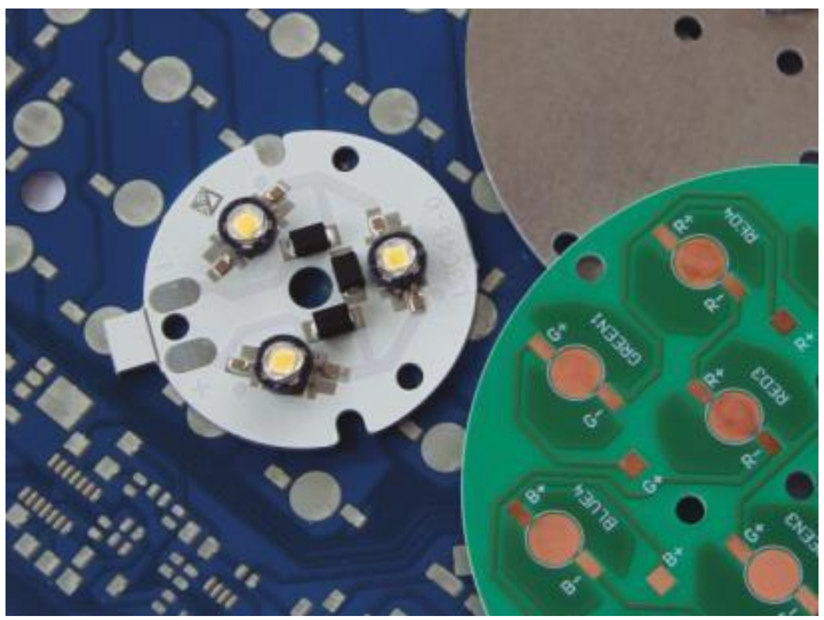
Thermal Management within PCB materials for the automotive industry

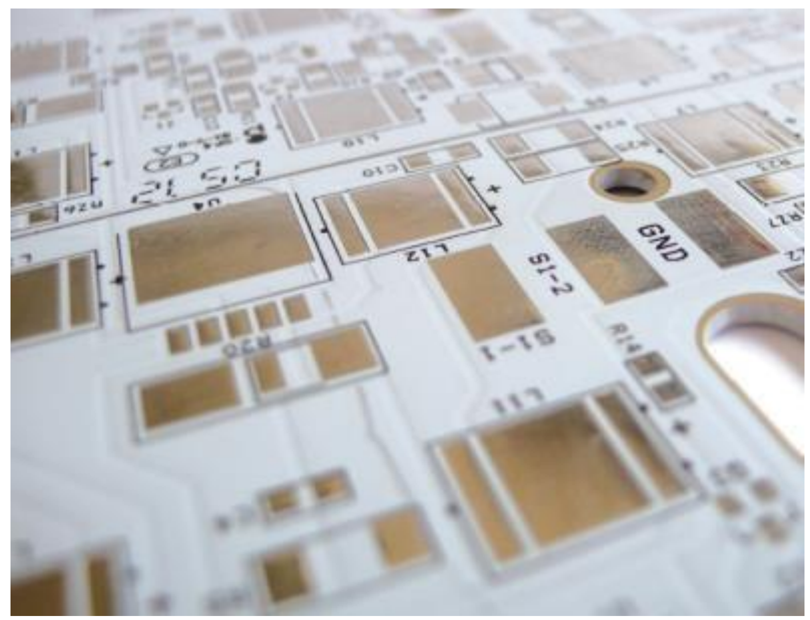
Table of Content

Insulated Metal Substrate (IMS)

IMS

Thick aluminum based substrate, cladded in ED copper foil.
Designed for an effective thermal dissipation and high electrical insulation.
Our proprietary formulated polymer-ceramic, ensures high thermal conductivity, dielectric strength, and thermal endurance.

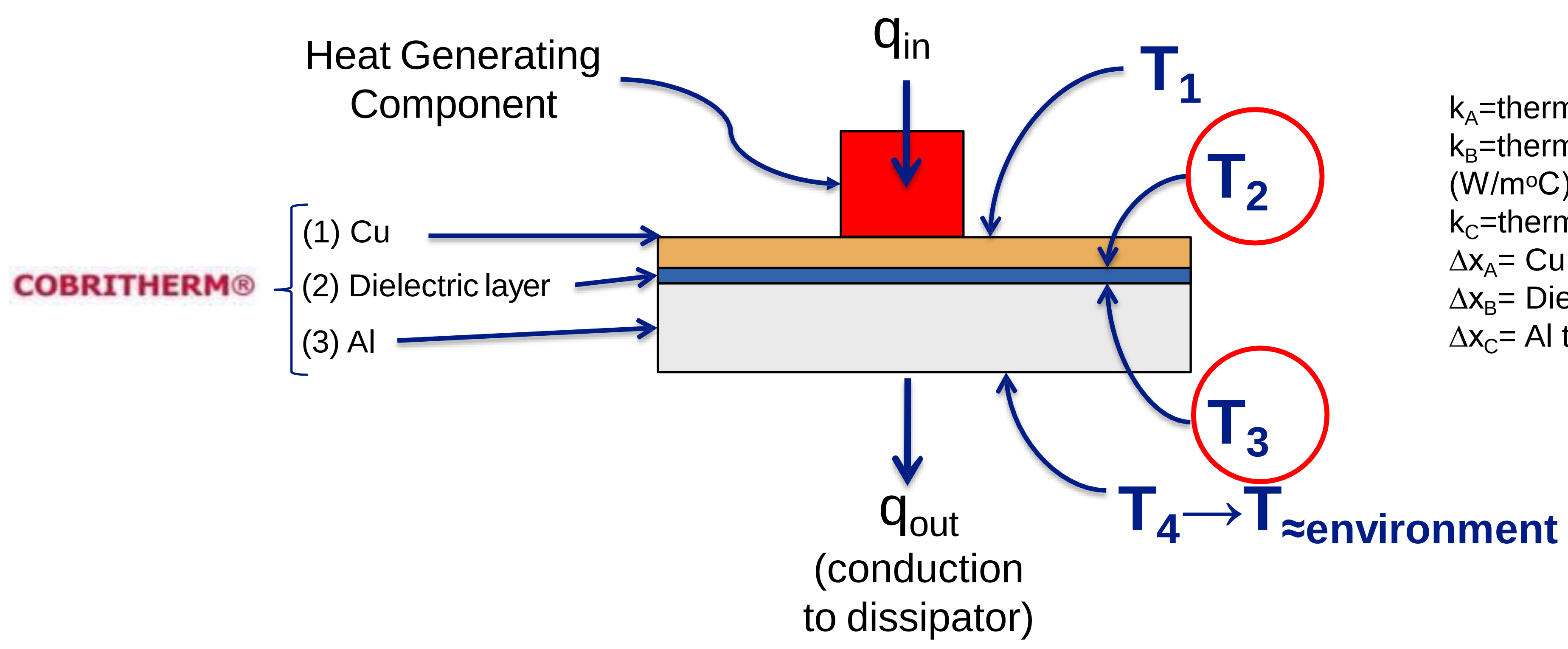




Insulated Metal Substrate allows:

- Processing by standard PCB procedures.
- Integrating heat dissipation with no need for extra components.
- SMD assembly process.

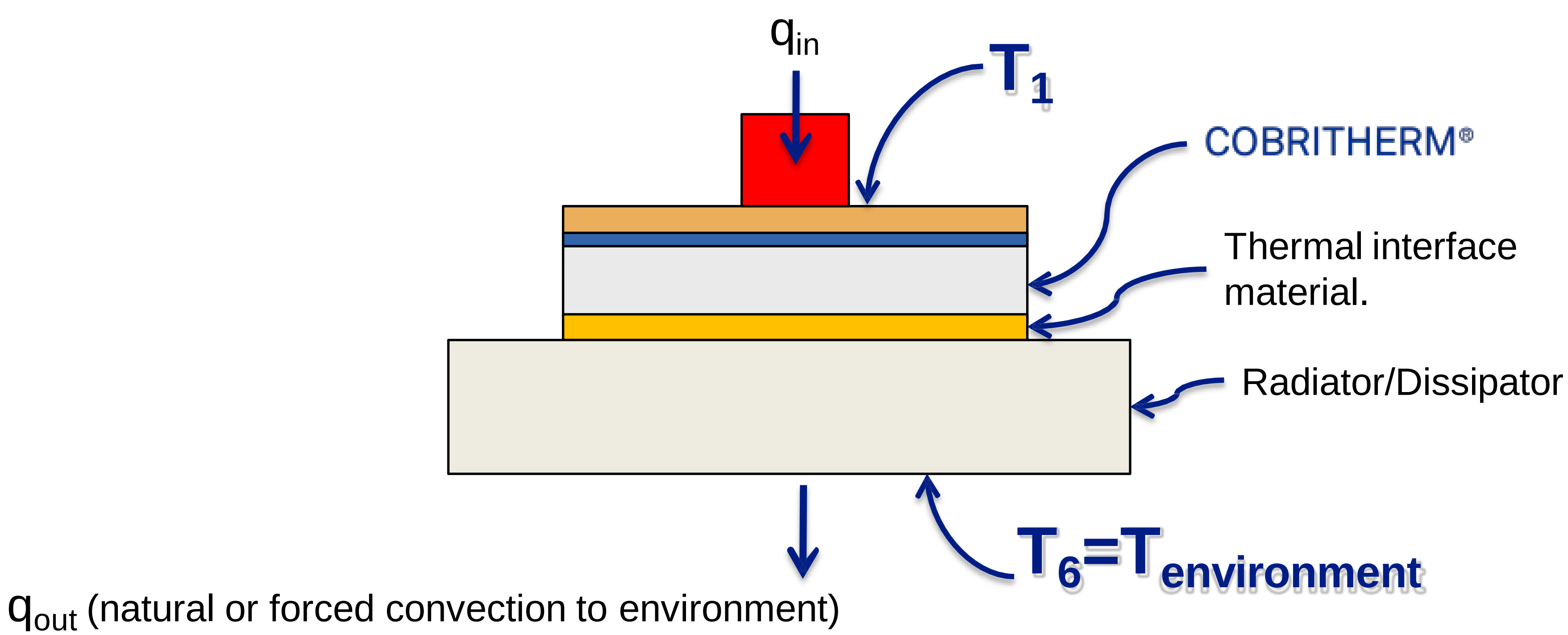
Insulated Metal Substrate (IMS)



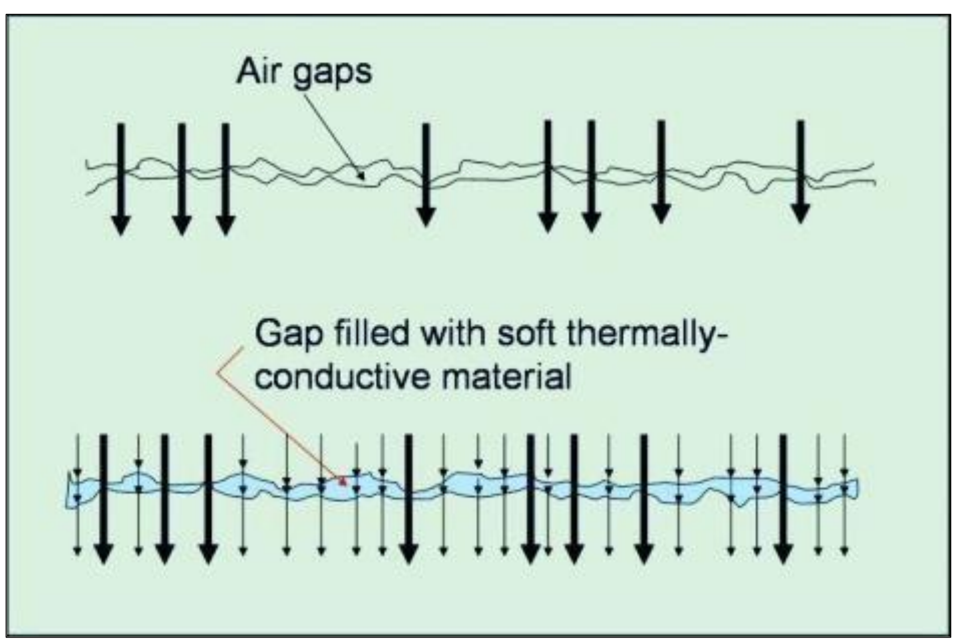
k_A=thermal conductivity of Cu (W/m°C)
k_B=thermal conductivity of dielectric (W/m°C)
k_C=thermal conductivity of Al (W/m°C)
Δx_A= Cu thickness (m)
Δx_B= Dielectric thickness (m)
Δx_C= Al thickness (m)

q, A, fixed by design.
Ideally: $T_1 \rightarrow T_4$ (environment)
So: Small ΔX, Large k desired
Limitations for ΔX: dielectric properties, conductivity, mechanical constraints, production limitations, etc.
Limitations for k: dielectric properties, material choice limitations.

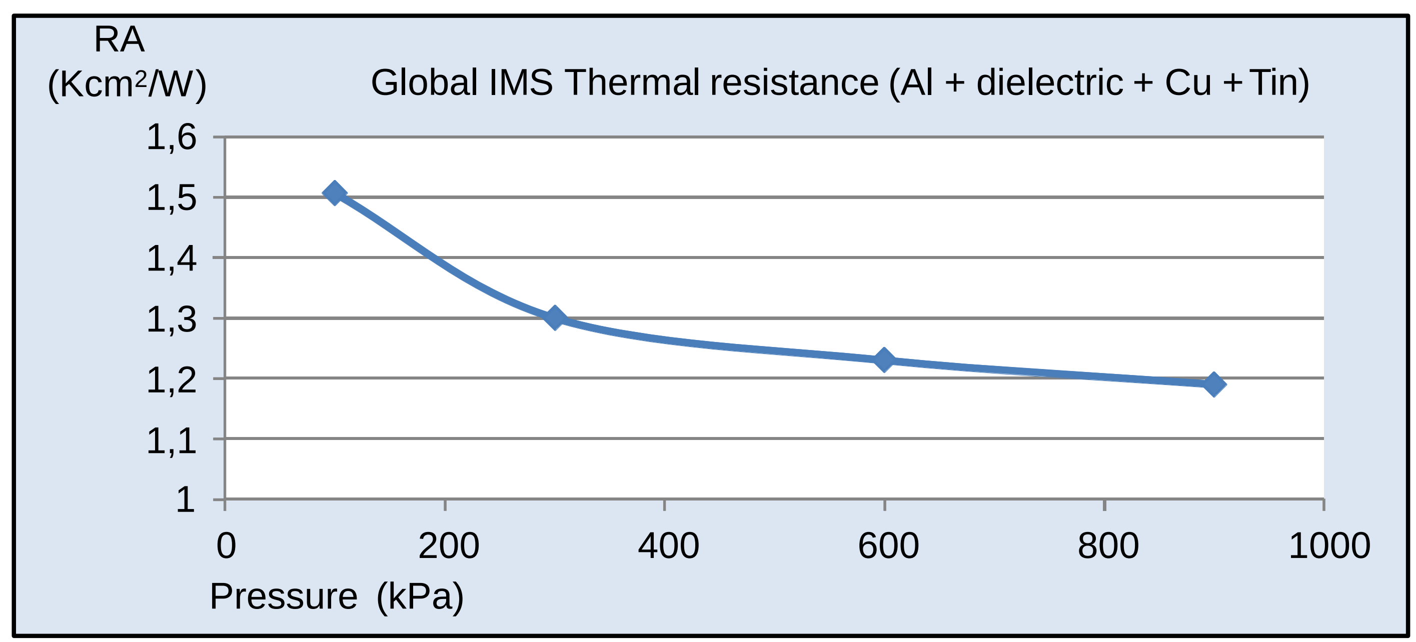
Insulated Metal Substrate (IMS)



Air gaps = Increased thermal resistance

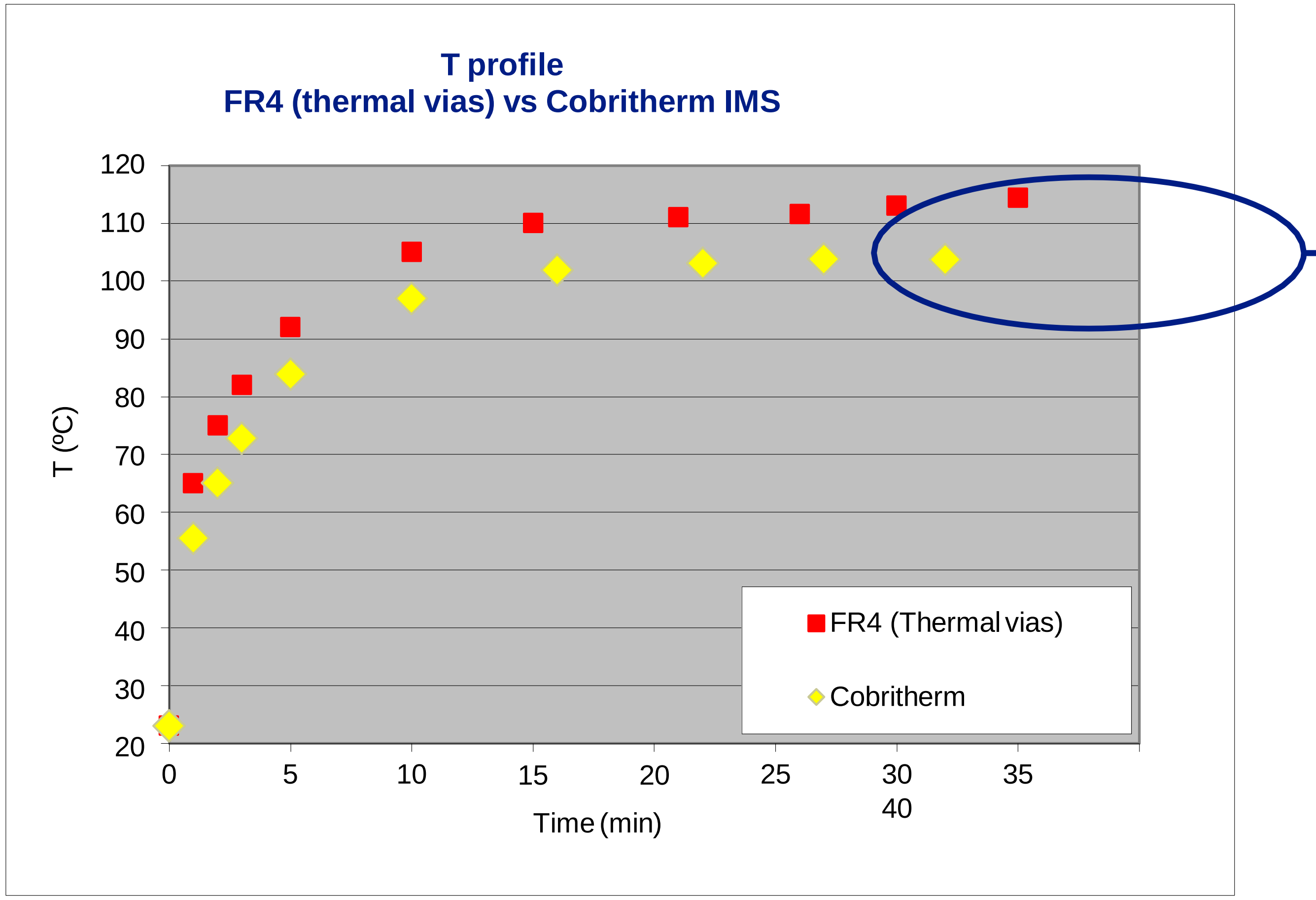


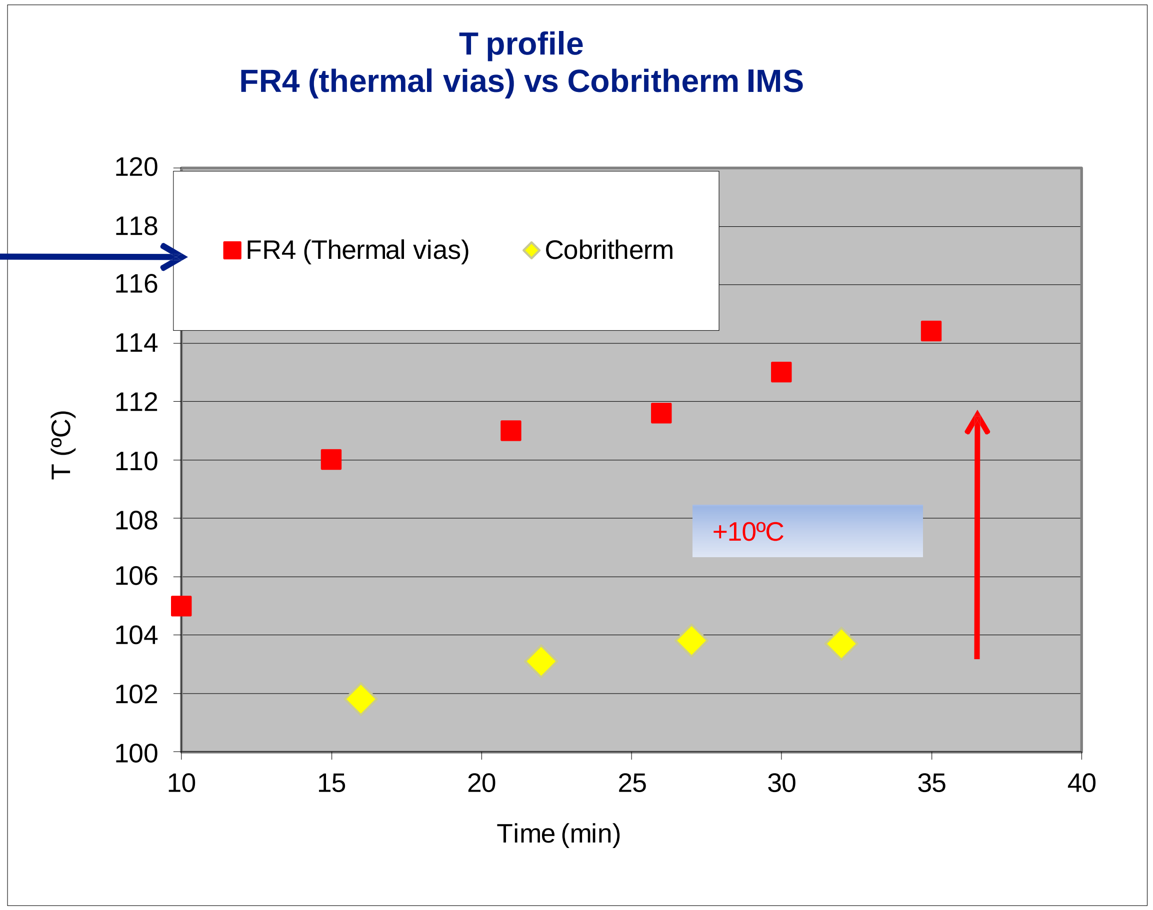
Thermal resistance and pressure



Thermal management

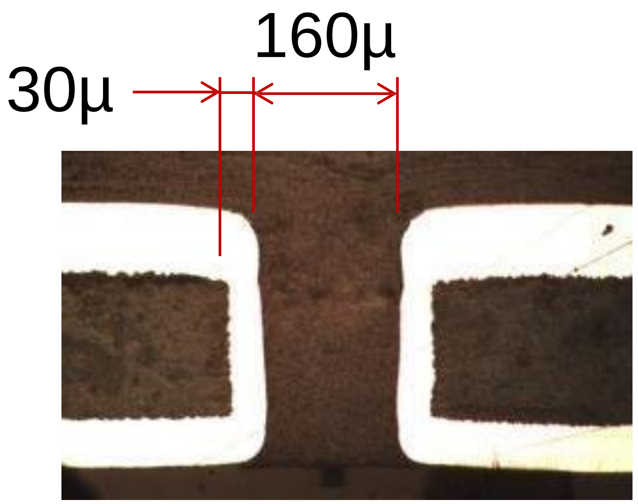
FR4 with thermal vias versus COBRITHERM®





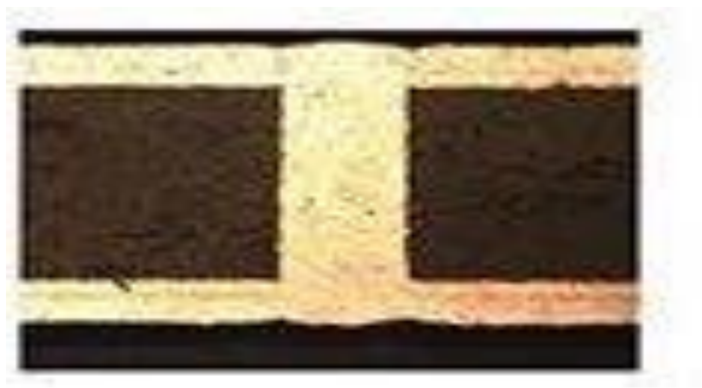
Thermal management

Thermal vias ≠ Thermal filled vias



Thermal vias PTH 200µ

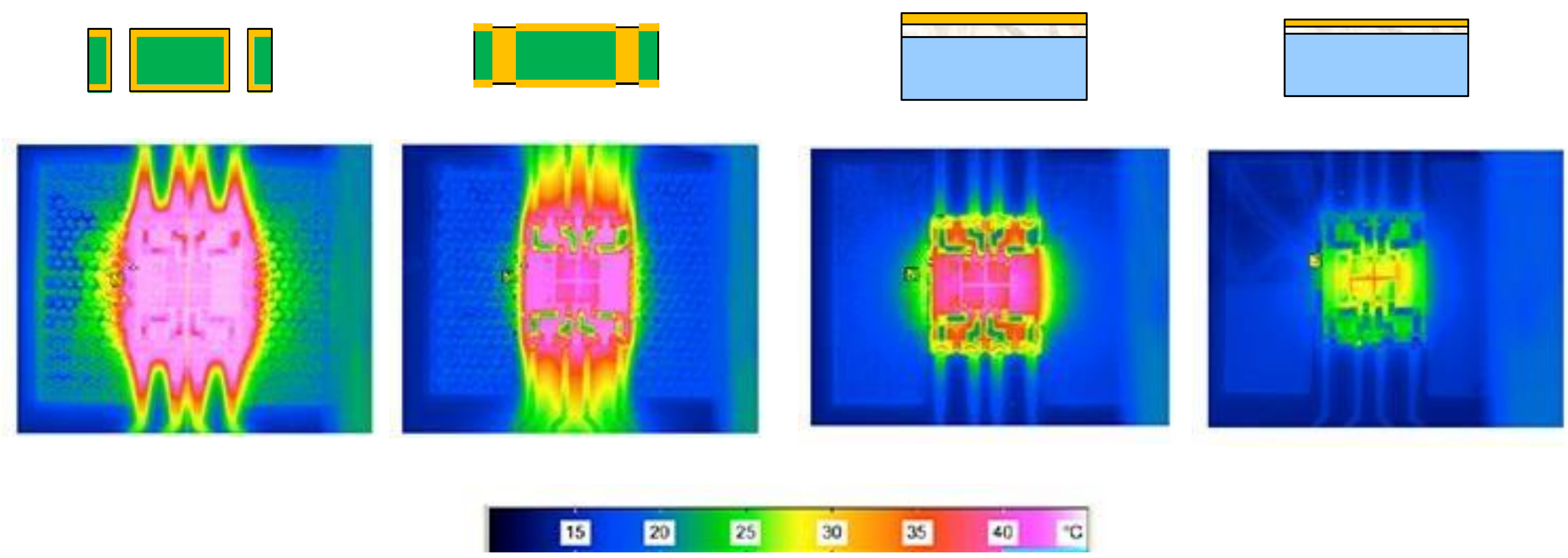
Filled thermal vias 150µ



Thermal management

Thermal vias vs IMS

FR4 1mm With thermal vias	FR4 1mm With filled thermal vias	IMS COBRITHERM ALCUP – G NT	IMS COBRITHERM ULTRATHIN



Thermal management

Basic advantages of IMS COBRITHERM®

- Perfect for cooling surface mount components
- Insulating layer: high electrical insulation + thermal dissipation
- Ideal for thermal dissipation
- Very low thermal resistance
- Greater robustness
- Good PCB workability
- Possibility of larger dimensions than DCBs

Main properties

How do we make Cobritherm?

With **ALUMINUM**

Aluminium type 5052 or 6061: The most suitable for large series and mechanical processes.

With **COPPER**

Type of copper: Electrodeposited Copper (ED Copper) with special dendritic growth finishing.

METAL	Thermal Cond W/mºK	CTE ppm/ºC	Density gr/cc
Aluminium	170	25	2.7
Copper	400	17	8.9

Main properties

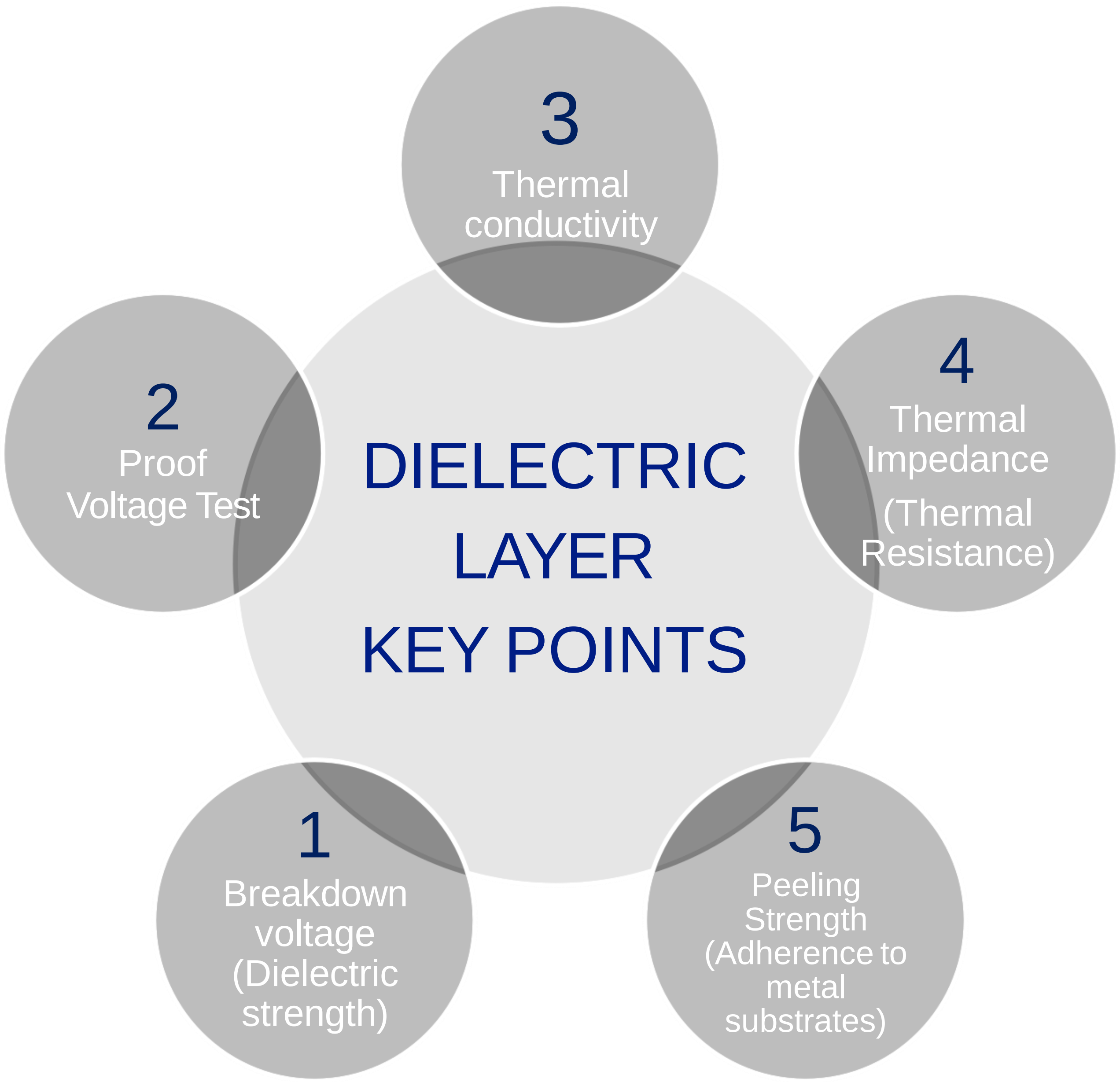
How do we make Cobritherm?

And with a **DIELECTRIC LAYER**:
The most important element in IMS

Organic resin, with ceramic filler to increase thermal conductivity

Filler type, size, shape, etc., determines IMS performances (%Filler-Polymer)

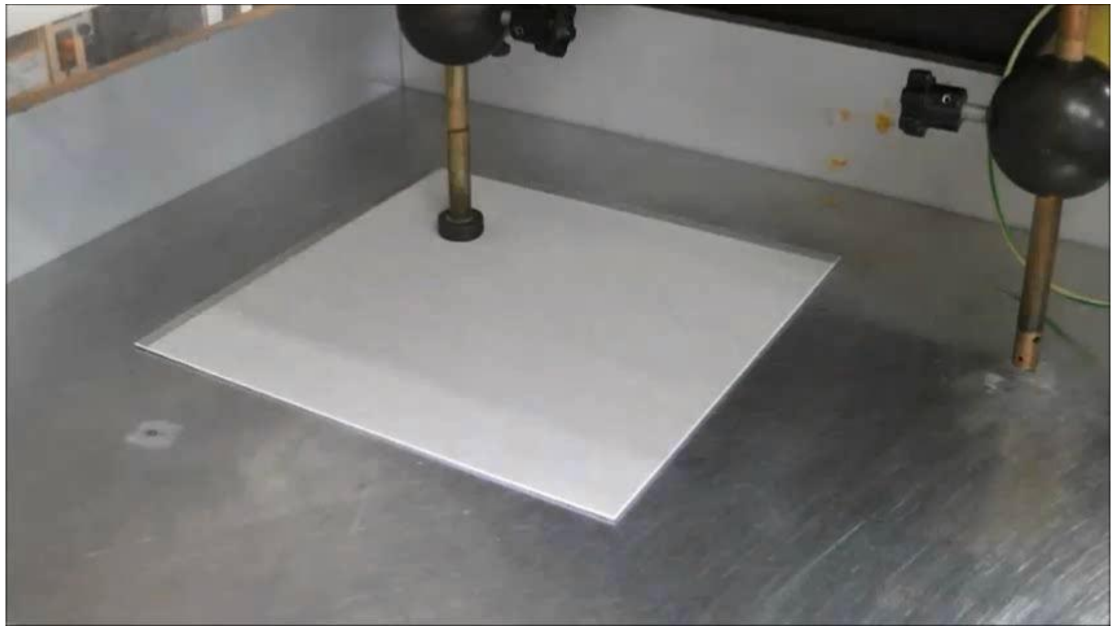
Usual ceramic fillers: Al_2O_3, AlN, BN, …

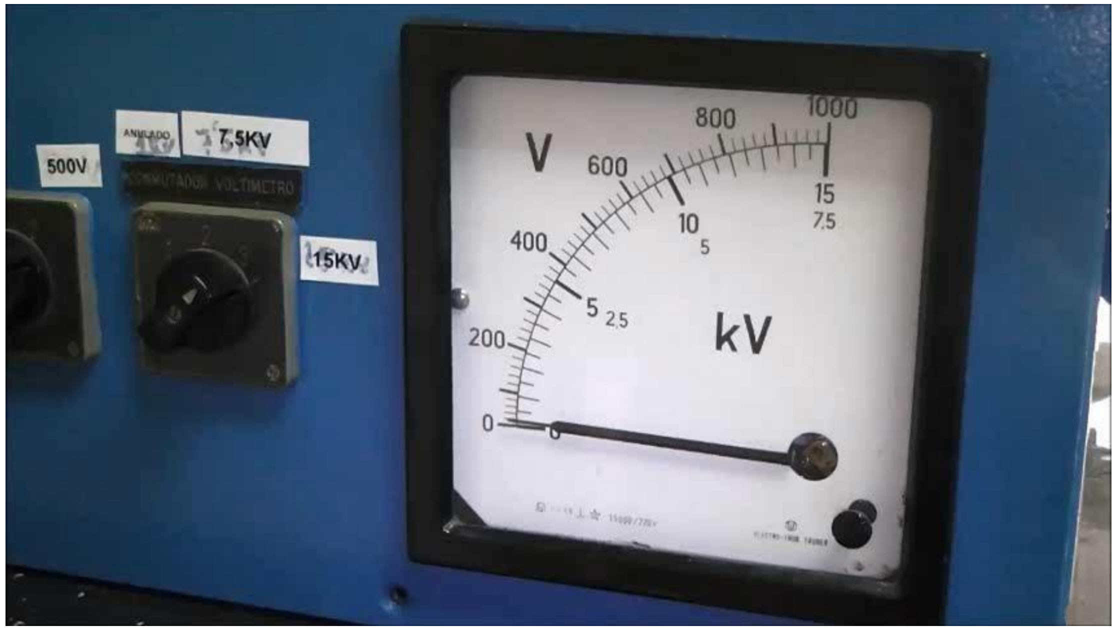


Main properties

1
Breakdown voltage (Dielectric strength)

Breakdown voltage (Dielectric strength)

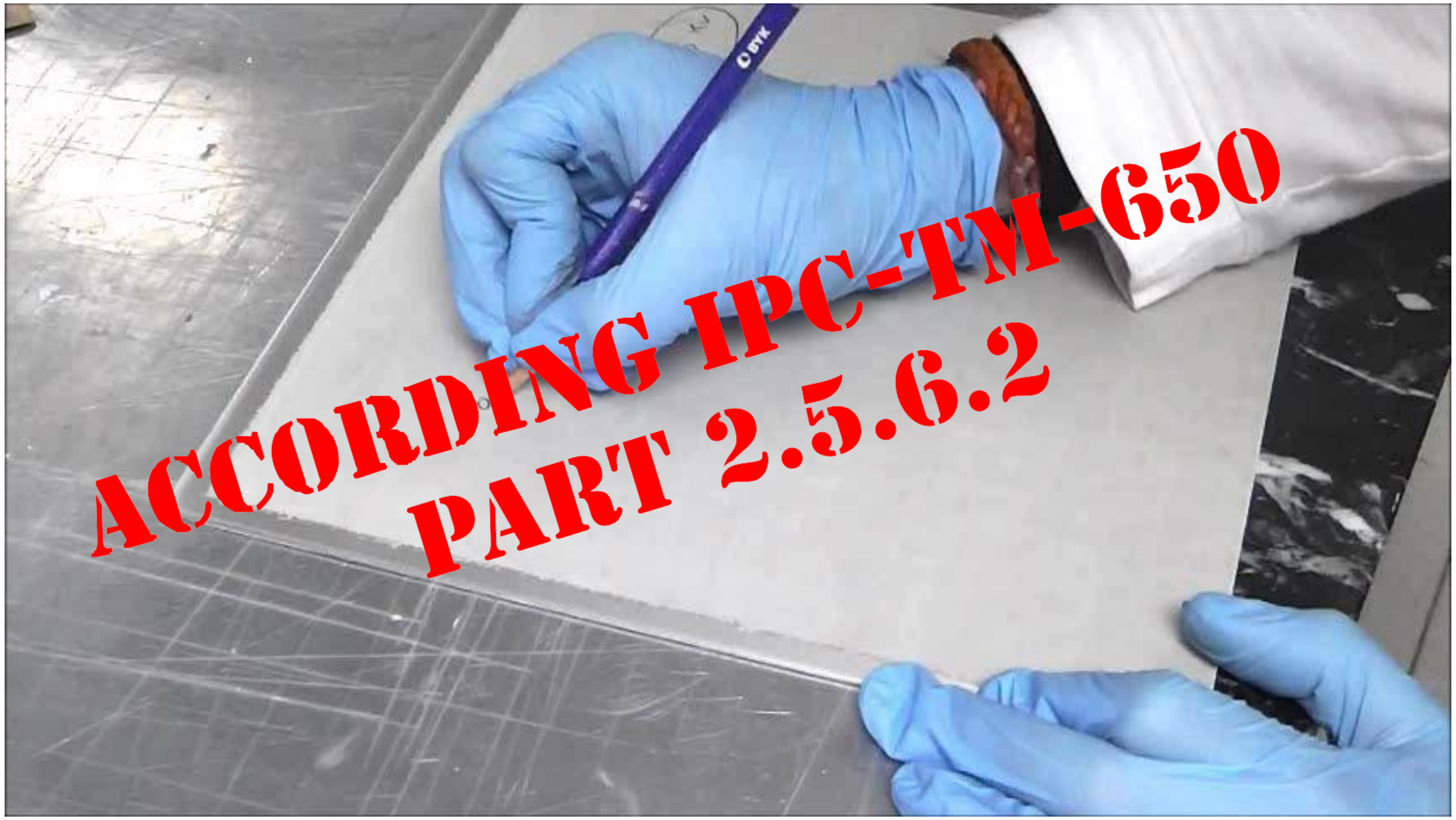




Main properties

1
Breakdown voltage (Dielectric strength)

Breakdown voltage (Dielectric strength)
Performed according IPC-TM-650, part 2.5.6.2



$$\frac{9,25Kv + 9,0Kv + 9,5Kv + 9,0Kv + 8,3Kv}{5} = 9,01\ Kv$$

Main properties

The <u>only worldwide </u>IMS supplier that <u>proof-tests 100% </u>of its production

1
Breakdown voltage

DIELECTRIC BREAKDOWN

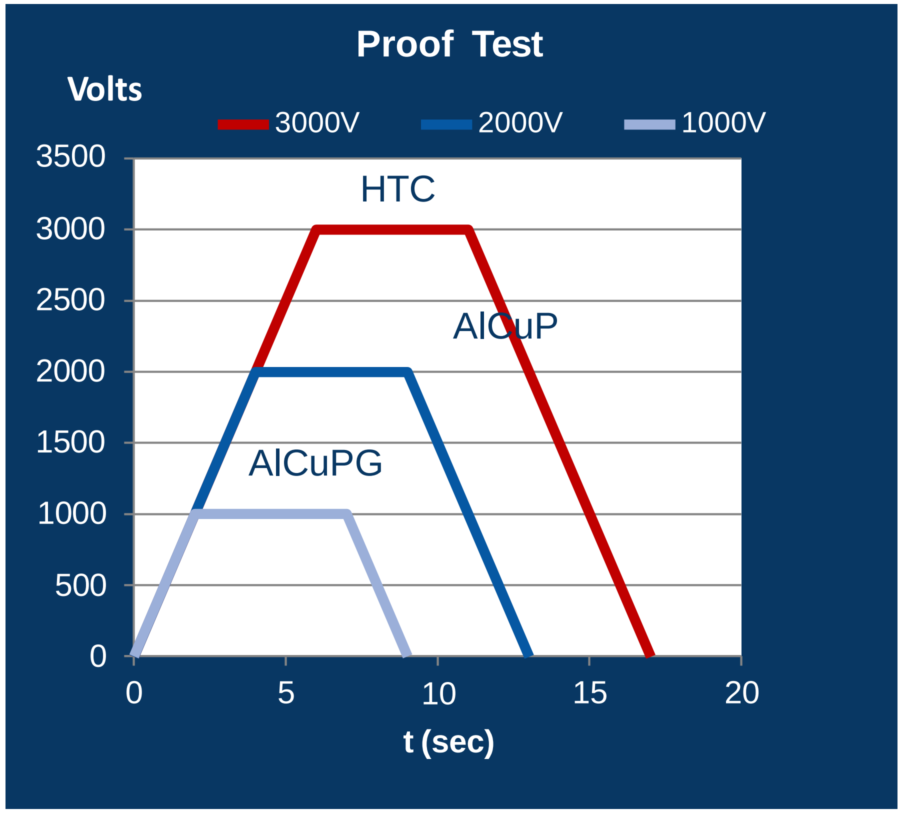
Performed according to IPC-TM-650, part 2.5.6.2. Increases AC voltage until dielectric layer fails by electric short. Test is made on a relatively small surface area on the dielectric part using metal electrodes. Values obtained should be treated statistically, and are only a dielectric performance reference, not guaranteed values.

2
Proof Voltage Test

ELECTRICAL PROOF TEST

Production electric control test, performed in 100% of the Cobritherm sheets: Exposes sheets to a DC (1000, 2000, 3000 V) electric field, raising it at 500 V/min. and holds voltage test for five seconds.

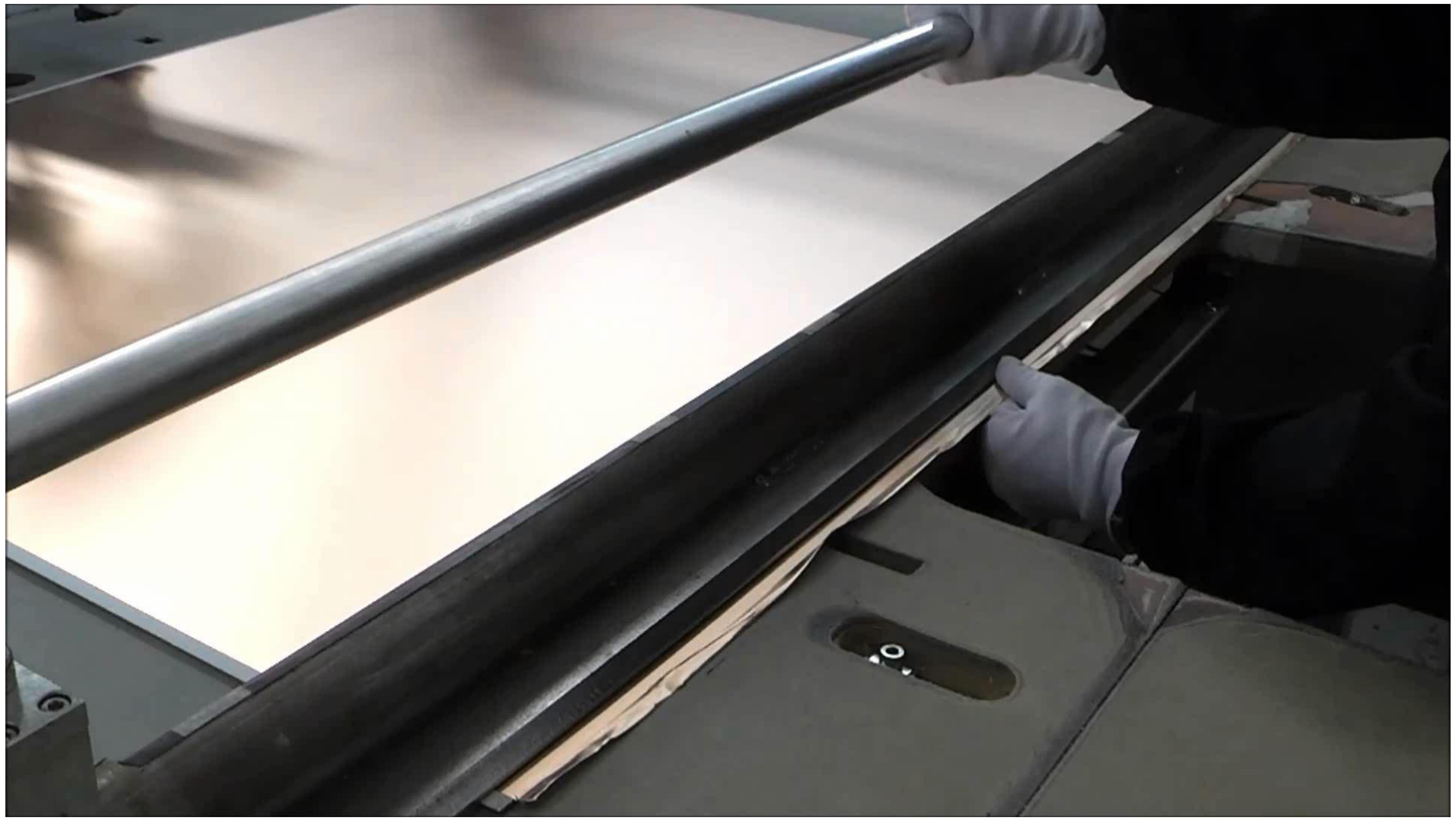
Proof-test from 1000 V DC to 3000 V DC: guarantee for the dielectric request.



Main properties

2
Proof
Voltage Test

Proof test / High Pot Test 3.000 V DC



Main properties

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3

Thermal conductivity

Thermal Conductivity

Thermal Conductivity is the property of a material to conduct heat.
All materials have a thermal conductivity value.

Aluminum Oxide = 40 W/mK
Epoxy resin = 0,2 W/mK

Copper = 400 W/mK
Aluminum = 170 W/mK

LED industry is focus on thermal conductivity values → Thermal resistance is the correct parameter to check

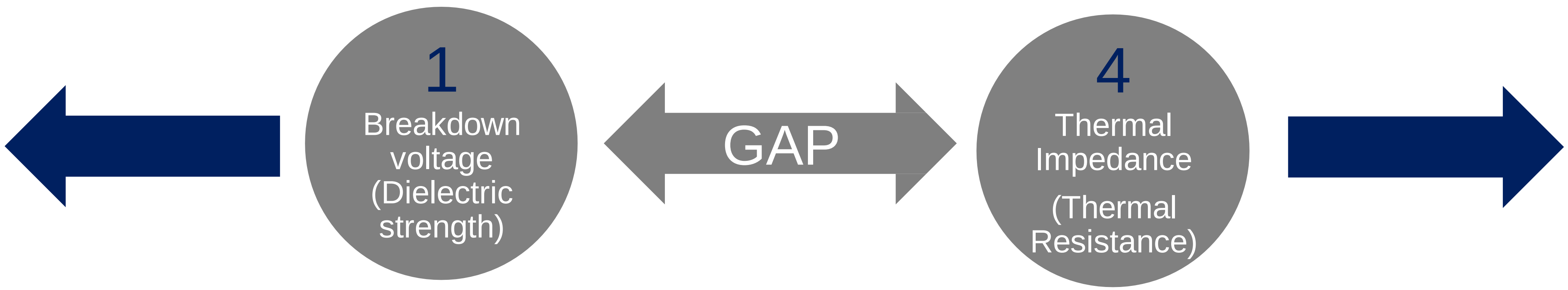
Main properties

Dielectric Strength

«The thicker the better»

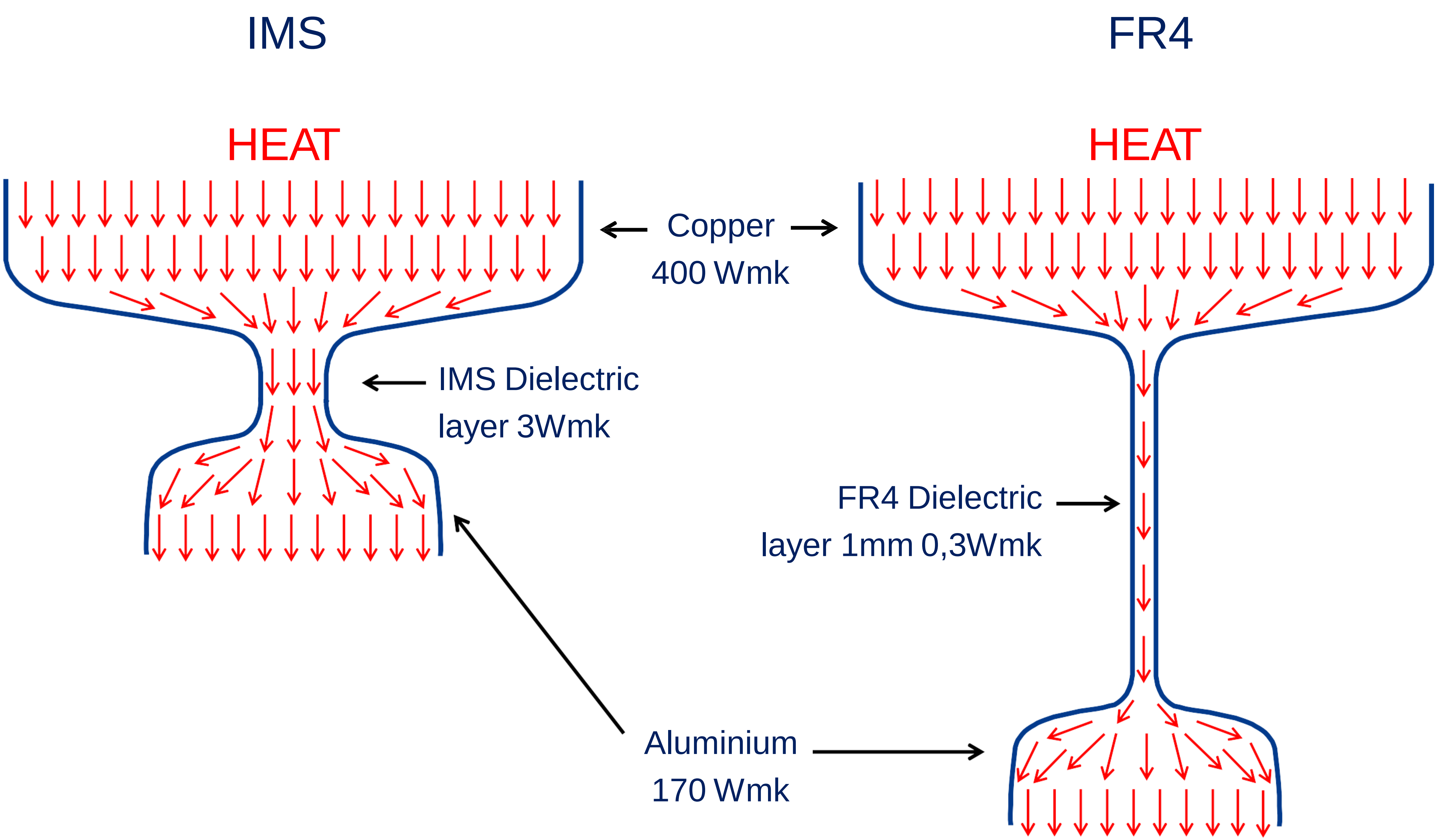
Thermal Resistance

«The thinner the better»



This is the challenge for IMS Suppliers

Main properties



Main properties

4
Thermal Impedance
(Thermal Resistance)

Thermal resistance or Thermal impedance

	Thickness	Copper	Dielectric layer Thickness	Dielectric layer W/mK	Global Conductivity W/mK	Global Thermal resistance (Al+dielectric+Cu) ºC/W
FR4	1mm	35/00	1mm	0,3	0,3	11,11
CEM-3	1mm	35/00	1mm	0,6	0,6	5,56
AlCuP	1,5mm	35/00	120	1,8	21,3	0,260
HTC	1,5mm	35/00	130	2,2	23,7	0,234
Ultrathin	1,5mm	35/00	35	3,2	70,9	0,074
Flextherm	1,5mm	35/00	25	0,7	33,3	0,156
Fastherm	1,5mm(1,4Al+0,1Cu)	35/00	0	--	141,1	0,035

97 %Reduction From FR4

71 %Reduction From AlCup

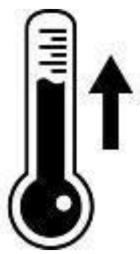
52 %Reduction From Ultrathin

99,7% Reduction From FR4 to Fastherm

Endurance limits – MOT values

MOT Maximum Operation Temperature

A dielectric layer is an organic layer

An organic layer gets deteriorated with: **Time**  **& Temperature** 

Constant high temperature will reduce 2 properties in the dielectric layer:

- Dielectric strength
- Copper adhesion to dielectric layer

$T_g \neq$ MOT

T_g:

Glass transition: Is the reversible transition in amorphous materials from a hard and relatively brittle state into a molten or rubber-like state.

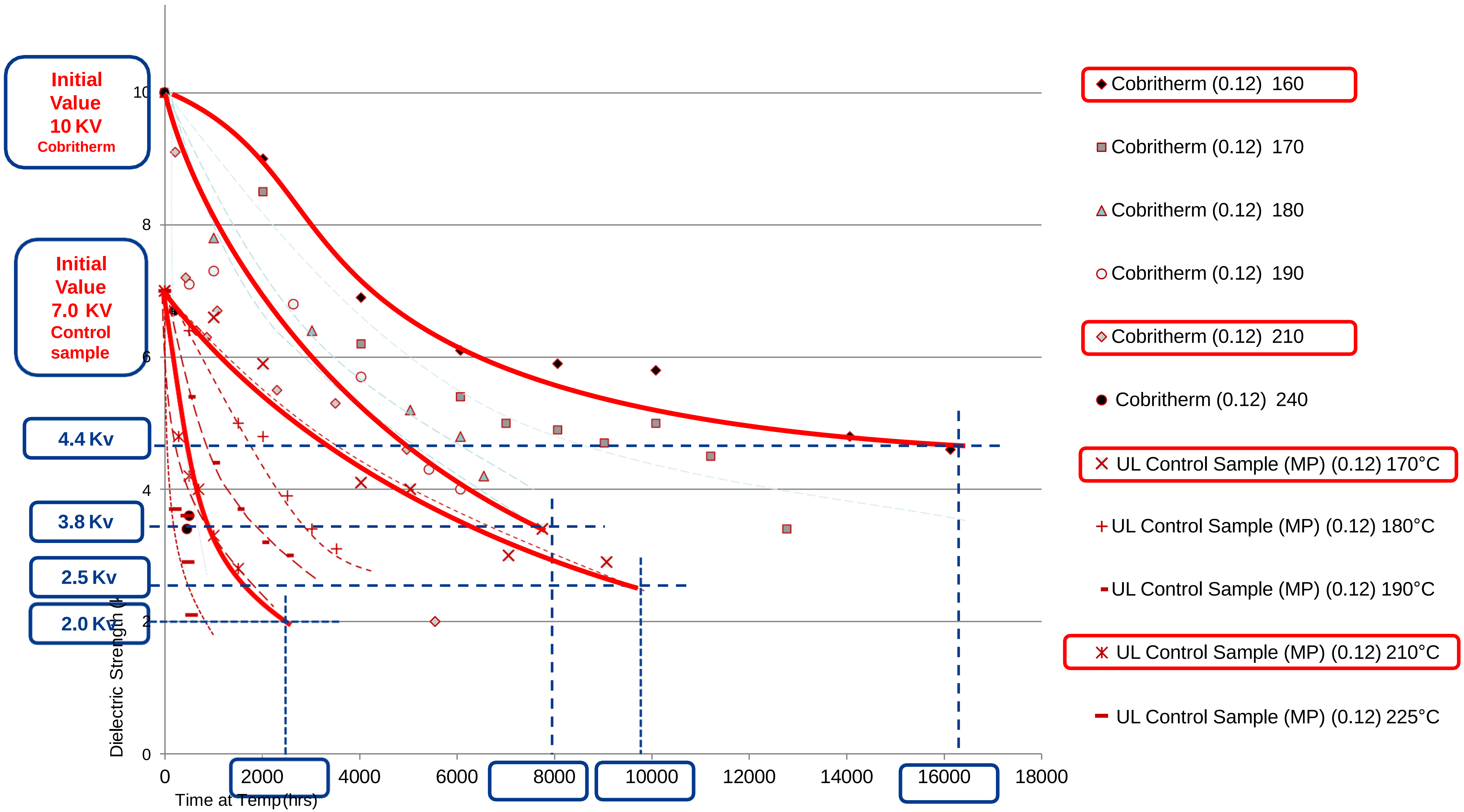
MOT:

An operating temperature is the temperature at which the PCB operates. The PCB will operate effectively within a specified temperature range. Outside this range, the PCB lifetime is dramatically reduced or may fail.

Endurance limits – MOT values

UL Endurance Test – Industry Benchmark

Dielectric strength vs Time at Temperature
COBRITHERM vs Industry Benchmark



THERMAL CONDUCTIVITY

D5470 is the most suitable method vs E1461 for this kind of materials

Steady state measurements like D5470, usually yield the highest level of accuracy, on the order of +/-5-10%, meanwhile time domain techniques such as E1461, the relative uncertainties are on the order of 15-20%, and at time even larger errors.

	D5470	E1461
TECHNIQUE BASED	∉ Steady state technique ∉ Time independent ∉ Direct measure of thermal resistance (apparent thermal conductivity)	∉ Pulsed (time domain) ∉ Time dependent
ASTM STANDARD RECOMMENDATION	∉ Electrical insulating materials for electronic applications	∉ Homogeneous isotropic materials
MAIN MEASURING DIFFERENCES	∉ Temperature of measuring 25-50ºC ∉ Temperature resolution 0.2K	∉ 400-600ºC ∉ 0.05K
CONSIDERATIONS	∉ Interfacial thermal resistance can be calculated	∉ Heat capacity and density have to be calculated to carry out the test

THERMAL CONDUCTIVITY

<table>
<tr><th colspan="3">SELECTED REASON FOR CHOOSING D5470 AS THE BEST METHOD FOR MEASURING THE THERMAL CONDUCTIVITY IN PCB WITH HIGH THERMAL CONDUCTIVITY</th></tr>
<tr><td></td><td>D5470</td><td>E1461</td></tr>
<tr><td></td><td>Specially recommended by ASTM for PCB laminates
(ASTM D5074 paragraph 5.1)</td><td>No comments or instructions related to PCB samples.</td></tr>
<tr><td>TETS CONDITIONS</td><td>∉ Values of conductivity measured at equal or similar electronics working temperature profile.
∉ Interfacial thermal resistances due to the contact between the sample and the equipment as well as the thermal oil, could be measured and excluded from the global resistance</td><td>∉ Only at high T could be carry out the measure.
∉ To reduce deviation high T are recommended (600ºC)
∉ Laser time pulse must be adjusted based on thickness and nature of the sample.
∉ Only one standard ceramic thermal diffusivity reference is available with uncertainty 6%.
∉ Reference specimen and the unknown specimen must be very similar in size, proportions, emissivity and opacity. To assure the correct data, reference and the unknown must be tested very close to each other, both temporally (minutes) and thermally (strictly at the same temperature).
∉ Large number of repeat experiments is needed to reduce random errors</td></tr>
</table>

THERMAL CONDUCTIVITY

SAMPLE	∉ Useful method for ceramics, metals and plastics ∉ Useful for heterogeneous materials	∉ Only for homogenous isotropic and solid materials. ∉ Heterogeneous and anisotropic materials frequently produce erroneous data.
	∉ No sample preparation is needed ∉ Built up metal base laminate is measured ∉ (metal base + dielectric + copper ED) ∉ Samples with reduced thickness or really too thin could be measured	∉ Coating of the specimen with very thin uniform graphite or other high emissivity coating on both faces is required previous to measuring. ∉ Metal base laminate by itself is not possible to be measured ∉ Thickness of the sample must be 1-6mm (only dielectric). ∉ Really big difference thickness between the sample measured and the real built up PCB laminate ∉ Only dielectric layer alone can be measured

RESULTS	∉ Thermal resistance due to internal interfaces are considered (internal built up of the metal base laminate, such as interface between dielectric layer and metal base and copper ED) ∉ Only the thickness of the sample as an external parameter is needed to carry out the calculation of thermal conductivity.	∉ Porosity of the material produce mistakes in the lecture ∉ Heat capacity and density of the specimen it is necessary to measure previously to obtain thermal conductivity. a) This method tends to give erroneous results for specific heat capacity for materials with large anisotropy (typically composites with directional structures). b) Density may be calculated. Error is included due to density is a thermal dependent parameter, and normally is measured at room temperature, and not at 400-600ºC (T used for calculation) c) Increasing of uncertainty due to accumulative measure errors

METHOD DESCRIPTION

D5470

This state technique is based on heat conduction between two parallel, isothermal surfaces separated by a test specimen of uniform thickness. The thermal gradient imposed on the specimen causes the heat flow. Apparent thermal conductivity is directly obtained from this data and the thickness of the specimen. **Fig 1**

E1461

A small, disc specimen is subjected to a high intensity duration radiant energy. The energy of the pulse is absorbed on the front surface of the specimen and the resulting rear face temperature rise (thermal curve) is recorded. The thermal diffusivity value is calculated from the specimen thickness and the time required for the rear face temperature rise to reach a percentage of its maximum value. **Fig 2**

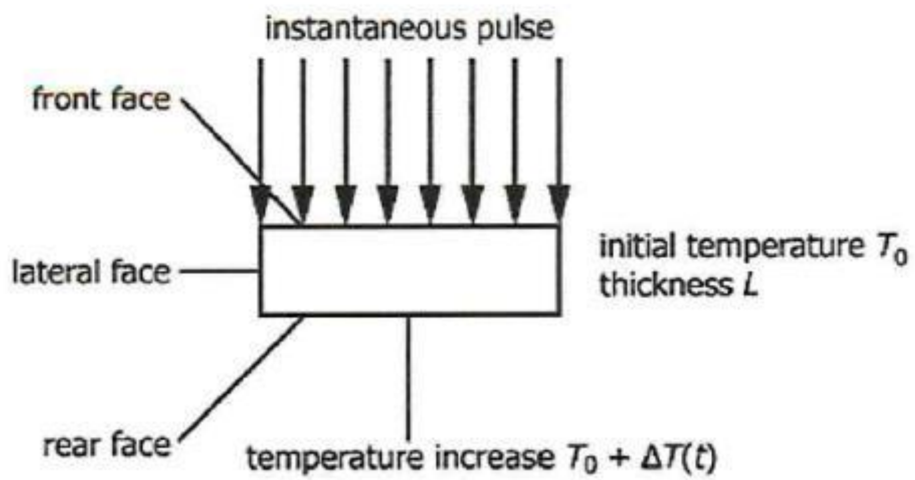


Fig 2 E1461 Schematic for the Flash method

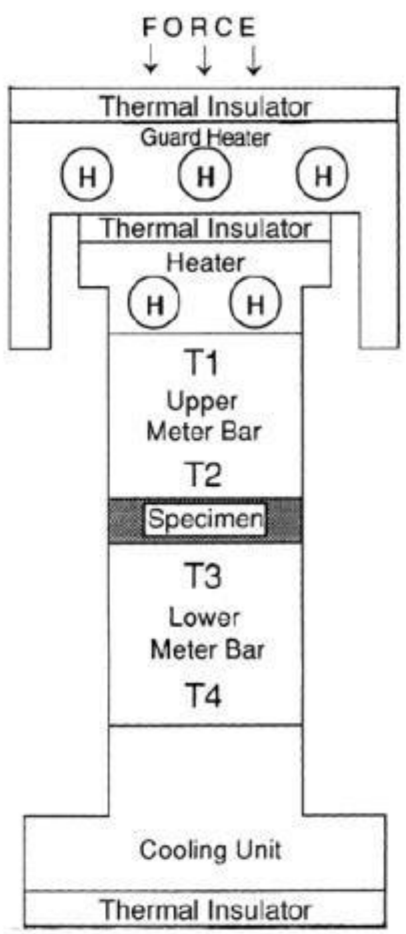


Fig 1 D-5470 Schematic equipment.
Guarded Heater Test Stack

COBRITHERM® ULTRATHIN 35-50-75µm

HTC ULTRATHIN COMPOSITION

Cu 35µm, 70µm, 105µm

Thermal conductive dielectric layer **35-50-75µm**

Al or Cu from 0,5 to 3 mm

RANGE

HTC ULTRA-THIN

- Provides higher thermal performance
- Excellent working temperature.
- Dielectric thickness of 35,50 and 75 µm.
- Thermal resistance Ultrathin 35µm down to 0,11 Kcm^2/W (0,017 $Kinch^2/W$).
- Thermal resistance Ultrathin 50µm down to 0,15 Kcm^2/W (0,024 $Kinch^2/W$).
- Thermal resistance Ultrathin 75µm down to 0,23 Kcm^2/W (0,036 $Kinch^2/W$).
- Offers excellent thermal dissipation conditions for high power LED applications.

	Composition				Dielectric layer					
	Aluminium		Copper		Thickness		Conductivity		Thermal impedance	
							1	2	3	4
	mm	inch	mic	Onz	mic	(mil)	W/mK	W/inchK	Kcm^2/W	Kin^2/W
Ultrathin 35µm	1,5	0,059	35	1	35	1,4	**3,2**	0,081	0,109	0,017
Ultrathin 50µm	1,5	0,059	35	1	50	2,0	**3,2**	0,081	0,156	0,024
Ultrathin 75µm	1,5	0,059	35	1	75	3,0	**3,2**	0,081	0,234	0,036

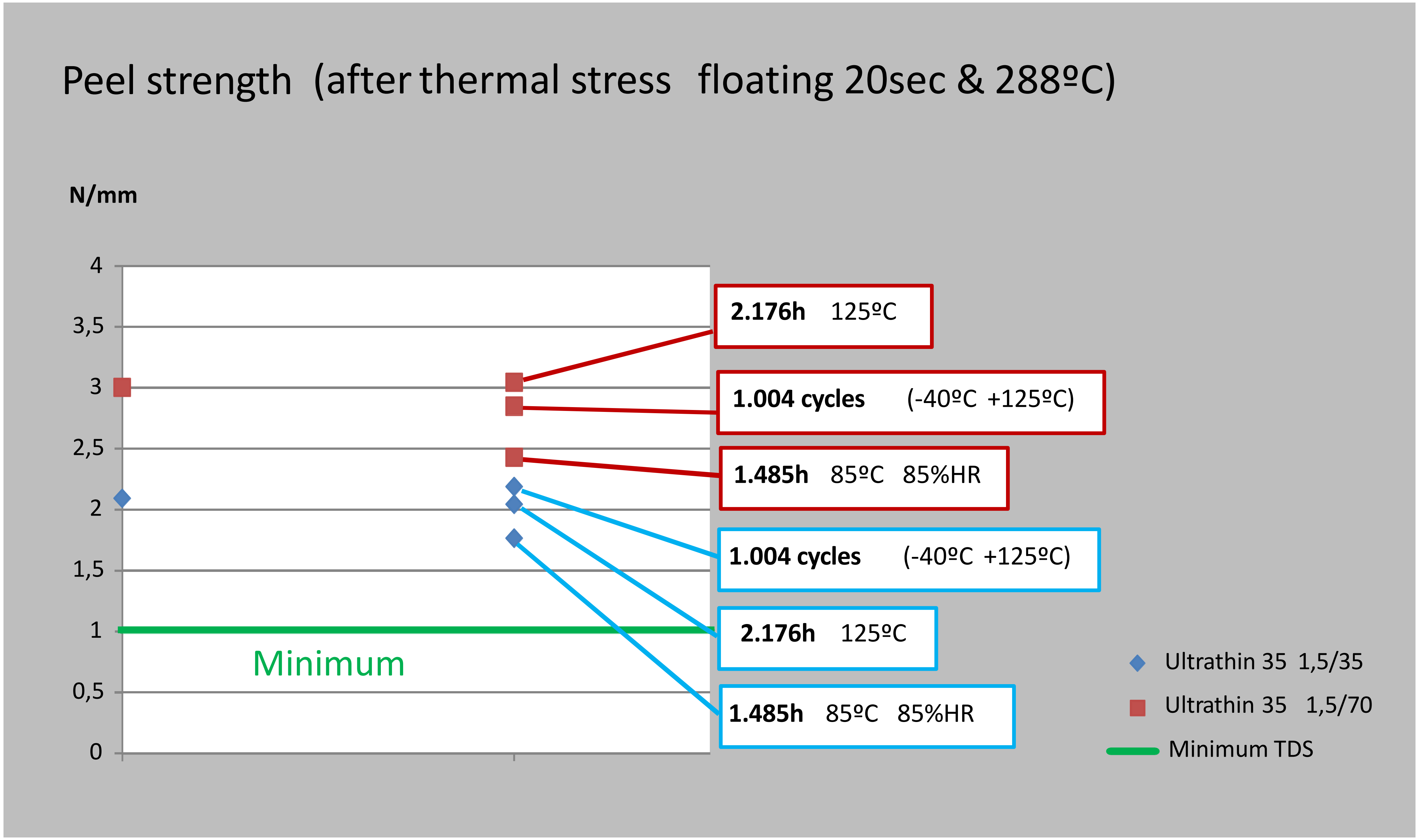
MPCB - Constructions

COBRITHERM® HTC ULTRA-THIN

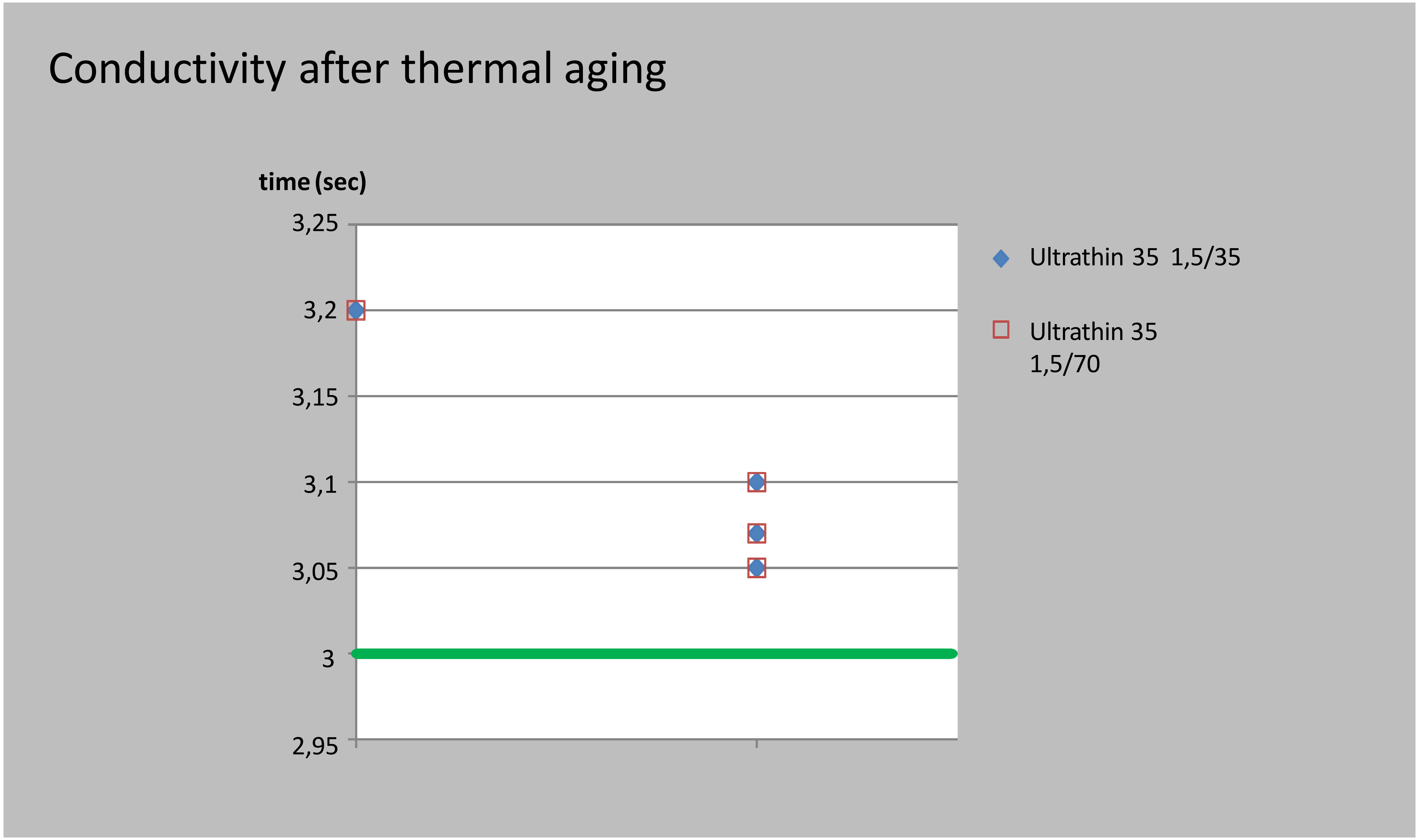
- Provides higher thermal performance.
- Excellent working temperature.
- Dielectric thickness of only 35 microns.
- Thermal resistance down to 0,11 Kcm² /W (0,017 Kinch/W) which offers excellent thermal dissipation conditions for high power LED applications.

	Composition				Dielectric layer							
	Aluminium		Copper		Thickness		Conductivity		Thermal impedance			
							1	2	3	4	5	
	mm	inch	mic	Onz	mic	(mil)	W/mK	W/inchK	Kcm²/W	Kin²/W	ºC/W	
Ultrathin 35µm	1,5	0,059	35	1	35	1,4	**3,2**	0,081	0,109	0,017	0,036	
Ultrathin 50µm	1,5	0,059	35	1	50	2,0	**3,2**	0,081	0,156	0,024	0,052	
Ultrathin 75µm	1,5	0,059	35	1	75	3,0	**3,2**	0,081	0,234	0,036	0,078	

Aging cycles



Aging cycles



COBRITHERM® ULTRATHIN 35-50-75µm

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ULTRATHIN
35µm

DATA SHEET DS_160208

COBRITHERM HTC 3,2W 35 ULTRA THIN LAYER (PROOF TEST 1000V)

DESCRIPTION **Insulated Metal Substrate (IMS), based aluminum clad with ED copper foil on the opposite side. It is designed for the reliable thermal dissipation of circuitry. A proprietarily formulated polymer-ceramic ultra thin bonding layer with high thermal conductivity and dielectric strength allows us to guarantee thermal endurance.** **The material is supplied with a film on the aluminum side to protect it against wet PCB processes.**			
ROHS compliance directive 2002/95/EC and REACH Nº 1907/2006			
STANDARD CONSTRUCTIONS			
Aluminum thickness, m (in)	1000 (0.039) – 1500 (0.059) – 2000 (0.078) – 3000 (0.12)	Aluminium Alloy / Treat	5052
Insulation thickness, m	35 micron (1,37 mils)	Dielectric thickness tolerance	± 10 m (0,4mils)
ED copper thickness, m	35 (1oz) – 70 (2oz) – 105 (3oz) - 210 (6oz)		
Other constructions available upon request			
UL Approved , QMTS2, QMTS8 File: E47820	**IPC 4101**		

(1) **Electrical proof test. 100% of our laminate production delivered, has been "on line" verified at 1000v V_{dc}: 500 V/sec. ramp // 5sec.**

PROPERTIES 1500 m Al / 35 m dielectric /70 m Cu	TEST METHOD	UNITS	TYPICAL VALUES	Guaranteed values
Time to blister at 288ºC, floating on solder (50 x 50 mm)	IEC-61189	Sec	>120	>60
Copper Peel strength, after heat shock 20 sec/288ºC (Cu 70mic)	IPC-TM 650-2.4.8	N/mm (Lb/in)	2,0 (16,0)	>1,5 (>10,3)
Dielectric breakdown voltage, AC **(2)**	IPC-TM 650-2.5.6.3	kV	3	2.5
Proof Test, DC **(1)**	--	V	1000	1000
Thermal conductivity (dielectric layer)	ASTM-D 5470	W/mK (W/inK)	3,20 (0,081)	3,00 (0,076)
Thermal impedance (dielectric layer) **HTC 35**	ASTM-D 5470	Kcm^2/W (Kin^2/W)	0,11 (0,017)	0,12 (0,018)
Surface resistance after damp heat and recovery	IEC-61189	MΩ	10^5	10^5
Volume resistivity after damp heat and recovery	IEC-61189	MΩm	10^4	10^4
Relative permittivity after damp heat and recovery, 10 kHz	IEC-61189	-	4,5	4,5
Dissipation factor after damp heat and recovery 10 kHz	IEC-61189	-	0,02	0,02
Comparative tracking index (CTI)	IEC-61112	V	600	>550
Permittivity	--	pF/m (pF/in)	6,7 (39,4)	6,7 (39,4)
Flammability, according UL-94, class	UL-94	class	V-0	V-0
Glass transition temperature of dielectric layer (by TMA)	IPC-TM 650-2.4.24	ºC	120	120
Maximum operating temperature	--	ºC	150	150

COBRITHERM® ULTRATHIN 35-50-75µm

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ULTRATHIN

50 µm

DATA SHEET DS_160307

COBRITHERM HTC 3,2W 5 0 m i c ULTRA THIN LAYER (PROOF TEST 750V)

DESCRIPTION

Insulated Metal Substrate (IMS), based aluminum clad with ED copper foil on the opposite side. It is designed for the reliable thermal dissipation of circuitry. A proprietarily formulated polymer-ceramic ultra thin bonding layer with high thermal conductivity and dielectric strength allows us to guarantee thermal endurance.

The material is supplied with a film on the aluminum side to protect it against wet PCB processes.

ROHS compliance directive 2002/95/EC and REACH Nº 1907/2006

STANDARD CONSTRUCTIONS

Aluminum thickness, m (in)	1000 (0.039) – 1500 (0.059) – 2000 (0.078) – 3000 (0.12)	Aluminum Alloy / Treat	5052
Insulation thickness, m	50 micron (2 mils)	Dielectric thickness tolerance	± 20 m (0,8mils)
ED copper thickness, m	35 (1oz) – 70 (2oz) – 105 (3oz) - 210 (6oz)		

Other constructions available upon request

UL Approved , QMTS2, QMTS8 File: E47820 **IPC 4101**

(1) **Electrical proof test. 100% of our laminate production delivered, has been "on line" verified at 750V**

PROPERTIES 1500 m Al / 50 mic dielectric /70 mic Cu	TEST METHOD	UNITS	TYPICAL VALUES	Values
Time to blister at 288°C, floating on solder (50 x 50 mm)	IEC-61189	Sec	>120	>60
Copper Peel strength, after heat shock 20 sec/288°C (Cu 35mic)	IPC-TM 650-2.4.8	N/mm (Lb/in)	1,5 (8,5)	>1,0 (>5,7)
Dielectric breakdown voltage, AC **(2)**	IPC-TM 650-2.5.6.3	kV	2,5	2,0
Proof Test, DC **(1)**	--	V	750	750
Thermal conductivity (dielectric layer)	ASTM-D 5470	W/mK (W/inK)	3,20 (0,081)	3,00 (0,076)
Thermal impedance (dielectric layer)	ASTM-D 5470	Kcm^2/W (Kin^2/W)	0,16 (0,024)	0,17 (0,026)
Comparative tracking index (CTI)	IEC-61112	V	600	>550
Flammability, according UL-94, class	UL-94	class	V-0	V-0
Glass transition temperature of dielectric layer (by TMA)	IPC-TM 650-2.4.24	°C	120	120
Maximum operating temperature	--	°C	150	150

COBRITHERM® ULTRATHIN 35-50-75µm

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ULTRATHIN

75 µm

DATA SHEET DS_160307

COBRITHERM HTC 3,2W 7 5 m i c ULTRA THIN LAYER (PROOF TEST 750V)

DESCRIPTION **Insulated Metal Substrate (IMS), based aluminum clad with ED copper foil on the opposite side. It is designed for the reliable thermal dissipation of circuitry. A proprietarily formulated polymer-ceramic ultra thin bonding layer with high thermal conductivity and dielectric strength allows us to guarantee thermal endurance.** **The material is supplied with a film on the aluminum side to protect it against wet PCB processes.**			
ROHS compliance directive 2002/95/EC and REACH Nº 1907/2006			
STANDARD CONSTRUCTIONS			
Aluminum thickness, m (in)	1000 (0.039) – 1500 (0.059) – 2000 (0.078) – 3000 (0.12)	Aluminum Alloy / Treat	5052
Insulation thickness, m	75 micron (2 mils)	Dielectric thickness tolerance	+ 20 m (0,8mils)
ED copper thickness, m	35 (1oz) – 70 (2oz) – 105 (3oz) - 210 (6oz)		
Other constructions available upon request			
UL Approved , QMTS2, QMTS8 File: E47820		**IPC 4101**	

(1) **Electrical proof test. 100% of our laminate production delivered, has been "on line" verified at 750V**

PROPERTIES **1500 m Al / 50 mic dielectric /70 mic Cu**	**TEST METHOD**	**UNITS**	**TYPICAL VALUES**	**Values**
Time to blister at 288ºC, floating on solder (50 x 50 mm)	IEC-61189	Sec	>120	>60
Copper Peel strength, after heat shock 20 sec/288ºC (Cu 35mic)	IPC-TM 650-2.4.8	N/mm (Lb/in)	1,5 (8,5)	>1,0 (>5,7)
Dielectric breakdown voltage, AC **(2)**	IPC-TM 650-2.5.6.3	kV	3,5	3,0
Proof Test, DC **(1)**	--	V	750	750
Thermal conductivity (dielectric layer)	ASTM-D 5470	W/mK (W/inK)	3,20 (0,081)	3,00 (0,076)
Thermal impedance (dielectric layer)	ASTM-D 5470	Kcm^2/W (Kin^2/W)	0,23 (0,016)	0,25 (0,039)
Comparative tracking index (CTI)	IEC-61112	V	600	>550
Flammability, according UL-94, class	UL-94	class	V-0	V-0
Glass transition temperature of dielectric layer (by TMA)	IPC-TM 650-2.4.24	ºC	120	120
Maximum operating temperature	--	℃	150	150

Recognised OEM Customers

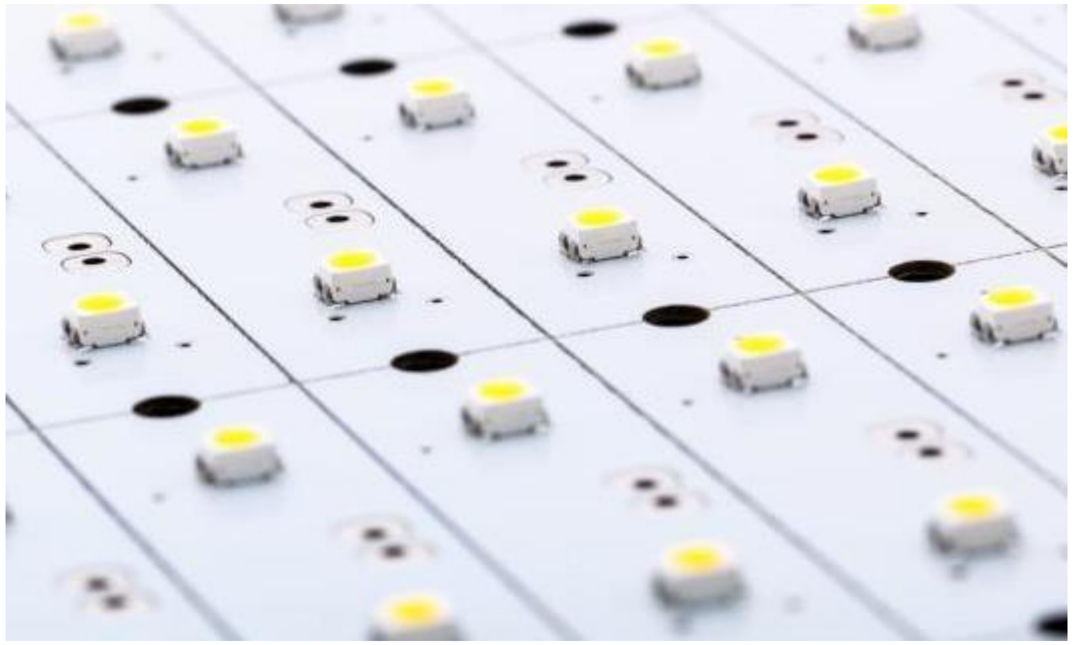
Delco Remy
HELLA
AL Automotive Lighting
NEW POL®
SIEMENS
B/S/H/ BSH Bosch und Siemens Hausgeräte GmbH
CHERRY
Merloni Elettrodomestici spa
DIOFLEX®
DELPHI
MAGNETI MARELLI
iGuzzini
ZKW
Valeo Service
Herkules Elektronik GmbH
Johnson Controls
CANDY
GYS
tyco Electronics
Continental
indra
daisalux
TRW
VLM Since 1945

MPCB - Constructions

FASTHERM®

New technology developed **by AISMALIBAR** to achieve a faster thermal transition from the LED thermal pad into the heat sink.

This superior thermal transition can be achieved by using the entire **COBRITHERM** HTC product range with either a Copper or Copper / Aluminium base.



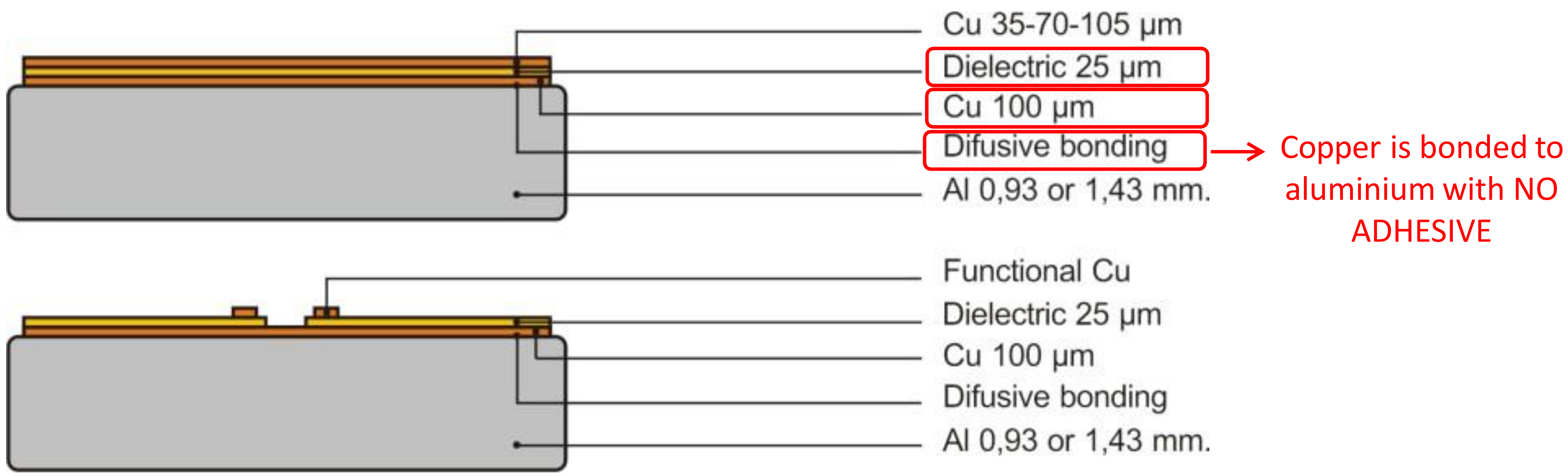
By using AISMALIBAR COBRITHERM HTC range together with FASTHERM technology

LED's operate at **30ºC to 50ºC** lower in temperature due to the direct thermal transition from the thermal pad to the heatsink

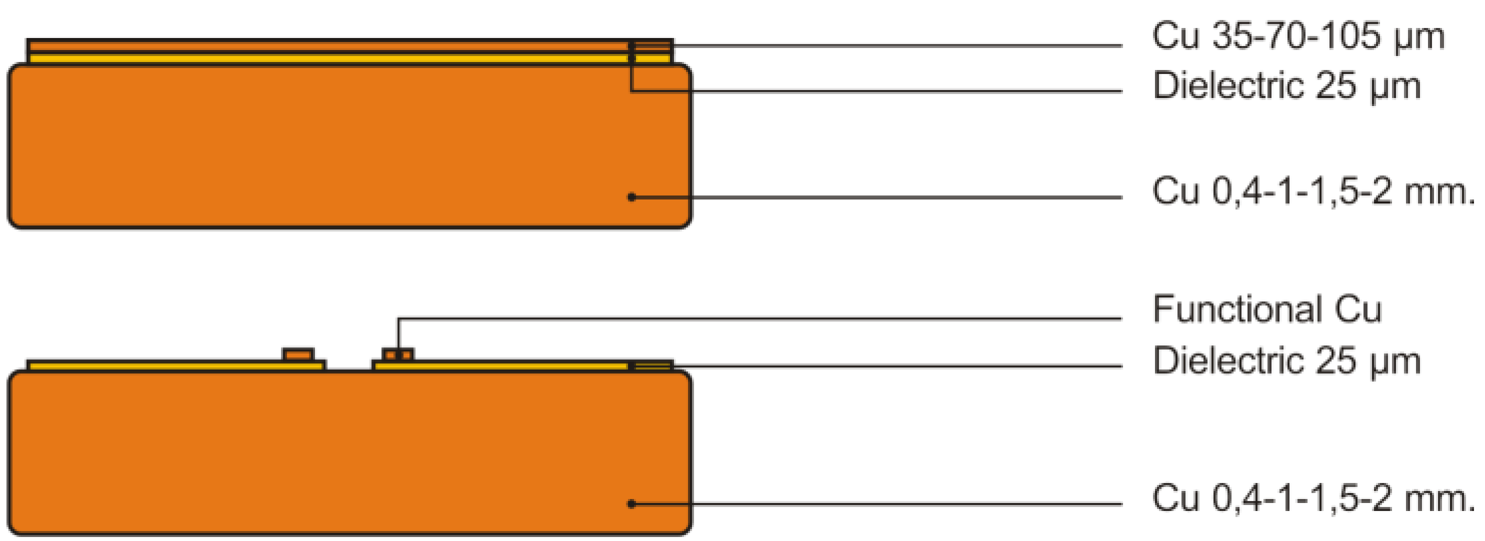
MPCB - Constructions

FASTHERM® COMPOSITIONS

Aluminium / Copper heat sink



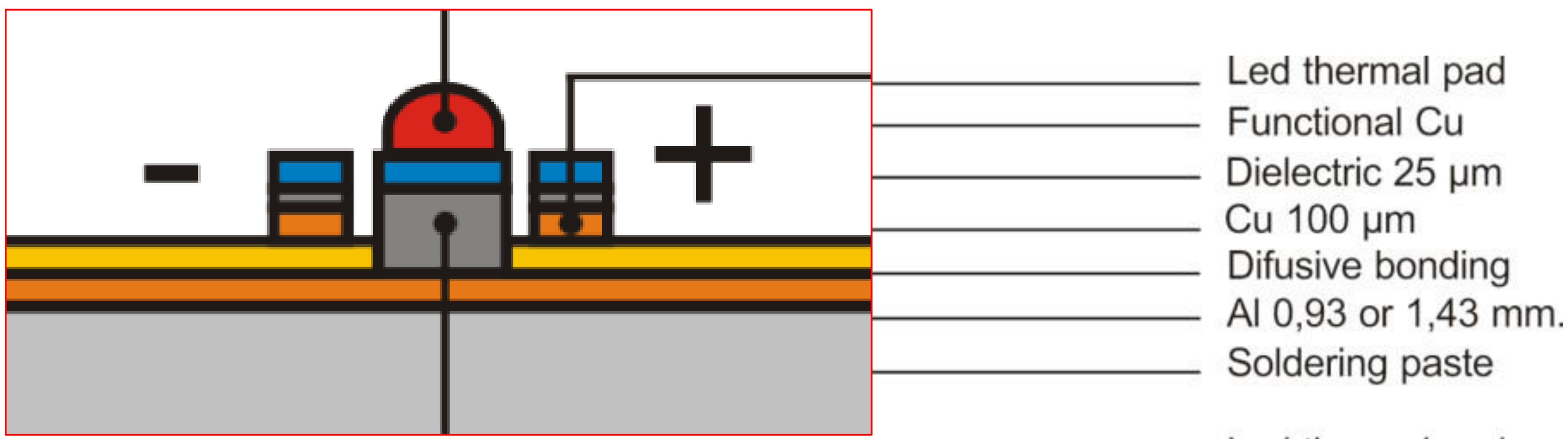
Copper / Copper heat sink

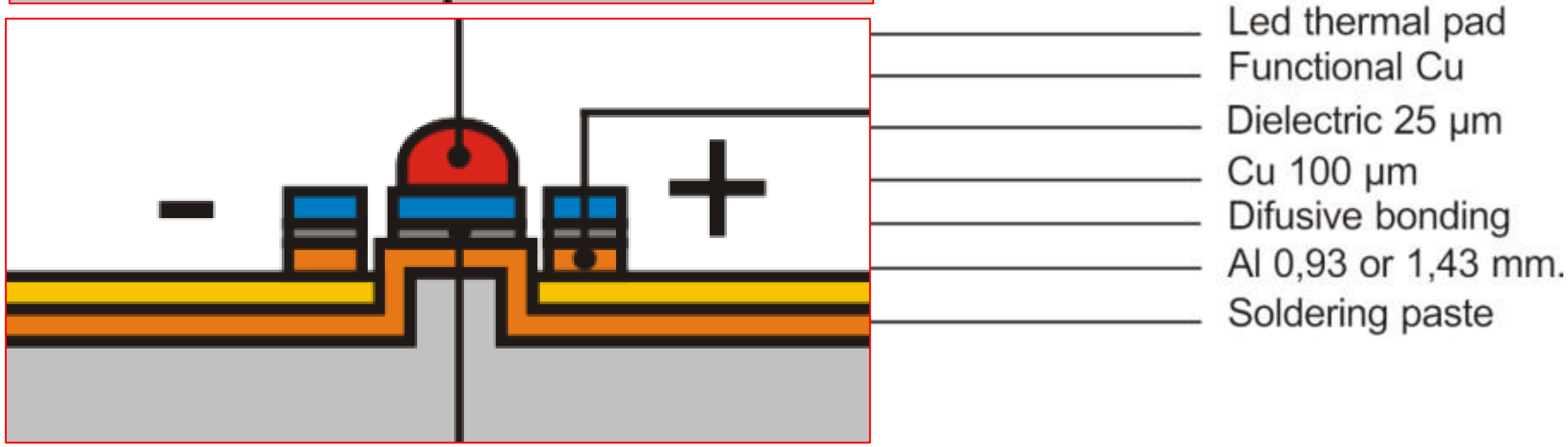


MPCB - Constructions

FASTHERM® COMPOSITIONS

Aluminium / Copper heat sink





MPCB - Constructions

FASTHERM® versus COBRITHERM®

	Composition					Dielectric Layer		IMS (Aluminum + dielectric + copper)				
	Aluminum		Copper (non functional)		Copper	Conductivity		Conductivity ºC/W			Thermal Impedance	
	mm.	inch	mic	onz	mic	W/mK	W/inchK	W/mK	W/inchK	Kcm2/W	Kin2/W	ºC/W
FASTHERM	1,43	0,056	100	2	70			132,8	3,374	0,118	0,018	0,039
ULTRATHIN	1,59	0,059	0	0	70	3,2	0,081	72,2	1,834	0,222	0,034	0,074
HTC 3,2w 90u	1,5	0,059	0	0	70	3,2	0,081	43,1	1,095	0,394	0,061	0,131
AlCuP	1,5	0,059	0	0	70	1,8	0,046	21,7	0,551	0,78	0,104	0,26
AlCuP-G	1,5	0,059	0	0	70	1,3	0,033	16,3	0,414	1,036	0,161	0,345

90%
Thermal resistance reduction

3D MPCB

Bendable and conformable FLEXTHERM®

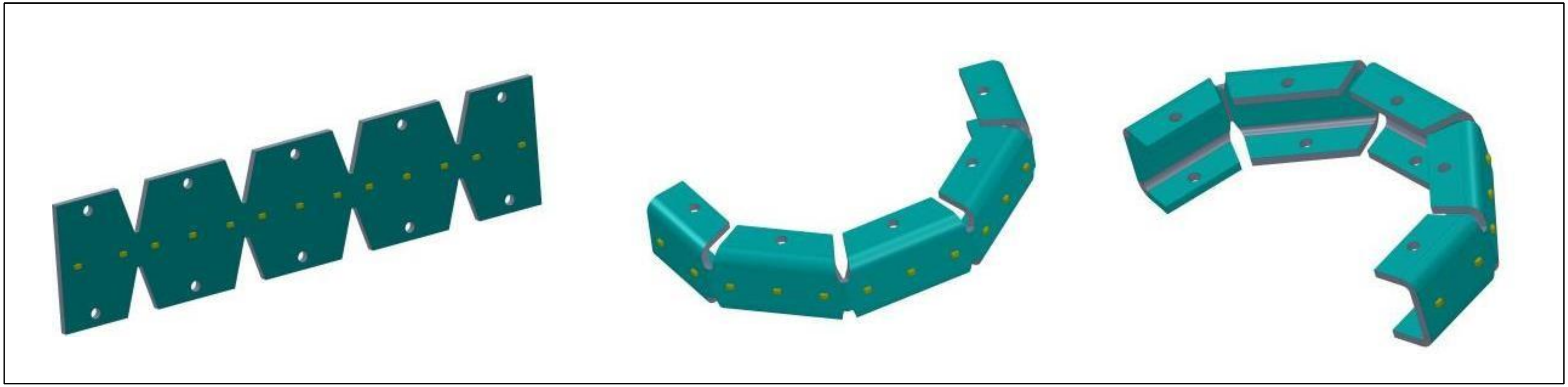
FLEXTHERM is ideal to produce conformable MPCB's which can be bent without compromising the initial dielectric strength between conductive layers. (Al and Cu).

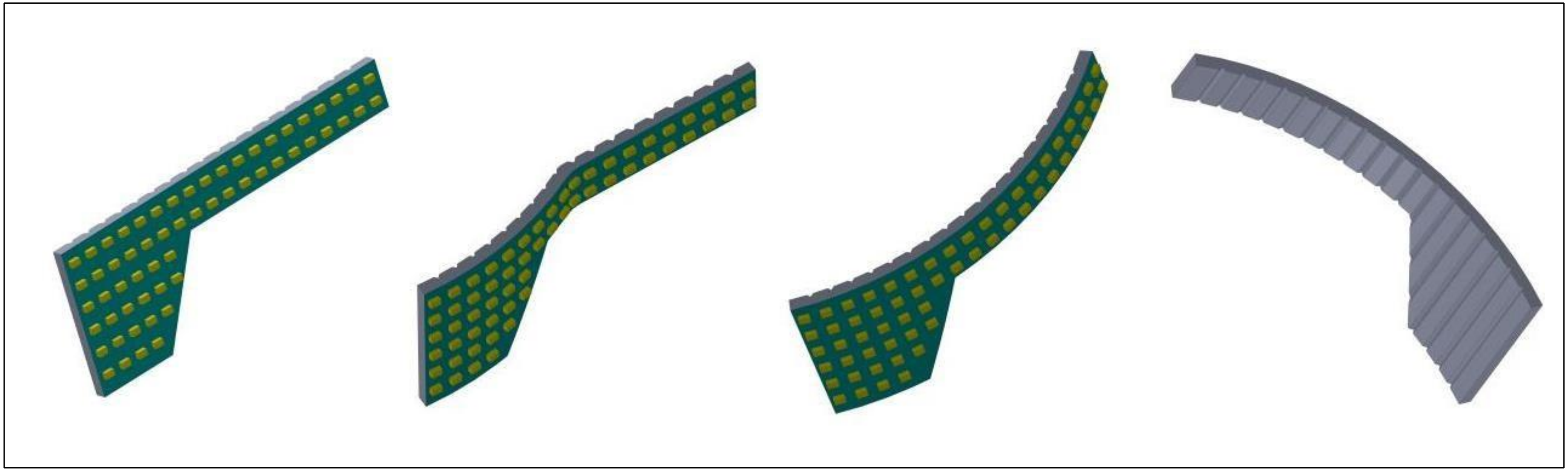
The flexible properties of this material enable it to conform to both the negative and positive radius allowing the product to adapt to the ever changing demands of the industry.

Typical applications for FLEXTHERM are high power LED, power supply modules and the automotive industry.

3D MPCB

Bendable and conformable FLEXTHERM®





FLEXTHERM®

Dullo INTERNATIONAL   Aismalibar

DATA SHEET
FLEXTHERM

DS_160727

DESCRIPTION

Insulated Metal Substrate (IMS), based aluminum clad with RA copper foil on one or both sides. It is designed for the reliable thermal dissipation of circuitry.

FLEXTHERM is ideal for conformable MPCB manufacturing. It can be bent after MPCB production while maintaining the initial dielectric strength in between conductive layers (Al and Cu).

SPECIFICATIONS

- Withstands Lead Free Soldering process
- Excellent for high temperature components applications
- Extremely low thermal impedance
- V-0 Granted
- Halogen Free
- High MOT values
- Produced with RA copper to grant conformable properties

The material is supplied with a film on the aluminium side to protect it against wet PCB processes.

ROHS compliance directive 2002/95/EC and REACH Nº 1907/2006   IPC-4101

STANDARD CONSTRUCTIONS

Aluminium thickness, µm (inch)	800 (0,032) - 1000 (0,039)– 1500 (0,059)	Aluminium Alloy / Treat	1050-3003 -5052-5754
Insulation thickness, µm	25 (0,98 mils) -35 (1.38 mils)	Dielectric thickness tolerance	± 8 µm (0.1 mils)
RA copper thickness, µm	35 (1oz) – 70 (2oz)		
Other constructions available upon request			

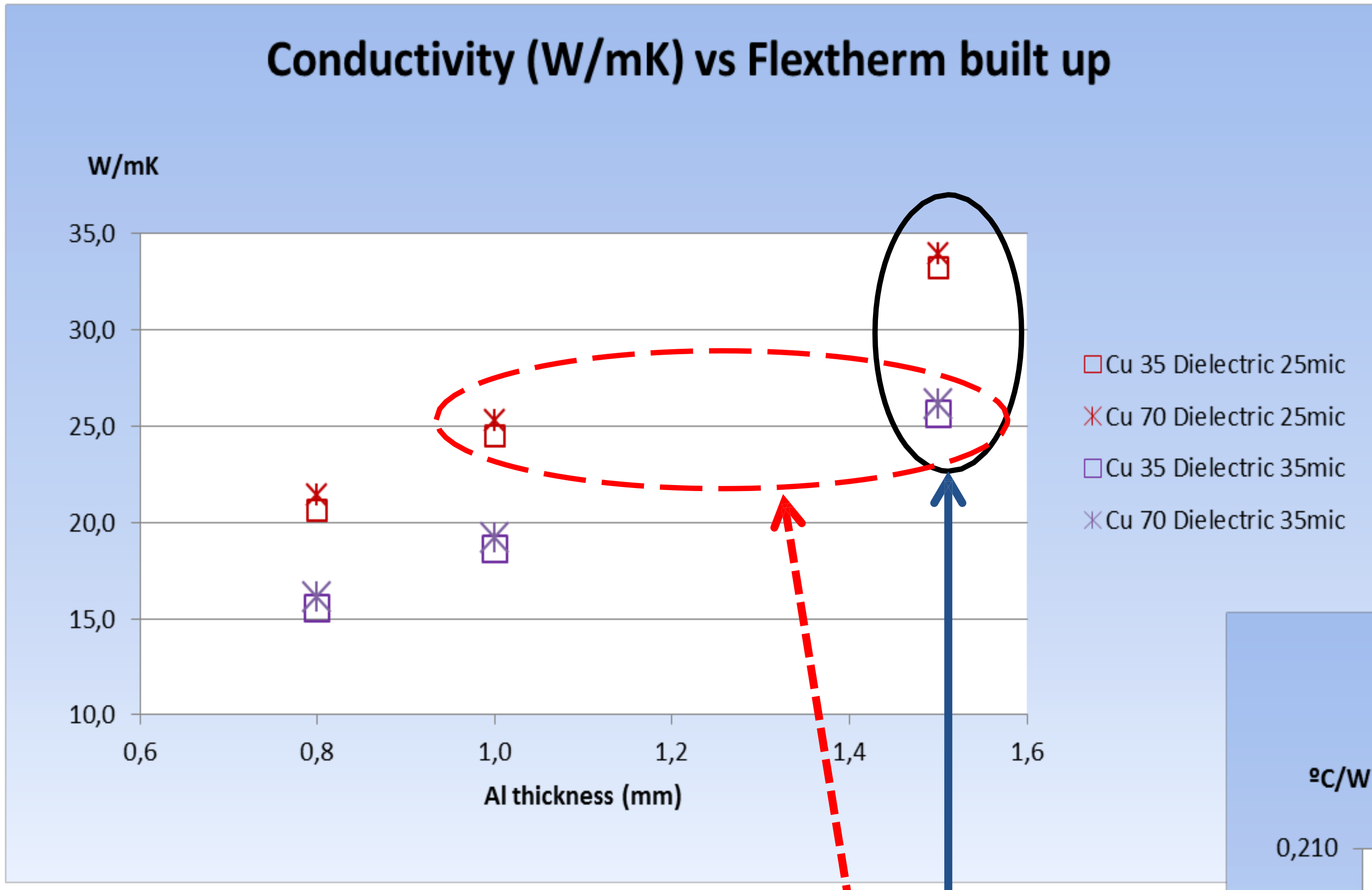
PROPERTIES 1500 µm Al / 25 µm dielectric / 35 µm Cu	TEST METHOD	UNITS	TYPICAL VALUES	Guaranteed values
Time to blister at 288°C, floating on solder (50 x 50 mm)	IEC-61189	sec	>60	>30
Copper Peel strength, after heat shock 20 sec/288°C	IPC-TM 650-2.4.8	N/mm (Lb/inch)	1,5 (16,0)	>1,0 (>10,3)
Dielectric breakdown voltage, AC (1) **Flextherm 25µm**	IPC-TM 650-2.5.6.3	kV	2	2
Dielectric breakdown voltage, AC (1) **Flextherm 35µm**			4	4
Thermal conductivity (dielectric layer)	ASTM-D 5470	W/mK (W/in·K)	0,7 (0,018)	0,6 (0,015)
Flammability, according UL-94, class	UL-94	Class	V-0	V-0
Thermal Impedance °C-m²/watt **Flextherm 25 µm**	Calculated	Kcm²/W (K in²/W)	0,36 (0,055)	0,42 (0,065)
Thermal Impedance °C-m²/watt **Flextherm 35 µm**			0,50 (0,078)	0,58 (0,090)
Maximum Operational Temperature		°C	140	130
Aluminium Thermal Conductivity	ASTM-D 5470	W/mK	135	130
Copper Thermal Conductivity	ASTM-D 5470	W/mK	375	380

(*) Values or parameters measured with a destructive method or limited size for the test sample must be considered as a representative values, and not as guaranteed values. They are not guaranteed over 100% of the material.

Thermal impedance profile

	THERMAL CONDUCTIVITY AND THERMAL IMPEDANCE										
	Composition				Dielectric layer				IMS (Aluminium+dielectric+copper)		
	Aluminium		Copper		Thickness		Cond.	Rth	Cond.	Rth	
	mm	inch	mic	Onz	mic	(mil)	W/mK	ºC/W	W/mK	Kinch2/W	ºC/W
Flextherm 25mic	0,8	0,031	35	1					**20,6**	0,065	0,139
	0,8	0,031	70	2					**21,4**	0,065	0,139
	1	0,039	35	2	25	1,0	**0,7**	0,119	**24,5**	0,067	0,144
	1	0,039	70	2					**25,3**	0,067	0,144
	1,5	0,059	35	1					**33,3**	0,073	0,156
	1,5	0,059	70	2					**33,9**	0,073	0,157
Flextherm 35mic	0,8	0,031	35	1					**15,5**	0,087	0,187
	0,8	0,031	70	2					**16,1**	0,087	0,187
	1	0,039	70	2	35	1,4	**0,7**	0,167	**19,2**	0,089	0,192
	1	0,039	70	2					**19,2**	0,089	0,192
	1,5	0,059	35	1					**25,7**	0,095	0,204
	1,5	0,059	70	2					**26,2**	0,095	0,204

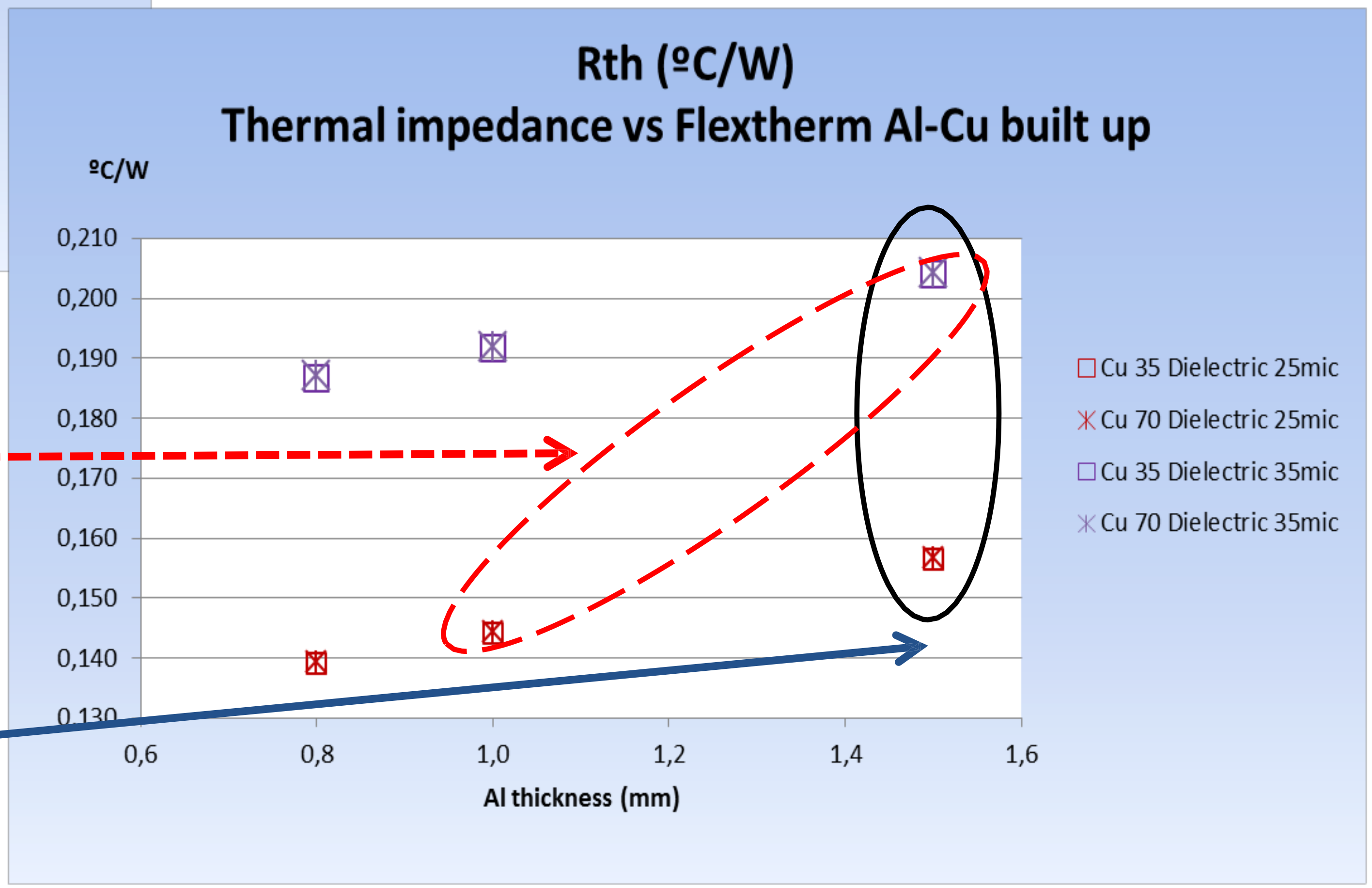
Thermal impedance profile



Thermal impedance is affected mainly by aluminum and dielectric thickness.

Copper thickness has practically no influence.

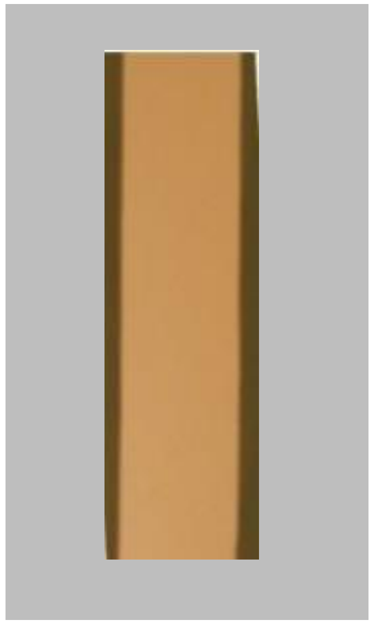
In spite of the thermal conductivity W/mK is higher or similar, due to the total thickness of the M-PCB, the final thermal resistance is worse.

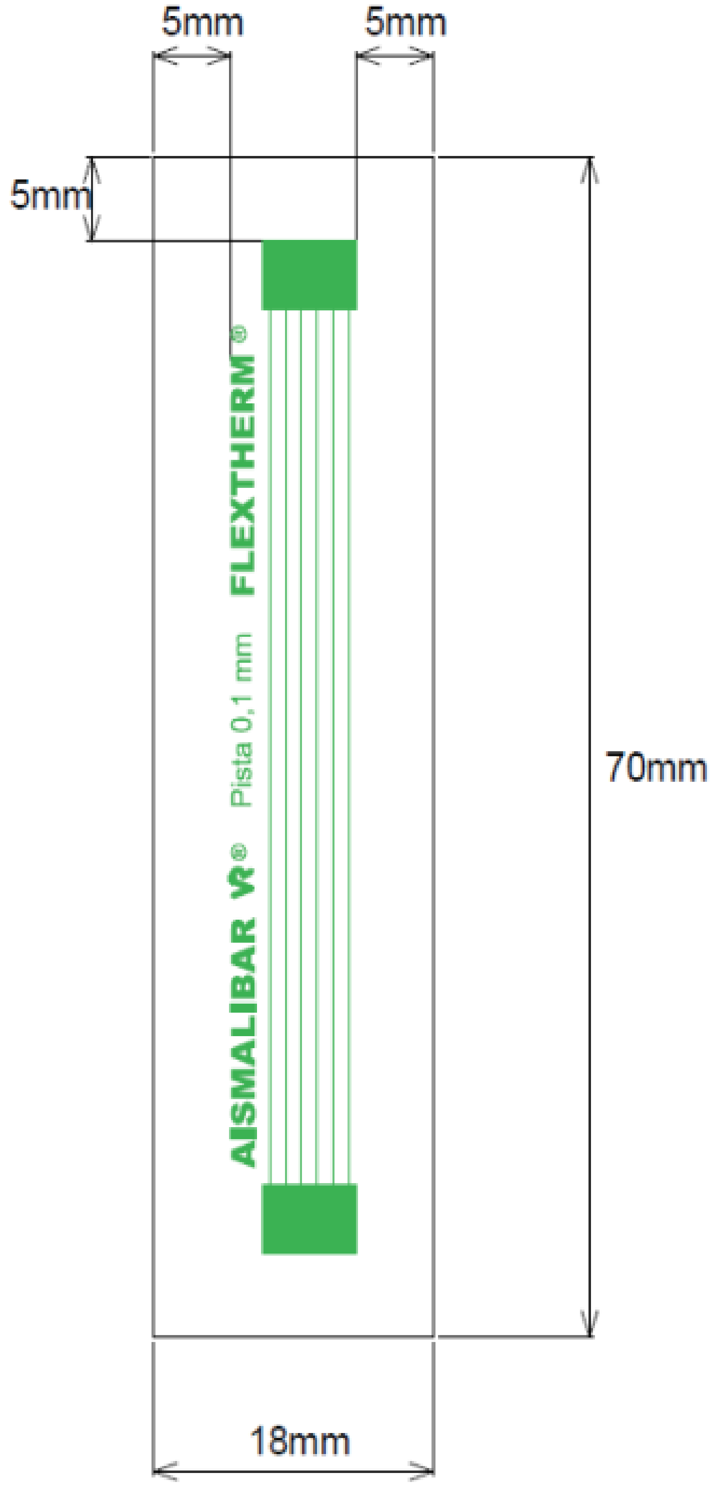


Bending test

Sample construction:

- Special design of the copper tracks has been carried out to evaluate the electrical isolation after several radios and bending angles.
- 35 and 70mic copper thickness were etched at 0,1mm to 1mm line width to study their fragility under positive and negative bending, as well as the tension produced over the dielectric layer at closed angles. Thinner the tracks, higher tension and more possibility for breaking the dielectric.
- Both dielectric thickness 25mic and 35mic, were tested.
- Full copper also was tested

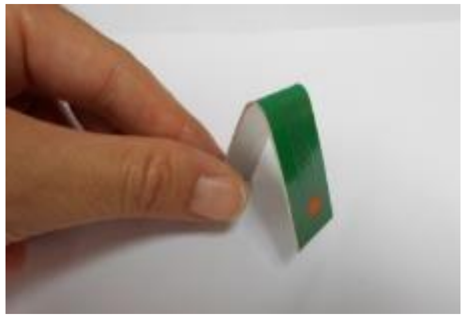




Bending test

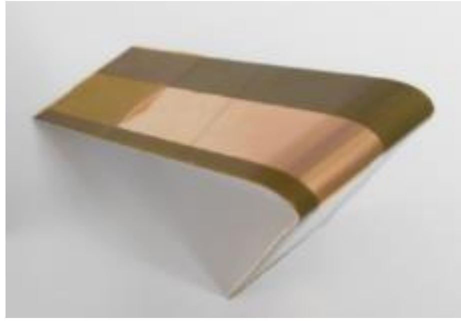
Test:

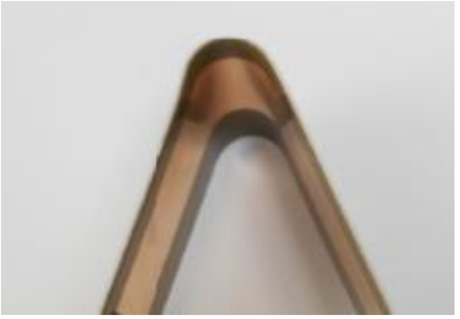
- Samples have been bended with positive and negative direction (copper inside and outside respectively).
- 1KV DC current is applied before and after bending (1KV maintenance 3sec).



POSITIVE BENDING

NEGATIVE BENDING





Bending test

1KV DC 3sec € 0.0mA Perfect electrical isolation

Mechanical stress € NO defect under visual inspection over Al, dielectric layer and Cu

Only Positive bending at radius <1mm and >/=60º breaks mechanically

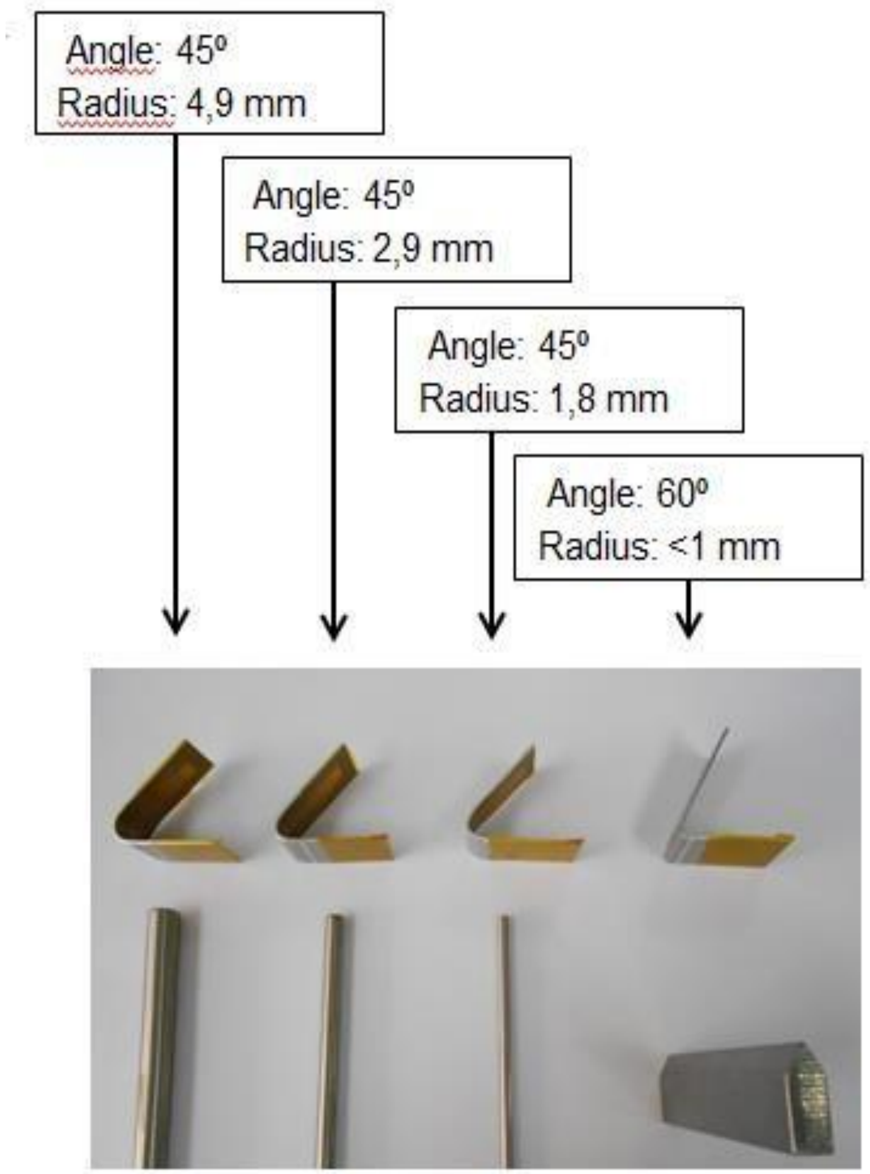
FLEXTHERM 0,8/35 - NEGATIVE BENDING

		Width Copper tracks (mm)				
Angle	**Radius (mm)**	**0,2**	**0,3**	**0,4**	**0,5**	**1,0**
45º	**4,9**	OK	OK	OK	OK	OK
	2,9	OK	OK	OK	OK	OK
	1,8	OK	OK	OK	OK	OK
60º	**< 1**	OK	OK	OK	OK	OK

FLEXTHERM 0,8/35 - POSITIVE BENDING

		Width Copper tracks (mm)				
Angle	**Radius (mm)**	**0,2**	**0,3**	**0,4**	**0,5**	**1,0**
45º	**4,9**	OK	OK	OK	OK	OK
	2,9	OK	OK	OK	OK	OK
	1,8	OK	OK	OK	OK	OK
60º	**< 1**	NOK	NOK	NOK	NOK	NOK
	(1) Copper tracks as well as dielectric layer breaks					

Note: Standard solder mask can have cracking problems.
Solder mask manufacturers can supply special solder mask for bendable porpoise.
Recommendation: PI cover layer is an ideal solution



Bending test

1KV DC 3sec € 0.0mA Perfect electrical isolation

Mechanical stress € NO defect under visual inspection over Al, dielectric layer and Cu

FLEXTHERM 1,5/70 - POSITIVE BENDING

		Width Copper tracks (mm)				
Angle	**Radius (mm)**	**0,2**	**0,3**	**0,4**	**0,5**	**1,0**
45º	**4,9**	OK	OK	OK	OK	OK
	2,9	OK	OK	OK	OK	OK

FLEXTHERM 1,5/70 - NEGATIVE BENDING

		Width Copper tracks (mm)				
Angle	**Radius (mm)**	**0,2**	**0,3**	**0,4**	**0,5**	**1,0**
45º	**4,9**	OK	OK	OK	OK	OK
	2,9	OK	OK	OK	OK	OK

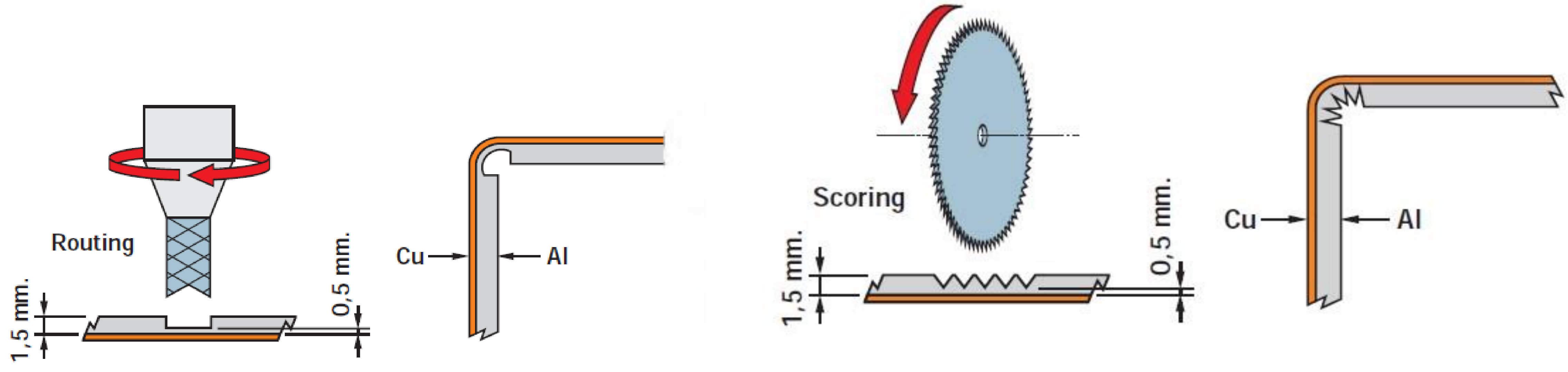
To achieve smaller radius and reduced angles on FLEXTHERM AL 1,5mm and over it´s recommended to reduce Al thickness with scoring or depth control on Aluminium side.

3D MPCB

FLEXTHERM® Orientative product applications

FLEXTHERM	Standard Construction (μ) Al / Dielectric / Cu	Dielectrical breakdown voltage AC	Orientative Applications
FLEXTHERM - 25	1.500 / 25 / 35 or 70	2.000 V	HiPo LEDs > 4 W. Medium Power applications, LEDs. Max. cost-effectiveness
FLEXTHERM - 35	1.500 / 35 / 35 or 70	4.000 V	High Power applications, DC Power converters

Possibilities to reduce radius



COBRITHERM® ULTRATHIN 35-50-75µm

Dullo INTERNATIONAL | Aismalibar

NEW HTC

4,0W

DATA SHEET DS_170331

COBRITHERM HTC 4.0W 35µ ULTRA THIN LAYER (PROOF TEST 750V)

DESCRIPTION

Insulated Metal Substrate (IMS), based aluminum clad with ED copper foil on the opposite side. It is designed for the reliable thermal dissipation of circuitry. A proprietarily formulated polymer-ceramic ultra thin bonding layer with high thermal conductivity and dielectric strength allows us to guarantee thermal endurance.

The material is supplied with a film on the aluminum side to protect it against wet PCB processes.

ROHS compliance directive 2002/95/EC and REACH Nº 1907/2006

STANDARD CONSTRUCTIONS

Aluminum thickness, m (in)	1000 (0.039) – 1500 (0.059)	Aluminum Alloy / Treat	5052
Insulation thickness, m	50 micron (2 mils)	Dielectric thickness tolerance	± 15 micron (0,6 mils)
ED copper thickness, m	35 (1oz) – 70 (2oz) – 105 (3oz) - 210 (6oz)		

Other constructions available upon request

UL Approved , QMTS2, QMTS8 File: E47820 IPC 4101

(1) **Electrical proof test. 100% of our laminate production delivered, has been "on line" verified at 750v V_{dc}: 500 V/sec. ramp // 5sec.**

PROPERTIES 1500 m Al / 35 m dielectric /70 m Cu	TEST METHOD	UNITS	TYPICAL VALUES	Values
Time to blister at 288ºC, floating on solder (50 x 50 mm)	IEC-61189	Sec	>120	>60
Copper Peel strength, after heat shock 20 sec/288ºC	IPC-TM 650-2.4.8	N/mm (Lb/in)	1,2 (16,0)	>1,0 (>10,3)
Dielectric breakdown voltage, AC **(2)**	IPC-TM 650-2.5.6.3	kV	2,5	>2,0
Proof Test, DC **(1)**	--	V	750	750
Thermal conductivity (dielectric layer)	ASTM-D 5470	W/mK (W/inK)	4,1 (0,104)	4,00 (0,102)
Thermal impedance (dielectric layer)	ASTM-D 5470	Kcm^2/W (Kin^2/W)	0,08 (0,013)	0,09 (0,014)
Flammability, according UL-94, class	UL-94	class	V-0	V-0
Glass transition temperature of dielectric layer (by TMA)	IPC-TM 650-2.4.24	ºC	120	120
Maximum operating temperature	--	ºC	150	150

(*) Values or parameters measured with a destructive method or limited size for the test sample must be considered as a representative values, and not as guaranteed values. They are not guarented over 100% of the material.

(2) **Dielectric Breakdown** test is a material destructive laboratory test. It is performed according the IPC-TM-650 part 2.5.6.3., by using AC voltage until electric failure on a relatively small surface area of the dielectric layer using metal electrodes. Values should be taken as a material reference and not as guaranteed values.

Success in automotive

COBRITHERM ®**ULTRATHIN 35µ**

Success in automotive

COBRITHERM®

Many Top manufacturers trust in our products
C- Class

Many Top manufacturers trust in our products
VW – Touran

Success in automotive

COBRITHERM®

Many Top manufacturers trust in our products

BMW

7 Series & 6 Series

New car models in 2016

New Clio 2016

New car models in 2016

Audi- Q-3

Audi- Q-5

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