Radio Guide

Radio Technology for Engineers and Managers

April 2005

Moving Ahead on the Digital Path

Inside Radio Guide

Digital Radio

Things We Have Learned

Page 4

We have had conference calls and meetings to discuss our installation experiences, and each of them has something to contribute, from project management and planning ideas, to audio processing choices and adjustments, AM array adjustments to pass HD radio, and FM filter and antenna tuning and combining options. Much of the information in this article was drawn from remarks made by these engineering leaders on our calls.

We are conducting our own experiments, both in the field, and the laboratory, and are continuing to work with various vendors to advance the state of the art and answer the questions which continue to come up as we gain experience in this new and exciting area – *Steve Davis, Senior VP Engineering, Clear Channel Radio*

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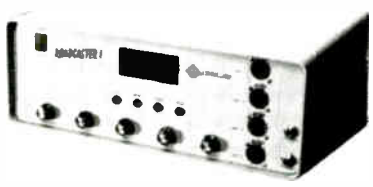

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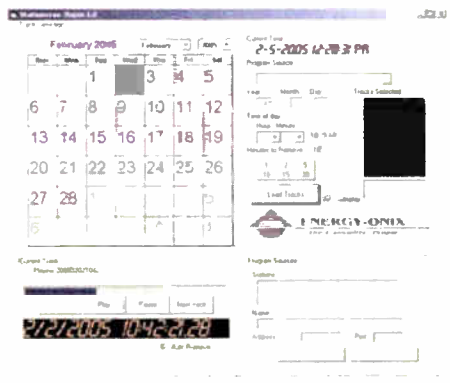

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Cover Photo : Courtesy of Stuart Peters, Manager, RF Customer Service, Broadcast Electronics.

Pictured: Jobie Sprinkle, Director of Engineering for WFAE in Charlotte, NC, and their repeater station, WFHE.

Radio Waves

by Barry Mishkind – Editor

Conferring, Conversing, and Otherwise Hobnobbing

It is good to have the opportunity to talk to you, in person, by letter and email, or via the phone. I always end up learning something good, and make new friends when we communicate.

An outgrowth of the effort to communicate was the Technical Initiative we announced last year. It has been gratifying to see how many sent in articles or tech tips – even suggestions – to share knowledge and experience with the industry.

The rest of the Awardees are listed on page 26. Most of them will be at the Lunch Gathering on Tuesday, April 19th at Noon in the Riviera Buffet Restaurant. If you are in Las Vegas, we hope to see you there.

However, our goal to invite you to share something back continues. True, many of you are stretched for time or under some idiotic legal-suit edit not to publish, but together we can handle this. More than a few of the published authors in the past year never thought they would be able to do an article. Yet, in the end, the feeling was, "it really was an enjoyable experience."

That is why we will continue to encourage more folks to take a moment and write articles. Your experience and viewpoint is important to us all.

One note on NAB, whether you are there or not:

Years ago, at NAB time, I would leave a memo for station staff advising them I was "off to confer, converse and otherwise hobnob with my fellow engineers," a take-off of the Wizard of Oz' final pronouncement when he got in the balloon.

A light-hearted way to put it, but I really do hope I get a chance to see you this year. Let's confer, converse, and hobnob! – *Radio Guide* –

Digital Radio

by Steve Davis
Senior VP Engineering
Clear Channel Radio

Things We Have Learned: Tips, Tricks and Traps

As more and more digital transmission systems come on line, engineers are discovering all sorts of things that they had not anticipated, as well as ways to deal with them. Clear Channel Radio has been aggressive in rolling out digital systems, and here Steve Davis shares some of the lessons learned so far.

[TULSA, Oklahoma] Digital Radio brings new challenges to the radio engineer. At Clear Channel, we are fortunate to have a large pool of talented engineers. Still, each new install completed adds to our knowledge base.

SEPARATE INPUT ANTENNAS

For example, we have noticed some IM products are apparently caused by lack of adequate isolation in the antenna hybrids, especially where we are backfeeding an existing combiner at a community antenna site.

The problem does not manifest itself in the digital transmitter since that is protected by a circulator, but it can be a problem with the analog transmitter. More study needs to be done on this, by both the transmitter and antenna manufacturers.

When energy from the digital signal gets back into the analog it produces a product that is right up under the upper sideband of the digital carrier, which combines with the analog, producing an intermod product right under the lower sideband and vice versa. We have also noted that solid state analog transmitters seem to be more immune to this; they do not tend to IM as badly as tube type boxes when hit with the returned digital signal.

We have measured isolation values in the neighborhood of 14 to 16 dB from one antenna input to the other on some of these dual input antennas, and feel that really is insufficient to obtain adequate performance. Jeff Littlejohn has noted that this problem is serious enough in some cases to noticeably degrade the quality of the digital signal. Early indications from our experimenting to determine the desired isolation, suggest it will be in the neighborhood of 20 to 25 dB.

The following chart, created by Randy Mullinax, a Clear Channel radio engineering VP, illustrates this.

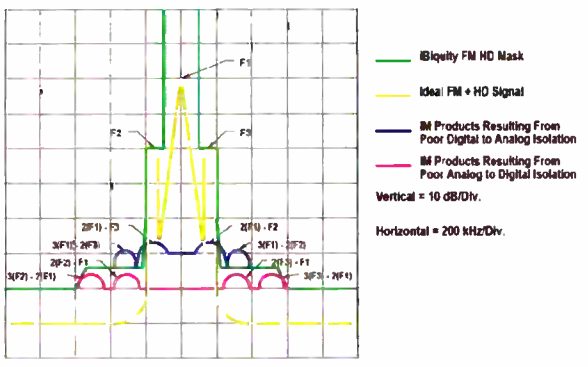

Figure 1: Potential IM Products in HD Systems (courtesy Randy Mullinax)

The manufacturers have not really studied this much because there is no accepted method to measure the total analog + digital spectrum in these antenna-combined systems (where do you put the sniffer?) Clear Channel is looking at a methodology for measuring this on a repeatable basis.

A SUGGESTED PROCEDURE

Randy has also come up with a suggested procedure for measuring and documenting the spectral purity of HD radio installations that use either separate antennas (space combined) or an antenna with a separate input used for the digital signal. We invite comments from the industry. Here is Randy's suggestion:

Take a directional sample from each transmitter and combine the samples together (after appropriate level correction). It is still necessary to use wattmeters, line loss and antenna gain calculations to determine the correct power level for the digital transmitter.

Pads are then used to set the digital carrier levels to 41.6 dB below the analog "unmodulated carrier level." I used a 3 dB combiner from an older transmitter for the experiment.

A suitable combiner is available from Mini-Circuits, Model ZFSC-2-1 (this is the same combiner used by Harris in their HD transmitters) for $44.95 – you will also need a range of attenuator pads that will allow you to adjust in 1 dB increments (0.5 dB would be even better), or a suitable adjustable pad.

If you choose to try this type of measurement, I recommend that you use at least 6 dB of pad at each input to the combiner for isolation purposes.

We conducted this experiment on the outputs of the transmitters in a high-level combined system so that we could compare the results to a sample taken from the output of the 10 dB combiner. The results of the experiment are shown in Figure 2. I feel that the results adequately quantify the spectral purity (as close as we are going to get in the "real world").

Figure 2: Spectral Comparison, Direct Measurement at Output Hybrid, vs. Combined Measurement Methodology (Randy Mullinax).

ANALYZING THE MEASUREMENT

The screen shot shows the results of measurements conducted on a high-level combined HD Radio transmission system, showing the outputs of both the individual transmitters and the combiner. That was our way of assessing the accuracy of the method.

The blue trace was taken from a directional sample at the output of the 10 dB combiner.

The red trace was taken from separate directional samples for the analog and digital transmitters with the samples combined together using a 3 dB combiner. The analog transmitter sample was applied to the -90 degree input of the combiner through a 6 dB pad. The digital sample was applied to the 0 degree input of the combiner through a 17 dB pad.

The green trace was also taken from separate directional samples as above. The analog transmitter sample was applied to the 0 degree input of the combiner through a 6 dB pad. The digital sample was applied to the -90 degree input of the combiner through a 16 dB pad.

There was a minor level mismatch (approximately 0.5 dB) through the combiner, which is the reason for the 1 dB difference in the pad used for the digital sample. We attempted to match the digital carrier levels for each trace a closely as possible.

HIGH-LEVEL COMBINED FM SYSTEMS

We have found that the spectral purity of high-level combined systems – and, presumably, mid-level or "split level" combined systems – can be greatly impacted by the digital signal reflected back to the analog transmitter via the hybrid combiner.

Again the effect appears to be more profound when tube-type transmitters are used to generate the analog signal. Hybrid balance and minimizing digital reflection back to the analog transmitter has been found to have a significant impact on the intermod levels.

A concern we have identified is a failure of the reject load. This could cause 10% of the analog (assuming 20 dB of isolation in the hybrid) to reflect back to the digital transmitter. Given the disparity of power between the analog and digital transmitters it could be sufficient to damage the digital transmitter. We are looking at ways to monitor and interlock for such a potential failure.

HD ON AM

As expected, the load presented to an AM transmitter has a significant impact on the system's ability to pass the IBOC signal. While there are specifications on the permitted VSWR, we have observed that of paramount importance is the symmetry of the load.

John Warner, our VP/AM Engineering, has been measuring the loads including tower and common point impedance through the passband and looking at symmetry on the Smith Chart. In some cases we have had to add a network stage to get the needed symmetry.

It is also important to carefully adjust the software setting for "Mag/Phase" on the IBOC exciter to get into compliance. Even setting to a dummy load is not enough – it needs to be set into the actual load. (Due to failed/tired components, some aging dummy loads are not 50 ohms, or are inductive.)

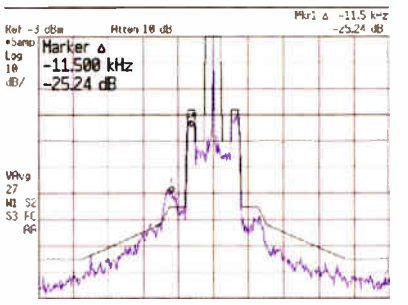

Figure 3: AM station before Mag/Phase adjustment into actual load.

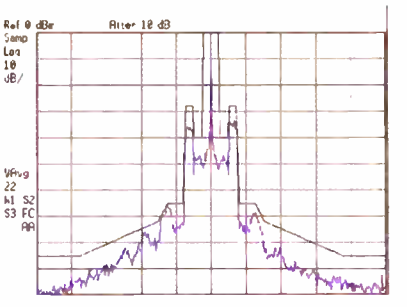

Figure 4: AM station after Mag/Phase adjustment.

Shown here, are a couple of pictures of "before and after" the correct number for mag/phase delay was dialed in to an actual operating system.

SEEKING TO DOING IT BETTER

Clear Channel's engineering team continues to learn, and improve the speed and quality of each installation as we go. Not only are we fortunate to have many outstanding broadcast engineers at our local markets, but our Regional Vice Presidents of Engineering each bring different areas of expertise to the table which truly complement one another.

We have had conference calls and meetings to discuss our installation experiences, and each of them has something to contribute, from project management and planning ideas, to audio processing choices and adjustments, AM array adjustments to pass HD radio, and FM filter and antenna tuning and combining options. Much of the information in this article was drawn from remarks made by these engineering leaders on our calls.

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An engineering veteran with over 25 years experience in broadcast facilities design, construction and maintenance, Steve Davis is the Senior Vice-President of Engineering for Clear Channel Radio. His email is: stevedavis@clearchannel.com

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Digital Guide

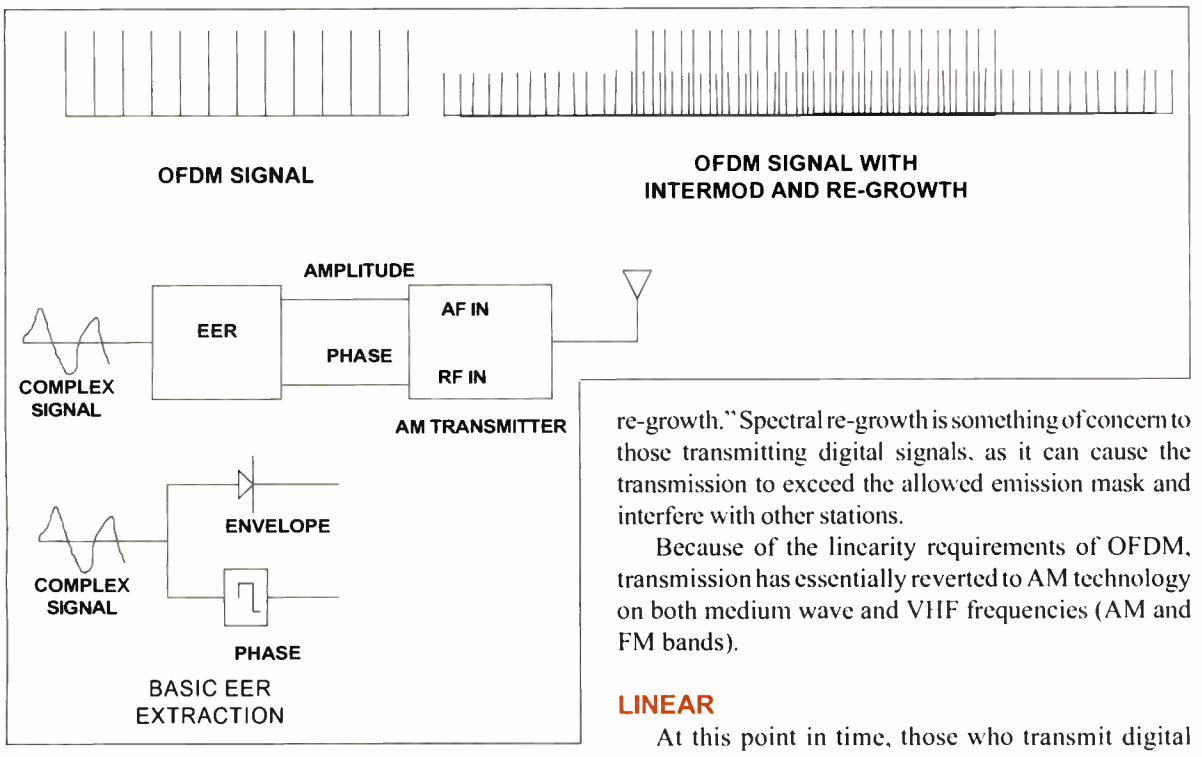
by Rob Meuser

Digital Transmission

Part 3: Linear Amplification

[NEW YORK CITY, New York] There are various methods of encoding a digital signal into a practical RF channel. In fact, by using various RF phase and amplitude states we even can encode more than one bit at a time on a carrier, in effect converting the digital signal into an analog value.

Last time out, we looked at spreading the data over a number of narrow interleaved carriers, effectively making the data transmission parallel; this technique is called OFDM. In such transmissions a guard interval plays an important part in making OFDM resistant to multipath and, to a certain degree, interference.



A PRICE TO PAY

However, there is a price to be paid using this technology – the price essentially being power and heat. There are two reasons linear amplification is required. The first is the QAM signal itself. Since there are both different states of phase and amplitude used in QAM to represent the symbols, that alone requires a linear amplifier.

This is really like going back to the future. Many of the old AM technologies that were once given up for outdated are having a comeback – technologies like Doherty Amplifiers and the use of EER are but two methods used for digital transmission.

As much as QAM needs good linear amplification, ODFM needs it even more. For QAM, we have to be able to pass the signal so that the amplitude states are not impaired; the amplifier must also be spectrally clean so that it does not interfere with adjacent channels. OFDM adds another level of complexity. Since the OFDM signal consists of multiple tones, there is also the issue of intermodulation distortion.

LESSONS FROM TUBE TRANSMISSION

If you think back to analog broadcasting, one of the tests often performed on transmitters (especially tube AM) is for IM distortion. There are a number of variations of the test; one is known as the CCIF test.

The CCIF test uses two equal amplitude tones spaced usually 1 kilohertz apart. A perfect amplifier would reproduce those two tones and those two ones only. A real amplifier will also produce the sum and difference of those tones and as distortion gets worse the sums and differences of those products, etc.

If you look at an OFDM signal, it could be viewed as the CCIF test on steroids. An amplifier that is not perfectly linear will produce IM products. There are two basic types of IM products that develop. The first is on-channel in between the OFDM carriers. If the distortion is severe enough, it can impair the integrity of the data being sent.

The second type of IM products is out-of-channel. A special term has been applied to there products: "spectral re-growth." Spectral re-growth is something of concern to those transmitting digital signals, as it can cause the transmission to exceed the allowed emission mask and interfere with other stations.

Because of the linearity requirements of OFDM, transmission has essentially reverted to AM technology on both medium wave and VHF frequencies (AM and FM bands).

LINEAR

At this point in time, those who transmit digital signals on VHF and higher frequencies really have only one option in using a good linear amplifier. The good news is that the same technology used for TV transmitters can be used at these frequencies. The bad news is that these amplifiers are less efficient than a class C or D FM amplifier. Currently a 10 kW solid-state transmitter becomes a 7.5 kW when the amplifiers are made linear.

Regardless of the method of FM combining used, a linear amplifier is required at the present time. As digital broadcasting matures, higher efficiency VHF amplifiers will probably be built.

Medium Wave digital broadcasting is an entirely different situation. Pure linear amplifiers have not been in general use for many decades. There have been only a few transmitters that generate an AM signal at a low level and then use a high efficiency linear amplifier to reach the ultimate power level. A method is needed to amplify the digital signal with the required linearity.

EER

Once again, we look back to the past (over 50 years ago) and revive an old technique. The technique is known as EER, which stands for Envelope Elimination and Restoration. It is also sometimes known as the Kahn method – Leonard Kahn used this technique and variations of it back in the early 50's. EER is basically a way to fool a non-linear AM transmitter into being a linear amplifier.

The principle of EER is deceiving simple. All forms of modulation contain two components, amplitude and phase (if you consider frequency an extension of phase). A pure AM or CW signal would have only the amplitude component and a pure FM signal would contain just phase (frequency).

Other forms of modulation like SSB and DSB as well as the digital signal we have been discussing contain both amplitude and phase. With EER, we separate the amplitude and phase. The amplitude component goes into the usual AM modulator while the phase is fed into the transmitter's RF chain in place of the crystal oscillator. Many will recall this is very similar to how AM stereo exciters interfaced into AM transmitters.

Early EER implementations extracted the envelope by means of a simple envelope detector and the phase by hard limiting. Modern implementations of EER can be completely digital. The open source program DREAM can generate a DRM style OFDM signal on a PC and output envelope and phase signals via the left and right channels of the PCs sound card. Next time we will look at how this all plays (or does not play) in the real world.

For over three decades, Robert Meuser has focused on the latest technologies for broadcasting. He welcomes your comments at robertm@broadcast.net

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IN THE MIDDLE OF THE ACTION... LIVE, FROM IRAQ.

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Field Guide

by Burt Weiner

Using GPS for Field Intensity Measurements

Some have suggested that doing a Directional Antenna Proof involves almost equal parts of science and art. However, in recent years GPS technology has helped make the process easier, more consistent and repeatable. Burt Weiner explains:

[GLENDALE, California] It is almost a given: full directional proofs are a time consuming and expensive undertaking.

In the average full proof you will most likely be measuring 400 points or more per mode of operation. Depending upon the number of people in the crew, it can take weeks, even months to do it right. Furthermore, errors in the accuracy of the location of the antenna, your location or the layout of radials can make all of your work meaningless.

For that reason, benefits from the GPS (Global Positioning System) technology have made it much easier for engineers to produce accurate RF proofs – and to do it much faster than we would ever have imagined. I would like to share some observations on how GPS can help you with your antenna proofs.

PROOF OF PERFORMANCE

Section 73.186(a) of the Federal Communications Commission's Rules sets specific requirements for conducting Proof of Performance measurements for a directional antenna system's field strengths. Always start here.

When preparing an antenna proof – for either an upgrade or a new station – it will be necessary to purchase numerous USGS map sections called Quads (short for Quadrangles) for the area that the proof measurements will encompass. In some cases this could require 20 or more different quad sections.

Next, you will have to locate the center of the antenna system precisely on the map. Then comes the fun of trying to accurately draw the long radial lines across all of the maps.

This is usually accomplished by laying the Quad sections on a large flat surface such as the conference room table or the kitchen floor and accurately taping them together long enough to draw the radial lines. Then even more fun comes in dealing with these large map sections in the car.

One method of doing close-in measurements is to use a "calibrated" rope. This method has been described in numerous papers. However, if your transmitter site is in a developed area such as Los Angeles then the rope method is not practical. It would have you climbing over fences through back yards, through or over houses and dragging it across busy streets; not a healthy activity.

GPS MAKES THINGS EASIER

There is inexpensive GPS hardware and software available that will turn almost any laptop into a very accurate mapping tool. Recent additions include the use of a Wide Area Augmentation System (WAAS) that is akin to Differential GPS and greatly increases the accuracy.

The software will allow you to precisely locate the antenna and draw the radials on the maps. The cost, including maps of your entire state on a single DVD, is most likely less than you would pay for the necessary USGS maps alone from your favorite map supplier.

If you have ever tried to use one of the street map programs you already know the problems due to lack of accuracy. Seeing a point located on the wrong side of the street – or worse, on the next block – can create real problmes!

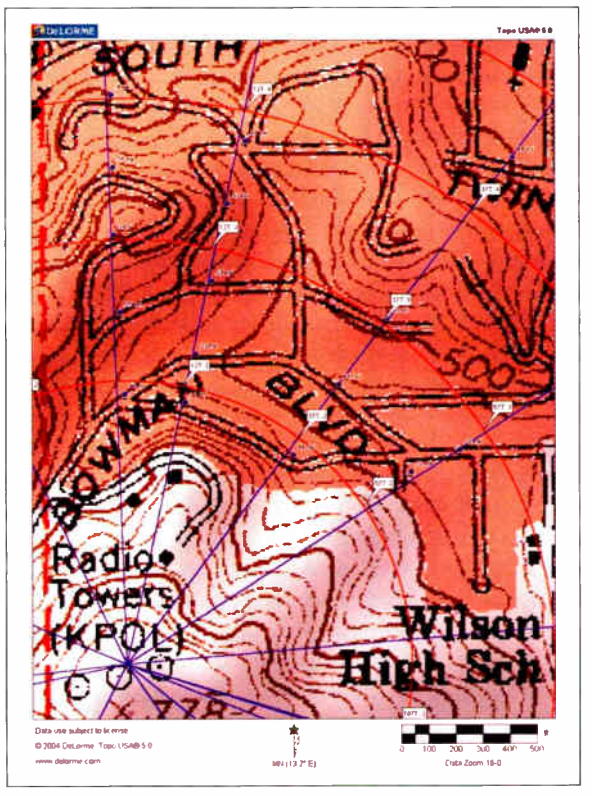
I use Delorme's TopoUSA Version 5.0. But instead of the TopoUSA data disks, I use the Delorme 3-D TopoQuad map data disks. These maps are authentic USGS 7.5-minute quad maps, the very same USGS Quads you would purchase to lay out and map your routes.

This program is installed on my desktop computer as well as my laptop. Once I have all of the requirements for the radial work, I can prepare the maps on my desktop computer in typically less than an hour and then transfer the data to a disc and into my laptop.

ADDITIONAL DATA

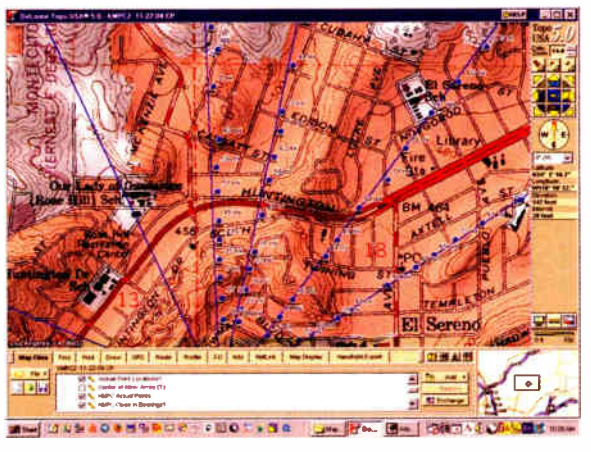
In addition to drawing the radials, I like to add aids to the maps to make life easier on the road such as circles centered on the station's antenna to show the distances out from the transmitter.

For example, I will draw a set of circles at one-tenth kilometer increments from the transmitter out to three kilometers for the close in measurements, and then from three to thirty kilometers in one-kilometer increments. You may not need that much distance, but it is nice to have it marked.

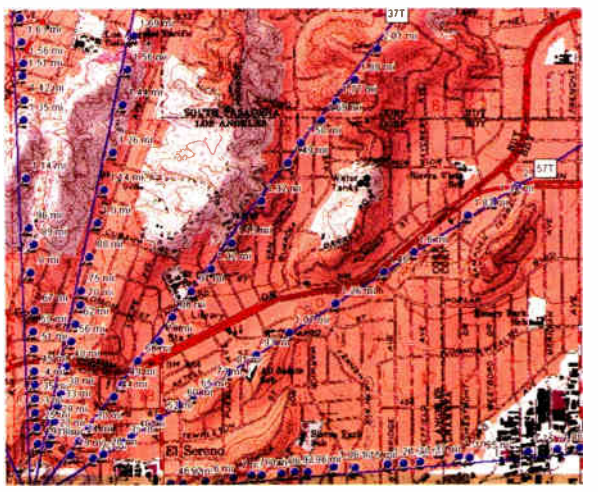


I draw the radials in blue and the distance circles in red. This way I do not lose track as to which is the radial and which is the distance circle when I am zoomed in on a small area.

At each point where the radial crosses a distance circle I draw a tag pointing to that intersection and mark the tag with the radial number and the distance. For example, a tag might be marked, "57T 8.0". This tells me that I am looking at the 57°T radial at 8.0 kilometers out. This is extremely handy and time saving. You do not have to move all over the screen to verify which radial you are looking at or to check the distance.



I also create a draw layer called, "Actual Points." In this layer I add pins as well as note the distance on the map (in software of course) at the actual locations where measurements are made. By placing these aids in separate draw files I can turn them on or off in any combination with a single mouse click.



At the completion of the proof I turn off all layers except for the radials and Actual Points and I am left with traditionally marked Quads ready for printing.

ON THE RADIALS

When I do radial work I like to work as a team with one person driving and measuring while the other person navigates and logs. In most cases we use two laptops with GPS; one runs the TopoQuads and is typically running NAD-27 Datum while the other is running with normal street maps such as Delorme's Street Atlas 2005.

While the Quads are quite accurate for drawing and location, they are not always current as to new streets and subdivisions. That is where Street Atlas comes in handy, but the Quads are our "Official Map."

By the way, some GPS devices automatically show you the heading and distance from a waypoint, such as the antenna, to where you are located. However, I personally prefer seeing where a radial is in relationship to my location and home in on it. That seems more in keeping with one's natural tendencies.

Part of our logging is writing a traditional description of a point location. While GPS is very accurate, it should not be solely relied upon to take the place of a written description of a point.

Craig Robbins does the backseat driving and logging.

If possible, I like to use measuring locations such as water meters, fire hydrants or manhole covers at the front of homes or buildings. Homes may change greatly in appearance, but the location of these utilities will seldom change and are generally easy to locate.

DEFINING REPEATABLE POINTS

The description needs to be written so that someone other than you will be able to locate the exact measuring location.

The longevity of a measuring point location also needs to be considered. For example, is that point in the middle of a vacant lot in a new housing development going to be there in another year or will it be the middle of someone's living room?

A point description such as "123 Rooster Beak Lane" is not sufficient enough to tell you specifically where the point is at that location. Nor is "127 feet east of the center of Barnyard Street on the north side of Rooster Beak Lane." "Over the water meter at 123 Rooster Beak Lane" is easy to read and locates the point precisely.

(Continued on Page 10)

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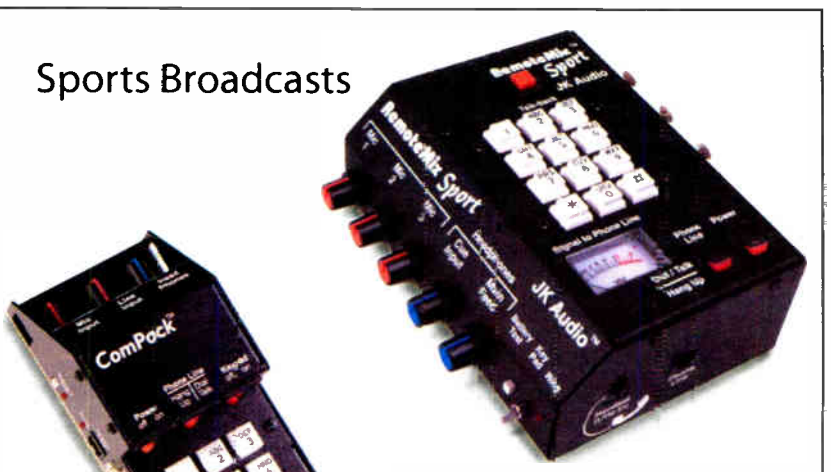

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Field Guide

Continued From Page 8

If the location is in the middle of a road and cannot be easily tied to a specific permanent landmark, sometimes I will use a spray can with white street marker paint to make a noticeable "X" at the spot.

On long country roads I will put an "X" on the road and describe the location as best as possible. Try to make the measurement and the "X" on the edge or center of the road where car tires are less likely to run over it. I have returned to some points two to three years later to find the "X" still vividly there.

LOCATING GOOD POINTS

When searching out new measuring point locations watch out for things that can affect the accuracy, stability and reliability of the point's reading.

Overhead power or telephone lines certainly come to mind but equally detrimental are tall street light standards or telephone poles. Anything that is long and capable of electrical conduction can be a problem. A wooden pole by itself will not cause a problem but a single thin wire running up that pole sure can.

A point of caution: new developments at first glance often might look quite benign, but in fact may have underground utilities that can greatly distort and cause erroneous readings.

An old trick I like to use when evaluating a measuring location is to look at the null depth when the meter is turned off-axis from the transmitter's direction for a minimum reading. The null depth is a pretty good indication of localized re-radiation. I always look for a null depth of 20 dB or more.

For example, when making the non-directional portion of a proof, if the orientation for maximum gives you a reading of approximately 630 mV/m and rotating the meter for a null gives you a reading of 30 mV/m, you can be reasonably confident that this will be a good location. On the other hand if the null was only down to 580 mV/m this likely is not a good location. On the log we will record the reading as "630/30." You will want to make the same null depth test when running the directional proof.

GATHERING SUFFICIENT DATA

Always locate more than the minimum number of points needed. Sprinkle them generously along each radial. This will give you a better opportunity to toss out the defective points that will surely show up when making the directional proof and still leave you with at least the minimum number of points required. For the close-in measurements I will take a reading at every street crossing, sometimes on both sides of the street and around corners, as long as it is on the radial.

A Mobile Laptop GPS System

While looking for points, we have been on some fun rabbit trails and wondered how they were ever surveyed; the GPS system using Quads assured us that we were on the correct road. We have also been in the mountains where there are dozens of small paths. Without the GPS it is difficult to be absolutely positive which path you are on, but with GPS there is no question – it is easy to locate the radial and know your exact distance.

During the process, remember that the points you locate and measure for the non-directional proof are the same ones you will return to when making the directional proof and any future partial proofs. Vague descriptions will certainly slow you down and may even result in erroneous readings.

(Yes, the notations on the maps in the drawings are in Miles. This was by client's request.)

Burt Weiner is a veteran of over 48 years and dozens of DA proofs in the Los Angeles market. Email Burt at biwa@earthlink.net

Audio Guide

Cornelius Gould

Processing From the Ground Up

Part 20: Digital Loudness and Delay

[CLEVELAND, Ohio] Once you come to understand some of the basics on how HD Radio works, you quickly get enough of an idea about what is happening that you are able to understand the audio processing advice you are getting from folks who have been there.

HD MEANS NO PROCESSING WAR

To being this discussion, we pick up on a comment I intentionally left hanging until this installment: I think loudness wars on HD will *not* be a problem in the sense that it has been in the past. There are several reasons for this.

First of all, for the time being the HD signal is going to be tied in with the analog. That is, all HD radios will blend to analog by default when the digital signal is unusable. This blending can happen quite a bit, depending upon where the listeners are, local terrain, and how the radio is designed.

For that reason, you will need to match the levels of the HD with the conventional analog channel. No matter how hard or crazy you push your analog signal, the digital signal has the ability to be (literally) about 6 dB louder. Thus, for most stations, setting the HD audio levels to match analog would mean a setting of around -6 on peaks.

This offset amount could change if you use aggressive amounts of clipping to get that "crazy loud" (and distorted) processing. Even in this situation, I would highly doubt it would be necessary to run the HD audio levels much beyond -4 dB full scale (dBfs) for loudness matching with the analog.

MORE IS LESS

Running the HD radio levels higher (to, say, 0 dB full scale) could be done, but it would really be pointless. Yes, you will be *really* loud in digital mode compared to analog, but that difference would drive listeners insane having such a huge loudness jump. Why? Because this loudness jump would be most annoying whenever the listener's radio is in a location where there is a lot of blending back and forth.

Blending from digital to analog seems to happen at the same rates and situations as blending to mono does on existing analog FM radios now. (There are some receivers you can force to receive only analog or only digital transmissions.)

With this sort of knowledge, let us now look more closely at what is happening to make sure you see the point. Since there is plenty of headroom on the digital side to match *any* kinds of analog loudness gains without having to resort to heavier HD processing, being louder on the digital side (to match the analog side) will not come with the detrimental effects associated with squeezing more loudness as witnessed by analog.

This is because a (legally) modulated FM broadcast station running at 100% has to dial in more clipping (which simulates brute-force loudness – the trade-off being audible distortion and listening fatigue) and more compression (which "fattens" the audio – the trade-off being listening fatigue as the audio levels are rapidly being turned up and down to try to "fill in" the quiet parts of the audio).

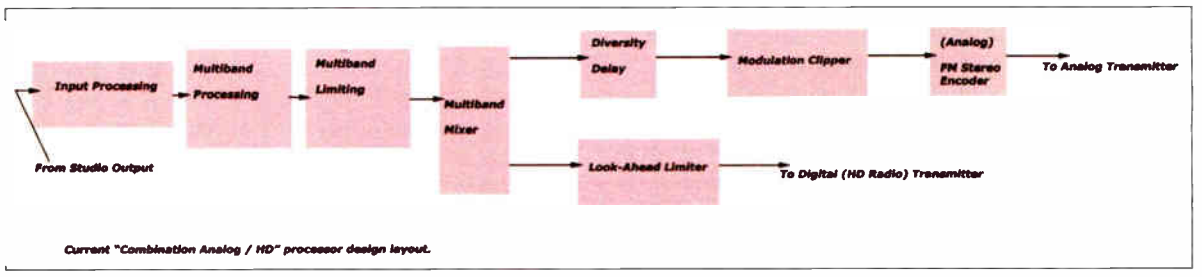
When loudness matching on the HD side, matching the brute force loudness gains on the analog signal is simply a means of just turning up the level a little bit, and touching up the HD processing just a little bit, if at all!

DIGITAL LOUDNESS WAR?

For the sake of argument, let us say all the radios out there are HD capable and next year we broadcasters all decide together to get rid of the analog channel and only broadcast HD. Then would the loudness wars ruin HD? I think it is highly unlikely because HD radios take about six seconds to buffer the digital stream before playback can begin,.

It is likely that radio people listening for loudness will forget exactly how that "loudness sounded" on a previous station before the digital audio playback kicks in. At that point, the listener essentially is open to suggestion as to which station is louder more than anytime before; if they *believe* they are louder or quieter than the "other guy," then that will be what their "ear" will tell them!

Now that we can put loudness wars out of our consciousness, we can focus on the more important aspects of adjusting our audio processors for digital radio.



Current "Combination Analog / HD" processor design layout.

MOVING THE KNOBS

This is a tricky act; it will take getting the "feel" of the HD CODEC because unfortunately there will be things you do to the audio processing the CODEC will like and other adjustments it will not like.

It is still too early to give precise pointers as to how each processor will react, given the wide range of variables that can alter each user's results with the same audio processing settings. However, we should comment on two key areas: Dealing with the delay, and source recordings.

DELAY ISSUES

We have heard a lot of discussion regarding HD radio delay and its effect on the on-air personalities, but what about how this delay will affect the person in charge of the audio processing system? When jumping into audio processing for this brave new world, a lot of folks forget the six-second delay between when you adjust a control on the processor, and when you hear the results on air.

Those of us who have worked extensively with audio processing and Internet radio feeds have begun to become used to it, and have come up with many techniques to deal with this issue.

My technique is this: Set up a monitor system that will allow you to hear Program, HD processed audio directly from the output of the processor, and the FM processed output of the processor. We will also need to hear "demodulated" audio from the output of an HD radio receiver, and from a standard FM analog tuner.

My first step is to adjust the audio processor while listening to program, and then the direct FM and HD processed outputs of the processor to make sure those both sound OK.

I then compare what I hear to the off-air analog/HD audio to see how it all sounds – constantly rechecking the *program* audio to make sure I have a decent reference.

One thing to keep in mind is that most audio CODECs "prefer" audio with some dynamic range to it. You can still do a lot of overall compression, if you desire that in your programming, but leaving some peak activity will allow the HD CODEC to properly function.

THE SOUND

Getting the sound you want from HD audio processing requires you not only to know how to get the processor to do tricks, but also to know some basic tricks to help massage the HD CODEC for best results. This is where that "level offset" built into the Ibiquity HD receiver system comes in handy.

Because the HD side has a level advantage, you can relax the look-ahead limiter activity, and have it "kick in" if the audio peaks exceed 0 dBfs, backing off until the audio matches the loudness of the analog channel. This will allow you to have all of the spectral and compression signature of the analog channel without the squashed "constipated" sound that comes with it as heard on the analog channel.

This process should be quick work on a combo HD/Analog broadcast processor. However, it will require some work when using separate audio processors, although not an impossible feat. One thing combo processors have going for them is the fact that most of the chain (Input filters, crossovers, filters used in other multiband processes, etc.) is identical, and will have a proper phase-match between analog and digital channels

While we are on this topic, I have run across more and more engineers looking towards using separate processors for analog and digital services. This is a great idea, if you have that kind of a budget, as it frees your digital channel from the spectral constraints of the analog channel, but keep one thing in mind: the processors must have matching characteristics!

DEALING WITH BLENDING AND AM CRUNCH

In the HD radio listening travels in my car, I have run into many situations where the blending between analog and digital happens as frequently as "mono blend" does on the existing analog FM service. Having phase mismatches will mean that your station will sound downright "strange" to listeners while their radios are constantly blending back and forth.

The analog FM stereo analogy to this situation is one having a left-right spectral phase mismatch that is not noticeable when listening in normal stereo reception, but mono listeners, and listeners with radios going through mono-blend on a regular basis *will* hear this stereo phase mis-match, and the station will sound quite "weird" to them!

AM HD radio processing follows similar guidelines as the FM, but because the bit-rate for AM is much lower than FM, the AM-HD CODEC has to work *much* harder, and as a result, it is much more "touchier" than FM HD. If there were some clipping in the program audio for FM HD, it would sound kind of weird, but listenable. In AM HD, the same scenario will yield the audio with exaggerated distortion characteristics, to put it simply.

In either case (AM-HD, or FM), make sure the source material feeding the HD audio processor is as clean as it can be without *any* distortion clipping being added for any reason. This will yield the best performance from your HD CODEC.

The trick I mentioned before about giving some "dynamic peak range" to the audio for FM goes a long way with AM-HD. How much (or little) you can get away with depends entirely on your format. But if you feel the AM-HD audio is suddenly sounding "worse" than it did when you first started, and you seem to be running into a brick wall, try backing off on the look-ahead limiting, and overall density as a start to get back on track.

Cornelius Gould is the Senior Staff Engineer for Infinity Broadcasting in Cleveland, Ohio. When he is not immersed in tweaking his digital audio, he can be contacted at: cg@radiocleveland.com

DA Q&A

by Ron Rackley, P.E.

Comparing Monitor Point Readings to the License Values

Directional Antennas for broadcasting were introduced in 1932, and opened up many possibilities for building stations that otherwise would have not been possible. Maintaining directional antennas is another matter; many engineers have more questions than answers. In this series, Ron Rackley will share his unique understanding of directionals and provide some of the needed answers.

[SARASOTA, Florida] **This is the question:** If one of the four monitor points of a directional antenna reads only about 50% of its maximum value while the other three are within about 10 - 15% of theirs – although the antenna monitor parameters show the licensed values – does that mean that there is a problem with the system?

Answer: The monitor points are all below their limits – this is a good thing. In all likelihood, the actual radiated field strength on the radial of the monitor point that appears to be low is much closer to the allowed limit – as specified by the standard pattern that is in the FCC database for the directional antenna – than is indicated by the monitor point reading.

This may be because things that impact monitor point readings change over time, while licensed maximum values do not (unless a new proof is run on the pattern).

THE AVERAGE COUNTS

When running a partial proof it is not unusual to find monitor points on certain radials that read significantly lower than they did at the time of the system's decades-old full proof, even though the overall radial average analysis shows the actual radiated field to be virtually unchanged.

The system must be adjusted to produce radiated field levels based on radial averages within the standard pattern, no matter how much the monitor point "headroom" might suggest otherwise. Over time, monitor point readings will change both gradually (as development occurs in the area surrounding the transmitter site, for instance) and seasonally (when monitor points read much higher in the winter than in the summer).

The readings can go both ways, of course, and when they go lower instead of higher you get apparent monitor point tolerance "for free." When they go higher, that can lead to time-consuming and sometimes expensive adjustment work and partial proof measurements.

ORIGINALLY LOW

Another possibility is that it may have been impossible to fill all of the nulls out to fit within the standard pattern by similar margins when the system was initially adjusted before the full proof. The engineer who adjusted the system may have been forced to leave a lot of headroom on the one radial in order to get the others "in." Although this is sometimes necessary when "cranking around" local reradiation or propagation anomalies, it does not necessarily indicate such a problem.

In many cases – particularly with older systems that were licensed before the present methods for specifying standard patterns were enacted – allowable null radial radiation levels were based on what signal levels would interfere with other stations and bore no resemblance to the theoretical radiation pattern.

In other words, the monitor point maximum values in such cases were set at the levels where the FCC would start worrying about interference to other stations if the readings changed – whether due to actual radiation pattern changes or environmental changes – without any consideration of the fact that such radiation values cannot be produced with changes in antenna parameters alone due to the tower geometry.

POTENTIAL IMPROVEMENT

Although generous monitor point limits should be taken as a blessing and not as "speed limit" signs, sometimes it is possible to improve coverage if a pattern is readjusted and a partial proof is run and filed with the FCC to obtain new operating parameters. There are cases where nulls were initially pulled in tighter than necessary because few people lived in them and optimizing null fill was not important at the time of the full proof.

Sometimes, but not always, the coverage can be improved in such situations by adjusting the directional antenna to different antenna monitor parameters and filing a new partial proof with the FCC to change them on the license – as long as all of the radials are "in."

Even if there is room for an increase, it does not necessarily follow that one can be achieved. That depends on how the monitor point limit was set in the first place. Parameter adjustments should never be made on the basis of monitor point field strength readings alone. In order to explore whether there is room to improve a pattern adjustment, it is necessary to run a partial proof on it.

It is certainly safe to simply leave a directional antenna system alone if its antenna monitor parameters and monitor points are all within their licensed limits. It is necessary to make radial field strength measurements to know if a low monitor point actually indicates that the radiation in a given direction can be raised without creating excessive radiated field.

Ron Rackley finds directional antennas fascinating, and is happy to share his thoughts. However, due to his existing commitments and travel schedule, he regrets being unable to reply personally. If you have suggestions for future topics, please send them to editor@radio-guide.com

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Audio Bandwidth @ 24 kbps @ 19 kbps	14 kHz 11.2 kHz	15 kHz 9 kHz	**15 kHz** **15 kHz**
Direct Internet Software Updates	No	No	**Yes, via Ethernet port**
Digital PC Audio Input	No	No	**Yes, via Ethernet port and supplied driver**
Audio Metering (XMIT/RCV)	Transmit only	One-at-a-time	**Simultaneous**
Audio Processing	None	Simple AGC	**Digital multi-band AGC with look-ahead limiter by Omnia**
Remote Control	No	RS-232 and dedicated computer	**Ethernet via Web browser**
Auto Dial Storage	19 Numbers	50 Numbers	**100 Numbers**
Frequently-Used Settings Storage	none	none	**30**
Standards-based POTS Codec	No - Proprietary	No - Proprietary	**Yes - aacPlus (MPEG HEAAC)**
Transmit-Receive Quality Display	No	Yes	**Yes**
Contact Closures	2	2	**3**
Display Resolution	120x32 LCD	120x32 LCD	**128x64 LCD**
Analog Cell Phone Interface	Optional	Standard	**Standard**
Mixer Inputs	1 mic, 1 mic / line	2 mic / line	**1 mic, 1 line**
Phantom Power	No	No	**Yes - 12 volt**
Automatic Voice-Grade Backup	No	No	**Yes**
Power Supply	External	External	**Internal auto-switching**
Local Mix Audio Outputs Headphone Line Level	 Yes Yes	 Yes No	 **Yes** **Yes**
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Radio.edu

A Non-Comm View

by John Devecka

Computers in the Station

Part 2: Specialized Operations, Special Computers

Selecting the right computer for the job is important, especially as we move closer to the center of programming operations.

[BALTIMORE, Maryland] When setting up the studio systems for your station, your IT department can be very helpful in assisting you to get the right computer hardware. They also may be able to help you out with an additional matter – money.

My initial purchase of computers for the station came almost completely out of IT funds, rather than the station's, done on a one-time basis. The trade-off: since my machines were all rack mounts, I will have to provide replacements rather than getting them on the "cycle" for vanilla replacements.

WLOY Server Rack

Still, it is good to know where you stand when planning your long-term budgets – such as when to plan your next round of hardware upgrades – especially if you cannot depend on outside funds to cover it!

Assuming you are not buying a self-contained production system, this will be the first of the specialized machines you will need for the station. Automation systems, often sold pre-configured with hardware will be the second. Newsrooms and other special workstations are the final group we will tackle. Streaming systems are sufficiently specialized that they will require a column (or two) all to themselves.

PRODUCTION SYSTEMS

Several easy and powerful software packages are available for basic audio production. These include Adobe Audition 1.5 (née Cool Edit), Audion's Vox Pro e2, Sony/Sonic Foundry's Vegas, etc.; all are stand-alone applications which use the basic computer audio card for input and output.

At about $500 you can look at things like Digidesign's ProTools with an mBox interface, or at a much higher price the 002 interfaces. Some of these programs will also have "Educational Pricing" available – *always* ask the manufacturer and/or your IT people about it.

If you are going to build an Audio Production machine, I would suggest a few items:

1. Boost the RAM to make sure the software does not bump against any limits in file size or number of channels.
2. Bigger (and multiple) hard drives to keep the operating system and the production audio separated.
3. Install a "real" soundcard instead of using the motherboard audio in the computer.
4. Consider a video card or boost video RAM to reduce problems with the display of multi-track software.
5. Get a good, fast network card for the system; possibly consider fiber-optic cards if you want maximum speeds.
6. Consider a mixer like the StudioDrive from Henry Engineering which can boost the power of the workstation considerably while not eating desk space.
7. Do not install *any* software not critical to the system or the production software – no photo editor, no word processing, etc.

BUILD THE RIGHT BOX

With products using outboard hardware like ProTools, there are extensive details on system configuration and software tested for compatibility found on their website (www.digidesign.com). Make sure the computer you want to buy is already tested for compatibility or on their schedule.

Most of the other systems are less computer-intensive and have minimum operating requirements available on their websites. In any case, *read* these before you specify your system parameters. Consider the last software release date, and whether a pending update means you should buy a bit more than the minimum system.

A ProTools system (and many of the other production systems) should have at least two hard drives, if not three. One should contain only the operating system and ProTools application software. The second should be used for all the audio files and work. This will reduce the fragmentation and failure rate on the operating system drives.

Also consider the speed of the drives you are using. Some software, like ProTools can be very demanding on data speeds and you need to make sure the drives are fast enough. The folks at Digidesign have gone to great lengths to show compatibility options on their website – from CPU choices to certified drives. If you are going to run ProTools, you need to look at their site.

AUTOMATION

Automation systems are another hardware intensive type of program. Depending on the system, you can get something pre-configured with computers or software only.

If the software you want for automation is available pre-configured with hardware, consider it. When a manufacturer pre-configures a system, it should reduce compatibility problems and provide reliable documentation for future support calls. Often they will also provide some additional materials or music with the system. Other times, it is a waste of your money.

I am not suggesting you buy one automation system over another, and a few minutes of time at www.radio-guide.com will allow you to find back issues which have lots of column inches devoted to automation systems. At WLOY, we are happy with 1 1 software's Jockey Pro software. Its configuration is similar enough to other systems that you can use it for hardware ideas.

SEPARATE MACHINES

When configuring computers for automation, ideally you will have several machines doing compartmentalized functions. Obviously, your budget drives the final configurations, but one computer each for the audio server, playback on-air and scheduling is an ideal starter setup. Keep in mind that you *can* do all of these from one machine – until it breaks.

At a minimum, it is a good idea to split all of the audio server duties into a separate machine to allow easy backup and security. My biggest fear is to find a student hacked my audio server and its 50,000 songs are now running as a Kazaa server.

If you are comfortable with networking software, isolate your automation system from all other computers in the station and from the campus network. If not, have your friends in IT help you configure a more secure network setup. Avoid doing any of this on a wireless network; security is more trouble there than you need. Locking down the sharing functions of your machines on the network reduces the chance of unwanted visitors sneaking in.

THE RIGHT MACHINE FOR THE LOAD

The On-Air computer used to play back automation audio does not need too much specialization other than a network card, but should be free of all ancillary programs aside from those needed for security. Again, check the manufacturer's specification list to make sure the system you are building/buying meets their minimum requirements.

Make sure the operating system and the automation software are specified to work together – Windows XP Service Pack 2 may or may not be supported, for example. Also, either create a drive partition or add a second drive to keep the operating system separate from the automation software.

The Scheduling computer can likewise be fairly plain, but with the security software. With the addition of something like Henry Engineering's StudioDrive, the Scheduling machine could also function as a Voice Tracking station, or add Audion's VoxPro or Adobe Audition for a News Desk function.

Since the scheduling operation is not a fulltime demand, doubling the functionality of this machine could be a nice addition. Voice Tracking and Scheduling will likely need the same kind of access to the database for the automation software, so they should cohabit very well. The same basic requirements for a machine doing audio production (not ProTools) will do well for a Voice Tracking station.

AUDIO SERVER

The Audio Server, however, needs to be a bit beefier machine to run the server software. It also will need a considerable amount of storage space in any configuration.

Assuming you want decent audio quality from your system, you will be using large MP3 or WAV files, and a fair number of them. Once you start loading in all the "best of" library and hot lists, you will find that a few thousand songs stack up real fast. More songs require more storage space, and multiple hard drives.

Calculate the most songs you can imagine needing, double it and multiply by the average file size. Stereo MP3 files at 192 kHz sampling average about 6 MB per song. You can reduce this rate considerably and still have tolerable audio, but remember that wonderful phrase "Garbage In, Hillary Duff Out" when you think about what can happen to your original material after sampling, compression, processing and streaming.

Backing up all the material on your audio server is a big chore. Multiple drives and a way to offload the material for storage are a critical. A DVD burner is a good way to dump bulk material for backup. A tape backup allows mass storage but it is slow. USB 2.0 or Firewire (1394) drives will allow for faster data transfer if you use external backup drives.

GENERAL MAINTENANCE ITEMS

Keep all of your software in one place. You want to have everything handy if something goes wrong and you need to reinstall. I have all of my discs for all of my machines in a 128-CD softcase, and I drag it into whichever room has the evil computer in it.

When you have to download updates, try to burn a CD of the updates and keep it. Keep a master list of all your serial numbers with the CDs too. Yes, that seems risky, but rest assured if you do not have a printed version handy, the information will be on the computer that just crashed.

There are many mass storage options out there, but I prefer a 200 GB drive to quickly connect up, backup everything, and sit on a shelf until it is needed. Critical stuff can still get burned to DVDs, but many ProTools projects are too big for that, so the spare drive is a big safety net.

Try to clear old work as often as possible and get in the habit of doing drive maintenance frequently. ProTools machines will benefit from having a DVD burner installed as the file size can be massive and you do not really want to break them up. Most of the other programs are fine with a CD burner.

Remember: They are computers – they break, they crash, they do things everyone in tech support tells you are impossible. So you need to be prepared. A good single-malt and a sledgehammer is my personal method, but your mileage may vary.

John Devecka now has cleaned up all the broken parts at WLOY and is happy to share the joys and frustrations from the process Email John at wloy@loyola.edu

The routing switcher gets a new twist.

(About five twists per inch, actually.)

Everybody needs to share audio. Sometimes just a few signals — sometimes a few hundred. Across the hall, between floors, now and then across campus. Routing switchers are a convenient way to manage and share your audio, but will your GM really let you buy a router that costs more than his dream car? Unlikely.

If you need a routing switcher but aren't made of money, consider Axia, the Ethernet-based audio network. Yes, Ethernet. Axia is a *true network*. Place our audio adapter nodes next to your sources and destinations, then connect using standard Ethernet switches and Cat-6. Imagine the simplicity and power of Ethernet connecting any studio device to any other, any room to any other, any building to any other... you get the idea.

Routers are OK... but a network is so much more modern. With Axia, your ins and outs are next to the audio, where they belong. No frame, no cards, no sweat.

Scalable, flexible, reliable... pick any three.

An expensive proprietary router isn't practical for smaller facilities. In fact, it doesn't scale all that well for larger ones. Here's where an expandable network really shines. Connect eight Axia 8x8 Audio Nodes using Cat-6 cable and an Ethernet switch, and you've got a 64x64 routing switcher. And you can easily add more I/O whenever and wherever you need it. Build a 128x128 system... or 1024x1024... use a Gigabit fiber backbone and the sky's the limit.

Are you still using PC sound cards?

Even the best sound cards are compromised by PC noise, inconvenient output connectors, poor headroom, and other gremlins. Instead, load the Axia IP-Audio Driver for Windows® on your workstations and connect *directly* to the Axia audio network using their Ethernet ports. Not only will your PC productions sound fantastic, you'll eliminate sound cards and the hardware they usually feed (like router or console input modules). Just think of all the cash you'll save.

Livewire

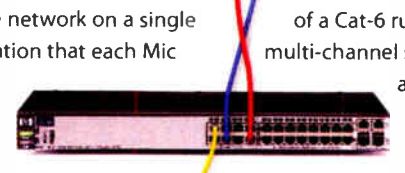
< · · · > 100/1000

There's a better way to get audio out of your PC. No more consumer grade '/' connectors — with Axia your digital audio stays clean and pristine.

Put an Axia Microphone Node next to your mics and send preamplified audio anywhere you need it, over Ethernet — with no line loss or signal degradation.

Put your preamps where your mics are.

Most mainframe routers have no mic inputs, so you need to buy preamps. With Axia you get ultra-low-noise preamps with Phantom power. Put a node in each studio, right next to the mics, to keep mic cables nice and tight, then send multiple mic channels to the network on a single Cat-6 cable. And did we mention that each Mic Node has eight stereo line outputs for headphones? Nice bonus.



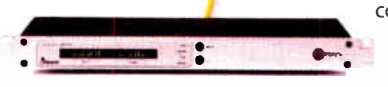
Put your snake on a diet.

Nobody loves cable snakes. Besides soldering a jillion connectors, just try finding the pair you want when there's a change to make. Axia Audio Nodes come in AES/EBU and balanced stereo analog flavors. Put a batch of Nodes on each end of a Cat-6 run, and BAM! a bi-directional multi-channel snake. Use media converters and a fiber link for extra-long runs between studios — or between buildings.

An Axia digital audio snake can carry hundreds of channels of digital audio on one skinny CAT-6 cable. We know you're not going to miss soldering all that multi-pair...

With a little help from our friends.

A networked audio system doesn't just replace a traditional router — it *improves* upon it. Already, companies in our industry are realizing the advantages of tightly integrated systems, and are making new products that reap those benefits. Working with our partners, Axia Audio is bringing new thinking and ideas to audio distribution, machine control, Program Associated Data (PAD), and even wiring convenience.



ENCO SYSTEMS INC

Scott Studios

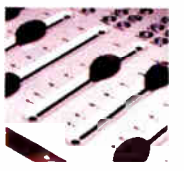
radio systems

BALSYS

Axia is already working with some great companies. Like Enco Systems, Scott Studios, Radio Systems, Balsys Technology Group, and of course Telos and Omnia. Check AxiaAudio.com/partners/ to find out who's next.

Would you like some control with that?

There are plenty of ways to control your Axia network. For instance, you'll find built-in webservers on all Axia equipment for easy configuration via browser. PathfinderPC® software for Windows gives you central control of every audio path in your plant. Router Selector nodes allow quick local source selection, and intelligent studio control surfaces let talent easily access and mix any source in your networked facility.



Control freaks of the world, rejoice: intelligent Axia mixing surfaces give talent complete control of their working environment. Reconfigure studios instantly and assign often-used sources just where they're most useful.

"This sounds expensive." Just the opposite, really. Axia saves money by eliminating distribution amps, line selectors, sound cards, patch bays, multi-pair cables, and tons of discrete wiring — not to mention the installation and maintenance time you'll recover. And those are just side benefits: our hardware is about half the cost of those big mainframe routers. That's right... *half*. Once you experience the benefits of networked audio, you will never want to go back. AxiaAudio.com for details.

AXIA

A TELOS COMPANY

Facilities Guide

by Glen Kippel

Building a Radio Studio in a House

Most radio stations are pretty secure in their studio facilities. So, when moving becomes necessary for one reason or another, anxiety can arise quickly. In the limited time available, not only is it important to locate a facility of the right size, capable of being modified for studios, and with a decent line-of-site for the STL. Glen Kippel found himself needing such a solution.

[PALM DESERT, California] Recently KHCS, licensed to Palm Desert, CA, was given notice that the lease on our studio building was being terminated. This was both good news and bad news as, although the facility was decades old and somewhat dilapidated, the rental cost was next to nothing.

SEARCH FOR ACCOMMODATIONS

After spending some time shopping for suitable commercial real estate, we determined this would not be a viable option. First off, the cost would have taken a sizeable chunk out of our operating budget; as a non-commercial listener-supported Christian broadcaster, money has always been tight.

And secondly, to take an open industrial space and divide it up with suitable partitions, some of them soundproof would require time for design and construction – time that exceeded our deadline to move.

When a vacant private home was made available for our use, we were skeptical at first. But, after being assured by the local zoning authorities that there would be no problem, we began to look in earnest.

SITE INSPECTION

On our initial walk-through, a family room with vaulted ceiling looked like it would be suitable for a new control room.

An adjacent room would serve as our "satellite control" and backup control room when the equipment from the old studio was moved over. We determined that a couple of bedrooms would serve as office space and an engineering shop.

Relocating a radio studio can be quite a challenge – not totally unlike overhauling your car's engine while you are driving it! Each step had to be carefully thought out so that the transfer could be made with a minimum of off-air time.

PROGRAM TRANSMISSION

A primary issue, frequency coordination for our STL had to be worked out and a Form 610 filed. Before proceeding with the move, we had to see if the new site would work out from an engineering standpoint as our STL frequency is shared with another station in the area.

As it turned out, another local station expressed concern because, although they are on a first-adjacent STL frequency, our path goes directly across their AM transmitter/STL receive site, and our STL transmitters are slightly more than a mile apart. Fortunately, cross-polarization and natural obstructions appear to have combined to prevent any problems.

Most of the programming on KHCS comes via satellite – either aired directly or recorded on our trusty Arrakis DigiLink 3 and played back later.

Fortunately, when our new 3.3-meter dish was installed to meet the requirements of the Christian Radio Consortium digital signal on AMC3 (formerly GE-3), we left our old Winegard 10-foot TVRO dish standing. Although the performance of the old dish was less than optimal, it was good enough to keep our programming going while the 3.3-meter DH solid aluminum dish was moved to the new studio location and re-aimed.

One of the downsides to being in a residential area is that you have neighbors. Hardly did we have the dish installed than a neighbor complained that it was blocking her view. Although her view actually was of our carport, to maintain peace we dug another hole, bought another pipe and moved the dish further back on our lot.

Once that issue was settled, we connected our new Wegener Unity 4000 satellite receiver through a pair of new Symetrix 581E distribution amps to a second DigiLink 3, purchased from another local station. This DigiLink was sent back to Arrakis in Colorado for a check-up to ensure that it was in good shape. Then we ran the system off-line for a couple of weeks to ensure all the levels were correct and that we were recording and playing back all of our time-shifted satellite programs on schedule.

The first three stereo output channels on the Unity 4000 are dedicated to networks from which we receive the majority of our program feeds. The fourth is switched to a few other networks using a Broadcast Tools DSC-32/64 Satellite Channel Controller. This unit converts DigiLink relay contact closures to ASCII strings that define the network output on the Unity's Port 4.

STUDIO FURNITURE

Of course, having a bunch of new equipment is of no use without the cabinetry to mount it in, so that had to be one of the first items ordered. KHCS chose an Argosy Dual 15 workstation with an 847 Rack Module on each side.

Argosy furniture is not customarily seen in radio studios, though it is common in recording studios around the world. The cost was far less than conventional broadcast furniture and the appearance and ergonomics are impressive. The satellite receiver, DA's, air monitor tuner, DigiLink and an existing Nakamichi cassette deck were mounted in an Argosy Spire dual 14-space rack that sits next to the operator.

Control B. This room handles most production, and serves as a backup able to go on the air either from a silence sensor trips or manually switched via remote control.

Argosy provided a custom cutout to fit an AEQ BC-500 console. While digital consoles are impressive-looking and have many features, we judged the cost too high for what is essentially one stand-alone studio.

What made the BC-500 especially desirable in this application is the fact that most audio inputs and outputs are on conventional XLR connectors. Prefabricated XLR jumper cables cost little more than the cost of the connectors, so we just ordered 19 pre-wired cables from BSW and plugged the audio sources into the board (via Henry Twinmatch interface boxes where applicable).

The board output connected to a Henry Patchbox, and from there to the DigiLink, MD, CD and cassette recorders. The only soldering or wire stripping necessary was for the Molex connectors on the DigiLink and the Euro-style blocks for the DA's and AEQ monitor sends. This vastly shortened the installation time.

AEQ also has available a board module with a built-in telephone hybrid. Since this sells for the same price as a standard module, this saved the cost of an external hybrid. We found this to be a satisfactory solution since KHCS does not do telephone talk but only needs to do an occasional phone interview.

We purchased an inexpensive desk from a local office-supply store for use as an interview table. As it turned out, the color matched the Spire rack closely. Two Russian-made Oktava MK319 condenser mics on O.C. White booms handle our in-house interviews.

Interview Desk in Studio

Monitoring is done on a pair of Mackie-Tapco s5 active speakers, which are perched on the Argosy 847 modules at each side of the control board. Other users may have their own preferences for speakers, but these do the job.

One stipulation on the use of the house was that we could not do much to change the architecture. Gluing acoustical foam on the walls was not an option. Fortunately, the problem was solved by purchasing a group of ASC Tube Traps, which combine bass absorption with high-frequency diffusion.

ASC Tube Traps

We placed an order for a Quick Sound Field package of eight Tube Traps, and when they arrived we simply placed them where we found problems with room resonance.

MOVING DAY

Once we determined that the studio and automation were performing properly, it was time to make the big move.

KHCS uses a dual-mono STL, so we jumpered the audio connections at the receive end of the STLs to carry a mono signal. Then, temporarily using a borrowed transmit antenna, we pulled down our transmit dish and transmission line. We also removed the other STL transmitter to take to the new site.

After re-installing the transmit dish and STL, it was time to re-orient the receive antenna. We were off the air for about an hour while we made the switchover. The other transmitter and the combiner were then moved and stereo operation was reestablished.

Dismantling of the old studio and re-assembling it came next. Once our old equipment was relocated to the new site, we wound up with two completely independent and redundant automation and satellite systems operating concurrently. In the rare case of failure of the primary automation system or satellite receiver, our Broadcast Tools silence sensor switches to the other system in about 60 seconds.

Control A is the On-Air Studio. The STL transmitters, audio pre-processing and EAS stuff are in the rack at the right. Satellite receiver, DigiLink, transmitter remote control and basic production gear is in the Marco console - a video console but quite efficient for this application, and part of our original equipment at KHCS.

One really nice perk at our new location is that, like most homes in the Palm Springs area, it came equipped with a swimming pool. This enables us to go for a quick swim on breaks. It gives an entirely new meaning to the term "office water cooler."

Studio "Sea"

When not out back swimming, Glen Kippel has been General Manager, Chief Engineer and Program Director of KHCS, Palm Desert, CA since 1992. He also takes out the garbage. Contact Glen at khcs@juno.com

MORE PRODUCTS... MORE APPLICATIONS

TT-1

The tiny TOOLS™ TT-1 is more than just an ordinary telephone line coupler. The TT-1 is a rack-able compact telephone line powered auto-answer and auto-disconnect hybrid. The TT-1 utilizes dual-hybrid transformers providing full duplex audio at a plain old coupler price. We provide a rear panel multi-turn hybrid NULL trimmer to allow the user to achieve 20 plus db separation figures. TT-1 features include: Front panel Line Seize button; call Drop button; Auto-Answer/TAP switch; Audio Mute switch; Off-Hook and Ring indicators. The rear panel is equipped with a RJ-11 jack for the telephone line and a second loop-thru RJ-11 that may be configured to disconnect attached devices when the TT-1 goes off-hook. Screw terminals are provided for balanced send and caller audio; remote optically isolated seize and drop functions and one SPDT off-hook dry relay contacts. The TT-1 may be set on a desktop, mounted on a wall or up to four units mounted on the RA-1, Rack-Able mounting shelf.

The TT-1 Telco Tool

The DTD-16 DTMF Tone Decoder

The tiny TOOLS™ DTD-16 is a full-featured DTMF tone/sequence decoder that is user programmable to decode up to six tone sequences or a single tone and assign it to any one of four relays, twelve open collectors and/or the RS-232 serial port. The relays/open collectors may be programmed to close for the duration of tone, pulse immediately after completion of detection, latch/unlatch or exclusive operation.

The DTE-16 DTMF Tone Encoder

The tiny TOOLS™ DTE-16 is a feature rich DTMF tone/sequence encoder that is user programmable to encode up to 15 tone sequences or a single tone via any one of 16 contact closure inputs and/or the RS-232 serial port. Each input may be programmed to generate a tone for the duration of the closure or tone burst immediately on command. A passive mixing network is provided to mix both the program and encoder audio if required.

The VAD-2

The tiny TOOLS™ VAD-2 is a user programmable two-input multi-number voice/pager auto dialer with integrated stereo silence sensor, designed for dial out paging and/or voice message notification. Two SPST relays are included for remote control functions.

The DC-8

The DC-8 Plus Dial-up Remote Control allows the user to control and monitor external devices from any touch-tone, telephone. The DC-8 Plus when called, will answer the phone line after a user programmable number of rings (up to 20), accept an access code (none to eight digits) and if valid, allow the control of six SPDT, two 2PDT relays and the monitoring of eight logic level status inputs. The DC-8 Plus is equipped with an adjustable audio hybrid, allowing the user to send and/or receive external audio, while controlling the unit

The STI-II

The STI II provides a hybrid interface between a single POTS line and a users PC COM port. The STI II is equipped with a programmable serial port, allowing control and monitoring via the users PC application software. This product makes those remote call-in recordings a snap while eliminating the DTMF tones. Various LED's, relays, pushbuttons, dipswitches and serial port comprises the user interface to the STI II.

The TS-6 Telephone 6 Six-Line Telephone Call Director

The TeleSwitch Six call director offers a low cost solution to interfacing up to six telephones lines to almost any hybrid The TeleSwitch Six is supplied with one Switch Console and Controller. The units are interconnected via CAT 5 cable. A total of four Switch Consoles may be attached to the controller. The TeleSwitch Six is a dual-buss device, meaning that calls can be answered on the telephone set, while calls are active on the hybrid. With TeleSwitch Six, lines can be answered, placed on hold (MOH audio input), busied out and routed to a telephone set and/or hybrid.

The STA III Smart Telephone Autocoupler III

The STA III provides the interface between telephone line and user equipment. The STA III provides a self-null hybrid with balanced input and outputs. The STA III monitors the telephone line for CPC calling party control and long dial tone hang up signals, allowing use behind PBX telephone switches and POTS lines

The AVR-8 Voice Remote Control

The AVR-8 is a voice remote control system that automatically reports changes detected on any of its eight status inputs to a remote telephone and/or pager. After speaking a greeting message that may identify the source of the call, the AVR-8 then speaks a unique message for each status input. The user may customize each factory-recorded message. Additional features include; four SPDT control relays, balanced telco audio, access codes, eight phone numbers per input.

The DEC-16

The DEC-16 may be used as a dial-up; dial-out or direct connect DTMF decoder. The DEC-16 is capable of automatically calling out, answering calls or connecting to an ENC-16, DTMF encoder or other DTMF encoder

The ENC-16

The ENC-16 may be used as a DTMF encoder, dial-up, dial-out or direct connect interface. It is capable of automatically calling and connecting to a DEC-16 either on a dial-up telephone line or a direct wire connection. There are 16 input lines. Each input can be used to generate DTMF tone strings from 1 to 16 digits long. The ENC-16 can operate as a master or slave device Set as a master it will it will automatically establish a connection to its slave encoder. If the connection is lost, it will re-establish contact automatically Contact closures and/or its RS-232 serial port may control the ENC-16.

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Power Supply

by Ronald J. Dot'o Sr., KWBY/KCKX

Part 2: Surge Suppression for EMP Protection

Protecting a plant against surges and strikes involves a bit more than a lightning gap and a surge suppressor on a power strip. Ron Dot'o continues his discussion on things you should consider to help your site survive the unexpected.

[WOODBURN/SLAYTON, Oregon] It is important to understand that protection against lighting strikes is critical. Many stations have lost some or all of their systems thanks to the tendency of that tall stack of metal to attract what some might term "nature's fury."

However, if you want to "harden" your site as much as possible, it is wise to factor EMP suppression into the mix. Since EMP spikes happen a lot faster than lightning spikes, conventional lightning protection devices are not fast enough to protect your equipment. On the other hand, EMP suppression is fast enough to protect gear from voltage transients that get by most voltage regulator circuits and UPSs.

The devices we will discuss come in three varieties: MOVs, Zener diodes and Gas Gaps.

MOVs

MOVs (Metal Oxide Varistors) are kind of like Zener diodes in that they "avalanche" at a critical voltage and conduct as long as the over-voltage is applied. They are rated in voltage and joules. The higher the joules rating the more current they will pass to ground and hopefully not self-destruct.

MOVs come in several shapes and sizes. Some look like big ceramic disk capacitors, some like a small hockey puck with mounting tabs with a push on blade in the top of the puck (PA series) and others are rectangular mounted on an aluminum plate with two opposing corners cut off to expose mounting holes in the plate and with two push on or screw hole connector blades mounted on the top (HE series).

PA and HE series made by General Electric.

It is best to install MOVs on each side of the 220 VAC line to ground in the breaker box, preferably in parallel with the top left and right circuit breaker outputs. Make sure they are not on the same phase or you will have double protection on one phase and no protection on the other phase.

If you look behind the breakers you will see two bus bars. The breakers choose one bus or the other by their configuration. The top left breaker will be on phase "A." The breaker just under that will be on phase "B." The third one will be on phase "A" again. That is why you can wire a 220-volt device to two adjacent breakers. Just install the MOVs in shunt with whatever load the breaker feeds.

A WARNING

While I am not a licensed electrician I played one in the Army and need to explain the difference in color codes. If you have *any* questions at all, immediately consult a licensed Electrician!

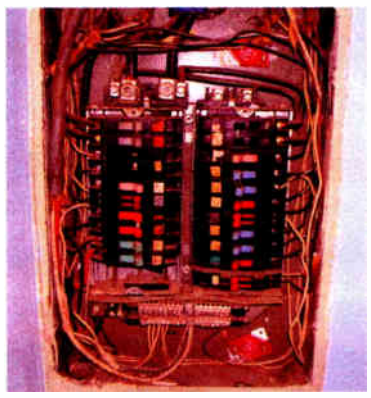
For the few new troops out there who are not familiar with the National Electrical Code (NEC) electrical wiring is different from electronic wiring. With electrical wiring Black is Hot, *not* Ground. White is Neutral, which gets ganged to the ground at the breaker box, and *only* at the breaker box. Green goes to Ground.

Some 220 VAC circuits have four wires and have four prong plugs. In those installations usually both the Black and the Red are hot, White is Neutral and Green is Ground.

As always, there are exceptions to everything, so buy an electrician a beer to get on his good side for when you need advice. (I hear that some of them actually do drink.)

PROPER SIZE AND PLACEMENT

The reason for installing MOVs in the uppermost breakers is that the spikes enter the box at that point, and you want to sink them as early as possible. It is recommended that you measure the voltage on each side of the line to ground and get the next higher voltage rated device. Attach it to the back of the breaker box with sheet metal screws and tooth washers of the proper size.

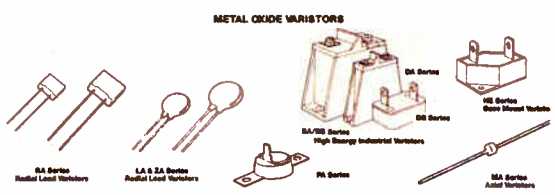


For three phase installations such as at the transmitter plant, measure each phase to ground and again select the right-sized MOV. In a Delta configuration all the phase voltages should be equal. In a "Y" configuration one of the phases usually has a higher voltage, which may require a higher rated MOV than the other two phases.

As an example: if the voltage to ground is 120 VAC, get a 135V MOV at the highest joule rating that will fit in the available space. Any spike above 135 VAC entering the facility, or being generated within, will cause the MOV to conduct momentarily, for as long as the over voltage remains, and sinks it to ground.

Do not install the MOV to the hot side of the input power as they occasionally ignite and stay conducting at the input voltage – kind of like an old VR tube – until they literally ignite and go into a meltdown mode. You want a breaker to pop and turn things off.

You can find surge suppression power strips practically everywhere, and many have phone line suppression built into them too. If you have a really limited budget you can buy disk type MOV's and solder them into the barefoot power strips from the hot to neutral, and the hot and neutral contacts to ground.



SOCKETED UNITS

RCA used to make an SK400 surge suppression three-prong plug/socket that you plugged in the wall and then plugged the unit into, and ECG used to make the same thing labeled EMF-2 for two prong plugs and EMF-3 for three prong plugs. Then there are the six outlet adaptors and power strips with surge suppression that are readily available.

Another method is to take a three-prong plug and wire disk type MOVs (such as the GE V130LA10A or NTE 2V130) into it from the hot to neutral, and hot and neutral to the ground and just plug it into the branch circuit that you want to protect. It will sink any transients on that branch to ground.

There is no reason not to use several levels of MOVs – in the breaker, at the wall, etc. My philosophy is the more staged protection the better!

There are several sources for MOVs. The NTE and Newark catalogs are a good place to start. You might even get lucky at your local parts vendor. In the NTE catalog look under "Transient Suppressors." In the Newark catalog look under "Varistors."

ZENER DIODES

Zener diodes are fast acting enough that after a comprehensive test program FEMA uses bipolar zeners to protect audio program and phone lines. The zeners are very high impedance when they are not conducting so the units being protected do not even know that they are there and they do not affect the audio response.

These devices will conduct in either direction when their breakdown voltage is exceeded. You install them across and from each side of the audio line to ground to protect the unit from external over voltages.

For units with RCA phono connectors, the easiest solution probably is just to open up the box and solder them from the center conductor to ground.

Measure the audio voltage across the pair and to ground on each side and then use a bipolar Zener of roughly twice the voltage rating and as high a current or wattage rating as you can fit in there.

For instance, if you have one volt of audio, wire a couple of two-volt zeners back-to-back and install. If you cannot find bipolar zeners you can make them by attaching two zeners of the same rating back to back.

For the incoming phone lines, measure the ring voltage on an incoming call (usually 90 VAC) and apply the appropriate diodes. Sometimes the phone company has some surge suppression built into their installation, but check it out and be certain. Electronic phones clearly are not as robust as those old network phones!

I found some bipolar Zeners in an old ECG catalog listed as ECG 4901 for 3.5 volts and the ECG 4903 at 4.0 volts. They are listed in the current NTE catalog cross-reference as NTE 4901/4903 so they should be available. General Semiconductors Inc. also makes bipolar Zeners.

GAS GAPS

Gas Gaps are hard to find these days, but not impossible. They can be found at Surplus Sales of Nebraska at: http://www.surplussales.com



They are usually used by AM stations, installed in the ATU box after the RF Ammeter from the tower feed line to ground as lightning protection – the theory being that the johnny balls will bleed off some of the over-voltage and the loop(s) in the feed line will slow down some of it before it gets bypassed to ground by the gas gap.

In a way, they are kind of like a great big NE2 neon bulb. They have a voltage and current rating and ionize when their voltage rating is exceeded and pass the

(Continued on Page 22)

New Nautel AM
Digital Transmitters

XR12
12 kW AM Digital Transmitter

Stay on the air
With power to spare

Quick Specs

- RF Output Power – 12 kW (rated)
  15 kW (capable)
- 145% positive peak modulation at 12 kW
- 1.5:1 VSWR at 12 kW, 100% modulation
- Dual hot-pluggable power modules and redundant standby module
- Dual DDS exciters with automatic changeover
- Plug and play integration with Nautel's NE IBOC AM HD Radio signal generator
- Built-in power preset scheduler allows for six preset power levels
- XR12 dimensions: 28.5" W x 73.5" H x 41" D
- New 25 kW and 50 kW XR transmitters also available

The fourth generation of Nautel's 12 kW AM transmitter provides unparalleled performance and reliability, and supports both HD Radio™ and DRM digital radio. The modular XR12 is over-engineered to allow aggressive signal processing and up to 145% positive peak program modulation at 12 kW, producing more sideband energy and a stronger effective signal. The XR12's reserve power capacity also makes it ideal for simultaneous, full power AM analog and digital service.

The XR12's two power modules and one standby module automatically maintain full power even under fault conditions. Power modules are hot-pluggable and can be removed and replaced without any interruption in service. For even greater redundancy, the XR12 includes a complete standby DDS exciter and modulation encoder that automatically takes over when it detects a problem.

A 240 x 60 LCD graphical user interface, advanced alarm system, 128-event log and on-board real-time clock make operation, troubleshooting and system monitoring easy.

This combination of redundancy, in-service repair, automatic fault recovery and sophisticated alarming makes the XR12 the most robust digital AM transmitter available today.

Visit Nautel at NAB2005 **Booth N2811**

Phone: +1.207.947.8200 **Fax**: +1.207.947.3693
info@nautel.com www.nautel.com

Power Supply

by Ronald Dot'o Sr.

Continued From Page 20

current to ground, which is supposed to keep lightning from taking out the RF Ammeter and the capacitors in the ATU.

To figure out the rating of the gas gap needed, just use Ohm's Law using the tower current squared @ 125% positive modulation times the tower resistance to calculate the feed line voltage. A gas gap tube with a voltage rating of about 25% higher should be close enough. You may have to choose a device that has a somewhat higher voltage rating than 25% higher, but then I hear that lightning has a lot of voltage so it should ionize just fine. As usual use the highest current rating that you can fit in there.

BALL GAPS

While you are at it, make sure that the johnny balls on the tower are properly adjusted. To adjust the johnny balls, turn off the transmitter and loosen the mounting hardware so that one of the balls can be moved farther away or closer to the other ball. Usually it is preferable to move the upper, ungrounded one.

Tone modulate the transmitter at maximum legal modulation and very slowly move the balls towards each other until you get an arc between them. Immediately turn off the transmitter. Then, *increase* the gap by 1/4" and tighten the balls in place. You may want to measure the gap for future reference.

Do not do this with your bare hands – use a proper length rod of HV insulating material. Furthermore, *do not* do this with an unmodulated carrier because, as soon as you add modulation, it will very likely arc over on the modulation peaks. I know, because I have made that mistake!

After everything is tightened down, turn the fully-modulated transmitter back on and spray water on the balls. This simulates rainy conditions, so you can make sure they will not arc easily – you may need to make an adjustment to the gap.

Also, if you have added an isolation loop in the tower feed wire you may have to have the tower resistance read as it may have changed slightly, which may require paperwork with the FCC.

The best lightning protection for a tower is to add a folded unipole kit to the tower, which requires the base insulator be jumpered thus putting the tower at ground potential. For further information on folded unipole towers call or email Ron Nott at Nott Ltd. He is a nice guy and likes to help. [www.nottltd.com]

STATIC DRAIN CHOKES

One thing every series-excited AM tower should have – and many do not – is a Static Drain Choke. It is an RF coil with a high RF impedance and low DC resistance that is connected from the tower feed line to ground.

As the wind blows past the tower it can cause a static charge to build up on it, which can grow to several thousand volts, and then arc back into the ATU components and the transmitter output. This has happened to me in rainy Salem Oregon so I am sure it must be a problem in dryer climates.

In effect, the choke puts the tower at DC ground potential to drain off the static charge but acts as a high impedance to RF sending it on to the feed line.

Static drain chokes are about three inches in diameter and about 18 inches long, are single layer wound and mount on two standoffs so they usually have to be mounted on the top or side of the ATU box from the feed line to ground. Kintronic Labs is a good source. [www.kintronic.com]

As with loops in the feed line a static drain choke in parallel with the tower may change its base resistance and you may have to have the tower re-measured. A quick way to tell is to take an antenna current reading, then add the choke and see if the reading changes without changing anything else.

If it changes, up or down, then you will have to re-measure the tower base resistance and calculate a new value for antenna current at the authorized power(s). You may also have to file paperwork with the FCC for the new current.

By giving attention to each of these products and the areas they protect, you will ensure that your station will not have unnecessary downtime, but will sail through anything that hits your facility from the sky or powerlines.

Ron Dot'o was a contract engineer in the '80's handling sixteen stations and barely making a living. Today he is semi retired and barely making a living. You can reach this "Nutz and Boltz Engineer" at: ron_doto@msn.com

FCC Focus

by Bruce Eisen

Honesty is the Best Policy

[WASHINGTON, DC] There has been a subtle but dangerous shift in the way some broadcasters view FCC regulation.

Years ago, a famous FCC case involved an engineer who allegedly took fraudulent measurements on behalf of an applicant competing to win a construction permit. That case gained notoriety largely because it involved professional wrongdoing.

SHIFT IN POLICIES

However, since deceitful conduct was often at the core of FCC proceedings, the issue to be tried at hearing hardly raised an eyebrow. How many years and untold amounts of money did it take to resolve cases with mutually-exclusive applicants contesting a single frequency? Worse, how many applicants actually adhered to the promises they made in hearings in order to secure their stations?

The costs and abuses that accompanied comparative hearings were a major reason Congress authorized the FCC to auction broadcast licenses rather than resorting to litigation to determine who should be a licensee.

But while taxpayer dollars were saved and the United States Treasury grew through auction payments, complete honesty in dealing with the FCC became somewhat obscured, even downplayed. After all, auctions are supposedly conducted without the "fly specking" that was the hallmark of comparative hearings.

TRUTH DEMANDED

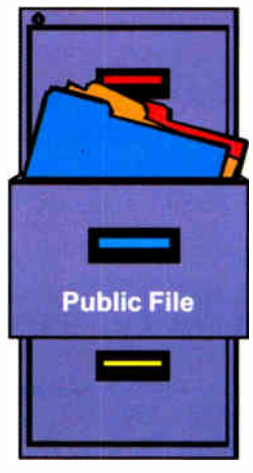
The FCC continues to hold that truthfulness remains its most constant regulatory demand. Nevertheless, many broadcasters have come to believe that the FCC is less interested in honesty than in generating federal revenues and monitoring the technical aspects of its regulation.

This belief is not entirely misplaced because the agency rarely pursues licensees with the intent of taking their licenses away. They once did, and their attempts (sometimes, but rarely successful) at least served to warn broadcasters not to play fast and loose with regulation.

Be careful: there is still a strong incentive to be absolutely candid with the agency and to be extremely up-front in all responses to the FCC when it requests information. Over the years, I have seen the FCC's close scrutiny of the industry morph into an enforcement policy based largely on fines that many stations view as a cost of doing business.

PAYING THE COSTS

The nearly obsessive concern with the slippery slope of indecency regulation is a prime example. No one loses a license. Instead, they pay through the nose for their wrongdoing.



The change has been significant, and at its worst can lull broadcasters into a sense of security that they are never in real jeopardy, particularly because the FCC is well known for avoiding hearings to determine if a station's license should be revoked or its renewal denied.

But just when it appears that we can relax, along comes a case like *San Francisco Unified School District*, where the FCC designated for hearing the renewal application of an unlikely target. The question to be determined by the FCC is whether or not a non-commercial educational licensee had misrepresented in its renewal application the completeness of its Public File.

The Public File is a matter of importance to the public and, by necessity, to all broadcasters. I often have cautioned stations to come clean in their renewal applications if their files have been less than perfect for the last license term.

There are those who do not believe the "Broadcast Issue Lists," properly compiled, are an effective way for the public and the FCC to learn about a broadcaster's past performance. They may be correct. But right now, the law requires such lists to be periodically maintained in the Public File.

There is no doubt the legal costs and efforts to defend the license will far exceed what it would have taken if the station had been truthful, or better, taken the proper steps in the first place to do the Public File properly.

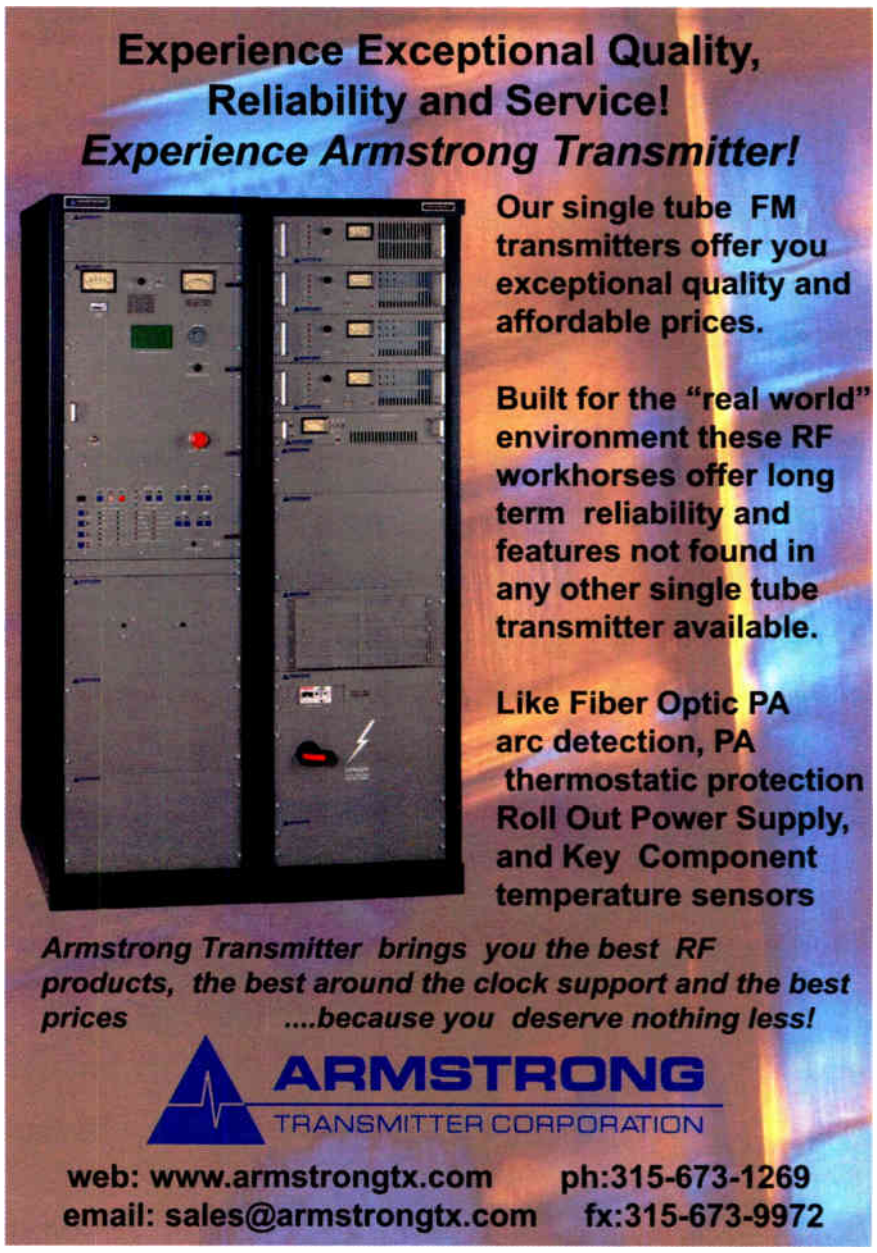
TELL IT LIKE IT IS

I think that a full and honest explanation of the facts and circumstances surrounding a deficient public file is both ethical and far better than stretching the truth or even lying to the Commission, thereby risking the possibility that someone, somewhere, has all the facts and is willing to spill the beans.

For most broadcasters, the ability to continue operating their stations is at the center of their lives. A renewal denial would be disastrous. Misrepresenting facts to the Commission is just not worth it.

There are continuous rumors that the FCC is about to move into a new enforcement era where broadcasters must get used to the idea of increased inspections and new FCC inquiries. I do not know if the rumors are true. I do know, however, that the years and money required to defend a license renewal are a terrible reminder of how important it is to be truthful in all dealings with the agency.

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



NAB 2005 Pr

Belar – NAB Booth N2414

Wizard – FM Modulation Analyzer

www.belar.com • 610-687-5550

The Wizard is a microprocessor controlled, digital baseband FM modulation monitor/analyzer that precisely measures peak modulation, peaks per minute, average peak modulation, modulation density, and more. The Wizard can operate with an existing modulation monitor, or it can be configured to replace an existing baseband modulation monitor. The Wizard Software (included with The Wizard) and an IBM compatible personal computer enable real-time graphing, logging, and remote operation.

The Wizard features user-defined parameters and settings for maximum flexibility. The two large UP/DOWN menu keys are used to cycle the 16 digit alphanumeric display to the desired menu; the UP/DOWN parameter keys are then used to select the desired setting. The configuration can be saved to non-volatile memory in the unit in the event of a power loss.

Two Composite Loop-thru's permit you to "touch up" your modulation remotely through the RS-232 port. When installed at the transmitter, Option 02 measures RF level, AM Noise, and Synchronous AM noise, eliminating the need for a separate AM Noise detector.

Broadcast Tools – NAB Booth N1400

DMS III – Digital Monitor and Switcher

www.broadcasttools.com • 360-854-9559

The Broadcast Tools Digital Monitor & Switcher is designed to accept and automatically or manually switch two AES signal sources when a digital error and/or analog silence are detected. Features include: Automatic control function that switches to a backup source upon failure of the main source; switch functions can be triggered by loss of clock, digital error flags, front panel transfer switch, external switch contact and/or the internal analog stereo silence sensor.

Additional features: Front panel error status and sample rate led indicators; front panel headphone jack and level control; balanced stereo monitor output; remote control; removable screw terminals; Plug & Play installation; dipswitch selection of precise time delay from 2 seconds to 85 minutes and restore timing delay from off to 10.2 minutes; sonalert; SPDT status relays; SPDT one-second pulse relay. The DMS III may be rack mounted.

Broadcast Tools – NAB Booth N1400

HPA-4 – Headphone Amplifier

www.broadcasttools.com • 360-854-9559

The HPA-4 with talkback/cue, powers up to four sets of headphones. Each output is supplied with a hefty stereo amplifier and may be configured to accept talkback/cue audio on the left headphone with a simple contact closure to ground. Front and rear panel T/R/S jacks are provided with each output, along with front panel level controls. The stereo balanced input is adjustable with the front panel master level control, while the balanced monaural talkback input is equipped with a rear panel trimmer.

Additional features include; front panel power, talkback/cue active and program audio activity LED indicators. Supplied in a one RU half-rack profile. The optional HR-1 provides 1/8" and 1/4" headphone jacks with level control, momentary push button (cough,dump,etc) and mic-ON LED. The HR-1 may be desktop mounted, under counter or turret mounted with the optional HR-1/MP mounting plate.

Comrex – NAB Booth N2118

ACCESS – Wideband Audio Codec

www.comrex.com • 978-784-1776

The New ACCESS from Comrex is a wideband audio codec to work reliably over most data networks including the Public Internet. The Comrex ACCESS is the first codec that is able to take advantage of revolutionary BRIC technology.

Comrex ACCESS Wideband Audio Codec

BRIC technology enables broadcasters to use a variety of commonly available Internet access points to broadcast high quality, real-time audio. ACCESS is capable of utilizing widely available wired circuits like DSL, Cable, POTS and Frame as well as wireless circuits like Wi-Fi, 1XRTT, EDGE and 3G data networks.

ACCESS will be available as both Rack Mount and Portable units. Capable of providing ultra-reliable, voice quality connections over IP connections, ACCESS also offers a high-quality stereo mode which offers optimized performance when used on managed data networks.

For more information on the new ACCESS codec visit Booth N2114 at NAB

D&H – NAB Booth C11447

3.0m Digital Satellite Dish – KU and C-Band

www.dhsatellite.com • 800-627-9443

DH Antenna announces a "NEW" 3.0m antenna.

This antenna has better specs and has been designed with a f/d ratio of 0.4 The antenna has been manufactured for the commercial digital Ku and digital C-band markets.

The main thrust for this antenna is for the *digital* market however, it will perform with excellence on the analog signals. The friendlier f/d on this antenna makes the gain slightly better than the older, deeper antennas. The feed illumination is much better, thus giving a better s/n.

Manufacturing is by the spinning process that gives you the most accurate antenna on the market. This antenna is available as either a fixed or steerable system. This antenna ships in one piece. Contact Michael Doll or Cindy Wille at 800-627-9443 or email at dhsat@mhtc.net

Energy-Onix – NAB Booth N2527

Documentor 2 – Multi-Channel Audio Logger

www.energy-onix.com • 518-758-1690

Energy-Onix plans to exhibit its multi-channel audio logger identified by the name Documentor-2. This unit has the capability of storing 300 days of a station program. It also has the capability of simultaneously driving ten computer terminals interconneeted by either a LAN or Internet system. These terminals would contain a player which would be able to select the desired program in the past 300 days by second, minute, hour, day, month and year.

The Documentor-2 will help station's confirm to their advertisers that their ads were placed in a timely fashion, to impress the FCC that no blasphemy was created on their station, to verify to the program director that the program is consistent with his desires.

The basic Documentor-2 sells for $1,295. and there is no limitation as to the number of station programs that can be recorded. Availability is from stock to two weeks. Energy-Onix will demonstrate its newest version of the Tele-Link as well as its multi-channel, RPU transmitter and receivers for the VHF and UHF range. In addition, Energy-Onix will display its standard AM/FM both in its solid state and vacuum tube forms.

oduct Focus

Gorman-Redlich – NAB Booth "At Large"

CRW-S – Weather Receiver

www.gorman-redlich.com • 740-593-3150

The Gorman Redlich Model CRW-S Weather Receiver is a highly sensitive and selective receiver for National Weather Service (NWS) transmissions. It is equipped with a SAME decoder and a digital tone decoder that processes the 1050 Hz signal tone for automatic audible and visual alarm signals in the event of emergency situations. The Model CRW-S has rear terminals for remoting and and (F) connector for external antennas.

Model CRW-S Weather Receiver

The 1050 Hz will close a relay in the Model CRW-S receiver. The 1050 Hz tone will also demute the receiver, activate a flashing LED, and cause the NWS audio (600 ohm balanced at 0 dbm) to be gated to a pair of rear terminals which can be used for remote alarm. Continuous audio is also available (600 ohm balanced at 0 dbm) with another pair of rear terminals and may be used for recording.

JK Audio – NAB Booth N3926

PBCport – Digital Hybrid

www.jkaudio.com • 800-552-8346

JK Audio introduces PBXport, the professional digital hybrid capable of providing talk show quality caller audio from your PBX phone system. PBXport allows you to send mic or line level signals into your PBX telephone system while maintaining excellent separation between your voice and the caller. This is a rack mount, road tough, and studio-worthy version of our popular innkeeper PBX. While innkeeper PBX has created its own following as a personal desktop interview tool, they've been asked by many to build a rack mount version with features specific to their applications.

JK Audio PBXport

Simply connect PBXport between the handset and base of any analog or digital telephone system. The 16 bit DSP uses a proprietary dual-convergence echo canceller algorithm to achieve excellent separation without any setup, and without sending a noise burst down the line.

Nautel – NAB Booth N2811

XR50 – 50kW AM Transmitter

www.nautel.com • 207-947-8200

XR50: The fourth generation of Nautel's 50 kW AM transmitter provides field proven reliability, and supports both HD Radio and DRM.

XR50 power modules are hot-pluggable and can be removed and replaced without any interruption in service. For even greater redundancy, the XR50 includes a complete standby modulation encoder and DDS exciter with automatic changeover.

The XR50's 240 x 60 LCD graphical user interface, advanced alarm system, 128-event log and on-board real-time clock make operation, troubleshooting and system monitoring easy.

The XR50 is designed to allow extended periods of unattended operation. It requires no manual tuning or adjustment, even with an antenna mismatch of up to 1.5:1 VSWR at 50 kW with 100% modulation. With over 84% efficiency and low maintenance costs, the XR50 is extremely cost effective to own and operate. And its compact rack (52" W 72" H x 40.5" D) is ideal for sites with limited space.

Orban – NAB Booth N813

Optimod-FM 5300 – Audio Processor

www.orban.com • 510-351-3500

The Orban Optimod-FM 5300 has put coveted five-band and two-band Optimod processing into a single rack unit package. Exceptional versatility allows broadcasters to adjust the processor's audio texture to brand the audio, knowing that the resulting signature sound will remain consistent.

Optimod-FM 5300 Audio Processor

With the 5300, an easy, one-knob Less/More adjustment allows broadcasters to customize any factory preset, trading cleanliness against processing artifacts according to the requirements of the market and competitive environment. Full Control gives the versatility to customize audio further. The Orban Optimod-FM 5300 also features Advanced Control to tweak presets at the same level as Orban's factory programmers.

This versatility makes the 5300 a superb choice for any format. Its five-band processing is ideal for any pop music format (even the most competitive and aggressive CHR), while phase-linear two-band processing yields ultra-transparent sound for classical, classic jazz, and fine arts formats.

Prophet Systems – NAB Booth N1402

NexGen 101 – Automation

www.prophetsys.com • 877-774-1010

With NexGen101 you get the best of both worlds, software designed specifically to run a single radio station, yet based on the ultra-reliable NexGen software. You can run your station with the core software, or choose the features that are important to your station, adding them "bit by bit." Run your station with $495 worth of software.

DigiLogger is Prophet System's advanced audio logging and digital archiving program, which allows you to retain as much of your station's audio as needed using compressed Record airchecks, recycle promotions, and save entire shows. DigiLogger can be configured to work with most analog or digital audio sources, including automation systems, satellite receivers, and switchers.

NewsGen, their standalone newsroom software enables reporters to write newscasts, receive and manipulate wire copy and digitally record, edit and play back audio. Completely scalable from an enterprise wide deployment to a server-based system.

Telos – NAB Booth N2816

Omnia-5 EXi & Omnia-6 EXi – Audio Processors

www.telos-systems.com • 216-241-7225

Omnia Audio announces a new line of audio processors for radio stations upgrading to HD Radio™ broadcasting: Omnia-6 EXi for FM, and Omnia-5 EXi for AM and FM broadcasters. The new Exi processors enhance and simplify the HD Radio audio chain and add essential new tools for HD Radio broadcasts, while simultaneously increasing the clarity and listenability of conventional AM and FM broadcasts: an onboard Diversity Delay method which simplifies and protects the broadcast signal of HD Radio for AM and FM, and an advanced new clipper design engineered to help eliminate Intermodulation Distortion (IMD).

The new Omnia-6EXi and Omnia-5 EXi audio processors incorporate Diversity Delay into the audio processor and moving it out of the HD Radio exciter, solving the problem of cumbersome equipment laden work bypass methods previously needed.

Omnia will present the new Ei processor line at the NAB April 18-21, 2005 in booth N2816.

The Radio Guide Technical Initiative

Communicating and Sharing A Hallmark of Radio Engineers

As mentioned in last month's issue of **Radio Guide**, the Technical Initiative has been a success. This month, we have more awards to announce, to recognize a number of folks who took the time to share their knowledge and experiences with us.

The judges mentioned how hard it was to pick the awards, as we had so many good articles submitted. And, again, we are honored by the generosity of the manufacturers who offered up their products as incentives to spur folks to consider writing.

We hope you have been, and will continue to be, impressed with the content and presentation of the articles in **Radio Guide Magazine**. Our continuing goal: to meet the needs you have in understanding the technology and Rules governing your job.

LOOKING BACK

Perhaps it was a tech tip. Some little idea that you were able to adapt and solve an annoying problem in your facility. Or an approach to deal with a major issue worrying you. Maybe it was one of the discussions on the digital radio signals we are starting to transmit around the ether. Or, perhaps, you enjoy historical information on a station or person that has a key place in the history of the industry.

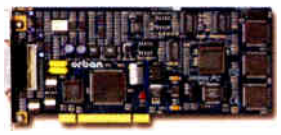
In all those areas, we are sure you find **Radio Guide** one of your favorites; we know that because you tell us in letters, email, and in person. And it makes it all worthwhile to know you look forward to your next issue of **RG**.

MORE AWARDS

It might have been the description of technology long obsolete that caught your attention, or the image of Don Kimberlin's race around Europe in person and by phone in order to arrange the television feed that would allow the Apollo Moon Landing to proceed (**RG, July 2004**). In any event, this first person historical account was mentioned by several of our judges as among their favorite articles.

So it is we offer our thanks to the fine folks at Prophet Systems, who are providing a **NextGen101** automation system as Don's award. As Don is not currently working in Radio, he plans to donate the system to an organization that will benefit from it.

The judges also found that Mike Erickson's articles on remote broadcasting – and the planning it takes to make them come off perfectly – were noteworthy. Thanks to Orban/CRL, Mike will receive an **Optimod PC 1100** audio processor on a PC card.



Among a number of articles that explain what is behind some of the technical issues and how to solve them, Gary Minker's articles on Line Sweeping were singled out for recognition. Broadcast Warehouse has kindly provided a **DSP-X** digital processor to award to Gary.

Finally, we come to a writer who has jumped all over the place in the past year or so. Ken Benner's series on how to ensure the Public File will pass inspection was only the start. Once this writing machine got started, he shared material with us on the history of the SBE and pioneer stations like KSTP. He also shared some great tech tips, especially in keeping those Nems-Clarke Field Intensity Meters going strong. We got a lot of letters and email from readers who found his tips helpful.

Like Don Kimberlin, Ken Benner has decided to donate his award to a deserving station. A **VoxPro** from Audion Laboratories will be sent out to KJNP in North Pole, Alaska in Ken's name.

These awards are in addition to the ones announced last month: Rich Wood, who will receive a **StudioDrive** from Henry Engineering, John Stortz, who will receive a **DH-20** from Comrex, and Bill Bordeaux, who was awarded the **rfInvestigator** package from rfSoftware.

Once again, our thanks to the writers, the judges, the manufacturers, and you ... the folks who read the magazine, comment to us, and make **Radio Guide** an important part of your life. In the end, we all benefit. – RG –

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Transmission Guide

by Terrence M. Baun, CPBE, CBNT

Determining FM Transmitter Output Power

[WESTFIELD, Indiana] Ever since the days when the Herbert Hoover and the Commerce Department regulated US broadcasting, government oversight of assigned power levels has been a primary function of broadcast regulation. It is no wonder then that power determination is near the top of the list during any complete FCC inspection.

MEETING THE REQUIREMENTS

For AM, the process is a relatively straightforward calculation based on measured current and impedance, with the only significant challenge requiring measurement to be made without modulation. By comparison, one might think that FM stations would have an easier time, since FM power is constant and unchanging with modulation.

However, because transmission line current and load impedance cannot be so conveniently measured in FM, the FCC has had to provide FM broadcasters with several alternative methods of determining power. In practice, that determination of FM power is neither easy nor uncomplicated – nor well understood.

To treat this subject with the legalism that it requires, what follows is the complete section on FM power determination from FCC 73.267, along with some commentary and examples derived from many visits to FM sites.

FM OPERATING POWER

FCC Rules, Section 73.267 Determining operating power.

(a) The operating power of each FM station is to be determined by either the direct or indirect method.

This might seem pretty straightforward, but it does require each FM station to select and employ one of these two methods for determining power. You cannot use both, or a combination of both, or randomly switch back and forth.

Unfortunately, in over 600 Alternative Inspections during the past ten years the question, "Do you use the Direct or Indirect Method for determining power?" seldom results in a simple one-word answer from FM Chief Engineers.

DIRECT OR INDIRECT

There are issues with either of these two methods. With the Direct Method, the operator need only log the power output percentage from the transmitter output meter, which has been calibrated against the calibrated wattmeter to read exactly 100% at the station's normal TPO. Plate voltage and current need not be logged, since recording the transmitter output meter percentage constitutes the official power determination.

However, to use the Direct Method requires purchase and installation of a calibrated RF Wattmeter, and may also require the availability of a dummy load, which can handle the normal TPO (+ 5%) of your transmitter.

The Indirect Method is arguably less accurate, but has the advantage of requiring no additional equipment. In fact the only requirement for utilizing the Indirect Method is that you are able to provide the FCC with source documentation of the transmitter efficiency factor you employ, whether determined by the transmitter manufacturer during factory test, or established by your own tests on a dummy load with a calibrated wattmeter.

Use of the Indirect Method is more difficult for operators, since they are required to log both plate voltage and plate current, multiply them together, and then multiply that product by the efficiency factor in order to determine the transmitter power output. The formula is:

> Final Stage Voltage x Final Stage Current x Efficiency = Transmitter Power Output (Watts)

In all cases, FM stations must select and employ one of these two methods for determining transmitter power and must be able to explain that choice and how it is implemented to the FCC upon request. An inspection is not the time to start clarifying your understanding of these issues!

THE DIRECT METHOD

According to the Section 73.267 of the Rules:

(b) Direct method. The direct method of power determination for a FM station uses the indications of a calibrated transmission line meter (responsive to relative voltage, current, or power) located at the RF output terminals of the transmitter. This meter must be calibrated whenever there is any indication that the calibration is inaccurate or whenever any component of the metering circuit is repaired or replaced. The calibration must cover, as a minimum, the range from 90% to 105% of authorized power. The meter calibration may be checked by measuring the power at the transmitter terminals while either:

(1) operating the transmitter into the transmitting antenna, and determining actual operating power by the indirect method described in §73.267(c); or

(2) operating the transmitter into a load (of substantially zero reactance and a resistance equal to the transmission line characteristic impedance) and using an electrical device (within ±5% accuracy) or temperature and coolant flow indicator (within ±4% accuracy) to determine the power.

CALIBRATING THE METER

Operating by the Direct Method requires the purchase and installation of a calibrated wattmeter. In typical FM use, these wattmeters utilize a sampling section installed in the transmission line between the transmitter output and the antenna feed line. The wattmeter is then connected to this sample section with the provided cable (do not change its type or length, it is part of a calibrated system) and placed at a convenient location, preferably one that can be easily observed during transmitter tuning.

The transmitter is adjusted to 100% of its TPO as indicated on the wattmeter, and the transmitter output meter is then set to read 100%. The transmitter output meter sample is then used to remotely monitor the system power directly. Note that the transmitter output meter and the calibrated wattmeter must track within the legal power range of 90-105%, and this calibration must be maintained within 2%.

The actual wattmeter is *not* connected to the remote control, but the transmitter output meter is. The wattmeter is normally left in-circuit at all times, but if it is not, an inspector will likely request that it be placed in service so it can be compared to the transmitter output meter.

The requirement that the wattmeter be calibrated means that the line section, sampling elements, cables, and meter movement were assembled, tested, and calibrated as a unit to government standards. When you receive your wattmeter system from the factory, you should save and file the Certificate of Calibration that verifies that this has been done. It is conceivable that an FCC inspector might ask to look at all the components of your wattmeter system to insure that they all bear the same serial number as noted in the calibration documents.

RECALIBRATION

Recalibration is not required unless there is some reason to suspect that one or more of the wattmeter components is replaced, or has become damaged. If this happens, you must send all components (including the line section, elements, wiring, and meter) back to the factory for re-calibration.

Formerly, stations utilizing the Direct Method were required to recalibrate their transmitter output meter to the calibrated wattmeter every six months, utilizing a dummy load. This rule no longer exists, but recalibrating the transmitter output meter with the wattmeter is required if any transmitter metering components are replaced or damaged or if there is any reason to suspect readings are inaccurate. Calibration between the two meters should be checked regularly as part of your normal maintenance schedule and the meters kept within 2%.

If the transmitter power meter (not the wattmeter) becomes defective, or must be replaced, you can easily recalibrate it to the wattmeter as above. If the wattmeter becomes defective, it must be returned to the factory. If you suspect the wattmeter is reading in error, you may check it by determining power via the Indirect Method, adjusting the transmitter to 100%, and checking to see if the wattmeter shows 100%.

Remember that the wattmeter has a stated calibration accuracy of +/- 5%, and that indirect and direct measurements seldom show exactly the same output power, so there will likely be some variation – but gross defects should be obvious.

There is another option for calibration: if your station has a 50 ohm dummy load of substantially zero reactance capable of handling your full TPO + 5%, you may utilize another calibrated wattmeter or a calorimeter to check the calibration of the wattmeter in question.

Note: if an FCC inspector suspects that a wattmeter indicates a transmitter is operating with unusual efficiency (either low or high) you may be asked to provide the factory efficiency factor for comparison even though you are operating utilizing the Direct Method. Be advised!

THE INDIRECT METHOD

Back to Section 73.267:

(c) Indirect method. The operating power is determined by the indirect method by applying an appropriate factor to the input power to the last radio-frequency power amplifier stage of the transmitter, using the following formula:

Transmitter output power = Ep x Ip x F

Where:

Ep = DC input voltage of final radio stage.

Ip = Total DC input current of final radio stage.

F = Efficiency factor.

(1) If the above formula is not appropriate for the design of the transmitter final amplifier, use a formula specified by the transmitter manufacturer with other appropriate operating parameters.

(2) The value of the efficiency factor, F, established for the authorized transmitter output power is to be used for maintaining the operating power, even though there may be some variation in F over the power operating range of the transmitter.

(3) The value of F is to be determined and a record kept thereof by one of the following procedures listed in order of preference:

(i) Using the most recent measurement data for calibration of the transmission line meter according to the procedures described in paragraph (b) of this section or the most recent measurements made by the licensee establishing the value of F. In the case of composite transmitters or those in which the final amplifier stages have been modified pursuant to FCC approval, the licensee must furnish the FCC and also retain with the station records the measurement data used as a basis for determining the value of F.

(ii) Using measurement data shown on the transmitter manufacturer's test data supplied to the licensee; provided that measurements were made at the authorized frequency and transmitter output power.

(iii) Using the transmitter manufacturer's measurement data submitted to the FCC for type acceptance and as shown in the instruction book supplied to the licensee.

CALCULATING POWER OUTPUT

Remember, with the Indirect Method, the operator never uses the transmitter power output meter to determine output power. The required determination is based only on the recording of final stage voltage and current and application of the efficiency factor to that product.

As mentioned, the Indirect Method requires that the station employ an efficiency factor that is appropriate for

(Continued on Page 30)

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	3.5 kW	1986	Harris FM 3.5K
	3.5 kW	1992	Harris HT3.5
	5 kW	1982	Harris FM 5K
	5 kW	1984	Continental 815A
	6 kW	1995	Henry 6000D
	10 kW	1996	BE FM 10B
	10 kW	2000	BE FM 10T
	10 kW	2001	Henry 10,000D-95
	20 kW	1978	Collins 831G2
	25 kW	1980	CSI T-25-FA *(amplifier only)*
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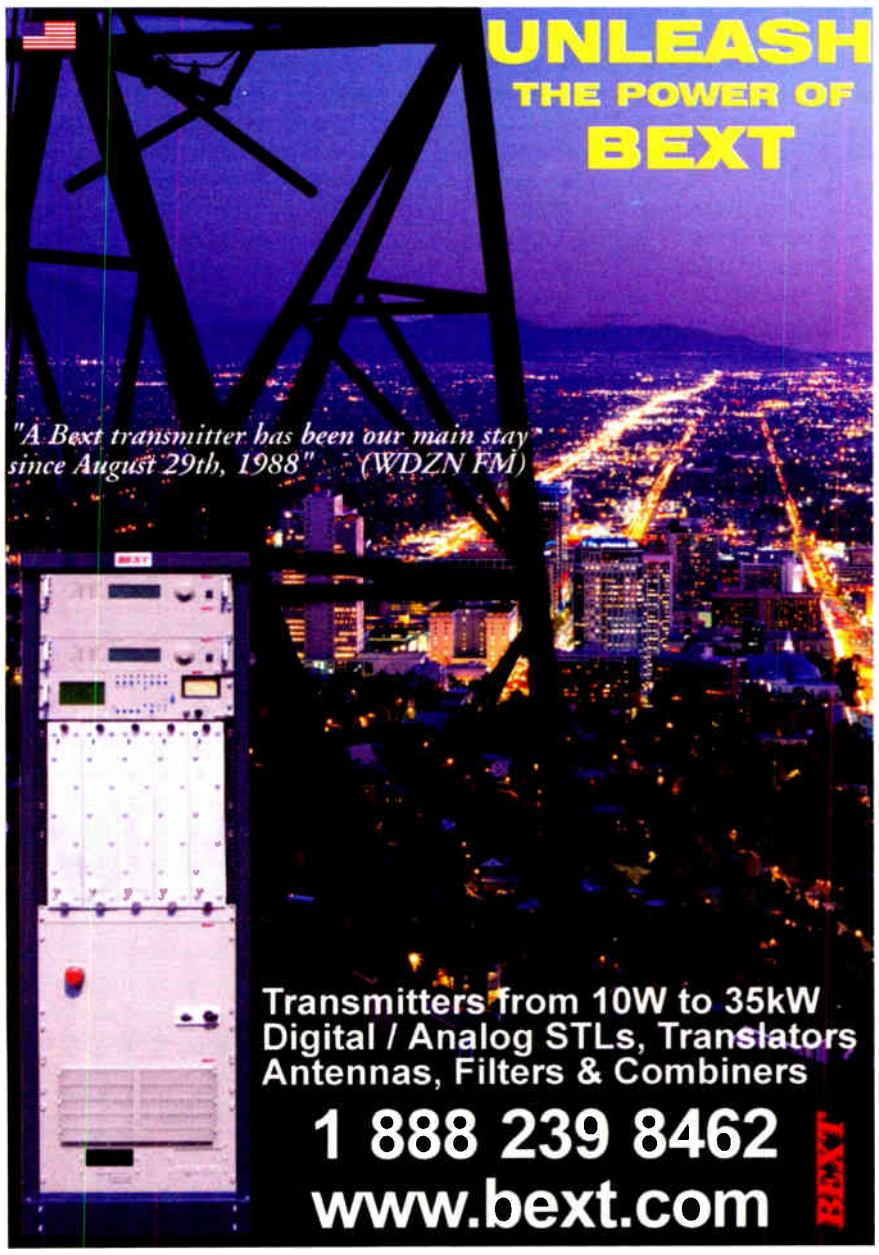

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Transmisson Guide

by Terrance Baun

Continued From Page 28

the power, frequency, and design of the transmitter, and that the factory source for that efficiency be made available to the FCC upon request. Most commonly, the station utilizing the Indirect Method will simply retain the transmitter checkout sheet, provided the tests were done at or near the station's power and frequency.

In order to enable operators to perform this calculation the station must provide either a calculator and instructions on multiplication of the parameters, or a prepared chart which incorporates the efficiency factor into a range of final stage voltages and currents and enables the operator to determine the power output in watts based only on the final stage readings observed.

A PRACTICAL EXAMPLE

Let us take a look at the kind of documentation the FCC is looking for. As an example, we will use a Harris HT 7FM series transmitter with a desired TPO of 6,800 watts. First, here is an excerpt from the Factory Test Data Sheet:

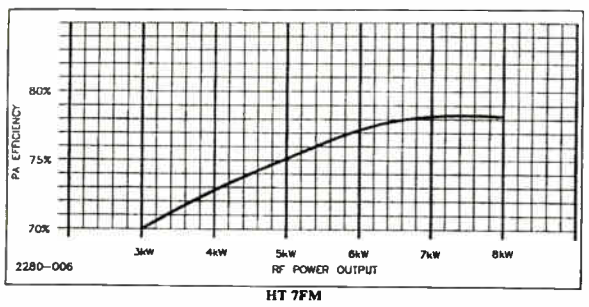
IX. PA PLATE EFFICIENCY AT CUSTOMER OPERATING POWER

			Ip (A)	Ep (V)	Efficiency (%)
90%	6120	W.	1.50 A	5400 V	75.5 %
100%	6800	W.	1.61 A	5395 V	78.4 %
105%	7140	W.	1.69 A	5375 V	78.6 %

Manufacturer's Factory Test Data Sheet for HT 7FM showing efficiency of 78.4% at 6,800 watts TPO.

But what if you cannot find the original test data or perhaps the transmitter was tested at a very different TPO or frequency from yours? Maybe you have re-tapped the plate transformer and significantly changed the Ep from the factory test value, or are reducing or increasing TPO due to an antenna or line change?

If your TPO is significantly different from the operating power specified on the test data sheet you cannot use that data but the FCC will permit you to determine the efficiency factor from a generic chart, which is usually found in the instruction manual. Here is what it looks like for the same transmitter:



Manufacturer's Generic Transmitter Efficiency Chart for HT 7FM. Note that chart indicates efficiency of 78% at 6,800 watts, whereas factory test data indicated 78.4%. Agreement is frequently not this close!

REPLACING MISSING DOCUMENTATION

What happens if you cannot find either the factory test data sheet, or the generic efficiency curves? Your first step should be to contact the factory for a copy of the original test data or the charts. If that is not possible, try to contact other users of the same transmitter type and attempt to locate an efficiency chart.

Remember, if you are operating using the Indirect Method you must have factory data available to back up the efficiency factor employed!

If all else fails, rent or borrow a calibrated wattmeter and dummy load and set up the transmitter to run at 100% of authorized TPO into the dummy load as read on the wattmeter. Then use the voltage and current figures you see on the transmitter meters to calculate the transmitter's efficiency factor.

Be sure to document and detail this test, and keep it with your station records. The FCC will want to examine this when you tell them you have determined your own efficiency factor.

What is the best way to determine the efficiency factor? Interestingly, the FCC has established an order of preference for determining efficiency when operating utilizing the Indirect Method:

1. The Dummy Load/Calibrated Wattmeter test to determine the Efficiency Factor (F) as described above is considered the best method;

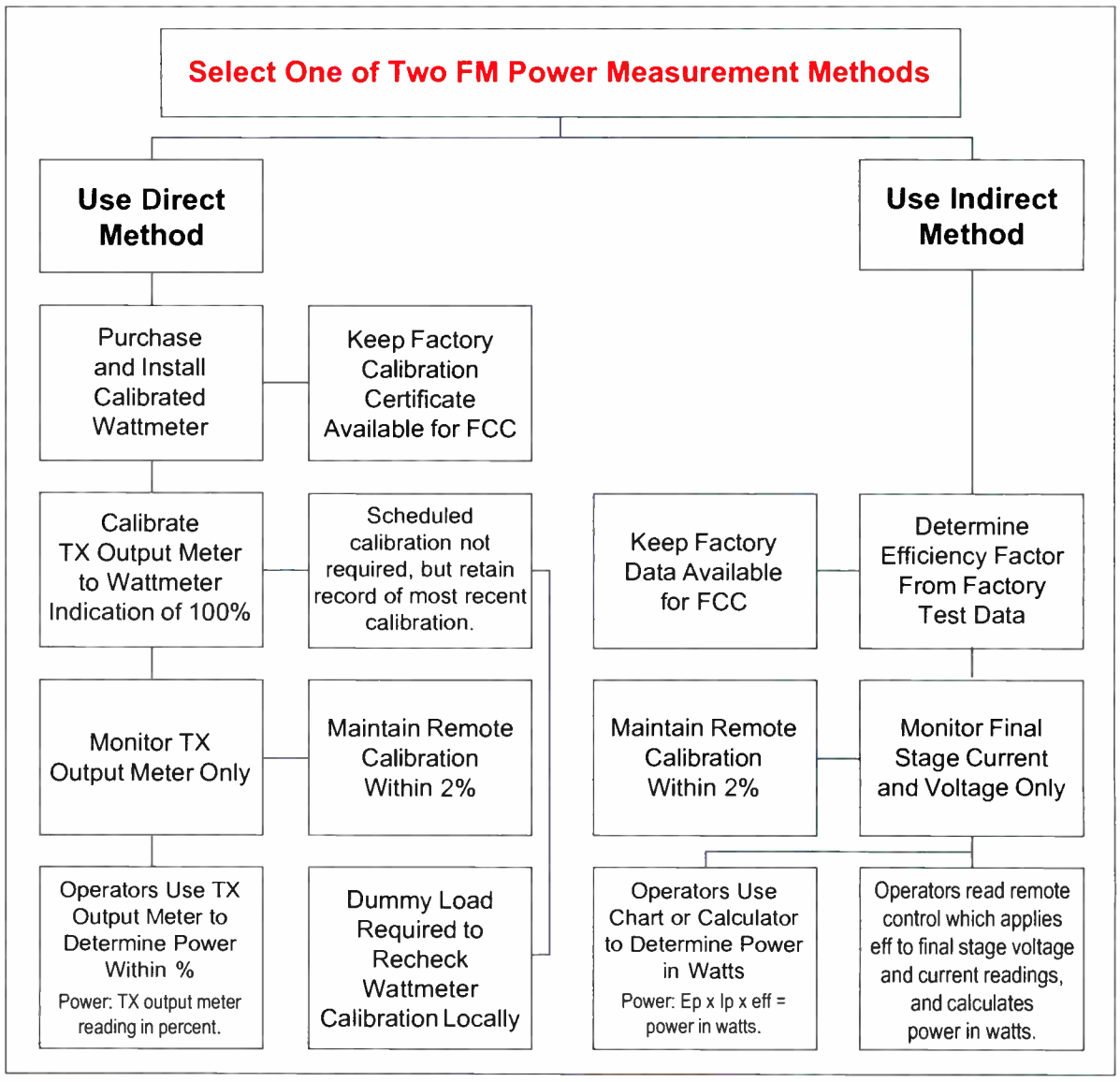
2. The Manufacturer's Final Test Data is considered second best, provided it was done at or very near the station's authorized power output and frequency;

3. The Generic Chart is considered the third best (and least desirable) because it represents an average of production-line transmitter efficiency over a wide range of conditions. However, if it is your only option, the inspector will accept it.

UNDERSTANDING THE OPERATION

The operator must know the permissible deviations in power. If the calculator method is used, whether by the operator or determined by the remote control system, you will need to calculate the actual 10% low and 5% high limits and make them available to the operator. The X-Y charts will normally incorporate shading or borders to indicate when calculated power is out of tolerance.

Below is a flow chart that summarizes the requirements for utilizing either the Direct or Indirect Method. Although it is a simplification of this article, it should help clarify the differences between the two methods of FM power determination and keep you legal for your next FCC inspection.



LOGGING PROCEDURES

For the Direct Method, the operator need only record the power percentage indicated by the transmitter output meter, which has been calibrated against the calibrated wattmeter. Only one reading is required. This indication is usually in percent, so the operator should have documentation available which shows that the allowable deviation in power is 90-105%.

For the Indirect Method, the operator must perform the calculation necessary to determine power by multiplying Ep x Ip x F (Efficiency Factor). This can be accomplished in several ways:

1. Provide a calculator at the control point with instructions on how to multiply the final stage voltage, current, and efficiency factor;

2. Construct an X-Y chart, which will incorporate the efficiency factor and display the resultant power for a given value of final stage voltage and current. These charts are easily constructed with a standard spreadsheet program or there are several freeware versions available. (If you need one, contact me via e-mail and I will send you one you can customize for your station);

3. Utilize one of the newer remote control systems that provides a feature that multiplies final stage voltage and current readings presented by the transmitter by the efficiency factor you specify and then displays the result on a dedicated channel. In this case, is suggested that the operator record the values of final stage voltage and current in addition to the computed power reading in watts as a double check of accuracy.

THE FUTURE

Time marches on. The technology we have been discussing is largely based upon high power vacuum tube topology, and recent developments may cause us to rethink the way we measure transmitter power in the future.

First, the development of solid-state transmitters has made obsolete the quaint "Ep" and "Ip" terminology; "Final Stage Voltage and Current" are now the preferred terms.

Then there are the new solid-state transmitters which have sufficient microprocessor horsepower to utilize the concept of "dynamic efficiency," whereby the relative voltages and currents of the solid state modules are constantly adjusted and their power outputs combined by the transmitter controller to provide the most efficient result at any given time. How would we establish an efficiency factor for a system like that?

Finally, many of the most recent transmitters actually have a calibrated digital wattmeter built in. If one can trace the calibration of that meter to a dummy load test at the time of manufacture, would that not meet the direct power requirements?

Of course, when we get to an all-digital system, we will begin dealing with peak power instead of average power, which adds another layer of complexity to this subject. Perhaps by then the FCC will revise the power determination Rules in FCC 73.267 and simplify them. We can only hope!

Terry Baun is the Principal of Criterion Broadcast Services, Westfield, IN, and serves as an ABIP inspector for Broadcast Associations in several states, including Wisconsin, Indiana, Ohio, and Michigan. Contact him at tbaun@criterion-broadcast.com

Full Duplex

by George Nicholas

Resource Management 103

[CEDAR RAPIDS, Iowa] We will wrap up our discussion – for now – of engineering resources with a third installment of both print and electronic information that will help make your job as the technical expert of your company more proficient.

FOLLOWING THE RULES

A nice note from Harold Hallikainen (www.hallikainen.com) brought some interesting information. Quoting Harold: "We recently began making daily updates, so the currently effective FCC Rules are always shown. In addition, Rules that have been passed but are not yet effective are also included.

"As part of this update, I generate a list of the 1,000 most recently changed Rules," said Hallikainen. "These are sorted reverse chronologically – with a link to the Rule, a link to the Federal Register publication of the change, and the title of the Rule."

Another feature I really like, but do not think most people know about, is CiteFind (a CiteFind link is at the bottom of each Rule section). Clicking on this link gives you a list of all the FCC documents at www.fcc.gov citing that particular Rule, including some context. This is useful for finding the documents creating or modifying a Rule along with documents indicating how it is being enforced.

SAFETY FIRST

While we have covered obvious (and some not so obvious) suggestions, they have all been technical. This next one is not. It is called *First Aid Fast*, and is provided by the American Red Cross. Typically, you receive one free of charge as part of Adult CPR training. I just received my second one in as many years, as I am trained in CPR.

Knowing CPR in our job is a good idea; it could be a matter of life and death, especially when we work around lethal voltages. This 85-page booklet is about the size of a 4 X 6 index card and will easily fit in a glove compartment or tool kit. It is not just for electrocution – I have been in several stations where someone has fainted, cut themselves, choked, gotten sick or required some sort of medical help prior to the EMS crews getting there.

While we are not the medical experts at our stations, good engineers are known to be able to deal with emergencies and handle crises better than most others on staff. Tell your boss it is only $15 or $20 to learn CPR and I bet he or she will reimburse you for it.

CHARTS AND TABLES

Another great source of information comes from manufacturers of our equipment. Many old-timers will remember keeping a copy of the old Collins catalogs from the late 1970's. They included a killer attenuation table with 'H' pads, 'O' pads, 'T' pads and various configurations. Distances to contour, distances to radio horizon, and VSWR charts were also very handy items.

Other manufacturers followed suit. Such catalogs are a good reference for their individual technology, as told on one page or less. The Internet has replaced many of the printed catalogs, but a lot of that information is floating around if you know where to look.

For example, many vendors include PDF copies of equipment manuals, parts lists, White Papers and such. Look on the www.orban.com site for Bob Orban's *Maintaining Audio Quality in the Broadcast Facility* – a staple for years. Electronics Research, Inc (www.eriinc.com) is another source I have used a lot. Some web sites offer search engines within their sites, or use one of several Internet search engines (each claiming to be the best). My vote goes to www.google.com for the most inclusive results.

Here is a plea to *all* manufacturers: Please scan your old manuals and post them. I realize it takes time and resources to do so, but the convenience in having them available on the 'net far exceeds the cost benefit. And your phone will ring less.

ADDITIONAL SUGGESTIONS

Your technical bookshelf should also include other non-technical books, such as books on organizational skills, self-help and management. Even if you are not a "manager" in the traditional sense you certainly have to manage people and projects. You will have an edge the boss will never suspect – your ability to read a situation and react favorably.

As I have mentioned before, there are several authors I like, especially John Maxwell. But there are dozens of great authors, both old and new. Peruse the bookstore and find a style you like. Jack Canfield's *The Success Principles* is currently on the nightstand. At nearly 500 pages, it is not necessarily a quick read, but it is jam-packed with great ideas, many of which I am sure I will write about in a future column.

If the name sounds familiar, Jack Canfield is co-creator of Chicken Soup for the Soul, so you know there will be a lot of "gems" in there. I picked up my copy for $16 at Sam's Club, but it is available just about everywhere.

As we wrap up, may I remind you Full Duplex means "two-way?" Please take a moment and drop me a line; tell me how you are doing, and if there is anything I can do for you, or even if it is just to say hello. I am always pleased to hear when someone mentions they have used an idea or two from the column, or ways we can improve.

Remember: it is not "us versus them." Rather, it is "utilizing the structure to maximize the signal in the direction we would like it."

George Nicholas specializes in technical and communications consulting throughout the US. If you have an experience to share, or an idea you would like to explore, email him at: georgenicholas@csi.com

Studio Guide

by Mark Shander

Microphone Talk:
Part 2: Dynamic Microphones

[PHOENIX, Arizona] Remote broadcasts, especially electronic newsgathering and interviews, usually call for the use of dynamic microphones.

Dynamic microphones have a reputation for being very durable and handling environmental conditions in which other microphones might suffer poor performance or fail to function at all. For example, perhaps you have heard the story about the guy who took an EV-635A and hammered nails with it, then put it back into service. Try that with a sensitive condenser microphone – it will never sound the same.

EV 635A Microphone

Dynamics do not need external power sources to operate, as condenser microphones do. In other situations, a battery is required for a microphone to work, as is the case with electret condensers that are used for newscasts and remotes. That said, the advent of cheap mixers and new lines of inexpensive, more durable condenser microphones are giving the old favorites a run for their money.

PICKING A MICROPHONE

When considering a particular microphone to put into service, first consider how it is going to be used, and specifically *who* will be using it. If it is someone with little recording experience or someone who will not pay a lot of attention to detail, use something bulletproof that can handle high SPLs (sound pressure levels), like the EV-635A we discussed earlier.

The Shure SM-58 or Beta 58 are also good choices, although these are likely better suited for use with a microphone stand rather than hand-held use; drop one on the grille and it is dented until you replace the grille.

Sportscasters using headsets now have a choice: they can use a dynamic microphone, an electret condenser, a large or small diaphragm condenser microphone, or a new bone microphone, which reminds one of the microphones we see secret agents using.

It can be argued that condenser microphones are better at acquiring sound and faithfully reproducing sound, but how good is good enough? With processing, a $120 Sennheiser microphone can sound better than an $800 condenser. It is subjective, but we all know what quality is when we hear it, and we all hear it every day.

Different kinds of microphones handle recording tasks differently. For example, it is rare that you will see that EV-635A in a recording studio with someone originating voice tracks with it. You might, however, see it in a production studio at a high school, with students creating commercials with it. Why is not that same microphone the best choice for both situations?

THE RIGHT TOOL

The recording industry and the broadcast industry are like cousins. While we share a lot of the same tools, we have different end requirements. Since we are broadcasting and we deal with higher noise floors and in most cases, lower signal-to-noise ratios than recording folks do, we need to add more processing and compression to our work. This is not just to sound louder than the next station, but to create the perception of higher-quality audio.

As we mentioned last month, compression reduced the difference between the softest sound possible and the loudest sound possible for a given source. Although you might be tempted to record Adam Sandler with the same microphone your daughter or son used with their karaoke machine, the correct selection would be the same microphone Whitney uses.

Protecting a microphone during watery or winter weather conditions is also vital. Several years ago a former Partridge Family television show child actor dropped an EV-635A into a dunk tank in which he was recording a video segment. The actor had to be taken to the hospital; the EV-635A was dried off, cleaned up, and put back in service 4 weeks later.

While the 635As above may have worked well following the ordeal, generally it is not a good idea to get sensitive recording equipment wet. The fact of the matter is, equipment and recording characteristics do change with temperature and humidity. Dynamics are less susceptible to changing characteristics and yield more consistent results

ANOTHER CHOICE

When is it appropriate to use a wireless microphone, and are wireless condensers good enough for recording? That is a good question. In general, they are fine for broadcasting, but most recording engineers will still insist on wired solutions. They are purists.

Some wireless microphones are really microphones that are typically hardwired, but have a wireless module attached to them. This is one of the better ways to go wireless. The newer units use spread spectrum technology and help give better performance and distance.

The lesson is that consumer equipment, though priced where we want our equipment to be priced, is still consumer equipment. Pay a little more and get something you know will sound good for years to come.

As the prices of condensers come down, it is tempting to use them in places where the more durable microphones should remain. Why not make your remote sound as good as possible? The reason is that the best it can sound is much better than it needs to sound, and the risk of exposure the equipment is subjected to is not worth the difference in performance.

Next month we will start taking an in-depth look at some microphone product lines, their pricing and where they excel as well as where they fall short. Microphones range in price from free to tens of thousands of dollars.

We will also explore some of the newest microphones that give many of our old favorites a run for their money.

Mark Shander has spent a good part of his life talking into microphones in radio, TV and on the Internet. He can be contacted at mark@shander.com

Transmitter Shack

by Marvin Collins

Power Upgrade on Tap for Mount Wilson, CA

Getting power to the mountaintop sites where broadcast transmitters are located is not always easy. Radio and TV use a lot more power than other services. At some point, more capacity is needed. But, getting it built can take a lot of time and effort. Marvin Collins gives us a glimpse into the process.

[LOS ANGELES, California] Power to Mount Wilson has been provided by the Southern California Edison Company (SCE) since 1914. The former Mount Wilson Hotel and the Mount Wilson Observatory were early customers.

57-YEAR-OLD UPGRADE

When Television and FM transmission were established on Mt. Wilson the power feed was upgraded in 1948. The primary power feed to Mount Wilson is still that 1948 upgrade – an underground cable, the type of which is no longer used. All the SCE employees who were trained for repairing this type of cable have retired, except for one.

This underground cable was backed up with an overhead feed, which goes most of the way to the mountaintop. Voltage on this line is 16,240 volts, which feeds five substations on Mt. Wilson, where the voltage is reduced to 4,160 volts for distribution to the individual TV stations, where another transformer is located to drop the voltage to 480, 240 or 208 as required.

All of the foregoing is known as the "Main" feed, which comes up the front side of the mountain from Pasadena, where SCE has maintained a substation since 1948 just for the purpose of providing power to Mt. Wilson.

FULL LOAD

This Main feed up the front side of the mountain was originally designed for 140 Amps at 16 kV. Over the years the load has grown to 250 Amps. The load is projected to increase to 290 Amps at 16 kV as more digital Television transmitters are put on the air.

In order to carry this growing load the underground and overhead Main feeds have been operated in parallel for the past two years. A failure of either the overhead or underground feed would be bad news, since neither line can carry the entire Mount Wilson load by itself.

There is a backup line, built in 1979 (known as "Chilao") which starts in La Canada, California and takes a longer 14-mile route to Mt. Wilson. This line normally does not feed Mount Wilson; its main purpose is to serve about 50 cabins in the Angles Forest. Since 1979 the Mount Wilson load has increased to a point where the Chilao line could not carry the entire load, if needed.

PLANNED IMPROVEMENTS

At a Society of Broadcast Engineers,Chapter 47 meeting, Ben Peterson, Transmission Engineer for SCE presented a three-phase plan to solve the Mount Wilson power problem. The first phase of the project will be to upgrade the Chilao line from 16 kV to 32 kV. This voltage increase will permit the same overhead conductors to carry the entire Mount Wilson load.

In order to increase the voltage to 32 kV it will be necessary to install larger insulators on the line, as well as new transformers at each end of the line. However, the US Forest Service has ordered a delay until nesting owls have hatched. (The Forest Service feels the helicopter activity required for the project would be detrimental to the nesting owls.)

When Phase One of the project is finished, the Mount Wilson load can be transferred to the Chilao line coming from La Canada. This will permit the shut down of the Main line coming from Pasadena. Phase Two will be the replacement of the Main feed from Pasadena with modern underground cabling and/or overhead lines.

Phase Three of the project will consist of rebuilding the power feed on top of Mount Wilson. The 4,160 Volt feeds between the five mountain top substations and the customers will be increased to 16 kV. This will require special transformers not normally used by SCE. But it is felt that going from 4,160 Volt feed to 16 kV is the right thing to do because of the size of the loads at each TV station.

The cost of the project is estimated at ten million dollars. SCE anticipates there will be some power interruptions at Mount Wilson as the work progresses; there will be times when backup generators will be needed. Coordination with the broadcasters will be necessary.

For a history of Mount Wilson see: http://www.oldradio.com/archives/stations/LA/mtwilson1.htm

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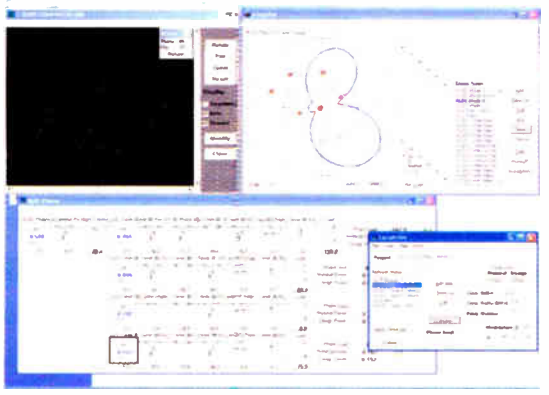
Watching the Los Angeles broadcast industry for over fifty years, Marvin Collins can be reached at KFIam640@aol.com

Kintronic Labs, Inc

KINTRONIC LABS IS SERVING THE AM/MW ANTENNA SYSTEM MARKET WITH STATE-OF-THE-ART EQUIPMENT FOR THE DIGITAL TRANSITION WORLDWIDE

ENGINEERING DESIGN USING IN-HOUSE SOFTWARE TOOLS



HIGHLY QUALIFIED ENGINEERING SUPPORT

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FAST REACTION PRODUCTION STAFF

WE ARE MAKING DIGITAL RADIO A REALITY NOW! CONTACT US TODAY.

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RF Specialties® Group

No doubt you've noticed the Products in Focus section in this issue of *Radio Guide*. Look over the list of products featured and then call the nearest RF Specialties office for more information and ask for our everyday low prices.

For over 20 years, radio and TV broadcasters have depended on the RF Specialties Group to provide all of their equipment needs. From towers to name brand FM and TV antennas to a full line of transmission lines, and yes, we have AM and FM transmitters from low power up to 50 kw in digital and analog.

Now you can purchase your audio needs from the microphone to the console and everything in between.

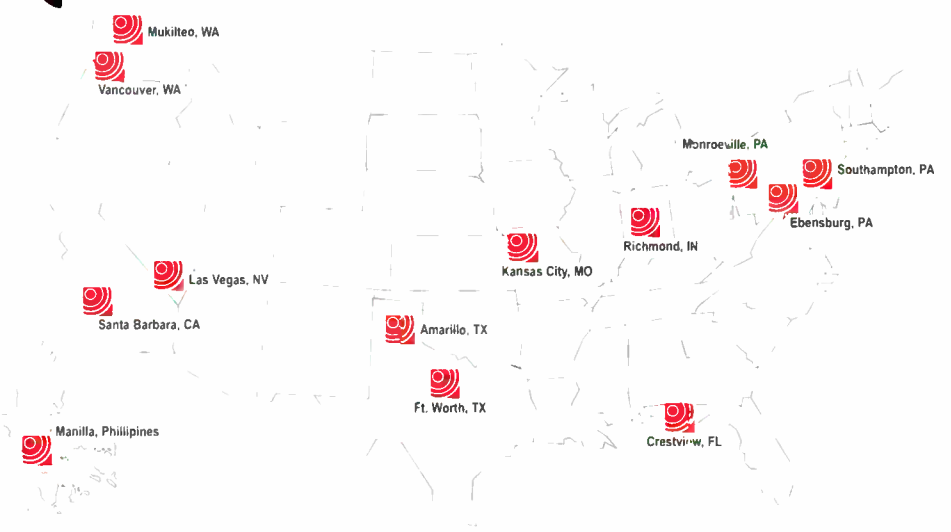
"I didn't know you guys sold that!"

Many think of us as only the "RF Guys." The RF Specialties Group Members wear many hats. With over 300 product lines, you'll discover how easy it is to make one call for all your equipment needs. No wonder we say....

RF is Good for You!

Visa and Mastercard are welcome.
Offices Independently Owned and Operated.

www.rfspec.com



Sam Lane	Santa Barbara, CA	1-800-346-6434
Bill Newbrough	Las Vegas, NV	1-888-737-7321
Bob Trimble	Vancouver, WA	1-800-735-7051
Walt Lowery	Mukilteo, WA	1-425-210-9196
Don Jones	Amarillo, TX	1-800-537-1801
Wray Reed	Ft. Worth, TX	1-888-839-7373
Chris Kreger & John Sims	Kansas City, MO	1-800-467-7373
Rick Funk	Richmond, IN	1-888-966-1990
Ed Young	Monroeville, PA	1-866-412-7373
Dave Edmiston	Ebensburg, PA	1-866-736-3736
Harry Larkin	Southampton, PA	1-888-260-9298
Bill Hoisington	Crestview, FL	1-800-476-8943
Ed Edmiston	RF Specialties of Asia (Manila, Phillipines)	+63-2-412-4327

Tool Guide

From the Radio Guide Tool Box

RX-11 Tone Generator

CONEX Electro-Systems Model RX-11 Programmable Tone Generator

The Conex RX-11 ToneJack provides audio sine and square wave signals of very accurate frequencies from 1 Hz to 29,999 Hz. It will deliver a balanced output level of +10 dBm into a 600 ohm load. The RX-11 is very useful in testing the frequency response of systems, filters, tone sensors, etc.

In addition to being a highly accurate audio frequency generator, the ToneJack can perform other functions that make audio testing easier and faster including:

User Programmed Frequencies.

The LIST mode lets you manually or automatically step through up to 10 frequencies that you program into the ToneJack yourself. You can preset the Auto-Step frequency step-time to be from 1 mS to 29,999 mS.

Tone Burst

You can program the ToneJack to output a specific frequency (from 1 - 29,999 Hz) for a specific number of milliseconds by using the BURST mode. The tone will stop at the end of the next complete half cycle following the specified time interval.

Sweep Generation

The SWEEP mode allows you to quickly check the frequency response of a unit under test while observing it's output on a standard oscilloscope. (The RX-11 includes a scope sync output for viewing the sweep.) The sweep is from 50 Hz to 20 kHz and the duration of each frequency can be varied from 3 mS to 29,999 mS.

The RX-11 operates on an internal, 9 volt alkaline battery (battery life approximately 30 hours) or on external power (6 - 15 VDC)

RS-232 Control

The ToneJack can also be controlled by a standard RS-232 interface such as a computer or terminal. This feature allows you to test a piece of equipment from some other location by communicating with a remote computer via modem or writing a simple test procedure program for your computer that would automate the testing.

The Conex RX-11 Programmable Tone Generator retails for $229.00

Back View of RX-11 Tone Generator

RX-11 Specifications

- Frequency range 1 hz - 29,999 Hz (1Hz steps).
- Sine and Square wave outputs.
- RS-232 controllable.
- Manual or auto-step through 10 user-assigned frequencies.
- Output level variable from 0 to 6.3 V P-P.
- Uses 9 V battery with jack for external power.
- Log sweep from 50 Hz to 20 Khz, with 25 frequencies.
- Scope sync output pulse for viewing the sweep.
- Compact (1.5" x 5" x 2.6" overall).
- Tone burst with duration of 1 to 65,535 mS.

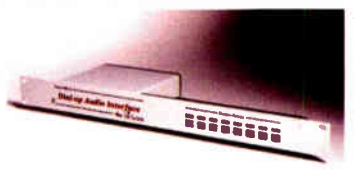
RX-11 Tone Generator

Conex Electro-Systems
1602 Carolina St., Bellingham, WA 98226
Phone: 800-645-1061
Website: www.conex-electro.com

Model RFC-1/B Remote Facilites Controller
- control transmiter from any telephone
- 8-64 channels of telemetry and control
- programmable control by date and time
- optional printer and modem adapters
- programmable telemetry alarms
- integrated rack panel

Model RAK-1 Intelligent Rack Adapter
- parallel printer interface
- internal modem for data transfer
- front panel status indicators
- battery backed power supply
- rack mountable chassis
- accessory package for RFC-1/B

Model DAI-2 Dialup Audio Interface
- perform unattended remote broadcasts
- fully programmable output on any key press
- momentary and/or maintained relay outputs
- four logic inputs with programmable output
- balanced audio input and output wth ALC
- seven DPDT relays and one 4PDT relay



Model AFS-3 Audio Failsafe
- contact closure or status voltage on alarm
- adjustable delay period from 30 sec to 5 min
- positive delay adjustment via rotary switch
- internal audible alert--continuous or pulsing
- front panel status indicators and bypass
- dual, balanced audio inputs

Sine Systems, inc

615.228.3500
www.sinesystems.com

Digital and Analog Transmitter Audio Switching Solutions, Analog to IBOC!

The AES-302 Digital Audio Switcher/DA/D to A Converter

The CDS-300 Composite Audio Switcher/DA

The CDS-302 Automatic Composite Audio Switcher/DA

Visit us at Broadcasters General Store
NAB Booth #N3304

Introducing the next generation **transmitter audio switchers** from BDI. Now you can have complete confidence in your signal path with this series of switcher/DA systems. We have **composite** and **digital** solutions for your routing and distribution requirements. If you system is all digital, choose the AES-302 to automatically switch, distribute and monitor your transmitter audio feeds. Still running an analog STL or stereo generator? Use either the CDS-300 or 302 to switch and distribute your baseband audio signals. Select one of the optional modules for the CDS series and convert your analog signal path into an AES digital output suitable for digital exciters and IBOC implementations. Visit our web site and download complete information about these problem solver products.

Broadcast Devices, Inc.
Tel. (914) 737-5032 Fax. (914) 736-6916
Website: www.Broadcast-Devices.com

bdi

VoxPro® PC

About VoxPro PC

VoxPro PC software provides fast digital recording and editing of voice and phone recordings on PC's with Windows® 2000 or XP Pro. VoxPro PC software uses a computer keyboard or an optional control panel (shown above) to execute its easy to learn features.

Features

- Faster than ever deleting, copying and moving files.
- Adjust gain after recording in one or two tracks.
- Compatible with virtually all sound cards.
- Imports-exports all popular formats including MP3.
- Fully re-sizable screen from minimal to full screen.
- Reverb, Echo, Chorus, Flanger, Tempo & Rate change and more.

Many more features at www.audionlabs.com

True, Easy Network

Move *multiple* files from user to user or room to room. Create files and instantaneously share them with other selected workstations. Access on-air files from another studio when you're off the air using your existing, station network.

"I can't tell you how excited our people are over the new features in 3.3. I am always busting my butt on getting levels right on our callers. The Adjust Volume feature makes every caller sound great."

Mark Borchert, CE, Triad, Fargo, ND

System Requirements: Pentium 3 or 4 or AMD Athlon (750MHz or better), 2K or XP Pro, 256 MB RAM, CD-ROM, 20GB hard drive, serial or USB port for control panel, USB or parallel port for hardware key

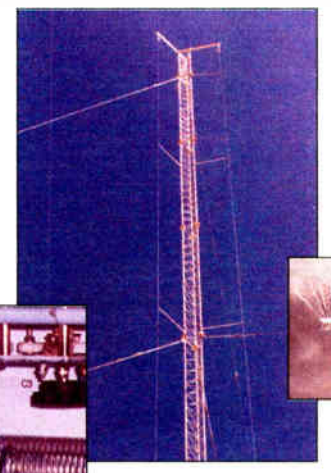
VoxPro PC is available at most broadcast distributors. For more information go to www.audionlabs.com or call us at: 206 842 5202 x204

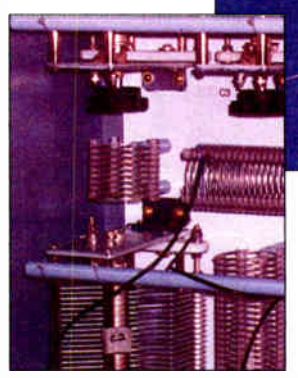
Gila-Stat

nott ltd

3801/4001 La Plata Hwy
Farmington, NM 87401

Manufacturers of the **Gila-Stat** Lightning Prevention System





Design and Manufacture of
Folded Unipole Antennas
Structure Detuning Systems

Design and Manufacture of
Lightning Prevention Systems
ROHN Towers & Accessories

Phone: **505-327-5646**
Fax: **505-325-1142**
Website: **www.nottltd.com**
Email: **judyn@nottltd.com**

Over 40 Years Broadcasting Experience

Protection Guide

Keeping You and Your Station Safe

DA Gap & DA Hook

DA GAP – Lightning Dissipation Horn Gap
DA HOOK – Personal Grounding Stick

DA GAP is a lightning dissipation horn gap of conventional design with a special fine adjustment mechanism that allows the gap width to be adjusted under full power and modulation. The concept of fine adjusting under full power and modulation, and the design of the adjustment mechanism was so unique that DA GAP has been given patent protection by the US Patent Office (Patent Number 5,661,262).

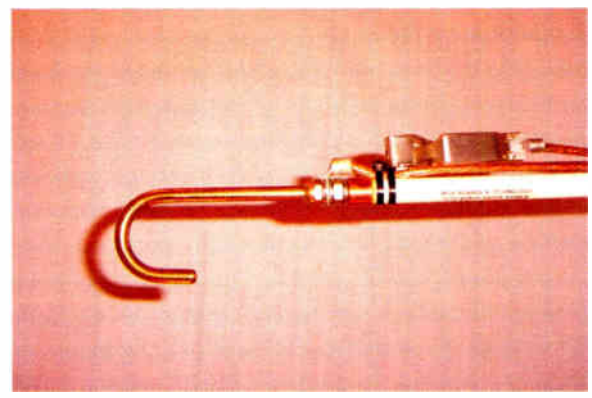
By being able to make the gap width adjustment under full power and modulation conditions, the tightest possible gap width can be maintained for lightning protection without flash-over on modulation peaks. All other gaps in use today must be adjusted cold and an average setting used. If you guess wrong, you will have lightning damage or constant flash-over on modulation peaks. Then the station would have to shut down for repair of lightning damage or for further cold adjustment of the gap width.

DA GAP is a lightning dissipation horn gap of conventional design with an exceptional feature that makes DA GAP superior to all other lightning dissipation gaps available on the market. DA GAP is the only gap that can be adjusted hot – while the tower is radiating power. Since DA GAP can be adjusted hot, the gap width can be optimized for the tightest possible setting providing maximum lightning protection with the minimum number of flash overs on modulation peaks. Should it be found that DA GAP was adjusted too tight and too many flash overs on modulation are occurring, DA GAP can be readjusted at any time with its companion adjustment tool – DA ADJUSTER – without leaving the air for maintenance.

The DA Gap

A horn gap is an effective method of lightning dissipation. When a lightning strike occurs, an arc forms between the narrowest part of the horn electrodes. This arc super heats the air in the near vicinity, causing a column of air to rise. The rising column of air causes the arc to rise above the narrowest portion of the horn gap and spread out between the wider portions of the gap until the energy is dissipated.

DA GAP is a well built protector. It is constructed of solid naval brass and stainless steel. The insulator is 1.75 by 6 inch RF grade ceramic and will withstand 1,650,000 volts. DA GAP is conservatively expected to last 20 years in service. At a cost of $350.00, DA GAP will protect a base insulator and network components for $17.50 per year.



The DA Hook

DA HOOK is a personal grounding stick that is carried into the tuning house or to the tuning cabinet where grounding sticks are not normally provided to ground components and towers so that work may be safely accomplished. The DA HOOK price is $49.95 each, plus $4.95 shipping.

Edward J. Wilk along with his wife Adrienne A. Wilk are owners of Wilk Science and Technology, Inc. Ed Wilk is a radio engineer who has worked exclusively in Chicago for the past 35 years. For the last 25 of those years, Ed has worked for WGN Chicago working at its studios, earth station and transmitter doing operations, emergency repairs, maintenance and construction.

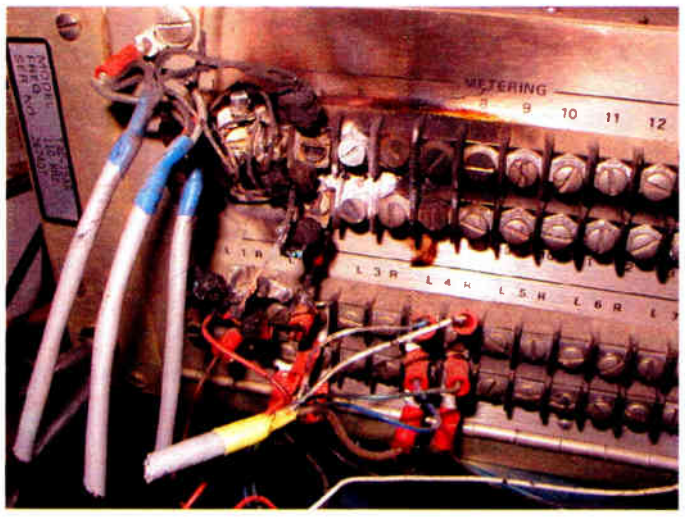
Wilk Science and Technology
Phone: 708-524-8515
Email: ewilk@ameritech.net

The Worst I've Ever Seen

A periodic display of the adequate, the bad and the ugly.

Bill Bordeaux comments: This comes under the heading: "I'm sure glad I wasn't in the transmitter shack when this happened."

This was an old bulletproof (until now) Moseley TRC-15 remote control wired to a Wilkinson FM transmitter.



"These Readings Don't Look Right"

Due to the downright creepy design of the PA voltage monitoring circuit, a failure of the capacitor that kept the sample circuit off from ground allowed the full PA voltage to find its way through the wiring harness of the transmitter and out to the poor old remote control. Yeow!

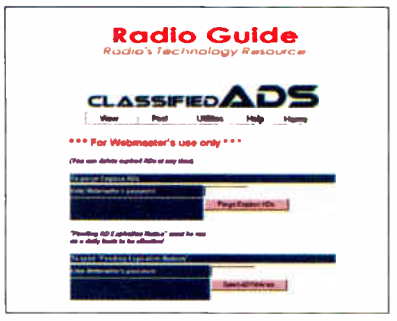
When the station went off the air, we first thought it might have been a power failure at the site. The remote control was no longer sending telemetry to the studios. Little did we know that the remote control had already passed to the Great Beyond.

Radio Web Sites

On-Line Resources for Broadcasters

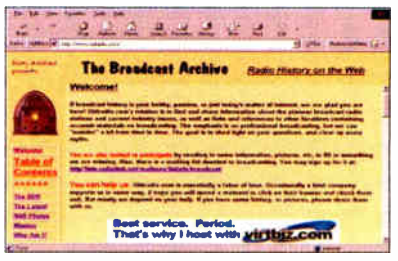
www.radio-guide.com

The official Radio Guide website. Information on current and upcoming issues, with industry links to technical information. Subscribe on-line.



www.radio-classifieds.com

Post your own used equipment ads.



www.oldradio.com

The ultimate radio history web site.

www.radiolists.net

Subscribe to these lists:

Broadcast List – for the exchange of info and opinions on broadcasting.

Tech-Assist List – for help with immediate technical problems.

Alternate Frequency List – for extended discussions of various broadcast topics.

Consultant Guide — Radio Consulting Engineers

Remote Broadcast Solutions

Amplified Mic/Line to Telephone Interface

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

Unattended Dial-Up Broadcasts with the DR-10

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

TelTap Pocket-Sized Manual Telephone Coupler

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

Discover more online at www.circuitwerkes.com

CircuitWerkes, Inc. - 2805 NW 6th Street, Gainesville, Florida 32609, USA 352-335-6555

Design » Build » Installation Radio and Television Studios

Ram Broadcast Systems builds studios for most of North America's major networks, group stations, and news organizations.

Ram offers comprehensive studio design, fabrication, systems integration, and components. Put Ram's 35 years of experience to work for you:

- Studio Design & Fabrication
- Pre-Wired Systems
- Broadcast Furniture
- Switchers
- Metering
- Amplifiers
- Wire & Cable
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- Accessories
- Used Equipment
- And More!

RAM

RAM Broadcast Systems
www.ramsyscom.com
800.779.7575

Gear Guide: Towers, Antennas, Phasors

AM Ground Systems

AM Ground Systems Company (AGSC) provides **AM Ground System** testing, maintenance and construction services. AGSC can test, rehab or build your small ND or huge DA ground system quickly and economically. Their extensive broadcast engineering experience and modern ground system installation & test equipment allows them to be reliable, fast and hassle free. AGSC AM ground system testing services feature physical, mechanical and electrical testing of AM ground systems of all types. They are able to repair many ground system problems without the expense of a total rebuild. Large array, emergency and compressed schedule work are their specialties.

Is your AM station's ground system over 30 years old? Has it been damaged or vandalized? Has your AM station's range dropped? They can help.

Phone: 877-766-2999
Website: www.amgroundsystems.com

Antenna ID Products

Custom made **Tower Signs** for AM-FM-TV and multi-tenant tower sites. Guy wire markers, and antenna taging systemem also avaliable.

Add your ASR or phone number at bottom. Dark lettering on 12 x 18 inch on heavy duty white aluminum.

First sign including set up – Price $57.50. Second and each additional identical sign – $37.50 (same)

GVPL973 guy wire markers. Extra heavy duty 8 foot x 2.5 inch tubular bright yellow plastic. Equipped with night reflective marking bands.

Phone: 610-458-8418
Website: www.antennaid.com

Armstrong Transmitter

Manufactured from Nautical Brass and constructed to exacting standards, Armstrong Transmitter's **FMA Antennas** offer FM broadcasters exceptional quality and reliability and exceptional signal coverage.

These true circular polarized antennas are available for low, medium and high power applications.

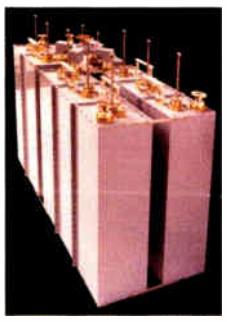
Armstrong also offers broadband vertical only standard and portable antennas with up to 2KW input, for emergency back up applications and manufactures a complete line of FM combiners, splitters and filters.

Armstrong has FM Solid State transmitters from 10W to 20KW, Single Tube FM transmitters 3.5KW to 35KW, Analog and digital STLs. And the award winning X1000B Solid State HD Radio Ready AM transmitter.

Phone: 315-673-1269
Website: www.armstrongtx.com

Bext

When Clear Channel needed precision crafted, low loss, four way **RF Combiners** with frequencies spaced 1 MHz apart to combine four stations into one common antenna, Bext was their choice.



Bext carries a line of RF accessories that includes FM Dual and Triple Cavity Filters, and a Series of RF Combiners in both Starpoint and Constant Impedance configurations.

Power levels up to 60 kW are available.

Any time multiple stations are to be located on the same tower, it makes good engineering, as well as economic, sense to combine them into a single antenna.

With a line of over 50 off the shelf Combiners, Bext can design and build your multi-frequency system with tight specifications and close frequency spacing.

Phone: 888-239-8462
Website: www.bext.com

Dielectric

Dielectric's **HD Plus™ FM Antenna** achieves a level of analog and digital signal isolation necessary for in-band on-channel (IBOC) broadcasts without the isolator required by the majority of separate antenna systems recently approved by the FCC for HD Radio.

The HD Plus antenna can easily be integrated alongside existing analog FM antennas, allowing the station the ability to continue its analog broadcast while also adding a digital broadcast of the same signal at the same frequency.

With the HD Plus, isolation exceeds 40 dB, over 10% more than the 36 dB required by the FCC. With such excellent isolation from the antenna, the need for a supplemental isolator in the system is effectively removed.

Phone: 207-655-4555
Website: www.dielectric.com

ERI

Electronics Research, Inc. delivers a broad spectrum of antenna, RF components, filter systems, and structural products for both radio broadcast applications. Their production version of the ERI LYNX™ Dual Input FM Antenna provides a low loss method to combine and transmit simulcast analog and IBOC FM signals.

The antenna incorporates a unique dual feed system that provides an excellent match for both the analog and digital IBOC transmitters while providing sufficient isolation to eliminate the need for a circulator in most applications. ERI also has information on its antenna mounting brackets and on its line of stand off mounting poles for both FM and TV antennas.

Phone: 812-925-6000
Website: www.eriinc.com

Harris Broadcast

Harris **AM Antenna Products** complement the Harris DAX and DX transmitter families from 1 kW to 200 kW. Harris recently added "Phase Rotation Networks" to its full line of Antenna Tuning Units, Phasors, and Diplexers. Many stations are now employing these networks to optimize the load presented to the transmitter for IBOC installations. Harris can work with your consultant or provide complete in-house engineering design services.

All products include true silver-plated coils (none rated under 20 Amps), generous grounding, and rugged, sturdy housing. ATUs can be provided as panel-mount or in a rugged weatherproof housing. Phasors and Diplexers are offered with a wide array of user selectable options and control systems. All systems are factory pre-tuned to theoretical values prior to shipment, and are provided with complete documentation.

Phone: 513-459-3400
Website: www.broadcast.harris.com

Jampro Antennas

The **JMPC-2+JMPC2-HD** array uses a special design which has proven to have good isolation (typical 29 to 32 dB). The two sections offer almost mirror images for band pass and takes up less tower space than some other approaches. The interleaved array allows stations with rented tower space to hold down costs and keeps the weight and wind loads to a minimum. The digital bays could be used as a back up should there be a problem in the normal analog transmission line or bays.

Jampro's also offers other HD FM antennas: dual input, separate elevation side mount models; dual input panels; dual input side mount models; low level combined, wide band arrays; mid level combined systems and high level combined antennas.

Phone: 916-383-1177
Website: www.jampro.com

Gear Guide: Towers, Antennas, Phasors

Kintronic Labs

Kintronic Labs(KTL) is a world leader in the design and manufacture of digital-ready HD radio-compatible AM/ Medium Wave radio broadcast antenna systems and accessories for fixed sites, or mobile sites, for transmitter power levels ranging from 10W to in excess of 1,000 kW.

Products include wideband antenna matching units, directional antenna phasing systems, multiplexed omni or directional antenna systems, folded unipole kits, tower detune kits, transmitter combiners, convection or forced air cooled dummy loads, low profile all-band antenna systems, fixed and variable inductors, RF contactors ranging in current rating from 40A to 200A and in voltage rating from 20kV to 80kV and a wide variety of other RF components and accessories.

Phone: 423-878-3141
Website: www.kintronic.com

LBA Technology

LBA Technology, Inc. designs and manufactures **Medium Wave Broadcast (AM) Antenna Systems** in use worldwide. Products include antenna tuning units, HD radio phasing units, multiplexers, transmitter combiners, directional phasing systems, folded unipole antennas, detuning systems and transportable antenna systems. Available RF components include fixed and variable inductors, vacuum and mica capacitors, RF contactors, standoff insulators, j-plugs, silver plated copper tubing, copper strap and wire. Integration and commissioning of total RF systems is available.

LBA Technology has recently introduced the CoLoCoil™, a system for colocation of communications antennas on "hot" MW broadcast towers, and the SAMWAS™ Antenna Systems for DGPS applications.

Phone: 800-522-4464
Website: www.lbagroup.com

MCI

Micro Communication Inc. offers a full range of **FM Channel Combiners** in a variety of constant impedance configurations.

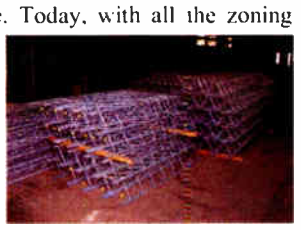
The combiner module consists of a number of precision bandpass cavities and coaxial hybrids that ensure excellent performance. In a multi-channel combining system one module is dedicated to each channel.

Low Loss • Low VSWR • High Isolation
Constant Impedance Design
High Power Handling • Stand Alone Filter.

Optional equipment may include provisions such as patch panels or switches, input test load ports, custom framing systems, N+1 systems, etc.

Phone: 800-545-0608
Website: www.mcibroadcast.com

Nott Ltd.

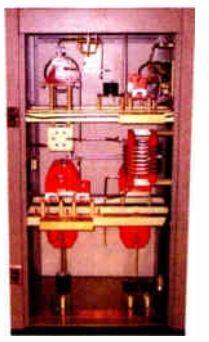


Nello Broadcast Towers. As antennas have dramatically changed, the tower appearance has pretty much stayed the same. Today, with all the zoning requirements, safety concerns, and rigid engineering specifications that need to be met, the tower appearance remains the same while structurally, towers are much more heavy duty.

Nello has made broadcast a major focus. Nestled in the heart of Amish country where craftsmanship is still a major focus, Nello produces a wide variety of towers for broadcasters. Nello manufactures guyed towers up to 1500' and self-supporting towers up to 800', plus tapered steel monopoles. Nello is American owned and all steel towers are made in America. Nello is one of the few tower manufacturers that are American owned and they take pride in the quality of their profession.

Phone: 505-327-5646
Website: www.nottltd.com

Phasetek



Phasetek's experienced staff of engineers and production personnel are dedicated to provide the Broadcast industry the highest quality, custom designed **Antenna Phasing Equipment**.

Precise and detailed systems specifications are developed to ensure maximum accuracy and the utmost efficient circuitry. Their staff is available to discuss your Phasor, Antenna Tuning Units, Diplexers, Dummy Loads, and other R.F. system needs with you and/or your Consulting Engineer.

Phasetek's manufacturing facility and components expertise are also available to design and fabricate any type of inductor or special R.F. component. Their Engineering and Production staffs' years of experience and commitment to quality are available to fill any special requirements.

Phone: 215-536-6648
Website: www.phasetekinc.com

SCMS

The **Davicom MAC/MiniMAC** systems by Comlab are used for monitoring, alarm and remote control. MAC products are optimized for broadcast, with graphic and audible monitoring of remote sites, enabling remote listening to a number of audio channels even when AC power has been lost. Extensive user programming capabilities are standard.

Encrypted, IP-capable MAC systems have two remote interface units, the MiniMAC+ and the MAC+. The MiniMAC+ is a compact 1 RU, with 2 audio inputs, 16 status and 8 metering inputs, 8 relay outputs and an RS232 port. The MAC+ is modular and widely scalable.

Davicom/Comlab can be seen at NAB Booth N1100. U.S. Broadcast distribution is handled through SCMS and their eight field offices.

Phone: 800-438-6040
Website: www.scmsinc.com

Shively Labs

Shively Labs will be showing several new components designed for HD Radio™ implementation.

Products include the new **2600 Series Bandpass Filters**, featuring a footprint 1/3 the size of filters with comparable performance.

Other new products include the 2630 low power branched combiner system, the 2640 balanced combiner system, low power patching systems with lockout-tagout capability, compact power dividers, low windload hybrids, and the industry's most popular digital injector for high level combining.

Phone: 207-647-3327
Website: www.shively.com

Valcom Manufacturing

The Valcom **Model V-147-CL2-TH** is a heavy duty, field proven, high reliability, coil-loaded, 49-foot whip antenna, for Medium Frequency (MF) use.

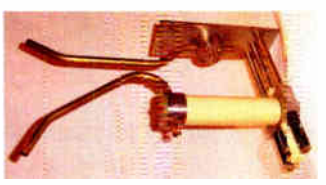
The pedestal base mounts the antenna to its foundation. The base is made of a continuation of the same high strength filament fiberglass used in the antenna. The result is an integral base insulator with exceptional electrical and mechanical properties.

Power handling capabilities are improved while eliminating the weight of conventional brass and porcelain insulators. The shape transmits the bending moment evenly to the base mounting bolts.

The V-147-CL2-TH is available in two standard configurations to meet various system and installation requirements.

Phone: 519-824-3220
Website: www.valcom-guelph.com

Wilk Science



DA GAP is a well built protector. It is constructed of solid naval brass and stainless steel. The insulator is 1-3/4 by 6 inch RF grade ceramic and will withstand 1,650,000 volts. DA GAP is conservatively expected to last 20 years in service. At a cost of $350.00, DA GAP will protect a base insulator and network components for $17.50 per year.

DA HOOK is a personal grounding stick that is carried into the tuning house or to the tuning cabinet where grounding sticks are not normally provided to ground components and towers so that work may be safely accomplished. The DA HOOK price is $49.95 each, plus $4.95 shipping.

Phone: 708-524-8515
Email: ewilk@ameritech.net

Service Guide: Radio Equipment Products and Services

Service Guide: Radio Equipment Products and Services

Final Stage

Send your information for publication to: **radio@rconnect.com**

Radio Guide Ads: April-2005

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Belar - 11	www.belar.com
BEXT - 29	www.bext.com
Broadcast Devices - 37	www.broadcast-devices.com
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Broadcast Software Intl. - 3	www.bsiusa.com
Broadcast Tools - 19	www.broadcasttools.com
Broadcast Warehouse - 26	www.broadcastwarehouse.com
BGS - 27	www.bgs.cc
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Econco Tubes - 9, 44	www.econco.com
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ERI - 5	www.eriinc.com
Freeland Products - 39	www.freeland-inc.com
Gorman Redlich - 9	www.gorman-redlich.com
Harris - 48	www.broadcast.harris.com
Henry Engineering - 2	www.henryeng.com
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Jampro - 27	www.jampro.com
JK Audio - 9	www.jkaudio.com
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Kintronic Labs - 35	www.kintronic.com
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NAB - 47	www.nab.org
Nautel - 21	www.nautel.com
Nexus - 39	www.nexusbroadcast.com
Nott Ltd. - 37	www.nottltd.com
OMB America - 13	www.omb.com
Orban - 48	www.orban.com
Peter Dahl - 13	www.pwdahl.com
Phasetek - 36	www.phasetekinc.com
Pristine Systems - 38	www.pristinesys.com
Prophet Systems - 31	www.prophetsys.com
PTEK - 11	www.ptekpower.com
RAM Broadcast Sys. - 41	www.ramsyscom.com
RF Specialties - 35	www.rfspec.com
Satellite Lynx - 39	www.satellitelynx.com
SCMS Inc. - 22	www.scmsinc.com
Shively - 34	www.shively.com
Sine Systems - 37	www.sinesystems.com
Superior - 31	www.superiorbroadcast.com
Telos/Axia - 15, 17	www.telos-systems.com
TFT - 27	www.tftinc.com
Tieline - 5	www.tieline.com
Transcom - 29	www.fmamtv.com

BLACKBOX Digital Audio Logger

Pristine Systems, Inc. announces the release of BLACKBOX Digital Audio Logger, Monitor, and Alert System. BLACKBOX goes a step beyond traditional audio logging functions by providing an extensive loss of modulation and RF signal strength alerting system, and a Virtual Radio playback environment.

BLACKBOX Digital Audio Logger, Monitor, and Alert System is a comprehensive radio audio logging product designed to meet compliance, proof, audit, programming, management, and engineering needs.

Up to 16 stereo (or 32 virtual mono) channels of logging are available. Choose from a variety of wav audio devices, and AM, FM, and TV tuner boards. Most popular audio storage formats are supported.

Advanced tools provide the Program Director or Consultant with everything needed for quick review or detailed analysis of the entire market. Of course, time based and microphone Skimmer modes are included.

A 'Virtual Radio' style player allows switching between multiple stations during playback.

www.pristinesys.com • 310-831-2234

2005 Radio Guide Event Calendar

Email your information to: radio@rconnect.net

SBE Certification Exam
April 19 – Las Vegas

NAB 2005 Spring Convention
April 16-21 – Las Vegas – www.nab.org

SBE Certification Exam
Jun 3-13 – Local Chapters – Apr 22 App Deadline

Northern New England Broadcasters & SBE-110
June 23 – Manchester, NH – bteffner@wcax.com

Texas Assoc. of Broadcasters (TAB)
Aug 3-5 – Austin, TX – www.tab.org

Nebraska Broadcasters Assoc. & SBE-74
August 10-12 – Lincoln, NE – www.ne-ba.org

SBE Certification Exam
Aug 12-22 – Local Chapters – Jun 10 App Deadline

IBC2005 Conference
September 8-12 – Amsterdam – www.ibc.org

2005 Fall Radio Show
September 21-23 – Philadelphia – www.nab.org

SBE Chapter 22
September 28 – Verona, NY – www.www.sbe22.org

Pittsburg Chapter 20 Regional SBE
Early Oct. – Pittsburgh – www.broadcast.net/~sbe20

Madison Broadcasters Clinic
Oct 11-13 – Madison, WI – www.wi-broadcasters.org

Boscon, Boston & SBE 11
Oct 25-26 – Marlborough, MA – www.bos-con.org

Arizona Broadcasters & SBE 9
Mid October – Phoenix, AZ – www.sbe9.org

SBE National and 2nd Annual Engineering Expo
Oct 10-20 – Grapvine, TX – sandytex@swbell.net

SBE Chapter 16 Regional Convention
October – Seattle – www.broadcast.net/~sbe16

SBE Certification Exam
Nov 11-21 – Local Chapters – Sep 23 App Deadline

NAB2005
THE WORLD'S LARGEST ELECTRONIC MEDIA SHOW

Special Activities

There are many reasons to go to NAB. This may be the best.

Annual Barry's Lunch Gathering
Tuesday, April 19 – 12:00 Noon
Riviera Hotel Buffet Restaurant
Info at: www.oldradio.com/nab.htm

Don't miss this annual "lunch with the bunch." This year's door prize will be a shocker!

Misc. Activities

BE HD Radio Seminar
Saturday, April 16 – 3:00 PM to 5:00 PM
Room N116, LVCC
www.bdcast.com/nab/2005/HD_Radio_Seminar.html

Nautel Users Group (NUG)
Sunday, April 17th – 9:00 AM to 1:30 PM
Riviera Hotel
Info at: http://www.nautel.com/nabpr/

Orban All-Star Band
Tuesday, April 19th – 6:00 PM to 9:00 PM
Las Vegas Hilton

NAB Ham Radio Reception
Wednesday, April 20 – 6:00 PM to 8:00 PM
Las Vegas Hilton Convention Center

SBE Oriented Activities

Ennes Workshop
Building the Next Generation Master Control
Saturday, April 16 – 9:00 AM to 5:30 PM
Room N110, LVCC

SBE EAS Meeting
Monday, April 18 – 2:00 PM to 4:00 PM
Room N236, LVCC

SBE Certification Exams
Tuesday, April 19 – 9:00 AM to 12:00 PM
Grand/Royal Salon, Las Vegas Hilton

SBE Membership Meeting
Tuesday, April 19 – 5:00 PM to 6:30 PM
Room N109/110, LVCC

YOUR FUTURE STARTS HERE

NAB2005

THE WORLD'S LARGEST ELECTRONIC MEDIA SHOW

When It Happens in the World of Electronic Media, It Happens Here First!

All Industry Opening Ceremony —
April 18, 2005

Sponsored by: accenture

State of the Industry Opening Address

Edward O. Fritts
President & CEO
NAB

Distinguished Service Award Recipient

Lowry Mays
Chairman of the Board
Clear Channel Communications

Spirit of Broadcasting Award Recipient: Howard University

H. Patrick Swygert
President
Howard University

Debbie Allen
Producer, Director, Actor and Choreographer
Howard University Alumna

Super Sessions

Convergence and Content on the Move: Riding the Digital, Mobile, Virtual and Personal Wave

April 18, 2005

Shane Robison
Chief Technology Officer/ Chief Strategy Officer
Hewlett Packard (HP)

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Video – The Next Wave in Publishing

April 19, 2005

Steve Saylor
Vice President of Digital Video and Audio
Adobe Systems Incorperated

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April 19, 2005

Jonathan Klein
President
CNN/US

Look Before You Leap – The Dollars and Sense of Transitioning to HD

April 19, 2005

David Krall
President/CEO
AVID

Taking It to the Streets – Mobile Devices Add Drama to Sports & Reality Programming

April 20, 2005

Mark Cuban
President
HDNet, LLC

New Technology for Digital Media

April 20, 2005

Kenneth Williams
Chief Executive Officer
Ascent Media

MultiMedia World Keynote Speaker

April 18, 2005

Hector Ruiz
Chairman & CEO
Advanced Micro Devices (AMD)

RTNDA Paul White Award Recipient

April 18, 2005

Charles Osgood
CBS

Radio Luncheon
April 19, 2005

Keynote Speaker

John Gage
Co-Founder and Chief Researcher
Sun Microsystems

Hall of Fame Inductee

Jack Buck
KMOX/St. Louis

Luncheon sponsored by: ASCAP

Broadcast Engineering Conference Opening Keynote Speaker —

April 17, 2005

Dr. Robert Pepper
Chief, Policy Development
FCC

Technology Luncheon

Keynote Address

April 20, 2005

Dr. Robert W. Lucky
Engineer/Author

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