

UL certification: the route to the US market

By Jim Armstrong, Microtek Laboratories, Inc., USA

If you are an electronics or PCB manufacturer who plans to sell products in the United States now or in the future, then you should be familiar with the process of getting your products UL tested and listed.

What is UL?

Underwriters Laboratories Inc. (UL) is an independent, not-for-profit product safety testing and certification organization, which has been testing products for public safety for over a century. Each year, more than 14 billion UL marks are applied to products worldwide.

Since its founding in 1894, UL has held the undisputed reputation as the leader in US product safety and certification and is becoming one of the best-recognized conformity assessment providers in the world.

UL has five testing laboratories in the United States. It also has several representative offices and affiliate agencies, as well as certified agencies, of which Microtek Labs is one. It is represented further afield by field representatives located throughout the world.

Why is UL certification necessary?

Electrical and electronic items sold within the United States must meet the US National Electrical Code (NEC) as well as various city, county and state electrical codes. In order to comply with these codes, electrical and electronic products must be "listed" as being compliant by an "authority having jurisdiction to identify a listed product". UL has been recognised as the 'de-facto' authority for listing products as compliant to the US electrical codes, and electrical inspectors and US customs agents look for the UL mark as a demonstration of this compliance. UL has developed a variety of "end product" standards to deal with listings and special requirements for different types of finished products. Each of these end product standards flows down requirements for components and parts used in the end product. For printed circuit boards and materials the standards for "part level" compliance can be found in the UL 746 series, UL 796, & UL 94 documents. It is often difficult for the board manu-

Si vous êtes un producteur électronique ou de C.I. qui songe à vendre ses produits aux USA alors vous devez devenir familier avec le fait d'avoir vos produits UL testés et catalogués. Cet article décrit les démarches à accomplir et comment faire pour éviter les pièges qui pourraient ralentir le procédé d'approbation.



Als Hersteller von Leiterplatten oder Elektronikgeräten, der seine Produkte heute oder in naher Zukunft in den USA absetzen möchte, sollten Sie mit dem Prüfprozess ihrer Produkte gemäss UL-Normen vertraut sein. Dieser Artikel beschreibt Schritt für Schritt, wie Sie ohne unnötige Verzögerungen zu einer UL-Zulassung gelangen können.



Se sei un produttore di C.S. che progetta di vendere negli Stati Uniti, oggi o nel futuro, devi avere familiarità con il processo UL, che testa e approva i tuoi prodotti. Questo articolo illustra il comportamento da seguire per evitare un eventuale passo falso che allungherebbe il processo di approvazione.



ABSTRACT

factor to determine which "end product" specification their customer is working to (i.e. UL 1950, etc.). Most PCB and material manufacturers therefore aim for the most stringent levels of possible UL product listing to cover all of their customers requirements regardless of which end-product specification they are working to.

The approval process (or short cuts in a long road)

Like most worthwhile things, the road towards UL certification can be shortened by following the “unpublished” road map that exists. This article briefly highlights the steps that can reduce detours and smooth out some of the bumps along the way.

Understanding how UL’s testing services are organised

UL’s Engineering Services division is organised into sections that evaluate specific types of products. Examining how products are constructed, conducting tests, evaluating results and developing safety standards for products are a few of UL’s responsibilities. UL also has field representatives who visit manufacturers’ facilities and perform “follow-up” services. They help confirm that products bearing the UL mark comply with applicable UL safety requirements.

Like most worthwhile things, the road towards UL certification can be shortened by following the “unpublished” road map.

When should a product be submitted?

Ideally, a product should be submitted as early as possible during its development. Often, a preliminary evaluation can be conducted to help identify areas needing change or rework. Although this is not a substitute for a complete UL investigation, and it does not authorise the use of the UL mark, it can reduce overall costs.

A preliminary evaluation can be completed quickly at one of UL’s laboratories or by a client agency facility such as Microtek Labs.

Client agents typically have extensive experience in the product categories for which they are agents, and will have developed relationships with the UL’s engineers, facilitating the speed, accuracy and understanding of the product approval process.

How to begin the submittal process

Contact one of UL’s client agents for assistance. They typically have extensive experience in the product categories for which they are agents, and will have developed relationships with the UL’s engineers, facilitating the speed, accuracy and understanding of the product approval process. Particularly important for companies that do not have a resident UL expert, the agent serves as liaison between the company and UL, and can answer general questions about UL’s services, identify the right engineering staff and work with UL management to resolve problems and the manufacturer’s concerns.

UL regards your file to be a private matter between your company and UL, and will not discuss any details of your file with non-company personnel without written authorisation via an Agent Authorisation Form (available from your agent).

This authorisation can be as limited as you wish and you may choose any agent you want.

Know your UL file!

If you have a UL file, read it and become familiar with it. This contains information on your process flow as well as specific material and process

limits, which may not correspond with the processes and materials you are currently using. File revisions are typically used to add new products in response to a particular customer need (new laminates, prepregs or solder masks). In doing this it is easy to forget modifications to your processing parameters. To save on costs, such modifications can usually be combined with other UL projects.

How much testing will it take?

Everyone wants to know how much testing will be necessary to accomplish a particular file update. When you submit your project request, the UL project engineer will determine what testing (if any) will be required. As for almost everything else, how you ask is almost as important as what you ask for, and an agent or someone experienced with UL can make all the difference. UL 796 defines the UL testing and acceptance requirements for PCBs. This includes a section titled “Variations in Printed Wiring Board Construction” which contains several tables that define the test program for specific types of file revisions. Another helpful document, IPC-A-22, published by the IPC, shows the same UL tables with recommendations on how to construct the test coupons for maximum effectiveness.

As for almost everything else, how you ask is almost as important as what you ask for, and an agent or someone experienced with UL can make all the difference.

The IPC-A-22 also includes the artwork (Gerber Files) necessary for UL testing, and can be adjusted to your specific needs.

Contacting UL

UL has several facilities in the United States with engineering departments and testing laboratories. Any correspondence with UL regarding your file should contain the name of the project engineer who was last involved in a project for your company along with your file number, which is what UL uses to identify your company.

If you are going to use the direct approach rather than going through a client agent, you should contact your UL project engineer personally. The personal touch, as with all business dealings, can make the difference between complete and limited success. UL makes extensive use of e-mail, but nothing works better than a phone call directly to the project engineer. It is important to follow up conversations with a letter confirming the discussions and decisions made during any verbal contact with UL personnel.

Your correspondence should consist of a concise letter to your project engineer asking for project initiation, and explaining your desired file changes. If you will be requiring sample aging (per the UL 796 charts) you should explicitly request that both 10- and 56-day testing be conducted concurrently. This strategy can save a tremendous amount of time should your 10-day test samples fail.

This is because the 10-day test is conducted at a much higher temperature than the 56-day test, and often fails. In this case, UL will simply discard the results of the 10-day and continue with the 56-day test without loss of time. If the 10-day test passes, the 56-day test will then be terminated.

What will UL's response be?

UL will respond to you in writing with a project application that defines the scope of the project and the UL costs

It's surprising how some companies overlook UL certification due to a lack of understanding of the process and more importantly, of the benefits it will bring.

you will incur to complete your file change. If test samples are required, they will specify both type and quantity of coupons for each. There are typically several ways to construct a multilayer package, and it would be best to use previously submitted constructions (if applicable), or use some of the helpful multilayer construction information found in the IPC-A-22 document. Review any letters from UL carefully to be sure that everything requested was addressed. If the samples requested are not what you expected, do not hesitate to contact the engineer for clarification. This initial process will define the scope of your program as well as how it will be listed in your file, and it is very important that everything be right at this stage of the game. You will also receive a follow-up services agreement that you must sign and return to be considered for UL recognition. Up to 4 times a year a UL follow-up services engineer will come to your facility, review your manufacturing process and sample marking, and then pick samples from your production to be tested at one of UL's facilities, to ensure that your product continues to meet the UL requirements. Of course the cost of this is passed on to you so be prepared!

Making test samples

Sample constructions must satisfy the pattern and material limits of the standard. Although UL 796 explains basic construction techniques, IPC-A-22 details several approaches to combining limits including how to mini-

mise the variety of constructions, and is well worth looking at. IPC-A-22 also contains a generic artwork pattern that may need to be modified to adjust for your needs.

Always make plenty of samples (2-3 x what UL requests). This gives you backup samples in case the coupons get lost, ovens overheat, or other unforeseen things happen. A few extra panels up front will provide you cheap insurance just in case.

Delamination

These coupons are comprised of solid round metal patterns (5mm, 7.5mm, 10mm in diameter) on both external layers along with the inner 2 layers of the multilayer.

The rating for a 4-layer coupon will extend the processing of 3 to x number of layers. The external layers must be plated as per plated through hole constructions.

Bond or peel strength

Test coupons must be made with the same laminate/prepreg constructions as the delamination coupons. The geometry of the peel coupons is defined in UL 796.

UL will typically request uncoated coupons plus coupons coated with one or two of your "recognised" solder masks.

Flammability

These must also be made from the same laminate/prepreg constructions as the delamination coupons. There must be no metal in these samples, and UL will typically request uncoated coupons plus coupons coated with one or two of your "recognised" solder masks.

Submitting your test coupons

Prior to submission to UL, it is a good idea to inspect the samples to ensure

that they do not have lifted conductors, scratched plating, voids or delamination. Ensure that the samples are the right size and that the edges are smooth. Identify your samples with your company name, UL file number, project number and type designation. UL usually requires that test samples be submitted along with the signed project application form and any requested payments.

It is also a good idea to include a short letter with the samples. You should copy this to the UL project engineer, and then via E-mail or a phone call, let him/her know that the samples have been shipped.

Remember that communication is key to a successful project.

What happens during testing

Unfortunately failures do occur. Don't be surprised that despite your good planning, close attention to detail and high quality materials, your samples fail. If this happens, ask for the failed test coupons back in order to determine why they failed.

Bond and peel strength failures are fairly rare, while delamination failures during the 10-day test are not uncommon.

For FR-4 materials a 94 V-0 flammability rating is expected while a 94 V-1 rating is typical for most other materials. Sample preparation, material thickness, solder mask and testing procedure can affect ratings.

If failures prevent UL approval of the file changes, the UL project engineer

will give you two options:

- Resubmit coupons for a retest (this is when those extra samples come in handy)
- Accept a lower level of approval (if applicable).

A client agent can be extremely valuable to you at this point. Failure analysis, test record review and negotiated results by an expert can get you back on track with a minimum amount of inconvenience, cost and delay.

What you can expect after testing

Once testing is completed, the UL project engineer will develop a formal report based on the test results. The engineer will then develop specific guidelines for the follow-up services program.

This document describes in detail the construction(s) and process flow of the product(s) listed and is intended to help the field engineers when they visit your facility. If, for some reason, your product doesn't meet UL's requirements, you will receive a letter explaining where it failed. If you choose to modify the product and want it retested, you should contact the UL engineering staff who originally tested the product.

The benefits outweigh the process (and the paperwork)

Imagine you are a jelly bean manufacturer who is restricted to offering multi-flavoured, rainbow coloured, coated candied delights to children in

Europe simply because you are unfamiliar with the process of getting certified by the biggest jelly-belly taste tester in the US.

Sounds silly, but it's surprising how some companies overlook the benefits of UL certification due to a lack of understanding of the process and more importantly, the benefits of UL certification.

Competitive advantage

The US market for PCBs and electronic products is too large to be ignored in today's global economy. Although UL listing of your product can be a daunting and expensive process, it opens the door to the US portion of the global market. ✓

Information request no. 1703

ERRATA CORRIGE

We apologise to our readers and to Morton Electronics Materials for the printing error which appeared in issue no. 15 (May/June) of Printed Circuit Europe, and for any confusion this may have caused. The article, which opened the special "Focus On" feature on High Density Interconnect, and which can be found on pages 47 - 49 of that issue, discussed how Morton and other suppliers to the PCB industry can contribute to the success of PCB manufacturers as they move into high density PCB production. In several cases, typical and potential line and space and via dimension were given. In some cases, the unit printed after the measurement was given wrongly as "mm" and "µ" instead of the correct version, "µm". The fault lies entirely with Printed Circuit Europe and we apologise for any confusion this may have caused.

Morton's new "Packaging Resist" is therefore capable of processing features with a finished size of 10µm lines and spaces in laboratory conditions, allowing PCB manufacturers to demonstrate 25µm capability, and produce prototypes at 37.5µm.

For further information on how a leading PCB materials and equipment supplier can help in achieving high density fine line PCB production, fill in the faxback form in this issue, quoting no. 1749

Microtek Labs has been serving the requirements of the materials, PCB and electronics industries for over 14 years. Microtek Labs is an ISO 9002 registered, IECQ approved, and DSCC recognised test facility and is now also a certified UL client agent.

The staff of Microtek Laboratories has taken a leading role in developing IPC, IEC, UL and DOD standards.