

# Radio Guide

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Digital Issue Now On-Line

May-June 2021 – Vol. 29, No. 3

## Watch Dog - A Swiss Army Knife Receiver



**Tamper Resistant Settings**



**Alarms**



Starting RFElectronics, Inc. Watch Dog Interference Monitor for 89.1 MHz  
 SNR at or above threshold: 30/10  
 SNR at or above threshold: 28/10  
 SNR at or above threshold: 28/10  
 SNR at or above threshold: 28/10  
 SNR at or above threshold: 27/10  
 SNR below threshold: 0/10  
 2021-03-15 22:37:04,89.1,0,0,88  
 2021-03-15 22:37:09,88.9,0,0,80  
 2021-03-15 22:37:14,89.3,0,0,80  
 2021-03-15 22:37:19,88.7,0,0,72  
 2021-03-15 22:37:24,89.5,0,0,76  
 2021-03-15 22:37:29,89.1,0,0,80  
 2021-03-15 22:37:34,88.9,0,0,80  
 2021-03-15 22:37:39,89.3,0,0,76  
 2021-03-15 22:37:44,88.7,0,0,88  
 2021-03-15 22:37:49,89.5,0,0,84  
 SNR is no longer below threshold  
 SNR at or above threshold: 30/10  
 SNR at or above threshold: 30/10  
 SNR at or above threshold: 30/10



**Watch Dog** 

Speaker    PWR    SNR    MOD    DAT    Headphone  
                   A            B            C

**EAS Receiver**



**Modular Board Design**




**Interference Tracking**



**Equipment Monitor**



Article – Page 6

  
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- Producer headphone audio mixing
- Field Reporter & Camera Ops headphone mixing
- Field Reporter Headphone output
- Intercom between Producer and Field reporter
- Party-line Intercom between Producer/Talent/Field reporter
- Camera Operators Headphones Output
- Talkback from Producer to Camera Operators
- Inputs for crowd mic, PA announcer, etc.
- Cue bus to audition auxiliary sources
- Main Program output to air or streaming

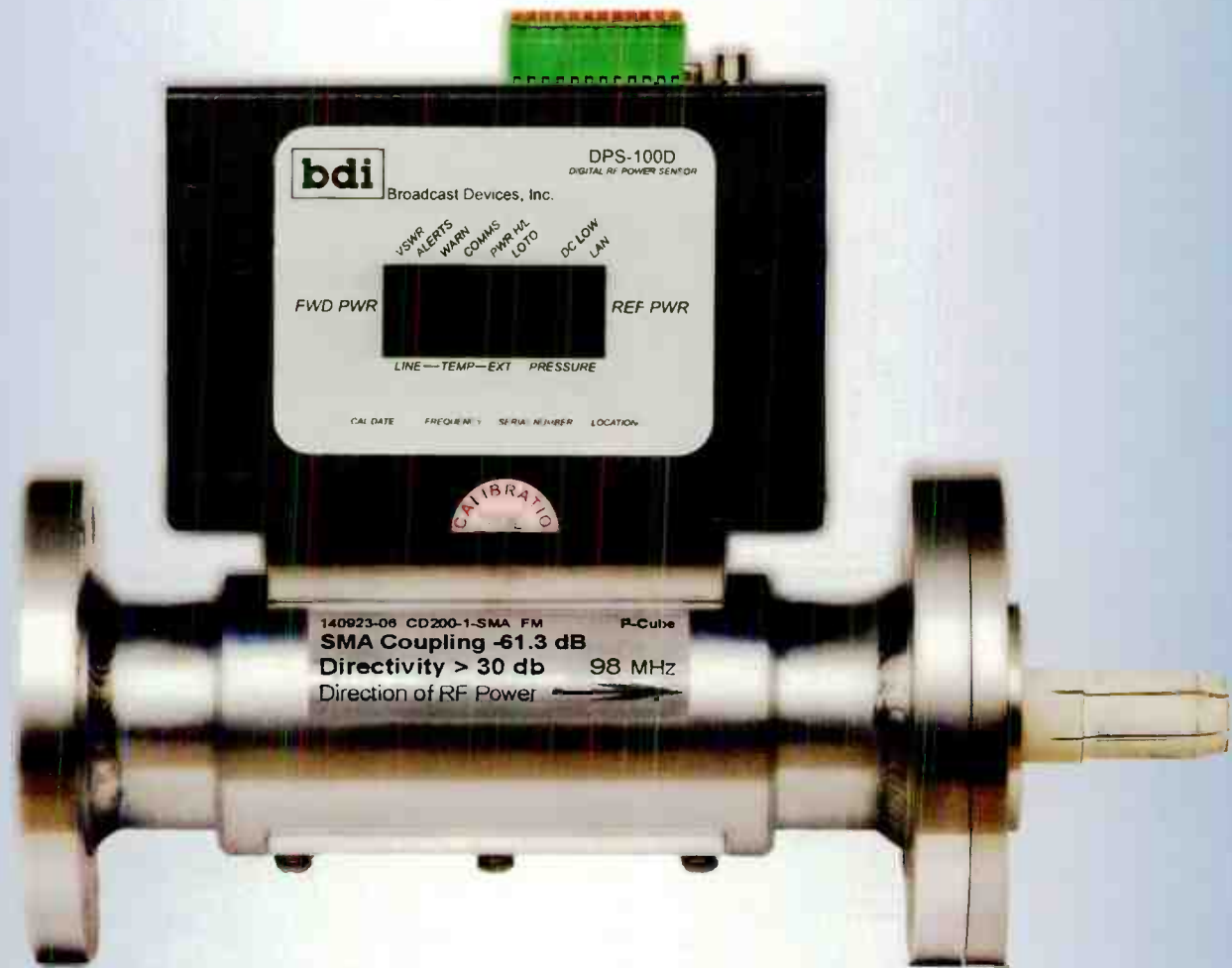
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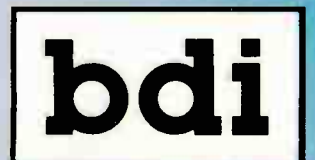
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# Radio Guide

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## In This Issue



### Critical Content for Radio

**Cover Story** - by Alexandra Johnson (page 6)

**Watch Dog - a Swiss Army Knife Receiver:** "The Watch Dog (WDI) by RfEngineers was inspired by the Dayton Industrial receivers that we all came to love. The Watch Dog is a truly versatile receiver capable of tuning the AM & FM broadcast bands as well as the NOAA VHF weather channels. It has a real-time RDS decoder, and a fully configurable monitoring and alarm system. The WDI can notify you of signal problems via front panel LEDs, rear panel open-collector outputs and/or the USB port."

**Chief Engineer** - by Scott Schmeling (page 10)

**Out of Site - Out of Mind:** "I received a call from the SINE, at this site one evening - the transmitter was off and would not come back on. I also was not able to log in with my laptop. It appeared power must be out. But that was strange since we have a generator there. You know what happens next ... I got in the van and headed down the road. While driving, I called my good friend Marv Olson who had maintained this site for the previous owner. It was apparent the generator had not kicked in, but Marv said that, to his knowledge, there had been no issues with that generator."

**Transmitter Site** - by John Marcon (page 40)

**Air Cooling Blues:** "The cooling system is a critical part in the operation of any broadcast facility. We would like to make sure that our offices, studios and transmitter room are kept cool and clean. Due to advances in solid-state, most transmitters in use today are of the air-cooled type. Because of their high efficiency, heat loss is low. Less heat means a simpler cooling system. Centrifugal fans are replaced with smaller axial DC fans."

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## Watch Dog - A Swiss Army Knife Receiver

by Alexandra Johnson – RF Engineers

The Watch Dog (WD1) by RFEngineers was inspired by the Dayton Industrial receivers that we all came to love. The Watch Dog is a truly versatile receiver capable of tuning the AM & FM broadcast bands as well as the NOAA VHF weather channels. It has a real-time RDS decoder, and a fully configurable monitoring and alarm system. The WD1 can notify you of signal problems via front panel LEDs, rear panel open-collector outputs and/or the USB port. Two independent audio outputs are provided; single-ended headphone audio on a 3.5 mm jack and 2 Watts of balanced audio on a StudioHub+ RJ45 connector. In this article we are going to explore some of the things you can do with this handy little device.



The first and most obvious use of a Watch Dog is as an EAS monitor. Once set to your monitoring assignment frequency, through its serial computer control port, the Watch Dog is safely locked to that channel. The radio cannot be re-tuned without the use of a computer and WD1 control software. The built-in hardware timer resets the receiver to the configuration saved in the internal EEPROM. Recovering from a power loss, it returns to the saved configuration upon power-up.

Like the Dayton receiver, the Watch Dog is designed to prevent the EAS monitor from mysteriously changing to another frequency. Since every Watch Dog is an AM/FM/NOAA receiver, only one spare unit is needed on the shelf, saving on the equipment budget.

But the Watch Dog is much more than just another EAS receiver. The WD1 is controlled through a serial computer port using its built-in Application Programming Interface (API). This is one major aspect that makes the Watch Dog receiver very versatile. The Watch Dog API allows complete computer control of the receiver.

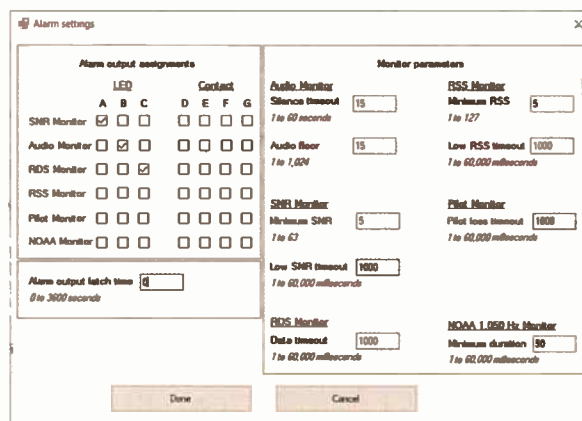


The WD1 Dashboard is a Windows program that uses the API to allow easy access of the major features of

the WD1. The casual user can simply download the latest version of the Watch Dog Dashboard from: [www.RFEngineers.com/WD1](http://www.RFEngineers.com/WD1) – for greater control, the API can be accessed directly via the USB port using a serial terminal program.

The WD1 Dashboard main page is where the receiver parameters are set up. Just a few clicks sets the mode, frequency, volume, and output. Once all the settings are entered you'll need to push the SAVE button to save the settings.

Other sections of the main page include Signal indicators, Live feed RDS, and Alarm states showing relative data for each section. A button in the Alarm section will bring up the next page.



The Alarm Settings Page is where the alarm assignments are made for the LEDs and the contacts. The assignments are for SNR, Audio, RDS, RSS, Pilot, and NOAA. The user can determine which alarms are assigned to the three LEDs and which alarms are assigned to the contacts. The Monitor Parameters box is where the alarm levels are set.

While a computer is needed to configure a WD1, once the tuner is setup only a USB power supply is required. Now you have a tiny but rugged receiver for EAS, confidence monitoring or any other dedicated task.

The API opens up a whole world of possibilities. Anyone with a little bit of programming knowledge can control the Watch Dog using this API and do it with just about any computer – a \$50 Raspberry Pi, for instance. Documentation for the WD1's serial API can be found at: <http://www.RFEngineers.com/WD1>

A simple Python script can make the Watch Dog receiver do some very cool things. Our customers have already come up with some clever uses of their own. We know of one user who has created an in-studio, real-time display that flashes warnings on loss of audio and scrolls RDS data. You will probably see that at the next NAB Show.

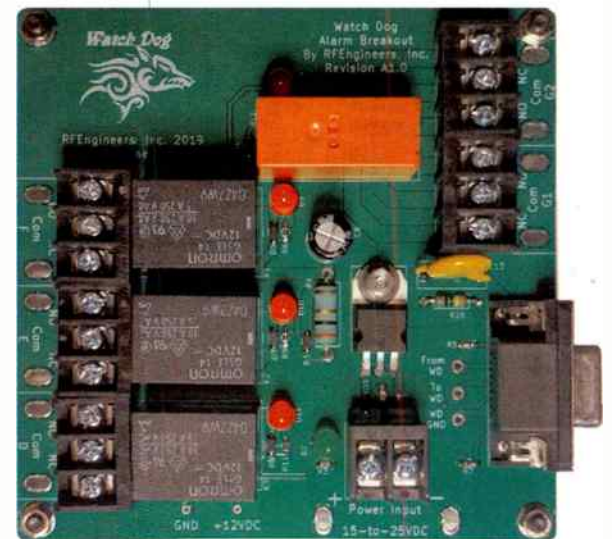
Even if you don't have a programmer's knack, other people do, and they have been posting projects on-line – many complete with source-code and instructions. For example, if you want to build an Interference Monitor/Recorder device there is a white-paper telling you how it's done. The instructions for this project can be found in the RFEngineers public GitHub repository: <https://github.com/rfengineers/Watch-Dog-Python>



### Interference Monitor / Recorder

Another recent magazine article described how the author used a Raspberry Pi computer and the programming language Python to add E-Mail alerts and remote control to a Watch Dog. The possibilities go on, confidence monitoring, multi-channel monitoring, data logging of SNR, RSS, multi-path, and RDS. are all easily accomplished.

Having complete computer control over a receiver presents some very useful opportunities to the broadcast engineer. This is especially true when the receiver's control interface makes it so easy to automate using simple Python scripts.



### The Optional AB1 Board

The AB1 Board converts the Watch Dog's open-collector alarm outputs into three 10-Amp SPDT and one 8-Amp DPDT relay outputs. Connecting the AB1 to the back panel D9, allows use of the dry contact closures to signal various conditions. These conditions include out of tolerance readings or the presence of a 1050 Hz alert on the NOAA weather channel. For example, if an alarm indicates a loss of audio a relay can switch to another content source.

The design was developed with interchangeable boards to optimize its flexibility. The Watch Dog's modular hardware architecture makes it possible to swap the internal balanced audio control board for a digital AES2 board. This YouTube video shows how it is done:

<https://www.youtube.com/watch?v=1yKjwDANcoY>

For more complete information on the Watch Dog see the user manual. It can be downloaded from: [rfengineers.com/WD1](http://rfengineers.com/WD1)

Whatever your need, the Watch Dog receiver is likely able to fill it. And paired up with a Raspberry Pi and a bit of Python code it can be a great "Swiss Army knife" for broadcast engineers. – Radio Guide

# Meet our latest audio codec...



The Gateway-4 provides two stereo connections, or one stereo and two mono connections, or up to four mono connections.

The Gateway-4 is designed for solutions requiring up to 4 audio streaming channels\* with traditional broadcast connectors, or AoIP standards AES67 and ST 2110-30 straight out of the box.

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\* The Gateway-4 codec supports 4 channels only and is not upgradable to support more channels.

## Inspecting Gadgets

*Little Devices with Big Impacts*

by George Zahn

I don't know about you, but every once in a while, I enjoy looking through *Radio Guide* and sometimes various catalogues to see what new equipment can perhaps make studio and remote broadcasting better. When I see something that might help us improve, with a budget price tag, that's great. Sometimes the breadth of a newer technology is so "out there" that it needs to be discussed so that engineers and managers can find ways to make it fit the broadcast world.

Just in recent issues of *Radio Guide*, we've seen agile and creative devices that can put your smart phone on the air, an AES/EBU silence sensor and audio switcher, improved Codecs, remote monitoring, Audio over Internet Protocol (AoIP) consoles, and mix interfaces we might not have imagined even a few years ago. Those are just a few of the items in this publication alone, alongside the many true "nuts and bolts" providers we need to do our job every day. All of these improve our quality, creativity, and efficiency.

Sometimes it's a little thing that catches your eye (or ear), and you think "how can this make us better?" A few items, in addition to those you can find here in *Radio Guide*, include a fairly inexpensive plug-in microphone upgrade that can turn any iPhone or Android into an emergency recording device without worrying about whether the mic built into your phone will pass muster for on-air use.

Other devices, slightly more pricy, yet more cost-friendly than ever before, include equipment for those of us who have given up on just about any CD recording and archiving. Anyone still recording to CD for quick ripping into a work station or perhaps archiving shows as a backup, has come to the painful realization that not all recordable CD media are created equal. Some CD recorders seem to work best with Sony CD-R – good luck finding them! Solid state recorders handling USB and/or SD card interface have become much more economical, and the media is actually available.

A third "gadget" that I was alerted to by a colleague, broadcaster and historian Mike Martini with Media Heritage, is something relatively experimental, and I'll mention it later to see how engineers and managers might see it ever fitting broadcast application. These three areas are some gadgets we should inspect. Some might just make your studio and remote recording better.

Again, one broadcaster's "cool idea" might not fit everyone's needs or mission, but it's a great chance to glance over technology to see what might be able to be added for a relatively small cost that might just bring greater returns in productivity, sound, and ability to meet our listeners' interests! Peruse those ads and catalogues and dream about a better year ahead!

### Plug and "Play"

Here's a neat idea I recently found. Imagine you have a chance to do a quick ad hoc interview in the field, and all you have is your smart phone. While you may have storage space on the phone to record, can you really trust the microphone on your smart phone to get broadcast quality audio?

I was pleasantly surprised to find that there are small add-on microphones that range from roughly 30 to 100

dollars, not bad as a convenient item to have with you or in a remote kit, or even for recording at the station if all studios are tied up. There are more than these available, but two that caught my eye and imagination included models from Zoom (the electronics company, not the virtual meeting interface) as well as Saramonic.

Is there one for your phone? It appears that, between just these two companies, they offer mics that offer 1/8 inch TRRS connectivity for the few phones that still may have mini jacks, or those who have USB C or Lightning to mini jack adapters. It's nice that they still offer those, but smart phones have largely dropped the mini jack in modern designs.

Not a problem here ... both Saramonic and Zoom offer petite plug in microphones that connect via Lightning and models that have a USB C connector. Saramonic appears to feature basic directional mono microphones. If you've used Zoom hand held recorders in the past, you know they have specialized in stereo and even four-microphone recording. The items from Zoom appear to be only for iOS devices, but they offer an X-Y stereo microphone, or as another option, a Middle-Side microphone for stereo recording. I predict there will be even more available as time passes.

### CD or Not CD?

Our station has just about abandoned any recording to CD, even though we have a few decent CD recorders in our racks. The dilemma, as stated earlier, is that decent recordable CDs are becoming harder to find. Our CD recording units seem to work best with Sony CD-Rs. We've tried less expensive CDs, but it's frustrating to be recording an interview or music program for quick digital editing later only to have the CD Recorder spit the CD out mid-program with an ERROR message.

We still have some less expensive recordable CD media in house that can easily and dependably burn from a computer burner for guests who may still request a CD copy of an interview. In studio, we've switched our primary recording to recently more-economical SD card



digital recorders, including the Tascam SD-20M, which has variable mp3 and wav audio settings to satisfy the pickiest producer. My estimate is that, especially for just cutting short drop-in segments to rip into office work stations, we may be saving dozens of CDs monthly that were previously only partially used for convenience.

We've also gone from archiving new shows on CD to storing evergreen shows on multi-terabyte hard drives for quicker access. We've spindled old shows for any future need. Obviously, we back up the hard drives on a regular basis to ensure that we have dependable backups.

### Let's Get "Hyper"

Now, to something that I've been turned on to that may well never make it to broadcasting, but maybe there are

inventive engineers who may find a way to use this newer technology in studios. You may have heard of this, but we audio geeks always love discovering technology and experiments with sound, that may be new to us.

As mentioned, my colleague Mike Martini gave me a thumbnail of some technology based on late 1990s, apparently created/modified by two different individuals, American Technology Corporation's Elwood Norris in 1996 as "HyperSonic Sound" and Audio Spotlight created by MIT's F. Joseph Pompei and offered through his Holosonics Company since around 2000.

Here's the simplified application: the audio wave to be delivered to the listener (let's say a museum visitor) "rides" atop a hypersonic audio wave – an audio wave well above the threshold of human hearing. The audio is emitted from a high frequency speaker aimed at a specific point (in our example, perhaps within a few feet in front of a display or piece of art). The original "audible" audio signal floats on the hypersonic wave and can only be heard when the hypersonic wave is "interrupted" by someone within the hypersonic field. At that point, the hypersonic wave "falls away" and the person in the interrupted field hears the audible spectrum audio which had been riding on the hypersonic wave.

Insert your "If a tree falls in the woods but no one is there to hear it, does it make a sound?" joke here. In teaching audio I've often referred to microphones and speakers as transducers which are inverse to each other. The microphone changes acoustic energy to audio and the speaker turns audio signal into sound. Now imagine the speaker projection equivalent to a hypercardioid microphone pickup pattern.

### "Targeted" Applications?

Much more gifted broadcasters and engineers may be able to explain this technology better than I could describe in a limited space, but companies such as Disney have been experimenting with this technology, and the exhibition application is perfectly evident. Imagine being in a quiet setting with others around you observing a display or artifact. The museum can easily aim their hypersonic signal directly in front of the display and you can hear the audio while someone a few feet from you is simply hearing ambient sound from the room.

Are there broadcast applications? I thought perhaps the directional audio could be used so that only the board operator could hear output of a modified cue speaker while the sound would not be audible to anyone else in the studio. Maybe you have far better ideas for using this technology!

While mentioning and thanking many of the advertisers in *Radio Guide*, I wanted to extend a heartfelt "thank you" to Kirk Harnack and *This Week in Radio Technology* for having me on a recent TWiRT podcast. If you have not checked out their podcast library yet, it is a wealth of information with insightful observations from many in the industry – [www.thisweekinradiotech.com](http://www.thisweekinradiotech.com)

What are some of the favorite gadgets, past or present that you may have just skipped over once in a periodical or catalogue, only to have it come back to you as an afterthought or a referral from a colleague? Let us know what studio improvisations and boosts you may have created from inspected gadgets!

*George Zahn is a Peabody Award winning radio producer and Station Manager for WMKV-FM at Maple Knoll Communities in Springdale, Ohio. He is a regular contributor to Radio Guide and welcomes your feedback. Share your stories with others by sending ideas and comments to: [gzahn@mkcommunities.org](mailto:gzahn@mkcommunities.org)*



# The astonishing new **Bluetooth Audio Gadget**. So much better than taping your phone to the mic.



There are plenty of ways a smartphone could be useful on air. Playing recorded audio, voice clips or music, for instance. How about using a SIP client as a codec? Or Skype or Zoom or social media sound? And of course, putting callers on the air. If only there was a professional bidirectional audio interface for cell phones...

Problem solved. The Bluetooth Audio Gadget makes it easy to put a smartphone on the air. Just pair your phone, and the Bluetooth Audio Gadget automatically negotiates the optimal codec algorithm (usually APT-X for Android, AAC for iPhone). Balanced audio I/O connects the Gadget to your console. The sound quality is amazing. And the Bluetooth Audio Gadget is bi-directional, so you can even send mix-minus to your caller.

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Order your Bluetooth Audio Gadget today. Your talent will call and thank you.



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World Radio History

# Chief Engineer

## Out of Sight, Out of Mind

by Scott Schmeling

You've heard the phrase "Out of sight, out of mind." Simply stated, it means if you don't see something very often, it is easily overlooked. As our areas of responsibility expand – for example, more transmitter sites are added – our visits to those transmitter sites tend to become less frequent. That is especially true if a site is not exhibiting any issues that would prompt a visit.

I have such a site. It has been basically trouble-free, since the day very heavy rains on still frozen soil caused a few inches of water to invade the building and take out the bottom row of power supplies in our Nautel transmitter. To prevent a reoccurrence, we constructed a pedestal for the transmitter to sit on, and replaced those power supplies. Mr. Nautel has been running just fine, thank you, ever since.

That's not to say I haven't visited the site at all since then ... just not very often. But let us travel back a few years to July of 2017.

I received a call from the SINE, at this site one evening – the transmitter was off and would not come back on. I also was not able to log in with my laptop. It appeared power must be out. But that was strange since we have a generator there. You know what happens next ... I got in the van and headed down the road. While driving, I called my good friend Marv Olson who had maintained this site for the previous owner. It was apparent the generator had not kicked in, but Marv said that, to his knowledge, there had been no issues with that generator.

As I got closer, I noticed that lights were out – *everywhere!* That confirmed the likelihood of a power outage. When I ended the call with Marv, I saw that the outdoor light on our building was lit. A quick check of the radio showed RDS data – but no audio (hmmm, the "wheels" started turning). And when I got out of the van I could plainly hear the generator engine. The generator engine had started, but for whatever reason, we had no generator power.

However, the main commercial power was back on, as was the transmitter. Why then no audio? The fuse on the Optimod had blown!

The very next morning I called a generator service company in the area. Tim said he'd be there right away

(that's what I call service!). He found a few bad components, but they later proved to not be the whole problem. He decided he'd have to "take it into the shop." That's as easy as putting it on a trailer and taking it away ... if you have a crane (**Figure 1**)!

When the generator came back it was as good as new! That's because it had a brand new generator set attached to the original engine. What we call a generator is actually three parts (that I can think of) – the engine, the transfer switch, and the generator itself, the part that actually *generates* the electricity.

Let's jump ahead now to earlier this year. The electric coop serving the area of our site offers a program whereby if you *allow* them to switch you to generator power during peak load times you pay a significantly lower rate. This was *very* appealing to management, so the process began.

Upon testing, we discovered the transfer switch was not operating properly. The cost to repair the switch was not that much less than the cost to replace. Replacing the transfer switch gave us a full warranty on the switch, so a new one was ordered.

One other thing to consider ... replacing the switch could be done either of two ways. Option 1 was to remove the original switch cabinet which would mean disconnecting all of the "plumbing" (the conduits to and from the cabinet), then mounting the new cabinet and redoing all the plumbing.

Option 2 was to remove the old switch and control circuits, then put the new "guts" into the old cabinet (no plumbing required). Option 2 was deemed *much* easier and faster.



A side note – there are control panels mounted to the doors of both cabinets, and the door of the new cabinet would not fit on the old cabinet. Tom (the electrician) would take the doors to a metal shop and the old door was "modified" to mount the new control panel.

We had a plan, but it just had to wait for a few weeks while Tom had and recovered from surgery!

My visits here were somewhat infrequent. But on one stop I could hear the audible alarm on the generator. So I opened the door to check the indicator panel. It showed LOW FUEL and OVER CRANK. I also noticed a fan belt was off its pulley. It was time for another call to Tim (the generator guy) and have the diesel tank filled. As before, Tim came as soon as the tank was filled and in no time he called to say the engine was running again!

After Tom's recovery period, he scheduled the day for the switch swapping. On that day, Tom and his crew arrived and prepared for the project. It was estimated to take 4 to 6 hours. We are a *commercial* station and we certainly didn't want to be off the air for *that* long. Fortunately, we have a 2.5 kW backup that could be powered by a portable generator that Tom brought just for that purpose. The generator was wired to "back-feed" the breaker panel and only the breakers for the 2.5 kW transmitter, the rack, and the lights were turned on. Then the work began.

I did my best to stay out of the way, but still be available for any *important decisions* (mostly, I stayed out of the way!) while the guys went to work and Tom took the two cabinet doors to the metal shop for modifications. When Tom's crew was done moving the transfer switch, we shut the small generator down and switched everything back to normal. Then Tim programmed the controller and we were ready for testing.

Everything had been going so smoothly...!

When Tim started the test, the generator engine started and the switch switched ... then within a minute the engine bogged down and everything went dark. This was not the result we were expecting.

Remember when I mentioned Tim had come out to take care of the engine earlier? His theory today was that there was "crud" in the diesel fuel that probably had plugged the filters. He would be back in the morning to check things out and replace the filters. This was good because the electric utility was going to be testing everyone enrolled in this program tomorrow at 1:00 p.m.

Tim also suggested I get in touch with a fuel and tank cleaning company. He said diesel fuel can develop a bunch of "crud" in the tank and that it needs to be cleaned periodically. *I had no idea!*

I have spoken with and scheduled a fuel cleaner. He said, among other things, that with the temperature swings we experience up here, condensation occurs, which brings moisture into the tank. This causes rust and potential microbial (algae) growth. *I had no idea!*

Next time I'll let you know what condition our fuel was in. But let me suggest that this is a good time to check all of those "out of mind" sites. Get your air ventilation/cooling system ready for summer heat. Check your generator if you have one, and maybe spray for weeds.

By the way, when they ran the test the next day everything worked *perfectly!*

That's all for now... until next time – keep it between 90 and 105!

*Scott Schmeling is the Chief Engineer for Minnesota Valley Broadcasting. He can be reached via email at scottschmeling@radiomankato.com*

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World Radio History

# Emergency Prep

## Good Housekeeping and Preparation Eases Emergency Stress

We've all had it happen. The "off the air" call comes when you need it least – when you're spending time with the family or when you don't have quick access to your work vehicle. Murphy's law steps in and raises havoc. If you aren't prepared it can spell disaster. The last thing you need is to add additional stress to a situation which is already potentially stress filled.

With a little bit of preventative good housekeeping you can minimize the effect of the "emergency," both on yourself and on your station's revenue stream.

### Organize Now, Not in the Middle of a Crisis

When you need to get your hands on your equipment manuals it is most often a crisis situation. The automation is down, your STL or transmitter is having a problem or another key piece of equipment is in need of an immediate fix to keep the station running.

An "off air" situation comes with its own level of stress. The last thing you need to do is add stress to yourself by taking precious time to look for equipment documentation. Just as stressful is discovering that your documentation doesn't contain the revisions that match the piece of equipment you have.

### Check Your Documentation Today

Take the time now to find all of your equipment manuals. Check to make sure the manuals you have match the technical revision of the equipment on hand. If the documentation you have doesn't match your equipment, call the manufacturer's support line to get the proper manual or schematic revisions that match.

Keep in mind that, on occasion, the engineering department will make changes to circuit boards or other design changes that become incorporated into production units before the formal documentation is completed. The equipment into which the changes are incorporated sometimes is shipped with the older documentation that doesn't include the changes.

At a lot of stations, the engineers who held the position before you may have made modifications that aren't reflected in the documentation you have. In this case take the time now, before a crisis, to modify your manuals to add those changes.

### Designate a Storage Location

Set up a file cabinet to store the manuals and be sure to return them to their proper storage location after each use. Take a quick trip to the office supply store to get the proper sized suspended file pockets you need. Make sure that each one is properly marked for identification.

Expanding hanging pocket files are also handy for manuals in three ring binders. The advantage of using these, rather than just sticking the binder in a drawer, is retention of loose pages. Should any pages fall out they will be "captured" in the suspension pocket and not lost in the file drawer.

### Storage at Your Transmitter Site

Make copies of the manuals for the equipment that is located at your transmitter site, or if you have an additional

site location such as a remote studio. Since these locations usually are limited for space, and in the case of the transmitter site it is usually rather Spartan, consider purchasing one of the waterproof and "critter" proof portable plastic storage containers that are available for file storage. Some models come with a suspension file frame. If the one you choose doesn't have one it can be purchased separately for a few dollars.

Be sure to mark the manuals you store here in the same way you did back at the station so there is consistency in your system.

### Electronic Files

Should you prefer to have copies of documentation on your computer or on a USB drive for storage, check the manufacturer's web site to see if they have an electronic version. If so, download it now. Make sure it matches the equipment you have.

If not, call the manufacturer to find out if one is available that has the revisions you need and if it could be sent via email or possibly downloaded from the manufacturer's site.

Worst case, scan your existing manual, with revisions, into your computer and save it as a PDF file for quick access.

Many manufacturers are happy to provide you with documentation that includes the revisions that match your equipment. By doing so they help minimize the number of calls you might have to make to their tech support line and they keep a happy customer, happy.

### Schematics

To make sure you always have quick access to readable schematics you may want to consider having copies made. Many office supply store copy centers are equipped with full size copiers that can handle a schematic.

One downside of electronic manuals is that schematics often are reduced to a size that is virtually unreadable. This is because the manufacturer is providing a printable version of the manual which prints out to normal letter size paper.

Some manufacturers will provide you with both the reduced version of schematics, to print with the manual, and full size electronic schematics. You can take an electronic, full size version of the schematics to the copy center and have them reproduced at size or reduced to a smaller size for ease of storage. Be sure that, whatever size you reduce it to, it is easily readable.

### The Legal Stuff

Should you choose to have copies made, you may need to get a release letter from the manufacturer. This letter must authorize reproduction of the material.

Some copy centers require this before they will run the job. This is their protection against someone illegally reproducing copyrighted material.

### Binders and Shipping Tubes

Depending on the size of the manual, you may opt to have the copy center bind it for you. Your other option is the old standby, a three ring binder.

A shipping tube is great for the schematics you are having made. Be sure that you get the size which is closest to the height of the schematic reproductions you have ordered. Nothing is less fun than trying to get documents out of a shipping tube after they have slipped down the tube and are now just out of finger's reach.

Once you get back to the office, clearly mark the binder and the shipping tube. You may want to place the tube next to the file cabinet that contains your manuals so you have quick access.

Some engineers have purchased a waterproof fishing rod tube for storing schematics at the transmitter site. While they usually are more expensive they are also "critter" proof.

Once you go through the process of organizing your documentation it will be ready when you need it.

### Quick Grab Tool / Safety Board at Your Transmitter Site

*An inexpensive idea, good in an emergency or even for routine maintenance.*

#### Materials

Peg board, peg board hangers, a white paint pen or sharpie, eight foot 2x4 studs, and anchors that are appropriate for the walls of your transmitter building. You could make this with half-inch plywood or strand board using nails or "L" hooks to mount the tools if you prefer.

Be sure you have a drill powerful enough to place the anchor holes in the wall and the proper drill bit at the size needed for mounting the board.

#### The Tool Side

Take an inventory of the tools that are unique to the site, a tube puller, high voltage probe, etc. – also those tools used the most to perform routine maintenance at the site.

With the board lying horizontal, place the tools on the board designating a location for each tool. Place the peg, lay the tool in place and outline it using the paint pen or sharpie. After you have outlined the tool mark the outline with the name of the tool. Also mark the holes where the peg will be placed when the board is mounted.

Upon finishing your layout, mount the board on the wall using the 2x4s and anchors. Then hang the pegs where you marked the holes. Finally hang the tools in their assigned positions.

You will now have immediate access to the tools that are unique to the site and those you use most often at the site. Plus, you can immediately tell which tool is missing after you finished routine or emergency work. Be sure the tool board is completely populated before you leave the site so everything you need will be ready for your next visit.

In an emergency, having tools hanging in the proper location can save precious time as you'll have the basics you need waiting for you when you get to the site.

#### The Safety Side

Designate a portion of the board to be used for safety equipment. You could paint it a different color or get some yellow and black safety tape for quick visual reference.

Put your first aid kit in this section. You may want to include a snake bite kit or a bee sting kit. You can use a clear, zip lock bag hung on a peg with the small kit inside.

Purchase a wooden cane for the board as well. This can be used as a personnel safety grab hook in a high voltage area.

These organizational tips will take very little time to put into place, and once you get them done you will save hours of frustration and stress in a "crisis." – Radio Guide



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# Testing & Tools

## Tools of the Trade

by Dave Dunsmoor

I've described various aspects of the job "broadcast engineer" over the past years here in *Radio Guide*. Primarily, my target audience has been the new folks in the business. Some may come from an electrical or mechanical background, some from on air talent, or any other seemingly non-engineering background. No matter, if they have "the knack," as Scott Adams describes in one of his Dilbert cartoons, they have the potential to do well.

Today I'm going to talk about what I think are the more important tools to have available to an aspiring broadcast engineer. AM, FM, TV, all require the same general things to get started.

Your first requirement is an honest desire to do this work. In order to succeed, one will have to really *want* to be in the business of "fixing things," and often under odd conditions. These "odd conditions" can be someone standing behind you, looking over your shoulder (or on the phone every few minutes) demanding to know when it'll be fixed, or it may be the very poor weather conditions hindering your access to the site, or cold conditions in the building due to power being out, or often your own anxiousness at being puzzled by the problem(s) at hand. To this, I say slow down, breathe, and think carefully. What do you know, what isn't working right, how might you cause the symptoms you're observing if you wanted to cause this problem on purpose?

Or, call a friend! Your second best tool is a mentor – a good and patient mentor. Someone who can/will answer the phone at odd hours, someone who will listen and, by past experience or by not being in the heat of the immediate situation, help you think clearly about your problem and symptoms. I've had a few mentors when I was first starting out many years ago. One in particular was John Valker (WØGH, silent key), who offered me a practical mindset to problems which occasionally puzzled me greatly. I really appreciated his way of simplifying what to me often seemed to be a large jumble of facts relating to whatever it was that I was facing.

Now let's discuss the actual hardware – the physical tools you'll need. Some will be required immediately, some as you can afford them, and some as the need arises. To quote a friend of mine, "poor people can only afford the best." There is some hard earned wisdom in that statement. Cheap (and cheaply manufactured) offshore made, hand tools will likely work once or twice, but a wrench, or a screwdriver that slips and fails to do what you need to accomplish, is at the very least inconvenient, and at worst can cost you the job – or luckily perhaps only a few hours of wasted time while you go get a decent tool – and there goes your reputation as a reliable and capable engineer.

Some of my favorites are Klein tools (often found at the home DIY or electrical supply stores), and Snap-on (which are guaranteed for life), and now Knipix are very good choices. I have a small Hunter wire cutter and Channellock needle-nosed pliers which are well over 40 years old which look and operate as new. Soldering tools, wire strippers, terminal crimpers, a small bench vise, are all important additions. A small tunable receiver is useful (but not immediately necessary). You'll not be doing any measurements with it, but it's nice to know how your

transmitter sounds (and that you're on the correct frequency) before you drag everything back out to the car.

I find that a tool bag to carry tools is more convenient than a conventional tool box – much easier to load/unload in the pickup than a toolbox would be. I have several types and sizes from various manufacturers. Lots of pockets and dividers makes it easier to find what you're looking for, and it helps to keep the tools and equipment in good condition.

I would put a good multimeter next on the list. I carry a **Fluke 87** when I want accuracy. I will admit to carrying a cheapie in the tool bag, but it's mostly for go/no-go determinations: is there AC power at this terminal, is this fuse good or bad, and so on. But for more accurate metrics, perhaps such as transmitter power tube filament voltage, you'll need meter that displays true RMS. This refers to the heating value of an AC voltage/current, regardless of the waveform. This is important when checking and setting that tube filament voltage to maximize its life. It will also tell you the truth when checking input/outputs of the switching power supplies used in the newer solid state transmitters.

One thing to mention here is that a stout carry case for delicate instruments is important. They can be obtained from a variety of on-line equipment suppliers, and for a reasonable price – certainly far less than equipment replacement costs. I use injection molded cases, and hard sided video/camera cases for this purpose.

A small audio generator is perhaps a next item to consider. However, with more and more stations moving into the digital domain exclusively, this may or may not be a worthwhile expenditure. The audio chain of your responsibility will dictate this. Many years ago I bought a Hewlett-Packard Transmission Test Set (which is an audio generator/receiver and a frequency counter all in one unit) from the local telephone cooperative. It's been a very valuable item for setting levels into various control boards, into STL transmitters, and checking levels out of STL receivers, and so on. If you have an analog audio chain, this is still valid. A test set such as this may be available from various surplus sales sources, or perhaps a small function generator may be more useful to you.



HP Transmission Test Set

The main difference between the two pieces is that the function generator may not have a receiver that incorporates a level measuring function. In which case you can use a high quality multimeter for most audio level measurements. A Fluke 8050A (again, available via surplus sources) for example, measures and displays audio in either AC



Tenma Function Generator

volts or dBm, and referenced to several selectable impedances. Read the specifications of your intended purchase to be sure its frequency range is suitable for your purposes. The 8050A, for example, is accurate (when new) up to 50 kHz on some voltage ranges. Good for audio, but not so useful for subcarrier measurements. Do your research. Here again is where a good mentor is beneficial.

A frequency counter may be a good next investment. Generally, the newer transmitters just "stay put" on channel, but it's always good to check occasionally. There are some FM exciters that need to be checked more often, and certainly AM transmitters which still utilize a crystal oscillator should be checked. How often? Depends on your knowledge of its tendency to drift, or not. I keep two counters in the shop, one is strictly for bench use, the other for field use as necessary. Both have been compared to a GPS receiver output so I have some assurance of accuracy. I wrote about this in greater detail in the January-February issue of *Radio Guide*.

Eventually you may find the need for an RF wattmeter, and the required elements for the power levels and frequencies you'll be working with, and this you should probably buy from a reputable source, to be sure of its accuracy rather than to piece it together from parts (and I've done both). You'll use this for FM exciter, STL transmitter, or remote broadcast transmitter power measurements, or perhaps for your own (or friends') amateur radio power measurements.

Add to this a great variety of test leads, cables, adapters, attenuators, and so on. Soon you'll have a regular complement of equipment! If you buy used, be careful with your selections, research reviews and post purchase, spend time to take good care of it all, keep it clean, keep the switches clean and working smoothly and they'll be ready to go when called upon. There are many other pieces of test equipment available, and whether you'll want to spend the capital on them depends on your level of involvement.

So now I do hope that you have gotten some reasonably good ideas as to how to get started in an interesting career from this article. I've been at this electronics business for well over 40 years, and even considering some of the more aggravating days, it's been very good to me. Perhaps because I've tried to be very good to my employers and clients. I thoroughly enjoy the hands-on aspect of this business.

Oscilloscopes, capacitor analyzers, spectrum analyzers, power supplies, audio generators and amplifiers, deviation meters, RF signal generators, low level RF power meters, and a variety of receivers all have a place in my shop, and the list can become nearly endless. But to get started, truthfully, a sincere interest and perseverance are the most important requirements.

*Dave is mostly retired, and does backup engineering for Air-1 and I-heart Media as requested. He can be reached at: mrfxit@min.midco.net*



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# Power Principles

## Reviewing a Generator Failure

by Wiely Boswell

Fresh off this outage, it's now time to debrief on this induced error. Every now and then I get things worse before they get better. I knew the storm front was coming the next day, so at the transmitter site I topped off two generators with diesel. Then I refilled several five gallon tanks. The next day it came through at 6:30 p.m. – it had lightning, wind, and rain. The generator went on line about 7:00 and storm out of area by 7:30. We about wore out our EAS. On the five mile trip to the site there were a lot of dark intersections and streets. The first thing I learned was to avoid large intersections if possible. No one was there directing traffic yet, and no one was stopping at intersections. It was wide spread damage and a long term power outage event.

In our shared transmitter building there is a blue, Ford diesel engine 3-phase generator that handles fan airflow through the building that heats up quickly with two generators running inside. The generators live well in the building with HVAC. However, they do not support the HVAC and there is no way it would cool them anyway – you need the cross flow of air through the building. The blue one covers some repeater tenants, tower lights, and exhaust fan with automatic intake louvers on the far side of building. It has a 30 gallon day tank and it never quit – I managed to keep feeding it diesel. You need to have something to clean your hands with oil-dry cat litter and/or mats to absorb spills. It's just messy.



We have a green, 3-phase 30KW Perkins diesel for the transmitter chain – Figure 1. It's a lot like a car with a starter, batteries, radiator, water pump, thermostat, oil pressure, air filter, and a control system.

It really does pay to have a yearly service contract. They learn your setup and they have you higher on their emergency service list. The other big building near us also uses same pro service. They know the site. A disaster recovery plan would have this contact and a fuel provider contact as well. Our green generator sits on the tank and is only 30 gallons. Next thing learned – need more fuel capacity for minimum 3 day run time. I just keep running and filling it up with containers but that is really not all that good as I will explain.

So I left the building several hours later with both generators running and good air flow through the building (the exhaust gas is piped outside). As I was driving back that morning to check and refill the generators, my green generator ran out of fuel and we went down. This is a bad thing in general for a diesel. You start sucking from the bottom of a tank and you never know what you might get. Even filling up a tank can stir it up and then the fuel filter can start to clog.

The first steps are to look at fuel level and any failure indicators. It looked empty and the fuel pickup point is slightly above the bottom. I added at least 5 gallons. This engine, being quite simple, has a fuel pump on the side of the block.

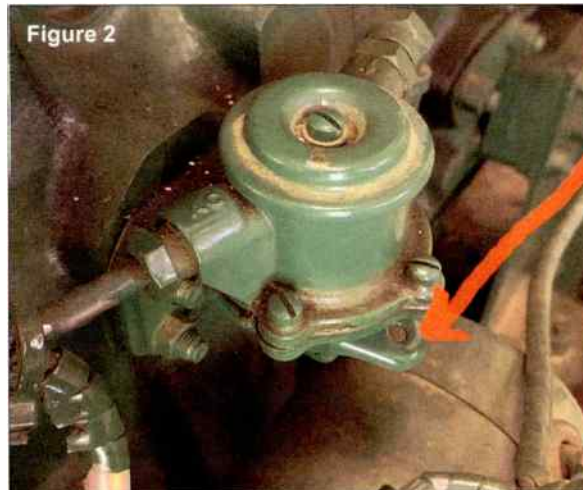


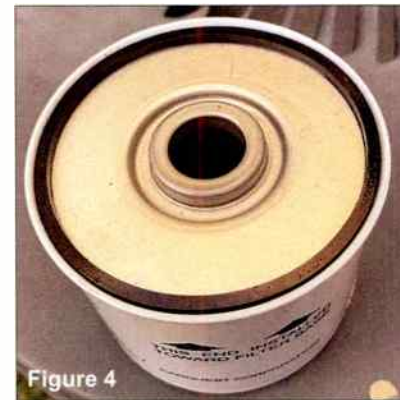
Figure 2 shows the manual pump lever so you can pump up the fuel system before you waste any starting power in the batteries. You could feel it pump solid several times and then it seemed easy to pump like you were not doing anything. The "circuit" is as follows: copper pickup tube with 45 degree cut at the end, connects to the fuel suction hose that goes from the pickup tube to the suction port of the fuel pump. From there, the pressure side of the fuel pump feeds to the fuel filter. Figure 3 shows the cartridge type fuel filter assembly with fuel input line disconnected. It has several lines in and out, but one goes to the high pressure injector pump. It is an expensive, very important part of the system. Each of the four cylinders is fed by a high pressure steel line that connects to a fuel injector that has a low volume and a perfect mist spray pattern. Not much flow but high pressure in the 10s of thousands of pounds. The pump also distributes fuel to each cylinder in rotation.



When pumping did not seem to help get it to start, it was time to bleed air further out of the system – air is bad for everything down the line. Next step – just slightly loosen the high pressure line on all of the four injectors, then try starting. You should start to see a spew from all the injectors as you start the engine. This will clear out any air trapped in the system. I saw some coming out but not real strong. Note: there is a return line also connected to the injector that joins with the other three returns – no need to touch.

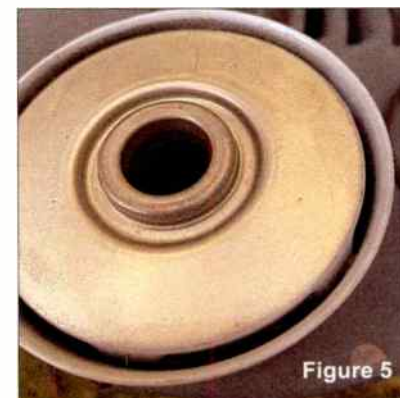
I surmised pressure was weak because of the fuel filter, so I went through the filter swap out. It has several "o" rings that come in the package. The way it appeared to fit right

in the rim of the filter looked so normal – Figure 4. It was hard holding all this and screwing it back together with a single bolt right up the center. With it all back together, I started pumping. It wasn't filling up, it was dribbling in. But I persisted and got the glass lower water catcher bowl full, and kept pumping. After a lot of this, I tried to prime the injectors. It seemed to prime then I pumped



some more and it started and quit – I was so close. So I did this several times, spending a couple of hours, but it seemed fuel starved. Then I tried another filter (pulling at straws), and verified suction at the fuel pump, both manually and by turning over engine. Never assume the crankcase fuel pump lever works just because the manual lever works. Then I saw a small crack in the tank line and wondered if it was losing vacuum, so I replaced the line. While there, I was able to unscrew the pickup tube to inspect for blockage ... it was good. I had used fuel additive so the fuel had not gone bad. That will block up a filter too.

I went all the way to the input to the fuel filter and I was getting good flow and it would also go freely through the mount with the filter removed. About then, the service man got there. I explained all this stuff in detail and he went through all this again. He did pull a solenoid off the pump that has to be energized to allow fuel flow – it was OK. I kept looking at the filter element and I could not see how the flow went through the element and, after a while, he couldn't either. So he walked outside with the element and got on the phone. The square "O" ring was blocking the input flow to the element! You have to stretch it and get it up in a groove in the base – Figure 5. I knew it was something less than intelligent I had done. He is going to look for a spin-on filter base upgrade. The big boy generators have two very large spin-ons in series. Extra filters can save the day (if you put them on right).



Well, when we got it going, the commercial AC power came back – sort of. When we loaded the power line down it went crazy. The transfer contactor started banging and we had to just turn off all commercial power and run the generator all night. I needed to find a good contact at the power company to explain it to, since they were just so over loaded with outages – so it ran one more night. At 4:00 a.m. it quit, with no real reason why, but I went out and restarted it. When it did restart, the blue generator shut off. It is on a separate meter and acted as if we were back feeding the line – it may have been the load issue. We put the transmitter back on line the next morning. It may have glitched a couple of times but then everything settled down. It was one of those tough weeks in two days.

Wiely Boswell is Chief Engineer of Faith Broadcasting, located in Montgomery, Alabama; CBRE, CBNE, and SBE 118 Chairman. He may be contacted at: [Wiely@faithradio.org](mailto:Wiely@faithradio.org)



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## The Linux Connection, Etc!

More Neat "Stuff"

by Tommy Gray CPBE CBNE

### Experimentation Mode = "ON"

Welcome to another article. In the Mar/Apr-21 issue of *Radio Guide* (page 18), I shared with you a few really neat little pieces of inexpensive engineering equipment. Since I wrote that article, a lot has happened around here. First, I finally got a new tower at a site that lost its tower over a year ago. You may remember, if you have been following this column, that we lost an old tower in a spring storm. It took about a year to get the tower company who owned the leased tower to put up a new one. I finally got back on the air a few weeks ago with a new ERI antenna and everything looks and sounds great. While I had an ERI tech onsite to perform the field tuning of the antenna, we had the opportunity to do a side by side comparison between the NanoVNA SAA-2N Network Analyzer I talked about in my last article, and a very good unit that the ERI tech brought.

We did side-by-side comparisons of several parameters and readings and found that the little NanoVNA performed admirably. Obviously it did not have all the capabilities of the nice Copper Mountain unit he was using, but I can tell you that I was impressed with what it could do in a real world situation. It would do any engineer, who spends a lot of time in the field, a lot of good to get one and keep it on hand for emergencies. We spent a couple of days on site, and while there, we tested it a few times and it was really a decent little analyzer. I was using the PC software for my Linux Laptop to display all the parameters on. This also allowed me to save my calibration data to use when I wanted to repeat the same measurement again. It was a real time saver.

### Moving On

One of the next things I had time to do since the last article, was to do some Python programming on my Linux Mint Cinnamon machines. Python is a free software that will allow you to do cross platform programming for Windows, MAC, and Linux. Having been a programmer for many years, it was an easy transition for me to learn Python programming. One of the first things I did after the traditional "Hello World!" app, was to write a complete "Music on Hard Drive" audio automation system just for fun. It took about a week in the evenings, while watching TV. It has three players, and program logs that can be easily loaded from a .csv file. At this time, it is fully functional, and could be used in a real world radio station situation if desired. I plan to post the Python scripts in a few weeks for anyone interested. The programming environment I used is called "Spyder5" and it is, of course, totally free right from the Linux Mint Cinnamon Software Manager.

### Python Audio Player for Radio Automation

This player will be posted on-line for anyone interested, later on this year as I get time. All it requires to run it is some way to create a .csv (comma separated values) text file program log which can easily be generated with any traffic or music scheduler or, as I did, with LibreCalc which is the Linux equivalent of Excel, (or even with a simple text editor), and a working sound card capable of playing more than one file at a time (for overlap). It allows you to separate your audio into categories as does most any commercial automation.

Figure 1 is a screen shot of the Spyder IDE (Integrated Development Environment) with the Python Script for the player loaded in it ready to run.

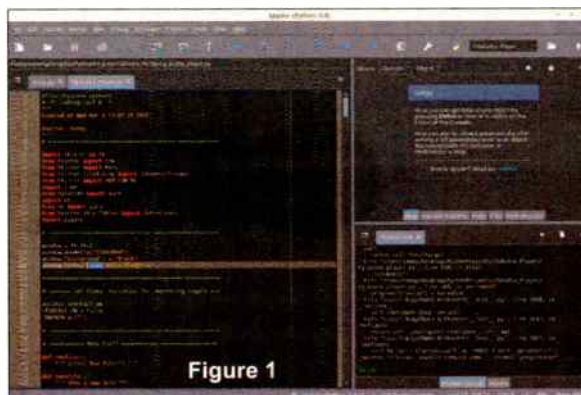


Figure 1

The Linux Audio Player I created in Python, using Spyder5, is shown in Figure 2.



Figure 2

### Up Next

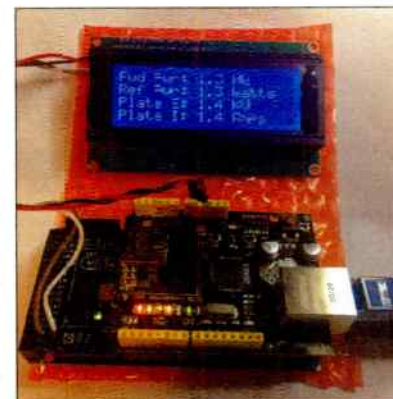
Well, right in the middle of playing with the Python Automation Program, I happened to be on our Broadcast Engineers Facebook group one evening, and a member posted a really neat article about an *Arduino Remote Control* system he had made using standard Arduino components and a few other things to add bells and whistles. It was so neat that I was stopped dead in my tracks and immediately went on-line and ordered an Arduino UNO R3, an Ethernet Shield, a 20x4 LCD display, and a Terminal Shield, to build something for myself. It all arrived in just a few days and, in the interim, I installed the Arduino IDE on a few computers and started experimenting. [www.arduino.cc](http://www.arduino.cc)

It became quickly evident that, in order to build a Transmitter Site Monitoring system with it, it was going to take more Analog inputs and capability than the little UNO had. So I again went on-line and ordered an Arduino MEGA 2560 and went to work. I added the additional code to transition from the UNO (which is great by itself!) over to the more powerful MEGA. I have, in just a couple of evenings, written the code to monitor all the necessary transmitter functions, as well as site functions like air conditioning, electrical power, tower lights, silence sensor, nitrogen pressure, etc. I also added the Ethernet shield that allowed me to setup up a web server so that I can access all the parameters from a web page.

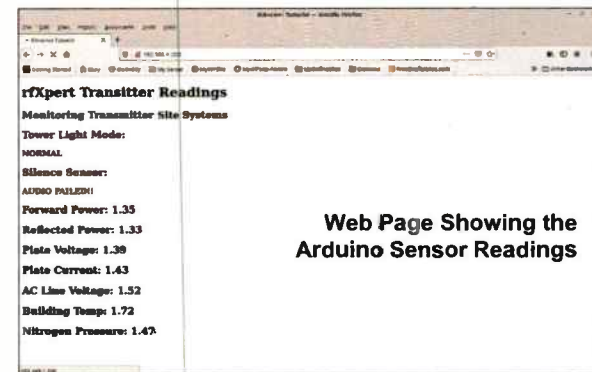
Here is the prototype programmed, and working. I plan to eventually mount it all inside a nice box on a rack plate so it will fit into a transmitter site 19" equipment rack.

### Arduino Mega 2560 Transmitter Monitoring System Prototype

So far, I have the code written, as I stated, to output the sensor readings to a Web page. Right now I just have it on my local LAN, but plan to finish up the code to allow access from anywhere, and from any browser. I am also working on the code to trigger alarms and post the alarm on the web page, as well as send text/email alerts. I have, at this point, just over \$60 in all the hardware. When it is done, I have a site that has Internet access already picked out where I plan to piggy back the unit with an existing remote control, and let it run for a few weeks to see how it performs. Once I am happy with it, I will also make the Arduino .ino file available for anyone wanting to try it. Now please don't swamp me with email wanting it right now as I don't want to make it available until it is completed and tested.



I cannot tell you how simple it was to get all the hardware working on my Linux Mint Cinnamon computers. It was virtually Plug and Play. I have read of other folks having problems from time to time with a Windows computer, but I had none of these issues. The OS found all the hardware, and it just came up working. When I added the Ethernet shield, I simply added the code and plugged it into the Arduino and it came up working on my network. Below is a screen shot of the simple web page I created. So far it is very basic but with the capability of the Arduino to let me program HTML and other code types, I plan to "pretty it up" a bit before I let it out for mass consumption. Keep in mind that the readings are just what came out of the Arduino inputs, as I do not have anything connected to either the digital or analog inputs at this time. I have tested them however, and they do work.



Web Page Showing the Arduino Sensor Readings

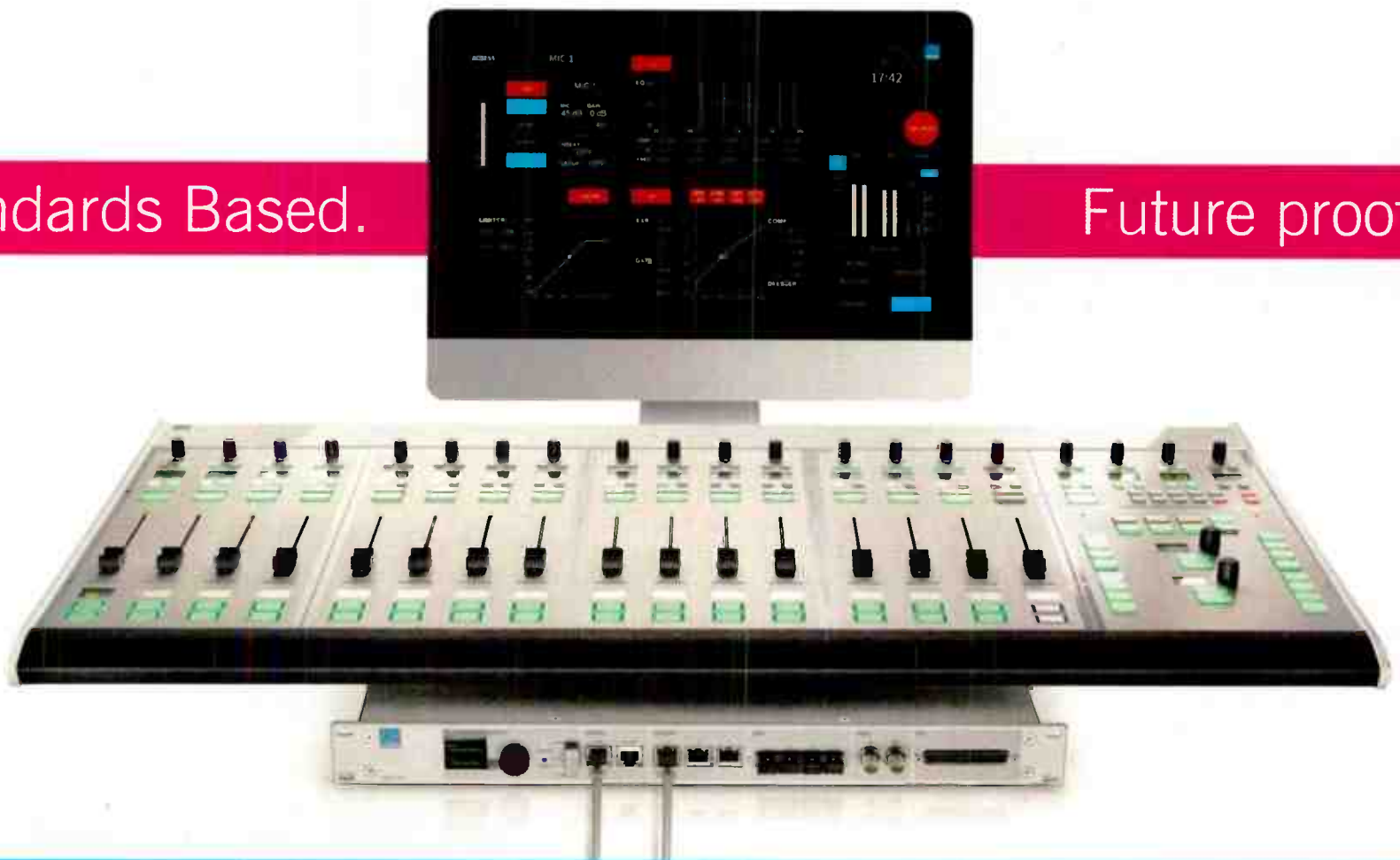
Once I get time, I will add all the legends (volts, amps, etc.), and format the page much better. The great thing is that you can use HTML and others to do normal web page formatting. Right now it is simply a working prototype. As you can see, there are some powerful capabilities in the Arduino boards that don't take a lot of time or effort (or expense) to take advantage of.

At this point I am using 7 analog inputs and two digital inputs, though there are a lot more available in the MEGA. Until Next Time!

Tommy Gray is a semi-retired veteran broadcast engineer currently staying busy doing Engineering and IT in the gulf south, through "Broadcast Engineering & Technology LLC", a Louisiana based Consulting and Contract Engineering Firm, serving the US. [www.BEandT.com](http://www.BEandT.com)

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# Radio History

## On the Road Again

### Chatham Marconi Maritime Center

by Steve Callahan

Imagine that it's 1915 and you're the lone radio operator or "Marconi Man" on an ocean-going ship in the North Atlantic. It's your job to maintain and operate the vessel's arc gap transmitter and send "Radio-Grams" to shore stations, relaying arrival information for the ship's passengers. Remember, this is decades before microphones so your Morse Code skills are top notch.

Your vessel is in need of a weather forecast so you are desperately scanning the ether for a signal from some other ship or shore station. Suddenly, you hear the familiar call letters W-C-C coming out of your headphones. It's the Marconi shore station at Chatham, Massachusetts on the outer edge of Cape Cod and they are sending news to another Marconi shore station in Norway. You are not alone as long as you can hear a radio operator at W-C-C.

I had the pleasure of going on the road recently to the Chatham Marconi Maritime Center at Chatham, Massachusetts. It was the day before their 100th anniversary and I had the privilege of getting a personal tour of the former Marconi station site.

The land for the station was acquired in 1915 and it took a year to construct the complex of buildings which still exist on the site today. There is an operations building where the transmitters were, and duty operators worked along with residences for them. Back in 1914 Chatham was a lonely place out on the outer edge of Cape Cod but the perfect place to erect towers and rhombic antennas pointed toward the north Atlantic and Europe. There were also residences for managers, a powerhouse to supply electricity for the facility and a hotel for unmarried employees and guests.

Marconi built the radio facility to compete with the transatlantic undersea cable which, coincidentally, came ashore in nearby Orleans. There is a fascinating "Cable Museum" in Orleans, but we'll save that for another day.

W-C-C was silent during World War I due to the conditions imposed by the Neutrality Act. However, in 1917 the U.S. Navy used the facility as an experimental antenna testing location and as a backup to their listening station at Belmar, New Jersey.

The Chatham station was used primarily for receiving incoming signals, while Chatham's transmitting facility was located at Marion, Massachusetts to prevent interference with signal reception, and was remotely controlled by the operators at Chatham. The Marion transmitters were RCA SSb-T3-Type H 300 kilowatt spark gap transmitters. In 1948, the transmitting antennas were moved closer to Forest Beach in South Chatham where the tower bases are still able to be seen today.

One of the other antennas used at Chatham was called Marconi T which was a non-directional antenna consisting

of a vertical wire which terminated in a horizontal top wire. W-C-C operators would first listen on the Marconi T antenna for any distress or hailing from ship at sea and then select the proper rhombic, directional antenna for better reception.

In August of 1919 a 30 foot loop antenna consisting of two loops was installed. The major loop was pointed toward Stavenger, Norway and the minor loop was pointed at right angles to the azimuth to Stavenger. The loop antenna had it's own building on the site.

RCA acquired W-C-C from the Marconi Corporation in 1921 and operated the facility as a shore to shore station with its sister station in Stavenger, Norway. However, the station was re-commissioned as a ship to shore station and it eventually became the busiest ship to shore station in the hemisphere and possibly world wide, because its antenna array was sensitive enough to hear ship messages from around the world.

The W-C-C antenna arrays were among the most sophisticated in the world with six masts, one mile long and 400 feet high, built in 1914. However, five of the masts were removed in 1919 and the last mast was removed in 1956. The Navy experimented with antennas at the site in the 1930's and during World War 2, the Navy built the largest rhombic antenna at the Chatham station to listen to radio transmissions from Berlin. W-C-C was the central station for the Navy's U-Boat direction finding network.

A Beverage Antenna, named for its inventor Harold H. Beverage, was built in Chatham in 1921 or 1922. It was 8 miles long and ran from Chatham to the Swan River in West Harwich. However, the largest Beverage antenna was an array of four phased Beverages, three miles long and two miles wide, and was built by AT&T in Houlton, Maine for the first transatlantic telephone system in 1927.

Rhombic antennas were used extensively at Chatham. Rhombic antennas are diamond-shaped antennas with each side at least one wavelength in length. They are supported by poles and are fed at one end with a transmission line and the other end with a non-inductive resistor. The resistor end is pointed toward the region of the world that it was designed to serve. When the Navy returned W-C-C to RCA after World War 2, there were six rhombic antennas at the Chatham site.

If you are into antenna theory, the Chatham Marconi Maritime Center's website has some very interesting and detailed articles on the construction and theory behind the antenna arrays built, tested, operated, and later dismantled at the site. Even though they were conceived back in the 1920, the theory still works today, as evidenced by the typical AM radio station directional array.

Today, the Chatham Marconi Maritime Center is often mistaken for the Marconi Tower site in Welfleet,

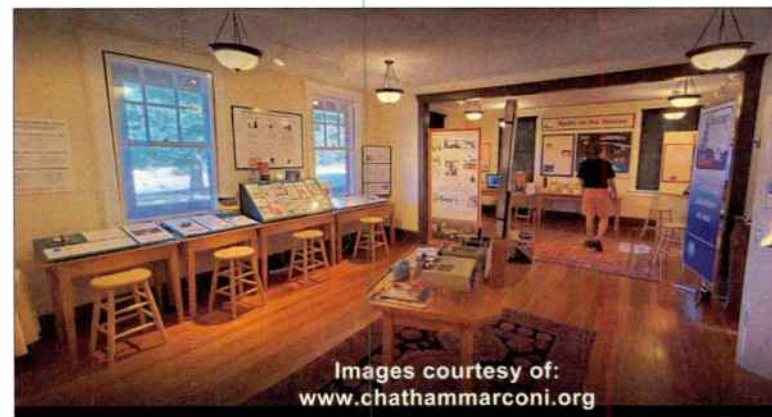
which is just up the road from Chatham. The Welfleet site is slowly disappearing into the ocean due to erosion and, unfortunately, there isn't much to see there anymore.

The Chatham property is a well maintained historical site and I met several of the museum's volunteers, including Ed Moxon, who guided me through the history of this most interesting site. One of the volunteers that I spoke with had been an operator of the station when it was operational and he told me stories of communicating with ships up and down the eastern seaboard. One story was of the SS Marine Electric, a freighter that had left New Jersey bound for Boston but never made it due to a structural flaw which caused the ship to crack in half in route.

If you're ever vacationing on Cape Cod and you're tired of sitting on the beach and would like to visit an informative, interesting and educational museum, stop in at the Chatham Marconi Maritime Center. They have a mocked-up transmitter complete with flashing lights and "glowing" mercury vapor rectifier tubes. They also have the original shipboard radio set from the hospital ship SS Hope which they surprisingly bought on-line.



Coincidentally, I have a personal connection with the Chatham Marconi site. Back in the 1980s, I was building WFCC (We're First Cape Classical), a new Class B FM station licensed to Chatham. The station owner was looking for a studio location and I suggested the old Marconi site in town which by now was being operated by MCI.



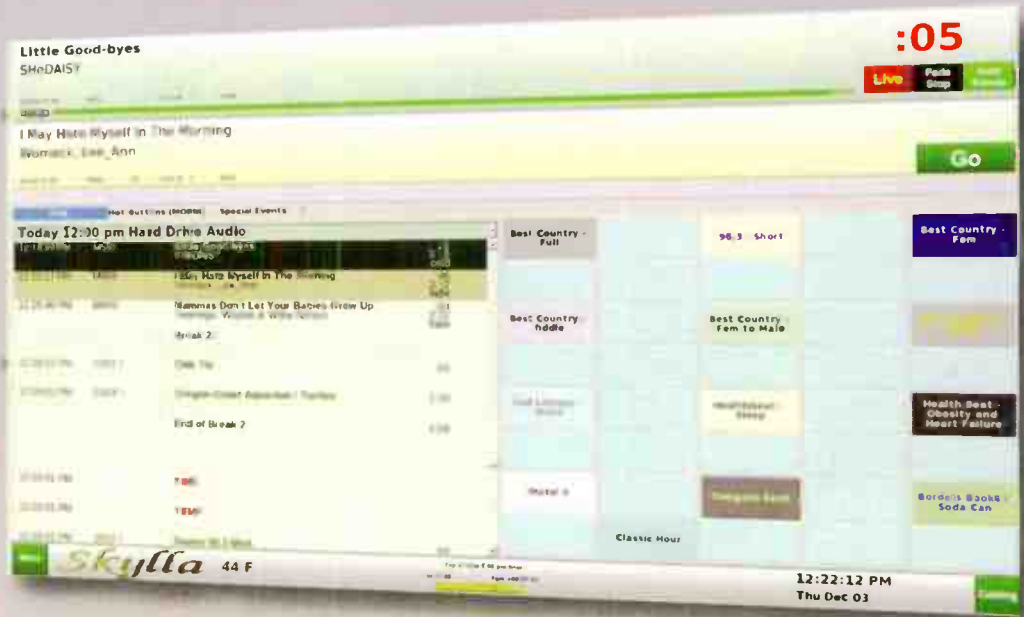
Images courtesy of:  
[www.chathammarconi.org](http://www.chathammarconi.org)

It had a very acceptable tower which could be used to mount an STL antenna. There was plenty of space and the radio history of the site was everywhere. It would have made an excellent studio site but the station owner chose instead a storefront in a strip mall on the other side of town.

Steve Callahan, CBRE, AMD, is a member of the engineering staff at Entercom Boston. Email at: [wvbf1530@yahoo.com](mailto:wvbf1530@yahoo.com)



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## Never Saddle a Dead Horse

by Michael Bradford

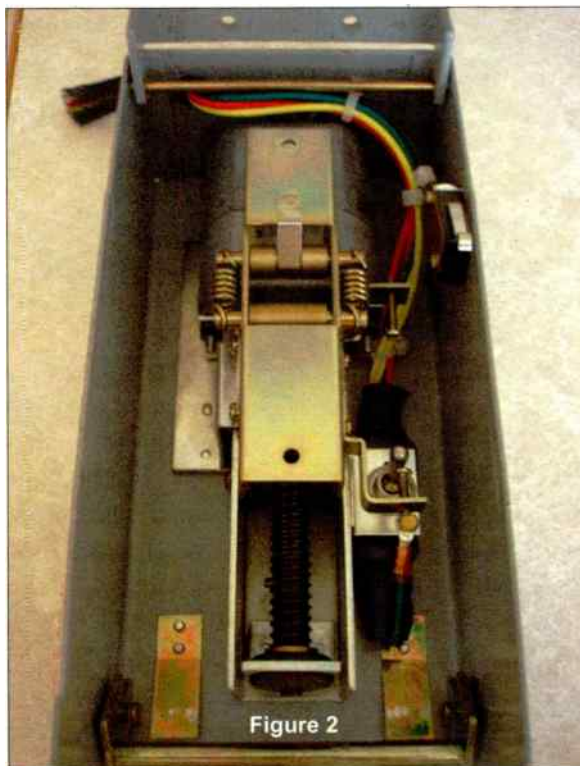
I am embarrassed to admit I got my tractor stuck on relatively flat ground. In my defense, I have been using the power line right-of-way for years to haul wood from trees on my property back to the driveway and up to the house without incident. This time, I failed to notice that heavy recent rains had formed a hidden pool of mud that was disguised as harmless flat ground. With a bucket full of firewood I was too far into the mud before I saw the trouble. I was stuck with all 4 wheels turning slowly, without moving an inch in any direction. It was obvious that I needed help so I called the nearest wrecker company and tried to think of a good excuse to avoid further embarrassment as I waited. I soon had to admit that the truth was my only option. The wrecker arrived within 30 minutes and quickly set up on the driveway and the operator hauled the snatch cable to the tractor and connected it to the frame under the bucket.

As I stood there checking over the operating gear on the wrecker, I noticed a piece of new cable and two saddle clamps between the frame and the main hoist. I also noticed that the two saddle clamps were installed upside-down. I remembered hearing the term, "Never saddle a dead horse!" when working with Larry Johnson and his crew from Great Lakes Tower Company over in Flat Rock, Michigan, when I was involved in the construction of dual-frequency WNZK. The crew workers were preparing the guy cable ends to connect to the guy anchors when I heard Larry mention that term. I had never saddled a horse, dead or otherwise, so I had to ask Larry what he meant. This is when I got a short lesson in guy cable preparation and proper installation of the saddle clamps.

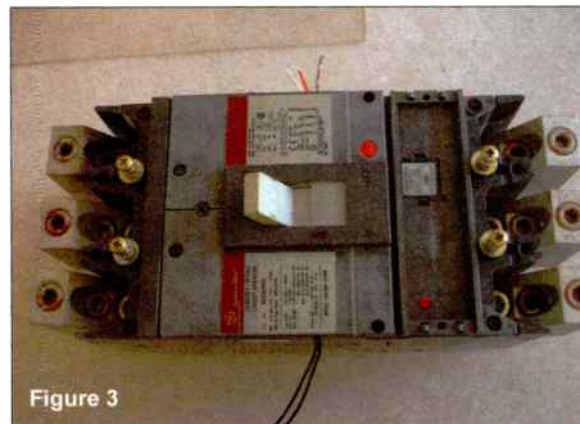


The traditional saddle clamp (Figure-1) is comprised of the saddle (middle piece), the shackle (bottom piece) and the nuts. The saddle must be installed over the "live" portion of the cable that is the longest and goes up to the tower. The "dead" length of the cable is the shorter end that loops around the thimble and is secured by the shackle. Hence the term, "Never saddle a dead horse" is a reminder of proper installation. The size of the clamp is determined by the size of the cable and the manufacturers specify proper torque for the nuts and spacing between adjacent clamps relative to the cable size and draw-down strength. Larry pointed out that the saddle-

clamps come in stainless steel, zinc coated or galvanized and the hardware cannot, and *must not*, be interchanged between styles when installing them. Well, I pointed out the error to the wrecker operator who promised to have a technician correct the installation when he got back to the "barn."



I was visiting my old friend and fellow engineer, Ed Trombley (known as "ET" by owners of many directional AM arrays as far away as Japan) when I spotted an interesting assembly taken from a Comark TV transmitter that ET was parting-out. (Figure-2) This "motor driven device" is made by GE and fits atop their SG series of 3-pole breaker assemblies (Figure-3)



You may recall the picture that made its way around the trade magazines some years ago, of the solenoid installed so as to allow remote resetting of the main breaker on the front of a remotely located transmitter. This solenoid could be activated by remote-control to turn that breaker back on and save a many hour trip to the

transmitter site, not to mention a many hour delay of programming. Genius!

This GE series of breakers are selectable between 100 Amps and 300 Amps by the choice of input/output lug connectors and a little chip installed into the breaker main body. When you choose the "motor driven device" option, by applying 120 or 240 VAC to the motor (24 VDC is another option) you can remotely reset the breaker. The technical sheet for the device indicates that transition time from on-to-off or vice-versa is 0.25 seconds! Of course, I had to connect an AC pigtail to the device just to see how fast it was. The motor-driven screw inside the unit did indeed change the breaker instantly – what fun that was to test it out. I got to thinking how great this breaker/remote control option would be for a mountain-top transmitter site or another middle-of-nowhere location that was prone to lightning strikes or other power issues.



Figure 4  
The GE SGMOM1 Motor Driven Device Mounted on the Circuit Breaker

The "motor driven device" mounts securely to the top of the breaker (Figure-4) and the whole assembly can be mounted in any position. The GE SGMOM1 device is available on eBay. The cost could be recouped the first time you didn't have to take 4 hours to travel to that remote site just to reset a breaker. *And* if you knew a storm was imminent you might turn a breaker off and switch to your generator in advance and avoid any lighting damage – all by remote control.

I'm gathering field data for an article on generator maintenance and "proactive" testing and fuel scrubbing. We all dread getting that call from the station manager at 4:30 when they need immediate help because the station's remote van has a dead battery because some jock left all the interior lights on overnight and a huge remote is planned for 9:00. That same general manager cannot understand why you need to spend money for a new generator battery or the need to run the generator under load for half an hour or hire a firm to "scrub" the diesel fuel to get rid of water, algae or suspended rust. If you give in and let things slide, guess who gets the blame when the generator won't start during an outage?

Sure hope all of you are staying safe during the Covid pandemic and still find a way to interact with fellow engineers ... even share a cupper or two.

Michael Bradford began his career at WCCW in 1962, A CPBE since 1984, and currently a contract engineer. You may reach him at: [mbradford@triton.net](mailto:mbradford@triton.net)

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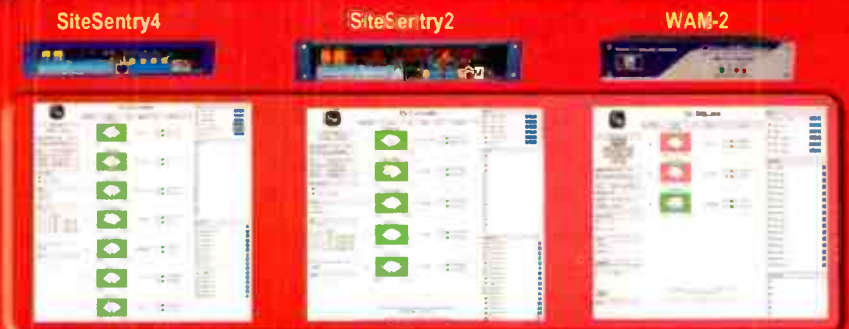
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## Odds and Ends

by Bob Reite CBT

For this issue I have pictures from two spectacular failures, and how we got the stations back on the air – and finally how to get rid of annoying robocalls.

### The Night Pattern Has High SWR

I was called to a 4 tower DA-2 with the complaint that the night pattern had high SWR – could barely make 100 Watts when it should be 1000 Watts. Day pattern and power were fine. The phasor control showed that the RF contactors in all of the antenna tuning units were operating, as well as the phasor itself. A quick glance inside the phasor conformed that the three contactors inside were in the correct position. In the past at this station, problems have been in the ATUs since they are more out in the weather. I checked all four ATUs and there was no problem there so I took another look at the phasor.

Nothing seemed obvious there at first, so I decided to exercise the tuning controls. After checking first, that the current dial settings were written down, I rocked the controls. All seemed good until I got to the phase control for tower 2. It “felt” bad, as well as making bad mechanical noises. Looking carefully, this is what I discovered in **Figure 1**.

This variable inductor is one of the ones at the bottom of the cabinet and the setting is about half way in, so it's why I did not notice it on first inspection. I turned the control off of the burned spot and the SWR was good

enough to make full power. However, I left it at 400 Watts to keep the monitor points under the maximum, since the phase setting for tower 2 was no longer correct.



Fortunately for the owner, he had acquired phasor components from another directional AM that had gone off the air for good. Among those were five variable

inductors with the same part number as the one that had burned up. The tower 2 phase control consists of two, 10 uH 15 Amp inductors ganged together. At least the one that went bad was on the rear, so I removed the bad one, which took a bit of doing as the manufacturer had really tightened down the shaft coupling. Not only did the manufacturer not want the coupling to slip, this was also an RF connection between the two coils. After removing the set screws, I moved the rear adjustment while holding the front, while at the same time working them apart. I then set both the new rear coil and the good front coil fully clockwise before installing the new coil and tightening the coupling.

The final step was to turn the control to the recorded dial position and check the array with the antenna monitor while on night pattern – it was close, but not correct. After fiddling with it for a half hour with not much luck, it occurred to me that the tower 2 phase control probably had been developing a high resistance for some time affecting the entire tuning of the array. So I set all the night pattern controls to the dial positions recorded from two years ago. These settings gave much better results and it only took a couple of minor adjustments to bring the antenna monitor readings within tolerance.

### 103.5 is Off the Air

I was on the way back from another job when the owner of the 103.5 called and said they were off the air. I considered this to be a bit lucky: as it so happened I was at the closest exit on the Interstate to get off and take a look at it.

(Continued on Page 28)

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## Odds and Ends

– Continued from Page 26 –

I would have really been annoyed if I had gotten all the way home before receiving the call. I arrived at the site to find that the Armstrong 3500 transmitter had shut down on no air flow. After opening the access panels it did not take long to find the problem.

Besides the destroyed motor run capacitor (**Figure 2**), the motor fuses were blown, which was a good thing, as this probably saved the motor windings. The bearings felt fine while spinning the motor by hand. It was now 5:30 PM so all suppliers were closed. I called the owner and let him know what the situation was. The plan was to connect the exciter directly to the antenna if I could not get a replacement capacitor the next day.

The next day I went to an electrical wholesale house and they tried to find one. They said it was a bit of an “odd duck” at 16 uF 400 Volts, but they could order one and get it there the next day, and if that was not good enough to try motor repair shops. I elected to try the motor repair shops. One was still closed due to COVID-19. However, the other shop, that the electrical supplier had a name and address for, was open. They did not have a 16 uF 400 Volt capacitor, but did have 15 uF at 440 Volts and 17.5 uF at 440 Volts. The man at the counter confirmed my thought that it would be OK to go larger, but not to go smaller. I purchased the capacitor and headed back to the transmitter site. With the new capacitor and fuses, the motor started and ran fine. But I did check the current draw

against the name plate rating of the motor just to be safe. It was 0.7 Amps lower than the name plate rating, which was a good sign. I then closed up the access panels and turned on the high voltage. After a minute of waiting for the exciter to phase lock (the exciter is off if there is no high voltage applied to the tube), the transmitter was back on the air again at licensed power.

it seemed to work well, until the day it decided to block the call from a Sine System transmitter control. This was very bad, as the Sine System was calling to let me know that power had been restored at the site and, as it so happened, the transmitter came back on in the middle of the night for the daytime only station! It was just lucky that I happened to look at the phone and noticed a voice mail waiting, so that I could call the Sine System control back, turn off the transmitter and reset the clock calendar. There is no known way to whitelist numbers with Call Protect.

But as it turns out, you don’t need another app. Android has a “do not disturb” mode. It can be found under the “Sounds and Notifications” menu. Select it, then go to “allow exceptions” and choose “Custom.” Here, check “Alarms,” then set “Calls from” to “Contacts only.” You can also choose “Favorite contacts only,” but with this choice you would need to go to the Contacts list and set each person that you want a call from as a “Favorite.” Callers that are blocked will still be able to leave a voice mail message, but 99% of the junk callers never do. The only minor fault that I have found with



Figure 2

### Killing Robocalls on Android

I totally despise robocalls. Robocalls are for things of no value if not outright fraud attempts. I tried the free Blacklist Plus app, but it was not reliable, in that it would not always turn the “ringer” back on for legitimate calls after having silenced a caller that was not on my contact list. I next tried AT&T’s free “Call Protect” app, and at first

using “Do Not Disturb” is that it blocks sounds from the timer function of “clock” but alarms still work. Please note that I have only tested this with Android version 6.0.1 “Marshmallow.” Newer versions of Android may differ.

*Bob Reite operates his contract engineering firm, Telecentral Electronics, Inc. servicing radio stations in Pennsylvania and New York state and may be contacted at br@telcen.com*

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# Practical Solutions

## Parts is Parts ... and Not Chicken

by Jim Turvaville

A meme came up on a Social Media page I was trolling recently, and it not only struck a funny bone, but really struck home as well. It said, "By the time my father was my age he had amassed, like, 30 coffee cans full of screws. I have none – what have I done with my life?"

My father (as well as my late brother) seemed to have the knack for collecting coffee cans that got filled with various items – while neither of them actually drank coffee. In my father's case, he worked at a utility power plant where the company always supplied coffee for the workers, and he regularly sequestered the empty coffee cans and brought them home. In my brother's case, I have no clue where he seemed to always be coming up with those cans, but I can assure you his were all labeled with their contents and a lot more organized than our Dad's ever were.

In my case, I actually have amassed a pretty good collection of my own storage containers, howbeit not coffee cans, since I've yet to have my first ever cup of coffee in my life to this point. As a child in the 1960's in a quite poor family, a huge staple in our life was *Peanut Butter*. From my earliest childhood memories, I've had a diet rich in that creamy, high protein and

comparably very affordable substance. In the past 60 years, that has not changed very much, and just in the past few years have I actually begun keeping those beautiful red-topped containers for my own method of organization.

In my retirement time, I have taken the time to build my overgrown tiny house and its companion tiny shop where I remain committed to keeping my life as functionally minimalistic as practical. That means one has to be smart about storage methods and often creative in maximizing the utilization of space available. One of my own commonly repeated sayings is that, "Things always multiply to equal – or exceed – the space available." If you have 240 square feet of shop space (which is my current situation) then, unless one is extremely cautious, you will end up having 400 square feet of things that you're trying to place in it. So being purposeful about your organization methods becomes more important as space becomes less plentiful.

To that end, I've built a couple sets of shelves specifically designed for the almighty Peanut Butter Jar; and since I always buy the same size jar every time, that makes spacing shelves a lot easier (Figure 1). These are just scrap 1x6 or plywood cut to that width,

with 2x4 blocks vertical between the shelves. I used 4-1/2" screws through the 2x4 into the wall for support and it is more than sufficient for supporting the shelf and contents. I did not have to be concerned with horizontal spacing of the 2x4's since my wall is solid OSB, but one may have to space them so the screws would hit a stud on 16-inch center.

Figure 1



These are an ideal repurposing of single-use containers in an environment where economy is more important than style. I have built similar setups at tower sites, workshops, and in utility rooms at the office, for keeping track of a wide assortment of smaller items where the general public – or most often the entire rest of the station staff – would never be present. Using a clear container lets me keep the various items in a cleaner dust-free storage, and able to know at a glance where to find those pieces and parts.

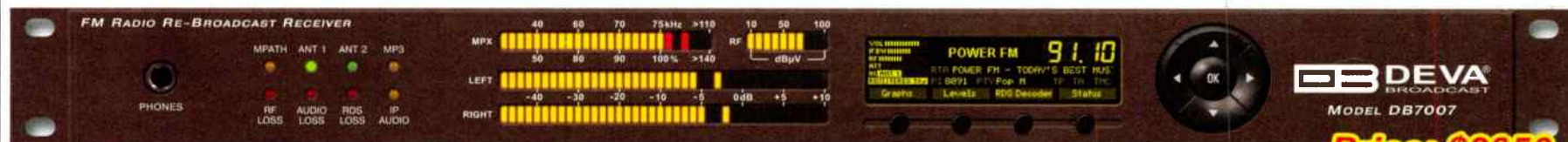
(Continued on Page 32)



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**Parts is Parts – and Not Chicken**

– Continued from Page 30 –

While I eat a lot of Peanut Butter, it does still take quite a long time to collect a sufficient quantity of those plastic jars for an entire shelf of matching storage options.

To that end, I have begun to adapt something that *does* collect very quickly at my house, and adapt them to a similar function – the 64 ounce juice container. While they are not very obviously useful as a closed container, my rotary cutting tool makes 15 second work of snipping off the top (Figure 2) to make an open clear container that finds life as a handy mini storage box (Figure 3).

I've also built the same type shelf as the Peanut Butter jars for the Juice container items, and it has the advantage of not requiring everything to fit in it for a



Figure 2

lid to be attached. That lets me put things a bit larger than would fit in a Peanut Butter jar as long as dust protection is not needed. I keep large electronic and electrical components as well as hardware and other spare parts.

Again, it's just 1x6 or plywood or some OSB ripped to that size and vertical 2x4's for spacers to affix to the wall (Figure 4). But at a towersite, where next to no one but you are going to be working, having some form of organization is not a waste of time and effort. And it's not only beneficial to you, it can be a life saver for a successor – yes, we're all going to have one, so we might as well get used to that thought and do a little bit of preparation for them!

I recently had to go back to a tower site of a small town AM/FM which I used to tend to on a regular basis back in the 90's. Back in "the day" this was a 250 Watt low-band AM daytime station, with a McMartin BA-1K AM transmitter and a then-modern Energy Onyx ECO-4 FM transmitter. However, now a shiny Nautel FM transmitter graced the floor, and the old McMartin had been replaced by a rack-mounted solid state AM box.



Figure 3

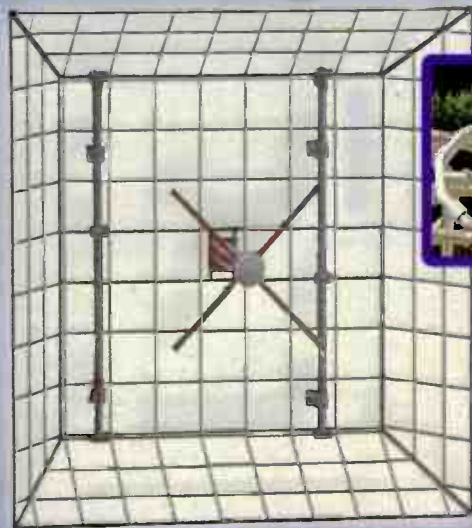


Figure 4

I began to look around the rather neatly arranged transmitter building. Sure enough, one wall was a metal shelving unit with half a dozen clear plastic containers with lids, containing equipment books, spare parts kits and notes from previous engineers. I ended up having to really dig for some hardware and parts, and about that time got hungry for some Peanut Butter for some reason. Still, someone had sure been nice to me by leaving lots of bread-crumbs and the repair was affixed in short order. I hope we all will be as kind where possible.

*Jim "Turbo" Turvaville is semi-retired from 42 years in full-time Radio Engineering and lives in Rural Wheeler County Texas in a "tiny house" where he maintains a small clientele of stations under his Turbo Technical Services (www.jimturbo.net) operation providing FCC application preparation and field work.*

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## Misc. Tech-Tips and Thoughts

– Continued from Page 34 –

Only a few paragraphs above, I mentioned that a good engineer is always learning. Investing the time on how to secure your station and its transmitter plant are well worth your time. If you use the Ubiquiti radios to connect to your remote transmitter site, you will want to go on the Internet and read this article: <https://arstechnica.com/gadgets/2021/03/ubiquiti-breach-puts-countless-cloud-based-devices-at-risk-of-takeover/>

Speaking of breaches, who can forget the Zombie Apocalypse where a radio station's EAS system was hacked. Go to YouTube and search for the video. There are several versions of various lengths; but the point is, security is something you can no longer keep putting off.

A great way of protecting your computer network is with "virtualization." This is where you load VMWare onto a computer and create one or more virtual machines. If anything should happen to one of the machines, you can wipe it and recreate it. It's a clever way of protecting the host computer, although it's not a perfect solution.

### Soap Box

One of the things I find frustrating is tech support. Don't get me wrong; I have talked with equipment manufacturers who have the best support. However, there are also those who are a nightmare. I don't appreciate being on the phone with someone who is not proficient in English. It's difficult enough trying to resolve a complex technical

problem; having a hard time understanding the person on the other end of the phone only makes things worse. In addition to that, I have spoken with tech support people in America who make you feel like you are a major inconvenience who knows nothing about technology. One transmitter company I know of only offers technical support during the day, and you only get voicemail on the weekends. To the companies that do offer tech support, let me suggest a few things:

1. Use people who have English as their primary language, or possess a good proficiency in English.
2. Instruct your staff to be patient, helpful, and not condescending.
3. Provide technical support 24 hours a day, seven days a week.
4. Where around-the-clock phone support is not possible, at least have someone on call who will return a call promptly.
5. If you don't offer phone support, at least supply an email address that is monitored 24 hours a day, seven days a week, and where a live person will reply promptly; or consider live chat support.

The next area that I find frustrating is in documentation. Some companies supply little to no documentation, and that is not a way to win repeat customers. Providing documentation should be as important as the product.

A company's documentation should be beta tested. Yes, I believe giving an outside engineer your first draft of the documentation should be standard operating procedure. I can't tell you how many times I have searched a technical manual looking for an answer, and it wasn't there. An outside engineer can find areas that may have been overlooked. The more carefully a technical manual is prepared, the fewer calls a company will receive for technical support.

This process can pay for itself many times over. When someone writes a technical document, he or she may not be qualified to see things the way a field engineer sees them.

### Free Software – My Tech Tip

One nice piece of software I discovered years ago is a free audio playout package. You have probably heard of it. It's called Zara, and other engineers I have shared my discovery with were delighted in how useful it can be. There is a free and a paid version available at: <https://www.zarastudio.es/> No, there is no free fast support, but you can join a Facebook group and get all or most of your questions answered. I plan to use this software for a backup playout system when I need to take my current live-assist system off-line.

### Looking for Input

Are you an engineer who has learned something new? Maybe you discovered a cool app that you love having on your smartphone. Or perhaps you found some software that is very helpful. Whatever gem you may have discovered, I would love hearing from you. Feel free to contact me at [stuzeneu@sbe.org](mailto:stuzeneu@sbe.org) – your useful information will be appreciated by my readers and me.

There you go; there's my (hopefully) useful tech tip. What's yours? I am waiting to get it in my email.

Thanks for reading my column. I hope you found something interesting or useful.

The thoughts, ideas, and opinions in this column are my own, and do not necessarily reflect the views of *Radio Guide* or its publisher.

*Steve Tuzeneu, CBT, is the general manager and chief engineer for WIHS 104.9 FM in Middletown, Connecticut. He is a member of the SBE, and an extra class radio amateur.*

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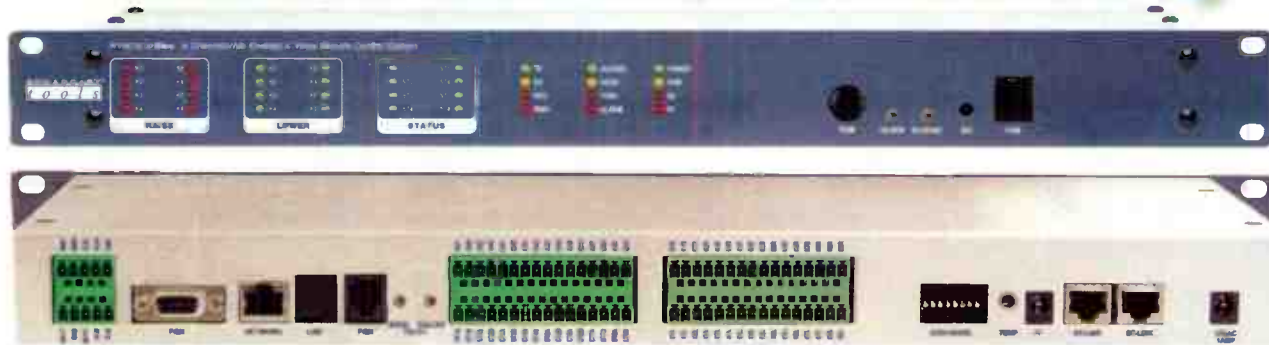


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# Small Market Guide

## Is Your Small Market Radio Station Vulnerable to Internet Predators?

by Roger Paskvan

As I am writing this column for *Radio Guide*, I just saw on the local evening news that our biggest pipeline distribution company on the East coast got hacked by a foreign invader and was put down to its knees for ransom. My first question would be: why would you connect the whole pipeline system to the Internet in the first place? Pipelines have nice wide right-of-ways that could easily have a private fiber line buried along the pipeline. It would be their own LAN that only the pipeline company would have access. There would be no outside influence and therefore no outside hackers. Well, they are not going to listen to me, but this incident reminded me of a client that fell into this same trap in a small market station last fall.

I received a call from this client in early October. He wanted me to come to his station and rip out his STL dishes with the electronics. Some smooth talking sales/consultant had talked him into a really good deal with trade (that dirty word) from their home town telephone company Internet provider. His great idea was to use the Internet for delivery of his station signals out to his transmitter, seven miles from town. It sounded logical and many stations are doing that on a daily basis, right now.

I respected his wishes, removed all his STL equipment, stacking it in the transmitter room – it was going to become eBay junk, furnishing the station coffee fund. I asked him how he liked the new Internet delivery of his

signals and he was very happy. Everything was pre-installed by a local IT guy, now on retainer. So life goes on in this modern era.

In mid-April, I was handed a message at my office; please call this client immediately. My friend was off the air and had been off the air for two full days. He was desperate and didn't know what to do. His Internet connection was frozen. His response was frightening; apparently his computers had become victims of some ransom hacker. He claimed that all his files in the whole station had been encrypted by this hacker. The person now emailed him and wanted \$10,000 to release his data or he would destroy all his records, billing and interconnect. He was definitely in trouble and in a panic mode. His IT guy had no solutions.



My first question was, is the pile of STL equipment still where I left it, in the transmitter room? He said, no, sold it on eBay for \$2,400 at Christmas. What a bad idea that was. He kept asking can you fix this. Frankly there wasn't a lot I could do. I asked if he had backups of his data. He said, that was in cloud storage and this hacker claims he got that too! Well, either pay the piper or lose it all and start over. I did tell him that I had some old STL equipment at the office and I could make a backup STL operational so he could stay on the air broadcasting. If this ever happens again or the Internet service goes down, it's cheap insurance.

IP hacking is becoming a bad science and we are all very vulnerable to that existence. Firewalls, passwords, VPN and a host of services are out there to prevent this thing from taking over your station computers. Small market providers are more susceptible to this sort of thing since small town Internet providers don't always have the revenue to protect their Internet. Metro Pro Internet services are also available for hardened connections.

An STL was installed again at this station and I got him back on the air. He eventually paid the ransom and got his data back. The lessons learned from this experience should speak for themselves to all small market stations. Don't rely on cloud storage for your whole operation. Make back HD copies of each day's data in case the system fails you. Take this backup HD home every night in case of a station fire. Purchase good quality protection software to catch some of these bugs before they bite. Most off all, if you still have an old STL, keep it as a standby since you never know when you may need the old reliable STL to carry the programming again. "What do you mean; the Internet is down, again?"

Roger Paskvan is a Professor of Mass Communications at Bemidji State University, Bemidji, MN. You may contact him at: [rpaskvan@bemidjistate.edu](mailto:rpaskvan@bemidjistate.edu)

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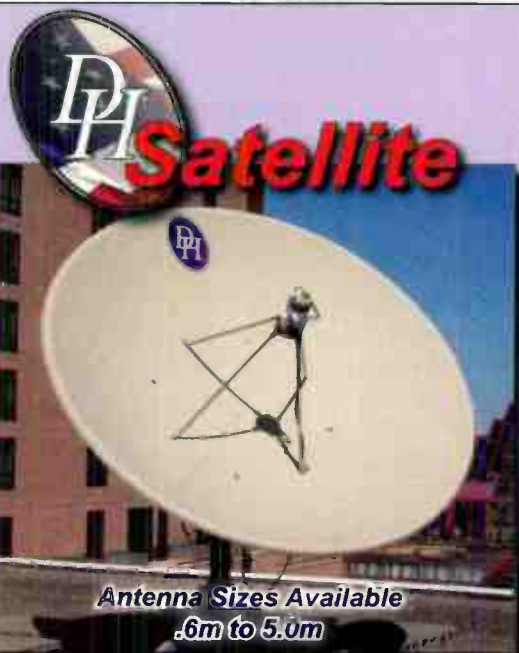
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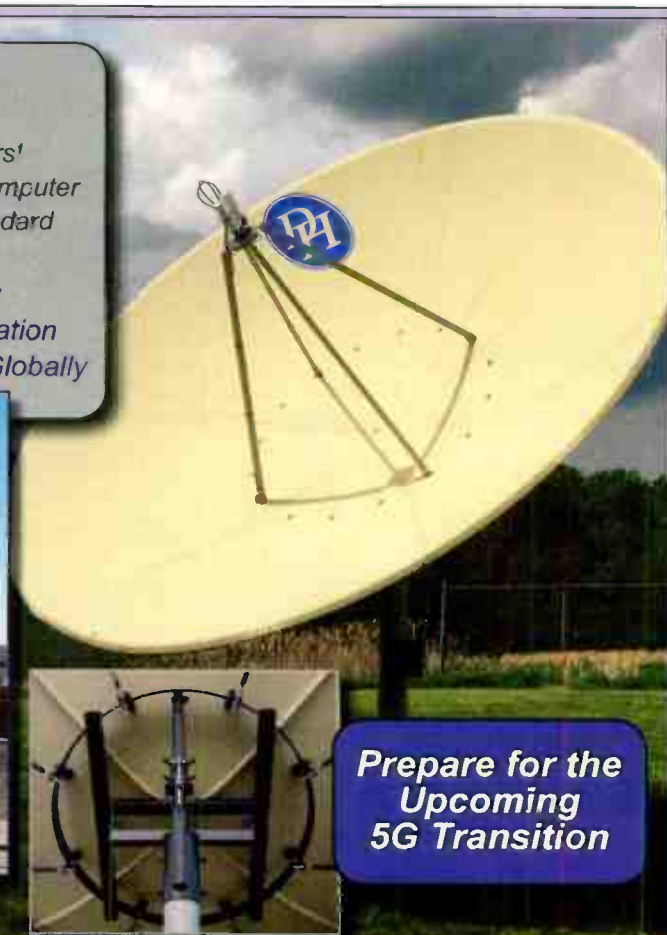
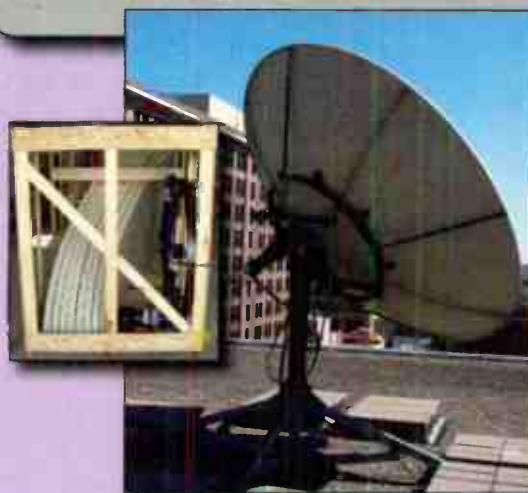
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# Transmitter Site

## Air Cooling Blues

by John L. Marcon, CBRE CBTE 8VSB Specialist

The cooling system is a critical part in the operation of any broadcast facility. We would like to make sure that our offices, studios and transmitter room are

transmitter room is a stand-alone building on a remote site. The usual and easiest set-up is to have air-conditioning to cool in summer and have a temperature-controlled exhaust fan to run in winter.

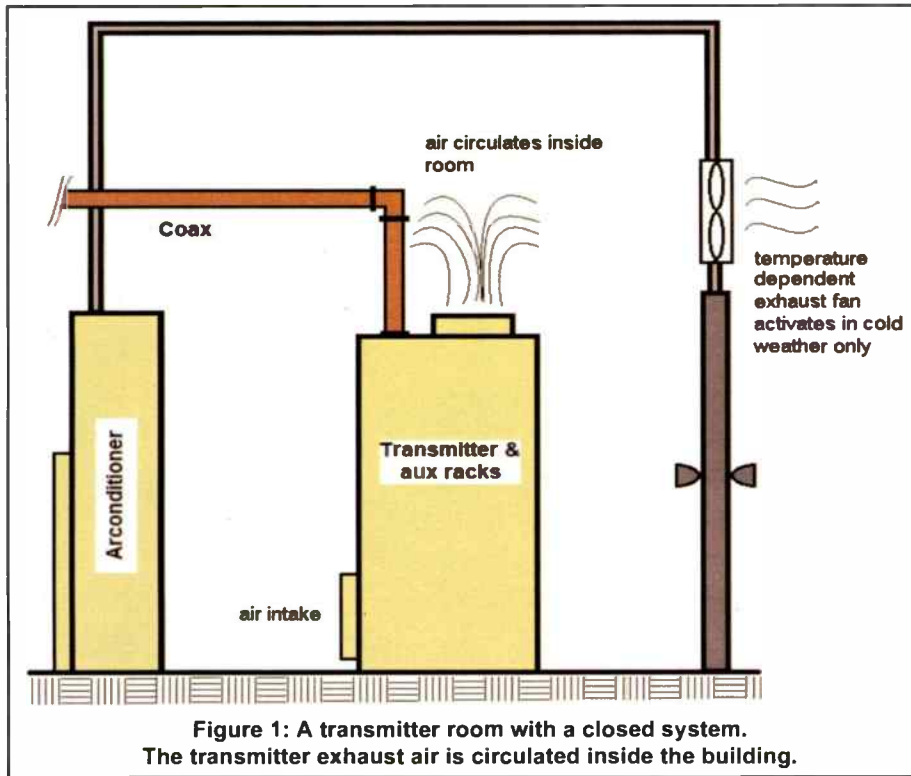


Figure 1: A transmitter room with a closed system. The transmitter exhaust air is circulated inside the building.

kept cool and clean. Due to advances in solid-state, most transmitters in use today are of the air-cooled type. Because of their high efficiency, heat loss is low. Less heat means a simpler cooling system. Centrifugal fans are replaced with smaller axial DC fans.

Back in the day, broadcast engineers worked with both liquid and air-cooling in their transmitters. In addition to the air-cooling stuff, we also dealt with leaking pumps, liquid coolant, water filters, etc. This reminds me of the time when I worked on a 250 kW AM transmitter that had large water cooling radiators for all four 6696 triode power tubes. It was literally water cooled, not glycol, and we had to catch rainwater to fill the large tanks. There were always water leaks in the system. The radio network also had a 50 kW that was also water-cooled. There were just a lot of moving parts in a combined air and liquid-cooled system. That was why we were so excited when the 50kW was replaced by a Nautel solid state. However, it was also the first time when I experience my first "air cooling blues" because we installed a big centrifugal exhaust fan on the transmitter room and that made a negative air pressure inside the room. I have a few things in this article that may help you avoid this kind of mistake in your own site. Let us look at two examples of an air-cooling system set-up.

### Closed Loop System

Consider a room or building with a 5 kW transmitter and one or two audio racks. Let us also say that this

transmitter. Thus, the cooling load for the AC is the total heat from the transmitter, auxiliary racks and from the walls that absorb radiated heat from the sun. In equation form:

Total heat load = heat load from transmitter + aux racks heat load + walls & ceiling heat load.

For a 5 kW FM, efficiency is typically 65%. AC power =  $5\text{kW}/0.65 = 7.7\text{ kW}$

a. Transmitter heat loss =  $7.7 - 5 = 2.7\text{ kW}$

b. Aux racks heat (estimate) = 500W (coming from audio processors, microwave receivers, etc)

c. Walls and ceiling formula:  $Q_w = (L \times H) \times (T_o - T_i)/R$

Where  $Q_w$  = heat in BTU/h, L = length of building, H = height,  $T_o$  = outside temperature,  $T_i$  = inside temperature and R is Thermal resistance. For concrete,  $R = \text{wall thickness (inches)}/10$ .

What is the capacity of air conditioning (AC) needed? Sometimes even the HVAC contractors do not know how to calculate the capacity of the AC needed for a transmitter installation. They based their computation on the square footage of homes or buildings and, based on that, they decide on the size of the AC. With a transmitter, you are not only dealing with square footages, but you are also dealing with a heat source at a high airflow. In computing for cooling capacity, we must include all heat sources within the room, not just the one coming from the

There are four walls and a ceiling so add up all the heat loads from these structures. The wasted heat from the transmitter and heat from aux racks are in Watts and these must be converted to BTU/hr by multiplying Watts by 3.41. Add about 50% headroom so that the AC is not running all the time. Once you got the total BTUs, you can look at the size of air conditioner that meets the total BTUs. Do not get an oversized air conditioner.

During the colder months, open the vent of the wall-mounted air conditioner and let the temperature-dependent exhaust fan run. The air will flow from the AC vent to the exhaust fan and will cool the entire room. This will save you on electricity cost. Better yet, have a separate filtered air intake duct with remotely operated turning vanes.

### Avoiding the "Blues"

1. As I mentioned already, getting the right capacity of the air-conditioner is crucial. Make sure your computations are right, especially in determining the waste heat of the transmitter. An undersized AC can make the AC run most of the time and can shorten the life of the compressor.

2. There are some installations that do not install an exhaust fan. You can see this in cell sites with their modular buildings. That will work too but it does not take advantage of the cooler weather in winter.

3. When the thermostat is mounted on the wall, especially if the wall is concrete, the thermostat absorbs the wall temperature and not the actual room temperature. In winter, even with the room temperature already hot, the air conditioner would not run because the thermostat is stuck at a lower temperature. Make sure the thermostat is reading the actual temperature of the room.

### Open Loop

The second type of set-up we see in a lot of radio or TV stations is the open loop system. In this method,

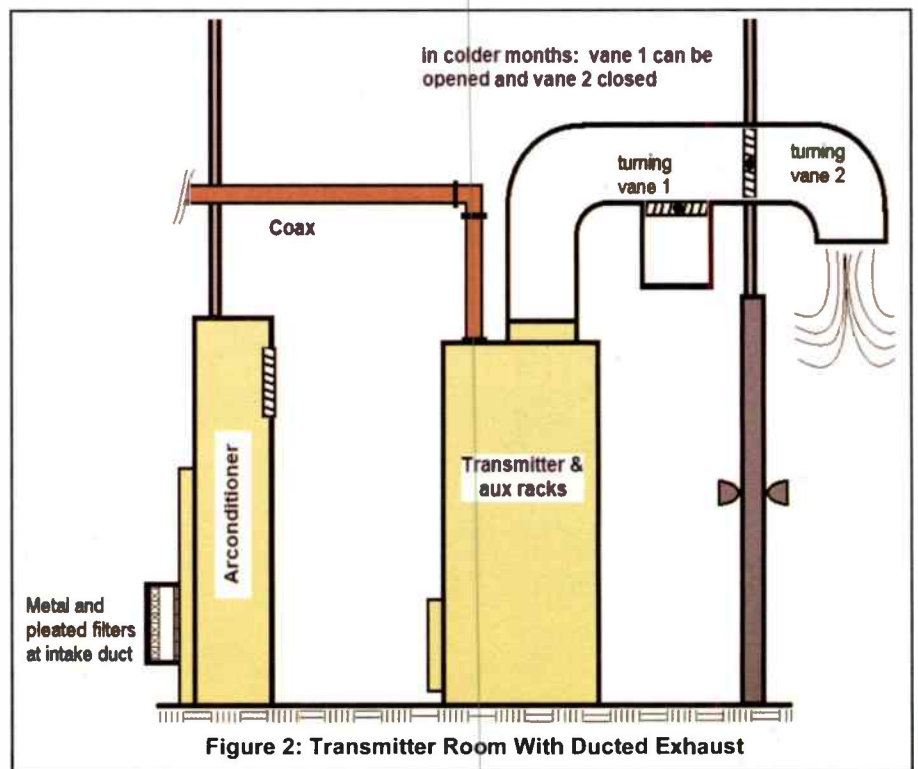


Figure 2: Transmitter Room With Ducted Exhaust

the air is taken in from one side of the room and discharged on the other side. (Continued on Page 42)

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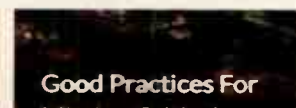
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## Transmitter Site

– Continued from Page 40 –

This option is more often used with higher power transmitters. A high power transmitter produces higher heat loss and therefore higher electricity cost. Using outside air will not require a much higher AC capacity, which results in lower electricity cost. Drawing outside air to cool the transmitter seems to be counter-intuitive because it also draws the high temperature air from outside. However, heat equations show that using outside air require less AC capacity. The open loop looks something like **Figure 2** on page 40. This set-up is looks more complex than the first one.

When we look at the first option, the total heat is the sum of the transmitter heat, the auxiliary rack heat and the wall heat load. The total heat load in option I is called *Sensible Heat*. In this second option, we need to consider another type of heat load: *Latent Heat*. Latent heat is due to the moisture content of the surrounding air. Because the first option is a closed system, we only considered sensible heat and not the latent heat. This time we need to compute for both latent and sensible because the transmitter room is drawing air from the outside. The air conditioner is designed to handle both of these types of heat loads. However, the more there is latent heat load for the AC, the lesser the capacity it will have for the sensible heat. This will require an even bigger AC capacity.

A psychrometric chart is needed to calculate the latent heat load. I cannot go into detail on the calculation but if the HVAC contractor cannot do the proper calculation, you may need a mechanical engineer to help in

properly sizing the air conditioner. If you ducted the air intake directly to the transmitter intake, then it will be a different calculation. In addition, the transmitter will not be cooled by the AC but by the outside air only. This is not desirable. Thus, it is better not to install a duct directly from the intake air to the transmitter but instead let the intake air get into the room itself.

### Avoiding the "Blues"

1. I have seen sites where they did not install an air intake system. Sometimes, they installed one but it is just a hole with a cheap MERV-1 glass filter. The resulting surface dust is just awful. Use a metal filter in series with a pleated filter. The filter should be at least a MERV-8 rating. If there is no air intake system, the air will come from every crack and cranny of the walls, ceiling and doors. A secondary result of this is that some insects and other little crawlers are sucked into the room – the room can become an insect zoo.

Think of the transmitter room as a car engine. An engine has an air intake and an exhaust manifold. The intake manifold air passes through an air filter first before it goes into the engine. The air and fuel mix are burned and then forced out into the exhaust manifold. The same is true with the transmitter room.

2. If the air conditioner is not the right size, it will not only have inadequate cooling, but it will also make the room air humid during summer. Remember that the AC is also a dehumidifier.

3. With the transmitter drawing air from the outside, the air pressure inside the building can go a bit negative. This becomes more pronounced when the intake filters are not cleaned or replaced regularly.

4. Bends in the duct – if you have a tube FM transmitter, like a Continental 816R, the high velocity air coming out of the chimney is very turbulent because the forced air passes through the grid and filament components, then through the tube fins and finally through the honeycomb screen at the top of the chimney. Turbulent air consists of air eddies or vortices and these need to dissipate through a straight duct. However, if there is a bend in the duct right at the top of the transmitter, these vortices will not have a chance to dissipate first and instead become more turbulent. This causes more dynamic pressure loss. In other words, the duct should go straight up first before it bends to lessen this effect. Dynamic pressure loss means the hot air is not getting pushed out fast enough and this increases the temperature at the tube.

The proper cooling system need to be efficient so that it will not be costly in the long run and will keep the facility running at the right temperature throughout the year. This will surely help make a better working environment.

*John L. Marcon, CBTE CBRE 8VSB Specialist, is the Chief Engineer for Victory Television Network (VTN) in Arkansas, with international experience in both Radio and Television Broadcast, and has an Electronics Teaching background.*



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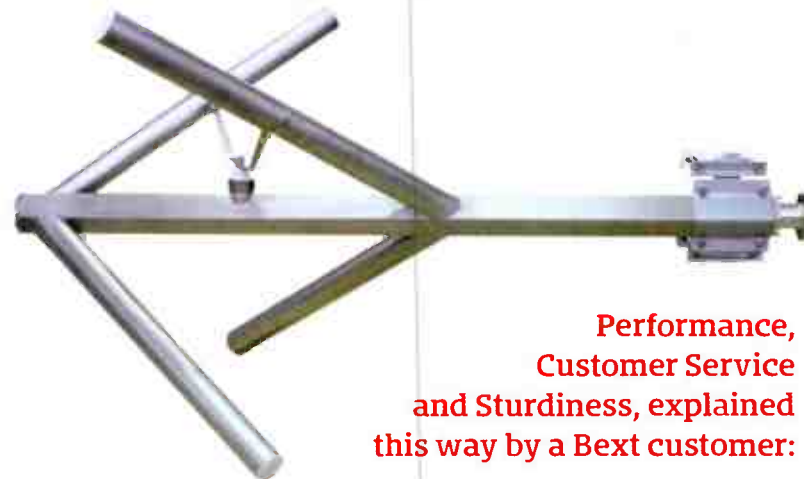


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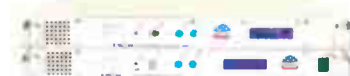
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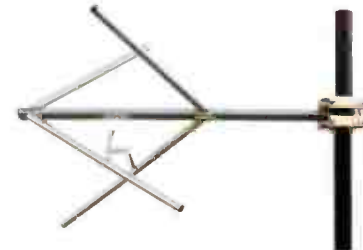
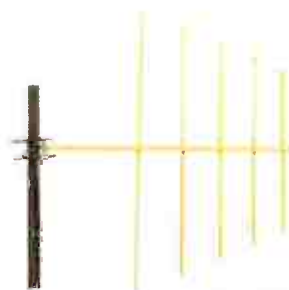
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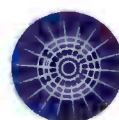
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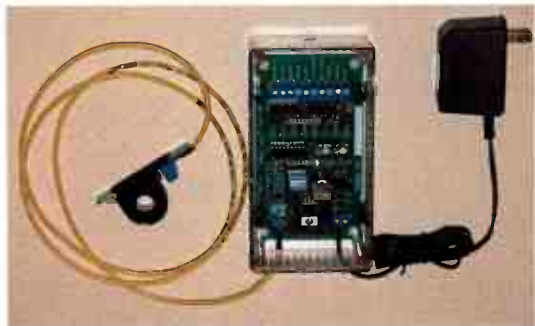
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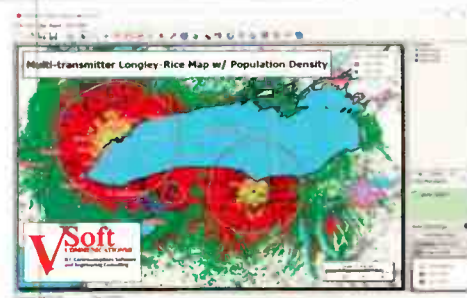
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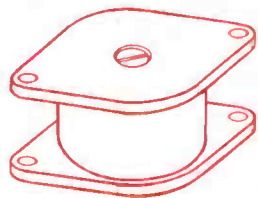


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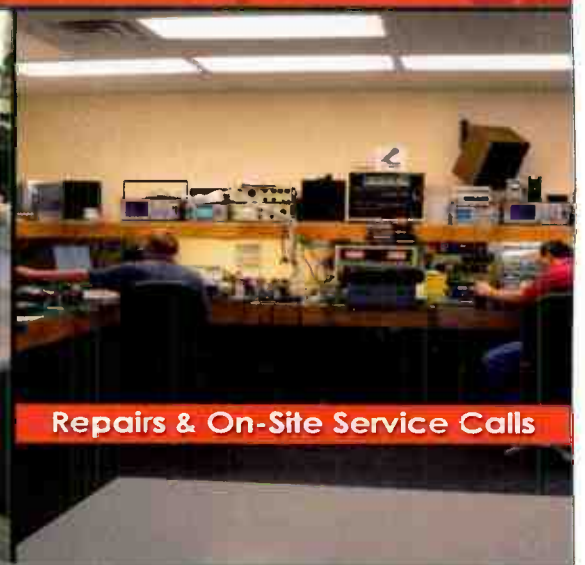
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# AM STEREO

## The Good - The Bad - and Gone

By Ron Erickson

Steve Miller was right, "Time keeps on slipping, slipping into the future."

I'm writing this article on the day before my wife's birthday in May 2021. We've been married since 1975, but we knew each other from drama class in high school, with both of us graduating in 1971. I've been in radio even longer than that, since my first weekend on-air job was at a local "day-timer" back when I was 15.

With technical advances, we always seem to lose something that perhaps wasn't perceived as a great loss at the time. No doubt, in hindsight, mistakes were made by the powers that be. I think one big mistake was broadcast deregulation. That's when most station owners decided they didn't need a full-time engineer for their station. Now, years later, we have a few good contract engineers that are in high demand. In my opinion, the big broadcast corporations overwork and typically underpay the one or two engineers that might maintain five, six, or more stations. We should never have allowed so much corporate ownership.

When it comes to AM, you may have noticed that the only answer to "revitalize" AM is to give FM translators to AM stations. This could

have been solved years ago ... it was what the FCC did, or rather *didn't* do, with AM Stereo.

I think it could have been ... no, *should* have been, the answer, not just for the survival of the band, but it would have allowed music formats to thrive on AM.

The concept for Stereo on AM is, and was not new, even back in the 70's. Leonard Kahn tested his system on a Mexican station in 1960.

It was around 1975 that FCC testing began on five proposed AM stereo systems; The Magnavox PMX System, The Harris V-CPM System, The Motorola C-Quam System, The Kahn-Hazeltine System and The Belar System.

Briefly, each of the first three used a type of Phase Modulation (where the stereo information was placed) and

Amplitude Modulation (where the standard L+R) mono signal was heard. None of these was compatible with the same receiver.

In 1980, the FCC declared the winner to be the Magnavox System, but soon after the announcement came accusations of the research and study being flawed and even incomplete. The certification of the Magnavox AM Stereo System was withdrawn in, with the FCC allowing the free market to determine the best AM Stereo system. Belar dropped out, and later Harris dropped it's design in favor of C-Quam, so then the big fight was with the Kahn system. Leonard Kahn claimed his system was technically superior to the C-Quam one. Kahn modulated the AM side-bands with left and right information. If you didn't have a Kahn compatible AM receiver, you could actually tune two AM radios, to just above and below the main signal, to hear stereo music.

There were some radios that could tune both stereo systems, but Motorola had government contracts and they used that fact to push companies building two system compatible radios to only build C-Quam receivers. GM, Ford, Chrysler and some import car companies were now installing C-Quam AM stereo radios in 1984 automobiles. We had one in our Chrysler "K" Car, and the AM Stereo sounded great! No multi-path when driving through Oregon mountain passes. Even though it wasn't as crisp on the high end, I didn't miss anything about FM. In fact, I found I preferred AM Stereo.

Meanwhile, C-Quam AM Stereo had been adopted as the AM Stereo Standard in Australia, Canada, Mexico, Japan and. In 1992, the FCC finally made a choice declaring Motorola C-Quam as the USA standard. So why don't we enjoy music in stereo on the AM band in 2021? The answer lies in the building of Stereo AM radios.

In 1993, a certification program was started to standardize the quality of AM stereo receivers. It was called AMAX. That standard, set forth by the Electronic Industries Association and the NAB, was for both broadcasters and makers of radios. The FCC endorsed it but failed to make it a requirement, once again, mistakenly making it voluntary. The AMAX AM circuit design was more expensive to build, so many receivers were built as mono AM tuners.

Leonard Kahn (right) was a brilliant engineer. With about 100 patents, Some say his work in radio puts him on par with Marconi, Lee de Forrest, Reginald Fessenden and Edwin Armstrong. Even though he lost the AM Stereo war, his AM Side-Band processor was re-born as the Kahn Powerside. That's when I

had an opportunity to chat with him on the phone. During our conversation, Leonard kindly explained what the heck the rack mounted passive Symetra-Peak did. (Perhaps you still have one in a junk pile somewhere - if so give me a call.) Leonard Kahn impressed me as knowing more about AM broadcasting than any ten engineers I have ever known.

Many years ago, a station I was working with in Oregon purchased a Power-Side. Leonard told me the closest installer was in Colorado. We arranged a visit and that was how I met Tim Cutforth. I've bumped into him from time to time, usually at the NAB show. Knowing Tim worked with Leonard, I gave him a call and asked him to talk about AM Stereo and Digital AM IBOC.

Tim related a story about driving from Denver to Salina, Kansas: "I was listening to 630 KOHW. It's a great dial position, but I was surprised to hear the station in stereo almost the entire distance, just dropping out at the sign for Salina. I'm really not sure if any stations still have C-Quam stereo, I mean, there's no reason now for KOHW to broadcast talk shows in stereo."

**Me:** "So Tim, what do you think about IBOC on AM?"

**Tim:** "When Boston Acoustics came out with an IBOC Compatible radio, I bought one and it sounds good. Here in Denver, we have a station, KPOF, that has always been super pristine on their processing. So one day, I turned on the IBOC radio and tuned into KPOF in IBOC mode. My wife walked by and heard a familiar song. She'll turn off the IBOC radio and turn on a twenty dollar clock radio to listen to the song she likes."

**Me:** "That sounds strange Tim, can you explain why would she do that?"

**Tim:** "She can't tell me what's wrong, but she says the digital audio irritates her hearing. I'm pretty sure it's the last octave in the signal because it is spectral generated and she hears it as noise. So I look at this and ask, if it irritates women's ears, why in the world would you want this to be your product?"

**Me:** "Thanks for the phone chat. Hope to see you again next April in Las Vegas." I feel a great sense of loss when I think about AM Stereo. I think about how different wording from the FCC could have made AMAX the regulated standard for receivers ... and that one change could have changed everything else.

*NOTE: Historic dates and facts were derived from various Internet sources including Wikipedia.*

Ron Erickson may be reached at 541-460-0249 or [ronerickson@gmx.com](mailto:ronerickson@gmx.com)



Tim Cutforth



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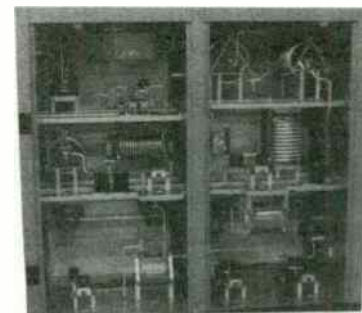
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