mostly the same as **"High"**. However, there are small differences as far as accuracy and processing speed are concerned.
- **Standard**
  With this setting Vision P400 positions the template in the image only with the help of standard algorithms for position and rotation adjustment. This means that the position of the object to be checked is calculated with the help of other checkers. Once the object position has been established, the corresponding rotated template is retrieved from the memory and used to perform the difference check in the appropriate rotated position.

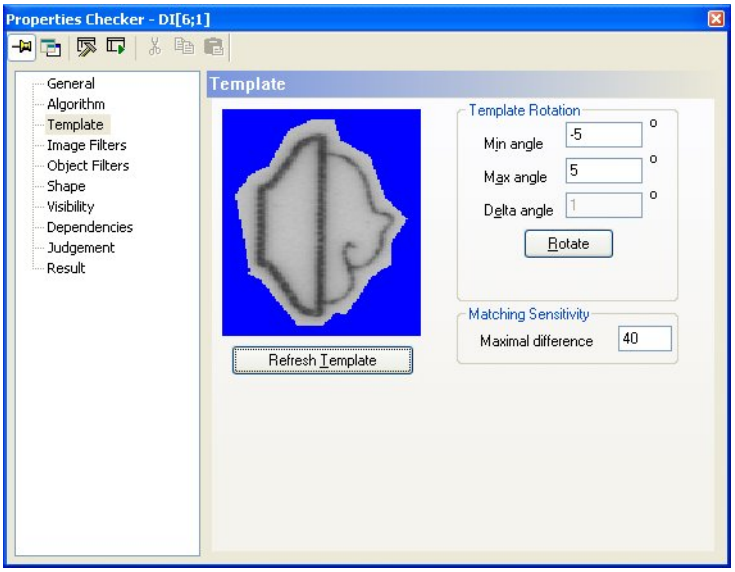
This method is extremely fast because no image rotations have to be performed during inspection. However, the effect of pseudo differences will be more pronounced. To improve the image processing, use a filter method to suppress the object's borders from the difference checking (see paragraph **Filter** (see page 401)).

12.11.2 Template

The template to be used for the difference calculation at hand is displayed to the left. The template is updated as soon as you change the checker shape. You can also force an update of the template with [Refresh Template].

Use [Refresh Template] when Vision P400 has read in a new camera image and you wish to use this image to generate a new template. The size of the image area used as a template will be modified so that it fits into the "Template" page.

Setting of the parameter "Accuracy"	Additional parameters
High	Maximal difference
Medium	
Standard	Slider for viewing the rotated templates
	Use filter
	Suppressed border
	Sensitivity
	Delta angle



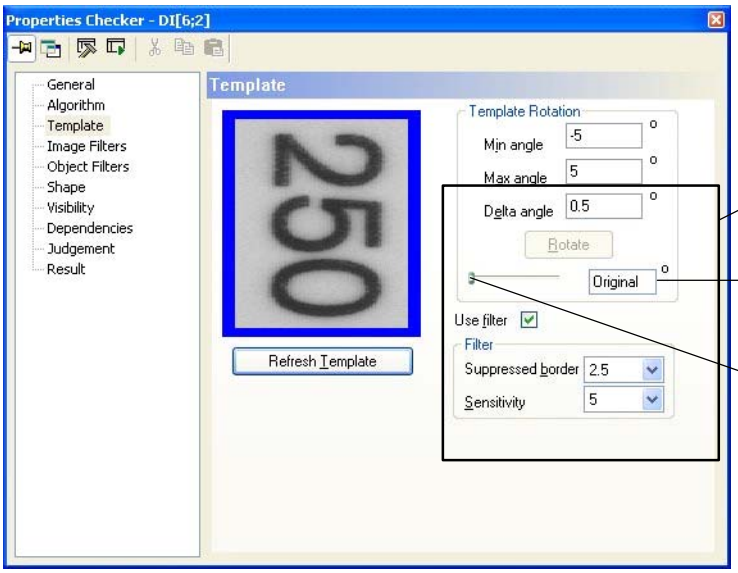
"Template" page of a difference checker with "Accuracy" = "Medium"

Template rotation

In order to speed up the checker calculation, all template rotations brought about by position and rotation adjustments may be calculated and saved in advance during the initial checker definition. To avoid excessive rotation calculations, we recommend defining the anticipated angle range of the rotations as narrow as possible. In addition, define the increment between the rotations. The confines of the rotation range are defined in the parameters "Min Angle" and "Max Angle", the increment itself in "Delta Angle". The "Min Angle" must always be smaller or equal to "Max Angle", the increment must be greater than zero. The option "Delta Angle" is only available if you have set "Accuracy" to "Standard".

To facilitate specification of the angle range, the value ranges available for "Min Angle" and "Max Angle" have been defined as -180 to 360 degrees, whereby the angle range -180 to 0 degrees is identical to the range 180 to 360 degrees. Let the value ranges -10 to 10 degrees and 170 to 190 degrees (which would be difficult to represent with any other choice of measure) serve to demonstrate the advantages of this approach.

Click [Rotate] to calculate the template rotation with the angle values you have entered. If you have selected the setting "Standard" for parameter "Accuracy" in the "Algorithm" page, some additional parameters appear on the "Template" page: As soon as Vision P400 has calculated the rotated templates and stored them in the memory, a slider and a display field appear beneath the [Rotate] button. You can view the rotated templates by moving the slider left and right. The rotation angle as compared to the original template appears in the gray field to the right of the slider.



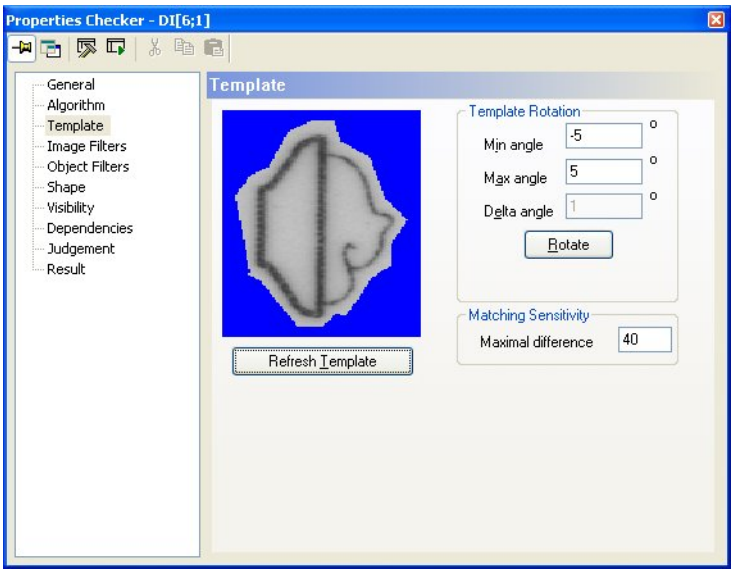
"Template" page of a difference checker with "Accuracy" = "Standard"

◆NOTE

In order to save storage space, the number of templates which may be calculated and saved in advance is limited. This number is a function of the size of the templates, the limits of the angle range, and the increment (delta angle). The system will issue an error message if the parameters specified exceed the number of templates that can be saved. In that case, you can either reduce the template size or the angle range or else increase the increment.

Maximal difference

If you have selected the setting "High" or "Medium" for the parameter "Accuracy" on the "Algorithm" page, this parameter appears on the "Template" page:



"Template" page of a difference checker with "Accuracy" = "High" / "Medium"

This parameter determines the maximal difference between gray values during matching. This means Vision P400 calculates the average of the gray-value differences of all pixels to compare. If this average is bigger than the value entered under "Maximal Difference", Vision P400 treats that image area as not matching with the template. The bigger the value you enter here, the more tolerant the matching process is towards differences between the object to be found and the template.

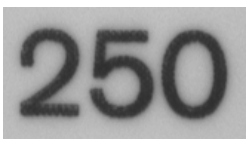
Filter

If you have selected the setting "Standard" for parameter "Accuracy" in the "Algorithm" page, some additional parameters appear on the "Template" page:

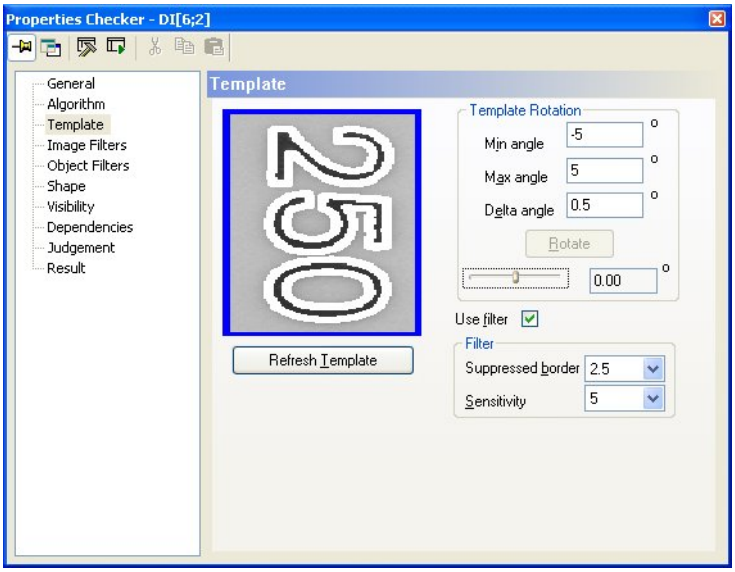
These parameters are useful to improve the results of the standard algorithm and help to suppress pseudo differences at the object edges.

Vision P400 uses a sobel filter to calculate the object edges. The user defines the sensitivity of this filter. The result of the sobel filter operation is then modified by the parameter "Suppressed Border". This parameter causes Vision P400 to consider differences within the object edges to be pseudo differences and suppress them.

The result of the parameters "Sensitivity" and "Suppressed Border" appear blue on the screen when you move the slider below the [Rotate] button left and right to display the rotated templates.



Original gray-value image used as a template



Rotated template with suppressed borders marked in white

Sensitivity

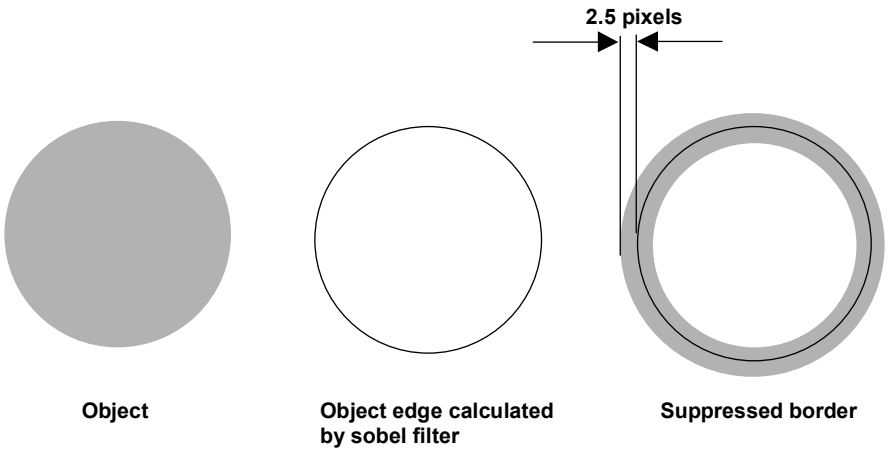
Here you define the sensitivity of the sobel filter. The smaller the entry, the higher the sensitivity. The highest sensitivity is achieved with 3, the lowest with 13. When you select the highest sensitivity, small differences in the gray values of individual pixels will be detected as edges.

Suppressed border

The value here represents half the width of the area alongside an edge which will not be inspected in order to avoid pseudo differences. The entry signifies the distance between the edge pixel and the edge of the area which will be left out during the inspection. This parameter works with the results of the sobel filter, i.e. the results of the parameter "Sensitivity". This means that if the sobel filter does not find an edge, there are no borders to be suppressed.

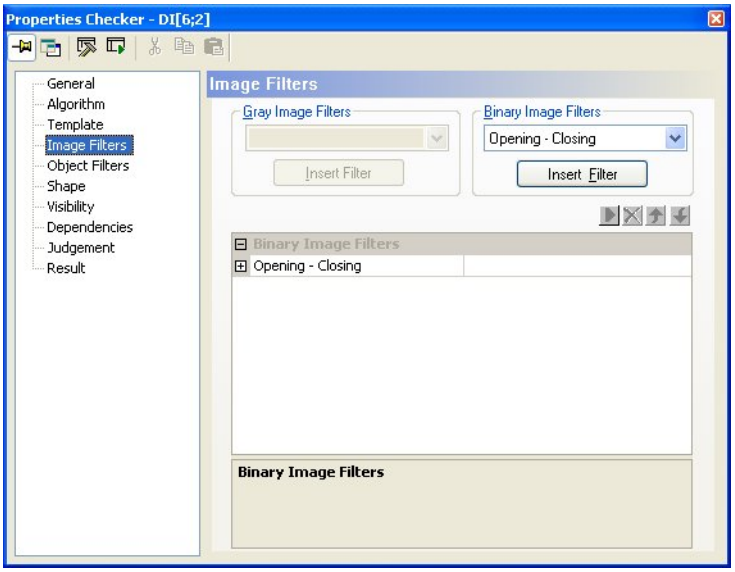
◆EXAMPLE

Vision P400 detects the object edge with the help of a Sobel filter and then uses the entry under "Suppressed Border" to determine the area that will not be inspected while subtracting the image from the template.



12.11.3 Image Filters

Filters which work on the gray-value image are not permissible. All other filters (see page 290) will be applied to the binary image, i.e. the result of the subtraction process.



"Image Filters" page for difference checker

12.11.4 Judgement

The criterion for the judgement is the number of objects for which the features have been calculated. This must be within the limits of "Number of judged objects: Lower limit" and "Number of judged objects: Upper limit" (inclusive). You can enter a valid range limit from 0 to 128. The default setting is 0 and 64.

12.11.5 Dependencies

In contrast to all other checkers, the difference checker can only depend on ONE exposure adjustment, which will then be used for the lower as well as upper limits of the slice levels.

12.11.6 Shape

You may assign one of the following shapes to a difference checker:

- Rectangle
- Ellipse/Circle
- Polygon
- Doughnut

◆NOTE

When creating the checker, make sure to leave at least 6 pixels distance to the image border. The template is always a rectangle, even if you have selected an ellipse or circle as the checker shape. In this case, Vision P400 uses the smallest circumscribed rectangle for display. The calculation of differences between the current object and the template, however, takes place only in the checker shape, i.e. the ellipse or circle.

12.11.7 Result

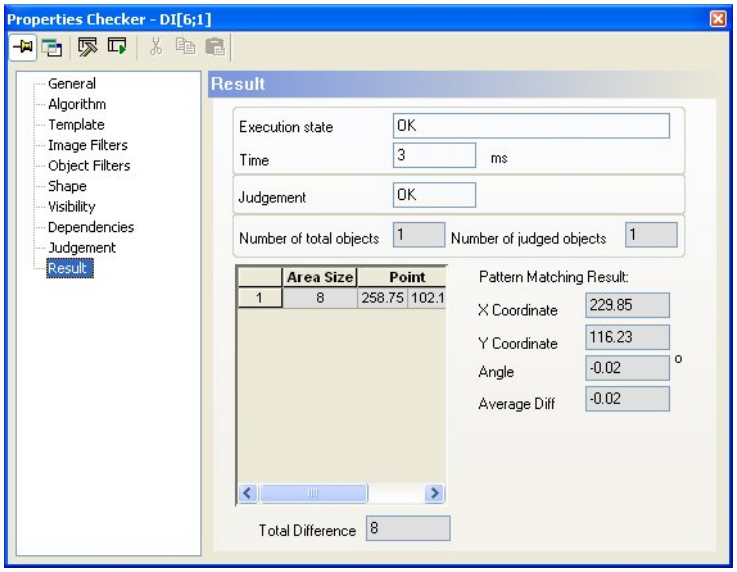
The result list displays the area size and center point coordinates of each object processed. The objects are listed in the order specified in the parameter "Output Order".

The "Number of Total Objects" field indicates the number of objects before application of the limit value defined in the "Maximal Number of Objects" parameter on the "Algorithm" property page. The "Number of Judged Objects" field indicates the number of objects for which the features have been calculated.

When you use the setting "High" or "Maximum" for the parameter "Accuracy", you find the results of the pattern-matching algorithm on the “Result” page. These results help to determine the degree of accuracy. The following results are available:

- Location of the highest matching candidate (x-/y-coordinate)
- Angle of the template at the location of the highest matching candidate
- Average gray-value difference

And the total area of all objects found is displayed in "Total Difference".



"Result" page for difference checker

12.12 Contour Matching Checker

The contour matching checker searches for a predefined template in the current camera image. The search is carried out with the contours of the template. The advantage is that the contour matching checker works independent of changes in lighting conditions and of objects that are misplaced, rotated or overlapping each other.

As opposed to other checkers, the contour matching checker works with TWO shapes:

- The **template area** is the area where the contour is defined with the aid of a reference pattern. The reference object's contour will be used for the matching process.
- The **search area** (shape) is the area within the camera image where you search for contours matching the contour defined in the template area.

Create a contour matching checker as follows:

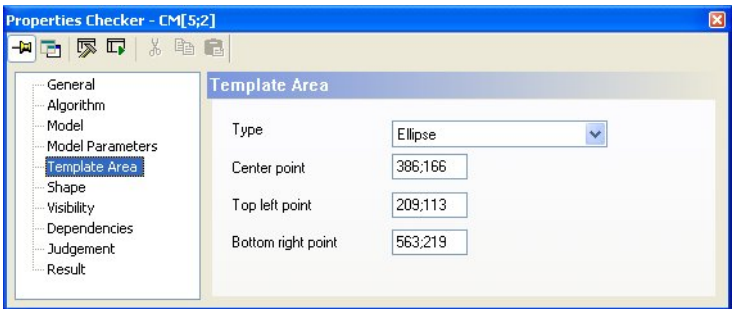
1. Set the template area (see page 409) to define the reference object
2. Set the search area (see page 410)
3. Set the model parameters (see page 423)
4. Optimize model parameters (see page 426)

12.12.1 Template Area

The template area is the shape which is set around the image area used to create the contour model. The template area shape is defined by blue dots connected by a blue-and-orange dashed line. Four different shapes are valid for use with a contour matching checker:

- Rectangle
- Ellipse (Circle)
- Polygon
- Doughnut (segment)

Use the icons from the shape bar (see page 115) to set the template area. Next, you select the shape of the search area (see page 410).



"Template Area" page of a contour matching checker

◆**NOTE**

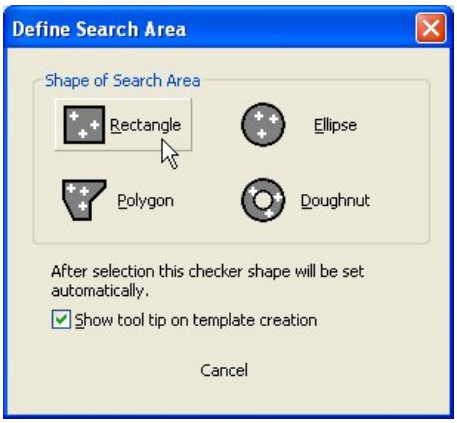
If you have set a polygon as the template area shape and want to change the size by way of the coordinates, identify the polygon nodes by clicking on the points in the table of coordinates. Vision P400 marks the selected point by a blue circle. You can use the mouse to drag the polygon node to a different position, thus modifying the polygon size.

12.12.2 Shape

For the contour matching checker you need to set two shapes:

- The shape of the template area (see page 409) and
- the shape of the search area (called "Shape").

For this reason the following dialog box appears when you have finished setting the template area for the contour matching checker:



Dialog for defining the search area of a contour matching checker

In this dialog box, select the shape you want to use for the search area. The size of the search area is set automatically by Vision P400. You can modify it just as you would modify a checker shape, i.e. you can change the size and/or position of the search area.

Because the contour matching checker works with two shapes (template area and search area), when you create the checker a tool tip is displayed indicating what the shape is used for. The tool tip display is controlled by the "Show tool tip on template creation" checkbox.

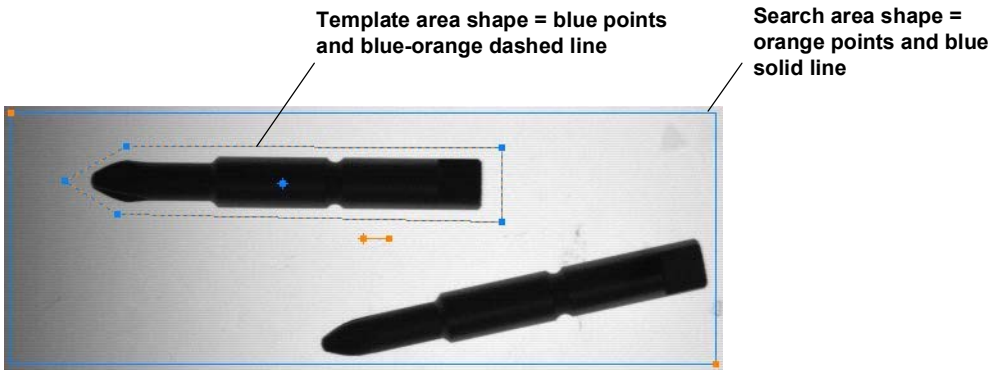
◆**NOTE**

Selecting [Cancel] in the dialog for defining the search area not only aborts the selection of the search area, but also the creation of the contour matching checker altogether.

Difference between search and template area

The shape determines the area inside the camera image where the checker will search for matching objects. The template area is set around the object to be searched for. It serves to create the contour model. The shape and the template area are displayed in different colors so it is easier to distinguish them:

- The shape (search area) uses orange dots and a solid blue line and
- the shape of the template area (see page 409) uses blue dots and a blue-and-orange dashed line.

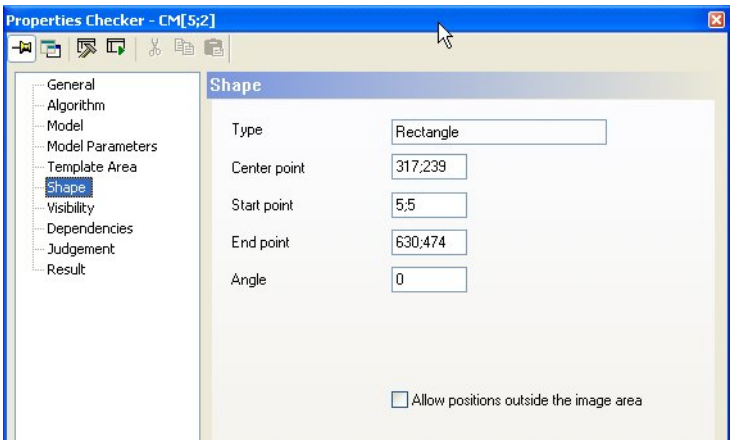


Difference between shape and template area for contour matching checker

Four different shapes are valid for use with a contour matching checker:

- Rectangle
- Ellipse (Circle)
- Polygon
- Doughnut (segment)

By default, the search area is created with the maximal size possible in the image range minus a margin.

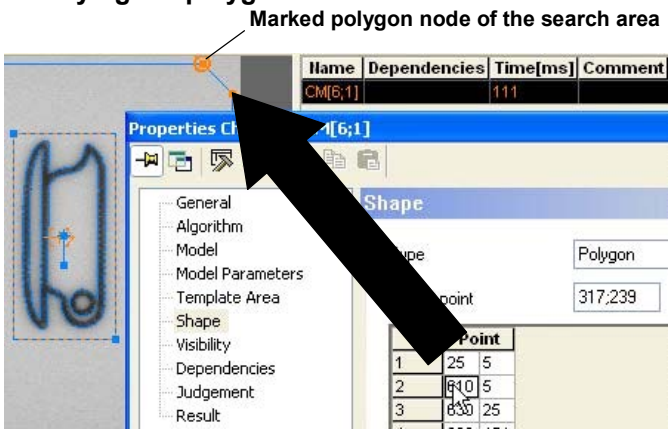


"Shape" page of a contour matching checker

You can decrease the shape of the search area with the keyboard or with the mouse. However, this will slow down the processing speed of the checker.

◆NOTE

When you have set a polygon as the search area shape and wish to change the size, identify the polygon nodes by clicking on the points in the table of coordinates. Vision P400 marks the selected polygon node with an orange circle. You can use the mouse to drag the polygon node to a different position, thus modifying the polygon size.



◆EXAMPLE

How to change the rectangular shape of a contour matching checker with a circular template area with the keyboard (first procedure) and with the mouse (second procedure).

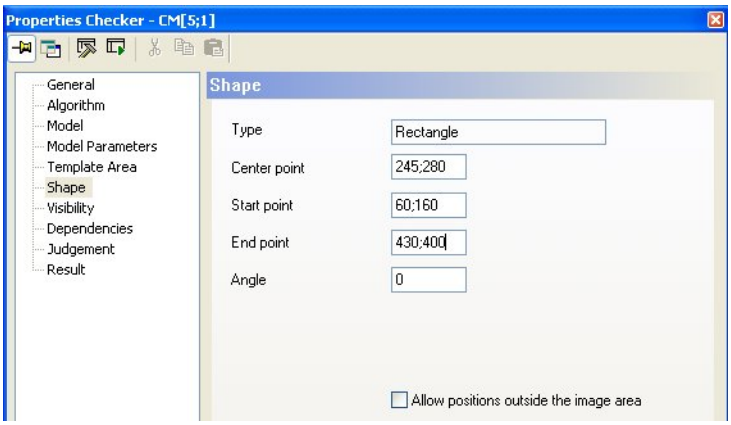
Making a shape smaller with the keyboard

◆Procedure

1. **Enter the new coordinates for the shape under "Start Point" and "End Point"**

   Use the status bar (see page 116) of the main window to retrieve the coordinates with the mouse.

2. **Click to apply the changes**

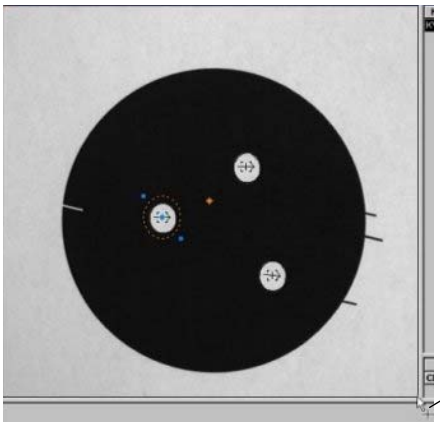


Making a shape smaller with the mouse

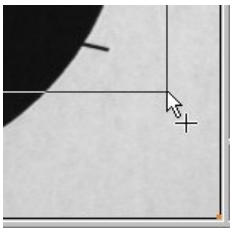
Procedure

1. **Left mouse click on the grip point of the shape and hold the left mouse button down**

   When you have selected the grip point, the mouse cursor changes to a cross.

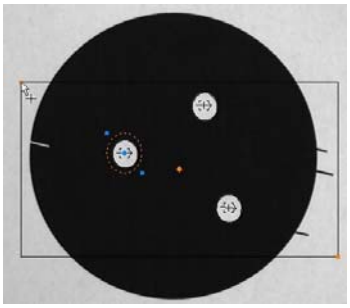


2. **Move the grip point of the shape to the desired position and release the left mouse button**

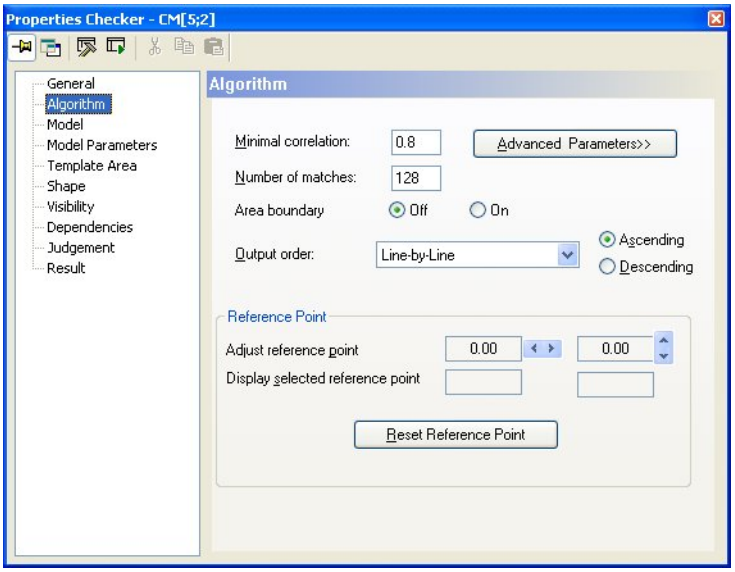


3. **Select the other grip point of the shape**

4. **Move the second grip point of the shape to the desired position**



12.12.3 Algorithm



"Algorithm" page of a contour matching checker

Minimal Correlation

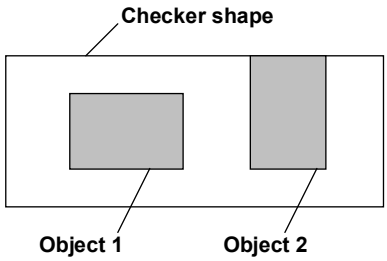
This parameter determines how many matching points Vision P400 has to find in the image in order to detect an object. The setting 0.8 means that Vision P400 has to find at least 80% of the contour points.

Number of Matches

Defines how many objects should be found at most. A maximum of 1024 objects can be found. When you set this parameter to "0", Vision P400 finds all instances of the object.

Area boundary

Use this parameter to define whether or not an object to be processed will be allowed to touch the shape. If "Area Boundary" is set to OFF, an object to be processed will not be permitted to touch the shape. If the parameter is set to "ON", the object to be processed will be permitted to touch the shape.



Parameter "Area Boundary"

With "Area Boundary" set to "ON", object 1 and object 2 would be processed. With "Area Boundary" "OFF", only object 1 would be processed since object 2 touches the shape.

Output Order

This parameter determines the sequence in which the objects appear in the result list. There is no default output order. You may choose between an ascending or a descending sorting order for the detected objects. You can sort by one of the following criteria:

- X- or Y-coordinate,
- line by line,
- column by column,
- in circular order
- List,
- X- or Y-coordinate of the reference point,
- angle
- correlation or
- scale

The scale is only calculated if you have activated the option "Use Scale" in the "Model Parameters Advanced" dialog box.

If you have selected "List" (see page 358) as the output order, the object position will be output as the coordinates of the point and not the reference point.

◆NOTE

If you want to use the output order "List", the checker cannot depend on a position and rotation adjustment checker.

Reference Point

The contour matching checker calculates two points (see page 428), the point and the reference point. As a default, the two points are identical. They refer to the center point of the shape of the contour matching checker.

If you would like Vision P400 to output a different point, e.g. if you would like to output a certain part of an object as the checker result, move the reference point accordingly. You can position the reference point of the object anywhere in the image.

The reference point can be adjusted via the mouse or by clicking buttons marked with arrows. The current coordinates are displayed. Use the button [Reset Reference Point] to reset the point moved to its original position (coordinates of the center point of the checker's shape).

Procedure

1. **Execute the contour matching checker by clicking or press <F8>**

   You need to execute the checker first before Vision P400 can display the reference point.

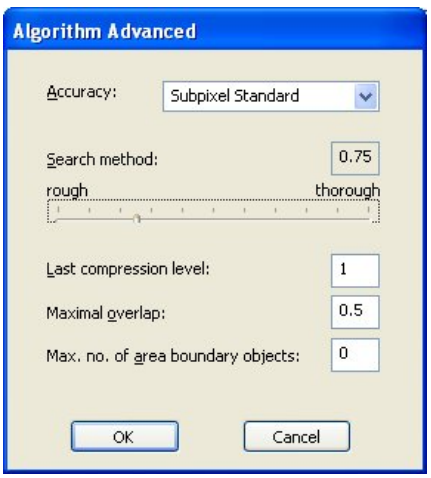
2. **Left mouse click on the grip point of the reference point**

   The mouse cursor changes its shapes as soon as you move it near a reference point.

3. **Drop the reference point at the desired position with a left mouse click**

12.12.3.1 Algorithm Advanced

Use the dialog box "Algorithm Advanced" for fine-tuning.



Algorithm Advanced

Accuracy

Here you define the accuracy of the search. You can search with pixel or with subpixel accuracy. The default setting is "Subpixel Standard". This method with subpixel accuracy is very fast and suits most applications.

If you would like to perform a more accurate search, change the parameter setting. However, this will slow down the processing speed of the checker. The table demonstrates the influence of the parameter on the calculation accuracy and calculation speed and may serve as a guideline.

◆EXAMPLE

Last Compression Level	Subpixel accuracy	Subpixel Standard	Subpixel Advanced	Subpixel High	Subpixel Very High
1	Relative run time	100%	120%	131%	142%
	Max. angle error	0,079°	0,025°	0,014°	0,013°
	Average angle error	0,027°	0,010°	0,006°	0,005°
2	Relative run time	69%	75%	79%	84%
	Max. angle error	0,167°	0,142°	0,133°	0,130°
	Average angle error	0,072°	0,048°	0,051°	0,050°
3	Relative run time	60%	62%	65%	67%
	Max. angle error	0,446°	0,260°	0,253°	0,252°
	Average angle error	0,206°	0,102°	0,101°	0,100°

◆NOTES

- **The values for run time and errors of measurement depend on the application.**
- **The bigger the model, the more accurate Vision P400 calculates the position, the scale, and the angle.**

Search Method

Use the parameter "Search Method" to influence the search algorithm by balancing a thorough against a rough but quick search. Use the slider to select a setting between "rough" and "thorough".

To understand the function of this parameter we need to take a closer look at the search algorithm. The checker performs a step-by-step search, starting from a very low image resolution. When the search algorithm detects something that could be possibly be a matching object, the position is stored. This position will be examined more closely at the next (more accurate) search step.

When you have selected a more thorough setting for the "Search Method", Vision P400 may also examine objects that are unlikely to match the template. This is because the low resolution at this stage makes it impossible to decide whether the object matches the template or not. This slows down the search process. The basic idea behind this parameter is to stop examining a possible match when it becomes unlikely that the value under "Minimal Correlation" on the

"Algorithm" page is reached. In other words, the purpose of this parameter is to avoid wasting time on objects that are unlikely to match the template.

If you set the search method too rough, this may have unwelcome consequences, too: In some cases a perfectly visible object is not detected because the matching process starts "on the wrong footing", i.e. a possible match is discarded at the low-resolution stage as unlikely and is not pursued.

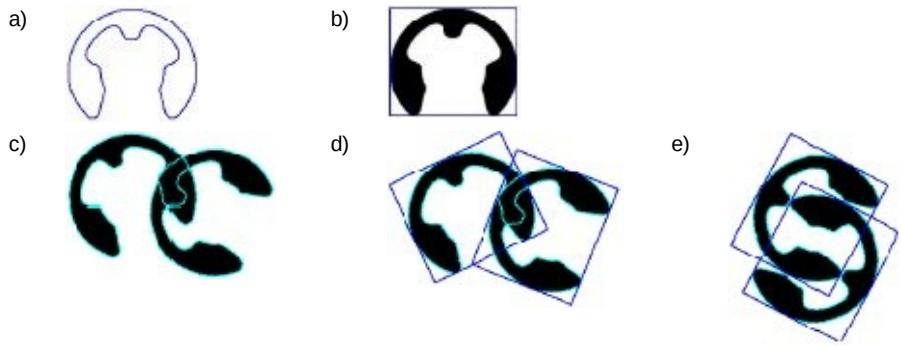
Please note that the parameters "Search Method" and "Minimal Correlation" work together. This means, enter a lower minimal correlation to perform a rougher search. In general, the processing speed increases if you combine a rough search method with a low minimal correlation. For more tips and tricks read the section on optimizing the settings (see page 426).

Last Compression Level

Use this parameter to shorten the search for objects if the application allows for less accuracy when it comes to the objects' position. The contour matching is performed on several compression levels (see page 419). Enter the level number where you wish to stop searching for objects. The default setting is 1, i.e. the search is performed until the last compression level is reached. How many compression levels are available depends on the template you have used for creating the contour model. The bigger the template/model (see page 419), the more compression levels (see page 419) are available.

Maximal Overlap

Here you determine by how much two objects may overlap (in percent). To achieve a high processing speed, Vision P400 does not use the object contour to calculate the overlap, but rather the smallest circumscribing rectangle. This means that you need to enter a comparatively large value even for "small" overlaps. The following pictures illustrate this:



a) Contour model, b) contour model with circumscribing rectangle, c) overlapping objects (overlap about 8%), d) overlap of the circumscribing rectangles by about 20%, e) worst-case scenario: Although the objects themselves do not overlap, the areas of the circumscribing rectangles overlap by almost 90%. In order to find the objects even in a worst-case scenario, enter a sufficiently high value under "Maximal Overlap".

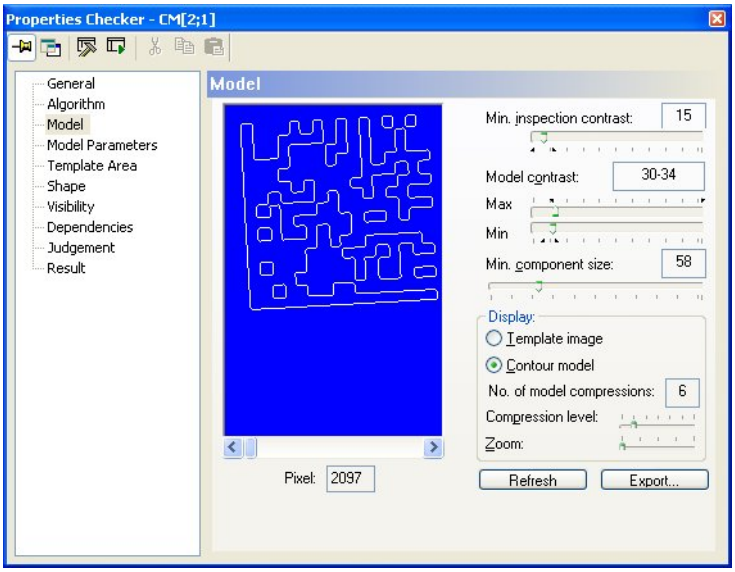
Max number of area boundary objects

This parameter acts as an offset against the number of objects to be found. If you want to find 5 objects for example, the search is aborted after 5 objects, even if there are 7 objects in the image for example. If 2 of the 5 objects found are then eliminated because they touch the edge of the search area, only 3 found objects are output, even though there are actually 5 valid objects in the image. With this parameter you specify how many more objects are to be sought

in order to buffer this problem. The maximum output is the number of objects you specified under "Number of matches" on the "Algorithm" property page.

12.12.4 Model

This page displays the registered template as an image or as the contour model derived from that image. You can view the template or contour model as a compressed or zoomed image.



"Model" page of a contour matching checker

Minimal inspection contrast

The value determines the minimal contrast for a pixel in order to be compared with the template image during the object search. The minimal contrast helps to separate the object from noise. If due to noise the image contains gray-value differences of up to 10 gray levels, set the parameter to at least 10. Use the slider to set the parameter and move it as far left as possible.

◆NOTES

- **This parameter value has to be smaller than the value entered for parameter "Min. Model Contrast". The two parameter values should be as far apart as possible.**
- **If you wish to find objects that are partially covered, the parameter value has to be slightly bigger than the noise to ensure a stable and accurate position detection.**

Model contrast

The model is extracted with the help of a hysteresis threshold. All pixels in the camera image with a gray-value difference to the neighboring pixels greater than or equal to the value set with the slider "Max Model Contrast" are accepted as "safe" points for the contour model. Accordingly, all pixels with a gray-value difference smaller than or equal to the value set with the

slider "Min Model Contrast" will be ignored. "Potential points" with a gray-value difference between the two slice levels will be accepted if they are connected by a path of "potential points" with the "safe" contour model points. That means that "safe" points influence their environment (hysteresis).

If "Min Model Contrast" and "Max Model Contrast" are identical, Vision P400 executes a simple segmentation. All pixels with a gray value below the set value are ignored, all pixels with a gray value above the set value are part of the contour model.

Use the sliders "Max Model Contrast" and "Min Model Contrast" to set the thresholds. You can immediately see the effect of changing the parameter in the image on the left.

Min. component size

The value determines the minimal size for a component of the model in order to be considered for selection. Components with less pixels than the minimal size will be suppressed.

Use the sliders to set the value for the threshold. You can immediately see the effect of changing the parameter in the image on the left.

Display template image/contour model

Here you define how the template is displayed in the window to the left: Either as a gray-value image in the different compression levels or as a contour model derived from the gray-value image. The display of the template and contour model is very important because it illustrates the effect of parameter "Min. Model Contrast". First, the parameter influences the quality of the contour model, which is used for the object search. Second, the parameter influences the number of compression (or pyramid) levels, which in turn influence the processing speed of the checker.

No. of model compressions

Vision P400 creates so-called image pyramids from the template image and the contour model to speed up the search process. For example, if the original image used for creating the model has a size of 100 x 80 pixels, the image of the first pyramid level is 50 x 40 pixels, the image of the second pyramid level 25 x 20 pixels etc. The more pyramid levels there are, the faster the search for the contour model will be performed in the image. As a template image has to contain at least 15 pixels, the parameter "Min. Model Contrast" directly influences the number of compression levels. When you change the parameter setting, you see the effect immediately on the screen. Especially for large contour models containing many contour points we recommend using the parameter "Optimize Large Models". This parameter is described in the section on "Model Parameters" (see page 423).

Zoom

Use the slider to zoom the selected display image.

Pixel

Here the number of pixels in the contour model is displayed. In the highest pyramid level the model has to contain at least 15 pixels.

Refresh

Use this button to teach Vision P400 a new template. First modify the checker shape to surround the area with the object you wish to teach, then click the button to teach the object as a template image.

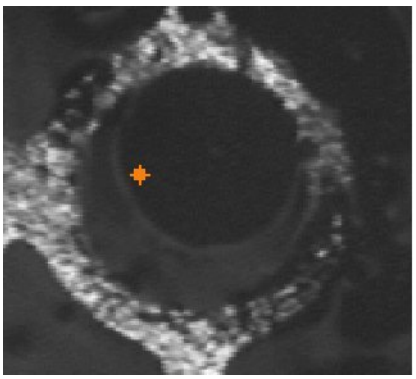
Export

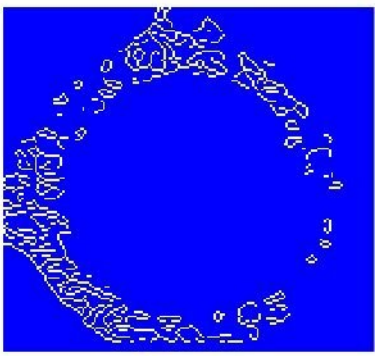
Use this button to export the contour model as a black-and-white bitmap file. This may be useful when you have only an image of bad quality to create the contour model and it is difficult to extract the object to search for. In such cases it is best to touch up the contour model created and teach the modified version as a new template. This way you can remove objects created by noise or complete interrupted contour lines.

In some cases it is necessary to create a model and use it as a template image. Please see the following example to find out how to proceed in these cases:

◆EXAMPLE

The template is the hole in a soldering eye. Due to poor image quality and variations in the image contrast, the template cannot be extracted by using a slice level. Even when you use the optimal setting for parameter "Model Contrast", the calculated contour model does not yield satisfactory results.

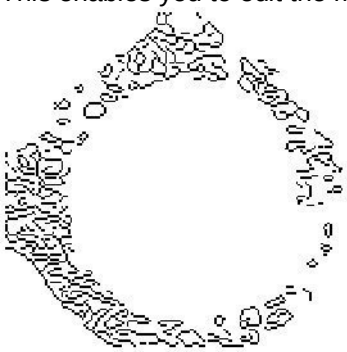




◆Procedure

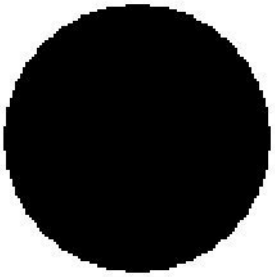
1. **Export model by choosing** Camera → Save as BMP...

   This enables you to edit the model with any graphics program.



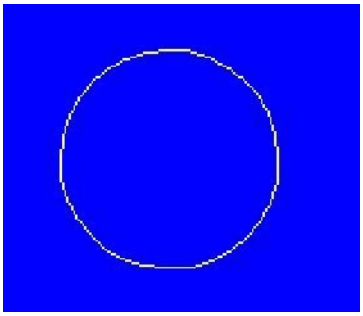
   In this case the model corresponds to the hole. An optimum model would be a black hole with the correct radius.

2. **Create a filled circle with a as close to the representation of the hole in the exported image as possible**



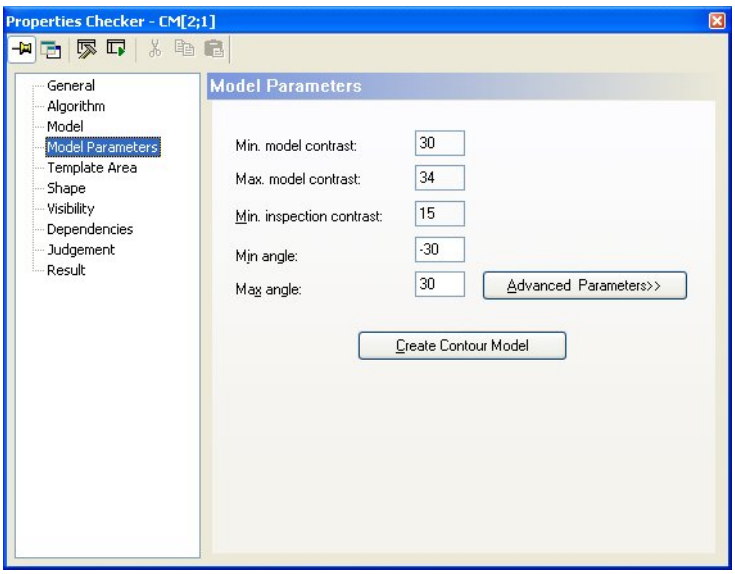
Every edge needs to be represented in the model. When the circle is not filled there are two edges and the model would not fit the requirements.

3. **Save the modified model as a bitmap file.**
4. **Load the image into Vision P400 by choosing** Camera → Load BMP...
5. **Adjust the checker shape to fit the new template**
6. **Select [Refresh] on the property page "Model" to update the template and to calculate a new contour model**



12.12.5 Model Parameters

Use this property page to create the contour model and to enter the expected angle range of the objects you wish to find.



"Model Parameters" page of a contour matching checker

Minimal / Maximal Model Contrast (display only)

The model is created from the pixel which have been extracted from the gray-value image with the help of a hysteresis threshold. The contrast values are only displayed here. To set the values, use property page "Model" (see page 419). You will also find an explanation of the pixel-extraction procedure there.

Minimal Inspection Contrast (display only)

The value determines the minimal contrast for a pixel in order to be compared with the template during the object search. The threshold value is only displayed here. To set the value, use property page "Model" (see page 419).

Min Angle/Max Angle

Indicates the angle range in which the object may be rotated compared to the template position. Please note that the bigger the angle range, the longer the processing speed of the checker.

Create Contour Model

With the button [Create Contour Model] you calculate the contour model on the basis of the parameter values entered.

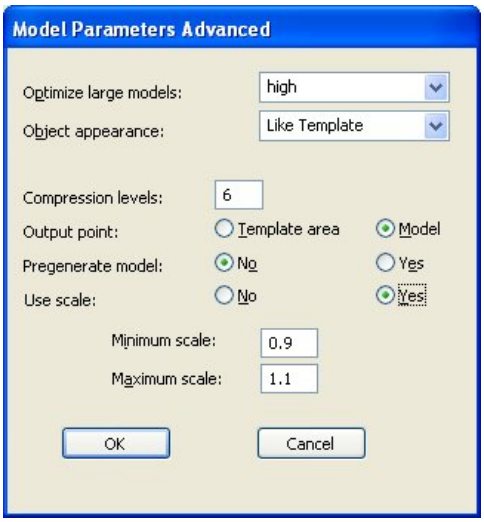
Model Parameters Advanced

This button opens a new dialog box where you can fine-tune the settings if one of the following conditions is true:

- You are using a big model and wish to optimize it.

- You wish to find objects of differing appearance,
- you wish to use scaling to find objects of different sizes, or
- you wish to set the gravity center of the template area as the output point.

12.12.5.1 Model Parameters Advanced



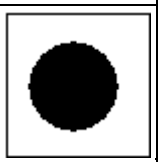
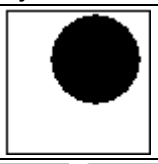
Advanced model parameters for contour matching checker

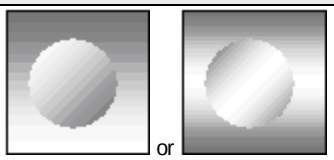
Optimize Large Models

Use this parameter to optimize large models with very many contour points. The bigger the number of contour points used, the more time the search algorithm needs to find an object. When you select an optimization method, Vision P400 reduces the number of contour points used to detect the object. This speeds up the search when you use large models. When you use this parameter, it may be necessary to modify the setting of parameter "Search Method" to make the search less thorough.

Object Appearance

This parameter defines which objects will be found against which image background.

Setting	Function	Example	
		Pattern	Matching objects
Like template	Finds an object looking like the template.		
Like template or inverted	When you have used a black object with a white background as the template, this setting enables Vision P400 to find objects also inverted objects, i.e. white objects with a black background. This slows down the checker's processing speed.		

		Example	
Dynamic	This setting enables Vision P400 to find objects with changing brightness as compared to the background (e.g. shiny metal parts like screw heads). This means objects may be brighter than the background in parts where the light is reflected and darker in parts where there is no light.		 or

Output Point

Use this parameter to determine the point to be output. You can choose between "Template Area"" and "Model".

When you select "Template Area", the output point is the center point of the template area you have set. When you select "Model", the output point is the center of gravity of the model.

Pregenerate Model

The pregeneration of the model normally leads to slightly lower run times because the model does not need to be transformed at run time. However, the memory requirements and the time required to create the model are significantly higher. This means loading an application containing a contour matching checker takes longer.

◆NOTE

Please note that the pregenerated model may yield slightly higher correlation values than a model transformed at run time. This is because transforming the model at run time necessarily leads to different internal data for the transformed models than pregenerating the transformed models.

Use Scale

Use this parameter to define whether you wish to find objects of variable size. This parameter heavily influences the memory need for processing and the checker speed.

Minimum Scale/Maximum Scale

Use these parameters to define the smallest and biggest size of the object you wish to find. The size is expressed in percent as compared to the template. When you enter 0.5 in "Minimum Scale" and 2.0 in "Maximum Scale", Vision P400 detects object from half the size to double the size of the template object.

◆NOTE

Do not forget to enter the decimal point. If you want to make entering decimals easier, you can reconfigure (see page 145) your keyboard by clicking the [Replace comma with decimal point on numeric keypad] button.

12.12.6 How to Optimize the Settings

To achieve optimum object recognition make sure to use a representative template image. The template image should reflect typical object features like position and rotation, overlapping and brightness. Carry out two steps to optimize the settings.

1. Stable detection of all objects
2. Optimized speed

Stable detection of objects

◆Procedure

1. **For teaching, use a template of sufficient size**

   The bigger the contour model, the more accurate Vision P400 calculates the position, the scale, and the angle.

2. **Make sure that the objects you wish to detect are all fully within the image**

   Objects "cut off" at the edge of the imaging range cannot be detected.

3. **Choose a rougher rather than a more thorough setting for the parameter "Search Method"**

   When the search method is too "thorough", it is possible that Vision P400 will not detect even perfectly visible objects. The more thorough you set "Search Method", the more thoroughly Vision P400 searches for objects. When you move the slider to the far right position, Vision P400 always detects all objects. However, this increases the processing time. Try to find a good compromise (see page 423) between the minimal inspection contrast and as thorough a search method as possible.

4. **If you wish to find objects which are partly hidden, decrease the value of parameter "Min Model Contrast"**

5. **If the contrast between object and background is low, decrease the value of parameter "Min. Inspection Contrast"**

   However, make sure to set the value higher than the noise.

6. **If the brightness of an object varies as compared with the image background or even varies within the object itself, change the parameter "Object Appearance" accordingly**

   If only a small part of the object is in front of a variable background, it may make more sense to only decrease the value of "Min Model Contrast".

7. **If you wish to speed up the processing and can tolerate minor errors of measurement, increase the value for parameter "Last Compression Level"**

   Find the optimum combination (see page 416) of the parameters "Accuracy" und "Last Compression Level" to ensure maximum processing speed.

8. **If two or more objects may overlap and you need to detect them nevertheless, increase the value for parameter "Maximal Overlap"**

   Please refer to the detailed description of the parameter (see page 416).

9. **If Vision P400 detects and displays several objects even though there is only one, this may be due to the symmetry of the object in question. Decrease the value of the parameter "Maximal Overlap" and make the angle range smaller**

Optimized speed

◆Procedure

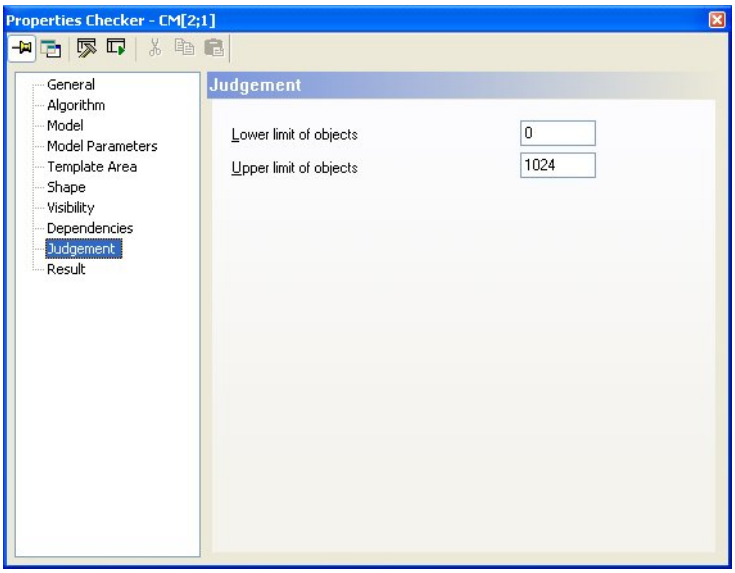
1. **Keep increasing the value of the parameter "Min. Model Contrast" as long as the objects are detected accurately**

   The higher you set this parameter, the faster Vision P400 performs the search.

2. **Choose the smallest setting possible for the angle range and the scale parameters "Minimum Scale" and "Maximum Scale"**
3. **Limit the search area as far as possible**

12.12.7 Judgement

The judgement criterion is the number of objects found. This must be within the limits of "Number of judged objects: Lower limit" and "Number of judged objects: Upper limit" (inclusive). You can enter a valid range limit from 0 to 128. The default setting is 0 and 128.

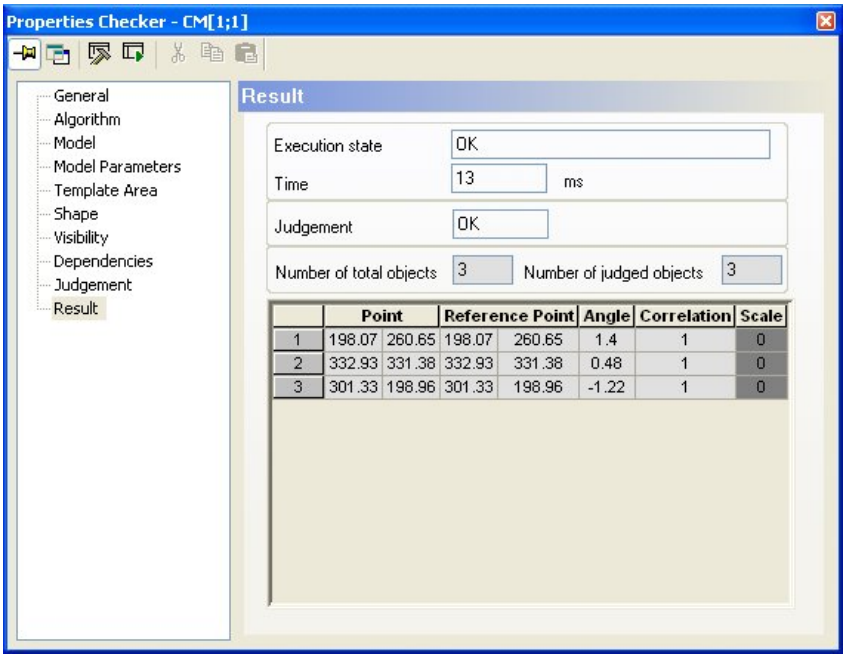


"Judgement" page of a contour matching checker

◆NOTE

For a more flexible evaluation of the number of objects please use the spreadsheet.

12.12.8 Result

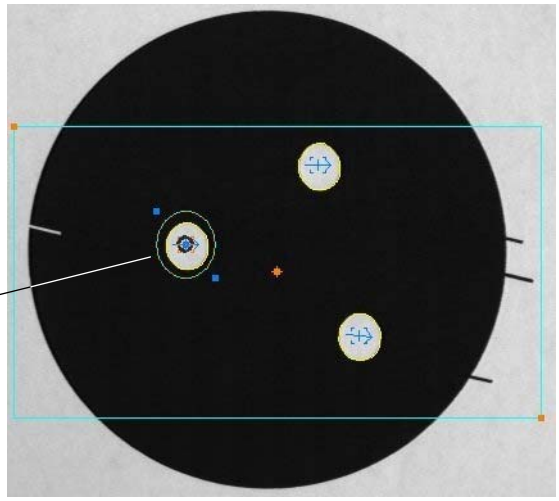


"Result" page of a contour matching checker

The result list displays the features calculated for each object detected. The objects are listed in the order specified in the parameter "Output Order". If the checker has not been working with scaling, the column for the scale factor is highlighted in gray.

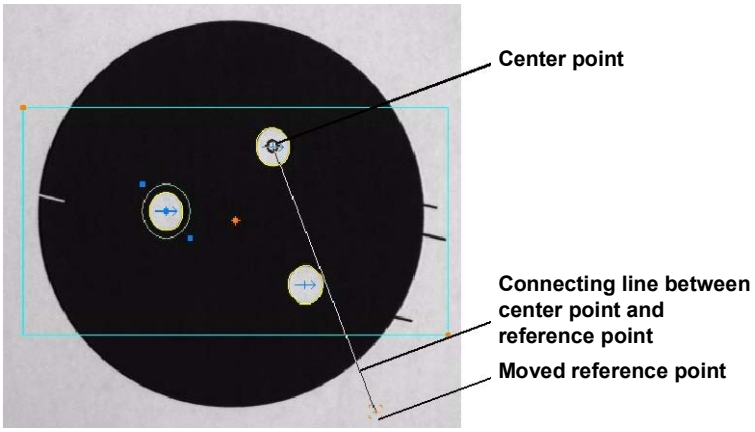
In addition, Vision P400 displays the "Number of Judged Object" to indicate for how many objects Vision P400 calculated the features.

When you click a value in the result list, the center point of the corresponding object is marked by a black circle.



Highlighting the objects detected by the contour matching checker

When you have moved the reference point (see page 414), Vision P400 draws a line connecting the reference and the center point.



Display of a reference point that has been moved from the default position

12.13 OCR Checker

Use the OCR (Optical Character Recognition) to read, identify and check letters, characters, or symbols by teaching.

Inspection task example for OCR checker

12.13.1 Terminology

Label Name for an object (a letter, cipher, or symbol). A label may consist of up to 255 letters. Blanks are not allowed.

Pattern A pattern is one representation of an object, e.g. a bold-printed capital "**A**" and a small "**a**" in italics are both patterns of the letter with the label A. The pattern is a gray-value image of the object.

Set of patterns All patterns of an object combined in a group or set. This group is identified by the label. From the patterns Vision P400 obtains the features which help to identify and differentiate between objects.

Font A kind of image database containing all pattern sets and their labels. For example, there are three different letters, which have been given the labels A, B, and C. Each letter has a set of 5 patterns. All letters and their patterns belong to font “Font 1”. A font may also contain symbols like company logos or other characters.

Classifier Set of data containing the features which help to differentiate between objects. The classifier’s features are calculated on the basis of a font and the user’s parameter settings. A classifier contains features from object patterns belonging to the same font. However, this does not mean that it contains features for **all** objects belonging to the font.

12.13.2 Distinguishing between Font and Classifier

In order to perform OCR, you need data describing the letters, ciphers, and symbols you wish to inspect. Vision P400 has to “learn” the data in order to be able to identify and judge the characters under the camera.

You “train” Vision P400 to read by creating a **font**. Working like a database for images, the font stores patterns of letters, ciphers, symbols, etc. together with the label you have assigned for each character.

The font files have the extension *.NFT and are stored in the sub-folder “fonts” of the installation folder.

In order to be able to compare the images stored in the font database, Vision P400 needs a **classifier**. The classifier contains feature information which has been extracted from the patterns saved. These features help Vision P400 to differentiate the objects during inspection (see page 441).

Vision P400 assigns names to classifiers automatically. The classifier files have the extension *.fnt and are stored in the subfolder "\fonts" of the installation folder.

Once Vision P400 has calculated a classifier on the basis of a font, you can decide whether you wish to use the fonts and its options or only the classifier for your OCR checker.

When you set the option "OCR Check Mode" on the "Algorithm" page to "Extended", a file is created in the "\fonts" folder with additional OCR information. The file name is the font name, the file extension is *.ocv.

◆**EXAMPLE**

If all OCR checkers work with the same font with the same parameter settings, it makes sense to use one OCR checker for pattern training and calculating the classifiers. All other checkers then use the calculated classifier.

Using the font means that the options on the following tabs are available: "Parameters" (see page 440) and "Customize" (see page 445). Using the classifier means that the options on these pages are not available.

◆**NOTE**

The distinction between font and classifier is very important. The font is the basis, the classifier is derived from the font’s data. There can be more than one classifier per font. You need either a font or a classifier to execute an OCR checker.

12.13.3 How to Pass on Applications with OCR Checkers

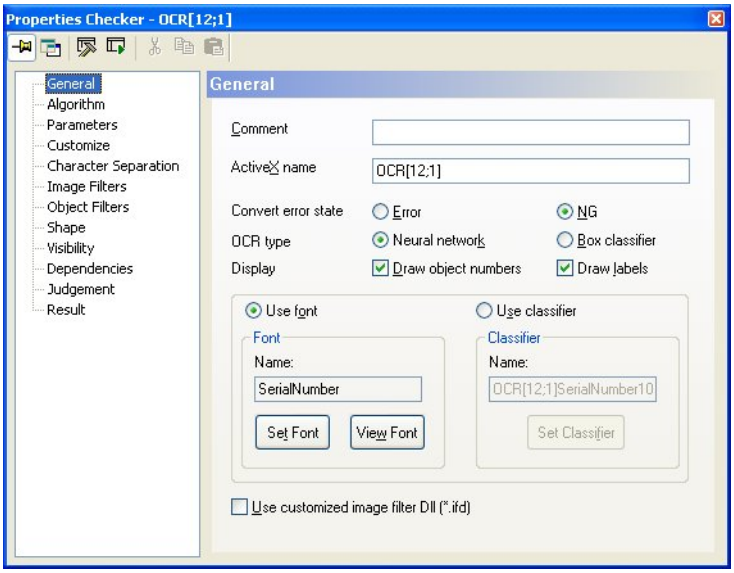
Font and classifier files contain information which is not saved in the application file *.nav. When you pass on application files to another person or wish to use an application on a different PC Imagechecker, you need to copy the font and classifier files as well.

An OLE client (see page 185) will help you to find out from the application file which font and classifier files you need. Use the function **getDependentFileNames** from the tool **VisionP400HelpersControl.ocx** to extract the following information:

- Name of the classifier file: Clf_Name.fnt
- Name of the font file: FontName.nft
- Length of the information in bytes
- Identifier string "Dep_Vision_P400"

12.13.4 General

The “General” page contains some additional parameters as compared to the other checkers.



“General” page of an OCR checker

ActiveX Name

You need the ActiveX name of a checker if you wish to read or modify the checker's parameters via an ActiveX client. The ActiveX client can only access the checker via its ActiveX name. The ActiveX name is defined by Vision P400 when you create the checker. You can modify the name when you have set the checker.

Convert Error State

In some instances, it makes sense to treat an error as an NG judgement so that an application is executed completely. If Vision P400 finds no object for the optical character verification, it generates an error and stops the application. If you know that the optical character recognition will not always work because you are inspecting different objects, but always wish to execute the application completely, set this parameter to "NG".

Use Customized Image Filter Dll (*.ifd)

Depending on the checker type Vision P400 offers a range of gray-value and/or binary image filters. The filters are designed to yield an optimum result for most applications. If the standard filters are not sufficient for an optimum result, enter a specially designed Dll here (the file extension "ifd" stands for "Image Filter Dll"). If you enter a name here, Vision P400 does not use the standard filters, but uses the filters from the Dll.

Please contact the technical support if you have an application that cannot be handled satisfactorily by the standard filters in Vision P400. The support staff will advise you on how the image-processing algorithms can be modified and will supply you with an extended library of filters specially designed for your application.

OCR Type

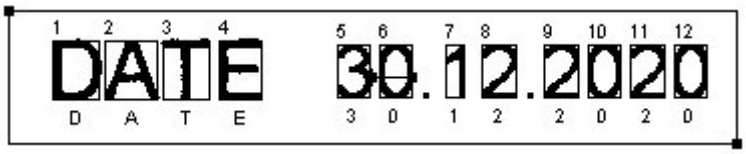
There are two different methods (see page 441) to classify the detected characters: a box classifier and a neural network. In general we recommend to prefer the neural network because the results tend to be more stable. We continue to support the box classifier for reasons of software consistency.

Draw Object Numbers

Activate this option if you wish to see the number of objects found (letters, symbols, etc.) on the screen. We recommend to activate this option if you wish to use the "Customize" (see page 445) page to group objects.

Draw Labels

Activate this option if you want Vision P400 to display the labels of the object the system has recognized on the screen.



display of object numbers and labels with the OCR checker

12.13.4.1 Use Font

Select an existing font or create a new font to perform optical recognition.

Set Font

Click [Set Font] to open the selection dialog box for font files.

◆NOTE

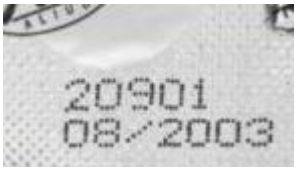
Before you use the font (see page 246), it is advisable to optimize the file.

Show

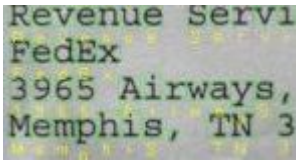
Click [View Font] to open the "Font Viewer" (see page 246) dialog. Here you can view and edit existing fonts.

12.13.4.2 Use Classifier

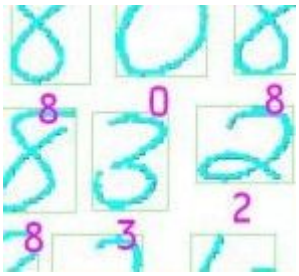
Activate this option (see page 440) if you wish to work with a classifier instead of a font. Vision P400 provides predefined fonts for the classifiers.



Dot Print



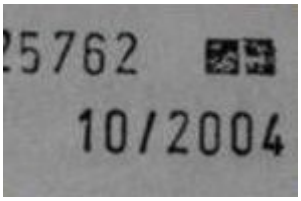
Document



Handwritten digits

Industrial

MICR, OCRA, OCRB



Pharma

◆NOTES

- **This option is not available when you have set the option "OCR Check Mode" (see page 434) to "Extended".**
- **Adding new patterns is only possible when you have selected Use Font.**
- **Selecting a classifier means that you cannot modify the settings on the pages "Parameters" and "Customize" because these parameters are determined by the font.**

12.13.5 Algorithm

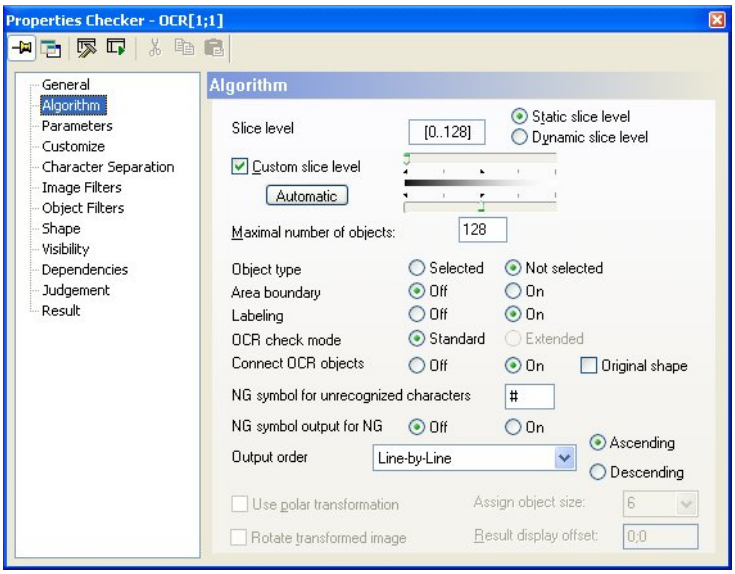
You may use either static or dynamic thresholding (see page 283) for binarisation.

With static thresholding, all the gray-scale image pixels whose values fall within the range of the binarisation thresholds are marked. You can set the static threshold value either with the camera slice level or with the customized slice level. Get a suggestion for the customized slice level by clicking on [Automatic] (see page 289).

With dynamic thresholding, the mean of the gray values in the environment of the current pixel is calculated. The environment is defined by the filter size. The dynamic threshold value refers to the difference between the gray value of the current pixel and the mean value. If a difference falls within the specified range, the pixel is marked in the gray-value image.

You may set the slice levels with the two sliders (see page 289). The first slider regulates the lower limit and the second slider regulates the upper limit. In the output image, all pixels whose

values fall within the range of the thresholding (inclusive) are marked with the color specified for that slice level under **Application → Colors...**. These pixels will be considered "selected".



"Algorithm" page of an OCR checker

Maximal number of objects

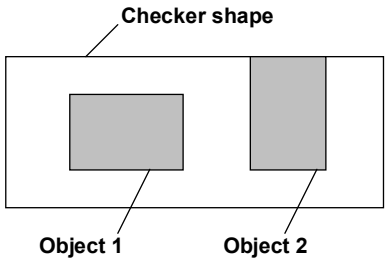
Use this parameter to limit the number of objects to be processed. You may process a maximum of 32767 objects. When there are more objects than the maximal number entered, Vision P400 only calculates and displays the features of the set number of objects in the order specified under "Output Order" on the "Algorithm" page and ignores the rest.

Object type

Here you determine which pixels will define an object. If you choose "Selected", the objects will be generated from the pixels whose gray value falls within the specified binarisation range. If you choose "Not Selected", the objects will be generated from the pixels of which the gray value falls outside the specified range.

Area boundary

Use this parameter to define whether or not an object to be processed will be allowed to touch the shape. If "Area Boundary" is set to OFF, an object to be processed will not be permitted to touch the shape. If the parameter is set to "ON", the object to be processed will be permitted to touch the shape.



Parameter "Area Boundary"

With "Area Boundary" set to "ON", object 1 and object 2 would be processed. With "Area Boundary" "OFF", only object 1 would be processed since object 2 touches the shape.

Labeling

If "Labeling" is "OFF", all pixels within the selected range will be gathered into an object. If, however, "Labeling" is set to "ON", only pixels linked to one another within the 8-fold neighboring relationship (see page 356) will be gathered into one object.

OCR check mode

You can choose between "Standard" and "Extended" check mode. The "Extended" check mode uses an additional algorithm to compare the gray-value projections of the detected object with a reference pattern. Vision P400 determines the grade of similarity between the two and calculates a result named "Quality", which helps to evaluate the printing quality of a label. The options for "Extended" check mode are described elsewhere (see page 444).

Connect OCR objects

This parameter is used for letters consisting of two or more parts like "ö", "i", and "j". By default, this parameter is activated in order to stop Vision P400 from treating each part as an individual object. Instead, Vision P400 treats objects which are very close to and positioned on top of each other as one single OCR object.

◆NOTE

Deactivate this parameter if you need to check print in a direction other than the usual reading direction, i.e. from top to bottom.

Original shape

If you activate this parameter, the parameters "Labeling" and "Connect OCR Objects" will no longer be available. This parameter is designed for dot code fonts. It makes Vision P400 use the originally detected characters for teaching the font and not the characters possibly modified by filters you have set.

◆EXAMPLE

Segmentation of a string of dot code characters

Original shape

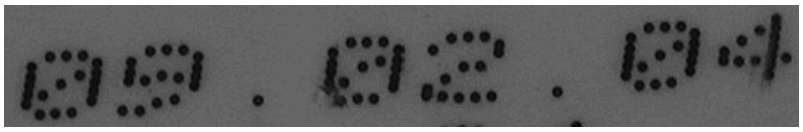
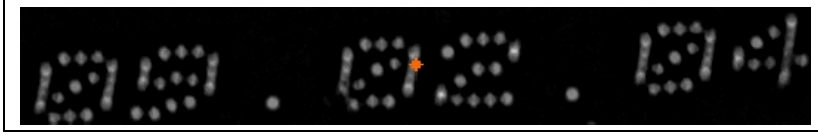


Image after using dot print enhancement

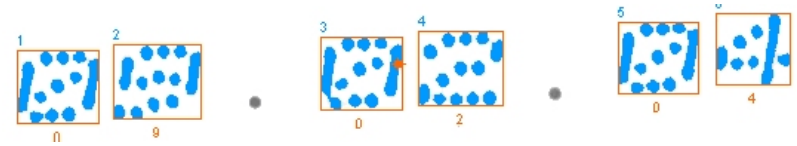


Inverted image

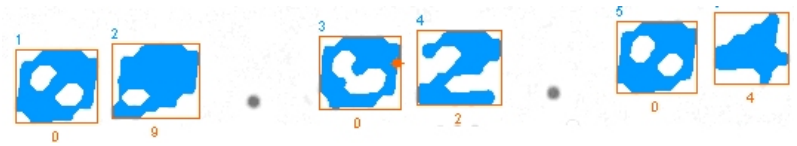
After applying the slice levels every dot is an object and would be detected as an individual object

After executing the binary filter "Combine Dot Prints"

After activating the parameter "Original Shape"



Without using the parameter "Original Shape"



NG symbol for unrecognized characters

Enter the character here that is output as the result of an object when the object does not have the expected correlation value. If "NG symbol output for NG" is set to "On", this character is also output on the result page under "String" if the judgement of the checker is "NG".

NG symbol output for NG

If this parameter is set to "On", on the result page under "String" the characteristic specified under "NG symbol for unrecognized characters" is output if the judgement of the checker is "NG", because too few letters were found for example.

Output order

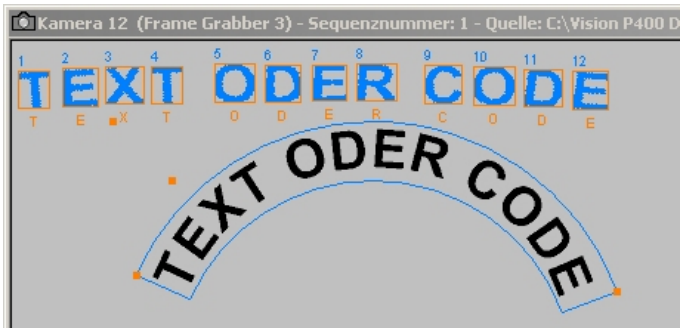
This parameter determines the sequence order in which the checker results are displayed. The default output order is Character Mode and assumes that objects should be read like European writing, i.e. from left to right and from top to bottom.

You may also choose to display results sorted by size or by coordinates: If you need to check print in a vertical direction, we recommend setting this parameter to "Ascending/Descending Y-Coordinate".

Use polar transformation

When you have created a code reader with a doughnut shape, use this option to "straighten out"

the selected ring segment. This will make the code appear to be written in a "straight" line. The straightened-out checker result will be displayed in the image area of Vision P400. Set the display position for the checker result with the parameter "Result Display Offset".



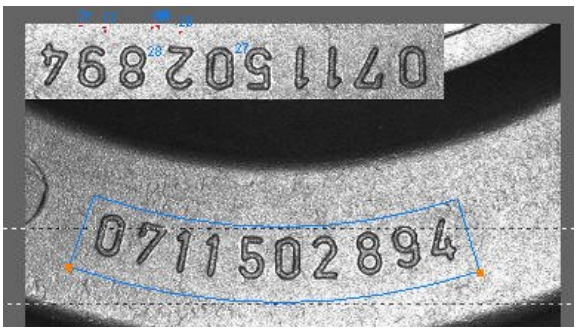
Effect of the parameter "Use Polar Transformation"

Assign object size

This parameter allows you to change the size of objects that should be output line by line. For example, if characters touch the line of characters above or below them, it is necessary to make the smaller. The larger the factor, the smaller the character size. In most cases this will be sufficient to prevent overlapping of lines. This parameter only effects the sorting of objects and is only used if you have select "Line-by-Line Adv" as the output order.

Rotate transformed image

This parameter permits the image to be rotated 180° following transformation. This can be of interest, for example, when the text - as here - is readable not from the center of the circle but from the outside of the circle.



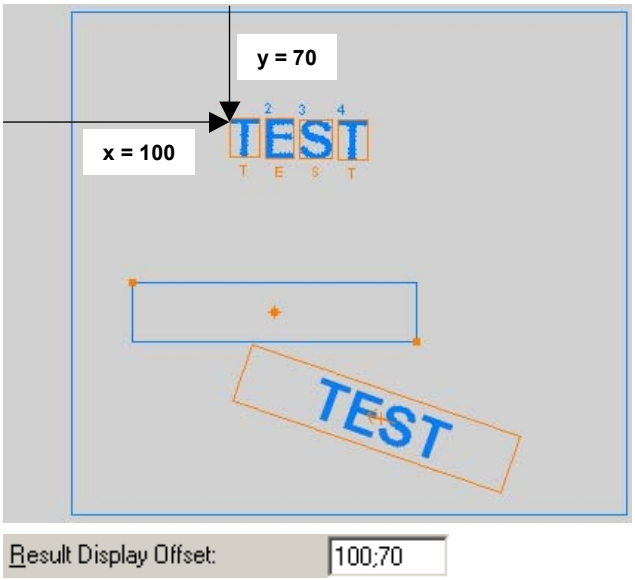
"Rotate transformed image" checkbox not activated

If the "Rotate transformed image" checkbox is activated

Result display offset

This parameter is only available if you have activated the option "Use Polar Transformation" or if the checker depends on a position adjustment. Vision P400 displays at this position images which have been transformed or rotated back to their original position. The position coordinates refer to the top left corner of the displayed checker result.

◆**EXAMPLE**



12.13.6 Image Filters

All image filters (see page 290) are available.

◆**NOTE**

The filter operators are used for the segmentation of characters only! They do not influence the object and pattern features with which Vision P400 calculates the classifier.

12.13.7 Judgement

The "Judgement" (see page 308) page works exactly like with the other checkers.

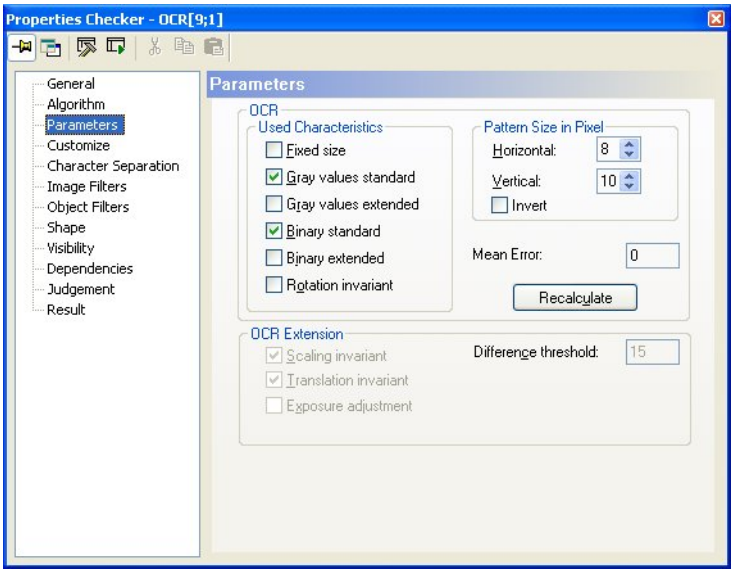
12.13.8 Shape

You may assign one of the following shapes to an OCR checker:

- Rectangle
- Ellipse/Circle
- Polygon
- Doughnut
- Object Shape

12.13.9 Parameter

Use this page to determine the features that the classifier should use to differentiate the different objects (letters, ciphers, symbols, etc.). When you have selected "Extended" as the "OCR Check Mode" on the "Algorithm" page, the options for the OCR extension at the bottom of the property page become available.



"Parameters" page of an OCR checker

Bear in mind that the more features you select, the better Vision P400 will be able to distinguish between different objects. However, selecting more features also means that it takes longer to calculate the classifier and to execute the checker. Rule of thumb: The higher the number of objects, the more similar the objects will be. Therefore, you need more features to ensure a reliable recognition.

The features available for calculation of the classifier can be sorted into groups. They are described in the following sections.

12.13.9.1 How Does the Classifier Work?

The Vision P400 classifier is a so-called box classifier. For each pattern Vision P400 calculates the selected features (see page 442). The characteristics used are as follows:

- Ratio of the character's height and width
- Width
- Height
- Relative number of pixels in the foreground
- Form feature anisometry
- Form feature compactness
- Scaled 2nd geometric moment of the region
- Scaled 3rd geometric moment of the region
- Scaled central geometric moment of the region
- Angle of the principle axis of inertia
- Number of connected components
- Number of holes
- Gray value of each individual pixel found in the character
- Horizontal / vertical projection of the gray values

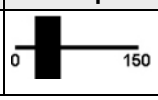
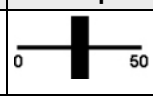
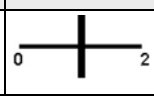
Vision P400 determines the characteristics of all patterns and obtains a range or box of characteristic values for each label. It then averages the values to obtain the set of features which will help to distinguish one label from another. The correlation factor is the average of all characteristics used for the classifier calculation.

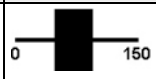
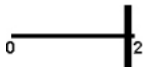
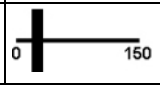
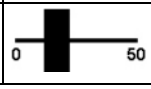
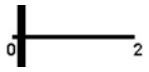
◆EXAMPLE

In order to differentiate between A, B, and C, you first teach Vision P400 by adding different patterns of the letter to the font.

Label	Pattern
A	A A A A A A
B	B B B B B B B
C	C C C C

Vision P400 calculates the box classifier, in this case for the features "Area Size", "Width", and "Number of Holes".

Pattern	Box: Area size No. of pixels	Box: Width No. of pixels	Box: Holes Number of holes
All A			

Pattern	Box: Area size No. of pixels	Box: Width No. of pixels	Box: Holes Number of holes
All B			
All C			

The next step is to calculate an average from the box and use the averaged characteristics to differentiate the objects, e.g. for letter B the average characteristics would be: area size = 75 pixels, width = 10 pixels, number of holes = 2.

12.13.9.2 Used Characteristics for Standard OCR

Fixed Size

This feature uses the pattern dimensions in X and Y directions. Select this feature if there is no difference in the dimensions of the trained patterns and the objects to be inspected.

Gray Value Standard/Extended

These two features use all available information on the pattern's gray values (gray values, histogram, gray-value projections in vertical and horizontal directions, etc.). As a rule, gray-value features are a safe means of differentiation. However, it takes longer to calculate them. The trained patterns are made uniform in size with the help of "Pattern Size in Pixel" (see page 443), i.e. Vision P400 keeps the height/width ratio to avoid distortions. The calculation time depends on the setting of "Pattern Size in Pixel".

Binary Standard/Extended

These two features use all available information on the pattern's binary properties (number of holes, perimeter, number of pixels, etc.). Select this feature if you have a limited number of characters to inspect or if the patterns have some unmistakable characteristics. In such a case the binary features are usually enough and should be given preference before the gray-value features to save calculation time.

Rotation Invariant

This feature uses all pattern properties that do not change if the object is rotated (number of pixels, etc.).

◆**NOTE**

Use this feature by itself. You cannot combine it with the other features.

12.13.9.3 Pattern Size in Pixel for Standard OCR

Use this parameter together with the gray-value features (standard / extended) to determine the pattern size. Remember that the bigger the size, the longer it takes Vision P400 to calculate the classifier.

◆NOTE

Set this parameter in such a way that it reflects the height/width ratio of the object(s) to be inspected. The current size of an object is displayed in the result list (see the values in the "Height" and "Width" columns).

If you read characters in the vertical instead of horizontal direction, activate the check box "Invert" to adapt the pattern size to the reading direction. Vision P400 uses the size in X-direction for the Y-direction and vice versa.

12.13.9.4 Average Confidence for Standard OCR

This field is only displayed if you select the option "Box Classifier" (see page 432) on the "General" page. The field displays a factor indicating the reliability of the character-recognition process so far. After recalculating the box classifier, Vision P400 uses the calculated features to reclassify all patterns which have been taught so far. In doing so, the system calculates for each object a correlation factor indicating how reliably this object is recognized during inspection. The factor displayed here is the average of all correlation factors obtained during the pattern reclassification.

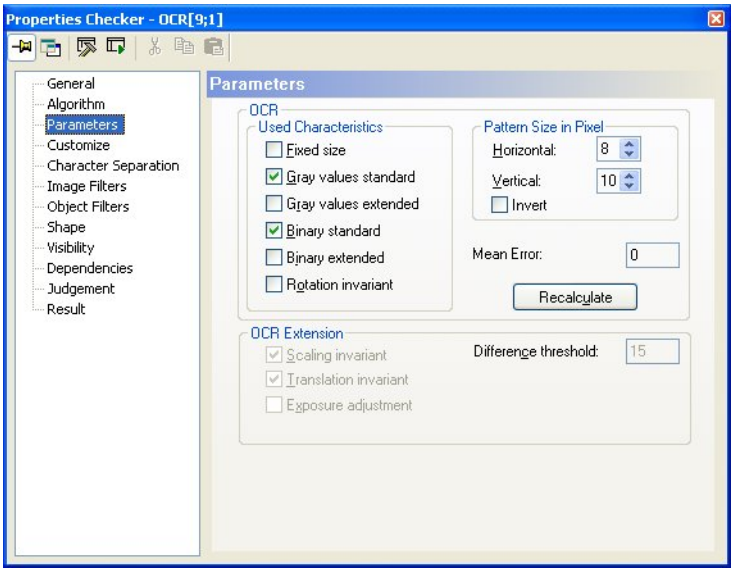
◆NOTE

Like the "Correlation" factor on the "Result" page, this factor depends on the number of objects to be distinguished. The smaller the number, the higher the "Average Confidence" and "Correlation". If more objects need to be distinguished, the values decrease. However, Vision P400 is still able to distinguish reliably between different objects. The factors only give an indication about the quality of the recognition process.

12.13.9.5 Mean Error

If you have selected the option "Neural Network" (see page 432) on the "General" page for classification, you will find here not the average confidence, but the mean error. This is the error that occurs when you apply the classifier to the letters taught during the training.

As opposed to the box classifier, the mean error should be as low as possible to ensure a successful training.



Displaying the mean error of the OCR checker

12.13.9.6 OCR Extension Options

The options in this part of the screen are only available if you have set the option "OCR Check Mode" to "Extended" on the "Algorithm" page.

The extended mode uses a reference pattern in order to classify an object detected in the checker shape as "good" or "bad".

◆NOTE

The reference pattern is always the first pattern of each label in the font file.

The comparison between the reference pattern and the object in the OCR checker shape is based on gray-value projections. For every trained pattern as well as the detected object, Vision P400 calculates the horizontal and vertical gray-value projections by adding the gray values in the rows and columns of the pattern. The gray-value projection of the reference is stored in the buffer and is compared with the projection of the detected objects. The similarity of the two projections is expressed in the "quality" value (from 0.00 = very low, to 1.00 = very high). This value is displayed in the "Quality" column on the "Result" (see page 449) property page.

Parameters for "Extended" check mode

Scaling Invariant/Translation Invariant

These two options refer to the geometry of the detected object and specify whether the size and/or position should be adapted automatically.

Exposure Adjustment

This option determines whether the gray values of the detected object should be modified according to changes in the lighting conditions.

Slice Level

This option specifies how large the difference between two gray values needs to be in order to be considered an error. If the difference exceeds the threshold, Vision P400 reduces the "Quality" value on the "Result" page. Therefore, the higher the threshold, the less sensitive Vision P400 reacts to small differences in gray values.

12.13.10 Customize

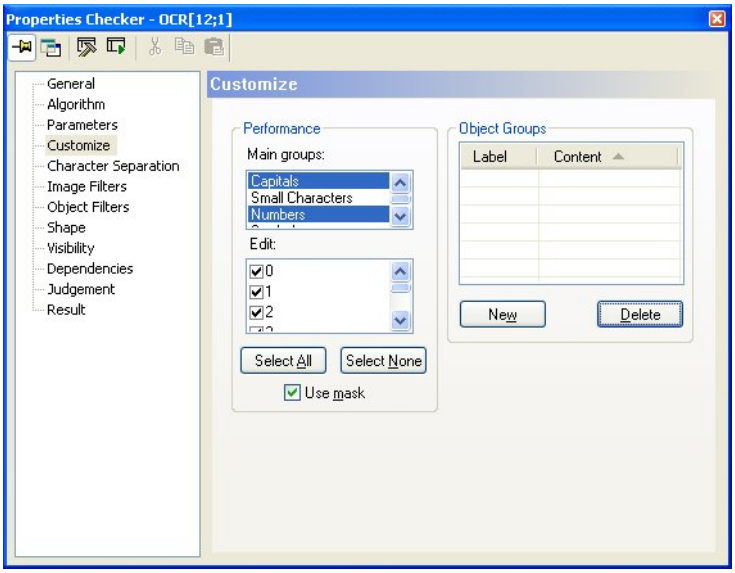
Use the “Customize” page to optimize the classifier calculation.

Main Groups

The more objects you have to distinguish, the longer the inspection time will be. If you are using a font with many patterns, say the alphabet, but you only need to inspect the word "date", that is the letters “D”, “A”, “T”, and “E”, there is a way to reduce the inspection time. Activate the option "Use Mask" to use this parameter group.

In the Main Group box you can limit the inspection to capitals, numbers, small characters, symbols, or user labels or any combination of these five. In the "Edit" box you see all patterns belonging to the selected group (e.g. the letters “A”, “D”, “I”, etc. are capitals, see figure below). Reduce the inspection time further by selecting only the items that need to be inspected.

There are two buttons available to speed up the selection process. By clicking [Select All], you select all items belonging to the main group; with [Select None], you deselect all.



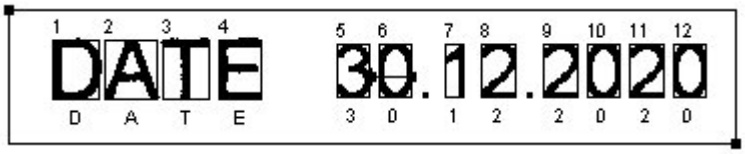
Using main groups to customize an OCR checker

Object Groups

Use this option to combine several recognized objects into one "result" (see page 449). When inspecting characters, each character appears as a recognized object in the result list. If you are inspecting an 8-digit date, it makes more sense to inspect the data as a string of digits rather than check each digit individually. It also means you can reduce data input in the spreadsheet.

◆EXAMPLE

The result list displays the recognized objects numbers 1 to 13 on the spreadsheet as individual results with a spreadsheet row for each result. The procedure below explains how you combine the objects into a group and have only one result in the spreadsheet.



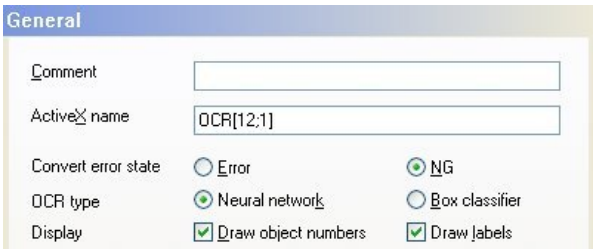
◆Procedure

1. **Double click on the OCR checker to open the property page**
2. **Click on the register tab “Customize”**
3. **Click [New] to create an object group**

   A row with the column headings “Label” and “Content” appears.
4. **Click into the white field below "Label"**
5. **Type in “DATE”**

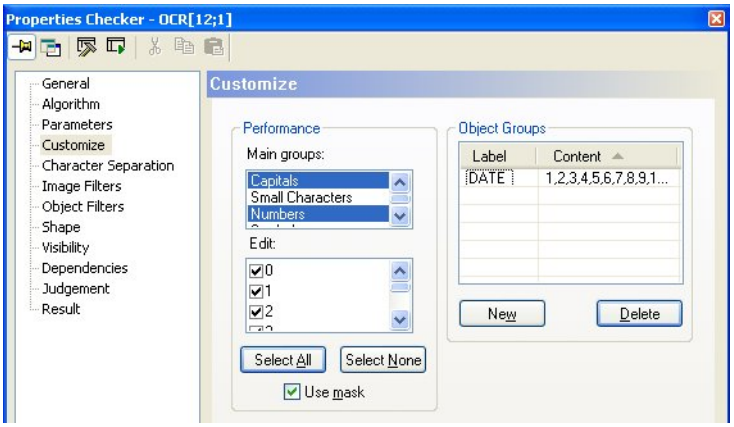
6. **Click into the white field below “Content”**
7. **Type in the object numbers separated by commas**

   If you cannot see any object numbers in the camera window, check whether the option "Draw Object Numbers" is activated on the "Algorithm" page of the OCR checker.



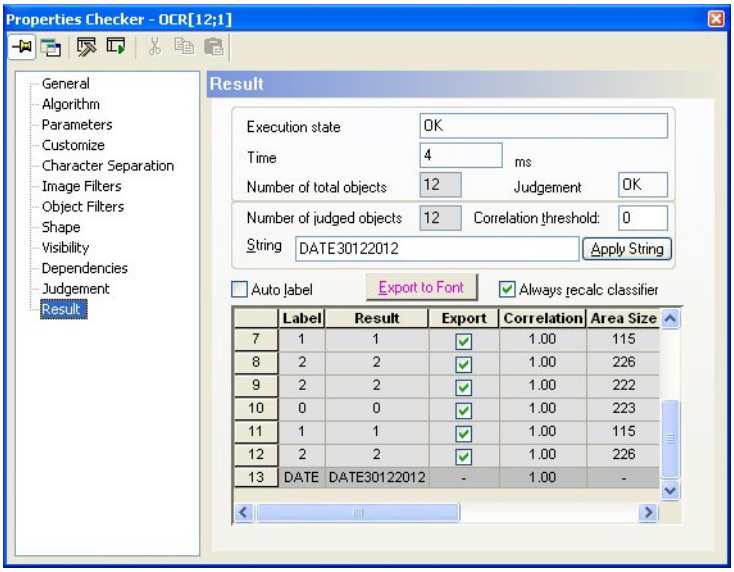
8. Click to apply your modifications

The “Customize” page should now look like this.



9. Click to execute the checker

At the bottom of the spreadsheet you find the object group “Date” as a new result. Use it for data transfer and further processing like all other spreadsheet data.



12.13.11 Character Separation

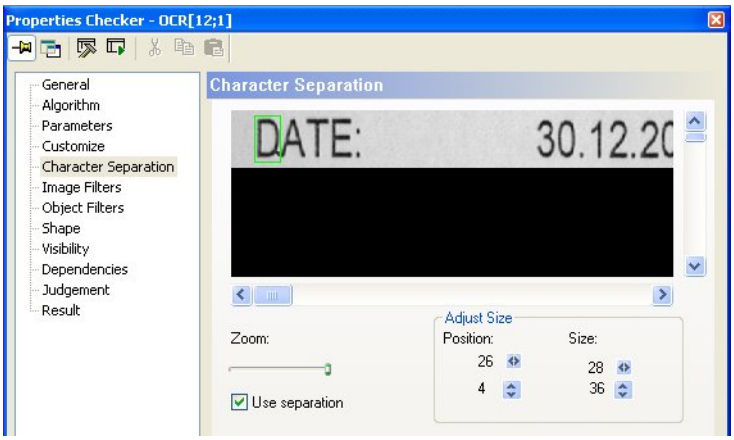
Use this page to separate characters which are or appear joined by accident. This is useful if you need to inspect print and there is a danger of Vision P400 mistaking two or more letters for a single character.

◆**NOTE**

This feature only works if the characters have the same size.

In the figure below the letters D and A are attached to each other. In order to separate them, activate Use Separation. Then use the "Adjust Size" options to determine the position and size of the separation box (the green rectangle surrounding the letter D).

The character-separation algorithm checks an area of +/- 2% around the separation box to find the thinnest part of the object. This is where Vision P400 separates the characters joined and treats them henceforth as two individual objects.



"Character Separation" page of an OCR checker

Use Separation

Click here to activate the character separation tool.

◆**NOTE**

If you are using character separation, an additional "Select separated objects" object filter (see page 301) is available as an additional filter.

Adjust Size

Click on the cursor keys to position and adjust the green separation box around the character you wish to separate from another character.

Zoom

Move the slider to zoom in and out of the image.

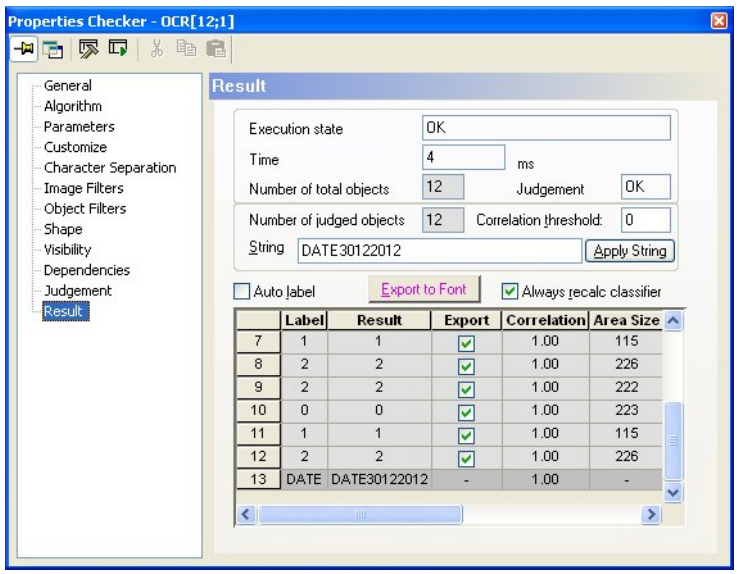
12.13.12 Result

The top half of the “Result” page for the OCR checker contains the same information on execution state, time, number of total and judged objects and judgements as for the other checkers. The bottom half contains the result list and some additional options. For best results with the OCR checker you need to train (see page 452) Vision P400.

The result list contains the following columns:

Column title	Contents
Label	Here you assign a label to the detected object. This is important for the training phase. When you have grouped the characters into a result by setting up an object group (see page 445), the label you assigned for the object group is shown here.
Result	Here Vision P400 displays the label of the object it has recognized. When you have set up an object group (see page 445), the result composed from all characters is shown here.
Export	Activate this option to export the result as a new pattern into the font.
Correlation	Factor indicating the reliability of the character recognition.
Quality	Quality of the detected object determined by the grade of similarity between the object and the reference pattern (from 0.00 = very low to 1.00 = very high).
Area Size	Number of pixels used in determining the label (useful for filter settings).
Surrounding rectangle	Coordinates of the rectangle surrounding the object.
Width	Width of the rectangle surrounding the object.
Height	Height of the rectangle surrounding the object.
Similar Class	Label with the next best correlation factor.

Vision P400 displays the results in the order selected under "Output Order". For OCR checkers the standard output order "Character Mode" means the order of detection from top left to bottom right. All objects that Vision P400 does not recognize receive the label “not_set”. Assign the correct label by clicking into the field and typing in the label. Alternatively, type all object names into the String field (see below).



“Result” page of an OCR checker in "Extended" check mode

Correlation Threshold

Here you can enter a value for the correlation threshold. An object needs to equal or exceed this value in order that Vision P400 automatically assigns the most similar label. If the result of the OCR checker is below the correlation threshold, the object is labeled "#" in the "Result" column and the "String" field.

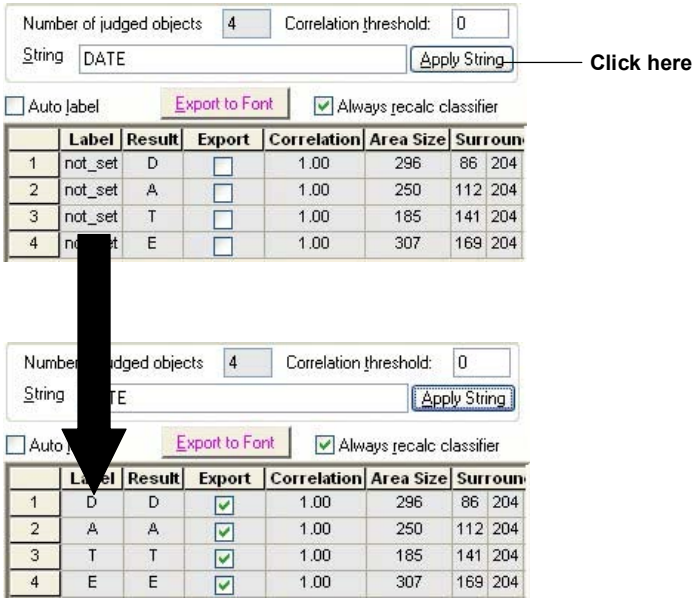
String

Additionally, you find all results in the field "String" combined together in one word. This string is also available for further processing in the spreadsheet: Click [Apply String] to enter the characters from the "String" field in the "Label" column of the result list.

If you enter more characters than there are objects detected by Vision P400, the system displays a warning message.

◆EXAMPLE

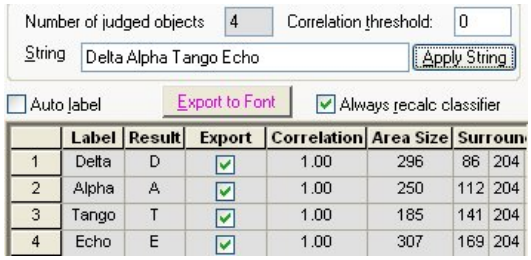
To assign the correct labels to the detected characters D, A, T, and E, enter DATE in the "String" field and click [Apply String]. The labels appear in the Labels column of the result list.



If you want to label the objects with names consisting of more than one character, use a blank to separate the labels. As a consequence, a blank cannot be used as part of a label name.

◆EXAMPLE

To assign the labels Delta, Alfa, Tango, Echo to the detected characters D, A, T, and E, enter the labels separated by blanks in the "String" field and click [Apply String]. The labels appear in the "Labels" column of the result list.



	Label	Result	Export	Correlation	Area Size	Surroun
1	Delta	D	☑	1.00	296	86 204
2	Alpha	A	☑	1.00	250	112 204
3	Tango	T	☑	1.00	185	141 204
4	Echo	E	☑	1.00	307	169 204

Auto Label

If you train Vision P400 with objects where the text or sequence of letters vary, activate this option to transfer the result automatically into the Label column. All you have to do is change the label for objects which have not been detected successfully and where Vision P400 assigned a wrong label.

If you have not activated the option "Auto Label", the entry in the "Label" column remains unchanged unless you edit it manually. This is useful if you are working with identical objects: As soon as there is a difference between the label and the result after executing the checker, Vision P400 marks the first row with such a difference by shading it red and scrolling it to the top of the result list.

Export to Font

Once a label has been entered (either manually or automatically with "Auto Label"), Vision P400 activates the check box "Export". This indicates that this result (pattern) and its label will be added to the font during the next export process. Results with an inactive Export box are not eligible for export to the font.

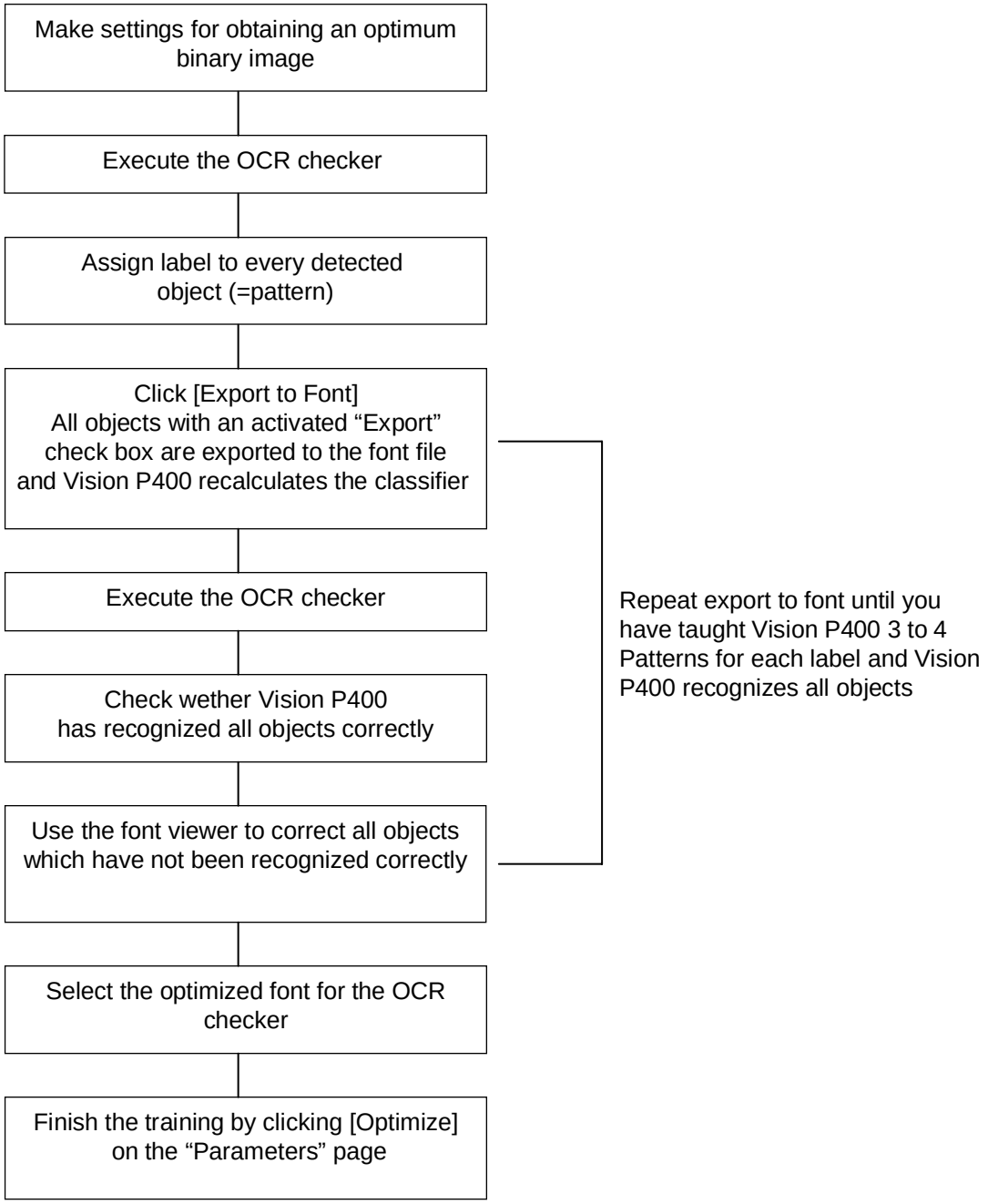
Click on the column header Export to activate/deactivate all patterns for export. Start the export of new patterns and labels to the font by clicking [Export to Font]. By default, Vision P400 exports all results with a cross in the "Export" box and recalculates the classifier with the parameters you have set on the “Parameters” page.

Always Recalc Classifier

The more patterns you teach (see page 452), the longer it takes to calculate the classifier. By deactivating the option "Always Recalc Classifier" you can prevent Vision P400 from recalculating the classifier for every new pattern and thus speed up the training phase. Please note that you must recalculate the classifier after the teach-in phase. To do so, click on [Optimize] under "Parameter" and see how the taught-in patterns have improved the character recognition rate.

12.13.13 Training Vision P400 in Optical Character Recognition

In order to train Vision P400 in optical character recognition, open the OCR checker's property page and follow the steps in the diagram below.



OCR training diagram

The first step is to make all settings to obtain an optimum binary image. This is necessary to separate the objects you wish to recognize from the image background. Once Vision P400

displays the objects you wish to recognize in the result list, you can start exporting the objects as patterns for the font file. This is where the actual training begins.

Execute the checker to obtain a first recognition result. If Vision P400 does not recognize an object correctly, use the font viewer (see page 246) to check the patterns you have stored so far. Delete wrong patterns and find out how many patterns have been stored for that label. Teach the font more patterns and repeat the process until the recognition result is reliable.

Speed up the training process by setting the parameters "Auto Label" and "Always Recalc Clf" appropriately (see page 449).

◆NOTES

- **To obtain reliable recognition results, make sure to teach Vision P400 2 to 3 patterns for each label (characters in thin and thick print, if possible). The higher the correlation factor, the more reliable the character recognition will be.**
- **Teaching patterns should have a size of at least 20 x 30 pixels!**

12.13.13.1 Training Tips

To optimize the optical character recognition training, please follow the recommendations below:

- Depending on the way the printed characters may vary, add two or three variations of the pattern (for example, in thick and in thin print).
- Then select the taught font in the Font Viewer (see page 246) and optimize it. Select the optimized font for the OCR checker (see page 431).
- Finally, select [Optimize] for the classifier.
- Use a rotation adjustment if the characters to be read may vary in position and orientation. We recommend to use the contour matching checker for rotation adjustment.

12.13.14 Result Handling in the Spreadsheet

Use drag & drop to transfer the results from the OCR checker to the spreadsheet for further processing. However, the result in the "Result" column differs from other checker results. This result is not a figure, but a string and therefore needs special handling in the spreadsheet.

That is why the spreadsheet contains a new column (see page 501), "String Reference", containing the actual string as a template for the checker result. Vision P400 compares the reference string with the checker result and forms an OK/NG judgement.

	Result Name	Value	String Reference	Judgement	NG	NG Max	Scans
Results	Start						
	OCR[9;1]result_13	DATE30122020	DATE30122020	OK	0	1	2
	End						
Formulas	Start						
	End						

OCR checker result in the spreadsheet

◆**NOTES**

- **As the OCR checker result is a string and not a figure, output to the parallel interface is not available.**
- **If you are checking figures with the OCR checker, you can use the result in formulas.**

12.14 Code Reader Checker

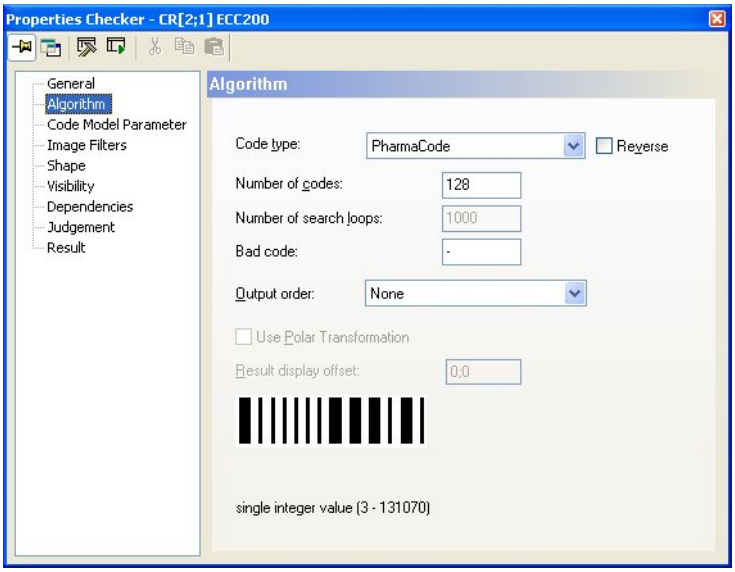
The code reader checker (code reader for short) searches the camera image for 1D or 2D codes and interprets them according to the selected type.

The code reader works reliably even if the light conditions vary and if the objects appear misadjusted, with differing orientations or are partially covered.

Create a code reader checker as follows:

1. Set the search area
2. Define the code type to search for
3. Optimize the parameters (see page 426) if the default settings do not yield a satisfactory result

12.14.1 Algorithm



"Algorithm" page of a code reader

Code type

Select the type of code you wish to read. Vision P400 can read the following code types:

1D Code (Bar Code)	2D Code
2/5 Industrial	Data Matrix ECC200
2/5 Interleaved	QR Code
Code 39	
Codabar	
Code 128	
Code 93	

1D Code (Bar Code)	2D Code
EAN 13	
EAN 13 Add-On 2	
EAN 13 Add-On 5	
EAN 8	
EAN 8 Add-On 2	
EAN 8 Add-On 5	
UPC-A	
UPC-A Add-On 2	
UPC-A Add-On 5	
UPC-E	
UPC-A Add-On 2	
UPC-A Add-On 5	
PharmaCode	
PDF417	

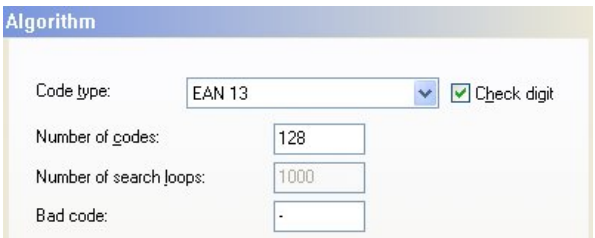
When you select a code type, an example is displayed at the bottom of the property page with information on how many and which items of data can be displayed with this code.

Reverse

This option is only available if you have selected "PharmaCode" under "Code Type". The option sets the correct reading direction, which cannot be determined automatically for this type of code. The parameter is hidden for all other types of code.

Check digit

This option is **not** available if you have selected "PharmaCode" under "Code Type". All 1D codes may contain a checksum, which can be used to verify the consistency of the code read. You need to set this parameter because Vision P400 cannot detect automatically whether the code to be read contains a checksum.



◆**NOTE**

This parameter is available only for 1D codes, but not for code of type "PharmaCode".

Number of codes

Enter the number of codes to be read.

Number of search loops

This parameter allows you to determine the sensitivity of the search algorithm. The smaller the value, the faster the search. When you enter a higher value, Vision P400 searches the image more thoroughly for possible codes. However, this increases the processing time.

◆NOTE

This parameter is only valid for 2D codes.

Output order

Use this parameter to determine the sequence order in which the detected codes will appear in the results list.

Use polar transformation

When you have created a code reader with a doughnut shape, use this option to "straighten out" the selected ring segment. This will make the code appear to be written in a "straight" line. The straightened-out checker result will be displayed in the image area of Vision P400 (see page 434).

Result display offset

This parameter is only available if you have activated the option "Use Polar Transformation". Here you define where Vision P400 should display the straightened-out checker result. The position coordinates refer to the top left corner of the displayed checker result.

◆NOTE

This parameter is available only for 1D codes.

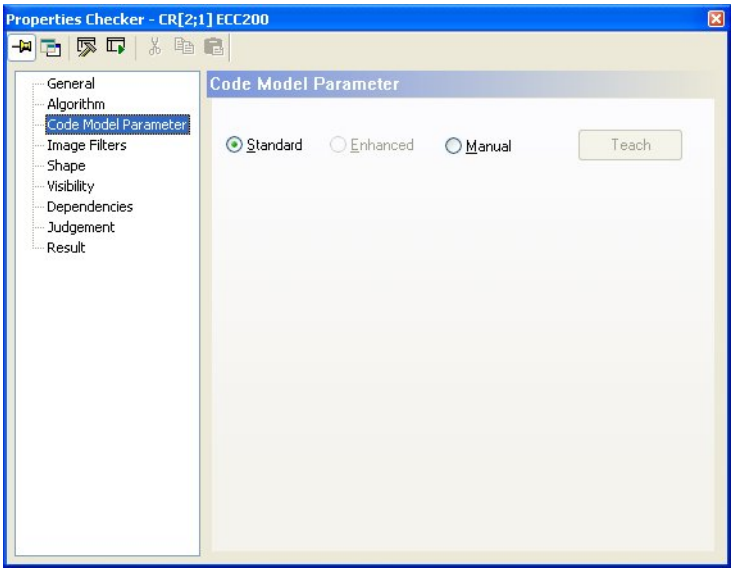
12.14.2 Shape

Four different shapes are available for a code-reading checker:

- Rectangle
- Ellipse/Circle
- Polygon
- Doughnut
- Object Shape

12.14.3 Code Model Parameter

The property page looks different depending on whether you have selected a 1D code or a 2D code on the "Algorithm" (see page 455) page.



"Code Model Parameter" page of a code reader checking a 1D code

Standard

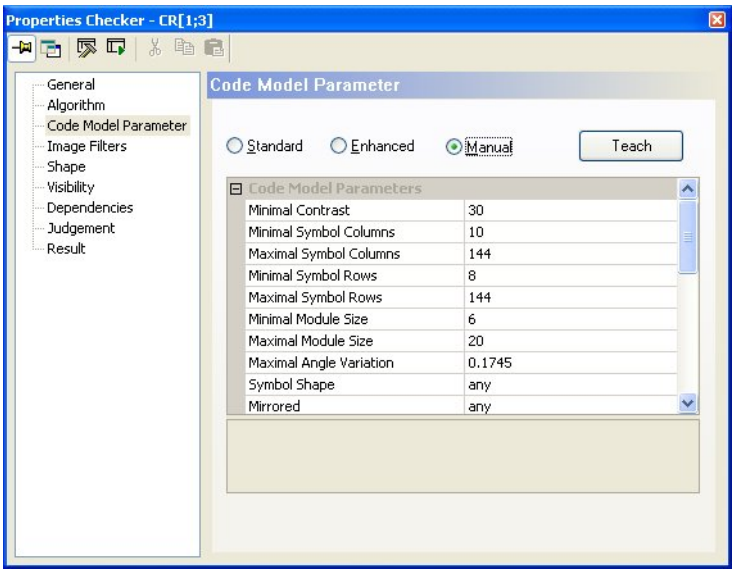
Default setting to detect clearly printed black-on-white codes. When you have selected a 2D code, a note explains the limitations of using the setting.

Enhanced

Use this setting if you need to detect black-on-white or white-on-black codes under difficult conditions. When you have selected a 2D code, a note explains the limitations of using the setting. With 1D codes, the parameter is grayed out

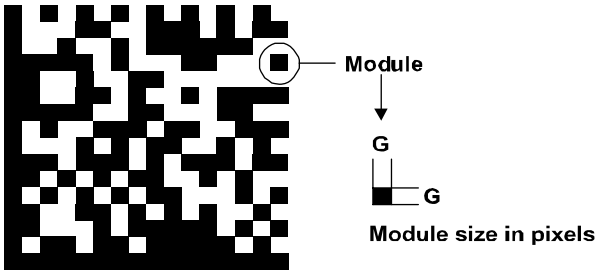
Manual

This option allows you to set every parameter individually. The parameters will be explained below. In general, the execution time for the code reader is decreased if the individual parameters have been set optimally for the code to be read.



◆NOTE

If you wish to use the number of decoding errors on the "Result" (see page 465) page to judge the quality of the code, we recommend setting the option to "Manual" and setting the parameters "Minimal Module Size" and "Maximal Module Size" to fit the code to be read as closely as possible.



Teach

If you have selected a 2D code for checking, use this button to teach Vision P400 the optimum parameter settings with the help of the current memory image. When you click the button, the parameter settings are saved. If you are working with a live image, Vision P400 automatically switches to the memory image.

If you teach two different codes (for example, one code is black on white and the other is white on black), Vision P400 selects the settings so that both types will be detected.

12.14.3.1 1D-Code Parameters

This is what a 1D code or bar code looks like:

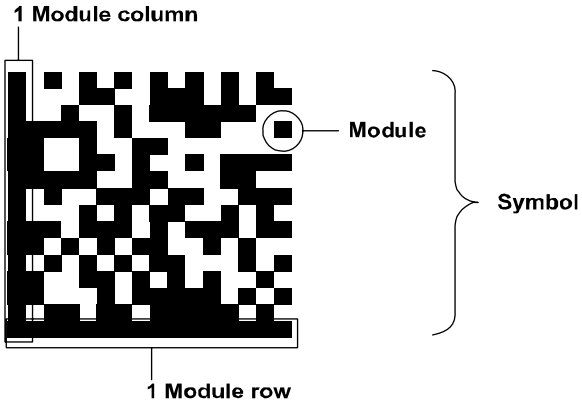
Sample 1D code

Parameter name	Description	Usage
Amplitude sobel	Minimal amplitude for edge extraction: The first step of the search for the bar code is based on the sobel filter. In contrast to thresholding the sobel filter has the advantage of being independent of different illumination conditions. In the case of a low contrast (difference between bright and dark elements) this value can be chosen lower to find all parts of the bar code. If the contrast is very good the value can be set to a higher value. This results in a better runtime because less pixels have to be evaluated.	Search for bar code region
Minimal element size	During the analysis of elements (or parts of them) this parameter is used to eliminate very small objects which do not belong to the bar code. You have to be aware that with a low image quality elements can be divided into smaller pieces. The parameter has to be larger than the smallest piece. With good image quality the value can be larger to reduce runtime. In any case the value may not be larger than the length of one element (in pixels). If the value is too large parts of the bar code may be missing.	
Maximal element size	Similar to the minimal size this parameter is used to suppress large objects. With a low resolution it is possible that multiple elements are extracted as one intermediate region. The value has thus to be larger than the size of this region. In addition, the value needs to be smaller than the total size of the bar code.	
Angle range	This parameter has the same function as the parameter "Sum Angles" but here it is used during the initial search for elements of the bar code. It influences how the orientation of the elements is estimated. For low-quality images this value has to be large. A small value results in a reduced runtime. The value is given in degrees.	
Correct angle	This parameter is used to decide if a region can be part of a bar code. For this the orientation of all boundary points are calculated. If enough points have the same orientation the region is accepted for further processing. Increasing this value reduces the amount of accepted regions and improves speed. For low image quality this value needs to be low.	
Dilation factor	After the initial step of finding elements these are combined into a bar code region. This is implemented using the closing operator. The mask size is automatically estimated. If this estimation is wrong it can be corrected using this parameter. If the bar code elements have large gaps the value has to be larger than one. If the bar code is very close to other objects and is wrongly connected to this object, the value may be smaller than 1. The parameter is independent of the image quality and runtime.	

Parameter name	Description	Usage
Sum of angles	This parameter is used for the final estimation of the orientation of the bar code region. First the orientation of the boundaries of all elements is calculated. Then the most frequent orientation is calculated. Using the neighboring orientations the mean orientation is calculated. The parameter determines the amount of neighboring angles used for summing up. The value is given in degrees.	
Minimal bar code area size	This value is used for the final decision if the region is a bar code. The parameter specifies the minimal area of the bar code. The area used here consists only of the boundary pixels of the elements and is thus smaller than the area of the code region. If areas are found which are too small, the value has to be increased. The parameter can also be used if small areas with the same orientation as the bar code elements are found. The parameter is independent of the image quality and runtime.	
Sigma Filter Value	For the extraction of the element widths the gray values of the bar code region are projected in the direction of the elements. The data calculated this way is smoothed to reduce noise. For bar codes with large gaps between the elements this value can be increased if extra elements are detected. The value should be larger than 0.5.	Extraction of element widths
Amplitude project	For the calculation of the element widths from the gray projections this parameter controls the minimal amplitude (gray-value difference) between dark and light elements. Increase this value if there is a lot of noise in the image (e.g. scratches). For low-contrast images the value has to be low.	
Width projection size	The gray-value projections are calculated only in a part of the bar code region along several scan lines (see "Number of Scan Lines" below). This parameter specifies half the width of the area that is used to calculate the gray-value projections. If the orientation of the region is not estimated correctly, this value must be small. In case of distortions (e.g. scratches) this value can be increased. For very narrow bar codes the value can be set to a small value.	
Length projection size	Sometimes the length of the bar code is too short to detect elements at the beginning and at the end. In this case the region is extended based on this parameter. If the bar code is positioned so close to another object that both areas are connected this value can be decreased.	
Interpolation	This parameter determines the type of interpolation used for the gray projection. For bilinear interpolation set the value to 1. If you do not want to use interpolation, set the value to 0. In this case the runtime is shorter, but the elements may possibly not be correctly detected.	
Number of scan lines	This value determines the maximal number of scan lines in which the bar code is searched. If you need to read bar codes with severe disturbances, set the parameter to a relatively large value. If the value is greater than 1, the default for "Width Projection Size" is 5; otherwise 25. The defaults are intended to ensure reliable detection of the barcode even when using just one scan line.	
Eliminate extra elements	This parameter eliminates elements extracted in the vicinity of the bar code that are parallel to the bars of the bar code. Hence, this parameter enables the correct decoding of the bar code if there are extraneous bars close to the bar code. The parameter is used for both ends of the bar code separately. This means that you can eliminate up to "Eliminate Extra Elements" extraneous bars on each side of the bar code.	

12.14.3.2 2D-Code Parameters

This is what a 2D code looks like:



Sample 2D code

The table lists the available model parameters in the order in which they appear in the dialog box. For 2D codes such as QR-Code and ECC200 additional parameters are available.

Parameter name	Description
Minimal contrast	Minimal contrast between the foreground and the background of the symbol (this corresponds with the Minimal gradient between the symbol's foreground and the background).
Minimal symbol columns	Minimal number of module columns in the symbol.
Maximal symbol columns	Maximal number of module columns in the symbol.
Minimal symbol rows	Minimal number of module rows in the symbol.
Maximal symbol rows	Maximal number of module rows in the symbol.
Minimal module size	Minimal size of the modules in the image in pixels.
Maximal module size	Maximal size of the modules in the image in pixels.
Symbol shape	Possible restrictions of the module shape (rectangle and/or square).
Mirrored	This parameter describes whether the symbol is or may be mirrored (which is equivalent to swapping rows and columns of the symbol).
Polarity	Possible restrictions of the polarity of the modules, i.e., if they are printed dark on a light background or vice versa.
Maximal module gap	Determines whether there is a gap between neighboring modules. Maximal gap size in symbol columns.
Minimal module gap	Determines whether there is a gap between neighboring modules. Minimal gap size in symbol columns.
Minimal module gap row	Determines whether there is a gap between neighboring modules. Minimal gap size in symbol rows.
Maximal module gap row	Determines whether there is a gap between neighboring modules. Maximal gap size in symbol rows.
Strict Model	Defines whether symbols must be exactly the same size as the taught-in model code or may deviate from the rules. If "yes" is set, only symbols precisely corresponding to the model are found and read, even if there are other readable symbols with different dimensions in the camera image. If "no" is set, codes may also be found which differ in size from the taught-in model.

Parameter name	Description
Persistence	Defines whether interim results are saved during symbol searching. By default (0) the interim results are not saved, owing to the high memory requirement. If you need the interim results from the symbol search for error fixing or for a display, set the parameter to 1.

12.14.3.3 QR Code Parameters

Parameter name	Description
QR model type	The old QR Code Model 1 and the newer Model 2 are supported.
Minimal symbol version	The minimal size of the symbol in modules.
Maximal symbol version	The maximal size of the symbol in modules.
Position Pattern Min	The search aids in the QR code are the nested light and dark squares in the three corners. Define how many search aids are to be found as a minimum (2 or all 3)

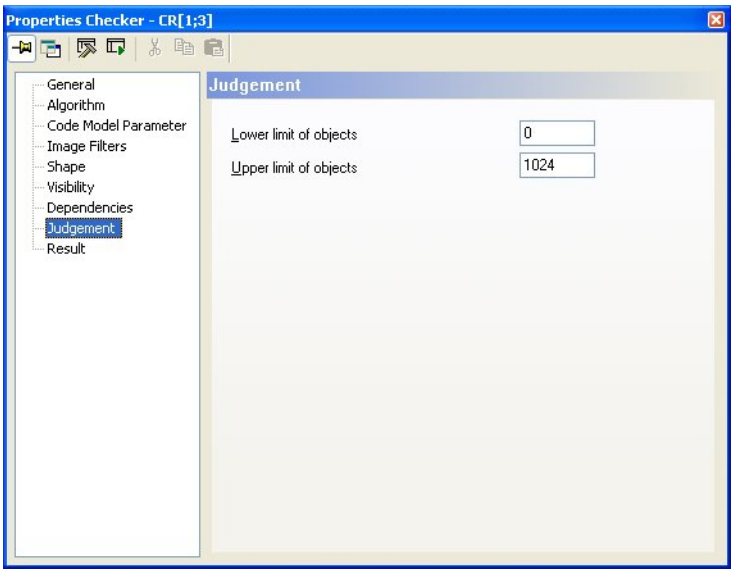
12.14.3.4 ECC200 Code Parameters

Parameter name	Description	Usage
Maximal Angle Variation	Maximal variation of the angle of the L-shaped finder pattern from the (ideal) right angle (the angle is returned in radians and corresponds to the distortion that occurs when the symbol is printed or during the image acquisition).	Image pre-processing and candidate search

12.14.4 Image Filters

All filters (see page 290) except for binary filters are available.

12.14.5 Judgement



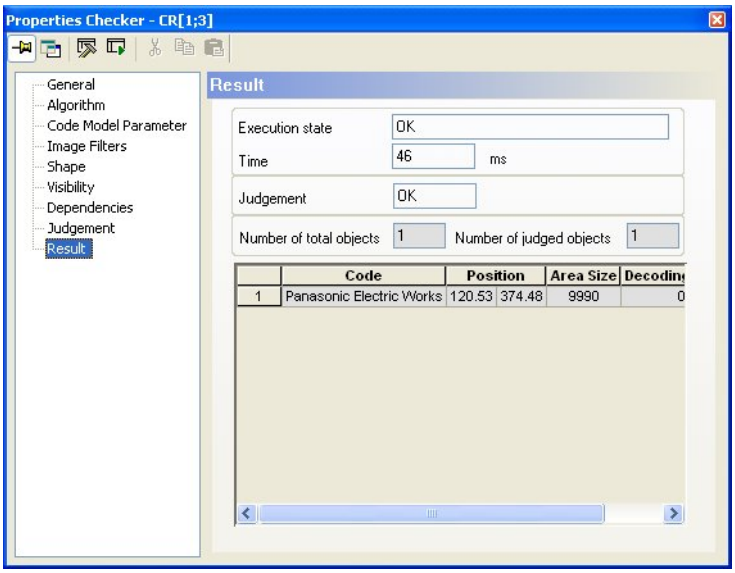
"Judgement" page of a code reader

The judgement criterion is the number of objects found. This must be within the limits of "Number of judged objects: Lower limit" and "Number of judged objects: Upper limit" (inclusive). You can enter a valid range limit from 0 to 1024. The default setting is 0 and 1024.

12.14.6 Dependencies

In contrast to all other checkers, the code reader checker can only depend on a position adjustment (see page 322).

12.14.7 Result



"Result" page of a code reader

Vision P400 outputs a list with the following results for each object detected:

Result Name	Description
Code	Decoding result output as ASCII text. If the code cannot be read, the result is output as "-".
Position	Position of the code in the image.
Area size	Size of the detected code in pixel.
Decoding errors	The number of errors that have been corrected during decoding. To a certain degree, this value can be used to judge the quality of the inspected code (see notes). The more errors Vision P400 had to correct, the worse the quality of the printed code. This result is only available for 2D codes.
Angle	Angle of the code in the image. This result is only available for 1D codes.
Parity	In order to use this result, the code must have a check digit. If the code does not have a check digit, please ignore the result. This result is only available for 1D codes.

In addition, the field "Number of Judged Objects" states the number of objects for which features have been calculated. Number of "Total Objects" states the number of remaining objects after applying the limit set in parameter "Maximal Number of Objects".

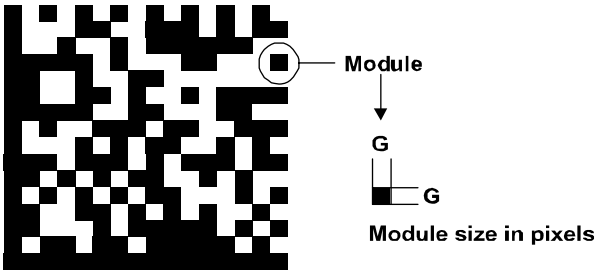
If you use the left mouse button to click on a result in the result list, the object's center of gravity is highlighted.

◆NOTES

- **When you have selected the ring as the checker shape and you are reading a 1D code, the selected image area is "straightened out" (see "Use Polar Transformation" for the OCR checker (see page 434)). Set the display**

position for the straightened-out image part in the camera image on the "Algorithm" page with the parameter "Result Display Offset" (see page 455).

- **The result in the "Decoding Errors" column may vary considerably, depending on whether you have selected "Standard" or "Enhanced" on the "Code Model Parameters" page. These parameters have been optimized to find all codes, if possible. If you wish to use the number of decoding errors to judge the quality of the code, we recommend setting the option to "Manual" and setting the parameters "Minimal Module Size" and "Maximal Module Size" to fit the code to be read as closely as possible.**



12.15 Geometry Checker

In contrast to all other checkers described, the geometry checkers are not image-processing routines in the ordinary sense. That is to say they do not extract their results directly from the current camera image but instead rely on results provided by other checkers and calculate additional features from these results.

Geometry checkers may use the result from any checker as a reference as long as two conditions are fulfilled:

- The reference checker result provides the coordinates of a point
- The reference checker is executed BEFORE the geometry checker depending on it, i.e. the reference checker must be positioned above the depending checker in the sequence.

Geometry checkers have no shapes and do not use filters. There are no parameters that need setting. The only thing users need to define is the dependencies (see page 473). Consequently, the Properties window is limited to the following pages:

- General
- Dependencies
- Result

You have three different geometry checkers at your disposal, all of which will be described in the sections to follow:

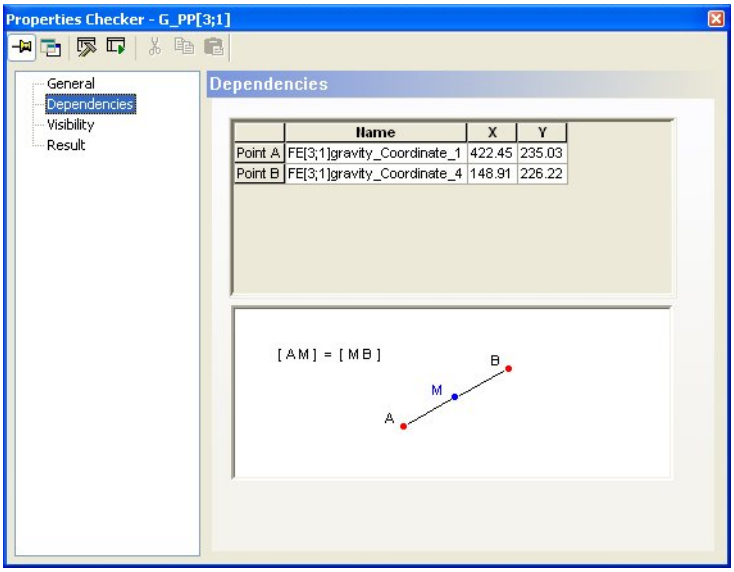
Geometry Point-Point (G_PP)

Geometry Point-Line (G_PL)

Geometry Line-Line (G_LL)

12.15.1 Geometry Point-Point (G_PP)

This geometry checker calculates the distance between two points (point A and point B) as well as the center point (M) and the angle between the horizontal line and the line defined by these two points.

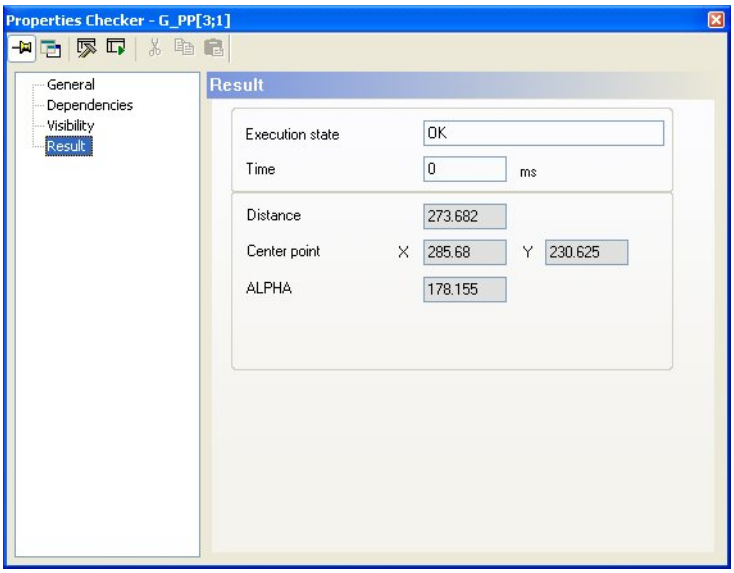


"Dependencies" page of a geometry point-to-point checker

◆**NOTE**

You set the dependencies with drag & drop (see page 473).

You will find the results on the "Result" page:



"Result" page of a geometry point-to-point checker

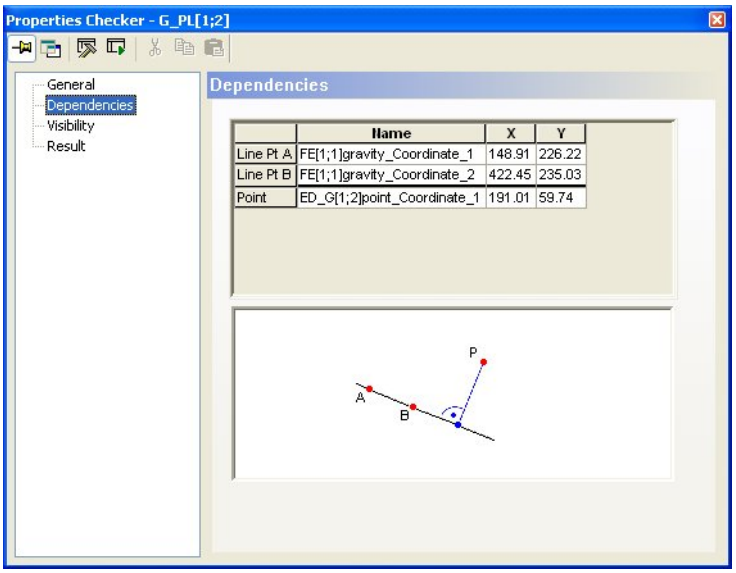
- **Distance**
  Distance between point A and point B
- **Center point**

coordinates of the center point M lie on the line connecting point A and point B

- **ALPHA**
  Angle ALPHA (counterclockwise) between the line connecting point A and point B and the horizontal. Base point for this angle is always the point listed in the dependency sheet under “Point A”.

12.15.2 Geometry Point-Line (G_PL)

This geometry checker calculates the distance between a point P and a virtual line which is defined by two additional points (line point A and line point B) and the anchor or foot point (L) of the perpendicular created by the point dropping to the line.

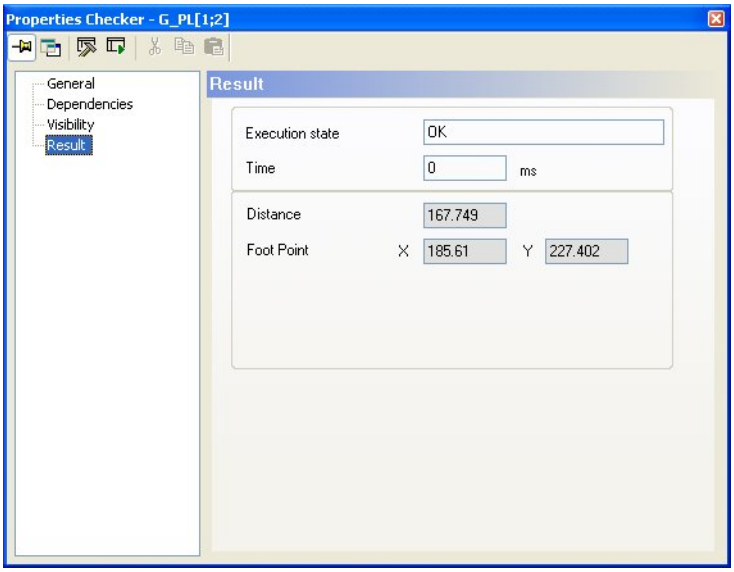


“Dependencies” page of a geometry point-to-line checker

◆NOTE

You set the dependencies with drag & drop (see page 473).

You will find the results on the “Result” page:

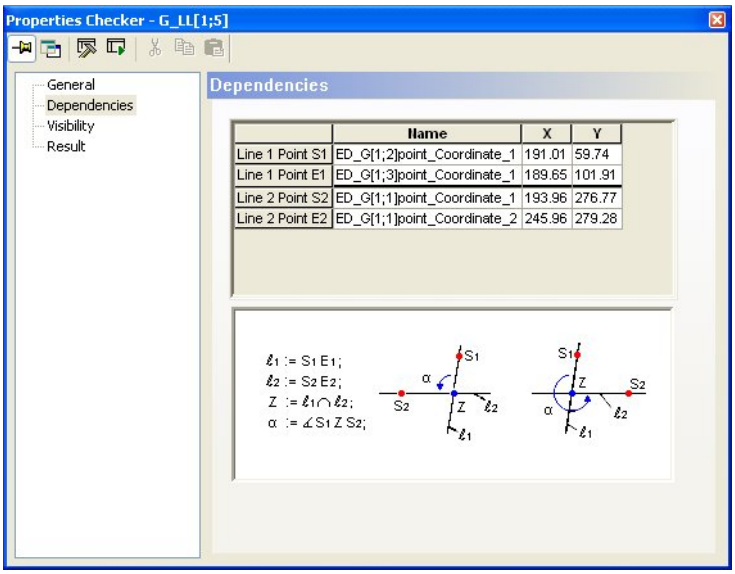


“Result” page of a geometry point-to-line checker

- **Distance**
  Distance between point and line
- **Foot Point**
  Coordinates of the foot point

12.15.3 Geometry Line-Line (G_LL)

This geometry checker calculates from two virtual lines (L1 and L2), created by two points each (Line 1 Point S1 - Line 1 Point E2 + Line 2 Point S2 - Line 2 Point E2) the point of intersection Z and the two enclosed angles (ALPHA, BETA). The points of line 1 and the points of line 2 could, for example, be the results of edge detection checkers.

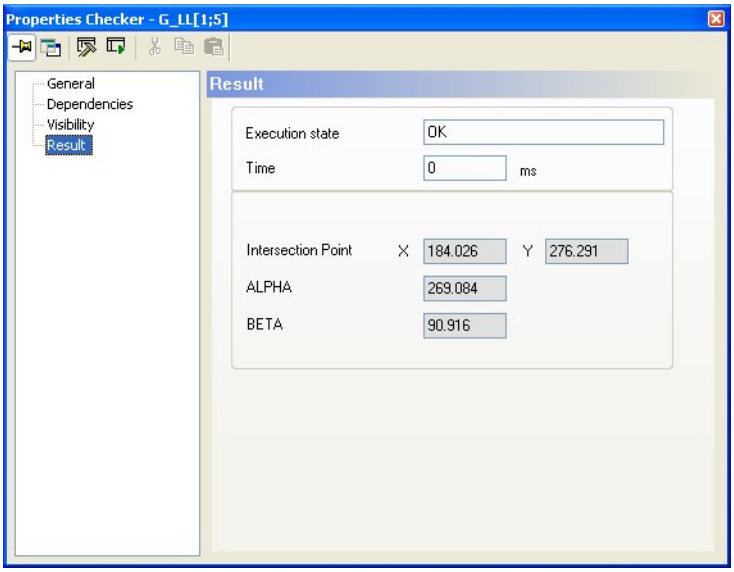


"Dependencies" page of a geometry line-to-line checker

◆**NOTE**

You set the dependencies with drag & drop (see page 473).

You will find the results on the “Result” page:



“Result” page of a geometry line-to-line checker

- **Intersection point**
  coordinates of the intersection point. The intersection point is the result of the 2 lines L1 and L2 which are determined by Line 1 Point S1 + Line 1 Point E2 and Line 2 Point S2 + Line 2 Point E2.
- **ALPHA**
  Angle Alpha is that angle which is defined by the two points (point S1 of Line 1 and point S2 of Line 2) as well as the intersection point Z of the two virtual straight lines, counterclockwise (see figure above)
- **BETA**
  Angle BETA = 360° - Angle ALPHA

◆NOTES

- **The objects used for defining the virtual lines need to be different. Otherwise the system will try to create a line from a single point.**
- **If you would like to use only three objects for a geometry checker type G_LL, i.e. if the two virtual lines have an intersection point in common, please make sure to enter the intersection point as Line 1 Point E2 and Line 2 Point E2 on the "Dependencies" page.**

12.15.4 Entering Checkers in the Dependency List

The dependency on the checker providing the results for the geometry checker is entered on the “Dependencies” page. Depending on the type of checker you use for reference, the procedure is different.

◆NOTES

- **You can remove a checker value you inserted in the "Dependencies" property page by right-clicking on the value you want to remove and choosing "Remove" from the pop-up menu.**
- **When you click on an inserted checker value from the list, the object from which the value originates is highlighted in the camera image. When you press the [spacebar] the object remains highlighted for as long as you hold it down.**
- **With the [Up arrow] and [Down arrow] keys you switch to the next checker value up or down in the list respectively. The object remains highlighted for as long as you hold down the arrow key.**

12.15.4.1 Drag & Drop Inspection Checkers

All inspections checkers, i.e. all checkers apart from geometry checkers, can be entered in the dependency list with drag & drop.

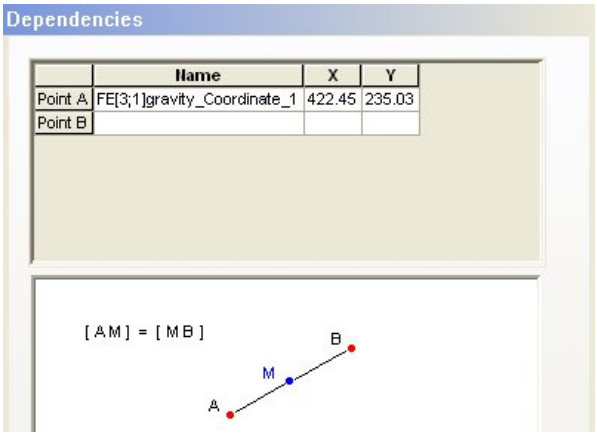
◆Procedure

1. **Select the geometry checker icon you wish to create with a left mouse click**
2. **Select the inspection checker you wish to use in the dependency list**
3. **Execute the checker by pressing <F8>**
4. **Select a result providing coordinates, e.g. from the "Gravity" column, with a left mouse click and hold the mouse button down**

	Area Size	Gravity		Angle
1	4253	4[illegible]15	235.03	1.08
2	1261	201.73	282.65	88.27
3	1259	238.13	283.86	88.2

5. **Drag the result to the "Dependencies" page of the geometry checker you have created in step 1**

6. **Release the left mouse button in the desired row**



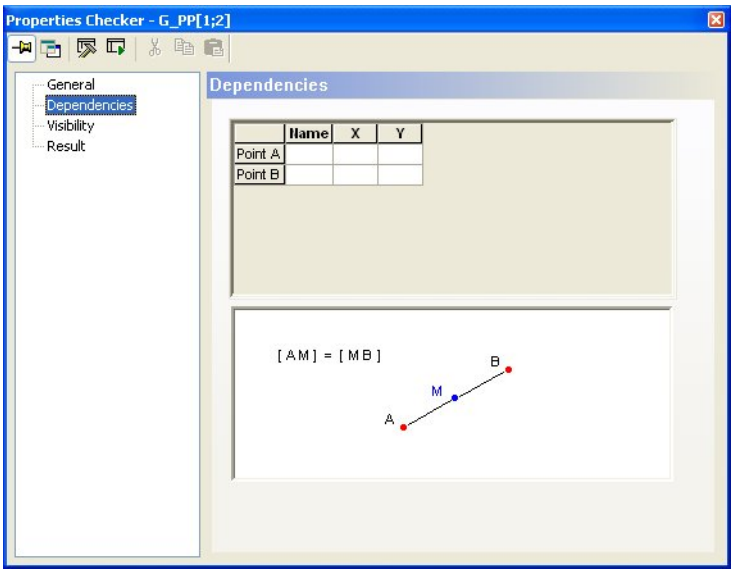
12.15.4.2 Entering Geometry Checkers

A different procedure is needed to enter geometry checker results in the dependency list of a geometry checker because it is not possible to have two geometry checker property windows open at the same time.

◆Procedure

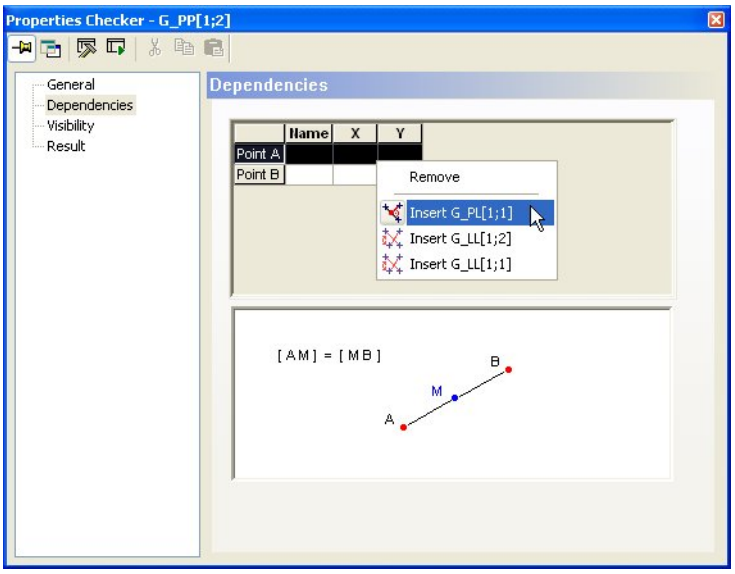
1. **Select the geometry checker icon you wish to create with a left mouse click**

   This example will show how to create a G_PP checker and make it depend on the results from a G_PL and G_LL checker, which have been created previously.

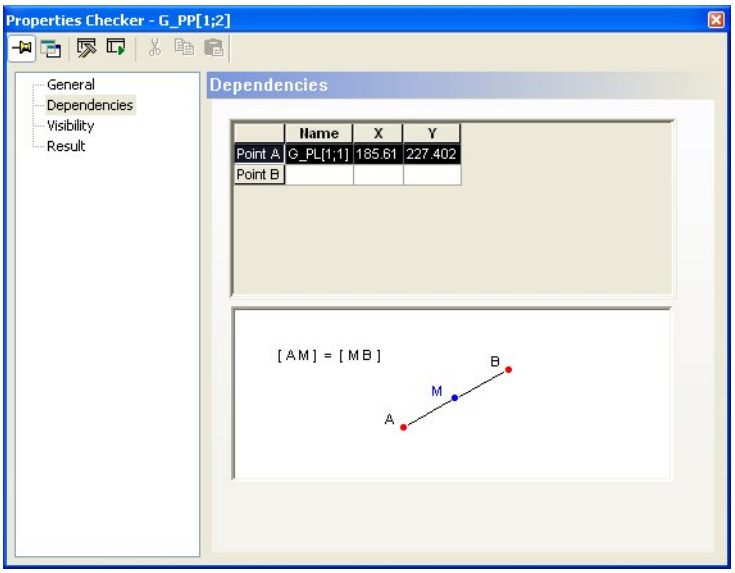


2. **Click the right mouse button on the "Point A" row**

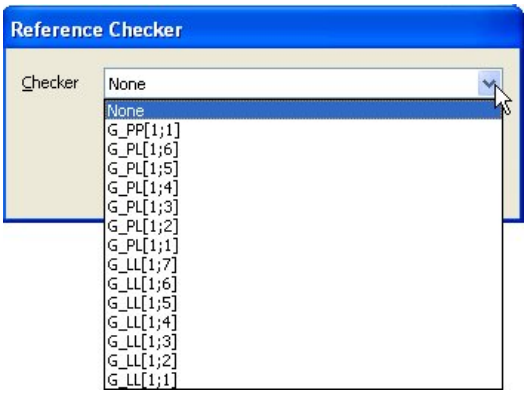
A pop-up menu appears. If you previously defined a maximum of 10 geometry checkers, this menu contains the names of all them. Select a geometry checker which you want to use as a reference.



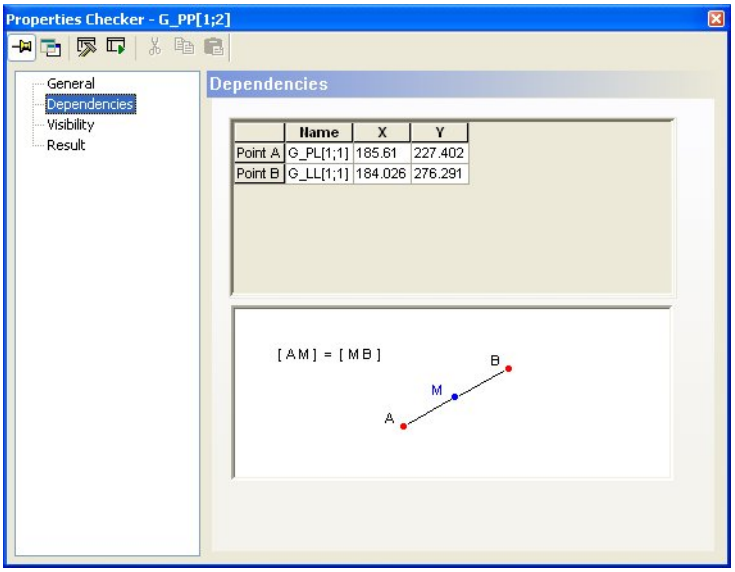
The selected geometry checker is inserted onto the "point A" row. Do the same for "Point B".



If you have defined more than 10 geometry checkers and the one you want is not in the list of the 10 most recent geometry checkers defined, from the pop-up menu choose "Select Checker". A dialog box appears. The pull-down list contains all available geometry checkers which can be referenced.

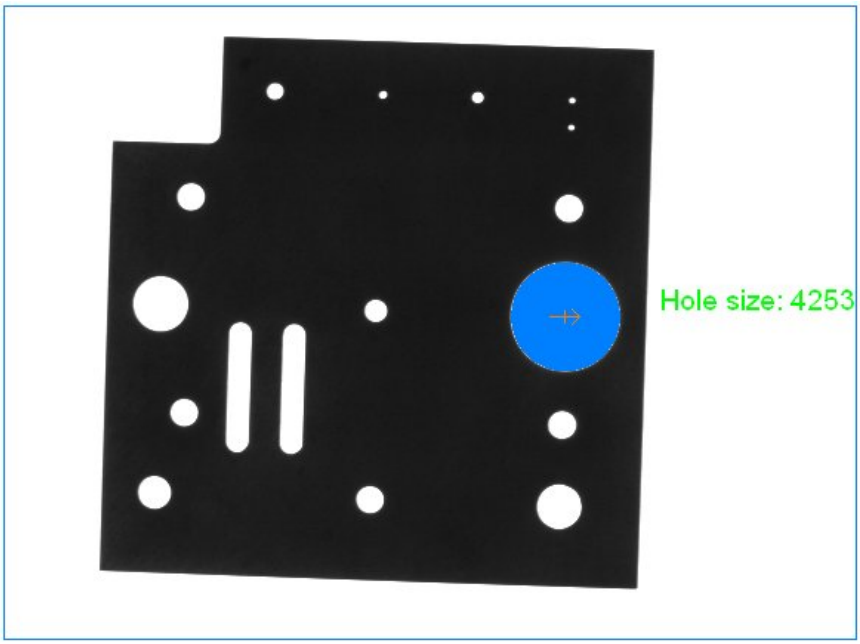


3. **Left-click to select a geometry checker**
4. **Click [OK]**



12.16 Indicators

With indicators you can highlight results and analyses (NG/OK) of spreadsheet results on screen with the aid of geometric figures, images or freely definable texts. The visibility settings of indicators are independent of those of the checkers. This means you can suppress the display of checkers in run mode while the indicators are all drawn.



Example of a text indicator with display of the result of a spreadsheet row

There are 6 different types of indicators:

Type	Description
Text	Display of a user-defined text and/or a spreadsheet result.
Line	Display of a line between two points optionally with or without arrow tips. Additional display of a user-defined text and/or a spreadsheet result.
Rectangle	Display of a rectangle, e.g. to mark an area in the image.
Ellipse	Display of an ellipse, e.g. to mark an area in the image.
Marker	Highlighting of a specific point in the image by selectable marker.
Bitmap	Display of any image in *.bmp format.

All indicators use the same properties pages, which may offer different setting options depending on indicator type:

- General: Contains a field for the comments as for the checkers (see page 287)
- Basic settings (see page 478)
- Position settings (see page 480)
- Display settings (see page 482)

- Result (see page 494)

Selecting and positioning indicators in the camera window

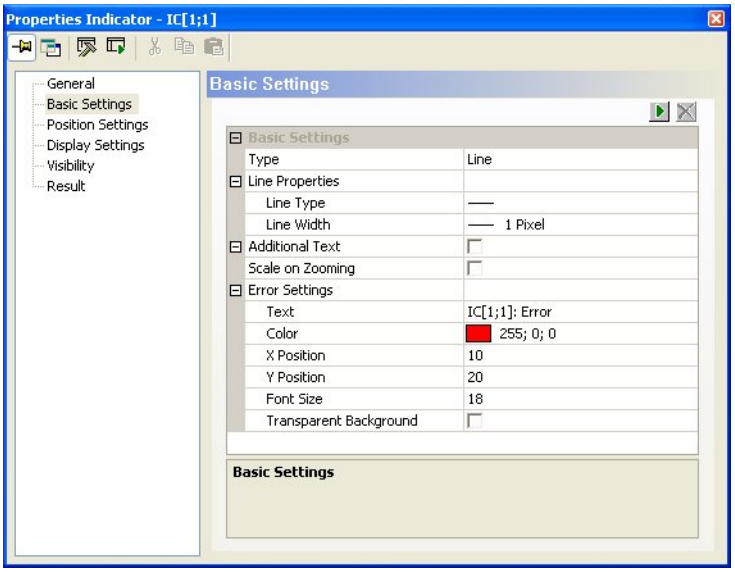
Select an indicator in the camera window by pressing <Ctrl> and simultaneously clicking the indicator with the left mouse button in the camera window.

You can reposition a selected indicator in the camera window. Again, press <Ctrl> and select the indicator in the camera window with a left mouse-click. As long as you hold down the left mouse button, you can move the indicator. Releasing the left mouse button determines the new position of the indicator.

If the indicator has been set to "Fixed Position" in the position settings, the new position will be entered as the fixed position. If the indicator has been set to "Depends on Results", the X-offset and Y-offset will be recalculated according to the new position of the indicator.

12.16.1 Basic Settings

The "Basic Settings" property page is used to define the indicator type, the error display method and other properties dependent on the indicator type.



"Basic Settings" property page of a line indicator

Type

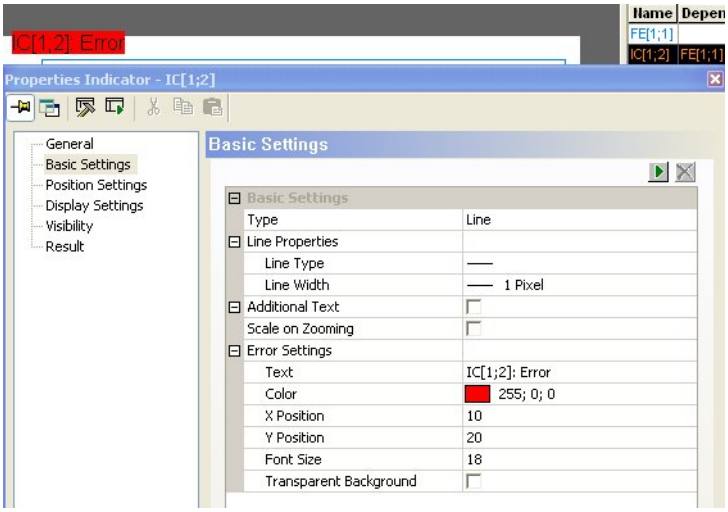
Here you determine which indicator type (see page 477) you want to use. Additional settings are displayed depending on type, such as for line types and widths etc.

Scale on zooming

Here you specify whether the indicator is scaled when zooming the image segment in or out.

Error settings

Here you define how an error during execution of the indicator is displayed. You can define the error text, the color, the position, the font size and a color for the transparent background. Note, however, that "Transparent Background" is not selected by default. This means that by default the error text you entered under "Text" is displayed in black on a rectangle in the selected color. If you have activated "Transparent Background", it is the text itself which is displayed in the selected color and not the background.



Error display with the preset values

◆NOTES

- **The text entered under "Error Settings" is used In the event of all indicator errors and displayed in the camera window. The exact cause of the error is indicated on the "Result" property page under "Messages:".**
- **Every time you create an indicator, Vision P400 creates a standard text in the "Text" field under "Error Settings". This standard text consists of the indicator name, ":", and the word "Error". When you copy an indicator, the text is only copied along if it has been changed by the user. Otherwise Vision P400 creates a new standard text containing the name and number of the copied indicator.**
- **If you do not want errors to be displayed in the camera window, enter an empty character string under "Text".**
- **The position set under "Error Settings" is only used if the error occurred in position calculation. Otherwise the error text is displayed at the calculated indicator position.**
- **If you cannot see an indicator in the image, there may be a number of reasons:**

Possible reason	Explanation	Remedy
Preset color	A black indicator in front of a black object only becomes visible when you click on the [Highlight] button. The indicator is inverted and so made visible.	Select a different color for the indicator.
Preset position	The indicator is outside of the displayed image segment. Double-click the [Highlight] button on the "Result" property page to move the displayed image segment so that the indicator is inside it and then click the [Highlight] button to highlight it.	Change the position settings, e.g. set a lower offset
No calculation or not yet drawn	The indicator has not been calculated or not yet drawn. In this case the [Highlight] button is deactivated.	Execute the indicator with or click to draw it.
Error occurred	An error has occurred when calculating or drawing the indicator, and you have entered no error text under "Error Settings".	Check whether an error is entered on the "Result" property page under "Messages".

Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.2 Position Settings

The position of the indicator is defined on the "Position Settings" property page. Different settings are possible depending on the indicator type.

For all indicator types you can choose between a fixed (= unchanging) position and a variable position (that is, dependent on spreadsheet or checker results) in the image. To distinguish between spreadsheet and checker results, checker results are marked by a "*" in front of their names.

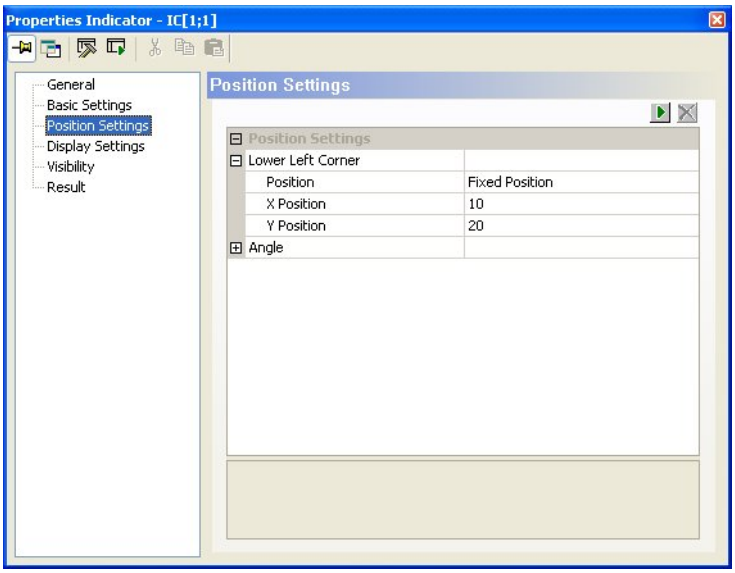
For a spreadsheet or checker result dependent position, enter the results in the relevant field by drag & drop.

◆SHORTCUTS

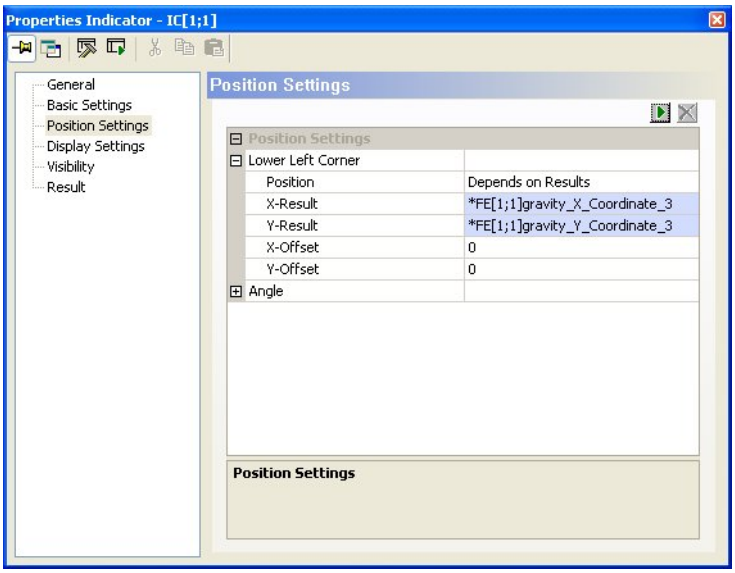
When you drag checker results into a field, you can transfer two related checker results at once like X and Y coordinates of a point by pressing the <Ctrl> key while releasing the mouse button over a field. This is useful, for example, when you want to transfer the coordinates of a result point onto the "X position" and "Y position" rows. This function is only available for checkers, not for spreadsheet results.

For checker results it is possible to check whether the "Type" of the result being entered matches the "Type" of the field in which it is to be inserted. It is not possible, for example, to transfer an angle result into the "X position" field. Vision P400 will not insert a non-matching result in the field, and outputs a message telling you so.

In the case of spreadsheet results, though, it is generally not possible to check whether the "Type" of the result and the "Type" of the field match. You can enter the result of a formula in the "X position" field for example, but it is not possible to check whether the formula result actually represents an X coordinate. Be sure to drag logical spreadsheet results into a field.



Position settings for a text indicator with a fixed position



Position settings for a text indicator with a variable position

Parameter	Available settings
Position	**Fixed Position:** The indicator is always displayed at the same location, which you define by entering the coordinate values under "X position" and "Y position". **Depends on Results:** Drag & drop the coordinates of a checker or spreadsheet result into the blue colored "X result" and "Y result" fields to define the position variably. You can then additionally move the indicator by the entered offset values starting from the inserted result in X and/or Y direction.

Parameter	Available settings
Angle Type	**Fixed Angle:** The indicator is always displayed rotated by the same value entered under "Angle". **Depends on Results:** Drag & drop an angle result of a checker or a spreadsheet result into the blue colored field to define the display angle variably. Note that Vision P400 cannot check whether a spreadsheet result is really an angle value.

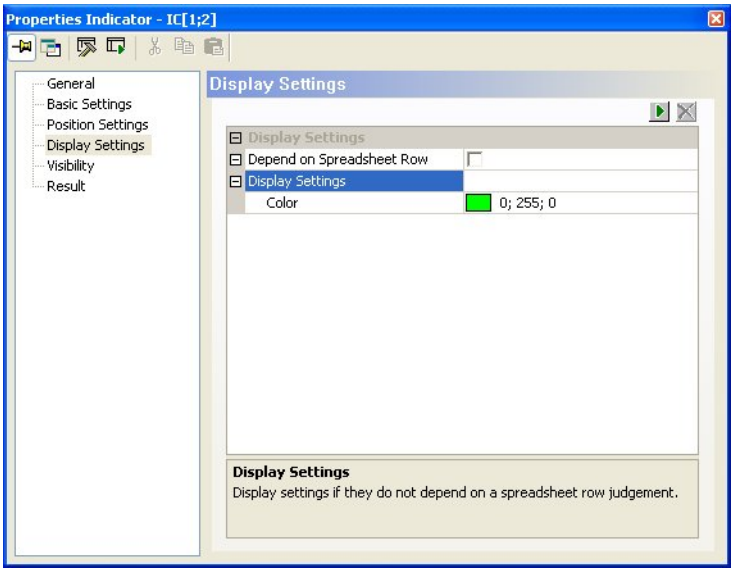
Descriptions of the further setting options on this property page are given for the respective indicator types.

Available icons

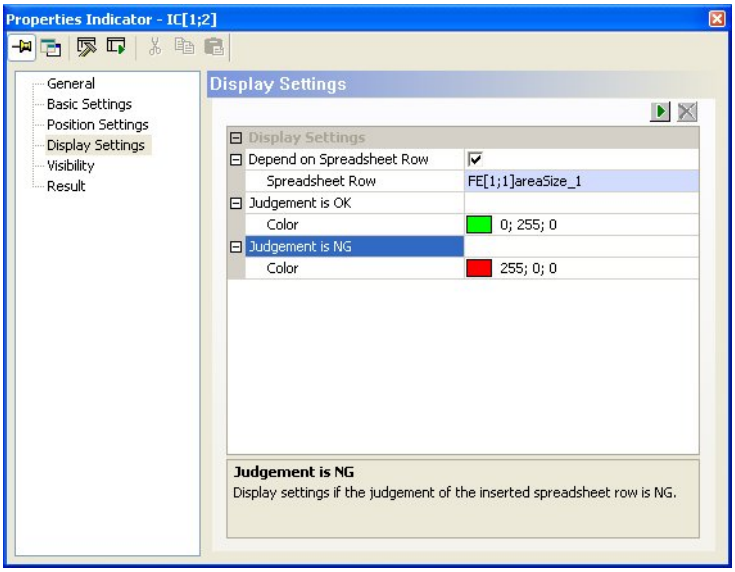
Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.3 Display Settings

The display mode of the indicator is defined on the "Display Settings" property page. The settings are identical for all types apart from the text (see page 483) indicator, the line indicator with text and the borderless bitmap indicator (see page 493). The text indicator and the line indicator with text require additional settings for text output. For the borderless bitmap indicator all the settings are covered by the basic and position settings.



Display settings of an indicator not dependent on any judgement



Example of a line indicator dependent on a judgement

Parameter	Available settings
Color	Select the color in which the indicator is displayed. The default color is green. To the right of the color field you see the RGB values of the selected color.
Depend on spreadsheet row	Activate this parameter when you want to make the display dependent on the judgement of a spreadsheet row. Then you can style the display differently depending on whether the judgement is OK or NG.
Judgement is OK/NG	Select the color in which the indicator is to be displayed In the event of an OK or NG judgement of the entered spreadsheet row. The default is green for OK and red for NG.

Descriptions of the further setting options on this property page are given for the respective indicator types.

Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.4 Visibility

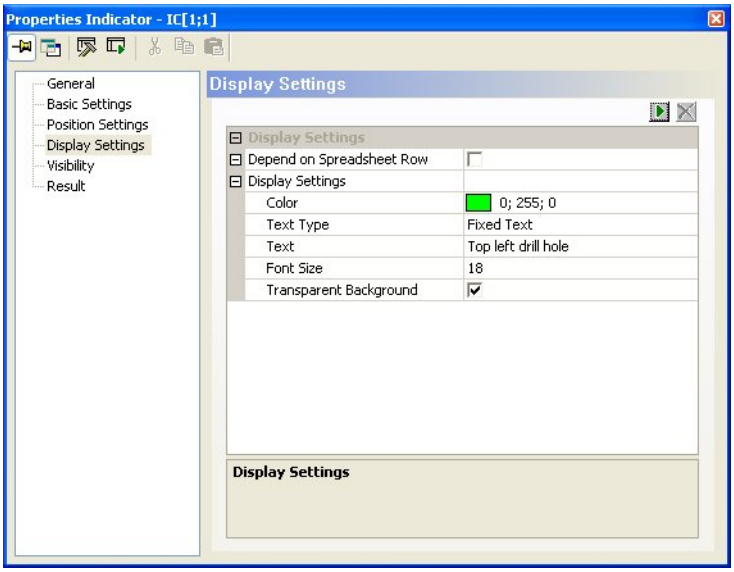
Please read the description under Visibility (see page 305) for the checkers.

12.16.5 Text Indicator

Here you will find all the setting options which the text indicator needs in addition to the settings shared by all indicator types.

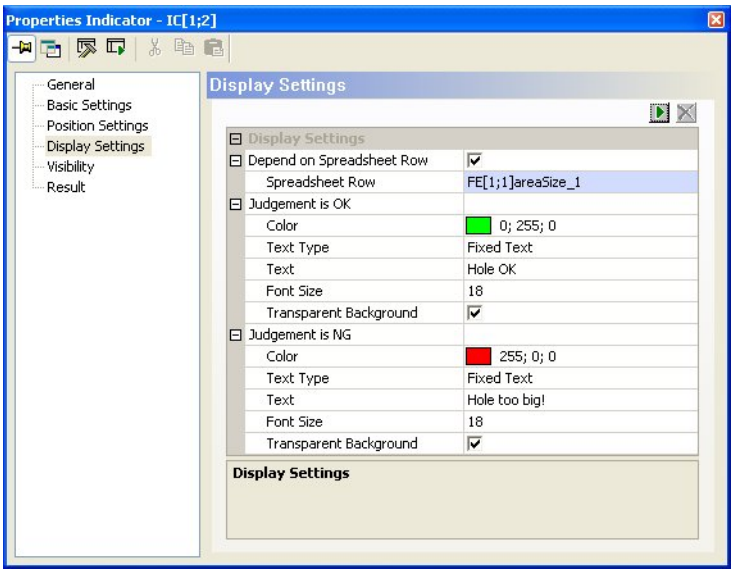
Display Settings

Here you define which text is displayed, and how.



Text indicator with fixed text (default settings)

By activating the "Depend on Spreadsheet Row" option you can define different texts whose display is dependent on the judgement (OK/NG) of a spreadsheet row. In this case you must drag & drop the desired row from the spreadsheet into the blue field next to the "Spreadsheet Row".



Settings for a text indicator dependent on the judgement of a spreadsheet row

◆NOTE

When you have selected "Depend on Spreadsheet Row" and drag a spreadsheet row into the "Spreadsheet Row" field, that spreadsheet row is automatically also entered in the "Spreadsheet Row" fields under "Judgement is OK" and "Judgement is NG", provided those fields are still empty. This also applies when you only retrospectively configure the text type so that it is dependent on a spreadsheet result and consequently needs a spreadsheet row as its reference. The spreadsheet rows for "Judgement is OK" and "Judgement is NG" influence each other mutually, as long as they are both empty. When a spreadsheet row is dragged into the field under "Judgement is OK", it automatically also appears under "Judgement is NG".

Parameter	Available settings
Color	Specify the text color.
Text Type	**Fixed Text:** Under "Text" specify which (fixed) text is to be displayed. **Spreadsheet Row Result:** The result of the spreadsheet row entered under "Spreadsheet Row" is displayed. **Name of the spreadsheet row + result:** The name and result of the spreadsheet row entered under "Spreadsheet Row" are displayed. **Text + result of the spreadsheet row:** The (fixed) text entered under "Text" and the result of the spreadsheet row entered under "Spreadsheet Row" are displayed. **Text + coordinates:** Under "Text" specify which (fixed) text is to be displayed. Drag & drop an X and Y coordinate result from the spreadsheet onto the blue rows underneath. Note that the coordinate value is delivered by the spreadsheet and cannot come directly from the checker results.
Text	This option is available for all text types for which you can predefine texts. Enter the text to be displayed.
Spreadsheet row	This option is only available for the text types linking to a spreadsheet result. Drag & drop here the spreadsheet row whose result is to be displayed.
Font Size	8 - 72 Point (default: 18 Point)
Transparent Background	If you deactivate this parameter, the text is displayed in black inside a rectangle filled out in the selected color.

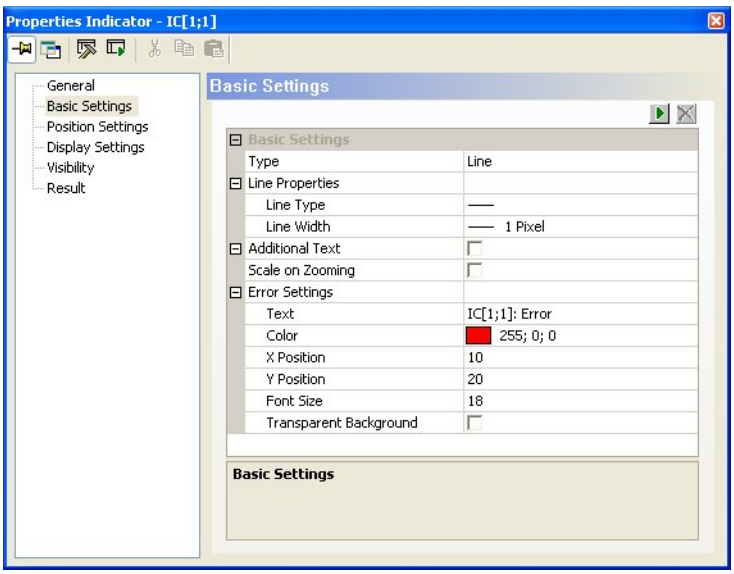
Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

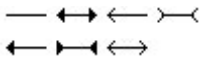
12.16.6 Line indicator

Here you will find all the parameters which the line indicator needs in addition to the settings shared by all indicator types.

Basic settings



Basic settings for the line indicator

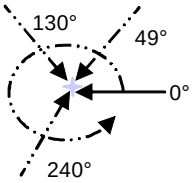
Parameter	Available settings
Line type	The following line types are available: 
Line width	1 - 5 pixels (default: 1 pixel)
Additional text	Activatable to label the line. The "Text Alignment" option is additionally displayed. The text itself is entered on the "Display Settings" property page under "Text".
Text alignment	**Centered, Line End:** When these two settings are set the Text is oriented to the angle of the line and is displayed either centered or right-justified with the line. **Centered and Horizontal, Line End and Horizontal:** When these two settings are set the text is displayed horizontal at the selected line position.

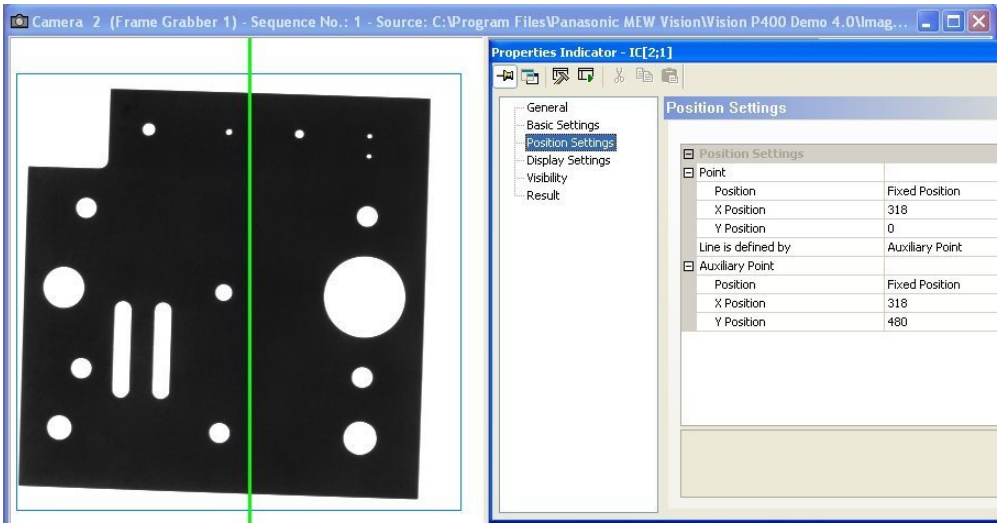
Position settings

There are two methods for drawing line indicators:

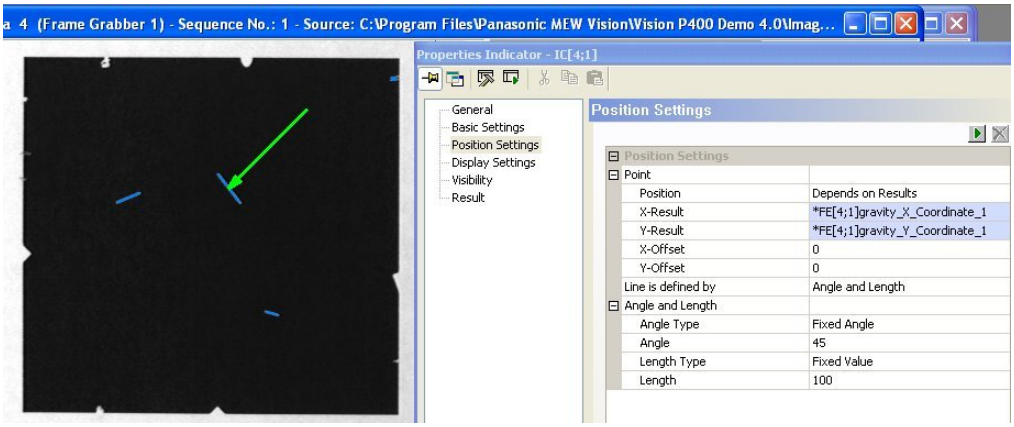
- With a start point and an auxiliary point
- With a start point and angle/length data

You must set different parameters depending on the setting you select for the "Line is defined by" parameter. As for the other indicators, the values may be either fixed or dependent on spreadsheet or checker results (for examples see below).

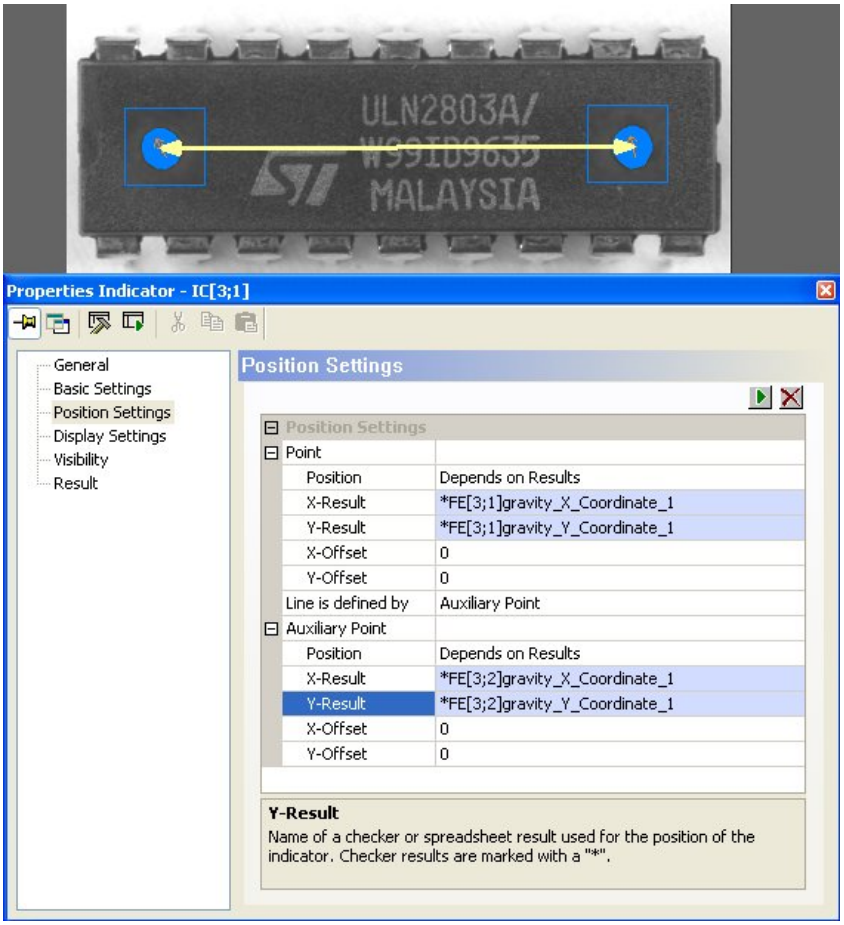
Line is defined by	Parameter	Additional setting options
Auxiliary point	Position	Fixed Position or Depends on Results
Angle and length	Angle type	Fixed Angle or Depends on Results The angles are translated as follows: 
	Length type	Fixed Value or Depends on Results



Example of a vertical line indicator in the center of the image (636x480)



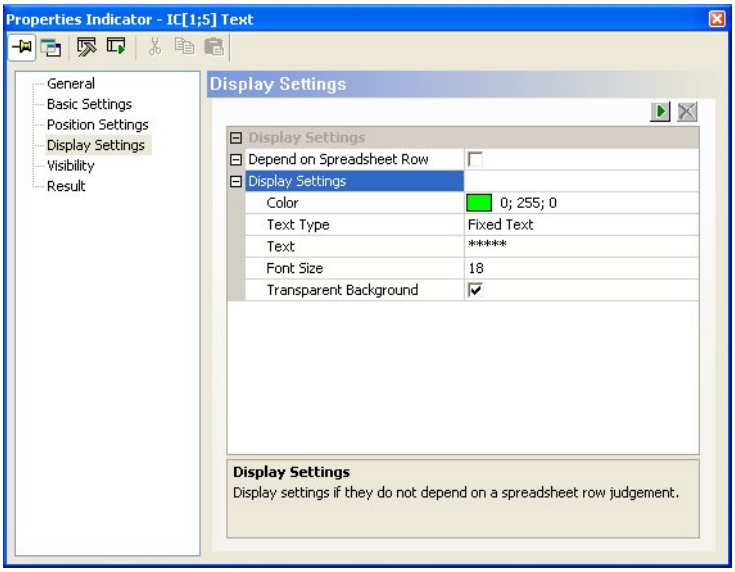
Line indicator defined by angle, length, and a result-dependent point



Example of a line indicator defined by result-dependent points

Display settings

Here you specify how the indicator is to be displayed and whether the display is to be dependent on a spreadsheet row. If you have activated the "Additional Text" parameter under "Basic Settings", the parameters for text type, text, font size and transparent background familiar from the text indicator (see page 483) are displayed.



Display settings when "Additional Text" under "Basic Settings" is activated

Parameter	Available settings
Color	Here you define the color of the line.
Text type	**Fixed Text:** Under "Text" specify which (fixed) text is to be displayed. **Spreadsheet Row Result:** The result of the spreadsheet row entered under "Spreadsheet Row" is displayed. **Name of the spreadsheet row + result:** The result and name of the spreadsheet row entered under "Spreadsheet Row" are displayed. **Text + result of the spreadsheet row:** The (fixed) text entered under "Text" and the result of the spreadsheet row entered under "Spreadsheet Row" are displayed. **Text + coordinates:** Under "Text" specify which (fixed) text is to be displayed. Drag & drop an X and Y coordinate result from the spreadsheet onto the blue rows underneath. Note that the coordinate value is delivered by the spreadsheet and cannot come directly from the checker results.
Text	This option is available for all text types which use user-definable text. Enter the text to be displayed with the line. It is displayed in the same color as the line.
Spreadsheet row	This option is available for all text types which use spreadsheet rows. Drag & drop here the spreadsheet row whose result and name is to be displayed.
Font size	8 - 72 Point (default: 18 Point)
Transparent background	If you deactivate this parameter, the text is displayed in black inside a rectangle filled out in the selected color.

◆**NOTE**

When you have selected "Depend on Spreadsheet Row" and drag a spreadsheet row into the "Spreadsheet Row" field, that spreadsheet row is automatically also entered in the "Spreadsheet Row" fields under "Judgement is OK" and "Judgement is NG", provided those fields are still empty. This also applies when you only retrospectively configure the text type so that it is dependent on a spreadsheet result and consequently needs a spreadsheet row as its reference. The spreadsheet rows for "Judgement is OK" and "Judgement is NG" influence each other mutually, as long as they are both empty. When a spreadsheet row is dragged into the field under "Judgement is OK", it automatically also appears under "Judgement is NG".

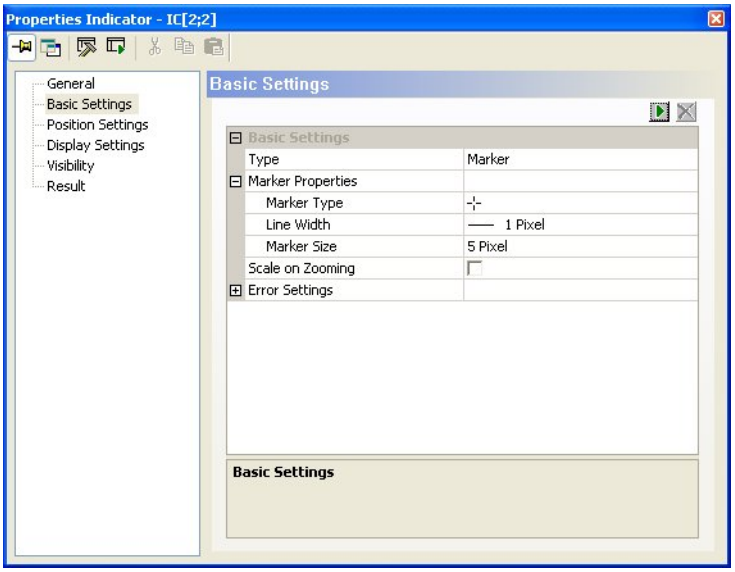
Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.7 Marker Indicator

Marker type indicators have a number of additional parameters in their basic settings.

Basic Settings



Basic settings for the marker indicator

Parameter	Available setting options
Marker Type	The following marker types are available:
Line Width	1 - 5 pixels (default: 1 pixel)
Marker Size	5 - 17 pixels (odd values)

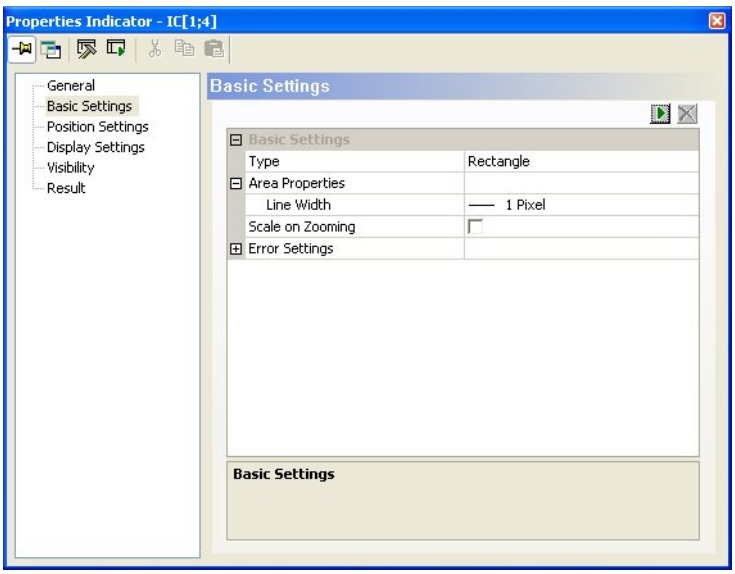
Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.8 Ellipse and Rectangle Indicators

Rectangle and ellipse indicators have a number of additional parameters in their basic and position settings.

Basic Settings



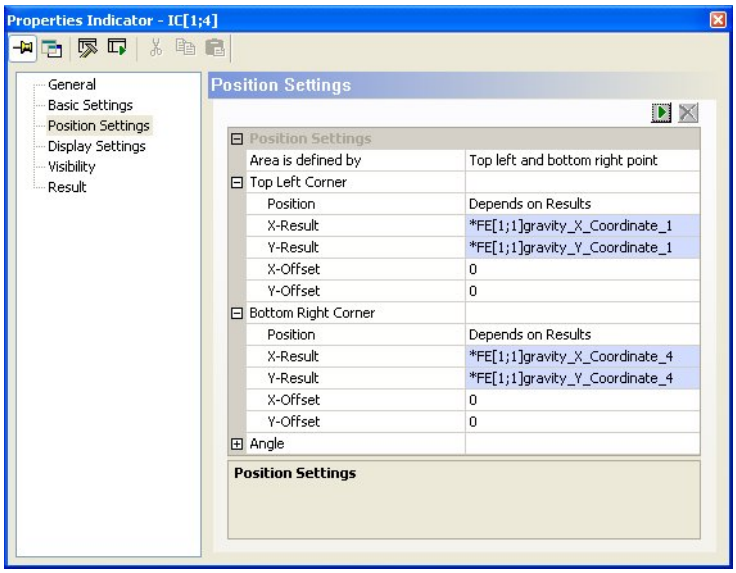
Basic settings for the rectangle indicator

In the "Area Properties" under "Line Width" select the line width in which the rectangle or the ellipse is to be drawn.

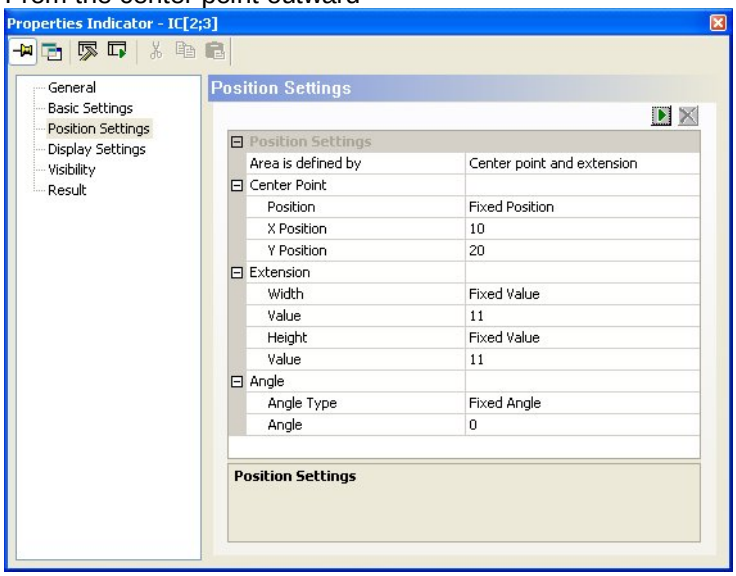
Position Settings

There are two methods for drawing ellipse and rectangle indicators:

- From the top left corner point to the bottom right corner point (the system internally assumes a virtual rectangle surrounding the ellipse)



- From the center point outward



You must set different parameters depending on the setting you select for the "Area is defined by" parameter. As for the other indicators, the values may be either fixed or dependent on checker or spreadsheet results.

Area is defined by	Parameter	Available settings
Top left and bottom right point	Top Left Corner	Fixed Position or Depends on Results
	Bottom Right Corner	
	Angle	Fixed Angle or Depends on Results
Center point and extension	Center Point	Fixed Position or Depends on Results
	Extension: • Width • Height	Fixed Value or Depends on Results

Area is defined by	Parameter	Available settings
	Angle	Fixed Angle or Depends on Results

Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

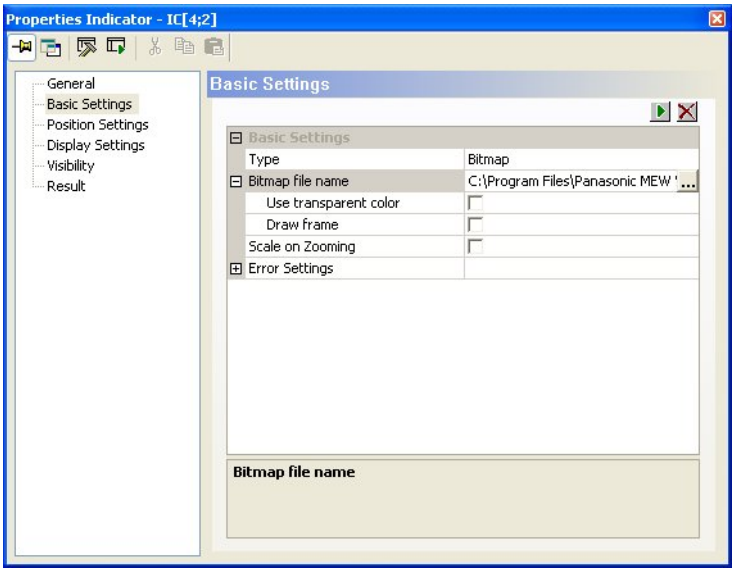
12.16.9 Bitmap Indicator

Here you will find all the setting options which the bitmap indicator needs in addition to the settings shared by all indicator types.

Basic Settings

Here you define which bitmap is displayed, and how.

Parameter	Available settings
Bitmap file name	Select a bitmap file in *.bmp format by clicking the [...] button at the right.
Use transparent color	You can hide part of the bitmap if you activate this parameter and select the color which is to appear transparent.
Draw frame	Activate this parameter when you want to draw a border round the bitmap, and select a line width of 1 - 5 pixels. The border color is defined on the "Display Settings" property page. The default color is green.



Bitmap indicator basic settings

◆NOTES

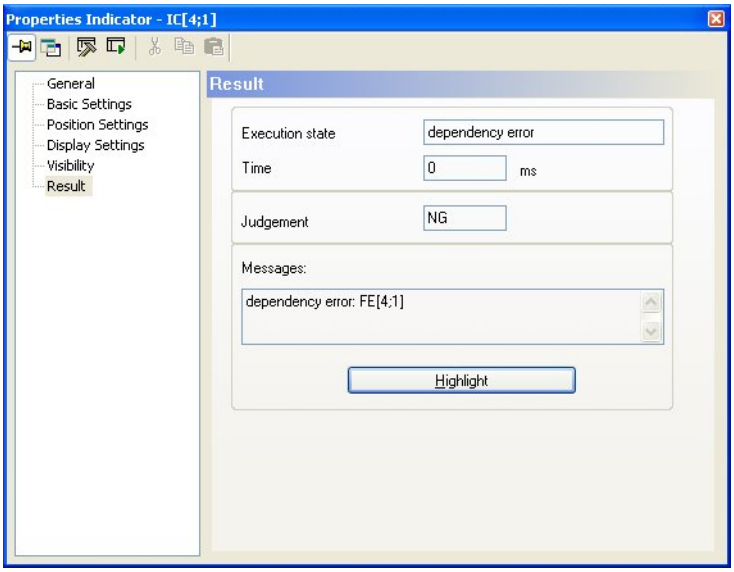
- **The bitmap must be saved in *.bmp format.**
- **The bitmap is shown in 1:1 scale.**
- **If you want to update the bitmap defined under "Bitmap file name" (new image, same file name), you must first delete the bitmap file name, then click on the icon and re-insert the bitmap file by choosing "Bitmap file name".**
- **The borderless bitmap indicator requires no display settings, because they are covered by the basic and position settings.**

Available icons

Icon	Functionality
	Draws the indicator with the current settings on the camera image.
	Only available if you have selected a parameter that depends on a result. Deletes the result in the fields with blue shading.

12.16.10 Result

An indicator has no results in the sense that a checker does. So here only the **execution state**, the **time** the **judgement** and - if an error has occurred - under "Messages:" a detailed error message, are output.



"Result" property page of an indicator which could not be executed

By clicking the [Highlight] button you can mark the indicator on screen. Then the indicator is displayed inverted in the image for as long as you hold down the button. The [Highlight] button is only active when the indicator has been calculated or already drawn.

If an indicator is outside the segment, but still within the camera image (because you have zoomed a different area of the camera image for example), you can double-click the [Highlight] button to move the displayed segment so that the indicator is in the middle of it.

If the indicator is outside the camera image, it is usually not possible to move the current image segment so that the result is positioned in the middle of it. In this case a warning message appears on the screen.

◆NOTES

- **When an error has occurred in calculating an indicator, it can only be highlighted if an error text is entered on the "Basic Settings" property page under "Error Settings".**
- **A borderless bitmap indicator is marked by a green surround; on a bordered bitmap indicator the surround is inverted.**

12.17 Print

When you select this option, you print out the parameters of the selected checker, object shape or indicator, together with information on the application, the camera, the frame grabber, and the date and time.

12.18 Properties

With **Properties** you can call up the property page of a selected checker, the object shape or the indicator and make changes.

12.19 Execute

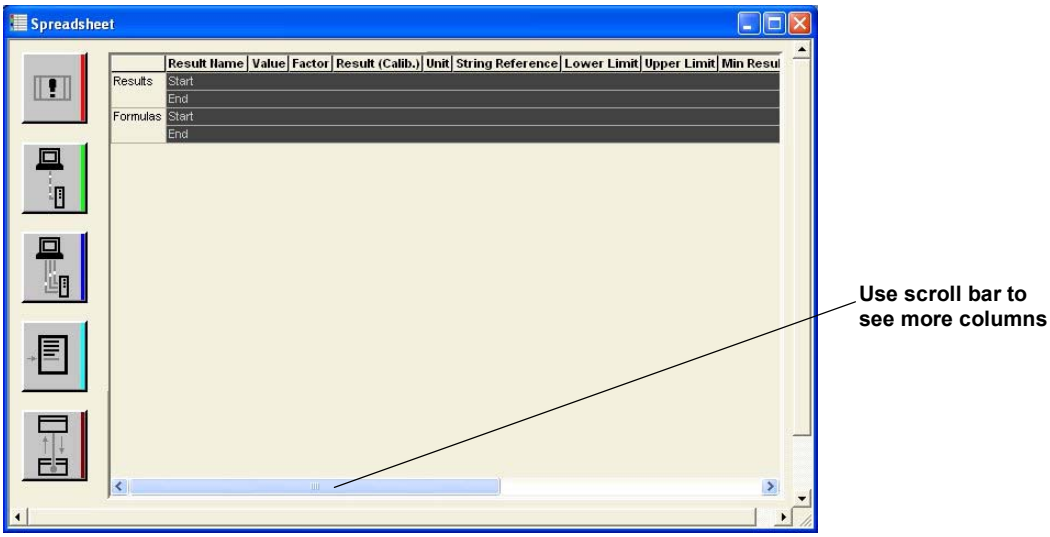
With this function you can execute the selected checker, object shape or indicator as a test. It does not scan a new image. Instead, it works exclusively with the memory image.

Chapter 13

Spreadsheet

13.1 Introduction

The spreadsheet is the central interface in the Vision P400 software. Choose **View** → **Spreadsheet** or click on to display the spreadsheet.



Spreadsheet

Here you can:

- view checker results
- view statistics
- assign checker results a user-defined name
- define data output to the interfaces
- execute arithmetical and Boolean calculations
- combine single results to a total one
- calibrate values
- define the system's actions when certain events occur
- set judgement limits
- use IfCase formulas to conditionally execute a checker sequence

13.1.1 Spreadsheet Columns

The following data can be displayed in the spreadsheet. You define which columns in the spreadsheet should be displayed or hidden (see page 588).

Column title	Description
Name	Name of the checker or formula result, can be modified by user
Value	Checker or formula result in pixels
Factor	Factor used for calibration. The factor can be calculated by Vision P400 or entered manually.
Result (Calib.)	Calibrated checker or formula result, or input of the reference value (see page 519) for calibration. The value in this column is used for: • data output via the interfaces • in the formulas • of indicators which display spreadsheet results If the result is not calibrated, the same value is displayed in the "Value" and "Result (Calib.)" columns.
Unit	Unit used for calibration
String reference	Reference value (see page 502) to verify a checker result of type string (OCR result, for example). Enter this value manually or via the serial or OLE interface.
Lower limit	Lower limit (see page 526) used for judging the checker or formula result. Enter this value manually or via the serial or OLE interface.
Upper limit	Upper limit used for judging the checker or formula result. Enter this value manually or via the serial or OLE interface.
Min Result	Lowest checker or formula result measured
Max Result	Highest checker or formula result measured
Range	Greatest difference of all maximum and minimum results
Average	Average checker or formula result (calculation formula: $a_m = a_1 + a_2 + ... + a_n / n$)
Sigma	Standard deviation $\sigma = \sqrt{\sum \frac{x_i^2}{n} - \left(\frac{x_i}{n}\right)^2}$
Judgement	OK/NG judgement of the checker or formula result (depending on the lower/upper limit (see page 526), or messages like "Error", "not executed"
NG	Number of NG judgements
NG Max	User-defined maximal number of permissible NG judgements. This number can be combined with an action (see page 563), which will be triggered every time the number of NG judgements can be divided by NG Max.
Error	Number of errors which occurred during execution (execution state error)
Scans	Number of times the application has been executed

◆NOTE

An error is treated as a NG judgement, i.e. whenever an error occurs, the value under "NG" is increased by 1.

13.1.1.1 Special Features of the String Reference

The "String Reference" column is only available for the OCR checker, and performs the function of a comparative rather than a limit value, meaning the column decides whether the result of the OCR checker is judged OK or NG. There are two ways of specifying a string reference:

- You enter a template text manually, e.g. "Copyright". This option is advisable when the same text always has to be checked.

	Result Name	Result (Calib.)	String Reference	Judgement
Results	Start			
	OCR[1;2]result_10	Copyright	Copyright	OK
	End			
Formulas	Start			
	End			

- You refer to another checker result on the spreadsheet. This option is advisable when varying texts have to be checked and the text in question can be identified by way of other checkers.

	Result Name	Result (Calib.)	String Reference	Judgement
Results	Start			
	OCR[1;1]result_14	Panasonic2007	=CR[3;1]decodedString	OK
	End			
Formulas	Start			
	End			

◆**EXAMPLE**

In the example, the code reader checker of camera 3 delivers the text for the string reference of the OCR checker of camera 1.

	Result Name	Result (Calib.)	String Reference	Judgement
Results	Start			
	CR[3;1]decodedString	Panasonic2007	Panasonic2007	OK
	FE[2;1]areaSize_1	15002		OK
	FE[2;1]areaSize_2	8943		OK
	FE[2;1]areaSize_3	4379		OK
	FE[2;1]areaSize_4	1387		OK
	FE[2;1]gravity_X_Coordinate_1	116.02		OK
	FE[2;1]gravity_Y_Coordinate_1	174.01		OK
	FE[2;1]angle_1	80.49		OK
	OCR[1;1]result_14	Panasonic2007	=CR[3;1]decodedString	OK

Function

The content of the "String Reference" column is interpreted by Vision P400 as follows:

Method	Entry in "String Reference"	Response of Vision P400
Referring to a fixed default	Does not begin with "="	Vision P400 interprets the entry as a fixed character string and compares it with the current checker result.
Referring to another checker result	Begins with "="	Vision P400 assumes that the string reference without the "=" contains the name of a spreadsheet row. The current checker result from this row is used as a comparative value when: • the string reference without the '=' contains the valid name of a spreadsheet row; • the checker result from that spreadsheet row is a string result; and • the spreadsheet row delivering the checker result was defined **before** the current spreadsheet row. If one of these conditions is not met, the string reference including the '=' is interpreted as a character string by way of a fixed default, and the checker result in the current spreadsheet row is always compared against it.

◆NOTE

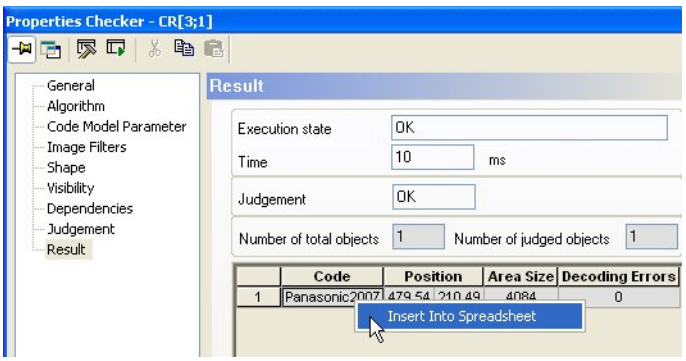
As for checker dependencies, the spreadsheet row whose result is to be used as a string reference must be ABOVE the row on the spreadsheet which needs the result as an entry in the "String Reference" column.

To link a string reference to a checker result:

◆Procedure

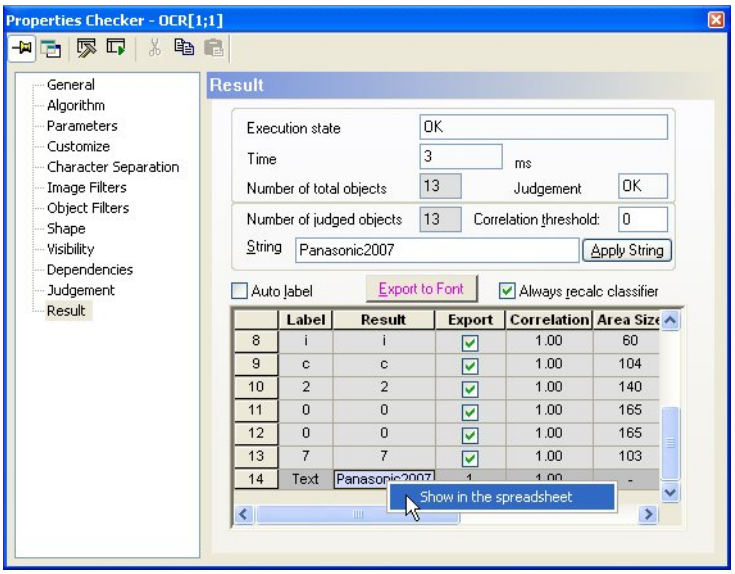
1. **Enter the result of the checker on the spreadsheet which is to deliver the comparative value**

   As the referenced spreadsheet row has to be above the row with the OCR checker on the spreadsheet, this result is inserted first. Right-click on the result in the checker result list and from the pop-up menu choose "Insert Into Spreadsheet".

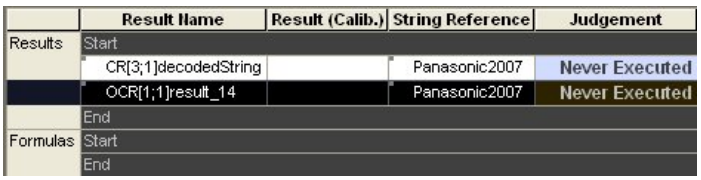


2. **Enter the result of the OCR checker on the spreadsheet**
3. **Open spreadsheet**

The quickest way is to right-click on the OCR result you just entered on the spreadsheet and then choose "Show in the Spreadsheet".

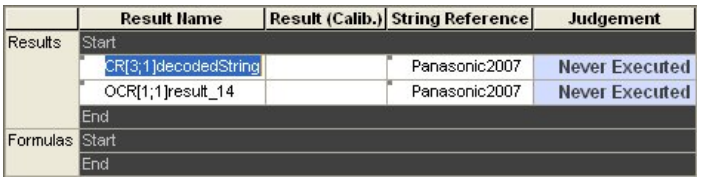


By default, Vision P400 applies the last valid checker result as the reference value when inserting a checker result.



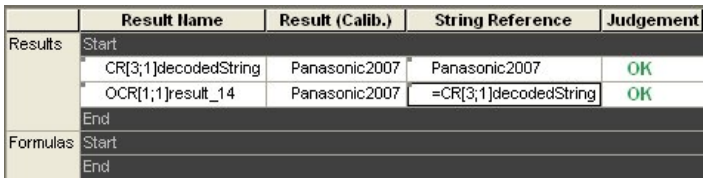
Next the name of the spreadsheet row 1 is copied to the clipboard with the code reader checker whose result is to be used as a string reference.

4. **Left-click in the "Name" field of the CL result**
5. **Select the complete name and press <Ctrl>-<c> to copy**



6. **Left-click in the "String Reference" field of the OCR result**
7. **Select the complete existing text**
8. **enter =**
9. **Press <Ctrl>-<v> to paste copied name <Enter>**
10. **Start the application with <F5>**

The spreadsheet column widths are automatically adjusted to the entry length, enabling you to see the full entry in the "String Reference" column.



	Result Name	Result (Calib.)	String Reference	Judgement
Results	Start			
	CR[3;1]decodedString	Panasonic2007	Panasonic2007	OK
	OCR[1;1]result_14	Panasonic2007	=CR[3;1]decodedString	OK
	End			
Formulas	Start			
	End			

◆NOTES

- **As long as a string reference is linked to a spreadsheet row, the row cannot be deleted.**
- **When moving spreadsheet rows, ensure the correct order is maintained, so that the rows to which others refer appear first. Otherwise an entry such as "=CL[3;1]DecodedString" will be taken literally by Vision P400 (interpreted as a manual text template).**
- **When a string reference is linked to a spreadsheet row, you can view the current value from that row. To do so, click in the "String Reference" field so the cursor starts flashing. If you leave the cursor where it is for a moment, the tool tip appears showing the current value of the row to which the string reference is linked.**

13.1.2 Available Options

Spreadsheet commands can be accessed either via the **Spreadsheet** menu or via the pop-up menu. The pop-up menu is context-sensitive, i.e. depending on where the cursor is positioned, the pop-up menu contains different options. Most options are available both in the **Spreadsheet** menu and in the pop-up menu. Some, however, are only available from either of the two, see table below.

Option	Explanation	Available in
Insert formula	**Spreadsheet** menu: Inserts a formula (arithmetic, Boolean, or IfCase) in the bottom section of the spreadsheet Pop-up menu: Inserts a formula (arithmetic, Boolean, or IfCase) at the position of the mouse cursor	both **Spreadsheet** and pop-up menu
Delete row(s)/contents	Deletes the currently selected row(s)/the complete spreadsheet	both **Spreadsheet** and pop-up menu
Reset statistics	Resets statistical values in the spreadsheet to zero (see page 587)	both **Spreadsheet** and pop-up menu
Properties	Opens the property window (see page 588) of the spreadsheet. Here you define which values should be displayed	both **Spreadsheet** and pop-up menu
Hide row(s)	Hides selected rows (see page 531)	both **Spreadsheet** and pop-up menu
Show row(s)	Shows hidden rows again (see page 531)	both **Spreadsheet** and pop-up menu

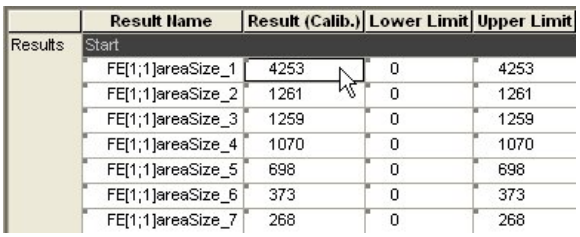
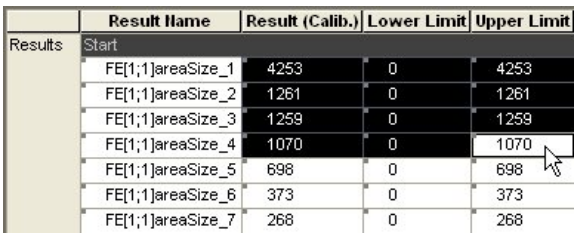
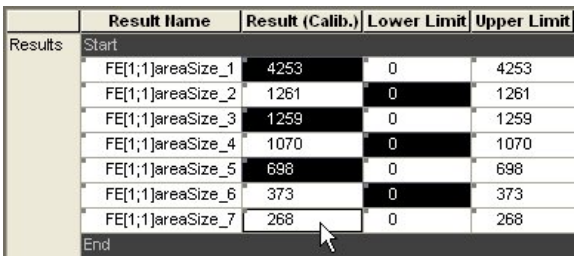
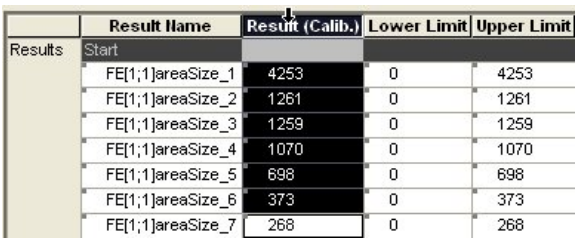
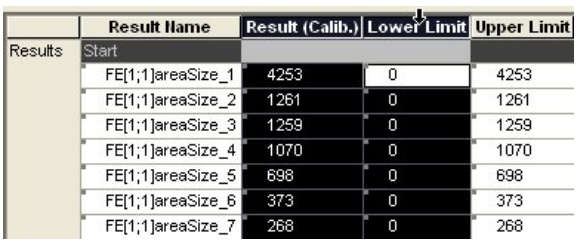
Option	Explanation	Available in
Lock row(s)	Activates the protection against editing (see page 534) for the selected row(s) in the spreadsheet. Locked rows are indicated by text in italics and a small red padlock symbol to the left of the result name.	both **Spreadsheet** and pop-up menu
Save as text file	Saves the contents of the spreadsheet in a text file.	both **Spreadsheet** and pop-up menu
Unlock row(s)	Deactivates the protection against editing (see page 534) for the selected row(s) in the spreadsheet. Locked rows are indicated by text in italics and a small red padlock symbol to the left of the result name.	both **Spreadsheet** and pop-up menu
Lock spreadsheet	Protects the spreadsheet against changes in setup mode by locking it (see page 531)	**Spreadsheet** menu only
Password	Sets a password (see page 537) for locking the spreadsheet	**Spreadsheet** menu only
Insert into ... <interface name>	Marks the item for output to the selected interface (see page 538)	Pop-up menu only
Copy	Copies the selected item to the clipboard, e.g. for entering limits and editing formulas (see page 571)	Pop-up menu only
Paste	Pastes the selected item from the clipboard, e.g. for entering limits and editing formulas (see page 571)	Pop-up menu only
Quote	Copies (modified) values from the columns "Min Result/Max Result" or "Average" to the selected cells in the column "Lower Limit" and "Upper Limit" (see page 519), respectively	Pop-up menu only
Print	Prints the spreadsheet as well as the objects selected for transfer to the interfaces	in the pop-up menu and under **Application → Print → Spreadsheet**
Add delta value	Modifies the selected cells from the columns "Lower Limit" resp. "Upper Limit" with the selected operator and the input value (see page 528)	Pop-up menu only
Calibrate	Opens the dialog box with the calibration options for results (see page 519)	Pop-up menu only
Edit all cells	Inserts the value entered (see page 529) in the selected cells (only for cells from the columns "Unit", "String Reference", or "NG Max")	Pop-up menu only
Background color	Displays the selected cells with a background color (see page 535)	Pop-up menu only
Spreadsheet controller	By selecting an item you limit the spreadsheet display to the selected checker and formula results (see page 237)	Pop-up menu only

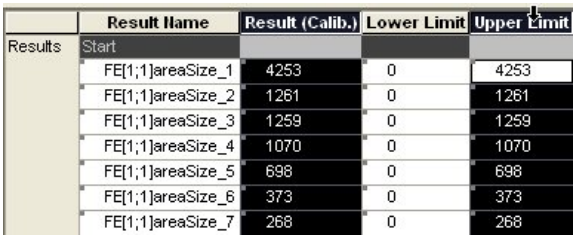
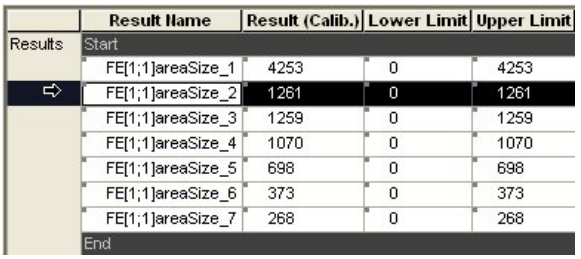
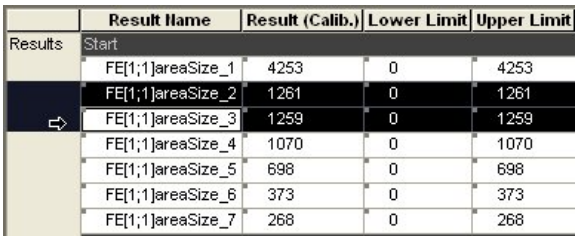
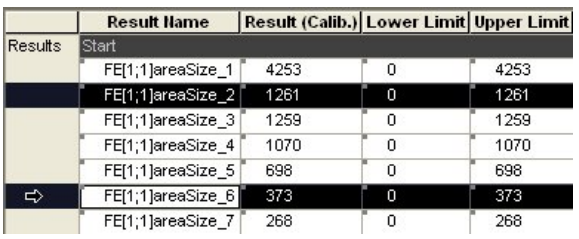
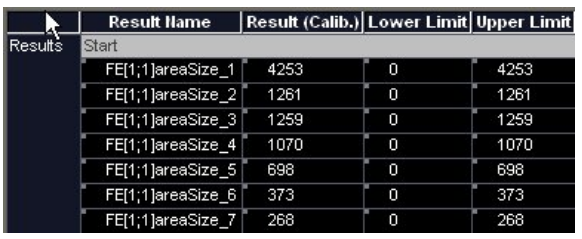
13.1.3 Selecting Items in the Spreadsheet

You select items in the spreadsheet in the same way as in other Windows applications:

- Left mouse click for individual items
- Left mouse click and <Shift> key for multiple connecting objects
- Left mouse click and <Ctrl> key for multiple objects

Please note that the options (see page 505) available in the pop-up menu vary depending on which cells, rows, or columns you have selected.

Select what	Mouse and/or keyboard operation
One cell	Left mouse click 
Multiple connecting cells	Left mouse click and hold the <Shift> key down 
Multiple non-connecting cells	Left mouse click and hold the <Ctrl> key down 
One column	Left mouse click 
Multiple connecting columns	Left mouse click and hold the <Shift> key down 

Select what	Mouse and/or keyboard operation
Multiple non-connecting columns	Left mouse click and hold the <Ctrl> key down 
One row	Left mouse click 
Multiple connecting rows	Left mouse click and hold the <Shift> key down 
Multiple non-connecting rows	Left mouse click and hold the <Ctrl> key down 
All spreadsheet cells	Left mouse click in the top Left area 

◆**NOTE**

When you have selected an individual cell, Vision P400 treats the whole row as selected.

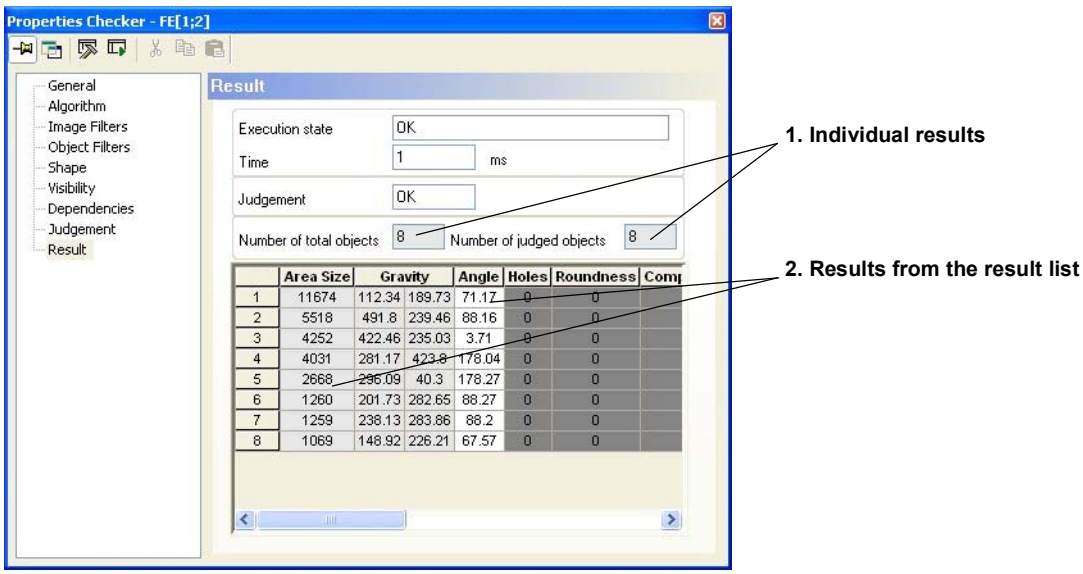
13.2 Transfer Checker Results to the Spreadsheet

This section informs you about which checker results can be transferred to the spreadsheet and how this transfer is done. Furthermore, you learn how to modify the (automatically created) name of the checker result in the spreadsheet according to your requirements.

13.2.1 Available Checker Results

Not all checker results are available for further processing. There are two groups of results which can be transferred to the spreadsheet for further processing:

- Individual results (usually gray-shaded results from the last two boxes on the "Result" page)
- Calculated results from the result list (results with white or light-gray background from the table on the "Result" page)



Results available for the spreadsheet

◆NOTES

- **Spreadsheet results are displayed to two decimal places.**
- **The value entered in the "Calibration" column can have up to three decimal places.**
- **After you have executed the application, the new checker results will be transferred to the spreadsheet and the statistics will be recalculated, i.e. the spreadsheet is updated.**

Highlighting results in the camera image

When you click a result from the list, the corresponding object is highlighted in the camera image. With the keys at the bottom you can leave the highlighting as it is or highlight different results:

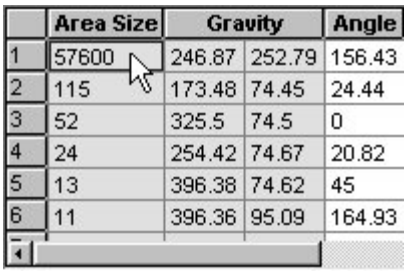
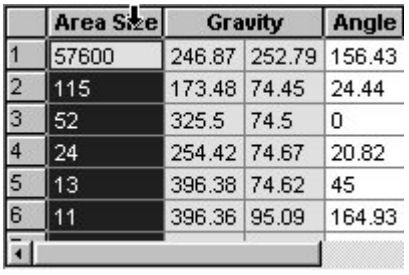
Key	Highlighted result
Spacebar	The result selected with the left mouse button is highlighted as long as you hold down the key.
Up arrow	The result above the result selected with the left mouse button is highlighted as long as you hold down the key.
Arrow left	The result left of the result you have selected with a left mouse click will be highlighted as long as you press this key.
Down arrow	The result below the result selected with the left mouse button is highlighted as long as you hold down the key.
Arrow right	The result right of the result you have selected with a left mouse click will be highlighted as long as you press this key.

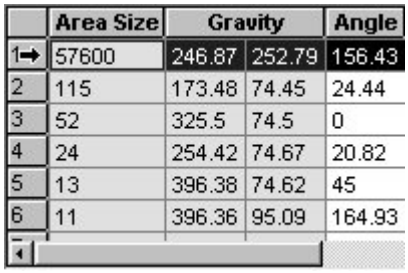
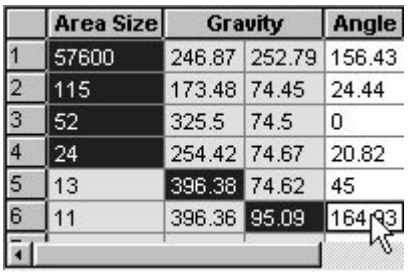
Only the results within the current displayed image segment are highlighted in the camera image. If a result is outside the segment, but still within the camera image (such as because only part of the complete image is visible after zooming), you can move the current image segment so that the result is positioned in the middle of it. To do so, double-click on the result.

If the result is outside the camera image (this is often the case with indicators), it is usually not possible to move the current image segment so that the result is positioned in the middle of it. In this case a warning message appears on the screen.

13.2.2 Selecting Checker Results

In order to transfer checker results to the spreadsheet, you need to select them first.

Select what	Click at position of mouse cursor
One checker result	Left mouse click 
One column of checker results (for more columns, repeat on desired columns)	Left mouse click 

Select what	Click at position of mouse cursor
One or more rows of checker results (for more rows, repeat on desired rows)	Left mouse click 
Multiple checker results in different columns and rows	Press <Shift> to select multiple results from the same column  Press <Ctrl> to select multiple results from different columns

◆NOTE

Any result you click on is color-highlighted in the camera image for as long as you hold down the mouse button.

13.2.3 Inserting Checker Results into the Spreadsheet

There are two ways of inserting checker results into the spreadsheet once you have selected one or more results. Depending on the method you choose, the selected checker results are inserted at the end of the spreadsheet or at a certain position.

Using the Right Mouse Button

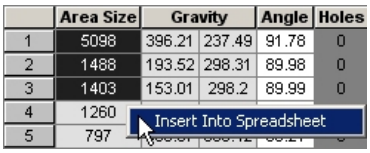
◆Procedure

1. **Select the checker results you wish to insert into the spreadsheet**
2. **Click the right mouse button**

   or, if you have selected more than one result,

   Press <Ctrl> and then click the right mouse button

   If the result has not yet been entered in the Spreadsheet, or if you have selected multiple results, a pop-up menu appears. For results already entered on the spreadsheet, the pop-up menu only offers the "Show in the Spreadsheet" option.



3. **Select "Insert into Spreadsheet" and click the left mouse button**

   All selected checker results are added at the end of the list of values already inserted into the spreadsheet.

◆**NOTE**

Please note that the option "Insert into Spreadsheet" is only available for checker results which can be inserted into the spreadsheet.

Using the Drag & Drop Function

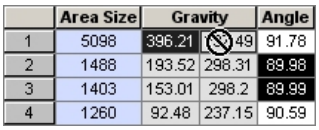
◆**Procedure**

1. **Select the checker results you wish to insert into the spreadsheet**

   or, if you have selected more than one result,

   Hold down the <Ctrl> key

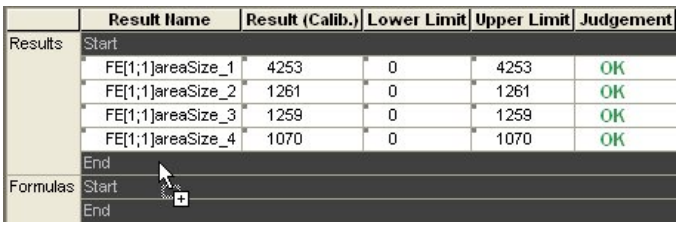
2. **Click the left mouse button somewhere in your selection and hold it down**



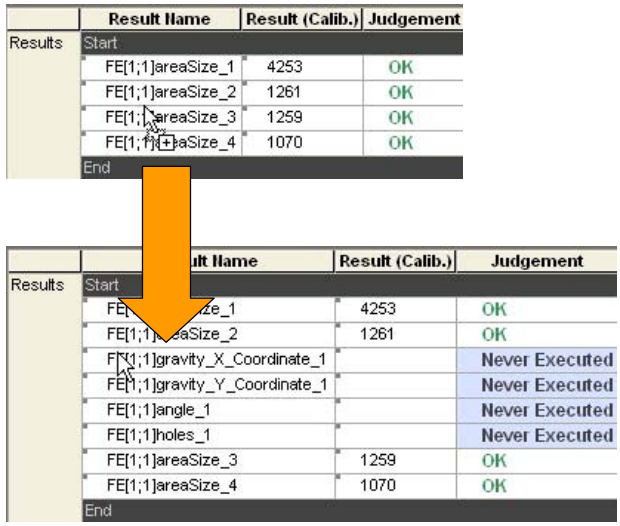
   The mouse cursor changes to a circle with a diagonal bar.

3. **Drag the selection to the spreadsheet**
4. **Drop the selection at the desired position in the spreadsheet**

   Drop as shown below to add the selected checker results at the end of the spreadsheet.



   Drop as shown below to insert the selected checker results right below the mouse cursor.



	Result Name	Result (Calib.)	Judgement
Results	Start		
	FE[1;1]areaSize_1	4253	OK
	FE[1;1]areaSize_2	1261	OK
	FE[1;1]areaSize_3	1259	OK
	FE[1;1]areaSize_4	1070	OK
	End		

	ult Name	Result (Calib.)	Judgement
Results	Start		
	FE[1;1]ze_1	4253	OK
	FE[1;1]eaSize_2	1261	OK
	FE[1;1]gravity_X_Coordinate_1		Never Executed
	FE[1;1]gravity_Y_Coordinate_1		Never Executed
	FE[1;1]angle_1		Never Executed
	FE[1;1]holes_1		Never Executed
	FE[1;1]areaSize_3	1259	OK
	FE[1;1]areaSize_4	1070	OK
	End		

◆NOTES

- **With both methods of inserting checker results into the spreadsheet, the sequence order can be modified by drag & drop.**
- **You have to drag the value only once into the spreadsheet. The values will be updated automatically.**
- **Newly inserted checker results are judged with "Never Executed" (with light blue background color) until you execute the application and a new judgement is made.**
- **When inserting the checker results, limit values are set (see page 526) at the same time. In this, 0 is entered as the lower limit and the current result as the upper limit.**
- **All checker results you have inserted into the spreadsheet are displayed with a background color in the checker's result list. The default color is a light blue. You can change (see page 145) the default color under** System Settings → Vision P400 Settings **on the "Tools" page with the [Color for Results Inserted in Spreadsheet] button.**
- **To find checker results already inserted into the spreadsheet quickly, right-click on the checker result and from the pop-up menu choose "Show in the Spreadsheet".**

13.2.4 Changing Result Names in the Spreadsheet

When you transfer a checker result to the spreadsheet, Vision P400 automatically assigns a result name. This name can be changed if you wish to make the spreadsheet display easier to read (see procedure below).

◆EXAMPLE

The figure below shows part of a spreadsheet with a result name as assigned by Vision P400. The result name helps to identify the checker result and can be interpreted as follows:

FE[2;3]areaSize_1
FE Feature extraction checker
2 Number of the camera to which the checker belongs
3 Number of the feature extraction checker in the camera
AreaSize_1 Area size of object No. 1

◆NOTE

Please note that each checker result has its unique name consisting of the checker abbreviation and numbers and labels.

You can change either an individual result name or many (connecting) result names simultaneously.

13.2.4.1 Change Individual Result Names

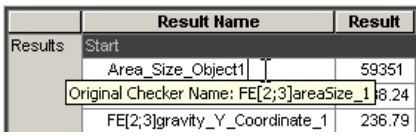
If you wish to change individual result names or the names you wish to change are not positioned in connecting spreadsheet cells and cannot be moved until they are connected, please proceed as follows:

◆Procedure

1. **View → Spreadsheet**
2. **Click on the checker result name you wish to change**

   Click into the cell name so that the cursor starts flashing.
3. **Overwrite part or all of the name**
4. **Press <Enter> to confirm the new name**

   If you click into the cell with the changed result name and wait a bit, a tool tip appears and displays the original result name (see figure below).



◆NOTE

The cursor in the "Result Name" cell must be flashing in order for you to be able to change the name or to see the original result name displayed!

13.2.4.2 Changing Multiple Result Names Simultaneously

With this function it is possible to change multiple checker result names in one step. However, the function is only available for neighboring results and you need an open editor to copy the result name to the clipboard.

Please proceed as follows:

Store New Result Name in the Clipboard

◆Procedure

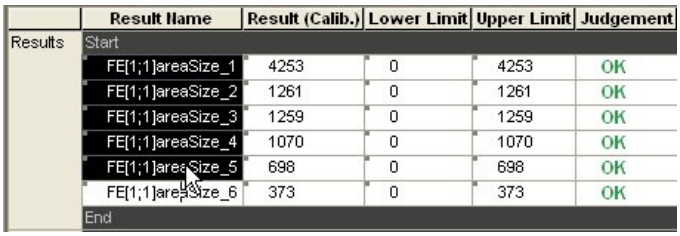
1. **Open an editor on the PC, e.g. Notepad**
2. **In the editor window, write the result name you wish to paste later**

   In this example, we want to rename all area results with "Object".
3. **Select the name and copy it to the clipboard with <Ctrl>+<c>**

Paste New Result Name into the Spreadsheet

◆Procedure

1. **View → Spreadsheet**
2. **Select the first checker result name to be changed with a left mouse click**
3. **Press <Shift>**
4. **Select the last checker result name to be changed with a left mouse click**



Make sure to click the "empty" space to the left or right of the result name. Because if you click the letters of the result name, the cell will be activated for editing and the

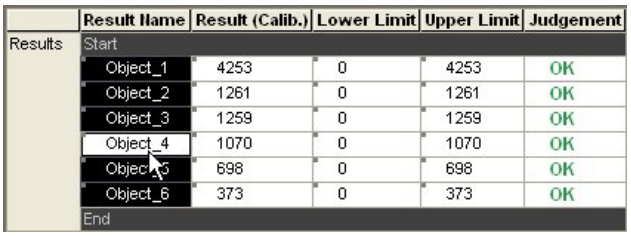
pop-up menu will not appear when you click the right mouse button. Instead, the cursor is flashing inside the result name cell.

5. **Click the right mouse button**

   If the cell you clicked last has been activated for editing, the pop-up menu will not appear. In this case, point the cursor to any cell from the selected area marked in black and click the right mouse button again.

6. **Select "Paste"**

   The text from the clipboard is inserted in the name column. Vision P400 automatically adds a number after the name to ensure that the result name is unique.



	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	Object_1	4253	0	4253	OK
	Object_2	1261	0	1261	OK
	Object_3	1259	0	1259	OK
	Object_4	1070	0	1070	OK
	Object_5	698	0	698	OK
	Object_6	373	0	373	OK
	End				

13.2.5 Finding Checker Results on the Spreadsheet

If you have entered a large number of checker results on the spreadsheet, you can make it easier to find them again by right-clicking on a blue-backgrounded checker result and from the pop-up menu choosing "Show in the Spreadsheet". Then the following happens automatically:

- The spreadsheet window is placed in the foreground.
- The spreadsheet row belonging to the result is selected and moved into the visible area of the spreadsheet. Any previously existing selection of spreadsheet rows on the spreadsheet is deleted.
- The "Spreadsheet Controller" (see page 237) window is displayed, and in it the "Toggle display of all hidden rows" option is activated.

13.2.6 Jumping from the Spreadsheet to the Checker Result

When you have inserted a checker result in the spreadsheet, you can jump directly from the spreadsheet result to the "Result" page of the checker. There are two possibilities to do that:

- Right mouse-click on a cell in the select spreadsheet row and select "Highlight in checker results" from the pop-up menu.
- Double-click left of the selected spreadsheet row in the gray area below "Results".

This is what happens:

- Vision P400 brings the camera window to which the selected checker result belongs forward
- Vision P400 highlights the sequence to which the selected checker result belongs
- The property page of the checker to which the checker result belongs is displayed.
- The checker result you have selected is highlighted on the checker's "Result" page (if the result exists, that is). If the checker from which you have selected the result works with a list, the object belonging to the selected result is moved into the visible area of the "Result" page.

13.3 Editing Functions

Vision P400 offers some special options in the spreadsheet. The following functions are available:

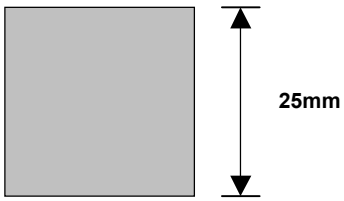
- Calibrate Values (see page 519)
- Quote (see page 526) and/or modify (see page 528) several limits simultaneously
- Edit (see page 529) several cells simultaneously

13.3.1 Calibrate Values

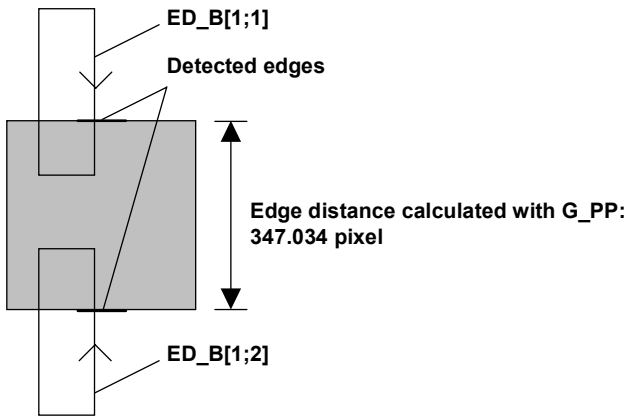
In the spreadsheet you can automatically calculate the calibrated value of any result.

◆EXAMPLE

Use a reference object that you have measured accurately. In this example we chose a square with a side length of 25 mm.



Put the object in the view range of the camera and measure the distance with two edge detection checkers and a geometry checker



These are the options for entering the values of the reference object for calibration:

- Enter them manually in the cells.
- Enter them simultaneously in multiple cells.
- Quote from an already calibrated spreadsheet row.

◆**NOTES**

- **You can only calibrate a spreadsheet row if there is a value not equal to 0 in the "Result (Calib.)" field.**
- **When a spreadsheet row is calibrated, the calibrated result is displayed in the "Result (Calib.)" field and the pixel value of the result in the "Value" field.**
- **When a spreadsheet row is not calibrated, the pixel value of the result is displayed both in the "Value" field and in the "Result (Calib.)" field.**
- **For a calibrated spreadsheet row the calibration factor is always not equal 1.0; for an uncalibrated row it is always equal to 1.0.**
- **The calibration factor is displayed by Vision P400 in the "Factor" field. If that spreadsheet column is hidden, you can still view the factor by clicking in the "Result (Calib.)" field so that the cursor starts flashing (!). If you leave the cursor where it is for a moment, the tool tip appears showing the calibration factor.**
- **The "Lower Limit", "Upper Limit", "Min Result", "Max Result", "Range", "Average", and "Sigma" columns always refer to the value in the "Result (Calib.)" column.**
- **When a spreadsheet row is calibrated, the "Min Result", "Max Result", "Range", "Average" and "Sigma" columns are automatically calibrated too. For the "Lower limit" and "Upper limit" columns you can choose whether this happens or not.**
- **The interfaces always transmit the value from the "Result (Calib.)" column.**
- **In formulas the value from the "Result (Calib.)" column is always used.**
- **Indicators displaying the result of a spreadsheet row always use the value from the "Result (Calib.)" column.**

13.3.1.1 Entering the Reference Value for Calibration Manually

◆**Procedure**

1. **First measure a reference object with the accuracy demanded**
2. **Inspect it with Vision P400**
3. **Enter the precisely measured value as a reference in the "Result (Calib.)" field of the spreadsheet <Enter>**

   A dialog box appears asking whether the lower and upper limits for judgement of the checker or formula result should be adjusted to the new calibration factor or not.

4. **Confirm if you want the limit values to be adjusted accordingly**

   The calibration factor is automatically calculated by Vision P400 and displayed in the "Factor" field. The cursor is now in the "Unit" field.

5. **Enter the unit (e.g. mm) in the "Unit" field <Enter>**

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	G_PP[1;1]distance	365.27	0.684425	250	mm	OK
	End					

When you execute the application with or <F5>, you see the value, e.g. in millimeters, in the "Result (Calib.)" field.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	G_PP[1;1]distance	365.27	0.684425	250	mm	OK
	End					

◆**NOTES**

- **Confirm each entry in the spreadsheet either with <Tab> or <Enter>.**
- **The calibration is only valid for this spreadsheet row. It does not serve as a reference calibration for other rows.**
- **If you enter an empty characteristic string or the value 0.0 in the "Result (Calib.)" column, the row calibration is removed.**
- **You can also enter the factor manually, if you know it. A dialog box appears asking whether the lower and upper limits for judgement of the checker or formula result should be adjusted to the new calibration factor or not. Confirm if you want the limit values to be adjusted accordingly.**

13.3.1.2 Entering Multiple Calibration Values Simultaneously

If you wish to calibrate multiple rows simultaneously with the same calibration value, please proceed as follows:

◆**Procedure**

1. **Select the fields in the "Result (Calib.)" column or in the "Factor" column for which you want to enter the reference**

   Click on the column header or, depending on the positions of the fields, press the <Shift> or <Ctrl> key (see page 506).

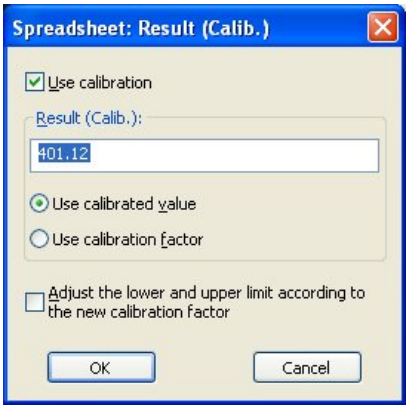
	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	35.85	1	35.85		OK
	ED_B[1;1]distance_2	90.31	1	90.31		OK
	ED_B[1;1]distance_3	346.09	1	346.09		OK
	ED_B[1;1]distance_4	401.12	1	401.12		OK
	End					

2. **Click the right mouse button in one of the selected cells**

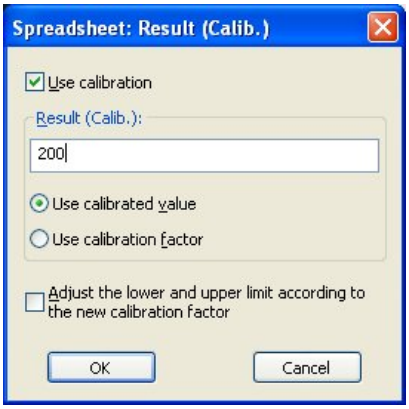
   This field must not be calibrated, meaning its calibration factor must be 1.

3. **Select "Calibrate..."**

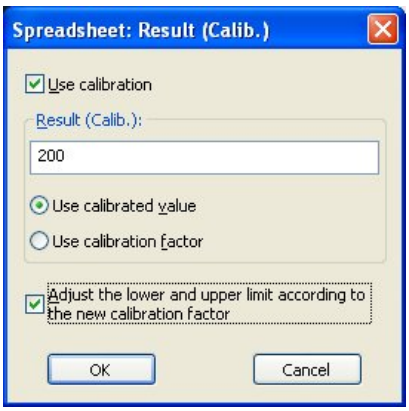
A dialog box appears in which "Use calibrated value" is preset by default and in the input box the value of the "Result (Calib.)" column of the last selected spreadsheet field is entered.



4. **Enter the new reference**



5. **Choose "Adjust the lower and upper limit according to the new calibration factor" if you want to adjust the limit values according to the new calibration factor**



6. **Click [OK]**

Make sure that the option "Use Calibration" remains activated. All selected fields in

the "Result (Calib.)" column now contain the entered reference. For each calibrated row Vision P400 calculates an individual calibration factor from the current result and the entered reference and outputs it in the "Factor" column. If under 5. you selected "Adjust the lower and upper limit according to the new calibration factor", Vision P400 also adjusts the lower and upper limit values.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	35.85	5.57	200		OK
	ED_B[1;1]distance_2	90.31	2.21	200		OK
	ED_B[1;1]distance_3	346.09	0.57	200		OK
	ED_B[1;1]distance_4	401.12	0.49	200		OK

◆NOTE

When you right-click on an already calibrated field, in the dialog box which then appears "Use calibration factor" is preset by default, because when a row is calibrated Vision P400 assumes that you want to apply the calibration factor of that row to the other rows. In this case, apply the procedure described in the section headed "Quote an Existing Calibration Value".

13.3.1.3 Quote an Existing Calibration Value

If you want to apply an existing calibration as the benchmark for the other rows, you have two options:

- You apply the calibrated value
- You apply the calibration factor

The procedures are virtually identical. The example below demonstrates how to apply a calibration factor:

◆Procedure

1. **Select still uncalibrated fields in the "Factor" column**

   Depending on the cells' position, use the <Shift> or <Ctrl>key (see page 506).

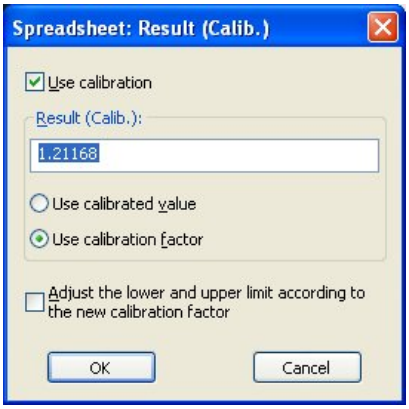
2. **Right-click on the "Factor" field of the row from which you want to transfer the calibration factor**

   This field must be calibrated, meaning its calibration factor must be unequal to 1.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	37.88	1	37.88		OK
	ED_B[1;1]distance_2	74.96	1	74.96		OK
	ED_B[1;1]distance_3	128.63	1	128.63		OK
	ED_B[1;1]distance_4	165.06	1.21	200		OK
	ED_B[1;1]distance_5	219.98	0.90	200		OK
	ED_B[1;1]distance_6	314	1	314		OK

3. **Select "Calibrate..."**

The following dialog box is displayed:



The calibration factor of the row in which you pressed the right mouse button has already been entered and the "Use calibration factor" option activated. If the cursor was positioned on an uncalibrated row when the pop-up menu was opened, the dialog box shows other settings. In that case Vision P400 suggests that you apply the calibrated value of the row in which you pressed the right mouse button.

4. **Choose "Adjust the lower and upper limit according to the new calibration factor" if you want to adjust the limit values according to the new calibration factor**

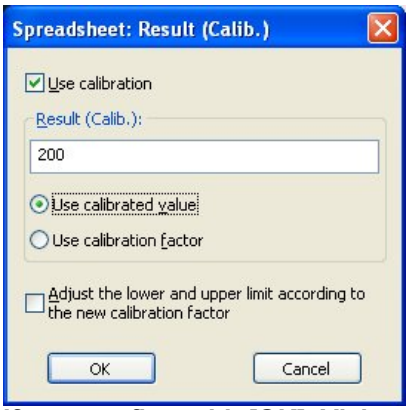
5. **Click [OK]**

   Make sure the "Use calibration factor" option remains activated. Vision P400 applies the calibration factor of the selected row for the other rows, enters it in the "Factor" column and recalculates the value in the "Result (Calib.)" column. If you selected "Adjust the lower and upper limit according to the new calibration factor", Vision P400 also adjusts the lower and upper limit values.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	37.88	1.21	45.898		OK
	ED_B[1;1]distance_2	74.96	1.21	90.828		OK
	ED_B[1;1]distance_3	128.63	1	128.63		OK
	ED_B[1;1]distance_4	165.06	1.21	200		OK
	ED_B[1;1]distance_5	219.98	0.90	200		OK
	ED_B[1;1]distance_6	314	1	314		OK
	End					

◆**NOTES**

- **A calibrated value is applied in the same way as detailed in this procedure: If the right mouse button click is made in a field of an uncalibrated row, the dialog box suggests you apply the calibrated result:**



If you confirm with [OK], Vision P400 applies the reference of the selected row for the other rows, enters it, calculates from it an individual calibration factor for each row and outputs it in the "Factor" column. If you selected "Adjust the lower and upper limit according to the new calibration factor", Vision P400 also adjusts the lower and upper limit values.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	37.88	5.27	200		OK
	ED_B[1;1]distance_2	74.96	2.66	200		OK
	ED_B[1;1]distance_3	128.63	1	128.63		OK
	ED_B[1;1]distance_4	165.06	1.21	200		OK
	ED_B[1;1]distance_5	219.98	0.90	200		OK
	ED_B[1;1]distance_6	314	1	314		OK
	End					

- **You can edit the value in the input box before clicking [OK]. Please note, however, that the modified input value will also be entered in the row you have selected with a right mouse click, i.e. the row with the original input value.**

13.3.1.4 Removing a Calibration

To remove a calibration, please proceed as follows:

◆Procedure

1. **Select the fields from which you want to remove the calibration**

   You can select the fields either in the "Result (Calib.)" column or in the "Factor" column. Depending on the cells' position, use the <Shift> or <Ctrl>key (see page 506).

2. **Select "Calibrate..."**
3. **Deactivate "Use Calibration"**
4. **Click [OK]**

The calibration is deleted.

◆**NOTE**

You can also remove the calibration of a spreadsheet row manually. To do so, enter an empty character string or the value 0.0 in the "Result (Calib.)" column.

13.3.2 Judgement Limits

On the spreadsheet limit values are used for logical evaluation (OK/NG) of the result values. When inserting the checker results in the spreadsheet, limit values are set at the same time. In this, 0 is entered as the lower limit and the current result as the upper limit.

If the result lies in between these limits, the judgment will be OK, if not it will be NG (not good). The result is displayed in the field "Judgement". OK is displayed in green, NG in red.

	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	ED_G[1;1]distance_4	70.83	65.83	70.83	OK
	End				

Spreadsheet judgement

◆**NOTES**

- **You need to enter the upper limit first as Vision P400 does not accept an upper limit that is lower than the lower limit: Lower limit <= upper limit. Bear this also in mind if you change the limit settings manually or via the interface.**
- **Confirm each entry in the spreadsheet either with <Tab> or <Enter>.**
- **If you calibrate values, the upper and lower limit always refer to the calibrated value, not to the pixel value.**

13.3.2.1 Quote Values for Both Limits

You may quote the current values from the columns "Min Result", "Max Result", or "Average" to be used as limits. The quickest method is to quote the values for the lower and upper limits simultaneously. Please proceed as follows:

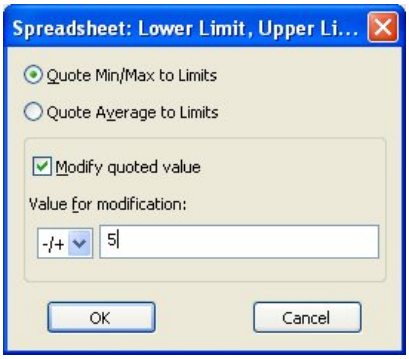
◆**Procedure**

1. **In the columns "Lower Limit" and "Upper Limit" select the cells for which you wish to quote the values**

   Make sure you select both limits for each row because otherwise an error may occur when you try to quote the values.

2. **Position the cursor on any of the selected cells and click the right mouse button**

3. **Select "Quote..."**



If the dialog box displayed looks different, it probably means you have selected cells only from the column "Lower Limit" or "Upper Limit".

4. **Select "Quote Min/Max to Limits" if you wish to take over the values from the columns "Minimum" and "Maximum" or select "Quote Average to Limits" if you wish to take over the average values**
5. **Activate "Modify Quoted Value" if you wish to modify the values to be taken over**
6. **Under "Value for Modification", enter the value to be used for modifying the values to be taken over**

   The default operator is "-/+" when you take over values for the lower and the upper limits. In this case, the modification value is subtracted from the lower limit and added to the upper limit. However, if you select "-" or "+", the modification value will be subtracted from or added to BOTH limits.
7. **Select [OK]**

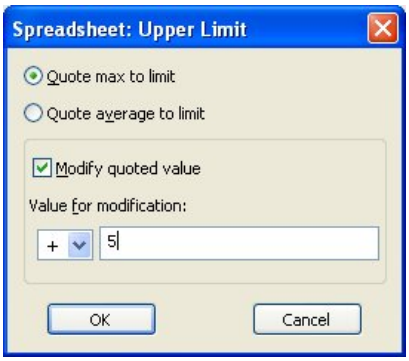
13.3.2.2 Quote Values for One Limit

If you wish to quote values for the upper and lower limit separately, you should begin with the upper limit. Otherwise an error may occur because Vision P400 does not tolerate it if you enter a lower limit that is above the upper limit. Please proceed as follows:

◆Procedure

1. **Select the cells from the column "Upper Limit" for which you wish to quote values from other columns**
2. **Position the cursor on any of the selected cells and click the right mouse button**
3. **Select "Quote..."**

If you have selected cells only from the column "Upper Limit", the following dialog box is displayed:



If the dialog box displayed looks different, you have selected cells also from columns other than "Upper Limit".

4. **Select "Quote Max to Limits" if you wish to take over the values from the column "Maximum" or select "Quote Average to Limit" if you wish to take over the average values**
5. **Activate "Modify Quoted Value" if you wish to modify the values to be taken over**
6. **Under "Value for Modification", select the arithmetic operator and the value you want to use to modify the applied values**

   Select "+" or "-" as the operator, depending on whether you wish to add or subtract the value for modification.
7. **Select [OK]**

13.3.2.3 Modify Existing Limits

You can modify all limits by adding or subtracting values. Please proceed as follows:

◆Procedure

1. **In the columns "Lower Limit" and/or "Upper Limit" select the cells for which you wish to modify the values**
2. **Position the cursor on any of the selected cells and click the right mouse button**
3. **Select "Add Delta Value..."**

4. **Enter the value for the modification and select one of the operators "+", "-", or "-/+"**

   It depends on the cells selected under "Lower Limit" and/or "Upper Limit" which operators are available and which operator is selected by default. With "-/+", the value you enter will be subtracted from the lower limit and added to the upper limit. With "-" or "+", however, the value will be subtracted from or added to BOTH limits.

5. **Select [OK]**

13.3.3 Editing Multiple Cells

It is possible to change the contents of multiple cells simultaneously in the columns "Unit", "String Reference" und "NG Max".

Procedure

1. **Select several spreadsheet cells from one of the columns listed above**

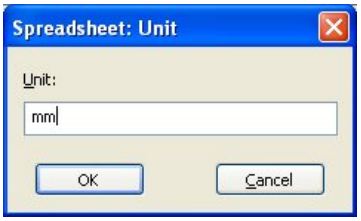
   Please use the multiple selection keys (see page 506) or select complete columns. In this example we want to enter "mm" in all cells from the "Unit" column.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	37.88	1	37.88		OK
	ED_B[1;1]distance_2	74.96	1	74.96		OK
	ED_B[1;1]distance_3	128.63	1	128.63		OK
	ED_B[1;1]distance_4	165.06	1	165.06		OK
	ED_B[1;1]distance_5	219.98	1	219.98		OK
	ED_B[1;1]distance_6	314	1	314		OK
	End					

2. **Click the right mouse button**
3. **Select "Edit All Cells"**

   A dialog box appears with the name of the column in which you have selected the cells.

4. **Enter the text for the cells**



5. **Click [OK]**

Vision P400 pastes the text you have entered in the dialog window into all selected cells.

	Result Name	Value	Factor	Result (Calib.)	Unit	Judgement
Results	Start					
	ED_B[1;1]distance_1	37.88	1	37.88	mm	OK
	ED_B[1;1]distance_2	74.96	1	74.96	mm	OK
	ED_B[1;1]distance_3	128.63	1	128.63	mm	OK
	ED_B[1;1]distance_4	165.06	1	165.06	mm	OK
	ED_B[1;1]distance_5	219.98	1	219.98	mm	OK
	ED_B[1;1]distance_6	314	1	314	mm	OK
	End					

13.4 Locking, Hiding, and Display Functions

You can lock or hide individual rows of the spreadsheet or lock the complete spreadsheet to protect it against changes.

13.4.1 Locking the Complete Spreadsheet

In setup mode, you can lock the spreadsheet with **Spreadsheet → Lock Spreadsheet** so that users cannot modify the entries in any way (changing limits, selecting different data for interface output, etc.). The lock can be combined with a password (see page 537).

When the spreadsheet has been locked, the word "[Locked]" appears in the blue title bar of the spreadsheet window. To unlock the spreadsheet, again choose **Spreadsheet → Lock Spreadsheet** so that the check mark disappears.

◆NOTE

Locking the spreadsheet affects ALL applications.

13.4.2 Hide Rows and Show Hidden Rows

It is possible to hide individual spreadsheet rows in order to have a better overview over large spreadsheets.

When a row is hidden, certain functions can no longer be executed via the user interface:

Available	Not available
Update contents by executing the application	Change properties of cells in the row, e.g. result name, limits, background color
Reset statistics	
Use row in a formula (copy name beforehand or enter it manually)	

◆NOTE

This does not apply to functions executed by the interfaces, e.g. changing limits.

If you wish to hide spreadsheet rows, please proceed as follows:

◆Procedure

1. **Select one or more spreadsheet rows**

   Depending on the rows' position, use the <Shift> or <Ctrl> key (see page 506) if you wish to select more than one row.

2. **Click the right mouse button**
3. **Select "Hide Row(s)"**

When a row is hidden, the separating line between the rows above and below the hidden row is thicker than usual (it represents the "missing" row). In this example the row with the 5th result is hidden.

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_1	4253	4253	4231	4253	OK
	FE[1;1]areaSize_2	1261	1261	1251	1261	OK
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
➡	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

When you hide the topmost row(s), a thick **blue** separation line appears above the first non-hidden row.
In this example the rows with the 1st, 2nd and 5th result are hidden.

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results ➡	Start					
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

To display a hidden row again, proceed as follows depending on the position of the row in the spreadsheet:

Show Hidden Middle Rows

◆ **Procedure**

1. **Select the row right above the thick blue separation line**

   It suffices to select one cell in the row (a selected cell is displayed with a black frame).

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

2. **Click the right mouse button**
3. **Select "Show Row(s)"**

   The formerly hidden row will be displayed again.

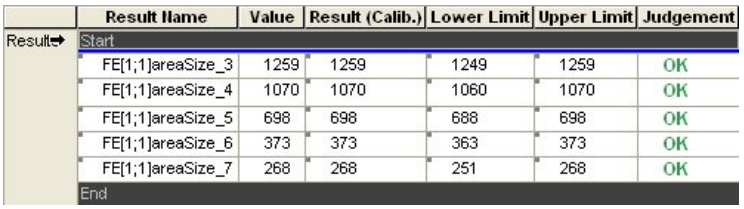
	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_5	698	698	688	698	OK
	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

Show Hidden Top Rows

◆Procedure

1. **Left mouse click on "Results"**

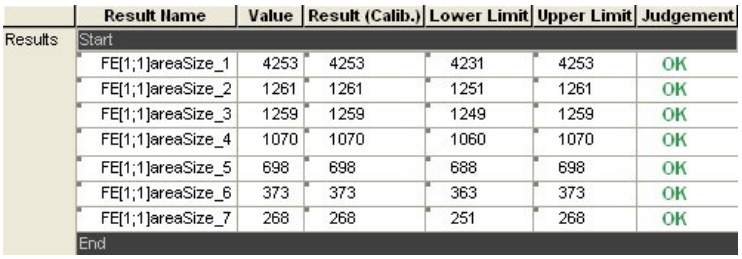
   The cursor turns into an arrow.



	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_5	698	698	688	698	OK
	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

2. **Click the right mouse button**
3. **Select "Show Row(s)"**

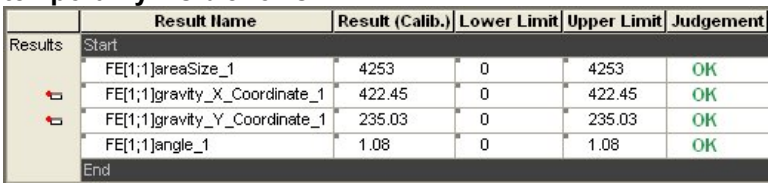
   If you have positioned the cursor in the first visible row above the thick blue separation line and use the show function, all hidden rows below the selected row will be displayed. In the example the rows 1 and 2 are no longer hidden.



	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_1	4253	4253	4231	4253	OK
	FE[1;1]areaSize_2	1261	1261	1251	1261	OK
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_5	698	698	688	698	OK
	FE[1;1]areaSize_6	373	373	363	373	OK
	FE[1;1]areaSize_7	268	268	251	268	OK
	End					

◆NOTES

- **If you have hidden spreadsheet rows, you can temporarily display them again by clicking on the icon in the Spreadsheet Controller. Then the icon is displayed on the spreadsheet to the left of the actually hidden but temporarily visible rows.**



	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	FE[1;1]areaSize_1	4253	0	4253	OK
	FE[1;1]gravity_X_Coordinate_1	422.45	0	422.45	OK
	FE[1;1]gravity_Y_Coordinate_1	235.03	0	235.03	OK
	FE[1;1]angle_1	1.08	0	1.08	OK
	End				

- **Hidden rows remain hidden when you save the application, close it, and then open it again. This is different from the spreadsheet controller (see page 237), which you can use to limit the display of checker and formula results when creating an application. However, the limits you make with the spreadsheet controller are lost when you save the application, close it, and then open it again.**

- **When you have hidden several rows at the top of the spreadsheet and there are also hidden rows below the first visible row in the spreadsheet, the show function will unhide both the top rows and the rows below the first visible row.**
- **If you have selected several neighboring rows with the <Shift> key and there are hidden rows among them, the hidden rows will be displayed when you choose "Show" from the pop-up menu.**

13.4.3 Lock Individual Rows

It is possible to lock individual rows of the spreadsheet. When a row is locked, certain functions can no longer be executed via the user interface:

Available	Not available
Update contents by executing the application	Change properties of cells in the row, e.g. result name, limits, background color
Reset statistics	
Use row in a formula (copy name beforehand or enter it manually)	

◆NOTE

This does not apply to functions executed by the interfaces, e.g. changing limits.

Locked rows are marked with a small red padlock symbol to the left of the result name. The text in the cells is displayed in italics.

If you wish to lock spreadsheet rows, please proceed as follows:

◆Procedure

1. **Select one or more spreadsheet rows**

   Depending on the row position, use the <Shift> or <Ctrl>key (see page 506).

2. **Click the right mouse button**
3. **Select "Lock Row(s)"**

	Result Name	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start				
	FE[1;1]areaSize_1	4253	0	4253	OK
	FE[1;1]areaSize_2	1261	0	1261	OK
	FE[1;1]areaSize_3	*1259*	*0*	*1259*	OK
	FE[1;1]areaSize_4	1070	0	1070	OK
	End				

To unlock a row, proceed in the same way, but select "Unlock Row(s)".

◆NOTE

Locked rows remain locked when you save the application, close it, and then open it again.

13.4.4 Changing the Background Color of Cells

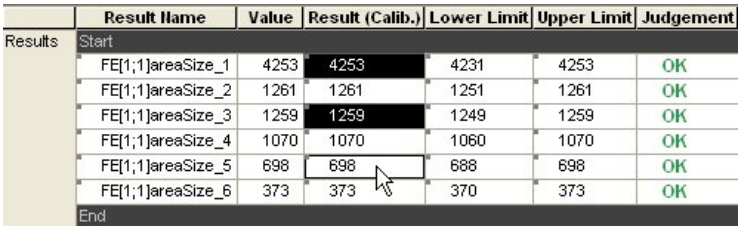
Use this function to change the background color of spreadsheet cells. However, please note that user-defined colors will be ignored if the cell color is used to convey a certain information. For example, the background color for cells in the "Judgement" columns is always red, if an error has occurred during result calculation. The red color will appear no matter what color you may have selected for the cell.

When you define a new background color, make sure it is different from the text color. For example, black as a background color will prove impractical.

◆Procedure

1. **Select one or more spreadsheet cells**

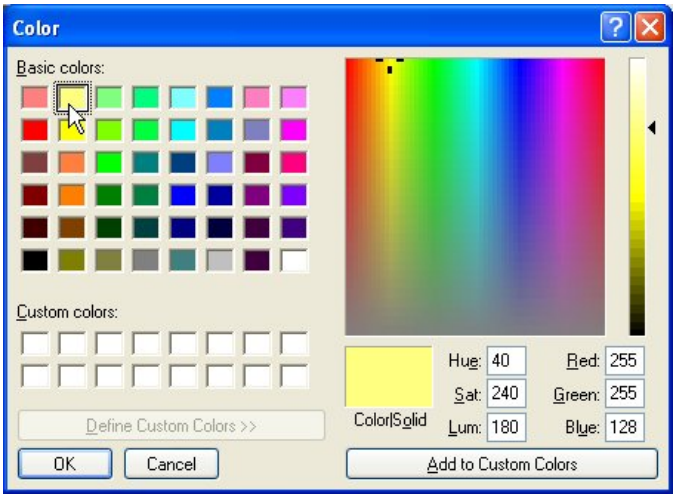
   Please use the multiple selection keys (see page 506) or select complete rows.



	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_1	4253	4253	4231	4253	OK
	FE[1;1]areaSize_2	1261	1261	1251	1261	OK
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_5	698	698	688	698	OK
	FE[1;1]areaSize_6	373	373	370	373	OK
	End					

2. **Click the right mouse button**
3. **Select "Background color..."**

The color selection dialog appears.



4. **Click the left mouse button on a basic color or on any of the colors on the right**
5. **Use the arrow on the far right to adjust the color brightness**
6. **Click [OK]**

	Result Name	Value	Result (Calib.)	Lower Limit	Upper Limit	Judgement
Results	Start					
	FE[1;1]areaSize_1	4253	4253	4231	4253	OK
	FE[1;1]areaSize_2	1261	1261	1251	1261	OK
	FE[1;1]areaSize_3	1259	1259	1249	1259	OK
	FE[1;1]areaSize_4	1070	1070	1060	1070	OK
	FE[1;1]areaSize_5	698	698	688	698	OK
	FE[1;1]areaSize_6	373	373	370	373	OK
	End					

The selected cells appear in the background colors you have chosen.

13.4.5 Setting a Password

Use this option to set a password for locking the spreadsheet. If you do not define a password, the spreadsheet can be locked/unlocked by any user.

◆Procedure

1. **System Settings → Spreadsheet Password**

   If you have not assigned a password yet, proceed to step 3.

2. **If you have already assigned a password to the spreadsheet, enter it under "Current Password"**
3. **Enter your new password under "New Password"**

   If you make no entry, the access to locking/unlocking the spreadsheet is not protected.

4. **Enter your password again under "Confirm New Password"**
5. **Click OK**

◆NOTE

This password only applies to locking/unlocking the spreadsheet. The application is protected by a dedicated password (see page 134).

13.5 Result Output to the Interfaces

This section deals with data output to the interfaces and/or file. There are 5 interfaces/file types available (see below). Select any result(s) from the spreadsheet for output on the interfaces and, in the next step, configure the correct data type and make the appropriate interface/file settings. All results which can be calculated in run mode will now be transferred automatically.

13.5.1 Available Interfaces

On the left side of the spreadsheet window you see buttons representing the available interfaces. Use these buttons to determine which results from checkers or formulas should be transferred to which interface.

Icon	Interface name
	Action (see page 563)
	RS232 (see page 506)
	P I/O (see page 506)
	FILE (see page 555)
	OLE (see page 506)

When you click on the button the "Objects for Data Transfer" window belonging to the interface opens up with the spreadsheet results you want to output to the interface. For the following interfaces additional basic settings are required for communication:

- RS232 (see page 158)
- P I/O (see page 173)
- OLE (see page 185)

13.5.2 Selecting Results for Output

All values from spreadsheet cells that are calculated when you execute the application can be output to the interfaces. Please note that depending on the type of spreadsheet row not all cells in the row are calculated. For example, in a row containing a Boolean formula, Vision P400 does not calculate the values in the columns "Min Result" and "Max Result". All calculated cells have the default color white.

Depending on the data type of the cell, the contents can be output to different interfaces:

Data type of the cell	RS232	P I/O	File	OLE
Numeric results (integer, double/string*)	x	x	x	x
Boolean results	x	x	x	x

Data type of the cell	RS232	P I/O	File	OLE
Textual string results	x		x	x

*All numeric results of type integer or double can also be output as a string.

For the individual cells and their data type please refer to the table:

Cell (column)	Data type
Name	String
Value	Numeric or string
Factor	Numeric
Result (Calib.)	Numeric or string
Unit	String
String reference	String
Lower/upper limit	Numeric
Min/max result	Numeric
Range	Numeric
Average	Numeric
Sigma	Numeric
Judgement	Boolean
NG	Numeric
NG max	Numeric
Error	Numeric
Scans	Numeric

Use the right mouse button or drag & drop to transfer multiple results from the spreadsheet to an interface.

◆NOTES

- **If you work with execution groups, please remember that the transfer to the interfaces only works for the data which has been calculated in the current start or for data from a formula which is either global or otherwise independent from execution groups.**
- **If you are trying to transfer multiple results to an interface, Vision P400 only accepts the values of those cells with a data type valid for the selected interface. Other values will be ignored.**

Using the right mouse button

◆Procedure

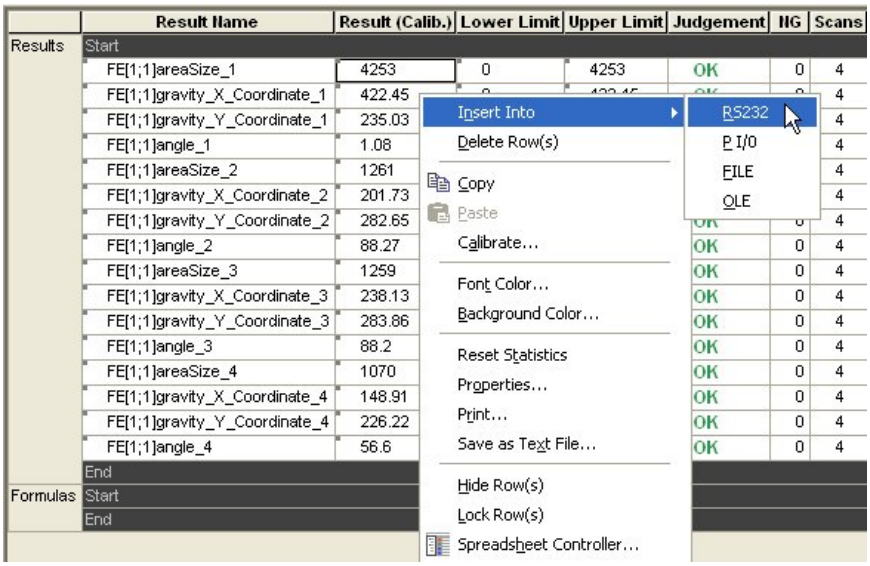
1. **Select one or more values you want to output to an interface**

   For multiple values, please use the multiple selection keys (see page 506).

2. **Click the right mouse button in one of the selected spreadsheet cells**

A pop-up menu appears. The data type of the cell where you clicked the right mouse button determines which interfaces will be displayed in the popup-menu.

3. **Select an interface with the left mouse button**



The transferred spreadsheet values appear marked in the color of the interface to which they will be output.

◆**NOTE**

The right mouse button works only as described if you have selected the field with the mouse (the field has a black border). The function is not available when the cursor is IN the field (flashing bar-style cursor).

Using the Drag & Drop Function

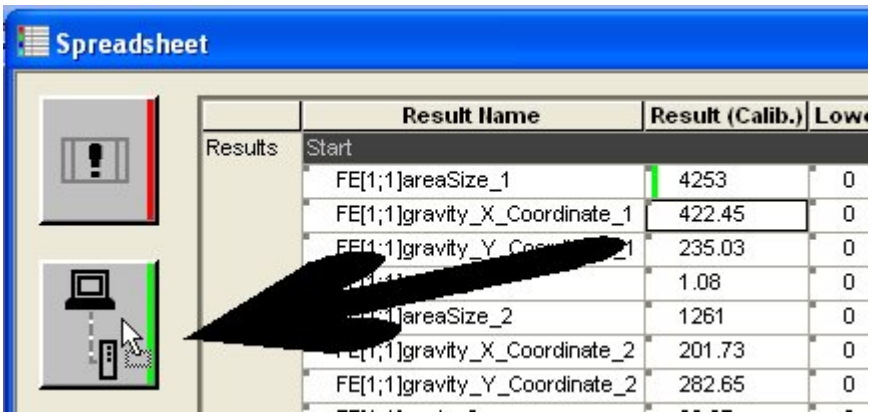
◆**Procedure**

1. **Select the values you want to output to an interface**

   For multiple values, please use the multiple selection keys (see page 506).

2. **Hold the mouse button down in one of the selected fields and drag the cell to the interface button**

   If you transfer multiple values to the interface please note that you have to hold down not only the mouse button but also the <Ctrl> or <Shift> key. Depending on the data type of the cell where you clicked the mouse button different interfaces may be available.



The transferred values will be marked in the spreadsheet with a small bar in the corresponding interface color coding, e.g. green for the serial and blue for the parallel interface.

The next step is to configure the objects you have marked for interface output in the "Objects for Data Transfer" window.

13.5.3 Configuring Checker Results for Data Transfer

All results you have selected in the spreadsheet for output to the interfaces need to have a data type (see page 541) assigned. Vision P400 automatically assigns a default data type. However, you can change both the output sequence and the data type manually.

13.5.3.1 Setting the Data Type

When you configure the result output to the interfaces, Vision P400 automatically assigns a data type:

Result	Property of output value	Default data type for interface			
		RS232 in ASCII mode and file	RS232 in MEWTOCOL mode	P I/O	OLE
NG NG max Error Scans	Numeric and integer	Integer	INT	INT16 INT 8	Integer

Result	Property of output value	Default data type for interface			
		RS232 in ASCII mode and file	RS232 in MEWTOCOL mode	P I/O	OLE
Result (Calib.) of all checkers except OCR checker and code reader Value Factor Lower/upper limit Min result Max result Range Average Sigma	Numeric and decimal	Decimal value	REAL	IEEE float	Double
Name Result (Calib.) OCR checker and code reader Unit String reference	Text	Text	STRING[16]	Not available	String
Judgement	Boolean	Boolean	BOOL	INT1	Boolean

For numeric values Vision P400 decides whether the transferred result will always be integer (e.g. the number of scans) or whether it may be a decimal figure, e.g. the result of a spreadsheet row. If it is integer, Vision P400 uses the largest integer data type available for that interface. If it is a decimal value, the data type will be "Decimal Value" or "Double", depending on the interface.

If the current result for a numeric data type is too big or too small, Vision P400 writes an overflow message to the error log and outputs an error. Please note that the overflow signal is only sent to the parallel interface if you have activated the sending of the signal on the P I/O's property page (see page 173).

The value ranges for numeric data types are given in the "ASCII Communication Protocol" (see page 160):

Data type	Value range
INT1	0 or 1
INT8	0 to 255 or -127 to +127
INT16	0 to 65,535 or -32,767 to +32,767
INT32	0 to 4,294,967,295 or -2,147,483,647 to +2,147,483,647
Integer	-2^{13} to 2^{13}
Double	1.7E -308 to 1.7E +308
IEEE float	3.4E -38 to 3.4E 38

It depends on the application whether a value is interpreted positively or negatively. Checker and calculation results can be negative/positive.

When outputting data to the parallel interface you need to consider not only the data type but also data representation and the value range, respectively:

Data type	Representation
Numerical data	INT8 = 1 byte; INT16 = 2 byte; IEEE float = 4 byte
Boolean data (OK/NG)	INT1 = 1 bit, 8 Boolean data in a row require 1 byte

The serial interface in PLC mode (MEWTOCOL) produces the value ranges below. If a result value exceeds the value range of the preset data type, Vision P400 outputs an execution result error (provided the "Execution Result Error" option on the property page of the RS232 interface is activated) and transmits the predefined error value (see page 163).

Data type	Representation
BOOL	0 or 1 (1 bit)
INT	From -32,767 to +32,767 (decimal, 16 bits)
DINT	-2.147.483.648 to +2.147.483.647 (decimal, 32 bits)
REAL	-3,402823E38 and -1,175494E38 also 0.0 and between +1,175494E38 and +3,402823E38
WORD	0 to 65535
DWORD	0 to 4294967295
STRING[..]	1 to 255 characters, programmable (e.g. with STRING[2] two characters can be transferred)
ARRAY OF WORD [0..]	1 to 9999 character pairs, programmable (e.g. with ARRAY OF WORD [0..1] four characters can be transferred)

◆NOTES

- **If no data type is selected (column entry: "not set" (see page 541)), the system outputs an execution result error to the interface regardless of the selected communication protocol.**
- **If a result of data type STRING[..] or ARRAY OF WORD[0..] exceeds the predefined number of characters, the system transmits the preset maximum number of characters and outputs an execution result error to the interface.**

There are two ways of manually changing the data type assigned automatically by Vision P400:

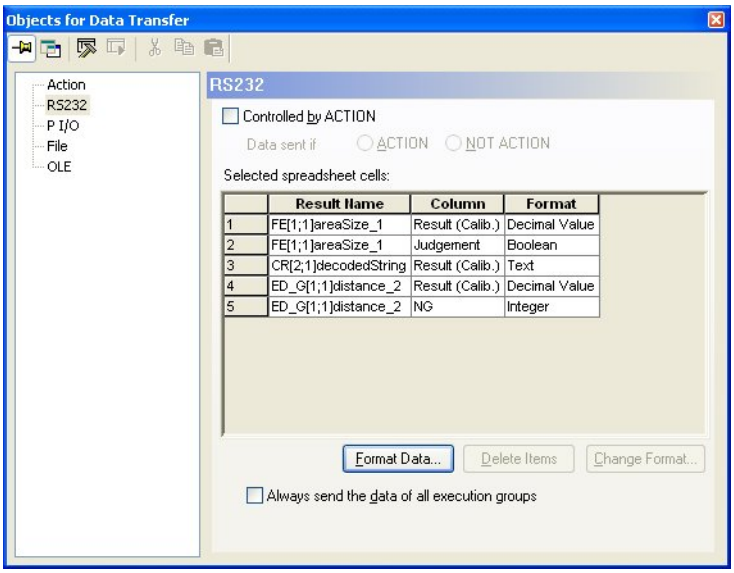
Data Type Changing via the Pop-up Menu

◆Procedure

1. **Click the corresponding interface button**

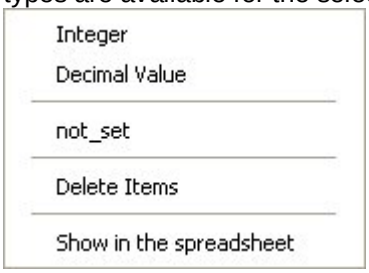
   The window "Objects for Data Transfer" appears (in this example, the RS232 interface has been selected).

2. **Select the row(s) to be edited with the mouse**



3. Click the right mouse button

A pop-up menu appears. The menu will look different depending on which data types are available for the selected value.



4. Select a data type

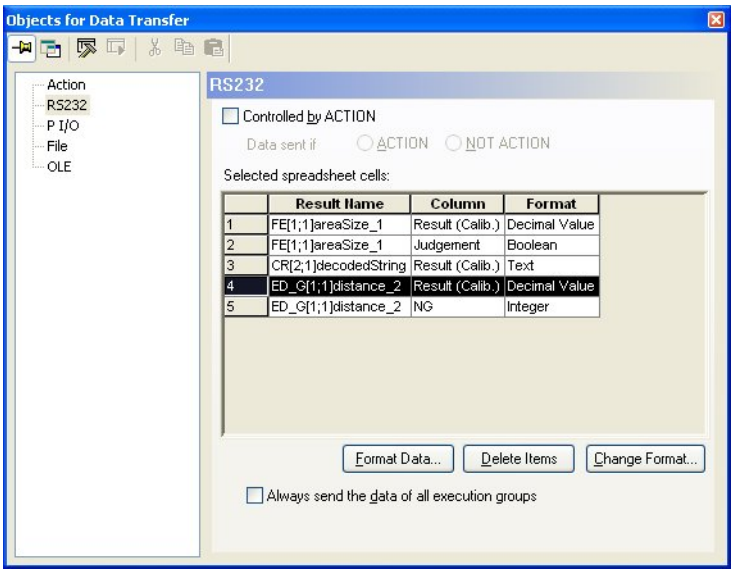
If you have selected several rows, Vision P400 displays only those data types (see page 538) which are common to all selected rows.

Data Type Changing via the "Change Data Type" Window

◆Procedure

1. Click the corresponding interface button

The window "Objects for Data Transfer" appears (in this example, the RS232 interface has been selected).



2. **Select the row(s) with the mouse you wish to edit and then select [Change Data Type]**

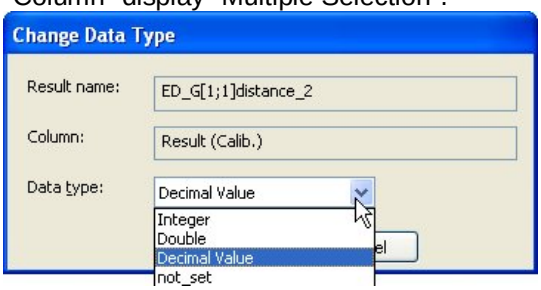
   or

   Double-click one of the selected rows

   Please note that you need to hold down the <Shift> or <Ctrl> key during the double-click when you have selected several rows. The "Change Data Type" window appears.

3. **Click the drop-down list to see all available data types**

   If you have selected several rows, Vision P400 displays only those data types (see page 538) which are common to all selected rows. The fields "Result Name" and "Column" display "Multiple Selection".



4. **Select a data type**
5. **Confirm your choice with [OK]**

13.5.3.2 Deleting Checker Results from the Result Output List

◆Procedure

1. **Click the corresponding interface button**
2. **Select the row(s) to be deleted**
3. **Select [Delete]**

   or

   press <Del>

   or

   Click the right mouse button and select "Delete" from the pop-up menu

13.5.3.3 Changing the Transfer Sequence

Normally, the checker results from the spreadsheet are transferred in the same sequence order as they were selected for the interface. You can change the transfer sequence to meet your requirements.

◆Procedure

1. **Click the corresponding interface button**

   The "Objects for Data Transfer" window appears.
2. **With the left mouse button, click on a row and keep the button pressed**
3. **Drag the row to the required position in the list**
4. **Release the left mouse button**

   This alters the sequence in which the objects are transferred to the interface.

13.6 Interface Settings

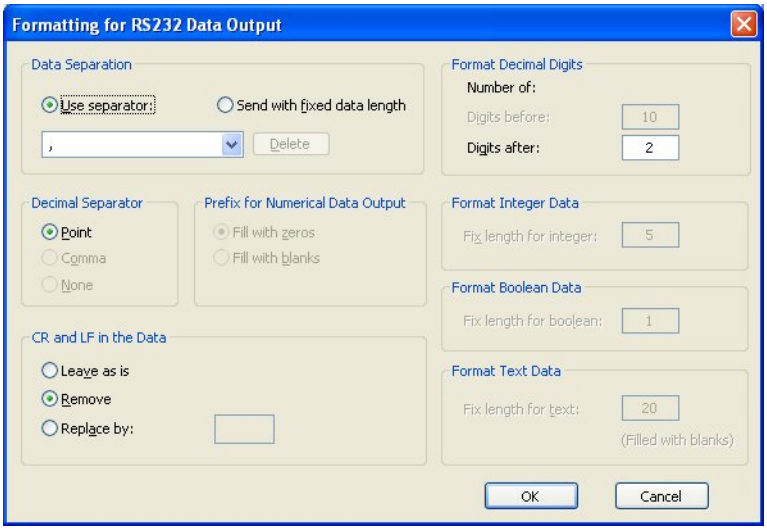
Depending on which interface you have selected for output, you can make additional settings. This enables you to influence the format of the result file and the data so that you get a layout tailored to your requirements.

Interface	Data Format Settings	Settings for the File	Other Settings
RS232 (see page 549)	Column Separator Decimal Separator Handling of CR and LF in the data	---	---
P I/O (see page 179)	---	---	Define whether data transfer should be controlled by handshake or, if not, whether the system should perform a forced reset on the Strobe signal after the reset time entered on the digital I/O property page.
FILE (see page 555)	Column Separator Extra Columns File Header Additional File Header Text Decimal Separator Handling of CR and LF in the data	File Settings Append to File Name Number Controlling Limited File Size	---
OLE (see page 563)	Data Container Index Execution Group Numbers	---	---

The following sections deal with the available setting options for all the interfaces in the same order as the interface buttons appear on the left side of the spreadsheet.

13.6.1 RS232 Interface

The RS232 interface offers some data format settings to determine the layout of the result output. Some of the options are also used for the File interface.



Data format for RS232 interface when using a separator

Depending on whether you want to output data with a fixed length or separated by a separator character, there are different settings available:

- Data separation using a separator:
  - Column Separator (see page 549)
  - Decimal Separator (see page 549)
  - Handling of CR and LF in the data (see page 549)
  - Format for digits after the decimal separator (see page 549)
- Sending data with fixed data length:
  - Prefix for Numerical Data Output (see page 550)
  - Decimal Separator (see page 550)
  - Handling of CR and LF in the data (see page 549)
  - Length and format of the data types (digits before and after the decimal separator) (see page 550)

13.6.1.1 Data Separation Using a Separator

Here you define the character which separates the columns in the result file from each other. By default, Vision P400 uses a comma to separate the columns.

◆NOTE

If you wish to use the comma as the decimal separator, you must select a different separator here.

User-Defined Separator

You may enter up to 22 characters in the list of available separators, then click [OK]. Use the [Delete] button to remove the character or string from the list of column separators. In this case, Vision P400 reverts to the comma as the default column separator, unless it is already in use as the decimal separator. In this case the semicolon is the default.

13.6.1.2 Decimal Separator

This option acts as a toggle switch and lets you define the character used to display decimal numbers. You can choose between a full stop (period) and a comma.

◆NOTE

This option is only available when the option "Use Separator" does not use a comma or full stop to separate the data columns!

In addition, you need to set the number of decimal digits after the decimal separator on the right side of the dialog box under "Format Decimal Digits".

The result of the code reader may contain line breaks (CR / LF = Carriage Return / Line Feed). In this case you need to define how Vision P400 should output the line breaks to the interfaces:

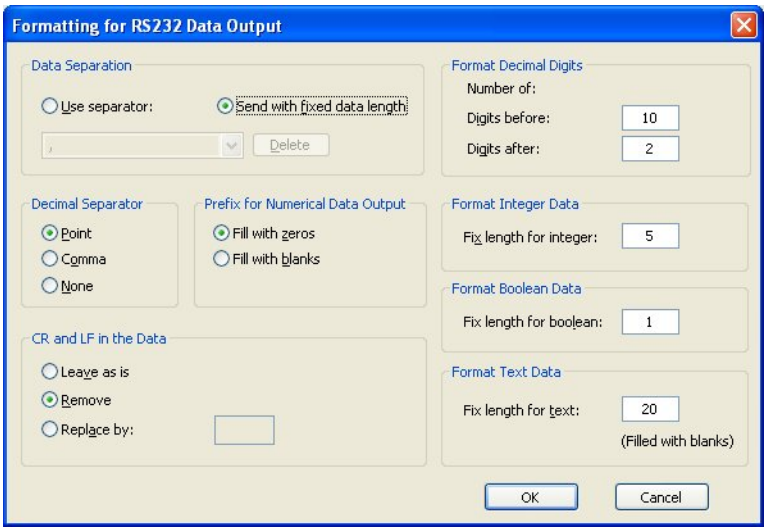
Setting	Functionality
Delete	If the result contains line breaks, these will be removed.
Replace by	Enter a character (or a string of characters) to be output instead of the line break.

	Result Name	Result (Calib.)	String Reference	Judgement	Scans
Results	Start				
	CR[2;2]decodedString	This text comprises several lines	This text comprises several lines	OK	2
	End				

Code reader result with several lines

13.6.1.3 Sending Data with Fixed Data Length

When you decide to send data with a fixed data length, some further options in the dialog box become available:



Data format for RS232 interface when working with a fixed data length

Prefix for numerical data output

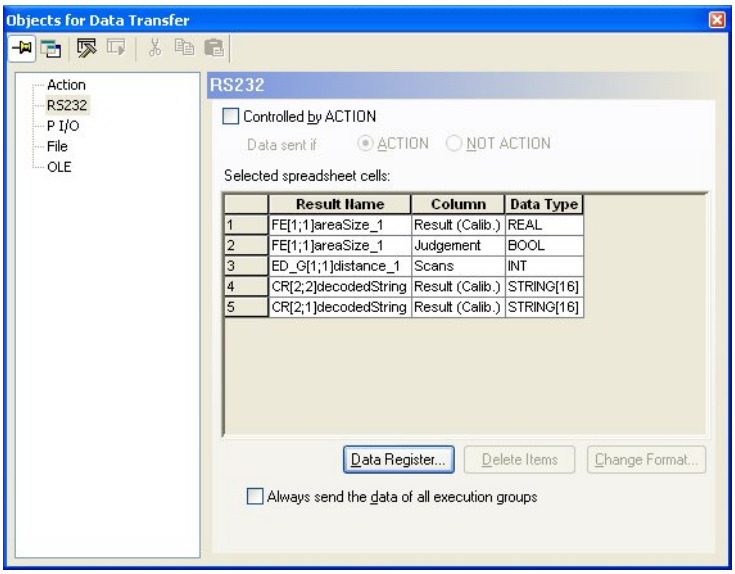
Use this option to define how to handle unused digits. You can fill unused digits with zeros or with blanks when a result has less digits than defined on the right side of the dialog box. When outputting text data, Vision P400 automatically adds blanks to reach the fixed data length for text.

Format decimal digits for the different types of data

The right side of the dialog provides options to set the number of digits for the different data types available. For decimal numbers you also need to define the number of pre-decimal digits and digits following the decimal separator.

13.6.1.4 Data Format for Transfer with MEWTOCOL

When transferring data with MEWTOCOL, you can assign the transferred data various data types. You can, for example, transfer a number as an integer or real value.



Data Register

Here you select the start register. The transferred data are filed starting with this register. The end register is automatically determined from the volume and the data types of the results being transferred. The start register is application-specific, and is saved with the application.

The start register is structured as follows. The first letter indicates the register type. The fifth digit specifies the start register number.

Memory area	Description
D	Data Register
F	File Register
L	Communication flag

Change format

Here you select the desired data type for all marked rows from the list under "Selected spreadsheet cells".

◆NOTE

The transfer speed and transfer commitment can vary across different data types. So select a data type which makes sense for the application!

The following data types are available:

Data Type	Value Range	Properties
BOOL	0 and 1 (1 bit)	The state 0 corresponds to FALSE and signifies that the switching variable is disabled/not set. The state 1 corresponds to TRUE and signifies that the switching variable is enabled/set.
INT	From -32768 to 32767 (decimal, 16 bits)	Variable values of data type INTEGER are whole natural numbers without decimal places.
DINT	From -2147483648 to 2147483647 (decimal, 32 bits)	Variable values of data type DOUBLE INTEGER are whole natural numbers without decimal places.
REAL	From -3.402823*E38 to -1.175494*E-38, 0.0, +1.175494*E-38 to +3.402823*E38	Variables of data type REAL are real numbers, or floating-point constants. There are seven effective numbers. The mantissa has 23 bits and the exponent 8 bits (based on IEEE754).
WORD	16 bit	A variable of data type WORD comprises 16 binary states.
DWORD	32 bit	A variable of data type DOUBLE WORD comprises 32 binary states.
STRING	Character string of variable length [0-255]; see notes	A variable of data type STRING comprises a string of up to 255 characters.
ARRAY OF WORD	Character string of variable length [0-9999]; see notes	In the data type ARRAY OF WORD [0..] the size of the range is given from zero to a maximum of 9999. This data type is suitable for transferring character strings and, as opposed to the STRING data type, has no data header.

◆NOTES

- **An ARRAY OF WORD with the number ARRAY OF WORD [0..1] can accommodate four characters; a String[2] can only accommodate two characters. If the result of an OCR or code reader checker is longer than the predetermined length for the configured STRING or ARRAY OF WORD data type, an execution result error is output and the result cut off.**
- **In the case of the BOOL data type, the order of results in the "Objects for Data Transfer" dialog box influences the data volumes and so also the transfer speed. If four BOOL values are always entered in succession in "Objects for Data Transfer" instead of alternating BOOL and INT values for example, the number of characters to be transferred is reduced. The reason for this is that four characters are always required to transfer a single BOOL value. But when several BOOL values are sent in direct succession, up to four BOOL values are always sent with four characters.**

Always send the data of all execution groups

This option has effects on the choice of destination registers, and should be used with due caution. The examples illustrate how the setting of this option affects the choice of destination registers when using execution groups.

◆EXAMPLE

Case 1: "Always send the data of all execution groups" is not activated. Only the results of the selected execution group are written to the registers as from the start address.

Advantage	Disadvantage
Shorter transfer time	If then a different execution group is selected, the registers are overwritten as from the same start address. On the one hand, this can be useful if the same data type is always written to a register for example, so as to have some influence on the control. On the other hand, dies can also easily result in an error if different data types are written to the same register.

Case 2: "Always send the data of all execution groups" is activated. All results of all execution groups are always transmitted, even if only the results of one execution group were calculated. For the results of the execution groups which were not calculated, the preset defaults (see page 163) are transmitted.

13.6.2 P I/O Interface

The "Objects for Data Transfer" window offers two settings concerning the transfer. Here you may define whether the data transfer should be controlled by handshake (see page 179) and, if it is, whether the Strobe signal should act as a forced reset. In addition, you can change the data type that has been automatically assigned by Vision P400 with the button [Change Data Type].

13.6.3 File Interface

All checker results selected for output via the File interface are written to file in the sequence defined in the "Objects for Data Transfer" (see page 541) window. They are separated by a separator character and form orderly rows and columns.

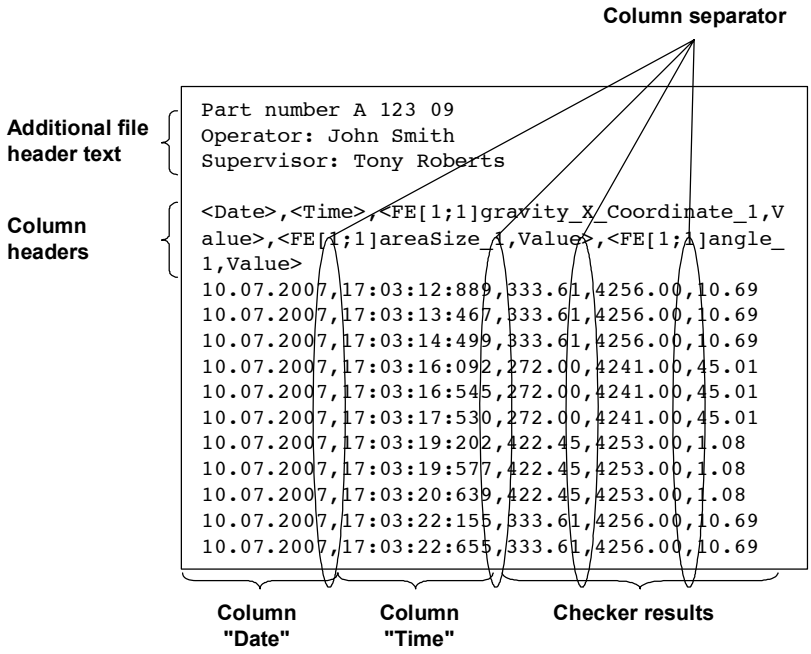
For each application start, the system begins a new line in the file. Use applications like Microsoft Excel or Microsoft Access to read and process the data file.

The example below shows a typical data file, as it is created when you transfer spreadsheet data to a file and execute the application several times.

◆EXAMPLE

This example file shows three checker results (x-coordinate, area size, angle) and the number of scans (13 altogether). The individual results are separated by commas. Each data record is preceded by the exact time. In the beginning, a comment has been

entered.


Column separator
Additional file header text
Column headers
Part number A 123 09
Operator: John Smith
Supervisor: Tony Roberts
<Date>,<Time>,<FE[1;1]gravity_X_Coordinate_1,Value>,<FE[1;1]areaSize_1,Value>,<FE[1;A]angle_1,Value>
10.07.2007,17:03:12:889,333.61,4256.00,10.69
10.07.2007,17:03:13:467,333.61,4256.00,10.69
10.07.2007,17:03:14:499,333.61,4256.00,10.69
10.07.2007,17:03:16:092,272.00,4241.00,45.01
10.07.2007,17:03:16:545,272.00,4241.00,45.01
10.07.2007,17:03:17:530,272.00,4241.00,45.01
10.07.2007,17:03:19:202,422.45,4253.00,1.08
10.07.2007,17:03:19:577,422.45,4253.00,1.08
10.07.2007,17:03:20:639,422.45,4253.00,1.08
10.07.2007,17:03:22:155,333.61,4256.00,10.69
10.07.2007,17:03:22:655,333.61,4256.00,10.69
Column "Date"
Column "Time"
Checker results

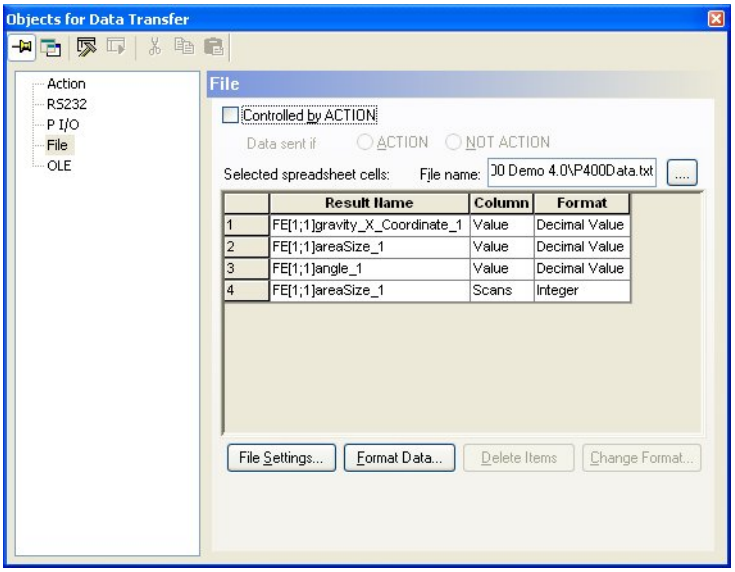
13.6.3.1 File Settings

Saving checker results to a file works similar to outputting them to the interfaces (see page 541). However, there are additional settings necessary for the file creation.

Procedure

1. **Click**

   The "Objects for Data Transfer" window appears with the “File” property page open. You see the list of all checker results selected for file export.

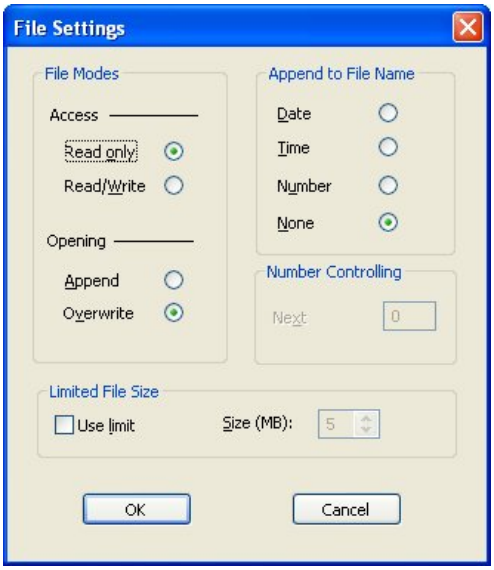


2. **Click in the field next to "File Name" and enter the path and name for your data file**

   When you change the file or folder name, Vision P400 checks whether the entry is valid. If the selected folder does not exist, a message appears and asks whether you really want to use the file name and the folder you have entered. If you confirm, you can also use applications which are normally executed on a different PC with a different folder structure. However, when you switch to run mode, an interface error will occur because Vision P400 will not be able to create the result file in the folder you have entered (because it does not exist).

3. **Select [File Settings]**

The "File Settings" dialog window appears.



4. **Set the options as necessary (for more information see below)**
5. **Click [OK]**

◆NOTES

- **Always enter the name of the folder where you want Vision P400 to save the result file. This makes it easier for you to find and access the result file on the PC. If you do not enter a folder name, a message asks whether you really want to use the file name without indicating a folder.**
- **If you allow an invalid folder to be entered and try to switch to run mode, an interface error occur because Vision P400 cannot create the file in which you try to save the results.**

13.6.3.2 File Modes

The options under "File Modes" help to regulate the access to the data file and how to handle new data when there already is a data file. As long as Vision P400 is in run mode, the system writes all results selected for file output into a file.

◆NOTE

Please note that the access options are only relevant as long as Vision P400 is in run mode. At all other times there are no access restrictions for the data file. It is very important that no other application tries to access the data file while Vision P400 is writing checker data into the data file.

Read Only

This ensures that other applications like Microsoft Excel or Microsoft Access can only read the file, but not delete it or overwrite it with different data.

Read/Write

Use this setting if you wish to allow other applications like Microsoft Excel or Microsoft Access to change or delete the data.

Append

Use this option if you do not want Vision P400 to overwrite existing data files. Instead, Vision P400 adds checker results from a new scan to the list of last results. Please note that this option is only available if you have activated "Date" or "None" under "Append to File Name" (see page 557).

Overwrite

Here you define whether you wish to overwrite the existing data file after leaving and restarting run mode or changing the application. Please note that this option is only available if you have activated Date or None under Append to File Name.

Always Overwrite

This setting appears when you have activated "Time" or "Number" under "Append to File Name". In this case, Vision P400 overwrites an existing data file if a new file has the same time or number included in the file name. Otherwise Vision P400 creates a new file.

13.6.3.3 Append to File Name

These options define the layout of the file name. Use these options if you wish to create a new data file every time Vision P400 switches to run mode.

Date

When you activate this option, every time you leave and restart run mode or change the application, the system switches to run mode or to another application Vision P400 checks whether the system date has changed. If the system date has changed, a new file is created. The file name follows the pattern: <User-defined name>_<two-digit day>.<two-digit month>.<year>.<user-defined extension>.

◆EXAMPLE

We assume that the user has entered TEST.DAT as the generic file name for the data file. If you have activated the option "Date" and Vision P400 has switched to run mode on three days in January 2001, the following files will have been created:

TEST_05.01.2001.dat
TEST_06.01.2001.dat
TEST_07.01.2001.dat

Time

When you activate this option, every time the system switches to run mode or to another application Vision P400 checks whether the system time has changed. If the system time has changed, a new file is created. The name follows the patter (24-hour clock mode):
<user-defined name>_<hour>.<minute>.<second>.<user-defined extension>

◆ **EXAMPLE**

We assume that the user has entered TEST.DAT as the generic file name for the data file. If you have activated the option "Time" and Vision P400 has switched to run mode on three different occasions, the following files will have been created:

TEST_07.12.20.dat = at 7:12:20 a.m.
TEST_14.05.09.dat = at 02:05:09 p.m.
TEST_21.34.54.dat = at 09:34:54 p.m.

Number

When you activate this option, Vision P400 appends a number (beginning with the number displayed under "Next Number") to the user-defined file name every time the system switches to run mode or to another application and creates a data file. The next free number is saved and used when the next start occurs in run mode or the application is changed. Reset the number with option "Number Controlling - Next Number" (see page 559).

◆ **EXAMPLE**

We assume that the user has entered TEST.DAT as the generic file name for the data file. If you have activated the option "Number" and entered 100 under "Next Number", the following files will be created:

TEST_100.dat
TEST_101.dat
TEST_102.dat and so on.

None

Vision P400 always writes data into the same file. Whether new data is appended to the existing data or overwrites the file content depends on the settings under "Options".

◆ **NOTE**

Please be aware when you activate options which entail the creation of files on your hard disk that the hard disk may be full after some time of continuous operation.

13.6.3.4 Number Controlling

When you have activated the option "Append to File Name - Number", Vision P400 appends a number (beginning with the number displayed under Next Number) to the user-defined file name every time the system switches to run mode or to another application and creates a data file.

Next Number

Use this field to enter the number to be used for the first data file which the system creates. When you save the application, Vision P400 stores the last number here and starts counting from this number when you activate run mode again.

When you enter a new number, Vision P400 starts with this number when you leave and restart run mode or when you change to another application. You can also use this option to reset the file numbering.

13.6.3.5 Limited File Size Options

When you enter a size limit for the data file, Vision P400 writes into a data file until the size limit is reached and then creates a new data file. The files are numbered by attaching the next free number to the generic or modified file name. Whenever you switch to run mode or change to another application, Vision P400 resets the file number to 0.

Use Limit / Size

Activate this field and use the arrow buttons next to "Size (MB)" to enter the size limit in megabytes. Alternatively, you can simply type in a figure.

◆EXAMPLE

We assume that Vision P400 creates 4,5MB data in a work shift with 355,000 starts and that you have entered 1MB as the size limit. So 5 data files are created:

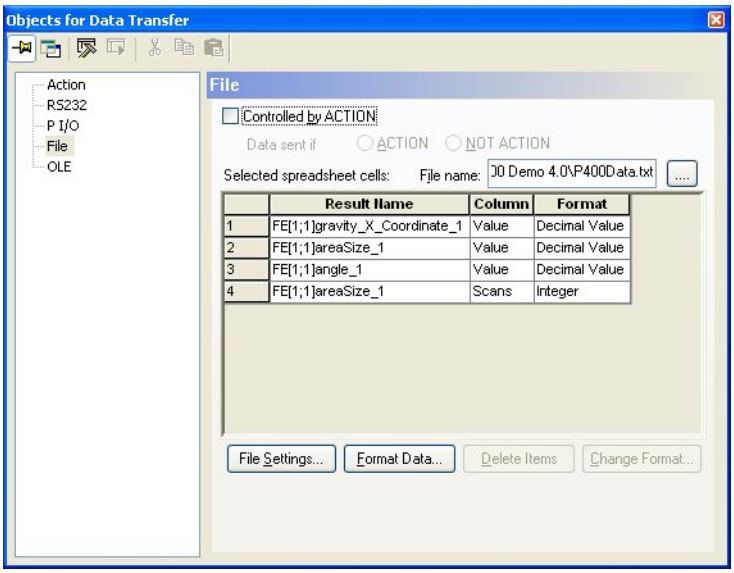
TEST_~0.dat (size: 1MB)
TEST_~1.dat (size: 1MB)
TEST_~2.dat (size: 1MB)
TEST_~3.dat (size: 1MB)
TEST_~4.dat (size: 0.5MB)

13.6.3.6 Data Formatting

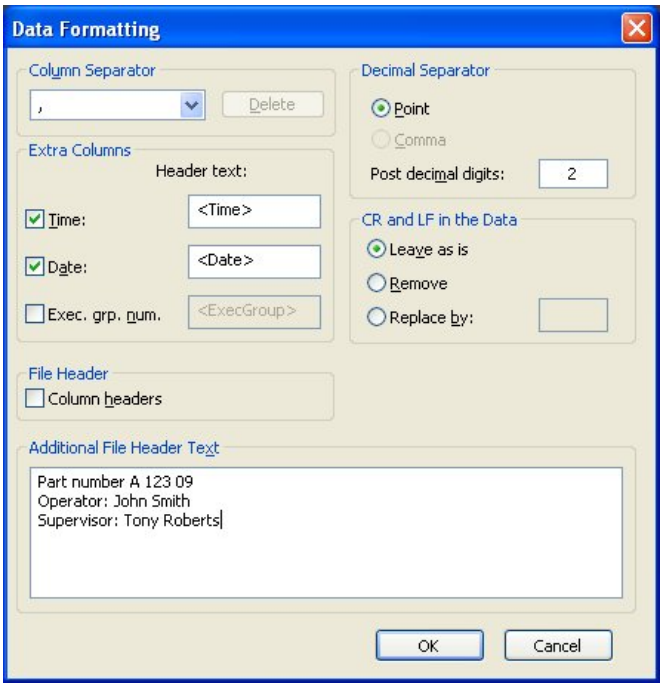
This dialog box allows you to add some application-specific information to the data file, e.g. information on the project, shift information, supervisory staff, etc.

Procedure

1. **In the "Objects for Data Transfer" window, click [Format Data]**



The "Data Formatting" dialog box appears.



2. **Make your settings (see sections below)**
3. **Click [OK]**

13.6.3.7 Column Separator

This option works exactly like for the RS232 interface (see page 549).

13.6.3.8 Extra Columns

When you activate this option, Vision P400 includes up to three additional columns in the result file. Click the corresponding checkbox to include the time, date and/or group number of the execution group in the result file. You can change the header text if you have checked the checkbox.

13.6.3.9 File Header

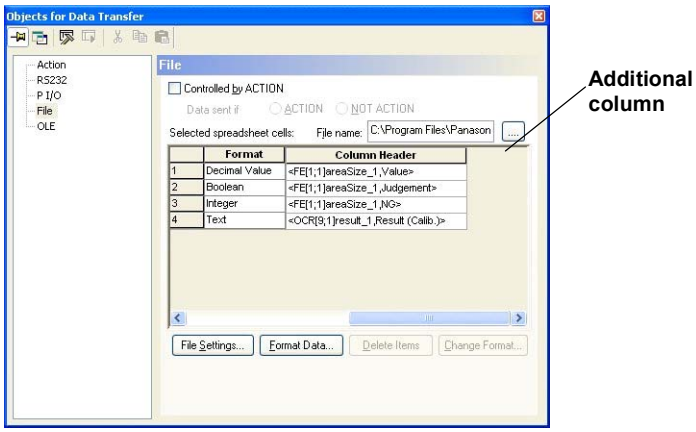
With this option, Vision P400 includes the headers of the result columns in the file header of the result file.

Column Headers

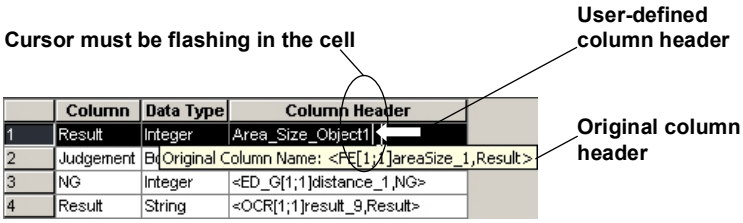
When you activate this option to include a header for each data column in the file header, an additional column appears in the "Objects for Data Transfer" window (see figure below). By default, this header includes the checker and result name. However, you can change the column header text in the "Objects for Data Transfer" window, if required. Simply click into the cells below "Column Headers" and type in the text you wish to use as a header.

◆EXAMPLE

The column header for the first result has been changed from the default <WI[2;1]AreaSize,Result> to Area Object 1. Results 2 - 6 still have the default column header.



Once you have changed a column header, you can see the original (default) column header if you click into the cell (the cursor must be flashing and the mouse cursor must be positioned in the cell) and wait. The system displays the default column name in the tool tip.



Changing the column headers also affects the pop-up menu: You find a new item "Default Column Header". Use this to reset the user-defined header to the default column header.

13.6.3.10 Additional File Header Text

Here you can enter a comment. Vision P400 prints the text before the data (excerpt from result file (see page 553)).

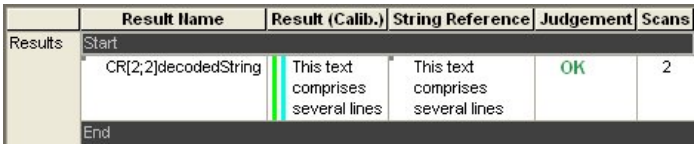
13.6.3.11 Decimal Separator

This option works exactly like for the RS232 interface (see page 549).

13.6.3.12 Handling of CR and LF in the data

The result of the code reader may contain line breaks (CR / LF = Carriage Return / Line Feed). In this case you need to define how Vision P400 should output the line breaks to the interfaces:

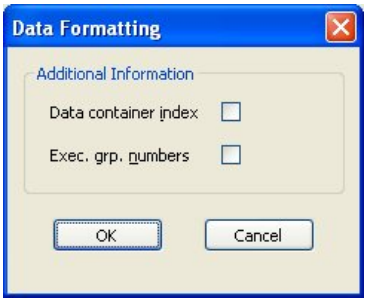
Setting	Functionality
Leave as is	All line breaks are output.
Delete	If the result contains line breaks, these will be removed.
Replace by	Enter a character (or a string of characters) to be output instead of the line break.



Code reader result with several lines

13.6.4 OLE Interface

The OLE interface offers two data format settings to determine the layout of the result output.



Data formatting for the OLE interface

13.6.4.1 Data Container Index

When you activate this option, for each result the index from the list of object for data transfer is also sent to the interface. For more information, please read the PDF document "Vision P400 ActiveX Controls.pdf", which has been stored in the Vision P400 installation folder.

13.6.4.2 Execution Group Numbers

When you work with execution groups, activate this option if you wish to output the number of the execution group which has been used to start the application.

13.6.5 Action

The [Action] button allows you to associate "NG Max" with one of the action options shown below by dragging it from the spreadsheet to the button. The action will be triggered when the value in the "NG" column is equal to or a multiple of the value in "NG Max", i.e. when "NG" modulo "NG Max" = 0.

However, only **one singular** result may be associated with one singular action. After you associated the value "NG Max" with the [Action] button, the cell will be marked with a red bar.

Using the right mouse button

Procedure

1. **Click the "NG Max" cell you wish to associate with an action with the right mouse button**

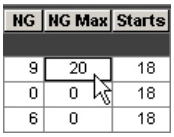
   The pop-up menu appears.

2. **Select** Insert Into → Action

Using the drag & drop function

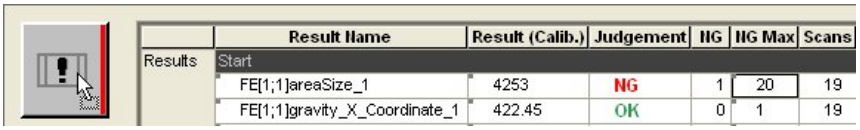
◆**Procedure**

1. **Select an "NG Max" cell with a left mouse click and hold the mouse button down**



NG	NG Max	Starts
9	20	18
0	0	18
6	0	18

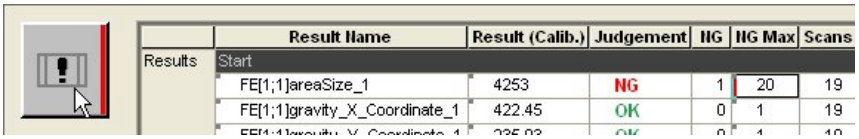
2. **Drag the selected "NG Max" cell to the [Action] button**



	Result Name	Result (Calib.)	Judgement	NG	NG Max	Scans
Results	Start					
	FE[1;1]areaSize_1	4253	NG	1	20	19
	FE[1;1]gravity_X_Coordinate_1	422.45	OK	0	1	19

3. **Release the left mouse button**

   The cell "NG Max" is marked with a red bar to indicate that the cell triggers the action if 10 or a multiple of 10 "NG" are counted.



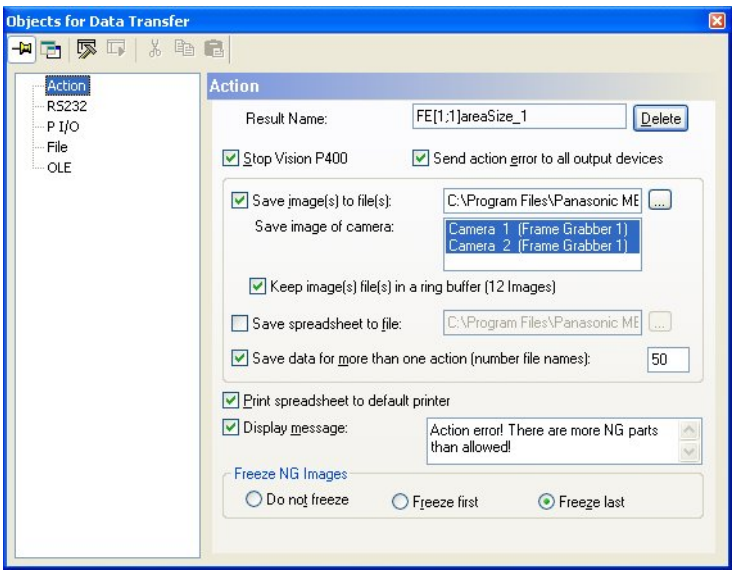
	Result Name	Result (Calib.)	Judgement	NG	NG Max	Scans
Results	Start					
	FE[1;1]areaSize_1	4253	NG	1	20	19
	FE[1;1]gravity_X_Coordinate_1	422.45	OK	0	1	19

   Next you define which action Vision P400 should perform when "NG" modulo "NG Max" = 0.

4. **Click on [Action]**
5. **Select the actions to be performed when the action (see page 565) is triggered**

13.6.5.1 Descriptions of the Available Actions

This section describes the actions available on the "Action" page.



Associating an action with "NG Max"

◆NOTES

- **The options marked with * may start time-consuming processes. We recommend that you check thoroughly to see whether this has a negative effect on the execution of your application.**
- **These actions are available only in run mode.**
- **You can use this function to control data output (see page 569) to the interfaces.**

Result name

This field contains the result to be associated with the action, i.e. the result you have dragged and dropped on the [Action] button. Click [Delete] to erase this result.

◆NOTE

When you erase a result, all settings in the dialog window are reset to the default values.

Stop Vision P400

Vision P400 will be stopped if the number of NG judgements has reached the limit defined in "NG Max" or a multiple thereof. The system will ignore all further start signals and signals to change the application. When you activate this option, the option "Send Action Error to All Output Devices" is also activated.

Send action error to all output devices

If the number of NG judgements has reached the limit defined in "NG Max" or a multiple thereof, Vision P400 sends an action error to the parallel and the OLE interface and PCError to all other interfaces.

***Save image(s) to file(s)**

Indicate the folder and a file name in which the active image(s) should be saved if the number of NG judgements has reached the limit defined in "NG Max" or a multiple thereof. The file name you have entered will be modified by Vision P400 so that the images of several cameras can be saved and also if you have activated the option "Modify File Names".

◆NOTE

When you have activated this Action option and deleted the folder selected here, Vision P400 will not save the images, but rather write a warning into the error log. You CANNOT simply rectify the problem by creating the folder again with the Explorer: You must exit run mode and select the folder and path in the "Action" page again.

Save image of camera

Select those cameras whose images you want to save after the number of NG judgements has reached the limit defined in "NG Max" or a multiple thereof. If you select this option, the two grayed-out options "Keep Image File(s) in a Ring Buffer (12 Images)" and "Save Data for More than One Action (Number File Names)" become available. The option "Keep Image File(s) in a Ring Buffer (12 Images)" controls at which point in time Vision P400 saves the camera images.

Keep image file(s) in a ring buffer (12 images)

When this option is active, all images (up to a maximum of 12 images) will be saved in the ring buffer. When you switch from run to setup mode or change the application and the action trigger is set, the images are saved in the folder specified under "Save Image(s) to File(s):".

Writing images in a ring buffer is quicker than writing to disk, so that Vision P400 resumes processing the application faster when you use this option. Please note that you can only access the images after switching from run to setup mode or changing the application and that the buffer has a limited size.

When you deactivate this box, Vision P400 writes all images as bitmaps directly on the hard disk. You can access the images immediately after they have been saved. Vision P400 only continues to process the application once the images are written to disk.

***Save spreadsheet to file**

Enter the path and file name for the spreadsheet contents to be saved after the number of NG judgements has reached the limit defined in "NG Max" or a multiple thereof. If you activate this box, the option "Save Data for More than One Action (Number File Names) will be activated, if it is not already selected.

◆NOTE

When you have activated this Action option and deleted the folder selected here, Vision P400 will not save the spreadsheet, but rather write a warning into the error log. You CANNOT simply rectify the problem by creating the folder again with the Explorer: You must exit run mode and select the folder and path in the "Action" page again.

Save data for more than one action (number file names)

When you mark this box, Vision P400 automatically changes the file name for the camera image or spreadsheet to be saved (depending on what you have selected) by adding a number, starting from 1. Please note that the effect of this option depends on how you set the option "Keep Image File(s) in a Ring Buffer (12 Images)". The file name follows the pattern:

Save data for more than one action	Keep image file(s) in a ring buffer	Files names of the camera images saved
Yes	No	<Custom name>_CAM<Camera number>_<Index>.bmp
	Yes	<Custom name>_CAM<Camera no.>_<IndexRingBuffer>_<Index>.bmp
No	No	<User-defined name>_CAM<camera number>.bmp
	Yes	<Custom name>_CAM<Camera number>_<IndexRingBuffer>.bmp

When this box is not marked, Vision P400 saves the camera image and/or spreadsheet under the user-defined file name, overwriting files of the same name.

Save data for more than one action	File name for the saved spreadsheet
Yes	<User-defined name>_<index>.txt
No	<User-defined name>.txt

If you have activated the option "Save Data for More than One Action (Number File Names)", you can enter the maximal number of files to be saved. When Vision P400 needs to save a greater number of spreadsheet and image files than the one entered here, the system resets the file number and starts again with 1. This prevents Vision P400 from filling the hard disk with saved spreadsheet and image files.

Whether you should enter a high or low figure in this field depends on your current requirements. On one hand, the figure should be high enough that files with contents you may need are not overwritten; on the other hand the figure should be as low as possible so that you have enough disk space to run Vision P400 and the operating system reliably.

◆NOTE

Please note that the effect of this option depends on how you set the options "Keep Image File(s) in a Ring Buffer (12 Images)" and "Save Data for More than One Action (Number File Names)". This is due to the fact that if "Keep Image File(s) in a Ring Buffer (12 Images)" is deactivated, Vision P400 writes the images into the buffer and only saves them to disk when you

- **change the application or**
- **switch from run mode to setup mode and then back to run mode.**

Keep image file(s) in a ring buffer	Save data for more than one action	Effect of the setting in "Maximal number of files"
No	Yes	When the maximal number of files is reached, Vision P400 resets the file number and overwrites the first file.
No	No	Vision P400 creates one file and overwrites the file with every new action.
Yes	Yes	When you switch to run mode or change the application, Vision P400 creates temporary files with the first free number. When you switch back to setup more or change the application, the files are saved. As soon as you switch to run mode again, new temporary files with the next free number are created. When the maximal number of files is reached, Vision P400 resets the file number and overwrites the first file.
	No	When the contents of the buffer is written to disk, any existing files with the same name, will be overwritten.

***Print spreadsheet to default printer**

Mark this box to print out the spreadsheet if the number of NG judgements has reached the limit defined in NG Max or a multiple thereof. If you have no printer installed, the option is grayed out.

***Display message**

Mark this box in order to define a message to appear after the number of NG judgements has reached the limit defined in NG Max or a multiple thereof.

◆NOTES

- **When you have dragged "NG Max" to the [Action] button, but do not enter a value and leave the default entry 0, the action will always be executed.**
- **When you are working with execution groups, an action is only executed when the trigger cell "NG Max" belongs to one of the executed execution groups.**

Freeze NG images

With "Freeze NG Images" you define whether Vision P400 should freeze the images that triggered an action or not. Vision P400 keeps executing the application normally, but only displays the frozen images, not the images it is inspecting.

When you have activated "Freeze NG Images", the images that have triggered an action will be displayed even if you have disabled the option "Image" in the "Update" box on the "General" page of the application properties.

The "freezing" of the images only works in run mode. When you return to setup mode and execute the application or select "Grab Image + Execute", the currently inspected images will be displayed.

◆NOTE

If you wish to save frozen images to a file in setup mode, make sure to save them before executing the application or selecting "Grab Image + Execute".

"Freeze NG Images" contains the following options:

Setting	Effect
Do not freeze	None of the images that have triggered an action will be frozen.
Freeze first	The first image that has triggered an action will be frozen.
Freeze last	The last image that has triggered an action will be frozen.

13.6.5.2 Using Action to Control Result Output to the Interfaces

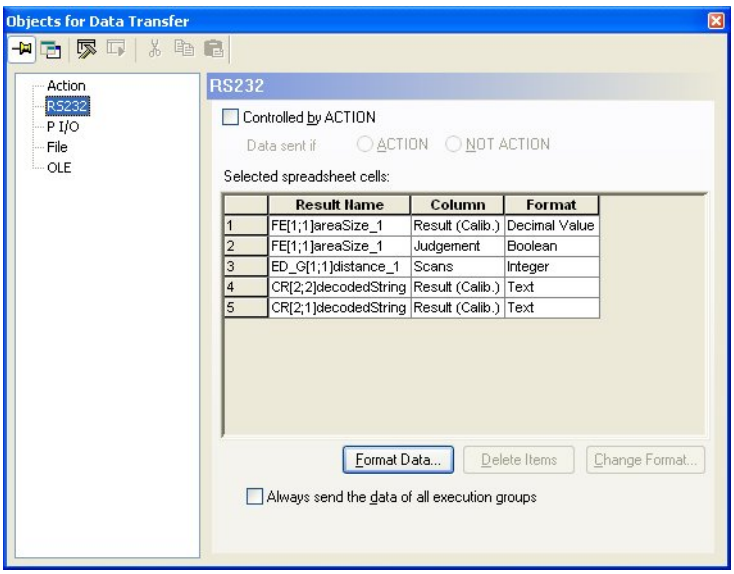
When you have defined an action, you can use the action to control whether and when Vision P400 outputs result data to the interfaces or not.

◆Procedure

1. **Drag the selected "NG Max" cell to the [Action] (see page 563) button**
2. **Select the actions to be performed**

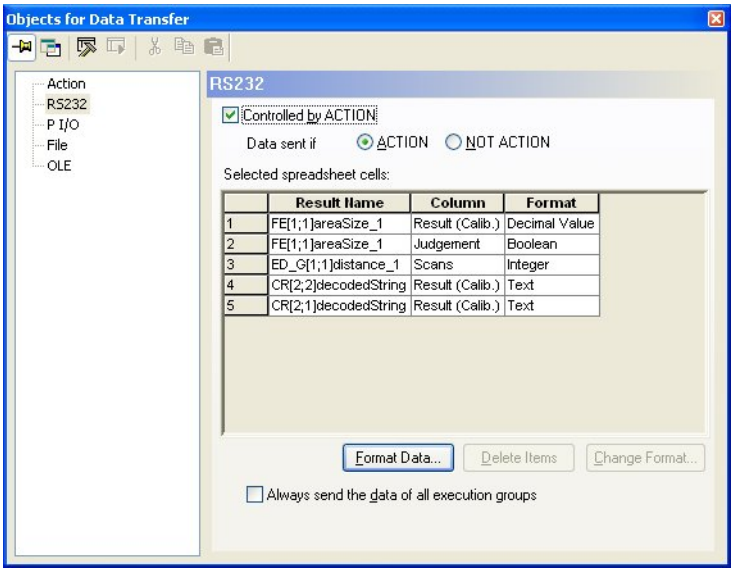
   Next you define how the action controls (see page 565) the data output to the interfaces. In this example, Vision P400 will control the output to the RS232 interface.
3. **Select the "RS232" page**

   Vision P400 displays the properties of the RS232 interface with the action control option and the data selected for output.



4. **Activate "Controlled by ACTION"**

Two additional action control options appear in the window.



5. Select whether the data should be sent when the action is TRUE or NOT TRUE

In this example, Vision P400 only sends the data selected for output to the RS232 interface when the action trigger is set, i.e. when "NG" modulo "NG Max" = 0. If you choose "NOT ACTION", Vision P400 always outputs the data when the action was not triggered as long as "NG" modulo "NG Max" <> 0.

◆**NOTE**

When you are working with execution groups, the action can be assigned to one or more camera/execution groups, depending on the result the action is based on. When you execute the application, the action only controls the interfaces if it is assigned to one of the EXECUTED execution groups. If the action is assigned to an execution group which is not executed by the application, the setting in "Controlled by ACTION" is ignored for all interfaces. The interfaces will work as if they are not controlled by the action, i.e. all data is always transferred.

13.7 Formulas

Use the formula function to make further calculations on the basis of the checker results. The entry under "Result Name" helps the system to find the result needed for the formula. Use this result name in the formula to perform calculations with the value under "Result". In case you defined a calibration, the calibrated value is used.

You may use arithmetic, Boolean or IfCase formulas:

- Arithmetic formulas let you perform mathematical operations on checker/formula results
- Boolean formula let you work with the OK/NG judgement of checkers/formulas
- IfCase formulas let you use judgement results of any number of checkers or formulas in order to identify an object and/or conditionally execute certain execution groups

Below find an explanation of arithmetic/Boolean and IfCase formulas as well as the procedures for setting up new formulas in the spreadsheet and working with them.

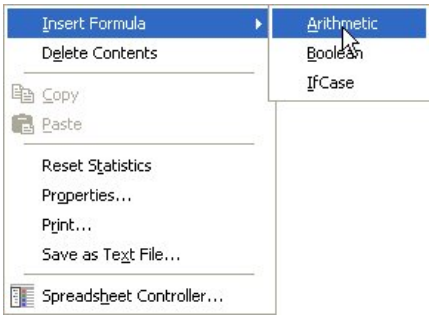
13.7.1 Arithmetic or Boolean Formulas

Arithmetic or Boolean formulas (for IfCase formulas (see page 575)) can be inserted by choosing the menu command **Spreadsheet → Insert Formula → Arithmetic/Boolean**. Or you can use the right mouse button in the spreadsheet:

◆Procedure

1. **Click on or between the "Start" or "End" row in the "Formulas" section of the spreadsheet**
2. **Click the right mouse button**

   The spreadsheet pop-up menu appears. If it looks different, it is because your cursor is not positioned on or between the "Start" or "End" row of the formulas.



3. **Select "Insert Formula"**
4. **Select "Arithmetic" or "Boolean"**

   A new formula row is added before the row you have selected with the cursor. If your cursor has been positioned on the start row, the new formula row is added behind this row.

5. **Open and edit the formula**

For opening and editing formulas you need the Formula Editor (see page 572).

◆**NOTES**

- **The name cell of a new formula is shaded in red as long as nothing has been entered in the formula editor.**
- **The result of the formula is displayed only after you have used** Application → Start**.**

13.7.1.1 Editing a Formula and Entering Checker Results

Vision P400 is equipped with a functional formula editor for arithmetic and Boolean formulas. When you open a formula, the corresponding formula editor (arithmetic or Boolean) appears in a separate window. In order to edit the formula the following symbols and options are available:

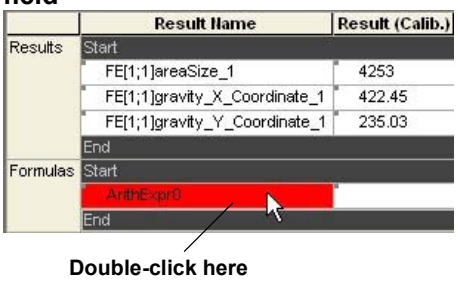
Arithmetic editor	Symbol	Boolean editor	Symbol
Addition	+	**AND**	&
Subtraction	-	**OR**	|
Multiplication	x	**XOR**	^
Division	/	**NOT**	~
Cosinus	cos( )	**1**	TRUE
Sinus	sin( )	**0**	FALSE
Absolute value	abs( )		
Square root	sqrt( )		
Arcus tangens	atan2( )		
Tangens	tan( )		
Arcus cosinus	acos( )		
Arcus sinus	asin( )		
Square	sqr()		
Minimum of x and y	min(x,y)		
Maximum of x and y	max(x,y)		
Constant pi (3.1415)	pi		

Options for both editors	Description
Operators - Insert always	If you activate this option, the corresponding operator is inserted before each checker result which you insert with drag & drop into the editor.
Others - Insert blank	If you activate this option, a blank is inserted before each item which you insert with drag & drop into the editor.
Properties - Global formula	This option is useful when you work with execution groups. If you activate this option, the current formula is treated as a global formula (see page 583). This means that the results of this formula can be used by other formulas, even if they belong to a different execution group.

Options for both editors	Description
Properties - Force error to NG	In some instances, it makes sense to treat a faulty formula as a NG judgement. For example, when an arithmetic formula cannot be calculated because it uses an object that has not been detected by Vision P400. If the judgement of the faulty formula is used by another formula, the second formula cannot be calculated either and is considered faulty. If you wish to calculate the second formula nevertheless, activate this option to convert the judgement of the first formula from error to NG.
OK	Use this button to save the changes and close the formula editor. Note that this option is only executed when you have entered a correct formula. Otherwise you will get a warning message.
Apply	Use this button to accept all changes to the formula. The editor window stays open. Note that this option is only executed when you have entered a correct formula. Otherwise you will get a warning message.
Undo	Use this button to undo all changes you made since you have last clicked [Apply] to save.
Cancel	Use this button to leave the formula editor without saving any of the changes made since you have last clicked [Apply].

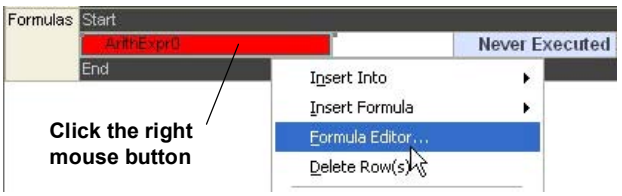
◆Procedure

1. **To open the formula, double-click in the textless area of the formula's name field**

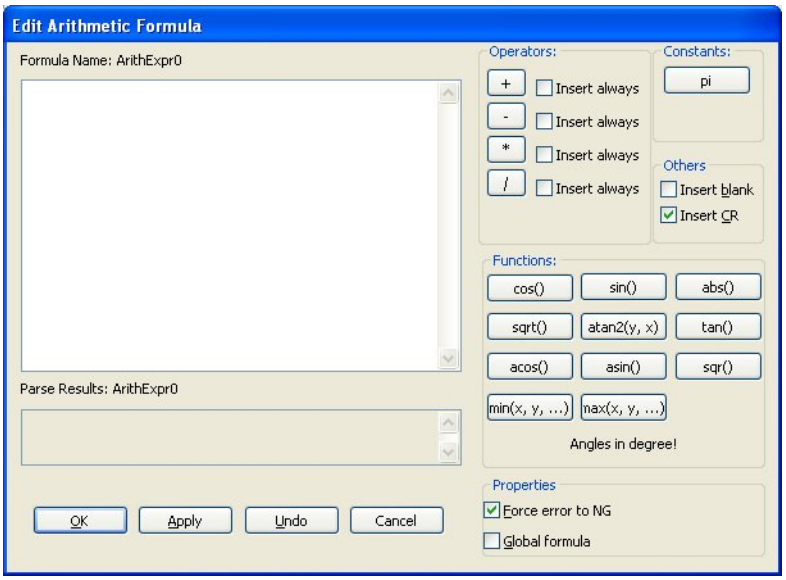


or

click the right mouse button on any cell of the formula row and select "Formula Editor"



The "Edit Arithmetic/Boolean Formula" dialog box appears. This procedure uses an arithmetic formula as an example.



2. **Insert a checker result from the spreadsheet into the formula by**

   drag & drop

   or

   by typing in the result name

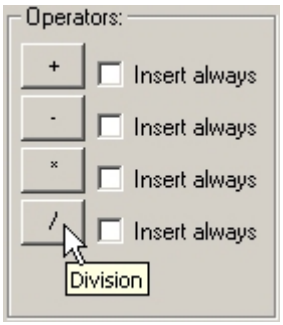
   or

   click on the result name so that the cell is surrounded by a frame, click the right mouse button and select "Copy" from the pop-up menu. Then click in the white area in the formula editor, click the right mouse button and select "Paste"

   Use drag & drop to insert multiple results or judgements into the formula simultaneously. For arithmetic formulas, select cells from the column "Result", for Boolean formulas from the column "Judgement" or select rows completely, when you wish to use their results or judgement in an arithmetic or Boolean formula.

3. **Use the operator and function buttons for calculation operations**

   If you are not sure about the meaning of an operator symbol, position the cursor on the button and wait until the tool tip appears. If want to insert multiple results or judgements simultaneously into the Formula Editor, first select "Insert always" for one of the operators.



4. **Enter the rest of the formula in the same manner**
5. **Click [Apply] or [OK]**

   The formula is checked for consistency and, if correct, is saved. Errors will be shown in the field "Parse Results". If you click [OK] the Formula Editor is then closed; click [Apply] and it remains open.

13.7.2 IfCase Formulas

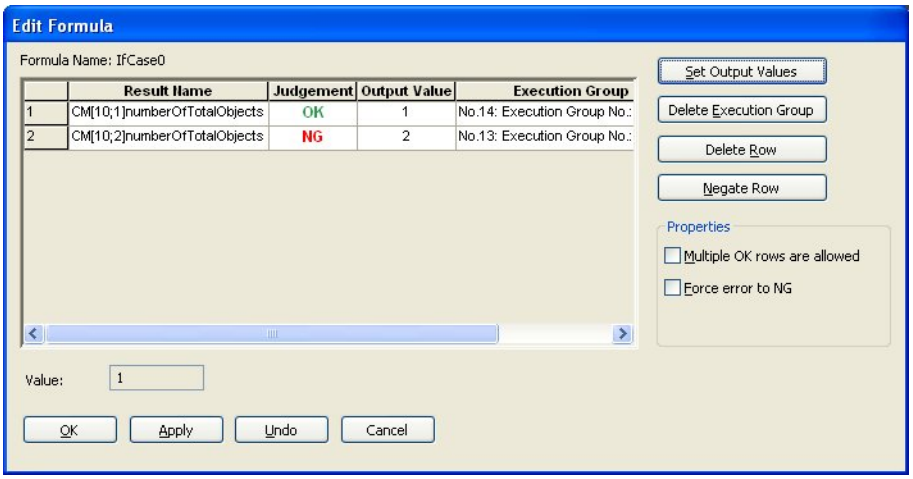
The IfCase formula uses the judgement results of any number of checkers or formulas essentially for two tasks:

- identify an object and/or
- conditionally execute certain execution groups

The IfCase formula contains a list of judgement results, which is processed completely from top to bottom. The aim is to find one (and - depending on the definition of the formula - **only** one) entry that is judged OK (see page 581) and act accordingly, for example by execution an execution group. The figure below gives an example.

◆EXAMPLE

The example below shows how to execute a specific execution group if a condition is true. If the judgement of the first checker result is judged as true = OK, Vision P400 is to run execution group 14.



Name

This column contains the name(s) of checker or formula results. The judgement of these results is the basis for the condition of the IfCase formula. Insert a result name from the spreadsheet with drag & drop. The sign "~" means that the judgement result will be negated and then judged (see description of "Judgement" column).

Judgement

This column informs you on how the IfCase formula evaluates the judgement of this checker or formula result. By default, the IfCase formula uses the same judgement as the spreadsheet. However, if there is a "~" before the entry in the "Result Name" column, the judgement is negated, i.e. OK becomes NG and vice versa.

If the judgement of a checker or formula result in the spreadsheet is neither OK nor NG, the IfCase formula displays "Error" or "Not executed" when you open the editor.

Output Value

Here you define the output value, which will be used as the result of the IfCase formula. The output value will appear in the formula editor in the "Result" field and in the "Result" column of the spreadsheet. The result of the IfCase formula is the output value of the first row to be judged with OK. Vision P400 always starts evaluating the judgements from row number 1 in ascending order. In the example above, the IfCase formula result as shown in the spreadsheet would be 1, as the row with this output value is the first row in the editor to be judged with OK. If no row is judged OK, the result of the IfCase formula in the spreadsheet will be 0.

The following entries are permitted in the "Output Value" column:

Input	Description
Any number	To do this you can also click on the [Set Output Values] button. Vision P400 automatically assigns output values to all rows starting with value 1 for row 1. Please note that this will overwrite any manual entries you may have made in the "Result" (see page 580) column.
The "*" sign.	The calibrated result of the checker/formula entered in the "Name" column is used as the output value.

Input	Description
The name of a checker or formula result	The calibrated result of the checker/formula entered in the "Output Value" column is used as the output value. You can drag & drop a result of this kind into the column: To do so, select the result from the spreadsheet, drag it over the "Output Value" column into which you want to insert it and press the <Ctrl> key while releasing the mouse button.

◆NOTES

- **If you want to use a checker result of the String type (such as the result of an OCR checker) as the output value, it must be possible to convert it into a number. If it is not, "Error" is displayed in the "Judgement" column when calculating the IfCase formula.**
- **If you want to use a formula result as the output value, the associated formula must be positioned in the spreadsheet before the IfCase formula which it uses as its output value.**
- **When you click either the [OK] or [Apply] button, the IfCase formula can only be saved if each row contains a valid value in the column "Output Value".**
- **While you are editing the "Output Value" column the [Set Output Values] button is deactivated.**

Execution Group

In the "Execution Group" column you can enter the name of an execution group. To do so, click in the column on the [...] button and a dialog box appears in which you can select the name of the group from a list box. If you choose "None", no name is entered or an already entered name is deleted.

When you enter an execution group name in the "Execution Group" column, you link a judgement with an execution group. When Vision P400 has judged all formula rows, Vision P400 executes the execution group assigned to the first row judged with OK. (This is the same row determining the output value and thus the result of the formula.) If you have not assigned an execution group to the row, Vision P400 will not execute any execution group. In the example, Vision P400 runs execution group 14 (the preset name "Group number: 14" was not changed), because the judgement linked to this execution group is the only one judged OK in the Formula Editor.

	Result Name	Judgement	Output Value	Execution Group
1	CM[10;1]numberOfT	OK	1	No.14: Execution Group No.: 14 ...
2	CM[10;2]numberOfT	NG	2	No.13: Execution Group No.: 13 ...

In order to ...	Do the following:
Enter a group name	Click the [...] button to open the "Available Execution Groups" dialog box and from the list box in it select the execution group.
Remove a group name	Click on a row in the Formula Editor and click the [Delete Execution Group] button or click [...] to open the "Available Execution Groups" dialog box and from the list box in it select "None".

◆**NOTES**

- **The execution group started by an IfCase formula will be executed without the camera grabbing a new image.**
- **If the calculation of an IfCase formula leads to the execution of an execution group, Vision P400 executes the assigned group IMMEDIATELY after calculating the IfCase formula, i.e. BEFORE calculating the next formula in the spreadsheet.**
- **To avoid infinite loops, Vision P400 executes each execution group only once. If several IfCase formulas use the same execution group, the group will only be executed once, after the first IfCase formula with the execution group is triggered.**
- **If a triggered execution group contains a checker sequence which has been executed before, Vision P400 will not execute the sequence again to avoid infinite loops.**
- **IfCase formulas cannot be global formulas.**

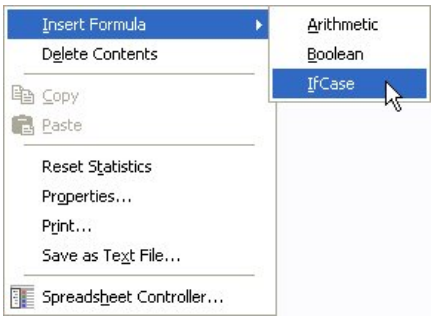
13.7.2.1 How to Create IfCase Formulas

You can insert IfCase formulas with the menu command **Spreadsheet → Insert Formula → IfCase**. Or you can use the right mouse button in the spreadsheet:

◆**Procedure**

1. **Click on or between the "Start" or "End" row in the "Formulas" section of the spreadsheet**
2. **Click the right mouse button**

   The spreadsheet pop-up menu appears. If it looks different, it may be because your cursor is not positioned on or between the "Start" or "End" row of the formulas.



3. **Select "Insert Formula", then "IfCase"**

   A new formula row is added before the row you have selected with the cursor. If your cursor has been positioned on the start row, the new formula row is added behind this row.

4. **To open the formula, double-click in the formula's name field**

   or

   click the right mouse button on any cell of the formula row and select "Formula Editor"

5. **Click a checker or formula judgement in the spreadsheet and hold the mouse button down**

   It is possible to drag several judgements into the IfCase formula at once. Select the cells in the "Judgement" column or select the spreadsheet rows containing the judgements completely.

6. **Drag the checker/formula judgement(s) into the IfCase formula**

   Please remember to use the <Ctrl> or <Shift> key if you try to drag multiple checker/formula judgements into the formula.

7. **Drop the checker/formula judgement(s) in the table**

   The judgement(s) will be dropped at the mouse cursor position. When you press the <Shift> key while dropping the checker/formula result, the "~" sign is inserted in front of the result name and negates the result judgement.

8. **In the "Output Value" column, assign an output value for the IfCase formula**

   When you drop the judgement(s) in the row, Vision P400 assigns the row number as the output value. If that number is already used, Vision P400 automatically assigns the next free row number. You can change the output value any time. It is possible to have the same output value for different rows.

9. **Enter an output value manually**

   or

   click on [Assign Output Value]

   Vision P400 automatically assigns output values to all rows starting with output value 1 for row 1, thus overwriting all previous entries.

10. Link an execution group with the [...] button in the "Execution Groups" column if you want

◆NOTES

- **There are two ways to negate a condition, i.e. insert "~" in front of the condition:**
  - **Press <Shift> when storing the checker/formula judgement(s) in the Formula Editor**
  - **Select the row and click [Negate Row]**
- **Every checker/formula judgement from the spreadsheet can be used twice in any given IfCase formula: Once as is and once negated.**
- **If you wish to change the sequence order of conditions in your IfCase formula, select a row with a left mouse click and drag it to the right position.**

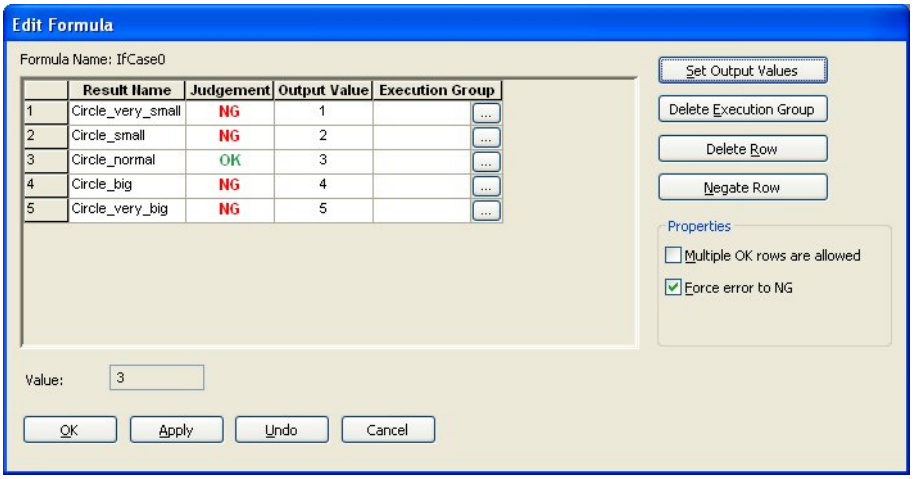
13.7.2.2 Available options

Some of the options described below require you to select a row first by clicking the left mouse button on any cell in the row so that the row background turns to black.

Button/Option	Description	Select a row first?
Set output values	Vision P400 automatically assigns the row number to each row as the output value. All previous entries will be overwritten.	No
Delete execution group	Vision P400 deletes the entry in the "Execution Group" column.	Yes
Delete row	Vision P400 deletes the selected row.	Yes
Negate row	Vision P400 negates the selected row by inserting the character "~" in front of the result name.	Yes
Multiple OK rows are allowed	Use this option to control the judgement of the IfCase formula. Define whether only one or more than one rows may be judged OK.	No
Force error to NG	When an error occurs, the judgement of the formula is converted to NG.	No
OK	Use this button to save all changes and close the formula editor. Please note that this is only possible if the entered formula is correct. Otherwise you will get a warning message.	No
Apply	Use this button to accept all changes to the formula. The editor window stays open. Please note that this is only possible if the entered formula is correct. Otherwise you will get a warning message.	No
Undo	Use this button to undo all changes which you have made since you have last clicked [Apply].	No
Cancel	Use this button to leave the formula editor without saving any of the changes made since you have last clicked [Apply].	No

13.7.2.3 Calculating IfCase Formulas

How Vision P400 calculates an IfCase formula is demonstrated in the example below.



IfCase formula for identifying circles of different size

◆EXAMPLE

This IfCase formula is designed to identify an object. There are 5 different kinds of circles, which may vary from one camera image to the next. The IfCase formula result relates to the size of the circle detected.

Vision P400 uses 5 checkers to evaluate the size of the circle arithmetically. All checkers have been set up to provide the circle size, but each has different limits. This way, only one checker result (and in turn, one condition) can be true = OK.

13.7.2.4 Judgement of IfCase Formulas

Vision P400 evaluates the IfCase formula beginning from row number 1 in ascending order. The first row in the list with judgement = OK determines the formula result and (if defined) which execution group will be executed. In the example above, this is the normal-sized circle condition from row 3. The result "3" is displayed in the formula editor and output to the spreadsheet.

Vision P400 always evaluates ALL rows in an IfCase formula. The judgement of the IfCase does NOT judge the result, but rather the number of rows judged as OK. How an IfCase formula is judged is determined by the option "Multiple OK Rows Are Allowed" (see table below).

Setting	Number of rows judged OK	Judgement of the IfCase formula	Result of the IfCase formula
Multiple OK rows are allowed = OFF	0	NG	0.0
	1	OK	As defined under "Output Value"
	More than 1	NG	0.0
Multiple OK rows are allowed = ON	0	NG	0.0
	1	OK	As defined under "Output Value"
	More than 1	OK	As defined under "Output Value"

Leave the option "Multiple OK Rows Are Allowed" OFF if you wish to identify objects unambiguously. If more than one condition is OK, the object evidently cannot be identified unambiguously.

If a row/condition in the IfCase formula is judged with "Error" or "Not executed", then this row is ignored and does not influence the result and the judging of the formula. Again, this is to help with object identification. If the object to be detected is not present in the camera image, then all formulas dealing with that object will fail and produce "Error". The fact that something is missing is not necessarily an error for the object identification, e.g. when you wish to detect an object with the characteristic "no holes".

IfCase formula judgement in the spreadsheet is	**If**
"Error"	The list of conditions is empty
	All rows are judged with "Error"
	At least one row is judged with "Error" and the rest of the rows is judged with "Not executed"
"Not executed"	All rows are judged with "Not executed"
"Forced NG"	Any of the conditions under "Error" is fulfilled and you have activated the option "Force Error to NG"

13.7.3 Global Formulas

Global formulas are useful when you use execution groups. In order to calculate a formula, Vision P400 needs all checker results included in a formula. However, with execution groups only the checkers belonging to the currently active execution group are executed.

In order to be able to use checker results from other execution groups, mark a formula as a “global formula”. This way, Vision P400 uses the last result calculated for the formula checkers, regardless of whether the checker has been executed with the active execution group or belongs to a different group which has been executed earlier. The only condition is that all checkers used in the formula have been executed correctly once.

◆EXAMPLE

When you work with execution groups and need the same calibration factor for all execution groups, create a global formula in one execution group to calculate the calibration factor, thus making it available for all other execution groups.

Global formulas can easily be recognized by the orange shading of the name cell in the spreadsheet.

Formulas	Start		
	ArithExpr0	6501	OK
	BoolExpr0		OK
	ArithExpr1	1465.25	OK
	End		

Global formula in the spreadsheet

◆NOTE

Please note that global formulas are recalculated every time you execute the execution group in which the global formula belongs. This is why it is not possible to use global formulas to access old results from the global formula’s execution group.

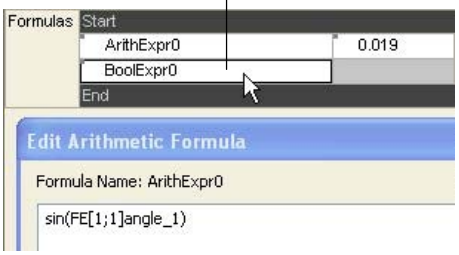
13.7.4 Switching to Another Formula in the Formula Editor

Vision P400 lets you switch to another formula when the "Formula Editor" window is open under the condition that the currently active formula is free of errors.

◆Procedure

1. **To open the formula, double-click in the formula's name field**

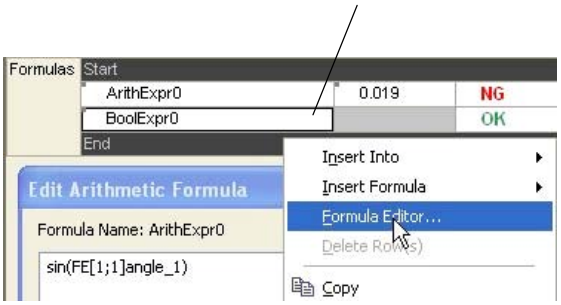
Double-click here to switch in the formula editor from the arithmetic to the Boolean formula



or

click the right mouse button on any cell of the formula row and select "Formula Editor"

Click right mouse button on a field so that the black frame surrounds the cell and select "Formula Editor" from the pop-up menu

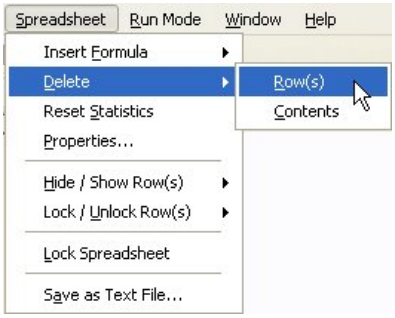


◆**NOTE**

Please note that you can only switch to another formula if the currently displayed formula is correct. Otherwise you need to parse it and correct the errors.

13.8 Delete

With **Spreadsheet → Delete** you can delete selected rows or the entire spreadsheet content. The same functionality is also available from the pop-up menu.



Delete spreadsheet rows/contents

Deleting Selected Rows

◆Procedure

1. **Select the rows to be deleted**

   For multiple rows, please use the multiple selection keys (see page 506).

2. **Choose Spreadsheet → Delete → Row(s)**

   or

   right-click and choose the "Delete Row(s)" option from the mouse menu

   or press

   <Del>

   The selected rows will be deleted.

Deleting the Whole Spreadsheet via the Menu

◆Procedure

1. **View → Spreadsheet**
2. **Spreadsheet → Delete → Content**

   The entire spreadsheet is deleted.

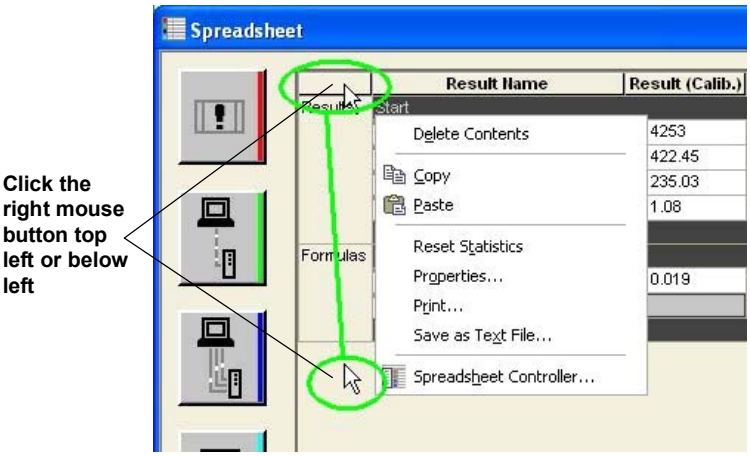
Deleting the Whole Spreadsheet via the Pop-up Menu

◆Procedure

1. **Right-click in the gray area at the very top left of the spreadsheet**

   or

   right-click in the gray area at the bottom left



2. **Select "Delete Contents"**

   The entire spreadsheet is deleted.

◆NOTE

The undo function is not available after executing Spreadsheet → Delete → Row(s) **or** Spreadsheet → Delete → Content**.**

13.9 Reset Statistics

Use **Spreadsheet → Reset Statistics** to reset the following statistical values on the spreadsheet to zero:

- Min Result
- Max Result
- Range
- Average
- Sigma
- Number of NG judgements
- Error
- Scans

◆Procedure

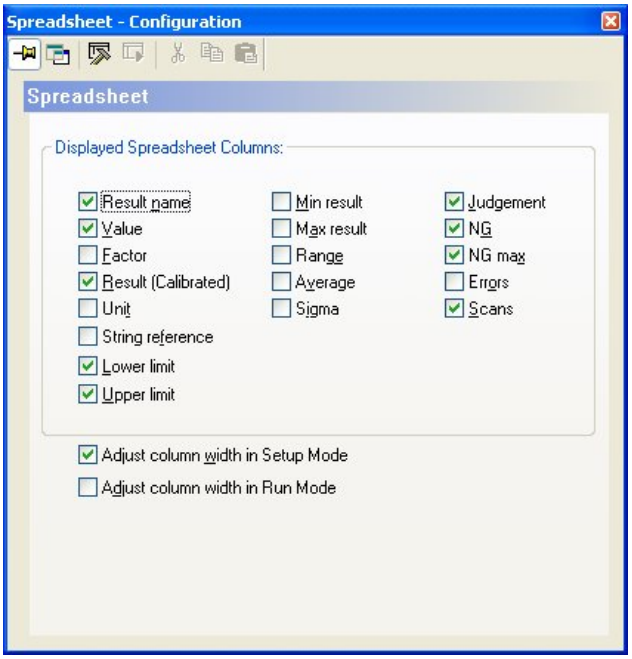
1. **Spreadsheet → Reset Statistics**

   or

   Click into the spreadsheet, click the right mouse button and choose "Reset Statistics"

13.10 Properties

With **Spreadsheet** → **Properties** you specify which values are to appear on the spreadsheet.



Spreadsheet property page

Please note that you can assign the value under "NG Max" (upper limit for the number of NG judgements) to an Action (see page 563). If the value or a multiple thereof is reached, the predefined action is performed.

All values displayed on the spreadsheet can be transferred to the interfaces. But only the value from "NG Max" can be linked to the [Action] button.

Adjust Column Width in Run Mode / Setup Mode

When you activate the option(s), Vision P400 recalculates the column width in the selected mode every time after you have executed the application so that the longest entry in the column determines the column width. When the option is not activated, the column width remains the same after executing the application. In this case it is possible that not all results are completely visible.

Chapter 14

Run Mode

14.1 Introduction

The system's operational mode from Vision P400 is called run mode. You will switch to run mode only after you have defined all your settings in the setup mode and are ready for Vision P400 to start work on the applications.

The setup mode is used for creating/editing applications.

◆NOTES

- **As soon as you have defined a password with** System Settings → Password**, activating/deactivating run mode is password-protected. Only exception: If you have checked the "Activate Run Mode at Startup" checkbox on the "Application" tab under** System Settings → Vision P400 Settings**, the password is bypassed when activating run mode.**
- **You will not be able to define settings (checker, application, interfaces) in run mode.**
- **It is not possible to change the windows' size and display order in run mode because this would negatively affect the time response of the system. Make sure to size and position your windows as desired while you are in setup mode.**
- **In run mode, the execution times displayed refer to the entire application. That means, the display shows the maximal image processing time for the sum of all cameras selected. Image processing takes place exclusively on the PC.**
- **Results marked in the spreadsheet can only be transferred to the interfaces in run mode.**
- **As the display of the "Parallel interface Monitor" affects the performance in run mode, we recommend leaving it switched off. If you need to change the settings, quit run mode and open the parallel interface monitor again.**
- **Application-specific settings from** Application → Properties **only take effect in run mode.**
- **Data or commands sent by the serial, parallel or OLE interface are only processed by Vision P400 in run mode.**
- **Windows 2000/Windows XP is not a real-time operating system. Please test the time response of your application extensively in run mode before installing the PC at its destination.**
- **When you exit run mode, the application is saved automatically unless it is write-protected. In this case the application is not saved and Vision P400 writes a warning into the error log file.**

14.2 Start/Stop

With **Run Mode** → **Start** you activate run mode. With **Run Mode** → **Stop** you return to setup mode.

Run mode menu

Another alternative is to click to switch to run mode and to switch to setup mode.

◆**NOTE**

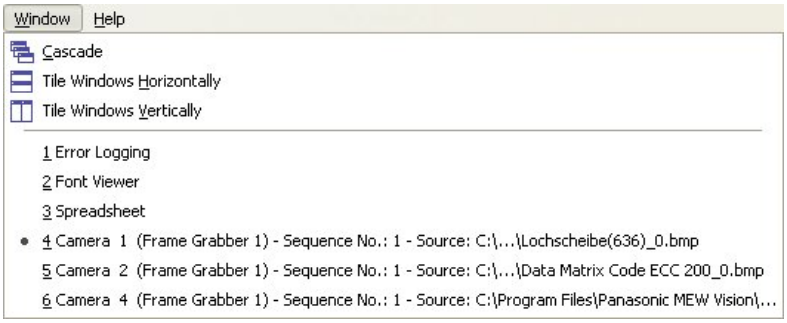
When you quit run mode and use camera/execution groups, the sequence list displays the checkers from the last executed sequence.

Chapter 15

Window

15.1 Window

With **Window** you can move one of the windows listed to the front of the screen. Listed are all windows which you opened but have not yet closed during your Vision P400 session. The window marked with a bullet is the active window you see in front on the screen.



Show list of open windows

You can switch to a different window using the window menu, the icon on the standard toolbar or the camera bar (see page 253).

Using the Icon from the Standard Tool Bar

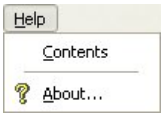
You can click to switch to the next camera window. This also works if the last active windows was for example spreadsheet window. By clicking several times you can "scroll" through all the camera windows. Windows that have been minimized, will be visible again and display with the standard size.

Using the Camera Bar

The camera bar shows thumbnail images from all connected cameras in ascending order. The camera bar is started by default with Vision P400 and docked in a fixed position at the bottom of the screen above the status bar. Click on the next thumbnail view to switch from one camera to the next.

15.2 Help

Vision P400 offers you sophisticated online help. The following submenus are available:



Help menu

Use **Help** → **Contents** to open the help window. There you find three property pages: "Contents", "Index", and "Search". The contents of the online help is the same as in this book.

15.2.1 Contents

With the “Contents” tab you open a list of books, which by and large correspond to the individual menus in Vision P400. Open the book about the menu you wish to know more about. A list of submenus will appear from which you can choose any topic with a mouse click.

15.2.2 Index

The "Index” tab displays an alphabetical list of all available topics described in the online help.

◆Procedure

1. **Help → Index**
2. **Click on a subject, e.g. "Checker", or type it in**

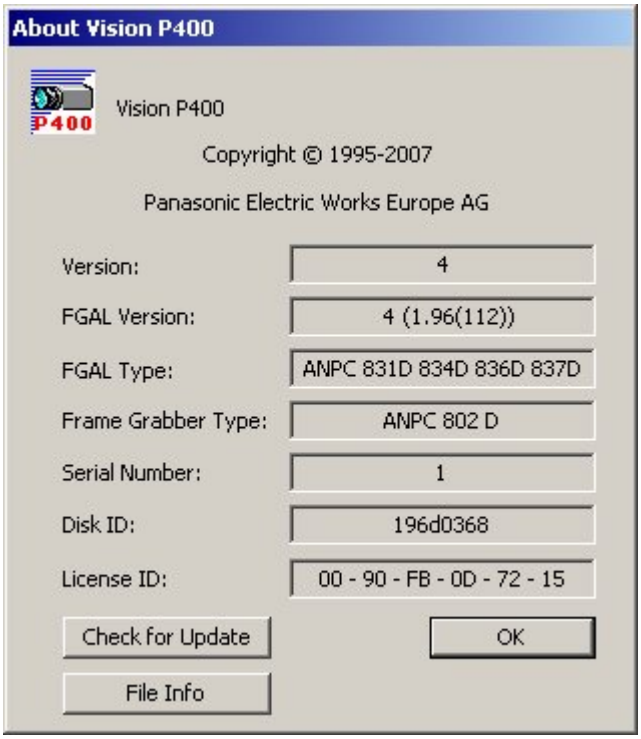
   You either see the explanation and/or a further index item you can click.

15.2.3 Find

The “Find” tab enables you to perform a full-text search of the help file. This way, you can find individual keywords and topics directly. Enter the keyword or select it from the list with the mouse.

15.2.4 About...

When you select **Help** → **About...**, you will see version information and the copyright of Vision P400. You can also check whether a new version is available and get an overview of the versions of all installed files



View version and serial number of Vision P400

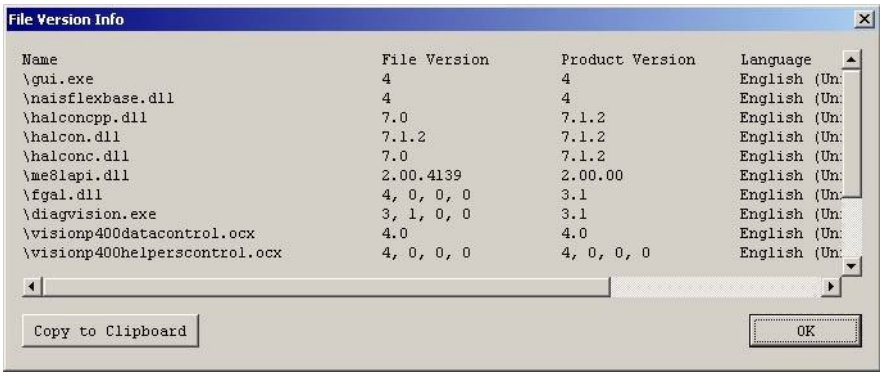
Option	Contents
Version	Vision P400 version number
FGAL version	Version number of the frame grabber software
FGAL type	Installed version of Vision P400: either **Standard** or **Simulation**
Frame grabber type	Type of frame grabber installed in the PC Imagechecker
Serial number	Serial number which has been entered during the installation of Vision P400. You can find this number also on the inside of the front door of the PC Imagechecker and on the packaging label.
Disk ID	If the license ID is not available, use this number as an alternative when requesting a license file.
License ID	Reference number for your license file

Check for update

With this button you check whether a new version of the software is available, provided you are connected to the Internet.

File info

With this button you open a dialog box listing version information for all installed files. This information can be very helpful for troubleshooting.



Chapter 16

Appendix

16.1 Hardware Settings

This chapter deals with the following hardware-related topics:

- BIOS configuration data
- Environment variables

16.1.1 BIOS Configuration Data

If you wish to restore the correct BIOS settings for the Imagechecker, please proceed as follows:

◆Procedure

1. **Start the Imagechecker while holding the <Del> key down until the BIOS setup menu appears**
2. **Use action "Load Optimized Defaults" to restore the predefined system state**

   The following settings are predefined and will be restored:

Area	Subarea	Option	Setting
Standard CMOS Features	Drive A		None
	Drive B		None
Advanced BIOS Features	Hard Disk Boot Priority	1	Ch1 M. : TRS Tele-Radio Space G
		2	Ch0 M. : HTE541040G9SA00
		3	Bootable Add-in Cards
	USB Hard Disk Boot First		enabled
	First Boot Device		HDD
	Second Boot Device		USB CDROM
	Third Boot Device		USB FDD
Advanced Chipset Features	Boot Display		CRT
Integrated Peripherals	Onboard Device	USB Keyboard Support	enabled
		AC97 Audio Select	All disabled
	Super I/O Device	PWRON After PWR-Fail *	On
		Onboard FDC Controller	disabled

   *This function is executed only when the power is interrupted for at least 10 seconds.

3. **Save the settings with <F10>**

16.1.2 Environment Variables

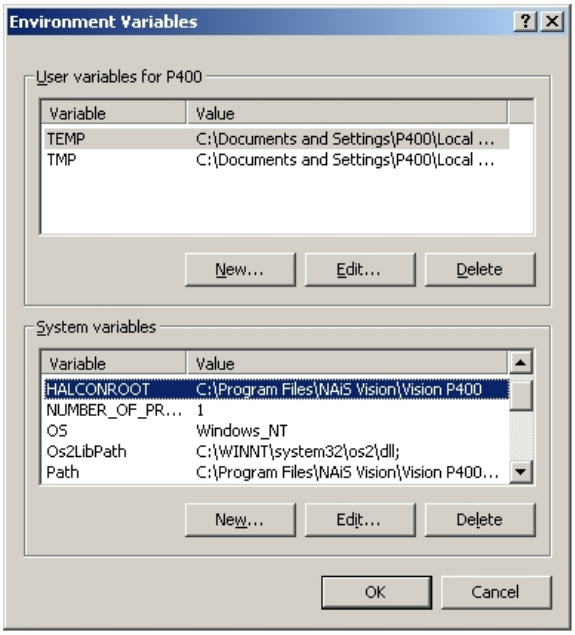
The following settings are made when you install Vision P400. The settings are absolutely necessary for working with Vision P400. If the path settings are not correct or missing altogether, Vision P400 will not be able to operate.

System

HALCONROOT: This is the path for the license file "license.dat". If the path set here is not the correct path for the license file, an error message will appear and Vision P400 will not start. This entry only exists when you are working with the demo version.

User

TEMP and TMP: This setting is used to store temporary variables.



Environment variables for Vision P400

16.2 Repair Service Instructions

Danger for people and equipment!
These instructions are intended for the exclusive use of authorized personnel. You should never even open the Imagechecker casing unless you have expert knowledge of applied computer engineering and are qualified to work on computer hardware.

16.2.1 Replacing the Fan and the Battery

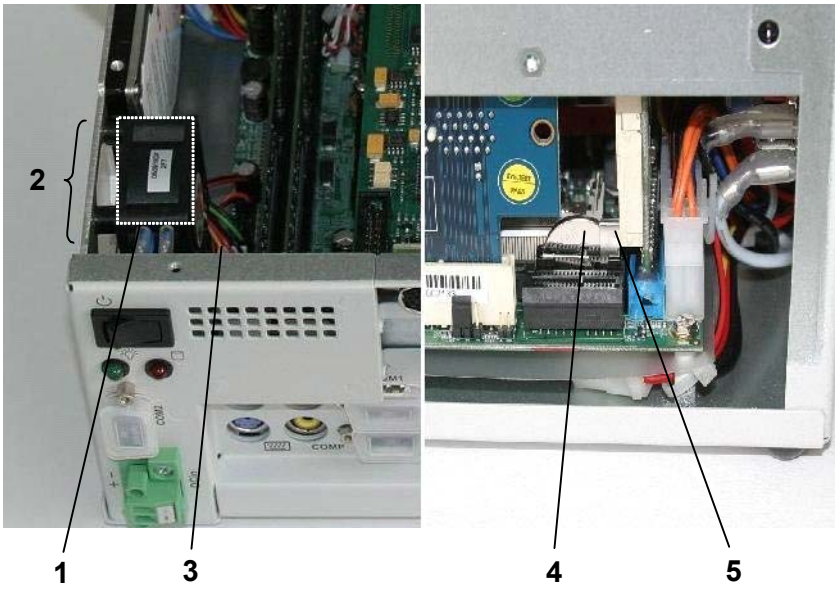
Both the fan ANPMA 8608 (lifetime of approx. 75,000 hours at 40°C) and the battery ANPMA 8610 have a limited service life and can be replaced, if necessary.

◆Procedure

1. **Pull the mains cable and disconnect the power supply**
2. **Unscrew the four screws of the top cover and pull the cover up to open the casing**

3. **In the case of the fan (1) unscrew the four fastening screws (2) and pull the connector (3) from its power supply**

4. **In the case of the battery lift the clip spring (4) and pull out the battery (5)**



5. **Fasten and connect the fan, respectively insert the new battery**

   Make sure to keep the cables securely away from the fan.

6. **Close the Imagechecker casing and fasten it with the four recessed-head screws**

16.2.2 Installing a New Hard Disk

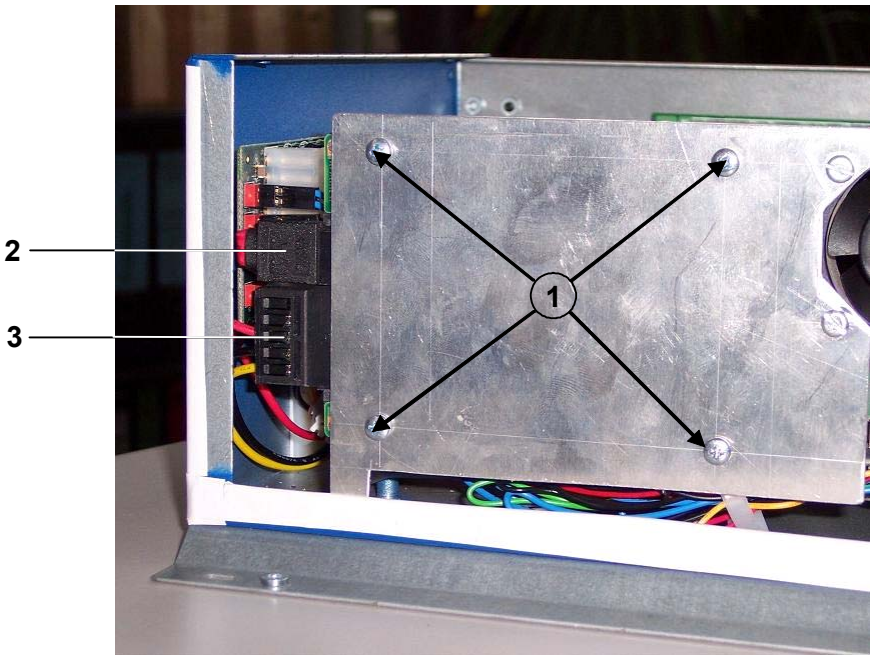
The hard disk drive ANPMA 861 has a limited service life. If necessary, you can replace the hard disk:

◆Procedure

1. **Pull the mains cable and disconnect the power supply**

2. **Unscrew the four screws of the top cover and pull the cover up to open the casing**

3. **Unscrew the four screws fastening the hard disk (1) and disconnect the S-ATA interface (2) and the power supply (3)**



4. **Remove the old hard disk**
5. **Insert the new hard disk**
6. **Re-fasten the screws and re-connect the unplugged cables**
7. **Close the Imagechecker casing and fasten it with the four recessed-head screws**

16.3 Error Handling and System Diagnosis

This chapters contains information about how you can diagnose and fix errors when operation Vision P400. You find information on the following topics:

- List of possible types of error (see page 605)
- List of possible error messages (see page 610)
- List of possible mistakes when setting or executing checkers (see page 611)
- Possible reactions of the interfaces (see page 611)
- System diagnosis (see page 612)
- Feedback form (see page 613)

16.3.1 Error Types

In Vision P400 six different error types can occur:

1. Unexpected error
2. Fatal error
3. Warning
4. Interface error
5. Action error (user-defined error)
6. Status message

16.3.1.1 Unexpected Error

After an unexpected error has occurred, it is impossible to continue image processing with Vision P400, not even in a limited way. When an unexpected error occurs, the only possibility is to save the current state of Vision P400 and to exit Vision P400 immediately.

If an unexpected error occurs, the Vision P400 session has to be stopped immediately and an error message appears on the screen. The system writes a detailed description in the window "Error Logging" and in the file "error.txt". A user-defined size limit for the file will be ignored. In addition to this, the error message will be sent to all available interfaces. It is not possible to start another application execution.

As soon as you have confirmed the error message about the unexpected error, Vision P400 terminates as there is no way of continuing.

◆NOTES

- **Whenever a fatal or an unexpected error occurs, Vision P400 automatically transfers the contents of the error file "error.txt" in a file with the name "errorfatal.txt". New contents will be added at the beginning of "errorfatal.txt". This way, existing entries in "errorfatal.txt" will not be overwritten.**

- **Whenever a fatal or unexpected error occurs, Vision P400 creates a new subfolder in its installation folder. This subfolder is called "P400Diagnostic<internal number>" and contains important information for analyzing the error. Please do not rename this subfolder and do not change its contents.**
- **Vision P400 creates up to 10 subfolders with the name "P400Diagnostic<internal number>". After that, existing subfolders will be overwritten when new subfolders with the same name are created.**

16.3.1.2 Fatal Error

After a fatal error has occurred, it is possible to continue image processing with Vision P400 to a limited extent. However, when a fatal error has occurred it is no longer possible to switch from setup to run mode, for example.

If a fatal error occurs, the Vision P400 session has to be stopped immediately and an error message appears on the screen. The system writes a detailed description in the window "Error Logging" and in the file "error.txt". A user-defined size limit for the file will be ignored. In addition to this, the error message will be sent to all available interfaces. It is not possible to start another application execution.

◆NOTES

- **Whenever a fatal or an unexpected error occurs, Vision P400 automatically transfers the contents of the error file "error.txt" in a file with the name "errorfatal.txt". New contents will be added at the beginning of "errorfatal.txt". This way, existing entries in "errorfatal.txt" will not be overwritten.**
- **Whenever a fatal or unexpected error occurs, Vision P400 creates a new subfolder in its installation folder. This subfolder is called "P400Diagnostic<internal number>" and contains important information for analyzing the error. Please do not rename this subfolder and do not change its contents.**
- **Vision P400 creates up to 10 subfolders with the name "P400Diagnostic<internal number>". After that, existing subfolders will be overwritten when new subfolders with the same name are created.**

16.3.1.3 Warning

Warnings usually have no impact on the running session except that a certain time is needed to write the warning into the file error.txt and into the “Error Logging” window (can be switched off in run mode).

You will receive a warning if a **calculation error** occurs in the spreadsheet or when **executing a checker**.

Calculation errors of checkers are for example dependency errors and land overflow errors. If such an error occurs, the checker will not be executed. The results are invalid and must not be processed further.

If a calculation errors occurs in the spreadsheet, for example when the system tries to divide a result by zero, the word "Error" is displayed in the "Judgement" column and the number of NG judgements is increased by one. In addition, a warning is displayed on the "Result" page of the checker in question. If other checkers use the result of a faulty checker, these checkers too display a warning (execution error, dependency error) on their "Result" pages.

16.3.1.4 Action Error

An action error is an action defined by the user. All actions performed by the system are user-defined. Action errors only occur in run mode if the number of NG judgements of a checker result exceeds the limit (or a multiple thereof) defined by the user in the cell “NG Max”.

16.3.1.5 Status Message

Status messages are no errors in the true sense of the word. They provide information on the status of a checker, when the execution of this checker leads to a result differing from what the user expected. The status message will help you to adjust the checker parameters to obtain the best results.

For example, the status message “no object after binarizing” informs you that there were no objects after the binarization procedure and that you need to change the binarization thresholds and to execute the checker again. Status messages only appear in the field "Execution State" on the checker's "Result" page. They are not written to the "Error Logging" window or into the "error.txt" file.

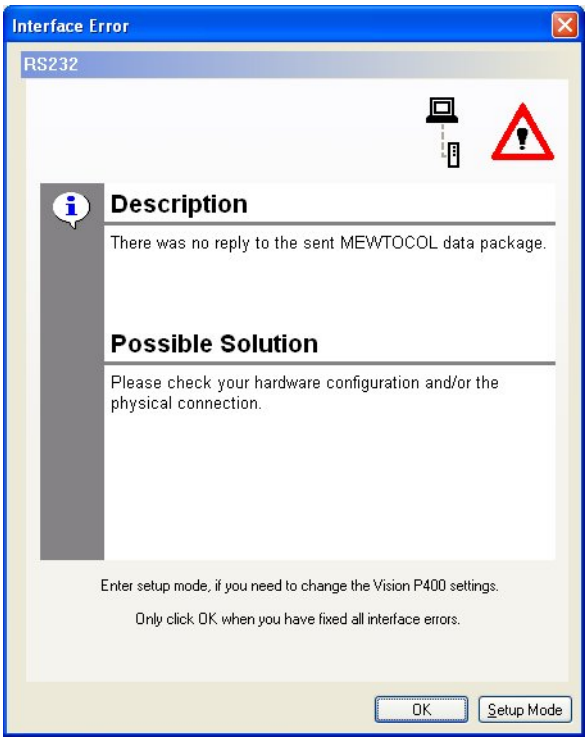
16.3.1.6 Interface Error

Interface errors are errors occurring in the communication between Vision P400 and external devices. It is possible to fix interface errors without exiting Vision P400. Interface errors only occur in run mode. Most errors of this type are caused by one of the following reasons:

- Vision P400 and the external device use different settings for the interface parameters, e.g. the baud rate settings differ.
- The external device does not respond within the expected time, for example if the parallel interface transfers data with handshake and the external device does not acknowledge the data transfer on time, thus causing a timeout.

This is what happens when an interface error occurs:

	Interface causing the error	All other interfaces
Reaction when the interface error occurs	Displays error dialog box, see below	Output a warning
Reception of control signals?	off	on
Output of data and signals?	off	on
Output of PCReady?	off	on



Example of an error dialog box when an interface error has occurred

The error dialog box provides an error description and suggestions for troubleshooting. If more than one error occurred in one interface, you can toggle between the errors. If errors have occurred in several interfaces, you can select each interface on the left side of the dialog window.

Depending on whether the error was caused by settings in Vision P400 or by settings in the external device, you need to proceed differently to fix the error:

Solving interface errors caused by Vision P400 settings

You need to switch to setup mode to change the settings. Please proceed as follows:

◆Procedure

1. **Select [Setup Mode] in the error dialog box**
2. **Change the settings in Vision P400**

   Also check the interface settings in the external device.
3. **Select [OK] in the error dialog box**

4. **Switch to run mode**

Solving interface errors caused by settings in the external device

You do not need to exit run mode. Please proceed as follows:

◆Procedure

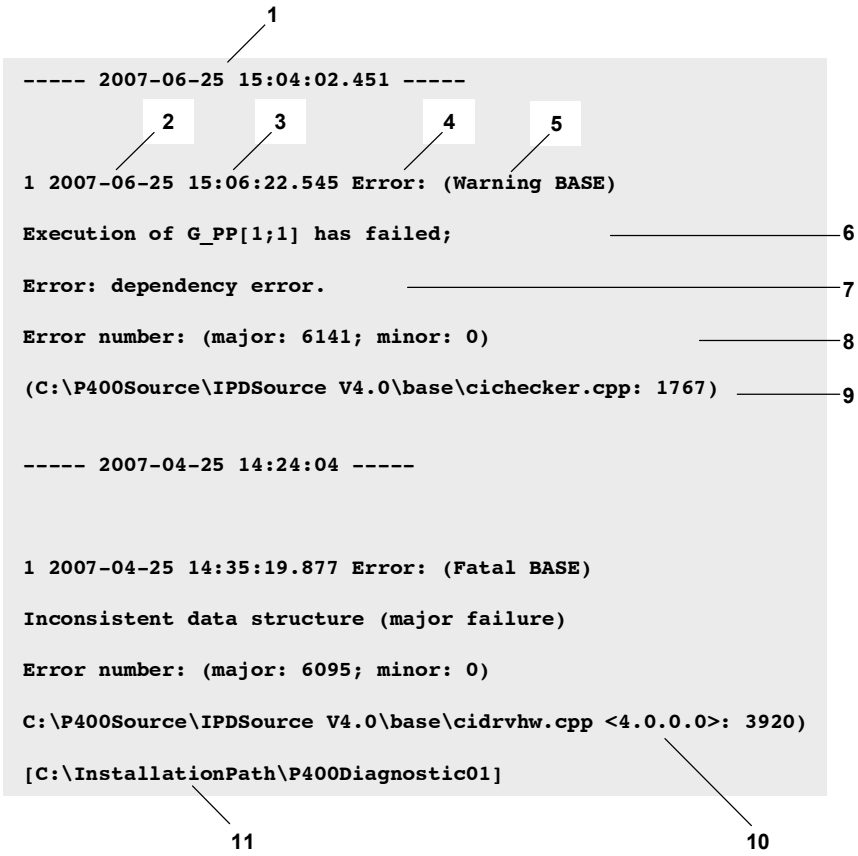
1. **Change the interface parameters of the external device so that they correspond to the Vision P400 settings**
2. **Select [OK] in the error dialog box**

◆NOTES

- **Only select [OK] in the error dialog box when you have fixed all interface errors. Otherwise the interface error will re-appear when you next execute the application.**
- **If you are in run mode when you select [OK], Vision P400 outputs the next data and signals to all interfaces affected by the error. If the error has not been fixed properly, the error dialog box will re-appear when you next execute the application.**
- **When you are in setup mode, you can only switch to run mode after you have fixed all interface errors.**
- **When both a fatal and an interface error occur, the fatal error has priority. This means you need to switch to setup mode and / or exit Vision P400 to fix the fatal error.**
- **As long as there is a fatal error in Vision P400, no interface error will be output.**

16.3.2 Error Messages in "error.txt"

Every time the program starts up a new section with the current date and time is created at the end of the file. Each error or warning is written in a new line.



Commentated extract from file "error.txt"

1	Date and time when Vision P400 was started
2	Entry number
3	Date
4	Time
5	Error type
6	Location of error
7	Faulty object
8	Error text
9	Error number
10	Information on the source code. In case of unexpected and fatal errors the version number is stored here.
11	Only for unexpected and fatal errors: Name of the subfolder in the Vision P400 installation folder with information for the error diagnosis

Below you find a list of all possible error types and locations where fatal errors or warnings may occur.

Error type	Meaning
Unexpected	Unexpected error, Vision P400 session will be terminated
Fatal	Fatal error, Vision P400 session will be stopped
Warning	Warns you that for example the execution of a checker has failed

Location of error	Meaning
GUI	An error occurred in the user interface
BASE	An error occurred in the "Base Classes"
Driver access error	System failed to access a driver
FGAL	An error occurred while the system tried to grab the image
Other files	Other causes

16.3.3 Errors When Setting or Executing a Checker

Errors which occur during the setting or execution of a checker can be divided into two categories: error occurring during the calculation of the checker/spreadsheet result or errors occurring when setting the checker.

Calculation errors are always displayed as warnings and appear in the “Error Logging” window (in run mode only if you have activated this option). Errors occurring during the setting of a checker are displayed as a status message in the field “Execution State” on the “Result” page of a checker. Status messages are displayed if the checker does provide a result, but this result is different from the expected result.

16.3.4 Interface Reaction to Errors

Depending on the error type, the interfaces react differently if an error occurs.

Parallel interface

Error type	Reaction
Unexpected/fatal error	The output “Error” will be set
Spreadsheet error	If an error (see page 605) occurs during the calculation of the spreadsheet data, the output "Execution Result Error" will be set.
Action error	The output “Action Error” will be set
Byte overflow	If a selected value is not within the range of the selected data type, the output “Byte Overflow” will be set. This error is equal to a fatal error.

Serial interface

Error type	Reaction
Unexpected/fatal error	"%?" will be sent

Error type	Reaction
Spreadsheet error	If an error (see page 605) occurs during the calculation of the spreadsheet data, the result in the data package is marked with a character: e.g. with an exclamation mark: 1,!,10,4. The character is user-definable (see page 158).
Action error	"%?" will be sent
Invalid application number	If an invalid application number was used for an application change, the error code “%z” will be transferred

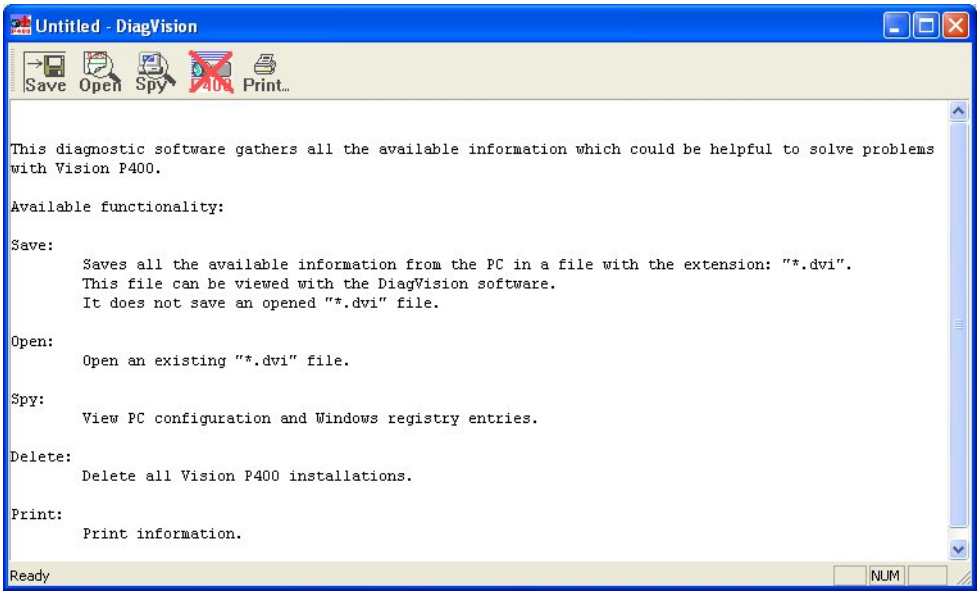
OLE

Error type	Reaction
Unexpected/fatal error	Signal PCError will be sent
Action error	Signal Action_Error will be sent if the action (see page 563) is triggered

16.3.5 System Diagnosis with DiagVision.exe

From version 1.7 onwards the installation of Vision P400 includes an English diagnosis tool called "DiagVision.exe", which can be found in your installation folder.

With the help of this tool you can retrieve a wide range of information about your hardware and software, which may help solve problems with Vision P400.



DiagVision startup screen

Icon	Meaning	Available functionality
	Save	Saves all the available information in a file with the extension *.dvi. This file can be viewed with the DiagVision software.
	Open	Open a diagnosis file with the extension *.dvi.
	Spy	Search for and check all available information individually or in bulk. The information displayed here is taken exclusively from the PC running the program. When you select this icon, all other icons will be deactivated.

Icon	Meaning	Available functionality
	Delete Vision P400	Use this option to remove all installed versions of Vision P400 from your PC. This is useful if you have installed several versions of Vision P400 on your PC and the standard deinstallation routine of the setup does not work anymore. Before the installation folders of Vision P400 and Vision P400 Demo are deleted, the system backs up all files with the extensions *.nav, *.fnt, *.nft, and the file "License.dat" in the folder C:\\VisionP400Backup. All other files in the Vision P400 and Vision P400 Demo installation folders will be deleted together with the folders.
	Print	Use this option to send all information from the document window to the default printer installed.

16.3.6 User Feedback

When producing the Vision P400 software we did everything possible to detect and remove software errors by highly sophisticated quality checks. As you know, it is nearly impossible to produce a flawless software product. That is why we kindly ask you for your support if a software error occurs in spite of all our efforts.

◆**NOTE**

If you wish to report an error, please send or fax a print-out of the file "error.txt" together with the report sheet on the next page. Alternatively, use the tool DiagVision.exe (see page 612) to create a *.dvi file and mail it to us. This will speed up the trouble-shooting process.

Thank you very much in advance for your help and understanding.

☐ **Software Error Report**

☐ **Change Request/Suggestion for Improvement**

From

Name:

Address:

Phone:

Facsimile:

Date:

Panasonic Electric Works Europe AG
IPD Sensors

Facsimile: +49-8024-648-222

Error description

Vision P400 version number
Vision P400 software serial number: Vision P400 Imagechecker number: Imagechecker serial number: (see label on casing or behind front door)
Environment (version number of the operating system, service pack installed, system configuration (network card, etc.)):
System behavior (C = Crash, P = Program failure, M = Miscellaneous):
Description of the problem or change request (in case of a software problem please attach a print-out of the file “error.txt”, a print-out of the faulty application (*.nav), and a screen-shot to document the problem):
Explain step by step what you have been doing before the problem appeared so we can reproduce the system behavior:

16.4 Camera Components

This chapter contains additional technical information on the cameras and camera-related hardware:

- Pin assignment (see page 615)
- Programming commands (see page 616)
- Vision P400 Communication (see page 620) and operation (see page 620) settings

◆NOTE

For lens selection tables, please turn to our homepage:
http://www.panasonic-electric-works.com/peweu/en/downloads/dd_x633_en_lens_selection_table.xls
Select your camera type by clicking one of the tabs at the bottom.

16.4.1 Cameras ANPC 831D/834D

The camera types ANPC 831D and ANPC 834D can be configured externally via an RS232 connection.

16.4.1.1 Pin Assignment for Trigger and RS232 Control

Please use the programming cable with order number ANPC 8300D.

Pin	Full frame shutter
1	TXD (RS232)
2	RXD (RS232)
3	GND
4	GND
5	Ext. Trigger IN
6	EEN OUT

16.4.1.2 Communication Settings

If you would like to control the camera via the serial interface, please set the following parameters:

Baud rate	9600bps
Data length	8 bit
Start bit	1 bit
Stop bit	1 bit
Parity	None
Xon/Xoff	None

16.4.1.3 Command List

The following tables give a complete overview of the camera settings and commands available. For a quick and easy configuration of the parameters described here please use the software "Camera Configurator" (see page 69).

Camera ANPC 831D

	Command name	Format	Parameters	Remarks
A – General settings and useful commands				
1	Echo Back	EB=[Para.]<CR><LF>	0=Echo off, 1=Echo on set to “Off “ when power up	Off at power up
2	Camera status request	ST?<CR><LF>		Current setting
3	Online help request	HP?<CR><LF>		Command list
4	Firmware version	VN?<CR><LF>		3-letter version, e.g. 100
B – Timing and shutter-related commands				
1	Scanning format	SC=[Param.]<CR><LF>	0=Full frame 1=1/2 partial 2=1/3 partial 3=1/6 partial	
2	Trigger mode	TR=[Param.]<CR><LF>	0=Normal 1=Edge Pre-Select 2=Pulse Width Control 3=Frame Delay Readout 4=Long Time Exposure 5=Start-Stop 6=Smearless	
3	Shutter speed	SH=[Param.]<CR><LF>	0=1/30 1=1/50 2=1/60 3=1/125 4=1/250 5=1/500 6=1/1000 7=1/2000 8=1/4000 9=1/10000 10=1/20000 11=1/40000 12=1/60000 13=1/80000 14=1/100000	With "Edge Preselect" mode, maximum is 9=1/10000
4	Trigger polarity	TP=[Param.]<CR><LF>	0=Active_L, 1=Active_H	
5	WEN polarity	WP=[Param.]<CR><LF>	0=Active_L, 1=Active_H	

	Command name	Format	Parameters	Remarks
6	CLK/WEN	CW=[Param.]<CR><LF>	0=WEN, 1=CLK	(To enable pixel clock)
7	HC synchronous accumulation	HC=[Param.]<CR><LF>	0=Sync, 1=Async	
8	Sync signal output	SO=[Param.]<CR><LF>	0=off, 1=on	
9	Shutter mode	SM=[Param.]<CR><LF>	0=Normal 1=Programmable exposure	
10	Programmable exposure	PE=[Param.]<CR><LF>	0=0.5H, 1=1.5H 1023=1023.5H	
C – Settings for gain and analog signals				
1	AGC level	AG=[Param.]<CR><LF>	Range 0 - 255	
2	White clip level	WC=[Param.]<CR><Lf>	Range 0 - 255	
3	Setup level	SU=[Param.]<CR><LF>	Range 0 - 255	
4	Gain level	GA=[Param.]<CR><LF>	Range 0 - 255	
5	Rear potentiometer select	RP=[Param.]<CR><LF>	0=off, 1=on	
6	Gamma select	GS=[Param.]<CR><LF>	0=1, 1=0,45	
7	AGC switch	AS=[Param.]<CR><LF>	0=off, 1=on	
D – Saving data to and loading data from EEPROM				
1	Load settings (from camera EEPROM)	LD=[Param.]<CR><LF>	0=Factory data area 1=User1 data area 2=User2 data area 3=User3 data area	Latest used data area becomes default at next power up
2	Save settings (to camera EEPROM)	SA=[Param.]<CR><LF>	1=User1 data area 2=User2 data area 3=User3 data area	If you do not save the current data, they will be lost when you switch off the system.

Camera ANPC 834D

	Command name	Format	Parameters	Remarks
A – General settings and useful commands				
1	Echo Back	EB=[Para.]<CR><LF>	0=Echo off, 1=Echo on set to OFF when power up	Off at power up
2	Camera status request	ST?<CR><LF>		Current setting
3	Online help request	HP?<CR><LF>		Command list
4	Firmware version	VN?<CR><LF>		3-letter version, e.g. 100
B – Timing and shutter-related commands				
1	Scanning format	SC=[Param.]<CR><LF>	0=Full frame 1=1/2 partial 2=1/3 partial 3=1/6 partial	

	Command name	Format	Parameters	Remarks
2	Trigger mode	TR=[Param.]<CR><LF>	0=Normal 1=Edge Pre-Select 2=Pulse Width Control 3=Frame Delay Readout 4=Long Time Exposure 5=Start-Stop 6=Smearless	
3	Shutter speed	SH=[Param.]<CR><LF>	0=Off 1=1/21 2=1/42 3=1/70 4=1/175 5=1/349 6=1/698 7=1/1397 8=1/2794 9=1/5587 10=1/14,000 11=1/28,000 12=1/56,000 13=1/84,000 14=1/112,000 15=1/140,000	In trigger modes 1 – 6 settings higher than 9 will result in a shutter time of 1/8381
4	Trigger polarity	TP=[Param.]<CR><LF>	0=Active_L, 1=Active_H	
5	WEN polarity	WP=[Param.]<CR><LF>	0=Active_L, 1=Active_H	
6	EEN/WEN	EW=[Param.]<CR><LF>	0=EEN, 1=WEN	
7	Pixel clock	PC=[Param.]<CR><LF>	0=no clock out, 1=clock out	
8	HC synchronous accumulation	HC=[Param.]<CR><LF>	0=Sync, 1=Async	
9	Sync signal output	SO=[Param.]<CR><LF>	0=off, 1=on	
10	Shutter mode	SM=[Param.]<CR><LF>	0=Normal 1=Programmable exposure	
11	Programmable exposure	PE=[Param.]<CR><LF>	0=0.3H 1=1.3H 1023=1023.3H	H=83.6µs
12	Binning	BI=[Param.]<CR><LF>	0=Off 1=vertical 2=horizontal 3=hor. + vert.	

	Command name	Format	Parameters	Remarks
C – Settings for gain and analog signals				
1	AGC level	AG=[Param.]<CR><LF>	Permissible value range: 0 - 255	
2	White clip level	WC=[Param.]<CR><Lf>	Permissible value range: 0 - 255	
3	Setup level	SU=[Param.]<CR><LF>	Permissible value range: 0 - 255	
4	Gain level	GA=[Param.]<CR><LF>	Permissible value range: 0 - 255	
5	Rear potentiometer select	RP=[Param.]<CR><LF>	0=off, 1=on	
6	Gamma select	GS=[Param.]<CR><LF>	0=1, 1=0.45	
7	AGC switch	AS=[Param.]<CR><LF>	0=off, 1=on	
D – Saving data to and loading data from EEPROM				
1	Load settings (from camera EEPROM)	LD=[Param.]<CR><LF>	0=Factory data area 1=User1 data area 2=User2 data area 3=User3 data area	Latest used data area becomes default at next power up
2	Save settings (to camera EEPROM)	SA=[Param.]<CR><LF>	1=User1 data area 2=User2 data area 3=User3 data area	If you do not save the current data, they will be lost when you switch off the system.

16.4.1.4 Camera Settings for Vision P400

The table shows the camera settings necessary for smooth operation with Vision P400. Values with gray shading differ from the factory settings. The cameras are delivered with the correct settings for optimum operation.

ANPC 831		ANPC 834	
AG=108	AGC level = 108	**AG=81**	AGC level = 81
AS=0	AGC switch = OFF	**AS=0**	AGC switch = OFF
CW=0	CLK/WEN = CLK	**BI=0**	Binning = OFF
GA=71	Gain level = 71	**EW=0**	EEN/WEN = EEN
GS=0	Gamma select = 1	**GA=67**	Gain level = 67
HC=0	HC synchronous accumulation = Sync	**GS=0**	Gamma select = 1
PE=524	Programmable exposure = 524.3H	**HC=0**	HC synchronous accumulation = Sync
RP=1	Rear potentiometer select = ON	**PC=0**	Pixel clock output = no clock out
SC=0	Scanning format = Full frame	**PE=1023**	Programmable exposure = 1023.3H
SH=0	Shutter speed = 1/30	**RP=1**	Rear potentiometer select = ON
SM=0	Shutter mode = Normal	**SC=0**	Scanning format = Full frame
SO=1	Sync signal output = ON	**SH=0**	Shutter speed = OFF
SU=73	Setup level = 73	**SM=0**	Shutter mode = Normal
TP=0	Trigger polarity = Active_L	**SO=1**	Sync signal output = ON
TR=2	Trigger mode = Pulse width control	**SU=74**	Setup level = 74
WC=124	White clip level = 124	**TP=0**	Trigger polarity = Active_L
WP=0	WEN polarity = Active_L	**TR=2**	Trigger mode = Pulse width control
		WC=121	White clip level = 121
		WP=0	WEN polarity = Active_L

◆**NOTE**

When you change the set values, save the new values with the command SA=1. Otherwise your changes will be lost as soon as the camera is no longer supplied with 12V DC.

16.5 Recommended Literature

Title	Author	Published by
Fundamentals Of Digital Image Processing	Anil K. Jain	Prentice Hall Englewood Cliffs 1989
Digitale Bildverarbeitung	Bernd Jähne	Springer Verlag Berlin Sechste überarbeitete und erweiterte Auflage 2005
Bildverarbeitung in der Praxis	R. Steinbrecher	Oldenbourg Verlag München 1993
Methoden der digitalen Bildsignalverarbeitung	P. Zamperoni	Vieweg Verlag Braunschweig Zweite überarbeitete Auflage 1991
Einführung in die digitale Bildverarbeitung	Wolfgang Abmayr	B.G. Teubner Verlag Stuttgart Zweite Auflage 2002
Digitale Bildverarbeitung: Grundlagen und Anwendungen	Peter Haberäcker	Hanser Verlag München 1991
Praxis der Digitalen Bildverarbeitung und Mustererkennung	Peter Haberäcker	Hanser Verlag München 1995
Das Handbuch der Bildverarbeitung. Methoden, Programme, Anwendungen.	Rolf-Jürgen Ahlers	Expert-Verlag Renningen 2000
Industrielle Bildverarbeitung. Wie optische Qualitätskontrolle wirklich funktioniert.	Christian Demant et al.	Springer Verlag Berlin Zweite Auflage 2001
Einführung in die industrielle Bildverarbeitung	Gerhard Weißler	Franzis Verlag Poing 2006

16.6 ASCII Codes

Dec.	Hex.	Character	Dec.	Hex.	Character	Dec.	Hex.	Character	Dec.	Hex.	Character
0	00	(NUL)	32	20	Space	64	40	@	96	60	`
1	01	(SOH)	33	21	!	65	41	A	97	61	a
2	02	(STX)	34	22	"	66	42	B	98	62	b
3	03	(ETX)	35	23	#	67	43	C	99	63	c
4	04	(EOT)	36	24	$	68	44	D	100	64	d
5	05	(ENQ)	37	25	%	69	45	E	101	65	e
6	06	(ACK)	38	26	&	70	46	F	102	66	f
7	07	(BEL)	39	27	'	71	47	G	103	67	g
8	08	(BS)	40	28	(	72	48	H	104	68	h
9	09	(HT)	41	29	)	73	49	I	105	69	i
10	0A	(LF)	42	2A	*	74	4A	J	106	6A	j
11	0B	(VT)	43	2B	+	75	4B	K	107	6B	k
12	0C	(FF)	44	2C	,	76	4C	L	108	6C	l
13	0D	(CR)	45	2D	-	77	4D	M	109	6D	m
14	0E	(SO)	46	2E	.	78	4E	N	110	6E	n
15	0F	(SI)	47	2F	/	79	4F	O	111	6F	o
16	10	(SLE)	48	30	0	80	50	P	112	70	p
17	11	(CS1)	49	31	1	81	51	Q	113	71	q
18	12	(DC2)	50	32	2	82	52	R	114	72	r
19	13	(DC3)	51	33	3	83	53	S	115	73	s
20	14	(DC4)	52	34	4	84	54	T	116	74	t
21	15	§ (NAK)	53	35	5	85	55	U	117	75	u
22	16	(SYN)	54	36	6	86	56	V	118	76	v
23	17	(ETB)	55	37	7	87	57	W	119	77	w
24	18	(CAN)	56	38	8	88	58	X	120	78	x
25	19	(EM)	57	39	9	89	59	Y	121	79	y
26	1A	(SIB)	58	3A	:	90	5A	Z	122	7A	z
27	1B	(ESC)	59	3B	;	91	5B	[	123	7B	{
28	1C	(FS)	60	3C	<	92	5C	\	124	7C	|
29	1D	(GS)	61	3D	=	93	5D	]	125	7D	}
30	1E	(RS)	62	3E	>	94	5E	^	126	7E	~
31	1F	(US)	63	3F	?	95	5F	_	127	7F	⌂

Dec.	Hex.	Character	Dec.	Hex.	Character	Dec.	Hex.	Character	Dec.	Hex.	Character
128	80	Ç	160	A0	á	192	C0	└	224	E0	Ó
129	81	ü	161	A1	í	193	C1	┴	225	E1	ß
130	82	é	162	A2	ó	194	C2	┬	226	E2	Ô
131	83	â	163	A3	ú	195	C3	├	227	E3	Ò
132	84	ä	164	A4	ñ	196	C4	─	228	E4	õ
133	85	à	165	A5	Ñ	197	C5	┼	229	E5	Õ
134	86	å	166	A6	ª	198	C6	ã	230	E6	µ
135	87	ç	167	A7	º	199	C7	Ã	231	E7	þ
136	88	ê	168	A8	¿	200	C8	╚	232	E8	Þ
137	89	ë	169	A9	®	201	C9	╔	233	E9	Ú
138	8A	è	170	AA	¬	202	CA	╩	234	EA	Û
139	8B	ï	171	AB	½	203	CB	╦	235	EB	Ù
140	8C	î	172	AC	¼	204	CC	╠	236	EC	ý
141	8D	ì	173	AD	¡	205	CD	═	237	ED	Ý
142	8E	Ä	174	AE	«	206	CE	╬	238	EE	¯
143	8F	Å	175	AF	»	207	CF	¤	239	EF	´
144	90	É	176	B0	░	208	D0	ð	240	F0	
145	91	æ	177	B1	▒	209	D1	Ð	241	F1	±
146	92	Æ	178	B2	▓	210	D2	Ê	242	F2	=
147	93	ô	179	B3	│	211	D3	Ë	243	F3	¾
148	94	ö	180	B4	┤	212	D4	È	244	F4	¶
149	95	ò	181	B5	Á	213	D5	€	245	F5	§
150	96	û	182	B6	Â	214	D6	Í	246	F6	÷
151	97	ù	183	B7	À	215	D7	Î	247	F7	¸
152	98	ÿ	184	B8	©	216	D8	Ï	248	F8	°
153	99	Ö	185	B9	╣	217	D9	┘	249	F9	¨
154	9A	Ü	186	BA	║	218	DA	┌	250	FA	·
155	9B	ø	187	BB	╗	219	DB	█	251	FB	¹
156	9C	£	188	BC	╝	220	DC	▄	252	FC	³
157	9D	Ø	189	BD	¢	221	DD	¦	253	FD	²
158	9E	×	190	BE	¥	222	DE	Ì	254	FE	■
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Record of Changes

Manual No.	Date	Description of changes
ACGM0103V10END	March 2008	First edition (based on ACGM0101V70DED)
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