

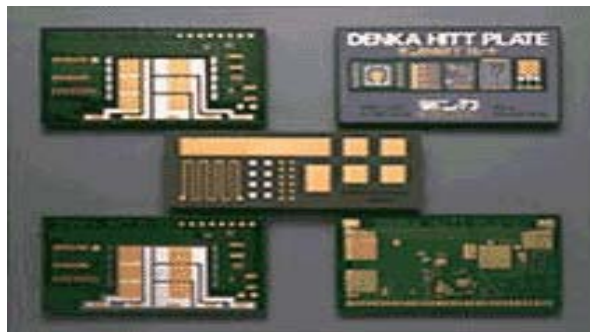


# LAMAR

## DENKA HITT PLATE

### Insulated Thermally Conductive Metal Circuit Board

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Constructed of conductive foil and epoxy-type insulating layers impregnated with an inorganic filler with high thermal conductivity, on top of an aluminum base. This is a metal circuit board with high thermal conductivity for SMT with low thermal resistance, equivalent to the alumina-ceramic substrates . These boards are highly regarded in the market, and are used in a wide variety of applications, including air conditioner inverters, stereo amplifiers, automobile and motorcycle electrical devices, and power supplies for communications equipment.

## Insulated Thermally Conductive Metal Circuit Board DENKA HITT PLATE

Progress is currently being made in the area of power hybrid ICs and substrates in terms of miniaturization, higher degrees of integration, and higher power. These substrates require a higher degree of heat radiation as well as higher reliability and processing power than their predecessors.

DENKA has released a series of products with high thermal conductivity, "DENKA BN THERMALLY CONDUCTIVE PLATE", "DENKA THERMALLY CONDUCTIVE SHEET", as well as "RAMDITE" a compound with high thermal-conductivity. "DENKA HITT PLATE" is a metal Circuit Board with high thermal-conductivity for SMT, which DENKA has developed using our high thermal-conductor technologies. "DENKA HITT PLATE" has a leading market position because of its high thermal conductivity and high reliability.

General characteristics of thermally conductive dielectric layer (typical values)

	High heat resistance, Ultra high thermal conductivity type TH-1	General purpose type K-1
Thermal conductivity ( W/m K )	4.0	2.0
Volume resistivity ( $\Omega$ cm ) at 23°C	$4.1 \times 10^{13}$	$2.2 \times 10^{13}$
Coefficient of thermal expansion ( $^{\circ}\text{C}^{-1}$ )	$6.7 \times 10^{-5}$	$7.8 \times 10^{-5}$
Young's modulus ( N/m <sup>2</sup> )	$5.4 \times 10^9$	$5.1 \times 10^9$
Poisson's ratio	0.34	0.30
Glass transition point ( $^{\circ}\text{C}$ )	165	104

### UL Regulations

The DENKA HITT PLATE has accepted the following UL regulations

		K-1	TH-1
E84531 Laminated plate	Flame resistance	94V-0	94V-0
	TI	115°C	Under application
	CTI	500+	600
E94793 Printed wiring board	Flame resistance	94V-0	94V-0
	Maximum operating temp.	115°C	Under application
	Multiple solder limits	100°C / 1min	100°C / 1min
		200°C / 2min	200°C / 2min
270°C / 1min		270°C / 1min	
200°C / 1min		200°C / 1min	

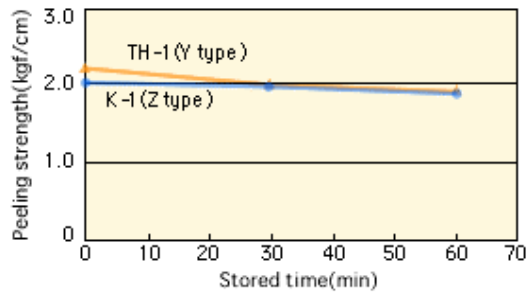
# Insulated Thermally Conductive Metal Circuit Board DENKA HITT PLATE

## Features - High Reliability

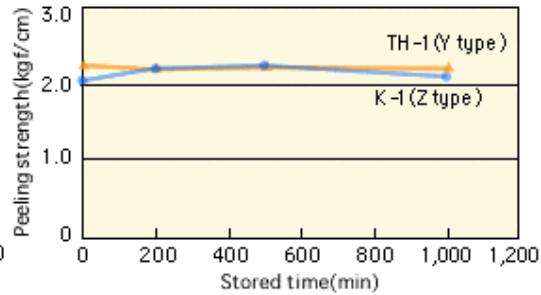
### Heat resistance

One problem with the conventional aluminum substrate is that its insulation layer peels off when the plate is dipped in a solder bath, or when the plate is treated in reflow soldering. This problem is solved with "DENKA HITT PLATE." On top of this, heat resistance is drastically improved.

### Peel strength of Cu foil when stored at 260°C



### Peel strength of Cu foil when stored at 150°C



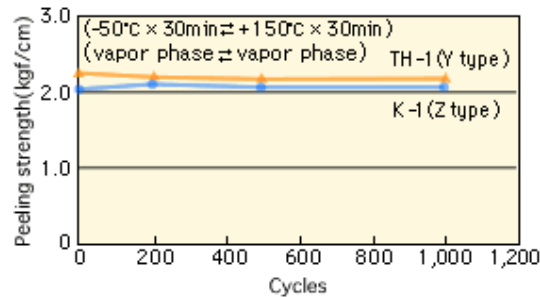
Sample substrate: AC15 (Al: 1.5mm, dielectric layer: 80μm, Cu foil: 35μm)  
TAC15Y (Al: 1.5mm, dielectric layer: 100μm, Cu foil: 35μm)

### Heat shock resistance

"DENKA HITT PLATE" has excellent heat shock resistance when compared with aluminum plate.

### Peeling strength of Cu foil when heat shock is applied

Sample substrate: AC15 (Al: 1.5mm, dielectric layer: 80μm, Cu foil: 35μm)  
TAC15Y (Al: 1.5mm, dielectric layer: 100μm, Cu foil: 35μm)



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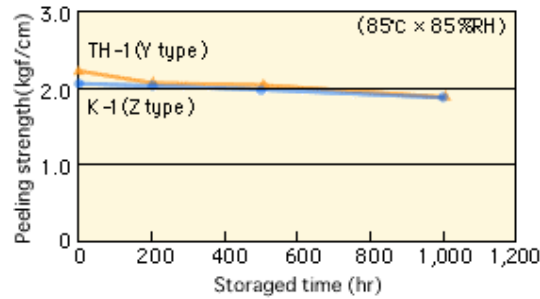
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## Moisture Resistance

"DENKA HITT PLATE" has excellent moisture resistance because insulating adhesives use dense inorganic fillers.

### Peeling strength of Cu foil when stored in high temperature and high humidity

Sample substrate: AC15 (Al: 1.5mm, dielectric layer: 80 $\mu$ m, Cu foil: 35 $\mu$ m)  
TAC15Y (Al: 1.5mm, dielectric layer: 100 $\mu$ m, Cu foil: 35 $\mu$ m)

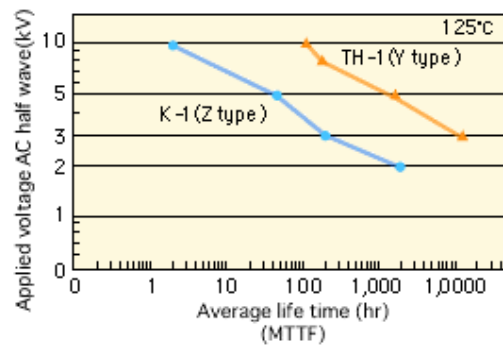


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## Durability

This figure shows the relationship between the average life of substrates coated with various thicknesses of dielectric layers and voltages applied to the substrates. It also shows that "DENKA HITT PLATE" has high insulation reliability under conditions of continuous voltage application.

### Continuous voltage application test

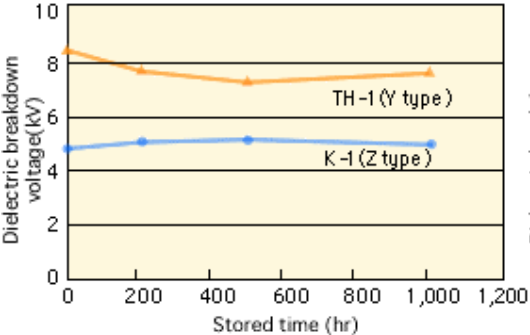


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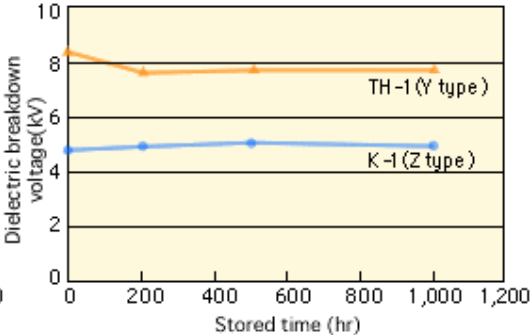
## Dielectric breakdown voltage

"DENKA HITT PLATE", with Z type dielectric layer, has dielectric breakdown voltage in about 5kV (effective AC value). Even, under high temperature and high humidity conditions, it keeps high withstand voltage.

### Change in dielectric breakdown voltage when sample is aged at 150°C



### Change in dielectric breakdown voltage when sample is aged at 85°C×85% RH



Sample substrate: AC15 (Al: 1.5mm, dielectric layer: 80µm, Cu foil: 35µm)  
TAC15Y (Al: 1.5mm, dielectric layer: 100µm, Cu foil: 35µm)

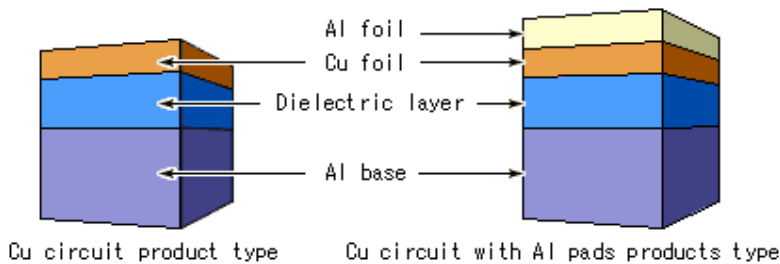
**Insulated Thermally Conductive Metal Circuit Board**  
**DENKA HITT PLATE**

**Standard Specification**

		Material	Type	Note
1	Base metal plate	Aluminum (1050)	1.0,1.5,2.0mm	
		Aluminum (5052)	3.0mm	
2	Thermally conductive dielectric layer	Epoxy resin filled with inorganic filler	Z type	Dielectric strength (AC2kV)
			Y type	Dielectric strength (AC3kV)
			X type	Dielectric strength (AC5kV)
3	1. Cu circuit	Copper foil (Ni plating / Ni-Au plating available)	35 $\mu$ m	for general circuits
			70 $\mu$ m	for large current circuits
			105 $\mu$ m	for large current circuits
	2. Cu circuit with Al pad	Al/ Cu claded foil	Al 40 $\mu$ m/Cu10 $\mu$ m	For wire-bonding (bare chip mounting)
Al 40 $\mu$ m/Cu85 $\mu$ m			for large current circuits	
4	Solder resist	Epoxy resin, etc.	5~30 $\mu$ m	

Please contact us concerning available combination.

**Substrate structure**



# Insulated Thermally Conductive Metal Circuit Board DENKA HITT PLATE

## Features - Thermal Conductivity

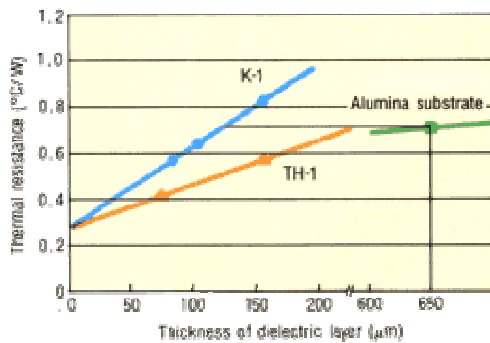
The most important point in the selection of a metal-based substrate is the characteristics inherent in its insulation layer. Epoxy, glass-epoxy and polyimide, etc. are used for this layer, but their thermal conductivity is not satisfactory.

DENKA HITT Plate is made by filling a high heat resistant epoxy resin with an inorganic filler which has good thermal conductivity using Denka's own unique technologies to achieve a substrate with thermal conductivity that is comparable with that of an alumina-ceramic substrate.

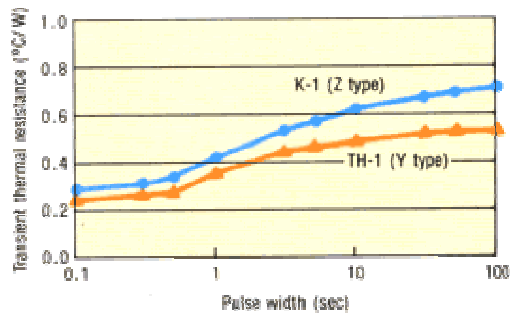
## Comparison of Thermal Conductivity

a) Thermal resistance characteristics

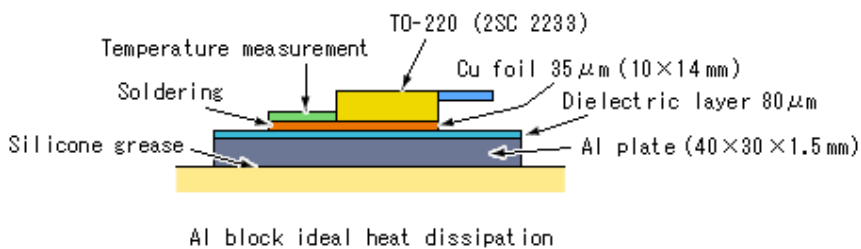
\*Simulated values are used for alumina-substrate values



b) Transient thermal resistance characteristics (20 W)



## Measuring Method used for the thermal conductivity of substrates.



## Comparison of thermal images by thermo-viewer

This photograph shows the thermal images with a 4A current applied for 10 seconds ( $T_r$ : TO-220). It can be seen that the temperature rise of the "DENKA HITT PLATE" is kept very small thanks to its excellent thermal conductivity.

