Electronic Components

Ferrite and Metal Composite Inductors

Design and Characteristics
What is an Inductor?

Current through the coil of wire creates a magnetic field and stores it.

The coil converts electric energy into magnetic energy and stores it.

Different core materials change magnetic field strength.
## Ferrite Inductor or Metal Composite Inductor?

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Ferrite</th>
<th>Metal Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ni-Zn</td>
<td>Mn-Zn</td>
</tr>
<tr>
<td>Inductance</td>
<td>Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Magnetic Saturation</td>
<td>Good</td>
<td>No Good</td>
</tr>
<tr>
<td>Thermal Property</td>
<td>Good</td>
<td>No Good</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Resistance of Core</td>
<td>Very Good</td>
<td>No Good</td>
</tr>
</tbody>
</table>
Ferrite and Metal Composite Comparison

**Advantage of Ferrite**
1. Higher inductance with high permeability
2. Stable inductance in the right range

**Advantage of Metal Composite**
1. Very slow saturation
2. Very stable saturation for the thermal

**Core Loss Comparison**

- Very low core loss in dynamic frequency range

- Good for Auto app especially

- Low power consumption capability
# SMD Power Inductor Lineup

<table>
<thead>
<tr>
<th>TPI</th>
<th>MPC</th>
<th>MPCV</th>
<th>MPLC</th>
<th>MPLCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrite core (Mn-Zn)</td>
<td>Metal core (Fe-Si-Cr or Amorphous)</td>
<td>Metal core (Fe-Si-Cr)</td>
<td>Metal core (Fe-Si-Cr or Amorphous)</td>
<td>Metal core (Fe-Si-Cr)</td>
</tr>
<tr>
<td>Flat wire (Direct terminal)</td>
<td>Flat wire (Direct terminal)</td>
<td>Round wire (Direct terminal)</td>
<td>Round wire (w/ lead-frame)</td>
<td>Round wire (w/ lead-frame)</td>
</tr>
<tr>
<td>Assembled</td>
<td>Molded</td>
<td>Molded</td>
<td>Molded</td>
<td>Molded</td>
</tr>
<tr>
<td>• Lowest DCR</td>
<td>• Low DCR</td>
<td>• Large Inductance</td>
<td>• Large Inductance</td>
<td></td>
</tr>
<tr>
<td>• Soft saturation</td>
<td>• Soft saturation</td>
<td>• Soft saturation</td>
<td>• Soft saturation</td>
<td></td>
</tr>
<tr>
<td>• Low acoustic noise</td>
<td>• Low acoustic noise</td>
<td>• Low acoustic noise</td>
<td>• Low acoustic noise</td>
<td></td>
</tr>
<tr>
<td>• Good thermal property</td>
<td>• Good thermal property</td>
<td>• Good thermal property</td>
<td>• Good thermal property</td>
<td></td>
</tr>
<tr>
<td>• AEC-Q200</td>
<td></td>
<td></td>
<td>• AEC-Q200</td>
<td></td>
</tr>
</tbody>
</table>

For Large load converter (CPU, GPU, Mem)
For Automotive
For Light load converter (system side)
For Automotive

<table>
<thead>
<tr>
<th>SBC</th>
<th>Ferrite core (Ni-Zn)</th>
<th>Round wire (Discrete type)</th>
<th>Assembled</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Wide lineup</td>
<td>• Good thermal property</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Small load system (Smart meter, Audio)

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Inductor Structure

TPI Series
Assembled Ferrite

- Conductor & Terminals
- Mn-Zn Core
- GAP

The lower DCR

Advantage of assembled ferrite
- The lower DCR
- The lower core loss

MPC/MPLC Series
Molded Metal

- Wire
- Terminal
- Molded Core
- Round Wire (Large Inductance)

Flat Wire (Low DCR)

Advantage of molded metal
- Smaller package
- Stable Inductance for thermal
- Low acoustic noise

GAP : Including the GAP into the core

Binder
- Insulating coating
- Around the metal power

Metal Powder

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When to Choose Ferrite or Metal Composite

**Interactive Architecture**
- TDP ≪ P_{\text{max}} (90A)
- Fs : 1~3 MHz
- Light load efficiency
- Shrinking : L x W

**Artificial Intelligence**
- TDP ≈ P_{\text{max}}
- Fs : 1~3MHz
- In light of P_{\text{max}} operation
- H: Low height restriction

- The lower core loss material for low power consumption
- Small footprint for low power loss on load

- Stable performance for high temp and peak power w/ Low loss metal material
- Low height component to construct AI module

Ferrite type
Metal type

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# Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Servers</th>
<th>Automotive</th>
<th>Notebook PC</th>
<th>POL (DC-DC Converter)</th>
</tr>
</thead>
</table>
| Requirement | • Large current  
• Low consumption | • High reliability  
• Heat resistivity | • Low acoustic noise  
• Saturation in small package | • Low consumption  
• Saturation in small package |
| Example MPN | • TPI  
• MPC  
• MPLC | • MPCV  
• MPLCV | • MPC  
• MPLC | • MPC  
• MPLC  
• TPI |
| Note | TPI for CPU power  
MPC,MPLCG for system power  
Buck converter | MPLCV: AEC-Q200  
Buck converter  
Boost converter | TPI,MPC for CPU power  
MPLCG for system power  
Buck converter | MPC for large power sys  
MPLCG for small power sys  
Buck converter  
Boost converter |

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<table>
<thead>
<tr>
<th>Application</th>
<th>Servers</th>
<th>Automotive Infotainment/LED Lighting</th>
<th>Notebook PC Desktop PC</th>
<th>POL (DC-DC Converter)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competitors</strong></td>
<td><img src="image" alt="Eaton" /></td>
<td><img src="image" alt="TDK" /></td>
<td><img src="image" alt="Vishay" /></td>
<td><img src="image" alt="TDK" /></td>
</tr>
<tr>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CMLB series</strong></td>
<td>SPM series</td>
<td>NA</td>
<td>NA</td>
<td>LHMI series</td>
</tr>
<tr>
<td><strong>SRC series</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>SRC series</td>
</tr>
<tr>
<td><strong>HCB series</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>SRC series</td>
</tr>
<tr>
<td><strong>SRP series</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>SRC series</td>
</tr>
<tr>
<td><strong>PCC series</strong></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>SRC series</td>
</tr>
</tbody>
</table>

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Ferrite Inductor for Servers

- AC Optimization
- DC Optimization
Power Conversion for CPU

From the Wall

Conventional Circuit
- Loss on the load line is a lot
- 12V Power Distribution

Improve power loss on the line to 1/16 by 48V power distribution

With STC
(Switched tank converter)

Efficient and scalable

1ST stage
- STC
(Switched tank converter)
- Soft SW topology

12V Power Distribution

2nd stage
- DC/DC Converter
- Hard SW Topology

1V

AC Optimization Inductor

DC Optimization Inductor

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DC Optimization Inductor for the Hard SW Topology
FET&IC

DC Optimization Inductor

Need to reduce this distance between CPU and Inductors

For next GEN
The current for an inductor 456A(Imax) / 7p = 65A for Xμsec at 125C

Peak power is going up and phases of DC/DC converter is increased by GEN. It's necessary reducing product width and put inductors closer to CPU as possible to improve the loss on the road line.

P = I^2 x R (∼ Distance)

Size: 11x8x8.2mm
Size: 10x6.5x9mm
Size: 11x6.0x10mm

Current Shape
Horizontal type

Saving Footprint
Vertical type

Narrow width required
DC Optimization Inductor

<table>
<thead>
<tr>
<th>Generation</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material GEN</td>
<td>Current</td>
<td>B45</td>
<td>NEW</td>
</tr>
<tr>
<td>Suitable Freq. [kHz]</td>
<td>600~800</td>
<td>800~1500</td>
<td>1500~3000</td>
</tr>
<tr>
<td>Core Loss [mW/cc]</td>
<td>24</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Permeability</td>
<td>2300</td>
<td>1000</td>
<td>≈1000</td>
</tr>
<tr>
<td>Magnetic flux density</td>
<td>520</td>
<td>480</td>
<td>&lt; 480</td>
</tr>
</tbody>
</table>

Material: B45
L : 10.0mm
W : 6.5mm
H : 9.0mm

Target: L = 70 nH, DCR = - mΩ, I_{sat} = >120 A
Proposal: L = 70 nH, DCR = 0.185 mΩ, I_{sat} = 124 A

Engineering Sample: Available
## DC optimization type

<table>
<thead>
<tr>
<th>Model</th>
<th>Package size L x W x H Max [mm]</th>
<th>L [nH] @100kHz, 0.1Vrms</th>
<th>DCR [mΩ] at 25°C</th>
<th>Rated Current Typ. [A] (Reference)</th>
<th>Temperature Rated Current Typ. [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I(_{sat1}) at 25°C</td>
<td>I(_{sat2}) at 85°C</td>
</tr>
<tr>
<td>TPI077050L070N</td>
<td>7.0 x 7.0 x 5.0</td>
<td>70 +/- 10%</td>
<td>0.28 Max</td>
<td>72</td>
<td>-</td>
</tr>
<tr>
<td>TPI077050L105N</td>
<td>7.0 x 7.0 x 5.0</td>
<td>105 +/- 10%</td>
<td>0.35 Max</td>
<td>58</td>
<td>-</td>
</tr>
<tr>
<td>TPI118082L150N</td>
<td>11.2 x 8.0 x 8.2</td>
<td>150 +/- 10%</td>
<td>0.29 +/-5%</td>
<td>93</td>
<td>79</td>
</tr>
<tr>
<td>TPI118082L180N</td>
<td>11.2 x 8.0 x 8.2</td>
<td>180 +/- 10%</td>
<td>0.29 +/-5%</td>
<td>79</td>
<td>67</td>
</tr>
<tr>
<td>TPI128080L180N</td>
<td>12.0 x 8.0 x 8.0</td>
<td>180 +/- 10%</td>
<td>0.29 +/-5%</td>
<td>78</td>
<td>68</td>
</tr>
<tr>
<td>TPI128080L210N</td>
<td>12.0 x 8.0 x 8.0</td>
<td>210 +/- 10%</td>
<td>0.29 +/-5%</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>TPI128080L230N</td>
<td>12.0 x 8.0 x 8.0</td>
<td>230 +/- 10%</td>
<td>0.29 +/-5%</td>
<td>64</td>
<td>56</td>
</tr>
<tr>
<td>TPI0706790L150N</td>
<td>6.7 x 7.0 x 9.0</td>
<td>150 +/- 10%</td>
<td>0.62 Typ.</td>
<td>60</td>
<td>51</td>
</tr>
<tr>
<td>TPI0706790L180N</td>
<td>6.7 x 7.0 x 9.0</td>
<td>180 +/- 10%</td>
<td>0.62 Typ.</td>
<td>50</td>
<td>42</td>
</tr>
<tr>
<td>TPI106090L070N</td>
<td>10.0 x 6.0 x 9.0</td>
<td>70 +/- 10%</td>
<td>0.185 Typ.</td>
<td>162</td>
<td>134</td>
</tr>
<tr>
<td>TPI966410L120N</td>
<td>9.6 x 6.4 x 10.0</td>
<td>120 +/- 10%</td>
<td>0.145 Typ.</td>
<td>90</td>
<td>78</td>
</tr>
<tr>
<td>TPI966410L150N</td>
<td>9.6 x 6.4 x 10.0</td>
<td>150 +/- 10%</td>
<td>0.145 Typ.</td>
<td>71</td>
<td>61</td>
</tr>
</tbody>
</table>

### Vertical (Narrow width)

**Under Development**
AC Optimization Inductor for the Soft SW Topology
The resonant inductor is comprised of upper and lower core using Mn-Zn ferrite, a center conductor and non-magnetic gap spacer.

Enable the lowest resistance and the lowest core loss by simple structure for STC.
Electrical current wave form in the STC utilizes the resonant is almost sine wave.

- Reduction of AC loss component is very important.

- The AC losses can be categorized into the ferrite iron loss, the copper conductor loss and fringing flux loss.

- Need to focus on Core Loss and Eddy Current Loss to improve the total loss.

* The skin effect can be led from frequency and so on.
STC utilizes series resonant with MLCC

- Low core loss is required for wide range Magnetic Flux Density
Development of Resonant Inductor

Inductor Design Modification for Fringing Flux Loss

- Distance between the GAP and the conductor is necessary based on the amount of magnetic flux leakage
Development of Resonant Inductor
Total Loss Comparison

35Ao-p, 300kHz

STC utilizes series resonant with MLCC

Material + Product Shape

The Core Loss is improved with the suitable material for STC topology.

The Fringing Loss is improved by the optimization of product structure.

Material

Product Shape

Conventional Magnetic Structure

Improved Magnetic Structure

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Conventional</th>
<th>Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Loss</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Copper Loss</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Air Gap Fringing Flux Loss</td>
<td>1.1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Loss Comparison

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To construct LC resonant circuit for STC topology, KEMET provides the best solution by Inductor and MLCC.

Inductor

L7 x W8 x H6 mm

AC Optimization Inductor

TPI078060L047N
TPI078060L056N
TPI078060L068N
TPI078060L082N

MLCC

U2J Leadless Stacks

1812, 0.47µF, 50V

Leadless stack U2J is suitable for STC

Sample KIT
Coming Soon

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### TPI Series Line-up 2

**AC Optimization Type**
- RoHS Compliant
- Halogen Free

<table>
<thead>
<tr>
<th>Model</th>
<th>L [nH] @100kHz, 0.1Vrms</th>
<th>DCR [mΩ] at 25˚C</th>
<th>Rated Current [A] (Reference)</th>
<th>Temperature Rated Current [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Isat1 at 25˚C</td>
<td>Isat2 at 60˚C</td>
</tr>
<tr>
<td>TPI078060L047N</td>
<td>47 +/- 10%</td>
<td>0.31 +/- 10%</td>
<td>90</td>
<td>83</td>
</tr>
<tr>
<td>TPI078060L056N</td>
<td>56 +/- 10%</td>
<td>0.31 +/- 10%</td>
<td>81</td>
<td>74</td>
</tr>
<tr>
<td>TPI078060L068N</td>
<td>68 +/- 10%</td>
<td>0.31 +/- 10%</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>TPI078060L082N</td>
<td>82 +/- 10%</td>
<td>0.31 +/- 10%</td>
<td>54</td>
<td>51</td>
</tr>
</tbody>
</table>

**Saturation Characteristics (Reference):**

- Stable saturation characteristics by Mn-Zn ferrite core

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Metal Composite Inductor for Automotive Applications
EV, X-by-wire technology will become more popular for future automotive applications.

- Red: Expect more opportunities from EV/HEV/PHEV cars and X-by-wire applications

**Major Automotive Applications**

- **Cluster**
  - Head up display
  - Multi function display
  - Flex suppressor, SMD coil

- **Electric water pump**
  - Toroidal coils

- **Blower motor**
  - Toroidal coils

- **Head lamp**
  - SMD coils
  - Ferrite cores

- **Camera**
  - SMD coils

- **Valve Matic System**
  - SMD coils

- **Audio/Navigation**
  - Bar choke coils
  - Toroidal coils
  - SMD coils

- **Air bag**
  - SMD coils

- **On vehicle battery charger**
  - Transformers

- **Battery cooling unit**
  - Toroidal coils

- **Keyless entry**
  - SMD coils
  - Flex suppressor

- **Power control unit**
  - Inverter transformers
  - Reactors

- **Electric power steering**
  - Bar choke coils
  - Toroidal coils
  - SMD coils

- **Ignition coil(DIS)**
  - Sm-Co magnet

- **Crank/Cam anglesensor**
  - Sm-Co magnet

- **Can communication module**
  - CAN filters
  - SMD coils

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TOKIN has a certification of ISO/TS16949
Applied plant: TOKIN Electronics (Xiamen, China)
TOKIN Electronics (Vietnam)
Products: EMI inductors, Power inductors
<table>
<thead>
<tr>
<th>Items</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temperature Exposure (Storage)</td>
<td>+155°C, 1000hr</td>
</tr>
<tr>
<td>Low Temperature Exposure (Storage)</td>
<td>-40°C, 1000hr</td>
</tr>
<tr>
<td>Biased Humidity</td>
<td>+85°C / 85%, 1000hr</td>
</tr>
<tr>
<td>Temperature Cycling</td>
<td>-55°C⇌+155°C, 30min./cycle, 1000cycle</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>100G, 6ms, half sin wave, XYZ each 3 times</td>
</tr>
<tr>
<td>Vibration</td>
<td>10～2000Hz, 30G for 20 minutes, 12 cycles each of 3 orientations.</td>
</tr>
<tr>
<td>Resistance to Soldering Heat</td>
<td>250°C, 5sec., 3times</td>
</tr>
<tr>
<td>Solderability</td>
<td>260°C, 5sec., dip test</td>
</tr>
<tr>
<td>Board Flex</td>
<td>60 sec minimum holding time.,2mm</td>
</tr>
<tr>
<td>Terminal Strength (Leaded)</td>
<td>60 sec minimum holding time.,1.8kg</td>
</tr>
</tbody>
</table>
# MPLCV Series Line-up

## Vishay IHLP-5A series
- Up to 155°C
- Round wire model
- AEC-Q200, RoHS compliant

## KEMET MPLCV series
- Up to 155°C, 30G
- Round wire model
- AEC-Q200, RoHS compliant

<table>
<thead>
<tr>
<th>Model</th>
<th>L [uH]</th>
<th>DCR [mohm]</th>
<th>Irms [A]</th>
<th>Isat [A]</th>
<th>Lo-20% [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPLCV0645L100</td>
<td>10 +/-20%</td>
<td>45 +/-10%</td>
<td>4.0</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>MPLCV0654L4R7</td>
<td>4.7 +/-20%</td>
<td>20 +/-10%</td>
<td>6.3</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>MPLCV0654L330</td>
<td>33 +/-20%</td>
<td>140 +/-10%</td>
<td>2.6</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>MPLCV0654L470</td>
<td>47 +/-20%</td>
<td>175 +/-10%</td>
<td>2.1</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>MPLCV1054L100</td>
<td>10 +/-20%</td>
<td>25 +/-10%</td>
<td>7.1</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>MPLCV1054L220</td>
<td>22 +/-20%</td>
<td>47 +/-10%</td>
<td>5.5</td>
<td>7.0</td>
<td></td>
</tr>
</tbody>
</table>

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## MPLCV Series Line-up Plan

### Vishay IHLP-5A series
- Up to 155°C
- Round wire model
- AEC-Q200, RoHS compliant

### KEMET MPLCV0630 series
- Up to 155°C, 30G
- Round wire model
- AEC-Q200, RoHS compliant

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MPLCV0630LR68</td>
<td>0.68 +/-20%</td>
<td>5.1 typ</td>
<td>10.9 typ.</td>
<td>13.5 typ</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L1R0</td>
<td>1.0 +/-20%</td>
<td>6.7 typ</td>
<td>9.5 typ.</td>
<td>12.0 typ</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L1R5</td>
<td>1.5 +/-20%</td>
<td>10.8 typ</td>
<td>7.5 typ.</td>
<td>10.0 typ</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L2R2</td>
<td>2.2 +/-20%</td>
<td>13.9 typ</td>
<td>6.6 typ.</td>
<td>9.0 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L3R3</td>
<td>3.3 +/-20%</td>
<td>20 typ</td>
<td>5.5 typ.</td>
<td>8.0 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L4R7</td>
<td>4.7 +/-20%</td>
<td>30 typ</td>
<td>4.5 typ.</td>
<td>7.2 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L6R8</td>
<td>6.8 +/-20%</td>
<td>47 typ</td>
<td>3.6 typ.</td>
<td>5.7 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L100</td>
<td>10.0 +/-20%</td>
<td>70 typ</td>
<td>3.0 typ.</td>
<td>4.3 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L150</td>
<td>15.0 +/-20%</td>
<td>97 typ</td>
<td>2.5 typ.</td>
<td>3.5 typ.</td>
<td></td>
</tr>
<tr>
<td>MPLCV0630L220</td>
<td>22.0 +/-20%</td>
<td>125 typ</td>
<td>2.2 typ.</td>
<td>3.0 typ.</td>
<td></td>
</tr>
</tbody>
</table>

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# MPLCV/MPHV Series Line-up Plan

<table>
<thead>
<tr>
<th>Size</th>
<th>Lineups by Size</th>
<th>Status &amp; Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5 x W5 x H3</td>
<td>MPLCV0530 series</td>
<td>0.47 – 4.7uH under preparation (MP start from 1H/CY2019)</td>
</tr>
<tr>
<td>D7 x W7 x H3</td>
<td>MPLCV0630 series</td>
<td>0.68 – 22uH under preparation (MP start from 2H/CY2018)</td>
</tr>
<tr>
<td>D7 x W7 x H5.4</td>
<td>MPLCV0654 series</td>
<td>4 model in MP</td>
</tr>
<tr>
<td>D8 x W8 x H4</td>
<td>MPLCV0840 series</td>
<td>1.0 – 22uH under preparation (MP start from 1H/CY2019)</td>
</tr>
<tr>
<td>D10 x W10 x H4</td>
<td>MPLCV1040 series</td>
<td>1.0 – 22uH under preparation (MP start from 1H/CY2019)</td>
</tr>
<tr>
<td>D10 x W10 x H5.4</td>
<td>MPLCV1054 series</td>
<td>2 model under preparation (MP start from 2H/CY2018)</td>
</tr>
<tr>
<td>D17 x W17 x H7</td>
<td>MPHV series</td>
<td>Just started developing (Target CY2022)</td>
</tr>
<tr>
<td>D22 x W22 x H13</td>
<td>MPHV series</td>
<td>Just started developing (Target CY2022)</td>
</tr>
</tbody>
</table>
### MPCV Series Line-up

#### Panasonic
**PCC-1280MF series**
- Up to 160°C, 30G
- Flat wire model
- AEC-Q200, RoHS compliant

#### KEMET
**MPCV series**
- Up to 155°C, 30G
- Flat wire model
- AEC-Q200, RoHS compliant

<table>
<thead>
<tr>
<th>Model</th>
<th>L [µH]</th>
<th>DCR [mohm]</th>
<th>Irms [A]</th>
<th>Isat Lo-30% [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPCV1060LR68</td>
<td>0.68 +/-20%</td>
<td>1.4</td>
<td>32</td>
<td>38</td>
</tr>
<tr>
<td>MPCV1060L1R0</td>
<td>1.0 +/-20%</td>
<td>1.7</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>MPCV1060L1R5</td>
<td>1.5 +/-20%</td>
<td>2.5</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>MPCV1260L1R0</td>
<td>1.0 +/-20%</td>
<td>1.5</td>
<td>32</td>
<td>42</td>
</tr>
<tr>
<td>MPCV1260L1R5</td>
<td>1.5 +/-20%</td>
<td>2.1</td>
<td>28</td>
<td>35</td>
</tr>
</tbody>
</table>
# Power Inductor Technical Roadmap

## Metal Composite Inductor

<table>
<thead>
<tr>
<th>For Consumer</th>
<th>Saturation optimization</th>
<th>Permeability optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topology</td>
<td>For all metal composite</td>
<td>To make DCR Lower</td>
</tr>
</tbody>
</table>

### For Automotive

- **MPC series** (Low DCR model)
- **MPLC series** (High inductance model)
- **MPCV/MPLCV series** (for Automotive app.)

### Material

- **SENNTIXII**: Nano Crystal
  - For Consumer
  - ~1MHz
  - -30% Core loss
  - Op temp < 150°C

- **MPC series**: Low DCR model
  - MPCHV series
  - 17x17, 22x22
  - Op temp < 180°C

- **MPLCV series**: High inductance model
  - Middle type (~40A)
  - MPLCV series
  - 5x5, 8x8

## Ferrite Inductor

### TPI series

- **DC Optimization**
  - For 12V-1V: L11xW8
  - ~800kHz
  - -20% Core loss

- **AC Optimization**
  - For 48V-12V: L10xW6.5
  - ~400kHz
  - ~300kHz
  - ~200kHz
  - AC Optimization with Frequency

### Material

- **BH5L**: ~800kHz
  - -20% Core loss
- **BH45**: ~1.5MHz
  - -20% Core loss
- **BHXX**: ~3MHz
  - Core loss

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**Expand lineup**

- To cross IHP series

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Factories and Products

TPI series: 2.5Mpcs/M
MPLC/MPLCV series: 10Mpcs/M

Xiamen, China
Magnetic devices, Sensors, Piezoelectric devices

Thailand
Tantalum chip capacitors, Electric double layer capacitors

Vietnam
Magnetic devices

Sendai
Magnetic materials

Toyama
Tantalum chip capacitors

Headquarters / Shiroishi
Magnetic devices, Piezoelectric devices,

MPC/MPCV series: 10Mpcs/M
Thank You!