CoreTech
PERFORMANCE FILM SOLUTIONS

A SAINT-GOBAIN BRAND

CONFORMAL PERMEABLE ANTENNA: **WHITE PAPER**

CoreTech SoftAlloy™

To maximize access to the congested RF spectrum while at the same time minimizing the impact of the antenna installation on the platform, requires the next generation of antennas to be ***multi-functional, broadband, and conformal.***

The most common challenge is meeting the required performance with limited real estate.

By replacing multiple legacy radiators and receivers, ***multi-functional*** antennas make maximal use of the available real estate.

These antennas must have ***broad instantaneous bandwidth*** to cover multiple bands and fully exploit software-defined radio, ultra-wideband waveforms,

and MIMO/diversity techniques.

And only ***truly conformal*** antennas that can be embedded anywhere into the surface of the platform, can provide this capability with minimal impact to the mission — in many cases improving the survivability of the vehicle.

Fig.1: Every VHF/UHF blade on an aircraft adds a drag penalty

A typical example is shown below:

The problem is conventional metal-and-dielectric antennas cannot meet these requirements because an electric-current-carrying antenna, placed parallel and in close proximity to a conducting surface, has its bandwidth decimated by the image factor $(2\pi h/\lambda)^2$ (where h is the separation of the metal antenna from ground). The antenna impedance becomes so low that it is rendered overly sensitive to losses, feed circuit imperfections, and tolerances of the installation environment.

Permeable conformal antennas are the solution. They can be viewed as the natural evolution of the 1950s ferrite dipole. The difference is that the modern versions are characterized by having extraordinarily large Efficiency-Bandwidth products (EBWP).

The key to the performance of these antennas is the use of high-magnetic-permeability composite materials as the antenna elements, such that the radiating current is the ***magnetic current*** (jωB) flowing in the material itself. For magnetic currents, the ***conformal image factor,*** instead of being detrimental, actually increases the antenna's radiation efficiency by up to a factor of 2.

An example of the advantage of the CoreTech SoftAlloy™ composite is shown by comparing low profile antenna alternatives to the traditional "egg-beater" SATCOM antenna (Fig.2). Ideally, the SATCOM antenna should cover both MUOS and UFO bands, a frequency band from 225 MHz to 380 MHz. As Fig.3 shows, the Army Research Laboratory has proposed replacing the traditional 12.5" tall antenna with an 18" x 18" x 2" low-profile antenna based on metaferrite technology. The toroidal conformal antenna using the CoreTech SoftAlloy composite would be three times thinner at 0.7" thick, as shown in Fig.4.

Furthermore, as the plots of Boresight Gain show, the CoreTech SoftAlloy composite antenna operates over a much broader band (232 MHz to 475 MHz versus 240 MHz to 320 MHz), a frequency band that is three times wider.

The reason the ***new technology is three times thinner and has three times more bandwidth*** than the state-of-the-art solution being considered by ARL, is that the CoreTech SoftAlloy composite's electromagnetic impedance is much higher than that of the metaferrite.

The ratio of the relevant tensor elements (μ/ε) for the CoreTech SoftAlloy composite is of the order of 12:1, while the reported values of the metaferrite range from 1:2 to 3:1.

Fig.2: Traditional "Egg-Beater" SATCOM Antenna

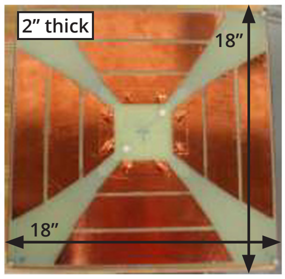


Fig.3: Army A145 Metaferrite Antenna

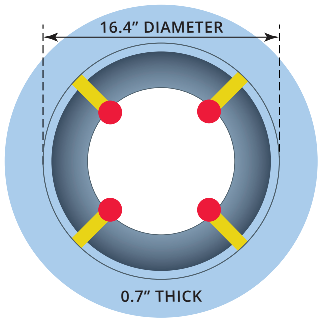
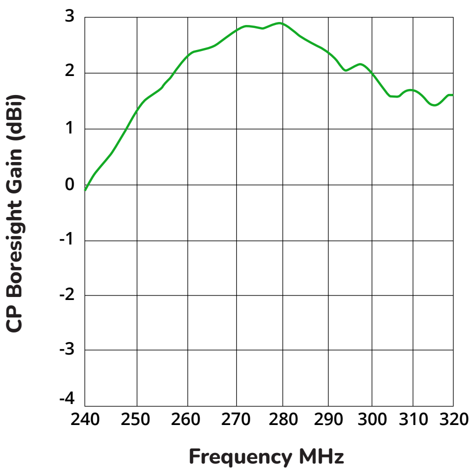
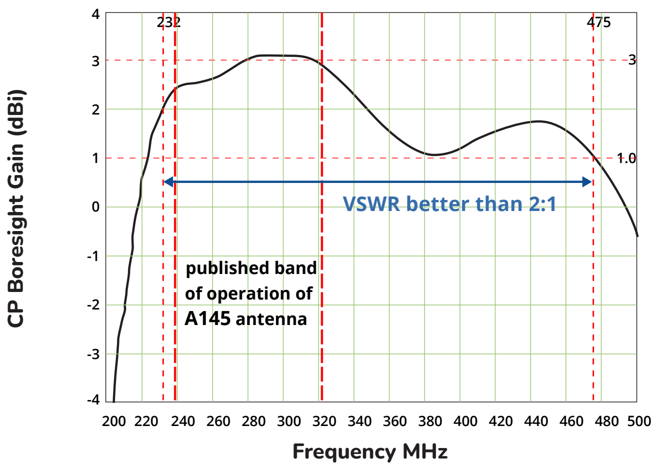


Fig.4: Conformal Permable Antenna Designed Using SoftAlloy™

Army A145 Metaferrite Antenna
2016 IEEE International Symposium
Phased Array Systems and Technology (PAST)



Conformal Permable Antenna
Designed Using SoftAlloy™



For more information on SoftAlloy™ and the antenna technology enabled by it, email coretechfilms@saint-gobain.com or visit us at www.coretechfilms.com.

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