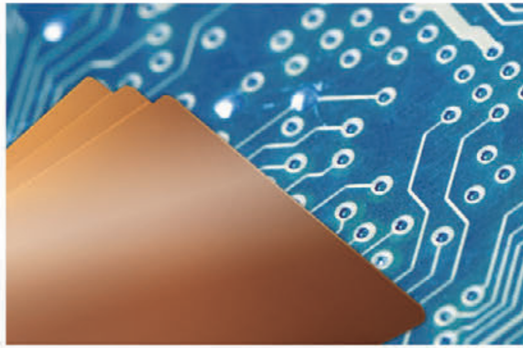
POLYTRONICS
POLYTRONICS TECHNOLOGY CORP.

# THERMALLY CONDUCTIVE BOARD



# Overview

## Thermally Conductive Board

Thermally Conductive Board (TCB), or insulated metal substrate, provides the advantages of high thermal conductivity, reliability and solder heat endurance. The TCB substrate is a sandwich structure, which includes layers of conductor, insulator and metal base. Traditionally, this insulator is made of epoxy, epoxy filled glass fiber, polyimide, or other dielectric materials. However, these kinds of insulators could not meet the requirement in high-power electronic devices. The heat generated by these devices will accumulate, and the life time and reliability of the end product will decrease.

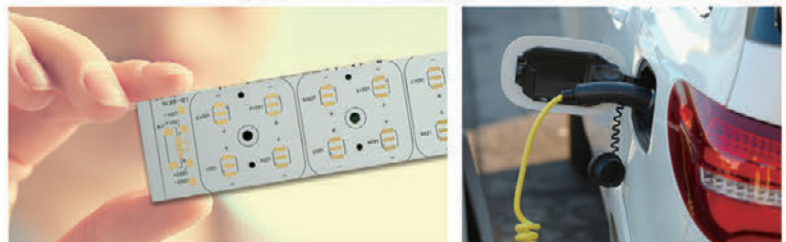
Polytronics' TCB product is not only a printed circuit board but also a heat transfer interface. The insulator is made by a unique polymer composite that combines epoxy resin and high thermal conductivity filler, and the thermal conductivity is up to 20 times higher than the traditional epoxy filled glass fiber system.

## Applications

- High brightness LED lighting
- Backlight module
- Automotive regulator
- EV BMS
- Power module
- Audio (equalizer, amplifier)
- Solar application

## Features

- Excellent thermal conductivity
- Excellent solder heat endurance
- Excellent reliability
- Customized substrate structure available
- RoHS compliance
- Halogen free
- Non solvent



## UL Certification

- File No: E312082
- UL 746E recognized
- UL 94V-0 Certified

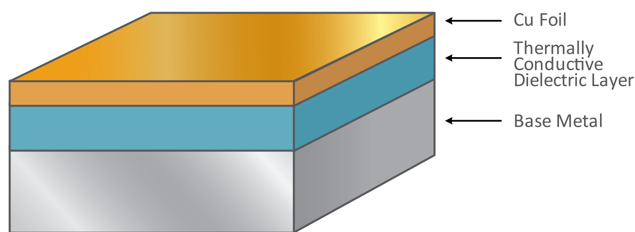
## Patents

Over 15 patents (US, TW, CN) issued and published covering material, process and product applications.

# Thermally Conductive Board - TCB

## Product Description

Polytronics offers various combinations of base metal, copper foil, and dielectric layers to meet the general requirement of single layer thermally conductive printed circuit boards.




Substrate structure of Insulated Metal Substrate

Table 1. Standard specification

| Item | Material | Specification |
|---|---|---|
| Panel Size | | 610x510mm |
| Base Metal | Aluminum<br>Copper | 1.0, 1.5, 2.0mm |
| Dielectric Layer | Epoxy resin<br>Ceramic filler | 80, 100, 150µm |
| Cu Foil | Copper | 1 oz, General Circuit |
| | | 2 oz, High Current Circuit |
| | | 3~6 oz, Ultra High Current Circuit |

If there is any specific inquiry other than the standard specifiction, please contact us.

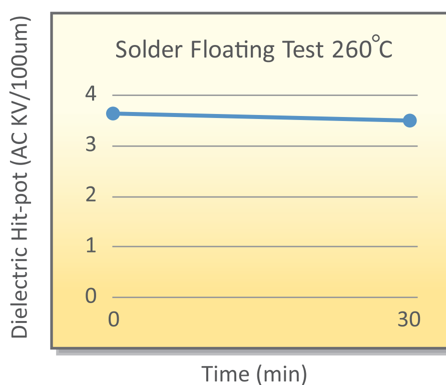
## Reliability Testing Data

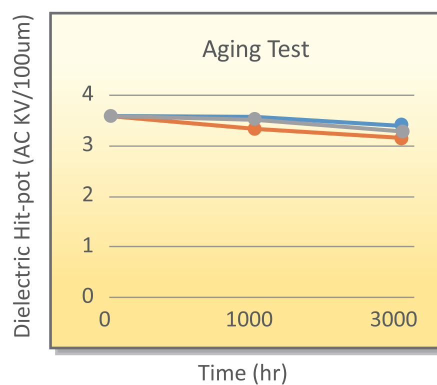
Polytronics TCB has excellent Hi-Pot withstand strength and peeling strength even after solder dipping, high temperature, high humidity, long term storage or thermal shock conditions.

Tested substrate:

TCB-C (aluminum thickness: 1.5mm, thermally conductive dielectric layer thickness: 100µm, copper foil thickness: 35µm)

### Dielectric Hi-Pot Withstand



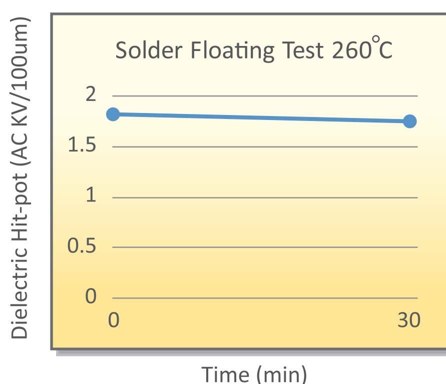



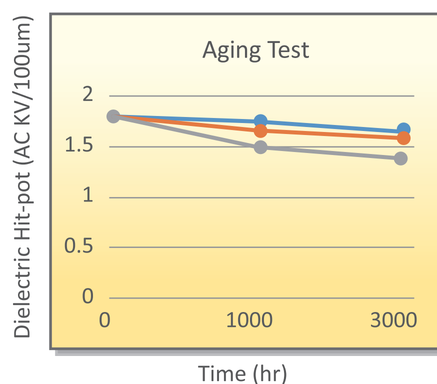

Aging test at 150°C

Thermal shock test during -50 C°/ 30min ~ 150 C°/ 30min

High temperature and humidity resistance test at 85°C/ 85%RH

### Peeling Strength




Aging test at 150°C

Thermal shock test during -50 C°/ 30min ~ 150 C°/ 30min

High temperature and humidity resistance test at 85°C/ 85%RH

*Kg/cm = 5.588 lbs/in

# Product General Properties

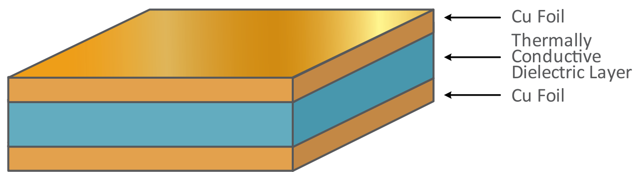
| Item | Test Method | Test Condition | | TCB-2L | TCB-2AL | TCB-3 | TCB-4 | TCB-8 | TCB-C |
|---|---|---|---|---|---|---|---|---|---|
| **THERMAL PROPERTIES** | | | | | | | | | |
| Thermal Conductivity [W/m-K] | TO-220 | C-96/25/65 | | 2 | 2.7 | 3 | 4 | 8 | 12 |
| Thermal resistance [°C/W], dielectric 100µm | D5470 | C-96/25/65 | | <0.15 | <0.13 | <0.12 | <0.11 | <0.08 | <0.06 |
| Water Absorption [%] | IPC-TM-650 2.6.2.1 | 23°C/24hrs | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Glass Transition Temp. (Tg) [°C] | IPC-TM-650 2.4.25 | DSC | | 110 | 130 | 140 | 150 | 150 | 180 |
| Thermal Resistance [minutes] | JIS C 6481 | Solder Floating, 260°C | | >30 mins | >30 mins | >30 mins | >30 mins | >30 mins | >30 mins |
| | IPC-TM-650 2.4.24.1 | TMA | T260 (mins) | >60 | >60 | >60 | >60 | >60 | >60 |
| | | | T288 (mins) | >30 | >30 | >30 | >30 | >30 | >30 |
| | | | T300 (mins) | >2 | >2 | >2 | >2 | >2 | >2 |
| Decomposition Temp. (Td) [°C] | IPC-TM-650 2.4.24.6 | TGA | 2% | 350 | 350 | 350 | 350 | 350 | 370 |
| | | | 5% | 400 | 380 | 400 | 400 | 400 | 400 |
| **ELECTRICAL PROPERTIES** | | | | | | | | | |
| Hi-Pot Withstand [AC KV/mm] | IPC-TM-650 2.5.7 | C-96/25/65 | | 50 | 50 | 30 | 30 | 30 | 30 |
| | | E-1000/150 | | | | | | | |
| | | Solder Floating, 260°C/30 min | | | | | | | |
| | | 150°C ~ -50°C/1000 cycles | | | | | | | |
| | | C-1000/85/85 | | | | | | | |
| Hi-Pot Withstand [DC KV/mm] | IPC-TM-650 2.5.7 | C-96/25/65 | | 60 | 60 | 40 | 40 | 40 | 40 |
| | | E-1000/150 | | | | | | | |
| | | Solder Floating, 260°C/30 min | | | | | | | |
| | | 150°C ~ -50°C/1000 cycles | | | | | | | |
| | | C-1000/85/85 | | | | | | | |
| Dielectric Constant | IPC-TM-650 2.5.5.1 | C-96/25/65, 1MHz | | 4.6 | 4.8 | 5.1 | 4.9 | 5.2 | 8.27 |
| Dielectric Loss Tangent | IPC-TM-650 2.5.5.1 | C-96/25/65, 1MHz | | 0.021 | 0.021 | 0.023 | 0.022 | 0.024 | 0.022 |
| Surface Resistance [Ω] | IPC-TM-650 2.5.17.1 | C-96/25/65, 1MHz | | >$10^{15}$ | >$10^{15}$ | >$10^{15}$ | >$10^{15}$ | >$10^{15}$ | >$10^{13}$ |
| Volume Resistance [Ω · cm] | IPC-TM-650 2.5.17.1 | C-96/25/65, 1MHz | | >$10^{13}$ | >$10^{13}$ | >$10^{13}$ | >$10^{13}$ | >$10^{13}$ | >$10^{13}$ |
| Comparative Tracking Index CTI [V] | UL 746E | C-40/25/50 | | 600 | 600 | 600 | 600 | 600 | 600 |
| **MECHANICAL PROPERTIES** | | | | | | | | | |
| Typical Peeling Strength [Kg/cm - lbs/in] | JIS C 6481 | C-96/25/65 | | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.3/7.3 |
| | | E-1000/150 | | | | | | | |
| | | Solder Floating, 260°C/30 min | | | | | | | |
| | | 150°C ~ -50°C/1000 cycles | | | | | | | |
| | | C-1000/85/85 | | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.4/7.8 | 1.1/6.2 |
| Thermal Expansion CTE [PPM/°C] | IPC-TM-650 2.4.24.5 | TMA | >Tg | 37 | 30 | 32 | 25 | 35 | 18 |
| | | | <Tg | 24 | 20 | 25 | 16 | 28 | 15 |
| Thermal Expansion CTE [%] | IPC-TM-650 2.4.24.5 | TMA 50~260°C | | 0.68 | 0.54 | 0.57 | 0.52 | 0.58 | 0.32 |
| **AGENCY RATINGS AND DURABILITY** | | | | | | | | | |
| Flammability | UL 94 | C-40/25/50 | | V-0 | V-0 | V-0 | V-0 | V-0 | V-0 |
| Solder Limit | UL 746 | C-40/25/50 | | 300°C/60sec | 300°C/60sec | 300°C/60sec | 300°C/60sec | 300°C/60sec | 300°C/60sec |
| Relative Temperature Index | UL746 | - | | 90 | 110 | 130 | 110 | 130 | 150* |

* This value is under long-term testing

# Thermally Conductive Core - TCC

## Product Description

Thermally Conductive Core (TCC) is a copper clad laminate, offering high thermal conductivity and reliability.TCC can be used when a multilayer or thin printed circuit board design is required. TCC is a sandwich structure made from an upper copper foil layer, a thermally conductive dielectric layer, and lower copper foil layer.



Substrate structure of Thermally Conductive Core

Table 2. Standard specification of TCC

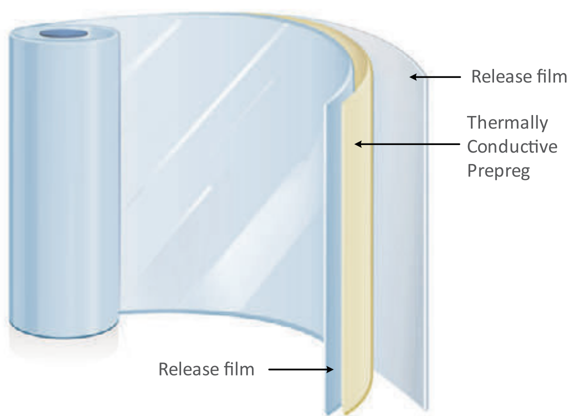
| Item | Material | Specification |
|---|---|---|
| Panel Size | | 610x510mm |
| Dielectric Layer | Epoxy Resin Ceramic Filler | 80, 100, 150µm |
| Cu Foil | Copper | 1 oz, General Circuit |
| | | 2 oz, High Current Circuit |
| | | 3~6 oz, Ultra High Current Circuit |

If there is any specific inquiry other than the standard specifiction, please contact us.

# Thermally Conductive Prepreg - TCP

## Product Description

TCP provides the advantages of high thermal conductivity and reliability prepreg. It can be used for single and multilayer thermally conductive printed circuit board applications. The TCP package is available in rolls or sheets as layers of upper release film, prepreg dielectric, and a lower release film.

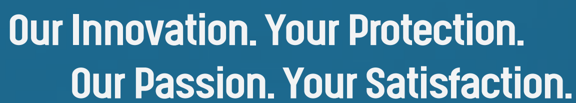


Substrate structure of TCP

Table 3. Standard specification of TCP

| Item | Material | Specification |
|---|---|---|
| Release Film Thickness | PET | 35µm, 50µm |
| Prepreg Size | Epoxy Resin Ceramic Filler | 520mm x 630mm (Panel) 520mm x 50M (Roll) |
| Prepreg Thickness | Epoxy Resin Ceramic Filler | 80, 100, 150µm |

If there is any specific inquiry other than the standard specifiction, please contact us.





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