MAGNETICS
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Effects of Temperature on Core Loss of Alloy Powder Cores

With modeling of transformer and inductor design becoming more sophisticated, design engineers are requiring more detailed information on soft magnetic core loss over a wide temperature range. This type of data is needed when using ferrites as the performance may or may not be dramatically different at various operating temperatures. Shown below are the Core Loss vs. Temperature graphs for two ferrite materials from Magnetics, R and T.

Figure 1 - R material

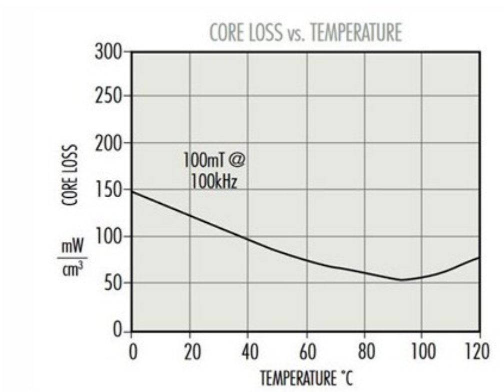
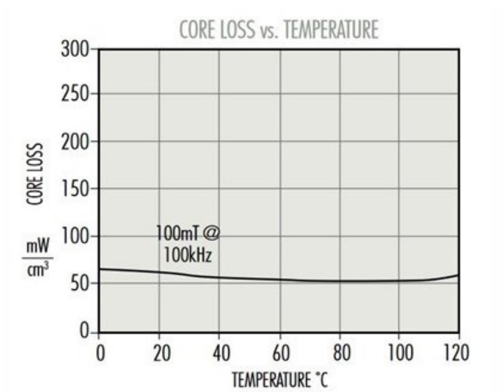


Figure 2 - T material



In the case of R material, the core loss as expressed in mW/cm^3 varies by a factor of 2X depending on the operating temperature of the device. This is by design. Most good power ferrites are engineered to show minimum core losses at a high temperature because the result is inherent thermal stability; as the device gets warmer it becomes more efficient and heats up less. In contrast, T material exhibits minimal change in core loss from 0 to 120° C, trading the natural stability of a steep negative slope for consistent efficiency regardless of device temperature.

Core loss for powder alloy materials like Kool Mμ® and MPP also varies over temperature, but the change in core loss with temperature is minimal like the T material shown above. Comparing our two new materials Kool Mμ® H*f* and Edge®, you can see that some materials exhibit slightly positive slope and others slightly negative. In both cases, like in all alloy powder cores, the difference in core loss over temperature is minimal. The Kool Mμ H*f* 60μ typical increase is around 70 mW/cm^3 at 120°C and the Edge 60μ typical decrease is 80 mW/cm^3. Both are around a 20% change, not significant enough generally to affect thermal stability or target efficiency.

Figure 3 - Kool Mµ H*f*

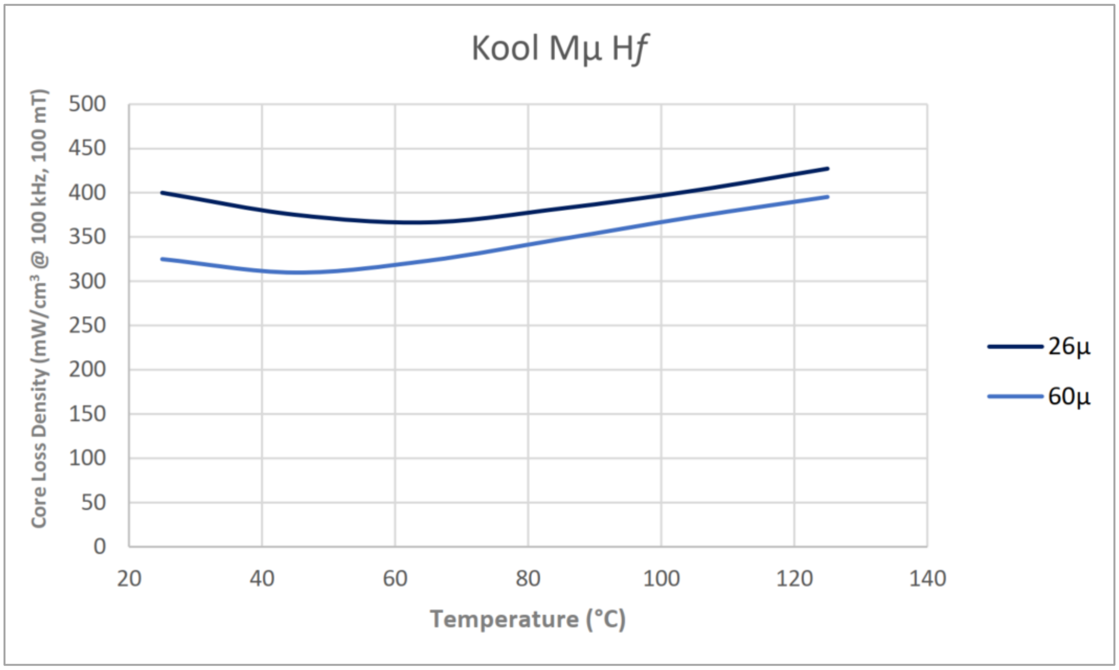
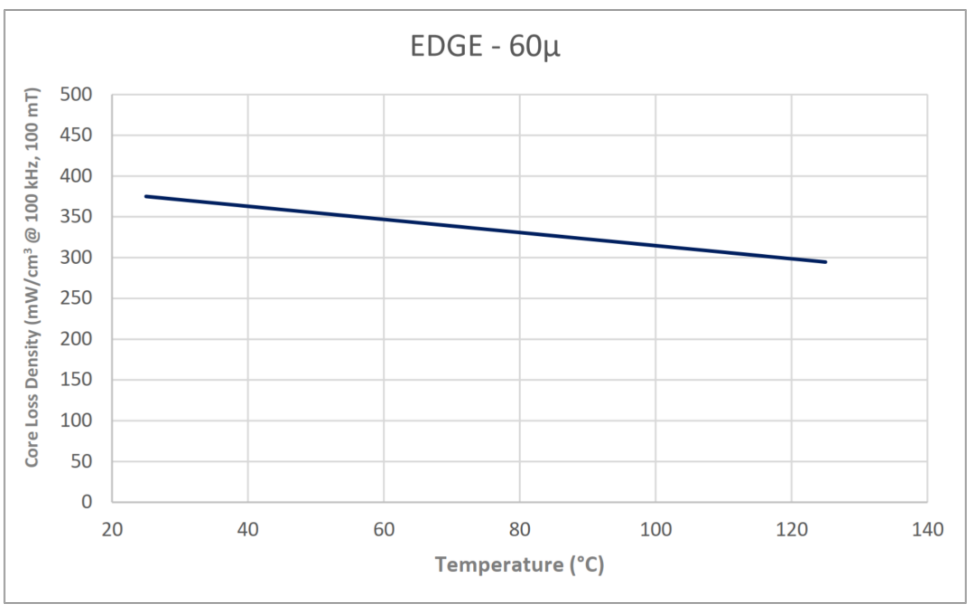


Figure 4 - Edge



The following graphs show the typical temperature performance of Magnetics powder core materials: MPP, High Flux, Edge, Kool Mµ, Kool Mµ MAX, Kool Mµ H*f*, and XFlux®.

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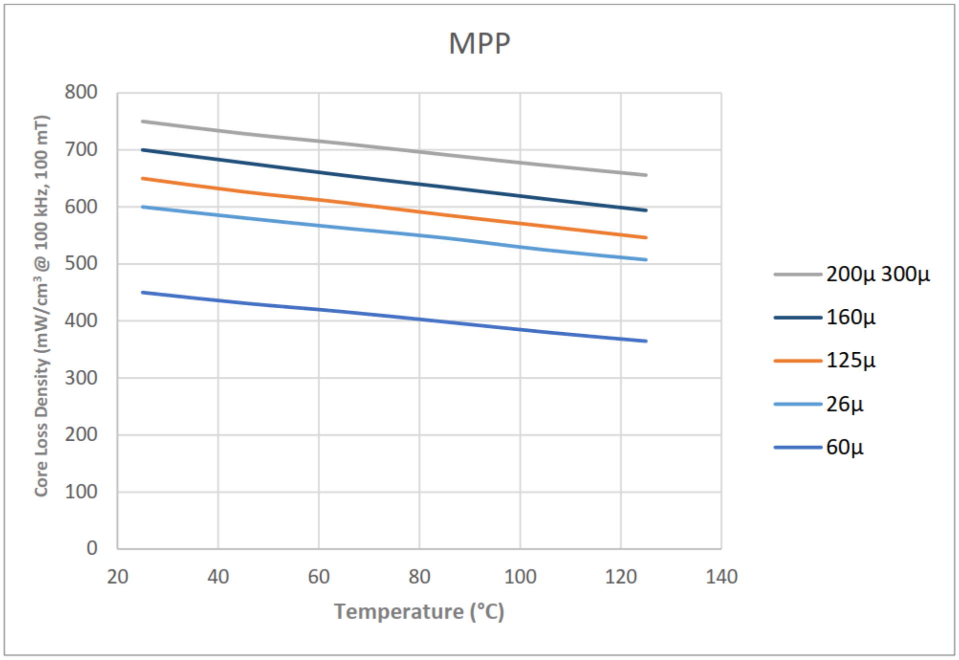
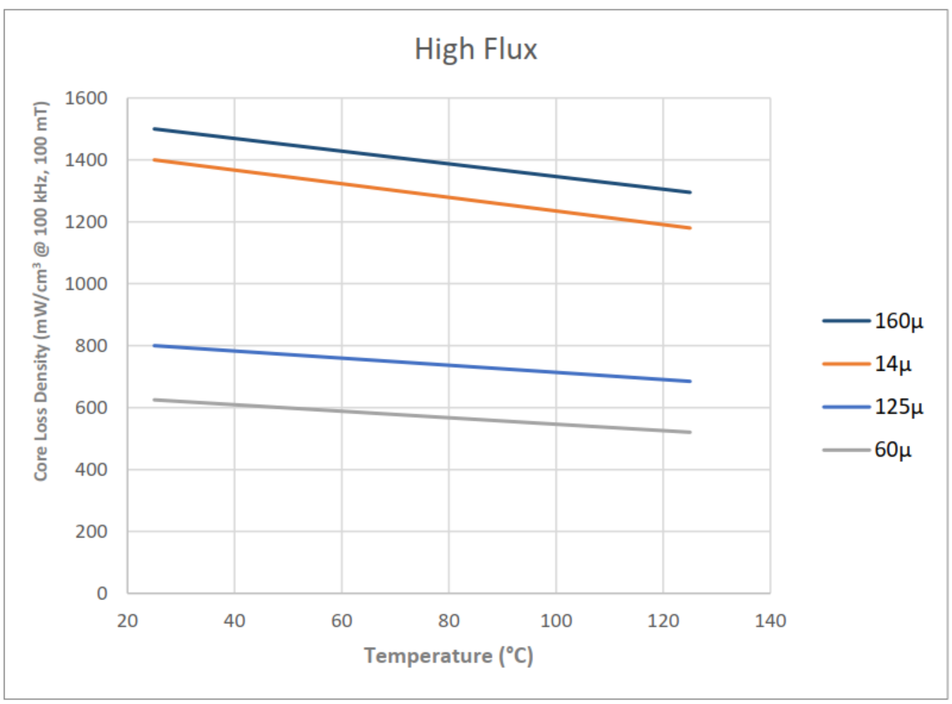
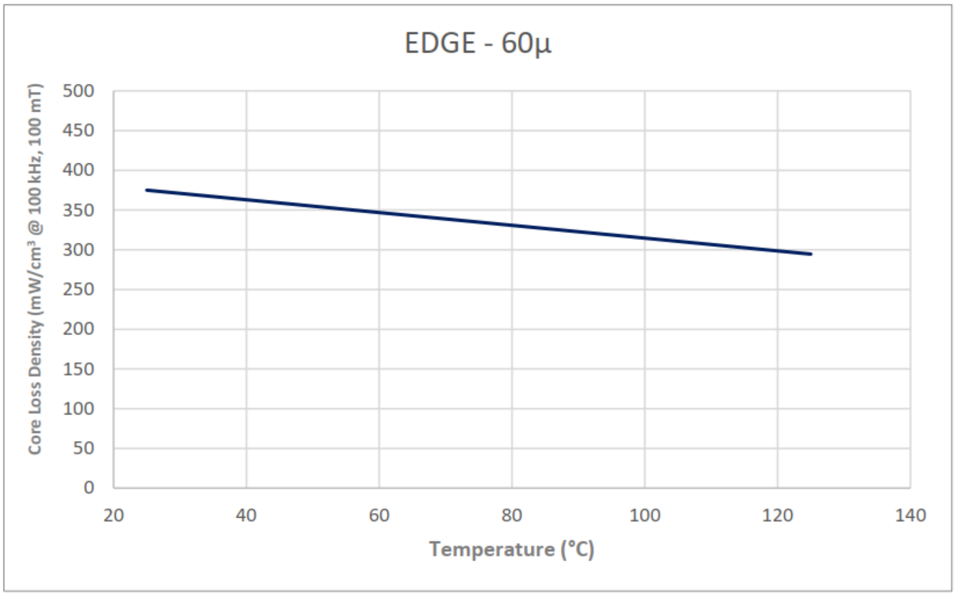
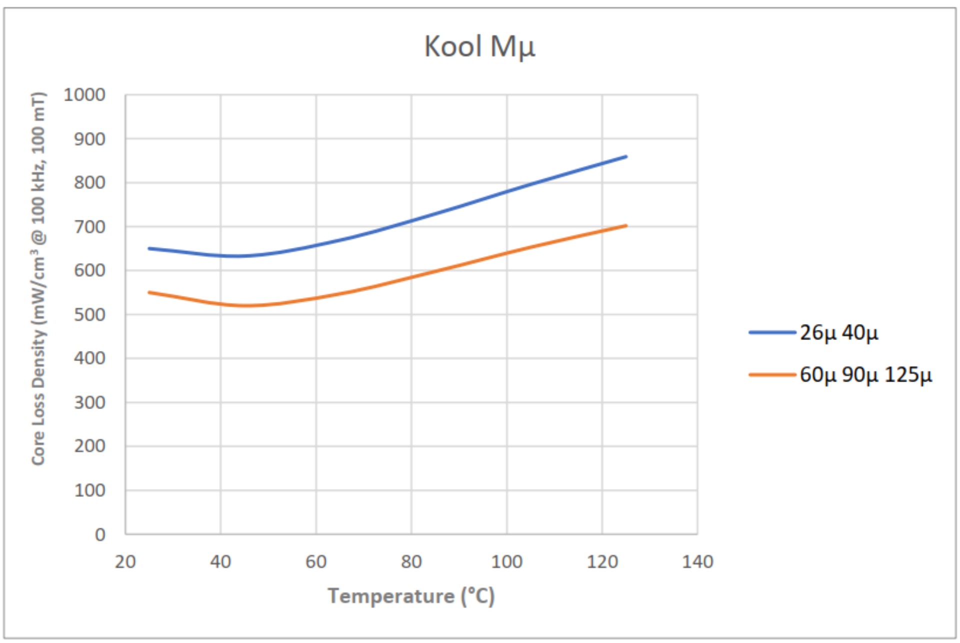
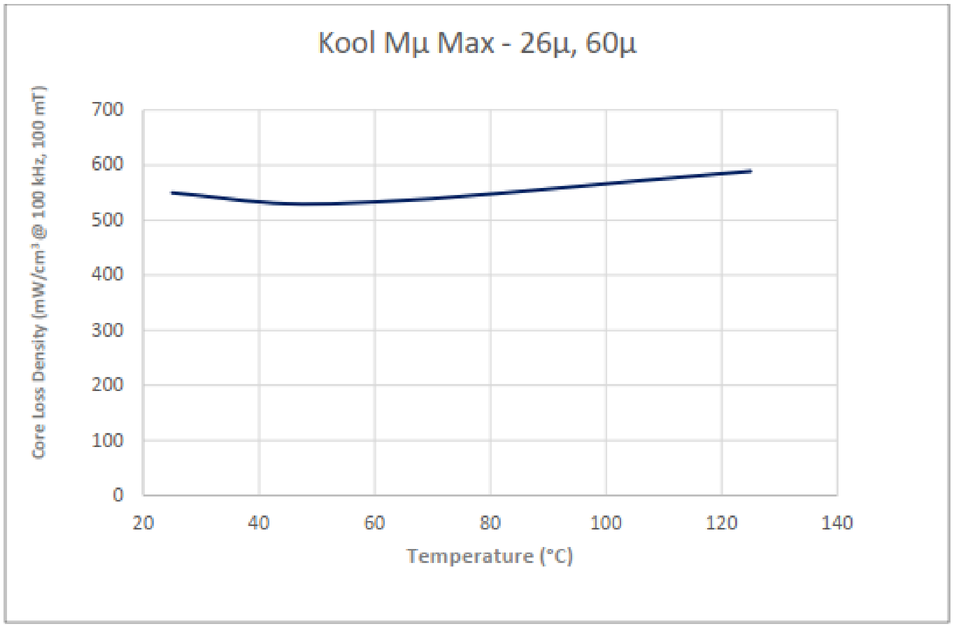
Magnetics Powder Cores – Loss vs. Typical Performance



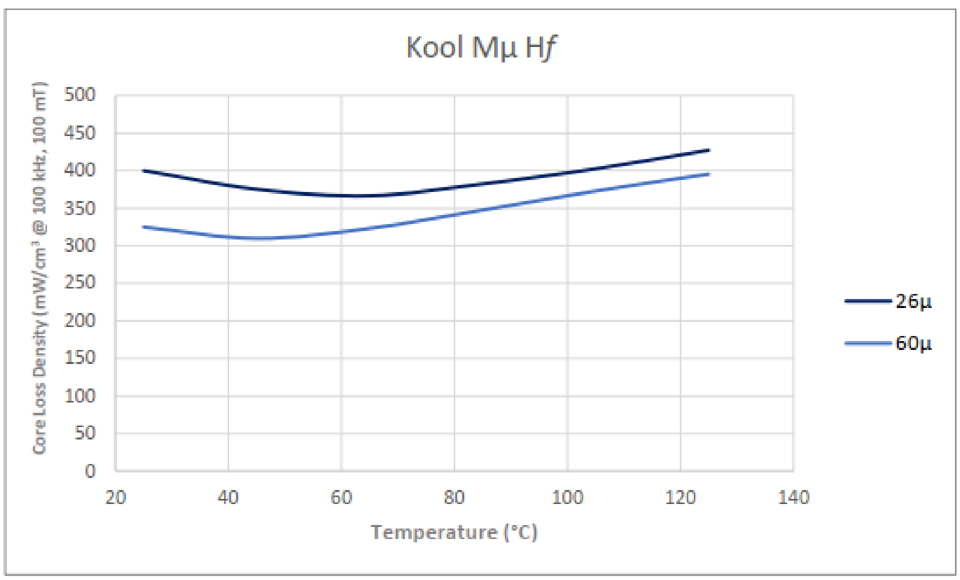



EDGE - 60µ
Core Loss Density (mW/cm³ @ 100 kHz, 100 mT)
500
450
400
350
300
250
200
150
100
50
0
20
40
60
80
100
120
140
Temperature (°C)


Kool Mµ
Core Loss Density (mW/cm³ @ 100 kHz, 100 mT)
1000
900
800
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
Temperature (°C)
26µ 40µ
60µ 90µ 125µ



Kool Mµ Max - 26µ, 60µ
Core Loss Density (mW/cm³ @ 100 kHz, 100 mT)
0
100
200
300
400
500
600
700
20
40
60
80
100
120
140
Temperature (°C)



Kool Mµ Hf
Core Loss Density (mW/cm³ @ 100 kHz, 100 mT)
0
50
100
150
200
250
300
350
400
450
500
20
40
60
80
100
120
140
Temperature (°C)
26µ
60µ

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