Minimum-Signal Measurement Problems

Dear Editor,

I am conducting some experiments on the ambient effects of UWB signals. With reference to the reports written by Millitech, "Overview of Calculating System MDS," the MDS [*Minimum Discernible Signal, or noise floor*] for 1 MHz bandwidth at a temperature of 293K, is –114 dBm. However, the results obtained from my experiments show an even lower signal. I would like to know the reasons for this phenomenon assuming my experiments are conducted correctly. Could it be possible to detect signals below the MDS in a shielded room? I have attached the results and the setup. Thanks.

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From Quan Lun's notes—Figure 1 is the setup used to calibrate the signal level measurement at frequencies corresponding to major radio services from approximately 1.5 GHz to 10 GHz. A correction factor was derived for each frequency that represents the sum of losses and gains in the filter, two LNAs, variable attenuator (minimum setting) and cables—plus the gain of the antenna used for measurements, which is not included in the calibration chain of Figure 1.

Table 1 summarizes the results, and includes the reference level measured at "A" in Fig. 1, the measured level through the chain (at "B" in Fig. 1), the antenna gain at each frequency and the correction factor. These are followed by the measured MDS level in the shielded room, and the equivalent MDS after applying the correction factor.

Our Experts' Evaluation

Among our experts, the chief concern was the use of an antenna in a shielded room. Reflections from the walls of a shielded room will increase the received signal levels. Unfortunately, the complex reflection patterns from the metallic walls make the behavior unpredictable. This is consistent with the random variations seen in measured MDS. The differences between the measured values and the –114 dBm theoretical MDS range from 2.8 to 6.6 dB.

The space inside the shielded room is nothing like the isotropic reference used for antenna gain. The best way to get accurate results is to make the measurements in an anechoic chamber. A calibrated open air test site (OATS) may also be used, if available at a nearby EMC test facility.

Another suggestion was for calibration that includes the antenna, mainly if high precision is important. To do this, a signal of known power is delivered to a standard-gain antenna, received and measured. Then this calibration source is removed and the device under test placed in the same location.

Frequency (GHz)	Reference Level at "A" (dBm)	Measured Level at "B" (dBm)	Total Gain (dB)	Antenna Gain (dB)	Correction Factor (dB)	MDS (dBm) Uncorrected	MDS (dBm) Corrected*
1.565	–55.22	–7.66	47.56	8.2	55.76	–60.31	–116.8
1.735	–54.68	–8.46	46.22	8.5	54.72	–65.39	–121.2
1.830	–55.98	–9.23	46.75	8.6	55.35	–63.88	–120.1
1.973	–56.33	–9.44	46.89	8.7	55.59	–64.04	–120.2
2.163	–56.81	–10.01	46.80	8.8	55.60	–64.80	–119.8
2.305	–56.13	–10.66	45.47	9.0	54.47	–65.44	–121.2
4.205	–57.68	–11.98	45.70	9.8	55.50	–65.52	–121.0
5.105	–57.81	–11.56	46.25	10.2	56.45	–65.03	–120.6
8.005	–58.03	–12.16	45.87	10.7	56.57	–65.28	–122.6
10.005	–58.66	–12.69	45.97	11.7	57.67	–61.74	–119.9

*MDS measurements used a slightly different correction factor determined at time of measurement

Table 1. Summary of signal level measurements and calculated results.

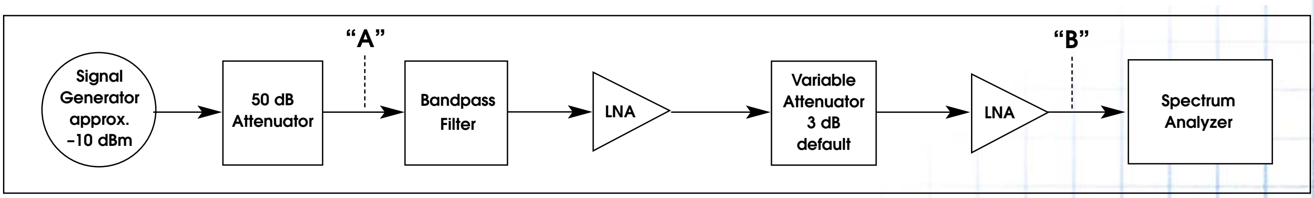

Figure 1. Signal level calibration setup.