Radio Guide

Radio Technology for Engineers and Managers June 2006

Ensuring Safety with Personal RFR Monitors

Inside Radio Guide

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Contents

June 2006

Cover Photo: A tower climber protects himself by use of the Nardalert XT personal RFR monitor.
Photo courtesy of Global RF Solutions - www.grfs.net

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PO Box 20975, Sedona, AZ 86341
Phone: 928-284-3700 Fax: 866-728-5764

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

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

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Radio Waves

by Barry Mishkind – Editor

Observe, Measure, Be Safe

It is said that knowing what to touch, and when, is the mark of a good engineer. (Also, what *not* to touch.) Safety is important – our safety and that of workers on or near our sites.

Therefore, it is important to understand the potential dangers from things like high voltage or Radio Frequency Radiation (RFR). FM has had the majority of attention, since often several antennas (or combined antennas) are in close proximity, adding up to a lot of power – and excessive RFR. Measurements are needed to identify which stations need to reduce power or shut down, depending upon the work being done.

Understanding the potential dangers around AM sites is just as important.

It is a bit easier now, with the introduction of techniques and meters that more accurately reflect RF levels at AM broadcast frequencies. But the best surveys with the best meters are of little use unless the results are understood and, with personal monitors, attention is given to the entire RF "environment" at transmitter sites.

For that reason, we encourage you to read John White's article on Page 4. It should give you some ideas on where and how to set up an RFR safety program at your station.

Also consider another type of important measurement, the focus of Don Mussell's article on Page 18. Being able to "see" things that are not normally visible will help you prevent problems from happening.

On the other hand, sometimes it is what you see that may present a challenge, as Mike Callaghan shows on Page 32.

We hope personal and RF safety is a high priority at your transmission sites, and by using all the tools available, you find any and all problems before they become major ones. *– Radio Guide –*

Ensuring Safety With Personal RFR Monitors

By John White

Radio Guide continues to be vitally interested in the personal safety of broadcast workers, both from a security standpoint as well as from Radio Frequency Radiation (RFR). In this, another in our series of articles on personal safety, John White discusses how important it is for a worker near transmitters to have a reliable personal RFR monitor.

In the December 2005 ***Radio Guide***, Richard Strictland presented an excellent article discussing RFR safety issues at the broadcast transmitter plant. Hopefully, as broadcast engineers, we have all taken these safety steps at our own facilities.

SAFETY – A PRIMARY CONCERN

However, the broadcast engineer's RFR safety responsibilities extend beyond the boundaries of our own transmitter plants. Recent FCC actions have made it clear that RF safety is not to be ignored. Furthermore, current climber RFR-safety training classes emphasize the hazards near our broadcast transmitter facilities.

When a crew is working on a tower near your broadcast transmitter you may be asked to reduce power, change antennas, or go off the air while the tower crew is at work. Most likely this will be based on an RFR survey or an alarm from some kind of RFR personal safety monitor.

This communications tower is close to my AM transmitter site.

It was just such a request from a crew working on a tower near one of my AM transmitters that caused me to take a second look at personal safety monitors. (A complicating factor was that this tower is detuned to prevent distortion of the directional pattern of my AM station.)

The tower is more than 450 feet away and the probability that AM RF levels exceeded worker safety standards there seemed unlikely. That, however, is not proof – and safety requires real knowledge.

BRIEF BACKGROUND

A short history of safety monitors is in order. With the first awareness of the need for RFR safety precautions, a number of so called "safety monitors" appeared.

These monitors were intended to be worn by a tower worker to alert the worker of any potentially dangerous RFR conditions by continuously monitoring the working environment. By any objective standard, the early units were not much more than untuned detectors that had little, if any, correlation with actual exposure levels.

Those earlier monitors also were usually restricted to limited frequency ranges – 30 MHz to 500 MHz was a fairly common range for these devices. Fortunately, these have since been replaced by meaningful safety products.

BETTER THAN SURVEYS

Due to the number of transmitters and frequencies found on communications towers, personal safety monitors are now a popular safety tool for tower crews who work on many different towers.

RFR surveys are seldom available for these communication towers. In fact, with multiple users often making unscheduled changes, an RFR survey easily can be out of date within days.

Such factors make personal safety monitors an attractive safety solution for tower crews and they now have become a real safety tool in RF environments.

DIFFERENT MONITORS, DIFFERENT ANSWERS

Following up, I met with the tower crew at the tower to evaluate the situation.

Upon arrival at the tower, we saw the monitors the crew were using clearly indicating an alarm near the AM detuning skirt on the tower. However, at the same time, a Narda RFR survey instrument gave readings well below the safety standard. (The skirt was grounded and disabled during this test.)

This crew was using a RadMan, an earlier generation instrument. Inspection of the label indicated a rated frequency range for the monitor of 3 MHz to above 1 GHz. We knew that in this application the monitor was being used outside the measurement range of the instrument and suspected that it may be giving erroneous alarms.

Because the areas in which the monitor was showing alarm indications were near the AM detuning skirt we assumed the monitors were probably detecting 1.64 MHz and 1.33 MHz.

AVOIDING FALSE ALARMS

To find out exactly what was happening and why the monitors differed, we set up a test of the safety monitor at the broadcast transmitter for verification.

Only broadcast signals were present and the known AM RFR levels immediately adjacent to the public side of the fence were less than 40% of the public exposure standards. Levels are known as a result of a sweep with Narda instrumentation meters in both the E (electrical) field and the H (magnetic) field per OET bulletin 65.

When the old RadMan monitor went into alarm some 70 feet from the fence we knew that false alarms were a likely problem. A conversation with Narda confirmed this conclusion.

The lesson here is simple: outside the specified operation frequency an instrument will no longer be accurate. Safety instruments must be used properly and within the ratings appropriate to the instrument and job.

Fortunately the Nardalert XT, a new-design personal safety monitor, is now available with an extended frequency range down to 100 kHz. The Nardalert XT is the only personal safety monitor that covers the full RF spectrum including Medium Frequency AM Broadcast frequencies.

RFR FROM DETUNED TOWERS

To complicate the off-site RFR safety issues, towers located close to an AM broadcast transmitter are likely to be detuned to protect the AM station. Such detuned towers will often have some form of tuned circuit, which reduces re-radiation current.

A typical detuning configuration is shown in **Figure 1** and consists of a skirt installed between 18 inches to as much as 10 feet from the face of the tower.

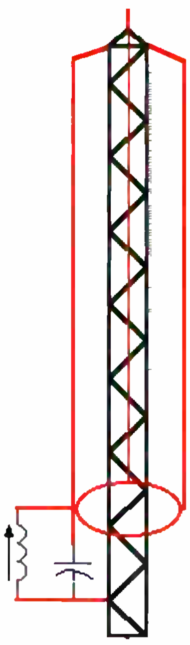


Figure 1: A typical detuning configuration.

Three or more drape wires are attached to the tower at the top. The bottom of the drape wires are connected to a common ring.

The parallel LC network is used to adjust the detuning network for a minimum re-radiated signal at the frequency of the AM Station. This will generate an RF voltage at the station's frequency on the detuning common ring, skirt wires, and the wire connecting to the detuning adjustment electronics.

SAFETY CONCERNS

The actual RFR field near the skirt will depend on distance from the broadcast transmitter, the power level of the station and, for directional stations, the bearing relative to the directional pattern of the station. Except where the tower is very close, the field levels are likely to be quite low.

Nevertheless, even when the fields are low, there are still safety considerations. Inadvertent contact with an energized detuning skirt can produce startle reactions due to the RF voltage that is present. Startle reactions are obviously a very real and dangerous safety hazard when a worker is climbing on a tower.

If a worker will be working in an area of the tower where contact with the detuning is possible, the proper safety procedure is to disable (ground) the detuning skirt. Most detuning equipment includes J-Plugs or other mechanisms to accomplish the grounding.

As broadcasters responsible for worker safety, we must accept this temporary condition in which the detuning will not be operational. This includes the possible need to reduce power to keep a monitor point within tolerance. At the same time, it is also reasonable to negotiate the work schedule to minimize impact on critical broadcast times, such as drive times.

TRYING OUT THE NARDALET

Thanks to Narda I had an opportunity to evaluate the new Nardalert XT at our AM plant and adjacent communications towers. The units are designed to be worn on the front of the body, either on the workers belt or in a front pocket. (In the photographs I am holding the monitor so it can be seen.)

At our transmitter facilities I compared the personal monitor to the results of the last RFR survey and found the correlation of the two to be excellent. The Nardalert sounded an alarm in the same fenced areas where RFR levels were known to be high.

At our Mt. Scott broadcast facility, a communications tower stands only 150 feet from our 10 kW AM broadcast tower. I measured the RFR field one foot away from the detuning network; with full AM power, the reading was 50 percent of the maximum allowable level. Measurements at the off-site communications tower 500 feet away show similar levels at less than one or two inches.

Detuning box at a communications tower.

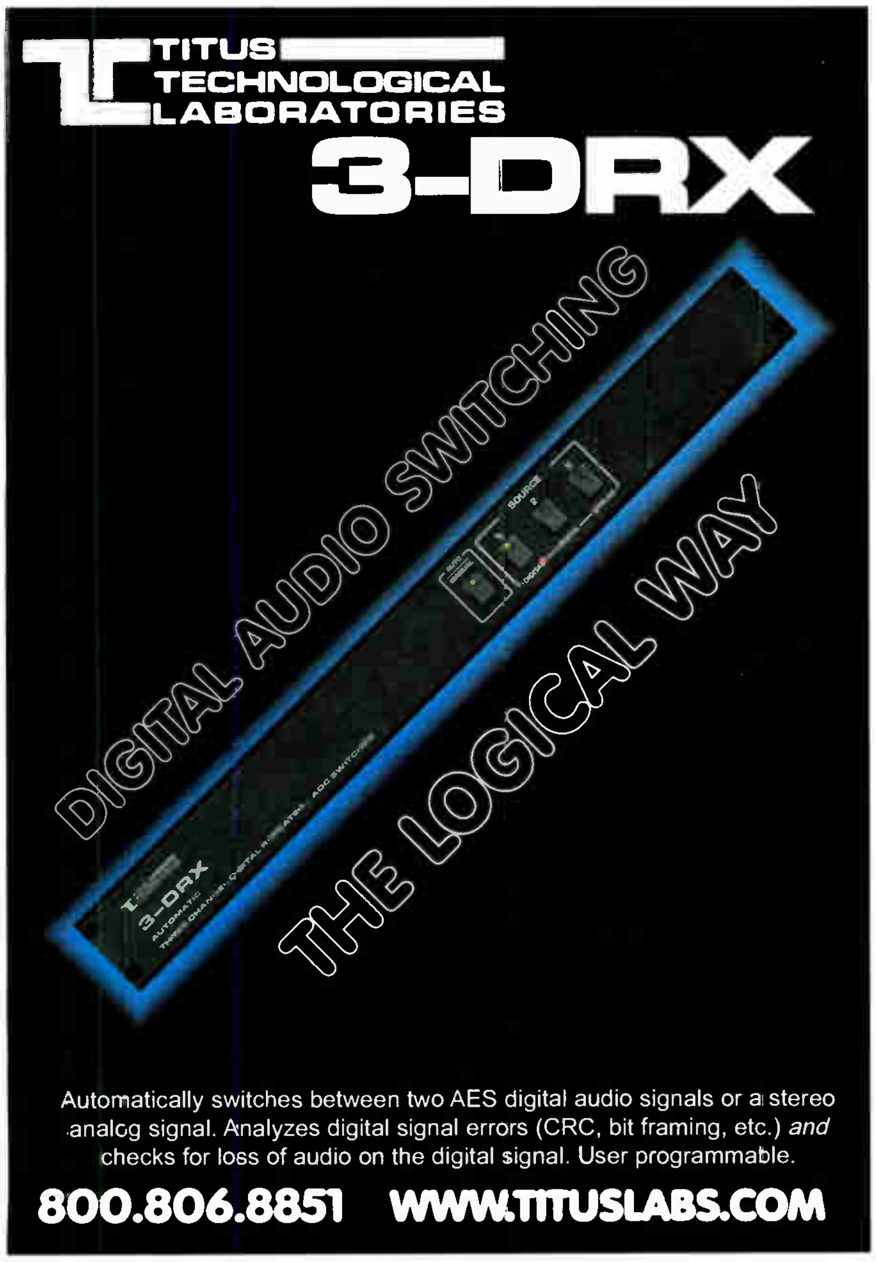
Current procedures at our facility call for the detuning to be disabled (grounded) any time a climber can come in contact with the detuning apparatus.

AM SITE "HOT SPOTS"

Normally, we think of RFR issues as being near FM antennas (especially multiple-station sites) and near AM tower bases. But RFR fields can be quite high at many locations around an AM broadcast transmitter plant.

A fairly typical, legacy AM Tuning House ATU arrangement is a perfect example. This kind of open construction was common with older AM installations, particularly non-directional stations where the transmitter building is placed next to the tower.

(Continued on Page 6)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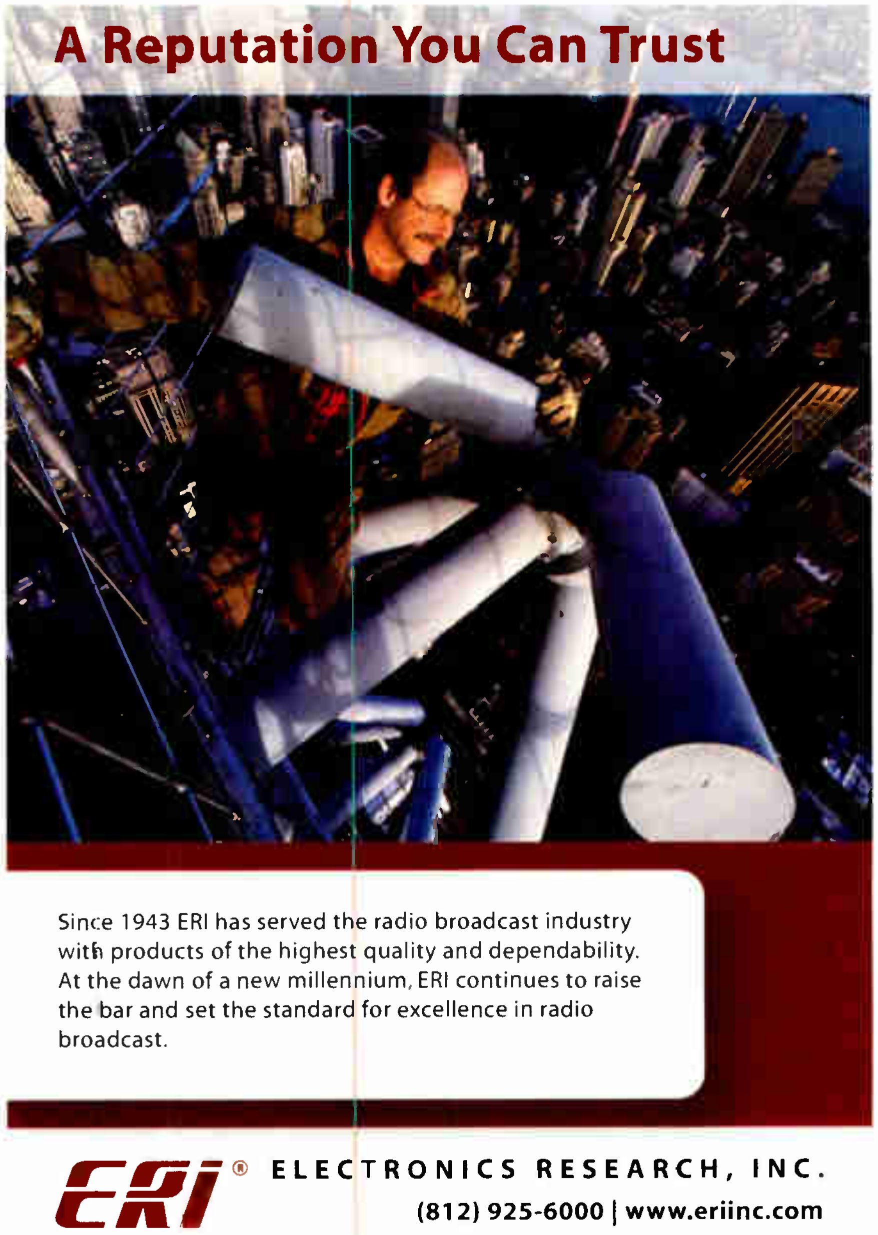
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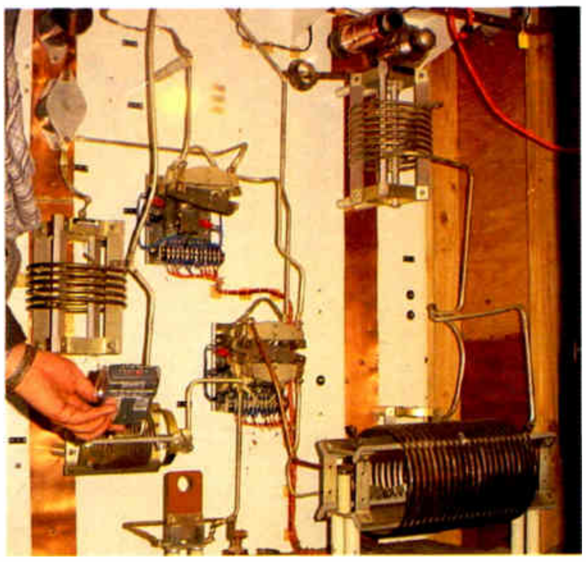
Ensuring Safety With Personal RFR Monitors

Continued From Page 4

The output network shown is one of a three-tower array and built into a small wooden tuning house building. The ATU is installed on an open shelf attached to one wall.



Inside the tuning house significant RFR levels are quite close.

At normal power RF power, RFR densities are at 100 percent of the worker standard 36 inches from the ATU component shelf.

INSIDE THE TRANSMITTER ROOM

Most transmitters are constructed to keep excessive RFR from escaping into the transmitter room. But that does not always shield you from exposure.

One example would be where the output network is actually mounted on the wall inside the transmitter room with the tower just outside. Still, even with the ATU outside, RFR can penetrate the building.

In our case, the transmitter building wall is immediately adjacent to the tower. At this location the Nardalert is indicating a 20 percent level which is exactly as measured during the site RFR survey.

Checking RFR levels at the transmitter building wall near to the tower.

Even enclosed RF cabinets should not automatically considered safe. Removable covers and doors may not be in good contact with the cabinet frame, especially after a number of years without maintenance.

At one of my transmitter locations I found the intensities at 50 percent a few inches from the cabinet near the edges of the doors. In some cases where the doors no longer fit properly, this easily could exceed 100 or 150 percent of the allowable level.

Yet another important area to evaluate is older transmitter equipment. Many older transmitters are provided with inspection windows to allow observation of the power amplifier tubes while the transmitter is in operation.

Do not forget to check levels near RF cabinet doors and older transmitters.

For example, some field reports indicate that looking into the inspection window in the final cabinet of a 316C while it is making full power is not a good idea. In fact, levels of 200 percent have been observed with the transmitter in operation!

In the final analysis, safety requires accurate instrumentation, proper use, and dedication by all. Be safe!

John White, CBRE, is the Chief Engineer for the Crawford stations in Portland and manages their hilltop site, which includes three self-supporting AM towers. You can contact him at jdwhite@teleport.com

Techie Stats

Nardalert XT Models A8860, A8862

- 100 kHz to 100 GHz.
- +3/-1 dB sensitivity, 500 kHz to 50 GHz.
- Five high intensity flashing LEDs: two yellow, three red 10%, 20%, 50%, 100% and 200% of standard.
- Two settable alarms: default at 50% and 200%; alarms are audible, vibrating, or both.
- The 8860 has the ability to store 30,000 data points and download them to a computer.
- 4.12" high x 3.0" wide x 1.37" deep.
- MSRP: $1630

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COMREX

Field Guide

by Grady Moates

The BE 4MX 50

With the new 50 kW transmitter – the 4MX 50 – now installed at several stations, real world field reports on the unit's operation are now arriving. The initial results already encouraged Broadcast Electronics to expand the line – a 25 kW model was introduced at the spring NAB show. In summarizing his experience, Grady Moates, owner of Loud & Clean Broadcast Science, answers the questions on the minds of many stations considering this innovative transmitter.

Late last year, WBIX replaced an aging Harris MW-50 with the new 4MX 50. The result has been everything we had hoped for – and more.

Our MW-50 was the WRKO-680 Rock 'n' Roll transmitter originally installed back in the mid-70's. An original MW-50, it had been field-upgraded to an "A," then to a "B" (although it never quite made the last step to a "C"). With all those field modifications, when I changed the frequency to 1060 kHz there were several times when it was difficult to get a handle on exactly what was in that old box.

It sure is nice to be able to breathe a sigh of relief now that the 4MX 50 is on the air.

A MODERN TRANSMITTER

When WBIX decided to look for a new transmitter, we looked at the various options. With the cost of electricity skyrocketing, efficiency was important.

Equally important was audio quality. With another 50 kW talk station right next to us on the radio dial, we simply *had* to improve our sound quality and be able to run at lower power levels without sacrificing audio performance.

The Broadcast Electronics 4MX 50 seemed to meet our needs. When running at less than 10 kW, the controller shuts down all but sixteen PA modules and power supplies; when running at less than 2 kW, it shuts down even more (we run 22 kW in critical hours, and 2.5 kW at night). This helps to keep energy consumption down.

A "SMALL" SIZE PROBLEM

One major concern was that, due to local zoning hassles which prevented expanding the transmitter room, we had to fit our new transmitter into a very small space.

If WBIX was to get a new 50 kW transmitter, it had to go here.

This constraint is where the 4MX 50 really saved the day. Fortunately, the 4MX 50 footprint is only 45 inches wide by 25 inches deep. This allowed the transmitter to be brought through the existing doors. In fact, we could not have put *any other* 50 kW transmitter into this room without removing the MW-50 to make room. That is space efficient.

After installing this 50 kW transmitter, we still have room to walk around to the back of the unit – so long as we do not try it after a large meal!

INSTALLATION

Not counting the time we spent modifying the site wiring to add a new transmitter to an existing triplex antenna system (that had not been designed for an additional transmitter), I think we spent six or seven man-hours between the truck arriving and it being on-the-air.

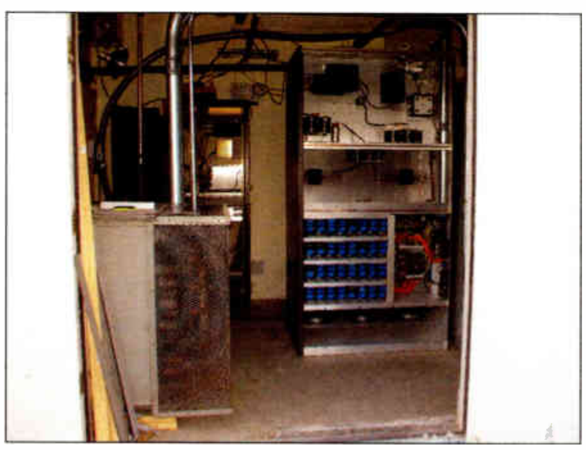
When the 4MX 50 was delivered, all the various modules were already in place. Because the 4MX 50 is two inches taller than our doublewide door frame, the least troublesome way to get it through the door was to remove the modules and flip the unit on its side for insertion into the room. The modules were then replaced in their original locations.

Loud & Clean's John Garrett tags and removes all the RF Power Supply and PA modules to lighten the 4MX 50 cabinet for insertion into the room.

We used a forklift to do the insertion into the room, but the unit was so light with the modules out that two engineers easily could slide it around and into place on the floor.

PREPARATION PAYS OFF

We had anticipated the transmitter's arrival by a couple of months, so the electrical conduit and ground strap were already roughed in at the final position of the 4MX 50. This permitted the electrician to be in and out in about an hour.



After installation – a comfortably tight fit.

Access to the I/O panel was simple; it was in its own little shielded compartment. The removable, 10-pin connectors made it easy to hook up control, telemetry and antenna system interlocks. A BNC connector was used for the RF sample and a separate three-pin connector was provided for audio.

All in all, we had the transmitter on the air with basic remote control, telemetry and interlocks quite quickly. Since this unit was one of the very first to be delivered, the factory had expected to send a couple of techs out to start it up and they were quite pleased that it was up and running before they got to town.

I switched back to the MW-50 after a day of running the 4MX 50 so that the BE guys could come in and bless my installation before we began regular, daily operation.

DESIGNED FOR SERVICE

Since we have an early, field-test unit, we have had the opportunity to dig into the box a bit.

There are sixteen PA motherboards (one for each pair of PA modules) and they are easy to remove and replace from the front of the transmitter – in about 15 minutes – by following the clear instructions provided.

The ability to remove any number of modules without turning off the transmitter (I have done it several times without incident) is very nice. It takes about 60 seconds to tell the controller to shut down a module, remove the RJ-45 control plug from the jack on the front of the module, unscrew the two thumbscrews holding the module in place, and slide it out.

Re-installation of a PA module while on-the-air does require that the 4MX 50 momentarily mute. This is so the relay that connects the PA module to the summing buss can energize without drawing an RF arc that would reduce the life of its contacts. The mute is automatic and lasts a couple of seconds.

INTELLIGENT PA MODULES

Each PA module has a temperature sensor that reports to the controller. This got a special test in our transmitter.

It turns out that a couple of the little circuit boards for the temperature sensor sub-assembly had imperfect wave-solder joints on the thermal device, resulting in overtemp alarms that did not actually exist. However, the controller was smart enough to know that a jump to 109 degrees Celsius was not real, so the transmitter never shut down.

The circuitry making the 4MX 50 so darned efficient is such a new concept that I have been surprised how little modification has been necessary since the field testing started. There were a couple of capacitor failures on two of the RF PA motherboards. The transmitter did not shut down when these two failures occurred; it simply adjusted the power of the other 31 modules up by 3% and continued to run.

I think it ran this way – at our full power – for a week until we had time to install the replacements. There have been no power supply failures at all, and no controller failures, either.

NOVEL, BUT NOT COMPLEX

The RF circuitry in the 4MX 50 is a totally new approach, and as such is a bit unusual (and patent-pending). However, there are not a lot of complex components involved; it is just a novel topology. (See Litz sidebar article.)

A lot of effort apparently went into making this transmitter easy to service.

As an example, on the evening when I saw the specious over-temperature alarm mentioned, I took the PA module out, completely disassembled it without a soldering apparatus, installed the new temp sensor sub-assembly, and reassembled the PA module with nothing more than a #2 Phillips screwdriver.

Testing for failed RF output devices is a simple ohm meter probing procedure that can be accomplished after removing just five screws, and the RF output devices also attach to the circuit board with screws, so they are quick and easy to replace. I have not had one fail, but I have seen a BE tech check them out.

The beauty of the design is that there is a one-for-one relationship between RF PAs and power supplies. This means that troubleshooting to determine whether a

(Continued on Page 10)

Field Guide

by Grady Moates

Continued from Page 8

problem in, say, slot 17 is the RF PA, the power supply or the RF PA motherboard is simply a matter of swapping cards and seeing whether problems move with cards or stay with the slot.

SOLVING MINOR ISSUES

As delivered, the transmitter used a normally closed external circuit as the "pattern change mute," so an open in the phasor controller would mute the transmitter. The 4MX 50 responds so quickly to this momentary open that dirty contacts in the triplex antenna system controller were causing quick, momentary transmitter mutes.

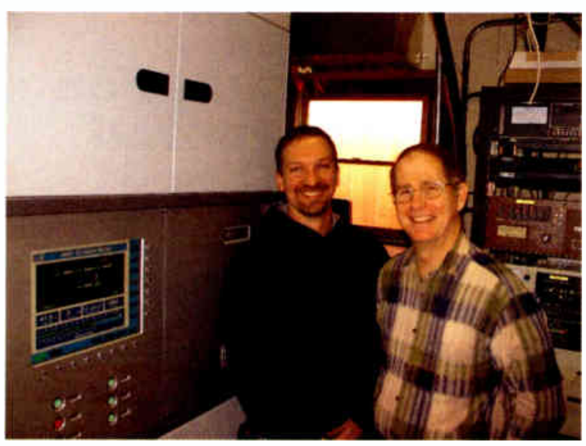
The 4MX 50's "event log" screen quickly showed us that we were getting erratic mute commands from outside the 4MX 50 and it was then an easy job to pull the offending relays out of the antenna system controller to burnish and "DeOxit" the contacts. That stopped the immediate problem from recurring.

Meanwhile, BE quickly changed the software so that the "Fast Mute" is now a normally open circuit (like everyone else uses). Since we received the software revision, the muting problem no longer can happen at all.

The impression I got during this process was that everybody kind of gets treated like family by the BE folks. They appreciate their customers' support and know that word-of-mouth reputation spreads fast when there is bad stuff to tell – so they work hard to prevent any bad stuff happening.

JUDGING PERFORMANCE

Since installing the 4MX 50, our power bill has dropped about 20%, compared to using the MW-50. It would have dropped more than that, but our old transmitter runs on 480 VAC and the BE runs on 240 VAC, so we had to put in a step-down transformer that runs quite hot. I think we would easily get another ten percent drop in power consumption if we had a 240 VAC service from the utility company.



Steve Schmitt and Jerry Westberg are all smiles as the 4MX 50 comes up and sounds good.

We plan to make that change in the fall of this year, when one of the other stations on the site moves away and we can move our transmitter to their 240 Volt service.

As you might imagine, our triplexed antenna system is quite high-Q; our 4MX 50 operates at 1060 and there is a 10 kW station running into our antenna system on 1200 kHz, only 140 kHz away.

The traps in the system put *huge* lumps in the passbands of both stations. We could never run aggressive modulation with the old MW-50, preventing us from having the "presence" on the dial that we needed to compete in the Boston market.

The 4MX 50 has changed all that. When we have good-quality source material coming from the studio, we are now the loudest, most natural sounding AM in town. Boston has several 50 kW AM stations on the dial, and I feel we sound much more solid than they do over much of the metro area.

RELIABLE, COOL OPERATION

The 4MX 50 has been on-the-air all day, every day, since January 18th, 2006. It is hard to gauge MTBF (Mean Time Before Failure) at this early date, but all of the little problems that we have had have been associated with the field-test status of the unit and these problems have already been designed out of production units.

We have sustained no component failures due to passing weather-related electrical disturbances. The transmitter senses the VSWR change when a tower-base ball gap arcs over, momentarily mutes the transmitter (so as to not maintain the arc) and then returns it to air.

The transmitter room is a good 15 degrees cooler now than when the MW-50 was running. In the winter, the ventilation system does not even come on. My off-air calls have dropped to nearly zero and have been almost all related to studio automation problems.

So far, the 4MX 50 has lived up to my expectations – and then some.

Grady Moates, owner of Loud & Clean Broadcast Science, has been doing engineering in the Boston area for almost 30 years. Contact Grady at grady.moates@loudandclean.com

– Techie Stats –

- Smallest 50 kW transmitter footprint available (< 56 cubic feet, < 8 square feet floor space).
- Lightest 50 kW transmitter available (<1100 pounds).
- 88% overall efficiency (mains power input to modulated carrier output).
- Each RF PA has its own switching power supply for best reliability and redundancy, and high quality audio at power levels as low as 250 Watts.
- Unsurpassed modulation accuracy, due to patent-pending "Fourier Modulation(4M)" technique.
- HD Radio or DRM is accomplished directly from the digital encoder datastream through an ethernet port (I & Q method is also available).
- Switching power supplies are power-factor corrected to 99% or better and designed to operate at 300% of the current demand at 145% positive peak modulation.
- RF PAs can be removed while transmitter is on-air.
- High power devices in RF PAs can be replaced with a #2 Phillips screwdriver.
- Diagnostic screens that display various aspects of transmitter operation.
- Diagnostics, status, and control available over IP.

BE's Smaller Transmitters:

It's in the Litz

Why does the 4MX 50 kW require only about one-third the footprint and weight of most other transmitters in its power class? In a word: "Litz."

Broadcast Electronics uses Litz wire coils in its new 4MX 50 kW and 25 kW transmitters – specifically in the output networks and power amplifiers.

WIRE WITHIN WIRE

Litz is a multi-strand construction of 3,400 small-gauge (48 AWG) wires that are precision-twisted and film-insulated. The multi-strands are then coated with extruded Teflon.

Litz Wire

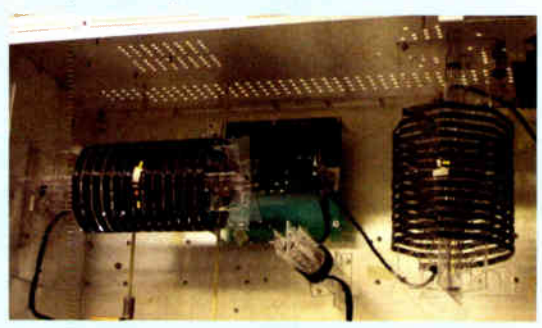
The word Litz is derived from the German word "litzendraht," which means woven wire. Litz cable consists of a number of individually insulated magnet wires twisted or braided into a uniform pattern, so that each strand tends to take all possible positions in the cross-section of the entire conductor.

LITZ COILS

The Litz coil design is different from solid conductance schemes in that it greatly reduces the "skin effect" of current running through the wires, which minimizes power losses and has the added benefit of reducing the physical size of the 4MX 50's output matching network.

Insulated wires are twisted together in a precision pattern to meet the transmitters' high conductance requirements. The strands in the Litz cable carry equal currents because each wire is surrounded by the same amount of flux per unit length, unlike a solid wire which has a high concentration of current that flows to the surface or skin and therefore creates greater power losses – the skin effect.

The result is that the Litz coils used in BE transmitters are small, requiring less space for the same power requirements.



Output coils in a 4MX 50.

Moreover, because Litz coils can easily be formed by wrapping wire strands around Lexan forms, versus forming copper tubing around solid conductors, the Litz coil is lighter than tubing coils.

by Cornelius Gould

Audio Processing for HD Radio

Part 4 – Codecs, Clippers, and Crud

As Corny brings this look at some of the issues in processing audio for digital radio to a conclusion, a look at the effects of clipping digital audio should be useful.

There are some important operational functions in a typical modern day perceptual codec. The point of the previous articles was to give you a better understanding of the delicate balancing act that must happen for these codecs to work in the first place.

Now we will bring actual program audio processing back into the foreground and explain the reasons why it is really hard to use tried and true methods of audio processing for analog broadcasting in a new bit-reduced world.

DEALING WITH AUDIO PEAKS

In an analog broadcast environment, a device known as a peak clipper is typically employed for peak modulation control. Using such a peak clipper is not a good idea for peak level control when you are using a system with a perceptual codec.

With a peak clipper, any momentary program spikes (brief, sharply higher peaks) in the audio wave forms that can cause the transmitter modulation to exceed 100% in FM (or 125% positive, and 99% negative in AM broadcast) are simply "chopped off." This chopping creates distortion, so most well-designed modern audio processors employ distortion management techniques to hide this distortion from our ears.

One of the side effects of using peak limiting clippers is that you inevitably create lots of rich harmonics. These harmonics can cause a broadcast station to exceed their legal spectrum mask (the amount of space a station takes up on the radio band), so special filters are employed to keep stations nice and legal.

On the surface, this seems like it would be OK for coded digital audio use too – but this is not the case.

WHEN PEAK CLIPPING GOES BAD

The audio bandwidth of analog broadcast audio from any of the traditional broadcast services can fit nicely within the confines of a 44.1 kHz digital signal and sound no different than the original analog broadcast signal when played back. But when perceptual coding is added to the digital mix, all kinds of strange things start to happen.

We will assume for the sake of this discussion that the perceptual codec in our examples are using 44.1 kHz as the sample rate. Now, let us go back a little bit and take another look at the issue of harmonics caused by the use of clippers as peak limiters.

While strict filtering can be applied to limit the audio bandwidth to 10 or 15 kHz (well within the capabilities of a 44.1 kHz sample rate), one issue stays behind that causes poor performance from the perceptual coder. That is the radically transformed harmonic makeup of audio components due to clipping.

This effect can be easily heard. In fact, it is the signature sound we have come to expect as the "sound of radio." For the past 30 years or so, we have become accustomed to the "less than detailed" sound of radio's high end. In this "radio sound," recordings of cymbals sound like repetitive "sippy sounds" and the natural "crack" sound in a snare drum recording is transformed to something that sounds more like a steam locomotive chugging up a hill – chugging at the tempo of the song.

The reason for these odd characteristics is mainly due to the way loudness has been built up during the "Modulation Wars" over the past 25 years or so.

LOUDNESS

In recent years, loudness has been largely determined by the amount of clipping applied to the processed audio signal. The more clipping, the louder you sound on the dial. Of course, along with this loudness comes more distortion.

We can demonstrate clipping quite easily. When audio exceeds a pre-determined level it is simply "chopped off," as if by a sharp knife, so as to maintain absolute level control. **Figure 1** shows a tone with no clipping; in **Figure 2** we see the very same tone, but with clipping implemented to maintain an absolute signal level

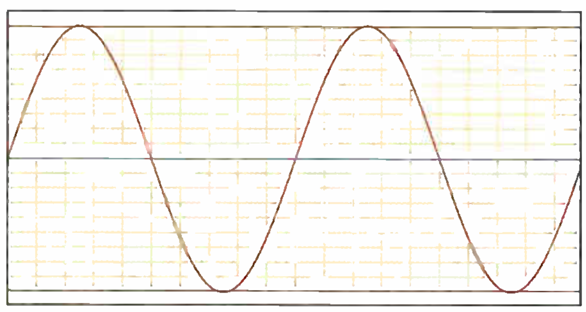


Figure 1 – A typical sine wave.

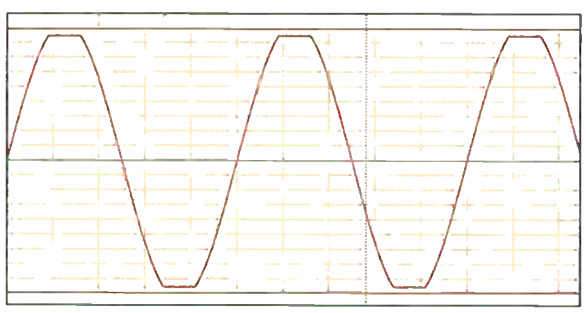


Figure 2 – Notice the flat top and bottom of the sine wave, when the audio is clipped.

While the out-of-band distortion components can be removed by filtering the clipped audio and most of the harmonic content we think of as the sound of distortion is hidden by various special processing algorithms within the processor, there is still a lot of actual distortion left behind.

It is this remaining distortion that gives us the perceived *illusion* of loudness.

HARMONIC DISTORTION

When you clip a signal, you cannot just toss those sliced-off tops into the alley behind the station.

What actually happens is that you end up creating a lot of harmonic content that was not originally part of the recording. If we change the view and timing of our display, we can see that clipping a single tone will create quite a lot of additional harmonics.

Figure 3 is a 6 kHz tone. If you widened the display, it could and would look just like **Figure 1**. Now, in **Figure 4**, see what happens when the wave is clipped.

While harmonics outside the target bandwidth of broadcast audio are removed by filters in the audio processor, there is still an awful lot of "garbage" left within the desired audio. This added content is referred to as spectral spreading.

When clipping is applied to complex audio, what was once a simple set of pure tones making up a sound becomes a dizzying array of overtones spreading out over a large chunk of audio spectrum.

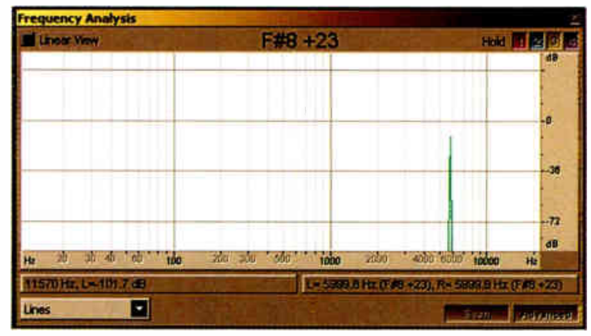


Figure 3 – A 6 kHz tone without any clipping.

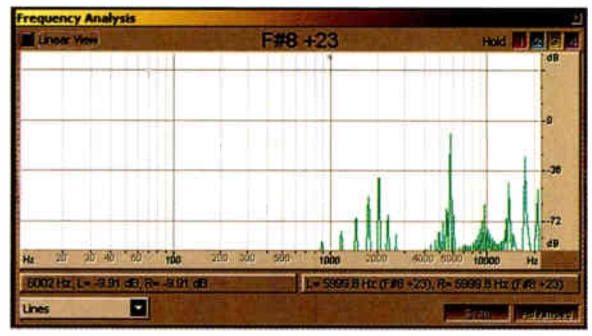


Figure 4 – The 6 kHz tone now has lots of company.

WHY CLIPPING IS A PROBLEM FOR CODECS

The reason perceptual codecs have such a hard time handling clipped material is because it becomes very difficult to find audio elements to remove without seriously altering the audio for the worse, yet the codec still must remove a large amount of data to meet the target bit rate.

What this means is instead of judiciously removing audio most of us would not perceive, the perceptual codec now has to discard large amounts of data without prejudice – and that does not leave a "pretty" sound picture. It almost literally has to throw the baby out with the bath water!

Another thorny issue is the AM and FM pre-emphasis curve. Pre-emphasis boosts the extreme upper end of the audio spectrum. This is necessary for proper operation on the analog broadcast service. This pre-emphasis is employed before the clippers, so the spectral spreading issue is much more pronounced at higher audio frequencies.

THE BALANCING ACT

As we learned, perceptual coding algorithms are a delicate balancing act to achieve audio that sounds normal to most people while possibly removing large amounts (if not most) of the original digital audio content. For HD Radio, we are indeed removing most of the original data and leaving behind a reconstructed facsimile of the original digital audio content.

This reconstructed audio is built up of tiny bits of data and a lot of "smoothing over" at the decoder end. The more channels we force out of the system, the more data we are asking the perceptual codec system to remove from the audio. This causes the handling of audio by the station processing to become increasingly more and more critical.

Because of this, there is little (if any) wiggle-room in terms of what is the most efficient use of what few bits are available to reproduce what sounds like full range digital audio.

A PROPER PLACE FOR CLIPPING

Not all clipping is bad. If we were to clip the low frequency area of the audio spectrum (bass), most of its harmonic content stays in the area that is easy for a codec to reproduce.

(Continued on Page 14)

Processing Guide

by Cornelius Gould

Continued from Page 12

A light amount of filtering can be added to the output of the low frequency clipper to remove harmonics that give the raspy or "blown woofer" sound that is unpleasant to the ear. This filtering also makes things even easier for the codec. With today's recordings, a bass clipper has been a useful tool used by processing manufacturers to preserve the sound of today's bass heavy recordings while maintaining absolute control over bass levels.

It is for these reasons that the best processing designs aimed at digital broadcasting are able to keep these bass clippers as part of their signal topology.

DIGITAL LIMITING

Since we cannot use clippers for overall digital peak limiting, audio processors designated for digital broadcast are designed these days using a device called a look-ahead limiter.

Look-ahead limiters operate by watching audio levels going into the limiter and, with the clever use of a delay line, predict the peaks before they make it to the output.

When a peak is about to occur, the look-ahead limiter almost instantaneously lowers audio levels to accommodate the peak, then returning the audio to the previous level just about as quickly.

ADVANCES IN THE PROCESSING ARTFORM

For the better part of ten years now, anyone involved with audio processing and digital broadcasting (including myself) has dreamed of a solution where the audio processor and the perceptual codec are merged into one to provide optimum codec performance.

This concept is similar to the one that led Bob Orban to design the Optimod 8000 back in the early 70's, where the FM stereo generator is integrated with the overall audio processing design, significantly reducing overshoot. The Optimod provided a quantum leap in loudness and FM stereo performance when it was introduced to the market place.

While this same kind of tight integration of the audio processor and codec has not happened yet, many of us in this area have not been held back. Actually, now that a digital broadcast chain can be designed with pure digital connections in and out of everything, we are able to get as close as we will probably ever get to the integrated processor/perceptual coder concept.

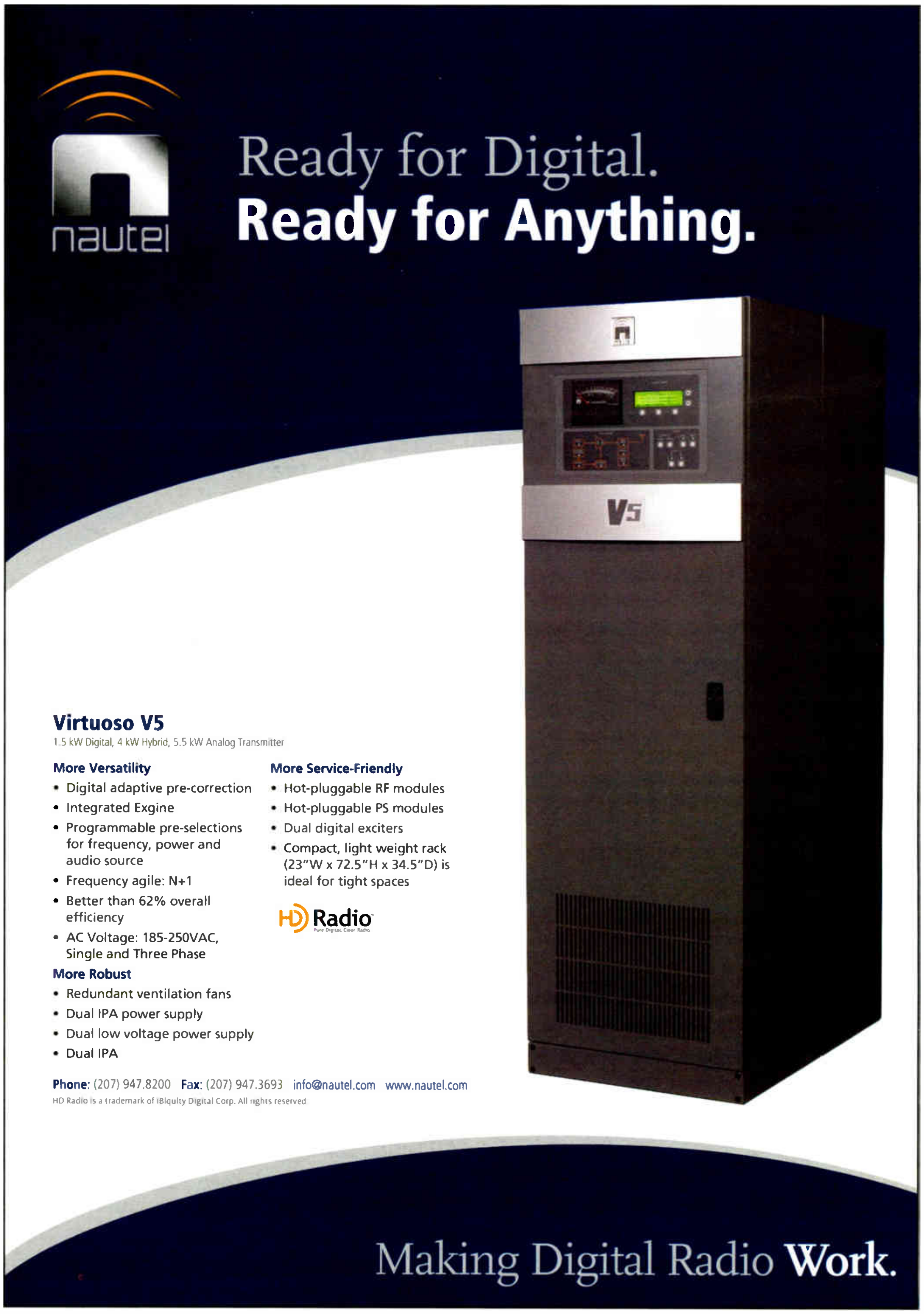
NEW IDEAS ARE COMING

The latest research by all in this particular area of audio processing involves some form of "codec conditioning."

Imagine if you will, an audio processing technology that can assist the codec in choosing the best material to remove to make its operation more efficient. Codec conditioning can be something as simple as user defined lowpass filters to help remove troublesome audio components in the program audio to much more complicated processes that can do so much more.

In the past 15 years or so since the first perceptual codecs went into widespread use in broadcasting, we have not only seen coding technology evolve in ways we can only dream of in terms of quality vs. data size, but we are also all witnesses to the next chapter of audio processing technology meant to deal with mixing audio processing and coded audio. And it is all happening now right in front of our eyes!

The Senior Staff Engineer at CBS in Cleveland, Cornelius Gould has been playing with audio processing for years. We do not expect that to stop any time soon. Questions and comments should be sent to him at cg@cgould.com



We're all talk.

And all action, too.

All talk and no action? That certainly doesn't describe any radio station we've ever seen. With guest interviews, news and traffic feeds, live reports and listener calls to juggle, a talk studio is one of the most active places on the planet. Seconds count, and there's no room for mistakes.

That's why we created Status Symbols® for the Telos TWOx12 Talkshow System. Instead of flashing lights to decipher, there's easy-to-understand picture icons that give talk pros the information they need with just a glance. What caller's next? Who's screened, and who's just holding? With Status Symbols, you'll know instantly. And only Telos has them.

TWOx12 has lots more benefits. Like Digital Dynamic EQ, for uniform caller audio despite less-than-perfect lines. Twin DSP-powered hybrids for quick, no-hassle conferencing. A unique Dual Studio Mode that lets you use your 12-line phone system like dual six-line systems for extra flexibility. And TWOx12 is the world's only talk show system that can work with either POTS or ISDN lines to deliver exceptional caller clarity. Impressive? You'd expect no less from the company that *invented* the digital broadcast hybrid.

Is TWOx12 the perfect union of word and deed? Thousands of broadcasters worldwide think so. Why not see for yourself?

Telos
AUDIO | NETWORKS

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

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

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

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

Digital Guide

by Steve Davis, Clear Channel Radio

The True (Actual) Digital Power in the AM Hybrid IBOC System

A recurring topic on the BROADCAST [BC] Internet mailing list (you can subscribe to or read the list at: www.radiolists.net) is trying to quantify the effect of AM IBOC transmissions on the occupants of adjacent channels. How much power is really being transmitted? Steve Davis went from discussing opinions to making actual measurements. He tells us what he learned.

With all the discussion regarding the true RMS power in the digital sidebands for the iBiquity AM IBOC system, I decided I needed to conduct some research and develop some factual data.

It took a while to accomplish this because I needed to consult with some experts and run some tests to verify our findings. While I feel this is basically an academic exercise, albeit a valuable one, the AM IBOC system will work, or not, regardless of our calculations or discoveries here.

DESIGN SPECIFICATIONS

The AM IBOC system currently in use was initially developed by broadcast engineers, scientists and PE's with CBS, Westinghouse, Gannett and others, with the goal being to permit digital transmission within the AM band while minimizing interference to existing analog operations.

To accomplish this, each of the digital carriers within the AM IBOC signal is orthogonal to (90 degrees out of phase with) its adjacent carrier, and the upper and lower sidebands are complex conjugates of one another.

This was implemented to cause the energy in the digital carriers to be nulled out in a typical AM receiver or envelope detector. The theory is similar to the way an out-of-phase power vector is used to null out (or reduce) the signal in an AM pattern null in AM directional antenna theory.

TOTAL TRUE RMS DIGITAL POWER

Calculating the "total true RMS digital power" in the AM sidebands utilizing the iBiquity IBOC digital transmission scheme is more complex than it first appears.

The reason for this is the presence of those multiple OFDM carriers within the measured passband. Typically, we deal with a single carrier or compare a single signal to another single signal and express that as a ratio in dB. A spectrum analyzer will conveniently display the relationship between signals in dB, making this a fairly simple matter.

However for the purposes of calculating the total true RMS digital power, given the multiple individual OFDM carriers involved, it is necessary to calculate the aggregate power of the multiple carriers, integrated across their full passband. This is *not* the power you will observe directly on a spectrum analyzer display when setting up the system or measure directly in the field with a field intensity meter (which is a voltage device not a power meter).

IBIQUITY SPECIFICATIONS

The NRSC and iBiquity standards set the maximum AM digital sideband power as 27.8 dB below unmodulated carrier (dBc). This -27.8 dBc is the figure we have been concerned with in the "real world" when deploying these systems, since this is the specification we need to meet. And we always certify that with a spectrum analyzer each time we launch a system.

Typically, we use a spectrum analyzer with 300 Hz resolution bandwidth to adjust our AM HD transmitters to ensure the digital sidebands meet the iBiquity specifications. We have purchased quite a few spectrum analyzers for the purpose of setting up AM and FM digital systems. They are also helpful, of course, for verifying occupied bandwidth and looking at spurious emissions.

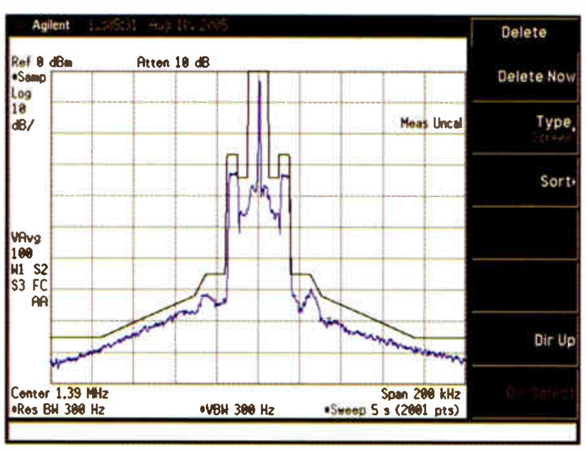
But in the case of "total true digital RMS power" these numbers, and the spectrum analyzer display, do not tell the whole story. To compensate for the difference in the 300 Hz measurement bandwidth used for spectrum analysis versus the total bandwidth occupied by all the digital carriers in the sidebands, a "Bandwidth Correction Factor" (BWC) must be employed to integrate the power across the band of interest.

BANDWIDTH CORRECTION FACTOR

The Bandwidth Correction Factor can be expressed as 10 log(4360.5 Hz / 300 Hz), or +11.6 dB. This represents integration of the power of the static, individual OFDM digital carriers across 4360.5 Hz.

Therefore, adding the BWC of 11.6 dB to the measured (required) digital sideband signal level of -27.8 dBc (what we read on our spectrum analyzers) gives us a total sideband power (for the upper or lower digital sidebands) of -16.2 dBc. At this level, the interfering true RMS power/energy of the IBOC digital sideband to a first adjacent station for a 50 kW AM station is 1200 watts (-16.2 dB below the 50 kW unmodulated carrier).

Self interference to the host analog station is 3 dB worse, since *both* sidebands are present within the host envelope. The total RMS energy in the two digital sidebands, combined, is 13.2 dB below unmodulated carrier within the host channel envelope, or 2400 watts for the 50 kW AM example.



A compliant AM IBOC spectrum plot.

IS IBIQUITY WRONG?

Nevertheless, iBiquity (and the NRSC mask) specifies each sideband at 27.8 dB below carrier. Accounting for both digital sidebands, the digital signal is still only specified at -24.8 dBc. What is wrong here? Are we all exceeding legal power?

No. -27.8 dBc is the correct level observed on a spectrum analyzer for each of the primary digital sidebands when setting up the system. It is not the total true RMS power integrated across all the digital carriers, which is what is being discussed here.

It is also worthwhile to note that when we speak of a 50 kW analog station, that too is not the power integrated across the full audio passband when modulated with a complex waveform. Furthermore, with 100% modulation the analog power will actually be 75 kW (150% of unmodulated power), while digital power never changes.

MEASURED RESULTS

OK, so far this is all a lot of theory. To confirm these numbers, we collaborated with an equipment vendor to conduct a test.

Using a waveform independent, true-RMS power meter, the total power in a properly adjusted IBOC AM transmitter was measured with an unmodulated carrier and all digital carriers turned off – *and again* with all digital carriers turned on.

The tests confirmed the math above: RMS power on either sideband was 16.2 dB below the unmodulated carrier and RMS power within the full band was 13.2 dB below the unmodulated carrier. This was also repeated using a calorimeter, which is truly bandwidth agnostic, and the same results were observed.

Therefore, I am fairly confidant that -13.2 dBc for on-band digital to analog and -16.2 dBc for first adjacent digital to analog are the right numbers for true RMS power of the digital carriers in a properly adjusted AM IBOC system. Just remember that these refer to an unmodulated carrier and for the *hybrid* mode – that is, analog and digital co-existing on channel.

LIVING ON THE RADIO DIAL

Will analog and digital co-exist in the real world? Sorry, I do not have the full answer as yet. None of this guarantees that AM IBOC signals will not create interference to other AM analog stations in the field – *nor does it guarantee that they will.*

While the system authorized by the FCC today has been extensively tested and verified by the system designers and the NRSC, I will be the first to admit that those were for the most part (except for some field tests) done under laboratory conditions.

In the long run, as they say, "the proof of the pudding is in the eating." Over 750 AM and FM stations have been converted to digital as of today. For reasons such as array and amplifier nonlinearities, pattern bandwidth, poorly adjusted or maintained arrays or phasing/branching networks, and impedance asymmetry, it is certain that there *will* be cases of interference. This will be something we as engineers will be asked to correct. The transmission system designers and receiver manufacturers will also continue to work to improve the system.

As the owner of more AM radio stations, in markets large and small, than any other broadcaster, you can rest assured that Clear Channel is very concerned about the potential for interference in the AM band. Whether our stations are the cause or the victims of interference, we will work diligently to correct it. We have more to lose than most.

Clear Channel's Senior Vice-President of Engineering Steve Davis has been active in broadcast engineering for over 25 years. He can be reached at stevedavis@clearchannel.com

"Some people don't like change. Change doesn't much care."

"I guess being the very first station to use Ethernet for audio routing has made WEGL a little famous! Someone's always on the phone: 'Tell me about your Axia system. What's the real story?'

"The real story is that two years ago, when our our old analog consoles began to fall apart, we put in an Axia IP-Audio network and SmartSurface. And I've never had a single reason to regret that decision.

"Sure, I was skeptical at first. But audio-over-Ethernet technology is compelling! Other companies just use CAT-5 to carry audio using proprietary protocols. Axia uses standard Ethernet to build a true network with uncompressed digital streams *plus* machine logic and program-associated data. No one else does that! I was a little concerned about dropouts and QoS problems, so we went to the Axia factory and assembled a network ourselves. It was easy to do, and it just *worked*. We were sold.

"The jocks took to the new board like fish to water. Show Profiles are their favorite part, since they can all have custom board setups. Some like their headphone levels blasting, some don't. Some like the mic on the left side, others on the right. I've got one guy who brings in his vinyl records every week for an oldies show; he's the only one who uses the turntables but when he loads his profile, they're ready to go.

"There were a few little bugs, but we had the very first surface! Axia support gave us new software right away and our problems were solved. Two years later, I'm more impressed than ever. I recommend Axia one-hundred percent.

"Since the first studio was installed, we've added a new production and interview studio, and we plan on building three more studios. It'll be all Axia — all the way to the transmitter."

— Marc Johnson, Chief Engineer, WEGL-FM
Auburn University, Auburn, Alabama

AXIA
A TELOS COMPANY

www.AxiaAudio.com

Maintenance Guide

by Don Mussell

Using Infrared Inspections to Locate and Diagnose Problems

Sometimes an engineer can suspect where a problem is located, but cannot see anything to act upon – a least until the smoke starts. In cases like this, as Don Mussell shows, thermal imagery can save a lot of time in zeroing in on troublesome components and save a lot of time and grief.

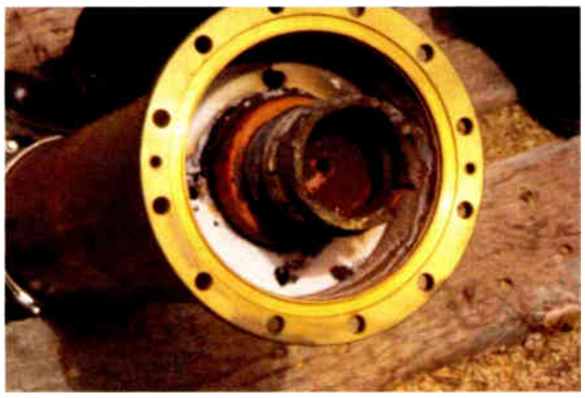
A few years ago, I got a frantic call on a weekend morning from one of my clients in Los Angeles. It appeared that the main antenna had stopped working – either shorted or open – and the main transmitter would not come up to normal power, due to the high VSWR.

The station was now on the backup antenna, but the problem looked pretty serious, especially since the entire facility was less than a year old. As you can well imagine, there was quite a bit of concern and curiosity about the cause of the failure.

INITIAL INSPECTION

This station's transmitter is located at Mt. Wilson, 5,700 feet above sea level. It normally runs very high power – 55,000 watts at the input to the four-bay main antenna. Despite the lack of visible physical evidence as viewed from the ground, we knew something had to have gone very wrong.

The next day, we got our riggers up on the tower to take a look. They also did not see anything that looked wrong on the outside of the system. But on a hunch, they opened up the six-inch flange adaptor on the input side of the antenna; black soot and chunks of carbonized copper were evident once the flange was cracked open.



The antenna transformer failure was apparent.

Deciding it was not practical to try to repair the five-foot-long matching section where the failure had occurred on the tower, the riggers brought it down to the ground.

PROBLEM SOLVED – OR WAS IT?

The damaged section was shipped to the manufacturer and we had a new section shipped back to us in a couple of days. After installation, the antenna system worked again just like new. But the cause of the failure was still unknown and the manufacturer was unsure about what happened as well.

And that, understandably, made me very nervous.

I decided that if the matching section outer jacket was running above normal ambient temperature, then perhaps the inner conductor might be running at a temperature high enough to cause another failure. But how do you measure the temperature of a copper line section 160 feet up in the air?

At full power, the high RFR levels at the antenna are unsafe for humans. The usual laser-guided infrared temperature gauges failed to accurately measure the temperature due to high RF levels swamping the readings, as well as the distance to the probe taking the readings.

ARRANGING FOR A "DIFFERENT" INSPECTION

Then I remembered that thermal imaging was very useful in electrical work when trying to find defective circuit breakers and bad connections. Perhaps it would work for an antenna up on a tower.

I called a local firm in Southern California and asked about doing an inspection of, not only the antenna system, but all of the electrical systems recently installed at the site. They said it would be no problem, just that we would have to check the tower and antenna after dark when the steel and attachments all cooled to the ambient night temperatures up there.

Everything at the site was less than a year old at the time and I assumed that nothing in the new electrical installation would be a problem. However, since I would already have the company up on the mountain, they might as well look at everything and give us a full report.

A few weeks later, the company representative arrived at the site just after dark. A nice clear summer evening with temperatures in the low 50's – it was the perfect environment for the outside readings.

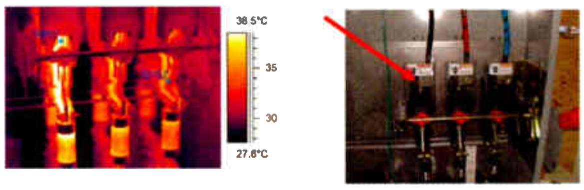
COVERING THE WHOLE SYSTEM

While we waited for the steel on the tower to cool, we inspected the inside electrical systems and the RF plumbing. It was a good thing we did that.

Mike Bivens of Infrared Services, Inc. views the breaker box with an infrared camera.

While I knew that the RF gear ran warm (my hands on the copper feedlines worked for this), I could not as easily check the electrical switchgear.

To say the least, I was very surprised by the inspection of the new breaker boxes and electrical distribution equipment. A brand new three-phase switch was running much hotter than others in the same box and clearly was defective.



The left breaker switch is clearly running hotter – 10.5 degrees C hotter.

This was a fire hazard and a failure just waiting to happen. Worse than that, it could have put the entire station off the air for an extended period of time.

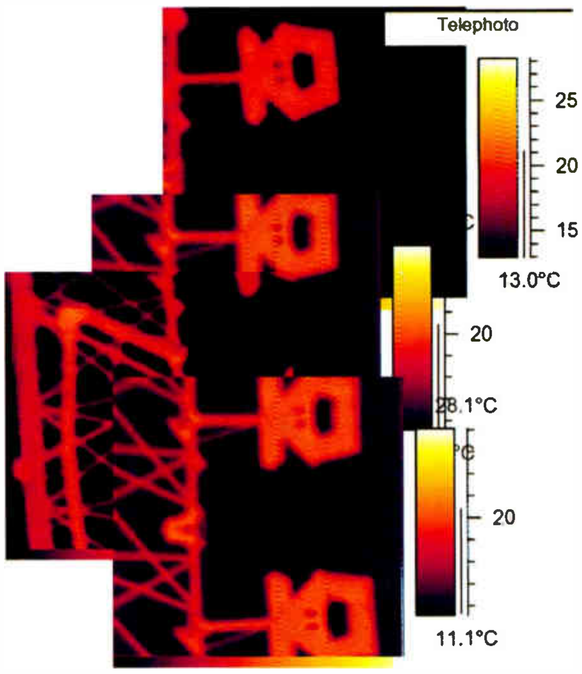
Since my concerns were more for the antenna system, I had not suspected any issues related to the power feed before this inspection. I had assumed that the new electrical switch gear was nothing to be concerned about. However, I was very wrong.

ONWARD TO THE ANTENNA

By this time, the outside was chilly and the antenna inspection was ready to go. The tech brought out his two-degree lens and focused in on the antenna and transmission line, 160 feet up in the air.

A narrow angle zoom lens allows a thermal view of the antenna.

To our relief, the temperature rise was only a few degrees on the antenna and matching section, which is considered within specification at the normal operating power for this facility.



The thermal imagery shows the antenna is working properly with no hot spots.

Even better, now we have pictures that show where the warm spots are, so we have a baseline for normal operation now.

This experience has led me to conclude that the station had good reason to hire a thermal image company every couple of years for a follow-up inspection. In fact, any station running significant power would benefit from this periodic maintenance.

HIGHER COMFORT LEVEL

It has been two years since that antenna failure and with the infrared inspection, I feel a bit more comfortable knowing that it is not overheating and ready to fail again.

In reviewing all the things learned during the process, we are now thinking that the cause of the burned-up section might have been due to some parts having become loose during shipping or possibly something to do with the bullets in the six-inch input elbow, including possible contamination.

In any event, it is good to see there are no longer any "hot spots" on the antenna or matching section. It does run warm but, at this point, that appears to be a normal condition with 55,000 watts applied.

Following the recommendations of the inspector, we replaced the defective breakers, lubricated the knife switches and generally tightened up everything in the electrical service. We also did a second sweep through the building to make sure that all was well.

While not everyone has to worry about running a high-power transmitter a mile above sea level, electrical and transmitter failures can be avoided in every transmitter facility by periodic inspections using both infrared thermal imaging services and, of course, an infrared-model thermometer measurement device.

After all, it is cheap insurance against that early morning phone call.

Don Mussell has been doing broadcast engineering since 1968. Based in Bonny Doon, CA, Don can be reached at dmsml@well.com or via his web site: www.well.com/user.dmsml

Radio.edu

A Non-Comm View

by Jeff Johnson

Radio 101: Helping Newbies Find Their Place in the Station

As the 2005-2006 school year comes to its end, Faculty Advisors are taking measure of this year's successes and making plans for next term. John Hingsbergen of WMUB, Miami (Ohio) University and George Zahn of WNKU, Northern Kentucky University spoke with Jeff Johnson regarding the material they plan to share with broadcasting students in the fall.

For a student, walking into the campus radio station for the first time can be both an exciting and intimidating experience.

He or she is likely to be enrolled in the Communication Arts curriculum and in addition to the unfamiliar, busy environment, the student quickly realizes they quite possibly will not only be *heard* by thousands but also *graded* on their performance.

OVERCOMING FEAR OF THE UNKNOWN

New students may very well have some excited anticipation of becoming part of the "Media." But at the same time, they may also be dreading the split-second timing demands of live on-air programming and likely have heard tales of draconian fines that can ensue from a language slip-up or logging error.

Then, too, as in any industry there are all those obscure and confusing acronyms and terminology. This is where a good Faculty Advisor really makes a difference in whether a student settles in to the program or they have a rocky start that "throws" them.

John Hingsbergen of WMUB, Miami University, Oxford, Ohio and George Zahn of WNKU, Northern Kentucky University, Highland Heights, KY try to make that difference. They offer new students solace, direction, and most importantly, a glossary, hints, tips, information and a board operator's checklist to build skills and confidence.

Hingsbergen advises, "A part of 'first things' a student should know is a glossary of terms like, 'board, pot, channel, modulation, carrier, and cue.'" In a sidebar is a convenient, basic glossary of radio terminology, which can be copied and supplied to new students. (It also is appropriate for interns at commercial stations, too.)

BOARD OPERATOR CHECKLIST

A "newbie" is likely to start first as a board operator. This is an important job and introduces the beginner to the broad spectrum of functions at the station. He or she is directly responsible for the proper operation of the station, although they may or may not be heard on-air.

Here is a list Hingsbergen uses to identify the tasks a board operator is expected to handle for on-air operations:

- Operate an audio console, CD players, minidisc players, turntables, and various types of tape machines and computer systems for on-air operation of the station. Programs may be live from station facilities, direct from satellite downlink, or on computer, CD, or tape.
- Understand relevant FCC Rules and be responsible for station operation during board shifts.
- Read PSA's, weather forecasts and announcements.
- Work with program producers in studio or remote broadcasts.
- Record program material from the satellite downlinks.
- Monitor news and weather information from various sources.
- Handle phone inquires from the listening public.

"I make sure they learn the elements they will find on all broadcast consoles: speaker and headphone monitoring, meters, faders (or pots), on/off switching for each channel, and delegation switches for outputs such as program, audition, aux1, aux2," says Hingsbergen.

"One thing I always tell new operators is that, once they learn one board, they should be able to go to any other on-air or production console and figure it out since they all have the same basic functions.

"Another thing I like to say in training is that running a board is like driving a car. At first, you have to think about all these switches, faders and meters. Eventually it will become second-nature and you won't have to think about it, you can operate largely by reflex."

KEEPING IT LEGAL

Hingsbergen continues, "They need to know the location of the transmitter remote control and metering in order to legally 'operate' the radio station when they are on duty.

"I remind them that they could be subject to a visit or call from an FCC inspector who will want to know where these items are and if they have been instructed in their proper operation. Understanding and logging EAS and tower light operations are other essential matters," he says.

George Zahn also has listed many serious and not so serious hints and tips garnered during his many years of teaching and working with young people new to radio.

- Take pride in your work, and do consistently good work. When that promotion goes to someone else or the raise does not come through this time around, the things that should be your constants – and the things you can always control – are your current and past and future work, your work ethic, and your professionalism. Do not surrender these. They will follow you everywhere and be your compass.
- When doing any project, stay a step ahead. Think about what needs to be done next and be prepared to do it.
- No matter what, your spouse/significant other will likely not care what model of microphone you just saw on that music video.
- If you are in broadcasting, you will likely *not* get rich. If you are in it for the money, and you have no aversion to ulcers, try sales.
- Always keep your eyes and ears open to learn as much as you can in an internship or when visiting broadcast facilities. Make a positive, professional impression on internships.
- Do not let anyone stunt your enthusiasm or steal your passion.
- Think like a producer – how can you make a project unique and make it better?
- No matter what, your spouse/significant other likely could not care less about the broadcast towers you just passed on your vacation drive.
- It is OK to get excited about what you do!
- Meet deadlines. Missing them will undermine the greatest of reputations.
- If you love broadcasting volunteer at a local NCE or public access studio.
- No matter what, your spouse/significant other will look at you like you are a fool when you point out terrible PA phasing from a podium with incorrectly-placed microphones.
- Listen to everything on the radio – music, announcers, spots – any of these items may have an effect on what you produce later in your career. Learn effective habits of successful announcers and producers, but do not directly imitate them.
- Communicate clearly in speech and writing, and follow through on what you commit to do.
- No matter what, it is doubtful your child will admit to being wowed by your intrinsic knowledge of frequency and amplitude, even if you are cool enough to make a presentation and demo to their class.
- Realize that broadcasting is not a 9-5, or a Monday through Friday, job. "What's a weekend, anyway?"
- Realize that broadcasting does not take holidays off.
- When you are young, management sees you as young, no matter your background or experience. Keep working at it and try to never lose confidence in your abilities. Not every manager immediately knows you as well as you know yourself. Good managers will discover your abilities in good time if you display them.
- No matter how experienced you become, you will always be learning.
- Be a gracious winner; learn from losing; and work to foster team-building.
- No matter what, very few people will ever truly understand the path you have chosen. Be patient with them.
- If you were editing with the pause button on a cassette deck, dismantling old radio gear, or collecting CDs before the age of 10, you may have the broadcasting bug and I am happy to report that there is no known cure.

Lastly, here is a tip that will ensure success in radio: *never* forget and leave the station banner behind at a remote!

Jeff Johnson is a Cincinnati based broadcast engineer and can be reached via his website: www.rfproof.com

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An Elementary Glossary of Radio Terminology

AUTOMATION – computer based automatic operation of the station.

BOARD OPERATOR or **BOARD OP** or **ENGINEER** – the person operating the station at the *CONTROL BOARD*.

BUMPS – very short music bits or sound effects inserted to time a station.

BACKTIMING – adding times of segments so the program will end at exactly the pre-determined time, making a smooth transition to the next program.

CARRIER and **MODULATION** – the radio frequency output of the transmitter and antenna is the *CARRIER* and the audio signal of the station is the *MODULATION*.

CHANNELS – inputs and outputs of a console. By mixing several channels, a program is sent to the air or to the recording device. Commonly encountered channels include:

- The **Program** channel is the main output to the transmitter.
- The **Audition** or **Aux** channels feed the signal to other outputs such as a recorder or a web stream.
- The **Cue** channel allows a particular *FADER* to be heard individually without putting it on the air.
- The **Monitor** channel is used to listen to the program being sent to the transmitter.
- The **Mix-Minus** or **Mix** – channel is the most difficult to understand. It is used when sending audio back to a telephone caller. The caller does not want to hear him or herself, but does want to hear everything else. It is the total mix, but *minus* the caller.

CHIEF OPERATOR – the Chief Operator is required to be named by management and is responsible for legal operation of the station including weekly review and signing of the station logs.

COLD ENDING – when the music stops abruptly.

CONTROL BOARD or **BOARD** – This is the mixer with the controls required to turn audio sources on and off, set their volume, and send them out to the transmitter or other destinations.

CUTS – program segments such as *SPOTS, MUSIC* or *PROMOS*.

DEAD AIR – when the station is not transmitting audio.

EAS – Emergency Alert System – the government mandated system to alert listeners of dangerous conditions.

FCC – Federal Communications Commission – the government body that regulates a radio station.

FINES or **FORFEITURES** – the FCC may levy fines for improper language and indecency resulting from the airing of commonly recognized profanities and other language such as slander.

(Continued on Page 22)

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	2.5 kW	1984	Continental 814R
	3.5 kW	1986	Harris HT 3.5
	5 kW	1982	Harris FM 5K
	6 kW	1995	Henry 6000D
	7+kW	2005	Harris Z16 HD
	10 kW	1988	BE FM 10A
	10 kW	1990	Harris HT 10
	20 kW	1985	Harris FM20K
	25 kW	1980	CSI T-25-FA *(amplifier only)*
	25 kW	1982	Harris FM25K
	30 kW	1986	BE FM30A
	50 kW	1982	Harris Combiner *(w/auto exciter-transmitter switcher)*

Miscellaneous Equipment

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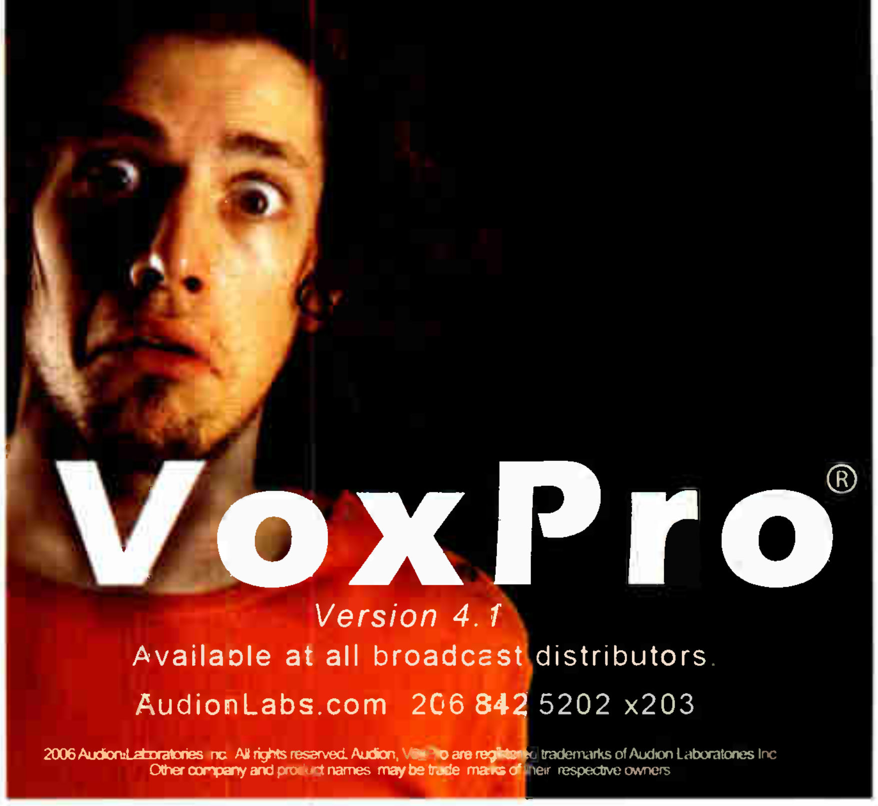

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Radio.edu

by Jeff Johnson

Continued from Page 20

INPUTS – the sources of audio coming into the console:

- **Cartridge** or **Cart** – a continuous loop tape cartridge similar to an 8–track tape.
- **Cassette** or **Cass** – the audio cassette recorder.
- **CD** – Compact Disk.
- **Comrex** – A brand name of high quality remote telephone connection equipment.
- **DAT** – Digital Audio Tape – similar to a small cassette.
- **Hybrid** – a telephone interface device.
- **ISDN** – a high quality telephone line often used to connect from a remote source.
- **MD** – MiniDisc – looks similar to a small computer floppy.
- **Microphone** or **MIC** – the thing you talk into!
- **RPU** or **Marti** – Remote Pickup Unit – a radio technology used to send program audio from a remote location. (Marti is another brand name.)
- **Reel to Reel** or R/R – a tape recorder.
- **Satellite** or **SAT** – network audio coming from a satellite.
- **Telephone** or **Telco** or **Phone** – audio from a dial up phone line.
- **Turntable** or **TT** – a record player still in use at some stations for music not on CD.

INTRO and **OUTRO** – Beginning and ending characteristics or phrases of a song, advertisement, or other audio cut. Example: "This is WNKU news."

LEGAL ID – the station's city of license and call letters in that order. They must be broadcast at the top of each hour or at the nearest natural break in programming.

LEVEL – shown on a Volume Unit (VU) meter. It may be a meter with a pointer or flashing LED's. Level is measured in dB's (deciBELS), which is a unit of relative loudness. The VU meter should never exceed the desired maximum of "0" by more than 2 or 3 dB's.

LICENSE – required by the FCC to operate a radio station. No personnel are required to hold a license.

LINERS – short station promotional sound bytes.

LIVE ASSIST – a person operating computer automation in manual mode.

NCE – Non-Commercial Educational – A type of license issued generally, but not necessarily, to Public Radio stations and generally, but not necessarily, at frequencies of 91.9 MHz or below.

OFF-AIR or **AIR SIGNAL** – the station's signal as received and monitored after it has been transmitted.

OFF AIR – When the transmitter is not operating.

PAN – sending a signal more to the right stereo channel or the left stereo channel.

POSITIONING STATEMENTS – station announcements promoting the character of the station. Sometimes called *Branding*.

POST or **HITTING THE POST** – talking up to a specific moment in the future. Example: introducing a song over a musical intro until the exact moment the vocal starts.

POT or **FADER** – The POTentiometer or volume control that sets the desired strength or *LEVEL* of each input source. It is one of the most *important* controls and yet it is too often set too low or too high. Keep in mind that setting the level too high does not make the station louder, it just introduces distortion.

POTS – Plain Old Telephone Service

PROFANITY DELAY – a device delaying broadcast of the signal for a few seconds to allow the operator to press a *DUMP* button immediately after a profanity or other undesired words have been spoken and before they go on the air.

PSA – a Public Service Announcement or an unpaid advertisement for a charity or civic event.

PUBLIC FILE – a file available to the general public containing specific information about the station and is required by the FCC.

REMOTE or **NEMO** – a source from outside of the studio.

REMOTE CONTROL – when the transmitter is not located at the studio and the station is in "attended" mode, the operator must be able to turn the transmitter off with the remote control if instructed to do so by the FCC. While not required by the FCC, logging of transmitter parameters will require familiarity with the remote control

SEND – a signal going out to a caller.

SPOT, SPOT BREAK or **BREAK SET** – an advertisement or a series of advertisements, promos, weather, traffic reports, liners, news, etc.

STANDBY – spoken by the operator when the microphone is about to be opened and put on the air. It means "SHUT UP NOW!"

STATION LOG or **LOG** – the legally required document recording station operation. Only two items are required to be logged by the FCC: EAS activity and tower light outages. Transmitter readings are not required, but are desirable to document legal operation of the station according to the terms of the license.

Programming information is not required nor are operators on duty required to be logged. However, station management does need to know who is operating the station during each time period.

TALKBACK – the channel for the operator to talk back to a performer without being heard on the air.

TRAFFIC and **TRAFFIC LOG** – the list of station operations second-by-second throughout the day. Produced by the *Traffic Director*.

UNDERWRITING ANNOUNCEMENT – a form of advertising used on NCE stations. It does not include pricing, comparative language, or incentives. – Radio Guide –

by Kent Winrich

Going Really Remote, as in International

It was in the Monday morning email – a request from the Program Director for a meeting. Immediately one's thoughts turn to the last debate over the audio processing.

If the PD is on the warpath again over the audio processing, you know the result well enough: another day of running back across town from the transmitter in downtown traffic, through that construction zone that makes gridlock seem like fun. Been there, done that once or twice.

But the email says he wants to see you right away. Most of us go through this periodically with each PD, and the familiar anxiety (or annoyance) begins to set in.

UNEXPECTED REQUEST

It was earlier this year when I got the email. "Oh boy," I thought. "How bad is it this time?" A deep breath, a knock on the PD's door. "OK Mr. PD man. What is it this time? Too much bass? Too much high end?"

And to my surprise, PD man said; "Nope! The audio sounds great!" (Thinking to self – Well, there is a first time for everything!) "What are you doing the first week of February?" *("Well, probably wading knee deep in mud or slush at a transmitter site.")* "We are going to send you on a week long remote to Mexico – and, go ahead, take your wife too."

Knowing that I had not had enough coffee yet, I thought my ears were playing tricks on me. "You said Mexico? In February? Like February, the worst time of year February?"

PD man continued, "Yup! You need to make sure that the morning show sounds good from Mexico."

TAKING THE SHOW ON THE ROAD

Normal remote broadcasts can be a challenge. Your air talent expect to have a working mini-studio wherever they go and the PD expects to have studio quality sound, even if you are in the most inconvenient location hundreds of feet from power and/or phone lines.

Now let us try that remote from a location outside of the country. Then, add in a second station – both our WRIT and WQBW were sending talent to the remote site. What are our options? And can you carry enough parts to ensure a successful remote "happens?"

WRIT's remote team on location, including an engineer (left) very pleased that the white he sees is sand instead of snow.

We have a variety of tools that we use for most of our remotes: ISDN, XPort, Vector, VoIP, Hotline, and – heaven forbid – the occasional telephone or cell phone. But the key question we had to answer right away was: What will work in Mexico?

In order to assemble the right package of gear, we needed to assess what method we would need to use to get audio back to home base. Furthermore, given the distance of the remote, it would be essential to have a backup plan in case the main line was lost.

CODEC TOOLBOX

When possible, we like to use ISDN. It can provide you with the best quality sound at the price of delay (depending on what codec you use). However with international ISDN you may not be able to get the connection you need.

Many "tech engineers" with whom I have worked in other countries have had no idea what makes up a proper ISDN connection. They mainly think that you need a data ISDN. In general, I have not had much luck in communicating with other countries in order to get a proper ISDN line set up.

That was, in fact, the case with this remote. Fortunately, a good fallback is Telos' XPort. The XPort is a box that will allow you to use a standard POTS line, but connect into a Telos XStream ISDN box. I have been told (though I have not tried it as yet) that the XPort will be able to utilize a digital phone line as well.

The real beauty of the XPort is that it is also an ISDN box and can be utilized as a backup ISDN. In ISDN mode it can connect to an ISDN box using ACC or good ol' g.722. Quite a flexible box indeed – and it operated perfectly for us on this occasion.

ADDITIONAL CHOICES

The Comrex Vector is a good old standby. It seems to work in almost any situation that offers a POTS line. It seems to be forgiving of international phone lines and holds on to a connection fairly well. During this particular trip to Mexico, we put it to good use, and it helped keep remotes from both stations running well.

Another backup "ready on the bench" is our Hotline. It also is limited basically to standard phone lines, but since it provides somewhat lower audio quality than a Vector, it is now mostly our backup.

Some stations are using Voice over IP (VoIP) these days – in other words, using the Internet as the transmission medium. Though we are not using it at our location, we are testing it out. Some concerns are audio quality, the amount of delay you incur, and the reliability of an Internet connection abroad.

I do, however use a VoIP phone system. This has saved us oodles of money in phone calls back to the studios. We even let our come-along listeners use it to call back home. You would not believe how many "Thank You's" I got for letting them call their kids or family.

Finally, if you get down to a cell phone, you really are hurting! The cost to roam outside of the US is quite expensive. If this is your lot, it might be a good idea to rent a phone locally and save a few bucks if you need to use a cellphone abroad.

LEGAL DETAILS

OK, now we have an idea of what we need for getting audio back to the studios. What else do we need to worry about? (After all we engineers are paid to worry.)

When doing remotes, I always contact the US Consulate for the country where I am headed. They usually have web pages with information about what you need to do to bring your equipment into the country.

If you are going to Mexico, for example, you will need to obtain a work permit called an FM-3. You need to physically go to a consulate office to apply for one, and *do not* wait until the last moment – it could easily take a few weeks for things to be worked out.

When you go to a consulate, you will need a US passport, a paper on company letterhead signed by a company official stating why you are bringing in equipment, and you need a list of the equipment you are bringing in including model numbers and serial numbers.

Trust me – you need to be sure to get this done as they will check all of your equipment at the airport when you land. You also need to do the same thing when you leave. By the way, the Mexican authorities will not let you take any batteries on board. (We had to leave about two dozen batteries in Mexico.)

LOCAL ARRANGEMENTS

After I obtain the paperwork for the country to which I am headed, I work very closely with the local hotel staff in getting everything set up in advance.

I ensure that there will be a crew ready to test – and troubleshoot, if necessary – all connections when we arrive, as well as have our Internet connections pre-arranged. I usually bring a small wireless network along as well as three laptops.

The laptops are perfect for the on-air people to do their prep work, as well as giving the listeners an opportunity to check their email. Again, the "Thank You's" abound!

For the VoIP phone, I am using a service from Packet8. I just plug it into the network I have created and we are good to go. It works flawlessly.

DEALING WITH LAST MINUTE NECESSITIES

While abroad, you must remember that there usually are no Radio Shacks close by. You will need to bring redundant everything; bring along enough tools to make any repairs that may be needed.

My equipment list usually includes screw drivers, wrenches, a soldering iron, some extra XLR connectors, a few knives, extra microphones, extra cables, power strips, extra phone lines, RJ-11 and RJ-45s, tape, any adapters I can find, backup software, and, of course, sun tan lotion.

Make sure you enlist a few people to help you lug this equipment around. On my last trip I had 16, yes *sixteen* cases of equipment! My wife, being the saint that she is, helped me lug this stuff through airports, in and out of buses, and back home.

Waking up at 4:00 AM in a sunny location can be a pain. But if you do your work in advance, plan, and make sure the local staff has your needs prepared in advance, it should give you some time to actually enjoy the local scenery.

Some side benefits from international remotes are hard to put into words.

If I can help you in any way on your international remote, please feel free to contact me. Especially if you need an engineer to go to any nice, warm location in February!

Kent Winrich, Director of Engineering for Clear Channel Radio in Milwaukee, WI, keeps his passport ready at all times. You can contact him at kentwinrich@clearchannel.com

by Bruce Eisen

Keeping Things Peaceful When Sharing a Tower

One of the more dangerous relationships in all communications is that of a tower owner and a lessee.

YOU NEED, THEY HAVE

Tower space is a seller's market and there is surely a trend toward multiple tower tenants. Often, although not always, a broadcaster needs the tower space more than the tower owner needs the revenues that can be derived from the rent.

With the explosion of wireless communications and the need for wireless providers to seek their own tower locations, property owners and tower owners have enjoyed many new opportunities that could conceivably squeeze out traditional broadcasters from appropriate space.

One might reasonably conclude that a broadcaster who does not own the tower it utilizes is at a distinct disadvantage and faces the prospect of worrisome negotiations and even loss of business. If that were not enough, there are bizarre stories about the conflicting business interests that surround tower politics, about zoning restrictions and unreasonable local regulation.

So, it remains important to know what your tower needs are and how they may change in the immediate and long term future.

TECHNICAL ISSUES

Tower problems encompass a number of issues, many of which are highly technical.

The FCC has increased its vigilance over the past decade with regard to radiation hazards as proved by the monthly mass of FCC forfeitures levied against broadcasters who have failed in some way to meet their obligations regarding RFR.

It is important to comply with all FCC Rules in order to ensure compliance with exposure limits. We also have a duty as responsible broadcasters to make certain that our operations are safe.

LEGAL AND "POLITICAL" FOCUS

While I am not competent to address the highly technical nature of antenna placement, RF, etc., I can comment upon the nature of "tower politics" and some of the legal binds in which broadcasters can become entangled.

Because your tower space is so critically important to a maximum service area and smooth operations, it is best to address potential problems before they occur.

After all, no one wants to approach the FCC with a last minute request for special temporary authorization in order to relocate a facility because of problems with a tower owner or a co-tenant. And you can be sure no one in management/ownership wants to be surprised by events that could reasonably have been foreseen.

LEASING FROM/TO COMPETITORS

Sometimes competitive tensions can develop between a broadcast tower owner and licensees leasing the tower space.

Not long ago, I became involved in a dispute with a broadcast licensee who owned a tower my client had leased for a significant amount of time. At first there was no real cause for competitive concern since their formats differed so greatly. However, over time, business decisions were made by both stations, resulting in converging formats; in other words more direct competition than had originally existed and a burgeoning source of irritation.

Because the lease, itself, actually spoke to the question of format and provided the lessor-licensee with the ability to terminate the lease if the lessee chose to broadcast a similar format, some difficult questions had to be answered quickly.

A CONTROL ISSUE

But what about the idea of having the lessor in a position to actually control the lessee's programming? Is that legal? Should the FCC intervene in a dispute to determine whether or not the lease agreement represented an abdication of licensee control by the lessee?

Ultimately, the parties were able to work out their disagreement, but there are many lease agreements in existence with similar terms and which should be closely scrutinized by the parties for any language that might run afoul of FCC Rules or case law.

My advice is to be very wary of any lease provision that gives a tower owner rights to determine core questions about programming.

(Continued on Page 27)

FCC Focus

by Bruce Eisen

Continued from Page 26

SITE COOPERATION

While that story highlights an exceptional situation, it is more than common for stations that lease space on towers to require regular maintenance at the site for a variety of reasons. This can result in real headaches.

For example, a station can enjoy economic benefits by leasing space on an existing tower rather than spending the significant funds on tower construction, lighting, etc. But there are both legal obligations and self-imposed obligations as good broadcasters that may come into play. Some of these involve problems that cause down time – and the potential loss of business.

For that reason, one of the keys to successful tower tenancy is to make certain that the rights and obligations of both the tower owner and the tenant are specified in the lease agreement. If difficulties arise, RF and otherwise, it is exceedingly important that the parties know exactly how and when they can access their individual facilities and what they can expect in the way of technical reaction from other tenants.

SCHEDULED MAINTENANCE

Most broadcasters have few problems cooperating instantly during an emergency and they realize it is a good idea to accomplish an antenna and transmission line inspection at specific intervals during the license term.

This is especially true if your station must deal with an issue of aging equipment. Such inspections are probably a good idea even in addition to ordinary maintenance. However, in either case, there will be a need for personal inspection of the facility.

This often calls for cooperation from the other parties occupying tower space. There are great complexities that can be involved in the coordination of power cutbacks where several stations are located on a single tower – or adjacent towers – and maintenance is required.

DEVELOP A COORDINATED PLAN

There is a profound need for setting out clear procedures that must be implemented so qualified personnel can climb the tower safely in order to accomplish their important tasks. In all these cases, expensive downtime for other broadcasters must be minimized to the greatest extent possible.

Adherence to the procedures is crucial. Imagine the horror of one station resuming its full power operation while a technician remained performing his work on the tower. Accidents have happened in the past and there must be a way to ensure that all tenants cut their full power for the necessary period of time while personnel are in harm's way.

Of course, all tower climbing must be effectively coordinated with all required parties. Failure to follow correct procedures could result in tragedy. At the very least, failures could cause even more down time and the prospect of lawsuits or complaints.

THE FCC VIEW

The FCC has no Rule or Regulation that specifically addresses the protection of tower workers, but it does include strong language in various OET bulletins released over the years that cite the need for procedures to insure occupational safety, especially in multiple transmitter environments.

Moreover, the FCC has stated that power reduction agreements may often be necessary to make sure that all licensees are aware of the potential for their stations to expose other individuals to harmful RFR at the site.

From a legal standpoint, site occupants are generally jointly responsible for compliance with FCC guidelines. But it does seem rather strange that the FCC does not have a specific Rule regarding necessary power reductions or procedures to be followed in tower maintenance situations.

LEARNING FROM PAST SITUATIONS

A reduction of power must be acknowledged by each tenant as a requirement to insure safety during tower access. At one time or another, everyone must deal with this problem, so it makes no sense not to cooperate and go the extra mile in accommodating neighbors.

I am sure that many readers will recall the "Mount Wilson incident" several years ago where the great challenge was to get co-located stations to cooperate with power reductions to allow for an antenna installation.

While Rules may not technically have been violated, the Mount Wilson experience demonstrated the great need for coordinated scheduling and cooperation among tower tenants to protect workers from dangerous exposure.

There are a couple of lessons to be learned from some of the great tower squabbles of the past. It should be axiomatic not to schedule routine maintenance during drive time and it should be just as natural to contact all tower occupants when maintenance, emergency and otherwise, is required.

Although, as noted, there is no specific FCC Rule covering this matter, a wealth of relative information may be found on this FCC web page: www.fcc.gov/oet/rfsafety/rf-faqs.html

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Bruce Eisen, of Kaye, Scholer, has been a communications attorney for some 20 years. If you have a question regarding the FCC Rules and Regulations, send it to Bruce at beisen@kayescholer.com

IT Guide

by Dana Puopolo

Voice Over IP

Setting Up Service

Growing in popularity, VoIP has become an important factor in long distance telephony. As we continue the discussion, Dana Puopolo introduces some new options and shows how to set up service for yourself.

By now you are probably interested enough in VoIP enough to buy an analog telephone adapter (ATA) or download a softphone program for your computer. If you have not done so as yet, do not worry. There are plenty of options in using VoIP. The easiest way is to sign up with one of the software services.

SKYPE

My favorite is Skype. It now boasts over ten million users, so it is likely many of your friends already use it. As previously mentioned, Skype will not work with a standalone ATA device.

You must use Skype with a computer, but calls to other users on a computer are free. For additional charges, you can also use Skype for incoming and outgoing POTS (Plain Old Telephone Service) calls.

Since being bought by ebay, Skype has announced a few changes. For example, Skype recently announced that outgoing POTS calls will be free for calls to the United States and Canada until at least the end of 2006! This makes Skype a "must have." (In response, Vonage announced it will now offer unlimited calls to many European countries.)

SOFTPHONES

Along with Skype, there are several other services that use software to operate via your computer (as a class, they are called softphones). Some of these SIP compatible VoIP providers will let you use either a regular phone or computer connections or both – just not at the same time.

The big advantage of using a softphone from a provider is that it comes pre-configured. You simply download their software, run it, and you are ready to go. You also can put a softphone on your laptop and take it on business trips. Before you leave, just unplug your hardware ATA at home.

Last time, we described a unique VoIP service, Free World Dialup (FWD). This service uses SIP and was created by Jeff Pulver, one of the founders of Vonage. It works with both softphones and ATA units. At present, it does not offer outbound or inbound POTS calling (except for outbound 800 numbers), but Jeff is getting ready to offer it soon.

However, there is a company that does offer free inbound POTS numbers that forward to FWD. That service is IpKall (www.ipkall.com). They will provide a free Seattle, WA incoming phone number for FWD. I use FWD to communicate with all my friends. Call quality is excellent.

I also know of a small group of stations that uses FWD to call between stations. They save a bundle on long distance that way. FWD is a good way to learn how to configure SIP phones because there is a step-by-step procedure on the FWD web page.

My favorite SIP compatible softphone providers are: Gizmo Project (www.gizmoproject.com), Stanaphone (www.stanaphone.com) and Vbuzzer (www.vbuzzer.com).

All three of these offer cheap outbound POTS calling (at either 1 or 1.6 cents a minute). Stanaphone offers free incoming POTS calls (with NYC area phone numbers). All three offer incoming POTS numbers from anywhere in the USA or Canada for a couple of dollars a month.

AVOIDING VOIP HOTEL HASSLES

You should be aware that one of the problems with VoIP usage in hotels is that many hotel Internet providers block UDP ports 5060-5080 because most SIP compatible providers use these ports for signaling. The hotels want you to pay to use their phone system, not your own.

One way around this is to use a provider that uses an alternate port. The best alternate port to use is port 80, which is used for WWW requests because if it were blocked users would be unable to surf the web.

Vbuzzer is one provider that uses port 80. Vonage also does, but you have to request it specially from customer service.

VOIP CONFIGURATION

Now, let us get into the nuts and bolts of configuring both softphones and ATA units. Setting up a SIP phone involves putting information into the right places within the configuration menu(s).

What is usually needed is the SIP server address, username, password, phone number, STUN (Simple Traversal of UDP through NAT) server address, port information, preferred CODEC, and whether static or DHCP IP addresses are going to be used.

Each of these except the STUN and IP addressing are unique to the provider and account used. STUN is needed for VoIP to work with non-public IP addresses, such as those used in home and business networks. (Before STUN, VoIP devices had to be used with public

(Continued on Page 30)

Multicasting.

It's like trying to fit —

well, you know.

Management has decided to multicast. Which seems like a terrific idea — until you consider just how little bandwidth each channel will get. How will the sound of your station(s) survive these shrinking bitrates? Omnia can help.

New Omnia Multicast with SENSUS™ restores the fullness and depth that bit-reduction steals. Our DSP gurus teamed up with the codec experts at Telos (the folks who introduced broadcasters to MP3 and MPEG AAC). Together, they developed a unique suite of tools to pre-condition audio for HD Radio™ multicasting.

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SENSUS technology enhances punch, preserves presence, and reduces artifacts. Even heavily bit-reduced channels (like multicast) can be significantly improved by Omnia running SENSUS. And like all Omnia processors, Omnia Multicast delivers the smooth, clean, pure signature sound that grabs your listeners and holds them hour after hour. No wonder the top stations around the world choose Omnia over all other processor brands.

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Continued From Page 28

IP addresses, such as those provided by cable and DSL modems or you had to manually open ports on your router.)

SIP phones can use any STUN server out there, and there are many available; virtually all VoIP providers have them. For example, FWD's STUN server's address is: stun.fwdnet.net:3478 (most STUN servers listen to port 3478).

The SIP server is the server used by the particular provider for their signaling. It is sometimes called the SIP proxy; these terms are interchangeable. FWD's SIP proxy is: fwd.pulver.com:5060. Username, phone number and password are assigned to you by the SIP provider when you sign up. In the case of FWD, your phone number is your username.

PORTS AND CODECS

The last two items usually needed are port number and codec information. As mentioned earlier, most SIP devices operate on port 5060 by default. Usually there is no reason to change this, unless either your SIP provider uses a different port (vbuzzer uses port 80, for example) or you are using multiple SIP devices or VoIP numbers connected to the same router.

However, if you were to use the same port for different devices and/or numbers, you might have collisions. Remember, UDP is a very simple data protocol. Fortunately, VoIP providers usually allow connections from a range of ports; the usual ones being ports 5060-5080. (If you buy a two line ATA such as the Linksys PAP2, you will find line two already set up to work on port 5061.)

Codec information is just that – you need to set the codec so it matches the one used by your VoIP provider. The most popular codecs are g.711u (also known as: PCMU), g.711a (aka: PCMA) and g.729. The first two consume about 64 kbps, the third approximately 26 kbps. Fortunately, most SIP providers and phones allow for multiple choices of codecs. As an aside, my two Grandstream telephones have g.722 as a codec option – perhaps useful as a poor man's Zephyr?

ONLINE HELP

A typical configuration page is available for reference at the mutualphone web site: http://www.mutualphone.com/Grandstream.htm. This is for a popular VoIP telephone, the Grandstream Budge Tone 102, and is all on one page. Be aware that if you use other types of ATA and/or softphones, the configuration stuff might be spread out over several pages.

For example, with the Linksys PAP2, STUN information is entered using the admin menu, advanced view, and SIP tabs. The STUN server setting is at the bottom of the page. STUN enable must also be set to "yes." All the other information needed to configure the PAP 2 is in the line 1 and line 2 tabs.

The selection between static and DHCP for IP addressing is in the system tab. Default is DHCP addressing (The ATA gets an IP address automatically).

If you looked closely enough, you probably found the mistake on the Grandstream configuration page. If not I will tell you what it is – they forgot to put in the STUN server! To make this phone work with the typical Internet connection, you would need to click the "yes" bullseye and put in: stun.fwdnet.net:3478, (or another STUN server) where it says: "NAT Traversal."

TROUBLESHOOTING

If you follow these directions, you will probably be rewarded with a dial tone. However, sometimes things do not work the first time out, and let me assure you it has happened to me more then once.

If this happens, try connecting the computer or ATA adapter directly to your public Internet connection (cable or DSL modem). If you get your dial tone now, it might be necessary to set a static IP address on your unit and DMZ or open ports to that address within your router.

SIP uses UDP ports 5060 through 5080 for signaling and ports 10,000 through 20,000 for voice transmission. Your router's instruction book should contain the details on how to do this.

There are many places to get help with VoIP. One of my favorites is the VoIP forums on www.dslreports.com. www.Voxilla.com has a wealth of configuration information for many VoIP providers that can be "pushed" into your ATA unit.

Other places to look include www.voipuser.org (a fine site in Great Britain), www.voip-info.org, and www.freeworlddialup.com. Furthermore, most every SIP provider has FAQ's and forums available where you can ask questions and search for answers.

Next, we will move to a larger platform and take a look at how VoIP can be used with an old computer to build an enterprise class PBX system, some ways to use ATA's wirelessly with your laptop, and we will top that off by discussing Linksys/Cisco's latest cutting edge enterprise VoIP products.

Dana Puopolo is a contract engineer equally at home with computers. You can contact Dana at dpuopolo@usa.net

The Worst I've Ever Seen

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

Dedicated to the Cause

By Mike Callaghan

There are some engineers who will just toss anything that breaks and buy something new. Others work hard to recover, rework, or rebuild broken gear. That may not be the easy way. It may not even be pretty. But there is real satisfaction in restoring equipment thought lost.

The Kintronic people build incredible products. They used to use Rexolite panels to insulate feed-through connections in their isolation coils and the antenna tuning houses.

Rexolite is an interesting material. When it insulates, it insulates really well. And when it catches fire, it burns like you would not believe.

A CLEANING PROBLEM

KTLK had lost one of these Rexolite panels in the past. When it goes up, it deposits this thick black particulate coating all over, especially on the inside of the cabinet.

When it happened the last time, I went in with a damp rag to rub it off. However, the water just made it into a thick, goopy black syrup that stuck to everything, which just made it worse.

So, for the most recent conflagration, I did not use water – I just wiped it off the inside. I was aware there was black soot falling all over everything, but I was busy and did not think about what might be happening to me. Besides, ATU's do not have mirrors on the backside of the door to help you comb your hair.

A slightly burned Rexolite panel.

WHAT A SIGHT!

So it was not until after I had finished cleaning the inside of the cabinet and climbed down the ladder that I got some input about my appearance. Jerry Burnham was walking towards me and said "Good God! You look like Al Jolson! Hey! Sing 'Mammy O Mine' for me!" Yeah, right!

After I got down off the roof and in front of a mirror I saw what Jerry meant. Yikes!

Jerry Burnham and a slightly tarnished Mike Callaghan.

From there I went home to shower, but not before I visited a 7-11 for a soda. The people in there did not know what to think. They huddled away from me and finally one guy asked, "What the heck happened to *you*."

Next time, we will do things differently.

The only response I could think of was, "I'm a chimneysweep!" The guy replied: "Yeah, well, you aren't supposed to get *inside* the chimney!"

By the way, Kintronic no longer uses Rexolite panels this way. Believe me, it is just as well!

Mike Callaghan is the Chief Engineer for KIIS-FM in Los Angeles. His email is mikecallaghan@clearchannel.com

Do you have a "Worst?" Let us know.

Studio Guide

by Mark Shander

New Condensers Give Good Sounds

In the late 1980s, controversial talk show host Tom Leykis programmed an Arizona AM station that had recently changed from a country music AM/FM simulcast to news/talk. Leykis did double-duty and served as the afternoon drive host for the station. Management gave him a lot of flexibility to do whatever he felt was right to build an AM audience.

CREATING A SOUND

I learned a lot about the business end of radio and, surprisingly, radio engineering from Leykis, as well as from the station's Chief Engineer. Being a creative talent, he knew exactly how he wanted the station to sound for it to succeed in the Phoenix market.

We would have extensive conversations over compression, microphone selection, microphone processors, air-chain processing, and, believe it or not, even how much plate reverberation to dial in for the station.

The station sounded louder and cleaner than many expected – different enough from other stations to be considered somewhat unique. (There was a bit too much reverb initially, which was eventually tuned down to become just a bit more subtle.)

SELECTING MICROPHONES

The microphones in the talk studio were all Shure SM-7s, run through Valley People Dynamite limiter/levelers before hitting the DA feeding the board input and router selector. The air-chain program feed was sent to a finely tuned Optimod. Listening to pre-delay was like listening to silk.

As we sought the right setup for producing liners, promos, etc, we sampled the AM production studio with its Sennheiser MD-421 microphone and then moved quickly to the FM production studio, which had just been completely renovated.

The FM production studio had a unique configuration. There was not a lot of flexibility, but there was a lot of new, wonderful equipment. Instead of a dynamic microphone, as the rest of the studios in the facility had, the FM production studio had a Neumann condenser microphone.

CONDENSER MICS

The Neumann had a small diaphragm and was mounted in a quirky, hands-off position near the console. Since everything was new and set to flat response characteristics, it was a great opportunity to put a condenser through its paces. Leykis and I spent about an hour in the studio comparing the characteristics of this microphone to others.

One advantage to the condenser is that the noise floor tends to be extremely low. While it is not really fair to compare a several-thousand-dollar Neumann to a $500 Shure dynamic microphone, it is fair to say that dynamics do an excellent job of reproducing voice frequencies while condensers appear to have a much greater range of sensitivity and sonic accuracy.

If they were more durable and less fragile, condensers could have easily replaced dynamic microphones in a number of broadcast studio situations. A lower price would not have hurt, too. At the time, it was sort of wishful thinking.

NOW THEY CAN

Moving forward to the present, microphone choices have changed. There now are very high quality, brand-name condenser microphones with a street price that is lower than most broadcast studio dynamic microphones. It only takes a low-end production mixer to supply phantom power.

Two condenser microphones sold as studio packs crossed my desk recently and I decided to put them to the test against a high-end condenser with characteristics similar to the Neumann condenser Tom Leykis and I used for production in the late 80s.

These inexpensive condensers are giving their more-expensive high-end counterparts a run for their money. In many cases they have a higher noise floor, but similar sensitivity and dynamic range as their multi-thousand-dollar counterparts.

DUAL CONDENSERS

These two-packs each consist of a large-diaphragm microphone for voice and a small-diaphragm microphone for something like an acoustic instrument. They are typically marketed to musicians and guitarists who would use the large diaphragm model to sing into, while pointing the small diaphragm microphone at an acoustic guitar.

The MXL 2001/603 pack from Marshall Electronics includes a large gold diaphragm studio microphone and a small diaphragm condenser. The other studio pack I evaluated was the AT2020/AT2021 pack from Audio-Technica.

In the Audio-Technica pack, the large diaphragm microphone had a cardioid pattern, which did have a bit more prominent proximity effect than that MXL appeared to.

SONIC EVALUATION

The MXL603 and the AT2021 sounded very similar when applied to musical instruments, though they differed when used as voice studio microphones. They both sounded a bit thin when compared to a dynamic microphone like a Sennheiser MD-421 or a Shure SM-7.

One nice thing about the tonal quality of these microphones is that they appear to have a more open sound and better frequency response on the high end than their dynamic counterparts. These microphones do make great FM studio microphones and I can easily see using any of them as extra microphones for talent in a studio.

However, for a host microphone, I would consider getting into the next higher class of condensers. These packs are an excellent value for the money, but they just do not produce the thick sound most broadcasters like to hear from primary studio microphones.

Mark Shander has used many microphones in his career in radio, TV and on the Internet. He can be contacted at mark@shander.com


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Radio War Stories

by Phil Alexander, CSRE, AMD

Adventures in the AM field

(Confessions of an AMD in the Trenches)

Part 6 – Solving Directional Arrays in 4/4 Time

Phil thought he had this array fixed but his field readings did not agree. He seems to have an idea that the factory fresh toroids and a newly calibrated phase monitor do not show the true operation – so he has had the CE intentionally mis-adjust the nighttime array to prove his point. Or is it on his head? (the point)

It took about twenty minutes to get all the readings stabilized on their licensed values except the number four tower which was now reading five degrees lower than normal on the monitor. Then, visiting the monitor point that had caused all the problems, we got a normal reading!

WHEN THE WRONG READING IS RIGHT

To make sure we had not gone crazy, we criss-crossed the null azimuths in the same area of the pattern in brief survey and, as expected, the null had moved. But where it moved was the curious part.

The null now was almost exactly on the correct radial used in the last full proof and the monitor point in the adjacent minor lobe had returned nicely inside its limit. After basking in the sunshine of satisfaction for a few moments, we switched to daytime pattern and returned to the transmitter.

I told my assistant to get a shorting connector and cap the number four phase sampling line at the far end by disconnecting it from its toroid while I broke out the TDR (time domain reflectometer).

The CE looked on, completely puzzled, so I told him we were going to do what I should have done before – check the line.

SOURCES OF BAD DATA

I had noticed the "problem" null had been relatively high in the original proof when the nighttime operation was added. Furthermore, the readings after most of the previous consultant's "crankings" showed it near the edge of the three degree FCC tolerance.

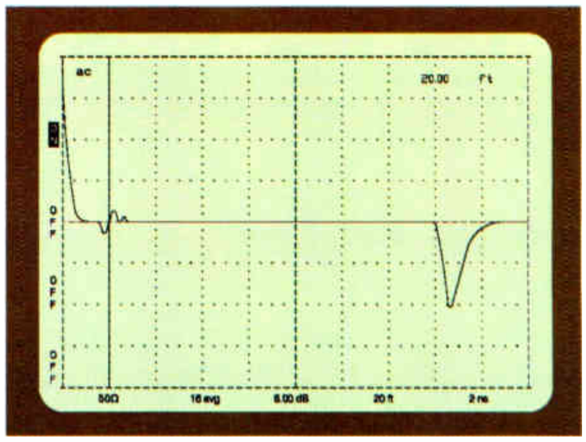
Years of field experience suggested we should check one particular component that we had over-looked.

Looking at the TDR trace, there was a clear anomaly at what appeared to be about twenty feet from the origin followed by a clean trace to the short at the end.

"Uh, huh," I said, "maybe we should take a look at that line – and the TDR shows we should start right here in the building."

A VERY OLD PROBLEM FINALLY UNCOVERED

Since I had not connected the phase monitor myself, I had overlooked checking the line connections. But, my mind was telling me to focus there now.



Something is not right here.

Three Heliax® lines came out of a bundle in the corner of the rack housing the phase monitor and each had a short, flexible, RG-8 jumper on the end for connection to the monitor.

On the fourth line, however, the RG-8 ran right into the bundle. I had not noticed it previously, but now it was the reddest of red flags.

I did clearly remember seeing the 1/2" Heliax at the other end when we installed the toroids and station records showed stabilized line had been in-stalled when the phase monitoring system was up-graded. But it was now obvious that something did not match the paperwork.

We cut the bundle apart and pulled out the RG-8, only to find it disappeared into a trench below the rack along with the three Heliax cables.

(Continued on Page 36)

Radio War Stories

by Phil Alexander

Adventures in the AM Field

Continued from Page 34

The steel plates covering the trench were held down by equipment sitting on them, so tracing was not an easy job. However at the next open point I shined a light into the trench and found the RG-8 coax had morphed into 1/2" Heliax.

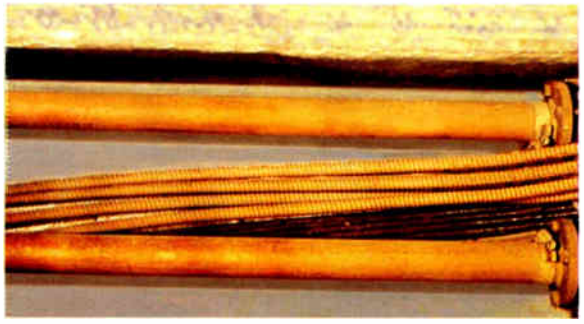
By tilting a rack backward and pulling up one corner of the phasor slightly we were able to work the trench cover out from under the equipment. Shining a light into the trench it was possible to see a coax connector under the phasor where the sample line changed from one type to another.

It looks like something is not right here either.

It looked as though someone might have run out of line during the original installation and used the RG-8 "extension," the spirit of the FCC sampling system Rule (Section 73.68) notwithstanding.

USING WHAT IS THERE

I said, "Well, we have plenty of Heliax now. We can use some from one of the isolation coils that were used with the old sampling loops. That will work, at least as a temporary fix, although I would prefer using a single piece of line."



But these cables look OK.

My assistant and the CE brought the coil from the number four tower inside, cut about 18 feet from it and worked the splice out from under the phasor so we could attach it to the coupling that joined the RG-8.

To be sure there were no problems I checked the cable run to the toroid with the TDR, then we pulled the new Heliax section into the phase monitor rack and installed the end connector. We cut the RG-8 "extension" down to the same length as the other pigtails and connected it to the monitor.

"Try the nighttime pattern now and see what the monitor says, but give it a few minutes to stabilize," I said.

MIRACLES DO HAPPEN

Without touching the phasor, the pattern came up with slightly less than a one degree error on the phase monitor for tower number four.

As the array stabilized, that error shrank to 0.3° from the licensed value and we "tweaked" the phasor to make the monitor reading correspond exactly with the license.

By this time the CE's eyes were the size of saucers. "How did you know?" he asked.

"To be honest," I said, "I wasn't sure until I saw the anomaly on the TDR trace. Then I knew we would find something like this." I went on to say, "I knew it had to be a line problem of some kind because everything else was known. That was the only possibility left."

LITTLE LINE, BIG PROBLEM

"But, such a short piece of line, how did it cause that much delay?" he asked.

First I told him to think about his frequency in the upper half of the band, the wavelength is relatively short. Then there is the propagation velocity of foam Heliax versus plain old RG-8 with a much slower velocity factor.

It turns out that, length for length, RG-8 appears electrically to be about 25% longer than foam Heliax. The result was nearly an extra 5° delay in the number four sampling line.

When the phasor was adjusted to give licensed values on the phase monitor the actual phase at the tower was advanced by about 5° and that error moved the null and increased the minor lobe size enough so that the monitor point in that minor lobe was always near or above its limit.

PHASING CONFUSION

"But, you told me to adjust it the other way. I don't understand that," said the CE.

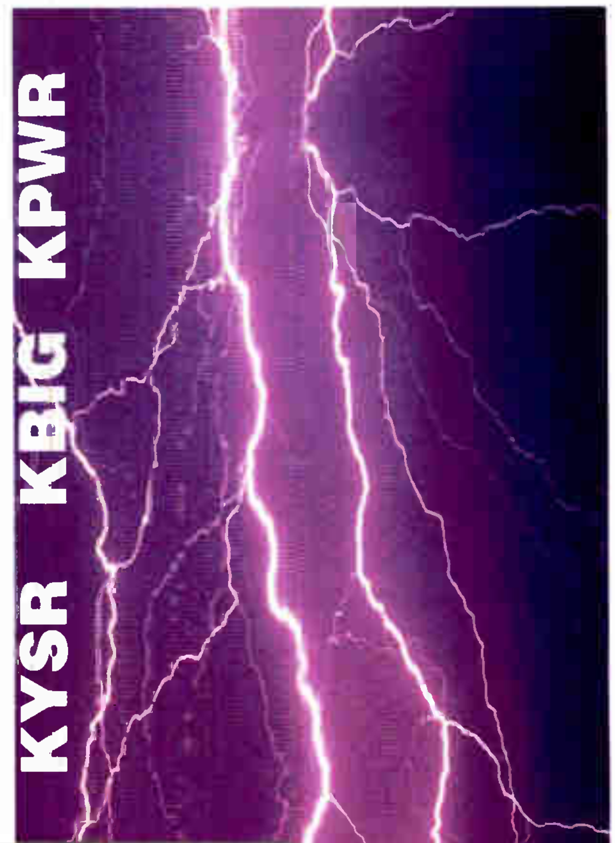
"Ah, that, my friend is just another one of the joys of working with a system that has unequal sampling lines," I replied.

Then I asked him to think carefully and tell me the highest phase number he had ever seen on a phase monitor, and he said he honestly could not remember.

TIMEOUT FOR A MATH LESSON

I had a piece of polar graph paper (like the one shown in **Figure 1**) in my briefcase, so I used it to illustrate the point.

(Continued on Page 38)



"At KPWR (Los Angeles), our CCA transmitter would occasionally trip breakers and go off the air without any obvious cause. **PowerClamp solved our problem immediately**."
Tom Koza, Chief Engineer

"At KBIG (Los Angeles) we had continuing problems of our transmitters throwing breakers, unexplainable input power glitches, and a host of other power line-related problems. **Ever since we installed PowerClamp our problems just went away**."
Terry Greiger, Chief Engineer

"KYSR (Los Angeles) uses a pair of Continental 816 transmitters, which use internal SCR regulators to control the screen and plate voltages. When the voltage of one AC phase was high, the SCR regulators would kick in, generate harmonics on the AC power line, and knock the other transmitter off the air. **We installed a PowerClamp and it totally solved the problem**."
Chuck Ide, Chief Engineer

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Transmitter circuit breaker trips for no reason?
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HENRY ENGINEERING

Radio War Stories

by Phil Alexander

Adventures in the AM Field

Continued from Page 36

"Let's say all the numbers going clockwise are positive phase and all those going counterclockwise are negative phase," I said. "Do you see how +181° is also -179°?" I asked.

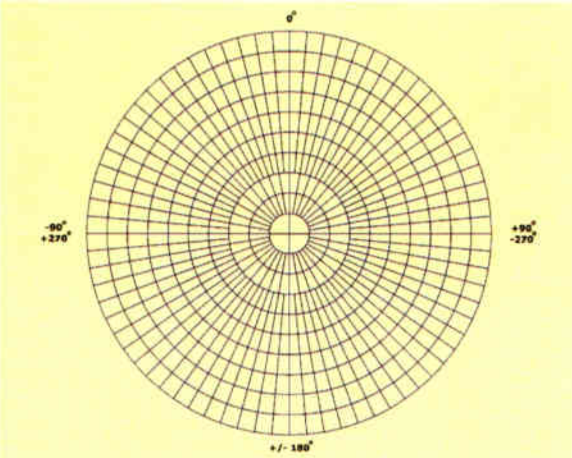

Figure 1: Two points cannot be more than 180° apart.

"For example," I said, "suppose you have a number that is -270°, but I tell you that numbers above 180° are not allowed. How would you represent the number on this chart?"

He thought a moment as he looked at the chart and said, "Well, it looks like it would be +90°, and if that is correct, I suppose the biggest number a phase monitor needs to show is 180°"

"Right," I replied, "so if the real number is +270 and it needs to be +265 the reading will go from -90° to -95°. That is why I told you to adjust the 'wrong' way."

NOW, BACK TO OUR STORY

He asked if he could take another look at the spreadsheet showing the actual phases in the system.

After looking at it a couple of minutes he asked, "What about all these numbers above 360°? And why do the numbers for the tower phases agree with the license in this row, but don't agree in that one?

SORRY, HE'S GOT SOME MORE MATH

"Look closely at the first numbers and subtract either 360 or 720 from them, depending on how far they are physically located from the transmitter," I suggested. "Consider that what I'm doing on that sheet is adding up all of the phase delays all the way to the towers and all the way back to the phase monitor," I continued.

"So you add up all the phase delays as negatives and go back to the phase monitor. Then you subtract all the multiples of 360° Any negative phase that is more than 180° it is converted to a positive phase less than 180° – which is what the monitor will read."

"How do you do that?" the CE asked.

"To convert a true negative phase over -180° to a positive just add 360 to it. On the other hand, if you want to convert a true positive phase over +180° to a negative indication, just subtract 360 from it. Phase correction from total to the angle the monitor shows really is that simple," I explained.

AHEAD WARP ONE DOWN THE COAX

I cautioned him that when you do this, using the actual delay of the line or cable is essential because the delay can be anything between 0.99 C to as little as 0.66 C (where C is the free space velocity of light), or anything in between.

	A	B	C	D	E
1	Tower	#1	#2	#3	#4
2	Location	East	Center	West	New West
3	Field Ratio	0.50	0.97	0.50	0.49
4	Base ratio	0.49	1.00	0.49	0.48
5	Sample Ratio	0.47	1.00	0.47	0.46
6	Licensed Tower Ø	-107.60	1.25	107.60	215.20
7	Licensed Ø Monitor Indication	141.9	0.0	-141.0	80.9
8					
9	Theoretical Phasing Design	0.00	108.85	215.20	322.80
10	Ø Lag Design to Tower	-322.80	-213.95	-107.60	0.00
11					
12	Line Delay	-356.20	-260.00	-166.00	-66.00
13	ATU Delay	-110.10	-97.45	-85.10	-77.50
14	Total Transmission Delay	-466.30	-357.45	-251.10	-143.50
15	Theoretical Ø Delay	-322.80	-213.95	-107.60	0.00
16	Phasor Out Ø Delay	-0.00	0.00	0.00	0.00
17	Phasor Out Ref. to #2	-0.00	0.00	0.00	0.00
18	Phasor Trim Ø°	0.00	0.00	0.00	0.00
19	Trimmed Xmsn. Theo. Delay°	-322.80	-213.95	-107.60	0.00
20	Relative Ø° Ref. to #2	-108.85	0.00	106.35	213.95
21					
22	Ø Sampling Line Physical°	-350.00	-260.00	-167.20	-73.10
23	Propagation %C	0.82	0.82	0.82	0.82
24	Ø Samp Line Delay°	-424.95	-315.68	-203.00	-88.75
25	Line Delay Adjustment	0.00	0.00	0.00	0.00
26	Total Sample Line Delay°	-424.95	-315.68	-203.00	-88.75
27	Ø Monitor Input Total Delay°	-891.25	-673.13	-454.10	-232.25
28	Ø Mon. Sample Ref. to #2	-218.12	0.00	219.02	440.87
29	Invert Sense / DISPLAY Ø	141.88	Reference	-140.98	80.87

A spreadsheet of system phases.

Thus, it is necessary to know the length of the line and divide that by the propagation velocity – or C factor – to get the equivalent delay length, then divide that by one wavelength at the operating frequency, and finally multiply by 360 to get the number of degrees of actual phase delay.

After adding in the delays of the phasor and antenna coupling networks, you can map out all the delays in an array. I explained that doing this is especially important in an array with unequal sampling lines. "Once you know where every delay is located you can begin understanding how the transmission system for the array really works.

(Continued on Page 40)

Radio War Stories

by Phil Alexander

Continued from Page 38

"Otherwise, you may start to question your sanity while trying to understand the actual phases versus the indicated phases."

TO THE FIELD ONE LAST TIME, WE HOPE

As this discussion came to a close, I could see the phase monitor showed the system was stable at the licensed phase and ratio values. So I suggested it was time for us to take another field trip.

This time we would check all the monitor points and make an abbreviated survey of all the nulls and minor lobes on one side of the pattern. (Remember, the station has a symmetrical pattern.)

Our survey map confirmed what I expected. The pattern was "in" in every respect, which is to say the nulls and minor lobes appeared exactly where the designer intended and the monitor points had "headroom" for the normal changes that can be expected in day-to-day operation.

SOMETIMES A HAPPY ENDING

It was getting late in what had been a very long day so I called the GM, Mr. Carpet, and told him the good news was that we were done and the better news was that his patterns were operating correctly.

Since we had been working nearly 18 hours, we decided to stay overnight and return home in the morning. Mr. Carpet said that sounded like an excellent plan and that if we had time before we called it a night he would like to stop by the motel and have an early dinner with us to hear a preliminary report.

During the dinner I explained how the problem had been created when the night operation was added and that I would be making a number of recommendations for equipment and changes that would make maintenance of the array patterns easier.

A NEW CORPORATE POLICY

The GM said he had met with the other owners and they now felt maintaining the system might cost less than the money they had spent during their five years of ownership doing quick fixes that failed almost as fast as they were made.

I told him our complete report would be in the mail in about ten days and that he could advise the FCC that the station had returned to normal licensed operation at full nighttime power.

I also explained that because the licensed operating values did not change and the monitor points were well within limits the station probably would not need to do the partial proof of directional performance usually required in these situations by Section 73.68(d) of the FCC Rules. No changes in the license were necessary because we had simply made repairs and modifications necessary to bring the station into compliance with its existing license.

Nevertheless, I recommended that a fully complete informal report of the modifications and realignment should be forwarded to the FCC for consideration by the Audio Services Division. I suspected they would accept the fact that no changes had been made, except for the removal of the loops and installation of toroids, and revise the sampling system notes of the license accordingly without requiring another partial proof of the system.

BLESSINGS FROM ON HIGH

We did file FCC Form 302-AM with information supporting relocation of three monitor points as required by Section 73.158(a) and the correct routes required by Section 73.158(b), but left the question of a partial directional proof of performance to the discretion of the FCC staff based on the informal report of our modifications and repairs to the phase sampling system.

There are times when the FCC staff understands what is written between the lines of a complete, detailed report, and this was one of those times. Perhaps inclusion of all the necessary details of the before and after, exactly in accordance with Section 73.68, affected the outcome, or perhaps it was the total candor and detailed clarity in reporting each corrective step we took that proved conclusive.

Regardless of the reason, the FCC "corrected" the sampling system description of the license with no further action required of the licensee. This, too, is an important lesson. The FCC staff is generally inclined to help those stations that try to do their job the "right" way.

A GOOD OUTCOME

In this case, the report made crystal clear that the station fully complied with its license in spirit as well as in fact and that it would and could continue licensed operation without problems. Reading between the lines, it was also clear this station had "turned over a new leaf" and intended to keep their operation fully compliant with the Rules in the future.

All too often these stories end on a sour note because there is no magic way to fix a directional system. And not all GM's are as interested and professional as Mr. Carpet. There are also times when a station cannot generate the funds needed for a true, professional directional overhaul.

Fortunately, sometimes it does work out like it did in this fictional case and another station returns from the "dark side." It is not often enough that you can say everyone was happy with the outcome. This was one of those times.

Phil Alexander is a contract engineer who loves to diagnose and fix in RF transmission and AM directional station problems. Based in Indianapolis, IN, Phil can be contacted at dynotherm@earthlink.net

The s.beat MP3 Digital Audio Player

More Improvements for the Swiss Army Knife

The combined Swiss Army Knife/USB memory stick was memorable in itself. But now the high-tech company Swissbit has come up with new features. Along with a radio, voice recorder and USB memory stick, Swissbit has integrated its smallest digital audio player (DAP) with a capacity of up to 4 GB into Victorinox's world-famous multifunctional tool.

The s.beat plays MP3, WMA, WAV and Ogg Vorbis files with full sound quality. And if this is not enough, the s.beat is also being marketed as the only MP3 player to come complete with all its accessories right from the power adapter to an extra USB cable.

s.beat MP3 DIGITAL AUDIO PLAYER

Using the SWISSMEMORY s.beat MP3 Digital Audio Player – s.beat MP3 for short – is a unique experience. Of course, there is the famous pen-knife with its lifetime guarantee. This classy item is far too good to be tucked away in your trouser pocket – thus the package includes a belt clip and an adjustable rubber wristband so you can work-out in style with the s.beat.

Along with the player, high-quality earphones are also included. When they are not in use, you can easily leave them around your neck until you need them.

The s.beat MP3 Digital Audio Player

A more gimmicky, but also extremely practical eye-catcher is the red remote control. Designed in the shape of the world-famous Victorinox logo, it can be used to control the audio player, thus making the s.beat one of the few MP3 players to have external controls.

With the s.beat, you are able to listen to your favorite songs and files with excellent sound quality whenever you are working or relaxing. The second earphone socket is another special feature, allowing you to share the audio with a second person, such as during a remote broadcast.

A SIZE TO SUIT EVERYONE

The fully equipped s.beat includes the expected set of key tools such as a knife, scissors and file inside its metal casing, in addition to the DAP. There is also a "flight version" which comes without tools.

If you want the best of both worlds – to make it through the security check at the airport, but still have all the tools – you can detach the MP3 player from the main body and attach the protective cap that is supplied with it.

The USB player can be carried separately.

In terms of capacity, you can choose between 1, 2 and 4 GB. The s.beat is fascinatingly diverse: It is an audio player, radio, USB memory stick and voice recorder all in one. Its integrated lithium polymer rechargeable battery delivers eight hours' playback time and is charged in computer USB ports. In case you need to access a USB interface that is hard to reach, the s.beat is supplied with an additional USB extension cable.

READY FOR USE ANYWHERE

Also included in the package is a multifunctional adapter. Thanks to its intelligent mechanism, it is compatible with all types of international wall sockets.

Along with a USB connection to recharge the s.beat's battery, it also boasts an extra interchangeable socket that can be used to plug other electrical devices, such as hairdryers and electric shavers, into any socket in the world.

The s.beat is available with many attractive extra accessories. You can find various accessories for all the Swissbit models, as well as additional information and downloads at www.swissbit.com – Radio Guide –

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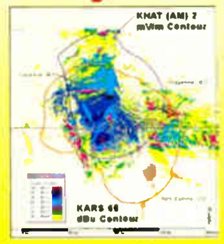

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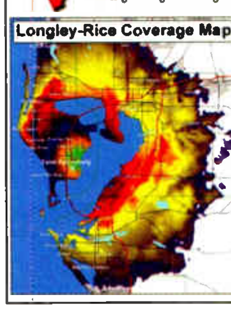

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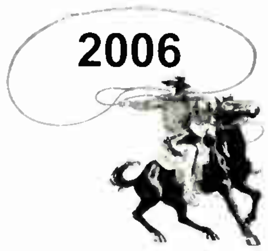

2006 RADIO ROUNDUP

The Radio Guide Industry Date and Event Register

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

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

New York City Ennes Workshop (SBE Chapt. 15)
June 17, 2006
4 Times Square, Midtown Manhattan
www.sbe15.com

Northern New England Broadcaster's & SBE 110
June 22, 2006
Manchester, New Hampshire
bteffner@wcax.com

New York State Broadcasters Conference
June 25-27, 2006
Lake George, New York
www.nysbroadcasters.org

31st Annual Conclave
July 13-16, 2006
Minneapolis, Minnesota
www.theconclave.com

SBE Leader-Skills Course II
August 8-10, 2006
Radisson Holte Airport, Indianapolis, Indiana
www.sbe.org/cal_index.php

AM/FM License Expiration Dates
August 1, 2006
Delaware & Pennsylvania
/www.fcc.gov/mb/audio/renewal/index.html

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

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

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

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

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

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

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

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

– 2007 –

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

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

SBE Certification Exam Dates

Exam Dates	Location	App.Deadline
November 10-20	Local Chapters	Sep. 22, 2006

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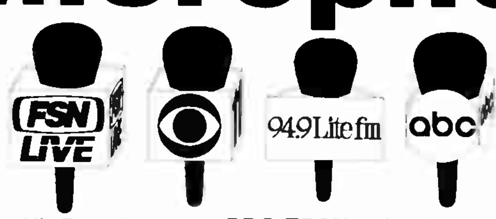

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