

THE P.C. BUILD GUIDE

By Jeannie Frazee



Image from blogspot.com [43]

Building your own P.C. allows you to assemble a customized product that can contain all of the components and functionality that you would choose for your personal system.

It takes careful planning, following the proper steps, and a few safety measures. But you can do it. If you adhere to all the information in each step of this guide, soon you will have your own P.C., and you can say “build it yourself!”

Prepping Your Workspace

Part 1 of 12

Ample Work Space and Static Mat

The work environment is crucial when building a computer. Electrostatic discharge (ESD) can damage computer components even if you cannot feel any static yourself. It takes 3000 volts for you to feel an electrostatic shock, but it only takes 100 volts or less to damage delicate computer electronics. [1]

You will need a clean, flat, surface with ample room for the case and parts and to allow you to work with them easily. The surface should be constructed of an anti-static material such as wood or metal if possible. Place a Static Mat on the work surface. The Static Mat will help you avoid EDS around your computer.

Static Mat Kits range in price from \$10 up. This kit from Velleman includes the ESD wrist strap. [2]



Image from Amazon.com [16]

Carpeting and Anti-Static Floor Mat

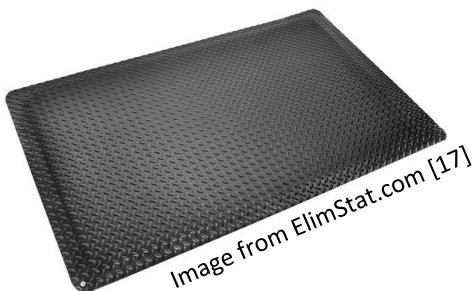


Image from ElimStat.com [17]

Carpeted rooms are not the best environment to work with computer components because of the possibilities of a build-up in ESD, however, if you must be in a carpeted room, place an anti-static floor mat on the floor at your work area, and stand on it while handling any of the computer's components. [1]

Anti-Static Wristband

Before starting your build, attach an anti-static wristband around your wrist and ground it to the metal computer case. This will help to eliminate EDS from your hands as you are working with the components. [1]

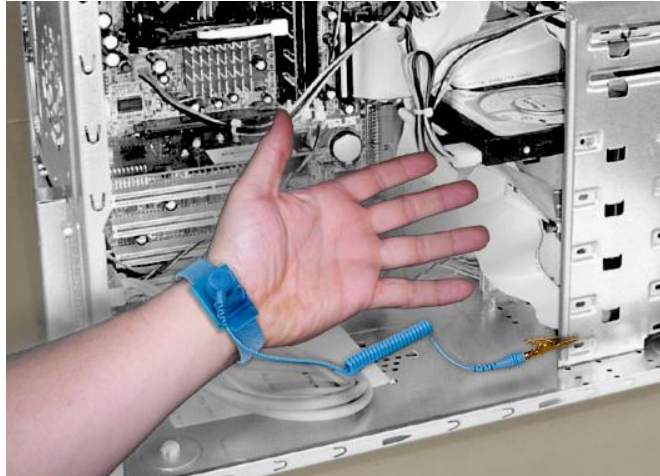


Image from chioszrobots.com [41]

Small Bowls

To make the build easier, have a couple small bowls in the work area to hold screws, and small items. [3]



Image from Ebay [42]

Tools

Assemble the tools you will need before you start. You will need the following: [4]

- ❖ Screw drivers with various heads. A Jewelers Tool Kit is recommended because many of the computer screws are very small. But, if you cannot get a Jewelers Tool Kit, you can purchase a screw driver with multiple heads or several different size screw drivers with a variety of heads.
- ❖ Needle Nose Pliers
- ❖ Extension Magnet – For picking up small parts like screws that may drop
- ❖ 3 Prong Holder – To retrieve small parts

SCREWDRIVERS:

Small precision screw driver set from Natch. This one sells for around \$20. But, there are also other, less sophisticated options for under \$10. [2]



Image from <https://wikimedia.org>

NEEDLE NOSE PLIERS:

Needle Nose Pliers to add and remove small components. Available at any hardware store for less than \$5 [2]

EXTENSION MAGNET:

This particular magnetic pick-up tool is from VasTools. It sells for under \$10. [2]





Image from www.ebay.com
Jewelsandtoolsplus

3 PRONG HOLDER:

A 3 prong holder has tiny grasping prongs that can grab and hold small parts such as screws. [4]

Additional Tools

In the event that the computer does not work as planned, you will need a way to do some troubleshooting. A good starting point is to test the power supply just to make sure that it is functioning correctly. Although, having a multimeter or power supply tester on hand to build a PC is not a necessity if everything works properly, it will save you headaches later if it doesn't. [4]

MULTIMETER



Image from analyseameter.com,
bing images.

POWER SUPPLY TESTER



Image from e-bay images.

Installing the Motherboard

Part 2 of 12

First you need to determine what capabilities you would like in your computer.

The motherboard you select will determine what hardware can be connected to it and what software can be run on that hardware. Therefore, it is suggested that you research motherboards to find one that suits all of your needs. [5]

The Computer Case

Once you determine the motherboard, you can select the computer case. You need to find one that is compatible with your motherboard. You will need to read your motherboard's documentation to find out what cases are compatible. Not all motherboards can fit in every case. [5]

Computer cases come in different sizes.

HTPC – Mini ITX, Macro ATX (specifically for home theater) (4)

Small Form Factor – Mini ITX Motherboard – (small, portable, good for home theater, limited computing)

Mini Tower – Micro ATX Motherboard – Can be tall and slender - (smaller, less intrusive, cheaper, limited computing capabilities)

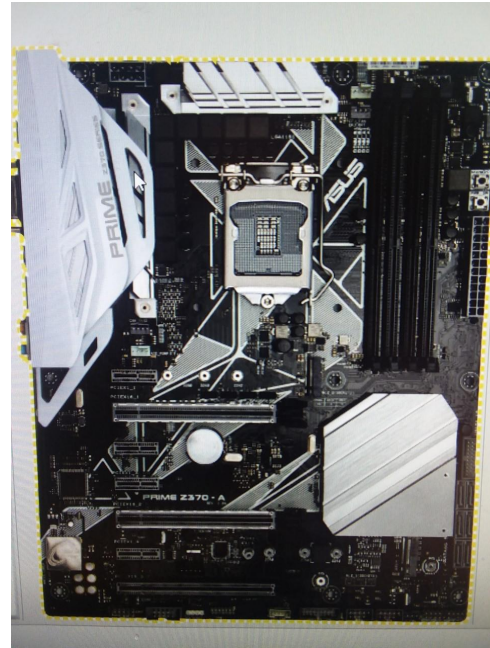
Mid Tower – ATX Motherboard - (more computing capabilities, more expensive, takes more space, good for most purposes)

Full Tower – ATX or EATX Motherboard – (most computing power environment, holds multiple fans, good for servers and extremely high-end gaming, needs more space, more expensive) [6]



Image from buildcomputers.net [6]

For this manual, we will be using a AMX compatible Mid Tower case and an AMX motherboard that supports an LGA1151 CPU socket. We chose the AMX motherboard and case, along with the LGA1151 CPU because we want a system with a fast processor, capabilities to install and use RAM in triple channel mode, and the ability to install a hard drive; CD-DVD drive; and PCIe Video Card. [7]



Images from TestOut.com [7]

Preparing to Install the Motherboard

Before attempting to install the motherboard attach the antistatic wristband to your wrist and ground it to the computer. Also, ground yourself by touching the metal frame of the computer case.

The motherboard should be wrapped in a gray antistatic bag. This protects the motherboard from ESD. Blue, pink, clear and green bags are static resistant, however, grey bags give the best protection.

Open the bag and lay the motherboard out on the work area on the Static Mat. [5]

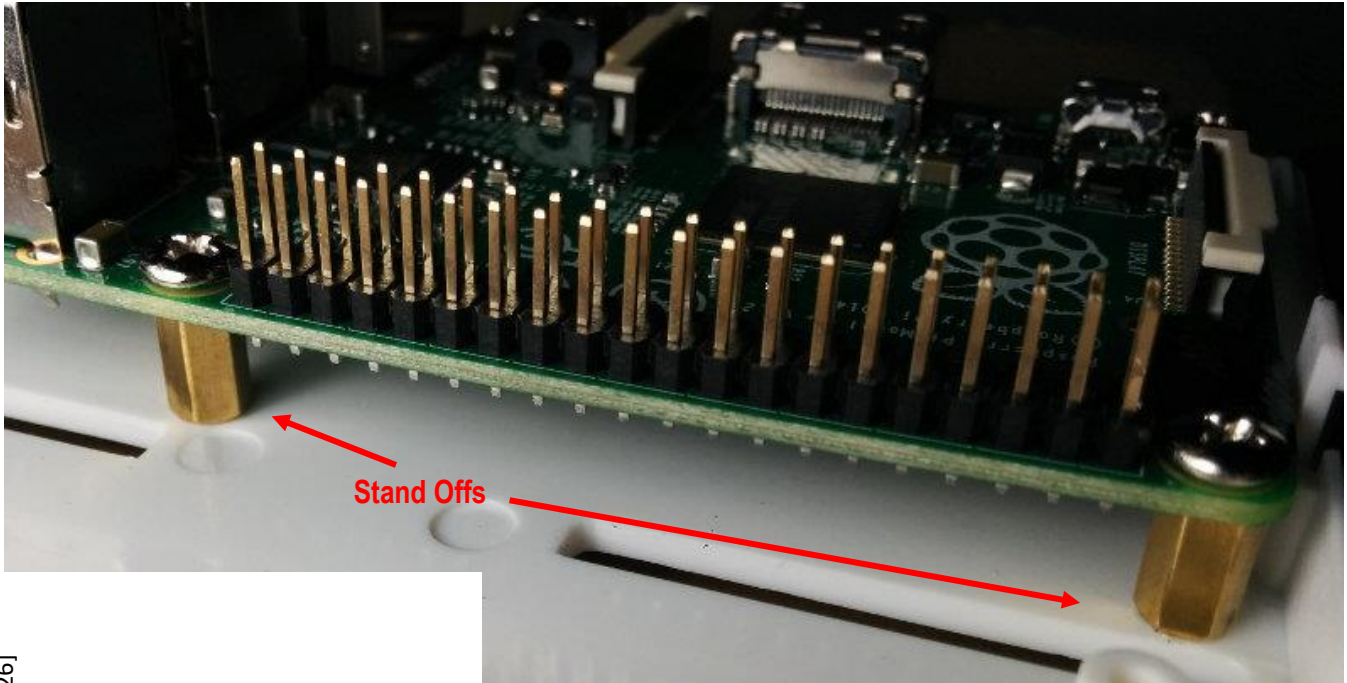


Image from Stack Exchange, Bing Images [25]

Image from Amazon.com [26]

Stand Off



There will likely be more holes in the case than you will use. To determine where to place the stand-off's, gently hold the motherboard above the mounting area and match the holes on the motherboard with the holes on the mounting area. Only place standoffs in holes in the mounting area that are also on the motherboard. Make sure you have a stand-off in each hole that matches a motherboard hole. If you do not, it could cause the motherboard to bend in that area after it is installed. [5]



Image from E-Bay.com [27]

Once all stand-offs are in place, you will insert the motherboard. Tilt the motherboard slightly and insert the I/O connectors into the I/O cover first. Then, lay the motherboard on the stand-offs. [5]

Screw the motherboard to the standoffs using fine-thread computer screws. You will want to secure it firmly, but not overtighten it. [5]

Installing the Power Supply

Part 3 of 12

Selecting the Power Supply

When selecting a power supply, you need to make certain that your power supply is compatible with your motherboard and the computer case. Some computer cases may be too small to house a regular size power supply. *(Remember, you will need adequate room for air-flow.)* As a general rule, a power supply can support a smaller size motherboard than its stated motherboard type, but not a bigger one.

Additionally, you will want to make sure that your power supply can handle all of the other components that you plan to install. Power Supplies are rated based upon the watts of power that they can support. You will need to figure the watt power needs of the components that you plan to install in order to see if the power supply can handle them. [8]

For this manual we are using an ATX, 20+4 pin PCIe. It will support the ATX motherboard and allow us to add power to the PCIe Video Card. [7]



Image from TestOut.com [7]

Connecting the Power Supply



Image from dansdata.com [28]

Place the power supply into the computer case. The fan and power connector side will face the back of the computer and be protruding out the back when properly placed.

Screw the power supply into the case. [9]

Installing the CPU

Part 4 of 12



Image from pcbitz.com [29]

Selecting the CPU

Your CPU must be compatible with your motherboard. Make sure you read your motherboard's documentation before selecting a CPU. [10]

For this manual, we are using an 8th Generation Intel Core Processor, LGA1151 CPU socket, i5-8600K, 3.60 ghz, 9 mb cache. This CPU is compatible with the ATX motherboard and has the processing power to run all of our necessary aps, plus our hard drive and CD-DVD drive, without being exceptionally expensive. [7]

Attaching the CPU

Take the CPU out of its anti-static plastic bag. Look at it closely. In one corner you should see a gold triangle. This triangle signifies that it is “pin one”.

You must line the CPU up correctly in the CPU holder on the motherboard.

Lift the lever on the CPU holder. Place the solder connections side of the CPU face down on the holder and line up “pin one” on the CPU with “pin one” on the connector. Close the lever. Check to make sure that the CPU is being held firmly in place. If it is not, you will need to try again. [10]

Image from pcstats.com [30]



Notches

Pin 1

**DO NOT ATTEMPT
TO TURN THE
COMPUTER ON
UNTIL THE
HEATSINK AND
FAN ARE
INSTALLED!**

Image from build-your-own-computer.net [33]



Applying Thermal Paste

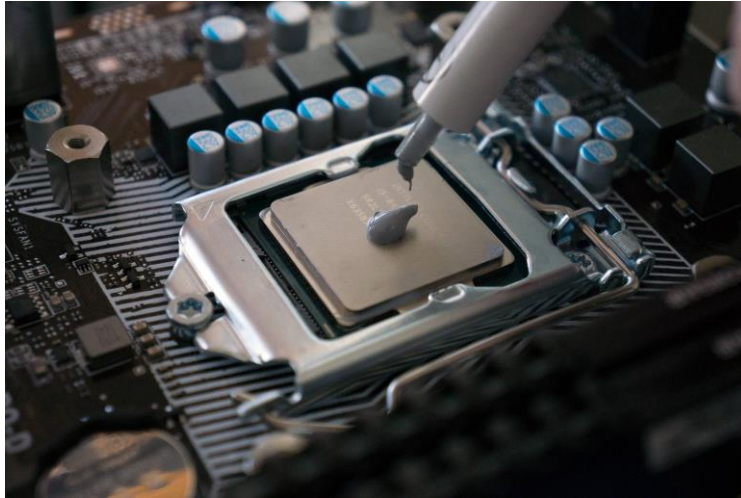


Image from Windows Central [31]

Next, apply either a thermal pad or thermal paste to the top of the CPU. This is very important, as it aids in drawing heat out of the CPU and into the cooling fan.

Squeeze the thermal paste onto the top of the CPU until it is the size of a green pea. When you apply the heatsink and cooling fan, it will spread across the CPU. [11]

Placing the Heat Sink and Cooling Fan

Place your heat sink and cooling fan on top of the thermal pad/paste and lock it in place. Different cooling fans have different locking mechanisms. Use the one that is supported by your motherboard CPU socket.

Check to make sure that the cooling fan is seated correctly and is firmly in place. [10]

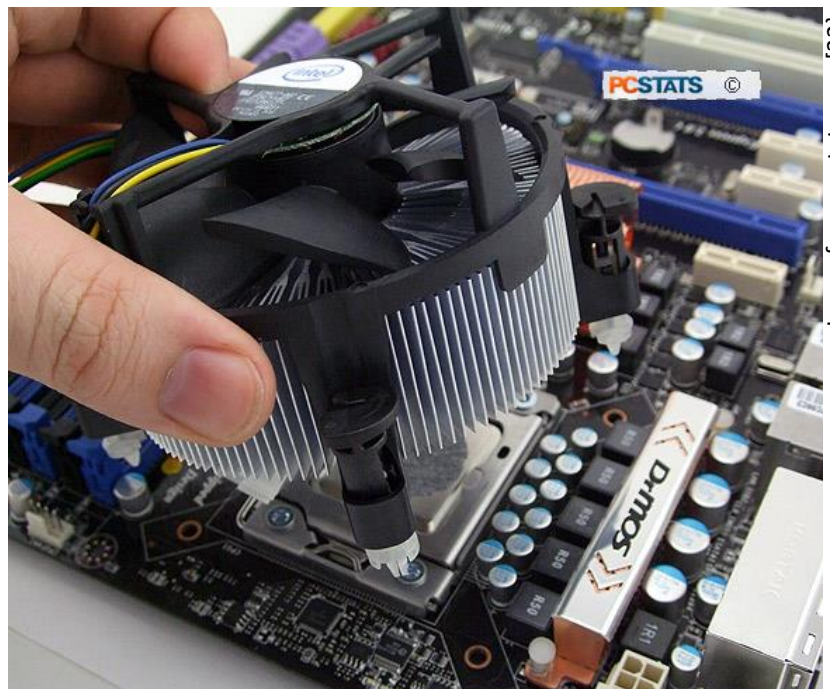


Image from pcstats.com [32]

Selecting a Cooling Fan

There are different types of cooling fans. Again, you will need to make sure that your cooling fan is compatible with your CPU and motherboard.

Some types of cooling fans include:

- ✓ Air Cooling with heat sink and fan
- ✓ Closed Loop Liquid Cooling that utilizes a pump, radiator and reservoir
- ✓ Open Loop Liquid Cooling
- ✓ Submerged Cooling, which is not often used [12]



Image from TestOut.com [7]

For this manual we are using an Intel fan and heatsink 1151 socket. It is an active cooling system because it actively pulls the heat off of the CPU. Although it is not the best cooling device available, it is compatible with our CPU and it is more economical than a liquid cooling system. It will work sufficiently for our needs. [7]

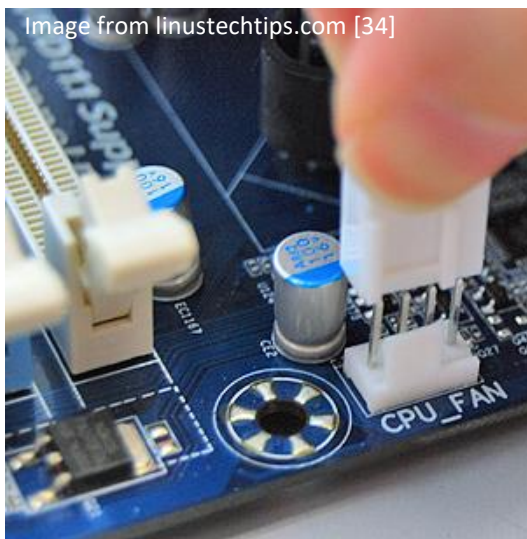


Image from linustechtips.com [34]

Plug the cooling fan into the motherboard. You will find a connector on the motherboard that says CPU Fan 1. Plug the fan into this connector. [10]

Connecting the Power for the Motherboard

On the power supply in the bundle of cables, there will be a cable with 24 pins to connect to the motherboard. This is the motherboard power cable. Sometimes the cable will be separated so that it has 20 pins plus 4 more. This is because some motherboards only have a 20 pin connector.

Look at the motherboard. You will see a slot with 20 or 24 slots in which the pins fit. They are “keyed”, so it will only go in one way. Plug the motherboard power connector in to this slot. [8]

Image from blogspot.com [35]



Image from wordpress.com [36]

Connecting the Power for the CPU

Next, look at the motherboard again. You will see another connector that looks similar to the motherboard power connector, but it will only have either 4 or 6 or 8 pin holes. This is the CPU Connector.

Find the corresponding connector on the power supply and plug it in. This supplies power to the CPU. [8]

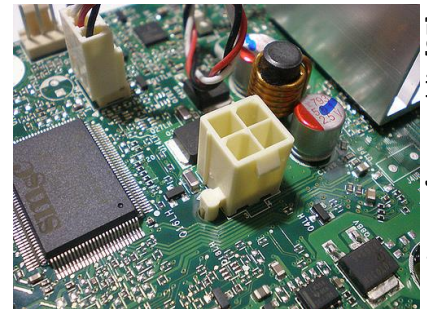


Image from reddit [37]

4 Pin Hole CPU Power connector on the motherboard

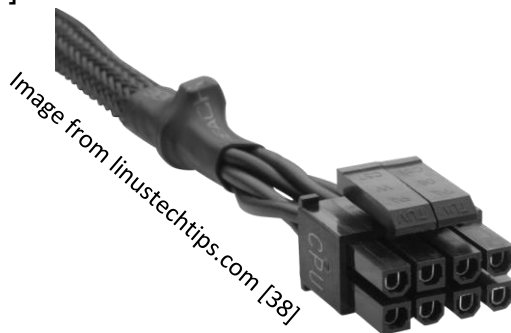


Image from linustechtips.com [38]

8 Pin CPU Power Connector

Installing Memory (RAM)

Part 5 of 12

Selecting Memory

When installing Memory, otherwise known as RAM (Random Access Memory), you must make sure that the Memory that you install is compatible with your motherboard. To do this, you should check your documentation for your motherboard by either referring to paper documentation that you may have or by going to the manufacturer's website and looking it up. [13]

Things that you need to look for are:

- What type of RAM your computer uses (i.e. DDR2, DDR3, DDR4, etc)
- The maximum memory that can be installed (i.e. 8 GB, 16 GB, 32 GB)
- The maximum speed that can be installed (i.e. 1500 MHz, 3000 MHz)
- Whether it uses "Buffered" or "Non Buffered" memory
- Whether it can take "EEC" or "Non-EEC" memory

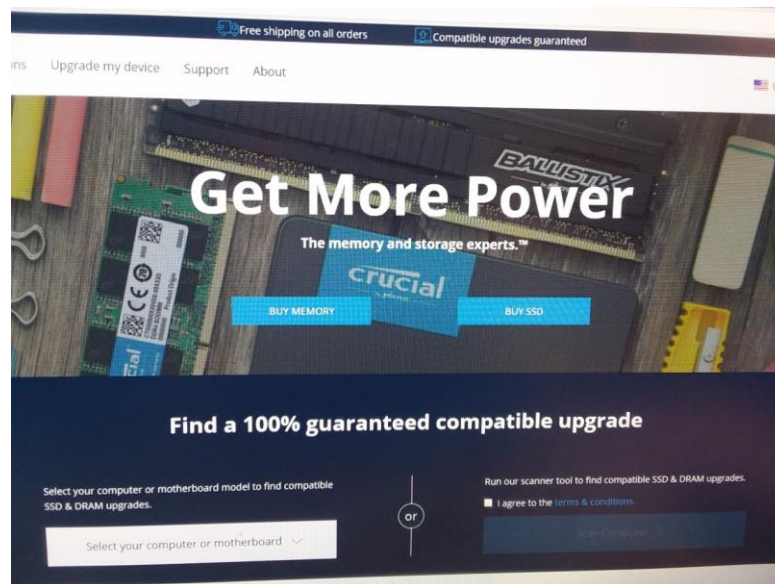


Image from www.crucial.com [14]

Once you have this information, go to www.crucial.com. Type in the manufacturer and model of your motherboard or CPU. It will give you a list of compatible RAM. Then, from that list, match the information that you have collected with the RAM listed. [14]

Keep in mind: You can purchase RAM that is of a higher memory and speed than what your motherboard supports, but it will be limited by the motherboard to the amount the motherboard supports.

Additionally, the limitations of your Operating System will also dictate how much memory can be used. A 32 bit Operating System can only support 4 Gigs of memory, whereas a 64 bit Operating System can use more. **Wait, don't purchase yet. There's more information to consider.**

When purchasing RAM, you should also consider your intended use for the system. If you are on a limited budget, you may want something more economical with a little less potential. Keep in mind, though, that you may be limited by that choice. Take future needs into consideration. As new technologies evolve, they often require more memory. [13]

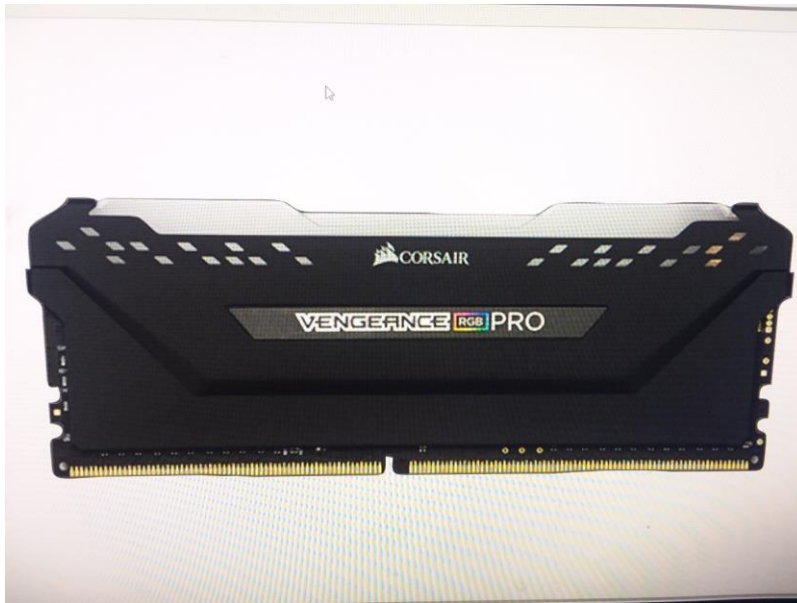


It is extremely important that you purchase all of your memory sticks in pairs of two that are exactly the same.

Additionally, if you are setting them up in triple or quad channel mode, you MUST use memory sticks that are ALL THE SAME. (3 for Triple and 4 for Quad.)

*We are using triple channel mode for this manual. [13]

Image from TestOut.com [7]



For this manual, we are installing Corsair Vengeance RGB Pro DDR4, 8 GB, 2400 MHz memory that we already had available on our shelf. [7]

It is compatible with our motherboard, which will allow for DDR4, 16 GB, unbuffered ECC or non ECC, 2133 MHz – 4000 MHz memory. Although our motherboard allows up to 4000 MHz memory, we are opting for the lower speed of 2400 MHz because our motherboard does not go over 2133 MHz without overclocking.

Overclocking means setting the system to run faster than it was intended. It can be done successfully, but it also wears out the CPU faster and can cause some system instability, so we are opting not to overclock for this manual. [13]

Installing Memory

To begin installing your memory, lay the computer down on its side again so that the motherboard is facing straight up.

Take the memory sticks out of their antistatic bags. **Do not hold the memory stick by the little metal connectors, as it could cause damage, particularly from EDS.**

We are going to be setting the memory up in triple channel mode, so you will need 3 memory sticks exactly alike. [13]



Image from PC Perspective [39]

Triple channel mode means that we will be putting three sticks of RAM in three specific RAM slots which will enable the three sticks of RAM to work together. This will speed up the memory, because data is distributed randomly in the three as if they were one, and information can be accessed quicker. [15]

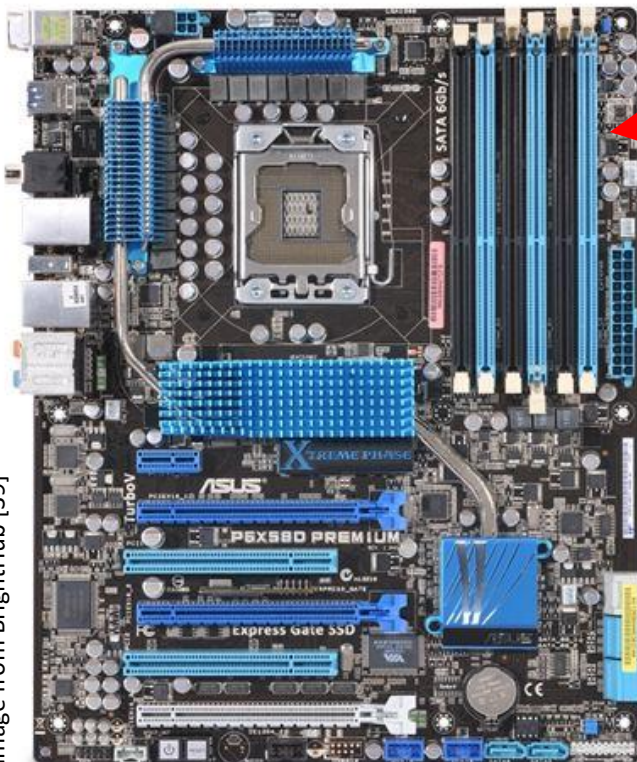


Image from BrightHub [39]

Look at your motherboard. You will see several long memory holder slots that look like this.

Now, look at your motherboard documentation. It will tell you which slot are which. They will be numbered with something like A1, A2, B1, B2.

Also, look at your motherboard documentation to see if your motherboard supports triple channel mode and in which order to place the memory modules in order to achieve triple channel mode.

It is very important that you know in which order the slots are arranged!

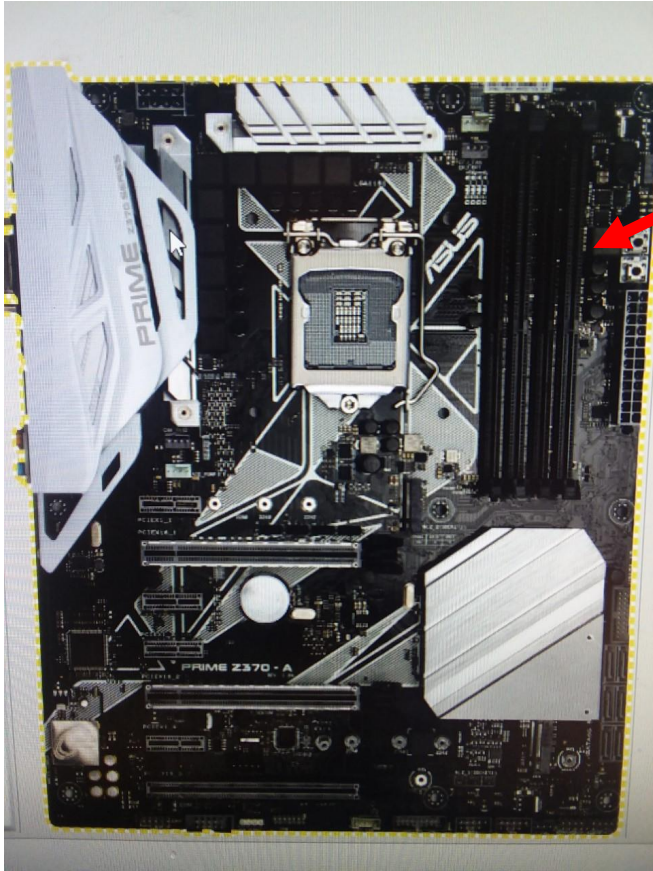


Image from TestOut.com [7]

Our motherboard looks like this.

Our slots are all black, but our documentation tells us that the slots are arranged from left to right as: B1, B2, A1, A2.

For motherboards such as the one shown on the last page, the blue slots will usually be A's and the black slots B's, (*but not always*).

We have checked to see that our motherboard accepts triple channel mode. It tells us that in order to achieve triple channel mode, we will need to put RAM in A1, A2, and B1

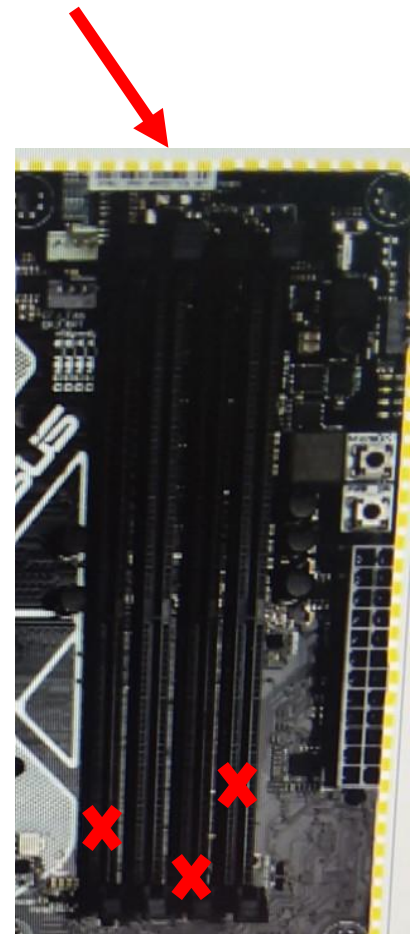
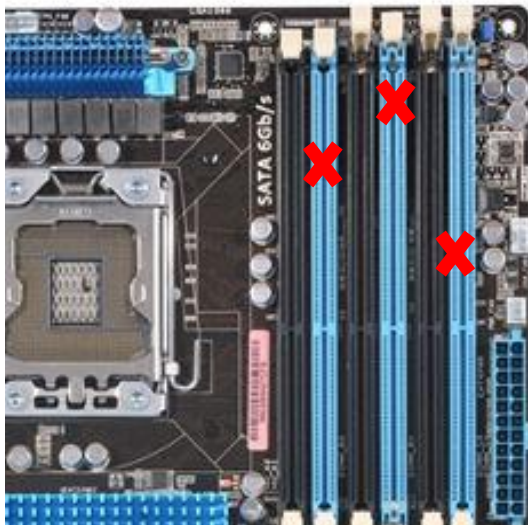
We have three sticks of RAM, so we will insert them in the first slot, the third slot and the fourth slot. [7]

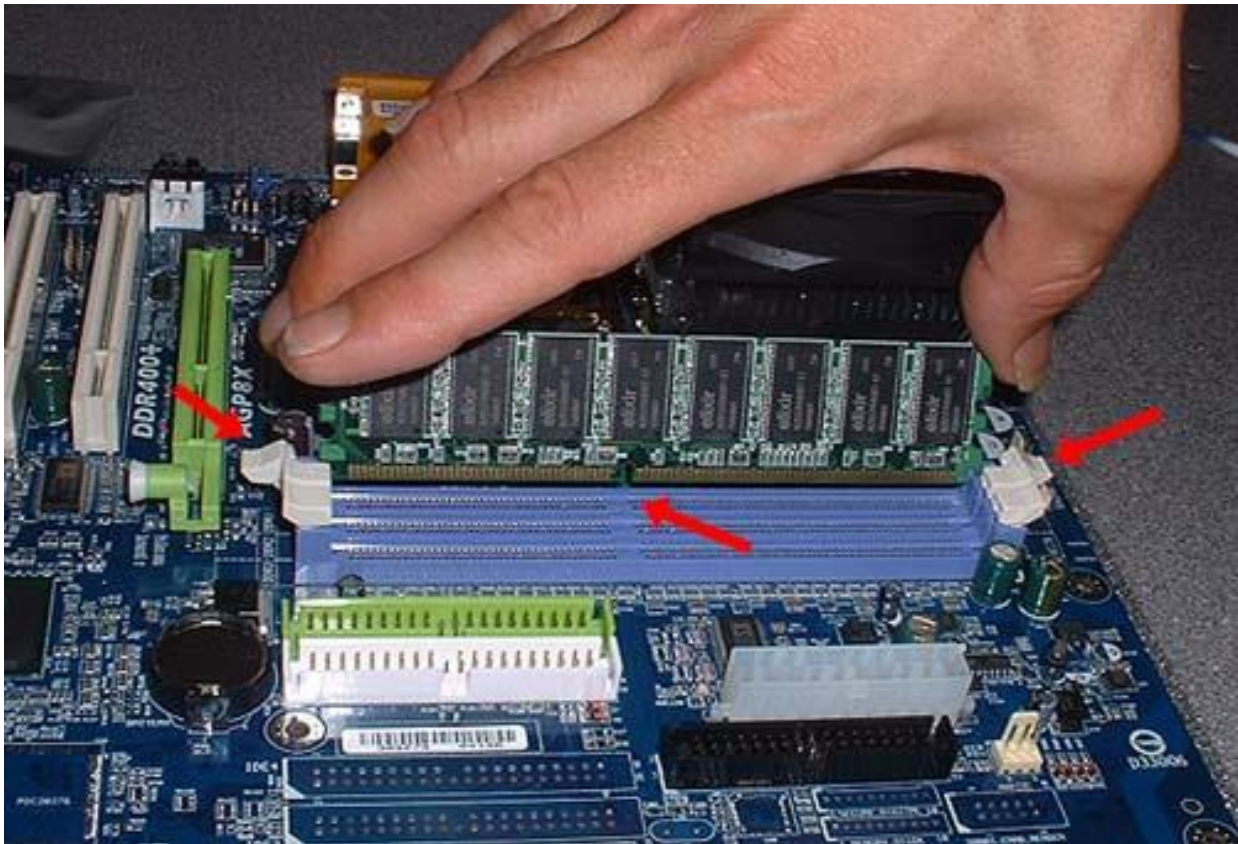
To see this more clearly, look at the motherboard below, which has lighter colored connectors:

Its RAM is documented as B1, A1, B2, A2, B3, A3

To set it up in Triple Channel Mode the documentation states to place the module in A1, A2, and A3.

So, we will place a RAM module in each of the blue slots





To install the RAM, hold it in your hand with the metal tabs down. Again, do not touch the metal tabs.

Look at the metal tabs at the bottom. There will be a small notch in the row of metal tabs. Line that notch up with the raised area on the RAM slot on the motherboard. It is set up this way so that you do not install the RAM incorrectly. If you have it turned in the correct direction, they should align. If they do not, turn the RAM module around.

(If the notch does not align when the module is turned in either direction, you have the wrong RAM module for your motherboard. You will need to return it and purchase the correct one.)

Gently, but firmly push it straight down until it clips into place.

When it is installed correctly, the clips should come up over the little slits on the sides of the RAM and hold it securely in place.

Do this with each of the three modules. [13]

Note about RAM. If you do not place the RAM in the correct slots for dual, triple, or quad channel mode, it will run in single channel mode, which is substantially slower. Also, if you have mix-matched modules so that they are not all the same, it will also run in single channel mode. [13]

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