



TechnoTronix
Electronics Manufacturing Services



Printed Circuit Board Assembly Process

- The Comprehensive Guide!



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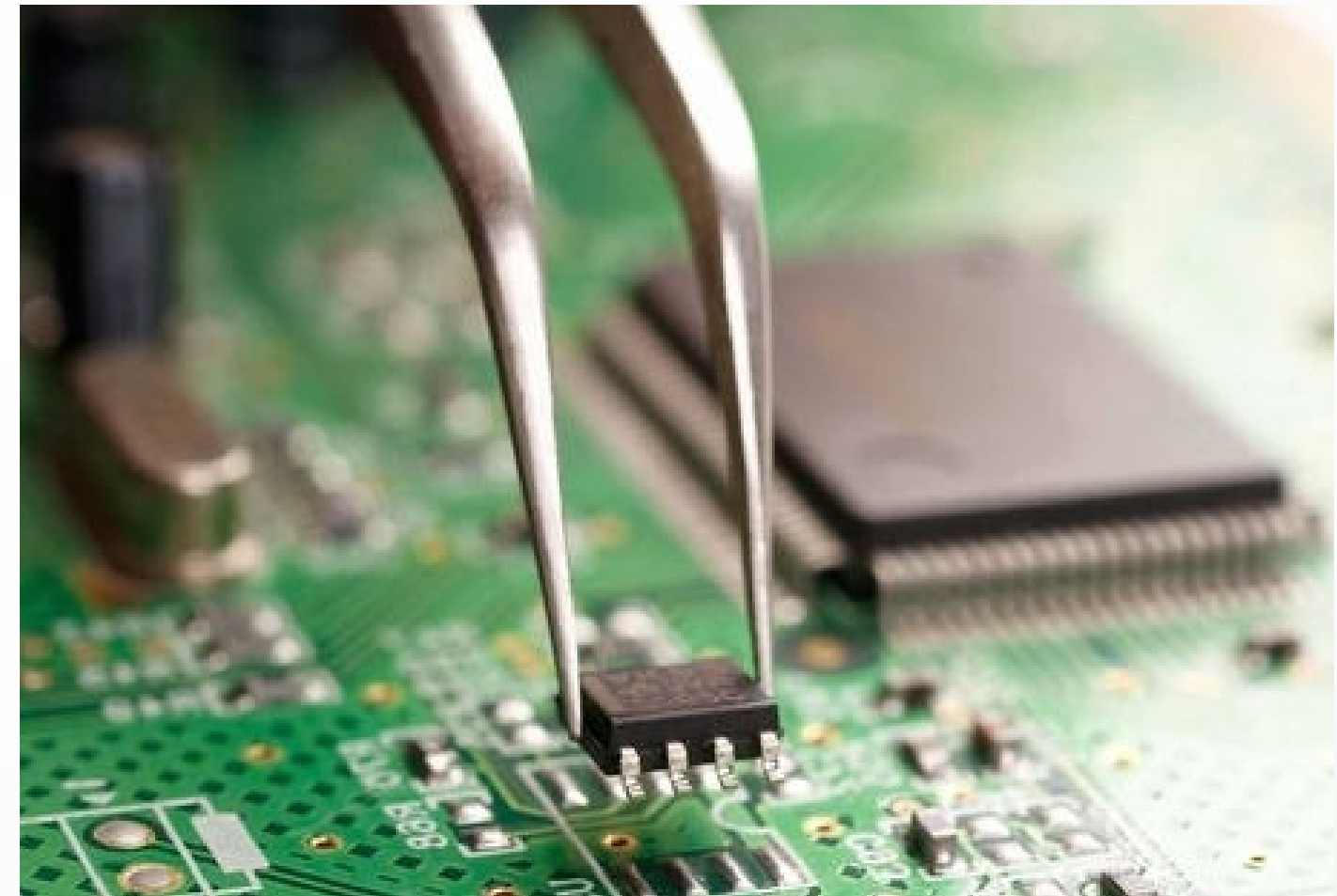
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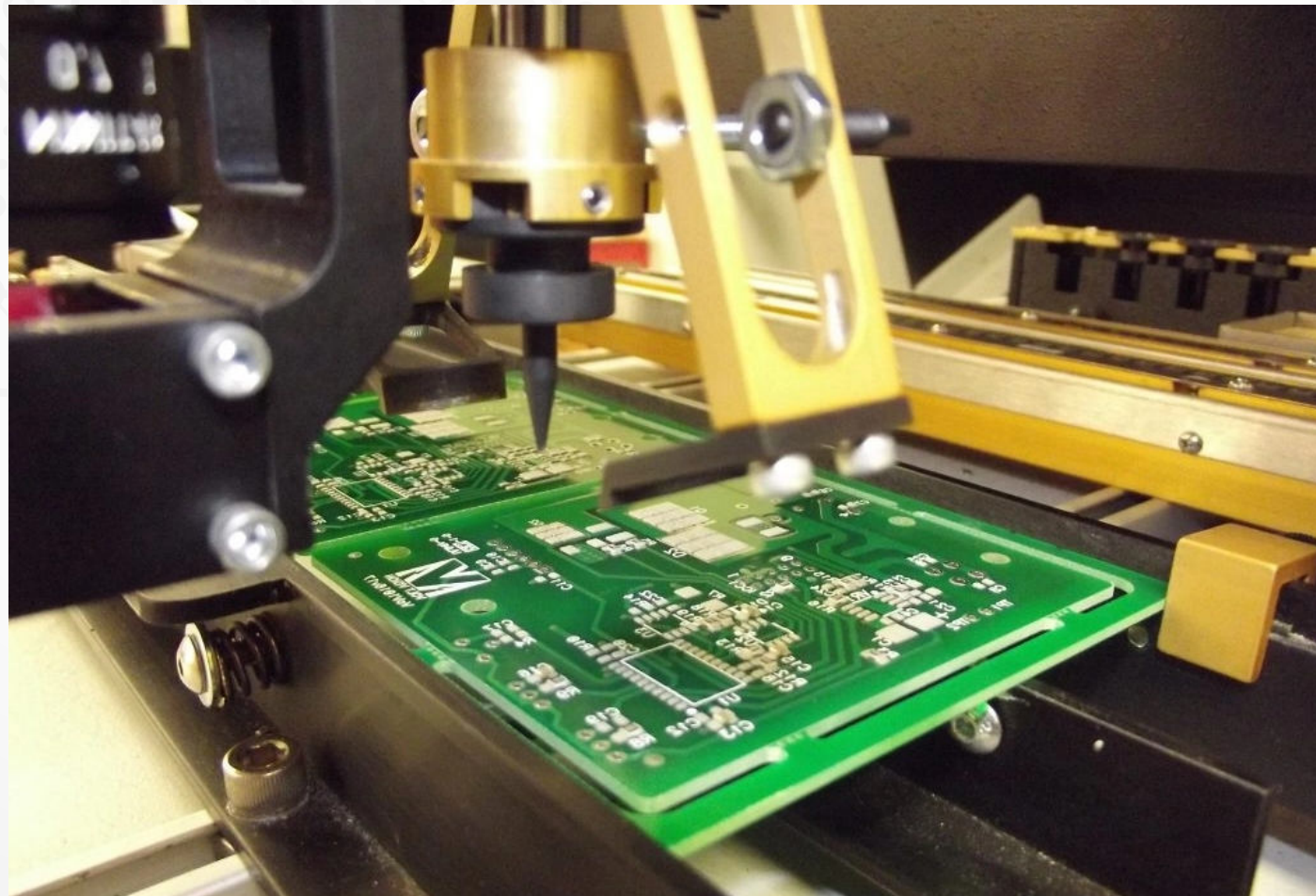
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About Printed Circuit Board Assembly Process

The use of electronics has been growing exponentially in our lives. Not just that we are seeing miniaturization as a rising trend when it comes to electronics. What makes all of this possible, however, are those small green chips that are at the heart of all electronic devices. Yes, we are referring to the Printed Circuit Boards or PCBs as they are popularly called. These are largely made of fiberglass; copper while being held together with epoxy and they are insulated with a solder mask.



What is Printed Circuit Board Assembly?



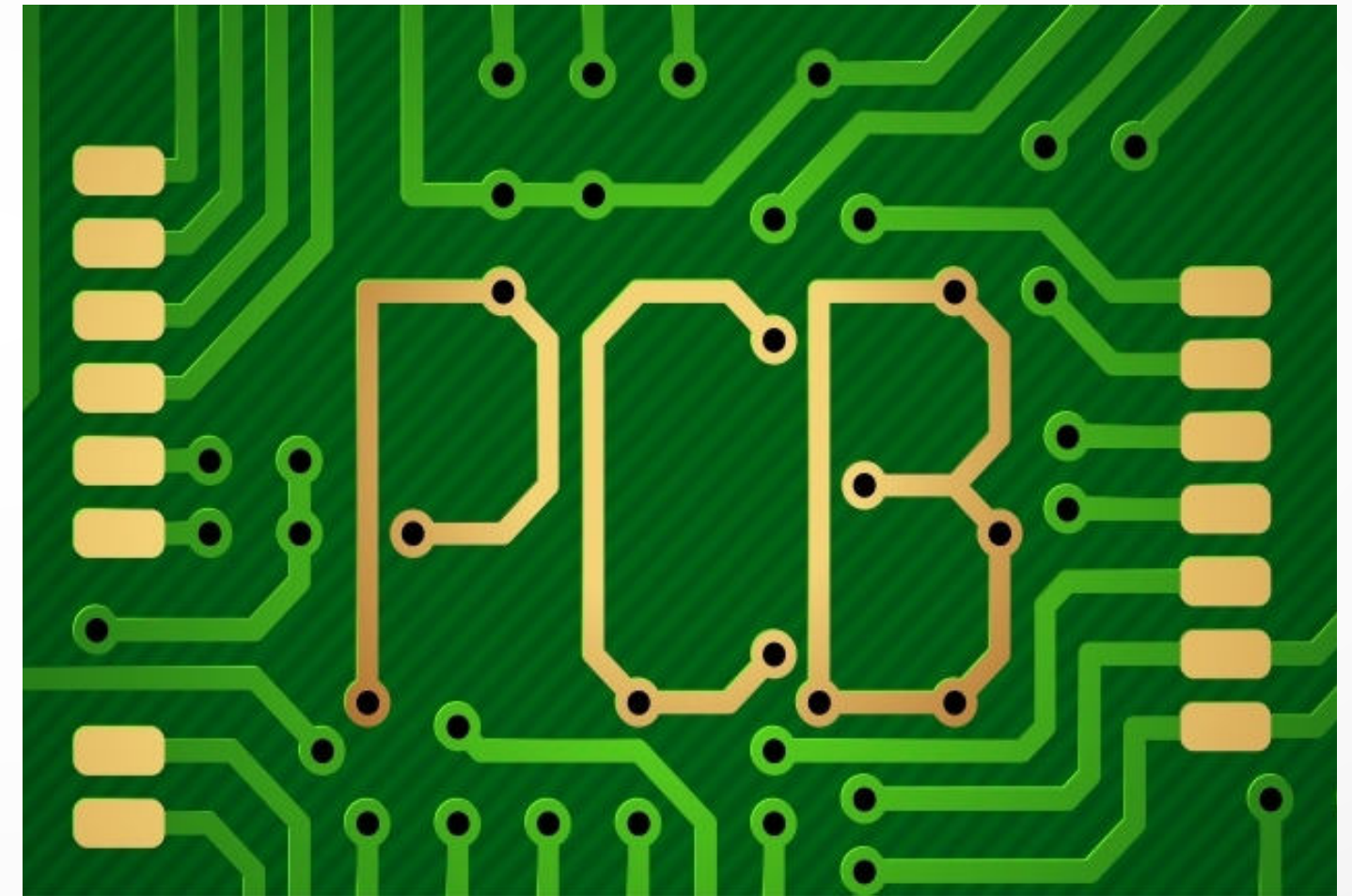
What gives these boards the complex functionality that you witness in the electronic products, are the components and the way they are assembled. Essentially, a Printed Circuit Board with components mounted on it is known as a printed circuit board assembly and this process of mounting components on the board is referred to as the PCB Assembly process. With the usage of PCBs becoming ubiquitous with increased usage of electronic products, it is important to understand the PCB Assembly process in detail.

The **Printed Circuit Board Assembly process** has a number of steps- some of these are automated and some are manual. Even before we get to the Assembly process, let us look at aspects of PCB design, types of PCB assemblies available and the component mounting technologies used.

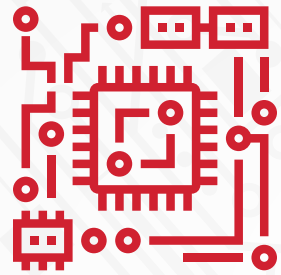
PCB Design

The basic unit of the PCB has a number of layers. These layers include:

- The base material of the PCB that gives the PCB its rigidity is known as the substrate
- On each side of the PCB is a copper layer
- Above the copper layer is the solder mask. Essentially, what it does is to insulate the copper traces. The solder mask is therefore responsible for smooth working of the PCBA as it ensures that the soldering does not happen on unwanted parts.
- The final layer on the PCB board is the silkscreen which adds labels and therefore indicates the function of the various components.

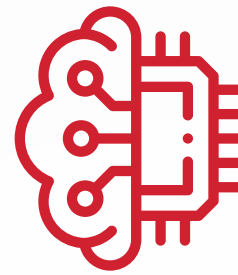


There are basically 3 types of Printed Circuit Board Assembly



Rigid PCBs

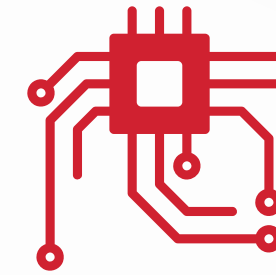
As the name indicates, these are inflexible PCBs. For such PCBs the base is made of materials such as FR4, epoxy or phenolics. There are also metal core PCBs. As the name suggests they are made of a metal core that spreads heat efficiently and therefore components that are heat sensitive, are protected.



Flexible PCB

Flexible PCBs offer more pliability than their rigid counterparts and therefore are of use in several applications.

- They offer greater connectivity
- They are known for their reduced weight
- They can absorb shocks and vibrations and are known for their durability
- They are resistant to environmental forces such as heat, chemicals and more.



Rigid PCBs

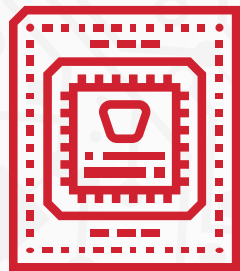
This is a hybrid design that essentially has the qualities of both rigid and flexible PCBs. Typically, these are multi layered with flexible circuit substrates joined with **rigid printed circuit boards**.

They find multiple applications such as:

- High-density applications
- Applications where there are 5 or more rigid boards.

When it comes to the component mounting technology for printed circuit board assembly,

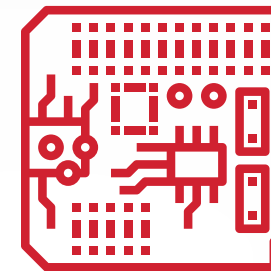
Two types of technologies find favour:



Surface Mount Technology

Electronic products are marked by complex circuitry. A large number of electronics are today manufactured thus with Surface Mount Technology. This is particularly useful for small, sensitive components such as resistors or diodes. The main advantages of surface mount technology include:

- It lends itself to automated production and soldering
- It is cost-effective
- It takes care of high component density
- It offers better performance when the environment is subject to vibrations.



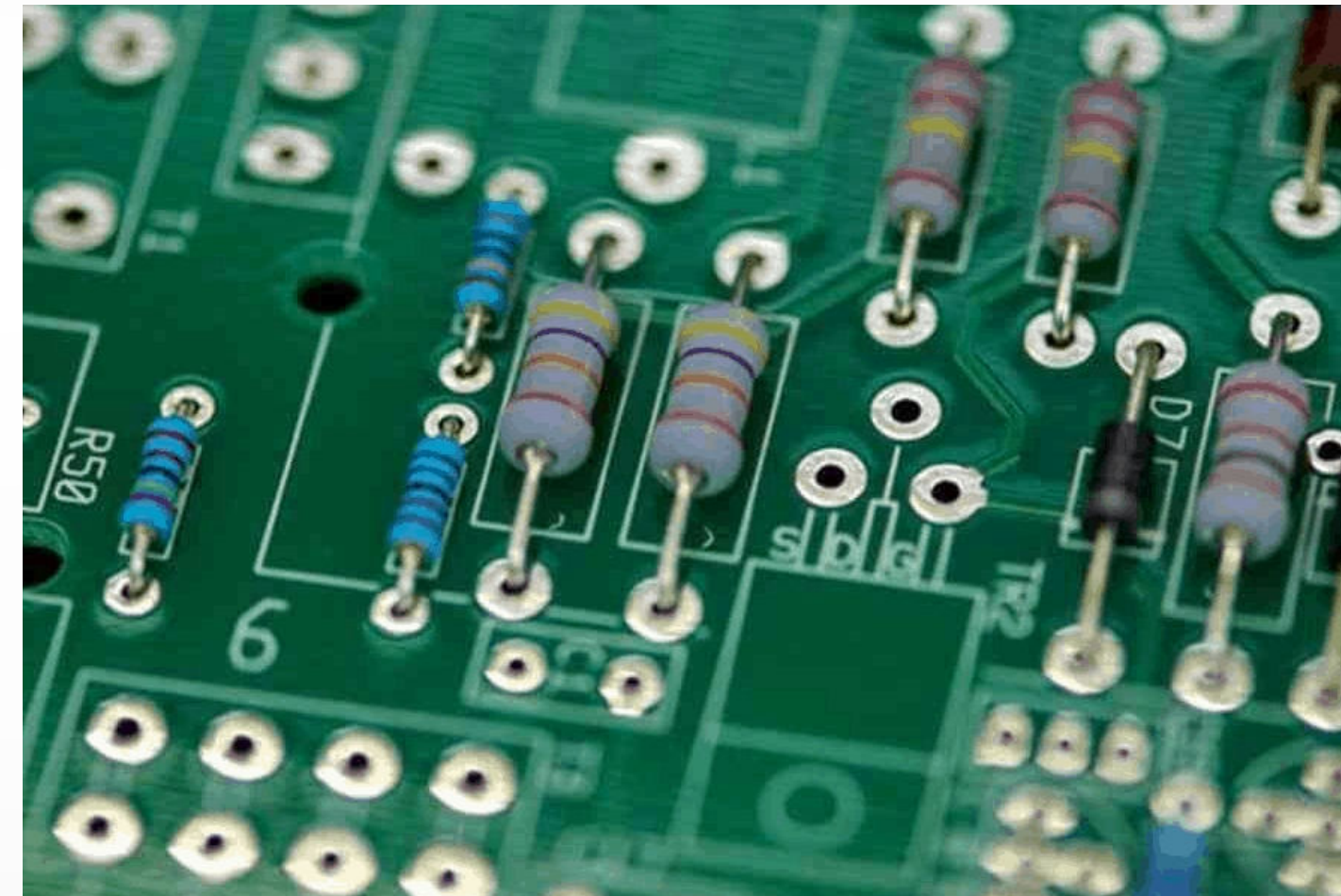
Through-hole technology

This is useful when components are to be mounted on the board through a process of plugging them through holes on the board. When there are large components, this technology is preferable. The other advantages that accrue with Through-hole technology include:

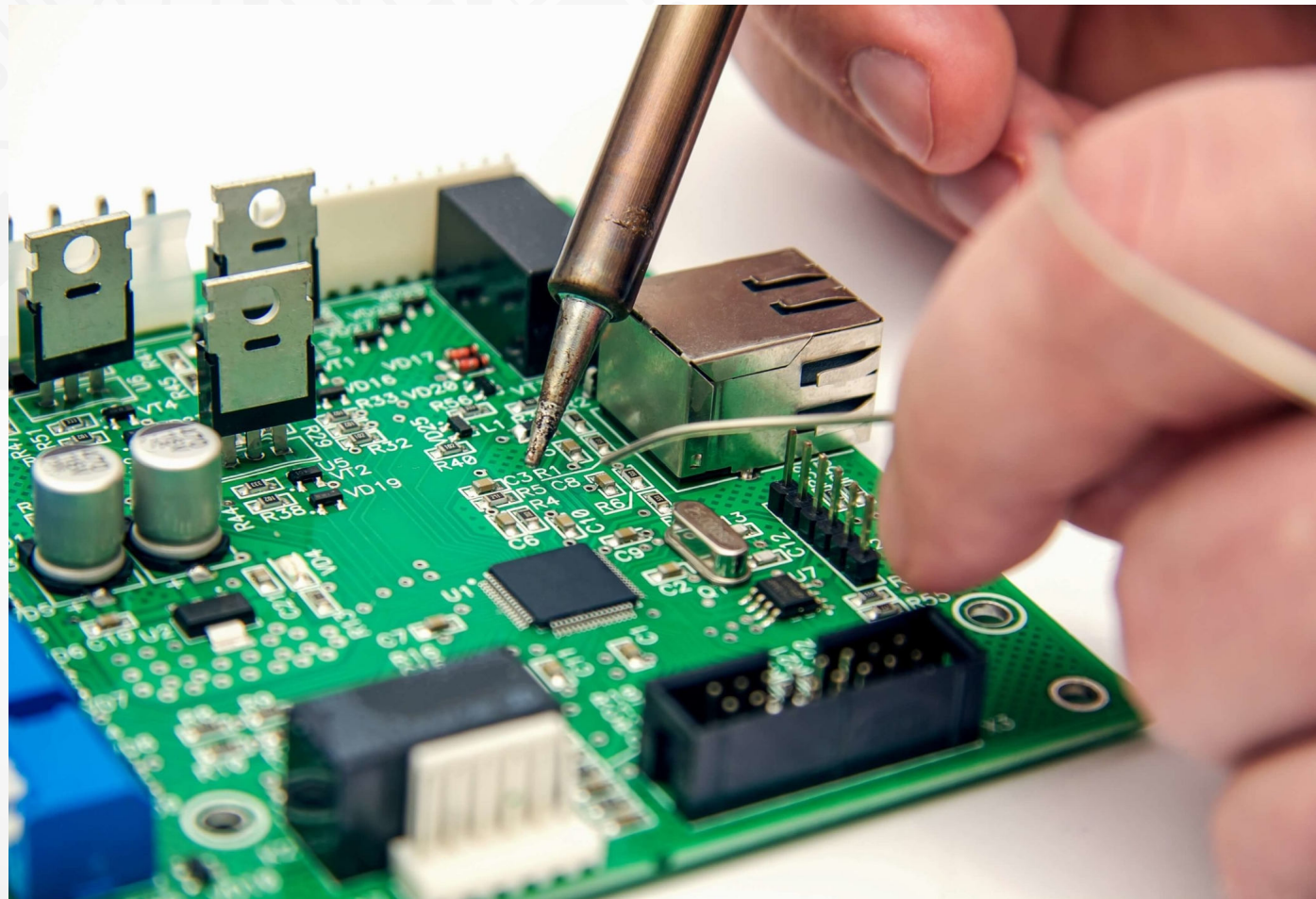
- It creates strong bonds between the components and the board. In applications like transformers, for example, where there is high heat, these work best.
- The components can be swapped out, so it lends itself to testing and to prototypes.

How to choose between SMT & Through-Hole Printed Circuit Board Assembly?

When you are dealing with complex boards with small parts and high density, SMT is largely preferred. For large components, applications that need to withstand heat, Through hole is the preferred choice. In many cases however, a combination of both may be the need of the hour.

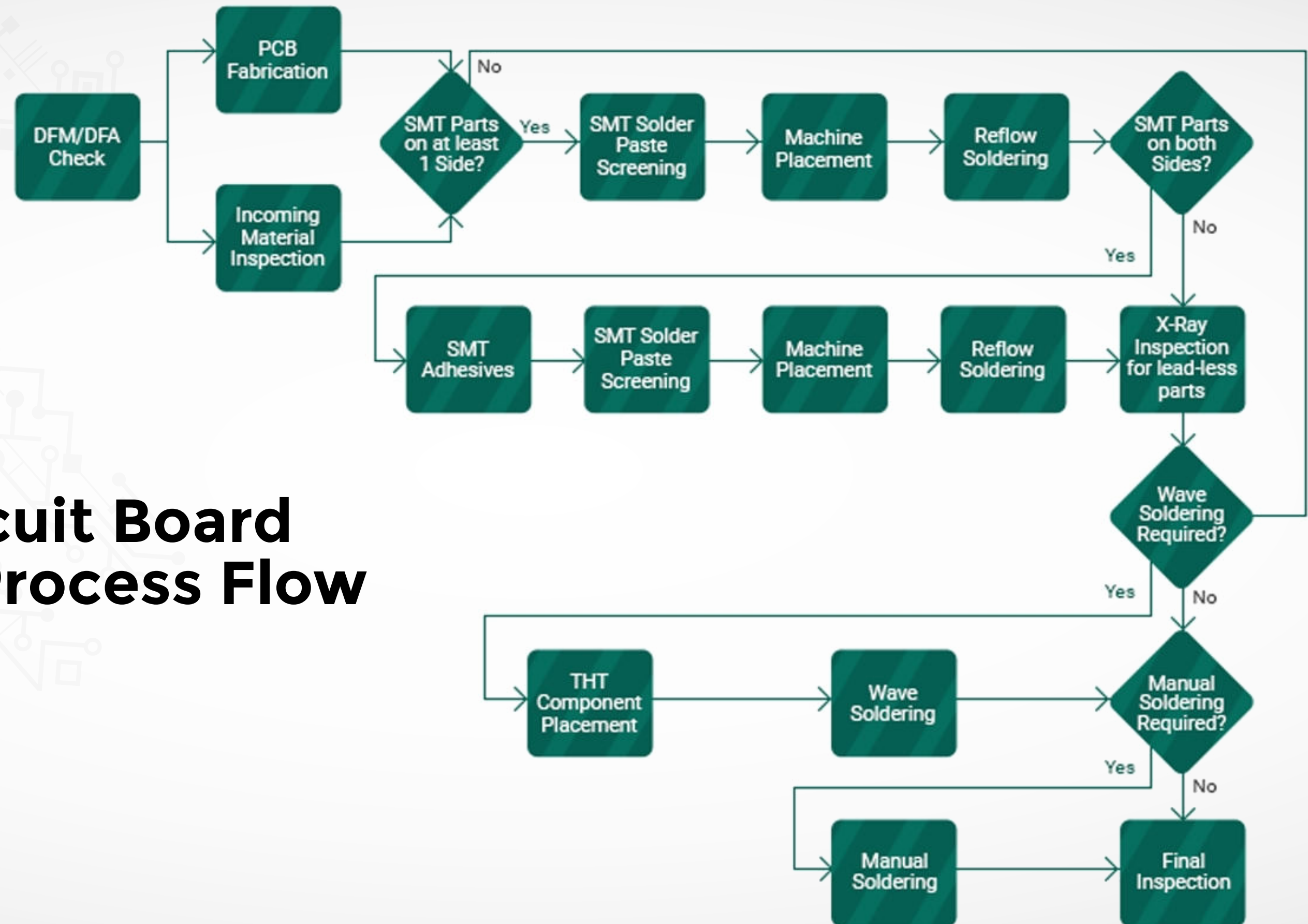


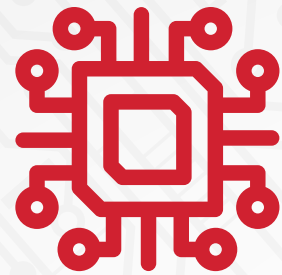
Preparatory Steps for Printed Circuit Board Assembly



Prior to the **Printed Circuit Board Assembly Process**, however, there need to be some preparatory steps. This largely includes assuring that the design of the PCB is right for which a Design for Manufacturability test is undertaken. This is to ensure that no operational issues are faced once the PCB is ready. A Design for Manufacturing check looks at the various design specifications, any missing features and more, which can impact the functionality of the PCB. For example, is the spacing between components too less, if so, if it not caught at the DFM stage, it could lead to short circuits at a later date. DFM can therefore go a long way in ensuring that costly errors are later avoided.

Printed Circuit Board Assembly Process Flow

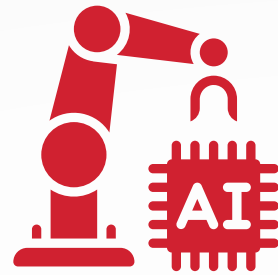




Solder Paste Stenciling

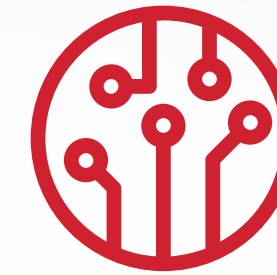
The first stage begins with the Solder Paste Stenciling. Essentially this means applying a solder paste on the board. A thin stencil is placed over the PCB, this allows the solder paste to be applied on certain parts of the PCB. Essentially, the solder paste is a mix of solder with the flux, which needs to be applied to the board at the correct places.

Once the stencil is removed, the solder paste remains in the exact location in which it was intended.



Pick and Place

The next step is what is known as Pick and Place. A robotic device now places the surface mount components on the printed circuit board. These are then soldered to the board. While earlier this process was manual, it is now automated that adds to precision and accuracy.



Reflow Soldering

This process ensures that the solder paste solidifies and that components are affixed to the board. Essentially, after pick and place the PCB board is moved to a conveyor belt. It is here that the board is heated to about 250 degrees Celsius, which melts the solder. Now it moves to cooler heaters where the solder cools and solidifies. This now connects the components to the printed circuit board.

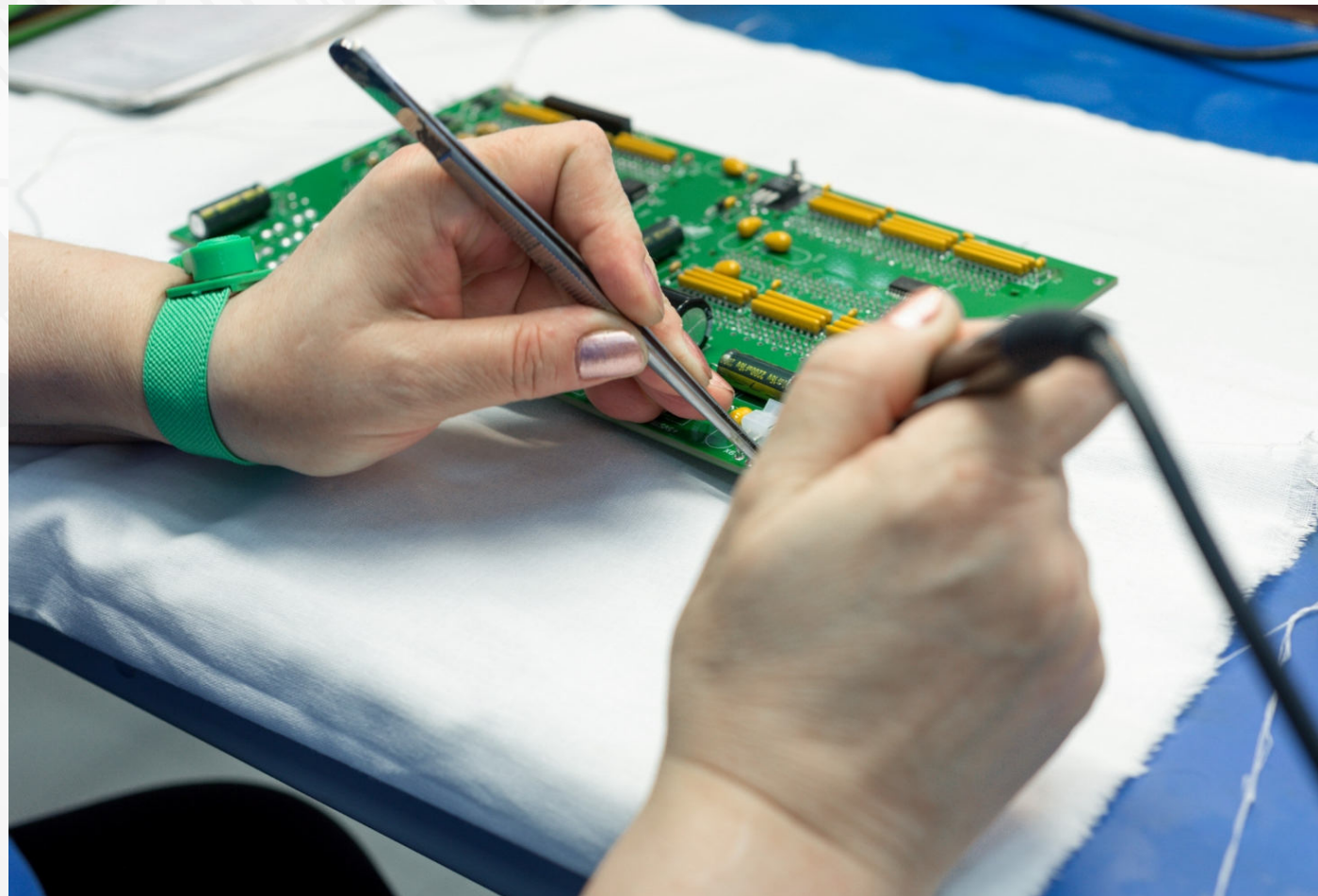
Quality Control

After this process, comes the very important process of inspection. It is important to check to see that the connection isn't poor and that there are no shorts as a result of misplaced components. There are a number of inspection methods that are in use. These include:

- Manual Inspection- This works well for small batches. However, when the number of boards increase, visual inspection becomes impractical
- AOI or Automatic Optical Inspection- This is suited for large batches where an AOI machine is used that has cameras at different angles. With different quality solders reflecting light in different ways, it is easy to identify the low-quality solder.
- X-Ray inspection- For layered PCBs, this method works well



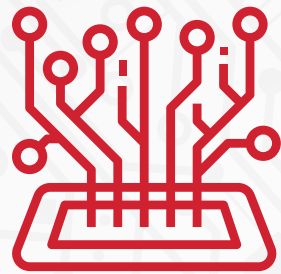
Functional Test



Post this comes the final inspection to test for functionality. With simulated signals running through the PCB at this stage, its electrical characteristics are tested.

This completes the PCB Assembly process. However, soldering can make the process messy. What is therefore extremely important, is to wash the product after the soldering process. For this, a high-pressure washing apparatus is used, where the PCB is washed in deionized water. Washing is then followed by a drying process which is then followed by packaging and shipment.

It is also important to note that there are some differences between THT Assembly, SMT Assembly and Mixed Technology Printed Circuit Board Assembly.

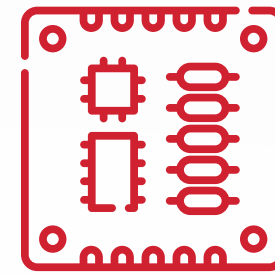


Through-Hole Components

The board also may contain a number of through-hole components, in which case these components require a special kind of soldering method.

This could be manual soldering where components will be inserted one at a time. The process can be lengthy depending on how many components there are.

There is also wave soldering which is an automated version. However, this isn't possible for double-sided PCBs.



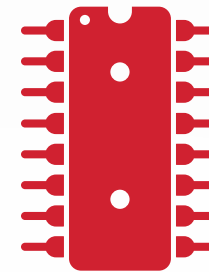
Through Hole Technology PCB Assembly Process

In this **Through Hole assembly** process the first step is that of component placement where components are placed manually conforming to a number of regulations regarding polarity and orientation of components. This is, then followed by a process of inspection. The last step is to do with wave soldering which involves the THT components to be accurately soldered onto the circuit board.



SMT PCB Assembly Process

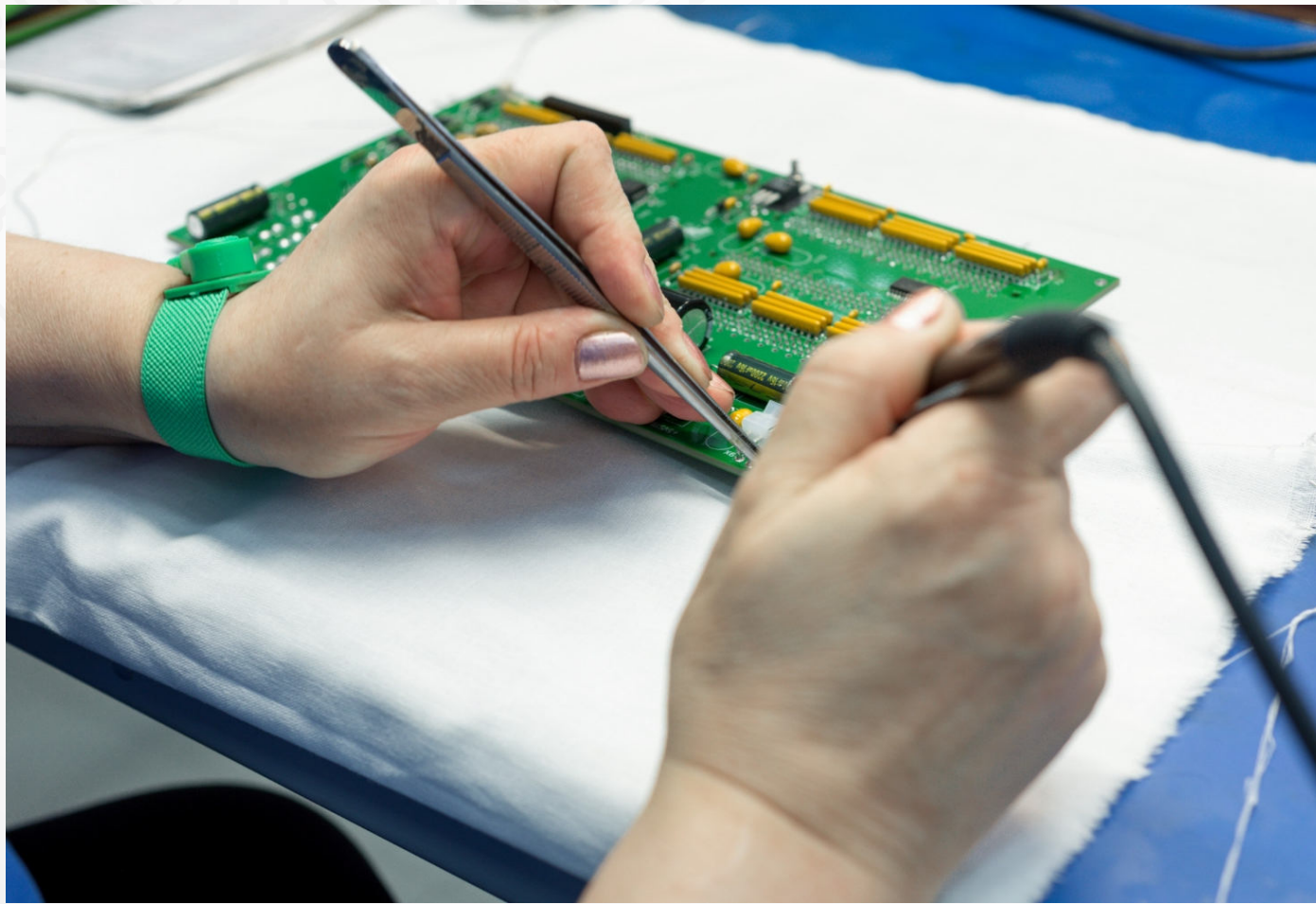
SMT Assembly process involves the steps of Solder Paste Printing where the solder paste is applied through a solder paste printer. This is then followed by mounting of components through an auto pick-and-place machine that sticks parts to the board. The final step is to do with reflow soldering which binds the components firmly to the board.



Mixed Technology Printed Circuit Board Assembly

With electronic products becoming increasingly complex and miniaturization becoming the order of the day, most boards have both Through-hole and SMD components. In such cases it is important to have a proper sequence in order. Hand soldering works well where there are many components on both sides and where SMD components are more. Where there are a small number of THT components, wave soldering is recommended.

Leading PCB Assembly Company



It is important to choose the right Printed Circuit Board Assembly (PCBA) USA who is technically sound and aware of all these nuances to do justice to your project. At Technotronix, we have over 4 decades of experience in both PCB fabrication and assembly. Our big advantage comes from our state-of-the-art equipment but also our experienced team of engineers who is equipped with the industry best-practices and ensures that you do not have to make any costly mistakes. In addition, our robust testing procedures ensure that what you get are reliable products. You can count on us for prototypes as well as large runs. With encouraging turnaround times, we are a go-to provider for clients across a wide variety of industries. In fact, a large body of clients who have complete faith in us, stands as the biggest testimony to our success.

Technotronix offers professional PCB Assembly services with 40 years of expertise. Our accurate PCB assembly process meets the quality standards, including ISO-9001:2015, RoHS, and more. You can rely on our PCB design tools that, in turn, lead to that perfect PCB Assembly. Our superior engineering capabilities mean that each board matches your exact requirements and technical specifications. In case if you have any questions, **Please feel free to contact us via email at sales@technotronix.us.**



If you have any questions regarding our PCB services, please contact us by calling or e-mailing us and we'll get back to you as soon as possible.

We look forward to hearing from you.

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