KYOCERA

LTCC DIVISION OF KYOCERA AMERICA
DESIGN GUIDE

- HIGH RELIABILITY
- HIGH INTERCONNECT DENSITY
- HIGH I/O COUNT
- EXCELLENT POWER HANDLING
- LOW-FIRE MATERIAL
- CUSTOM TRANSMISSION LINES
- CUSTOM MULTICHIP MODULES
- EMBEDDED PASSIVE COMPONENTS

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March 2004

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LTCC Design Guide

Multilayer Ceramic (MLC) Devices offer an alternative packaging method for thin and thick film hybrids, plastic packages, etched circuit boards and other packaging methods. MLC offers innovative technical solutions with extensive design options with low NRE and fast deliveries. New low fire processes utilizing noble metal conductors, known as LTCC, offer significant performance opportunities. KAI LTCC uses low dielectric tapes manufactured by Dupont and Ferro. All material systems are supported with gold and silver conductor materials. A full range of components (e.g., seal rings, pins, R.F. connectors and heat sinks) can be brazed with gold-based brazes, or soldered with lead-based solders. All tape systems offer a full range of resistor materials that can be co-fired with the tape on the surface for laser trimming to high tolerances or on internal layers for devices such as voltage dividers.

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Production Processes

Kyocera America's LTCC division is capable of producing parts in high volume or in prototype lots. The design considerations of each style of production are different. High volume manufacturing requires maximizing through-put, while minimizing the number of operations in order to minimize cost. These considerations require tolerances to be increased while the number of via sizes or features (such as cavities) should be minimized.

The LTCC division is also the premier producer of complex LTCC packages. These packages are typically manufactured in low volume, and require very tight tolerances. To accommodate both needs, this design guide presents two levels of tolerancing to follow: the "preferred" tolerancing is required for high volume manufacturing. The minimum tolerancing can be accommodated at low volume manufacturing, but will entail a higher cost.

For either high or low volume, the quote and production process is the same, and is illustrated below. Paramount to the process is interaction with the customer at quote generation, contract review, and project review. These interactions ensure that what is produced and delivered is exactly what the customer wants and needs.

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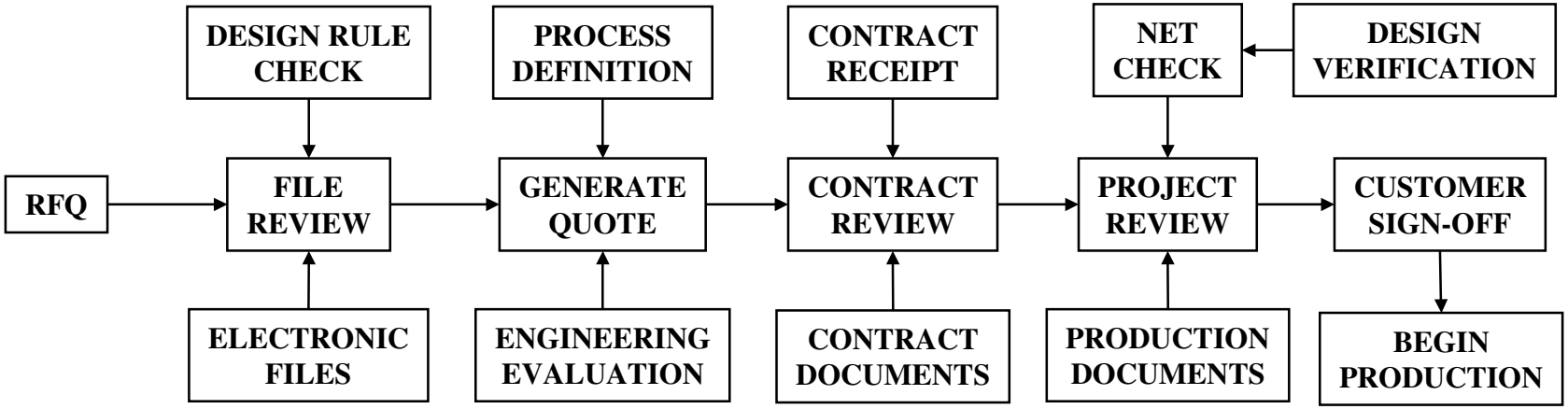
Production Processes



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Materials and Properties

Material Property	units	Dupont 951	Dupont 943	Ferro A6M	Ferro A6S
ELECTRICAL					
Dielectric Constant	(0.1-2 GHz)	7.8	7.4	5.9	5.9
Dielectric Loss Factor	(0.1-2 GHz)	0.0015	0.0005	0.0012	0.0012
THERMAL					
Expansion Coefficient	(ppm/C)	5.8	6	7	>8
Conductivity	(W/mK)	3.3	4.4	2	2
MECHANICAL					
Flexural Strength	(MPa)	320	230	170	>160
Young's Modulus	(GPa)	120	150	92	92
PHYSICAL					
Green Tape Thickness	(mils)	4.5, 6.5, 10	2, 5, 10	5, 10	5, 10
Fired Tape Thickness	(mils)	3.6, 5.4, 8.1	1.8, 4.5, 9	3.7, 7.4	3.9, 7.8

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Process Variation

Kyocera LTCC is a data-oriented company, enabling the delivery of quality products our customers demand. All of our design criteria are based on extensive measurements of our processes, and defined as ± 3 standard deviations of the distribution.

SV: Shrinkage Variation = 3 sigma of fired length. It is critical to consider the impact of shrinkage variation on design considerations. Shrinkage behavior of ceramics depends on many parameters including particle size and shape distribution, as well as size and mass of the package laminate.

SV, Dupont 951 = 0.4% of linear dimension

SV, Ferro A6M = 0.9% of linear dimension

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Package Design Considerations

1. Maximum working area:
   - Ferro: 4.0in X 4.0in
   - Dupont: 4.30in X 4.30in
2. Minimum package thickness: .020in.
3. Avoid using thin tape (.0037 fired) for surface layers when defining layer stack.
4. When calculating overall package thickness, .0004in should be added to each tape layer containing greater than 30% metal coverage to compensate for metal loading.
5. Conductor layout of each tape layer should be uniform in X, Y and Z to minimize ceramic distortion caused by imbalanced metal loading.
6. Chamfered corners are acceptable, but not preferred. If chamfers are required, make reference or minimum tolerance of ±.010in to apply.
7. Standard dimensional tolerance of material is ±SV, No Less Than(NLT) ±.005in.
8. Standard flatness of .004in/in.

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Package Design Considerations (cont.)

- X1 and Y1: Tolerances are defined by the cutting tolerance (typically ±.005”).
- X2 and Y2: Tolerances are defined by the material shrink variation. To prevent cutting into a conductor line, conductors must be pulled back a minimum of the shrink variation expected over the package length X1.
- X3 and Y3: Tolerances are defined by the shrink variation, with a minimum tolerance of ±.005in.
- X4: Width is a function of the number of cavities, package thickness, and Y3. Typically X4/Y3 minimum is 1/4.