

POE Installation

This video covers the installation of of a Power Over Ethernet (POE) HAT (Hardware on Top) on Raspberry Pi 4b+ computers.

The components

The POE module used is the official Raspberry Pi model (OEM (Original Equipment Manufacturer)). It was chosen based on feedback from other models available on Amazon.

Other models have some advantages to their application that include:

Allowing the user to use the GPIO pins for other purposes.

Smaller footprint that can provide access to the display and camera connectors

Capability of continuing to use heat sinks

Elimination of the fan

Fans used on Raspberry Pi devices

Since the devices have been used, many fans have been used. A majority of them haven't lasted long (when used on a continuous basis) producing noise due to dust getting into the bearing or brushes.

This particular POE system uses brush-less fans that decrease the chances of noise. The fans also operate on a thermostat control using pin 18 of the GPIO.

GPIO applications

Covering the GPIO to operate a POE Hat isn't necessary. If you don't need the connections, it can serve as protection for the pins as well as cover them up if you intend to use the Raspberry Pi as a computer.

Some cluster cabinets include additional fans to cool down the computers (with POE) that require access to the GPIO pins for power. These fans can be soldered to the connectors but this configuration may be difficult to maintain in the future (if it can't be disconnected quickly).

Removal of heat sinks

If heat sinks are utilized on the device, these heat sinks must be removed, when using this particular model.

The space (between the processor and the POE HAT) wasn't adequate to provide enough clearance to provide cooling and could short circuit (or cause an electrical fire) when used.

The cooling fan is used to cool the whole board using the thermostat controls that are set in the configuration file.

If the Raspberry Pi has been overclocked (it is never recommended to overclock over 2ghz) a cooling system should be utilized to prevent any overheating.

POE Switches

POE switches operate with Ethernet cables that provide data only as well as data and power to small electronic devices.

These switches are typically not available from traditional electronic stores but are available from home improvement or hardware stores since it is treated as a an electrical appliance.

Since it is being treated as a electrical appliance, it's application should require additional precautions when in use to avoid any damage to existing computer equipment or an electrical fire. If you aren't comfortable installing this product, someone with an electrical background should be the person to install it.

POE switches are typically used for security cameras and voice over internet phones (VOIP) such as model made be Cisco that function as a traditional land based telephone using one cable for power as well as communication.

Because of the low wattage used on Raspberry Pi computers, these computers can utilized power over Ethernet to power the device as well as provide high speed data, eliminating many of the cables that are used to operate and power the device eliminating the USB-C power adapter.

More wattage is provided to the Raspberry Pi that can operate additional devices connected to the unit.

If the device has adequate power, the red light on the POE switch will turn on.

How to turn off the Raspberry Pi

The power cord, you were using, had an on and off control. There are some POE hats that have the ability to provide a power button. Some cluster cases have power controls available as well.

If the device ever need to be reset, this can be accomplished in one of two ways:

1. If you are logged into the device (using SSH) type in the following

```
# sudo shutdown -c
```

The device will have to be unplugged from the Ethernet cable and plugged back in to restart the device.

2. Rebooting the device by typing in the following (using SSH):

```
# sudo reboot
```

3. Unplugging Raspberry Pi from Ethernet connection. Wait 20 seconds. Plug Ethernet cable back into the device.

POE IEEE standards

There are several standards (IEEE) that are used for POE but only two used for POE hardware on Raspberry Pi devices. When purchasing POE equipment, the POE hat should work with the same standard that the POE switch supports. Some of these standards can be added using firmware upgrades to the POE switch.

The standards used are:

Standard	Watts per port
802.3af, 802.3at (type 1)	15.4
802.3at (type 2)	25.5

After producing this video, it was discovered that the wattage per port (with the chosen switch) wasn't adequate for this application. It has been replaced with a Netgear GS305EP POE+ switch providing the necessary power for the devices.

If you use a POE switch (rather than a POE+ switch) undercurrent conditions can occur resulting in devices and services disconnecting from the device while in use.

Raspberry Pi POE + HAT's (OEM series used on this video) are capable of using up to 24.5 watts of power that can facilitate Ethernet, USB connections (as long as they are not a magnetic hard drive) WiFi, and Bluetooth services at the same time without devices dropping off due to under current concerns.

Netgear switches offer a lifetime warranty on their devices (whether they are purchased new or used). Once the device is installed, it should be registered on netgear.com with your account (if you have created one).

Netgear's website has a complete listing of all technical information on their product line (based on model number) so that you can do the research before purchasing. It is important on their product line to buy the correct switch based on the version number.

It is a managed switch that provides additional software features to create virtual LAN connections, static IP addresses, and updates to the firmware. This switch operates at level 2 on the network topology (data link).

POE switches are typically sold in electronic departments of traditional stores (since they are a powered device) but may be available in home improvement stores.

A POE switch should have at least one non-powered Ethernet port to connect to the network switch. The switch should make it easy to differentiate between the data-only Ethernet connections as well as the powered connections.

Most POE switches provide POE Ethernet ports in a cluster of four. If Raspberry Pi devices are being built in a cluster, it may be necessary to build them in groups of four.

Any unused POE ports should be covered to prevent any devices from being accidentally connected to the network that aren't POE approved.

Using Ethernet cables with a POE switch

Ethernet cables (used for POE purposes) should be Cat5 or Cat5e that provide no additional shielding using metal or foil. Only RJ45 with plastic connectors only can be used. The insulation on the side of the cable should be clear as to what type of cable it is.

Using metallic shielded cables (Cat 6 or higher) can cause an electrical fire or damage equipment.

These cables should have a distinct color than the other cables used on the network for identification purposes. In this presentation, white is used.

Since this setup is being used in an electrical configuration, additional precautions should be exercised.

If you are going to make your own Ethernet cables, some local and state regulations may not require you to do so unless you are an electrician (especially Washington State). If a fire were to happen and your insurance company is using the cable as the cause. If it was made by hand (not by an electrician) it may not be covered. Cables that purchased as complete (in the package) would be covered.

If you make your own cables and they need to be tested, never plug testing equipment that has an Ethernet cable connected to the POE switch. These cables should be disconnected from any network connections before being testing (testing only from end to end of the cables).

Running POE devices as a cluster

Some cluster cases provide space for the POE switch as well providing a professional setup that can manage and operate the system.

The system shown on the video, is available on Amazon and provide open air ventilation to keep the device to a temperature at or below 150 degrees Celsius. This case should be adequate to provide an additional expansion board (on the bottom of the Raspberry Pi) that will be used for solid state memory using an NVM system that will be covered on a future video.

Using a magnetic hard drive on a POE Raspberry Pi

While the Raspberry Pi does provide power that can run a USB magnetic hard drive (that doesn't include an external power supply) additional features may have to be enabled to increase the power. It is recommended to use solid state devices on Raspberry Pi's including flash drives, Solid State Drives (SSD), and Non Volatile Memory (NVM) modules that require less power to operate.

To use Western Digital Passport magnetic hard drives, a powered USB hub should be used to connect the drive to the computer.

When this setup is used, the USB drive should be unplugged before booting the computer (using the SD card). If you are using the USB drive to boot the computer, this step can be ignored.

A future video will show how to install NVM modules to a Raspberry Pi.

Headless Raspberry Pi's

A headless Raspberry Pi contains no graphical user interface (GUI) and doesn't require a video connection, a keyboard, or a mouse using secured shell (SSH) to manage the system reducing the amount of cabled down to one (when POE is used).

Several computers can managed using a keyboard video mouse (KVM) switch. These systems can be expensive to utilize on HDMI systems since the video signals have to amplified based on length especially when 8 port switches are purchased.

The Raspberry Pi cluster shown uses two computers operating on Ubuntu Server (64-bit) that don't include a GUI since these devices are performing tasks that operate in a cloud based environment or utilize applications from you phone or computer.

If you are used to using Windows, Mac OS, or Chromebook, you may not be too happy using the GUI.

Since raspberry Pi's don't contain separate video processor with memory, graphical utilization can be problematic.

Memory can be configured for graphics (using raspi-config) setting aside (up to 256mb) for video applications using and micro HDMI adapter.

The lack of a GUI can increase the amount of memory available and can be slow to operate and can be problematic to use on traditional televisions (unless the configuration file is modified to handle the correct television, resolution, and refresh rate).

Configuring the fan to work with Raspberry Pi

Configuring the fan to work can be done a few different ways.

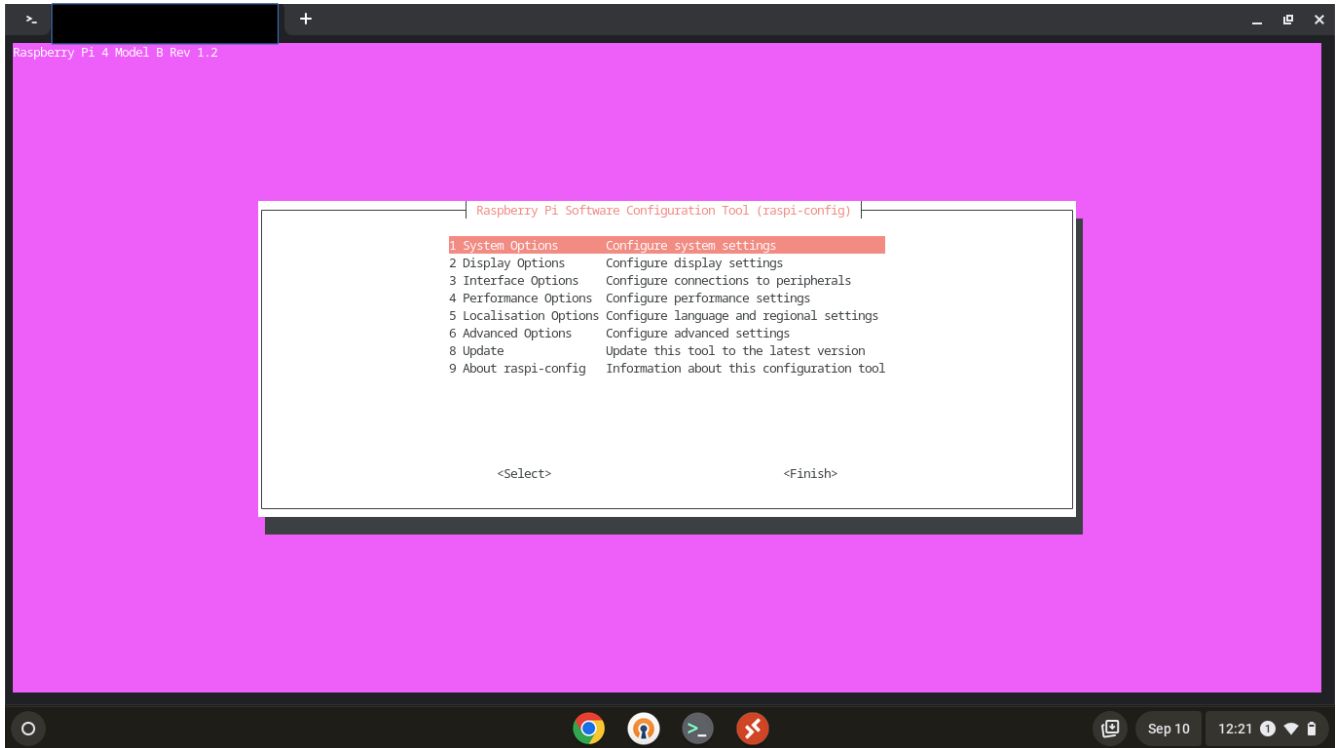
If you are not using the Raspberry Pi OS, raspi-config should be installed by typing in the following (after logging into the computer):

```
# sudo apt install raspi-config
```

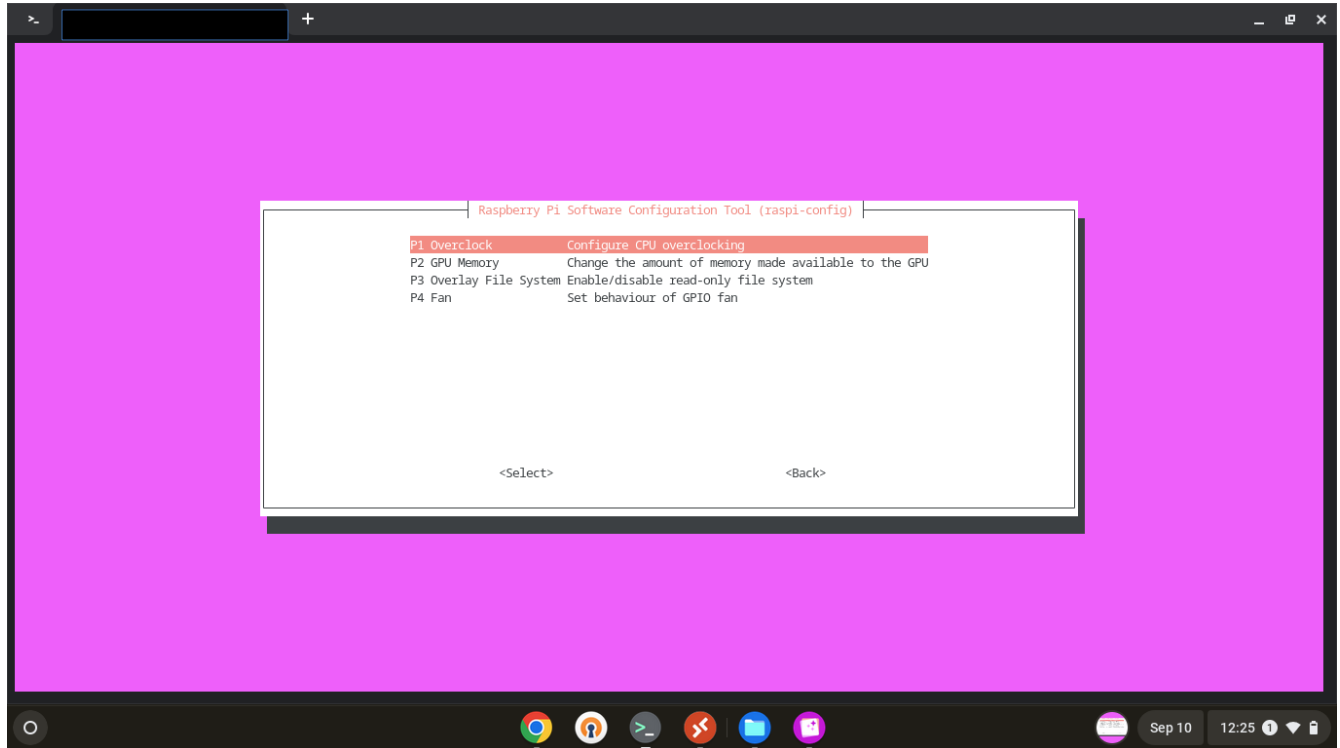
once it is installed, type in:

```
#sudo raspi-config
```

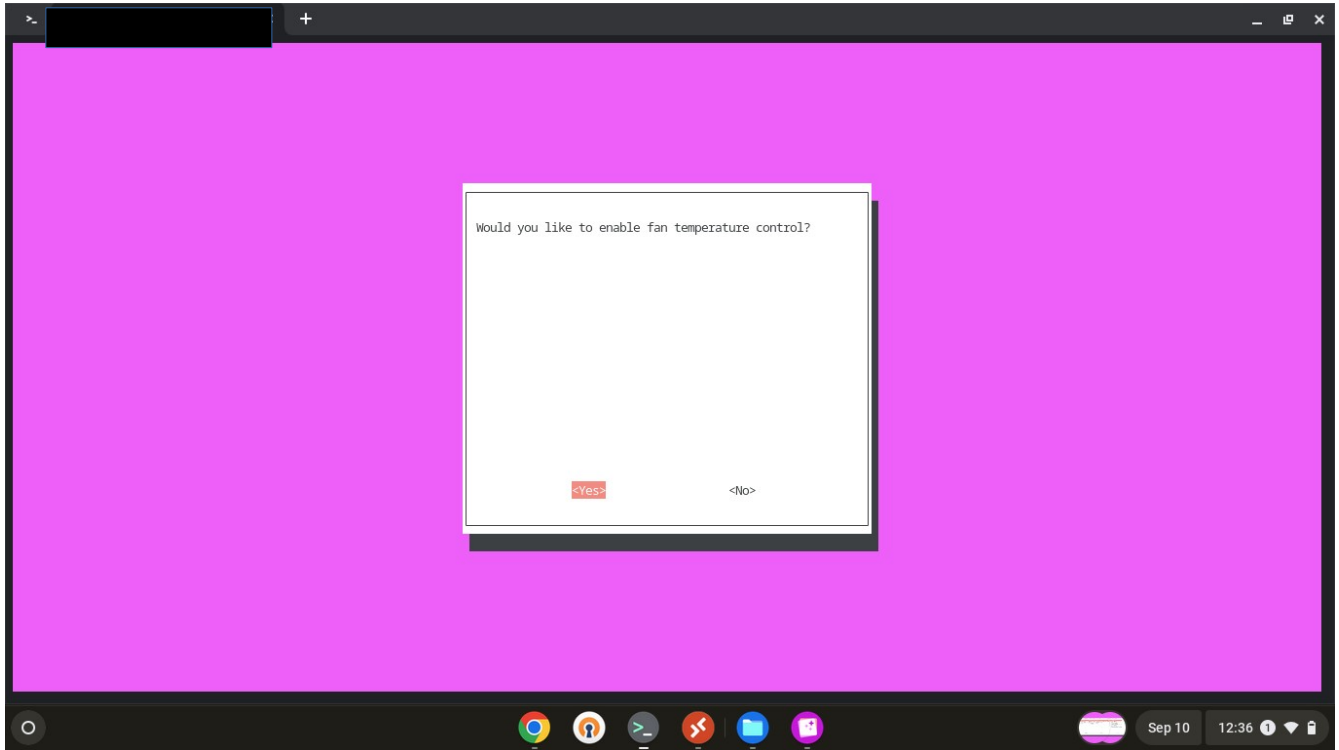
This screen will appear:



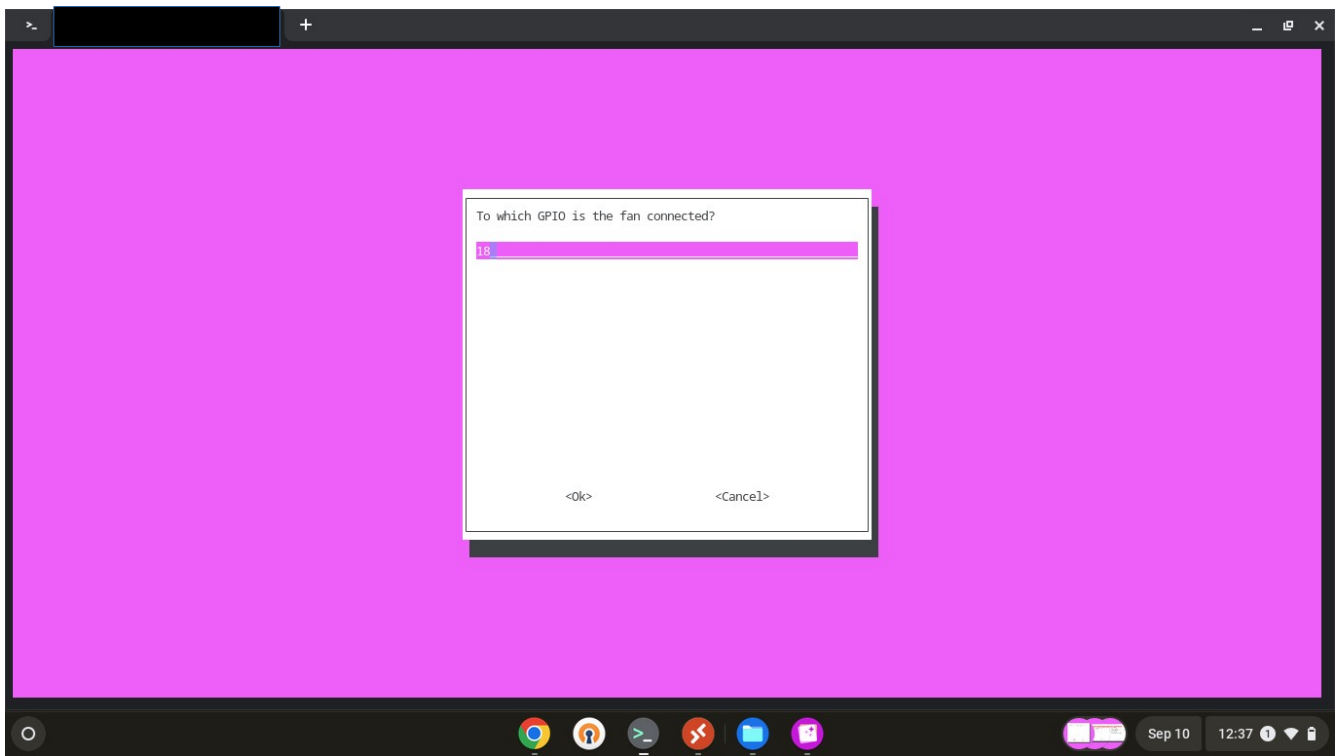
Select option 4 (Performance Options)



Select option P4 fan

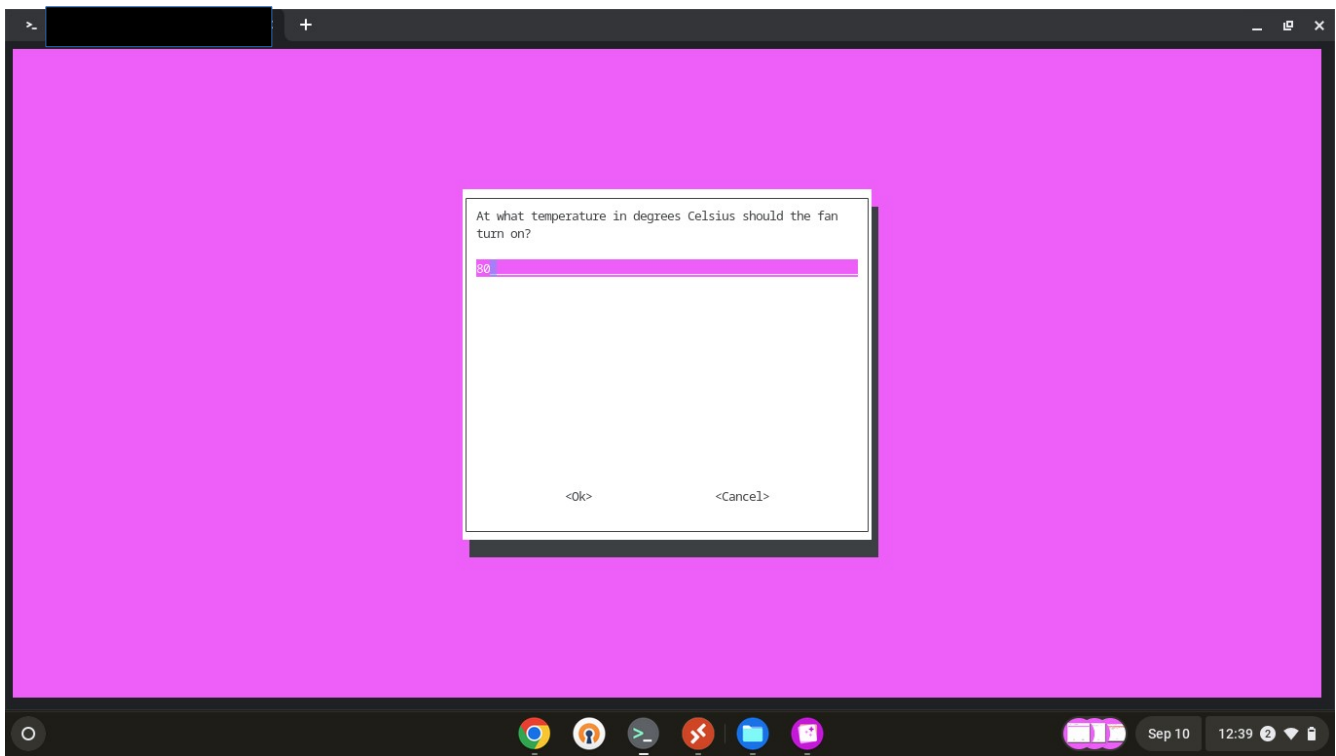


Select Yes and press enter.



If you are using the official Raspberry Pi HAT, this should be set for 18.

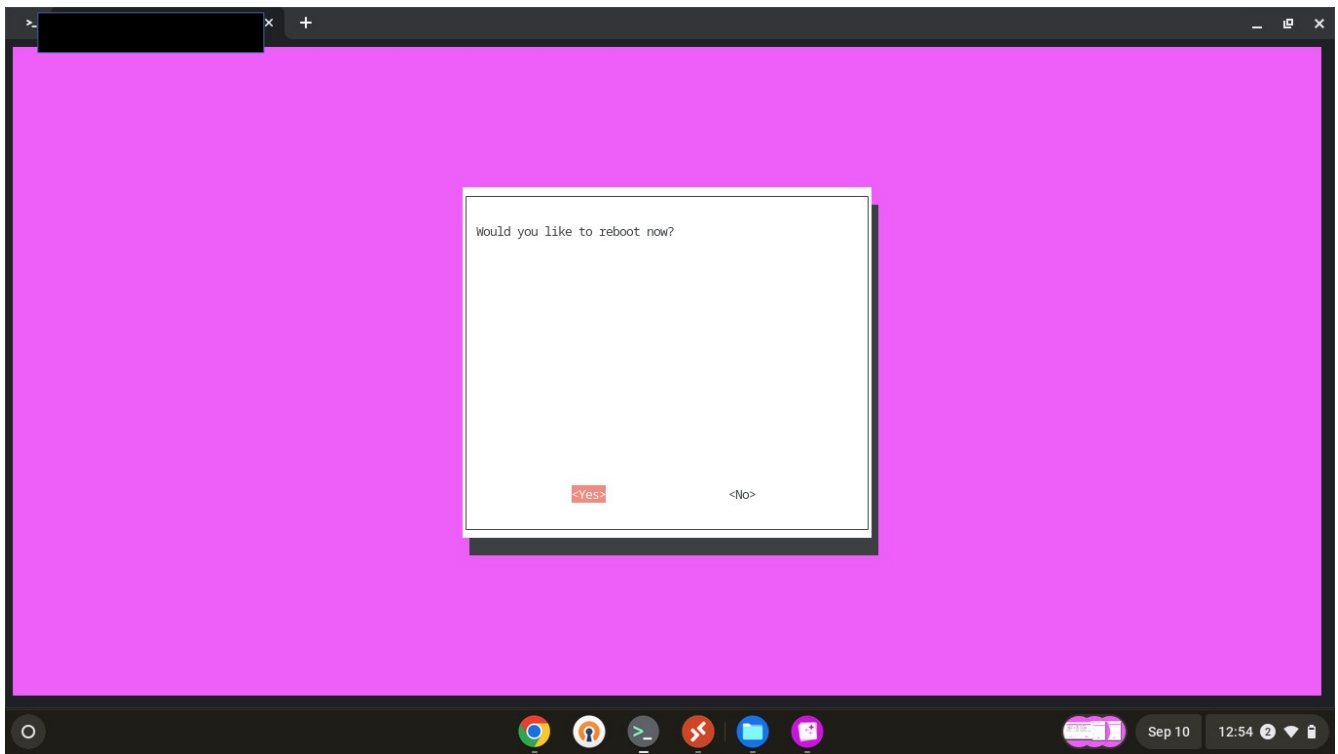
Once entered, press the Tab button to get to OK and press enter.



This setting is in Celsius. For the US, it should be set to 60 degrees (140 degrees Fahrenheit) making sure it is cooled down. This setting may operating a the highest speed that can cause additional noise.

One entered, press tab to select OK and press enter.

A confirmation message will appear that is has been sent. Press OK to continue.



Press enter to select Yes and reboot the computer.

This setting can be modified using the configuration file.

Depending on which operating system you are using, the file can be modified (using nano or vi).

For Raspberry Pi, modify the following file:

```
/boot/config.txt
```

At the end of the file, add the following:

```
dtparam=poe_fan_temp0=50000
```

```
dtparam=poe_fan_temp1=60000
```

```
dtparam=poe_fan_temp2=70000
```

```
dtparam=poe_fan_temp3=80000
```

Once saved, reboot the device.

For Raspberry Pi systems with Ubuntu, modify the following file:

```
/boot/firmware/config.txt
```

(enter the same dtparam settings above and save the file)

This hardware addition can cause increases in ten