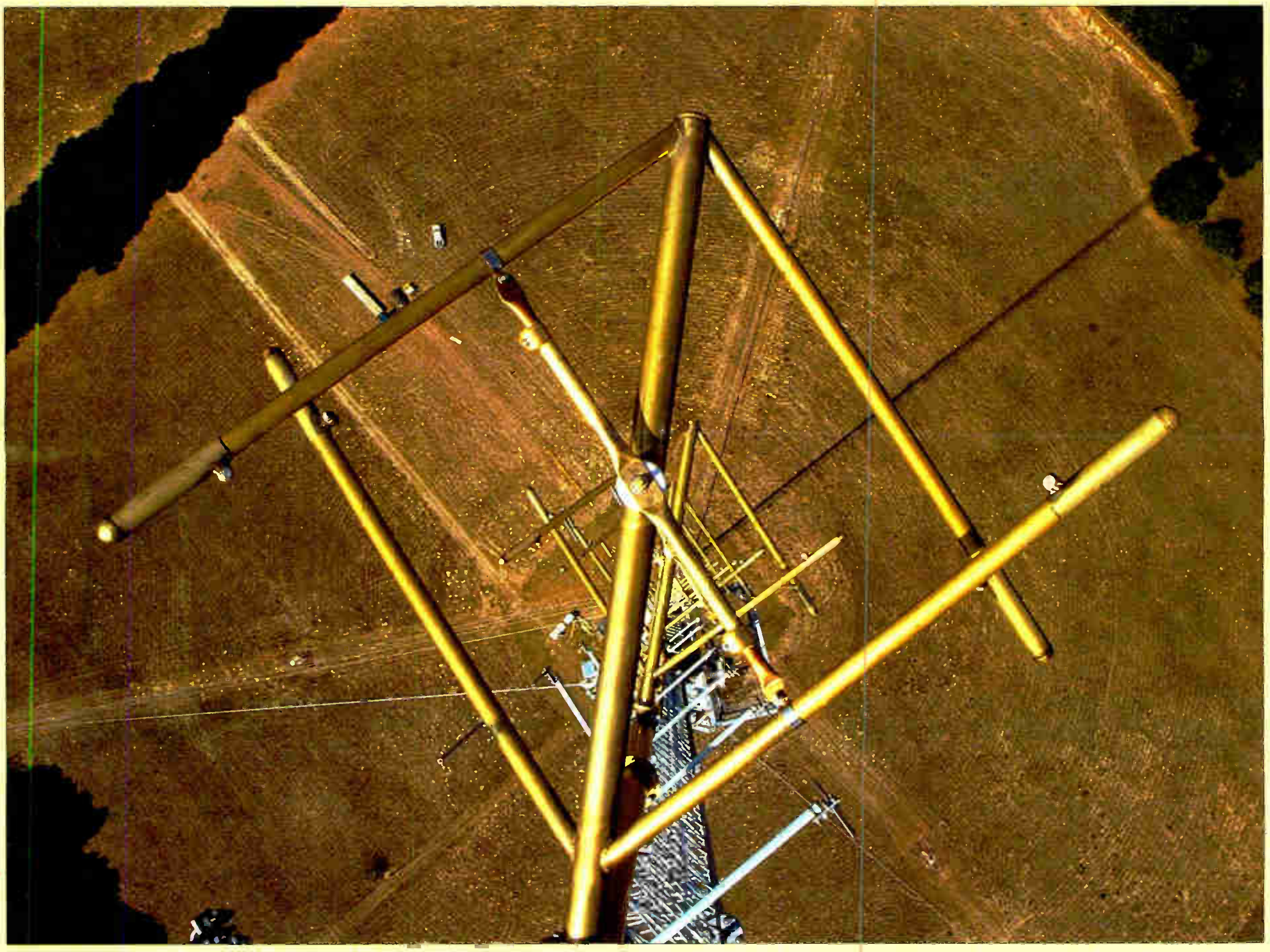
Radio Guide

Radio Technology for Engineers and Managers
August 2006

Antennas and Ground Systems Keys to an Improved Signal



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Improving Coverage with a Jampro 8-bay Antenna
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We faced a tricky engineering problem at WOGK, a 100,000-watt FM station based in Ocala, Florida. The WOGK antenna was twenty years old. It was an 8-bay step-pole design with the size of the pole reduced in each section, which was not good. It was not only not doing the job, but over the years it had suffered quite a bit of damage from the harsh climate, including broken elements. It definitely needed replacement.

The project began in 2002 when I met with the station's management and sales team to identify where the signal was lacking or weak, and what coverage area was desired.

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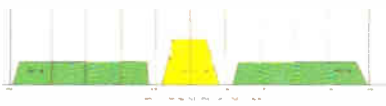

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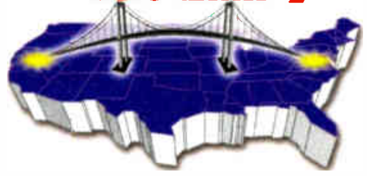

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Cover Photo: The view from 1,369 feet, looking down at WOGK's new Frequency-Matched tower and antenna from Jampro. Courtesy: Allan Harrol, SECS Project Manager.

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Radio Waves

by Barry Mishkind – Editor

Something Needs to Happen

The FCC came close in early July. The NPRM was on the agenda for action. Then, just hours before the newly fully-constituted FCC was to meet and (presumably) give the "go-ahead" for 24/7 operation of AM IBOC, it was "pulled."

Here we are in Summer 2006. AM radio sees many of its FM sisters moving to digital. Nevertheless, late every afternoon digital AM radio still is forced to return to pumpkin status.

What happened? How come each time one part of the industry is ready to roll, some other part of the industry seems unwilling to make a crucial decision? Indeed, if terrestrial radio is going to combat all the newer forms of broadcasting, from satellite radio to WiMax to tomorrow's hot technology, why is it so hard for the industry leaders and regulators to get together?

Some Progress

The manufacturers and many broadcasting companies have done their part. A great deal of innovation, problem resolution and fine-tuning has been accomplished. The number of IBOC installations continues to grow.

Sure, the debates over program content, processing for digital radio, and technical issues continue, but ultimately digital radio – especially AM – will not have a chance to grow unless it is up and running 24/7.

Time to Move Ahead

Radio Guide believes that unless the industry gets its act together and does something more than the minimum, terrestrial radio could become endangered.

Not right now. But just as the industry taught two generations of listeners that commercials cause cancer, it now often teaches listeners to go somewhere else for crisp, clean audio entertainment and news.

The message has to change. Something needs to happen soon. *– Radio Guide –*

Improving Coverage with a Jampro Frequency-Matched Tower and JHPC-8 Eight-Bay Antenna

By Tim McGuire

You run into all kinds of broadcast problems in Florida, but the major ones are weather related. We have heat, humidity, high winds, salty air, lots of lightning, even tornados, not to mention the brutal hurricanes for which we are famous.

Together, these conditions play havoc with towers, antennas, electronics and it seems that I am always "putting out fires," especially ones literally caused by lightning strikes. It is a challenge, but I love it. For 25 years I have been a Chief Engineer and/or a Contract Engineer serving radio stations all around the state.

We faced a tricky engineering problem at WOGK, a 100,000-watt FM station based in Ocala, Florida. The WOGK antenna was twenty years old. It was an 8-bay step-pole design with the size of the pole reduced in each section, which was not good. It was not only not doing the job, but over the years it had suffered quite a bit of damage from the harsh climate, including broken elements. It definitely needed replacement.

ANALYZING THE SITUATION

The project began in 2002 when I met with the station's management and sales team to identify where the signal was lacking or weak, and what coverage area was desired.

You can measure the signal of a radio station in Florida with a spectrum analyzer and a lot of high tech equipment, but that measurement will change in a week due to weather conditions, temperature inversions and the like. Over a long period of time, however, with feedback from the station's staff, listeners, and sales people we had a very good picture of where we were hot and where we were weak or missing.

Some areas, like up in Gainesville were hit and miss, although for the distance you would expect a lot better signal than we had. Bottom line, the station's coverage in its own market was marginal or poor and we wanted to get coverage up, uniform and improved.

FINDING THE RIGHT ANTENNA

My antenna research started with wind loading considerations – a prime concern in hurricane alley. I was working with the station's original 1,270-foot G-7 Stainless tower and I did not want to increase the wind load, rather I wanted to get better wind load characteristics if I possibly could.

I called several antenna manufacturers. Some did not even want to touch the project because their antennas would likely compromise the current wind load specifications. Others solutions were prohibitively expensive or not conducive to our site.

My research took me down many paths, but the Jampro JHPC model seemed to shine above all others. On paper, it looked like this high power side-mount met all my wind load requirements as well as my bandwidth requirements – important since IBOC (HDFM) was in the future.

My next step was a call to Bob Groome, Jampro's Domestic Sales Manager. We had long discussions about what I wanted to do and eventually Groome suggested that a Frequency-Matched Tower (FMT) section might be the way to go since it would provide us with a more predictable coverage.

CAREFUL DESIGN AND TESTING

My concerns were the different spacing between the bays and the current WOGK stepped diameter pole and the effects on the gain and elevation patterns of the array. To a certain extent, this is true, because it does affect gain from the top bay to the bottom bay because the spacing is different between the pole and the element.

Groome addressed these and other concerns and sent us a preliminary design plan. He also had Jampro's in-house engineers check the wind load factors. Just to be certain it met our requirements, the station hired its own engineer to review the antenna's wind load characteristics. It not only met them, but the rig would be a few hundred pounds lighter.

We made several more revisions to the order to meet all our requirements for the design before I signed-off to have the antenna built. It would consist of an 85-foot high uniform faced frequency-matched tower section mounted with eight in-line JHPC "Penetrator" side mount antennas, the system rated to handle a 50 kW input.

Jampro JHPC-8 antenna on a frequency-matched tower section.

When the antenna was ready, station VP Jim Robertson flew me out to California to personally oversee the Frequency Matched Tower and antenna tests using Jampro's Pattern Optimization Service. There, I worked with Wayne Martin, Range Manager on Jampro's year-round, far-field, full-scale 700-acre test range.

OPTIMIZING

During the testing, Jampro people made several suggestions as to the best configuration for our facility. This was great because we could physically rotate the actual FMT/antenna combination and get a 360-degree view of what was happening in real life as opposed to in theory. You could see where the signal was going and mount the antennas on the FMT to the best advantage.

It is worth noting that no antenna, including a panel antenna, is perfectly omni-directional. In practice, pole mounts tend to "end fire" from the front of the radiators in the vertical plane while the horizontal plane tends to be somewhat circular – not very desirable for a station in the middle of the state.

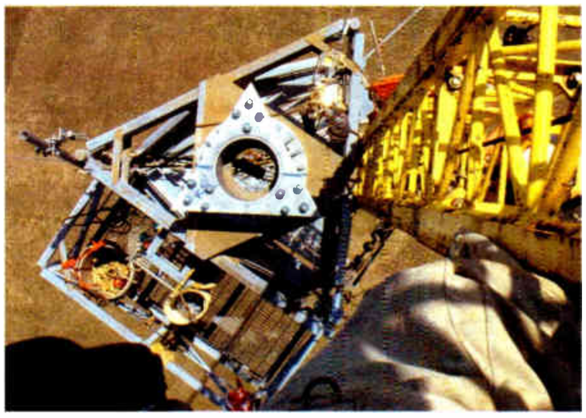
On the test range, vertical tuning elements were mounted on the Frequency-Matched Tower to optimize the antenna. This put the horizontal and vertical patterns in line with each other to make a generally circular signal pattern without having the dead spots that we had before.

In the end we were able to make our station much more omni-directional than it originally was – actually even more omni-directional than our old pole mount, which in years past was thought by many engineers at the time to be the most omni-directional setup possible.

MATING FMT TO TOWER

Once this was accomplished, Jampro fabricated an adaptor (1,200 pounds) to attach the FMT to our Stainless G-7 tower with coordinates for the best overall mounting location. The adaptor was designed so the coax could go right through the center, inside the tower – an advantage in protecting the cable from severe weather.

Building a major project such as this is very stressful. It takes big money and a collaborative effort of several parties. You are dealing with a very tall tower and then attaching an 85-foot FMT on top of that. It is very dangerous and there is a great potential for injury (or even death). Fortunately, I had a good rigging crew: Southeastern Communications Services out of Sarasota, (secs-wireless.com), led by Project Manager Allan Harrol.



Jampro manufactured adaptor plate to mate the Stainless G-7 Tower and the Jampro FMT section.

All of the Jampro components went together as they were supposed to and everything was rock solid. Jampro's mounting brackets and adaptors were all top notch. If a part was missing or had any problems, Jampro was immediately responsive and solved the problem.

EXCELLENT RESULTS

When we fired up the new antenna, it worked fine and has been working perfectly ever since. The station coverage is greatly improved with a stronger signal in all directions and no holes in the coverage. Before, we were very weak to the west coast, an important market. Now, we are now reaching 14 counties in north-central Florida and the signal can be heard as far south as Orlando, north to the Florida-Georgia border and we reach both the east and west coasts with a strong signal.

We accomplished our goal with a slightly reduced wind load. A spectrum analyzer shows that the VSWR is relatively flat. Reflective power is very low and we have a true circular pattern with more predictable coverage. After the recent tornado, I sent a tower rigger up to check the FMT and there was no apparent damage. (By the way, Jampro X-Rayed all the FMT welds before it was shipped to me and installed.)

Jampro worked hard on this one and they really came through. Initially, they were not my first choice, but their service, equipment, and professionalism changed my mind; I would use Jampro again. Bob Groome, my sales/engineering contact stayed the course with me throughout the entire project. If something went wrong – and let us not kid ourselves, stuff happens – he made good on it. In my book, Bob and Jampro are "top-shelf."

A SUCCESSFUL PROJECT

Arbitron today rates WOGK, K-Country 93.7 ("Today's Best Country ... Yesterday's Favorites"), #1 in its Top 100 market. I would like to think that my small company, the Jampro Frequency-Matched Tower, and the 8-bay side-mount, center-fed antenna array that we installed there played a small part in WOGK's current success.

From an engineering standpoint it has been a tremendous accomplishment simply because, from the day we turned it on and tuned it in, it has operated flawlessly. Better yet, it is still standing despite four major hurricanes and a tornado that carved a path of destruction just a mile southwest from the tower.

The most important fact is that the new Jampro FMT and antenna improved the station's market coverage significantly – I would guesstimate by about 20 to 30%. You cannot ask for a better result.

Tim McGuire is an SBE Senior Broadcast Engineer with 25 years experience as Chief Engineer or Contract Engineer for many Florida radio stations. An expert in broadcast lightning systems, Tim is President of McGuire Broadcast, Inc. Contact him at tim@mcguirebroadcast.com

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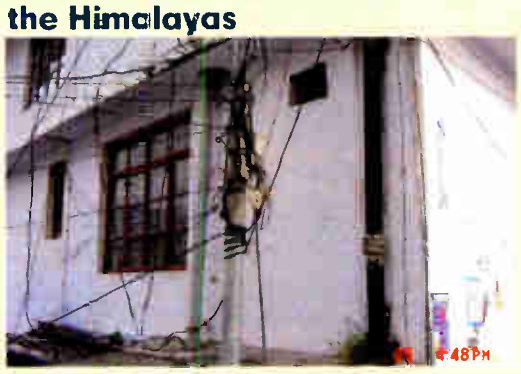

"The results [with ACCESS] were especially reliable considering that Dharamsala has one of most "problematic" Internet infrastructures that we have come across." — David Baden, Chief Technology Officer Radio Free Asia

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Ski Mountain Remote

This picture, really demonstrates what ACCESS is about. This product truly has the ability to cut the wires.

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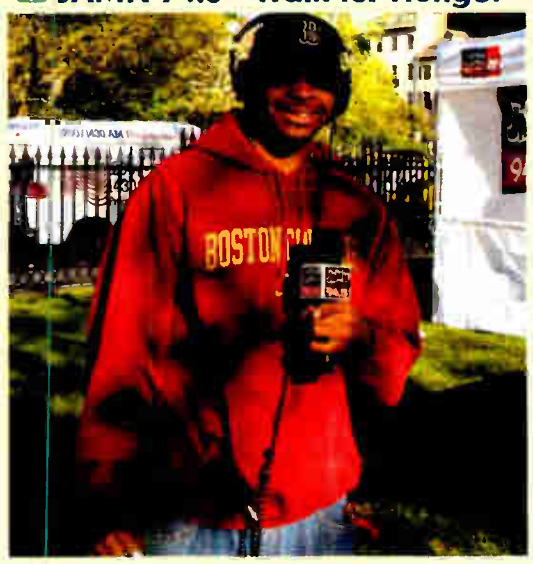
JAMN 94.5—Walk for Hunger



"ACCESS was used on the air exclusively for JAMN945 at this one. It was all over EVDO with a tremendous amount of active cell phones in the area. The ACCESS was connected to the Verizon wireless Broadband...

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COMREX

Transmission Guide

by Ron Nott

The Elevated Radial System

For more than eight decades the buried ground radial system has been the standard for AM broadcast antennas. When the FCC came into existence during the 1930s, standards were established that are still in effect today.

However, during the last two decades, computer analysis has determined that the standard buried radial system of 90 or 120 wires may not be the best that can be built. In fact, Numerical Electromagnetic Computation (NEC) indicates that an elevated radial system of only four wires can do just as well or better.

The only problem is that a four-wire system may result in some scalloping resulting in a slightly four-leaf clover pattern. To resolve this, a six-wire elevated system can be utilized, which results in minimal scalloping and an essentially omni-directional pattern.

BUT DOES IT WORK?

Sometimes the experts belittle anecdotal experiences as if they were fiction. They say that you must perform extensive scientific measurements to validate a theory. But who is going to perform these measurements on AM radio, a technological relic in the eyes of many?

When an elevated radial system is installed for an AM broadcast station, the FCC often requires an antenna Proof of Performance, because it deviates from the standard buried radial system described in the Rules. Such a Proof for a non-directional station is simple and inexpensive. For directional antennas (DAs), the cost is the same as for a non-DA because it has to be done anyway.

While we have furnished a relatively small number of elevated radial systems, the antenna Proof results have easily exceeded the FCC requirements. The point is that elevated radial systems have been proven to fully comply with FCC requirements for minimum field strength.

BURIED RADIALS

Ideally, radials should be laid directly on the surface of the ground because this would cause the least signal attenuation. But this is not practical. Radials must be buried for their own protection; otherwise they will be exposed to damage and theft.

Burying radial wires in the ground automatically introduces attenuation of the AM signal. It is caused by the dirt. The deeper the wires are buried, the greater the attenuation. Yet, even when they are buried, radials may be subject to pipeline or cable trenchers and farmers plows.

And do not forget, the velocity of propagation in a buried radial wire is determined by the relative permittivity (dielectric constant) of the soil and the burial depth. A quarter-wavelength buried radial is seldom, if ever, a quarter wave long as far as the RF is concerned. It is almost always longer than if it were in free space and its electrical length may vary with soil moisture.

DETERIORATION AND THEFT ISSUES

Futhermore, after radials have been buried for many years, it is impossible to fully know the condition of a ground system. Are the radials corroded? Have they been cut by construction?

Buried radial systems are normally made of pure copper. During the last six months, the price of copper finished goods has approximately tripled. In addition to a big increase in the cost of a new or replacement system, your copper is much more attractive to copper thieves.

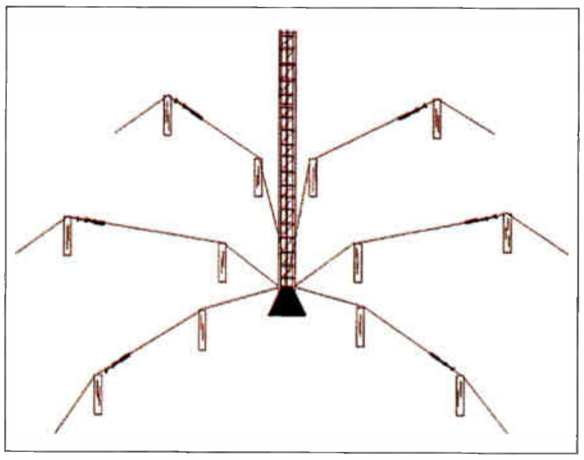
It is easy for the thieves. They come in the night and dig a hole near the base of your tower. They peel a few wires out of the ground, wrap them around the bumper of their vehicle and drive away. The wires peel out of the ground, the thieves coil them up and take them to the scrap dealer.

ELEVATED RADIAL SYSTEMS

A buried radial system is very labor intensive, not to mention the copper cost. An elevated radial system requires less labor and less in materials costs. Because it is up in the air, it is easily inspected at any time.

Imagine six wires equally spaced around your tower(s) tapering upward at about 30-degrees to posts about 12 to 15 feet above ground, then extending outward to another post or possibly two for a lower frequency station. The wires are attached to the ground rods at the base of the tower and by a ground strap to the ATU.

Beyond this ground connection, the wires must be insulated throughout their length. Each wire is slightly more than a quarter-wave long. A turnbuckle and tensioning spring provide adequate tension to support the wires. The posts may be steel or wood, but the wires must be insulated from them because considerable RF voltage develops at their outer ends. Back-guys may be needed at the outermost posts.



An Elevated Ground System

For strength, the wires are Copperweld, which, because they are made of steel with thin coating of copper, have virtually no scrap value. And they are much less costly than pure copper wires. Pure copper wires would stretch under tension, but the Copperweld will not.

There are wires up in the air, but they are high enough to allow vehicle traffic under them. If necessary, elevated radials can go over buildings, which is better than routing wires around or under them.

You can inspect the system every time you visit your transmitter site and the wires are not surrounded by dirt that attenuates your signal.

There may be RFR concerns with high powered AM stations, but because the current is divided six ways, radiation is minimal from each wire and occurs mainly from the inner portion of the wires near the tower where the RF current is the greatest. There is normally high RF voltage at the ends of the radials, but they are up in the air where they are safe.

ELEVATED RADIALS WITH FOLDED UNIPOLES

These two technologies work extremely well together in that the radial wires are bonded to the tower legs at ground level. The continuity for the RF current is ideal. While most of the RF current in a folded unipole is in the skirt wires, there is also current in the tower legs that then flows into the elevated radial wires.

Alaska is hard on buried radial wires. Each winter there is frost heave, which means that the ground moves around. This movement of the soil can break radials. One station engineer told me that he had to install a new radial system every three to five years or his signal went to pot.

His 10 kW station coverage had deteriorated greatly, so we furnished a combination folded unipole antenna and elevated radial system. One problem was the possibility of snowmobilers being clotheslined by the elevated wires. Elevating the wire to about ten feet above the deepest snow solved this. The end result was great. After installation, the station range was from 90 to 100 miles and more.

BUILDINGS AND PAVEMENT

Another story is about an old station on the west coast. As a result of the rainfall, the old tower had rusted away, so a new, taller one was purchased in order to install an FM antenna. The old buried radial system had deteriorated and, because the station was located on a small college campus, one-story dormitory buildings had been built as close as forty feet away from the tower.

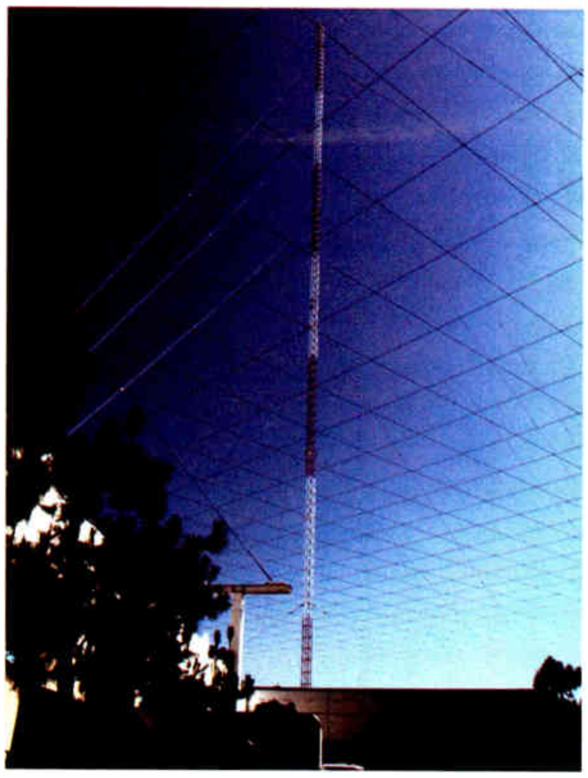
The station even had received an advisory from the FCC stating that they were not meeting the minimum field strength requirements, so they had problems.

The solution was to install a folded unipole antenna and elevated radials emanating out from the tower about 20 feet above ground. This completely solved the problems. The field strength requirement was now easily met and the signal gets out very well.

Nevertheless, because large trees cover the campus, I advised the engineer to prune their branches away from the elevated radials. When I spoke with him about two years later, he said that this was not necessary. Because the station is 10 kW, RF arcs from the wires just burn off the leaves and small branches. A breeze sways a branch near a wire and when it gets close enough, there is a zzzzt and the leaves and twigs just go away.

FLEXIBLE SOLUTIONS

An elevated radial system can solve many problems. If the transmitter site is in a swamp or lake, just elevate the wires above it. If the environment is not amenable to buried radials for other reasons (rocks, buildings, pavement, etc.), just go overhead with them.



This elevated system puts lots of overhead lines over an industrial park.

An elevated radial system is less expensive and performs equal to or better than a conventional buried system. Variations in pattern shape due to weather and season changes will be minimized. Plows and hooves are hard on buried copper wires. Now a farmer can grow crops or run livestock under the ground system.

Also, you can visually inspect the radial system any time. There is no more wondering about the condition of the buried wires, although a small fence may be required near the tower site to keep people away from the sloping portion of the wires.

Ron Nott operates Nott Ltd. in Farmington, NM, where he provides a wide array of tower systems and services. Contact Ron at ron@nottltd.com

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Transmitter Shack

by John Stortz

An Understanding of Lightning Helps Protect Stations

John Stortz lives in one of the more lightning-prone areas of the country, if not the world. His experiences in dealing with lightning damage, lightning prevention, and enhanced grounding just might be useful in your situation.

A lot of the mystery of lightning comes because a broadcast engineer is unable to measure the intensity of a lightning strike. One strike might be 10,000 Amperes but another one might just as easily be 100,000 Amps.

One Universal Ground Adapter I purchased carries a specification of 0.075 Ohms. That sounds good. But if it should be passing 10,000 Amps, there would be 750 Volts across this ground strap! At 100,000 Amps, the voltage could be *7,500 Volts!* Suddenly I realized I could be killed by touching two pieces of equipment that were both well-grounded.

Not only are there human safety issues, but this helps explain why a tower site might survive a severe thunderstorm today, then be blown up from one "bolt out of the blue" tomorrow.

NOT QUITE RIGHT

When we acquired WHGN in February 2003, it had been recently rebuilt by the former owner. The new tower was designed to support several cellular antennas in addition to the station's needs. The new building was also designed so space could be rented to future tenants.

Unfortunately, the cellular market began to shrink as consolidation took over. Anticipated tower revenue never happened. As costs mounted, some areas became compromised – like the grounding. As you might expect, this has caused problems.

The contractor "forgot" to finish grounding. A little digging revealed several useless ground straps.

During our first summer, we could barely stay on the air. Lightning destroyed telephone lines, as well as circuit cards in the strobe light controller, remote control, satellite receiver, and ISDN backup equipment. It clearly appeared that lightning energy was moving through the equipment to reach the utility ground.

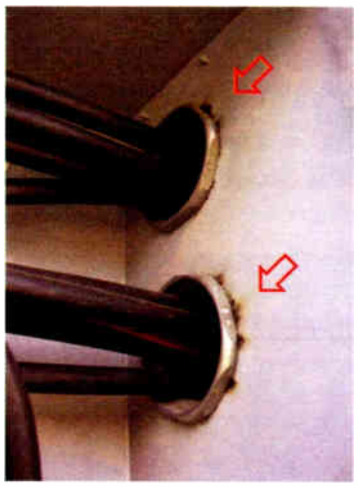
CALLING CARD

Among the reasons we suspected lightning damage to the gear were the many burn marks on electrical conduits, boxes, and other painted metal junctions at the transmitter site.

Along with equipment damage, lightning actually spot-welded the mounting screws into the rails of the ungrounded relay racks. We decided to run two-inch copper strap across the top, middle, and bottom of the racks and then connected the bottom strap to the station ground.

We also found:

- No grounding for the transmission lines where they entered the building.
- No surge protection for incoming electrical and phone lines.
- Inadequate bonding at the tower ground connections.
- Lightning-induced damage to the strobe light controller.
- Transmission lines and utility lines enter the building at opposite corners (inviting lightning energy to pass through the equipment, rather than around it).
- The tower and utility grounds were not joined.



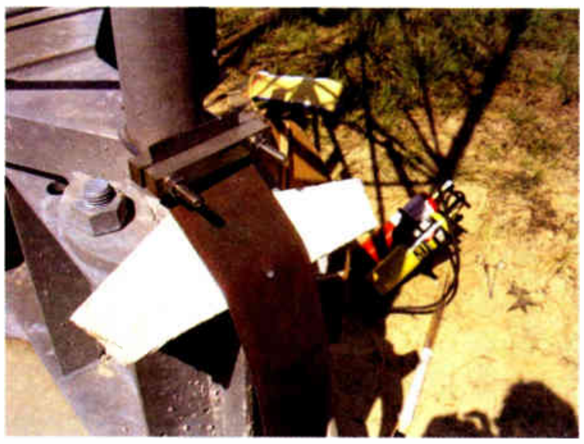
Burn marks on the WHGN main power conduit. A sure sign lightning had been here more than once.

POOR TOWER GROUNDING

As with WKZM, we found the ground bonding at the WHGN tower was not as good as it needed to be.

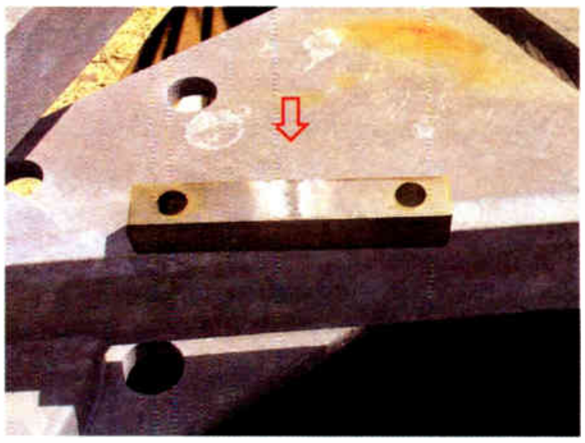
At first glance, we were very impressed with the tower grounding. Heavy copper strap was attached to the tower with a stainless steel clamp. Although it looked like there were no galvanic problems here, I added the scrap of a composite material behind the copper to prevent the copper from contacting the galvanized tower.

Furthermore, each of the tower legs had its own clamp and copper strap radiating away from the base.



An impressive looking ground clamp, but it really did not work all that well.

However, a detailed examination revealed there was very little surface contact. The copper was cut back to allow clearance for the U-bolt. Additionally, the flat bracket made little contact with the round tower leg. Upon disassembly, it became obvious not only how small the contact area was, but also that lightning had flowed between these pieces.



The ground clamp actually had only a small contact area. The pitting indicates where lightning current had passed.

FINDING THE PROBLEMS

Why would so much energy seek to pass through the equipment? As we discussed last month (***Radio Guide**, July 2006*), it must have been the easiest path.

Measuring one strap at a time revealed each strap was independent of the others and resistance was in the thousands of Ohms. Lightning must have been seeking the better ground, the utility ground.

The two straps which radiated away from the tower and building were only extended about 30 feet, connected to only two ten-foot rods on each strap. We extended the straps about 20 feet and drove 60-foot rods near each end, but left a pigtail beyond the last rod. Someday, we may need to extend the grounds even further.

GROUNDING TECHNIQUES

There seem to be two schools of thought on proper grounding techniques: single-point grounds and multi-point grounds. I would like to address the reasons of why we chose the multi-point grounding technique we used.

WHGN's greatest problem is poor soil conductivity. The site is built on a hill of sugar sand, which can have resistance around 5 megohms per square inch. One 60-foot ground rod measures about 4,000 Ohms on a Simpson 260. Our ground tester cannot measure above 1,100 Ohms. It is almost like the station was built on top of a huge glass insulator.

With that in mind, we prefer multi-point for several reasons:

1. With a guyed tower, grounding is already spread out over several acres of land because each guy anchor has a ground connection.
2. Electrical and telephone services have additional ground points.
3. In the Florida sand, conductivity of any one ground rod is very poor. The more points in parallel, the faster the energy can dissipate.
4. The way local electrical codes are written, electricians routinely drive two ground rods and inspectors demand it. So there really is no such thing as a single point ground.

DIFFICULT GROUNDS

We replaced eight-foot ground rods with several sixty-foot rods. (The longer rods are assembled from ten-foot sections connected with brass couplings; the coupling has an outside diameter about twice that of the rod.)

Unfortunately, as the assembly is driven into the earth, the coupling forces the soil out more than the diameter of the rod. Therefore, a long ground rod does not have the best contact with the earth until the soil settles back around the rod.

In time, the soil should settle back, however at this site, the soil does not appear to be closing well. Nearly a year later, one of the sixty-foot ground rods can still be easily rotated and lifted by hand; it would appear the sand has *not* settled back around the ground rod. Ground resistance has not decreased all that much, either.

(Continued on Page 10)

Transmitter Shack

by John Stortz

– Continued From Page 8 –

Driving ground rods in different soil types requires different techniques. At WKES, we used threaded ground rods, due to availability. The rods were driven into fairly firm earth. We noticed the rods would loosen and even work out of the coupling if we did not tighten them occasionally. At WKZM, we used compression couplings, rather than threaded. These appeared to work very well there.

However, compression couplings do not work in soft, sandy soil. We had problems with compression rods becoming separated from the coupling. We lost several rods, somewhere down below.

IMPROVED OPERATIONS

By August, WHGN was surviving most thunderstorms, using some temporary fixes – such as my automotive jumper cables – to connect the transmission line to the main electrical panel. It looked a bit goofy, but it helped keep us on the air.

We added several deep ground rods and additional copper strap to complete a "halo," or perimeter ground. A perimeter ground helps to maintain the same earth potential throughout the entire facility and prevent large currents passing through the station's equipment.

The only damage sustained in the 2004 and 2005 lightning seasons were blown surge protectors on the phone lines. (We suspect the energy is flowing from our local ground *into* the phone cable.)

UNEXPECTED DAMAGE

Lightning can also create less-obvious damage to an improperly grounded tower. Another Florida station had their antenna burn up three years in a row. After the third burn, the flexible transmission line was replaced and the old line analyzed.

Lightning had burned the outer jacket and water collected between the jacket and outer copper. There happened to be a pinhole-sized defect during manufacturing of the outer copper shield. When hydrostatic pressure became greater than the gas pressure in the line, water entered. Once inside the transmission line, the water vapor collected high up on the tower, where temperatures were cooler. When enough water collected, the antenna shorted and burned.

At WKZM, water entry was due to a faulty installation, rather than lightning. I discovered water dripping from the end of WKZM's flexible transmission line, indicating water had worked into the outer jacket of the cable. Slitting the outer jacket at the lowest point, I allowed water to exit outdoors, releasing the water pressure. At the first opportunity, a tower climber repaired the jacket.

NINE POINTS TO PONDER

To conclude, from years of experience, here are nine key points which contribute to a more "lightning-proof" station:

1. Lightning *will* strike a broadcast tower. Expect it to happen.

2. Lightning *will* take the easiest path to ground – even if the path includes vital broadcast gear. This is a difficult concept. Remember the Jacob's Ladder: current always flows in the easiest path.

If lightning damages a piece of equipment, make a better path to bypass the energy to ground around the vulnerable part or it will happen again and again.

3. Lightning consists of very high current. My rule of thumb is 10,000 Amps. If you have 10,000 Amps passing through one Ohm of resistance, there will be a difference of 10,000 Volts across this resistance during a lightning strike. One local electrician said 50,000 Amps is more realistic, but 10,000 Amps is easier for my simple mind to work with.

A one Ohm ground resistance is nearly impossible to achieve. A local power company attempts to drive ground rods to whatever it takes to obtain a ground resistance of 10 Ohms. If the resistance were "only" 10 Ohms, there would be 100,000 Volts in the ground system during a lightning strike of 10,000 Amps. Would anyone intentionally connect 100,000 Volts to their broadcast equipment?

4. Lightning consists of a number of high frequency pulses. Grounding designed for DC or AC power frequencies is of little use for lightning protection. Round, solid ground wires become inductors; flat copper straps are better because even ground rods have inductance as well as resistance. Ground testers are not likely to measure reactance, but it is a factor to consider.

Long ground wires and rods are not ideal. Keep the ground wires – or strap – as short and straight as possible between equipment and "ground."

5. Avoid sharp bends in ground wires and straps. Lightning pulses do not travel around sharp bends very well. Electricians like to make sharp bends in wires to dress them up, but it is more practical to have wide curves than sharp bends in ground wires. Also, keep ground wires as short as possible.

6. If you have the opportunity to design a new building, have all utilities pass in and out of the building near the same general area where the tower's RF lines enter and exit the building. This shortens the ground path, rather than risking lightning passing through the equipment as it travels from the tower to the ground[s].

7. If lightning appears to be unpredictable, it is because we do not have all the information needed to accurately understand it.

For example, why would lightning strike the side of a tower, rather than the top? Unseen masses of swirling air change the point of lowest ionization and, therefore, change the strike point. This can be demonstrated with the Jacob's Ladder: the arc can be made to go back down the "ladder," or even extinguished, by blowing on the spark. Similarly, lightning can be influenced by unseen air currents.

One engineer told me, "I have been around enough lightning to know that it will do whatever it wants and not obey any rules." Not so! Lightning *always* follows God's Laws of Physics as reliably as any other form of energy does.

8. Another engineer mentioned, "a major thunderstorm fried it all, from the phasing cabinet to the towers. All was replaced; but the insurance got more expensive."

Important hint: when making an insurance claim, include a detailed statement, signed by the station engineer, describing what was observed and what was done [or planned] to prevent future damage.

If the insurer learns the station took measures to reduce future risk and the station will likely survive the next storm, it may help prevent a rate hike. It certainly cannot hurt. On the other hand, if you expect your insurance to pay and pay, one day you will suddenly discover you are no longer insured.

9. Ground rods do not last forever. Soil can – and does – react, chemically, with metals. Ground rods can become dissolved, corroded and ineffective.

Ground rod resistance should be checked every five years, or so, to determine effectiveness. A ground tester is the most meaningful way to measure ground resistance. There are companies that will test a ground system for a fee.

Another possibility is finding a guy from a local utility who has access to the equipment and can test your site as a side job. We were fortunate to find and purchase a deeply discounted ground tester at a local electrical supply store.

The Jacob's Ladder demonstrates how lightning will always flow in the weakest path. If he learns from that simple experiment, a station engineer can protect important broadcast equipment from lightning damage, allowing him to stay home at night and catch up on his reading.

John Stortz is Chief Engineer for the Moody stations based at Clearwater, FL. When not dodging lighting strikes, John can be contacted at KA4FLX@aol.com

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12 lines, two digital hybrids, and superior audio performance. Desktop Director controller features handset, speakerphone and headset jack. Drop-in controls available for popular consoles.

New Call Controller has Status Symbols, DTMF pad and recorder controls (like Desktop Director), but lets talent use their favorite wireless phone or any standard handset for call screening.

Status Symbols show exactly what's what. Intuitive icons show calls locked on-the-air, which hybrid they're on, who's next in queue and more. So much better than a panel of blinking LEDs.

Assistant Producer enables talk show production via LAN or WAN. Status Symbols, Caller ID support, instant messaging and caller database are just a few benefits. Supports touchscreens, too.

by Jeff Johnson

Assessing and Assuring the Safety Competence of the Crew on Your Tower

A disturbing number of tower climbers have been killed in recent months. While few of us will ever find ourselves climbing or working on our towers, as engineers and mangers we likely will be hiring and overseeing the work of tower crews. The key question is: How can we ascertain that the work is being done safely as well as legally?

Any injury or death on a station's property is disturbing personally – and potentially devastating to the station's fiscal health due to lawsuits and/or lost air time. It makes sense to try to minimize such events.

Common sense methods and precautions are obvious, but there are other issues in play. For example, what is specifically required and enforced by OSHA?

TRAINING FOR SAFETY

Earlier this year, I attended a course at Comtrain (www.comtrainusa.com), in Monroe, WI. The course, "*Tower Climbing Safety and Rescue*," prepares and certifies participants like myself to have an understanding of legally required equipment and procedures for safe climbing and, if necessary, rescue of an injured or incapacitated fellow climber.

The rules and regulations set into law by OSHA predominately relate to employers. The policies to be obeyed by employees are those generated by their employer's internal imperatives in response to OSHA oversight.

This article is not intended as a comprehensive overview of these regulations, but as a practical guide for those contracting such work in order to judge the general safety awareness and compliance of those working on a station's towers and property.

PUTTING SAFETY FIRST

When assisting or observing a tower crew's work, those on the ground have important safety concerns to follow. For example, anything – even a small nut – when dropped from hundreds of feet can be lethal. Everyone within a radius of 50% of a tower's height should wear a hard hat. (Comtrain even recommends a 100% radius.)

Although other hazards such as weather and RF exposure potentially affect a climber, falls are the most obvious – and among the most deadly. As we will discuss, these are no places to take chances.

There are three terms to understand: fall *protection*, fall *restraint*, and fall *arrest*. Each has a particular meaning. 100% fall protection must be maintained whenever a worker is more than six feet above a lower level or the ground. Either of two methods is satisfactory – fall *restraint* or fall *arrest*.

FALL PROTECTION

Obviously, avoiding a dangerous fall in the first place is the best outcome. This is a role of fall *protection* and encompasses fall *restraint*. Fall restraint is one means or another of *preventing* a climber from being able to fall dangerously. Speaking plainly, fall restraint prevents any fall but a minor slip of a short distance.

Railings, temporary or permanent, are an obvious example of fall restraint. Towers do not employ railings except perhaps on platforms. A tower climber's fall restraint consists of positioning lanyards (ropes) and possibly apparatus at the waist such as a "pelican hook" (a large latching attachment device that looks like a pelican's pouch in profile). Fall restraint should restrict a fall to no more than *two feet*.

All such attachment equipment connects to a climber's body harness, which encircles the chest, waist, and legs of a climber. It likely also includes a seat consisting of a wide web or board on which the climber can sit while working.

Additionally, there will be "D" shaped attachment rings on each side of the waist belt for short horizontal attachment to the tower such as with a pelican hook, *spreader bar* (a stiff metal bar which connects on each end to the waist "D" rings and has an attachment hole in the center) or a *safety climb device* (a device which rides the safety climb cable provided on some tower's ladders and slips freely up but grabs tightly with any rapid downward movement).

There will be "D" rings for more vertical attachment via lanyards to the seat for hanging in a sitting position, and a "D" ring on the back between the shoulders.

THE PERSONAL FALL ARREST SYSTEM

A Personal Fall Arrest System (PFAS) consists of:

1. An anchor point.
2. A body harness.
3. A connecting device.

A PFAS is a component of fall protection designed to control and stop a fall. The back "D" ring of the harness is used as the connection point on the harness for fall *arrest*.

It is recommended that a PFAS be utilized whenever a fall restraint system is in use. Fall arrest is a safety backup that comes into play when a fall has occurred. Perhaps fall restraint might fail due to equipment failure, a bad attach point, or negligence. A fall then will be more than the maximum of two feet provided by fall restraint provisions.

MINIMIZING INJURY THE GOAL

It is important to arrest the fall in a gradual manner to minimize injury. Just as automotive air bags and chassis crush zones cushion occupants in a car crash, fall arrest gear must absorb energy while stopping the fall over an 18-inch deceleration distance.

This can be accomplished by a means of a shock absorbing lanyard attached to the climber's harness back "D" ring. When the fall occurs, the lanyard stretches 18 inches to minimize the rate of deceleration. It can be thought of as a specifically engineered bungee.

OSHA limits free fall to a maximum of six feet and the total allowable fall to nine and a half feet. It is important to keep the attach point to the structure of the PFAS as high as possible, preferably at the height of the harness attach point or higher.

The PFAS attachment must be made to an adequately strong (5,000 pound rated), favorably located anchor point. If no convenient anchor point is available, such as the void between the legs of a self supporting tower, a Temporary Horizontal Life Line (THLL) may be strung as an attach point. A secondary vertical safety rope properly attached well above the work position and with a rope grab on the safety rope attached to a shock absorbing lanyard connected to the back "D" ring also satisfies the 100% fall protection rule.

SELF-RETRACTING LANYARDS

Another fall arrest system is the Self-Retracting Lanyard (SRL). This is a spool of cable or webbing that operates rather like the retractor on an automotive seat belt. It allows two feet (24") of free fall, then 18" of deceleration. An SRL with a large spool of cable or webbing will allow greater freedom of movement about a work zone, while affording adequate fall arrest.

The attachment point to the tower should be at as small an angle above the climber as possible to avoid a horizontal swing should a fall occur.

There has never been a rule against riding the winch line. OSHA has stringent requirements, however. Two of the most prominent are the requirement of a trial lift before lifting personnel, and a ban on capstan-type winches. The full set of regulations is at:

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2770

IF A FALL OCCURS

If – unfortunately – a fall has occurred and the victim is in his or her harness hanging from the back "D" ring, the victim is not yet safe.

The danger here is that a climber may suffer suspension trauma, a topic covered in a previous article in ***Radio Guide*** (February 2004). Suspension trauma is a condition in which the straps of the body harness around the legs – which are now supporting the greater percentage of the body's weight – restrict circulation. Blood then will pool in the legs causing the victim to pass out.

To combat suspension trauma, newer harnesses may have a deployable lanyard, something like a jump rope to stand on, lessening the constriction of the upper legs.

QUICK RESCUE ESSENTIAL

In any case, the fall victim must be quickly rescued. He or she may be able to swing over to the tower and reattach, but in many cases will be hanging in mid-air. Another climber must now attempt a rescue.

The technique taught at Comtrain is controlled descent via a rope from above the victim, utilizing a descent device. The Comtrain session employed a Fisk Descender.

Eric Amundson of Comtrain demonstrates the Fisk Descender.

A Fisk Descender is rather like a double pretzel through – and around which – the descent rope passes with considerable friction. The friction is controllable by tugging or releasing the free end of the descent rope and increases with load thus making control somewhat independent of weight.

Rescuer lowers to above the victim's back.

HELPING SOMEONE DOWN

To effect a rescue, the rescuer attaches the descender device to a spreader bar attached to his waist "D" rings (something like a belt buckle). The descent rope is threaded around the descender, and with it the rescuer lowers himself to above the victim.

(Continued on Page 14)

"We outgrew our old studios. With Axia, that won't happen again."

"Kaya FM is a trailblazer. We were the first independent radio station licensed in South Africa after apartheid. We invented our own unique format, a mix of music and talk. We grew into one of the most popular stations in Johannesburg. And we completely outgrew our original studios.

"Moving to Newtown, the city's cultural and entertainment center, required 'showcase' facilities; **dynamic, striking studios** that mirrored the buzz and excitement of our station and community.

"We also needed a routing system that would **seamlessly link all of our studios** and news facilities — cost-effectively, of course.

"Our equipment search began with the usual suspects, but nothing clicked until we saw Axia. Using Ethernet switches and CAT-6 cable to share audio between destinations makes a lot of sense, and costs a lot less than those expensive mainframe routers. Axia is **more flexible, too.**

"This is **a system we'll *never* outgrow,** because we can expand it by plugging in more audio nodes wherever we add new inputs.

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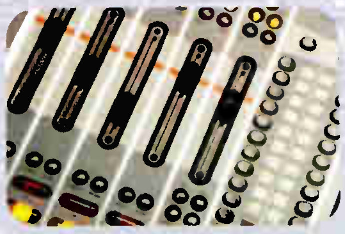

"I think **Axia was the perfect choice** for Kaya FM. We have all the functionality we wanted, and we got it for half the price of systems with less features. In fact, we've already ordered another new Element control surface! Axia is a technical dream... I can't imagine a better fit for our station."

— Russell Pope, Operations Manager
Kaya FM, Newtown, Johannesburg, South Africa

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Safety Guide

by Jeff Johnson

Continued from Page 12

At that point, the rescuer now can also connect the attachment point of his spreader bar and the descender to the victim's back "D" ring. These connections are made with what is essentially an openable chain link called a carabiner. The descender, the rescuer's spreader bar, and the victim's back "D" ring are now all connected at the same point.

In order to be able to descend from this point, the taut PFAS device of the victim must be unhooked or cut. The rescuer then relaxes the tension on the loose end of the rescue rope and the two people descend slowly to the ground or a platform.

The rescuer and victim begin their controlled descent.

The victim approaches safety.

ATTENTION AT GROUND LEVEL

The rescuer must be mindful to keep the victim upright on his knees for a number of minutes – and only then slowly lower the victim to a seating position and then a prone position. This procedure is outlined in greater detail in the aforementioned article on suspension trauma.

Careful attention to proper procedure is important. It prevents a rush of blood to the brain causing a stroke.

TALK IT OUT BEFORE CLIMBING

Although crew safety meetings are required only weekly, it is prudent to hold a safety meeting the first thing each day.

Four points should be discussed:

1. The location of a first aid kit.

2. The location of the nearest emergency medical facility and the location of the worksite if an emergency crew must come to the site.

3. A hazard assessment.

4. An understanding and agreement by each worker to an emergency response plan.

When observing a tower crew, if such a safety meeting is held each morning, an inspection of equipment is made before placing it in service each day, and employment of 100% fall protection is observed when above six feet, you can be assured that a fall or other accident on your site causing injury or liability is unlikely.

The author recommends acquiring the book "Tower Climbing Safety and Rescue" from Comtrain.

A longtime radio engineer in the Cincinnati market, Jeff Johnson can be reached via his website: www.rfproof.com

Independent Talkback

A Headphone System with Selectable Talkback for Each User

FlexPhones Master

The FlexPhones Master is a professional Broadcast/Studio six channel distributed headphone system with independent talkback capabilities. Each of the six channels provides stereo program monitoring and selective talkback with interconnection via CAT5 cable to multiple Active Headphone Remotes (AHR-1) and/or Monitor Selector Interface (MSI). Multiple masters may be cascaded to form larger systems.

The FlexPhones Master is equipped with inputs for stereo program and talkback audio. Rear panel program and talkback trimmers are provided to pre-set maximum input levels. The microphone/line level talkback input is available via a rear panel plug-in euroblock connector, while the front panel XLR connector facilitates the use of a user-provided gooseneck microphone or headset. The front panel is equipped with a level control for local headphones with both 1/4" and 1/8" stereo headphone jacks. The six front panel talkback switches allow the user to independently communicate with each AHR-1 listener and can be configured to insert talkback audio into only the left or both ears and dim either or both program channels. Any combination of switches may be pressed, while the "All-Call" interrupts all listeners. The Talkback function can be remotely controlled. Six RJ45 jacks are provided to distribute audio and power via CAT5 cable to the AHR-1's, which conform to the Studio Hub format. Low-Z balanced audio distribution is used to preclude audio degradation with long cable runs.

AHR-1 Active Headphone Remote

The Active Headphone Remote (AHR-1) contains a stereo amplifier designed to work with any combination of high-efficiency headphones with impedances between 24 and 600 ohms. The AHR-1 is equipped with 1/8" and 1/4" headphone jacks, level control, user-configured utility momentary pushbutton and LED indicator. Two rear panel RJ45 jacks are provided for connection via CAT5 cable to the FlexPhones Master. The AHR-1 may be desktop mounted, under counter or with the optional HR-1/MP or HR-1/MP-XLR mounting plates, which may be turret or counter-top mounted.

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INNOVATIVE PROBLEM SOLVING TOOLS FOR BROADCAST

RF Guide

by Alan Alsobrook

Spur Hunting for Fun and Profit

Recently during a round of Equipment Performance Measurements (EPM's) I discovered a spur on one of the stations I measure that exceeded the allowed emissions of Section 73.44 of the FCC Rules.

The interesting part is that the spur was coming from a different station. I was measuring a station on 930 kHz, when I heard the station's program audio on 1710 kHz.

SEEKING THE SOURCE

This is not entirely uncommon during NRSC mask measurements. Intermod products often result from mixing one station's RF in the PA of another close-by station.

When doing these measurements, the spectrum analyzer is tuned to the frequency in question. While the spectrum analyzer is measuring and storing the occupied bandwidth sweeps, I look and listen for spurs with an FIM 41 – comparing the audio from the spectrum analyzer's built-in receiver with the audio from the FIM, as I scan up the dial.

It developed that while I was scanning for any "misplaced" instances of the 930 kHz station I hit upon a signal with the same audio, but quickly noticed it was off-axis from the transmitter site. After a bit of direction finding, I determined it was emanating from Station A's site at a higher level than permitted.

In this particular instance it was easy to run the numbers in my head and know what was happening. In other occurrences a spur calculator program could come in handy to determine which mix products might be in play.

VERIFYING THE EMISSION SOURCE

Of course it needed to be fixed. So it was time to start at the beginning and determine how and why the spur was being developed.

In this case the spur was easily determined to be the mix product of the second harmonic of a station on 1320 kHz (Station A), less the fundamental of the 930 kHz station (Station B). Noting that the second harmonic was more than properly attenuated at Station A and far below the level of the spur, this gives us reason to believe that the spur must somehow have been generated in the power amplifier of transmitter A, then traveling back to the tower.

Using a sniffer probe connected to an FIM-41 around the PA of transmitter A it was easy to determine that this was in fact what was occurring. The second harmonic along with many mix frequencies were easily receivable.

PREVENTION TRUMPS FIXES

Once you know where the spur is being generated and what products are making it, the next step is to determine the best way to eliminate it.

There are two different ways to attack the issue: either block the spur frequency from being retransmitted or, better yet, prevent it from being developed in the first place. I was just a young pup when I had this situation explained to me by L. S. Stevens of Plough Broadcasting. His words of wisdom were, "Sure you can build a trap to block the spur frequency, but wouldn't it be much better if there was no spur generated that needed to be blocked?"

At that time Stevens was resolving a spur resulting from a mix of 590 kHz and 680 kHz by the 590 kHz transmitter in Atlanta. The spur was the result of 680 kHz mixing with the second harmonic of 590 – 1180 kHz. The result was 500 kHz, an international maritime distress frequency and one that got the FCC's attention very quickly. A very good and fast resolution was imperative. Steven's point was if you can keep the 680 kHz out of the 590 kHz transmitter, then you will not have the 500 kHz – or any other mix products – develop.

In this case Station B is about a mile from Station A. (There is a third station, on 600, that is also in close proximity.) All are 5 kW stations. Station A's half-wave towers seem to really like the fundamental of Station B and are able to couple quite a bit of station B's power back into transmitter A. So it seemed the best course was to find a way to stop station B's carrier from reaching A's transmitter.

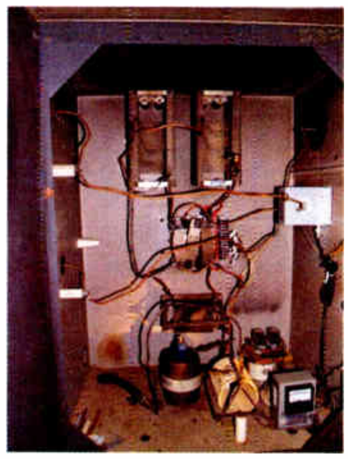
REASONING IT OUT

With the problem known, it was time to start working on a solution.

In this particular situation the transmitter was a BE AM-5. Like most of the newer (non-tube) transmitters it has a high-bandwidth output section and power amplifier. The broad design is a good aspect of transmitter design for outgoing signals, but it causes a bit more of a problem with incoming signals than its tube-type predecessors, which typically had a high-Q (narrow bandwidth) PA circuit and output stage.

An offending signal can easily get back into the low-Q PA. Once there it is able to mix with any of the harmonics of that transmitter and create new signals, which are then amplified by the PA and head back for the antenna to be radiated as a spur. The ability for a transmitter to receive a signal from the antenna, amplify it and send it back is sometimes referred to as turnaround loss. The higher your turnaround loss numbers are the less chance you have of a spur resulting from a mix.

In order to fully understand the circuit and make adjusting things more than just "a guess in the dark," it was necessary to create a schematic for the system. As has been said many times, before you start working on a DA, take your time and document everything.



The system was not new – nor well documented.

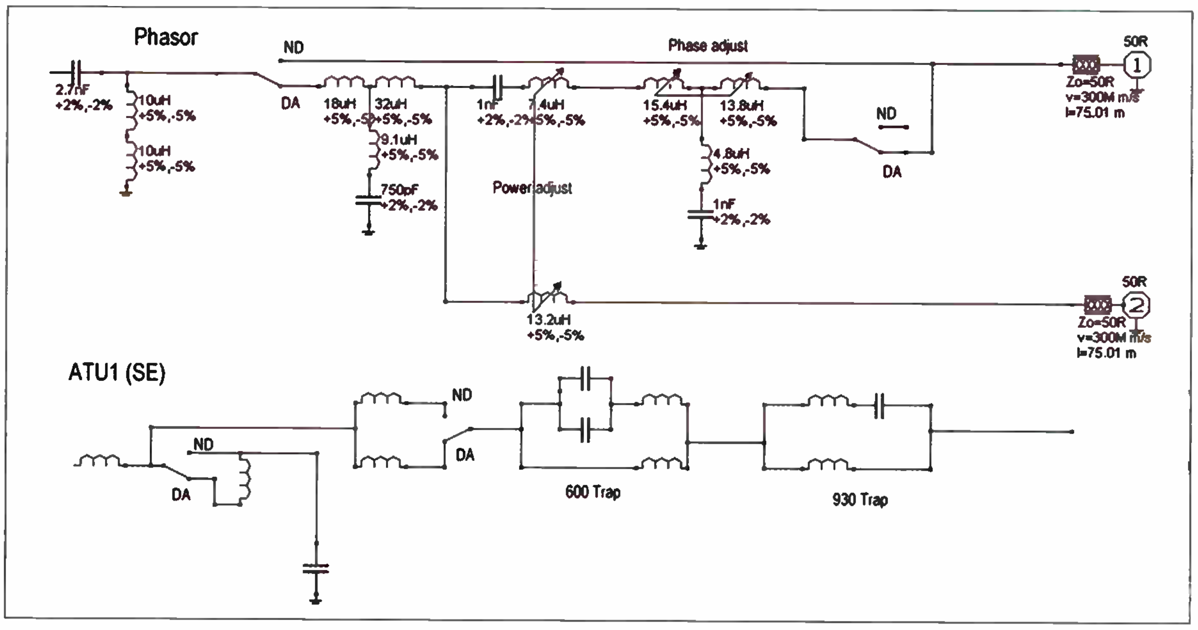
Therefore, before going any further, I made two trips to the site, shut down the system, and crawled through the phasor making note of every coil position and the "as adjusted" value of every component. From the sketches, I drew the schematic on the computer, so it could be annotated and printed out. The exact ATU values were not recorded, although they probably should have been, due to the need to return the transmitter to the air for morning drive.

While checking the system out, I noted an additional problem: the impedance of the day and night circuits were not the same and the transmitter was left tuned in-between the two patterns. It was right on the ragged edge of a VSWR trip in either mode. Obviously while fixing the spur, this problem needed to get corrected at the same time.

A COMPLICATION

While investigating troubles like this it is wise to take the time to note the licensed values and compare them to the hardware on site. At this station, I noticed the licensed Common Point was 75 Ohms, yet the feedline looked relatively new and was 50 Ohms.

The 75-Ohm Common Point – often utilized years ago – does present a bit of a problem for the newer 50-Ohm transmitters. They have a 50 Ohm output and *really need* to see 50 Ohms. The previous fix was to add an L-network just before the Common Point to make the transition to 50 Ohms.



A schematic drawing of the 1320 system, missing the values for the ATU.

This should explain why it is so important to do a detailed Equipment Performance Measurement, as required by Section 73.1590(a)(1) whenever a new transmitter is installed.

DEVISING A SOLUTION

To come up with a solution, a complete investigation of the transmission plant must be done. In this case, I was unable to locate any schematic of the RF circuits, the visual inspection showed an older 2-tower directional antenna (DA) array that many people have tinkered with over the years. The Antenna Tuning Unit (ATU) components showed their age.

Being a T-matching person, I was not too excited about doing it this way, but fellow engineer and ***Radio Guide*** writer Phil Alexander assured me that L-networks work very well, and it would be just fine to keep it.

Then we ran the numbers on what the L-circuit should be and that did not match with the existing circuit. This was something else to address upon my return to the site.

The difference in transmission line impedance was not really a big problem for the directional antenna (DA) pattern, but it threw a wrinkle into matching out the day impedance.

(Continued on Page 18)

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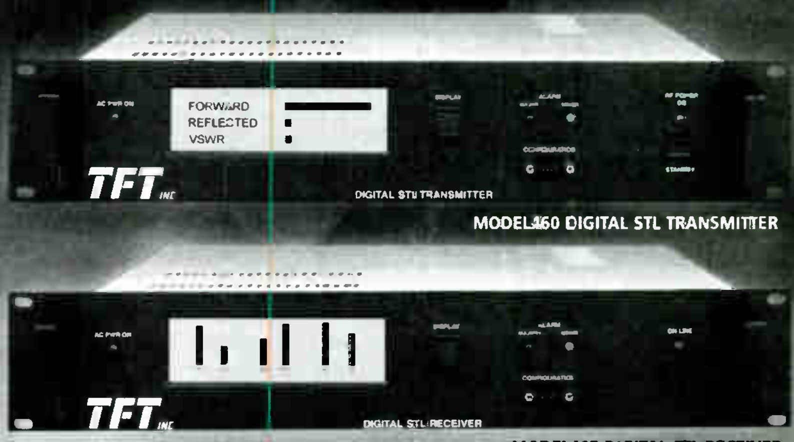

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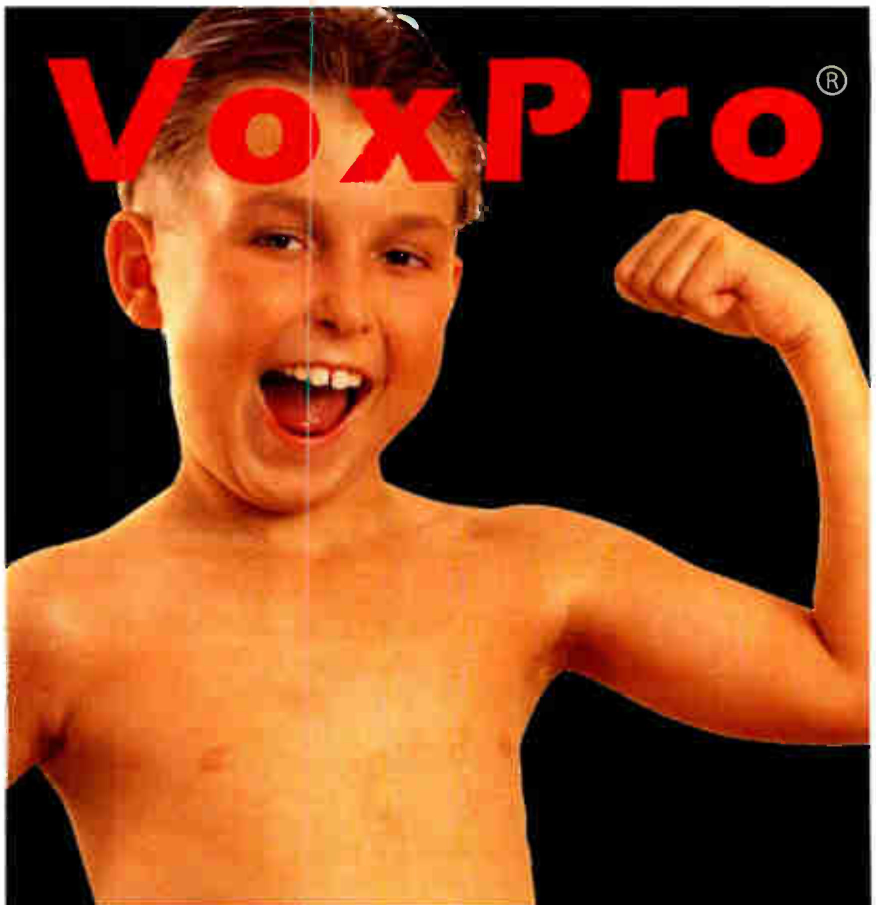

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RF Guide

by Alan Alsobrook

– Continued from Page 16 –

The components in the phasor were able to easily compensate for the transmission line in the DA array. On the other hand the non-directional (ND) mode is typically tuned at the ATU.

The problem is that if you tune the ATU for 75j0 and then let it go down a 50 Ohm line it is not going to be 75j0 on the other end. The transmission line will act as a transformer and change the Z presented at the other end. I added this to the list of things that need to be worked out.

A PLAN OF ATTACK

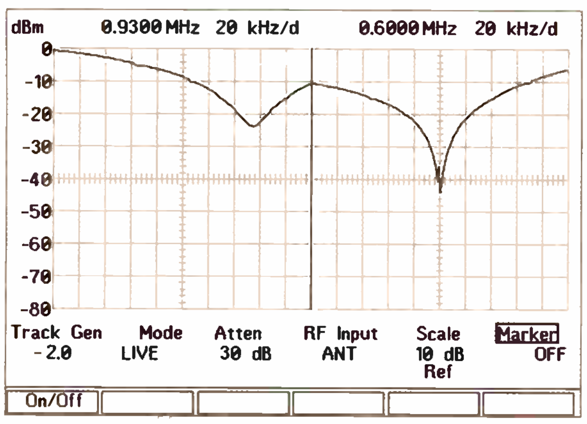
With a schematic drawn, it was easy to determine that a box of extra components I noticed mounted on the left side of the ATU were series reject filters for 930 kHz and 600 kHz. Obviously someone had run into this problem before at this site and fixed it at least once. The question that now came to mind was whether there was something wrong with the trap or will I have to add more attenuation?

With the information at hand at least now an attack plan can be developed.

1. Check the existing trap and adjust or repair as needed.
2. Check spur level.
3. Add additional trap if necessary.
4. Verify all directional parameters and set Common Point to 75j0.
5. Rebuild L-network ahead of the Common Point to give the transmitter 50j0.
6. Check and adjust the ND and set for 75j0 at the phasor.
7. Verify all parameters and pattern switching one more time.
8. Pack up and head home.

PUTTING THE PLAN TO WORK

Back on site, it was time to check the existing traps using a spectrum analyzer with a tracking generator. The source of the troublesome spur was quickly seen.



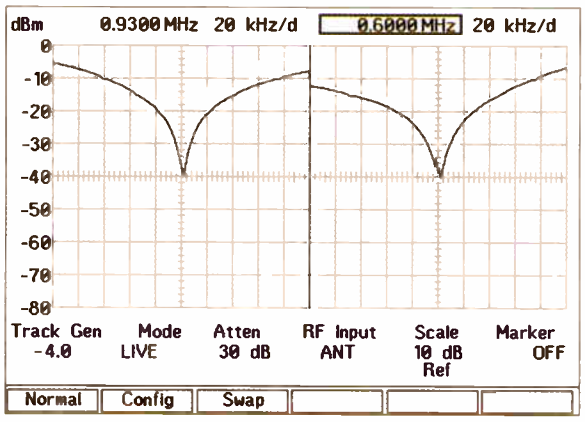
Sweep of the output network before adjustment.

The 930 kHz trap was not on 930 kHz; it looked a bit more like it was on 985 kHz and only providing about 8 dB of attenuation on 930 kHz. It was time to start making some adjustments.

It was clear the pass circuit was working correctly, so the only adjustment to be made was on the reject coil. With a series trap there are two legs; one is a series resonate with a capacitor and coil to pass the desired signal, and the second, which is usually one component to parallel resonate the circuit, to block the undesired frequency.

As I started to make the adjustments, the age of the circuit made itself known. The coil clip did not want to make good contact with the coil and the braided wire strap that was used did not want to maintain contact with the clip. That called for another quick repair; the clip and wire were replaced with a new clip connected with silver plated strap.

With just a few slight adjustments the filter was looking much better with 40 dB of rejection of the undesired frequency.



Sweep of the output network after the adjustment.

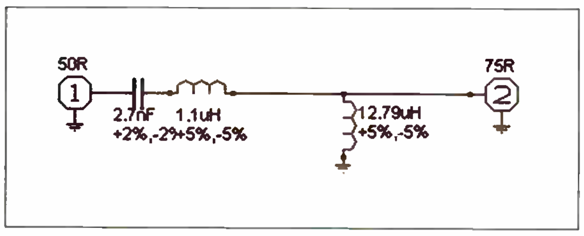
A check for the spur was then made on site and the spur now measured 30 dB lower than it did before the adjustment. Fortunately, I had achieved success on step 1 – all the DA parameters were right on the money; there was no change to them at all. That allowed me to drop step 3 from list. All in all, things were looking pretty good!

CLEANING UP THE OTHER ISSUES

Now it was time to let the transmitter see 50 Ohms. At this point, even with the Common Point sitting on 75j0, the transmitter was seeing something different than the desired impedance.

The only way this had been tolerated in the past was that this BE AM-5 does have tuning and loading controls. Most of the newer AM transmitters seem to have removed these adjustments as a cost cutting feature, so they have to see something very close to 50j0 or they just will not run!

The calculated values for the correct L-network (looking from the transmitter) was a series .0034 uF capacitor followed by a 12.78 uH coil to ground. The existing circuit had a .0027 uF capacitor and two coils – a 10 uH and a 20 uH.

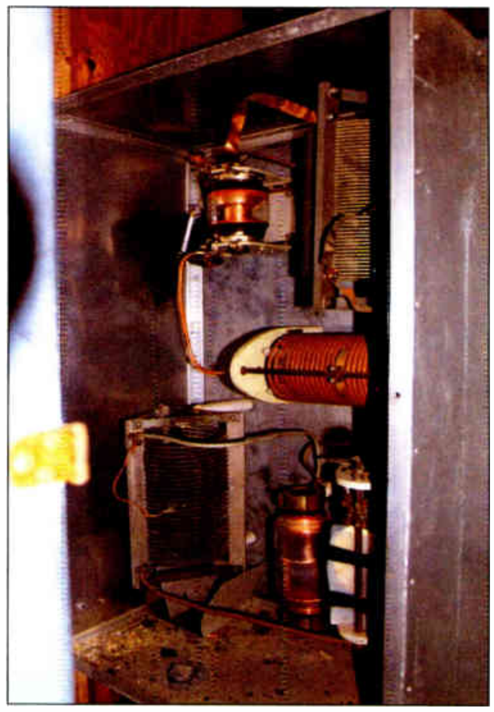


The redesigned L-network.

Doing a few quick mental calculations, I saw that putting a 1.1 uH coil in series with the capacitor would make it look like .0034 uF, so that would work.

The way the 10 uH and 20 uH coil were mounted (obviously in a hurry, probably about 0530 in the morning as dawn was breaking and the PD was screaming about missing morning drive), it would really be nice if one of the coils could just go away. It seemed to compute: 20 uH - 1.1uH - 13 uH = 5.9 extra uHs. That seemed like enough microHenries to me, so one coil could be used as two. It is a bit more complicated to adjust – you must realize that you are making two separate adjustments if you move the center tap.

It was decided the capacitor should be attached to the coil, then 1.1 uH down the coil a tap would be drawn off to go to the Common Point and 12.79 uH further down the coil it would be tapped to ground.



In the end, all it took was a quarter turn of the coil to fix the problem.

What do you know, Phil was right! (He usually is right; we just do not want to let him know that.) We now had 75j0 at the Common Point looking like 50j0 at the transmitter.

BALANCING MODE LOADS

With that all done it was time for my final feat of the evening: removing the difference between the day and night impedance at the transmitter output. This would prove to be a bit more difficult.

Back out at the tower working on the day ATU, I was able to move the resistance value up to 75 Ohms without a problem. To do that I was adjusting the output leg of the T-network. Of course, this is where one normally would think to adjust the reactance (j) and not the resistance (R).

For that reason, once the R value was up, I tried in vain to try to correct the j. No matter what adjustments I made I could not get the j to move in the direction I wanted.

Back at the phasor, we were seeing an impedance of 75+j18 Ohms that would not budge. To do anything any more drastic would require that I get into the common circuits for both day and night. I really did not want to go there so, for better or worse, I decided that I would remove the j at the phasor. Doing some quick calculations I came up with something like a .008 uF capacitor in series.

I had only brought smaller value capacitors with me, so it was time to scrounge around the site. After looking through all the caps that were stored at the site the biggest one we found was a .0012 uF. (Curiously, this .0012 capacitor had a sticker on it that said "good removed from WLW-1 10-12-66." I guess this is a traveling capacitor.) Using it and the 10 uH coil that was removed from the L-network I was able to wash the j out and get a 75j0 that perfectly matched the DA Common Point.

FINAL CHECKOUT

A quick final check through all the parameters and pattern switching showed that everything was operating just fine. The DA was running right on the numbers, when we switched the system to non-directional and back, the reflected power meter just sat on zero. The whole system appeared to be happy. It was time to pack up and head home.

A few days later I dropped by the station and redid the EPM measurements. This time, the station passed easily.

Alan Alsobrook, CSRE, AMD, is a Contract Engineer based in St. Augustine, FL. He also serves as the Alternate FCC Inspector for Florida. If that were not enough, he runs around in fire trucks. Contact Alan at aalso@bellsouth.net

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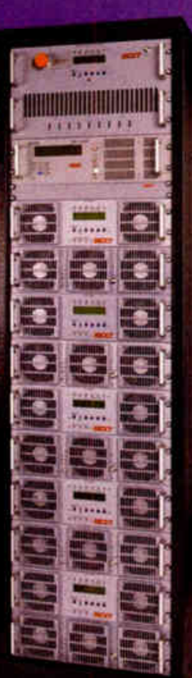

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A Radio War Story

by Rockwell Smith

Fixing Problem Sites Can Take Time

If you happened to have been there, you might well have asked why I would be standing around, draining water out of a transmission line as if it were a fountain. It looked a little silly, but that was only the tail end of a number of strange problems which I had to face at that particular site.

AN ALARM SIGNALS TROUBLE

This little mess all came to light the day the transmitter dumped. The remote called to tell me we were off the air. I tried the usual re-start sequence and each time there would be a blip of RF apparent on the receiver, but the transmitter would drop immediately. It was that tell-tale sign of the transmitter hitting an overload when it comes up.

So off I went, up the hill. Once in the transmitter building, I immediately saw the VSWR overload lamp was lit. As I investigated the situation, applying power brought the Forward Output Power meter up to about 50% or 60% and then, with a quick "thunk," down it went.

Switching the meter to Reflected Power, I hit the plates and the meter pegged almost instantly. However, when I switched the transmitter to the dummy load, all was OK. So, the fault was a real one. I began thinking, "This is *not* a good thing."

NOT A PERFECT SITE

Perhaps a little background history is in order here. There were some other strange things that led up to this point.

Since I took over the engineering for this station in 1996, I was not involved in any of the original installation or upgrading. But, I did know that this antenna and four-inch line were put up in 1987 at the same time a new Harris FM35K was being installed.

During the installation of the new antenna, the previous antenna – still in service at the time – failed catastrophically and burned up. The station immediately got permission to operate with the new transmitter and antenna as soon as they could be on line.

Of course, in the rush to get back on the air, many corners were cut and many items were never really completed. These all came back to haunt the station many times over the following years.

SOME BASIC PROBLEMS

There were two items that were immediately obvious when I started with the station in 1996. The first was that the control board in the FM35K would fail often.

The station had two control boards: the one in the transmitter at any given time – and the one at the factory being repaired. These traded places far too frequently. There was a controller failure two or three times every year.

The other issue was plate blockers. The station had been running at reduced power for months, if not years, because at full power a blocker would last about three months. Previous engineers and management blamed the transmitter – serial #0001 for the FM35K series. They simply figured it was a problem child.

ONE PROBLEM DOWN

After I had been there about a year something that should have been very obvious suddenly jumped out at me. The transmitter had never been properly grounded. The only grounding was the negative power supply lead, the AC ground, and the antenna.

When I contemplated what could have happened, I was glad the main damage was the periodic controller failure. Some four-inch strap and an afternoon with the brazing torch solved the grounding issue, and we never had another controller fail.

AN OLD SOLUTION RECALLED TO MIND

The plate blockers, however, were still an issue. The transmitter spent more time with the supply switch in the half-voltage position than it did at full power. After some lengthy discussions with Harris and a recollection from many years ago when I installed a new transmitter for another station at this same mountaintop, we discovered the root problem.

I had remembered that the new transmitter (an AEL I was installing in 1974) blew its plate blocker while we were tuning it for the first time. Upon questioning the factory (in 1974 AEL did have good support), they asked me what the elevation was. When I told them it was 7,200 feet they immediately said they needed to send a new blocker that had additional insulation for the elevation.

I passed this recollection on to the Harris engineer. He did a little checking and discovered my current Harris transmitter had been tuned and tested at the factory for operation at sea-level. Further checking indicated several changes that were recommended for our elevation had never been done. Harris agreed to send a factory engineer out at no charge other than hotel and meals for the two days it took to look at our FM35K.

The tech and I spent two nights making the minor modifications and installed their new plate blocker (the one they were then putting into their new T series). I am happy to say I never have had to install another blocker since, and the box was perfectly happy at full power (which, at that time, was 34.5 kW).

A NEW ISSUE

The following spring, on the first really warm day, the transmitter once more went quiet. For what seemed to be no reason at all, the main disconnect fuses (175 amp fuses in a 200 amp panel) had opened.

The fuses were replaced and everything seemed fine – for two weeks. Then the fuses opened again. Research turned up the following: While the panel was rated at 200 amps, a continuous load of nearly 150 amps was creating enough heating to weaken the contacts, causing further heating and ultimately the fuse failures. This had never been obvious before since the transmitter had never run long enough at full power create the problem.

An analysis of the load by our electrical contractor resulted in our having to upgrade the disconnect to 400 amps, fused at 200 amps. It had really never been done right in the first place.

TRIMMING THE COAX

Perhaps you recall how the antenna and line were rushed to completion. The coax was forty feet longer than necessary but, instead of cutting off the extra length, it was left lying on the ground.

Although there was an ice-bridge about eight feet off the ground that the other feedlines followed, this one came clear to the ground at the base of the tower, had a big, sweeping loop, and then went up into the building about ten feet above ground. Aside from looking bad there never was a problem with the line being on the ground.

In 1999 the station was inspected by our present owner prior to the purchase of the property. One of the issues to be corrected was the coax. It was to be shortened and attached to the ice bridge so that it no longer was on the ground. This was done and I must admit the installation did look better. Unfortunately, it did not last.

NEW PROBLEMS

Five days later, in the middle of the day, I was informed by the person on the air that the station sound is "full of static." I called the remote control to verify the power output and discovered only 12% output was indicated from the full plate voltage and normal plate current. That meant 88% of the power was going somewhere it should not be going.

I shut the transmitter down and headed for the hill. The problem was pretty obvious: I discovered the output filter in the Harris was toast. The outer conductor had burned completely through all the way around the filter.

This ex-filter was not going to transfer power very well.

At the time I had no idea why this would have failed. My only recourse was to replace the filter with a piece of hardline, cut back the power, and wait for a new filter. The new filter arrived in a few days, was installed, and everything looked like it was back to normal.

NOT QUITE SOLVED

I kept the power down for three or four days and then put it back to a full 100%. All seemed OK, until five days later when the power was down again, despite full voltage and current – and I found the new filter had burned through, just like the original.

All this happened with a sale pending and I had no clue why it kept blowing up. As the deadline for closing run out, the sale was finalized with a $20,000 allowance given because of the unsolved transmitter issue.

The station remained at reduced power for a few months as the problem was pondered. Finally our consultant was on the hill with me and noticed something, asking, "Is the coax grounded between the tower and the transmitter?"

Well, it was not. When it was shortened and attached to the ice bridge, the grounding kits were overlooked. It had not been grounded before and there was no problem. But apparently, when it was lying *on the ground*, it dissipated enough RF that additional grounding was not needed. When it was raised and attached to the ice bridge it needed to be grounded. Grounding was installed and the problem was solved.

LOW PRESSURE

I have purposely not addressed the matter of line pressure until now. This was another item that was overlooked in the original installation.

The previous owner's attitude was that there had never had been a problem and so it was not worth the trouble (and expense) of pressurizing the coax. However, when we shortened the line, I did note that a fair amount of gas escaped when we opened it; I borrowed a tank and gauge and re-pressurized the line after shortening it.

A year later it still held pressure so I did not worry much about it either – although in hindsight, I sure should have paid more attention to it.

(Continued on Page 22)

A Radio War story

Continued from Page 20

FINDING THE VSWR CAUSE

With the history lesson complete, let us return to the matter of the hard VSWR trip.

It had been a wet winter, and there was still snow on the ground. There had been lots of ice on the tower and it had gone through several cycles of icing and melting the previous weeks. When the line had been re-routed, there was a low spot where it left the tower and then went uphill to the building.

After pondering all of the possible scenarios, I took a chance and drilled a hole at the low point. We hit a gusher and drained about two gallons of water out of the line.

The line was not quite as dry as it should have been.

After draining the line, we cautiously applied about 20% of normal power, and it was fine. A day or so later we brought it up to 50%; it was still OK.

NOT QUITE DONE YET

Now for the irony. I had insisted the hole should remain open to continue to drain any additional water that might still be in the line or prevent a new build-up of water.

I was overruled by my superiors and we plugged the hole. Of course, within three weeks we had another hard VSWR trip. So, I removed the patch, drained more water, and this time I won the argument about keeping the "drain" open.

We were scheduled to install a new antenna and new line that summer, so we kept the power around 60-70% and had no additional failures. When the old line came down, we found where some loose hardware had worn through the coax jacket and the outer copper, and created a leak.

This was the place the dry air got out and the water got in.

The problem spot had been mounted about two-thirds of the way up the tower.

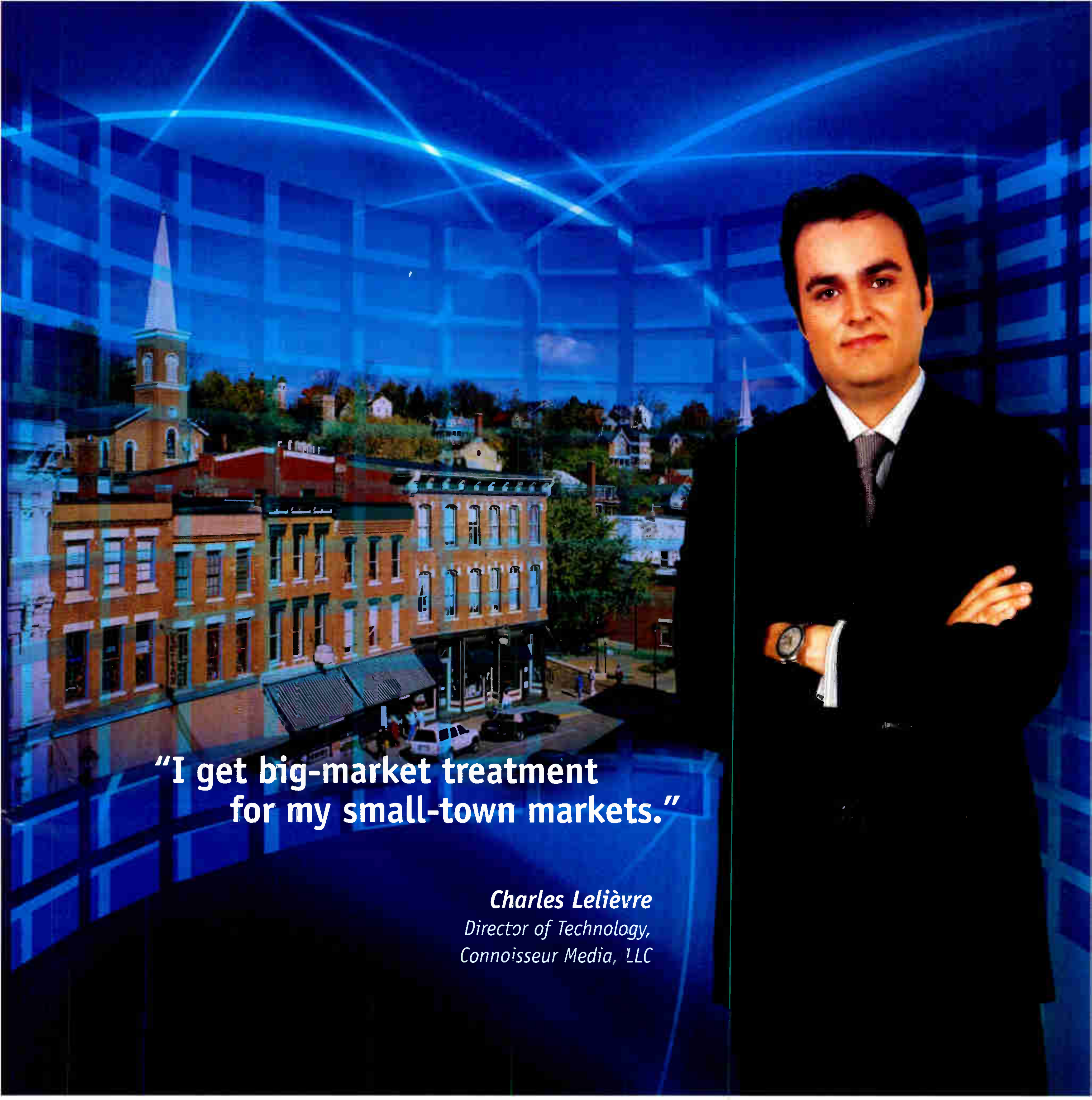
Water in the line plus high power equals bad coax.

After the new line was installed, we cut open the line at the low spot. Sure enough, we found that the inner conductor had been badly burned by the arcing.

These days, I now am much more diligent about checking coax line pressure. Furthermore, any time tower work is being done, I now insist on having the whole coax run inspected for anything that might be loose and/or could rub against the line.

It is better to do that than find yourself watching as gallons of water stream out of a damaged length of coax.

A veteran broadcaster for over 44 years, Rockwell Smith is the Radio Engineering Manager for the Journal Broadcast Group stations in Boise, ID. He can be reached at rockwell@rmci.net



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Signal Guide

by Lyle Henry

Modulation Monitoring in the Digital Age

Ever since the FCC deleted the requirement that all stations maintain a calibrated modulation monitor to ensure compliance with the Rules, the number of stations that operate with old, out of calibration units – or no monitor at all – has grown from a few to many. Some claim that they use an oscilloscope to ensure compliance.

In this article, Lyle Henry helps explain why scopes might not be "generous" enough, especially when digital transmission is taken into consideration. Worse yet, without the proper tools, stations may be cheating themselves of valuable modulation.

Understanding how to measure the modulation of broadcast transmitters is important in staying compliant with the FCC Rules and Regulations. Engineers need to know what the FCC Rules say about what constitutes a modulation peak and, now, how to read digital modulation.

Just as importantly, being aware of the limitations of the indicating and monitoring equipment in use is essential to getting the most out of your spot on the dial. And with the rollout of IBOC transmission, much of the legacy equipment can be misleading, if not just plain inaccurate.

SOME BACKGROUND

FM stations are limited to 100% modulation, but are permitted to increase that by 1/2 of the SCA modulation they are using, up to a total of 110% modulation. AM stations are limited to 125% positive and 100% negative peaks, although for all intents and purposes, an AM station would not want to go all the way to -100%, which is the point the carrier is pinched off, and heavy distortion as well as adjacent channel splatter occurs.

Our analog FM modulation monitors (including modulation indicators on exciters) have historically been too fast in responding to modulation peaks. The result is that stations attempting to be legal often cheat themselves on average (RMS) modulation.

Eric Small at Modulation Sciences addressed this problem with the ModMinder and published papers explaining the phenomenon a number of years ago. Later, Arno Meyer at Belar Electronics Laboratories developed his solution, called The Wizard.

DEFINING A PEAK

So what is this FCC peak issue on which Eric and Arno took advantage? Simply this: that a peak was defined as being 10 cycles of a 10 kHz sine wave (from back when the FCC listed specifications for monitors). This is equivalent to a time span of one millisecond. And stations appeared to be allowed to have up to five such peaks within five milliseconds, resulting in essentially a five millisecond burst (50 cycles) before it had to be counted as a peak.

Now, fast response in a monitor is nice if you want to know exactly what is happening with your station. We do not want gear that lies to us when we are trying to figure out what is going on. But being able to then slow the peak display down and take advantage of the Rules is a very desirable feature.

Both the Modminder and The Wizard offer such adjustable "peak weighting" which can be set to ignore short peaks. The selection is in terms of "cycles of 10 kHz sine waves" up to 45, or a small safety margin below the magic five millisecond FCC peak.

PEAKS THAT ARE NOT PEAKS

Another contributing factor is that the more complex the waveforms (L+R, pilot, L-R, RDS, SCAs) making up the total signal, the more insignificant peaks will be present. Thus the benefits of peak weighting become increasingly more relevant.

We are going to have analog for a long time yet, and those who are not using a modulation monitor with peak weighting are probably cheating themselves on modulation. If running a digital SCA, such a monitor becomes essential.

THE DIGITAL CONNECTION.

Digital SCAs can really bite us in the modulation if we do not take full advantage of modern test gear. Digital signals have peaks that are often several dB above their RMS power. Generally, the higher the data speed and the steeper the sides of the occupied digital bandwidth, the greater the peak to average ratio becomes. 3-6 dB are commonly seen. More may occur.

As an example, when running a digital SCA, an indicator without peak weighting will show lots of short wispy peaks with little energy in them. If the digital signal has a 6 dB peak to average ratio, often called the "crest factor," that signal would show 20% injection when it had an RMS injection of only 10%.

Since we are measuring voltage when we talk about injection, 10% is just 1/4 the power of 20%. But RMS power is what does the work! Even though the Rules permit increasing station modulation by 1/2 of the SCA injection up to 110% when adding subcarriers, there is no point in losing more main channel modulation than necessary and having SCAs that are not as robust as they could be.

Lyle Henry is a long-time engineer in the Los Angeles market and a well-known consultant around the world, specializing in SCA applications. Contact Lyle at lylehenry@fastmail.fm

Tech Support Forum

by Ted Alexander

Tech Support Follies

"Hello. Tech Support. How Can I Help You?"

With those words, tech support people throughout the industry handle calls from all sorts of customers. Some of them even have technical experience. Many anecdotes exist regarding some of the interesting problems and questions asked.

Did you ever wish you could be a "fly on the wall" to hear what really goes on when a tech support person goes into action? Ted Alexander lets us in on some of the good stuff.

In the late 60's, Joe South wrote and sang "*Walk a Mile in My Shoes.*" For over 40 years I was on the station side of the fence, doing air shifts, getting great ratings, supervising construction of some 50 kW blowtorches, installing HD AM and FM – in general, doing what a broadcaster does.

Now I work on the "other side" – the tech-support side of our industry. I thought you might be interested in some stories about a few of the stranger calls we have handled; calls that could drive a tech support person crazy and/or make one wonder just what kind of qualifications the person on the other end of the call really has.

I have "Walked the Miles" as a station engineer, but if you have never answered a tech support line, then walk a few miles with me (carrying your FIM-41) on this side of the fence. Names and places have been disguised, but the story line reflects *actual calls*. I sincerely hope you do not recognize anyone here.

"IT'S NOT MY PROBLEM YOU DIDN'T FIND ANYTHING WRONG"

Reading and having a basic understanding of the operating manual would seem elementary, right? But, sometimes an experienced support engineer wonders whether if the caller even unpacked the manual in the first place.

Here, a customer had sent in a unit that he just could not get to work. We checked it and found it met all specifications. On the test bench it worked just as it should, so we sent it back.

Tech Support Rep: "Hello, tech support."

Caller: "Can you tell me what was wrong with my unit?"

TSR: "Yes, we found no problem with the electronics. When we checked your unit we found that your input and output pots were both turned all the way down."

Caller: "So, all you guys did was turn up the pots?"

TSR: "Yes."

Caller: "Then why do I have to pay for repair time when nothing was wrong?"

"IT'S YOUR FAULT!"

Every so often, when someone in the field cannot make a piece of equipment work, we get an angry call. It certainly cannot be his fault! Someone *must* be to blame – and it is not going to be him.

TSR: "Hi, tech support."

Aggravated Caller: "Your service department must be asleep!"

TSR: "Why?"

AC: "I just got my unit back, plugged it in, and it is completely dead – no lights, no sound."

TSR: "Have you connected all the cabling just as it was before you sent it in?"

AC: "Yes ... and it is on a UPS, too. I made sure to mark and label all the connections and hooked it up exactly as I had it before."

We went through all the connections and, just before I was ready to have him pack it up and send it back, he asked one more question: "What's that plastic thing by the plug that has a "One" and a "Zero" on it?"

You just have to know I cannot make these things up.

CALLER EDUCATION

TSR: "Hello, this is tech support ..."

Upset Caller: "Hello. I just got my hybrid back from you guys and it still doesn't work."

This customer had returned a hybrid complaining that it never did work correctly from "day one" and, right out of the box, the auto-answer function did not work. He was additionally frustrated that we could not find any problem with the unit after he sent it back under warranty. I checked and learned our service guys found it met all factory specifications and all functions were normal before we returned it.

Now, occasionally some "accidents" happen in shipment, so I asked him to inspect the unit and pop the top to see if anything had been jarred loose. Everything was solid and tight. Then I asked him if he had followed all the instructions for setup in the manual. Yes ... you are already ahead of me. Here it comes:

The caller said he had used these before and did not need to read the instructions. I asked him if the auto-answer dip switch was on and was met with a long pause. Eventually he said: "Oh, its working now."

This started me thinking about writing a book titled "The Duh Factor." Instead, I decided to share these with you. And there are more. To quote the Big Guy: "I'll be back."

Before he went over to the tech-support side, Ted Alexander, was well experienced as chief engineer for many Cleveland area radio stations and as a national voiceover talent. Now at Telos/Omnia/Axia, you can call him on the tech support line – or email Ted at AMFMTV@aol.com

Field Guide

by Burt Weiner

Anritsu MS2721A Spectrum Analyzer

Getting the Whole Picture

Test gear not only needs to be accurate to be useful, but also easy to operate, especially for those who do not use it every day. According to Burt Weiner, the Anritsu MS2721A helps the radio engineer to see exactly what is happening in the RF chain.

For me, the need to obtain a proper spectrum analyzer really became apparent in June of 1994 when the FCC proclaimed in Section 73.44 of the Rules that a swept-frequency RF spectrum analyzer was virtually required for demonstrating NRSC compliance for the required yearly AM NRSC Proof.

As a contract engineer in the Los Angeles area, I have accumulated a great deal of test gear over the years in order to properly service my clients. From radio carrier frequency measurements to TV sync levels and timing, my garage turned into something close to a laboratory for broadcast investigation.

However, the requirements for meeting the new NRSC-2 made it necessary to move up a notch in terms of capabilities. After all, spectrum analyzers are not common in the radio industry.

UPGRADING TEST GEAR

Spectrum analyzers have always been considered an esoteric piece of test equipment well out of the reach of most of us. With the slowdown of the aerospace industry, test equipment has started to pour into the used test equipment market place. No place is this more prevalent than on eBay.

My first analyzer was a Tektronix 492. While it did not have the pre-requisite 300 Hz Resolution Bandwidth (RBW) for measurement compliance within 11.5 kHz of the carrier, it did an "OK" job. A few years later I upgraded to a Tektronix 494P which gave me a better displayed noise floor and 100 Hz RBW. But oddly enough, it did not provide the required – and standard – 300 Hz found in other Tektronix analyzers, probably because the 49x series were considered microwave products.

The 492 and the 494P are really neat analyzers but not really suited to "portable" field work in spite of having a handle. I found myself schlepping the spectrum analyzer, tripod, loop antenna, a generator, outboard preamp and a passel of attenuators used in various configurations around the preamp to try and get a decent gain structure and noise floor and at the same time maintaining sufficient headroom. All of this was time consuming and began taking its toll on my back.

PREPARING FOR DIGITAL

As IBOC transmission began to appear it was soon apparent that I really needed to break down and get an instrument that not only had the 300 Hz RBW but had Average Detection and be able to set the number of samples over which the desired spectrograph was averaged. Front-end dynamic range and Displayed Average Noise Level were also major considerations.

Since I do a lot of microwave work I decided that my new instrument had to go up to at least 6 GHz with continuous coverage and without the use of outboard converters. I started looking at my usual supplier of test equipment, eBay, but was not finding what I really wanted.

The idea of having to buy a new piece of test equipment that cost more than my first home, was a wee bit intimidating, to say the least.

I discovered the folks at Anritsu were about to release their new Spectrum Master (MS2721A), a model well suited to the broadcast community because of its extended range and enhanced features. This unit, which covers from 100 kHz to 7.1 GHz, appeared to have all the features that I needed and is a truly portable, handheld lab-grade instrument.

CAREFUL PLANNING

What frightened me most was not the price but the thought of how to approach my Minister of Finance – Margaret. She has always been quite understanding and agreeable when "we" needed to purchase necessary equipment but this might just be pushing it a bit far.

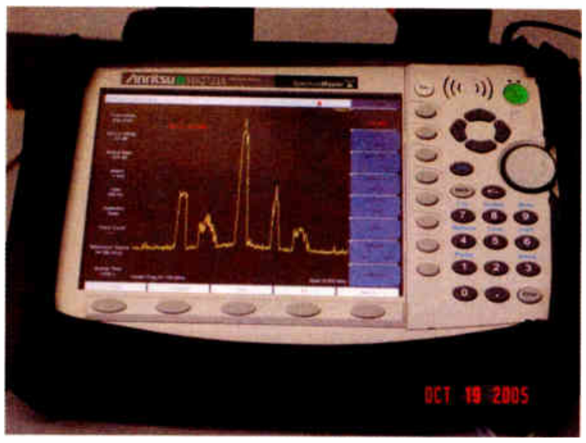
I began by leaving brochures of the MS2721A lying around where they could be found and then, after a while, brochures with prices.

One day the Minister of Finance was watching me pack up the car to go out to do a round of NRSC proofs. I picked up the 494P and as I lifted its heavy 48 pounds out to the car I muttered my best imitation of Igor from the movie, "Young Doctor Frankenstein." Next came the sixty-pound Honda generator with the appropriate huffing and puffing and louder muttering.

OPPORTUNITY STRIKES

So, the Minister of Finance says to me, "Dear, isn't there something lighter you could get to do that?" "Well ... funny you should ask."

The next morning I put in a call to our local Anritsu representative, Murray Guidi, at C-Wave in Redondo Beach, CA. I arranged for a demonstration at my home, where I had access to a variety of signals I wanted to check out, so we could put the Anritsu through its paces.



Anritsu MS2721A

I must tell you, when Murray opened the case and handed it to me, I was stunned at just how large the eight-inch display screen looked. Fortunately, Murray had planned on leaving the instrument with me for several days and I could take it with me to do a few NRSC proofs.

A COMFORTABLE FIT

Having used spectrum analyzers for many years I found the controls of the MS2721A very intuitive. In less than an hour's time I had pretty much mastered the instrument and was able to quickly find my way around and set it up to display what I needed.

I now found myself getting much better results with gear weighing a total of about ten pounds. Speaking of weight, the MS2721A itself is only about seven pounds with its protective cover and internal battery.

After using the instrument for almost a week, I felt I had no choice left – I must have one for myself. With the approval of the Minister of Finance, I placed the order. It arrived about one week later.

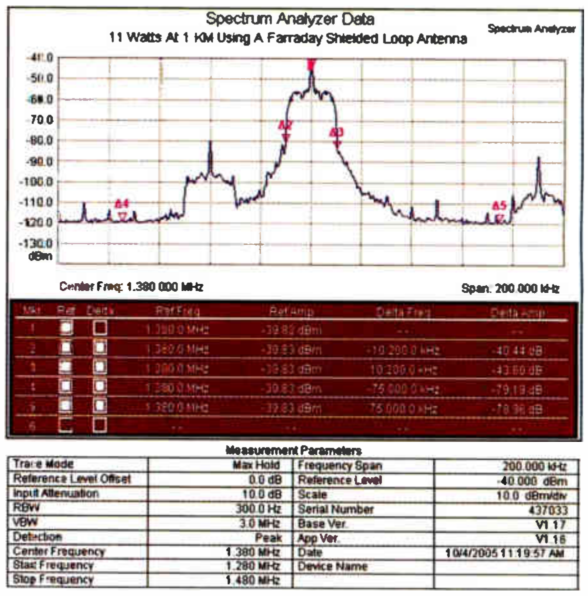
The unit is easy to carry and use on site.

LOW POWER MEASUREMENTS

One of the things that immediately impressed me with the operation of the MS2721A was the low noise floor of the instrument.

With the antenna input connector terminated with 50 Ohms, the instrument set was for 300 Hz RBW at 30 kHz Video Bandwidth, the internal preamplifier was on and in peak detection mode. I was able to obtain an instrument-displayed noise floor of approximately -135 dBm. This meant that for NRSC proofs I was limited only by the external ambient noise.

My first real test of this was to measure a client station in the desert that had a nighttime power of only eleven Watts. At a distance of approximately one kilometer, the instrument showed the peak carrier at almost 80 dB above the noise floor.



Eleven Watts at 1 km is almost 80 dB above the ambient noise.

Something worth mentioning is that I was about two kilometers away and in the main lobe of another station operating at five kilowatts at the other end of the band. The dynamic range of the MS2721A's front-end is more than sufficient to handle this without any problems.

IBOC MEASUREMENTS

When setting up and measuring IBOC signals using iBiquity methodology you are looking at an averaged rather than a peak-held signal display. The MS2721A is capable of such average detection and allows you to set the number of sample sweeps for a given averaged spectrograph, with the display counting the samples as they are taken.

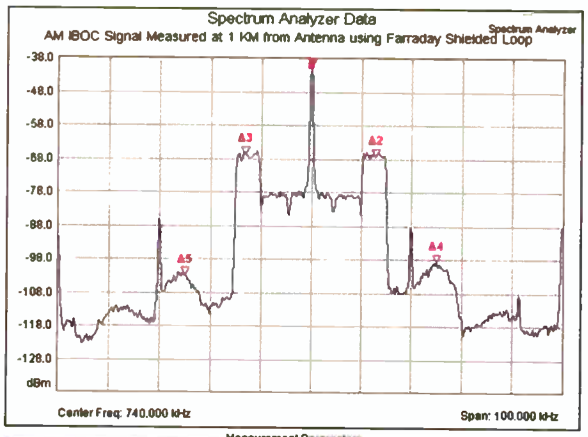
At 300 Hz RBW I found the average single trace sweep time for 100 and 200 kHz spans is about 250 milliseconds. When making FM measurements with 1 kHz RBW and a span of 1200 kHz, the individual trace sweep time is about 275 milliseconds. This allows you to see the result of an adjustment fairly quick even with 50 or more samples.

(Continued on Page 28)

Field Guide

by Burt Weiner

Continued from Page 26



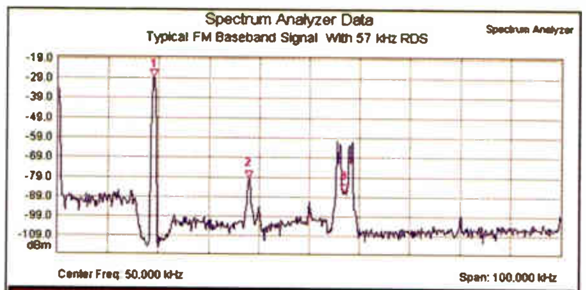
Measurement Parameters

Trace Mode	Average	Stop Frequency	790.000 kHz
Trace Average	50	Frequency Span	100.000 kHz
Reference Level Offset	0.0 dB	Reference Level	-37.624 dBm
Input Attenuation	0.0 dB	Scale	10.0 dBm/div
RBW	300.0 Hz	Serial Number	437033
VBW	300.0 kHz	Base Ver	V1.29
Detection	Sample	App Ver	V1.28
Center Frequency	740.000 kHz	Date	3/22/2006 2:28:40 PM
Start Frequency	690.000 kHz	Device Name	

Looking at an AM IBOC signal.

The wide bandwidth of the MS2721A is a very welcome feature. As you can see from the following spectrograph, it does a very credible job of looking at the FM broadcast baseband output of a FM monitor in my workshop. With specifications of 100 kHz to 7.1 GHz, I have found it to be quite accurate displaying amplitude as far down as to below 10 kHz.

The internal demodulator is capable of AM, wide FM, narrow FM and SSB. It has two features that I think are especially handy. First, you can almost listen and scan at the same time. You can set the amount of time it listens between scans. I have mine typically set to listen for two seconds and scan. With the short scan time noted above it is almost the same has having continuous audible monitoring.



Mkr	Ref	Delta	Ref Freq	Ref Amp	Delta Freq	Delta Amp
1	☐	☐	19.000 0 kHz	-20.60 dBm	--	--
2	☐	☐	38.000 0 kHz	-79.62 dBm	--	--
3	☐	☐	57.000 0 kHz	-86.39 dBm	--	--
4	☐	☐	--	--	--	--
5	☐	☐	--	--	--	--
6	☐	☐	--	--	--	--

Measurement Parameters

Trace Mode	Min Hold	Frequency Span	100.000 kHz
Reference Level Offset	0.0 dB	Reference Level	-18.200 dBm
Input Attenuation	0.0 dB	Scale	10.0 dBm/div
RBW	300.0 Hz	Serial Number	437033
VBW	100.0 kHz	Base Ver.	V1.29
Detection	Peak	App Ver.	V1.28
Center Frequency	50.000 kHz	Date	2/27/2006 12:38:03 PM
Start Frequency	0.000 Hz	Device Name	
Stop Frequency	100.000 kHz		

Off-Air FM Composite Baseband

The other neat feature is that you can set the demodulation mode and frequency separately from the swept frequency of interest anywhere within the range of the instrument. I have found this very handy in searching for interference – or just listening to the radio while I work.

MASTER SOFTWARE TOOLS

Anritsu's Master Software Tools (MST) is available free from Anritsu's website. It gives you the capability to download and install new releases in the firmware for the MS2721A as well as other related software.

Using the MST program I can edit titles, add or modify markers and save the traces as JPEG files for easy import into reports. The program will also alert you when new releases are available.

The MS2721A has both internal and removable memory. The removable memory consists of a common Compact Flash Memory card located on the top of the instrument near the external power connector.

The card can easily be removed by pushing a release button next to it, causing the card to pop out far enough to be able to grab it with your fingers. I can put the card into my computer's reader and in a few seconds I have all of my stored traces along with the instrument parameters for each trace.

Burt Weiner is a well-experienced radio engineer in Los Angeles. Contact Burt at biwa@earthlink.net

– TECHIE STATS –

Features:

- Handheld (6.4 lbs), battery-operated design.
- Large, daylight-viewable transflective 8" color display.
- Built-in pre-amplifier
- Displayed Average Noise Level < -153 dBm typical in a 10 Hz resolution bandwidth at 1 GHz.
- RBWs: 10 Hz to 3 MHz in 1-3 sequence; VBWs: 1 Hz to 3 MHz in 1-3 sequence.
- Three traces with Trace Averaging.
- Six Markers plus six delta markers.
- Multi-segmented upper and lower limit lines.
- Stores up to 2000 measurement test set-ups/Save up to 2000 measurement traces.
- Automatic time and date stamp of saved data including instrument parameters.
- Alphanumeric labeling of saved measurements.
- 50-Ohm Interface standard (75-Ohm interface capability - instrument internally corrects for adapter loss)
- RJ45 Ethernet 10/100 Base T and USB 2.0 Interfaces.
- AM, FM and SSB demodulation with built-in speaker and headset jack.

The Worst I've Ever Seen

A Visual Display of the Good, the Bad, and the Plain Hard-to-Believe

A Rather Damp Situation

by Allen Sherrill

If you watched any of the cable news channels in early June, you might have thought the summer storms and hurricanes were lining up like airplanes awaiting take-off to slam the country with wind, lightning and water. An over-reaction to last year's hurricanes? Perhaps. But then the first tropical storm of the season visited North Carolina ...

This past June 14th, the remnants of Tropical Storm Alberto moved through the Carolinas, bringing large amounts of rain. On that day the Raleigh, North Carolina area received over seven inches of precipitation.

A BIT MORE THAN SLIGHTLY DAMP

That morning I awoke to a torrential downpour. On my way in to work, I was diverted to a couple of nearby transmitter sites due to weather-related power outages and other problems. Shortly after noon, as I was trying to finally make it in to the office for the day, the PD for our AM stations WDNZ and WCLY called me and told me both stations were off the air.

Both of these stations are diplexed onto a rather short tower, located in a swampy area just south of downtown Raleigh. I figured the problem was going to be another power outage, but as I drove to the site, I remembered that the base of the tower is located close by a creek that was very likely to be flooding with all the rain.

Sure enough, when I arrived the area around the tower was under about three feet of water. I was able to get the WDNZ transmitter to run briefly at low power by playing with the tuning and loading, but the water was still rising. When it got above the base insulator – that was pretty much the end of the broadcast day for both stations.

WAITING IT OUT

The flooding caused problems all over Raleigh, with several creeks running over their banks and flooding homes and businesses. The rain eventually stopped about mid-afternoon and the flood waters slowly receded.

I returned to the WDNZ/WCLY site around 8:00 PM and found the site was still flooded, but the water had dropped away from the tower base. At that point, we were able to get both stations back up on the air at nominal power.

Meanwhile, as I worked on the transmitter, it was apparent more than the radio stations were affected – I was treated to the sight of a large beaver swimming around the flooded tower field, gathering sticks for his den.

Fortunately, the transmitter site survived the flooding with minimal damage. The only equipment casualty was a beacon flasher which got wet and caused the tower's top beacon to blink at a fast rate – sort of like a fire truck.

Courtesy: Ken Stewart

A little water may be good for enhancing conductivity, but this was ridiculous.

All through June a lot of rain fell in the mid-Atlantic regions, flooding sections from Pennsylvania to Virginia. We hope your facility avoids dealing with the amount of water WDNZ/WCLY received or at least has an operative plan for dealing with unforeseen weather disasters or other catastrophes and keeping the stations on the air 24/7!

Allen Sherrill is the Director of Engineering for Curtis Media, in Raleigh, NC. Allen's email is asherrill@curtismedia.com

IT Guide

by Tren Barnett

Password Maintenace

When my grandfather was a young man, cars did not have keys and, while homes had locks, most doors were left open. Many of us reflect longingly about such bygone times.

The world has changed; we now live in a world where we must lock our homes, our offices, our cars, our gates, and many other things. It is common to have many keys and pass-codes, and we usually guard them carefully. Because of the increase of crime, many of us use alarm companies to monitor our offices and homes.

CYBER SECURITY

Many of us realize the virtual world in which our computers live is no safer than the streets of Harlem at night. We buy tools to monitor our computers and stop pop-ups, spyware, and viruses just like the alarm company.

So why is it that while we would never leave our keys in our front door to our home at night, we leave the keys to our computer in the computer while we are away?

I often work with different companies to set up network security. These companies are willing to spend thousands of dollars securing their networks with firewalls, encryption tools, specialized VPN tunnels. Then they hand out the keys to their virtual kingdoms to their employees.

How secure are these virtual kingdoms? Only as secure as the holders of the keys; that is, the passwords.

WHEN JANITORS HAVE PASSWORDS

I find it quite ironic that so much time and effort is put into securing a network and the computers on it, and then someone leaves his virtual keys in the virtual door.

What am I talking about? If we think the cleaning crew does not know our passwords after we leave them under the keyboard, stuck to the monitor, or written down elsewhere we are kidding ourselves. But let me assure you, we can take this a step further: if we think the cleaning crew does not use these passwords, we are being foolish.

Most logs that I have reviewed show abnormal security activity at all hours of the day and night. Yes, night. Even if all the announcers are coming out of computers, when the crew arrives to clean your office they do not think twice about testing out passwords.

SOLUTIONS

What can be done? Do consider firing the janitor, especially if he has access to medical records, social security numbers, or bank accounts. If we know he has actually accessed this type of data he should be considered dangerous and not qualified for his job.

It is important to realize that people exist who take delight in destroying our data, reformatting our hard-drives, sending messages to the president of our company, and stealing bank accounts and social security numbers.

Indeed, the very hackers we are afraid of on the outside may be working for us on the inside.

STEPS TO ENHANCE PASSWORD SECURITY

The following suggestions will help protect your facility from being hacked from outside – or inside.

It is true that some of these ideas may cause a little inconvenience. But a little inconvenience is much better than being unable to work because you have been hacked.

- Monitor the security logs frequently.
- Put in place policies and procedures for all network users and privileges. (This policy should require IT or MIS notification prior to termination.)
- Do not permit passwords to be taped to monitors, desk drawers, etc.
- Require that screen-savers start up after a limited time period (i.e. 5 minutes). These screen savers should require a password to unlock the system after they have started.
- Change passwords frequently. Usually 45 days or less.
- Require superior strength passwords by:
  - o Not allowing users to use their names.
  - o Require both upper and lower case letters with a minimum length and a requirement of at least one number.
- Do not allow passwords to be re-used for a period of time. Sequentially numbered passwords are a bad idea.
- Lock accounts out after three failed attempts either permanently or for a period of at least two hours.
- Allow outside access to the network only for the absolute minimum number of users, including e-mail.
- Require additional authentication for access to sensitive data.
- Force system logoffs at shift changes.
- Know your users and walk amongst them, so that you can identify problems more quickly.
- For users with set schedules, control access by limiting the hours their accounts can access the networks.

Now, these are only suggestions, so please, if your staff gets angry, do not shoot me!

Remember that good security starts at the top, is multi-layered, and not overly documented. Personally, I avoid overly publicizing security measures, talking with outside vendors, or advertising vpn servers through DNS.

Tren Barnett is an experienced Systems Administrator and programmer in Tucson, Arizona. He can be reached at tpb@ironmind.net


DYNAMIC
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Tech Tip

by Phil Alexander

A Clever Null Verifier

Maintaining directional antennas sometimes can be difficult, especially on an older array that tends to "move around" depending upon weather conditions. Phil Alexander shares a rather interesting solution devised by one engineer.

Many older in-line patterns of the typical super-cardioid type require occasional phasor adjustments to keep the monitor points within limits.

When directional stations were staffed by several full-time engineers, realignment was quick and simple. One engineer took a field intensity meter to a known, critical, monitoring point and communicated with the transmitter site by two-way radio as the other engineer adjusted the phasor.

This became somewhat more difficult to accomplish when a station's engineering "staff" shrank to one, as it often did following elimination of the "First Phone" duty operator requirement for all directional arrays.

It was at a mid-west directional station that I found this device which at first I could only refer to as a "Whatzit?" It took me a little while to figure out its exact purpose. My first clue was that this was installed at an in-line array.

IN-LINE ARRAYS

Most of the old, in-line, super-cardioid arrays have a minor lobe on the "back" side of the pattern, usually with two or more pairs of minima located symmetrically on either side of the pattern not far away. The pattern may look like a pumpkin, a pear shape, or a figure eight in line with the towers as the phases move from around 110 degrees to around 160 degrees, but the idea is the same.

Often, the "back" tower in the array has a low operating base impedance making it more sensitive to changing environmental conditions.

Typical field ratios in these systems are near 0.5 : 1.0 : 0.5 in the classic three tower case. (Four or five tower arrays of this type tend to be variations of the three tower case with ratios significantly lower than 0.5 in one – or both, in the five tower case – end tower(s).)

A Curious Item

WHEN GOOD ARRAYS GO BAD

As base impedance shifts, the phase delay in the ATU changes causing some change in null azimuth. The result is a monitor point out of tolerance, either in one of the minima or in the minor lobe on the "back" of the pattern, or both.

What is a solo engineer maintaining the pattern to do? One option is driving to the point, making a measurement, going back to the phasor, adjusting, driving to the point – back and forth – and consuming a lot of time and gasoline.

Another option is getting help from a friendly engineer in the market to read the meter at a known point as you adjust the phasor. As the number of engineers shrinks, this has become more difficult, especially if the pattern is one of those that moves with every change in ground moisture, as many of the older ones of this type often do.

A CLEVER IDEA

The picture actually shows a clever use of a special case. The well-known "pattern formation" issue is not significant in the special case of measuring field ratios on the tower line directly "behind" or "in front" of an in-line array.

Enter the "whatzit?" in the picture. A pickup loop directly on the tower line "behind" the pattern can give a very good indication of the minor lobe in line with the towers and, with some experience, it can be a very useful indication for adjusting the phasor, before driving to a monitor point for the official measurement.

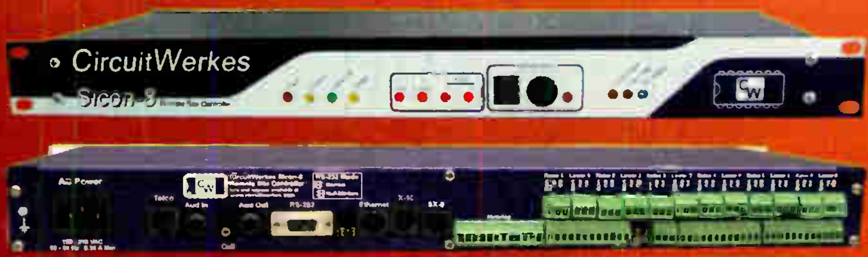
This loop (about 18 inches in diameter), connected to the external port of field intensity meter by a length of coax, can give a very sensitive indication of the minor lobe on the FIM as you adjust the phasor. Of course, all indications are relative, and a measurement while the pattern is adjusted for correct operation should be a useful guide.

A location 30 to 60 electrical degrees "behind" the "back" tower seems to work well. If you try this, you will notice that, if it is too close to the "back" tower, it may be overly influenced by that tower's field. Therefore, 45 degrees and beyond may be more useful.

I wish I could say I invented this trick, but that honor belongs to someone unknown in the past history of the station where I found it. My only contribution was in finding it after cutting the weeds that had hidden it from view, saying "Whatsit?" and figuring it out.

Phil Alexander, CSRE, AMD, is an active contract engineer based in Indianapolis, IN. Contact Phil at dymothem@earthlink.net

The New Sicon-8 Voice Remote Control



The CircuitWerkes Sicon-8 Voice Remote Control

- Use our pre-recorded voice responses or record your own!
- 8 channels of metering, status and control (expandable to 16) and up to 5 alarms per channel.
- No accessories necessary to control your site right out of the box.
- Auto-ranging, auto-calibrating meters make setup a snap.
- Function scheduler, auto-logging & alarm reporting included.

Introducing the Sicon-8, a revolutionary transmitter site controller with custom voice recording technology for perfectly natural sounding dial-up or radio link control. All of the I/O, including 8 channels of relays, are included on the main board so there is no need to buy anything else. All metering, status and control connections are on depluggable screw terminals. An expander chassis, the SX-8, adds eight channels of metering, status & control to an existing Sicon-8 for a maximum of 16 channels. Designed to be controlled from any dial-up telephone, an auto-answer cell phone or from its serial port, the Sicon-8 gives you the control options that you need. A free, Windows program, the Sicontroller, gives you full access to all of the Sicon-8's programming and control functions. Basic logging functions are included. Live Internet interfacing is accomplished with an inexpensive accessory. Visit us online at www.circuitwerkes.com for complete info on the Sicon-8.

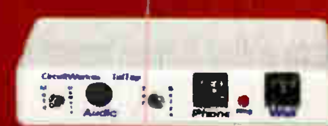
Remote Broadcast Solutions

MicTel Mic/Line to Telephone Interface

- Outputs & Inputs for telephone handset, cellular phone or balanced line level at up to +10dBm.
- Operates up to 36+ hours on two 9V alkaline batteries.
- High quality, user-switchable, internal limiter prevents clipping.
- External power input with silent, auto-switching battery backup.
- Individual gain controls for send, receive and headphones levels.

Unattended Dial-Up Broadcasts with the DR-10

- The DR-10 is a Dial-Up remote control with balanced, telephone audio input & output that can control many automation systems or your audio console for unattended remote broadcasts.
- Our Silencer™ option removes control tones from the audio path.
- Use the DPDT relays to insert the phone audio directly into the program path when necessary, especially for emergencies.



TelTap Pocket-Sized Manual Telephone Coupler

- Can be used as a phone tap or a passive manual telephone coupler.
- Send or receive telephone audio.
- Compact size & low cost makes the TelTap a great addition to your remote kit for main or backup capabilities.

Discover more online at www.circuitwerkes.com

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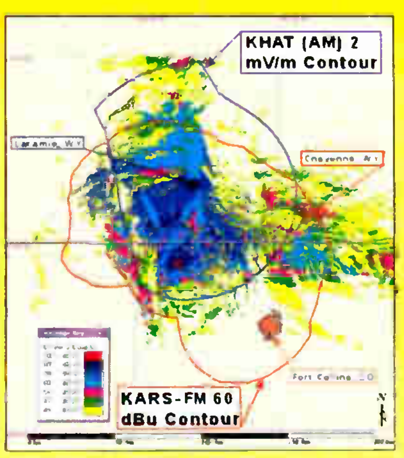

rfInvestigator is a tool for analyzing FCC spacing, FCC contours & much more! Population data, LULC data, terrain data, Longley-Rice models, Topo! maps & drive test data can all be displayed in **rfInvestigator.** It offers a host of advanced features, many of which are not found in similar programs or are offered as expensive additions, like a terrain profile tool and our antenna design tool that can automatically calculate your antenna pattern for you. Add our DB-Builder program and *never* buy another FCC database! Ever!

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Survival Guide

by Rich Wood

Everyone Has a Place

Ever since Sarnoff dissed Armstrong there has been an uneasy balance of terror between broadcast disciplines.

LAST OF THE DINOSAURS

In the earliest days, Engineers roamed the earth with impunity. It took dozens of them to keep all the equipment running. We had no choice, we had to respect them.

Then, without warning, Raptors appeared in the form of General Managers, Program Directors and – worst of all – Personalities. Engineers found themselves nipped at the heels from everywhere.

It gets worse each year as more equipment takes care of itself and the other folks get downsized or puppetized by Headquarters. Justifying one's existence in 21st Century Broadcasting can become a full-time job; turf becomes more important than ever.

ALL RADIO PEOPLE ARE EQUAL

I have this quaint belief that every department in a radio station is critical to its success. However, the question "Can't we all just get along?" becomes evermore critical today as Wall Street (greed) replaces Broadway (entertainment) as our reason for being.

Some of the most serious conflicts are those between Engineers and Program Directors. Neither can do their jobs without the other, yet an uneasy, oft-broken, truce exists from day to day.

As a long time programmer with a lot of computer and engineering geek in me I understand both perspectives. Picking on Program Directors as major engineering irritants is probably unfair; there are so many other potential conflicts that we may need several articles – or a book – to cover all the possibilities.

In the olden days Program Directors actually made decisions, so we will tackle them first.

SOME ARE MORE EQUAL

No department can honestly argue that entertainment is not our Prime Directive. Without compelling programming there really is no reason for any of us to exist.

That compelling programming also brings with it huge egos that have to be buffered by the Program Director. After all, no Engineer wants to be faced with angry talent on loan from any Higher Power. Neither Personality nor Engineer is known for UN-style diplomacy.

IN THE OTHER'S EYES

The PD sees the Engineer as someone dressed in something flannel and jeans that were torn at work rather than at the factory. He sees an overloaded pocket protector and enough white medical tape to repair a lifetime of glasses. (Anyone who has been to a Hamfest knows exactly what I am describing.)

In return, the Engineer sees the PD as a badly dressed creature with hair (or intentional lack of it) configured to match the programming.

At XTRA we changed format from something to New Wave. Overnight, the programming staff changed from recognizable humans to the undead with spiked hair. It was trendy. Still is.

A friend steeped in the ways of contemporary fashion assures me the "Geek Look" is even trendier than spiked hair, so Engineers win this one. However, never wear white tape after 6:00 PM. Only black electrical tape is appropriate.

THE BLAME GAME

Another culture war escalates when the Program Director, under orders from the Sales Manager (not sure of the lineage here), announces a remote that is *really remote* – for early that same afternoon. The advertiser's check has already been cashed and he is expecting his "KIA Karnage" extravaganza to go off without a hitch.

However, something got lost along the way. The Engineer told the Program Director about the ISDN lead time and the PD passed it along to the Sales Manager who forgot to tell the Account Executive. The General Manager now gets into the act and wants to know who screwed it up.

It must have been the Engineer.

Engineers are known to work miracles (for example, getting the bathroom to work again is a miracle), so one was expected. You need to go easy with miracles or you will end up being expected to do the loaves and fishes thing and be a general handyman because you are so, uh, erm, *handy.*

WE HAVE FAILURE TO COMMUNICATE

This is a communications industry. That is probably why we rarely communicate.

There is nothing more frustrating for someone who deals in things ephemeral ("Why does a format work?" "Why does a personality making $285 million need a ride to work?" "How come Arbitron shredded every diary with our call letters in them?") than to be confronted by an Engineer supported by the laws of physics. There is no wriggle room.

Engineers have to use that awesome power for good – preferably their own good. Or course, Engineers with great people skills usually do not have as many communication problems.

BRIDGING THE GAP

The most well-liked and effective Engineers with whom I have worked have been the ones willing to take the time to carefully "explain the process."

Remember, the PD is the one who gets the blame when the local Ranchero station beats you in a market where everyone still thinks Ranchero is a car.

Most people understand and appreciate simple explanations – especially those backed up by detailed memos, directions, and training. After all, even the best employees need help at a time when analog goes digital and most of the staff has been downsized.

You do have the time for all that, right?

For over four decades Rich Wood has worked with local stations as well as network operations. You can contact Rich at Rich Wood Multimedia headquarters: richwood@pobox.com

Radio History

by Kevin Webb

Tesla – More Than Just a Coil

How is it that a man who, over 110 years ago, created the blueprint for all of radio broadcasting, described in surprising clarity the necessary elements for what we know now as television, created balls of plasma in his hand with literally the snap of his finger, and held over 700 patents – how could such a man be lost to time?

Essentially, this is the question I posited in last month's biography of Nikola Tesla. The true history of Tesla is stunning in its scope and impact on today's technological world down to this day.

If that (***Radio Guide**, July 2006*) was your first introduction to the man who is responsible for the genesis of radio, I invite you to explore further the incredible adventure that is Tesla's first use of radio waves and of broadcasting.

TECHNOLOGY FOR PEACE

Tesla was a pacifist who believed that wars should not be fought by men but instead prevented by each country's technical superiority. He thought such terrible weapons would surely cause countries to think twice before going to war.

Thus, Tesla demonstrated the world's first wireless robotic radio-controlled boat to visitors to the first Electrical Exhibition at Madison Square Garden in 1898.

Tesla's remote-controlled submarine was directed by three separate radio frequencies to execute complex robotic commands using computer-type logic gates to control each sequence. These commands would then be actuated, resulting in operation of the craft. And again, this was in 1898.

Thousands witnessed Tesla sending his coded pulses by radio transmitter, received by the submarine's receiver, and which then commanded the boat to move.

MORE THAN THE OBVIOUS

Typically ahead of his time with this invention, Tesla disclosed just the basic idea in Patent No. 613,809 in order to protect his discoveries. The true nature of the invention was kept secret as Tesla hoped the US Navy would see the true potential of this as a wartime weapon.

Tesla's remote controlled submarine.

Unfortunately, many people, including high-ranking Navy personnel, just could not accept this as more than "trickery."

Not only was he demonstrating wireless – the forerunner to modern radio – he was also introducing industrial automation as well as the precursor of today's guided weapons and vehicles.

What Tesla did not reveal to the public were the specifications for a wirelessly-controlled torpedo boat with no crew, powered with a battery-driven motor plus other battery-operated motors that would steer, control lights and raise and lower the craft in the water.

Think of it: A fully automated battery-operated submarine in the late 1890s! Additionally, six 14-foot torpedoes would be placed similar to bullets in a magazine so when one is fired, another would fall into place for the next firing. Finally Tesla estimated the full cost of such a craft would be around $50,000.

AND THERE WAS MORE

Now, this will blow your mind: Science writer Kenneth M. Swezey later wrote that Tesla had not revealed he also had devised "a system to prevent interference by means of coordinated tuning devices responsive only to a combination of several radio waves of completely different frequencies. Another was a loop antenna which could be completely enclosed by the copper hull of the vessel; the antenna would thus be invisible and the vessel could operate completely submerged."

No less than Mark Twain, a good friend of Tesla's, wanted the concession to sell this invention saying he had high level Austrian and English contacts plus William II of Germany. Now there is a scary thought.

Sadly, the US Navy dismissed the wireless and crewless torpedo submarine saying, "it was impractical."

SEVEN HUNDRED MORE

This makes me think of the many mysterious inventions by Tesla that were witnessed by many people.

We know Tesla created his inventions entirely inside his mind before building them. Not just ideas but the full workings in detail. Thus a good number of his patents remained in his head. Thus begs the question: What phenomenal inventions have been lost for all eternity with Tesla's passing?

Whole books easily could be written on almost every one of Tesla's over 700 patents and we still would not begin to touch the surface of the true impact of Tesla into today's world.

For example, a new electric car company recently was named in Tesla's honor. Tesla Motors Inc. all-electric car is capable of astonishing acceleration speeds of 0 to 60 MPH in only four seconds! Called the "Roadster," its top speed is 135 miles per hour, travels about 250 miles on one three-hour charge, uses lightweight lithium-ion batteries, and will cost between $85,000 and $120,000.

It is more than a pipe dream. The company plans to start selling its first model next year. Perhaps if Tesla lived longer or had more funding, this car might have been introduced in the 1950s.

Kevin Webb is the GM for Tieline Technology in Indianapolis, IN. Contact him at kevin@tieline.com

Humor in Radio

by Bob Doll

Stories That Missed the "Radio Funny Book"

Bob Doll recently published "The Radio Funny Book," a collection of amusing anecdotes, on-air (and off-air) gaffes, and other strange behind-the-scenes stories that explain a lot about our history. Here he shares a few goodies that got left out for space and/or deadline reasons.

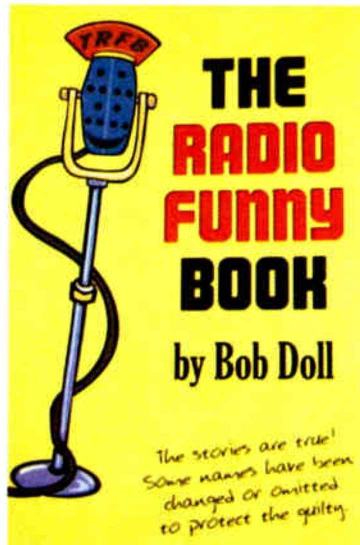
It is amazing how much technology has done for the radio business. John Schad, who launched "Smarts" in Emmetsburg, Iowa, is a long time "radio guy" who remembers getting a golf tournament on the air while he was at WSIV, outside Peoria, Illinois. He shares the following story:

"Those days there were no wireless phones or Marti RPUs," Schad recalls. "You ordered a telephone line, which we did by the 18th hole. Things went flawlessly, then a three-way tie developed. The final three holes would be played on one, two, and three. I stretched 500 feet of cable from the telephone line to hole number one. I was 100 feet short.

Schad continues: "I saw some garden hose laying on the green. I blew the water out and connected it to the cable. Just in time for the finish, the announcer talked into the garden hose and came on the air. Listeners were mystified by the 'echo' on the broadcast, but they heard every word of the exciting finish."

IT REALLY WASN'T PLANNED THAT WAY

Kevin Doran, now the longtime owner of WLEA, Hornell, New York, has developed into a newsman with few equals. It was not always that way. He remembers covering his first weather emergency: The rain was still falling as Kevin told his radio audience during a flood, "The situation here is fluid." As he broke for music, the selection played was *"Raindrops Keep Falling on My Head."*



After reading my book, Tom McAuliff emailed me from WMRC, Milford, Massachusetts, saying that some years ago a woman listener called repeatedly to complain that the disc jockey was changing the words to her favorite song. In her mind, the situation continued as she called again and again.

Finally, the agitated listener literally took things into her own hands, hurling a rock the size of a football through the station's street-level control room window, shattering the glass and narrowly missing the disc jockey on duty.

The station got a new shatter proof window. The irate listener got a free trip to a nearby mental hospital.

THIS JUST IN

No matter when you set the deadline, something always comes in late. Such was the case of this item from Jim Bohannon, longtime network talker on *Westwood One*.

He started out at age 14 on KWLT in his hometown, Lebanon, Missouri. But after all these years, he still remembers his first boss telling him, "I'd pay you what you're worth, but, the federal government won't let me." The minimum wage was $1.00 an hour back then.

BUSY BUILDING

There is something very special about radio. That was brought to me vividly by my great radio friend, John Meyer, at Crown Point in Northern Indiana. He had sold his station and was "cleaning out his desk." The new owners were running a continuous tape on the station: a sound effect of wood being sawed, nails be hammered. The sounds were interrupted every ten minutes by a voice saying, "We're building a new radio station."

John was the only human in the building when the door opened. The business agent of the local building trades union came across the threshold, telling John, "I've been listening to the station," and asking, "Has there been a union permit issued for this job?"

"The Radio Funny Book" (Infinity) is 156 pages of stories like those above. It is $13.95 plus S/H at www.buybooksontheweb.com, www.amazon.com, www.borders.com, and the NAB Radio Store on the web. Bob Doll can be reached at Dolbobbar@aol.com

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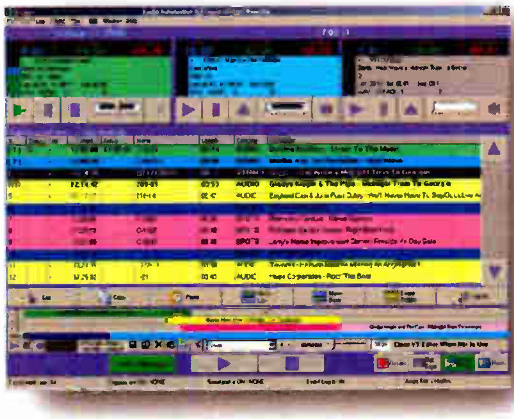

Simian - radio automation and digital playout system.

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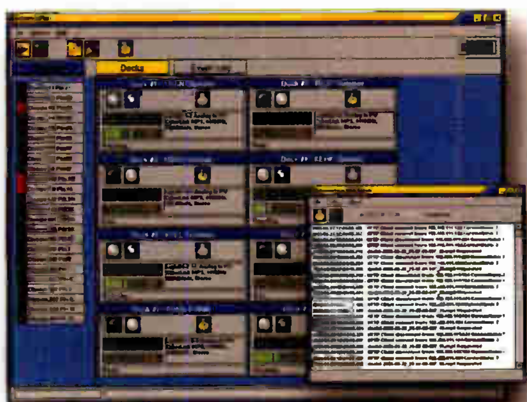
Stinger - Instant Access to 288 'rapid-fire' audio files.

Digital Cart Player

WaveCart - the original on-screen cart machine replacement.

Audio Logging



SkimmerPlus - skimming and audio logging with web playback.

Complete Systems

Systems - fully configured with hardware, software and music.

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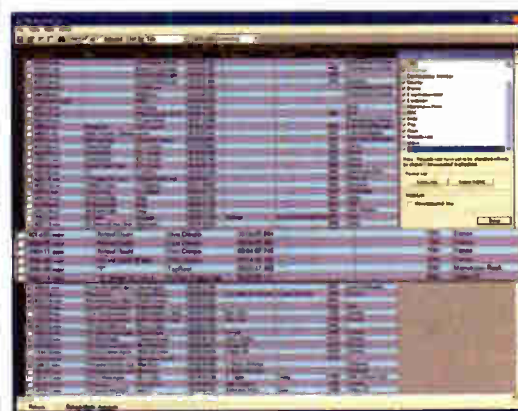
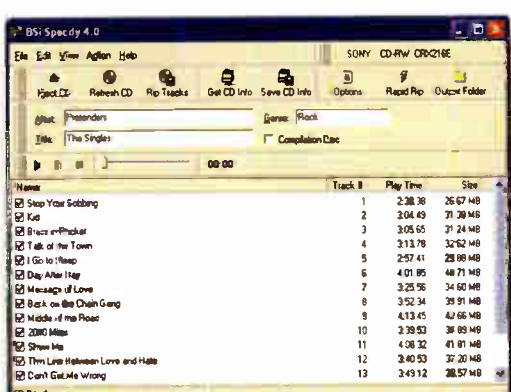


MusicStore - select from over 48,000 ready-to-play songs.

CD Ripping



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BSI

SkyTone USB Phones Make Portable VoIP User-Friendly

Over the past few months (April through July 2006), Dana Poupolo has given ***Radio Guide*** readers a solid understanding of Voice over IP (VoIP), the technology that makes it possible to use the Internet rather than traditional PSTN circuits as the transmission medium for telephone calls.

VoIP benefits such as free or low-cost long-distance calls have made it as hot as the "imitation iPod" radio format pioneered by Jack FM. However, many users balk at having to wear a computer headset to use a VoIP service.

If that is stopping you, an Internet USB phone can solve the problem. One choice is the family of SkyTone USB phones from Radian Technologies (www.eRadian.com), designed for use with the eBay-owned, 100-million-user Skype VoIP service. Skype can be downloaded free of cost at www.skype.com or installed from the CD that comes with each SkyTone phone.

PLUG AND PLAY

SkyTone phones easily plug into the USB port of your desktop or notebook computer with a coiled six-foot cord. They look and act like conventional handsets, and ring like ordinary phones although they are dedicated exclusively to Skype calls. The phones have a keypad and an LCD to display the Skype number, user ID, and/or icons, depending on the model.

You get free calls to other Skype users anywhere in the world and low-cost calls to non-Skype users for rates as low as 2 cents per minute – even to most overseas destinations. (Plus, at least through the end of 2006, you can call anywhere in the US and Canada without cost.)

SkyTone's two handheld models have a special advantage for contract engineers: they are as small and lightweight as a cellphone so they can travel with you.

SIMPLE OPERATION

The SkyTone RST101 (MSRP $29.99) resembles a Nokia cellphone. Touching the button with the green phone icon causes your Skype contact list to pop up on your PC screen.


SkyTone RST101

To dial a fellow Skype user, scroll through your Skype contacts and select the person you wish to call. To dial a non-Skype user, hit the plus sign on the keypad and dial their number as usual. To answer an incoming Skype call, simply pick up the phone, push the green button, and you are connected.

The SkyTone RST102 (MSRP $39.99) has a slightly different form factor with a few extra convenience features, including a backlit LCD display and enhanced readout.

On the RST102, the incoming Skype user ID appears on the display (only the Skype number is seen on the RST101), along with the Skype icons for incoming and outgoing calls.

ADDITIONAL FEATURES

Both models also support Skype conference calls, let you put Skype calls on hold, and feature echo cancellation and noise reduction for optimal voice quality.


SkyTone RST102

The SkyTone line also includes two desktop USB phones, an adapter that converts many traditional phones into Skype-friendly handsets, and a gateway that permits remote access to your Skype account from a regular phone.

SkyTone products are available at select CompUSA stores and through on-line retailers including Amazon.com, Target.com, Buy.com and Walmart.com. If you are looking for a comfortable way to use VoIP, this might be a place to start. – *Radio Guide* –

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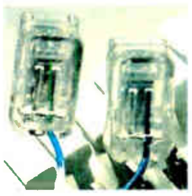

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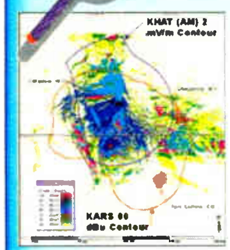

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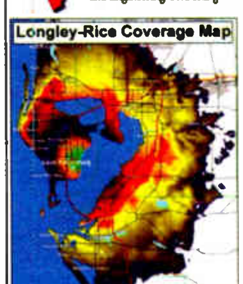

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2006 - 2007

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The Radio Guide Industry Date and Event Register

Email your dates and information to: ***radio@rconnect.com***

National & SBE • Regional & State • FCC Applications & Deadlines

PAB Engineering Conference
September 7, 2006
Hershey Lodge, Hershey, Pennsylvania
/www.pab.org

BOS-CON 2006 Boston SBE Regional Convention
September 13, 2006
Marlborough, MA
www.bos-con.com

BOS-CON 2006 Ennes Workshop
September 12, 2006
Marlborough, MA
www.bos-con.com – www.sbe.org

NAB 2006 Radio Show
September 20-22, 2006
Dallas, Texas
www.nab.org/conventions/radioshow/2006/

34th Annual SBE22 Broadcast & Technology Expo
SBE 2006 National Meeting
September 26-27, 2006
Verona, New York • www.sbe22.org

121st AES Convention
October 6-8, 2006
Moscone Convention Center, San Francisco, CA
/www.aes.org/events/121/

SBE Chapter 20 – Pittsburgh Regional Expo
October 12, 2006
Monroeville, Pennsylvania
www.broadcast.net/~sbe20

NAB New York
October 23-26, 2006
New York, New York
www.nabnewyork.com

2006 Broadcasters Clinic
October 24-26, 2006
Madison, Wisconsin
www.wi-broadcasters.org

CBI Conference
October 24-30, 2006
Adam's Mark Hotel, St. Louis, Missouri
/www.askcbi.org

SEA-CON 2006
Fall 2006
Seattle, Washington
www.broadcast.net/~sbe16

Texas Association of Broadcasters (TAB)
53rd Annual Convention and Trade Show
August 9-11, 2006
Austin, Texas
www.tab.org/convention.php

– 2007 –

Great Lakes Broadcasting Conference & Expo
March 2007
Lansing, Michigan
www.michab.com

NAB 2007
April 14-19, 2007
Las Vegas, Nevada
www.nabshow.com

OAB Annual Convention and Engineering Conf.
Spring 2007
To be announced.
www.oabok.org

SBE Certification Exam Dates

Exam Dates	Location	App.Deadline
Nov 10-20, 2006	Local Chapters	Sep. 22, 2006
Feb 9-16, 2007	Local Chapters	Dec 29, 2006
April 17, 2007	NAB Las Vegas	March 2, 2007
June 1-11, 2007	Local Chapters	April 20, 2007
Aug 10-20, 2007	Local Chapters	Jun 8, 2007

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