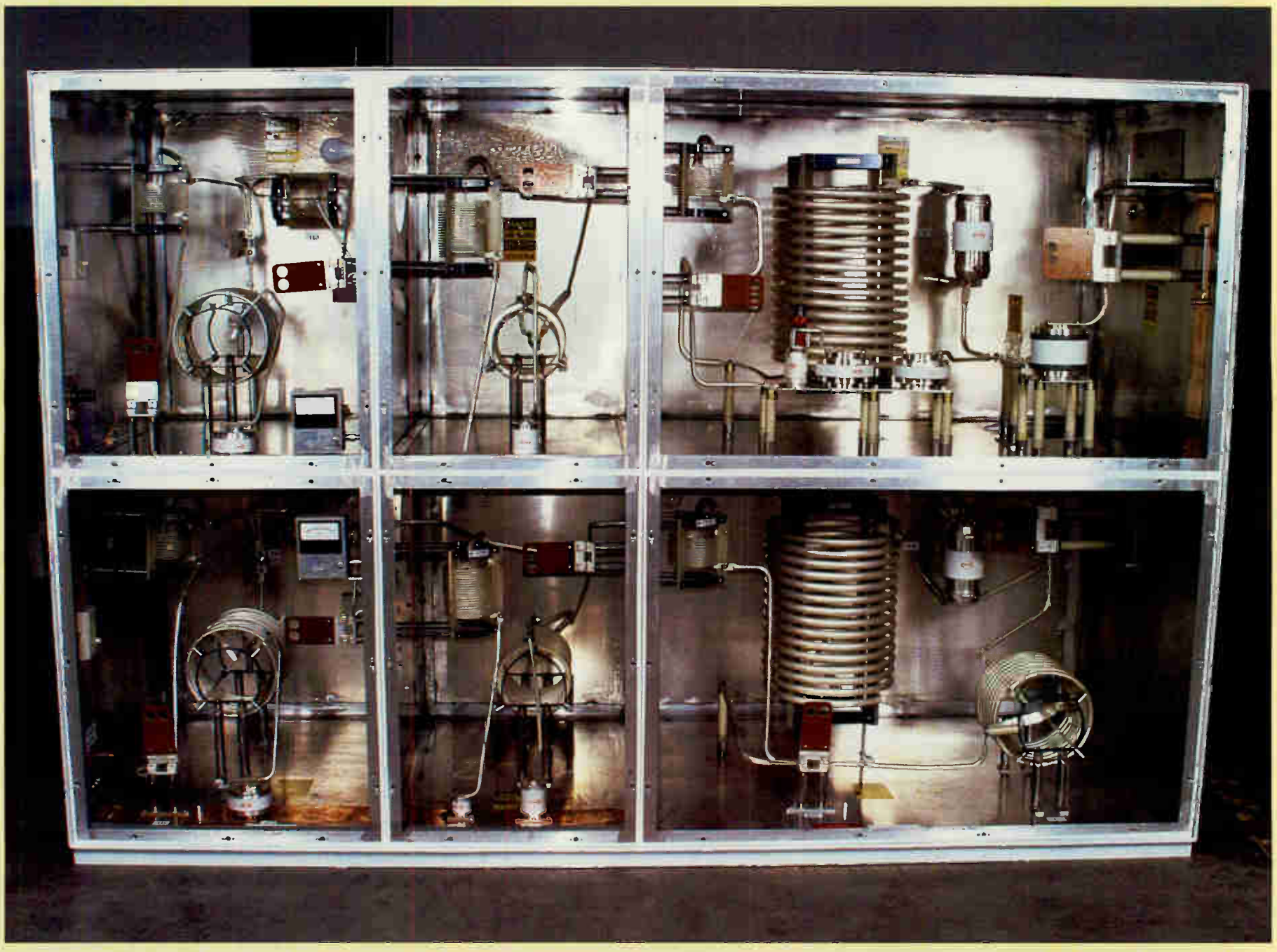
Radio Guide

Radio Technology for Engineers and Managers October 2007

Maximizing Vertical Real Estate by Diplexing AM Stations



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Two AM Radio Stations One Tower

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Why not have two AM stations share the same radiator? Actually, it is possible; it has been done for a long time and, as the intricacies involved in locating AM transmitting facilities become more difficult and expensive, this alternative becomes more and more attractive.

Here, we will examine the basics of collocating two AM facilities and the fundamentals of how and why the AM combiner, also called a diplexer, works. You will not walk away as an expert after reading it. However, we hope it will spark some thought on how to arrive at a solution to what might seem to be an almost unsolvable predicament: having to locate or relocate an AM transmitter site.

Radio Guide

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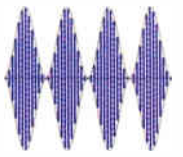
Radio Waves

by Barry Mishkind – Editor



They say the best minds are those capable of thinking outside the box. Our goal this month, as with each issue of ***Radio Guide***, is to lay out some of the best thinking in the industry and give you ideas on how to do your job better.

Sure, electronics has its hard and fast rules. Often circuitry is designed to be fairly straightforward – at least the parts that are user serviceable. Nevertheless, when troubleshooting a problem, we may come up against the unexpected; something that should work just does not.

That is when the great engineer's creative mind kicks in to figure out a problem's cause and solution – or, at least, figures out how to get there. It may be some knowledge, a trick that was picked up, or just knowing whom to call to get the clue needed to solve the problem.

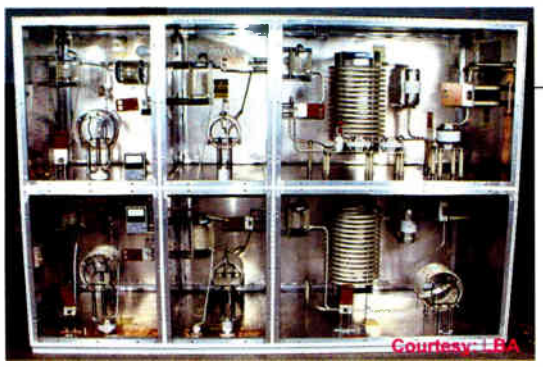
When we learn from one another, we can use the knowledge to plan ahead and solve some problems before they hit. For example, if you have ever been in an emergency situation and picked up a phone, only to hear silence, following Jack Gardner's tip (Page 16) on getting reliable phone lines now could save the day sometime.

Also, since few transmitter sites feature complete shops and tool kits, reviewing Jeff Welton's suggestions (Page 18) could ensure you will have what you need the next time you need to fix something.

Tips and tricks come from unexpected places. As George Zahn points out (Page 12), you may well have some talented ears on staff. All you have to do is get to know them. Understanding the station staff and how they do their jobs often leads to relationships that can make your job easier, which is Tom May's point (Page 14).

Please read on. We want you to be a great engineer!

– Radio Guide –



Transmission Guide

Two AM Radio Stations, One Tower

by Jack Layton, CPBE

"Vertical real estate" is a phrase that had no practical meaning a couple of decades ago. Its mere mention would have brought questioning frowns, much like the puckered brow of the caveman on the Geico commercial when his response is invited – *"What?"*

Even today, if the phrase is mentioned in casual conversation, the average person might react in the same manner as the caveman. When, however, the subject of vertical real estate is brought up in a conversation with broadcaster technical types everyone recognizes it as an antenna structure for a broadcast facility.

VERTICAL REAL ESTATE

To begin, vertical real estate is expensive. The investment involved in the construction of the tower associated with a broadcast facility is considerable. In addition, the horizontal real estate associated with locating such a structure is also expensive.

Furthermore, in many localities it is nearly impossible to obtain the necessary permits to construct anything taller than 50 feet! The NIMBY (not in my back yard) clause associated with the self-preservation instinct of human nature is sure to come into play. Plus, the ongoing maintenance of the painting and lighting of such a structure is not an insignificant figure on the annual operating spreadsheet.

For a long time it has been common practice for towers to be shared by several FM, TV, microwave, cellular and two-way communication antennas. It is also not unusual to see the support structure for these same facilities doing double duty as an AM radiator. This dilutes the costs of maintenance and allows the owner of the tower to quickly recoup some of his capital investment.

MULTIPLE AM SIGNALS?

Why not have two AM stations share the same radiator? Actually, it is possible; it has been done for a long time and, as the intricacies involved in locating AM transmitting facilities become more difficult and expensive, this alternative becomes more and more attractive.

The objective of this article is to examine the basics of collocating two AM facilities, and the fundamentals of how and why the AM combiner, also called a diplexer, works. You will not walk away as an expert after reading it. However, we hope it will spark some thought on how to arrive at a solution to what might seem to be an almost unsolvable predicament: having to locate or relocate an AM transmitter site.

At the least, this material will contribute to your knowledge of the subject – to be stowed away in your memory banks and brought out to be applied to a future problem at a future date.

RADIATOR CONSIDERATIONS

It is rare that collocated AM facilities start out to be that way. If you are fortunate enough to be in this situation you can begin from scratch to optimize the design for both facilities.

More than likely you will be faced with the situation of having to locate your transmitter site at an already built and operating AM facility – or having another station collocate on your tower. In this situation there are some already cast-in-stone facts that you will have to take into consideration before moving forward.

First off, the site must be located where the facility will provide the minimum amount of required signal over the city of license.

In addition to the location, the height of the existing radiator has to be analyzed. Ideally, the tower should be between 70 degrees and 225 degrees tall at both frequencies. If night time operation is a part of the equation the vertical angle skywave generating characteristics of the tower must also be taken into consideration.

OPPOSITE ENDS OF THE DIAL

Widely spaced frequencies could pose an efficiency problem: a 150-foot tower serving as a 90 degree, quarter-wave radiator at 1600 kHz will only be 30 electrical degrees at 540 kHz. This will not meet the FCC's minimum efficiency requirements at the lower frequency. At the other end of the spectrum, a 455-foot, 90 degree radiator at 540 kHz will be 266 degrees at 1600 kHz. This is much taller than optimum for use at the high end of the band.

Such a coupling might be usable by installing a three-wire detuning skirt on the upper part of this structure to electrically shorten it at 1600 kHz. If done correctly it will have minimal effect on the structure's radiation characteristics at 540 kHz.

CLOSE NEIGHBORS

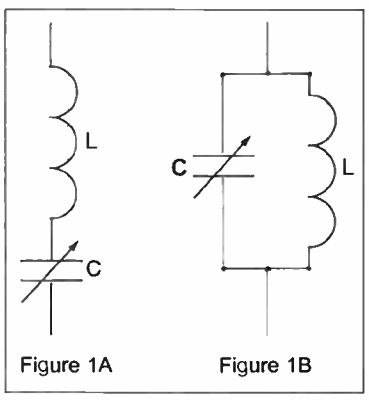
On the other hand, the frequencies of the two facilities must not be too close together. Generally, a bare minimum of 150 kHz between them is acceptable.

There must be a minimum of 80 dB of isolation between the two transmitter ports – that is, energy from transmitter A must be attenuated by 80 dB at the input on the combiner where the output of transmitter B is fed into the system and vice versa. If the frequencies are too close this isolation will be impossible to obtain. Excessive intermodulation products are likely to be generated.

KEEPING THE STATIONS APART

The series/parallel pass/reject tuned circuit is the basic building block of the combiner.

The RF attenuation through the series resonant L/C circuit **(Figure 1A)** will be minimal at the frequency where the capacitive reactance (X_C) of C is equal to the inductive reactance (X_L) of L. The RF attenuation through the parallel resonant L/C circuit **(Figure 1B)** will be maximum at the frequency where the capacitive reactance of C is equal to the inductive reactance of L.



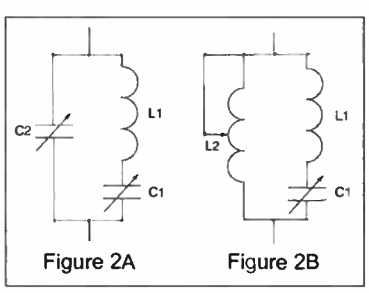
Basic series and parallel circuits.

In other words, the series resonant circuit can be looked upon as a pass filter and the parallel resonant circuit a reject filter. If we were to combine the characteristics of the two by careful selection of reactive values we can create a pass/reject filter.

A PRACTICAL EXAMPLE

Station A operates on 800 kHz; Station B operates on 1200 kHz. L1 in the series circuit **(Figure 2A)** is 30 uH. It presents an inductive reactance (X_L or +X) of +150.8 Ohms at 800 kHz.

When C1 is adjusted to .001319 uF, –150.8 ohms capacitive reactance (X_C or -X) at 800 kHz, the combination forms a series resonant circuit at that frequency. Attenuation of 800 kHz energy through it is minimal.



Typical series/parallel circuits.

At 1200 kHz the 30 uH of L1 presents an X_L of +226.2 Ohms; the .001319 uF value of capacitor C1 at this frequency presents an X_C of –100.5 Ohms. In this series circuit the reactances can be added together to determine the total which is +125.7 Ohms X_C (226.2 – 100.5).

Enter now the series/ parallel tuned circuit. If we place C2, a .001055 uF capacitor with a reactance of –125.7 ohms at 1200 kHz, across the L1/C1 combination we have a parallel circuit resonant at 1200 kHz. Thus, as shown in **Figure 2A**, we have a pass/reject filter where the pass frequency (800 kHz) is lower than the reject frequency (1200 kHz).

REVERSING THE FREQUENCIES

Let us now reverse the scenario making 1200 kHz the pass frequency and 800 kHz the reject frequency. The combination of L1/C1 **(in Figure 2B)**, is chosen to series resonate at 1200 kHz. As we saw above the 30 uH inductor presents an X_L of +226.2 Ohms at 1200 kHz.

Therefore, if C1 is adjusted to .000586 uF (–226.2 Ohms) a series resonant circuit at 1200 kHz is created. At 800 kHz L1 presents an inductive reactance of +150.8 Ohms and C1 a capacitive reactance of –339.5 Ohms. The combination results in an X_C of –188.7 ohms (+150.8 – 339.5) at 800 kHz. An inductor of 37.5 uH, X_L of +188.7 Ohms, across the L1/C1 combination will form a parallel resonant circuit at 800 kHz.

Thus, in **Figure 2B** we have a pass/reject filter where the pass frequency (1200 kHz) is higher than the reject frequency (800 kHz).

THE COMBINER

With the pass/reject circuitry under our belts, we can proceed to placing these building blocks of L/C circuits into their proper places to configure a viable combiner that will allow the two transmitters, one at 800 kHz and the other at 1200 kHz, to share the same 310-foot uniform cross section, guyed tower. The block configuration of the combiner is shown in **Figure 3**.

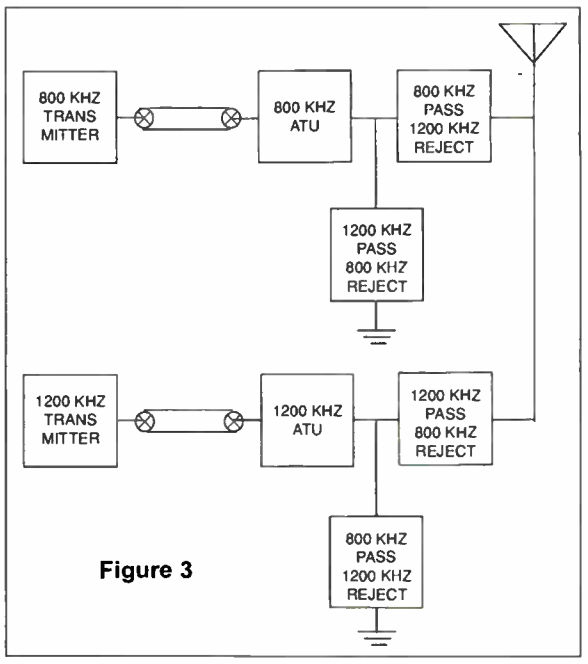


Figure 3

A typical combiner system.

The pass/reject circuitry is as shown in **Figures 2A and 2B**. The radiator is 91 degrees, just slightly taller than a quarter-wave length at 800 kHz, and 136 degrees at 1200 kHz. The measured input impedances at the two frequencies are 50 +j68 and 425 +j200 respectively.

FOLLOWING THE RF

Each transmitter feeds its own coaxial transmission line out to the base of the tower. Separate T-networks comprise the antenna tuning units (ATUs) matching the coaxial feed lines to the base impedance at the respective frequencies.

For the 800 kHz feed, an 800 kHz pass/1200 kHz reject circuit is placed in series with the feed between the ATU network and the tower. A 1200 kHz pass/800 kHz reject circuit is placed between the output of the ATU network and ground. It provides a low impedance path to ground for the minimal amount of 1200 kHz energy that manages to flow back through the 800 kHz pass/1200 kHz reject circuit. At 800 kHz it is a high impedance.

(Continued on Page 6)

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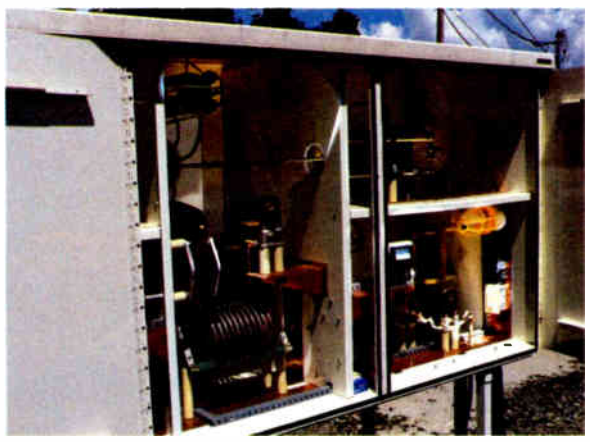
Transmission Guide

Continued From Page 6

Two AM Radio Stations, One Tower

In the 1200 kHz feed the same configuration of circuitry is used, this time passing 1200 kHz energy from the ATU to the radiator and rejecting 800 kHz energy flowing back from the radiator. An 800 kHz pass/1200 reject circuit shunts 800 kHz energy present to ground while presenting a high impedance to the flow of 1200 kHz energy.

The outputs of both networks are connected to the radiating structure. The entire configuration of ATU T-networks and the four pass/reject networks form the combiner.



Part of an installed combiner cabinet.

ADJUSTING THE COMBINER

Each reactive branch of each network is first adjusted to its calculated value using an RF bridge and a signal generator. The pass and the reject circuits are then touched up by injecting signal from the generator, at the appropriate frequency, into one input port while adjusting for a minimal amount of this energy at the other input port of the combiner as indicated by a tuned voltmeter (a field intensity meter) on that other input port.

Final touchup is then accomplished by energizing the system with a moderate amount of RF power from the transmitters and fine adjusting for a minimal amount of intermodulation products as observed on a spectrum analyzer.

COLLOCATING AM DIRECTIONALS

Not only is it possible for two non-directional stations to share the same radiator but a pair of directional stations can share the same set of towers, each producing its own individual and distinct radiation pattern.

All of the considerations heretofore mentioned must be taken into account. In addition, the physical configuration and orientation of the towers must be such that both radiation patterns will provide adequate signal over the city of license and adequate protection for same and adjacent channel stations.

The transmitter for each facility would feed its own phasor and would have its own set of transmission lines. Just as we did for the non-directional station there would be an ATU network and the appropriate pass/reject circuits at the base of each tower.

Once the combiner circuitry is properly adjusted the directional antenna systems are then adjusted to produce the desired patterns. A current transformer at the output of the ATU network is used as the sampling device. At this point it will see only the RF energy from one station.

DESIGN CONSIDERATIONS

The design, construction and adjustment of combiners is best left to the experienced engineer. Adequate isolation between input ports will result only when there is careful selection of the component values for the pass/reject circuits.

Physical isolation (read electrical/mutual coupling) between components must also be taken into consideration. For starters, the components associated with the 800 kHz feed are best mounted in a shielded box, separate from those associated with the 1200 kHz feed. If the inductors in the pass/reject filters couple energy, one from another, the electrical isolation between the two RF input ports will suffer.

Furthermore, sufficient internal shielding between components as well as orientation of the inductors to minimize coupling is a must.

THE TRIPLEXER

If you thought the diplexer/combiner bordered on black magic, now enter the triplexer world.

As its name implies, this provides for three transmitters to be combined into a single antenna. The complexities of design and adjustment of such a system are greatly magnified over that of the diplexer. As a matter of fact, such a system makes the two-frequency combiner look like child's play! All of the aforementioned criteria of tower height and frequency separation must be met and there will be three ATU networks and three sets of pass/reject circuits.

WELCOMING A NEW NEIGHBOR

A single piece of vertical real estate can be used for many simultaneous purposes. As we have just seen, two or three AM stations can use the structure for their radiator. At the same time, the same tower can be used as the support structure for several FM antennas, STL antennas, RPU antennas and two-way radio antennas.

Indeed, when the cellular operator comes to town looking to locate a site, and the town fathers tell him to go away, the existing tower owner can step up and say, "Welcome, we can – and will – accommodate you!"

Jack Layton is a long-time consulting engineer, author, ABIP inspector, and surveying enthusiast in McMurray, PA. Contact Jack at layton2@earthlink.net

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FCC Focus

by Cary Tepper

Don't Jump the Gun

Anyone who has ever owned or managed a radio or television station knows that a lot of careful planning goes into building a new broadcast facility – or modifying the operations of an existing facility. What many people do not know is that the Rules and policies of the FCC strictly dictate the scheduling of the many activities necessary in constructing or modifying a broadcast station.

HOLD YOUR HORSES

Whether you decide to build a new tower structure or lease space on an existing tower structure, each alternative has its own unique challenges to overcome. Besides choosing the right equipment for your budget, there are often local and state regulations with which you must comply.

But, just when you think you have everything in place to move forward, a bright red neon sign appears on the horizon with an important message – "Beware of Premature Construction."

Many broadcasters and engineers do not realize this, but the policy is decades old. You simply cannot build a new tower structure or install a new antenna and transmission line at will. In fact, many activities are considered unauthorized until you get the required FCC Construction Permit.

SECTION 319(a)

The root of the problem, so to speak, is found in Section 319(a) of the Communications Act, which states in the pertinent part that *"no license shall be issued under the authority of this Act for the operation of any station unless a permit for its construction has been granted by the Commission."*

Although the wording of Section 319(a) has changed slightly in the last twenty-seven years, the interpretation has remained generally the same – you are absolutely prohibited from doing certain things until the FCC issues you a Construction Permit.

Certain FCC Rulings from the early 1980s indicate that one of the purposes of Section 319(a) was to discourage broadcast applicants from making considerable investments in the construction and installation of broadcast facilities and then use those investments to exert undue pressure on the FCC to authorize service.

The legislative history of Section 319(a) clearly shows that an overriding Congressional concern was the prejudicial effect that a "substantial expenditure" would have on the FCC's consideration of a particular application. At the time, Congress differentiated between substantial expenditures and minor expenditures, since the language of Section 319(a) must also be implemented in conjunction with the FCC's companion statutory responsibility to provide a prompt institution of broadcast service.

LEARNING FROM THE RULINGS

The FCC has not published any convenient list of permitted or prohibited actions, so the only reasonable guidance available to us comes from the select number of published Rulings regarding premature construction.

Some of the FCC's Rulings are a little vague. We need to be careful not to make any assumptions. Each Ruling is carefully worded, and must be viewed narrowly, such as:

Ruling 1. The construction of three steel sleeves intended for use as support for a television tower to be located on the roof of an applicant's present studio building was prohibited before the FCC issued a Construction Permit, since there is no evidence that the three sleeves used together could be used for anything other than to support the proposed new tower.

In contrast, the construction of a rooftop room to house transmitting equipment was permissible since that small building had, in and of itself, no intrinsic television facility function. (WSAV, Inc., 1955).

DELIVERY AND INSTALLATION

Ruling 2. The purchase of a transmitter and its delivery to the transmitter site may be done prior to the issuance of a construction permit. The transmitter may be delivered, but not installed prior to the issuance of the construction permit. (Nelson County Broadcasting Co., 1977)

In other words, you can have the transmitter delivered and set up, but you cannot connect it to the transmission line until the FCC issues the Construction Permit.

Ruling 3. The installation of a tower base and anchors and the installation of a new power line (which would be impossible to accomplish in winter months) does not constitute prohibited premature construction. (Christian Broadcasting of the Midlands, 1986)

Please note that the language specifically mentions the winter months. What is not clear is whether all of this activity would be impermissible for a broadcaster in a warmer climate who does not have severe winter weather with which to contend. *(Continued on Page 10)*

FCC Focus

by Cary Tepper

Continued from Page 8

In all likelihood, this Ruling must be narrowly interpreted for parties with a winter weather issue because the only other similar published Ruling related to a broadcast station regarding the pouring of concrete footings involved a Michigan broadcaster.

In that situation, the FCC stated that *"you are the licensee of several radio broadcast stations located in Michigan and that as a practical matter it is impossible to pour concrete footings for towers about six months of the year because either the ground is too frozen to be dug or the concrete will not properly cure. As a consequence, you state that a Construction Permit issued between November and April in northern states is effectively conditioned to an April commencement date."* (Patton Communications Corporation, 1980).

WHAT MIGHT BE PERMISSIBLE

Ruling 4. In 1988 the FCC published a point-to-point microwave case which affirmed that the literal language of Section 319(a) must be read in conjunction with the FCC's companion statutory responsibility to provide prompt institution of service to the public. Since this Ruling did not involve broadcast facilities, it is not clear whether the tower preparation work would be permissible for broadcasters.

Nevertheless, in this instance the FCC held that, while pre-authorization tower construction or installation of radio antennas is clearly prohibited, the following steps are unquestionably permissible prior to receipt of an authorization to construct: (1) site clearance; (2) pouring of concrete footings of a tower; (3) installation of a tower base and anchors; (4) installation of a new power line; (5) purchase and on-site storage (but not installation) of radio equipment and other preliminary steps not having an intrinsic radio communication use related to the proposed facility. (MCI Telecommunications Corp., 1988)

This Ruling pertained to several sites throughout the country, some of which were clearly subject to severe winter weather, and three sites which were in warmer climates. Since the FCC did not expressly distinguish the various sites in terms of a winter weather issue, it is simply not clear whether all five of the permissible activities outlined in this Ruling could reasonably apply nationwide to broadcasters regardless of climate conditions.

WHAT NOT TO DO

Ruling 5. The installing of antennas and transmission line – or increasing the height of a tower – is a significant violation of the prohibition on premature construction. (Virginia RSA 6 Cellular Ltd. Partnership, 1992)

This cellular telephone services Ruling was nearly identical to that issued against a California college in 1999 where the FCC held that the installation of an antenna, transmitter, transmission line and related wiring at a tower site prior to grant of the station's application to relocate was a clear violation of Section 319(a) of the Communications Act. (California State University at Sacramento, 1999).

RPU AND STL PROCEDURES

It is important to note that different policies and guidelines apply to Broadcast Auxiliary stations, such as studio-transmitter links (STL) and remote pickup unit operations (RPU), because the application and approval process is quite different from that which applies to full power station facilities.

Under the latest FCC procedures for STL facilities, you must first submit your proposal for frequency coordination *before* a formal FCC application is submitted. Since frequency coordination can take several weeks to complete, the FCC recommends that you begin the process at least sixty days before you actually need to operate the STL.

Once the frequency coordination is completed, a formal application should be submitted as soon as possible. At that time you can actually construct your STL *at your own risk*, and operate it for up to 720 hours, before formal FCC approval is secured. However, should the FCC deny your STL application or require you to amend the frequency or path, what you previously constructed might be inoperable or require expensive changes.

PLANNING PREVENTS PROBLEMS

If there is a general rule to be learned from the mistakes of others regarding these activities it would be to think twice before doing anything.

Please plan carefully and talk to your company's communications legal adviser before moving forward with any actual construction or equipment installation. It will not cost much, but could save you a lot of money and prevent fines.

Cary Tepper is a principal of the law firm Booth, Freret, Imlay & Tepper, PC in Bethesda, Maryland. He can be reached by phone at: (301) 718-1818 or email at: tepperlaw@aol.com

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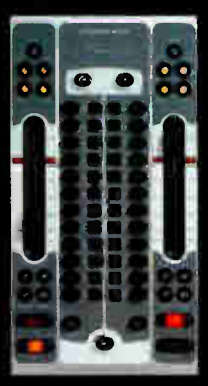

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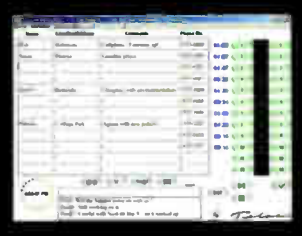

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Studio Guide

by George Zahn

Utilizing the Ears at Hand

Usually it is the Engineer or Program Director who decides how a station will sound. Sometimes the two work together. But are there other ears in the station that should be consulted? George Zahn discusses the "hidden resources" that may be around your station.

In our discussion of microphones and shaping your station's identity through the sound they create, it is important to determine whom you trust to make the decisions – or provide input so the right decisions are made.

WHO'S EARS?

Does the Chief Engineer have the right set of ears to make the call on what microphone or processing is best? Maybe it is the PD who writes up the order for replacement microphones. Perhaps your production director makes the call, even if he or she is simply great at editing and creative production. Or does the GM make an aesthetic or budget-based choice?

How much weight should be placed on these personnel, and possibly other players, including your announcers? We could poll 99 different stations and get 100 different answers. There is no magic formula – each radio station has the same basic titles, but the personal background and experience of each person is dramatically different.

It was during an innocent dinner conversation with a fellow broadcaster that our discussion turned to shop talk and I realized that some of the notions I once held about microphone decision-making for a station may have been too superficial, by limiting input to the personnel mentioned above.

A discussion on microphone changes at one of Cincinnati's top stations forced me to look deeper, and I would like to impart an important lesson I learned: Sometimes we need to look and listen beyond the commonly consulted directors. Understanding the backgrounds of our other staff may well help us discover surprising extra sources of competent input on our station's sound.

CASE IN POINT

My dinner companion was Chris Lynn, a midday music host and Assistant Program Director of WRRM-FM, a popular commercial music station in Cincinnati and consistent ratings performer.

Chris worked his way to the APD position after coming to WARM 98 in 1999. He has good radio background, which might well give him some room to talk about favorite gear. But when we talked about studios, I was assuming that he was like many in broadcasting: a product of some limited experience with the equipment we all have encountered in our stops along the way.

We had met just once before and promised we would get together again to discuss radio. I expected we would discuss programming and broadcast "war" stories with no interview intended; honestly, he did not know I wrote for ***Radio Guide***.

Then shortly into dinner, he started talking about microphones.

AN EDUCATED EAR

The key here is that he was not just mentioning a "Shure" or an "Electro-Voice" without the model numbers. He was discussing the detailed pros and cons of specific microphones. Some opinions I agreed with, others were different from my experience, but he was talking specifics, not just something he read in a trade magazine or happened to hear from someone else along the way.

It was obvious from the discussion he had first hand knowledge and, more importantly, could hear the differences between microphones – and could articulate those differences well. WRRM uses that kind of input from qualified staff such as Chris, but not all stations do.

"At WARM 98, the Program Director (T.J. Holland) basically has the final say on many microphone choices, but leans on the 'ears' of me as the APD for input," says Lynn, who says from his experience that consulting down-line staff on technical matters is not always done at other stations.

EAR OF THE BEHOLDER

On broadcast microphones, Lynn is not shy about his preferences; he is a big fan of the Electro-Voice RE-27, especially over the popular RE-20 (both are dynamic mics made by EV).

"The first generation RE-27s have a crisper sound, more like a condenser," Lynn says. "The newer generation seems to be less consistent on midrange reproduction. The RE-27 also sounds warm, and you can have more control over the proximity effect of the RE-27 by working the microphone from slightly different angles," he adds. "The RE-20 is just too flat. The RE-27 just punches through music better than an RE-20."

Nevertheless, the RE-20 remains a popular broadcast announce microphone. I asked him his thoughts on why the RE-20 remains a staple if the RE-27 is, in his opinion, better. "The RE-20 is reliable, and it's had great longevity," he said. "Just like the Shure SM58 for hand-held work, it's an old but good design."

As we were talking, I was thinking: "Here's a guy not just splitting hairs, but giving passionate opinions about his experience." It was the beginning of a lesson for me. If he had been on my staff and I only polled my top-line management, I might never have known his thoughts.

NOT A SHURE THING

I was interested in the FM station's approach to the increasing demands for announcer fidelity and performance. Lynn imparted an interesting story, as WRRM has faced a real dilemma that may be encountered at other stations.

According to Chris Lynn: "we had been having our old Shure SM5B microphones (now out of production) repaired over time, and the feeling was that even with the repairs, the SM5B's did not sound as good as they originally did." That posed a problem that, in this case, Lynn tells us was "fixed" mainly by the engineering staff.

"Our engineer heard a Heil Sound PR-40 microphone (list $325) and fell in love with it," said Lynn. "It's a rugged, inexpensive dynamic that was ordered to replace the old SM5B microphones." According to Lynn, the Heil Sound microphone was not a popular choice among all the staff. "It was great on affordability, but I found it was consistently muddy. I would have tried a RODE NT1-A or NT2-A for our studio applications."

(The RODE NT1-A (list $229) is billed as a low-noise studio cardioid condenser, the NT2-A (list $399) is a large diaphragm, switchable, three-pattern condenser (omni, cardioid, bidirectional) with a two-position bass roll-off (40 Hz, 80 Hz) and a -5 dB or -10 dB pad.)

TRY BEFORE YOU BUY

Clearly, microphones are among the most subjective choices we make as broadcasters. What might sound great as a demo to the engineer or other decision-maker in a show room or a foreign studio might not always work as well when it arrives at home base.

This is why we recommend trial runs in your own plant when at all possible, through the use of loaners from the manufacturer or dealer – or engineers temporarily swapping microphones.

A side note on the studio/microphone front, Lynn says that another key to optimal sound is a good microphone pre-amp. He reports that WRRM uses Symetrix 428 units for basic compression; otherwise the settings are flat, with any processing being done through the on-air chain by the station's audio processor.

MUSIC TO MY EARS

Part of the perspective Chris brought to the conversation was his musical background as a performer and as a recording engineer, neither of which are his full-time vocation.

This is not to say that anyone with a musical pedigree automatically becomes a microphone expert, nor does it necessarily make him more credible on broadcast applications. What I found in talking with him was that he was able to articulate some of his broadcast microphone perspectives better, utilizing his musical experience and understanding. His comment on the RE-27 "punching through music" led us down a path to music recording and one of the real surprises of this casual conversation-turned-interview.

I had taken his RE-27 comment to be that of an announcer on-air punching through the music when talking over a musical intro. As I asked further, Lynn explained he was actually referring to adding vocals in a music mix. My innocent question had revealed much more beneath the veneer of a radio announcer. Chris Lynn had been a musician for years and actually has recorded works in a home studio.

"BASS-IC" PIANO SET UP

For those of you who have mentioned that some of the music recording tricks we have passed along in these articles are helpful, I will share details on the most unusual piano setup I have heard in some time.

Chris has a 6'2" Steinway in his home studio, and proposes this as his favorite way to microphone that piano: "I like to use two SM 81's (affordable Shure cardioid, electret condenser microphones) in a coincident pair above the strings." OK, I was with him so far – that is a pretty basic setup for stereo pickup of a piano.

Then he hit me with the twist: "I also have mounted an inexpensive AudioTechnica PZM on the crossbeam under the piano near the bass strings," he added, "that gives me the full bass of the instrument. But I have to warn you it may not always work if the piano has pedal trap issues. That might take some adjustment."

I personally have done coincident, matched condenser stereo miking overhead before – even using a "High-Low" setup: one cardioid condenser (e.g. Shure SM81) over the treble strings, along with a cardioid dynamic microphone (e.g. Sennheiser MD 421) underneath the piano and aimed up at the bass strings using the sound board as a baffle to prevent phasing. But I had never thought of adding what I called a "sub-woofer" microphone under the piano in addition to the stereo pair up top. Whether it is a broadcast or music studio, we are always learning!

USE YOUR RESOURCES

The bottom line: An engineer may be terrific on towers and the transmitter, the PD may be able to create a clock that smokes the opposition, the production guru may be the best editor you have ever met, and the general manager may be an astute artist at judging character and team building.

We may win awards and we are well-deserving of our positions, but we all know that no member of our team is perfect. Indeed, we may each have opinions about microphones, but which of us has the real experience? Do we simply give credence to everyone on staff who sits in front of or sets up a microphone? Definitely not.

We cannot assume that the input should only come from our first-line management, no matter how valuable they might be. Instead, by cultivating the right people on our individual teams who have the "ears" – and can articulate the differences – we just might find an unexplored "golden ear" capable of giving us invaluable input on our microphone and processing choices.

We need to understand and "mine" those sometimes hidden resources on our staff. How many Chris Lynn's do you have around that might bring to the table a different way of looking at microphones or processing – someone how could help your station stand out on the dial?

George Zahn, Station Director at WMKV-FM in Cincinnati, OH, enjoys discussing new techniques to help stations improve their sound. E-mail him at gzahn@lifesphere.org

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Nothin' but Net • Did you know you can plug a PC directly into an IP Audio network to exchange audio? Can't do that with a mainframe router. Well, you *could* add more input cards to the mainframe, buy high-end audio cards and run more wiring... but with Axia, you just install the **IP-Audio Driver** on any Windows PC to send and receive pure digital audio right through the PC's Ethernet port — no sound card required or additional router inputs needed. The single-stream version is great for audio workstations; the multi-stream version lets you send and record **16 stereo channels simultaneously** — perfect for digital automation systems.

Put that in your pipe • How many discrete wires can a CAT-6 cable replace? Well, a T-3 data link has 44.7 Mbps of throughput. But Axia networks' Gigabit Ethernet links give 1000 Mbps of throughput between studios – more than 22 times the capacity of a T-3, enough for 250 stereo channels per link — the equivalent of a **500-pair bundle on one skinny piece of CAT-6**. Use media converters and optical fiber for even higher signal density. Think that might save a little coin in a multi-studio build-out?

Level headed • These green, bouncing dots built into every Axia Audio Node are confidence meters. One glance and you know whether an audio source is really active — or just playing possum.

Jammin' on the mic • Radio studios and microphones go together like Homer Simpson and donuts. Unfortunately, so do preamps, mic compressors, EQ boxes, de-essers — let's face it, most studios house more flying saucers than Area 51. Axia helps clean up the clutter by including mic preamps with our Microphone Nodes; not bargain-basement units either, but **studio grade preamps** with headroom enough to handle Chaka Kahn. Phantom power, too. And if you choose to use Axia Element consoles in your studios, you'll find world-class mic processing built right in: vocal dynamics (compression and de-essing) from the audio processing gurus at Omnia, plus three-band parametric EQ with SmartQ, available on every mic input. Rap on, Grandmaster.

Very logical, Captain • Routing logic with audio used to be as hard as performing the Vulcan Mind Meld. But Axia makes it simple, converting machine logic to data and pairing it with audio streams. So **logic follows audio throughout the facility** on Axia's switched Ethernet backbone. Eight assignable GPI/GPO logic ports, each with five opto-isolated inputs/outputs, are built into every Element power supply, so you can control on-air lights, monitor mutes, CD players, DAT decks, profanity delays, etc. Got more than eight audio devices? Add a GPIO node like this one wherever you've got gear.

AES yes • You like your audio to stay digital as much as possible, right? We get that; our AES/EBU Audio Nodes let you plug AES3 sources right into the network. Studio-grade sample-rate converters are inside, anything from **32 kHz to 96 kHz** will work. Oh, and there are 8 AES ins + 8 AES outs in each node. Digital distribution amp, anyone?

Heavyweight champion • This Axia StudioEngine works with our Element Modular Consoles (the fastest-growing console brand in the world, by the way) to direct multiple simultaneous inputs and outputs, mix audio, apply EQ, process voice dynamics and generate multiple mix-minuses and monitor feeds on the fly. To make sure it delivers the reliability and ultra-low latency broadcast audio demands, we powered the StudioEngine with a fast, robust version of Linux — so fast that **total input to output latency is just a few hundred microseconds.** How can one little box do so much? There's a blazingly fast Intel processor inside, with enough CPU muscle to lift a small building. Strong *and* fast: Ali would approve.

Push to play • Axia Router Selector Nodes are **really advanced selector and monitor panels** that you can put anyplace you need access to audio streams. Like newsrooms, dubbing stations, or even the station's TOC, so you can monitor any of the thousands of audio streams on your network at a moment's notice. The LCD screen scrolls through a list of available streams, the eight Fast Access keys let you store and recall the streams you use most. There's even an input, for convenient connection of an analog or AES device. Sweet.

Brains in the box • The typical radio jock cares for studio equipment about the same as a five-year-old cares for a puppy: haphazardly, if at all. That's why we **took the CPU out** of our Element modular console and put it in here, with the power supply and GPIO ports. That means a greatly reduced chance of being taken off the air by a Coke spilled into the board. Because we know that you have better things to do on a Sunday night than trying to dehumidify circuit boards with a hair dryer.

You got to have friends • Delivery system providers like ENCO, Prophet, BSI, BE, iMediaTouch, DAVID Systems and more all have products that **work directly** with Axia networks. So do hardware makers like AudioScience, International Datacasting, 25/Seven, Telos and Omnia. Check out the whole list at AxiaAudio.com/partners/.

Quick Connect • Axia I/O is presented on RJ-45 and adheres to the StudioHub+ standard. A couple of clicks and you're done.

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Routing

Survival Guide

by Tom May

Taking Proper Care of Your Newsroom – and News Crew

Perhaps you are busy at the workbench troubleshooting a piece of gear when a voice quietly mutters "I hate to bother you, but I think there's something wrong with my microphone cable." Looking up, you see an XLR connector dangling by the cable shield.

It is obvious the connector simply has worn out and the reporter standing sheepishly in your doorway has probably been fighting with it for weeks or even months. If this situation sounds familiar, it might be a sign that it would not hurt to spend a little more time building the relationship with your news staff.

PERCEPTIONS

Left un-nurtured, the relationship between reporters and engineer can sour quickly. Engineers are busy from the moment we set foot through the door until we go home.

Reporters also have busy days. From their perspective, the engineer can be very intimidating, especially when looking to get a "simple microphone cable fixed." They see someone who has little time, speaks in gibberish, and wields a smoldering metal stick. Many have never seen a circuit board in person, with its vast copper highways and blue cylindrical buildings.

From the engineer's perspective, it may seem the newsroom is full of people rather proficient at hassling you with mundane problems. Still, as any good engineer knows, if you do not properly maintain a piece of equipment, chances are it is going to break down at the most inopportune time. That is why it is important to give your newsroom some extra TLC.

DON'T CHEAP OUT ON NEWS

Sadly, the equipment in many newsrooms can be found in a dilapidated state. This gear takes a beating during day-to-day operations even with the most delicate operator. Yet it is probably the most under-maintained equipment in your facility. If your station is serious about news operations, this is not the place to get cheap.

When a reporter comes to you with a problem, it is important to look into the issue quickly and in a positive manner. Nine times out of ten the fix is simple and will only take a few moments of your time – including explaining the fix to the reporter. If you simply fix things and walk away, you become a babysitter instead of a mentor.

True, sometimes equipment is abused and the user will try to abuse your good nature as well. Do not suffer these situations silently! Your time is valuable – and this goes double for cases where you must make unnecessary repairs. When someone has damaged equipment through carelessness or neglect, let them know exactly how much time and money is being lost. If a trend emerges, inform management and provide a detailed history. A paper trail with dollars spent and hours lost is hard to overlook.

PROVIDE THE RIGHT TOOLS

A good field kit for news should contain two different microphones: a handheld "stick" microphone for interviews and a short shotgun microphone for natural sound gathering. Your kit should also include various adapters and attenuators. Many mult-boxes run a bit on the hot side and a 10 dB pad can easily become a lifesaver. (A 50 dB pad is equally as valuable if a reporter needs to piggyback the line-out of a TV camera.)

Solid state flash memory recorders are available now at cost-effective prices. Imagine the look on a reporter's face when you tell them they no longer have to change media every 75 minutes of recording, or that recordings can be transferred to their workstation in faster than real time!

But simply giving your reporters these tools is not enough. You need to take time to teach them what various connecters look like and what they are called. They need to understand the difference between microphone and line level. Consider common mistakes that someone might make with the equipment. Let your reporters practice interviewing you, and point out any mistakes they make in a constructive way.

BUILD BRIDGES

Never treat the news staff harshly. Sure, it is easy to fire off a nasty remark at 5 a.m. when you get a phone call saying "the console is broken," when the person simply forgot to put the microphone in "Program." Have you ever pulled away from the transmitter site early in the morning, only to get two blocks down the street and realize you are still on the dummy load? Cutting some slack here can buy you major respect points down the road.

Instead, bite your tongue a bit and keep in mind that reporters and engineers share many attributes. For example, we both work unusual hours and we know what it is like to be on call.

Take the time to talk to your reporters in passing – that hammer you were fetching can wait a few minutes. Ask them what they are working on and how their equipment is performing. Give your reporters the opportunity to ask questions, by doing so you put them in their element. This helps to defang your mysterious nature, and chances are you can catch a problem before it goes critical.

UNDERSTAND DIFFERING PERSPECTIVES

Keep in mind that engineers and reporters have two completely different perspectives on the world.

The engineer spends time understanding how physical things interact, while reporters on the other hand are equally fascinated by the interaction between people. The problem is that reporters must understand various types of communication technology in order to successfully do their jobs, just as you must interact with your co-workers effectively.

As an engineer you need to provide your newsroom not only with the right tools, but the proper training on how to use them.

HELP THEM BE SAFE

Safety is commonly overlooked when it comes to a typical radio news operation.

Take battery safety for example. Most people take batteries for granted; frequently there is little respect for the power they possess. Teaching your staff not to carry batteries in their pockets or allow them to come into contact with jewelry is crucial.

Also, make sure your staff can identify the difference between a "Heavy Duty," Alkaline, NiCD/NiMH, and Lithium-ion batteries. They need to know which ones can be thrown in the trash, which can be recharged, and the consequences if batteries are abused. A simple search on YouTube will yield many inspirational videos on why you should not abuse batteries.

SAFETY IN THE FIELD

Of course, just like you, reporters are typically running toward the problem while everyone else is running away. Help them do it as safely as possible.

News gatherers may face downed power lines, flooded roadways, chemical spills, or any number of hazardous situations. There are seminars that specifically address the dangers reporters may face when out in the field – such training may be required by OSHA if remote vehicles are used in your daily operations.

Are your reporters ready for disaster? If a disaster occurs in your market, do your reporters know where backup facilities are located and how to use the equipment there? Are they prepared for a power failure or an EAS activation? A good disaster preparedness plan will always include your news staff – after all, what good is keeping the transmitter on the air if nobody is able to deliver vital information?

EVERYONE BENEFITS

Having a good relationship with your newsroom will save everyone from headaches and frustration. The story will get out, the reporters will stay safe, and you will get the respect of your fellow co-workers.

As an added bonus, often the news staff now will spot potential problems long before you do. Treating your reporters well will ensure you get the message and will save everyone from unpleasant situations down the road.

Tom May is the Chief Engineer for WUWM in Milwaukee, WI. He can be reached at tmay@uwm.edu

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Emergency Guide

by Jack Gardner

Maintaining Phone Service During Emergencies

With the move to electronic phone systems, VoIP, cell phones, etc., many stations face difficulty in maintaining communications during a major emergency. Jack Gardner provides some ideas on how to keep the phone operating, especially when all heck breaks loose.

When a major disaster, such as an earthquake, tornado, hurricane or a terrorist attack occurs, one of a station's most important tools suddenly may not be functional. While we plan to have field equipment and staff available to handle the demands of broadcasting during the emergency, many of us are not prepared for trying to do the job without telephones.

EMERGENCY PHONE LOSS

Here is an important thing to think about at every station: during emergencies when telephone traffic skyrockets, cellular networks overload and crash, and your land lines will usually experience severe dial tone delays due to call blocking.

During the 1989 Loma Prieta earthquake in San Francisco, we realized at my station that we had overlooked the probability of immediate overload of telephone central offices, and therefore experienced 20 minute or longer delays for dial tone. In addition, inward calling to area code 415 was totally blocked.

Without the ability to call out, we learned of the earthquake and collapse of a section of the Bay Bridge from monitoring California Highway Patrol frequencies.

OFFERING HELP

Also, we heard that KGO had suffered severe damage to their three tower antenna array and was off the air.

Since we had 50 kilowatts on 770 kHz with an ERP of 250 kW in our major lobe (aimed to the west), we sent a city grade signal over the entire Bay Area. The fact that our frequency was right between KCBS on 740 kHz and KGO on 810 kHz, the two major news and information stations in San Francisco, put us in the best radio neighborhood. I decided to offer to carry KGO's reports via our facilities which covered over 50,000 square miles of central and northern California.

However, we could not call directly to KGO, even after waiting half an hour for a dial tone from our local central office.

Finally, we decided to try using dial-in plus code access for long distance with an MCI credit card. That worked somehow because MCIs circuits were separate from the AT&T network and their switching and billing computers allowed access into the 415 area code. We arranged with KGO engineering for us to call in to a monitoring coupler to pick up their audio, which we then broadcast from our site east of the Bay Area for a little over a day. After KGO got back on the air with a temporary 10 kW signal, we returned to our regular schedule – with a heavy number of cut-ins for news and information updates.

PLANNING FOR THE FUTURE

This experience made us realize that any station with a commitment to public service should never be without functioning telephone service. I sought to find out how police, hospitals and emergency services managed to have working phone lines when others did not.

A couple of contacts made me aware of Essential Service lines. Since radio is the primary information dissemination medium, particularly when power outages are widespread, it certainly makes sense to consider land line communications critical. Hurricane Katrina is an excellent case study.

GETTING ESSENTIAL SERVICE

You should contact your station's land line provider and ask to have at least a couple of your lines specially designated as *Essential Service*. This functions when central offices are put into load control (or call blocking) and puts your designated lines in the same category as hospitals, law enforcement and other emergency services in having priority access to switching equipment.

Usually, a telephone company will not make all your lines Essential Service, but will do so with one or two lines. When your lines have been designated, you should see the code ESS shown by line numbers on your phone bills – these are Essential Service lines.

These days, you will probably have to be very persistent to get to the right person to get the Essential Service designation. With extreme persistence you may be able to convince your telephone company to make sure your essential lines are copper all the way to their central office, thus avoiding the potential for repeater failure.

Jack Gardner is the former owner of a large California station and was also a founder and part owner of the first private radio station in Russia, which grew into the Radio 101 Network. Contact Jack at jackgardner1@gmail.com

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Maintenance Guide

by Jeff Welton

Tools of the Trade

An engineer often heads to a transmitter not knowing what he will face, much less what tools he will need. However, as Jeff Welton explains, having a good toolkit need not cost a fortune.

Frequently over the course of a year, there is discussion on the Internet lists (e.g. www.radiolists.net) about tools and recommendations for what you need at the site, in the truck, at home, etc. In this article, we will discuss various levels of stocking for tools and equipment to have at your transmitter site, so that you never arrive to do an emergency repair, only to discover that the item you need is back in the shop.

WHAT DO YOU NEED?

Before you start stocking the tool box, it is important to have a goal in mind. What level of maintenance do you need to be able to perform?

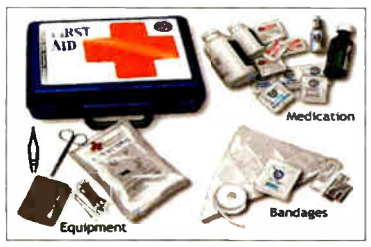
For example, if all you are interested in is a kit to make sure you have the necessary items for emergency repairs, you probably will not need the equipment to do bench level work. Site conditions also have an effect on your choices; if you have running water or air conditioning on site, you will require tools that are unnecessary at sites without water or air conditioning.

We will try to break down the following suggestions in increasing order of detail, based on equipment and level of repair. Keep in mind that the following is only a series of suggestions and that it will be necessary to take a look around your plant to see what other specific items may be needed that are not mentioned.

PLAY SAFE!

Before we start with hand tools, there are two items that should be present at every transmitter site – or any other location where you may be working.

Item number one is a properly stocked First Aid kit. If your site work is primarily limited to inside the building, this would include Band-Aids, gauze, cleaning wipes, sterile dressings, adhesive tape, and scissors as an absolute minimum. Burn dressings are also recommended. A good idea is to consider the nature of injuries that would typically be possible, based on the type of work you do.



A basic First Aid kit is essential.

If you are in a remote area with snakes, an anti-venom kit is also a good idea. If the site is not equipped with potable running water, then a couple of bottles of water will help clean any wounds prior to dressing – not to mention providing prevention against dehydration.

And here is an important point: with all First Aid kits, if you use something, *replace it immediately!*

FIRE CONTROL

The second thing that is an absolute must is a fire extinguisher – and please remember – it must be certified for use with electrical fires. In most cases the extinguisher should have a Class C rating (for electrical fires) as well as a Class A rating (for handling ordinary combustibles).

Whichever type you use, take the time to understand the capabilities of the extinguisher, so you have the right one for the job. Some firefighters advise against the powder-type Class ABC units, as they tend to be corrosive to electronic gear.

Furthermore, for anything except the smallest transmitter room, it is a good idea to have more than one extinguisher available, so they are always close at hand. It would not hurt to have one in the truck as well.


Keep several handheld fire extinguishers handy.

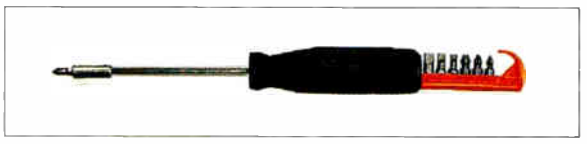
Especially if you are doing any brazing or torch work, a Class A water extinguisher should be at the work location before work starts, not mounted to a wall three rooms and fifty feet away. By the time you run to get it, you may be facing a much more serious situation.

The condition of the extinguisher should be regularly checked as part of your maintenance program. Otherwise, it might not discharge properly when you need it.

THE BARE MINIMUM

There is a short list of items such as which make up my travel kit pretty much anywhere I go, regardless of the job. These tools will do the trick for many basic repairs and could be called the "bare essentials" as far as site tools go.

To start, this would include a multi-bit screwdriver. Make sure you have two or three bit sets, as these little fellows tend to strip or fall into inaccessible areas at the least convenient times. A nice screwdriver might even have an LED light to shine on the work area.


A screwdriver that stores the bits in the handle is handy.

In addition, you cannot go wrong with a couple of adjustable wrenches – this will make sure you have something to get off most nuts or bolts, even if you do not have the proper standard wrench. A socket set (metric and English sockets) with a couple of extender bars will get the things you cannot reach with a wrench. Finally, linesman pliers, a pair of needle nose pliers, and side cutters will round off the set to cover pretty much any mechanical disassembly and reassembly requirement.

Remember also that a lot of electrical connections are made with hex socket screws and may require an Allen wrench. In a pinch, a matching sized bolt with double locked nuts on it, in conjunction with your adjustable wrench, will make a suitable substitute.

CAN'T TOUCH THAT

If you are doing any electrical work whatsoever, carry a voltage probe (not a multimeter, but an actual one-hand Volt Alert). This will tell you if you are about to grab onto something that is energized – an experience you may never have the opportunity to repeat.

A multimeter is also a requirement for most work at this level. A low end unit with Volt and Ohm functions will get you started. For basic level repairs, it is a good idea to have a 25 or 75 Watt soldering iron, depending upon your preference, extra tips, and some solder.

To complete the bare essentials, an auxiliary light source is one of the most necessary things at almost every transmitter site I have visited. These days, I prefer my headband flashlight with ultra-bright LEDs. This provides sufficient illumination to get the job done, is always pointed where I am looking, and does not need an extra hand to hold it.

All of the tools mentioned here can be purchased on a very modest budget. Perhaps you might need to buy them over a couple of months, but do get them all, along with an inexpensive carrying case.

ADDING TO THE KIT

Once you have acquired the basic tools for each site you work at, you can start to augment the kit depending upon your specific needs.

For instance, if any of your equipment uses edge connectors or Cinch Jones type plugs and sockets, it is frequently possible to solve many problems with a can of Cramolin™ or DeOxit™ and a toothbrush. A squirt of contact cleaner and scrubbing with a toothbrush will resolve several intermittent issues.

Contact cleaning and treatment products can clear problems with connectors.

However, *do not* use a wire brush, sandpaper or other abrasive on these contacts, as this will cause wear, remove any protective plating and degrade operation over the long term. At the same time, a sheet of mild abrasive such as emery cloth will often come in handy for cleaning copper strap before soldering, or for cleaning solenoid contacts in high voltage contactors.

OTHER CONSUMABLES

As you fill out your toolbox it should contain some basic parts. The first thing that comes to mind is fuses – at least one of every fuse used in every piece of equipment at the site should be available and identified individually, rather than all being tossed into a single drawer.

Similarly, if there is anything that uses batteries for memory backup or any other function, a set of these is recommended. Remember that many types of batteries have a shelf life, and the ones in the toolbox should be replaced as necessary to ensure that a fresh complement is always available.

That covers the basics. An acceptable basic tool kit can be put together for less than $50.00 in one quick trip to the hardware store. While it will not be the highest quality and may not last more than a few uses for some tools, it will, if properly stocked, get you out of a pinch.

BUILDING TO THE NEXT LEVEL

As you become involved in more detailed work, the quantity and quality level of tools required also increases.

A torch and vise grips come in handy when dealing with copper strap, etc.

For example, if you do any plumbing or work with copper strap, a propane torch, igniter, and solder – as well as a can of solder flux – are useful. A pair of Vise Grips™ or clamping pliers is good for heat sinking the

(Continued on Page 20)

Maintenance Guide

by Jeff Welton

Continued from Page 18

work or holding two pieces together while they are being joined. Do not forget to include a pair of suitable work gloves.

Getting into the more detailed levels of disassembly and repair will frequently be made easier if you have a nut driver set (again, both English and metric), as well as a proper set of combination wrenches suitable for the equipment at the site.

At this level, we would also increase the quality of the voltmeter, to ensure we have one that includes a diode test function, and replace the multi-bit screwdriver with a full screwdriver set – ensuring that we have the necessary drivers for any oddball screws that may be contained in the equipment (covering Torx™, slotted, and Phillips head screws in all common sizes would be the initial priority).

FILTERS AND BELTS, TOO

Although this is more in the realm of parts than tools, a full set of replacement air filters for everything in the site (transmitter, air handling system, air conditioner, etc.) and a set of belts for everything that has a belt (generator, cooling system, and the like) will frequently let you take care of an emergency without a trip to the hardware or auto supply store. As you use them, replenish the supplies.

Likewise, if you have a generator, replacement fuel filters, oil filters and hoses should be kept on hand. In most cases, the first time you need these items they will have paid for the cost of having them on site, as opposed to having to leave, go get them and come back.

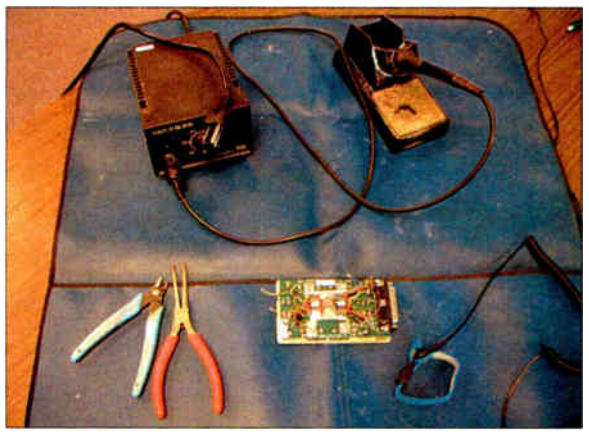
If you are trying to judge the cost point: at this level, we are heading into the $250.00 price range, depending on the number of belts and filters, as well as the quality of hand tools purchased.

GOING ALL THE WAY

Now, assuming price is not an issue, but making sure we have everything necessary to do any level of repair at the site is a priority, we can stock the "dream toolbox." For this, we will need all of the tools mentioned in the previous sections, as well as a few others.

First, you will want to consider the possibility of bench repair of equipment. For this we need to add a few more sizes of wire cutters and needle nose pliers, as well as a set of smaller wrenches and nut drivers, possibly going down to 5/32", or 4 mm.

The screwdriver set could be augmented by a set of jeweler's screwdrivers, for detailed work. A proper grounded-tip soldering iron (about 40W or so) is recommended. A groundable static mat for use with static sensitive assemblies is will prevent introducing problems during repairs. Portable versions of these items are available at many electronic supply stores.



A soldering kit, complete with static mat and grounding strap.

Depending upon the work you intend, some other specialized tools may be required. Power supply diodes are torqued to specific levels, so a torque wrench would be needed. MOSFETs and many other devices are also torqued, requiring a torque nutdriver. Consult your equipment manuals, as many will list any special tools required, frequently including manufacturer and model numbers.

SCOPING IT OUT

It is almost guaranteed that, at some point, some technical support person will want to have you look at something on an oscilloscope.

Depending on budget and application, this could be as simple as a low end single-trace 10 MHz unit or all the way up to the portable multi-meter/oscilloscopes available from several test equipment manufacturers. Be sure to include a proper set of scope probes as well – nothing is more frustrating than measuring something you know must be 5 V peak to peak and having the scope insist that it is only 1 V.

Oscilloscopes can range from inexpensive to costly spectrum analyzers.

Do not forget to that scope probes can fail as well – so always have at least one spare on hand.

ADDING IT UP

At this level, the price depends purely on the test equipment used. An entry level "advanced" toolkit could be put together for less than a thousand dollars; a fully-stocked, singing and dancing toolbox will run in the range of about $4,000 to $5,000.

Either way, that covers the basics of the toolbox. Hopefully this will make sure that you are never caught short during a 3 a.m. visit to a transmitter or studio site, when the hardware store is closed.

After 16 years in Technical Support at Nautel Ltd, Jeff Welton is now handling sales for the western half of the country. Contact Jeff at jwelton@nautel.com

The Worst I've Ever Seen

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

The Case of the Foundation that Went Away

Normally, when you plant a tower, you expect it to stay up. Depending upon the tower size and height, a good foundation and, perhaps, guy wires are installed. A concrete foundation about five feet square and four feet deep would normally have held this relatively short tower up just fine.

On the other hand, what is the old phrase? "If something can go wrong, it will!" And it does.

MECHANICAL BEAM TILT

The folks at Advanced Tower Services, Inc. in Albuquerque, NM were met with this sight last month.

A clue to the problem is seen along the ground. According to Cliff Barbieri, President of Advance Tower Services, noted the foundation problem was caused by a break in a six-inch water main that was to feed the fire hydrant in the foreground.

No, this was not an attempt to bounce a signal off the Moon.

There was some warning. Barbieri says the water utility "started getting calls about 4:30 a.m. from people in the neighborhood complaining of low water pressure; they said it probably ran for a few hours."

AND THAT LED TO ...

What set off the water main? Barbieri continues: "They think there was a leak in the three-foot concrete storm sewer pipe that caused the soil to wash away about eight feet below ground. After that happened, the weight of the soil and asphalt above the void collapsed, breaking the six-inch PVC water line going to the fire hydrant. Then the six-inch jet of water washed the soil away."

Still attached to the base, but not at the right angle.

With all that water flowing, it would seem like it would have flooded the street and been noticed quickly. However, Barbieri noted "it never flooded into the street because there is a huge pump inside that concrete vault, used for a storm sewer lift station." Instead, it just ate away the ground until, well, the tower was not very towering.

Our thanks to Rico Gonzales of Advanced Tower Services for the pictures.

REMEMBER LAST MONTH?

Last month's *"What's Wrong with this Picture?"* brought some interesting comments. Most were amazed that the transmission line was routed through the exhaust duct. Donald Johnson from Bext seemed to have the best eye, counting four major issues with the installation of an FM transmission line.

1. Coax going through the air duct, causing reduced airflow of at least 50%.
2. Duct tape is used instead of clamps on the air vent.
3. Several cables are tie-wrapped to the output coax, allowing possible RF pickup and/or lightning damage.
4. One cable, with what appears to be 1 to 1.5 inch pigtails, could allow RF pickup on the cable due to the very close proximity to the coax.

We invite you to share your pictures of installations that fall just short of perfection. We are not here to laugh, or point fingers, but to show areas that sometimes do not get planned out just right.

We hope you will share with us your favorite picture of one of the good or the bad installations out there. Please send it to us at Editor@radio-guide.com

Congrats to you, Rick Dees, on your inauguration into the **Radio Hall of Fame**.

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IT Guide

by Steve Lewis

Gazing the Microsoft Vista

Microsoft recently announced the beta testing of Service Pack 1 for the Vista version of the Windows Operating System. While SP1 may solve some of the issues that users have reported with Vista, Steve Lewis – like many IT folks – is taking a wait and see stance.

Microsoft's latest release of the Windows desktop operating system, Vista, has been nothing but controversial among many users and support personnel. Features (as Microsoft refers to them) have become annoyances to many – and the butt of advertisements from competing vendors.

Now that it has been out and in the hands of real people, I have yet to find a glowing report on its usefulness. What is a guy in charge of the network and desktops to do?

NT AND WIN2000 GOING AWAY

If your organization still runs on pre-Windows 2000 you need to seriously consider upgrading to Windows XP. As you will read later, Microsoft has planned obsolescence into its support policies and, like NT before it, there will come a day when you just will not be able to get any more help for Win2000.

Additionally, new software from many vendors already is not guaranteed to work on pre-2000 operating systems. Before long, the list may well include Win2000.

If you run Win2000, I strongly urge you to move on up to XP and get better support for a longer period of time. I have located copies of XP Pro with SP2 (single license) for as little as $85 each on the web, useful for smaller organizations. It is possible you may be able to find a volume license edition.

FROM XP TO VISTA?

The most compelling reason to upgrade from XP to Vista has, so far, been its glitz and glamour. It looks cool, but is it worth a couple of hundred bucks times, say, 50 desktops?

My advice to you is: No! If your organization currently runs XP on its desktops, it is absolutely not time for your IT department to upgrade all those machines. With XP, you are in good shape for several more years.

If you are concerned about support for XP, worry not.

In fact, you can visit the Microsoft web page that explains their standard policy at http://support.microsoft.com/?pr=lifecycle and read it for yourself. Windows XP was released in 2003 and will be supported until 2014. That is a long time in computer years and, given that Microsoft tends to release new operating system software every three to four years, Microsoft will see the error of its ways and correct the problems Vista has caused around, say, 2014.

VISTA FEATURES WITHOUT VISTA

Here are some of the reasons you can stick it out with XP and do not have to upgrade to Vista. (I would like to thank Preston Gralla, Dave Methvin, and Computerworld for their inspiration and information.)

While some features in Vista appear to be compelling, you do not have to run Vista to take advantage of them. For example, the anti-spyware program Windows Defender comes built-in with Vista. However, Microsoft offers a free download of Windows Defender for XP. I do not recommend the program as your sole source of protection, but it is available should you choose to use it.

XP CAN BE SAFE

Vista does sport a built-in firewall. So does XP, though XP's is inferior. From last month's column you already know about third-party firewall protection that is likely much better than Microsoft's version.

Vista also boasts hardware encryption to keep hard disk data safe. Alternatives for XP from third parties exist such as PC Key, a small USB device that provides hardware data encryption. You can read more about it at http://us.kensington.com/html/6331.html.

Finally, parental controls are standard on Vista. Yet, for about $50 you can add similar protection on up to three computers (you did say that you have three air studios, right?). Visit www.webroot.com to find out more about their "child protection" and while you are there, take a look at their anti-spyware offering.

A PRETTY FACE

I personally find Vista pleasing to look at – when I am not actually using a computer. When I sit down to write a program or work with a database, I want 100% of my CPU dedicated to the important tasks at hand.

If you must appease anyone with a burning desire for the eye-candy that is the Vista user interface, there are free and shareware programs available to install those very things. I have gone so far as to turn off the meager eye candy in my XP boxes.

Sometimes "corporate" mandates an upgrade to Vista. It is worth knowing that it is possible to run XP inside a virtual machine, even though you will lose a lot of power. On the other hand, if you have software that refuses to run or causes trouble on Vista, that may provide you a way out.

Steve Lewis has experience on the air, as an engineer, and as an IT Manager. Contact Steve at mswmv@myvb.net

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Heavy Metal

by Jeff Johnson

Working with 500 Kilowatts – An Interview with Clyde Haehnle

Perhaps you might have wondered what it might have been like to be on site and in control of a 500,000 Watt transmitter that literally covered most of the United States, as well as being heard well in Europe. So far as the U.S. broadcast industry is concerned that is Heavy Metal. With that power at its command, WLW was truly "The Nation's Station" during the mid-late 1930s and early 1940s.

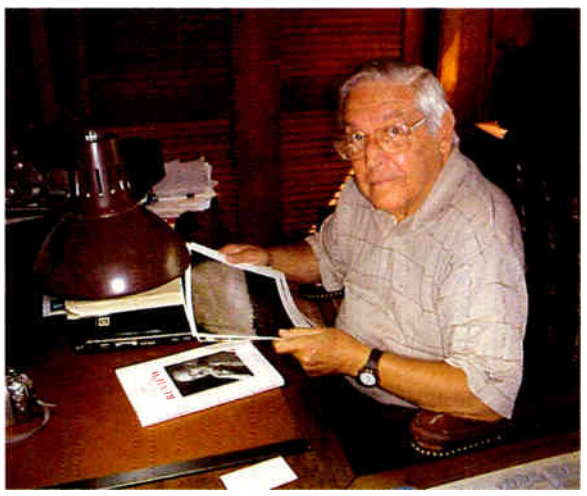
Clyde G. Haehnle *was there* when the mighty WLW 500 kW transmitter was on the air at full power. He was an engineer at the station during 1941 and 1942, a period of "experimental" broadcasts from 12:00 Midnight until 2:00 a.m. The broadcasts extended through 1943.

The purpose of those broadcasts was to keep the big transmitter in top operating condition should it be needed during WWII. "Superpower" broadcasting had been finally denied by the FCC by that time – the last such broadcast on a regular basis had been made by March 1, 1939.

THE HAND ON THE CONTROLS

Clyde Haehnle was one of the engineers who actually worked on and operated the 500 kW transmitter.

Haehnle graduated from the University of Cincinnati with the degree of Electrical Engineer and joined the Crosley Radio Corporation (and its successor, AVCO Broadcasting Corporation) in 1941. He later became an engineering Vice President and Executive Assistant to the President of AVCO Broadcasting Corporation until AVCO sold its broadcast interests in 1976. Mr. Haehnle was then Executive Vice President of R. C. Crisler & Company, a Cincinnati station brokerage firm.



Clyde Haehnle at the time of our interview examining one of his extensive collection of historic broadcast photographs.

This summer, I had the opportunity to interview this fascinating man, still active in his mid-80s. Of course, one of the first things I wanted to know is what it was like to be in charge of the big rig. What was it like to *be there*?"

ROUSING THE BEAST

Haehnle told me "There were three operators at the transmitter for normal broadcasts. When we were doing experiments two or more engineers would be involved. The mercury rectifiers had to be warmed up first. We gave them a half hour. If they were not adequately warm, an arc-back would occur and everyone on the local power grid would know it!"

In a paper written by Mr. Haehnle with an engineering colleague, Ed Dooley, they elaborated on the startup procedure: *"When the rectifiers were warm, the water flow through each 898A power tube jacket was checked. The 898A filaments were turned on and each filament strand was checked with dark welding goggles. The power transformer primaries were set to a wye connection for lower PA voltage. Next, the 3,000 Volt bias supply to the PA units was checked, and each PA unit and each modulator unit was turned on and observed."*

The WLW second harmonic filter today. The switch on the right selected 50 or 500 kW operation.

"When everything was warm and ready," Haehnle continued, "we would throw a switch on the second harmonic filter to connect the 500 kW rig to the antenna transmission line. The WLW 50 kW Western Electric transmitter would become the driver – the IPA stage." According to Haehnle, the 50 kW transmitter was run at 25 kW in order to drive the 500 kW PA.

PEDAL TO THE METAL

Again, from the paper: *"The final steps included bringing up the 50 kW driver and checking the tuning on the driver and each of the three PA amplifiers. After a wait of several minutes, the power transformer primary was changed to a delta connection for full PA voltage. The final step was to check the tuning and loading on each PA where the operators had the thrill of dipping the plate current to over 100 Amperes.*

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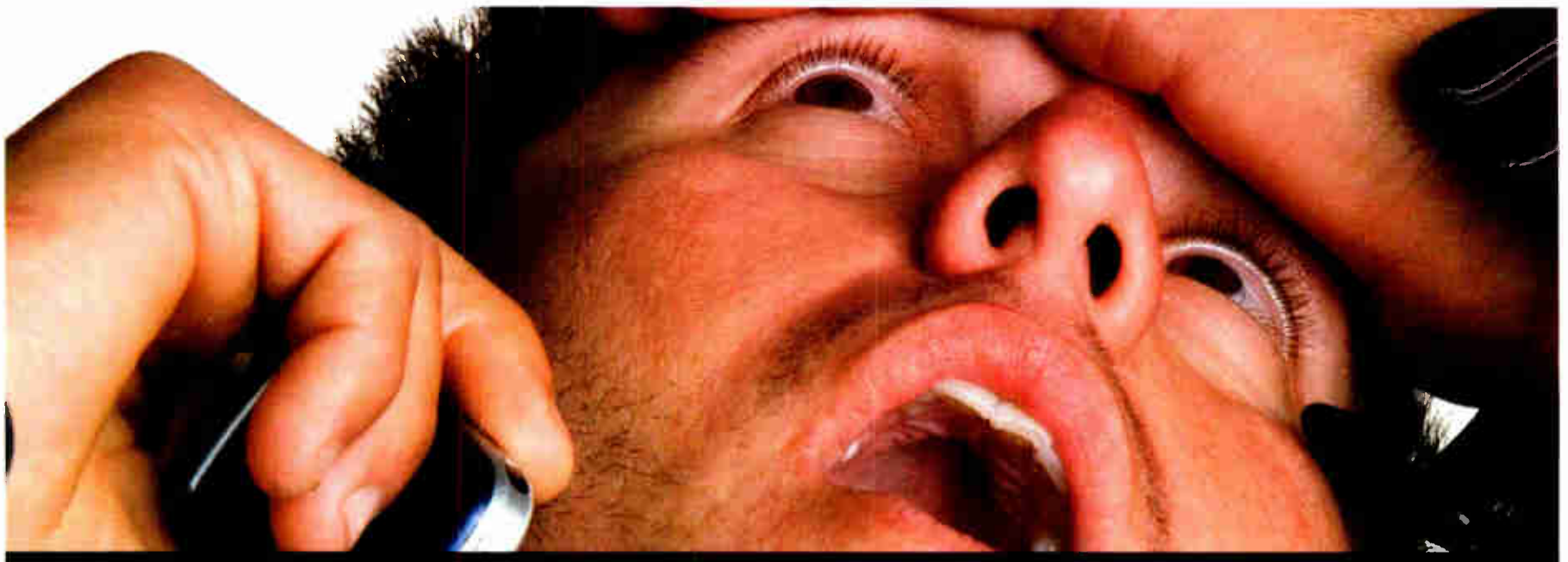

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Continental Electronics

Heavy Metal

by Jeff Johnson

Continued From Page 26

"The output of the transmitter was fed through the harmonic filter to suppress the second harmonic. The RF was then fed via the 50-500 kW antenna switch into a 100 Ohm air-dielectric 10-inch coaxial line which was custom fabricated from aluminum pipe."

Haehnle mentioned there was a special procedure when the 500 kW unit was activated: "The technical operators at the studio would ride the gain exactly the same as if they were feeding the 50 kW. We at the transmitter would have slowly decreased the modulation prior to the 50 kW to 500 kW switch. We would then 'hit' the 500 kW and sign on with 100% modulation. This was to overcome the automatic volume control built into most receivers."

At 500 kW, WLW really was the Nation's Station.

STANDING NEXT TO THE POWER

I was curious as to what the big rig sounded like. Haehnle said "During operation of the 500 kW there was always a loud hum from the breaker panels and the numerous filament transformers. The huge modulation transformers always gave off loud audible and sometime understandable audio."

Of course, since the transmitter was water-cooled, there was no fan noise. So I asked what other memories he had about conditions while at 500 kW. Haehnle remembered: "It was hot in there I recall, and when any arcing would occur there was a strong odor of ozone. Shutdowns were not uncommon. Rectifier arcbacks, gassy tubes, overheating mica condensers, and rodents in the power cage could cause them. When the transmitter tripped, the high-speed primary breaker would shake the building and the delta-wye breakers would reset."

As one might image, it was not desirable to shut the whole transmitter down each time a fault occurred. Haehnle explained that each of the three final stages could be removed from service by pressing a red button on the front of the stage marked "EMERGENCY SHUT DOWN."

The EMERGENCY SHUT DOWN button is top center.

While a faulty stage was serviced, the two remaining PA stages could be retuned, bringing the total power back up to 450 kW.

A TUNING NIGHTMARE

Tuning the large PA had to have been very tricky. Haehnle recalls: "Every adjustment required readjustment of everything else until all was just right." In the photograph above, the coupling control is to the left of the shutdown button and the tuning control is to the right.

Haehnle showed me a photo of himself at one of the power amplifier rear doors. His hand is on the output coupling helix. Behind that you can see the Faraday shield, the drive for the plate tank coil and just a bit of the unique aluminum pipe plate tank capacitors.

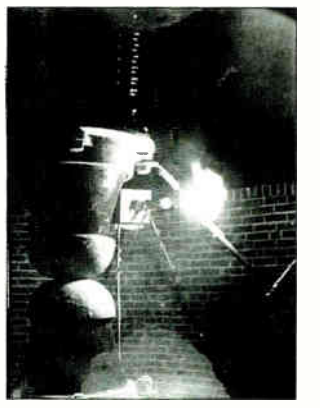
Clyde Haehnle at the rear of a power amplifier output cubicle.

Seeing that coil helps provide an idea of the size of the transmitter. The tubes were equally impressive, in size and cost. Haehnle said "They cost around $1,200 then and were leased by the hour. I recall the tube life to be 3,000 to 4,000 hours.

THE ORIGINAL FLAMETHROWER

With all that power, there were special precautions taken to protect the transmitter and the rest of the equipment.

Haehnle explained: "If there was an arc at the spark gap at the base of the tower, the power of the transmitter would sustain the arc. To combat this, there was a special photocell aimed at the gap. When the photocell sensed an arc, it would shut the transmitter down for a moment to quench the arc.



The 500 kW rig sustaining an arc across the spark gap at the base of the tower.

(Continued on Page 30)

Heavy Metal

by Jeff Johnson

Continued From Page 28

Like all tall towers, WLW's distinctive Blaw-Knox tower tended to attract electricity from the sky. Haehnle remembers: "Yes, when lightning would strike there was what looked like an 'electric umbrella' around the tower as lightning jumped the guy insulators. To get an idea of the current in the guys during a strike, GE engineers placed metal slugs on the guy wires and measured the degree of magnetization of these slugs.

By daylight you can see the photocell aimed at the gap.

THE BUILDERS

The mention of GE engineers being involved brings up the story of the transmitter's pedigree. Although there was an RCA logo on the transmitter, Haehnle and Dooley note it was built by others.

"RCA did not build transmitters at that time, so they subcontracted the work to General Electric and Westinghouse. GE was responsible for design and construction of the radio frequency amplifiers, DC power supplies, high voltage rectifiers, harmonic filters, RF transmission line, antenna tuning equipment, control systems, and control console. GE engineers assigned to the project were Edward A. Leach, George W. Fyler, and Ray H. Williamson.

"Westinghouse was responsible for the audio frequency amplifiers, modulators, modulation transformers, filament supplies, isolation switching, motor generators for control circuits and bias, water pumps, heat exchangers and the entire cooling system. Westinghouse engineers assigned to the project were John A. Hutcheson and Gerald V. Bate."

TEN MEMORABLE YEARS

Reading the Haehnle/Dooley paper, one can only wonder what course U.S. broadcasting would have taken if WLW (and others) were permitted to stay at super power levels. Somewhat surprisingly – especially given Crosely's push for higher power, and the cost of the transmitter in the mid-1930s depression era – WLW's entire history as a super power station stretched a mere ten years.

From Haehnle and Dooley: *"The design and construction began in January 1933 and the components were shipped to the Mason, Ohio site, approximately 25 miles north of Cincinnati, in August of that year. During that time, Blaw-Knox designed and began erection of the 831 foot cantilever guyed vertical tower. By December 1933, the amplifiers were installed and tests were conducted during the experimental period of 1:00 a.m. to 5:00 a.m.*

"The 500,000 watt transmitter was completed and first went on the air commercially on April 17, 1934 and was used in regular operation until March 1, 1939 when Senator Burton Wheeler of Montana railroaded a resolution through the Senate limiting the power of commercial U.S. broadcast stations to 50 kW. This was done on behalf of Mr. Ed Craney, one of his constituents who owned a 250 Watt station and wanted 50,000 Watts on 700 kilohertz. From 1939 to 1943 the 500 kW transmitter was operated experimentally [as W8XO] from Midnight to 2:00 a.m. each night."

Haehnle told me the "experimental" operations continued to ensure the transmitter was maintained in "ready condition" should it be needed in case of a national emergency during the Second World War, as well as hopes the U.S. Government could be persuaded to allow super power operation once more. *"In 1943, it was shut down to be dismantled and shipped to Australia at the request of the U.S. government. Although some of the components were removed, the dismantling was halted and most of the transmitter remains intact today at the Mason, Ohio site."*

Nevertheless, the end result was, as Haehnle well stated: *"An exciting period in the history of broadcasting had come to an end."*

DISSECTING THE 500 kW BEAST

Although others have commented on the technical details of the 500 kW transmitter, it is interesting to take a look at some of Haehnle's pictures, some taken during when he revisited the site – and some from the super power days. The comments are from the article he and Dooley wrote.

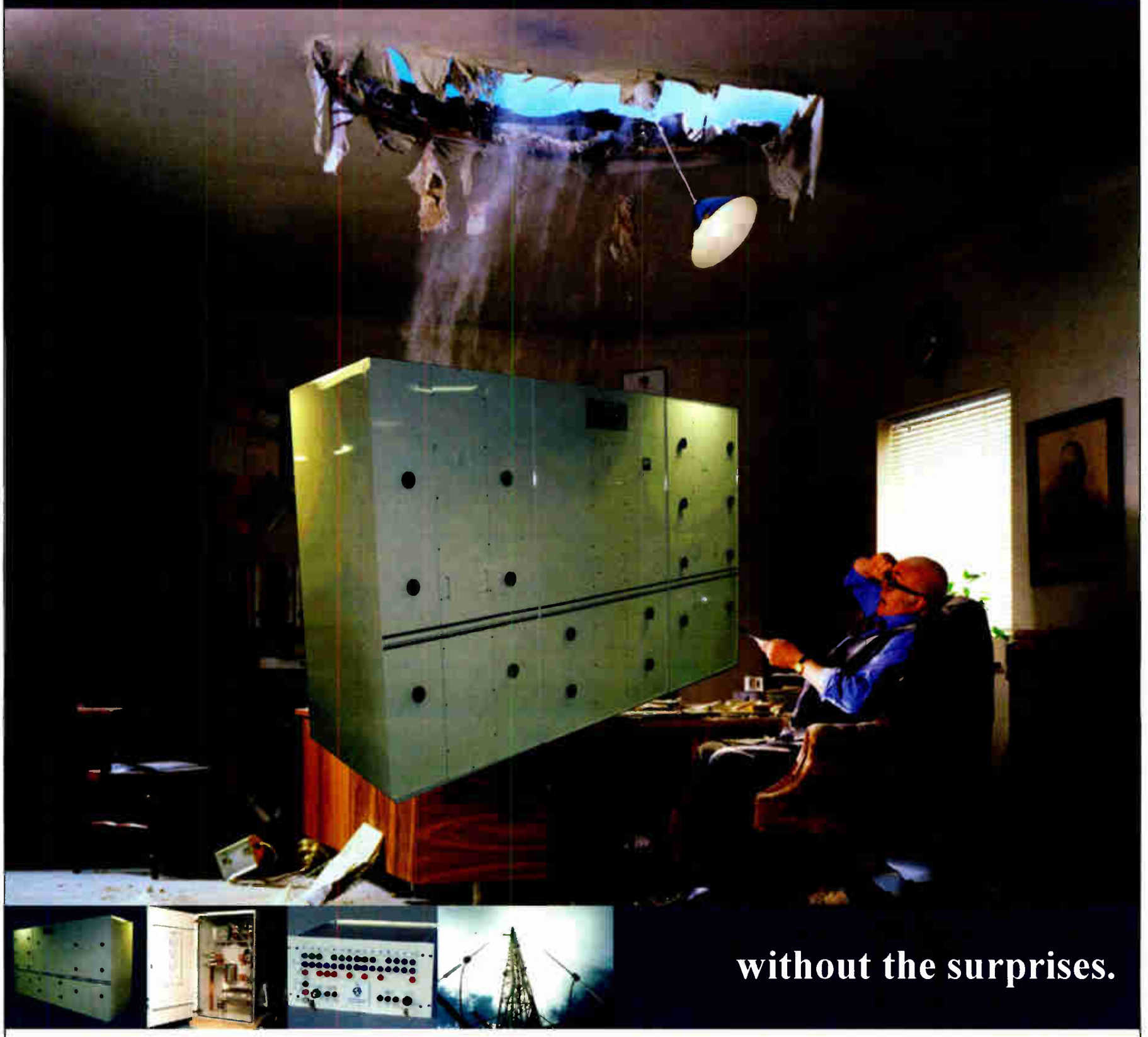
"The main 500,000 watt transmitter unit is 54 feet wide and 13 feet high and 17 feet deep. There are three power amplifier cubicles, two modulator cubicles, and a rectifier cubicle. In the back of the transmitter are pairs of metal lined wood doors providing access to the rear of each of the six cubicles. The power amplifier doors provide access to the output coupling helix, the faraday shield, and the variable plate tank coil.

The rear doors of the WLW 500 KW transmitter.

"The plate tank capacitor is fixed tuned and constructed of grids of one-inch aluminum pipe. The control circuit relays are panel mounted in the rear of the rectifier cubicle.

Since a Western Electric 50 kW transmitter was already in use at the station, it was decided that the 500 kW unit would use the Western Electric unit as a driver. When the 500 kW transmitter was in use, the 50 kW modulator section was isolated, and the unmodulated 50 kW RF amplifier was fed into a load and part of the RF signal [25 kW] was used to drive the 500 kW RF amplifiers." (Continued on Page 32)

AM Directional Systems...



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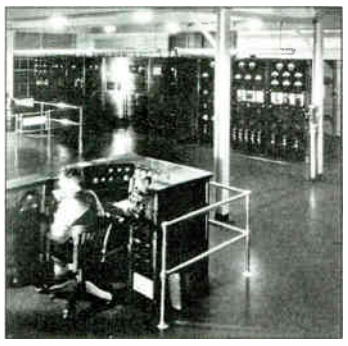
Heavy Metal

by Jeff Johnson

Continued From Page 30

"The 500 kW RF amplifier consisted of three separate amplifier units with their inputs in parallel and their outputs in series, with switching capability to permit isolating one or more of the units. Each RF amplifier contained four type UV-862 triode tubes, with each tube rated at 100 kW plate dissipation, operating in a push-pull-parallel Class C mode. The three RF amplifiers were high level plate modulated by two modulators, each with four 862 triodes in a push-pull-parallel Class B mode."



A view across the operator's console to the Western Electric 50 kW transmitter (left) – where it sits to this day.

"The high-voltage rectifier was three-phase-full-wave, incorporating six 870A mercury arc tubes rated at 60 Amperes each."

A TUBE-LOVER'S DREAM

It took just a few tubes to keep this transmitter going! From the Haehnle/Dooley paper:

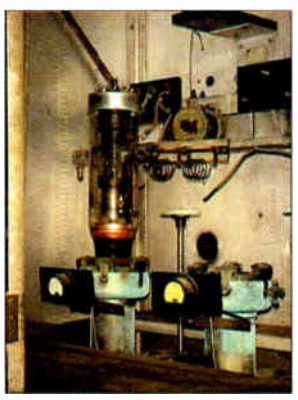
"The complete transmitter utilized 22 type UV-862, 100 kW tubes, two in the 50 kW driver, 12 in the RF amplifiers, and eight in the modulator. DC generators were required to supply 4,150 Amperes to light the filaments of these tubes."

Calculating an original cost of $1,200 per tube, that complement of 22 tubes cost $26,400 (perhaps a quarter of a million 2007 dollars!), or somewhere between $7 to $9 an hour ($70 to $90 an hour today?) to operate – again, not including the rest of the tubes, nor the power costs.

"In 1935, the 862's with their antiquated DC filaments were replaced with 898A tubes with three-phase-six-wire filaments. The filaments in these tubes were multi-strands of pure tungsten which could be operated on DC, single-phase, three-phase, or six-phase. The voltage was 28.6 Volts phase-to-phase, with a current of 140 Amperes or nearly 7.5 kW just to light the filament of each tube. The peak rated emission of each tube was 90 Amperes with an amplification factor of 45.

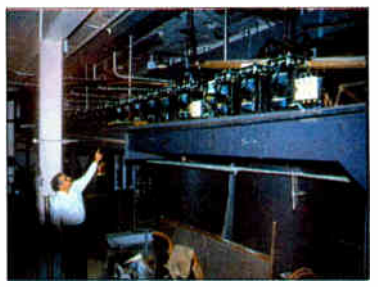
UV862 tubes in operation.

"The AC filaments of each 898A required three single-phase high-reactance transformers with a 240 Volt primary and a 16.5 Volt 140 Ampere secondary. The high reactance was needed to limit the start-up current in the cold filaments to 200 Amperes. Each transformer was 13" high, 10" wide, and 8" deep, and weighed over 150 pounds. The secondaries were wound with a copper conductor 3/4" wide and 1/4" thick, wrapped with cotton tape. Sixty of the transformers were mounted on a structural steel bridge in the basement directly under the transmitter cubicles to limit the lead length to the tubes. The weight of the filament transformers alone was almost five tons.



A UV898 tube in its socket today. Notice the disconnected filament leads at the top.

"Each tube was cooled by a flow of distilled water around the anode at 30 gallons per minute plus 15 cubic feet per minute of airflow on the filament and grid seals. At maximum plate dissipation there was a 22 degree Fahrenheit rise in water temperature at a 30 gpm rate. The 22 tubes each with 30 gpm of pure distilled water flow required 50 horsepower pumps capable of 660 gpm of flow. A network of 50 feet of 1-1/2" Pyrex pipe for the inlet and outlet of each tube was required to isolate the 15 kV tube anode jacket potential. This was nearly 1/2 mile of Pyrex pipe.



Clyde Haehnle pointing to the row of filament transformers in the basement beneath the 500 kW transmitter.

"The heated distilled water was pumped through two Westinghouse boiler type heat exchangers which were cooled with 1,500 gallons-per-minute of raw water. The raw water was then pumped outside to a 60 x 60 foot spray pond where the raw water was cooled and recirculated. High temperature water stills were operated continuously to maintain the quality and quantity of the distilled water in the system.

"The maximum rating on each tube was 15,000 Volts on the plate, 7.5 Amperes plate current, and 2.0 Amperes of grid current. The rectifier system utilized six 870A mercury arc tubes in a three-phase-full-wave configuration. Each tube was rated at 15,000 Volts, 60 Amperes.

"These tubes required at least 15 minutes of warm-up time before high voltage could be applied. The filaments were single-phase 5 Volts at 65 Amperes. Frequently these tubes would arc-back. It is estimated that the peak inverse surge current was about 4,000 Amperes. The local power company and the entire electric network were aware when these tubes experienced an arc-back."

(Continued on Page 34)

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BROADCAST WAREHOUSE

Heavy Metal

by Jeff Johnson

Continued From Page 28

WLW's 500 kW Transmitter at a Glance

700 kilocycles
Mason, Ohio
500 kW AM, Plate Modulated
RCA Serial Number 1

Regular Operation:
April 17, 1934 - March 1, 1939

Main Cabinet: 54' W, 13 ' H, 17' D

(3) PA sections:
Drive: parallel, input 25 kW
Total: twelve UV862/898A triodes
Class C, push-pull parallel
Ep=11.8 kV Ip=64 A

(2) Modulator sections:
Total: eight UV862/898A triodes
Class B, push-pull parallel
Transformers: two at 180 kVA
Reactor: 4.5 H @ 60A

Cooling:
Distilled water, 30 gal/minute/tube

FEEDING THE ENGINE

"The 33 kV of primary power was fed by the local power company via two separate and independent circuits, one from the east and one from the west of the transmitter location. A sub-station located outside the transmitter building reduced the 33 kV to 2,300 Volts which was fed underground to the transmitter building.

"The three power transformers each had a 430 kVA rating with a 2,300 volt primary and were connected so the primaries could be in a 'Y' connection for start-up voltage and 'delta' connection for full running voltage. The filter reactor was 0.25 Henries at 125 amperes. It weighed 3,190 pounds and was cooled with 160 gallons of oil. The rectifier provided 12,000 Volts at 90 Amperes under no modulation. The modulation reactor was 4.5 Henries at 60 Amperes, weighed 9,500 pounds and was cooled with 525 gallons of oil.

"Two modulation transformers were required. Each unit was rated at 180 kVA from 30 to 10,000 hertz. The primaries were push-pull, 6,365 volts each side. The secondary was 4,250 Volts. The two transformers in series developed 8,500 Volts rms to modulate the 12 kW RF amplifiers. Each modulation transformer was 8' high, 6' wide, and 5' deep, weighed 35,700 pounds, and was cooled with 725 gallons of oil that weighed 5,450 pounds. That will give you some idea of the size of components being dealt with."

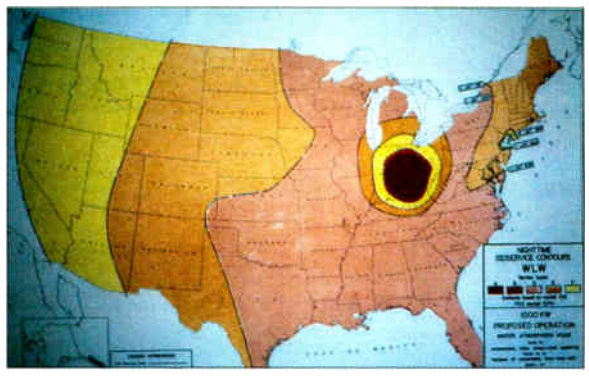
Truly heavy metal!

END OF THE DREAM

I asked Haehnle if he had met Crosley – the driving force behind super power broadcasting – personally, and what was his measure of the man. "I met Powel Crosley only twice," Haehnle said. "The first time was when we dedicated the six 200-kW short-wave transmitters at the Voice of America in 1944. I met him once again at the studios when we purchased WINS in New York City. He was a brilliant man and highly respected. He was always Mr. Crosley, never Powel."

Once the authority to run 500 kW was permanently revoked, Crosley lost his interest in broadcasting and appliance manufacturing, selling his radio stations and most of his manufacturing plants in 1945. He retained his automobile plant and the Cincinnati Reds baseball team.

Despite an industry association dedicated to maintaining the clear channels and lobbying for as much as 1,000 kilowatts, to maintain "white area" coverage and combat increasing man-made RFI, the FCC declined. After 14 years of hearings, the FCC, citing the rise of FM and Television, decided by 1960 to assign additional stations and breakdown the formerly clear channels once and for all. Super power was over.



The unfulfilled dream:
WLW's proposed contours at 1,000 kW.

It really was a fascinating and wonderful opportunity to speak with and learn from a man who had first-hand experience with one of the most famous transmitters of all time. For his part Haehnle still remembers those days in a positive manner: "I always felt that I was a very privileged person given the opportunity to work at WLW," he said. "We were always leaders in broadcast engineering."

Perhaps the best testament to men like Clyde Haehnle is that fact that the story of WLW and its super power heyday continues to be known, talked about, and appreciated by broadcasters all over the world.

Jeff Johnson lives in Cincinnati, very close to the shadow of WLW's famous antenna. Contact Jeff at jeff@rfproof.com

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Remote Guide

by John Schad

Running a Remote Remotely

The Internet is revolutionizing the way that radio stations handle remote broadcasts, but stations do not have to invest in thousands of dollars in equipment to do Internet-based remotes. Oftentimes the equipment needed is already there.

Here is a way to use "floorsweepings" in the form of old computers to set up a great sounding remote broadcast link.

OVERCOMING LATENCY

Many stations have used some form of audio streaming to do remotes but have run up against difficulties because of the latency factor – sometimes as much as three minutes elapse between the transmission of the audio from the remote site and the reception of the audio at the studio. That makes it impossible to take spot breaks or do any form of studio interaction.

However, an Internet-based service called GoToMyPc (www.gotomypc.com) has inadvertently supplied an answer. GoToMyPc has been around for many years and is an easy and inexpensive way to take control of your office computer from a laptop or any computer at a remote location.

Recently, the people at GoToMyPc added audio to the mix. Now, if you are on the road, you can log into your office computer and listen in near real time to your music library (or any audio on that system) while you work through GoToMyPc.

The audio is broadcast quality, and you can actually pick a higher or lower quality level when Internet bandwidth is a consideration. But the good thing is that there is very little buffering and relatively little latency delay in the audio. The most delay we saw in testing was about five seconds – normally the audio arrived within a second or two of when it was transmitted.

TESTING IT OUT

Our company helps out at a local LPFM station that runs a lot of remote broadcasts. Therefore, we decided to try out GoToMyPc as a means of setting up a high quality link from a remote site to the studio. For our tests we put a morning show host at the studio and another in his home, with a link to a PC at the house.

To do a remote, we simply set up a laptop computer to be a host for GoToMyPc and logged into it from a PC in our studios. That PC had its audio output wired into the control board.

At the remote site, we plugged a broadcast mike into the laptop and watched the studio connect. Once the connection was made, audio from the remote site was arriving at the control board. It proved to be a very simple way to set up a link.

In our experiments we found the audio quality to be about the same as a Marti remote – plenty good for most remote applications, including school band concerts, etc.

THE LATENCY ISSUE

We experimented with the two-host show concept, one person in the studio and another at home, and found that the latency was short enough that, aside from rapid interaction, it could be made to work.

A remote such as a football game would be ideal for this use, since the only time the remote operator is interacting with the station is during spot breaks, and the latency is short enough to make that an easy transition.

The laptop computer at the remote site can also be used to originate any spot breaks, using a downloadable program such as Winamp and building a play list that consists of the spots in the broadcast. The play list will play through the same audio cards and therefore down the GoToMyPc link just as the microphone does.

We did notice that anything we did on the laptop would tend to increase the latency problem, but by playing the spots directly from the remote, latency is not so much of an issue. For stations working on a tight budget, playing the spots – or even music – from the remote site can be done without a board operator.

EASY LINKING

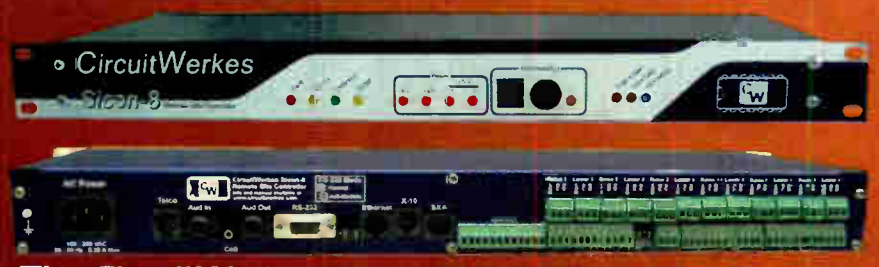
The GoToMyPc technology makes it easy to link to the laptop because they use their own servers, both ends of the connection actually log in to the servers, eliminating all the hassle of punching ports through routers or requiring fixed IP addresses.

Logon is simple and very quick; you are talking in seconds. Everything that happens takes place just as if you were at the studio, not a remote site. For our experiment we used two moderately fast Internet connections. The studio end had about a 750K downlink speed and the remote link just shy of a 1 MB uplink. We used the high quality audio setting and never had any pauses or breaks in the audio during the entire broadcast. Any slower links would probably require a lower quality audio setting.

GoToMyPc is not free, but it is inexpensive. They also offer a free trial period so stations wanting to try this technology can do so without immediately buying the subscription. Stations considering using this technology should realize that any two PCs will work, and they do not even have to be very new or very fast. The only reason to use a laptop at the remote site is for convenience, since the same thing can be achieved with any PC that has a working sound card or sound section on the mother board.

John Schad is President of Smarts Broadcast Systems, in Dallas, TX. You may contact John at johnschad@smartsbroadcast.com

The New Sicon-8 Voice Remote Control



The CircuitWerkes Sicon-8 Voice Remote Control

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

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

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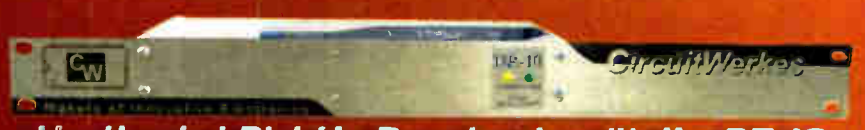

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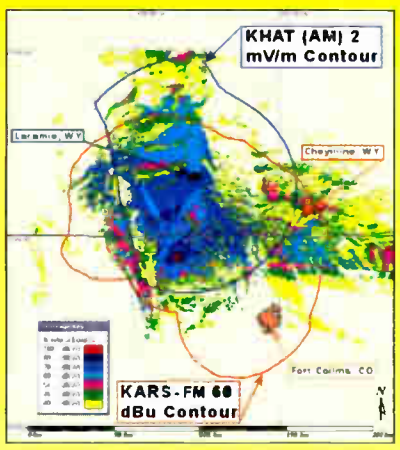

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TFT 5290 STL Handles Tough Double-Hop Duty

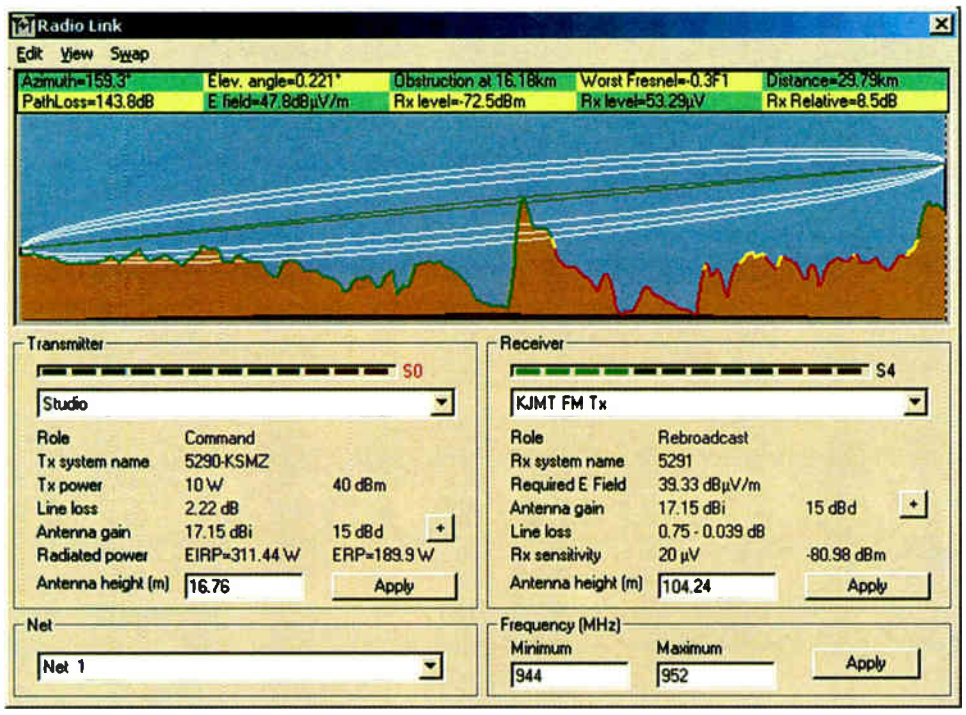
by Scott Gray

Two Arkansas radio stations faced a tough challenge implementing STL feeds, one of them being a double-hop path. The versatile TFT 5290 system met the challenge.

Mountain Home Radio consists of two brand new stations, KSMZ - 94.3 FM "SAM 94-3" Adult Hits and KJMT – 97.1 FM "Mountain Talk 97" Conservative News/Talk. The primary market area for the two stations is Mountain Home, Arkansas, a small town of about 65,000 full and part-time residents in the Ozark Mountains of North Central Arkansas.

Our studios are located in the heart of Mountain Home, in a strip center mall. However, the KSMZ tower was located about nineteen miles due east of town at Viola. It is sitting on the only available land. The area in which we had to locate KSMZ was so tight that a move across the road – or even a few hundred feet in the same cow pasture – would short space the station. Although the tower is 500 feet tall and the elevation is about 100 feet higher than the studio location, there are three terrain obstructions in the path preventing a direct STL shot.

Furthermore, the KJMT tower also really could fit only at one location: Push Mountain – about eighteen miles south of Mountain Home. That site is about 400 feet above the city.



The path to Push Mountain. Note the obstruction.

PLANNING THE INSTALLATION

These new stations were built from scratch. As one of the owners, I was to plan and oversee every aspect of the buildout, from the location of the towers and studios to selection of the equipment. Mike Wiseman, my friend, engineer, and "right hand guy" was responsible for the installation of all the equipment and the studio buildout.

Given the topographic challenges, it was decided the best solution and cleanest path would be a double-hop: first up to Push Mountain and then over to the KSMZ tower at Viola. A sixty-five foot utility tower was erected behind the mall for STL equipment. This was the maximum height available due to logistics of the area.

While the station provides a city-grade signal to most of Mountain Home, the path to Push Mountain is made difficult ten miles from the studio by the topography of the White River. Just above the White River is a cliff with several houses right dead-center in the path to the 350 foot KJMT tower atop Push Mountain.

TFT GEAR SOLVES THE PROBLEM

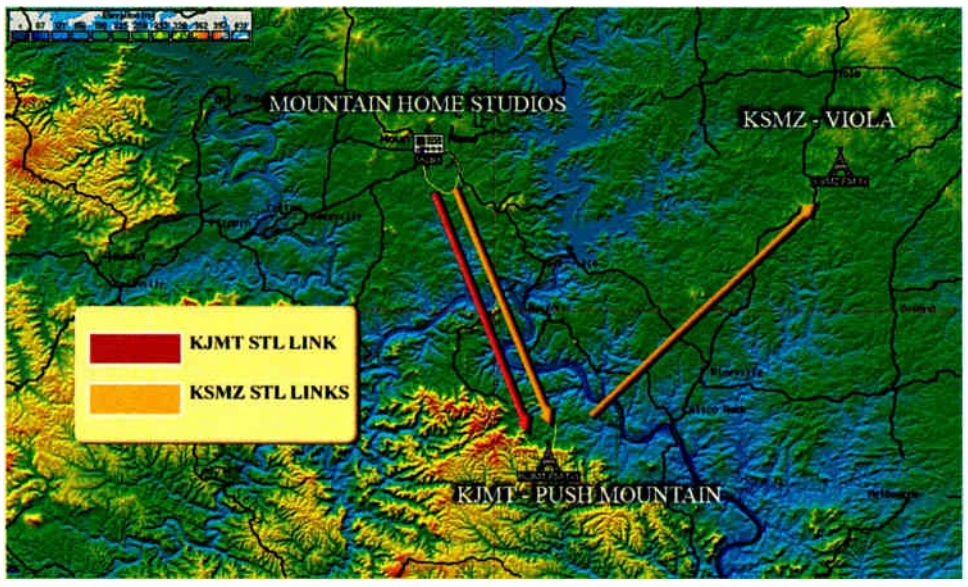
Wray Reed of RF Specialties of Texas has previously helped us with several projects and complete station buildouts. Wray suggested we use TFT STLs for this project and introduced us to Darryl Parker of TFT.

TFT 5290s were ordered to operate at 20 Watts for the tough paths. Scala paraflectors were employed with 7/8-inch Andrew transmission line. The TFT transmitters operate like a champ. They provide twenty-two and twenty-three Watts of forward power with one Watt or less reflected.

At the time of order, we did not know what frequencies would be coordinated. This has always been a problem with other manufacturers – but not so with TFT. In fact, it takes about five seconds to change the TFT frequency on the front panel with the press of a button. Most other units require opening the top lid and changing dip switches. The TFTs dialed in easily, and can be changed on the fly should you need to change frequency, in case of a move from one location to another.

BUILDING THE LINKS

We knew the link from the studios to Push Mountain was marginal, but it was the best chance we had. We used one receive dish near the top of the tower at 342 feet AGL and a splitter to the two receivers. (We used two separate transmit antennas at the studio.)



Terrain map of the STL paths.

Using a digital meter that displays in steps 8, 16, 31, 63, 125, 250, 500, 1000, etc., the TFTs initially gave us a reading of 63 uV each; we had expected around 100 uV. With a reading of 1 mV or more, you do not really care how accurate the meter is, but at 63 it would be nice to know whether you are at 63 or 124. (Employing a Marti receiver for KJMT we reassured ourselves that there was about 100 uV. TFT later pointed out that there is a calibrated DC sample port on the rear panel.)

Next we needed a signal from Push Mountain to Viola for the 2nd hop to KSMZ. This hop was over twenty-two miles and again employed a TFT 5290 transmitter for the repeater. The transmit antenna was mounted at 254 feet AGL atop Push Mountain. The KSMZ paraflector receive antenna is mounted at 390 feet AGL. We used a TFT receiver for KSMZ, which gave us 500 uV of signal, satisfactory for the path between Push and Viola.

TROUBLE CROPS UP

Unfortunately, once the link to Viola was working, we developed reception problems at the interim point on Push Mountain. The older temporary Marti receiver apparently was going bad.

We contacted Darryl Parker, and he sent us a new TFT receiver overnight. It was installed and operational by noon the next day, but at only 31 uV signal indication. (This is the same path that showed 100 uV on the Marti.) To provide a permanent solution, Darryl did some additional terrain studies and path work for us, and recommended we replace the paraflector with a 10-foot dish. While we await the dish, an in-line amplifier was installed, giving us 250-400 uV of received signal.

TECHIE STATS

- Front panel frequency agility in 6.25 kHz steps.
- Composite or mono configurable.
- Normally 10 Watts (20 Watts optional).
- Receiver automatic switchover to backup.
- Built-in bandpass and IF filtering.
- Selectable wide/narrow IF.
- AC Power requirement: Tx = 100 W, Rx = 20 W.

Complete specifications: www.tftinc.com/products/datasheets/stl5200.pdf

VERSATILE, STABLE LINKS

If you face a challenging path, be sure to specify the 20 Watt transmitter version, as they still offer a 10 Watt version – the price difference is negligible for double the power. The receiver has a narrow/wide bandwidth setting and a high/low gain setting. We have found the wide/high to generally provide the best signal. If you have more signal than you need, you can always select the low gain setting.

We are on the air and operating with the TFT. Overall, I would recommend the TFT 5290 STLs over the Marti STL 20C. You cannot beat the versatility and user-friendly front panel.

Information on TFT products can be had at www.tftinc.com or you may call 408-943-9323.

Scott Gray can be reached at: scott@graymediacorp.com Mike Wiseman can be reached at: mikewiseman@mountaintalk97.com

Audemat-Aztec GOLDENEAGLE HD Receiver

by Eric B. Schecter

When KSON-FM launched HD broadcasting in December 2006, one challenge was how to measure our new signal and insure that we complied with the myriad of iBiquity specifications. Enter the Audemat-Aztec GOLDENEAGLE HD. So what is this box that rocks? Is it a Linux computer? Is it a spectrum analyzer? Is it a modulation monitor? Answer: It is all the above and more!

The GOLDENEAGLE HD is available as an FM version (standard), an AM-only version, or an AM/FM combination. We chose the FM-only version, with spectrum analyzer option. It would meet our current and future needs as more stations in our cluster are converted to HD.

THE HEART OF THE GOLDENEAGLE

The unit is comprised of two very important components:

- An iBiquity approved precision HD radio tuner.
- The proprietary IP2 system, which is computer-based architecture responsible for the "heartbeat" of the system. The IP2 supports communication in and out of the unit, data acquisition, and stand-alone operation.

Upgrades to the unit can be accomplished by convenient plug-in modules to include such things as DTMF, relay control, logic inputs and other features. Do not be concerned about obsolescence; the GOLDENEAGLE HD is software based, and upgrades from any computer are a breeze to accomplish.

START WITH A GOOD ANTENNA

A strength of the GOLDENEAGLE HD lies in the graphical user interface. The Java application is actually downloaded from the unit itself by connecting to the unit's internal website. Once downloaded, the application allows you to begin basic system configuration.

A helpful hint: make sure you have a very good antenna feeding your unit. It is desirable to have signals in excess of 60 dBu for accurate off-air measurement. Ideally, you should avoid splitters, taps or any other devices that might corrupt the incoming signal. Any multipath in the signal will result in some interesting – and possibly misleading – readings.

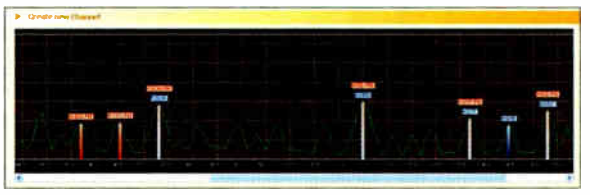
Although operation from the front panel touch screen is possible (and necessary for initial set-up), most users will benefit by interfacing the unit with a LAN or at least a laptop. Due to the limited screen size, a Palm-type stylus is used to navigate and enter data. Although you can use your finger, the stylus is easier. Despite its small size (3 inches wide by 2.25 inches high) the screen is useful for everyday tasks such as the viewing alarms and real -time measurements. This is especially true if the receiver is located near the audio processing and HD encoding equipment.

At www.audemat-aztec.com, Audemat-Aztec provides a very complete user manual, so for greater detail, I refer the reader to this website.

STARTING THE ENGINE

Setting up the unit for real off-air measurements begins by starting the application and logging in to the unit. On the Basic Configuration page you can add a specific channel manually or tell the unit to do a market scan and add a station based on what you see from the scan. A maximum of 10 channels may be configured.

Once a station is selected, up to 12 tabs are presented, based on your monitoring configuration. These tabs are where the real work gets done. The first five tabs relate to HD Radio measurements. On each tab you set whether or not the monitored values will generate alarms and what values will trigger those alarms. The HD tabs are HD Level, Audio, Alignment, Data, and the most recent addition – the NRSC Mask measurement.



A screen capture from the San Diego, CA, market.

The remaining tabs are similar in function to the HD tabs and are used to set parameters for radio signal level, analog audio, total modulation, stereo, RDS, and RDS Data.

REAL-TIME MEASUREMENTS

For me, the most useful top-level menu is the Real-time measurements selection. Tabs included in this menu are: AM/FM HD Radio, AM/FM Analog Radio, Spectrum Analyzer, Modulation Monitor, Audio Monitoring, and Audio Streaming. Consider the AM/FM HD Radio tab: There are five sub-tabs for PSD, SIS, Stream Info, Alignment, and Readings.

The GOLDENEAGLE provides several interesting and valuable features. One such function of this monitor is the ability to let you hear what you are seeing – even if you happen to be on the other side of the country from the unit. From within the application, you can "stream" demodulated audio to your computer speakers. This is a great feature.

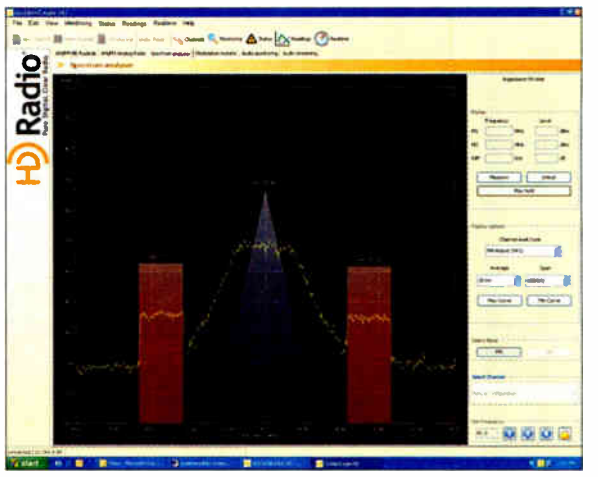
You have the choice of low or high bandwidth options and the ability to listen to analog audio or split analog and HD audio. The split mode is very useful when you want to get an audible measure of audio time alignment. I was able to walk in our alignment using this feature – and then fine-tune it using the alignment measurement screen. The audio streaming offers the choice of either an embedded player or the default player on your computer. I was never able to get the embedded player to work properly, but WinAmp had no issues playing the stream.

BUILT-IN SPECTRUM ANALYZER

The Spectrum Analyzer option is perhaps one of the greatest strengths of the unit. Additionally, you can employ an NRSC mask overlaid on the spectrum display. If the signal to noise ratio at your receive site is less than 80 dB, you may observe noise hovering well above the bottom of the mask according to Tony Peterle, Technical Support Manager at Audemat-Aztec.

Peterle explained how the SA works this way: "The spectrum analyzer is a Fast Fourier Transform (FFT) device, and as such, operates differently from a traditional SA. Accordingly, the resolution bandwidth approaches, but does not exactly match the iBiquity specification of 1 kHz RBW. However, for on-going monitoring and analysis of the spectrum the GOLDENEAGLE HD fills this role."

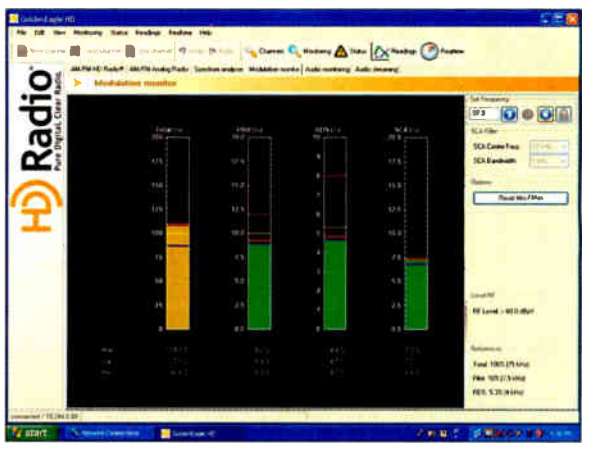
The Digital Demodulator screen (included with the Spectrum Analyzer option) yields real-time displays of both analog and digital levels, with maximum and minimum peak hold lines. This display is also available on the front panel screen.



Power checks for the main and HD carriers are quick and easy.

MODULATION MONITORING ON YOUR DESKTOP

If your collection of modulation monitors is in need of replacement, you are in for a treat. The included modulation monitor function permits simultaneous viewing of all-important parameters including RBDS injection and SCA levels. The SCA filters can be configured for 67 or 92 kHz at a variety of bandwidths.



The GOLDENEAGLE modulation monitor screen.

By the way, if you have ever had a sneaking suspicion that someone has been in your workspace that should not be there, the unit even offers a webcam interface as a standard feature.

While a "Quick Start" guide is included for those that desire a short cut to immediate gratification, I cannot stress the following strongly enough: It will take a new user some time to explore all the options available, and reading the 100-plus-page manual is time well spent. Take your time to tour all that is offered. The more advanced user can jump right in and make measurements in short order. If you do run into a problem, factory support is excellent and timely.

Put simply and directly, the GOLDENEAGLE HD offers a powerful array of monitoring and measurement options in a compact package.

Eric B. Schecter, CBRE, is Director of Engineering, Lincoln Financial Media Co. of California, San Diego, CA. He can be reached at: eschecter@jpc.com

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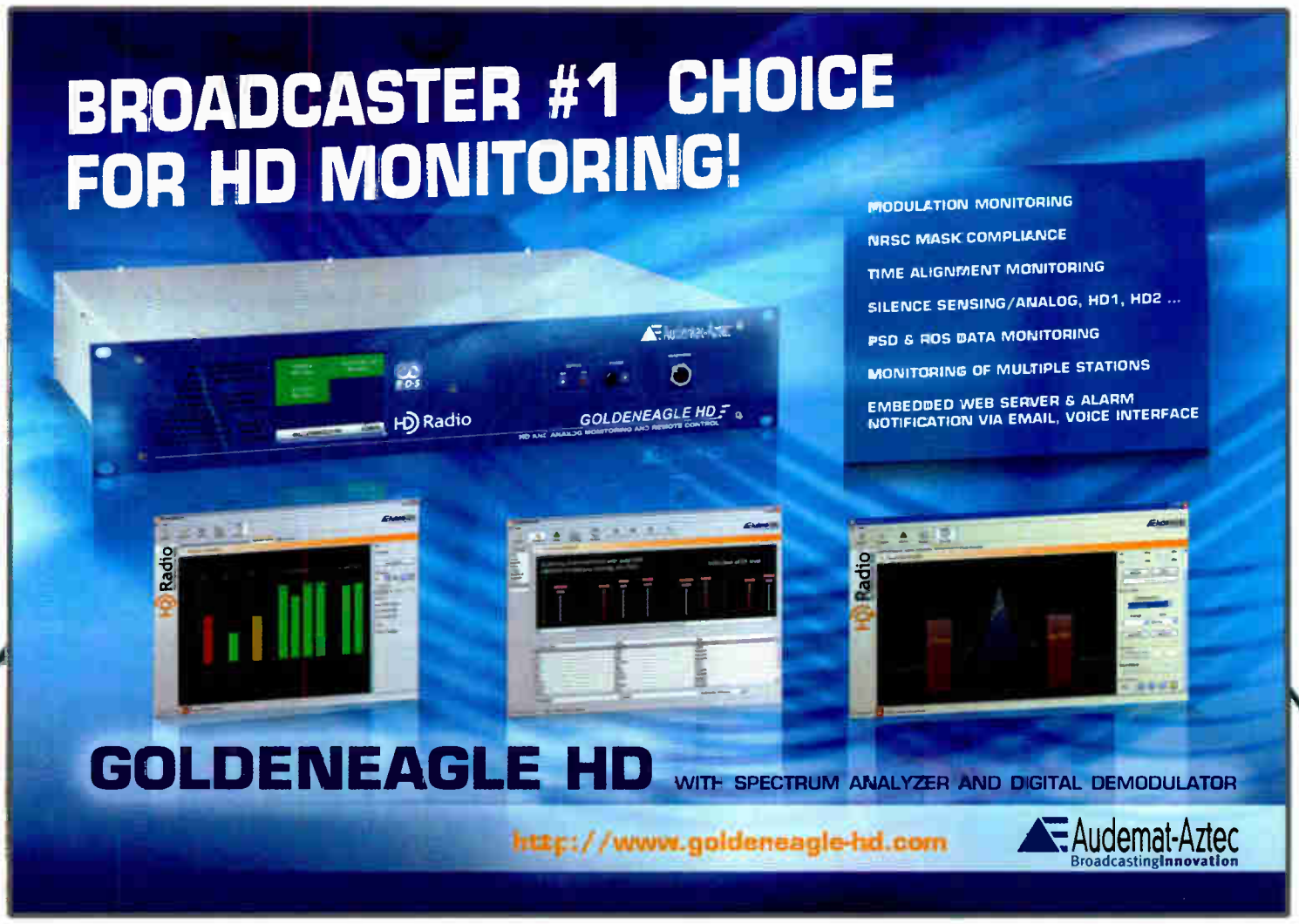

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Fanfare's FP-TRO HD Radio Translator System

by Marv Southcott
Fanfare Electronics

As many stations convert to digital transmission, FM translator operators have had two new problems to solve – getting translators and receivers that are compatible with the HD signal. Fanfare, long a manufacturer of high grade receivers, now offers a complete HD translator package.

With the introduction of HD Radio, there was a need for development of a "heterodyne" type re-transmitting system. A system was needed that could not only translate without de-modulation and re-modulation, but had the sensitivity to deal with low signal conditions.

DIGITAL VS ANALOG

For stations seeking to translate HD signals, especially in areas with problematical reception of the originating station, the FP-TRO from Fanfare may be just the product they need. Significantly, the translation occurs entirely within the analog domain.

There is no HD decoding or encoding going on anywhere in the translator chain. The apparatus of the receiving/rebroadcasting system is entirely analog from antenna to antenna. In addition, it is never demodulated nor decoded.

The development of the FP-TRO began in the year 2000 when I met with Omega Reception Technology's President Fred McCutcheon to discuss Omega's new AM radio circuit. Circuit designer Warren Brown had recently patented his new "no tailed pair" (NTP) based amplifier and extended the technology into a remarkable AM receiver.

NEW TECHNOLOGY – THE NTP AMPLIFIER

Brown's was a significant achievement, which is now the subject of a telephone-book-sized set of technical papers and a U.S. Patent.

What is NTP is all about? According to Brown it is quite simple. "If you are never to clip a signal, or drive any of the active stages into momentary overload – as is found in a lot of today's circuitry – you will not get as much static as you would if you did."

In addition to TRF control circuits that do not drift and mixers that do not combine impulse noise with the signal, the NTP has made possible the construction of an IF strip with a wide bandwidth but very steep and deep flanges and a very high speed AGC. This AGC is used to remove any envelope content (AM interference – usually caused by multipath) from the IF signal before it is sent to the converter unit, which takes the cleaned and regulated IF signal from the receiver unit and, using a linear modulator technique similar to the one in the receiver, reconverts it back to a frequency on the FM band.

BUILDING A BETTER TUNER

In conventional tuners, or translator converters, it is common practice to use only one front end stage and many IF stages in order to get sufficient reduction of adjacent channels.

The Fanfare FP-TRO HD Radio translator system.

It also is common practice in FM tuners to bring the IF strip into limiting (clipping) as soon as possible. This is in order to attempt to remove the AM content from the signal before it is either demodulated or reconverted and rebroadcast. Unfortunately, doing so indelibly imprints the noise from the AM domain to the FM, or time, domain. A fast AGC, such as that used by Omega Technology in the Fanfare FP-TRO, does not exhibit this fault.

The Fanfare FP-TRO, is based on an ultra-high performance tuner section having a triple, dual-stage tuned-radio-frequency (TRF) front end, and a linear modulator based RF-to-IF conversion system. This circuitry can exhibit a 20 to 40 dB advantage over a conventional mixer in noisy reception conditions. Both of these system components were made possible and economically feasible through use of the NTP invention.

BRINGING THE SYSTEM TOGETHER

At the April, 2007 NAB show the Fanfare FP-TRO HD Radio translator system was demonstrated to an audience consisting of representatives from the Crown Broadcast engineering team and the well-known "translator doctor" Tom King of KCRW.

Each left the demo impressed with the fact that the FP-TRO could reliably translate all available Las Vegas HD stations, right down to the first adjacent, without any apparent signal loss or distortion.

TESTING IN THE FIELD

Field trials of the FP-TRO were next and Fanfare was fortunate to have Tom King as host. The group for which he contracts was actively looking at the effectiveness of translating HD Radio in the Oxnard/Santa Barbara area.

The mountaintop translator site.

"The translator on which the FP-TRO was to be demonstrated was K272DI, 102.3 MHz, a translator of KCRU's 89.1 signal. KCRU is licensed as a satellite station of KCRW, Santa Monica," said Steve Herbert, KCRW's Chief Engineer.

The original translator installation utilized a Crown FM-30 at 10 Watts. This installation also used the same 10-Watt output power level using Crown's LA-75 linear amplifier strapped to 10 Watts. The same antennas, transmission lines, and original signal source are used.

FIELD TESTING

The FP-TRO system consists of two boxes – one being the receiver and the other being the upconverter/translator. They are connected by a short length of 50 Ohm coax. The installation went off without a hitch. With the FP-TRO in place and fired up, retransmitting an HD Radio signal, the Fillmore, CA, area was alive with solid HD Radio coverage.

The equipment appeared to be performing well. To confirm this Steve Herbert radioed back his observations as he drove around the Fillmore valley taking signal strength and quality readings. "The receiver I used was a Kenwood KD-HDR1 coupled to a Kenwood EZ-500 car stereo," He said. "I drove approximately 130 miles that day testing and listening to the station. The HD signal was solid to least seven miles out."

Herbert continues: "The translator's analog signal carries about twenty miles before it is completely lost, but that varies depending on terrain. Bottom line – it worked and we look forward to extending to our translator listeners the opportunity to benefit from the additional features and services HD offers now and in the future."

FIELD TRIAL A SUCCESS

The signal was just converted from one frequency to another without any of the multipath or impulse noise normally found in a rebroadcast signal. With this technology, any HD2 or HD3 signals are also translated. According to Tom King, the test was an "unqualified success."

What had taken place was unique for a translator retransmitting an HD Radio signal. The receiving/rebroadcasting system was entirely analog from antenna to antenna. There was no demodulating, decoding or encoding anywhere in the translator chain.

"The installation was simple to accomplish with only a few more interconnects than usual," said King. "The receiver did not overload with a 400 Watt station within twenty-five feet of the receive antenna. The HD signal coverage followed the 60 dBu contour of the station and was consistent throughout the area. Overall signal quality was excellent and modulation was very clean as expected for an IF translator."

The FP-TRO has continued to do the "seemingly impossible" by solidly translating KCRW's HD Radio signal throughout – and beyond – the normal coverage footprint without any power boost.

MULTIPATH PROBLEMS OVERCOME

A conventional tuner – equipped with HD-R capability – was used to conduct some of the analog tests. As expected, its incoming signal was fraught with typical multipath noise. Yet, that same tuner exhibited no multipath on the incoming station as long as it was tuned to the FP-TRO's output. The FP-TRO had removed the effects of the multipath, even in the rebroadcast signal. (Of course, multipath that occurs between the FP-TRO's rebroadcast signal and the conventional tuner cannot be taken into consideration.)

Listeners have commented on how well the FP-TRO deals with annoying multipath. Even stations that were nearly unlistenable due to multipath on many good tuners and receivers were found to be crystal clear through the receiver unit of the FP-TRO pair.

According to Warren Brown the FP-TRO was the first tuner he has experienced that truly seemed to lick multipath interference. This was particularly true on some strong local stations with horrific multipath problems. The FP-TRO's receiver picked up weak stations without any "sputter and rattle" where Brown did not even know FM stations existed.

NOT A CURE-ALL

It is easy to view versatile equipment like the FP-TRO as a "panacea" for all translator reception woes, but we are not there as yet. We did find an area where there was strong HD signal on both second and first adjacent channels. In that instance the skirts of the heavily-modulated first or second adjacent HD signal could easily get mixed in with that of the fundamental and the translator might end up translating both, which we all realize is a no-no.

In this case, where the translation is of "dirty" next-adjacent HD stations, the FP-TRO might not offer the most cost-effective solution over that of a typical exciter-based setup. But that situation is far from the norm. In general, the FP-TRO has the cleanest tuner I have produced.

By the time this article appears, we will have our surface mount device (SMD) prototype in the field. As soon as trials are competed, production units will follow during the fourth quarter of 2007.

More information on Fanfare can be found at fanfarefm.com

Marv Southcott is the President of Fanfare, in Lancaster, NY. He can be reached at msouthcott@fanfarefm.com

Tom King can be reached at tking@kcbx.org

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1967
First Orban product sold to customer: a stereo synthesizer sold to WOR-FM, New York.

1972
Bob Orban's first of 24 patents issues (U.S. #3,670,106, "Stereo Synthesizer").

June 2007 *
SCMS acquires assets of Major Broadcast Equipment Supplier

2005
Orban Optimod 8500 Third Generation of Digital Processing is released and takes audio processing to a new level of industry setting standard.

1975
OPTIMOD 8000 audio processor introduced for the new FM format. Bob Orban and partner, John Delantoni, set up Orban Associates as a privately held company.

2003
OPTIMOD-FM 8300 is introduced at NAB in Las Vegas. OPTIMOD-PC ships. World's first audio PCI Sound Card with Optimod-class DSP for broadcast signal processing.

1976
SCMS founded by Bob Cauthen

2007*
Orban begins shipping the new Optimod 6300 high-quality, multipurpose stereo audio processor for digital radio, digital television, netcasts, STL protection, satellite uplink protection, and digital mastering.
Orban also introduces the all-digital 9300 Optimod-AM audio processor for monophonic AM shortwave, medium wave and long wave broadcasts.

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2000
Orban Optimod 8400 Second Generation of Digital Processing is released to immediate great reviews and becomes the new industry standard.
Orban Inc. is purchased by CRL from Harman International.

1978
OPTIMOD-AM 9000A offers AM stations a more "FM-like" sound quality and reduced interference.
In modified form, the receiver equalizer and low-pass filter ideas form the basis for the NRSC-1 standard issued in 1987.

1996
First low-priced, all digital processor for FM introduced, OPTIMOD-FM 2200.
The DSE 7000FX introduced with new DSP engine offering on-board effects like reverb, equalization and compression.

1983
OPTIMOD-TV Model 8182A introduced. Adds Hilbert-transform clippers and a CBS Loudness Controller to the original 8180A.

1991
Orban leads the transition to digital with the first successful DSP-based FM audio processor, OPTIMOD-FM 8200.
Thousands on air around the world.

1987
Orban's first product using micro-processor technology is introduced. The 787A Programmable Mic Processor incorporates equalization, compression, and de-essing in a digitally-controlled analog signal path.

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* Go to http://www.orban.com/about/timeline/ for a full look at Orbans timeline

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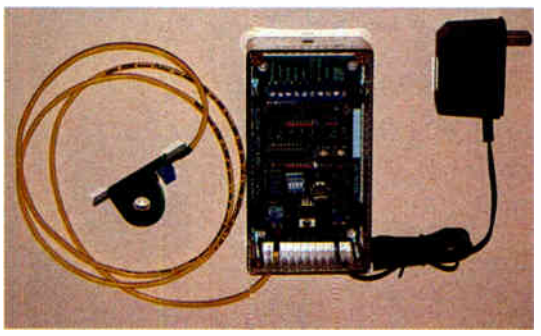

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MR2 & MR-PRO Minirators
Analog Audio Generator

The MR2 & MR-PRO are the new standards for portable audio generators - the behind-the-scenes stars of thousands of live performances, recordings and remote feeds. Both pocket-sized analog generators include a new ergonomic instrument package & operation, balanced and unbalanced outputs, and a full set of output signals.

- Sine waves - Swept (chirp) and Stepped sweeps
- Pink & white noise
- Polarity & delay test signals

Plus the MR-PRO adds:

- User-stored custom signals & generator setups
- Phantom power measurement
- Impedance, balance measurement & cable tester
- Protective jacket

MiniSPL
Measurement Microphone

The precision MiniSPL measurement microphone (required for the AL1 Acoustilyzer and optional for the ML1 Minilyzer) is a precision reference mic for acoustics measurements, allowing dBSPL, spectrum and other acoustical measurements to be made directly.

- 1/2" precision measurement microphone
- Self powered with automatic on/off
- Omni-directional reference microphone for acoustical measurements
- Required for the Acoustilyzer; optional for the Minilyzer

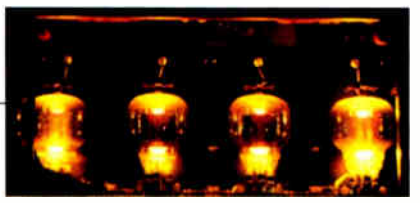
MiniLink USB interface
and PC software

Add the MiniLINK USB interface and Windows software to any ML1 or DL1 analyzer to add both display and storage of measurement results to the PC and control from the PC. Individual measurements and sweeps are captured and stored on the instrument and may be uploaded to the PC. When connected to the PC the analyzer is powered via the USB interface to conserve battery power. Another feature of MiniLINK is instant online firmware updates and feature additions from the NTI web site via the USB interface and your internet-connected PC.

- USB interface fits any ML1 or DL1
- Powers analyzer via USB when connected
- Enables data storage in analyzer for later upload to PC
- Display real time measurements and plots on the PC
- Control the analyzer from the PC
- Firmware updates via PC
- MiniLINK USB interface is standard on AL1 Acoustilyzer

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

Final Stage



RADIO ROUNDUP

The Radio Guide Event Register

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

BOS-CON 2007
October 5, 2007
Marlborough, Massachusetts
www.bos-con.com

123rd AES Convention
October 5-8, 2007
The Javits Center, New York
www.aes.org/events/123/

Madison Broadcasters Clinic
October 9-11, 2007
Madison, Wisconsin
www.wi-broadcasters.org

Pittsburgh SBE20 Regional Convention
October 10-11, 2007
Monroeville, Pennsylvania
www.sbe20.org

35th Annual SBE22 Broadcast/Technology Expo
October 16-17, 2007
Verona, New York
www.sbe22expo.org

5th Annual Ohio Broadcast Engineering Conf.
November 29, 2007
Worthington, Ohio
Contact: Patti Geary at pgeary@oab.org

Great Lakes Broadcasting Conference & Expo
March 10-11, 2008
Grand Rapids. Michigan
www.michmab.com

Radio Guide Advertiser Info – October 2007

Advertiser - Page	Website	Advertiser - Page	Website
AM Ground Systems - 19	www.amgroundsystems.com	Jampro - 34	www.jampro.com
APT - 6	www.aptx.com	JK Audio - 9	www.jkaudio.com
Armstrong Transmitters - 19	www.armstrongtx.com	Kintronic Labs - 9	www.kintronic.com
Audioarts Engineering - 24	www.audioarts.net	LBA Technology - 31	www.lbagroup.com
Audion - 27	www.audionlabs.com	Lightner Electronics - 19	www.lightnerelectronics.com
Axia - 13	www.axiaaudio.com	Micro Communications - 30	www.mcibroadcast.com
Bay Country - 17	www.baycountry.com	Moseley - 16	www.moseleysb.com
BEXT - 17	www.bext.com	Nautel - 10	www.nautel.com
Broadcast Devices - 39	www.broadcast-devices.com	Nott Ltd. - 26	www.nottltd.com
BGS - 2	www.bgs.cc	NTI Amercia - 46	www.minstruments.com
Broadcast Software Intl. - 3	www.bsiusa.com	OMB America - 30	www.omb.com
Broadcast Technology - 32	www.broadcasttech.com	Omnia - 15	www.omniaaudio.com
Broadcast Warehouse - 33	www.broadcastwarehouse.com	Orban - 48	www.orban.com
CircuitWerkes - 37	www.circuitwerkes.com	Peter Dahl - 19	www.pwdahl.com
Comet - 8	www.comet.ch	Pristine - 2	www.pristinesys.com
Comrex - 5	www.comrex.com	RAM Broadcast Sys. - 29	www.ramsyscom.com
Continental - 27	www.contelec.com	Radio Systems - 23	www.radiosystems.com
D&H Antennas - 39	www.dhsatellite.com	RCS - 22	www.rcsworks.com
Davicom - 14	www.davicom.com	SAS - 21	www.sasaudio.com
Econco Tubes - 39, 44	www.econco.com	SCMS Inc. - 41, 43	www.scmsinc.com
ERI - 36	www.eriinc.com	Shively Labs - 23	www.shively.com
Fanfare - 31	www.fanfare.com	Telos - 11	www.telos-systems.com
Gorman Redlich - 29	www.gorman-redlich.com	TFT - 17	www.tftinc.com
Graham Studios - 17	www.graham-studios.com	Tieline - 7	www.tieline.com
Henry Engineering - 2, 35	www.henryeng.com	Titus Technology - 29	www.tituslabs.com
Inovonics - 1, 28	www.inovon.com	Transcom - 36	www.fmamtv.com

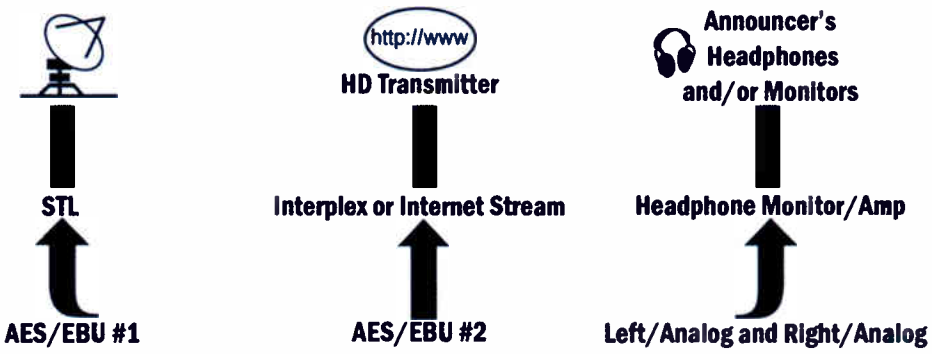
Radio Guide Engineering Services

Going HD?

The **Orban Optimod 6300** is perfect for processing your HD digital channels.

THREE OUTPUTS

- **A studio AGC (with peak limiting for STL protection)**
- **A no-compromise processing chain for digital transmission and media**
- **A low-delay talent headphone processor**



orban 6300 OPTIMOD

FOUR CHOICES OF PROCESSING

AGC · AGC with Limiting · Multiband · Multiband with Limiting

- **Two digital AES/EBU outputs and one stereo analog output.**
- **Mastering-quality look-ahead limiter provides tight peak control for both "flat" and pre-emphasized channels.**
- **Flexible routing: Any output can emit the AGC or Multiband processed audio, with or without look-ahead limiting.**
- **Exclusive Precode™ technology minimizes artifacts in low bitrate codecs (like HD Radio's HDC) without sucking the life out of the audio.**
- **New compression ratio and knee controls makes the 6300 ideal for mastering and production studio applications.**
- **Remote controllable via GPI contact closures, Ethernet, and RS232 serial connections.**
- **Smooth, responsive PC Remote Control application for Windows PCs is included.**
- **Quick Setup wizard, dozens of excellent factory presets, and LESS-MORE control make setup and tuning easy.**
- **Includes CBS Loudness Controller™ for TV applications.**

orban crl

For a list of distributors visit
www.orban.com

7970 South Kyrene Road
Tempe, Arizona 85284
Phone 480-403-8300
Fax 480-403-8301

The Orban 6300 is a high-quality, multipurpose stereo audio processor for digital radio, digital television, netcasts, STL protection, satellite uplink protection, and digital mastering. With 20 kHz audio bandwidth, the 6300 succeeds Orban's popular OPTIMOD-DAB 6200 audio processor but offers improved processing algorithms and more flexibility.