ED-Pi4PCOOLER Cooling Performance Testing

1 Overview

This chapter introduces the Test device, Test purpose, Required Test Peripherals, and Test Program.

1.1 Product Overview

ED-Pi4PCOOLER is a passive cooler for Raspberry Pi 4, which provides excellent cooling performance for Raspberry Pi 4.

1.2 Test Purpose

Test the cooling performance of ED-Pi4PCOOLER.

1.3 Test Overview

By reading the temperature and frequency of Raspberry Pi 4 CPU, the cooling performance of ED-Pi4PCOOLER can be judged.

At the same ambient temperature, the lower temperature of Raspberry Pi 4 CPU and the higher the frequency indicates the better cooling performance.

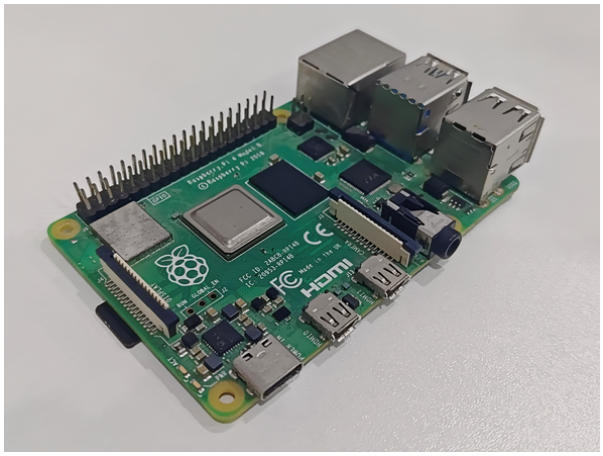
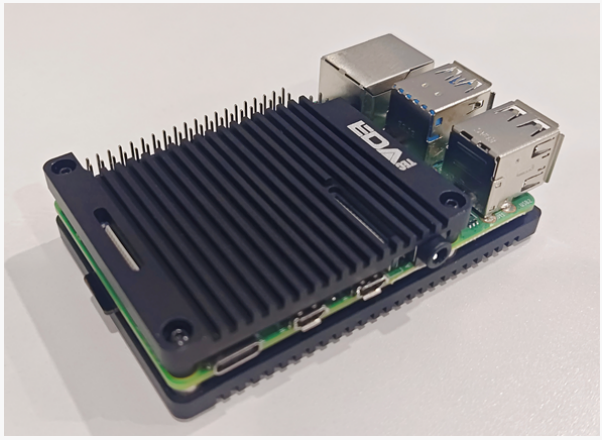
Test Content	Data Source
Cooling test of ED-Pi4PCOOLER on Raspberry Pi 4	The temperature of Raspberry Pi 4 CPU

2 Cooling Performance Testing

2.1 Device Under Test

2.1.1 Hardware Configuration

The following two groups of equipment were configured to test and compare the cooling effect of ED-Pi4PCOOLER.

Group	Configuration	
A	Raspberry Pi 4	
B	Raspberry Pi 4 + **ED-Pi4PCOOLER**	

2.1.2 Software Configuration

Operation System: 2024-07-04-raspios-bookworm-arm64.img

2.2 Test Equipment and Environment

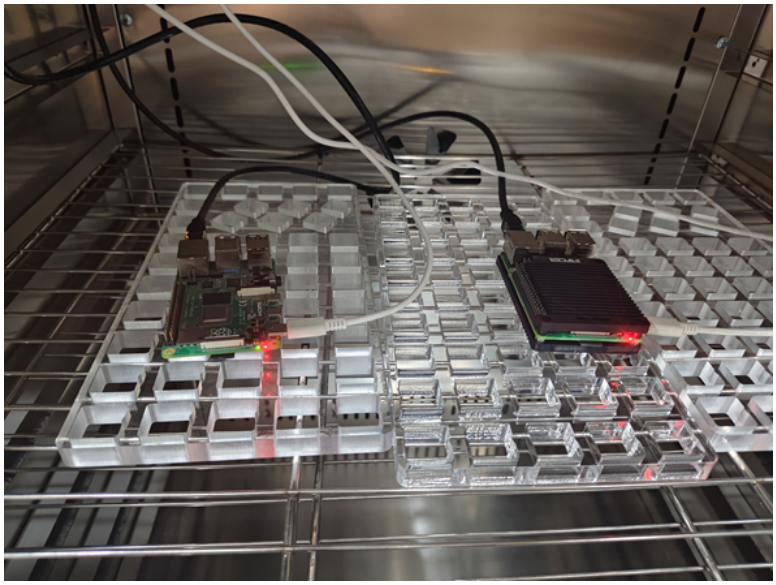
2.2.1 Test Equipment

Test Equipment	Quantity
Raspberry Pi 4 Model B 8GB	2
Raspberry Pi 15W USB-C Power Supply	2
ED-Pi4PCOOLER	1
Thermostat	1
Network Cable	2

2.2.2 Test Environment

Temperature: Constant temperature (25℃, 45℃)

Humidity: 20%



2.2.3 Test Software

This script is used to make the Raspberry Pi 4 CPU 4 core run at full load, record the temperature data of Raspberry Pi 4 CPU every 5s, save it in a ".csv" file and print it to the terminal.

```
#!/bin/bash
#

PID_BENCH=

FILE=./temp$1-bench.csv

[ "$(whoami)" == "root" ] || { echo "Must be run as sudo!"; exit 1; }

if [ ! `which sysbench` ]; then
    apt-get update -y
    apt-get install -y sysbench
```

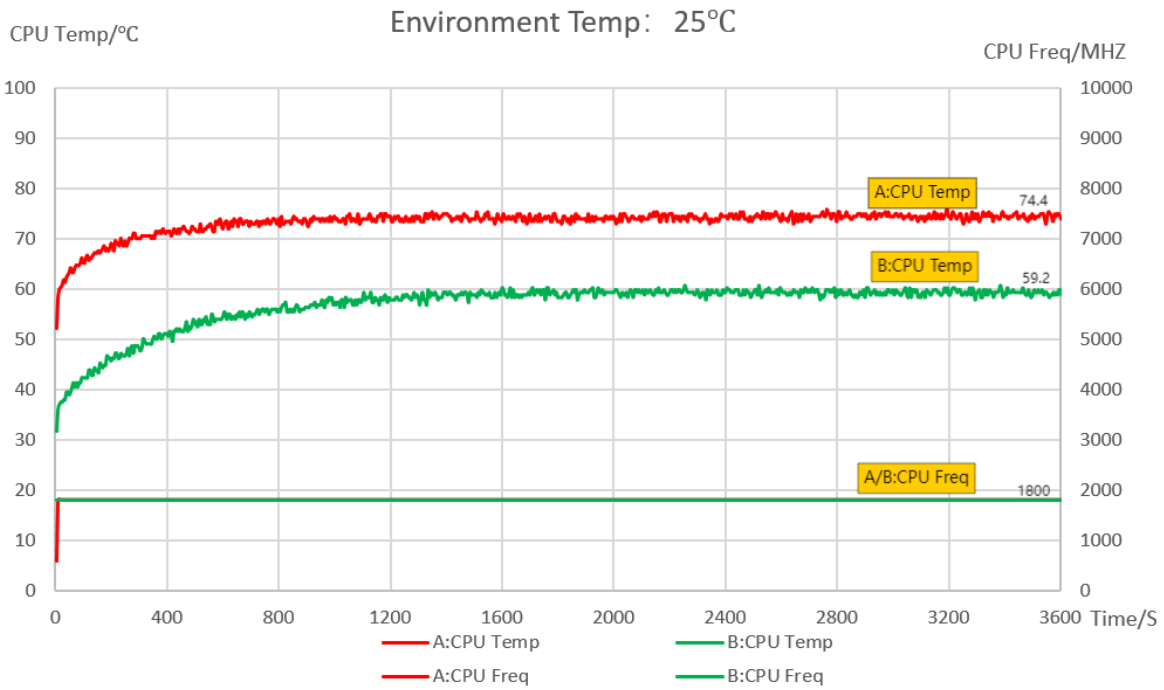
```
fi

trap ctrl_c INT

ctrl_c() {
    echo "** CTRL-C Detected"
    echo "** Kill Bench and Exit"
    kill $PID_BENCH >/dev/null 2>&1
    exit 0
}

bench() {
    while true ; do
        sysbench --test=cpu --cpu-max-prime=20000 --num-threads=4 run > /dev/null
2>&1
        # sleep 1
    done
}

monitor() {
    Counter=14
    DisplayHeader="Time      Temp    CPU         Throttle       Vcore"
    echo "Time,      Temp,    CPU,         Throttle,       Vcore" >> ${FILE}
    while true ; do
        let ++Counter
        if [ ${Counter} -eq 15 ]; then
            echo -e "${DisplayHeader}"
            Counter=0
        fi
        Health=$(perl -e "printf \"%19b\n\", $(vcgencmd get_throttled | cut -f2 -
d=)")
        Temp=$(vcgencmd measure_temp | cut -f2 -d=)
        Clockspeed=$(vcgencmd measure_clock arm | awk -F"=" '{printf
("%0.0f",$2/1000000); }' )
        CoreVolt=$(vcgencmd measure_volts | cut -f2 -d= | sed 's/000//')
        echo -e "$(date '+%H:%M:%S'), ${Temp}, $(printf '%4s' ${Clockspeed})MHz,
$(printf '%020u' ${Health}), ${CoreVolt}" | tee -a ${FILE}
        sleep 5
    done
}

echo "********** Raspberry Pi Benchmark **********"
echo ""
echo "           Press 'CRTL + C' to Exit         "
echo ""
echo "******************************************"
echo ""

touch ${FILE}

bench &
PID_BENCH=$!

monitor
```

2.3 Test Steps

1. Flashing the **2024-07-04-raspios-bookworm-arm64.img** image to two groups of devices, connect them with ssh, and update them using the following commands in turn `sudo apt updae` and `sudo apt upgrade` commands.
2. Configure devices in groups A and B to test each other. Each test lasts one hour.
3. Run the script in the test software to set the Raspberry Pi 4 CPU to run at full load with 4 cores and read the CPU temperature and frequency data.
4. Evaluate the cooling effect of ED-Pi4PCOOLER by comparing the temperature and frequency data of the Raspberry Pi 4 CPU of the two groups of devices; the lower the temperature of the Raspberry Pi 4 CPU and the higher the frequency of the device when it is running stably under the same ambient temperature, the better cooling effect will be.
5. The final test from a constant temperature of 25 ℃ conditions gradually in the thermostat increased by 5 ℃, read the CPU temperature and frequency data, test out the critical value of the group B device does not downclock the environment temperature.

2.4 Test Result and Analysis

Environment temperature 25°C

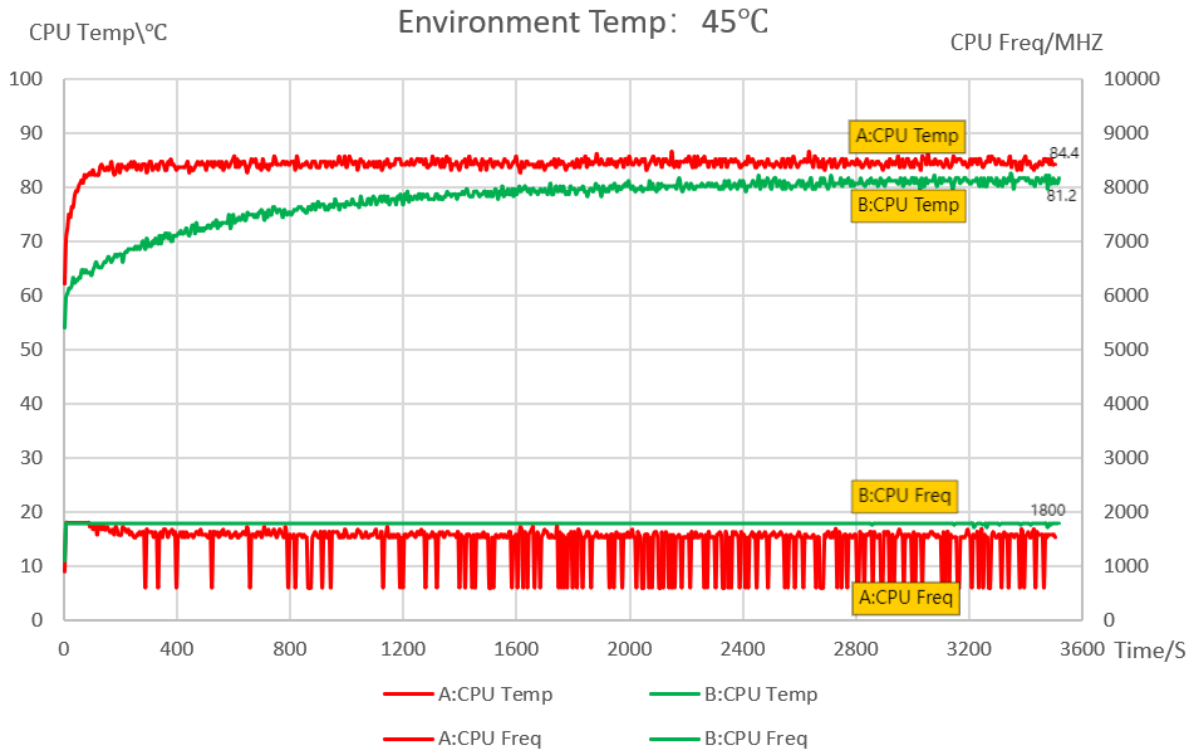


1. The following table shows the average temperature of the Raspberry Pi 4 CPU during stable operation of the two groups of devices

Group	Configuration	Stable running temperature of CPU (℃)
A	Raspberry Pi 4	74.4
B	Raspberry Pi 4 + **ED-Pi4PCOOLER**	59.2

2. When the device is running at a steady state in a 25°C environment, the **ED-Pi4PCOOLER** can reduce the temperature of the Raspberry Pi 4 CPU by approximately 15°C, allowing the Raspberry Pi 4 CPU to run continuously at its maximum mains frequency (1800MHZ).

Environment temperature 45°C



1. The following table shows the average temperature of the Raspberry Pi 4 CPU during stable operation of the two groups of devices

Group	Configuration	Stable running temperature of CPU (℃)
A	Raspberry Pi 4	84.4
B	Raspberry Pi 4 + **ED-Pi4PCOOLER**	81.2

2. Starting with a gradual increase of 5°C at a time in a 25°C environment, the critical temperature for Group B devices without CPU downclocking was finally tested to be 45°C; in this environment, the ED-Pi4PCOOLER can reduce the temperature of the Raspberry Pi 4 CPU by about 3°C, allowing the Raspberry Pi 4 to run continuously at its maximum mains frequency (1800MHZ).