



Benefits of UL Certification

UL認証の利点

2015 JPCA UL Forum

June 5 2015

Objectives 目的

UL Background 背景

Demand Driver for PWB Certification PWB認証の必要性

2015 STP Topics 2015 STPトピック

New PWB Services 新しいPWBサービス

PWB Information for Submittal 申請に必要なPWB情報

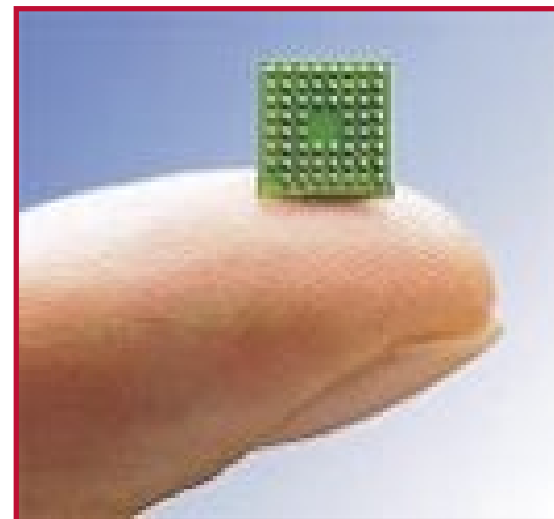


Global Electronics PWB Migration

世界的なエレクトロニクスPWBの遷移

Industry wants PWBs to be

- Smaller より小さく
- Cheaper より安く
- Environmentally friendly 環境にやさしく
 - Lead-free and halogen-free 鉛フリーやハロゲンフリー

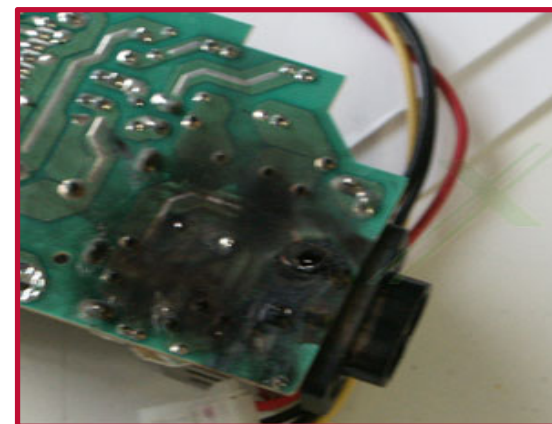


OEMs turning to

- Unique rigid PWB constructions ユニークなリジッドPWB構造
- Flexible PWBs フレキPWB

Are the new constructions safe?

新しいPWB構造は安全か？



Demand Driver for UL's PWB Program

UL PWBプログラム必要性

- Driven by end product safety concerns: 最終製品の安全性において
 - Fire 発火
 - Electric Shock 感電
 - Personal Injury 負傷
 - Environmental Hazards 環境危険性
- Characterize the behavior of the PWBs: PWBの挙動を特徴づけ
 - Physical, electrical, flammability, thermal 物理的、化学的、難燃性、温度
- Used as guidance for end product safety design:
最終製品の安全設計のガイドとして使用
 - Material manufacturer, PWB fabricator, end product manufacturer
材料工場、PWB製造者、最終製品工場



Why UL Certification for PWBs?

なぜPWBにUL認証か？

Certification is driven by end-product hazards and requirements

認証は最終製品の危険性と要求によって必要となる

- PWB safety hazards caused by the potential failure mechanisms

PWBの安全上の危険性は潜在的な故障メカニズムに起因する

- Many end-product Standards require UL Recognized PWBs,

多くの最終製品の規格ではUL認証のPWBが要求されている

for example:

- IEC 60950 (Information Technology Equipment)
- IEC 60601 (Medical Equipment)
- IEC 60065 (Audio & Video Equipment)
- IEC 60335 (Appliances)
- IEC 62368 (ITE and Audio/Video Equipment)
- IEC 61010 (Equipment for Laboratory Use)



Requirements & Standards 要求事項と規格



Components コンポーネント			End Product Requirements 最終製品の要求事項	
Plastics	Laminates/ Coatings	PCBs		
<ul style="list-style-type: none"> UL 94 UL 746A QMFZ2 	<ul style="list-style-type: none"> UL 94 UL 746E QMTS2, QMJU2 	<ul style="list-style-type: none"> UL 796 UL 796F ZPMV2 ZPXK2 ZPVI2 	<ul style="list-style-type: none"> IEC 60950 IEC 60065 IEC 62368 IEC 60601 IEC 60335 IEC 61010 	<ul style="list-style-type: none"> Information Technology Equipment Audio & Video Equipment ITE and Audio/Video Equipment Medical Equipment Appliances Equipment for Laboratory Use



Why UL Certification for PWBs?

なぜPWBにUL認証か？

- Certification is driven by end-product requirements
認証は最終製品の要求によって必要となる
 - Using Recognized materials and components can significantly reduce testing
UL認証材料を使用することによって試験点数が大幅に削減できる

Many end-product Standards require UL Recognized PWBs,
多くの最終製品の規格ではUL認証のPWBが要求されている

for example:

Product	SELV, LPS below 15VA	SELV, LPS above 15VA	SELV, Non- LPS	Non-LPS with hazardous Voltages
ITE, Audio/Video IEC 60950-1, IEC 60065, IEC 62638	Min. HB under ZPMV2 *	Min. V-1 under ZPMV2 *	Min. V-1, MOT under ZPMV2 *	Min. V-1, MOT under ZPMV2 - multilayer, coatings, spacings, etc. could add other end-product testing requirements*

* The actual ratings required will be dependant on the end-product and how the PCB will be employed; always check with the end-product manufacturer what ratings they actually need the PCB to achieve!

*実際に必要な定格は、最終製品とPCBがどのように使用されるかによる。必ず最終製品工場にPCBに必要な定格を確認！



Benefits of UL PWB Recognition

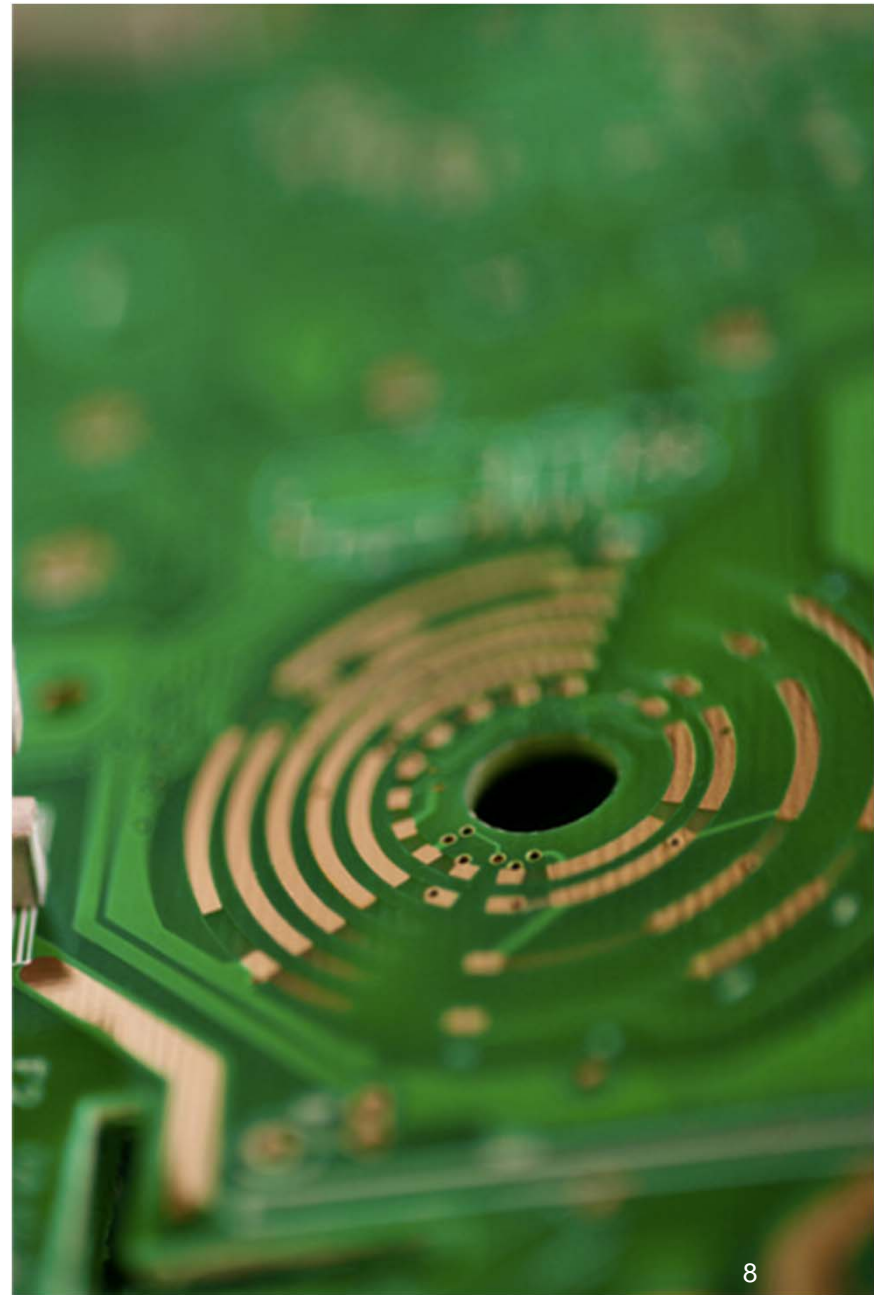
PWB認証の利点

- PWBs covered by UL's Component Recognition Program

UL部品認証プログラムでカバーされるPWB

- Type Testing 認証タイプ別試験
 - Confident that PWB complies 安全確信
 - Pre-selection allows for less testing
事前選択による 試験点数削減
 - UL Recognized PWBs used Globally
世界で使用
- On-going compliance FUS
FUS検査による信頼性の継続
 - Audit during production 工場検査

 Ongoing confidence the component complies 安全性の継続的な確認



UL PWB Certification

UL PWB認証

- Basic Service for PWBs is Safety certification

PWBの基本サービスは安全認証

- UL Mark demonstrates PWB certification ULマークはPWB認証を表す
- UL PWB program accepted internationally ULPWBプログラムは国際的に認識

- PWB Certification Options PWB認証オプション

- Full Recognition – MOT and Flame rating フル認証 – MOTと燃焼定格
- Flame only – Flame rating only 燃焼のみ認証 – 燃焼定格のみ
- Materials (QMTS2 or QMJU2) ≠ PWBs (ZPMV2) PWB材料認証 ≠ PWB認証

- UL iQ Database for PWBs (not the same as IDES)

- Intended for end-product, PWB mfrs, and EMS (Electronic Manufacturing Services) 最終製品、PWB工場、EMS用
- Database includes Rigid and Flexible PWBs, Laminates and Coatings
Rigid PWB, フレキPWB及びPWB基材、コーティングが登録

- Enables searching by UL ratings, company name, type designation and UL File Number UL定格、社名、タイプ名、ファイル番号で検索可能





UL[®] IQ for Printed Wiring Boards

ome

Introduction

Help

Contact Us

SEARCH:

Company

Parametric

Type Dsg

Tradename

File Number

Welcome to UL's IQ for Printed Wiring Boards Database

UL's IQ for Printed Wiring Boards includes materials covered under the following categories

Printed Wiring Boards

Component - Printed Wiring Boards - (ZPMV2)

This category covers printed wiring boards for use as components in devices or appliances. The boards may use organic or inorganic base materials in a single or multilayer, rigid or flexible form. Circuitry construction may include etched, die stamped, precut, flush press, additive, and plated conductor techniques. Printed-component parts may be used.

Laminates

Component - Laminates - (OMTS2)

This category covers materials that have been tested in accordance with established methods to define their properties in order to facilitate construction. The constructions may use flexible materials in a single or multilayer build-up and in combination with additional flexible or rigid materials. These materials may consist of filament-wound tubing, industrial laminates, vulcanized fibre, and other materials for use in fabricating Rect

FMIC Flex PWB's

Component - Flexible Printed Wiring Boards - (ZPXK2)

This category covers printed wiring construction incorporating flexible materials for use as components in devices or appliances. Flexible materials may be used in a single or multilayer build-up and in combination with additional flexible or rigid materials. The constructions may use flexible materials in a single or multilayer build-up and in combination with additional flexible or rigid materials. These materials may consist of filament-wound tubing, industrial laminates, vulcanized fibre, and other materials for use in fabricating Rect

PWB Coatings

Component - Coatings for use on Printed Wiring Boards - (OMJU2)


This category covers permanent coatings for use on Recognized printed wiring boards. These coatings may consist of solder resists (sol



The materials covered in this database are incomplete in certain constructional features or restricted in performance capabilities and are intended for use in investigation rather than for direct separate installation in the field. THE FINAL ACCEPTANCE OF THE COMPONENT IS DEPENDENT UPON ITS INSTALLATION BY THE USER.

UNDERWRITERS LABORATORIES INC.

Home



**Underwriters
Laboratories**

UL*iQ*™ for Printed Wiring Boards

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Introduction
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SEARCH:

Company

Parametric

Type Dsg

Tradename

File Number

Search for :

Printed Wiring Boards
▼

Construction Type: <input type="text" value="n/a"/>	Company Name: <input type="text"/>	Country: <input type="text" value="n/a"/>
Flame Class <input type="radio"/> equal to <input type="text" value="n/a"/>	<input type="radio"/> single sided <input type="radio"/> double or single sided	Conductor Attributes
Max Operating Temperature (C): <input type="text" value="n/a"/>	Max Solder Temp (C): <input type="text"/>	Min Width <input type="text"/> mm
Comparative Tracking Index (CTI): <input type="text" value="n/a"/>	Solder Time (sec): <input type="text"/>	Min Edge <input type="text"/> mm
Meets UL796 DSR <input type="text" value="n/a"/>	<input type="checkbox"/> show multiple solder limit types only	Max Area Diam <input type="text"/> mm
<input type="checkbox"/> additionally certified in accordance with Canadian National requirements		Min Ext Thk <input type="text"/> mic
		Max Int Thk <input type="text"/> mic
		Max Ext Thk <input type="text"/> mic

*Triangle symbol is marked on those products within a given type designation that comply with direct support of current-carrying parts performance level requirements of UL 796. "AI" is used to indicate that all base materials under that type designation comply with direct support of current-carrying parts performance level requirements of UL 796.



2015 STP Topics

UL's Collaborative Standards Development System (CSDS)

をご参照ください

<http://csds.ul.com/Home/Default.aspx>

STP 796 and 746E

1. Report for the Addition of Requirements for the Thin Core PWB Program for UL 796
2. Report for the Clarification of Requirements for Solder Limit Evaluation for Laminates and PWBs for UL 746E and UL 796
3. Report for the Revision of UL 796 to Comply with the Requirements of the Style Manual for UL Standards for Safety
4. Report on the Status of the Proposals For UL 746E Dated September 17, 2014
5. Report on the Status of the Proposals For UL 796 Dated October 17, 2014
6. Discussion of the Addition of 150° C RTI Laminate ANSI Grades to Section 7 of UL 746E
7. Discussion of XRF Testing for ZnCl Analysis of Vulcanized Fibres to Section 13 of UL 746E
8. Proposal to Add a Tolerance to the 24-Hour Alternate Flame Conditioning Test Described in Paragraph 4.3 of UL 746E
9. Proposal to Add ANSI Grade Definition of Type CEM-3 With Filler to Table 7.4 and in New Paragraph 7.7.7 of UL 746E
10. Proposal to Revise Paragraph 10.3.4 of UL 746E to Clarify the Intent of the Exception to Paragraph 10.2.1.3



STP 796 and 746E (continued)

- 11. Proposal to Replace References to Type FR-4 Material in Various Requirements of UL 746E with References to Type FR-4.0 and/or FR-4.1 Material**
- 12. Proposal to Clarify Requirements For Additional Adhesive Tests in Paragraphs 17.11.1 and 17.11.2 of UL 746E**
- 13. Proposal to Clarify the Test Sample Requirements for Conformal Coatings in Paragraph 22.2.1 and Figure 22.1 of UL 746E**
- 14. Proposal to Delete Figures 22.3 and 22.4 from UL 746E**
- 15. Proposal to transfer of Requirements From Paragraph 22.2.2 to Paragraph 22.4.1 of UL 746E**
- 16. Proposal to clarify Sample Requirements in Table 22.1 of UL 746E**
- 17. Proposal to Clarify the Requirements for Direct Support of Current-Carrying Parts in Paragraph 9.3.1 of UL 796**
- 18. Proposal to Remove the Reference to the Dissimilar Material Thermal Cycling from Table 24.1 of UL 796**
- 19. Proposal to Add Requirements Describing the Maximum Area Diameter on the Bond Strength and Delamination Test Pattern as Section 10.8A of UL 796**



STP 796F and 746F

1. Report for the Clarification of Requirements for Solder Limit Evaluation for Laminates and PWBs
2. Report to Discuss Using the T260 Test Method for Dissimilar Material Evaluation for UL 746F and UL 796F
3. Report on the Status of the Proposals For UL 796F Dated November 14, 2014
4. Proposal to Add Requirements for Alternate Condition for Flammability Samples as Paragraphs 4.3 and 4.4 of UL 746F
5. Proposal to Add References to Section 7 and Table 7.1 of UL 746B, and to Section 8 of UL 746F to Paragraph 8.1.1 of UL 746F
6. Proposal to Add Requirements to Clarify the Required Samples for IR Testing of Non-Homogenous Films to Table 8.2 of UL 746F
7. Proposal to Add Requirements for Sample Thickness Tolerance as a New Table 8.6 of UL 746F
8. Proposal to Replace References to Thermal Shock with References to Thermal Stress Throughout the Requirements of UL 746F
9. Proposal to Delete Reference to the Coverlay Test from Paragraph 12.3.2 of UL 746F
10. Proposal to Clarify Requirements for Stiffener Applications and Evaluation in FMIC Constructions in Paragraph 2.9.2 of UL 796F
11. Proposal to Clarify Requirements for Dissimilar Material Test Method Specified in Section 5.14 of UL 796F



New UL Services for PWBs

PWBの新しいULサービス

PWB Performance testing

PWBパフォーマンステスト

- **IST – Interconnection Stress Testing**
- **CAF – Conductive Anodic Filament Growth**
- **SIT - Signal Integration Testing – SET₂DIL / VNA / SPP**
- **Conformal Coating Performance Testing**

IST, CAF, SITは別プレゼンテーションをご参照ください



Coating Performance Testing

コーティングパフォーマンステスト

Purpose 目的

- Conformal coating applied to electronic circuits to provide environmental barrier and/or electrical insulation

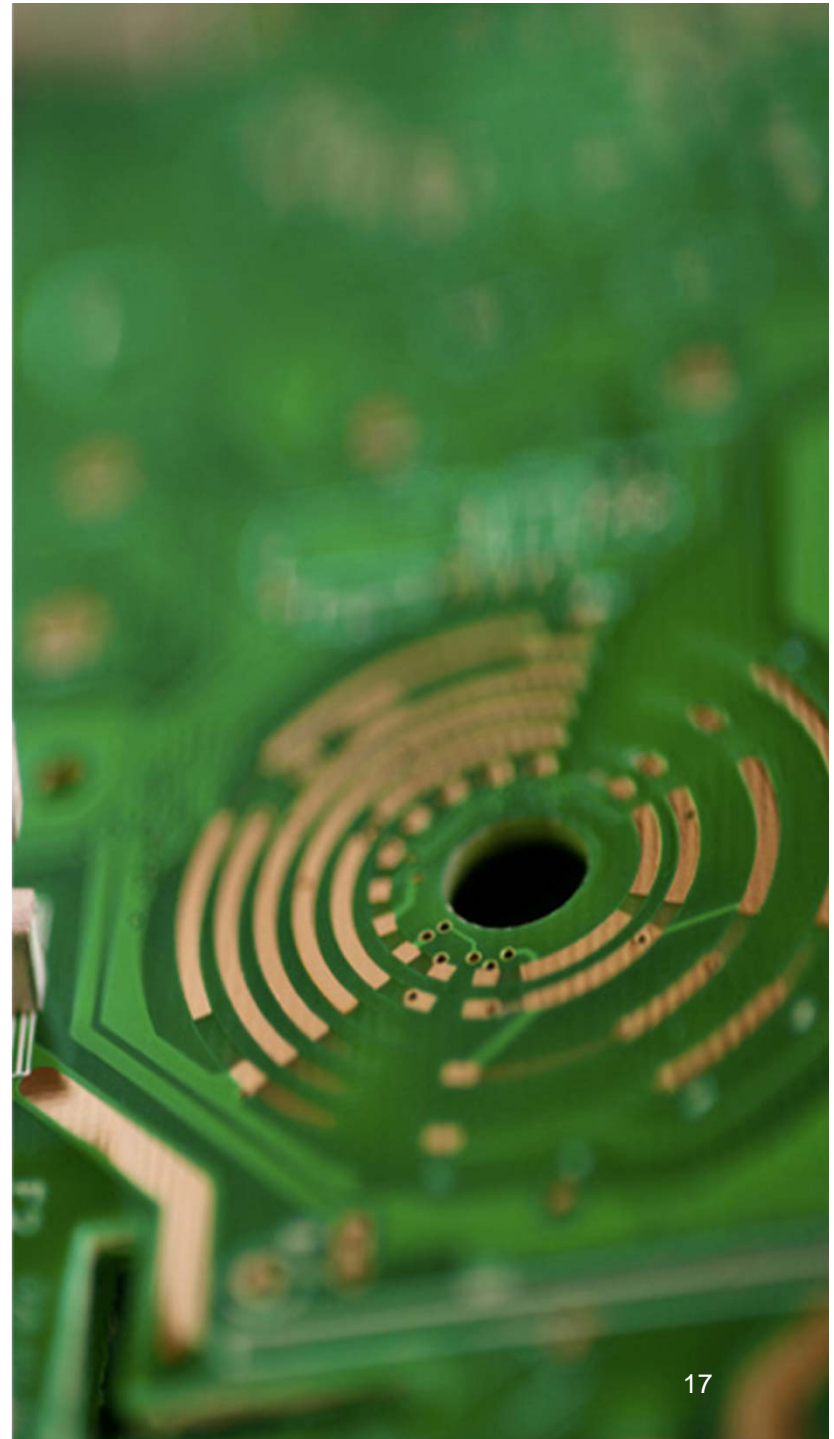
コンフォーマルコーティングは周囲環境に対するバリアや絶縁のため電気回路に用いられる

Programs プログラム

- Certification testing 認証試験
- Performance testing パフォーマンス試験
- Validation testing バリデーション試験

Testing 試験

- UL94 Flammability
- UL746E Electrical testing
- Modular services
- IPC-CC-830 Qualification and Performance of Electrical Insulating Compounds
- IEC 60664-3 Insulation Coordination for Equipment within Low-Voltage Systems



Quickturn PWB Certification クイックターンPWB認証

Production Board Testing 製品テスト

Benefits 利点

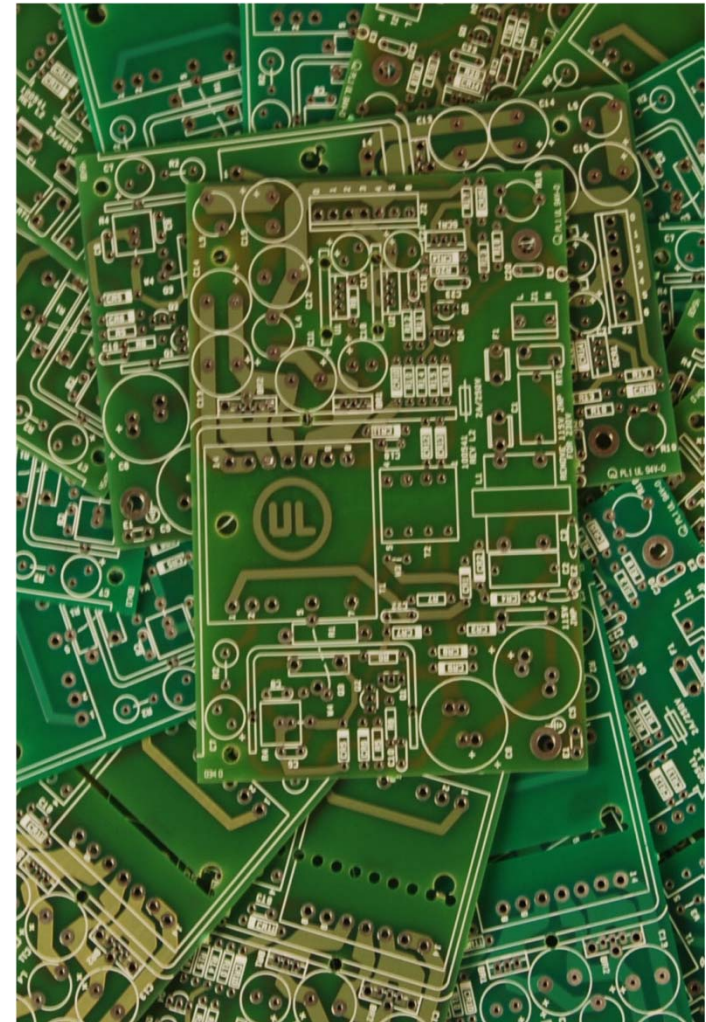
- Faster time to market より早く市場へ
- No need for specialized UL samples 特別サンプル不要
- Two week turn around time 試験期間2週間

Engineering Project Review エンジニアレビュー

- Review BOM, construction stack-up and trace layout to determine the test program. 試験を決めるため、BOM、構造スタックアップ、トレースレイアウトのレビュー
- UL consultation to ensure PWB compliance to end-product requirements. PWBが最終製品要求に適合するかULと打ち合わせ
- UL Certification provided as final deliverable. UL認証

Testing 試験

- Production boards are tested 製品試験
- Specific materials, construction stack-up and trace layout are identified for certification 特定材料、構造スタックアップ、トレースレイアウトが特定された認証



Pre-Certification Service プレサートフィケーション

Program プログラム

- Technical consultation with UL engineer エンジニアの技術サポート
- Submitting work to UL, need to avoid delays ULへ直接申請
- Predetermine test program and sample requirements 試験プログラムとサンプル要求の事前決定

Benefits 利点

- Accelerate time to market 時間短縮
- Early engagement with UL 早い段階からULとのかかわり
- Clear guidance of project scope 明確なガイダンス
- Minimize rework and redesign of samples 最小限のリワークや設計変更

Deliverables 成果物

- Early communication with UL 早い段階からのULとのコミュニケーション
- Agreed project scope and expected completion time スcope、納期の見通し
- Detailed list of test program and sample requirements 詳細サンプルリスト
- Certification project price quote 認証プロジェクト費用の見積もり
- Credit of 100% precert fee to subsequent certification project 本申請の費用はプレサート費用分減額(総額費用は変化なし)



Non-Halogen and RoHS Compliant Certification

ノンハロゲンと RoHS適合認証

Non-Halogen Program ノンハロゲンプログラム

- Evaluates materials for halogen content – Fluorine, Chlorine and Bromine
ハロゲン(フッ素、塩素、臭素)含有材料の評価


RoHS Compliant Program RoHS適合プログラム

- Verifies materials comply with RoHS directive RoHS指令への適合確認
- Determination of six substance level – Pb, Hg, Cd, Cr6, PBB, PBDE
6物質のレベル測定 – 鉛, 水銀, カドミウム, 六価クロム, ポリ臭化ビフェニル, ポリ臭化ジフェニルエーテル

Deliverable 成果物

- Certification listed in Online Directory and iQ Database
オンラインディレクトリ及びiQ データベースに記載

Benefits 利点

- Find materials that meet RoHS requirements
RoHSの要求に適合した材料を見つけることが可能
- Industry leading test methods through IEC standards
IEC 規格を通じ、試験方法をインダストリーがリード
- Communicates credibility 信用性を伝える
-  Reduce time to market 市場までの時間短縮

2000 hour LTТА Formulation Variation Program

2000時間 LTТАフォーミュレーションバリエーションプログラム

OPPORTUNITY 利点

- Any polymer variation すべてのポリマーバリエーション
 - A candidate versus A' control 候補材 VS 基準材
- Addition, Deletion, Replacement, Change in Level 追加、削除、代替、比率変更
- Reduced testing - Final ratings after 2000 hour LTТА confirmation test
試験数減少 - 2000時間確認試験の後、最終定格

EVALUATION 評価

- Analysis of chemical formulation, analytical data, and performance data for comparable results between control and candidate
候補材と基準材が同等であるかの確認
- Basic analytical testing conducted at UL (IR, TGA, DSC, DMA, PDSC)
分析試験はULで行う
- Short-term side-by-side testing per UL 746A, Table 9.1
短期的サイドバイサイド試験は UL 746A, Table 9.1

LIMITATIONS 制限

- Validate the same RTI only 同じRTIとしての検証
 - Not for an increase in RTI RTIのアップのためではない
 - Not for an evaluation of a reduced thickness 厚みを薄くする評価ではない



LTТА Fixed-Time Program

LTТА フィックスドタイムプログラム

Benefits: 利点

Consistent, faster completion time (5k hours vs 10k hours)

一貫した、迅速な完了時間(5000時間 vs 10000時間)

Hybrid Method

Fixed Time		
Time1	F50 temp1	Requirement: 1.Minimum 10°C spread of aging temperature. 2.Reasonable aging intervals; 552hr, 1008hrs, 2016hrs and 5040hrs are preferred. 3.Linear regression is used to determine end point temperature. 4.Minimum 500 hours required for 1 st aging interval (Time 1) 5.Minimum 5000 hours required for 4 th aging interval (Time 4) 6.No spread limitation for end point temperature of Time1~4.
Time2	F50 temp2	
Time3	F50 temp3	
Time4	F50 temp4	
Fixed Temp		
Temp1	F50 time1	Requirement: 1.Minimum 10°C spread of aging temperature . 2.Best Fit is used to determine end point time, it could be linear/ 3 or 4 order polynomial/ exponential. 3.Minimum 500 hours required for end point time of Temp1 4.Minimum 5000 hours required for end point time of Temp4
Temp2	F50 time2	
Temp3	F50 time3	
Temp4	F50 time4	

Hybrid Method



Summary of New FR-4 Groups 新しいFR-4グループ

Established in 2013 2013年発行

New UL/ANSI types replacing FR-4 in UL 746E

UL/ANSI Type	Primary Resin	Secondary Resin(s)	Filler ¹	Flame Retardant	Reinforcement
FR-4.0 (Brominated FR-4)	Epoxy ²	Any	Inorganic Max 45%	Bromine	Woven Glass
FR-4.1 (Non-Halogen FR-4)	Epoxy ²	Any	Inorganic Max 45%	Non-Halogen	Woven Glass
¹ Examples of inorganic fillers include, but are not limited to: Silica, Clay, Talc, Ceramic, Calcium Carbonate, Aluminum Hydroxide, Fumed Silica and Titanium Oxide.					
² Epoxy functionality, minimum 50% by weight of organic resin.					



MyHome@UL, online access to UL info

マイホーム@UL

Benefits 利点

- Exclusive to UL customers
- 24x7 password protected access
- Staff from your company access to UL documents

Features 特徴

- Request Quote
- MyProjects – status of project
- UL Reports
- Variation Notices and Inspection Report – alert to notices within hours of posting
- UL Staff Directory
- UL iQ Database and Online Certification Directory

Set Up セットアップ

- Access www.ul.com, click on “MyHome login”
- Company subscriber number needed



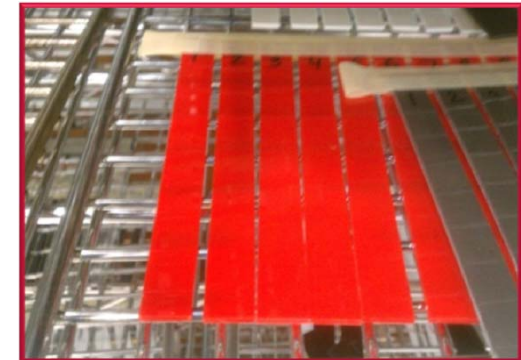
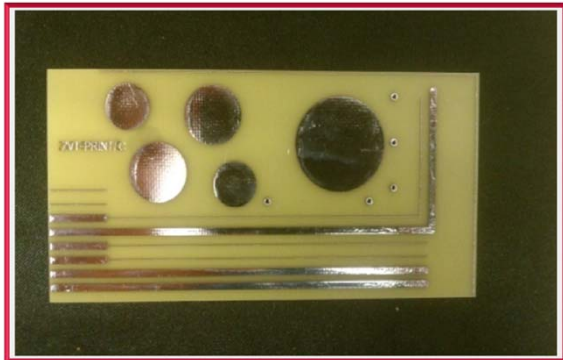
PWB Info for Recognition Submittal

認証申請に必要なPWB情報

PWB Evaluation and Testing: Overview

PWBの評価、試験のまとめ

- Most common PWB tests PWBの一般的な試験
 - Bond Strength, Delamination and Micro-section Analysis
 - Flammability: Uncoated and Coated
 - TAT – 3 weeks to 10 weeks based on test conditioning time
試験所要時間: 3—10週間
- Constructions requiring additional testing (complex)
追加試験が必要な構造（複雑）
 - Conductive Paste, Silver Plating, Plugged Holes, Undercoats and Overcoats, Embedded Components, Flex PWBs, Thin Core, Hybrid, HDI and Metal Base Multilayers



PWB Pre-selection Programs

PWBプリセレクションプログラム

- Generically similar materials can be added as alternates with little or no testing

類似材料は少ない試験数、あるいは試験なしで追加できることがある

- Two pre-selection programs for rigid materials:

リジッドPWBでは2つのプリセレクションプログラム

- MCIL or CCIL Program MCIL(CCIL) プログラム
- Permanent Coatings Program パーマネントコーティングプログラム

- One pre-selection program for flexible materials:

フレキシブルPWBでは1つのプリセレクションプログラム

- Polyimide UL/ANSI-like Flex PWB (FMIC) program



PI UL/ANSIライクフレックスPWBプログラム

Types of PWBs プリント基板の種類

Single-layer 両面板

- No internal circuitry
- Single-sided, or
- Double-sided

Multi-layer 多層板

- Contains at least one internal layer of circuitry
- Mass-laminate
- HDI
- Hybrid

Metal-base メタルベース

- Metal core supporting the thin insulation material
- Metal core not part of the circuitry and usually used as a heat sink

Flexible フレキ

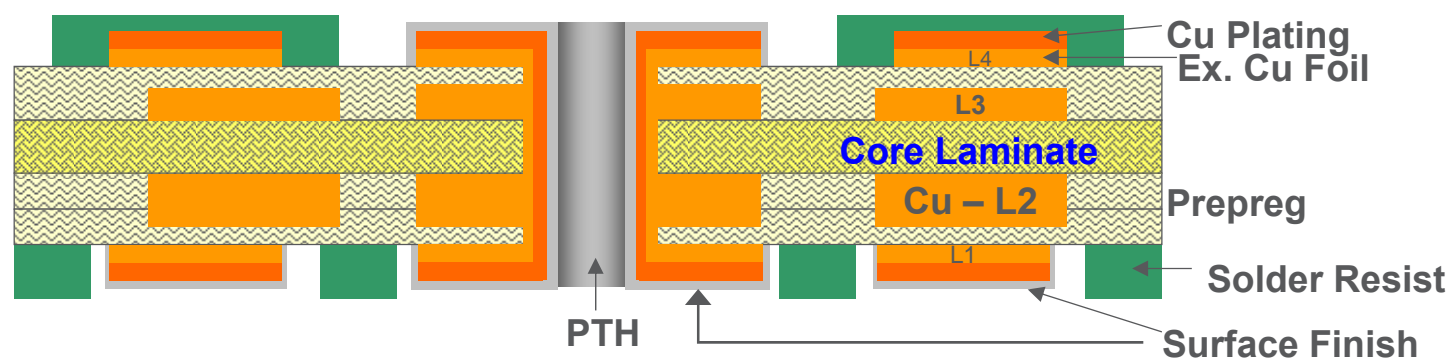
- Single or multilayer construction with flex properties
- Refer to UL 796F for specific requirements



PWB Construction PWB構造

– Information Needed 必要情報

4 layer Example



Key information for UL: 必要情報

Material 材料	Laminate/prepreg – Mfr., Grade, Thickness Coatings: Solder Resist, Plug hole, etc. – Mfr., Grade, Color
Construction 構造	Laminate/prepreg thickness – Min. & Overall Min. Build-Up Copper thickness – Min starting outer layer Cu foil. (Max=102 μ m if no specified) Maximum inner layer Cu thickness
Parameter パラメータ	Pattern Limits – Min. Midboard/ Edge trace width, MAD Temp – MOT, Solder Limits
Processing プロセス	Each step with temperature higher than 100°C Any lamination step with pressure – specify max pressure temperature & time Any plating step Surface Finish type



Manufacturing Process 製造プロセス

- Information Needed 必要情報

Any process step over either 100° C or the maximum operating temperature of the PWB:

- Need to know max exposure time above this temp, max temp, max pressure, and max number of cycles

100CあるいはMOTの温度以上の工程について、最大時間、最高温度、最大圧力、最大繰り返し回数

All final finishes, hole plugging materials, and coatings to be used

表面処理、穴埋め、コーティング材

Details on plated through holes (PTH's) and contact fingers

スルーホール、端子部の詳細

If etchant is chromic sulphuric クロム硫酸のエッチング

Best practice - notify UL engineer about all process steps and they can advise you what is critical



最善策 : すべての製造工程をお知らせください。

PWB Listing Card Information

リスティングカード

- Type Designation
- Circuitry Limitations
- Solder Limits
- Maximum Operating Temperature (MOT)
- Flame Class (V, VTM, HB)
- Direct Support (DSR)
- Comparative Tracking Index (CTI)

Wiring, Printed - Component							E99999			
UL LLC										
333 Pfingsten Road Northbrook, IL 60062-2096 U.S.A.										
ML-PWB										
Multilayer printed wiring boards										
Cond	Cond	Cond	Cond	Cond		Max	Solder	Solder	Max	Meets
Width	Width	Thk	Thk	Thk	SS/	Area	Limits	Limits	Oper	
Min	Edge	Min	Max Int	Max Ext	DS/	Diam	Temp	Time	Temp	
(mm)	(mm)	(mic)	(mic)	(mic)	DSO	(mm)	(C)	(sec)	(C)	
0.05	0.05	9	70	102	DS	50.8	260	20	130	UL796
										DSR
										CTI
										All
										0
Report Date: 1965-10-01										
Last Revised: 2015-06-05							© 2015 UL LLC			



PWB Circuit Parameters PWB回路パラメータ

- Min **line width**: thinnest trace on the PWB
最小線幅:有効面内の最も細い線幅
- Min **edge width**: thinnest trace within 0.40 mm of PWB edge
最小エッジ幅:PWB端から0.40 mm 以内の最も細い線幅
- **Max area diameter** (MAD): maximum unpierced conductor area
MAD:最大銅残直径
- Min **conductor thickness** (external): minimum Cu foil thickness
最小コンダクタ厚(外層):最小銅箔厚
- Max **conductor thickness** (internal & external): maximum Cu foil and plating thickness
最大コンダクタ厚(内層、外層): 最大銅箔+メッキ厚



PWB Solder Limits ソルダーリミット

- Solder limits simulate the assembly process

ソルダーリミットは部品実装工程をシミュレート

- Maximum temperature 最大温度
- Maximum cumulative exposure time 最大累積時間
- Designed to evaluate the physical fatigue of the anticipated soldering temperatures during assembly

部品実装時の半田付け温度の物理的疲労を評価するため

Assembly is typically surface mount technology

部品実装は一般的に表面実装

- PWBs exposed to at least three cycles of soldering PWBは最低3回の半田サイクル
 - One cycle for single-sided; two for double-sided; three for PTH soldering or rework 片面、両面、挿入部品あるいは手直し
- Multiple solder limits represent the reflow temperature profile



マルチプルソルダーリミットはリフロー温度プロファイルを代表

Maximum Operating Temperature

Minimum acceptable MOT specified by end-product requirements

最終製品の要求により必要なMOTが決まる

- End-product exposure under normal operating conditions 通常の動作条件下での最終製品状態
- Represents PWB maximum temperature PWBの最高温度を代表
- Cannot exceed base material RTI 基材のRTIを超えることはできない
- MOT ≠ RTI
- LPS/SELV end products may not require MOT LPS/SELV 製品はMOTが必須ではない

Simulated on PWBs with short-term thermal conditioning

短期的温度条件をシミュレート

- Exposure temperature based on PWB manufacturer request 試験温度は、PWB工場のリクエストによる
- MOT determined by analysis of PWB physical properties: MOTはPWB物性分析により決定



- Conductor adhesion and PWB delamination
- 10 day or 56 day Bond Strength / Delamination testing

RTI vs. MOT

RTI (Relative Thermal Index) - The temperature below which the critical property of a material will not be unacceptably compromised through chemical thermal degradation, over the reasonable life of an electrical product

電気製品の適正な寿命期間にわたり、化学熱分解によって、材料の臨界特性が許容できないほど損なわれない温度

MOT (Maximum Operating Temperature) – The maximum continuous use temperature the PWB may be thermally exposed to under normal operating conditions in the end product

PWBが最終製品において通常の動作条件下でさらされる最大連続使用温度

PWB MOT shall be equal or less than the Material RTI

PWB MOT はMaterial RTIと同じかそれ以下



PWB Flame Class PWB燃焼定格

Minimum acceptable flame class is specified in end-product requirements

最低許容燃焼定格は最終製品の要求による

Determined by performing UL94 burning tests on the PWB

UL94の燃焼試験により決まる

- With and without coatings based on finished PWB

コーティングあり、なし

- After thermal stress exposure to simulate the assembly process

部品実装工程を想定したサーマルストレス暴露後

Classification represents small scale sample evaluation and burn time

分類は、数本のサンプル評価と燃焼時間による

Flame Classes

- V-0, V-1, V-2
- VTM-0, VTM-1, VTM-2
- HB



PWB Marking Example PWBマーキング

All Marking Information in Close Proximity

すべての情報は近接させる

- **Company Name or Trademark**
社名あるいはトレードマーク
- **Factory ID (required if more than one factory)**
ファクトリーID (工場が2つ以上の場合)
- **PWB Type** PWBタイプ
- **UL Mark** ULマーク (optional)
- **Flame Class** 燃焼定格 (optional)
- **CTI and/or DSR** (optional)





THANK YOU.

ありがとうございました。

谢谢

謝謝

대단히 감사합니다

बहुत बहुत धन्यवाद

ขอบคุณมาก

Маш их баярлалаа