CLAIMS

1. A component pick-and-place system comprising:

a control unit;

at least one transport line for transporting a plurality of component trays in a longitudinal direction; and

at least one transfer line for transferring a plurality of pick-and-place (PnP) devices; wherein each of the plurality of PnP devices comprises:

a control and valve unit;

an automatic pitch conversion unit having at least one column and at least one row of pickup tips positional at a parking area and an active area, the automatic pitch conversion unit further comprising:

a X-pitch conversion mechanism comprising:

a first drive motor;

a plurality of movement transfer elements for transferring rotary motions of the first drive motor to cause a pair of X-pitch bands to move in a linear direction along the longitudinal direction;

a pair of engagement arms fixedly engaged to the pair of X-pitch bands and slidably attached to a respective pair of guide rails, wherein the pair of engagement arms is configured to sequentially engage each of the at least one column of pickup tips to move it to a desired X-pitch position when the pair of X-pitch bands are moved;

a first pair of guide rails, wherein each of the at least one column of pickup tips is slidably attached to the first pair of guide rails and sequentially adapted to move to the X-pitch position along the first pair of guide rails by the pair of engagement arms, wherein the pair of engagement arms is adapted to disengage from the each of the at least one column of pickup tips when it is at the desired X-pitch position;

a Y-pitch conversion mechanism comprising:

a second drive motor;

a plurality of movement transfer elements for transferring rotary movements of the second drive motor to a pair of Y-pitch arms to cause a pair of Y-pitch rods to

move in a linear direction in a lateral direction perpendicular to the longitudinal direction;

a pair of pickup tip holders slidably engaged to the pair of Y-pitch rods for simultaneously moving the at least one row of pickup tips on each of the pair of Y-pitch rods to a desired Y- pitch position.

2. The system of claim 1, wherein the X-pitch conversion mechanism further comprises a second pair of guide rails spaced apart from the first pair of guide rails, wherein another of the each of the at least one column of pickup tips is slidably attached to the second pair of guide rails and sequentially adapted to move to the X-pitch position along the second pair of guide rails by the pair of engagement arms.

3. The system of claim 2, wherein the each of the at least one column of pickup tips is adapted to move along the first pair of guide rails followed by the another of the each of at least one columns of pickup tips is adapted to move along the second pair of guide rails by the pair of engagement arms to respective desired X-pitch positions, wherein the X-pitch between each column is variable.

4. The system of any of the preceding claims, wherein each of the plurality of PnP devices is configured to pick components from the component trays along the transport line, conduct Y-pitch conversion on-the-fly and place the components in the component trays along another transport line.

5. The system of claim 4, wherein the Y-pitches along the transport lines are different.

6. The system of claim 1, further comprising a programmable software recipe configured to execute commands for X-pitch and Y-pitch conversions.

7. The system of claim 6, wherein the programmable software recipe is configured to obtain tray format or matrix information associated with a component size and a corresponding tray pocket geometry, and to configure selected pickup tips of a plurality of pickup tips of each of the plurality of PnP devices as active pickup tips arranged into one or more active pickup-tip arrangement, wherein the active pickup-tip arrangement comprises a selected set of

columns/modules of active pickup tips, each active pickup tip being disposed at an intersection of one of the selected columns/modules and a respective row position, wherein the programmable software recipe is configured to set respective X-pitch positions of the selected columns/modules and of pickup tips and a Y-pitch spacing between row positions of the pickup tips within the selected columns/modules such that the active pickup tips correspond to respective component pocket positions defined by the tray format or matrix, whereby the active pickup-tip arrangement is configured for simultaneous pick-up of a plurality of components from a component tray.

8. The system according to claim 7, wherein, when a component of a different size or type is selected using the programmable software recipe, and the different size or type is associated with a different tray, carrier, inspection or workstation format or matrix, the programmable software recipe is configured to reconfigure the active pickup-tip arrangement by changing one or more of:

    the selected set of columns/modules;
    the respective X-pitch positions of the selected columns/modules;
    the row positions of the pickup tips within the selected columns/modules; and
    the Y-pitch spacing between the row positions,
    such that the active pickup tips correspond to respective component pocket positions defined by the different tray, carrier, inspection or workstation format or matrix.

9. The system according to any of the preceding claims, wherein the X-pitch conversion mechanism further comprises one or more column sensors configured to determine actual positions of the pickup tips in each of the at least one column of pickup tips in an X-pitch direction and wherein the Y-pitch conversion mechanism further comprises one or more row sensors configured to determine the actual positions of the pickup tips in the at least one row of pickup tips in a Y-pitch direction.

10. The system according to any of the preceding claims, wherein a suction portion of each pickup tip is configured to be removed with a quick release mechanism.

11. The system according to any of the preceding claims, wherein each of the pair of engagement arms comprises a pin cylinder and a pusher, and wherein the control and

valve unit is configured to activate the pin cylinder to enable the pusher to engage or disengage the pair of engagement arms.

12. The system according to any of the preceding claims, wherein each of the at least one row of pickup tips is adapted to be slidably attached to the pair of Y-pitch rods such that each of the at least one row of pickup tips are simultaneously moved for Y-pitch conversion.

13. The system according to any of the preceding claims, wherein the Y-pitch conversion mechanism comprises one or more link arms adapted to transfer rotary movement of the second drive motor to the pair of Y-pitch arms, and wherein the length of the one or more link arms is extendible to facilitate an increase in the numbers of rows of pickup tips.

14. The system according to any of the preceding claims, further comprising a balancing mechanism adapted to be in synchronous motion with the Y-pitch conversion mechanism, the balancing mechanism being connected to the Y-pitch conversion mechanism via a shaft.

15. The system according to any of the preceding claims, wherein the automatic pitch conversion unit further comprises a pantograph mechanism configured to keep the pitch between each row of pickup tips equidistant from each other.

16. A pick-and-place (PnP) device for transferring semiconductor components comprising:

a plurality of pick-and-place (PnP) modules, each PnP module comprising at least three pick-and-place (PnP) heads;

a transfer mechanism for moving each of the plurality of PnP modules to a component X-pitch position above a tray or workstation, the transfer mechanism comprising:

a first drive motor;

a plurality of movement transfer elements for transferring rotary motions of the first drive motor to cause a pair of X-pitch bands to move in a linear direction along the longitudinal direction; and a pair of engagement arms fixedly engaged to the pair of

X-pitch bands and slidably attached to a respective pair of guide rails, wherein the pair of engagement arms is configured to sequentially engage each of the plurality of PnP modules to move to a component X-pitch position when the pair of X-pitch bands are moved; wherein each of the at least one column of pickup tips is slidably attached to the first pair of guide rails and sequentially adapted to move to the X-pitch position along the first pair of guide rails by the pair of engagement arms, wherein the pair of engagement arms is adapted to disengage from the each of the at least one column of pickup tips when it is at the desired X-pitch position;

a pitch adjustment mechanism for adjusting the Y-pitch of the at least three pick-and-place heads, the pitch adjustment mechanism comprising:

a second drive motor;

a plurality of movement transfer elements for transferring rotary movements of the second drive motor to a pair of Y-pitch arms to cause a pair of Y-pitch rods to move in a linear direction; and a pair of pickup tip holders slidably engaged to the pair of Y-pitch rods for simultaneously moving a plurality of rows of pickup tips to a desired Y-pitch position.

17. The PnP device of claim 16, wherein, based on tray format or matrix information associated with a component size and corresponding tray pocket geometry, selected pickup tips of the PnP device are configurable as active pickup tips forming an active pickup-tip arrangement, wherein the active pickup-tip arrangement comprises a selected set of columns/modules of active pickup tips, each active pickup tip being disposed at an intersection of one of the selected columns/modules and a row position of the pickup tips within the selected columns/modules, wherein respective X-pitch positions of the selected columns/modules and a Y-pitch spacing between row positions of the pickup tips within the selected columns/modules are configurable such that the active pickup tips correspond to respective component pocket positions defined by the tray format or matrix, whereby the active pickup-tip arrangement is configured for simultaneous pick-up of a plurality of components from a component tray.

18. The PnP device of claim 17, wherein the active pickup-tip arrangement is reconfigurable for a different component size or component type associated with a different tray, carrier, inspection or workstation format or matrix by changing one or more of:

the selected set of columns/modules;

the respective X-pitch positions of the selected columns/modules;

the row positions of the pickup tips within the selected columns/modules; and

the Y-pitch spacing between the row positions,

such that the active pickup tips correspond to respective component positions defined by the different tray, carrier, inspection or workstation format or matrix.

19. The PnP device of claim 16, wherein the transfer mechanism further comprises a second pair of guide rails spaced apart from the first pair of guide rails, wherein another of each of the plurality of PnP modules is slidably attached to the second pair of guide rails and sequentially adapted to move to the X-pitch position along the second pair of guide rails by the pair of engagement arms.

20. The PnP device of claim 19, wherein the each of the plurality of PnP modules is adapted to move along the first pair of guide rails followed by the another of each of the plurality of PnP modules is adapted to move along the second pair of guide rails by the pair of engagement arms to respective desired X-pitch positions, and wherein the X-pitch between each column is variable.

21. The pick-and-place(PnP) device of claim 16, wherein the pitch adjustment mechanism comprises one or more link arms adapted to transfer rotary movement of the second drive motor to the pair of Y-pitch arms, and wherein the length of the one or more link arms is extendible to facilitate an increase in the plurality of rows of pickup tips.

22. A method of automatic pitch conversion for a component pick-and-place system as claimed in any one of claims 1 to 15, the method comprising the steps of:

(a) selecting a component to run with a recipe in the control unit;

(b) obtaining a tray format or matrix information from the recipe;

(c) determining with the control unit, whether X and Y pitches of a tray matrix are identical to the PnP device; and

(d) inputting a command with the control unit to carry out X-pitch and/or Y-pitch conversion on the PnP device when the X and Y pitches arc determined not to be identical.

23. The method of claim 22, further comprising the step of moving each of the plurality of columns of pickup tips to a parking area of the PnP device, and thereafter scanning to determine the X-pitch position of each of the plurality of pickup tips in the parking area.

24. The method of claim 23, further comprising the step of sequentially moving each of the plurality of columns of pickup tips from the parking area to the connect X-pitch position in the active area.

25. The method of claim 24, further comprising the step of scanning each of the plurality of columns of pickup tips at the active area to confirm the X-pitch positions of the pickup tips.

26. The method of claim 25, further comprising the step of moving each of the plurality of rows of pickup tips to a home position whereby the Y-pitch between each pickup tip is at a minimum.

27. The method of claim 26, further comprising the step of simultaneously moving each of the plurality of rows of pickup tips to the collect Y-pitch positions.

28. The method of claim 27, further comprising the step of scanning each of the plurality of rows of pickup tips to confirm that the pickup tips are in the correct Y-pitch positions in the active area.

29. The method of any one of claims 24 or 27, further comprising configuring the control unit to input a command to cany out X-pitch and/or Y-pitch conversion on the PnP device when the X and/or Y pitches are still determined not to be identical.