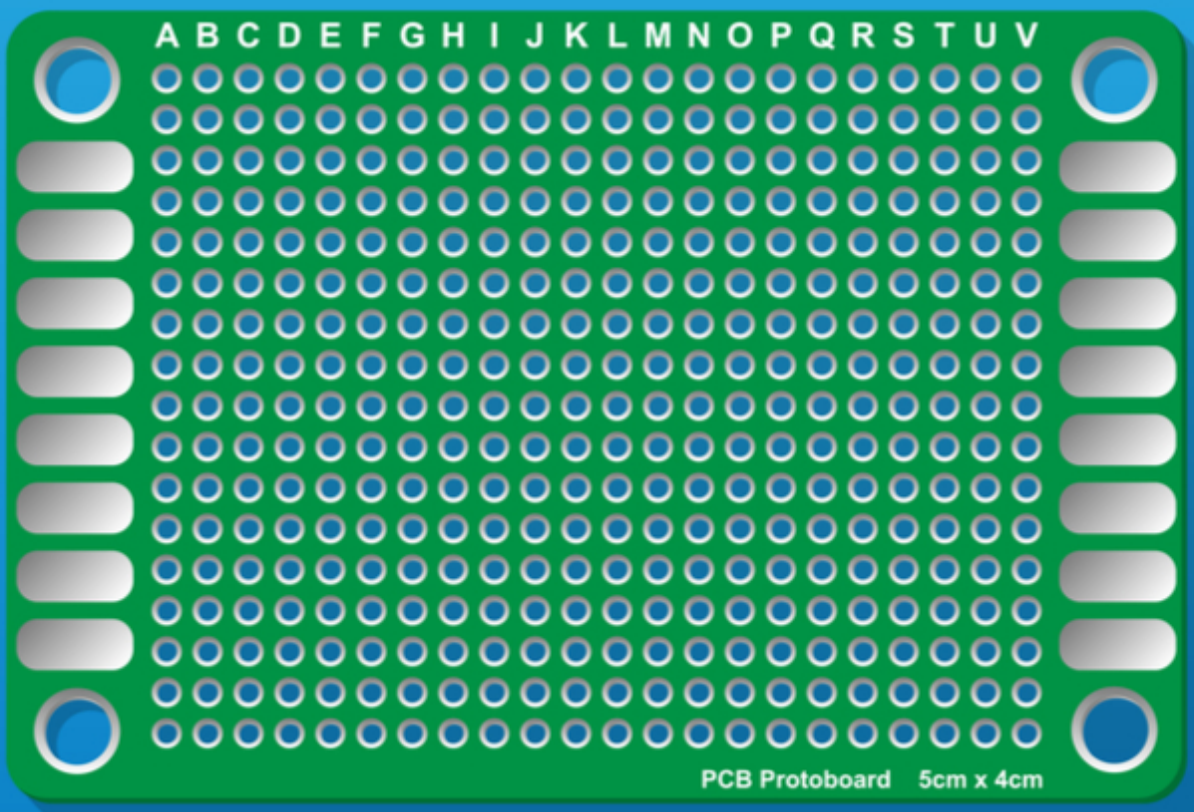
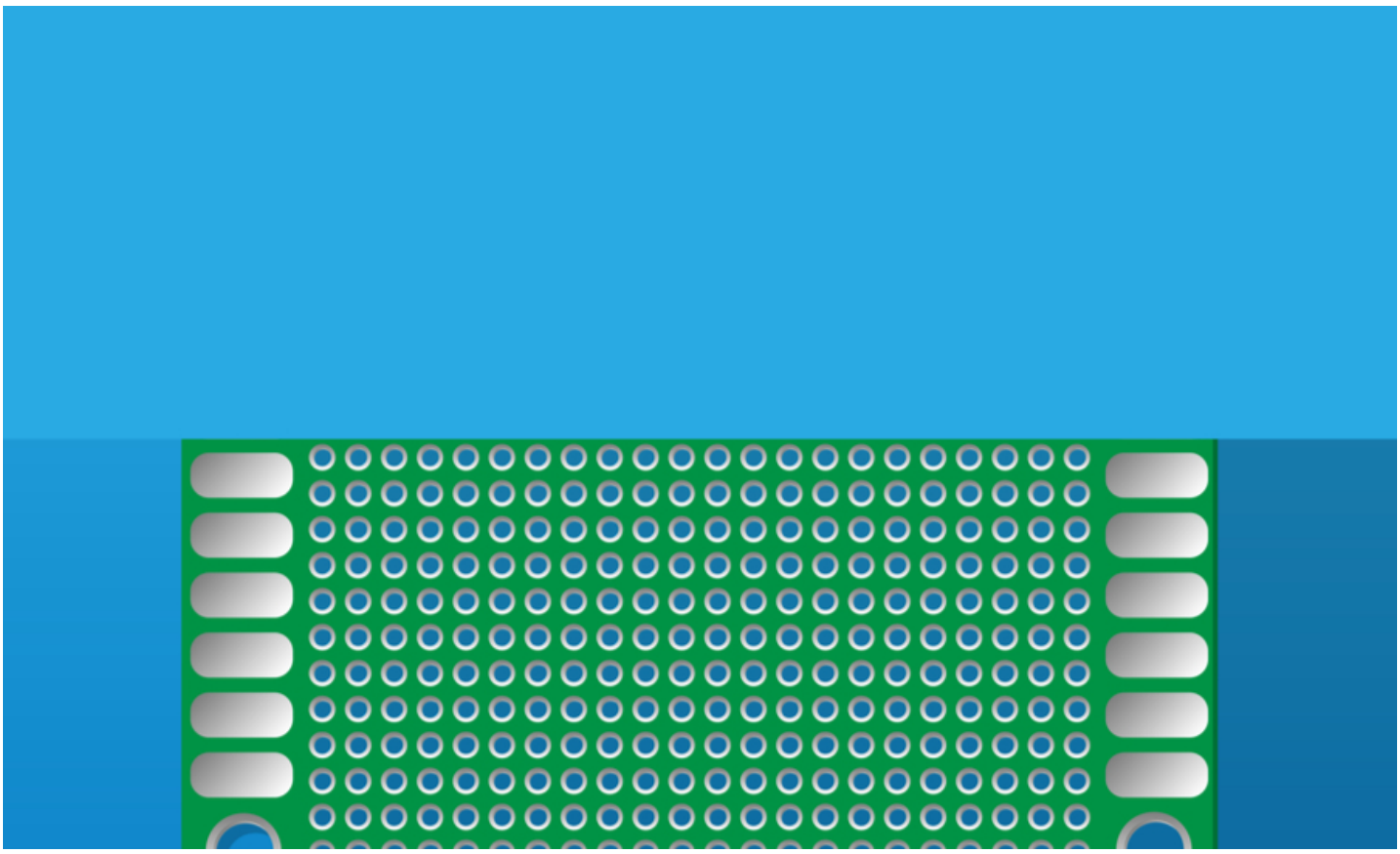
Altium®

PCB Design Testing





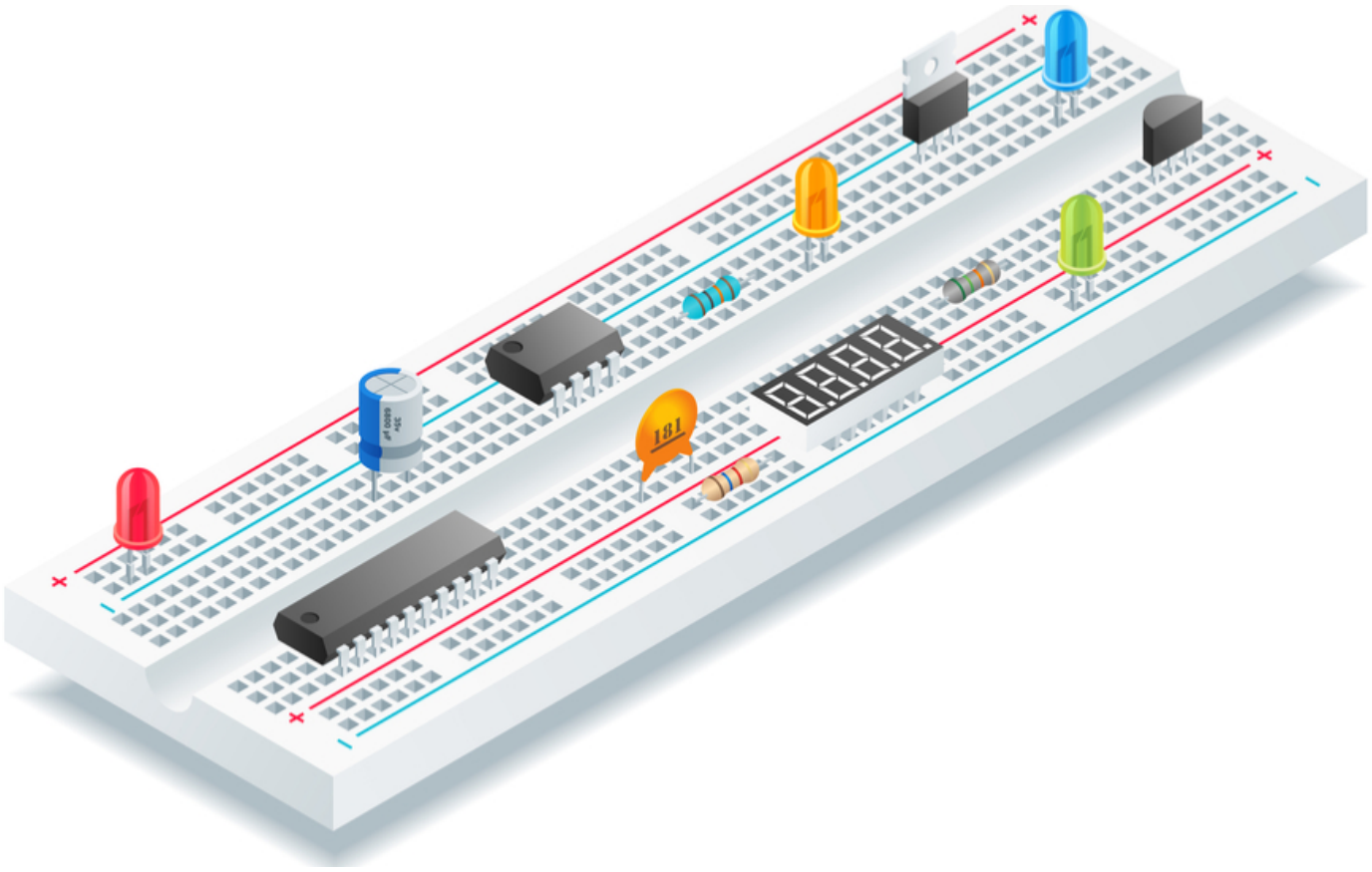
PCB DESIGN TESTING

The most successful PCB designs result from practice, but for your PCB to function as intended, you also need to test your design. By testing the electronic components of your board before manufacturing you can be sure that it will perform as you intended with your design. Schematic simulation does not guarantee the functionality, reliability or even manufacturability of your design. Applying good design for manufacturing (DFM) practices will help you ensure that your design can be manufactured. Learn here to test functionality and reliability during design.

Join us as we discuss a variety of topics to help you with PCB Design Testing , including:

- The Advantages and Disadvantages of Designing with Breadboards
- Understanding the Nuances Between Breadboard Projects and Prototype Layouts
- Practice Makes Perfect: How to Test Electronic Components during PCB Design

THE ADVANTAGES AND DISADVANTAGES OF DESIGNING WITH BREADBOARDS



Breadcrumbs, breadboards, and breadwinners. Two of which will provide you with a delicious and nutritious meal enough to feed a family, one will provide you with the foundational playground to which your PCB design will spawn from. I will save you time, effort, and many awkward encounters by telling you that if you go around trying to stick jumper leads into breadwinners around town, your design will most likely not succeed.

Similarly, you will likely not maintain proper signal integrity amongst other issues if you try to route your CPU through a mountain of breadcrumbs. Let's loave the questions behind conclude that breadboards are what you use for your PCB design. All jokes aside, breadboards are likely going to be in the desk drawer of every PCB designer and will likely be the first place you will turn when in need of a sandbox style domain for you to test your new designs on.

But some questions will remain even for the seasoned designers. Is it appropriate to use a breadboard for every design application? Are there limits to what these wonderful contraptions can do? Can similar prototyping challenges be accomplished via computer simulation? By further understanding the capabilities of a breadboard, you can determine if using one is best for your design needs.

WHAT ADVANTAGES DO BREADBOARDS HAVE?

It may appear that the limits these boards have are enough to send you running for greener pastures, however, the advantages the boards carry will likely be ample for any designer to at least consider.

The ease with which you can change a breadboard is one of its biggest benefits. Imagine you have a rock-solid design all drawn out and soldered up, only to find that there is a bug buried deep within the system. A long and messy road of desoldering and debugging is in your future. Now if you were to wire up your design with the removable and easily adjustable jumper leads, this design fix would be a seamless event of unplugging and replugging.

Additionally, if your rock-solid design was to be soldered up, ready to go, but then failed in a catastrophic way (cue mini explosion noises), your entire circuit may be in jeopardy and you'll potentially be out of otherwise perfectly functional components. With the breadboard acting as a sort of shield for your (hopefully non-) failing systems, you can ensure that portions of your design will remain intact.

Originally, breadboards were just that; boards used to cut bread on.

WHAT LIMITS DO BREADBOARDS HAVE?

Originally, breadboards were in fact as they sound to be; a board in which bread was cut on. These wooden boards were easy-to-access, and inexpensive way to mount your electrical projects on. As they began to develop the first true electrical boards, the term was just too commonly used with electronics to be abandoned, thus remained the term "breadboard." So aside from the fact that

modern breadboards aren't viable tools to cut your delicious sourdough on, there are a few other limitations that exist that must be taken into account when determining your next prototyping steps.

Breadboards will not be a good tool when designing circuits with high voltage. Although most PCB applications deal in low-voltage applications, if you find yourself in the area of 50V, pay attention and consider the fact that the board connections are not suited for this voltage application. Similarly, the boards will have difficulty in keeping up with high current applications. When heading into 20mA's or greater, you will likely find your design not performing as well.

In addition, when dealing with frequencies in the higher, more precise reaches of the spectrum, your signal integrity will certainly be in jeopardy and will not easily travel through the board. The reason for most of the errors you will run into with signal integrity (as well as the aforementioned disadvantages) is due mainly to the physical connection strips within the boards. These strips carry a very high resistance and can, in turn, carry stray capacitance that may wreak havoc.

Computer simulations can sometimes be a better alternative to a physical breadboard

WHAT ALTERNATIVES ARE THERE TO BREADBOARDS?

We've moved from the original boards back in the days of cutting our bread atop our circuit designs to physical copper strips integrated within the board, but what's the next step in breadboard prototyping? Some simulated programs mimic what breadboards aim to accomplish but will not run you the labor of setting up the circuit design (in a physical sense). Limitations of these programs are not nearly as lengthy as a physical board.

As long as the ability is written into each simulator, you can test and simulate to your heart's desire. The only caveat of these

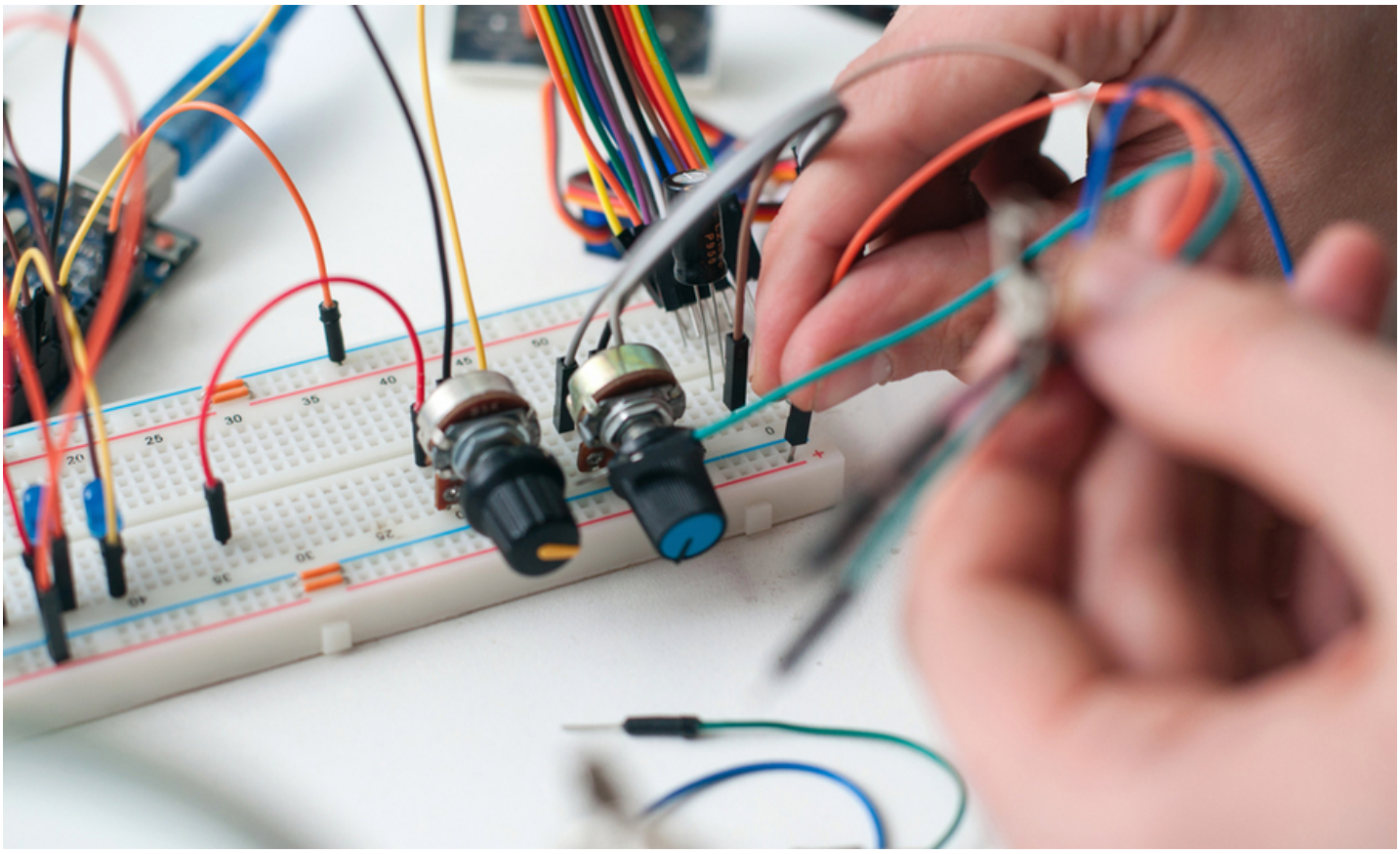
programs is the learning curve associated with each, and each likely has its own degree of difficulty.

Aside from the benefits of augmenting my physical board arrangements via interactive visual CAD simulation software, I personally enjoy seeing a physical mock-up of my circuits prior to any finished soldering of a design. It gives me a real world, real functioning mock-up for me to physically hold and feel. This, of course, is my own preference and will highly depend on what my design aims to accomplish, but nothing beats a circuit constructed with my own two hands.

A program that encompasses features such as Design Verification which allow you to simulate your design under a vast array of variables in order to test for flaws and inconsistencies without ever setting foot in a lab setting. A very powerful tool that may save you many headaches (from the plume of blown caps your rock-solid design may run through). If you're looking for a PCB design software with this and other prime features, consider Altium Designer.

Knowing what we know now, where does your design stack up to when considering your use of a breadboard? If you are still questioning the benefits, limitations, and simulated alternatives relative to your design, talk to an Altium expert today.

UNDERSTANDING THE NUANCES BETWEEN BREADBOARD PROJECTS AND PROTOTYPE LAYOUTS



I was just making myself some lunch and cutting up some fixin's for a sandwich when it occurred to me that I was using a breadboard. Although I've always thought of it as a cutting board, it is actually what my grandmother would have called a breadboard; a flat piece of wood for slicing bread. For those of us in the electronics world a "breadboard" is something very different then what we use in the kitchen, and so I decided to look it up. I was surprised to learn that the term "breadboard" comes from many years ago when people were first experimenting with electronic circuits. They would grab the family breadboard, pound some nails into it, and start wiring up their circuits.

Today we've advanced quite a bit in how we wire up circuits, and the breadboards of today are nothing like those early slabs of wood. This is a good thing too as I have no desire to share my platform for building sandwiches with my platform for building electronics. Not only that but if I were to pound nails into what my wife uses to slice bread with, I would be toast!

Breadboards are very different than the circuit boards that PCB designers are used to, and for those of you unfamiliar with a breadboard we'll take a quick look at what they are. We'll also look at the benefits a breadboard as well as the benefits of a PCB. So come along with me and let's see why PCBs and breadboards are the best things since sliced bread.

BREADBOARD PROJECTS, WHAT ARE THEY?

A breadboard is a platform to build the prototype or temporary circuits on. They are also a great way to test a new part by building a quick and simple circuit to run the new part through its paces. Breadboards come in different sizes, but they are all characterized by a dense pattern of holes with which to put thru-hole component leads or jumper wires into. Rows of these holes are connected together underneath the breadboard so that by putting a lead or a wire into one hole, it will connect to another lead or wire in a different hole in the same row. These rows can be oriented vertically, horizontally, or both depending on its size and complexity of the breadboard. Additionally, breadboards will also have rows specifically designated for power and ground to simplify those connections for the user.

Breadboards come in two different versions; solderless and solderable. The solderless versions are more common as they are the easiest to work with. Each row of connected holes has a metal clip in the hole to capture the leads or wires that you will put into it. A soldered breadboard, on the other hand, requires that each lead or wire be soldered into the hole. This makes the soldered versions of breadboards more robust as the leads are permanently captured, but they are not as reusable as the solderless versions.

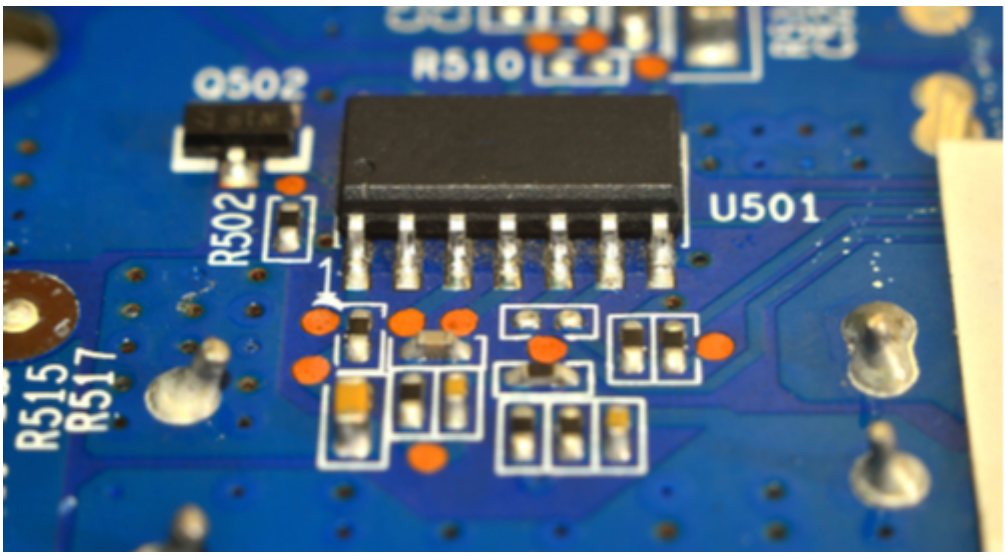
A circuit built on a breadboard for testing

ADVANTAGES OF USING A BREADBOARD

As I originally stated, a breadboard is a great way to build a prototype or temporary circuit. They can be done quickly compared to designing a printed circuit board, and do not require a CAD system or other similar tools typically used in the design of PCBs. With the relative ease of connecting components together, breadboards also lend themselves well to electronics education.

Breadboards will allow you to connect various components together in different combinations allowing you to produce many

different circuits. If you are using a solderless breadboard, you can create these circuits without any special tools either. Being able to quickly and easily make component and wiring changes, as well as any needed repairs to the circuitry, keeps it adaptive. Breadboards are also very easy to test as you have unobstructed access to the circuitry for probing, and you can easily break into a circuit to test it.



There are many benefits to creating your prototypes with a PCB layout

ADVANTAGES OF USING A PROTOTYPE LAYOUT

Although there are many benefits of using a breadboard, there are many more advantages to creating a prototype PCB layout instead. Here is a partial list of those advantages:

- You can create the size of a circuit board that you need instead of being restricted by the size of the breadboard.
- You can use any component that you want, such as surface mount parts, instead of being restricted to thru-hole parts.
- It is easier to see and understand the circuits without looping wires going everywhere like they do on a breadboard.
- A PCB is more robust than a breadboard which will bend under the weight of many large parts.
- The copper of a PCB is more durable than the metal connections and jumper wires of a breadboard.
- The components on a PCB are soldered in for a strong connection, and won't slip out of the clips like they can on a solderless breadboard.
- A PCB will have a better current carrying capacity than a breadboard because the power traces or metal area fills can be adjusted during the design for the optimum width. A PCB can handle higher voltages than a breadboard as well.
- Signals will perform better on a PCB without the higher parasitic inductance and capacitance that is typical in a breadboard.
- Replicating a PCB is a much easier task than creating multiple hand-assembled breadboards. This will reduce your manufacturing time and costs considerably.

- If you are trying to sell your circuit board, you will probably find that a completed breadboard just isn't attractive to buyers like a completed PCB layout is.

Although a breadboard is a great way to learn electronics on or to build a quick test circuit, there are many more benefits to creating your prototype boards with a PCB layout. Fortunately, there are resources available to you to help you create your prototype layouts quickly and inexpensively.

Make sure that your PCB design software is intuitive to learn, use, and has the capabilities to create the prototype PCB layouts that you need. To quickly get your designs ready to build so that you can test your new circuits as a finished PCB instead of a breadboard, consider using Altium's CircuitStudio to grant you access to the features and tools that you need from your design software.

Would you like to find out more about how Altium can help you to design your prototype PCBs? Talk to an expert at Altium.

PRACTICE MAKES PERFECT: HOW TO TEST ELECTRONIC COMPONENTS DURING PCB DESIGN

When I was younger, well much younger, I had dreams of one day being a pro athlete. I wanted to be the guy who scored the winning touchdown, knocked in the winning run or hit the buzzer-beater. Although I never made to the professional level, I did have some success and I learned a lot. The most important thing was the results you achieved were strictly tied to your preparation. In other words, if I wanted to do well in the game I had to test myself by practicing.

I'm still using those skills, though: in order for your PCB to function as intended, you need to test your design. By testing the electronic components of your board before manufacturing you can be sure that it will perform as you intended with your design.

The most successful teams that I played on had coaches who stressed the importance of practicing as if you were playing in an actual game. It is one thing to shoot baskets alone, but it is something else to make them when you are being defended. The same difference exists between simulating your circuit's schematic without the physical and material restrictions of the actual board and testing your electronic components during PCB design.

IS TESTING PCB COMPONENTS DURING DESIGN NECESSARY?

Although this is a very important design step, schematic simulation does not guarantee the functionality, reliability or even manufacturability of your design. Applying good design for manufacturing (DFM) practices will help you ensure that your design can be manufactured. However, there are additional steps you can take to test functionality and reliability during design.

The reasons for performing a schematic simulation of your circuit are to:

- Determine Component Parameters: Primarily voltages, currents, and impedances.
- Verify Circuit/System Operation: Check inputs/outputs, and signal levels.
- Make Changes and Correct Errors: Replace parts, or make design changes.
- Save Costs: By not having to buy components or materials for testing.

But what if you knew that one of your board's electronic components would fail at some point once it is in the field? You would either replace the component or change your design to remove the source of the failure before manufacturing the board. A design tool like a power distribution network analyzer (PDNA) allows you to evaluate parameters of your PCB as if you were using electronics testing equipment on the actual board.

You can condense your design rule checking into a smooth operation within your layout software.

Performing tests on your PCB electronic components during design will not only make sure that your boards will function properly and be reliable but also save costs if changes have to be made.

HOW TO TEST PCB COMPONENTS DURING DESIGN

The use of a PDNA provides a united design and analysis environment for your PCB design. You can perform power distribution analysis over the entire board or only specify predefined areas. Additionally, voltage gradient overlays give the power to look at voltage drops on the ends of all traces; including vias. You can also look at current density on your traces to make sure there are no potential undercurrent/overcurrent issues.

This ability to look at a component's incoming and outgoing traces can be used to determine the component's specific parameters. Employing these capabilities during design is akin to a successful practice where you can follow it up by moving to fabrication and assembly confident that your board will perform as designed.

Successfully practice your PCB design without ever leaving your layout software.

The ability to gather thermal, signal, and power integrity, current density, and trace impedances during design is a significant benefit to the PCB design process. Not only are you able to perform design for manufacturing (DFM) checks, but you can also test the board's electronic components, both of which can save development time. With the right PCB design software such as Altium designer, PDNA and other smooth design methodologies are available to you.

For more information and tips on testing electronic components during PCB design and how to make corrections that will avoid post manufacturing problems, contact an Altium PCB design expert.

ADDITIONAL RESOURCES

Thank you for reading our guide on PCB Design Testing . To read more Altium resources, visit the Altium resource center here or join the discussion at the bottom of each original blog post:

- The Advantages and Disadvantages of Designing with Breadboards
- Understanding the Nuances Between Breadboard Projects and Prototype Layouts
- Practice Makes Perfect: How to Test Electronic Components during PCB Design