

CLAIMS**1. A liquid cooling module comprising:**

a main body comprising:

a cooling core comprising a microfluidic structure configured to carry a cooling liquid; and

a plurality of slots;

a sealing pad configured to transmit heat from an electronic device to the cooling core; and

a plurality of fins extending from the main body, each of the plurality of fins comprising an internal circulating liquid duct such that the liquid cooling module comprises a plurality of internal circulating liquid ducts in fluidic communication with the microfluidic structure;

wherein a first fin of the plurality of fins comprises a first internal circulating liquid duct comprising:

a first portion connected to a first slot of the plurality of slots and configured to lead the cooling liquid away from the cooling core;

a second portion connected to a second slot of the plurality of slots and configured to lead the cooling liquid towards the cooling core; and

an intervening portion connecting the first portion and the second portion; and

wherein a second fin of the plurality of fins includes a second internal circulating liquid duct configured to receive the cooling liquid from the first internal circulating liquid duct via the second slot of the plurality of slots, the second internal circulating liquid duct comprising:

a first portion connected to the second slot of the plurality of slots and configured to lead the cooling liquid away from the cooling core;

a second portion connected to a third slot of the plurality of slots and configured to lead the cooling liquid towards the cooling core; and

an intervening portion connecting the first portion and the second portion.

2. The liquid cooling module according to claim 1, further comprising:
 - a pump configured to pump the cooling liquid so that the cooling liquid flows along the microfluidic structure and the plurality of internal circulating liquid ducts.
3. The liquid cooling module according to claim 2,
 - wherein the pump is any one selected from group consisting of a mechanical gear pump, an electroosmotic pump, and a piezoelectric actuator pump.
4. The liquid cooling module according to any claim 2, further comprising:
 - one or more temperature sensors configured to sense temperature parameters of the liquid cooling module; and
 - a control circuit configured to control the pump based on the temperature parameters.
5. The liquid cooling module according to claim 4,
 - wherein the one or more temperature sensors comprise a conductor temperature sensor configured to sense a temperature parameter of a region between the sealing pad and the microfluidic structure; and
 - wherein the one or more temperature sensors comprise a convection temperature sensor configured to sense a temperature parameter related to the cooling liquid.
6. The liquid cooling module according to claim 1,
 - wherein the main body further comprises a plurality of backside studs configured to transmit heat from the sealing pad to the cooling core.
7. The liquid cooling module according to claim 1,
 - wherein the microfluidic structure comprises an array including a plurality of micro-jet channels configured to cool the cooling liquid via micro-jet impingement.

8. The liquid cooling module according to claim 7,
wherein the microfluidic structure comprises an inlet channel configured to direct the cooling liquid to the array; and
wherein the microfluidic structure comprises an outlet channel configured to direct the cooling liquid away from the array.
9. The liquid cooling module according to claim 1,
wherein each of the plurality of fins comprises a conduction fin extending into the internal circulating liquid duct.
10. The liquid cooling module according to claim 1,
wherein the plurality of fins is arranged in a plurality of rows.
11. The liquid cooling module according to claim 10,
wherein the plurality of fins is configured such that the liquid coolant flows in parallel paths, each path formed by internal circulating ducts included in a row of fins.
12. The liquid cooling module according to claim 10,
where the plurality of fins is configured such that the liquid cooling flows from a first path formed by internal circulating ducts included in a first row of fins to a second path formed by internal circulating ducts included in a second row of fins.
13. The liquid cooling module according to claim 1,
wherein the plurality of slots is aligned in parallel in a staggered manner.
14. The liquid cooling module according to claim 1,
wherein the intervening portion of the first internal circulating liquid duct extends parallel to a first axis, the first axis perpendicular to a second axis in which each of

the first portion and the second portion of the first internal circulating liquid duct extends parallel to; and

wherein the intervening portion of the second internal circulating liquid duct extends parallel to the first axis perpendicular to the second axis in which each of the first portion and the second portion of the second internal circulating liquid duct extends parallel to.

15. The liquid cooling module according to claim 14,

wherein each of the first slot, the second slot, and the third slot extends parallel to a third axis which is perpendicular to the second axis.

16. The liquid cooling module according to claim 1,

wherein the first internal circulating liquid duct is configured so that the flow of the cooling liquid along the first internal circulating liquid duct is in a first rotation direction; and

wherein the second internal circulating liquid duct is configured so that the flow of the cooling liquid along the second internal circulating liquid duct is in a second rotation direction opposite the first rotation direction.

17. The liquid cooling module according to claim 16,

wherein the first rotation direction is anticlockwise; and

wherein the second rotation direction is clockwise.

18. A method of forming a liquid cooling module, the method comprising:

forming a main body comprising:

a cooling core including a microfluidic structure configured to carry a cooling liquid; and

a plurality of slots;

forming a sealing pad configured to transmit heat from an electronic device to the cooling core; and

forming a plurality of fins extending from the main body, each of the plurality of fins comprising an internal circulating liquid duct such that the liquid cooling module comprises a plurality of internal circulating liquid ducts in fluidic communication with the microfluidic structure;

wherein a first fin of the plurality of fins comprises a first internal circulating liquid duct comprising:

- a first portion connected to a first slot of the plurality of slots and configured to lead the cooling liquid away from the cooling core;

- a second portion connected to a second slot of the plurality of slots and configured to lead the cooling liquid towards the cooling core; and

- an intervening portion connecting the first portion and the second portion;

and

wherein a second fin of the plurality of fins comprises a second internal circulating liquid duct configured to receive the cooling liquid from the first internal circulating liquid duct via the second slot of the plurality of slots, the second internal circulating liquid duct comprising:

- a first portion connected to the second slot of the plurality of slots and configured to lead the cooling liquid away from the cooling core;

- a second portion connected to a third slot of the plurality of slots and configured to lead the cooling liquid towards the cooling core; and

- an intervening portion connecting the first portion and the second portion.

19. The method according to claim 18, further comprising:

- forming a pump configured to pump the cooling liquid so that the cooling liquid flows along the microfluidic structures and the plurality of internal circulating liquid ducts.

20. The method according to claim 18, further comprising:

forming one or more temperature sensors configured to sense temperature parameters of the cooling module; and
forming a control circuit configured to control the pump based on the temperature parameters.