

DESCRIPTION

TITLE OF INVENTION: HANDLER FOR TESTING ELECTRONIC COMPONENT AND METHOD FOR REARRANGING ELECTRONIC COMPONENT OF HANDLER FOR TESTING ELECTRONIC 5 COMPONENT

Technical Field

[1] The present invention relates to a handler for supporting the testing of electronic components by electrically connecting the electronic components and a
10 tester to each other.

Background Art

[2] A handler for testing electronic components is the equipment that handles electronic components in order to electrically connect the electronic components to a tester.

15 [3] As the degree of integration of electronic components such as semiconductor devices increases, there is a trend toward the line width of circuits becoming increasingly narrow. Accordingly, higher precision is required when electronic components are connected to testers.

20 [4] For example, although an error range of 20 μm was previously sufficient to ensure the appropriate electrical connection between electronic components and testers, an error range of 10 μm or less, up to a few μm is required now.

[5] Meanwhile, among electronic components, there are dies that are separated into individual units from a wafer state.

[6] Dies may be completed as final products by undergoing a packaging task or by stacking them for High Bandwidth Memory (HBM) production and then undergoing a packaging task.

[7] The testing of dies is required to perform post-die tasks.

[8] Electronic components in a die state may be tested by electrically connecting the contact pads thereof to a tester.

[9] Dies have fine intervals between the contact pads thereof and are significantly thin, making them prone to breaking or cracking, so that no suitable test method capable of adequately supporting the testing of electronic components in a die or HBM state has been proposed until now. Accordingly, the applicant proposed Korean Patent Application Publication No. 10-2021-0088373 (hereinafter referred to as the 'conventional art').

[10] The conventional art proposes a technology for aligning the positions of electronic components by rearranging the electronic components before connecting them to a tester.

[11] The conventional art is configured to allow for the reduction of errors in the positions of electronic components by scanning the electronic components on a test table (named the 'chuck' in the conventional art) with a

camera to determine the current positions (arbitrary positions) of the electronic components and performing position adjustment to move the electronic components to correct positions.

5 [12] According to the conventional art, there is provided a picker that temporarily grips an electronic component at a current position.

[13] The picker may grip or release an electronic component.

10 [14] When the picker grips an electronic component, the test table moves the electronic component from an arbitrary position to a regular position through rotation, lifting/lowering, and/or horizontal movement, and then the grip of the electronic component by the picker is released.

15 [15] Meanwhile, as the demand for electronic components requiring precise contact with a tester increases, there is a need to expand the handling capacity of the handler according to the conventional art. However, the time taken in the rearrangement process of the handler according to the
20 conventional art acts as an obstacle to expanding the handling capacity.

[16] [Conventional Art Literature]

[17] [Patent Literature]

[18] (Patent Document 1) Korean Patent Application
25 Publication No. 10-2021-0088373

Disclosure

Technical Problem

[19] It is necessary to further reduce the time required for the rearrangement of electronic components in the handler according to the conventional art.

5 Technical Solution

[20] A handler for testing electronic components according to the present invention includes: a transport shuttle provided with a transport table capable of transporting electronic components by moving with the electronic components loaded thereonto; a first hand configured to load the electronic components onto the transport table that is placed in a first area by the operation of the transport shuttle; a second hand configured to unload the electronic components from the transport table that is moved from the first area to a second area by the operation of the transport shuttle; a test table configured such that the electronic components unloaded from the transport table by the second hand are loaded thereonto; a rearrangement mechanism configured to rearrange the electronic components, loaded into temporary zones of the test table by the second hand, to regular zones; a movement mechanism configured to move the test table to rearrange the electronic components to the regular zones by using the rearrangement mechanism; a connector configured to enable the electronic components to be tested by electrically connecting the electronic components, loaded onto the test table, to a tester; and a

controller configured to control the transport shuttle, the first hand, the second hand, the rearrangement mechanism, the movement mechanism, and the connector; and the rearrangement mechanism includes: a rearrangement picker
5 capable of gripping an electronic component; a rearrangement camera disposed to be spaced apart from the rearrangement picker; and a rotator configured to correct the misalignment of the electronic component gripped by the rearrangement picker by rotating the rearrangement picker.

10 [21] The rearrangement picker and the rearrangement camera may have their fixed positions in the horizontal directions.
[22] The rearrangement picker and the rearrangement camera may be coupled to each other so that the relative arrangement positions thereof are fixed.

15 [23] The movement mechanism may include a horizontal mover configured to move the test table horizontally.
[24] The rearrangement mechanism may further include an elevator configured to lift or lower the rearrangement picker.

20 [25] The rearrangement picker and the rotator may include a plurality of rearrangement pickers and a plurality of rotators, respectively, and the rearrangement pickers may be rotated independently of each other.

25 [26] The rearrangement mechanism may further include a plurality of elevators configured to lift or lower the rearrangement pickers independently of each other.

Advantageous Effects

[27] According to the present invention, the position of an electronic component in the Θ -axis direction may be corrected by the rotation of the rearrangement picker, so
5 that the time required for rearranging the electronic component may be reduced, thereby improving the handling capacity of the handler.

Description of Drawings

[28] FIG. 1 is a conceptual plan view of a handler for
10 testing electronic components according to a first embodiment of the present invention;

[29] FIG. 2 is a schematic plan view of a transport table applied to the handler for testing electronic components of FIG. 1;

15 [30] FIG. 3 is a schematic perspective view of a first hand applied to the handler for testing electronic components of FIG. 1;

[31] FIG. 4 is a reference view illustrating the first hand of FIG. 3;

20 [32] FIG. 5 is a schematic perspective view of a test table applied to the handler for testing electronic components of FIG. 1;

[33] FIG. 6 is a schematic plan view of a test board coupled to the handler for testing electronic components of
25 FIG. 1;

[34] FIG. 7 is a reference view illustrating the electrical connection relationship between the test board of FIG. 6 and an electronic component;

[35] FIG. 8 is a reference view illustrating temporary
5 zones placed in the test table of FIG. 5;

[36] FIG. 9 is a reference view illustrating regular zones generated in the test table of FIG. 5;

[37] FIG. 10 is a schematic diagram of a rearrangement mechanism applied to the handler for testing electronic
10 components of FIG. 1;

[38] FIG. 11 is a reference view illustrating the areas of an electronic component photographed by a rearrangement camera in the rearrangement mechanism of FIG. 10;

[39] FIGS. 12 and 13 are reference views comparing the
15 conventional art with the present invention;

[40] FIG. 14 is a reference view illustrating a movement mechanism applied to the handler for testing an electronic component of FIG. 1;

[41] FIG. 15 is a schematic view of a rearrangement
20 mechanism according to a modified example of the rearrangement mechanism of FIG. 10;

[42] FIG. 16 is a reference view illustrating the operational relationship between the test table of FIG. 5 and the rearrangement mechanism of FIG. 10;

[43] FIG. 17 is a schematic diagram of a rearrangement
25 mechanism according to an extended example of the rearrangement mechanism of FIG. 10; and

[44] FIG. 18 is a schematic diagram of a rearrangement mechanism according to a modification of the rearrangement mechanism of FIG. 17.

Mode for Invention

5 [45] Preferred embodiments according to the present invention will be described with reference to the accompanying drawings. For the sake of brevity, descriptions of well-known or redundant components are omitted or abridged as much as possible.

10 [46] **<First Embodiment>**

[47] FIG. 1 is a conceptual plan view of a handler TH for testing electronic components (hereinafter abbreviated as the 'handler TH') according to the present invention.

[48] The handler TH for testing electronic components
15 according to the present invention may be divided into a movement part MP, an unloading part LU, rearrangement parts RP, and a connection part CP. The handler TH for testing electronic components includes a transport shuttle 100, a first hand 210, second hands 220, test tables 300, vacuum
20 devices 400, rearrangement mechanisms 500, movement mechanisms 600, connectors 700, and a controller 800.

[49] In the movement part MF, electronic components may be moved such that the electronic components are handed over between the unloading part LU and the rearrangement part RP.
25 To this end, the transport shuttle 100 for transporting electronic components is installed in the movement part MP.

[50] The transport shuttle 100 is provided to transport electronic components between the unloading part LU and the rearrangement part RP.

5 [51] The transport shuttle 100 has a movable transport table 110.

[52] The transport shuttle 100 may have at least one transport table 110.

10 [53] The transport table 110 is capable of reciprocating in one direction. According to a preferred example, the transport table 110 is capable of reciprocating in the X-axis direction.

[54] In the case where the transport table 100 includes a plurality of transport tables 100, the plurality of transport tables 110 may be provided in parallel with each other in the Y-axis direction.

[55] Furthermore, the plurality of transport tables 110 need to be implemented to reciprocate in the X-axis direction independently of each other.

20 [56] The transport table 110 may move back and forth between a first area A1 located on an unloading part LU side and a second area A2 located on a rearrangement part RP side.

[57] Electronic components may be loaded onto the transport table 110.

25 [58] The transport table 110 does not have a pocket structure having depressions into which electronic components can be seated, but has rather a vacuum structure

which secures electronic components seated on a flat surface by using vacuum pressure.

[59] As shown in the schematic plan view of FIG. 2, vacuum holes VH and vacuum depressions VG for vacuum-sucking
5 electronic components are formed in the transport table 110.

[60] One vacuum hole VH and one vacuum depression VG form a pair.

[61] The vacuum pressure coming via the vacuum hole VH acts on an electronic component while being evenly distributed
10 via the vacuum depression VG.

[62] Since electronic components may be fixed to the transport table 110 by vacuum pressure, the movement of the electronic components does not occur during the process of moving on the transport table 110 in the X-axis direction.
15 Accordingly, as long as the electronic components are placed precisely on the transport table 110, the tolerance for the positional misalignment of the electronic components, which has been a problem in the past, may be minimized.

[63] The vacuum holes VH and the vacuum depressions VG may
20 be arranged in a 2×8 matrix, but the loading capacity of the transport table 110 may be increased or decreased as needed.

[64] In the unloading part LU, electronic components are fed to the handler TH or recovered from the handler TH.
25 That is, electronic components to be tested are fed to the handler TH via the unloading part LU, and tested electronic components are recovered from the handler TH via the

unloading part. Electronic components may be loaded onto a carrier such as a JEDEC tray, a ring frame, or some other customer tray and may then be fed to the handler TH or recovered from the handler TH.

5 [65] Electronic components to be tested in the unloading part LU are loaded onto the transport table 110 in the first area A1, and tested electronic components loaded onto the transport table 110 in the first area A1 are unloaded from the transport table 110. To this end, the first hand 210 is
10 provided in the unloading part LU.

[66] The first hand 210 is provided to load electronic components onto the transport table 110 or unload electronic components from the transport table 110.

[67] For unloading operations by the first hand 210, the
15 transport table 110 has to be moved toward the unloading part LU and be placed in the first area A1.

[68] The first hand 210 loads electronic components to be tested onto the transport table 110 in the first area A1, or unloads tested electronic components from the transport
20 table 110 in the first area A1.

[69] The first hand 210 may have one or more pickers capable of gripping or releasing electronic components.

[70] The pickers may grip electronic components by vacuum pressure.

25 [71] The first hand 210 may be provided with a plurality of pickers to increase the working capacity in a single operation. For example, as shown in the schematic diagram

of FIG. 3, the first hand 210 may have four pickers P1 arranged in a 2×2 matrix. The number of pickers P1 provided in the first hand 210 may be increased or decreased depending on the implementation.

5 [72] The first hand 210 has elevators E1 for independently lifting/lowering the pickers P1. By the elevators E1, the pickers P1 may selectively grip or release electronic components. Accordingly, the electronic components moved to the transport table 110 by the first hand 210 may be
10 individually seated on the transport table 110 while their positions are being individually and precisely adjusted. Furthermore, the electronic components unloaded from the transport table 110 by the first hand 210 may be classified according to the test grade.

15 [73] The first hand 210 may further include a camera C1.

[74] The first hand 210 may grip an electronic component with the picker P1 after accurately calculating the position of the electronic component by analyzing an image captured by the camera C1 before gripping the electronic component.
20 Accordingly, the picker P1 may grip the electronic component more precisely, and, thus, can place the electronic component at a correspondingly correct position on the transport table 110.

[75] The picker P1 may be implemented to grip electronic
25 components of various heights.

[76] For example, an implementation may be made in such a manner as to determine the lifting height of the picker P1

according to the height of an electronic component preset by an administrator. In this case, when the specifications of an electronic component to be tested change, it entails the inconvenience in which an administrator has to re-enter the height of the electronic component.

[77] For example, an implementation may be made in such a manner as to determine the lifting height of the picker P1 for gripping or releasing an electronic component by calculating the height of the electronic component from an image captured by the camera C1. In this case, operational convenience is improved because the handler TH automatically recognizes the height of the electronic component and then operates the picker P1.

[78] The first hand 210 may further include rotators R1.

[79] The rotators R1 each rotate an electronic component ED in the Θ -axis direction by using a vertical line in the Z-axis direction as the axis of rotation, as shown in FIG. 4.

[80] The rotators R1 may rotate the respective pickers P1 individually. Accordingly, the first hand 210 may not only move the electronic component ED in the X-, Y-, and Z-axis directions, but may also rotate the electronic component ED in the Θ -axis direction. That is, the first hand 210 may correct the misalignment of the electronic component ED photographed by the camera C1 before gripping and may then seat it on the transport table 110. The position of the electronic component ED seated at a precise position on the transport table 110 by the first hand 210 is fixed by vacuum

pressure. Accordingly, during the process of moving the electronic component ED by the first hand 210, the positions of the electronic component ED in the X-, Y-, Z-, and Θ -axis directions may be precisely adjusted.

5 [81] However, it may also be possible to provide a rotation means for the electronic component ED separately from the first hand 210.

[82] For example, an implementation may be made such that, when the first hand 210 grips the electronic component ED from a JEDEC tray or ring frame and feeds it to the rotation means, the rotation means may correct the misalignment of the electronic component ED by fixing the electronic component ED with vacuum pressure and then rotating it. The electronic component ED, the misalignment of which has been corrected by the rotation means, may be gripped again by the first hand 210 and then moved to the transport table 110.

15 [83] In the example of FIG. 3, the first hand 210 is provided with four pickers P1. When a plurality of pickers P1 are provided in this manner, the targets to be gripped may be different for the respective pickers P1.

[84] For example, some pickers P1 may be implemented to grip electronic components ED in a live-bug state (in the state in which terminals face downward), and the remaining pickers P1 may be implemented to grip electronic components ED in a dead-bug state (in the state in which terminals face upward). In this case, all the electronic components ED fed to the handler TH via a JEDEC tray or ring frame may be

handled regardless of their loading state, thereby increasing the usability of the handler TH.

[85] In the rearrangement parts RP, electronic components ED to be tested are unloaded from the transport table 110, and the unloaded electronic components ED are rearranged.

[86] According to the present embodiment, two rearrangement parts RP are symmetrically arranged on both sides with the connection part CP disposed therebetween. By having the two rearrangement parts RP in this manner, the handling capacities of the handler TH and a tester are improved.

[87] The second hands 220 are provided in the rearrangement parts RP.

[88] The second hands 220 unload electronic components ED to be tested from the transport table 110 or load tested electronic components ED onto the transport table 110.

[89] For unloading operations by the second hands 220, the transport table 110 has to be moved toward the rearrangement part RP and then placed in the second area A2.

[90] The second hands 220 unload electronic components ED to be tested from the transport table 110 in the second area A2 or load tested electronic components ED onto the transport table 110 in the second area A2.

[91] In the same manner, the second hands 220 each have one or more pickers capable of gripping or releasing electronic components ED. Preferably, the second hands 220 may each be provided with a plurality of pickers to increase the working capacity in a single operation. For example, the second

hands 220 may each have four pickers arranged in a 2×2 matrix. The number of pickers provided in the second hand 220 may be increased or decreased depending on the implementation. Furthermore, the pickers of the second hand
5 220 may be provided to be movable independently of each other in order to selectively grip or release electronic components ED.

[92] The second hands 220 may be provided in the same operational structure as the first hand 210. However, the
10 number of pickers P1 provided in the first hand 210 and the number of pickers provided in each of the second hands 220 may differ from each other. Meanwhile, to lower the manufacturing cost of the second hands 220, individual elevation or rotation means for the pickers may not be
15 applied to the second hands 220.

[93] The second hand 220 unloads the electronic components ED to be tested from the transport table 110 in the second area A2 and loads them onto the test table 300 that has been moved to the rearrangement part RP.

20 [94] Furthermore, the second hand 220 loads the electronic components ED, loaded onto the test table 300 and having been tested, onto the transport table 110 in the second area A2.

[95] The test table 300 is provided to be loaded with the
25 electronic components ED that are unloaded from the transport table 110 by the second hand 220.

[96] As shown in the schematic excerpt of FIG. 5, the test table 300 is provided to have a flat top surface. Accordingly, electronic components ED are loaded onto the test table 300 in such a manner that the electronic components ED are placed on the flat top surface of the test table 300.

[97] When viewed in a plan view, the test table 300 may be formed in the shape of a disk as in FIG. 5(a) or in the shape of a square plate as in FIG. 5(b).

[98] According to the present invention, the test table 300 may be moved in the X- and Y-axis directions, or may be rotated in the Θ -axis direction by using a vertical line V, passing through the center of the test table 300 in the Z-axis direction, as the axis of rotation.

[99] Furthermore, the test table 300 may be lifted/lowered by the connector 700 to be described later.

[100] Generally, during the process of moving an electronic component ED to the test table 300, shock or inertia accompanying the movement occurs. Accordingly, the position of the electronic component ED loaded onto the test table 300 may be misarranged due to shock or inertia. To prevent this problem, the vacuum holes h are formed in the areas where electronic components ED are loaded on the test table 300. Furthermore, when vacuum pressure is applied via the vacuum holes h, the electronic components ED may be fixed to the test table 300. That is, when the electronic component ED is placed on the test table 300 by the second hand 220,

the electronic component ED may be seated at the position, where it was placed, without change by the vacuum pressure.

[101] According to a preferred example, a camera C2 may be installed at the center of the test table 300. In this case, the camera C2 is used to identify the angular position (the position in the Θ -axis direction) of a test board TB to be described later. However, any position where the angular position of the test board TB can be identified may preferably be considered as a position for the installation of the camera C2.

[102] The vacuum device 400 provides vacuum pressure to the vacuum holes h in the test table 300 via a vacuum circuit (not shown). The vacuum pressure provided by the vacuum device 400 is transmitted to the electronic components ED via the vacuum holes h. Accordingly, the positions of the electronic components ED loaded onto the test table 300 may be fixed by the vacuum pressure.

[103] The vacuum holes h may be implemented to be selectively opened or closed depending on the control of the vacuum circuit (not shown). Accordingly, the electronic components ED may be fixedly loaded onto the test table 300, or may be removed from the test table 300.

[104] According to the present invention, the electronic components ED loaded onto the test table 300 and to be tested are precisely rearranged in the rearrangement part RP. This will be described in detail later.

[105] In the connection part CP, the electrical connection is set up between the electronic components ED, loaded onto the test table 300 that is moved to the connection part CP, and the tester.

5 [106] For the electrical connection between the electronic components ED and the tester, the tester is provided with the test board TB. Furthermore, the test board TB is coupled to the handler TH. More specifically, the test board TB is coupled to the connection part CP.

10 [107] The electronic components ED loaded onto the test table 300 are electrically connected to the test board TB. Accordingly, the electronic components ED may ultimately be electrically connected to the tester via the test board TB.

[108] In this case, the test board TB will be described in
15 brief.

[109] FIG. 6 is a bottom view showing the bottom surface of the test board TB.

[110] Although the test board TB is formed in the shape of a disk in the example of FIG. 6, the test board TB may also be
20 provided in the shape of a square plate.

[111] As shown in the bottom view of FIG. 6, test zones TZ corresponding to respective electronic components ED are arranged on the test board TB. The test zones TZ correspond to the electronic components ED, loaded onto the test table
25 300, in a one-to-one correspondence.

[112] Each of the test zones TZ is provided with test pins t for electrically connecting to one electronic component ED.

[113] The test pins t in each test zone TZ form a single set to form the test zone TZ, and are electrically connected to an electronic component ED. Accordingly, the test zone TZ and the electronic component ED have to be aligned with each other. When the coordinates of the electronic component ED on the test table 300 do not match the coordinates of the test zone TZ on the X-Y plane, a failure occurs in the electrical connection between the electronic component ED and the tester.

[114] In particular, as shown in the conceptual example of FIG. 7, when the electronic component ED on the test table 300 is placed at an angular position rotated by a rotation angle θ_1 in the θ -axis direction relative to the test zone TZ, a failure occurs in the electrical connection between the electronic component ED and the tester. Accordingly, all the test zones TZ of the test board TB and all electronic components ED on the test table 300 have to be aligned with each other.

[115] The rearrangement mechanism 500 is provided to achieve the alignment between the test zones TZ and the electronic components ED.

[116] According to the present embodiment, the electronic components ED are moved from the transport table 110 to the test table 300 by the second hand 220. During this process, an error in the position of the electronic component ED may occur due to an operational error or shock of the second hand 220. Accordingly, the positions on the X-Y plane or

angular positions of the electronic components ED loaded onto the test table 300 by the second hand 220 may differ from each other. That is, the electronic components ED loaded onto the test table 300 may not be aligned with the test zones TZ of the test board TB.

[117] It does not matter when the range of error tolerances between the electronic components ED and the test zones TZ is wide. However, the reality is that a precision within 30 μm is required for the packaged semiconductor device and a precision within 5 μm is required for the die or HBM. To overcome this issue, in the present invention, when the second hand 220 moves electronic components ED from the transport table 110 to the test table 300, it loads them into temporary zones first. Then, the electronic components ED are rearranged from the temporary zones to regular zones. According to a preferred example, the planar shape and area of the temporary and regular zones may be the same as the planar shape and area of the electronic components ED.

[118] The temporary zones are not set positions, but are any positions where electronic components ED are placed on the test table 300 by the second hand 220. That is, the temporary zones are not set by the controller 800 or are not fixed, but are the positions determined by the second hand 220 as desired. For example, when the second hand 220 seats electronic components ED onto the test table 300, the zones where the electronic components ED are seated become the

temporary zones BZ. The exaggerated FIG. 8 shows an example of the temporary zones BZ on the test table 300.

[119] The regular zones RZ refer to the positions where the electronic components ED and the test zones TZ are aligned with each other. The exaggerated FIG. 9 shows the relationship between the temporary zones BZ and the regular zones RZ on the test table 300.

[120] Although the regular zones RZ may be preset, they may be set to match the positions and arrangement of the test zones TZ on the test board TB after the electronic components ED to be tested have been loaded onto the test table 300.

[121] The rearrangement mechanism 500 is provided to rearrange the positions of the electronic components ED, loaded onto the test table 300 by the second hand 220, from the temporary zones BZ to the regular zones RZ.

[122] According to the present embodiment, the second hand 220 loads the electronic components ED, unloaded from the transport table 110 and to be tested, into the temporary zones BZ. Then, the rearrangement mechanism 500 operates to move the electronic components ED, placed in the temporary zones BZ, to the regular zones RZ. In this case, the temporary zones BZ include not only the positions in the X- and Y-axis directions, but also the angular positions in the Θ -axis direction based on the angularly misaligned, rotated states of electronic components ED.

[123] For reference, when only a theoretical design that does not give consideration to machining errors is taken into consideration, the interval between the pickers of the second hand 220 may be the same as the interval between the electronic components seated onto the transport table 110. In this case, the adjustment of the interval between the electronic components ED moved from the transport table 110 to the test table 300 or from the test table 300 to the transport table 110 by the second hand 220 may not be required. Accordingly, the manufacturing cost may be reduced accordingly. In the same manner, the interval between the pickers of the second hand 220 may be the interval between the test zones TZ of the test board TB, and may be the same as the interval between the regular zones RZ on the test table 300.

[124] For reference, although FIG. 9 shows the misalignment between temporary zones BZ and regular zones RZ as significant, the misalignment between temporary zones BZ and regular zones RZ may be various. In some cases, temporary zones BZ and regular zones RZ may have the same centers but only slight differences in angle.

[125] The temporary zones may be named arbitrary positions, and the regular zones may be named regular positions.

[126] In the sense that an electronic component placed in a temporary position is rearranged to be placed at a regular position, the state where correction is required in either a horizontal direction or a twisted rotation angle is referred

to as the temporary position, while the regular position refers to the position where the electronic component is aligned as the desired state. Furthermore, the situation in which an electronic component is seated at a temporary
5 position does not always means that the electronic component is incorrectly aligned.

[127] Meanwhile, as shown in the schematic diagram of FIG. 10, the rearrangement mechanism 500 includes a rearrangement picker 510, a rearrangement camera 520, and a rotator 530.

10 [128] The rearrangement mechanism 500 has a fixed position. For example, the rearrangement mechanism 500 may be fixedly mounted onto a frame that forms the skeleton of the handler TH.

[129] The rearrangement picker 510 may grip or release an
15 electronic component ED. The rearrangement picker 510 may grip the electronic component ED by vacuum pressure.

[130] The rearrangement picker 510 has a fixed position in the horizontal directions, which are the X- and Y-axis directions.

20 [131] The rearrangement camera 520 is disposed to be spaced apart from the rearrangement picker 510.

[132] The rearrangement camera 520 is provided to photograph an electronic component ED. In particular, as shown in the example of FIG. 11, the rearrangement camera 520 is provided
25 to photograph a first or second corner E1 or E2 out of the four corners of the electronic component ED. In this case,

the first and second corners E1 and E2 face each other in a diagonal direction.

[133] According to one preferred example of the present invention, the distance between the rearrangement camera 520 and the electronic component ED is kept shorter than that in the conventional art. Accordingly, as shown in the example of FIG. 12, assuming that the rearrangement camera 520 captures an image by using the center O of the electronic component ED as the center of the image, all or at least a portion of the edge of the electronic component ED is outside the angle of view. That is, according to the present invention, the rearrangement camera 520 is installed such that the overall electronic component ED cannot be placed intact within an image I captured by the rearrangement camera 520. The focal length of the rearrangement camera 520 is set to the distance between the lens of the rearrangement camera 520 and the electronic component ED. Accordingly, in the image captured by the rearrangement camera 520, the first and second corners E1 and E2 of the electronic component ED may be distinguished more clearly.

[134] (a) of FIG. 13 shows an image I1 captured by a camera according to the conventional art, and (b) and (c) of FIG. 13 show images I2 and I3 captured by the rearrangement camera 520 according to the present embodiment. (b) of FIG. 13 is the image I2 of the first corner E1 of an electronic

component ED, and (c) of FIG. 13 is the image I3 of the second corner E2 of the electronic component ED.

[135] When the numbers of pixels of the images I1, I2, and I3 in (a), (b) and (c) of FIG. 13 are the same as one another, the corners E1 and E2 and edge of the electronic component ED may be distinguished more clearly in the images I2 and I3 of (b) and (c) of FIG. 13 than in the image I1 of (a) of FIG. 13. According to the present invention, the processing and analysis of the images I2 and I3 may be made easier, and thus the time required may be reduced. Furthermore, according to the present invention, the processing and analysis of the images I2 and I3 may be performed more precisely. Therefore, according to the present invention, the current position (the coordinates on the X-Y plane and angular position) of the electronic component ED placed in the temporary zone BZ may be determined more precisely.

[136] The positions of the corners E1 and E2 may be accurately determined by comparison with other specific points on the test table 300 or by comparison with the coordinates of the test table 300.

[137] For reference, the corners E1 and E2, which are the targets photographed by the rearrangement camera 520, may be replaced with special marks or patterns depending on the implementation.

[138] According to a preferred example, the rearrangement picker 510 and the rearrangement camera 520 are grouped and

combined into a single module. Accordingly, the relative positions of the rearrangement picker 510 and the rearrangement camera 520 are fixed.

[139] The rotator 530 rotates the rearrangement picker 510.

5 [140] The rearrangement picker 510 may be rotated by the rotator 530.

[141] The rearrangement picker 510 may be rotated forward or rearward in the Θ -axis direction by the rotator 530 by using a vertical line V1 in the Z-axis direction as the axis of rotation.

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[142] According to the present embodiment, the position of the rearrangement picker 510 is fixed in the horizontal directions, but the rearrangement picker 510 may be rotated by the rotator 530 in the Θ -axis direction.

15 [143] As the rearrangement picker 510 is rotated, the electronic component ED gripped by the rearrangement picker 510 is also rotated. Accordingly, the error of the electronic component ED rotated in the Θ -axis direction may be corrected in the state in which the electronic component

20 ED has been gripped by the rearrangement picker 510. That is, the rotator 530 has the function of correcting the error of the electronic component ED in the Θ -axis direction.

[144] That is, the reason why the rotator 530 is required is to correct the angular position of the electronic component

25 ED in the Θ -axis direction in the temporary zone BZ to rearrange it to the regular zone RZ.

[145] For example, the angular position of the temporary zone BZ may not be aligned with the angular position of the regular zone RZ. This means that the angular position of the electronic component ED in the temporary zone BZ is not aligned with the angular position of the regular zone RZ.

[146] The angular position of the regular zone RZ is aligned with the angular position of the test zone TZ on the test board TB.

[147] When the angular position of the temporary zone BZ is not aligned with and is rotated from the angular position of the regular zone RZ, the angular position of the temporary zone BZ will be aligned with the angular position of the test zone TZ. In this case, alignment between the electronic component ED and the test zone TZ may not be achieved without the correction of the angular position of the electronic component ED in the temporary zone BZ. Accordingly, when the electronic component ED in the temporary zone BZ is rearranged to the regular zone RZ, the angular position of the electronic component ED has to be corrected.

[148] In the present embodiment, the rotator 530 corrects the angular position of the electronic component ED gripped by the rearrangement picker 510 by rotating the rearrangement picker 510 in the Θ -axis direction.

[149] The movement mechanism 600 is provided to move the test table 300.

[150] The movement mechanism 600 in the present embodiment may rotate the test table 300 in the Θ -axis direction.

[151] Furthermore, the movement mechanism 600 in the present embodiment may move the test table 300 horizontally.

5 [152] As shown in the schematic excerpt of FIG. 14, the movement mechanism 600 includes a rotary mover 610 and a horizontal mover 620.

[153] The rotary mover 610 may rotate the test table 300 forward and rearward in the Z-axis direction by using a
10 vertical line V2, passing through the center of the test table 300, as the axis of rotation. The reason why the rotation of the test table 300 is required is to align the test table 300 with the test board TB. When there is another mechanical design for aligning the test table 300
15 with the test board TB, the rotary mover 610 may be omitted.

[154] The horizontal mover 620 moves the test table 300 horizontally on the X-Y plane.

[155] The horizontal mover 620 may be divided into and provided as an X-axis mover 621 and a Y-axis mover 622.

20 [156] The X-axis mover 621 may move the test table 300 horizontally in the X-axis direction.

[157] The Y-axis mover 622 may move the test table 300 horizontally in the Y-axis direction.

[158] According to the present invention, the movement
25 mechanism 600 has two functions.

[159] A first function of the movement mechanism 600 is to move the test table 300 horizontally in order to selectively

position the test table 300 in the rearrangement part RP and the connection part CP. Under the first function, an operation for moving the test table 300 horizontally in the X-axis direction is performed as a main operation. By the
5 first function of the movement mechanism 600, the test table 300 may move back and forth between the rearrangement part RP and the connection part CP.

[160] A second function of the movement mechanism 600 is to move the test table 300 to rearrange the electronic
10 component ED using the rearrangement mechanism 500. Under the second function, an operation for moving the test table 300 horizontally in the X- and Y-axis directions is performed as a main operation. By the second function of the movement mechanism 600, the electronic component ED
15 placed in the temporary zone BZ may be moved to the regular zone RZ.

[161] The connector 700 electrically connects the electronic components ED, loaded onto the test table 300 that is moved to the connection part CP, to the tester.

20 [162] The connector 700 may press the test table 300 toward the test board TB placed above the test table 300. Accordingly, the electronic components ED loaded onto the test table 300 are electrically connected to the test board TB, thereby ultimately electrically connecting the
25 electronic components ED to the tester. The testing of the electronic components ED is performed in the state in which the electronic components ED have been electrically

connected to the tester by the connector 700. In this case, the electronic components ED loaded onto the test table 300 has to be in the state in which they have been rearranged from the temporary zones BZ to the regular zones RZ through
5 a rearrangement operation performed in the rearrangement part RP.

[163] In the present embodiment, the test table 300 is positioned below the test board TB. Accordingly, the connector 700 is provided to lift/lower the test table 300.

10 [164] According to the present embodiment, the connector 700 has two functions.

[165] A first function of the connector 700 is to electrically connect the electronic components ED, placed on the test table 300, to the test board TB by lifting the test
15 table 300 toward the test board TB placed above the test table 300. In this case, the electronic components ED are electrically connected to the test board TB via respective corresponding test zones TZ.

[166] A second function of the connector 700 is to lift the
20 test table 300 in the rearrangement part RP so that the rearrangement picker 310 can grip or release the electronic component ED. Furthermore, the second function of the connector 700 is to lower the test table 300 so that, when the test table 300 is moved by the movement mechanism 600,
25 the test table 300 does not interfere with the electronic component ED gripped by the rearrangement picker 510. That is, the second function of the connector 700 is to lift the

test table 300 during the process of rearranging the electronic component ED.

[167] As described above, according to the present embodiment, during the process of rearranging an electronic component ED, the test table 300 is moved horizontally or vertically and the rearrangement picker 510 is rotated. This will be further described using an example.

[168] When the rearrangement picker 510 needs to grip an electronic component ED in a temporary zone BZ for the rearrangement of the electronic component ED, the rearrangement picker 510 has a fixed position in the horizontal directions and the test table 300 is lifted by the connector 700. Then, the rearrangement picker 510 enters a state in which it can grip an electronic component ED loaded onto the test table 300.

[169] When the rearrangement picker 510 grips the electronic component ED, the test table 300 is lowered by the connector 700. Thereafter, the test table 300 is moved horizontally by the operation of the movement mechanism 600, while the electronic component ED gripped by the rearrangement picker 510 is rotated by the operation of the rotation mechanism 530. Accordingly, the regular zone RZ into which the electronic component ED is to be loaded is aligned with the electronic component ED being gripped by the rearrangement picker 510. Then, the test table 300 is lifted again by the connector 700, thereby allowing the test table 300 to enter a state capable of supporting the electronic component ED.

[170] When the electronic component ED is fixed to the test table 300 by the vacuum pressure provided via the vacuum hole h in the state in which the test table 300 is supporting the electronic component ED, the rearrangement
5 picker 510 releases the electronic component ED.

[171] When the rearrangement picker 510 releases the electronic component ED, the connector 700 lowers the test table 300.

[172] According to the present embodiment, when the test
10 table 300 is moved horizontally for rearrangement, the rearrangement picker 510 is also rotated, thereby reducing the time required for rearranging an electronic component ED and making the calculation required for correcting the misalignment of the electronic component ED simpler, so that
15 the handling speed required for rearranging the electronic component ED can be improved.

[173] For reference, as in the present embodiment, when an implementation is made to move the test table 300 horizontally during the process of moving the electronic
20 component ED from the temporary zone BZ to the regular zone RZ, the manufacturing cost may be reduced.

[174] According to a preferred example of the handler TH according to the present invention, the rotational movement, horizontal movement, and vertical movement of the test table
25 300 are required for alignment between the test table 300 and the test board TB. Accordingly, when a movement structure for the test table 300 is also utilized for the

rearrangement of the electronic component ED, the manufacturing cost may be reduced.

[175] The controller 800 controls the components, such as the transport shuttle 100, the first hand 210, the second
5 hands 220, the vacuum devices 400, the rearrangement mechanisms 500, the movement mechanisms 600, and the connectors 700, required for the appropriate operation of the handler TH.

[176] The controller 800 analyzes images to calculate the
10 degree of misalignment of the electronic component ED when the camera C1 photographs the electronic component ED loaded onto a JEDEC tray or ring frame, and also controls the rotator R1 to operate to correct the misalignment of the electronic component ED when the picker P1 of the first hand
15 210 grips the electronic component ED.

[177] The controller 800 analyzes images acquired by sequentially photographing the first and second corners E1 and E2 of the electronic component ED, loaded onto the test table 300 by the second hand 220, with the rearrangement
20 camera 520 to calculate the temporary zone BZ of the electronic component ED on the test table 300. Then, the relative positional relationship between the temporary zone BZ and the regular zone RZ may be known, so that the direction and movement distance for the horizontal movement
25 of the test table 300 and the rotational movement of the rearrangement picker 510 required to move the electronic component ED to the regular zone RZ may be determined.

[178] The controller 800 may be implemented to calculate the height of the electronic component ED via an image captured by the camera C1 or the rearrangement camera 520 and determine the lifting height of the picker P1 or the lifting height of the test table 300. However, when an implementation is made to allow an administrator to input the height of the electronic component ED via a separate input means, the controller 800 determines the lifting height of the picker P1 and the rearrangement picker 510 according to the height of the electronic component ED set by the input.

[179] Next, the operation of the handler TH described above will be described.

[180] First, in the unloading part LU, the first hand 210 loads the electronic components ED to be tested onto the transport table 110 in the first area A1. During this process, the positions of the electronic components in the X-, Y-, and Θ -axis directions may be adjusted.

[181] Once all the electronic components ED have been loaded onto the transport table 110, the transport shuttle 100 operates to move the transport table 110 to the second area A2. Then, the second hand 220 unloads the electronic components ED from the transport table 110 and moves them to the test table 300 placed in the rearrangement part RP. In this case, the positions of the electronic components ED loaded onto the test table 300 by the second hand 220 are temporary zones BZ. In this case, the number of electronic

components ED that can be loaded onto the test table 300 may be larger than the number of electronic components ED that can be loaded onto the transport table 110. In this case, the transport table 110 may move back and forth between the first area A1 and the second area A2 two or more times to transport electronic components ED to be tested.

[182] Once all the electronic components ED to be tested have been loaded onto the test table 300, the controller 800 operates the rearrangement mechanism 500 and the movement mechanism 600 to rearrange the electronic components ED from the temporary zones BZ to the regular zones RZ.

[183] When the rearrangement of electronic components ED on the test table 300 is completed, the movement mechanism 600 operates to move the test table 300 to the connection part CP. Thereafter, the connector 700 operates to lift the test table 300 toward the test board TB so that the electronic components ED are electrically connected to the tester.

[184] When the testing of the electronic components ED is completed, the connector 700 operates to lower the test table 300 and then the test table 300 is moved to the rearrangement part RP by the movement mechanism 600. Then, the second hand 220 moves the tested electronic components ED to the transport tray 110 in the second area A2, and the transport tray 110 filled with the tested electronic components ED moves to the first area A1. Then, the first hand 210 unloads the tested electronic components ED from the transport table 110.

[185] According to the present invention, two rearrangement parts RP are disposed, and are provided with two second hands 220, two test tables 300, two rearrangement mechanisms 500, two movement mechanisms 600, and two connectors 700.

5 This is intended to improve the operation rate by reducing the idle time of the tester.

[186] For example, it is assumed that the testing of electronic components ED is performed in the state in which the test table 300 on one side has been aligned with the test board TB. Then, on the test table 300 on the other side, the task of emptying the tested electronic components ED, the task of filling the test table 300 with electronic components ED to be tested after the tested electronic components ED have been emptied, and the task of rearranging the electronic components ED are performed. Accordingly, the operation rate of the handler TH may be increased and the idle time of the tester may be minimized.

[187] **<Modified Example of First Embodiment>**

[188] According to the present modified example, an elevator is added to the rearrangement mechanism 500.

[189] As shown in FIG. 15, the rearrangement mechanism 500 in the present modified example includes a rearrangement picker 510, a rearrangement camera 520, a rotator 530, and an elevator 540.

25 [190] In the present modified example, during the process of rearranging an electronic component ED, the rearrangement

picker 510 is lifted by the elevator 540 instead of the test table 300 being lifted.

[191] For example, when the rearrangement picker 510 is lowered, it may grip an electronic component ED from the test table 300 or seat an electronic component ED onto the test table 300. That is, according to the present modified example, in the rearrangement part RP, the vertical position of the test table 300 is fixed and the rearrangement picker 510 is lowered by the elevator 540, so that an electronic components ED can be handed over between the test table 300 and the rearrangement picker 510.

[192] (a) of FIG. 16 shows the state in which the rearrangement picker 510 has currently been lifted.

[193] In the state of (a) of FIG. 16, the test table 300 may be moved horizontally such that the rearrangement camera 520 can photograph an electronic component ED or the rearrangement picker 510 can grip an electronic component ED.

[194] (b) of FIG. 16 shows the state in which the rearrangement picker 510 has been lowered.

[195] In the state of (b) of FIG. 16, an electronic component ED may be handed over between the rearrangement picker 510 and the test table 300.

[196] According to the present modified example, the position of the rearrangement picker 510 is fixed in the horizontal directions. Then, the rearrangement picker 510 is lifted in the vertical direction, so that the

rearrangement picker 510 can grip the electronic component ED on the test table 300 or seat the electronic component ED on the test table 300.

5 [197] According to the present modified example, the connector 700 operates only when the electronic component ED on the test table 300 is electrically connected or disconnected to or from the tester. Accordingly, the occurrence of the operational errors caused by the settings disrupted due to frequent use may be minimized, and the
10 electrical connection between the electronic component ED and the tester may be accurately set up accordingly.

[198] As described above, according to the present modified example, the horizontal position of the rearrangement picker 510 and the position of the rearrangement camera 520 are
15 fixed during the process of rearranging the electronic component ED. Then, the rearrangement picker 510 is lifted/lowered and rotated and the test table 300 is moved horizontally, thereby rearranging the electronic component ED. This will be described further using an example.

20 [199] To rearrange the electronic component ED, the test table 300 is first moved horizontally such that the rearrangement camera 510 can photograph the electronic component ED placed in the temporary zone BZ.

[200] The rearrangement camera 520 photographs the
25 electronic component ED on the test table 300. In this case, the test table 300 may be moved horizontally again by

a predetermined distance to photograph both corners E1 and E2 in two stages.

[201] When the photographing is completed by the rearrangement camera 520, the test table 300 is moved horizontally such that the electronic component ED placed in the temporary zone BZ can be gripped by the rearrangement camera 520. Then, the rearrangement picker 510 is lowered by the elevator 530 to grip the electronic component ED placed in the temporary zone BZ.

[202] When the rearrangement picker 510 grips an electronic component ED, the rearrangement picker 510 is lifted by the elevator 530, and the rotator 530 and the movement mechanism 600 operate to move the test table 300 horizontally and rotate it such that the electronic component ED gripped by the rearrangement picker 510 is aligned with the regular zone RZ. When the electronic component ED gripped by the rearrangement picker 510 is aligned with the regular zone RZ, the rearrangement picker 510 is lowered again by the elevator 530, thereby enabling the rearrangement picker 510 to seat the electronic component ED on the regular zone RZ of the test table 300.

[203] When the electronic component ED is fixed to the test table 300 by vacuum pressure provided via the vacuum hole h in the state in which the test table 300 is supporting the electronic component ED, the rearrangement picker 510 releases the electronic component ED.

[204] When the rearrangement picker 510 releases the electronic component ED, the elevator 530 lifts the rearrangement picker 510.

[205] **<Second Embodiment - Extended Example>**

5 [206] In the extended example, the rearrangement mechanism 500 is provided with a plurality of rearrangement pickers 510.

[207] As referenced from FIG. 17, the rearrangement mechanism 500 includes two rearrangement pickers 510, a
10 rearrangement camera 520, and two rotators 530.

[208] The rearrangement mechanism 500 may grip two electronic components ED with the two rearrangement pickers 510.

[209] The two rearrangement pickers 510 may operate
15 independently of each other.

[210] The two rotators 530 rotate the two rearrangement pickers 510 independently of each other. That is, even when two electronic components ED gripped by the respective two rearrangement pickers 510 are misaligned at different
20 positional angles, the two electronic components ED may be corrected independently of each other according to the degree of misalignment.

[211] According to the present extended example, the rearrangement camera 520 sequentially photographs two
25 electronic components ED placed in the two respective temporary zones BZ, and then the two electronic components are gripped by the two rearrangement pickers 510.

[212] The two electronic components ED gripped by the two rearrangement pickers 510 are independent of each other, and simultaneously, the correction of the misalignment in the Θ -axis direction may be performed.

5 [213] It is also possible to include three or more rearrangement pickers 510 and three or more rotators by further expanding the present extended example.

[214] **<Modified Example of Extended Example>**

10 [215] Referring to FIG. 18, a rearrangement mechanism 500 according to the present modified example includes two rearrangement pickers 510, a rearrangement camera 520, two rotators 530, and two elevators 540.

[216] The two elevators 540 are provided to lift/lower the rearrangement pickers 510 independently of each other.

15 [217] According to the present modified example, the sequential seating of electronic components ED is possible during the process in which the rearrangement picker 510 seats the electronic components ED onto the test table 300. That is, one electronic component ED is first seated into
20 the first regular zone RZ of the test table 300, and then the other electronic component ED may be seated into the second regular zone RZ of the test table 300.

[218] When the present modified example is applied, the rearrangement of electronic components ED may be performed
25 more precisely.

[219] The present modified example may also be further extended to include three or more rearrangement pickers 510, three or more rotators 530, and three or more elevators 540.

[220] The above-described embodiments have been described
5 using preferred examples of the present invention, and may have various forms of application. Therefore, the present invention should not be understood as being limited only to the content described above. Instead, the scope of the present invention should be understood as the separately
10 described claims and their equivalents.

CLAIMS

[Claim 1] A handler for testing electronic components,
the handler comprising:

5 a transport shuttle provided with a transport table
capable of transporting electronic components by moving with
the electronic components loaded thereonto;

a first hand configured to load the electronic
components onto the transport table that is placed in a
first area by an operation of the transport shuttle;

10 a second hand configured to unload the electronic
components from the transport table that is moved from the
first area to a second area by an operation of the transport
shuttle;

15 a test table configured such that the electronic
components unloaded from the transport table by the second
hand are loaded thereonto;

a rearrangement mechanism configured to rearrange the
electronic components, loaded into temporary zones of the
test table by the second hand, to regular zones;

20 a movement mechanism configured to move the test table
to rearrange the electronic components to the regular zones
by using the rearrangement mechanism;

a connector configured to enable the electronic
components, loaded onto the test table, to be tested by
25 electrically connecting the electronic components to a
tester; and

a controller configured to control the transport shuttle, the first hand, the second hand, the rearrangement mechanism, the movement mechanism, and the connector;

wherein the rearrangement mechanism comprises:

5 a rearrangement picker capable of gripping an electronic component;

 a rearrangement camera disposed to be spaced apart from the rearrangement picker; and

10 a rotator configured to correct misalignment of the electronic component gripped by the rearrangement picker by rotating the rearrangement picker.

[Claim 2] The handler of claim 1, wherein the rearrangement picker and the rearrangement camera have their fixed positions in horizontal directions.

15 [Claim 3] The handler of claim 2, wherein the rearrangement picker and the rearrangement camera are coupled to each other so that relative arrangement positions thereof are fixed.

20 [Claim 4] The handler of claim 1, wherein the movement mechanism comprises a horizontal mover configured to move the test table horizontally.

[Claim 5] The handler of claim 1, wherein the rearrangement mechanism further comprises an elevator

configured to lift or lower the rearrangement picker.

[Claim 6] The handler of claim 1, wherein the rearrangement picker and the rotator comprise a plurality of rearrangement pickers and a plurality of rotators,
5 respectively, and the rearrangement pickers are rotated independently of each other.

[Claim 7] The handler of claim 6, wherein the rearrangement mechanism further comprises a plurality of elevators configured to lift or lower the rearrangement
10 pickers independently of each other.