EPC9149 & EPC9174
Transformer Overview
# Specifications – EPC9149

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetizing Inductance</td>
<td>≈ 2.2</td>
<td>µH</td>
</tr>
<tr>
<td>Leakage Inductance</td>
<td>≈ 6.4</td>
<td>nH</td>
</tr>
<tr>
<td>Continuous Primary Current</td>
<td>21</td>
<td>A&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>Continuous Secondary Current</td>
<td>42‡</td>
<td>A&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>Primary turns</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Secondary turns</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Operating frequency</td>
<td>1</td>
<td>MHz</td>
</tr>
<tr>
<td>Construction</td>
<td>FR4 planar</td>
<td></td>
</tr>
<tr>
<td>Series Resonant Capacitance</td>
<td>3.96</td>
<td>µF</td>
</tr>
</tbody>
</table>

‡ Each half
## Specifications – EPC9174

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetizing Inductance</td>
<td>≈ 1.8</td>
<td>µH</td>
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<tr>
<td>Leakage Inductance</td>
<td>≈ 6.4</td>
<td>nH</td>
</tr>
<tr>
<td>Continuous Primary Current</td>
<td>25</td>
<td>A(_{\text{RMS}})</td>
</tr>
<tr>
<td>Continuous Secondary Current</td>
<td>50‡</td>
<td>A(_{\text{RMS}})</td>
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<tr>
<td>Primary turns</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Secondary turns</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Operating frequency</td>
<td>1</td>
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<td>Series Resonant Capacitance</td>
<td>3.96</td>
<td>µF</td>
</tr>
</tbody>
</table>

‡ Each half
Connection Overview

- Minimize power path losses
  - Primary side connection
  - Secondary bottom connection

Transformer connection locations

Primary
- \( P_P \)
- \( P_N \)
- \( S_{P1} \)
- \( S_{C1} \)
- \( S_{N1} \)

Secondary
- \( S_{P2} \)
- \( S_{C2} \)
- \( S_{N2} \)

Core area

Resonant Capacitor
Layer Assignment & Details

- 2 oz Copper thickness windings
- Interleaved windings for min. loss
- Low termination & via losses

*Image courtesy of Mohamed H. Ahmed from CPES at Virginia Tech, presented at PCIM 2019
Winding Details - Primary

- Primary winding cross-over
- Opposite side resonant capacitor connection
Winding Details - Secondary

- Connections (FETs) part of winding
  - Eliminates leakage inductance
Core Overview

ML91S – Proterial (fka Hitachi metals): $\mu_c = 900$

![Diagram of ML91S core with dimensions and operating region graph.](image)
Core Drawing

<table>
<thead>
<tr>
<th>Scale</th>
<th>Material</th>
<th>Customer Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:1</td>
<td>ML91S</td>
<td>U-36-4.57-12.2</td>
</tr>
</tbody>
</table>

Units: mm, Standard tolerances ±0.2

Dimensions:
- 12.2 ± 0.3
- 7.6 ± 0.2
- 4.57 ± 0.2
- 1.57 ± 0.2
- R0.3
- R0.15
- Ra1.6
- Q

Details:
- Detail K
- Detail Q
Core Assembly

Kapton straps

Kapton spacer
≈ 7.5 mil / 190 μm EPC9149
≈ 10 mil / 250 μm EPC9174
Estimated Loss Summary EPC9149

Operation at 1 kW
• Primary winding ≈ 2.6 W
• Secondary winding ≈ 2.1 W
• Core ≈ 1 W
• Actual losses may be higher

Exclusions:
• Proximity losses not calculated
• Fringing losses not calculated

Assumptions:
• Winding losses based on current density
• Core losses based on power loss density
Estimated Loss Summary EPC9174

Operation at 1.2 kW
• Primary winding ≈ 3.7 W
• Secondary winding ≈ 3.0 W
• Core ≈ 1.1 W
• Actual losses may be higher

Exclusions:
• Proximity losses not calculated
• Fringing losses not calculated

Assumptions:
• Winding losses based on current density
• Core losses based on power loss density
Transformer Location on PCB

Resonant Capacitor Bank