



High-speed bulk material foreign body X-ray and color sorting machine

Intelligent high-definition X-ray inspection machine

Multi-purpose foreign body inspection machine for packaging

X-Ray Foreign Body Detection User Manual v3.2

Before operation this machine, please read this manual thoroughly, and keep a copy with the machine for future reference. This manual is to be considered part of your machine.

March 2025



1. PRODUCT OVERVIEW



Please read and understand the contents of this manual carefully before installing, operating, maintaining or servicing the equipment. To ensure the correct operation and safety of the equipment, please keep this manual in a safe place for reference when needed.

Although this manual has listed the possible dangerous situations caused by the equipment as detailed as possible, we cannot exhaust all possibilities. Therefore, when performing operations not listed in this manual, please be sure to obtain more information from the supplier or contact our after-sales service department. When installing, operating and maintaining/repairing the equipment, in addition to following the instructions in the manual and on the equipment, be sure to take adequate safety measures.

The copyright of this manual belongs to our company and is protected by copyright law. Unauthorized disclosure, reproduction or copying of the contents of this manual is strictly prohibited without the written permission of our company.

Every effort has been made to consider carefully when writing this manual, but if you encounter any unclear points, errors or questions during reading, please be sure to provide the model (model) of the equipment and then consult the supplier or after-sales service department.

When installing, operating, maintaining and inspecting the device, be sure to follow the instructions and warnings listed in this manual. If you encounter any problems or are unclear, please contact your dealer or our after-sales service department immediately. Do not perform any operation before obtaining the necessary instructions.

Please note that the contents of this manual are subject to change without prior notice. Therefore, when using the equipment, please keep an eye on the latest updates and revisions and ensure that you have the latest version of the manual.



1.1 X-ray foreign body detector overview

X-ray foreign body detectors are widely used in food and industrial production fields. Their functions include detecting foreign bodies such as metal, glass, stone, bone, high-density rubber and plastic. It provides an important means for high-standard enterprises to conduct quality control and quality assurance during the production process.

1.2 Applicable objects

This manual is applicable to users who operate the Golden Shield series X-Ray foreign body detection software, including technical operators and administrators (maintenance engineers).

1. General Notes

For electrical wiring work, please ensure that it is entrusted to professionals with legal qualifications. Unauthorized personnel engaging in electrical wiring work will violate relevant laws and regulations. Improper electrical wiring may cause dangerous situations such as fire, electric shock and grounding faults.

2. To ensure safety, please ensure that the device is properly protectively grounded. It is recommended that you entrust professionals with formal electrical wiring work qualifications to perform protective grounding work on the device to minimize the risk of electric shock caused by grounding errors.
3. To ensure the normal operation and safety of the device, do not pour water on the device and avoid installing it in a humid or condensation-prone place. Unless the device is clearly marked as waterproof, contact with water will cause device performance degradation, loss of function, malfunction and even electric shock. Therefore, please pay special attention to avoid moisture contact with the device to ensure its normal operation and safe use.
4. To ensure the safe operation of the device, please install it in a solid and level place. If the device is installed in an unstable or tilted position, it may cause device performance degradation, function damage or even rollover, causing personal injury. Therefore, please make sure that the device is firmly installed to prevent potential dangers and accidents.
5. When operating the device, please be sure to wear appropriate work clothes and make sure to fasten any buttons or zippers on your clothes. Choose non-slip shoes and tie your shoelaces. Please avoid wearing any accessories, including ties and belts. If you must wear them, please use clips to secure them. In addition, please cover your hair completely in a hat or hair cap. Failure to comply with the above regulations may cause hair or fibers to be mixed with the handled goods, causing foreign matter contamination accidents. At the same time, foreign objects may be entangled in the device, which may cause personal injury. Therefore, please be sure to comply with the above requirements to ensure food hygiene and personal safety.



6. To ensure safety, please do not attempt to disassemble, repair or modify the device unless explicitly instructed in the user manual. Using tools such as screwdrivers and wrenches to disassemble, repair or modify the device may cause electric shock, fire or personal injury. For your safety, please do not attempt to perform these operations on your own. If the device needs to be repaired, please contact the dealer or our customer support department and entrust them to perform the corresponding repair work.
7. Before you start operating the device, make sure nothing is placed on it to prevent it from mixing with the merchandise being processed by the device and causing contamination accidents. Placing objects in the device may result in dangerous situations such as electric shock, fire or personal injury.
8. Before performing maintenance or inspection on the equipment, be sure to cut off the power supply and wait for at least 5 minutes. This is to ensure that the charge inside the electrical components is eliminated to prevent the risk of electric shock. Please keep this safe operation step in mind to protect your personal safety.
9. Please strictly follow the maintenance and inspection steps clearly listed in the user manual, and do not perform other unauthorized or unspecified maintenance. This is to avoid potential risks of electric shock, fire or personal injury. As a professional, please follow the prescribed procedures and guidelines to ensure safety.
10. Do not turn off the main power switch during operation unless an emergency occurs. Turning off the main power switch of the device may result in the deletion of configuration data and statistics. Please operate with caution and ensure that necessary operations are performed within the appropriate maintenance window to avoid data loss and system failure.

1.3 Working environment

Do not use the X-ray foreign body detector in the following environments to avoid equipment instability or even damage:

1. Where there is severe vibration on the ground or close to the vibration source.
2. In an environment where the temperature is below -10°C or above 40°C, or the humidity is greater than 85%.
3. Power supply with voltage fluctuation greater than 10%.
4. In an environment where volatile fuels, corrosive gases or dust exist.

1.4 Safety protection in use

1. The equipment is non-explosion-proof. External impact must be avoided during installation and use.
- 2.. The equipment uses thickened steel plate shielding and protective curtains to ensure radiation safety. During the operation of the equipment, it is strictly forbidden to put your hands or other parts of your body into the shielding curtain of the X-ray detection machine, and it is forbidden to open the equipment casing.



3. There is an emergency stop button in front of the equipment to deal with sudden emergencies and stop the equipment operation immediately.

2

INTERACTIVE INTERFACE INTRODUCTION

2.1 Permissions

Compared with administrators (maintenance engineers), technical operators do not have the authority to log out to the desktop, delete products, or modify parameters.

2.2 First Interface



The first interface is the software startup interface, which is the preparation interface before starting to run. Click "Start" to jump to the second interface. "Login" is used to log in to the administrator mode.

Label ①: Software exit area, including one-key shutdown and exit buttons. After one-key shutdown, the host and backend will be shut down. After about one minute, the host power can be cut off by rotating the switch. The exit button is to exit the software and return to the system desktop, but it will only appear after logging in as the admin administrator.

Label ②: Visualize the X-ray warm-up progress and detector calibration progress. When the device has not been turned on for more than three days, the software will automatically warm up the X-rays when it is turned on again. Otherwise, no warm-up is required and the progress is 100%. The longer the device is not turned on, the longer the X-ray warm-up time is, which is usually controlled within 50 minutes. Under normal circumstances, the detector needs to be



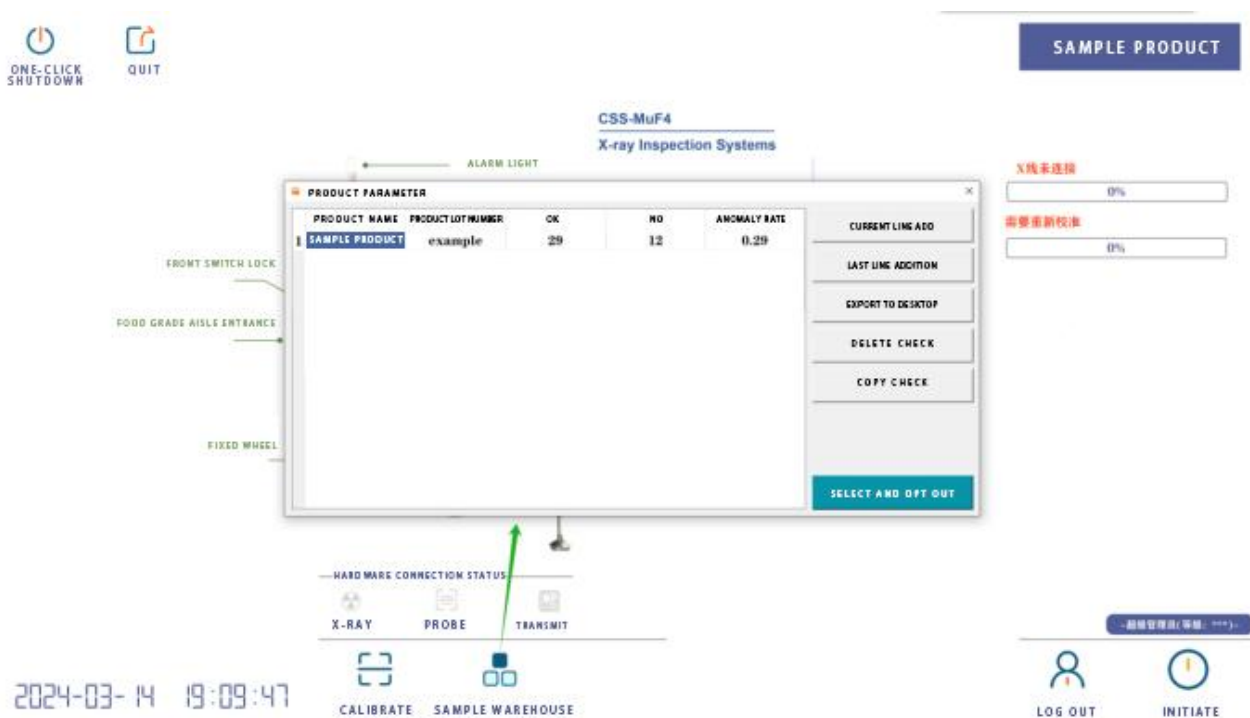
calibrated once after each startup. Click the "Calibrate" button to calibrate. The detector calibration progress can be viewed through the progress bar. When the detector calibration progress reaches 100%, you can start the software.

Label ③: Check whether the hardware (X-ray, detector, transmission controller) are connected normally. Normal connection is gray, abnormal connection is blue.

2.3 Product Selection



Click the Inspection Library button on the first interface . The product selection interface will be opened. The inspection library can store more than 1,000 product information. Select the product to be tested (or produced), click the Select and Exit button , the selected product can be loaded. All parameters of the currently selected product can be adjusted in the third interface.



**Other button descriptions:**

CURRENT LINE ADD

: Adds a new product at the position of the currently selected row.

LAST LINE ADDITION

: Add a new product at the end of the table.

EXPORT TO DESKTOP

: Convert the report to Excel format and save it to your desktop.

DELETE CHECK

: Delete the currently selected product.

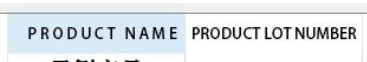
COPY CHECK

: Create a new product and copy all parameters of the currently selected product. All parameters of the two will remain the same.

Additional notes:

1) When the software is opened, the last produced product will be selected by default.

2)  The Delete Selected button will only appear after logging in with admin privileges.

3)  Product name and product batch number are required when creating a product for the first time. By default, only letters and numbers are supported.

2.4 Second Interface

The second interface is the main operation interface during the production process.



Label ①: Real-time display interface. When a product passes through the X-ray machine, the image will be displayed in the current area.

Label ②: Thumbnails of recent abnormal products are stored. Click to zoom in to view ①.



Label ③: The hardware status of the device during operation, including light source, detector, transmission and



algorithm. **ACTIVATE** After clicking the button, red means normal and gray means abnormal.

Label ④: Real-time status of other parameters of the equipment during operation, which can be used for equipment maintenance, status monitoring and unknown error assessment.

Label ⑤: Three-dimensional visualization area of product features. Mainly used to evaluate the detection accuracy and complexity of the current product. It should be noted that **Cull mode:**  the current module will only be enabled when the culling mode is set to 1, otherwise the resource overhead will be large. The culling mode will be further explained later.

Other button descriptions:

Production mode: ☐

: After checking this option, the transmission will not be stopped even if any unexpected situation occurs (such as partial hardware power failure).

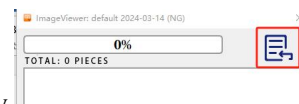
Background storage: ☐

: When checked, the original image will be saved in a RAW file named with today's date. This option is only effective when the Elimination Mode is set to 1. **Cull mode:** 



IMAGE DATA

: Open the anomalous image folder for the day. select the image folder you want to browse.



Click the button in the red box to



ARGUMENT

: Open the third interface.



RETURN TO MAIN SCREEN

: Return to the first interface.



ACTIVATE

: Controls the start and stop of detection.

Detector calibration schedule:

0%

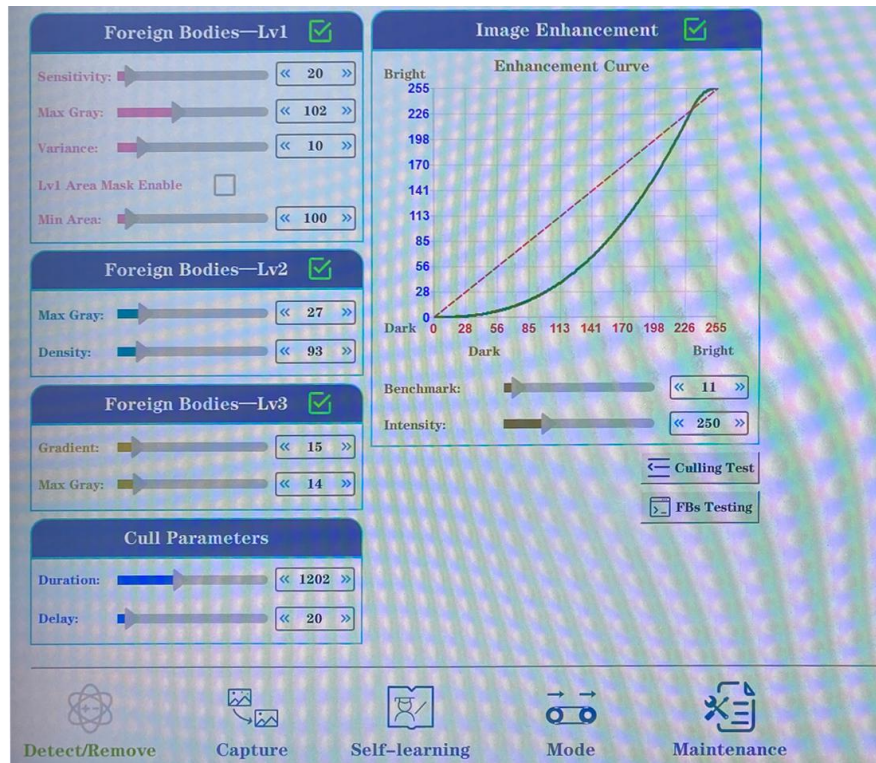
: It is displayed synchronously with ② of the first interface and disappears automatically when the progress reaches 100%.



: Enlarge/reduce the image in the mark ①.

2.5 The third interface

The third interface is the operation interface for adjusting the current product parameters.



Label ①: used to adjust the identification parameters. Among them, there are three detection algorithms for foreign body detection (Lv1 is the shape detection algorithm, Lv2 is the light and dark detection algorithm, and Lv3 is the gradient detection algorithm) to meet different detection needs. Sealing detection and bulk material detection are optional, and packaging foreign body machines do not have this function.

Label ②: Function option bar, click to switch to different pages.

Label ③: Test window. The image in the current window will be synchronized with the image in the second interface label ①. At the same time, you can also manually select through the "Foreign Object Test" button.  Slide the progress bar in the identification parameter to automatically display the detection effect of the current parameter in the test window.

Label ④: Restore default settings: Restore all parameters of the current product to the default parameters. Save as default parameters: Reset the default parameters with the current parameters.



Identification parameters: used to control the detection accuracy of foreign objects

Foreign body detection—Lv1:

Sensitivity level: The larger the value, the stricter the foreign body judgment; the smaller the value, the looser the foreign body judgment.

Maximum grayscale: The grayscale of the target must be less than this value to be detected.

Maximum shade: The deviation between the center and the surrounding of the target is greater than this value to be detected.

Whether to open Lv1 area shielding: After checking, targets with less than the minimum area will be shielded.

Minimum area: The limit of Lv1 area shielding.

Foreign body detection—Lv2:

Attenuation level: Only foreign objects with a grayscale lower than this value will be detected.

Density: Only foreign objects with an area larger than this value will be detected.

Foreign body detection—Lv3:

Decision level: Only foreign objects with grayscale less than this value will be detected.

Attenuation level: Only foreign objects with gradient greater than this value will be detected.

Note: All parameters of foreign object detection can be automatically set by the self-learning function.



: Manually import test images



Image parameters: used to control the acquisition process of product images.

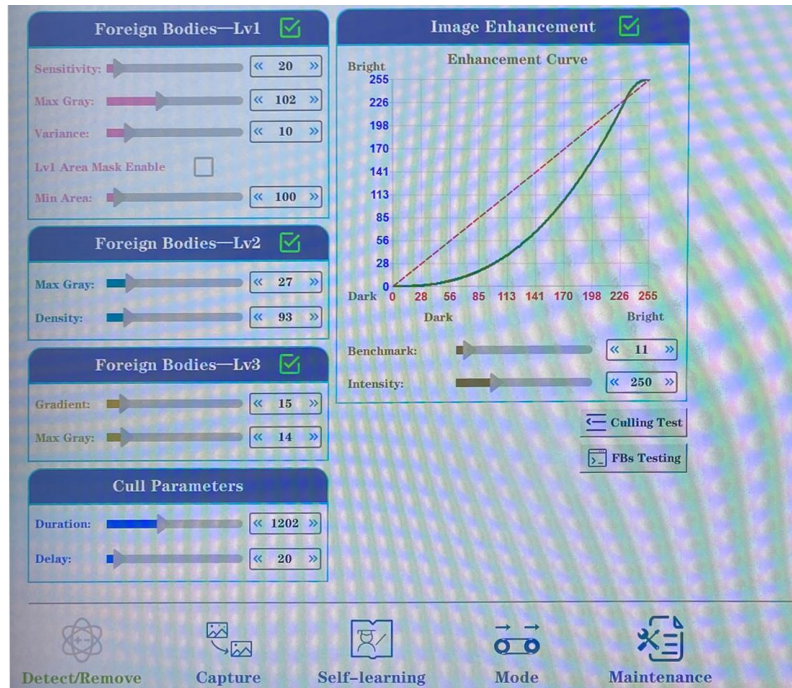


Image emphasis: used to adjust the brightness of the image. Non-administrators should debug with caution.



: Click to enable image emphasis.

Emphasis Baseline: Used to control the emphasis base of the image.

Emphasis Strength: Used to control the degree of emphasis on the image. The greater the value, the greater the image contrast.

Image capture parameters: used to control the original image acquisition process.

Enable partial zoom: The image will be magnified, unchecked by default.

Acquisition test: Click and wait for a while, the image of the current parameters will appear in the test window. Generally used for development and maintenance.

Segmentation threshold: The threshold for local magnification. The larger the threshold, the higher the image magnification.

Enlarge the margin: The larger the white margin of the local enlargement, the more white margin will remain.

Front/Back Frames: Used to control the left and right white margins of the current image during acquisition. Except for the seal inspection machine, the default is 1.

Background determination: The grayscale threshold of the image when a product exists. If the grayscale is less than this value, it is considered that the product has passed.

Single frame columns: The number of columns for collecting one frame of data.

Raw Stretch: Used to control the contrast of the sensor's raw data.

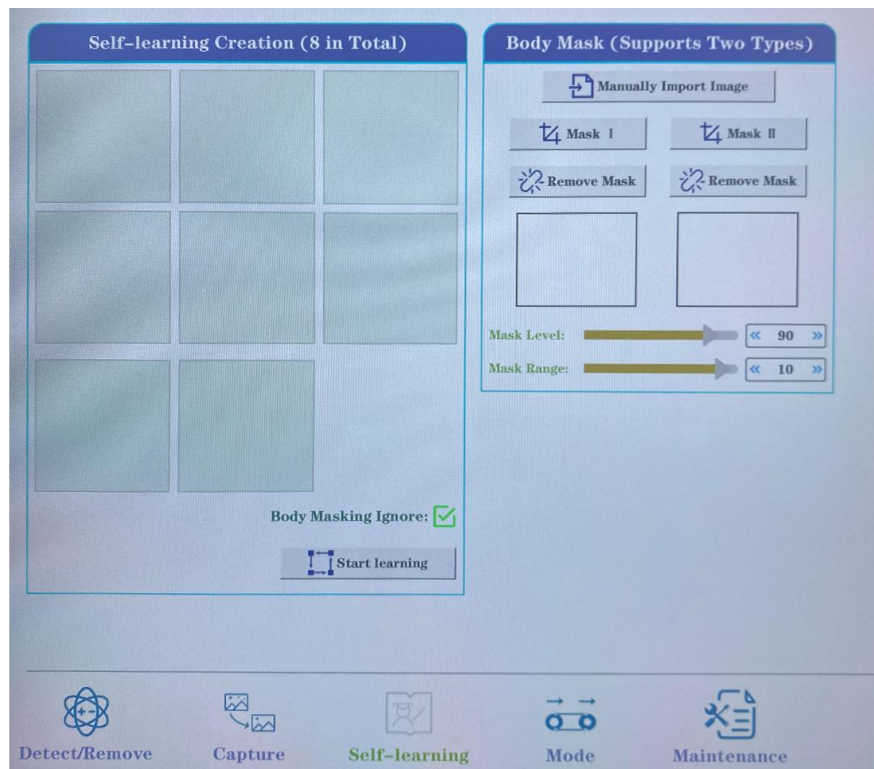


Width limitation: When the image width is less than this value, no image is formed to eliminate possible anomalies on the channel or belt.

Integration time: The exposure time of the detector must be correctly matched to the transmission speed.

Image trimming: The upper and lower parts of the acquired image are trimmed to solve the problem that the two ends of the detector are not irradiated by the rays.

Image capture mode: the image display mode, which changes automatically according to the rejection mode.



Self-learning:

Self-learning task creation: When the device is calibrated, it will light up. Click this button and the device will start. You can place various situations of the current product (different shapes, overlapping packages, wrinkles, etc.) at will. It will stop automatically after learning 8 times. The shielding learning function of the main body is turned on by default to prevent the machine from mistakenly learning the area that needs to be shielded.



: Used to remove the entity that currently needs to be shielded.

Shielding level:Shielding level: used to judge the morphological similarity between the main body and the anomaly. The smaller the level, the stricter the judgment between the two.

Shielding range: It is used to judge the area similarity between the entity and the anomaly. The smaller it is, the stricter the judgment between the two.



Hardware configuration: Set various hardware-related parameters.

Elimination parameters:

Action duration: How long the removal action lasts before it is reset. The unit is milliseconds.

Rejection delay: The delay from finding an exception to starting to reject. Unit: milliseconds.

Time alignment: used to solve the problem of inaccurate elimination caused by time deviation of algorithms or sampling. The default value is 20. If there is no special need, non-professionals should not adjust it.

Rejection mode: see software for description. The mode with the word "bulk" is used for small products to pass through in piles, and the mode without the word "bulk" is used for single pieces to pass through. Most standard machines use modes 1, 2, and 8, and others require special scenarios and hardware configurations.



: Click the button to test the hardware culling effect.

X-ray tube voltage (kV):

Tube voltage: adjusts the energy value of the X-ray. When the product is thick, the recommended voltage is 55~65kV. When the product is thin, the recommended voltage is 40kV. It should be noted that the tube current does not have an open interface in the CSS series software and can be adjusted dynamically during operation. For specific adjustment strategies, please refer to the following table:

产品厚度	管电压	管电流							
		2.0mA	3.0mA	4.0mA	5.0mA	6.0mA	7.0mA	8.0mA	
< 5mm	30kV								8.0
薄	35kV								8.0
↑	40kV								8.0
	45kV								7.7
	50kV								7.0
50mm	55kV								6.3
↓	60kV								5.8
	65kV								5.3
	70kV								5.0
厚	75kV								4.6
100mm	80kV								4.0

Conveyor:

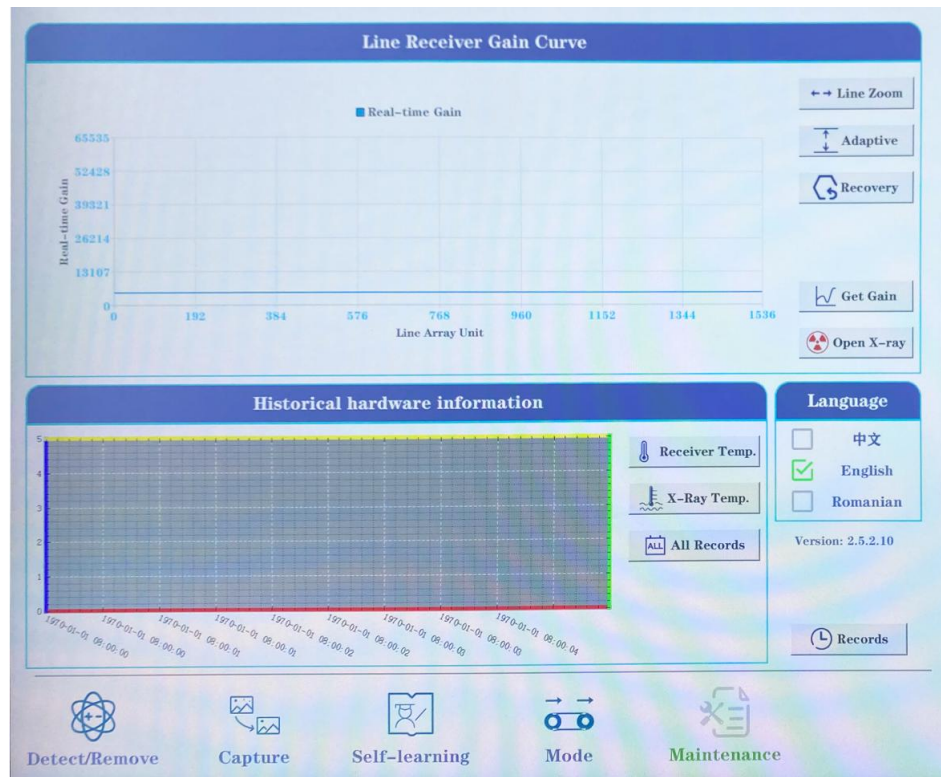
Transmission speed: Control the transmission speed. The default setting for standard machine is 4000mm/min. If you want to change it, you need to synchronize it with the integral time.

Transmission ratio: Control the motor transmission of the conveyor belt.

Direction: Control the running direction of the conveyor belt.



Bulk material hardware parameters: Exclusive to bulk material machine, not open to packaging machine.



Maintenance:

Detector gain curve:

Read Gain: Read the detector response data and display it in the window.

X-ray On: Used to turn X-ray on and off to view the detector offset and gain values respectively.

Horizontal Axis Zoom: Increase the spacing of the horizontal axis.

Adaptive Adjustment: Adaptively adjust the vertical axis response.

Restore: Restore the initial coordinate position of the window.

Historical hardware statistics:

Historical detector temperature: Click to view the detector temperature curve for the last three days.

Historical ray temperature: Click to view the ray temperature curve for the last three days.

All historical records: Click to select a file in the history and visualize it (create a data file for three days).

Language selection: switch between Chinese and English, additional dependent components need to be customized and selected.

History View: Click to switch to the second history maintenance interface, as shown in the figure below. Click the icon in the red box to update the software usage history, ray usage history and total X-Ray irradiation time. Press the "Exit History" button to exit the history maintenance page. : **Error history** is used to refresh the log interface.



3. INTRODUCTION TO THE MAIN OPERATION PROCESS

3.1 when the product has been entered earlier

The software automatically opens after booting

Initializing: High-precision X-Ray Machine for Foreign Bodies...

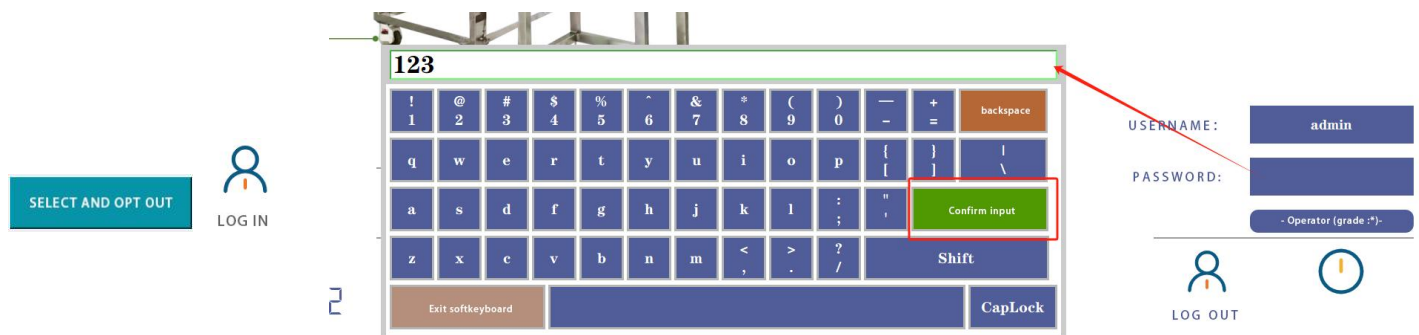
Method 1: After the software is started, it will automatically switch to the inspection product selected before the last shutdown -> click Calibrate -> click Start -> click Start

Method 2: Click on the inspection library -> click on the product you want to inspect -> click on Select and Exit -> click on Calibrate -> click on Start -> click on Start

3.2 When the product is a new category

-->Click on the inspection library->Click on the last row to add->Double-click on the column where the product name is located and enter the product name->Double-click on the column where the product batch number is located and enter the product batch number

->Click to select and exit->Log in as a secondary administrator (user name: worker password: 000, then press Enter on the keyboard)





3.3 Self-learning function

This function needs to be enabled when the default parameter false detection rate is high or there are objects such as desiccants and aluminum buckles that need to be shielded.

->Click on the inspection library->Click on the product you want to inspect->Click to select and exit->Click to calibrate

->Log in as administrator (user name: admin, password: 123, then press Enter on the keyboard)

->Click Start->Click Parameters



INITIATE



ARGUMENT

->Click on self-learning->Check the box to enable the main unit shielding learning->Click to start self-learning (it will stop automatically after 8 learnings, and the software will automatically calculate the algorithm parameters)

Self-learning task creation (8 times in total)

Ontology mask learning enable: ☒

Priming self-learning



->After clicking Close, click Start



HOLD AND RETURN



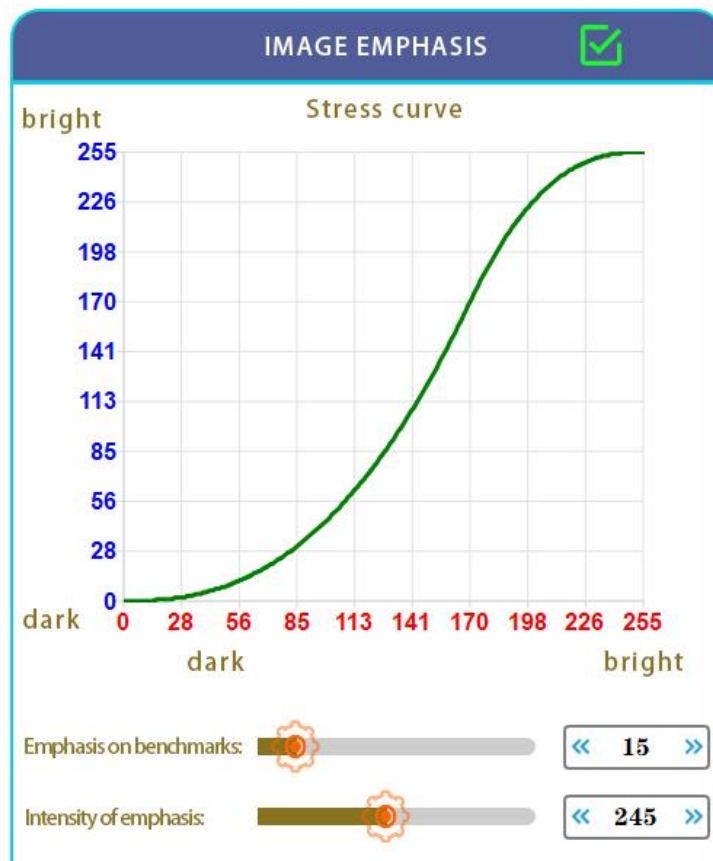
ACTIVATE

3.4 Image Emphasis

->Log in as a secondary administrator (user name: admin password: 123, then press the Enter key on the keyboard)

->Click Start->Click Parameters

->Click Image Parameters->Check Enable Enhancement->Adjust the sliders for Emphasis Base and Emphasis Intensity until the contrast between the foreign object and the image is at its maximum.



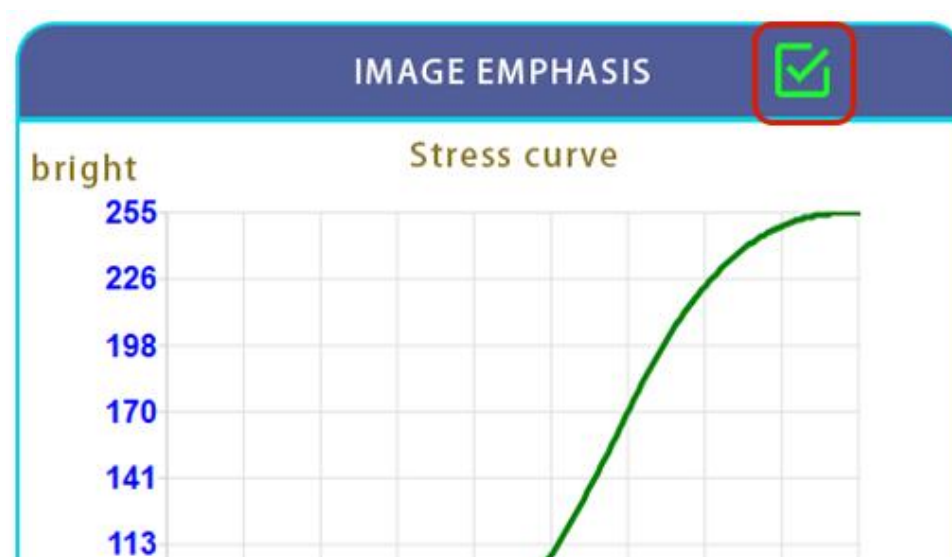
3.5 Maintenance Guide

When clicking Calibration or Start does not work, the solution is: Check whether the light source, detector, and transmission on the main interface are connected normally (normal connection is gray, abnormal connection is blue).



2. Solution when the image is oversaturated or too dark after successful calibration and startup:

-> First check whether the enhancement function is turned on. If it is turned on, turn it off.->



->If the first step does not work, click Image Parameters and adjust the image stretch factor to around 42500.



Image capture parameter

Local emission energy: ☐ Acquisition test

Segmentation threshold: << 54 >>

Enlarge the residual edge: << 20 >>

Number of front frames: << 1 >>

Number of rear frames: << 1 >>

Background decision: << 208 >>

Number of columns per frame: << 32 >>

Original stretch: << 64100 >>

Width limit: << 87 >>

2. Solution when the image suddenly stops appearing during use:

-> First check whether the light source, detector, transmission, and algorithm are all normal (red means normal after startup, gray means abnormal)

Real-time state

CPU usage: 5.8 %

Memory usage: 11.2 %

Tube voltage: 0 kV

Tube current: 0 mA

Detector temperature: 0 °C

X-ray temperature: 0 °C

Collection time: 0 S

Processing time: 0 S

Elimination calibration: 0 S



->If the first step is normal, check whether the tube current and tube voltage are greater than 0%.



->If the second step is normal, check whether the light source temperature and detector temperature are over-temperature (if it exceeds 52℃, an alarm will be sounded and the machine will be shut down).

Solution when no image is displayed upon startup:

-> Possible situation 1: The two sides of the detector are not irradiated by the radiation, and the image trimming

parameters can be slightly increased. 。

-> Possible situation 2:  The original stretch parameter is too large, please adjust it to about 42500

-> Possible situation 3: There is interference in the transmission channel, and the machine needs to be stopped to clean the belt and channel and recalibrate.

3.6 Turn off the X-ray foreign body detector

1. The technical operator clicks the "One-key shutdown" button to directly shut down the computer or the administrator (maintenance engineer) exits the software and shuts down the computer from the Windows power management in the lower left corner of the computer.
2. Turn off the right safety lock (rotate 90 degrees counterclockwise);
3. Perform safety checks (power supply, etc.).

4. PERMISSION MANAGEMENT

Each CSS series software relies on a super dog alone. The software can only work properly when the super dog is correctly plugged into the USB port.



5. QUALITY ASSURANCE

1. The guarantee period is eighteen months (consumer goods and travel cost are not included).

2. The main quality warranty maintenance certificate

1. Please keep this guarantee letter, if you lost it, please connect with us in a month.
2. If this guarantee letter has been altered or it has no our stamp, it is useless.

3. The following conditions need to pay reasonably even in the assurance period.

1. Natural reasons
2. Operating mistakes
3. Voltage is not fit for our operation instruction
4. Repack it without our guides
5. Damaged for borrowing to others
6. Damaged for authorized machine modification
7. Damaged for authorized calibration
8. Authorized transshipment mistake
9. Serve for long distance area

4. Notes:

1. Where the original in Guangdong province installation of our products, if the product moved to outside Guangdong-area use, whether or not within the effective warranty period, the transportation and travel expenses of the service personnel should be paid by the client.

2. All customers outside of Guangdong province, whether or not in the warranty period, the service of transportation and travel expenses paid by the customer.