Inductance vs. IDC in WCM317 and WCM318 Series Inductors

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HIGHER POWER IN COMPACT DESIGN

WCM317 and WCM318 series (Figure 1) utilize WCM designed 410-50 and 410-60 cores and bobbins, respectively, which allow high power in a compact size.

The series contain patented[1] Shaped Foil Technology which combine the low DC resistance of foil with the low AC resistance of Litz wire.

FIGURE 1: **WCM317 & 318 inductors**. WCM317 utilizes the WCM410-50 core and bobbin set, which is 63% the size of the WCM410-60 core and bobbin set.

WHY MEASURE SATURATION

Inductors are limited by the maximum possible magnetic field that can be supported by ferrite material before it saturates (Figure 2).

At a critical DC bias point, the material's permeability will drop as will inductance.

Knowledge of this saturation point is critical information for the inductor manufacturer to provide to the circuit designer to ensure successful designs.

Unforeseen inductance drop could cause a short to sensitive components.

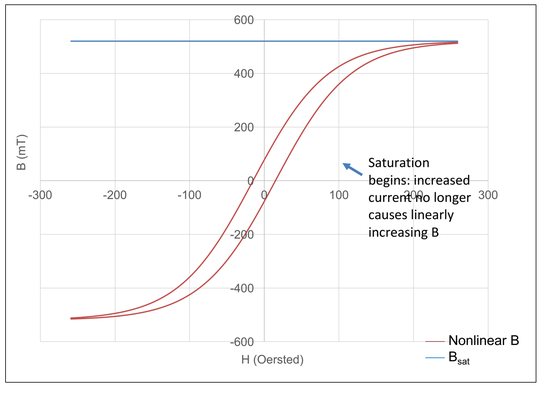
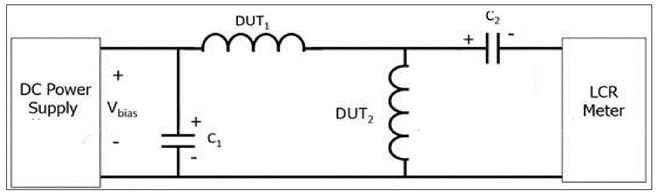


FIGURE 2: **Example magnetic field (B) versus magnetizing force (H).** This curve can be measured by proxy by measuring inductance versus current – proxy is more important to circuit designer.

TESTING L *vs*. IDC: METHODS

Inductance was tested in a test circuit on an GW-Instek 819 LCR meter and an SL10-150 DC Power Supply. Two DUTs were placed in parallel in reference to the LCR meter. Two large aluminum electrolytic capacitors (C: 100000 µF) were placed between the LCR meter to protect the machine from DC.



- Inductance of test circuit was measured at 100 kHz, V = 0.1 V, with varying levels of DC bias. Resolution was adjusted as needed: near saturation resolution was increased.
- Final inductance values were multiplied by two and offset to match the 0 A value to the average value of the unloaded pair.

L *vs*. IDC

All inductors in 317, 318 series can tolerate at least 10A of DC bias before starting to saturate. Figures 3A and 3B show saturation for WCM317 inductors. Figures 3C and 3D show saturation for WCM318 inductors.

- In parts with lower unloaded inductance, temperature rise limits the maximum DC bias of the part: component heats excessively before saturation is reached. WCM could measure more of the saturation region in parts with higher unloaded inductance.
- Parts with higher unloaded inductance tolerate lower levels of DC bias in the same package size.

WCM317

PN	Unloaded Inductance (uH) +/- 10%	Current at which saturation begins (A)
WCM317-01	63.65	13
WCM317-02	29.49	20
WCM317-03	19.04	24
WCM317-04	8.46	37
WCM317-05	6.58	41
WCM317-06	4.81	48
WCM317-07	3.31	60
WCM317-08	2.08	70

WCM318

PN	Unloaded Inductance (uH) +/- 10%	Current at which saturation begins (A)
WCM318-01	112.65	11
WCM318-02	51.79	19
WCM318-03	30.47	25
WCM318-04	14.74	32
WCM318-05	11.6	39
WCM318-06	6.56	55
WCM318-07	4.62	60
WCM318-08	3.04	80

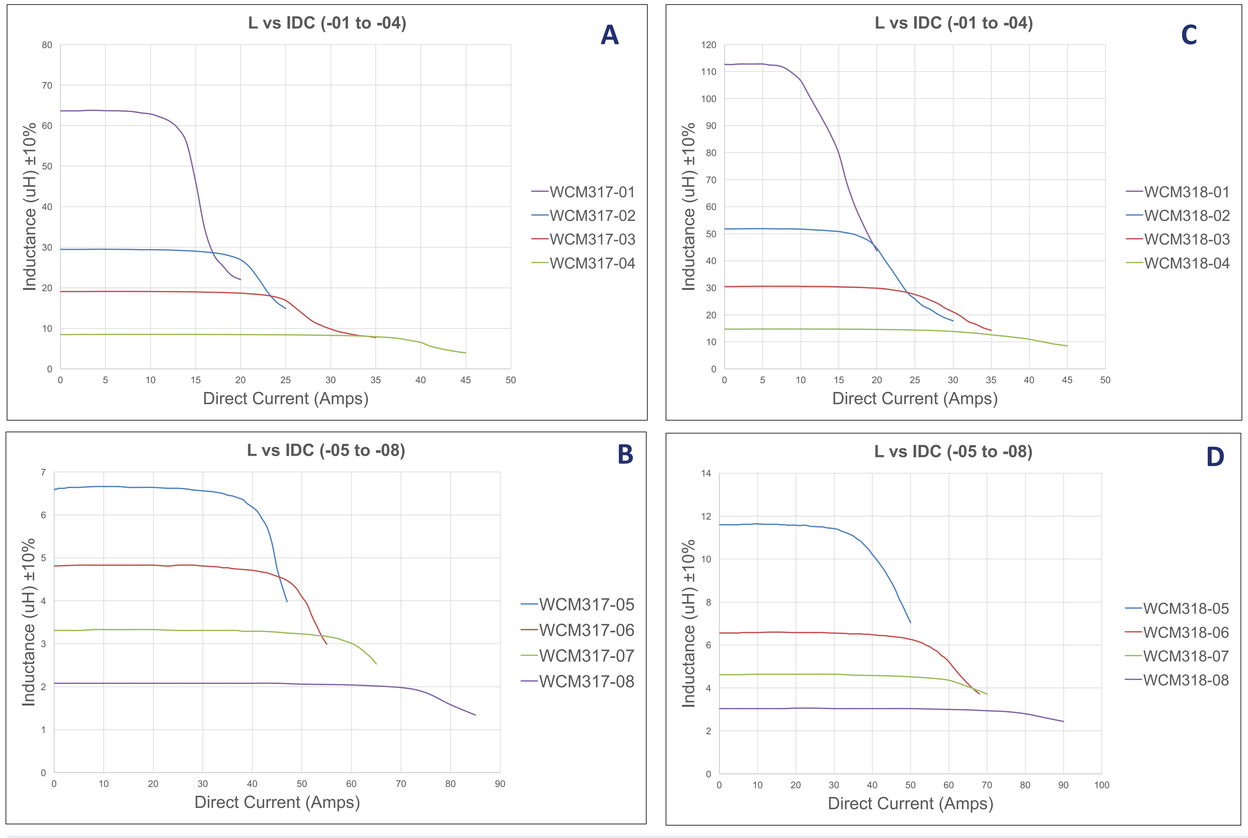
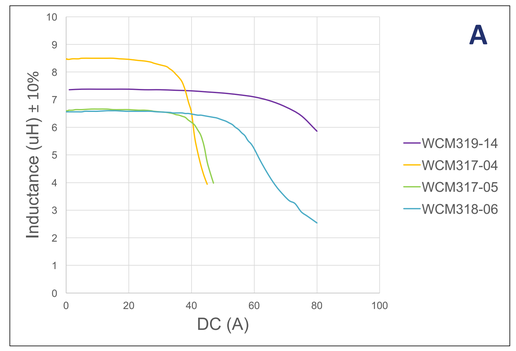


FIGURE 3: **Inductance versus DC for WCM317 (3A, 3B) and WCM318 (3C, 3D) series.**

SERIES COMPARISON

- Larger sizes (WCM319, WCM320) allow for higher DC bias to be used. WCM319 uses the WCM 410-70 core and bobbin, while WCM318 utilizes the WCM410-88 core and bobbin.
- Designers can choose WCM317 or WCM318 sizes to reduce footprint if the lower supported DC bias is sufficient for the application.



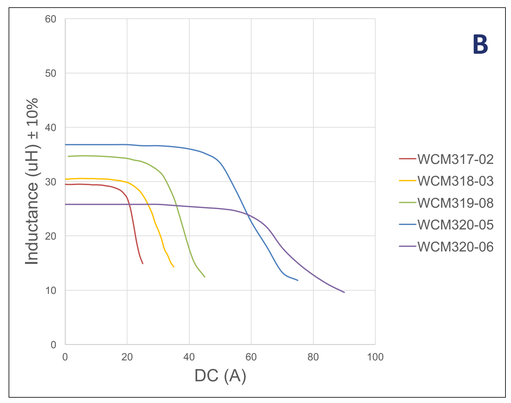


FIGURE 4: Comparison of saturation within similar inductance ranges. 4A shows saturation for 4 parts in the 6.5 to 8.5 uH range. 4B shows saturation for 5 parts in the 25 to 37 uH inductance range.

SUMMARY

- West Coast Magnetics has extended measurements on L vs. IDC into the new, smaller 317 and 318 series. These inductors can tolerate 10+ A of DC bias, with some up to 80A.

FURTHER WORK

- Test saturation with higher percentage ripple: higher level on the LCR meter, or adding amplifier
- Check that rolloff current measured is consistent with known physical properties of the ferrite material – translate L vs. I to B vs. H
- Explore L vs. Idc for smaller cores and bobbins in the WCM 410 series.

REFERENCES

1. Patent US20170221625A1, *Magnetics devices including low AC resistance foil windings and gapped magnetics cores*, 2017.