C251-E040A

SHIMADZU
Excellence in Science

Microfocus X-Ray Inspection System

Xslicer SMX-6010

Seamless Fusion of X-Ray Fluoroscopy and Planer CT* Imaging

Xslicer SMX-6010 is a planer X-ray inspection system, featuring a micro-focus X-ray generator and a 3 megapixel flat panel detector.
It delivers high-accuracy images with a wide dynamic range that enable detailed observations of internal structures and defects.
In addition, the system switches smoothly between fluoroscopy and planer CT (PCT), enabling a variety of observations matched to the shape of the sample.
This supports the inspection of samples ranging from electronic parts with improved miniaturization to mounted boards with advances in high-density multilayer design.

*Refer to page 12.

Xslicer™ SMX-6010

Microfocus X-Ray Inspection System

High-Accuracy Imaging

High-accuracy images with a wide dynamic range are obtained thanks to the 3 megapixel flat panel detector and Shimadzu's unique HDR processing.

* HDR: High Dynamic Range

Simple Operation

Start fluoroscopic imaging in just three steps. With the simple UI, imaging can start easily regardless of the operator's experience level. A single button switches between fluoroscopy and PCT. The imaging method can be switched easily to suit the sample.

Versatile, User-Friendly Functions

The system features a Teaching Function and Stepwise Movement, enabling consecutive imaging, as well as functions for a variety of measurements, including BGA measurements and area ratio measurements, resulting in a more efficient inspection process.

Contents

System Configuration

An easy-to-maintain Shimadzu X-ray generator and various safety mechanisms reduce costs and ensure safe use.

X-Ray Generator

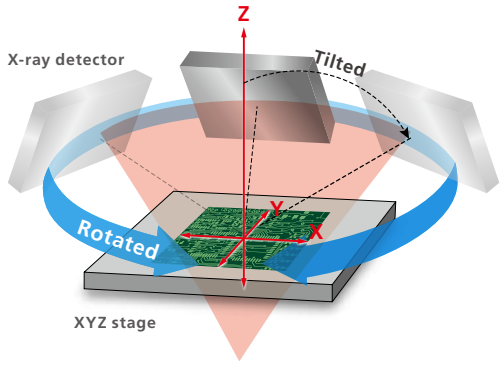
The Xslicer SMX-6010 features a160-kV open tube and can resolve down to 1 micron.
Due to the integrated high-voltage transformer, no greasing is necessary.
The filament replacement process is simplified by automatic adjustments.
Note: 1 µm resolution by JIMA chart analysis.

X-Ray Detector

Equipped with a 3 megapixel flat panel detector.

Five-Axis Stage

In addition to the X, Y, and Z axes of the sample stage,
the detector tilts and rotates.
Five-axis movement supports inspections from any angle.



X-Ray Shield Box

The X-rays are well shielded. (Maximum 1 µSv/h external X-ray leakage)
The front door lock mechanism prevents the front door from opening during X-ray emission.
The interlock mechanism also disables movement of the 5-axis stage when the door is open.

Collision Sensor

A collision sensor is provided around the X-ray detector to stop the Stage in the event of an emergency (a collision with the sample).

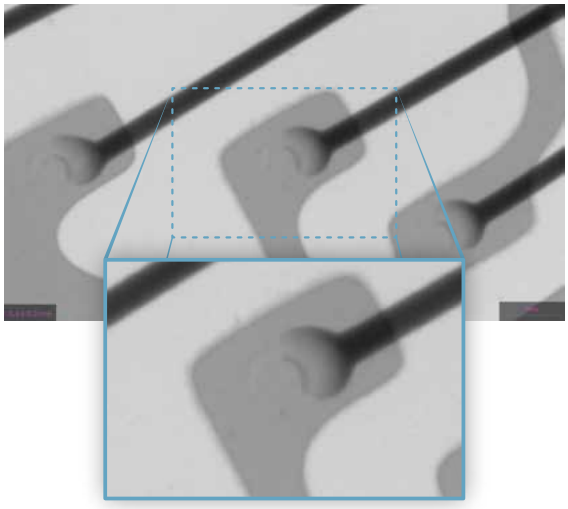
Utilities

System operation requires only the following: 200 V AC ± 10 %, 1.5 kVA (ground resistance 100 Ω max.)
There is no need to provide air or cooling water.

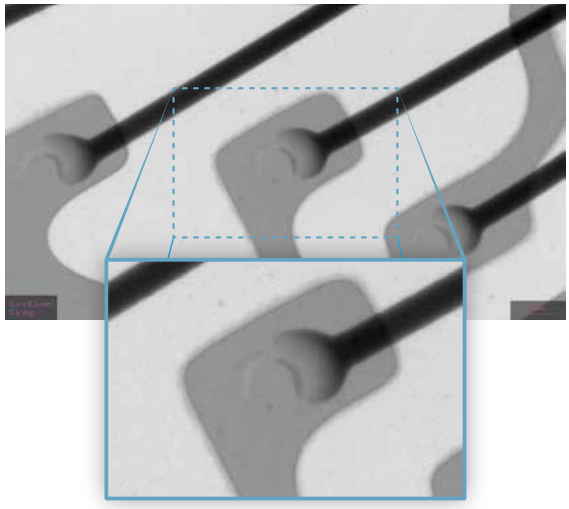
High-Accuracy Imaging

Equipped with a 3 Megapixel Flat Panel Detector

Detailed internal structure and defects can be revealed due to the 3 megapixel flat panel detector (2.3 times larger than previously).



1.30 Megapixel Fluoroscopic Image
(Previous Shimadzu Instrument)



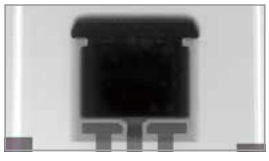
3 Megapixel Fluoroscopic Image

New HDR Processing Function

Shimadzu's unique, proprietary image processing technique/algorithm allows fluoroscopic images with a higher dynamic range, Regions that are both easy and difficult to penetrate can be observed at the same time, which shortens inspection times.

No HDR Processing

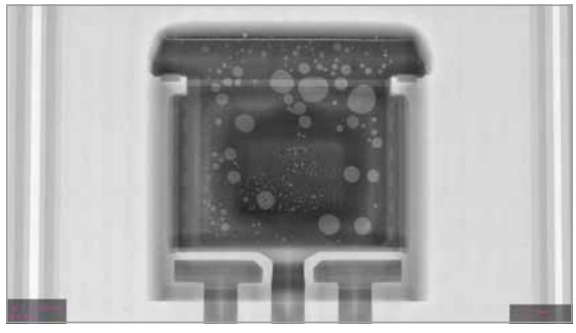
Bright regions are too bright.



Dark regions are too dark.

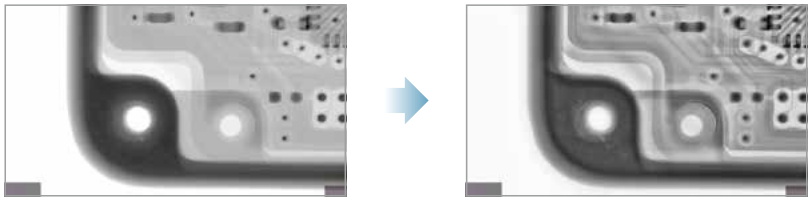
IC

HDR Processing



Both bright and dark regions are displayed with the appropriate contrast.

HDR Processing Application Example (Left: No HDR Processing; Right: HDR Processing)



Sample: Electronic Control Unit

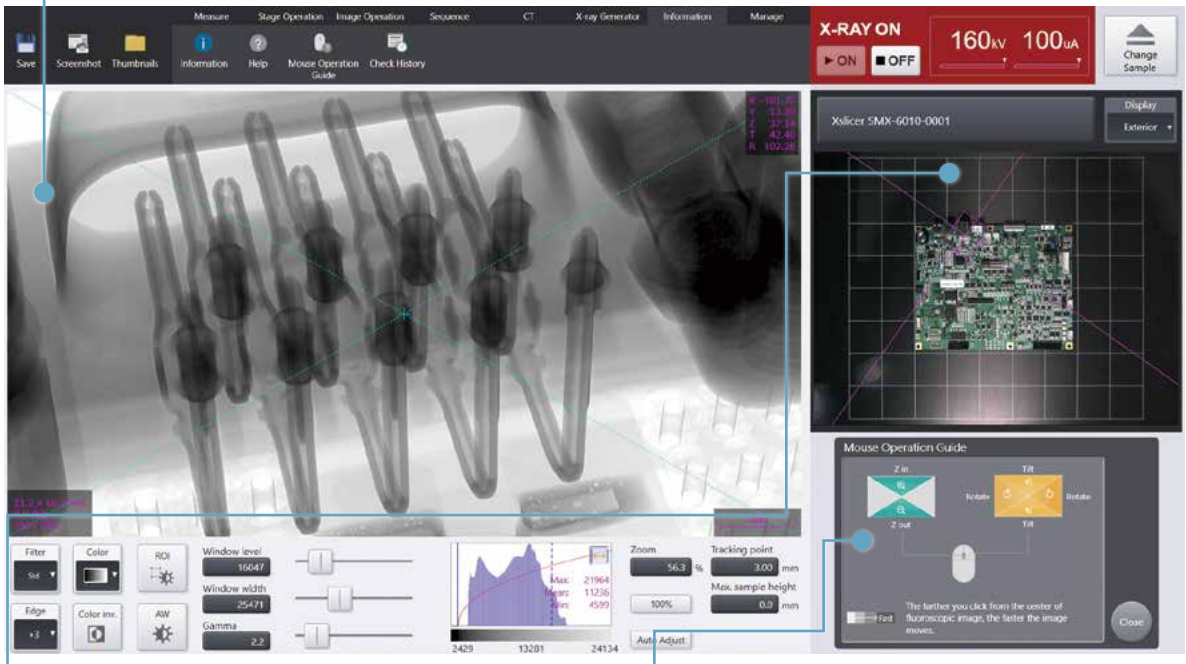
Simple Operation

Imaging in Three Steps

Fluoroscopic imaging in just three steps.
A large monitor screen and simple button layout provide excellent visibility for intuitive operation.
X-ray inspections are easy to perform, even for operators using the system for the first time.

Stage Positioning via the Live X-ray Image

Simply click on any position in the X-ray image to control all stage movements, such as changing the XY position, tilt, rotation, or field-of-view size.



Using Exterior Images for Stage Positioning

An observation camera provides a top-down view of the entire sample region. The user can alter the position of the sample using this top-down view. Just select a point of interest in the top-down view to accordingly move the stage. The image can be magnified to allow for fine positioning over individual components.

Positioning with a Mouse

All stage and manipulator positioning can be controlled using the mouse, allowing the operator to concentrate on examining the image on the monitor.

STEP 1

Change the sample.

Click the sample replacement button.
- X-ray emission stops.
- The stage automatically moves to a position where it is easier to replace the sample.

STEP 2

Start the inspection.

Close the front door and click [Start].
- X-rays are emitted.
- An exterior image of the entire stage area is captured.

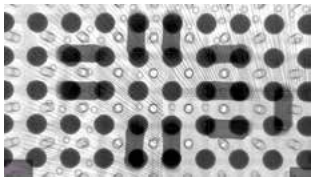
STEP 3

Position the stage.

Click on the exterior image to roughly position the stage. Then click on the 2D X-ray live image to observe a position of interest.

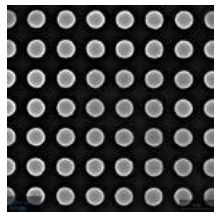
Switch Smoothly between Fluoroscopy and PCT

Switch between fluoroscopy and PCT imaging by simply clicking on the menu tab. X-ray fluoroscopic images are captured and cross-sectional images are created by tilting the flat panel detector and rotating it 360 degrees. There is no need to install a separate unit for PCT imaging.
Simply select the scan mode, scan angle, and scan region to easily configure the CT imaging scan conditions.
A region of interest in the fluoroscopic image can be observed immediately with a PCT scan.



Fluoroscopic Image

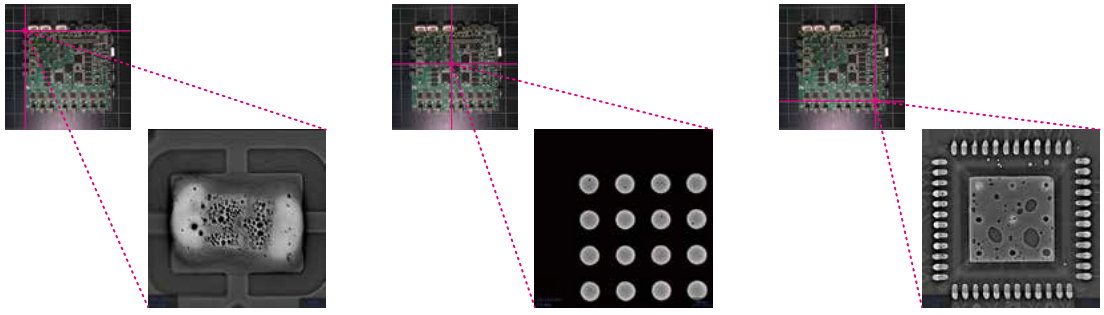
Simply select the imaging conditions ([Simple], [Normal], or [Sharp]) and the imaging angle.



PCT Imaging

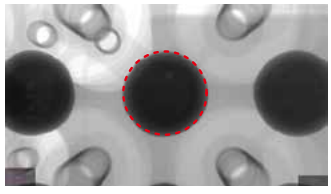
Wide PCT Imaging Range

PCT images can be obtained at any position within a 350 mm × 350 mm area (depending on the tracking point). There is no need to move the sample to the center of the rotary table as in conventional PCT, so the scan can be positioned just by clicking on the scanning site.



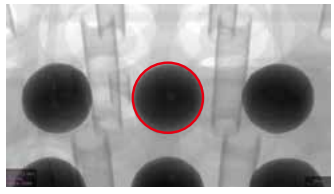
Set Tracking Points Easily

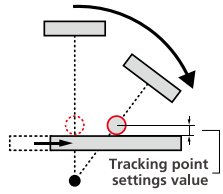
To set a tracking point, simply tilt the detector and double-click the point of interest.
When a tracking point is set, the stage follows the movement of the tilt axis, so the point of interest is never lost.



Not tilted
(The point of interest is marked with a ○.)

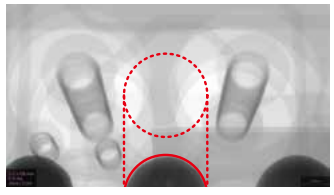
Tilted

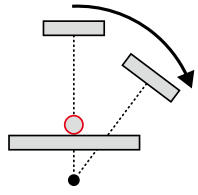




Tracking ON
When tilted, the point of interest never leaves the center of the window because the stage tracks it.

Tilted



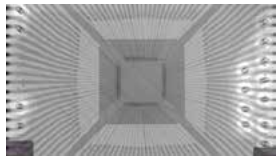


Tracking OFF
When tilted, the point of interest does not remain at the center of the window because the stage does not track it.

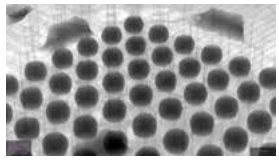
Versatile, User-Friendly Functions

Teaching Function

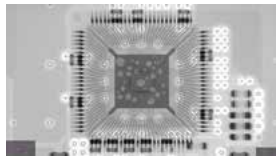
Fluoroscopic and PCT imaging can be automated using the Teaching Function, which moves the sample stage to preregistered points of interest.
Additionally, for visual inspection, OK and NG judgment functions are included.



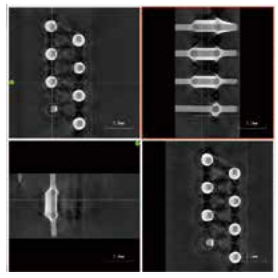
Point 1 (Fluoroscopic imaging)



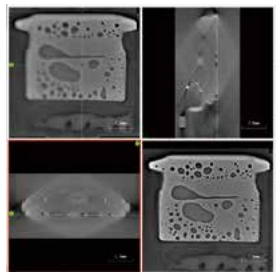
Point 3 (Fluoroscopic imaging)



Point 5 (Fluoroscopic imaging)



Point 2 (PCT imaging)

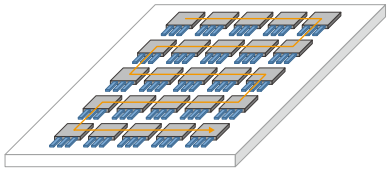


Point 4 (PCT imaging)

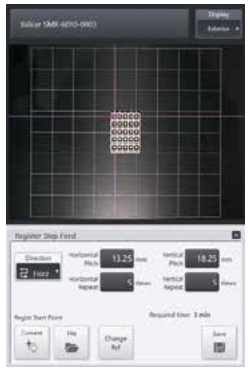
Stepwise Movement

The Stepwise Movement function moves the stage at constant intervals. It specifies the starting position, amount of movement, and number of movements. When this function is used, observations are performed while the stage makes consecutive movements from the starting position in accordance with the settings. Consecutive fluoroscopic or PCT scans can be performed of samples arranged at set intervals.

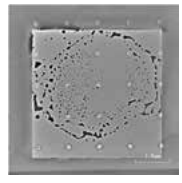
Example of Consecutive PCT Images of 25 Samples Aligned on a Pallet



ICs Aligned on a Pallet



Continuous PCT scan possible (e.g., 25 scans)



Cross-Sectional Image

Determination Results

Exterior Image

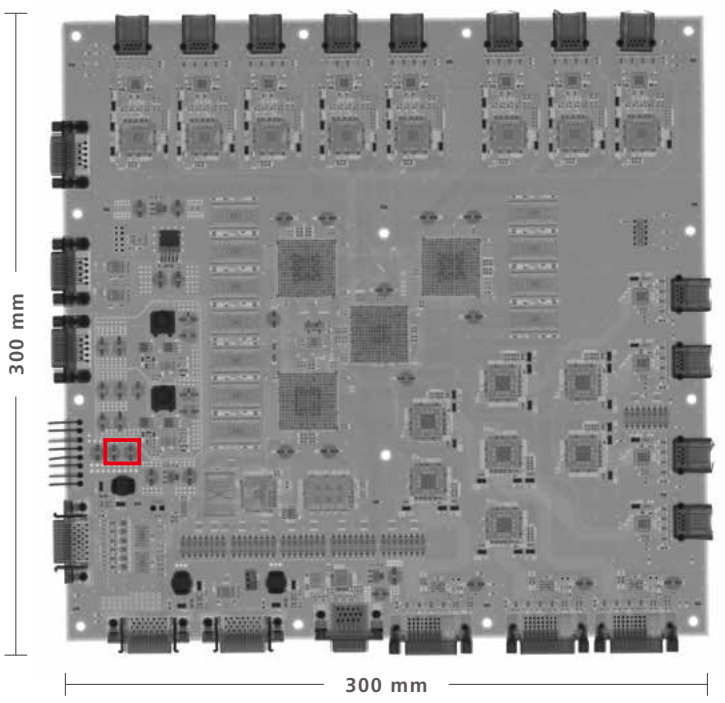
A list of the determination results is displayed when all the configured points have been inspected.

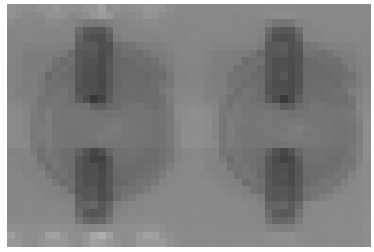
□ : Pass ■ : Fail ■ : Defer

Selective measures can be performed after inspecting the results.

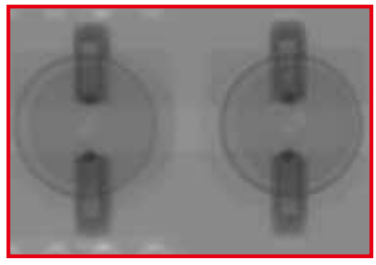
Panoramic Imaging Function

A wide-range fluoroscopic image can be obtained just by specifying the imaging span on the external image. An improved stitching process ensures there are no visible lines in the panoramic image where the individual images are joined. A fluoroscopic image up to 32 megapixels in size can be obtained.





2.23 Megapixel Panoramic Image without Stitching (Partially Enlarged) (Former Model)

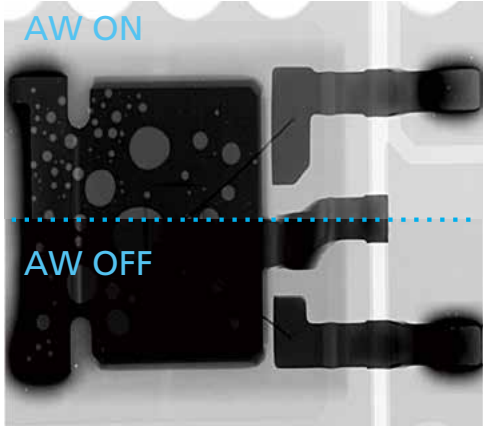


32 Megapixel Panoramic Image with Stitching (Partially Enlarged) (Xslicer SMX-6010)

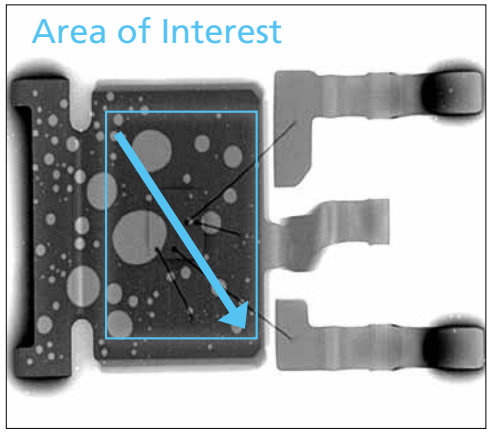
Image Adjustment Functions (Auto Window Function and Region of Interest Function)

The contrast can be automatically optimized to make the area of interest easy to see. Normally, with this sort of optimization function, the part outside the region of interest becomes difficult to see. However, a proprietary image processing algorithm automatically adjusts the image to ensure that the part outside the region of interest remains as easy to see as possible.

Depending on the changing conditions, the optimal window level and window width are specified in real time.



When selecting an area of interest, the window level and window width are optimized for the specified range.



Versatile, User-Friendly Functions

Ball Grid Array (BGA) Measurements

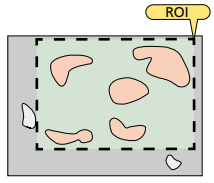
BGA bump diameters and void ratios can be measured.
With our proprietary image processing algorithm, complicated parameter settings are unnecessary.*
Multiple settings can be saved and applicable ones can be accessed for each inspection target prior to measurement.
* Manual adjustments may be required depending on the sample.

(Measurable Items)

- Total void ratio
- Maximum void ratio
- Bump diameter
- Bump roundness

Area Ratio Measurements

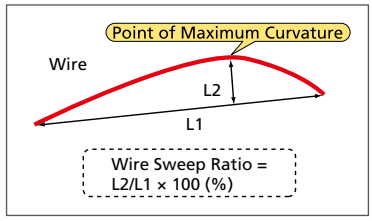
Die bonds, solder paste wettability, and other area ratios can be measured.
The parameter settings are not required thanks to Shimadzu's proprietary image processing algorithm.*
It is also possible to save multiple settings, and then call up the applicable settings for each inspection target prior to measurement. Furthermore, pass/fail determinations can be made based on the area ratio.
* Manual adjustments may be required depending on the sample.
* The measurement range (ROI) can be configured manually.
* The image below shows an example of an area ratio measurement using PCT imaging.

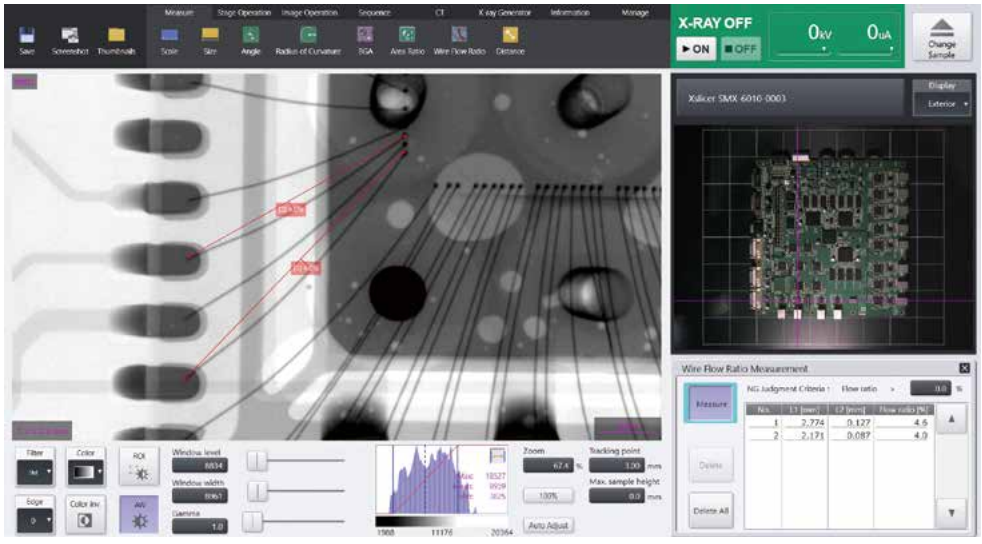


Static Image

Wire Sweep Ratio Measurements

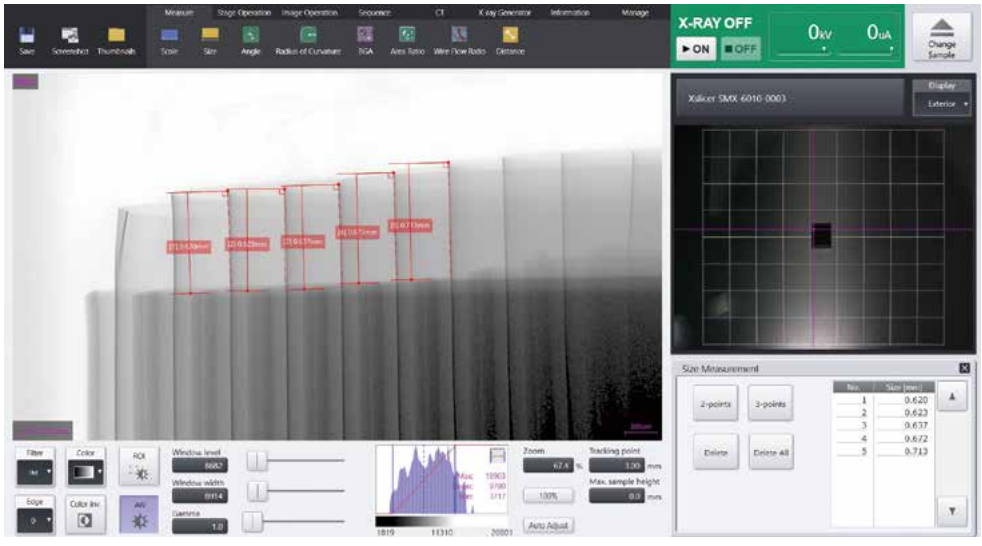
The wire sweep ratio can be measured by specifying both ends of the bonding wire and the point of maximum curvature. Pass/fail determinations can be made depending on the wire sweep ratio.





Dimension Measurements

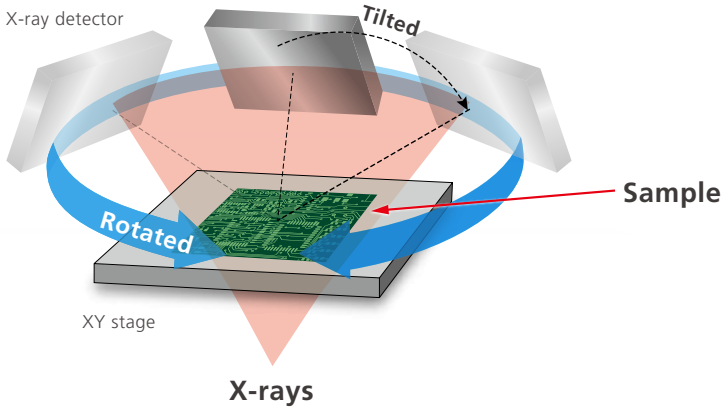
The Xslicer SMX-6010 supports both 2-point distance and 3-point measurements.
With this system, sizes are measured efficiently by calculating calibration data internally in synchronization with the fluoroscopic magnification.



Types and Features of CT Imaging

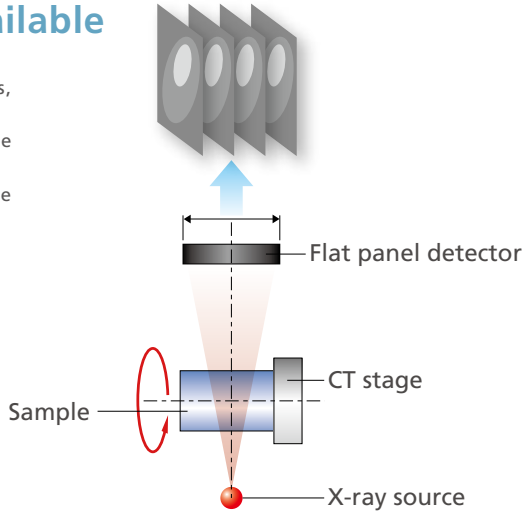
Planer CT (PCT): Included as standard

CT imaging is performed by tilting the X-ray detector to a certain inclination, rotating it, and then capturing fluoroscopic images. The sample on the XY stage can approach the X-ray generator, so enlarged PCT images can be captured regardless of the sample width.



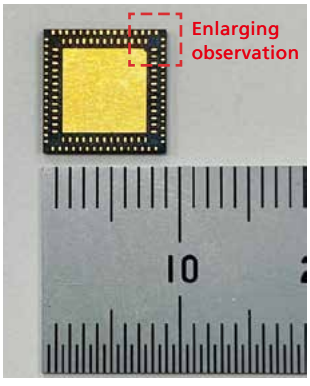
Vertical CT (VCT): Optionally available

CT imaging is performed by fastening the X-ray detector upwards, rotating the sample, and capturing fluoroscopic images.
Enlargement depends on the width of the sample, but images can be captured vertically with respect to the X-ray emission direction.
VCT images can be captured simply by placing the CT unit on the fluoroscopic stage, and switching the software tab.

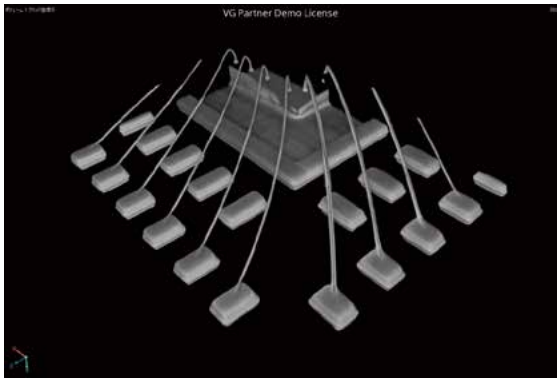


Main Specifications

Size	PCB: 100 × 150 mm max. Small sample objects: Dia 50 × 100 mm max. * Even for the sizes listed above, special chucks or other jigs might be needed depending on the size of the sample and the imaging position.
Weight	200 g max.



IC Chip

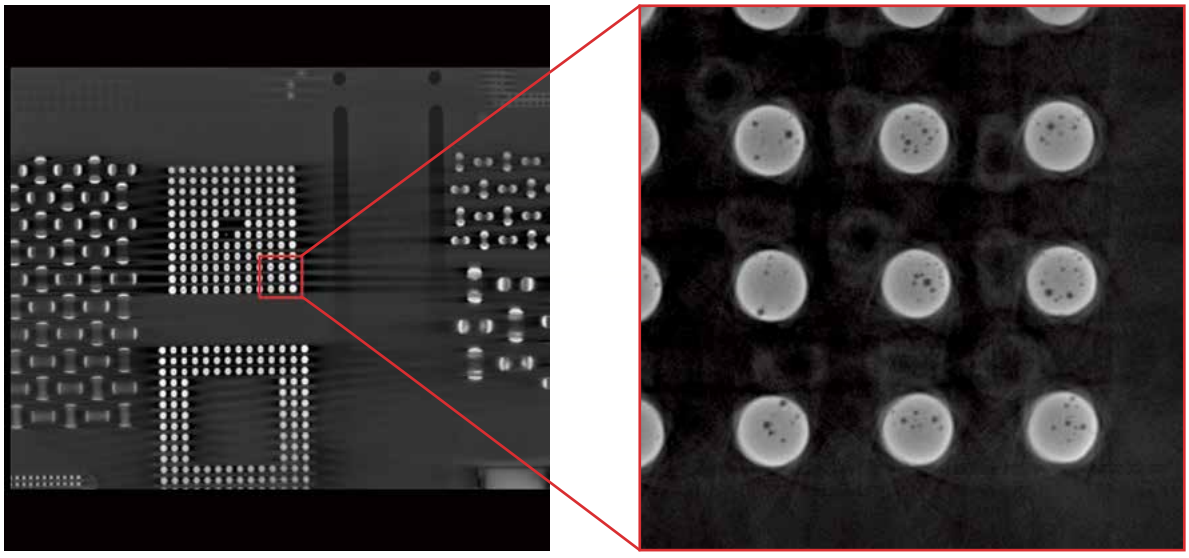


VR Image Scanning Region = 3.6 mm

*Teaching Function and Stepwise Movement are not available when the VCT option is used.

Key Feature of Planer CT (PCT)

High-magnification images can be obtained for samples like circuit boards, unlike with Vertical CT, which is affected by the width of the sample.

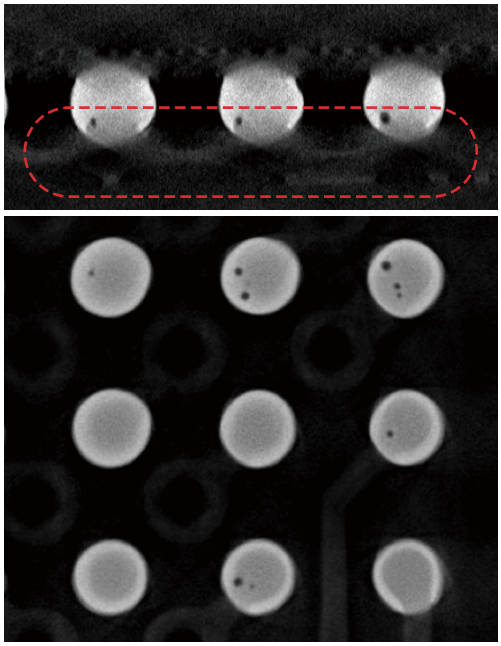


Vertical CT　　Xslicer SMX-6010

Key Feature of Vertical CT (VCT)

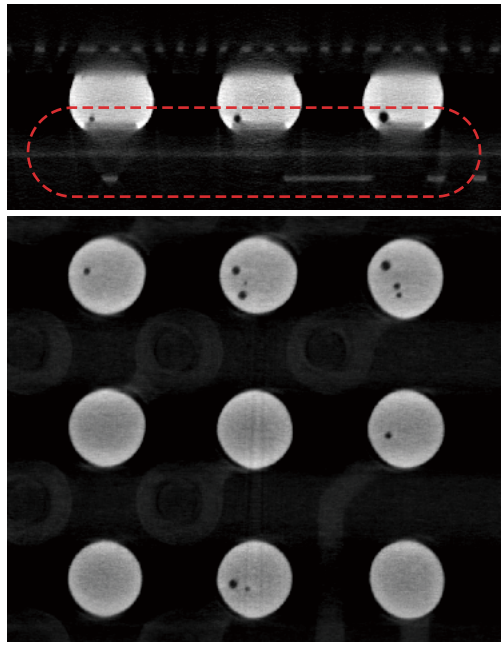
With PCT, image reconstruction is based on the images captured in the direction of tilt, so there is a slight impact on the vertical-section images.
With VCT, images are captured vertically with respect to the X-ray emission direction, enabling clear vertical-section images.

Vertical sections of PCB patterns and BGA will be unclear with PCT.



BGA Captured with PCT (60° imaging angle)

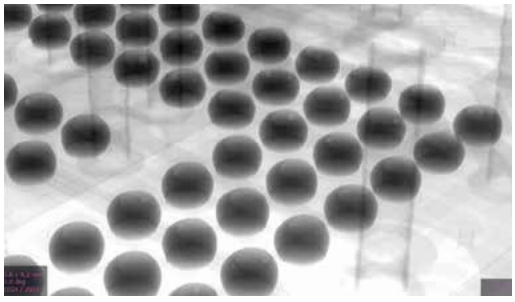
Clear vertical sections of PCB patterns and BGA are captured with VCT.



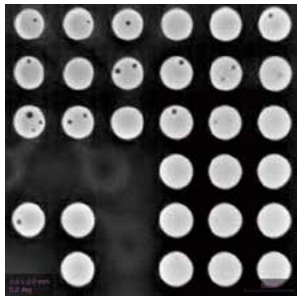
BGA Captured with VCT

Applications

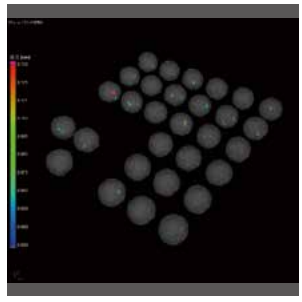
Ball Grid Array



Fluoroscopic Image

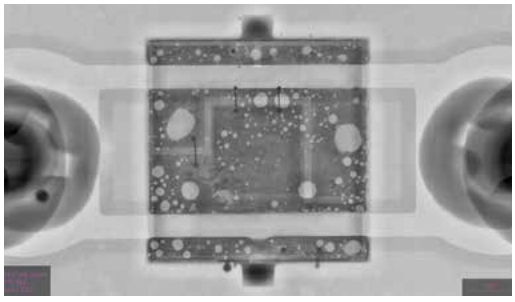


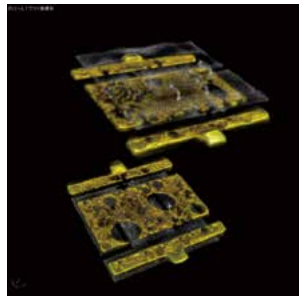
Cross-Sectional Image
Scanning Region = 3 mm
(Imaging with PCT)



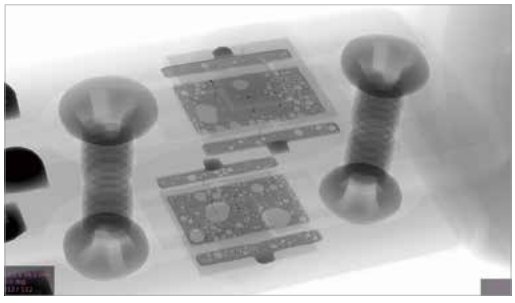
VR Image

Vehicle Mounted LED Lamp





VR Image

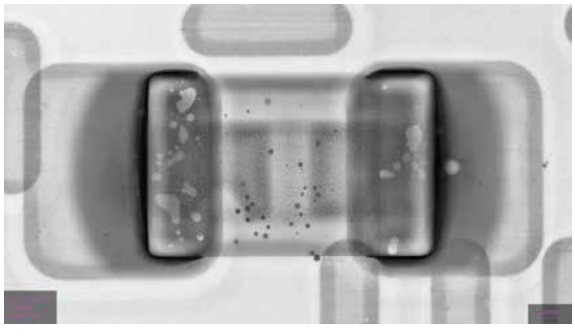


Fluoroscopic Image

Top: Cross-Sectional Image
Scanning Region = 9 mm
Bottom: Area Ratio Measurement
(Imaging with PCT)

Area Ratio
Measurement Results

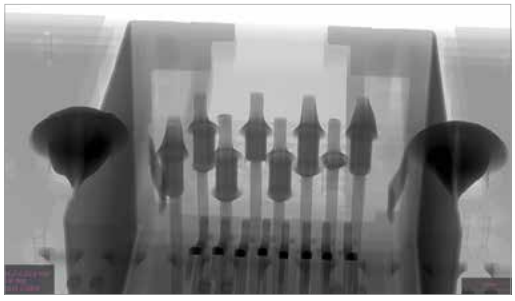
Chip Capacitor



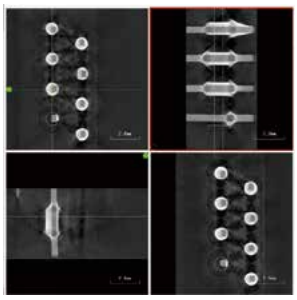
Fluoroscopic Image

Fluoroscopic Image

LAN Connector



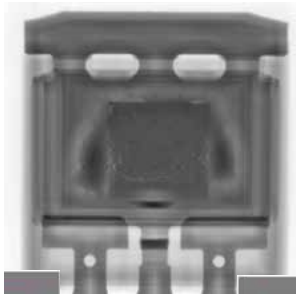
Fluoroscopic Image



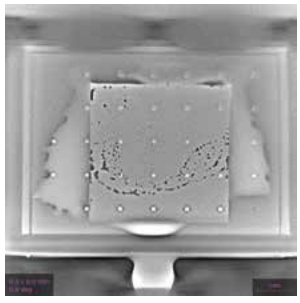
MPR Image Scanning Region = 9.5 mm (Imaging with PCT)

VR Image

Insulated-Gate Bipolar Transistor



Fluoroscopic Image

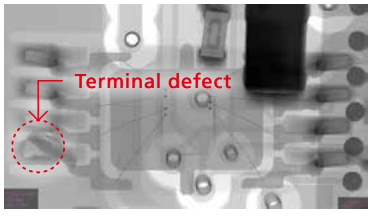


Cross-Sectional Image Scanning Region = 8 mm (Imaging with PCT)

Fluoroscopic Image

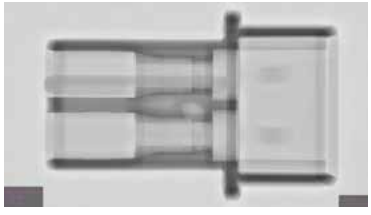
Others

IC with terminal defect



Fluoroscopic Image

Connector



Fluoroscopic Image

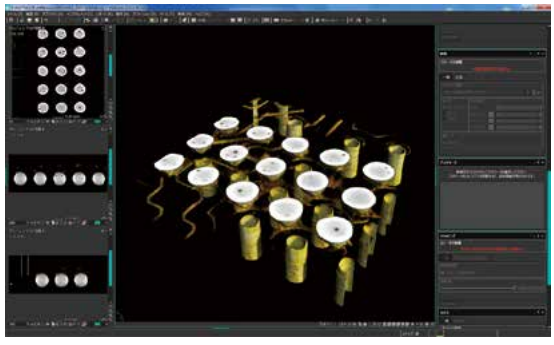
18650 Lithium-Ion Battery

Fluoroscopic Image

Optional Software

VGSTUDIO™ Voxel Analysis and Visualization Software

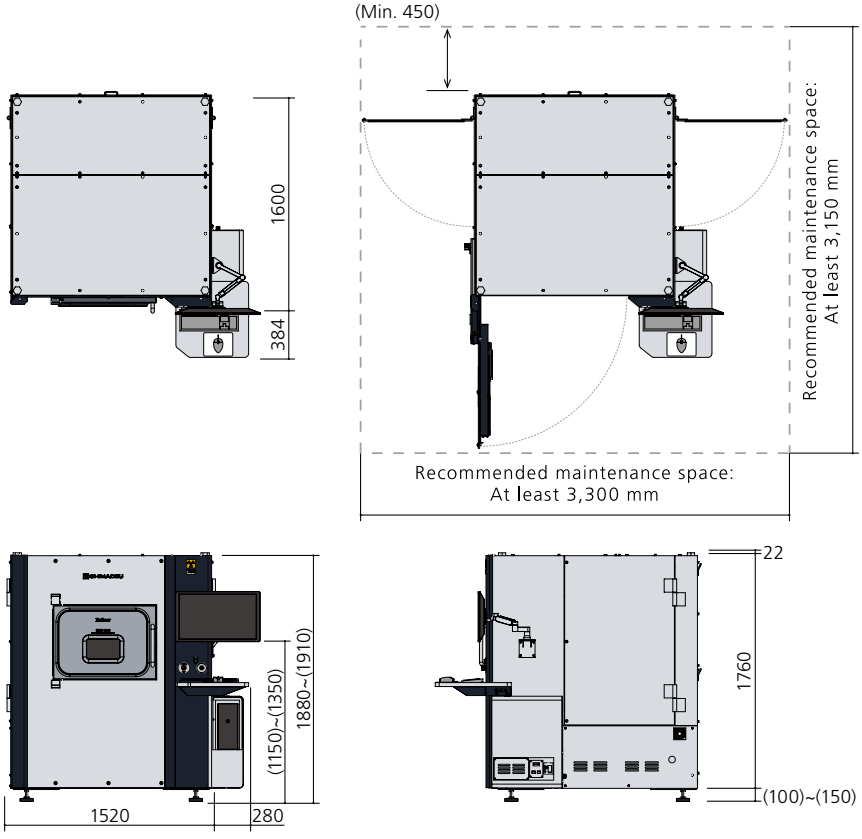
The VGSTUDIO software uses the volume rendering (VR) technique to display three-dimensional images from cross-section images obtained using X-ray CT imaging. It includes functionality for creating basic animation and simple measurements.



Specifications

Model	Xslicer SMX-6010
Spatial Resolution	1 µm (JIMA chart resolution)
Maximum Sample Size	470 × 420 × 100 mm, max. 5 kg
Fluoroscopic Inspection Stroke	X: 460 mm, Y: 410 mm, Z: 100 mm, ±180° rotation, 60° tilt
CT Scan Range	X: 350 mm, Y: 350 mm
Laminographic Angle (CT Scan Angle)	45° or 60°
X-Ray Output	Max. tube voltage: 160 kV, Max. tube current: 100 µA, Rated Output: 16 W
Detector	Flat panel detector
Fluoroscopy FOV (on Carbon Plate)	0.75 mm (vertical) × 1.3 mm (horizontal) to 21 mm (vertical) × 38 mm (horizontal)
CT FOV (on Carbon Plate)	3 to 30 mm (given 45° laminographic angle) / 3 to 14 mm (given 60° laminographic angle)
Power Requirements	200 V AC ± 10 %, 1.5 kVA (ground resistance 100 Ω max.)
Weight	Approx. 2,450 kg
Operating Environment Conditions	Ambient temperature: 15 to 30 °C, Ambient humidity: 35 to 80 % (no condensation)
External Leakage Dose	1 µSv/h max.

Size Layout and Dimensions (units: mm)



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