PTFE Microwave Substrates - Mature Products for an Emerging Market

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Why PTFE?

As a PCB substrate:

- Lowest loss
- Best dielectric consistency
- Lowest moisture absorption; 0.02%
- Best copper adhesion (like FR4)
Why PTFE?

As a PCB substrate:

- Temperature stable (UL MOT 180°C)
- Thermal-cycling reliability
- Excellent chemical resistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Temperature</td>
<td>125°C</td>
</tr>
<tr>
<td>Cold Temperature</td>
<td>-35°C</td>
</tr>
<tr>
<td>Dwell at Temperature Extremes</td>
<td>10 minute</td>
</tr>
<tr>
<td>Transfer Time</td>
<td>15 seconds</td>
</tr>
<tr>
<td>Number of Cycles</td>
<td>400</td>
</tr>
</tbody>
</table>
Automotive Design Activity (PTFE PCB):

- Collision avoidance radar
- Near-distance radar
- Tyre-pressure sensor
- Satellite radio antenna
- Engine management sensor
- Other sensor

RF/MW Low-loss
Temperature/Chemical resistance
PTFE PCB Processing

- Established in US and Europe
- 3 of top 5 European PCB processors have volume PTFE capability
- Volume manufacture in Asia (China) growing - driven by telecom's & domestic-satellite-receiver LNB requirements
- >100,000m² processed annually
- Typical 24” x 18” panel processing
PTFE Opportunities

- Hybrid multilayer PCB; use of thin-cored PTFE substrates (RF/MW) combined in multilayer package with lower-cost FR4 (DC control).
- Use of thin-cored or unsupported PTFE (Taclamplus) for hybrid multilayer PCB’s. As demonstrated in recent PROKOSMOS project.
- Use of laser machining technology
- PTFE Multilayer; Taconic Tacpreg™ enabling MLB formation:

Eg. 6 lyr, 3 x RF-35 + 2 x TP-32 P/Preg
= ~ $0.58 - $0.85/sq.in finished PCB
Taconic Laminated PTFE Materials

- **Manufacturing:**
  - Petersburg, USA
  - Mullingar, Ireland
  - Cheonan, Korea (coated fabric)

- **Overview of Products:**

<table>
<thead>
<tr>
<th>Taconic Grade</th>
<th>Dk</th>
<th>Df @ 20GHz</th>
<th>Min. Thickness</th>
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<tbody>
<tr>
<td>Taclamplus</td>
<td>2.1</td>
<td>0.0007</td>
<td>0.025mm</td>
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<tr>
<td>TLY</td>
<td>2.2</td>
<td>0.0011</td>
<td>0.13mm</td>
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<tr>
<td>TLX</td>
<td>2.5</td>
<td>0.0025</td>
<td>0.13mm</td>
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<tr>
<td>TLE</td>
<td>2.95</td>
<td>0.0038</td>
<td>0.038mm</td>
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<tr>
<td>TLC</td>
<td>3.2</td>
<td>0.0040</td>
<td>0.50mm</td>
</tr>
<tr>
<td>Orcer™ RF-35</td>
<td>3.5</td>
<td>0.0050</td>
<td>0.05mm</td>
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<tr>
<td>Orcer™ RF-60</td>
<td>6.15</td>
<td>0.0032</td>
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<tr>
<td>Orcer™ Cer-10</td>
<td>10</td>
<td>0.0037</td>
<td>0.63mm</td>
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</table>
In Summary

- **LAMINATES**: PTFE/glass laminates for PCB are manufactured in volume using mature technology

- **PCB Capability**: Existing w/w volume manufacture

- **Multilayer**: PTFE substrates can be “mulilayered” and are compatible with laser-machining technology