DuPont™ Pyralux® TK

flexible circuit materials

Technical Information

Description

DuPont™ Pyralux® TK flexible circuit material is a flexible copper clad laminate and bonding film system specifically formulated for high-speed digital and high-frequency flexible circuit applications. With a dielectric constant (DK) of 2.3 or 2.5, and low loss (DF) of 0.0015 or 0.002 depending on the ratio of DuPont™ Teflon® to DuPont™ Kapton® polyimide film.

The clad dielectric is a proprietary layered composite of Teflon® and Kapton® films. A variety of copper foil weights are available; the standard foils are 18 and 36 micron rolled annealed (RA) copper.

The bonding film is also a layered dielectric, made with Teflon® and Kapton® films. The bonding film contains a Teflon® film with a lower lamination temperature than the clad.

Applications

Pyralux® TK laminate and bondply films are designed for high speed flex applications, including microstrip and stripline controlled impedance constructions. Key property advantages are:

- Low dielectric constant
- Low loss tangent
- Low moisture absorption
- Tight thickness tolerance
- Standard flex properties
- Wide processing latitude
- Thin—50, 75, and 100 microns

Constructions

Pyralux® TK flexible circuit material is available in a variety of thicknesses.

Table 1
DuPont™ Pyralux® TK Clads—double sided only

Pyralux® TK Code	Copper micron	Dielectric micron	Copper micron
185018R	18	50	18
187518R	18	75	18
1810018R	18	100	18
365036R	36	50	36
367536R	36	75	36
3610036R	36	100	36

Table 2
DuPont™ Pyralux® TK Bonding Films

Pyralux® TK Code	Teflon® micron	Kapton® micron	Teflon® micron
252525	25	25	25
255025	25	50	25

Packaging

Pyralux® TK clads are supplied in a sheet form, with standard dimensions of 24" x 36", 24" x 18", and 12" x 18" (610 x 914mm, 610 x 457mm, and 305 x 457mm). Other dimensions are available upon request.

Pyralux® TK bonding films are supplied on 610 mm (24 in) wide by 76 m (250 ft) long rolls, on nominal 76 mm (3 in) cores. Other widths and lengths are also available.

Specifications

UL V-0
IPC-4204/13 (clad)
IPC-4203/5 (bonding film)
RoHS Compliant
Pb-Free alloy compatible

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DuPont™ Pyralux® TK Copper Clad Laminate

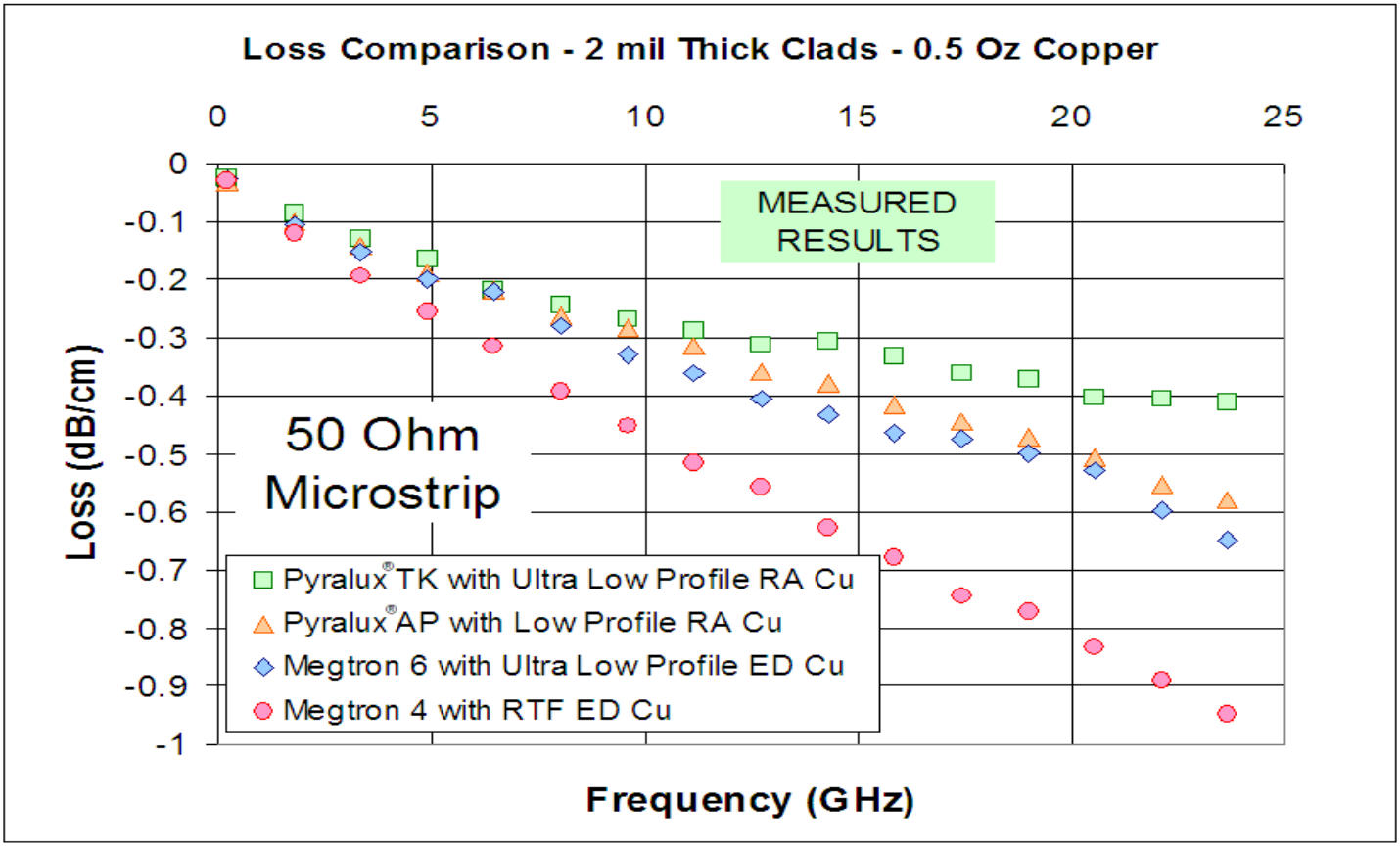
Property	Pyralux® TK 185018R	Pyralux® TK 187518R	Pyralux® TK 1810018R
Dielectric Constant 10 GHz, Normal*	2.5	2.3	2.5
Dielectric Constant 10 GHz, In-plane**	2.8	2.6	2.8
Loss Tangent 10 GHz	0.002	0.0015	0.002
Peel Strength AR, N/m (pli), 18 um Cu	1200 (7)	1200 (7)	1200 (7)
Peel Strength AS, N/m (pli), 18 um Cu	1200 (7)	1200 (7)	1200 (7)
Peel Strength After HAST, N/m (pli), 18 um Cu	900 (5)	900 (5)	900 (5)
Moisture Absorption, %	0.6	0.3	0.6
Solder Float, 3 min at 288°C	Pass	Pass	Pass
Dimensional Stability %			
Method B, After Bake, MD/TD	-0.03/-0.07	-0.14/-0.21	-0.06/-0.08
Method C, After Bake, MD/TD	-0.04/-0.11	-0.20/-0.31	-0.10/-0.12
MIT Flex Test, with LF coverlay	730	404	N/A
CTE, ppm/C (50 to 250°C)	27	27	27
Modulus, MPa (kpsi)	3100 (450)	2400 (350)	3100 (450)
Tensile Strength, MPa (kpsi)	220 (30)	145 (21)	185 (27)
Elongation, %	60	75	60
Dielectric Strength, volts/um (volts/mil)	200 (5000)	190 (4800)	170 (4300)
Flame Rating, UL	V-0	V-0	V-0
RTI, UL	200°C	200°C	200°C
Decomposition Temperature 2%/5%	531°C/548°C	531°C/548°C	531°C/548°C

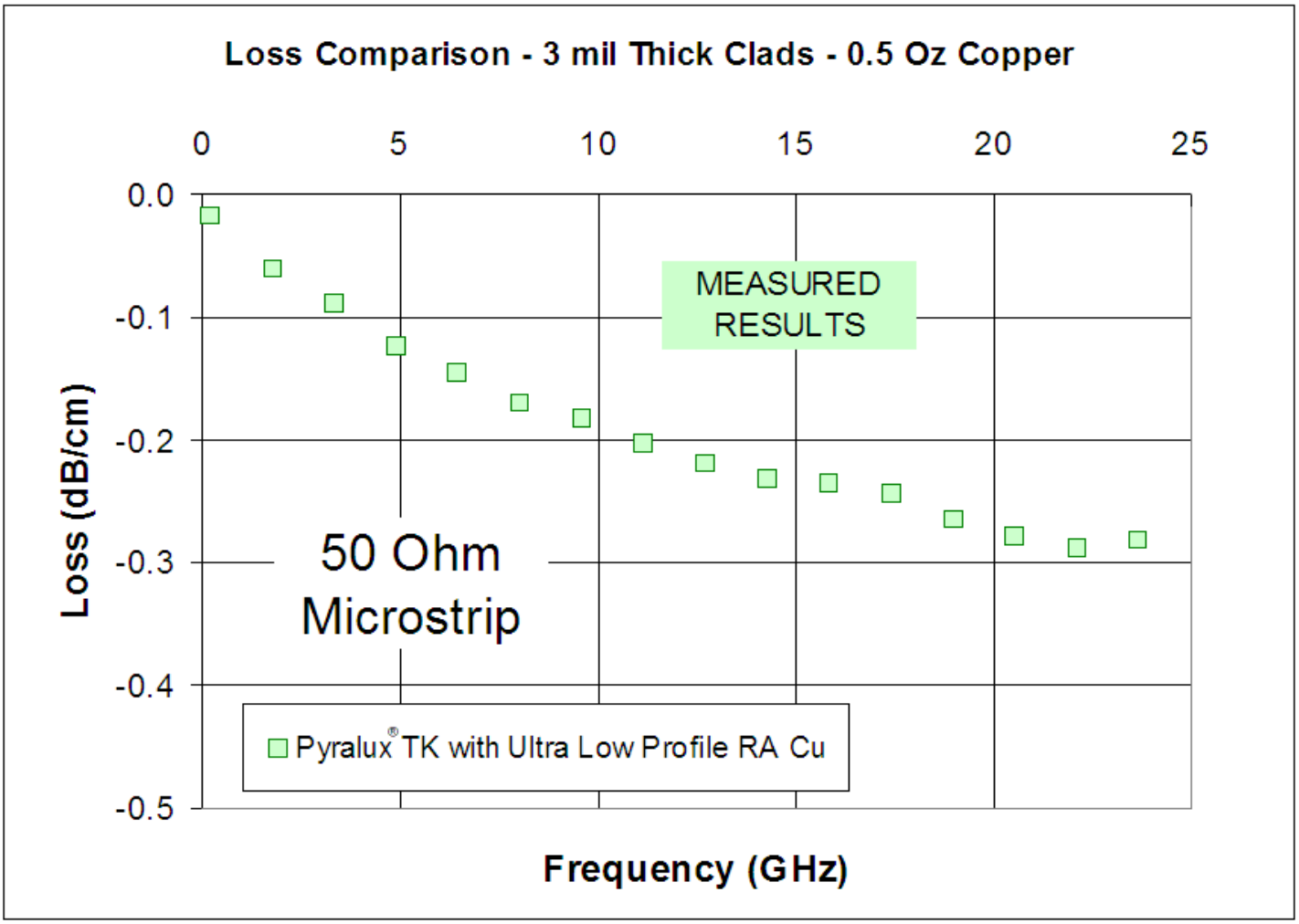
*IPC-TM-650-2.5.5.5 value to be used in design calculations.
**In-plane values are bulk properties measured by ASTM-D-2520
HAST Conditions are: 2 atm, 120°C, 90% humidity, 96 hours
MIT Flex Test: 18 um copper lines, 0.38 mm radius

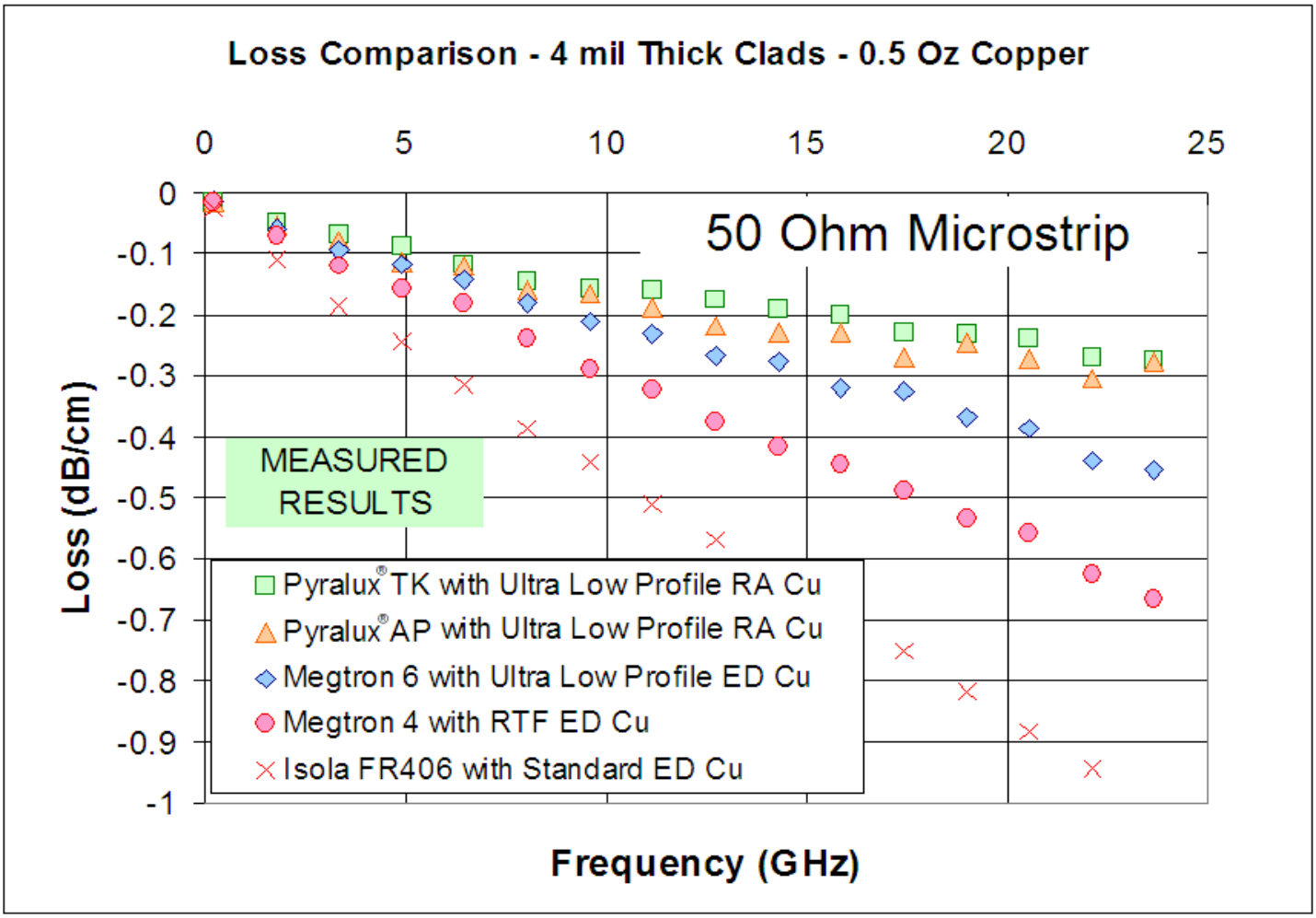
Pyralux® TK Bondply

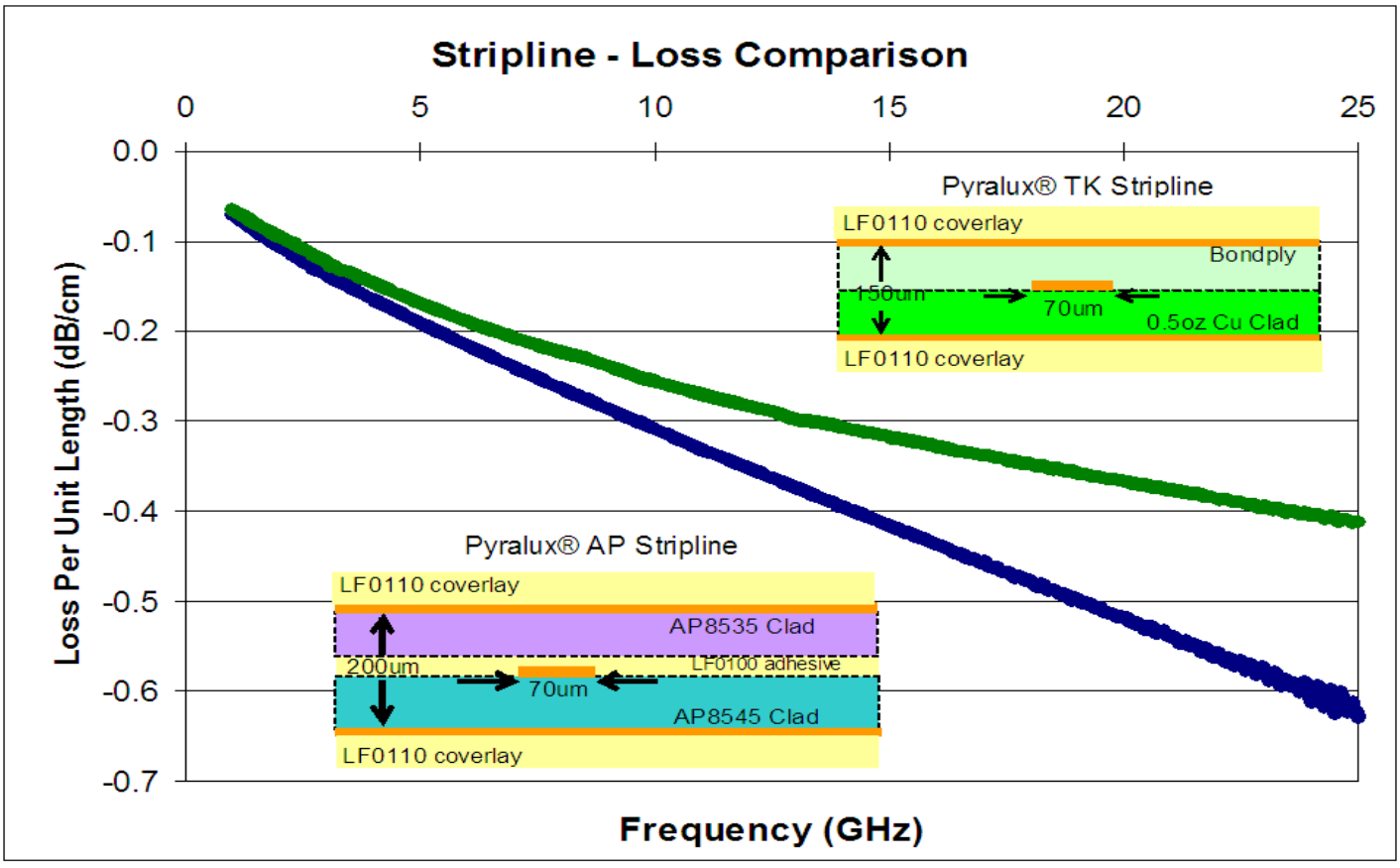
Property	Pyralux® TK Bondply 252525	Pyralux® TK Bondply 255025
Dielectric Constant 10 GHz, Normal*	2.3	2.5
Dielectric Constant 10 GHz, In-plane**	2.6	2.8
Loss Tangent 10 GHz	0.0015	0.002
Peel Strength to Dielectric of TK Laminate, N/m (pli)	1200 (7)	1200 (7)
Peel Strength AR to Copper Foil, N/m (pli), 36 um Cu	1000 (6)	1000 (6)
Peel Strength AR, to Shiny Cu, N/m (pli), 18 um Cu	500 (3)	500 (3)
Moisture Absorption, %	0.3	0.6
Solder Float, 10 sec at 288°C	Pass	Pass
Dielectric Strength, volts/um (volts/mil)	190 (4800)	170 (4300)
UL Flame Recognition	V-0	V-0
Decomposition Temperature 2%/5%	494°C/514°C	494°C/514°C

*IPC-TM-650-2.5.5.5 value to be used in design calculations.
**In-plane values are bulk properties measured by ASTM-D-2520


Loss Comparison - 2 mil Thick Clads - 0.5 Oz Copper
0
5
10
15
20
25
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
Loss (dB/cm)
MEASURED RESULTS
50 Ohm Microstrip
Pyralux® TK with Ultra Low Profile RA Cu
Pyralux® AP with Low Profile RA Cu
Megtron 6 with Ultra Low Profile ED Cu
Megtron 4 with RTF ED Cu
Frequency (GHz)


Loss Comparison - 3 mil Thick Clads - 0.5 Oz Copper
0
5
10
15
20
25
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
Loss (dB/cm)
MEASURED RESULTS
50 Ohm Microstrip
Pyralux® TK with Ultra Low Profile RA Cu
Frequency (GHz)


Loss Comparison - 4 mil Thick Clads - 0.5 Oz Copper
50 Ohm Microstrip
MEASURED RESULTS
Pyralux® TK with Ultra Low Profile RA Cu
Pyralux® AP with Ultra Low Profile RA Cu
Megtron 6 with Ultra Low Profile ED Cu
Megtron 4 with RTF ED Cu
Isola FR406 with Standard ED Cu
Loss (dB/cm)
Frequency (GHz)


Stripline - Loss Comparison
Pyralux® TK Stripline
LF0110 coverlay
Bondply
150um
70um
0.5oz Cu Clad
LF0110 coverlay
Pyralux® AP Stripline
LF0110 coverlay
AP8535 Clad
200um
LF0100 adhesive
70um
AP8545 Clad
LF0110 coverlay
Loss Per Unit Length (dB/cm)
Frequency (GHz)

Processing Suggestions

Bondply Lamination

1. Start with cold press.
2. Pull vacuum for at least 15 minutes before applying pressure or heat.
3. Start pressure and heat. Aim peak temperature to 280–290°C (535–554°F). (Do not exceed 300°C (572°F)).
4. Aim pressure to a maximum of 250 psi (1.7 MPa). Lower pressures may work as well.
5. Ramp rate is not critical and can vary with capability of lamination press.
6. Hold at peak temperature for 60 minutes to insure best adhesion.
7. Cool down under pressure. Cool down rate is not critical.

TK Bondply adhesion to dielectric and copper surfaces is mainly determined by peak lamination temperature and time at peak temperature. Pressure has very little effect. This is even true for conformation and flow of the TK bondply adhesive around circuitry.

Clad Preparation for Bondply lamination

Adhesion of treated copper foil to TK bondply varies with copper foil type and chemistry. Test adhesion before deciding on copper foil. (We have found that Nikko (Gould) RA coppers work well.)

Adhesion of TK bondply to shiny copper requires a good microetch of 40 microinches or more to achieve good adhesion. Alternative oxides give even higher adhesion. We successfully tested:

- Cobra Bond (OMG Group)
- Circubond (Dow, was Shipley)
- Bondfilm (Atotech)

Adhesion of TK bondply to TK clad dielectric is very good. However, make sure to not damage the Teflon® surface of the TK clads after etching (i.e. no pumice scrubbing or plasma etching). This will remove the activated surface, which will reduce adhesion to TK bondply and standard coverlays.

Press Pad Recommendations

Use press pads that can survive 280 to 290°C for bondply lamination. Possible options:

- Sheets of skived PTFE film along with sheets of copper and aluminum foil.
- Taconic TacPad™ Press Pad Material
- We are still testing new press pads and will add after testing.

Drilling and Desmear Recommendations

The procedures used today to drill and desmear high speed PTFE boards should be adequate for DuPont™ Pyralux® TK flexible circuit materials. The Teflon® in Pyralux® TK is chemically similar to the PTFE fluoropolymer used in present high speed laminate. Do not use undercut drill bits for drilling Pyralux® TK clads. It is critical that the drill bits not get so hot that they start to melt the Teflon® layers.

For circuit constructions with Teflon® and other dielectrics, one should always run the desmear process for non-Teflon® dielectric first. Then, run the desmear process for the Teflon®. Therefore, Pyralux® TK could be desmeared initially in the same process used for Pyralux® AP and then followed by a Teflon® preparation.

Options for Teflon® Desmear:
Sodium Etch: This is a Sodium Napthalene solution available from Poly-Etch or Fluoro-Etch. It works well and has been used for many years. Most PCB manufacturers who routinely run high speed PTFE boards will already have sodium etch available.

Plasma Etching: The Teflon® can be prepared for plating with plasma etching as well. There are several different gases for preparing Teflon® layers:

- Pure nitrogen
- Nitrogen/hydrogen mixtures (from 70/30 to 30/70)
- Helium
- Oxygen

The general goal is to remove the fluorine from the surface of the Teflon® to improve wetting. That is why the standard gases for other dielectrics (CF4/02) should never be the last plasma gases used in a multistage process.

Laser Drilling

Pyralux® TK works well with Carbon Dioxide lasers. We do not recommend laser drilling vias with standard UV lasers. Use standard desmear after laser drilling.

Coverlays

Pyralux® LF and FR coverlays are compatible with Pyralux® TK laminate. The adhesion between the coverlay adhesive and the TK dielectric is very good. A few epoxy based coverlays have also demonstrated good adhesion based on internal testing.

Rigid-Flex

Several prepregs used in rigid flex applications have shown good adhesion to the dielectric surface of the TK clad. Both epoxy and polyimide prepregs were tested.

General Information

Handling

Pyralux® TK laminate and bondply are more sensitive to static build up than traditional flexible circuit materials because of the low moisture levels. After etching, handle sample carefully to prevent collection of particulate.

Storage Conditions and Shelf Life

Pyralux® TK laminate and bondply do not require refrigeration and will retain their original properties for a minimum of one year when stored in the original packaging at temperatures of 4–29°C (40–85°F) and below 70% humidity. The material should be kept clean and well protected from physical damage.

For more information on DuPont™ Pyralux® flexible circuit materials, please contact your local representative, or visit our website:

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