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## Low Temperature Co-fired Ceramics (LTCC) Circuitry & Packaging Solutions

### BENEFITS

Low Temperature Co-Fired Ceramic (LTCC) provides a multilayer interconnect technology combining the benefits of High Temperature Co-Fired Ceramic (HTCC) and Thick Film technologies. This yields a high density, high frequency, high reliability and high performance packaging solution.

With decades of ceramics experience, NATEL EMS has developed detailed processes supporting:

- DuPont 951/9K7 Green Tape
- Ferro A6/A6B Green Tape

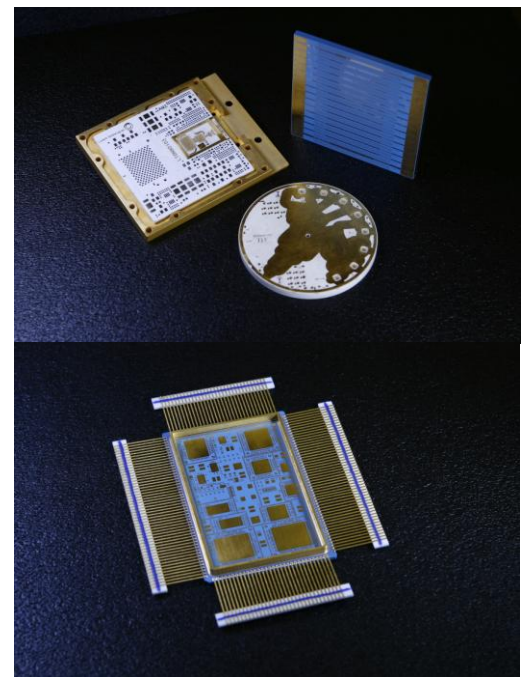
All tape systems are available in gold, silver/plated silver and mixed metal conductor systems.

### FEATURES

- Ideal for High Frequency applications to 100Ghz
- Embedded passive components and RF and Microwave Filters
- High density and High Frequency multilayer interconnect
- Cost competitive plated Silver systems available
- TCE closely matches that of Si, GaAs and SiC and other components
- Brazed on components (connectors, seal ring, heat spreaders)
- Cavities, Cutouts, blind, buried, stacked, staggered and thermal Vias
- Chip and Wire and Hermetic packaging
- Outstanding and demonstrated long-term reliability

### TYPICAL APPLICATIONS

- Multifunctional ceramic packages
- Analog/Digital/Mixed Signal
- Radio frequency (RF) microwave
- Embedded components
- RF modules for high frequency (GHz) applications
- Radar/ Blue tooth /Wireless
- MEMs, Flip Chip and Surface Mount packages
- Multi Chip Module Packaging
- Fiber Optic Transceivers
- Integrated Circuit (IC) packaging





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## CHARACTERISTICS

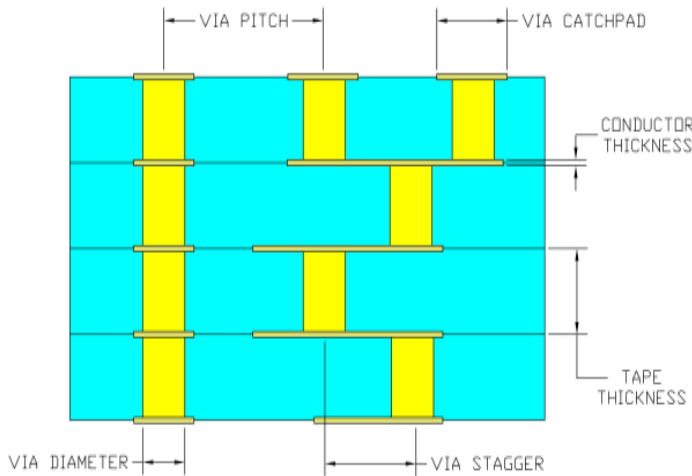
TABLE I (below) lists the typical characteristic of LTCC materials and FIGURE 1 (next page) describes the typical LTCC key features. Please contact us for a full copy of our LTCC Design Guidelines.

**TABLE I TYPICAL LTCC COFIRED MATERIAL CHARACTERISTICS**

| PROPERTY                                      | DUPONT 951             | DUPONT 9K7             | FERRO A6               | FERRO A6-B             | HERATAPE CT700         |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|
| <b>Color</b>                                  | Blue                   | Light Blue             | White                  | Black                  | Blue                   |
| <b>Available Fired Thickness (mils)</b>       | 3.7, 5.2, 8.2          | 4.2, 8.3               | 3.7, 7.4               | 3.3, 6.7               | 3.6, 5.7, 7.9          |
| <b>Dielectric Constant (K)</b>                | 7.28                   | 7.1                    | 5.9                    | 6.5                    | 7.9                    |
| <b>Loss Tangent</b>                           | 0.15%                  | .0010                  | <0.2%                  | <0.5%                  | <0.2%                  |
| <b>Microwave Insertion Loss(DB/in) @10Ghz</b> | <0.6                   | 0.10                   | 0.18                   | <0.35                  | -                      |
| <b>Insulation Resistance</b>                  | >10 <sup>12</sup> Ohms | >10 <sup>12</sup> Ohms | >10 <sup>12</sup> Ohms | >10 <sup>12</sup> Ohms | >10 <sup>12</sup> Ohms |
| <b>Breakdown Voltage</b>                      | >1000 V/Mil            | >1000 V/Mil            | >900 V/Mil             | >1000 V/Mil            | >1000 V/Mil            |
| <b>Flexural strength MPa</b>                  | 207                    | 230                    | >124                   | >124                   | -                      |
| <b>Fired Density gm/cc</b>                    | 3.1                    | 3.1                    | 2.5                    | 2.5                    | 3.1                    |
| <b>Surface Roughness</b>                      | <10 μ in               | <10 μ in               | <15 μ in               | <15 μ in               | <22 μ in               |
| <b>Shrinkage</b>                              |                        |                        |                        |                        |                        |
| <b>X, Y</b>                                   | 12.7% ± .2%            | 9.1% ± .3%             | 14.8% ± .2%            | 14.5% ± .2%            | 15% ± .2%              |
| <b>Z</b>                                      | 15% ± .2%              | 11.8% ± .5%            | 25% ± .2%              | 35% ± .2%              | 25% ± .2%              |
| <b>Metallization</b>                          | Au/Ag – Ag - Au        | Au/Ag – Ag - Au        | Au/Ag – Ag - Au        | Au/Ag – Ag - Au        | Au/Ag – Ag - Au        |



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| FEATURE                   | DESIGN RULE         |
|---------------------------|---------------------|
| VIA DIAMETER              | .04,.06,.1,.15,.20" |
| VIA PITCH                 | MIN.PITCH 0.010"    |
| VIA CATCH PAD             |                     |
| VIA TO EDGEN SPACING      |                     |
| VIA STAGGER               |                     |
| LINE SPACE                |                     |
| LINE WIDTH                |                     |
| CONDUCTOR TO EDGE SPACING |                     |
| ISOLATION GAP             | 0.006" MINIMUM      |
| GROUND PATTERN AREA       | 80% MAXIMUM         |
| CASTELLATION DIAMETER     | 0.010               |
| TAPE THICKNESS            |                     |
| RESISTOR LENGTH           |                     |
| RESISTOR WIDTH            |                     |
| RESISTOR OVERLAP          |                     |

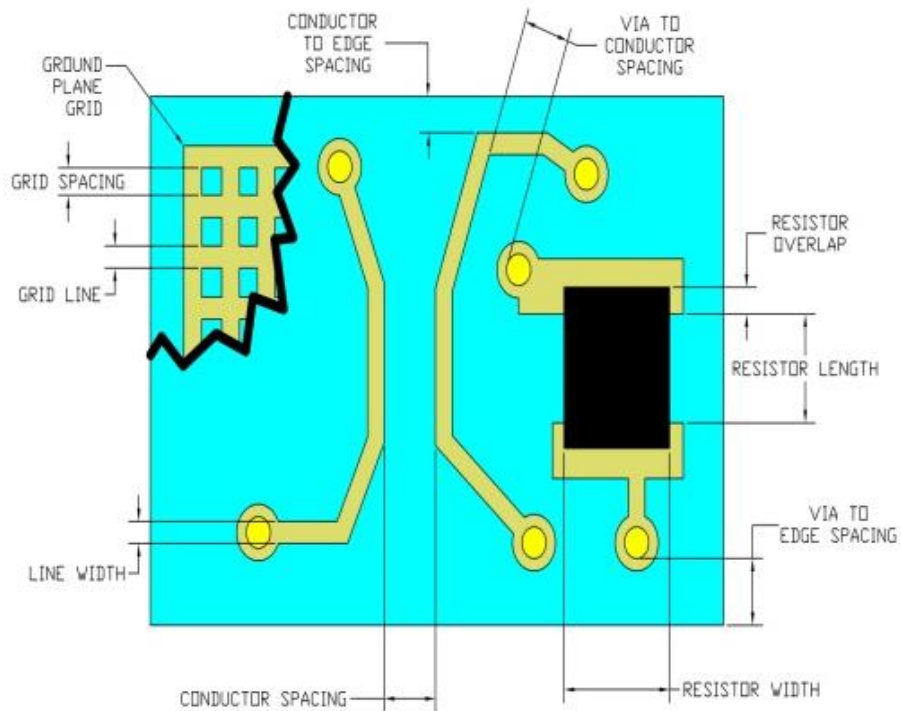


Figure 1 LTCC FEATURE SET