

Abracon AIRD Inductors Achieve High Breakdown Voltage Lighting Applications

Introduction

In a typical LED lighting application, the controller handles several hundred Watts of power, and the ballast voltage can go up to around 300 Volts. Therefore, it is imperative that the inductor used is able to simultaneously withstand high power and high voltage.

Insulation Mechanism

When inductors are used in a high voltage application, the partial discharge over an extended time period degrades the insulation layers and the metallization near the voltage gap. Eventually, this partial discharge chars through the metal and conducts current across the gap.

MnZn Ferrite core is characterized as high permeability, high flux-density core-material and is commonly used in such inductors. However, the intrinsic property of this core material is poor insulation performance. The insulation typically breaks down between 200 ~ 300V, which may cause overheating and may result in controller-board failure.

To overcome this challenge, Abracon's AIRD series inductors utilize a specialized epoxy coating on the surface of the core.



[Figure 1, epoxy coated AIRD inductor]

Breakdown Voltage Assessment

In order to verify the Breakdown voltage of an inductor, a HI-POT Analyzer is utilized to perform this test.



[Figure 2, Hi-Pot Analyzer]

Test conditions:

- Ambient Temperature: $25 \pm 3^\circ\text{C}$
- AC Test Voltage: 1000V, 1500V
- Leakage current threshold: 0.1mA
- Test dwell time: 60 seconds



[Figure 3, AIRD inductor Breakdown voltage test (tube removed for testing)]

Test Result:

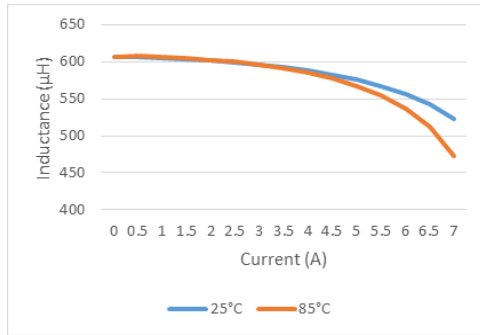
Test #	Withstand Voltage	Leakage Current	Test Result
1	1 kV	0.007mA	PASS
2	1.5 kV	0.009mA	PASS

Saturation Current

Besides withstand voltage, another key factor for designing a successful LED controller boards is the saturation current of the inductor. Saturation current is defined as a current where the inductance approximately drops to 90% of the initial inductance at 0A.

In switch-mode power supply (SMPS), high-power Boost or Buck convertor peak ripple current can reach 5A or above. With high saturation current, and soft saturation curve, converters are expected to operate smoothly.

The saturation current test is performed with inductor AIRD-03-681K (680 μH) at 2 different temperatures (25 and 85 $^\circ\text{C}$).



[Figure 4, AIRD-03-681K... Inductance vs. Current curve at different Temperature]

As is evident in figure (4), this inductor keeps soft saturation at both 25°C and 85°C operating temperatures, while the saturation current easily exceeds the 5A target.

Conclusion

In a high-power lighting application, selecting inductors with high Breakdown voltage & high saturation current are key parameters for a robust design. Abracon’s AIRD series of Inductors are ideally suited to meet these requirements.

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