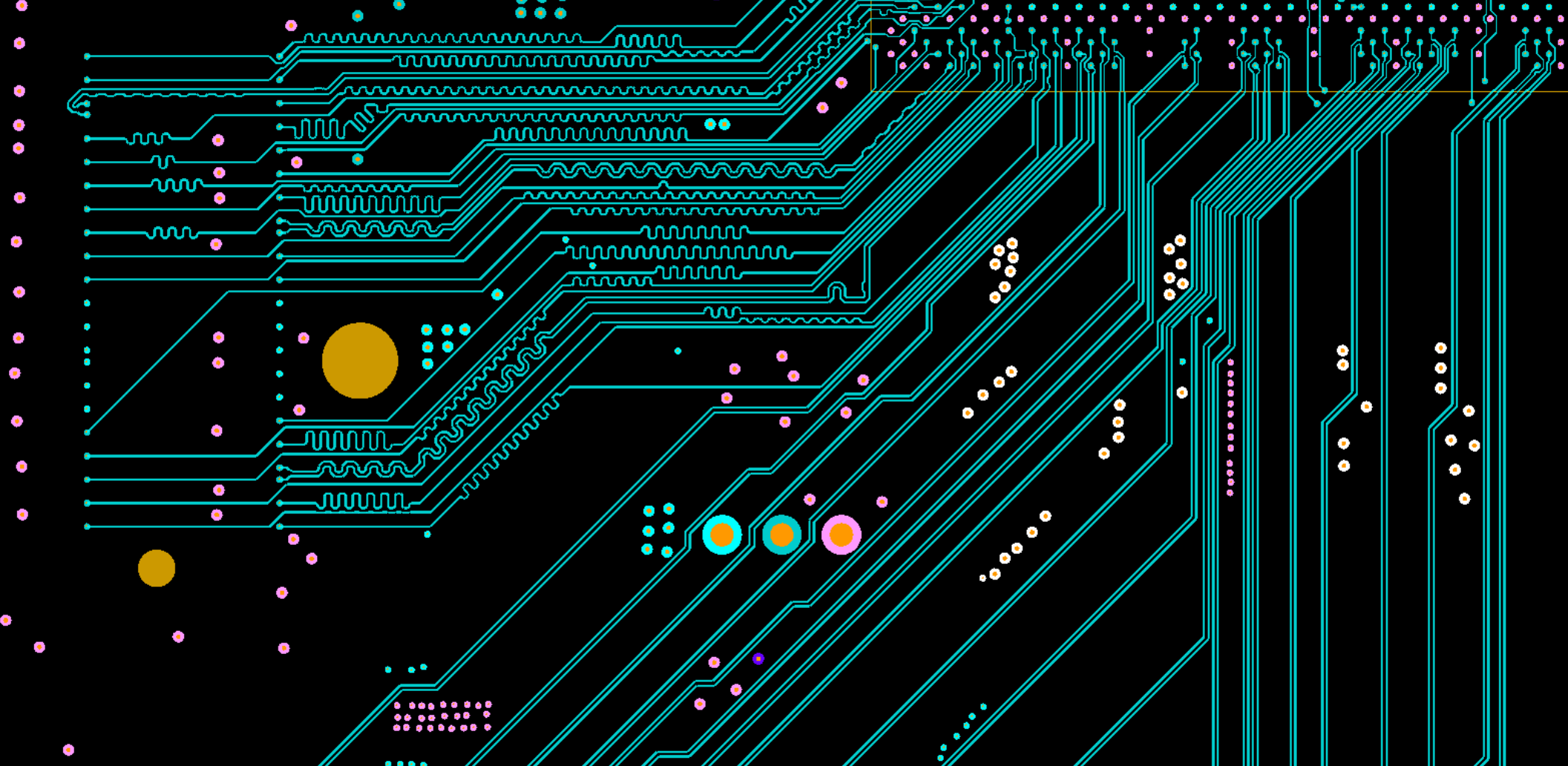




DIGITAL INDUSTRIES SOFTWARE

Routing automation with PADS Professional

Accelerate design time and increase product quality

[siemens.com/software](https://www.siemens.com/software)

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1. Why manual routing methods fall short

Manual routing is a process of the past – learn how and why the best engineers are using sketch routing to work faster and improve the quality of their designs. This paper covers six topics, including:

1. Why manual routing methods fall short
2. How much does automation really help?
3. If automation is so great, why don't designers rely solely on autorouters?
4. Some design aspects cannot be replaced by automation
5. Sometimes, technology can save you a lot of time and effort
6. How does sketch routing in PADS Professional work?

FACT:

The demand for high-quality products is increasing, even for simple products. If your product is of poor quality or is unreliable, your customers and your competition will make sure the world knows about it!

FACT:

PCB and systems design complexity is constantly increasing.

FACT:

Time-to-market schedules are getting tighter and more difficult to achieve.

FACT:

Manual routing takes a lot of time and can delay projects.



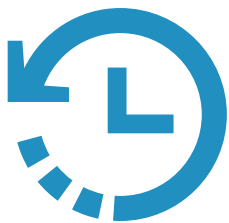
Did you know that there are new interactive routing technologies that accelerate design time and improve product quality?

Relying on traditional PCB routing techniques can delay projects for several reasons:

- **Manual labor-intensive:** Traditional PCB routing involves manually routing traces between components. This can be time-consuming, especially for complex and densely populated boards. Each trace needs to be precisely routed, which increases the risk of errors and requires extensive manual effort.
- **Limited automation:** Traditional routing tools have limited automation capabilities. While they may offer basic features like auto-routing, they often fall short when it comes to handling complex design constraints, making it necessary for designers to manually intervene and fine-tune the routes.
- **Inefficient iteration:** When changes or design iterations are required, traditional routing techniques can be slow and cumbersome. Adjusting existing routes or incorporating design changes can be time-consuming, leading to project delays.
- **Difficulty in handling complex designs:** As PCB designs become more complex with increased component density and the need for multiple layers, traditional routing techniques struggle to efficiently manage these intricacies. The complexity can result in longer design times and reduced design accuracy.
- **Resource constraints:** Traditional PCB design often relies on designers with extensive experience and expertise. Finding and retaining such skilled designers can be challenging, which can contribute to project delays.

2. How much does automation really help?

Automation can significantly accelerate design time, provided it is used effectively. The extent to which automation speeds up the design process depends on various factors, including the complexity of the design, the quality of the routing automation tools, the skill level of the designer and the specific requirements of the project.

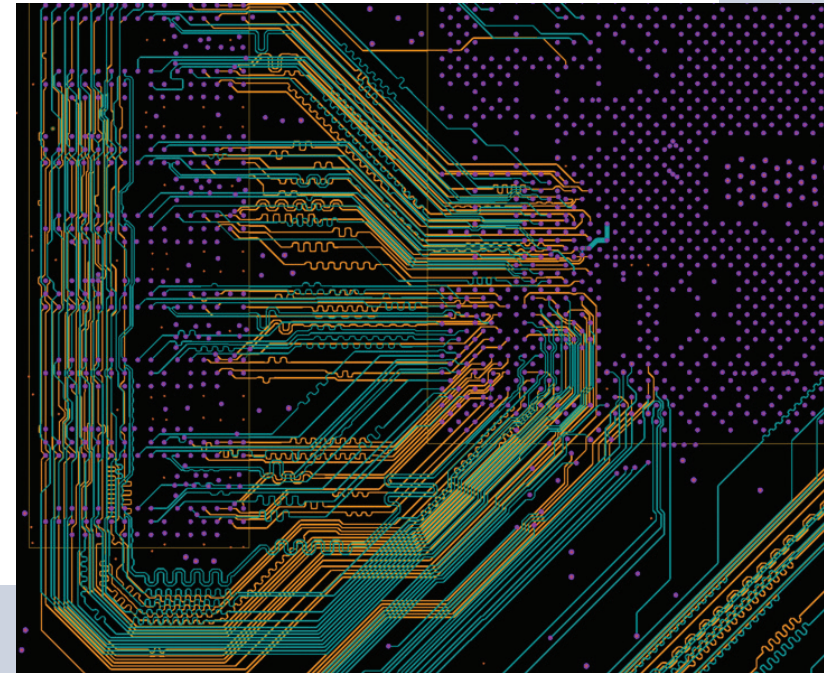


Here are several ways in which PCB routing automation can expedite the design process:

- **Faster routing:** Automation tools can quickly generate connections between components, especially for simple or repetitive routing tasks. This saves designers a considerable amount of time that would otherwise be spent manually routing traces.
- **Efficient resource utilization:** Automation allows designers to make better use of their time and expertise. Instead of focusing on routine tasks, they can concentrate on more critical aspects of the design, such as optimizing signal integrity, reducing interference and ensuring the board meets design constraints.
- **Consistency:** Automation ensures a higher level of consistency in routing, reducing the risk of human errors. It helps maintain uniform trace widths, clearances and other design parameters throughout the PCB, which can prevent time-consuming revisions and debugging later in the design process.
- **Rapid iteration:** When design changes are required, automation tools can help designers quickly adapt the layout to accommodate those changes. This rapid iteration capability can be especially valuable in fast-paced development projects.
- **Reduction in learning curve:** Automation tools with intuitive user interfaces can help designers become proficient faster, reducing the time needed to learn and master the software.

It's essential to note that the degree of time savings depends on the specific project and the tool's capabilities. For simple PCB designs, automation may lead to a substantial reduction in design time. In more complex projects, while automation remains beneficial, the time saved might be proportional to the design's intricacy.

Ultimately, PCB routing automation is a valuable resource for designers seeking to expedite their design process, reduce errors and enhance the overall quality of their PCB layouts. The impact on design time will vary, but it is a critical factor in managing project schedules and meeting tight deadlines.



3. If automation is so great, why don't designers rely solely on autorouters?

Full automation isn't always the perfect solution:

The look of a hand-drawn design

Automation can't always replace human experience and intelligence. Some things, you just prefer to do manually.

Clean up

Cleaning up after an autorouter takes time, causing some designers to stick to manual routing.

Simple design

An autorouter is most efficient on PCBs with many layers and lots of digital signals; not all boards are like that.

While PCB autorouters are a valuable tool in the PCB design process, there are several reasons why PCB designers don't rely solely on them:

- **Complexity and customization:** PCB designs can be highly complex and often require customization to meet specific design constraints and requirements. Autorouters may struggle to handle the intricacies of these designs effectively. Designers need to consider factors like component placement, signal integrity, EMI/EMC compliance and thermal management, which often necessitate manual intervention.
- **Control over critical signals:** Some PCBs include critical high-speed signals or analog components that demand precise routing. Designers have an in-depth understanding of the system's

requirements and can route these signals optimally to ensure signal integrity, reduce interference and meet specific design goals. Autorouters might not make the best choices in such cases.

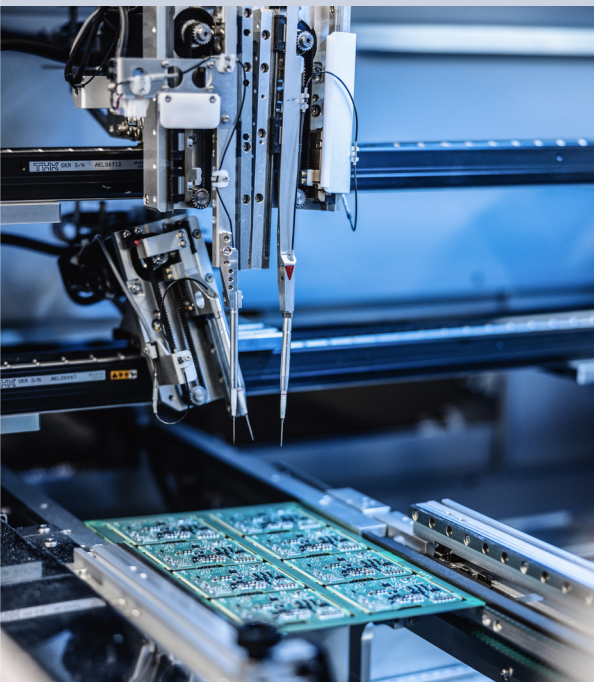
- **Avoiding routing mistakes:** Autorouters can make mistakes, especially when dealing with complex designs. These mistakes can lead to costly rework and delays. Human designers can actively review and correct routing errors in real-time, reducing the likelihood of issues.
- **Learning curve:** Autorouters can have a steep learning curve, and mastering them can take time. Designers who are already skilled in manual routing may find it more efficient to use their expertise rather than invest time in learning and configuring autorouter settings.

- **Specific design philosophy:** Designers may have a specific design philosophy or methodology that autorouters cannot replicate. They may prefer a particular style or approach to PCB layout that aligns with their design philosophy and project requirements.

In summary, while PCB autorouters can automate portions of the design process and save time, they are not a one-size-fits-all solution. Designers play a crucial role in ensuring that the design meets specific project requirements, constraints and goals. A combination of manual design expertise and the judicious use of autorouters can yield the best results in terms of design quality, efficiency and meeting project objectives.

4. Some design aspects cannot be replaced by automation

Despite the many advantages of automation in PCB design, there are several crucial aspects of the design process that cannot be entirely replaced by automation.



These aspects require the expertise and creative problem-solving skills of human designers. Here are some examples:

- **Design concept and specification:** The initial design concept and specification are typically determined by engineers and designers who assess the project's functional requirements, constraints and objectives. Automation cannot replace the creative thinking required to develop a suitable design concept.
- **Component selection:** Selecting the appropriate components for a PCB design is a critical task. Designers need to consider factors like component availability, cost, performance and power consumption. Automation cannot make these subjective decisions.
- **Signal integrity and high-speed design:** PCBs with high-speed signals require careful planning to maintain signal integrity. Designers must ensure that impedance is matched, signal traces have specific lengths and reflections are minimized. Automation tools may not have the insight required to handle these tasks.
- **Routing critical signals:** Identifying and routing critical signals in the most optimal way to minimize crosstalk, electromagnetic interference and signal degradation often requires the experience and intuition of a human designer.
- **Thermal management:** Designing a PCB with proper thermal management is vital, especially for high-power applications. Decisions about heat sinks, vias and copper pours to dissipate heat effectively rely on human judgment.
- **EMI/EMC compliance:** Meeting electromagnetic interference and electromagnetic compatibility standards is a complex task that requires in-depth knowledge and human judgment. Automation tools may not understand the nuances of EMI/EMC compliance.
- **Complex design trade-offs:** Designers frequently face trade-offs between various design parameters, such as cost, performance, size and manufacturability. Making these trade-offs effectively is a human-centered decision-making process.
- **Customization for unique requirements:** Some PCB designs have unique or project-specific requirements that automation tools may not accommodate. Designers must adapt the design to meet these unique demands.
- **Creative problem solving:** When unexpected design challenges arise, creative problem-solving is essential. Designers use their experience and creativity to find innovative solutions to these issues.
- **Project management and communication:** Design projects involve collaboration with other team members and stakeholders. Designers play a key role in project management and effective communication, ensuring that the design aligns with the project's goals and timelines.

While automation tools can streamline and accelerate many aspects of PCB design, they are most effective when used in conjunction with the skills and expertise of human designers. The human touch is necessary for creative problem-solving, critical decision-making and adapting to the unique requirements of each design project. Designers play an indispensable role in ensuring the success and quality of PCB designs.

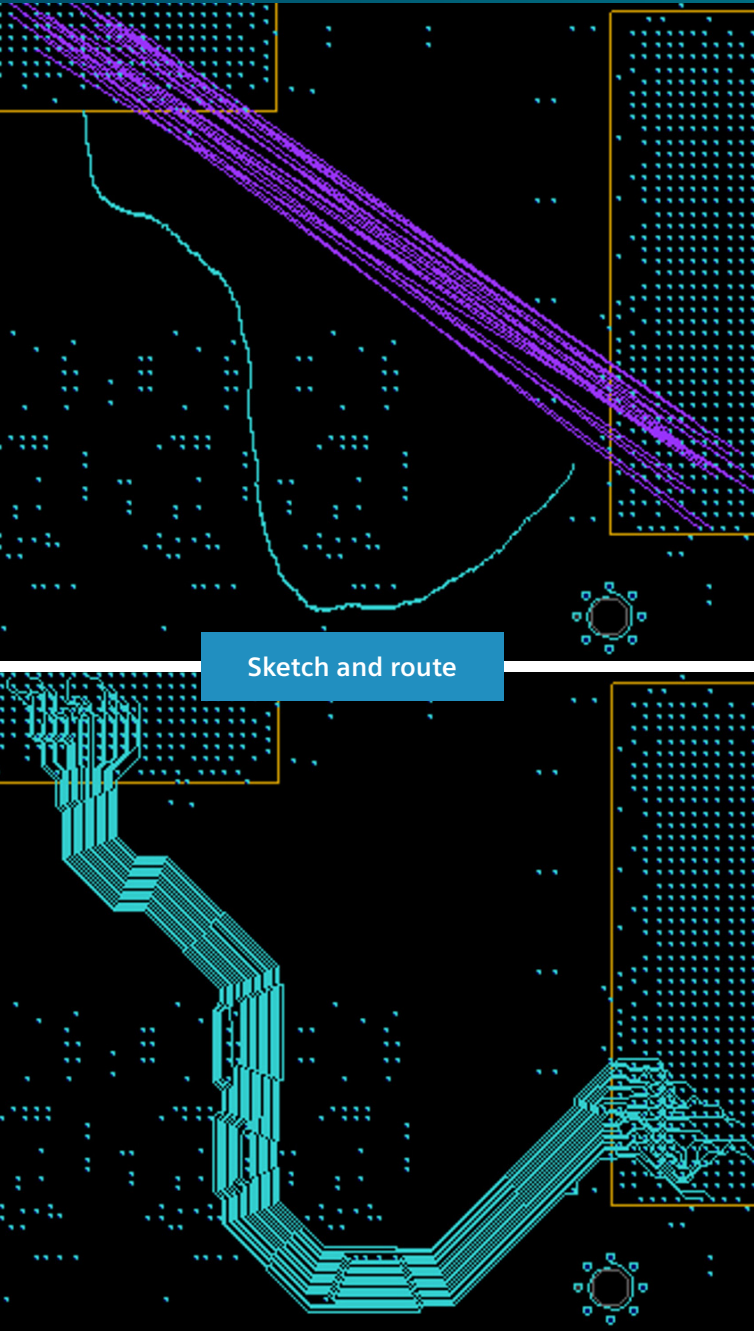
5. Sometimes, technology can save you a lot of time and effort

Gain higher quality, greater user control and exceptional performance with sketch routing in PADS Professional – the perfect combination of automation, human experience and intelligence!

- Draw sketch paths to determine the trace routing of selected net lines
- Achieve high design quality and high completion rates more quickly than with manual routing
- Route individual traces or hundreds of single-ended/differential pairs
- Automatically optimize pin escapes for enhanced routing without adding unnecessary vias

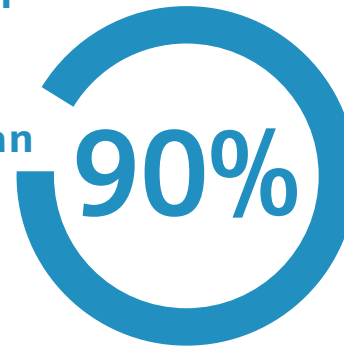


6. How does sketch routing in PADS Professional work?



- Viewing your design intent and routing strategies in the form of a super-efficient sketch, PADS™ Professional automatically fans out, untangles and routes the associated nets with the quality of an experienced PCB designer.
- Sketch routing reduces complex routing times by orders of magnitude. A designer simply sketches where the routing should go. The Sketch Router will route individual, dozens, or even hundreds of netlines many times faster than manual routing.
- Sketch routing focuses on quality; little cleanup is needed, often none at all.
- Sketch routing automatically optimizes the escapes from components like BGAs so that they can be routed without additional vias. Completion rates are generally greater than 90 percent.

**Completion
rates are
generally
greater than**



Sketch Routing in PADS Professional

- Dynamic Push-and-shove
- Sketch Router
- Real Trace Routing

Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, [Siemens Digital Industries Software](#) – Accelerating transformation.

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