RF Marking Principle for Making MIL-STD Shielded Enclosure Measurements

MICHAEL J. BLEFKO
Antenna Research Associates*

INTRODUCTION

This article describes the RF marking principle and its applicability to shielded enclosure measurements. An antenna analyzer which employs the RF marking principle is described as it applies to shielded enclosures. The utility of the marking principle lies in the ability of the user to perform measurements of relative amplitude and phase of an RF signal with power levels as low as -120 dBm. Due to the relatively small physical size of the marking device, very small enclosures can be measured for compliance with the standard.

A measurement technique for amplitude and phase reduces the complexity of equipment required for MIL-STD measurements.

RF MARKING PRINCIPLE

The RF marking principle is a measurement technique which captures for analysis the amplitude and phase information encoded on the lower sideband of the test frequency. The antenna analyzer, which is based on a vectorial receiver design, marks the main carrier and extracts extremely low levels of amplitude and phase information from the RF signal (Figure 1). The frequency gap between the main carrier and the sideband is small enough to assume that the amplitude and phase variations due to the test are identical for both the main carrier and the sideband. A double-down conversion from the RF frequency range is performed within the analyzer. Two selectable (50 Hz or 5 Hz) extremely narrowband filters comprise the final stage of the analyzer processing unit. These filters extract the amplitude and phase information and the result is displayed.

This measurement arrangement is different from more traditional techniques in that it allows the user to apply the marking at a physical point on the receiving device. For shielded enclosures, marking the receiving antenna is possible using a physically small (inches) wideband marking device connected between the receiving antenna output and the analyzer input. Unlike the arrangement in MIL-STDs, in which an antenna, an attenuator, and a receiver need to be placed inside the enclosure for an accurate measurement, only the receiving antenna and the wideband marking device are required to be inside the enclosure to use the marking principle.

MIL-STD TESTING OF SHIELDED ENCLOSURES

To measure shielded enclosures with insulation greater than 80 dB, an RF signal from an external generator is fed through the antenna analyzer and then applied to a radial transmitting antenna such as a whip. For this case the attenuator in line is set to 0 dB. The transmitted signal is received by a second radial which has the RF marking probe in line. The level on the analyzer is

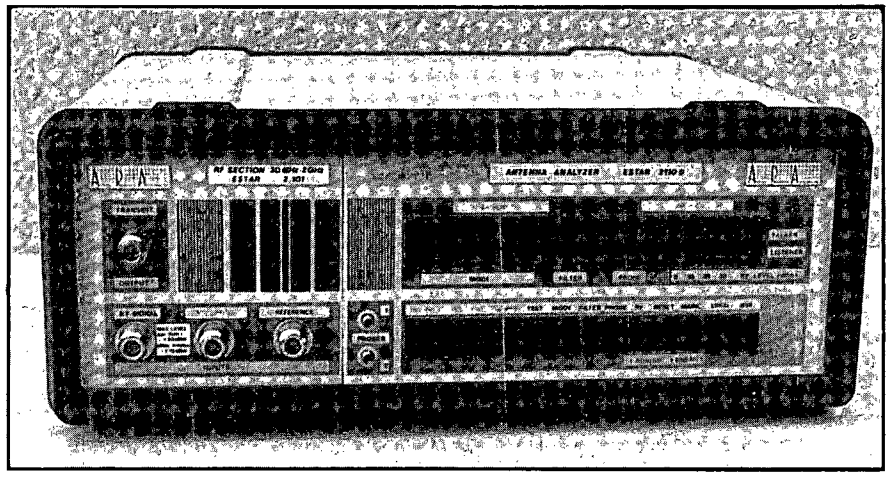

Figure 1. *Antenna Analyzer.*

*See Advertisement on Page 279.

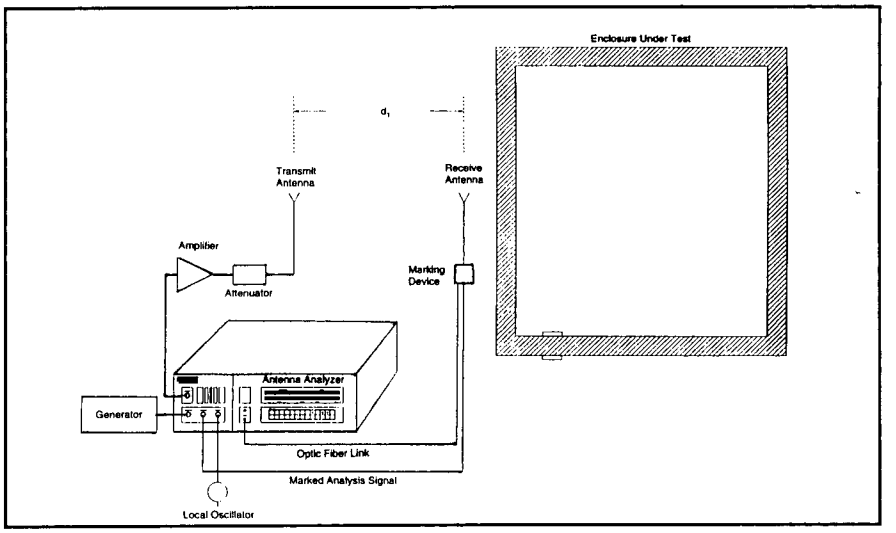

Figure 2. *Test Setup for Shielded Enclosures.*

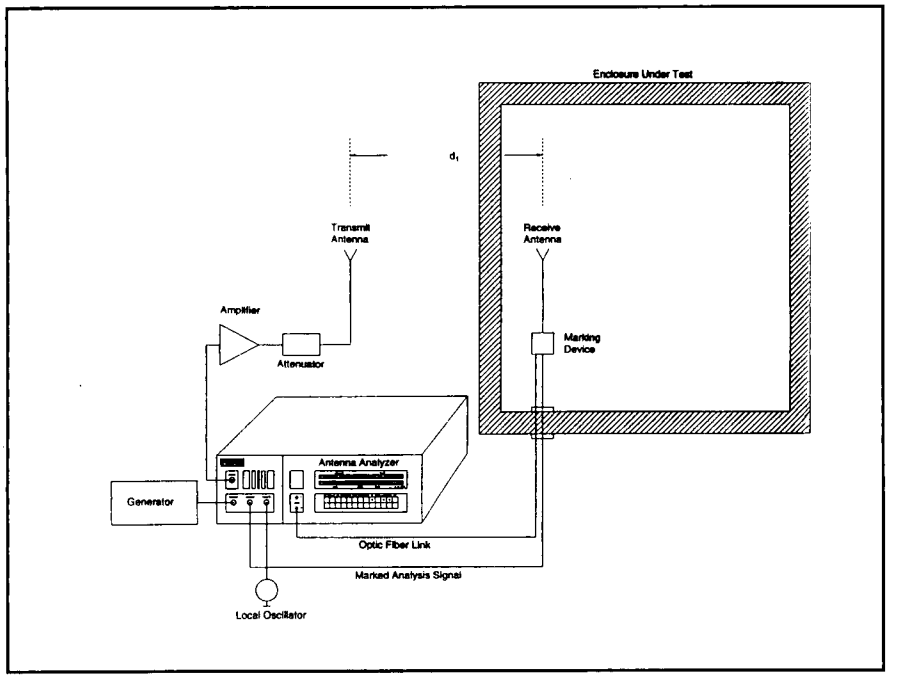

Figure 3. *Placement of RF Marking Probe.*

calibrated to 0 dBm. The configuration is identical to that shown in military standards (Figure 2). However, the wideband marking device is used in place of the recommended attenuator, detector, and receiver.

The second radial and the RF marking probe are now placed inside the shielded enclosure under test (Figure 3). It is important to note that the marking device is powered by battery and does not need an external supply. Also the wideband marking device is optically linked to the antenna analyzer to not only avoid, but completely eliminate, any spurious coupling to the line. Levels greater than -80 dBm can be measured with this configuration.

To increase the dynamic range even further, the attenuator shown in line in Figure 2 is set at 30 dB. Once again the level is calibrated to 0 dBm on the antenna analyzer front panel. The receive antenna is then placed inside the enclosure under test and the attenuator is removed. With this configuration, attenuation levels in the range of -140 dB have been recorded for high performance enclosures. These levels are measurable due to the narrowband filtering and the unique technique of marking the main carrier signal.

CONCLUSION

MIL-STDs describe the attenuation measurements for enclosures and electromagnetic shielding. Levels in the range of -100 dBm are cited in order to quantify and verify compliance with the standard. To date, accurate but elaborate test configurations have been required to measure these low levels. The antenna analyzer surpasses the MIL-STD with a dynamic range of -120 dBm and greatly reduces the complexity of equipment required.

REFERENCES

1. Pradeep K. Wahi, Y. Boison. "RF Marking Principle and Its Application in Making Antenna Measurements," AMTA 15th Annual Meeting and Symposium, October 1993, p. 227.

MICHAEL J. BLEFKO *received a B.A. in Physics from Franklin and Marshall College and a B.S. in Electrical Engineering from the Georgia Institute of Technology in 1987. During his graduate studies he spent one year as a Teaching Assistant in the Georgia Tech Engineering Department. From 1987 to 1990 he worked for Nurad, Inc. in Baltimore, Maryland on radome design and high power quad ridged EMC horn design. He has been with Antenna Research Associates, Inc. since 1990 and currently is Engineering Director. His professional interests include microwave antenna design and test with a primary concentration in horn antennas and EMI/EMC shielding technology. He is a member of Eta Kappa Nu and IEEE. (301) 937-8888.*