How to Power a Computer from a Car

An overview and guide with details of how a VIA EPIA Mini-ITX mainboard can be powered from the standard 12V DC power source in a car.

By Peter Bridger
www.ThisStrife.com

Introduction

This guide has been written with the aim of providing an insight into the potential ways of powering a computer, using a standard 12V car power supply.

I have personally put together a computer, which is purely designed for being operated and run in a car. What does this offer? Everything a normal PC can do. It is possible to use GPS for navigation and route planning, to watch DVDs and listen to MP3s stored on the computer. There are many possibilities, all you need to start with is a solid base. The aim of this article is to give that to you, by helping you understand how you may run a computer from in your car.

Car Battery to Powered PC

If you car doesn't need to be manually started by a crankshaft, chances are it is fitted with a standard 12V battery. The battery in your car is not the same as the AA batteries in your TV remote, or even the types of batteries used in boats and recreational vehicles. Before going ahead and using the battery for power, it's a good idea to understand a bit more about this device.

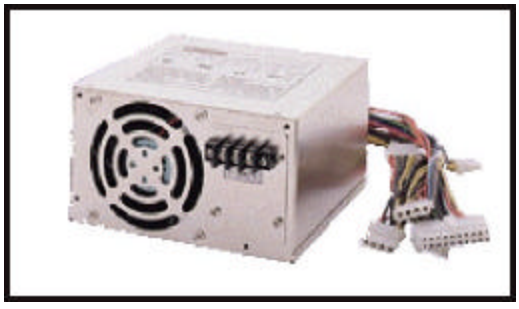
Car batteries are lead-acid batteries, but have been optimized for their particular purpose. For the average car user the battery is placed under a similar set of demands. Typically this involves a large surge of current, which is required to start the engine. After the car has started, the alternator normally manages to keep the spark plugs firing and provide power for the car radio and other electrical systems. Used in this way it is unlikely that a standard car battery will ever be drained to more than 20% of it's total capacity.

Due to this set of demands, car batteries have been designed to give a high current surge of power to start the car. However, they are not designed to be completely drained.

For these reasons it's best to not place too high power demands on your vehicles electrical supply. If you really want to use a lot of power, I would recommend using a separate deep cycle battery. These are designed to give a steady output and can be safely discharged.

So now we've got our 12V power supply, how do we run a PC using it? Inside a computer many different voltages are needed, from 12V supplies for the drives to a much smaller 2V for the CPU. What we need is a way to convert our 12V input, into the variety of voltages needed to power a PC. There are two ways to do this, each with it's own advantages and disadvantages.

DC to DC



The first way, and the more efficient way is to employ a DC to DC converter. The way this device works is by taking in the 12V power from your car, and then splicing and converting this into the many different voltages your computer needs. A more basic way of thinking about it is to imagine a standard ATX power supply, but in this case it would take in 12V DC rather than the typical 240/120 AC mains voltage.

As we're just taking a DC power supply and effectively slicing it up, this is nice and efficient way to power a computer from your car.

However as DC to DC converters are quite a niche market, purchasing one can be quite an expensive experience. Additionally, you must make sure the DC to DC converter you bought is designed to take in 12V. For these reasons using a DC to DC converter is a more complex experience than just using an inverter. Although if money is no object, then they are generally the superior choice.

DC to AC to DC

The other to go about powering the computer uses more equipment, but it can be cheaper and easier to setup.

This method employs one important piece of equipment called an inverter. This gadget effectively takes in the 12V DC power from your car battery and converts it to a 240/120V AC supply. What is the advantage to this? Primarily is gives us a standard power output, just as you'd find in a domestic power socket. This allows us to plug in any household electric item straight into the inverter. However there are a few things to bear in mind before connecting your 35" plasma TV to your car.

Every inverter has a rated output given in Watts (W), this tells you the maximum amount of watts it can produce. If you exceed this ceiling, then you'll overload the inverter. This won't result in it exploding and anything so dramatic, but it will overheat and it's efficiency will drop.

One more thing to bear in mind is that some electrical appliances, for example a TV, demands a surge of power when it's first turned on. This initial surge can place quite a large power demand on your inverter, which means that such a device won't operate on an inverter if it can't meet it's initial power demands.

Now we've got our inverter connected into the car, we can move onto the next part of system. As we have a standard domestic power outlet, we can just plug a standard computer PSU straight into it. This effectively means you could build a computer which would run from a household power socket, then just take it into your car, plug it into your inverter and it would work. This is the main appeal of using an inverter, the simplify of it's implementation.

When choosing which inverter and PSU to use, you must keep in mind the wattage both the inverter and the PSU produce. If you pair up an 80W inverter with a 300W power supply, you won't have made a wise choice.

By and large it's best to choose an inverter that can produce a bit more power than the PSU. So connecting a 120W PSU to a 150W inverter would be fine.

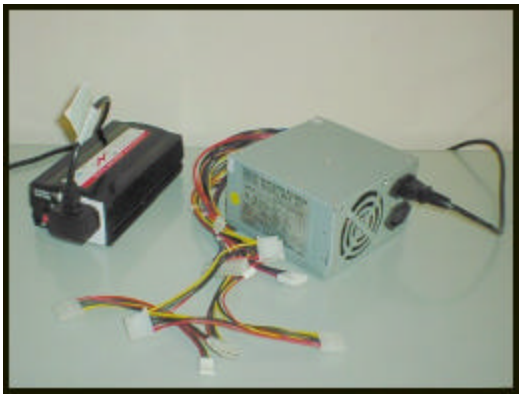
Remember, the more power you demand from the PSU and thus the inverter, the more heat will be produced and the lower the efficiency will drop.

So to sum up, make sure you've got a strong enough PSU to operate whatever you plan to use on your computer. Then pair this with an inverter that has a bit of legroom to operate with.

Installing an Inverter

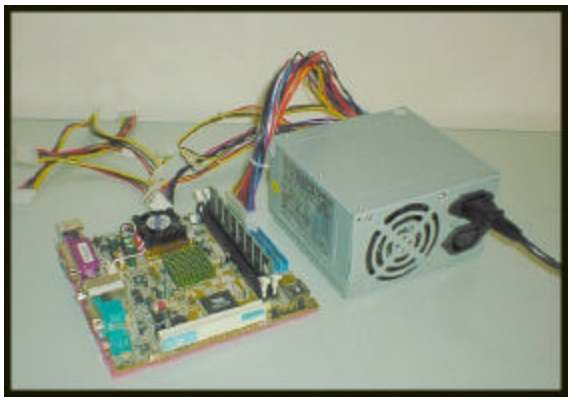
Once you've purchased the correct specification inverter and PSU for your project, the first thing you'll want to do is plug the inverter into your car cigarette lighter socket. Virtually all cars are fitted with one, giving you easy access to your cars 12V power supply. If your car isn't fitted with a cigarette lighter socket, then you'll need to buy a kit to fit one. These typically consist of a cigarette lighter socket and a pair of cables that you can clamp directly onto the car battery.

Cigarette lighter sockets normally have a picture of a cigarette on them, to indicate their purpose. Once you have located the socket, remove the cigarette lighter device from the socket if one is plugged in.



Now you can plug in your inverter, by simply pushing in the input plug into the socket. On some inverters a LED on the plug will indicate if a circuit has been made. If your inverter has an LED, but it is not lit, try turning on your cars ignition. Some cars have been manufactured to keep the cigarette lighter socket active at all times, but others need the ignition key to active certain electrical devices.

By now we've effectively got a live mains socket to use, so the next step is to plug in your PSU. This is exactly the same procedure you'd use to plug your PSU into a wall socket, expect in this instance we're plugging it into the inverter.



Now we're ready to plug the main ATX power connecter from the PSU into the motherboard. Also you can connect up the power cables to any drives that need to be powered for your computer to operate.

At this stage all the electrical wiring to power your computer is finished.

To test the setup, first make sure everything at the computer end is wired up. This means have a keyboard/mouse connected and a monitor.

Turn on your inverter and you'll most probably hear a slight humming noise from the PSU. Finally you can now turn on your motherboard, if everything is connected together properly it should whir into life.

If this doesn't happen, check all the electrical contacts on the cigarette socket, inverter and PSU. If you still can't get anything to happen, it's a good idea to check the fuses. There'll most likely be one in the plug on the power cord that goes from the inverter to the PSU. Also most inverters contain a fuse in the cigarette lighter plug. To check this fuse, unscrew the end of the inverter plug.

Other considerations

By now you should have a computer running from your car, however before you drive off into the sunset, there are a few things to bare in mind.

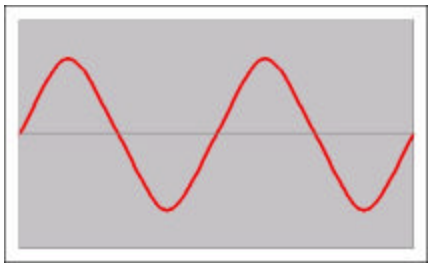
Overheating; bad for the Earth's icecaps, and equally bad for most electrical equipment. If your inverter, PSU or CPU overheats, you'll be faced with problems. For this reason it's imperative that you keep this equipment as cool as possible.

The heat can come from two sources, internally or externally. When we're talking about internal heat, it means a strained inverter overheating from having to large power demanding input on it or a CPU with a failed fan, getting too hot.

These instances can be avoided by making sure all your equipment is in good working order, that the fans are running and that you're not pushing them outside their standard operating ranges.

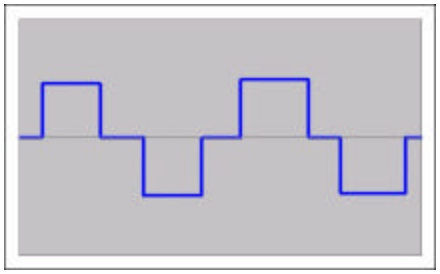
The other type of over heating, which many people forget about, comes from external sources. If you leave your inverter out in bright daylight, it will rapidly heat up. A black mat finish on such a device means that it will soak up heat like a sponge. So even if your computer system is running along perfectly, leaving it out in the sunlight to overheat will quickly grind things to a halt.

There is one main disadvantage to using an inverter, which is that the electrical power it converts has a different wave pattern than that which a household 240/120V has.



AC stands for Alternating Current, and it does just that. An AC power supply operating at 50Hz will switch it's polarity 50 times a second. You can see this in the waveform picture, it results in a wavy pattern. This shows the polarity of the power changing, giving us a nice clean wavy line. The image to the left demonstrates this type of waveform.

DC means Direct Current, which means no switching of polarity, just a nice clean steady power supply. So the inverter must take this DC power and turn it into an alternating current, just like in a household power supply.



The trouble is this is more difficult than you might think, so what most inverters do is produce a modified sine wave output. Which does alternate like a typical AC supply, but just not as cleanly. To the right you can see how a modified sine wave looks.

You can buy inverters that do a better job of creating a cleaner AC output, but these devices are

a fair bit more expensive than inverters that employ a modified sine wave output.

Why is this a problem? Generally speaking it's not, and most equipment doesn't mind using the modified sin wave output that most inverters produce. But even though a device may work on a modified sine wave, it is likely to produce a humming noise.

The only way to get around this, without buying a more expensive inverter, is by applying sound insulation. This can have the downside of also insulating heat, giving you a quiet, but hot PSU. So this may be an area you may want to experiment in, depending on how distracting you find this problem. Personally I find the engine noise to be much more of a distraction, than a slight humming.

Where to Buy Equipment

The following equipment list is only supplied as a guideline or suggestion as to where you can find these items. I do not endorse any of the following companies or they products. If you find a device elsewhere that meets all your criteria, then invest in that one instead.

Inverters

Remember when buying an inverter make sure it is compatible with your PSU. As each country in the world has it's own particular domestic power standards.

http://www.electronixwarehouse.com/car/accessories/power-inverters.htm

http://www.maes.ltd.uk/Power_Inverter.php

http://www.majorpower.com/inverters/

http://www.mdsbattery.co.uk/departments/Department003.asp?DepartmentID=113

DC to DC converters

These devices are a little more tricky to find, I suggest you do you own research here.

http://www.emca.co.uk/bps-7004.htm

http://www.procase.com.tw/2677.htm

PSU

If you're running a computer in your car, hopefully you've designed it to be low powered. So you'll need to get a low power PSU unit. A 120W PSU is a good bet, Flex-ATX ones can easily be found at this rating.

http://www.insight.com/

http://www.dabs.com/

http://www.seasonic.com/products/p_all.htm#

Finally

Remember powering your car system is about building a solid foundation with which to create your ideal car computer, whatever this may be. It doesn't matter how flashy and advanced the computer is, if your power supply keeps cutting out.

Most of the time it's worth paying out a little extra to get a name you trust or something that is covered by a warranty. By the same thread, it's always worth looking around to see if you can find the same product cheaper being sold elsewhere. I've seen the same inverters varying in price by as much as 50% of the price of the cheapest.

However you wish to tackle this part of your car system, I wish you the best of luck and hope you enjoy working to create your own system.

Peter Bridger

peter.bridger@thisstrife.com

www.thisstrife.com