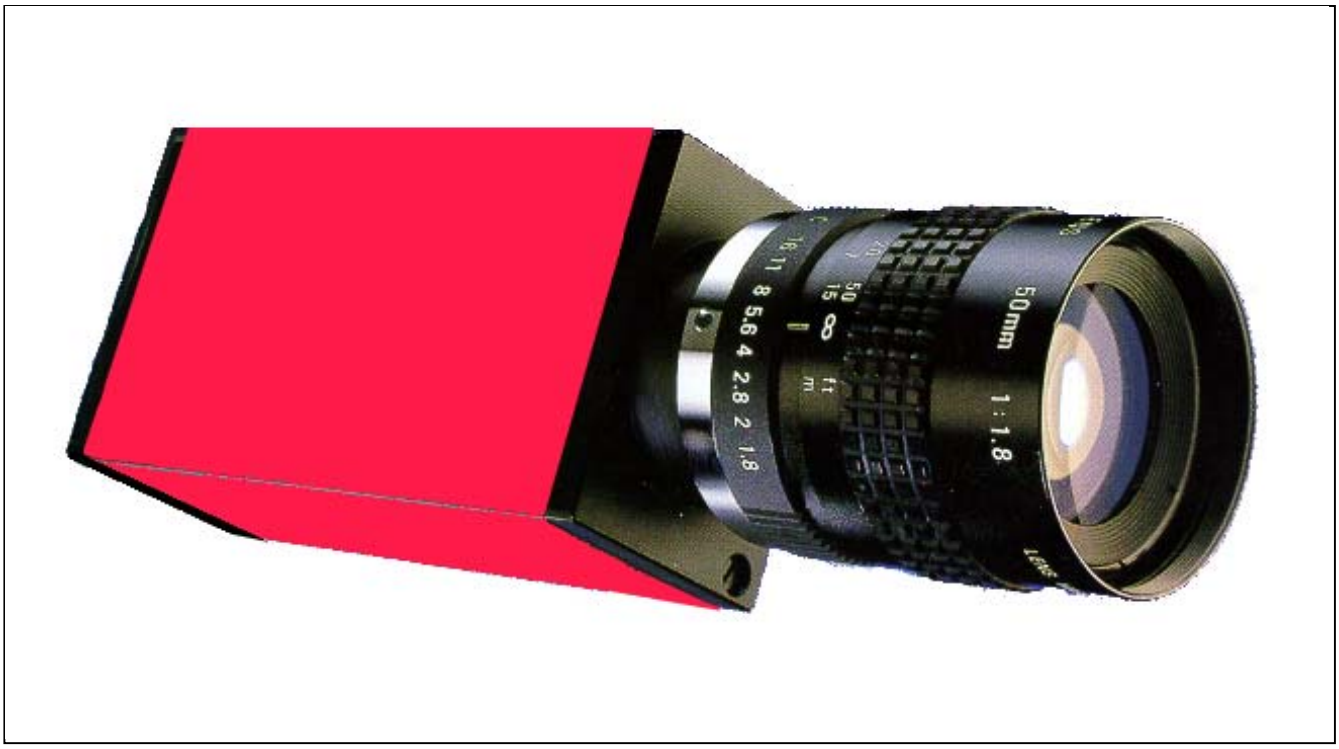
Smartcamera *redCAM*

General Manual



Version 1e-2001

ADVANCED MACHINE VISION

Note

We have tried to offer this ***redCAM*** manual to our customers free of errors and easy to understand. However, any information for improving this manual or for the elimination of errors are welcome.

We can not assume responsibility for any error in this manual, or for any operating error which may result from such errors.

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Table of contents

1 INTRODUCTION 5

2 INSTALLATION 7

3 RUNNING THE PROGRAM 9

3.1 USER INTERFACE 9

3.2 HOW TO SET UP THE INTERFACE 12

3.3 HOW TO LOAD AND SAVE PARAMETER FILES 15

3.4 DISPLAY OF VIDEO IMAGE 26

4 MEASUREMENT 28

4.1 FUNDAMENTALS 28

4.1.1 Terms 28

4.1.2 Evaluation of measured values 32

4.1.3 Measurement 36

4.2 STRUCTURE OF A MEASUREMENT TASK 38

4.2.1 How to create a process 39

4.2.2 How to set pattern parameters 42

4.2.3 How to treat measurements 51

4.2.4 Calibrating the measurements 60

4.2.5 Serial and parallel communication 63

5 COMPLETENESS 73

5.1 FUNDAMENTALS 73

5.1.1 Terms 74

5.1.2 Evaluation process 75

5.2 STRUCTURE OF A CONTROL TASK 80

5.2.1 How to create a process 81
5.2.2 Control window 84
5.3 THE DIFFERENT WINDOWS OF THE PROGRAM 86
5.3.1 Windows for glue inspection 86
5.3.2 Completeness window (Completeness control) 93
5.3.3 Fiducial Finder window 104
5.4 REFERENCE 115
5.5 HOW TO CALIBRATE COMPLETENESS 122
5.6 HOW TO PREPARE AUTOMATIC MODE 131
5.7 SERIAL AND PARALLEL COMMUNICATION 138

1 INTRODUCTION

What is *redCAM*?

A small but complete vision system. The vision sensor ***redCAM*** closes the gap between photo electric sensors and image processing. By integrating camera and image processing hardware ***redCAM*** can be used as a sensor, offering the efficiency of industrial image processing. The ***redCAM*** is appropriate where a simple photo electric sensor is not sufficient and a high performance system is oversized.

With a size hardly exceeding the dimension of a standard CCD camera ***redCAM*** can easily be integrated everywhere into production. Standarized industrial interfaces and a protocol meeting industrial requirements makes integration of ***redCAM*** into a production plant easy.

The ***redCAM*** is being adapted by an external PC or notebook used as a programming device to the needs of production. For this purpose you have in hand a comfortable and easy-to-use Windows program. Using this program and the operating manual the system can be parameterized without having knowledge of programming and image processing. After disconnection the camera operates self-contained.

During the development of the high-performance image processing software for ***redCAM*** Leuze electronic could go back to a yearlong experience in industrial image processing with high-performance systems. The functions of pattern recognition, gray scale value analysis, and edge detection can solve a wide range of operating and controlling tasks where photo electric and simple sensors are not exact and flexible enough.

Short description of the system

The package consists of one ***redCAM*** vision sensor and the specific Windows parameterizing program. The ***redCAM*** is pre-configured for the operation of **one** of the following tools:

Measurement:	A tool for automatic optical measuring of components in production.
Completeness:	A tool for automatic optical test of existance, features and position of components in production.
Reader:	A tool for automatic optical identification of components by means of fonts and optional further features.
Barcode:	A tool to read barcodes under harder conditions.
DataMatrix Reader:	A tool to read DataMatrix Codes.

In addition you need a PC with the operating system Windows95, Windows98 or WindowsNT for the operation of the program **and** a monochrome screen (camera-type ViS 5, ViS 7) or a VGA-screen (camera-type ViS 7V; ViS 6P, ViS 8P or higher) to display the image recorded by the sensor and the faded-in measuring devices.

By help of the serial interface and four separately opto-decoupled parallel in- and outputs the vision sensor can be directly connected to the control system. Running in automatic mode ***redCAM*** is a self-contained sensor executing and loading data and programs stored in EEPROM. This guarantees instant readiness after the switch-on of the operating voltage and 100%-control of produced components at high clock frequencies.

How to use this Operating Manual

This Operating Manual first describes basic concepts and processes. Then you will be guided throught the functions step by step. The use of the functions by means of menus or through the buttons of the control bar are described in detail. With the help of sketches and numberings the proceeding is comprehensibly explained.

2 INSTALLATION

The installation program guides you through the installation. The program copies the files to an existing folder on your hard disk, alternatively the folder might be newly created. In addition to that an entry for the Windows95 start menu is created. We recommend to create a link to the program on your desktop in order to accelerate the start of the parameterizing software. For Barcode and DataMatrix Reader there is no parameterizing program available currently.

System requirements

- Hardware and software requirements:

- Windows95, Windows98 or WindowsNT
- 486 or Pentium based system
- Mouse or track ball
- VGA graphics adapter
- Minimum 16MB RAM for Windows 95 (more for higher Windows versions)
- Approx. 5MB available hard disk space for installation of the files
- A free serial interface on the PC

An additional monochrome screen (or RGB screen) for the video display of the vision sensor. A VGA screen is not suitable for video display.

- Back-up copies

The software is provided on CD-ROM. You should make a back-up copy of the original CD-ROM, in order to be able to continue your work in case the original CD-ROM gets damaged. Use the back-up copy for installation and keep the original CD-ROM in a safe place.

- Installation

The files are compressed. Thus, you cannot copy the files manually to your hard disk. An installation program facilitates the installation procedure.

This program is started from the CD-ROM drive of your PC. For most systems the drive name is D:. The following installation instructions refer to D: as the drive name of your CD-ROM drive.

How to install on your PC:

- Insert the CD-ROM containing the programs Completeness, Measurement, Reader or Barcode into the CD-ROM drive of your PC
- Select the start button on the windows task bar and then Run. Insert source drive, path and then SETUP into the dialog box.
- D:\SETUP.EXE
- Follow the instructions given in the various dialog boxes of the installation program and store the program in a folder of your own choice. After completion of the installation you can start the program like every other program under Windows.

Removal of the program

You can remove the parameterizing program and the required additional files from your PC. To remove the parameterizing program from your PC:

- Select the *Start* button in the Windows task bar and then *Settings*. From the pop-up menu select *Control Panel*.
- In the *Control Panel* window double-click on *Add/Remove Programs*. You will find the parameterizing program in the list of installed programs.
- Select it and klick on the button *Remove*. Follow the instructions given in the various dialog boxes of the deinstallation program.

3 RUNNING THE PROGRAM

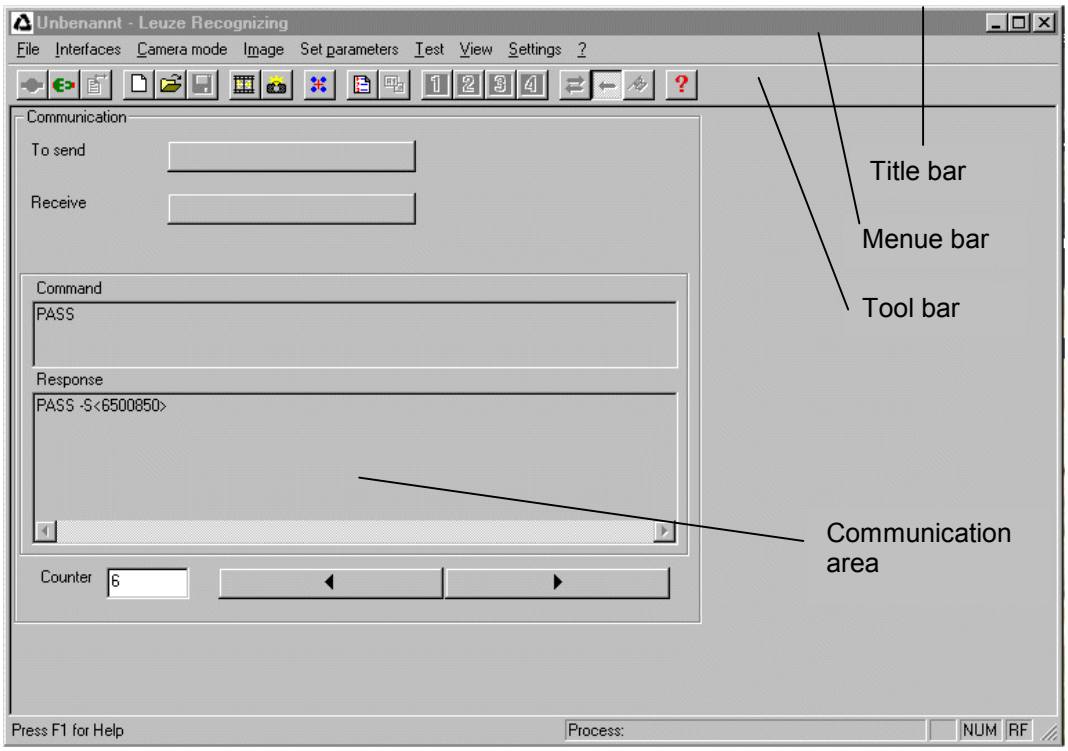
After having installed the program you can start it now. How to start the program:

- Select the Start button in the Windows task bar and then Programs.
- In the pop-up folder menu select the entry for the parameterizing program and klick on the program icon.

After starting, the parameterizing program appears in a window which you can zoom to screen-size using the usual Windows buttons.

3.1 USER INTERFACE

The program user interface appears in the usual layout of a Windows operating system. You will find a primary window which you can zoom to screen-size using the title bar buttons. Using further buttons you can reduce the window to a symbol or you can close it completely. In the right and the bottom margin there are scroll-bars. To change the window's size, klick and drag on the lower right corner of the window.



Example: User interface of the Detection-parameterizing program

The window consists of:

- Title bar
- Menue bar
- Tool bar
- Communication area

The communication area consists of:

- Buffer status indicator
- Command text fields
- Counter with buttons
- Title bar

The title bar is at the top of the window:

- Title bar

On the left side of the title bar there is the program icon. Next to it you will find the name of the current document being processed. To the right there is the title text of the program; in the right sight you will find the window buttons.

- Menue bar

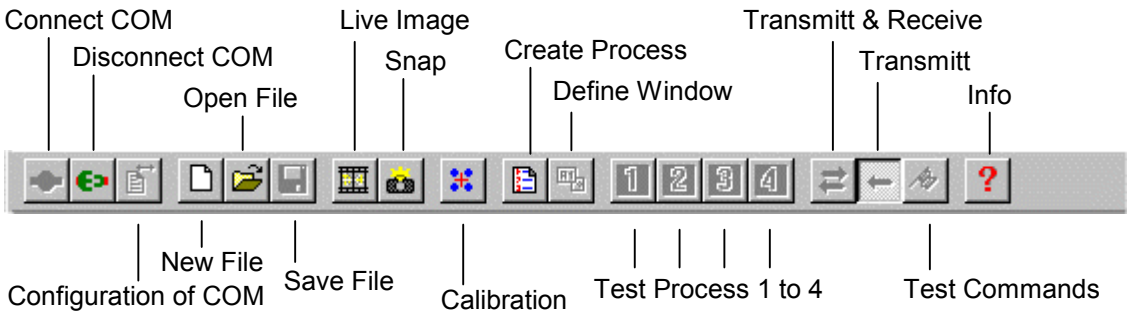
Below the title bar there is the menue bar with the menue entries:

- Menue bar with short-cuts

You can select the menue titles either with the pointer element (mouse) or the keyboard short-cuts. These short-cuts are underlined.

- Tool bar

You can start actions of the program with the tool bar below the menue bar, here the tool bar of the Completeness program is shown:



Example: Completeness program tool bar with quick info

The meaning of the icons can easily be understood from their graphics. When you point with the mouse to an icon without clicking, a quick-info box will appear after a short time showing a short description of the icon.

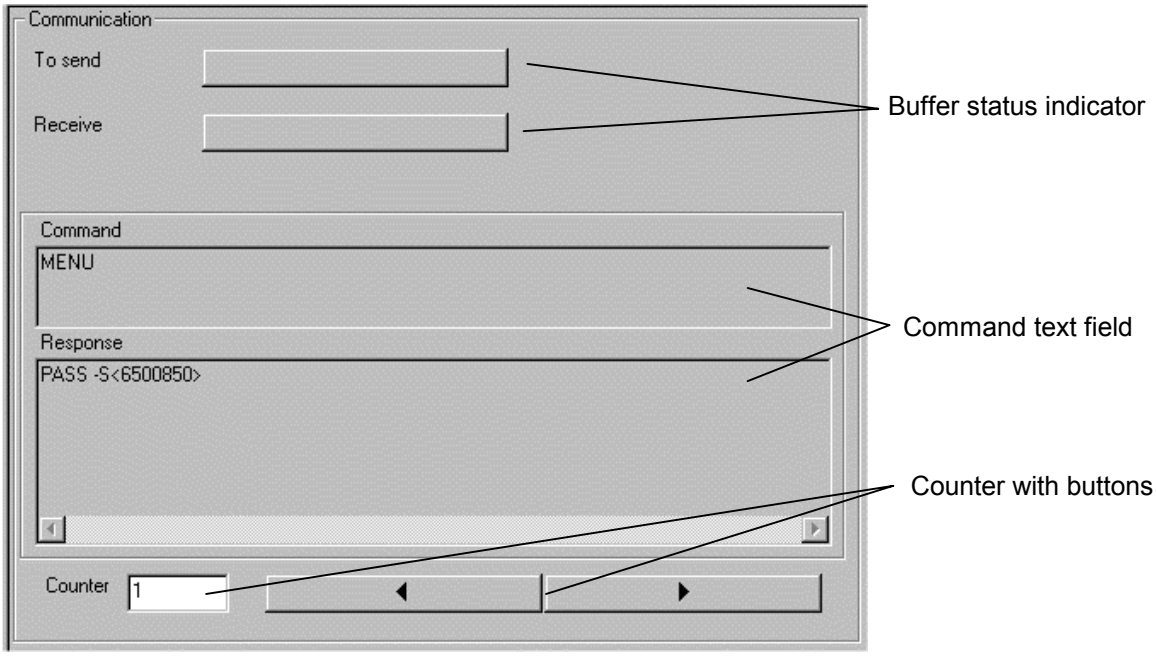
At start-up, the buttons of the tool bar appear grey to indicate they are not available. Only the buttons to connect and configure the interface are available and therefore coloured. Since the connection to the vision sensor has not been completed yet,

you cannot execute actions that require an established communication link. The buttons are not active. They will be available after connection of the interface.

- Communication area

A large part of the user interface consists of the communication area. This area shows the status and the texts of the serial communication with the vision sensor. The communication area consists of:

- Buffer status indicator
- Command text field
- Counter with buttons



Example: Communication area

The command text field as well as counter and buttons are not visible after start-up of the program. By actuating the button *Commands* and *Responses* in the menue *View* the following display appears.

You will not need this area when normally operating the program. It may be useful for advanced applications, for example debugging.

- Buffer status indicator

The serial communication with the vision sensor uses a buffer each for transmitting and receiving commands. The majority of actions carried out in the program generate a command to ***redCAM***. New commands are being entered in the buffer and lead to a deflection of the status indicator. A filled bar indicates there are still commands in the corresponding buffer and communication with ***redCAM*** has not been completed yet.

The upper bar indicates commands still to be transmitted to the sensor (bar filled) or if all commands have already been transmitted (bar empty).

For almost every command a response of the sensor is expected. The status bar below shows if a current response has already been read (bar empty) or if it still exists completely or partly in the buffer (bar filled).

Watch the status indicators of the buffers and delay - if necessary - any changes of adjustments until the current communication has been completed.

- Command text fields

There are two command text fields. The upper field shows the current command being transmitted from the program to the vision sensor. The field below shows responses to commands generated by the sensor. During communication always the final command and the corresponding response are visible.

- Counter with buttons

Communication between program and sensor is stored in a list. The counter helps you memorizing a command during communication and finding it again later. Step by step you can run throught the list with the buttons until you reach the desired command and a corresponding response.

3.2 HOW TO SET UP INTERFACE

To communicate with the vision sensor you have to choose the interface the sensor is connected to, and - if necessary - adjust its parameters. The transmission parameters of the serial interface of ***redCAM*** are:

Baud rate	*9600 Baud*
Data bits	*8*
Parity	*None*
Stop bits	*1*
Protocol	*None*

How to adjust the parameters of the connected interface

- Select the *Start* button from the Windows task bar and then *Settings*.
- Click on *Control Panel* in the folder menue.
- The *Control Panel* window opens. Double-click on the *System* icon.
- In the now open field *System Properties* choose the *Device Manager* tab and click on *Interfaces* (*COM* and *LPT*).
- Choose the interface in use.

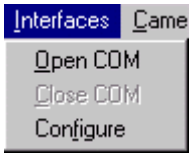
The properties window for the corresponding interface opens. Adjust the transmission parameters mentioned above.

- Select *OK* in both property fields and close the *Control Panel* folder window.

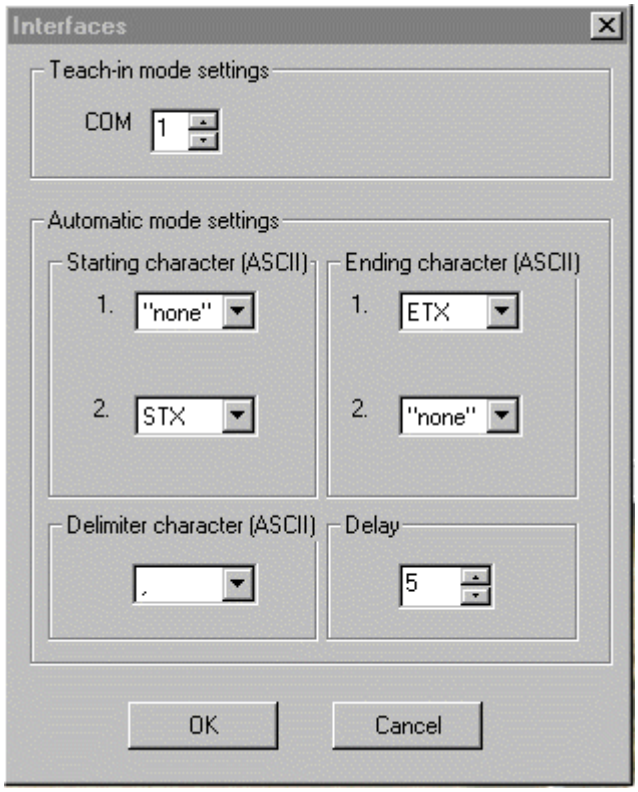
How to select the interface in the program

- Use the button below to configure the interface

or select the item *Configure* in the *Interfaces* menu



- Set the COM-number of the connected interface in the *Interfaces* dialog box.
- Select *OK*.

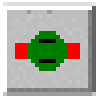


Example: Interface dialog box

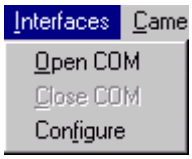
After having correctly set up the interface, open it to be able to communicate with the vision sensor. In the previous condition of the program you see the tool bar buttons as gray icons. This indicates that the buttons are not activated. Only the button to open the interface is activated and therefore colored. With interface closed no actions requiring an established communication link communication are possible. The other buttons will be available after the opening of the interface.

How to open the interface

- Use the button to open the interface



or select the item *Open COM* in the *Interfaces* menu.

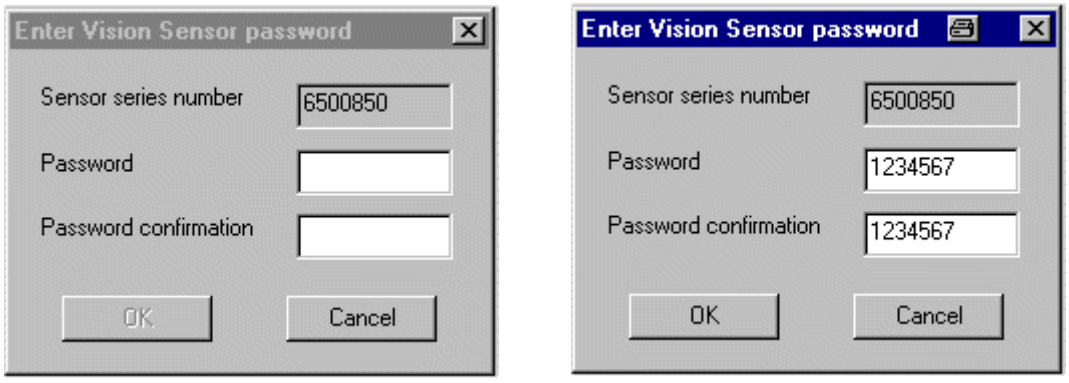


Initially there is a command in the transmission buffer of the program as shown by the buffer status indicator. Once the connection is made, the buffer contents are transmitted and the indicator finally is empty. The commands and responses are shown in the command text field and the counter rises. In case the connection could not be opened, the buffer status indicator remains filled, and the counter holds its original level.

How to unlock the vision sensor

IMPORTANT: The vision sensor has got an unlocking function being checked by a password. Every sensor comes along with a unique password issued by Leuze electronic. After having opened the interface a dialog box enables you to enter a seven-digit password in case the sensor is still locked. Enter this password and repeat it correctly in the password confirmation field. After this select the *OK* button now available. The correct password unlocks ***redCAM***. Having entered a wrong password, the dialog box is shown to you again.

- You can enter a wrong password up to ten times. Then the sensor remains locked.
- The unlocking of ***redCAM*** has to be executed only once. This can be done by you or by Leuze electronic.



Example: Password dialog box without and with entered password

- Look up the password of the current vision sensor (type plate on bottom-side of sensor or delivery note).
- Enter the password.
- Repeat the password in the *Confirmation* field.
- Select *OK*.

After the opening of the interface and a possible unlocking of the sensor, the buttons in the tool bar will be available and you have access to the actions (as indicated by the now colored symbols).

3.3 HOW TO LOAD AND SAVE PARAMETER FILES

Data consistency between program and sensor

By means of the parameterizing program you can set up a succession of control tasks which you can store in a file with a file name you can choose freely. Since the camera can work autonomously, these control tasks have to be stored in the camera as well. When a connection between camera and parameterizing program is being set up, a comparison between information stored in the camera and the PC-file has to be made.

After the connection to ***redCAM*** has been set up, this procedure is being carried out in several steps:

- Read file name from vision sensor
- Open file
- Compare file contents with sensor data
- Enter data into program

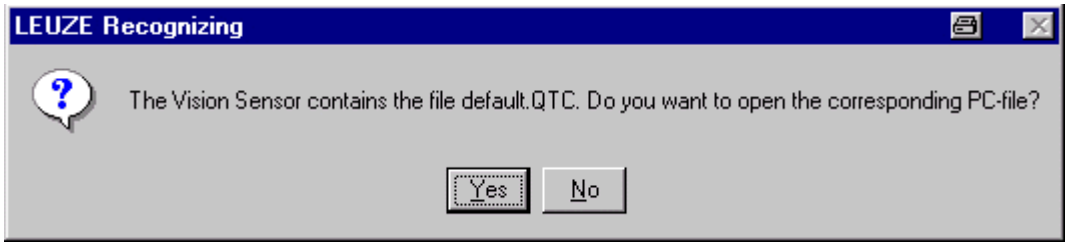
While updating the program, this procedure works automatically. In every cycle there is the option of stopping the entire process.

After setting-up the connection between program and ***redCAM***, the program does not have any data yet. The sensor however, has stored the data in the internal EEPROM. Now you need to transmit the data from ***redCAM*** into the program.

For this, the name of the file saved last is stored in the vision sensor. This name is read by the sensor. Data extensions for the different parameterizing programs are:

Completeness	*.qtc
Measurement	*.qtm
Reader	*.qti

The program shows to you the file name and expects confirmation for opening the file stored in the PC.



Example: Dialog box of the program *Completeness* for automatic opening of the PC file belonging to the sensor

When clicking on the *Yes* button the program continues opening the file. If you select *No*, the process will be aborted and the program gets no data. You can load the program and the sensor as well with data of a different file using the item *Open/Load Vision Sensor* in the *File* menu.

- Selection

- *Yes* continues opening the file,
- *No* stops the process.

In case of stopping you can load an existing file.

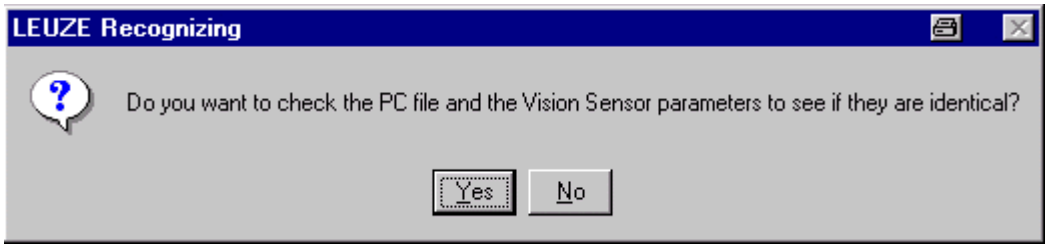
- Automatic opening of the file

After confirming, the program opens the given file which has to be in the program's working directory. After this a comparison of the versions proceeds as an additional check of data consistency between file and sensor. If there is no corresponding file on your PC or in the working directory of the program, you will get the following information and the procedure stops.

Example: Error message - File not found

Comparison of versions

To make sure, not only file names are identical, an additional comparison between the data of the PC file and of the sensor ***redCAM*** is performed. Only when these two checks have been correctly executed, the program will be actualized by using data of the file.



Example: Dialog box to perform the comparison of versions

Prior to the check, the program expects a confirmation to start the version comparison. Select *Yes* to perform the check or *No* to avoid the check.

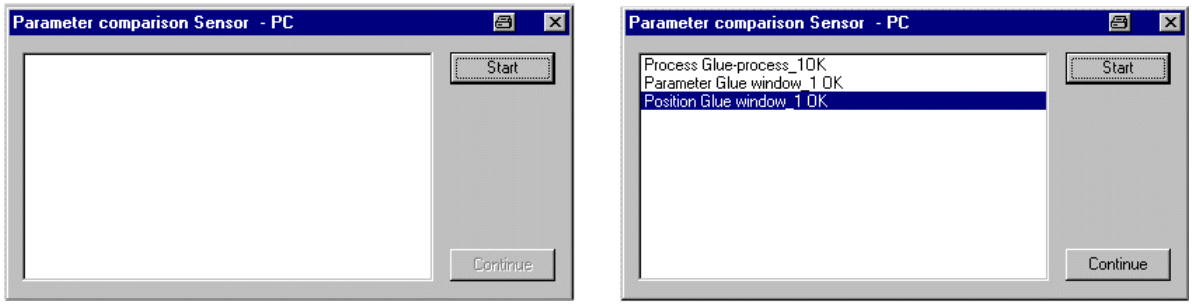
- Selection

- *Yes* continues the comparison,
- *No* bypasses the procedure. The PC file is opened.

Select *Yes* to perform the check. Then a dialog box appears in which you start the comparison by clicking on *Start*. The result window shows you the single results of data comparison. After having finished the comparison, you can either repeat the check or click on the button *Continue* to get information of the overall result of the check.

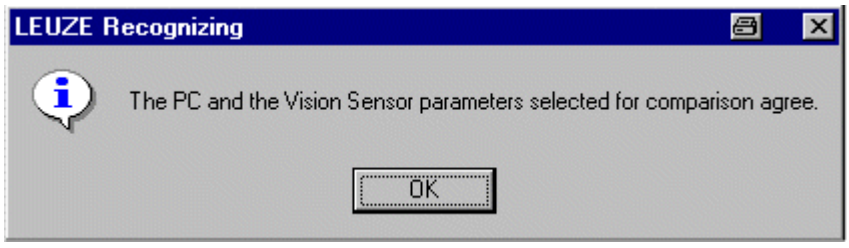
- Selection

- *Start* starts the version comparison,
- *Continue* continues after comparison.



Example: Version comparison dialogue box before and after data comparison

After the check you will get a report of the overall result where data of file and sensor are completely identical or show differences. After the result report a corresponding message appears. If the data are identical, the program will be updated with the file data after clicking *OK*.



Example: Version comparison with identical data

If data are not identical, the program expects a user input to load the different data to ***redCAM***. The existing data will be overwritten.

- Selection

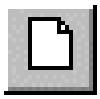
- *Yes* data will be loaded to ***redCAM***,
- *No* aborts the process. The program will not be updated.

Example: Version comparison with different data

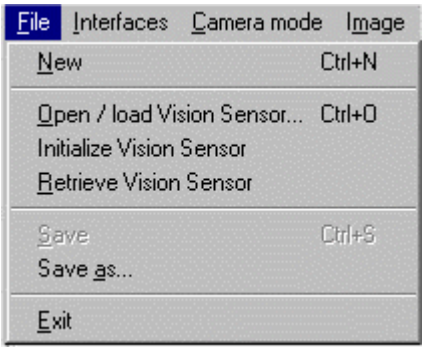
Having aborted the automatic opening of a file, you see the parameterizing program in its initialized status. Neither a calibration nor any parameters exist in the program.

How to create new parameter files

- Click on the button to create a new file



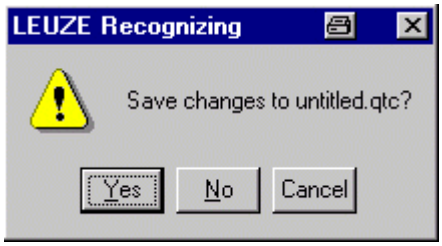
or select *New* in the *File* menu.



If you have worked on a file and wish to create a new one with features and windows, you can do so by using the *New* button in the tool bar or the *File* menu. If you are working on a file and you have not stored the last changes of your current file, you will receive a corresponding message.

- Selection

- *Yes* data are stored in the named file, and the program is being initialized
- *No* The program is being initialized without storing the last changes
- *Cancel* No action is performed



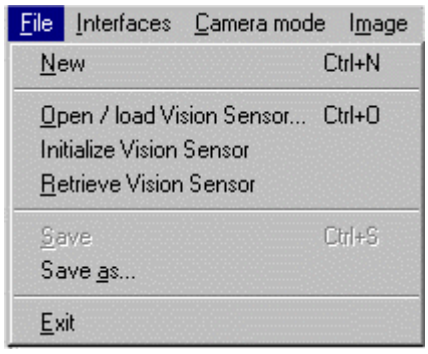
Example: Dialog box to save the last changes when creating a new file

IMPORTANT: When creating a new file, the program is being initialized. Data on the sensor are not being erased though. Only data structures are released, so they may be used again when parameterizing. If you want to start parameterizing from zero, you will have to initialize the system explicitly (see chapter). To do so, select *Initialize vision sensor* in the *File* menu.

How to open an existing file

If you have already created files and wish to load an existing one, you can either use the *Open* button in the tool bar or the respective item of the *File* menu. Use the button to load a file

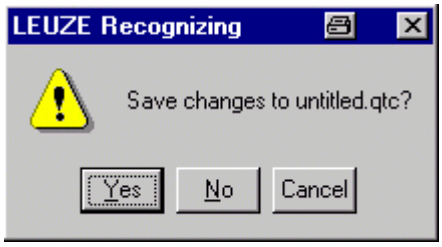
or select *Open / load Vision Sensor* in the *File* menu.



This loads the file into the program and passes it on to the vision sensor via serial interface. If the last changes of your current file were not saved, you receive a corresponding message.

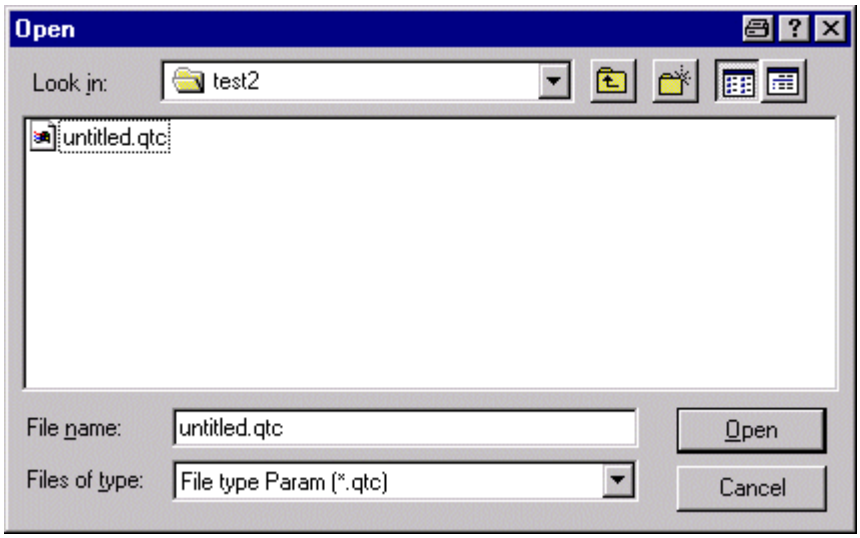
- Selection

- *Yes* data are saved in the named file,
- *No* continues without saving the last changes,
- *Cancel* no action is performed.



Example: Dialog box to save the last changes when creating a new file

A dialog box opens where you can select folder and file. The selected file appears in the *File name* text field. Using the *Open* button you start loading the file.

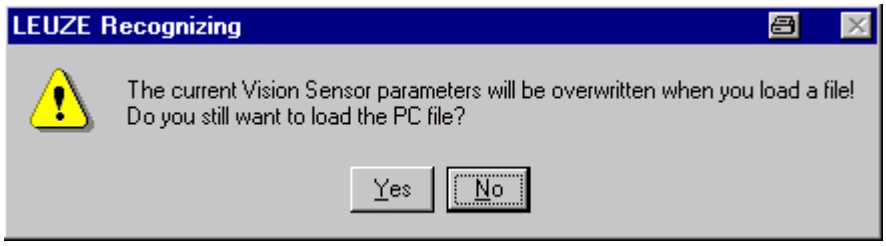


Example: Dialog box of the Completeness program to select a file

Before data can be transmitted to sensor and overwrite the current data, the program expects confirmation to make sure that no unintended loss of data occurs.

- Selection

- *Yes* data are loaded and transmitted to sensor,
- *No* stops the procedure.

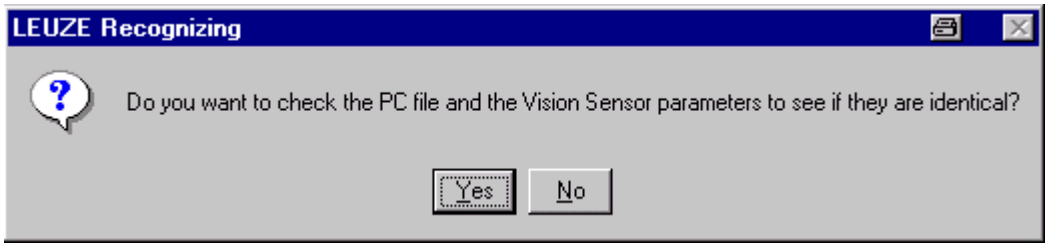


Example: Dialog box to load existing data to the vision sensor

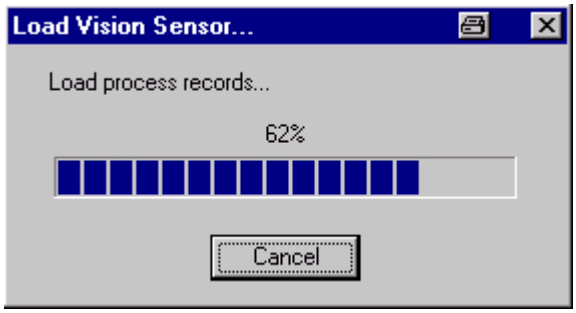
After using the *Yes* button, the dialog box appears again to ask if data on the vision sensor and in the PC file should be compared.

- Selection

- *Yes* data are compared,
- *No* no comparison is performed.



Selecting comparison starts the same procedure as described in comparison of versions. Then loading and transmitting of data to the sensor starts. The progress indicator provides you with information on the transmission status. After ending the display vanishes, and you can work on with new data.



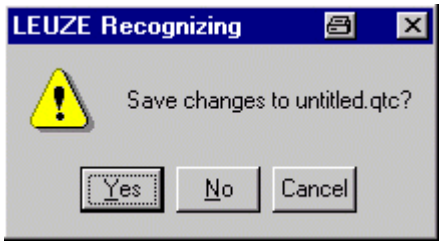
Example: Progress indication while loading a file

Initializing

Initializing ***redCAM*** erases data in program **and** sensor. If you want to work with completely new data in the program and on the sensor, you have to explicitly execute this menu function. When you want to initialize the system (sensor and parameterizing program), select *Initialize vision sensor* in the *File* menu. If the last changes of your current file were not saved, you receive a corresponding message.

- Selection

- *Yes* data are stored in the named file before initializing,
- *No* initializing without saving of last changes,
- *Cancel* Abort no action is performed

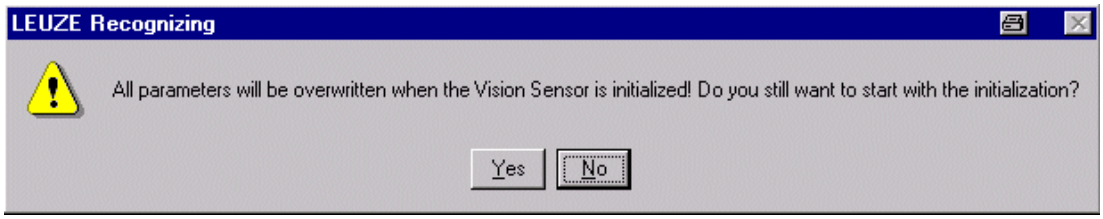


Example: Dialog box to store the last changes while creating a new file

Before data can be initialized in sensor and program, the program expects a confirmation to make sure that no unintended loss of data occurs.

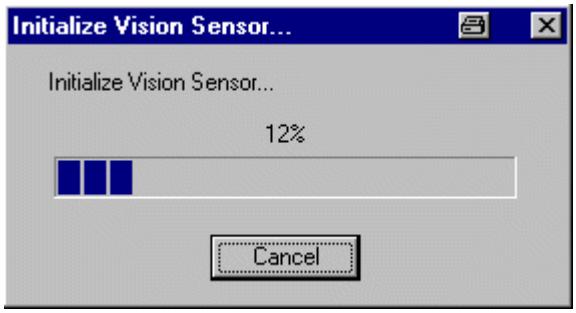
- Selection

- *Yes* initializing is executed,
- *No* stops the process.



Example: Dialog box to initialize sensor and program

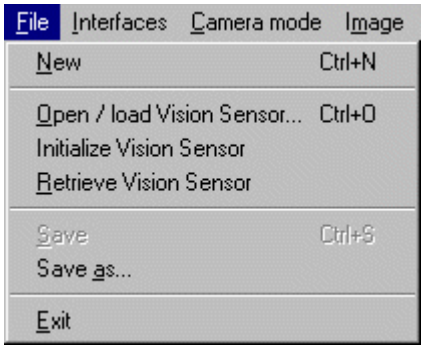
Now you can watch the initializing process of the vision sensor in the communication area of the *Completeness* program. When the process has finished, the buffer indicators are empty.



Example: Communication field during initializing process

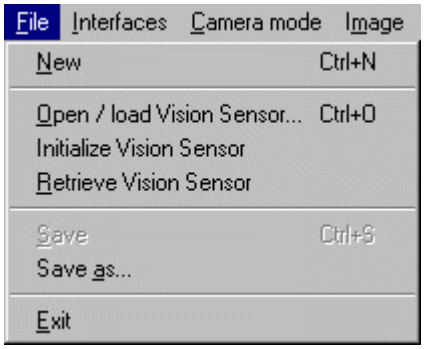
- How to initialize *redCAM*

- Select *Initialize Vision Sensor* in the *File* menu.



Retrieving the vision sensor

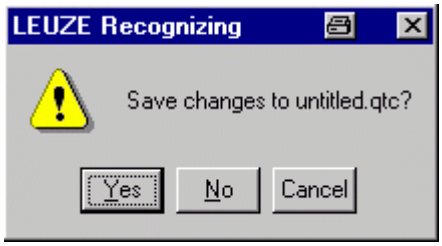
Retrieving the vision sensor is an important aid helping you when the file belonging to the connected sensor is not available on the PC anymore. Using the Retrieve function you can directly load the data of ***redCAM*** into the program. However, you only get default names for your data as the original names chosen by you are not stored on the sensor.



If you wish to retrieve data from the sensor, select *Retrieve Vision Sensor* in the *File* menu. Having not saved the last changes of your current file, you receive a corresponding message.

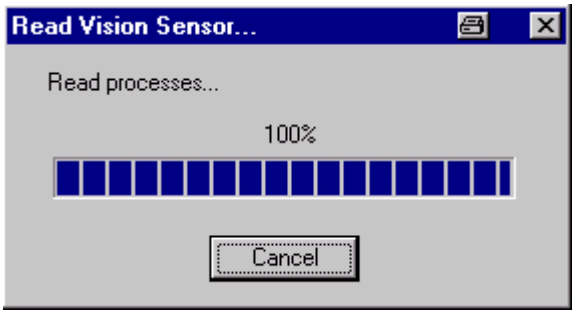
- Selection

- *Yes* data are stored in the named file,
- *No* continues without saving the last changes,
- *Cancel* no action is performed.



Example: Dialog box to save the last changes when creating a new file

After saving your current data, the transmission from sensor to program starts. The progress indicator provides you with information on the transmission status. After the transmission is completed, the progress indicator vanishes and you can continue with new data.



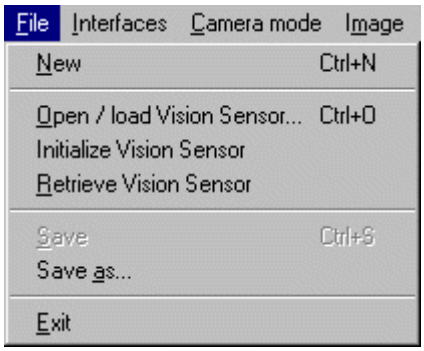
Example: Progress indicator while retrieving data from the sensor

How to save parameter data

To save your newly created or changed data, you can use the *Save* button in the tool bar or select *Save* in the *File* menu.

To save a file use the button

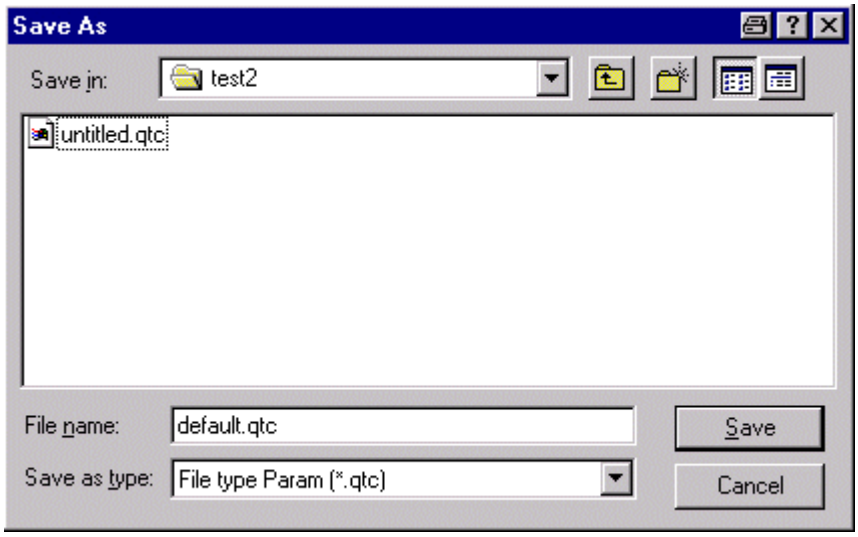
or select *Save* in the *File* menu.



If new data is being saved for the first time, no file name has been assigned to it yet. You can learn this from the entry Untitled at the document's name in the title bar. Then you will get a dialog box to assign or select a file name. Otherwise the data will be saved with the file name indicated in the title bar.

- Save as...

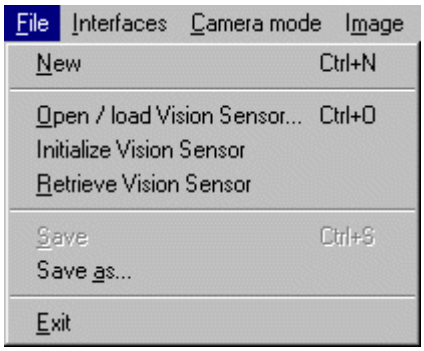
To save data under a different file name, select *Save as*... from the *File* menu. A dialog box appears in which you can select a folder and select or assign file name.



Example: Dialog box to save a file

- How to save data in a different file

Select *Save as*... from the *File* menu and enter the desired Name in the *File Name* text field. Finally select *Save*.

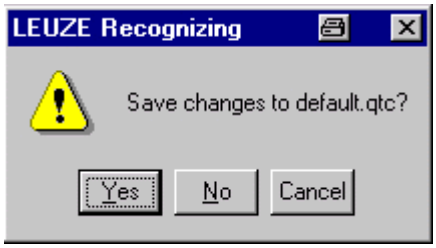


How to exit the program

Select *Exit* from the *File* menu (see picture just above) or click on the *Close* button in the window's title bar. When you exit the program, you will be asked by it if you want to save the last changes:

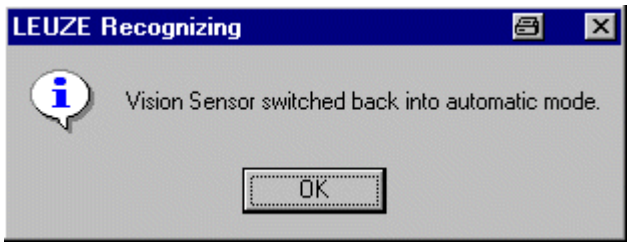
- Selection

- *Yes* data are saved in the file named before initializing,
- *No* initializing without saving of last changes,
- *Cancel* no action is performed.



Example: Dialog box to save the last changes when closing the program

To communicate with the program, the sensor in set into a specific parameterizing mode, the so-called set-up mode. Automatic mode is the normal operation mode of ***redCAM*** used in production. When leaving the program and connecting the sensor to the control system of the plant, finally the sensor is switched to automatic mode by the program. You receive a message you have to confirm with the *OK* button. Now the program shuts down.



Example: Message that the camera is switched to automatic mode

3.4 DISPLAY OF VIDEO IMAGE

The vision sensor has two different ways to display the video image:

- Snap mode
- Live mode

In snap mode, a picture is being taken at a certain moment, and stored in the image memory of the sensor. This image is then displayed permanently. Using live modus, the picture is being transmitted from the camera module to the video output. You can watch the current scenes in the sensor's field of vision on a connected video monitor.

You can switch on display mode with the buttons in the tool bar or in the *Image* menu. Either one of the two modes is always switched on.

- Snap mode

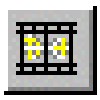
Select either the Snap button in the tool bar

or select *Snap* from the *Image* menu.

Clicking on the *Snap* button records an image. Then you can see the recorded image from the image memory. This is being read out continuously and displayed. The sensor switches automatically to snap mode when drawings of the search window are displayed on the video monitor. This happens, for example, when patterns are added or changed.

- Live mode

Select the *Live* button from the tool bar



or select *Live* in the *Image menu*.

In live mode, the given image recorded by the camera module is directly displayed. So you can watch the current scene in the sensor's field of vision. The image memory is bypassed in this display mode. Live mode is activated when you use the button *Live*. The sensor switches to live mode automatically when search operations are being tested resp. executed.