WIDE-BAND CURRENT TRANSDUCERS USING COMMON MODE FILTER CHOKES

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Introduction

- Wide band target:**
- Low frequency: high flux, high μ_r
 - High frequency: propagation in the winding
- Nanocrystalline material
 - By chance possible to use common mode chokes

Electrical properties given by the manufacturer

Properties	Test conditions		Value	Unit	Tol.
Inductance	10 kHz/ 0.1 mA	L	2x 3.0	mH	+50%/-30%
Rated current	@ 70°C	I _R	26.0	A	max.
DC Resistance	@ 20°C	R _{DC}	2x 4.5	mΩ	max.
Rated voltage	50 Hz	U _R	250	V (AC)	max.
Insulation test voltage	50 Hz/ 5 mA/ 2 sec.	U _T	1500	V (AC)	

Common mode choke

Principle scheme

Manufacturer data of insertion loss with a 50 ohm load

TF using the transmission line model

$$Z(f) = \frac{1}{\frac{1}{360 \Omega \tanh\left(\frac{j f \frac{\pi}{2}}{f_r}\right) + \frac{1}{2800 \Omega}} + 0.006 \Omega}$$

Model for the resonance of leakage inductance

Operation limits

Saturation, shunt temperature, eddy current

Transfer using 10 times higher shunt resistance

Real design goes to lower freq.

PCB Lay -out

Conclusions

- Strong points:**
- Wide band: from 0,5Hz up to 50 MHz is possible, **ratio 10⁸**;
 - Low phase shift in a wide frequency range.
 - Known limits of operation.
 - High current capability
 - Single pulse operation is possible
- Weak points::**
- No DC output, saturation at 2.2A DC at input;
 - Saturates early at low frequency
 - Low output voltage level