Meet the Needs of the SMT Age

Please read this user manual carefully before running

SM-VL-800D/L680/H680 Automatic Optical Inspection Machine

USER MANUAL

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2.Main Uses and Scope of Application of Equipment

AOI (Automatic Optical Inspection) is composed of workbench, camera system, electromechanical control and system software. During inspection, the circuit board to be inspected is first placed on the workbench of AOI machine, and the inspection program of the product to be inspected is called out through positioning. The X/Y workbench will send the circuit board under the lens according to the command of the set program. With the assistance of special light source, the lens will capture the image required by AOI system and carry out analytical processing. Then the processor will move the X/Y workbench to the next position to collect and carry out analytical processing on the next image. Through continuous analytical processing on the image, a higher inspection speed can be obtained. AOI image processing in essence is to digitize the captured images, and then compare them with pre-stored "standards". After analysis and judgment, if defects are found, their position will be prompted, and image characters will be generated for further confirmation by the operator. Or, the circuit board will be sent to the maintenance platform for maintenance

AOI used in online inspection is mainly for the following two targets:

--Final quality: monitoring the final state of the product when it goes down the production line. At this time, AOI is usually placed at the end of the production line.

In this position, the equipment can obtain a wide range of process control information.

-Process tracking: monitoring the production process by using inspection equipment. It is often required to place the inspection equipment at several positions on the production line to monitor the specific production conditions on-line and provide necessary basis for the adjustment of the production process.

The placement position of AOI can be flexibly arranged according to production requirements, but for its main purposes, three positions are common:

-AOI inspection is arranged after solder paste printing: the AOI inspection is arranged after the solder paste printing, which is a typical arrangement because many defects are caused by poor solder paste printing. Insufficient solder paste may lead to component loss or open circuit.

-AOI inspection is arranged before welding: arrange the inspection before welding and after the patch and plug-in process to inspect defects caused by poor mounting and plug-in.

-AOI inspection is arranged after welding: this is the most common arrangement of AOI, which can inspect defective products in all previous processes to ensure that the final defective products will not be used by customers.

3.Working Conditions of Equipment

To avoid external factors affecting the normal use of this equipment, please follow the following items:

1. Operating environment of this equipment:

    The environment temperature of the equipment is: 10°C to 35°C; the relative humidity is:35% to 80%.The equipment shall be placed in a place free from direct sunlight, dew and splashing of chemical liquids such as water and oil.

2. When the equipment is in normal use, please reserve a certain space in front of and behind the equipment so as to facilitate the maintenance of the equipment and the emission of internal heat. Do not cover the equipment with cover during its normal operation, so as not to affect the heat emission.

3. Please keep the equipment in the following places when the equipment is not used:Environment temperature: 0°C to 40°C; relative humidity: 35% to 80%

    The equipment shall be placed in a place free from direct sunlight, dew and splashing of chemical liquids such as water and oil.

    To prevent dust, the   equipment may be covered.

4. Impact or strong vibration should be avoided. Otherwise, the failure of equipment may be caused.

5. When cutting off the power supply of the equipment, please perform the system exit/shutdown process in the following order. If the power supply is directly cut

off or restarted without performing this process, the data will not be kept intact

and the hard disk may also be damaged.

The correct exit procedure is as follows:

Exit application program → Exit Windows → Cut off power supply

6. When the equipment is running, do not open the safety door of the equipment

to avoid accidents.

7. Repeated ON /OFF of the power supply will cause the failure of the main machine.

After the power supply is OFF, please restart the power supply after 20 seconds.

8. To prevent the PCB or equipment to be inspected from being damaged, please

use the substrate of inspection object conforming to the specifications and

dimensions of the equipment.It is necessary to note that the height requirements

of the equipment for the parts of PCB are as follows:PCB inspection surface

9. Height of front part ≤ 30 mm Height of back part of PCB inspection surface

≤50mm

4.Main Technical Parameters

Programming mode: automatic writing, manual writing, CAD data import, automatic

component library matching inspection mode: optimized inspection technology

covering the whole circuit board. Jointed board and multi-mark with Bad Mark

function

inspection type: whether paste printing has parts defects such as offset, lack of tin,

excessive tin, open circuit, pollution; whether there are mounting defects such as

missing parts, offset, skew, Manhattan effect, side erection, turning over, wrong parts, breakage, reverse, etc; whether there are solder joint defects such as excessive tin, lack of tin, cold soldering and bridging; whether there are PCB defects such as copper foil pollution, black pad, blister, lack of copper foil, oxidation, etc.

Image recognition: automatically setting parameters (such as offset, polarity, short circuit, etc.) according to different inspection requirements.

SPC statistics function: recording the inspection data in the whole process, and making statistics and analysis. Viewing the production status and quality analysis of any area.

PCB size: 50*50mm(Min)-400*360mm(Max)

PCB bend: <5mm or 3% of PCB diagonal length

Height of PCB parts: above < 30mm, below < 50mm

PCB transmission system: bottom-up fixing, automatic compensation for PCB deformation, automatic board feeding and discharging, automatic adjustment of width

Positioning accuracy: <16um

Movement speed: 800mm/sec

Image processing speed: 0402chip < 12ms

Camera and lighting system: full-color high-speed digital camera, optional lens resolution between 8um and 25um , three-channel RGB light source

Driving system: AC servo motor system, precision grinding ball screw

Minimum part inspection: 01005 chip & 0.4pitch IC

Software system: Windows 7

Calculation methods: color operation, color extraction, gray scale operation, image comparison, etc.

Output display: 22-inch widescreen (16:10,1680*1050 resolution) display

Output signal: OK/NG signal, equipment operation status signal, alarm signal

Network communications: supported

Data transmission tool: supporting CAD, Excel, Txt and other commonly used formats

Machine models: S-L680 (on-line), S-H680 (off-line)

Air pressure requirement: compressed air in pipeline is required, ≥0.49MPa

5.Main Working Principles

This equipment performs inspection mainly based on optical principle and comprehensive use of principles color operation, color extraction, gray scale operation, image contrast.

1. Optical principle

AOI's light source is composed of red, green and blue LED lamps. The three primary colors are combined into different colors. Combined with the specular reflection, diffuse reflection and oblique reflection in the optical principle, the welding of the patch elements on the PCB is displayed. As shown in the following figure:
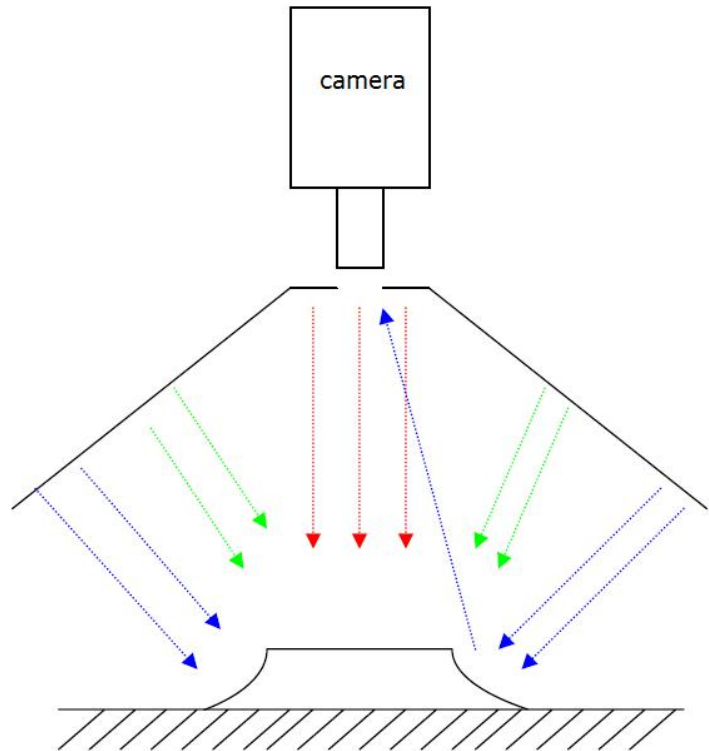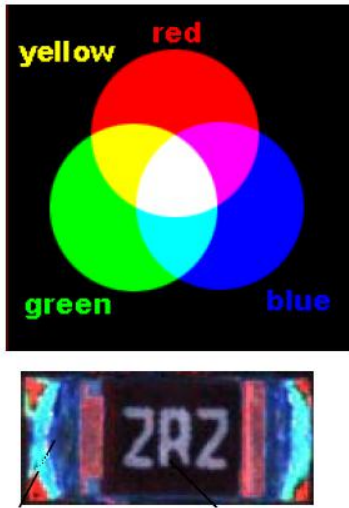
2. Color operation principle

Through rasterization of a BMP picture, the imaging details, such as the position coordinates of the color distribution of each pixel and the color transition relationship between imaging grids, are analyzed and several functional formulas are listed. Then, data extracted from several similar pictures with the same area size is analyzed and calculated. The calculation results are restored according to the weight relationship set by software and the pixel colors and coordinates of the original BMP image to a virtual and weighted digital image. The main digital information covers the image's graphic outline, color distribution, weight relationships allowing changes, etc.

3. Principle of image contrast

During inspection, the equipment captures the images of the inspected circuit board through the CCD camera system, transfers the images into the computer through digital processing, calculates and compares the images with the standard images (the comparison items include the size, angle, offset brightness, color and position of the components, etc.) and outputs the images with the comparison results exceeding the rated error threshold through the display, and displays the specific positions of the images on the circuit board.

4. Principle of color extraction

Any color can be mixed with red, green and blue in a certain proportion. A three-dimensional color cube is formed with red, green and blue.Color extraction is to cut a small color cube that we need from a set of color cubes. In other words, the color range is selected according to needs. Then, whether the ratio of the color in the inspected image that meets the color in the cube to the total number of colors in the image meets the setting range required. Under the red, green and blue light, this method is most suitable for the inspection of soldering tin such as resistance and capacitance.

5. Principle of gray scale operation

The target image is converted into gray scale image according to certain method. Then, a certain brightness threshold is selected for image processing. The image below the threshold is directly turned into black, and the image above the threshold is directly turned into white. In this way, the concerned areas, such as characters and IC short circuits, are directly separated from the original image.

6.Installation and Commissioning of Equipment

1. Equipment installation

This equipment is mainly divided into two parts, namely control system and image acquisition system. The equipment has already been installed before leaving the factory. It is only necessary to confirm that all signal lines of the control system and image acquisition system have been correctly connected. Turn on the equipment after adjusting the level. Correct the light source and camera parameters.

2. Level adjustment

After the equipment is moved to the destination and the specific position for placement of the equipment is determined, the level of the equipment must be adjusted first. Correct adjustment of the level enables the equipment to run more smoothly, with less noise and longer service life. The steps for adjusting the equipment level are as follows

● Suspend the four foot cups of the equipment and push it onto the wire body with casters. Ensure that the front rail of the equipment and the front rail of the front machine are on the same longitudinal line. Then adjust the foot cup downward to make the casters suspended, and raise the rail to make it on the same level as the rail of the front machine.

- Adjust the front, back, left and right levels of the equipment. At the same time, confirm that the reference of the equipment track and that of the front machine track are consistent on the longitudinal line and horizontal plane.

- If tools such as wooden stick are used to pry the equipment so as to slightly move it, please make sure that the wooden stick is in contact with the steel frame at the bottom of the equipment and should not be in contact with the equipment casing. Otherwise, the casing will be damaged and even be deformed by too violent pry.

- The track width can be adjusted to the same as that of the front machine track. The PCB sliding on both tracks should be smooth without height drop.

- Lock the fixing nuts of the four foot cups.

3. Starting the equipment

Connect the air pressure, connect the power supply according to the standard on the equipment nameplate, and ensure the safe grounding of the equipment. Turn on the red universal change-over switch on the right side of the equipment to start main power supply, check to ensure the emergency stop button has not been pressed, and then press the RUN button to turn on the main power supply of the equipment. Then, turn on the power of the host. After the system normally enters the Windows interface, double click on the AOI software shortcut on the desktop to open the software.

If there is an emergency during operation, press the emergency button immediately. After eliminating the emergency and ensuring that the equipment and personnel are safe, rotate the emergency button clockwise

and release it to reset. Press the RUN button again to turn on the main power of the

equipment again.

7.Use and Operation of Equipment

This Manual involves two models of the series products of Southern Machinery

AOI.S-L680 is an on-line model of this series (hereinafter referred to as the on-line

model). The machine is embedded into the user's production line through

connection equipment to automatically complete board feeding, inspection and

board discharging; S-H680 is the off-line model of this series(referred to as off-line

model). It requires operators to manually load the circuit board to be inspected for

inspection. Except for the functions related to the loading of fed and discharged

boards, the models have similar programming and inspection functions and use the

same inspection algorithm. Unless otherwise specified herein, the functions are

common to both models.When the user clicks on the AOI icon on the Windows

desktop to start the program, the system will first enter the login screen

The user logs in the system for subsequent operations according to the user name and password preset by the administrator. Southern Machinery initial password is 123456. The system inspects the validity of user login, determines the user operation level, and grants corresponding operating authorization. Users in a bi-lingual environment can choose to log in the English interface.

Users are divided into the following three operating levels.

Administrator: operating all functions and set user name, password and operation level of other users through user management program

Programmer: operating programming and debugging related programs

Operator: implementing inspection according to pre-tested programs

After logging in, the system will automatically complete a series of initialization work, including camera parameter setting and public library loading, and prompt the user whether to directly open the inspection program used last time. If the user does not directly open the previous program at startup, the programmed program in the machine can be selected and opened through the program opening function in the system.
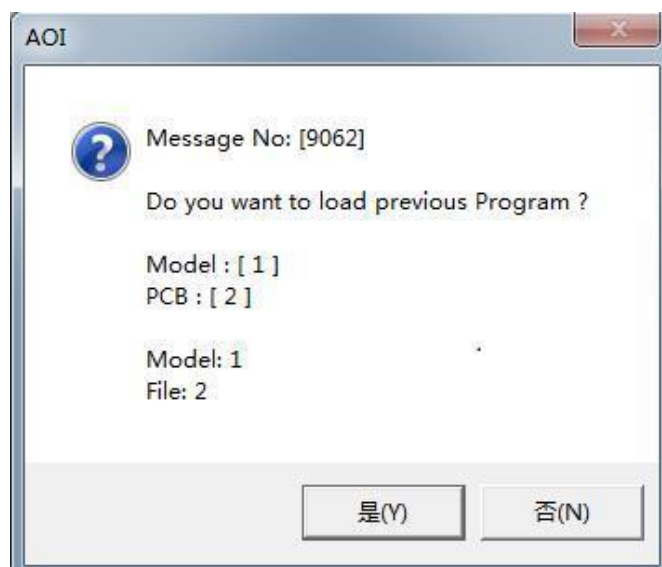
After logging in, the user enters the main menu interface of the system which is the main entrance for all system operations. The user enters the following hierarchical submenu from the main menu and selects the corresponding function to operate.

In this Manual, we basically describe the function operation with submenu structure, and the sequence will be slightly adjusted according to the user's operation steps. Some functions are designed for dual-track models, which is not covered by this Manual and will be skipped.
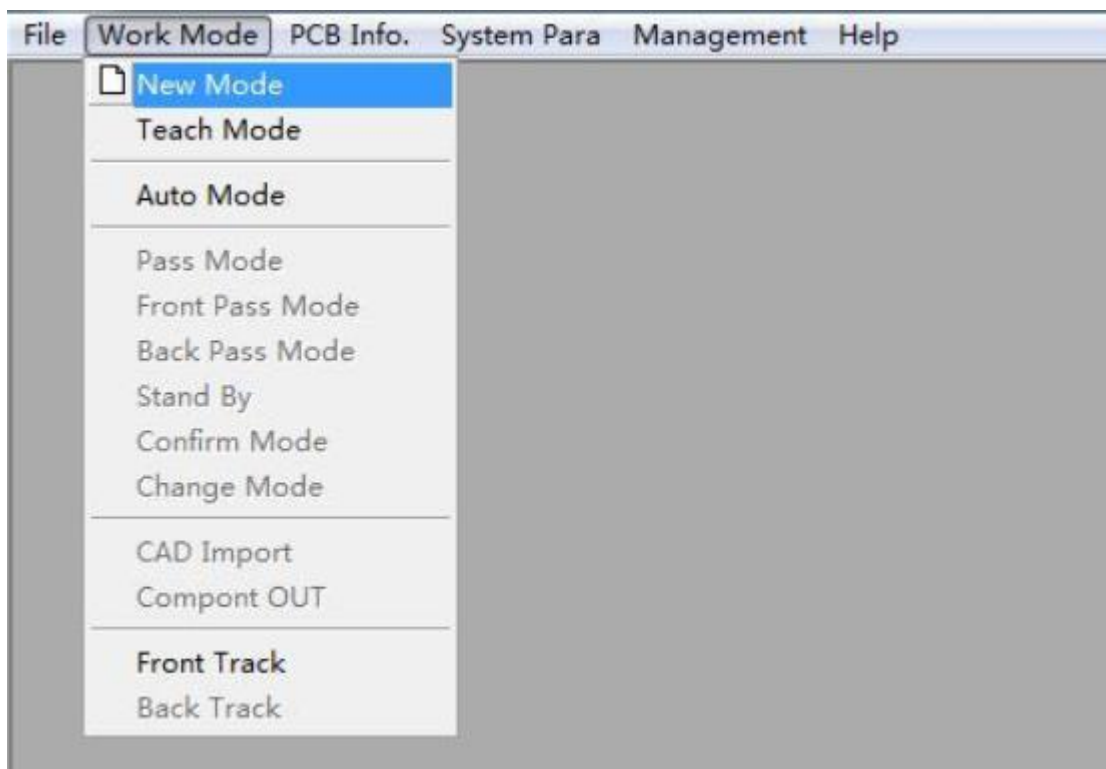
Both on-line model and off-line model support left and right board placement. The most frequently used modes actually are off-line left board placement and on-line right board placement. In this Manual, the off-line left board placement mode will be explained in details.

1. Working mode

The working mode submenu under the main menu is the entrance for the user to switch various operating modes.

1.1 New program mode

The user can create a new inspection program through this function.

Before entering the new program mode, the user should place a qualified PCB for programming on the lower left corner of the workbench and fix the fixture on the workbench.

After entering the new program interface, the user may click on the position icon in the lower left corner of the schematic diagram of the substrate on the right side of the screen to quickly move the workbench to the predefined

position in the lower left corner of the board to be inspected (the setting process is described in other relevant sections below). This position is also regarded as the zero point of the PCB. The operator can also directly click on the move arrow button in the figure to move the workbench in place. The midpoint of the crosshair in the image is the current location of the camera center.

For the main working interfaces of the system, the upper left part of the screen is used to display the actual image of FOV, which is called image working area. The image working area has several functional options:

· Continuous collection: it is used to set continuous photo taking and image displaying.

· Single-step moving: moving an unit for each click of moving button

· Crosshair: marking the crosshair in the center of the current screen. The crosshair intersection is the current camera center.

· FOV center: after FOV path planning is completed, check this option, and the camera will only move to the nearest FOV center.

· Light source: switching different light source images when the multi-light source option is turned on

· Moving button: the move buttons around control the camera to move and take pictures.

· Positioning button: after clicking on this button, click the mouse in the image working area to quickly move the camera to this position.

· Screen switching: switching between full screen display and half screen display

· Screen scaling: the user may select and drag the scroll bar to scale the display scale of the screen working area image.

One of the key operations in creating the new program is to define the size of the board to be inspected because the size of each board to be inspected is different. When the lower left corner of the board is fixed at the fixed position of the workbench, the position of the upper right corner will be different. Thu user needs to move the camera center crosshair to the upper right corner of the board through the moving button (as shown in the figure below), and click

on the "setting upper right corner" button below to complete the size definition of

the board to be inspected.
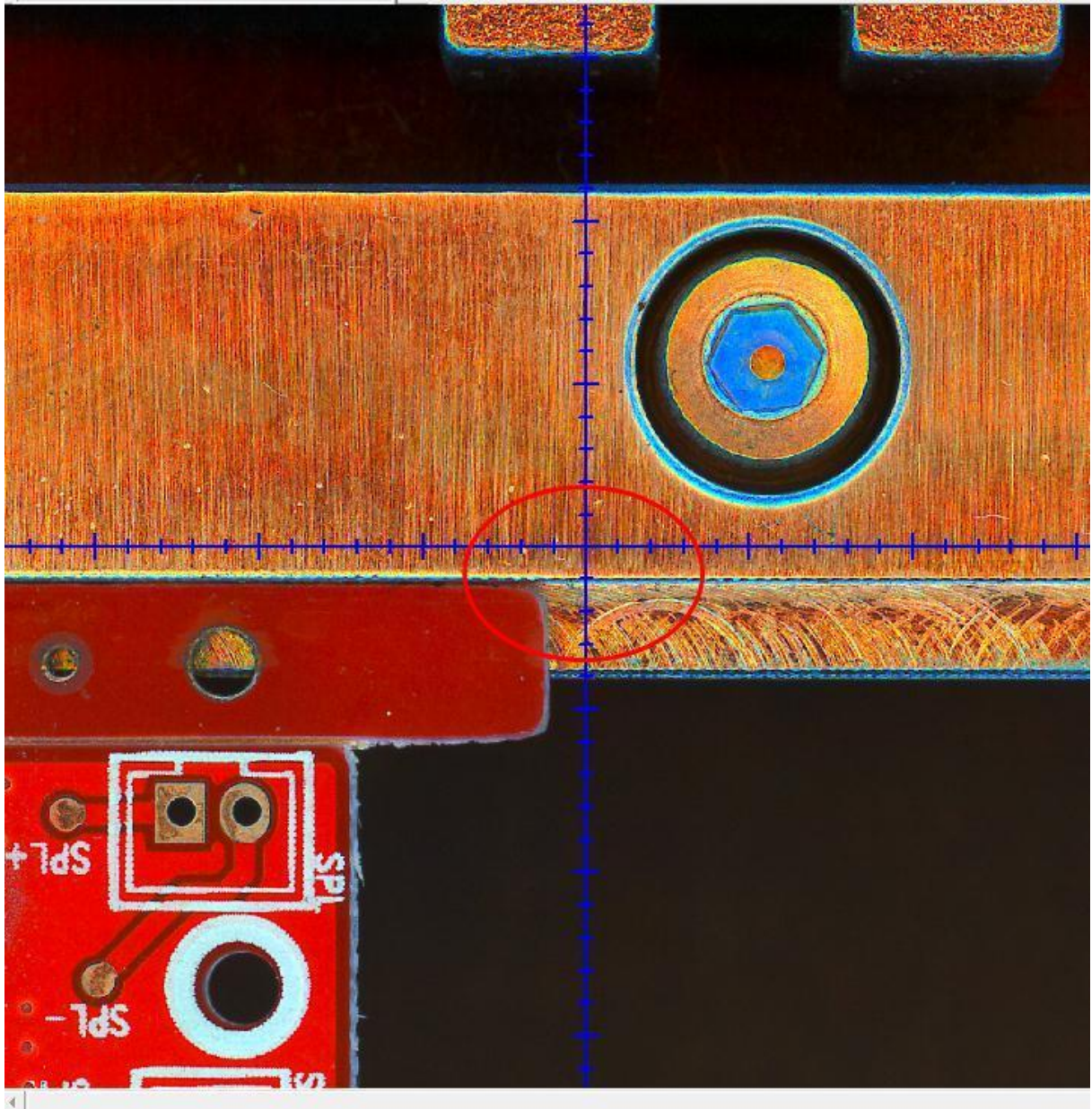
After the board size definition is completed, the operator clicks on "PCB scanning" to

start scanning thumbnails of the whole board. The thumbnails will receive

pixel-compression and will only play a role of position indication in subsequent

operations. If the user needs to use the off-line programming (OLP), check the

"saving PCB image" option before starting scanning. The image will not be

compressed and will be relatively large. When it exceeds a certain size, the user may need to check the "splitting image" option.

Before the scan starts, the user will be prompted to enter the name of the new program. The size of the board, the scanned image and all program information will be stored in the name of this program. In this system, AOI programs are named, stored and managed at two levels: model name and file name. During scanning, the display area on the right side of the screen will display the scanning progress and stitching images in real time, and the size of each stitching block is determined by the FOV field of view predefined by the operator.
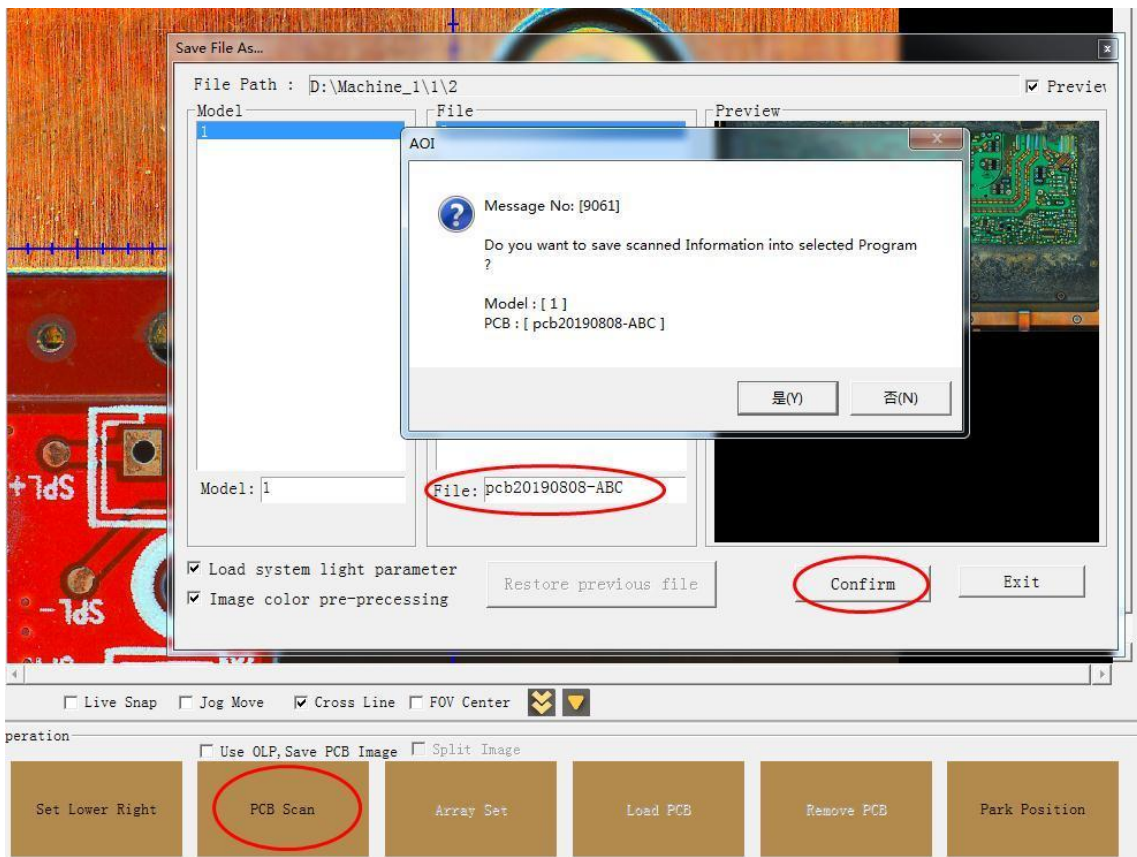
After the scan is completed, the user will be prompted to set the Mark point
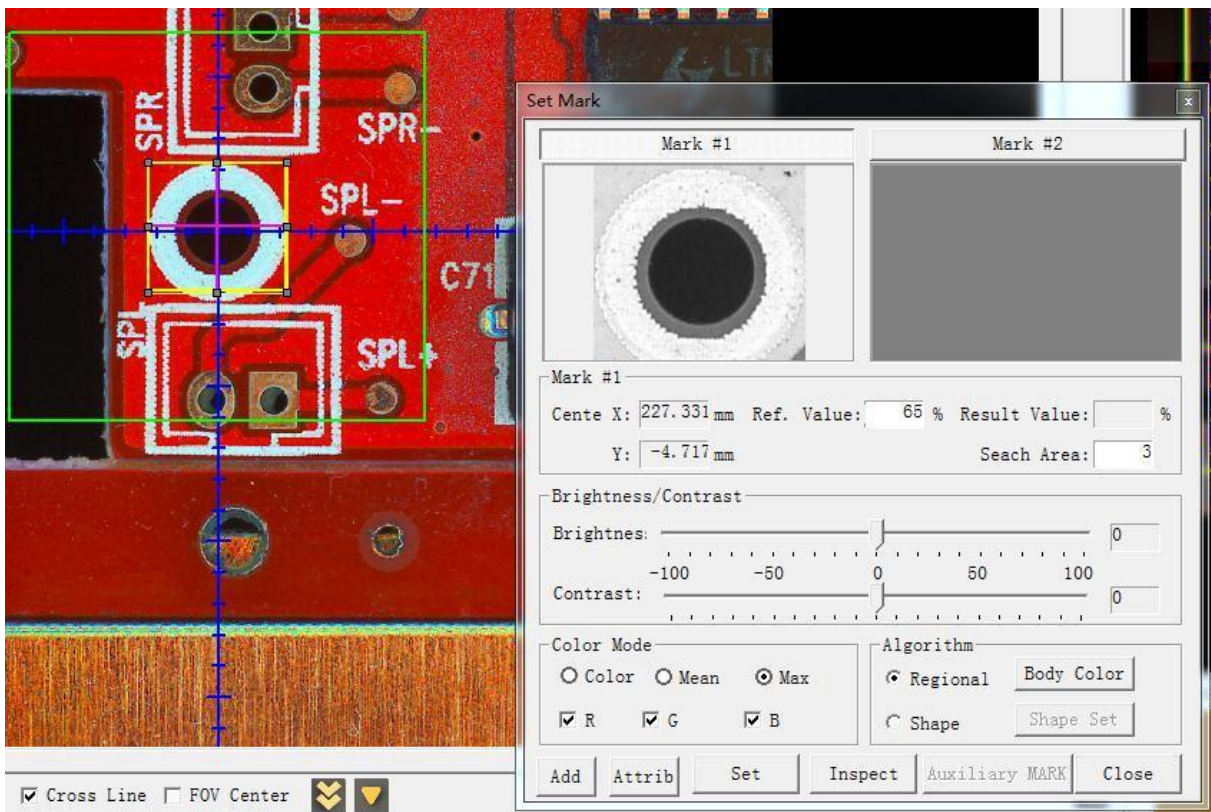
The inspection program for one PCB must set at least two Marks (it is better to find stable image features in the diagonal corners of one PCB as Mark points). Mark points will be used to correct the final positions and angles of all components to be inspected on the board, which is the basis for correct drawing and inspection of subsequent inspection algorithms.

The user may move the camera to the appropriate position and select the appropriate components or feature frames on the image working area to define the Mark point position and size and then define its reference value, search area, image pretreatment, Mark point inspection algorithm and other parameters.

The Mark point inspection algorithm is usually the region method (template matching) or the feature method (contour comparison). If the Mark points to be

inspected have different visual appearances in actual situations and result in Mark point inspection failure, the user may consider grouping Mark points and adding inspection templates to improve the matching success rate.

After setting the Mark point, the new program is created. The user can enter editing mode for subsequent programming.

1.2 Editing mode

The editing mode is the most complex and important interface of the system, and is the core of the system. In this mode, the user can define and modify elements to be inspected, inspection frame, inspection algorithms and related inspection parameters in the established inspection program.

Click on "select" to enter this menu item, and the system will take a picture immediately and inspect the Mark point of the current program. If Mark point is successfully inspected, the image position will be corrected immediately according to the offset calculated by Mark point, and the image will be displayed.
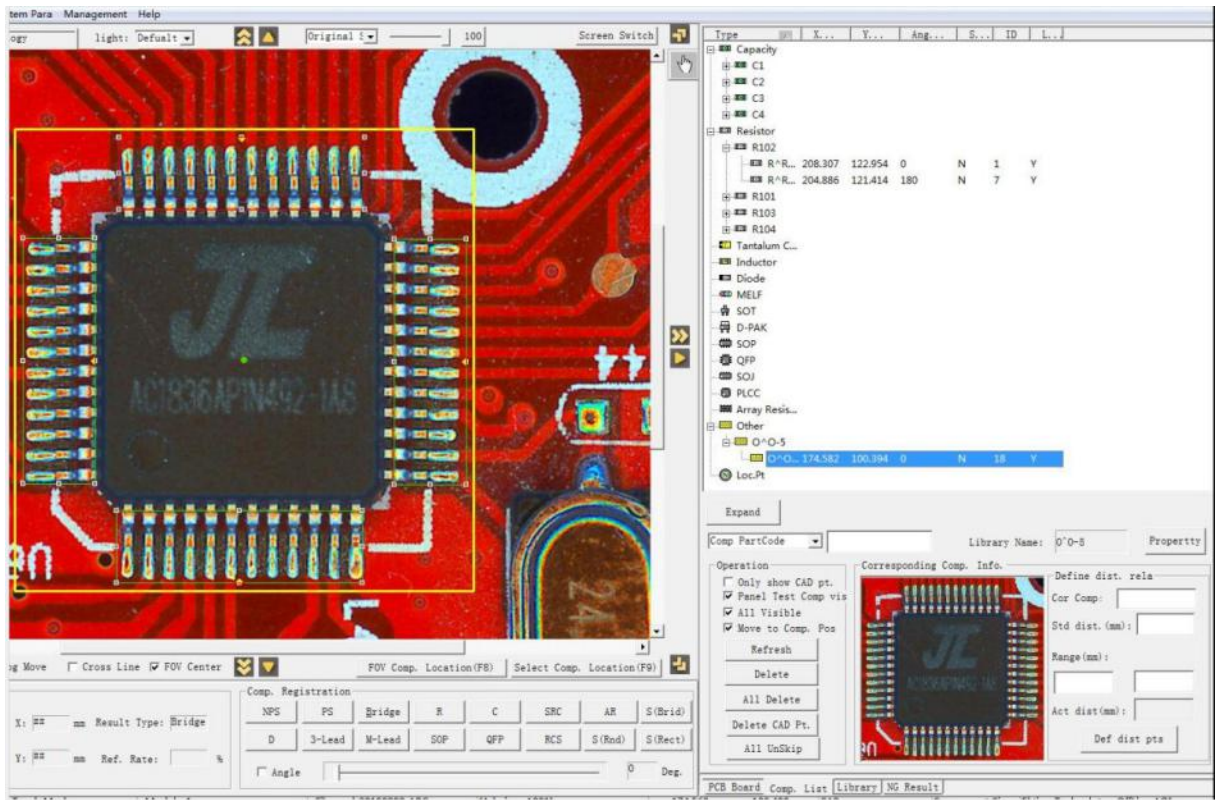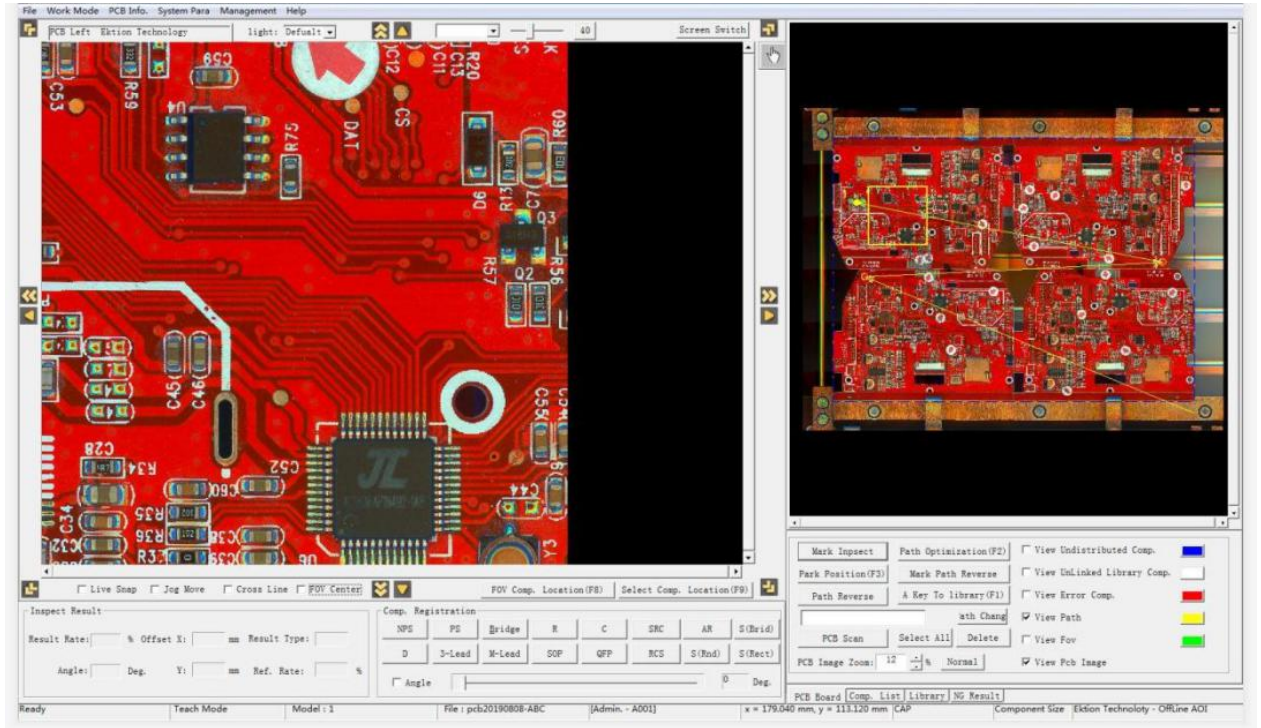
The editing mode main interface is divided into left and right parts:

The image working area on the left shows the image taken by the camera at the current position, with the size of only one FOV. It is usually refreshed when there is editing operation, or it can be refreshed automatically through the continuous collection option. The crosshair at the bottom of the screen, the image zoom scroll bar at the top of the screen,the screen switching button, and the move buttons at the four sides of the screen can all facilitate operation during editing.

The selection of light source channel above the image working area takes effect when the user selects multiple photographing states, and the user can select different image effects under different predefined light source combinations to carry out targeted programming (for example, silk screen is inspected with bottom side light). The default display is color multi-channel diagram.

The image area is the main operation area of the editing mode. The user can define the coordinate position, component size, angle, inspection algorithm and standard of the component to be inspected by framing at the corresponding position of the image in this area with mouse. This process is called component registration. Component registration is the basic data of an inspection program. All inspections are carried out around the component registration data.Under the framework of this system, component registration is divided into two levels, component and inspection frame under it. One component contains one or more inspection frames. The main programming work is based on the inspection frames. The inspection algorithm is also based on the inspection frame settings. The inspection of one component is

based on the separate inspection of all inspection frames under it. The system comprehensively determines whether the component is qualified according to the inspection results of these inspection frames.
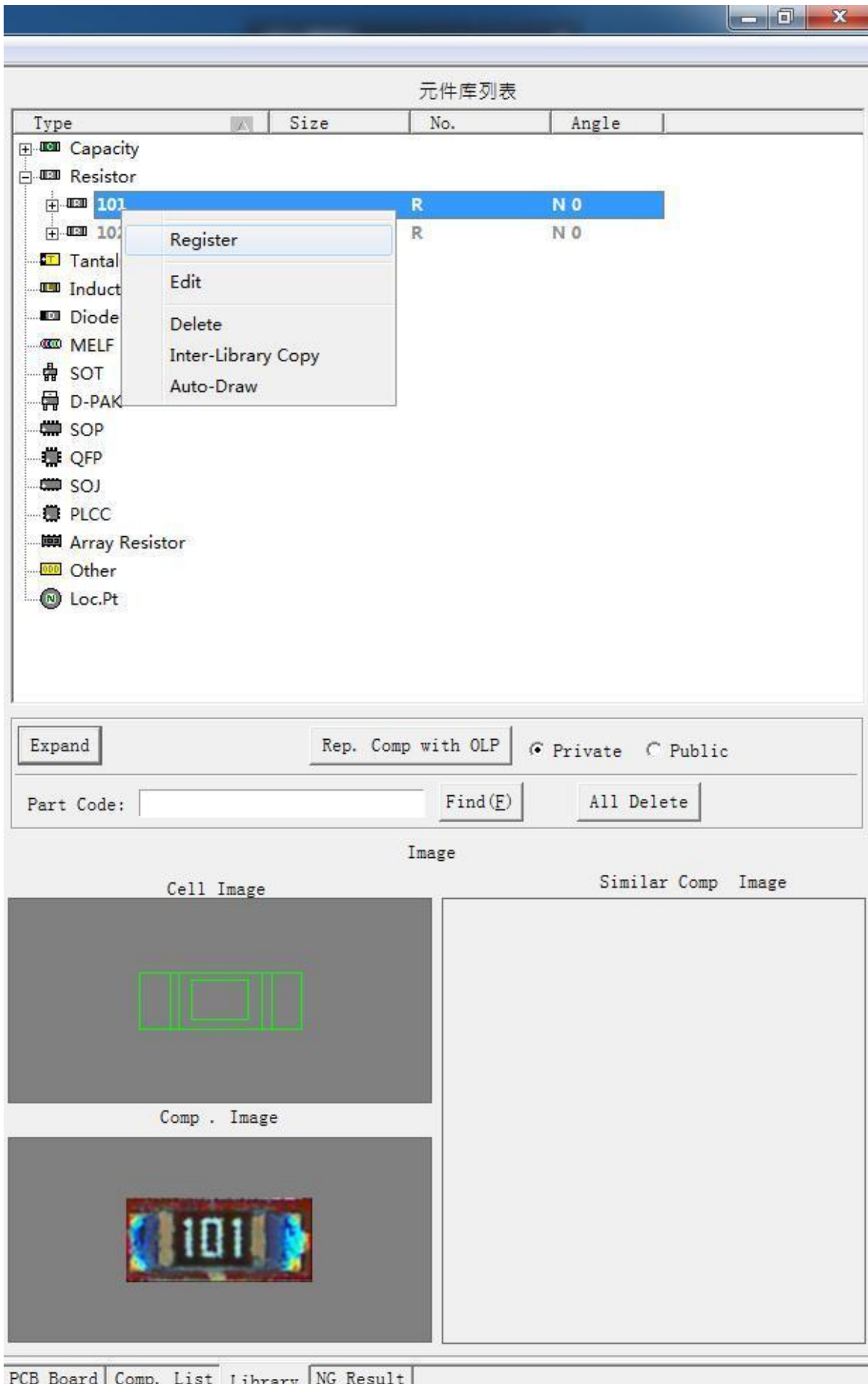
The right working area is divided into four pages:

- PCB image page: displaying thumbnails of the program. The positions and sizes of all programmed elements, FOV, skip region, jointed boards are displayed through thumbnails. The user can quickly move the camera lens to a certain position on the thumbnail by clicking the mouse to take picture and refresh the image working area.

- This page also has some commonly used function buttons:

· Mark point inspection: inspecting Mark points once and correct the image of the image working area

· Path optimization: calculating the number and path of FOV needed for inspection according to all currently defined elements to be inspected and FOV size.

· Change of Mark points order: changing the inspection order of two main Mark points to be inspected.

· Path reversal: reversing the FOV path already defined and changing the order of Mark points. This function can reduce the total inspection path length and save camera moving time.

· Path adjustment: its purpose is the same as that of path reversal. The user can freely define the FOV inspection path according to FOV serial numbers, and the serial number of each FOV is separated by commas

· Position to be inspected: moving the camera center to a predefined position to be inspected.

· One-click entering: all components that have not been entered into the catalog are entered into the catalog by default material code

· Preparing thumbnails: rescanning to prepare thumbnails

· Adjusting the thumbnail display scale

· Component list page: it is used to display defined inspection components. The user can find, delete and shield part or all of the components here, or may double click on the corresponding component to move the camera center to the component to take photos and display them in the screen working area on the left side of the screen.

- Among all components, the components whose coordinates are imported through CAD but whose registry definition has not been completed will exist as special components. The user can choose to view or delete such CAD locating components in this interface. In addition, the user can also define the ranging operation between the center points of the two related elements.
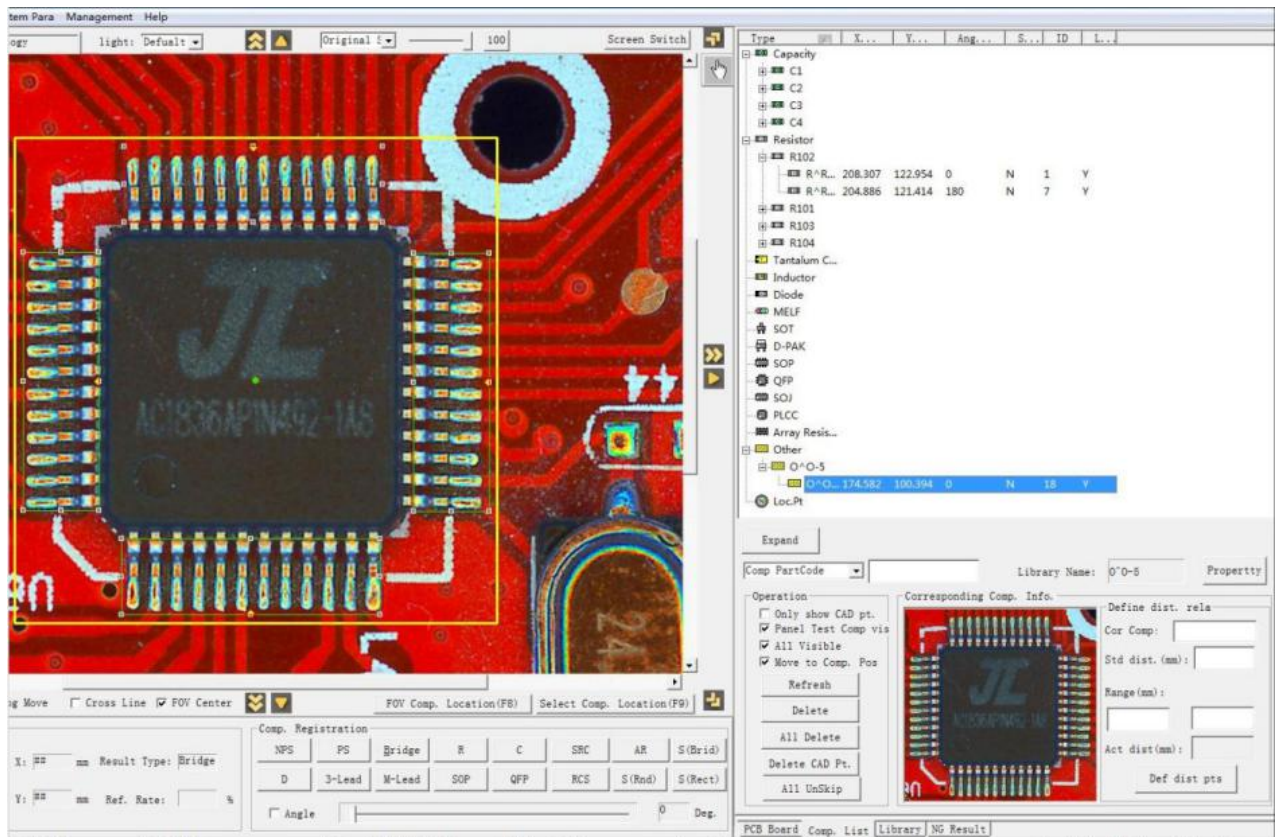
- -Component library page: it is used to manage private and public libraries of
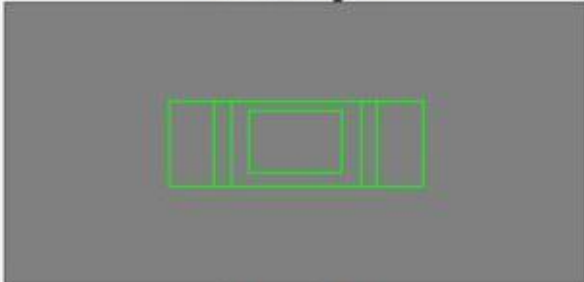
components in the system

元件库列表

Type	Size	No.	Angle
⊞ Capacity			
⊟ Resistor			
⊞ 101		R	N 0
⊞ 102		R	N 0
Tantal			
Induct			
Diode			
MELF			
SOT			
D-PAK			
SOP			
QFP			
SOJ			
PLCC			
Array Resistor			
Other			
Loc.Pt			

Register
Edit
Delete
Inter-Library Copy
Auto-Draw

Expand   Rep. Comp with OLP   ● Private ○ Public

Part Code: [   ]   Find(F)   All Delete

Image

Cell Image

Similar Comp Image

Comp . Image

PCB Board | Comp. List | Library | NG Result

元件库列表

Type	Size	No.	Angle
⊟ Capacity			
⊞ C1		C	Y 0
⊞ C2		C	Y 0
⊞ C3		C	Y 0
⊞ C4		C	Y 0
⊟ Resistor			
⊟ 102		R	Y 0
cell_000	084x044	lib0000001	000
cell_001	048x032	lib0000002	000
cell_002	032x044	lib0000003	000
cell_003	032x044	lib0000004	000
⊞ R101		R	Y 0
⊞ R102		R	Y 0
⊞ R103		R	Y 0
⊞ R104		R	Y 0
Tantalum Capacity			
Inductor			
Diode			
MELF			
SOT			

Expand   Rep. Comp with OLP   ⦿ Private ○ Public
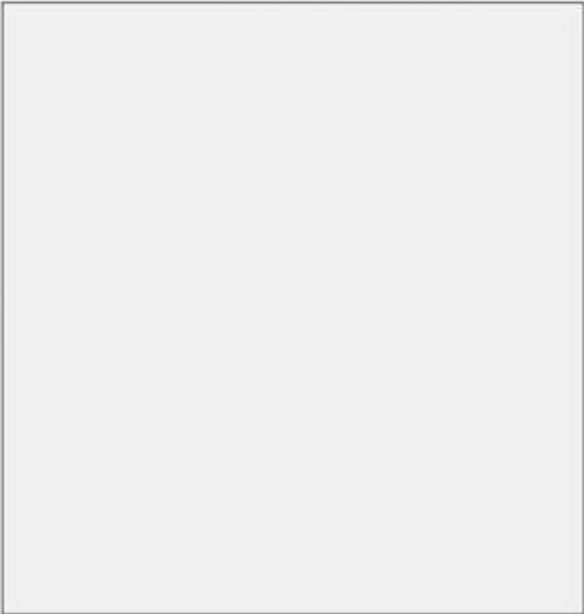
Part Code: [   ]   Find(F)   All Delete

Image

Cell Image

Similar Comp Image

Comp . Image

PCB Board | Comp. List | Library | NG Result

Library is an important part of this system. The user stores the registered component data in the library in component material codes. After that, the user may use the components in the library to register other identical components, so that these components maintain the same registration diagram and inspection standards. The modification of the standards in the library will automatically apply to all registered components corresponding to the library components. Repeated use of component inspection standards in the library can simplify programming, shorten debugging time and increase inspection stability.

The library of this system is divided into two parts: private library and public library. The private library is defined by single inspection program and stored together with the inspection program. It is effective within that inspection program. The public library data is cross-library and stored separately. It can be shared by all inspection programs running on an AOI machine. The inspection program directly uses private library data during inspection, and the system supports manual and automatic exchange data between public library and private library.In the component library page, the data of the two libraries can be switched by selecting the private library button and the public library button. The library files are sorted and listed by component category, and can be collapsed or expanded in the display area. When the user clicks to select and view a certain component, the corresponding registered image will be displayed in the lower image area. The user May also find and delete the library components of a material code through on-screen keys.By clicking to select the components in the library and then clicking

to confirm at any position in the image, the user can use the component standards in the library to automatically frame on the image area to register the components, thus realizing the purpose of reusing the component definition data to simplify the programming process.

The newly registered component will inherit the inspection standards of the corresponding component in the library. If the user directly uses the component in the public library for registration, the system will inspect whether the component of the same material code already exists in the private library. If such component already exists in the private library, the system will directly use the component in the private library for registration. If there is no such component in the private library, the component in public library will be automatically copied to the private library. Then, the new component registration will be performed using the component in the private library.In addition, if a component in the image working area is selected, select a component in the library on this page, and click on the "replacing the selected component with the component in the library" button. All components with the same material code as that of the selected component will be replaced by the selected component in the library at the original coordinate position. This is the "standard replacement" function in this system.

On the component library page, regardless of a private library or a public library, if the user clicks on a component in a library and then click the right mouse button, a menu will pop up. The menu includes the following functions:

Registration: click registration mentioned above

Component attribute: popping up the registration data of this component and the inspection frame under it for the user to modify and maintain (refer to component registration)

. Deletion: deleting the component from the current library

Copy of component between libraries: the system will pop up component library copy window. The user can use this function to copy the component registration information between the public library and the private library. The copy range includes single component, category and all components. For existing components, there are two modes for selection, namely overwriting and skipping. If a component in the private library has already been used for registration in the current program, it cannot be overwritten.
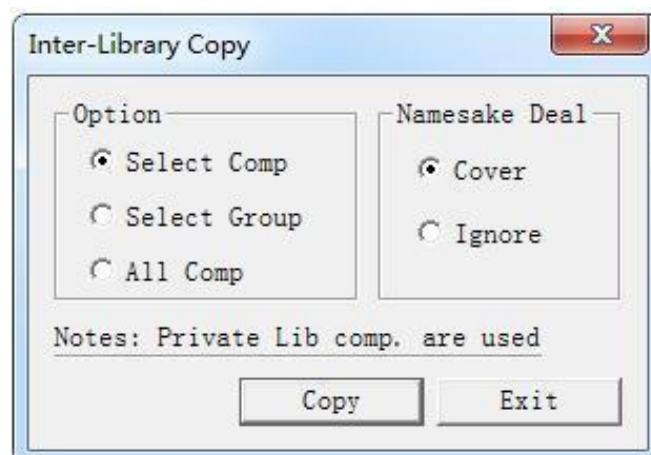
. Automatic component framing: clicking on this function to use the currently selected components as the template to automatically search for possible matching components at a fixed matching standard rate within the image working area, The registration will also be automatically completed.

- NG result interface: this page provides auxiliary functions mainly used for debugging steps after completion of programming.

After the user implements an inspection in the debugging mode, the NG components in the inspection results will be filled in this table, facilitating search and location when adjusting the program according to the test results.

No.	Location	Index	FOV	Angle
1(1)	C-7	35	2	0
2(1)	C-6	34	2	0
3(2)	R-3	26	2	0

Comp. Image

Option

☑ Inspect Complete extraction Result

☑ Double Click Move To Comp.

NG Num: 3

Clear Ng Result

PCB Board | Comp. List | Library | NG Result

s.: | CAP | Component Size | OffLine AOI

The system provides a variety of component registration methods for different user environments:

- Frame registration: this is the most direct method of registration. The inspection frame is the most basic inspection unit of a component. According to the number of inspection items, the component can be divided into single frame component and combined frame component.

- The user can draw a single frame inspection for a single inspection item of a simple element, which is single frame component; the user can also draw a single frame for each inspection part of a component to obtain a series of single frame components, and then merge these single frame components that have not been entered a combined frame component as required.

- To simplify the programming process, the system provides combined frame samples of a variety of commonly used components for the direct use of users. There are two rows of inspection frame category buttons under the image working area, including single frame and combined frame.

- During registration, according to the inspection requirements of the components to be registered, click on the button corresponding to the category of the inspection frame, then click the left mouse button at the location of the components to be registered in the image working area to drag for framing, and release the mouse when the component registration area is completely framed. The component size and coordinate location will be set accordingly, and the component attribute window

and the inspection frame attribute window under it will automatically pop up in the right screen. The system will automatically provide the preset initial value for the inspection frame according to the preset value, and the user can modify and adjust it as required.

- For the components with completed framing, if they have not been entered and are not associated with the components in the library, any registration parameters set at this time only cover the components and cannot be shared.

- CAD import registration: if the user has the coordinate position file (EXCEL or text format) of the component on the PCB, the coordinate file can be imported through the CAD import function provided by the system, and the system will automatically generate CAD virtual component points at the corresponding positions and display them in the image working area as special point images.

- If the component material code contained in the coordinate file already exists in the component library, the system will automatically use the components in the file library to complete registration at the coordinate point (this function will be described in detail in " 'CAD import").

- If the material code does not exist in the component library, the user may directly frame on the CAD virtual component point to cover the CAD virtual component for registration. Then, select whether to enter the component

immediately and automatically overwriting the CAD points of the same material code on the PCB.

- The user may not enter the component for underwriting immediately, and can manually enter the component after necessary adjustments are made to the components registered through framing. When entering, CAD virtual components of the same material code will also be automatically replaced.

- -Registration based on component library: according to the introduction of the previous component library function, the user may select the component in the previous component library function, the user may select the component in the component library and click on the location of the component to be registered in the image working area. The system will automatically complete registration with the component in the library at that location. The component registered by this method has already been associated with the library file.

- Copy registration: this method is relatively flexible. In the non- registration mode, the user can select one or more components by clicking the left mouse button and dragging in the image working area for framing, press Ctrl+C (Copy) or Ctrl+X (Cut), and then click on the button at the appropriate position on the screen to complete copy or cut registration (no two registration icons are selected. Click the right mouse button to cancel if two registration icons selected). If the copied component has been entered into the library before, the newly registered component will have been entered and share the registration information in the

library with other registered components of the same material code. If the copied component has not been entered, the newly registered component will inherit the default standards of the original component but maintain its own standards and will not share the standards with the original component.

- -Automatic search and registration: for the selected single entered component, the user may select the automatic component framing function in the component library submenu to find the component region matching the current library component template in the image working area for automatic framing registration, thus simplifying the registration process. However, this function requires the user to prepare reliable template images and appropriate standards in advance, otherwise it is easy to frame more components or miss components.

The system provides a series of editing methods to help users complete registration:

- In this system, the same component can appear on the PCB to be inspected at any angle. Registered components have not only coordinates but also angles. However, each inspection frame in the component has only coordinates and no angle with respect to the component, and can only rotate along with the rotation of the component. After registering a component, the user may adjust the component angle through subsequent operations. For new component registration based on entered component, the system will try to automatically set the component registration angle. When many components on the board are at non-standard angles, the user may check "angle registration" below the working area, and drag the angle registration scroll bar to rotate the whole image in the image working area to an

appropriate angle to facilitate framing registration. After framing, cancel the angle registration, and the newly registered components will maintain the set angle.

- In addition to defining the size and position of the frame by dragging the frame during frame initiation, for registered components that have not been entered, the user can click on the inspection frame of a component to

select the inspection frame, then select the edge point with the left mouse button, and drag the mouse to change the size of the component, or hold down shift+arrow key to adjust the size of the inspection frame. However, after the components are entered, the size of the inspection frame and components can no longer be changed. The following registration operations can be performed after selecting the component:

· Press space key to rotate by 45 degrees

· Press Ctrl+R,Ctrl+T to rotate the current component forward and backward by 1 degree

· Press Ctrl+I,Ctrl+O to rotate the component with the material code of the current component forward and backward by 1 degree

· Press Ctrl+W to rotate the selected component block in the current frame by 45 degrees with the block as the center

· Press Ctrl+H to horizontally mirror the selected component block in the current frame

· Press Ctrl+V to vertically mirror the selected component block in the current frame

· Press Ctrl+A to start the angle rotation window and customize the component

rotation angle
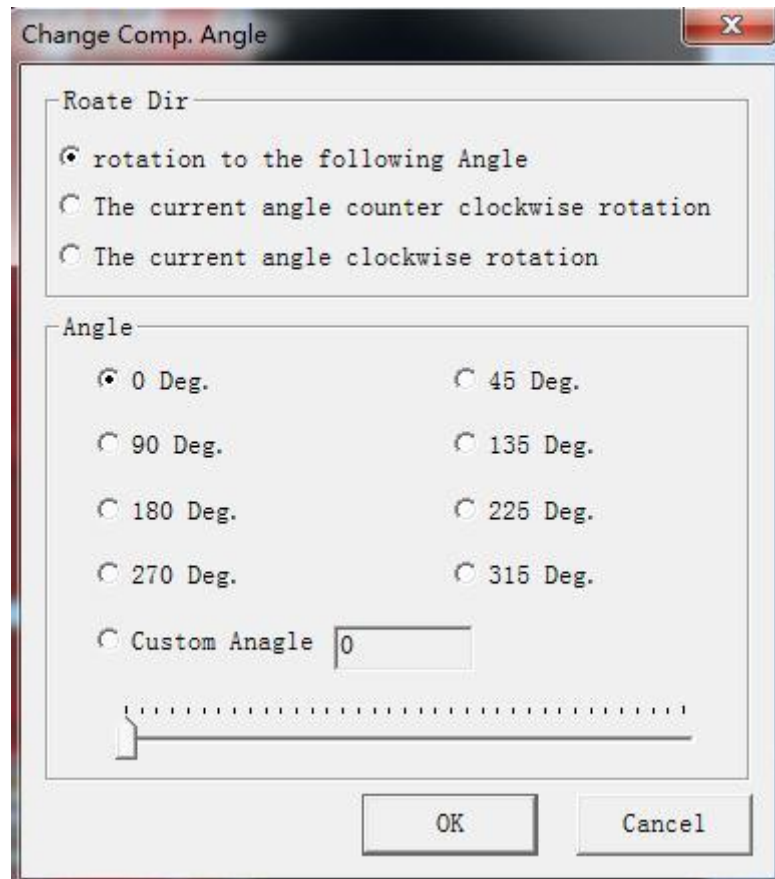
· Press the arrow keys or drag the mouse to move the component position

· Scroll the mouse wheel to change the search range of the current inspection

frame

· Press the delete key on the keyboard to delete the currently selected

component or components

- Through framing registration, the user can enter components into the private library after completion. There is a small blank circle in the center of the components that have not been entered, and there is a small green circle in the center of the components that have been entered.

- Manual entering: after selecting components that have not been entered into the library, press Ctrl+Q or click the pop-up menu to pop up the "component receipt window". in this interface, the user can select information, such as entering category, entering material code, and can also select whether to enter the component into public library at the same time; if this material code already exists in the private library, the user will be prompted whether to overwrite it; if the user chooses to enter the component into public library at the same time and this material code already exists in the public library, entering will be prohibited from ensuring uniform registration standards for registered components with the same material code across programs.
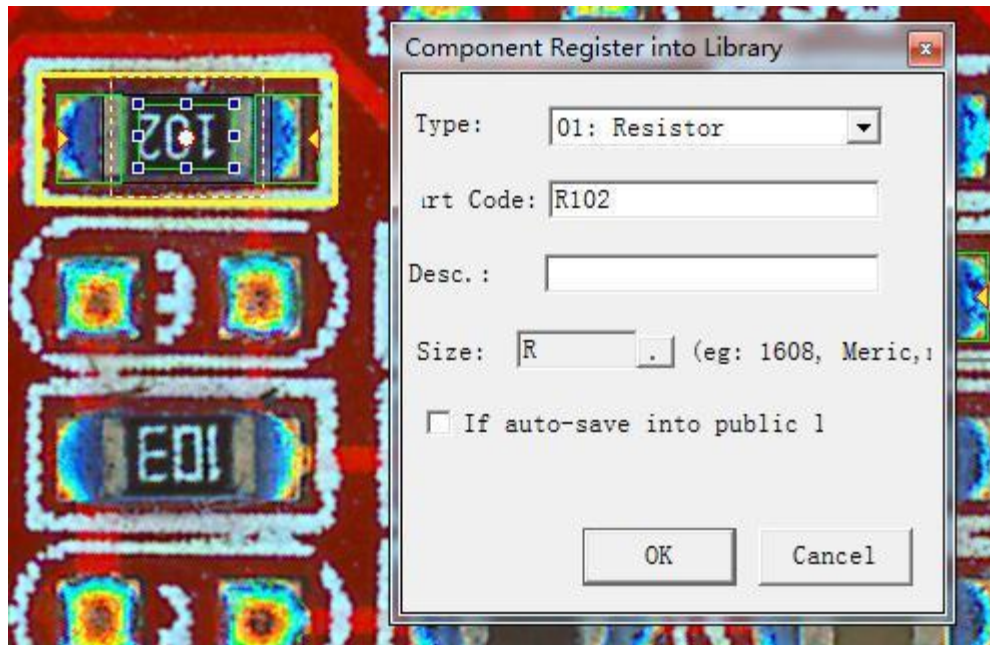
One-click entering: it is a fast and simple entering mode. The system will traverse all

components not entered in the current working area to automatically enter them into

the private library rather public library with automatically generated material codes.

Since there are no standardized material codes for this entering mode, it is generally

only applicable to standard sharing of the same components within a single

program.

- Click the right mouse button in the image working area when registering, and the

following menu will pop up

Copy Lib	
Unlink Lib	
Copy	Ctrl+C
Cut	Ctrl+X
Delete Comp.	Ctrl+D
Ins.Comp to Lib	Ctrl+Q
Delete Cell	
Comp Replace	
IC share attr.	Ctrl+B
✓ Auto Inspect Select Comp	
✓ View Center Point	
view Location	
Cell Learn	
Clear Learn Info.	
Change Angle...	Ctrl+A
Add Group	Ctrl+S
Delete Group	
Merge Comp	
Split Comp	
Def total insp	
Change Working Project	▶
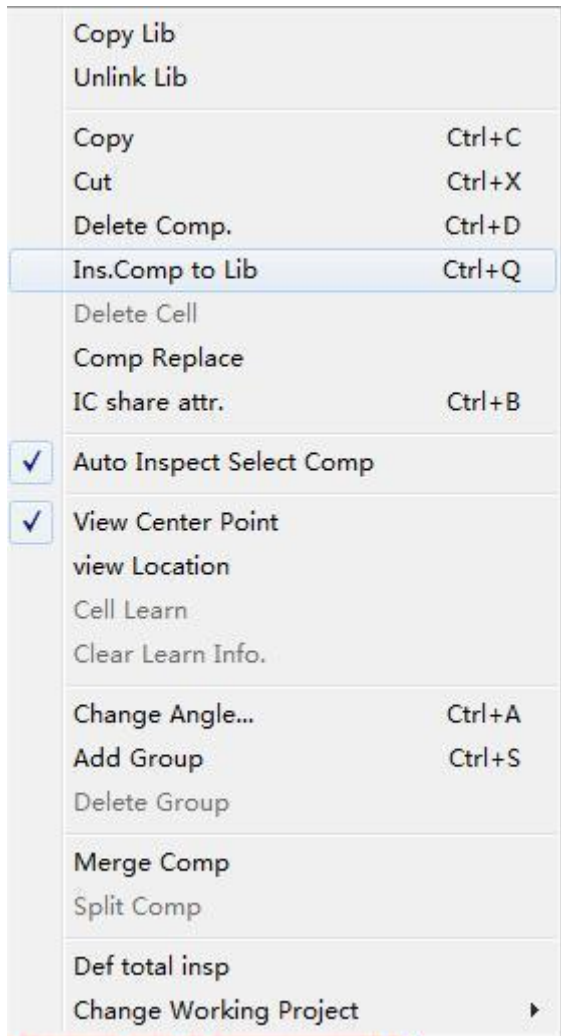
Single point copy: click this option on entered components to quickly copy registered components

Link cancellation: click this option on the entered component to cut off the association between the currently registered component and the component in the library, so that the component can return to the independent registered state without entering

Copy: copying registered components

Cut: cutting registered components

Component deletion: deleting registered components

Component entering: manual entering (described above)

Inspection frame deletion: if a component has not been entered, use this function to delete the selected specific inspection frame from the current component.

Single point standard replacement: select a received component and then click on another entered replaced component with the mouse, then the clicked replaced component and all components with the same material code will be replaced by the selected entered component. This function can be used to replace registered components that have been entered in batches.

Automatic inspection of the selected component: after this option is checked, double click on an inspection frame to run the inspection logic once and return the result.

Display of component center point: displaying a small white (not entered) or green (entered) circle at the center of the component

Display of component name: displaying the component name near the center of the component

Inspection frame learning: if the algorithm of the current inspection frame is image learning, performing this function to complete one learning.

Clearing learning information: if the algorithm of the current inspection frame is image learning, this function can clear the existing learning information

Angle modification: modifying component angle (described above)

Adding unit group: for a certain inspection frame of the entered components, the user can add multiple inspection templates under the condition of changing the size of the inspection frame. When performing the inspection, the system will automatically and sequentially inspect these templates until a certain template meets the inspection standards, thus increasing the inspection pass rate and stability. This operation is called adding unit group, which is simply called adding group.

Each unit group of a registered component can have different image templates and inspection standards, but must have the same size and direction. If the menu item is selected on the inspection frame of a certain incoming component, the system will take the current corresponding image of the component as the image template for the newly added group, and a new window will pop up for users to modify the parameters and confirm the group addition.

Unit group deletion: deleting all the unit groups added under the current inspection frame, leaving only the template and standard originally entered.

Merging: when registering through manual framing, one component consists of a single frame. Although the single-frame inspection algorithm corresponding to a single component is simple, it cannot achieve the ideal .inspection effect in some cases. The final inspection result of the component should be determined by the cooperative determination of multiple inspection frames with different sizes, different positions and different algorithms. At this time, it is necessary to merge separate inspection frames into one component. The user can merge multiple components selected in the frame into one component through this function, and the single frame in the original component becomes one of the multiple inspection frames of the merged component. The inspection result of the merged component is the sum of the inspection results of these frames inspected separately. Only components that have not been entered can be merged.

Merge cancellation: this function is the reverse operation of components merge. It splits multiple frames of the originally merged component into multiple individual components, each of which contains only one single frame.

Definition of overall inspection: in this system, the user can use the overall inspection function to inspect large solder balls, foreign matters, etc. However, it is troublesome to make the overall inspection frame for the whole board area. Therefore, the system provides this function to help users define multiple overall inspection frames covering the whole board at one time.

Selecting the current PCB file: this function is only used for multi-PCB production with same production line. After the system loads the multi-PCB inspection program, if the user loads multiple programs in the editing state, they can select different programs from the lower menu of the menu item to switch between these programs. After switching, the image and program content in the working area will switch to that of the selected program.

In addition to framing registration and entering, component inspection algorithm and parameter setting are also the core parts of the system. In addition to clicking on the component in the component list to enter the component attribute page, the user may also directly select component or inspection frame in the working area. The component attribute and inspection frame registration information page will automatically pop up. If the inspection frame already contains more than one unit group, the template image of the unit group will pop up at the lower part of the screen.

For the component that has not been entered, the pop-up component registration information window is the independent registration information of the component. For the component that has been entered, the pop-up

information is the shared information in the component library corresponding to this component. At this time, all modifications to the registration information are modifications to the component in the library, and are

automatically applicable to all registered components corresponding to the component in the library.

The following figure illustrates a typical combined frame component.
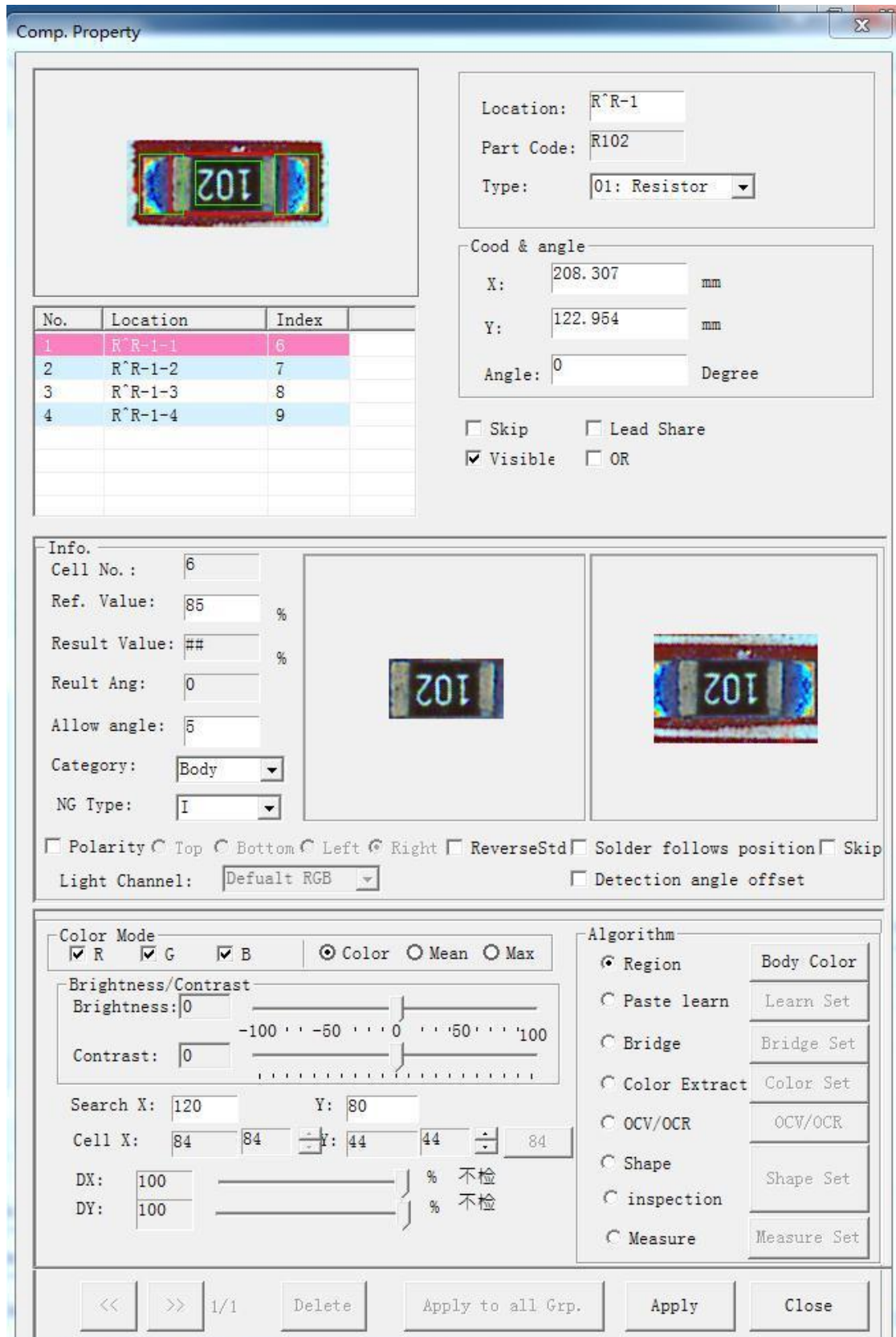
As the container of the inspection frame, the component is a separate hierarchy. The user modifies the component name, shields component inspection, sets whether the component is visible, selects the inspection frame under it and implements other operations in the component attribute window.

As mentioned above, all inspections of the system are focused on inspection frame. Therefore, the setting of the registration information of the inspection frame is the most important part of the system. All these settings are made.

through the registration information window. When a new component is registered, the system will automatically provide a preset registration information value for the new registered component according to the settings, and the user may adjust and modify the value as appropriate.

- For the inspection frame depending on the image matching algorithm for inspection, it is set with polarity. The user can set polarity for the inspection frame in this interface. For the inspection frame without polarity, the system will match views in 180 degrees in two directions during inspection. If matching is successful in any direction, the inspection will be deemed successful. For the inspection frame set with polarity, the component on the screen will display a small triangle in the polarity direction, and the component will not be reversed by 180 degrees during inspection.

- Unit angle setting: the maximum allowable rotation angle in positive direction and negative direction when the component is matched.

- The "reverse standard" option is to reverse the inspection standard. When the inspected value exceeds the set qualified reference value, it will be deemed qualified according to the forward standard. If the reverse standard is adopted, it will be deemed unqualified and will be deemed qualified only if it is lower than the qualified reference value.

- When checking "skip inspection", it indicates that this frame will not be inspected during inspection and will be deemed qualified directly.

- "Relocation of the attached frame with the body" indicates that when the component has multiple inspection frames and the inspection suggests offset of the body frame, the other frames are automatically offset and corrected with the offset value of the body.

- The user can highlight the color and grayscale features of the image to be inspected by adjusting the color mode and brightness contrast of the inspection frame, so that the set inspection logic can play its role more easily and more stably in inspection.

- For general algorithms such as region method, the size of the search range of the inspection frame is also a very important parameter in addition to the determined size of the component and inspection frame. The actual position of the component on each PCB to be inspected and registration setting ratio will have slight position and angle offset, and the search range determination system will determine the

search range of the component. The search range can be modified in this interface or enlarged and reduced with the mouse wheel, but must not be smaller than the inspection frame. The size of the inspection frame of the entered component cannot be changed in essence. However, when setting the inspection parameters, it can be temporarily reduced (not larger than the original inspection frame) to make the image of the inspection frame as close to the component to be inspected as possible, thus improving the inspection accuracy.

- The offset range inspection scroll bar is used to set the allowable offset range ratio of the template and the image to be inspected. If this ratio is exceeded, the qualified reference value will be matched immediately during inspection. The inspection frame result of the component is also NG. When the ratio is set to 100%, it indicates that only reference value matching is implemented and offset is not inspected.

- The NG category drop-down box is a preset result display defined by users for the NG result of the inspection frame. If the inspection frame is determined as NG during inspection, the preset result will be displayed as the inspection result of the inspection frame when the NG result is displayed. The preset value in this drop-down box is defined in the external text file ERRORTYPE.INI, and can be modified by users.

- The inspection category and algorithm are used together and are the main basis of inspection logic. Although they can be freely matched, the system has preset the

main correlation between them. The correlation does not need to be changed in general.

- The commonly used inspection categories include body inspection, silk screen inspection, bar code inspection, solder joint inspection, etc. The most commonly used algorithms are region method, OCV and color extraction. The main matches include:

- Body inspection-region method: it is used to inspect component positioning, similarity matching, locate and inspect leakage, error, reversal, etc.Silk screen inspection-OCV: it is used to inspect silk screen and error Solder joint inspection-color extraction: it is used to inspect polarity points and leakage through the analysis of image color.

The parameter setting of the each algorithm is introduced below:

- Region method is the most important inspection algorithm, and its core algorithm is matching. It is mainly used for component positioning, shape inspection, etc. Benchmark value is the most important index of the algorithm. It is the standard of matching similarity between the image to be inspected and the registration standard during inspection. When the inspection result is greater than or equal to the qualified benchmark value, it indicates that the inspection is qualified. When the inspection result is less than the standard, it indicates NG. The previously mentioned

unit group addition is mainly aimed at such inspection. When the matching between one inspection frame template and the image to be inspected fails to reach the standard, the system automatically tries to match with the templates of other unit groups.Only when all unit groups fail to match can NG be determined. Raising the reference value can prevent missing report, but will increase false report, which can be overcome by adding more unit groups. However, the addition of too many unit groups will increase the debugging time and affect the inspection speed. Therefore, adjusting the reference value and increasing the balance settings between unit groups are the key factors for the stable and effective operation of the inspection program.

- As an important supplement to the region method, the system supports the algorithm of template comparison only for the parts with special color and brightness range within the range of the components to be inspected. The user can click on the body color extraction button to enter the following screen:
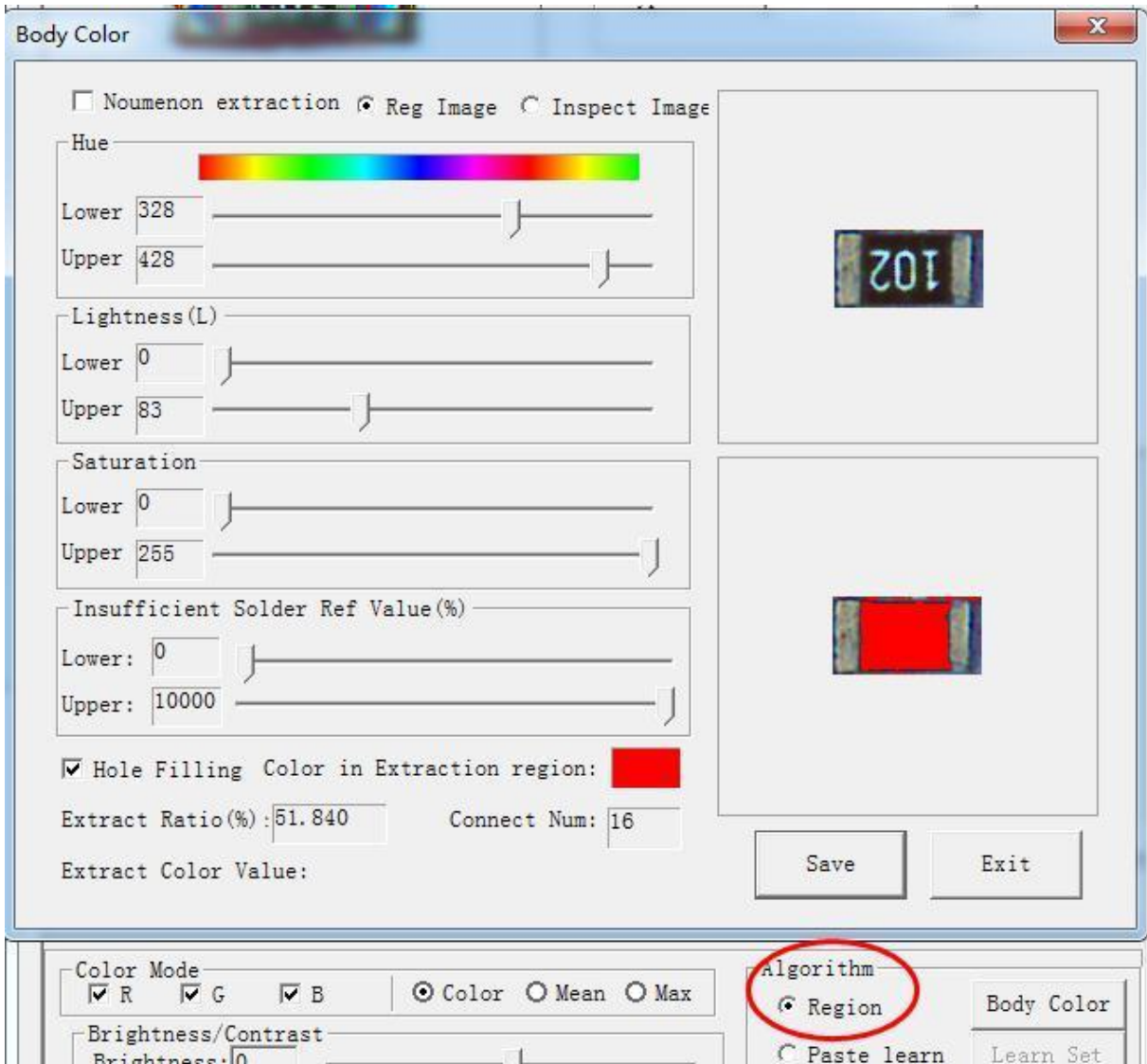
Check the "body color extraction" box, and select the part that meets the color conditions from the whole component by adjusting the tonal brightness and saturation scroll bar. If the part has closed holes, the user can select "fill holes" to fill, and use the "color extraction area" scroll bar to filter out some small color extraction parts, so as to obtain the most stable template range to be compared. This method is suitable for the situations such as different silk screen in the middle of resistors affecting the inspection results of the common region method.

Among it, users can initially test the parameter setting effect by switching the registered image and the image to be inspected. Users can also directly double click on the image to be inspected to extract HSV values of current pixel point to set appropriate color brightness parameters.

- OCV and OCR re also important inspection algorithms. They are mainly used to inspect the correctness of silk screen characters.

- OCV algorithm is similar to region method. It mainly uses OCV algorithm for template comparison. The principle of qualified inspection is whether the set reference value is reached. Unit groups addition can also be performed. Before the actual inspection of OCV, the system will automatically use the region method to initially locate the components to improve the accuracy of OCV inspection.

- OCR algorithm is to recognize characters to be inspected and match them with predefined characters instead of images. For characters with clear standards, OCR algorithm has higher inspection accuracy.

- Click on the OCV/OCR algorithm in the attribute interface of the inspection frame, and then click on the "OCV/OCR" button to enter the OCV character segmentation window, as shown in the following figure
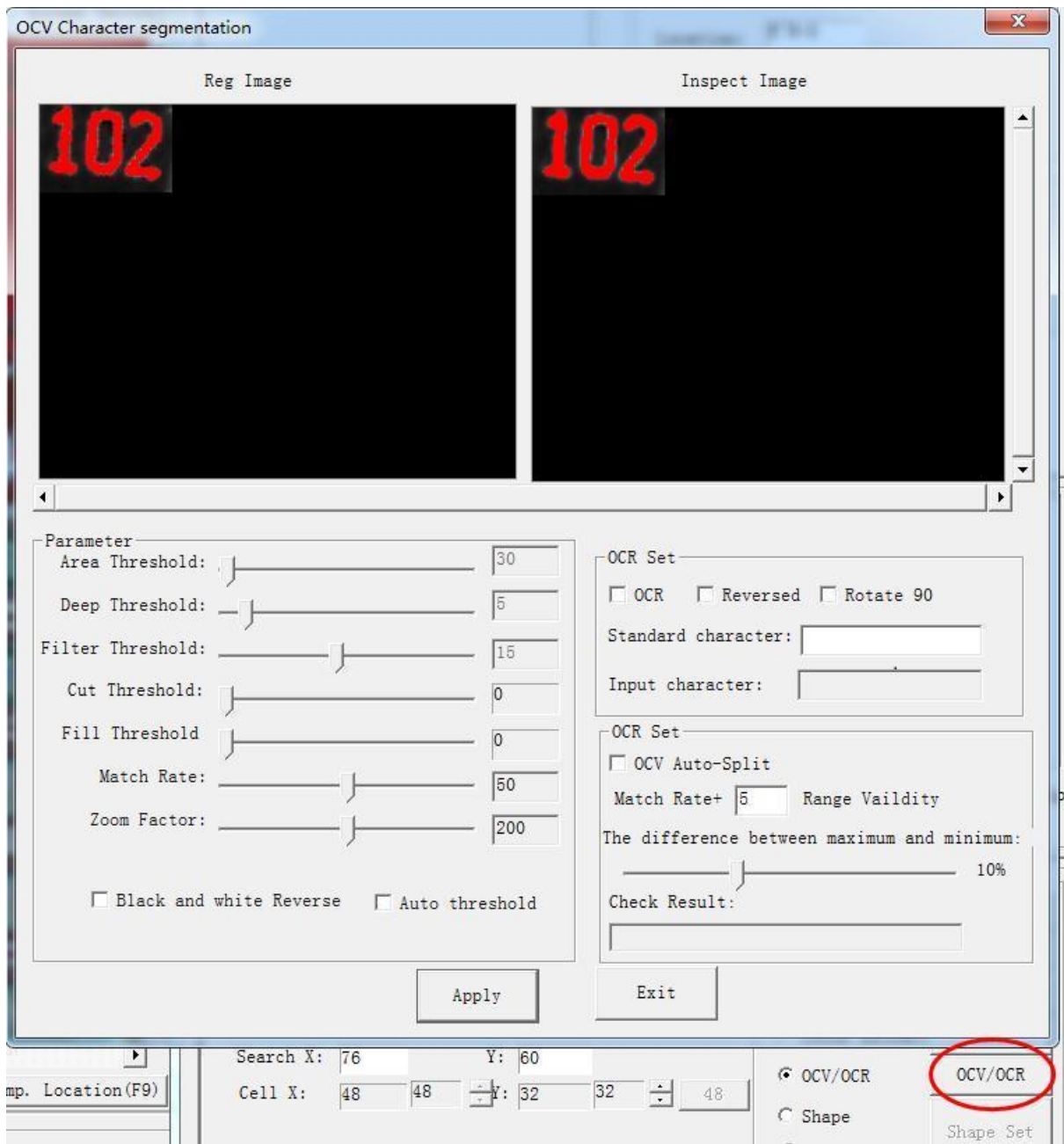
- In the parameter adjustment part in the lower part of the figure, the user may adjust the image gray level and area segmentation threshold through scroll bars and parameters selection, and segment the silk screen part to be extracted from the background as clear as possible through pretreatment such as corrosion and filling holes. The black-and-white reversal and automatic threshold options are also set for this purpose and can be used according to requirements.

OCV segmentation setting is a supplement to OCV inspection. After checking this option, if the inspection result value is only slightly higher than the reference value according to ordinary OCV inspection, the system will automatically segment the silk screen content to be inspected into characters and then inspect character one by one. This can improve the inspection accuracy and stability to prevent missing inspection.

The "valid value setting within a certain range above the reference value" is the threshold for judging whether to implement re-inspection with segmentation value after the normal OCV inspection value exceeds the reference value. If the difference between the inspection value and the reference value exceeds this threshold, it indicates that the normal OCV is sufficient to judge whether the inspection is OK. Even if the segmentation inspection is checked, the segmentation inspection will not be carried out and will be directly deemed OK, which can save the inspection time.
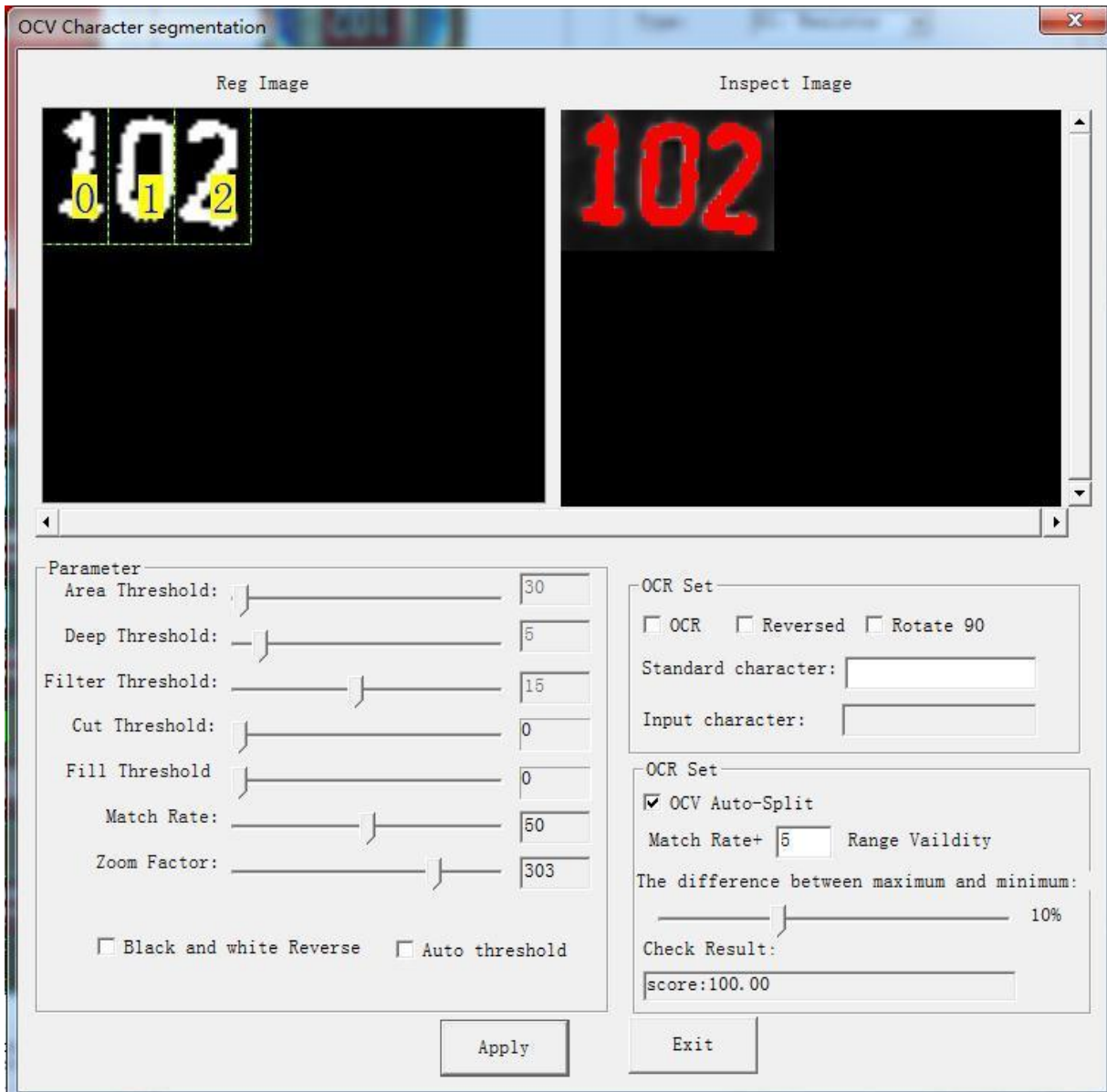
- However, if the OCR option is checked, the system will directly use the OCR algorithm instead of the OCV algorithm. If the standard character string is directly input, the system will automatically recognize the image according to the inspection frame, and then compare it with the standard character string to determine OK/NG. As for auxiliary functions, the user may choose to carry out pretreatment such as reversal and rotation on the inspection frame image.

OCV Character segmentation

Reg Image

Inspect Image

Parameter

Area Threshold: 30

Deep Threshold: 5

Filter Threshold: 15

Cut Threshold: 0

Fill Threshold 0

Match Rate: 50

Zoom Factor: 303

☐ Black and white Reverse ☐ Auto threshold

OCR Set

☑ OCR ☐ Reversed ☐ Rotate 90

Standard character: 102

Input character: 102

OCR Set

☐ OCV Auto-Split

Match Rate+ 5 Range Vaildity

The difference between maximum and minimum:

10%

Check Result:

score:100.00

Apply   Exit

-   Click-on feature method. Click on the "feature method" button to enter the

feature extraction parameter window. The logic of the algorithm is similar to that of

the region method. It is usually used to judge whether the matching value of the

shape outline in the registration map and the image to be inspected reaches the

standard value by comparing the outline features in the image. In the basic

parameter adjustment part of the feature extraction

parameter window, the user may adjust the segmentation threshold and the

connected domain area threshold through the scroll bar and the parameter selection,

so as to stably segment the feature part to be extracted and improve inspection

stability.

- The feature extraction algorithm is often used to inspect BGA pins. If BGA

inspection is checked, many options for BGA pin features, such as color, shape, size,

number and other parameters, will be added on the basis of extracting outline

features with common threshold. During inspection, BGA components meeting the

set number standard under this threshold condition are deemed OK. If not, they will

be deemed NG.
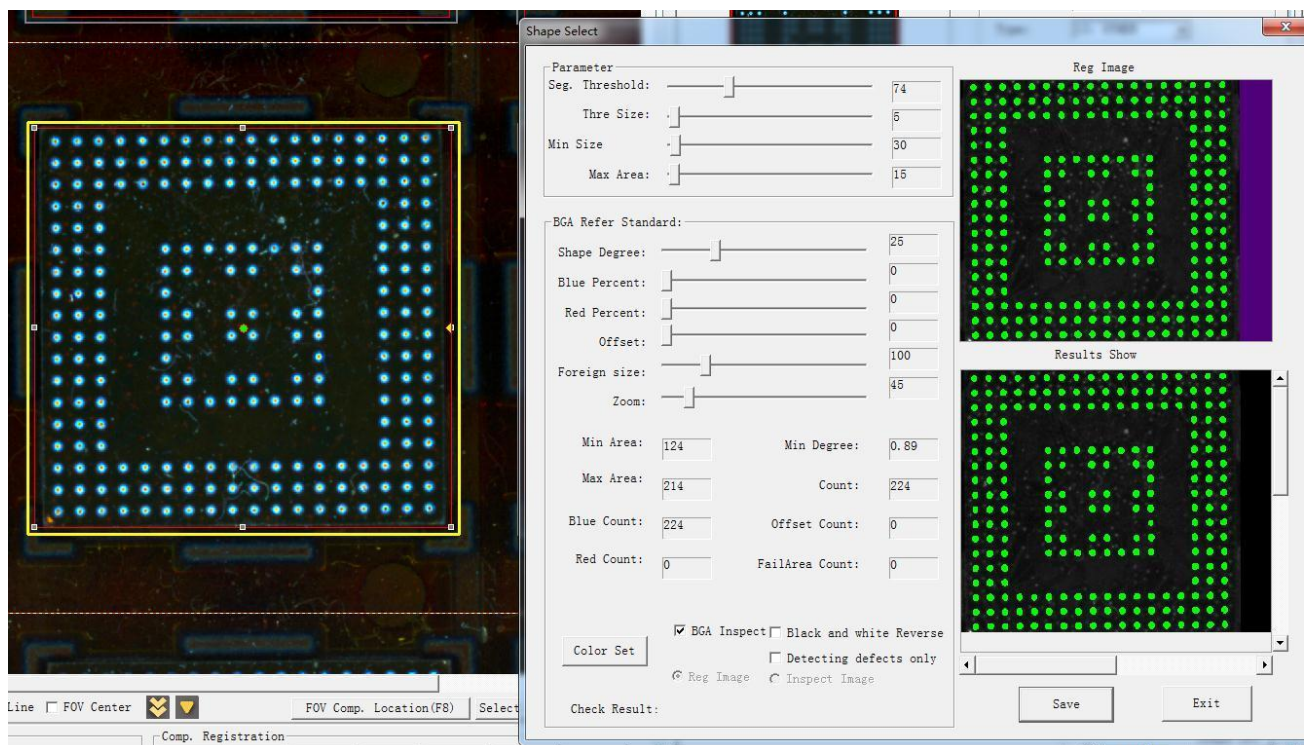
- Overall inspection. Click on the "overall inspection" button to enter the overall

inspection setting window. The window interface for overall inspection parameter

setting is the same as feature extraction, except that the parameter setting is slightly different. This algorithm is usually used to quickly inspect foreign matters in some large regions and mismatches, such as solder balls, material offset and other defects. It can also be used to inspect the size mismatch of some relatively large printed circuits.

-    Similarly, the user can adjust the segmentation threshold and the connected domain area threshold through the scroll bar and parameters selection. By calculating the connected domain based on the comparison difference between the registered map and the map to be inspected and filtering out the parts smaller than the threshold, large foreign matters such as circuit pits and burrs can be inspected, and size mismatches can also be inspected.
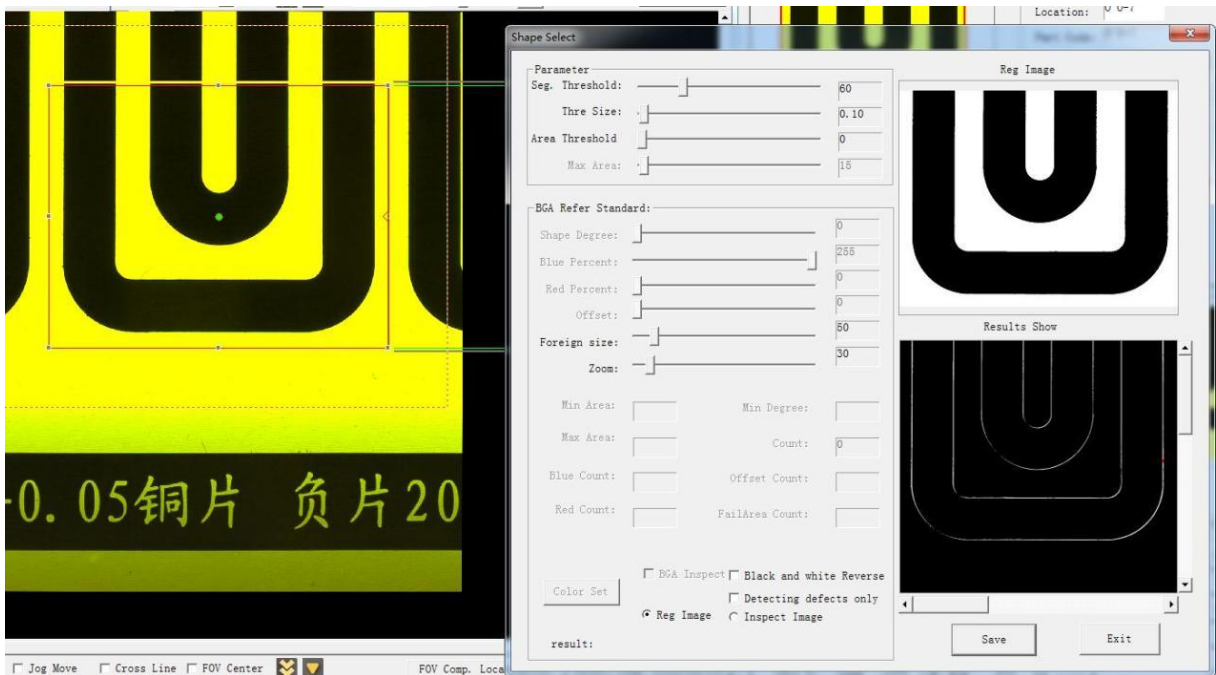
- The image learning algorithm is seldom used and will not be Discussed in detail here.

- Color extraction is another major inspection algorithm. The user can enter the color extraction interface by clicking on the "color extraction" button to set and test the color extraction of the inspection frame
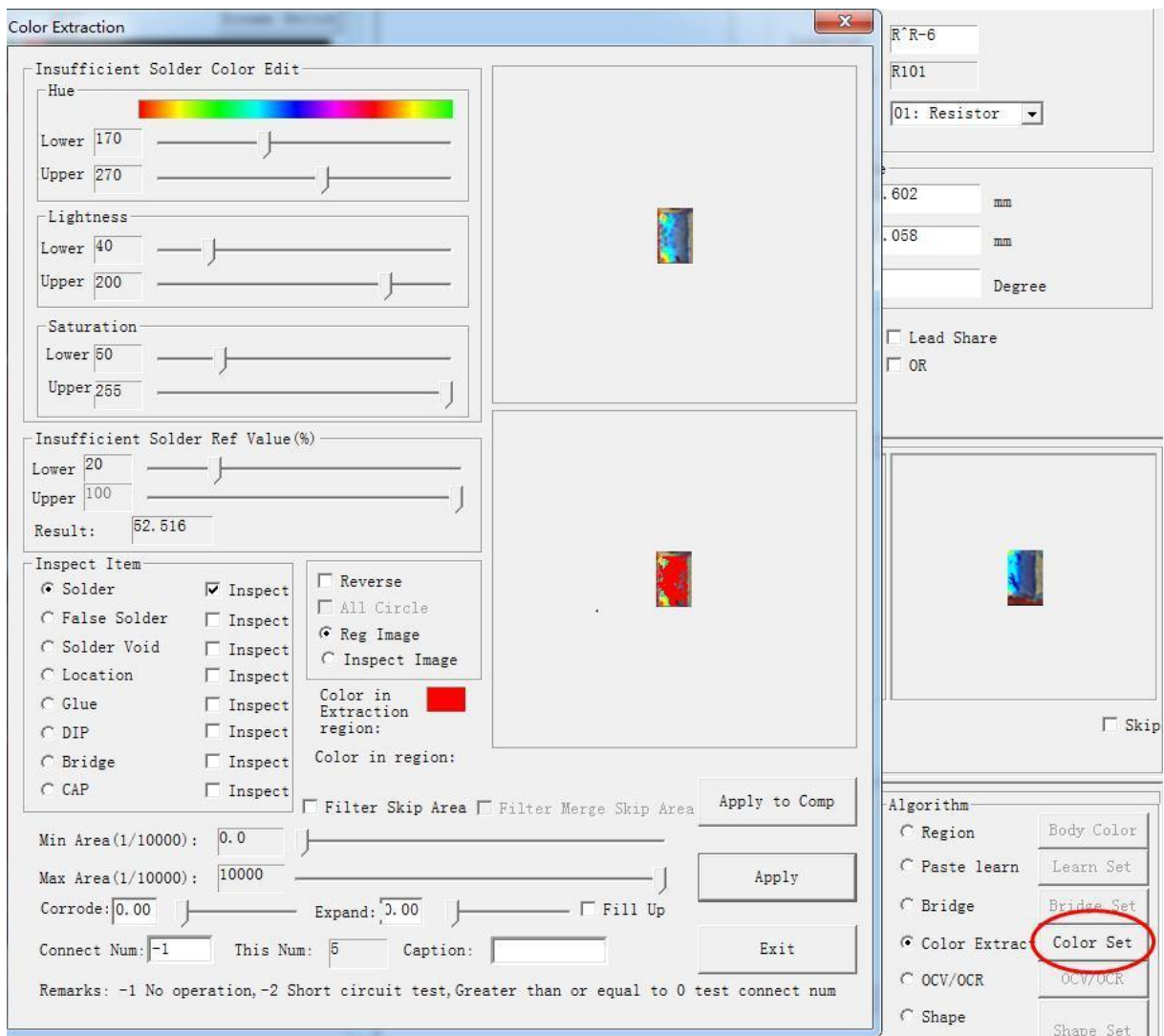
Compared with the single inspection frame of other algorithms which contains only one standard (different standards can be expanded only by adding groups), the single inspection frame for color extraction in this system

contains up to 8 different color standards corresponding to color extraction of annular or circular regions, thus increasing flexibility and versatility.

  Each algorithm can be selected in combination, and the standards are set separately. The user can customize the inspection name of each color standard through the "item" column.

For each item, color extraction determines whether the inspection frame can reach this color standard and thereby determines whether the inspection frame is qualified or NG =by setting the thresholds of three channels, including hue, brightness and saturation, of pixels within the image section and setting the ratio of pixel points satisfying the thresholds of the three channels to the pixel points within the section as standard . The "reverse standard" option in the interface is to reverse the standard.

In addition to the standard color extraction ratio algorithm, the system also supports the calculation of the extracted color according to the connected domain. It can filter out the connected domain of certain areas according to the connected domain area threshold and fill the holes in the connected domain, thus increasing the flexibility of the color extraction algorithm.

Moreover, the number of connected domains that meet the threshold standard can also be set.To simplify color parameters extraction, during the setting of body and capacitance polarity, double click on the original image at the upper right of the interface, the system will automatically extract the color channel value of the selected point and automatically preset the segmentation threshold. The extraction map at the lower part will be displayed correspondingly, and the corresponding presetting of array and scroll bar at the left will be automatically completed. The user can make adjustment and save on this basis.

The "registered image" and "image to be inspected" in the setting interface are used to switch between the registered image and the image to be inspected on site and help the user debug.

Generally, group addition is not performed in color extraction mode. Otherwise, confusion will easily occur.

- The user clicks on the "IC short circuit" option and enters the short circuit setting window through the "short circuit setting" button

This function is mainly used to inspect IC type solder pin short circuit. By adjusting the segmentation threshold and area threshold, the solder pin and the background are stably segmented. If the background has some bright colors (such as white board) and is not easy to segment, the user may segment with blue channel value or red channel value only, or ignore the long straight lines in the background.

After the segmentation is completed, the system will automatically inspect the pin number and average pin width under the current segmentation threshold to inspect whether there is a short circuit between the pins. If the component is IC type component and it is necessary to inspect soldering apart from short circuit between pins, the user may click on "pin defining" button to open the corresponding window, define the exact position and size of IC solder pins by framing, and automatically generate the IC solder joint frame with "color extraction" as the corresponding inspection algorithm.
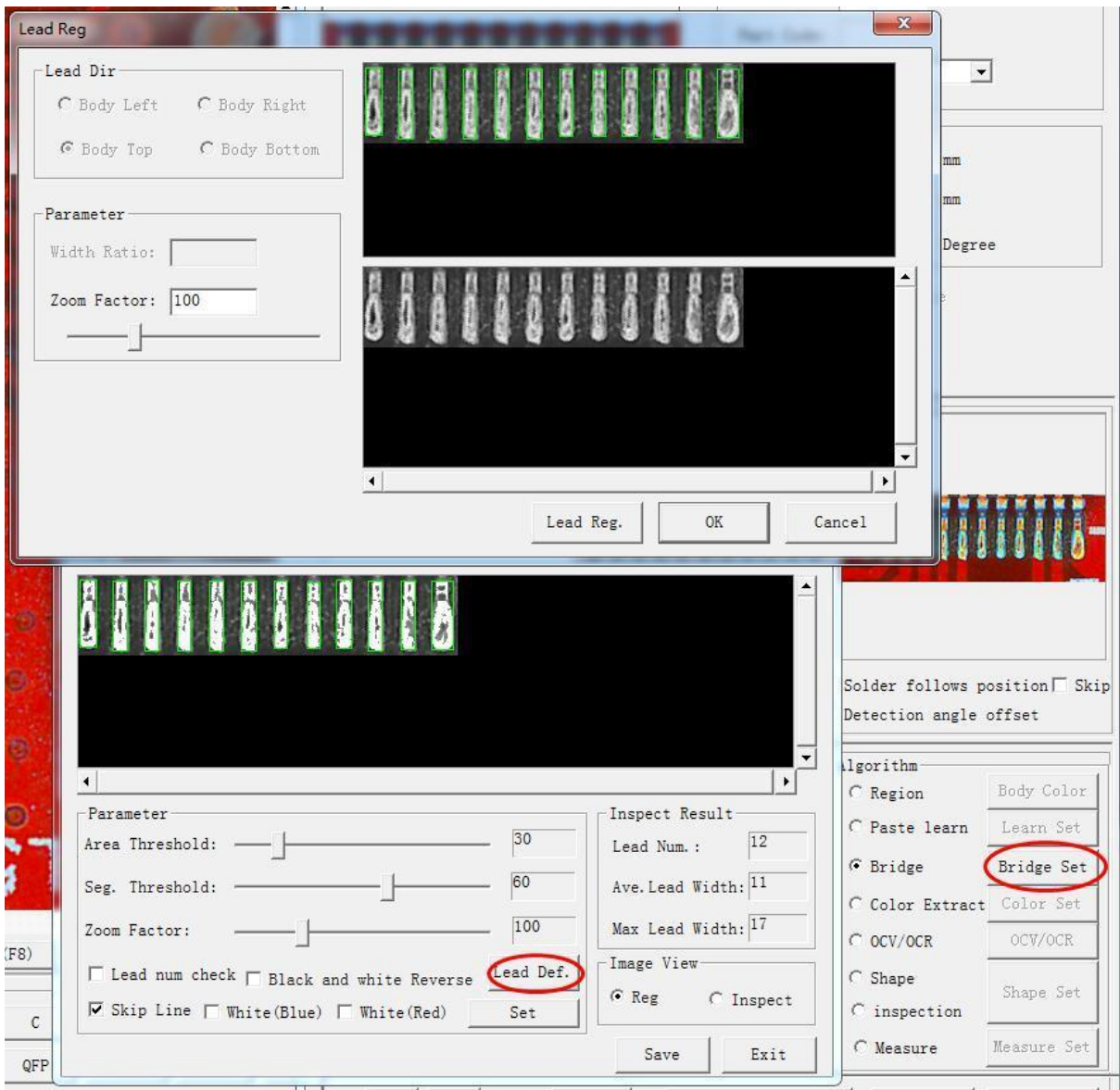
- In addition to the traditional inspection items and methods, the system also provides the function of inspecting the distance between two components and measuring certain dimensions of the components.

- The user can extract the connected domain boundary of each part of the component stably through the color threshold and the segmentation threshold, then select the corresponding inspection items and set the inspection standard. If the measurement result of the component exceeds the threshold range during

inspection, the component will be deemed NG and the measurement result will be displayed.
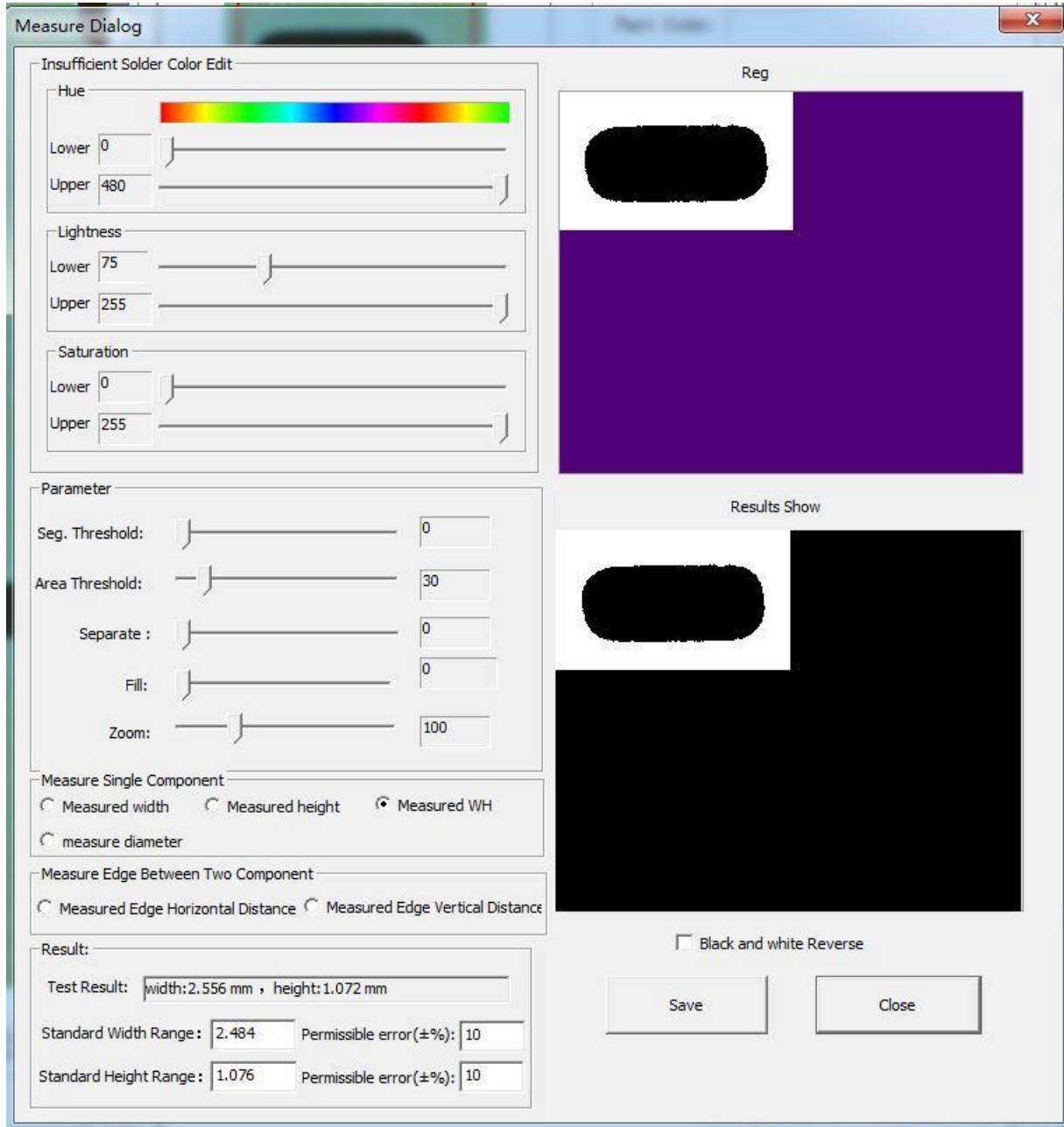
After setting or adjusting the registration information parameters, the user should press the application button to save. If the component has been entered, the result will be stored in the library file. Otherwise, the result will be stored in the registration

information of the component. If the inspection frame has multiple groups, the user can choose to update all groups simultaneously with the modified information.

If the inspection frame has multiple groups, the user can switch between different groups by clicking on the double-headed arrow in this interface, and can press the delete button to delete the current group (basic registration information cannot be deleted)

After setting up an inspection frame, double click on the inspection frame in the image working area, and the system will automatically inspect and return the inspection result value.

After a component is registered and entered (especially when it is copied and registered), its current position may have some offset from its corresponding component template image in the library. However, as long as the offset is within the search range of the inspection frame, the user can correct it by clicking on "FOV component location" or pressing F8.

1.3 Inspection mode

After the component registration is completed in the editing mode, the user can debug or formally inspect the registered program by switching to the inspection mode from the working mode menu.

The main interface of the inspection mode is still divided into the left image working area and the right thumbnail area.

The image working area of the inspection mode dynamically displays the images photographed by camera on the situation of PCB passing through the AOI on the production line.

The thumbnail area will display the steps and inspection results of the current inspection program as a whole. The user can select the speed of motion control of the inspection platform in the thumbnail area. The statistical data of the upper part of the image working area reflect the main inspection result statistical data in real time for the user to track and refer.

The user operates debugging and formal inspection through various keys and options on the lower part of the image working area
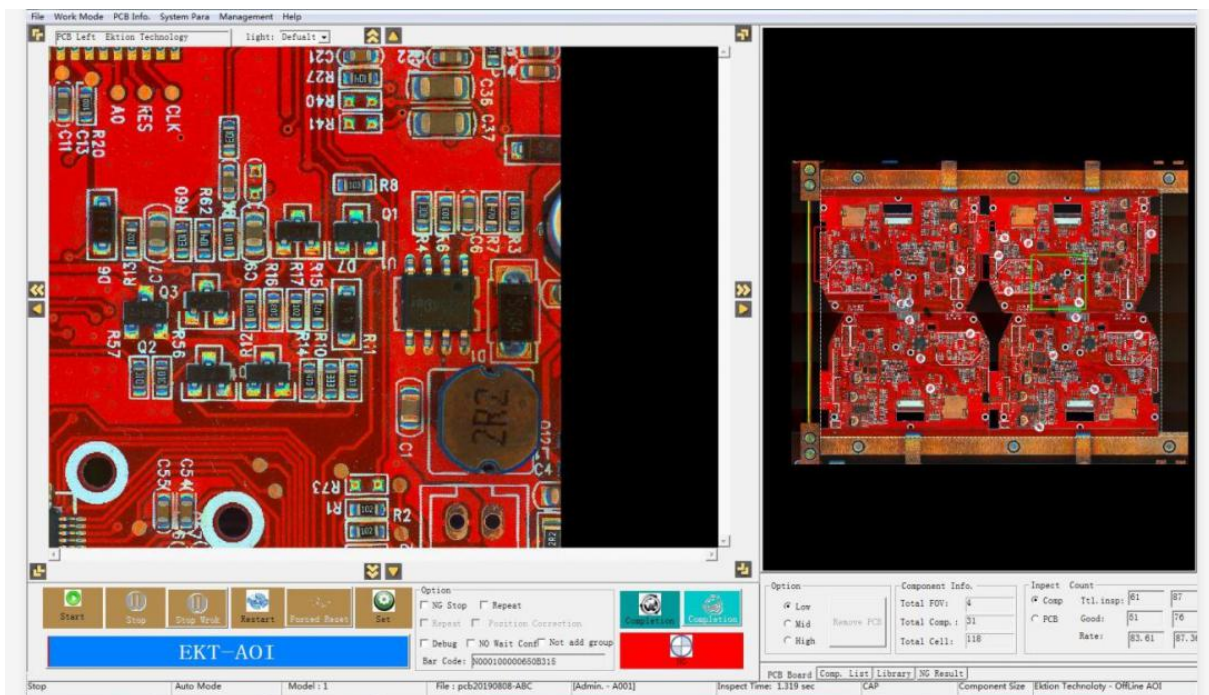
Debugging inspection mode:

In the main interface of inspection mode, check "debugging mode" and click on "start" to enter debugging mode. According to AOI inspection logic and FOV path, the system will implement movable photographing, Mark point inspection, correction and component inspection, and finally display the inspection results for users' reference and debugging.

In the inspection result display interface, the PCB image is displayed in the image display area, and the positions of NG components in the figure are indicated by navigation line.
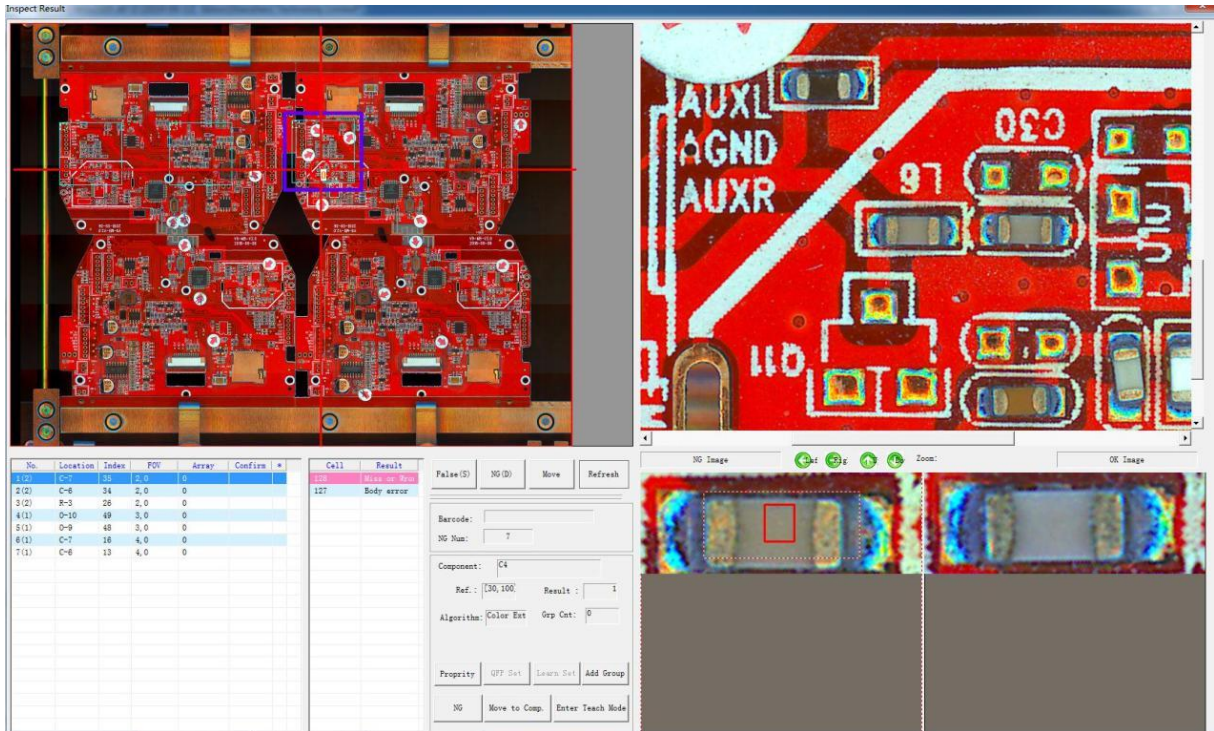
The upper right NG FOV image area displays the FOV image of the current position of NG element. The FOV image can be adjusted by scaling.

The two tables at the bottom left respectively list the components judged as NG by the inspection program and the NG inspection frame information under them. The user can switch between different components and different inspection frames with arrow keys. The navigation line in the left image working area will correspondingly move to the position of corresponding component. The data column in the middle will also display the inspection algorithm, reference value, result value and other information.

When switching components and inspection frames, the two image interfaces at the lower right will respectively display the registered image of the currently selected NG

component and the actual image of the corresponding component of the inspected PCB. The user can compare and refer the images to determine whether the system inspection result is misjudged, and then take corresponding debugging operations.

In the debugging interface, programmers usually adopt the following debugging methods according to missing report or false report:

- If the component registration position is found to be offset, the user may directly click on the small arrow icons on the registered image to adjust the registered component position.

- For region method and OCV type inspection frames, the user may add new unit groups by clicking on the "adding unit group" button to add inspection templates and reduce false reports

- Click on the "component attribute" button to open the current inspection frame editing interface of the current component, from which important parameters including benchmark value, algorithm and search box size can be adjusted.

- -Click on "entering editing mode" button to switch directly from inspection mode to editing mode. The user can re-register the component in this mode.

- -The "Refresh" button is used to re-check the NG component of the current PCB using the registered parameters instantly adjusted by users without re-taking photos for inspection, so as to inspect the effectiveness of the user parameter adjustment.

- NG judgment in editing mode has no practical significance, and will not be

  saved by the system

If the test is conducted in debugging mode, the system will only test one PCB at a time. After exiting the test result window and returning to the main window of the test mode, it is necessary to click on "start" to start the second test.Test result parameter setting:

In the main interface of inspection mode, click on the "setting" button to set necessary parameters for the interface displaying inspection results. The main functions are as follows:

- Initializing statistical variables

- Initializing the image learning template

- Whether to shield certain categories of components
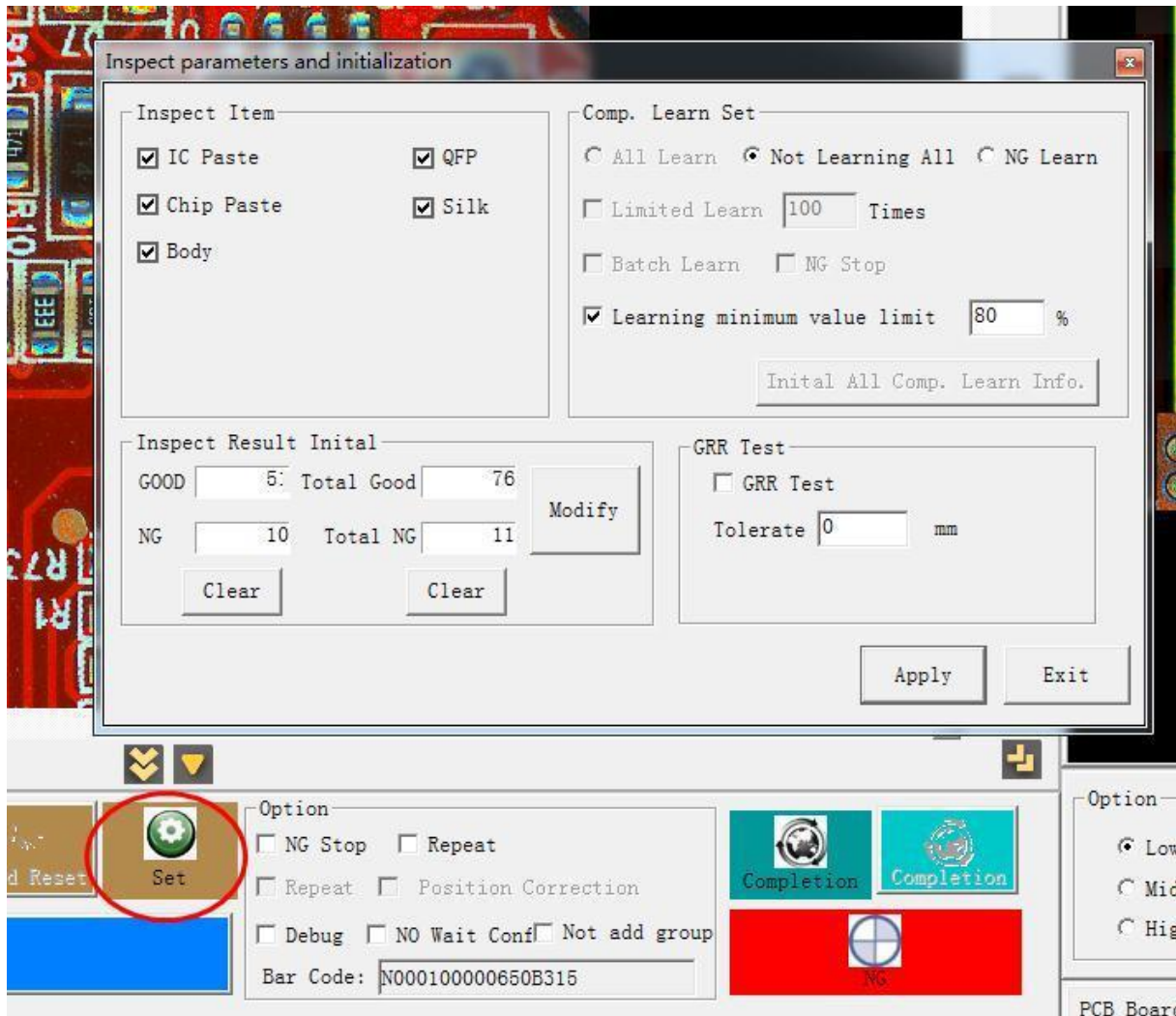
Formal inspection mode:

In the main interface of inspection mode, click on "starting" button without checking

"debugging mode", and the system will start formal inspection mode until the user

clicks on the "stop" button in the main interface of inspection mode.The inspection

logic of formal inspection is the same as that of debugging mode. According to AOI

inspection logic and FOV path, the system will implement movable photographing,

Mark point inspection, correction and component inspection, and finally display the

inspection results for users' reference and debugging.

If all the test frames of the current PCB have passed the inspection successfully, the

PCB will be deemed PASS, and the word "PASS" will be displayed in the screen display

area of the inspection mode in green.

In the inspection result display interface, the PCB image is displayed in the image

display area, and the position of NG element in the figure is indicated by navigation

line
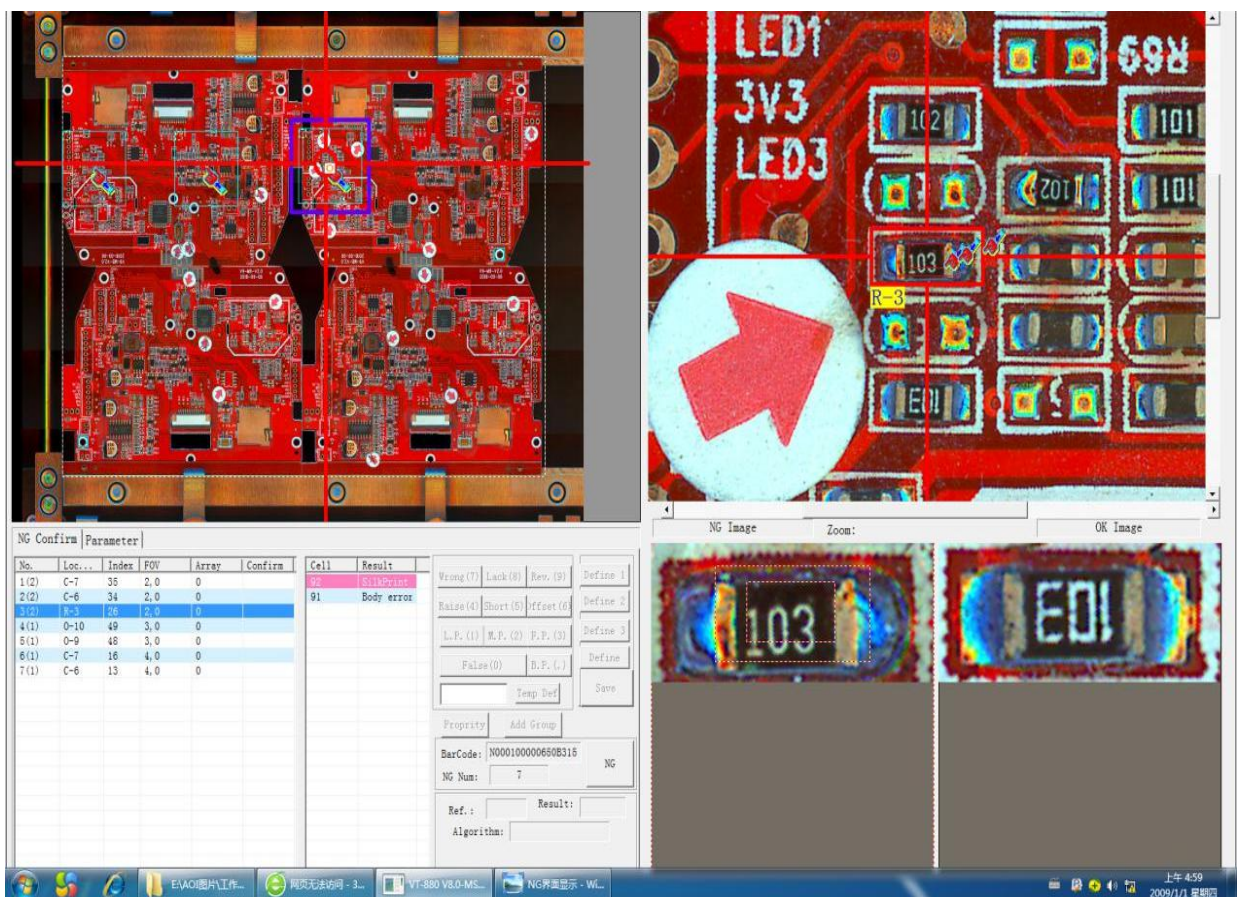
If the current PCB inspection has an inspection frame determined as NG, the NG result display interface will pop up after the inspection is completed for comparison and confirmation by users.

The NG error display interface of the formal inspection mode is quite similar to that of the debugging mode, but the user cannot make any adjustment to the program parameters at this time, and can only make final judgment based on the inspection results and reference images. There are two situations for judging the inspection results:

-    If the user has not started the database recording mode, the test results and final confirmation results will only be used as temporary references. The user can select, view and confirm the test results with arrow keys or +key on the keypad conveniently.

-    If the user has started the database recording mode, the test results and   final confirmation results will be stored in the database. In this case, the   user can define the commonly used NG category in the text file DEF

ERROR.Southern Machinery, and the system will automatically load this file and map it to the number keys on the keyboard for the user to select when confirming (special NG category can be temporarily defined).

- In fact, a default NG category has been defined fir each inspection frame

    during component registration. This default NG category will be used when the

system judges the inspection as NG. The user can simply press the +key to accept

this default NG category, or press the corresponding number key to select the NG

category more in line with the actual situation as the final confirmed NG category. If

it is false report, the user may simply press the 0 key to confirm. The final

confirmation results will be recorded in the database for subsequent report analysis

or shared with other platforms.

Setting of parameters of the confirmation interface:

In the NG confirmation area in the formal inspection mode, there are two pages. The

first is the normal confirmation page and the second is the parameter setting page.

The user can set parameters for NG result display. The parameter setting mainly

includes the following functions

- Setting of the color and thickness of screen navigation box and navigation

    line

- Font setting of jointed board letters

- Size setting of the component registered image and inspection image

- Sorting mode setting of NG display results
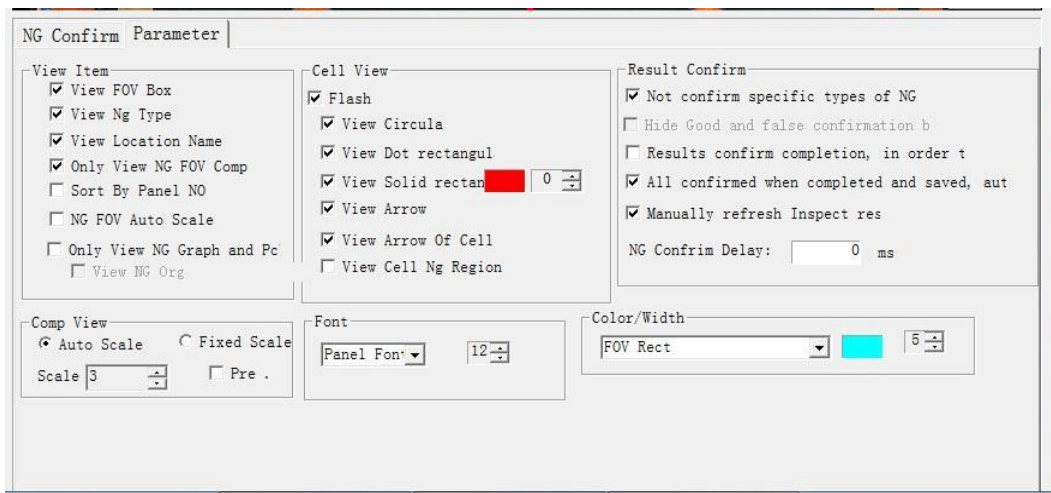
If the user selects "not waiting for result confirmation" in the main interface of the inspection mode, and the inspection result of the previous PCB is not confirmed when the inspection result of the next PCB is given, the inspection result of the next PCB will automatically cover that of previous PCB, and AOI will continue the inspection of the next board. If "not waiting for result confirmation" is not checked, AOI will suspend operation under the above circumstance and will not operate until the inspection result of the first board is confirmed.If repeated inspection is checked in the main interface of the inspection mode, the inspection will be automatically repeated.

It is usually used for machine aging and stability test. The reset and forced reset buttons are used to manually restore the state of the machine to the state for inspection. This is a manual intervention operation commonly used when the machine is not in automatic operation for some reason.
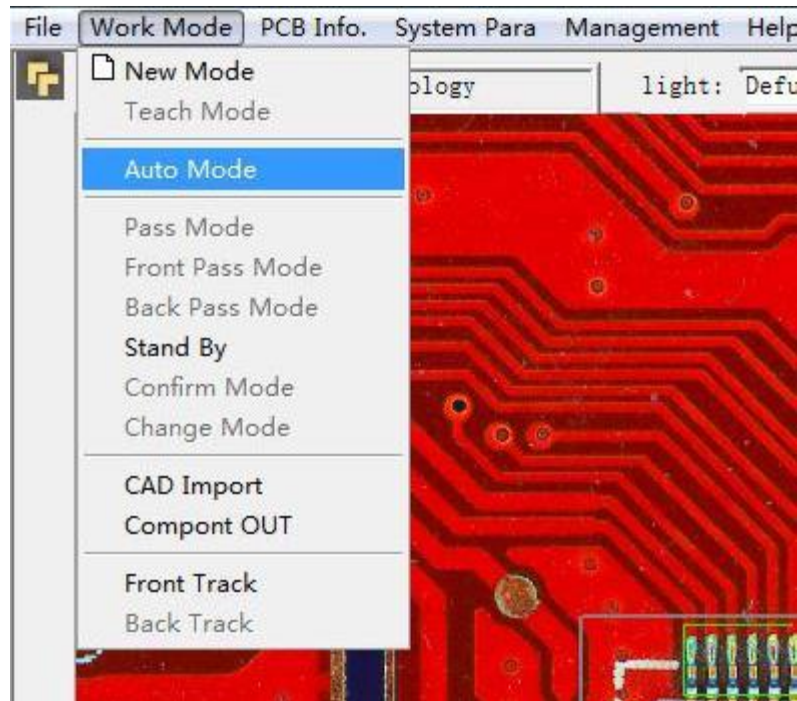
In addition to several main working modes, there is a pass mode for the on-line machine. In this mode, the boards on the track directly pass through the on-line machine. Only the number of boards is counted, and no inspection will be carried out. In other words, the on-line machine serves as a inspection conveyor.
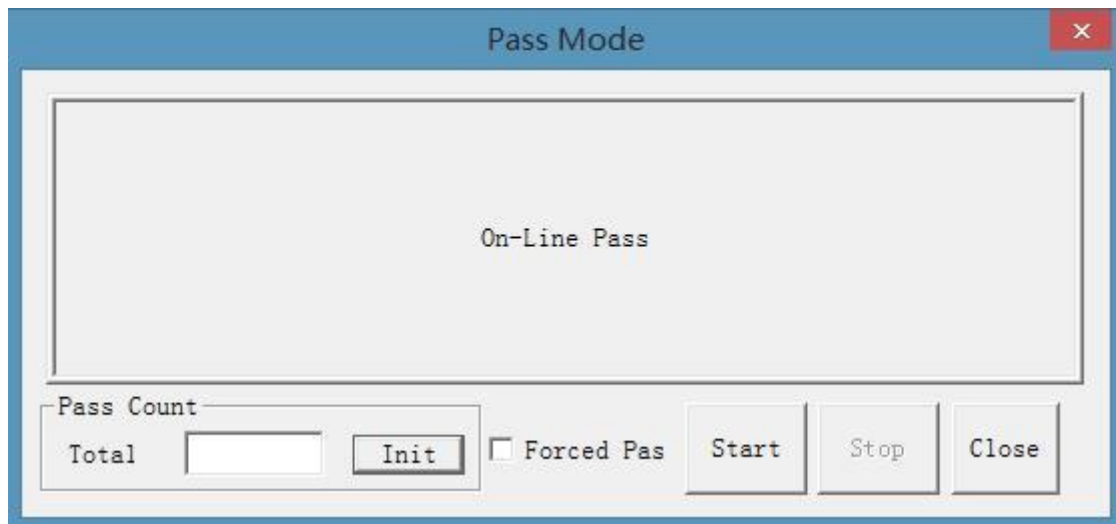
Several other modes are not applicable to this type of model and are not introduced here.

1.4 CAD import In

the programming mode of the new program, the user can obtain the name, material code, coordinate, rotation angle and other information of all components by other means (usually kind coming from CAD files). If these data are stored according to the specified file category (the system supports EXCEL and TEXT files) and arranged according to the specified text format (component name, X coordinate, Y coordinate, angle, material code), the user can directly import such files into the program file being edited through this function. With the registration information already defined by material code in the public library, the system will use the corresponding components in the library to complete automatic registration of these components in the new program.

Newly registered components will be considered to have been entered and pointed

to the corresponding components in the library. If the material code of the imported

new component does not have corresponding components in the library, the

component will appear in the program file with special material item(CADLOC) and

identifier (small box with blue center) after import. The user may use the editing

method mentioned above to cover the frame on the component for registering and

entering the component, and may selectively and automatically replace other

components of the same material code in the program.

This function can greatly simplify the programming process and improve the

programming speed
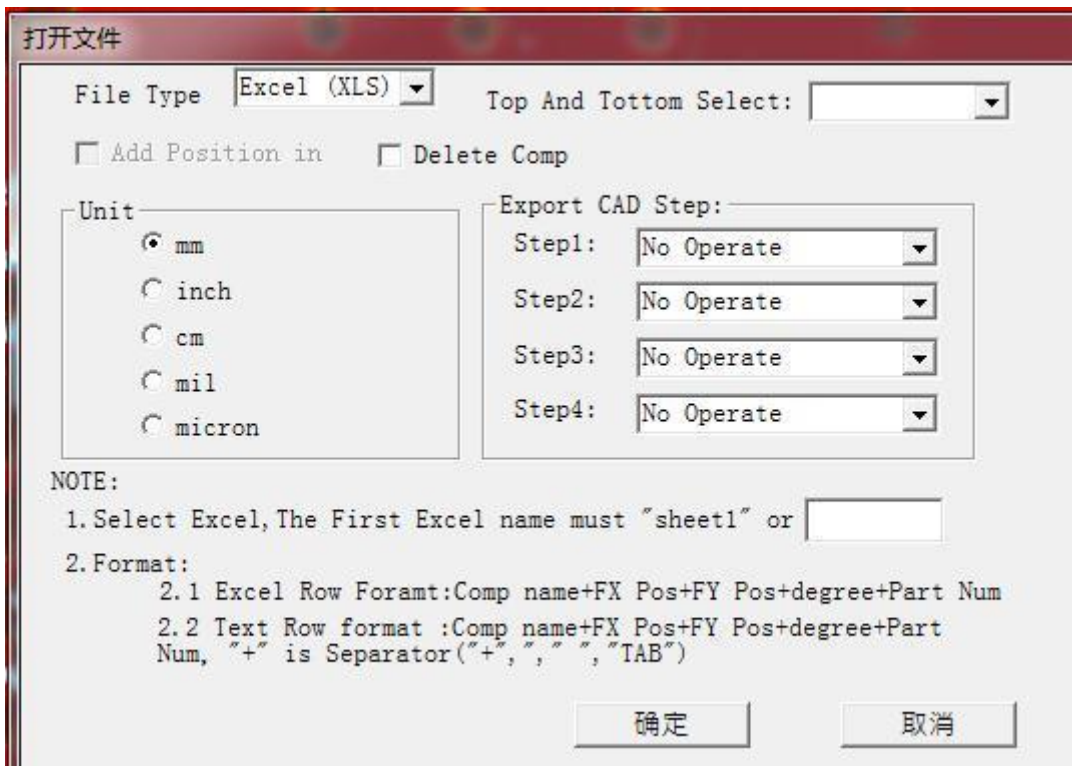
The coordinate system in which the CAD source files are created is different from this system. Therefore, when importing, the user may use different scale units, and choose to delete all components existing in the current program

or just add components in the CAD file to the program. If coordinate system offset is found after importing, the user may use the standard component editing to carry out overall mirroring, rotation and movement on all coordinates and components imported in CAD, thus completing fast registration. In addition, for the formats of the imported files requires, there are special instructions on the import interface. The user should pay special attention to them.

1.5 Component export

In editing mode, the user can export the component the names, coordinates, angles and material codes of all components registered in the program (excluding private and public libraries) to the text file of the operating systems. Then, the user may import this file into the programming files of other AOI machines or use it for other purposes.
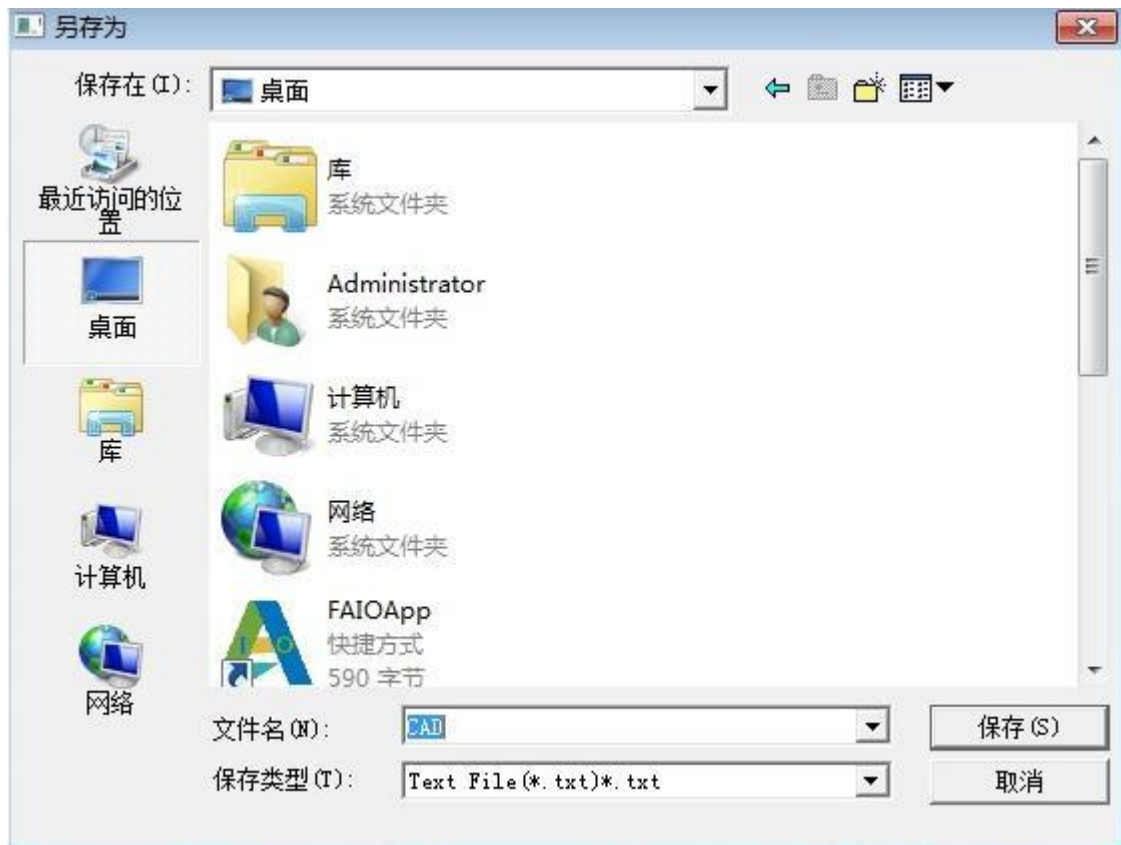
2. Substrate configuration

2.1 Viewing the information of the substrate for operation

With the programming file open, the user can browse the name and size of the

current program through this function, and adjust the overall offset of the substrate

(adjusting the overall offset of environmental coordinates between different AOI

machines. It is generally unnecessary). The image pretreatment parameters can also

be adjusted and set here. The pretreatment parameters can also be set when creating

a new program. However, setting pretreatment parameters will have an impact on

the inspection efficiency. Special attention should be paid if there are strict

requirements for the inspection speed.

If the board to be inspected is jointed board composed of various boards with

separate bar codes, setting should be made in this interface.
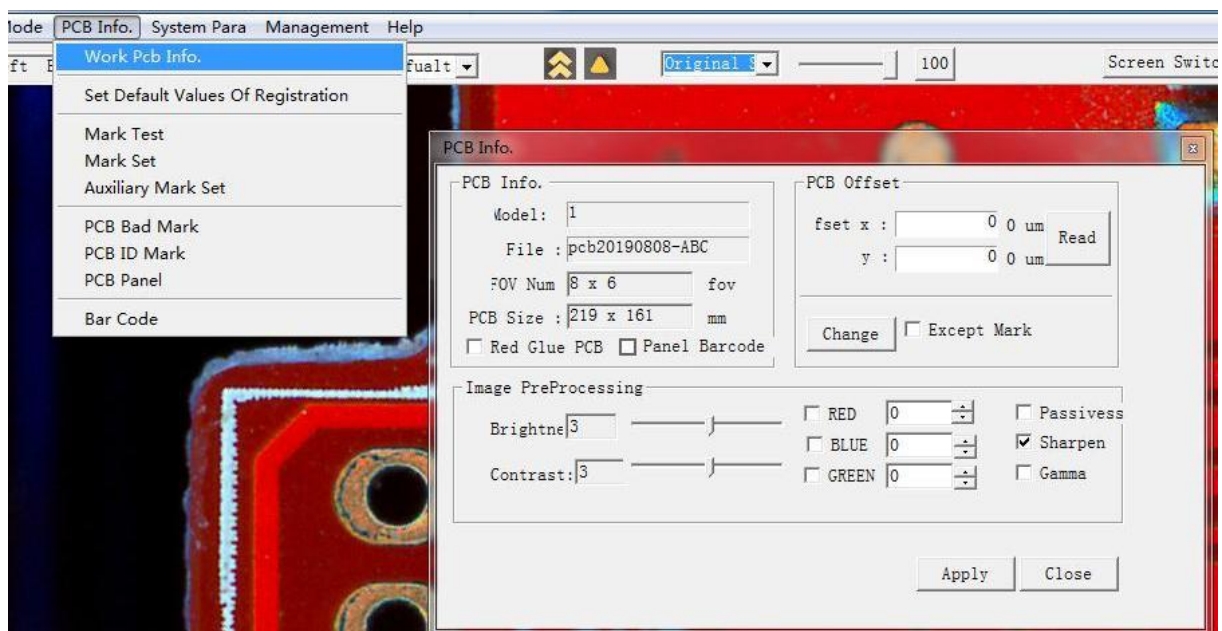
2.2 Registration Default Settings

In editing mode, the user can use this function to set default values of parameters

during component registration in advance. These default values are shared by

programs. In this way, when the user registers a new component through framing,

the system will use this default parameter value as the inspection parameter of the

component according to the algorithm corresponding to the registered component.

The user may make changes as needed. However, if these default values are set

reasonably, they can be used by default in component registration without change,

which can improve the efficiency of registration and debugging.
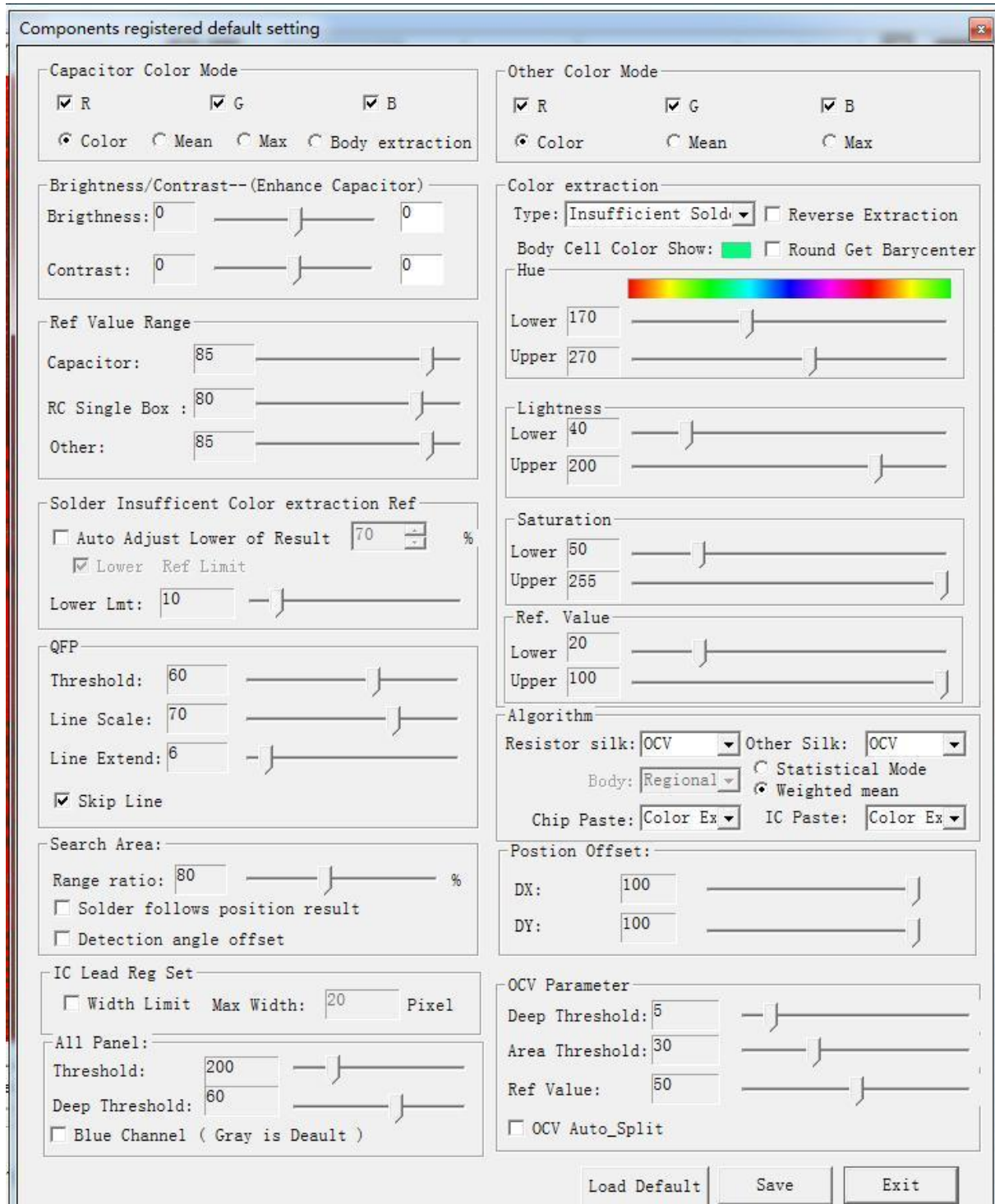
2.3 Mark points setting

This function has been introduced in the part of creating a new program and will not be explained in detail here.Mark points can be reset during program inspection and debugging, but it is better to reset the two Mark points at the same time, and correspondingly inspect and move all component coordinates to ensure that all component positions under the new Mark points are correct.

2.4 Auxiliary Mark points setting

In addition to a pair of normal Mark points, the system also supports setting up a pair of auxiliary Mark points. The auxiliary Mark points have the same setting method and purpose as those of the normal Mark points. However, their action is limited to a specific region of the PCB. They only correct the offset of the components within this region. This is more suitable for the case where independent Mark points are required by a separating action region on the PCB.

Therefore, in addition to the same definition method as the Mark point, the user needs to define the action region of the auxiliary Mark point by setting the upper left corner and the lower right corner.

.
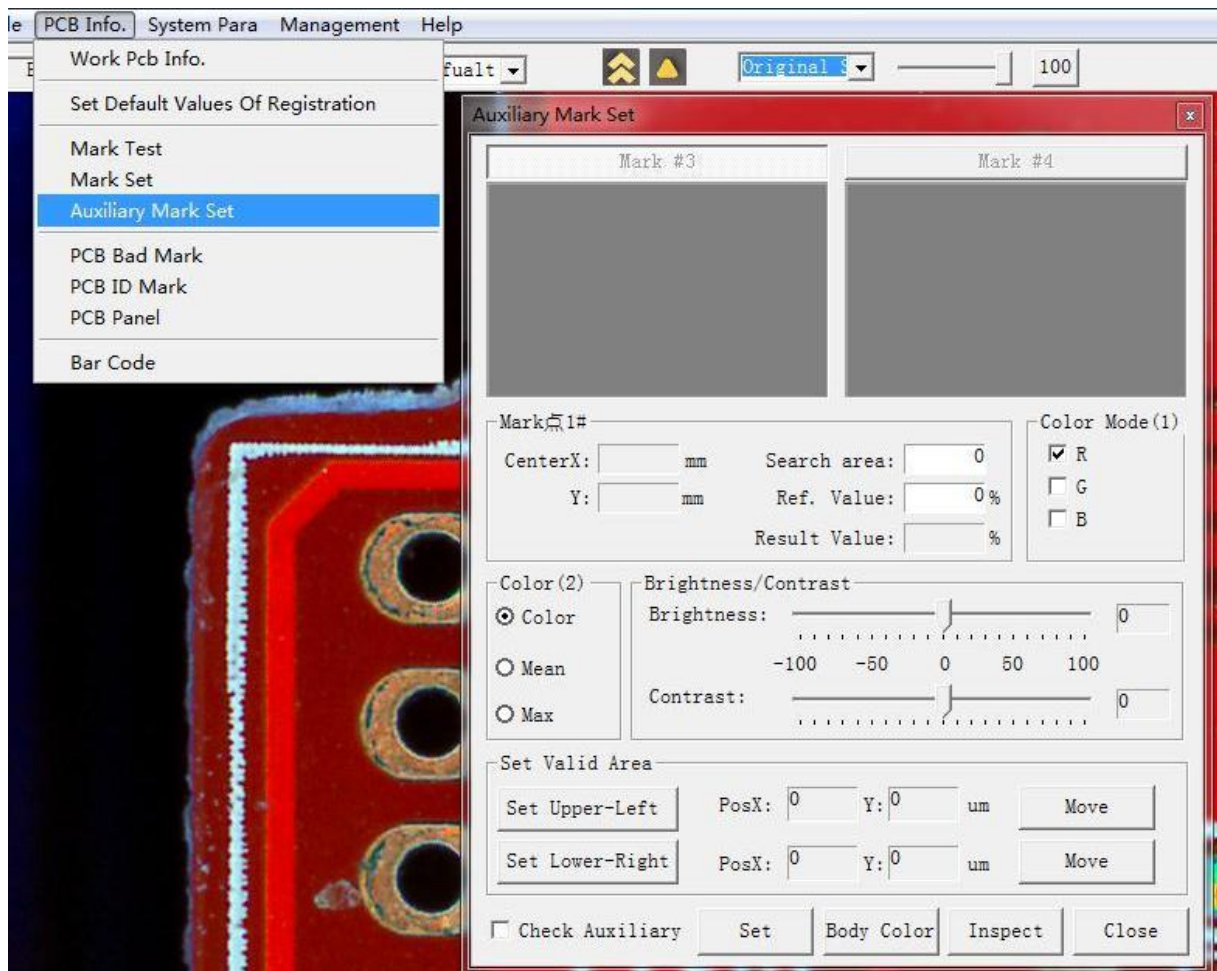
2.5 Setting PCB Bad Mark

PCB Bad Mark is an optional auxiliary function. It is used to skip the inspection of all components in a certain PCB region under certain conditions.

The user can enter the setting of this function by clicking on "setting PCB Bad MarK" on the main menu. The setting of Bad Mark consists of two steps.
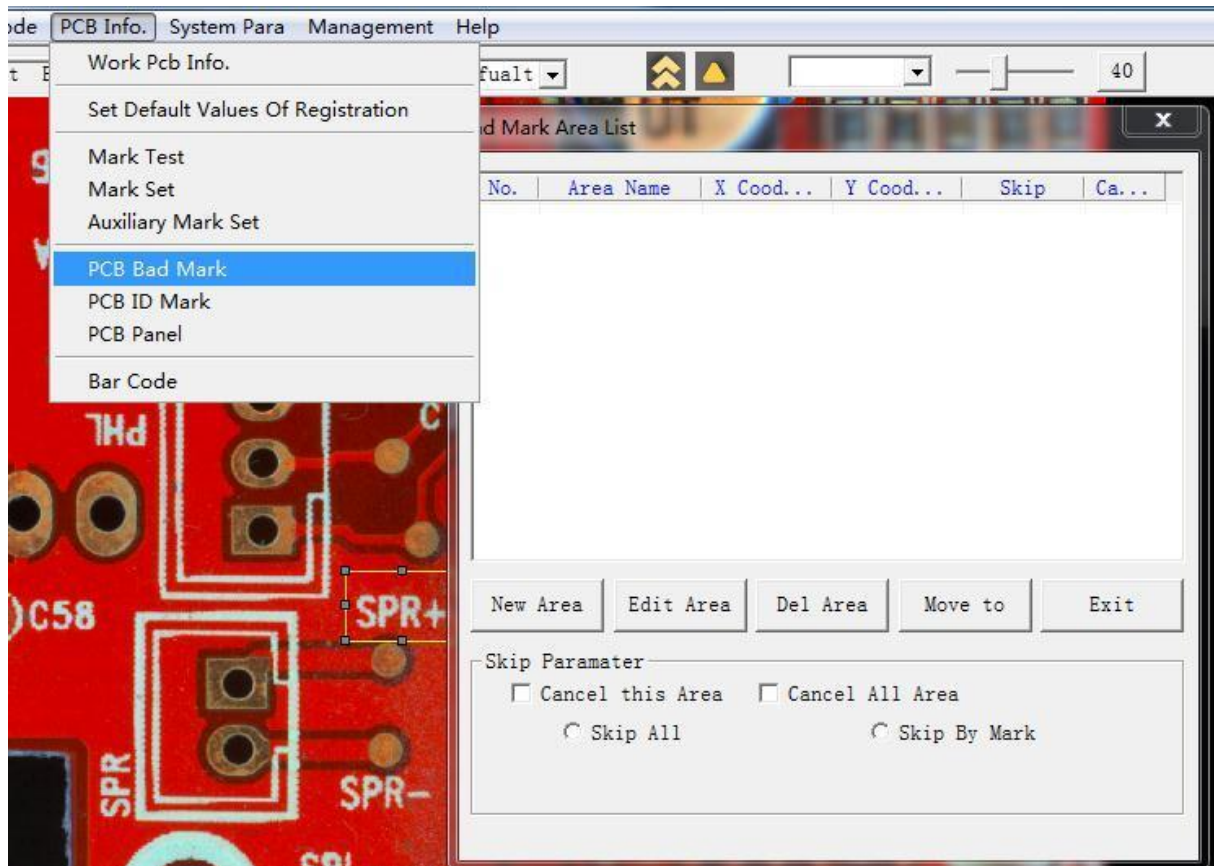
The first step (as shown above): the user creates a new skip region, or selects to edit

or delete a skip region with the corresponding button. For the existing skip region,

the user can choose to cancel the skip or choose one of the following three ways as

the skip mode for the skip region:

-Direct skip: the inspection of all components in this region will be skipped

-Skip point skip: this mode is the most common. When the system inspects, all skip

points are inspected first. If the inspection of the skip points corresponding to a

certain area fails, the inspection of all components in this area will be skipped.

-When the component inspection failure in a certain area exceeds a certain percentage, the inspection of this area will be skipped, which means that all components including the tested components in this area will not be deemed NG.The second step (as shown in the following figure): when the user creates a new skip region or edits an existing skip region, a new window will pop up and the name of the skip region will be automatically generated. The name can be modified but has no practical significance. The definition of skip region includes two parts:

-Defining a new image: defining the skip points corresponding to the skip regions by framing the feature image in the image working area. After the image is defined, the corresponding pretreatment parameters and qualified reference values are set. The inspection algorithm for skip points is the region method and is only executed when the skip mode is selected as skip point skip.

-Sub-region: a skip region can have multiple skip sub-regions. The user can add sub-regions by selecting a region in the image working area box and pressing the "adding sub-region" button, or delete existing sub-regions.The inspection of all components contained in these sub-regions will be skipped when the skip condition is satisfied.

-After defining the skip region, save and exit
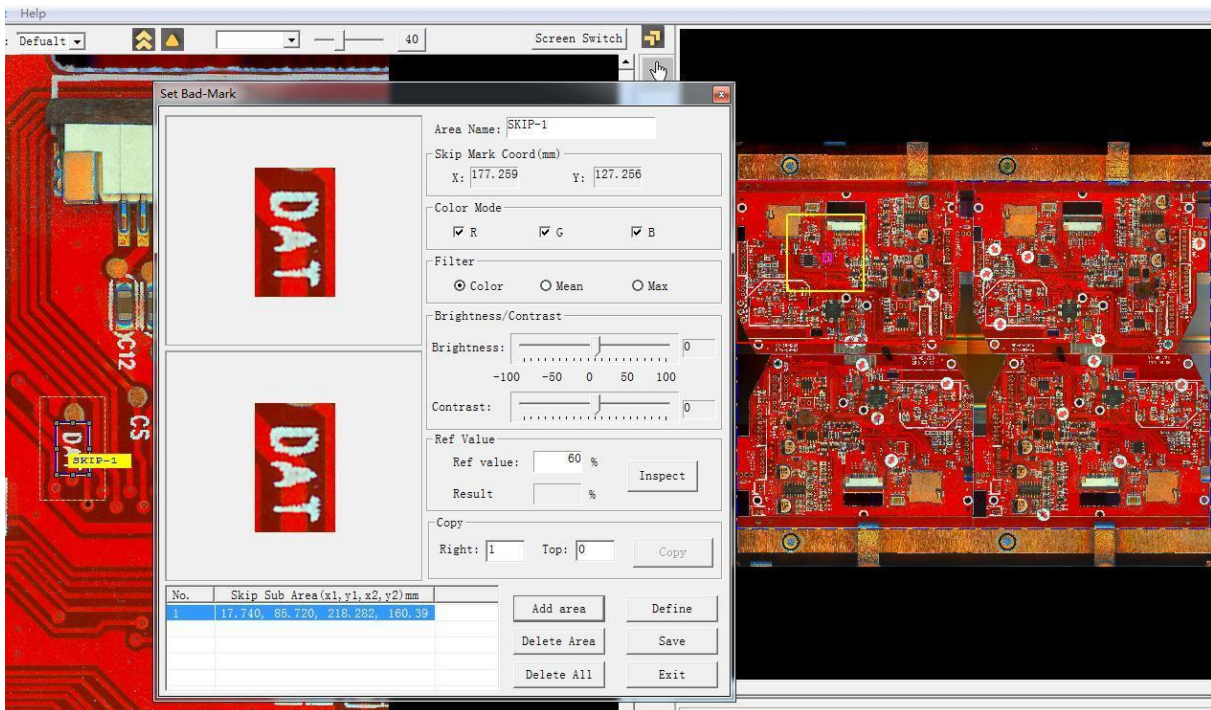
2.6 Setting PCB ID Mark

This system supports the user to inspect no more than 10 different PCBs on the same line. Of course, these boards should have the same width in terms of hardware requirement.

Different types of boards are distinguished by unique mark which is called ID mark.

Click on this function on the main menu to set and disable ID mark. The setting method is very simple. Frame the feature points, set the qualified reference value and search range, test and exit.

Once ID mark is set, it can be modified but cannot be deleted. The user can choose to disable the defined ID mark.

If multiple files are allowed to be opened at the same time through setting system technical parameters, when the user opens a program with ID Mark set and not disabled, the system will automatically prompt the user to choose to open other programs with ID Mark and load them into memory at the same time. In the editing mode, the user manually switches between the programs (the last item in the pop-up menu, which has been mentioned above). In the formal inspection, the program will try to find the ID mark of the PCB currently photographed and inspected in the loaded programs to determine the inspection program corresponding to the PCB currently photographed and will automatically switch to the correct program in the memory to complete the inspection.
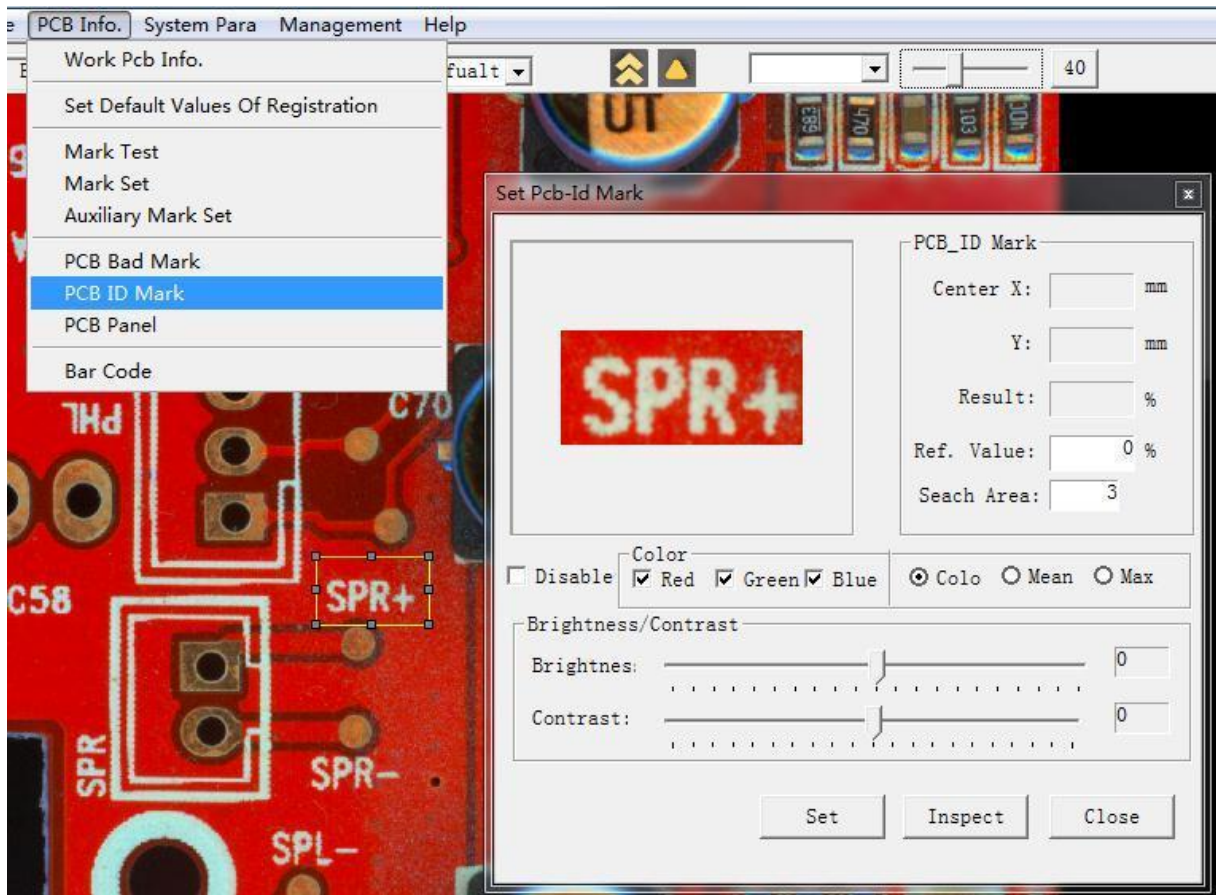
2.7 Setting jointed PCB

Part of PCB are joined by multiple sub-boards containing the same components.

Although the user can simplify programming by completing component

programming on a certain jointed board and then using the component duplication

function, the user needs to know and record the board where NG components are

located in some cases. This requires the jointed board definition function. After the

jointed board is defined, the jointed board number will be shown in the display of all

NG data.

The user enters the jointed board definition window by selecting the "setting jointed

PCB" function on the main menu.
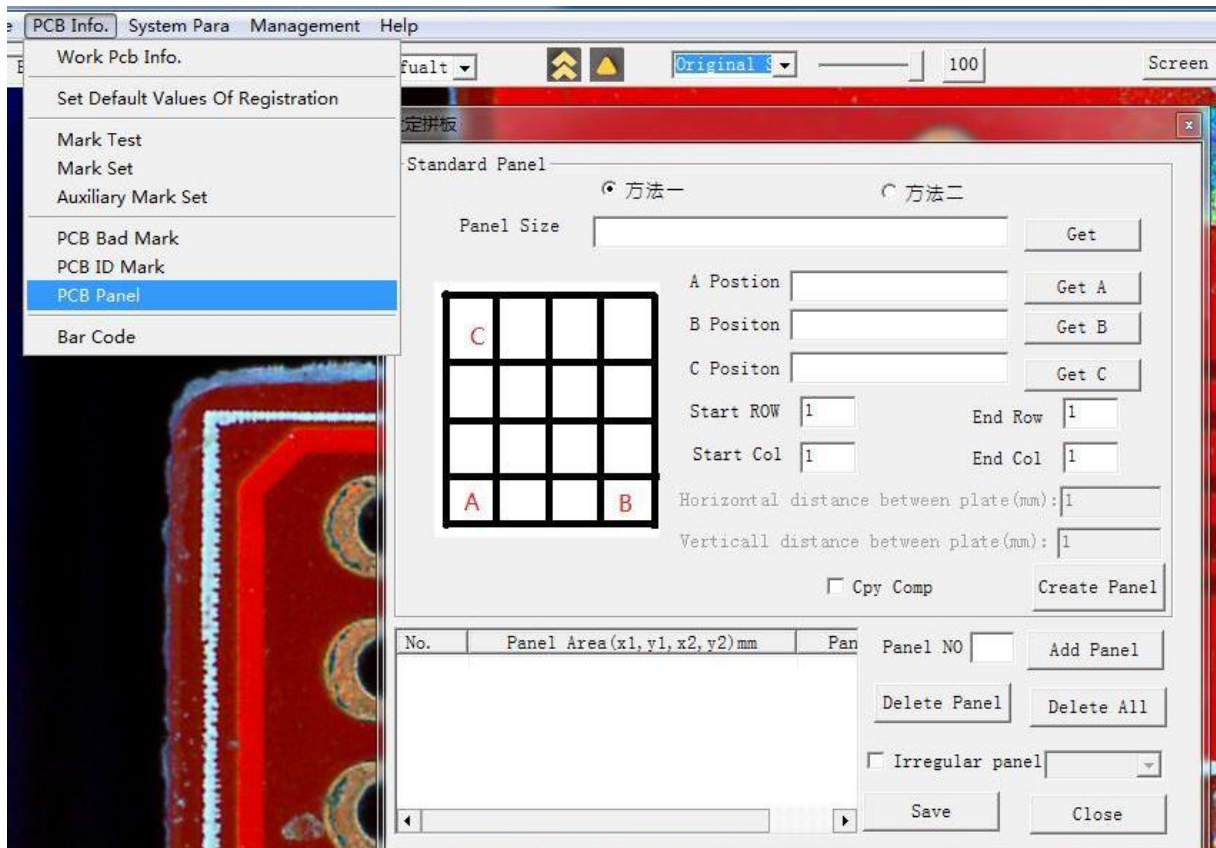
There are two ways to add jointed boards.

Standard jointed board mode: draw a frame (area a in the figure) that accurately covers the whole jointed board at the bottom left of the thumbnail area, click "getting jointed board size" and then open the crosshair in the image working are. Use the mouse to locate and click the same positions of three jointed boards respectively in the bottom left, bottom right and top left to obtain the positions of point A, point B and point. Enter the total number of rows and columns of jointed boards, and click "copy jointed boards". The system will calculate the specific position and size of each jointed board, automatically generate jointed boards and copy each jointed board. The registered components on the A jointed board can also be copied to other jointed boards.

Manually adding jointed boards: frame the sub-board area in the thumbnail area, fill the panel number in the jointed board number editing box, and press the "adding sub-board" button, or delete the sub-board. Finally save and exit.

During inspection, the system will automatically calculate the jointed board area to which a component belongs and obtain the corresponding jointed board number. The jointed board range has no logical meaning and is only used for display and recording.

For some special-shaped joint boards that cannot be directly covered by the whole rectangular frame, the user may use the second method, namely defining multiple joint boards (referred to as small joint boards) with multiple rectangular frames to cover one joint board and then binding these small joint boards together. The method is to define a joint board (small panel), select the irregular jointed board option, and select other jointed boards (small joint board) bound to it in the drop-down box. In this way, the components on the jointed boards bound together will be treated as the same jointed board during inspection.

2.8 Bar code setting

Two bar code applications are involved in this system.

The first application is to register and inspect bar code as a component. In the editing mode, set the inspection category of bar code component as bar code identification. The system will try to read the bar code automatically during inspection. If the bar code is successfully read, the component will be judged as OK, otherwise it will be judged as NG. This mode is mainly used for reading bar code on the jointed board. If multi-board and multi-bar PCB operation mode is selected, the bar code of the jointed board will be automatically associated with the jointed board where it is located, namely all components on the jointed board.

The second bar code application is to use the bar code as the unique identification mark of the PCB. It is usually used when the user needs to record the inspection results board by board. When the system formally inspects a PCB, it will firstly read the identification bar code. If it is not successful, it will report an error and terminate the inspection until the user manually inputs the bar code. In fact, this manual barcode inputting method is not very suitable for the on-line AOI that cannot stop operation
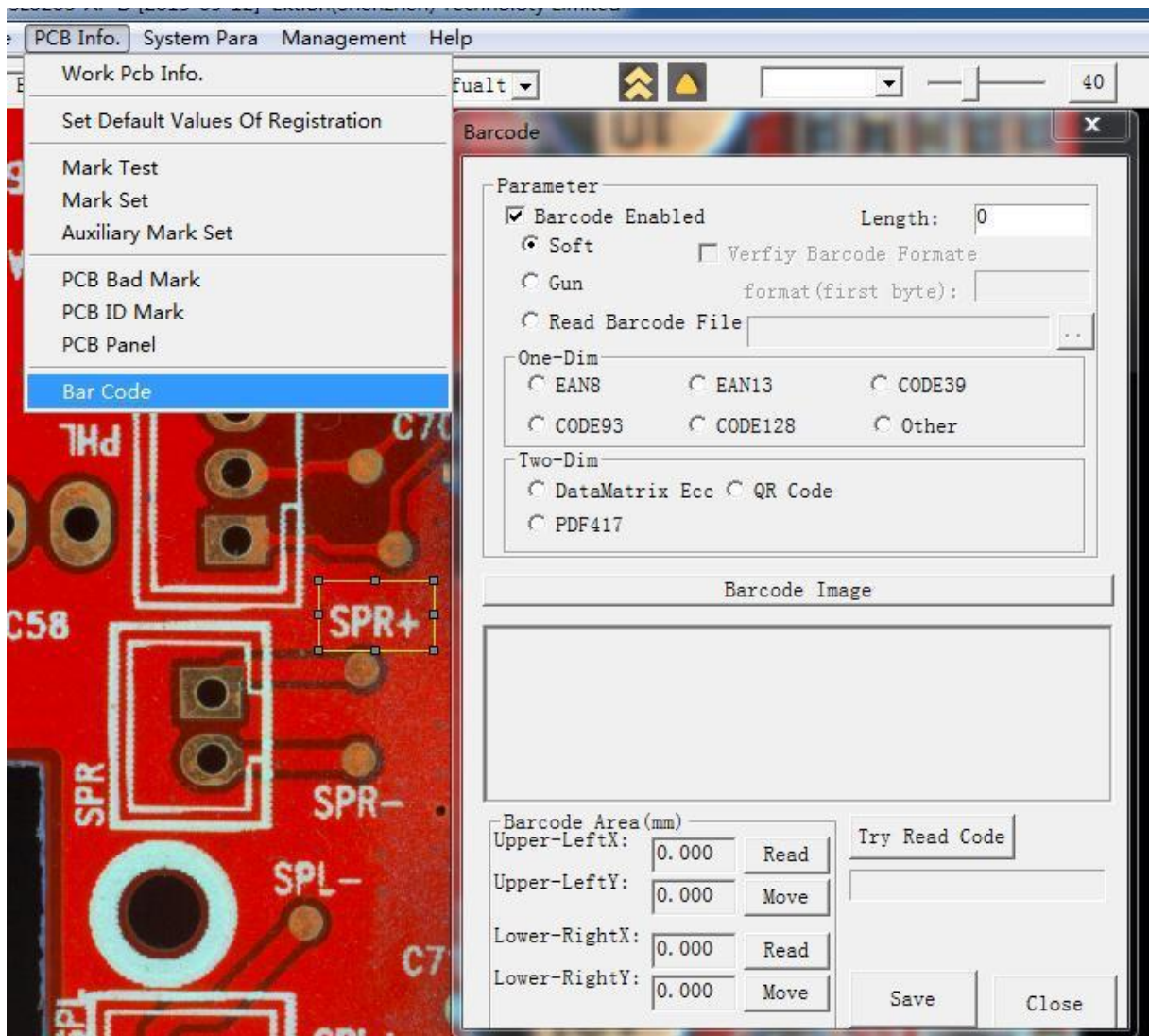
To enable the second method, bar code setting is required: select Enable Bar Code option in the bar code setting window and set the bar code length. The user can choose two different scanning modes: hand held barcode scanner and camera scanning.

When using hand-held bar code scanner, the user can set the format of the bar code. In terms of hardware, the matching bar code scanner is externally connected at an appropriate position. Standard keyboard input or non-standard external trigger is

adopted. This method is suitable for cases with single user products and fixed bar code position.

When using camera scanning, the user does not need special external bar code scanner, but need to select the bar code type. It is also necessary to define the upper left corner and lower right corner of the bar code with the camera crosshair in the image working area and read the coordinates to frame the bar code range. During the inspection, the system directly uses the camera to read and analyze the barcode image in this area. Although this mode is simple, it has requirements for the barcode type. Moreover, it has higher requirement for the definition of the barcode, and has slightly poor stability.

If the user does not enable barcode, the system will automatically assign a unique serial number to each PCB during inspection.

3. System configuration

3.1 System composition

This function provides a user interface for the user to set and modify some important system configuration parameters
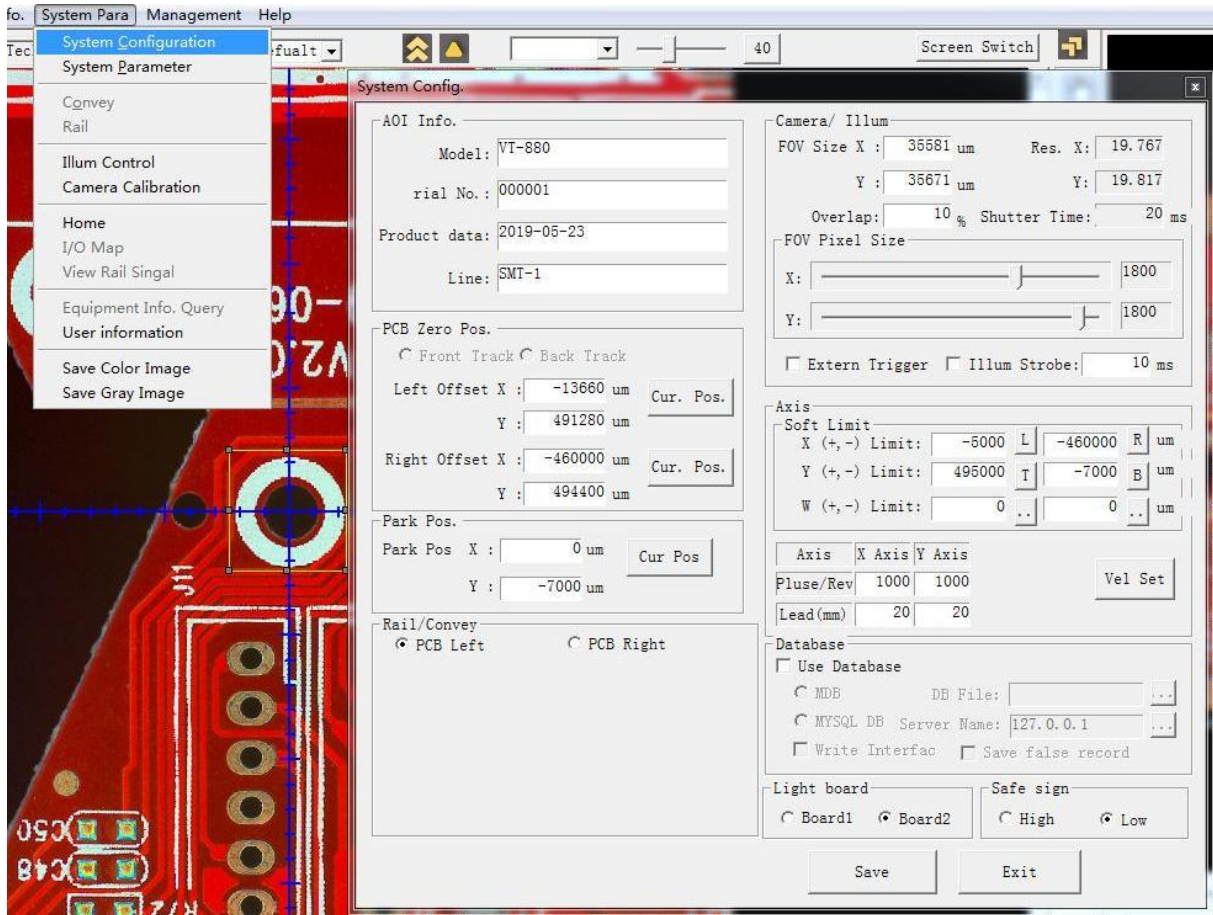
- Model, serial number, factory date and assembly line number, as some basic machine information, are important reference data for inspection data storage.

- The user can select left board placement or right board placement.

- If the board is placed on the left, the user needs to set the left offset (PCB zero). In the editing mode, move the camera's central crosshair to the lower left corner of the PCB in the image working area, and then click the current position button of the left offset in this interface to set the current position of the camera as the left offset. Similarly, if the board is placed on the right, the lower right corner is set as the right offset position.

- The position to be inspected is the position where the camera center will automatically return after the inspection of each PCB is completed. Its setting method is similar to that of the offset.
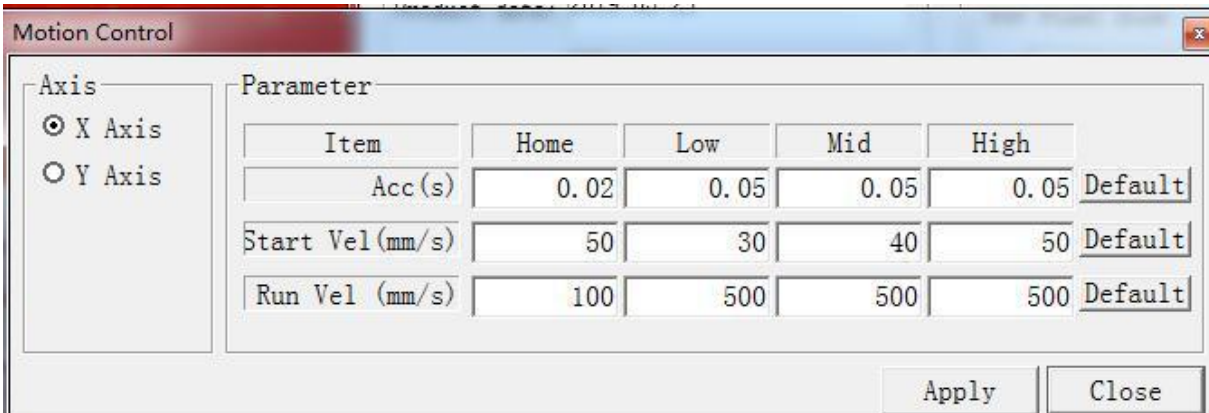
- The regulator board is related to safe sign and hardware. It has default value and does not need to be modified by users.

- FOV pixel size is divided into X direction and Y direction. Under the condition that the maximum camera pixel value is fixed, the user can adjust the size of the screen display image by adjusting the range of the field of view (FOV) (no more than the maximum camera pixel)

- Resolution: it is also divided into X direction and Y direction. It set by the camera calibration program, indicating the actual distance (um) corresponding to one pixel point in the current camera height setting.

- FOV size: the actual distance (um)covered by one FOV expressed by multiplying the FOV pixel size by the resolution.

- Overlap ratio refers to the ratio of ignoring a part of FOV edge when inspecting the drawing. It can avoid gaps caused by minor errors of coordinates during FOV jointing.

- The user can activate the strobing mode of the light source. Usually, the light source is in the normally on mode.

- Each motion axis of the AOI machine has a hardware limit switch. In addition, the user can also set software limit. When the motion axis moves to the software limit position (less than the hardware limit), the motion axis will stop moving to ensure safety.

- The limit setting is similar to that of the offset mentioned above. Move the camera center to the limit position in the image working area, click on the

corresponding button to take the coordinates, or directly enter the   coordinates

of the limit point.

- For speed setting, only X axis and Y axis can be seen in the off-line model.

While, on-line model also supports adjustment of track width and the

movement speed of the feed belt. Subdivision and lead are related to

hardware and do not require adjustment. The user can click on the "speed

setting"button to open the corresponding window and set the   initial speed,

acceleration, movement speed and other indicators of each movement axis.

- Using database: checking this option indicates that the test data will be

saved in the database for reference by reports and interface programs.

- If the user chooses to use the database, the system provides two different

database options.For stand-alone operation, the user can select the MDB MS

Access database which is relatively simple, and then click on the file selection

button to select the database save path.

If AOI is networked or there is requirement for longer data storage time, the user may use the large database My-SQL. However, it is necessary to install the database server and specify the name of the database server.
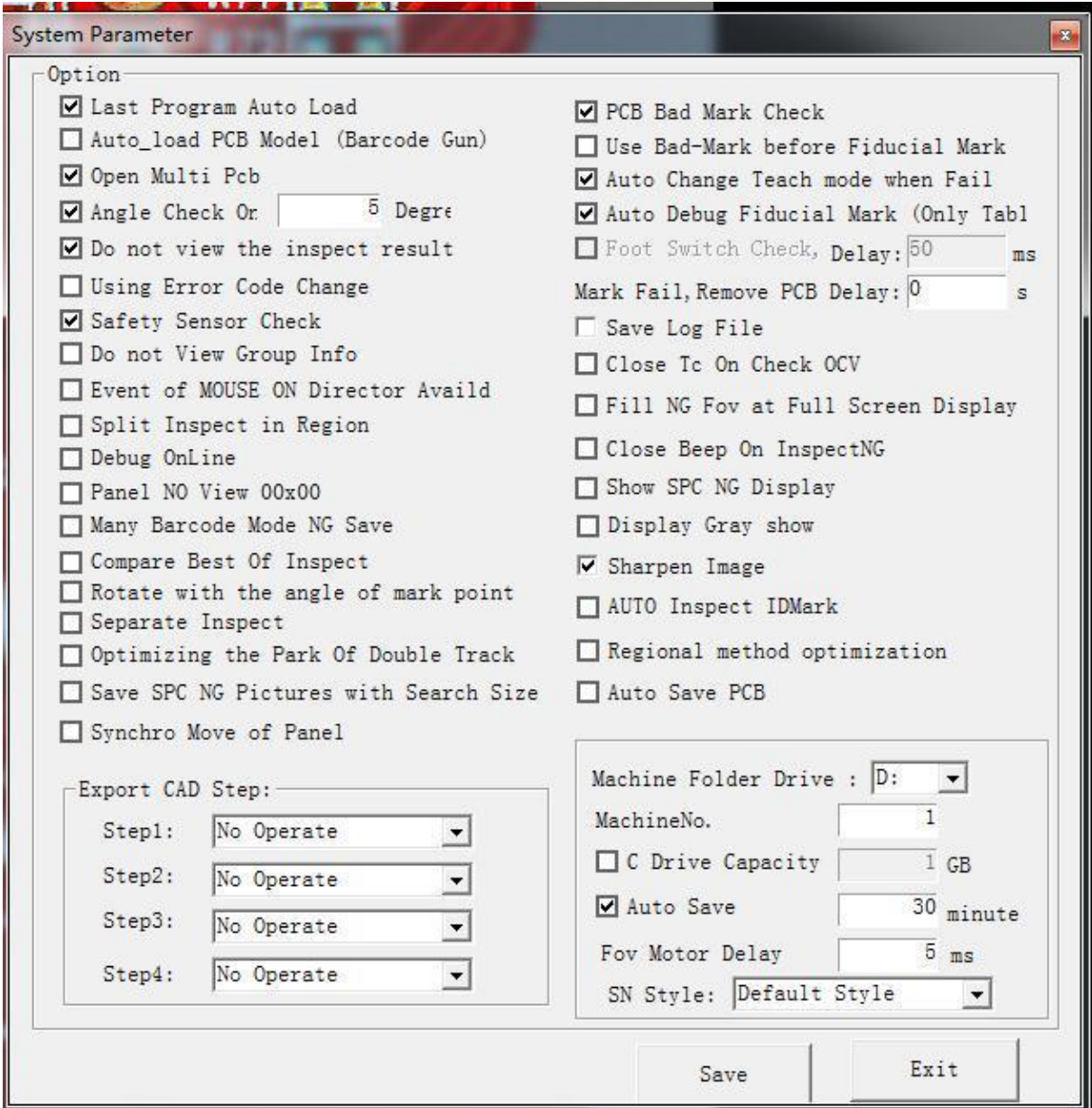
- In addition to the database settings, the user can also choose whether to write inspection data into standard interface tables and choose whether to save the data reported NG in the test but confirmed as false judgment.

On-line models have several unique settings:

- Automatic adjustment of track width: the track width will be automatically adjusted to the saved width when the program is loaded

- Entry and exit in the same direction: the fed and discharged boards are in the same direction. The on-line model is used as the off-line model

- Simultaneous feeding and discharging: board feeding and board discharging are performed at the same time, thus saving time

- Same-side inspection:

- Discharging delay:

- Feeding delay:

- Blocking delay:

- Compensation for the in-place distance of the fed board: distance compensation for the fed board to move forward after it reaches the in-place sensor

3.2 System technical parameters

In addition to the system composition parameters, the system also has some

important parameters related to inspection for the user to set.

- Automatically prompting to open the program used last time when the

  system starts.

- Some users' AOI programs are related to bar codes. The function of starting

  program by scanning bar code can be set

- Allowing opening multiple files simultaneously. This is function is used for inspection of various PCBs with the same line. The boards are distinguished by ID Mark

- Allowable rotation angle. The angle at which a single element is allowed to rotate during inspection

- Whether to display inspection results on NG display interface

- For NG components, the system has preset result NG code, but the user can choose custom NG code

- The user can shield safety devices such as light curtains

- The user can set the moving axis of the mouse with the moving direction key, but the disadvantage is that the function is effective on after clicking the button

- In the editing mode, if the current selection box has multiple group information, the user may choose whether to display them on the screen with pop-up window

- The user can choose to automatically divide the component into two parts for separate inspection when inspecting the component with the region method to improve the inspection accuracy

- Displaying jointed board number by rows and columns

- Supporting multiple jointed boards with multiple bars. Usually, multiple jointed boards share a temporary bar code

- Set whether to rotate the image according to the angular deflection inspected by Mark point. Since the rotation is time-consuming and affects the

inspection efficiency, only the offset in X direction and Y direction is corrected by default, and the angle is not corrected.

- When SPC reports are displayed, NG images are usually displayed only according to the size of the inspection frame. But the user can define to display according to the size of the larger search box.

- If the user need to use the skip region, the "using PCB Bad Mark" function needs to be checked.

- Defining whether foot switch is used (applicable to special occasions)

- In the on-line mode, If the Mark point detection fails during the detection, the user can define the time to delay the board exit

- If special system problems need to be eliminated, the user can choose to save the log file and submit the log file to the supplier for technical analysis.

- If necessary, the user can choose to turn on the multi-light source photographing inspection mode. In this mode, the system will take photos repeatedly under different light source settings at each editing and inspection position. In the editing mode, the user can choose to program the components with images under different light sources to achieve better inspection effect. However, this mode will increase the inspection time and affect the efficiency.

- For the user who needs to display NG results in full screen, the system provides the way of embedding the NG FOV into the thumbnail for overall display to replace the default FOV display mode.

- The user can set whether to turn off the buzzer when NG exists.

- The user can set whether to replace the default color images with gray image.

- The speed optimization of region method should be checked generally. This is mainly for compatibility with the old version of the system.

- If a component has multiple template groups during inspection, the user can set whether all groups need to be inspected to find the best inspection value during inspection. The default is to inspect the end of the first reaching the standard and take the result as the final inspection result.

- During the formal inspection, the user can choose whether to directly adjust the parameters of some inspection frames through switching to the editing mode without stopping the machine, especially in the on-line mode, so as to keep the inspection smooth.

- The system also provides special mode settings for non-standard system users, which can be ignored by standard system users.

- The user can choose to set the operating system drive letter and folder number for program file storage. For example, if D and 1, the program files will be stored under D:\Machine_1\and will be stored hierarchically by model and file name.

- The system's automatic save time setting can remind the user to save the program file within a fixed time, so as to prevent the program being edited from being lost when the machine is shut down due to special software and hardware reasons.

3.3 PCB drive

This is a function of on-line model.

The user can manually obtain belt drive to control the board feeding and discharging.

The screen can display whether any board is sensed at feeding position, discharging

position and inspection position
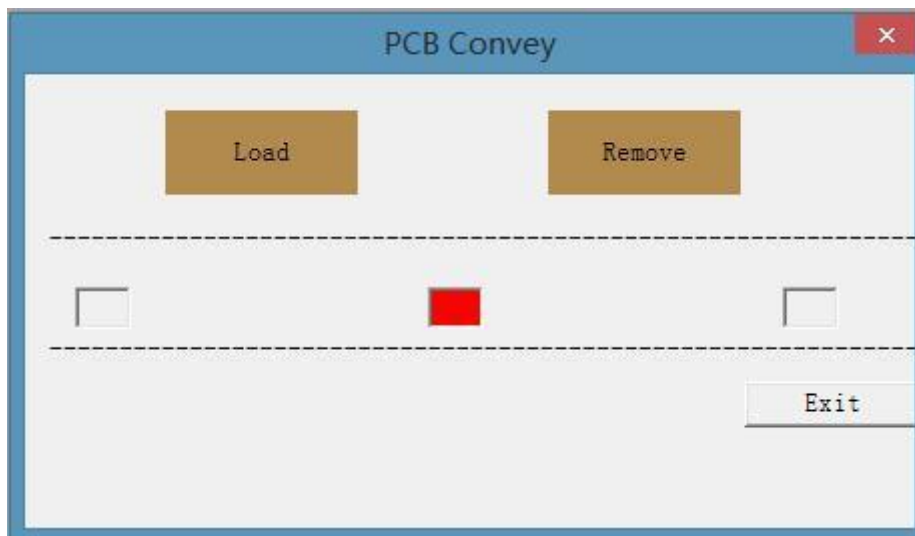
3.4 Track width adjustment

This is a function of on-line model.

For the tracks of on-line model, the track close to the user is the fixed track,

and the other one is the movable track with adjustable position and width.

Based on this function, the user can move the movable track back and forth to

adjust the track width. The inching setting is for the convenience of users to

adjust more accurately.

The user can preset the maximum and minimum width of the track to limit

the   range of motion when adjusting the track width.

The position to be inspected refers to that controlled by the track width

adjustment movement. If the user does not load program and set the track

width when starting the machine, the moving track will stay at this position.

PCB width refers to the width after track adjustment.The adjusted width can

be saved so that the system will automatically run to this width the next time

the program is opened without manual adjustment.
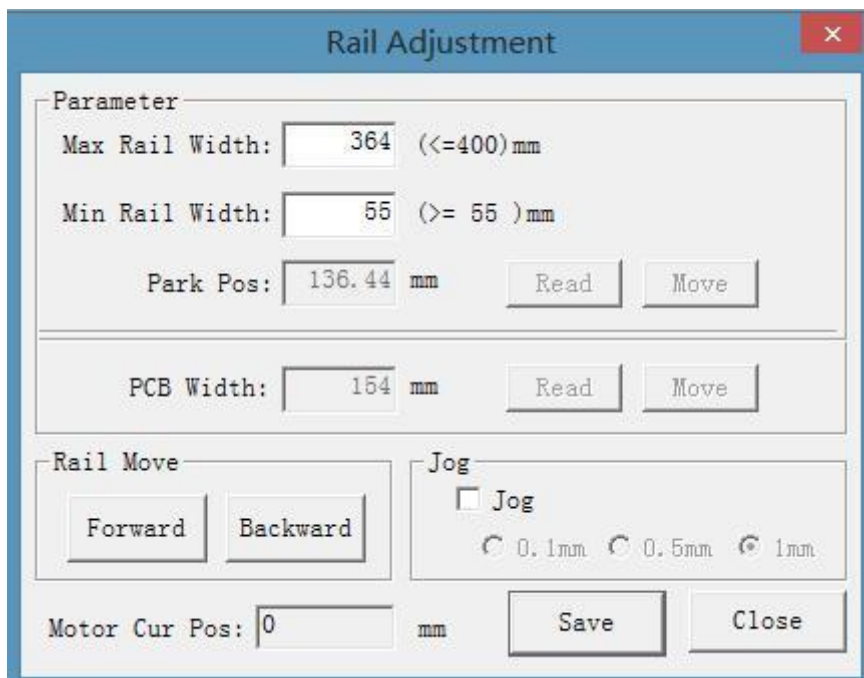
3.4 Brightness adjustment

In the system, the individually setting of light sources of four channels

is supported. The combined action of light from each channel will produce different

overall lighting effects. To ensure the stability of the inspection effect, it is necessary

to ensure the stability of lighting effects. If the customer has multiple Southern Machinery AOI and the program needs to be used across machines, the brightness intensity of each AOI should be kept consistent.

Brightness adjustment is carried out by taking pictures of standard color paperboard with a camera. The color paperboard should be larger than the actual coverage area of FOV (all the pictures taken should be color paperboard only), so that the reflected light is consistent. The brightness of the light source of each channel is adjusted by changing the number of the light source controller of each channel and the color gray value of each channel under the comprehensive image effect is also obtained. User slightly adjust the brightness of the light source of each channel and finally fix the color gray value of each channel on a certain reference value combination. The adjustment is completed.

If the user chooses to take photos repeatedly under different light source combinations, the default light source channel can be selected here.

As some Mark points on the circuit board have better inspection effect under coaxial light, if the user's machine is equipped with coaxial light, the user can choose to turn on the coaxial light when inspecting Mark points.

In addition, if the user adjusts the focal length with this window pop up, the system will calculate the clear image of the currently obtained image and display the image with the maximum clarity obtained during adjustment. The user can judge whether

the focal length has been adjusted to the best by comparing the clarity obtained

from current position adjustment with the maximum clarity.
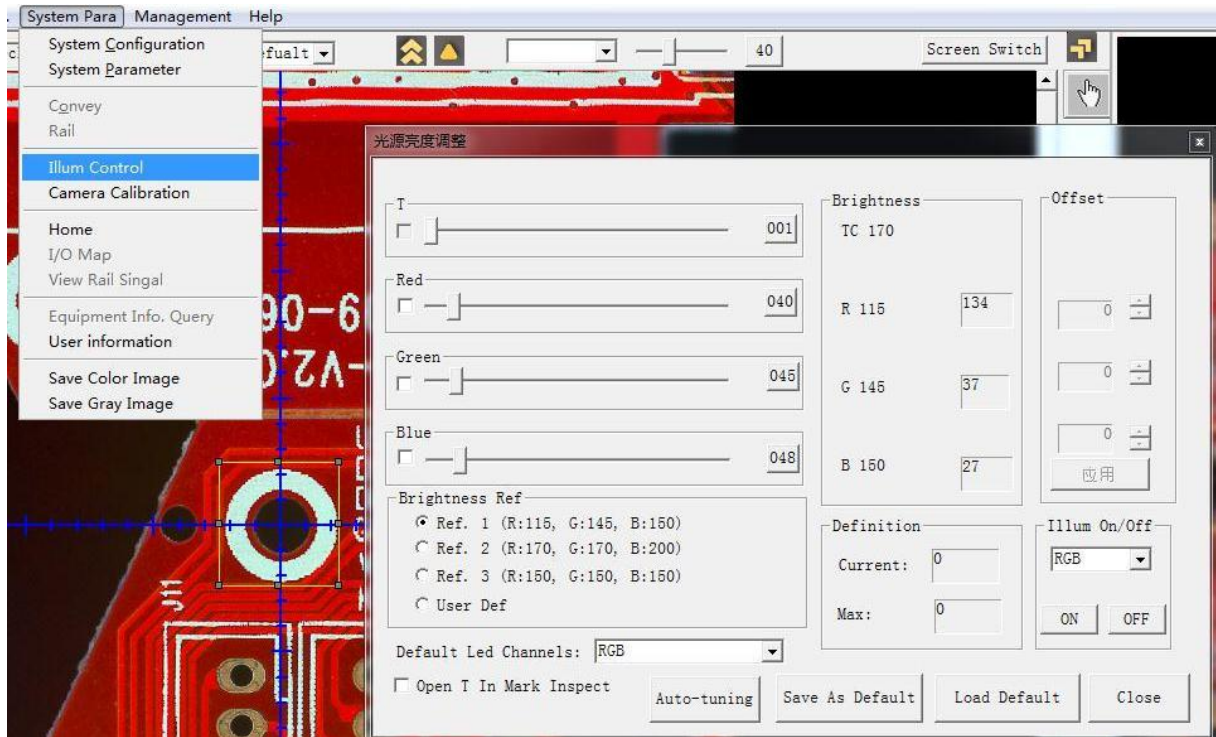
3.6 Camera calibration

Combined with the camera calibration function, the proportional coefficient between

the pixel under the current camera setting and the actual distance on the board can

be obtained. The proportional coefficient is divided into X direction and Y direction

and expressed by the micron corresponding to each pixel (um/pixel). This parameter

is one of the most important parameters in this system, and is the basis for the

correct operation of the whole system. It must be strictly implemented.

In addition, the deflection angle of the camera can also be obtained from calibration, based on which the system will automatically correct the rotation of the image after the photographing is completed.

Under the condition that the camera hardware settings (pixels, lenses) are fixed, the actual width that the camera can shoot will change due to the different heights of the camera from the board surface. The user can adjust the camera height based on the factory settings according to the maximum product width produced, so as to make maximum use of the pixel value of the camera. However, once it is set, it should not be changed easily in principle, otherwise the user cannot continue to use previous programs.

If the customer has multiple Southern Machinery AOI and the program needs to be used across machines, the camera calibration values of each AOI should be kept consistent.

Once the height of the camera is modified, the user must use this function to recalibrate the camera.

SOUTHERN MACHINERY

System Para | Management | Help

System Configuration
System Parameter

Convey
Rail

Illum Control
Camera Calibration

Home
I/O Map
View Rail Singal

Equipment Info. Query
User information

Save Color Image
Save Gray Image

Camera Calibration

Calibration Parameter

X Scale: 19.767 um

Y Scale: 19.817 um

XAngle: 0 Deg.

YAngle: 0 Deg.

FOV X: 35.581 mm

FOV Y: 35.671 mm

Notes:Please select the middle of screen image is clear,moderate size,and the surrounding is not easy to confuse the image box calibration,About 2 minutes to complete,do not quit the program.

Set Image | Calibrate | Save | Close

In the editing mode, select the calibration image (preferably circular mark) in the image working area by framing. In this interface, click on the "defining image" button to define the calibration image and press the "starting calibration" button to calibrate. After successful calibration, the calibration

value will be displayed. If the user chooses to save the parameters, the original calibration value will be overwritten.

3.7 Return to origin

Manually move the X axis and Y axis to the machine origin for system recovery

after pressing the emergency stop button.

3.8 Track transmission signal inquiry

It is an on-line model function, and is used to query the current IO status

related to the board feeding and discharging to help users understand

and eliminate the problems of board feeding and discharging
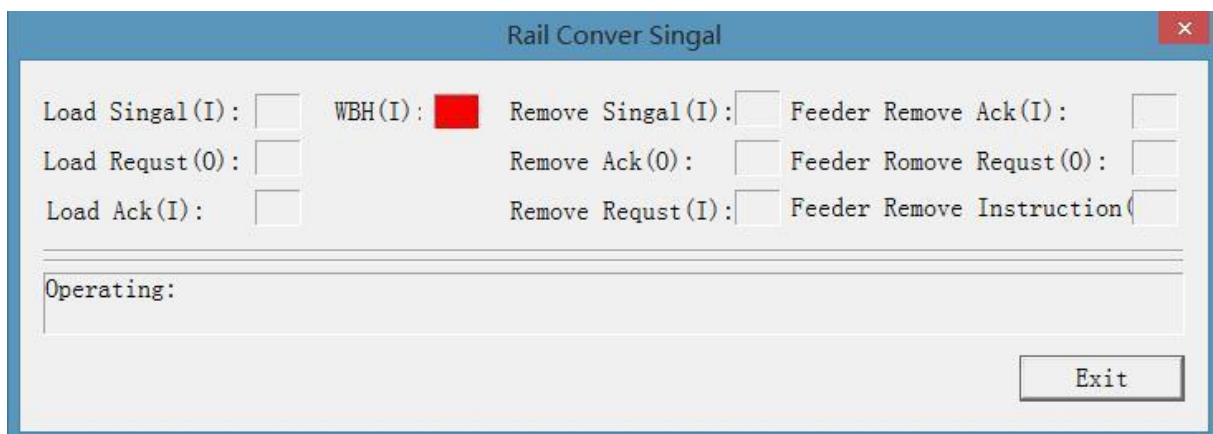
3.9 User management

In this system, users need to log in with user name and password, and

administrators need to set user name and password for each user and set user

category. Users cannot modify their own passwords.

This system has three types of users Administrator: operating all functions,

including user management.

Programmer: creating, modifying and debugging programs.

Operator: opening the program for inspection.
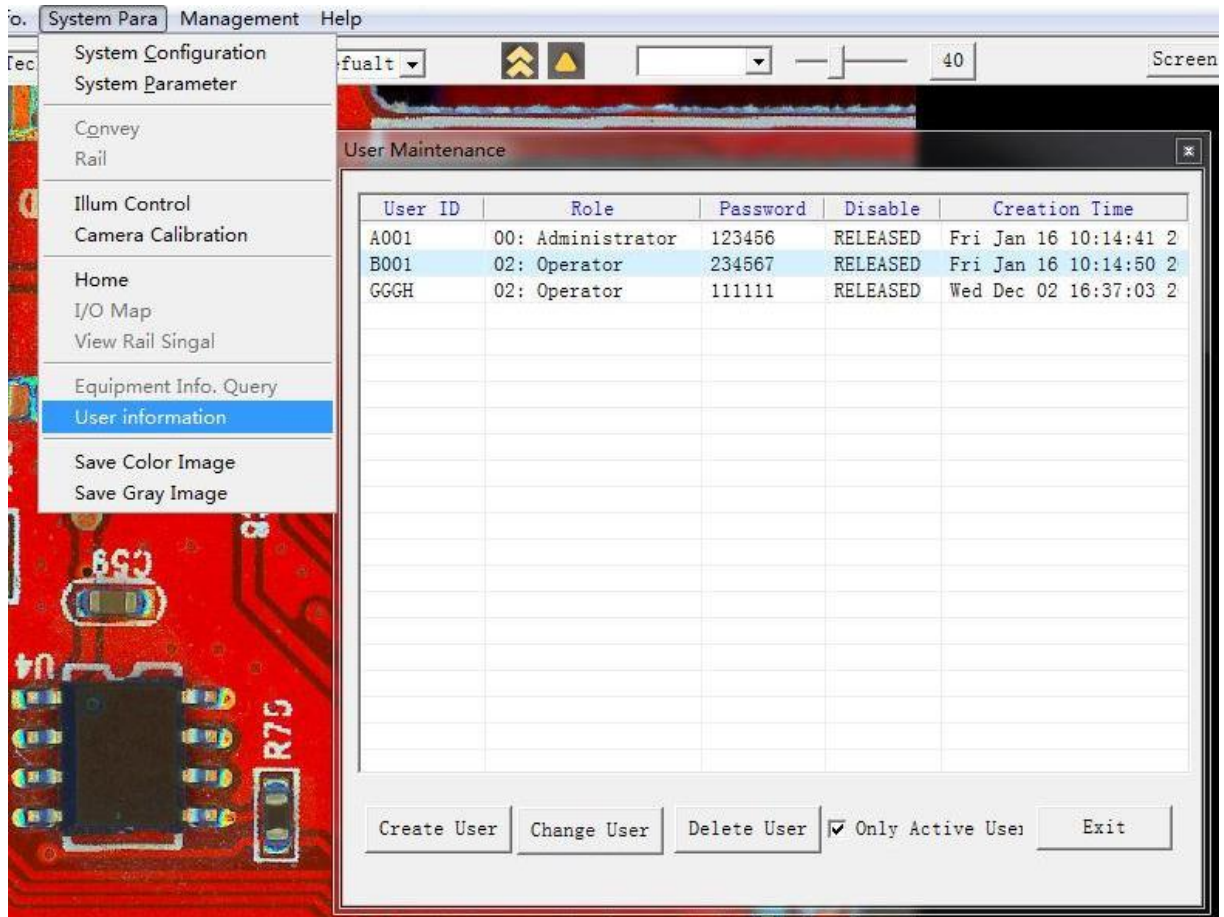
Administrators create and modify users in this interface. The created users cannot be deleted and can only be locked and disabled.

The user information file will be stored in the working directory in an encrypted manner and should be carefully kept. If the file is lost or damaged, all users will be unable to log in the system. At this time, it is necessary to contact the supplier for help.

3.10 Saving color images

It is a simple tool function used to save the color image of the current image working area in the directory file selected by the user for comparison and reference.
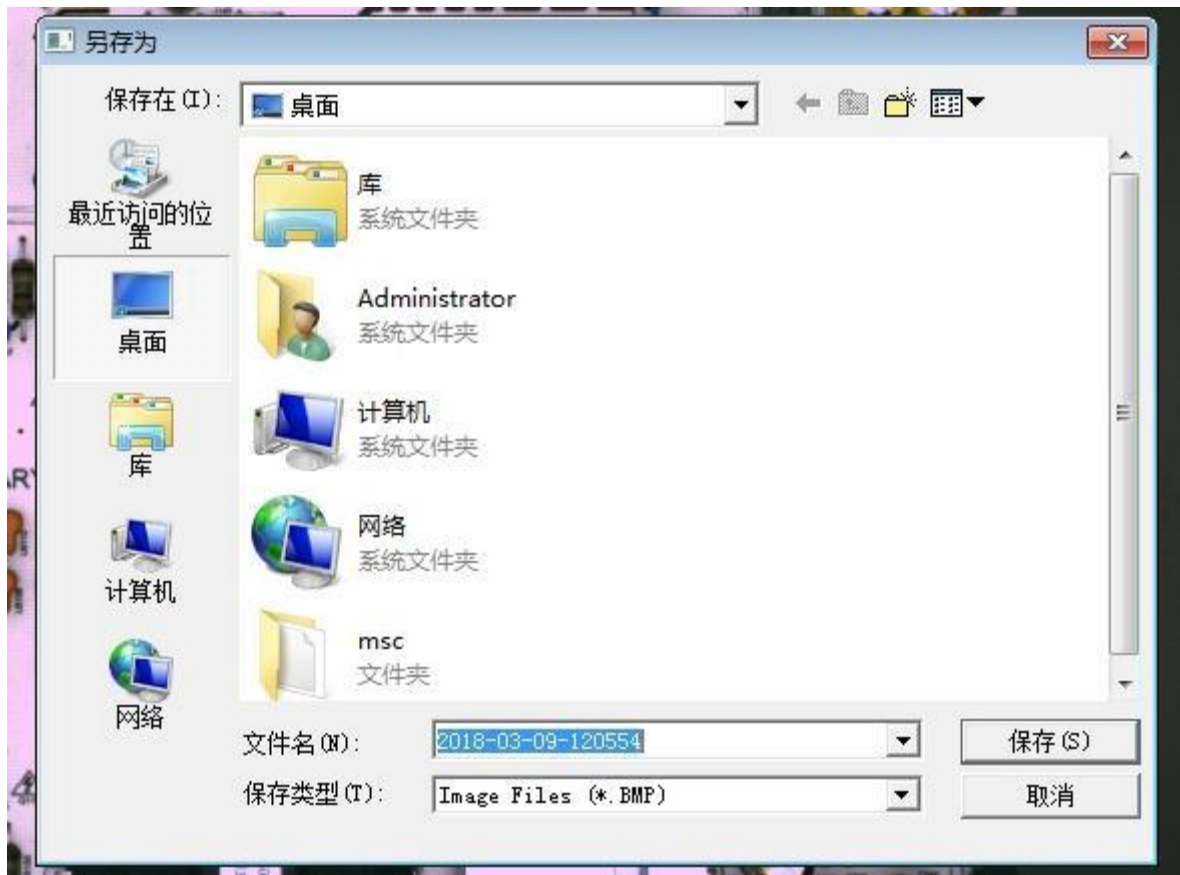
3.11 Saving grayscale images

Simple tool function to save the image of the current image working area in grayscale format in the directory file selected by the user for comparison and reference

4 Production management

There is only one option under this menu item. It is used to start the statistical

process control (SPC).As mentioned above in this Manual, the user can choose

whether to store the inspection data and confirmation data in the database (simple

Access database or a large MySQL database) when setting AOI inspection parameters.

Report data will come from these stored data. If the user has not selected storage,

the report function cannot be used.
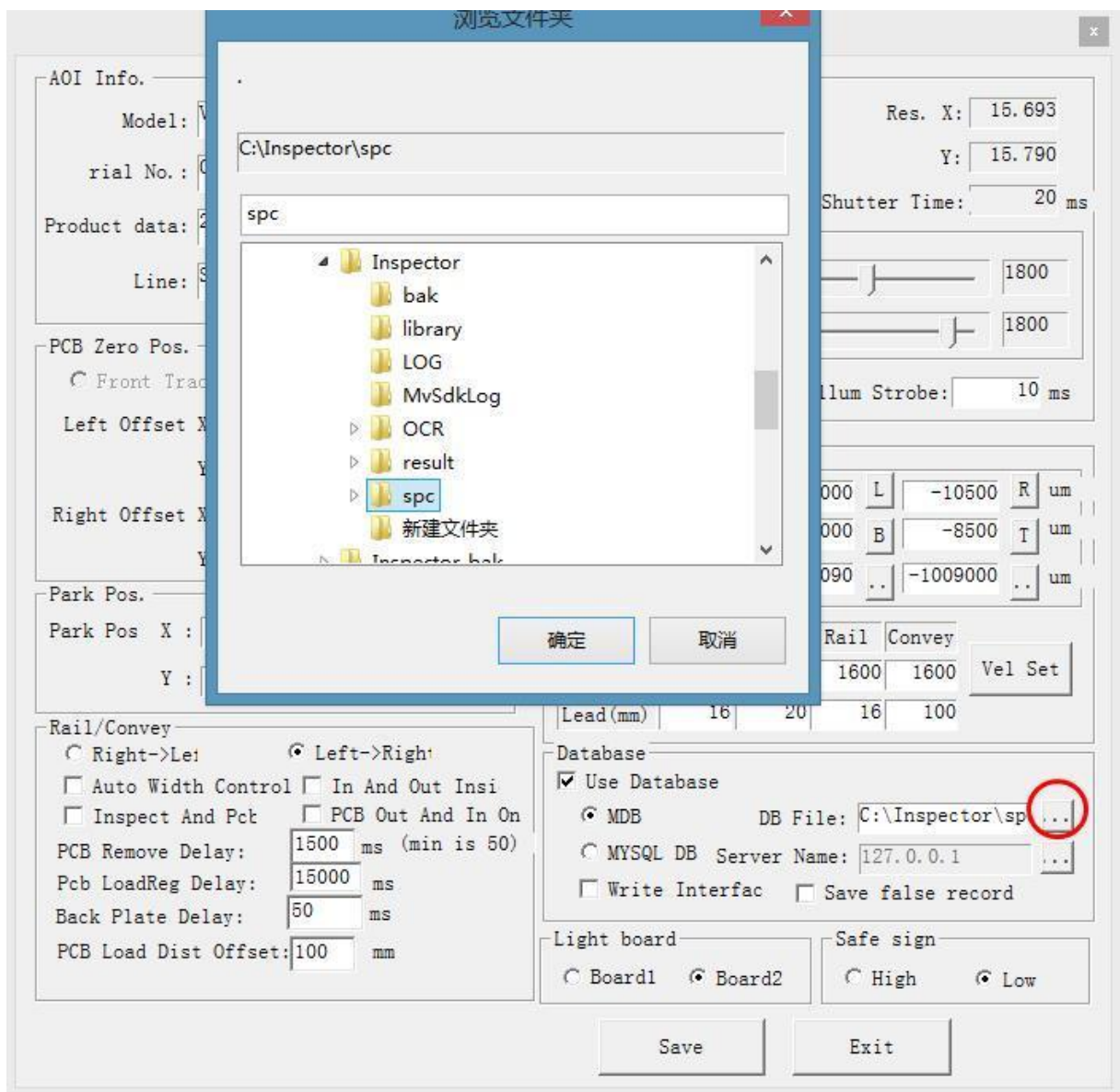
Before entering the statistical report, the system will automatically check whether the database connection has been successfully set up and whether the database has been connected. If the connection fails, the system will pop up the database setting window, where the user can set the correct database type and path. The user name and mode can be defaulted. If the connection still fails after setting up, it may be because the database system installation fails. At this time, it is necessary to contact the supplier for help.

Statistical process control (SPC) is a subsystem that can run independently and has its own main menu.

As long as the path of the database is set correctly, SPC can access the database storing inspection data through network to realize data sharing. Since the network architecture of each organization is different, please contact the computer network maintenance personnel and supplier for specific settings.

Functionally, SPC is divided into three parts: common analysis report, off-line review and maintenance station

The analysis report provides multiple commonly used reports. The user can select parameters such as inspection time and inspection program name. The system will select inspection data from the database and make classification statistics. The user can also trace back and query the inspection value of each component inspection frame and the corresponding inspection diagram from the historical inspection data in detail.

Reports and statistics can be exported to EXCEL files. The user can also selectively delete some expired data from the database to avoid database overflow and improve report efficiency.

Off-line review and maintenance station are mainly used for non-standard designed

required by customer and are not universally applicable. The system also provides

some standardized software and hardware parameter settings (such as barcode

scanner, pci card, rfid reader, NG definition, auditing process, etc.), which can meet

some simple user standard review requirements. The following is a brief illustration

with several figures
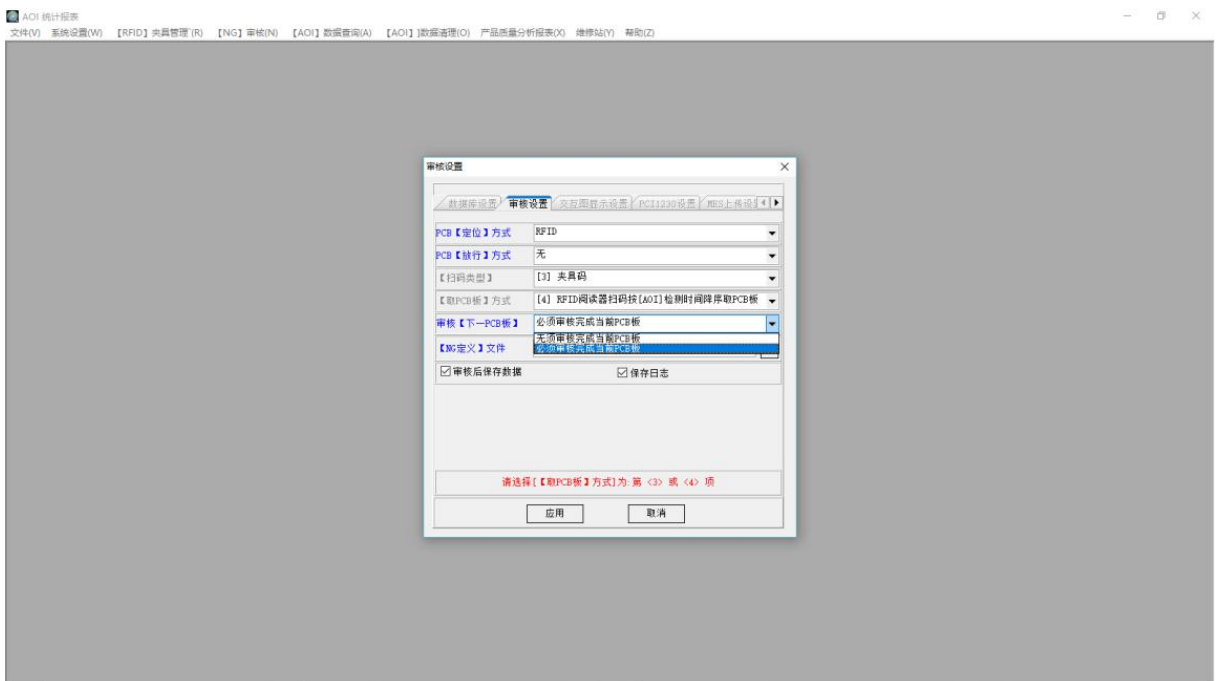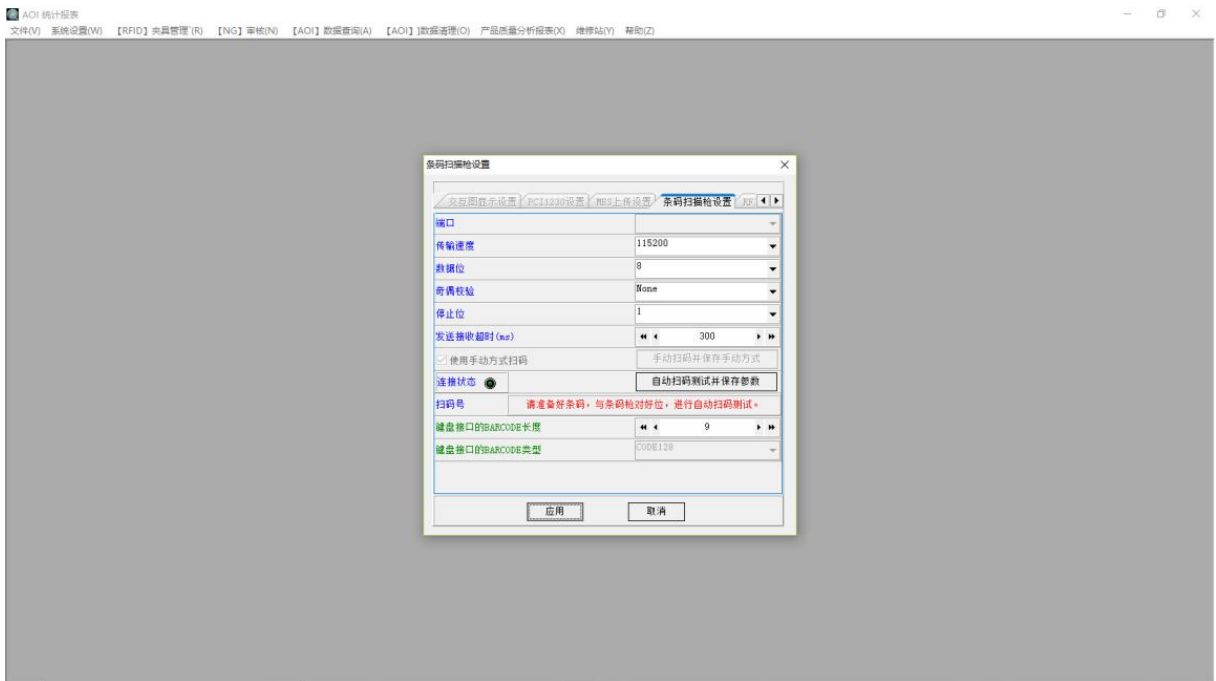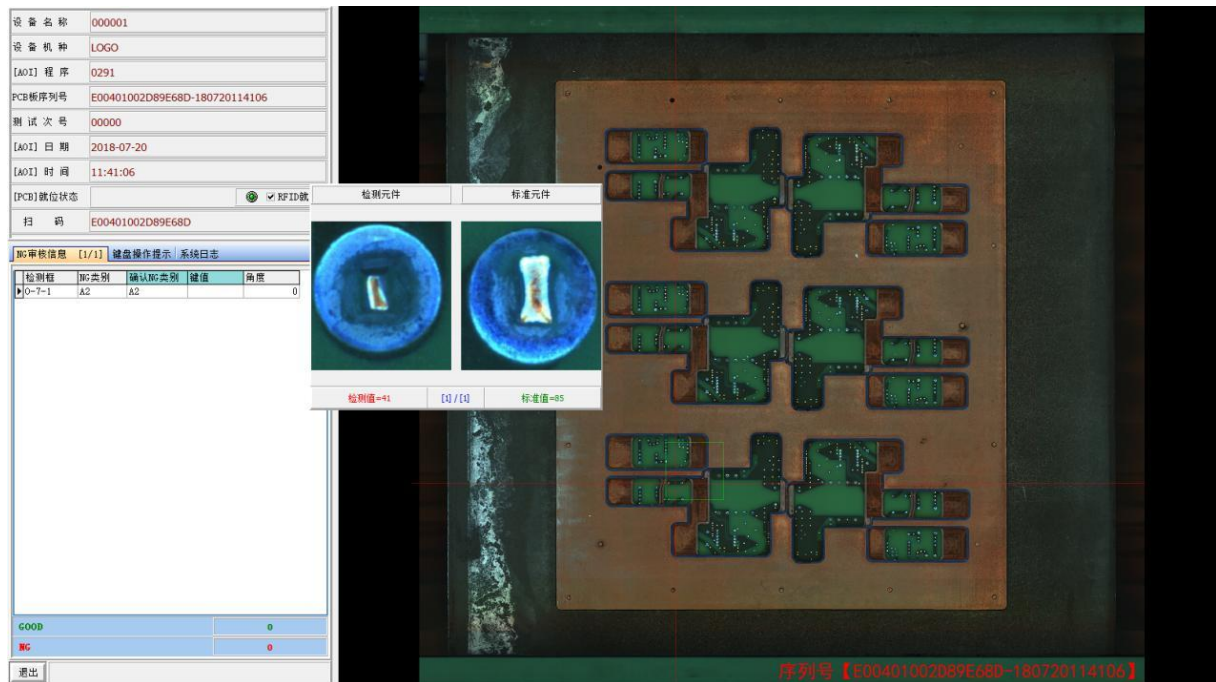
5　File management

This function is to manage AOI programs written by users.

5.1 Opening file:

Select this menu option to start manual opening of the file window. The user can open the previously stored program for editing and inspection by selecting model and file.

If some programs are provided with ID mark (supporting inspection with the same line), the system will prompt to open other programs at the same time (ID mark also needs to be set) when opening these programs. Up to 10 programs can be opened at the same time. In the editing mode, the user can manually switch between several programs. In the inspection mode, the system will automatically switch between several inspection programs according to different ID marks.

When opening the file, the user can choose whether to pretreat the image obtained from each photographing. The pretreatment parameters are set when creating a new program and can be changed in the PCB information window. Please note that selecting image pretreatment will slightly slow   down the unit inspection.

"Loading system light source settings" in this screen is a default option, indicating that the system default light settings will be used when opening this program for operation. However, the system supports setting the unique light source for a program and separately saving it together with the program.

At this time, the user can directly use the program's direct light source setting without selecting this option when opening the program.

To minimize the loss to users caused by program damage due to system reasons, the system will automatically make a backup of a program after it is successfully opened each time. In this way, when the system cannot open a damaged program, the user can choose to restore the backup version successfully opened and saved last time to reduce the loss to the last modified content.
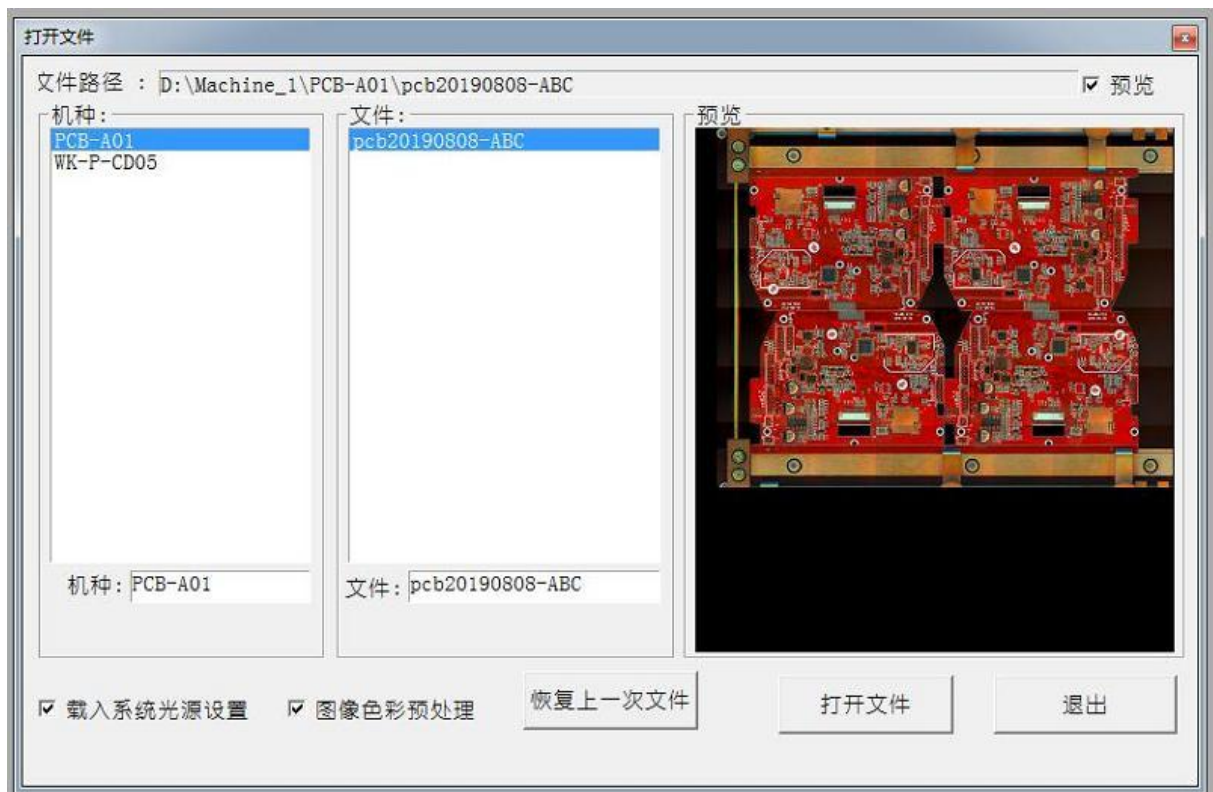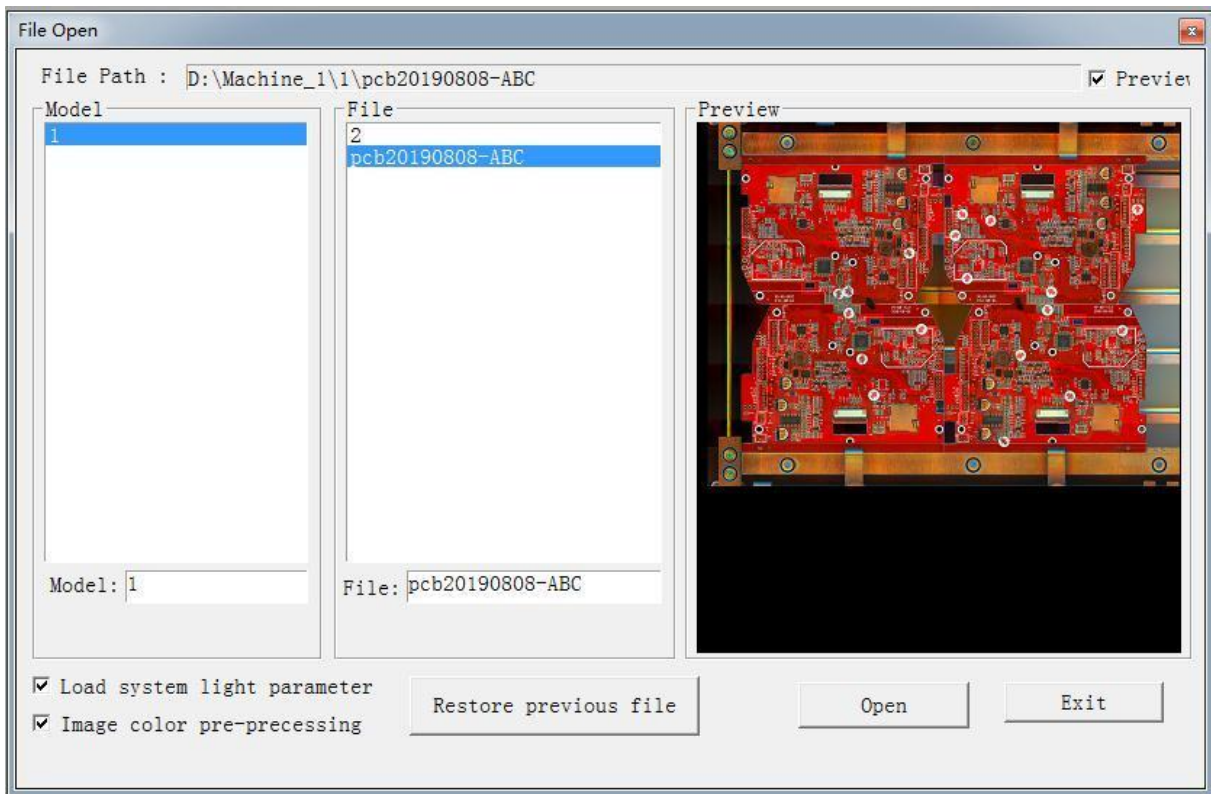
5.2 Maintenance

In the mode resetting state, the user can start the program maintenance

window with this button to delete and rename the program files according to

the model and file layer.
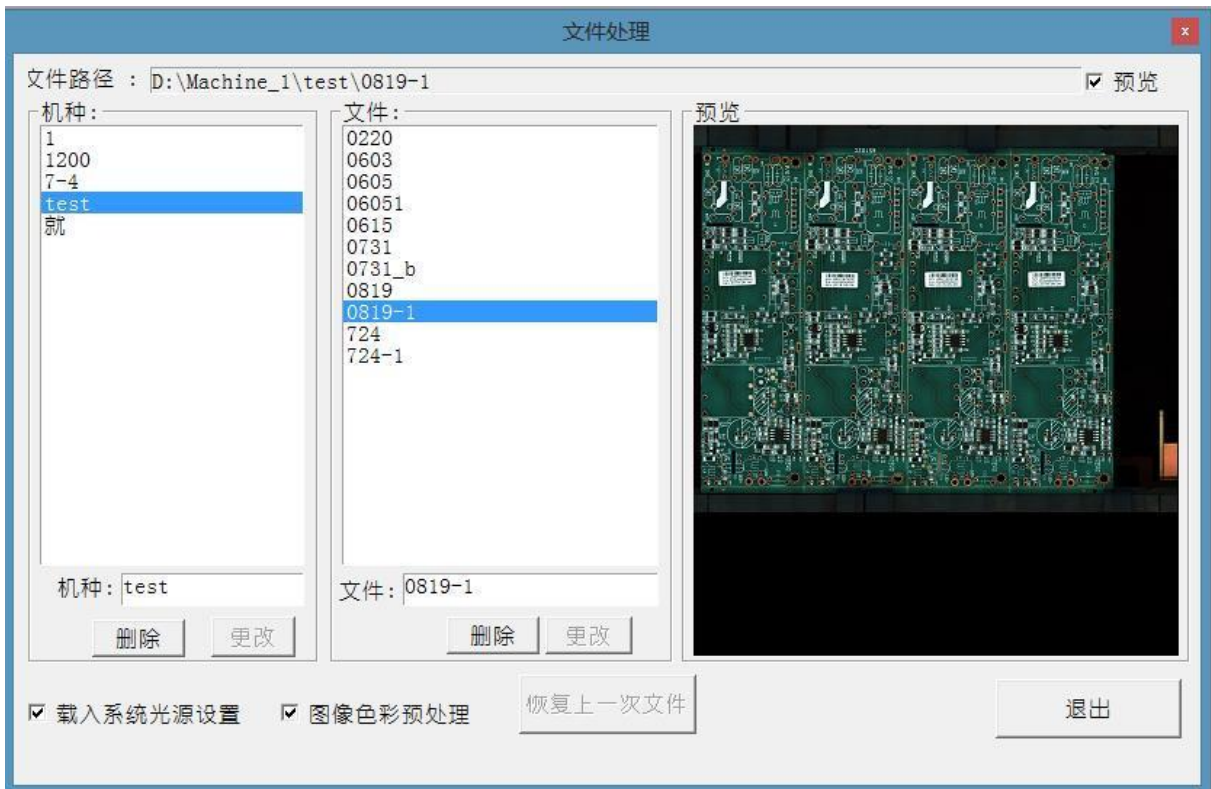
5.3 Saving

Select this menu option to instantly save the program files currently being edited and tested in the working area, including private library, public library and various technical parameters.

5.4 Saved as

This function is similar to saving operation, except that the user can choose to save the program in the current working area as another new model and file name by selecting this menu item. It can be used as the program copy function.

8.Common Equipment Faults and Troubleshooting Methods

1. Shake during machine operation

    Reason and solution: the level of the machine is not adjusted properly. Use a level meter to adjust the level of the machine and tighten the screws fixing the foot cup.

    The steps for adjusting the machine level are as follows:

    ① Suspend the four legs of the machine

    ② Adjust the level of the left and right of the machine

    ③ Adjust the level of the back and forth of the machine (only one foot in front should be adjusted. An area can be fixed with 3 points), put down the suspended foot cup of the machine and tighten the screws for fixing the foot cup.

2. Electric shock when touching the machine

    Reason and solution:

    The ground wire of the machine has poor contact or is not grounded, and induced electricity with a certain voltage will be released through the servo driver during the operation of the machine.This problem can be solved by grounding protection. The specific method is to lead a wire from the rear   cover screw of the machine and connect it to the dedicated ground wire of   the workshop. (Note: do not confuse or misconnect electrostatic wires with ground   wires)

3. The machine makes the sound of "beeping" for a long time.

    Reason and solution:

Computer hardware failure. Check whether the memory module is firmly

inserted and reinsert it after pulling it out. Or, the computer maintenance

personnel check for other faults.

4. The system prompts that X axis or Y axis cannot be moved when running the

program

Reason 1: poor interface contact of motion control card.

Solution: close the program, pull out the interface of the motion control line,

check whether there is any blockage or deflection at the interface, and reconnect

after eliminating the problem.

Reason 2: poor contact at X or Y filter or falling off.

Solution: close the power supply and open the machine casing to confirm

whether there is any poor contact.

Reason 3: loose wiring of the motion control card.

Solution: open the back cover of the machine, use a multimeter to inspect,

and   lock the loose part.

5. Black screen of display

Reason: the display power supply is not turned on or the signal line is not

connected properly

Solution: check the power and signal lines of the monitor.

6. The component frame offsets when moving the camera left and right or back

and forth

Cause: lens calibration is not accurate.

Solution: calibrate the lens. Select a clear character or positioning hole on   the

surface of the currently inspected PCB for lens calibration.There should   be no

similar pattern near the calibration area, otherwise the calibration result will be

inaccurate.

7. Too many misjudgments in normal inspection

    Reason 1: the component frame offsets

    Solution: ①Check whether the PCB is fixed and fix the PCB and fixture.

    ②Make the machine return to the calculation starting point to inspect   whether

    the coordinates of the components offset as a whole. Then, redefine the

    coordinate starting point.

    Reason 2: incoming materials are changed (stand-by materials are used)

    Solution: re-register a standard with new components and include the original

    standard and the newly-built standard into the same group.

    Reason 3: inadequate learning and debugging lead to false report.

    Solution: debug a few more boards.

8. Missing judgment of component

    Reason 1: the component has no registered standard

    Solution: register standard for the component and optimize the lens.

    Reason 2: there is no lens optimization after adding components.

    Solution: optimize the lens

    Reason 3: the error range of the standard linked to the component is too large.

    Solution: reduce the error range of the component standard by reducing the

    error multiple or re-register a standard to replace the original standard.

9. Constant offset or reversal of several components during inspection

    Reason 1: the component frame has offset.

Solution: move the lens to the position of the component and pull the component frame straight.

Reason 2: the incoming materials of components have been changed or the silk screen has been changed.

Solution: re-register a new standard for current component and include it and the original standard into the same group.

10. Missing inspection of IC pin short circuit

Reason 1:there is no short circuit inspection frame for IC pin.

Solution: carry out short circuit inspection on the standard of this component in the standard library.

Reason 2: the threshold of short circuit inspection is too large.

Solution: reduce the short circuit inspection threshold of components in the standard library.

11. Inspection failure because Mark point identification fails

Reason 1: PCB is not fixed properly.

Solution: lock the fixture for the PCB to fix the board.

Reason 2: PCB is not placed in the direction of thumbnail.

Solution: place the PCB in the direction of the thumbnail.

Reason 3: program debugging error.

Solution: check the inspection model name and call in the correct test program.

Reason 4: the original Mark point was not selected well. Or, the Mark point was   oxidized on PCB and the color difference is too large.

Solution: cancel all Mark points and select other points to define Mark   points.

12. The inspection cannot run normally after the exchanges of the programs made by two machines.

Reason: it is impossible to ensure that the mechanical origin of each machine is in the same position during the machine manufacturing process, and the coordinate origin for programming corresponds to the mechanical origin.

Solution: redefine the origin of coordinates after the exchanges of the programs made by two machines, and then realign the position of the component frame for the exchanged programs. However, the program exchange between the two machines is only applicable to the PCB inspection program files that can be shared between the machines with the same board feeding direction and track direction and the same inherent resolution of the lens.

13. The host is not powered on

Cause: power socket failure.

Solution: use a multimeter to determine if there is voltage at the power input.

If there is no voltage, it indicates that there is no power input, and the power supply needs to be replaced.

9. Repair and Maintenance of Equipment

1. To ensure the normal operation of the equipment and prolong its service life, please perform the following regular maintenance work:

a) At the end of the day, turn off the power supply of the computer and

equipment, and suck the dust on the equipment table surface with a vacuum

cleaner. If there is no vacuum cleaner, dry towel can be used to   wipe off the board

dust and the like from the bench surface. Note: do   not blow the surface with an

air gun. The dust and debris will be blown   into the top of the equipment and will

attach to the screw rod, guide rail or lens, which will affect the accuracy and service

life of the equipment. If metal debris is blown into the electrical appliance, there may

be the risk of short circuit and fire.

b)   Wipe off the dirt on the equipment surface with towel. Note: do not use

organic solvent (e.g.board washing water) to wipe the surface of the

equipment, otherwise the paint on the surface of the equipment will be

damaged.

c)   Maintain the screw rod and guide rail every month. Clean the old oil with

clean white cloth, and then evenly brush the oil on the surface of the screw rod

and guide rail with No. 10 or No.11 oil brush. Note: grease and lubricating oil

must be of good quality. Otherwise, the surface friction on the screw rod or guide

rail will be increased, thus shortening the service life of the screw rod and   guide

rail and affecting the accurate positioning of the machine. Recommended:

Germany OKS Super Grease OKS422, or referring to the grease used in mounter

maintenance.

d)   Clean the filter cotton on the left side of the industrial computer panel

every 1 month. Note: filter cotton should be dried after cleaning and then   put

back in place.

e) Check the light source every 3 months. Since the brightness of LED

lamps may change slightly after half a year, the light source needs to be

checked once to ensure normal inspection.

f) Calibrate the camera every three months. Since the camera keeps

moving every day, it is necessary to check whether the camera screws and lens

screw are fixed properly and whether the calibration value is   within   the

acceptable range.

2. Detailed inspection process of each component

1) Determining whether each groove-shaped photoelectric sensor works   normally

There is one X-axis and one Y-axis on this equipment, and there are two

groove-shaped photoelectric sensors in the width direction of the track. If

paper is put into or taken out of the groove, the signal lights will normally   be on

or off.

2) Determining whether the PCB photoelectric sensor works normally

The equipment is equipped with a photoelectric sensor at the rail inlet end, the left baffle cylinder, the right baffle cylinder and the outlet end respectively. Under normal conditions, when a PCB passes through the rail, the signal lamp color will changes.

3) Determining whether the mechanical limit switch works normally There is a mechanical limit switch at the end of the X axis and Y axis of this   equipment, which can be checked and confirmed by multimeter. Under normal conditions,both ends of the connecting line are in conducting state. When the axis runs to the end, the mechanical limit is pressed to disconnect both ends of the connecting line. If the mechanical limit switch   is damaged, a spare part installed in the side-by-side position can be used for replacement.

4) Lubrication and maintenance of screw rod and guide rail parts

Screw rod and guide rail are the main transmission components of the equipment operation. Their maintenance is the most important part to ensure the transmission and positioning accuracy of the equipment.   During the annual   major maintenance, special attention should be paid to removal of old oil and   dust and application of new oil. It is recommended to use the German super lubricating grease OKS-422. The   specific operation steps are as follows:
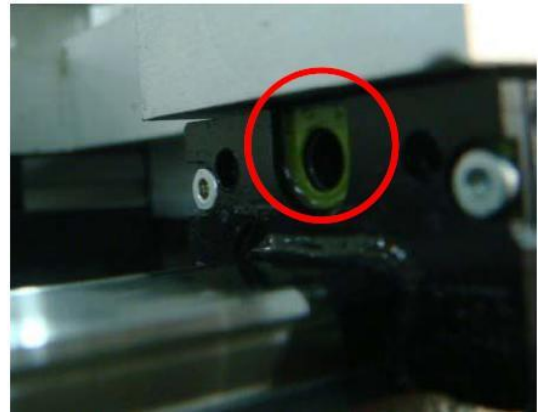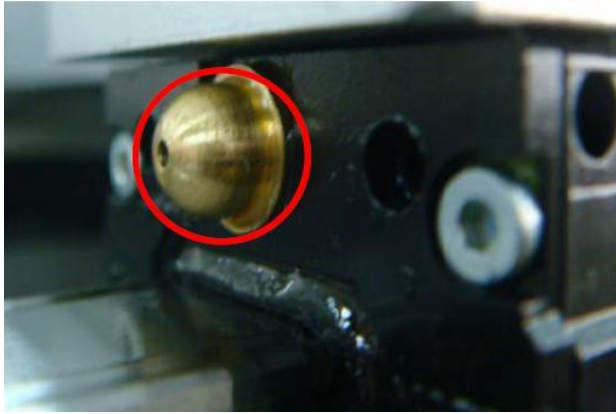
Step 1: use cloth strips to wipe off the old oil on the screw rod/guide rail.

Step 2: apply grease evenly on the surface of the screw rod with a special oil gun, and push the X/Y axis to move back and forth to absorb the grease.
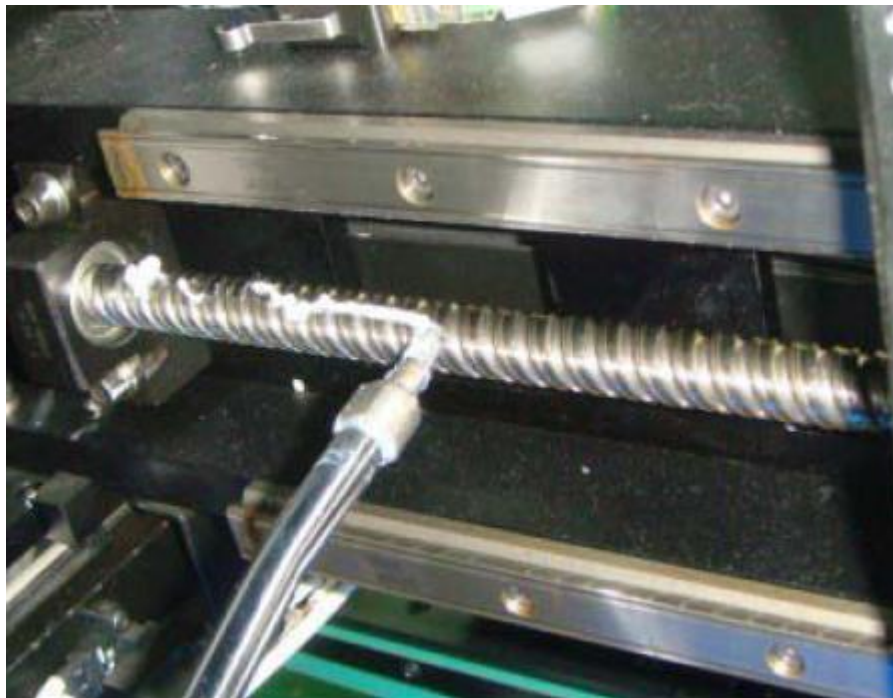
Step 3: if the slide block on the guide rail has an oil nozzle protection cover, take it off before filling.

Step 4: insert the oil injection gun head into the oil injection nozzle of the sliding

block and press it tightly. Gently press the pressure rod of the oil injection gun to

evenly inject grease into the sliding block, and make the sliding block slide back and

forth on the guide rail to evenly apply the grease.
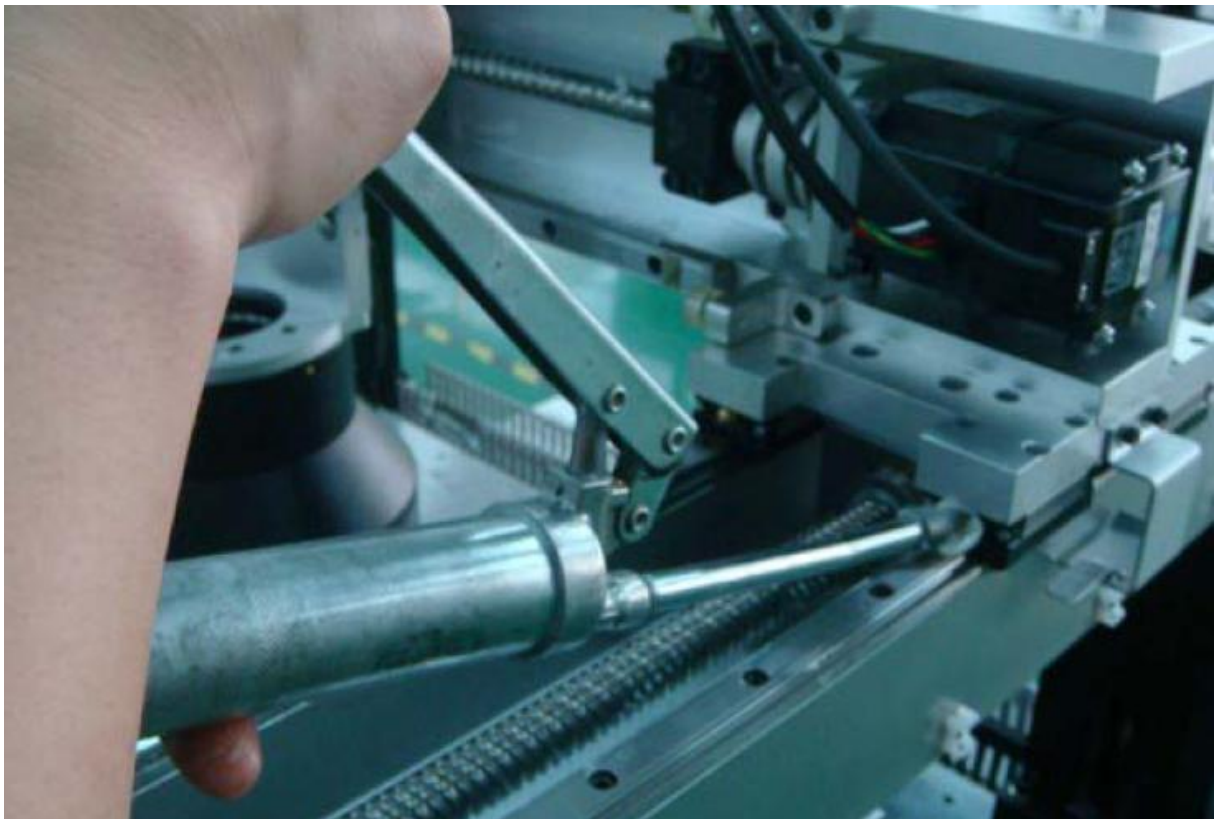
11.3

3. Confirmation form of check process/results

	No.	Check content	Inspection result	Responsible person	Remarks
Hardware part	1	Check whether the power supply is well wired and grounded.			
	2	Check whether the power supply and signal wiring on the back of the host are in good contact. Lay emphasis on motion control card and image collection card.			
	3	Check whether the camera fixing screws re firm.			
	4	Check whether the light source connection is stable and whether the light source will flash when shaking the light source line.			
	5	Check whether the light source casing will collide with the machine housing; use the mirror to check if there is any unlit LED inside the light source.			
	6	Check whether the track screws are tight and whether the width adjustment function is normal.			
	7	Check whether the buttons on the machine panel are normal.			
	8	Check whether the main power switch of the equipment works normally and whether it is fixed and locked.			
	9	Check whether the camera cover is properly installed.			
	10	Repeatedly lift and lower the flip cover of the display to observe whether there are abnormal image display and other abnormal situations.			
	11	Check whether the host is fixed and locked by screws.			
	12	Check and clean the filter screen at the front end of the industrial control computer.			
	13	Check whether the display works normally, whether the buttons are operated effectively, and whether there are scratches on the surface, etc.			
Software part	14	Clear the hard disk files that are not necessary for the equipment and store the files in categories.			
	15	Open the machine condition monitoring window to check whether the origin signal, limit signal and in-place signal of the X axis and Y axis are normal.			
	16	Check whether the working areas of the X axis and Y axis are all within the visual range of the camera.			
	17	Check whether the aperture and focus adjustment screw on the camera lens are locked.			
	18	Start and exit the program to see whether AOI software can be started normally and whether there is any error.			
	19	Open the light source brightness inspection window and use the color paperboard to adjust the light source to the standard value.			
	20	Take a PCB for lens calibration.			
	21	Use PCB to make a simple program: check whether the standard registration is normal and whether the inspection frame will offset during the inspection.			
	22	If fixture is used, check whether the fixture and clamp plate is normal (whether the plate is firmly fixed).			
	23	Check whether the equipment system backup is normal			
Abnormal situation, handling and results					
Remarks:		1. In the table, o indicates normal situation, and " x " indicates abnormal situation 2. In case of any abnormality, the abnormal situation, handling and results must be filled in and signed by the responsible department head for confirmation.			

Equipment maintainer: Approved by: Reviewed by: