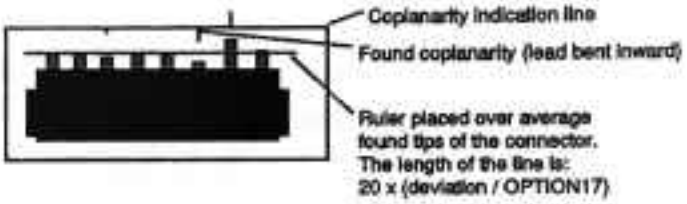
OPTION	DESCRIPTION
OPTION17	Coplanarity check tolerance. Unit is in $^1/_{100}$ mm. Coplanarity check is done by placing a ruler around the tip of the leads (average tip found). In the case of multi-sided connectors, this happens on the side as indicated in OPTION06.  **Notes:** • A graphical presentation will only be shown if OPTION09 is set to 1. • During calibration this option must be set to ZERO
OPTION18	Connector 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 connectors, a delay time can be entered in this OPTION.
OPTION19 to OPTION20	All these options must be set to 0.

NOTE

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

8.3.5. DISPENSE FILE SETUP

With the availability of vision, it is possible to make use of vision feedback system for controlling glue dot sizes.

Notes:
1. *This is only possible when the system is equipped with UFOS - xxDS software and when the fiducial camera is equipped with **white** light, i.e. as with the High Speed Dispenser system.*
2. *xxDS software cannot be used on a CSM60V, CSM84V , CSM84VZ and CSM168V.*

Every time before dots are being supplied to a board, pre-dispense dots can be placed on the PCB. By means of measuring these dot(s) the size of dots can be controlled. Feedback is always done per board. One dot or a group of dots can be used as a feedback reference. Refer to the figure on the next page.

8.4. CALIBRATION

8.4.1. Calibration: Introduction

Fiducials, components and connectors must always be calibrated. This must be done to let the vision system work with a scaling system that belongs with the certain object. This scaling system determines the matrix from which the vision system has to calculate the shifts and rotations. Scaling and shift values are very dependent on camera focus, camera position, camera field of view, camera lighting and component thicknesses. Since the scaling that belongs to a certain fiducial or component cannot be determined during running process, this has to be determined in advance.
To determine this in advance is done by means of the **<CALIB>** utility. How the calibration utility must be used and what the values in the CALIBRATION and SETUP sections of the vision file mean, will be discussed in the following sections.

8.4.2. Calibration: When necessary?

When the following situations occur, calibration is necessary:

IMPORTANT

Fiducial Camera:

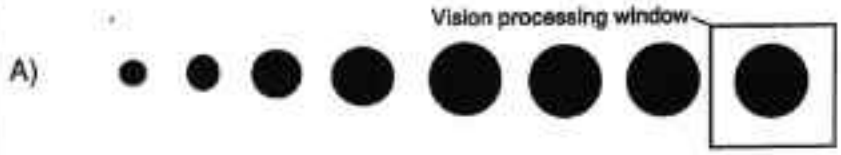
1.	Calibration:	The first time a fiducial is ever calibrated. Normally any new type of fiducial will not change in thickness, only in shape, therefore any new fiducial does not have to be re-calibrated. The existing vision file may be copied. Make sure that the area and perimeter values are updated.
2.	Re-Calibration:	When vision systems change. All fiducial files must then be re-calibrated. Example: Change from VICS1000 to SBIP
3.	Re-Calibration:	When changing from SBIP software version 2.0 (or lower) to software version 2.2 (or higher). All fiducial files must then be re-calibrated. This is necessary because a change is made from square pixel emulation to true pixel scaling.
4.	Re-Calibration:	When the total machine is moved to a new location.
5.	Re-Calibration:	When the fiducial camera is replaced.

IMPORTANT

Component Camera:

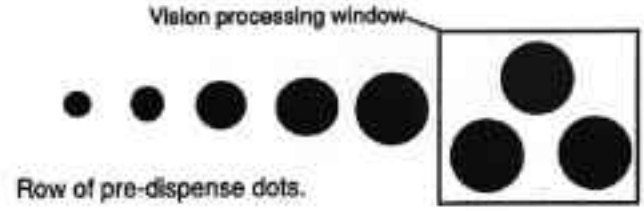
1.	Calibration:	Calibration must be done for **all new** components that will be used. Calibration scale and shift values are very dependent on component thicknesses. It can be that components with the same thickness can use the same calibration file, but it is recommended, for accurate placement reasons, to always calibrate any new component.
2.	Re-Calibration:	When vision systems change. All fiducial files must then be re-calibrated. Example: Change from VICS1000 to SBIP

OPTIÓN	DESCRIPTION
OPTION02	The **minimum** average area of the **sum** of **all** possible dot areas of HEAD1, HEAD2 **and** HEAD3. It must cover the smallest possible measured area of the pre-dispense dot. In general, this option should be set to **10**. Unit in mm^2.
OPTION03	Here the SHAPE code is defined. This is the difference in size of shape beween the circumscribing square relative to a circle (dot). This value is generally set to **355.**
OPTION04	Shape tolerance. This is the amount of deformation of the dot size. Unit is in percentage (%). This parameter is generally set to **10**
OPTION05	**HEAD1** reference area. This depends on the measured area of the pre-dispense dot(s) of HEAD1. Values may lay between **25** and **450.**
OPTION06	**HEAD2** reference area. This depends on the measured area of the pre-dispense dot(s) of HEAD2. Values may lay between **25** and **450.**
OPTION07	**HEAD3** reference area. This depends on the measured area of the pre-dispense dot(s) of HEAD3. Values may lay between **25** and **450.**
OPTION08	**HEAD1** pre-dispensing timer. Unit is in mSec. This parameter is generally set to **30**
OPTION09	**HEAD2** pre-dispensing timer. Unit is in mSec. This parameter is generally set to **30**
OPTION10	**HEAD3** pre-dispensing timer. Unit is in mSec. This parameter is generally set to **30**
OPTION11	The minimum number of objects that can be found in the WINDOW1. The minimum number is **always** 1 and the maximum number of dots allowed in WINDOW1 is **10.** The number of dots inside the processing window **must** be within this range.
OPTION12 to OPTION17	All these options are not used and should be set to 0 (ZERO).
OPTION18	Dispense dote 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 dispense dots, a delay time can be entered in this OPTION.
OPTION19 to OPTION20	All these options are not used and must be set to 0 (ZERO)



Row of pre-dispense dots.

Use this dot as a reference for the vision feedback system



Row of pre-dispense dots.

To make the feedback system not dependent on just one dot, a group of dots can be used. The **average size** of this group will act as a reference dot.

Only vison file number 30 can be used for dispense vision feedback control.

NO.	FILE NAME
0.	PCB 1
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.	BADMARK
.	
.	
[redacted]	<==

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

Note: *In most cases a glue dot is not reflective, therefore the object is **black**. However, when lighting system or glue type changes, this must be checked.*

(GO) = SHIFT - G

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

For DISP (dispense), the options have the following meaning:

OPTION	DESCRIPTION
OPTION01	The **maximum** average area of the **sum** of **all** possible dot areas of HEAD1, HEAD2 **and** HEAD3. It must cover the largest possible measured area of the pre-dispense dot. In general, this option should be set to **500**. Unit is in mm^2

3. Re-Calibration: When vision systems change. All component files must be re-calibrated.
Example: Change from VICS1000 to SBIP

4. Re-Calibration: When the total machine is moved to a new location. All component files must be re-calibrated.

5. Re-Calibration: When the component camera is replaced. All component files must be re-calibrated.

6. Re-Calibration: When any camera setting like aperture, field of view or focus is changed. All component files must be re-calibrated.

7. Re-Calibration: When the vision head (head3) is replaced. All component files must be re-calibrated.

8.4.3. Calibration: Requirements

For reliable and accurate placement it is very important that calibration is done under optimum conditions.

IMPORTANT

Fiducial calibration requirements:
Before calibration of fiducials is performed, the following requirements are necessary:
1. Good board positioning and correctly adjusted locating pins
2. No board warp at fiducial location.
3. Clean, good recognisable fiducial. Take the most perfect fiducial.
4. Well focussed fiducial camera. (Refer to section 8.2.2.2.).

IMPORTANT

Component (and connector) calibration requirements:
Before calibration of components and connectors, the following requirements are necessary:
1. Correct component camera setup (refer to section 8.2.3. and onward).
   - Field of View (focus)
   - Aperture

   The component camera settings are now fixed and should not be changed.
2. Range of used components must meet camera requirements. If not, more fixed camera's must be used.
3. Use of CAD data.
4. The components and/or connectors which will be used must be in **perfect** shape. Manual exposure should be avoided. Since calibration requires 4 components (mounting at 4 angles), 4 perfect components are at least required.
5. When entering component specifications, enter those given by the manufacturer of the component.
6. Center of the camera must be taught as precisely as possible.
7. Make sure the the Veritcal size (V-SIZE) and Horizontal Size (H-SIZE) of the monitor are set correctly. The whole picture must be visible on the vision monitor. (V-Size and H-Size knobs are usually found at the rear of the monitor).
6. Use of a calculator. This is considered much more accurate and time efficient.

Use perfect components.

When any of these requirements are not met, correct calibration cannot be guaranteed.

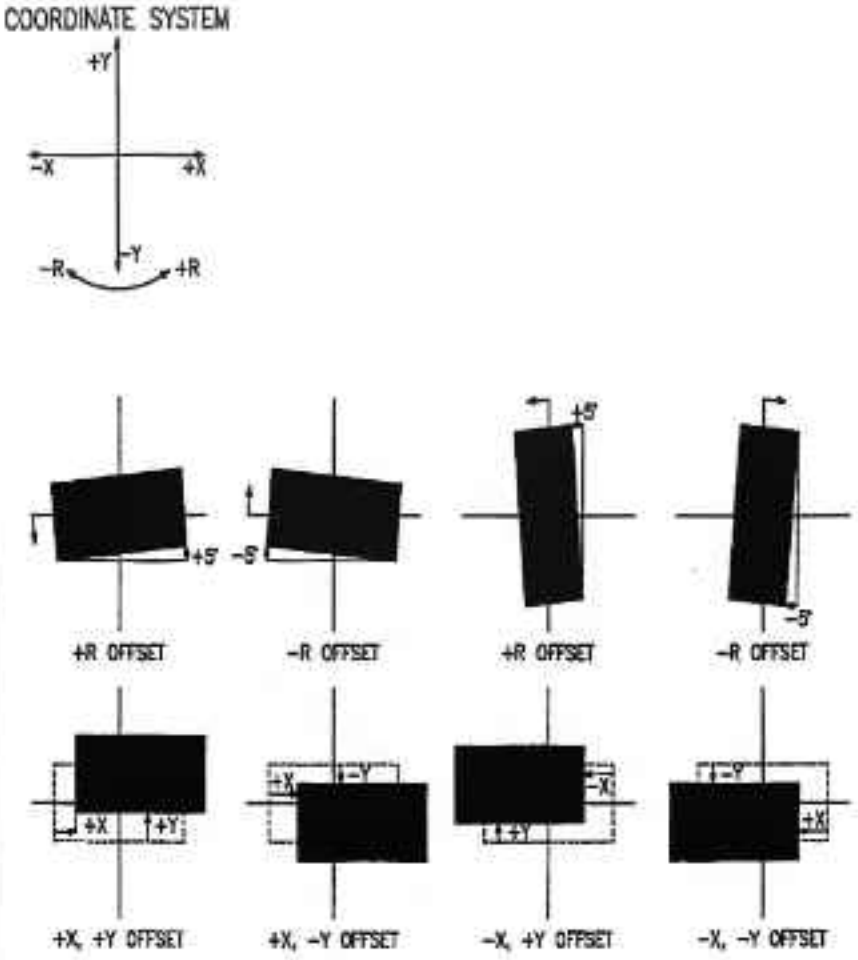


Fig. 8.4.5. Component orientation after mounting.

- When the component is rotated clockwise, the offset rotation is negative.
- When the component is rotated anti-clockwise, the offset rotation is positive.
- When the component is mounted too high, the shift offset is +Y
- When the component is mounted too low, the shift offset is -Y
- When the component is mounted too far to the right, the shift offset is +X
- When the component is mounted too far to the left, the shift offset is -X

Calibration Procedure:

INIT CALIBRATION

- INIT CALIBRATION OF A COMPONENT -

Step 1: Execute the <CALIB> utility and choose at 'INPUT PART NUMBER' the correct part that needs to be calibrated.

TIP

For the first component ever to be calibrated, a QFP100 is recommended.

Step 2: At the question: INIT ADJUSTING or FINE ADJUSTING, choose INIT ADJUSTING = **0**

NOTE:

SBIP v2.0. and lower

Very important after calibration are the found scale values. The scale values represent if the camera sees exactly what it is supposed to see. The scale value is not a fixed value, but the scale X/Y ratio should always be the following:

If the SBIP software version is 2.0. or lower, the X/Y ratio of the scale must be:

1.01 ± 0.05

SBIP v2.2. and higher

If the SBIP software version is 2.2. or higher, the X/Y ratio of the scale must be:

1.203 ± 0.05

The Shift values must always be in the area of:

X Shift: -2.10 ≈ -2.80
Y Shift: 2.10 ≈ 2.80
R Rotation: 0.00 ≈ 0.40

Incorrect scale and shift values after calibration will result into incorrect placement of components. If the values are not near to the values mentioned above, then check if all adjustments, settings and requirements are correct and calibrate the fiducial again.

8.4.5. CALIBRATION: COMPONENT CALIBRATION

Before calibration of components and/or connectors is performed, it must be sure that the requirements of section 8.4.3. are met.

Component calibration exists of two parts. The CSM exists of an XY coordinate system and the component camera exists of an XY coordinate system. During component calibration it is necessary to match both these coordinate systems. This can be done by correcting the head3 offset. However, this can only be done **once** (be aware that the Head3 offset is a machine parameter).
The calibration procedure that will be described below shows that during the calibration of the very first component the head3 offset will be changed. Any new component calibrated after this may not change this head offset anymore.

IMPORTANT

When the Head3 offset is changed, critical positions that are used by this head must be taught again. This is especially true for the Automatic Nozzle Exchange station positions. Incorrect taught positions may cause damage to the VANE head.

TIP

For a very first component ever to be calibrated, a QFP100 type of component is recommended.

During calibration, the component will be mounted on the board. By means of the fiducial camera it must be determined if the component has been mounted with a shift in X and/or Y direction and if there is any rotation.

When looking at the vision monitor it can be seen what the shift and rotation direction is. This is shown in figure 8.4.5. This orientation is a reference that will be used during the whole calibration procedure.

STEP 5: - When the <CALIB> utility is started, the following questions will appear.

- INPUT PART NUMBER -> **0** (input 0 for fiducial)
  0 MEANS FIDUCIAL
- INPUT FIDUCIAL NUMBER - > **0** (input the fiducial number specified in the board file)
- STROKE = 15 (0.1mm)
  INPUT STROKE TO MODIFY - > **0**
  INPUT 0 if OK

  Note: *Fiducials must have a clearance of 2mm surrounding the fiducial. When the window is set large enough, a stroke of 15 is sufficient. A too small stroke may cause difficulties during calibration. The stroke must be set to a value ≥ 10.*

IMPORTANT

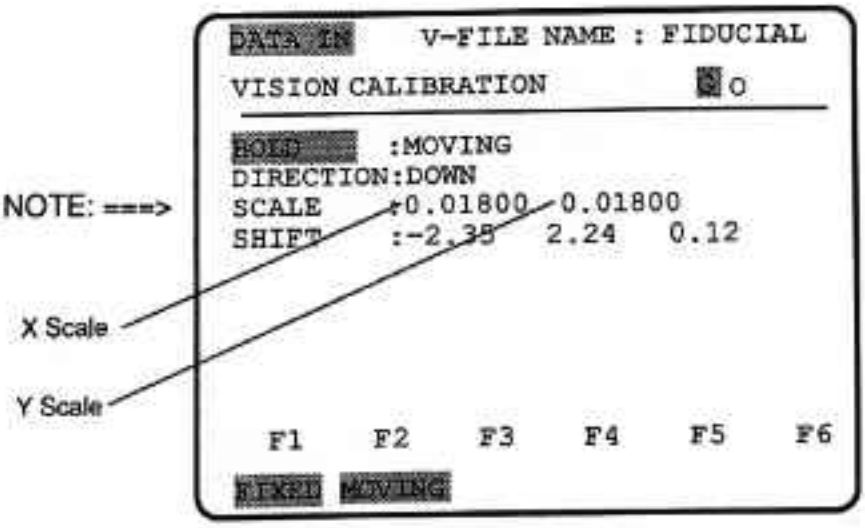
- TEACH CENTER POSITION
  ON READY PUSH RUN KEY (set the camera center to the middle of the fiducial)

STEP 6: When pushing the RUN key after the last question the calibration utility will start the calibration process. The calibration utility will always give a result OK. Nevertheless, it should always be checked that the fiducial will **never** touch or leave the processing window. If this occurs, the calibration values will be incorrect.

STEP 7: To check if calibration was successful, the following check must **always** be preformed.
Go to the fiducial file of the fiducial that was calibrated and choose:
2. CALIBRATION. The screen will look like the following:

SEE NOTE: ===>

Example Only.
(SBIP v2.0.)



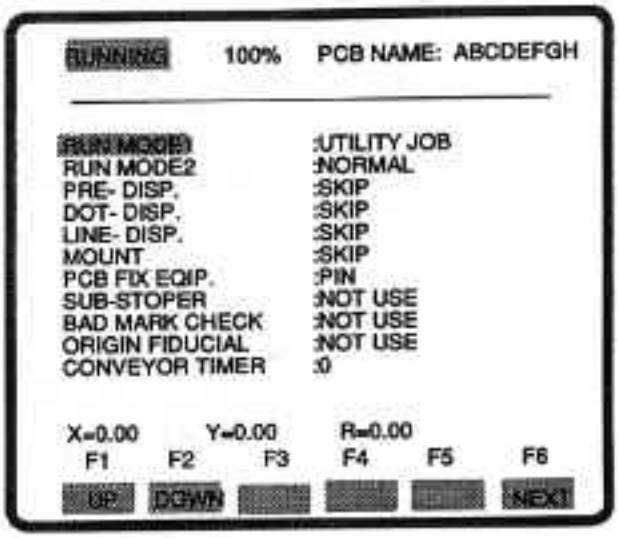
8.4.4. Calibration: Fiducial Calibration.

Before starting fiducial calibration, it must be made sure that the requirements, mentioned in section 8.4.3. are met and that the fiducial file is set up correctly. When the PCB is positioned and the fiducial camera is above the fiducial that must be calibrated then the following steps must be taken.

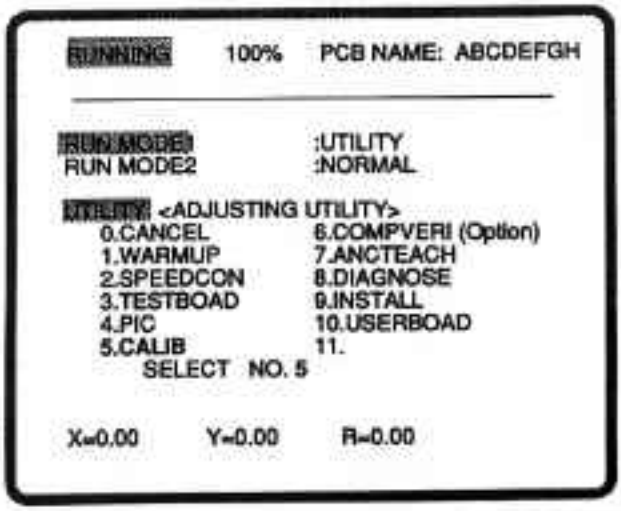
STEP 1: From the Main Menu. Choose: 1. RUNNING

STEP 2: From the Board selection menu (of RUNNING), choose the board that will be used for the calibration process (e.g. Acceptance board) and press <F6> . (USE A BOARD WITH **CAD DATA** ONLY)

STEP 3: In the RUNNING menu, select for RUN MODE1: 'UTILITY JOB' and press the <RUN> key.



STEP 4: In the UTILITY menu, choose: 5. CALIB by entering the number: **5**. After selecting this number, press the ENTER key: ⏎



Step 17: Check with the fiducial camera the component and measure the shift found in X and Y direction at the mount angles 0° **and** 180° (for component orientation, refer to figure 8.4.5.).

Note: *There should be no more rotation. This was corrected in steps 1 to 15.*

Step 18: Execute again the <CALIB> utility and choose 'FINE CALIBRATION'

Step 19: The shift offsets that were measured at step 17 must be entered in FINE CALIBRATION on the following way:

0° =	$X=X.XX^{0°}$	$Y=Y.YY^{0°}$	R= **0.00**
180°=	$X=X.XX^{180°}$	$Y=Y.YY^{180°}$	R= **0.00**

Where :

- $X.XX^{0°}$ = The X shift value measured with the component mounted at 0°
- $Y.YY^{0°}$ = The Y shift value measured with the component mounted at 0°
- $X.XX^{180°}$ = The X shift value measured with the component mounted at 180°
- $X.XX^{180°}$ = The Y shift value measured with the component mounted at 180°

Note: *The Rotation values must be 0 otherwise the corrections made in steps 1 to 15 will be lost.*

Step 20: In the next step the 'FINE CALIBRATION' utility will ask if the HEAD OFFSET must be change. When calibrating a component for the VERY FIRST TIME on a machine, this answer should be **YES.** Any other new component calibrated after this very first component should answer here: **NO.**

VERY FIRST COMPONENT

- CHANGE HEAD OFFSET? (choose **YES**)
  YES = 0
  NO = OTHER

ANY NEW or NEXT COMPONENT

- CHANGE HEAD OFFSET? (choose **NO**)
  YES = 0
  NO = OTHER

IMPORTANT

When at CHANGE HEAD OFFSET, 'YES' was chosen, make sure that the positions of the Automatic Nozzle Station are re-taught. Incorrect settings of this station may cause damage to the HEAD3.

Step 21: Go back to the running program and mount the component again at the 0° **and** 180° mount angle. Measure the component shift again, at both angles, by means of the fiducial camera.
Repeat steps 16 to 21 until there is **no shift** visible when mounting at 0° **and** 180° mount angle.

As long as it remains the first component ever to be calibrated, then in step 20 'YES' must always be chosen to change the head3 offset.

Step 8: In the next step the 'FINE CALIBRATION' utility will ask if the HEAD OFFSET must be change. When correcting the 0° rotation angle always enter at this question: **NO**

- CHANGE HEAD OFFSET? (choose NO)
  YES = 0
  NO = OTHER

Step 9: Go back to the running program and mount the component again at an angle of 0°. Measure the component rotation again by means of the fiducial camera.
Repeat steps 5 to 9 until there is **no rotation** visible when mounting at 0°.

CORRECT 180° MOUNT ANGLE ROTATION

- - Correct Mount angle at 180° -

Step 10: Mount the component at 180° **only** and just after mounting press the <STOP> key.

Step 11: Check with the fiducial camera the component and measure the rotation (for component orientation, refer to figure 8.4.5.).

Do not measure the X and/or Y shift. First the rotation must be corrected.

Step 12: Execute again the <CALIB> utility and choose 'FINE CALIBRATION'

Step 13: The rotation offset that was measured at step 11 must be entered in FINE CALIBRATION on the following way:

0° =	X=**0.00**	Y= **0.00**	R= **0.00**
180°=	X=**0.00**	Y= **0.00**	R= [R.RR]

Where [R.RR] is:
QFP, SOP and PLCC: If the measued offset was +R.RR°, then enter the +R.RR° value (for a found -R.RR°, then enter the -R.RR° value).

Step 14: In the next step the 'FINE CALIBRATION' utility will ask if the HEAD OFFSET must be change. When correcting the 180° rotation angle always enter at this question: **NO**

- CHANGE HEAD OFFSET? (choose NO)
  YES = 0
  NO = OTHER

Step 15: Go back to the running program and mount the component again at an angle of 180°. Measure the component rotation again by means of the fiducial camera.
Repeat steps 10 to 15 until there is **no rotation** visible when mounting at 180°.

CORRECT X and Y SHIFT

- Correct the (machine) X and Y shift -

Step 16: After there is no rotation at a mount angle of 0° and 180° the X and Y shift can be corrected. If this is the very first component on the machine ever to be calibrated also the machine head3 offset must be adjusted.
Go to the running program and mount the component at 0° **and** 180°

To find out if the calibration was successful can be done by checking the scale values that were found during calibration. The <CALIB> utility will enter these in the 2. CALIBRATION screen. It is very important that the camera sees the component as it should see the component. The scale values are very much dependant on the thickness of the component, this is not a problem as long as the X/Y ratio of the scale is in the following range:

IMPORTANT

X/Y Ration: **1.203 ± 0.005**

If this is **not** the case, mounting components accurate will not be possible. When the scale ratio is not 1.20 the following may have occured:

NOTE

Calibration should be run at full speed.

- Apeature setting of the camera is not correct (overexposed)
- Oil or Moist dripping out of the nozzle tip causing the component to slip.
- Component touched or exceeded the processing window during calibration.
- Wrong choice of nozzles (too small nozzle for a too large component or visa versa).

Make sure that all items are set correctly and try calibrating again. Go back to step 1.

CORRECT 0° MOUNT ANGLE NOTATION

- Correct Mount angle at 0° -

Step 5: If calibration was successful. Take an acceptance board and mount the component at an angle of 0° **only.** Just after the program has mounted the component press the <STOP> key.

Step 6: Check with the fiducial camera the component and measure the rotation (for component orientation, refer to figure 8.4.5.).

Do not measure the X and/or Y shift. First the rotation must be corrected.

Step 7: Execute again the <CALIB> utility and choose 'FINE CALIBRATION'

Step 8: The rotation offset that was measured at step 6 must be entered in FINE CALIBRATION on the following way:

0° =	X=**0.00**	Y= **0.00**	R= [R.RR]
180°=	X=**0.00**	Y= **0.00**	R= **0.00**

Where [R.RR] is:

SBIP v2.0. and lower

Note:

QFP and SOP: If the measured offset was +R.RR°, then enter the -R.RR° value (and visa versa: -R.RR° becomes +R.RR°)

PLCC: If the measured offset was +R.RR°, then enter the -½R.RR° value (and visa versa: -R.RR° becomes +½R.RR°)

SBIP v.2.2. and higher

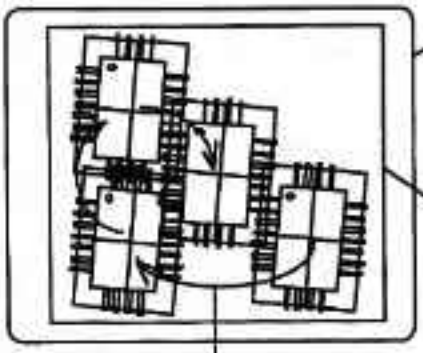
Note:

QFP, SOP and PLCC: If the measued offset was +R.RR°, then enter the +R.RR° value (for a found -R.RR°, the enter the -R.RR° value).

Step 3: After pressing <ENTER > at step 2, the system will start with the process in calibrating the component. A stroke of 50 should be sufficient. When 50 is too much. Use any value bigger than 20. A stroke smaller than 20 maynot be used.
The following screen may appear as well:

- CAN THIS PART BE STANDARD?
  answer Yes if the part is perfect.
- TEACH CENTER POSITION
  ON READY PUSH RUN KEY
  set the component in the center of the screen and press <RUN>

The system will start calibrating the component. During calibration it must be made sure that the component never touches the processing window or leaves the processing window (stroke is too large).



During calibration, the component must move freely within the processing window without touching or leaving this window.

Step 4: After the message 'CALIBRATION OK' is displayed it must be checked if the calibration really has been performed correctly. The <CALIB> program must be exitted and you should go to the vision file of the component that was just calibrated and the scale values in the 2. CALIBRATION must be checked:

Example Only

SEE NOTE: ===>

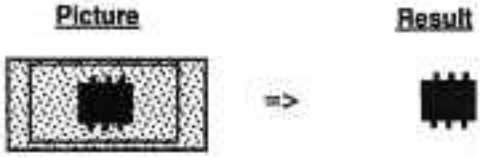
```
DATA IN      V-FILE NAME : QFP100
VISION CALIBRATION          0
HOLD        :FIXED
DIRECTION:UP
SCALE       :0.10812  0.09010
SHIFT       :234.95  612.70  179.99

  F1    F2    F3    F4    F5    F6
FIXED MOVING
```

X Scale

Y Scale

8.4.6.2. Diffusing plate: Running Mode

In running mode, when the BINARY parameter is set to 'AUTO', it should be avoided that three objects are found during the vision process. This will disturb the vision process. Therefore, in running mode, the processing window should reside within the diffusing plate. For all components that can be picked by the small nozzle, this can be realized. An example is given in figure 8.4.6.2.



NOTE

When using multirecognition and the component is shown in a different angle than in which the component was calibrated, then a manually set threshold level for the BINARY parameter is inevitable.

8.4.6.3. Diffusing Plate: Calibration

Running calibration with the BINARY parameter is set to AUTO will generally result in problems in recognizing the component. In the third pass of calibration, the component is shown with a rotation of 90°. This means that the processing window, during calibration, must be set large enough to handle the stroke and rotation of the component. This cannot be done without creating the error as described in section 8.4.6.1.

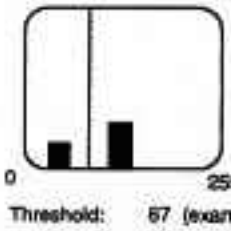
To calibrate successfully a component that uses the small nozzle with diffusing plate, a step by step procedure is given below:

Step 1: Bring the component, that needs to be calibrated, with the small nozzle above the (correct) camera.

Step 2: In UFOS, go to the vision file of the component.

Step 3: In the SETUP menu of the vision file, set the WINDOW 1 size in such a way around the component that it resides within the diffusing plate. Make sure all settings for that component are correct and set the BINARY parameter to 'AUTO'.

Step 4: Go to the TEST menu of the vision file an make a histogram of this setting. On the bottom of the histogram the automatic threshold value is displayed.



It can be seen in the figure 8.4.6.1.1. that there are three objects within the processing window: One object is the background, one object is the diffusing plate and one object is the component. From three objects, the vision system has to choose an automatic threshold level. The vision system, during scanning, tries to find an edge where the threshold levels, at least by a threshold difference of 40, differ from each other and then determines where to set the automatic threshold level. Most of the times, when the processing window is set to large, the following can be seen in a histogram:

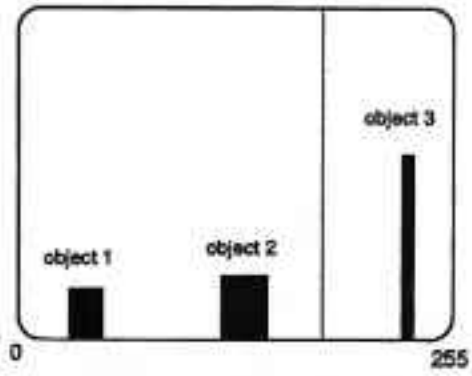


Fig. 8.4.6.1.2. Where to set threshold level

In figure 8.4.6.1.2. you find that the vision system sets its automatic threshold level between the second and third object. If it is known that a threshold of 0 is black and a threshold level of 255 is white, then the first object (near to black) is the component, the second object is the diffusor plate and the third object is the background. Since there are three objects, vision cannot decide where to set the threshold level and it takes the first edge it can find and that is between the background and the diffusing plate. This is between the second and third object. The result is that only the diffusing plate is found as an object. See figures below:

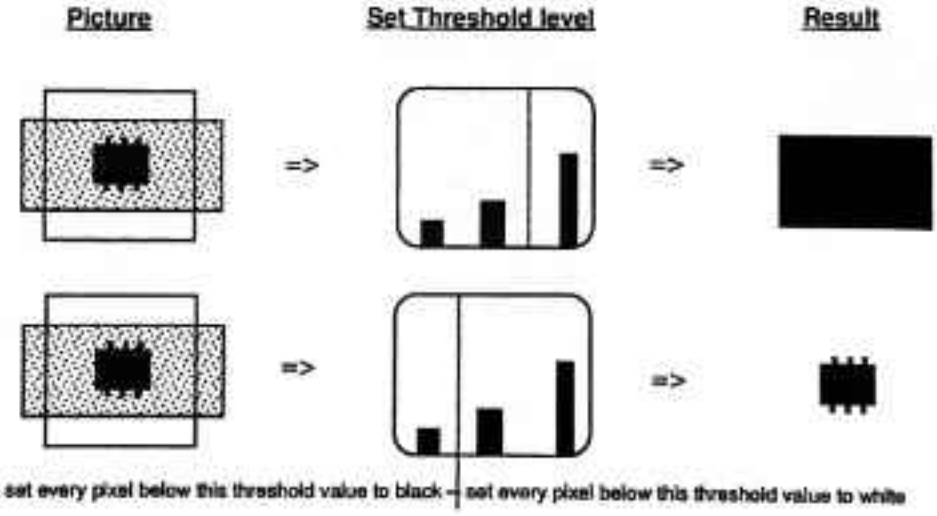


Fig. 8.4.6.1.3. Result of setting a good or wrong set threshold level

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8.4.6. Using the diffusing plate

The nozzle shaft of the VANE is larger than a number of components that can be handled by the small nozzle. The shadow of this nozzle can influence the recognition of the component. In order to solve this, the diffussing plate is attached to the small nozzle to eliminate this shadow effect.

During calibration or during running, the use of this diffusor plate can give problems if it is not properly used. This can occur when the BINARY parameter is set to 'AUTO'.

On how to handle the diffusing plate during calibration and in running mode is described in the following sections.

8.4.6.1. Diffusing plate: Determining the threshold

Some basic vision principles are written briefly described below:

1. When searching for the component, the vision system tries to find one component object that can differentiate itself from the background.

2. During scanning (or after scanning) the vision system has to differentiate the foreground from the background by determining a automatic threshold level

3. If the vision system finds two objects (a fore- and background object), then the vision system sets a threshold level and the final picture will result in all pixels below the set threshold level to turn black and all pixels above the threshold level to turn white. This will give a clear black/white picture which the vision system can work with.

In the case of the diffusor plate the following will happen:

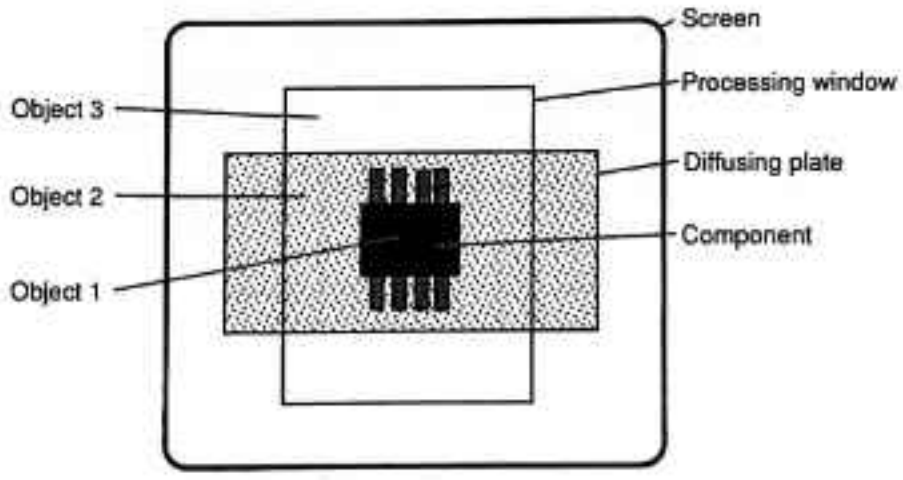

Fig. 8.4.6.1.1. Diffusing plate

- - Correct Mount angle at 90° and -90° -

Step 22: Mount the component at 90° **and** -90° and just after mounting press the <STOP> key.

Step 21: Check with the fiducial camera the component and measure the rotation at both angles (for component orientation, refer to figure 8.4.5.).

IMPORTANT

There should be no X and Y shift anymore as this was corrected in steps 16 to 21. If there is still a X and/or Y shift, then this means that the very first calibration was not done correctly.

Step 23: Execute again the <CALIB> utility and choose 'FINE CALIBRATION'

Step 24: The rotation offsets that were measured at step 21 must be entered in FINE CALIBRATION on the following way:

90° =	X=**0.00**	Y= **0.00**	R= [R.RR$^{90°}$]
-90°=	X=**0.00**	Y= **0.00**	R= [R.RR$^{-90°}$]

Where :

R.RR$^{90°}$ = The rotation offset measured with the component mounted at 90°

R.RR$^{-90°}$ = The rotation offset measured with the component mounted at -90°

*The shift values must be **0** otherwise the shift corrections made in steps 16 to 21 will be lost.*

NOTE:

Step 25: In the next step the 'FINE CALIBRATION' utility will ask if the HEAD OFFSET must be change. When correcting the 90° and -90° rotation angle always enter at this question: **NO**

- CHANGE HEAD OFFSET? (choose **NO**)
  YES = 0
  NO = OTHER

Step 26: Go back to the running program and mount the component again at a 90° and -90° mounting angle. Measure the component rotation(s) again by means of the fiducial camera.
Repeat steps 22 to 26 until there is **no rotation** visible when mounting at 90° and -90°.

304.8 (1) **No object.**

No object found with video scan routine. There has been a failure in determining the centre position of the object from where the calculation of the position of the corners starts. This could be caused by a bad contrastbetween the component and it's background.

304.8 (2) **Inconsistent corners found**

During detecting a PLCC component one or more corners were found on an unexpected location. This can be a result of a too large processing window causing a detection of too many points.

304.9 **Crosshair not perpendicular**

After detection of a PLCC component it was found that the crosshair, that is determined after finding the four corners, is not perpendicular. The criteria of this error is when the two crosshair lines have an angle of 5° or more towards each other.

304.10 **Divide by zero.**

This error occurs in the video scan routine if the lines through the points are wrong. This could be caused by a bad contrastbetween the component and it's background.

304. 15 **No object.**

No object found with video scan routine. The error occurs when there is afailure in determining the left or right side of a component. This could becaused by a bad contrast between the component and it's background.

304. 16 **No object.**

No object found with video scan routine. The error occurs when there is afailure in determining the top or bottom side of a component. This could be caused by a bad contrast between the component and it's background.

320.1 **Top lead detect error.**

Occurs if the number of edges of the top leads of a QFP is not even. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

320.2 **Left lead detect error.**

Occurs if the number of edges of the left leads of a QFP is not even. Thiserror can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

301.6 Number overflow.

If the correlators are used for rough measurement, this error occurs when, after a reduction of the recognitions, the number of recognitions is bigger then four. The corners searched for, are the top right and bottom left corner. This error can occur when a wrong thrashold is selected or when the reflecting plate is not totally in the window.

301.7 Number overflow.

If the correlators are used for rough measurement of a PLCC, this error occurs when, after a reduction of the recognitions, the number of recognitions is bigger then four. This error can occur when a wrong threshold is selected or when the reflecting plate is not totally in the window.

304. Divide by zero.

This error should never occur.

Object detect error

The CON(nector)(could not be found. This error can occur when the connector is in the window or attached to the nozzle.

304.1 No recognitions.

If the correlators are used for rough measurement, this error occurs when, after a reduction of the recognitions, the number of recognitions is zero. The corners searched for, are the top left and bottom right corner. This error can occur when a wrong threshold or wrong mode is selected or when the quality of the image is very bad due to the light.

304.2 Object detect error.

If the correlators are used for rough measurement, this error occurs when,after a reduction of the recognitions, the number of recognitions is smaller then three. The corners searched for are, the top right and bottom left corner. This error can occur when a wrong threshold or wrong mode isselected or when the quality of the image is very bad due to the light.

304.4 Object detect error.

If the correlators are used for rough measurement of a PLCC, this error occurs when, after a reduction of the recognitions, the number of recognitions is smaller then three. This error can occur when a wrong threshold or wrong mode is selected or when the quality of the image is very bad due to the light.

304.5 No object.

The positions found by the correlator are wrong. This could be caused by a wrong threshold, a bad image, or a wrong mode.

8.5. OTHER POINTS TO NOTE

1) Do not handle any of the cameras, especially the movable camera, carelessly. This can cause offset in the calibration, making precise mounting impossible.

2) The aperture and focus of the fixed camera lens can be changed. Adjustment has been made with the focus turned all the way to 0.3m or less, so please do not move it.

   Movable cameras do not have apertures, so the brightness must be adjusted using the appropriate knob.

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3) Replace the fluorescent lamp when a noticeable deterioration of the brightness occurs. The lamp should last about 1500 hours.

4) If, during running the parts are always having an offset in the same direction, then the head offsets have changed, or the fiducial scale factors are not set correctly. A wrong PCB block origin may also be the cause.

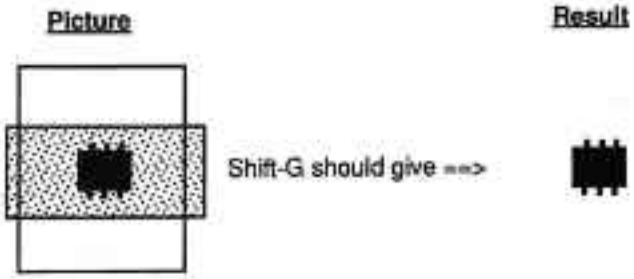
5) If, during running, the mount position varies a lot it can be due to a loose camera lens (fiducial and/or component camera) or due to a rattling arm or loose belt. Wrong calibration scales, due to wrong camera adjustments, may also cause this trouble.

8.6. ERROR CODES

Error Code	Description
301.3	**Recognitions overflow.** If the correlators are used for rough measurement, this error occurs when there are very much recognitions. The corners searched for, are the top left and bottom right corner. This error can occur when a wrong threshold is selected or when the reflecting plate is not totally in the window.
301.4	**RTR overflow.** If the correlators are used for rough measurement, this error occurs when, after a reduction of the recognitions, the number of recognitions is bigger then two. The corners searched for, are the top left and bottom right corner. This error can occur when a wrong threshold is selected or when the reflecting plate is not totally in the window.
301.5	**Recognitions overflow.** If the correlators are used for rough measurement, this error occurs whenthere are very much recognitions. The corners searched for, are the topright and bottom left corner. This error can occur when a wrong hreshold is selected or when the reflecting plate is not totally in the window.

Step 5: The threshold level determined by the histogram can be used as an input for the BINARY parameter in the SETUP menu.
Go to the SETUP menu and set the BINARY parameter to 'MANUAL'. Set this manual threshold level to the value found with the histogram.
Test with SHIFT-G (GO) if the component really can be recognized. If, for some reason, it cannot be detected, set the manual threshold to a correct value (this will be around the value that was found in the histogram).

Step 6: Now set the WINDOW1 parameter large enough so that the component can be calibrated. Test with SHIFT-G (GO) for correct detection of the component.



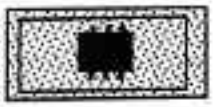
Step 7: Run the CALIB utility to calibrate the component. Because, for calibration, the BINARY parameter was set to 'MANUAL(..), the threshold level for the three objects is set between the correct two objects (component and diffusing plate).

Back to running mode

Step 8: If the calibration process is completed successful (process is described in section 8.4.5.) then go back to the vision file to set back the original values, so that the component can be recognized during normal running process:

Step 9: Go to the SETUP menu of the vision file and set the BINARY parameter back to AUTO.

Step 10: In the same SETUP menu, set the WINDOW 1 value in such a way that it resides within the diffusing plate.



The system, with this component, can be now used in running mode.

331.3 **Lead detect error.**

If no check on the number of leads is selected, this error occurs when no leads are detected at one of the sides of a horizontal positioned SO. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big.

331.4 **Divide by zero.**

Should never occur.

331.5 **Lead detect error.**

If no check on the number of leads is selected, this error occurs when no leads are detected at one of the sides of a horizontal positioned SO. Thiserror can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big.

331.6 **Divide by zero.**

Should never occur.

332 **Incorrect number of leads found**

The number of leads found during vision recognition, in CON(nector) mode does not match the number specified in OPTION05.

332.3 **Lead number error.**

Occurs if the number of left or right leads of a QFP is not equal to the number given in the vision file. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big.

332.4 **Lead number error.**

Occurs if the number of top or bottom leads of a QFP is not equal to the number given in the vision file. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

332.5 **Lead number error.**

Occurs if the number of leads of a horizontal positioned SO is not equal tothe number given in the vision file. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

332.6 **Lead number error.**

Occurs if the number of leads of a vertical positioned SO is not equal to the number given in the vision file. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

330.1.E2 **No object of this size**

Advanced fiducial algorithm: The size of the objectdoes not match the values entered in OPTION07 and OPTION08. Change OPTION07 and OPTION08.

330.1.E3 **Multiple candidate objects**

Advanced fiducial algorithm: More than on e object is found inside the processing window.

330.1.E4 **No free space**

At least 1mm free of other objects in all directions. Change the window size, it was probably too small.

330.1.E5 **Horizontal size wrong**

Advanced fiducial algorithm: The measured size is outside the tolerance value. Change OPTION08 and OPTION02

330.1.E6 **Vertical size wrong**

Advanced fiducial algorithm: The measured size is outside the tolerance value. Change OPTION07 and OPTION02

330.4 **Object detect error**

The QUAD (PLCC) component was not found. This error can occur when the PLCC is not in the window or when it is not attached to the nozzle.

321 **Lead pitch too small / too large**

The value entered in OPTION03 In CON(nector) mode does not match the measured value.

Cumulative lead pitch too small / too large

The value entered in OPTION15, in CON(nector) mode does not match the measured value.

Coplanarity error

A lead is bent more than the tolerance that is specified in OPTION17, in CON(nector) mode. When using TEST0 as display mode, it can be determined which lead is bent.

331 **Lead detect error**

If no check on the number of leads is selected, this error occurs when no leads are detected at one of the sides of a connector.

321.10 **Pin width error.**

Occurs if the width of one of the bottomleads of a horizontal positioned SO is not between the value & tolerance given in the vision file.

321.11 **Lead pitch error.**

Occurs if the pitch of one of the bottomleads of a horizontal positioned SO is not between the value & tolerance given in the vision file.

321.12 **Pin width error.**

Occurs if the width of one of the leftleads of a vertical positioned SO is not between the value & tolerance given in the vision file.

321.13 **Lead pitch error.**

Occurs if the pitch of one of the leftleads of a vertical positioned SO is not between the value & tolerance given in the vision file.

321.14 **Pin width error.**

Occurs if the width of one of the rightleads of a vertical positioned SO is not
between the value & tolerance given in the vision file.

321.15 **Lead pitch error.**
Occurs if the pitch of one of the rightleads of a vertical positioned SO is not between the value & tolerance given in the vision file.

330 **Area Error**

QUAD mode: The area value entered in OPTION01 does not match the measured value.

Perimeter Error

QUAD mode: The perimeter value entered in OPTION03 does not match the measured value.

330.1 **Object detect error.**

The fiducial is not found. This error can occur when the fiducial is not in the window, or when the quality of the fiducial is very bad.

Default FAIL

During advanced fiducial algorithm, an unknown error occured.

330.1.E1 **0 or too many objects**

Advanced fiducial algorthm: When zero (0), the object is too close to the boundaries of the processing window or there are too many clusters inside the processing window. Increase the size of the window or clean up the PCB which is visible inside the window area.

320.3 Right lead detect error.

Occurs if the number of edges of the right leads of a QFP is not even. This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

320.4 Bottom lead detect error.

Occurs if the number of edges of the bottom leads of a QFP is not even.This error can occur if the distance between the body of the component and the ruler selected with option 7 in the vision file, is to big or when there is bad contrast between the component and it's background.

321.1 Top lead pitch error.

Occurs if the pitch of one of the top leads of a QFP is not between the value & tolerance given in the vision file.

321.2 Left lead pitch error.

Occurs if the pitch of one of the left leads of a QFP is not between the value & tolerance given in the vision file.

321.3 Right lead pitch error.

Occurs if the pitch of one of the right leads of a QFP is not between the value & tolerance given in the vision file.

321.4 Bottom lead pitch error.

Occurs if the pitch of one of the bottom leads of a QFP is not between the value & tolerance given in the vision file.

321.5 Pin width error.

Occurs if the width of one of the bottom leads of a QFP is not between the value & tolerance given in the vision file.

320.6 Lead Detect error

If no check on the number of leads is selected, this error occurs when no leads are detected at on of the sides of a QFP. This error can occor if the distance between the body of the component and the ruler selected with option 7 in the vision file is too big.

321.8 Pin width error.

Occurs if the width of one of the topleads of a horizontal positioned SO is not between the value & tolerance given in the vision file.

321.9 Lead pitch error.

Occurs if the pitch of one of the topleads of a horizontal positioned SO is not between the value & tolerance given in the vision file.

9.2.3. Fiducial Recognition: Calibration

At delivery time the CSM is equipped with a fiducial file (file 0). If new fiducial files are needed (different style/form) it is only needed to copy the existing file to a new location and then change the specific parameters.

If, for some reason, the CSM has no fiducial file, then input the scale of the camera and the position of the camera relative to the teaching unit head (shift along the X and Y axes, and the amount of rotation). Then start the <CALIB> utility program (refer to section 8.4. in the SBIP: Enhanced vision system).

The calibration settings and numeric values are different for each machine. These settings are adjusted shen the equipment leaves the factory, therefore, in most cases, there is no need to change them.

CAUTION:

When the movable camera is removed or when the height of the movable camera is adjusted, or also in the case when the lens of the movable camera is removed or adjusted, ALL settings will need to be readjusted. This is because the movable camera is defined as the machine teaching unit. If re-calibration in this case is not performed, or when the calibration is not correct, it will be impossible to mount components accurately.

The calibration parameters or outcome of the calibration utility can be found in the following screen:

DATA IN - VISION - CALIBRATION

LABEL	SET LABEL	REMARKS
HOLD	MOVING	Selects movable vision camer nr. 1
DIRECTION	DOWN	Camera 1 is facing downwards
SCALE	X: 0.008 ~ 0.012 Y: 0.008 ~ 0.012	Changes depending of the type of lens and the focus position
SHIFT	X: -2.67 ~ -1.83 Y: 1.72 ~ 2.47 R: -2.00 ~ 2.00	Changes depend on the SCALE setting

IMPORTANT:
After fiducial calibration, the X/Y scale ratio must be 1.

9.2.4. Fiducial Recognition: Test

Testing the recognition of a fiducial is done in the following screen:

DATA IN - VISION - TEST

A full description of the test procedure is given in the SBIP section 8-2-2, item (4).

9.2.2. Fiducial Recognition: Setup

The term *Setup* refers to specifying the parameters to enable precise image processing of the fiducial marks on the PCB.

To setup the parameters for the fiducial marks the following screen must be active.

DATA IN - VISION - 1. SETUP

For fiducial recognition the following options are used.

LABEL	SET VALUE	REMARKS
MODE	FID	
CAMERA	1	Select fiducial camera nr. 1
OBJECT	WHITE BLACK	Use when mark is brighter than surrounding PCB area Use when mark is darker surrounding PCB area
BINARY	AREA (30 ~ 50) or AUTO	Value in parentheses indicates the number of pixels in the surface area of the mark. Input the optimized binary value for the actual mark.
FILL	NO, 1 or 2	Changes depending on the status of the binary procesing results
CUT	NO	Changes depending on the status of the binary processing results
WINDOW1	ON+	The size is generally a range that contains the mark and should be as small as possible.
DISPLAY	TEST1	Any value is acceptable for processing.
OPTION01	20 ~ 314	Surface area mark. Unit is 0.01mm With a circular mark that has a diameter of 1mm, the value will be: 0.5x0.5x3.14=0.78, so "78" will be the input for OPTION01.
OPTION02	10 ~ 100	Allowable error in surface area of mark (tolerance): Unit is % To avoid having a check run, input 0; Standard value is 30.
OPTION03	10 ~ 628	Peripheral length of mark. Unit is 0.01mm. With a circular mark that has a diameter of 1mm, the value will be: 1x3.14=3.14, so "314" will be the input for OPTION03.
OPTION04	10 ~ 100	Allowable error in peripheral length of the mark (tolerance). Unit is %. To avaoid having a check run, input 0; Standard value is 30.
OPTION05	0 ~ 50	Length of cursor. Unit is pixel. If 0, the default value of 8 pixels is used.

NOTES:

1. *All Setup parameters other than mentioned above should be set to 0 or OFF except OPTION11 to OPTION14 which contain R-Axis correction values.*
2. *The values for the shaded items change depending on the circumstances.*

SECTION 9 VICS1000: ENHANCED VISION SYSTEM

CSM84VZ ONLY

9.1 VICS1000: Introduction

The VICS1000 board is an enhancedvision system with a processing resolution of 512 pixels (horizontal) by 480 pixels (vertical). This vision board is delivered with the CSM84VZ machine only when no use of the SBIP enhanced vision board is made.

As the operating and handling is very much simular to the SBIP enhanced vision system, therefore only the differences between the VICS1000 and SBIP will be discussed in this section.

9.2. Fiducial Recognition

9.2.1. Basic Internal Processing

The basic internal processing is a binary trace. This converts a density-variable image of a 256-level density to a 2-level density binary image: Pixels with a density value of less than the threshold value are converted to a density value of 0, while those above the threshold value are converted to a 1. The edge of the fiducial (here the target object) can then be traced and the contour of the fiducial can be extracted.

For the processing (see previous paragraph), inputting data pertaining to the surface area and the peripheral lenth enables objects satisfying the conditions in the vision sysstem to be identified as fiducial marks. An error is assumed if there are two or more objects fulfilling the conditions, or if no object fulfilling the conditions is found.

For **OPTION01** and **OPTION02**, refer also to section9.2.2.

[WINDOW1] is used to define the range of the area to be processed. There are several optional parameters which can be used in processing. For **OPTION01** and **OPTION02**, input the surface area of each of the fiducial marks, and the allowable margin of error. For example, if the suface area of the mark is 3.00mm^2 and the dispersion is within 20%, enter 300 for OPTION01 and 20 for OPTION02. If 0 is entered for OPTION02, judgement is not done based on surface area (tolerance checking is not performed).

For **OPTION03** and **OPTION04**, refer also to section9.2.2.

In the same way, **OPTION03** and **OPTION04** are used for the peripheral length of the fiducial mark and the allowable margin for error. For example, if the peripheral length of the mark is 6.50mm and dispersion is within 30%, enter 650 for OPTION03 and 30 for OPTION04. If 0 is entered for OPTION04, judgement is not done based on peripheral length (tolerance checking is not performed).

If both OPTION02 and OPTION04 are 0, the object with the largest suface area is taken as the fiducial mark.

For **OPTION05**, refer also to section9.2.2.

It is possible to change the length of the center cursor, used when teaching, via the **OPTION05** parameter. When this value is set to 0 (default value), the center cursor length is 8 pixels. When teaching cannot be carried out easily, any value between 0 and 50 can be set (see figure 9.2.1.)

Figure 9.2.1. Fudicial mark recognition

332.20 **Lead end error.**

Occurs when, while searching for the end of every top lead of a horizontal positioned SO, no end is found. This could be caused by a bad contrast between the component and it's background or by a very thin lead.

332.21 **Lead end error.**

Occurs when, while searching for the end of every bottom lead of horizontalpositioned SO, no end is found. This could be caused by a bad contrast between the component and it's background or by a very thin lead.

332.22 **Lead end error.**

Occurs when, while searching for the end of every left lead of a vertical positioned SO, no end is found. This could be caused by a bad contrastbetween the component and it's background or by a very thin lead.

332.23 **Lead end error.**

Occurs when, while searching for the end of every right lead of a vertical positioned SO, no end is found. This could be caused by a bad contrast between the component and it's background or by a very thin lead.

332.24 **Lead end error.**

Occurs when, while searching for the end of every fine lead of a vertical positioned SO, no end is found. This could be caused by a bad contrast between the component and it's background or by a very thin lead.

400 **No window defined.**

This error occurs in CON(nector) mode. The processing window does not match the values, specified in the OPTIONS, that must be checked.

COMMUNICATION ERROR

Internal error. An unknown command is received. Restart machine.

OBJECT DETECT ERROR

PLCC component has bad shaped corners causing wrong detection. As a result of this a position can be given to the robot that is outside the working area. After this error the component will be dumped and a retry will be made.

UNEXPECTED ERROR

An unknown situation occurred during QUAD recognition. The component will be rejected and will be dumped. A retry will take place.

VFILE RECEIVE ERROR

Internal error. The checksum of the vision file send was not correct. Restart machine.

OPTION15 and OPTION16 should be used in conjunction with the parameters for the lead pitch detection funtion, OPTION03 and OPTION04. Moreover, when processing algorithm A is used, together with BINARY, FILL and CUT parameters (for normal QFPs and other components), no internal processing is carried out. The settings of OPTION15 and 16 are then invalid and the value does not matter.

To clarify OPTION01 to OPTION08, these options are shown in figure 9.3.4.

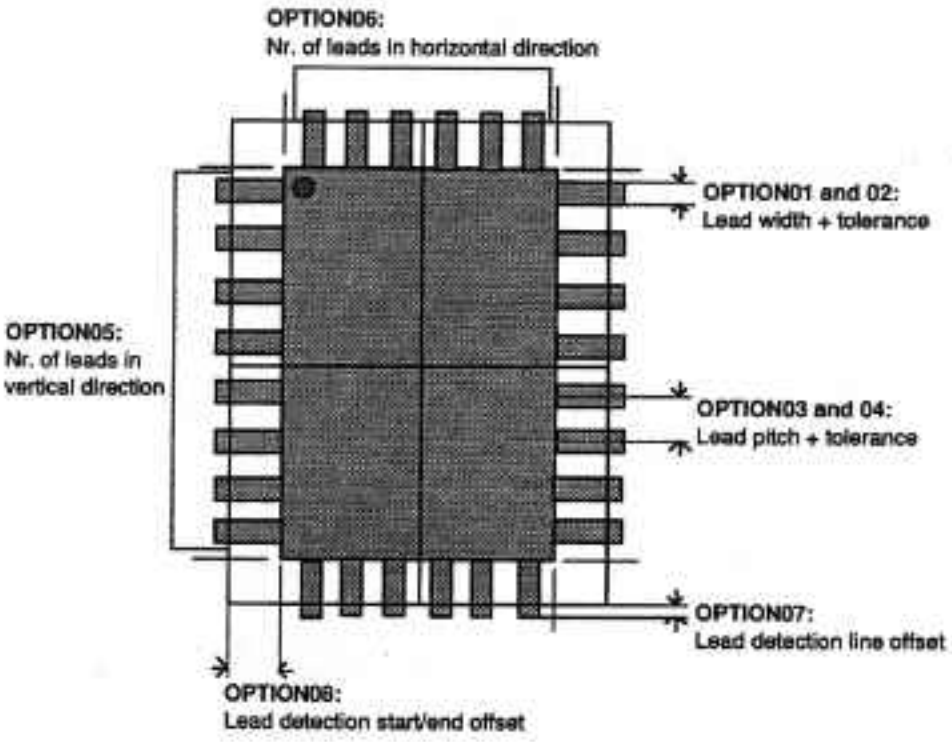


Figure 9.3.4. Option Parameters (QFP)

NOTE: *For SOP type of components the options have the same meanings. SOP type of components have leads in only 2 directions, these can be shown horizontally or vertically. Dependent on the direction the correct number of leads must then be entered into OPTION05 or OPTION06. When both options contain a value, the value specified in OPTION05 will be used to determine the number of leads (the leads must then be shown in the vertical direction).*

OPTION15 is used with QFP components on which the leads are spread out (refer to figure 9.3.2.). It is possible to run a check to make sure the leads are within the acceptable tolerance. If the check is not to be carried out, set this parameter to 0.

Using this funtion is performed in the following order:

1. Make sure that the entered value in OPTION03 is valid
2. Set the value of OPTION 15 to 0
3. The value of OPTION16 must be set to 0 (zero)
4. Run the <CALIB> program
5. Adjust the SCALE and SHIFT values
6. If an error is found then enter a specific numeric value for the lead bent detection tolerance (initial recommendation is a value in the range of 30 ~ 50) into OPTION15 (Unit is in %). Repeat step 4 to 6 if the <CALIB> program continues in failing to recognize the component.

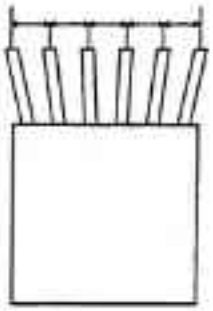


Figure 9.3.2. OPTION15

OPTION16 is used to check whether the leads on QFP components are all bent in a consistent direction. This is done by detecting the angle at which the leads are bent (refer to figure 9.3.3.). If the check is not to be carried out, set this parameter to 0.

Using this function is performed in the following order:

1. Make sure that the entered value in OPTION03 is valid
2. Set the value of OPTION16 to 0 (zero)
3. Run the <CALIB> program
4. Adjust the SCALE and SHIFT values
5. If an error is found then enter a specific numeric value for the lead bent angle (initial recommandation is a value in the range of 50 ~ 100) into OPTION16 (Unit is in 0.01 °). Repeat set 3 to 6 if the <CALIB> program continues in failing to recognize the component.

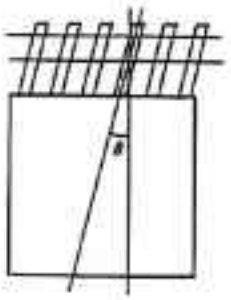
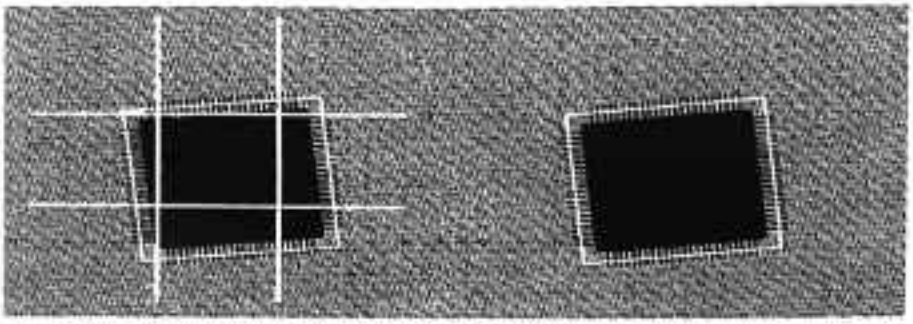


Figure 9.3.3. OPTION16



Processing Algorithm A Processing Algorithm B

Figure 9.3.1. Processing Algorithm

The lead width and allowable error (tolerance) are input for **OPTION01** and **OPTION02**, while the lead pitch and allowable error arre input for **OPTION03** and **OPTION04**.

Example:
If a QFP has a lead width of 0.3mm and a lead pitch of 0.65mm, then the input for OPTION01 will be "30" and the input for OPTION03 will be "65". If the allowable error for both is e.g. 30%, then the input for OPTION02 and OPTION04 will be "30".

When in OPTION02 and OPTION04 are set to 0 (zero), it causes a check of the lead width and lead pitch to be skipped. Since the lead width and lead pitch are not closely tied to the measured length, input the optimum allowable error for the conditions by hand. As a default, 0 can be input for OPTION02 and 30 can be input for OPTION04.

For **OPTION05** and **OPTION06**, input the number of leads in the vertical and horizontal directions.

Example:
If a QFP has 30 vertical leads and 20 horizontal leads, then the input for OPTION05 will be "30" and the input for OPTION06 will be "20"

When OPTION05 and OPTION06 are set to 0 (zero), it causes the check of the number of leads to be skipped and the component will be judged to be oriented vertically. For an SOP, the leads in the direction for which a value is input will be detected, but if values have been input for *both* OPTION05 and OPTION06, then the value in OPTION05 is given the priority and the value in OPTION06 is ignored.

OPTION07 if the offset amount when setting the lead detection line from the quadrangle circumscribing a previously detected component. This value is default set to 0. If, for example, a lead detection should take place 5 pixels inside the quadrangle, then "5" should be input into OPTION07.

OPTION08 is used after setting the detection line of the lead, to specify the offset amount setting the position where lead detection is to start and stop. The unit of measuremet is pixels. Default this value is set to 0 (zero). If, for example, a QFP with bumpers (BQFP) is not detected, this value is generally set to 10.

The section flag for the processing algorithm used with edge detection is input in **OPTION09**. A detailed descriptions of the used processing algorithms can be found at the beginning of this section.

OPTION10 is to define the type of recognition that will be used. When set to 0, normal recognition wil be executed. When set to 1, multi-stage recognition wil be executed.

9.3. Component Recognition

9.3.1. Normal and Multi-stage recognition

There are two types of vision recognition: normal recognition and multi-stage recognition. With normal recognition, the component is recognized once, correction is applied, and the component is mounted, this method also enhanced the overall system performance. With multi-stage recognition, the component is recognized two or three times, with correction being applied, so that components can be mounted with higher precision. The type of recognition to be used is selected using the **OPTION10** (Recognition type) parameter in the vision file.

9.3.2. Detection of center position and slant angle

9.3.2.1. Detection of center position and slant angle of QFP and SOP

There are two types of processing algorithm used in position correction: Processing Algorithm A and Processing Algorithm B.

a) Processing algorithm A

Multi-value processing is used to search directly for the leads along the side of the component, and a straight line is then drawn connecting the peripheral leads at both ends. The average of all of the lead positions intersecting this straight line is then computed to determine the center point of the component side. The intersecting point which ties together the center points of the opposing sides is used as the center position of the QFP, and the slope of the intersecting lines is used as the slope of the QFP. The straight line which intersects the leads is called the lead detection line. When Processing Algorithm A is selected, **OPTION09** is set to 0.

b) Processing algorithm B

In order to draw the lead detection line, binary data processed in advance is used, and the lead detection line is determined from the circumscribed rectangle of the component. Processing subsequent to this is the same as that for Processing algorithm A. The only point which differs is that, because binary data is used with Processing Algorithm B, the BINARY, FILL and CUT parameters in the vision file must be set to appropriate values, creating a rectangular shape with no gaps between the leads. This step is not necessary when using Processing Algorithm A. When processing Algorithm B is selected, OPTION09 is set to 1.

Refer also to figure 9.3.1.

Processing algorithm A is faster than Processing Algorithm B, because leads are searched directly. Algorithm B is slower because the binary data must be processed in advance. This processing is appropriate, however, if the components have projecting sections other than leads, such as QFPs with bumpers.

Both processing algorithms are constructed so that factors such as the number of leads, lead pitch, lead width and lead bending are checked. This lead check function is designed to reject any inappropriate components (by generating an error) before they are mounted on the PCB. Furthermore, the function is provided with a number of parameters in order to carry out more stable image processing on componenents with irregular shapes. The parameters OPTION01 to OPTION20 are used with the lead check function and with irregularly-shaped components.

Details of the various display modes:

OPTION	MODE(S)	DESCRIPTION
INPUT0	All modes	Grey Image
INPUT1	QFP/SOP	Grey Image + Lead pitch graph
	BQFP	Grey Image + Binary Image
	All other modes	Binary Image
EDGE0	(B)QFP, SOP	INPUT0 + search area + lead's position
	QUAD	INPUT0
	CON	INPUT0 + lead position
	FID	INPUT0 + outline
EDGE1	(B)QFP, SOP	INPUT1 + search area + lead's position
	QUAD	INPUT1
	CON	INPUT1 + lead position
	FID	INPUT1 + outline
CROSS0	(B)QFP,SOP	INPUT0 + cross line + lead detect line
	QUAD	INPUT0 + cross line + outer line
	CON	INPUT0 + center + lead tip line
	FID	INPUT0 + center of gravity + angle
CROSS1	(B)QFP,SOP	INPUT1 + cross line + lead detect line
	QUAD	INPUT1 + cross line + outer line
	CON	INPUT1 + center + lead tip line
	FID	INPUT1 + center of gravity + angle
ALL0	QUAD	EDGE0
	All other modes	EDGE0 + CROSS0
ALL1	QUAD	EDGE1
	All other modes	EDGE1 + CROSS1
TEST0	All modes	CROSS0 + result (data)
TEST1	All modes	CROSS1 + result (data)

OPTION01 to OPTION20

Depending on the component, the OPTION parameters vary in functionality, but all result in describing the component with its tolerances. These values are used during processing.

In QUAD, (B)QFP and SOP mode, **OPTION10** to **OPTION14** are used by the <COMMON> program for automatic correction of the R-axis. The operator/user must not use/change these values. If the data is deleted, the utility program <CALIB> must be executed again for the specific component.

9.3.3. . Component Recognition: SETUP

MODE: Image processing Mode
This determines the type of processing mode. During component recognition this field selects a specific processing method to recognize the chosen component. In this section the following modes are discussed:-

SOP, QFP (no bumpers):	Refer to section 9.3.3.1.
QFP (with bumpers):	Refer to section 9.3.3.2.
QUAD (PLCC):	Refer to section 9.3.3.3.
CON:	Refer to section 9.3.3.4.

The processing mode for FIDucials is described in section 9.2.2.
The CON mode replaces the previous known CHIP mode

BINARY: Binary Trace
This converts a density-varibable image of a 256-level density to a 2-level density binary image. Pixels with a desity value of less than the threshold value arre converted to a density value of 0, while pixels with a density value above the threshold value are converted to a 1. The edge of the target object can then be traced and the contour of the object extracted. At display of a binary image, all pixels with a density value of 1 are converted to a density value of 255 and are displayed (to create a white on black, or black on white picture on the screen).

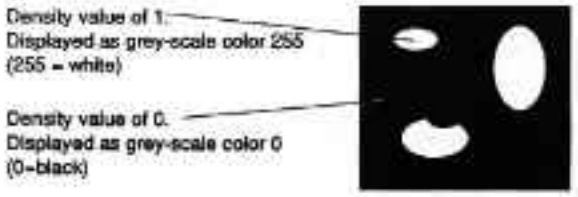


Figure 9.3.7.
Binary Trace

WINDOW1; WINDOW4
This sets the relevant range for image processing. The meaning differs depending on the processing mode. In processing modes that are already set up in advance, only *WINDOW1* can be used.
Using the 1-LEFT, 1-RIGH and other function keys, the corners of the window can be moved up, down, left and right to change the size of the window. In up/down direction this can be done 1 pixel at a time, while in left/right direction this can only be done in units of 16 pixels. 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. **OFF** causes the window display to disappear. Initial values of WINDOW1 are ON+(0,0)(255,239). All other windows are set to OFF.
The maximum window size is 256x240. The image processing board surface contains 512x480 pixels and are all scanned during processing. Therefore, limiting the window size increases the processing speed.

DISPLAY: Display Screen
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. Regarding this speed, **INPUT0** is the fastest for displaying the input image only.
In order to confirm the results of recognition funtions such as component regonition, the **CROSS0** parameter is useful. If numerical analysis is required, then the **TEST0** parameter can be used. Details on the DISPLAY mode are shown next.

9.3.2.3. Detection of center position and slant of PLCC (QUAD)

The basic internal processing is a binary trace. This converts a density-variable image of a 256-level density to a 2-level density binary image: Pixels with a density value of less than the threshold value are converted to a density value of 0, while those above the threshold value are converted to a 1. With this processing, the object with the largest surface area is taken as the component, and the center of gravity is set as the center of the component. The slant of the component is determined from the linear compents of the 4 sides: upper, loweer, left and right.

When multi-stage recognition is selected, OPTION10 is set to 1.

Figure 9.3.6. PLCC Recognition

9.3.2.4. Detection of center position and slant angle of Connector

This mode allows for precise position adjustment of connector-type components which have leads on one side.

The basic processing is the same as that for Processing Algorithm B of detection of the center position and slant angle of QFP and SOP (refer to section 9.3.2.1.). As the processing in advance, the circumscribed rectagle of the component is determined from the binary data, and the lead detection line is drawn on the side with the leads. Connectors do not have leads on plural sides, which makes it different from QFPs. In order to elevate the precision of detected position and detected angle in the vertical direction to the lead side, the average of the position of the leads along the side, which is detected by the processing subsequent of above, is computed to determine the center point of the component. The slope of the line which ties together the tips of leads is used as the slope of the component.

The parameters used are the same as with the QFPs and SOPs except for OPTION06.

OPTION05 is used to input the number of leads. This is the only option the number of leads can be specified into.

OPTION06 is used to specify the direction of the leads. This is to determine where the detection line must be placed.

0 = Upper Side
1 = Lower Side
2 = Left Side
3 = Right Side

9.3.2.2. Detection of center position and slant of QFP with bumpers

Refer to figure 9.3.5.

The use of the parameters for QFPs with bumpers is simular to that of QFPs without bumpers. The only exception is for the parameters OPTION08, OPTION09 and the BINARY, FILL and CUT parameters.

OPTION08 is used after setting the detection line of the lead. It specifies the offset amount by setting the the position where lead detection is to start and stop. The unit of measurements is pixels. For QFPs with bumpers this value should be set around 10.

Algorithm B is generelly selected via **OPTION09** since this algorithm is appropriate for components which project sections other than leads (in this case bumpers). Algorithm B is selected by setting OPTION09 to a 1.

The **BINARY**, **FILL** and **CUT** values are used to stabilize the binary image processing for rough positioning, and should therefore be set so that the intervals between leads are filled in.

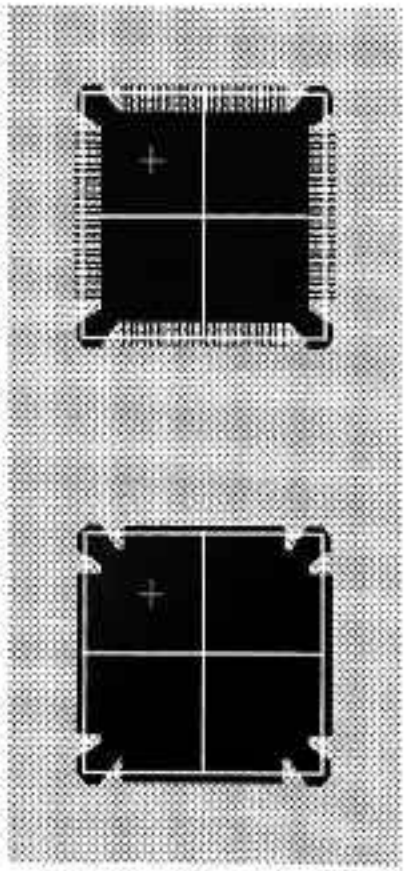


Figure 9.3.5. QFP (with bumpers) recognition

9.3.3.4. Setup: Connector Recognition

LABEL	SET VALUE	REMARKS
MODE	CON	
CAMERA	2 or 3	Vision fixed camera number 2 or 3
OBJECT	BLACK	
BINARY	AUTO	
FILL	NO	
CUT	NO	
WINDOW1	ON+	This size should be as small as possible, just large enough for the component to fit inside.
WINDOW 4	OFF	
DISPLAY	TEST1	
OPTION01	20 ~ 50	Lead width. Unit: 0.01mm
OPTION02	0 or 10 ~ 30	Allowable error in Lead width. When no tolerance check should be performed, this value must be set to 0. Unit: %
OPTION03	80,127, ...	Lead Pitch. Unit: 0.01mm
OPTION04	0 or 10 ~ 30	Allowable error in Lead Pitch. When no tolerance check should be performed, this value must be set to 0. Unit: %
OPTION05	0 ~ 100	Number of Leads. When no check should be performed on the number of leads, this value must then be set to 0.
OPTION06	0, 1, 2 or 3	Lead direction: 0 = Upper direction 1 = Lower direction 2 = Left direction 3 = Right direction
OPTION07	-5 ~ 5	Lead detection line offset
OPTION08	0	Lead detection start/end offset
OPTION09	0	Select Processing algorithm A
OPTION10	0 or 1	Select Standard or Multi-Stage recognition type
OPTION15	0 or 30 ~ 50	Lead bent detection tolerance. When no tolerance check should be performed, this value must be set to 0. Unit: %
OPTION16	0 or 50 ~ 100	Lead bent detection angle. When no tlead bent detection should be performed, this value must be set to 0. Unit: 0.01°

The center position detected, when using connector recognition, serves as the center postion at the tip of the lead. Be aware that this is different from the center position of the mounting point. Recognition can also be carried out with the processing algorithm selection set to 1 and the BINARY, FILL and CUT parameters used. Refer to section 9.3.3.2. for the settings parameters for QFP components (with bumpers).

NOTES:

1. *All items not shown in the table above should be set to 0 or OFF, except OPTION11 to OPTION14 which contain R-Axis correction values.*
2. *The values of the fields that are shaded change depending on the circumstances*

9.3.3.3. Setup: PLCC / QUAD recognition

LABEL	SET VALUE	REMARKS
MODE	QUAD	
CAMERA	2,3	Vision fixed camera number 2 or 3
OBJECT	BLACK	
BINARY	AUTO or MANUAL	*These three item are used to stabilize the binary image processing for rough positioning and should therfore be set so that the intervals between leads are filled in.*
FILL	2,3	
CUT	NO	
WINDOW1	ON+	
WINDOW4	OFF	
DISPLAY	TEST1	Any value is acceptable for processing
OPTION01		Area of the object Unit: 0.01mm^2
OPTION02	30	Allowable error in the area of the object. When no tolerance check should be performed, this value must be set to 0. Standard is 30. Unit: %
OPTION03		Perimeter of the component Unit: 0.01mm
OPTION04	30	Allowable error in the perimeter of the component. When no tolerance check should be performed, this value must be set to 0. Standard is 30. Unit: %
OPTION10	0 or 1	Standard or Multi-stage recognition type.

NOTES:

1. *All items not shown in the table above should be set to 0 or OFF, except OPTION11 to OPTION14 which contain R-Axis correction values.*
2. *The values of the fields that are shaded change depending on the circumstances*

9.3.3.2. Setup: QFP (with bumper) recognition

LABEL	SET VALUE	REMARKS
MODE	QFP1	
CAMERA	2,3	Vision fixed camera No. 2 or 3.
OBJECT	BLACK	
BINARY	AUTO	*These three items ar used to stabilize the binary image processing for rough positioning, and should therefore be set so that the intervals between leads are filled in.*
FILL	NO	
CUT	NO	
WINDOW1	ON+	The size should be as small as possible, just large enough for the component to fill inside
WINDOW4	OFF	
DISPLAY	TEST1	Any value is acceptable for processing
OPTION01	20 ~ 50	Lead width. Unit: 0.01mm
OPTION02	0 or 10 ~ 30	Allowable error in lead width. When no tolerance check on lead width should be performed, this value must be set to 0. Unit: %
OPTION03	65, 80, ...	Lead Pitch. Unit: 0.01mm
OPTION04	0 or 10 ~ 30	Allowable error in lead pitch. When no tolerance check on lead pitch should be performed, this value must be set to 0. Unit: %
OPTION05	0 ~ 100	Number of leads in the vertical direction. When no check on the number of leads should be performed, this value must be set to 0.
OPTION06	0 ~ 100	Number of leads in the horizontal direction. When no check on the number of leads should be performed, this value must be set to 0.
OPTION07	-5 ~ 5	Lead detection line offset
OPTION08	5 ~ 20	Lead detection start/end offset
OPTION09	1	Select processing algorithm B
OPTION10	0 or 1	Select standard or multi-stage recognition type
OPTION15	0 or 30 ~ 50	Lead bent detection tolerance. When no tolerance check on lead bent detection should be performed or when this funtion is not applicable, this value must be set to 0. Unit: %
OPTION16	0 or 50 ~ 100	Lead bent detection angle. When no lead bent detection should be performed, this value must be set to 0. Unit: 0.01°

NOTES:

1. *All items not shown in the table above should be set to 0 or OFF, except OPTION11 to OPTION14 which contain R-Axis correction values.*
2. *The values of the fields that are shaded change depending on the circumstances*

9.3.3.1. Setup: SOP and QFP (no bumper) recognition

LABEL	SET VALUE	REMARKS
MODE	QFP1 SOP	
CAMERA	2 or 3	Fixed camera no. 2 or 3.
OBJECT	BLACK	
BINARY	AUTO	
FILL	NO	
CUT	NO	
WINDOW1	ON+	The size should be as small as possible, just large enough for the component to fit inside the window.
WINDOW4	OFF	
DISPLAY	TEST1	Any value is acceptable for processing
OPTION01	20 ~ 50	Lead width. Unit: 0.01mm
OPTION02	0 or 10 ~ 30	Allowable error in Lead Width (tolerance). When no tolerance check should be performed, this value must be set to 0. Unit: %
OPTION03	65, 80, ... 80, 127, ...	Lead pitch (for QFP). Unit: 0.01mm Lead pitch (for SOP). Unit: 0.01mm
OPTION04	0 or 10 ~ 30	Allowable error in Lead Pitch (tolerance). When no tolerance check should be performed, this value must be set to 0. Unit: %
OPTION05	0 ~ 100	Number of leads in the vertical direction. When no tolerance check should be performed, this value must be set to 0.
OPTION06	0 ~ 100	Number of leads in horizontal direction. When no tolerance check should be performed, this value must be set to 0.
OPTION07	-5 ~ 5	Lead detection line offset
OPTION08	0	Lead detection start/end offset
OPTION09	0	Select processing algorithm A.
OPTION10	0 or 1	Standard or Multi-Stage recognition Type
OPTION15	0 or 30 ~ 50	Lead bent detection tolerance. When no tolerance check on lead bent detection should be performed or when this funtion is not applicable, this value must be set to 0. Unit: %
OPTION16	0 or 50 ~ 100	Lead bent detection angle. When no lead bent detection should be performed, this value must be set to 0. Unit: 0.01°

NOTES:

1. *All items not shown in the table above should be set to 0 or OFF, except OPTION11 to OPTION14 which contain R-Axis correction values.*
2. *The values of the fields that are shaded change depending on the circumstances.*
3. *When in SOP mode, either OPTION05 or OPTION06 must be set. And if OPTION05 = 7 (SOP14 pin), the component must be in horizontal direction. If both OPTION05 and OPTION06 are 0, the vision system default judges its direction as being vertical.*

9.3.5. Error Codes

Error Code	Description
183	**V Memory Destroyed** memory destruction caused by noise or static electricity. Switch power on/off to restart.
184	**Vision Error** VICS1000 card cannot receive data or commands because of noise of static electricity. Replace VICS1000 card
185	**V Interface Error** Communication problems between VICS1000 and Robot occur. This can be due to bad wiring from the C/K card to the VICS1000 card or due to a defective VICS1000
186	**Vision Aborted** An u<STOP> command was given while the vision was calculating. The <RUN> key can be pressed to continue operation.
301	**Lead detection error** The total number of detected leads is too large (there are too many objects in the processing window representing leads). The object is not correct or make the processing window smaller.
320	**Lead number error** The correct number of leads could not be detected in QFP, CON or SOP mode
321	**NG (not good)** IC lead width or pitch exceeds the allowable range in QFP, CON or SOP mode.
331	**Lead number error** The correct number of leads could not be detected in QFP, CON or SOP mode
332	**Lead pitch error** The pitch found during processing does not match the values and tolerances specified in the OPTIONS in QFP, CON or SOP mode

9.3.4. Calibration

CAUTION:

RE-CALIBRATION is *ALWAYS* necessary in the following occasions:-

1. **When the head, camera or the lens is removed or adjusted in height**
2. **When the fixed camera or the lens of the fixed camera is removed or adjusted in height.**
3. **When the total machine is moved to a different location.**

Camera scale and the relative positions (amount of shift in the X and Y axes and amount of shift in the direction of rotation) of the camera with the machine starting point should be input.

If the calibration is not correct, it will be impossible to mount parts accurately.

Use the Calibration utility program <CALIB> to perform a **fine adjustment**. Each VFILE contains its own calibration values (scale, shift) depending on the thickness of the component.

When new files are created for component recognition, copy data from an existing VFILE and change the specific information. Then use the fine calibration program <CALIB> for camera calibration of the scale and shift.

The following settings are found in the DATA IN - VISION - CALIBRATION menu.

LABEL	SETTING VALUE	REMARKS
HOLD	FIXED	Use fixed camera for component calibration.
DIRECTION	UP	Fixed camera faces upwards
SCALE	Standard Fixed Camera X:0.0900~0.1200 Y:0.0900~0.1200	Value may vary dependant on kind of lens and position of the focus.
SHIFT	X:300.00~600.00 Y:300.00~500.00 R:178~182	Value may vary dependant on the position of the camera and the distance from the machine origin

IMPORTANT: After calibration the X/Y scale ratio must be 1.

SCALE is the size of one pixel in the component image.

SHIFT is the distance between the vision origin and the center of the field of view of the camera. This is the number of pixels from the origin of the CCD multiplied by the scale.

For a complete component calibration procedure, please refer to section 8.4. in the SBIP: Enhanced Vision system. This procedure can be used as well. Take note that the X/Y Scale ratio must be 1 after calibration (see note in the left border).

Error Code	Description
400	**SETUP error** There is an error in the vision file setup
401, 402, 403	**Object overflow** There is an error in the vision file setup