

SUPPORT NOTE

SN018 | Cracks on Molded Power Inductors



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1. INTRODUCTION

This support note aims to explain the influence of visual surface irregularities around the core which may occur during the manufacturing process of molded inductors.

The key advantages of inductors produced by molding technology are high saturation current and high power density which exhibit soft saturation characteristics, low core losses, high operating temperature, and a small footprint. Unlike most power inductor cores, the molding material is not a ferrite, but a mixture of metal powder and resin binder which is pressed around the inductor coil. The resin binder creates a distributed air gap and greatly enhances the electrical characteristics of the inductor. After pressing, the mixture is cured along with the inductor coil in an oven to increase the bonding strength between resin binder and metal powder. Unlike other manufacturers, all WE molded inductors have a surface coating to prevent rust which could affect the reliability of the product.

2. VISUAL APPEARANCE & EFFECTS

The previously described molding process, as well as the physical properties of the core material, imposes limitations on achieving a perfectly uniform visual appearance. However, because a good appearance and performance are desirable, this support note explains visual non-uniformities that may be observed in a molded power inductor.

Cracks around the core are nearly impossible to eliminate as the molding process involves curing the resin binder and metal powder together. During the manufacturing process small scratches can be caused by surface friction when ejecting the component. Small to medium-sized cracks can occur in addition to the superficial scratches due to the materials. These are considered as optical appearances which have no influence on the performance of the product.

Product Series' name			
WE-PMCI	WE-LHMI	WE-MAPI	WE-PMFI
WE-LHMD	WE-MXGI	WE-XHMI	WE-MCRI

Table 1: Product Series.

Samples of products from the Table 1, with and without visual irregularities, have passed all industry standard tests including thermal shock, mechanical shock, terminal strength, vibration, humidity, moisture resistance, operational life, and others, as defined by the AECQ-200 specification. Moreover, these irregularities do not affect the reliability or performance of the product. Würth Elektronik eiSos has established internal standards to evaluate such cracks in order to ensure consistently high quality and the specified electrical parameters according to the datasheet. A summary is presented in the following section.

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3. CRACKS

Cracks and scratches are classified as either acceptable or rejectable. To be judged as a rejectable part, all of the rejectable conditions (e.g. number, length, width) of at least one surface have to be met.

All of the pictures below are based on the [WE-LHMI](#) product series. The acceptable and rejectable criteria are applicable for all the molded inductor products from WE listed in Table 1.

Acceptable cracks

In general, cracks which are hard to recognize with the human eye, are acceptable.

Rejectable cracks

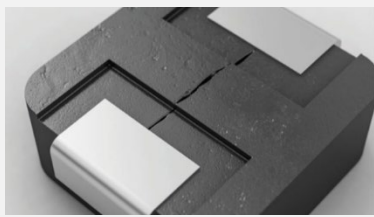
Type of irregularity	Surface	Picture	Visual	Number of irregularities	Length	Width
Crack / scratch	Top		Easy to identify by human eye and clear cut in the component	> 1 crack	$\geq 1/2$ of affected surface length	≥ 0.2 mm
Crack / scratch	Side without clip		Easy to identify by human eye and clear cut in the component	> 2 cracks	$\geq 2/3$ of affected surface length	≥ 0.2 mm
Crack / scratch	Side with clip		Easy to identify by human eye and clear cut in the component	> 2 cracks	$\geq 1/2$ of affected surface length	≥ 0.2 mm
Crack / scratch	Bottom		Easy to identify by human eye and clear cut in the component	> 1 crack	$\geq 2/3$ of affected surface length	≥ 0.2 mm

Table 2: List of the various rejectable cracks

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4. CHIP OFFS

Chip offs can occur through the handling of the components during the manufacturing process. Even though the chip offs do not affect the function of the part until the coil is exposed or broken, Würth Elektronik eiSos has established internal standards to evaluate the chip offs. Chipping may occur on the surface, edges and corners of the inductor (Figure 1):

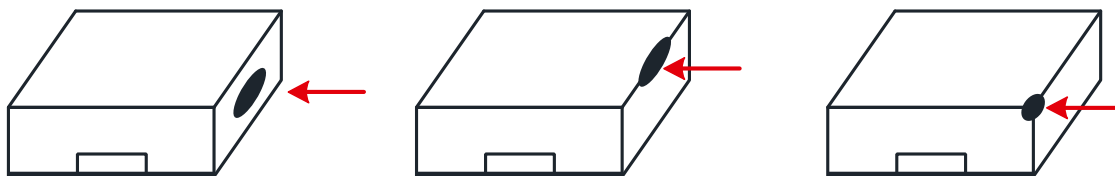


Figure 1: Chip off at various locations.

Type of irregularity	Picture	Number of irregularities	Length	Width	Area
Chip offs		> 2 chip-offs	$\geq 1/2$ of affected surface length	$\geq 1/4$ of affected surface width	$\geq 1/16$ of affected surface area

Table 3 Examples for assessment of rejectable chip offs

5. ELECTRICAL PERFORMANCE

Based on the design and construction similarities between WE-LHMI and the series listed in Table 1, as well as on our internal experience, including comparable mechanical structure, material system, termination design, binder composition, and other key elements of molded inductor architecture, the conclusions obtained from the tested part below can reasonably be extrapolated to the other product series. A synchronous step down switching regulator is implemented using an LTC3810 controller and a WE-LHMI [74437368068](#) inductor without visual imperfections.

The DC/DC converter has the following specifications:

- 60 W power
- 250 kHz switching frequency
- 24 V input
- 12 V output at 5 A

The WE-LHMI [74437368068](#) with an inductance value of 6.8 μH achieved following test results:

11.78 V, 5.02 A with 93% efficiency.

A large chip, approximately 15% of the volume, was broken off the original inductor intentionally (please refer to Figure 2) and the part was retested in the circuit.

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Figure 2: Broken edge on WE-LHMI [74437368068](#).

This inductor achieved the same operating results as the original part without chipping. The waveforms of the inductors with and without chipping are shown in Figure 3.

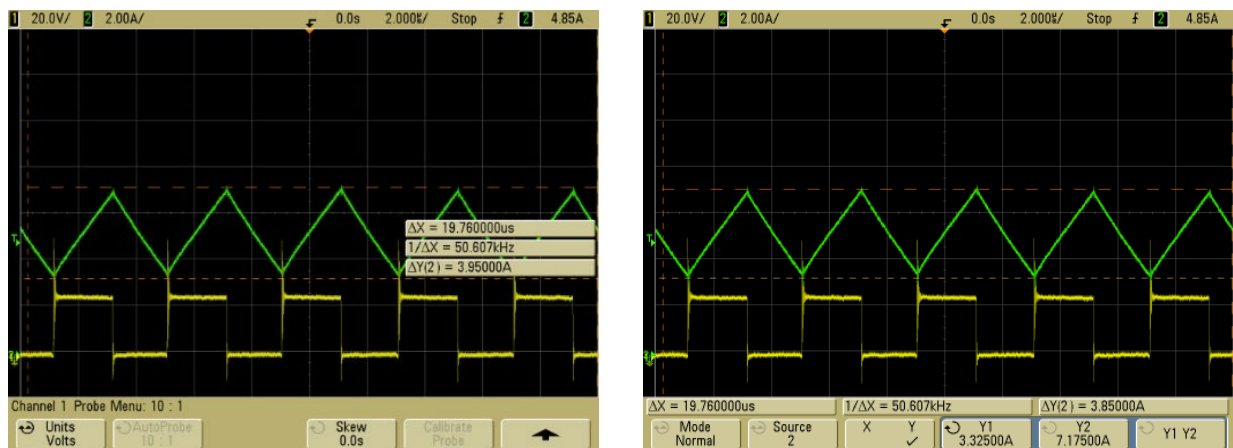


Figure 3: Waveform of the inductor current and switching voltage with inductance without visual features (left side) and with 15% chipping on the inductor core (right side).

The green waveform represents the current measured through the inductor using a Hall effect probe and the yellow waveform represents the voltage measured at the drain of the MOSFET.

The reasons for the consistent performance even with large, unacceptable cracks as well as chip offs are:

- The high flux density in the core only occurs in the closest area next to the windings
- The core material has a distributed "air gap" and the resulting lower relative permeability of the material drastically reduces the effect of discontinuities in the material (cracks).
- The magnetic cross-sectional area on the sides of the inductor is much larger than the center therefore the flux density is lower. As demonstrated, even with large chips, the flux can easily distribute to other areas without affecting performance.

6. SUMMARY

Molded inductors meet the requirements of modern electronic circuits by offering stable inductance at high currents while maintaining a compact design. Composite molding technology offers many advantages; however, due to the underlying physical principles, minor irregularities may occur. These do not affect the performance or electrical parameters of the component, provided they remain within the limits specified above.

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REVISION HISTORY

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SN018a	2021/07/12	Initial release of the application note
SN018b	2026/06/23	New layout, overall update, text improvements

Note: The current version of the document and the release date are indicated in the footer of each page of this document.