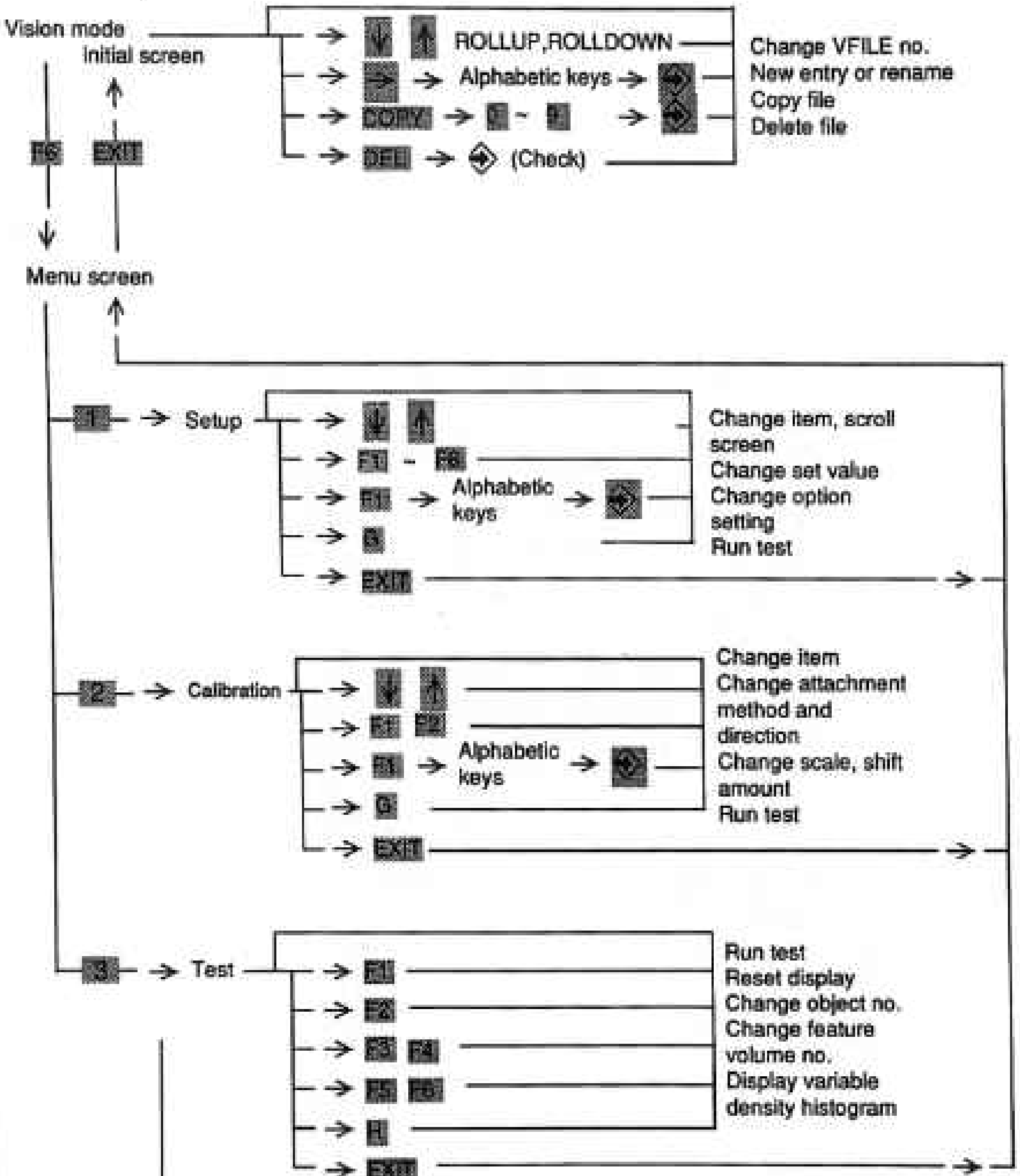
7-3-6
Chart of vision mode operation keys (Supplement)



7-4 SETTING AND ADJUSTMENT THE NO.3 FIXED CAMERA

7-4-1 Overview

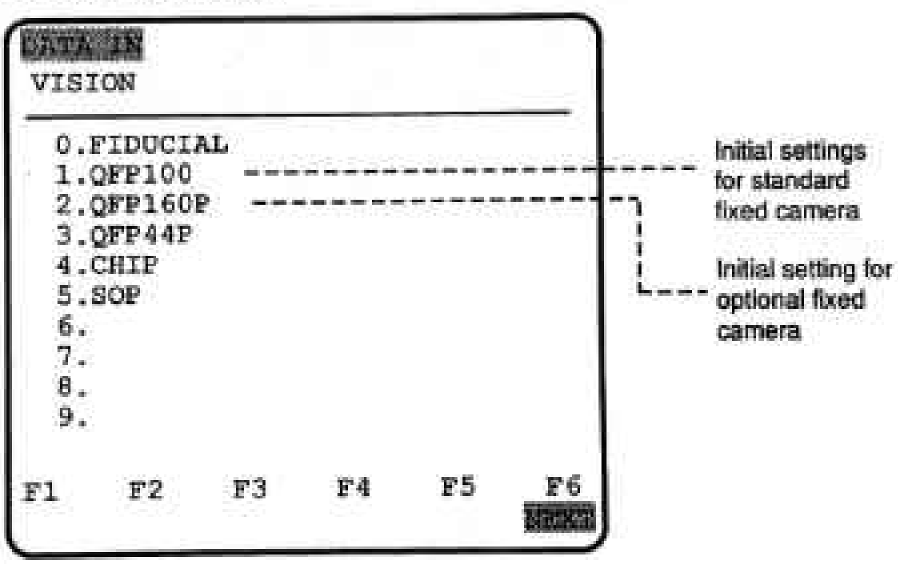
The VISION MOUNTER is provided with one fixed camera as standard equipment. By adding another fixed camera as an option, recognition of parts such as QFPs can be widely expanded.
The method is explained in this section. The fields of recognition are different for the standard and optional fixed cameras, but both cameras are used in basically the same way. The optional fixed camera can recognize larger parts such as QFPs than the standard fixed camera. Conversely, the fixed camera can handle recognition of QFPs with a lead pitch of 0.5 mm. The most advantageous methods of using the two cameras are shown in the table below.

Item	Standard fixed camera	Optional fixed camera
Lead pitch	0.5mm MIN.	0.65mm MIN.
External dimen-sions (NOTE1)	MAX. sq.32mm	MAX. sq.40mm
Mold part dimen sions	MIN. sq.10mm	MIN. sq.10mm

NOTE

Either camera can be used for recognition of parts less than sq.32mm, but the cameras can be used to best advantage by using the standard fixed camera for parts less than sq.25mm, and the optional fixed camera for larger parts.

When the optional fixed camera is used, the initial screen in the Vision Mode is as shown below.
The VFILE No. "1.QFP100P" file listed on the screen is the default settings file for the standard fixed camera. The VFILE No."2.QFP160P" contains the default settings for the optional fixed camera.



NOTE The contents of this section are based on SBIP software versions 2.0 and higher.

8.1. SBIP: Introduction

In the past years the quality and accuracy demands for products have increased so much, that the speed has grown rapidly for automated visual inspection. Most of the inspections and arguments are of minor difficulty and do not need large systems (framegrabbers) which are very expensive. The need is to have a simple system with many possibilities and with a low price. The SBIP card (**S**ingle **B**oard **I**mage **P**rocessor) is one of such cards, because it has many possibilities and a good price versus performance ratio.

The SBIP is build around the TMS34010 Graphics System Processor supplied by Texas Instruments. The TMS34010 is a very powerful Graphics Processor with special instructions for manipulating pixels in a video memory. The video memory can store an image supplied by a video camera. The video memory is 256 Kbyte in size and can store on interlaced image of 512 x 512 x 8 pixels (or 2 non -interlaced images).

On the card a system memory contains the program for the processor. The board has a 1 Mbyte system memory to store programs, textfonts, templates and even images.

In the TMS34010 a video controller keeps track of all the signals needed for a proper monitor image. Two binary correlators are also available on the card. The correlators are the so-called 'Febris' chip correlators. They are able to correlate a matrix of 16 x 16 pixels. They meet the demands for template matching at video speed.

The video-output of the card is managed by a RAMDAC. The output for a video monitor has an output look-up table capable of supplying the red, green and blue output with 256 gray levels or 256 colours.

8.2. CAMERA SETUP

8.2.1. Camera Types

For the fiducial and component camera use is made of Black & White television camera's. In the CSM system two camera types can be found.

Sony XC-77: Identified by means of its long body.
Sony XC-75: Identified by means of its short body.

The use of new camera types also requires different lenses. These are shown in the following table.

Camera	Lens: Fiducial Camera	Lens: Component Camera
Sony XC-77	MS-509	F:16 mm (CDML1614)
Sony XC-75	FIT436 (B=0.95)	F:12 mm (CDML1212)

IMPORTANT

The Sony XC-77 can be used in conjunction with an SBIP vision card. The Sony XC-75 however can only be used with SBIP boards that have revision level 5 and higher (The SBIP-ASSY must be of Field Change level 3 or higher (FC 3)).

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(3) **CALIBRATION**

For the definition of calibration, see Section 7-3-4, "Camera Calibration".
The calibration items are set in the same way as those for the standard fixed camera, using the automatic calibration setting program <CALIB>. The SCALE and SHIFT values after running the <CALIB> program become values within the ranges stated below. The SCALE values are different depending on whether a standard or optional fixed camera is being used. After the program has been run, fine correction can be done through key input. See for a complete calibration procedure section 7-2-5.
Calibration data exists separately for each vision file. When new parts are being registered, however, if a vision file has already been registered, the calibration data can be used, for the most part, without changing anything. Fine adjustment is required if the thickness of the part has changed with more than 10%.

Item	Label	Set value	Remarks
Camera maintenance status	HOLD	FIXED	Fixed camera
Camera field direction	DIRECTION	UP	Same as above
Scaling in the X and Y directions	SCALE NOTE1	Standard fixed camera X: 0.1460 ~ 0.1510 Y: 0.1460 ~ 0.1510 Optional fixed camera X: 0.1730 ~ 0.1830 Y: 0.1730 ~ 0.1830	Changes depending on lens type and focus position
Shift amount in the X, Y,and R directions	SHIFT	X: 300.00 ~ 600.00 Y: 300.00 ~ 500.00 R: 178.00 ~ 182.00	Changes depending on distance between camera attachment position and machine origin

NOTE

When entering new settings for a vision file, the SCALE value must be within the range stated above when the <CALIB> program is run. Since a new scale is automatically set after the <CALIB> program is run, the value does not have to be particularly precise.

(4) **TEST**

The vision file for the optional fixed camera should be tested in the same way as that for the standard fixed camera. Image processing defects that occur during the should be resolved as outlined in Section 7-3-7, "Error Status Table".Conversely, this is very convenient when setting the BINARY value in the setup items and the camera lens aperture value.

(5) **Other Precautions**

There is a cover over the top of the fluorescent lamp in the optional fixed camera. When replacing the fluorescent lamp, first turn off the power supply, and then remove the cover. Also remove the tube from the inside. When assembling, be careful that the height of the cover does not change. Also, don't forget to run the <CALIB> program if the camera or lens is moved or readjusted.

7-4-2 Setting the optional fixed camera

(1) Vision file

The vision file for the optional fixed camera is created in the same way as that for standard fixed camera, between No. 1-29. To created the file, go to the initial screen of the Vision Mode, copy the master file, and then change the portions which are different.

(2) Setup

The contents of the setup items are, for most parts, the same as those for the standard fixed camera, described in section "7-2-3-1 hardware-setup" and "7-3-3. Setup". In this section, only the parts which differ between the standard and optional fixed cameras are explained.

Item	Label	Set Value	Remarks
Camera selection	CAMERA	3	3 : Optional fixed camera (2 for standard fixed camera)
Binary threshold value setting	BINARY(NOTE1)	AUTO or MANUAL (50-200)	AUTO is stable against changes in light. MANUAL offers a faster processing time, but an appropriate threshold value has to be set.

NOTE

The setting conditions are somewhat stricter than when using a standard fixed camera (when CAMERA has been set to 2). In the setup items, set BINARY to AUTO and run a vision test.
The outer shape of the part should stabilize as a binary image. Please refer to the file in which the initial settings have been stored (2.QFP160P).

8.2.2. Fiducial Camera Setup

8.2.2.1. Fiducial camera lens magnification adjustment.

Figure 8.2.1 shows how to set-up the **magnification** by adjusting the total length of the lens tube to 86.1 mm. After adjustment secure the tube with the lock nut.

Example only:
Here XC-77 camera with lens.

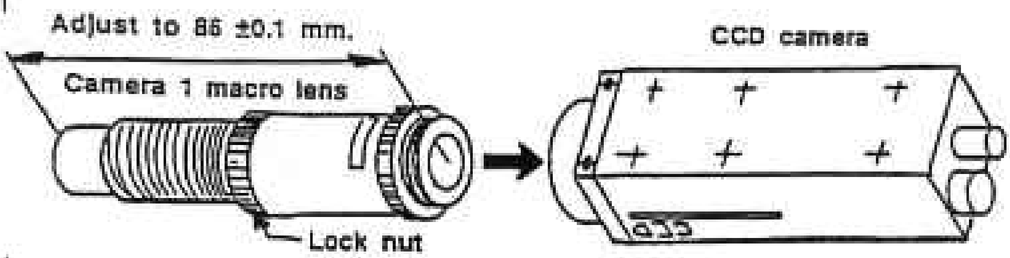


Figure 8.2.1. Fiducial camera lens magnification adjustment

8.2.2.2. Fiducial Camera: Focus Adjustment

Mount a test PCB in the CSM and make sure it is correctly fixed by the push-up and locate pins. Loosen the camera fixation bolts a little and look for a fiducial mark or QFP pattern on the screen and adjust the camera height so that an optimum sharp picture is obtained. Tighten the camera fixation bolts. See figure 8.2.2.

Example only:
Here XC-77 camera with lens.

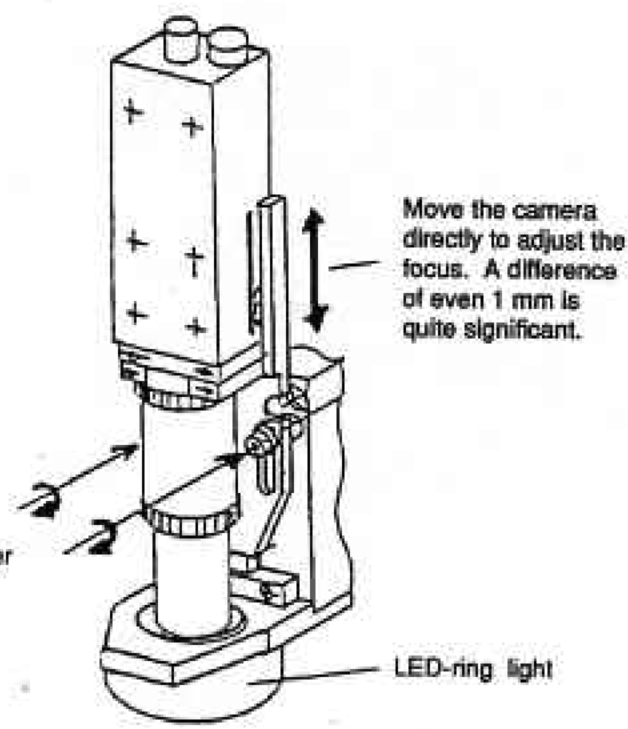


Figure 8.2.2. Focussing of the fiducial camera

8.2.2.3. Fiducial Camera: Brightnes Adjustment

The fiducial camera lens is a fixed lens and therefore the brightness cannot be controlled by adjusting an aperature ring on the lens. The tip of the lens is fitted into a LED assembly who distribute the light for the fiducial camera. The intensity of the LEDs on this board can be adjusted with the potentiometer which is on the LED PCB. It can be checked by taking a histogram of a good fiducial. If the background is saturated (near threshold of 255), then LED adjustment is incorrect. Background threshold (non-reflective) should have a threshold in the area of 10– 30.

8.2.3. Component Camera Setup

8.2.3.1. Component Camera: Extension Rings

The lenses that are used in the vision systems are camera lenses. The minimum focus distance of these lenses is 0.3 meters. Because the distance between the component and the camera lens is much shorter than this 0.3 meters, the focus range of the lens must be adapted to the new focus distance. This can be realized by adding dedicated extension rings to the lens. The size of the extension ring is dependent on the camera, lens and used field of view of the camera which is again dependent on the type of components that will be used.

The field of view that can be used is dependent on the type of lighting that is used in the system. The CSM84V uses white ringlight while the CSM84VZ uses red LED background. As a result of all these differences, the following extension rings are applicable for each system:

NOTE: *Fine pitch = 0.3mm ≤ pitch ≤ 0.5mm. Standared pitch = pitch > 0.5mm*

NOTE The extension rings are also very much dependent on the type of camera and lenses used.

System	Camera Type	Camera	Lens	Extension Ring(s)	Field of View
CSM84V	Fine Pitch	XC-77	F:16 mm	1.5 mm	34 mm
CSM84V	Standard	XC-77	F:16 mm	1.0 mm	45 mm
CSM84V	Fine Pitch	XC-75	F:12 mm	0.6 mm	34 mm
CSM84V	Standard	XC-75	F:12 mm	0.3 mm	45 mm
CSM84VZ	Fine Pitch	XC-77	F:16 mm	1.0 mm	45 mm
CSM84VZ	Standard	XC-77	F:16 mm	0.5 mm	54 mm
CSM84VZ	Fine Pitch	XC-75	F:12 mm	0.3 mm	45 mm
CSM84VZ	Standard	XC-75	F:12 mm	0.2 mm	54 mm

Table 8.2.3.1. Extension Rings for the CSM84V and CSM84VZ

The use of the extension rings immediatly determines the focus area of the camera. The focus area is related to the field of view. On how to focus the camera is described in the following sections.

Dependent on the component range, 1 or 2 (in some cases even 3) component camera's can be installed. The CSM identifies the component camera's as CAMERA 2, CAMERA 3 and/or CAMERA 4 (CAMERA 1 is the fiducial camera).

The location of the extension rings can be found in figure 8.2.3.1.

Example only:
Here shown for a XC-77 camera with F:16mm lens.

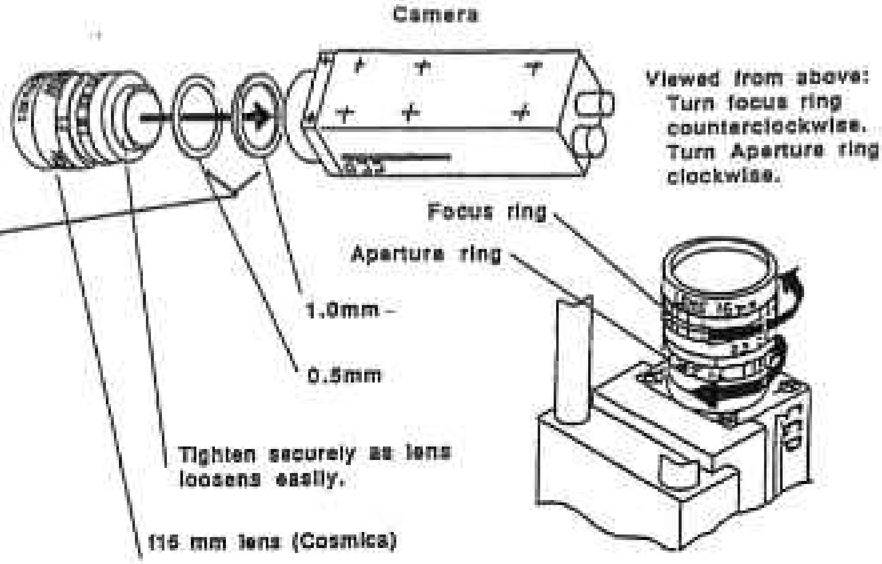


Figure 8.2.3.1. Component Camera

CSM84V only

8.2.3.2. Component Camera: Ringlight adjustment

Adjust the height of the fluorescent lamp assy as shown in figure 8.2.3.2. . Take into account not to interfere with the chuck heads 1 and 2. The clearance between the chuck-heads and the assy should be minimum 5 mm. Make sure to work with clean hands when working on the camera's and never touch the CDD surface with your bare hands and never leave the CDD surface exposed.

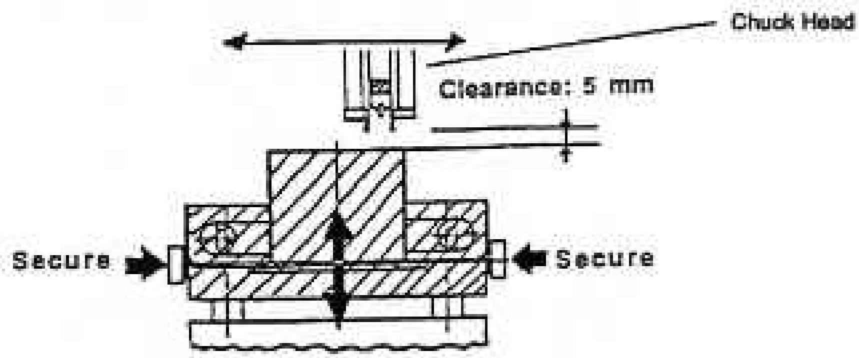


Figure 8.2.3.2. Ringlight Adjustment (CSM84V only)

Ringlight intensity can be set via at the power supply box of the ringlight. Standard this is set to LO intensity. When the ringlight looses intensity, this can be adjusted by switching the intensity level to HI.

8.2.3.3. Component Camera: Focussing

The type of extension rings used (see section 8.2.3.1.) determines the field of view used of the camera. This immediatly reflects on the focus area for the camera. The following steps should be taken in order to focus the component camera.

Focussing the component camera:

Step 1: From the MAIN MENU on the screen, select 3. DATA IN.

Step 2: From the DATA IN menu, select 3. VISION

Step 3: Here you see a list of all appiciable vision files. By moving up and down with the cursor keys you activate the camera that belongs to that particular vision file. When it is not sure which camera is selected, then enter the vision file by pressing <F6> and go to the 1. SETUP menu. On the second line the CAMERA which is used in that particular vision file, is specified (for more information on vision file contents, please refer to section 2.4).

Step 4: Once the vision file is activated, go back to the MAIN MENU and select 2. MANUAL.

Step 5: Move the nozzle tip of the VANE head over the selected camera by activating the X and Y movement keys.
Note: *With the CSM84V there is always light so the nozzle can be seen on the monitor. On the CSM84VZ, when reaching the camera with the head, you must activate the LED backlight. This can be done by going to screen 3 in the manual mode and by pressing <F3> for DO(36) (refer also to section 3-2 of this manual).*

Step 6: Turn the focus ring of the component camera fully counter clockwise until it hits its hardlock (at the side of 0.3m).
Turn the aperature ring also counterclockwise and set it to a position near an aperature of 16.

Step 7: Make sure the Vertical size (V-Size) of the monitor is set correctly. The V-Size should be set in such a way that the full picture can be shown on the vision monitor. The picture may not disappear at the top and bottom of the monitor. Adjusting the vertical size of the monitor can usually be done by the V-Size knob that is, in most cases, located at the backside of the monitor.See also figure 8.2.3.3.1.

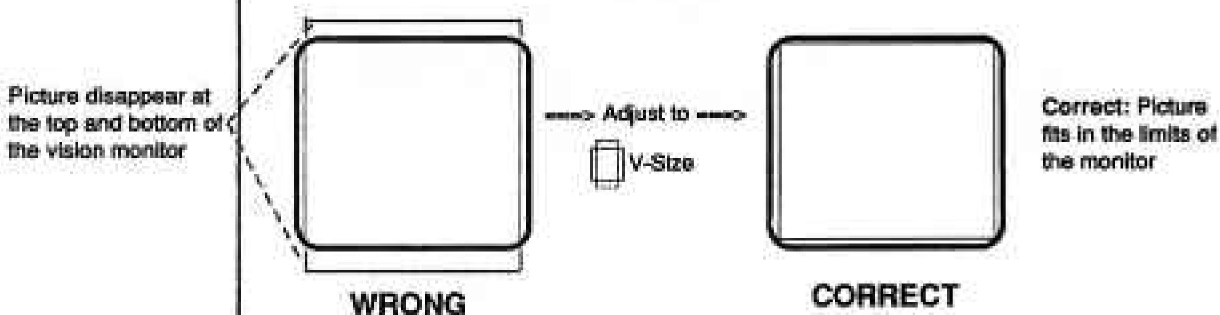


Figure 8.2.3.3.1. Adjusting the vertical size of the monitor

Step 8: Switch on the vacuum of the vision head by pressing <F3> in screen 6 of the manual mode and attach a (preferably) transparant ruler to the nozzle (make sure of course that a nozzle is attached that can carry the ruler) in such a way that the ruler is seen **vertically** on the vision monitor.

Step 9: Loosen the retaining bolts of the component camera and move the camera up or down until the ruler on the monitor indicates that the correct field of view is set. This field of view is dependant on the extension ring used, it can either be 34mm or 45mm for the CSM84V or 45mm or 54mm for the CSM84VZ (see also section 8.2.3.1.). Once the correct field of view is reached, secure the camera height by tightning the retaining bolts. Camera height adjustment is shown in figure 8.2.3.3.2.. The field of view as seen on the vision monitor is shown in figure 8.2.3.3.3.

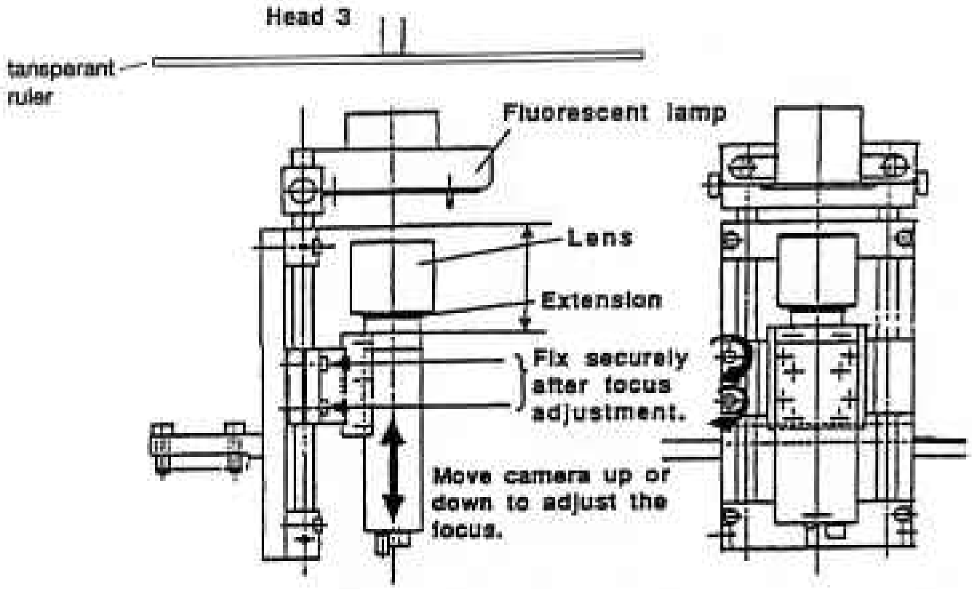


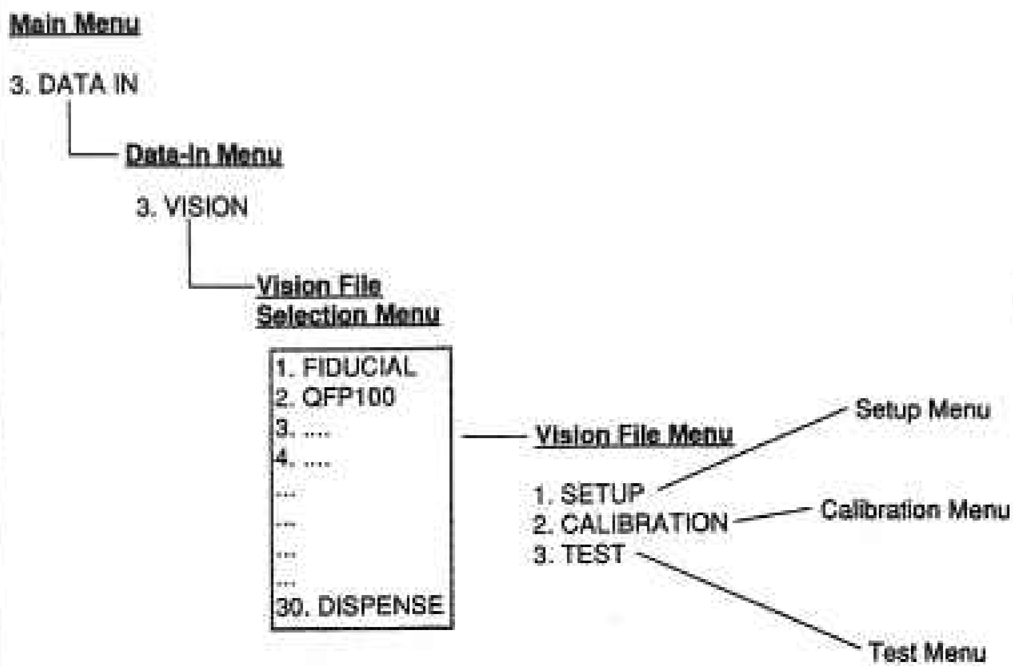
Figure 8.2.3.3.2. Component camera height adjustment (here shown for CSM84V)

Figure 8.2.3.3.3. Component camera focus (f.o.v.) adjustment

8.3. SOFTWARE SETUP

8.3.1. File Structure

The operating system has the following structure to reach the vision files:



8.3.1.1. Vision File Selection Menu

When vision mode is selected (MAIN --> Data input --> Vision), the screen shown below (figure 8.3.1.1.) will appear. Up to 31 different vision files can be registered. A file is selected by writing a file name in a file number from 0 through 30. The file selected can then be registered. The contents can then be renewed and converted.
Vision file 0 is generally used for defining a fiducial (but not necessary) and vision file 30 can only be used to define dispense dots for the vision feedback system when using adhesive applications. Vision files 1 to 29 are commonly used to define various types of components. However, when defining different styles of fiducials and bad marks, vision files 1 to 29 can be used also.

<u>Using the Vision File Selection Menu</u>:

(a) Select one file number between 0 and 30 with the ↑ and ↓ keys. After being selected, the original image picked up by the camera assigned in the file is displayed. (This is equivalent to the execution of the robot language 'VFILE' statement.)

(b) A new file name can be registered (or an old file can be renamed) by pressing the

Step 4: Look at your vision monitor while **slowly** opening the aperature ring. Do this very slowly as the distance that you have to move is very minor. On the vision monitor the background will start changing colors. The aperature must be set in such a way that the color RED is shown **on the whole screen.** The background LED is a homogene backlight system. This must also be represented on the vision monitor by means of a complete red screen (**note:** If the field of view gets larger it might be that the borders are of a green color) When set correctly, the aperture ring will be set near to an aperture of **16.** For setting the aperture ring, refer to figure 8.2.3.4.1., refer to figure 8.2.3.4.3. for the vision monitor appearance.

Example only.

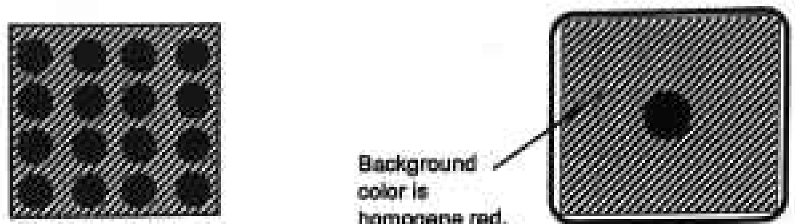


Figure 8.2.3.4.3. Aperture adjustment with a homogene backlight system

IMPORTANT

The color BLACK should **always** be avoided. A black background represents an overexposed camera. The RED color represents the optimum linear area.

Brightness adjustment on the CSM84V and CSM84VZ (when using a <u>monochrome</u> vision monitor):
Brightness adjustment, when using a monochrome monitor, is very complex because the background colors cannot be noticed. The following situation occur on a black and white monitor when using white ringlight:

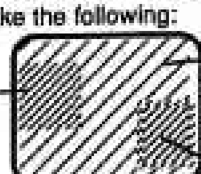
a) Background black, no component visible = **not good**
Cause: Not enough light. Aperture ring to much closed

b) Background black, component body black (outline of component visible) = **not good.**
Cause: Camera overexposed (aperture a little too far open

c) Background black, component body white = **not good.**
Cause: Fully overexposed, aperture too far open.

d) Background dark-grey, light grey and/or white = **good**

Situation d) is the situation that should be obtained by closing the aperture ring and slowly opening it again. It must be opened that far that the black color disappears on the right bottom corner of the monitor without letting the left side of the monitor (where the light is too less) gets too black also. This is only a small area in the aperture setting. Just like with the color adjustment, this will be a setting near to an aperture of **16.** As an example the screen will look like the following:



> **NOTE** When using homogene background, the black color should change into light grey. Then the adjustment is good. When continuing to open the aperature the screen will be black again because it is overexposed. With the lightgrey background, the component must clearly be visible (=Black component, light background).

Example only.

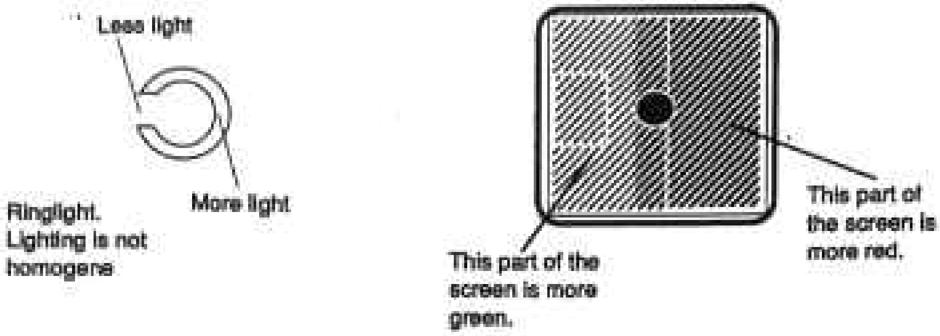


Figure 8.2.3.4.2. Aperture adjustment with a ringlight system

IMPORTANT: The color BLACK should **always** be avoided. A black background represents an overexposed camera. A red/green color represents a linear working area for the vision system.

CSM84VZ

Brightness adjustment on the CSM84VZ (when using a color vision monitor):
It is very important that not only you see the component on the vision monitor, but that the vision system can also see (and recognize) the component. The vision system can only do this when it is working in a linear area. This can only be done when the camera is not overexposed or underexposed. When underexposed, the system cannot find the component. When overexposed, the vision system cannot follow the component correctly. Especially the latter is very important. When the camera is overexposed, it seems to the user that the vision system has no problems with recognizing the component, but the fact is that it has many problems in following the contour of the component that the result is that it sees the component in a different way than it is in reality. This may cause wrong calculations for rotation and shift adjustment and this finally results in wrong placements (if a camera is overexposed it is shown as a BLACK background on the vision monitor). It is necessary to obtain an as much as possible linear area for the vision system. This can be done in the following way:

Step 1: Activate the camera (see step 3 of the previous section) and move the VANE head above the camera.

IMPORTANT

Step 2: If the backlight LEDs have stayed on too long, the LEDs loose intensity. This may cause wrong interpretation of background colors. Before starting the adjustment procedure, make sure that the LEDs of the backlight have been OFF for at least 1 minute.
Switch on the backlight by means of pressing <F3> in screen 3 of the manual mode.

Step 3: Close the aperature ring (turn fully counter clockwise to the hard lock at the **C**)

8.2.3.4. Component Camera: Brightness Adjustment.

Before adjusting the brightness, the focus must be set correctly as is described in the previous section.

CSM84V

Brightness adjustment on the CSM84V (when using a <u>color</u> vision monitor):
It is very important that not only you see the component on the vision monitor, but that the vision system can also see (and recognize) the component. The vision system can only do this when it is working in a linear area. This can only be done when the camera is not overexposed or underexposed. When underexposed, the system cannot find the component. When overexposed, the vision system cannot follow the component correctly. Especially the latter is very important. When the camera is overexposed, it seems to the user that the vision system has no problems with recognizing the component, but the fact is that it has many problems in following the contour of the component. This results into the camera seeing the component in a different way than it is in reality. This may cause wrong calculations for rotation and shift adjustment and this finally results in wrong placements. It is necessary to obtain an as much as possible linear area for the vision system. This can be done in the following way:

Step 1: Activate the camera (see step 3 of the previous section) and move the VANE head above the camera.

Step 2: Close the aperture ring (turn fully counter clockwise to the hard lock at the **C**)

Step 3: Look at your vision monitor while **slowly** opening the aperture ring. Do this very slowly as the distance that you have to move is very minor. On the vision monitor the background will start changing colors. The aperture must be set in such a way that the color RED is shown as much as possible on the side where the light is the most bright (this is usually on the right side of the monitor). Towards the left on the vision monitor the red color should change into a red-green, green, greenish-blue color. When set correctly, the aperture ring will be set near to an aperture of **16.**
Refer to figure 8.2.3.4.1. for the lens adjustment, refer to figure 8.2.3.4.2. for the vision monitor screen appearance.

NOTE: If the brightness of the fluorescent lamp is too week, the setting will not be near to an aperture of 16. In this case set the intensity level to HI (at the power supply in the system cabinet) and readjust the brightness setting.

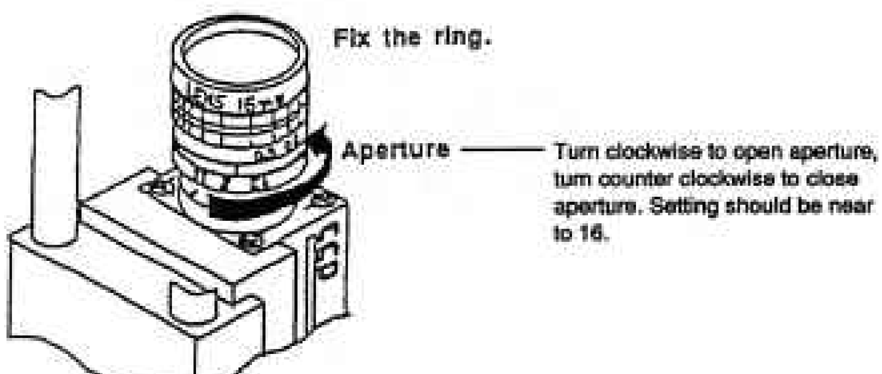


Figure 8.2.3.4.1. Camera lens brightness adjustment

PARAMETER
BINARY

BINARY: This parameter is used to determine the binary threshold level during recognition of a component or fiducial. When recognizing fiducials and components the lighting system is not the only source of light. Light coming from outside the system may be of influence (dark hall, light hall, sunlight etc). Therefore it is always recommended to use the AUTO value. Here the vision system will adapt to the external variables which can influence the recognition of the applicable object. The following parameters can be chosen:

AUTO: At vision recognition, the vision system will determine the threshold to be used at that particular moment. This setting is perfered.

BINARY: Binary threshold should be used if the system cannot use the AUTOMATIC threshold to recognize the component. This setting is a fixed setting. This can be true in the following situations:

CSM84V — 1. When the background lighting withing the processing window is not homogene. This can occur with larger type components in a ringlight system.

CSM84VZ — 2. When using a diffusor plate with the processing window being larger than the object + the diffusor plate (this means that more thresholds in the background are present).

CSM84VZ — 3. During calibration of a component attached to the same diffusor plate. Since the diffusor has to rotate, the processing window must be set big enough to cover all angles. The same situation as in 2. will occur. Also it can occur that the leads are not recognized anymore because the background LEDs lose intensity when used frequently right after each other. In both cases, after calibration, the BINARY mode can be set back to AUTO.

AREA: Fixed object binary. Here the P-Tile method is used. It determines the ratio between the number of black and white pixels of the object. When the value is 255, the screen is almost black. When the value is 0, the screen is almost white. When the value is 128, the number of black pixels is the same as the number of white pixels.

+, -, +10 and -10: With these keys the binary threshold and area object threshold can manually be changed by means of these function keys.

PARAMETER
FILL & CUT

FILL: Not used on the SBIP Enhanced Vision System

CUT: Not used on the SBIP Enhanced Vision System

(c) Change the settings using the F1, F2, F3, F4, and F5 keys. The content of the function keys changes according to the selected item. When entering numerical values, press the F1 or EDIT key and the 0-9 keys to input the value. Then press the ◈ key to enter the value.

(d) Use the F6 key to scroll through the functions.

(e) Press the G key to run an image processing test. The results of the processing will be displayed on the vision side of the CRT, but no changes are reflected on the robot side. Settings can be changed to see how the image will be processed in this simple test.

(f) Pressing the EXIT key ends the setup operation and returns to the menu screen.

In the SETUP screen the following parameters can be chosen:

PARAMETER MODE

MODE: This parameter determines the image processing mode. It selects the type of algorithm that is used to determine the applicable component, connector, glue dot or bad mark. In this mode the following parameters can be selected:

BINARY: Binary trace. Used to determine Bad Marks (refer to section 8.3.3.)
FID: Fiducial mark recognition. Used to recognize fiducial marks
QUAD: Used to detect the center and angle of PLCC components (non-leaded, J-Leaded components or rectangular shapes).
SOP: Used to detect the center and angle of SOP/TSOP components (two side leaded components).
QFP1: Used to detect the center and angle of QFP components (four side leaded components).
CON: Used to detect the center and angle of connectors
DISP*: Used for adhesive dot size control*

NOTE

The DISP mode is only applicable for the High Speed Dispenser system. Recognizing glue dots requires a white fiducial lighting system.

PARAMETER CAMERA

CAMERA: This parameter allows to select the camera that is applicable for the fiducial or for the applicable component. The following camera's can be selected:

CAMERA1: Moving camera. This is always the fiducial camera and is used to find fiducials and bad marks.
CAMERA2: First fixed component camera. Refer to section 8.2.3.
CAMERA3: Second fixed component camera. Refer to section 8.2.3.
CAMERA4: Third fixed component camera. Refer to section 8.2.3.

PARAMETER OBJECT

OBJECT: This parameter is used for object identification. The following parameters can be chosen:

WHITE: The object is more reflective than the surrounding area.
BLACK: The object is less reflective (or not reflective) than the surrounding area.

In the vision file menu one of the three items allows the contents of the file to be changed and a test to be run.

"1" key: Setup	Image processing procedures, conditions, windows and other parameters are set.
"2" key: Calibration	In order to match the mechanical system of coordinates with that of the vision system, both the scale of the vision coordinate X and Y axes and the shift volume of the X, Y, and R axes are set.
"3" key: Test	An image processing test is done to confirm the parameters established during setup and calibration. In addition, a variable density histogram is plotted to check the brightness.
<EXIT> key: Exit	Pressing this key concludes editing of the file contents and returns operation to the initial screen.

8.3.1.3. File Structure: Vision File Setup screen (1. SETUP)

If in the particular Vision File Menu, 1. SETUP is chosen, a screen similar to figure 8.3.1.3.1. will appear on the UFOS monitor. Using this screen is described below:

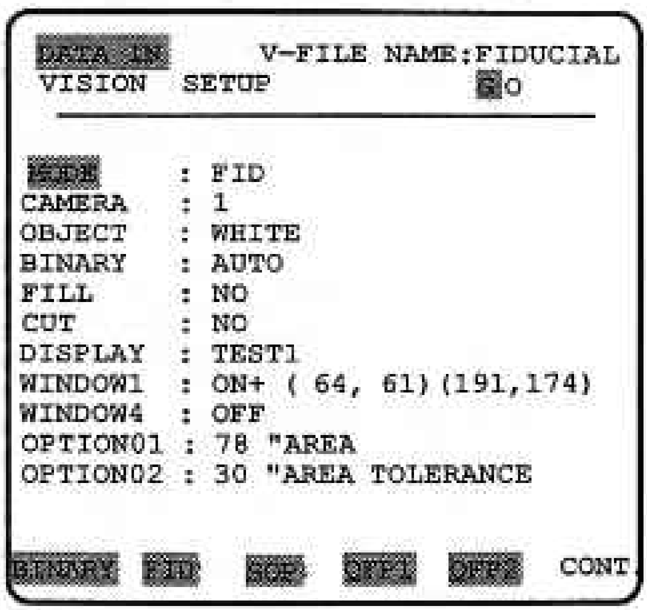


Fig. 8.3.1.3.1. Vision File Setup Menu (here: example of vision file)

(a) Use the ↑ and ↓ keys to select a setup item. The content of the function keys changes according to the selected item.

(b) Use the ROLL UP and ROLL DOWN keys to scroll through the screen display.

(c) Pressing <COPY> , a number key (i.e. 0-9) and ⇨ key will select a file number to which the data file, at the cursor, can be copied. The file name and the contents of the entire file are then copied. (It is possible to repeat a file name, but it is easier to distinguish between files if a different name is used.)

(d) A file is deleted by pressing the DEL key, when the cursor is at the file to be deleted, and confirming (In other words, the register is erased.).

```
DATA IN
VISION
 ______________________________________
   0.  FIDUCIAL
   1.  QFP100
   2.  QFP160P
   3.  QFP44P
   4.
   5.
   6.
   7.
   8.
   9.

F1    F2    F3    F4    F5    F6
```

To access screen fig. 8.3.1.1. from MAIN MENU, press MAIN MENU →3→3.

Fig. 8.3.1.1. Vision File Selection Menu

8.3.1.2. File Structure: Vision File Menu

After a file has been selected from the initial screen in the vision mode, when pressing the <F6> key the contents of that file can be shown and changed. In this sample initial screen, selecting file no. 0 will cause the following type of screen to appear.

```
DATA IN        V-FILE NAME : FIDUCIAL
VISION
 ______________________________________
   1. SET UP
   2. CALIBRATION
   3. TEST
```

File name

Menu

Example:
To access screen fig 8.3.1.2. from fig 8.3.1.1., press F6

Fig. 8.3.1.2. Vision File Menu (here: fiducial File Menu, file 0)

Beneath the coordinates the number of leads found on the component, for each side, is displayed. For the QFP1 algorithm leads on all four sides are expected and displayed. For the SOP algorithm leads on opposite sides are expected and displayed and for the PLCC (QUAD) algorithm no leads are expected and are also not displayed. For connectors, leads on one side are expected and displayed.

Bad Marks: The numeric data on the screen is displayed on the following way.

Example Only

Binary	Vision	Robot
XC	239.00	0.12
YC	269.00	0.08
Area	2317	1.47

The vision XC and YC coordinates is the distance, in pixels, from the camera origin to the center of the found object. The Robot XC and YC coordinates is the distance, in mm, from the processing window center to the center of the found object. The Vision Area is the area of the object in the number of pixels, while for the Robot this is presented in mm^2 . The AREA represents the number of white or black pixels found in the processing window. 'White' or 'Black' is defined by the parameter 'OBJECT' (see 'OBJECT' in this section). Whether a pixel is determined as black or white by the vision system is dependent on the manual threshold level that is set. This is defined by the parameter 'BINARY' (see 'BINARY' in this section).

PARAMETER
OPTION01
to
OPTION20

OPTION01 to OPTION20:
Dependent on the algorithm used (see 'MODE' in this section), the OPTIONs 01 to 20 have different meanings. For a description and explanation on these options, please refer to the section that describes the handling of Fiducials, PLCCs, SOPs, QFPs and connectors.

8.3.1.4. File Structure: Vision File Calibration screen (2. CALIBRATION)

"Calibration" is selected by pressing "2" when the vision screen is displayed. In the vision system, the definition of the direction of the coordinates (front or rear) and the feature amount are changed in accordance with the direction and method of attachment of the camera's mechanical (robot unit) section. Once the robot and camera are set up in the workplace, they must be attached, and then their respective directions must be set correctly. After this, in order to make sure the coordinates of the mechanical system match those of the vision system, the scale for the vision system X, Y and R axes is set, as well as the amount of shift along the X, Y and R axes.
Even though the scale and shift values can be entered manually, these values should **only** be determined by the <CALIB> utility. These scale factors are very much dependent on the thickness of a component. Therefore, every new type of component must always be calibrated in order to get the correct scale values that belong to that component.

The scale values, found in this screen (refer to figure 8.3.1.4.) must **always** have a ratio that is the same as the physical hardware that is actually 'seeing' the component. Since this hardware is the CCD chip in the camera and the X/Y ratio of a CCD cell is X/Y=1.20, then the scale values found must caalways have this ratio: X/Y=1.20. This value must be within the following range:

IMPORTANT:

SCALE Ratio X/Y = 1.203... ±0.005.

Example only:

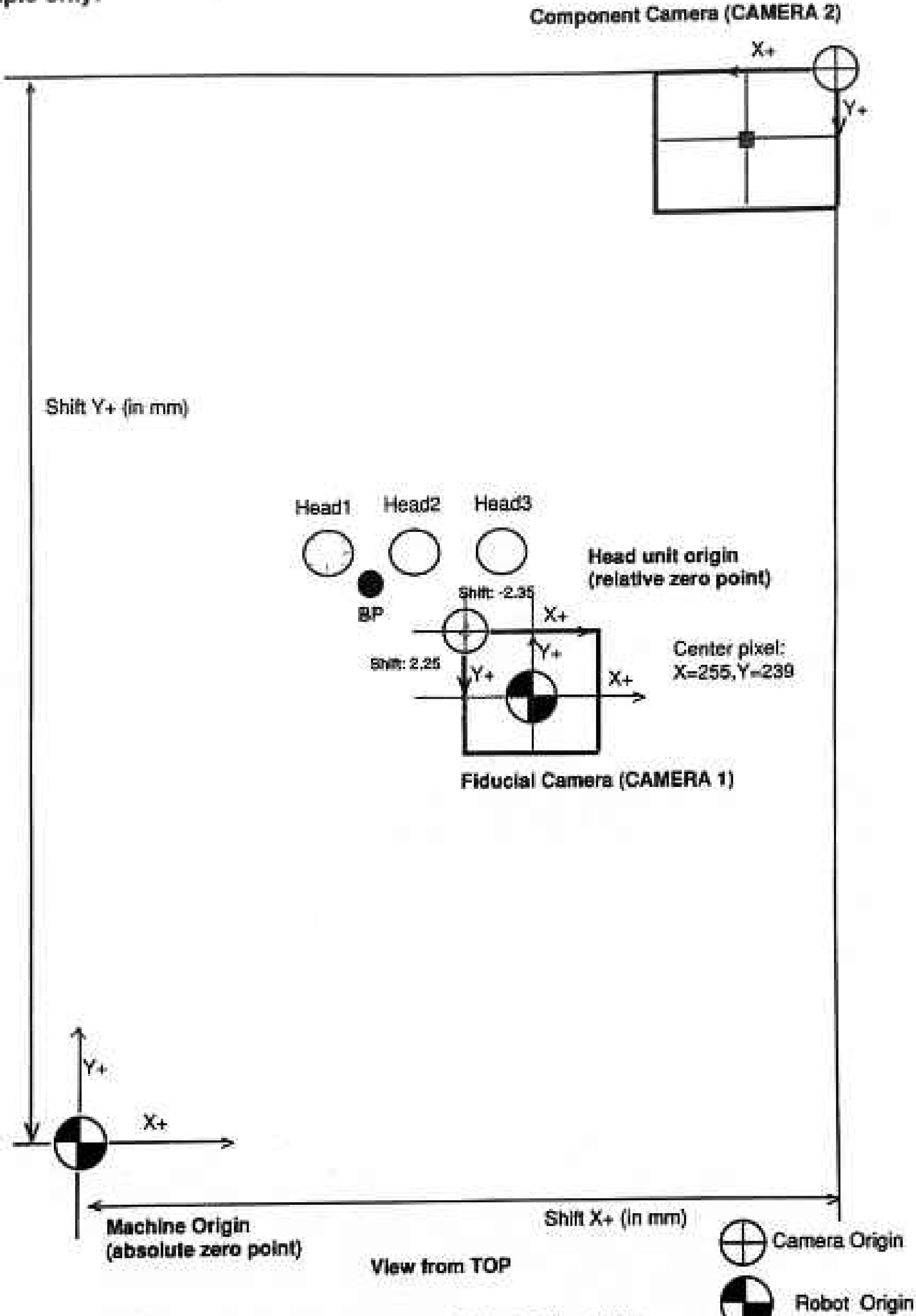


Fig. 8.3.1.3.4. Origin definition CSM

When using the TEST0 and TEST1 parameters for the display option, dependent on the object, numeric data will be displayed on the screen. This information is the following:

Fiducials: The numeric data on the screen is presented in the following way:

Example Only

Fiducial	Vision	Robot
XC	247.50	-0.08
YC	231.56	0.08
Area	15596	1.67
Circ	425	4.48

- The Vision XC and YC coördinates is the distance, in pixels, from the camera origin to the center of the found fiducial.
- The Robot XC and YC coördinates is the distance, in mm, from the camera center to the center of the found fiducial.
- The Vision Area is the surface area of the fiducial in pixels while the Robot area represents this in mm^2.
- The Vision Circ is the peripheral length of the fiducial measured in the number of pixels while for the robot this is measured in mm.

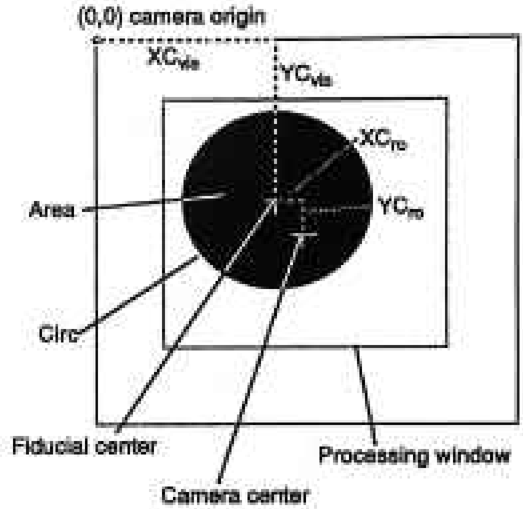


Fig. 8.3.1.3.3. TEST0 and TEST1 numeric data with fiducials.

Components: The numeric data for components is shown on the following way:

Example Only

Refer also to figure 8.3.1.3.4.

Component	Vision	Robot
XC	256.02	489.20
YC	235.12	492.74
Theta	2.61	2.38

Leads Left: 20
Leads Right: 20
Leads Top: 30
Leads Bottom: 30

The Vision XC and YC coördinates is the distance in pixels from the camera origin to the center of the found component. The Vision Theta (angle) is the angle, in degrees, of the component found by the vision system (calculated in a scaling system of 1:1.20). The Robot XC and YC coördinates is the distance, in mm, from the machine origin to the center of the found component. These numbers can vary very much as they are dependent on the location of the component camera(s). The theta is the vision angle converted to an angle based on the metric scaling. The unit is shown in degrees.

PARAMETER
WINDOW1
WINDOW4

WINDOW1 and WINDOW4:
[WINDOW1] defines the processing area where an object needs to be found. The whole object must be located within this processing window. To keep the processing time as limited as possible and to avoid multiple objects because of a too large window, an as small as possible window size should be chosen.
[WINDOW4] immediately determines where the rulers should be placed. The rulers will be positioned on the window border. This will skip all search times to find the object since the position of the rulers is already determined. WINDOW4 can only be used if the pickup of a component is very accurate. Normally this WINDOW4 is OFF and WINDOW1 is used.

Using the 1-LEFT, 1-RIGHT, and other function keys, the corners of the window can be moved up, down, left and right to change the size of the window. The corners move one pixel at a time in the up/down directions, but in the left and right directions, movement is possible only in units of 16 pixels at a time, except for Window 4. The four numerical values shown in two groups each are the X and Y coordinates of the corner. ($0 \le X \le 255$, $0 \le Y \le 239$). ON+, ON- and OFF select whether or not the window is effective. ON+ and ON- indicate the directionality of the window, and either value may be set. Setting OFF causes the window display to disappear. For the initial value, [WINDOW1:] is ON+ (0, 0) (255, 239), and other windows are OFF.

During normal processing WINDOW1 is set to an appropriate value and WINDOW4 is always set to OFF.

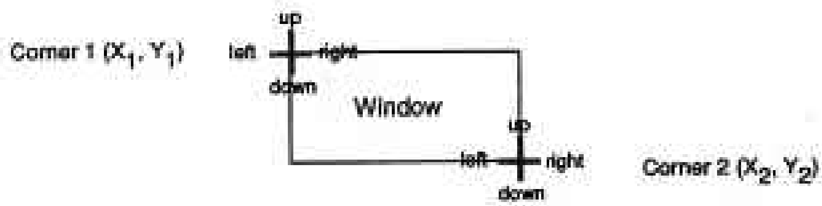


Fig. 8.3.1.3.2. Window 1 and Window 4 corner definition

PARAMETER
DISPLAY

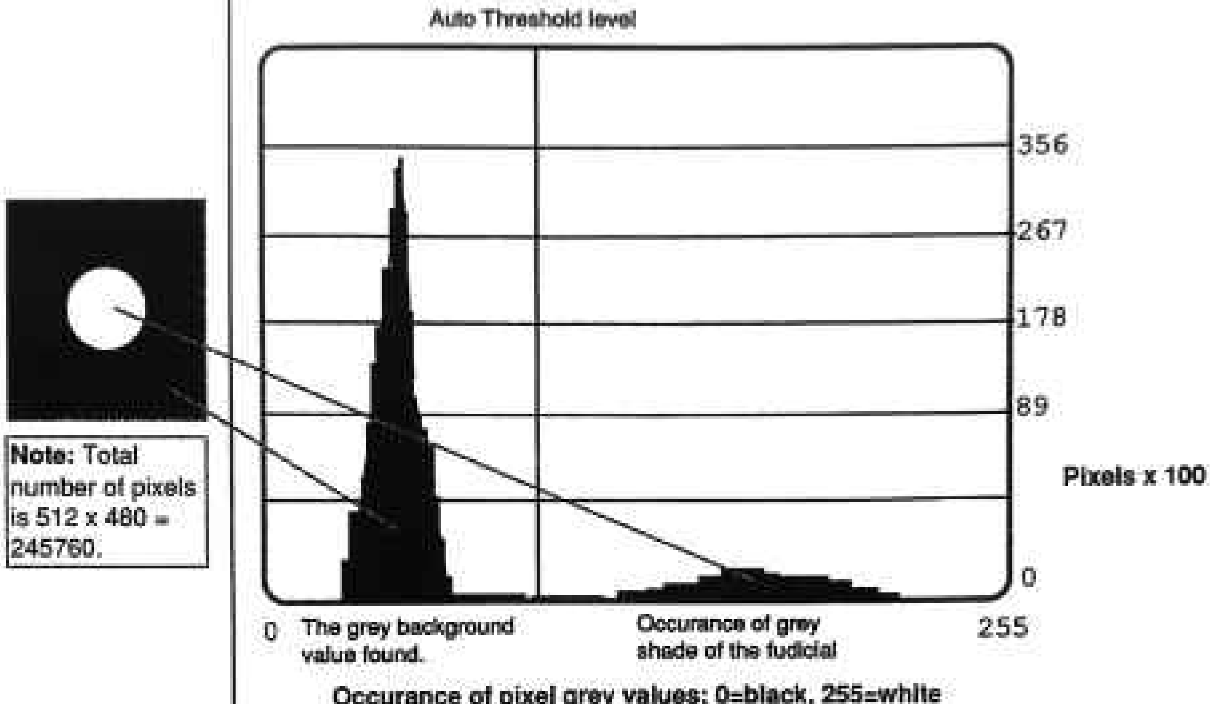
DISPLAY:
After image processing is run, the image to be output on the CRT is selected. This does not affect the processing content in any way, but if the display is particular complex, that segment is run as the total, slowing down the processing speed. Thinking in terms of speed alone, INPUT0 is the fastest for displaying the input image only. The 4 items shown below are displayed, some of them overlapping in different processing modes.

	Original Image	Binary Image	Center Position	Numerical Data
INPUT0	yes			
INPUT1		yes		
EDGE0	yes			
EDGE1		yes		
CROSS0	yes		yes	
CROSS1		yes	yes	
ALL0	yes		yes	
ALL1		yes	yes	
TEST0	yes		yes	yes
TEST1		yes	yes	yes

EDGE0 = INPUT0, EDGE1 = INPUT1
ALL0 = CROSS0, ALL1 = CROSS1

Example only

(d) Pressing H (=SHIFT-H) will cause the image read from Window 1 to be displayed as a variable density histogram. This is used to check the threshold of the automatic binary encoding and the distribution of lightness and darkness in the image. The robot screen display will not change at all. It will show the automatic threshold level between light and dark pixel clusters during the calculation. The screen may look like the following (example only. Here: fiducial).



Note: Total number of pixels is 512 x 480 = 245760.

Fig. 8.3.1.5.3. Example of Histogram of a fiducial

(f) Pressing EXIT ends the test and returns to the menu screen.

8.3.1.6. Test: Feature Volume Chart

The processing mode established in [MODE:] determines the definitions of the various feature volumes in the image processing procedure, so check carefully before proceeding. The table below shows the feature volumes corresponding to each image processing mode. When a vision program is run, the output varies depending on the program. The matrix expends dependant on the number of objects found. The meaning of the parameter s are:

Feature table for BINARY

	MODE = BINARY	
	OBJ = 0	**OBJ > 0**
FEA=0	0 when object is found	Total number of objects

(a) Pressing F1 starts the image processing. When the processing is completed, the status, execution time, total number of objects, and feature volume are displayed. When "OK" appears, the feature volume may be extracted. If an error has occurred, take corrective action in response to the error status displayed on the screen.
If the processing was normal, the following display will occur. Execution time is measured in milliseconds. Refer to figure 8.3.1.5.2.

```
DATA IN      V-FILE NAME : QFP100
VISION  TEST                    HISTOGRAM

STATUS     : OK
EXE. TIME  : 120[MSEC]
NUMBER     : 4
FEATURE    : (1,1)=1.23456E3

OBJ
FEA

   F1      F2      F3      F4      F5      F6
   GO    RESET   OBJ(+)  OBJ(-)  FEA(+)  FEA(-)
```

Fig. 8.3.1.5.2. Test screen. Pressing F1 for test execution

NOTE

For feature volume charts, refer to section 8.3.1.6.

(b) When the STATUS shows "OK", use F3 and F4 to select the object number, and F5 and F6 for the feature volume number. After each selection has been made, the specified feature volume is displayed, to be checked by the user. The feature volume is displayed as an exponential value.

In the example above, the data for the feature volume number 1 of object number 1 is:

$1.23456 \times 10^3 = 1234.56$

The definitions of the object and feature volume numbers change depending on the processing mode established during setup. Features indicating position and length are shown in mm, the surface area is measured in mm^2, and the angle in degrees.

The figure between brackets represents a position in a matrix. This matrix is also referred to as the feature volume chart. With the OBJ(-), OBJ(+), FEA(+) and FEA(-) keys a field of this matrix can be selected. The meaning of each field of this matrix depends on the algoritm that was chosen (parameter 'MODE' in the vision file SETUP screen). For more details on the feature volume chart, please refer to section 8.3.1.6.

(c) F2 is used to reset the vision monitor, and display the original image.
Alternately pressing F2 and F1 will repeat the test as many times as desired.

PARAMETER SCALE **IMPORTANT:**	SCALE:	Determines the scaling in X and Y direction of the found fiducial or component during calibration. The values are dependant of the thickness of the component. In all cases it should be made sure that the ratio between the X and Y values must be **1.203...±0.005.**
PARAMETER SHIFT	SHIFT:	Determines the system coordinates shift volume relative to those of the robot. Units for X and Y are in mm. Unit for R is in degrees.

8.3.1.5. File Structure: Vision File Test screen (3. TEST).

Press "3" on the menu screen to select "TEST" and run an image processing test. In this function, an image is actually read and processed in accordance with the currently specified setup and calibration settings. (This corresponds to the VGET instruction in the robot language.) If the image processing proceeds normally, "OK" will appear on the screen. If it does not, an error message will be displayed under STATUS.

When "OK" is displayed, the time required to execute the image processing will be shown under EXE.TIME, the total number of objects (and/or intersecting points) will be displayed under NUMBER, and "FEATURE: (x, y)" will show the feature volume corresponding to feature y of object x. If "OK" does not appear or if the feature volume is different from what was expected, the setup and calibration settings are not the optimum settings, and should be revised.

The feature volume which can be extracted changes depending on the image processing mode.

```
DATA IN                     V-FILE NAME : QFP100P
VISION  TEST                              HISTOGRAM

STATUS     :        ----------------------  Post-test error
EXE. TIME  :        ----------------------  notice
NUMBER     :        ----------------------  Execution time
FEATURE    :        ----------------------  Number of objects
                                            Features




   F1      F2      F3      F4      F5      F6
```

To access screen fig. 8.3.1.5.1. from fig 8.3.1.2., press 3 (3.TEST).

Fig. 8.3.1.5.1. Vision File test screen.

NOTE ON CALIBRATION:

For more information on calibrating fiducials and components, please refer to section 8.4.

An example and a description of the vision file calibration screen is given below:

Example only

```
DATA IN        V-FILE NAME :QFP100
VISION  CALIBRATION          GO

HOLD       : FIXED
DIRECTION: UP
SCALE     : 0.10000  0.08000
SHIFT     : 300.00 500.00 180.00





F1     F2     F3     F4     F5     F6
FIXED  MOVING
```

To access screen fig. 8.3.1.4. from fig. 8.3.1.2., press 2 (2.CALIBRATION).

Fig. 8.3.1.4. The vision file calibration screen

(a) Use the ↑ and ↓ keys to select the desired setup item. The operations assigned to the function keys will change according to the item selected.

(b) Use the F1 and F2 keys to change the setting. When numerical data is to be input, press F1 (EDIT), and then use the 0-9 keys to enter the value. Input the value by pressing the key.

(c) Press the G key to run a test of the image processing. The results are displayed on the vision side CRT, but no changes are made on the robot side CRT. It is easy to change the settings and run a test to see the image processing results. Among the setup items, set [DISPLAY:] to either (TEST0) or (TEST1). If numerical data is displayed on the vision side CRT, the image processing is being carried out correctly.

(d) Use the EXIT key to terminate the calibration procedure and return to the menu screen.

PARAMETER HOLD

HOLD: Determines what type of camera was used in determining the calibration values. Possible options are:

FIXED: Fixed camera = Component Camera's.
MOVING: Moving camera = Fiducial Camera.

PARAMETER DIRECTION

DIRECTION: Specifies the direction of the camera's field of view. Possibilities are:

UP: Camera faces upward = Component Camera
DOWN: Camera faces downward = Fiducial Camera.

Feature table for FID(ucials)

	MODE = FID	
	OBJ x = 0*	**OBJ x > 0**
FEA=0	Image processing completed =0	Total number of objects
FEA=1	X coordinate of center of gravity for fiducial mark Unit = mm	X coordinate of center of gravity for fiducial mark Unit = mm
FEA=2	Y coordinate of center of gravity for fiducial mark Unit = mm	Y coordinate of center of gravity for fiducial mark Unit = mm
FEA=3	Angle of object number 'x'	Angle of object number 'x' (OBJ = x). Unit = degree
FEA=4	Surface area of fiducial mark. Unit in mm^2	Surface area of object number 'x' (OBJ = x) Unit in mm^2.
FEA=5	Peripheral length of the fiducial mark. Unit in mm.	Peripheral length of object number 'x' (OBJ = x). Unit in mm.

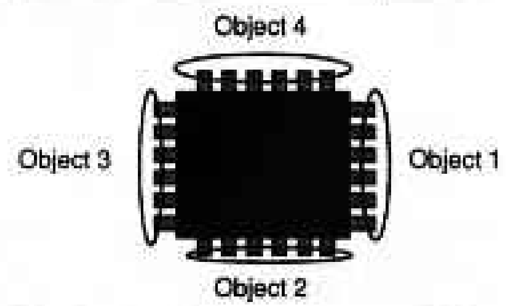
* **Note:** When more objects are found in the processing window, then the chosen object (which meets the values in the fiducial file) is specified in the colom OBJx=0. In case of one fiducial, the values in both coloms are the same

Feature table for QUAD (PLCC)

	MODE = QUAD (PLCC)	
	OBJ x = 0	**OBJ 1 ≤ x ≤ 4**
FEA=0	Image processing completed	Total number of objects
FEA=1	X coordinate of center of gravity of the PLCC Unit = mm	X coordinate of center of gravity of the PLCC Unit = mm
FEA=2	Y coordinate of center of gravity of the PLCC Unit = mm	Y coordinate of center of gravity of the PLCC Unit = mm
FEA=3	Angle of object. Unit = degree	Angle of object. Unit = degree

Feature table for SOP or QFP1

	MODE = SOP or QFP1	
	OBJ x = 0	**OBJ 1 ≤ x ≤ 4**
FEA=0	Image processing completed	Total number of objects
FEA=1	X coordinate of center of workpiece. Unit in mm.	X coordinate of midpoint of side x. Unit in mm.
FEA=2	Y coordinate of center of workpiece. Unit in mm.	Y coordinate of midpoint of side x. Unit in mm.
FEA=3	Angle of workpiece. Unit in degree.	Number of leads detected on side x



PA1303/00, 1304/00,
1304/05 & 1304/60

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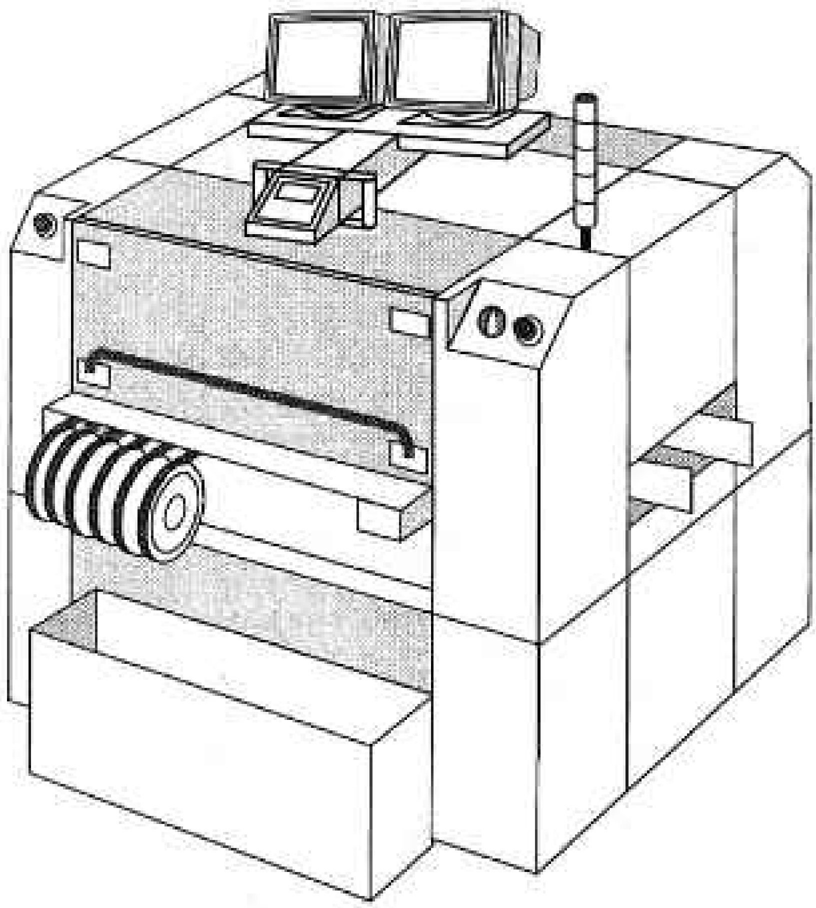


4822 871 60616 93.05 Updated till: Dec-93

8.3.2.4. Fiducial File: Setup parameters

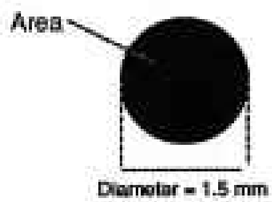
For a description on the parameters MODE, CAMERA, OBJECT, BINARY, FILL, CUT, DISPLAY, WINDOW1 and WINDOW4, please refer to section 8.3.1.3.

GO = SHIFT - G

At all times in the fiducial setup file, the settings can be checked by pressing SHIFT-G (for 'GO'). The results will be shown on the vision monitor.

For a fiducial, the options have the following meaning:

Example:

OPTION	Description
OPTION01:	Fiducial area in $^1/_{100}$ mm^2.  Area: $^1/_4 \times \pi \times d^2$. Area: $^1/_4 \times 3.14 \times 1.5^2 = 1.76$ mm^2 Option01 = **176** Durchmesser! Option01 is not used when Option05 is set to 2 or 3. **TIP:** Make sure that the camera is in focus. The value that must be entered into this option can also be calculated by the vision system. Press SHIFT-G for 'GO' and read on the vision monitor the Area value that is stated under the Robot values. Multiply this value by 100 and enter this in Option01. **<u>IMPORTANT:</u>** Make sure that this value represents the actual size of the object. Incorrect values (with high tolerance values in OPTION02) will lead towards inaccurate component placements.
OPTION02:	If OPTION05 = 1: Tolerance of the fiducial surface area. If OPTION05 = 2 or 3: Tolerance of the size of the object (the size of the object is then defined in OPTION 7 and 8). If this option is set to 0, no tolerance check is performed. Unit is in percent (%). This value is generally set to **30** **Note:** During calibration, this value must be set to 0.
OPTION03:	Fiducial peripheral length in $^1/_{100}$ mm.  Umfang Peripheral length: $\pi \times d$. Peripheral length: $3.14 \times 1.5 = 4.71$ Option03 = **471**

8.3.2.3. Fiducial File: Screens

The vision file number for PCB fiducials is usually 0. But when using more types of fiducials for more types of boards, then any file number is allowed. When the applicable fiducial is chosen from the Vision File menu and <F6> (for NEXT) is pressed, then the following screen will appear on the UFOS monitor.

Example only

```
DATA IN          V-FILE NAME : FIDUCIAL
VISION
-----------------------------------------

   1. SET UP
   2. CALIBRATION
   3. TEST
```

Fig. 8.3.2.3.1. Fiducial file menu

The Fiducial setup screen exists of 29 lines. To access all lines you should scroll with the cursor up and down to be able to access all parameters. When 1. SETUP has been chosen, a screen like the following will be shown on the UFOS monitor:

Example only

```
DATA IN          V-FILE NAME : FIDUCIAL
VISION  SETUP                       GO
-----------------------------------------

  MODE     : FID
  CAMERA   : 1
  OBJECT   : WHITE
  BINARY   : AUTO
  FILL     : NO
  CUT      : NO
  DISPLAY  : CROSS1
  WINDOW1  : ON+ (64,61)(191,174)
  WINDOW4  : OFF
  OPTION01: 78  "AREA
  OPTION02: 30  "AREA TOLERANCE


   F1          F2     F3     F4     F5          F6
 [illegible] [illegible] [illegible] [illegible] [illegible] CONT.
```

Type 'G' to start a test sequence.

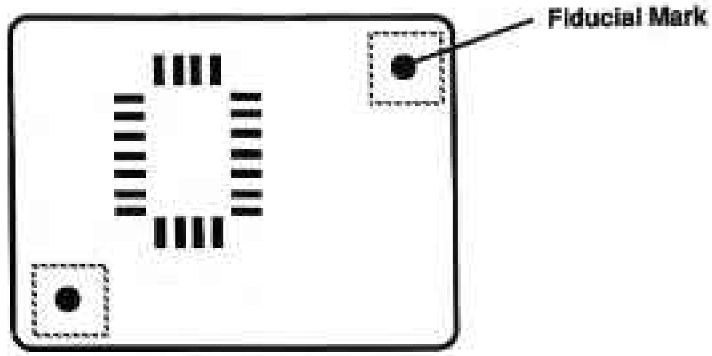
Fig. 8.3.2.3.2. Fiducial file SETUP menu (opening screen)

8-2-2-2
Fiducial camera calibration and software setup

8.3.2. FIDUCIAL FILE SETUP

8.3.2.1. Fiducial file: Introduction.

The vision file number for fiducials can be any file number (0-29), but is usually file 0. Basically, the file name is not important, but here the file used to align circuit boards will be called "FUDICIAL". In case of fiducial mark identification, binary image processing is used to find the centre of gravity offset of the fiducial marks. This process is done at two locations to align the X,Y and the rotation of the pattern of the boards.



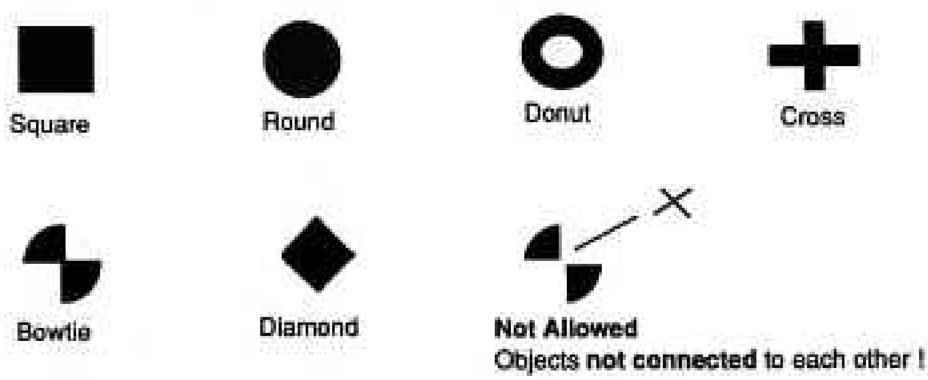
PCB

To create a new file, copy an already-existing fudicial file on the initial screen of the Vision Mode, and then correct only the lines which are different.

8.3.2.2. Fiducial File: Fiducial Types

Basic operation of a fiducial algorithm is to find the center of gravity of the object (in this case a fiducial). Fiducials may therefore be of any shape. A fiducial must exist of one solid object, therefore it is not allowed to use two objects for one fiducial. Commonly used fiducials are round, donut, square, diamond, bowtie or crossed.

Note: Any other solid fiducial type is possible also.



IMPORTANT

To meet fiducial specifications, the fiducials must have a clearance of 2mm surrounding the fiducial.

8.3.3. BAD MARK FILE SETUP

Even thought any name can be used for a bad mark vision file, it is recommended to use 'BADMARK' as a filename. Bad mark recognition takes place in response to the brightness of the image. No position data or other data is used. The only factor which can be adjusted by the user is the level of brightness. This function has no relation at all to calibration.

Bad mark location:

- Bad marks are located relative to the PCB origin or relative to the block origin. For more details on this subject, please refer to section 4-5-6-2 of this chapter.
- Bad marks must be of a relative large size. Be aware that bad marks are checked for existance **before** fiducial alignment is done. This implies that bad mark locations are an *estimate* location and not an exact location. Also the bad mark should be large enough to overcome this problem.

The object will be identified as 'object found' or 'no object'. This is determined by the value which is entered in the parameter BINARY. If, for example, BINARY is set to MANUAL (150), then the average found grey value of all pixels, in the processing window, is above a threshold of 150, then the object is WHITE. If the average found grey value of all pixels, in the processing window, is below 150, then the object is BLACK. Whether the object is found or not is dependent on what is entered at the parameter OBJECT. This can be WHITE or BLACK, then the setting in BINARY and the found average grey value will determine if the found object is 'found' or 'not found'.

Below you will find a common setting for a bad mark and an example of a bad mark. Press SHIFT-G and check on the vision monitor if 'OBJECT FOUND' or 'NO OBJECT' is displayed.

For the description of the various parameters, please refer to section 8.3.1.3.

Example only

MODE:	BINARY	
CAMERA:	1	
OBJECT:	WHITE	;Object, in this example, is white. White means that the found grey value in WINDOW1 must be 150 or higher.
BINARY:	MANUAL(150)	;In this case: If average found grey value < 150 : Black object If average found grey value ≥ 150 : White object
FILL:	NO	
CUT:	NO	
WINDOW1:	ON+(10,10)(143,134)	; Depends on the object.
DISPLAY:	TEST0	

All OPTIONs are not used and must be set to **0** (ZERO).

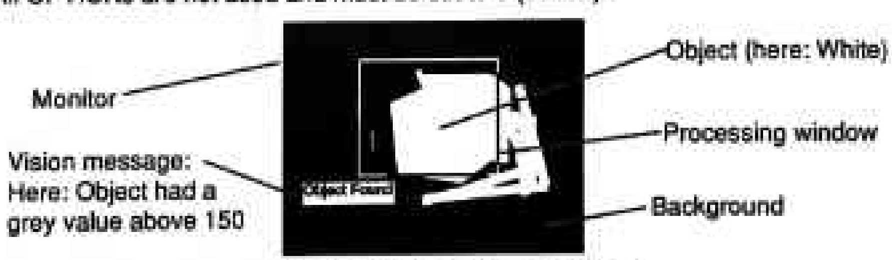
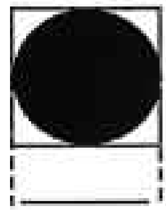


Fig. 8.3.3. Example of Bad Mark

Only used when OPTION05 is 2 or 3.

OPTION	Description
OPTION08	Horizontal size of the circumscribing rectangle of the object in 1/100 mm. circumcribing rectangle  horizontal size of circumcribing rectangle **Note:** During calibration this value should be ZERO.
OPTION09 to OPTION17	All these options are not used and must be set to 0 (ZERO).
OPTION18	Fiducial image intake delay time. Unit is in mSec. When the servo system of the CSM needs more time to stabilize itself it can give difficulties when takking images of fiducials. To overcome this problem a delay time can be entered in this option. the entered delay time is system dependent, but should be kept as low as possible to keep system performance high.
OPTION19 to OPTION20	All these options are not used and must be set to 0 (ZERO).

As an example, a vision file for a 1.5mm diameter (round) fiducial will look like the following:

Fid 5 bei 420 L.1

Example only: Fiducial file contents.

MODE:	FID	
CAMERA:	1	
OBJECT:	WHITE	
BINARY:	AUTO	Manual 39
FILL:	NO	
CUT:	NO	
DISPLAY:	TEST1	
WINDOW1:	ON+ (32,35)(223,205)	(80,71) (207,186)
WINDOW4:	OFF	
OPTION01:	176	140
OPTION02:	20	40
OPTION03:	471	600
OPTION04:	30	40
OPTION05:	1	2

All other options contain the value 0. If OPTION05 is 2 or 3, enter the correct values for OPTION02, 06, 07 and 08. If the servo system does not stabilize itself, enter a suitable value in OPTION18.

OPTION	Description
OPTION03 (continued)	Option03 is not used when Option05 is set to 2 or 3. **TIP:** Make sure that the camera is in focus. The value that must be entered into this option can also be calculated by the vision system. Press SHIFT-G for 'GO' and read on the vision monitor the Circ value that is stated under the Robot values. Multiply this value by 100 and enter this in Option03.
OPTION04:	If OPTION05 = 1: Tolerance of the fiducial surface area. If this option is set to 0, no tolerance check is performed. Unit is in percent (%). This value is generally set to**30** **Note:** During calibration, this value should be set to 0. This OPTION is not used when OPTION5 is 2 or 3
OPTION05: bei einem Fiducial der so aussieht	Algorithm Selection: bei einem flachen Fiducial 1: Standard fiducial algorithm. **IMPORTANT**: This algorithm must always be used when calibrating fiducials. All other OPTIONs are not used and must be set to 0. 2: Advanced fiducial algorithm. This algorithm uses OPTION02, OPTION06, OPTION07 and OPTION08. 3: First the standard fiducial algorithm will be executed and the second trial will be the advanced fiducial algorithm. This algorithm uses OPTION02, OPTION06, OPTION07 and OPTION08. egt. 4: Fiducial Teaching: This is a special product which requires special hardware. This manual will not discuss this option.
OPTION06: Only used when OPTION05 is 2 or 3.	Ruler threshold. If not zero (0), then this value is the first ruler threshold out of six (40 - 25 - 20 - 17 - 10 - 5). If zero then all six ruler thresholds are default and a successful threshold will be swapped so that it becomes the first one for the next fiducial measurement. A fixed ruler threshold can be put into this option. Valid threshold values are: 40, 25, 20, 17, 10 or 5. **TIP:** Set the initial value to zero and press SHIFT-G (for 'GO') and read the result value on the screen. Put this value into this vision file option. **Note:** When not set to zero: A larger value gives a more reliable result.
OPTION07: Only used when OPTION05 is 2 or 3.	Vertical size of the circumscribing rectangle of the object in $^1/_{100}$ mm. During calibration, this value should be ZERO. 

OPTION	DESCRIPTION
OPTION01 (continued)	The surface area is used to find defects in the size of the component. It is not used as a tool for accurate placements.
OPTION02	Tolerance of the surface area. Unit is in percentage (%) When no check should be performed and when OPTION01 is set to 0, then this OPTION02 should (also) be set to ZERO (0).
OPTION03	Peripheral length of the PLCC. Unit is in mm/100 (0.01 mm). 30mm  30mm Width = 30 mm Length = 30mm Peripheral Length = 4 x 30 = 120 mm OPTION03 = 100 x 120 = **12000**
OPTION04 to OPTION08	All these options must contain the value 0 (ZERO).
OPTION09	Algorithm selection: 0: Template matching. Also referred to as: Real Time Recognizer. Normally this algorithm selection is chosen. 1: Object search. Also referred to as: Video Scan. This algorithm is generally chosen if the Real Time Recognizer (algorithm 0) cannot recognize the component due to irregularities in the component (such as edges or corners sticking out). 2 & 3: Not used for PLCC components.
OPTION10	Recognition type: 0: Standard recognition: The component is only recognized once, correction is applied and the component is mounted. This method also enhances the overall system performance when using vision recognition. 1: Multi-stage recognition: The component is recognized two or three times with correction being applied so that the components can be mounted with higher precision. **Note:** During calibration, this option must be 0.
OPTION11	Calibration rotation offset correction at 0°. Unit is 1/100 degree. The rotation offset, when mounting at 0° is normally determined by the rotation value in the Camera Shift (find in 2. CALIBRATION of a vision file). Therefore this option is normally set to 0 (ZERO).

The component setup screen exists of more than 29 lines. To access all lines you should scroll with the cursor up and down keys to be able to access all parameters. When 1. SETUP, from the component file menu, was chosen, a screen like the following will be shown on the UFOS monitor:

Example Only

```
DATA IN       V-FILE NAME:QFP100
VISION  SETUP               GO

MODE      : QFP1
CAMERA    : 2
OBJECT    : BLACK
BINARY    : AUTO
FILL      : NO
CUT       : NO
DISPLAY   : TEST1
WINDOW1   : ON+ ( 64, 61)(191,174)
WINDOW4   : OFF
OPTION01  : 30 "LEAD WIDTH
OPTION02  : 0 "LEAD WIDTH TOLERANCE

  F1      F2     F3     F4     F5     F6
BINARY   FID    SOP    QFP1   QFP2   CONT
```

Fig. 8.3.4.2.3. Example of QFP100 setup file

A full detailed description of the setup file for various type of components is given in the following sections. Please find the appropriate section belonging to your type component.

8.3.4.3. Component File Setup: QUAD (PLCC)

For a descripton on the parameters MODE, CAMERA, OBJECT, BINARY, FILL, CUT, DISPLAY, WINDOW1 and WINDOW4, please refer to section 8.3.1.3.

GO = SHIFT - G

At all times in the fiducial setup file, the settings can be checked by pressing SHIFT-G (for 'GO'). The results will be shown on the vision monitor.

For PLCC type of components, the options have the following meaning:

OPTION	DESCRIPTION
OPTION01	The surface area of the object. Unit is in $mm^2/10$ ($0.1mm^2$).  Width = 30mm Length = 30mm Surface = 30 x 30 = 900 OPTION01 = 900 x 10 = 9000

Example only

```
DATA IN
VISION
________________________________________
 0.  FIDUCIAL
 1.  QFP100
 2.  QFP160P
 3.  QFP44P
 4.
 5.
 6.
 7.
 8.
 9.

F1     F2     F3     F4     F5     F6
                                   NEXT
```

To access this screen from the main menu: Choose 3. DATA IN and then 3. VISION.

Fig. 8.3.4.2.1. Vision file menu.

(a) Select one file number between 0 and 30 with the ↑ and ↓ keys. After being selected, the original image picked up by the camera assigned in the file is displayed. (This is equivalent to the execution of the robot language 'VFILE' statement.)
(b) A new file name can be registered (or an old file can be renamed) by pressing the → (= cursor right) key, a combination of alphanumeric keys (max. 8 characters) and key
(c) Pressing <COPY> , a number key (i.e. 0-9) and key will select a file number to which the data file can be copied. The file name and the contents of the entire file are then copied. (It is possible to repeat a file name, but it is easier to distinguish between files if a different name is used.)
(d) A file is deleted by pressing the DEL key and confirming (i.e. 1). (In other words, the register is erased.)

After a selection of one of these vision files is made (by pressing <F6>, the following screen will appear. A full description of the CALIBRATION and TEST screen can be found in section 8.3.1.4. and 8.3.1.5.

Example only

```
DATA IN            V-FILE NAME : QFP100
VISION
________________________________________

    1. SET UP
    2. CALIBRATION
    3. TEST
```

Fig. 8.3.4.2.2. Example of component file menu (here QFP100 was chosen)

8.3.4. COMPONENT FILE SETUP

8.3.4.1. Component file: Introduction

When fiducial recognition is applied, but no bad mark recognition, then up to 29 types of components can be stored in memory. Component names and pin numbers can be used as filenames to make it easier to remember which file contains what data. Changing the processing mode enables PLCC, SOP, QFP or CON detection.

A sample of a vision file directory is shown below:

NO.	FILE NAME
0.	FIDUCIAL
1.	QFP-100
2.	QFP-54P
3.	QFP-80P1
4.	QFP-80P2
5.	QFP-80P3
6.	QFP-100P
7.	SOP-48P
8.	SOP-60P
9.	LIF22
.	
.	
.30	Dispense dot

When creating a new component vision file, copy an existing vision file of a similar type component in this screen and correct any difference.

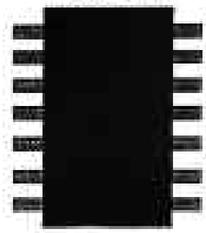
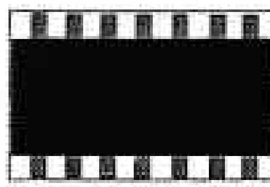
IMPORTANT: *For correct, and accurate, component placement, it is always recommended to calibrate every newly added component. For component calibration, please refer to section 8.4.*

It is necessary to preset the vision file setting to use the vision system for the purpose which it is specified for. The vision file is used to select cameras, functions, condition settings, scale and amount of shift in the coordinates.

8.3.4.2. Component File: Screens

When vision mode is selected (MAIN --> Data input --> Vision), the screen, as shown in figure 8.3.4.2.1., will appear. The vision file has the capacity to register 31 different files (reserved: Vision file #0 for fiducials and Vision file #30 for dispence dot recognition). A file is selected by writing a file name in a file number between 0 and 30. The file selected can then be registered. The contents can then be renewed and converted.

OPTION	DESCRIPTION
OPTION10	Recognition type: 0: Standard recognition: The component is only recognized once, correction is applied and the component is mounted. This method also enhanced the overall system performance when using vision recognition 1: Multi-stage recognition: The component is recognized two or three times with correction being applied so that the components can be mounted with higher precision. **Note:** During calibration, this option must be 0.
OPTION11	Calibration rotation offset correction at 0°. Unit is 1/100 degree. The rotation offset, when mounting at 0° is normally determined by the rotation value in the Camera Shift (find in 2. CALIBRATION of a vision file). Therefore this option is normally set to 0 (ZERO).
OPTION12	Calibration rotation offset correction at 90°. Unit is 1/100 degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION13	Calibration rotation offset correction at 180°. Unit is 1/100 degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION14	Calibration rotation offset correction at -90° (270°). Unit is 1/100 degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION15 to OPTION17	These options are not used and should be set to 0 (ZERO).
OPTION18	Component intake delay time. Unit is in mSec. When the servo system of the CSM needs more time to stabilize itself and therefore can give difficulties when taking images of components, a delay time can be entered in this OPTION.
OPTION19 to OPTION20	These options are not used and must be set to 0 (ZERO).

OPTION	DESCRIPTION
OPTION06	Number of horizontal leads. Dependent on the component orientation above the component camera, this option can contain the number of horizontal leads or contains the value 0 (ZERO). Horizontal view  Here: OPTION05 = **0** OPTION06 = **7** Vertical view  Here: OPTION05 = **7** OPTION06 = **0**
OPTION07	Lead detection line offset. This is the line offset relative to the quadrangle circumscribing the detected component. Values can be in the range from -5 to 5.  Circumscribing rectangle. A ruler placed **outside** this rectangle is positive. A ruler placed **inside** this rectangle is negative. The number specified is the step in the number of pixels.
OPTION08	Not used for SOP components. This value must always be **0**.
OPTION09	Processing algorithm: 0: Template matching. Also referred to as the Real Time Recognizer. With SOP components generally this processing algorithm is used. 1: Object search. Also referred to as Video Scan. This should only be used if the component has irregularities around its housing. These irregularities may influence wrong recognizing of the component when using processing algorithm 0 (template matching). 2: Template matching with fine rulers. This is generally not used with SOP components. Fine rulers are only applicable with fine pitch components. 3: Object search with fine rulers. This is generally not used with SOP components. Fine rulers are only applicable with fine pitch components.

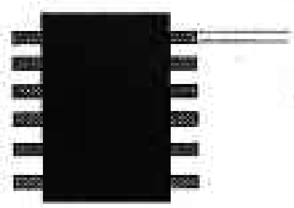
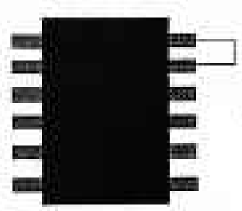
8.3.4.4. Component File Setup: SOP

For a descripton on the parameters MODE, CAMERA, OBJECT, BINARY, FILL, CUT, DISPLAY, WINDOW1 and WINDOW4, please refer to section 8.3.1.3.

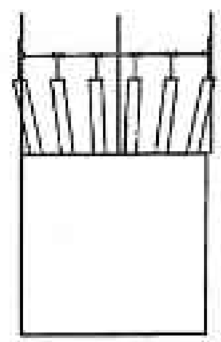
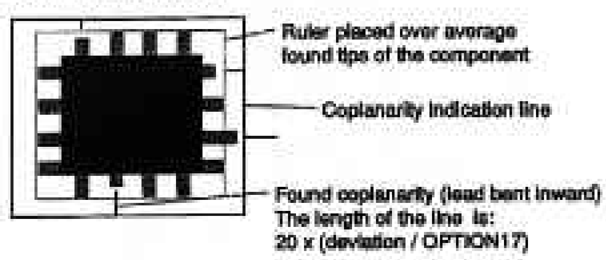
GO = SHIFT - G

At all times in the fiducial setup file, the settings can be checked by pressing SHIFT-G (for 'GO'). The results will be shown on the vision monitor.

For SOP type of components, the options have the following meaning:

OPTION	DESCRIPTION
OPTION01	Component lead width. Unit is in $^{1}/_{100}$ mm (0.01mm). Information on component lead width can be found in the component manufacturer's data sheets.  Lead width = 0.3mm Then OPTION01 = 100 x 0.3 = **30**
OPTION02	Component lead width tolerance. Unit is in percentage (%). **Note:** Lead width tolerance is not a measurement for placement accuracy. It is used as a measurement for component quality. This value is generally set to **30**
OPTION03	Component lead pitch. Unit is in $^{1}/_{100}$ mm. Information on component lead pitches can be found in the component manufacturer's data sheets.  Lead pitch = 0.65 mm Then OPTION03 = 100 x 0.65 = 65
OPTION04	Component lead pitch tolerance. Unit is in percentage (%). **Note:** Lead pitch tolerance is not a measurement for placement accuracy. It is used as a measurement for component quality. This value is generally set to **30**
OPTION05	Number of vertical leads. Dependent on the component orientation above the component camera, this option can contain the number of vertical leads or contains the value 0 (ZERO). **Note:** Refer also to OPTION06

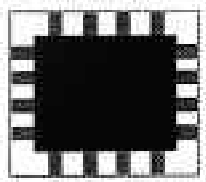
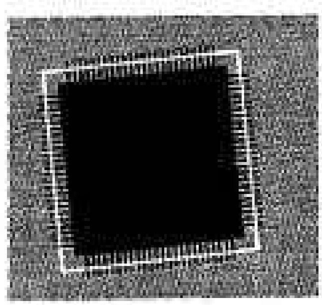
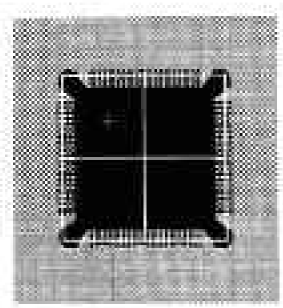
OPTION	DESCRIPTION
OPTION12	Calibration rotation offset correction at 90°. Unit is $^{1}/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION13	Calibration rotation offset correction at 180°. Unit is $^{1}/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION14	Calibration rotation offset correction at -90° (270°). Unit is $^{1}/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION15 to OPTION17	These options are not used and should be set to 0 (ZERO).
OPTION18	Component intake delay time. Unit is in mSec. When the servo system of the CSM needs more time to stabilize itself and therefore can give difficulties when taking images of components, a delay time can be entered in this OPTION.
OPTION19 to OPTION20	These options are not used and must be set to 0 (ZERO).

OPTION	DESCRIPTION
OPTION14	Calibration rotation offset correction at -90° (270°). Unit is $^{1}/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION15	Cumulative lead check tolerance. Unit is in percentage (%) This algorithm will start checking the distance from the center of the middle lead to the center of the outer lead. Notes: 1. When set to 0 (ZERO) no cumulative lead check will be performed. 2. During calibration, this parameter should be set to 0 (ZERO). 
OPTION16	This option is not used and should be set to zero (0)
OPTION17	Coplanarity check tolerance. Unit is in $^{1}/_{100}$ mm. Coplanarity check is done by placing a ruler around the tip of the lead (average tip found). The deviation from this line for every lead is checked and shown on the screen. In general cases leads that are bent are considered shorter in a 2-dimensional view.  **Notes:** •When no coplanarity check should be performed, this option should be set to 0 (ZERO). •During calibration, this option must be set to 0 (ZERO)

NOTE

Graphical presentation only available with software versions 2.2. and higher.

OPTION	DESCRIPTION
OPTION09	Processing algorithm: 0: Template matching. Also referred to as the Real Time Recognizer. Except for fine pitch components (see algorithm 2 and 3) and for component irregularities (see algorithm 1) this algorithm is recommended. 1: Object search. Also referred to as Video Scan. This should only be used if the component has irregularities around its housing. These irregularities may influence wrong recognizing of the component when using processing algorithm 0 (template matching). 2: Template matching with fine rulers. Same as algorithm 0, but now using fine rulers. Fine rulers should be used when using components with fine pitch. 3: Object search with fine rulers. Same as algorithm 1, but now using fine rulers. Fine rulers should be used when using components with fine pitch. **Note:** Fine pitch are generally components with a pitch < 0.5. It is also very dependant on the background lighting system. When processing algorithm 0 or 1 works fine for a certain fine pitch components, then this algorthm is recommended. Otherwise, choose algorithm 2 or 3.
OPTION10	Recognition type: 0: Standard recognition: The component is only recognized once, correction is applied and the component is mounted. This method also enhanced the overall system performance when using vision recognition 1: Multi-stage recognition: The component is recognized two or three times with correction being applied so that the components can be mounted with higher precision. **Note:** During calibration, this option must be 0.
OPTION11	Calibration rotation offset correction at 0°. Unit is $^1/_{100}$ degree. The rotation offset, when mounting at 0° is normally determined by the rotation value in the Camera Shift (find in 2. CALIBRATION of a vision file). Therefore this option is normally set to 0 (ZERO).
OPTION12	Calibration rotation offset correction at 90°. Unit is $^1/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.
OPTION13	Calibration rotation offset correction at 180°. Unit is $^1/_{100}$ degree. This is to correct any rotation offset that still occurs when mounting at this angle. This option is normally updated by the <FINE CALIB> utility. It can also be manually updated. For more information on calibration, refer to section 8.4.

OPTION	DESCRIPTION
OPTION06	Number of horizontal leads.  Then: OPTION05 = 4 OPTION06 = 4
OPTION07	Lead detection line offset. This is the line offset relative to the quadrangle circumscribing the detected component. Values can be in the range from -5 to 5.  Circumscribing rectangle. A ruler placed **outside** this rectangle is positive. A ruler placed **inside** this rectangle is negative. The number specified is the step in the number of pixels. Note that the ruler must **cross** all leads.
OPTION08	QFP algorithm. This option determines the processing algorithm for QFPs to detect if the QFP has bumper or not. 0: Standard QFP algorithm 1: Bumper QFP algorithm  QFP: No bumpers OPTION08 = 0  QFP: With bumpers OPTION08 = 1

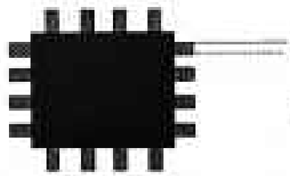
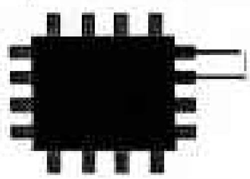
8.3.4.5. Component File Setup: QFP1

For a descripton on the parameters MODE, CAMERA, OBJECT, BINARY, FILL, CUT, DISPLAY, WINDOW1 and WINDOW4, please refer to section 8.3.1.3.

GO = SHIFT - G

At all times in the fiducial setup file, the settings can be checked by pressing SHIFT-G (for 'GO'). The results will be shown on the vision monitor.

For QFP type of components, the options have the following meaning:

OPTION	DESCRIPTION
OPTION01	Component lead width. Unit is in 1/100 mm. (0.01mm) Information on component lead width can be found in the component manufacturer's data sheets.  Lead width = 0.3mm Then OPTION01 = 100 x 0.3 = **30** % tolerance
OPTION02 tolerance	Component lead width tolerance. Unit is in percentage (%). During calibration this value must be set to 0 (ZERO). **Note:** Lead width tolerance is not a measurement for placement accuracy. It is used as a measurement for component quality. This option is generally set to **30**
OPTION03	Component lead pitch. Unit is in 1/100 mm (0.01mm). Information on component lead pitches can be found in the component manufacturer's data sheets.  Lead pitch = 0.65 mm Then OPTION03 = 100 x 0.65 = 65
OPTION04	Component lead pitch tolerance. Unit is in percentage (%). **Notes:** Lead pitch tolerance is not a measurement for placement accuracy. It is used as a measurement for component quality. This option is generally set to **30** During Calibration this value should be set to 0 (ZERO).
OPTION05	Number of vertical leads. **Note:** Refer also to OPTION06

OPTION	DESCRIPTION
OPTION04	Component lead pitch tolerance. Unit is in percentage (%). **Notes:** •Lead pitch tolerance is not a measurement for placement accuracy. It is used as a measurement for component quality. Generally this value is set to **30** •During calibration, this must should be set to 0 (ZERO).
OPTION05	Number of leads that can be found on the side as is indicated at OPTION06. **Note:** When set to 0, no check on lead count is performed  **Here: OPTION05 = 8**
OPTION06	Lead direction: 0: Up 1: Down 2: Left 3: Right **Note:** Only one side is checked. If two sided connectors are used, only the side indicated by OPTION06 will be checked. The other side will be ignored.  **Here: OPTION06 = 0**
OPTION06 to OPTION08	All these options must be set to 0 (ZERO)
OPTION09	Coplanarity deviation display mode (refer also to OPTION17). 0 = Deviation not shown on the vision monitor 1 = Deviation shown on the monitor **Note:** Showing the deviation consumes more processing time and may therefore slow down system performance
OPTION10	This option is not used and should be set to ZERO (0).

NOTE

Starting SBIP software version 2.2. it is possible to support large connectors. It is possible for the connector housing to be located **outside** the processing window. As long as **all** the leads, specified in OPTION05 and OPTION06, are located **within** the processing window.

NOTE Only available with software version 2.2. and higher.

OPTION	DESCRIPTION
OPTION18	Component intake delay time. Unit is in mSec. When the servo system of the CSM needs more time to stabilize itself and therefore can give difficulties when taking images of components, a delay time can be entered in this OPTION.
OPTION19 to OPTION20	These options must contain the value 0 (ZERO).

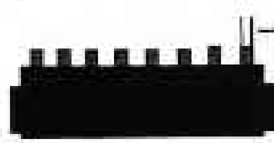
8.3.4.5. Component File Setup: CON

For a descripton on the parameters MODE, CAMERA, OBJECT, BINARY, FILL, CUT, DISPLAY, WINDOW1 and WINDOW4, please refer to section 8.3.1.3.

GO = SHIFT - G

At all times in the connector setup file, the settings can be checked by pressing SHIFT-G (for 'GO'). The results will be shown on the vision monitor.

For CON (connectors), the options have the following meaning:

OPTION	DESCRIPTION
OPTION01	Connector lead width. Unit is in 1/100 mm (0.01mm) Information on connector lead width can be found in the component manufacturer's data sheets.  If lead width = 0.3mm Then OPTION01 = 100 x 0.3 = **30**
OPTION02	Connector lead width tolerance. Unit is in percentage (%). **Notes:** •Lead width tolerance is not a measurement for placement accuracy. It is used as a measurement for connector quality. Generally this value is set to **30** •During calibration, this option must be set to 0 (ZERO)
OPTION03	Connector lead pitch. Unit is in 1/100 mm (0.01mm). Information on component lead pitches can be found in the coonnector manufacturer's data sheets.  Lead pitch = 0.65 mm Then OPTION03 = 100 x 0.65 = **65**