Shively Labs

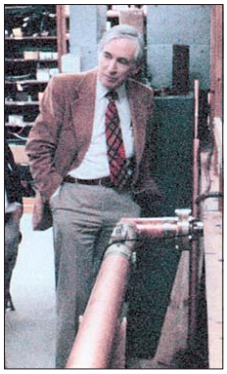
Antennas that Work

During a long hot summer, what could be more refreshing than a visit to Maine? This month ***Radio Guide*** *flees the desert for a road trip to the cool climate around Shively Labs' factory.*

Shively Labs in Bridgton, Maine has been building a reputation for high quality antennas, designed to maximize FM ERP and enhance station coverage, for nearly a half a century. Over the past four and one-half decades, Shively antennas have found their way across the country and around the world.

A BRIEF HISTORY

Shively Labs is named for founder Ed Shively. He was a broadcast design engineer who had worked at Crosley, RCA, and Dielectic, where, as Research and Design Chief under Dr Charles Brown (another RCA alumnus), he designed the RCA BFC- antenna series. (RCA was typically grateful; they gave Shively the usual $2.00 for the patent.)



Ed Shively (1925 -1993)

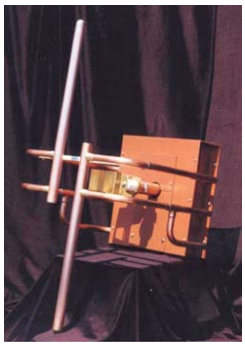
Shively saw the time coming soon when FM broadcasting would grow. Realizing that the FM spectrum would soon become crowded and good signal coverage – along with the ability to predict and control it – would be essential for a station's success, he focused on developing the sophisticated and rigorously engineered products needed.

In 1963, Shively went out on his own, founding Shively Labs to produce antennas for custom projects. While most of the industry was focused using wideband antennas to combat performance issues from icing during the winter time, eschewing the "standard" helix design, Shively pushed the technology of the time and developed a line of ring-stub radiators.

FOCUSED ON FM

Shively started with the 6710, which was the first FM antenna to add a variable vertical component to the standard horizontal antennas of the early 1960s. This design also permitted the user to adjust the horizontal/vertical ratio from elliptical radiation to more circular radiation.

When it was clear that the future would center around circular polarization, Shively modified the 6710 into a fixed-ratio antenna, the 6810 series. Since then, Shively Labs has built up a series of FM ring-stub radiators that remain among the most popular FM radiators on the market.



The distinctive Shively stub-ring antenna elements.

Over four decades later, Shively Labs still produces the 6800 series, from low power to high power, as well as flat panel antennas, Lindenblad antennas and, most recently, antennas with multiple inputs for IBOC transmission. Additionally, Shively manufactures the filters and combiners necessary to operate at combined sites and in high RF environments.

JOINING FORCES

In order to make the company's future more secure, Shively negotiated a sale to a company founded by Peter Howell.

Howell Laboratories had begun by manufacturing high quality dry air machines for military use in the early 1960s. Shively Labs was purchased by Howell in 1980 and combined operations under the Howell Laboratories name, with the broadcast and military manufacturing operating side by side.

The company became employee-owned in 1996, and continues that way to the present.

THE FACTORY

All together, some 60 Shively employees are the engine driving the work in the 33,000 square-foot factory. Engineers, machinists, welders, braisers, assemblers and test technicians, as well as office workers and support staff combine their talents to produce high quality radiators.

The antennas and other products are fabricated on site from primary materials, to assure top quality.

And since no two installations are exactly alike, each Shively antenna is designed, manufactured, assembled, and tested specifically for each customer's application and power level.

BUILDING FOR THE FUTURE

Bob Surette joined Shively after graduation from Lowell Technological Institute (LTI) in 1973. In the succeeding 34 years, Surette has become one of the most respected FM antenna experts in the industry, designing antenna arrays to overcome many difficult transmission issues. He is also well known for his ability to clearly explain the principles of FM transmission (analog and digital) at many venues, including the famous "Bob and Tom" Shows at many NAB Radio Conventions.

Since 1985, Surette has pioneered the use of large combiner networks to co-locate a dozen or more stations on one antenna while overcoming the group delay issues that might have prevented such a system from working. Today, some of these installations combine well over a Megawatt of RF in a reliable, efficient system.

An 8-station combiner at Cougar Mountain in Seattle, WA.

Combiners have also proven useful in providing an input port for digital signals as stations convert to IBOC.

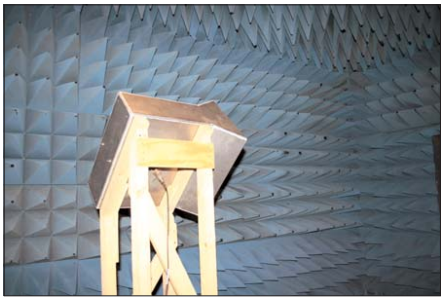
The Cougar Mountain system in Seattle, Washington was one of the first to demonstrate how to inject the digital signal into the "reject" load port. A more recent project at 4 Times Square in New York City challenged Shively to pack a lot of combiner in a small space.

The Shively Combiner at 4 Times Square.

PATTERN MODELING

Perhaps one of the best known outgrowths of the work done at Shively Labs is how they demonstrate the benefits of modeling and testing antennas before mounting them in the field.

In addition to the metal working and fabrication activities, Shively has both an indoor pattern test range – constructed from RF absorbing anechoic material – and an outdoor pattern test range to test the performance of the antennas. With an RF signal to noise ratio of 50 dB, it is possible to measure patterns with extreme accuracy.



The indoor RF anechoic chamber.

The ranges are used regularly to prove the custom designs will radiate as expected.

PREVENTING PROBLEMS WITH RANGE TESTING

A major reason why pattern testing on the test range is so important is that the wavelength at FM frequencies is approximately 10 feet, meaning a quarter wavelength ends up around 2.5 to 3 feet.

In many installations, this is very close to the cross-section width of the tower, which then can act as a parasitic resonator, modifying the radiated pattern of the antenna in unwanted ways. By modeling the antenna on the test range, it is possible to determine what unwanted interactions might exist and mount the antenna in a way that avoids such problems.

The outdoor test range at Shively Labs.

It is interesting to note that at Shively Labs, the test range is done at a 4.5:1 scale. While some manufactur-

(Continued on Page 6)

Shively Labs

Antennas that Work

Continued from Page 4

ers suggest that only full scale testing is useful, the experience at Shively is that by scaling the tower, antenna and frequency transmitted, accurate radiation patterns can be measured.

The process identifies not only where the tower might interfere with the signal, but also the mounting position where the signal is launched for best reception in the desired population center. This is especially important with side-mounted antennas, but even pole mounts show the effect of the tower as a parasitic radiator.

Using scale models, Shively can quickly test the effects of various antenna mounting solutions.

However, there is an extra benefit from using a test range like the one at Shively Labs – it is much easier to try different mounting positions for the antenna, as well as any intentional parasitic radiators. Furthermore, modeling the effects from interaction with other antennas on the tower as well as the coax can be done much more easily.

Engineers from all over have come to Bridgton to participate in the range testing. The large number of tests compiled over the years show the likely operation of a new antenna, and real world results in coverage have confirmed the pattern range results. This makes the process of optimizing the antenna a much quicker job than previously.

PARTS AND SUPPORT

Because Shively builds most every part of their antennas, they can provide parts and service for virtually every antenna that has been built at the factory.

Support for an FM antenna is, of course, not always something that is done easily or quickly. With most FM antennas sitting from hundreds to several thousand feet above the transmitter building, it is not easy for an engineer to know the condition of an antenna, unless something drastic happens and something like the transmitter's reflected power meter goes off the scale.

By measuring the radiated pattern of an antenna, the range technician can ensure it can be mounted in the best location to cover a station's market area.

Shively recommends that tower crews check the physical condition of the antenna regularly, as well as doing a transmission system "sweep" to ensure the coax and antenna continue to operate in an efficient manner. If a problem is observed, the factory can assist in repair, or even refurbish the antenna in the factory and return it to the station in "like new" condition.

As for those stations where an engineer finds himself without documentation, Shively maintains a library of drawings for each antenna manufactured, and is happy to help engineers rebuild the documentation on their system.

MOVING INTO THE DIGITAL AGE

As stations began installing digital transmission systems, a lot of research went into how the existing antennas would operate under digital transmission and how to combine the analog and digital signals. Shively has developed several approaches for high level and dual-antenna modes.

Other special projects include combinations of varying element spacing and mechanical and electronic beam tilt. Shively Labs remains committed to developing products to meet the transmission needs of FM broadcasters, keeping RF radiation levels under control around the transmitter site, and putting the RF over the listening area.

Just as Ed Shively anticipated the need for symmetrical and balanced radiators that dominate today's directional and digital antenna markets, Shively Labs works hard at staying on the cutting edge of the new filtering and combining techniques that have changed the face of HD Radio implementation.

The result is, as many engineers have found over the years, that Shively antennas work.

For more information on Shively Labs and their products and services, browse to www.shively.com or call 1-888-Shively.