

LIGHTING APPARATUS FOR USE IN EXAMINING EXTERNAL
APPEARANCES OF DEVICES AND AN AUTOMATIC DEVICE
EXTERNAL APPEARANCE EXAMINING APPARATUS USING
THE LIGHTING APPARATUS

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TECHNICAL FIELD

This invention relates to a lighting apparatus for use
in examining external appearances of electronic components
(as will be collectively referred to as "devices" herein)
10 such as semiconductor devices, filters, vibrators, etc., and
also to an apparatus for automatically examining external
appearances of devices using the lighting apparatus. In
particular, the present invention relates to such a lighting
apparatus and an apparatus for automatically examining
15 external appearances of devices which are used and useful in
examining an external appearance of an IC which is a typical
example of semiconductor devices, for example, a surface
mounted LSI (Large Scale Integration or Integrated circuit).

Further, such types of lighting apparatus are used
20 when a person or human operator examines external
appearances of devices by looking at them by his or her eyes,
and also are used in examining them by an apparatus for
automatically examining external appearances of devices,
which has image or picture processing means. In addition,
25 hereinafter, a lighting apparatus will be described by way
of example in case that it is mainly used as a light source
of an apparatus for automatically examining external

appearances of devices, and for the convenience of explanation, an example will be described in which an IC is illuminated by the lighting apparatus and the external appearances thereof are examined by the apparatus for
5 automatically examining external appearances of devices. However, it is needless to say that such lighting apparatus can be used in illuminating all devices including not only semiconductor devices but also devices such as filters, vibrators, etc. and in examining external appearances of the
10 devices. (An apparatus for automatically examining external appearances of devices will be also referred to as "an automatic device-exterior examining apparatus" or "an automatic device-external appearance examining apparatus" herein.)

15

BACKGROUND ART

It should here be pointed out that tests of ICs including LSIs include, for example, testing at the wafer stage in a manufacturing process and testing on completed
20 packaged ICs. The testings of completed packaged ICs include testing the electric characteristics thereof and testing the external appearances thereof. The testing of the external appearances is performed by a person or human operator who looks at the external appearance of a packaged
25 IC by his or her eyes, or by using an automatic device-exterior examining apparatus, and in any event it is necessary to illuminate such IC.

Heretofore, an illumination used in examining external appearances of ICs was such that the whole of an IC to be tested was illuminated in a fixed brightness or luminance in both cases of visually examining the external appearance of the IC and using an automatic device-exterior examining apparatus, and such fixed illumination for the IC to be tested was effected by depositing a light source at a position above the IC or obliquely above the IC or at one side of the IC and illuminating the IC from the light source placed at that position. This is because conventional packages were relatively large and the number of input/output lead pins of each package was relatively low so that spaces between two adjacent lead pins (the pitch of the lead pins) were relatively wide and because highly precise tolerances were not required, and so the above-mentioned fixed illumination could suffice for the visual inspection for the external appearances and the automatic device-exterior examination.

An automatic device-exterior examining apparatus generally has an image processing section similar to an image processing device. Fig. 5 shows an example of processing of image data in a prior image processing device. A camera unit 50 converts a picture image taken thereby into digital data of picture elements, namely, pixels consisting of, for example, 302,000 pixels in total of 624 pixels in abscissa $\times$ 484 pixels in ordinate and outputs them. The pixel data are directly stored in an image or picture memory

51, or stored in the image memory 51 through a filter 52 and a LUT (Look-Up Table) 53.

The LUT 53 is a transform table for selecting a color to be displayed on a television (TV) monitor 18 or the like, and is a memory into which output data corresponding to input data have been previously written with values of input data as addresses thereof. The function of data conversion of the LUT 53 are utilized to perform binarization or digitization of data or preprocessing of a picture of light and shade or conversion process of a displayed image.

The filter 52 has a function which, for example, when the circumference of an IC to be tested is blurred, serves to preprocess by emphasizing the edge of the IC in cooperation with data output from a shading memory 58. A window memory 55 is used to draw a window or windows on the screen of the TV monitor 18. A graphic memory 56 is used to display the results of a measurement as a graph or is used as a working area. A character memory 57 is a memory which is used for displaying mainly characters and also is used to edit programs or to display the collected results or the like.

A display control section 54 is a control section which directly deals with or processes pixel data from the camera unit 50, or deals with the pixel data from the image memory 51, and displays a image or picture on the TV monitor 18. This display control section 54 displays an image using data of the window memory 55, the graphic memory 56, and/or

the character memory 57 depending upon a command.

In case of using an automatic device-exterior
examining apparatus consisting of such image processing
device using a camera, an examination for external
5 appearances of prior devices could be also effected in the
fixed illumination stated above with only the brightness of
illumination automatically adjusted.

However, owing to the recent requests of markets, the
miniaturization of various appliances and high density
10 mounting of parts or components have advanced, and devices
have also been miniaturized with an increasing number of
surface-mounted packages. Specifically, taking the QFP
(Quad Flat Package) among VLSI (Very Large Scale Integrated
Circuit) by example, it is so small, ranging from 10mm×10mm
15 to 30mm×30mm in length and width, and such package is
provided on its four sides with lead pins, with as many as 8
to 76 lead pins on each side. In addition, the pitch of
leads is extremely narrow, ranging from 0.3mm to 0.8mm, and
the thickness thereof is as thin as 2mm to 10mm.

20 Because surface-mounted packages such as QFP or SOP
(Small Outline Package) are supposed to be soldered directly
to the surface of a printed circuit board, the bottom faces
of the end portions of the lead pins must be flat and the
width of the pitch of leads must be constant. In order to
25 perform an inspection of the external appearance which needs
such fine and minute and accurate observation, the above-
mentioned prior fixed illumination does not suffice, and

more precisely and more strictly controllable illumination has been required. This is because it is difficult to determine whether the bottom faces of the end portions of the lead pins is flat or not or to determine whether the width of the pitch of leads is constant or not by the prior
5 fixed illumination, even if the difference in light reflection between lead pins should be found.

DISCLOSURE OF THE INVENTION

10 It is an object of the present invention to provide a compact lighting apparatus for use in examining external appearances of devices which is adapted to be able to illuminate a device evenly and to make it easily to illuminate a device from any specified direction.

15 Another object of the present invention is to provide a compact automatic device-external appearance examining apparatus with high resolution having the above-mentioned lighting apparatus which is adapted to automatically examine the external appearances of devices with accuracy.

20 The lighting apparatus for use in examining external appearances of devices according to the present invention comprises an illumination frame having an opening formed at substantially the central portion of the frame for putting a camera or an operator's eyes thereon, a multiplicity of
25 brightness-controllable light emitting elements arranged around the opening of the illumination frame, and an illumination control means for selectively controlling the

brightness of each of the light emitting elements. In case of illuminating a device to be tested, i.e. device under test (commonly called DUT), if there is an or some unevenness in the whole illumination for the DUT, then the

5 brightness of each of the light emitting elements can be adjusted to eliminate such unevenness of illumination. Also, there are cases that an illumination from a direction somewhat downwardly of DUTs can make the reflections from portions of the DUTs to be examined (observed) better than

10 illuminations from other directions, and in these cases the brightness of each of the lighting elements is controlled so that, for example, the light emitting elements placed on the upper portion of the illumination frame are extinguished and only the light emitting elements placed on the lower portion

15 of the illumination frame are turned on. A converse illumination may be generally true. By such illumination the portions of a DUT to be examined can be illuminated more intensively than the remaining portions or vice versa thereby providing a distinct contrast of light and shade.

20 Herein, "brightness adjustment" or "brightness control" means that the brightness of each lighting element is increased or decreased and also each lighting element is turned on or off. The brightness control may be effected by manual or automatically.

25 The illumination frame is preferably in a shape of quadrilateral analogous to a DUT, for example, which is long in vertical or is long in horizontal if the DUT is long in

vertical or if the DUT is long in horizontal. This is because the whole surface of the DUT is sufficiently exposed to the illumination. The opening at the central portion may have a size such that a lens of a camera can be inserted
5 into or the line of sight or eyes can be turned toward the DUT. The size of the frame is determined depending upon that of the DUT.

The light emitting elements may be a miniature light emitter such as an LED (Light Emitting Diode), a fluorescent
10 tube, a candescent lamp or the like. The light emitting elements are arranged within a given area of the illumination frame. It is preferred that the light emitting elements are arrayed regularly in row and column because the uniformity of illumination can be obtained and it is easy to
15 control the brightness thereof by such regular arrangement of the light emitting elements. In case that DUTs have a particular nature or character in reflection of light, it is desired to change the numbers of the light emitting elements in the upper and the lower portions or the left and the
20 right portions. It is preferred that the brightness of each light emitting element can be controlled by control of voltage or current.

The illumination control means for controlling the brightness of each of the light emitting elements performs a
25 control of the brightness of each light emitting element including turn-on or turn-off of each light emitting element. At first, all light emitting elements are turned on with the

same brightness, and if there is an unevenness of the luminance on the surface to be observed of a DUT, then the brightness of the light emitting elements is controlled for row unit, column unit and/or block unit so as to eliminate
5 the unevenness of the illumination. Here, one block is composed of a plurality of light emitting elements. The brightness control may be done for each light emitting element at the end thereof. This brightness control can be effected manually or automatically, and in case of an
10 automatic brightness control, preferably the brightness may be controlled by a given control sequence and the control sequence may be stopped at the optimum value obtained. This illumination control means may be mounted on a position contiguous to the illumination frame or at another separate
15 location.

The lighting apparatus thus constructed can illuminate a DUT uniformly and also can project an intense illumination on a specified position or portion of the DUT so that, for example, even if an IC has many of lead pins and a very
20 narrow width of the pitch of leads, it can illuminate the IC so as to be able to accurately measure the degree of the flatness of the end portions of lead pins and/or the width of the pitch of leads.

On the other hand, the automatic device-exterior
25 examining apparatus according to the present invention comprises the brightness-controllable compact lighting apparatus constructed as mentioned above, a camera for

photographing or imaging a device to be tested and
converting the photographed picture into a multiplicity of
data of pixels and outputting them, an image processing
means for processing the pixel data input from the camera
5 and converting them into image data, an operation processing
means for measuring the external appearance of the device to
be tested in accordance with preset items of examination,
and display means for displaying an image according to the
image data input from the image processing means.

10 The camera is preferred to be a CCD (Charge Coupled
Device) camera. The reason is that conversion of analog to
digital (A/D) can be easily done in such camera, but
conventional cameras can be used. The A/D conversion is
preferred to be performed within the camera. It is desired
15 that the sensitivity of the camera is high because it is
intended to take the light and shade in the reflection of
light distinctively. The lens of the camera is mounted in
the opening formed at the central portion of the
illumination frame of the lighting apparatus stated above
20 and is opposed to a DUT.

 The pixel data obtained by the camera are sent to the
image processing means wherein they are converted into image
data. The image processing means may have the same
construction as that of a prior image processing device, and
25 it is desired to provide the illumination control means
mentioned above within the image processing means. The
reason is that the control of the illumination is effected

by using the image data processed by the image processing means and the operation data in the operation processing means.

5 The operation processing means performs various processings of operations on the basis of the image data, and outputs the results. The image data and, if necessary, the data obtained from the results of operation processing are supplied to the display means (TV monitor), and the display means displays the image of DUT corresponding to the
10 image data.

 The operation processing means performs various measurements in accordance with preset items of examination (measurement), and outputs the results of measurements through an output terminal of the result of measurement, and
15 also displays and/or prints out. The items of examination include, for example, the number of lead pins, the width of the pitch of leads, the degree of flatness of lead pins or the like for LSI or QFP stated above, though the items of examination can be different between DUTs.

20

BRIEF DESCRIPTION OF THE DRAWINGS

 Fig. 1 is a perspective view showing one embodiment of a lighting apparatus for use in examining external appearances of devices according to the present invention;

25 Fig. 2 is a diagrammatical view showing one embodiment of an automatic device-exterior examining apparatus provided with the lighting apparatus of Fig. 1 according to the

present invention together with an IC to be tested;

Fig. 3 illustrates illuminated conditions of a lead pin of the IC photographed by using the lighting apparatus of Fig. 1, wherein Fig. 3(A) is a side view showing a lead pin of an IC of good quality, Fig. 3(B) is a perspective view looking Fig. 3(A) from the left side, Fig. 3(C) is a side view showing a lead pin of an IC of bad quality, and Fig. 3(D) is a perspective view looking Fig. 3(C) from the left side;

Fig. 4 is a flow chart for explaining an example of an examining process by the automatic device-exterior examining apparatus according to the present invention; and

Fig. 5 is a diagrammatical view for explaining a flow of image data in an example of a prior image processing device.

BEST MODES FOR CARRYING OUT THE INVENTION

Now, the preferred embodiments of the present invention will be described in details with reference to the accompanying drawings.

A lighting apparatus and an automatic device-exterior examining apparatus according to the present invention can be used in illuminating all devices including not only semiconductor devices but also devices such as filters, vibrators, etc. and in examining external appearances of the devices. However, hereinafter, an example will be described in which an IC typical of semiconductor devices is

illuminated by use of the lighting apparatus and the external appearances thereof, particularly the external appearances of lead pins are examined by use of the automatic device-exterior examining apparatus.

5 Fig. 1 is a perspective view showing one embodiment of a lighting apparatus for use in examining external appearances of devices according to the present invention. The lighting apparatus according to the present invention comprises an illumination frame 10 having an opening formed
10 at substantially the central portion of the frame for putting a camera or an operator's eyes thereon, a multiplicity of brightness-controllable light emitting elements 19 arranged around the opening of the illumination frame 10, and an illumination control section 11 for
15 selectively controlling the brightness of each of the light emitting elements 19.

 Since the lighting apparatus of the present embodiment is so constructed as to illuminate an IC such as VLSI or QFP, the illumination frame 10 is formed in a shape of
20 rectangular quadrangle which is long in horizontal analogous to the IC which is long in horizontal as shown in Fig. 2. Also, in the present embodiment, a lens of a camera 9 is put into an opening formed at the central portion of the rectangular frame 10, and a multiplicity of the light
25 emitting elements 19 are arranged around the opening as the center thereof.

 The light emitting elements of LEDs are used as the

light emitting elements 19, and the light emitting elements 19 are arrayed regularly in row and column. However, the light emitting elements existing in the upper portion of the frame above the opening are thinned out to the degree of
5 about half of the number of the light emitting elements existing in the lower and both side portions of the frame (the light emitting elements in the upper portion are arrayed substantially alternately). Such regular arrangement of the light emitting elements makes it easy to
10 control the brightness thereof, and the reason why the light emitting elements existing in the upper portion of the frame are thinned out is that in the present embodiment it is aimed principally at measurement of the external appearances of lead pins, and an intense illumination from a direction
15 somewhat downwardly of IC can make it easy to examine the external appearances. In this manner it is preferred that the light emitting elements 19 are so arranged that the optimum condition of illumination is obtained in consideration of the items of examination for the external
20 appearances. Of course, it is possible that the light emitting elements may be arrayed without thinning out them and the brightness thereof may be controlled.

Further, the luminance of one LED is about 2000mcd (milli-candela), and so it is desirable that the number of
25 LEDs is determined by taking into consideration the size of DUT, a distance to DUT, items of examination, accuracy of test, etc. Usually, it is sufficient to use LEDs ranging

from 40 to 60. Also, the emitting color of LED which makes the sensitivity of the camera high is preferred.

The illumination control section 11 is provided on a position contiguous to the illumination frame 10 and
5 performs the initialization of illumination and the correction for illumination depending upon the results of measurement. That is, in the initialization of illumination a calibration target is placed on a measuring position at a fixed distance in front of the lighting apparatus and is
10 illuminated, and if the photographed image is good, then the value obtained at that time is set as the optimum value. If the photographed image is inferior, then such control is done that the brightness control including turn-on and turn-off of each of the light emitting elements is performed by a
15 predetermined fixed sequence and the control is stopped when the optimum value is obtained. Also, the lighting apparatus is so constructed that if a failure or defect has resulted from the measurement of each DUT, it can be re-adjusted so as to be able to measure under the optimum condition each
20 time.

Fig. 2 is a diagrammatical view showing one embodiment of an automatic device-exterior examining apparatus provided with the lighting apparatus of Fig. 1 according to the present invention together with an IC to be tested. The IC
25 20 to be tested is put on and fixed to a rotatable stage 21 which is rotatably mounted on a measurement pedestal 22. The IC 20 is an LSI of QFP, in this embodiment, and the

package is provided on its four sides with lead pins, and all the four sides must be measured. Therefore, by rotating the rotatable stage 21 by 90° each time the external appearances of lead pins of one side is measured, all four
5 external appearances of lead pins on each side can be measured. The examination for the external appearances is completed when the external appearances of lead pins on all four sides are measured.

The camera 9 and the lighting apparatus are opposed to
10 the IC 20 to be tested and are positioned at a fixed distance therebetween. The lighting apparatus illuminates the IC 20 properly in the manner stated above, and the camera 9 converts the photographed picture into a multiplicity of data of pixels and outputs them to the image
15 processing section 12. The camera 9 is a CCD camera in which the photographed picture is immediately converted by A/D conversion into pixel data of 484×624 points. The distance resolving power for the IC can be enhanced by appropriately selecting a distance between the camera 9 and
20 the IC 20 and/or the magnification of the lens. For example, the image is taken by 100 pixels per a distance of 10mm of the IC 20, high resolving power of 0.1mm/pixel can be obtained. Image data of 8 bits are used in this embodiment, in practice, high resolving power of 1/5 (experience value)
25 of 0.1mm, namely, about 0.02mm, can be obtained.

The image processing section 12 receives the pixel data sent from the camera 9 through an image data input

terminal 13a, and processes them to emphasize the light and shade of the image. This processing of emphasizing the light and shade of the image makes it easy to determine the position of measurement. An example thereof will be
5 described with reference to Fig. 3. Further, in Fig. 3 for the convenience of the explanation only one lead pin of the IC 20 to be tested is illustrated. Fig. 3(A) is a side view showing a lead pin 25 of good quality of the IC 20, and it is found that the bottom face of the end portion of the lead
10 pin 25 is flat. Fig. 3(B) is a front view of Fig. 3(A), which shows a case that an intense illumination is projected to the IC 20 from somewhat downwardly of the IC. By this illumination an intense reflected light is incident into the camera 9 from the end face of the lead pin 25 which is shown
15 with black color in Fig. 3(B) and it is displayed in white (bright) and distinctly on the TV monitor 18. The width of the lead pin 25 can be determined or measured from the number of pixels in this white or bright portion, and also the central position thereof can be determined. Moreover,
20 though not shown in Fig. 3, an interval or distance between adjacent two lead pins, i.e. the width of the pitch of lead can also be determined.

Fig. 3(C) is a side view showing an example of a lead pin 26 of bad quality of the IC 20, and it is found that the
25 end portion of the lead pin 26 is curved somewhat upwardly and that the bottom face of the end portion of the lead pin 26 is not flat. Fig. 3(D) is a front view of Fig. 3(C)

which also shows a case that an intense illumination is projected to the IC 20 from somewhat downwardly of the IC. In the case of the inferior lead pin, a reflected light is not incident into the camera 9 from the end face of this inferior lead pin 26 and it is displayed in black (dark) on the TV monitor 18. Therefore, the width of the lead pin 26 and also the central position thereof cannot be determined. As a result, it is determined to be an inferior article, nevertheless, there can be a case that the operator would like to determine the position of the inferior lead pin 26. In such case an illumination from somewhat upwardly of the IC is emphasized by driving the illumination control section 11 whereby an intense light reflected from the end portion of the inferior lead pin 26 is incident on the camera 9 and the position of the end portion of the inferior lead pin 26 can be confirmed in the image processing section 12. In addition, the degree of flatness (offset) relative to the position of the excellent lead pin 25 can be determined.

The image processing section 12 processes the pixel data input from the camera 9 and converts them into image data, as stated above, and displays an image corresponding to the image data on the TV monitor 18 by emphasizing the light and shade of the image, or changing any portion to be measured of the IC to any color display through the LUT 53, or displaying a window or windows, or displaying characters, if necessary. The output signal from the image processing section 12 is supplied to the TV monitor 18 through a TV

image output terminal 17.

The operation processing section 14 performs various processings of operations such as the determination of good or inferior lead pin, measurement of the width of lead pin, 5 the width of the pitch of leads or degree of the flatness and the like on the basis of the image data. The results of the operations can be displayed on the TV monitor 18, and also can be outputted to the outside through an output terminal 16 for outputting the result of measurement. Also, 10 items of measurements and a procedure of processing method are inputted from an input terminal 15 for set values to the operation processing section 14. The operation processing section 14 performs control of the whole system, too. The control data from the operation processing section 14 is 15 outputted from a lighting apparatus control data output terminal 13b to the lighting apparatus. Further, setting buttons and/or ten keys may be provided on the operation processing section 14 itself so that the items of measurements and the procedure of processing method can be 20 inputted through the buttons and/or ten keys. It is convenient that the illumination control section 11 is also provided within the operation processing section 14.

Fig. 4 is a flow chart for explaining an example of operation when an inferior IC particularly in its external 25 appearance was detected in the procedure of measurement. An IC 20 to be tested is secured on the rotatable stage 21, and then a measurement of reflected light is started by a

measurement start signal (step 30). In next succeeding step 31 whether preset measurement points could be measured or not, that is, all lead pins could be measured or not is determined. When the result of the determination in step 31 is YES, then the result of the measurement for that IC is outputted in step 32 and the examination for the external appearance ends (step 33). When the result of the determination in step 31 is NO, the illumination control section 11 is operated to effect the brightness control of the light emitting elements 19 in step 34. For example, the position of turn-on LEDs may be changed. Subsequently, in step 35 re-measurement of lead pin or pins which could not be measured by the preceding measurement is performed, and in step 36 whether the measurement of lead pins can be done or not is determined. When the result of the determination in step 36 is YES, then the result of the measurement for that IC is outputted in step 32 and the examination for the external appearance ends (step 33). When the result of the determination in step 36 is NO, the process comes back to step 34 again, wherein the position of turn-on LEDs may be further changed, and in step 35 re-measurement of lead pin or pins which could not be measured by the preceding second measurement is performed again. The re-examination in step 35 is carried out by three times in this example, and the number *i* of re-examination (retry) is counted by steps 37 and 38. When the number of re-examination exceeds three times, that is, the result of the determination in step 38

is YES, then the process proceeds to step 39 wherein a decision that the measurement cannot be performed is rendered and the examination for the external appearance ends (step 40).

5 As is apparent from the foregoing description, in accordance with the present invention, the examination for external appearances of recent very compact and minute devices having high accuracy can be easily carried out. Since the lighting apparatus according to the present
10 invention has a multiplicity of light emitting elements the brightness of each of which is controllable and which are arranged around a camera for observing a DUT and further the brightness of each light emitting element can be controlled based on the result of the observation, it can illuminate
15 the DUT uniformly and also can project an illumination from a specified direction on the DUT, and so an irradiation on a specified portion of the DUT and the observation thereof can be correctly and accurately performed. Accordingly, a lighting apparatus indispensable to the observation on
20 minute and very fine portions of a DUT is provided.

 The automatic device-exterior examining apparatus according to the present invention is provided with a lighting apparatus which can illuminate a portion or portions to be measured of a DUT from any direction.
25 Therefore, the automatic device-exterior examining apparatus can make clear the light and shade of the portion of the DUT photographed by a camera, and the automatic measurement is

easily done. Also, the distance resolving power for a DUT can be enhanced to less than 0.1mm/pixel by increasing the number of pixels in image data, and so the very high accurate measurement can be carried out.

- 5 In this manner the present invention is optimum for the examination or observation for fine and minute external appearances of devices such as semiconductor devices, filters, vibrators, or the like, and the technical effects thereof are remarkable.

CLAIMS:

1. A lighting apparatus for use in examining external appearances of devices comprising:

an illumination frame having an opening formed at substantially the central portion of said frame for putting a camera or an operator's eyes thereon;

a multiplicity of brightness-controllable light emitting elements arranged around said opening of the illumination frame; and

an illumination control means for selectively controlling the brightness of each of said light emitting elements.

2. The lighting apparatus according to claim 1 wherein said light emitting elements are ones of LED.

3. An automatic device-exterior examining apparatus comprising:

a lighting apparatus for use in examining external appearances of devices comprising an illumination frame having an opening formed at substantially the central portion of said frame for putting a camera or an operator's eyes thereon, a multiplicity of brightness-controllable light emitting elements arranged around said opening of the illumination frame, and an illumination control means for selectively controlling the brightness of each of said light



emitting elements;

a camera for photographing or imaging a device to be tested and converting the photographed picture into a multiplicity of data of pixels and outputting them;

an image processing means for processing the pixel data inputted from said camera and converting them into image data;

an operation processing means for measuring the external appearance of the device to be tested in accordance with preset items of examination; and

display means for displaying an image according to the image data inputted from said image processing means.



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