



Meander Line Antennas

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The wireless revolution is creating a flood of new wireless devices that dramatically increase the availability of voice and data nearly anywhere in the world. While this revolution is significantly expanding the opportunity for new, smaller and better wireless communication terminals, it also is creating new performance demands for antennas.

Original Equipment Manufacturers (OEMs) are increasingly requiring antennas that feature higher gain, smaller physical size, and more versatility. SkyCross Inc. is meeting these new challenges through its development of a new generation of antennas based on Meander Line Antenna (MLA) technology.

SkyCross' state-of-the-art antennas are smaller and can be embedded directly within the handset. In addition, they feature better gain and improved efficiency, resulting in longer battery life than other handsets currently available on the market today. Furthermore, MLA technology allows engineers to design ultra broadband antennas capable of operating at multiple frequencies and in a variety of modes.

Physically Small, Electrically Large Antennas

The patented MLA technology allows engineers to design physically small, electrically large antennas. Antennas that perform comparable to MLA products are typically much larger and more expensive.

MLA technology was originally developed by BAE SYSTEMS, formerly Sanders (a Lockheed Martin Company) in the Information and Electronic Warfare Systems (IEWS) unit for military applications where unobtrusive, high performance antennas are required for both satellite and terrestrial communications. *(SkyCross has acquired exclusive worldwide license to use BAE SYSTEMS' MLA and other antenna technology to develop and manufacture various products for commercial customers. SkyCross also has continued rights to receive an exclusive worldwide license for improvements to this current technology.)*

With this state-of-the-art technology, engineers are able to combine smaller, antenna-radiating elements with a meander line structure and geometry to achieve broadband performance in a small envelope. MLA technology allows engineers to electrically couple the fields of different segments of the antenna lines to significantly enhance their performance.

The result is the development of an antenna that can resonate broadband and produce circular as well as horizontal and vertical polarization and achieve high gain—typically 1-4 dB greater than other antennas on the market today.

Narrowband and Broadband MLA

MLA antennas may be configured into two distinct classes. The narrowband class exhibits extreme compactness for a given operating bandwidth. The broadband class boasts extreme bandwidth capability, capable of covering multiple octaves without the need for tuning. Both classes achieve performance very near to the theoretical Chu-Harrington limit—indicating that they are as small as possible for the exhibited bandwidth.

Volumetric Efficiency

The SkyCross MLA has a number of significant advantages over more conventional antennas—one is high volumetric efficiency. A comparative measure of an antenna's volumetric efficiency (size) is often expressed on a volume versus bandwidth graph in relation to the theoretically determined limit. The so-called Chu-Harrington relationship establishes the limiting values of bandwidth versus volume for a 100 percent efficient antenna—one that radiates all of the power applied to its feed terminals.

Compared to other antennas, the narrowband MLA is demonstrated to provide the most effective use of physical volume for narrow bandwidths (~ 10–15%). This is easily seen in Figure 1.

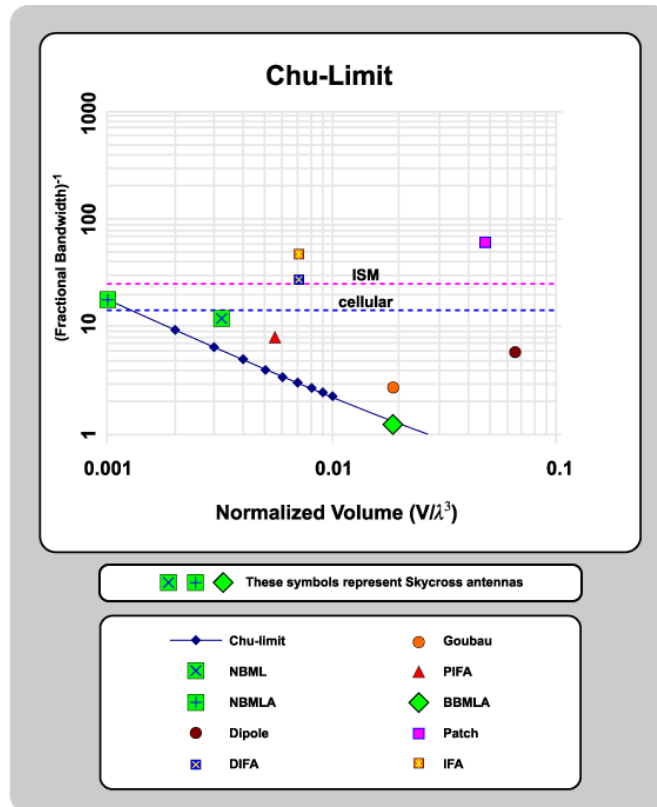


Fig. 1 MLA comparison of size versus bandwidth. The narrowband MLA antennas illustrated are at the leftmost portion of the graph indicating small frequency bands associated with the various wireless services.

All MLA antennas shown exhibit a smaller physical volume for a given bandwidth as compared with other antennas shown on the graph. The MLA achieves its performance gains through an effective and complete utilization of the antenna volume.

Multi-mode Operation

Another advantage of the MLA is the ability to achieve multi-mode operation in one antenna structure. The MLA can be used in two radiation modes that can be excited simultaneously or that can be individually selected electrically.

The fundamental mode is that of a monopole—the so-called “monopole mode” producing a linear polarized radiation field resembling that of two closely spaced monopole antennas. In the monopole mode, the primary antenna current is perpendicular to the antenna ground plane.

The second mode of operation is the “loop mode” where the primary antenna current is parallel to the antenna ground plane and the maximum radiation is perpendicular to the ground plane. The loop mode can be used for satellite communications since one or the other linear or circular polarization may be obtained through the use of a “crossed” radiating structure.

Applications and Significance

MLA technology exhibits features suited to many applications, such as mobile handsets; wireless data including laptops, PC cards and access points; and UWB.

Portable and Handsets

The MLA is truly suited to next generation wireless products due to its small size and excellent performance characteristics. Handsets often require worldwide GSM operation with Global Positioning System (GPS) operating at 1575 MHz for location of the user in emergency (911) situations. The broadband MLA is able to cover all three required bands simultaneously—having coverage from 800-2500 MHz in a size 0.8 x 0.5 x 1.25 inches.

The lower limit of the bandwidth is determined by the antenna volume, which can be reduced to 0.4 x 0.25 x 0.625 inches if the requirement for 850 MHz band coverage is dropped.

Coverage of the different frequency bands is also possible with multi-band conventional antenna designs. A disadvantage of currently used multi-band embedded antennas is detuning when held in proximity to the body. It is common to observe resonance shifts completely out of band with some embedded cellular handset antennas resulting in an attenuation of up to 24 dB (measured). The broadband MLA, however, does not exhibit measurable proximity detuning under similar conditions.

MLA handset antennas also feature reduced specific absorption rate (SAR) due to their distributed near-field radiation. It has been shown statistically that signal strengths can be increased on the average by as 2-3 dB with the use of embedded, reduced SAR antennas such as the MLA. The advantage gained is due in part to a reduction of absorption of the radiated signal by the human body. Studies show that conventional high SAR antennas, such as the dipole and its derivatives, lose approximately 40–50% of their radiated signal to absorption in the head.

The increased effective gain available with low SAR antennas provides a number of advantages in addressing problems that are currently experienced by cellular users and service providers. The advantages are:

- Improved reception quality at the cellular tower receiver results in
 - Fewer dropped calls
 - Improved customer satisfaction (lower churn)
- Lower power consumption in the handset
 - Provides for longer battery life
 - Allows smaller batteries to be used and increases the overall life of the battery, resulting in lower cost to the end user
- Significant improvement of voice quality near the edge of the cell
 - Provides better reception in border areas
- Potentially larger cell sites possible
 - Decreased cost for service providers due to reduction in the number of cells

Conclusion

SkyCross engineers have begun leveraging advanced technology, such as Meander Line Antennas, to create nearly invisible antenna solutions that not only reduce the size of devices but also significantly improve performance. Today antennas are being developed that achieve higher gain, allow multiple frequency operation, provide directional control over mobile handset emissions, provide wider bandwidth for ever-increasing data rate requirements, and are less obtrusive.