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High frequency inductive components - Electrical characteristics and measuring methods -
Part 3: AC loss measured by sinusoidal wave of inductors for DC-to-DC converters

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High frequency inductive components - Electrical characteristics and measuring methods - Part 3: AC loss measured by sinusoidal wave of inductors for DC-to-DC converters

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The text of this International Standard is based on the following documents:

Draft	Report on voting
51/1617/FDIS	51/1625/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62024 series, published under the general title *High frequency inductive components - Electrical characteristics and measuring methods*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

This document is intended for high-frequency inductive components used in DC-to-DC converters.

Power saving of DC-to-DC converters is crucial owing to heat generation measures for miniaturization and high-density mounting, longer battery life for mobile devices, and increased power consumption in data centres with increased communication traffic. Under these circumstances, the loss of high-frequency inductive components is an important characteristic that determines the power saving of DC-to-DC converters. To measure the loss for possible implementation in DC-to-DC converters, it is important to measure the AC loss at current values close to the actual drive, but there was no measurement standard. AC loss measurements for high-frequency inductive components are defined in IEC 62024-1, but the measured currents are small and are not intended to be driven by DC-to-DC converters. IEC 62044-3 and IEC 63300 address testing for large alternating current, but the applications are different because they are for magnetic materials such as cores. Therefore, appropriate metrics for high-frequency inductive components for DC-to-DC converter are crucial. This document introduces a method for measuring the loss of high frequency inductive components when an alternating current corresponding to the actual drive is applied.

This document is one of the IEC 62024 series of standards for high-frequency inductive parts.

This document specifies the test method and a measuring jig for accurately comparing AC losses of high-frequency inductive components for DC-to-DC converters by sinusoidal wave current. This document also presents measuring principles, application ranges, and attentions of each method. Two different measurement methods with different ranges of measurement frequencies are presented. AC losses are measured by setting the frequency, the magnitude of the current, and the DC bias current.

The inductor current used in a DC-to-DC converter is a triangular wave, and the inductor loss depends on the shape of the triangular wave in addition to the current, frequency, and DC bias current. Therefore, the loss value measured by the measurement method using the sinusoidal current in this document does not necessarily match the inductor loss of the DC-to-DC converter, even if the same effective current is used. The measurement results are described in Annex A.

In the future, a separate standard defining the triangular current drive testing can be developed for publication.

1 Scope

This part of IEC 62024 specifies test methods for AC losses of high-frequency inductive components for power supplies used in DC-to-DC converters and similar devices at currents close to actual operation and introduces the measurement principle, scope of application and matters to be noted for each method. This document is applicable to leaded and surface mount inductors with dimensions in accordance with IEC 62024-2.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

4 Select measuring method

This document covers two methods for measuring AC losses of inductors at high currents: the digitizing method using cross-power spectrum calculation, herein referred to as the cross-power method, which is suitable for low frequencies, and the amplified vector network analyzer method, using S-parameter which is suitable for high frequencies.

Table 1 shows the frequency range and impedance range for each measurement method. The recommended connection method for the amplified network analyzer method varies depending on the impedance range to be measured.

Table 1 – AC loss measuring method

Measuring method	Connection method	Frequency range	Impedance range
Cross-power method	-	10 kHz to 10 MHz	0,1 Ω to 10 kΩ
Amplified vector network analyzer method	Shunt through	100 kHz to 200 MHz	1 Ω to 100 Ω
	Series through	100 kHz to 200 MHz	10 Ω to 10 kΩ

5 Cross-power method

5.1 General

The cross-power method is one of the multiplying methods. By sampling and detecting voltage and current signals, performing FFT (Fast Fourier Transform) processing and calculating, it is possible to measure the inductor loss accurately, including harmonic components generated by the inductor nonlinearity. The cross-power method conforms to IEC 62044-3.