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DEVICE WITHOUT SET-UP KIT FOR THE TARGETED MOVING OF ELECTRONIC
COMPONENTS

The present invention relates to a device without set-up kit for the targeted moving of electronic components with the features indicated in the preamble to Patent Claim 1.

Devices for the targeted moving of electronic components are required in particular in the testing and sorting according to quality classes of electronic components. During the actual testing procedure, the electronic component which is to be tested is initially brought into conductive contact with an electrical contact device (such as a test socket, for example). As a function of the test result, sorting or marking according to quality classes takes place thereafter.

A device is known from the prior art for the handling of electronic components, in which the electronic components which are to be tested are delivered on carrier-like set-up kits in plate or strip form, and are moved within the handling device positioned on these set-up kits.

Such handling devices with plate-shaped or strip-shaped set-up kits suffer from many disadvantages:

On the one hand, the connection between the plate-shaped or strip-shaped set-up kit and the test socket of the electrical testing device is always subjected to tolerances. On the other, there is a degree of play between the embedding of the electronic component in the plate-shaped or strip-shaped set-up kit and the electronic component.

In addition, the plate-shaped or strip-shaped set-up kits are subject to substantial wear during transport inside and/or outside the handling device, as well as when being loaded with electronic components. This wear is expressed in an increase in



the tolerances and accordingly in a shortening of the service life.

The procurement of the plate-shaped or strip-shaped set-up kits is also associated with substantial costs and maintenance times. The reason for this is that for each variant of an electronic component a separate set-up kit is required in the form of a plate-shaped or strip-shaped carrier set, which is expensive to manufacture.

The costs of a set-up kit amount as a rule to a sum of at least US\$ 20,000.00. Due to the substantial technical investment and effort in design and manufacture, the delivery time for a set-up kit is at least 60 to 90 days.

A further disadvantage is that, at the transition from one type of electronic component to another type of electronic component, the plate-shaped or strip-shaped set-up kit and the device for moving the electronic component, designed to fit precisely to the component, must be changed.

This change of set-up kit and the replacement of the moving device are associated with considerable temporal delays (approx. 4 hours), during which the test device cannot be used for testing the electronic components.

In addition to this, the handling device in this situation, after the introduction of a new plate-shaped or strip-shaped set-up kit and a new device for the movement of electronic components, is not immediately ready for operation again.

Rather, the precision of the fit and the functional capability of the new set-up kit and the movement device, designed to fit precisely to it, must first be tested in tedious series of tests and with the use of a large number of original electronic components, which can be very expensive.

In addition to this, the storage of set-up kits which are not

currently in use requires special cost-intensive storage conditions, as well as a well-organized and elaborate storage system.

A device is further known from the prior art for the handling of electronic components, with which the electronic components are not conducted on a plate-shaped or strip-shaped set-up kit but moved individually and piece by piece to a test socket, and sorted subsequent to the test.

A particular disadvantage with this handling device is the fact that damage is frequently suffered by the foot-shaped or spherically-shaped contacts of the electronic components, so incurring a substantial wastage quota.

The objective on which the present invention is based is therefore the provision of a device for the targeted moving of electronic components, which is essentially not subject to tolerances, in particular at the introduction of the electronic components into the testing and contactor device, even with very long periods of use, and operates essentially free of play, the degree of wear of which is markedly low, and which ensures a particularly long period of use and service life, which is suitable for the moving of electronic components of the most widely differing housing dimensions, contact types and contact spacings, and in this situation is not committed to its own set-up kits, adapted to the particular electronic components in each case, or moving devices for electronic components which are designed to fit these set-up kits precisely, and of which the changing from one type of electronic component to another type of electronic component is not associated with a change of set-up kit or a change of the movement device, and is therefore not associated with substantial costs or extended downtimes of the handling device, and which, in the event of a change in the type of electronic component, does not require any elaborate and expensive test of functional capability and precision of fit of a set-up kit or of the interplay between the set-up kit and the movement device, and which also does not require any separate

storage container for the storage of set-up kits not currently in use, or any well-organized and elaborate storage system for this purpose.

According to the invention, this objective is resolved with a device of a generic type, by way of the features described in the characterisation part of Patent Claim 1. Particularly advantageous embodiments are the objects of the sub-claims.

Embodiments of the invention are described in greater detail on the basis of the drawings. These show:

Figure 1: A schematic perspective view of a device according to the invention for the targeted movement of electronic components with two counter-directional conveyor belts and an electrical contact device on one side face;

Figure 2: A schematic perspective view from obliquely above of a movement device according to the invention, with four laterally displaceable handling devices, represented only in schematic form, on a transverse carrier element capable of displacement along the parallel longitudinal carrier elements;

Figure 3: A schematic view of the cable drawing mechanism used by way of example in Figure 2, for the displacement of the H-shaped movement device as well as of four handling devices located in a displaceable manner on the side faces of the transverse carrier element and only indicated in the drawing;

Figure 4: A simplified schematic plan view of a cable drawing mechanism according to Figure 3 with two handling devices located in a displaceable manner on side faces of the transverse carrier element, whereby the cable drawing mechanism for the drive of the transverse carrier element is designed in the form of an endless

belt, and at the same time displaces a handling device in the x-direction;

Figure 5: A schematic view of a transverse bellows element of a movement device according to the invention with two handling devices, represented in somewhat greater detail, whereby the component holder of the rear handling device points vertically downwards to accommodate an electronic component, while the component holder of the front handling device is directed horizontally in the contact position;

Figure 6: A transverse beam element of an H-shaped movement device according to the invention, with five different displaceable handling devices on the front face of the transverse beam element of the movement device, whereby the five component holders of these handling devices with extended accommodation surfaces engage in each case on a strip-shaped assembly of several electronic components in a horizontal contact position;

Figure 7: A simplified schematic plan view of a transverse member strip drive and two handling device cable drawing mechanisms for driving two handling devices displaceably located on the side face of the transverse carrier element, whereby the ends of the transverse carrier belt drive is located on the transverse carrier element itself, and each handling device is capable of being displaced in the x-direction along the transverse carrier element by means of a separate cable drawing mechanism;

Figure 8: A schematic, partly sectional side view of the area between the handling device and the electrical contact device, whereby a device is provided for in this area which is capable of being pivoted inwards and outwards

for the deflection of electromagnetic radiation, which allows for the observation of the underside of an electronic component by a measuring device.

The device according to the invention for the targeted moving of electronic components comprises essentially at least one conveying device (1) for the delivery of electronic components (3). It further comprises at least one handling device (2) for the taking up, pivoting, displacement, and/or rotation along the x-axis and/or y-axis and/or z-axis, as well as for the depositing of electronic components (3). The device according to the invention further comprises at least one movement device (4) for the movement of the handling device (2) about and/or along the x-axis and/or the y-axis and/or the z-axis, as well as at least one measuring device (5) for the determination of the position and alignment of the electronic components (3). As a major feature, the device according to the invention also comprises at least one electrical contact device (8) for the establishment of at least one electrically conductive connection between at least one electronic component (3) and at least one test device connected downstream of the electrical contact device (8).

As a major constituent part, the device according to the invention further comprises at least one central data-processing device (6), which is in connection on the one hand with at least one measuring device (5) as well as with at least one test device connected downstream of the electrical contact device (8), and, on the other, the drive elements (16) for driving the, at least one, handling device (2) and/or the, at least one, movement device (4) and/or the, at least one, conveying device (1, 9).

A special feature of the present invention is to be seen in the fact provision is made for at least the drive media (16) for the movement of the, at least one, conveying device (1) and/or the, at least one, handling device (2) and/or the, at least one,



movement device (4) outside the temperature chamber (12) which may be present. This measure increases the service life of the drive media (16) considerably.

The provision of a temperature chamber (12) is in most cases obligatory in the testing of electronic components, since the test temperatures may lie in the range from -60°C to $+200^{\circ}\text{C}$.

If the electronic components (3) are, for example, moved on a slow-running conveyor belt (9) to the draw-off point, there will be sufficient time available during the transport on the conveyor belt (9) for the temperature of the electronic components (3) to be balanced with the temperature of the temperature chamber (12).

Located inside the temperature chamber (12) are, at least, the electrical contact device (8) and, for preference, the handling device (2) as well as the section of the conveying media (1) pointing in the direction of the electrical contact device (8).

The drive media (16) are, for preference, electrical or pneumatic drive media, which are designed in the form of cylinders, actuator motors, stepped motors, servomotors, or electromagnets. These can be put into effect, for example, by a spindle drive, worm drive, cable drawing mechanism, belt drive, band drive, toothed belt drive, toothed bar drive, pneumatic cylinder, flexible shafts (22, 24), Bowden cables (23), or a combination thereof.

The conveying media (1) may be, for example, a vibration conveyor, a slide, or a conveyor belt. As a rule, the conveying media (1) comprise at least one conveyor belt (9), of which the direction of run is directed in a plan view parallel or at right angles to the contacting plane (7).

As an alternative or addition to this, it is possible for the conveying media (1) to be designed in the form of at least one manual or automatic conventional commercial loading or unloading device for tubular, tray-form, rail-form, bar-form, cassette-

form, strip-form, or belt-form storage containers for electronic components (3).

In particularly preferred embodiments, however, the conveying media (1) are embodied by at least two conveyor belts (9), running essentially parallel to one another (see Fig. 1).

The direction of run of at least one conveyor belt (9) is in that case aligned by way of example at right angles in the direction of the contactor device (7), while the direction of run of the, at least one, further conveyor belt (9) is aligned counter to the direction of run of the first conveyor belt. The second conveyor belt (9) can, for example, lead off the electronic components deposited on it, which have been sorted by classes. The guide rails (21) which may be provided, shown in Figure 1, in this case prevent the components of different quality classes from being unintentionally mixed.

The handling device (2) comprises at least one component holder (18) in the form of at least one gripper or suction element, for preference easily exchangeable. A suction element (18) according to the invention can, for example, essentially feature the shape of a tube, and have a more or less extended accommodation surface (11), as required, at its free end. Since each suction element or gripper is suitable, by way of its design, not only for one single housing size of a specific kind of electronic component (3, 3'), but in principle can be considered for the accommodation and transport of electronic components of the most widely differing housing dimensions and types, it is not necessary, in the case of the transport device according to the invention, at each transition from one type of electronic component to another, or at each change of housing of the electronic components (3), to replace the component holder (18) or even, as with the prior art, to replace the entire movement device for the electronic components (3).

The component holder (18) is for preference capable of being

pivoted by at least 90° or 180° about a longitudinal axis (10) running parallel to the contact plane (7), for example by means of a Bowden cable (23) (see Figures 5 and 6). In this way, the component accommodation surface (11) of the component holder (18), located as a rule at the end, can be brought into an essentially parallel alignment to the electrical contact device (8) and then moved back into the depositing position, pointing vertically downwards.

In particularly preferred embodiments, the handling device (2) further comprises at least one second carriage, which is capable of displacement vertically in the z-direction, and which is located for example on the front face of the carriage (17), which is capable of being displaced in the x-direction. This second carriage, capable of displacement in the z-direction, may carry at least one component holder (18) on its front face.

If appropriate, a flexible shaft (22) can drive, by means of a worm gear, the additional carriage in the z-direction, located in a vertically sliding manner at the carriage (17).

This leads on the one hand to the advantage that orientation errors of the component holder (18), pointing vertically downwards, when lowering onto the electronic component (3) along the y-axis can be compensated for by a movement of the second carriage along the z-axis, which compensates for this orientation error.

The adjustability of the handling device (2) along the z-axis further leads to the advantage that orientation errors in respect of the rotation with a strip-shaped or plate-shaped grouping of electronic components (3') can be rectified particularly rapidly and simply in terms of instrumentation.

As can be seen in particular from Fig. 6, it is possible, by simple raising and/or lowering in the vertical z-direction, of at least one, or two or all component holders (18), to compensate with no difficulty for an orientation error of the plate-shaped or strip-shaped grouping about the horizontal axis

of rotation.

This type of correction of orientation errors can be used not only with plate-shaped or strip-shaped groupings of electronic components (3'), for example, but in principle also with such individual electronic components (3') on the housing surface of which there are at least two accommodation surfaces (11) of at least two container holders (18).

As an alternative or in addition to this type of correction of orientation errors with regard to the rotation of electronic components (3) it is possible for the handling device (2) to be designed in such a way that it will allow for at least one rotation of the component holder (18), pivoted upwards in the contact position, about its longitudinal axis (y-axis).

For this purpose, a flexible shaft (24) can be in contact, for example by means of a worm drive, with a rotatable circular table located on the second carriage, said carriage if appropriate being capable of displacement vertically in the z-direction, whereby the circular table can carry at least one component holder (18) on its front face. In the accommodation or deposition position of the component holder (18), pointing vertically downwards, this rotation mechanism can if necessary be blocked.

The, at least one, movement device (4) for moving the handling device (2) comprises for preference essentially two parallel guide rails (13), spaced at least some distance apart, and a transverse carrier (15) extending at right angles to the longitudinal axis (14) of the guide rails (13) (see in particular Figures 2 to 4 and 7). The transverse carrier (15) is for preference mounted on the guide rails (13) so as to be longitudinally displaceable.

On the face of the transverse carrier (15) pointing in the direction of the electrical contact device (8), there are

arranged, as a rule, a plurality of handling devices (2) about and/or along the x-axis and/or the y-axis and/or the z-axis, in a displaceable and/or pivotable manner. Accordingly, the, at least one, handling device (2) can be provided, for example, on at least one carriage (17), which is located on a guide rail (25) provided on the face of the transverse carrier (15), capable of displacement at least in the x-direction, for example by means of a cable drawing mechanism (19).

The displacement or pivoting movements of the handling device (2) about the same or different axes can be carried out dependently or independently of one another (see Figures 5 and 6).

As can be seen in particular from Figures 3 and 4, the transverse carrier (15) is capable of displacement on the guide rails (13), for example by means of two drive elements (16), which take effect by means of at least one toothed belt or cable drawing mechanism (19).

In the embodiments of the movement device (4) shown in Figures 3 and 4, the same drive elements (16) as move the transverse carrier (15), as a function of their direction of rotation, for preference carry out the displacement movement at the same time of a first handling device (2) on the face of the transverse carrier (15) in the x-direction.

During the contacting process, as far as may be required, a considerable contact pressure of the transverse carrier (15) is to be applied in the direction of the electrical contact device (y-direction).

Under certain circumstances this may lead to a rotation of the conveyor belt (19), which displaces the transverse carrier (15) in the y-direction, which may result in an unintentional change of position in the x-direction of the handling device (2), which according to Figure 4 is coupled to the transverse carrier conveyor belt (19).

Inasmuch as a substantial contact pressure is to be applied by the transverse carrier (15) in the y-direction, it has transpired to be advantageous, in order to avoid unintentional changes of position of the handling devices (2) in the x-direction, for the belt drive (19), toothed belt or cable drawing mechanism of the transverse carrier (15) to be designed not in the form of a circulating endless belt, but with its end points in a fixed connection with the transverse carrier (15) (see Figure 7). The actuation of the handling devices (2) in the x-direction is then effected, for example, by means of additional drawing cable, belt, or toothed belt mechanisms (19), decoupled from the transverse carrier drive belt (19).

As can be seen from Figure 7, two drive assemblies (16), for example, located outside the temperature chamber and started synchronously, provide exclusively for the movement of the transverse carrier (15) in the direction of the electrical contact device (8) (y-direction).

As a rule, further handling devices (2) are provided for on the side face of the transverse carrier (15), for preference four to ten of them (see Figure 6). These can, if appropriate, be displaced by further drive media (16), if appropriate independently of the transverse carrier (15) as well as independently of the first handling device (2), dependently or independently on one another, along the x-axis and/or the y-axis and/or the z-axis.

The, at least one, measuring device (5) is, for example, at least one mechanical or contact-free optical, electrical, capacitative, or inductive measuring device (5).

The field of vision of at least one measuring device (5) is for preference directed essentially towards that section of the conveying media (1, 9) which is adjacent to the electrical contact device (8), and delivers the electronic components (3) which are to be moved. This may, for example, be an input

camera, which in the plan view (live-bug) determines the position, the orientation, and the dimensions of the housing of electronic component being delivered (3).

As a rule, the dimensions of the housing of an electronic component (3) are subject to tolerances. The positions of the contact media of an electronic component (3) may be subject to tolerances in respect of the housing of the electronic component (3).

To ensure the optimum contact between the arrangement of the contact media of the electronic component (3) on the one hand and the electrical contact device (8) on the other, in a preferred embodiment of the device according to the invention the dimensions, position, and alignment of the housing of the electronic component (3) are detected not only with a first measuring device (5), such as an input camera in the plan view (live-bug).

Rather, it is possible, by means of a second measuring device (5), such as a fine positioner camera with telecentric lens, to assess in addition the underside (dead-bug) of the electronic component (3) with the arrangement of contact media which in the final analysis are determinant for establishing trouble-free contact.

As can be seen in particular from Figure 8, it is possible for this purpose to make provision on the front face towards the electrical contact device (8) for a device (26), capable of pivoting outwards and inwards, for the deflection of electromagnetic radiation, from the area between the electrical contact device (8) and the free end of the component holder (18) pivoted upwards in the direction of the electrical contact device (8). This allows for the representation of the underside (dead-bug) of an electronic component (3) located on a component holder (18) pivoted upwards in the direction of the electrical contact device (8) on the representation plane of, for example, the fine positioner camera (5).

The device(s) (26) for the deflection of electromagnetic radiation may be, for example, one or more pivotable or fixed totally-reflective or partially-permeable mirrors or three-edged or five-edged prisms.

In Figure 8 a mirror-type device (26) pivots away upwards as the electronic component (3) approaches.

It is of course also possible, instead of a path pivoting movement upwards, for the mirror-type device (26) to pivot downwards.

This arrangement leads to the advantage that the electronic component (3), in comparison with the embodiment with the mirror-type deflection device (26) pivoting upwards, can be moved earlier in the direction of the electrical contact device (8), and especially to the fact that the risk of a collision between the approaching electronic component (3) and the mirror-type deflection device (26) no longer pertains at an earlier moment than in the case of a mirror-type device (26) pivoting upwards. This saving of time leads to an increased throughput and so improves the economic performance of the device according to the invention.

It is of course possible for the pivot axis of the deflection device (26), as shown in Figure 8, to be provided for, in a side view, in the area of the contact device end of the deflection device (26).

As an alternative or addition to this, the one or more pivot axes of the deflection device (26) can be provided for in the area of the deflection device (26) located opposite, turned towards the electronic component (3). Of particular advantage in this case is the fact that the fine positioner camera (5) is able, in a particularly simple manner, on the one hand to observe the underside of the electronic component (3) and, after activation of the opposite axis of rotation, on the other hand is also able to observe the electrical contact device (8), and

can detect contamination or manifestations of wear there.

In an embodiment which is particularly favourable to manufacture in terms of costs, the device (26) for the deflection of electromagnetic radiation for the observation of the underside of the electronic component (3) is provided in a fixed position, for example, laterally to or below or above the electrical contact device (8). Disadvantageous in this case is, in particular, the fact that the signals derived at that point from the fine positioner camera (5) may not accord fully, under certain circumstances, with those values which, after the displacement of the component holder (18), pertain in the contacting position. This can lead to a slightly disadvantageous influence on the contacting quality.

It has proved to be particularly advantageous for one or more reference markers (27), unambiguously allocated to the co-ordinate system of the electrical contact device (8), to be provided within the field of vision of the measuring device (5; fine positioner camera) directed towards the device (26) for the deflection of electromagnetic radiation. The provision of such reference markers allows for independence to be achieved of the positioning of the electronic component (3) from the maintaining of the exact setting angle of the mirror-type or prism-type deflection device (26).

The reference markers (27) can be, for example, dots, crosses, notches, or the like, which are located, printed, or reflected into the device (26) for the deflection of electromagnetic radiation.

As Figure 8 shows, it is also possible to make provision for the reference markers (27), for example, on a glass plate (30) connected downstream of the deflection device (26) in the direction of the fine positioner camera (5).

To avoid the flooding of the fine positioner camera (5) with background signals incurred by the handling device (2),

provision is made to advantage of a sight diaphragm (31) as represented in Figure 8. This diaphragm can, for example, be pivoted in from top and bottom and from left and right, or can close in iris diaphragm fashion around the component holder (18).

It is of course also possible for the sight diaphragm (30) to be located directly on the component holder (18). The use of such a diaphragm (30) allows for the use of an especially simple and favourably-priced fine positioner camera (5).

As an alternative or in addition to the two measuring devices described [(5) for example input camera and fine positioner camera] the field of vision of the, at least one, measuring device (5) can acquire, directly or indirectly, the area of the electrical contact device (8) and/or the deposit area (sorting camera) corresponding to the quality classes. A sorting camera (5) of this nature takes a view, for example, of the beginning section of the conveying media (1, 9) conducting away the sorted and deposited electronic component (3), or of the storage container for electronic components (3, 3').

It is self-evident that the measuring device (5), "optical" in the broadest sense, can operate with radiation of the most widely differing wavelengths. Accordingly, use may be made in particular of an optical measuring device (5) based on laser radiation, infrared light, or X-ray radiation. In this way it is possible to determine not only the position and orientation of electronic components (3, 3'), but also to check on their material properties.

A special feature of the present invention consists of the fact that at least one of the longitudinal axes of the two cameras (5) is, if appropriate, directed at least somewhat obliquely, and, in a side view, is inclined upwards in the direction of the contactor plane (7). This leads to the advantage that observation of the handling device (2) is possible which is less

obscured by projecting modules or component groups, in particular of the component holder (18) and of the electronic components (3, 3') being delivered.

The measuring device (5) is in connection with the data-processing device (6), and via this with the drive media (16) of the conveyor media (1, 9) and/or of the handling device (2) and/or of the movement device (4).

In especially preferred embodiments, the measuring device (5) comprises at least one further camera-type measuring element, the direction of view of which is essentially towards the electrical contact device (8). For this purpose too, it is possible for at least one prism and/or at least one completely or partially permeable mirror to be provided, stationary or capable of pivoting inwards and outwards in the field of vision of the, at least one, measuring device (5).

The direction of view, originally directed essentially vertically downwards of the, at least one, measuring device (5) can in this way be pivoted especially easily, without movement of the measuring device (5), through, for example, 90° or 180°, in particular in the direction of the electrical contact device (8) and/or of the deposition location of the electronic components (3).

The, at least one, central data-processing device (6) contains at least one programmable microprocessor.

This is designed to advantage in such a way that it determines, from the measurement signals incoming from the measuring device (5), first the position and/or the angle of rotation and the geometrical surface centre of gravity " of the electronic component (3) delivered and to be moved.

This "geometrical surface centre of gravity" can be, for example, the centre of gravity of the surface identifiable in the plan view of the housing of an electronic component (3). As an alternative or in addition to this, the "geometrical surface



centre of gravity" can be the centre of gravity of the surface extended by the free ends of the contacts, which if appropriate are leg-shaped.

The microprocessor may further be designed in such a way that, on the basis of the data delivered by the measuring device (5), it then determines the deviations of the deposition location (11) of the component holder (18) on the electronic component (3) from the surface centre of gravity calculated previously. The microprocessor is for preference also designed in such a way that it determines a correction signal which compensates for these deviations and passes on to the drive media (16) of the handling device (2) and/or the movement device (4) such manipulated variables as are imposed for fine tuning with the correction signals. The correction of an orientation error of the accommodation surface (11) of the component holder (13) on an electronic component (3), occurring in the horizontal x-y plane, is effected according to the invention in such a way that the deviation (Δy) determined by the measuring device (5) in the horizontal in respect of the y-axis, with the component holder (18) pivoting upwards, is transformed into a correction in the z-direction ($\Delta y = \Delta z$).

The manipulated variables issued to the drive media (16) by the data-processing system are basically determined by the location and position of the electronic component (3) which is to be taken up, the location and position of the electrical contact device (8), and the position and location of the deposition point corresponding to the individual quality class in each case.

The, at least one, programmable microprocessor is, in addition, designed in such a way that it issues such manipulated variables to the drive media (16) of the handling device (2) and the movement device (4) that the electronic component (3) taken up by the component holder (18) initially comes into engagement in a precise match with the electrical contact device (8), at a contact pressure which is adequate for the measurement. The



programmable microprocessor is further designed in such a way that the manipulated variables issued following the measurement to the drive media (16) of the handling device (2) and the movement device (4) have the effect of the component holder (18), laden with an electronic component, being pivoted downwards out of the measurement position, pointing horizontally or vertically, and the electronic component (3) being deposited, as a function of the test result, sorted according to quality classes on the, at least one, conveying device (1) for removal.

Of particular significance is the fact that the device according to the invention is suitable not only for moving and testing individual electronic components (3). Rather, with the device according to the invention, it is possible, in an entirely satisfactory manner, to move an assembly group of several electronic components (3'), which is designed, for example, in strip shape, lattice shape, rail shape, bar shape, tube shape, strand shape, tray shape, band shape, or plate shape.

To summarise, it may be said that, with the device according to the invention for the targeted moving of electronic components, play can be excluded between the plate-shaped or strip-shaped set-up kit mandatorily required by the prior art and the electronic components placed in it. In addition, the device according to the invention does not encounter the problem of a tolerance between a set-up kit and the test socket.

Because the device according to the invention can do without strip-shaped or plate-shaped set-up kits, wear of such set-up kits during transport inside and/or outside the handling device or during the loading with electronic components can be excluded. This results in a particularly long service life of the device and long-term freedom from tolerances.

Of particular advantage is, further, the fact that, at the transition from one type of electronic component to another type of electronic component, no change is required of a plate-shaped

or strip-shaped set-up kit or of a device for taking up and transporting electronic components. This leads to substantial savings in time and costs.

Especially since the device according to the invention can do away with set-up kits, no expensive storage containers are required for set-up kits which are not in use. Likewise, a well-organized and elaborate storage system for set-up kits not in use is rendered superfluous, by contrast with the devices known from the prior art.

Thanks to the unrestricted controllability and the pronounced movability of the component holder (18) about all the axes, damage to the electronic components (3) or their contacts (legs or spheres) during movement will be excluded.

This is a particularly significant advantage in relation to devices known from the prior art, for moving individual electronic components. In the case of the prior art, the tested electronic components are simply deposited without sensor systems, and are centered by means of a centering or positioning surface respectively. This can easily result in damage, especially to leg-shaped contacts.



CLAIMS

1. Device for the targeted moving of electronic components, characterised in that it comprises:
 - At least one conveying device (1) for the delivery of electronic components (3),
 - At least one handling device (2) for taking up, pivoting, displacing and/or rotating about and/or along the x-axis and/or the y-axis and/or the z-axis, as well as for depositing at least one electronic component (3),
 - At least one movement device (4) for moving the handling device (2) along and/or about the x-axis and/or the y-axis and/or the z-axis,
 - At least one measuring device (5) for determining the position and orientation of the electronic components (3),
 - At least one electrical contact device (8) for establishing at least one electrically-conductive connection between at least one electronic component (3), to be tested for its quality, and at least one electronic testing device located downstream of the electrical contact device (8),
 - At least one central data-processing device (6), which is in connection at least with one measuring device (5) and with a testing device downstream of the electrical contact device (8) on the one hand, and the drive elements (16) for driving the, at least one, handling device (2) and/or the, at least one, movement device (4) and/or the, at least, one conveying media (1) on the other hand.
2. Device according to Claim 1, characterised in that the drive media (16) are provided for the movement of the, at least one, conveying device (1) and/or the, at least one, handling device (2) and/or the, at least one, movement

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device (4) outside a temperature chamber (12), inside which are located at least the electrical contact device (8) and the handling device (2) and at least the section of the conveying media (1) pointing in the direction of the electrical contact device (8), whereby the drive media (16) are electrical or pneumatic drive media, which are designed in the form of cylinders, actuating motors, stepped motors, servomotors, or electro-magnets, which take effect by means of a spindle drive, worm drive, cable drawing mechanism, belt drive, toothed belt drive, toothed bar drive, pneumatic cylinder, flexible shafts (22, 24) or Bowden cables (23).

3. Device according to one of the foregoing claims, characterised in that the conveying media (1) comprise at least one conveyor belt (9), the direction of run of which in the plan view is aligned parallel with or at right angles to the contacting plane (7) and/or at least one manual or automatic loading and/or unloading device, for tubular, tray-shaped, rail-shaped, bar-shaped, cassette-shaped, belt-shaped, or band-shaped storage containers for electronic components (3).
4. Device according to one of the foregoing claims, characterised in that the conveying media (1) comprise at least two conveyor belts (9), running essentially parallel to one another, whereby the direction of run of at least one conveyor belt is aligned at right angles in the direction of the contacting plane (7), while the direction of run of the, at least one, additional conveyor belt (9) is aligned counter to the direction of run of the first belt.
5. Device according to one of the foregoing claims, characterised in that the handling device (2) features at least one component holder (18) in the form of at least one gripper or suction element, which is capable of pivoting by

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90° or 180° about a longitudinal axis (10) running parallel to the contacting plane (7), so that the component take-up surface (11) of the component holder (18) is aligned essentially parallel to the electrical contact device (8).

6. Device according to one of the foregoing claims, characterised in that the, at least one, movement device (4) for the movement of the handling device (2) comprises essentially:

- Two guide rails (13) essentially parallel to one another and spaced at least a certain amount from one another;
- A transverse carrier element (15), extending at right angles to the longitudinal axis (14) of the guide rails (13), which is mounted so as to be longitudinally extendible on the guide rails (13), whereby, on the front face in the direction of the electrical contact device (8), on the transverse carrier (15), a plurality of handling devices (2) are located along the x-axis and/or the y-axis and/or the z-axis in a displaceable manner and/or pivotable manner, whereby these displacements or pivoting movements of the handling devices (2) can be carried out about the same of different axes, dependent on or independently of each other.

7. Device according to one of the foregoing claims, characterised in that the transverse carrier (15) is capable of displacement along the guide rails (13) by means of a belt drive (19), thrust rod, toothed rail, toothed belt, or cable drawing mechanism, in the direction of the electrical contact device (8), whereby the drive medium or media (16) of this belt drive (19), thrust rod, toothed bar, toothed belt, or cable drawing mechanism is coupled to or uncoupled from the drive media (16) which take effect in the x-direction on the handling devices (2), and whereby the belt drive (19), toothed belt, or cable drawing mechanism which may be present if appropriate, is designed





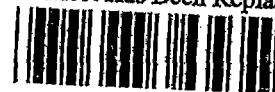
in the form of a circulating endless belt or is in a fixed connection with its end points (28) with the transverse carrier (15).

8. Device according to one of the foregoing claims, characterised in that the transverse carrier (15) is capable of displacement on the guide rails (16) by means of two drive media (16), which take effect by means of at least one drive belt or cable drawing mechanism (19), whereby these drive media (16) at the same time displace a first handling device (2) on the face of the transverse carrier (15) in the x-direction.
9. Device according to one of the foregoing claims, characterised in that additional handling devices (2) are provided on the transverse carrier (15), which are capable of displacement along the x-axis by further drive media (16), independently of the transverse carrier (15) and of the first handling device (2).
10. Device according to one of the foregoing claims, characterised in that the measuring device (5) is at least one mechanical or at least one contact-free optical, electrical, capacitative, or inductive measuring device, the field of vision of which is directed essentially towards that section of the conveying media (1) which is adjacent to the electrical contact device (8), whereby the, at least one, measuring device (5) is in connection via this with the drive elements (16) of the conveying media (1) and/or the handling device (2) and/or the movement device (4).
11. Device according to one of the foregoing claims, characterised in that the, at least one, measuring device (5) comprises at least one image-processing device with at least two camera-type measuring elements, the direction of vision of which is essentially directed from above,





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directly and/or indirectly, at least onto the end section of the conveying media (1, 9) delivering the electronic components (3) and/or onto the electrical contact device (8) and/or onto the beginning section of the conveying media (1, 9) removing the sorted and deposited electronic components (3), whereby the longitudinal axis of the direction of view runs perpendicular to at least one of the two measuring elements, in a side view, or is inclined upwards in the direction of the electrical contacting plane (7).

12. Device according to one of the foregoing claims, characterised in that, on the front face towards the electrical contact device (8), provision is made for a device (26), capable of being pivoted outwards and inwards from the area between the electrical contact device (8) and the free end of the component holder (18), pivoted upwards in the direction of the electrical contact device (8), for the deflection of electromagnetic radiation, which allows for the representation of the underside of an electronic component (3) located in a component holder (18), pivoted upwards in the direction of the electrical contact device (8), on the representation plane of at least one camera-like measuring device (5).
13. Device according to one of the foregoing claims, characterised in that reference markers (27) allocated unambiguously to the co-ordinate system of the electrical contact device (8) are provided for inside the field of view of the, at least one, measuring device (5) directed towards the device (26) for deflection of electromagnetic radiation.
14. Device according to one of the foregoing claims, characterised in that the, at least one, data-processing device (6) contains at least one programmable microprocessor, which is designed in such a way that it



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determines, from the measurement signals incoming from the measurement device (5), the position and/or the angle of rotation and the geometrical surface centre of gravity of the electronic component (3) which is to be moved, determines the place of deposition of the accommodation surface (11) of the component holder (18) on the electronic component (3) from the surface centre of gravity thereof, and determines a correction signal compensating for these deviations and transmits manipulated variables to the drive media (16) of the handling device (2) and/or the movement device (4), which are imposed with the correction signals for fine tuning, whereby these manipulated variables are determined essentially by the location and position of the electronic component (3) which is to be taken up, the location and position of the electrical contact device (8), and the position and location of the deposition point corresponding to the particular quality class in each case, and whereby the, at least one, microprocessor issues these manipulated variables in such a way to the drive media (16) of the handling device (2) and of the movement device (4), that the electronic component (3) taken up by the component holder (18) initially comes in contact in a precise fit with the electrical contact device (8), at a contact pressure which is sufficient for the measurement, and the component holder (18), loaded with the electronic component (3), consequent to the measurement, pivots out of the horizontal or vertical measurement position, pointing upwards, and deposits the electronic component (3), sorted by quality classes according to the test result, on the, at least one, conveying device (1) for removal.

15. Device according to one of the foregoing claims, characterised in that the, at least one, electronic component (3) which is to be moved represents a compilation of several individual electronic components (3'), which are designed as strip-shaped, lattice-shaped, rail-shaped, tubular, bar-shaped, or plate-shaped.

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