ISCE

The Institute of Sound and Communications Engineers

Engineering Note 4.4

Methods of measurement for loudspeaker line transformers

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DISCLAIMER

Methods of measurement for loudspeaker line transformers

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These methods are not in a standard yet, but may be in the future.

Measurements, except where stated, are made with the transformer loaded with a (low inductance) resistive load of the rated value, and in the highest power transfer condition if there are 'power' tappings.

Insertion loss

Apply rated line voltage V_r at 1 kHz to the primary winding, with no load on the secondary winding. Measure the secondary voltage V_a. Then connect the load resistor R to the secondary winding, readjust the input to rated line voltage if necessary and measure the secondary voltage V_b again. Express the insertion loss in decibels, $20 \lg(V_a/V_b)$.

NOTES

1. With no load, the transformer losses are normally very low at 1 kHz: the on-load copper loss is much greater than the iron loss.
2. The power delivered to the load resistor is Vb^2/R. From Note 1, the power input to the transformer is (very nearly) Va^2/R, and this latter value can be compared with the rated value.

Effective frequency range

a) Low frequency end: Apply rated line voltage at 1 kHz and measure the input current (as voltage across a known low-value resistor in series if no suitable ammeter is available). Reduce the frequency until the current has risen by 11% (1 dB). Note the frequency as the low-frequency limit of the effective frequency range.

NOTES

1. This criterion for the low-frequency limit corresponds to typically 1% third-harmonic distortion due to core saturation.
2. The reason for measuring the low limit of the effective frequency range on-load is that it allows for the reduction of magnetic induction due to the voltage drop across the primary resistance.

b) High-frequency end: Apply rated line voltage at 1 kHz and measure the secondary voltage. Increase the frequency until the secondary voltage falls by 3 dB. Note the frequency as the high-frequency limit of the effective frequency range.

Input impedance at surveillance frequencies:

a) Input impedance at 30 Hz: Apply one twentieth of rated line voltage at 30 Hz to the primary winding with the load resistance connected to the secondary. Measure the input current I_p and calculate the (modulus of the) input impedance $Z_{30} = V_r/20I_p$.

b) Input impedance at 20 kHz: Apply one twentieth of rated line voltage at 20 kHz to the primary winding, with the secondary connected to the rated load resistance R in series with an inductor of value R/8 mH. Measure the input current Ip and calculate the (modulus of the) input impedance $Z_{20k} = V_r/20I_p$.

NOTE - The inductance R/8 mH is an average value for the loudspeakers generally used. If the transformer is designed for use with a specified loudspeaker(s) , then the actual value of voice-coil inductance may be used, provided this is noted with the results.

Test jig

If transformers have to be measured as a regular activity or in quantity, it's worth making a simple jig, which can be built into a small plastic or metal box. This saves a lot of time otherwise spent in making sure that all the connections are correct.

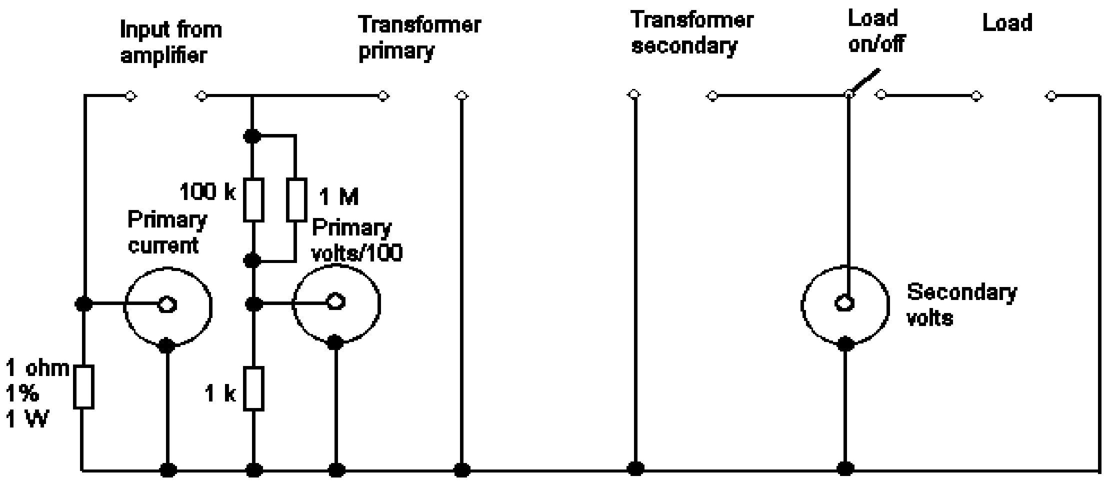

Figure 1 – Test Jig