CLAIMS

1. An apparatus for testing an integrated circuit of a device, comprising:

an apparatus frame;

a holder for the device, secured to the apparatus frame;

a contactor support structure held by the apparatus frame;

a plurality of terminals held by the contactor support structure, the holder and contactor support structure being movable relative to one another so that each one of the terminals makes releasable contact with a respective contact of the device;

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support structure;

an actuator connected between the apparatus frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the apparatus frame and toward the surface of the holder so that the terminals are urged against contacts of the device;

a power source;

a power electrical path connecting the power source to a power terminal of the terminals held by the support structure;

a signal source; and

a plurality of signal electrical paths, each connecting the signal source to a respective signal terminal of the terminals held by the support structure.

2. The apparatus of claim 1, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the piston relative to the cylinder.

3. The apparatus of claim 1, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

4. The apparatus of claim 1, further comprising:

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor substrate to transfer force from the contactor substrate to the force distribution substrate.

5. The apparatus of claim 1, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

6. The apparatus of claim 5, wherein the distribution board has a plurality of layers having a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

7. The apparatus of claim 5, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.

8. The apparatus of claim 1, further comprising:

a cartridge, including a cartridge frame that is removably mountable to the apparatus frame, the contactor board forming part of the cartridge;

a contactor interface on the contactor support structure; and

a connector interface having a surface for connecting to a surface of the contactor interface.

9. The apparatus of claim 8, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly.

10. The apparatus of claim 9, further comprising:

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge; and

a pump connected to the outlet of the pressure reduction passage so as to reduce a pressure in the area between the common subassembly and the second unique contactor subassembly.

11. A cartridge, comprising:

a cartridge frame;

formations on the cartridge frame for mounting the cartridge frame in a fixed position to an apparatus frame;

a contactor support structure;

a contactor interface on the contactor support structure;

a plurality of terminals, held by the contactor support structure, for contacting contacts on a device;

a plurality of conductors, held by the contactor support structure, connecting the interface to the terminals;

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support structure; and

an actuator connected between the cartridge frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the cartridge frame and toward the surface of the holder so that the terminals are urged against contacts of the device.

12. The cartridge of claim 11, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the

piston relative to the cylinder.

13. The cartridge of claim 11, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

14. The cartridge of claim 11, further comprising:

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor substrate to transfer force from the contactor substrate to the force distribution substrate.

15. The cartridge of claim 11, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

16. The cartridge of claim 15, wherein the distribution board has a plurality of layers having a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

17. The cartridge of claim 15, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.

18. The cartridge of claim 11, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly.

19. The cartridge of claim 18, further comprising:

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge.

20. An apparatus for testing an integrated circuit of a device, comprising

an apparatus frame;

a holder for the device, secured to the apparatus frame;

a contactor support structure held by the apparatus frame;

a plurality of terminals held by the contactor support structure, the holder and contactor support structure being movable relative to one another so that each one of the terminals makes releasable contact with a respective contact of the device;

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support structure;

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor

substrate to transfer force from the contactor substrate to the force distribution substrate;

a power source;

a power electrical path connecting the power source to a power terminal of the terminals held by the support structure;

a signal source; and

a plurality of signal electrical paths, each connecting the signal source to a respective signal terminal of the terminals held by the support structure.

21. The apparatus of claim 20, further comprising:

an actuator connected between the apparatus frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the apparatus frame and toward the surface of the holder so that the terminals are urged against contacts of the device.

22. The apparatus of claim 21, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the piston relative to the cylinder.

23. The apparatus of claim 21, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

24. The apparatus of claim 20, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

25. The apparatus of claim 24, wherein the distribution board has a plurality of layers having a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

26. The apparatus of claim 24, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.

27. The apparatus of claim 20, further comprising:

a cartridge, including a cartridge frame that is removably mountable to the apparatus frame, the contactor board forming part of the cartridge;

a contactor interface on the contactor support structure; and

a connector interface having a surface for connecting to a surface of the contactor interface.

28. The apparatus of claim 27, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly.

29. The apparatus of claim 28, further comprising:

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge; and

a pump connected to the outlet of the pressure reduction passage so as to reduce a pressure in the area between the common subassembly and the second unique contactor subassembly.

30. A cartridge, comprising:

a cartridge frame;

formations on the cartridge frame for mounting the cartridge frame in a fixed position to an apparatus frame;

a contactor support structure;

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor substrate to transfer force from the contactor substrate to the force distribution substrate;

a contactor interface on the contactor support structure;

a plurality of terminals, held by the contactor support structure, for contacting contacts on a device;

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support

structure; and

a plurality of conductors, held by the contactor support structure, connecting the interface to the terminals.

31. The cartridge of claim 30, further comprising:

an actuator connected between the cartridge frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the cartridge frame and toward the surface of the holder so that the terminals are urged against contacts of the device.

32. The cartridge of claim 31, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the piston relative to the cylinder.

33. The cartridge of claim 31, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

34. The cartridge of claim 30, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

35. The cartridge of claim 34, wherein the distribution board has a plurality of layers having

a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

36. The cartridge of claim 34, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.

37. The cartridge of claim 30, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly.

38. The cartridge of claim 37, further comprising:

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge.

39. An apparatus for testing an integrated circuit of a device, comprising

an apparatus frame;

a cartridge, including:

a cartridge frame that is removably mountable to the apparatus frame and forming a holder for the device;

a contactor support structure;

a contactor interface on the contactor support structure;

a connector interface having a surface for connecting to a surface of the contactor interface;

a plurality of terminals held by the contactor support structure, the holder and contactor support structure being movable relative to one another so that each one of the terminals makes releasable contact with a respective contact of the device; and

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support structure;

a power source;

a power electrical path connecting the power source to a power terminal of the terminals held by the support structure;

a signal source; and

a plurality of signal electrical paths, each connecting the signal source to a respective signal terminal of the terminals held by the support structure.

40. The apparatus of claim 39, further comprising:

an actuator connected between the apparatus frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the apparatus frame and toward the surface of the holder so that the terminals are urged against contacts of the device.

41. The apparatus of claim 40, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the piston relative to the cylinder.

42. The apparatus of claim 40, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

43. The apparatus of claim 39, further comprising:

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor substrate to transfer force from the contactor substrate to the force distribution substrate.

44. The apparatus of claim 39, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

45. The apparatus of claim 44, wherein the distribution board has a plurality of layers having a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

46. The apparatus of claim 44, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.

47. The apparatus of claim 39, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly.

48. The apparatus of claim 47, further comprising:

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge; and

a pump connected to the outlet of the pressure reduction passage so as to reduce a pressure in the area between the common subassembly and the second unique contactor subassembly.

49. A cartridge, comprising:

a cartridge frame;

formations on the cartridge frame for mounting the cartridge frame in a fixed position to an apparatus frame;

a contactor support structure;

a contactor interface on the contactor support structure;

a plurality of terminals, held by the contactor support structure, for contacting contacts on a device;

a plurality of electrical components mounted on the contactor support structure on a side of the contactor support structure opposing the terminals held by the contactor support structure;

a plurality of conductors, held by the contactor support structure, connecting the interface to the terminals, wherein the cartridge includes a common subassembly and a first unique contactor subassembly that is replaceable with a second unique contactor subassembly; and

a pressure reduction passage in communication with an area between the common subassembly and the second unique contactor subassembly and having an outlet on an external side of the cartridge.

50. The cartridge of claim 49, further comprising:

an actuator connected between the cartridge frame and the contactor support structure, having first and second portions that are movable relative to one another to move the contactor support structure relative to the cartridge frame and toward the surface of the holder so that the terminals are urged against contacts of the device.

51. The cartridge of claim 50, wherein the first and second portions of the actuator are a cylinder and a piston, respectively, the piston being located in the cylinder so that the cylinder and the piston jointly define a volume, further comprising:

a fluid line connected to the volume to modify a pressure of the volume and move the

piston relative to the cylinder.

52. The cartridge of claim 50, wherein the actuator includes an inflatable and deflatable bladder, the first and second portions of the actuator being opposing sides of the bladder.

53. The cartridge of claim 49, further comprising:

a force distribution substrate, the electrical components being located between the force distribution substrate and the contactor support structure; and

a stand-off component between the force distribution substrate and the contactor substrate to transfer force from the contactor substrate to the force distribution substrate.

54. The cartridge of claim 49, wherein the contactor support structure includes a distribution board substrate and a contactor substrate mounted to the distribution board substrate.

55. The cartridge of claim 54, wherein the distribution board has a plurality of layers having a plurality of different stiffnesses, one of the layers in a half of the distribution board substrate opposing the terminals held by the contactor support structure being stiffer than a majority of the layers.

56. The cartridge of claim 54, wherein the distribution board has a plurality of layers including a plurality of metal layers and a plurality of insulating layers, at least a first of the layers having a lower CTE than any other one of the layers, so that an overall CTE of the distribution board is between a CTE of the first layer and a CTE of one of the other layers.