Thermally Conductive Printed Circuit Board Materials

The T-lam™ System

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WHY

Conventional PCB

Components

Heat Transfer

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

- T-preg
- IMpcb Laminate
- Mounting Hole
- Metal Base

Two-Layer IMpcb

- Plated Through Holes & Thermal Vias
- T-lam DSL
- T-preg
- Mounting Hole
- Metal Base
Multilayer IMpcb

- Plated Through Holes & Thermal Vias
- T-preg
- DSL
- T-preg

Mounting Hole

Buried Via’s

T-preg Bonding Layer

Hybrid IMpcb with FR-4 / T-preg

- Plated Through Holes & Thermal Vias
- FR-4 Multilayer

Mounting Hole

Buried Via

T-preg Bonding Layer
Double-Sided Metal Core PCB

The T-lam™ System
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