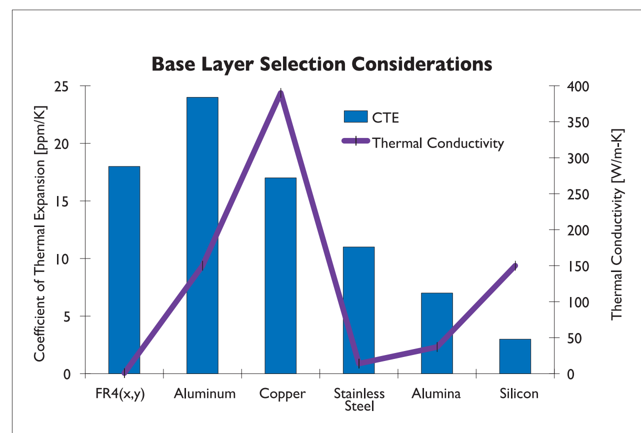
Base Metal Layer Design Considerations

- Coefficient Of Thermal Expansion And Heat Spreading
- Coefficient Of Thermal Expansion And Solder Joints
- Strength, Rigidity And Weight
- Electrical Connections To Base Plate
- Surface Finish
- Costs

METAL / ALLOY	THERMAL CONDUCTIVITY [W/mK]	COEFFICIENT OF THERMAL EXPANSION [ppm/K]	DENSITY [g/cc]	MODULUS OF RIGIDITY [GPa]	YIELD STRENGTH [MPa]
Copper	400	17	8.9	44.1	310
Aluminum 5052	150	25	2.7	25.9	215
Aluminum 6061	150	25	2.7	26	230

Coefficient Of Thermal Expansion And Heat Spreading

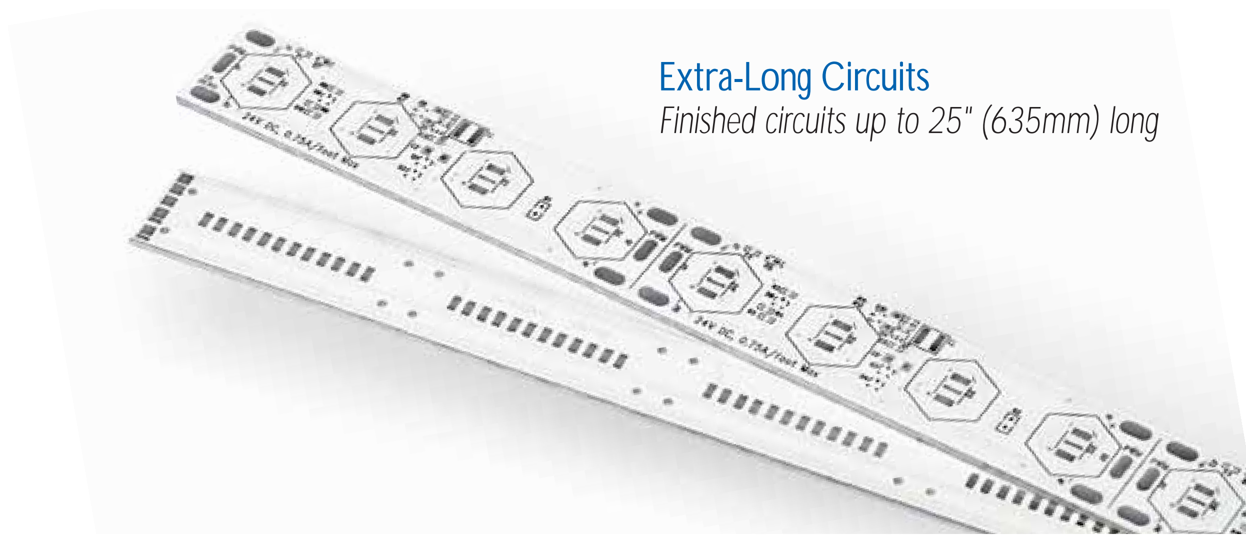
The adjacent graph depicts the CTE of the base material in relationship to the heat spreading capability of the metal. Although Aluminum and Copper are the most popular base layers used in Thermal Clad, other metals and composites have been used in applications where CTE mismatch is a factor. The adjacent table represents standard and non-standard base layers.



Coefficient Of Thermal Expansion And Solder Joints

Solder joint fatigue can be minimized by selecting the correct base layer to match component expansion. The major concern with thermal expansion is the stress the solder joint experiences in power (or thermal) cycling. Solder joints are not mechanically rigid. Stress induced by heating and cooling may cause the joint to fatigue as it relieves stress. Large devices, extreme temperature differential, badly mismatched materials, or lead-free minimum solder thickness may all place increased cyclic strain on solder joints.

Solder joint fatigue is typically first associated with ceramic based components and with device termination. The section on "Assembly Recommendations" (page 18-19) covers these issues in more detail.



Extra-Long Circuits

Finished circuits up to 25" (635mm) long

Base Thickness

Copper and aluminum Thermal Clad is normally purchased in one of the standard-gauge thicknesses shown in the table below. Non-standard thicknesses are also available.

Electrical Connections To Base Plate

If a connection to the base plate is desired, copper is the most compatible base layer to use. When using electrical or thermal vias, it is important to match the circuit and base coefficients of thermal TCE expansion as closely as possible. Otherwise, excess plated-hole stress will occur during thermal cycles. Other base layer materials can be used for connection, but will require different connection schemes.

Costs

The most cost effective base layers are aluminum and copper because they represent industry standards. Copper is more expensive than aluminum when comparing the like thicknesses, but can be the less expensive option if design considerations allow for a thinner layer. As an example, typically the cost of 0.040" (1.0mm) copper is equal to the cost of 0.125" (3.2mm) aluminum.

Aluminum - Thicknesses

Inches	Millimeters
0.020	0.51
0.032	0.81
0.040	1.02
0.062	1.57
0.080	2.03
0.125	3.18
0.160	4.06
0.190	4.83

Copper - Thicknesses

Inches	Millimeters
0.020	0.50
0.032	0.81
0.040	1.02
0.060	1.52
0.080	2.03
0.125	3.18

*Standard thicknesses highlighted

Surface Finish

Aluminum and copper base layers come with a uniform commercial quality brushed surface. Aluminum is also available anodized with choices of clear, black, blue and red colors.

Standard Thermal Clad Panels

Available in:

- 18" (457mm) x 24" (610mm)
  Usable area: 17" (432mm) x 23" (584mm)
- 18" (457mm) x 25" (635mm)
  Usable area: 17" (432mm) x 24" (610mm)
- 20" (508mm) x 24" (610mm)
  Usable area: 19" (483mm) x 23" (584mm)