CLAIMS

1. An apparatus to automatically place layers of a printed circuit board on a fixture, the apparatus comprising: a robotic device including:

a base that is secured to a surface,

an upright column that extends upwardly from the base, and

a movable arm rotatably coupled to the upright column, the movable arm being configured to rotate about a vertical axis defined by the upright column, and further configured to rotate from a position in which the movable arm is disposed over a laminate sheet fixture and to pick up a laminate sheet to a position in which the movable arm is disposed over a board layup fixture to deposit the laminate sheet in the board layup fixture, and from a position in which the movable arm is disposed over a bond film fixture and to pick up a bond film to a position in which the movable arm is disposed over the board layup fixture to deposit the bond film in the board layup fixture.

2.The apparatus of claim 1, wherein the movable arm of the robotic device further is configured to move in x-axis and y-axis directions but rigid in a z-axis direction.

3.The apparatus of claim 2, wherein the movable arm is configured to vary a radius of arc and travel about the vertical axis and configured to lower and raise an end effector supported by the movable arm in a the z-axis direction.

wherein the movable arm includes a user flange that is configured to receive and mount thereon the end effector,

wherein the end effector includes an actuator that is secured to the user flange and to a fixed plate, the movable arm being configured to move the fixed plate vertically in the z-axis direction, and

wherein the fixed plate is disposed on a horizontal plane and supports a vacuum tool having top floating plate and a bottom floating plate, which is secured to the top floating plate, the top floating plate and the bottom floating plate being configured to move relative to the fixed plate in the x-axis and y-axis directions.

42. The apparatus of claim ~~3~~1, wherein the robotic device is a selective compliance assembly robot arm.

~~5. The apparatus of claim 3, wherein the movable arm includes a user flange that is configured to receive and mount thereon the end effector.~~

~~6~~3. The apparatus of claim ~~5~~1, wherein the end effector is configured to pick up the laminate sheet from the laminate sheet fixture and place the laminate sheet on the board layup fixture and to the bond film from the bond film fixture and place the bond film on the board layup fixture.

~~7. The apparatus of claim 5, wherein the end effector includes an actuator that is secured to the user flange and to a fixed plate, the movable arm being configured to move the fixed plate vertically in the z-axis direction.~~

~~8. The apparatus of claim 7, wherein the fixed plate is disposed on a horizontal plane and supports a vacuum tool having top floating plate and a bottom floating plate, which is secured to the top floating plate, the top floating plate and the bottom floating plate being configured to move relative to the fixed plate in the x-axis and y-axis directions.~~

~~9~~4. The apparatus of claim ~~8~~1, wherein the top floating plate includes a plurality of ports, which are connected to a source of air, the ports providing an air cushion between the top floating plate and the fixed plate to facilitate a small amount of movement between the top and bottom floating plates and the fixed plate when aligning the bottom floating plate with one of the laminate sheet, bond film and board layup fixtures.

~~10~~5. The apparatus of claim ~~8~~1, wherein the bottom floating plate includes a plurality of suction cups, which are configured to releasably secure the laminate sheet to the bottom floating plate.

~~11~~6. The apparatus of claim ~~10~~5, wherein each suction cup is secured to a vacuum source, and by applying vacuum to the suction cups, the bottom floating plate releasably secures the laminate sheet to the bottom floating plate and by terminating vacuum to the suction cups, the bottom floating plate releases the laminate sheet from the bottom floating plate.

~~12~~7. The apparatus of claim ~~11~~6, wherein the suction cups are disposed around a periphery of a bottom surface of the bottom floating plate.

~~13~~8. The apparatus of claim ~~8~~1, wherein the bottom floating plate includes a plurality of vacuum ports, which are configured to releasably secure the bond film to the bottom floating plate.

~~14~~9. The apparatus of claim ~~13~~8, wherein each vacuum port is secured to a vacuum source, and by applying vacuum to the vacuum ports, the bottom floating plate releasably secures the bond film to the bottom floating plate and by terminating vacuum to the vacuum ports, the bottom floating plate releases the bond film from the bottom floating plate.

~~15~~10. The apparatus of claim 9~~14~~, wherein the vacuum ports are uniformly arranged on a bottom surface of the bottom floating plate.

~~16~~11. The apparatus of claim 1, wherein each of the laminate sheet fixture, the bond film fixture and the board layup fixture include a flat plate having at least one alignment pin, which is provided to initially position the bottom floating plate with respect to the fixture when moving an end effector of the robotic device to the fixture.

~~17~~12. The apparatus of claim ~~16~~11, wherein the at least one alignment pin is received within an opening provided in the bottom floating plate.

~~18~~13. The apparatus of claim ~~16~~11, wherein each fixture further includes a plurality of additional pins to finely locate the laminate sheet with slots provided in the laminate sheet.

~~19~~14. The apparatus of claim 1, further comprising a table configured to support the robotic device, the base of the robotic device being secured to the table, the table being configured to support complimentary components of the robotic device.

~~20~~15. The apparatus of claim 1, further comprising a controller to control the operation of the robotic device.