Shielding Effectiveness Troubleshooting

Shielding Effectiveness (SE) test is requested to be regularly done to guarantee MRI apparatuses can operate at their best having thus the highest I/Q they are able to provide. Therefore, certificates, which attest that every single aspect of SE matches or overcomes requirements, are made by means of RF instrumentation.

However, certificates can only witness whether SE is adequate or not and when SE is not sufficient then actions must be taken in order to resume SE to the initial satisfactorily conditions. Most times, regular well-done preventive maintenance is enough to guarantee the requested SE. However, sometimes maintenance is not effective, resulting thus in a poor SE. In such a case, of course, the failure must be fixed. Nonetheless, before fixing the problem, the origin of it must be found.

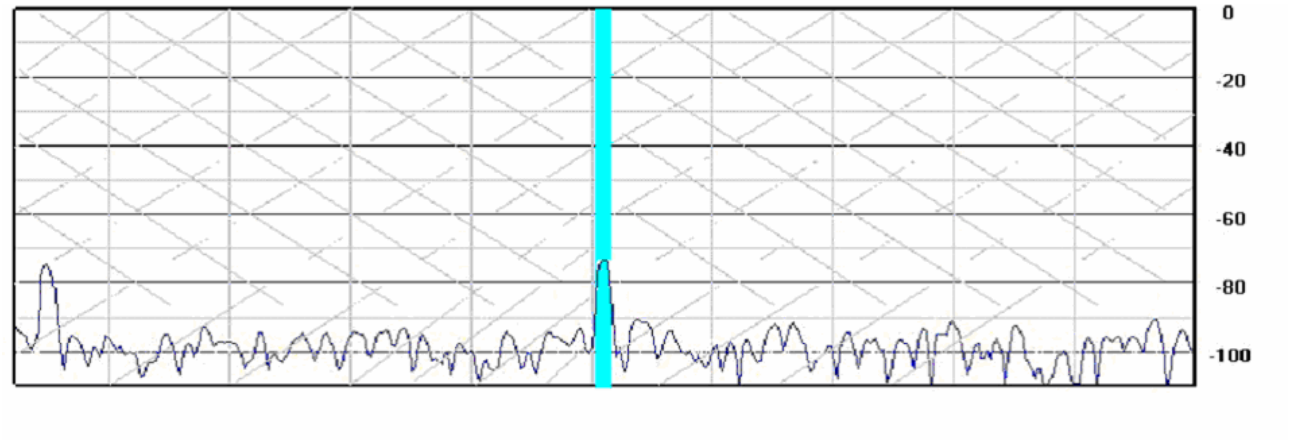
The process of finding the cause of a poor performance, namely a leak, is called Troubleshooting. Similarly to SE measurement, troubleshooting can be conducted using either standard RF general purpose equipments or specific SE instrumentations.

SE Troubleshooting using RF generators and spectrum analyzers

It is very rampant the concept that a general purpose spectrum analyzer, along with a RF generator, is the best way for this kind of troubleshooting. Definitely, it is the technique which has been used since ever for seeing RF signals and therefore also leakages coming out for shielded rooms. But, is it really the best and more effective way for troubleshooting? Let us analyze the situation more in detail.

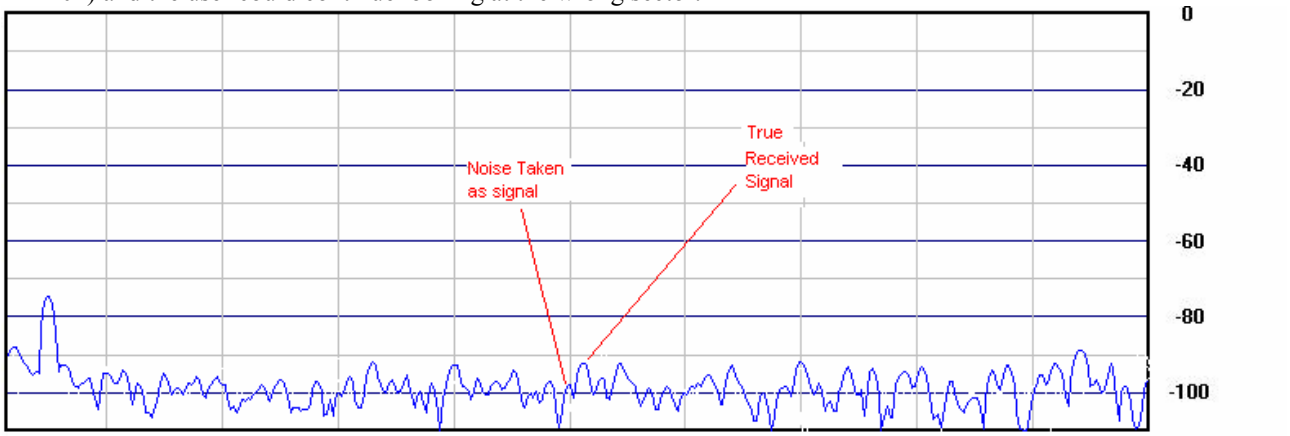
A spectrum analyzer shows a frequency-domain view of the restricted world the user is looking at. The depicted picture depends on settings as well as performances of the setup. Thus, a lot of moving signals can be seen on its screen. Indeed, in addition to the generated signal also noise and other spurious ones are present.

This “panoramic” view of signals, leads the user to think that much more information are present than only looking at one frequency. Instead, as only one known tone is generated by the user, most signals are useless. More precisely, the almost totality of information is ineffective as all frequencies refer to unknown signals. Among all only one is significant: the generated signal. Here below there is an example where a spectrum is shown. It clearly shows that only the colored sector is the important part as all the remaining, more than 99%, is just a waste.



But the picture could be even worse as for the following picture where the signal is lower and the user can be misled thinking the signal is a spur, as many others present, and taking noise instead. As shown here below the error would result in an overestimation of about 10dB. Moreover, there might have been a thermal drift in the meantime (see

EE1201) and the user could continue looking at the wrong sector.



As a consequence, not only does not a spectrum analyzer add any useful information but it can even adversely affect the measurement as the user might be distracted from the real signal or, even worse, misled. And this comes very true when the user is not RF experienced.

The second aspect which does not make a spectrum analyzer particularly good for troubleshooting, compared to a specific instrument, is when it is used for locating a leak. Typically, to locate the exact place where the leak is, the user sweeps the sensor, normally made of a "small loop antenna" thanks to its good directivity, around weak points such as doors or windows just to mention some. Then, while moving the antenna, the user has to look at the screen of the spectrum analyzer and see when and where the level of generated signal is too high. Operation that is not easy as the sweep, when the sensitivity is high the RBW must be narrow (see EE1201), takes time. During this time the antenna cannot be moved otherwise some spot, perhaps the leaking one, can be missed. As a result, the user must continuously look at the screen while the spectrum analyzer sweeps making sure the antenna is not moved. Conversely, if the user looks at the antenna, to make sure it does not skip any spot, the peak in the spectrum may be left unnoticed.

SE Troubleshooting using the SEMS

As mentioned above, troubleshooting is a very important aspect of SE and it can be time demanding. Keeping this in mind, as the SEMS has been designed specifically for SE measurements, some additional function has been also included. Thus, a special feature called "Sniff" has been added with the purpose to speed up, but mainly to ease, the troubleshooting.

Indeed, based on the policy to discard all unneeded and disturbing signals, the SEMS just displays the only worthy signal so that the user is not distracted by anything else. Thus, only one "live" figure is displayed, along with its minimum and maximum value recorded since last clear, so that the user can easily see whether an insufficient attenuation, namely a leak, is present with no possibility to get a wrong number. And in spite of the fact the SEMS uses a very narrow RBW in order to have a very good sensitivity, it is still very fast allowing the user to move the small loop antenna without particular caution.

Furthermore, the SEMS adds another feature which facilitates even more locating leaks. Indeed, an audible warning is available and when the attenuation is worse than a configurable threshold, the buzzer warns the user that in that spot the shielding is poor. The advantage of this feature is very valuable as the user does not even have to look at the display and can fully concentrate on antenna location. Therefore, the user just moves the antenna around the weak points and listens to the SEMS until the buzzer is heard: then the leak is located. Easy, fast and error-free.

Conclusion

In spite of the belief that a General Purpose Spectrum Analyzer, thanks to its broad view or panoramic view, is the best troubleshooting tools for SE, the reality is that the majority of information is worthless as signals do not belong to any known source. Moreover, particular care and skill must be used to avoid pitfalls.

The SEMS instead, thanks to the fact it has been conceived for SE measurements, includes a specific mode for troubleshooting which makes it amazingly easy even for inexperienced personnel and, despite its better than 100dB SE dynamic range, it is much faster than any standard Spectrum Analyzer.