

F49 A New High Bs_{at} Ferrite Material for Saturation Limited Applications

In power magnetics there are several constraints which limit flexibility and performance. These constraints include but are not limited to:-

- 1) Cost
- 2) Size (includes shape)
- 3) Capabilities of material

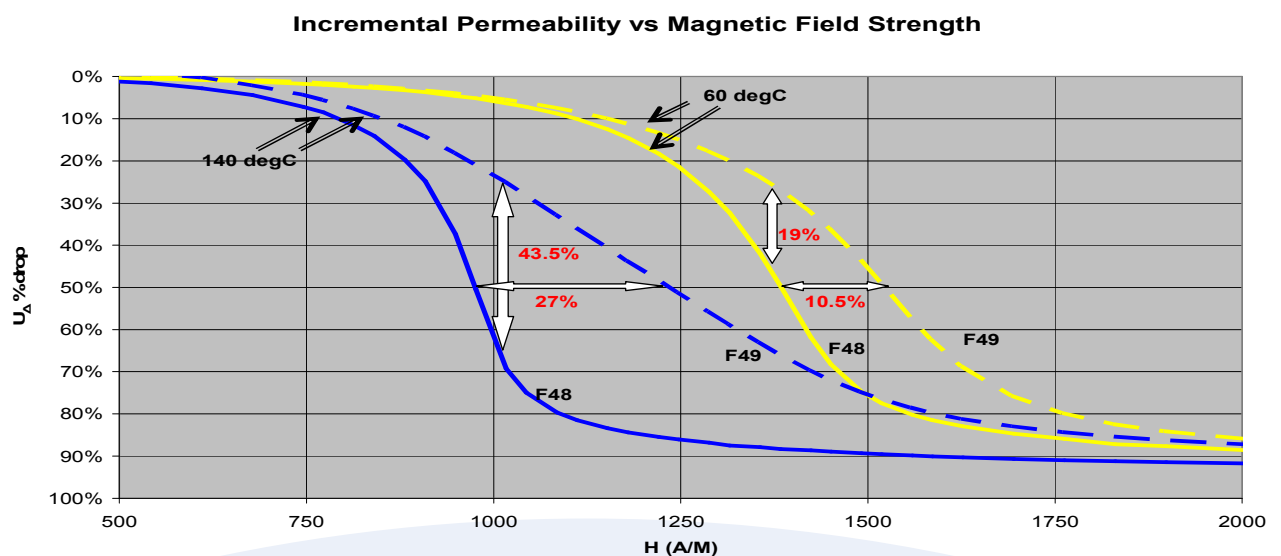
If cost and size were not issues then the choice of material would be simplified; in the real world optimisation is the key to producing a cost effective design. The choice of material is very much dependant on the application and the chosen topology.

The F49 material is ideally suited for saturation limited applications including:-

- Power Chokes for switch mode powers supplies
- Power factor correction Chokes
- Miniature inductors for point-of-load (POL)
- Inductors for voltage regulator modules

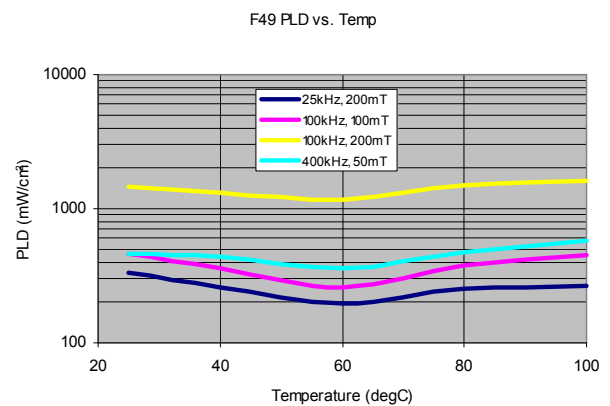
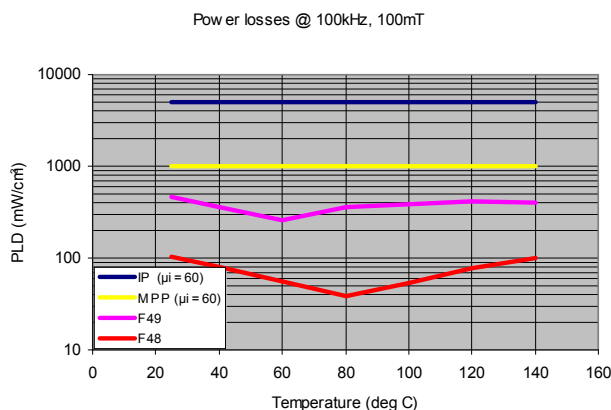
In these applications the main function of the inductor is to help smooth out the ac ripple voltage so as to produce a constant DC output from the converter. In doing so the inductor will have to store energy while sustaining a high DC bias, particularly in applications where the output current is high due to the trend of lower and lower output voltages. The effect of the DC bias causes the core to operate at a higher point on the B-H curve, and a high AC ripple current (which is superimposed on this DC point) can saturate the core. For this reason either iron powder, or gapped ferrites or tape wound cores are used. Note that magnetic materials store very little energy so the distributed gap of iron powder cores or the air gap in ferrites and tape wound cores are utilised to increase energy storage.

The graph shows plots of Incremental permeability vs. Field strength, for 60 and 140 deg C measured on toroids gapped to an approx μ_e of 245 in F48 and F49 material. The plots show the drop in permeability as the Field strength is increased, which could have otherwise been shown as Inductance vs. DC current.



The designer is interested in the maximum permissible dc loading; how much DC current can the core handle without the inductance falling below the minimum acceptable value for the design. It can be seen that the F49 will sustain over 10% more DC current than F48, which translates to 20% more stored energy at 60 deg C for an acceptable inductance drop of 50%. This increases to 27% more DC current at 140deg C. Many designs only allow for a 25% drop in inductance. The graph shows that for the same DC loading; when the F49 inductance drops to 75% of its "no load" value the F48 would have dropped to 56% at 60 deg C - a difference of 19% and as much as 43.5% at 140deg C.

The energy storage capability of an inductor is limited by the saturation flux density of the core. In applications where the AC ripple is low in frequency and amplitude, iron powder cores are preferred as the higher flux densities results in reduce core size. However in high frequency applications and applications where the magnitude of the ripple current is high the core becomes loss limited. The F49 will be most suited to these applications as the losses are almost one order of magnitude lower than Iron powder and over half the losses of MPP cores. Power loss curves of the F49 material at various frequencies and flux densities are shown below. Also shown is a comparison graph displaying the difference in power losses between F49, F48 and typical iron powder materials.



The curie temperature of F49 is much higher than typical power grade materials, which accounts for the high saturation flux density. Although losses are higher than F48 it is still much less than Iron powder, thus bridging that grey area where ferrite may now be the material of choice, due to the lower cost and now improved performance.

F49 is available in standard shapes; ER, Planar, RM, U, ETD, EFD and Ring cores. If you would like more technical information (including a complete data sheet), pricing information, availability or samples, please contact MMG MagDev Limited directly at the contact details shown below.

MMG MagDev Limited
Unit 105 Faraday Park, Faraday Road, Dorcan
Swindon, Wiltshire, SN3 5JF, UK
Tel: +44 (0) 8704283814
Fax: +44 (0)1793 524357
sales@magdev.co.uk
www.magdev.co.uk