

Altium®

PCB Designers



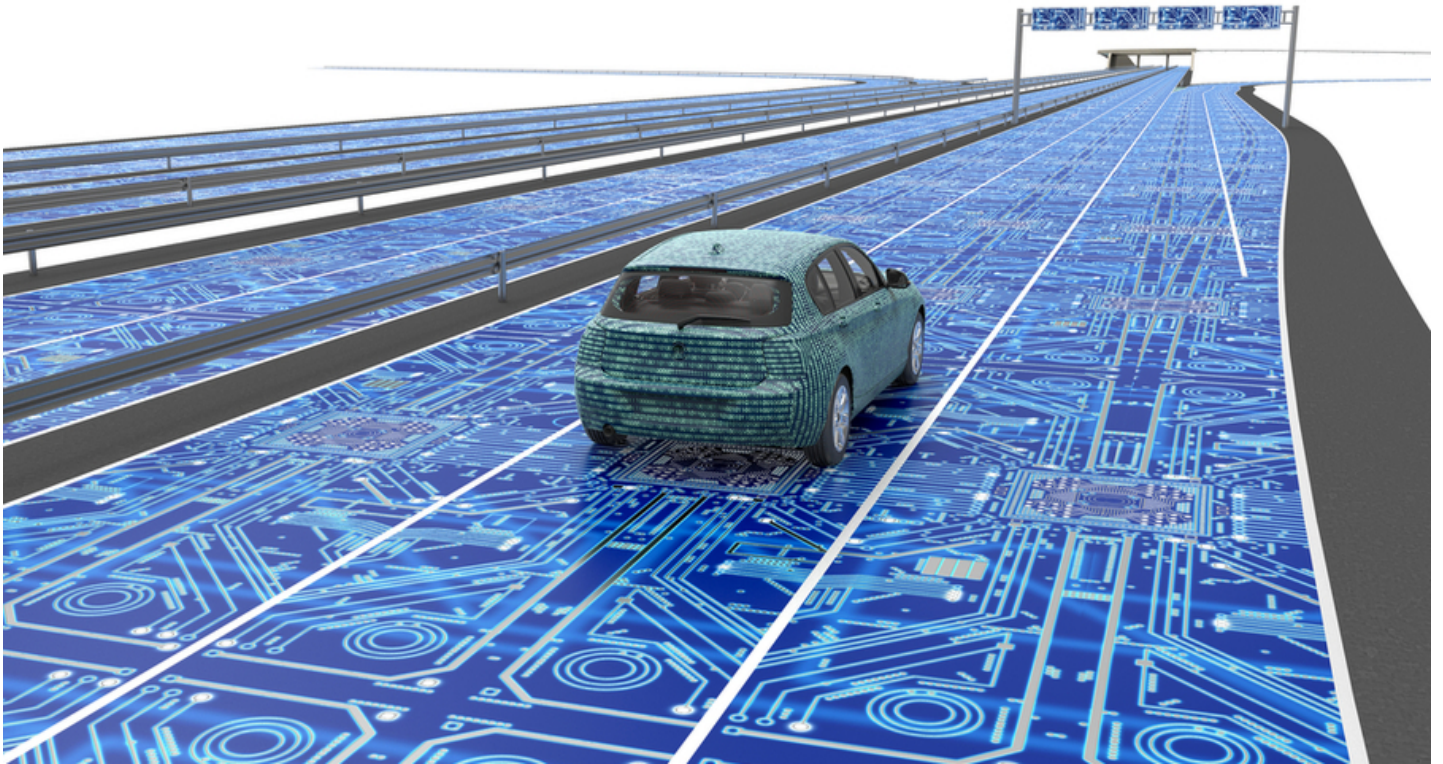


PCB DESIGNERS

PCB Designers have exciting careers. Technology is constantly changing and engineers will always have another day of work. Get on the fast track to efficient, scalable growth and become an expert PCB Designer. Try Altium Designer software and try *new* things because benefits to the Unified Data Model Approach include not just time savings, but the potential of simultaneous design that is available with the integrated schematics. Here we have a collection of PCB design articles related specifically to PCB Designers and what the job market looks like today, from a variety of angles, such as:

- Implications of Growing Automotive PCB Market Share for PCB Designers
- PCB Designer Responsibilities: How to manage Engineering and Manufacturing expectations
- How to Become a PCB Designer in Today's World
- What Does it Take to Be a PCB Layout Designer?

THE IMPLICATIONS OF GROWING AUTOMOTIVE PCB MARKET SHARES FOR PCB DESIGNERS



Luxury used to mean heated seats, now it means a self-driving car with a 17" LED display in the dashboard. With automotive PCBs gaining market share, the modern designer should start thinking about how their designs can enable essential and luxury features in connected cars. They should also get ready to learn cutting edge design techniques such as rigid-flex and HDI in order to meet automotive requirements.

Do you remember the "dynamic duo" days they used to do back in school? My friend and I always dressed up as the classic Batman and Robin. I was Batman, of course. Albeit a Batman with no Batmobile and a 90's homemade utility belt - no wonder I couldn't convince any girls to be Catwoman. For engineers, the Batmobile represents a different dynamic duo that is becoming more prevalent as technology advances: PCBs and cars. Luxury in a car used to mean heated seats, now it means PCBs driving for you and a 17" LED display in the dashboard. Sadly no one has integrated jet engines into their cars yet. With automotive PCBs gaining market share, the modern designer should start thinking about how their designs can enable essential and luxury features in connected cars. They should also get ready to learn cutting edge design techniques such as rigid-flex and HDI in order to meet automotive requirements.



I think this will be my next ride. Editorial credit: Rubens Alarcon /Shutterstock.com

ACCELERATING MARKET SHARE

Gadzooks Batman, that market is growing so quickly, it's going to explode! The connected car market is on the rise, and the automotive PCB market is expanding with it. That means you'll soon be designing as many PCBs for cars as for IoT devices.

Futuristic cars used to be reserved for millionaires and comic book superheroes, or millionaire comic book heroes. Now everyone wants one. It's estimated that by 2020 75% of cars will be connected. That translates into approximately 250,000,000 connected cars on the roads. With many modern cars using upwards of 70 microprocessors, a lot of PCBs will need to be designed.

Not only do modern cars need lots of PCBs, they're also willing to pay for them. In 2015 more than 50% of a car's cost could be made up of electronics. That number is now pushing 70% in 2017. The money in cars is quickly shifting from metal to microcontrollers. You could be there to cash in.



Tesla is spoiling us with a full-size computer monitor in the dashboard. Editorial credit: Kaspars Grinvalds / Shutterstock.com

CONNECTED CAR FEATURES

Throughout the ages, the Batmobile has sported a variety of gadgets, from smokescreens to rockets. Today's car also has a wide variety of special features designed to entice customers and appease regulators rather than defeat villains. The features you can expect to design fall into five general categories: engine, powertrain, body, infotainment, and power.

Engine and Powertrain: These are the kinds of processes you don't see that keep your car going. Pistons, spark plugs, differentials, transmission, all things I know about without knowing exactly how they work. The electronics governing these systems will have rigorous safety requirements, so prepare for headaches. Engine and powertrain PCBs will be pushing a combined market share of **\$4 billion by 2020**. I think I could delve into certification requirements for that kind of money.

Body: Body electronics are things like Tesla's neat automatic door handles. They could also be things like **sound canceling systems** and, Mr. Freeze's nemesis, seat warmers. These electronics are estimated to be worth close to **\$3 billion by 2020**.

Infotainment: Back in my day we rigged up a tiny CRT TV with included VCR to watch movies in the car. Now kids each get their own seatback screens. If you design PCBs for these kinds of systems you could enable children everywhere to watch Batman and Robin. Infotainment PCBs will be worth a whopping **\$1 billion in 2020**.

Power: Last but not least the category that's a game changer for the automotive industry, power electronics. While no one is quite sure how fast the market for electric vehicles (EVs) is growing, they know it is indeed growing. As **battery costs fall and energy densities rise**, we can expect to see more and more cars using electric motors. That means they'll need designers like you to make battery management systems, charging boards, etc. for this **\$800 million market**.

FUTURISTIC DESIGN TECHNIQUES

Sadly futuristic cars need futuristic PCBs, which will require you to learn next generation design techniques. What with all the PCBs and wires going into cars now, manufacturers are [running out of space inside cars](#). What is the solution? Small PCBs that can fit anywhere, A.K.A. high density interconnect (HDI) and rigid flex. Strict EMI requirements in cars will also require you to master EMI design.

Even though you might hate mastering the techniques needed to shrink PCBs, car manufacturers will love how small you can make HDI boards. In order to truly master HDI, you'll need to become familiar with a [variety of vias](#) and [efficient fanout strategies](#).

If you want to jam a PCB into some hidden space in a car, chances are it will need to be flexible. You may not be ramping your car into the Batcave, but potholes and speedbumps will still cause dynamic forces to act on your PCBs. [A flexible PCB](#) won't snap apart if any Jokers try to ram your car.

This wouldn't be a good PCB article if I didn't touch on my favorite topics, EMI and smart forks. Lucky for you, this time we are only going to discuss EMI. Cars are semi-closed systems, and as such have strict EMI requirements. That means you'll need to think about things like [routing differential pairs](#), [good grounding](#), and [separating AC/DC signals](#).

WHERE TO GO FROM HERE

The electronics in cars nowadays may make you feel like a millionaire vigilante. Just one that conquers boring commutes instead of crime. If you want to capitalize on the rapid growth of the automotive PCB industry, you'll need to know thine enemy. Look at all the different systems and features, and focus on which kind you want to design. You might want to then brush up on your advanced design techniques in order to meet the industry's strict requirements.

If you're going to do all this in a reasonable amount of time, you'll need some good software to help you. [CircuitStudio](#) is on the cutting edge of design and already has [documentation](#) to help you learn its more advanced features.

Have more questions about how to build the Batmobile? Call an [expert at Altium](#).

PCB DESIGNER RESPONSIBILITIES: HOW TO MANAGE ENGINEERING AND MANUFACTURING EXPECTATIONS



My wife works at an elementary school, and the thing she dislikes the most is when she has to put herself between two kids in an argument. Being caught in the middle like that is frustrating for her because it is often difficult to turn it into a “win” for both sides of the argument.

We as PCB designers are often in the same position when we have to mediate the needs of electrical engineering and mechanical engineering. Trying to negotiate a “win” for both sides can be one of the most difficult things that we have to do. We are the “no man’s” land between two sides of a war, and it is our job to come up with an amazing board design that satisfies both sides. To do that we need to find ways to get both sides working together. Here are some ideas on how we can best do that.

IMPROVE COMMUNICATIONS

The first thing that we can do to help the relationship between electrical engineering and manufacturing engineering is to improve communications between them. I know that it’s tempting to avoid the conflict by burying our heads in the sand and focus on routing traces. Ultimately though, our goal is to produce the best design possible. The only way we are going to be able to do this is to get these two groups communicating instead of fighting against each other.

Encouraging participation in the design process by both groups is a great way to improve communications. I have seen companies where people felt unattached and left out of the design process resulting in an “us versus them” mentality. This usually happens

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because the people don't know each other, are unsure of who has what responsibilities or are blocked by antiquated corporate policies.

To open up communication in situations like this, get these people involved. Ask for their opinions on what you are doing, and make sure that regular design reviews are scheduled. If someone isn't part of the review that should be, get them on board. Finding out that a design failed due to a missed detail because a key person was absent during the design process is a tragedy. On the other hand, I've personally experienced the success that you can have when all team members are freely giving input during the design.

DOCUMENT THE DFM PROCESSES

Another way that you can help the relationship between electrical engineering and manufacturing is to make sure that your company's DFM processes are documented. This way everyone has a clear understanding of what the design objectives are.

There is a vast difference in how the **design for manufacturing** (DFM) processes are documented amongst companies. Some are very detailed and available online, or in some sort of printed format. The designs at these companies are often gated to the DFM documentation and won't be released without the proper authorization. Then on the flip side, there are those companies who have little if anything in the way of documented DFM practices. If DFM practices are followed at all it is usually in the form of "tribal knowledge" based on previous manufacturing experiences.

So how can you help in this documentation process? First of all, make sure that you are fluent with your company's current DFM documentation. If your company doesn't have any DFM processes documented, start working on them yourself. A good place to start is by collaborating with your company's manufacturing engineers or your manufacturing vendors. Researching industry established manufacturing specifications is another good way to gather information. The important thing is to start capturing these standards and get them documented. Even if all you do is to just create some simple "bullet-points" in a text document, it's a good place to start.



The key is to get everyone working together instead of against each other

CHECK FOR DFM COMPLIANCE IN DESIGN BEFORE GOING TO MANUFACTURING

Even by following the rules, there can still be some DFM errors that get missed in design. Because DFM checking is traditionally done in manufacturing, electrical engineering usually isn't aware of those errors until notified by manufacturing. With the design being kicked back and forth between groups for checking and correction, there is yet another opportunity for friction between departments.

With DFM checking tools readily available, you should run these checks first before you send the design to manufacturing. Some PCB design tools have DFM checking functionality built into them in addition to their regular [DRCs](#). There are also plenty of third-party checking tools available as well. By participating in the DFM checking, your electrical engineers can learn what manufacturing is looking for and correct those problems before they get to the manufacturing floor. Not only will this save the time and money that would be spent on bad boards and re-designs, but it will also help in getting everyone working together.

USE AN ONLINE PCB BILL OF MATERIALS

Another great way to improve cross-departmental [communications](#) is for all departments to have live access to an online PCB bill of materials. Manufacturing can use it to plan ahead for parts in upcoming designs. Engineering can see real-time stock inventories and post online part requests. [BOM management tools](#) can provide this online service which will eliminate the time, errors and waste of traditional paper documentation processes.

As designers we have a big job ahead of us trying to satisfy the requirements of both electrical engineering and manufacturing engineering. Fortunately though there's a lot of help out there for us to successfully negotiate a win for both sides of this conflict. [PCB design software](#), like [Altium Designer](#), has enhanced features that can help you design for DFM compliancy. Would you like to find out more about how Altium can help your design needs? [Talk to an expert at Altium](#).

HOW TO BECOME A PCB DESIGNER IN TODAY'S WORLD



What did you want to be when you grew up? When I was a kid, I wanted to be Scotty on Star Trek. No joking, I really did. The idea that someone could fiddle around with electronic parts and blinking lights to create some gizmo that would save the day was really appealing. A few years later I tried to imitate Scotty by taking all the parts for a kit radio and soldering them together on a thin sheet of wood. Without realizing it, I had designed my first circuit board at the wise old age of 12 years old.

How about you? Have you ever thought about being a circuit board designer? Perhaps you are already in school and headed for an engineering degree. Or maybe you're an electronics technician or you are doing some kind of CAD drafting. Maybe you're not even in the electronics industry, but the idea of becoming the next Scotty sounds really good to you.

If any of this has caught your interest, keep reading. I'll tell you a little bit about what it means to be a PCB designer, what kind of education will help you, and what the future holds for our industry. You may never become an expert in warp drive on a starship, but you may find out that you have a talent for designing a circuit board.

WHAT EXACTLY IS A PCB DESIGNER?

Printed circuits became popular in the 1950s and the need for PCB designers to create those circuits took off. Originally circuit boards were designed, or "laid out," on a drafting board at four or even ten times the actual size using tape, knives, stickers, and a steady hand. When completed, those drawings would be recreated on film using a reduction camera, and that film would be used to

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make the PCB tooling at the fabrication shop. Today PCB layout is done on advanced Computer Aided Design systems (CAD), and their output is used to create the PCB tooling.

The PCB designer will create the library models (footprints) for the parts that will be included on the print circuit board within the CAD system. Then the designer will create the circuit board design within the CAD system using the footprints that have been created. Once all of the required footprints have been placed on the board, the designer will connect all of the electrical connections using lines that represent metal in a process called trace routing.

A good PCB designer is part electrical engineer, part manufacturing expert, and part computer guru with a smidge of process engineer thrown in the mix as well. Mostly though, a PCB designer has to have the ability to see beyond the lines and shapes of components on their computer screen in order to visualize where the design is headed. A good PCB designer can create something from nothing while solving many different puzzles along the way.



Many companies are now requiring degrees for PCB design positions

WHAT KIND OF EDUCATION IS REQUIRED TO BE A PCB DESIGNER?

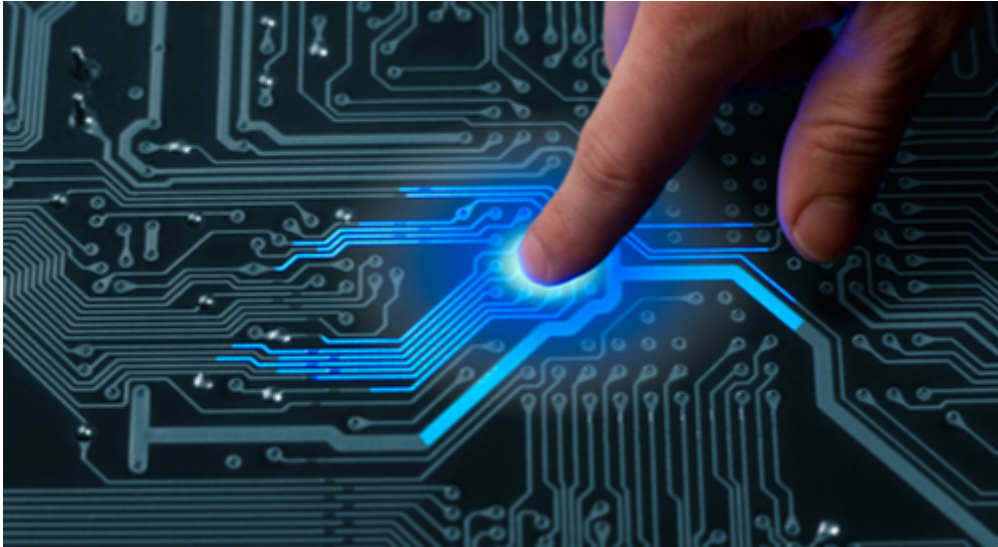
Many engineers are laying out their own printed circuit boards today. To become an electrical engineer or a mechanical engineer you will need a BS in those related fields. Traditionally though, PCB designers are those who do the layout of the board only without doing any of the engineering of the board.

For those who are doing PCB layout only, there isn't much out there in the way of a degree specifically in PCB layout. You will also find that there are still **many positions** that do not require the PCB designer to have a degree of any kind. However, you will have much better success as a PCB designer if you have a degree that includes courses in drafting, computer-aided design, electronic design, or other related areas of study. As PCB designs become more complex, more companies will begin to require degrees for

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their PCB designers.

There are many certificate courses that are very helpful for the PCB designer. Some companies offer specific PCB design and CAD training classes. There is also the IPC [Certified Interconnect Designer \(CID\)](#) course which is an absolute must for the new PCB designer.



The future is bright for PCB design

WHAT IS THE FUTURE FOR THE PCB DESIGNER?

The need to design current and evolving PCB technologies is growing. With more and more electronics such as IoT becoming everyday parts of our lives, the future of electronic design is very bright. However, the pool of experienced PCB designers is shrinking as many designers are approaching the age of retirement. The industry needs more PCB designers, and those that are currently involved are reporting that their [compensation and job satisfaction is on the rise](#).

Do you have a passion for creating things and making them work? If so, then designing printed circuit boards may be what you are looking for. If you are ready to start a career as a PCB designer, take a look at Altium. [Altium Designer](#) is [PCB design software](#) that is made for engineers and PCB designers to create world-class PCB designs. Not only will the software help you with all aspects of your design, but Altium offers [training](#) on its software that will help you to hit the ground running.

Would you like to find out more about how Altium can help you to step into the world of PCB design? [Talk to an expert at Altium](#).

WHAT DOES IT TAKE TO BE A PCB LAYOUT DESIGNER?



In the movie “Men of Honor,” Robert De Niro portrayed Billy Sunday, a Navy diving instructor with a challenging pedagogical method. He motivated his student divers by describing how hard their job would be to prepare them for the difficulties of their tasks. He concluded his speech by saying, “I don’t know why anybody would want to be a Navy Diver.” His honesty, in this case, wasn’t intended to be demotivating—sometimes a job takes a certain type of person, one who is willing to do work that others won’t.

There have been days that I’ve thought the same thing about my own career: “I don’t know why anybody would want to be a PCB layout designer.” But even with the adversity, I only have to remind myself that I can and am doing things with my skills that most other people can not. My experience and visually-oriented mind can imagine how components need to be arranged on a circuit board in order to create an efficient design. Furthermore, I know how to use the tools at my command to connect the components and make the circuit board function as it should.

The job can be challenging and demanding at times, and most of the people you know and interact with won’t have much of a clue as to what it is that you are actually doing. But on the other hand, you will get to experience an incredible feeling of accomplishment when you see your design working as it was intended. I don’t know why you would want to be a PCB layout designer—only you can know that reason, but I imagine that you’re here because you’re interested in pursuing and finding creative solutions for difficult designs. So dive in, and if you find your treasure then you know you’re in the right field.

COMMON CONFUSIONS OVER PCB LAYOUT DESIGNERS

It never ceases to amaze me how often people misunderstand what it is that I do. Especially when I describe myself as a “PCB Designer,” it is not unusual to get a blank stare in return. Even my coworkers don’t always seem to have much of an idea as to what it is that I do, or am doing when I complete my work. There are others who have point blank demanded I tell them why in the world anyone would want to do something like this.

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Much of my job appears to just be moving lines and shapes around on a computer screen, to the untrained eye; however, I promise, to anyone wanting to know more about what the PCB designer they work with does, this is hardly a game. We're not 'creative time wasters,' and we're not relics from an older system. Being able to effectively assuage these concerns, too, is part of the job expectations for a PCB layout designer.



Most people have no idea what a PCB Layout Designer actually is

THE ATTRIBUTES OF A PCB LAYOUT DESIGNER

Unlike in video games where you can minimize and maximize your attributes to focus solely on the skills you need, being a **PCB designer** requires some of the most diverse combinations of skills that I know of. A large part of the designer's role is to utilize their **creative thoughts to problem solve** board design challenges; however, this creativity is only enabled if a layout designer has the technical capacity to enact their ideas. Here is a list of what I find to be important traits:

1. Great attention to detail: When your job entails trying to map solutions to minor adjustment changes, or has you working with materials that don't fill your whole palm, you need to be able to focus on the details.
2. Keeping up-to-date on industry trends: In an industry where new technology is constantly popping up, and new software is enabling more efficient and smart design solutions, ignoring industry trends will mean more work for you down the line.
3. Learning new design techniques: While this seems to be one of the most common-sense needs for a PCB Layout Designer, it can be easy to make a habit of your layout designing by finding a few techniques which work and applying them to your layouts. But this may encourage continuous errors, or enable new errors to pop up as your layouts become more complex.
4. Long hours: Just like with any job, it is good to keep a strong idea of what you need to get done, and when it needs to get

done. But sometimes, even with the best priority management, you will have to complete designs and work extra hours to meet deadlines.

5. Common ground problem solving: The biggest wrench in many of these plans is the amount of time a layout designer will spend managing others and managing design demands from multiple sources. As a designer, you will need to **manage and balance** those that you work with. Often you will be the rope in a tug-of-war between engineering and manufacturing, and it will be up to you to find a solution that will satisfy both sides.

HERE'S THE TREASURE AT THE BOTTOM OF THE OCEAN

After everything that I've said so far, you may also be wondering why anyone would want to be a PCB layout designer. It still might not be for you, but these are some reasons why I love PCB layout design:

- Your work will challenge you: Designing a circuit board so that it meets the manufacturing specifications and works as it is intended will keep you on your toes.
- You will be exposed to new ideas: Technology is constantly changing, and you will always looking at better ways to accomplish your task.
- Decent working conditions: More than likely, you won't be designing boards outside in the rain or snow. While that might not be everyone's goal, it certainly is one of mine.
- Good salary: Most PCB layout designers make a good salary, and it isn't uncommon to make a great salary. While I can't give specific numbers, I hope these superlatives can offer some guidance.
- Seeing what you create come to life: One of the greatest joys that I have is in seeing the designs that I create come to life in the products that my company markets. There is nothing better than seeing an appliance, computer, or cell phone work because it contains a PCB in it that I've designed.
- Creating hardware: Although most people won't understand what it is that you do, most everyone will be impressed when you can show them what you've created. I have a wall at home where I've hung examples of some of my PCB designs, and I always get questions about what they are and what I do. It is no small joy of mine to tell their stories.



Some of the largest challenges you'll face will feel like the most rewarding to complete.

I am a PCB layout designer because I love it. I get to do something every day that is challenging, fulfilling, and rewarding. How about you? Are you ready to step into the world of PCB design and enjoy the same experiences that I have described? If you are, then you will need to work with design tools that can enable you to be successful from the start.

PCB design software, like [Altium Designer](#), is intuitive for the entry level designer and powerful enough for the veteran designer. Whichever end of the experience spectrum that you are at, Altium Designer can help you to be a success.

Find out more about how Altium can help you by [talking to an expert at Altium](#).

ADDITIONAL RESOURCES

Thank you for reading our guide for PCB Designers. To read more Altium resources, visit the Altium resource center [here](#) or join the discussion at the bottom of each original blog post:

- [Implications of Growing Automotive PCB Market Share for PCB Designers](#)
- [PCB Designer Responsibilities: How to manage Engineering and Manufacturing expectations](#)
- [How to Become a PCB Designer in Today's World](#)
- [What Does it Take to Be a PCB Layout Designer?](#)