Tech Article

An Early PCB Cleaning Plan Leads to Manufacturing Success

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Industry: Electronics

Published:
Global SMT & Packaging

PCB designers are recognizing the benefit of specifying their cleaning choices earlier in the design process.

An early PCB cleaning plan helps produce better boards. Good PCB (printed circuit board) design practices are critical in order to deliver a board that performs as intended. When designing a PCB, there are many factors an engineer must consider. Everything from properly orienting the components on the PCB to carefully routing the signal traces to determining the best flux/paste mixture.

All must be planned before any PCB prototyping or production starts. However, cleaning is a critical aspect of PCB design that is often overlooked during initial planning.

Previously, some PCB designers didn't think about PCB cleaning until the very end of their project. Or, at least well into the process after important decisions about coatings, solder pastes and other materials had already been finalized. This left designers with an elegantly designed PCB, but also possibly one with flux residues which could not be removed. That resulted in a poor performing PCB that was susceptible to catastrophic field failures, disruptive product recalls and costly PCB returns. It also impacted production timelines and budgets as designers searched for a post-manufacturing cleaning fix that might work.

Recently though, more PCB designers are recognizing the benefit of specifying their cleaning choices earlier in the design process. With an early PCB cleaning plan, it is typically much easier to identify and resolve any cleaning problems prior to prototyping and production. This is especially true when manufacturing high-reliability PCBs such as in medical or military products where cleanliness is critical or validation is required. Therefore, some designers are proactively creating an early PCB cleaning plan. They are specifying cleaning details in the early stages of PCB design which helps them create clean, reliable boards using a trouble-free manufacturing process.

Early Cleaning Fluid Specification

As the electronics industry continues to use smaller PCBs filled with tightly packed components, they become more difficult to clean. Reductions in pitch between conductors along with the increased use of leadless and bottom termination components increase the probability that contamination like flux residue gets trapped on the PCB. If the contamination isn't cleaned, especially hard-to-clean white residue left behind from no-clean fluxes, the risk of the board malfunction is high.

If a conformal coating is used, trapped moisture absorbed by the flux residue may be released during curing operations, causing the conformal coating to separate from the board. This can allow corrosive materials, dust, or water to penetrate the PCB causing corrosion, signal transmission problems, or even complete component failure. Therefore, it is important for the PCB designer to choose an appropriate flux remover to clean any residue from the boards.

Choosing a Cleaning Fluid and Method

Choosing the right cleaning fluid and method is important as it ultimately contributes to the functionality and reliability of the board. PCB components can be loosened, connections can be broken and substrates can be damaged

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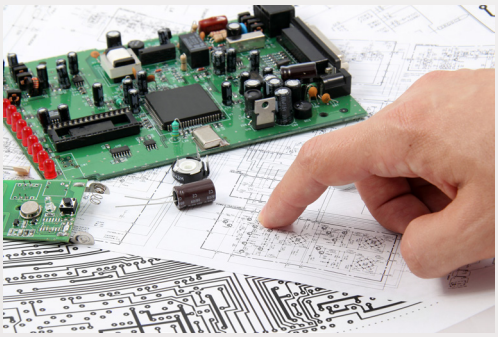
Small batch testing prevents possible headaches during full production.



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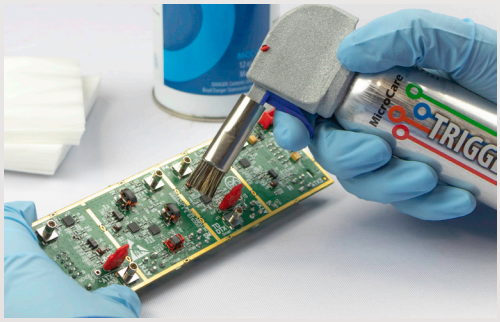

Field engineers can recommend the best cleaning fluid and tools for successful PCB cleaning.

if the wrong cleaning fluid or inappropriate cleaning method is used. For example, a cleaning fluid with a very high cleaning strength may potentially attack plastics or other soft materials on the PCB. Or a high-pressure spray used to clean under tight-fitting components could possibly knock delicate components out of alignment.

To avoid PCB damage, the cleaning fluid should be compatible with all materials on the board. The cleaner should be strong enough to effectively remove the flux residue, yet not cause damage to plastics or coatings. Designers should also match the cleaning fluid to the contaminant to be removed, whether it is flux residue, marking inks, dust or fingerprint oils. Since “like cleans like” (or in other words, solvents with polarity clean polar contaminants) it is critical to choose a contaminant-matching cleaning fluid to get the PCB perfectly clean.

Pre-testing Prevents Headaches

Choosing a flux and solder paste early in the design process only to discover later that they can’t be cleaned is a problem. Therefore, early pre-testing is recommended. Test cleaning gives a designer insight as to how their choices of pastes, fluxes and cleaners impact the performance of the board.

Some designers recognize the benefit of test-cleaning in small batches prior to full-scale manufacturing. They find it beneficial to produce and clean a limited run of PCBs first, ensuring cleanliness before going into full production mode. Once the cleaning fluid and process are proven to work on a smaller scale, then they ramp up to the higher volumes they need. Through small-batch preemptive testing, they are minimizing surprises and ensuring better board reliability before it becomes a major headache.

Some design engineers can do their own cleanliness testing in-house. For those who do not have testing capabilities, they can out-source their cleanliness testing. There are a number of reputable companies that conduct comprehensive cleaning trials using designer-supplied, real-world PCBs and contaminants, not just test coupons. The cleaning evaluations are conducted to the cleanliness standards specified by the PCB designer whether it be simple visual testing or strict IPC-610 requirements. The methodical testing results produced in a lab are verified and documented to validate the cleaning process. Pre-testing also helps with production planning by predicting and verifying expected outcomes.

A Consultative Approach with Cleaning Experts

Designers looking for help with their early PCB cleaning plan should consult with a critical cleaning partner that specializes in collaboration and cooperative problem-solving. By inviting chemists and cleaning experts to join them at the research stage, designers can avoid unexpected issues, reduce costs, ensure PCB reliability and deliver their finished product faster. Here is what to look for in a vendor partner.

- **On-site Technical Expertise:**
  Look for a supplier with technical expertise in cleaning a variety of PCB substrates using a variety of cleaning methods including both benchtop

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and vapor degreasing. The experts can perform on-site cleaning audits to determine the substrate(s) used and the contamination to be removed. They can suggest which cleaning tools, methods and fluids will work best.

- **Ongoing Field Support:**
  Choose a vendor that supports PCB designers throughout each phase of the process from research and design to testing and manufacturing. They can identify and solve potential cleaning problems well before the PCBs are manufactured.

- **Cleaning Lab:**
  Some companies can conduct in-lab cleaning tests to match the cleaning fluid to the flux and paste contaminants. This ensures the PCBs are clean and will function properly.

Conclusion

When designing a PCB, cleanliness is a factor that designers must consider to ensure long-term PCB performance, functionality and reliability. It is recommended that they select cleaning fluids and methods early is the design process since it is easier to resolve cleaning problems before manufacturing begins. This helps reduce unforeseen problems including rework and scrapped boards.

Designers should partner with a cleaning expert to select the best cleaning methods and fluids. It will help prevent production delays, improve product quality and positively improve the bottom line.

About the Author:
Emily Peck is a Senior Chemist at MicroCare which offers benchtop and vapor degreasing critical cleaning solutions. She has been in the industry more than 6 years and holds a MS in Chemistry from Tufts University. Peck researches, develops and tests cleaning-related products that are used on a daily basis in electronics, medical, fiber optic and precision cleaning applications.
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