Core Selection Procedure

Only two parameters of the design application must be known: inductance required with DC bias and the DC current. Use the following procedure to determine the core size and number of turns.

1. Compute the product of LI^2 where:
   L = inductance required with DC bias (millihenrys)
   I = DC current (amperes)

2. Locate the LI^2 value on the Core Selector Chart (page 2-3, 2-4, & 2-5). Follow this coordinate to the intersection with the first core size that lies above the diagonal permeability line. (Small core sizes are at the bottom; large core sizes are at the top.) This is the smallest core size that can be used.

3. The permeability line is sectioned into standard available core permeabilities. Selecting the permeability indicated will yield the smallest core that can be used. Lower or higher permeabilities can be used, but the resulting core size will be larger.

4. Inductance, core size, and permeability are now known. Calculate the number of turns by using the following procedure:

   (a) The nominal inductance (A_L in nH / Turn^2) for the core is obtained from the core data sheet. Determine the minimum nominal inductance by using the worst case negative tolerance (-8%, -12%, or -15%, depending on the core size). With this information, calculate the number of turns needed to obtain the required inductance (see A_L and Inductance Considerations, page 1-5).

   (b) Calculate the bias in Amp-Turns from:
   H = NI/le

   (c) From the Permeability vs. DC Bias curves (page 3-18 through 3-20 & 4-34 through 4-36), determine the rolloff in per unit of initial permeability (μpu) for the previously calculated bias level.

   (d) Increase the number of turns by dividing the initial number of turns (from step 4a) by the per unit value of initial permeability. This will yield an inductance close to the required value. A final adjustment of turns may be necessary if a specific inductance is required.

5. Choose the correct wire size using the Wire Table (page 3-27). Duty cycles below 100% allow smaller wire sizes and lower winding factors, but do not allow smaller core sizes.

6. The core chosen will have an inductance equal to or greater than that required when biased with the specified DC current. The resulting winding factor will be between 25% and 45%.

Core Selection Example and Analysis

Choose a core with the following requirements:

(a) minimum inductance with DC bias of 1.0 mH
(b) DC current of 3.0 amperes

1. The product of $LI^2 = 1.0 \times 3.0^2 = 9.00$

2. This coordinate passes through the 60µ section of the permeability line and, proceeding upwards, intersects the horizontal 55586 core line. The part number for a 60µ core of this size is 55586.

3. The 55586 core data sheet shows the nominal inductance of this core to be 38 nH / Turns^2, ±8%. Therefore, the minimum inductance of this core is 34.96 nH / Turns^2.

4. The number of turns needed to obtain 1.0 mH is 169 turns. The magnetizing force (DC bias) is 56.6 Amp-Turns, yielding 68% of initial permeability. The adjusted turns are 249.

5. The wire table indicates that #20 wire is needed for 3.0 amperes. Therefore, a 55586 core with 249 turns of #20 wire will meet the requirements.

An analysis of the preceding result yields the following:

1. Calculate the DC bias level in Amp-Turns:
   H = NI/le = Amp-Turns

2. The permeability versus DC bias curve shows 48% of initial permeability at 83.5 Amp-Turns for 60µ material.

3. Multiply the minimum A_L 34.96 nH / Turns^2 by 0.48 yields 16.78 nH / Turns^2.

4. The inductance of this core with 249 turns and with 83.5 Amp-Turns of DC bias will be 1.04 mH minimum. The minimum inductance requirement of 1.0 mH has been achieved with the DC bias.

5. 249 turns of #20 wire (0.634 mm^2) equals 157.9 mm^2, which is 39% winding factor on this core (total window area of 401 mm^2).

Core Selector Charts

The core selector charts will quickly yield optimum permeability and smallest core size for DC bias applications. These charts are based on a permeability reduction of not more than 50% with DC bias, typical winding factors of 25% to 45%, and an AC current, which is small relative to the DC current. These charts are based on the minimum inductance tolerance of the chosen core size and permeability.

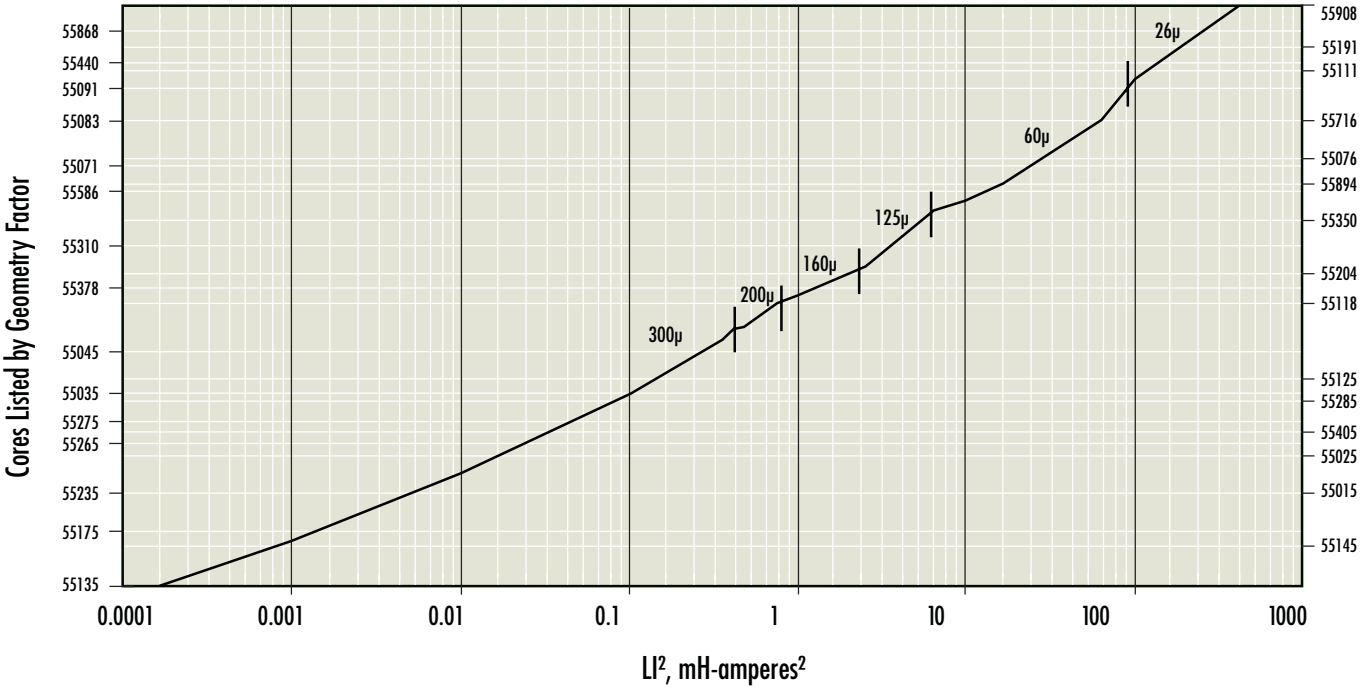
If a core is being chosen for use with a large AC current relative to any DC current, such as a flyback inductor or buck/boost inductor, select a core that is one or two sizes larger than indicated by the selector charts. This will assist in reducing the operating flux density of the AC current that generates core loss.

For additional power handling capability, LI^2, multiple stacking of cores will yield an equivalent multiple power handling for a given core size. For example, double stacking of the 55908 core will result in a doubling of its power handling capability to about 1000 mH-amperes^2.

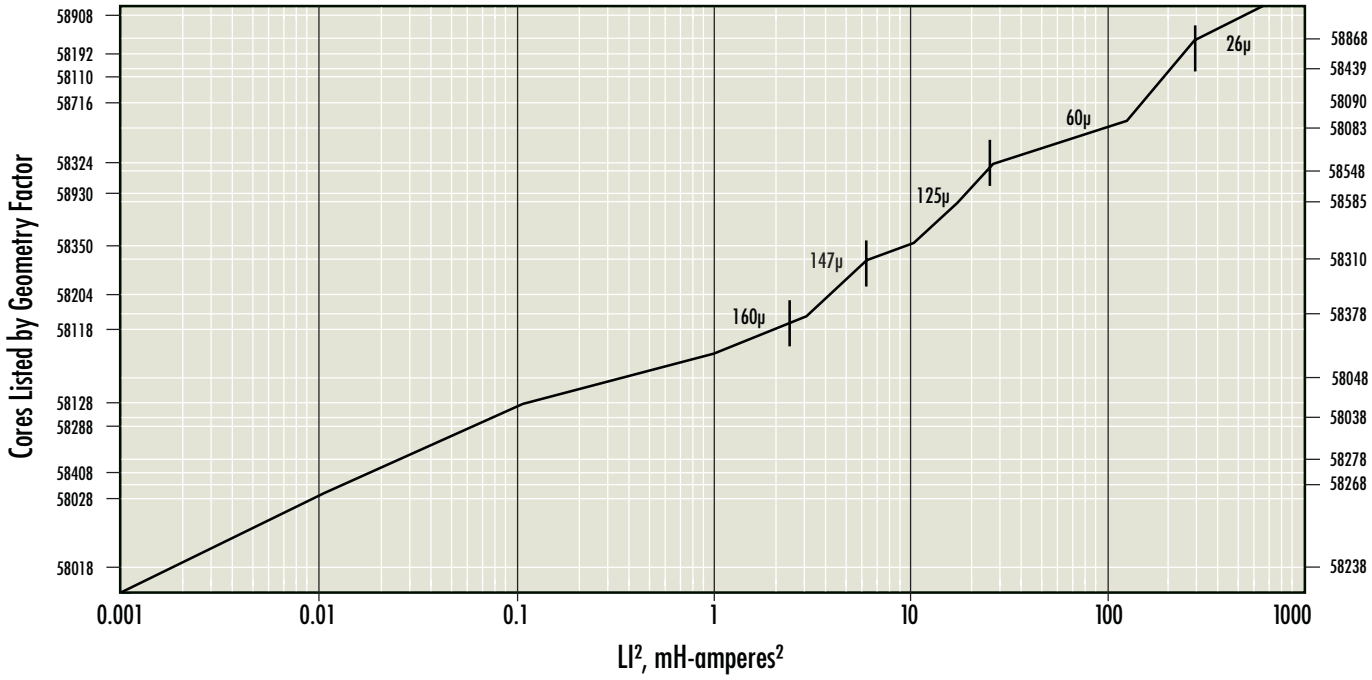
Cores with increased heights are easily ordered. Contact Magnetics for more information.

Core Selector Charts

MPP

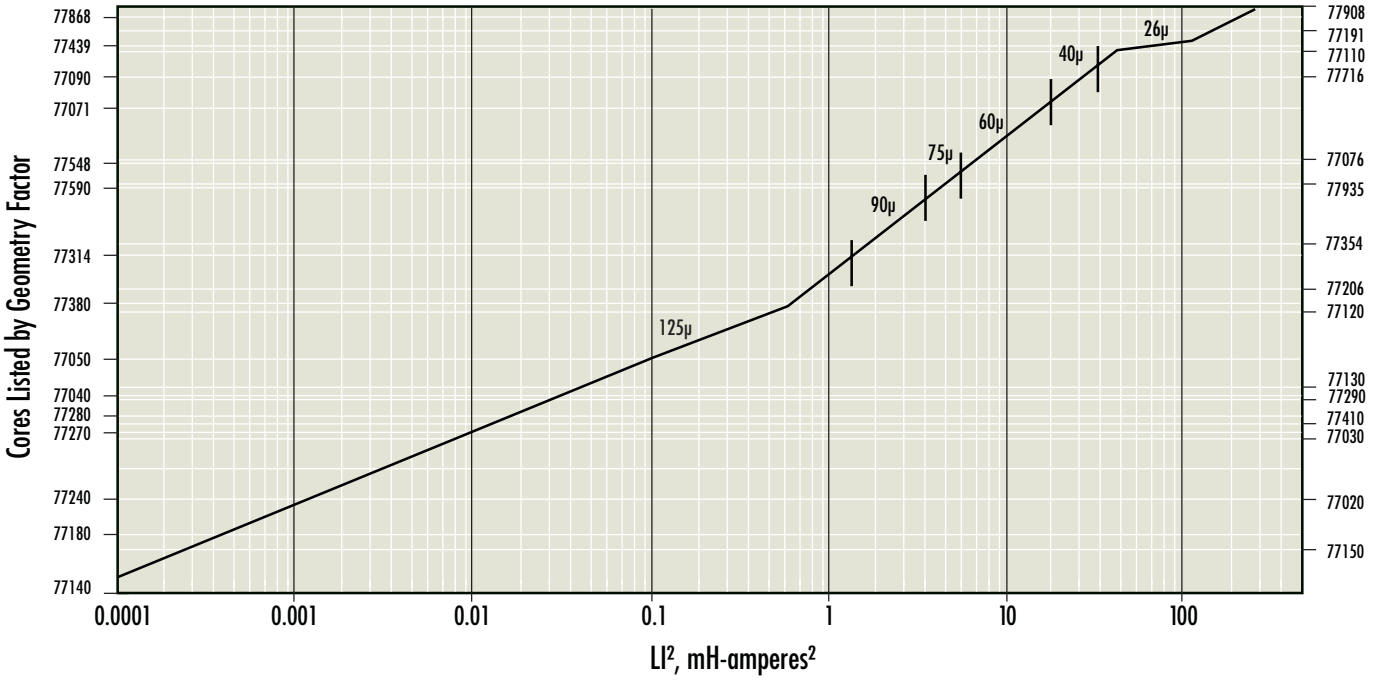


High Flux

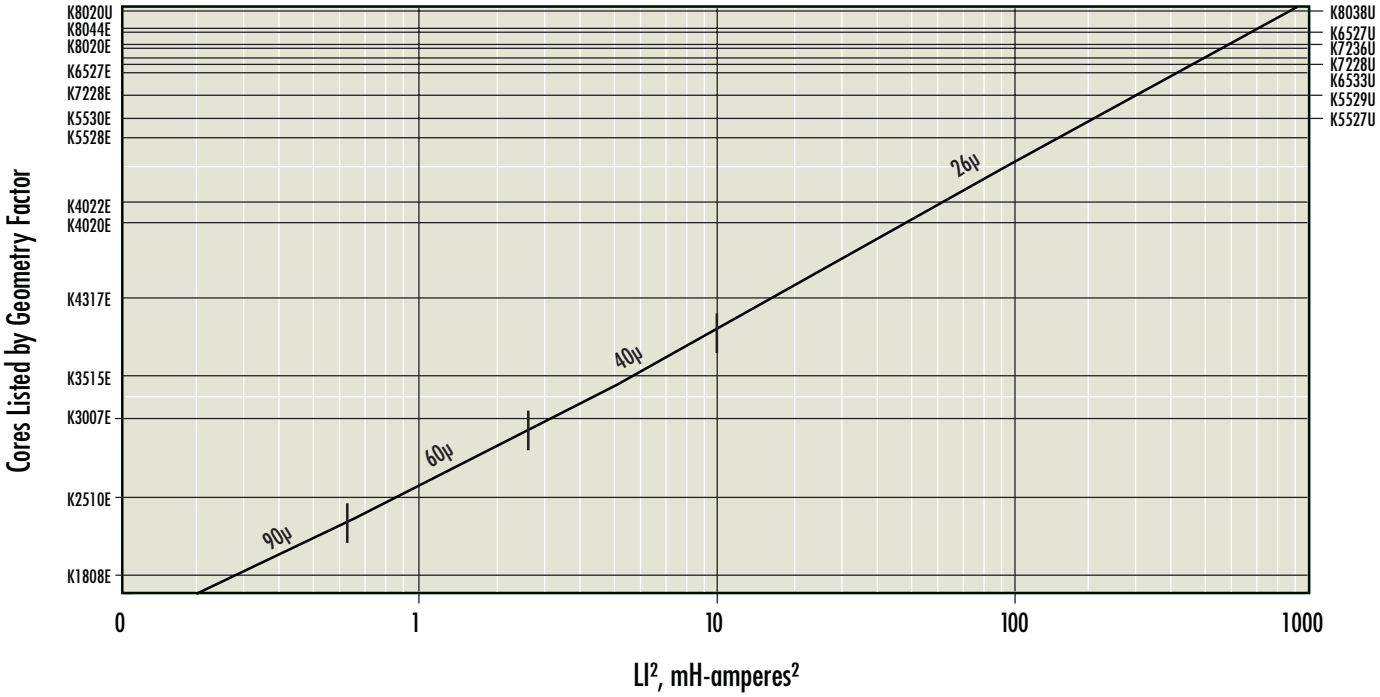


Core Selector Charts

Kool Mμ® Toroids

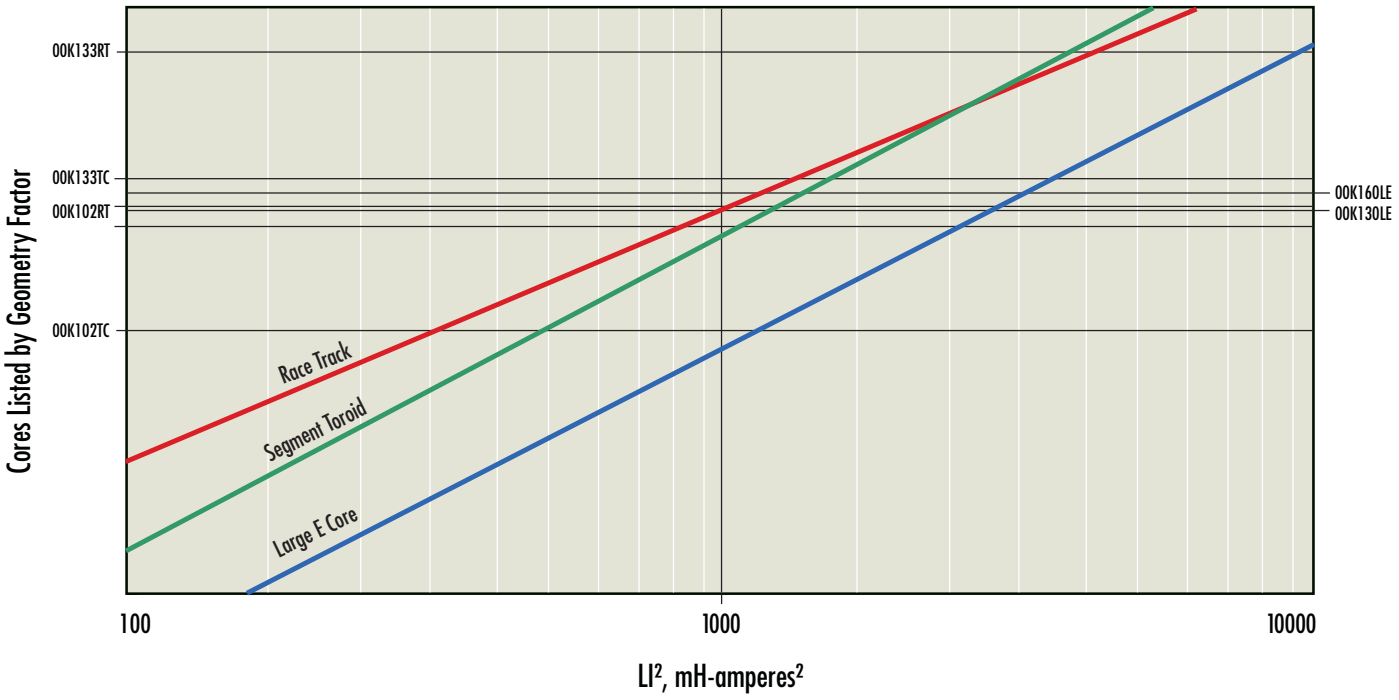


Kool Mμ® E and U



Core Selector Charts

Segments and LEs



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