Welcome to the

MASTER COURSE

Welcome to the EasyPCBuilder Master Course, where we offer 80 pages of the latest and most relevant details about how to choose your parts to build a computer and understand how each component relates to each other.

This course will guide you through considerations of purchasing individual computer parts in detail, and aims to answer any and all questions that you have about purchasing and preparing parts to build a computer.

This information is designed to be utilised in with support of the EasyPCBuilder videos available on the EasyPCBuilder website and YouTube channel which show you how to subsequently assemble your computer, and install your operating system on it.

This document when used with our online videos, will ensure that you can not only learn, but become the master of computer building, building an enhanced, well rounded understanding of what is inside a computer, what makes it work, and how it all goes together.

A personal thank you for purchasing this Master Guide, watching the EasyPCBuilder build videos and for supporting the website.

Scroll below to start the **EasyPCBuilder Master Course**!

Introduction

This book has been written for people wanting to learn, with a conscious effort made to avoid discussion of overly technical concepts and their related complex numerical analysis.

This guide has been detailed as an 'Introduction to Computer Building' and aims to encompass the concepts and detail as seen as *relevant* for new and intermediate builders.

This Master Course has been created in efforts to excite and motivate, to aide your learning and understanding in the genre of Computer Building and its associated fields (Electrical, Electronic, Software design and analysis). As we were once new builders the field, we found some texts and analysis to be overly technical and intimidating, and have put the utmost effort into removing these barriers and any other items that have been seen as unnecessary or irrelevant for new and intermediate builders.

The content of this book may be criticised by experts for its omission of specialised detail in some technical areas, where we have kept numerical analysis and overly complex details either brief or omitted in some areas. In these areas, we have aimed to provide educated and accurate assessments, stated in an accessible manner, summarising these technical concepts as clearly and concisely as possible.

We aim to keep the concepts simple, providing relevancy, giving you a broad, general understanding, overview and analysis of this field.

We have written this Master Guide to ensure that primary computer building concepts are communicated in a form that is readily understandable, which you can relate and build upon. This is the manner upon which we initially learnt, and then built upon these fundamentals with complex analysis after we had a firm understanding of the basic principles of the field.

We hope that this book finds you well and that you gain your desired knowledge today, enabling you to create tomorrow, and indefinitely from herein. We hope that this book assists you in many ways on your journey forward.

Kind Regards,

Brett

REVISION HISTORY

Revision	Author	Date
D	EasyPCBuilder	March 2017

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The EasyPCBuilder Master Course Contents

1. General Build Information

What tools you will need?

- A clean workspace of around 2m2, preferably with no carpet
- A Philips head screwdriver
- A small socket set (if available)

Having a clean environment with enough space will ensure that your components can be laid out appropriately and that you don't lose or damage any items when shifting the large case and other components around.

We would usually recommend that you build on a wooden, slate, or other hard surface to ensure static cannot easily conduct on the surface on which you are working.

We also recommend working in areas that are not conductive to static, such as on hardwood floors, or tiles. You can easily build up thousands of volts of static charge when working on or walking on carpeted areas, which is why we always recommend the use of an anti-static wrist band.

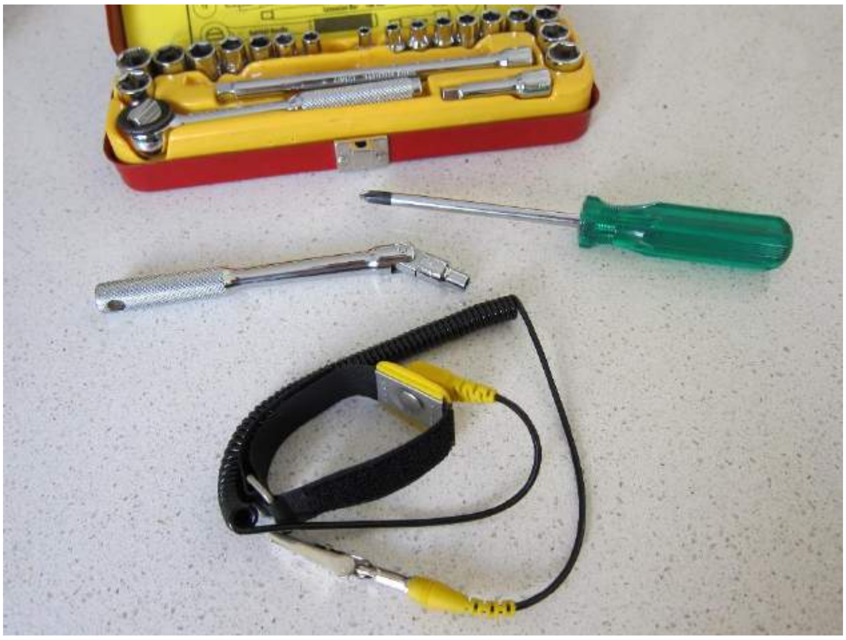

Figure 1 - A Philips head screwdriver, Anti-static wrist band and small socket set

Why use an anti-static wrist band? Will I be fine without one?

A question that many people asked on the video, is why are you using an anti-static wrist band, and will I be ok not using one?

We are sure many people have 'successfully' built their computer without using an anti-static wrist band. However you don't have to make a component non-functional for it to be affected by static electricity. The main issue with static electricity is a *partial discharge event* where the static electricity exerted on the component is not enough to make the component non-operational, but may be enough to affect the lifespan, reliability and longevity of the component.

If you hear of people's computers failing after a few months or weeks, or spontaneously crashing, it may be due to this reason of not having appropriate static protection upon their initial component install. Ie: an item during installation becomes partially damaged, but still operates within the tolerances required by the hardware initially. As the hardware ages, or is placed under heavy operating load (higher temperatures, clock speeds) where all integrated circuits are not operating as indented by the manufacturer (due to these static events), you will likely see hardware failure and system crashes.

For the $5 USD that it costs to purchase and use one of these bands, it is highly recommended. The price is likely 0.5% or 1% of your total build costs! With the understanding of the potential impacts of ESD, I hope the several dollar investment becomes much easier.

If you would like to read more about ESD (Electrostatic Discharge) and its affects, there is more elaboration on the category here: http://en.wikipedia.org/wiki/Electrostatic_discharge

Where do you connect the Anti-static wrist band to the case?

There were several questions on the video as to why I used a 'riser' to connect the anti-static wristband to the case.

Figure 2 - A generic motherboard riser

The main reason that this was utilised is that the motherboard riser itself is not painted, and it is metallic. When screwed into the case (which subsequently removes any paint in the thread) it is not insulated by any painted surface, allowing the riser connection to be grounded from the case.

An anti-static wrist band clipped straight to a painted computer case is nearly ineffectual. A painted surface insulates most items touching it, and will not conduct electricity, which will mean your body itself will not disperse the built up static electricity.

Ground and Anti-Static Wrist Straps

The built-up static electricity needs somewhere to go, which is commonly referred to as 'earth' or 'ground'. This is the natural reference point of zero-voltage, that when your built up static electricity is discharged to this level, you can work on sensitive electronic components with the assurance you will not damage them by Electro Static Discharge.

In order to do this, you need to ensure a continuous path to ground. Most housing plumbing of the copper type must be wired to ground for safety reasons, so a good alternative may be to utilise a metal tap or similar to use as a ground reference point also to drain any static electricity.

Further References

See the EasyPCBuilder video link below for a further explanation and details https://youtu.be/0bUghCx9iso?t=98

For further reading, we recommend an excellent article from Technomicon Media.

http://www.technomicon.com/TechTips/TechTips-4-8-10.html

Do the screws and mounting hardware come with the case or motherboard?

This is a question that comes up frequently so it is worth covering here. When you buy your computer, there will be some additional parts included to support your build.

Your motherboard will usually come with:

1. Two SATA data cables, enabling you to connect two SATA enabled devices to your motherboard (your hard drive or solid state drive storage devices)

Figure 3 - A SATA Data Cable

2. A motherboard backing plate, which you press into the back of your case to provide a neat fitment for your rear motherboard interface ports.

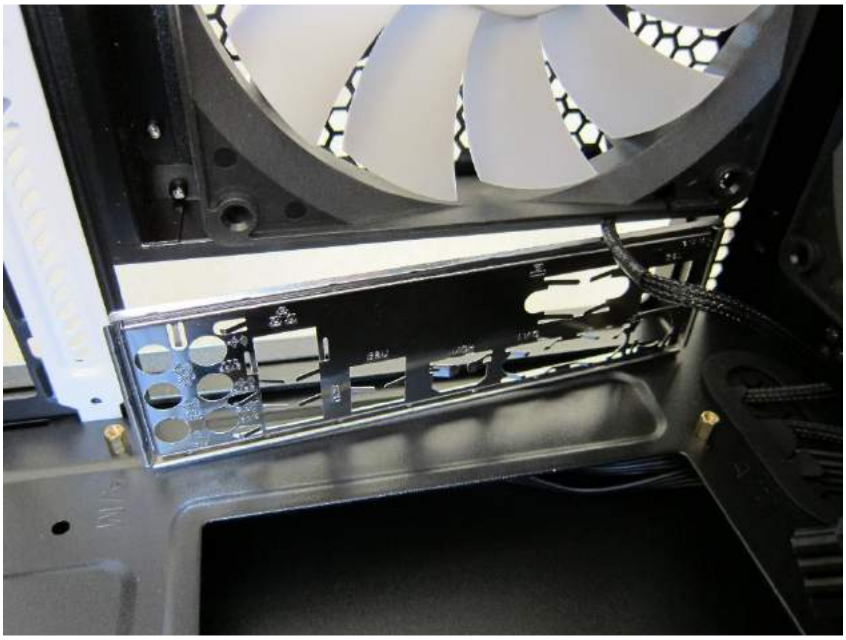

Figure 4 - A motherboard backplate in a case

Your case will come with an assortment of screws for mounting your:

- Motherboard (risers/standoffs and associated screws)
- Power Supply
- Solid State Drive
- Hard Drive
- DVD/CD drive
- Thumb screws for case side panels

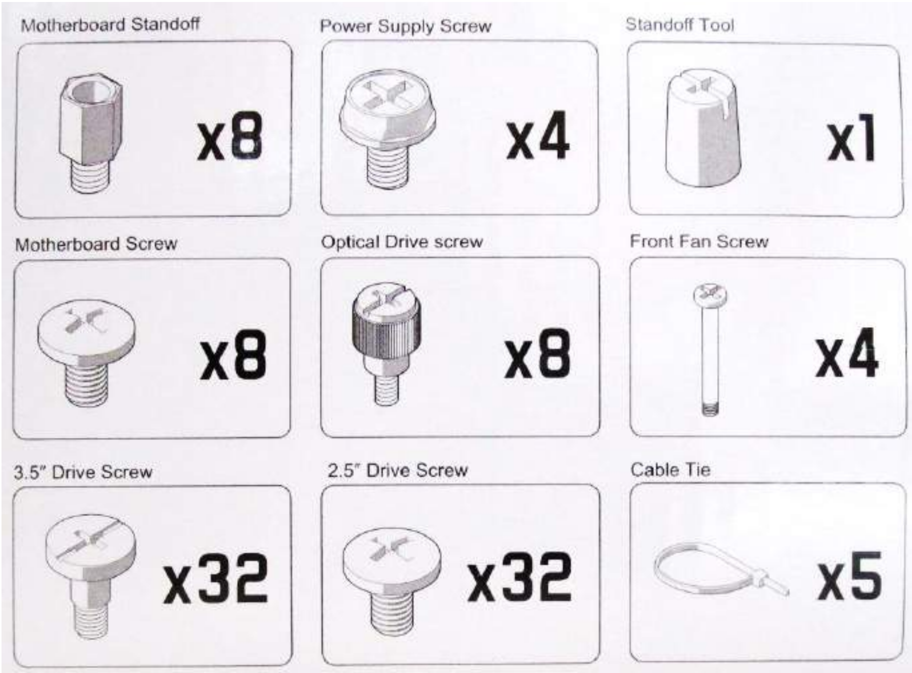

Figure 5 - A visual description of each of the screws which generally come with your computer case

There is further detail regarding this in the sections below, but generally all required screws and cables for your build will be provided with your case, motherboard and power supply.

A quick tip though, where you are planning to run more than two SATA data devices in your computer (for instance an SSD, HDD and DVD drive) you will require an extra SATA data cable, which are inexpensive at only a few dollars as many motherboards only provide two out of the box!

2. Computer Case Types

There are several factors to decide on where choosing a computer case. You have a choice of several size cases (from small to large) which support motherboard form factors of different sizes and different expansion abilities. First, let's explore a defining factor in choosing your case size, the motherboard 'Form Factor'.

Defining case size - The Motherboard Form Factor

The size, location of mounting holes, number of interface points and the power supply type and back panel configuration of a motherboard is largely determined by the computer motherboard 'Form Factor'.

'Form factors' are an industry wide standard, consisting of agreed sizes and specifications, which ensures that motherboard types are consistent and their standards are known for manufacturers and consumers, and also ensures case interface compatibility between different brands and manufacturers (as with any standard).

The current Form Factors for consumer builds are generally:

- ATX (Standard – Most popular)
- Micro ATX
- Mini ITX

Figure 6 - Computer motherboard form factor types. Source: VIA Motherboards.

Why do different form factor types exist?

Motherboards of different form factor types serve different purposes, dependent on the goal of a build, which is largely defined by size, and to a lesser extent, cost.

Where the size of a board is reduced, reductions in available interfaces and expandability are undertaken. These usually consist of:

- Less expandability slots (such as available PCI-Express slots)
- A reduction in Available RAM slots
- A reduction of SATA HDD/SSD interfaces
- A reduction in other features such as on board networking, sound;
- A reduction in available USB interfaces

For simple systems where this expandability is not required (ie a simple Micro ATX home theatre PC may not require 4x expansion slots) this may not be an issue, and the smaller form factor enables the case to fit effectively into a low line cabinet or similar.

The usual gaming or office computer will consist of a Standard ATX form factor motherboard, due to them being the 'standard' ie they are mass produced, freely available, and support a wide range of functions. To find a compatible case, you just have to search the case manufacturer website to see if their case supports your form factor required.

As an example for the Fractal Design Arc Mid R2 case, this case supports Standard ATX, Micro ATX and Mini ITX motherboards. This is logical, as a case that supports the larger form factor (Standard ATX) will likely support the smaller form factor motherboards. A Micro ATX case however will not support a larger 'standard' ATX motherboard however.

Mini ITX cases

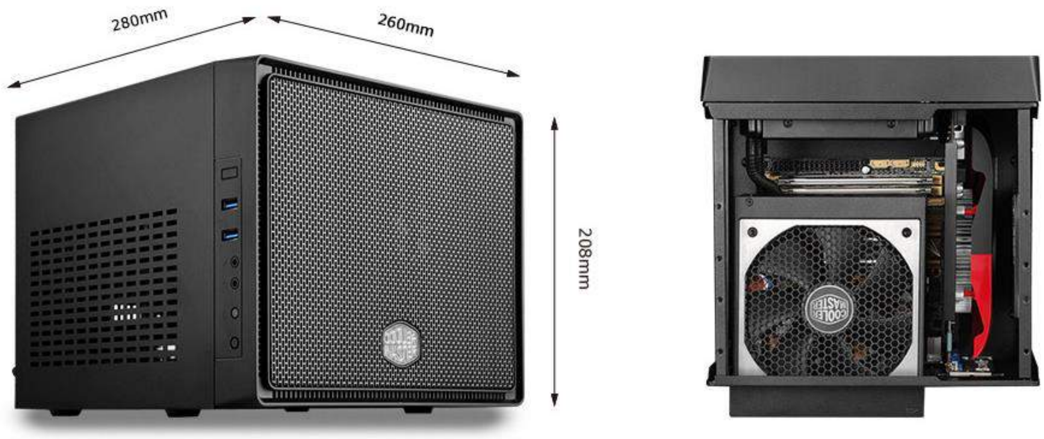

Figure 7 - A CoolerMaster Mini ITX Case Source:Coolermaster.com

Quite usually the small cube type cases only measuring 20cm3. The motherboard must fit into this case size (17cm x 17cm) and internal case size space is restricted for graphics cards and power supplies. A case of this size is great for portability for LAN's or low powered computer operations such as data logging.

HTPC (Home Theatre PC) cases

Figure 8 - A CoolerMaster HTPC Case Source:Coolermaster.com

Similar to Mini ITX cases in size but many are built in a more landscape orientation than a cube shape (which can support both Mini ITX form factors and Micro ATX form factor motherboards.

This case type allows you to install several hard drives, larger CPU cooling heatsinks and high powered, low profile graphics cards to be utilised with ease, blending in to your home theatre setup in a stealthy manner.

Micro ATX Case

Figure 9 - A CoolerMaster Micro ATX Case Source:Coolermaster.com

Built for portability again, but a slightly larger form factor allows more components to be added to the motherboard inside, such as graphics cards and other card interface devices. The Micro ATX case will be the most common case type for a portable gaming computer as it allows a gaming capable graphics card to be installed and the case size provides effective cooling and also allows multiple hard drives to be installed

ATX Mid Tower

Figure 10 - A Fractal Design Arc Mid R2 ATX Mid Tower Case Source:Fractal-design.com

The most common size case for your regular gamer or user, who wishes to build a computer, and has no need for it to be immediately portable. A case of this size allows a lot of flexibility with computer configuration as you are able to install 1-2 DVD Drives, up to 5x Hard Drives or Solid State drives, support multiple high end graphics cards and many computer cooling solutions.

The added benefit of a case of this size is that it also allows effective air flow inside the case, enabling the efficient cooling of your hot CPU and Graphics cards. Smaller cases are not as capable in this manner and may have fans constantly running at high speed in order to disperse the computers heat generated. This case supports an ATX motherboard which is the generic size standard, and also supports smaller motherboards such as Micro ATX where you wish to utilise one.

EATX 'Extended ATX' Full-tower

Figure 11 - A Corsair Obsidian 750D Extended ATX case Source: Corsair.com

The largest of the consumer case sizes, which allows for exceptional expansion of the computer interfacing components. A case like this is primarily used for specific purpose configurations (computer servers) or gamers who are wishing to push their computer performance to the edge and will utilise multiple graphics cards, CPU and storage solutions which also require very effective cooling to ensure that the system performs correctly.

A case like this could be a worthy solution for the $2000 Gaming PC where you are looking to also run two graphics cards in parallel and overclock your CPU. Not for the faint at heart!

3. Computer Case Considerations

The usual case choice for a gaming or office PC would be either an ATX Full or Mid-tower case (Mid is a really great option for intermediate gamers as explained above). Let's look at how we arrive at this.

The size of your case will be determined by the components that you wish to fit inside of it. The main items that affect the type of case that you can use (the minimum case size) are as follows:

1. The length of graphics card that you wish to install
2. The height of your CPU cooler (if you are installing an aftermarket cooler)
3. The motherboard type that you are looking to install

Graphics Card Length

If you are looking to utilise a standalone graphics card in your computer, the length of the graphics card will be a primary consideration with your case. Most intermediate to high end graphics cards measure around 300mm long, which will usually keep you in ATX Mid or Full tower territory.

An ATX Mid tower (a Fractal Arc Mid R2 for example) supports a graphics card length of 290mm. A case like this also provides the option to remove the upper Hard Drive cage for 430mm of attainable graphics card length, but this may not be an optimum outcome for some situations.

A current day gaming graphics card such as a Radeon R9 290 usually has a length of 289mm! The manufacturers usually allow a small tolerance for a gap, but it may not be a substantial amount! (see photo attached).

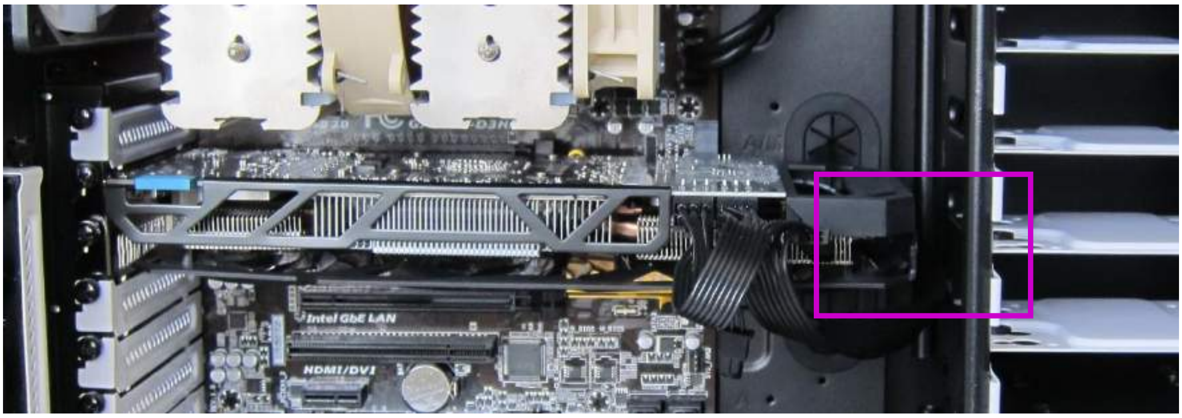

Figure 12- A Graphics Card in case. A close fit, but this is compatible and fine for use.

Some cases are not build deep enough to suit all graphics cards, or may require drive bays to be removed in order to effectively install a graphics card. Case manufacturers are aware of this, so where you know your graphics card type that you wish to use, the length of the card will be readily available on the graphics card manufacturer website, which you will be able to cross check with your case manufacturer website.

You can also fit standalone graphics cards of similar length into Micro ATX towers, however unless you require a case this small for portability or otherwise, we'd recommend against a case this small due to heat dispersion in such a and adequate ventilation in such a small area, for the most part it is just not as efficient as the larger cases for adequate transfer of heat unless you really require it. There may also be reduced height graphics cards that are compatible with this Micro ATX option also.

CPU Cooler Height

If you are planning on utilising a stock CPU cooler such as those supplied with your CPU, this is likely not an issue. Stock coolers are made to suit an extremely large range of computers, but increasingly CPU manufacturers are selling only the CPU itself without a cooler, so aftermarket CPU cooler types and things to look out for will need some consideration.

For example, consider the heights of two popular CPU coolers:

- Cooler Master Evo 212 X CPU cooler = 158mm (6.2 inches)
- Noctua NH-D14 = 160mm (6.3 inches)

In comparison, the stock Intel CPU cooler height is 50mm! (2 inches)

Taking an example of the 'Fractal Arc Mid R2' case (an EasyPCBuilder favourite), the website states that this case supports CPU coolers of 180mm tall.

This size would be compatible in most ATX Mid and Full towers, however may not work in a Micro ATX Tower where a general CPU cooler height may be constricted by case space. This is definitely worth checking prior to purchasing a Micro ATX tower.

Figure 13 - Aftermarket CPU cooler height - even a close fit in an ATX Mid Tower!

What is your power supply type and size?

Most will be compatible, but this will have to be checked where you are looking to build using a Micro ATX, Mini ITX or HTPC case. Due to the restricted case enclosure size, the power supply size is usually restricted. You may find that most of these cases will come with an included power supply in an effort to solve this for you, but do be mindful of the power supply size where you have to order one for yourself.

How many Hard Drives, Solid State Drives, DVD Drives will you use?

Most Mid Tower ATX cases will support 4x Hard Drive/Solid State drives and at least one DVD drive position. Where you require more than this minimum, it may be worth investing in a Full ATX tower which can support up to up to 10 drives (6x HDD and 4x SSD).

Perspex Case Side

Not specifically a requirement, but a nicety. If you wish to view your components after installation and enjoy the techy-ness of your computer, choose a case with a Perspex side window! Where this is lit up with some simple lighting it can make your computer an excellent piece of visual artwork!

Motherboard Risers / Standoffs

A question that we frequently had in the build video was 'what is a riser / standoff'? A riser /standoff is a piece of conductive material that isolates the conductive underside of your motherboard from the conductive computer case itself by lifting it up slightly, providing an insulating air gap.

Figure 14 - A motherboard riser / standoff

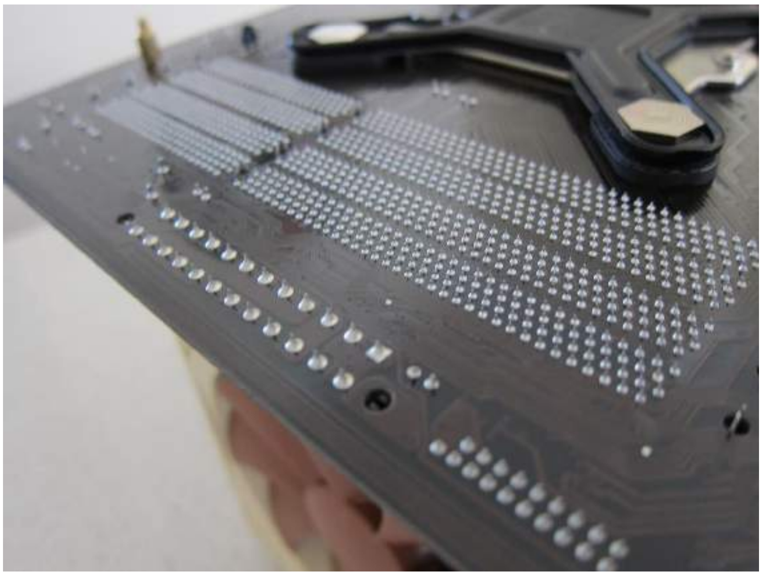

Figure 15 - The conductive motherboard underside

From the picture above, each of the silver 'through hole' mounts represent part of an electronic circuit on your motherboard, each of which have varying voltage and current levels. In normal operation, your computer case is connected to ground via your Power Supply Unit (PSU) which would be properly connected and mounted to your case.

Where this insulating airgap (in the form of a riser/standoff) is not used, these through hole pins would be pressed directly against your computer case, creating many unintended direct paths to the case ground.

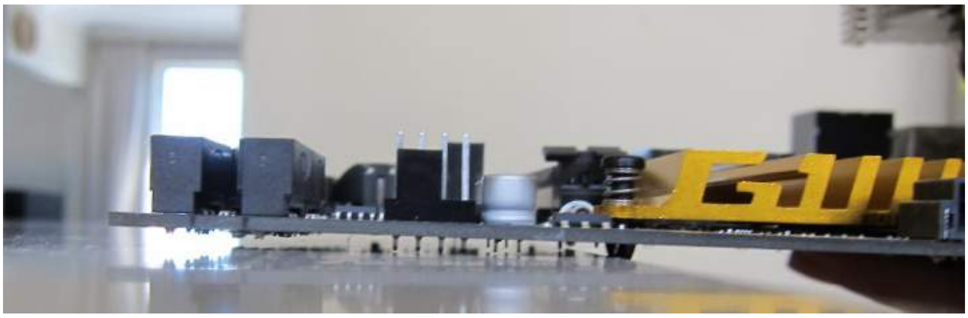

Figure 16 - Where motherboard riser/standoffs are not used, the through hole pins sit directly on the grounded chassis - not good.

If you were then to attempt to power up your computer with your motherboard mounted like this, the motherboard supply would immediately feed directly to the case ground with little to no resistance, exerting a large power transfer in a short amount of time. This would damage the motherboard paths and components that were incorrectly earthed in this manner, and potential power supply damage also if appropriate protections were not built in.

So the key tip here is to ALWAYS use risers. You don't need to buy them separately, they are always included with any new case purchased.

To clarify, there are also several cases that offer in built 'risers' to mount motherboards, but these are only included on specific brands and case types. For future reference, in built risers generally look like this:

Figure 17 - A case with inbuilt risers. Not always common, but handy.

If the inside of your case mounting plane is completely flat (which is generally the case) ensure you use a riser (as pictured below) in order to make sure your motherboard is mounted correctly, providing the insulating air gap that your motherboard requires to work correctly!

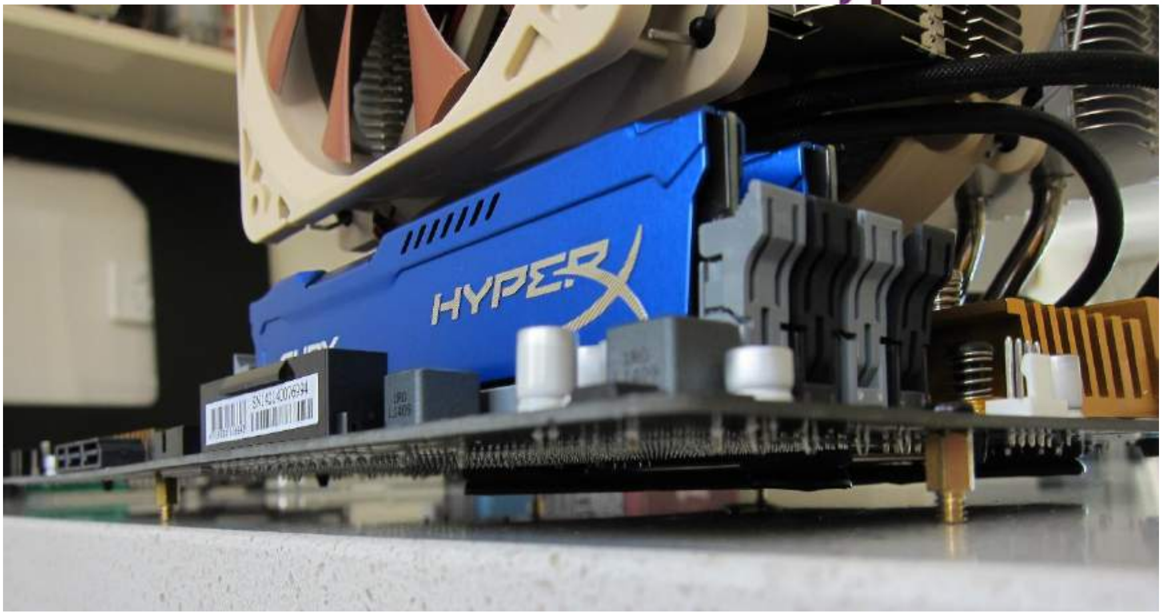

Figure 18 - The insulated air gap provided by risers / standoffs

Motherboard riser positions

As we show in the EasyPCBuilder Build Video, each motherboard type may have different riser mounting positions. The best thing to do is refer to your motherboard manual which may state how many mounting holes your motherboard requires to mount, which is usually dependent on your motherboard size (Mini ATX, ATX, Micro ATX) etc.

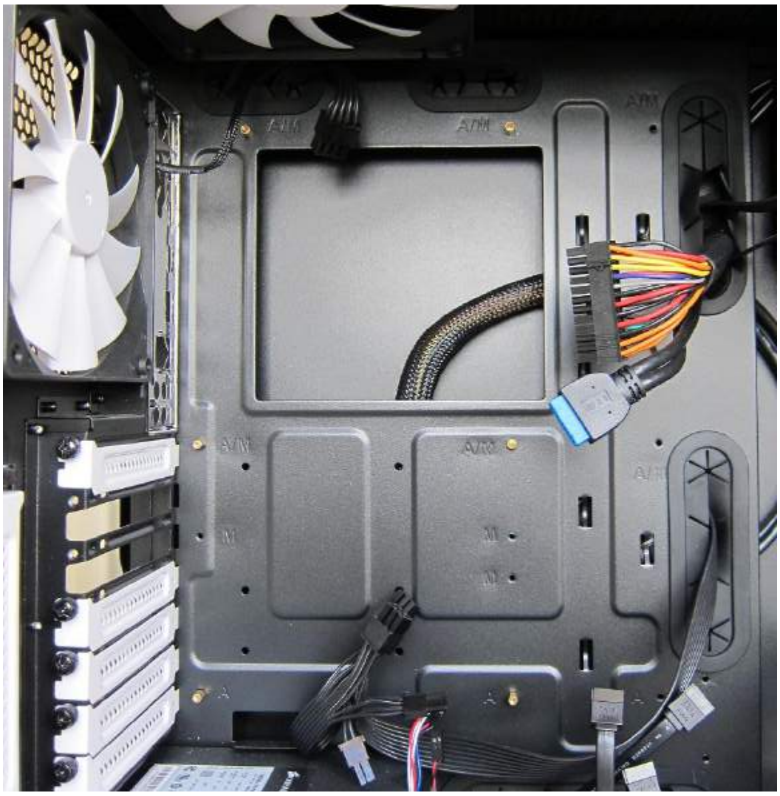

Figure 19 - Motherboard mounting points on an ATX motherboard (See 6 Gold coloured risers)

You will be able to identify a motherboard mounting point by the large through hole on the board, usually surrounded by a metallic silver ring (as pictured).

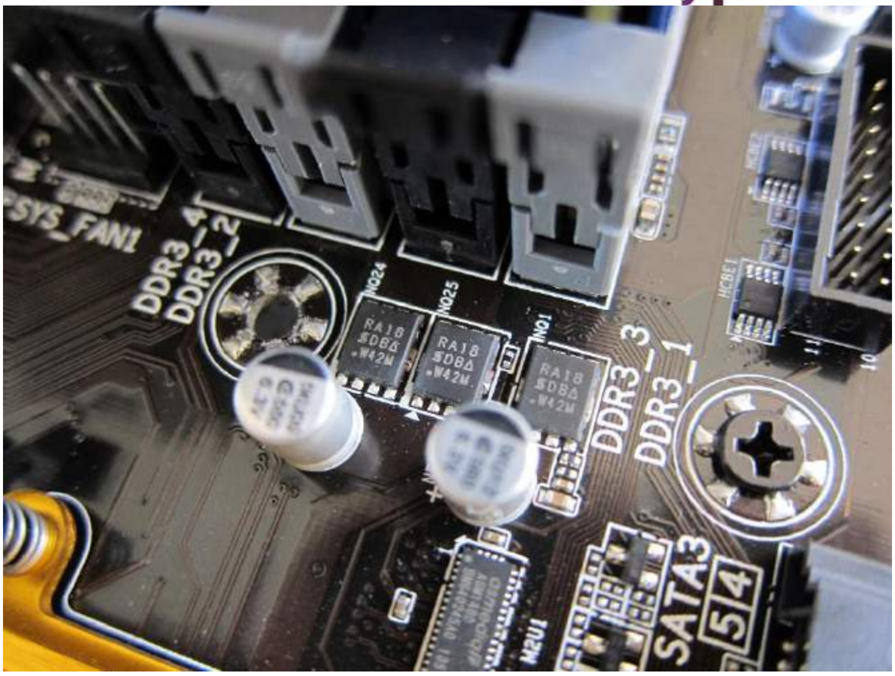

Figure 20 - A motherboard mounting point – LHS no mounting screw, RHS with mounting screw installed.

Be careful not to install excess motherboard mounting risers than your motherboard provides mounting points for. Due to different motherboard sizes, it may be possible to install a riser where your motherboard does not have an appropriate mounting hole for it, which could press against a motherboard circuit, creating an unintentional path to ground.

A good tip is to count the motherboard mounts and check their position against the case, count the number of risers installed into the case and check their position with the motherboard! Some motherboard mounting holes can be positioned only inches away from alternate and incorrect positions so check, check and check again! Getting this incorrect is one of the easiest ways to do damage to your new computer.

End of the EasyPCBuilder Master Course Preview

Grab a copy from the website today!

"A momentary investment for a lifetime of knowledge"

Kind Regards,
Brett
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