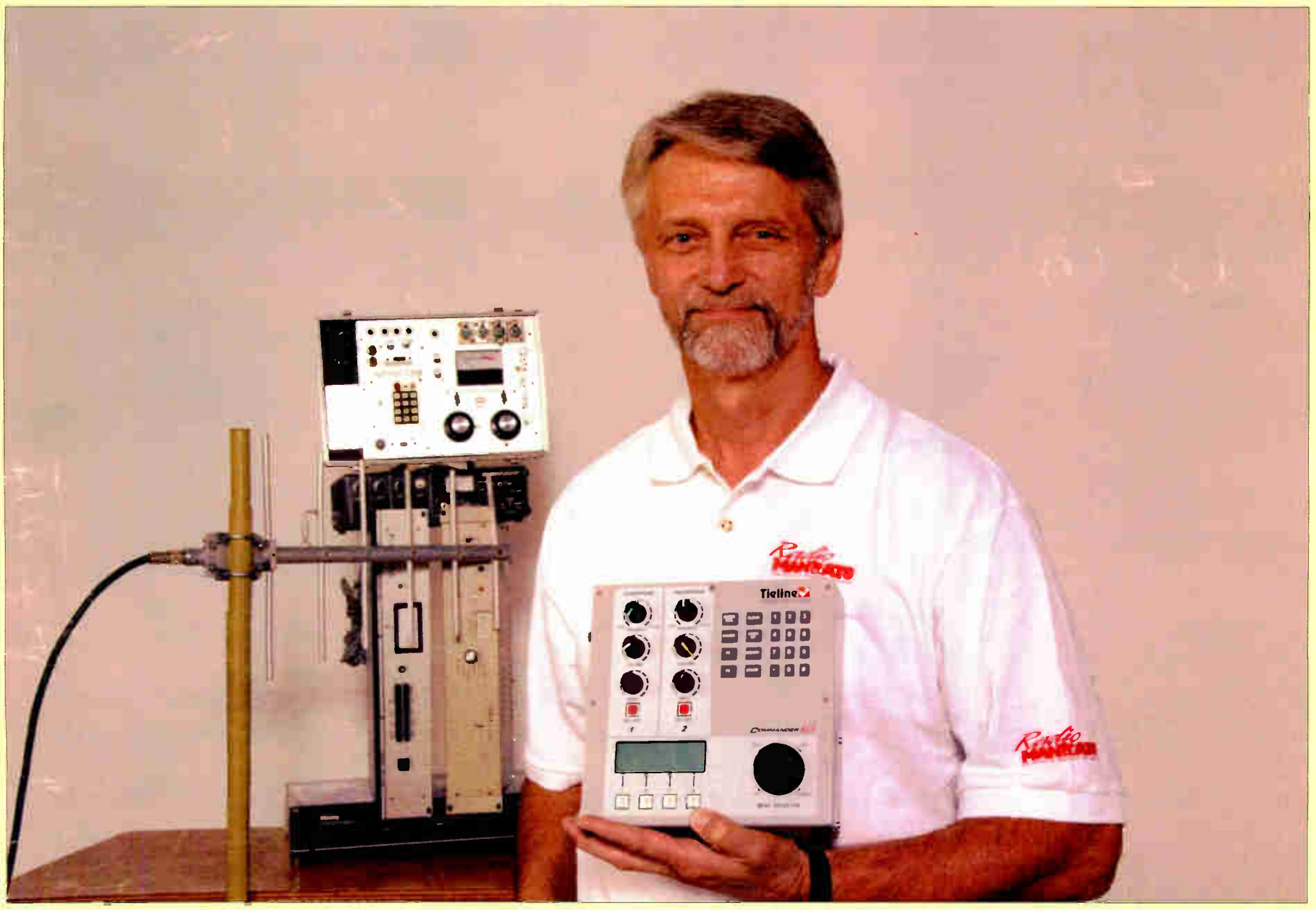
Radio Technology for Engineers and Managers

Radio Guide

www.radio-guide.com

September-October 2008 – Vol. 16, No. 5

Remotes are Easier Without the Heavy Gear



Inside Radio Guide

MEAT & POTATOES WITH SOME PRETTY COOL BELLS AND WHISTLES.

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DIGITAL SPECTRAL PROCESSOR
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Scott Schmeling enjoys no longer having to do heavy lifting to get a remote broadcast on the air.

Photo by Rick Apitz from Shayds of Color, New Ulm, MN.

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PO Box 20975, Sedona, AZ 86341

Phone: 928-284-3700 Fax: 866-728-5764

Ray Topp *(Publisher)*
radio@rconnect.com

Barry Mishkind *(Editor)*
editor@radio-guide.com

Radio Waves

by Barry Mishkind – Editor

The Fall NAB Show went on in Austin this year, despite a little distraction called Ike, which gave the radio industry another chance to show how they can serve the community during disasters.

Many stations relied on generators for more than a few days as they focused on getting information out to listeners, many of whom were in the dark or displaced entirely. Other stations were literally just dead in the water.

It is clear disaster preparedness needs continued attention. That is why **Stan Adams** offers help on **Page 14** in assessing your facility – and what you might need to survive on-air during an emergency. **Gary Minker's** discussion starting on **Page 28** also provides food for thought on protecting your facility.

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For those of you interested in attending the next **AM Transmission Seminar**, arrangements are being made for the week of February 16, 2009 in Orlando, Florida. The three-day program, led by Phil Alexander and Alan Alsobrook, along with several guest speakers, covers the transmission path from the output of the transmitter to the antenna.

More than just a lot of sitting and listening, the program sets time aside for everyone to personally handle the equipment, see how it is used, and to ask questions.

Alan also notes that Disney World is close to the seminar venue – and no snow will be seen!

For more information or to reserve a seat, go to www.radio-guide.com – or call 928-284-3700. – *RG* –

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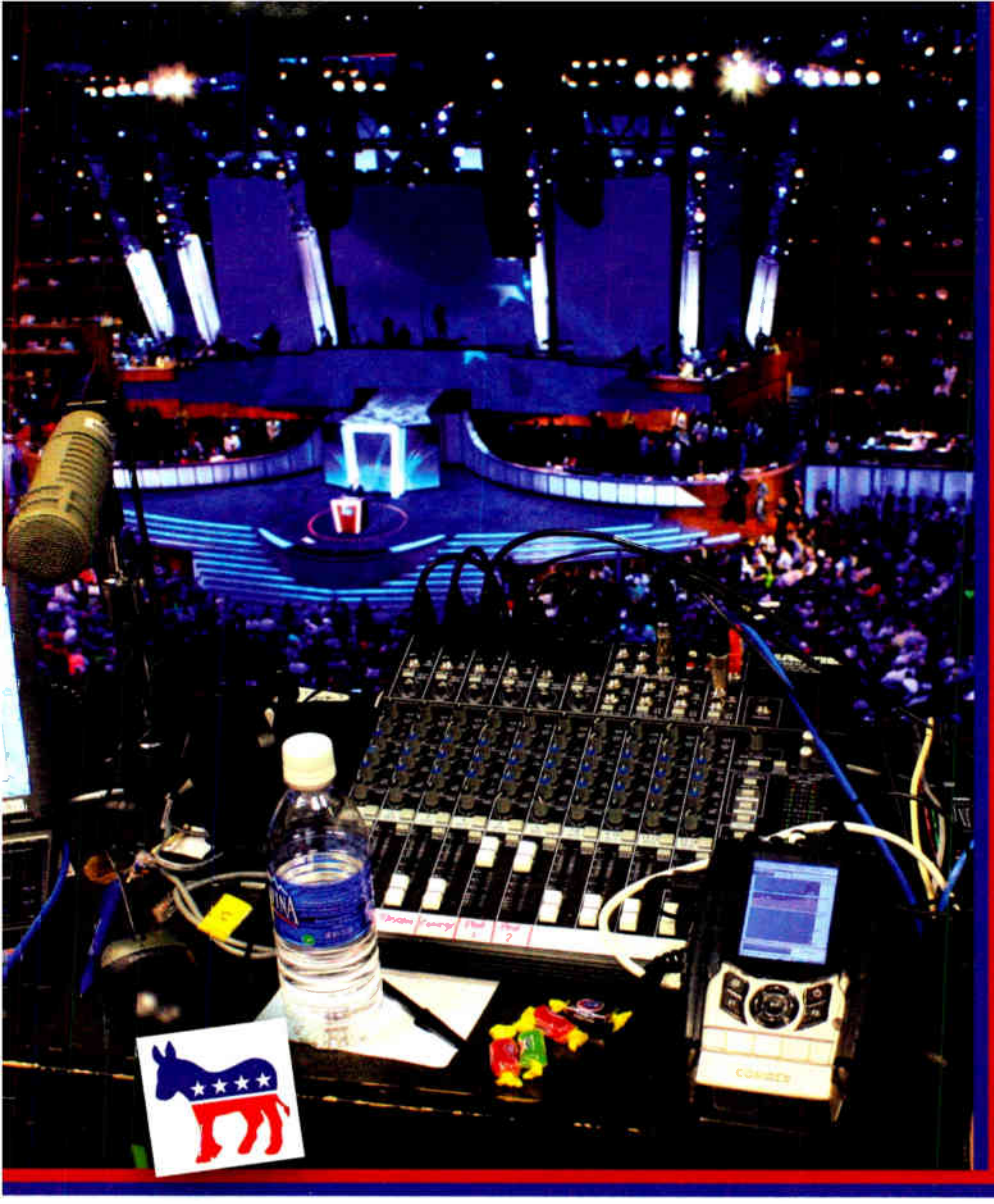

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Doing Remote Broadcasts with Tieline – Leave the Heavy Gear Home

by Scott Schmeling

The time was when doing a remote broadcast involved sending out one or two techs with a van full of gear to set up at a site while hoping for good line-of-sight for the RPU. (The alternative was ordering expensive phone loops in advance.) Audio quality was always a concern. Frequency extenders helped, but only in recent years have the major manufacturers like Tieline developed solutions that literally allow staff to arrive on site with a small case – and connect great sounding audio to the studio within seconds. Scott Schmeling has seen the changes.

I am Chief Engineer for Minnesota Valley Broadcasting, a family-owned group of radio stations across southern Minnesota. Minnesota Valley Broadcasting was started nearly sixty years ago by Don Linder. Seven stations operate out of our Mankato location – with son John at the helm (although Don still takes an active part in the daily operations of the company).

PLACES TO GO

Anytime you have that many stations, lots of remote broadcasts from a variety of locations will follow. Like many stations, we used to haul a lot of gear to do remotes. But no more. The new generation of remote gear has changed the way we do things. Let me tell you how it all started.

KTOE in Mankato, Minnesota, is a Minnesota Twins affiliate. In November, 2006, we were making plans to send our morning team to Twins Spring Training in Ft. Meyers, Florida. Our manager asked me to have an ISDN line installed at the motel where they were staying so we could broadcast the morning show live at poolside.

During the discussion, I told him about the Tieline units and how they could work over an Internet connection. The thought of no installation fee or long distance charges made his eyes light up! He said to "check on it." After talking with Tieline, a demo was scheduled.

TESTING THE WATERS

Because of the number of people involved in Florida, we chose the i-Mix for the remote site and the TLR300B2 Commander rack unit for the studio. The equipment arrived the day our guys were flying out, so we prepped and tested everything, and overnighted it to their motel.

The i-Mix ready to go.

As a side-note, I found a hard-sided tool case at Home Depot. It is the kind that looks like a metal attaché case. The i-Mix, power supply, associated cables, and a 5-port 10/100 switch all fit beautifully inside. Everything is organized, easily transported and, most importantly, *protected.* The case cost us about $25.

We also sent along an analog POTS set on this trip – just in case. Good thing they did because Mr. Murphy certainly made his presence known! A problem with a FedEx aircraft delayed delivery by one day, and our first morning's program sounded like any other telephone remote.

Day Two started with the POTS equipment again, but as soon as the Tieline equipment arrived and was hooked to the Internet the POTS was "swept off the table." Back at the studio we watched as the connection established itself. We got a "pair of 99's" almost instantly, indicating excellent line quality, and heard the audio in cue.

When we potted the Tieline up and could hear them in the monitors, there was a moment of awed-silence followed by one word, "Wow!" It was incredible. I know the phrase is overused, but they sounded like they were "in the studio" – you could even hear birds chirping in the background.

To prove they were poolside, one of the guys splashed his hand in the water. Now picture this contrast: they were enjoying 60-degree Florida weather poolside, meanwhile we were experiencing a Minnesota blizzard!

The Morning Blend poolside in Florida.

In addition to our on-air team, several loyal Minnesota Twins fans (and KTOE listeners) had also made the trip to Florida and were in attendance for the morning broadcasts. The programs included live interviews with some members of our "Poolside Audience" as well as members of the Minnesota Twins' organization.

EASY DUPLEX

We discovered that by wiring the "Send" output of our Gentner telephone interface to the input of our studio Tieline unit we could easily control what was being sent back to the remote.

For example, we could feed them a mix-minus, which allowed them to hear what was on the air when they were not talking. Or we could send them Control Room microphone audio so they could communicate with the board operator.

This was especially helpful since, as I had mentioned earlier, we were in the middle of a good-old Minnesota blizzard and we had *lots* of storm information to get out. The crew in Florida did have control of our computer system through a VPN connection but, considering the complexity of the morning show, we opted to also have a board operator. Even though everything worked flawlessly, we never regretted that decision.

SHARING THE FEED

After the demo was finished and we purchased the Tieline units, we planned our studio installation for the most flexibility. At the time, there were four stations in the building that we wanted to be able to use the Tieline equipment with ease.

Although the Tieline can be used as a stereo device, we configured it as dual mono. We could not foresee ever doing a stereo remote and, by running it in dual mono mode, we can run two remotes on two different stations simultaneously.

First, the Tieline outputs were wired to each of the stations' consoles. Then, to easily select what station was feeding which of the two channels on the Tieline, we installed a Broadcast Tools SS 4.2 switcher. We wired a mix-minus feed from each of the studios to the inputs of the switcher and adjusted for proper audio levels.

The Tieline can be fed by any station, using the BTI switcher.

Since the SS 4.2 switcher has two outputs and the Tieline has two inputs we have total flexibility. With a recent addition of more stations, we have replaced the SS 4.2 with an 8-input version. We can easily switch any studio to either Tieline channel.

I asked Red Lewis, part of KTOE's "Morning Blend" for his impression of the Tieline equipment. He said, "I love it! After so many years of Martis, or on the phone when the Marti didn't work, I can set up the Tieline in just a couple minutes, hit a couple switches, and like a snap we're on and rolling!"

HERE, THERE, EVERYWHERE

The Tieline's flexibility, ease of setup, and lack of heavy gear gets us into and on the air rapidly from most anywhere. Tieline, how do I use thee? Let me count the ways.

We now have used Tieline on countless remotes. We originate Minnesota State University, Mankato Maverick sports including football, basketball, baseball, and hockey broadcasts. That means we might be in Mankato, or we might be "up North" in Bemidji or Duluth, or farther north to Anchorage, Alaska. We also travel to Colorado, Wisconsin, and other states.

The variety of locations exposes us to a variety of connection issues. Fortunately, virtually anytime an IP connection is not available, POTS is – and the audio quality of a Tieline on POTS is just as incredible. In fact, when I am listening to a game using Tieline I cannot stop smiling – it sounds that good. Tieline quality plus top-notch talent truly makes us sound like the big guys.

NOTICEABLE DIFFERENCE

Keith Wright of our Marshall, Minnesota, location was ecstatic recently; they had just finished the Lyon County Fair.

In the past, using Marti equipment, remotes had to be coordinated among their five stations. And there always was a low-level hiss in the audio (something we had accepted as an inherent part of the system).

This year he used their two Tieline field units to connect to the rack unit back at the studio. They were able to run *full programs* rather than short drop-in's from the fair on two stations at the same time (including a phone line for listener requests). They also used a VNC connection to control the iMediaTouch computers at the studio so no board operator was required.

Everyone was amazed at the quality and reliability. In fact, response was so great they had to schedule an additional day of broadcasts. They did experience some momentary drop-outs that were traced to a bad CAT5 cable. Once the cable was replaced, the problem was gone.

MALLING AROUND

In another instance, we were setting up in the Food Court of a local mall for the morning show. Wireless Internet was available so we bought a "Wireless Bridge" for the Tieline but had trouble setting it up and decided to "try something."

What we did was to enable Internet Connection Sharing on the laptop controlling the computer back at the station (if it was hooked up using the wireless connection). Then we plugged a small network switch into the LAN port of the laptop and the i-Mix into the switch.

(Continued on Page 8)

Thousands

of people across America use Tieline codecs for remote broadcasts every day.

"The broadcast was wonderful - Tieline's wireless 3G provided all the benefits of a remote pickup unit with bidirectional audio paths, and a communications circuit."

Marcus Xenakis,
Director of Engineering and IT,
Clear Channel Radio in Philadelphia

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Doing Remote Broadcasts with Tieline – Leave the Heavy Gear Home

– Continued from Page 6 –

Connecting to Tieline can be done in a variety of modes.

Again we got a pair of 99's – meaning a rock-solid connection. The Tieline was "riding" on the VPN connection along with the laptop that was controlling the automation back at the studio. Everything ran flawlessly. It was a beautiful thing. I do not remember for sure, but I think we said, "Wow," again.

... AND IT'S AN STL, TOO

Our most recent Tieline application is the most interesting (so far). It happened early in 2008 when we started building a brand new radio station.

With no viable RF path available, a conventional STL was not an option. After checking other possibilities, our decision was to order a pair of single-rack-unit Tielines and use them for an STL over IP. Used this way, Tieline offers either a 20 kHz stereo MusicPlus algorithm or a linear, uncompressed audio codec.

The "interesting" part of this is that the transmitter site is out in the boonies (quite literally, in the middle of a Minnesota corn field). It is too far from any central office, so no DSL is available, nor is cable. However, wireless Internet is available through one of the area's cell phone companies. We had Clear Wave wireless Internet installed in February and, after a few adjustments, the Tielines were happy and talking with each other.

Of course, in February, there are no leaves on the trees and the fields are bare. In June, when we were getting ready to put the station on the air, it was quite a different story: the trees were in full canopy and the corn was well over "knee-high." Our signal level was low and error rate was very high.

The recommendation was that we raise the wireless antenna up forty feet or so. I mounted the antenna at sixty feet where I could clearly see the Clear Wave transmit site. That increased our receive signal level substantially and gave us a very low error rate. Once again, the Tielines were happy and talking.

STUDIO TO STUDIO

As part of this project, we also built a studio in New Ulm, a neighboring town about thirty miles away. The plan was to do various air shifts from the New Ulm studio, the rest of the day would be out of Mankato. Equalized phone lines and STL were not an option.

Tieline solved this problem, too. We installed the smaller field unit in New Ulm. It connects with our rack unit back in Mankato. We control our iMediaTouch computer using a VPN/VNC connection. Since the music and commercials are coming out of the iMediaTouch (in Mankato), we just send voice or other locally generated audio from the New Ulm studio. The audio we are sending is mono, so only one channel is used.

Since the music and commercials are coming out of Mankato, there is no way to monitor them directly on the console in the New Ulm studio. Fortunately, Tieline is bi-directional, so we send a mix-minus from the Mankato console back to New Ulm. That way, the talent in New Ulm can hear what is on the air.

Because of the latency of the digitized audio, we did not even consider trying to monitor on-air – the delay of the talent's voice coming back to them in their headphones would have been impossible to deal with.

Therefore, I installed a relay on the console that switches the on-air monitor source between the mix-minus and true on-air so when the microphone is off the talent hears "air" and when it is on he hears the mix-minus being fed back from Mankato. There is a slight delay but the format is Classic Rock with no intro ramping, thus it is really not an issue.

SOLID SUPPORT

I have to say I have been totally pleased with the quality and reliability of the Tieline products – and support has always been top-notch. When we have had "issues" or questions, Bill, Brice – and even Kevin – have always been right there to help. If they do not know the answer right then, they find it.

What tremendous tools the Tieline products are for broadcasters. Using our Tieline equipment we can go virtually anywhere and produce high-quality sounding broadcasts without the high cost of equalized or ISDN lines. And with the flexibility of the gear, I cannot wait to see what we will try to do with it next – it is so exciting!

Scott Schmeling is the Chief Engineer for Minnesota Valley Broadcasting, based in Mankato, MN. You can contact him at scottschmeling@radiomankato.com

RemoteMix 4

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The RemoteMix 4 can be powered by batteries or the included AC adapter, so you'll never lose a connection – even during a loss in power!

We think we've done our homework with RemoteMix 4. And it'll be in your hands in plenty of time for the fall sports season.

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Security Guide

by Curt "Cowboy" Flick

Seeking Solutions for Copper Theft

Broadcast facilities, power substations, and many other infrastructure sites are losing stunning amounts of metal to thieves these days. This is not something happening "over there" but right in our own backyards and antenna farms.

SUPPLY AND DEMAND

As the constant drumbeat of news stories points out, crack-heads and other lowlife thieves have discovered what they see as an attractive way to get a quick buck. Not enough to make a living, but as a way to get their next "fix."

With "scrap" metal going for record prices, no questions asked, at many scrap yards, tremendous damage is being done, and repair costs are escalating. New laws are proposed to control the problem in some places, unfortunately with only limited success.

In some cities, manhole covers are being stolen or entire neighborhoods stripped of street lighting, risking accidents and potential death to innocent bystanders. However, while a manhole cover is worth maybe five to twenty dollars on the scrap market, the copper in your radials, strap, coax, wire, and air conditioners is worth considerably more per pound – and often easier and less risky to steal. It is every manager's nightmare.

Now, compare the thief's chance of being seen and arrested while stealing a manhole cover compared to his chance of being seen and arrested at your (often remote) transmitter site?

ALMOST TOO EASY

Thieves have the time to watch the patterns of who comes to your site, and when. They think they know how to get in, steal the copper, and get out without getting caught. And all too often, they can.

I would be surprised if you could replace a ground system for less than about $8,000 per tower, depending on your specific soil conditions. Worse, a new ground system could disappear even before it has been fully installed. A freshly-plowed field will signal to the thieves that you have just put in some fresh scrap for them to steal. And fresh copper is even easier to pull out than old copper, so they will do more damage faster the second time around. Scratch another $8k.

After all, they have already proven to themselves that they can do it, with minimal effort.

Collateral damage also can be a problem. First, thieves will test your security by breaking any lights. Then they cut through your FCC required fencing to steal your copper – and now *you* are in violation of ANSI RF Rules!

Should a child come through the fence and get themselves electrocuted at your plant, you are liable! In this case, you are *guilty* until proven innocent, yet a thief who cannot be expected to know what kind of hazard they caused is still innocent until proven guilty.

SCRAMBLING FOR IDEAS

How do we stop them? Many suggestions have appeared on Internet mailing lists, in various articles, and in conversations.

For example, some suggest painting the copper used at our sites with something to make it appear less as metal and more as something "worthless" to the thief. Others suggest using metals with less scrap value, supposedly to make it less attractive to the thieves, such as copper-weld steel wires in place of higher value copper for ground radials.

But this will not prevent theft. That depends on thieves evaluating an ROI (return on investment) in a logical, businesslike manner – which is a pipe dream. Thieves do not have the intellectual capacity nor desire to realize the ROI is not there until after the damage is done and you are off the air.

Yet the real problem is not the copper, the aluminum in power lines, or the steel in a tower. The problem for us, is the replacement and repair costs.

BEYOND COMMON SENSE

Again, it is not about ROI. The thieves just do not care. It is strictly about their time available – which is virtually unlimited – and their need for their next "fix."

To them, it is well worth wrecking your transmitter plant in hopes of obtaining five or ten dollars at the scrap yard. They never even consider the hundreds of thousands of dollars of damage they can cause in the process nor the disruption to the broadcast business if a new tower has to be purchased, shipped, and stacked, and the week or so to plow in and reconnect a new ground system.

After all, these are people that risk their lives to steal live high-lines from power stations – an obviously (to us) stupid plan. But they only see the "free" metal for the taking. Clearly, their own life is worth less to them than the $31 worth of scrap they might get if they do not die. They never consider the possibility of losing their lives for a few dollars as a poor ROI. *They just do not think that way.*

UNDERSTANDING THE ROOT PROBLEM

Replacing copper ground radials with something of less dollar value on the scrap market is not a solution. It does not even begin to address the issue, shown by someone recently being brazen enough to cut down an entire tower for the hope of scrap value,

We can talk about using steel, and other less than valuable materials. But the thieves work cheap – and at great risk to life and liberty. "Value" has an entirely different meaning to them than to us. We *must* accept this as fact or we will never find a workable solution.

We must stop thinking like practical engineers and think like the wacked-out, worthless scum of the earth. Understand what *they* value and their selfish me, me, me attitude. Only then can we stop them.

FINDING VIABLE SOLUTIONS

In other words, start thinking about *what will stop them.* Laws and rules merely keep honest people honest. Honest law-abiding citizens are not our problem, hence laws, signs, and rules will not help.

Start by realizing that – even to them – time has some value. In other words, make it cost them time and effort, so that the prospect of invading your site becomes unattractive to them. Really, nothing else will work. Fortunately, your costs in slowing or stopping them certainly will be less than that to repair the damage they do, plus any off-air revenue losses.

There are ways to make a site less attractive to a thief, but we need to make it *completely* unattractive, actually *repulsive*, in order to stop them. I personally favor junk yard dogs and shoot-to-kill armed guards, but protecting your property is illegal in many places, so some other way is needed. About the *only* way to win is to make it so difficult to remove metals that the thieves decide it is more cost effective to spend their time elsewhere.

BEYOND PAINT AND TAR

For instance, painting and tarring will make copper less attractive to the scrapper but the thief will not know that until after the damage is done. Meantime, the thief will not care. Once he has destroyed your plant, the only difference it will make to him is that now he needs to go out and destroy another facility to finally achieve his goal of getting high.

So we are back to making him work so hard for the metal that he gives up. One suggestion is to pour cement plugs every five feet or so along the length of AM ground radials. Cement can be a good start.

I am thinking as one of those guys who plows in radials, lays and bonds straps and screens, tunes ATU's and such – and at the same time trying to think as a spaced-out crack-head with nothing to live for but my next fix.

If we were to encase the copper – not in something that simply marks it, as the thieves will not care – but in something that makes it extremely difficult to remove, this can have the desired effect.

ENCASED IN CONCRETE

Paving the entire radial field is one thought, but not really practical. On the other hand, all it might take is merely dry-sacking (pouring a powdered mix) the entire radial with an inch or so of concrete as it is plowed in. It will absorb moisture from the ground and cure into a hard concrete mass, encapsulating the copper radials in a relatively short time.

The result is should be both that the copper will be exceedingly difficult to remove and not worth much if they still take it.

Installation will a bit take longer, yes. More work initially, yes. More cost more initially, yes. A low-maintenance, one-time solution? Perhaps. We are not talking about terribly high quality concrete, and it may or may not actually encase the radial wires, but it *will* make them more difficult to remove when (not if) the thieves come calling.

There are several other products that create a "goo" with water and "set" around the radials, preventing them from just being "pulled" out. The added time and effort is likely to be a turn-off to a thief.

MORE OPTIONS

Another approach is plowing radials much deeper, say two feet instead of the normal six inches or so. Depending upon your local conductivity, plowing deeper can have much the same effect without the risk of the lime in the concrete mix destroying the copper itself, over time.

When was the last time your transmitter site was visited? A human presence works. Can you afford a full-time guard? Probably not, so we need to be a bit more creative. Infra-red motion detectors, cameras, perimeter alarms, and so on, all have their place, but are not a panacea.

You will probably only need to catch them once, along with a high probability of capture in the future, to gain a reputation as someplace not to go a stealing. It may cost an extra $10,000 for added security, Internet-based webcams watching the site, and flood lights mounted and powered on the tower and around the buildings. But the cost of doing nothing is too high.

DO *SOMETHING*

The point is that a comprehensive security approach is no longer an option in our society. It is mandatory to create the impression that a broadcast station is not the place to go stealing stuff. If we can do that, we will all benefit. But it will not be easy – and likely not cheap.

We cannot ignore this problem any longer. It is a cost of doing business. The probability (not just a possibility) of actually being apprehended will cause even them to pause, and possibly go elsewhere.

What can we do? What is certain is that we must do *something*. Otherwise it is simple "pay me now or pay me more later on." Much, much more.

A versatile broadcast engineer from construction to IT, Curt "Cowboy" Flick has built many facilities around the country. He can be contacted at curt@spam-o-matic.net

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Can a radio console be over-engineered?

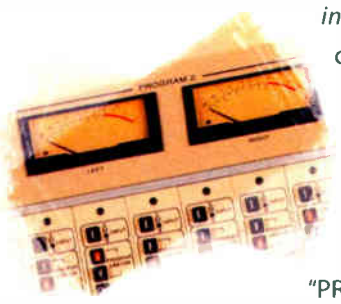
(Only if you think "good enough" really is good enough.)

"OCD" redefined

Building great consoles is more than punching holes in sheet metal and stuffing a few switches in them. Building a great console takes time, brain-power and determination. That's why we've hired brilliant engineers who are certified "OCD": **Obsessive Console Designers,** driven to create the most useful, powerful, hardest-working consoles in the world.

How It began

"20-odd years ago," says Axia President Michael "Catfish" Dosch, "I was designing custom consoles for recording studios. Somebody at **PR&E** – it was still called **Pacific Recorders** then – liked what I was doing and invited me to move there. Work with Jack Williams, the guy who practically *invented* the modern radio console? I jumped at the chance; BMX consoles were ultra-reliable, sounded great, and nearly indestructible!



"PR&E was a dream job. Jack taught me how to design consoles without compromise — how to **over-engineer** them. It's great to see, 15 or 20 years later, that many of the boards I designed are still on the air.

"By the late 1990s, computers and routing switchers were becoming an essential part of the broadcast studio, and I'd been thinking about how useful it would be to combine console, router, and computer network. I shared some of my ideas with Steve Church, who'd introduced digital phone hybrids and ISDN codecs to radio. He thought the same way I did about computers in radio studios, and we decided to work together."

A new kind of console

In 2003, Axia was launched to make digital consoles, but with a twist: Axia consoles would be integrated with the routing switcher, and **networked** to share resources and capabilities throughout the studio complex. This intelligent network of studio devices lets Axia build consoles that are **more powerful** and easier to use than ever.

Our team of engineers blended the best ideas from old-school analog consoles with innovative new technology to produce **bullet-proof boards** that can actually make shows run smoother and sound better.

There's a reason these board-ops are smiling. Axia consoles are in more than 1000 studios worldwide.

And we invented a way to network studios, consoles and audio equipment using Ethernet. It's called **Livewire™**, and it's now an industry standard. Livewire carries hundreds of channels of real-time, uncompressed audio plus synchronized control logic and program-associated data on just one skinny CAT-6 cable.

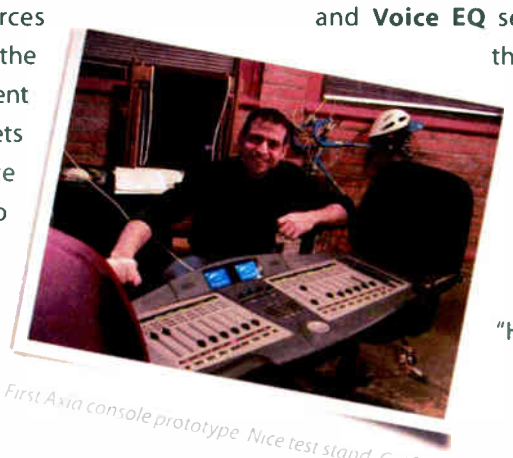
Lots of well-known broadcast software and hardware companies (over two dozen already) now make products that work directly with Livewire. Thanks to this scalable network technology, **integrated router control** is a standard feature of every Element. Any source in any studio can be loaded on any fader with no need for add-on panels.

And Livewire lets you bring computer audio into the air chain without going through multiple A/D/A conversions. Our **IP-Audio Driver** lets you connect computers directly to the network without any intermediate I/O — all that's needed is a CAT-5 cable and your computer's Ethernet port.

Feature packed

Board-ops told us they wanted a console that's **powerful, yet easy to use.** So we designed Element to be user-friendly, yet still have all the power of a full-on production board.

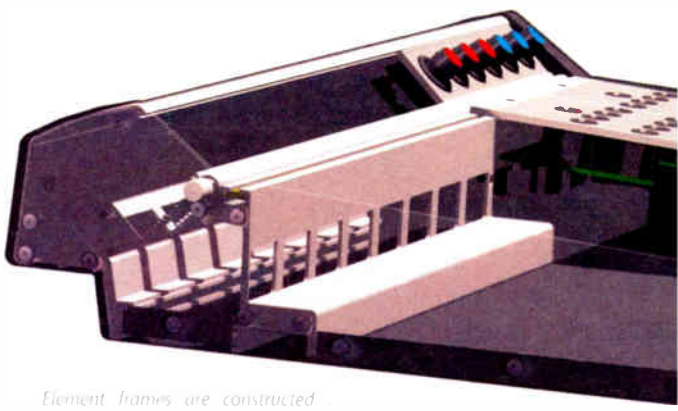
For example, Element Show Profiles can **recall each operator's favorite settings** with the push of a button — audio sources, fader assignments, monitor settings and more. And each jock's Show Profile contains personalized **Mic Processing** and **Voice EQ** settings that load every time they're on the air (so the midday guy will stop badgering you for "just a little more low end"). There's even a "panic button": one key-press returns a Show Profile to its default state instantly. (No more 3 A.M. "Help!" calls.)



First Axia console prototype. Nice test stand, Catfish.

Did we say "mic processing"? You bet. Every voice channel gets **studio-grade compression, de-essing and expansion** from the processing experts at Omnia, plus three-band parametric EQ to sweeten the deal. There's even built-in **headphone processing** so you don't have to waste money building a separate side-chain just for the studio cans.

Jocks have complained for years that making a mix-minus is too hard — so Element **constructs mix-minuses automatically**. Plus, mix-minus settings are saved for each audio source, so that sources, backfeed and machine logic all load at once. And every fader has a "Talkback" key to **communicate with phone callers**, remote talent or other studios using the console mic.



Element frames are constructed from custom aluminum extrusions for maximum rigidity. Modular face plates and control panels are machined from thick plate aluminum. Even the hand rest is a beefy extrusion. With this heavy metal, even that ham-handed overnight jock won't [illegible]

Speaking of phones, board-ops have enough distractions without having to reach for an outboard phone control panel. Element has **hybrid controls with dedicated faders** for Telos talkshow systems; there's even a **dial pad** so jocks can dial, pick up, screen and drop calls without ever diverting their attention from the console.

Nearly every air talent has accidentally changed a fader's audio source while it was on-the-air. To prevent that error, **Element "queues" source changes**: the operator must turn the fader off before the next assigned source "takes".

Consoles

The radio console, redefined.

Element was designed to fulfill either a **production or on-air** role, with amazingly powerful features waiting just beneath the intuitive surface. For instance, Element can mix in 5.1 Surround as well as stereo. That's standard; **nothing extra to buy** (except more speakers). There are four stereo Aux Sends and two Aux Returns, so production guys can use their favorite outboard FX boxes. Great for **custom IFB feeds**, too.

Clear the junk out of your studio. Element has 8 submixers built in

Got a PA mixer tucked away in a studio corner to mix mics for live performers, talk shows and such? Element has **8 Virtual Mixers** — no outboard gear needed. And the Virtual Mixers emulate ACU-1s, allowing tight integration with automation and satellite systems.

You can **administer Element remotely**, from home, the airport — wherever there's network access. A password-protected web server lets you examine the state of the console, see what's on the air and even fix operator mistakes, without ever leaving the comfort of that new Aeron™ desk chair you (ahem) "requisitioned" from the Sales department.

Small VU meters mounted at desk level are hard to read, so we re-invented the traditional meter bridge. Element's **big meters** are presented on an easy-to-read computer monitor along with large analog and digital clocks, event and countdown timers, and tallies that light when mics are open, delay is active, or during phone calls. You can even customize the display by adding your station's logo.

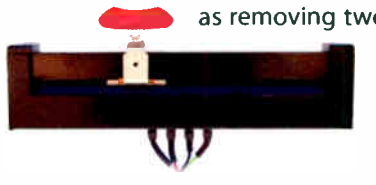
Beneath the surface

There's more to building a great board than just features. **Consoles have to be rugged,** to perform flawlessly 24/7, 365 days-a-year, for years at a time. So when it came time to choose the components that would go into Element, we literally scoured the globe for the absolute best parts — parts that would take the torture that jocks dish out on a daily basis.

First, Element is fabricated from thick, **machined aluminum extrusions** for rigidity and RF immunity. The result: a board that will stand up to nearly anything.

With so many devices in the studio these days, the last thing anyone needs is gear with a noisy cooling fan. That's why Element's **power-supply is fanless**, for perfectly silent in-studio operation.

Element modules are **hot-swappable**, of course, and quickly removable. They connect to the frame via CAT-5, so pulling one is as simple as removing two screws and unplugging an RJ — no motherboard or edge connectors here.



Faders take massive abuse. The ones used in other consoles have a big slot on top that sucks in dirt, crumbs and liquid like the government sucks in taxes. By contrast, our silky-smooth conductive-plastic faders actuate from the side, so **grunge can't get in**. And our rotary controls are high-end optical encoders, rated for more than **five million rotations**. No wipers to clean or wear out — they'll last so long, they'll outlive your mother-in-law (and that's saying something).

Element's **avionics-grade switches** are cut from the same cloth. Our design team was so obsessed with finding the perfect long-life components that they actually built a mechanical "finger" to test switches! Some supposedly "long life" switches failed after just 100,000 activations; when they found the switches used in Element, they shut off the machine after **2 million operations** and declared a winner. (The losers got all-expense-paid vacations to the landfill.)

Individual components are **easy to service**, too. Faders come out after removing just two screws. Switches and rotary volume controls are likewise easy to access. And all lamps are LEDs, so you'll likely never need to replace them.

Engineers have said for years that console finishes don't stand up to day-to-day use. Silk-screened graphics wear off; plastic overlays last longer, but they crack and chip — especially around switches and fader slots, where fingers can easily get cut on the sharp, splintered edges. We decided that we could do better.

Element uses high-impact Lexan overlays with color and printing on the back, where it **can't rub off.** And instead of just sticking the Lexan to the top of the module like some folks do, our overlays are **inlaid on the milled aluminum module faces** to keep the edges from cracking and peeling — expensive to make, but worth it. For extra protection, there are **custom bezels** around faders, switches and buttons to guard those edges, too. Element modules will **look great for years.**

By the way, those on/off keys, fader knobs and bezels are our own design, custom-molded to give **positive tactile feedback**. The switch is flush with the bezel, so it's easy to find by touch. But if something gets dropped on it, the bezel keeps the switch from being accidentally activated.

More than just products

Catfish learned something else important from his time at PR&E: "Even the best products are nothing without **great support.**" So Axia employs an amazing network of people to provide the best support possible: Application Engineers with years of experience mapping out radio studios... the most **knowledgeable, friendly** sales people in the biz... Support Engineers who were formerly broadcast engineers. Plus a genius design team, software authors who dream code... one of the **largest R&D teams** in broadcast.

And now Axia has become radio's **first console company to offer 24/7 support**, 365 days a year. Chances are you'll never need that assistance, but if you do, we'll be ready for you. Our 'round-the-clock help line is +1-216-622-0247.

Proudly Over-Engineered

Are Axia consoles over-engineered? **You bet.** If you're looking for a cheap, disposable console, there are plenty out there — but this ain't it. Not everyone appreciates this kind of attention to detail, but if you're one who seeks out and appreciates excellence wherever you may find it... Axia consoles are built **just for you.**

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Operations Guide

by Stan Adams

Avoiding the Single Point of Failure

As we continue our look at the preparations that stations can make to withstand and recover from emergencies and disasters, Stan Adams considers a term most have heard about – the "single point of failure." It is something none of us wants to have, but it can appear in the strangest of places.

The concept of the "single point of failure" is an old concept and it has been used since the formation of the modern building industry, telephone companies, and railroads, and about any other industry you would like to name.

On a bit more personal level: when the body is engulfed in a massive injury or illness, doctors must think about the frailty of the most important systems. Whatever might be the weakest of all the links becomes the most important or as we might say: "a chain is only as strong as its weakest link."

THE SMALLEST PART

In the broadcasting industry single points of failure (SPF) can be found all though the chain from microphone to antenna. Only a careful review of the entire system can illuminate where those points may be – and sometimes we do not find them out until after an actual failure because some of them are hidden to our eyes and thinking until after the fact.

Not long after I joined MCI Telecommunications in the very early 1980s it was discovered that one of the weakest points in the system, and the cause of outages for our million plus customers in those years, was a simple one dollar BNC connector.

We used thousands upon thousands of them to carry baseband, timing and multiplex signals – the old fashioned solder tip and compression ground braid type. My father would have trouble understanding how anything soldered would fail because he was totally set against any type of a compression or mechanical fitting for audio or video and pulse usage. Of course, we know better today.

THE COSTS OF SPF

It cost millions of dollars of company funds and manpower to change out most of those connectors to a hex crimp tip and sleeve. We had to have Amphenol design a whole new series of connectors for us, with cable to match.

The effort was worthwhile: it dropped cable related outages by over 90% in the space of about three years. If you have ever worked with blue or purple 75 Ohm cable with a jacket similar to TFE, then you have used the product produced for MCI Telecom.

In broadcast, perhaps the most obvious candidate for a single point of failure is the station with one transmitter, one antenna, and just one source of power. The failure of any of these immediately puts the station off the air, instantly costing significant money in lost revenue, as well as the loss of the listeners' confidence that the station will be there when they need it.

The solution seems obvious: install a spare transmitter, stand-by antenna, and a generator. However, having been in the broadcasting field now both full and part time for about 40 years, I know how hard it can be to justify such an expense for the Mom and Pop facilities.

MITIGATING THE COSTS

Perhaps the answer is in budgeting for and resolving these single points of failure one at a time, over a reasonable period of time. This is one place where the large broadcast groups have an advantage: a better leverage of finances for such endeavors.

Certainly, consolidation has had benefits, especially when a number of studios or transmission systems are built together – similar equipment or facilities which are close by will help increase the speed and success of quick repairs.

SPF COMBAT TOOLBOX

It is important to have and use the right tools in order to eliminate single points of failure. Among the more potent are redundant equipment, fault tolerant gear, and protective devices.

By the way, redundant systems do not have to mean complex or real expensive. An auxiliary transmitter does not need to be brand new, nor at full power. But do not be fooled into thinking that redundancy will always work, because it will not. An automatic switch will fail to activate or a loose wire will fall off at the worst possible time.

If a broadcast operation uses standby power generation equipment in which more than one unit is required, how do you know that both will come up and synchronize properly without already switching the load to the gensets? Can you imagine the potential damage if you are trying to cover multiple stations (radio and TV), microwave, STLs, and the like?

FAULT TOLERATION

Being fault tolerant means a failure of one part or subsystem will not cause complete system failure. Hardware fault-tolerance sometimes requires that broken parts can be swapped out with new ones while the system is still operational. Such an implemented system represents the vast majority of fault-tolerant systems.

In such systems the mean time between failures should be long enough for the operators to have time to fix the broken devices before the backup also fails. It helps if the time between failures is as long as possible, but this is not specifically required in a fault-tolerant system.

An example of a device that is not fault tolerant might be a ten dollar float switch that sticks in a cooling tower, not allowing fresh water into the tower. Eventually the remaining water evaporates leaving a hot building full of computer chips. (Suppose it is Sunday morning at 5:00 a.m. How are you going to get 100 gallons of water quick enough to cool down a building that is already above 90 degrees? Hint: been there, done that – call the fire department!)

PROTECTIVE DEVICES

These devices are generally considered as being somewhat passive in nature. For example, you likely have a well-known manufacturer's surge protector box on your power entrance. Other protective devices include spike filters, UPSs, lightning rods, and other grounding schemes.

However, does it have lights to show if the protective fuses are in proper operating order? Some of these units have no lights at all. So how does one tell if the surge cell on a specific phase is properly working?

Reliable protection for your equipment is not hopeless nor is it necessarily expensive. The most valuable tools are a good mind set and a willing set of hands.

Generally, stations located south of the Ohio River have far more trouble with lightning than do stations in the north – of course, a 500-foot tower anywhere is a major lightning arrestor! So use all means to make a quick path to ground for any potential surge.

When you specify a new tower you might consider putting multiple ground rods on the top and running 0-gauge wires down each of the legs to the master station ground, cad-welding all ends. This may be one of the quickest paybacks that you will find in your situation.

A LOOK AT YOUR STATION

Next time, we will take a look at your station and try to help you identify as many single points of failure as possible. And as we do this, I want to carry along the idea of how can we verify that our monthly and quarterly inspections are really working.

This is the heart of the ISO-2000 project – to have a verifiable, documented method by which we inspect and have confidence in our communications system. While the total program may be out of the realm of possibility except for the largest broadcasting of chains, there is no reason to not follow the spirit of the principle.

Perhaps your Director of Engineering pops in to visit you and your facility. How does he know that you are following a proper method of doing – for example – monthly generator checks? By the way, are you dropping the breaker at the pole? If so, you better keep a spare breaker or be prepared to quickly wire around a switch that mechanically fails.

The DoE will also want to know how long your generator has been run under load. If it never does, you are only asking for carbon build-up in the genset and a failure when you really need it. Are your essential and non-essential power sections marked in colors, or in some way that a quick inspection will reveal their source? If you are using diesel fuel, your day tank had better be connected to one of those essential circuits.

UNDERSTAND THE SYSTEM

An approach I have always used in my work, when checking a station, is to actually place my hands on each piece of the puzzle and then conceptualize about that part. (I should not have to tell you to make sure you de-energize anything you work on, right?)

For instance, using dual power feeds from the utility provider is a great idea when available. But if there is any place where the lines come within six or so of each other, you still have a potential single point of failure in the event someone wants to get in there with a backhoe.

Does cooling or heating come into play in your general thinking? If so, start with the power feeding the building and place your hand on each single section that the power goes through to ensure the HVAC will run when you need it.

Follow the same process for the RF system. And what about RF grounding, especially for small signal cable, racks, and satellite receivers? At MCI we would separate all those grounds – except to run a single line back to the master ground buss bar, which would hang on the wall.

As with other components, if you run your satellite feeds in through the same outside entrance, then again you have a single point of failure – especially if one of those receivers is meant to back up your main program receiver.

SET UP YOUR OWN PROGRAM

Since every facility is different, not every idea will work in every case. But that should not stop you from seeking to find and prevent as many of these single points of failure as possible.

Now, I know I am going to get both some "love" and "hate" mail over this, but at the end of the day my answer will be: "it is your facility, not mine." Perhaps together we can develop a checklist. Do the original equipment manufacturers consider any of these principles as they build their systems? I would like to see what they would have to say about this, too.

What have you found that we can share with others?

Stan Adams is in Memphis, where he is recovering from the leftovers of Ike, one of 2008's more annoying storms. If you have suggestions to share with Stan, contact him at stanleybadams@yahoo.com

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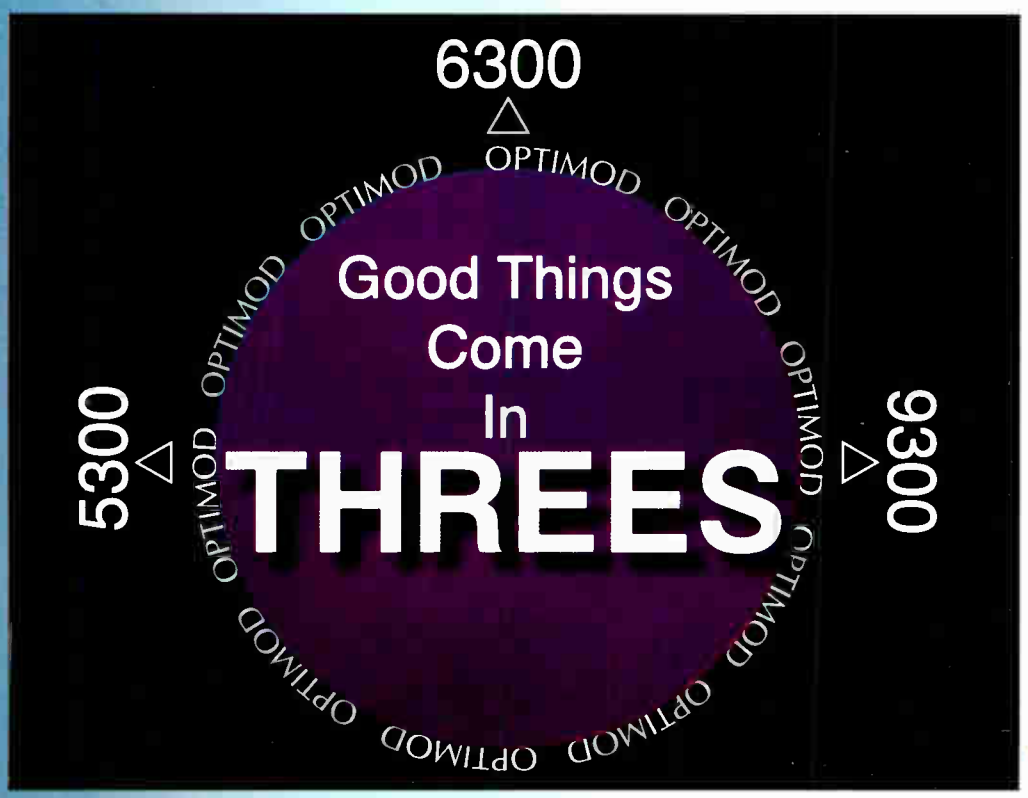

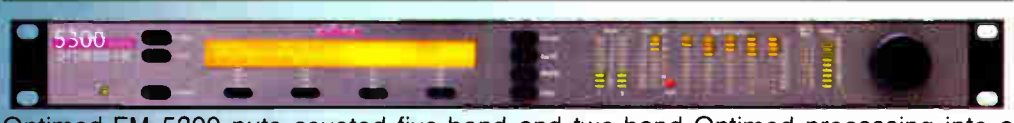

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South-Atlantic: **1-770-632-1295** Art White
North-East: **1-315-623-7655** Jim Peck
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Studio Guide

by George Zahn

The EV 635A

The Dinosaur That Will Not Go Away

A great joy in the privilege of doing this column for ***Radio Guide*** is the opportunity to hear from a wide variety of engineers and managers as they react to the information printed here.

Among the various microphones we have discussed, however, none has spurred so many comments as *The Hammer* – the Electro-Voice 635A. Witness the fact that I made a vague reference in ***Radio Guide*** back in 2006 to the 635A and an unorthodox demonstration.

I had described briefly what I now refer to as "The Legend," which dates back to the 1960's when one of broadcasting's most durable marvels was introduced. Little did I know then that we would hear so much more about this iconic dynamic microphone which has become a staple of electronic newsgathering over the decades.

IT'S "HAMMER TIME"

To recap, a brief summary of my mention of the 635A almost two years ago: "The Legend" goes that the demonstrator of the 635A spoke into the microphone to show its quality. He then potted the microphone down and proceeded to hammer a nail or two into a two-by-four, literally using that same demonstration microphone as a hammer.

The Electro-Voice 635A

The demonstrator then potted the microphone back up – and it sounded the same!

GETTING TO KNOW THE HAMMER

The first feedback came on some clarification of the origins of the microphone that would become the 635A that we still know today.

Recording engineer Eric O'Brien of Imperial Sound Studios in Terre Haute, Indiana wrote and explained that the Electro-Voice Model 664 was the first to have the "hammer" nickname. EV "co-founder" Lou Burroughs (he formed Electro-Voice out of a partnership with Al Kahn) would hammer a few nails into a two-by-four, using the 664, and then use the same microphone for PA during sales pitches to prospective customers.

Thanks to O'Brien, we know that not only was the generic term "hammer" used, but also the moniker "Buchanan Hammer" because the microphones were originally built in Buchanan, Michigan.

EYEWITNESS ACCOUNTS

When I referred to Mr. O'Brien's recollections, the 635A story continued to grow. I started receiving more eyewitness stories of those who actually attended these demonstrations, thus verifying "The Legend." One, Chief Engineer Bill Draper from CC of Hudson Valley in Poughkeepsie, New York, emphatically states, "I can tell you from first hand experience, it's no legend!"

Draper continued, "I was one of the founding members of New York City Chapter 15 of the SBE back in the late sixties. We held our meetings in the spacious performance studio of WQXR, courtesy of then CE 'Doc' Masoomian. At one of those first meetings our guest speaker was none other than Lou Burroughs who started his presentation using a 635A feeding the PA and then proceeded to pound a few nails into a two-by-four with it. Afterward the mic sounded as good as ever and I became a believer."

Draper says that to this day, if a microphone is needed for newsgathering or remote work, the 635A is the microphone he recommends.

MEETING THE CHALLENGE

Peter Boyce of Midamerica Electronics Service in New Albany, Indiana adds that he observed a direct challenge to Burroughs at another SBE demonstration.

"Lou Burroughs was demonstrating the new 635A hand-held microphone, removed from a stack of new, boxed 635A's. Al Scherer, member of SBE chapter 35, took him to task and said it was a special mic for the demonstration, upon which Mr. Burroughs asked Al to come forward and choose which new, boxed mic he preferred him to use for demonstration. He simply took the new mic, and proceeded to drive more nails in the board."

Boyce even noted the reactions in the room of engineers, "There was noticeable cringing on the part of most engineers who were in attendance. Back in those days, the microphone was considered a precision instrument – not to be dropped or blown into. Ribbon mikes in fact failed when the ribbons were stretched from the 'blowing test.' Lou knew he had a good product, and the broadcasters bought them by the case-full. There are many 635A mikes still in use after more than forty years."

A DURABLE PRODUCT

In Mr. Boyce's correspondence, he added that the 635A can still be ordered today – and that is very true. A quick check of the Electro-Voice web site still touts the microphone for its durability, and features an article on one broadcaster who has used the same model for more than 30 years.

The EV 635A model is omnidirectional and not stunning to look at, although it does come in what EV calls a fawn beige (basically a gray) or black finish, either of which can be re-finished if the microphone gets nicked up. The listed frequency response of 80 to 13,000 Hz, +/- about 3 dB (from the EV response graph – the dB variation is not even listed on the official EV website), will not likely win any Grammy awards if you are recording a piano or a harp, but that is not its purpose.

It is obvious Burroughs was not really expecting this microphone to end up as a critical music recording device. The simple dynamic microphone design was forged to handle the pitfalls, and sometimes pratfalls, of mishandling in the field. It was designed to be used exclusively for voice work – not critical arias, but for the news reporter who needs a disaster proof microphone. From the stories about these microphones being dropped or accidentally run over, the steel encased microphone's legend continued to grow.

NOTEWORTHY DRAWBACK

Lest you think from the exulted lore that this is the perfect microphone, please keep in mind that – in addition to the marginal frequency response for anything other than voice – this is also an *omnidirectional* microphone. I imagine a few novice news reporters may have had less than ideal audio brought back while interviewing a fire chief on the job, while standing a bit to close to a noisy firefighter pumper truck. And obviously, the omnidirectional pattern is a detriment to its use as a PA microphone due to the risk of feedback.

Even today, you can still buy the 635A in single boxes or six-packs. The price point of under $180 list (you can find it new retail for $100-$130) makes it an attractive buy for multiple microphone purchases at large news organizations. It is lightweight, about six ounces, and most companies that make custom logo clip-on microphone flags have designs that are made for the handle dimensions of the 635A.

In today's digital domain, we are constantly bombarded with new criteria and a host of improvements to everything technical; sometimes it seems some of our technology is already outmoded as we remove it from its original box.

Yet, while there may be crypto-zoologists out there still searching for the Loch Ness Monster or other creatures that were thought extinct, the EV 635A is alive and well. As proof, we offer many sightings, thanks to many of our readers who can confirm that this 40 year-old "dinosaur" from the 1960's can still hold its own.

George Zahn reports that his parent organization has changed names and email addresses. He still welcomes your email comments and experiences, but now at Maple Knoll Communities: gzahn@mkcommunities.org

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Safety Guide

by Dave Dunsmoor

"Think Twice, Act Once" Prevents Accidents

"Measure twice, cut once" is an old adage used by craftsmen from tailors to carpenters. When thinking about putting your hands into a piece of electronic gear, especially with high voltages or power RF lurking, taking a moment to think about exactly what is in front of you can save your time, parts, fingers, or more. Dave Dunsmoor describes his education about how to avoid that unwanted "Ka-BOOM!"

To paraphrase one of my favorite comics, Ron White, "Has this ever happened to you? It has to me, I've seen it."

Of course, it is one thing to know (philosophically) about all the potential ways to get hurt, or worse, at our job. It is quite another to get your diploma the hard way. The school of hard knocks can be unforgiving.

Now, I know that none of you electronic veterans have done any of the following things, but these stories are for the benefit of the new guys to consider – and to learn from them without having to do the lab portion of the lessons.

IT *WAS* A QUIET MORNING

One day my co-worker was working quietly at his desk while I was working up a little circuit on an old Heathkit protoboard; we had wanted to check the operation of a new piece of test equipment.

When I first scoped the circuit, I noticed that it was essentially flatlined, instead of having the desired waveform. After looking things over, I noticed that I had inserted a tantalum capacitor backwards across the power supply terminals.

However, instead of stopping and turning off the power, I immediately grabbed the capacitor so as to remove it from the board. Of course, as soon as I tugged on it the slightest bit, it exploded.

A backwards capacitor in an energized circuit is not exactly something you should want to touch.

It left my fingers stinging, my ears ringing, a little bit of a mess on the board, and a co-worker who had a slight bruise on his knee after his jump.

KA-BOOM!

A slightly different – but even louder experience – occurred some years ago when I replaced four large electrolytic capacitors in a transmitter power supply. My co-worker and I carefully put things back together, and powered the transmitter up. We completed the necessary paperwork and were about to leave the building.

You probably can already guess exactly what came next: there was a very loud explosion, followed by a loud hissing and the sounds of electrical arcing, and then flames started blowing out the top of the transmitter cabinet.

It seemed like far too much time had elapsed before I got to the breaker panel and pulled the power, then grabbed for the fire extinguisher – but really, I think it was probably five seconds at the most. I shot the Halon into the crack between drawers, and the remaining fire was extinguished immediately.

At this point, I was quite puzzled. We had been quite careful to be sure that the capacitors were installed correctly with regard to the polarity. To calm down, we went for lunch.

After lunch we inspected the wreckage. Sure enough all the caps were installed correctly. So what had gone wrong? As it turned out, the replacement caps were rated with a working voltage of 75 VDC in a power supply circuit running at a nominal 67 Volts. Clearly there was not much headroom there, and that is what caused the catastrophic failure. We replaced the caps with some rated at 100 Volts – and that solved the problem.

THE CAPACITOR THAT CHARGED ITSELF OUT OF THIN AIR

Some years ago I removed the main power supply filter capacitor from a tube rig, replaced it with a newer, smaller one, and got the noise figure back down to where it was supposed to be. I placed a strip of RG-8 shield around the terminals of the old capacitor and took it back to the shop. All well and good so far.

A few weeks later I removed the shorting jumper and left the capacitor on the floor in the back room. The plan was to go back and test it, to see what was wrong with the capacitor that had caused it to not filter very well.

Fortunately, between the time that I had removed it and when I went back to inspect it more closely, I remembered a comment made by an old Navy sonar man to the effect that "the capacitors in the bottom of the boat would pick up a charge out of the air." That did not make sense, given what I knew at the time, but I knew this guy was a straight shooter, so I took him at his word.

It was a good thing I had listened. I shorted the capacitor one more time with a screwdriver before clipping the test leads onto it. A loud snap and an arc convinced me that his observation was certainly correct, even if the explanation did not make sense.

Later on I attended a seminar put on by Sencore, a test equipment manufacturer. A small portion of the presentation dealt with high voltage capacitors, and an explanation of "dielectric absorption." This explained the apparent "charge out of the air" phenomenon.

THE WRONG TOUCH

Then there was the story about the Motorola tube business-band transceiver that had spent its life under the seat of a concrete truck.

I was a young tech at the time, troubleshooting the high voltage power supply, an old "vibrator type" which supplied around 550 VDC to the RF power amplifier (PA). For whatever reason – the logic of this decision having long since expired – I operated the Transmit/Receive relay with the index finger of my right hand.

Although I was careful to keep my left hand in my pocket, I felt the resulting shock far more in my chest than in my fingers. That is to say, that experience gave me an "Associate Degree" in being much more careful in the future. At least, it should have done so.

WORKING WHEN YOU ARE TIRED

One Friday some years later, a pal and I went to the State Fair to see some band. What sounded like a good idea at the time (a couple of beers, a little music, go home), somehow stretched out a bit. We got home a bit on the late side – he dropped me off at my house as the sun was rising.

It was only an hour or so later when I received an anxious call from a station, informing me that the cantankerous old AM transmitter was off and the Saturday morning "sell lots of stuff" show really needed to go on. I found my way to the transmitter, somehow decided that the RF PA tube needed to be changed, and did so.

The next day I was a bit more clear-headed. As I was re-thinking the events of the previous day, I recalled that I had not used the shorting stick before I reached in and removed the old PA tube. That recollection gave me perhaps a "Bachelors Degree" in being careful around high voltage.

KNOW WHERE THE POWER IS

My final story recalls the time I was measuring distances on the ATU platform of a self-supported AM tower with a skirt feed. The project was to replace the old two-by-fours that were used to support the feed ring with something more appropriate.

Sure enough, as I swung the trusty old Stanley tape around, I briefly brushed against one of the skirt wires and, before I could pull my hand back, there was a small puff of smoke from my finger and an arc at the tape.

Waving a metal tape around under a tower may result in more than a measurement of distance.

My finger eventually healed with no other ill effects, but that tape has the reminder permanently embossed. Now, perhaps, I have earned that "Masters Degree" that I have been working all these years to get.

LEARNING FROM OTHERS

These stories are meant to illustrate three things.

The first is something my dad tried to tell me when I was a kid: "think about what you're going to do *before* you do it." That one sometimes seems to have taken a while to really sink in.

Secondly, if at all possible, learn from other people's experience. This one seems to be the tough one, but can really pay off when done well. And it is really handy if, once you have learned something really useful, you *remember* it.

Finally, even when you have carefully thought out what you are going to do and have done it as well as you can – occasionally things do go wrong.

This is where emergency preparation and planning come into play as in the episode of the exploding power supply capacitors. The breaker panel was readily accessible and the fire extinguisher was nearby. This prevented the fire from getting out of hand and perhaps destroying the entire building.

Dave Dunsmoor is a contract engineer in the Minot, ND area, as well as a Navigation/Communications (NAVCOM) Technician for the FAA. Contact him at mrfixit@min.midco.net

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Antenna Guide

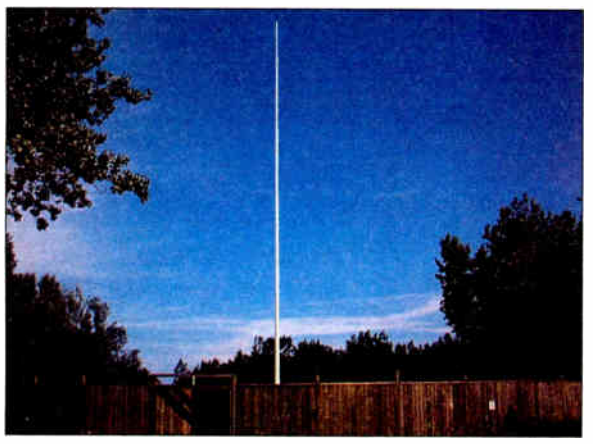
by Grant Bingeman

A Look at a Low Profile Antenna in Use

Low-profile antennas for AM broadcast stations are all the rage these days, especially for use in the upper end of the standard AM band. This article addresses the radiation efficiency of a Valcom 85-foot tall tower as a function of its ground system of buried radial wires, to see how effectively it can work for broadcasters.

LESS THAN 100 FEET

We are going to take a look at the installation at CHHA Toronto, Ontario. CHHA operates omnidirectionally, with 10 kW on 1610 kHz during the day, reducing power to 250 Watts at night.



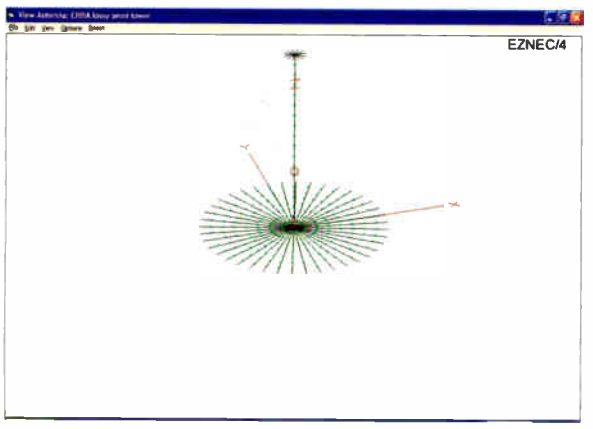
The CHHA tower.

A wavelength at 1610 kHz is 611 feet, so our reference tower is 152 feet tall, 90 electrical degrees. A quarter-wave tower over ideal ground produces a vertically-polarized electric field of 313 mV/m at one kilometer when the input power is 1,000 Watts (equivalent to 195 mV/m at a mile).

The tower used by CHHA is 50 degrees in physical height, but is top-loaded and has a built-in loading coil located in the lower third of the tower. The top-loading is a spherical cage, which is actually more of a voltage-gradient control device than a capacitance top-hat. The licensed value is 60 electrical degrees.

INSTALLATION

As recommended in the Valcom installation instructions, the initial ground system consisted of 40 buried wires, each 40 feet long (24 degrees) having a diameter of 0.125 inches.



EZNEC representation of the CHHA installation.

These wires are buried 2.4 inches at their ends in 5 mS/m soil; performance would improve if the ground conductivity were higher.

As built, the input impedance of the 85-foot tower is 19.5 -j61.5 Ohms, producing a vertically-polarized, ground-wave electric field at one kilometer of 169 mV/m for 1,000 Watts input to the tower base.

ANALYZING THE EFFICIENCY

This is a rather poor radiation efficiency of 169/313 or 54 percent – equivalent to a power efficiency of 29 percent. Therefore, when CHHA is operating with its full power of 10,000 Watts, only 2,900 Watts are contributing to the RF signal, which means that 7,100 Watts are wasted as heat, just warming the dirt. The loss is 20 log [105/195] = 10 log [2900/10000] = 5.4 dB. This is a very poor condition for a full-time permanent broadcast radio station.

Is this the best that can be had from such an antenna? Are there reasonably easy ways to improve the radiation efficiency? I used EZNEC4 to analyze the antenna and see what options exist.

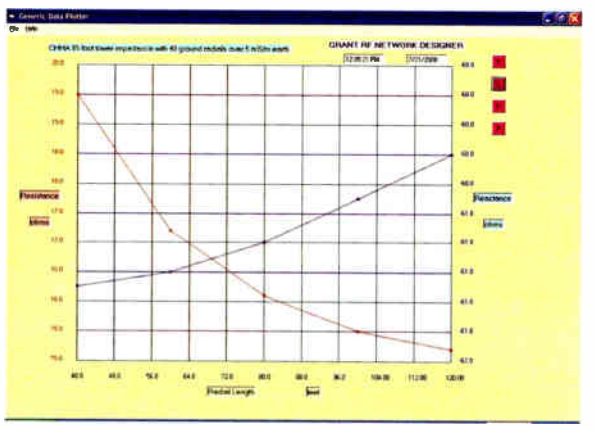
(The Method of Moment (MoM) engine I used was NEC4, as integrated by Roy Lewallen in his early EZNEC/4 Pro version 3.0.59. The first five-foot section of the tower near the base was modeled as a one-inch diameter wire in order to ease the transition between the 1/8-inch diameter ground wires and the 10-inch diameter tower. The top-hat was variously modeled as six or twelve horizontal radials each five feet long in order to simulate the measured site impedances. But as mentioned previously the top-hat is more an anti-corona device, and does not influence performance significantly.)

ENHANCING THE GROUND SYSTEM

In this study, all the wires and coils are assumed to be lossless. The MoM model current expansions are five feet long.

If we increase the ground radial length to 80 feet (47 degrees), the input impedance becomes 16.1 - j61.2 Ohms and the field at one kilometer becomes 185 mV/m. Radiation efficiency is now 59 percent and power efficiency is now 35 percent, a slightly better result.

Changing the ground radial length to 120 feet (71 degrees), the input impedance becomes 15.2 - j60.6 Ohms. Now the field at one kilometer becomes 190 mV/m. Radiation efficiency is 61 percent, power efficiency 37 percent; another small improvement.



Input impedance vs. radial length.

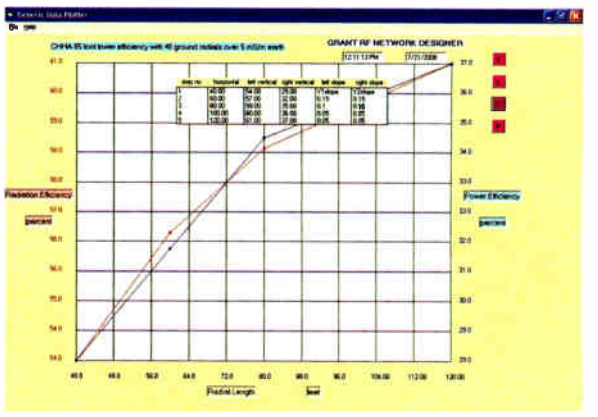
As expected, the input resistance drops and the ground losses are reduced by increasing the length of the 40 ground radials.

MORE RADIALS

Increasing the number of radials will also reduce losses. Still using 120-foot-long radials – but using 80 of them – the input impedance becomes 14.1 - j62.3 Ohms, and the field at one kilometer becomes 196 mV/m. The system radiation efficiency is now at 63 percent, power efficiency 39 percent. Again, only a small improvement.

The ultimate ground system of 120 radials, each 120 feet long produces an input impedance of 13.7 - j62.9 Ohms, and a field at one kilometer of 198 mV/m. It would appear that this is where the radiation efficiency tops out at 63 percent – we have reached the point of diminishing returns.

A radiation efficiency of 63 percent is a power efficiency of 40 percent. If we lose half of the input power to heating, we know that the electric field is down 3.0 dB to the square root of 0.50, thus 70.7 percent of its ideal lossless value. So a power efficiency of 40 percent means the signal intensity is reduced to 63 percent of the lossless value. Fortunately, we do not need to settle for this.



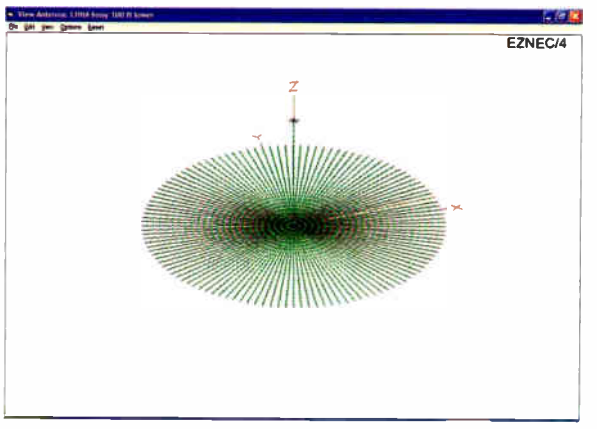
System efficiency vs radial length.

OTHER OPTIONS TO CONSIDER

In order to improve efficiency, a taller tower is indicated. But first let us explore what a wetter ground having a conductivity of 30 mS/m will do for us.

The configuration with 120 radials, each 120 feet long, has an input impedance of 13.7 - j61.3 Ohms, but the field strength jumps to 267 mV/m at a kilometer. Radiation efficiency is now 85 percent; not bad.

Now, if we increase the tower height to 100 feet, maintaining the top-loading and internal loading coil, we might expect an input impedance of 19.5 + j5.1 Ohms, now close to resonance. The internal loading coil value of 12.2 uH has not been changed, and the result is a field at one kilometer of 268 mV/m for our kilowatt. This is a radiation efficiency of 86 percent, not really much of an additional improvement.



A taller tower and more radials.

Because the loading coil is not located directly at the base of the tower, its reactance is transformed by the transmission line effect of the portion of tower between the coil location and the base. Thus we see a change in both resistance and reactance at the tower base.

It would be a simple matter to calculate the effective surge impedance of this part of the tower given the data we now have. With no internal loading coil, the input impedance is 18.6 - j131.7 Ohms, and the field at one kilometer remains at 268 mV/m.

Continuing with no loading coil, but a tower height of 120 feet (71 degrees) over the large ground system in 30 mS/m soil, the input impedance becomes 28.7 - j56.1 Ohms, and the field at one kilometer is 272 mV/m.

This small improvement is hardly worth the effort and expense. We are approaching the best performance that can be attained with a 90-degree tall tower operating over this particular medium.

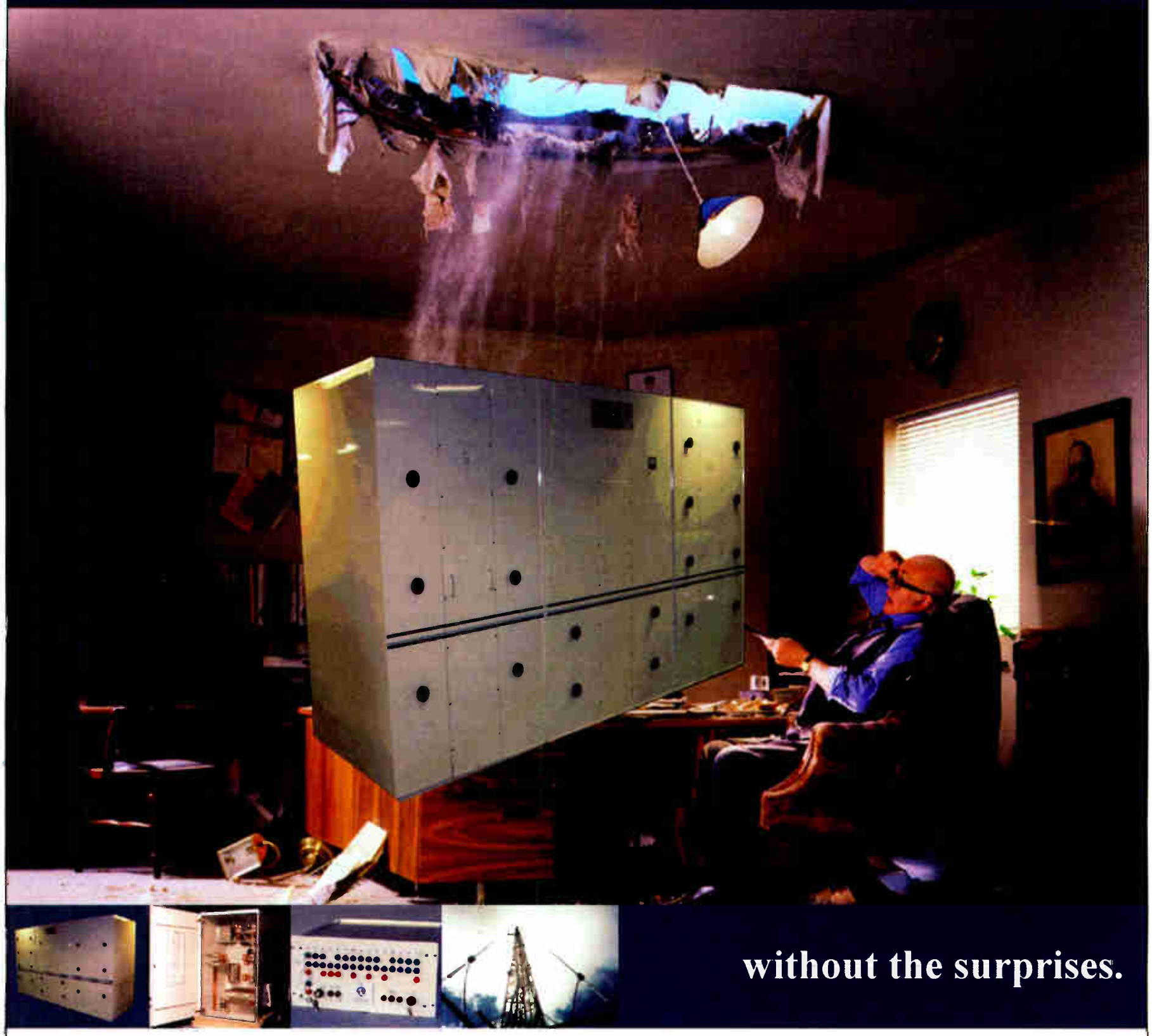
CONCLUSION

The 85-foot Valcom tower is a valid solution for tight spaces, but compromising the ground system seriously reduces signal intensity. Therefore, the amount of land needed to be purchased for a radio station transmitter and antenna site is dictated largely by the ground system.

It should also be noted that tower radiation can be adversely affected by nearby trees absorbing and also re-radiating the signal. According to consultants such as Ben Dawson, the near-field has to be clear of trees taller than about 30 electrical degrees.

Grant Bingeman, P.E., is a design engineer, well-known in the broadcast industry for his work at Gates/Harris, Rockwell/Collins, and Continental Electronics. His email is GrantBingeman@cs.com

AM Directional Systems...



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FCC Focus

by Cary Tepper

Avoiding Fines During Unattended Operation

As you may know, in 1995 the FCC adopted the Report and Order in MM Docket 94-130 (10 FCC Rcd 11479). This permitted radio and TV broadcast stations to be operated without a person physically standing by to monitor the transmitter's operation ("unattended operation").

A DEREGULATION "GOTCHA"

The action permitted licensed broadcast stations to take advantage of the advances in station monitoring equipment and the inherent reliability and stability of today's transmission equipment. Indeed, most of our clients have availed themselves of the unattended operations policy during the overnight hours.

Unfortunately, there has been a prevailing misunderstanding about whether a broadcast station can operate unattended *during regular weekday, daytime business hours*.

The result is that one of our clients just got cited by the FCC for improper daytime operations, and the FCC assessed a fine in excess of $10,000 for various possible Rules violations. Obviously we are going to appeal the assessment, but many of these issues could have been avoided.

UNDERSTANDING UNATTENDED OPERATION

Since unattended operation is now a hot item at the FCC Enforcement Division, it might be well worth your time to take a few minutes and review the questions and answers listed below.

1. Notification to Commission: Am I required to notify the Commission when my broadcast station begins unattended operation of its transmitter?

No. Notification is not required when a station begins unattended operation of its transmitter. See FCC Rule 73.1300.

2. The Main Studio Rule: Does the Unattended Operation Rule permit me to eliminate the Main Studio for my station?

No. The Report and Order had no effect on the Main Studio requirements for radio stations. The "unattended operation" refers to a lack of human monitoring of the transmitter itself, not the entire station.

All full-power radio stations, excepting those for whom waiver of the Main Studio Rules was granted, are still required to comply with the Main Studio requirements of FCC Rule 73.1125. Note, however, that the Rules do not require the Main Studio staff to monitor an unattended broadcast transmitter.

At the same time, the FCC Policy does require that *two people must be on site during the business day* – one full-time management person, and another part time person to watch over the studio when the manager is not there. In other words – no station should ever be locked and unavailable during normal business hours – even though the Public File *might* legally be somewhere else.

CONTROL POINT

3. Transmission System Control Point: How and when do I notify the FCC of the establishment of a Transmission System Control Point location?

The location of a transmission system control point or remote control point for radio stations, other than at the transmitter site or at the main studio, must be sent by letter to the Audio Division (1800B) at the FCC, Washington, DC 20554 within three days of the initial use of that point.

Such Notice must include the station's call sign and Facility ID Number, with any notification of the transmission system control point address, and provide the telephone number at that control point. (Post Office (P.O.) boxes are not acceptable addresses.)

The Rule does not preclude the establishment of multiple transmission system control sites or set a limit on the location of these sites. Further, notification is not required if personnel can be contacted at the Main Studio site or transmitter site during all hours of operation.

4. Location of Transmitter Control Personnel. Are the persons designated by the licensee to control the transmitter required to be at a fixed site?

The answer depends on the level of automation employed by the station, as follows:

Fully Automated – where the station's control and monitoring equipment makes any adjustments necessary without human supervision.

In the event of a malfunction which could cause interference, if the automated system cannot correct the malfunction, the equipment automatically shuts the transmitter off after three hours (or three minutes for certain AM station conditions).

The system may be configured to contact designated personnel within these time limits, but operator control is not necessary to deal with the malfunction. In this case, personnel to control the transmitter are not required to be at a fixed site. See FCC Rule 73.1400(b).

Partially Automated or Not Automated – where the transmission, monitoring, or control facilities are (1) supervised on an ongoing basis by a designated person, whether by direct supervision or by remote control from another site, or (2) are configured to contact a person designated by the licensee who must then take steps to resolve the malfunction or terminate operations in the event of a malfunction, the station is considered "attended" and the person who can take control of the transmitter must be located at a fixed site.

Equipment used for remote control operation must provide sufficient monitoring and control capability so as to ensure compliance with FCC Rule 73.1350. Please note that these requirements do not preclude the monitor-and-control equipment from being configured to contact a second person initially. If the second party is unavailable or cannot take control, the equipment must then contact the designated person at the fixed site, and control or cessation of operations must occur, within the time periods specified in FCC Rule 73.1350.

By the way, whether automated or not, the station must also have the means of receiving, retransmitting, and logging EAS alerts and tests.

5. Dedicated Telephone Line. If I use a telephone line for transmitter control and notifications or alarms, am I required to employ a dedicated telephone line for that purpose?

Yes. A dedicated telephone line (using the public switched telephone network) to the transmitter site may not be used for other purposes during periods when it is in use for transmitter monitoring, alarms, or control.

Pursuant to FCC Rule 73.1350, such a line is used for the sole purpose of interacting with the broadcast transmitter and monitoring equipment. However, the telephone line may be used for other purposes during periods when the transmitter is being monitored and controlled by other means – for example, by a person at the transmitter site.

EXERCISING PROPER CONTROL

6. Is a station required to have automated equipment in place before unattended operation may commence?

No. At the present time, the FCC does not require the installation of automatically adjusting monitoring and control equipment (referred to in the Commission's rules as an Automatic Transmission System or ATS) before a station employs unattended operation of its broadcast transmitter.

If automatically adjusting monitor and control equipment is not employed, suitable equipment must be employed which is expected to operate within assigned tolerances for extended periods of time without constant human monitoring. See FCC Rule 73.1400.

7. Monitoring Procedures. What technical monitoring procedures must be in place for a station employing unattended operation?

A station, attended or unattended, must establish suitable monitoring procedures of its equipment and maintenance schedules for the station and indicating instruments to ensure that the equipment is operating properly. See FCC Rule 73.1350(c).

The FCC does not prescribe any particular procedure or schedule interval for a station to use. We suggest that any procedures established be reduced to writing to provide proof that monitoring procedures exist. Note that indicating instruments must comply with the requirements of FCC Rule 73.1215,

Remember, too, that the Chief Operator of the station, whether attended or unattended, is responsible for weekly inspections of log entries and the additional information required by FCC Rule 73.1870(c).

WHEN TROUBLE OCCURS

8. Response Time. How long do I have to respond to and correct a transmitter malfunction?

In general, the licensee or permittee must correct any malfunction which could cause interference or turn the transmitter off within three hours of the malfunction.

However, some malfunctions must be corrected within three minutes. Therefore, personnel designated by the licensee to control the transmitter must have the capability to turn the transmitter off at all times or include an alternate method of taking control of the transmitter which can terminate the station's operation within three minutes. See FCC Rule 73.1350(b)(2).

Examples of situations requiring termination within three minutes are operations posing a threat to life, property, public safety (e.g., by causing interference to a land mobile based emergency radio system), or those likely to significantly disrupt operations of other stations (such as spurious emissions or operation substantially at variance from an authorized radiation pattern), unless the power is sufficiently reduced in that period to eliminate any excess radiation. See FCC Rules 73.62 and 73.1350.

TRANSLATORS AND BOOSTERS

9. How do the Unattended Operation Rules apply to my FM translator or booster station?

Unattended operation for FM translator and booster stations is covered by FCC Rule 74.1234.

The Rule requires that if the transmitter cannot be promptly reached at all hours and in all seasons, means must be provided so that the transmitter can be turned on and off at will from a point that is accessible 24 hours per day. Furthermore, the equipment shall automatically and immediately terminate transmitting if the input signal is lost.

Also the FCC does ask the name, address, and telephone number of the person or persons in control of the transmitter be provided to them in the form of a letter addressed to the Media Bureau.

DOCUMENTATION

10. Station Log – Should out-of-tolerance conditions and corrective actions to the transmitting equipment be recorded in the station log?

Yes. The station should take care to record each failure, out-of-tolerance condition, or corrective action (including calibration of automatic devices) made to the transmission system equipment, including monitoring and control devices. See FCC Rules 73.1820(a) & (a)(1).

FCC Rules 73.1800 and 73.1820 state that the entries in the station log should be made by the person designated by the licensee to take charge of the transmitting equipment. Automatic equipment also may be used to record entries for the station, provided that the requirements of 73.1820(b) are met by the recording device. Station logs must be kept at least two years.

Log entries must be made of any malfunction or extinguishment of tower lighting, or any notification made to the FAA of the same, and a log entry should be made when normal functioning resumes. See FCC Rules 17.48, 17.49, 73.1820, 74.734, and 74.1234.

An important note: While regular log entrees for most transmitter, directional antenna system, monitor points, and tower lighting systems are no longer required by the FCC, it is still a good idea to do make such readings regularly, including a daily visual observation verifying the proper operation of the tower lighting. This provides documentation, if needed, that the station normally operates within licensed parameters and any non-standard operation is short-term.

Cary Tepper is a principal of the law firm Booth, Freret, Imlay & Tepper, PC in Bethesda, Maryland. He represents hundreds of commercial and noncommercial radio and TV stations. Contact him at tepperlaw@aol.com

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This ultra-consistent microphone may be used with confidence in a wide variety of studio and live miking applications, even under the stringent demands of digital recording systems.

Great Low Price

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Industry standard RDS... The RDS 3 is an industry standard UECP compliant, fully dyanmic RDS encoder with TCP/IP connectivity.

Band Scanner GPS

USB FM Scanning Receiver, Modulation & RDS Analyzer, 12 Channel GPS Receiver

This is a tool to evaluate FM broadcast band congestion and to log station identification parameters."Band Scanner GPS" is a Google Earth compatible tool for visualisation of collected FM Radio measurements.

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Just plug it into your network and get server or world time accuracy in any room or studio.

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Delivers great sound quality while working 24 hrs a day 7 days a week. Affordable price suitable for small and medium-sized radio stations.

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5.8 GHz Audio over IP Links

- Wireless bridging between buildings
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SAVE ON PACKAGE DEALS

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Enable users to create flexible, cost-effective distributed audio systems using standard IP technology.

BARIX

Package 2 5.8 GHz APTX Coding Package

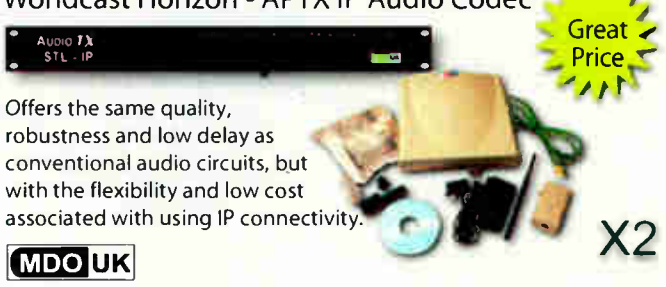
Worldcast Horizon- APTX IP Audio Codec

A fully duplex, two channel stereo codec designed to enable real-time transport of broadcast quality audio over IP networks.

APT

Package 3 5.8 GHz AAC Coding Package

Worldcast Horizon - APTX IP Audio Codec



Offers the same quality, robustness and low delay as conventional audio circuits, but with the flexibility and low cost associated with using IP connectivity.

MDO UK

Practical Engineering

Keeping Your Transmitter Cool and Other Handy Hints

By Mike Langner

In this time of reduced budgets and fewer resources for broadcast engineers, working "smarter, not harder" has become more important than ever. Here, gleaned from a 50-year career in broadcast engineering, are handy hints from one of those "old guys who's seen it all."

Proper cooling is one of the keys to reliable transmitter site equipment operation. Therefore, it goes without saying that providing such cooling is a primary concern.

But what if the cooling system fails? How can you know before damage occurs? Here is how.

A CHEAP OVERHEAT ALARM

For under $50, you can prevent thousands of dollars of damage and many hours of repair work resulting from an overheated transmitter room.

Start by purchasing two "line operated" thermostats from your local home improvement or electrical supply store. While you can adapt both the "heating" and the "cooling" types, the heating type adapts more quickly with fewer parts.

Set one of the thermostats at a temperature above your normal in the transmitter room – 90 degrees Fahrenheit, for example. Then set the other at a temperature beyond which you do not want the transmitter to stay on the air – or at least not without a drastic reduction in power output in order to avoid damage to your equipment; perhaps 100 degrees Fahrenheit.

Connect the first (90 degree) thermostat to a status alarm on your remote control. Set that channel to notify you if the alarm goes off. The second (100 degree) thermostat can, depending upon your choice (and transmitter capabilities), severely cut back the transmitter power or turn it completely off.

Of course, you should choose your own temperature settings based on your equipment and your building's ambient temperature.

This setup has worked well. Shortly after we installed thermostats at several remote sites, one site without redundant air coolers lost its cooling. A $20 thermostat saved a many thousand dollar, 6-month-old 20 kW FM transmitter from "meltdown."

THE RIGHT BUILDING TEMPERATURE

Now that we have protected the transmitter, we should turn our attention to keeping the transmitter from ever getting so hot we need an "over temperature shutoff."

One false economy practiced by too many stations is not having dual air conditions (or ventilation fans). Dual – as in *two separate units*, not just one large single unit. More than one GM who ignored his engineer and, instead of dual units, bought one air handler, has ended up with a failed fan motor – and a toasty transmitter before strange readings brought help.

Just as with the thermostat alarm we just discussed, set the two units at different temperatures. If the one fails for some reason, the other can take over. Rotating the "lead" unit will exercise both and lengthen service times.

For further backup, use that thermostat that signals a "hot building" via the remote control. Hook it up to an auxiliary blower to either bring more air into the building or suck more air out of it.

AVOIDING ICING EVEN IN THE DESERT

On very humid days, those of us using refrigerated air to cool our buildings can find ourselves with air conditioners that have lots of cooling power but not a lot of airflow. What happens is the condenser can quickly "ice up," causing the air conditioner to be ineffective.

This is why you should never, never, never run your transmitter building air conditioner at "low fan speed." Instead, if it gets too cold in your building, raise the temperature setting. You can only violate this rule if your air conditioner has "freeze detection" on it – where, if the low pressure Freon line gets too low, the "cut-out" switch will cycle the compressor off until the high pressure side receives heat from the cold coils, something it cannot well do if the cold coils are covered with ice.

Can you roll your own ice sensor? Sure. Just as your transmitter likely has a "sail switch" after its blower, install one in the cold air discharge from your air conditioner. If the air conditioner ices up, the airflow stops. Your sail switch should turn the compressor off until airflow is fully re-established.

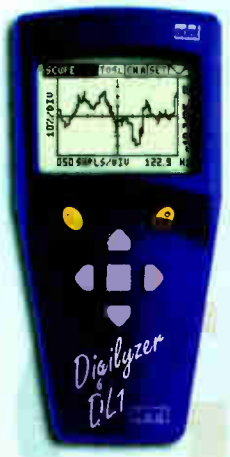
In the better grade installations, these ice blockage sensor switches operate a timer. This way, the cold coils not only become free of ice – a further time-determined interval is employed to make absolutely sure all the ice is gone and the Freon pressure in the air conditioner has equalized.

(Continued on Page 26)

MINSTRUMENT MATRIX

Sophisticated Minstruments from NTI give you comprehensive test capability... and these flexible audio instruments fit in the palm of your hand

DL1 Digilyzer
Digital Audio Analyzer



A handheld digital audio analyzer with the measurement power & functions of more expensive instruments, the DL1 Digilyzer analyzes and measures both the digital carrier signal (AES/EBU, SPDIF or ADAT) as well as embedded digital audio. In addition, the DL1 functions as a smart monitor and digital level meter for tracking down signals around the studio. Plugged into either an analog or digital signal line, it automatically detects and measures digital signals or informs if you connect to an analog line. In addition to customary audio, carrier and status bit measurements, the DL1 also includes a comprehensive event logging capability.

- AES/EBU, SPDIF, ADAT signals
- 32k to 96k digital sample rates
- Measure digital carrier level, frequency
- Status/User bits
- Event logging
- Bit statistics
- VU + PPM level meter for the embedded audio
- Monitor DA converter and headphone/speaker amp
- Audio scope mode

DR2 Digirator
Digital Audio Generator

The DR2 Digirator not only generates digital audio in stereo & surround, it is a channel transparency and delay tester as well, all condensed into a handheld package. Delivering performance & functionality challenging any digital audio generator made today, it produces all common audio test signals with sampling frequencies up to 192 kHz and resolution up to 24 bit. The Digirator features a multi-format sync-input allowing the instrument to be synchronized to video and audio signals. In addition to standard two-channel digital audio, the DR2 can source a comprehensive set of surround signals.

- AES3, SPDIF, TOSLink, ADAT outputs
- 24 bit 2 channel digital audio up to 192 kHz SR
- Sine wave with stepped & continuous sweeps; White & Pink Noise; Polarity & Delay test signals
- Dolby D, D+, E, Pro-Logic II, DTS and DTS-HR surround signals
- Channel Transparency measurement
- I/O Delay Measurement
- Sync to AES3, DARS, word clock & video black burst
- User-generated test signal files

AL1 Acoustilyzer
Acoustics, Audio & Intelligibility Analyzer

The AL1 Acoustilyzer features extensive acoustical measurement capabilities as well as analog audio electrical measurements such as level, frequency and THD+N. With both true RTA and high resolution FFT capability, the AL1 also measures delay and reverberation times.
With the optional STI-PA Speech Intelligibility function, rapid and convenient standardized "one-number" intelligibility measurements may be made on all types of sound systems, from venue sound reinforcement to regulated "life and safety" audio systems.

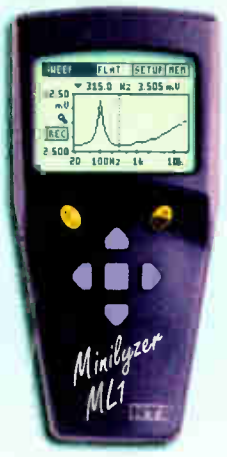
- Real Time Analyzer
- Reverb Time (RT60)
- Delay measurements
- High resolution FFT with zoom
- Optional STI-PA Speech Intelligibility function
- Automatic Distortion analyzer (THD+N)
- Frequency, RMS Level, Polarity measurements
- Requires optional MiniSPL microphone
- Includes MiniLINK USB interface & Windows PC software for storing tests and PC transfer

MR-PRO Minirator
High performance
Analog Audio Generator +
Impedance/Phantom/Cable measurements

The MR-PRO Minirator is the senior partner to the MR2 below, with added features and higher performance. Both generators feature an ergonomic instrument package & operation, balanced and unbalanced outputs, and a full range of signals.

- High (+18 dBu) output level & <-96 dB residual THD
- Sine waves & programmable swept (chirp) and stepped sweeps
- Pink & white noise
- Polarity & delay test signals
- User-generated custom test signals & generator setups
- Impedance measurement of the connected device
- Phantom power voltage measurement
- Cable tester and signal balance measurement
- Protective shock jacket

ML1 Minilyzer
Analog Audio Analyzer



The ML1 Minilyzer is a full function high performance audio analyzer and signal monitor that fits in the palm of your hand.
The comprehensive feature set includes standard measurements of level, frequency and THD+N, plus VU+PPM meter mode, scope mode, a 1/3 octave analyzer and the ability to acquire, measure and display external response sweeps generated by a Minirator or other external generator.

Add the optional MiniLINK USB computer interface and Windows-based software and you may store all tests on the instrument for download to your PC, as well as send commands and display real time results to and from the analyzer.


MiniLINK

- Measure Level, Frequency, Polarity
- Automatic THD+N and individual harmonic distortion measurements k2 – k5
- VU + PPM meter/monitor
- 1/3 octave analyzer
- Requires optional MiniSPL microphone for SPL & acoustic RTA measurements
- Frequency/time sweeps
- Scope mode
- Measure signal balance error
- Selectable units for level measurements

MR2 Minirator
Analog Audio Generator

The MR2 pocket-sized analog audio generator is the successor to the legendary MR1 Minirator. It is the behind-the-scenes star of thousands of live performances, recordings and remote feeds.

- Intuitive operation via thumbwheel and "short-cut" buttons
- New higher output level (+8 dBu) & low distortion
- Programmable Swept (chirp) and Stepped sweeps
- Sine waves
- Pink & White noise
- Polarity & Delay test signals
- Illuminated Mute button

NTI Americas Inc
PO Box 231027
Tigard, Oregon 97281 USA
503-684-7050
www.minstruments.com
info@ntiam.com

Practical Engineering

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WHEN THE POWER GOES OUT

Many of us have experienced a remote site failure and, when the remote control/telemetry does not work, wondered if there is a complete power failure – or *exactly what has happened?* Well, here is how to end the wondering!

The easiest and most cost-effective way to get the information you need is to make sure the remote control is operating – so you do not need to go to the site to find out the situation. A UPS for the remote control is less than $100 and pays for itself almost immediately.

With an operating remote control, you quickly can determine if there is power from the utility – or the generator, if you have one.

GETTING MORE INFORMATION

To get more detailed information on the power available, purchase an inexpensive 1.5 Volt DC "wall-wart" power supply from an electronics store or, if you wish, homebrew one. If you have three-phase power, get two or three, depending on how much you want to know about the power in your building.

Bring the output(s) from the 1.5 Volt power supplies to your remote control. Put each one on its own metering channel or use "Raise/Lower" on one channel to select which power supply your remote control reads. If you set full voltage from the power supplies to indicate normal power line voltage on your remote control, you will have inexpensive metering of your building power at your fingertips.

Want to know definitively if your building power is good but a breaker is blown? Put a power supply after the breaker. Now you can both check building power and learn if the breaker of interest has tripped.

Important note: Be sure that your 1.5 Volt power supply is "transformer isolated" in design so that the secondary is isolated from the mains supply. Some "switcher" supplies are marginal in their insolation. If there is any question, employ a low power-isolation transformer, or build your own power supply using a filament or other low voltage transformer.

VERIFYING AND TIMING AN OUTAGE

Sometimes it is helpful to know exactly when and how long an outage was. First, let us verify the outage:

Take a 120 or 240 Volt AC relay. Wire it with a pushbutton so that when you press the pushbutton, the relay pulls in and then is held in by running AC power through one of the Normally Open (Closed when energized) contacts. The relay will happily stay engaged until a power outage of greater than about two-tenths of a second. When you return to the site to see if there indeed was an outage, just look to see if the relay has dropped out.

If you would like to get a little fancier, add tally lights to display the power condition. Even better, add a battery operated or AC-powered clock that has *hands on its face*. It will stop running when the power fails and indicate what time the lights went out.

Want more icing on the cake? Got one more relay? With a little logic, by hooking the second relay to the first, you can start a second clock that you have stopped at 12:00 – or one that defaults to 12:00 when powered up. Either way, you will have and indication of the elapsed time since power restoration.

Now you know:

(1) that there was a power failure.

(2) when it started.

(3) how long power has been back on.

Any inexpensive travel clock should work in both applications. Almost all travel clocks run from a single 1.5 volt battery, so having your relay connect/disconnect a battery to each clock so that it starts is a trivial job.

Here is a variation on the theme: while you have the first clock stop upon a power failure, the second clock keeps running through the power failure and stops *upon restoration of power*. The logic to do this is a bit different, but still simple.

Now you can directly read the time of the outage and the time of restoration. Both clocks in this version must "have hands" so that when they are stopped, they will "remember" the time at which they were stopped.

We have some more of these simple procedures and circuits to do other neat things around the facility and we will share some of them with you next time. You are also welcome to share your ideas with us!

Mike Langner was the Albuquerque market Chief Engineer for Citadel until his retirement. A lifelong Ham and former station owner, he continues to be active in the industry. Contact Mike at mlangner@swcp.com

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Protection Guide

by Gary A. Minker

Protect Gear By Understanding Grounding Methodologies

Arguments over exactly "how it works" have long been a part of the world of electronics design. Perhaps the most severe disagreements and passionate arguments are over the part of a circuit that is supposed to be at "ground potential." Gary Minker's goal is to help us better understand circuit grounds and grounding.

Change is not necessary or relevant for all things. However, change comes from the evolution of an idea that has been developed and has reached a point where some form of need, requirement, growth or progress mandates that new ideas be considered. It is this consideration that promotes change.

MORE THAN FEET ON THE GROUND

Grounding is a term that has been widely used and misused for the last hundred years. It is my hope to shine some light on this subject and make proper grounding procedures a bit less of a mystery for the engineer.

Back before grounds – before the era of wire-based conduction of electricity – Benjamin Franklin tried very hard to incinerate himself by flying a kite during an electrical storm in an effort to prove or disprove wild theories about the phenomenon of lightning.

Franklin's conductor was a wet string to which he had tied the fabled metal lock key. It was his hope that he would be able to change the theories about lightning and make practical judgments about what he learned. Although he did not think to use rubber-soled shoes, he did survive the experiment, much to our benefit today.

DEFINING THE TERMS

Grounding. Here we go again! Grounding, Earthing, by any other name – the conduction of electrons, or static potential, to Earth or a commonality of potential amongst objects commonly at the potential charge of the surrounding earth.

Grounding is a term that can be construed to connote a Noun, Verb, or Adjective. Like many words in the English language it can have many meanings and therefore easily be grossly abused. Grounding is a practice, a convention, and an art form.

In this discussion we also will use some generic terms. These terms will include, but not be limited to, Strike, Pulse, EMP, Voltage, and Current.

My goal is to introduce you to the concept of the Distributed Single Point Ground – an adaptation of the widely accepted Single Point Ground theories being promoted by a number of manufacturers of electronic equipment. In the concept of Single Point Grounding, there is only one point that is tied to earth and from this point all sources of power, control, signal sourcing, and – of course – grounding emanate.

THE NEED FOR REVIEW

While it has become common practice to unify the Single Point Ground within an apparatus, this practice has not been properly extended to the installation of complex associations of apparatuses within a given site. In fact, although the Single Point Ground is an appropriate and safe way to control fault energy within an apparatus, the Distributed Single Point Ground is required due to the complexity of most electrical, industrial, and transmitter sites.

On the other hand, some will say, "We have done it this way for decades, made few significant changes, killed low numbers of people, and have had some success with the way we do it. Why change now?" This attitude obviously can be applied to much of everyday life.

Conversely, we have seen many changes in the global grounding scenario as evidenced by the multitude of educational grounding primer documents and de-facto standards that claim there is enough data, if not history, to recommend changes in this time-honored methodology. Not so curiously, grounding practices usually are held tightly to the convention of the writer of a particular document.

GROUNDING IS A RELIGION

Though a provocative statement, this is also a generally accurate statement.

The art, science and craft of Grounding has been around for such a long time and there are so many beliefs, facts and myths, that it can be allowed that no singular methodology is wholly correct. In fact, in today's modern world, the problem of patent infringement and other legalities drives these numerous fallacies; it is impossible for any one company to create a methodology that would be totally correct without stepping on another company's Patent or Copy rights.

If this were not complicated enough, simple pride and misunderstanding account for the rest of the outright fabrications and distortions of the truth.

In grounding, conventional thought also has to accept that every situation is different. Certainly there are similarities, but the small esoteric differences in every facility mandate that an open mind must be maintained in the design and application of whichever convention is used.

WHO DO YOU TRUST

In this discussion, I am guided by numerous large and venerable corporations that have been involved in the Two-Way Radio and Broadcast businesses.

One might think these corporations should be regarded as knowledgeable and experienced, and should under any circumstances be held above reproach in their teachings, as these teachings are developed supposedly in the vein of protecting the end-user from harm. In truth, these teachings mainly are developed to protect the corporation from harm – and inadvertently protect us, the users of the equipment. Corporations protect themselves at our expense, driven by liability concerns and the ramifications of exposure and indemnification.

Among these venerable corporations, some documents from Motorola, Telos, Polyphasor, and Nautel are offered up for evaluation. While there are literally hundreds of published works, selected topics will be used to illustrate the numerous considerations required here.

These works are selected to promote a combative comparison amongst the documents – not to initially promote a theory or point. It should be noted that these works completely and totally contradict each other. To make matters more confusing, the works of Polyphasor, typically authored by Mr. Roger Block, contradict each other from document to document. It is my intent to show the extreme diversity of the Religion of Grounding and to make some sense of it in proper applications.

GROUNDING GOALS

Grounding is a descriptive activity, regardless of the method. The user makes the assumption that any particular purveyor has no ax to grind and is selflessly promoting the objective of protecting equipment and personnel from damage due to a lightning strike, or other electrical faults.

These strikes may be either direct conduction, or impressed in the form of near field static or EMP (ElectroMotive Pulse, a magnetic impression wave). The real goal is to avoid the "Strike" in the first place.

A secondary goal is to minimize the strike – or at least to control the strike and any potential for damage. These are simple goals. We shall develop the thoughts in sequence.

This transmission line shows the effects of a lightning strike.

AVOID THE STRIKE

There are many half truths and loads of outright lies about lightning strikes.

It is a fallacy that the tallest thing gets struck every time; the smallest things can be struck as many times as the largest thing. Lying down in a field during a storm may not prove to be safer than standing up.

To avoid the strike, it is accepted that the ground charge potential in respect to the cloud charge must be bled off so that the difference of potential no longer exists. If there is no longer a difference of potential, there can be no strike. The huge debate is over *exactly how* this is accomplished. Patent infringement suits abound here.

It is accepted that a sharp object will dissipate a charge and a rounded object will gather a charge until (in either case) a sudden discharge event occurs. Leaving Patent Law out of the equation, these two theories have been proven in physics by everyone from Nicola Tesla to your high school teacher. No matter how you do it, get rid of the difference of potential.

MINIMIZE THE STRIKE

If at first you do not succeed, try again.

We will assume attempts at dissipating a charge did not do the trick. Some would argue trying to dissipate the charge actually caused a strike to occur anyway.

This is partially true. If nothing is ventured there is nothing gained. But, by attempting to bleed off the difference of potential, is it possible to inadvertently create a step leader, which is the pre-cursor to the actual strike. The idea is to bleed off the charge so that the strike will not happen. If the charge is building at a rate faster than you bleed it off, the strike will likely occur.

On the other hand, it is widely accepted that if you have been bleeding off the charge, the impending strike will contain substantially less energy than if you had not bled off any charge. You have therefore minimized the strike to the best scenario. If you are going to get hit, get hit with the least energy possible.

CONTROL THE DAMAGE

Ah, we have arrived at the most important aspect! Whether or not you have managed to reduce the magnitude of the strike, the real concern is *"Where does it go?"*

When lightning strikes are not controlled, damage occurs, including hidden damage inside the connectors.

This is really the point of proper grounding techniques. Sure, we would prefer to stop the strike in the first place or, at minimum, give all those streaming surplus charge ions a chance to harmlessly equalize the difference of potential, leaving less energy to hit you. The ultimate goal is to control damage.

(Continued on Page 30)

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Protection Guide

by Gary A. Minker

– Continued From Page 28 –

So, then, where do you want the residual charge to go? How do you get it to go there? What is required to do this? The questions grow and – as you might fear – the answers as given in the referenced documents contradict each other.

KEEP IT OUTSIDE

It is fairly fruitless to debate the cloud-to-ground or ground-to-cloud theories of positive or negative streaming or the direction of the actual strike. The point is that hundreds of kilovolts and tens of thousands of Amperes are looking for a place to go.

The safe bet is that you do not want it anywhere in the building – and would be happier if it would just dissipate into the ground *somewhere else.*

Here is a repeated caution: diligent reading of the offered documents may well lead you astray, and in the application of the thousands of pages tips and hints you will often wind up causing yourself significant damage instead of avoiding it.

RESISTANCE: HIGH, LOW, OR BOTH?

Once again, in order to avoid being your own worst enemy, the idea is to harmlessly divert the strike energy into the earth, not running it around the plant in circles where it will cause problems to equipment, personnel, or structures. Misapplication and cross-application of conflicting conventions is very dangerous.

The typical grounding system is designed for a taunting low resistance with little thought as to the inductances involved. In contrast, we will learn that low resistance and low inductance coupled with strategically placed higher resistances and high inductances are our friend.

For example, when setting up a ground system, it is tempting to tie it all to the building steel. After all, that is one big hunk of steel!

Nevertheless a most egregious fallacy is that the steel used in your building or in your foundations makes a good ground. This steel may make a barely suitable substitute for a Faraday Cage but never a ground.

THE BUILDING IS NOT GROUND

One of the reasons this can be a real problem is that when energized as a conductive part of the intended grounding system, sometimes referred to as a Ufer (after its developer, Herbert Ufer) tremendous damage can occur due to sudden expansion of metals and from generated steam. This has been seen to shatter solid concrete and destroy foundations along with other critical building components like columns and beams. Such fracturing allows water and salts intrusion which further promotes and accelerates deterioration.

The possibility of electrocution from energized building steel is a tremendous problem, as is fire from arcing. These objects of steel should be tied to the grounding system and isolated from your electronics, but in such a fashion as to drain their charges and minimize the chance for the electrocution of equipment and personnel.

This clearly dictates that the use of these steel components as conductors in the grounding system is wrong if not extremely dangerous. As well meaning as it may be, the National Electrical Code even can cause some problems of this sort. Generically, the Code requires that all metal objects related to the electrical system be tied together.

This causes much flag waving by designers of grounding systems. The overzealous bonding of every metallic thing to every other metallic thing causes damage in the worst way. It is impossible to sufficiently bond objects together so as to eliminate the action of circulating currents during a strike event. It is these circulating currents that cause the primary damage.

DOWNWARD DISSIPATION

Untamed strike energy needs to go into the earth and be dissipated downward. That is the key word – *downward* – although the energy also radiates outward (spherically) from the point where a strike hits. Getting in the way of this energy is usually fatal.

Vegetation, animals, and people are killed every year by both lightning and downed power lines. They die due to simple electrocution. While it is established by theory that many people die from the hysteria that an electrical shock imposes – thus causing their own heart attack – the fact of electrocution is real and cannot be disputed.

There is documentation offered that says, when in near proximity of a downed power line or caught in an impending lightning strike, you should stand perfectly still with your feet close together. This is because energy is being dissipated into the earth and as it radiates horizontally, outwardly from the point of contact, voltage gradients are established.

BE VERY CAREFUL

These voltage field gradients may be sufficient to breach your footwear (provided you are not lying down as some ancient lore suggests) and these gradients enter your body via the legs and impose a sufficient difference of potential via voltage and current to cause electrocution.

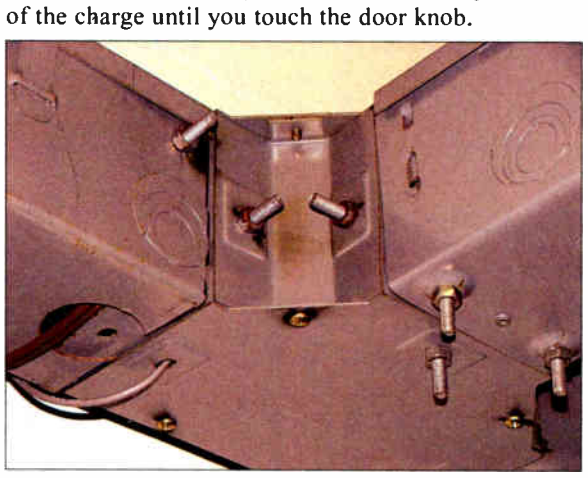
It has been suggested that, if you find yourself in an open field, leave the affected area by shuffling your feet one inch at a time, never breaking contact with the ground, or hopping with both feet together or hop on one foot until safely out of reach of the voltage gradients.

Variations of these theories are commonly taught to electric utility personnel. Other than electrocuting vegetables and creatures, this horizontal gradient of electricity from a nearby strike is also unfortunately picked up by the grounding systems of buildings that are in the way of the emanating waves.

SORTING OUT THE FACTS

Theory says a Single Point Grounding system has no circulating path. With no circulating path, there may exist a difference of potential but that difference may only cause normally conductive and non-conductive objects to physically move and/or stream ions in an attempt to equalize their charge with their surroundings.

For example, when shuffling across a carpet in a dry environment, you build a static charge. This charge builds and dissipates by itself. You are totally unaware of the charge until you touch the door knob.



Circulating currents can built sufficiently to penetrate into wiring trays as demonstrated by the arc flares.

We want to control the strike and where the damaging energy goes. It is accepted that the single point, or star ground is effective. If all objects emanate from a central point of reference, a strike charge will elevate the potential of all objects of the quantity for the duration of the energy impression and upon dissipation of that energy, all objects within the entity will return to a normal potential.

By removing the circulating current paths, everything in the room stands up with a potential rise and once dissipated milliseconds later, it all sits back down untouched. Without circulating paths, there is no current flow. Ohm and Kirchoff would be proud. With no I/R losses there is no voltage drop. With no voltage drop, there is no dissipation of current. With no dissipation, there is no heating, arcing or burning.

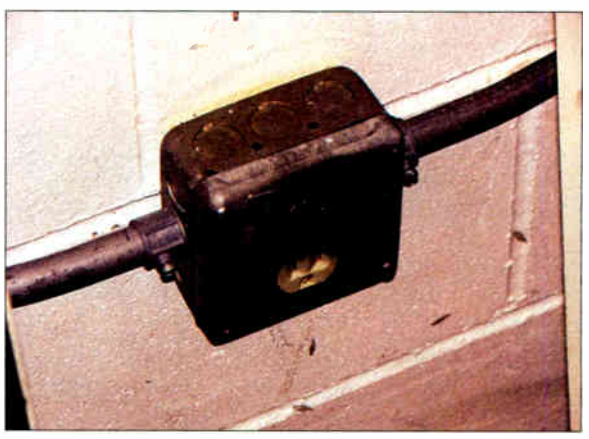
While the works of Polyphasor are contradictive, the works of Motorola in the R56 manual (while a very good publication) poorly apply many conflicting conventions in a singular manual. The correct applicative approach is to take the conventions from each work, and condense them in to a cohesive theory which is properly applied for each specific scenario.

COMMON ISSUES

As each site is different, so each site is the same. There is a shelter of some type and there is equipment contained within the shelter along with random personnel. There also is often a source of entry for the strike energy.

Assuming the worst, the lightning rod is adjacent to the shelter. This distance is typically under 100 feet. A properly designed dissipative array should direct the strike energy developed from the tower downward into the earth and away from the shelter horizontally and vertically. Allowing it to enter the building can bring unpredictable damage as the strike can exit almost anywhere.

While it is convenient to assume or think that the electrical supply of a device can be sufficiently insulated from its metallic case (Hi-potting tests), the fact is that flashovers do occur. These are unavoidable when the aforementioned difference of potential exists in a sufficient quantity to breach any insulation medium.



A breech in the insulation barrier in an electrical socket due to arc over.

Proper design of the grounding applications of the various electrical and radio related conductors descending from the tower also assist the strike on its controlled way downward and directively outward path.

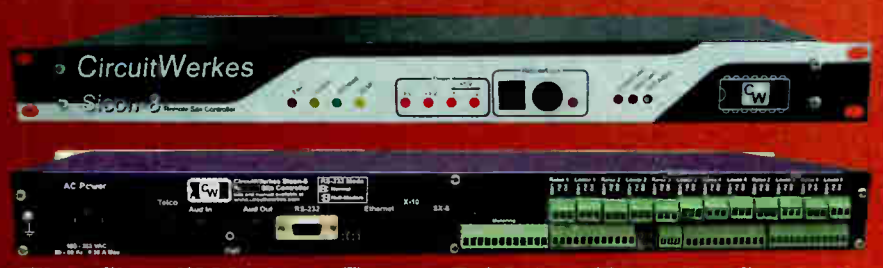
Stray energies will radiate horizontally through the earth toward the shelter. This energy and the remaining energy on the conductors attack the shelter. The National Electrical Code contributes to the damage by mandating that all electrical devices be contiguous. There is no definition of what contiguous means other than to be connected by conductive means. This is a good loophole that we will exploit to our advantage.

Effective strike control is to control the strike. This means putting the energy where you want it, not where you do not want it.

In Part 2 of our discussion we will dig deeper into methods of controlling strike potential as well as surges and spikes from the AC Mains. You will find some new theories of directivity are introduced while complying with the NEC – and keeping the integrity of the equipment and the safety of personnel as priorities.

Gary Minker has analyzed hundreds of electrical and transmission systems. The owner of Radio Works RF Consulting in Lake Worth, FL, he can be contacted at gary@radioworksrfconsulting.com

The New Sicon-8 Voice Remote Control



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.

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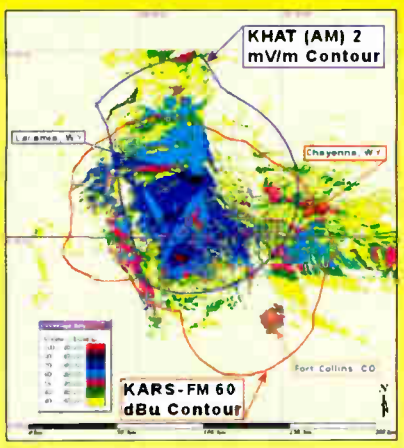

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reconfigured for different talent, studio and format requirements.

E-6 INPUT CHANNELS can access networked audio sources with the press of a button. All sources are displayed right above the fader. Each fader has its own mix-minus output (in addition to the console's own 4 MXM busses). SET buttons at the top of each channel can access a powerful array of production tools individually tailored for each input strip. These include four bands of parametric EQ, compressor/limiter, expander, pan, mode, HPF, LPF and phase reverse. These EQ/DYNAMIC functions allow powerful per channel mic processing. The console has four output busses (can include 5.1 surround), 4 mix-minus busses and 4 aux mixes (all with TB). Each input channel also has two programmable buttons for customized functions, as well as ON/OFF switches with built-in machine control (logic follows source).

The Wheatstone Evolution-6 Digital Audio Control Surface

in EVENT RECALL
e to be instantly

THE REALTIME HI-RES GRAPHIC DISPLAY keeps operators up to date and completely informed concerning all surface functions. Metering, bus assignment, channel status and sources, event recall, monitors, EQ and dynamics—all appear here via the mouse/trackpad driven GUI. Note the surface drives the VGA monitor with built-in circuitry (no external PC required).

THE MONITOR/SET PANEL (right) has Control Room, Headphone, and two independent Studio outputs. It also allows the operator to program input channels via the SET function: aux mix and mix-minus assign (4 each; all with talkback), input source select, and pan. The panel also has fourteen programmable buttons which can initiate custom functions like remote setups, intercom, machine commands and salvos.

Available in 4, 8, 12, 16, 20, or 24 channel mainframes

The E-6 audio control surface interfaces directly with Wheatstone's E-Series network switch and associated studio satellite I/O cages. Wiring between components is via single CAT-5 cables, eliminating point-to-point multi-pair runs. **Each studio surface operates independently, yet can share all network sources and mixes with others.**

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by Jim Bender

The Good Engineer

Sometimes when you look at an installation, it is easy to reach conclusions about the engineer who built it. Of course, we all do things differently. But, as the old saying goes, "appearances can be deceiving." Jim Bender helps us to take a second look at what goes into broadcast engineering.

"It doesn't look like Ron is a very good engineer," my young apprentice offered.

We had been looking at a new FM translator that had suddenly appeared at a shared site in the two weeks since our last visit. Since we maintained three other FM translators at the site, we were always concerned when a new source of RF showed up. There was always potential for intermod products and sloppy installations tended to invite trouble.

FIRST IMPRESSIONS

David was my latest apprentice, with about sixteen months of OJT. He and I had examined both indoor and outdoor segments of the translator, and I had asked him to tell me what he saw.

The two-piece translator was not grounded, except through the AC power cords, there was no lightning protection on the antenna leads, the outdoor coaxial connections were not sealed and taped, the cable penetration in the roof had not been re-sealed, and the rack-mount equipment was simply stacked on the bench, rubber feet and all. A copy of the Construction Permit was lying on the stack.

Ungrounded, the transmitter and receiver were stacked on the counter – rubber feet and all.

We immediately knew which contract engineer had performed the installation. "I think Ron knows the difference between good engineering and bad engineering," I countered, "but he probably promised the customer more than he could deliver, and ran out of time."

OVERPROMISING

In my younger years, this had been a hard lesson for me to learn. Eager to please the demanding GM, I would agree to whatever arbitrary timetable he set, risking marriage and health to keep my ill-advised promise.

The first problem was that I had an exaggerated assessment of my own abilities. In some ways, I really believed I was a miracle worker and it was my duty to uphold the sacred tradition that the good engineer could do anything. Secondly, I often grossly underestimated the time required to test and troubleshoot. In fact, I usually did not allow time for testing and completely dismissed the notion of having to troubleshoot my work. After all, I reasoned, it *will* work properly from the moment I pronounce it "Finished."

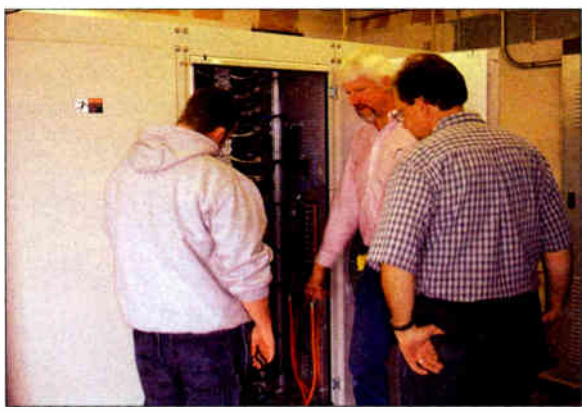
And finally, I was overly optimistic about beating Murphy's Law. In the radio business, we all tend to be optimists, and I steadfastly refused to give in to the Murphy superstition.

FINDING THE BALANCE

The best way to beat Murphy is with experience. It took this hardheaded engineer many years to learn that the customer is more interested in something working right rather than something not working sooner.

In time, you can anticipate some of the things that *can* go wrong with a project. Based upon your experience, you can plan your work to minimize certain types of trouble, or allow time in the schedule to deal with it *when* it pops up.

For something to work right, it has to meet a number of tests. Some of those are regulatory matters. Some are safety concerns or customer-specified performance benchmarks. Some are based in what we call "Good Engineering Practice." A good engineer has to know all that and either have the necessary test equipment or call in a specialist to make any needed measurements.



The author explains the power distribution in a new transmitter to apprentice Loren Denison, while Citadel Director of Engineering Martin Stabbert observes.

The Standards of Good Engineering Practice have evolved with the industry and the profession. There are often several ways of solving a problem, several ways of getting the job done. Again, it is experience over time that can point the way to the best method, the safest method, the fastest finish, or the nicest-looking result.

Sometimes, we will not know we took the wrong path until we get to the wrong destination, but a good engineer has to consider alternatives and make decisions based upon the things he knows today. A good engineer also is safety conscious – not only for his own safety, but for that of other site users and unsuspecting site visitors. Remember that group of fifth graders that wants to see the transmitter!

SETTING A REASONABLE DUE DATE

A couple of decades ago, my GM called me to his office to give him an update on the schedule for a new production room.

I had on hand the delivery dates for the remaining equipment and, allowing a number of days for pulling, soldering, and punching cables, some time for testing and adjusting levels, and a little bit of buffer for the unexpected, I gave him a date. He seemed satisfied and I went back to work.

The date was about two weeks off, but those were the days of analog tape machines and cart machines, and the new production room would be the new production standard for the facility. I remember the anticipation I shared with the Production Director, waiting for the new MCI reel-to-reel machines to arrive. The new ITC 99B cart recorder was already sitting on the bench and seemed to be working to our house specs. Virtually everything on the air that was not live was carted, and this machine would soon be recording it all.

A SCHEDULING SURPRISE

About fifteen minutes later, the Ops Manager stopped by the shop and said, "I hear the new production room will be ready in about three weeks."

Trying to keep my voice calm and even, I said, "I'd like to make it sooner but you know how important it is to make sure everything is working right. We don't even have the reel-to-reel machines yet." I must have covered up my shock and surprise fairly well, for he mumbled agreement and continued down the hall.

Another fifteen minutes went by while I just sat there, dumbfounded. Apparently, the GM had padded my estimate with an additional week, and then just made the official announcement in the programming meeting.

I thought: "How could he do this to *me*? My date had not been picked out of thin air! *My* date was not arbitrary, but was based upon sound logic and experience. How could he change *my* date without consulting with *me*?"

In those days, it was a matter of pride for the engineer to meet and beat deadlines, to exceed expectations, to deliver more than was promised. I thought my estimate was conservative. To my way of thinking, the GM had said that he did not think I could deliver on my promise.

To this day, I am still amazed that I did not march down to the GM's office and demand an explanation. It must have been the early stages of maturity – or fear. Something like that.

WE BOTH LEARNED SOMETHING

I thought about that for several hours, through lunch and into the afternoon. I had been feverishly making up source cables for the production room when the GM came in and closed the door.

"I told the guys it would be three weeks before the new production room would be ready," he said. "I didn't want them breathing down your neck as you were getting to the most critical part of the project."

For the second time that day, I covered up the shock and surprise. "Thanks. I appreciate that," I told him, with my best attempt at a calm, steady engineer's voice.

Apprentice Luke Babcock learns to dress console cables to the punch blocks.

I was thankful, not only for the trust I had built up with the GM regarding realistic schedules, but that he, too, wanted the job done right, not quicker.

SEEING THE WHOLE PICTURE

Back at the translator site, I again picked up the Construction Permit. I noted the frequency, site coordinates, antenna type, ERP. They all looked in order. Then I saw the expiration date – it was that very Friday.

I called my apprentice away from making entries in the site log. "Look at this," I said, pointing to the expiration date on the CP.

"Looks to me like he procrastinated until last minute and he suddenly had to hurry to get it on the air," David surmised. "That would explain having to take some shortcuts."

"Well, I said. "We don't know why it came down to the wire. But he saved the CP, so it actually looks like Ron is a hero."

Up by the headwaters of the Missouri River at Three Forks, MT, Jim Bender is an experienced contract engineer working hard to train good engineers. Contact Jim at jabender@imt.net

Ed Buterbaugh

1943-2008

By Chris Arnaut

With the recent passing of Ed Buterbaugh, the radio industry will simply never be the same. Sadly, Ed lost his battle with cancer on September 1, 2008 at the age of 65. At the end, he was at home in Harrow, Ontario, surrounded by his family.

As an engineer, he was excellent. As an advocate for the industry, he was, without exaggeration, one of the greats.

50 YEARS IN BROADCASTING

Ed Buterbaugh began his career as a broadcast engineer at the age of fourteen. He held top-level engineering positions in Washington D.C. and New York City. He was a fixture in the Detroit Market for 30 years, 13 as VP/Director of Engineering at CKLW, Windsor, ON, and 20 years as Director of Engineering at WJR Radio in Detroit.

Throughout much of his career he also worked as an independent engineering consultant for a variety of stations.

His reputation really began during his tenure at CLKW AM 800 in Windsor Ontario. During the 1970s and early 1980s Ed's innovative way of approaching audio processing produced fidelity that challenged the FM stations of the day.

Envious engineers from all over marveled at the sound Ed created. Within the broadcast industry, it was generally acknowledged that "The Big 8" owed much of its success to the engineer behind the scenes, as much as the talent on the air.

SETTING THE STANDARD

In 1984, Ed brought his talents to the "Golden Tower of the Fisher Building" as the Chief Engineer of WJR. Once again, Ed's reputation of accepting nothing less than excellence was realized.

Edwin Reed Buterbaugh
1943-2008

Using state-of-the-art equipment and processing techniques that had never been deployed before, the stereo quality of WJR's signal became a benchmark for AM quality and fidelity that remains in place today.

Ed's talents and passion for excellence could not have been better demonstrated than during the production of University of Michigan Football. Using innovative approaches including stereo microphones for the crowd (as well as the parabolic!), Dolby noise reduction, digital-delay units, a twenty-four channel console, and a team of engineers Buterbaugh produced countless games of broadcast excellence. Ed Buterbaugh's name during the credits became almost synonymous with that of Frank Beckmann and Jim Brandstatter, the voices of Michigan Football.

TEAM LEADER

Ed surrounded himself with talented people. While working for him, I did not understand his talents as a manager as he was protecting us, his worker bees, from the unnecessary day-to-day battles he faced in management and budgetary meetings.

The longer I had the Chief Engineer position he vacated at his retirement, the more I appreciated his talents, knowledge and, most of all, his passion.

PEER RECOGNITION

In 2004, the year of his retirement, Ed received the Carl E. Lee award from the Michigan Association of Broadcasters (MAB) in recognition for his efforts and accomplishments. These efforts included two complete studio reconstructions at WJR (in 1987 and 2000), as well as his contributions to the MAB Engineering Board and tireless work as the Chairperson of the South-East Michigan EAS committee.

Ed had numerous awards including Billboard Magazine's Engineer of the Year award, and was instrumental in WJR being named Major Market Station of the Year for six years running by the Michigan Association of Broadcasters.

Ed will always be remembered for accepting nothing less than 110% effort and broadcast excellence. Those fortunate to have known him or worked with him are blessed with some of the knowledge that he was able to pass on. The anecdotes folks tell of Ed's passion, temper, humor and experiences will assure he will certainly not be forgotten.

Radio will never be the same again.

Chris Arnaut is currently at WDIV in Detroit. His email address is carnaut@wdiv.com

Station Stories

by Scott Fybush

From Art Deco to All-News, History at the Top of the Dial

Back in 2006, when the facility that is now WFED in Washington, DC marked its 80th anniversary, the milestone did not get much attention. There was probably a good reason for that: how many radio stations would want to recall an early history that included an affiliation with the Ku Klux Klan?

LONG DISTANCE MOVE-IN

WFED's early story does not even begin in Washington. It started 300 miles to the north, in Brooklyn, NY, on September 25, 1926, when the Twentieth Assembly District Regular Republican Club put WTRC on the air at 1250 kilocycles, with a whopping 50 Watts of power.

The next year, WTRC moved to a four-way, share-time arrangement on 1470, along with other long-forgotten Brooklyn signals such as WIBS and WMBQ. But, the Twentieth District Republicans soon gave up on their little radio venture, selling the equipment in the summer of 1927 to the Independent Publishing Company, which moved the station to Mount Vernon Hills, Virginia, across from Washington.

The station came back on the air as WTFF; the calls stood for "The Fellowship Forum," the pro-Klan weekly magazine the company published. (Additional evidence exists to suggest that even in its Brooklyn days the station had Klan ties – the Twentieth District club was said to have been funded by Fellowship Forum Publisher James S. Vance.)

In its new home within sight of the nation's capital, WTFF soon gained a more powerful voice. By the summer of 1928, Vance had increased WTFF's power to 10,000 Watts on its new frequency of 1480 kc, a move that was a mixed blessing. Although the station was now heard clearly across the Potomac, it was also expensive to operate.

THE CBS YEARS

While Vance needed money, the new CBS radio network needed a powerful outlet in Washington, and a deal was soon struck for what we would now recognize as an LMA. CBS assumed control of the station, which had by then been renamed WJSV in its owner's honor. Then, in 1932, the network purchased the station outright and moved its transmitter closer to Washington, operating from a site in Arlington, Virginia.

The Arlington site stood for only a decade. With the construction of National Airport nearby, WJSV was moved once more in 1940, picking a site in what was then rural Wheaton, Maryland, a few miles north of the District line. By then on 1460 – and soon to move to 1500 with the NARBA shifts of 1941 – the station built one of the most technologically advanced transmitter facilities then standing anywhere in the country.

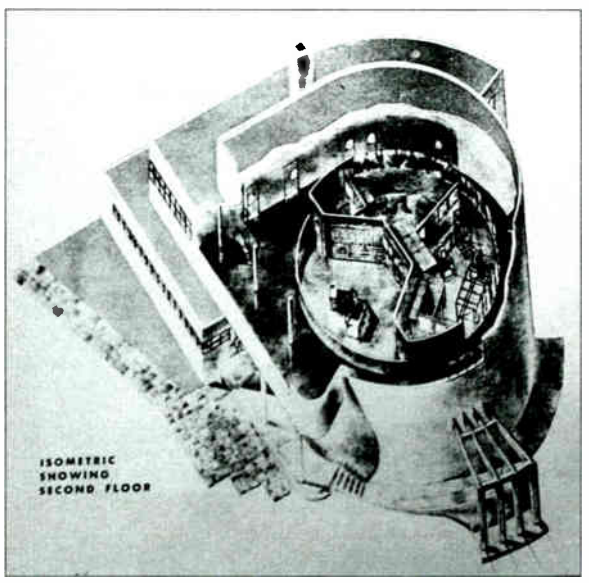
The 1940's Art Deco transmitter building still stands in Wheaton, MD.

The transmitter building was built of thick reinforced concrete, said to be so strong that the entire structure could be tipped on its side and rolled away. Rolled? Indeed, because the building was designed in full Art Deco style, with a circular transmitter room at its center.

In a sunken "well" at the center of the room sat the Western Electric 407A transmitter that boosted WJSV to a full 50,000 Watts. With the increase in power came a directionalized antenna array of three towers, to protect co-channel KSTP, St. Paul, Minnesota at night.

The Western Electric 407A was installed in 1941.

It is interesting to note that, in contrast to modern transmitters which are constructed in complete cabinets, WJSV's new WE and its accompanying phasor were open in the back and at the top. An artist's rendering of the building shows how the installation was planned.



A cutaway drawing shows how the transmitter and phasor were laid out.

NAME AND OWNER CHANGES

The year 1943 brought new call letters to the station, as WJSV gave way to WTOP, named for the station's "top of the dial" position. The calls had been relinquished by a police department in the Midwest – after a suitable "donation" by CBS.

LEGENDARY CE

A talented young engineer had joined the station's staff in 1938.

Granville "Granny" Klink had already made a name for himself in his native Philadelphia, where he worked for Philco and Western Electric as well as WIBG and WDAS. During his tenure at WTOP, Klink oversaw many changes. The station adopted an all-news format in 1969, shed its FM signal in 1971 (donated to Howard University, it became WHUR-FM), then was sold by the Post in 1978, moving its studios around the corner from Broadcast House.

Klink was promoted to chief engineer of WTOP radio and TV in 1951, and remained with the station until his death in 1997 at age 88. He also carefully documented the station's evolution.

CBS sold a minority share in the station to the Washington Post in 1949. Five years later the newspaper purchased the radio station outright, combining it with the former WOIC-TV (Channel 9, now WUSA) and building a new studio facility, dubbed "Broadcast House," next to the TV transmission tower in Northwest Washington.

Over the next two decades, WTOP changed owners three more times, from Chase Broadcasting to Evergreen Media (which became Chancellor Media) to present owner Bonneville Communications, and changed studio locations once more, in 1989, to its present home in a quiet residential neighborhood near American University, at 3400 Idaho Avenue.

COPING WITH MARKET GROWTH

As the Washington suburbs continued to sprawl ever deeper into Virginia and Maryland, the AM signal from the Wheaton transmitter site proved inadequate to the task.

The "null" toward St. Paul that once fell over farmland instead fell over wealthy suburbia. Despite a tweak to the directional pattern made possible by a mutual-interference agreement among WTOP, KSTP and a third 1500 signal, WLQV in Detroit, much of the Washington market simply could not pick up WTOP, especially after dark.

In 1997, WTOP bought a class A FM signal, WINX-FM (94.3) located in Warrenton, Virginia to simulcast its all-news format into the Virginia suburbs.

A year later, Bonneville traded that 94.3 signal for a bigger Class B signal licensed to Warrenton, the former WUPP (107.7), bringing an FM signal all the way to the Beltway. WXTR, Frederick, Maryland (820) was added to the network in 2000.

As the market grew, the station used simulcasts to cover the suburbs.

WTOP LEAVES 1500

Then, in January 2006, Bonneville removed WTOP's all-news format from the AM dial, moving it to the Washington-licensed Class B signal on 103.5 that had been programming classical music as WGMS. The new WTOP-FM was joined by an FM signal in Frederick, WTLP (103.9), with the Warrenton 107.7 signal being added back to the simulcast in the fall of 2008.

WTOP's move to FM came just before a major renovation of the Idaho Avenue studios. Chief engineer Dave Garner, along with an engineering team that included Ken Sleeman, Art Rose, Dave Kolesar and Brian Oliger, oversaw the construction of a new studio, promoted on-air as the "Glass-Enclosed Nerve Center."

WTOP's new main studio.

Built around Harris digital consoles and studio furniture, a $2.5 million budget included the demolition of the walls that had enclosed the old newsroom, creating more space for the station's growing news staff.

(Continued on Page 38)

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Station Stories

by Scott Fybush

– Continued from Page 36 –

Looking into the studio from rebuilt newsroom.

1500 CARRIES ON

Meanwhile, out at Wheaton, meanwhile, the AM 1500 facility was undergoing changes of its own.

After a stint as WTWP – "Washington Post Radio" – with studios downstairs at Idaho Avenue and across town at the Post's newsroom, the AM signal flipped in 2007 to WWWT – "Talkradio 3WT" – and, finally, it changed to "Federal News Radio," WFED, on September 15th.

While the formats changed, the Art Deco transmitter building remained largely untouched. In 1957, the Western Electric gave way to a 50 kW RCA Ampliphase, backed up by a 10 kW RCA. The Continental 317C-3 that still serves as WTOP's backup transmitter was installed in 1982, and in 1996 the current Harris DX50 was installed.

FM came to the site in 2005, when Bonneville refitted a former transformer vault on the ground floor of the building as a backup site for its 103.5 FM facility, then WGMS and now WTOP-FM.

The Harris HT25CD transmitter housed in the room has seen recent use during DTV-related tower work at the FM station's main site in Northwest Washington.

HISTORY ON THE AIR

Upstairs, it is easy to imagine the glory days of the Forties and Fifties, when the site was still new. The broad, curving stairway that brought visitors upstairs back then still leads them to the huge, round transmitter room.

Today, the view looks up to the circular Art Deco lighting in the ceiling – and down into a transmitter well that is home to the DX50 Main transmitter, the Continental backup, and the station's old phasor.

The WFED transmitters and phasor.

The phasor, built in the seventies by CSP in several cabinets from the old Western Electric transmitter, is in process of being replaced by a new Kintronics phasor which will be installed in another room of the building.

Overlooking the well is a small announce booth, barely large enough for one person. Built in the sixties to allow for overnight program origination from the transmitter, it was used for only a few years.

Among the announcers who used it, though, was a young newsman named Sam Donaldson.

HISTORY IN THE AIR

To one side of the room, doorways lead to an engineering office, a kitchen, shower, and bathroom facilities – a legacy from when the station was staffed around the clock - and a small office that is being rebuilt as an emergency WFED studio.

And all around the well, bookshelves that line the catwalk surrounding the transmitter area are filled with the station's legacy – manuals, notebooks, scrapbooks, photo albums, and equipment saved by Granny Klink during his six decades with the station.

From this booth, the station could go live when necessary.

Ken Sleeman holds a vintage tube from the Western Electric 407A 50 kW transmitter.

The material was donated to WTOP after Klink's death and is gradually being scanned and preserved. The hope is to someday create an on-line museum chronicling the long and remarkable history of Washington's biggest AM signal and a most prominent all-news radio voice.

Scott Fybush is a regular contributor to ***Radio Guide****, and publisher of a yearly calendar of various tower sites. For more information contact him at scott@fybush.com*

Survival Guide

by Romualdo "Rolin" Lintag

Seeking Out the Soul of a Station

Seldom do we discuss those things that are not obvious in the station. It is just natural for us to talk about what we do see. We see the equipment that is being used, the way the equipment performs, the way the rooms are arranged or maintained.

Of course, we do see the technicians and the production personnel, but oftentimes they become just "faces" that work in the station each day. Management styles often get so caught up with the daily rote and the urgent that we fail to see the not so obvious – yet more important "things" in the station.

With your indulgence, allow me to show you the world beyond transmitters and printed circuit boards. There is more for us to see than just repairing equipment or producing that spot. Let us dig deeper to understand the true soul of the broadcast station.

MAN BEFORE THE MACHINE

When you buy the equipment, you get the technology that makes the hardware tick. In short, the machine will perform as it was designed. However, the best equipment in the station will never put out the best signals on the air all by itself.

Of greater concern should be the people who will use and get the best out of those machines – people who may not necessarily behave the way you want them to, especially when you send mixed signals. In this mixed-up world, we tend to love machines and use people. This is easy to deny but our actions and decisions give us away.

For example, how much of your budget do you allocate to train your people? How do you value your employees compared with how you take care of your equipment? How do you view working relationships?

MAINTENANCE FREE?

If we are going to have a balanced view, we need to look at man and machine as two sides of a single coin. After all, a coin has no value unless it has both sides.

Some managers view employees the same as those sealed batteries that have the "maintenance-free" label – they just keep on working, without putting any electrolyte in. But you and I know that people are more complex than that.

So before slashing that part of the budget that will build camaraderie, teamwork, and self-respect among the staff, think again as to how much you will *really* lose or gain. If you want more golden eggs to come, do not kill the hen that lays it!

CULTURE MAKES (OR BREAKS) THE STATION

Here are some questions to put the issue in perspective: Just how does your station staff respond to daily correspondence or spare parts requisitions? How do they view management actions?

Do your technical and programming departments coordinate well enough with each other? How does each department view each other? How is your staff turnover rate?

The grandeur that was Rome did not fall due to any outsider's strength. The decay within itself destroyed it. Just because your station is now number one does not guarantee you will forever be on that pedestal. Getting the crown is one thing – defending your title is quite another.

Bottom line: if your station operates in an atmosphere of coercion, in an ambiance of fear of failing or losing one's job when the ratings are not on your side, who knows how soon your empire will fall?

THE SECRET OF CHAMPIONS

Gone are the days of hierarchical top-down military rule within business organizations. Employees of the 21st century are just too info-smart to work wholeheartedly for a tyrant.

The more relevant business paradigm nowadays is that of motivating, coaching, training, leading and, yes, empowering. Doing so from the heart can motivate others to reach for greater heights each day. When that happens, for example, a technician will not only repair equipment, he will also be appreciative of how creatively the production folks use it. Working for such a station, no one needs "Friday Nights Are For Fun" because every day will be fun.

In other words, if your technical people think that maintaining the equipment is a boring chore then they are not being motivated enough. Do we care enough to see that our people go the extra mile in improving themselves professionally and personally? Or are we merely content when they man their shifts with no foul ups?

When all is said but nothing gets done, we are suffering from management vertigo. What we see is a mirage that does not exist and therefore does not do any of us any good.

Improve on your focus and see beyond the obvious – to the soul that drives success at your station.

Rolin Lintag, CSTE, is an experienced broadcast engineer in Arkansas. His email is: rolin_lintag@yahoo.com

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Originally designed for the rigors of six channel television sound, the ***ACS-300 Audio Control System*** provides six channels of balanced I/O where each channel or groups of channels can be remotely turned on, off or dimmed by a pre determined level. Uses include monitor muting for consoles that lack this feature or for paging applications where audio dimming or muting is required. Of course, the ***ACS-300*** is well suited to six channel audio surround applications too. Each input is differentially balanced and can provide up to 14 dB of gain. All outputs are differentially balanced 600 ohm impedance. Use any time audio needs to be turned on or off and line amplification is desired.

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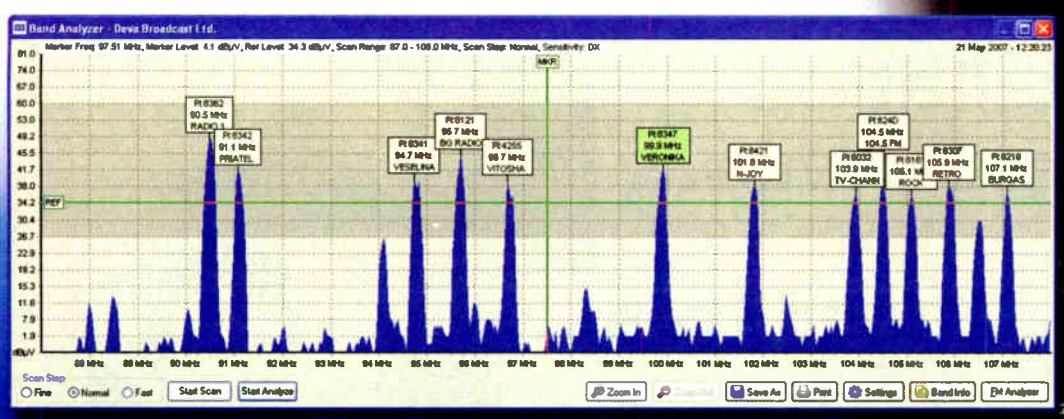

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Band Scanner Pro

The Band Scanner is a tool to evaluate FM broadcast band congestion and to log station identification parameters. The system is powered by the USB port of any Windows PC. Supplied free of charge Windows software sweeps the receiver across the FM band, logging every carrier and generating a spectrum display of carrier level vs. frequency. It then analyzes each carrier and creates a station list. Stations with an RDS presence are further refined to show all the radio data groups being transmitted. Its interface is like a portable radio: It may be tuned manually through the receiver screen or by double-clicking a point on the spectrum plot or an entry on the station list. Spectrum plots may be saved as jpg or bmp files. The RDS data error level is graphed in a separate window on the receiver screen. The program can be monitored with headphones plugged into a standard 1/8" jack.

Tech Tips

by Mike Callaghan

Are You Sure You Can Control That Transmitter?

Transmitter remote control systems have made great strides from the early days when they used telephone stepping relays to select (most of the time) which channel they would control and meter.

Outside circuits are still required to carry commands to the transmitter, as well as to return the telemetry values we need to monitor. The telephone circuit or radio link has to carry information in two different directions – each important to the process.

LOSS OF TELEMETRY

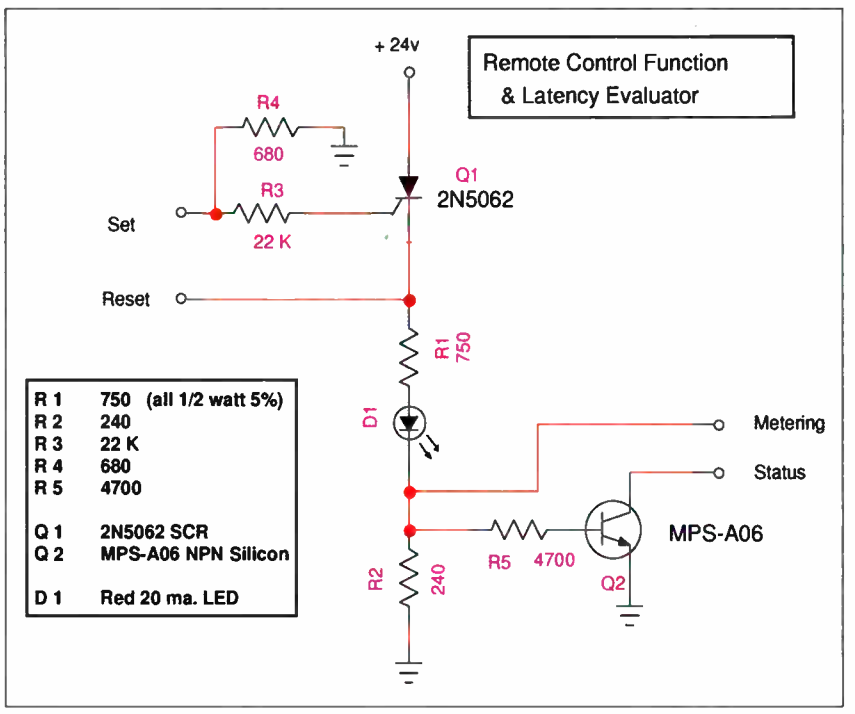
If the return link breaks, you will know fairly soon since you will not be able to get any meter readings. And with units like the Burk ARC-16 you will get a psychedelic light show that leaves no doubt the circuit is open. On the other hand, the loss of the control (or command) side of the remote control is not always obvious.

A telemetry link failure may not be critical if what you need to do is insignificant – like switching off deicers or test running a generator; you will have time to track down the problem before it becomes something major. But if you need to start the backup transmitter, a broken link can become a real problem, one you may not learn about until you need to switch something and find that you are unable to do so. That is *not* the time to find out your remote control system is not working.

By the way, do not think that just because you get metering it always means the command link is working. Many remote control units send back all the data all the time, and a reading at the studio just shows what that channel already has in storage.

BUILDING IN CONFIDENCE

The schematic presents a simple circuit, easily built, that uses a single remote control channel to verify that the command link is operational. A "Raise" command switches on a sample meter reading *as well as that channel's status light.* They both stay active until a "Lower" command turns them off.



If desired, the circuit can normally stay latched "on" all the time. If the power fails, it will drop out; this can help explain momentary outages as having been a power dip rather than an equipment problem.

HOW IT WORKS

The circuit itself has no moving parts, using a small signal SCR to latch the metering and status on and off.

When power is first applied, the positive power supply appears at the top (the anode) of the SCR. The SCR stays off until a "Raise" (SET) is applied to the gate through voltage divider R3 and R4. This pulls the SCR's cathode up to almost the power supply voltage

Current then flows up through R2 and through the LED and R1. A metering sample (which comes out to about 2 Volts) appears at the bottom of the LED, and the same voltage pulls current through R5 to turn on Q2. Q2's collector is what pulls the status line low on the remote control, making it operate.

The SCR stays latched until a "Lower" pulse is applied to the cathode (or there is loss of power). This means it has the same voltage on the anode and cathode; and this turns the SCR off, restoring the original condition.

DIAGNOSTICS

Using this circuit, an unused remote channel allows verification that commands are reaching the transmitter, as well as showing how long it takes for a command to produce a response. If the data line gets noisy it may still pass the commands, but the response time will be longer and worse yet, unreliable.

Construction is so simple it is easier to build it on a Radio Shack perfboard than to do anything fancier. If you want to make a lot of them, a PC layout might be advisable. The parts cost is pocket change, and the result will give you one less thing to worry about.

Mike Callaghan is the Chief Engineer for Clear Channel's KIIS in Los Angeles and a long time Southern California Radio Geek. He is always finding innovative ways to solve problems. Mike can be reached at mikecallaghan@clearchannel.com

Tech Tips

by Ernest R. Swanson

A CellJack II Modification for Modern Cell Phones

The CellJack II was designed for the old style, bag cell phones used in the 1980's and 90's, which utilized the old analog 800 MHz cellular frequencies. It was made to be inserted in between the handset and the body of the cell phone, utilizing a RJ-45 connector and a homemade cable.

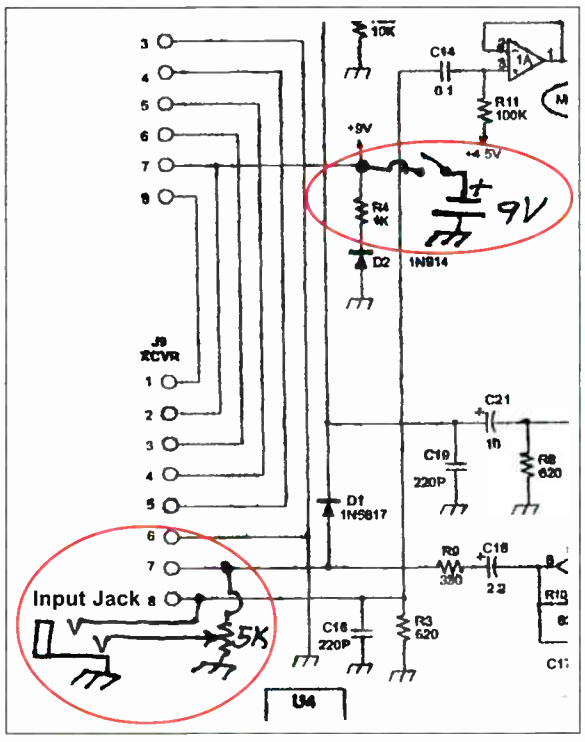
Today, cellular companies are deserting analog mode for the newer digital modes. Since this system is not available in most areas any more, the bag phones are awkward and all but useless. However, I will describe a modification to the CellJack II to allow it to be used with most modern cell phones.

EASY MODIFICATION

The modification is fairly easy and the cost is fairly inexpensive. First make up a cable with 2.5 mm stereo phone plugs on each end. One end will plug into the CellJack II and the other will plug into the headset/ microphone jack on the cell phone.

The following is the parts list:

- 9-Volt battery holder (Mouser Electronics 12BH610).
- 2 each, 2.5 mm Stereo phone plugs (Mouser Electronics 171-3306).
- 2.5 mm Stereo phone jack (Mouser Electronics 161-7100).
- 5K pot (Mouser Electronics 594-248-1502).
- SPST bat handle mini-switch.



CONSTRUCTION

Mount the following parts on the CellJack II:

- A 9 Volt battery case on the top with 4-40 quarter-inch hardware.
- Drill a hole for the 9-Volt leads to go into the unit.
- Drill and mount 2.5 mm jack on rear.
- Drill and mount 5 k pot on rear.
- Drill and mount a SPDT switch on rear.

Now, make the following connections on the inside circuit board:

- Connect the 9-Volt (black) wire to ground.
- Connect the 9-Volt (red) wire through the newly mounted switch to R4 which is a 1 k resistor.
- Run a wire from the sleeve of the phone plug to ground.
- Run a wire from the tip of the phone plug to the wiper of the pot.
- Run a wire from the ring of the phone plug to the junction of C18 (220 pF) and R3 (620 Ohm resistor) on the circuit board.
- Run a wire from the low end on the pot to ground.
- The high end of the pot is wired to R9 (330 Ohm resistor) opposite end to where C18 is mounted.

PUTTING IT TO WORK

Set your audio levels according to the meter on the front. Use the pot to adjust the output audio to the cell phone you are using. The new switch is a battery saver, as I have a tendency not to remove the battery.

Whether you are into recycling or just happy to get a piece of gear off the shelf and back into remote cell-casting service, this is an inexpensive project that will make everyone happy.

I would like to thank John at Conex Electro-Systems, Inc for his help, suggestions, and a schematic diagram.

Ernie Swanson is an engineer based in Fort Atkinson, WI. You can reach Ernie at ernie@nrgmedia.com

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How Did They Do That?

by Stanley B. Adams

How WBZ Pioneered Synchronized Timing

Using time code from WWV, GPS, or other sources, stations commonly synchronize many aspects of operation, from local clocks to network joins to synchronous booster transmitters. Nearly a century ago, the idea of such precision was daunting. And yet, as Stan Adams explains, a few radio stations stretched the technology of the day to breaking point, in the pursuit of better serving their listeners.

In the Analog Age audio was, for the most part, audio. Whether direct from a microphone to the transmitter, or subject to delays of up to 500 ms in program equalizers (or several seconds over transcontinental phone lines), the time alignment of audio was generally taken for granted, aside from one particular application that we will discuss.

Today, as we aggressively pursue the digital world of transmission, there is a lot to know about precision timing. Everything from digital consoles to digital STL's and transmitter exciters needs a precision timing source so that every frame is in perfect alignment.

LOCKING TO THE CLOCK

Even before the full advent of digital broadcasting, telephone switches were required to be locked to clock sources traceable back to Stratum 1 levels. T1's that carry programming and overhead signals over telco systems have cards that must be set to either loop timing to the reference of the telephone switch or they must be set to run on your timing.

We did this by using Loran-C signals which provided a perfect time and offset from slave and master stations. By using sophisticated logic, the receiver was able to auto-tune itself so as to lock up a 10 MHz oscillator, for example. Then this standard would become the standard to a secondary oscillator attached to the switch – providing perfect timing for all 1.544 MB T1s.

I was responsible for installing, aligning, and maintaining this equipment for MCI Telecommunications as early as 1983. The other telephone companies did the very thing, now they use a newer revision of Austron Company equipment where GPS has also been added to the existing Loran-C and Disciplined Frequency Standard (DFS) backup. We could easily maintain short term accuracy to one part in 10^{13}th – better than your frequency counter could resolve. In fact, we were furnished with specially made HP Counters that would count into the sub-digit category.

DIFFERENT TIME, DIFFERENT TOOLS

Now, let us roll the clock back to the early 1920's, when Westinghouse built WBZ at the factory in Springfield, MA. Soon after, they found that WBZ's 250 Watts was not able to cover the entire city of Boston. Power increases were tried, but did not completely do the job. Thus began work on a secondary transmitter to solve the problem. One roadblock: how to prevent the two transmitters from interfering with each other.

Today we have digital tools that eliminate many problems. To take care of signal coverage issues, synchronous transmitters (usually known as boosters) are not uncommon.

On the other hand, when WBZ began, back in those early days of broadcasting, it was a whole different story.

A whole series of issues had to be overcome. Not only was Westinghouse proposing to operate WBZA on the same frequency as WBZ, but other physical realities had to be taken into consideration. If the stations were close in frequency, but not synchronized, they would "beat" against each other and produce annoying tones from the beat frequencies.

Then, it was found that the Brunswick Hotel location of the WBZA transmitter would prove unsatisfactory.

TRIAL AND ERROR

The engineers discovered an effect opposite of that from which WBAY in New York City suffered. In NYC, the building steel was close enough in wavelength to actually shunt a tremendous amount of power to ground with WBAY, but with WBZA the hotel was of a frame construction and did not allow an adequate ground facility.

WBZA was later moved to the Statler Hotel in 1927, but not until after some experimentation already had been tried, helping to pave the way for several companies to "loop" time their stations in different cities. A great deal of the information about this is included in a paper published in the mid-1930's by Mr. S.D. Gregory, a Radio Engineer attached to the Westinghouse Electric Radio Operations Department in Washington, DC.

Continued on Page 48)

How Did They Do That?

– Continued from Page 46 –

We can break the experiment into about four time periods, the first being the original trial when WBZA was at the Brunswick Hotel, and then at the Statler Hotel, where different methods of generating the broadcast carrier frequency and the synchronization methods were developed and fine-tuned.

EARLY CRYSTALS

At WBZA a 50 kHz signal was derived from a piezo crystal. The output of the oscillator produced three harmonics: 150, 450 and 900 kHz.

The frequency stability in those days was poor at best. But the Westinghouse engineers still attempted to compensate. A 250-Watt tube supplied 125 Watts of 50 kHz down a phone line toward WBZA. When the weather was good the experimental lash-up would "sort of work," but when there was moisture, leakage helped to drop the synchronization signal to zero at the Boston end.

The frequency was lowered to 25 kHz with a harmonic multiplier added at both stations. No crystals could be obtained at this time for such a low frequency so they used a free-running master oscillator with a UX-210 tube. In 1926, the two stations were able to commence their first continuous, synchronous operation.

A DIFFERENT LOCATION

As we noted, the transmitter was moved to the Statler building in 1927 because of the large number of grounding issues. A new transmitter was added and the synchronizing system installed improved filers to keep radio RF and audio from having more than minimal effects on the timing loop.

The antenna systems also were updated at that time. With an increase in power to 500 Watts, and with a higher depth of modulation, the Boston area was provided with a much better solution. Interference from each station was minimized in fringe areas – although not totally eliminated.

This situation lasted for almost two years until late 1928, when the new Federal Radio Commission's allocation plan for the broadcast spectrum went into effect. Both Westinghouse stations were moved from 900 to 990 kHz.

ANOTHER APPROACH

As 1929 came to a close, improved frequency multiplication equipment was installed at the stations, using lower power tubes of a better quality and in a better circuit. The oscillator acted as a wideband multivibrator with a crystal filter on the output, tuned to 990 kHz. Additional sharply-tuned circuits prevented any other frequency from getting into the power stages.

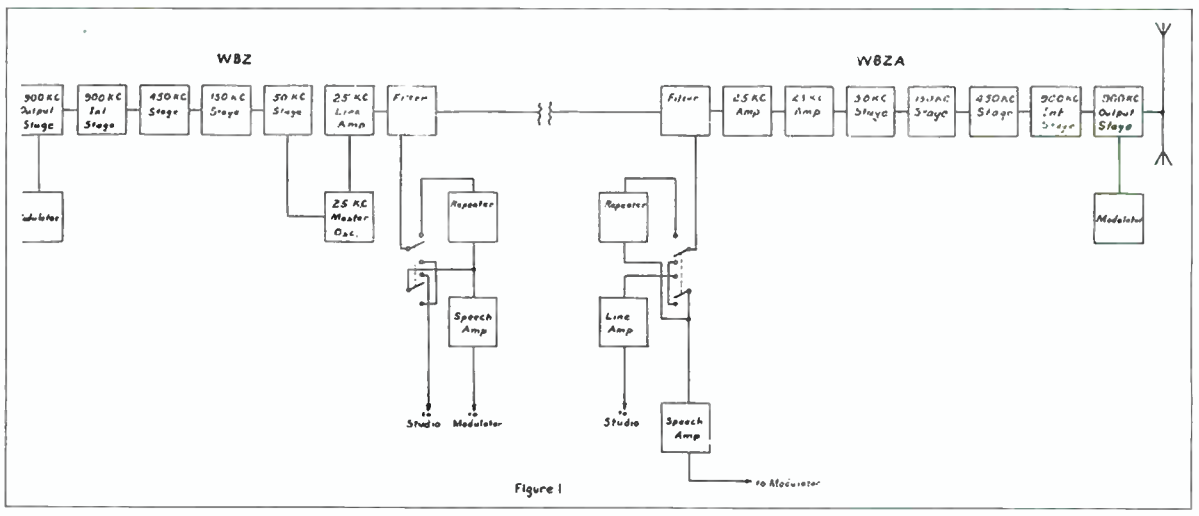
The WBZ transmitter used a 990 kHz crystal that would be common today, and then further divided this frequency to 165 kHz. A second multivibrator further divided it to 27.5 kHz. This signal was fed down the synchronizing line by using a power amplifier of four 845 tubes.

OBSTACLES TO OVERCOME

For a moment, consider some of the problems that they were facing: This was the first time that frequencies above the limit of hearing were actually sent down phone lines. Secondly, at the beginning there was little if any equalization and the concept of differential phase – where the sine wave would no longer be a sine wave and thus introduce very unwanted effects at the received end – was not well understood, if at all.

Phase hits, jitter and signal drop-outs all affected operation; nevertheless, this was just the way that Westinghouse decided to use as they sought a way to cover all of the major sections of Boston. They were willing to try

(Continued on Page 50)



A schematic of the original WBZ-WBZA synchronizing circuit.

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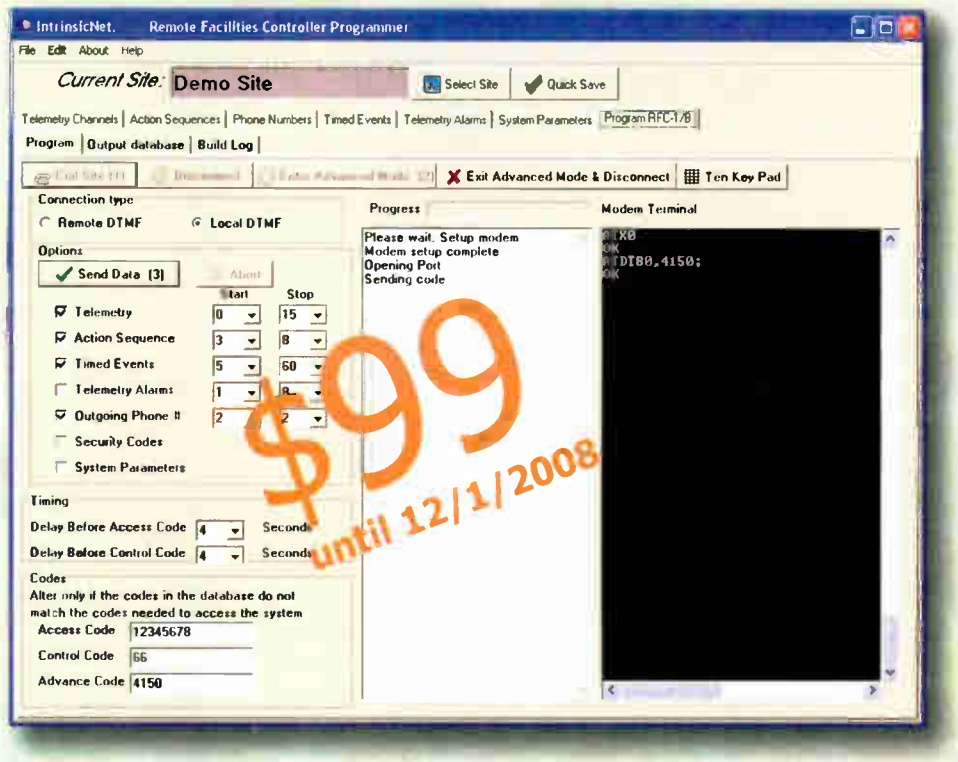

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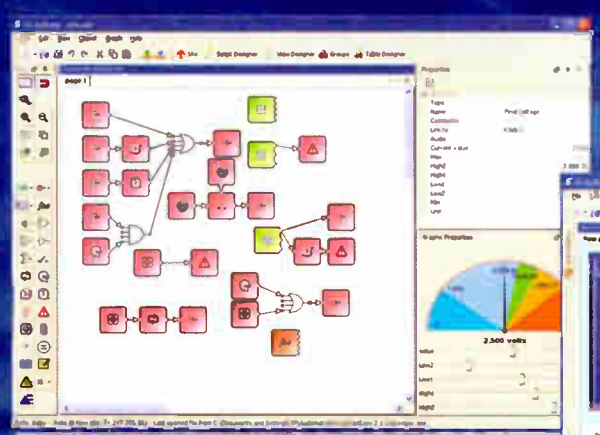

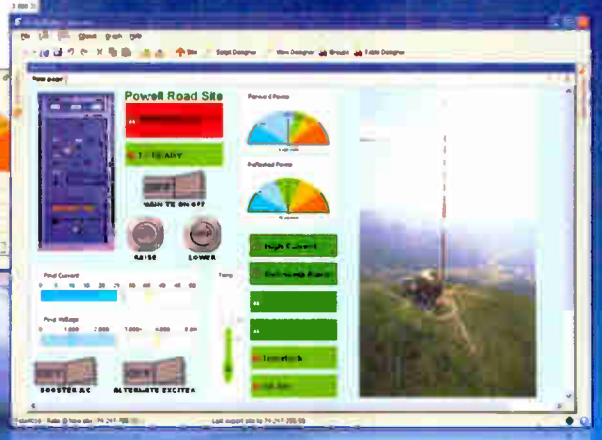

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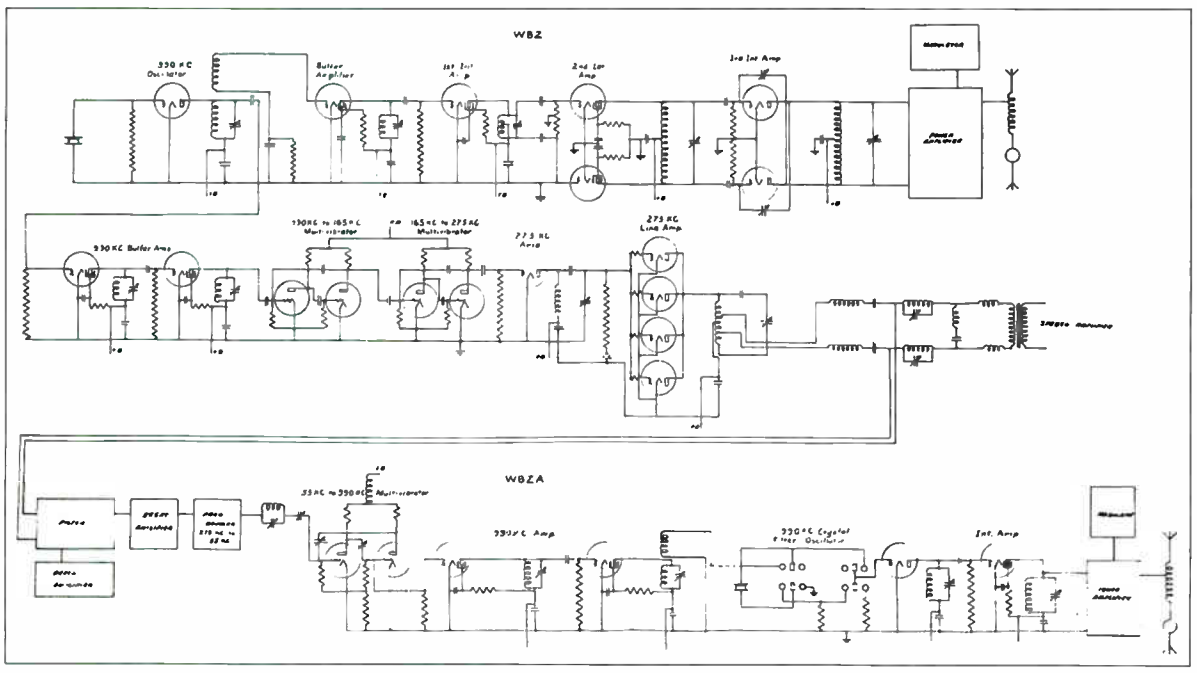
SEALEVEL

How Did They Do That?

Continued From Page 48

How WBZ Pioneered Synchronized Timing

on the customer, as it were, their "tinkering." It would not be the last time this philosophy would be used (some might point to IBOC today as an example).



The schematic for the new WBZ-WBZA synchronous circuit.

Similar experimentation was going on at other sites with the goal of devising a permanent solution of frequency control for other Westinghouse stations, including KDKA, Pittsburg and KYW, Chicago. A master tuning fork was operated at 5,000 cycles and by passing through a system of harmonic amplifiers became the control frequency of the KDKA shortwave transmission system to Chicago and also to KFKB in Hastings.

PRETTY SOLID

Westinghouse Radio Director, Dr. Frank Conrad, was not yet satisfied with the solution for WBZ and WBZA. During these trials it had become clear that it was important for the timing loops at all receive ends to be made able to stand on their own during the fade periods of the feeding transmitter. Hence, the principle of a loosely "locked" master oscillator came into being.

Successive upgrades of equipment during this time led to a poor division of RF power and thusly poor population coverage over the population centers of Boston, Providence and Worchester. It was at this time that WBZ was moved to Millis, MA (Southwest of Boston) whle WBZA was moved out to East Springfield. All calculations and power tests from an experimental test transmitter proved that this would be an ideal site. WBZ then installed an RCA Model 50B.

The developmental progress was documented in the Institute of Radio Engineers *Proceedings* for October of 1930 by Kaar and Burnside. Duplicate crystal control units were placed within the transmitter and a new type of frequency multiplier was used.

In essence, the transmitter crystals served as the back-up if the synchronizing tone from East Springfield were to fail. This system worked well enough that WBZ used it until they discontinued operations of WBZA in 1962.

As Mr. Gregory put it: "In achieving success in the automatic synchronization of the Westinghouse stations WBZ and WBZA our engineers were forced to depart from prevailing practices in many instances and to carry on developments along new lines."

The full text and associated schematics of the Gregory's Westinghouse document are posted at www.radio-guide.com/technical.htm

I am especially indebted to Mr. Roy Humphrey of KDKA Radio, Pittsburgh.

Stan Adams is a frequent contributor to ***Radio Guide****. Contact him at stanleybadams@yahoo.com*

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	10 kW	1985	Harris MW10B Solid State
	12 kW	2000	Nautel XL12 Solid State
FM	1.0 kW	2007	Crown FM1000A (new) Solid State
	1.0 kW	2007	Crown FM 1000E (new) Solid State
	1.0 kW	2007	Crown FM2000E (new) Solid State
	3.0 kW	1996	Henry 3000D
	10 kW	2005	Harris Z16HD **IBOC** Solid State
	10 kW	2005	Harris Z16HDS **IBOC** Solid State
	10 kW	1986	Continental 816R-1A
	10 kW	2001	Henry 10,000D-95
	14+5 kW	2005	BE Fmi1405 Solid State
	30 kW	1988	BE FM30A
	35 kW	1986	BE FM35A
	50 kW	1982	Harris Combiner *(w/auto exciter-transmitter switcher)*

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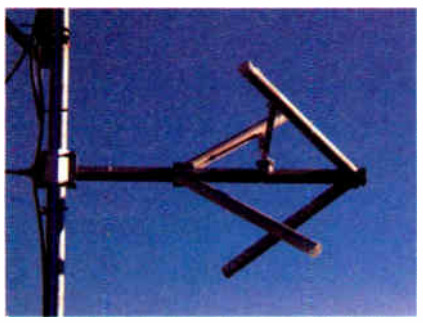

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"Designing receivers that broadcasters can rely on"

Tech Tips

by Gary Peterson

Keeping the Hotline Clear

At times, contacting staff after hours or on weekends and holidays can be a challenge. At many stations and clusters, the business lines automatically go to voice mail.

Trying to get someone by using the request/contest lines can be problematical at best. And for obvious reasons, most DJs are encouraged not to have their cell phones turned on in the control room – not to mention the many places cellular coverage is unreliable anyway, including a below ground-level studio complex like ours.

THE HOTLINE

The usual solution is to install a "Hotline," marked so that when it rings, staff will answer quickly. That way it should make it easier to notify an operator of a technical problem, allow a salesperson to have a spot pulled/changed, allow notification of an emergency/weather/news event, etc.

Our five-station cluster uses an unlisted hotline number that rings into all five control rooms and four production studios. This unlisted number was distributed to all our employees, local law enforcement, and emergency management contacts.

We then installed line ring-detectors from sandman.com in each room to drive high-wattage, incandescent light bulbs – which can be seen through closed eyelids.

A COMMON PROBLEM

However, it has been noted many times that the hotline was busy for long periods of time, therefore defeating its purpose. It became evident that some announcers had given the "secret" number to their significant others in order to make themselves more available.

If an employee makes an outgoing call, the line used is selected from outgoing trunks and shows the main business number on Caller ID. However, it soon became apparent that for incoming calls from friends and lovers, the hot line was just too convenient.

Of course, having the hotline tied up with non-emergency related chatting was unacceptable.

A SIMPLE SOLUTION

Our solution used a Radio Shack (Realistic) cassette recorder with VOX (voice-controlled recording).

I connected an old QKT voice coupler across the hotline tip and ring in the TOC and fed the output to the cassette machine. Input audio will start the recording and the tape will stop after about ten seconds of silence.

A couple of tests indicated that it worked great; it would automatically record any conversations on the hotline. The recorder was also physically inaccessible to the staff.

ALTERNATIVE CONFIGURATION

The hardware portion of the solution could also be handled by an old PC with appropriate software. And, any number of cast-off telco interfaces would work to connect the phone line to the recording device. I just happened to use what was readily available at the time.

As an example, in lieu of a cassette deck with VOX, a Philmore recording control (Model No. TEC36) will handle the record interface and control functions on a standard recorder.

The Philmore unit sells for about $21.95. I recently purchased one and it works very well. The only thing that would improve the concept would be time and date stamps on the recordings. If a PC were used as the recorder, this should be easily accomplished.

CLEARING THE LINES

When we put the system into operation, the staff was notified that all hotline calls were now being automatically recorded. They were also told that any really "good stuff" might be played at the next Christmas party.

It appears our next party will not feature "juicy" conversations; none have been found on the cassettes. Since the recording system was announced, the hotline never seems to be busy, except for legitimate issues.

Gary Peterson is Chief Engineer for New Rushmore Radio Co., Inc. in Rapid City & Sturgis, SD. He can be contacted at kzerocx@rap.midco.net

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Vorsis VP-8 Digital Audio Processor

by Whit McGee

If it sounds like I am in love with our new sound that we achieved with the Vorsis VP-8, you are right.

The Vorsis VP-8

You might wonder why a Program Director is writing this report. However, think about it: in many small markets, where engineers are part-time, program directors actually are the ones responsible for the station's programming, music and sound.

FACING OFF AGAINST THE COMPETITION

WVOK is a small-market station with a hot-AC format playing 80s, 90s, and current music with a wide playlist. We are typically billed as one of the top stations in the area, although the ratings book does not cover our town.

Our big issue is that while we are in a small market, we compete with stations in nearby medium-size markets that have bigger budgets and stronger signals.

We had a top-of-the-line processor of seven or eight years ago, but it was no longer doing what we needed. Lately, our competitors started sounding both louder and cleaner. I talked with a lot of people at a lot of stations seeking advice, but in the end we decided to try something new.

FINDING A NEW ANSWER

Earlier this year we finally had the opportunity. As a small market station, we are on a limited budget. What we pick had to be good enough to make us sound competitive. We tried two other processors, both really disappointing. A friend saw the Vorsis VP-8 at NAB, told me about it, and that is what we eventually selected.

A slim one rack-unit, the VP-8 was easy to install. No extra equipment was needed; it was on air the first day it arrived. Setup was very user friendly. We put it in, powered it up, and in ten seconds we were on the air with music. It was the easiest experience I have ever had with a processor.

WVOK PD Whit McGee checks the preset on the VP-8 front panel.

We started with the Quick Start preset. It was so nice to have this; no other unit that we tried offered it. It is a combination of all the good things about the VP-8. Not too loud, but it is loud. Not too clean, but it is clean. It shows what the VP-8 is really capable of doing.

SEEING IS BELIEVING

The modulation monitor looked like it was reading line voltage, it was so still. But we heard no grunge, none of the ugly nastiness we heard with the other processors, no voice distortion, no clipping in the music. It broke the mold of what we are so used to seeing in processors.

At first, it seemed the VP-8 was almost beyond my understanding. The wide range of presets is fantastic; we could not ask for more. There is a sound for every person, every format, every market. However, I was concerned at the beginning – I did not know quite how to get the sound I wanted and the station needed.

It turns out that there is a little learning curve. I quickly discovered the VP-8 is not going to be a processor that does things they way our old processor did. Then the factory presets and the Vorsis GUI came to my rescue.

EXCEPTIONAL GUI

The GUI, with its huge amount of analysis on the screen, took the guesswork out of the setup. For someone like me without a ton of experience, its layout with color and shapes made setup much easier. Instead of seeing numbers, we see what the processor is doing, displayed in real time.

The Vorsis GUI

We experimented and settled for a while on a modified version of Quick start, tweaked for our needs. The support team at Vorsis was extremely helpful, resulting in the absolute perfect setup for us.

HELPFUL CUSTOMIZATION

After working with Quick Start, we got in touch with Jeff Keith, the Vorsis product manager at the Wheatstone facility. I described in programmer's terms, and layman's terms, what I wanted to do.

Jeff said, "I'll work on a sound for your station then I'll send you a few presets to try. If you like one of them, use it as a starting point to tweak. If not, we'll start again."

One day later, four different presets arrived by email. Each had different levels of loudness. One was just about perfect for us. Jeff then helped me make a minor adjustment to arrive at our beautiful sound.

ACHIEVING THE DESIRED SOUND

WVOK ended up with an AC sound, warm, a little bit of compression and coloration, a sound that you could listen to all day with no problem. We are competitive with the other stations in the bigger markets. We are loud, clean, have huge bass, and are completely legal.

What I liked the most about the VP-8 is the Vorsis Bass Management System – a programmers dream. The name of the game in radio processing is "who has the best sounding bass." Now I can say "we do!" Our bass is cranked up 50% more than we could with any other processor, without giving up any headroom or loudness. Vorsis lets us push the bass far beyond what we would ever want before it starts distorting.

The Vorsis rear panel.

My engineer was really impressed, even blown away, that we got a four-band AGC/compressor and an eight-band limiter for a price tag under $3,000, a ton of processing horsepower at a perfect price. Our station spent a very modest amount of money to get what we value to be worth much, much more.

I thought I knew what processing could do. Vorsis took it a step further with that extra push without scarifying quality to get that loudness. Every station with a VP-8 can have a truly signature sound that is not limited to the "sound of the manufacturer." With the VP-8, you can get "your sound." We did.

TECHIE STATS

- True multi-mode audio processor, with six built-in operating modes:

  FM, AM, FM-HD, AM-HD, MP3/AAC >48k, and MP3/AAC <48k.
- FM mode: Reference-grade stereo encoder; adjustable diversity delay (to 10 seconds) for HD; dual SCA inputs.
- AM mode: 4.5 kHz, 5 kHz, 6 kHz CCIR and 10 kHz NRSC lowpass filters; adjustable positive asymmetry, LF tilt correction and dual transmitter outputs.
- 80 preset slots; front panel headphone output.
- Selectable all-pass filter to make voice energy more symmetrical.
- Phase-linear four-band AGC with adjustable crossover points.
- Four band parametric EQ may be placed before or after multiband section.
- Precision eight-band limiter.
- Eight-band final limiter (different algorithms specifically tailored to the requirements of each mode).
- Advanced distortion-masked clipper for absolute FM and AM peak control.
- Adjustable input high pass filter may operate in stereo or M/S.
- 1RU

Whit McGee is the Program Director at WVOK in Oxford, Alabama. Contact him at whit@k98.fm

Omnia ONE Audio Processing

by Tom Taylor

The twenty-first century has brought some amazing changes to radio technology.

FROM TUBES TO MICROPROCESSORS

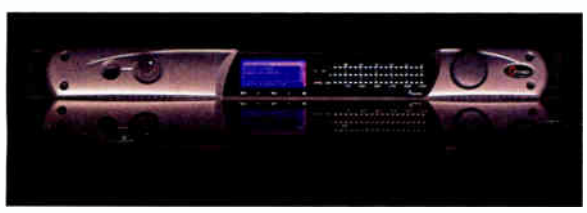
Back in the "Good Old Days," vacuum tube based computers took up entire floors in buildings. A staff was required to operate and maintain them. Performance was not much better than a modern scientific calculator.

Today, single chip sets on small circuit boards eclipse the performance of even the most powerful of the early personal computers. This improvement in computational power has led to digital audio processing – and as the technology matures, the performance and pricing just get better and better.

Telos-Omnia is a company which has been at the forefront of the digital revolution. Steve Church and Frank Foti have been industry visionaries and lead a company producing an innovative, cost-effective product line. And I especially like a company led by former chief engineers – guys who have walked the walk and truly understand the industry.

COMPLETE FLEXIBILITY

One of the new products this year and a true paradigm shift in audio processing philosophy is the Omnia ONE.



The Omnia ONE

Using the latest digital processing techniques and designed as a "universal hardware platform" the ONE provides the flexibility to perform many different jobs in the broadcast facility. The dual firmware banks allow different "modes" of operation to be stored. So no matter what kind of "cast" you need processing for – AM, FM, HD, podcasting, or streaming – the Omnia ONE will be a formidable option.

Under the hood, a wideband gain-rider plus four-band AGC allows fine adjustments to create a "signature" sound. Omnia ONE also offers look-ahead final limiting optimized for the HD codec with feedback limiters for the lower two bands and feed-forward for the upper two bands. SENSUS™ codec-conditioning technology promises enhanced clarity and musicality even at low bit rates. Omnia ONE also promises time-aligned, dynamically flat, perfect-reconstruction crossovers and selectable phase rotation for vocal warmth and presence.

The ONE's I/O section includes analog and AES/EBU connections, plus Livewire interface for direct integration with Axia IP-Audio networks. Silence-sense can automatically switch to a backup input upon loss of audio. It also offers flexible remote control via Ethernet, RS-232, or GPIO connection.

BIG SIGNAL, LIMITED BUDGET

The station I engineer, WRAS, Atlanta is a student-run 100,000 Watt station owned by Georgia State University. We were finally getting ready to stream the station's audio and I needed processing. Fighting a limited budget, I looked at the various software solutions and was leaning in that direction until an engineer buddy told me about the new "wonder box" from Telos-Omnia.

Now, at $2,995 retail, I was not expecting much. I have tried dozens of various and sundry "cheap" processors over the years. There was always a reason they were cheap – usually because they sounded cheap. I guessed we could probably make the "wall of sound" – but I carefully saved the packing material because I was sure it would be going back.

INSTALLATION

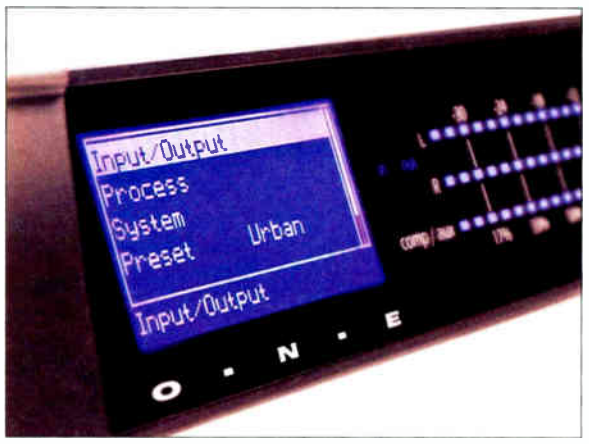
I decided that to really get a feel for the ONE's "personality" I would need to try it on the air. After all, one of the selling points was the ability to make the ONE an entirely different processor. The ONE would serve as a backup to the main processor so I needed to find out how well it would work

Generally, installation was a snap. The ONE occupies only one rack unit, with no ventilation holes, so finding a place for it was not difficult. My only complaint was the AES audio interfaced through RJ45 connectors. (I had a loaner – the cables were missing.) After building the appropriate adapter cables it was smooth sailing.

Setting up the Ethernet connection was somewhat painful because of firewall issues with my DSL modem, but after getting the modem settings correct the IP connection through the built-in browser was excellent. I used a laptop with a 3G card and punched through all the presets while sitting in the car. (The best way to make the PD happy is sitting in the PD's car and listening to what they hear every day)

SELECTING THE SOUND

The menu is very intuitive and very much like the usual Omnia format. It was very easy to dial in the input/output settings, set pre-emphasis, and then select a processing preselect.



Intuitive screens make setup a snap.

I started with the "rock" preset since the station plays typical college radio material during the daytime. I figured this was a good starting point.

I did modify the rock preset to add a little more "brilliance" but my adjustments were minor. For the most part, I was happy with the preset as it was – at least for the alternative/rock dayparts.

RICH SOUND

The sound was simply amazing! I switched back and forth between my $10,000 main processor and the Omnia ONE and could not believe how close they sounded. The $3,000 processor was just as smooth, just as silky, and just as intelligent as the $10,000 processor – it was just fantastic.

The real test was when different types of music were played in the specialty shows. Music genres ranged from classical to blues to bluegrass. I was amazed at how intelligently the processor handled all the different music types, especially Classical. Dynamic range is important to Classical music, artistically, and the ability of a processor to create "perceived dynamic range" says much about the sophistication, or "intelligence" of its processing algorithms.

The Omnia ONE was very graceful, even with the moderately aggressive "rock" setting. Dynamic range was "squeezed" enough to make the quiet passages loud enough in a noisy truck, but the music still sounded like it had quiet and loud elements. It sounded very much like the local NPR station, which I think has a great compromise between loudness and quality – and a much more expensive processor!

New presets are continuously being developed and can be easily downloaded as can software updates. Omnia customer service is second to none – they will help you set up and tweak your ONE until you are happy.

FILLING MANY ROLES

The ONE's flexibility is certainly a key feature.

An AM/FM owner could use one processor to back up both stations. It can also back up the web stream processor or the production room processor. I will be using my original Omnia ONE for the Internet stream, but plan to buy another for the auxiliary transmitter processing chain.

It will be nice to know that these two processors can handle any audio processing job in the station. I can even help if one of the local AM stations gets in trouble and needs a loaner.

WISH LIST

I have only two complaints. As mentioned earlier, I did not like the AES interface (although it is plug-and-play with Radio System's Studio Hub cabling).

I also would have liked a daypart automation scheduler. There are remote select inputs which could be used in conjunction with an external automation timer, but it would be nice to have it built-in. I am not sure if many stations change processing, but with the many types of music and programming at a college station you really must have it and use it.

I appreciate and seek out companies who provide quality, innovative products with technical support which we can count on in the future. Thus I would like to thank Church and Foti for all they and their company have contributed to making radio better through technology and its intelligent use.

And thanks to the Omnia ONE – now any station can have a "major market" sound at an affordable price.

TECHIE STATS

- Analog XLR balanced inputs and outputs.
- Digital AES/EBU input, output and external Sync input.
- Automatic input fail-over on loss of audio.
- Ethernet, RS-232 Modem and GPI remote control ports.
- DB9 "Interface" connector for dry contact closure "Trigger Script" remote control.
- Livewire(tm) / Ethernet RJ45 jack.
- Built-in stereo headphone jack with front panel level control.
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Tom Taylor is the Chief Engineer for WRAS, Atlanta, as well as a Staff Engineer at CBS Radio, Atlanta. Contact Tom at: taylorengineer@bellsouth.net

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- For the fact that **both the transmitter and receiver can measure the modulation percentage and pilot signal level** (19 KHz stereo without disconnecting the audio from the transmitter).
- For its **remote control**.
- For its **analog telemetry**.
- For being made for **mono or stereo (MPX) signal**.
- For its **capability to work with AC power voltage from 90 to 250 V, 50/60 Hz**, and also with external battery if needed.

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Orban's Optimod 8500 Helps Tame WUVT's Multiple Formats

by Kevin Sterne

It was in a rather unusual and interesting way that WUVT aquired our Optimod 8500 digital audio processor. Let me explain.

OUT OF TRAGEDY COMES GOOD

On April 16, 2007 the nation's eyes were on the events at Virginia Tech. I am the Chief Engineer for the student-run radio station there, WUVT-FM Blacksburg, VA. (For background information on WUVT, see ***Radio Guide***, July 2007. Or pick your favorite Internet search engine and search my name; you will probably find several hundred thousand results, if not more than a million. From the results, you will get a glimpse of the impact of April 16, 2007 on my life.)

In the days and weeks following, the radio engineering community responded with many people saying the same thing, "How can we help?" Multiple companies offered to donate equipment, time, and people in order to help out WUVT.

One such company, Orban, offered to give us a brand new Optimod 8500; we just could not refuse such a great gift. Even though my recovery kept me away from the initial installation and use, my colleagues at WUVT made sure it was ready when I returned.

MULTI-FORMAT CAPABLE

All and all, the 8500 is an excellent processor. In the past year of using the 8500, we have seen some slight problems on our end but, more importantly, have had a great sounding air product for our listeners in the New River Valley and beyond.

Officially we consider ourselves a block format, meaning at certain times during certain days we have specific audio content. Our content can vary from Rock to Jazz, from Celtic to Talk, and even from Folk/Americana to Electronic in a matter of minutes. The 8500 is accommodating to our format though, by allowing different audio processing schemes to be loaded at scheduled times. This has come in handy for us since, as I mentioned, our air product will sound different at certain times.

The Optimod 8500 can alter processing automatically.

Another great feature of the processor is in the fact that it can be plugged into an Ethernet port for updates to the firmware of the processor, as well as remote computer logins to control the processor.

I have found that the remote computer login is most useful whenever the radio station undergoes a major format change during college break times, when all of scheduled preset load times change. Entering in the information for the scheduled load times using a computer keyboard is much easier than using the large knob and three buttons on the front of the 8500.

THE DIGITAL DELAY ISSUE

Nevertheless, we have experienced some problems in using the 8500 to its full extent.

For example, even though the additional delay from the 8500 with some format presets is only milliseconds, it has been enough for our DJs to notice. At WUVT, we like to have the student DJs listen to themselves on headphones while they are talking; the headphones as well as the studio monitors get their audio from a little receiver in the studio which allows the DJ to hear what the listeners are hearing.

However, the additional delay from the 8500 was enough of a change from our previous audio processing, that it actually caused some DJs to become fairly irritated. One way of compensating for the "tunnel" sound was training the DJs to change the source of the headphone audio to the audio that is leaving the sound board. Of course, this training led to the second problem we have experienced.

The Optimod 8500 in the WUVT rack.

Since our student DJs are learning to speak on air, we encourage them to always use bed music while talking. But the delicate process a DJ must go through in mixing the level of their microphone with the level of the bed music (so that the DJ can still be heard) becomes even more delicate when using the 8500's automatic gain control.

The result is that, as our DJs are talking, the bed music frequencies often times are ramped up more than the voice frequencies and the DJs voice becomes unintelligible. Interestingly, this problem also has confronted those stations using digital transmission – the eight-second delay has pushed many announcers to use the "Program" bus instead of off-air.

The 8500 does offer a solution for stations in this situation: a "headphone monitor" output, which provides a virtually delay-free feed for monitoring purposes.

A SPECIAL NEED

The last problem that I have noticed about using the 8500 on WUVT is something that very few other radio stations would encounter. It comes out of our block format, with its widely varying musical genres.

Despite the block format schedule, transitions between DJs are often very relaxed – meaning a DJ often will not end their show right at the ending time specified on the schedule. Their last song may run a minute or two short or over the time they are supposed to end their show. If, for example, a rock show is transitioning to a jazz show and the rock DJ runs a minute or two over, the jazz processing scheme is loaded and the song that the rock DJ is playing sounds drastically different.

The change is so drastic that when it happened to me while doing a radio show, I had to look at the transmitter monitor to make sure nothing had gone wrong with the transmitter. When I figured out everything was alright with the transmitter, I looked up at the clock and realized the audio processing had changed since I had run my show a little long.

DIGITAL SOLUTION ELUSIVE

We have talked to Orban about this problem and asked if there was some way in which the audio processing change could be slowed down – perhaps cross-fading from one preset to another preset.

Unfortunately, they have told us that, with the current software setup of the 8500, to accomplish a cross-fading effect would require setting up several "in-between" presets, loaded at 5 to 10 second intervals until the transition was complete. However, this would call for us to create 100 or so transition presets as we have several hard processing changes.

At a regional radio engineering show we talked with the Orban representatives about our problem again and ask for their suggestions. They suggested we should look at the remote control interface on the 8500, which allows the user to program eight audio presets to be loaded via remote command. The idea was that if we could use the remote control to change the processing while the upcoming DJ was talking before his first track, then our problem would be solved.

While the remote control interface would be useful, our processing has so many different presets that eight may not be enough to cover them all. Furthermore, in order to get the processing to change at the correct time, we would have to rig up a pushbutton for the DJs to push while they were on-air – and they would have to remember.

We even thought about having the signal for a processing change be sent to the 8500 whenever the DJ enters in their first song on our computerized playlist logging system. This probably will not work though, because some DJs, including me, are guilty of entering in the information for a song a minute or two into that song instead of at the very beginning of the song, which would cause the processing to change in the middle of that song.

A viable solution for this problem is still being sought.

GETTING THE JOB DONE

None of these issues mean the Orban Optimod 8500 is not a great audio processor. In fact, the audio processing part of the 8500 is excellent. The problems we have experienced would not be present if we were a single audio format station – as is the case with many commercial stations today.

Part of not being able to use the 8500 to its fullest is that we have not developed the right equipment to work with the 8500. In that sense though, there is a little inflexibility, but I think the fact you can schedule presets to be loaded at a certain time is an advantage over some other processors.

Our special needs not withstanding, the scheduling of presets is great for when our station varies from music programming to talk programming. There no longer is a time when – ten minutes into a talk program I am helping to produce – that I have to run back to the processor and flip the switch to generate mono instead of stereo. Conversely, the listener is not listening to music in mono whenever I forget to flip the switch back to generate stereo.

The presets are also very good in their labeling as to what type of audio the preset should be applied to. Jazz works well with Jazz, Classical works well with classical, and so on. You are even able to customize any of the presets a little further, depending on your exact taste in audio processing.

All in all, we are very happy that Orban has provided us with this excellent processor.

Kevin Sterne continues as Chief Engineer at WUVT. You can contact him at: ksterne@vt.edu

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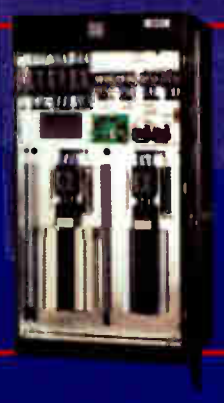

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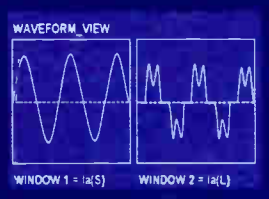

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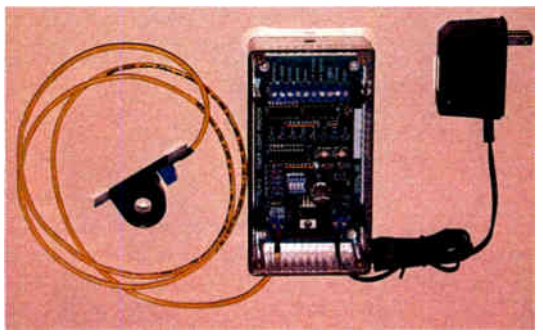

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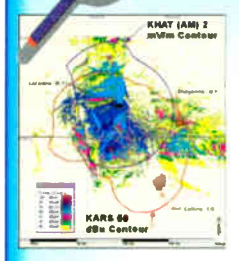

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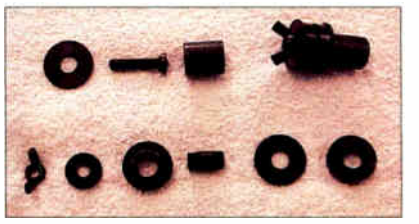

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Industry Information

Audessence – ESE – Henry Engineering – Inovonics – LBA Technology

Audessence ALPS Leveling Processor

Audio processing as a practical solution to real world level problems in broadcast began life the early 1960's – simple and often crude limiters, compressors and clippers were used in controlling dynamics to prevent the overload of transmitters and other equipment. Rapid progress was made predominantly in the 1970's and 80's and refinements of these same techniques continue today, except instead of discrete circuits of semiconductors, caps, resistors and such, these fundamental building blocks now exist in a virtual, digital world.

What started out as the well-intended art of gracefully controlling audio, turned into a more sinister science as sound industries manuvered for a competitive edge – recording artists complained when recordings were louder than others on albums; meanwhile the radio waves were starting to "heat up" and engineers devised ever more devious combinations of tweaked outboard equipment to sound "hotter." Along the way some healthy competition to sound more enticing and exciting, turned to carnage when efforts focused solely on loudness – at any cost.

Processing equipment manufacturers became the arms dealers and indeed, these manufacturers were locked in a war of their own as a fickle industry purchased what they perceived to be the most effective weapons. The fallout from the war manifested itself as a loss of quality, and a new problem – listener fatigue.

With the rise of digital, broadcasters now find themselves on a new playing field with brand new rules. Digital platforms employ perceptual coding which (in simplest terms) reduces the audio to the target bitrate by discarding information less perceivable to the ear, so processing in the old-fashioned way works against this coding principle resulting in the burbling, smeared and generally peculiar sound we all consider as accepted properties of digital platforms – be it DVB, DAB, HD radio or Streaming.

The audio engineering company Audessence carried out detailed research into audio pre-processing for codecs (mp2, mp3, aac/+) commonly used by broadcasters, and they concluded that a new approach was required – a 21st century platform needs a 21st century solution.

The ALPS leveling processor was specifically developed with digital coding in mind, and is designed to deliver a consistent, non-fatiguing program with superb clarity and far fewer annoying artefacts than traditional multiband compressors. And because ALPS was developed as a generic processor for digital audio, it is designed to be easily configurable by the end-user to fit all applications.

The software interface has been carefully designed to be both flexible and simple and a wizard enables preset generation for all situations. ALPS is increasingly being chosen by experts across all audio disciplines including Digital Radio (airchain processing), television sound levelling, microphone processing, codec and STL protection, Outside Broadcast, streaming and more.

Graham Sloggett, Sales Director at Audessence said "The feedback we get from ALPS is always positive. Finance people love the price, engineers love the performance, the control software and the spread of presets – ALPS just works straight from the box"

Audessence
info@audessence.com
www.audessence.com

Inovonics Model 525 AM Reference Receiver

Inovonics, Inc. announces immediate availability of their Model 525 AM Reference Receiver and Modulation Monitor.

The 525 is a frequency-agile wideband AM-broadcast receiver that utilizes a highly linear phase-locked detector to provide accurate off-air measurements of AM carrier modulation. An important feature of this new monitor is the ability to resolve the amplitude-modulation component of the station's carrier during IBOC "Hybrid Digital" broadcast operation.

Positive and negative carrier modulation is shown simultaneously on a high-resolution LCD display. This can be switched to provide a readout of received signal strength and asynchronous noise as well, two parameters that can influence the modulation reading. Measurement response is pancake-flat to 10 kHz, although a menu-controlled low-pass filter in the audio-monitor output provides a cutoff that can be programmed between 10 kHz and 2 kHz in 1 kHz steps. This allows the user to preview the sonic compromises imposed by pre-transmission audio filtering and to simulate the response of consumer radios.

Additional features of the 525 include easy, menu-driven setup, five station presets, two sets of peak flashers, and remote "tally" alarm outputs for overmodulation, carrier loss and program audio loss. The 525 is supplied with a weatherproof outdoor loop antenna at no additional cost.

Inovonics
800-733-0552 – sales@inovon.com
www.inovon.com

Henry Engineering "MonitorMix" Option for SixMix USB Console

Henry Engineering is now offering the "MonitorMix" option for their popular SixMix USB Broadcast Console.

The compact SixMix USB Console is often used for doing remote broadcasts. In these applications, the remote-site talent may need to hear a mix of local Program audio mixed with the "Return Cue" audio that is sent from the main studio back to the remote site. This enables the remote-site talent to hear everything that is being broadcast: the remote site audio and audio that is mixed in at the main studio.

The MonitorMix option does exactly that: Return Cue audio that's sent via POTS, IP, ISDN, etc. can be mixed with the SixMix Program bus, so the remote-site talent can hear both in his headphones. A mix-level control allows the Return Cue audio level to match that of the SixMix Program bus audio.

The MonitorMix option can be ordered with any SixMix console; it can also be added to SixMix units that have already been purchased. The cost for the MonitorMix option is $125.

Henry Engineering
626-355-3656 – info@henryeng.com
www.henryeng.com

ESE ES-188 NTP Referenced Master Clock

The ES-188 is designed to simplify locking local facilities to external time sources when a slight time offset is required. Broadcast facilities place a high priority on the ability to continuously output a clean signal while switching between a variety of internal and external sources.

While it might be expected that synchronizing internal clocks to an external source would resolve the issue, synchronization is only a partial solution. Due to a variety of system-based delays, simply synchronizing clocks is not enough. The ES-188 provides users the ability to offset local clocks from an NTP Time Server so that local events can occur at precisely the correct time.

The ES-188 is a 1RU black anodized unit that displays nine digits (Day of Year, Hour, Minute & Second) of time as received via a user selected NTP server. Several types of time code (ESE-TC89, ESE-TC90, USB, RS232C/ASCII, SMPTE/EBU and IRIG-B), as well as a 1PPS signal are generated by the ES-188 and output on the rear panel. These outputs allow the ES-188 to easily interface with new or existing computers, automation systems and third-party clock systems.

The ES-188 features rugged construction, automatic correction for Daylight Savings Time and 4-hour battery back-up. Options include ASCII "NPR" Time Code Output, Relay Contact Closure, 220 VAC, 12-35 VDC power input and UL approved power supply. Software is also supplied with the ES-188 which permits the user to continuously update a computer's Windows® clock to the time available on the USB port.

ESE
310-322-2136 – ese@ese-web.com
www.ese-web.com

LBA CAMI Tower Isolator

LBA Technology, Inc. announces the CAMI series of new-concept, broadband medium-power isolators for AM towers. CAMI isolation systems permit other antennas to be mounted on "hot" AM towers.

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With pending FCC approval of translators for AM daytime stations, CAMI will provide an simple, cost effective, way to mount the translator antenna on existing AM towers without major changes to the transmitting system.

LBA Technology
803-951-7443 – www.lbagroup.com

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The Radio Guide Event Register

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www.wi-broadcasters.org

IBS Fall 2008 Coast-to-Coast Conference Schedule
October 18, 2008 - Boston, MA
October 25, 2008 - Chicago, IL
December 6, 2008 - Los Angeles, CA
http://www.ibsradio.org/

Pittsburgh SBE Chapter 20, 2008 Equipment Expo
October 20-21, 2008
Monroeville, Pennsylvania
www.sbe20.org/expo.html

6th Annual Ohio Broadcast Engineering Conf.
November 14, 2008
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www.oab.org/engineering/

Consumer Electronics Show (CES)
January 8-11, 2009
Las Vegas Convention Center, Las Vegas, Nevada
www.cesweb.org

IBS International College Radio Conference
March 6-8, 2009
New York, New York
www.frontiernet.net/~ibs/2Kconvo.html

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Las Vegas Convention center, Las Vegas, Nevada
www.nabshow.com

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