SIMPLE AND EFFECTIVE TECHNIQUE TO VERIFY IMPACT OF HIGH TEMPERATURE AND HIGH VOLTAGE HIGH FREQUENCY STRESSES ON INDUCTOR ELECTRICAL PERFORMANCE

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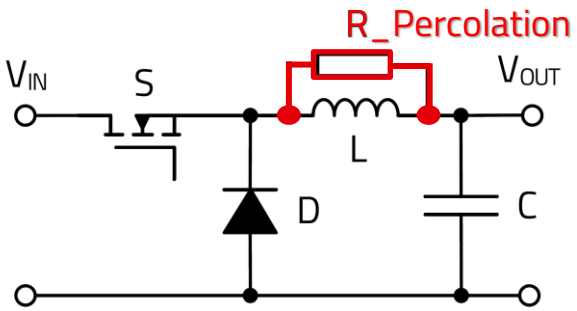
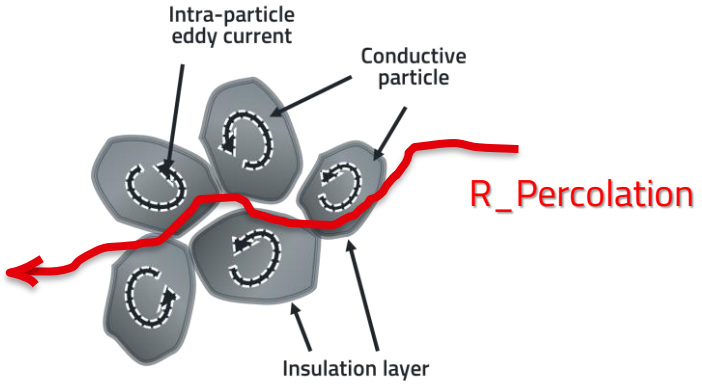
POWER MAGNETICS @ HIGH FREQUENCY WORKSHOP 2025

INTRODUCTION

Molded Power Inductors degradation due to percolation phenomena:

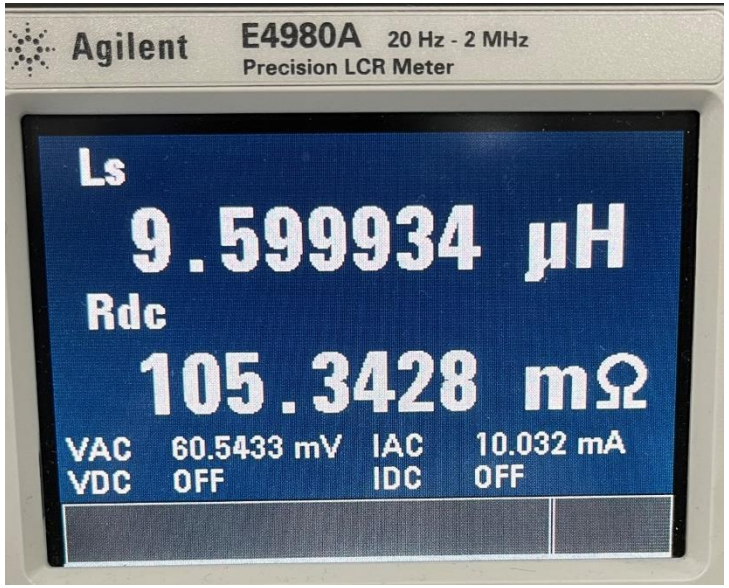




WE have „discovered" that molded power inductors exhibit a percolation behavior as a result of being exposed to higher temperatures or voltages. This leads to a passive device degradation, which in turn affects the DC–DC converter's long-term performance.

UNDETECTABLE PHENOMENON

- Material degradation is not detectable during standard AECQ200 qualification testing

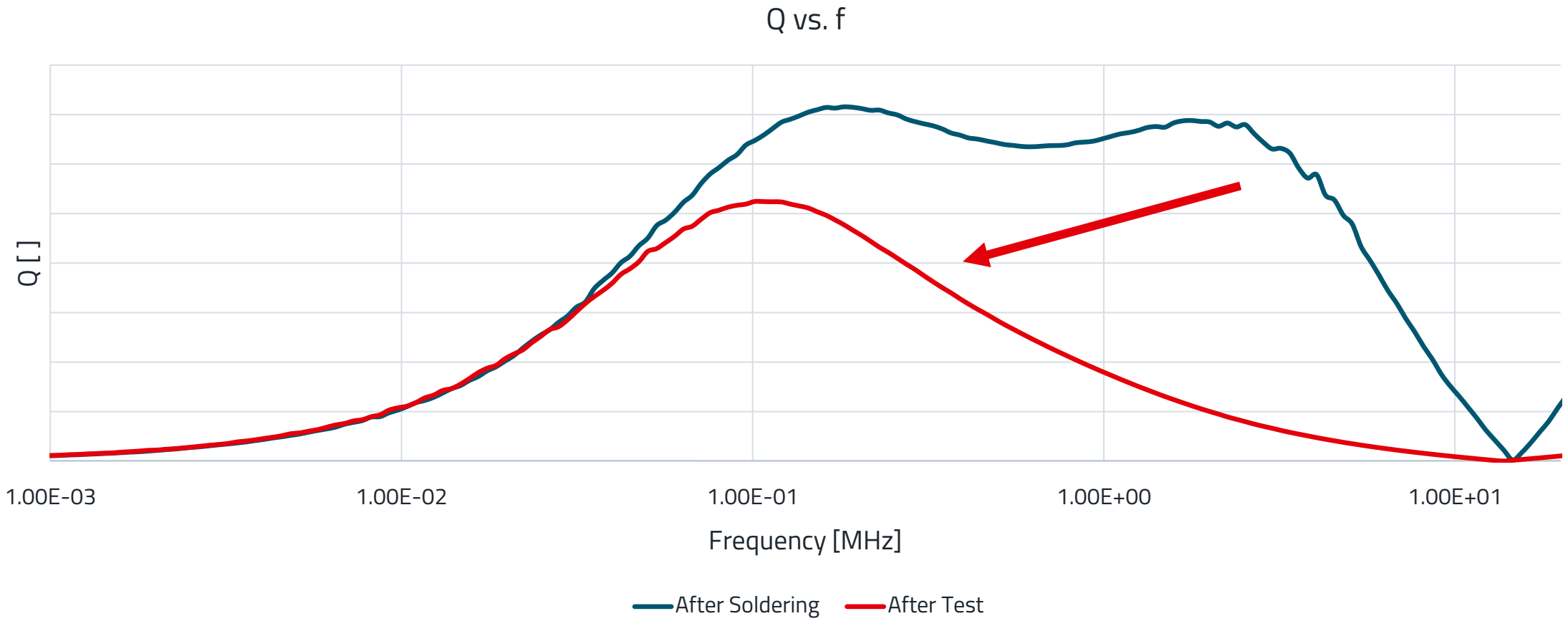


Good part

Compromised part

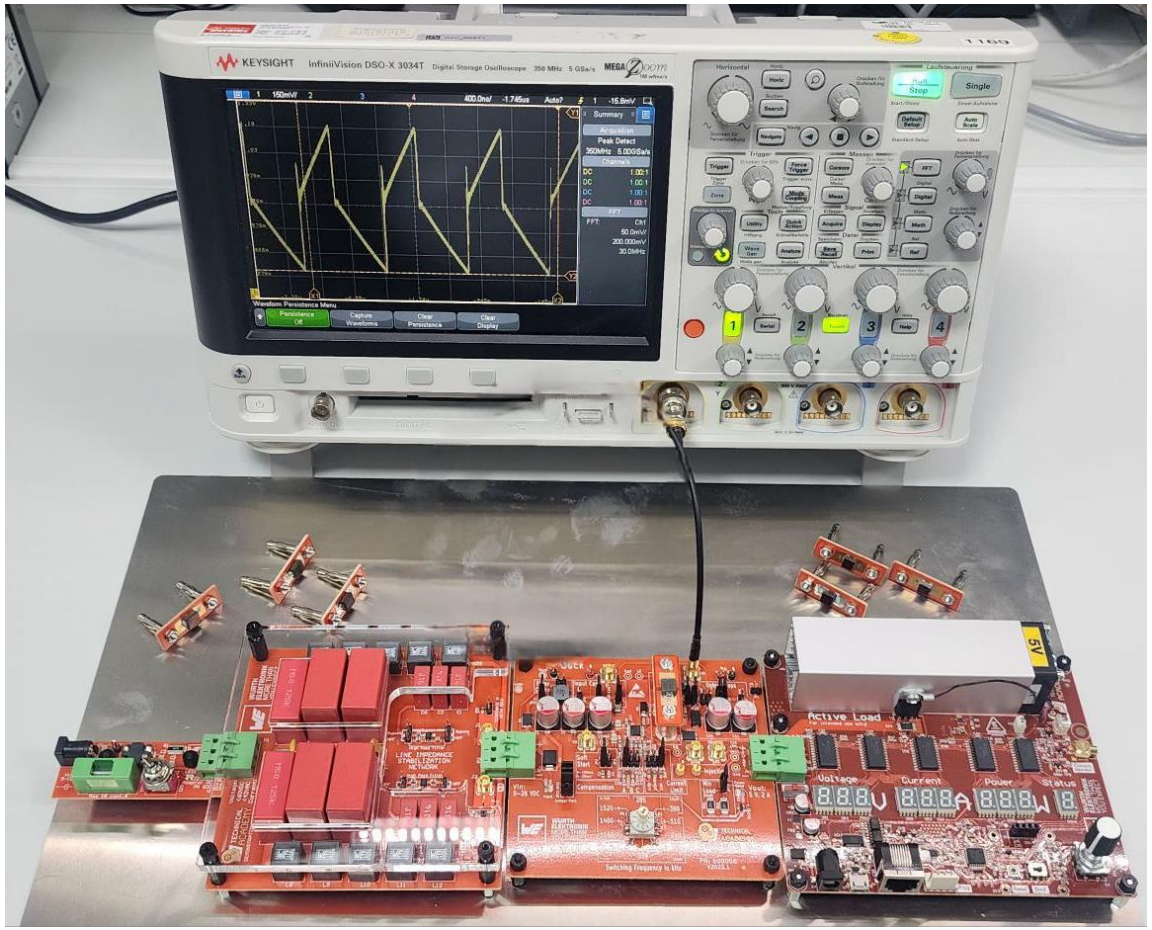
MOLDED INDUCTOR PHENOMENON

Change in Q is the main driver of this phenomenon!



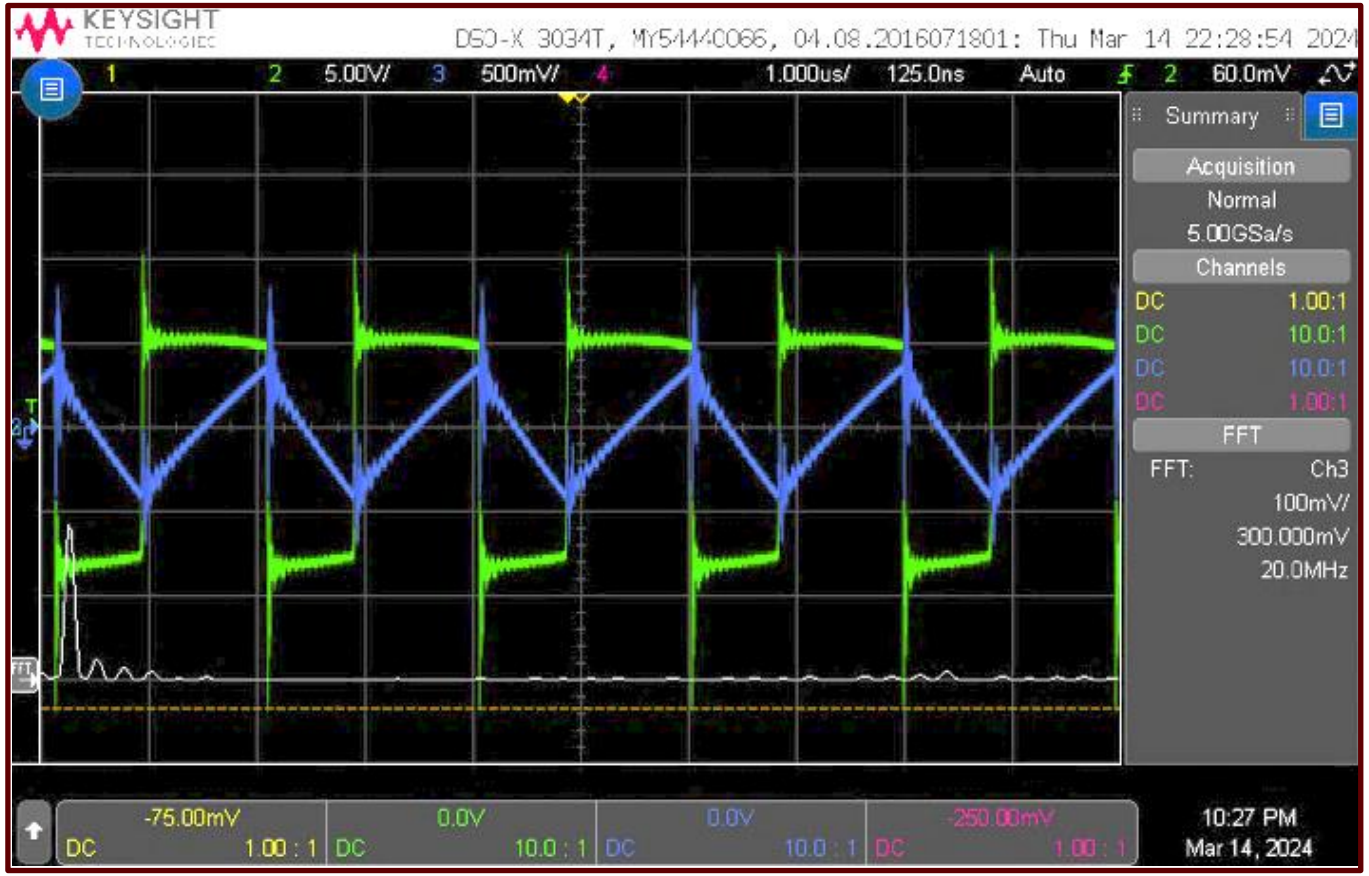
DEMOSTRATION SETUP

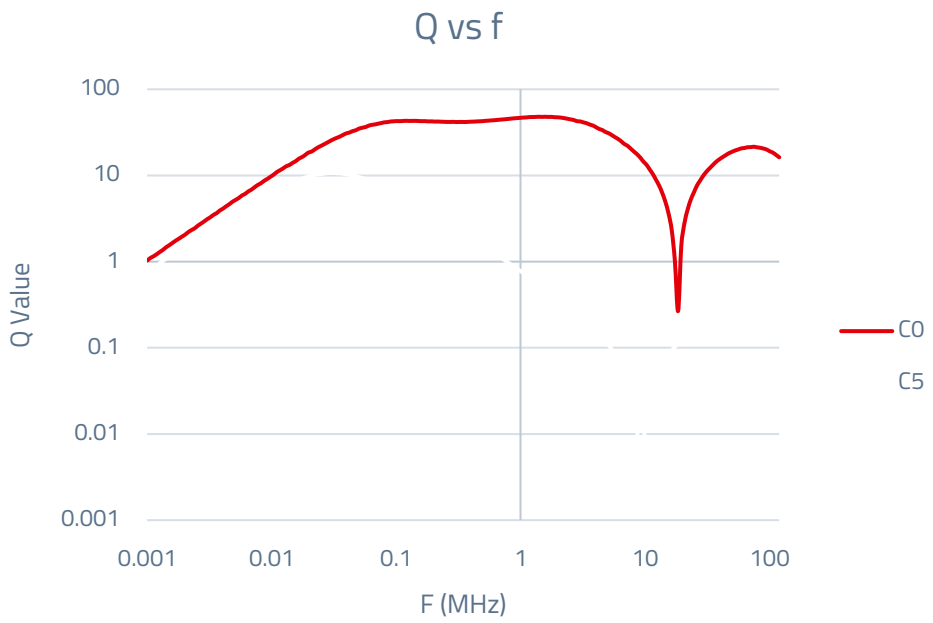
Showing components affected by high temperature or high voltage in a DC-DC Converter

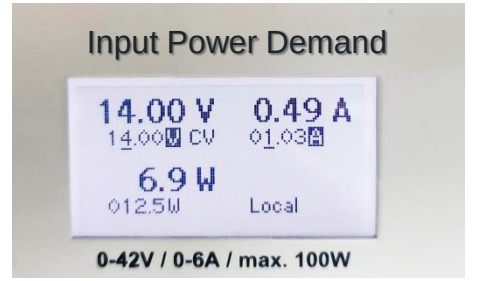


EFFECTS ON A DC-DC CONVERTER:

Before high voltage

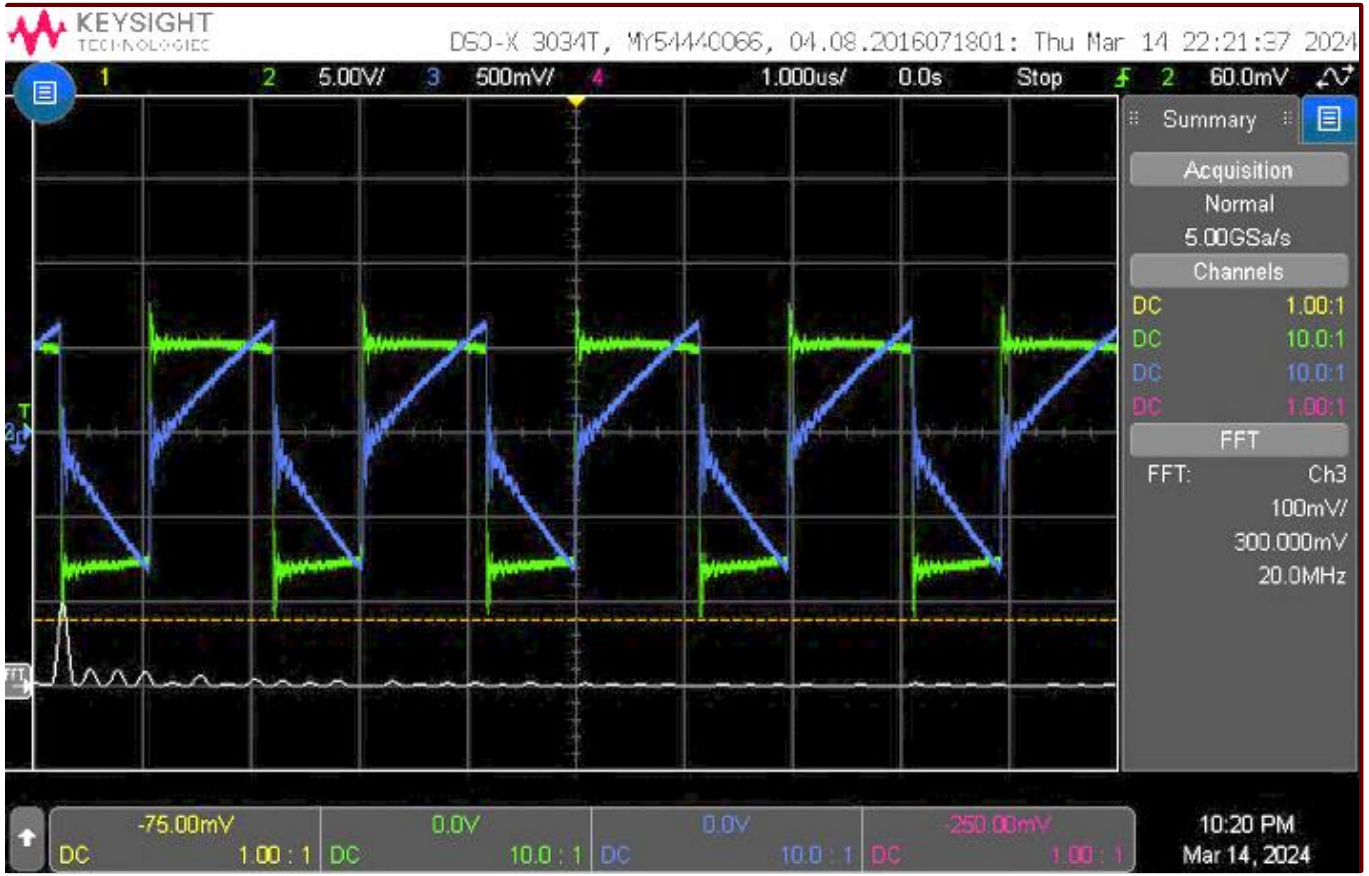


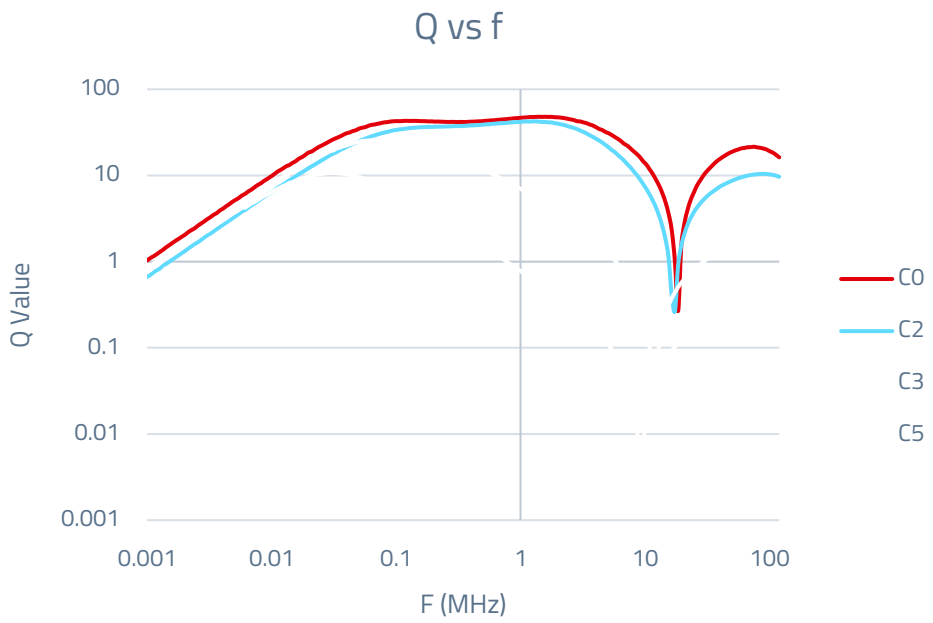


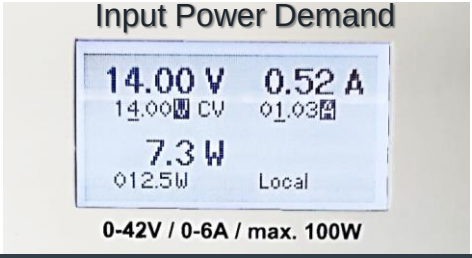


EFFECTS ON A DC-DC CONVERTER:

Start of phenomenon

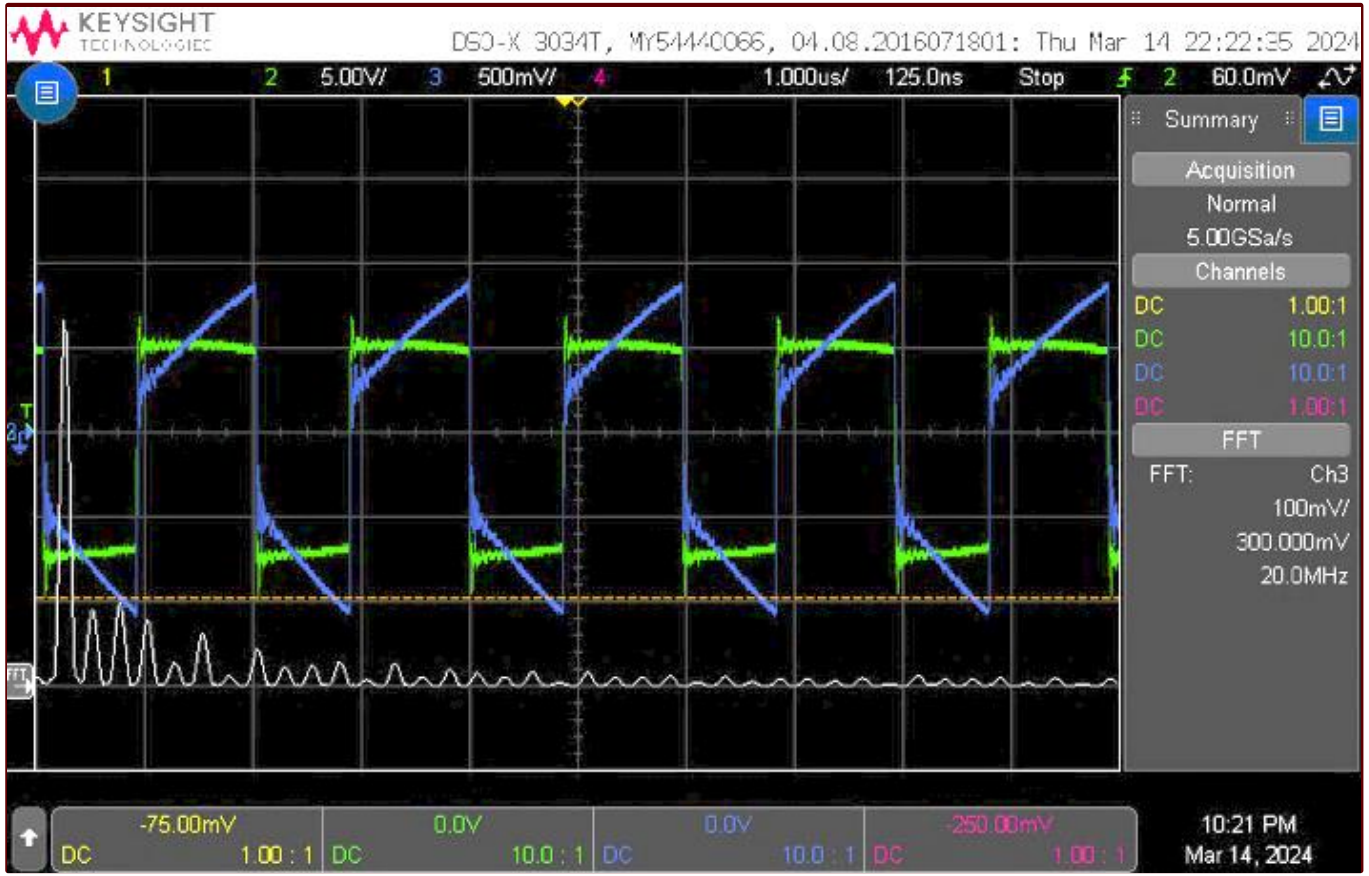


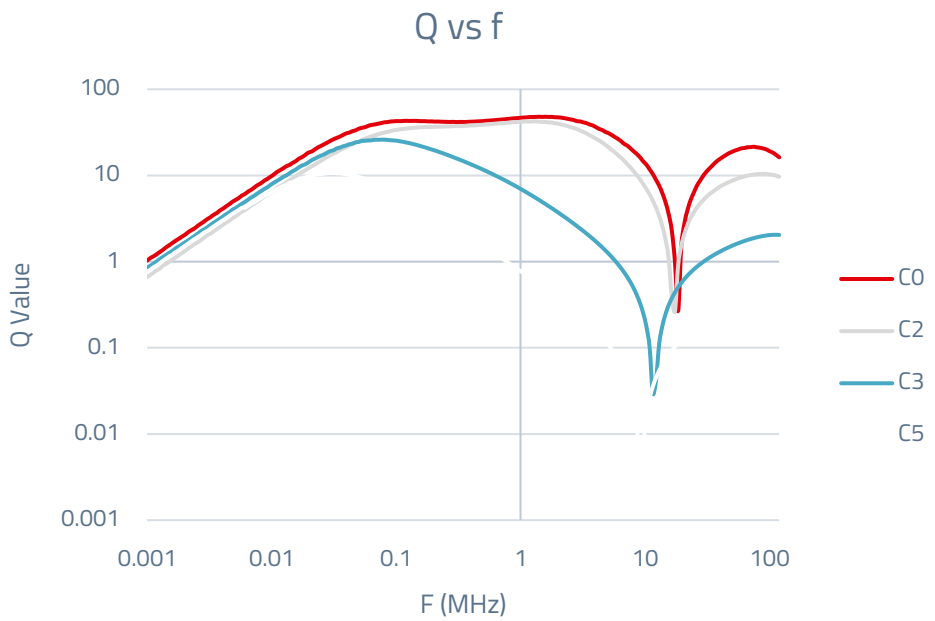


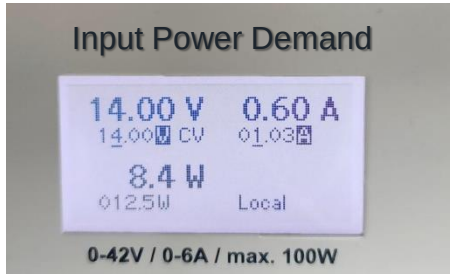


EFFECTS ON A DC-DC CONVERTER:

Part with percolation

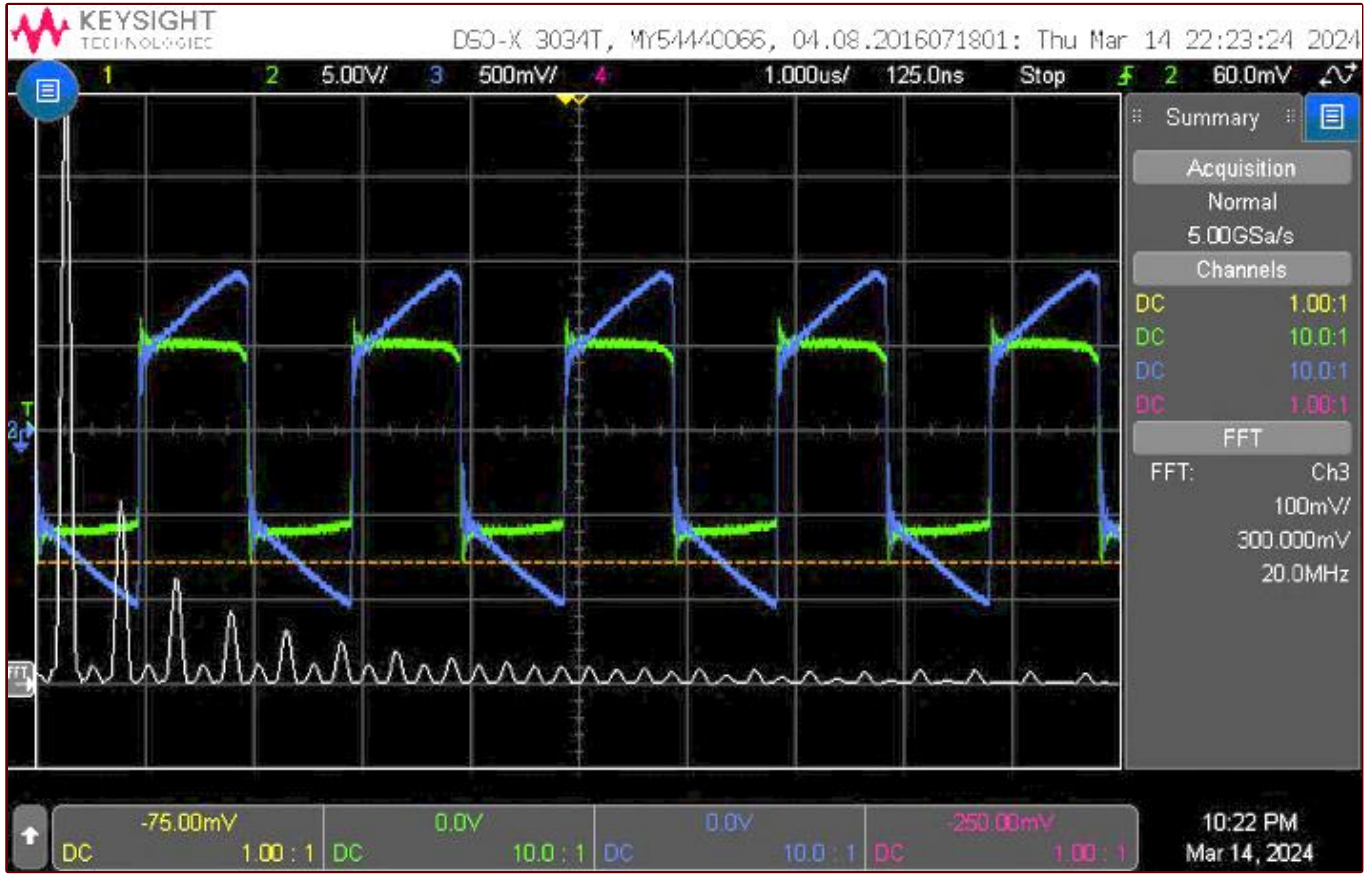


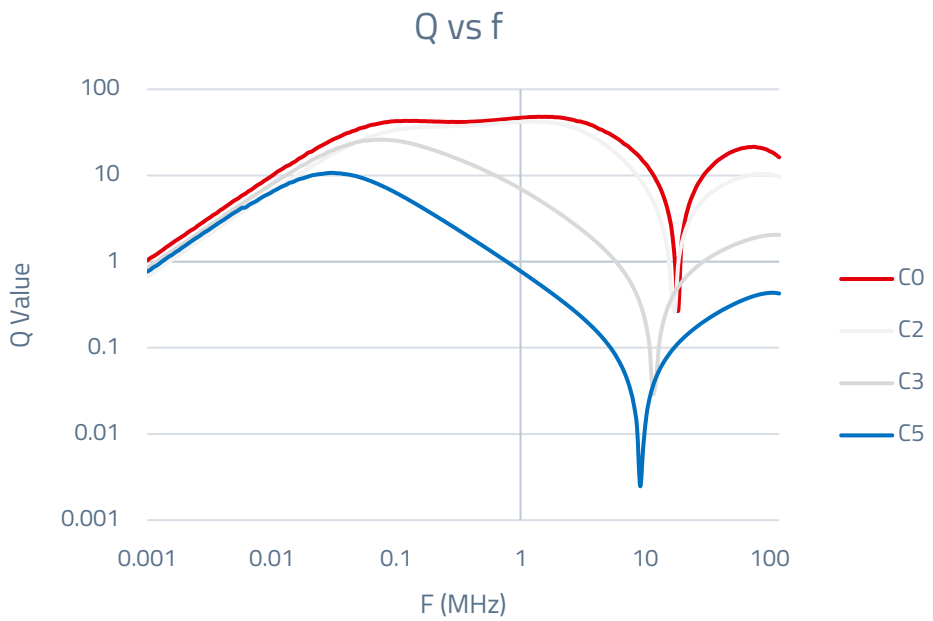


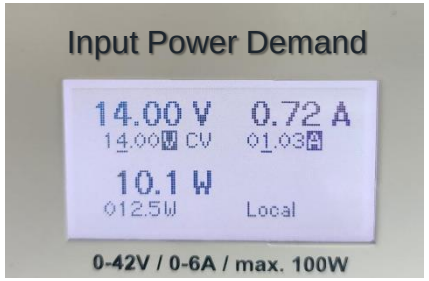


EFFECTS ON A DC-DC CONVERTER:

Part severely compromised

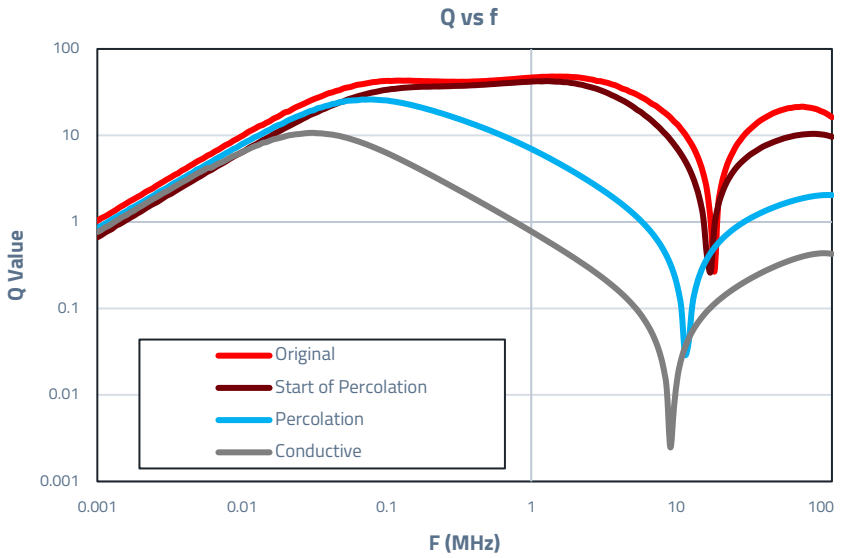






CONLCUSIONS

- The material degradation allows the start of percolation phenomenon. It is more evident when it transitions from an insulating to a conductive state, by the increase of the core losses due to higher eddy currents.
- This process starts after the exposure to high temperature or high voltage. It is distinctly measured as a critical decrease of Q Value at high frequencies.
- It is evident from the change in the inductor ripple current, the increased harmonics, and consequently, the efficiency decreases when used in a DC converter over time.



Thank you for your interest!

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WÜRTH ELEKTRONIK EISOS