EMCO ELEKTRONIK GMBH
news special
Sonderausgabe 05-2023

kapteos

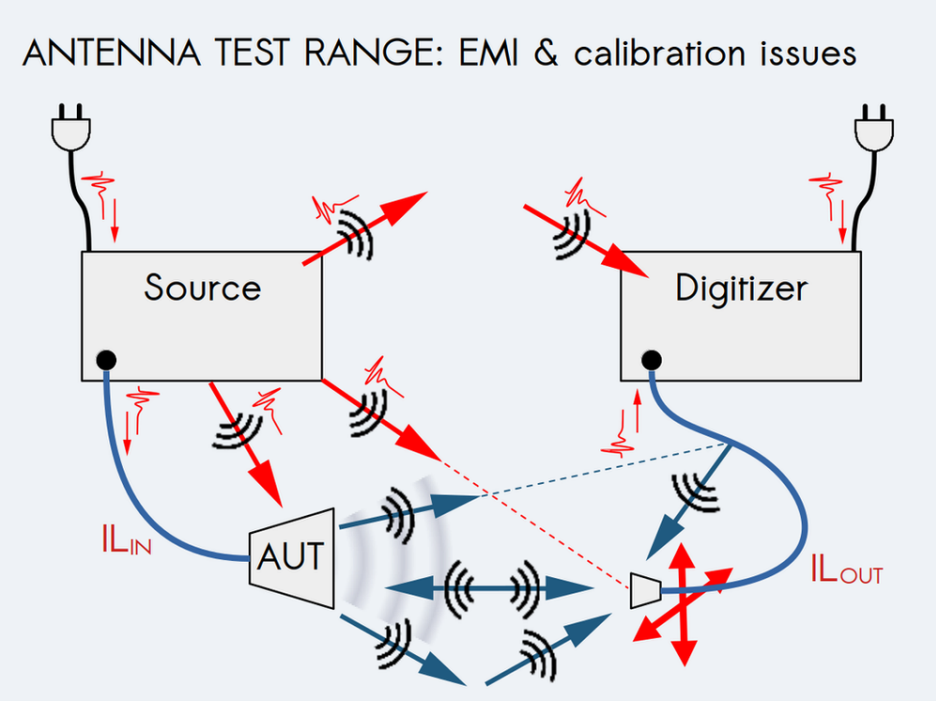
Antenna Testing: EMI Issue !

When dealing with antenna testing, besides calibration issue, ElectroMagnetic Interference (EMI) constitutes a classical problem!

Antenna Testing Issue

When dealing with antenna testing, ElectroMagnetic Interference (EMI) constitutes a classical issue that limits the measurement accuracy when it doesn't prevent making measurement. Identifying the source of EMI remains a challenge and solving EMI issue is generally tricky, time-consuming and costly. Under the heading EMI we consider:

o conducted and radiated interferences uncorrelated with the useful signal (e.g. disturbances of the electric grid, electric transients link to switch activation, motherboard clock signal...),
o directly coupled useful signal via unwanted conducted and radiated paths (represented in blue in the figure where AUT means Antenna Under Test).



Uncorrelated EMI

Uncorrelated EMI can be classified in two types:

o electrical transients, especially detrimental in the time-domain

o narrow peaks (e. g. 10-MHz synchronization frequency of RF apparatuses) in the signal spectrum which are usually detrimental only in the frequency domain.

Correlated EMI

Magnitude of correlated EMI varies accordingly to the signal strength. However, this correlation concerns only the magnitude: unwanted coupled signal is generally extremely environment-dependent and is not phase-locked to the signal. Consequently the coupling factor is unstable and changes continuously: at first order, an unwanted coupled signal can be seen as a noise source which magnitude is driven by the useful signal strength.

Calibration Issue

Antenna testing requires also the use of RF cables with at least one moving RF cable during antenna testing (see RF cables in Fig. above with their insertion losses given by ILIN and ILOUT). Due to their high insertion loss and dispersion, time-consuming calibrations are required and the higher the frequency, the higher the calibration issue. For example, a 10m long high-end RF cable SHF4M presents huge insertion loss (20.5 dB) and a very poor phase stability (given to be only better than 720°) @ 40 GHz!

Replacing the reference classical receiving antenna by an optical receiving antenna

One solution to overcome both EMI and calibration issue for antenna testing consists in substituting the classical metallic receiving antenna by a full dielectric optical receiving antenna (see Fig. opposite).

Using an optical receiving antenna permits:
o to carry out antenna testing in the near-field, at a distance as short as ~ λ from the AUT,
o to suppress calibration issue as seen in table below,
o to assess EMI contribution as an optical receiving antenna can be remotely switched ON and OFF while letting the same the whole experimental setup.

The comparative analysis of the experimental setups represented in the two figures above leads to the table below:

BENCHMARK OF EMI & CALIBRATION ISSUES

	Classical metallic antenna	Optical antenna
EMI issue	+ EMI for RF link btw antenna & digitizer	+ EMI for OE converter
Calibration Issue (unwanted parasitic Reflections)	+ unwanted & cable-position-dependent parasitic reflections for RF link btw antenna & digitizer + much bigger contributions of unwanted parasitic reflections on ATR walls (> x 4) & on receiving antenna (> x100)	
Insertion losses	For a 10m RF link SHF4M IL_{OUT} = 8.9 → 20.5 dB @ 8 → 40 GHz	IL_{OUT} << 0.01 dB
Phase Stability	$\delta\varphi < 18\ f_{GHz}$ degree (720° @ 40 GHz!)	$\delta\varphi$ [°] = 0,02 f_{GHz} (0.8° @ 40 GHz!)

As compared to classical antennas, optical receiving antennas permit to reduce so much unwanted parasitic reflections that there is no more absolute requirement to use an anechoic chamber for antenna testing! Moreover, the issue concerning RF cables insertion loss and dispersion disappears instantaneously.

EMI assessment using an optical antenna

With an optical receiving antenna, the whole experimental setup can be kept functional and in the same state, except the switching OFF of the optical receiving antenna. Indeed, switching ON or OFF the laser that feeds the optical receiving antenna permits to remotely switch ON or OFF the optical receiving antenna at any time. When laser is OFF, except EMI contributions carried by the probe laser beam itself, all other EMI contributions are still active. It could be shown that these latter contributions are negligible. Therefore, the signals recorded with laser ON and OFF correspond to the useful signal radiated by the AUT with all EMI contributions, and the EMI contributions only, respectively.

Conclusion

Using an optical receiving antenna brings a great benefit for the precise assessment of the measurement accuracy. Comparatively to classical metallic antenna, optical receiving antennas allow a straightforward evaluation of the EMI contribution to the signal delivered by the antenna and, therefore, gives a practical tool to assess in real time the impact linked to the implementation of means of improvement to reduce EMI issue. Lastly, optical receiving antenna allows a near field antenna testing at a distance of and waives the absolute requirement to use an anechoic chamber for antenna testing.

LEARN MORE

Die EMCO Elektronik GmbH ist Ihr lokaler Ansprechpartner für die Produkte aus dem Hause Kapteos in Deutschland, Österreich und der Schweiz.
Gerne stehen wir Ihnen als kompetenter Ansprechpartner zur Verfügung.
Wir freuen uns auf Ihre Anfrage!

Ihr Partner für EMV und HF:

EMCO Elektronik GmbH
Tel.: 089 89 55 65-0
Fax: 089 89 59 65-10
Email: info@emco-elektronik.de
Web: www.emco-elektronik.de