1. What is LTCC
- LTCC: Low Temperature Co-fired Ceramics
- Tapes are commercially available
- Starting material is in tape form, 60-100μm thickness
- Tapes are laminated to desired thickness before sintering
- Conductors are in paste form
- Typical sintering temperature is around 900 °C
- All processing is done in “green” state, before sintering
- A technology useful for integrating passive components < 200 W

2. Motivation
- Explore the possibilities for low profile inductors for load converters using LTCC technology
- Develop a magnetics integration technique suitable for high current application

3. Converter Topology

4. Inductor Construction

5. Comparison of LTCC Technology with PCB

<table>
<thead>
<tr>
<th></th>
<th>LTCC</th>
<th>PCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Capability</td>
<td>500 °C</td>
<td>135 °C</td>
</tr>
<tr>
<td>Metal scheme</td>
<td>Silver alloy</td>
<td>Copper</td>
</tr>
<tr>
<td>Metal stability</td>
<td>Stable</td>
<td>Oxidises at elevated temperature</td>
</tr>
<tr>
<td>CTE (silicon)</td>
<td>4 ppm/K</td>
<td>4 ppm/K</td>
</tr>
<tr>
<td>CTE (metal)</td>
<td>-</td>
<td>17 ppm/K</td>
</tr>
<tr>
<td>CTE (substrate)</td>
<td>4-7 ppm/K</td>
<td>17 ppm/K</td>
</tr>
<tr>
<td>Thermal cond.</td>
<td>4 W/mK</td>
<td>0.3 W/mK</td>
</tr>
<tr>
<td>Elec. Cond. Of metal</td>
<td>&gt; 1.7e7 S/m</td>
<td>5.8e7 S/m</td>
</tr>
</tbody>
</table>

LTCC is more feasible for integrating with silicon

6. Light Load Efficiency Improvement using LTCC inductor

7. Shielding for LTCC Inductor as Circuit Substrate

8. Advantages of Using Inductor as Circuit Substrate
- Footprint reduction
- Reduced resistive loss compared with co-packaged inductor
- Prospect of integrating with silicon devices due to good CTE match
- Improved thermal conductivity compared with polymer based substrate

9. Disadvantages of Using Substrate Inductor
- Shielding required due to presence of magnetic substrate
- Reduced thermal conductivity compared with Al₂O₃ or AlN substrate material