

Thermally Conductive Printed Circuit Board Materials

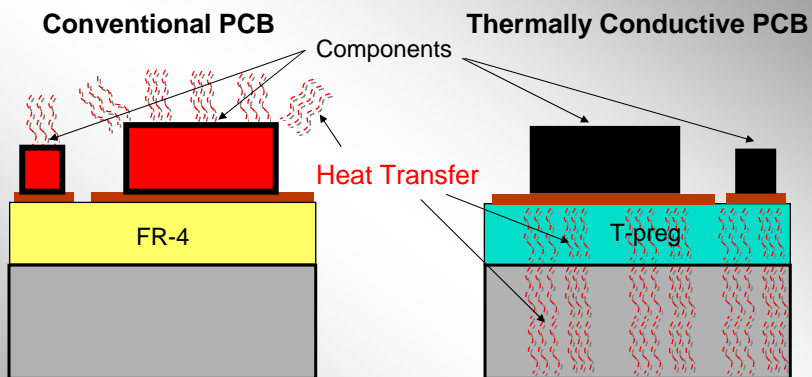
The T-lam™ System

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WHY



Thermal Conductivity (Tc) of FR4 ~ 0.25 W/m-K
Thermally Conductive Dielectric: TC ~ 1.0 – 4.0 W/m-K
Thermally Conductive PCB ~ 4-16 times heat transfer



Thermally Conductive PCBs Basic Materials

Copper Foil

-circuitry, electrical path



Thermally Conductive Dielectric

-electrical insulation
-adhesion
-thermal transfer



Base Metal (Al or Cu)

-heat sink/spreader, mechanical support



Thermagon's T-lam™ Products are PCB Building Blocks

Thermally Conductive Dielectric

T-preg™



Double Sided Laminate

DSL™



Insulated Metal PCB

IMPCB™

or

Insulated Metal Substrate (IMS)
Metal Core PCB (MCPCB)



Thermally Conductive Dielectric T-preg™ 1KA

- Boron Nitride/Epoxy Composite
- Fiberglass Reinforced
- Thermal Conductivity = 3.0 W/m-K
- Dielectric Strength = 800 V/mil
- Peel Strength = 4 - 6 pli
- Maximum Operating Temperature = 110 - 130°C
- Thickness = .006, .008, .010, and .012”
 - .004” available for low voltage applications (LED’s)



Double Sided Laminate DSL™

- Copper Foil Weight/Thickness
 - 1, 2, 3, 4, 5, and 6 oz (8 and 10 oz upon request)
 - .0014, .0028, .0042, .0056, .0070 and .0084”



Insulated Metal PCB IMpcb™



- **Base Metal Composition/Thickness**
 - Aluminum; 6061 and 5052
 - 0.031, 0.040, 0.062, and 0.125”
 - Copper; C1100
 - 0.031, 0.040, 0.062, and 0.125”

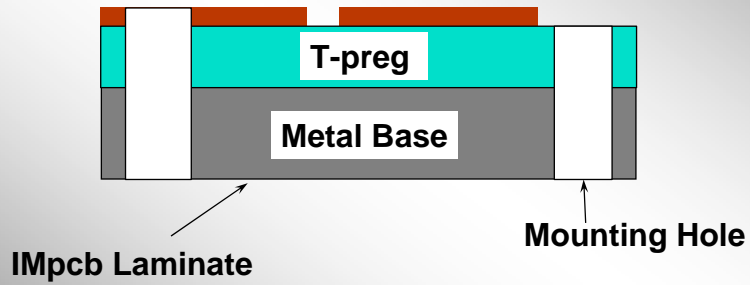


Types of Thermally Conductive PCB's

- **Single Layer** Foil/T-preg/Metal Base
- **Hybrids** PCB/T-preg/Metal Base
- **Multilayer** DSL/T-preg/Metal Base
- **Metal Core** Foil/T-preg/Metal Core/T-preg/Foil
 - Multilayer FR-4/ T-preg/Metal Base
 - Teflon/T-preg/Metal Base
 - Multilayer Polyimide/ T-preg/Metal Base



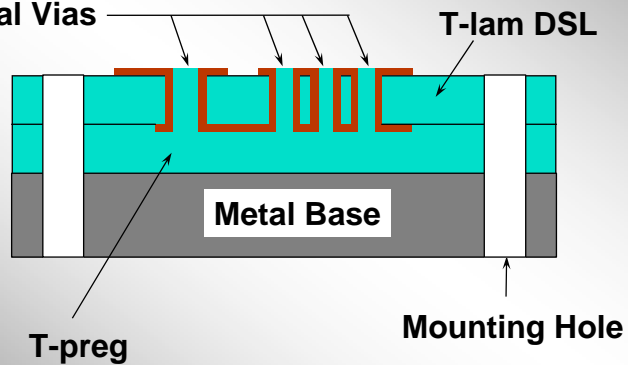
Single Layer IMpcb



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Two-Layer IMpcb

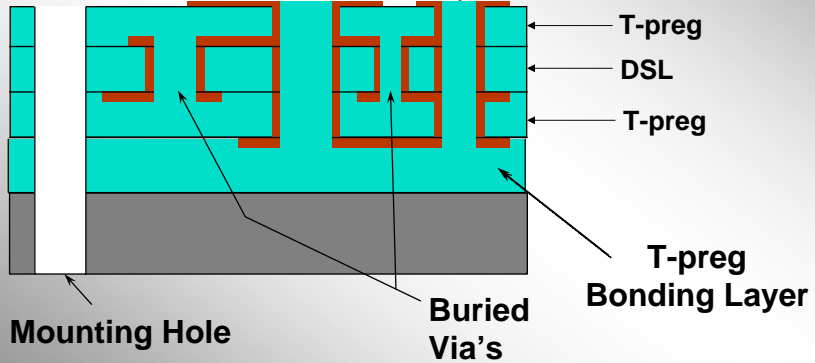
Plated Through Holes
& Thermal Vias



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Multilayer IMpcb

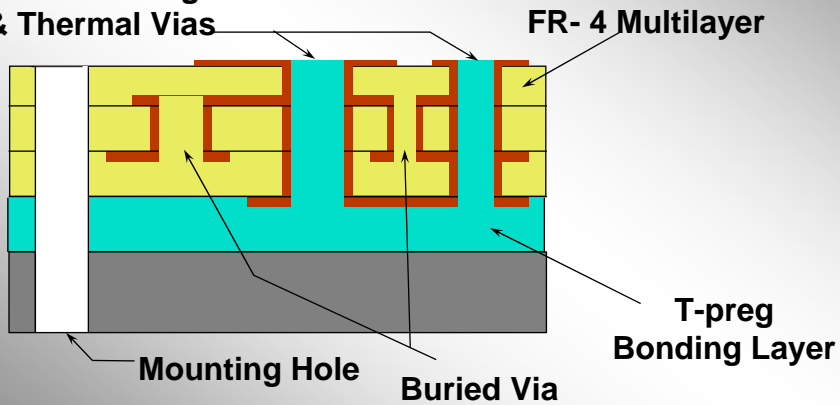
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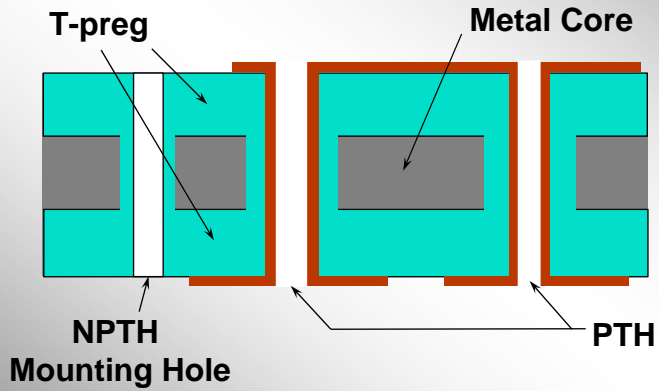
Hybrid IMpcb with FR-4 / T-preg

Plated Through Holes
& Thermal Vias

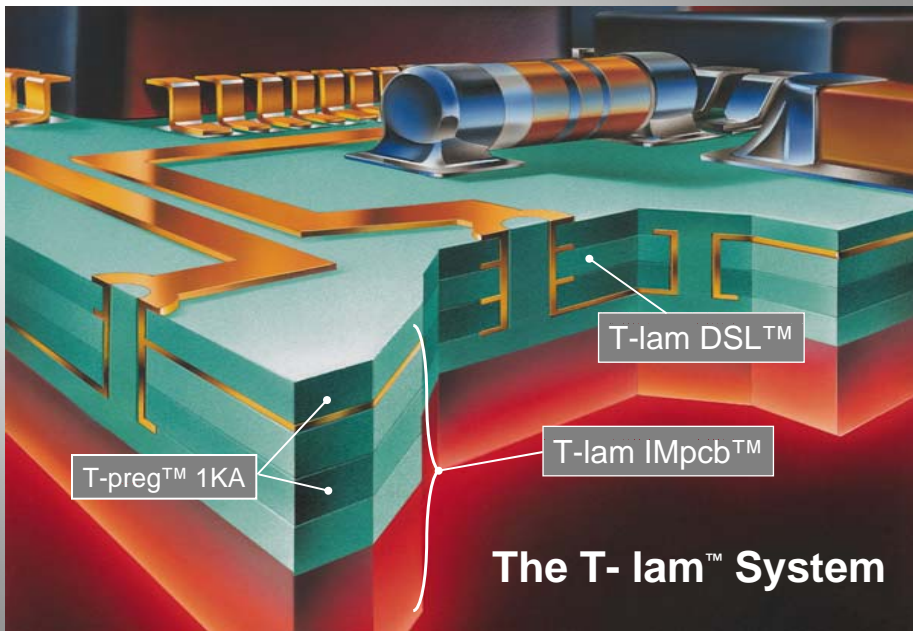


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Double-Sided Metal Core PCB



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The T-lam™ System

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Qualified Fabricators

- **Qualified (preferred) T-lam PCB Fabricators in USA, Canada, China, Taiwan, Korea & The UK provide prototyping and low to high volume capabilities.**
- **Multiple fabricators provide ample capacity and second source alternatives.**
- **International fabricators provide high volume capacity at very competitive prices, and local access for CM's.**
- **Customer/OEM/CM preferred fabricators can be qualified for high volume production.**



Summary

- **T-lam Thermally Conductive PCB Materials**
 - T-preg, free-standing dielectric sheet
 - DSL, double sided laminate
 - IMpcb, insulated metal printed circuit board
- **T-preg dielectric offers ~ 10x thermal transport compared to conventional PCB dielectric materials**
- **Single layer, multilayer, and hybrid PCB capabilities**
- **Global PCB Fabricator base capable of meeting any production requirements**

