NSA chamber validation measurements below 30 MHz using loop antennas

Martin Wiles BSc, MSc, MBA

Albatross Projects GmbH,
Daimlerstrasse 17,
89564 Nattheim, Germany.
M.Wiles@albatross-projects.com

F-W. Trautnitz

Albatross Projects GmbH,
Daimlerstrasse 17,
89564 Nattheim, Germany.
F-W.Trautnitz@albatross-projects.com

Dr. Alexander Kriz

Seibersdorf Laboratories,
Seibersdorf, Austria.
alexander.kriz@seibersdorf-laboratories.at

***Abstract*— In CISPR 16-1-4 [1], an extension of the chapter on the suitability of EMC test sites from 9 kHz to 30 MHz is being prepared. This work is progressing towards a (Committee Draft for Vote) [2]. An international standard is currently forecast for publication in 2021.**

Keywords—NSA, Loop Antenna ; Chamber Validation

I. INTRODUCTION

As part of the work of the German VDE Standard Working Group and the CISPR Ad Hoc Group 1 many measurements have been taken in recent years including a RRT (Round Robin Test) [3] as well as further studies on coupling effects in the test setup were undertaken [4].

In addition, the Normalized Site Attenuation (NSA) was compared at different measurement distances from 3 to 10 m, with loop antennas, see fig.1, (diameter: 60 cm and 30 cm) and then also compared to the NSA measured values from the RRT that had used 50 cm loop antennas, and recorded at the same test site at a distance of 10 m. The 60cm loop antennas have since become the preferred antenna for this measurement for reason explained later in this pape.

It will be shown that the required measuring accuracy for the chamber validation is guaranteed using most of the available chamber technology. In particular, these measurements have shown that the NSA criteria cannot be met beyond the test distance of 7m. This has already been taken into account in the measurement uncertainty text of the draft standard. Note that in the interlaboratory comparisons [3], the acceptance criterion on an OATS (Open Area Test Site) can be met in a distance of 10 m.

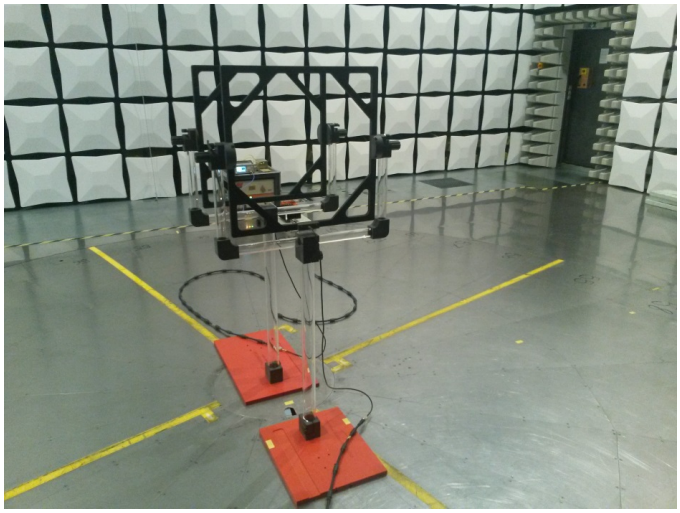

Fig 1. 60cm magnetic loops

II. METROLOGICAL INVESTIGATIONS AND MEASUREMENT OF THE NSA FROM 9 KHZ TO 30 MHZ

Before starting the NSA measurements a detailed investigation of the test equipment configuration was carried out.

As was seen already from the previous measurements in the context of the interlaboratory comparisons, several effects were observed including the coupling effects between antennas, coupling via cable shielding, depending on the contacting of the shielding of transmitting and receiving cables on the shielding, as well as the grounding of the test equipment can produce larger NSA deviation. These factors were analyzed by different measuring configurations, ground connections up to the complete electrical isolation of the transmitting and receiving measurement systems. More information about the influence of ground loops can be found in [5].

The 60 and 30 cm loop antennas used were supplied by Seibersdorf Labor GmbH. The measurements were carried out according to the current draft method [2] with the NSA measured in three orientations Hx, Hy, and Hz as shown in in fig. 2(a), (b), (c).

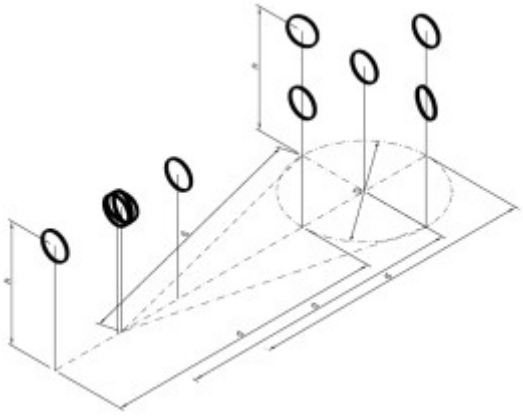

Fig. 2a: Orientations Hx

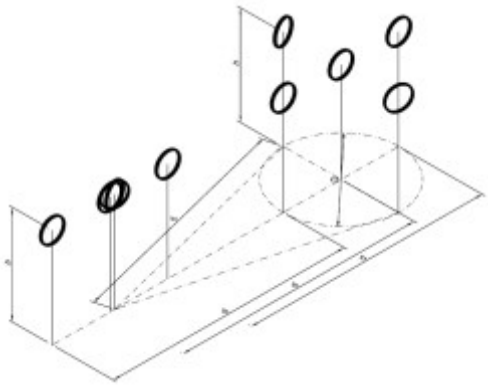

Fig. 2b: Orientations Hy

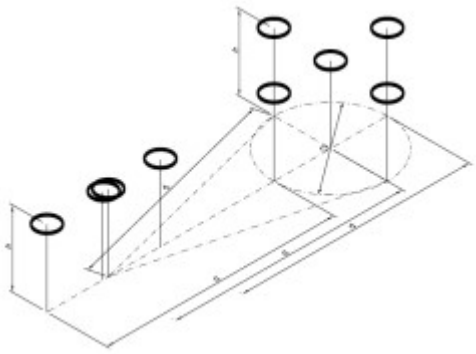

Fig. 2c: Orientations Hz

1) Measurement of NSA at measurement distances of 3 m to 10 m with 2 different loop antennas in the orientations Hx, Hy, and Hz

The first set of NSA measurements were carried out at test distances from 3 to 10 m in increments of 1 m in the orientations Hx, Hy, and Hz. As shown in Figures 3 to 5 with 60 cm loop antennas.

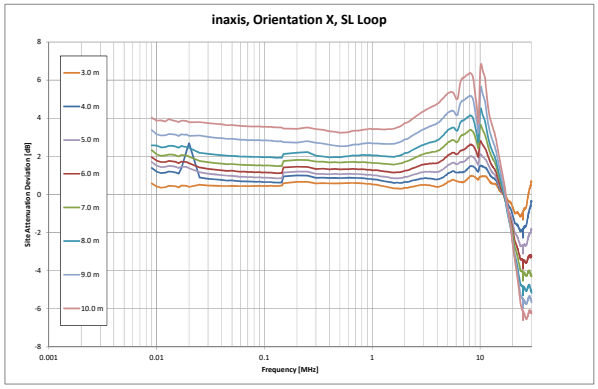

Fig. 3: NSA measurement (Hx), 3 to 10m test distance, 60cm loop.

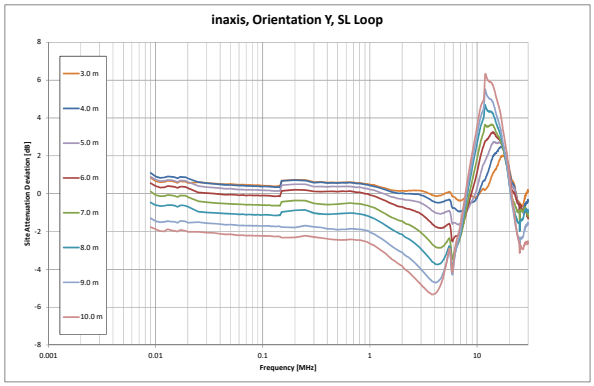

Fig. 4: NSA measurement (Hy), 3 to 10m test distance, 60cm loop.

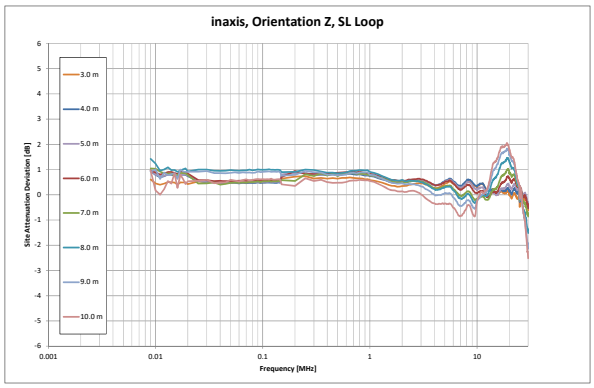

Fig 5: NSA measurement (Hz), 3 to 10m test distance, 60cm loop.

Figures 6 to 8 show the second set of measurements now for the 30cm loop antennas.

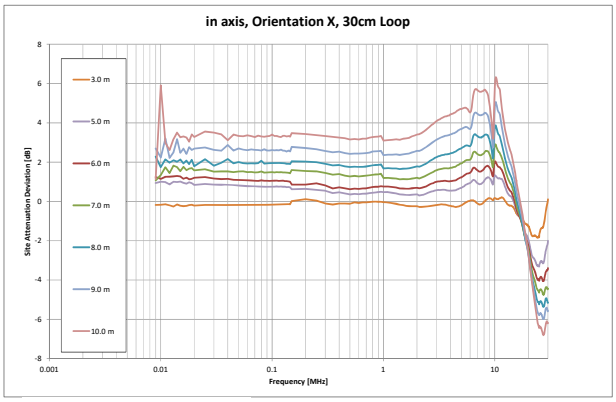

Fig. 6: NSA measurement (Hx), 3 to 10m test distance, 30cm loop.

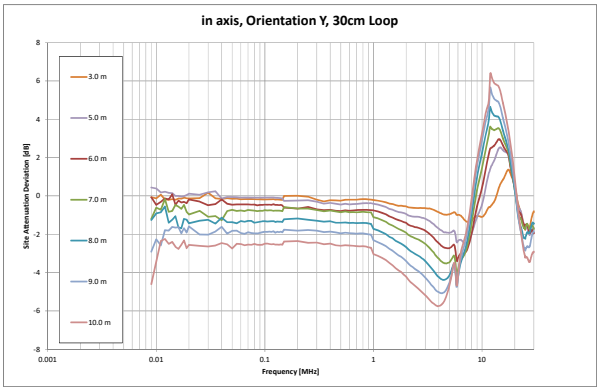

Fig.7: NSA measurement (Hy), 3- 10m (excl.4m) test distance, 30cm loop.

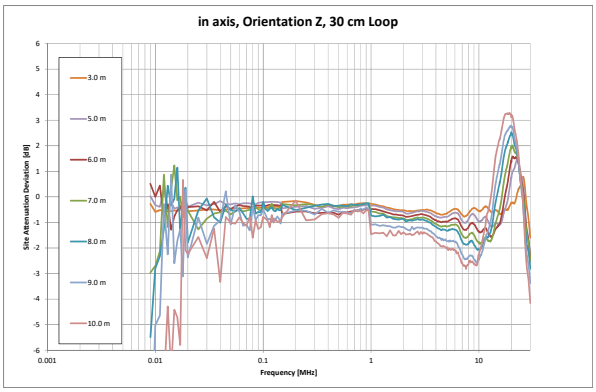

Fig. 8: NSA measurement (Hz), 3- 10m (excl.4m) test distance, 30cm loop.

From these results it is evident that the 30cm loop antennas exhibit greater deviations in measurements below 100 kHz. This is attributed to a number of factors starting with the higher antenna factor for these 30cm loops which with the limited dynamic range of the test equipment puts the measurement in to the noise. Comparing the measurements between the two different size loops, it is observed that in the Hx and Hy orientations the results show deviations of about 1.0dB at short test distances, and with increasing test distance the influence drops to about 0.5dB. In contrast the deviation is constantly about 1.0dB for the Hz orientation.

III. Conclusion

The new proposed chamber validation method in CISPR 16-1-4 for the frequency range 9 KHz-30 MHz was performed in a chamber at several test distances, with 2 different loop antennas and the results of the have been discussed here.

It has been shown that the required measuring accuracy for the validation of the site can be guaranteed with available technology. However, the investigations regarding the measuring distance have shown that it is not possible to comply with the NSA acceptance criterion at a test distance greater than about 7 m. This has been taken into account in the draft standard.

Acknowledgment

Dipl.-Ing. (Univ.) Jochen Riedelsheimer, Albatross Projects GmbH and Dipl.-Ing. Ronald, Svadlenka, SLG Prüf- und Zertifizierungs GmbH.

References

[1] CISPR 16-1-4 Ed 4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements. 2019.

[2] CISPR A 1299 CD. CISPR 16-1-4 am1 f2 Ed. 4.0: “site validation below 30 MHz”. June 2019.

[3] Trautnitz, F.-W., Riedelsheimer, J.: Erstellung eines Validierungsverfahrens für EMV Messplätze im Frequenzbereich von 9 kHz – 30 MHz mit Magnetfeldantennen, EMV Düsseldorf 2014.

[4] Trautnitz, F.-W., Riedelsheimer, J.: Validierung von Störfeldstärke – Messplätzen im Frequenzbereich von 9 kHz – 30 MHz mit Rahmenantennen, EMV Düsseldorf 2016.

[5] Kriz.A. “Ground Loops during Site validation of anechoic rooms”, IEEE EMC & SI Long Beach, 2018.

[6] ANSI C63.4-2014 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. 2014.