

Description



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Method and apparatus for identifying the position of connections and/or edges of components

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The invention relates to a method for identifying the position of connections and/or edges of components in accordance with the preamble of Patent Claim 1.

10 When SMD components are being mounted automatically on printed circuit boards or ceramic substrates, the individual components are removed from a magazine or a feed device by means of a component-mounting head and are then position in a predetermined
15 position on the printed circuit board or the ceramic substrate. Since the components in the magazine or in the pick-up position of a feed device have a positional tolerance of about 1 mm, but must be positioned with high accuracy on the printed circuit board or the
20 ceramic substrate, automatic position identification and correction are required. The position identification process should take as little time as possible in order to allow a high component-mounting performance of the automatic component-mounting
25 machine.

Known arrangements for identifying the position of the connections and/or the edges of components use an objective lens to image the component, or details of the component, onto a large-area CCD camera, and use
30 digital image processing to determine the position of the component connections. Afterwards, with the aid of a conveying apparatus on which the component is fastened to the component-mounting head, the position of the component is corrected prior to emplacement. In
35 practice, the method is also referred to as optical centring of the components.

WO 93/19577 discloses a method for position identification in which a direct shadow cast by the



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connection region of a component side is produced on
the photosensitive area of a spatially resolving
optoelectronic transducer

as camera. In this case, the optoelectronic transducer is fastened on the component-mounting head and the position of the connections with regard to the optoelectronic transducer is determined. By means of a
5 known relative position of the optoelectronic transducer with respect to the component-mounting head, the position of the connections with regard to the component-mounting head is determined therefrom. In this method, it is assumed that the position of the
10 camera relative to the conveying apparatus is precisely known and can be moved to precisely. Any error caused by a drift in the camera location or by transient processes when moving to the camera position influences the measurements as an error. Therefore, it is
15 necessary to wait until the conveying apparatus has settled.

Methods are also known in which, during continuous movement of the conveying apparatus with the component, the component is recorded with a very short
20 exposure time (flash operation). At the instant of recording, the position of the conveying apparatus relative to the camera is then determined by adopting a counter reading of axes of the conveying apparatus. In the event of drag errors between counter reading and
25 current position of the conveying apparatus, the determination of the relative position between component and conveying apparatus is made more difficult in this method as well.

The object of the invention, therefore, is to
30 specify a method and an apparatus which ensure more accurate and faster identification of the position of components with regard to the conveying apparatus.

The object is achieved according to the invention with a method of the type mentioned in the
35 introduction with the characterizing features in accordance with Patent Claim 1.

By virtue of the joint recording of position markings fixedly connected to the conveying apparatus

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and of the connections and/or the edges of the
components, the relative

position between the conveying apparatus and the connections and/or the edges is determined in the image evaluation unit without knowledge of the exact position of the camera, as a result of which more accurate
5 position identification is ensured. Transient processes do not influence the accuracy, since they act on the position markings and the connection and/or the edge in the same way.

In accordance with the refinement of the method
10 according to the Claim 2, the position markings are connected to the conveying apparatus in such a way that they are arranged in direct proximity to the connections and/or the edges, as result of which they lie with the connections and/or the edges in a common
15 depth of field range of the camera and are recorded sharply together.

In the preferred refinement of the method in accordance with Claim 3, the position markings are imaged by optical imaging into the direct proximity of
20 the connections and/or edges, as a result of which the surroundings of the connections and/or the edges are kept free of complicated constructions.

In Claim 4, the method is advantageously developed by the imaging being effected onto a matt
25 plate in direct proximity to the connections and/or the edges, thereby simplifying the recording of the imaging by the camera.

In the method according to Claim 5, faster implementation of the identification of the position of
30 the components is ensured by virtue of the fact that the recording is effected with a short exposure time and thus also during the movement of the conveying apparatus.

Claim 6 specifies an apparatus for carrying out
35 the method which is developed further in the dependent claims.

The apparatus according to Claim 7 transfers the current position of the conveying apparatus to the recording in a particularly stable manner by the direct arrangement of the position markings in direct
5 proximity to the connections and/or the edges.

The refinement of the apparatus according to Claim 8 has the additional advantage that the optical imaging apparatus produces a real image of the position marking in proximity to the connections and/or the
10 edges, thereby avoiding complicated fastening constructions in direct proximity to the connections and/or the edges.

In the advantageous refinement in accordance with Claim 9, the optical imaging device is also
15 fixedly connected to the conveying apparatus, so that the position of the real image is not dependent on a possibly varying position of the optical imaging device.

The refinement according to Claim 10
20 additionally provides a matt plate onto which the real image is projected, which facilitates the recording of the real image by the camera.

According to Claim 11, the matt plate is also connected fixedly to the conveying apparatus in order
25 to avoid additional uncertainties during the position determination process.

The matt plate can also advantageously be connected to the camera in accordance with Claim 12, as a result of which the conveying apparatus becomes
30 lighter and thus more movable more simply.

In an advantageous refinement, the matt plate can be configured as part of a field lens in accordance with Claim 13, as a result of which more light is available for the real image.

The invention is explained in more detail below using exemplary embodiments in the figures of the drawing.

In the figures:

- 5 Figure 1 shows a schematic cross section through an apparatus for position identification with position markings in direct proximity to the connections, and Figure 2 shows a schematic cross section through an apparatus for position identification with imaging of
10 the position markings onto a matt plate fastened on the conveying apparatus in direct proximity to the connections, and Figure 3 shows a schematic cross section through an apparatus for position identification with imaging of
15 the position markings onto a matt plate fastened on the camera.

Figure 1 illustrates how the connections 1 of a component 2 are used for position identification. Analogously to the connections 1, the edges of the
20 components 2 can also be used for position identification. In this case, by way of example, the component 2 is fastened, in a manner that allows it to be released, by means of a suction pipette 3 on a conveying apparatus 4 of a component-mounting head (not
25 illustrated). The conveying apparatus can move translationally in at least 3 directions X, Y, Z in order to pick up the component 2 from feed devices (not illustrated) and in order to place the component 2 on printed circuit boards or ceramic substrates (not
30 illustrated), and a rotary movement D about a central axis 5 of the suction pipette 3, for example, is additionally provided for the purpose of positional correction of the component. A camera 6 with an image evaluation unit 7 connected downstream and serving for
35 digital image evaluation records the connections together with at least one position marking 10, which is fixedly connected to the conveying apparatus by means of a fastening apparatus 11. As a result, the

relative position between the position marking 10 and the conveying apparatus is fixedly prescribed and known. In this case, the position marking 10 is arranged

in such a way that it is situated in the same depth of field range of the camera 6 as the connections 1, so that the position marking and the connections 1 are imaged sharply together. Consequently, in the image evaluation unit 7, the relative position between the components 2 and the conveying apparatus 4 is determined directly and a correction of the movement of the conveying apparatus 4 is determined therefrom in order to achieve the correct emplacement position of the component 2 on the printed circuit board or the ceramic substrate.

Figure 2 illustrates, as an additional exemplary embodiment, an apparatus in which the position markings 10 are further removed from the connections 1 by comparison with the previous exemplary embodiment, but are imaged onto a matt plate 13 by means of an optical imaging device 12. In this case, the matt plate 13 is arranged in direct proximity to the connections 1, with the result that it is situated together with the connections 1 in the same depth of field range of the camera 6. In an advantageous manner, the matt plate 13 and the optical imaging device 12 are fixedly connected to the conveying device 4 by means of the fastening apparatus 11, so that displacements between these components which would lead to less accurate position determinations do not occur.

The matt plate 13 can also be dispensed with if the real image of the position marking is recorded directly by the camera 6. Complicated constructions in proximity to the component 2 and the connections 1 are thereby avoided, as a result of which components 2 of different sizes can also be processed by a common position identification device.

Figure 3 illustrates that the matt plate 13 can also be fastened on the camera 6. The matt plate 13 can advantageously be designed as part of a field lens 14, the field lens 14 constituting at least part of the

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optical imaging device 12. By virtue of the field lens
14, more light

is available for generating the image; the image acquires greater luminous intensity.

By virtue of the direct recording of the position of the conveying apparatus 4 with the connections 1 of the component 2, it is possible, with a shorter exposure time, to determine the relative position between the conveying apparatus 4 and the connections 1 even when the conveying apparatus 4 is moving relative to the camera 6, as a result of which the time for position identification is reduced and the component-mounting performance is increased.

Claims

1. Method for identifying the position of connections (1) and/or edges of components (2) with regard to a conveying apparatus (4), on which the components (2) are fastened, for transport, in a manner that allows them to be released, in which case, in position identification devices comprising a camera (6) with an image evaluation unit (7) connected downstream, the camera (6) records an imaging of the connections (1) and/or of the edges at least in regions, and at least one position marking (10) is fixedly connected to the conveying apparatus (4),
characterized
in that a real image of the position marking (10) is generated in direct proximity to the connections (1) and/or the edges, and
in that the real image is recorded together with the connections (1) and/or the edges by the camera (6), and in that the relative position between the connections (1) and/or the edges and the position marking (10) and hence between the connections (1) and/or the edges and the conveying apparatus (4) is determined from the common recording of the position marking (10) and the connections (1) and/or the edges.
2. Method for position identification according to Claim 1,
characterized
in that the real image in direct proximity to the connections (1) and/or the edges is projected onto a matt plate (13).

3. Method for position identification according to either of Claims 1 and 2,
characterized
in that the connections (1) and/or the edges and the position marking (10) are recorded jointly with a short exposure time during the movement of the conveying apparatus (4).
4. Apparatus for identifying the position of connections (1) and/or edges of components (2) with regard to a conveying apparatus (4) on which the components (2) are fastened, for transport, in a manner that allows them to be released, having a camera (6) with an image evaluation unit (7) connected downstream, in which case the camera (6) records an imaging of the connections (1) and/or the edges at least in regions, and at least one position marking (10) is fixedly connected to the conveying apparatus (4) by means of a fastening apparatus (11),
characterized
in that an optical imaging device (12) is arranged in such a way that the said optical imaging device (12) generates a real image of the position marking (10) in direct proximity to the connections (1) and/or the edges, with the result that, for the camera (6), the imaging of the connections (1) and/or edges can be recorded jointly with the real image.
5. Apparatus for position identification according to Claim 4,
characterized
in that the optical imaging device (12) is fixedly connected to the conveying apparatus (4).

6. Apparatus for position identification according to either of Claims 4 and 5,
characterized by
a matt plate (13) arranged in direct proximity to the connections (1) and/or the edges, the real image being projected onto the said matt plate.
7. Apparatus for position identification according to Claim 6,
characterized
in that the matt plate (13) is fixedly connected to the conveying apparatus (4).
8. Apparatus for position identification according to Claim 6,
characterized
in that the matt plate (13) is fixedly connected to the camera (6).
9. Apparatus for position identification according to one of Claims 6 to 8,
characterized
in that the matt plate (13) is designed as part of a field lens (14).