CLAIMS

What is claimed is:

1. A vapor chamber, comprising:

a sealed enclosure comprising:

a main chamber;

a first elongate chamber extending laterally from a first side of the main chamber; and

a second elongate chamber extending laterally from a second, opposite side of the main chamber;

a first capillary structure lining a first interior surface of the sealed enclosure; and

a second capillary structure lining a second, opposite interior surface of the sealed enclosure,

wherein distal portions of the first elongate chamber and the second elongate chamber are configured as reservoirs that store an excess volume of a working fluid in a liquid state when a heat source is in a first operating state and release the excess volume of the working fluid towards the main chamber when the heat source is in a second operating state,

wherein the distal portions of the first elongate chamber and the second elongate chamber are disposed outside a footprint of a heat dissipation structure disposed on an exterior surface of the vapor chamber.

2. The vapor chamber of claim 1, wherein the heat source comprises a processor, and the first operating state is a steady state power mode of the processor, and the second operating state is a turbo power mode of the processor.

3. The vapor chamber of any one of claims 1 to 2, wherein portions of the first capillary structure and the second capillary structure disposed in the distal portions of the first elongate chamber and the second elongate chamber are configured as the reservoirs, wherein the excess volume of the working fluid is stored in and released from the portions of the first capillary structure and the second capillary structure disposed in the distal portions of the first elongate chamber and the second elongate chamber.

~~4. The vapor chamber of claim 3, wherein the excess volume of the working fluid is stored in and released from the portions of the first capillary structure and the second~~

~~capillary structure disposed in the distal portions of the first elongate chamber and the second elongate chamber.~~

~~5~~4. The vapor chamber of any one of claims 1 to 3, wherein each of the first capillary structure and the second capillary structure comprises at least one of a sintered metal-containing powder, one or more layers of a metal-containing mesh, one or more layers of a metal-containing foam, or a metal-containing fiber structure.

~~6. The vapor chamber of claim 1, wherein the distal portions of the first elongate chamber and the second elongate chamber are disposed outside a footprint of a heat dissipation structure disposed on an exterior surface of the vapor chamber.~~

~~7~~5. The vapor chamber of any one of claims ~~6~~1 to 4, wherein the heat dissipation structure comprises a first fin structure disposed over a portion of the first elongate chamber, and wherein the distal portion of the first elongate chamber is outside of the footprint of the first fin structure, and/or

wherein the heat dissipation structure comprises a second fin structure disposed over a portion of the second elongate chamber, and wherein the distal portion of the second elongate chamber is outside of the footprint of the second fin structure.

~~8. The vapor chamber of claim 6, wherein the heat dissipation structure comprises a second fin structure disposed over a portion of the second elongate chamber, and wherein the distal portion of the second elongate chamber is outside of the footprint of the second fin structure.~~

~~9~~6. The vapor chamber of any one of claims 1 to 5, further comprising a third capillary structure attached to the first capillary structure, wherein the third capillary structure is positioned between the first capillary structure and the second capillary structure, wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs, and

a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.

~~10. The vapor chamber of claim 9, wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs.~~

~~11. The vapor chamber of claim 10, further comprising a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.~~

~~12~~7. A vapor chamber, comprising:

a cover portion secured to a base portion to form a sealed enclosure, the sealed enclosure comprising:

a main chamber;

a first elongate chamber extending laterally in a first direction from a first side of the main chamber; and

a second elongate chamber extending laterally in a second, opposite direction from a second, opposite side of the main chamber, wherein a width of the main chamber is greater than a width of the first elongate chamber and a width of the second elongate chamber;

a first capillary structure disposed in the main chamber, the first elongate chamber, and the second elongate chamber, the first capillary structure lining a first interior surface of the sealed enclosure; and

a second capillary structure disposed in the main chamber, the first elongate chamber, and the second elongate chamber, the second capillary structure lining a second, opposite interior surface of the sealed enclosure,

wherein portions of the first capillary structure and the second capillary structure disposed in distal portions of the first elongate chamber and the second elongate chamber are configured as reservoirs that modulate a volume of a working fluid circulating in the vapor chamber based on an operating state of a heat source.

~~13~~8. The vapor chamber of claim ~~12~~7, wherein the reservoirs are configured to:

store an excess volume of the working fluid in a liquid state when the heat source is in a first operating state; and

release the excess volume of the working fluid towards the main chamber when the heat source is in a second operating state.

~~14~~9. The vapor chamber of any one of claims ~~13~~ 7 to 8, wherein:

in the first operating state of the heat source, a nominal volume of the working fluid is configured to circulate in the vapor chamber; and

in the second operating state of the heat source, the nominal volume of the working fluid and the excess volume of the working fluid are configured to circulate in the vapor chamber,

wherein the nominal volume of the working fluid is substantially equal to the excess volume of the working fluid.

~~15. The vapor chamber of claim 14, wherein the nominal volume of the working fluid is substantially equal to the excess volume of the working fluid.~~

~~16~~10. The vapor chamber of any one of claims ~~13~~7 to 9, wherein the heat source comprises a processor, and the first operating state is a steady state power mode of the processor, and the second operating state is a turbo power mode of the processor.

~~17~~11. The vapor chamber of any one of claims ~~12~~7 to 10, wherein each of the first capillary structure and the second capillary structure comprises at least one of a sintered metal-containing powder, one or more layers of a metal-containing mesh, one or more layers of a metal-containing foam, or a metal-containing fiber structure.

~~18~~12. The vapor chamber of any one of claims ~~12~~7 to 11, wherein the distal portions of the first elongate chamber and the second elongate chamber are disposed outside a footprint of a heat dissipation structure disposed on an exterior surface of the vapor chamber.

~~19~~13. The vapor chamber of any one of claims ~~18~~7 to 12, wherein the heat dissipation structure comprises a first fin structure formed on the cover portion and disposed over a

portion of the first elongate chamber, and wherein the distal portion of the first elongate chamber is outside of the footprint of the first fin structure, and/or

wherein the heat dissipation structure comprises a second fin structure formed on the cover portion and disposed over a portion of the second elongate chamber, and wherein the distal portion of the second elongate chamber is outside of the footprint of the second fin structure.

~~20. The vapor chamber of claim 18, wherein the heat dissipation structure comprises a second fin structure formed on the cover portion and disposed over a portion of the second elongate chamber, and wherein the distal portion of the second elongate chamber is outside of the footprint of the second fin structure.~~

~~21~~14. The vapor chamber of any one of claim~~s 12~~7 to 13, further comprising a third capillary structure attached to the first capillary structure, wherein the third capillary structure is positioned between the first capillary structure and the second capillary structure, wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs, and

a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.

~~22. The vapor chamber of claim 21, wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs.~~

~~23. The vapor chamber of claim 22, further comprising a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.~~

~~24~~15. A system, comprising:

a processor; and

a vapor chamber, wherein the processor is in physical contact with a surface of the vapor chamber, the vapor chamber comprising:

a sealed enclosure comprising:

a main chamber;

a first elongate chamber extending laterally from a first side of the main chamber; and

a second elongate chamber extending laterally from a second, opposite side of the main chamber;

a first capillary structure lining a first interior surface of the sealed enclosure; and

a second capillary structure lining a second, opposite interior surface of the sealed enclosure,

wherein distal portions of the first elongate chamber and the second elongate chamber are configured as reservoirs that modulate a volume of a working fluid circulating in the vapor chamber based on an operating state of the processor,

wherein the distal portions of the first elongate chamber and the second elongate chamber are disposed outside a footprint of a heat dissipation structure disposed on an exterior surface of the vapor chamber.

~~25~~16. The system of claim ~~24~~15, wherein portions of the first capillary structure and the second capillary structure disposed in the distal portions of the first elongate chamber and the second elongate chamber are configured as the reservoirs.

~~26. The system of claim 24, wherein the distal portions of the first elongate chamber and the second elongate chamber are disposed outside a footprint of a heat dissipation structure disposed on an exterior surface of the vapor chamber.~~

~~27. The system of claim 24, further comprising a circuit board, wherein the processor is attached to the circuit board and positioned between the circuit board and the vapor chamber.~~

~~28~~17. The system of any one of claims ~~24~~15 to 16, wherein:

in a first operating state of the processor, a nominal volume of the working fluid is configured to circulate in the vapor chamber; and

in a second operating state of the processor, the nominal volume and ~~the~~ an excess volume of the working fluid are configured to circulate in the vapor chamber.

~~29~~18. The system of claim ~~28~~ 17, wherein the nominal volume of the working fluid is substantially equal to the excess volume of the working fluid, or

wherein the reservoirs are configured to:

store the excess volume of the working fluid in a liquid state when the processor is in the first operating state; and

release the excess volume of the working fluid towards the main chamber when the processor is in the second operating state.

~~30. The system of claim 28, wherein the reservoirs are configured to:~~

~~store the excess volume of the working fluid in a liquid state when the processor is in the first operating state; and~~

~~release the excess volume of the working fluid towards the main chamber when the processor is in the second operating state.~~

~~31~~19. The system of claim ~~24~~17, wherein the first operating state is a steady state power mode of the processor, and the second operating state is a turbo power mode of the processor.

~~32. The system of claim 24, wherein each of the first capillary structure and the second capillary structure comprises at least one of a sintered metal-containing powder, one or more layers of a metal-containing mesh, one or more layers of a metal-containing foam, or a metal-containing fiber structure.~~

~~33~~20. The system of any one of claims ~~24~~15 to 19, wherein the vapor chamber further comprises a third capillary structure attached to the first capillary structure, wherein the third capillary structure is positioned between the first capillary structure and the second capillary structure,

wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs,

wherein the vapor chamber further comprises a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.

~~34. The system of claim 33, wherein a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the main chamber is less than a distance between the first interior surface of the sealed enclosure and the second interior surface of the sealed enclosure in the reservoirs.~~

~~35. The system of claim 34, wherein the vapor chamber further comprises a reservoir capillary structure disposed in each of the reservoirs, the reservoir capillary structure positioned between the third capillary structure and the second capillary structure.~~