

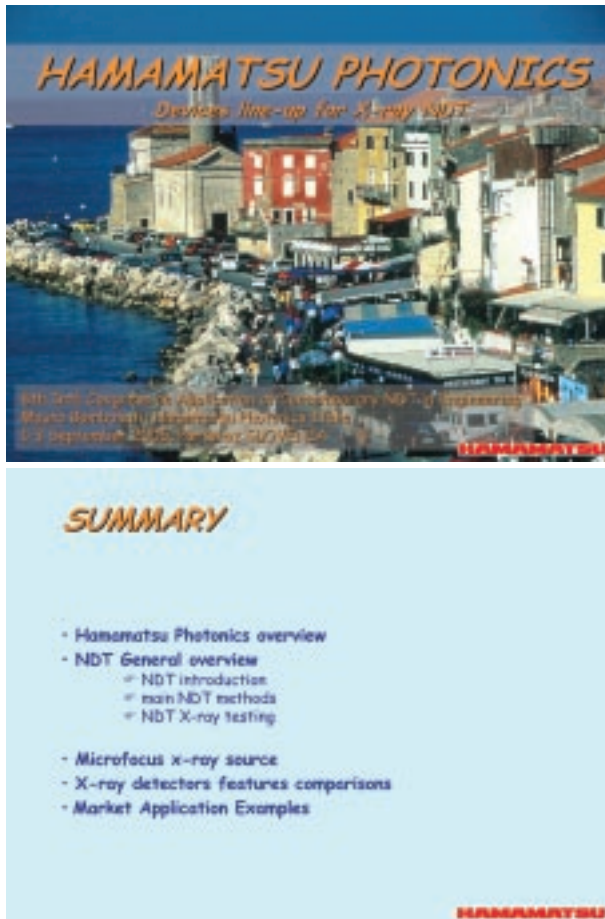
The 8th International Conference of the Slovenian Society for Non-Destructive Testing
"Application of Contemporary Non-Destructive Testing in Engineering"
September 1-3, 2005, Portorož, Slovenia, pp. 461-470

DEVICES LINE-UP FOR X-RAY NDT

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PRESENTATION



The slide features a background image of a coastal town with colorful buildings and a harbor. The title "HAMAMATSU PHOTONICS" is written in large, stylized orange letters at the top, with the subtitle "Devices line-up for X-ray NDT" below it. At the bottom left, there is a small text box containing the conference details: "8th Int. Conf. on Application of Contemporary NDT Engineering", "Marco Bombonati, Hamamatsu Photonics Italia", and "1-3 September 2005, Portorož, Slovenia". The word "HAMAMATSU" is printed in red at the bottom right of the slide.

SUMMARY

- Hamamatsu Photonics overview
- NDT General overview
 - NDT introduction
 - main NDT methods
 - NDT X-ray testing
- Microfocus x-ray source
- X-ray detectors features comparisons
- Market Application Examples

HQ in Hamamatsu City, Japan

Solid State Div. Electron Tube Div.



System Div.



Laser Grp.



Hamamatsu Photonics Italy



NDT general overview

National and International standards for quality require management to establish quality system. As a consequence NDT are important tools for quality control. They are used for:

“setting and controlling manufacturing and assembling processes”
“defecting after same manufacturing and assembling stage of working cycle”

“in service inspection allows to know the defects generated between two successive inspection and their punctual increasing in size”

The correlated NDT methods are chosen according

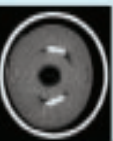
component materials
manufacturing processes
class, shape and dimension of the part
service

General overview: NDT X-ray testing

X-ray testing, such as ultrasonic testing being among the oldest methods, successfully used for every materials (metal or plastic), are likely the most popular. However today radiography is extensively used in many areas due to large improvement made in “radiographic detectors” and in “computed reconstructive tomography”.

In “radiography” X-ray beam diverges from a single source to project a shadowgraph of an object onto a detector. 3-D object elements may overlap making themselves hard to be identified.

In “reconstructive tomography” there is no overlap since the image is computed from several projections. X-ray source and detector are moved around the object and hundreds of X-ray pictures are made. The image had a form of a two dimensional mapping of discrete non-overlapping elements in a single plane of the object.



What is Microfocus ?

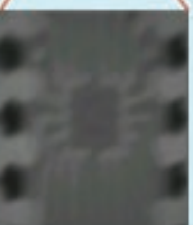
X-ray Pictures with the Sources



Sewing Wipe
15mm dia.



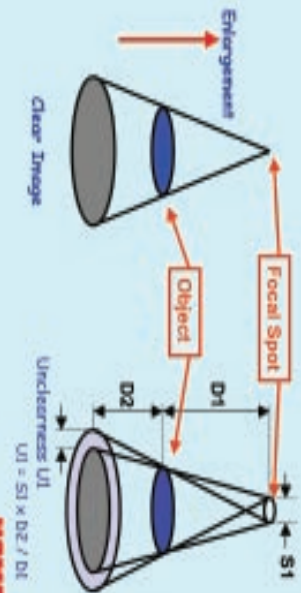
IC Package



With 10mm Focal Spot
MF-X Geometrical Mag. x18

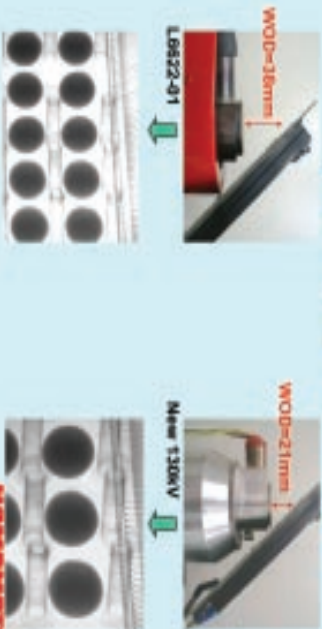
With Conventional X-ray Source
Geometrical Mag. x8

What is Microfocus ? Focal Spot Size and Image



XXXXXXXXXXXXXXXXXXXX

Comparison for Factor of W.O.D L6622-01 v.s New One Object Placing Angle : 45 degree



XXXXXXXXXXXXXXXXXXXX

Conventional Open MFX



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Hamamatsu MFX source examples

L9181 - 130 KV



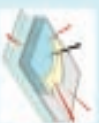
Target Voltage: 40 to 130KV
 Target Current: 0 to 300mA
 Max. Output Power: 37W
 Focal Spot Size: 5mm (4W)
 Min. Distance Focus/Object: 13mm

160KV - L9191

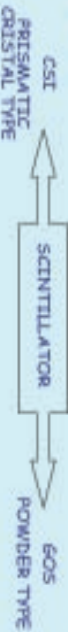


Target Voltage: 20 to 160 KV
 Target Current: 0 to 200 mA
 Max. Output Power: 32 W
 Focal Spot Size: 1 mm
 Min. Distance Focus/Object: 0.5mm

XXXXXXXXXXXXXXX



SCINTILLATOR

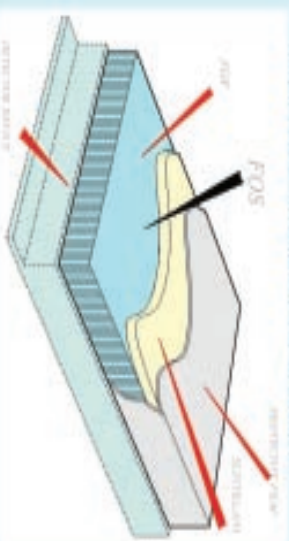


- HIGH RESOLUTION
- SUITABLE ACCORDING WITH THE X-RAY INCIDENT LEVEL, ENERGY
- HIGH RELATIVE LIGHT OUTPUT
- LOW COST
- NOT MUCH HIGROSCOPIC EFFECT
- SCATTERING EFFECT
- NOT SUITABLE ACCORDING WITH THE X-RAY INCIDENT LEVEL, ENERGY
- NOT LOW COST

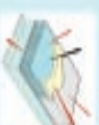
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COMPARISON X-RAY SOLUTIONS

material and resolution

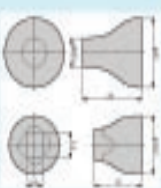


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FOP: Fiber Optical Plate

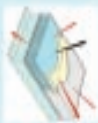
TAPERED FOP
 TECHNICAL SOLUTION FOR ALL CCD CAMERA SERIES
 TAKE A LARGE FIELD OF VIEW AND COLLIMATE IT ON CCD



FIBER STRUCTURE
 The FIBER CORE is smaller than pixel CCD area

STRAIGHT FOP: Field of view / CCD RATIO 1:1
 TAPERED FOP: Field of view / CCD RATIO > 1

XXXXXXXXXXXXXXX



FOF: Scintillator with FOP



XXXXXXXXXXXXXXXXXXXX

X RAY CAMERAS OVERVIEW

CB086 series



| | |
|----------------------|----------------------------|
| Spatial resolution: | 25 - 62 um |
| Field of view: | 8.8 x 6.6 - 32.5 x 24.4 mm |
| Imaging device: | CCD |
| X Ray voltage range: | 10 - 100 kVp |
| Scintillator: | 605 |

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X RAY CAMERAS OVERVIEW

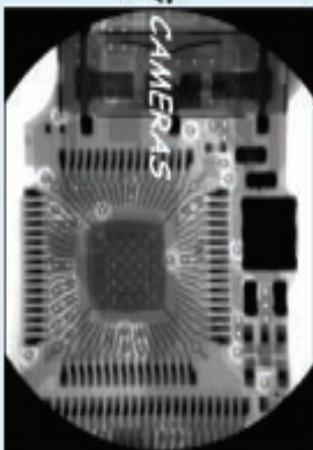
ANALOG

CB086 SERIES

X CUBE

—CB086-301

C2716



XXXXXXXXXXXXXXXXXXXX

X RAY CAMERAS OVERVIEW

X CUBE series



| | |
|----------------------|----------------|
| Spatial resolution: | 8 lp / mm |
| Field of view: | Diameter 25 mm |
| Imaging device: | CCD |
| X Ray voltage range: | 30 - 300 kVp |
| Scintillator: | CSE |



XXXXXXXXXXXXXXXXXXXX

X RAY CAMERAS OVERVIEW

Intensifier with CCD



| | |
|---------------------|----------------------|
| Spatial resolution: | 62 - 89 um |
| Field of view: | 53 x 39 - 33 x 25 mm |
| Imaging device: | CCD |
| Scintillator: | CST |



X RAY CAMERAS OVERVIEW

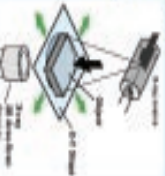
Comparison linear and area scan

LINEAR SENSOR CAMERA



C7390 SERIES
C8133 SERIES

AREA SCAN AREA (CCD)



G6086 SERIES
C7716 II SERIES
X-QUEB SERIES
FLAT PANEL
DIGITAL CCD
CAMERAS

ONLY ONE DIRECTION MOVING

OBJECT TRANSPORTED ON A
BELT CONVEYOR

- WOOD INSPECTION
- FOOD INSPECTION

2 D MOVING

OBJECT ON X Y STAGE

- BGA INSPECTION
- PCB BOARD INSPECTION



DIGITAL CAMERAS

LINEAR SENSOR
CAT742 X DIGITAL
FLAT PANEL



X RAY CAMERAS OVERVIEW

Digital CCD camera series CAT742-55



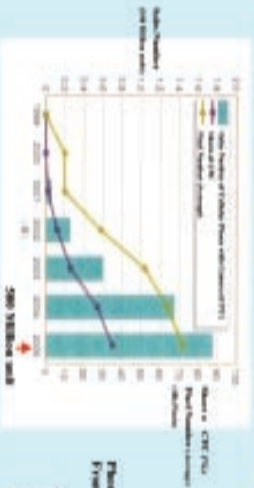
CUSTOMIZED PRODUCT

| | |
|-----------------|-------------------------|
| Resolution: | 1024 x 1024 pixel |
| Field of view: | 31.6 x 25.3 mm with FOP |
| Imaging device: | CCD |
| Scintillator: | 605 |



Market Now ?

Market Trend for Cellular Phone



Phone with 1.3M Pixel camera
From Nokia

Factors to Popularization
Low Cost, Practically, Entertainment Service



Windows Entertainment in Pho

PC Board Multilayer Inspection

With an X-ray imaging system in X-ray NDT for multilayers PC boards, the cost, looking of position of "reference markers" in each layer, can check through an X-ray image analysis, the relative markers position and a possible bad alignment. Multilayers PC boards with a bad alignment has to be disassembled before PC board drilling process; bad alignment could cause a lack of conductivity through the layers.

Suitable Horamatsu Product :

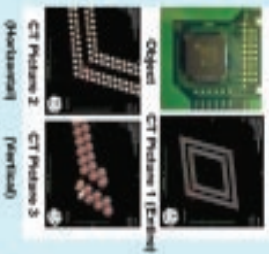
- H72586-series X-Ray CCD Module
- C62056-series X-ray CCD Camera
- 50KV Microfocus Spd X-ray Source
- H8480 X-ray CCD Camera



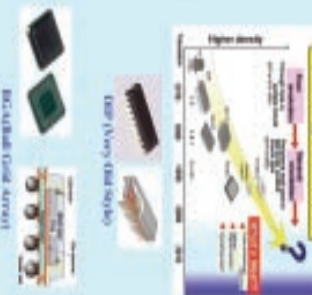
Market Now ?

Micro CT for Semiconductor

Example of BGA



Package Trends



Include Grid Array

Semiconductor Inspection

Manufacturers of microprocessors and integrated circuits are producing more and more powerful miniaturized micro-electronic devices.

This is made possible by the use of silicon which has offered increasing functionality and is reaching a feature size where the perfection and purity of the silicon wafers used is critical to device performance.

The semiconductor X-ray inspection, easily exceeds this trace detection level and will be able to check the quality of the silicon wafers for example the presence of micro cracks or impurity.

Suitable Horamatsu Product :

- Microfocus X-ray Source
- C7336 II equipped with CCD Camera

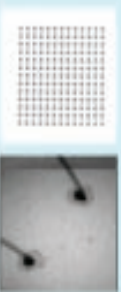
Additional requested product by Market :
MPX Open type source



BGA Inspection

Using X-ray inspection, the image displayed in a high magnification, shows resolution good enough to allow to find the critical details of discontinuity in bonding wires whose dimensions are steadily being made small.

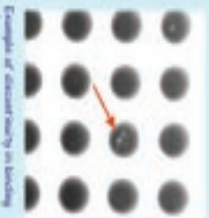
Suitable Hemanates Product:
 C6086 series CCD X-ray Camera
 Microfocus X-ray Source



Additional requested product by Market
 Standard focus X-Ray Source



BGA Inspection



Example of discontinuity in bonding wires
 SPECS:

- 2D ANALYSIS
- HIGH RESOLUTION and HIGH MAGNIFICATION
- REAL TIME IMAGING
- INTENSIFICATION AND CONTRAST ENHANCEMENT



C6086 SERIES
 C6086-II SERIES
 X-CUBE

PC BOARD MULTILAYER INSPECTION



SPECS:

- 2D ANALYSIS
- HIGH RESOLUTION
- REAL TIME IMAGING
- INTENSIFICATION AND CONTRAST ENHANCEMENT



C6086 SERIES
 C6086-II SERIES
 X-CUBE
 X-Y STAGE AND CONTROL PANEL

Market Now ?

Micro CT for Orthodontics

The Technology Division Envisage



X-Ray Food Inspection

The X-ray Food Inspection is becoming a daily necessity. In order to guarantee high quality production levels, Old or traditional inspection technologies (i.e. "Tefrand", "Ultrasound" or "Induced Currents") can not guarantee high resolution detection systems as the X-ray one. Not less important is also a rising interest in security control systems as X-ray food boxes inspection.

Suitable Heamontau Product :

56493-646 / -1296 SI Array PD

56493 - High speed version

C7390 Linear sensor Array



Additional requested product by Market:
Mini focus X-Ray Source



X-Ray Food Inspection



C7390 / C8133 SERIES

CONVEYOR BELT
OR SIMILAR

SPECS:

- 3D ANALYSIS with CONVEYOR BELT
- HIGH RESOLUTION and SENSITIVITY
- HIGH LINEAR SPEED
- LARGE DETECTION WIDTH



Wood Inspection

The X-RAY inspection enables the identification of defects also on particularly dry and rough boards based on the penetration of the rays through the wood, which varies depending on the density of the material. The system, while measuring length and width indirectly, as the boards are conveyed under the X-RAY signal connected to an encoder, determines the coordinates of the Defects which can then be transmitted to a saw located downstream for cutting (if required), so as to ensure the Elimination of the Defect.

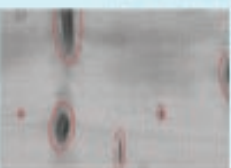
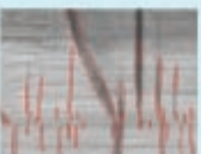
Suitable Heamontau Product:

56493 -series 5 Array PD

C7390 Linear sensor Array



Wood Inspection



SPECS:

- 3D ANALYSIS with CONVEYOR BELT
- HIGH RESOLUTION and SENSITIVITY
- LARGE DETECTION WIDTH

