X RAY BAGGAGE AND PARCEL INSPECTION SCANNER

User Manual Guide

2M® TECHNOLOGY

CONTENT

Chapter 1 Safety Warning Signs

The meaning and positions of the safety warning signs on the X-ray inspection system are shown in Table 1-1.

Table 1.1 Meanings of Safety Signs

No.	Sign	Purpose or Meaning	Position
1		Film safety and radiation danger signs	Lintel of access
2		Sign for Goods Placement **[Remark:** The sign for 150180B see **4.4 Inspection of Goods]**	Lintel of access
3		Sign for forklift position	Below the bottom side panel
4		Warning sign for strong current	Exterior of power box
5		GND terminal sign	Internal GND of equipment
6		Sign for X-Ray Source	X-ray source or sensor box
7		Sign for Moving Parts Present	Both sides of roller
8		Sign for Minding your hand	The front of the console panel
9	EMERGENCY	Sign for emergency stop	Near Emergency Stop button
10	POWER	Sign for Power Light	On or Near the power light
11	X-RAY	Sign for X-ray light	On or near the x-ray light
12	ALARM	Sign for alarm light	On or near the alarm light

Chapter 2 Safety Precautions for Operation

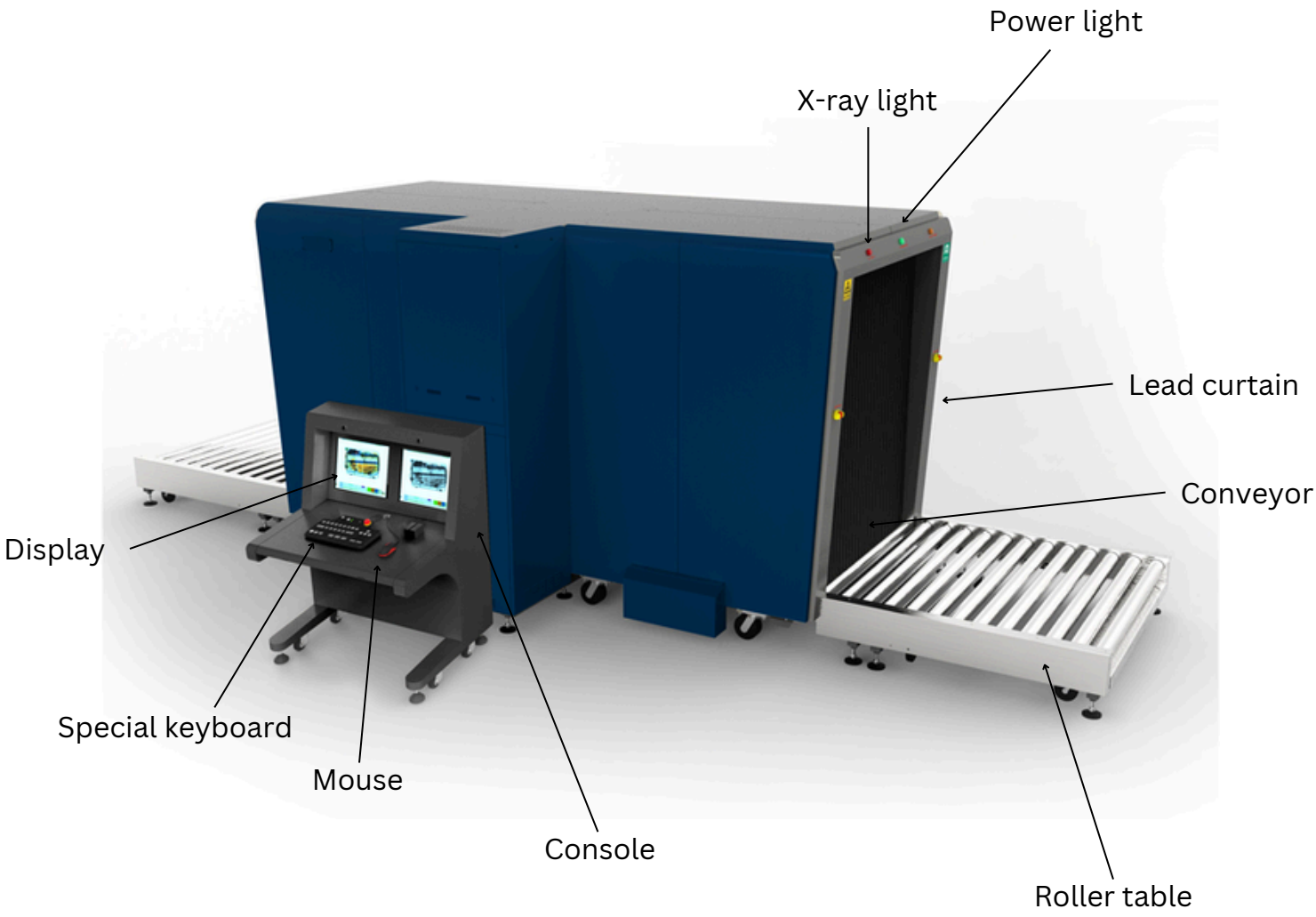
1. Before the operation of X-ray inspection system, the operator should receive the training related to the radiation protection according to the requirements of local laws and regulations.
2. The installation and operation situations of X-ray inspection system should be reported to the relevant competent department in the location where the equipment use and the radiation safety inspection shall be conducted if necessary. Please regularly check the radiation protection conditions of X-ray.
3 The operators should know about regulations and requirements related to the radiation before the operation of X-ray inspection system.
4. After the outage of the X- ray generator in the equipment for a long time, the preheating must be done according to the corresponding prompts of the running inspection station before the usage again in order to guarantee the service life of the X-ray generator.
5. The operation and storage environment of X-ray inspection system should avoid the conductive dust, chemicals, etc.
6. The operators should receive the necessary training on how to operate the equipment before operation.
7. Before supplying the power to the equipment, be sure that the power supply voltage of the equipment supplied on site should be consistent with the power supply voltage required of the equipment and simultaneously the power supply capacity shall not be lower than the working power of the equipment, as shown in the power supply parameters table of X-ray inspection system.
8. The equipment power supply should be in good grounding condition, and when the grounding conditions required are not satisfied, the equipment must not be operated.
9. When the parts of the equipment need to be installed or replaced, please contact the professional maintenance personnel or the after-sales service department.
10. When the external cables, conveyor, lead curtain or indicator lights of the equipment are detected to be damaged, please stop using the equipment and contact the local after-sales service department.
11. It is forbidden for the operators to open the access panel for the equipment to access to the internal components, because such operation should be conducted by the professional maintenance personnel.
12. The equipment should be attended with someone after it is started and runs.
13. Any part of our body (or other living body) is forbidden to access to the channel when the equipment is running.
14. The goods in inspection pending should be placed on the conveyor belt or roller according to the prompt requirements of the sign on the s passage inlet.
15. After the conveyor is switched on, the operator should pay attention to the position of the goods to be inspected on the conveyor belt in order to prevent the goods for inspection from blocking passages or falling.
16. In the process of inspection, please prevent the liquid from flowing into the device, and the similar situation occurs, be sure to stop the conveyor for cleaning immediately.
17. When the equipment in operation, do not cover the vents of the access panel to ensure that the heat dissipation inside the equipment internal is in good condition.
18. For the daily cleaning maintenance of the equipment, please cut off the power supply to ensure safety.

Chapter 3 Equipment Appearance and Special Keyboard

Introduction to this chapter:

Equipment appearance
Special keyboard

3.1 Equipment Appearance



> ★ **NOTE:**
>
> Because the emergency stop button has the locking function, so if you need to restore the normal state of emergency stop button, you need to rotate the button along the direction arrow by about 30° to get the button up and reset.

Power indicator light: The scanning channel inlet and outlet of the equipment and the special keyboard are equipped with the power indicator lights so that these lights are on at the same time when the equipment is switched on.

X-ray indicator light: The scanning passage inlet and outlet of the equipment and the special keyboard are equipped with the X-ray indicator lights so that these lights are on at the same time when there is the X-ray emission.

Alarm indicator light: The scanning channel inlet and outlet of the equipment are equipped with the yellow alarm indicator lights. When the software sets up the alarm function enabled, and the goods to be checked contains the suspected dangerous goods, drugs or impenetrable goods, the display screen will indicate the image mark box and the alarm indicator lights are on at the same time.

Lead curtain: All scanning channel inlets and outlets of the equipment are equipped with the lead door curtains. When there are X-ray emissions, X ray can be blocked in the passage in order to protect the X-ray from leakage outward.

Conveyor: The conveyor, installed inside the passage, is mainly composed of the motorized pulley, roller, direction changing roll, belts and stand, and is used to transport the goods to be checked through the channel.

Console (Control board): It used to place the display which is used to display the images of the checked items and a special keyboard which is used to provide the operation of the equipment hardware and the image processing operations.

PC mouse (optional): The image can be zoomed by rolling the mouse wheel, and the left button is used to control the menus and functional buttons on the screen. After the image is amplified, you can hold the left mouse button to drag the image so as to realize the flexible operation with the image in motion and static states.

3.2 Special Keyboard

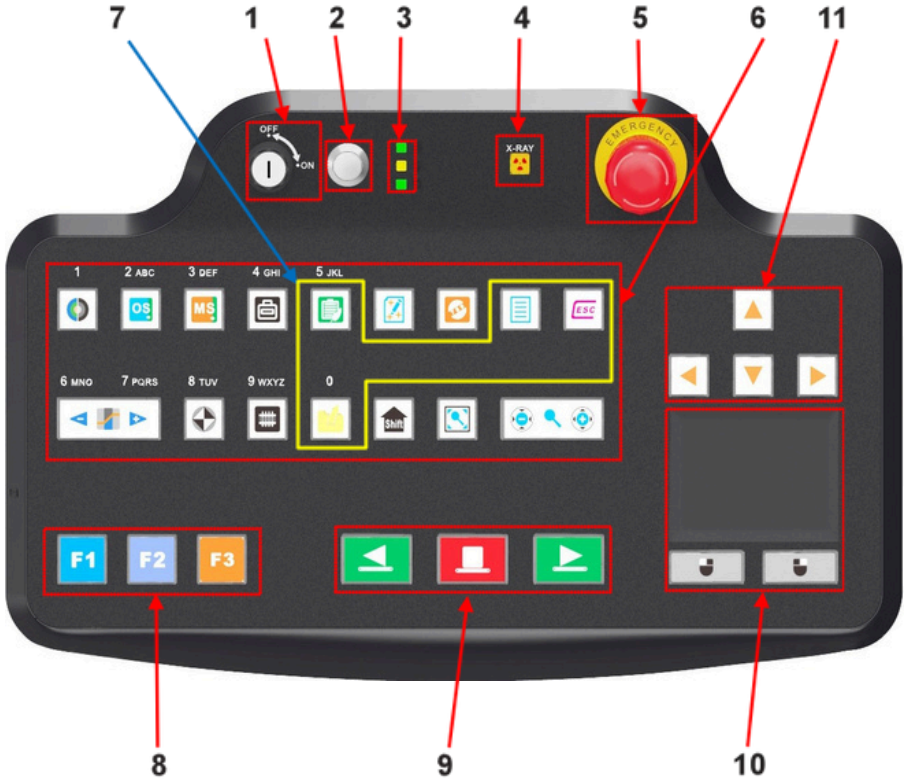


Fig 3.2 Operation Keyboard

1. **Key switch**  : It is used to switch on the power supply of the equipment control system and simultaneously is designed to prevent the non-operators from operating the equipment. Rotate this switch clockwise to the "ON" state to switch on the power supply of the equipment control system and rotate it counterclockwise to the "OFF" state to turn the power OFF, exit the software, shut down the industrial control computer and disconnect the system power supply.

> ★ **NOTE:**
> The key can be pulled out only in the "OFF" position.

2. **Start button**  : When a key switch is in the "ON" position and the "Start" button is pressed, the system is powered on and begins to start up, and at the same time the power indicator light is on.
3. **Status indicator lights**  : After the system is powered on, it is used to indicate the working state of the keyboard, and consists of the power indicator light, the indicator light for the communication between the keyboard and the host and swiping card indicator light from top to bottom.
4. **X-ray indicator light**  : It says that the X-ray is being emitted.
5. **Emergency Stop button**  : When this button is pressed, the X-ray generator and conveyor on the equipment stop immediately.

6. Image Processing buttons:

 **Color Image/BW button**: It is used to switch between Color and B/W image modes. When you click it, the system enters the black and white image display mode; when you click it again, the system switches to the color display mode so as to realize the switchover of Color Image/BW mode. After entering the system menu, you can input "1", as shown in the menu button.

 **Organics Sieving button:** It is used to enable/disable the organics sieving image function. Click it once to enable the organics sieving image processing function, and click it again to disable the function. After entering the system menu, you can input "2 or a, b, c or A, B, C", as shown in the menu button.

 **Inorganic Sieving button:** It is used to enable/disable the inorganics sieving image function. Click it once to enable the inorganics sieving image processing function, and click it again to disable the function. After entering the system menu, you can input "3 or d, e, f or D, E, F", as shown in the menu button.

 **Invert button:** It is used to enable/disable the image invert state. Click it once to enable the image invert function, and click it again to disable the function. After entering the system menu, you can input "4/g, h, i/G, H, I ", as shown in the menu button.

 **Super Enhancement button**: It is used to enable/disable the image super enhancement function. Click it once to enable the function, and click it again to disable the function. After entering the system menu, you can input "8 / t, u, v/T, U, V", as shown in the menu button.

 **High Penetrating Power button**: It is used to enable/disable the high penetrating power image processing function. Click it once to enable the function. After entering the system menu, you can input "9 / w, x, y, z/W, X, Y, Z", as shown in the menu button.

 **Sign Alarm button**: Under the condition of full screen image, when you press this button, the parts of the image which are impenetrable are displayed in purple red. When you press it again, the image will change from the marked state to the normal state.

 **Z789 Suspicious Organics Enhancement button**: It used to enable, switch and disable 7/8/9. Click it once to enable the function, and click it again to disable the function.

 **"Optimal Screen" button**: Under the condition of full screen image, when the image is zoomed in or move left and right, you can press the "Optimal Screen" button to restore the image with the magnification of 1.0 and be relatively centered state.

 **Function Switch:** It is not enabled.

 **Zoom In/Out button**: This button is used to zoom in or zoom out the image (with the rate of 1~64), with the magnification indicated at the bottom of the screen and the constructed drawing for the amplified image indicated on the lower right corner. When zooming in image, the current full screen image area is marked out by a red box and you can move and display the image amplified zone through the direction keys.

 **Variable Absorption Rate button**: It is used to adjust the image variable absorption rate. After pressing  button to enter the system menu, please input "6 / m, n, o/M, N, O"; after pressing  button to enter the system menu, please input "7/p, q, r, s/P, Q, R, S", as shown in the menu button.

7. Function keys:

 **Energy-saving button**: When the system is in the ready state, the upper left of the screen will pop up the corresponding prompt: Energy-saving mode is enabled by pressing this button. When the energy-saving sensor is covered by the luggage, the system will start to scan normally, and the display will indicate the current inspected image. If the energy-saving sensor module fails to detect there are goods sorting within 15 seconds, the conveyor will stop running automatically in order to avoid the conveyor idler running without package so as to achieve the purpose of the energy saving. When you press this button again under the condition of the system in the ready state, the upper left of the screen will pop up the corresponding prompt: Energy-saving mode is disabled! At the moment, the system will return to the normal state. After entering the system menu, please inlet "5 or j, k, l, or J, K, L", as shown in the menu button.

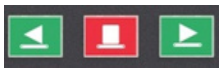
> ★ **NOTE:**
> The energy saving function is non-standard configuration, if you want to use this energy saving function, the equipment should be equipped with the energy-saving sensor module.

 **Menu button**: Press this button to enter the system menu. Then press the capital letter, small letter and digital switching button in turn.

 To exit.

 **Image Management button**: Open the image management dialog box. After entering the system menu, please input digital "0", as shown in the menu button.

8. **Custom functional buttons** :  The different processing functions-"F1", "F2," "F3" can be set separately as required, as shown in the main interface of the X-ray inspection system in Chapter 4 (Fig 4.4). The default configuration of the functional shortcuts: F1 stands for "Super Enhancement"; "F2" stands for "Local Enhancement"; "F3" stands for "Invert".

9. **Conveyor control buttons**  : Press "  "button to control the forward rotation of rollers; press "  " button to stop the roller, press "  " button to control the reverse rotation of the roller.

10. **Mouse**  : Touch this area to control the mouse direction; click the this area for the confirmation, which is equivalent to the function of the left mouse button; click the left key to confirm the mouse options The right button is not used.

11. **Direction Navigation buttons**  : Under the conditions of image amplified to the full screen, press these direction buttons to get the image to move up and down, or move left and right. Under the condition of the image in the original state: Left and Right direction buttons are used to pull in and pull back the historical images.

Chapter 4 Equipment Operation

Introduction to this chapter:

Inspection before Boot
Boot
Login
Inspection of Goods
Power Off

> ★ **Warning**
> Before operating the equipment, please be sure to read the "Safety Precautions for Operation" of this manual!

4.1 Inspection before Boot

Step 1 Check whether the cable connections of the equipment power supply are in good condition; Check whether the equipment power supply is grounded reliably; whether the Emergency Stop button on the external cover plate is pressed down, if yes, please rotate it clockwise to reset it; whether the Emergency Stop button on the special keyboard of the equipment is pressed down, if yes, please rotate it clockwise to reset it; whether the keys of the special keyboard work properly. The connection position of the power supply is shown in Fig 4.1 below:

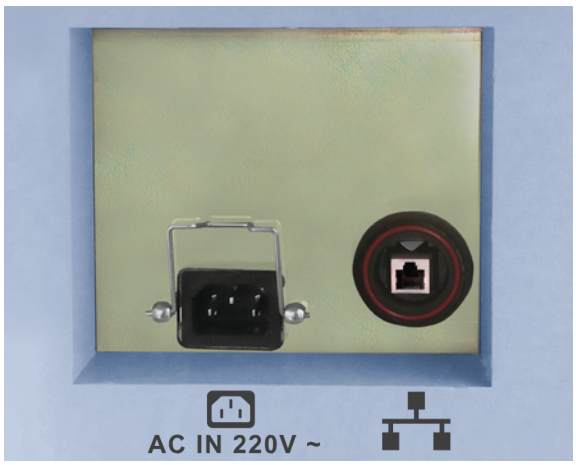


Fig 4.1 Connection Position of Power Supply

> ★ **NOTE**
> If you find the damaged cable sheath, failure of the Emergency Stop button or unsmoothspecial keyboard, please stop operating the equipment and contact the local after-sales service department.

Step 2 Check whether the lead curtains at the channel inlet and outlet which are used to prevent the X-ray leakage are in good condition; the door curtains should be free from the obvious gaps and obvious damage.

> ★ **NOTE**
> If there are the excessive gaps between the curtains or the lead curtains are seriously damaged, please stop operating equipment and contact the local after-sales service department.

Step 3 Check and make sure that the surface of the belts should be no cracks, and a certain distance should be reserved between the conveyor belt edge and the guard boards on two sides; check whether belts are deviated or stuck.

> ★ **NOTE**
>
> If the conveyor belt position obviously deviates from the channel center (its edges are stuck in the guard boards on two sides) or the belt has insufficient tension (the conveyor surface is loose), the operator should adjust the conveyor position under the guidance of professionals, or read the maintenance manual carefully.

Step 4 Check whether there are some goods in the equipment channel, if any, please clear it out of the channel.

4.2 Boot

Step 1 Plug the power cable plug into the power supply socket on site to ensure the normal power supply.

Step 2 Insert the key into the key switch  of the special keyboard and rotate it clockwise by 90°to "ON" position; then press and hold the power button  for about 1 second until the power indicator lights of the equipment  and special keyboard  are on, and wait for the system boot.

> ★ **NOTE**
> Before pressing the power button, please check whether the emergency stop buttons of the equipment  and the special keyboard  are pressed down, if yes, then the X-ray generator and conveyor can't be started. Before booting the equipment, please rotate the Emergency Stop button clockwise by 30 °and then release it to reset it.

> ★ **NOTE**
> During the start-up process of the equipment, if the conveyor or X-ray generator goes wrong, please press the Emergency Stop button to shut off their power supply.

4.3 Login

Step 1: The system will will automatically login as the default user.

> ★ **NOTE**
> If the system disabled the automatic login function, then you need to select a user and enter the login password before login.

Step 2: After login, the system directly enters the XBIS software to display "Clear the Channel" , then please select a way to clear the channel, as shown in Fig 4.2.

Fig 4.2 Prompt Interface of Clearing Passage

Choose the way:

If there are goods in the channel, please click the button / on the interface or click button / at the special keyboard , then the conveyor will run in the relevant direction and the goods in the will be cleared out of the channel; click on the interface or click the button of the special keyboard to stop the conveyor.

After clearing the channel or when the channel no need to be cleared, you can click OFF F1 on the interface or press key F1 on the special keyboard to turn off the clearing channel interface.

Step 3: If the machine is not used for more than 24 hours, then when the system boot up for the first time, the system will get into a preheating process to make the X-ray generator ready, Please wait about 1-20 minutes until the preheating is finished, the system will enter the main interface .

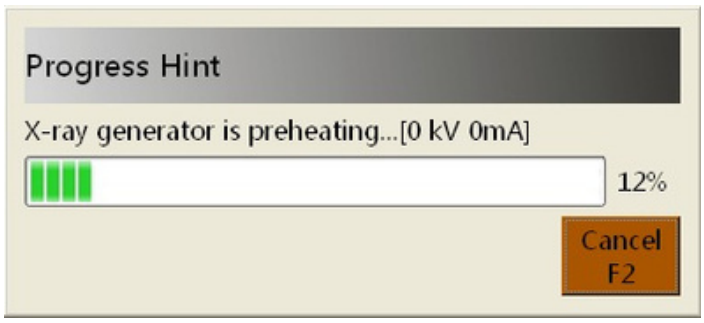


Fig 4.3 Preheating Interface of X-Ray Generator

★ **NOTE**

Purpose of x-ray generator Preheating: The anode voltage of the ray tube is increased gradually in order to reach the working state. This process can effectively extend the lifetime of the X-ray generator.

Time of x-ray generator Preheating: It is depend on the interval of the last two booting time of the equipment.

Boot Time Interval (Y)	Time of Tube Preheating
1 day < Y < 3 days	3 minutes
3 day ≤ Y < 30 days	6 minutes
30 day ≤ Y < 90 days	12 minutes
90 day ≤ Y	60 minutes

Step 4: After the preheating process is over, the system directly enters the main interface.

System Main Interface:

Here is the main interface, as show in Fig 4. 4.

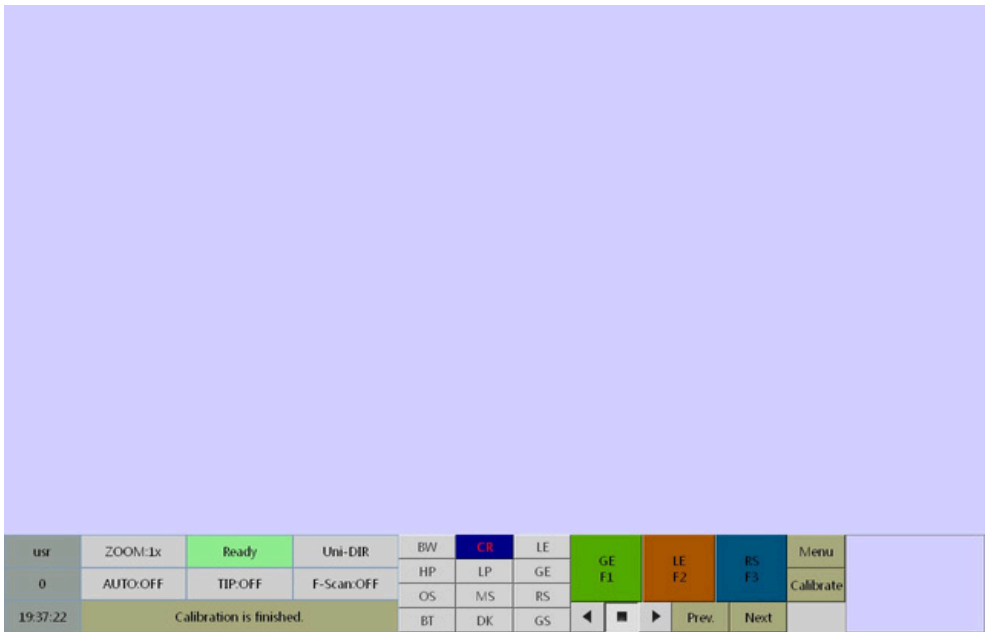


Fig 4.4 Main Interface of X-Ray Inspection System

4.4 Inspection of Goods

Step 1: The system will complete the calibration automatically while entering the main interface; when the system status bar pops up “Calibration over” and “Ready”, you can conduct the inspection of goods.

Step 2: The goods to be inspected should be stably placed on the conveyor according to the way indicated as the “Goods Placement Sign”  at the equipment inlet.

The “Goods Placement Sign” for 150180B is  .

★ Description

Light and thin goods, dirty goods or the goods with the damaged package should be placed in the appropriate plastic container for inspection.

★ NOTE

Be sure to place the goods to be checked outside the lead curtains! It is forbidden to stretch your hands into the channel!

Be sure to prevent the goods to be checked from falling or accumulating at the exit of the channel; If happen, please press the emergency stop  buttons of the equipment or the special keyboard  to stop the conveyor.

Step 3: When you click the button  /  of interface or  /  button of the special keyboard, the conveyor begin running. Place the goods to be checked in the middle of the conveyor so that the goods can enter on the passage by the running conveyor. When the goods to be inspected abeing scanned in the channel, the red X-ray indicator lights on the equipment 

and the special keyboard 

are ON at the same time, and the system will display the scanned image on the display, as shown in Fig 4.5a or Fig.4.5b.

Figure 4.5a Goods Scanning Image (Single Perspective)

Figure 4.5b Goods Scanning Image (Double Perspectives)

★ **Description**

When the system enables the Bi-directional Scanning function, you need to click  or  button to scan the goods, or the system will scan the goods only when the conveyor rotates forward.

Step 4: Depends on the scan image, click the button in the image processing functional area on the software interface to identify and judge the image, or` click the image function keys on the special keyboard to identify and judge the image.

Step 5: After the goods to be checked move out the equipment channel with the conveyor, you can click the  button on the special keyboard to stop the convey, and then you can remove the goods or turn to the further inspection.

4.5 Power OFF

★ **NOTE**

Before the shutdown operation, please make sure the scanning has ended and there are no goods left in the equipment channel.

Step 1: After the completion of inspection work, you can click the button ■ on the software interface or  button on the s pecial keyboard to s top the conveyor. Step 2: Rotate the key switch counterclockwise to “0” position to get the equipment to begin to shut down; about 1 minute later, the system equipment and all the indicator lights are off. Then you can turn off the external power supply at this time.

★ **NOTE**

After the equipment is turned off by rotating the key switch, please don't immediately disconnect the external power supply, but observe the green indicator light on the special keyboard and wait for all lights off; 10 seconds later, cut off the power.

If the equipment is equipped with the uninterrupted power supply (UPS), then when the self- checking indicator light is off, you can turn off the UPS. After all the lights (including the power indicator light of the display) are off, please wait for 60 seconds before the next boot, otherwise, the industrial computer will fail to start.

Step 3: Take away the key on the special keyboard and keep it properly.

Chapter 5 Operation of Drawing Reading

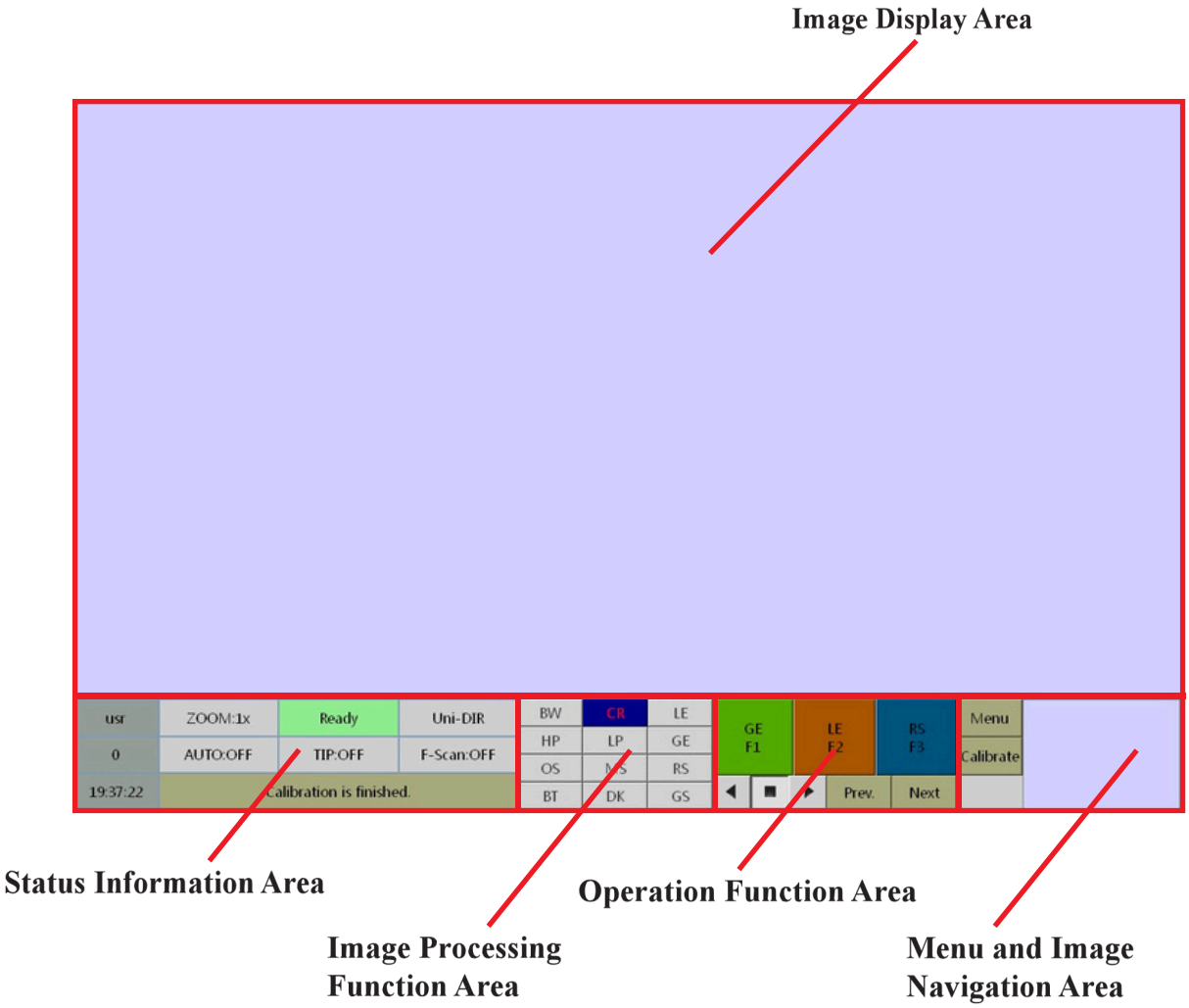


Fig 5.1 Function Area Diagram of Main Interface

Introduction to this chapter:

Status Information Area
Image Processing Function Area
Operation Function Area
Menu and Image Navigation Area
Image Display Area

5.1 Status Information Area

Fig 5.2 Status Information Area

1. usr **: Current login user group.** The software has set up three kinds of users, namely sys (system management group), mt (maintenance group) and usr (operation group). When you log in with the different user names, the corresponding selected user names will be indicated. For the initial startup of the equipment, the system will automatically log in with “usr”-the operator identification by default. If you want to modify the corresponding user name and permission, you should carry out the related setting via menu.

2. ZOOM:1x **: It refers to the current magnification rate.** When the image is zoomed in, the corresponding magnification rate (1~64) will be indicated in the status bar.

3. Ready : It refers to the current status of the equipment, including six statuses, namely“Waiting”, “Ready”, “Preparing”, “Scanning”, “Paused” and “Fault”.

a. When the software is started normally and the conveyor not runing, the equipment should in the "Ready" state.
b. When the conveyor is running normally and there is no luggage on the conveyor, then the equipment should be in the "Waiting" state.
c. When the conveyor is running normally and the luggage on the conveyor have been sent to the channel and trigger the inductive switch, then the equipment should be in the "preparing" state, and the X ray indicator lights are on at this moment;
d. When the X-ray emission is stabilized and the parcels reach above the collimator, then the equipment should be in the "scanning" state;
e. In scanning state, when you stop the conveyor, the convey or belt will move in the reversed direction for a certain distance in order to keep the integrity of the image , at this moment, the equipment should be in the "Paused" state.
f. When the luggage inside the passage have been scanned, then the equipment should be in the "Waiting" state.
g. When the equipment goes wrong, for example the Emergency Stop button or micro switch is triggered, etc., the equipment will be in the "fault" status, the background of the status bar is red at the same time..

4. Uni-DIR **: It refers to the current scanning mode .** It refers to the current scanning mode. If the Bi-directional scanning mode is not enabled, then “Uni-DIR” is indicated on in the status bar; for this case, the luggage will scanned only when the conveyor rotate forward. If the Bi-directional Scanning mode is enabled, “Bi-DIR” is indicated on in the status bar; for this case, the luggage can be scanned in both direction.

5. 0 **:** It refers to the counter for the parcels count and can show the total number of the parcels sorted by the current user at this time, or the total quantity of the parcels.

6. AUTO:OFF **: It refers to the "automatic sensor switch" status bar.** When the “Hide” or “Show” status is set under the menus the "Assist Check"- "Display Identification Tags”. In the “Hide” setting state, the automatic status bar is off; in the “Show” setting state, the automatic status bar is

on. The red marker box is used to mark out the goods difficult to penetrate; the yellow marker box is used to mark out the suspected explosives; the green marker box is used to mark out the suspected drugs.

7. TIP:OFF **:** It refers to TIP on/off state and shows whether the TIP function is enabled.

8. F-Scan:OFF **:** It refers to the forcedly scanning status bar and shows whether the "Forces a Scan" function is enabled.

9. 00:15:46 **:** It refers to the current system time.

10. Calibration is finished. **:** It refers to the information display area.

a.To display the result of the equipment automatic calibration: Calibration over or calibration failure.

b.To display the fault code:

[100] Failure to communicate with the master controller;
[101] Power switch of master controller triggered
[102] Emergency switch triggered
[103] Micro-switch for L-type box triggered
[104] Micro-switch for side cover plate triggered
[105] Acquisition system fault

NOTE: Emergency switch refers to the Emergency Stop button.

5.2 Image Processing Function Area

BW	CR	LE
HP	LP	GE
OS	MS	RS
BT	DK	GS

Fig 5.3 Image Processing Function Area

As shown in Fig 5.3, you can not only operate the image processing functions in the image processing area on the software interface but also directly operate them via the special keyboard. In addition to the 12 image processing functions above, there are the image magnification, pseudo-color processing, suspicious organics enhancement, suspicious objects alarm marker box, edge enhancement and other processing functions.

5.2.1 Color Image/BW Display

Click "Color Image/BW" button or press  key on the special keyboard to choose the color or BW image reading. The color image is the 4-color image, and the scanned items can be divided into 4 types, including orange for the organic matter, blue for inorganic, green for mixture, black (or red) for the items with the uncertain material properties which generally refer to the items difficult to penetrate. When operating the "Color Image/BW" button, you can switch the display modes of color and BW images, as shown in Fig 5.4.

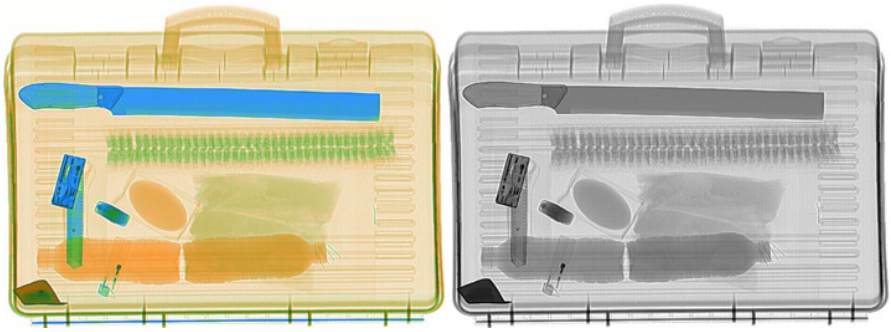


Fig 5.4 Color Image/BW Images Comparison

5.2.2 Image Local Enhancement (LE)

This function is used to fade up the darker areas of the image and make the object hidden behind the thick object clearly be displayed, but the normal image areas are not affected. Under the normal image display status, when you can press the function button, the system enters the image local enhancement state, and when you press it again, the image display state is changed from the local enhance state to the normal image display state, as shown in Fig 5.5.

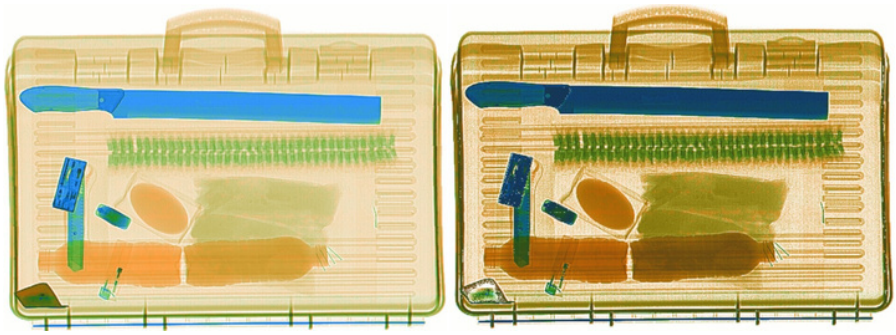


Fig 5.5 Color Image/Image Local Enhancement (LE)

5.2.3 Enhancement of High Penetrating Power (HP)

As the areas with the high penetrating power are brighter and the contrast is lower. Click the "HP" button, or the button  on the special keyboard to get the brighter areas indicated at the appropriate contrast so as to clearly show the areas with the high penetrating power, the normal areas, however, are affected and indicated at the lower contrast. As shown in Fig 5.6.

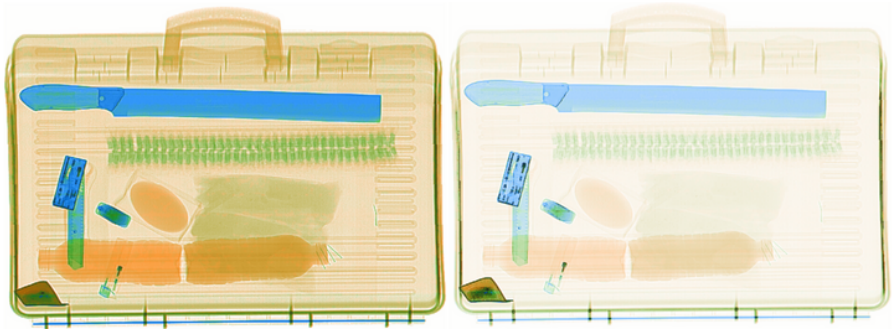


Fig 5.6 Enhancing Effect of Color Image/High Penetrating Power

5.2.4 Enhancement of Low Penetrating Power (LP)

As the areas with the low penetrating power are darker and are not easy to observe. Click the "LP" button to get the areas brighter and improve the contrast so as to clearly show the areas, the normal areas, however, are affected with the lower contrast. As shown in Fig 5.7.

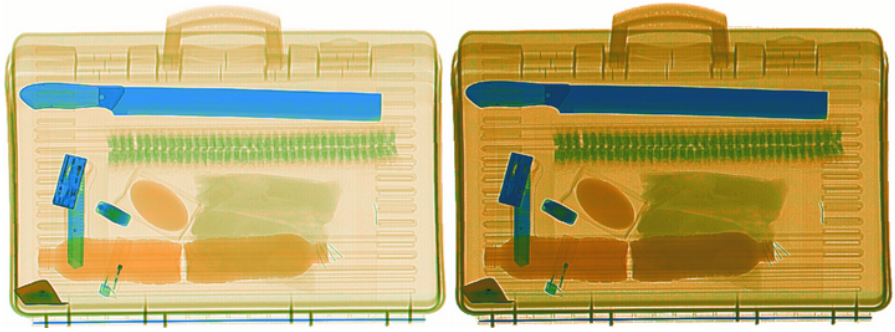


Fig 5.7 Enhancing Effect of Color Image/Low Penetrating Power

5.2.5 Super Enhancement (GE)

Click the "Super Enhancement" button or key on the special keyboard to conduct the image enhancement processing in details so as to clearly display the objects hidden behind the thick object. Press this functional button to automatically switch between the normal display and super enhancement mode of the image. Press this button again (or the press “ESC” button) to stop the display switch, as shown in Fig 5.8.

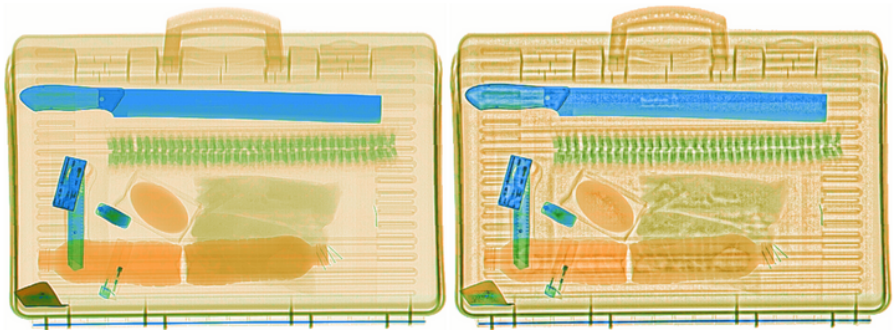


Fig 5.8 Color Image/Super Enhancement Display Effect

5.2.6 Organics Exclusion((OS)

Click the "Organics Exclusion" button or key on the special keyboard to get the orange part (organics) to be indicated in gray level and the blue part (inorganic) to be highlighted. This function helps operators to judge the knife rest, guns, gas cans and other goods, as shown in Fig 5.9.

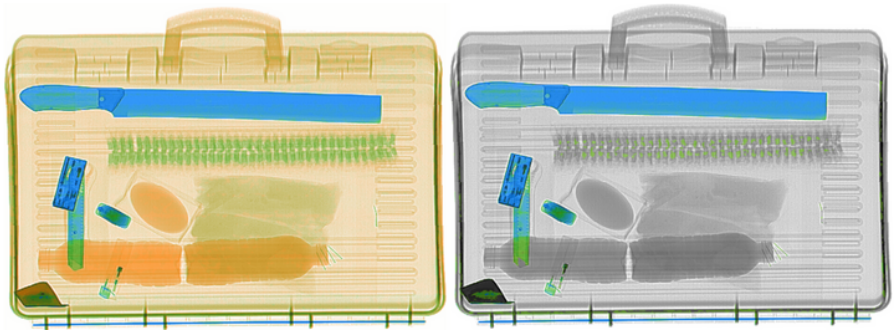


Fig 5.9 Color Image/ Organics Exclusion Display

5. 2.7 Inorganic Exclusion (MS)

Click the“ Inorganic Exclusion” button or 

key on the special keyboard to get the blue part (inorganic) to be indicated in gray level and the orange part (organics) to be highlighted. This function helps operators to judge the explosives, drugs, gasoline and other flammable, as shown in Fig 5.10.

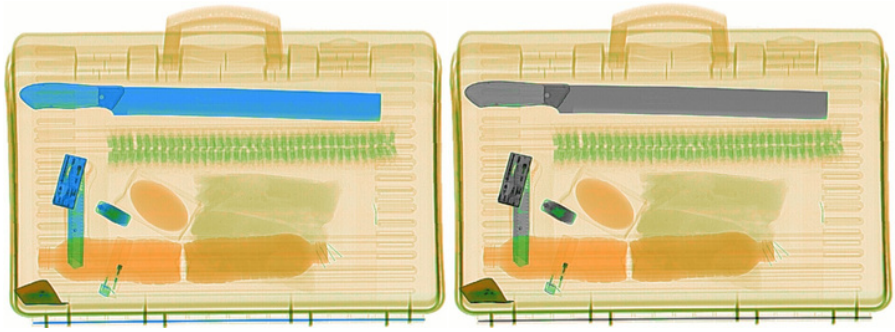


Fig 5.10 Color Image/ Inorganic Exclusion Display

5.2.8 Negative (RS)

Click the “Invert” button or  key on the special keyboard. Usually the objects with high X-ray absorption rate are in deep black, and the objects with the low absorption rate are in bright white on the image display interface. On “RS” mode, however, the objects with high X-ray absorption rate are in bright white, and the objects with the low absorption rate are in deep black. Click the “RS” button to switch to negative display, in this way, the smaller or thinner high-density objects (such as metal wire) will become clearer. The “RS” button can be used at the color images or grayscale images mode. as shown in Fig 5.11.

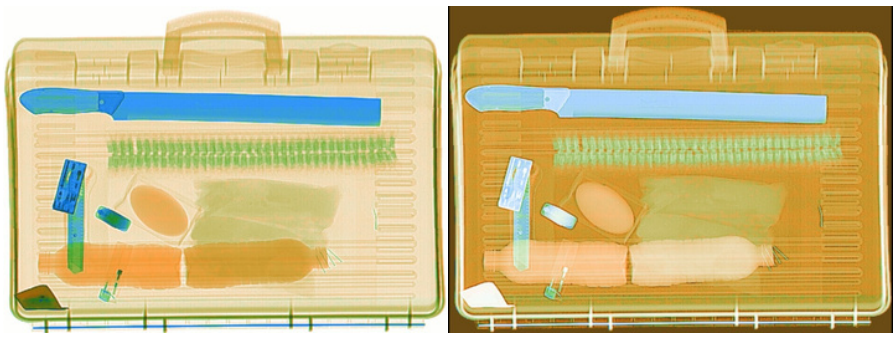


Fig 5.11 Color Image/ Negative Image Comparison

5.2.9 Brightening (BR)

Click “BR” button to brighten the whole image, as shown in Fig 5.12.

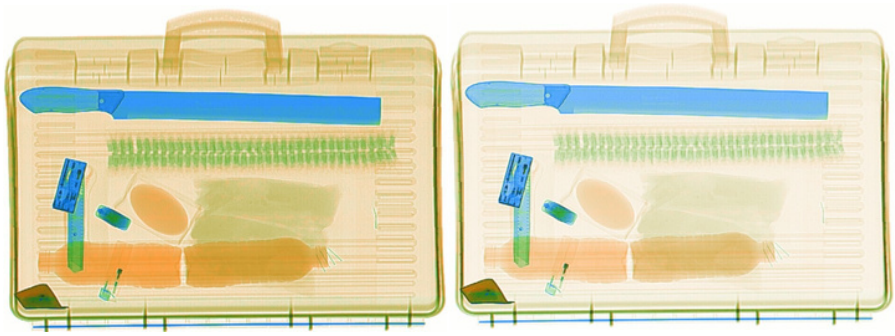


Fig 5.12 Color Image/ Brightenging Image Comparison

5.2.10 Darkening (DK)

Click “DK” button to darken the whole image, as shown in Fig 5.13.

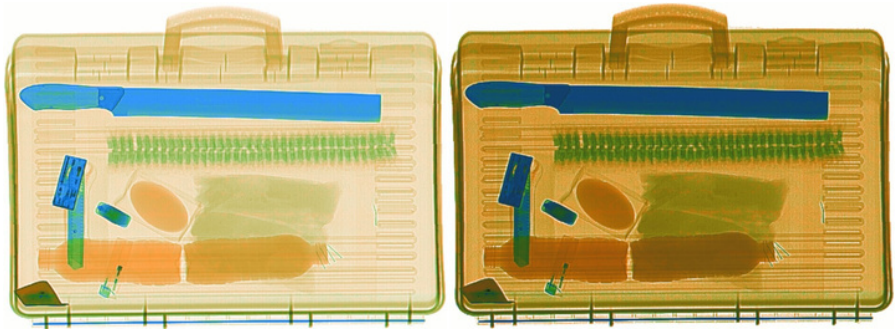


Fig 5.13 Color Image/ Shadowed Image Comparison

5.2.11 Gray-Level Scan (GS)

Click “GS” button to get the image to automatically transform the grayscale mapping so as to brighten gradually the darker area and darken gradually the brighter area at the same time. In this way, the operator is easy to find the most suitable contrast and brightness of the current image. Press this button again to stop the gray level scanning and display the image as current contrast and brightness. Here are the brightest image and the darkest image , as shown in Fig 5.14.

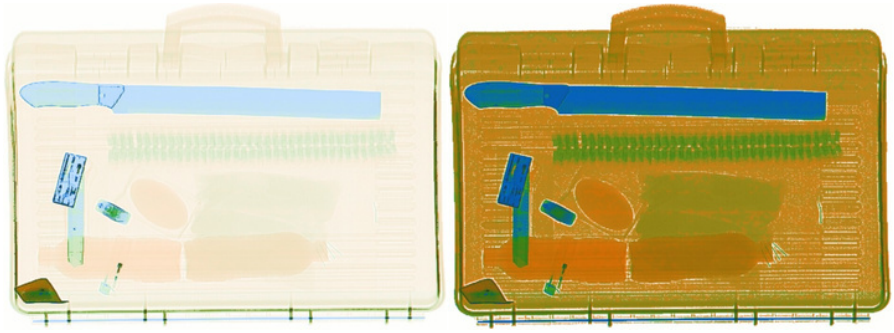


Fig 5.14 Gray-Level Scan

5.2.12 Image Magnification

On the image display interface, the image can be zoomed in with the constructed drawing for the amplified image indicated on the lower right corner. When zooming in image, the current full screen image area is marked out by a black box and you can move and display the zoomed part by the direction keys.

a. Zoom in/out the image by the mouse wheel..

b. Zoom in/out the image by  keys on the special keyboard.

c. At the original state,, you can also press “UP”/”DOWN”  keys on the special keyboard to zoom in/out the image. Besides, you can press  button to get the image display in the optimal screen way.

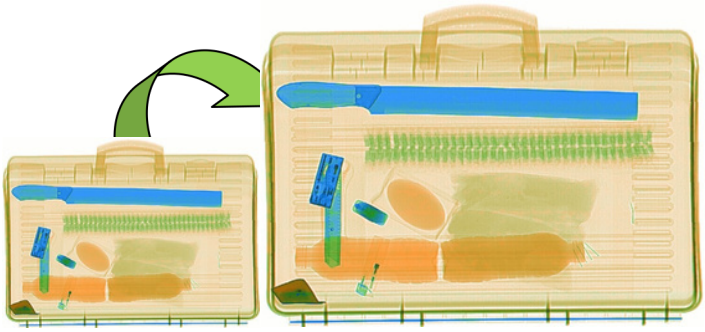


Fig 5.15 Image Magnification

5.2.13 Pseudo-Color Processing (PC)

The pseudo- color processed image is rich in details, which helps the operator to identify the image details; when you press the "PC" button, the image on the display screen will change, as shown in Fig 5.16. When you press it again to restore the original state.(Refer to the programmable keys of Section 6.6) .

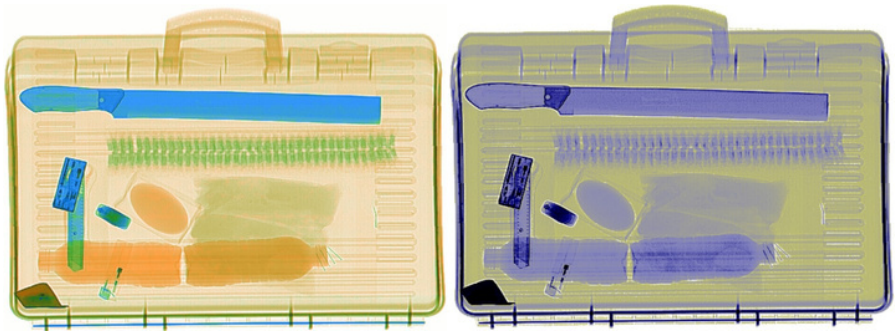


Fig 5.16 Image Pseudo-Color Processing Effect

★ Description

The combination of the pseudo- color display function and high penetrating function is suitable for the view of the high-density objects; the combination of the pseudo- color display and the invert function is suitable for the view of the thready objects.

5.2.14 Suspicious Organics Enhancement Z7/Z8/Z9

The equivalent atomic number r(Zeff) of explosives and drugs is relatively concentrated within the interval [7, 9], as shown in Table 5.1.

Table 5.1 Equivalent Atomic Number of Explosives and Drugs

Equivalent Atomic Number (Zeff) Objects	
7	Water, plastic explosives
8	Impure Drugs or explosive
9	Pure drugs

Press the key on the special keyboard to enable the suspicious enhancement display function, namely to further highlight the organics with the equivalent atomic number Zeff = 7, 8 or 9.You can view the organics with the equivalent atomic number Zeff = 7, 8 or 9 in turn, at this moment, other areas of the image are indicated in gray level, only the organics with the specified equivalent atomic number are indicated in amaranth so as to make it easy to view the suspicious objects.

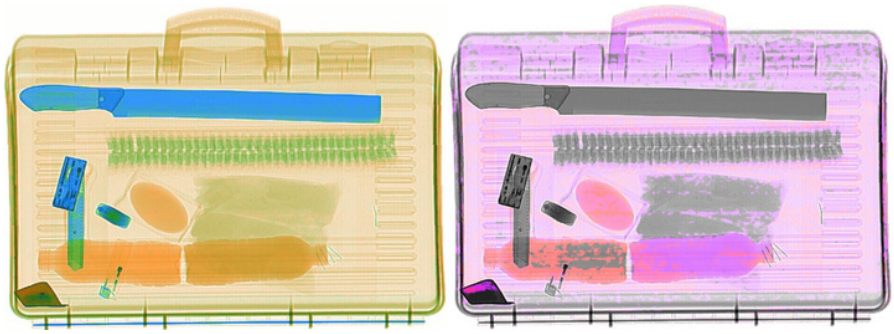


Fig 5.17 Suspicious Organics Enhancement Z7

5.2.15 Alarm Sign Box of Suspicious Organics

Click the button on the special keyboard to mark out the inspecting items, such as the ones difficult to penetrate, explosives and drugs with red, yellow and green boxes; at the same time, the yellow alarm ALARM is on to alert the security personnel to make a judge, as shown in Fig 5.18.

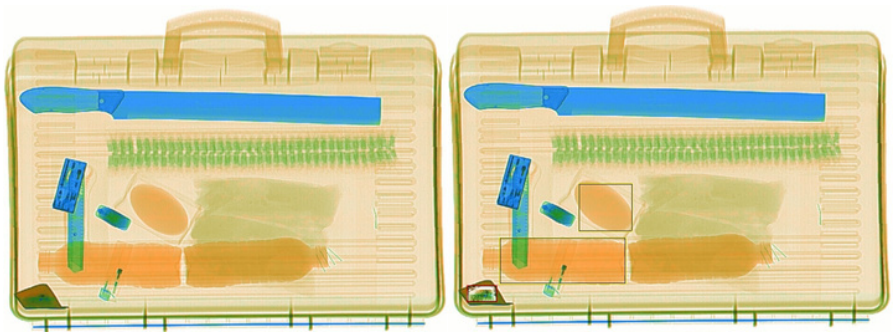


Fig 5.18 Alarm Sign Box of Suspicious Organics

5.2.16 Edge Enhancement (EE)

Click the "Edge Enhancement" button to sharpen the original image in order to make the image clearer and its profile sharpened. The software has already enabled the edge enhancement function by default. As shown in Fig 5.19, the left one is the original image, and the right one is the image with enhanced edges. (Refer to the programmable buttons in Section 6.6).

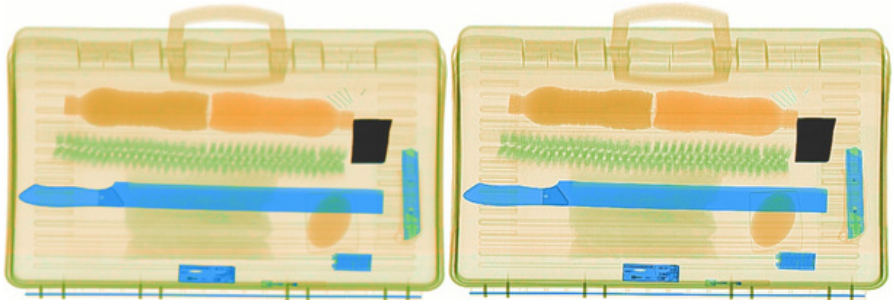


Fig 5.19 Image with Enhanced Edge

5.3 Operation Function Area

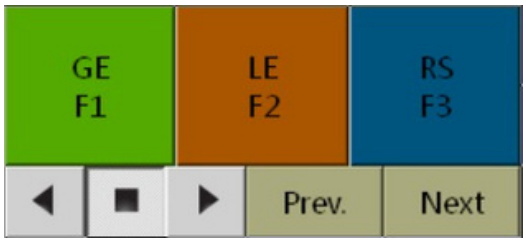


Fig 5.20 Operation Function Area

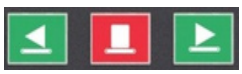
In the operation function area, there are "Super Enhancement F1", "Local Enhancement F2", "Negative F3", "Forward", "Stop", "Reverse", "Prev." and "Next" buttons which can be operated on the special keyboard and on the software interface.

5.3.1 Function Shortcut Keys

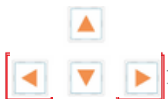
Click "F1", "F2", "F3" or 

keys on the special keyboard to conduct the super enhancement, local enhancement and negative processing of the inspecting image. You can set "F1", "F2", "F3" to the different image processing functions as required.

5.3.2 Forward, Stop and Reverse

Click  or  keys to on the special keyboard to get the conveyor for the "Forward", "Stop" or "Reverse" motion.

5.3.3 Pull Back and Pull In

Click "Prev." and "Next" buttons or the LEFT/RIGHT keys of  navigation keys on the special keyboard (at the state of optimal screen) to display the Prev. or the Next image.

5.4 Menu and Image Navigation Area

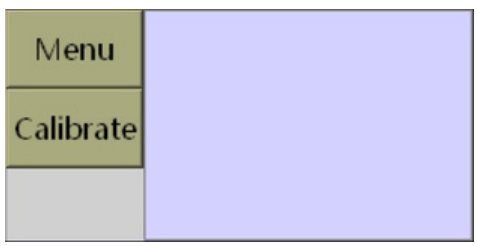


Fig 5.21 Image Navigation Area

The menu and image navigation area includes the menu, calibration and image direction navigation areas.

5.4.1 Menu

Click 

or  key on the special keyboard to enter the menu interface. There are the "Logout", "Image Management", "About" submenus when you login as the operator group (usr).

5.4.2 Calibration

Click Calibrate to calibrate the related performance of the equipment. And the calibration results will be indicated at the calibration result status bar of the information area.

5.4.3 Status

" CTRL " refers to the normal scan state or the corresponding setting state. Click "Menu" button or button on the special keyboard to enter the menu interface, and press button again to switch " 123 " , " abc " or " ABC " digital and character input format state; when entering the state of training, the Training will be displayed on this location.

5.4.4 Image Navigation

The relative position of the image in the whole display screen can be indicated in the image direction navigation area.

5.5 Image Display Area

Fig 5.22 Image Display Area

Image display area: To display the image of inspecting objects for the operators for the identification image and image processing.

Chapter 6 Menu Operation

Introduction to this chapter:

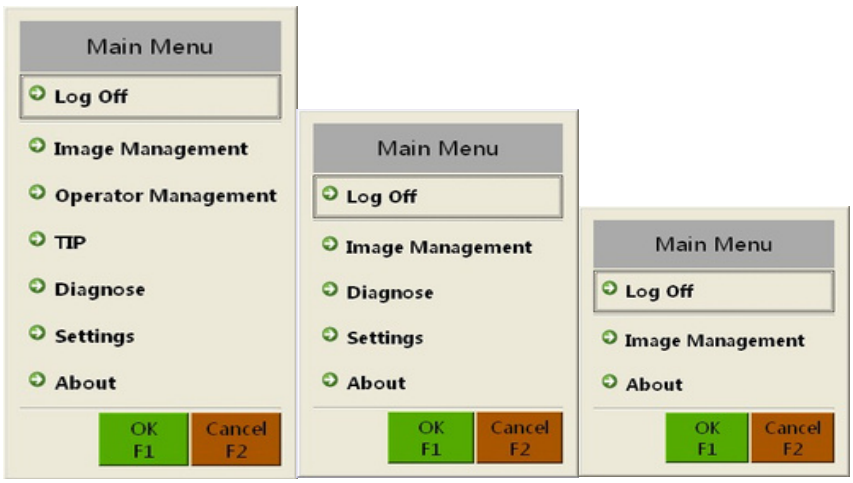
Logout
Image Management
Operator Management
TIP (Dangerous Goods Insertion)
Diagnosis
Settings
About

Click the "Menu" button or key on the special keyboard to enter the menu; the system has three level permissions group by default: operation group (usr), maintenance group (mt) and system administrator group (sys).

Functional Permission of Operation Group (usr): Logout, Image Management and About, as shown in Fig 6.1-C (usr).

Functional Permission of Maintenance Group (mt): Logout, Image Management, Diagnosis, Settings and About, as shown in Fig 6.1-B (mt).

Functional Permission of System Administrator Group (sys): Logout, Image Management, Operator Management, TIP, Diagnossis, Settings and About, as shown in Fig 6.1- A (sys)

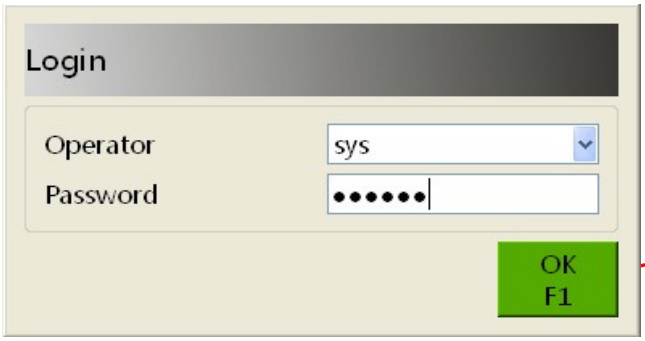


A(sys) B(mt) C(usr)

Fig 6.1 Menu Operation Authority

6.1 Logout

Click "Logout" button on the main menu and then select the "sys" from the operator options; later, input the password in the password field with the special keyboard then press F1 button on the special keyboard to confirm logging in the Administrator group, as shown in Fig 6.2.

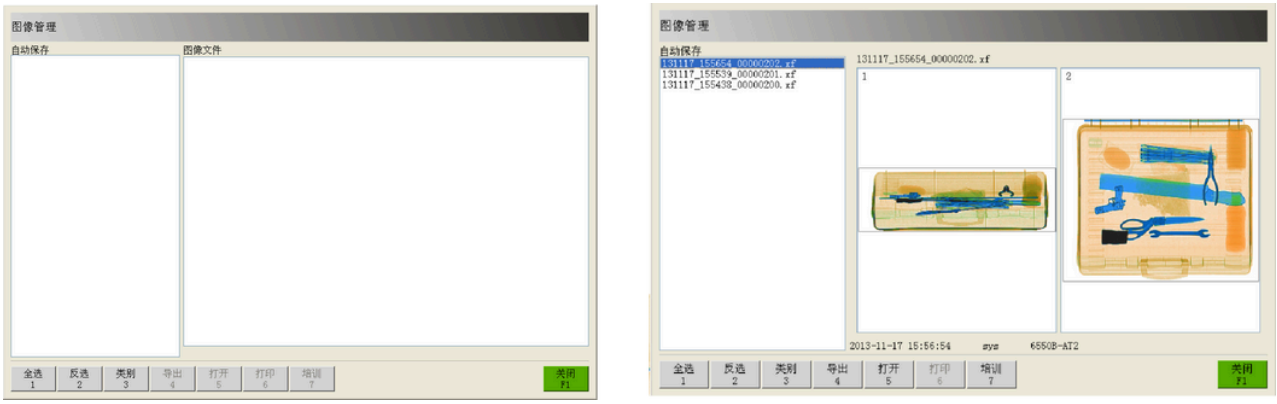


Description: The buttons is divided into two layers. Among them, the lower button **F1** means that the key on the special keyboard is used for the operation directly, in the same way, the same function buttons will appear in the introduction of operation buttons next, the lower layer prompts that the corresponding buttons on the special keyboard are used for the direct operation.

Fig 6.2 Login Interface

6.2 Image Management

Press “Image Management” on the main menu or click the key on the special keyboard to enter the image management interface, as shown in Fig 6.3.



Single Perspective Double Perspectives

Fig 6.3 Image Management Interface

Image Filtration

Click “Category 3” button to filtrate the image with the category and time.

a. “Category” list includes “Automatically Save” and “Sample” options. The “Sample” images are image files built-in the equipment(no “Sample” images for Double Views machine) , while “Automatically Save” images are the image files recorded and saved in the `scanning process.

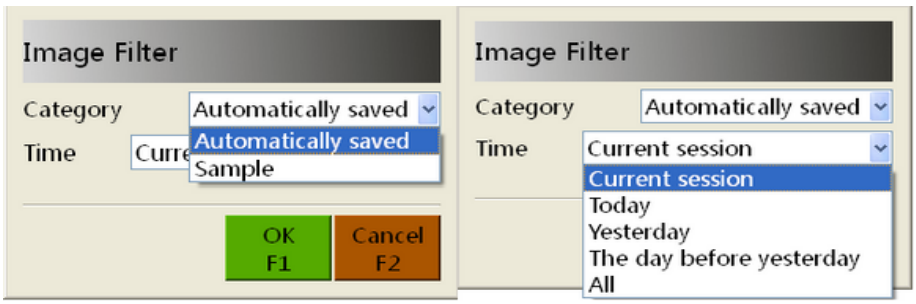


Fig 6.4 Image Filter

b. Under the "Time" list, there are “Current Session”, "Today", "Yesterday", "The Day Before Yesterday" and "All" options.

When the "Auto Save" list has the corresponding images, then the "Export", "Open", "Print", "Training" also become its operational items.

Fig 6.5 Image Management Menu

Image Selection

You can select the corresponding images in the automatically saved list by "Select All" button, "Deselect" button and a single click of the mouse applied on the image file and other operations. When an image is selected, you can not only preview the contents of the image, but also can preview "Model", "Login User", "Scanning Time" and other information below the image, as shown in the red box part of Fig 6.6.

Fig 6.6 Image Preview

Exporting Image

Insert a memory device (such as U disk, etc.) to choose the images to be exported, and then click the "Export" button and select format types of the exporting image (such as the special format (XF), PNG, BMP, JPEG, TIFF, GIF) so as to import the images into the external memory device.

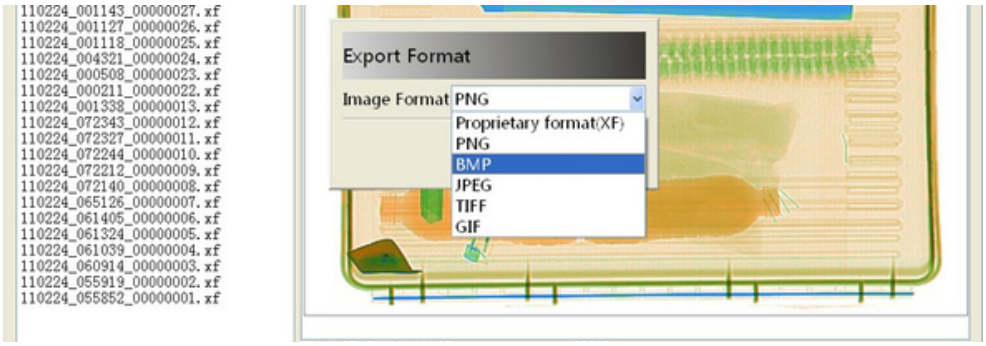


Fig 6.7 Image Export Formats

Opening Image

Select a image and click “Open” button to conduct the full-screen preview and image processing of the image.

Printing Image

If the equipment is equipped with the printer, then you can click “Print” button to print the selected image(s).

Training of Operators

When you click “Training” button (The upper left corner of the screen will pop up a hint: Has entered the training mode.) and then press down “Forward” or “Reverse” button or click  or

 button on the special keyboard, the system will enter the operator training mode.

Fig 6.8 Prompt Box of Training Mode

If you want to end the training state, you need to click “End Training” on the lower right corner of the screen, and the upper left corner of the screen pops up a prompt “Has withdrawn from the training mode”!

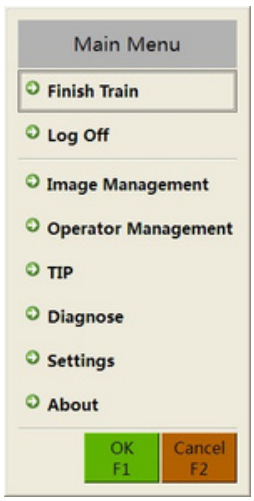


Fig 6.9 Ending Training

6.3 Operator Management

Select “Operator Manage” option on the main menu to enter the operator management interface, as shown in Fig 6.10.

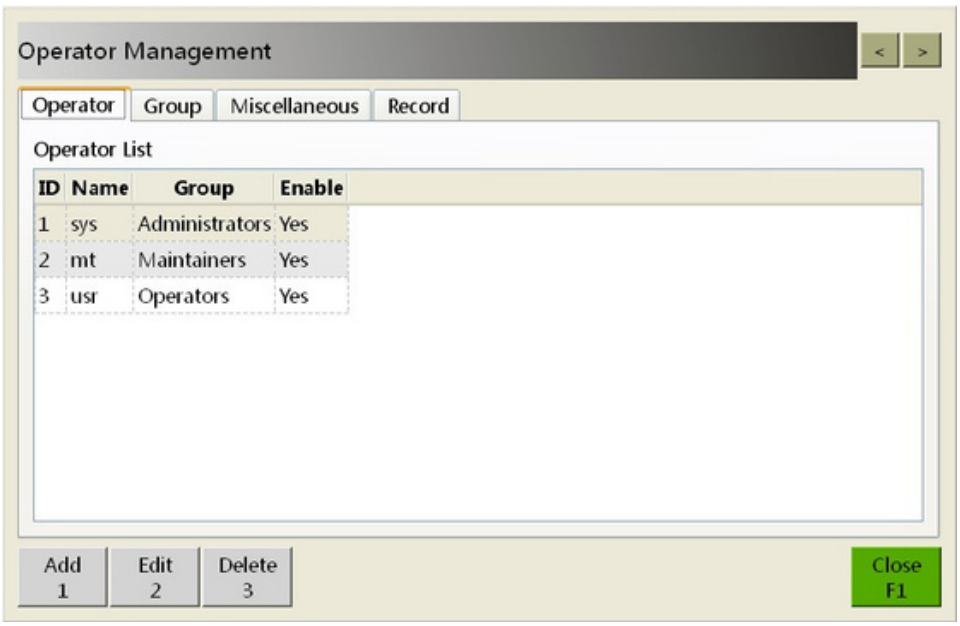


Fig 6.10 User Management Interface

Operator

The operator information in the operator list includes the name of the operator, permissions(group) and enabled. Click "Add" button to increase the number of operators. Input the operator name, select the permissions (group), and enable and reset the password, as shown in Fig 6.11.

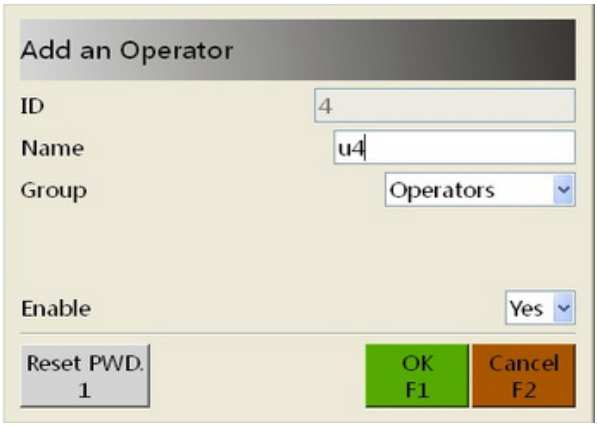


Fig 6.11 Adding Operators Interface

Click the "Edit" button to modify the name of the operator, group, password and enabled state, as shown in figure 6.12.

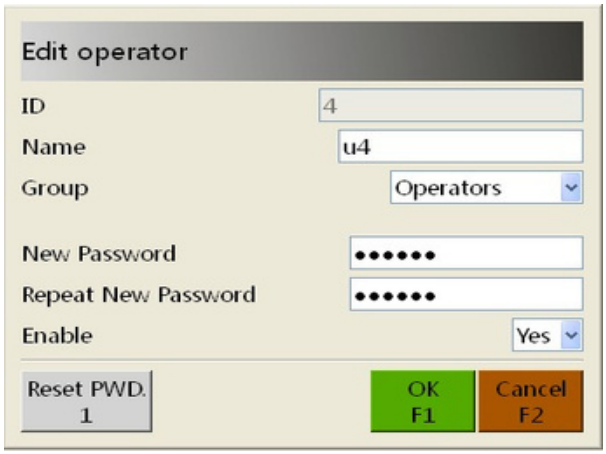


Fig 6.12 Editing Operator Interface

When selecting the operator, you can click “Delete” button to delete the operator, as shown in Fig 6.13.

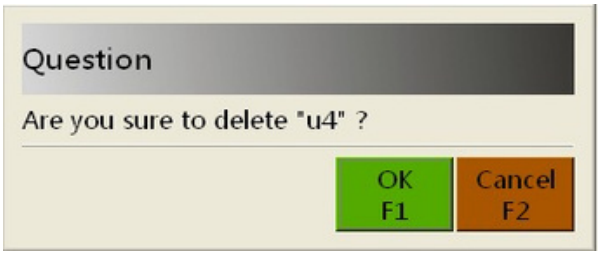


Fig 6.13 Deleting Operators Interface

Group

The group list has three permission groups, namely administrator group, maintenance group and operation group; the privilege list shows all the permissions of this group.

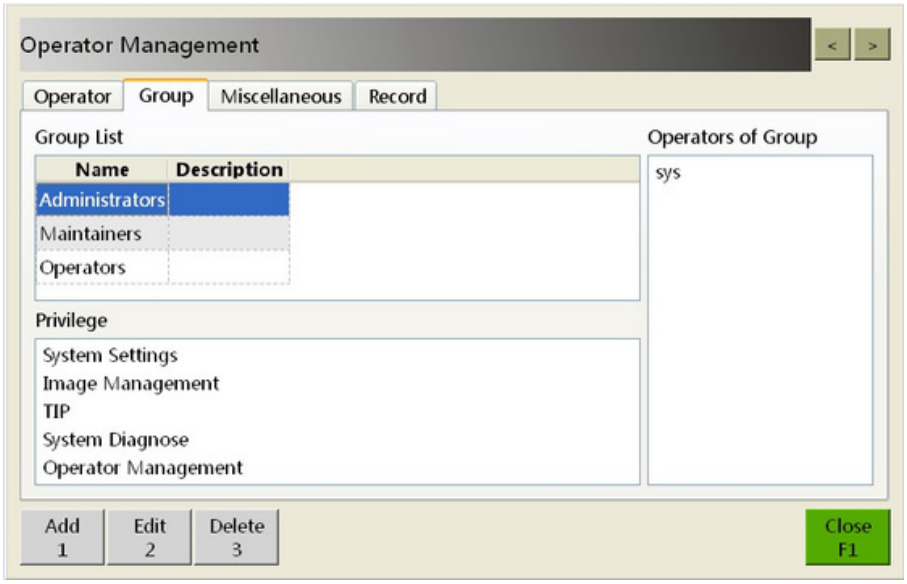


Fig 6.14 Group Interface

Click "Add" button, entering the group name and description and choosing group permissions (system settings, image management, TIP, system diagnosis, operator management), and then click "OK" button to increase a new group, as shown in Fig 6.15.

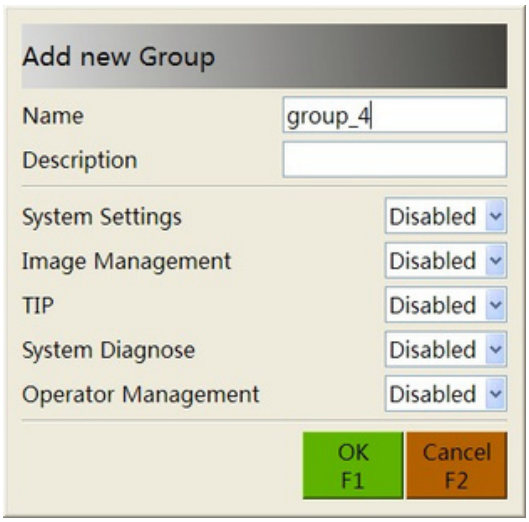


Fig 6.15 Adding & Editing Operation Group Interface

Click the "Edit" button to modify the name, description and permission of the group;
Click the "Delete" button to delete the groups, as shown in Fig 6.16.

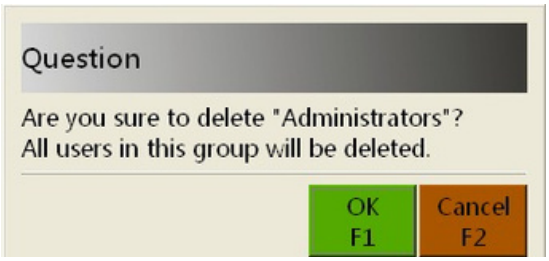


Fig 6.16 Deleting Operation Group Interface

Miscellaneous:

Set up “Automatically Login the System” and “Operator Automatically Login”. The default settings are “enabled and usr”, as shown in Fig 6.17.

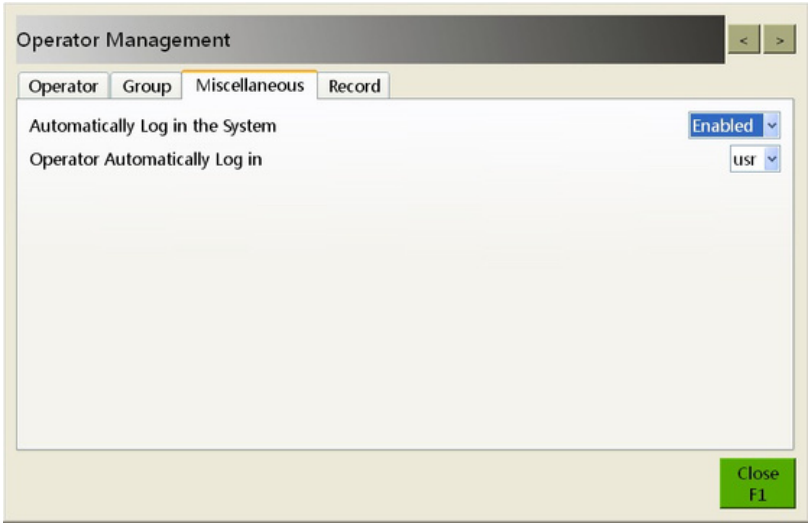


Fig 6.17 Setting Interface of Other Operation Groups

Log

The log list includes “Operator”, “Login Time”, “Logout Time”, “Time” and “Count”, as show in Fig 6.18.

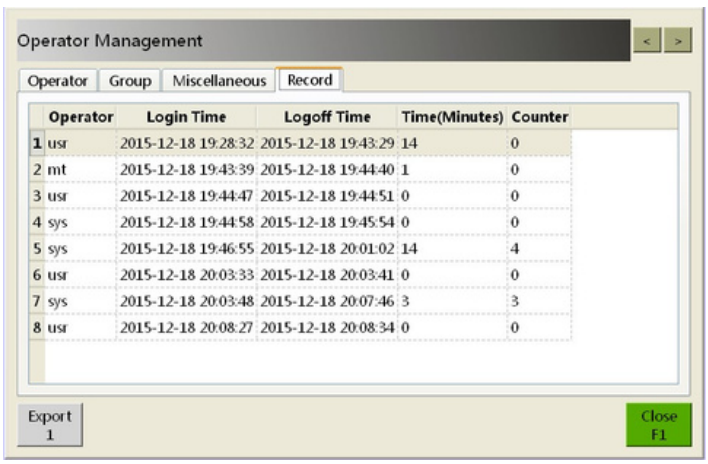


Fig 6.18 Operator’s Log Interface

Click the "Export" button to select the exporting location (local or external memory device), and also click "Create Directory" button and enter the name of the new directory (to save the in the directory), as shown in Fig 6.19.

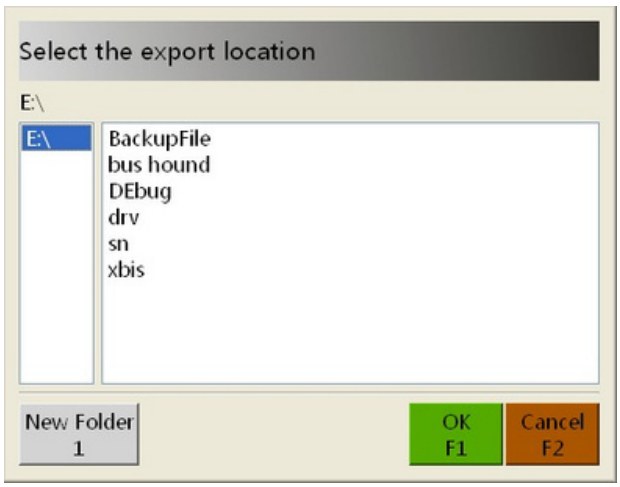


Fig 6.19 Creating Directory Interface

Click “OK” button to save the log in the current directory, as shown in Fig 6.20.

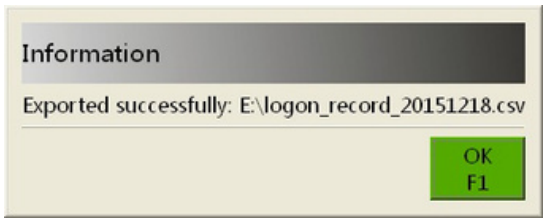


Fig 6.20 Exporting Log Interface

6.4 TIP (Dangerous Goods Insertion)

According to the related parameters of the administrator, the system can automatically insert the images of the dangerous luggage into the scanning image list of items to be scanned or automatically insert different kinds of dangerous goods into the real images of the checked goods. Select "TIP" list on the main menu to enter the TIP system interface, as shown in Fig 6.21.

Image Library

The image library lists the image folders of dangerous goods to be inserted "knife", "knife2" and so on. Open the pull-down menus of the corresponding file and choose the corresponding files to preview the image content, as shown in Fig 6.21.

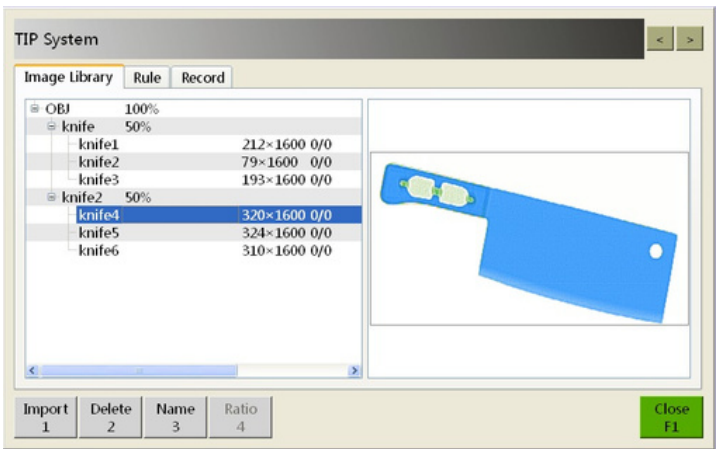


Fig 6.21 Image Library

a. **"Import":** You can import typical images as the TIP images within the scope of the permissions.
b. **"Delete":** Within the scope of the authority, you can choose the corresponding example images and click the “Delete” option, then the "Delete" option is brightened, at this moment, you can delete the corresponding TIP images.
c. **"Name":** Within the scope of the authority, you can choose the corresponding example images and click the “Name” option, then the "Name" option is brightened, at this moment, you can rename the corresponding example images.
d. **"Proportion":** You can modify the proportion of the example images in the total TIP inserted images, and the proportion of “knife + knife2” is always 100%.

Principle

You can set up the TIP enabled state, insertion interval, floating ratio, motion decision time and static decision time, as shown in Fig 6.22.

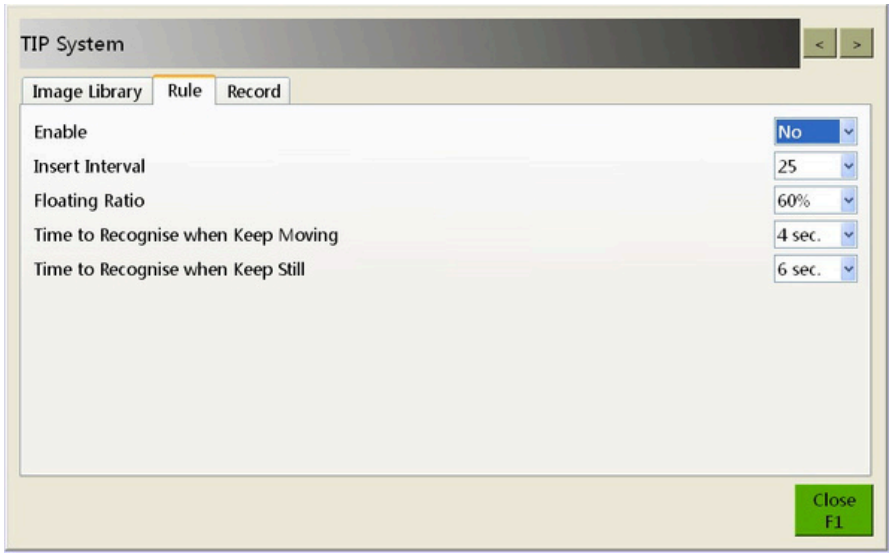


Fig 6.22 TIP Principle

a. **"Enable":** It refers to the enabled state of TIP, and you can choose "yes/no". If you select "yes", the TIP is ON and at the same time, the information area on the application software interface also displays: "TIP: ON"; if you select "no", the TIP is OFF and at the same time, the information area on the application software interface also displays: "TIP: OFF". In addition, only in the condition of "TIP: ON", the settings below are valid.

b. **"Insertion interval":** It refers to that how many parcels one dangerous product is inserted per. The range is the value of multiples of 5: 5-100, and the insertion is random.

c."**Floating Range":** It refers to the floating range of the insertion position for the TIP pic. and can be set to the value of multiples of 5 by 0% ~100% .

d. **"Time to Recognise when Keep Moving":** It refers to the time from the appearance to disappearance of the TIP pic. in the case of insert the TIP pic. while the scanning images are moving(i.e., you can recognise the TIP pic in this period of time). During this period, if the tester or the user presses the functional shortcut- " Recognise TIP" (a functional shortcut can be set to "Identify TIP" on the system setting, as shown in Section 6.6), then the interface will pop up the prompt: “Has Recognise TIPxxx”; if no action is applied to " Recognise TIP" shortcut in this period, the interface will pop up the prompt:” Fail to Recognise TIPxxx”, as shown in the settings above.

   When TIP pic. are inserted, you can press " Recognise TIP" functional shortcut within 4 seconds, then the interface will pop up the prompt: “Has Recognise TIPxxx”; if no action is applied to " Recognise TIP" shortcut within 4 seconds, the interface will pop up the prompt:” Fail to Recognise TIPxxx”. 4 seconds later, the TIP pic. will disappear automatically, and it can reappear only in the training mode.

e. **"Time to Recognise when Keep Still":** It refers to the time from the appearance to disappearance of the TIP pic. in the case of insert the TIP pic. while the scanning images are static. The principle and process are as the same with moving state.

Record

Record the process related to the TIP insertion and list "Operator", "Begin Time", "Finish Time", ”Injection, "Recog. Count", "Recog. Ratio" and other information, and then export the related information through the "Export" button on the lower left corner.

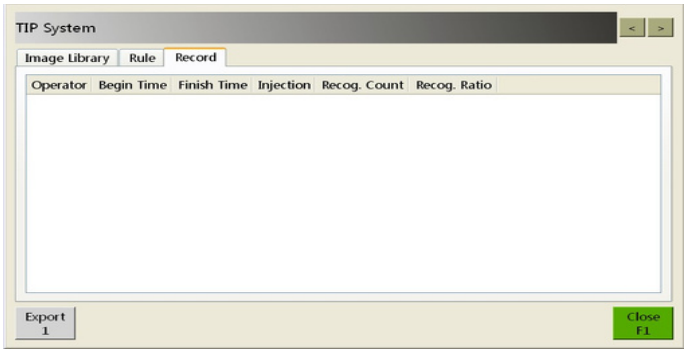


Fig 6.23 TIP Record

NOTE: The corresponding record of the TIP report generated in the current login will be provided when the user logs in again after the logout.

6.5 Equipment Diagnosis

The system software can carry out the diagnosis operation for the key components of the equipment through this diagnosis interface.

Select "Diagnosis" menu on the main menu to enter the equipment diagnosis interface, as shown in Fig 6.24a or Fig 6.24b.

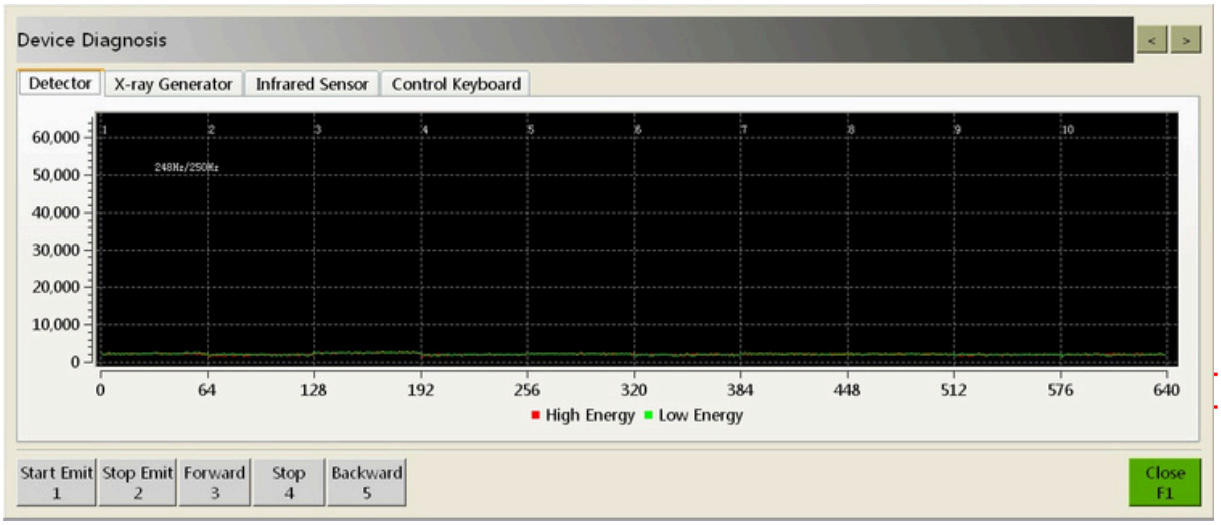


Fig 6.24a Equipment Diagnosis Interface (Single Perspective)

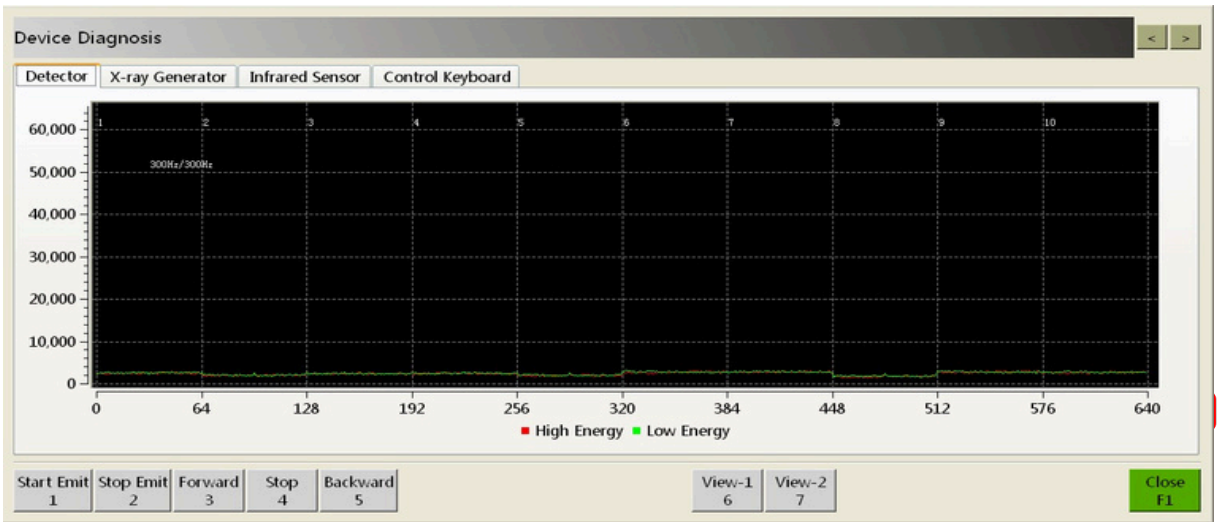


Fig 6.24b Equipment Diagnosis Interface (Double Perspectives)

"Detector" diagnosis module can display the gray level data curve of the sensor array and you can press “Start Emit” and “Stop Emit” to observe the gray level of the curve so as to check whether the detector is in good condition and whether the position of the detector board is in the appropriate postition.

a. When you click the "Start Emi" button, the X-ray begins to emit and the curve rises; when you click the "Stop Emi" button, the X-ray stops emitting, the curve falls back.
b. Click the "Forward", "Stop" and "Backward" button to realize the "Forward", "Stop" and "Reverse" operations of the conveyor.
c. Click the "View-1/6" as the main perspective curve diagnosis interface, click the "View-2/7" as the side perspective curve diagnosis interface.
d. Click the "OFF" button to get the system to exit from the equipment diagnosis menu.

The standard reference curve is as shown in Fig 6.25a or Fig 6.25b:

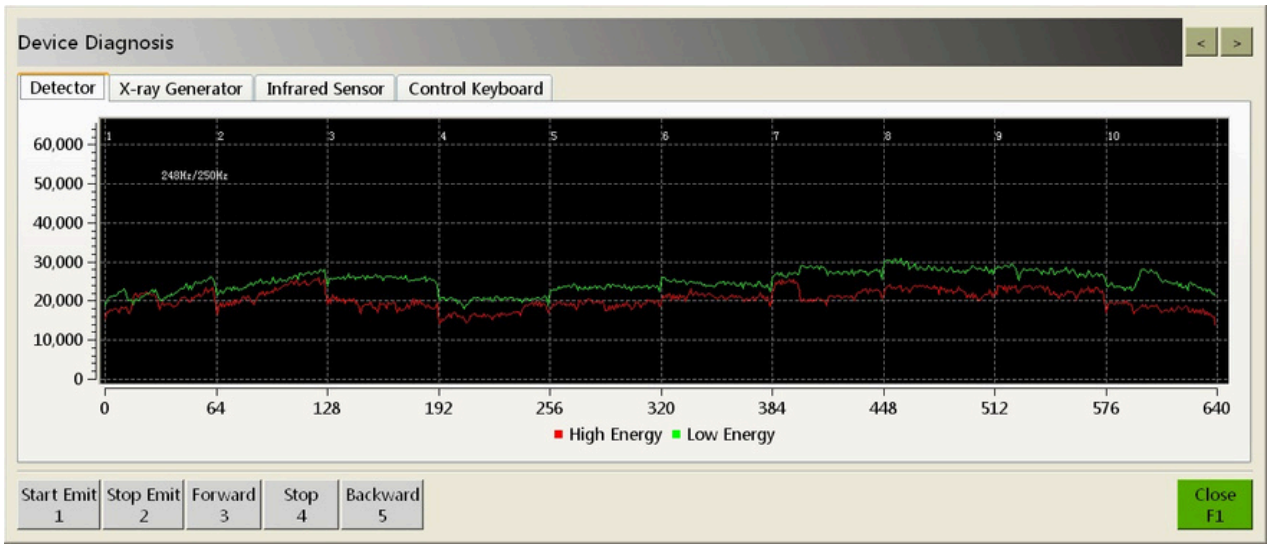


Fig 6.25a Detector Diagnosis Interface (Single Perspective)

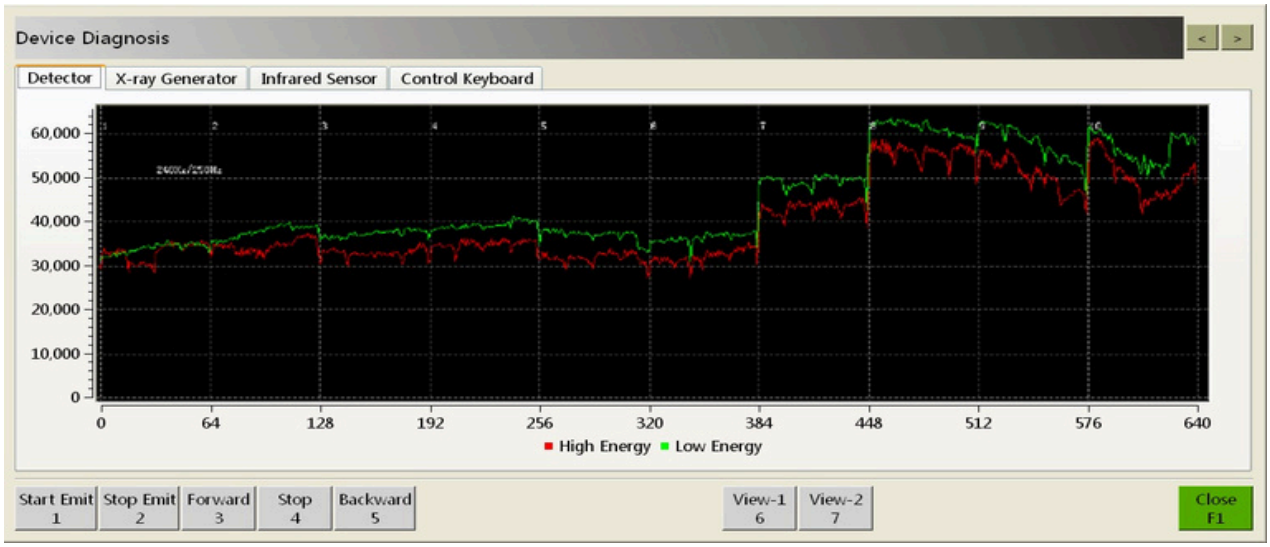


Fig 6.25b Detector Diagnosis Interface (Double Perspectives)

Curve Judgement Criterion:

a. The different devices are equipped with different number of the detection plates and the number of sensing points differs. For example, the number of sensing points shown in the figure above is the number of sensing points for 6550B equipment.

b. The gray level of the curve should be 25000~55000, and the whole curve presents an arc with a hollow center.

Diagnosis of X-Ray Generator

"X-Ray Generator" -The diagnosis module can show whether the voltage and current are normal under the condition of the normal emission of rays so as to make a preliminary judgment of X-ray generator, as shown in Fig 6.26.

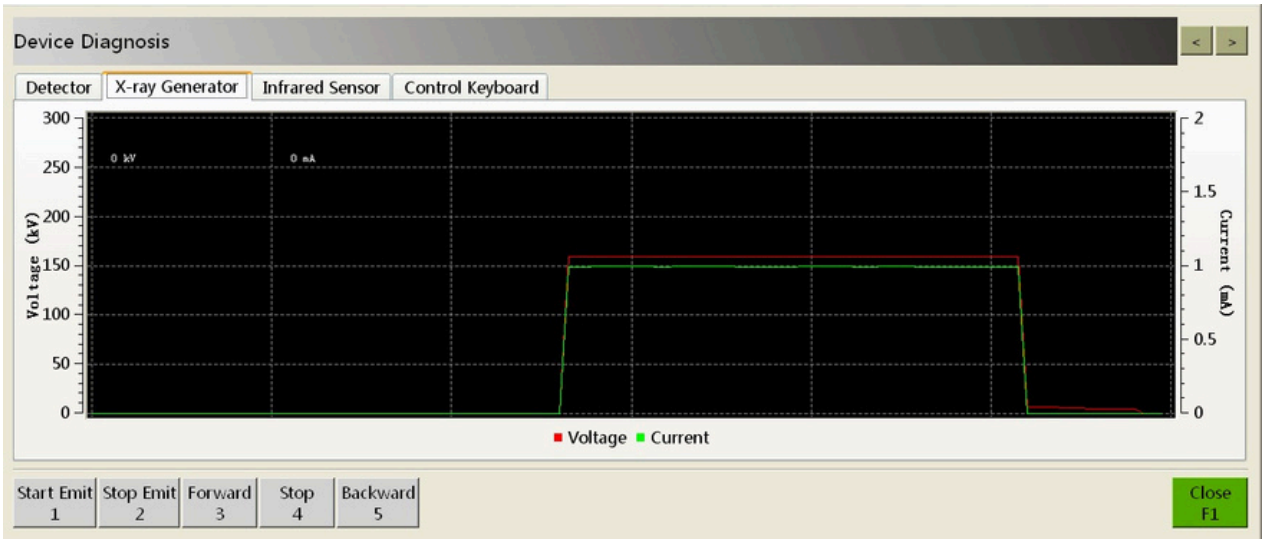


Fig 6.26 Diagnosis Interface of X-Ray Generator

a. When you click the "Beam-out" button, X-ray begins to emit, and the system begins to display the normal voltage and current; when you click the "Beam-End" button, X-ray stops emitting, and the system stops indicting the voltage and current. The specific voltage and current settings vary with the equipment with different models.
b. Click the "Forward", "Stop" and "Backward" button to realize the "Forward", "Stop" and "Reverse" operations of the conveyor.
c. Click the "OFF" button to get the system to exit from the equipment diagnosis menu.

Infrared Sensor Diagnosis Module

The "infrared sensor" diagnosis module is used to diagnose whether two pairs of infrared sensors are activated at entrances and exits. Test Method 1: When you place an opaque object at the entrance to keep off the ray of infrared sensors, then Port A will output a high-level square wave; the longer the blocking time is, the wider the square wave will be, which shows that Port A is normal. Port B can be tested in the same way.

Test Method 2: When you place a luggage on the conveyor and click the Forward 3 button, then Port A will output a high-level square wave, which shows that Port A is normal. When you click Backward 5 button, then Port B will output a high-level square wave, which shows that Port B, with the effect as shown in Fig 6.27.

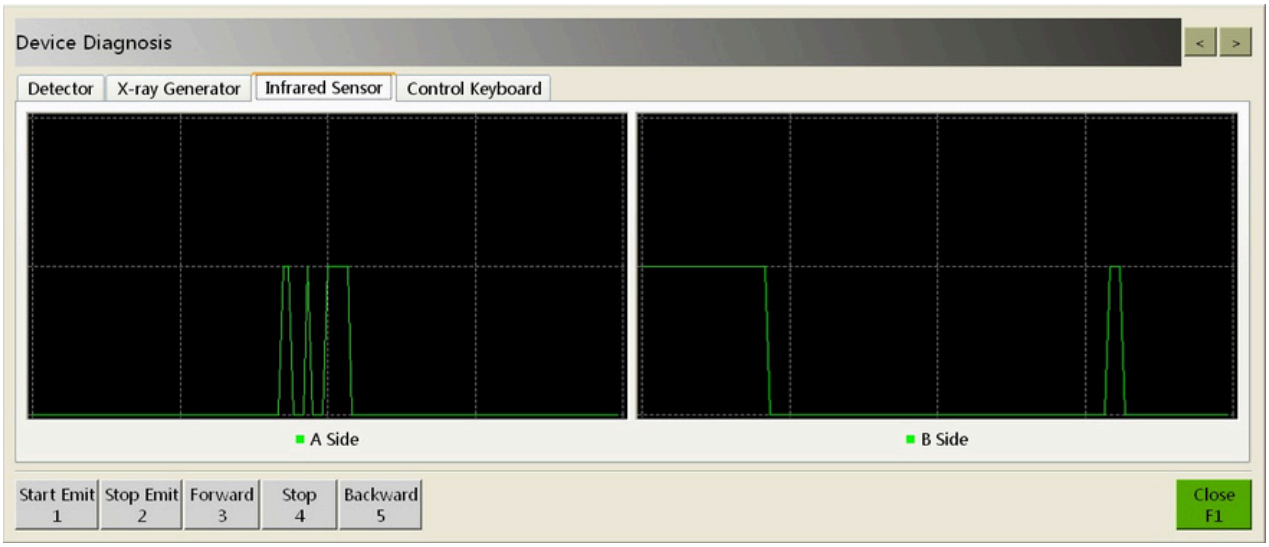


Fig 6.27 Diagnosis Interface of Infrared Sensor

Special Keyboard Diagnosis

The "Special Diagnosis" module is mainly used to test whether the keys on the special keyboard are valid.

a. Except that the "Power" button, the "right button" of mouse and the mouse navigation area can't be tested in the diagnosis module, other keys on the keyboard can be diagnosed in this module.

b. When you click the buttons on the multifunction keyboard, the corresponding button on the software interface will be on. During the test, you should repeatedly test each button for 6-10 times and observe whether the key on the keyboard is pressed or up normally and the corresponding button is on timely and smoothly. The test results are as shown in Fig 6.28.

c. When you click "Exit" button, the system exits from the diagnosis menu of the special keyboard.

Fig 6.28 Diagnosis Interface of Special Keyboard

This diagnosis module is mainly used for the equipment debugging of the professional and technical personnel.

6.6 System Setting

Select "Settings" menu on the main menu to enter the system setup interface, as shown in Fig 6.29.

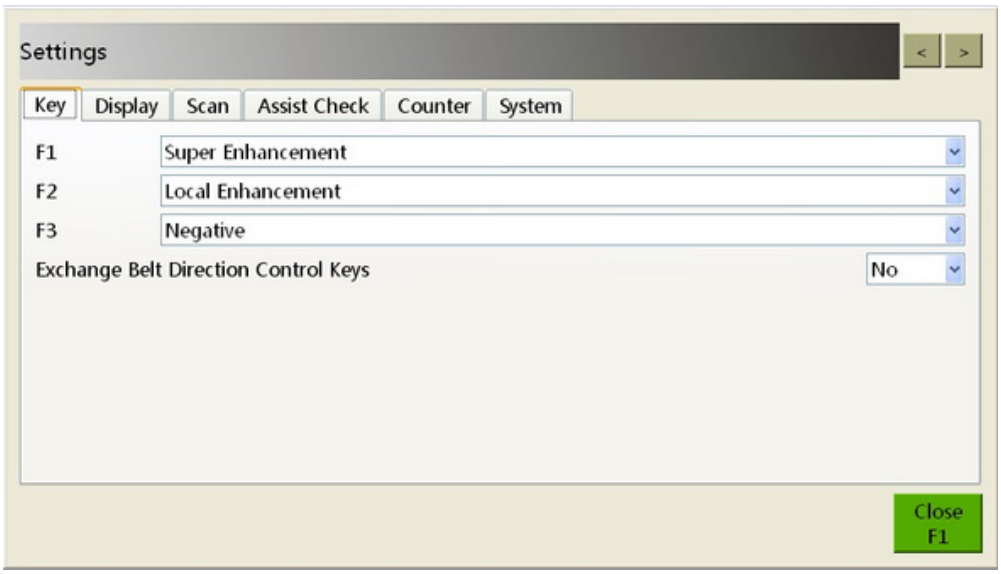


Fig 6.29 System Setup Interface

Programmable Keys

"Programmable Keys"- functional shortcuts, such as F1, F2 and F3 as shown in the figure above.

a. The different functions can be given through the drop-down menus on the right of F1, F2 and F3, such as main menu, scroll to old, scroll to new, zoom-in, zoom-out, origin size, magnifier, default process, original image, edge enhancement, super enhancement, high penetration, low penetration, brightening, darkening, local enhancement, Black and White, pseudo color, colorizing, organics exclusion, inorganic exclusion, Z789, negative, gray scanning, var-absorbency minus, var-absorbency plus, colorizing/ Black and White, organics/ inorganic exclusion, high penetration/low penetration, brighten/darken, force scanning, calibration system, Assistant recognise, recognise TIP, log off, power save, reset automatically, image management, operator management, TIP management, system settings, system diagnosis and about. According to the factory default settings: "F1" stands for "Super Enhancement", "F2" for "Local Enhancement" and "F3" for Negative, as shown in Fig 6.30.

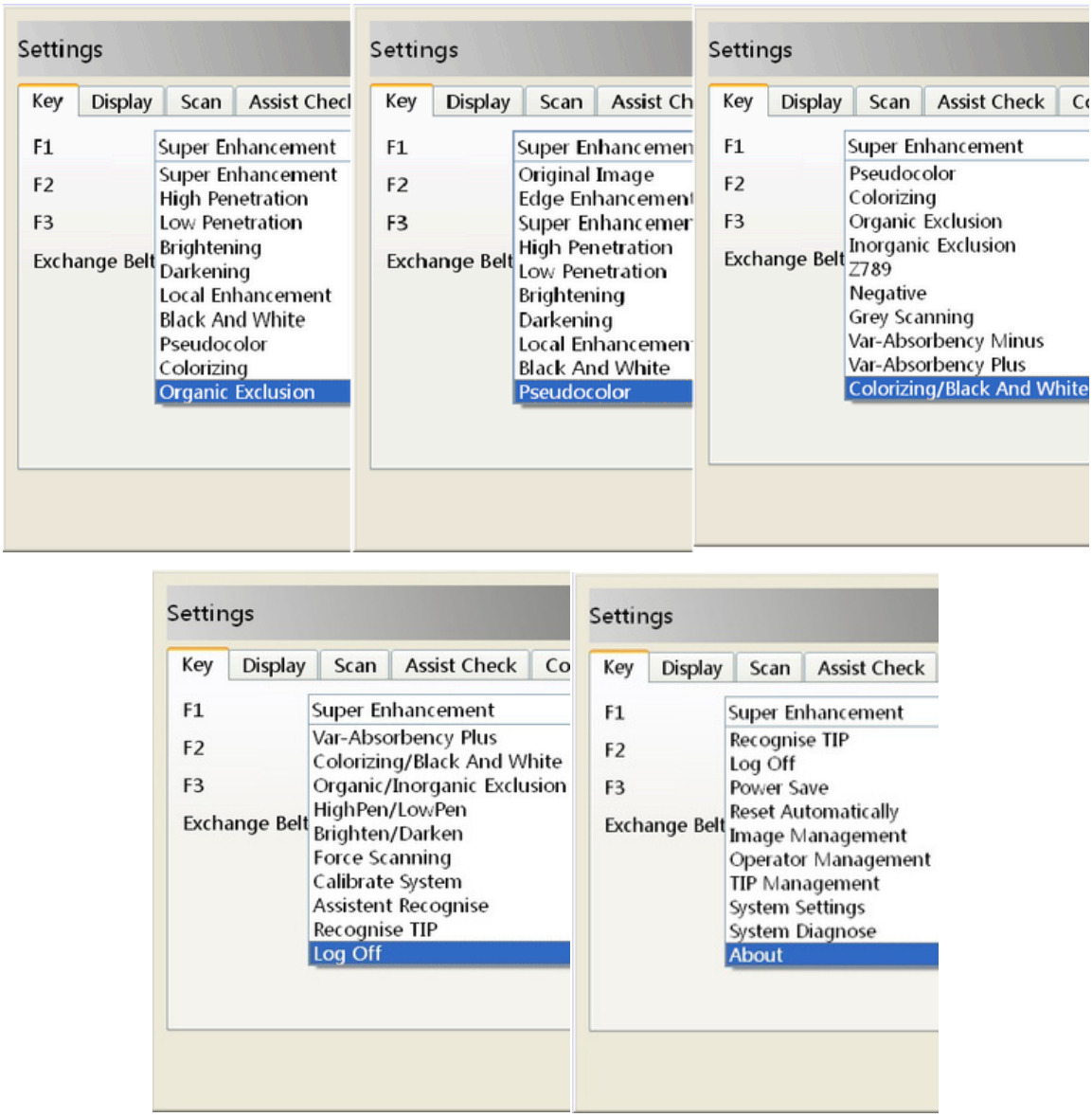


Fig 6.30 Functional Shortcut Setting

b. Exchange Belt Direction control keys": You can select "Yes/No" through the drop-down menu to enable or disable the control function.

c. When you click "Close" button, the system will exit from the system setup interface.

Display

The "Display" function module is used to set the mirror image or max. magnification rate of the images, as shown Fig 6.31.

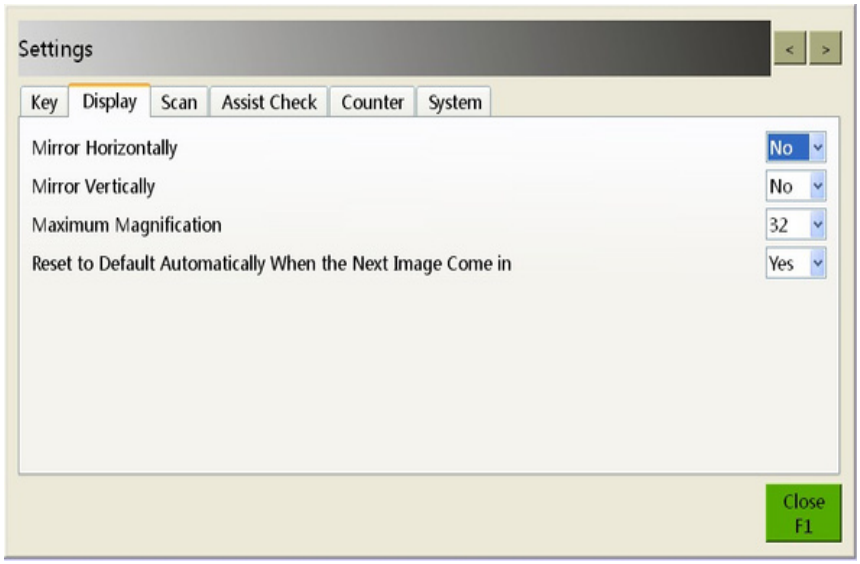


Fig 6.31 Display Interface of System Setup

a. Mirror-Horizontally": You can select “Yes/No” option through the drop-down menu to enable or disable the control function. If you select "Yes" option, it means to enable the mirror horizontally function and the image will be mirrored horizontally while scanning. If you select "No" option (by default), it means to disable the mirror horizontally function.

b."Mirror-Vertically": You can select “Yes/No” option through the drop-down menu to enable or disable the control function. If you select "Yes" option, it means to enable the mirror-vertically function and the image will be mirrored vertically while scanning. If you select "No" option (by default), it means to disable the mirror vertically function.

c.“Maximum Magnification” can be set to 1-64 at the default of 32.

d. When you select " Close" button, the system will exist from the system settings menu.

Scan

"Scan" function module is mainly used to control the scan mode, and enable or disable the automatic calibration when logged in to system..

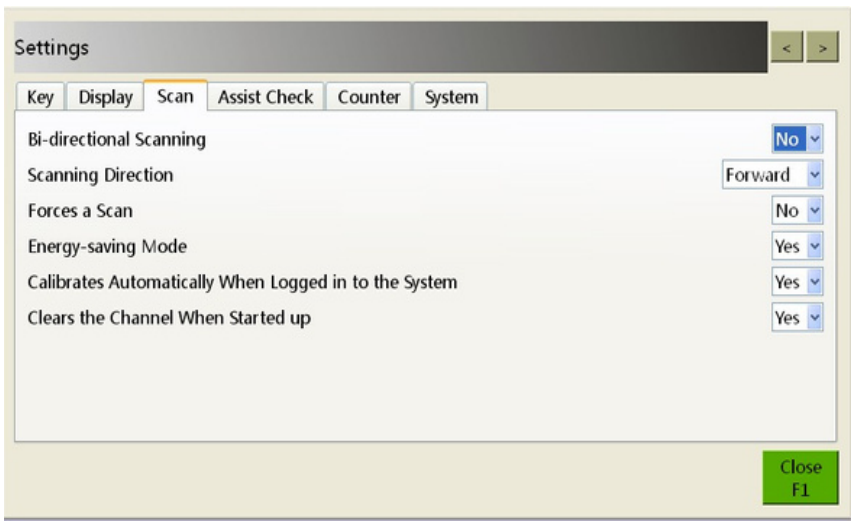


Fig 6.32 Scanning Interface of System Setup

a. "Bi-directional Scanning": It refers to that X-ray will scan the luggage when it pass the channel from both side and will present the image. You can select “Yes/No” option through the drop-down menu to enable or disable the control function. If you select

"Yes" option, it means to enable the Bi-directional scanning function. If you select "No" option (by default), it means to enable the Uni-directional scanning function.

b. "Scanning Direction": You can select “Forward” or “Backward” option, at this moment, the luggage can be scanned by X-ray Uni-directional only. The “Forward” option is by default. When the “Bi-directional Scanning” function is enabled, however, the scanning direction is not optional.

c. “Forces a Scan”: It used for scanning ultra-thin goods. You can select “Yes/No” option through the drop-down menu to enable/disable the “forces a scan” function. “No” is by default, generally.

d. “Energy-Saving Mode”: If there are no other luggage coming in 15 seconds after the last luggage have been scanned by X-ray, then the conveyor will stop running so as to achieve the purpose of the energy saving. You can select “Yes/No” option through the drop-down menu to enable/disable the energy-saving mode. “No” is by default, generally.

e. “automatic calibration when logged in to system”: It refers to the automatic calibration process of equipment when logging in the system. You can select “Yes/No” option through the drop-down menu to enable/disable the self-check function. “No” is by default, generally.

Assist Check

“Assist Check” refers to the Assist check of “Display Identification Tags”, “Difficult to Penetrate”, “Explosive”, “Drug” and other items, as shown in Fig 6.33.

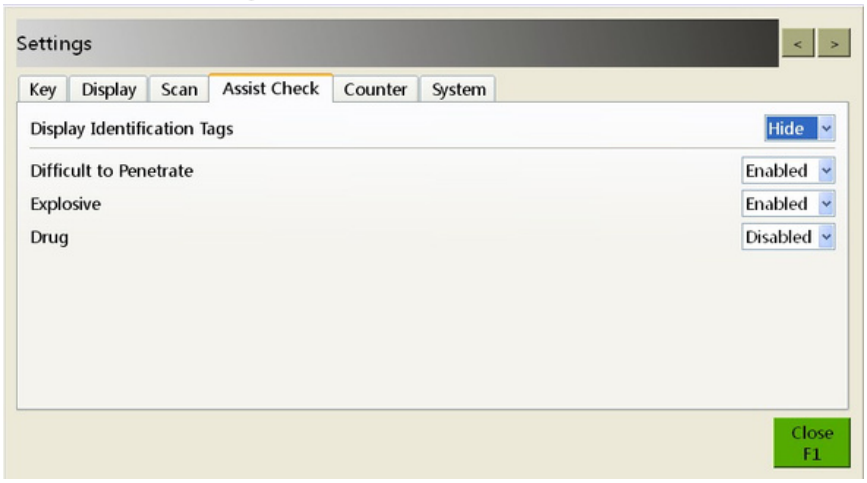


Fig 6.33 Auxiliary Check Interface of System Setup

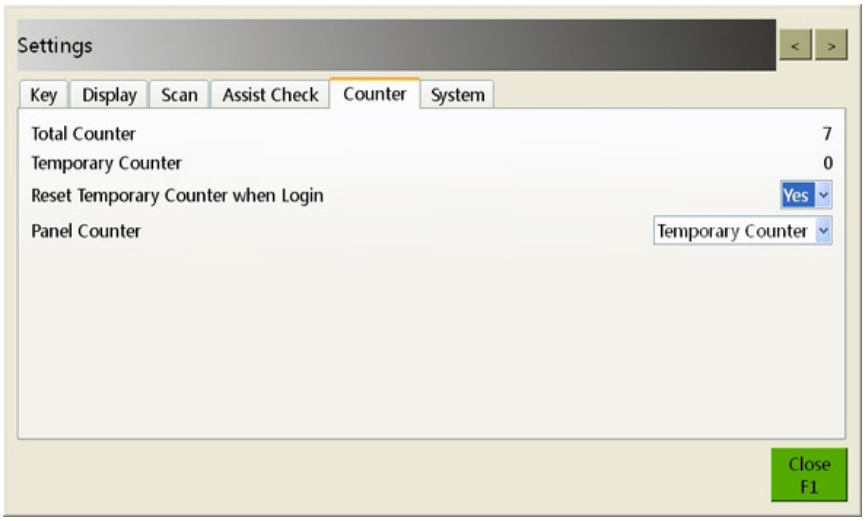
a. “Display Identification Tags”: It is equivalent to the alarm box and you can select “Display” or “Hidden” option through the drop-down menu. If you select "Display" option, then the position(s) of the corresponding dangerous goods will be marked with the marker boxes if the system detects the objects difficult to penetrate, explosives or drugs (on premise that the functions are enabled) when scanning.

b. “Difficult to Penetrate, “Explosives” and “Drugs”: These options refer to the goods property check and you can enable or disable these functions through their respective down-drop menu.

c. When you select “Close" button, the system will exist from the system setup menu.

Counter

“Counter” function module is mainly used to display the total counter, temporary counter and other information.

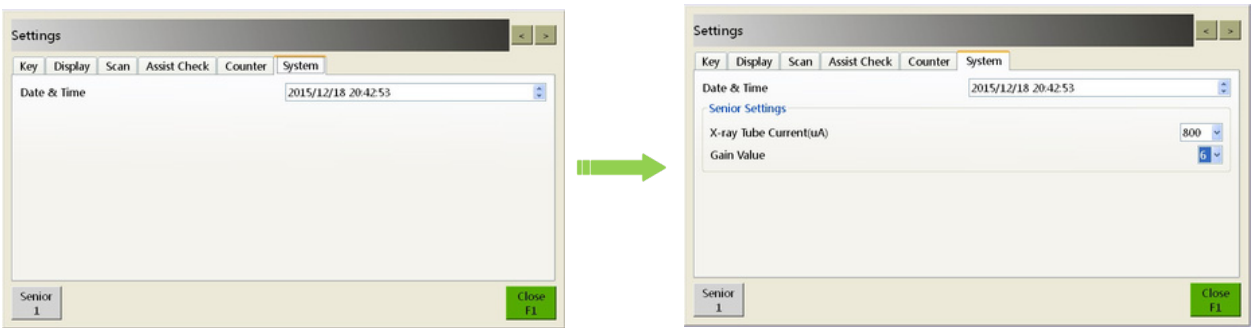


6.34 Count Interface of System Setup

a. "Total Counter": It is used to count the total number of the parcels sorted by different users in different dates.
b. "Temporary Counter": It is used to count the number of parcels sorted by one user.
c. "Reset Temporary Counter when Login": It refers to automatically reset the Temporary Counter last time when you log in, but it will not change the total number. You can choose "yes/no" option, but “No” is by default, generally.
d. "Panel Counter": It refers to the counter number indicated in the software information area, and it can display the temporary counter/total counter.
e. When you select " Close " button, the system will exist from the system setup menu.

System

On the “System” setting module, you can set the system date/time, tube current, gain value and factory number.



6.35 System Interface of System Setup

a. “Date/Time” synchronizes with the equipment industrial PC and it can be changed, but there is no need, generally.
b. When you select the “Senior” option and input the corresponding password, the system can enter the tube current, gain or factory number menu, as shown in the figure above (right): The "Tube Current" varies with the different models. For examples, the tube current is set to 1000 μA and 800 μA for 10080B and 6550B, respectively. The gain is "6" by default, and the factory number is automatically generated in the registration of the debug software, and does not need to make change.

> ★ **NOTE**
> The tube current and gain settings are used for as a reference standard of the delivery inspection, so these settings shall be not modified by the non-professional technical personnel.

c. When you select "Close" button, the system will exist from the system setup menu.

6.7 About

Select “About” function module on the main menu to enter the “About X-Ray Inspection System” interface, as shown in Fig 6.36.

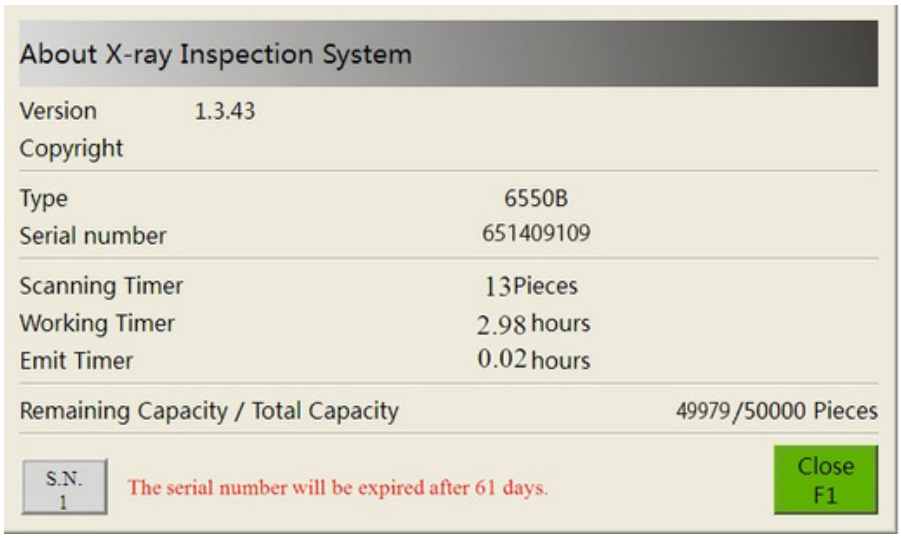


Fig 6.36 Equipment Information

About Equipment Information

The module mainly shows the version and copyright of the software, equipment model, factory number, scanning time, working time, emit time, storage capacity of the image files and other information. (The information on the figure above is just for reference).

Authorization Management

After entering “About” interface, you can click “Serial Number” button to enter the authorization management interface:

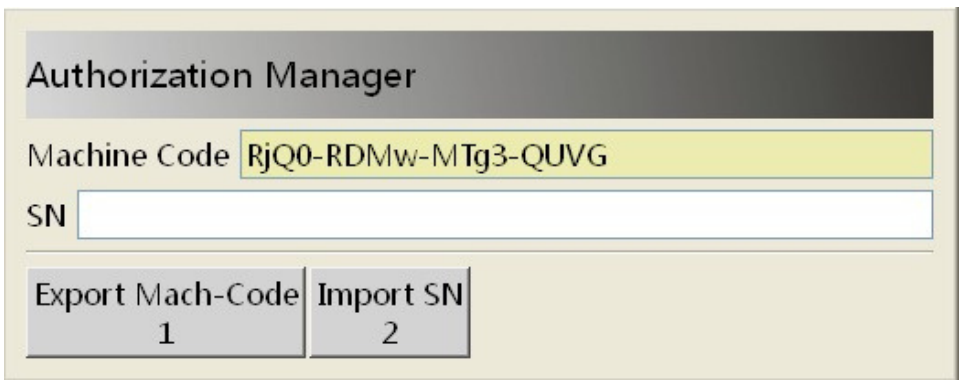


Fig 6.37 Authorization Manager Interface

After entering the interface, you can click “Export Mach-Code” button or press “1” key on the special keyboard to rename and then click “OK” button or press “FI” button to save it.

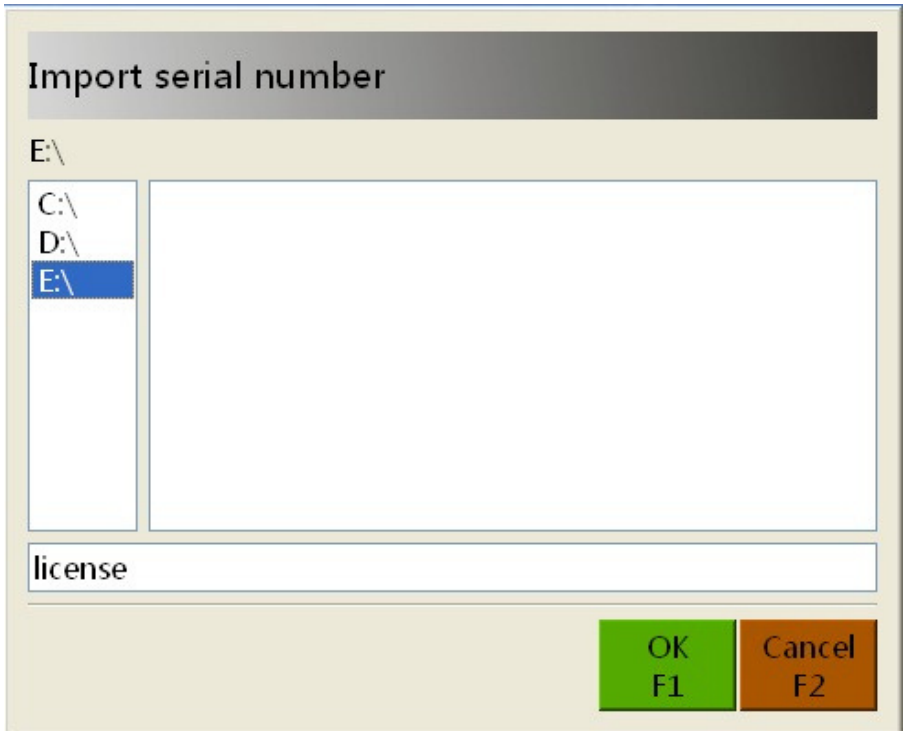


Fig 6.38 Export Machine Code Interface

Pass the saved machine code file passed to the equipment supplier to register, and the serial number registered by the equipment supplier will be provided to the user. When the user clicks “Import Serial Number” button or press “2” key on the special keyboard to import the registered serial number, the system will automatically identify whether the sequence number is valid; if yes, you can click “OK” button or press “FI” button to enable the corresponding function of the equipment.

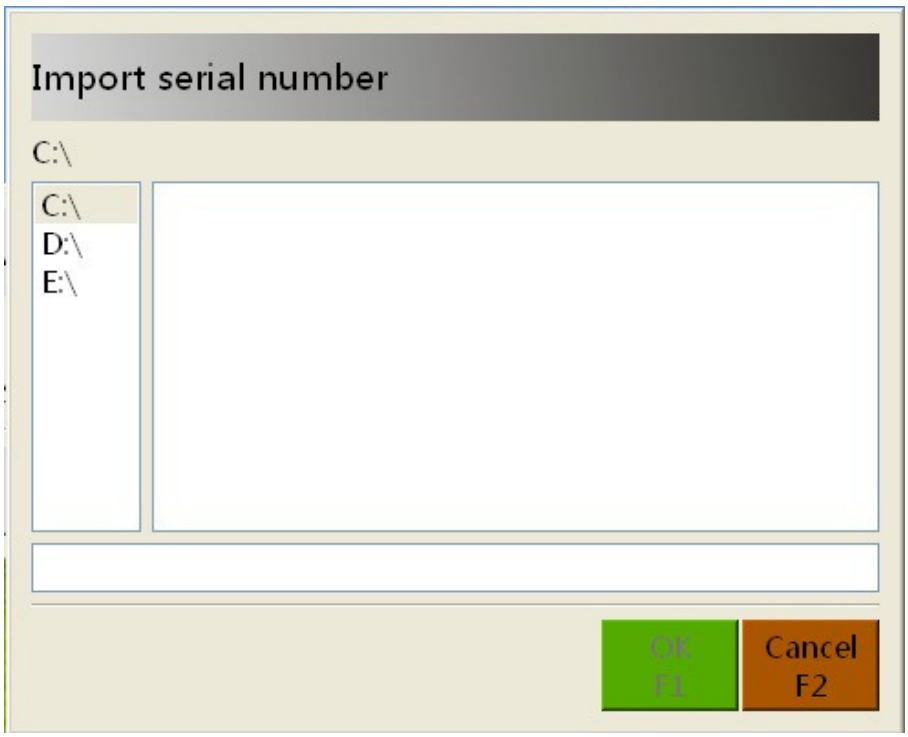


Fig 6.39 Import Serial Number Interface

Chapter 7 Care and Maintenance

The daily care and maintenance is the work that must be done in equipment work time and is an important part of the reasonable usage and operation of the system. This chapter presents the following requirements of the daily care and maintenance.

Introduction to this chapter:

External Cleaning of Equipment
Clean-up of Photoelectric Sensor
Display Clean-up
Inspection of Conveyor
Inspection of Lead Curtain at Access
Inspection of X-Ray and Power Indictor Light
Inspection of Emergency Stop Button

7.1 External Cleaning of Equipment

During the long-time running process of the equipment, dust and all kinds of dirt are accumulated on the equipment surface. So it is necessary to clean up the surface of the equipment on a regular basis in order to guarantee the normal operation of equipment.

The surface of the equipment should be cleaned with the moist towel.

The guard plates and uprights of the equipment should be cleaned up.

> ★ **NOTE**
> Before cleaning the exterior of the equipment outside, be sure to turn off the power supply of the equipment and cut off the equipment external power supply.

7.2 Clean-up of Photoelectric Sensor

If The injection port of the photoelectric sensor is covered or blocked, When the conveyor is started, the equipment will emit x-ray and scan immediately. If you check the system setup, and find out "Force a Scan" function is disabled, then you can judge the photoelectric sensor may be covered or blocked.

Please turn off the equipment and take out the key from the operation keyboard with you. Check the state of photoelectric sensor and find out that the photoelectric sensor is located on the inner wall of the channel inside the lead curtain. Then check whether the photoelectric sensor is covered, which may affect the accuracy of the photoelectric sensor signal. For this case, you can gently wipe the surface of the photoelectric sensor with the moist cotton ball to restore the cleanliness of the surface.

7.3 Display Clean-up

During the long-time running process of the equipment, there is dust or fingerprints on the surface of the display which will affect the image resolution of which the operators identify the goods. For this case, you can clean the display screen with the dedicated monitor cleaner and adjust the brightness of the display under the condition of cutting off the power of the display.

7.4 Inspection of Conveyor

During the long-time inspection work, the conveyor belt of the equipment may deviate from the center of the channel, and if the motor end comes out due to the off tracking of the conveyor, then it is necessary to adjust the conveyor belt. Please contact the professional maintenance personnel to adjust the running condition of the conveyor belt or read the maintenance manual carefully.

7.5 Inspection of Lead Curtain at Access

If you find the clearance of the lead curtains is too large, or the lead curtains fall off or are damaged, please contact the professional maintenance personnel to replace or supplement them.

> ★ **NOTE**
> Please wear the gloves when adjust or replace the lead curtain .

7.6 Inspection of X-Ray and Power Indictor Light

> ★ **NOTE**
> The system administrator and maintenance personnel can inspect the state of the X-ray indicator light by the corresponding operation of the diagnosis maintenance program.

7.7 Inspection of Emergency Stop Button

The Emergency Stop buttons on the equipment cover plate and the operation keyboard are the key safety devices, so if one of them or both are loose or its shells are damaged, be sure to stop the equipment immediately, and contact the professional maintenance personnel to maintain or replace the corresponding Emergency Stop button. Only after the maintenance can the equipment continue to be used.

> ★ **Description**
> After the maintenance, please press this Emergency Stop button. At this moment, the motor inside the system stops running; the X-ray generator stops emitting X-ray and the display will pop up a prompt – the Emergency Stop button is pressed down, which show that the switch can work normally.

Chapter 8 Common Faults and Troubleshooting

This chapter will introduce the common faults and troubleshooting.

Introduction to this chapter:

Key Switch Indicator Light Not ON & Equipment Not Power-On
Display Not ON after System Power
Conveyor Fails to Run
Auto Shutdown during Equipment in Operation

8.1 Key Switch Indicator Light Not ON & Equipment Not Power-On

Symptom

Rotate the key switch on the operation keyboard to start the system, at this moment, if the right indicator light can not turned on, which means that the equipment cannot be powered on.

Diagnosis

The power supply cable plug of the equipment is loose.
The control cable plug of the special keyboard is loose.
The breaker at the input end of the equipment power is not closed or the fuse blowout..

Solutions

Step 1: At first, check whether the power supply cable plug of the equipment is inserted into the power socket on the operation place, and the power supply is normal. If the plug is loose, please insert it again.
Step 2: Check whether the control cable plug of the operation keyboard is loose, if yes, please insert it again, and screw up the screws on both sides to fasten the plug.
Step 3: Rotate the key switch on the operation keyboard. At the moment, if the right indicator light is on and the device can be started, which show that the fault is removed, if not, continue to carry out the following steps.
Step 4: Use some tools to open the cover plates of the equipment where the breaker and fuse are installed to check whether the breaker is closed and whether the fuse is blowout. If the fuse is burnt out, it should be replaced with the new one with the same specification.
Step 5: Rotate the key switch on the operation keyboard again. At the moment, if the right indicator light is on and the device can be started, which show that the fault is removed.

> ★ **Remark**
> If the fault still can't be removed on the basis of the above steps, please contact the professional maintenance personnel.

8.2 Display Not ON after System Power-on

Symptom

After the equipment is powered on and started up, the display is not on.

Diagnosis

The power switch of the display is not turned on.
The cable plug of the display is loose.

Solutions

Step 1: At first, check whether the power switch of the display is turned on and make sure the switch is turned on, at the moment, the switch indicator light should be on.

Step 2: Check whether the cable plug of the display is loose, if yes, please insert it again, and screw up the screws on both sides to fasten the plug.

Step 3: Observe whether the display screen outputs the image. If the image is output, which shows that the fault is removed.

> ★ **Remark**
> If the fault still can't be removed on the basis of the above steps, please contact the professional maintenance personnel.

8.3 Conveyor Fails to Run

Symptom

When you press  or  button, the conveyor fails to run.

Diagnosis

The Emergency Stop button or the safety interlock is triggered by mistake.

Solutions

Step 1: Check whether the system status panel shows the prompt of "[102] Emergency Stop switch triggered"; if yes, please carry out the following steps.

Step 2: Inspect the Emergency Stop buttons on the cover plate of the equipment and the special keyboard in turn; if any switch is pressed, please rotate it clockwise to reset it.

Step 3: Observe whether the information of "[102] Emergency Stop switch triggered" on the system status panel disappears; if yes, please press  or  button again, at the moment, the conveyor should run; if there is an information of "[104] Micro switch of the cover board triggered", please carry out the following steps.

Step 4: Check whether the cover plates of the equipment are installed in place in turn; if you find that any cover plate is loose, please install and fix it again.

Step 5: Observe whether the information of "[104] Micro switch of the cover board triggered" on the system status panel disappears; if yes, please press  or  button again, at the moment, the conveyor should be started and run.

> ★ **Remark**
> If the fault still can't be removed on the basis of the above steps, please contact the professional maintenance personnel.

8.4 Auto Shutdown during Equipment in Operation

Symptom

A sudden black screen happen to the display during the equipment in operation, and the power indicator light of the equipment is off.

Diagnosis

The external power supply cable plug of the equipment is loose, or the breaker or fuse is blowout..

Solutions

Step 1: At first, check whether the external power supply cable plug of the equipment and the power socket are loose; if yes, please insert the power plug again reliably and take some anti-looseness measures to the power plug.

Step 2: If the external power supply of the equipment is OK, then you need to check whether the breaker or fuse is off; use some tools to open the cover plates of the equipment where the breaker and fuse are installed to check whether the breaker is closed and whether the fuse is in good condition.

> ★ **Remark**
> If the fault still can't be removed on the basis of the above steps, please contact the professional maintenance personnel.

Chapter 10 Attachments

10.1 Terminology

■ **Equipment**	Micro-dose X-ray security inspection equipment based on the computer platform for energy resolution.
■ **Line Resolution:**	The equipment has the ability to distinguish the single solid copper line. The line resolution is generally expressed in the nominal diameter of the line (mm) or the corresponding wire size (AWG).
■ **Penetration Resolution**	The equipment has the ability to distinguish the single solid copper line under the condition of the aluminum alloy steps with the specified thickness. The penetration resolution is generally expressed in the nominal diameter of the line (mm) or the corresponding wire size (AWG).
■ **Penetrating Power**	It refers to the ability of the equipment to penetrate the goods to be inspected and is generally expressed in the thickness of the steel plate (mm).
■ **Space Resolution**	It refers to the ability to distinguish the metal wire and is generally expressed the nominal diameter of the line (mm).
■ **Equivalent Atomic Number**	In interaction of X-ray and matter, the equivalent atomic number is the characteristic parameter used to calculate the attenuation, absorption and scattering ability regard with to X-ray. For the elementary substance, the position number in the periodic table, namely the electron number of an atom for the substance, it is the atomic number; for the compound or mixture, it is obtained by calculation or experiment.
■ **Organics**	Substance with the equivalent atomic number less than 10.
■ **Inorganics**	Substance with the equivalent atomic number more than 18.
■ **Organics Resolution**	It refers to the ability of the equipment to distinguish organics and is expressed in the thickness of discriminable organic step.
■ **Inorganics Resolution**	It refers to the ability of the equipment to distinguish inorganics and is expressed in the thickness of discriminable steel step.
■ **Impenetrable Area**	It refers to the area where the goods to be inspected cannot be identified by the equipment. The strength that the X-ray penetrates the goods to be inspected and reaches the detector is almost zero.
■ **Uncertain Material Area**	It refers to the area where the X-ray can penetrate but the detector cannot identify the material property of the goods to be inspected.
■ **Pass Rate**	It refers to the quantity of goods in length of 1 meter inspected by the equipment within one hour.

■ **Single Inspection Dose**	X-ray dose absorbed by the goods to be inspected in the process of one inspection in Gy (1Gy=1J/kg).
■ **Ray Leaking Dose Rate**	Ionizing radiation intensity per unit time of the X-ray which penetrates the radiation shield and leaks out of the equipment in uGy/h.
■ **Micro-dose X-ray Security Inspection System**	X-ray security inspection system with the single inspection dose less than 5uGy.
■ **Start Button of Secondary Electric Power Supply**	It refers to the switch component which should be confirmed twice to power on the equipment, and is generally applied for the radiation equipment.
■ **Preheating Tube**	It refers to the process of X-ray tube's voltage being increased gradually in the boot and automatic start process of the equipment, and its purpose is generally to protect the service life of the ray tube.
■ **Scroll**	It is used to display the image from left to right of the screen or from right to left.
■ **Operator Sensor**	Sensor used to detect the operator on-the-job state. If the system is equipped with such component, then when the operator is close to it, the equipment can normally; when the operator is away from it, the equipment will automatically shut off the power supplies of the X-ray generator and the conveyor.
■ **Emergency Stop button**	It is used in an emergency and will cut off the power supplies of the X-ray generator and the conveyor at once.
■ **X –ray Detector**	A sensor which can detect (measure) X-ray and convert the X-ray intensity into the processed electrical signal.
■ **Test Object (Box)**	Test object used to test and evaluate the performance indications of X-ray image
■ **Test Card**	Test object used to test and evaluate an index of X-ray image

Remarks: The definitions of terminologies above are from the national standard (GB 15208.1-2005) and other data.