Section 1. About CSC Cores

Section 2. CSC Cores for Applications
Section 1.
About CSC Cores
I. Soft Magnetic Materials

- Soft Magnetic Materials
  - Ferrite
  - Metals
    - Powder
      - MPP (Ni-Fe-Mo)
      - High Flux (Ni-Fe)
      - Sendust (Fe-Si-Al)
      - Mega Flux® (Fe-Si)
        - HS (Fe-Si-Al-Ni)
        - KS (Fe-Si-Al)
        - KH (Fe-Ni-Si)
        - Fine Flux (Fe-Si-Al)
        - HP (Fe-Si-Al)
    - Strip
      - Fe-Si
      - Amorphous
      - Permalloy
II. Soft Magnetic Powder Cores

What is Magnetic Powder Core?
- Made from ferrous alloy powders
- Evenly distributed air gap
- Low core losses at high frequency
- Nearly no magnetic leakage flux
- High DC Bias characteristics

Advantages of Distributed Air Gap
- Higher DC Bias at Large Current
- Lower Core Loss
- Minimized Audible Noise
- Free from Leakage Flux
- No Heating & EMI Noise

• Soft Saturation

Better DC-Bias
## II. Soft Magnetic Powder Cores

<table>
<thead>
<tr>
<th>Material</th>
<th>Perm.(μ)</th>
<th>Bs(kG)</th>
<th>Core Loss</th>
<th>DC Bias</th>
<th>Temp. Stability</th>
<th>Curie Temp(°C)</th>
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<tbody>
<tr>
<td><strong>Ni-Fe Alloy</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>MPP</td>
<td>26-200</td>
<td>7</td>
<td>Lower</td>
<td>Good</td>
<td>Best</td>
<td>450</td>
</tr>
<tr>
<td>High Flux</td>
<td>26-160</td>
<td>15</td>
<td>Low</td>
<td>Best</td>
<td>Better</td>
<td>500</td>
</tr>
<tr>
<td>HS</td>
<td>60-90</td>
<td>13</td>
<td>Low</td>
<td>Better</td>
<td>Better</td>
<td>500</td>
</tr>
<tr>
<td>KH</td>
<td>26-90</td>
<td>16</td>
<td>Medium</td>
<td>Best</td>
<td>Better</td>
<td>600</td>
</tr>
<tr>
<td><strong>Fe-Si Alloy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mega Flux®</td>
<td>26-90</td>
<td>17</td>
<td>Medium</td>
<td>Best</td>
<td>Better</td>
<td>700</td>
</tr>
<tr>
<td><strong>Fe-Si-Al Alloy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KS</td>
<td>26-60</td>
<td>14</td>
<td>Medium</td>
<td>Better</td>
<td>Good</td>
<td>500</td>
</tr>
<tr>
<td>HP</td>
<td>19-60</td>
<td>8.5</td>
<td>Lowest</td>
<td>Better</td>
<td>Good</td>
<td>500</td>
</tr>
<tr>
<td>Fine Flux</td>
<td>26-60</td>
<td>12</td>
<td>Low</td>
<td>Better</td>
<td>Good</td>
<td>500</td>
</tr>
<tr>
<td>Sendust</td>
<td>26-125</td>
<td>10</td>
<td>Low</td>
<td>Good</td>
<td>Good</td>
<td>500</td>
</tr>
<tr>
<td>Iron</td>
<td>10-100</td>
<td>10</td>
<td>Highest</td>
<td>Poor</td>
<td>Poor</td>
<td>770</td>
</tr>
<tr>
<td><strong>Strip</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe-Si Strip (Gap)</td>
<td>20</td>
<td></td>
<td>High</td>
<td>Better</td>
<td>Good</td>
<td>740</td>
</tr>
<tr>
<td>Amorphous (Gap)</td>
<td>15</td>
<td></td>
<td>Low</td>
<td>Better</td>
<td>Good</td>
<td>399</td>
</tr>
<tr>
<td>Ferrite</td>
<td>Ferrite (Gap)</td>
<td>3-5</td>
<td>Lowest</td>
<td>Poor</td>
<td>Poor</td>
<td>100-300</td>
</tr>
</tbody>
</table>

Better Efficiency Better Solutions to you
III. CSC’s Soft Magnetic Powder Cores

Power of Stable High Quality
- In house Powder Making
- Accumulated Know-how for various powders
- Continuous Research and Development

Manufacturing process

- **Powder Making**
  - Gas/Water Atomization
  - Control of particle distribution & magnetic property

- **Ceramic Insulation**
  - Control of air gap, Core loss & Q value

- **Pressing**
  - Core shape & size
  - Control of magnetic property
  - Core strength

- **Core Finish (Coating)**
  - Epoxy coating
  - Anti-rust treatment

- **Core Annealing**
  - Epoxy coating
  - Anti-rust treatment

- **Inspectio Packing**
  - L, Q, DCB, Appearance
  - Vacuum packing for uncoated core

- **Facilities**
  - Capacity: 16Milion pcs/Month
  - Facilities: 20~3000Tons press machines
  - Basic analysis equipment
  - Reliability test machines
  - Automatic L/Q machines etc
III. CSC’s Soft Magnetic Powder Cores

- **Pyeongtaek Korea factory**
  - MPP Powder, MPP Cores, KH Cores,
  - Customized special shape cores
  (More for customized, small & special production)

- **Weihai China factory**
  - Toroidal cores of HF, MF, HS, HP, CF, KS, SD
  - Special shape cores of KEQ, SEQ, RK etc
  - Powders of HF, MF, SD, HP
  - Core finish (epoxy coating) line
  (More for mass production)

*Factory |
--- |
PT | WH | Total |
--- | --- | --- |
Employees | 60 | 142 | 200
### III. CSC’s Soft Magnetic Powder Cores

#### ✦ 2019 Improved Property in 60\(\mu\) Toroidal Cores (Typ.)

<table>
<thead>
<tr>
<th>Materials</th>
<th>Part No# Identification</th>
<th>Available Perm. ((\mu))</th>
<th>Max. Bs (kG)</th>
<th>DC Bias</th>
<th>Core Loss([\text{mW/cm}^3]) @50kHz, 1000Gauss</th>
<th>60(\mu)</th>
<th>26(\mu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Flux</td>
<td>CH270060G</td>
<td>26-160</td>
<td>15</td>
<td>82%</td>
<td>230</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>High Flux Titanium</td>
<td>CH270060GT</td>
<td>60</td>
<td>15</td>
<td></td>
<td>130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mega Flux</td>
<td>CK270060G</td>
<td>19-90</td>
<td>17</td>
<td>82%</td>
<td>661</td>
<td>590</td>
<td></td>
</tr>
<tr>
<td>Mega Flux Titanium</td>
<td>CK270060GT</td>
<td>60</td>
<td>17</td>
<td></td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPP</td>
<td>CM270060G</td>
<td>26-200</td>
<td>10</td>
<td>55%</td>
<td>170</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>KH</td>
<td>KH270060G</td>
<td>26-90</td>
<td>16</td>
<td>85%</td>
<td>469</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td>HS270060G</td>
<td>60-90</td>
<td>13</td>
<td></td>
<td>206 -&gt; 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>HP270060G</td>
<td>19-60</td>
<td>8.5</td>
<td>75%</td>
<td>136</td>
<td>110 -&gt; 90</td>
<td></td>
</tr>
<tr>
<td>Fine Flux</td>
<td>CF270060G</td>
<td>26-60</td>
<td>12</td>
<td>74%</td>
<td>273</td>
<td>273 -&gt; 190</td>
<td></td>
</tr>
<tr>
<td>KS</td>
<td>KS270060G</td>
<td>26-60</td>
<td>14</td>
<td>71%</td>
<td>565</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>Sendust</td>
<td>CS270060G</td>
<td>26-125</td>
<td>10</td>
<td>50%</td>
<td>230</td>
<td>230</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core Loss (\text{mW/cm}^3) @50kHz, 1000Gauss</th>
</tr>
</thead>
</table>

![Graph showing Core Loss and DCB percent at 1000e Gauss](image)
III. CSC’s Soft Magnetic Powder Cores

◆ 60μ Toroidal Core Comparison data

<table>
<thead>
<tr>
<th>Core Type</th>
<th>DCB (%)</th>
<th>Core Loss (mW/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 Oe</td>
<td>100 Oe</td>
</tr>
<tr>
<td>HF GT</td>
<td>97</td>
<td>85</td>
</tr>
<tr>
<td>HF</td>
<td>95</td>
<td>82</td>
</tr>
<tr>
<td>HS</td>
<td>91</td>
<td>72</td>
</tr>
<tr>
<td>KH</td>
<td>95</td>
<td>83</td>
</tr>
<tr>
<td>MF GT</td>
<td>93</td>
<td>80</td>
</tr>
<tr>
<td>MF</td>
<td>93</td>
<td>76</td>
</tr>
<tr>
<td>Fine Flux</td>
<td>88</td>
<td>65</td>
</tr>
<tr>
<td>HP</td>
<td>82</td>
<td>56</td>
</tr>
<tr>
<td>SD</td>
<td>77</td>
<td>48</td>
</tr>
</tbody>
</table>
III. CSC’s Soft Magnetic Powder Cores

◆ Permeability vs. Frequency Curves

- **MPP**
  - MPP 25u
  - MPP 60u
  - MPP 125u
  - MPP 160u
  - MPP 200u

- **HighFlux**
  - HighFlux 25u
  - HighFlux 50u
  - HighFlux 125u
  - HighFlux 147u

- **SENDSUT**

- **MegaFlux®**
  - MegaFlux 25u
  - MegaFlux 50u
  - MegaFlux 60u
  - MegaFlux 75u
  - MegaFlux 90u
III. CSC’s Soft Magnetic Powder Cores

◆ Permeability vs. Frequency Curves

- **HS**
- **KH**
- **KS**
- **FineFlux, HP**

![Permeability vs. Frequency Curves](image-url)
IV. CSC’s Titanium Line (Grade ‘GT’)

◆ Property of Titanium Line (GT)  High Flux 60µ & Mega flux 60µ

<table>
<thead>
<tr>
<th>High Flux GT DC-Bias (%)</th>
<th>@50 Oe</th>
<th>@100 Oe</th>
<th>@200 Oe</th>
</tr>
</thead>
<tbody>
<tr>
<td>97%</td>
<td>85%</td>
<td>48%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Flux GT Coreloss (mW/cm²)</th>
<th>@50 kHz</th>
<th>@50 kHz</th>
<th>@100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.4</td>
<td>130</td>
<td>330</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mega Flux GT DC-Bias (%)</th>
<th>@50 Oe</th>
<th>@100 Oe</th>
<th>@200 Oe</th>
</tr>
</thead>
<tbody>
<tr>
<td>93%</td>
<td>80%</td>
<td>48%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mega Flux GT Coreloss (mW/cm²)</th>
<th>@50 kHz</th>
<th>@50 kHz</th>
<th>@100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>109.5</td>
<td>500</td>
<td>1280</td>
<td></td>
</tr>
</tbody>
</table>
IV. CSC’s Titanium Line (Grade ‘GT’)

◆ Customer’s Feedback about High Flux GT

2.2kW Server Power PFC choke Efficiency Comparison

<table>
<thead>
<tr>
<th>P/N</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH270060G18</td>
<td>95.887%</td>
</tr>
<tr>
<td>CH270060GT18</td>
<td>96.187%</td>
</tr>
</tbody>
</table>

Titanium Grade
96% @ 230V, 50% Load
IV. CSC’s Titanium Line (Grade ‘GT’)

◆ Customer’s Feedback about Hight Flux GT

1.3kW Server Power PFC choke

Spec.
- Frequency = 70kHz
- Rms Current= 10.8A / Peak Current= 19.3A / Ripple Current= 7.2A
- L(10.8A) = 277.16μH
- L(19.3A) = 138.6μH Min

<table>
<thead>
<tr>
<th>Condition</th>
<th>CH270060G14</th>
<th>CH270060GT14</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Turns</td>
<td>Φ1.1 * 75Ts</td>
<td>Φ1.1 * 75Ts</td>
</tr>
<tr>
<td>L(10.8A)</td>
<td>316.7μH</td>
<td>326.8μH</td>
</tr>
<tr>
<td>L(19.3A)</td>
<td>141.4μH</td>
<td>142.2μH</td>
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<tr>
<td>Core Loss</td>
<td>2.6W</td>
<td>1.9W</td>
</tr>
<tr>
<td>Copper Loss</td>
<td>7.7W</td>
<td>7.7W</td>
</tr>
<tr>
<td>Total Loss</td>
<td>10.3W</td>
<td>9.6W</td>
</tr>
</tbody>
</table>
IV. CSC’s Titanium Line (Grade ‘GT’)

Customer’s Feedback about Hight Flux GT

6.6kW OBC PFC Choke

Spec.
- Frequency = 30kHz
- Rms Current = 45A, Peak Current = 52A, Ripple Current = 7A
- L(52A) = 98μH Min

<table>
<thead>
<tr>
<th>Condition</th>
<th>CH467060G 2EA</th>
<th>CH467060GT 2EA</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Turns</td>
<td>Φ3.0 * 24Ts</td>
<td>Φ3.0 * 23Ts</td>
</tr>
<tr>
<td>L(52A)</td>
<td>101.4μH</td>
<td>99.4μH</td>
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<tr>
<td>Core Loss</td>
<td>1.2W</td>
<td>1W</td>
</tr>
<tr>
<td>Copper Loss</td>
<td>12.8W</td>
<td>12.3W</td>
</tr>
<tr>
<td>Total Loss</td>
<td>14W</td>
<td>13.3W</td>
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## V. CSC’s Special Shape Cores

<table>
<thead>
<tr>
<th>Materials</th>
<th>Perm.</th>
<th>Block</th>
<th>E</th>
<th>EER</th>
<th>EQ</th>
<th>Cylinder</th>
<th>Round Block</th>
<th>U</th>
<th>ER</th>
<th>Ellipse</th>
<th>Planar E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mega Flux</td>
<td>26μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td></td>
<td>40μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td></td>
<td>60μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td>Sendust</td>
<td>26μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td></td>
<td>40μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td></td>
<td>60μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td>High Flux</td>
<td>26μ-60μ</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td></td>
<td>75μ-90μ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>〇 (+ 1 Core)</td>
<td>〇</td>
<td>〇</td>
<td></td>
<td>(+ 1 Core)</td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td>60μ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
<tr>
<td>HP</td>
<td>19-60μ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
<td>〇</td>
</tr>
</tbody>
</table>

- Various shapes & Size
- Small volume with high DC Bias
- Automatic winding – High productivity
- Low wire usage
- Customized distinctive design
V. CSC’s Special Shape Cores

<table>
<thead>
<tr>
<th>Uncoating vs.</th>
<th>Coating vs.</th>
<th>AQ (Mirror face)</th>
</tr>
</thead>
</table>

- Uncoated and AQ cores show same DC Bias performance
- Coated cores have anti-rust function
Section 2.
CSC Cores for Applications
CSC Cores for

Server / Telecom Power
I. Technical Trend of Server/Telecom power

- Better efficiency
- Lower loss
- Reducing wire loss

The most suitable core materials for your PFC Choke

* Titanium level with CSC Cores! 0.1 ~ 0.3% Real efficiency improvement!

<table>
<thead>
<tr>
<th>80 PLUS Test Type</th>
<th>115V Internal Non-Redundant</th>
<th>230V Internal Redundant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of Rated Load</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>80 PLUS</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>80 PLUS Bronze</td>
<td>82%</td>
<td>85%</td>
</tr>
<tr>
<td>80 PLUS Silver</td>
<td>85%</td>
<td>88%</td>
</tr>
<tr>
<td>80 PLUS Gold</td>
<td>87%</td>
<td>90%</td>
</tr>
<tr>
<td>80 PLUS Platinum</td>
<td>90%</td>
<td>92%</td>
</tr>
<tr>
<td>80 PLUS Titanium</td>
<td>90%</td>
<td>94%</td>
</tr>
</tbody>
</table>

Material | 60µ Core Loss
---|---
HP Core | 90
High Flux | 130
HS Core | 150
MPP Core | 170

Verified Quality by Global leading server makers

- HPE, DELL, Inspur, Huawei, Cisco, Juniper & many ODM companies like Delta, FSP, Greatwall...
## II. Recommended Materials for Server/Telecom power

### Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>High Flux (CH)</th>
<th>HP (HP)</th>
<th>HS (HS)</th>
<th>Mega Flux® (CK)</th>
<th>MPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Preference</td>
<td>• Toroid: 229~330 60u</td>
<td>• EQ, Round Block + Cylinder, Various customized shapes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perm. ($\mu_I$)</td>
<td>26-160</td>
<td>19-60</td>
<td>60-90</td>
<td>19-90</td>
<td>26-200</td>
</tr>
<tr>
<td>Bs (kG)</td>
<td>15</td>
<td>8.5</td>
<td>13</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Bs (kG@60u)</td>
<td>14</td>
<td>8.5</td>
<td>11.5</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Curie Temp [°C]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>700</td>
<td>450</td>
</tr>
<tr>
<td>Frequency Range [Hz]</td>
<td>10M</td>
<td>10M</td>
<td>10M</td>
<td>5M</td>
<td>10M</td>
</tr>
<tr>
<td>DC Bias</td>
<td>CH GT &gt; CH &gt; CK GT &gt; CK &gt; HS &gt; HP &gt; MPP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Loss</td>
<td>HP &lt; CH GT &lt; HS &lt; MPP &lt; CH &lt; CK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp. Stability</td>
<td>MPP, CH &gt; HS, CK &gt; HP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>CH &gt; HS &gt; CF ≥ CK, KS &gt; CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- High Efficiency
- PFC / Output Choke
- 600W~3kW
- Suitable for Lower Rack (1U = 40mm)
- EQ, EI, UIU, ER, UR.. Shape cores
- High Density & Lower Heating
- High DCB, Low Loss: HF GT, HP
### III. DCB & Core Loss – 60u

#### Material Comparison

<table>
<thead>
<tr>
<th>Material</th>
<th>60μ DCB (%) @100 Oe</th>
<th>60μ DCB (%) @200 Oe</th>
<th>60μ DCB (%) @300 Oe</th>
<th>60μ Coreloss (mW/cm³) @50 kHz, 500 G</th>
<th>60μ Coreloss (mW/cm³) @50 kHz, 1000 G</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP Core</td>
<td>55</td>
<td>24</td>
<td>13</td>
<td>22</td>
<td>92</td>
</tr>
<tr>
<td>HS Core</td>
<td>72</td>
<td>37</td>
<td>20</td>
<td>31</td>
<td>150</td>
</tr>
<tr>
<td>High Flux (GT/G)</td>
<td>85/80</td>
<td>48/45</td>
<td>25/24</td>
<td>70/90</td>
<td>130/180</td>
</tr>
<tr>
<td>MPP</td>
<td>54</td>
<td>18</td>
<td>8</td>
<td>38</td>
<td>170</td>
</tr>
</tbody>
</table>

---

**Graphs:**

- **% Permeability (%) vs. DC Magnetizing Force, H (Oe):**
  - Green: High Flux GT 60u
  - Blue: High Flux 60u
  - Red: HS 60u
  - Grey: HP 60u
  - Pink: MPP 60u
- **Magnetic Flux Density, B (Gauss) vs. Fs @ 50kHz:**
  - Green: High Flux GT 60u
  - Blue: High Flux 60u
  - Red: HS 60u
  - Grey: HP 60u
  - Pink: MPP 60u
### IV. New High Permeability HEQ

#### HEQ 75u/90μ

<table>
<thead>
<tr>
<th>Perm.</th>
<th>DC-Bias (%)</th>
<th>Coreloss (mW/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@50 Oe</td>
<td>@100 Oe</td>
</tr>
<tr>
<td>60u</td>
<td>58.5u (97.5%)</td>
<td>51.7u (86.2%)</td>
</tr>
<tr>
<td>75u</td>
<td>72.1u (96.1%)</td>
<td>58.7u (78.3%)</td>
</tr>
<tr>
<td>90u</td>
<td>79.9u (88.8%)</td>
<td>53.4u (59.3%)</td>
</tr>
</tbody>
</table>
IV. New High Permeability HEQ_Design example

◆ HEQ 75μ

Choke for Laptop - End User: A*** (TAIWAN)

Choke spec.: 100KHZ, L(17A)=10μH

<table>
<thead>
<tr>
<th>Material</th>
<th>High Flux 75μ</th>
<th>High Flux 60μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL Value</td>
<td>125nH/N²</td>
<td>99nH/N²</td>
</tr>
<tr>
<td>L(0A)=</td>
<td>12.5μH @10Ts</td>
<td>11.98μH @11Ts</td>
</tr>
<tr>
<td>L(17A)=</td>
<td>10.8μH</td>
<td>10.6μH</td>
</tr>
</tbody>
</table>

- Higher inductance with less number of turns
- Lower copper loss
V. New HSEQ / HPEQ

◆ HSEQ / HPEQ 60µ

Why HS or HP?

<table>
<thead>
<tr>
<th>Materials</th>
<th>Perm. (µ)</th>
<th>Bs (KG)</th>
<th>Core Loss</th>
<th>DC Bias</th>
<th>Temp. Stability</th>
<th>Curie Temp [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP</td>
<td>60</td>
<td>8.5</td>
<td>Lowest</td>
<td>low</td>
<td>good</td>
<td>500</td>
</tr>
<tr>
<td>HS</td>
<td>60</td>
<td>13</td>
<td>Lower</td>
<td>medium</td>
<td>Best</td>
<td>500</td>
</tr>
<tr>
<td>Mega Flux</td>
<td>26–60</td>
<td>17</td>
<td>High</td>
<td>Good</td>
<td>Best</td>
<td>700</td>
</tr>
<tr>
<td>High Flux</td>
<td>26–60</td>
<td>15</td>
<td>Low</td>
<td>Best</td>
<td>Best</td>
<td>500</td>
</tr>
</tbody>
</table>
V. New HSEQ / HPEQ Design example

◆ Design Example – HPEQ 60μ

Output choke (80 PLUS Titanium 900W Server Power) - Maker: L***** (TAIWAN)

* Customer Requirements

<table>
<thead>
<tr>
<th>No</th>
<th>Inductance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.72uH ±13%</td>
<td>@130KHz, 1Vrms</td>
</tr>
<tr>
<td>2</td>
<td>4.86uH ±13%</td>
<td></td>
</tr>
</tbody>
</table>

HP Toroidal → HS Toroidal → HP EQ

<table>
<thead>
<tr>
<th>Part #</th>
<th>Material</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP234060E13</td>
<td>HP 60μ</td>
<td>96.65</td>
</tr>
<tr>
<td>HS234090E13</td>
<td>HS 90μ</td>
<td>96.62</td>
</tr>
<tr>
<td>HPEQ2619K-060</td>
<td>HP 60μ</td>
<td>Testing</td>
</tr>
</tbody>
</table>

Input voltage: 230V @50% Load
### VI. New Special Shape Cores – Plate Core

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1. Part Type | Plate Core  
Ex.) KP2626A-026 |
| 2. Shape | Plate |
| 3. Material | Mega Flux, Fine Flux |
| 4. Permeability | 26u ~ 50u |
| 5. Size(mm) | W x L : 400 x 400 Max.  
H : 0.5~3 mm |
| 6. Features | Good core strength  
Good flatness  
Large surface  
Less leakage flux by no bulk air gap |

Surge Inductor for 5G base station
## IV. Application Example

### Out put choke (96% 3KW Server power)

Choke specification: 100KHZ, L(0A)=2.5uH, L(Ip=200A)=1.5uH, DCR=0.3m ohm, ΔI = ± 10A. Space: 24mm*36mm.

<table>
<thead>
<tr>
<th>P/N</th>
<th>CH330060*2pcs</th>
<th>HEQ3222S-060*2pcs</th>
<th>RH3624A-060*2pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path Length</td>
<td>8.15cm</td>
<td>6.35cm</td>
<td>6.78cm</td>
</tr>
<tr>
<td>Cross Section Area</td>
<td>1.344cm²</td>
<td>1.523cm²</td>
<td>1.77cm²</td>
</tr>
<tr>
<td>AL</td>
<td>122nH/N2</td>
<td>181nH/N2</td>
<td>197nH/N2</td>
</tr>
<tr>
<td>Inductance</td>
<td>Φ4.6mm*5Turns</td>
<td>Φ3.7mm*4Turns</td>
<td>Φ3.7mm*3.5Turns</td>
</tr>
<tr>
<td>L(0A)</td>
<td>3.05μH ± 8%</td>
<td>2.90μH ± 12%</td>
<td>2.41μH ± 12%</td>
</tr>
<tr>
<td>L(200A)</td>
<td>1.87μH ref. / 1.50μH min.</td>
<td>1.88μH ref. / 1.50μH min.</td>
<td>1.83μH ref. / 1.50μH min.</td>
</tr>
<tr>
<td>Inductor Size</td>
<td>33.83<em>33.83</em>23.22 (Excluding coil)</td>
<td>32<em>22</em>22.2</td>
<td>36.2<em>24</em>22.4</td>
</tr>
<tr>
<td>Total Loss</td>
<td>DC 11.51 / AC 11.64</td>
<td>DC 11.70 / AC 11.84</td>
<td>DC 11.38 / AC 11.55</td>
</tr>
<tr>
<td>Wire Length &amp; Weight</td>
<td>30.5cm / 50g</td>
<td>16.9cm / 21g</td>
<td>16.5cm / 21g</td>
</tr>
</tbody>
</table>
CSC Cores for Solar
I. Technical Trend of Solar Inverter

- **With CSC power cores**
  
  ✓ Decentralization (Central → String, Modular, Micro)
    - Smaller & Lighter (more than 50% ↓ vs. Silicon steel)
  
  ✓ High integration (efficient space utilization, cost saving)
    - High power density, Small size design
  
  ✓ Better Solution to your customers
    - Solving your noise & Heat problem, High efficiency
  
  ✓ Duration (High reliability & Long life)
    - Fully verified products passed all the reliable test of temperature, humidity, thermal shock, etc.
## II. Recommended Materials for Solar

### Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>High Flux (CH)</th>
<th>HS (HS)</th>
<th>Fine Flux (CF)</th>
<th>KS (KS)</th>
<th>SENDUST (CS)</th>
<th>Mega Flux® (CK)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market Preference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Big size toroidal core: OD467 ~1625 / 26u ~90ui</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Block/Cylinder/Ellipse Cores: 40~60ui</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perm. ($\mu_t$)</td>
<td>26-160</td>
<td>60-90</td>
<td>19-60</td>
<td>26-60</td>
<td>26-125</td>
<td>19-90</td>
</tr>
<tr>
<td>Bs (kG)</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Bs (kG@60u)</td>
<td>14</td>
<td>11.5</td>
<td>10</td>
<td>14</td>
<td>8.5</td>
<td>16</td>
</tr>
<tr>
<td>Curie Temp [°C]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>700</td>
</tr>
<tr>
<td>Frequency Range [Hz]</td>
<td>10M</td>
<td>10M</td>
<td>10M</td>
<td>5M</td>
<td>10M</td>
<td>5M</td>
</tr>
</tbody>
</table>

**DC Bias**

- CH > CK > HS > CF > KS > CS

**Core Loss**

- CH < HS < CF < CS < KS < CK

**Temp. Stability**

- CH > HS, CK > CF, CS, KS

**Cost**

- CH > HS > CF ≥ CK, KS > CS

- **HS**: Good DC Bias with Low core loss
  => small volume, high power, high efficiency, low heat

- **CF**: Economically optimized DCB & Core loss
  => Value for cost

- **CS, KS, MF**: The most cost-effective design
  Easy assembly

---

**PV inverter**

- DC-DC boost converter
- DC-AC filter

---

Better Efficiency Better Solutions to you
III. DCB & Core Loss – 60μ

### Material Comparison

<table>
<thead>
<tr>
<th>Material</th>
<th>60μ DCB (%)</th>
<th>60μ Coreloss (mW/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@100 Oe</td>
<td>@200 Oe</td>
</tr>
<tr>
<td>High Flux (GT/G)</td>
<td>85/80</td>
<td>48/45</td>
</tr>
<tr>
<td>HS Core</td>
<td>72</td>
<td>37</td>
</tr>
<tr>
<td>Fine Flux</td>
<td>62</td>
<td>30</td>
</tr>
<tr>
<td>SENDUST</td>
<td>48</td>
<td>22</td>
</tr>
<tr>
<td>KS Core</td>
<td>61</td>
<td>34</td>
</tr>
<tr>
<td>Mega Flux® (GT/G)</td>
<td>78/76</td>
<td>48/45</td>
</tr>
</tbody>
</table>

### Graph

- DC Magnetizing Force, H (Oe)
- Magnetic Flux Density, B (Gauss)
- Core Loss (mW/cm³)
- Core Loss (mW/cm³)
- Frequency 50kHz

Better Efficiency Better Solutions to you
III. DCB & Core Loss – 26u

### Material Comparison

<table>
<thead>
<tr>
<th>Material</th>
<th>26μ DCB (%) @200 Oe</th>
<th>26μ DCB (%) @300 Oe</th>
<th>26μ DCB (%) @500 Oe</th>
<th>26μ Coreloss (mW/cm²) @50 kHz, 500 G</th>
<th>26μ Coreloss (mW/cm²) @50 kHz, 1000 G</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Flux</td>
<td>82</td>
<td>67</td>
<td>41</td>
<td>48</td>
<td>230</td>
</tr>
<tr>
<td>Fine Flux</td>
<td>74</td>
<td>54</td>
<td>28</td>
<td>57</td>
<td>273</td>
</tr>
<tr>
<td>SENDUST</td>
<td>50</td>
<td>34</td>
<td>18</td>
<td>50</td>
<td>230</td>
</tr>
<tr>
<td>KS Core</td>
<td>71</td>
<td>55</td>
<td>33</td>
<td>121</td>
<td>565</td>
</tr>
<tr>
<td>Mega Flux®</td>
<td>82</td>
<td>69</td>
<td>45</td>
<td>147</td>
<td>660</td>
</tr>
</tbody>
</table>

### Graph

- Graph showing DC Magnetizing Force, H (Oe) vs. % Permeability (%) for different materials.
- Graph showing Magnetic Flux Density, B (Gauss) vs. Core Loss (mW/cm²) for different materials at a frequency of 50kHz.
IV. Application Example

**Design Example #1: Mega Flux Ellipse Core vs Amorphous C Core**

1) Current = 40A, 
   Inductance = 900μH min, 
   fs = 18 kHz
2) Assembled Core Size 
   Length = 60mm max, 
   Width = 40mm max, 
   Height = 110mm max
3) Total Weight = 2.0 kg max
4) DCR = 38mΩ max
5) Core Loss = 40W max
6) Total Loss = 100W max

<table>
<thead>
<tr>
<th>Inductance [μH]</th>
<th>Mega Flux Ellipse Cores LK6035A X LK3520A-060</th>
<th>Amorphous C Cores AMCC 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>L(0A)</td>
<td>1,887</td>
<td>1,465</td>
</tr>
<tr>
<td>L(30A)</td>
<td>1,210</td>
<td>1,270</td>
</tr>
<tr>
<td>L(40A)</td>
<td>911</td>
<td>988</td>
</tr>
<tr>
<td>L(50A)</td>
<td>678</td>
<td>290</td>
</tr>
</tbody>
</table>

| Size (Core)     | 60mm x 35mm x 97mm                          | 52mm x 40mm x 102mm       |

<table>
<thead>
<tr>
<th>Weight</th>
<th>Mega Flux Ellipse Cores</th>
<th>Amorphous C Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>1.086 kg</td>
<td>0.938 kg</td>
</tr>
<tr>
<td>Copper</td>
<td>0.607 kg</td>
<td>0.787 kg</td>
</tr>
<tr>
<td>Total</td>
<td>1.693 kg(98%)</td>
<td>1.725 kg(100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Loss [W]</th>
<th>Mega Flux Ellipse Cores</th>
<th>Amorphous C Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>32.9</td>
<td>36.6</td>
</tr>
<tr>
<td>Copper</td>
<td>42.5</td>
<td>55.2</td>
</tr>
<tr>
<td>Total</td>
<td>75.4(82%)</td>
<td>91.8(100%)</td>
</tr>
</tbody>
</table>

Mega Flux Ellipse Cores have more softer saturation than Amorphous C Cores
IV. Application Example

- **Design Example #2: Mega Flux Round Block + Cylinder vs NPH226060**

  1. Current = 101.8A, Inductance = 100μH min, fs=1 kHz
  2. Assembled Core Size
     - Length = 150.1mm max, Width = 73.6mm max, Height = 73.6mm max
  3. DCR = 10mΩ max
  4. Total Loss = as low as possible

<table>
<thead>
<tr>
<th>Bobbin</th>
<th>Mega Flux Round Block + Cylinder Cores</th>
<th>NPH Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>1 Turn Length</td>
<td>122.5mm</td>
<td>354.4mm</td>
</tr>
<tr>
<td>Current Capacity</td>
<td>5.3 A/mm²</td>
<td>5.3 A/mm²</td>
</tr>
<tr>
<td>Wire Size</td>
<td>5.2mm x 2.6mm</td>
<td>Ø2.4mm x 2P</td>
</tr>
<tr>
<td>Winding Turns</td>
<td>38Ts</td>
<td>16Ts</td>
</tr>
<tr>
<td>Total Wire Weight</td>
<td>566g</td>
<td>690g</td>
</tr>
<tr>
<td>Winding Factor</td>
<td>43%</td>
<td>42%</td>
</tr>
<tr>
<td>DCR</td>
<td>5.8 mΩ</td>
<td>7.1 mΩ</td>
</tr>
<tr>
<td>Inductance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0A</td>
<td>314.8μH</td>
<td>318.0μH</td>
</tr>
<tr>
<td>101.8A</td>
<td>159.2μH</td>
<td>127.4μH</td>
</tr>
<tr>
<td>Size (Core)</td>
<td>80.5mm x 30.2mm x 107mm</td>
<td>58.04mm x 58.04mm x 145.17mm</td>
</tr>
<tr>
<td>Weight</td>
<td>Core</td>
<td>1.334 kg</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>0.566 kg</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.9 kg (82%)</td>
</tr>
<tr>
<td>Loss [W]</td>
<td>Core</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>30.2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34 (88.5%)</td>
</tr>
</tbody>
</table>

- **Original Design: NPH226060 9Stacks**

- **RBK8030A-060 X CK3030-060**

- **Benefits**
  - Less Weight
  - Lower Loss
V. Application Example

- Actual Coil performance using CSC Cores

3KW ACL
- ACL - DC Bias (I vs L)
- RBK5420-060
- CK740060

4KW ACL
- ACL - DC Bias (I vs L)
- RBH6424-060
- RBK7024-060

3KW DCL
- DCL - DC Bias (I vs L)
- RBK5420-060
- CK740060
- ES7228-060

4KW DCL
- DCL - DC Bias (I vs L)
- RBK7428-060

Better Efficiency Better Solutions to you
V. Application Example

- **Actual Coil performance using CSC Cores**

**6KW ACL**

ACL - DC Bias (I vs L)

- RBK-7428-060
- RBH8030-060

**6KW DCL**

DCL - DC Bias (I vs L)

- RBH8030-060

**Over 10KW**

ACL - DC Bias (I vs L)

- LK7035-060
- RBK7428-060

DCL - DC Bias (I vs L)

- LK7035-060
- RBK7428-060

**16KW ACL**

- RBK-7428-060
- RBH8030-060

**25KW ACL**

- LK7035-060
- RBK7428-060

**16KW DCL**

- RBH8030-060

**25KW DCL**

- LK7428-060
- BK14060-060

**75KW DCL**

- LK7428-060
- BK14060-060

**17KW DCL**

- LK7035-060
- RBK8030-060

**Over 10KW**

- LK7035-060
- RBK7428-060

- LK7428-060
- BK14060-060

16 KW ACL

- RBK-7428-060
- RBH8030-060

25 KW ACL

- LK7035-060
- RBK7428-060

Over 10KW

- LK7035-060
- RBK7428-060

- LK7428-060
- BK14060-060

16 KW DCL

- RBH8030-060

25 KW DCL

- LK7428-060
- BK14060-060

75 KW DCL

- LK7428-060
- BK14060-060

17 KW DCL

- LK7035-060
- RBK8030-060
CSC Cores for

UPS (Uninterruptible Power Supply)
I. Technical Trend of UPS Inverter

• *With CSC power cores*

✓ Modular for fast & easy replacement
  → Accomplish compact, Lightweight, Flexible and Versatile products
✓ Better Solution to your customers
  → 99% High efficiency
✓ Duration (High reliability & Long life)
  → With fully verified products passed all the reliable test of temperature, humidity, thermal shock, etc.
II. Recommended Materials for UPS

### Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>High Flux (CH)</th>
<th>HP (HP)</th>
<th>Fine Flux (CF)</th>
<th>KS (KS)</th>
<th>SENDUST (CS)</th>
<th>Mega Flux® (CK)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market Preference</strong></td>
<td>* Big size toroidal core: OD467 ~1625  19ui ~ 40ui * Block/Cylinder/Ellipse/U Cores: 26ui</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perm. ((\mu_t))</td>
<td>26-160</td>
<td>19-60</td>
<td>19-60</td>
<td>26-60</td>
<td>26-125</td>
<td>19-90</td>
</tr>
<tr>
<td>Bs (kG)</td>
<td>15</td>
<td>8.5</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Bs (kG@60u)</td>
<td>14</td>
<td>8.5</td>
<td>10</td>
<td>14</td>
<td>8.5</td>
<td>16</td>
</tr>
<tr>
<td>Curie Temp [°C]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>700</td>
</tr>
<tr>
<td>Frequency Range [Hz]</td>
<td>10M</td>
<td>10M</td>
<td>10M</td>
<td>5M</td>
<td>10M</td>
<td>5M</td>
</tr>
</tbody>
</table>

- **HP**: High Efficiency with Low core loss
  => Great performance at High switching frequency

- **HF**: Good DC Bias with Low core loss
  => small volume, high power, high efficiency, low heat

- **CF**: Economically optimized DCB & Core loss
  => Value for cost

- **CS, KS, MF**: The most cost-effective design
  => Easy assembly, Easy winding with shaped cores
### III. Recommended Materials for UPS

#### Material Comparison

<table>
<thead>
<tr>
<th>Material</th>
<th>26μ DCB (%)</th>
<th>26μ Coreloss (mW/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@200 Oe</td>
<td>@300 Oe</td>
</tr>
<tr>
<td>High Flux</td>
<td>82</td>
<td>67</td>
</tr>
<tr>
<td>HP Core</td>
<td>75</td>
<td>51</td>
</tr>
<tr>
<td>Fine Flux</td>
<td>74</td>
<td>54</td>
</tr>
<tr>
<td>SENDUST</td>
<td>50</td>
<td>34</td>
</tr>
<tr>
<td>KS Core</td>
<td>71</td>
<td>55</td>
</tr>
<tr>
<td>Mega Flux®</td>
<td>82</td>
<td>69</td>
</tr>
</tbody>
</table>

#### Graph

- **% Permeability (%) vs DC Magnetizing Force, H (Oe)**
- **Core Loss (mW/cm³) vs Magnetic Flux Density, B (Gauss)**

- Graphs showing comparison of different materials under varying conditions (50 kHz, 500 G and 1000 G)
### III. Recommended Materials for UPS

#### New Block Core 26u

<table>
<thead>
<tr>
<th>BK7320-026</th>
<th>L</th>
<th>L(%)</th>
<th>Q</th>
<th>LDC</th>
<th>DCB(%)</th>
<th>CORE LOSS @50kHz, 1000G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now</td>
<td>1,329</td>
<td>1.42</td>
<td>88.3</td>
<td>1,224</td>
<td>92.10</td>
<td>414.0</td>
</tr>
<tr>
<td></td>
<td>1,332</td>
<td>1.65</td>
<td>88.0</td>
<td>1,226</td>
<td>92.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,331</td>
<td>1.57</td>
<td>87.8</td>
<td>1,223</td>
<td>91.89</td>
<td></td>
</tr>
<tr>
<td>Loss improved</td>
<td>1,329</td>
<td>1.42</td>
<td>87.0</td>
<td>1,223</td>
<td>92.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,352</td>
<td>3.17</td>
<td>89.4</td>
<td>1,239</td>
<td>91.64</td>
<td></td>
</tr>
<tr>
<td>BK6320-026</td>
<td>1,334</td>
<td>1.80</td>
<td>99.8</td>
<td>1,244</td>
<td>93.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,329</td>
<td>1.42</td>
<td>98.5</td>
<td>1,242</td>
<td>93.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,327</td>
<td>1.27</td>
<td>98.4</td>
<td>1,246</td>
<td>93.90</td>
<td>300.0</td>
</tr>
<tr>
<td></td>
<td>1,335</td>
<td>1.88</td>
<td>99.7</td>
<td>1,243</td>
<td>93.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,328</td>
<td>1.34</td>
<td>98.6</td>
<td>1,243</td>
<td>93.60</td>
<td></td>
</tr>
<tr>
<td>Now</td>
<td>1,104</td>
<td>3.18</td>
<td>89.3</td>
<td>1,020</td>
<td>92.39</td>
<td>420.0</td>
</tr>
<tr>
<td></td>
<td>1,105</td>
<td>3.27</td>
<td>89.4</td>
<td>1,019</td>
<td>92.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,106</td>
<td>3.36</td>
<td>89.4</td>
<td>1,022</td>
<td>92.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,101</td>
<td>2.90</td>
<td>88.7</td>
<td>1,016</td>
<td>92.28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,103</td>
<td>3.08</td>
<td>89.3</td>
<td>1,017</td>
<td>92.20</td>
<td></td>
</tr>
<tr>
<td>Loss improved</td>
<td>1,084</td>
<td>1.31</td>
<td>94.4</td>
<td>1,015</td>
<td>93.63</td>
<td>300.0</td>
</tr>
<tr>
<td></td>
<td>1,081</td>
<td>1.03</td>
<td>93.6</td>
<td>1,012</td>
<td>93.62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,081</td>
<td>1.03</td>
<td>93.8</td>
<td>1,014</td>
<td>93.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,082</td>
<td>1.12</td>
<td>93.5</td>
<td>1,015</td>
<td>93.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,082</td>
<td>1.12</td>
<td>93.6</td>
<td>1,014</td>
<td>93.72</td>
<td></td>
</tr>
</tbody>
</table>
IV. Application Example

❖ Design Example #1: Mega Flux Ellips Core

A. Design Target: \( L(100A) = 63\mu H \)

<table>
<thead>
<tr>
<th>Plate</th>
<th>Mega Flux Ellipse Core</th>
<th>Original Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Shape</td>
<td>LK6035A-040</td>
<td></td>
</tr>
<tr>
<td>Unit Size</td>
<td>60mm x 35mm x 13.5mm</td>
<td></td>
</tr>
<tr>
<td>pcs</td>
<td>Upper 1pcs, Lower 1pcs Total 2pcs</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>194g x 2pcs = 388g</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Shape</td>
<td>LK3515A-040</td>
<td>Total 5pcs Stacking</td>
</tr>
<tr>
<td>Size</td>
<td>35mm x 15mm x 20mm</td>
<td></td>
</tr>
<tr>
<td>pcs</td>
<td>1 post stack 3pcs Total 6pcs</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>67g x 6pcs = 402g</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Size</td>
<td>87mm x 60mm x 35mm</td>
<td>80.5mm x 58.0mm x 58.0mm</td>
</tr>
<tr>
<td>Core Weight</td>
<td>388g + 402g = 790g</td>
<td>168g x 3 + 195g x 2 = 894g</td>
</tr>
</tbody>
</table>

Bobbin

<table>
<thead>
<tr>
<th>Bobbin</th>
<th>Thickness 0.8mm</th>
<th>Original Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Turn Length</td>
<td>87.1mm</td>
<td>193.4mm</td>
</tr>
<tr>
<td>Wire Size</td>
<td>6.0mm x 3.3mm</td>
<td>4.2mm x 3.3mm</td>
</tr>
<tr>
<td>Current Capacity</td>
<td>5.05 A/mm²</td>
<td>7.22 A/mm²</td>
</tr>
<tr>
<td>Winding Turns</td>
<td>30Ts</td>
<td>30Ts</td>
</tr>
<tr>
<td>Total Wire Weight</td>
<td>603g</td>
<td>422g</td>
</tr>
<tr>
<td>Winding Factor</td>
<td>33%</td>
<td>23%</td>
</tr>
<tr>
<td>DCR</td>
<td>3.1 mΩ</td>
<td>4.5 mΩ</td>
</tr>
<tr>
<td>Inductance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0A</td>
<td>96μH</td>
<td>92~100μH</td>
</tr>
<tr>
<td>100A</td>
<td>81μH</td>
<td>63μH min</td>
</tr>
<tr>
<td>300A</td>
<td>31μH</td>
<td>24μH min</td>
</tr>
</tbody>
</table>
### IV. Application Example

<table>
<thead>
<tr>
<th>Customer</th>
<th>UPS Power</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A** E****</td>
<td>20 – 1200KVA</td>
<td>HP1016019/ HP1016026/ CK1016060/ HP572019 HP1320019</td>
</tr>
<tr>
<td>V****</td>
<td></td>
<td>BK53/63/73/83/93/9320-026</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CK467/CH571/CH610/CF610026</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BH6020/7020/8020-026</td>
</tr>
<tr>
<td>S******</td>
<td></td>
<td>CK7770/778040</td>
</tr>
<tr>
<td>A**/S********</td>
<td></td>
<td>CS571026/CK571026</td>
</tr>
<tr>
<td>D****</td>
<td></td>
<td>UK4123A-026 / KS467026</td>
</tr>
</tbody>
</table>

* Low loss, low heat, small volume, high efficiency solution

1. **Design trend in Materials**
   - High quality MF, HP, High Flux

2. **Design trend in Shapes**
   - Toroid, Block, U cores
CSC Cores for Automotive
I. Technical Trend of Electric Automobile

<table>
<thead>
<tr>
<th>Application</th>
<th>Power</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Materials</strong></td>
</tr>
<tr>
<td>OBC</td>
<td>3.3kW ~ 22kW</td>
<td>HF, HS, MF</td>
</tr>
<tr>
<td>LDC</td>
<td>1.7kW ~ 2kW</td>
<td>MF</td>
</tr>
<tr>
<td>HDC</td>
<td>20kW ~ 70kW</td>
<td>MF</td>
</tr>
<tr>
<td>EMI Filter</td>
<td>1.7kW ~ 10kW</td>
<td>HF, SD</td>
</tr>
<tr>
<td>Charging</td>
<td>3kW ~ 50kW</td>
<td>HF, HS, MF</td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
<td>KH, HP, KS – Toroid, EE, SQ shapes</td>
</tr>
</tbody>
</table>
### II. Recommended Materials for Automobile

#### Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>High Flux (CH)</th>
<th>HS (HS)</th>
<th>KH (KH)</th>
<th>Mega Flux* (CK)</th>
</tr>
</thead>
</table>
| Market Preference | • High Flux troid 60ui for small size inductor  
• HEQ, KEQ, KSQ, ER shaped core 60ui for high power density with small & easy winding design |
| Perm. ($\mu_0$) | 26-160 | 60-90 | 26-90 | 19-90 |
| Bs (kG) | 15 | 13 | 16 | 17 |
| Bs (kG@60u) | 14 | 11.5 | 15 | 16 |
| Curie Temp [°C] | 500 | 500 | 600 | 700 |
| Frequency Range [Hz] | 10M | 10M | 10M | 5M |

**DC Bias**

- CH GT > KH > CH > HS > CK

**Core Loss**

- CH GT < HS < CH < KH < CK

**Temp. Stability**

- CH, KH > CK
## III. DCB & Core Loss – 60u

### Material Comparison

<table>
<thead>
<tr>
<th>Material</th>
<th>60μ DCB (%)</th>
<th>60μ Coreloss (mW/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@100 Oe @200 Oe @300 Oe</td>
<td>@50 kHz, 1000 G @100 kHz, 500G</td>
</tr>
<tr>
<td>High Flux (GT/G)</td>
<td>85/80 48/45 25/24</td>
<td>130/180 70/90</td>
</tr>
<tr>
<td>KH Core</td>
<td>80 46 26</td>
<td>430 222</td>
</tr>
<tr>
<td>HS Core</td>
<td>72 37 20</td>
<td>150 80</td>
</tr>
<tr>
<td>Mega Flux° (GT/G)</td>
<td>78/76 48/45 30/27</td>
<td>500 / 590 280/330</td>
</tr>
</tbody>
</table>

### Graph

- **% Permeability (%)** vs DC Magnetizing Force, H (Oe)
- **Core Loss (mW/cm²)** vs Magnetic Flux Density, B (Gauss)
III. DCB & Core Loss – 26μ

**Material Comparison**

<table>
<thead>
<tr>
<th>Material</th>
<th>26μ DCB (%)</th>
<th>26μ Coreloss (mW/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>@200 Oe</td>
<td>@300 Oe</td>
</tr>
<tr>
<td>High Flux</td>
<td>82</td>
<td>67</td>
</tr>
<tr>
<td>KH Core</td>
<td>85</td>
<td>69</td>
</tr>
<tr>
<td>Mega Flux®</td>
<td>82</td>
<td>69</td>
</tr>
</tbody>
</table>

**Graph**

- DC Magnetizing Force, H (Oe) vs. % Permeability (%)
- Magnetic Flux Density, B (Gauss) vs. Coreloss (mW/cm²)
Thank You