



APPLYING CUSTOMER ATTUNEDSM COLLABORATION

teamSENTINELnano
ANTENNA INTEGRATION

CASE STUDY

CASE STUDY

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THE CHALLENGE

The Espy Corporation sought to take advantage of the ever-shrinking size of computing and RF componentry to add a new 'nano' product to their teamSENTINEL® line of wideband recording radio frequency (RF) sensors. Fitting all the electronics in its small transit case was relatively easy. Fitting a high performance VHF through C-band sensor (antenna) required finesse.

OUR SOLUTION

In collaboration with Espy, Cyntony successfully specified and sourced prototype and production wideband fractal antennas from the manufacturer, without additional engineering fees, enabling Espy to cost-effectively build and deliver ultra-portable teamSENTINELnano® systems their customers can rapidly setup and operate anywhere, anytime.

TECHNICAL DISCUSSION

There's a persistent dichotomy in wireless technology. Ever improving semiconductor physics and engineering prowess produces smaller RF electronics and computers that reduce size, weight and power consumption- while increasing performance. But in the realm of antennas, the physics of electromagnetics severely bounds the design space; some of the best antenna designs are little changed in the last fifty, even 100 years. So although you'd rarely use a vintage radio transceiver for today's wireless challenges, you'd most certainly consider using 1950's state-of-the-art antenna technology (such as the log-periodic dipole array) for directional wideband antenna applications in the 21st century!

The Espy Corporation faced this dilemma. Their successful teamSENTINEL family of recording RF and direction finding (DF) sensor systems employ a combination of commercial-off-the-shelf computing, storage and receiver subsystems along with custom RF conditioning for long-term recording of RF energy over a wideband stare, with simultaneous review and processing of the RF data as it is recorded. The equipment is typically mounted in 19-inch racks and housed indoors with connection to remote outdoor antenna systems. A transportable 'mini' version of the product employs hard cases with internal 19" racks to allow for more tactical and expeditionary use of the system, again connected to separate monitoring and/or DF antenna subsystems.

Ultimately though, Espy's customers wanted an all-in-one, totally portable RF monitoring system capable of running Espy's teamSOIGNE® client and server signal mining application suite; plus have great all-direction sensing using an integrated antenna.

NEED

Espy contacted Cyntony with a seemingly simple request: provide a VHF through C-band omnidirectional monitoring antenna with no gaps in coverage, dipole or better gain through the whole frequency range, and fit in a transit case lid for the teamSENTINELnano® (tSnano) system with a form factor of roughly 20 x 15 x 0.5 inches.



Avoiding the old saw about antenna gain, bandwidth and size - i.e. pick any two - Cyntony took on the sourcing challenge, knowing that although compromise would be required, certain antenna approaches open up favorable corners of the design space.

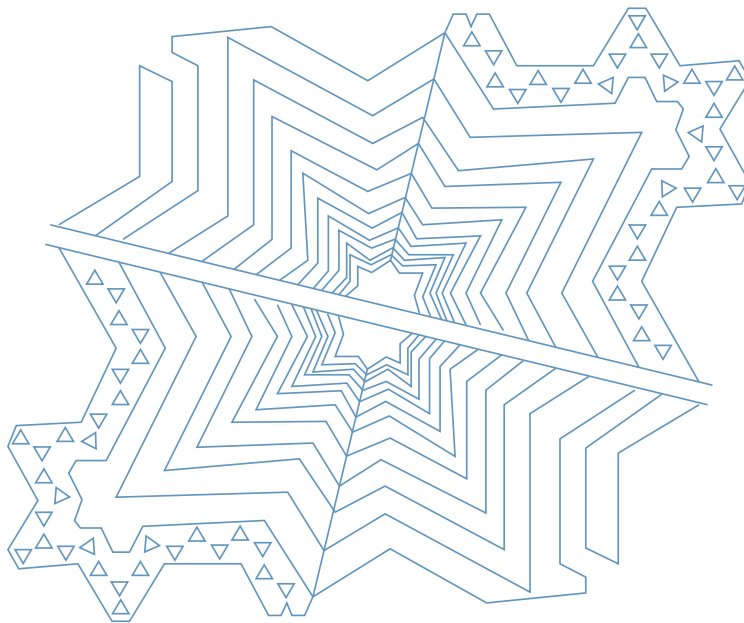
Antenna designers like to think in terms of wavelength when considering the applicability of a design approach to the engineering challenge. The dipole is one of the easiest antennas, simply consisting of two straight $\frac{1}{2}$ wavelength conductors. At 30 MHz, a dipole would be 5 meters long! Clearly this is too big to fit in the case lid.

So what's the lowest frequency a simple dipole could be to fit in this case? 20 inches is approximately $\frac{1}{2}$ meter. Fitting a half-wavelength dipole in that length implies a free-space wavelength of 1 meter, which means the antenna would be tuned to 300 MHz. This is not low enough for the specifications- indeed 300 MHz is the start of UHF, not VHF (which starts at 30 MHz). There's another problem with a standard dipole, its bandwidth is only about 10% around its lowest frequency, and is multi-band, not wideband.

SPECS AND SOURCING

Closely collaborating, Cyntony and Espy settled on goals of: frequency range 150 - 6000 MHz, gain at least 0 dBi, panel size no bigger than 19.5 x 13.5 x 0.1 inches and a single SMA jack connection. That's a 40:1 bandwidth!

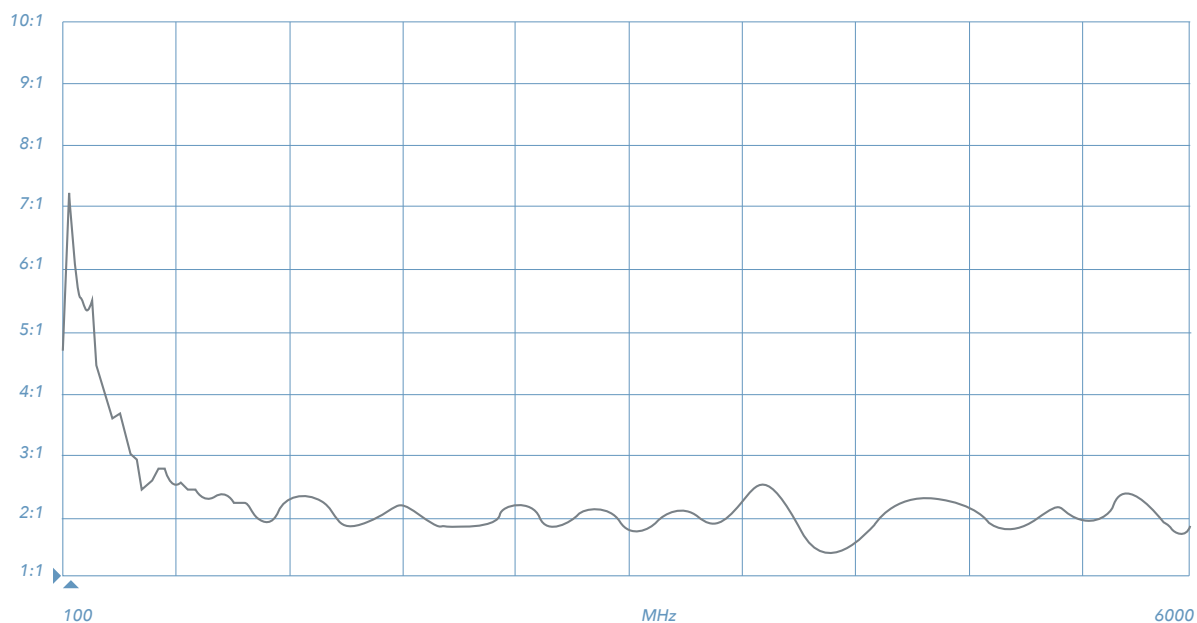
To attain such wideband performance in so small a panel ($\frac{1}{4}$ wavelength at its lowest frequency), an advanced frequency independent antenna design is needed. Drawing upon Cyntony founder David Moschella's experience leading Fractal Antenna Systems, Inc. (FAS) in the 2000s, we knew that such compact frequency independent designs exist and had been successfully applied to counter radio-controlled improvised explosive device electronic warfare (CREW) and in-building wireless communications.



SKETCH OF ULTRA-WIDEBAND PLANAR ELEMENT

Cyntony sourced, and FAS provided, a prototype of this patented fractal antenna approach in weeks, allowing Espy to quickly determine the antenna provided great wideband frequency coverage for the teamSENTINELnano receiver. The graph below shows the VSWR of this design, which is very well suited to monitoring applications.

VSWR OF OMNI-C010, 100 TO 6000 MHZ (X:1)



USE CASE

OMNI-C010

With the prototype proven, work shifted to creating version one of the antenna to fit the transit case lid. Mechanical and electrical details were captured in an interface control document (ICD) to specify form, fit and function requirements for the product, dubbed OMNI-C010. First deliveries adhered to the ICD using standard PCB materials with little embellishment. From an RF perspective, the antennas worked great and met the basic requirement of mounting in the case lid.

INTERFACE CONTROL DOCUMENT

NOTES

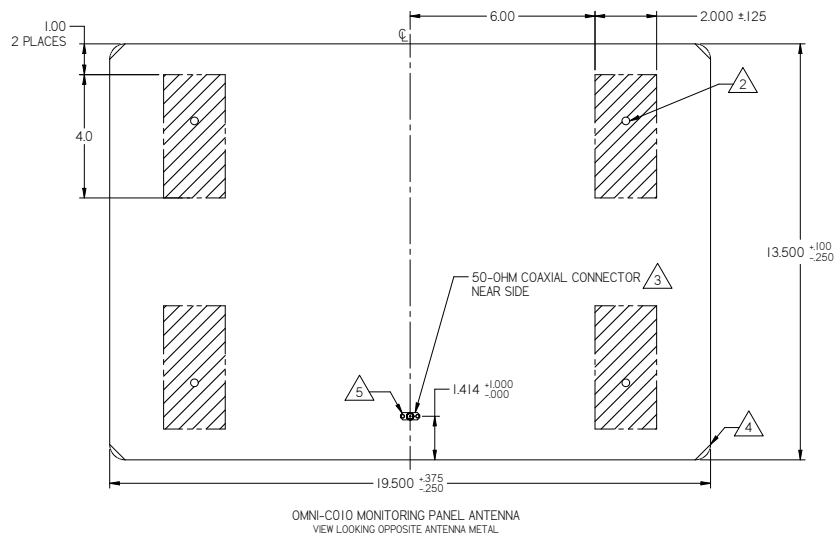
1. VENDOR SHALL PROVIDE OMNI-C010 ANTENNA ON PRINTED CIRCUIT BOARD SUBSTRATE OR MATERIAL WITH EQUIVALENT STIFFNESS. SUBSTRATE COLOR SHOULD BE BLACK.

2. VENDOR SHALL PROVIDE IEA Ø0.201 THRU HOLE LOCATED WITHIN EACH HATCHED ENVELOPE. MOUNTING HOLE LOCATIONS MAY BE MISALIGNED WITH RESPECT TO EACH OTHER AND SHALL BE PLACED APPROPRIATELY TO MINIMIZE NEGATIVE PERFORMANCE EFFECTS.

3. VENDOR SHALL ORIENT SMA CONNECTOR (AMPHENOL 132143 OR EQUIVALENT) SUCH THAT THE CENTER PIN IS PERPENDICULAR TO THE PLANE OF THE ANTENNA. THE CONNECTOR SHALL BE INTERCONNECTED WITH SEMI-RIGID CABLE RG405 OR SIMILAR.

4. CHAMFER CORNERS BY 0.50 X 45DEG OR ROUND CORNERS WITH R0.50

5. PERMISSIBLE TO MOVE CONNECTOR FROM CENTERLINE OF ANTENNA BY +/- 1.00



CONTINUOUS IMPROVEMENT

Customers using the tSnano requested the ability to remove its antenna from the case lid to mount it externally, say on a wall or tripod. Espy engineers accommodated with an apparatus and frame to hold the antenna, necessitating a refinement of the OMNI-C010 mechanical details. Espy also requested the addition of specific marking and branding information. Cyntony handled all the details required to revise the sourcing details for this new embodiment.

OMNI-C010-01

The final revision of the antenna panel, OMNI-C010-01 is shown below. It contains features for easy dis/engagement of the antenna in its frame, as well as specific Espy brand markings.



FINAL REMOVABLE ANTENNA PRODUCT: OMNI-C010-01

PRODUCT SUCCESS

Antennas are key components of wireless systems. Too often they are an afterthought, but for forward thinking companies like Espy, attention to the antenna proved to be a powerful differentiator. As you can see in the picture below, the seamless integration of the antenna solution provided by Cyntony enhances the teamSENTINELnano product's aesthetics, functionality and desirability.

CUSTOM CREATION

Your specialty antenna and electronics challenges don't have to be so difficult. Just starting to think about something new? Great, that is the best time to consult with us; we are creative and imaginative. Cyntony relishes the opportunity to contribute to your team, applying our knowledge, expertise, and systems integration experience to sourcing excellent, low-risk solutions for your project - with no engineering fees. Contact Cyntony today for a free discussion of your needs - or crazy idea!



LID-STORED ANTENNA IN CUSTOMIZED CASE

TESTIMONIAL

"Cyntony is an **exceptional partner** for The Espy Corporation in the realm of RF antenna solutions, delivering knowledge and expertise rooted in years of real-world experience.

Many times Cyntony has helped Espy filter a myriad of antenna options to help us quickly and effectively **choose the best solution** for our requirements. And when optimal off-the-shelf solutions were not immediately available, Cyntony developed custom solutions, like the teamSENTINELnano OMNI-C010 antenna - designed to our unique needs.

Cyntony is a force-multiplier for Espy."

*Mr. Whitney Harris
VP, Founder
The Espy Corporation*



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OMNI-C010 and OMNI-C010-01 are covered by US Patents 7345642 and 7659862

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