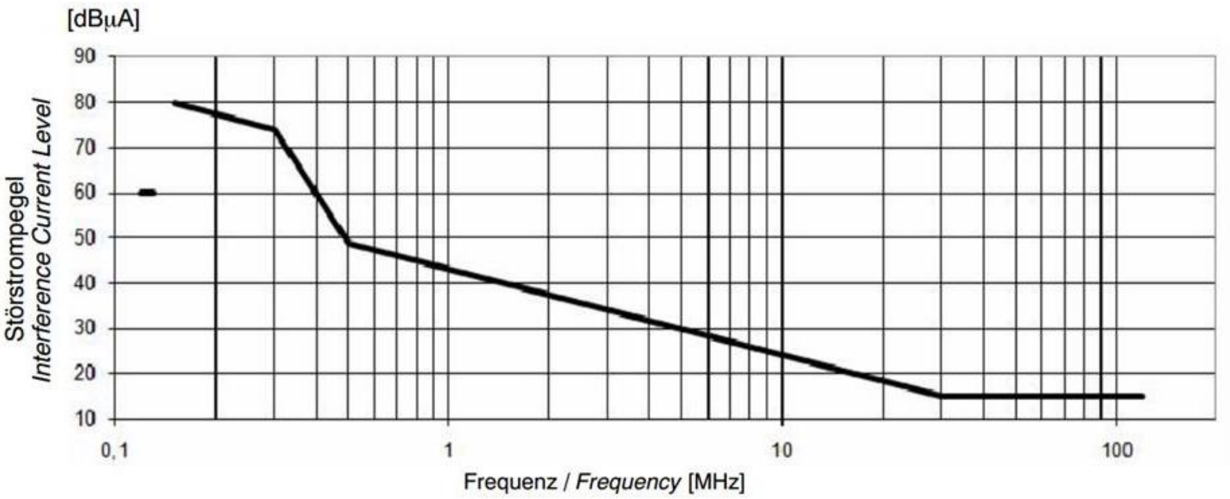
1. Introduction

RF current probes can be embedded into EMCview, using a suitable correction / conversion file. This application note elaborates the simple mathematical procedure to convert RF current probe characteristics, typically specified as transfer impedance in dBΩ or transducer factor in db(1/Ω) into a suitable correction file for EMCview.

RF current probe noise measurement specification in dBµA

Following example curve shows conducted noise limits for measurements with RF current probes. The limits are given in dBµA.



The limits are given in dBµA, whereas EMCview software extracts measurement values from spectrum analyzers in dBµV. Thus we need to convert from dBµV into dBµA.

Using Ohm´s law: $I=U/R$

Applying logarithm to both sides of the equation: $\log(I) = \log(U/R)$

…subsequently application of logarithmic laws :

$$\log(I) = \log(U/R) = \log(U) - \log(R)$$

convert Ω into dB(Ω): $dB(\Omega) = 20\log(Z)$

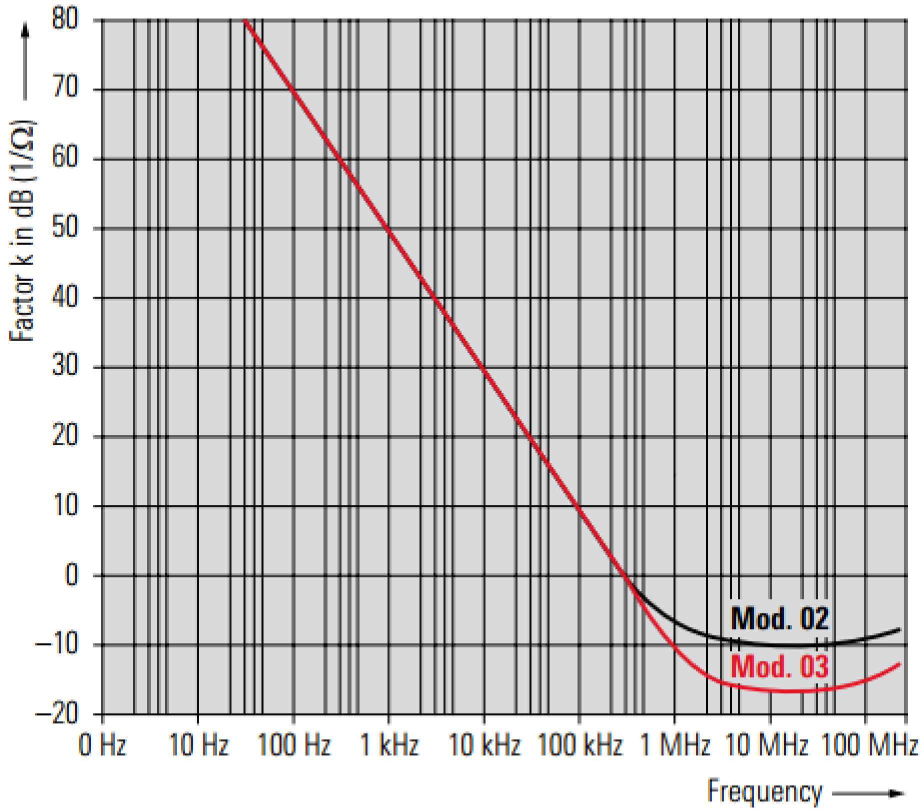
we obtain Ohm´s in dB-format:

$$dB\mu A = dB\mu V - 20\log(Z)$$

extract dBµV:

$$dB\mu V = dB\mu A + 20\log(Z)$$

If we take a look at the RF current clamps of R&S, model EZ-17, we see that we don´t even need to convert into dB(Ω). We can extract the transducer factor, means the reciprocal value of the transfer impedance directly from the curve:



Transducer factor of the R&S EZ-17 models

Transfer impedance Z_T		
In range with constant transducer factor	3.16 Ω	7.1 Ω
Transducer factor k[1] in range with flat frequency response	–10 dB (1/Ω)	–17 dB (1/Ω)

[1] The manual contains a table specifying the transducer factor from 20 Hz to 200 MHz. The transducer factor k is calculated as $k = 20 \log (1/Z_T)$, where Z_T is the transfer impedance.

According to logarithmic laws log(1/z) = -log(z), means we take the values from the curve and enter it into the LISN correction file with inverted sign.

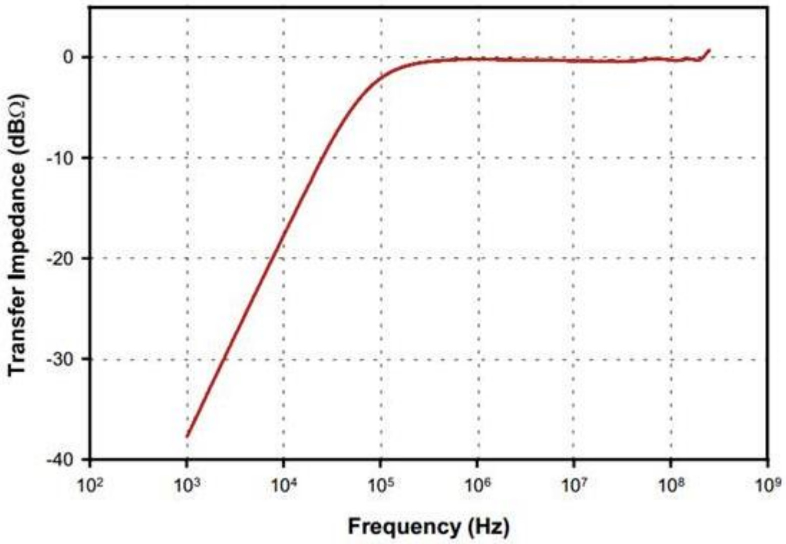
Correction coefficients for model 02

Frequency	Correction coefficient [dB]
30Hz	-80dB
100Hz	-70dB
1kHz	-50dB
10kHz	-30dB
100kHz	-10dB
1MHz	6dB
10MHz	10dB
100MHz	9dB

Correction coefficients for model 03

Frequency	Correction coefficient [dB]
30Hz	-80dB
100Hz	-70dB
1kHz	-50dB
10kHz	-30dB
100kHz	-10dB
1MHz	10dB
10MHz	16dB
100MHz	15dB

In the case of a Fisher current probe, the transfer impedance is also already specified as logarithmic values:



Specifications

Frequency:	1 kHz – 250 MHz
Internal diameter:	32 mm
External diameter:	71 mm
Height:	19 mm
$Z_t\Omega$[1]:	1
dBΩ[1]:	0
Connector:	Type-N
DC to 400 Hz:	100 amperes
RF(CW):	2 amperes
Peak Pulse Current[2]:	50 amperes

1: Probe calibrated with 50 Ω + j0Ω Load Impedance.
2: Depends upon the pulse width and pulse rep. rate.

Assuming that we use the above Fisher Probe and assuming that the spectrum analyzer measures a value of 40dBµV at 1MHz:

From the Fisher data sheet we extract a transfer impedance of approximately -38dB(Ohm) at 1kHz
Under application of dBµA = dBµV - 20log(Z):

➔ 40dBµV – (-38dBOhm) = 78dBµA which means that the measured value of 40dBµV corresponds with a current of 78dBµA

Assuming that we measure 25dBµV at 1MHz, we derive a transfer impedance of 0dB(Ohm) from the curve.

➔ 25dBµV-0dBOhm = 25dBµA

Using EMCview software we would take a „LISN" file and simply entert he values oft he transfer impedance curve:

Frequency	Correction coefficient [dB]
1kHz	-38dB
10kHz	-18dB
100kHz	-3dB

1MHz	0dB
10MHz	0dB
100MHz	0dB

The values shown by EMCview can then be considered being dBµA.

Version	Date	Author	Changes
V 1.0	20.04.2017	Mayerhofer	Creation of the document