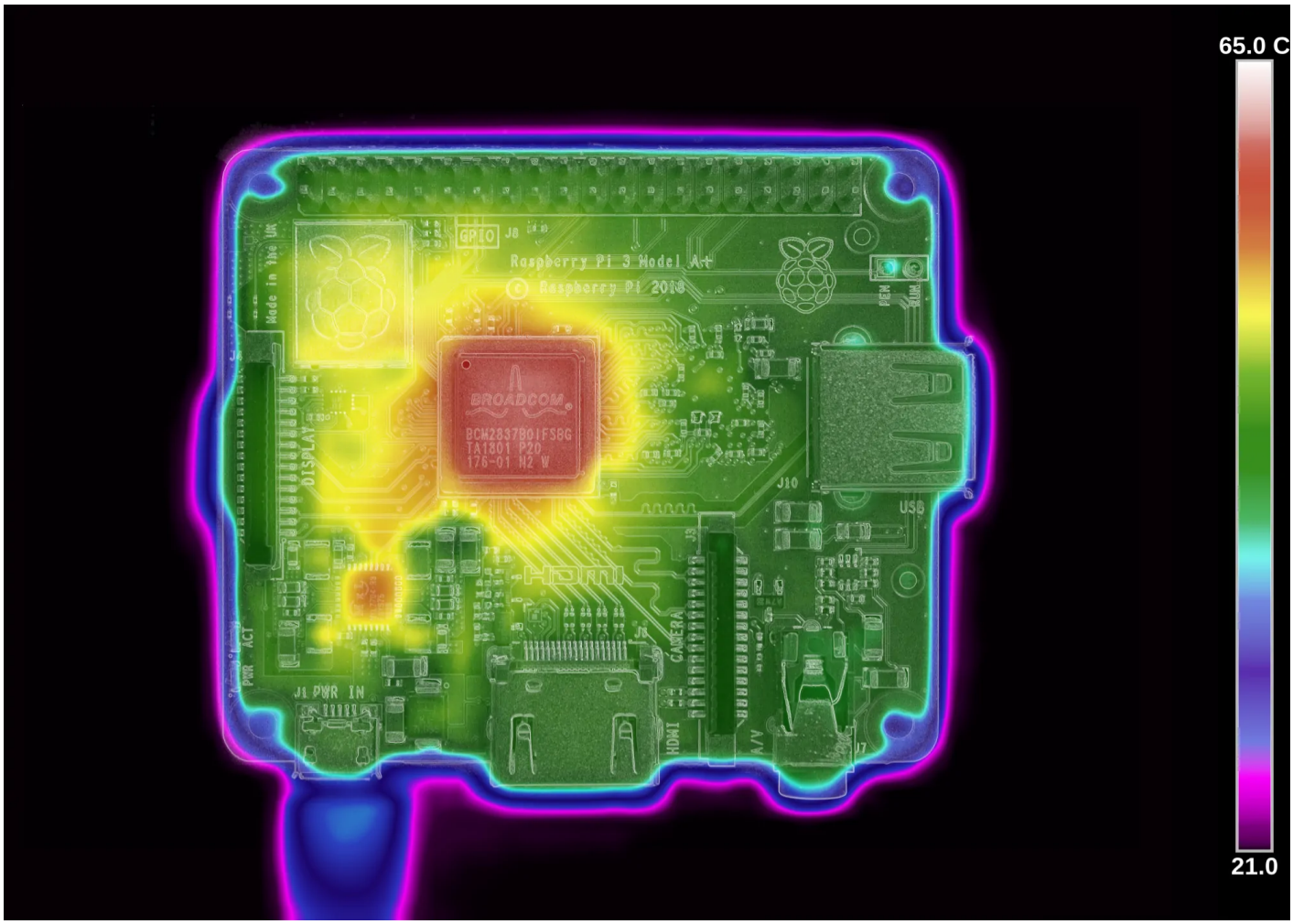
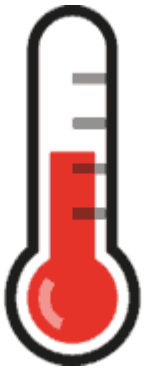
The Operating Temperature For A Raspberry Pi



I was doing some heavy processing on my Raspberry Pi for a few minutes the other day. When I turned it off and picked it up, I was shocked by how hot it felt. That lead me to wonder:

What is the operating temperature for a Raspberry Pi? **The operating temperature for a Raspberry Pi is between 0°C and 85°C. Specifically, the CPU is qualified from -40°C to 85°C and the LAN is qualified from 0°C to 70°C.**



Notes About Operating Temperature

When I first saw the operating temperature I noticed that the range for the LAN was lower than the overall range of the board. This worried me, because what happens if the LAN gets up to 85°C?

Luckily, after doing some research I found that this simply doesn't happen. Almost all of the heat generated by a Raspberry Pi comes from the processor. This is also where a Raspberry Pi measures its own temperature. To prevent overheating, all Raspberry Pi boards begin to throttle the processor when the temperature reaches 80°C and even further when it reaches the max temp of 85°C.

Another interesting fact about the operating temperature was the bottom of the range. While Raspberry Pi has qualified the board down to 0°C, there is a rumor that the pi can operate while submerged in liquid nitrogen. I was unable to find the exact source of this rumor but it wouldn't surprise me if it were true.

In general, Raspberry Pi's tend to run 20-30°C above the ambient temperature of the room they are in. If you are pushing your Raspberry Pi to the max and using the full CPU/GPU, then you might run into a situation where the Pi will start to slow itself down to prevent any damage.

How To Check The Operating Temperature

It's nice to know the operating temperature of a Raspberry Pi, but that doesn't do you any good if you don't know how hot your board actually is. To find out the current temperature of your board you are going to use the **vcgencmd** command.

This is a specific command for Raspberry Pi's that gives system information other than the default Linux system status commands. To get the temperature of your CPU, simply type this into the command line:

```
vcgencmd measure_temp
```

The output will be a single line of text that looks something like this:

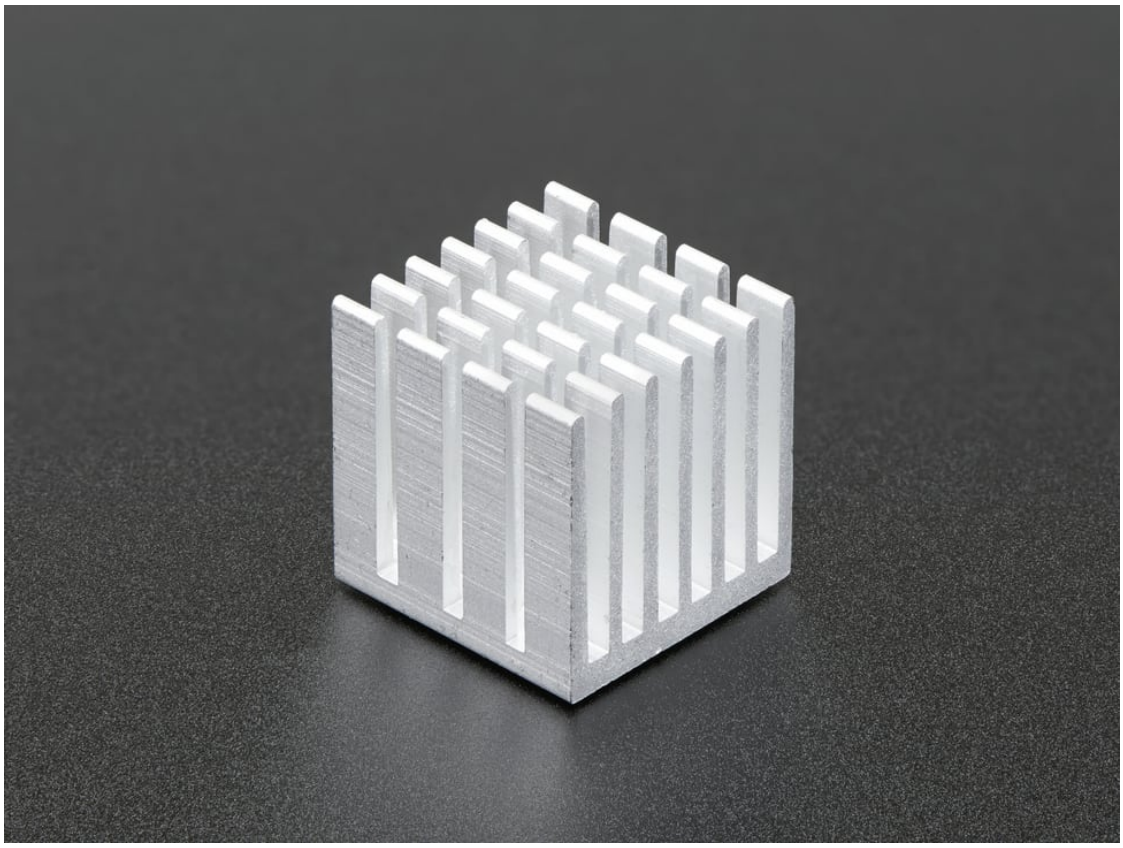
```
temp=50.8'C
```

This temperature will be your current CPU temp. It is probably a good idea to check this temp after setting up a new project to make sure your Pi isn't throttling itself. If you are running on the hot end of the spectrum, you may want to consider cooling your CPU down using a heatsink or an active cooling method.

Heatsinks And Cooling Your Raspberry Pi

There are three primary ways to cool a Raspberry Pi down if it is running a little hot. Each of these have their pro's and con's but any of them are viable options.

Install A Heatsink



A heatsink is a small metal block that you attach directly to your Raspberry Pi. They are made out of thermally conductive metal such as an aluminum or copper alloy. These small blocks “pull” the heat out of the processor and release it into the air. This technique is called passive cooling and is the cheapest but also least effective method for cooling your board.

While not on the top of the list for effectiveness, when it comes to the low power Raspberry Pi, a heatsink is often more than enough to keep your CPU below the 80°C throttling threshold.

Use A Fan

Setting up a small fan or two to actively push air over the surface of your Raspberry Pi is a great way to keep it cool. A constant flow of air will provide a great environment for your Raspberry Pi. Often a fan is used in along with a heatsink as both are very low cost solutions to a hot Raspberry Pi.

Another advantage of using a fan is that it can be powered directly from the GPIO pins if so desired. Most fans run on a very low voltage so the 5V header should be more than enough to keep you fan spinning and providing a healthy airflow for your project.

Use Liquid Cooling

Liquid cooling is by far the most effective, but also most expensive route to keeping your Raspberry Pi cool. Liquid cooling. When I say expensive, I mean EXPENSIVE. A typical liquid cooling setup will run you at least $100. Typically, Raspberry Pi's are used because they are a low cost option. If you are running a project that needs liquid cooling, a Raspberry Pi might not be the right board for you.

If, for some reason, you decide that you want to move forward with liquid cooling, you should have no reason to think that you will ever come close to the 80°C temperature range. Liquid cooling is an extremely powerful method that can keep overclocked gaming computers in the 50°C range so there is almost no possible way to overheat your Raspberry Pi while using this method.

Related Questions

What does the thermometer symbol mean?

If the thermometer symbol is showing up it means that your Raspberry Pi is reaching its maximum temperature. A half-full thermometer means that the CPU temperature is between 80°C and 85°C. If the thermometer is full, the temperature is over 85°C.

How fast is a Raspberry Pi

Raspberry Pi CPU speed varies between models. The first model had a 700MHz processor. The Raspberry Pi 4B comes with a 1.5GHz quad-core processor. While usually below the speeds of a personal computer, all of the models are able to run basic computer software such as open source word processing and spreadsheet tools.

Can a Raspberry Pi get too cold?

There probably are not many instances where this will happen. While the operating temperature of a Raspberry Pi technically bottoms out at 0°C, the boards are actually able to handle colder temperatures. As long as the proper voltage is being applied, the board should be able to run.

Matt Schmitt

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ABOUT ME

I'm Matt Schmitt, a chemist, digital marketer, programmer, husband, parent, and hobbyist. I love the possibilities that science and technology hold. I hope that this blog helps others discover some of the awesome potentials that technology offers to nonprofits and higher education.

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