

Board surface height compensation : DOP (Distortion Observation Point) compensation

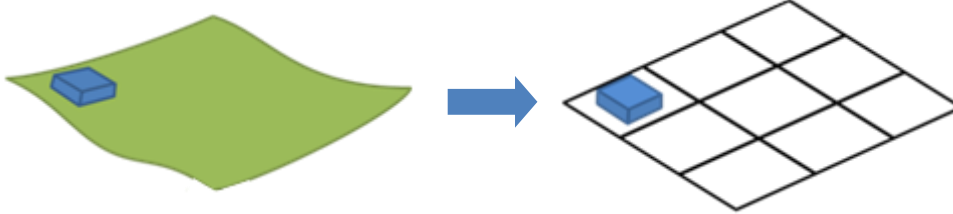
Contents

1. OUTLINES	2
2. OPERATING ENVIROMENTS	2
3. PROCEDURE TO ENABLE DOP COMPENSATION FUNCTION	2
4. EDIT DIALOG	5
5. 2 TYPE OF DOP COMPENSATION AND PROPER USE	6
6. CHECK THE COMPENSATION RESULT AND FINE TUNING.....	8
7. HOW TO USE LOCAL POINT TYPE DOP	10
8. COLOR AREA SETTING	11
9. MASK.....	15
10. REVISION.....	17

1. OUTLINES

Compensation with Distortion Observation Point (=DOP compensation) is a new function to compensate board warpage.

With this compensation, problems caused by clamping a board such as height offset, angle, or deflection can be corrected. The board surface image is also corrected to be flat and its height is set as 0um. Images among FOVs are shown more smoothly and flexible boards are compensated more accurate.



2. OPERATING ENVIROMENTS

This function is available with BF2 and BF2-Editor.

Software version: (BF-3Di) V1.1.0.1 or greater. (BF-3Si)V1.0.0.1 or greater

(BF-3DiL/D/Z)V1.0.0.1 or greater

3. PROCEDURE TO ENABLE DOP COMPENSATION FUNCTION

Step 1: Go to BF2→BF2 Option.

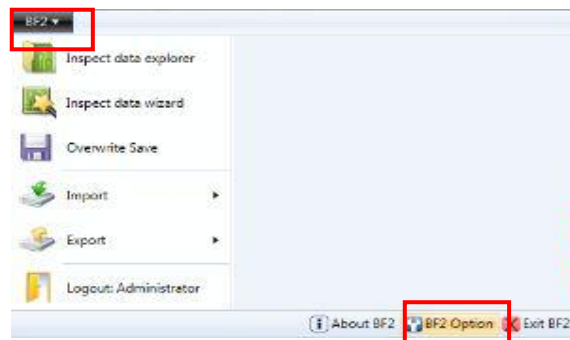


Fig1 BF2 Option

Step 2 : (3DAOI) Machine→Image Capture→Select **Do not compensate board height**.

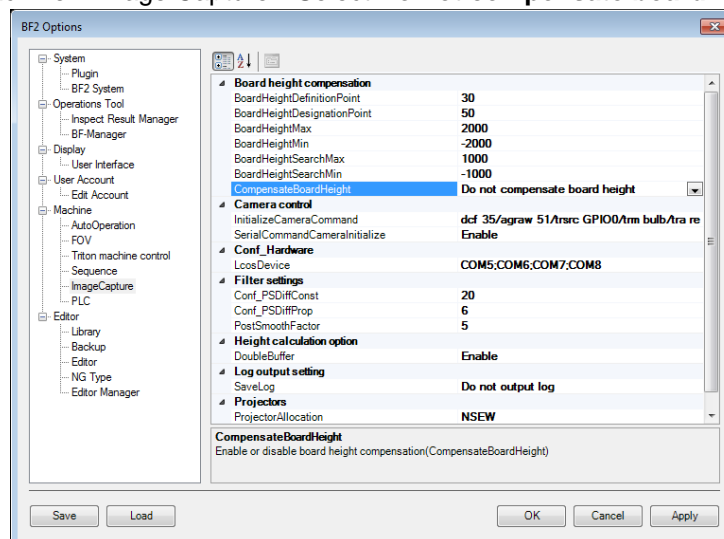


Fig2 Disable Board height compensation

Step 3 : Machine→FOV→DistortionMeasurementEnabled→Select **True**

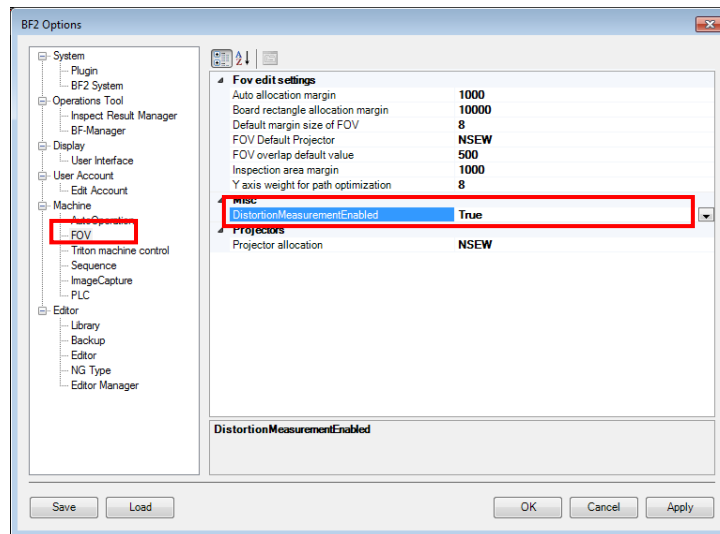


Fig 3 Enable Distortion Measurement

Step 4: **User Account**→**Edit Account**. Allow the following operation.

- Menu.FOVMenu.SubMenu.ClearDistotionSubMenu
- Menu.FOVMenu.SubMenu.MeasureDistotionSubMenu

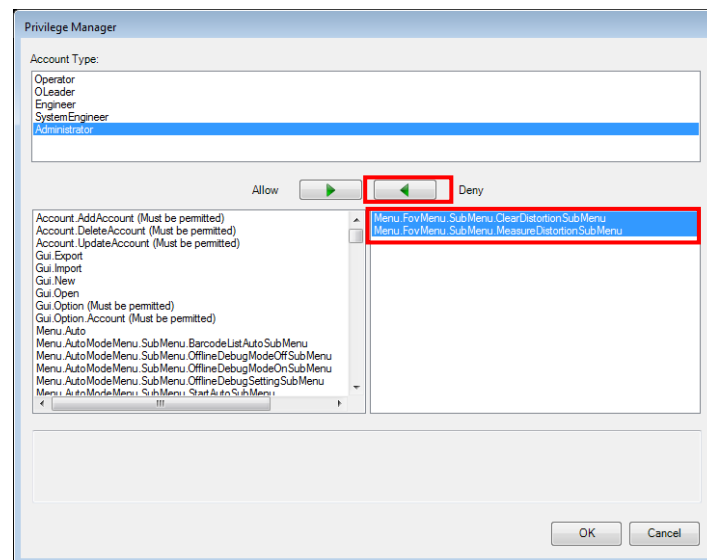
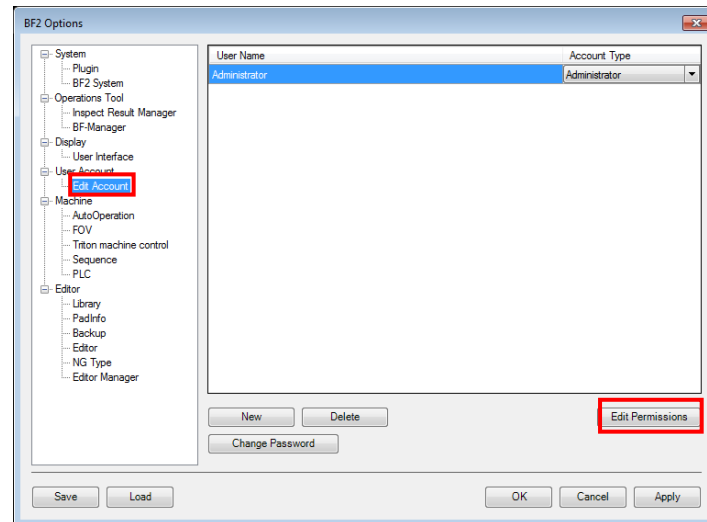


Fig 4 ClearDistotion / MeasureDistotion Privilege setting

4. EDIT DIALOG

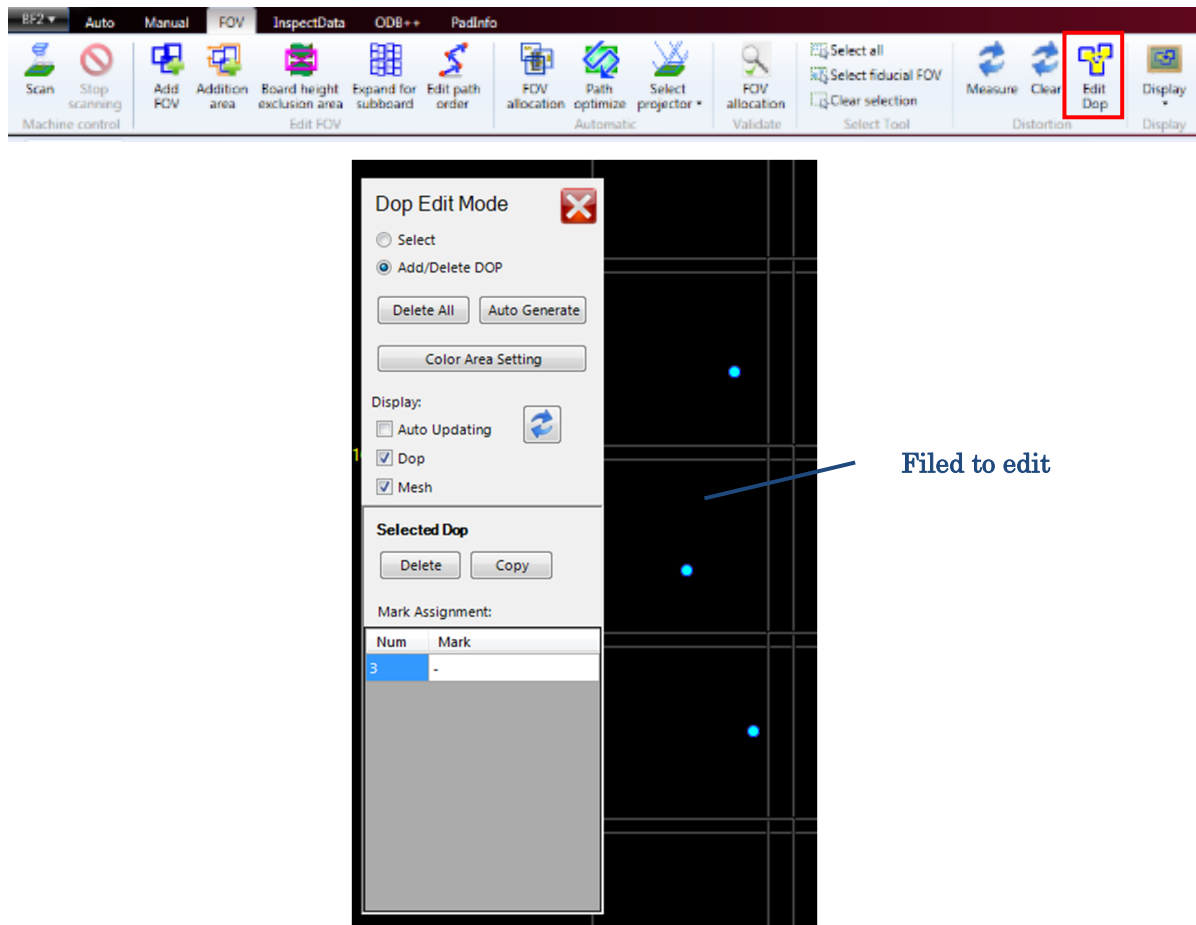


Fig 5 DOP Edit Panel

Items	Contents
Select	Switch to selection mode.DOP is selectable when clicking or dragging a DOP in the edit field. FOV is also selectable by clicking or dragging.
Add/Delete DOP	Switch to ADD/DELET mode. A DOP is added by clicking on the edit filed. DOP is deleted by clicking or dragging a DOP.
Delete All	Delete all DOPs
Auto Generate	Activate a function to generate DOPs automatically. Refer to SFM for the detail.
Color Area Setting	Activate color area setting function. (Refer to BF-3Di Programming Manual:SJ00DCM05-xx:4.3.10 Board Height Compensation Settings)
Display	
Auto Updating	Changed are made immediately. Release this function if a board size is large and update takes some time
Update button	Perform DOP compensation.
DOP	Display DOPs
Mesh	Display Mesh (yellowed triangles). Release this function if a board size is large and update takes some time.
Selected Dop: This is displayed when selecting DOPs.	
Delete	Delete selecting DOPs
Copy	Duplicate selecting DOPs
Mark Assignment	Assign fiducial marks to selecting DOPS. Marks which are not used for component position correction are not listed here.

5. 2 TYPE OF DOP COMPENSATION AND PROPER USE

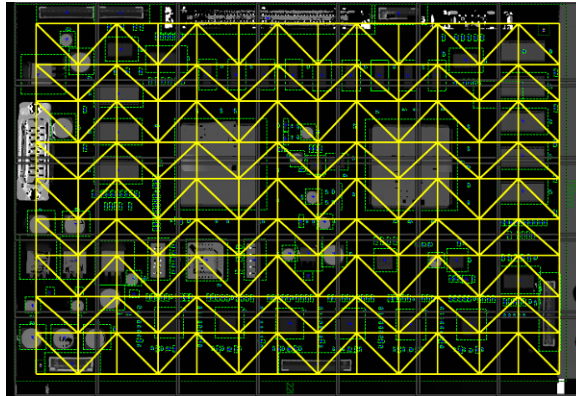
DOP compensation has 2 types.

- **Find Plane type**

FIND PLANE is the default type. FIND PLANE searches board surface every FOV.

As shown in the below, distortion observation points are located in every corner of triangle regularly. Board warpage is corrected by every triangle.

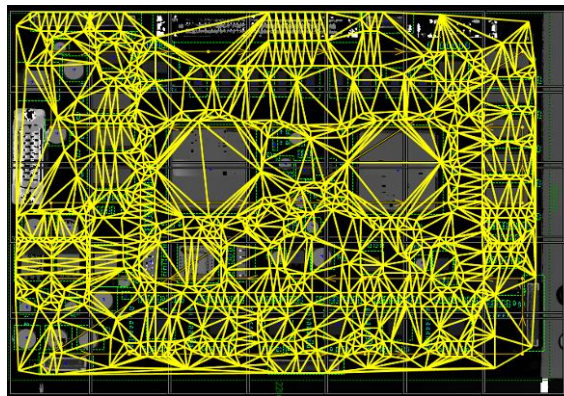
DOPs of FIND PLANE type are not added or deleted manually.



- **Local point type**

The location of distortion observation points can be specified manually. (Setting observation points on wiring pattern are recommended)

DOPs of LOCAL POINT type use the height information of the points where it's located for height compensation. LOCAL POINT type DOPs always requires fiducial mark correction to calculate the same position's board height.



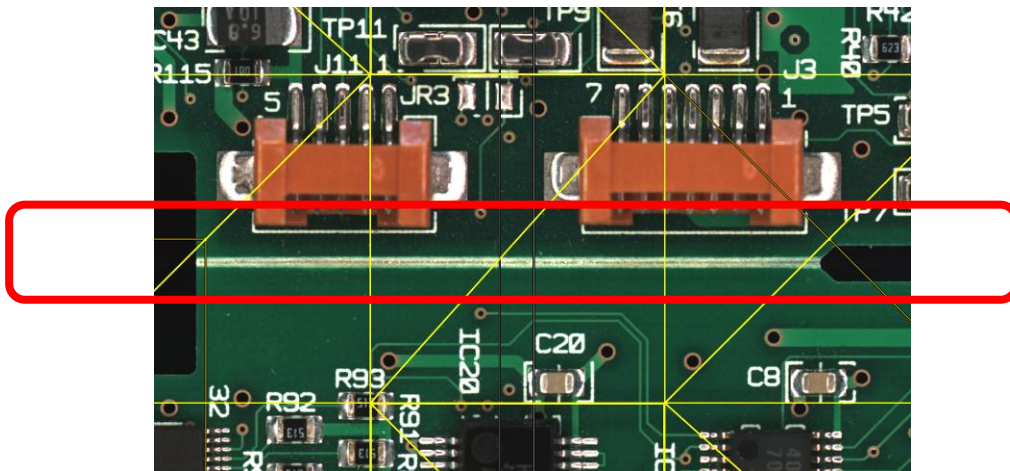
How to use them properly

Normally FIND PLANE type is enough to compensate board warpage.

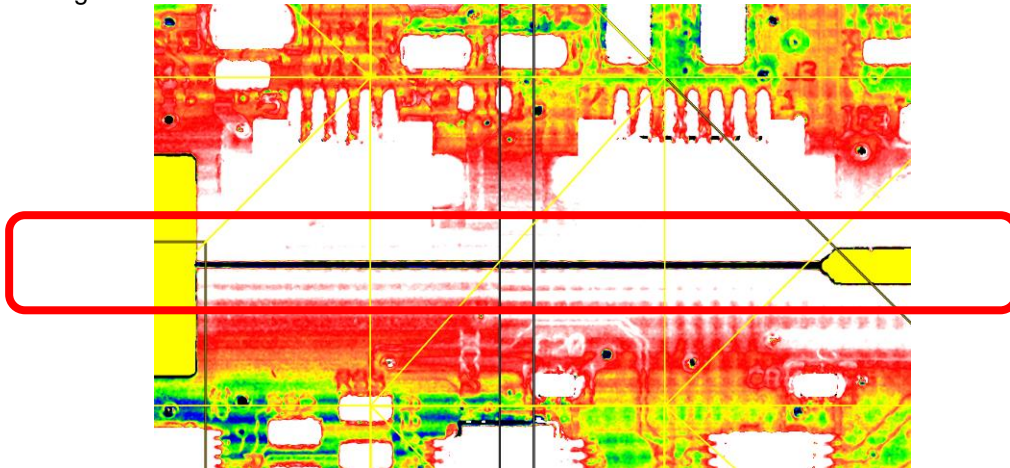
With the following cases, LOCAL POINT type has more accurate compensation.

- Flexible boards: If warpage is large in a FOV, FIND PLANE type is not enough.
- Sub Blocks: If a FOV has several sub blocks inside, every sub block has different height, FIND PLANE type is not enough to compensate.
- Boards on board: If a FOV has different board height inside, FIND PLANE type is not enough to compensate.
- Translucent part in a FPV: If most parts of a FOV are covered with translucent parts, FIND PLANE type is not enough to compensate.

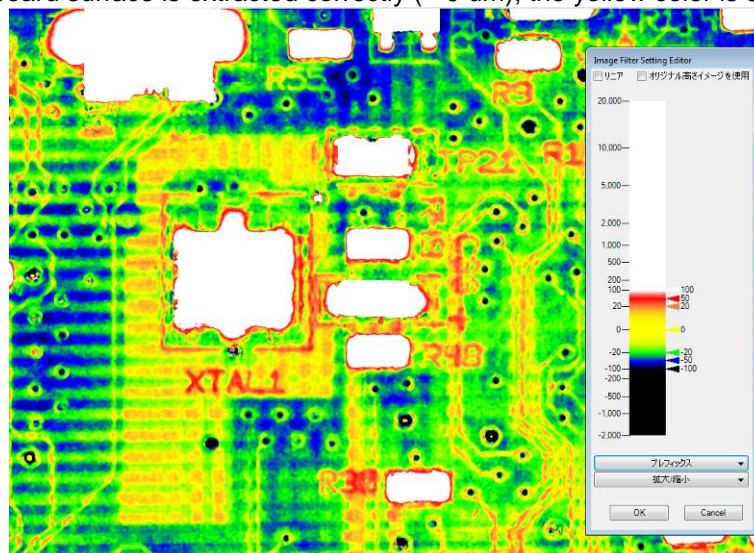
Examples: Using FIND PLANE type with a split board



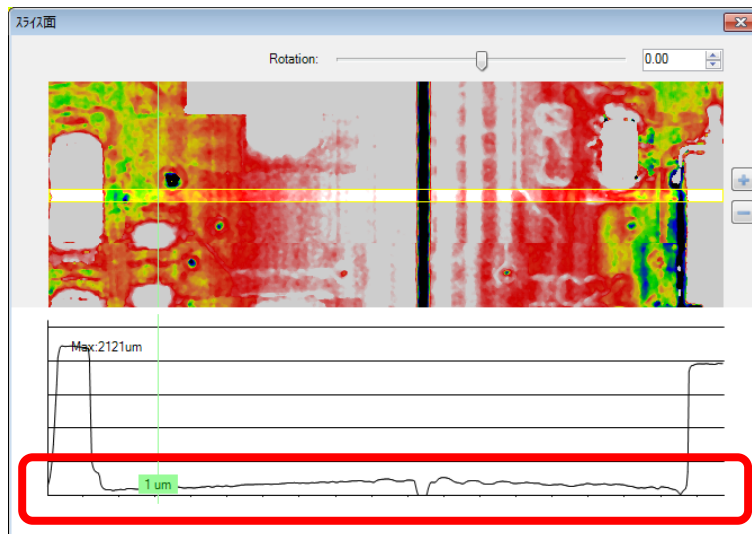
Board height View:



If the height of board surface is extracted correctly (= 0 um), the yellow color is shown as below.



The below is the height histogram around split. The board heights are different.

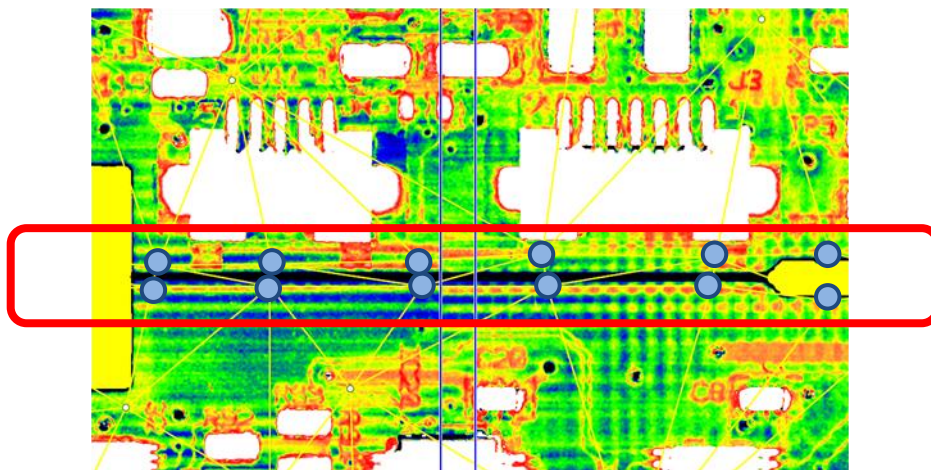


A FOV has different board height and FIND PLANE type is not enough to compensate board warpage with this case.

Next step is LOCAL DOP type.
Locate LOCAL DOPs along the split.
DOPs in the corner of yellowed triangles should not be connected to DOPs in other blocks.

Also all components on a block should be surrounded by yellowed triangle created by DOPs on the same block.

Now the compensation is performed correctly.



6. CHECK THE COMPENSATION RESULT AND FINE TUNING

This section describes how to check the compensation result after FOV allocation and how to do fine tunings.

Go to step 1 after completing FOV allocation.

Step 1: Scan the board. FIND PLANE type compensation is performed every scanning.

Step 2: Select board height filter, and check if the height of board surface is about 0 um.

If the height of board surface is calculated correctly, further tuning is not necessary. Go to next steps only if the compensation is not proper.

Step 3: Try Board Color settings

Refer to 「SJ00DCM05-xx BF-3D AOI Programming Manual 4.3.10 Board Height Compensation Settings」 for further details.

After setting board color, go to FOV tab→Measure to perform compensation.

Check if the height of board surface is 0 μm . If not, go to next steps.

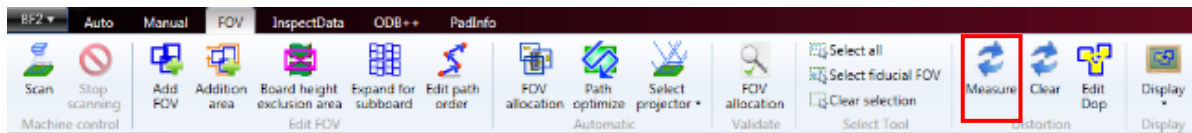


Fig 6 Measure

Step 4: If the above settings are not enough, check the following cases.

- If the height is different between FOV because of having many or less wiring pattern.
→Try Color Area Setting (Section 8)
- If the compensation is not proper in FOVs having translucent parts.
→Try Color Area Setting (Section 8)
→If Board Area Setting is not enough, try Local point type.
- If the board edge are warped and the height image of components around edge becomes higher or lower.
→Try LOCAL POINT type. (Section7)
- Each sub block has different angle around slit, height image of components around edge becomes higher or lower.
→Try LOCAL POINT type. (Section7)

7. HOW TO USE LOCAL POINT TYPE DOP

Step 1: Go to **FOVtab** → **EditDop**

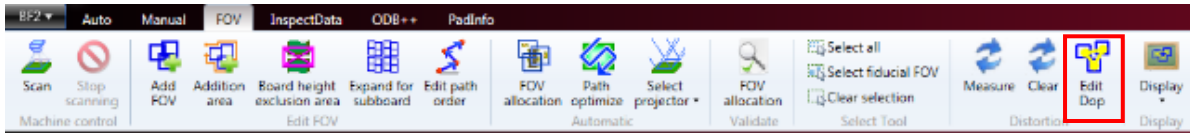


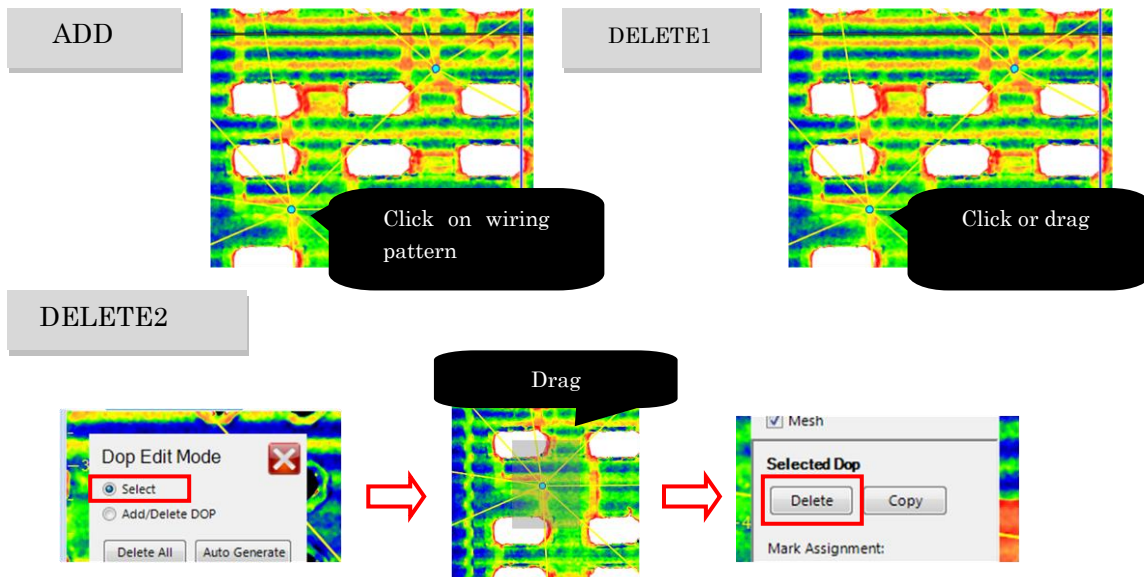
Fig 7 Edit Dop

Step 2: Select **Add/Delete DOP**



Fig 8 Adding / deleting local DOP

Step 3: Click on wiring pattern to add local type DOPs. Compensation is updated immediately. Add observation points while confirming with board height filter. When deleting observation points, select **Select**, **drag** points, and select **Delete** or click/drag DOPs with selecting **Add/Delete DOP**



Step 4 : After adding DOPs, select added points and assign fiducial marks. Fiducial marks that are not used for components position correction are not listed here.

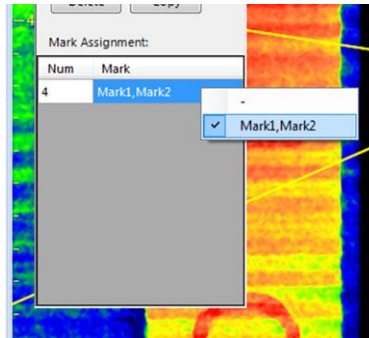
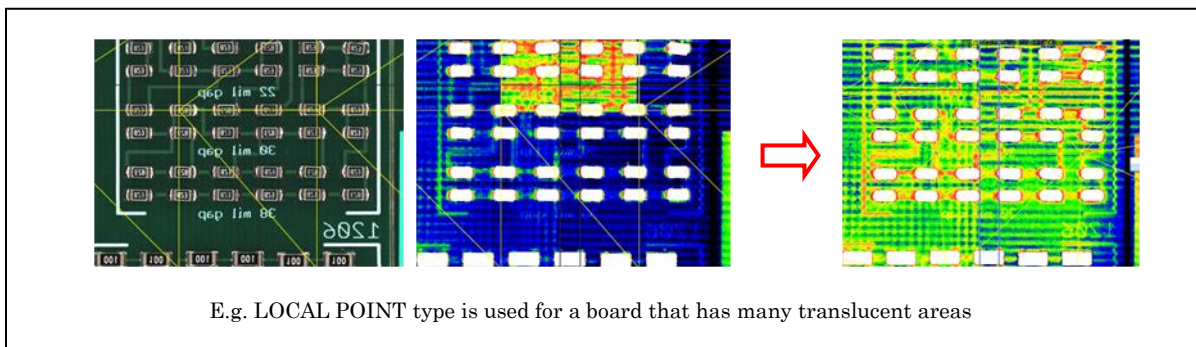


Fig 9 F/D mark assignment



8. COLOR AREA SETTING

FUNCTION OUTLINE

This is the function to specify area to extract board color. The extracted board color is used for FIND PLANE type DOP.

The board color is extracted from the specified area every single scanning so that the influence from board color variation will be less.

(Refer to BF-3Di Programming manual: SJ00DCM05-xx 4.3.10 Board Height Compensation Settings)

Edit dialog

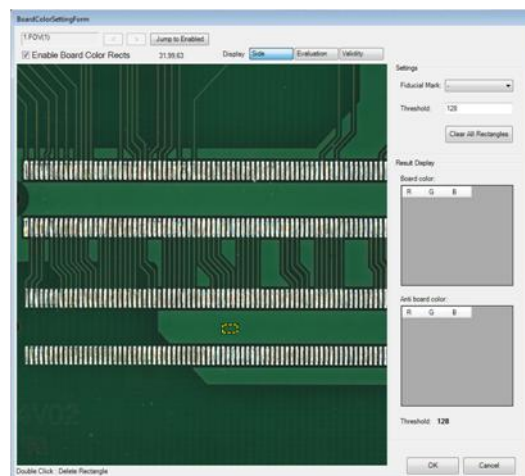


Fig 10 Board color setting

Items	Contents
Enable Board Color Rects	Switch enable/ disable board color setting. Board color setting can be set in one FOV only. Other FOVs also use the color information extracted in a FOV.
Jump to Enable	Display a FOV having board color setting.
Display	
Side	Display Side color image
Evaluation	Colors that are similar to board surface color→Display it brightly Colors that are similar to others→Display them darker
Validity	Areas in the Evaluation image with brightness greater than the Threshold are displayed in white and all other areas in black.
Setting	
Fiducial Mark	Select F/D Marks to correct the position to extract board color
Threshold	Sets the threshold value when converting the Evaluation image to the Validityimage.White areas in the Validity image are recognized as the board surface.
Clear All Rectangles	Delete all board color extract area
Result Display	
Board color	Display RGB from the board color extracted area.
Anti board color	Display RGB from the non-board color extracted area

Operation

Step 1: Go to **FOV tab**→**EditDop**

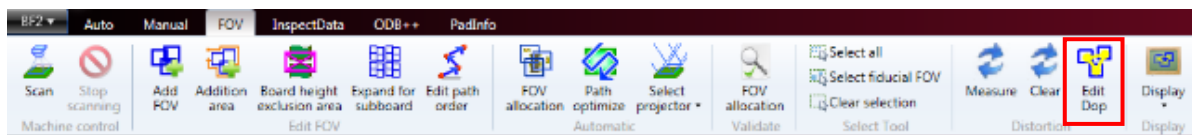


Fig 11 Edit Dop

Step 2: Click **Color Area Setting**. Board color setting form is shown.

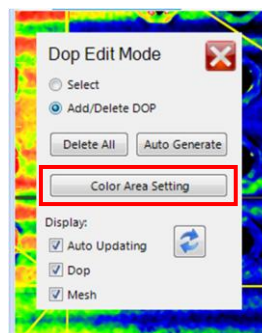


Fig 12 Color area setting

Step 3: Enable **Enable Board Color Rects** to specify a FOV to extract board color.

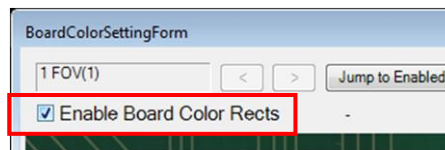


Fig 13 Enable Board Color Rects

Step 4 : Specify area by dragging to extract board color and select **Apply average as board color**. Normally wiring pattern should be selected as board color area. The large area where are no other components around it is preferable.

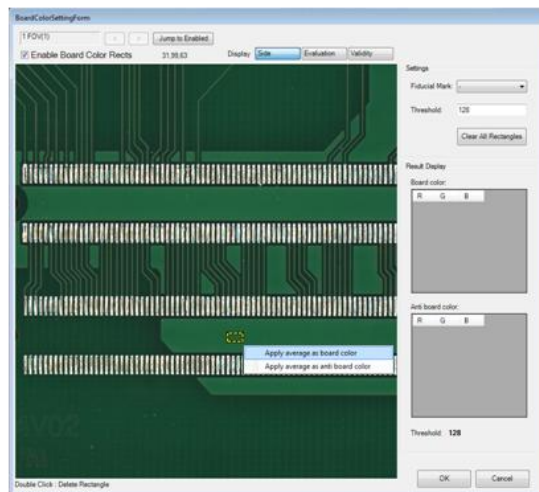


Fig 14 Area setting to extract board color

Step 5: Drag area except board surface such as insulation area, silk. Components, or holes to register non-board color and select **Apply average as anti board color**.

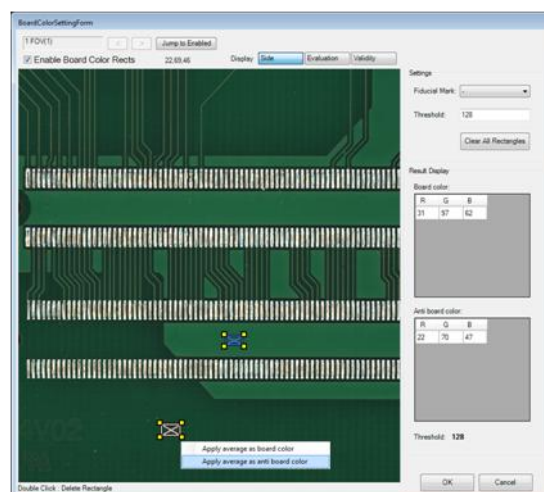


Fig 15 Area setting of non-board color

Step 6: Select **Validity**. The area recognized as board color is shown in white. The area recognized as non-board surface is shown in black. If this separation is not enough, repeat the above Step5-7. To delete area to extract board color, double-click them.

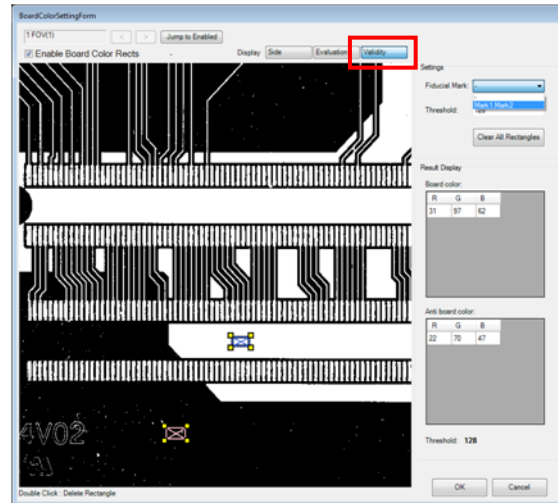


Fig 16 Validity

Step 7: Assign fiducial marks to correct positions. Marks which are not used for component position correction are not listed here.

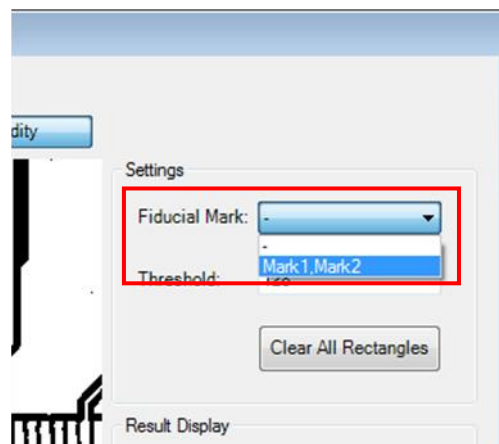


Fig 17 F/D mark assignment

Step 8: Select OK. Check the result with board height filter.

9. MASK

FUNCTION OUTLINE

This is the function to eliminate unnecessary area from FIND PLANE type DOP compensation.

EDIT DIALOG

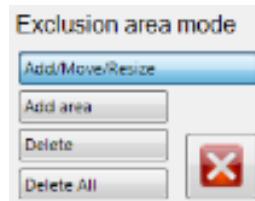


Fig 18 Exclusion area mode

Items	Contents
Add/Move/Resize	Add exclusion area by dragging on the display. Drag and drop to move area Dragging the corners of exclusion area to adjust the size.
Add area	Create complex pattern by clicking on the display
Delete	Delete exclusion area by clicking inside of exclusion area
Delete All	Delete all exclusion area

Operation

Step 1 : Go to **FOV** tab → Click **Board height exclusion area**

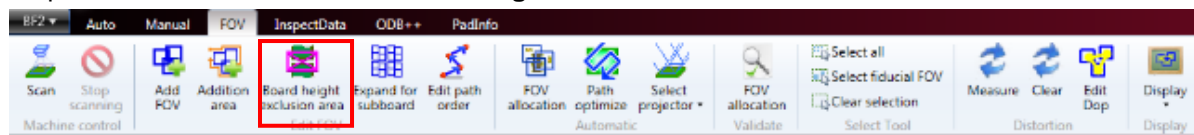


Fig 19 Board height exclusion area

Step 2 : Select **Add/Move/Resize**

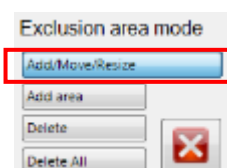
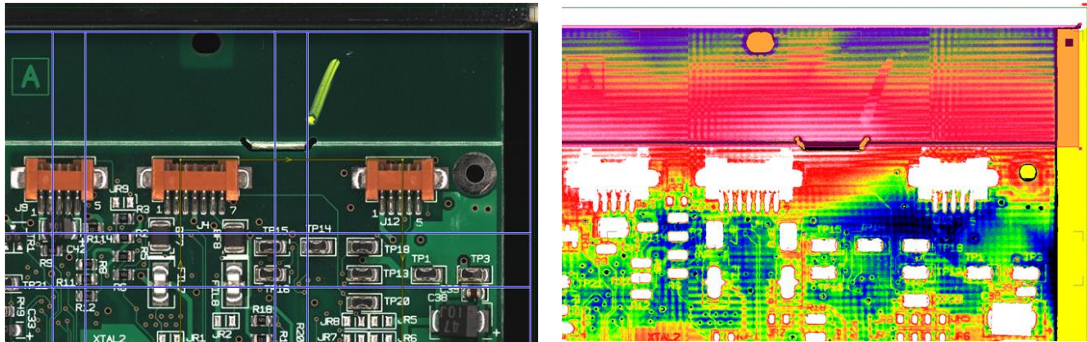


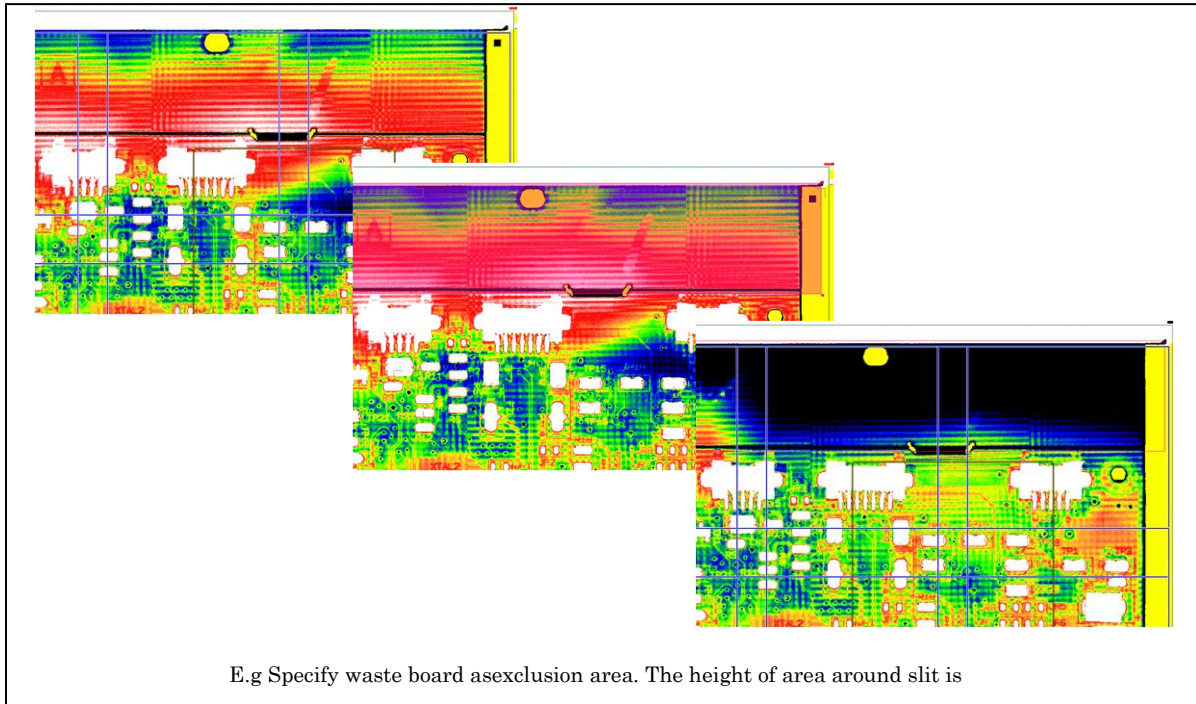
Fig 20 Exclusion area mode

Step 3 :Drag area to eliminate from the compensation. Exclusion area is added and shown in pink.



e.g. Specify waste board as exclusion area. Height calculation around slits not proper due to height differences between Board and waste board

Step 4: Close exclusion area mode and scan the board. Check the result with board height filter if the result is not proper, repeat step3-4. To delete exclusion area, select **delete** and click area to delete..



E.g Specify waste board as exclusion area. The height of area around slit is

10. REVISION

Revision	Date	Description	Written by
00	2014/12/04	First	S.Yanagisawa
01	2015/12/15	Update	G.Kurio
02	2016/1/6	Update	A.Iwase