Antennas Enable Performance in a Smaller Size


Glossary of Acronyms

ADC— Analog to Digital Converter
CDMA— Code-Division Multiple Access
CMOS— Complementary Metal-Oxide Semiconductor
DARPA— Defense Advanced Research Projects Agency
DSP— Digital Signal Processor
JTRS— Joint Tactical Radio System
MUOS— Mobile User Objective System
PA— Power Amplifier
PLL— Phase-Locked Loop
RAM— Random Access Memory
SFQ— Single Flux Quantum
SINAD— Signal to total noise and interference ratio
SME— Superconducting Microelectronics
VLSI— Very Large-Scale Integration

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As any designer knows, at any frequency up to 1/2 of the wavelength, a longer radio antenna operates more efficiently than a shorter one, With today's emphasis on tight design criteria, cramming more functionality into less space, while conserving power and improving antenna technology, is high on the hit list.

In many cases, it may be impractical for products to allocate antenna space as long as 1/2 the wavelength dimension at operating frequency. In the past, when a designer did not have the real estate for a λ/2-wavelength antenna, the default approach was to use a λ/4- or a λ/8-wavelength, or even smaller multiples. Again, however, as the designer is keenly aware, each smaller antenna is less efficient.

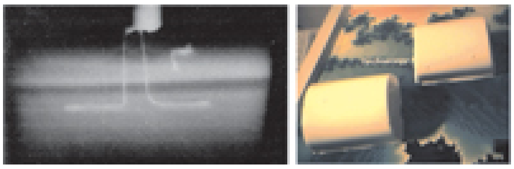
[1]

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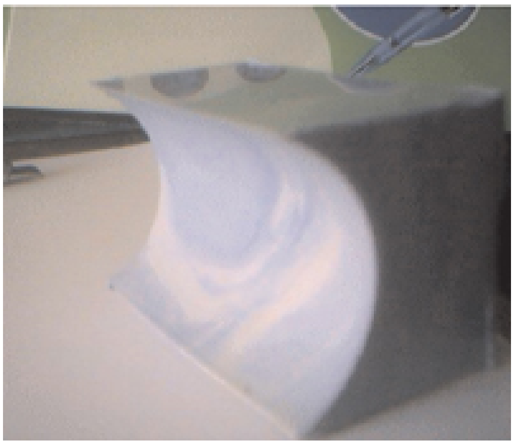
Figure 1. X-ray (and top visible) view of the 3D antenna elements encapsulated in an engineered dielectric.

In some design situations, &quotantennas&quot are printed onto PCBs, but these are the least efficient radiators of all. In virtually all design scenarios, Focused Wave Technology (FWT) provides an antenna of a given length that exhibits a radiation gain substantially larger than other designs of the same size.

FWT technology works by encapsulating 3D antenna elements in a spatially-configured dielectric material. This causes antenna elements to transmit and receive electromagnetic energy as if the elements themselves were longer. Furthermore, the technology enables shaping of the external surfaces of the dielectric, thereby forming a lens, and selectively increasing or decreasing the broadcast power in a given direction. This feature is not available in conventional antennas of any size. Figures 1 and 2 illustrate FWT antennas using an X-ray and a visible image.



[2]

A product designer can benefit from FWT technology in various ways. In one application, an allocated antenna space is maintained, with FWT technology providing greater gain while increasing the radio link range. In another application, the designer reduces the power requirements, thereby doubling or tripling battery life. In still another situation, miniaturization will be paramount. In that case, a reduction in length of 1/2 in each linear dimension will yield a reduction in cross-sectional area of 3/4 and a reduction in volume of 7/8. Clearly, FWT antennas are well-suited for many military applications, as a more powerful, focused, encapsulated and miniaturized antenna offers two important advantages: (1) a given space allocated for antennas can hold more antenna capacity, and (2) the conformal shape of the dielectric enables the antenna to be installed in an airframe without the need for a hardened window &#151 decreasing the failure rate of the platform. Alternatively, for consumer markets, the conformal shapes of FWT antennas can be exploited to form logos, automotive cowlings or decorative themed sculptures.

The planar and conformal design features allow the designer to include the radio communications components directly onto the antenna substrate, freeing or saving space in the product envelope. The FWT uses an integral substrate, which can be designed to *accept mission-critical circuitry* while maintaining a *short and simple circuit-antenna interconnection*. This *electronic real estate* enables system integration with radio receiving and transmitting chips, integral baluns and band-shaping filters. It is clear that use of the *electronic real estate* intrinsic to FWT antennas offers cost and performance advantages. Figure 3 depicts an FWT standard using RFICs.

[3]

The FWT group offers antennas from 50 MHz throughout 10 GHz. Narrowband, dual-band and triple-band antennas benefit from FWT technology, as do wideband antennas, with useful bandwidths over a 5:1 range. Antennas for the emerging UWB high-band (3.3 GHz to 9.8 GHz) are available as well. Available designs include omni-directional, hemispheric or pinpoint beam-shaped spatial-gain profiles. For more information about the FWT group and FWT technology, go to: www.fwt.niat.net.

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