

PC BUILDER'S GUIDE, PART II - ASSEMBLING A PC

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The Computer Builder's Guide, Part II

- Assembling a PC -

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In this article, we'll be stepping through the process of actually building a computer, which practically anyone can do - all you need is a screwdriver, some patience, and a little ingenuity from time to time! If you've read [Part I](#) of this article, you learned how we went about selecting the parts for this project. We set our budget (\$500) and then worked within that budget to best serve our intended purposes. There's always a bit of give and take in this process, as you discover new uses you'll have or realize that the products you need cost either more or less than you thought they might.

Right off the bat, we made a small change to our build list that increased our budget by over \$50, but which should pay us back with a much better user experience. We're big fans of solid state drives (SSDs), and while a \$100 SSD simply doesn't make sense if you're working within a \$500 budget, there is another option: a "hybrid hard drive." We decided it was worth increasing our budget another \$60 to upgrade from a standard 500GB hard drive to a 1TB hybrid drive. We get twice the capacity, but also much faster boot and app-launching times. You can read our review of the Seagate Solid State Hybrid Drive that we used [here](#).

Other than that, we're working with the components we selected previously, so read on to learn how it all came together!



- > The Windows 7 to Windows 8.1 Upgrade Guide
- > PC Builder's Guide - Picking Parts
- > [PC Builder's Guide II - Assembling a PC](#)
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Step 1: Setting Out Your Parts: The first thing you'll want to do is review all the components you have, making sure everything you purchased is at hand. You probably don't want to open everything all at once - leave the parts boxed up until you're ready to install them, or things could get really messy!

Step 2: Preparing Your Case Because everything needs to fit inside your case, you should take it out first and get a feel for its design before you do anything else. First things first - set the case down on a soft surface, such as a carpet, a sheet, or a towel, and remove the side panel (typically the left side panel). Then look around the case to determine where each of your components will go. Make note of the front panel cables that you'll eventually need to attach to your motherboard (including the cable for the all-important power switch!). Set out the various screws and other fasteners that the case came with and try to match them up with the illustrations that (hopefully) appear in the instruction manual.

Note that most high-quality cases provide you with all the fasteners you'll need to install all the typical components, including the motherboard, hard drives, SSDs, video cards, optical drives, the power supply, etc. We encountered an issue right away, however, in that our Zalman case didn't come with a sufficient number of motherboard setoffs, which are the little "legs" on which the motherboard sits, and into which the motherboard screws are fastened. We had to be a bit creative and decide where we really need the provided standoffs via trial and error. Unfortunately missing

parts is a common issue, so check the inventory before you're knee-deep into your build!

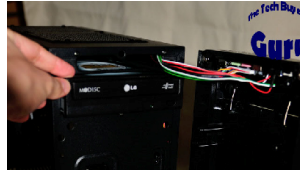
One optional step at this point is to route all the cables from the front panel neatly along the edges or back of the case. You may use twist-ties or other fasteners to keep them together.



Starting from scratch: an empty case!

Step 3: Installing the Optical Drive

While this step doesn't necessarily have to come next, it's often easiest to install an optical drive, like a DVD burner, before anything else is in the case. To do so, you'll probably need to pull the front panel off the case, which is often secured with plastic tabs. These can be fragile (and yes, we've broken them in the past), so it's best to identify where they protrude into the case and gently push on them while pulling on the panel from the outside. Eventually, the panel will pop off, and you'll be able to insert the optical drive (which almost always goes in from the front).



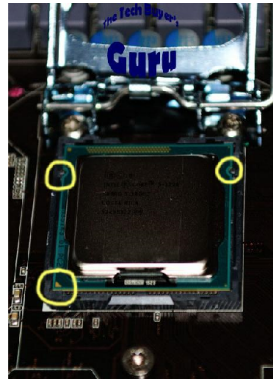
This process is illustrated in the photo to the right. You'll see that the front panel is detached, hanging on only by the front panel cables. The DVD burner here was set into place, and then affixed using screws that came with the case. Many cases have tool-less securing devices that make it very simple, although either way, you'll likely have to figure out exactly how far the optical drive should be pushed in to make sure it lines up correctly with the front panel. You can adjust it later once you've reattached the panel.

Step 4: Installing the CPU

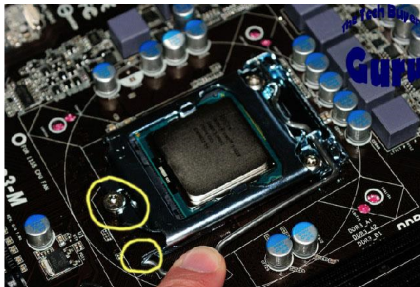
So you passed Step 3 with flying colors - on to the challenging stuff! Installing a CPU is often the step that worries people the most, and for good reason - the CPU is a small and relatively expensive component that looks quite fragile. But installing it isn't that hard, as shown in the illustrations that follow. Note that this is specific to Intel - the process of installing an AMD processor will vary slightly.



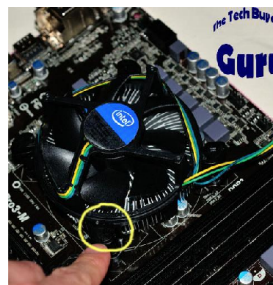
It's hard to damage a CPU as long as you handle it correctly. Notice how we are holding it by the edges, so as to avoid touching the electrical contacts underneath. We then gently place it into the CPU socket, as shown in the next photo.



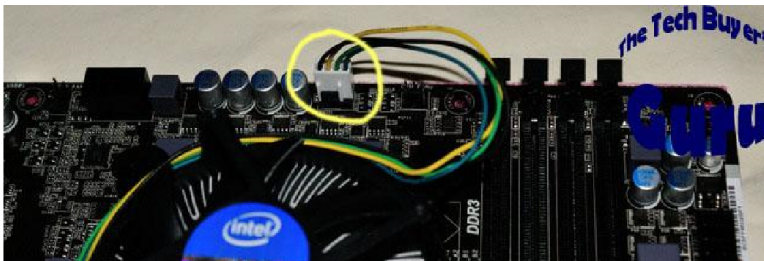
Notice how the tabs on both sides of the socket fit into notches on either edge of the CPU. Also note that a yellow triangle lines up with a white triangle in the lower left-hand corner.



This is the scariest part - you need to hook the bracket under the bolt (top circled part), and then lower the locking bar, hooking it under the restraint (lower circled part). It requires a large amount of force, and you might think you're crushing the CPU when you do it!



This is the heatsink/fan assembly, which must be secured on top of the CPU. It comes with thermal interface material (TIM) pre-applied, but always confirm it's there. To secure it, push down on the four plastic pins until they lock in place.



The last step here is to connect the CPU fan. Your system may not start, or alternatively will issue a warning, if this fan is not connected. Why? Because without the fan spinning, it's very likely the CPU will overheat, shutting down the system and potentially causing damage.

Step 5: Installing the Motherboard

There are a number of steps that come with installing the motherboard. Let's start with the easiest step first - installing the rear input/output (IO) shield. This comes with your motherboard, and is custom-cut for the specific ports on the motherboard. You just need to snap it into place, making sure it's fully inserted or the motherboard won't sit correctly in the case.

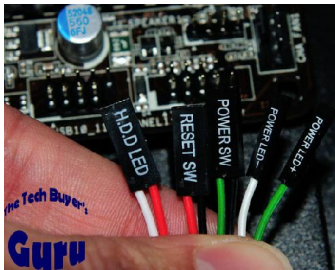
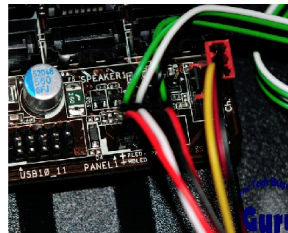


The next step is to install the mounting posts. These are typically gold-colored metal posts on which the motherboard will sit. Sometimes they are pre-installed, but even if they are, you'll need to make sure they are in the right locations for your motherboard. Hold the motherboard over the mounting area to see if the holes in the motherboard will line up with the posts before you continue to the next step.

OK, on to the actual motherboard installation. This is when you will feel like you're getting close to the end - because your system will really start looking like a computer. To mount the motherboard in the case, we recommend you grab it by the CPU heatsink - this is a good test of whether the heatsink is firmly attached (it better be!), and also avoids contact with any delicate componentry on the motherboard. As you lower it down, do so at an angle, focusing on lining up the rear ports with the I/O shield. Then lower the whole board down, taking care to line it up with the mounting posts. You will know it's in place if you can see the mounting post holes through the screw holes in the motherboard. Once you've done that, locate the motherboard screws that came with the case and use them to secure the motherboard to the case. When you're done, it should look something like the photo below (although if you look closely, you'll see the motherboard screws have not yet been inserted).



There is one more step before we can say the motherboard installation is complete - we need to attach the front panel connectors - these are typically for the power button, reset button, front audio plugs, front USB ports, and various LED lights. You will probably also have at least one case fan that needs to be connected. What you'll see below are a closeup of the power and reset button plugs and the LED panel plugs, which are the trickiest to install because they are so small, and the corresponding "headers" on the board can be hard to decipher. They also must be matched up by positive and negative leads. Positive will generally be a bright color, while negative will be black or white.

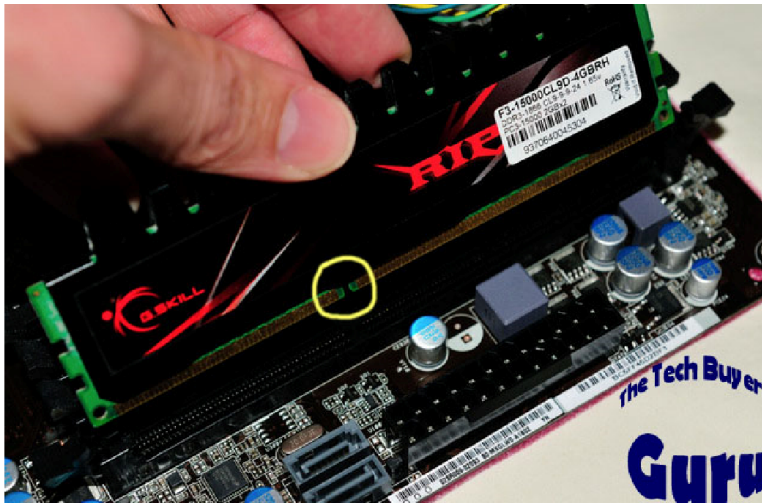


Remember to match positive to positive

The other connectors, like the front audio plugs, front USB ports, and fans, are fairly straightforward. The front audio plug will be labeled HD_Audio, and there will only be one corresponding header on the motherboard. It will usually be on the left side of the motherboard, either on the lower edge or near one of the PCIe slots. There will probably be multiple USB connection headers, possibly including a single USB 3.0 header (which looks quite different from the rest due to being about twice as large). They'll all be along the lower edge or right edge of the motherboard. Fan connectors will always be either 3 or 4 straight pins, and the fan connector can only be installed in one orientation due to a tab that will block it otherwise. The fan headers will be labeled chassis fan, power fan, system fan, or some abbreviation of these words. The photos above show a USB header (labeled USB 10_11), as well as a fan header (CHA_FAN1). The red-colored plug in the right-hand picture is a fan plug inserted into the fan header.

Step 6: Installing the Memory (RAM)

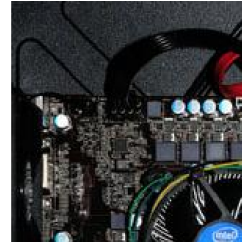
Now's when we start putting the final touches on the motherboard to make it fully functional. We need to insert the RAM into the motherboard. There will be either two or four RAM slots on most motherboards, although very high-end motherboards can have six or eight. Assuming you are using DDR3 RAM, which has been the most common standard since about 2010, you will see that there is a notch in the RAM stick and a tab in the motherboard that match up so you can only install the RAM in one direction. The notch in the RAM stick is circled below. To insert the RAM, hold it with both hands on either side, and press down straight into the RAM slot. The locking tabs on either side should pop up when the RAM is in place.



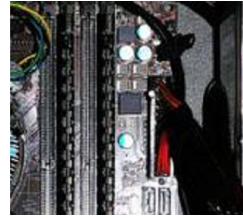
If you have more slots than you have RAM sticks, the RAM sticks should be inserted in every other slot, so for instance, the second and fourth slot from the left is typically optimal on a four-slot board. Having two sticks in alternating slots (or having all slots filled) allows for "double-date rate" operation, which speeds things up a bit (but certainly doesn't double the speed!). Do keep in mind that it's always better to have an even number of sticks than an odd number of sticks for that reason. If you only have one stick, you should probably use the second slot, but take a look at your motherboard manual to be sure.

**Step 7: Installing
the Power Supply**

The power supply will typically be mounted in the rear of the case, either at the top or bottom. Note that you should be careful to make sure that the power supply fan is either facing the interior of the case, or if it's facing the exterior that there is a vent in the case. The power supply mounting bracket shouldn't let you install it incorrectly, but just make note of the fan orientation to make sure. There will be four screws that attach the power supply to the rear of the case; there may also be a support tab on which the power supply rests if it's mounted on top (as it would otherwise pivot downwards due to its weight). In the picture below, you can see the power supply has been mounted in the lower rear portion of the case, beneath the motherboard.



The black cable is the 8-pin CPU power connector



Here you see the 24-pin motherboard power cable installed

The closeup photos on the right show you the two critical power cables that must be attached to power up your system - the 8-pin (or 4-pin) CPU power cable, and the 24-pin motherboard power cable. The motherboard power cable connector is hard to miss due to being the largest connector coming from the power supply, and having the largest header on the motherboard. The CPU power connector will always be somewhere near the CPU, and will have a 2x2-pin arrangement or a 4x2-pin arrangement. It's location often causes cable management problems - we've chosen to route the CPU power cable underneath the motherboard rather than across the top of it.

A special note here - one of the reasons the build above is not a total mess at this point is that we used a modular power supply. We actually don't have all necessary power connectors attached, but as you'll see later, even when everything is installed, it's still very neat. We *strongly* recommend purchasing a modular power supply, even if it costs \$10-20 more than an equivalent non-modular power supply. It makes building a system, particularly a compact system, so much easier, and makes the finished product look twice as nice!

Step 8: Installing the Hard Drive

We're getting really close to the end now! A word of warning - our Zalman case uses a somewhat unique hard drive mounting system, due to the case's compact dimensions, but the basic principles remain the same. In one form or another, there will be a 3.5" drive rail or mount, and in newer cases, there will also be a 2.5" drive rail or mount for SSDs. In this case, we've installed a 2.5" notebook-class drive, a Seagate SSHD, attached to the lower mount on the drive bracket panel. You can see the bottom of it through the holes in the metal panel. The right-hand picture shows you the SATA data connectors we needed to insert, one for the hard drive and one for the optical drive we installed earlier. You may have additional drive connections to make, of course. Make sure to connect the power supply SATA power connectors at the same time as the SATA data connectors. A hard drive communicates with the system through the SATA data connector, but will not function without power, which can only be supplied via a power supply's SATA power connector. Both are pictured below.



SATA power (left) and SATA data (right)



In this closeup are the two SATA connectors used for this build - a black SATA 6Gbps cable for the hard drive in the motherboard's SATA_0 6Gbps port and a red SATA 3Gbps cable for the DVD burner, in the SATA_5 3Gbps port.

**Step 9: The
Finishing
Touches**

All right, we're just about ready to turn this baby on. Let's go over the following checklist before we install the side panel onto the case:

- (1) 24-pin motherboard power connector (right side of motherboard) is firmly connected
- (2) 4-pin or 8-pin CPU power connector (upper-left of motherboard) is attached
- (3) SATA power connector to optical drive and hard drive(s) (on drives) are attached
- (4) SATA data connector to optical drive and hard drive(s) (lower-right of motherboard) are attached
- (5) CPU fan connector (above CPU socket) is inserted
- (6) All optional fan connectors (located in various locations) are connected
- (7) All front panel connectors, especially the power and reset buttons (lower-right of motherboard) are connected
- (8) Any required video card 6-pin or 8-pin PCIe power connectors (none used in this build) are connected
- (9) RAM sticks are firmly inserted
- (10) CPU heatsink/fan is firmly attached

So everything's in place? Great! Let's slide the side panel into place and secure it with the included thumbscrews:



Step 10: Powering On

The next step of the build is to power it on. First, make note of whether there is a power switch on the back of the power supply. It will need to be in the on position to power up the system, but it doesn't actually turn the system on, it only activates standby. The universal symbols "I" and "O" signify on and off, respectively. Once you've confirmed that is in the "I" position and the 3-pin power plug is connected to a wall socket, or better yet a surge protector socket, you're almost ready to power the system on.

You will of course need to connect a monitor, keyboard, and mouse. The monitor may be connected using a variety of connectors, and that will depend on your motherboard or video card (depending on what you're using for video output) and your monitor. The common connections are VGA (analog), DVI (digital), HDMI (up to 1920x1200 digital with sound), and DisplayPort (ultra-high-resolution digital). Your keyboard and mouse will likely connect via USB. We recommend initially setting up your system with a wired rather than a wireless keyboard and mouse. That way you can eliminate one potential source of problems (and in fact, some wireless input devices may not be detectable by the motherboard before an operating system loads).

OK, now that we've covered those steps, it's time for the moment of truth! *Will the system turn on?*

If you've installed everything properly and reviewed the checklist in the prior step, you'll probably be fine, but believe it or not, our test system did not turn on with our first attempt. We narrowed it down to a 24-pin motherboard power connector that was not fully inserted, so if you have a similar issue, don't panic, just go through the checklist again!

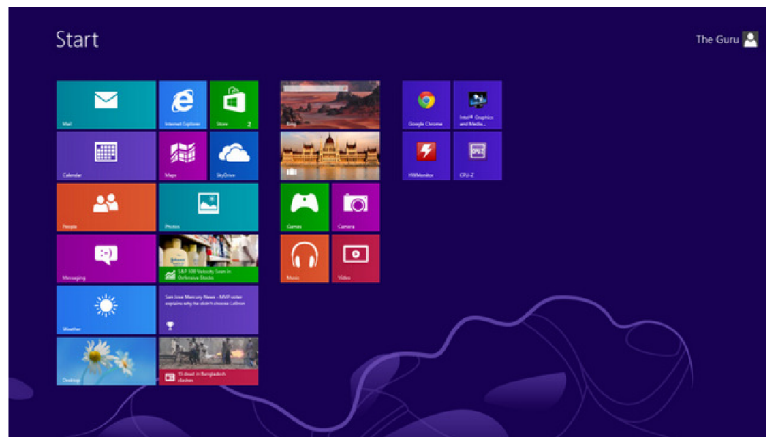
If the system powers on, you'll see a message or graphic come on from your motherboard's BIOS or UEFI (essentially, a mini operating system), which functions even without any actual operating system installed. You can even interact with it without a hard drive connected. If you see this screen, you know you're in business!

Step 11: Installing the Operating System

The final step of the building process is installing an operating system. Assuming you were able to get through Steps 1-10, this shouldn't be too hard. You will notice that booting up without an operating system will eventually lead to an error message indicating a missing boot disk. That's not a problem (yet). Let's get a "boot disk" in there.

What you'll need to do is insert the operating system DVD into the optical drive. Many motherboards will by default search for an optical drive to install the operating system, but if yours doesn't (and you have the Windows DVD-ROM in the drive), access the BIOS at startup by holding the key indicated on screen, usually F11, F12, or Delete. You'll need to change the "boot order" so that the optical drive is first.

Once the DVD is accessed, Windows will slowly boot off of it. Don't worry - this is not a sign of things to come. Your system will be much faster once the operating system is on the hard drive or SSD. You'll have a few choices here, but assuming this is a brand-new system, you don't need to select a custom installation - just use the default option. Once you've allowed Windows 8 to go through its installation process (selecting a few things along the way like your time zone and user name), you'll be greeted with something like this:



Ta-da! You have a new computer!

We hope you found this guide helpful. If you did (or maybe even if you didn't), let us know below!

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