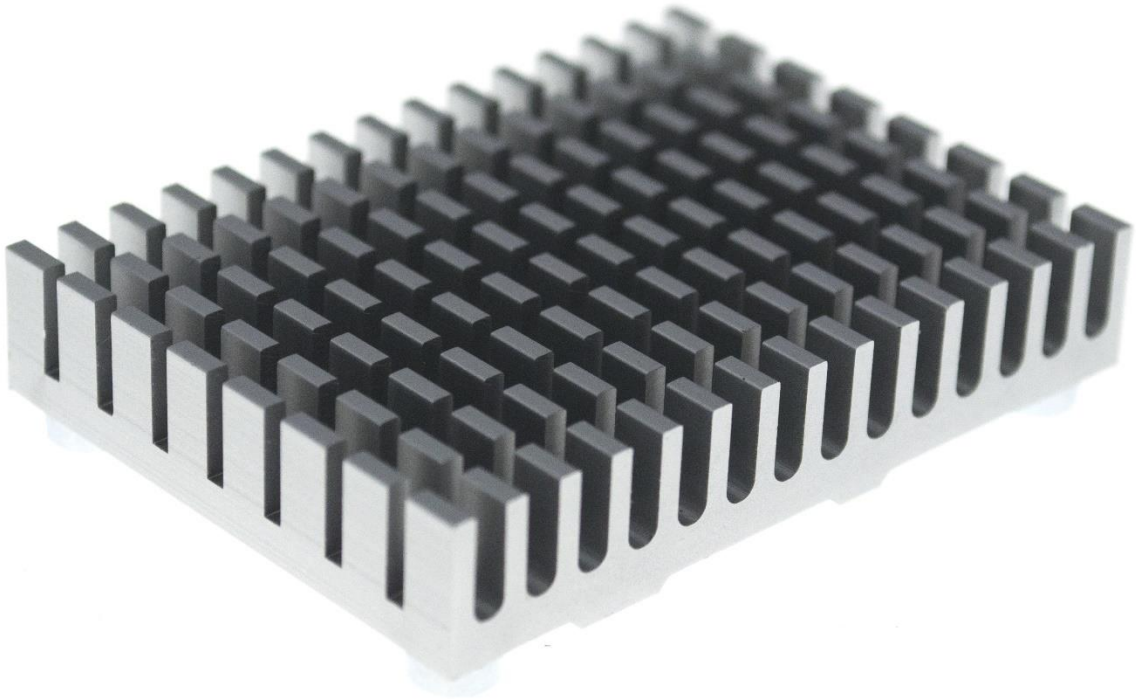
Cooling Performance Testing Report of CM4 Cooler

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Cooling Performance Testing of CM4 Cooler

1. Purpose

Test the cooling performance of CM4 Cooler at different temperature and operating frequency.

2. Method

Put two CM4 IO boards (CM4 Module installed) in the constant temperature and humidity oven. One with CM4 Cooler while the other one without CM4 Cooler. Set different temperature and different CPU operating frequency, read the temperature of CPU, compare the temperature difference between two CM4 modules, then show the cooling performance of CM4 Cooler.

3. Steps

- Prepare for 2pcs CM4 IO board samples
- Put 2 CM4 IO boards into the thermostat oven.
- Connect HDMI cable, mouse and keyboard to the CM4 IO board.
- Power on the boards
- Set temperature on the oven.
- Run shell command to read the temperature of CPU
- Observe and record the output data on the screen.

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4. Equipment



No.	Name	Specifications	Quantity
1	Constant temperature and humidity oven	0.8KW	1
2	CM4 IO board	V1 version	2
3	CM4 Module（LITE)	2G memory	2
4	CM4 Cooler (with thermal-silicon pads)	Silver	1
5	CM4 IO Case	Black	2
6	Mouse with USB interface	Standard	1
7	Keyboard with USB interface	Standard	1
8	HDMI cable	Standard	2
9	Screen	With standard HDMI interface	1
10	Power supply cable of screen	/	1
11	DC power adaptor	12V，2.5A DC	2
12	USB_HUB cable	2 ports	1

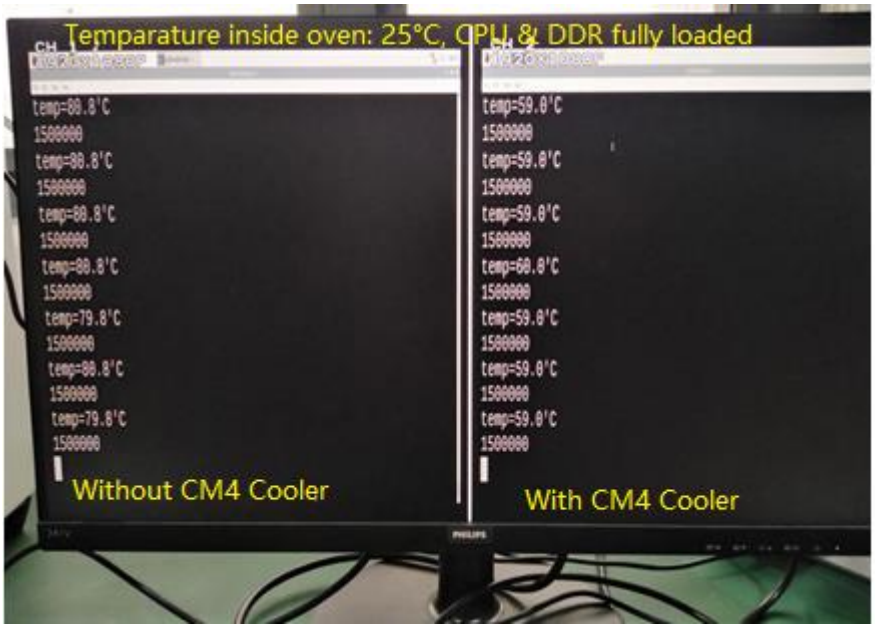
5. Samples

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No.	Module version	Motherboard	CM4 Cooler	External case	Picture
Sample 1	CM4 Module LITE	CM4_IO_BOARD	Silver	Black	
Sample 2	CM4 Module LITE	CM4_IO_BOARD	/	Black	

6. Testing Data

The following data are the internal temperature of CPU, and there is no fan inside the oven to generate the air-flow.



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- When CPU runs at 750 MHz (Unit: °C):

Temperature of inside Oven	Without CM4 Cooler		With CM4 Cooler		Temperature Difference	
	Normal	Fully loaded	Normal	Fully loaded	Normal	Fully loaded
25	47.2~48.7	62.3~63.7	39~41	50~51	6.2~9.7	11.3~13.7
30	53.8~55	68.1~69.6	43~44	56~8	9.8~12	10.3~13.6
35	57.4~59.4	73~74.5	52~53	60~61	4.4~7.4	12~14.5
40	62.3~64.2	78.4~79.3	56~57	65~66	5.3~8.2	12.4~14.3
45	68.1~69.6	81.3~82.7	62~64	69~71	4.1~7.6	10.3~13.7
50	72.5~74.5	84.2~85.2	63~64	72~73	8.5~11.5	11.2~12.2

- When CPU runs at 1GHz (Unit: °C):

Temperature of Oven	Without CM4 Cooler		With CM4 Cooler		Temperature Difference	
	Normal	Fully loaded	Normal	Fully loaded	Normal	Fully loaded
25	47.7~48.2	68.6~70.1	39~41	53~54	6.7~9.2	14.6~17.1
30	52.1~53.5	73~74	43~45	57~59	7.1~10.5	14~17
35	56.9~58.4	78.8~80.3	48~49	64~66	7.9~10.4	12.8~16.3
40	61.8~63.3	83.7~84.7	54~54	66~67	7.8~9.3	16.7~17.7
45	66.7~68.6	84.7~85.2	58~59	71~73	7.7~10.6	11.7~14.2

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50	72~74	84.2~86.6	63~64	76~78	8~10	6.2~8.6

- When CPU runs at 1.5GHz (Unit: °C):

Temperature of Oven	Without CM4 Cooler		With CM4 Cooler		Temperature Difference	
	Normal	Fully loaded	Normal	Fully loaded	Normal	Fully loaded
25	49.1~51.1	79.8-80.8	42~43	59~60	6.1~9.1	19.8~21.8
30	54~55	81.3~82.3	45~47	63~64	7~10	17.3~19.3
35	58.9~59.9	81.3~82.3	52~53	68~70	5.9~7.9	11.3~14.3
40	64.2~64.7	82.7~83.7	55~57	73~75	7.2~9.7	7.7~10.7
45	69.1~70.6	84.2~85.7	61~62	79~81	7.1~9.6	3.2~6.7
50	73~74.5	84.7~86.2	65~66	82~83	7~9.5	1.7~4.2

Note:

- Normal: CPU and memory are not loaded with any additional application code after the system booted up.
- Fully loaded: CPU and memory work at full capacity under the official system via the stress command.
- The maximum temperature of CPU without CM4 Cooler is about 85 degrees because the Stress test command actually does not fully load the CPU and memory, while it is because there are over-temperature protection on the software to prevent CPU damage.

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7. Conclusion

CM4 Cooler clearly reduced the temperature of CM4 module.

When the environmental temperature is 25°C, the CPU and memory are fully loaded, the temperature of CM4 Module with the CM4 Cooler is about 20°C lower than the one without the CM4 Cooler.

The heat dissipation performance of CM4 Cooler is relevant to the temperature difference between CM4 Module and environment, the greater the temperature difference, the better the cooling performance.

CM4 Cooler enables the CM4 Module to operate at full speed safely at below 45°C environmental temperature.

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