

EPC9149 & EPC9174 Transformer Overview



Specifications – EPC9149

Specification	Value	Units
Magnetizing Inductance	≈ 2.2	μH
Leakage Inductance	≈ 6.4	nH
Continuous Primary Current	21	A_{RMS}
Continuous Secondary Current	42 [‡]	A_{RMS}
Primary turns	4	
Secondary turns	1	
Operating frequency	1	MHz
Construction	FR4 planar	
Series Resonant Capacitance	3.96	μF

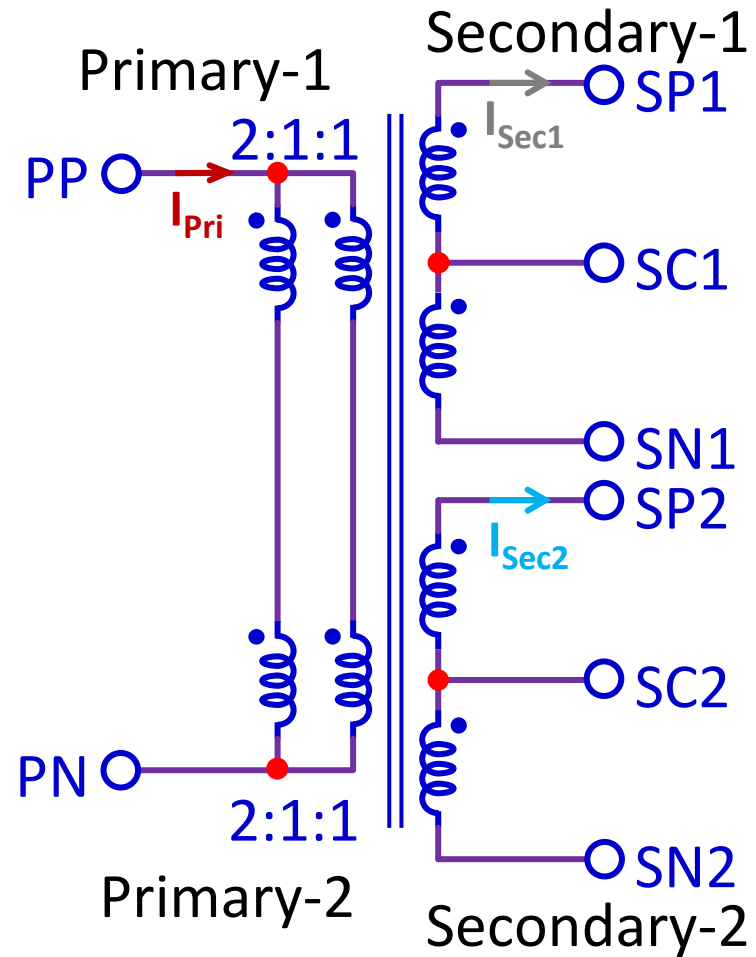
[‡] Each half

Specifications – EPC9174

Specification	Value	Units
Magnetizing Inductance	≈ 1.8	μH
Leakage Inductance	≈ 6.4	nH
Continuous Primary Current	25	A_{RMS}
Continuous Secondary Current	50 [‡]	A_{RMS}
Primary turns	4	
Secondary turns	1	
Operating frequency	1	MHz
Construction	FR4 planar	
Series Resonant Capacitance	3.96	μF

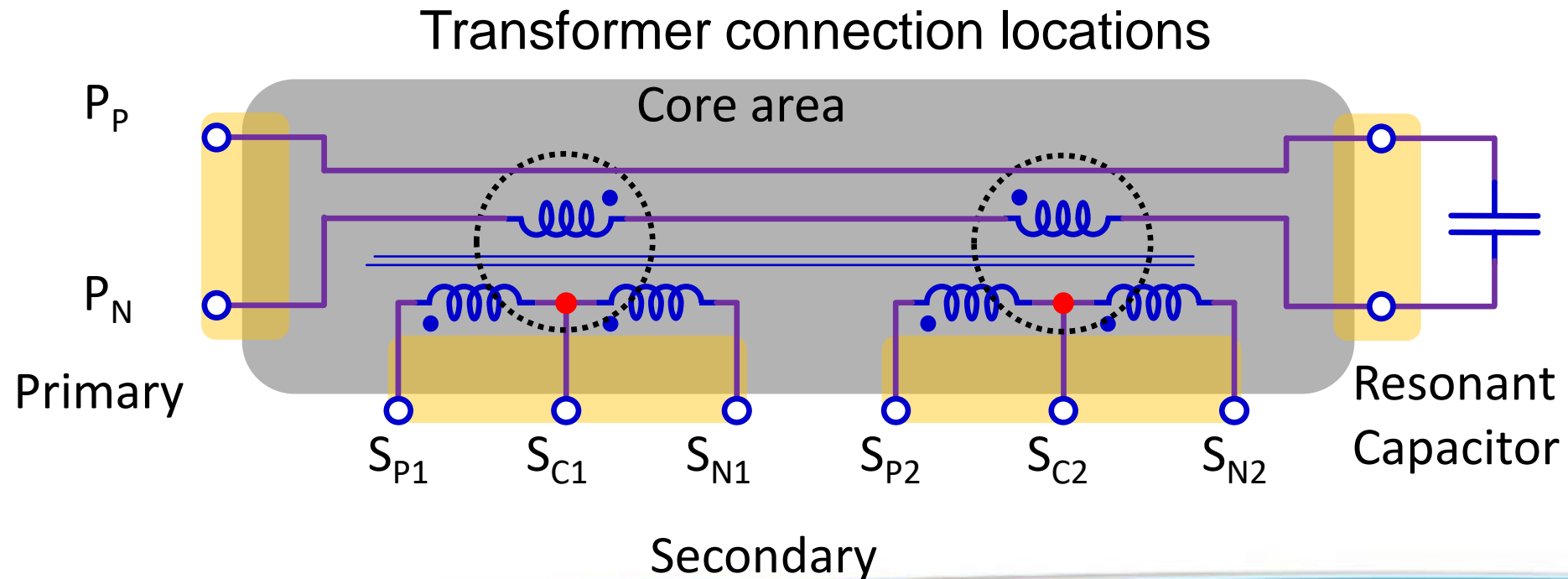
[‡] Each half

Transformer Schematic

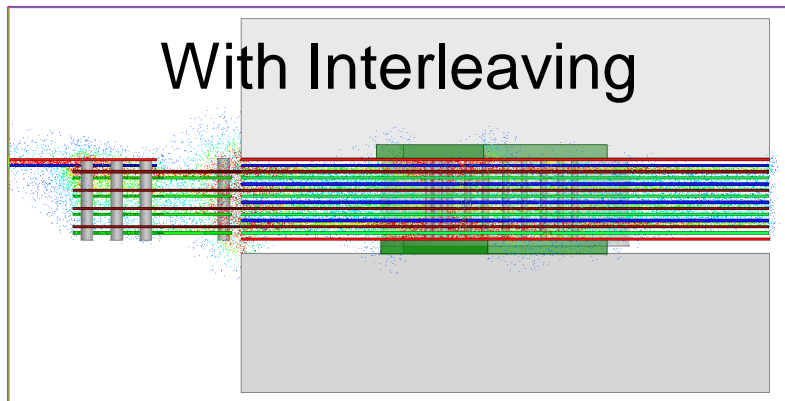
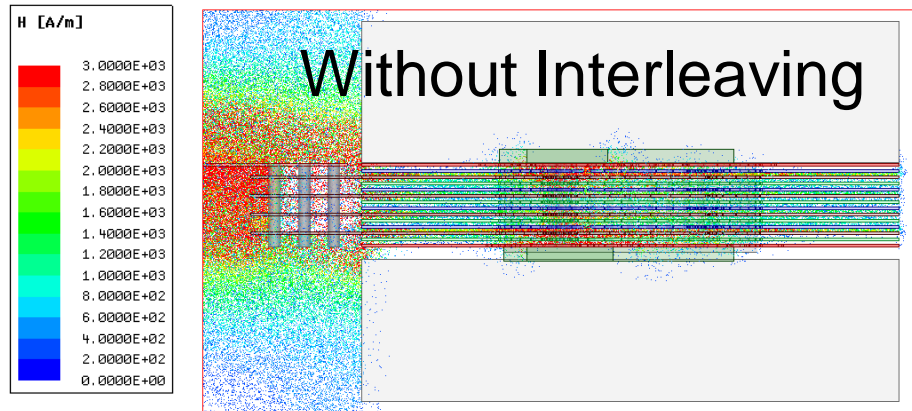


Connection Overview

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



Layer Assignment & Details



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

Layer Stackup

1	Shield
Pri 3	2 Sec-
	4 Sec+
	5 Sec+
Pri 6	7 Sec-
	8 Sec-
Pri 9	10 Sec+
	11 Sec+
Pri 12	13 Sec-
14	Shield

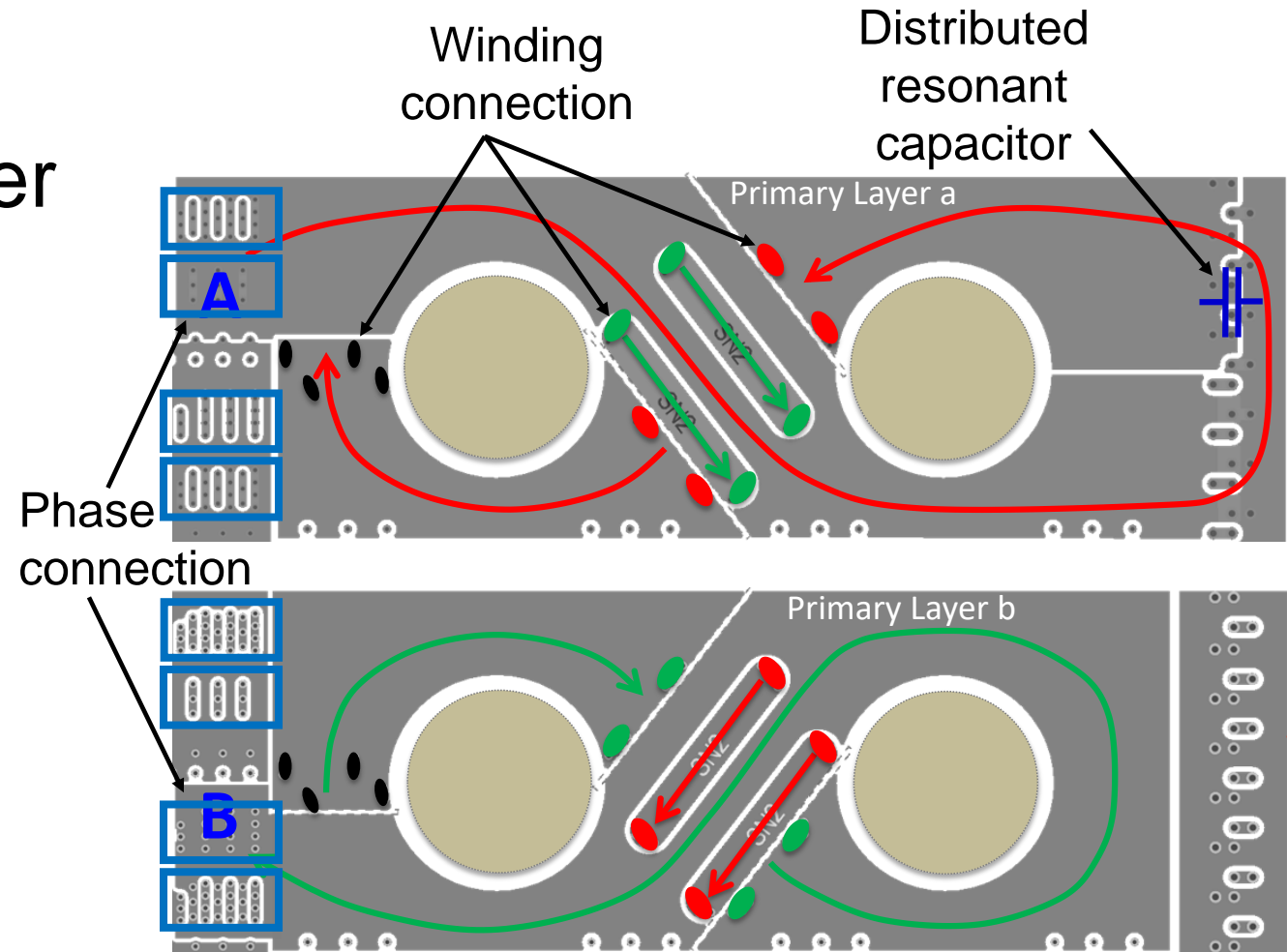
Parallel

6 & 12 parallel

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

Winding Details - Primary

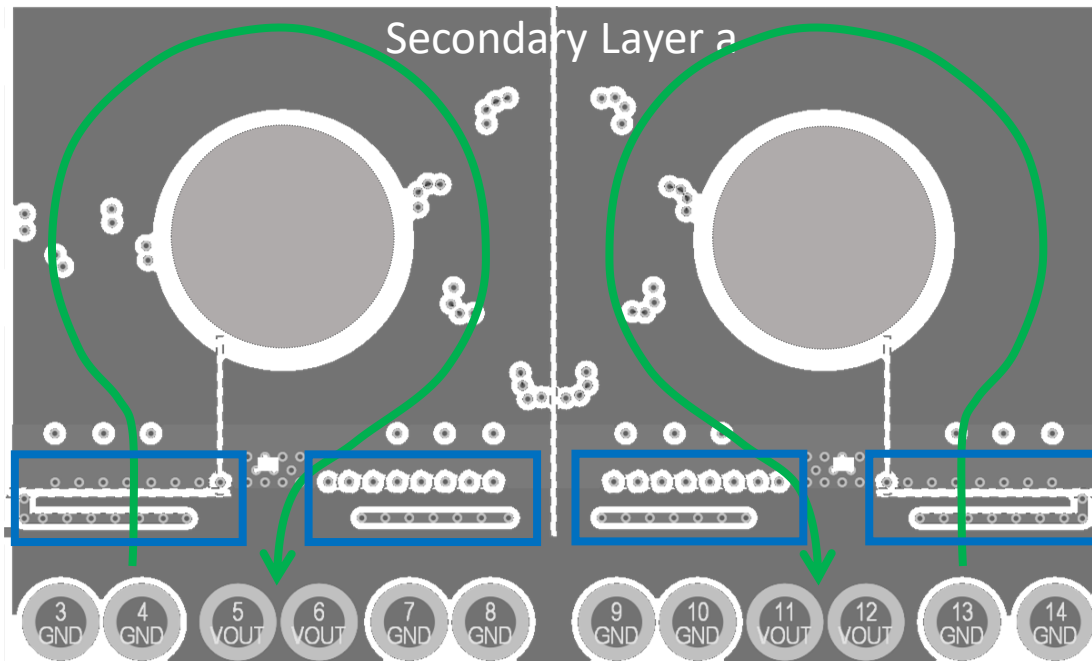
- Primary winding cross-over
- Opposite side resonant capacitor connection



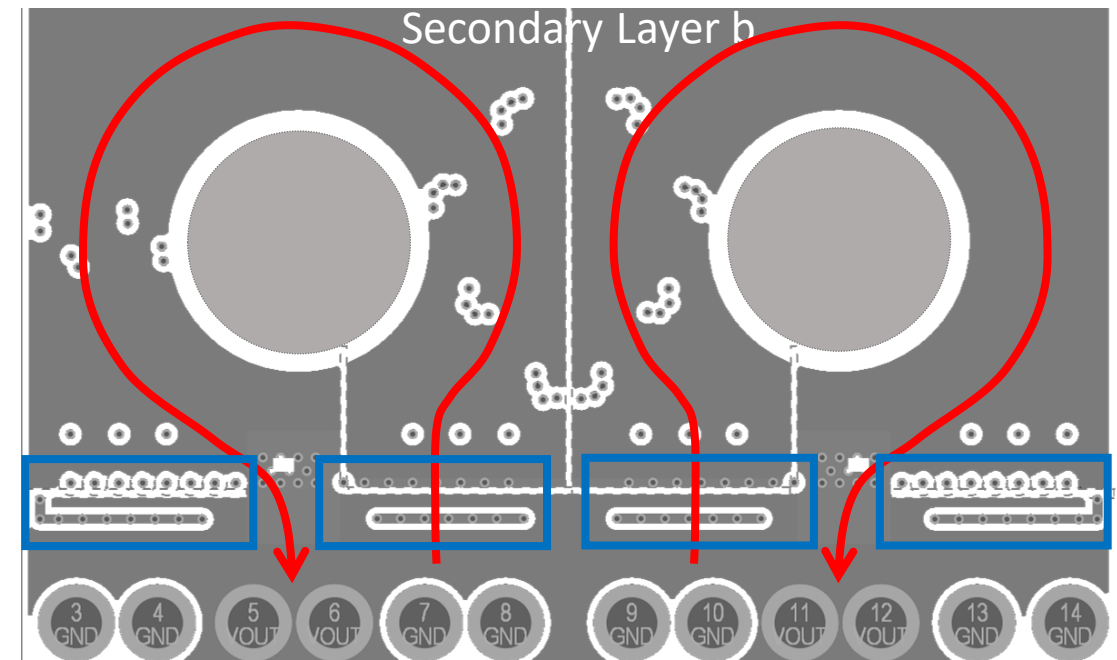
Primary winding design

Winding Details - Secondary

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



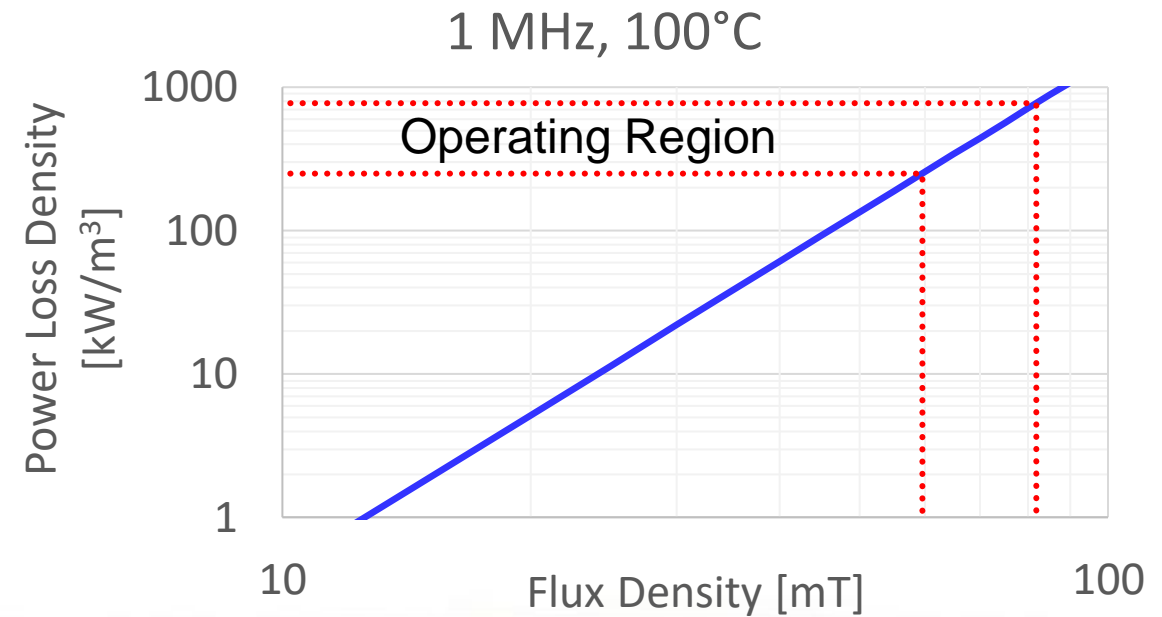
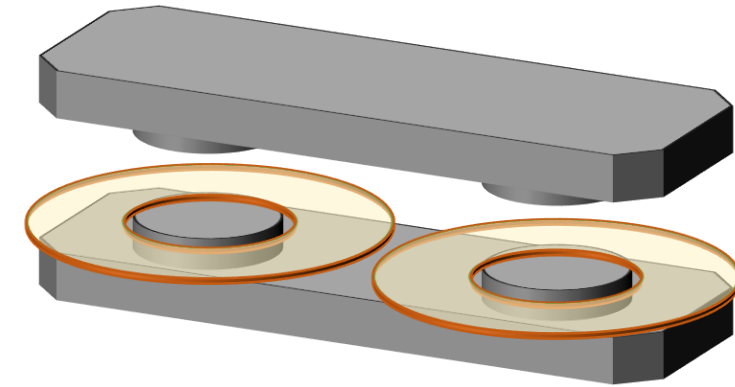
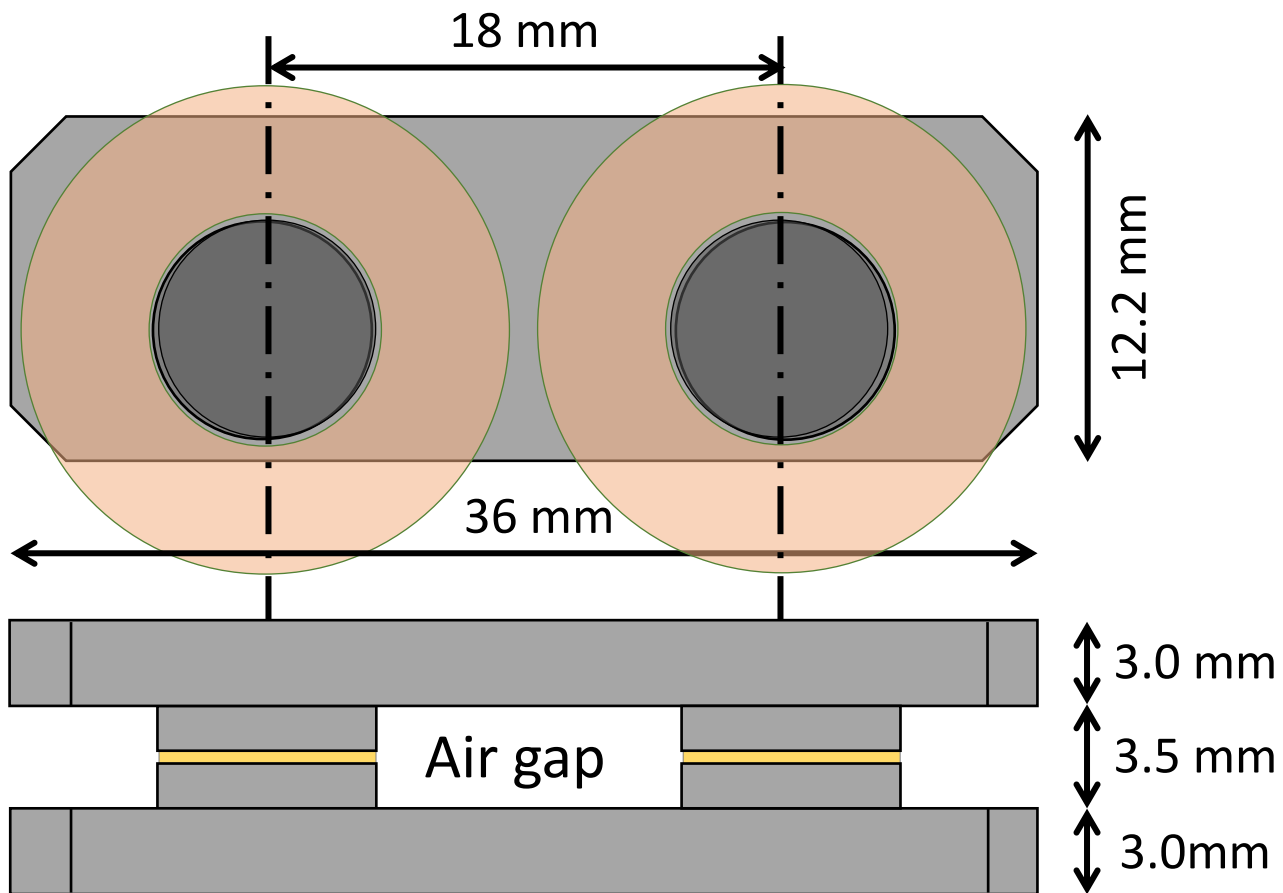
Negative



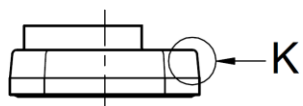
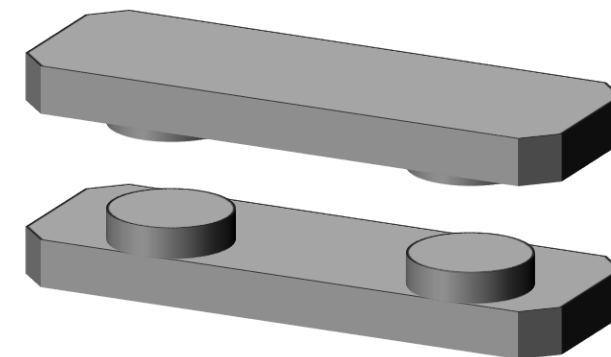
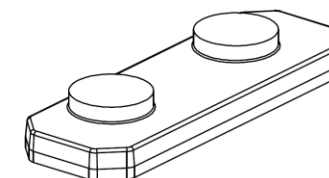
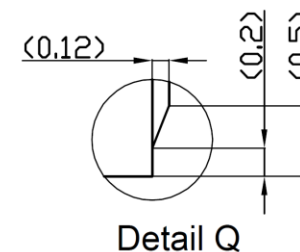
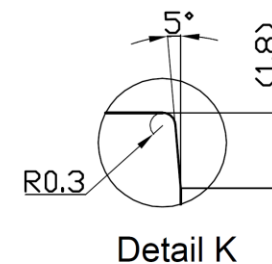
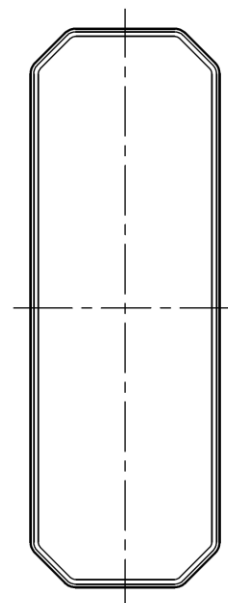
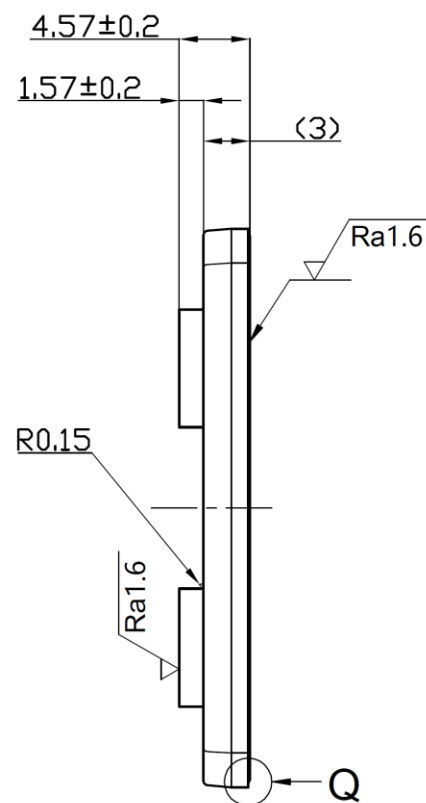
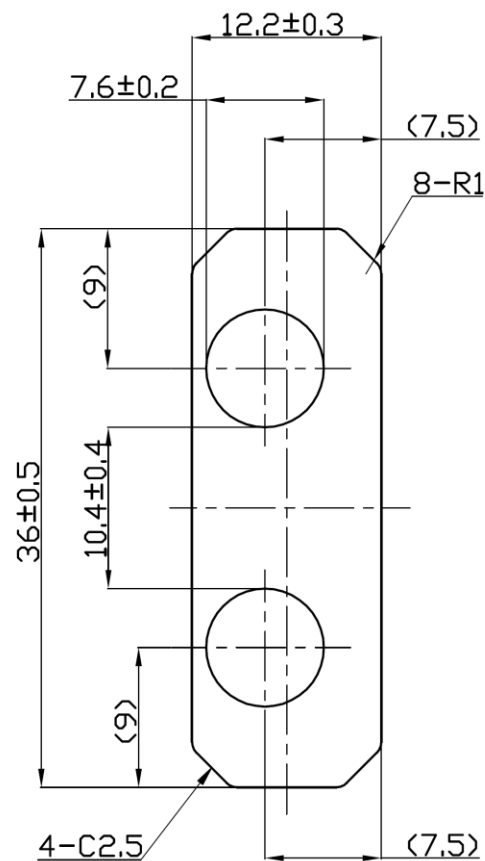
Positive

Core Overview

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



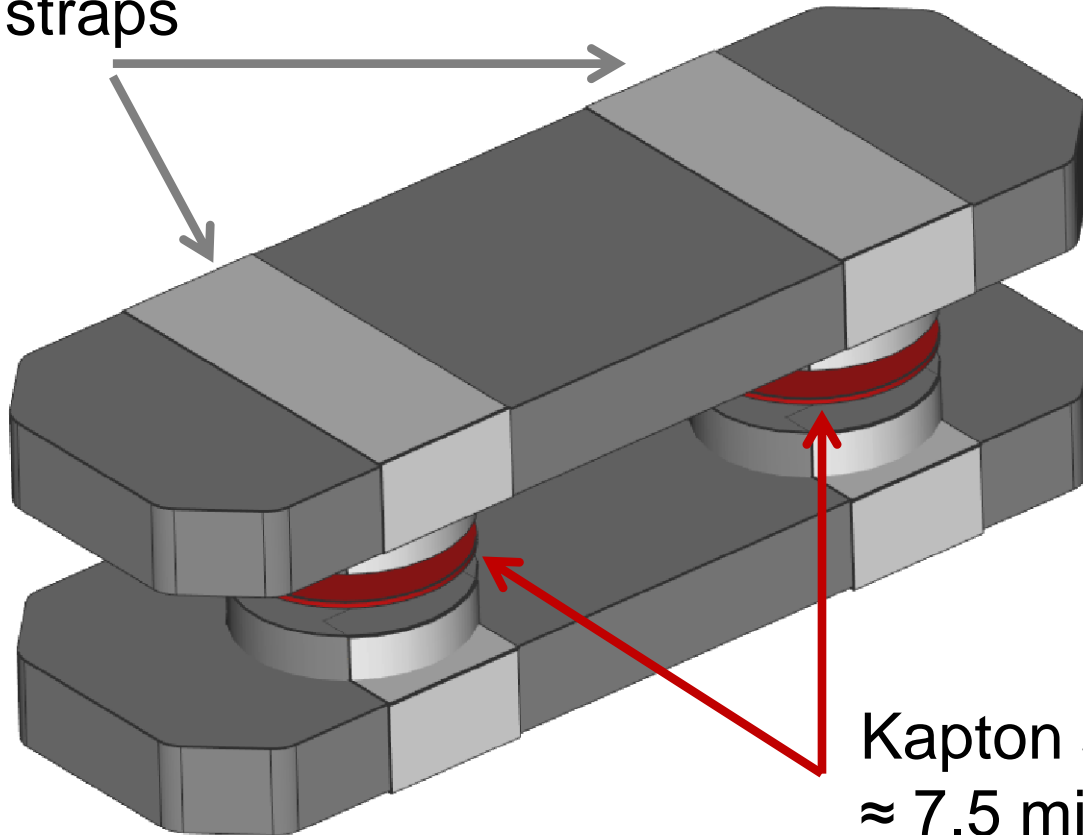
Core Drawing



	Scale 3: 1	Material ML91S	Customer Part number U-36-4.57-12.2
Unit: mm	Standard tolerances ± 0.2		Product Name

Core Assembly

Kapton straps



Kapton spacer

≈ 7.5 mil / 190 μ m EPC9149

≈ 10 mil / 250 μ m 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:

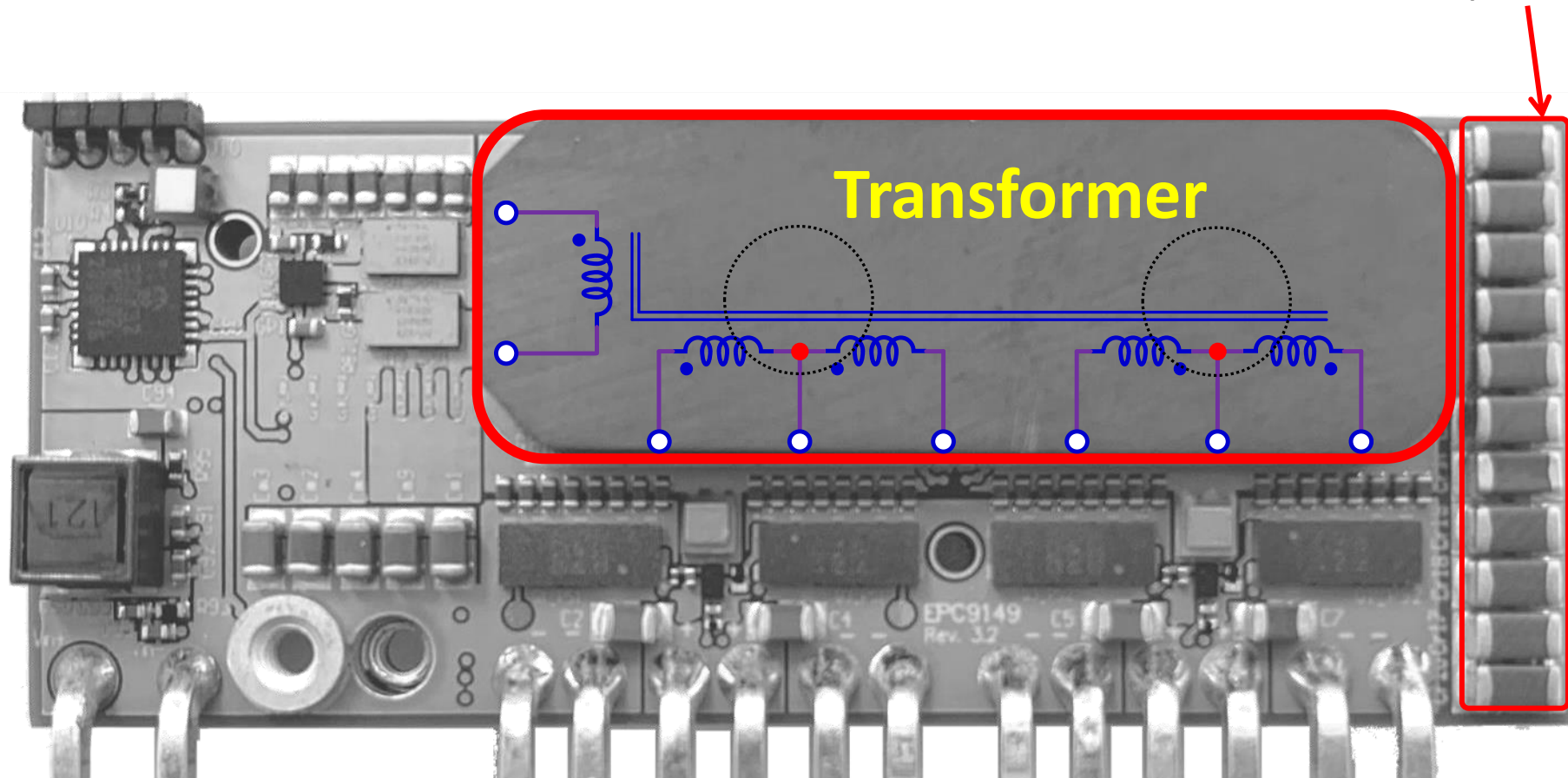
- Proximity losses not calculated
- Fringing losses not calculated

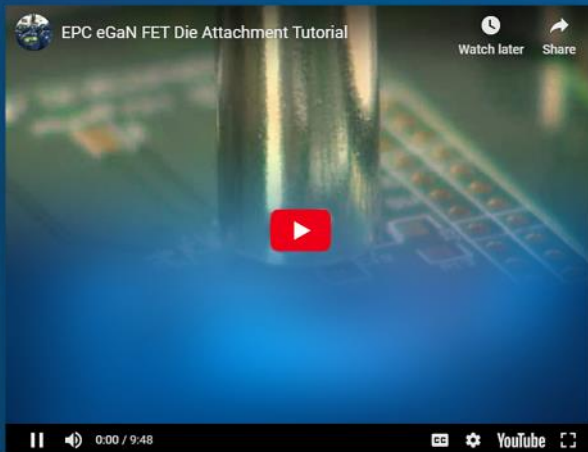
Assumptions:

- Winding losses based on current density
- Core losses based on power loss density

Transformer Location on PCB

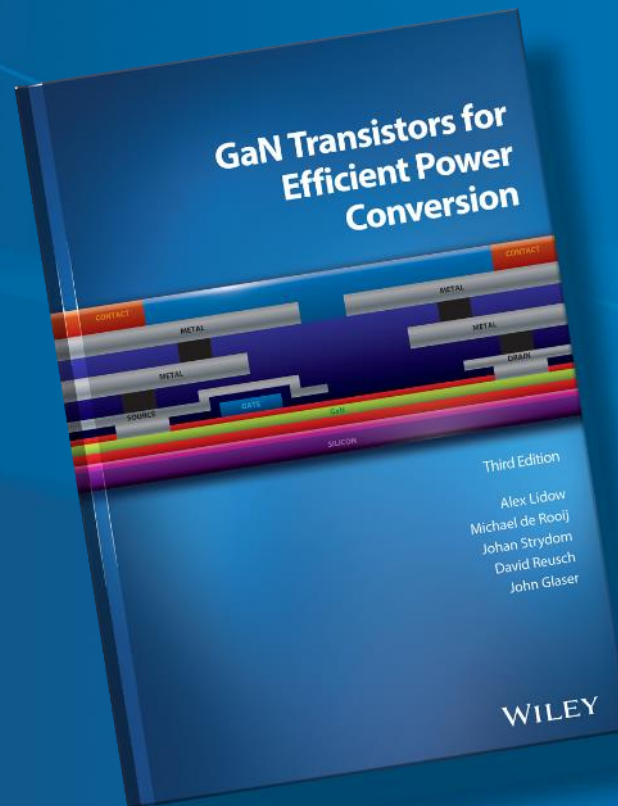
Resonant Capacitor Bank



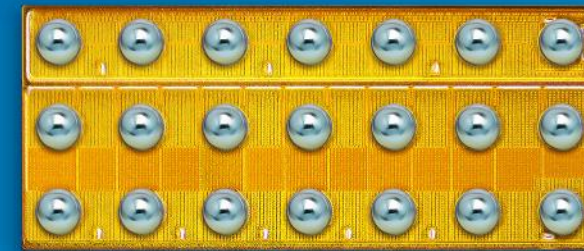


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