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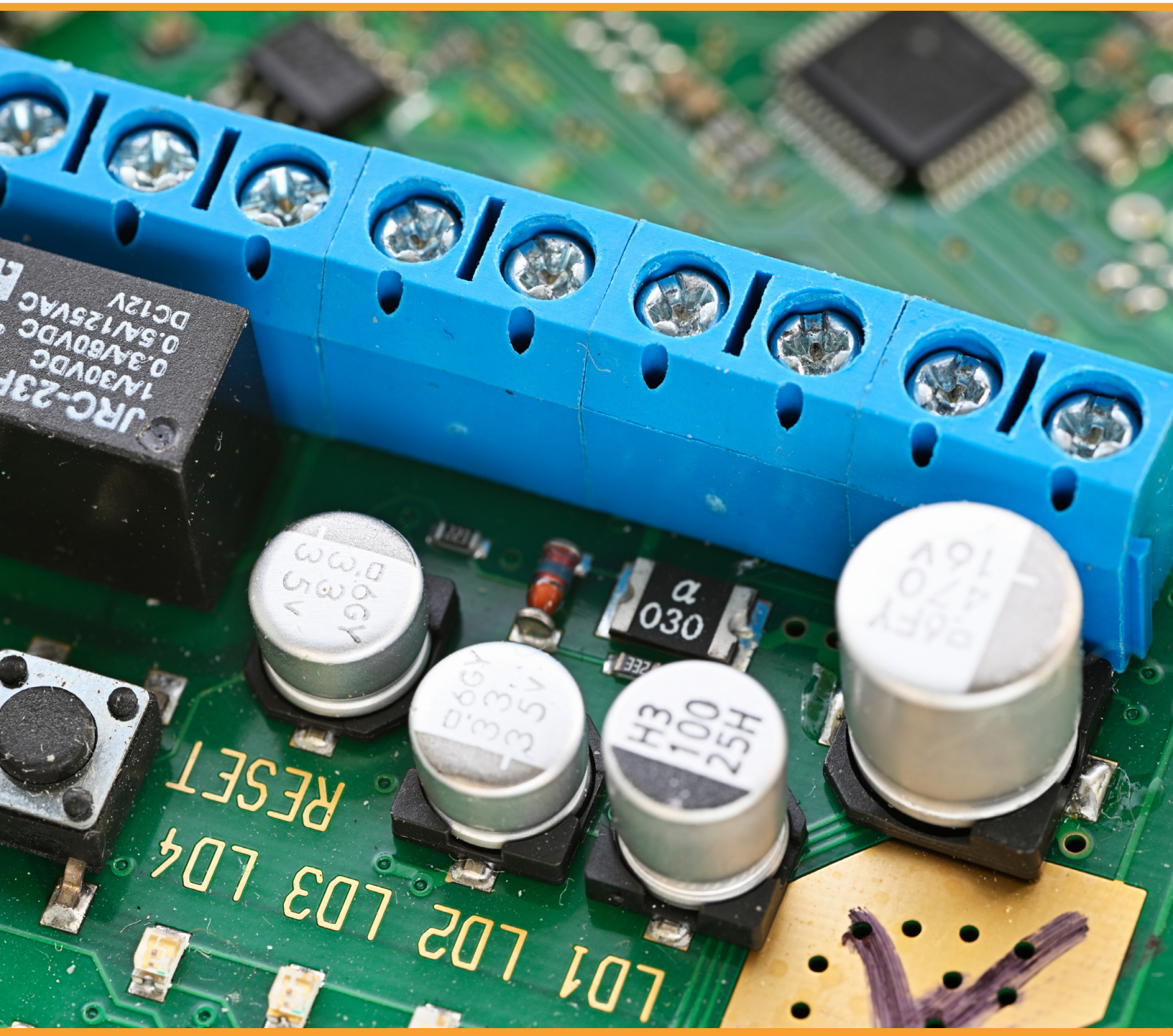
PCB TERMINAL BLOCKS PROVIDE VALUABLE ELECTRONIC INTERCONNECTIONS



Designing PCBs with terminal blocks requires an understanding of the types of terminal blocks available, the best way for them to be packaged for delivery, and how to solder them to reduce the potential for failure.

The printed circuit board (PCB) was introduced almost 90 years ago and has since seen immense changes and improvements, bringing sophistication to the electronics world. Printed circuit boards come in a multitude of sizes and shapes to fit the ever-growing application base for digital technologies. Multilayer printed circuit boards have been assembled since the 1960s, and for most electronic equipment, more than one PCB is used.

Early PCBs were populated with electronic components such as transistors, diodes, resistors, and capacitors, all having their own leads. PCBs used a through-hole arrangement where a hole was placed in the center of a solder pad, which allowed for the component lead to be inserted. Once the leads were in place, the components could be soldered to the pad on the opposite side of the board using a number of different methods, including manual soldering.

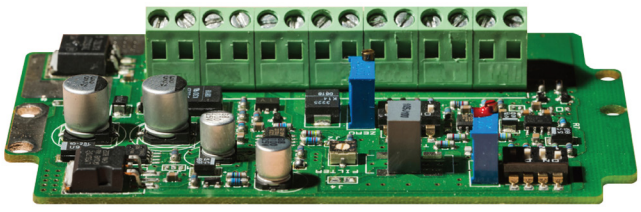


Figure 1: *By the late 1960s, chip manufacturers were designing surface-mounted components that attached directly to the board for increased manufacturing automation.*

As technologies advanced, digital electronic chips were developed with a band of pins along their outside edge, which were often short enough that they didn't go through the board. By the late 1960s, chip manufacturers were designing and manufacturing surface-mounted components designed to be mounted directly to the PCB, allowing for increased manufacturing automation (see Figure 1). Although through-hole and surface-mounted technologies can both be used to populate a PCB, most boards incorporate primarily surface-mounted components. At the moment, the exception to this rule would be larger components such as transformers and heat-sink power electronics.

PCBs are made using substrates and laminates. The substrate is the base material for the board, typically some type of fiberglass or fabric that has been reinforced with resin, creating a stiff surface to house the components so they'll be able to withstand some measure of shock and vibration without breaking. The laminate is a copper clad material that is fused to the substrate using heat and pressure, and then the copper is etched away to form the conductive circuitry of the PCB. Once finished, multiple PCBs can be joined to create a multilayer board.

Interconnecting PCBs with the outside world requires connector and terminal block manufacturers to provide a wide array of products. Different industries need different types of interconnections depending on the specific needs of the application, and there are different mounting methods to consider.

PCB Terminal Blocks

Printed circuit board terminal blocks should offer highly dependable connections without the need for wire lugs. For example, you might want to use tubular screw clamps or box clamps for light duty applications and screw-cage clamps for heavy-duty applications.

Figure 2: *Illustrated are the three primary types of terminal block design.*

Although it is recommended that you use ferrules—especially for export applications or when fine stranded wires must be terminated—users can also simply strip and insert the wire and then tighten the screw. Be sure to use board-mounted terminal blocks that meet or exceed most international standards and are accepted worldwide.

The two primary types of PCB terminal blocks are screw clamp and spring clamp designs. Screw terminal blocks are simple to use; just insert the wire into the open clamp, tighten the screw, and remove your screwdriver for a reliable and safe connection. The benefit of using a screw-type terminal block is that it can be effectively manufactured for a wide variety of sizes and configurations while offering the maximum in wire efficiency and reliability to the user.

Be sure that the terminal block you select is able to handle the physical stress of multiple wires mounted in the same general location without putting undue stress on the PCB. Terminal blocks must be sturdy and tough and made from high-impact materials such as polyamide PA66 and self-extinguishing plastics regardless of where they are mounted. Note that most terminal blocks are color-coded so that the user can easily determine ground wires from hot wires and control wires.

Spring clamp terminal blocks take less time to wire during installation. Through the use of a narrow screwdriver or by hand while using a lever, users need only to open a pre-loaded stainless steel spring. The wire is then inserted into an opening in the spring leg. Once the screwdriver is removed or the lever closed, spring force presses the conductor against a copper-tin plated clamp housing for a highly reliable connection. The terminal blocks can be used with solid or stranded wire for a very secure connection.

Another spring clamp terminal block design is made specifically for single wire connections and allows the wire to be pushed directly into the spring block without using a screwdriver—for a tool-less connection—to complete the operation. Push-in spring clamp terminal blocks are growing in popularity based on their ease of use (see Figure 2).

With spring clamp terminal blocks in general, conductors can be terminated securely in mere seconds, independently of one another and with absolute reliability. This easy installation reduces wiring time by over 50% while delivering a reliable, maintenance-free connection independent of operator skill. Not only are these terminal blocks versatile, offering a reliable gas-tight connection, but they are vibration proof, having no screw to loosen during operation.

These types of terminal blocks are particularly easier to use with small wires than screw type terminal blocks. They provide a fail proof and safe connection with no torque requirements. Like other terminal blocks, spring clamp devices accept wires with or without ferrules to provide a completely maintenance free operation.

PCB terminal block design and manufacturing has come a long way in the past few years due to the advancements in materials and the needs of specific applications. Many manufacturers offer a full line of components that fit the broadest uses in the industry. For example, Altech has expanded their PCB terminal block line to offer standard single- and double-level fixed and pluggable terminal blocks in metric and U.S. pin spacings and a wider array of products within each pin spacing.

Mounting Types

PCB terminal blocks that are designed for fixed mounting should offer users high densities with maximum flexibility. Altech offers a line of PCB terminal blocks with a modular construction that simplifies ordering and reduces the need for extensive inventory. Two- and three-pole modules can be interlocked to create multipole assemblies or the company can provide tailored assemblies to your specifications. The company's fixed mounted terminal blocks are available with box clamps including wire protector or screw-cage lift type clamp operations that offer several wire entry options to make installation and repair easy and accessible. Lift-type clamps are used in applications with heavy-duty requirements while wire protector versions are for cost sensitive applications.

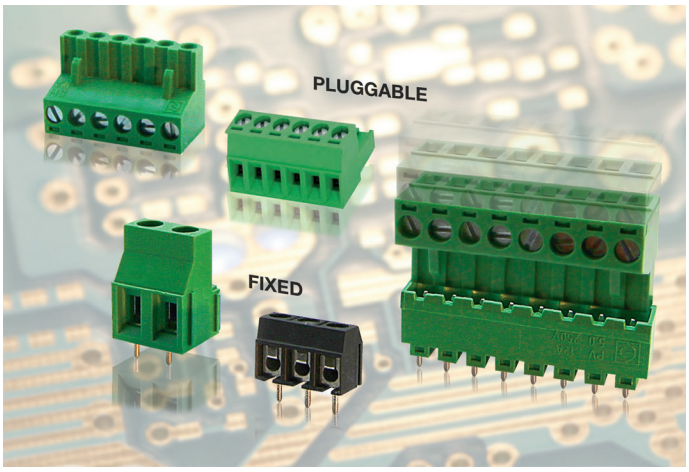


Figure 3: *Pluggable terminal blocks come in header and plug combinations designed to speed and simplify board replacement.*

The company's pluggable terminal blocks are header and plug combinations designed to speed and simplify board replacement and reduce costly downtime. The two-piece plug and header design requires no special tools to operate. Headers are soldered into the board and accept the plugs, which are easily removed for fast, convenient board or device replacement when necessary.

Single-mold designs are available for maximum strength. Modular designs are also available, which are assembled from two- and three-pole modules when a user needs maximum flexibility to meet changing requirements. Header configurations include vertical and horizontal, single- and double-level with closed or open ends. Pluggable PCB terminal blocks come with either screw or spring clamp connection technology.

When choosing screw technology connection types, consider your application and maintenance needs. When your application calls for the highest reliability and frequent wire terminations, screw-cage lift type clamps are a solid choice. As the clamp is tightened, the nickel-plated cage rises, pressing the wire firmly against the busbar, ensuring a solid connection. On the other hand, with box clamp wire protector designs, tightening the screw presses the conductor directly against the bottom of the clamp. These systems are a great choice for cost-sensitive, lighter-duty applications.

PCB terminal blocks feature precision-formed or machined metal parts, which are electrolytically plated. Nickel or tin-plated brass cage clamps or tubes, stainless steel wire protectors and springs, and tin-plated solder pins satisfy the most demanding requirements. Housings are precision-molded from self-extinguishing UL-94 V0 polyamide, providing excellent strength and temperature resistance. Each clamp style is offered in metric and inch pin spacing.

Depending on the company's products you work with, most manufacturers have some sort of markings to identify terminal inputs. Altech offers their users to order hot stamp, inkjet, and laser imprinting for permanent marking of large quantities or custom marked terminals. Otherwise, standard marking is consecutive numbers, left to right. Custom imprints are also available for specific customer needs (see Figure 4).

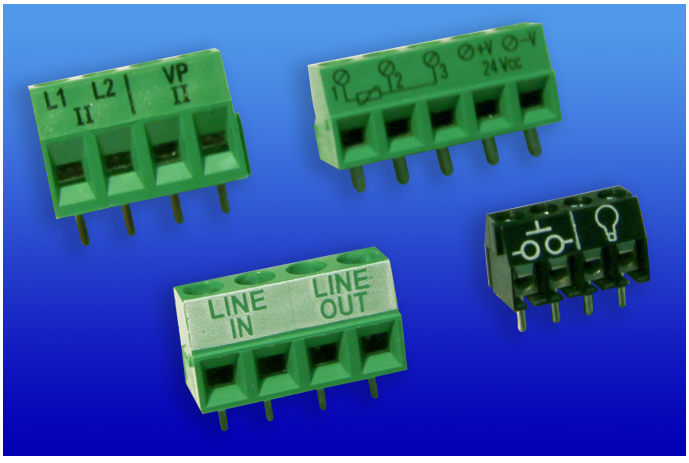


Figure 4: *This photo illustrates the marking capabilities available to the customer.*

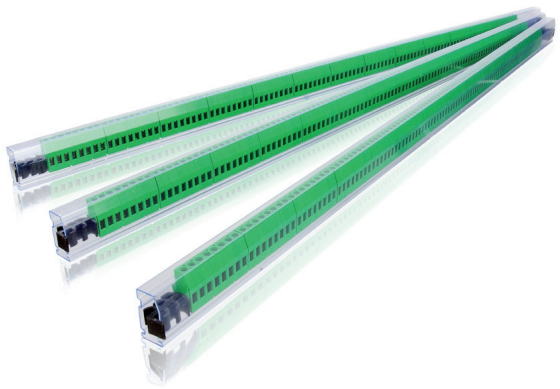


Figure 5: *Tube packaging is most often used for gravity feed automation systems.*

Packaging Options for Automated Assembly of PCB Terminal Blocks

Special packaging is often available for terminal blocks so customers can easily fit the products into their particular production methodology. There are three basic types we'll consider here: tube packaging, tray packaging, and tape and reel packaging. Early on, in integrated circuit manufacturing, hard plastic tubes were used to deliver components, including terminal blocks (see Figure 5). Multiple tubes can be stacked and transported within a facility or shipped while keeping the components safe. These long tubes allow for gravity feed systems where the components are easily available for automatic placement machines.

Tape and reel packaging means that terminal blocks are set into specially designed pockets in a long piece of

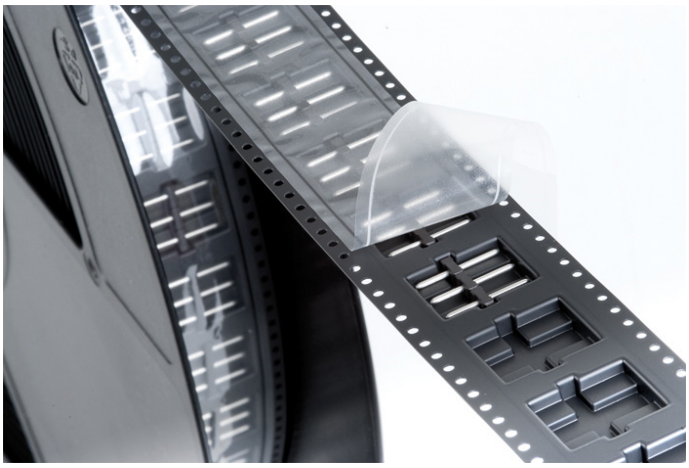


Figure 6: *Tape and reel packaging is used to feed components into automated machinery, providing a much faster deliver than other methods.*

plastic tape (see Figure 6). The tape is sealed to keep the components in place and then wound around a central reel. This protects the terminal blocks from damage during storage. Tape and reel packaging helps to feed components into automated machinery, which can operate much faster than other methods. Tape and reel packaging also eliminates orientation errors in how the components enter the system.

Figure 7: *Tray packaging is designed to work with pick-and-place machines and allows for safe storage and transport of larger parts.*

Tray packaging, like the name suggests, is when the terminal blocks are available in trays (see Figure 7). This form of packaging is designed to work with pick-and-place machines. Trays are covered with a thin plastic to isolate components from the outside environment. This protection helps maintain component durability during shipping and receiving. The added durability allows for lower levels of production loss. Tube and tray packaging of components allows for the safe storage and transport of larger parts that do not fit comfortably in a tape and reel operation.

Pros and Cons of Reflow and Wave Soldering

For many manufacturers, reflow soldering is the most common method of PCB soldering. The process first applies solder paste made of a precise mixture of flux and solder. Once applied, the PCB is placed into a reflow oven where hot air is raised to a predetermined level where the solder paste melts and forms the solder joints. This process can be applied to specific parts of the PCB as well. Reflow soldering preheats the PCB to eliminate thermal shock during the soldering process, which doesn't require a lot of monitoring.

Wave soldering is most often used when engineers need to solder a large number of PCBs simultaneously. The process begins by applying flux to the components that need to be soldered. The flux cleans the metal prior to soldering. Like reflow, a preheating cycle ensures that thermal shock is avoided. A "wave" of solder then moves across the PCB, soldering the components to the board. A cooling cycle is used to permanently bond the solder in place. If temperatures inside the wave soldering machine are not correctly maintained, a number of failures can occur. If the oven is too hot, the PCBs can develop cracks, but if the soldering oven is not hot enough, cavities on the PCB may result in conductivity issues and structural weakness. Wave soldering machines do save a lot of

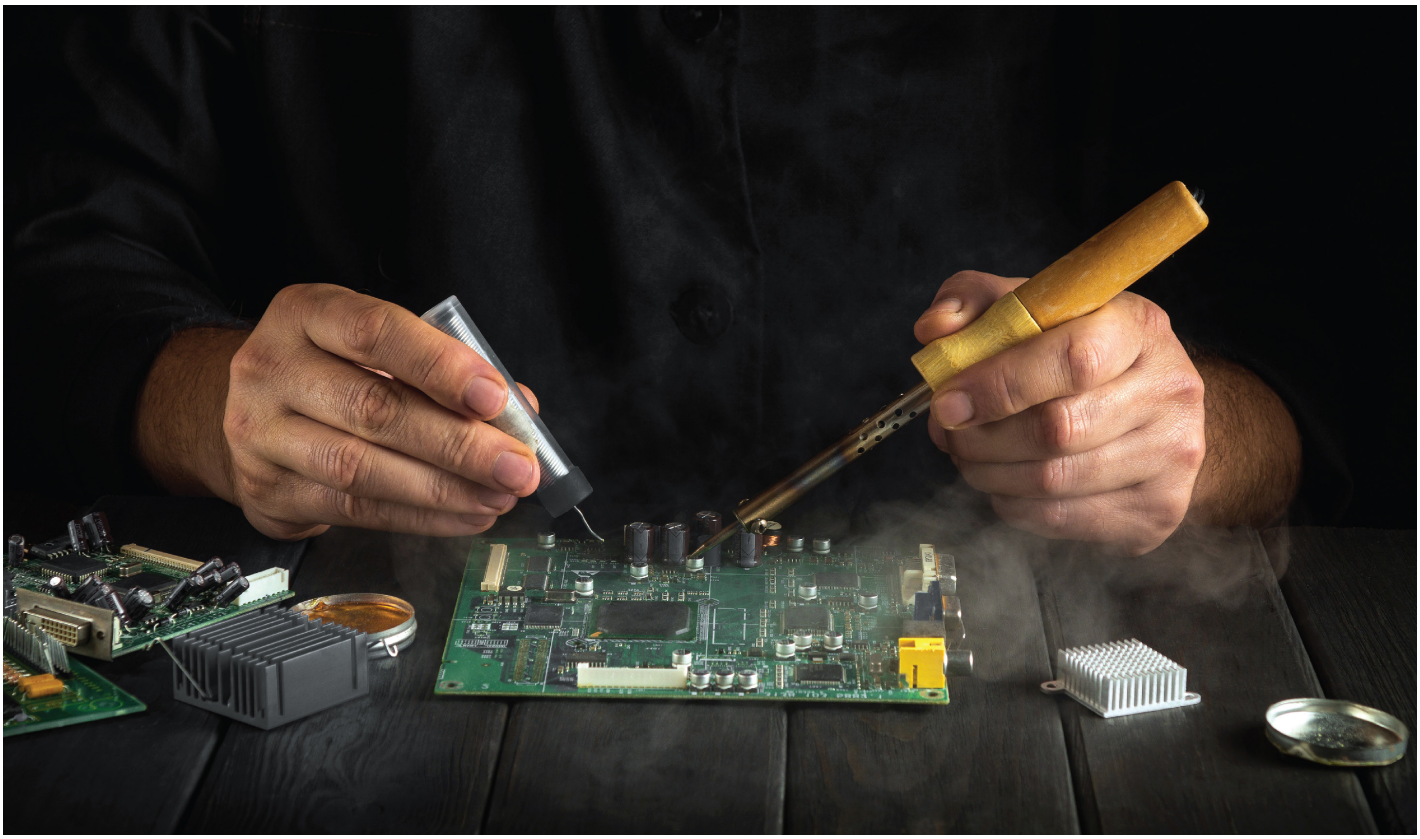


Figure 8: *Besides automated soldering solutions, manual soldering if often necessary when a PCB component needs to be replaced.*

time, initiate less warpage of PCBs, and are often more affordable, depending on your company's needs.

Like the selection of any component, understanding what's available, how the product is packaged and delivered (depending on your manufacturing process) and how the product is installed, are all important decisions. This is especially true for PCB terminal blocks. The more engineers know about the whole process and the needs of the user, the better decision they can make on product type from the very beginning.