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Transmitter Site – *by Bob Reite (page 30)*

How Hard Can Two Towers Be?: *"I was called in to repair a two tower directional AM array near the top end of the dial. The array is two 1/4- wave towers, 60 electrical degrees apart. The pattern is basically a cardioid with some minor lobes.*

Upon entering the transmitter building I discovered that the two controls for power tower 2 and common point "tune" were outright missing from the phasor. The controls for power tower 2 and phase tower 2 were there, but just knobs sticking through the front panel. No turns counting dial. It looked like they had been there at one time – there were four small holes for mounting screws and a rectangular cutout that the tuning shaft went through."

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Cover Story

Davicom, 30 Years of Innovation

Passion and Friendly Support in Site Management Systems

by John Ahern - Comlab Telecommunication Inc.

It all started with a question about faxes. It was March 1992 and one of our customers called to ask if we could develop a remote-control system that would send alarms by fax.

The Quebec Provincial Police was deploying a completely new Emergency Management center with UHF radios, as well as 911 software, and they needed to monitor their 235 remote radio repeater sites. Alarms would be sent by voice-response system with DTMF control and by pager, but also by modem to a VT-100 terminal as well as by fax!

Fax machines were ubiquitous in office environments in the 1980s and 1990s, so faxes were a big thing to have in a monitoring and control system, especially given that nobody else was doing it at that time.

After some part searches and spec sheet analyses, we answered the customer and said yes to the faxes. So we got the contract! *That was when Davicom got into the Remote Control Business.*

A few months later, the RCMP (yes, the Mounties!) called to ask if our remote control system could send alarms over microwave links using serial communications to remote sites. There were no phone lines in their remote regions of Labrador, but they did have UHF radio links. This request led us to develop ways of reliably communicating over low bandwidth channels with our systems.

In 1995, seeing the benefits of our transmitter remote controls, the CBC called and asked if we could tweak our products and add some specific features that they needed to efficiently monitor their Canada-wide network. One request/suggestion that they had was for Virtual Logic Gates, and that feature has turned out to be at the core of our product's versatility and intelligence for the past 27 years. We did the work, and upon seeing the results, the CBC gave us a contract for over 200 units in 2 provinces. This eventually turned into a countrywide deployment a few years later. *That was when Davicom got into the Broadcast Remote Control Business.*

These last three examples also illustrate how customer-driven innovation became embedded into our company DNA. Who better than our customers to know what they need to make their jobs easier?

Eventually, and thanks to strategic partnerships with top-rated U.S. dealers, we began selling units across the USA. Then, through Radica Broadcast Systems in the UK, sales began to take off not only in the UK, but also worldwide in Australia, Taiwan, Hong Kong and many other countries.

I'll Never Have Internet at My Remote Transmitter Site!

One year at the NAB Show, a visitor told me that they would *never-ever* have Internet at their transmitter sites. They said that the sites were too remote and too small and that the bandwidth would never be available. But in the early 2000's the Internet was gaining momentum and the World Wide Web was spreading rapidly. Others were seeing the benefits of using this new technology to speed up and expand the possibilities of their remote site monitoring systems. We shared this view and thought that the sheer potential of the Internet would drive innovation to the point of eventually bringing IP everywhere. So we therefore added some IP capability to our first generation of products, but quickly realized that we needed a whole new design to take full advantage of the Web, Email, FTP and especially SNMP, which we knew would be a game-changer in the broadcast industry. This was also the period when the European Community decided it was time to remove all lead from new products as well as to create a regulatory framework for the electromagnetic compatibility of electronic devices.

With all these constraints, it was time for a major redesign which needed to include RoHS and CE conformity if we wanted to continue selling in Europe and around the world. Our 2nd generation of products was therefore developed and then released in 2007. We had to do this while making sure we retained backward compatibility with our 1st generation as well as a planning a well-defined upgrade path to the 2nd generation.

This is also when we decided to develop our own in-house EMC lab to ensure easier testing to CE EMC, FCC and ISED requirements.

Given the fact that our equipment is often used at sites with multi-kilowatt transmitters and where lightning often strikes, setting up this EMC lab was a great decision. It has ensured that our products are reliable and rock solid for use in broadcast facilities. Shielded chassis, RF gaskets and uncompromising RF engineering are a bit more expensive than homebrew designs, but we think that the extra effort is worth it when so much is riding on the operation of a broadcast site.

Davicom: The Next Generation

In 2018, after 11 years with Generation 2, and mainly because of difficulties in obtaining processor chips and other parts, we decided that it was time for Generation 3 of our Remote Control Systems.

Now identified as the Cortex Series, this generation of remote site management systems allows users to benefit from an HTML 5 interface, but also to use SNMP, FTP, SMTP and MODBUS GPIO. The machine is designed to run on an embedded Linux OS, and as it now stands, our code has over 750,000 lines. Managing a code base of this size would not be possible without using modern software methods such as Agile Development and tools for version and bug tracking as well as programmer collaboration.

Nowadays, having a very powerful and versatile product is not enough to ensure it will be successful. One part of our success has always been our top-notch tech support. Managed by our resident Newfoundlander, Andrew Mulrooney, we are always ready to help, even in cases where, for example, the problems stem from external networking issues not directly related to our products. Since our support team can't be on-line 24/7, we also set up our Davicom Exchange (DEX) Support Portal as the repository of all things Davicom technical. The DEX even hosts an annual breakfast where users exchange information and boast of their Davicom hacks during the spring NAB show.

Lightning Sensors: Davicom Strikes Back

One thing we learned during our DEX breakfasts was that a major headache for many broadcasters was damage resulting from lightning. This led us to look into how we could help broadcasters strike back at this lightning problem, and our family of lightning awareness products was the result.

The DVLD Lightning Detector is an electromagnetic field sensor that detects lightning at distances of up to 40 miles. It allows stations to take protective action, if so desired, by disconnecting sensitive equipment and/or starting up backup generators before a storm blows through. The DVLC Lightning Counter detects if a tower has actually been hit by lightning and safely counts the event. This information can be very useful as an indication of proper site grounding or even to help support insurance claims.

Supply Chain Chaos: Davicom Gets Smart

As many of you may know, the past 18 months have been very difficult in the electronic manufacturing world. Components have become very difficult to source and delivery delays are chaotic. To mitigate these issues, we have increased our parts inventory significantly and redesigned some circuits to allow for use of different parts from various suppliers. Some delays are unavoidable, but these moves have allowed us to keep delivering products during this tumultuous period.

To The Future and Beyond!

As the future unfolds before us with Cloud Computing, Artificial Intelligence, the Internet of Things, 5G and many other technologies, we know we can rely on our tried and true principles of customer-driven innovation, unmatched tech support and reliable products, designed for demanding environments.

To continue responding to customer needs, new accessories and sensors will be coming on-line in the next year. These will be based on technologies fully developed/tested/supported by the Davicom team, and *not* DIY projects designed around hobby boards. Some cloud-based services are also in the works, *but they will always have a fall-back path so that users aren't left high and dry should the cloud service cease to be offered.* Stay tuned!

Oh, and by the way, our 3rd generation Cortex units can still send faxes and communicate over low-bandwidth connections! – *Radio Guide*

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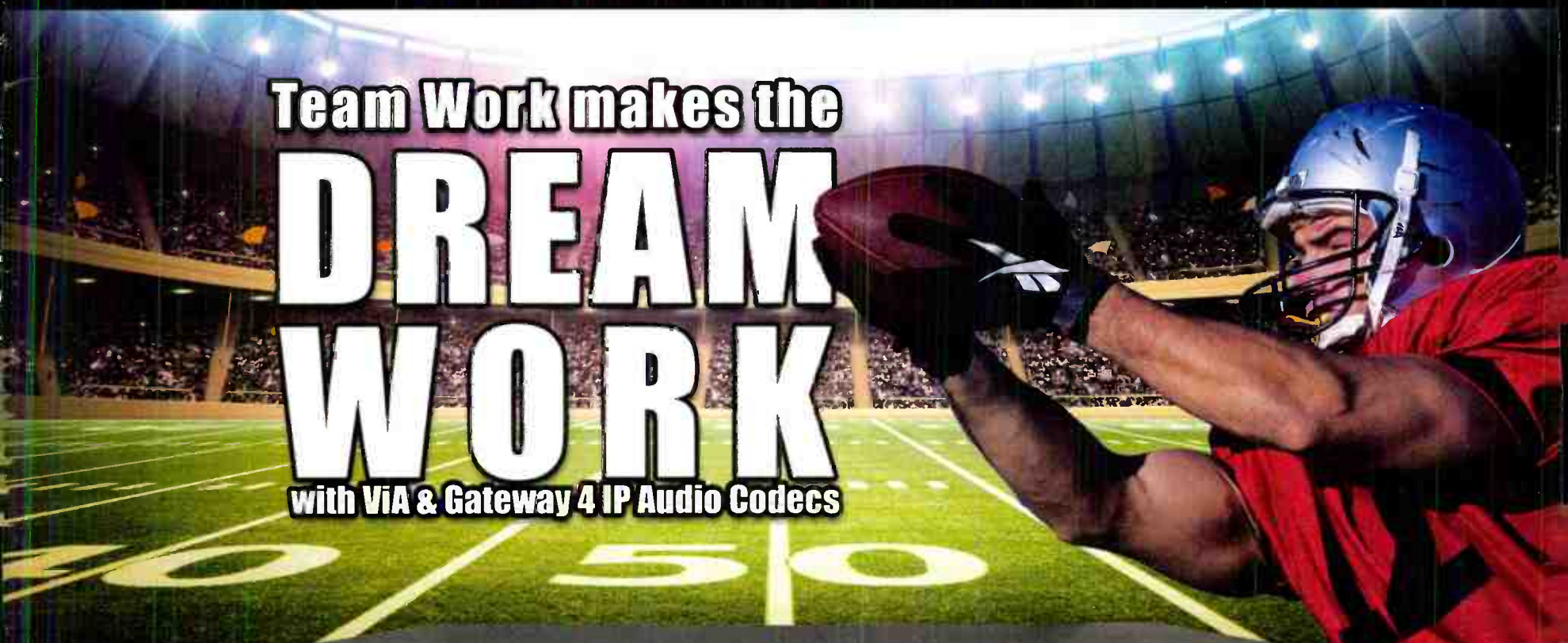

* The Gateway 4 codec supports 4 channels only and is not upgradable to support more channels.

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E-mails, We Get E-mails

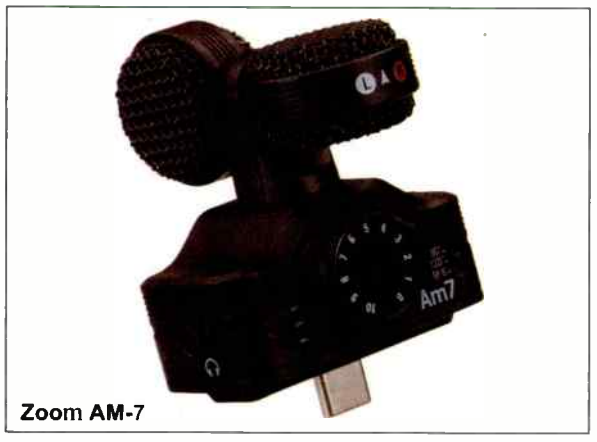
Some interesting recent questions answered.

by George Zahn

At the end of virtually every one of my articles in *Radio Guide,* I solicit your comments or questions. Here are a few interesting questions that have arrived in recent months.

Terry asked about some possible resources for microphones or mixers via USB to record onto a Samsung Galaxy smart phone. First, there are a few quick tips. Basically any USB microphone will likely work with a USB C to standard USB adapter into your phone, so you may be able to choose your personal preference. Many USB mics now have a USB C output, so you may not need the adapter.

If you wish to have a mic connection that is low profile and attaches directly into the USB C port of the phone, Rode makes the VideoMic Me-C USBC microphone for under $100, and it is a directional microphone. I've seen mixed reviews, and one of the most useful comments is that it is a slight improvement in quality and directionality versus the built in Samsung microphone..



Zoom AM-7

If you're looking for a stereo USB C plug in, Zoom makes a Middle Side stereo mike, the AM-7 with USB C connector. It's a low profile small mic that plugs right into the USB C. It has switchable M-S, 90 degree, or wider 120 degree angles. Keep in mind though, that these are small diaphragm mics and may not give the fullest fidelity – but for the price, may be worth a shot if you like to tinker. Some reviews indicate that the mic may wobble a bit in the port. As always advised, read reviews before shelling out the cash.

Get Input Before You Buy

I have used an Audio Technica ATR2100X-USB handheld microphone for Zoom and other interactions on my laptop and the performance is satisfactory. I strongly suggest reading reviews and discussing with other professionals in selecting a USB microphone. The best mic is likely not the prettiest design. Many amateur podcasters who buy these mics are not necessarily savvy to frequency response or other measurements, and some mics will have limited specs listed, so trust your ear if you can compare microphones.

A quick instance: A frequency response of 20 Hz to 20,000 Hz (20 kHz) looks great but it means almost nothing without knowing the variance in that range. A good mic would be 20Hz-20kHZ plus or minus 3 decibels. Most less expensive mics will not show that variance in the specs.

If you have an analog or digital mixer with USB output that you already use, you may be able to simply interface that mixer with the USB C port on the phone to try it. Again, an adapter to the USB C input of your phone might be needed. There are also fairly inexpensive Analog to USB adapters that will take analog quarter inch or XLR inputs and provide a digital USB output for the phone. Having a recording app on your phone would be a must.

A caveat: I have a Samsung S20 with the standard USB C port. While working on this article, I tried connecting my USB C microphone to the Samsung using a USB-C to USB-C cable and the phone didn't recognize the microphone, even when I switched to Pro Video mode on the camera (there is an option there to switch to a USB microphone). I'm still iffy on claims that a straight USB connection will work, and welcome any readers' tips.

Any "Port" in a Storm

Terry, I will tell you that in a pinch, I have used the app Easy Voice Recorder on my Samsung phone. I installed it as a backup in the case of being by chance "in the right place at the right time" to interview someone. Murphy's Law would dictate that at that moment, my Zoom recorder wouldn't be handy, so the app was my backup.

I first used it to grab a few quick actualities at an event I was attending for WMKV. I was actually there in a sound reinforcement technical capacity, but the opportunity arose to grab a few clips for our news, and I whipped out the phone, using the phone's mic, and was surprised by the quality of what resulted.

I have since done a few extended interviews with the same app in a pinch and frankly, the only major coloration came more from the recording area (reverberation, etc.) than frequency response for voice. The Easy Voice Recorder records in .m4a, and is a good option if you have no other availability. I wouldn't recommend the Samsung built-in microphone for music recording.

For analog mic or mixer input, you can also get a USB C to a 3.5mm miniplug jack dongle for the phone, to give you additional audio input. A properly wired XLR to miniplug adapter (usually TRS) would allow most any microphone (save maybe a condenser mic needing outside phantom power) to the phone.

If you're trying to do rough multi-track recording in the field, there are also apps such as n-Track Studio DAW, BandLab, and others that allow you to do rudimentary multi-track production on your phone. I don't think these will replace desktop and laptop editing, simply because the GUI (graphic User Interface) on the phone may be limited.

Splitting Image

A question from Victor on my article on Virtual Virtuosity took the concept of Zoom and other competitors with different participants in "boxes" on the computer screen, and inquired about TV, especially network news programs, having several people from different venues on the same "split" screen. This is often done through either software (especially now with digital capability) or in the "old days" with video switchers which allowed transitions between video sources.

This question has taken me a bit farther afield, but here are some interesting notes on split screen's history. Having studied film and been in media most of my life, I learned some things from Victor's question.

The concept of split screen can be traced back to very early film. The British short film Santa Claus showed what was called "parallel action" in one film frame. The technique was achieved with double exposure by filmmaker George Albert Smith. That was 1898!

TV and film has used split screen for both artistic and practical uses since then. Digital media has made the split screen much easier, but even in my early collegiate training in the 1970s and 80s, the aforementioned video switchers would allow the director to use the output of two cameras, or one camera and a video source, to occupy the same screen.

For television, the technology definitely was evolving before the Internet. Split screen has often been used for two people in distant locations, often one person in studio and a correspondent elsewhere in the city, region, or across the planet (the farther the participants, the more interesting were the delayed replies of nodding reporters waiting the for the signal to bounce off of a satellite to hear the question.

One Track-Two Shots

It seems that some innovative uses of split screen go back to Turner Broadcasting. Among the sources I found, it was TBS that was credited with a split screen experiment in 2000 for a NASCAR race. As opposed to baseball, basketball, football, and hockey, motor sports don't have predictable breaks for commercials. TBS introduced a way of providing the commercial content, split with the continuous action of the race. It later added to the technique by showing pit stops split with the race itself.

We see that today in other applications. Baseball telecasts may feature an interview with a manager or player in the dugout or bullpen. Instead of audio-only, you often see the interviewee inserted as a small "screen in screen" insert. *The Late Show with Stephen Colbert* often shows Jon Batiste and Stay Human playing music for the audience on part of the screen with the commercial on a split screen.

The location of CNN studios in Atlanta also led to CNN using far more split screen than other networks. The reason is almost purely logistical. Just as radio interviews have used ISDN, satellite, split recorded interviews, or CODECS with a host in one city and a guest in a professional studio in another city, CNN had to depend on similar video technology since they weren't centered in New York, Washington, D.C., or Los Angeles where many of the newsmakers are. Other networks had bureaus and/or stations in those markets to give more presence of two or more people in one studio.

One article I discovered was an example of a split screen on CNN of two people (a host and an interviewee) who were just about ten feet apart in the same outdoor setting. Sometimes, split screen for two people in close proximity may be used to isolate one person for later excerpts that would be better as a single shot than a two shot. In audio, we can simply edit the voice clip, but the single shot for video allows the material to be used in different ways.

For post production, there are apps and pieces of software such as Filmora, iMovie, and FlexClip today can be had for reasonable prices to create multiple split screens.

Thanks to Terry and Victor for their input and questions. I welcome any more info from readers with other questions as well!

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*

Chief Engineer

Two Transmitters – Three Issues

by Scott Schmeling

In December of 2015 I started a Word document titled "Scott's Words of Wisdom." The *only* thing there is ... half of knowing how something works, is knowing how it can fail. (I just made that up!) Apparently, I haven't come up with any other nuggets worth sharing since then.

But there's a converse that's also true – *when* something breaks is when you really start to learn how it works! That fact became quite evident for me recently.

We have a 5 kW Nautel AMPFET ND5 AM transmitter built in May of 1990 that's been working almost without fail from the day it was installed. If memory serves me correctly, the only issues we'd had were failures of the RF Amps in the Power Subsystems. That only caused the transmitter to run at a slightly reduced power level while the Power Subsystem was sent back to the factory for repair. Unfortunately, when something works this well, you have to *re-learn* the transmitter all over again when something fails.

A few weeks ago, during the morning show, I heard a little noise (not as much as a "pop"... just a noise), and TPO dropped to *zero!* Thankfully, this transmitter has a spare exciter in hot standby. I flipped the Exciter switch from "B" to "A" and we were back on the air literally seconds after dropping off! *But* (it seems like, so often there's a *"BUT!"*) there was a rather serious hum in the audio. *This* I had encountered once before.

The Exciter Drawer is composed of, among other things, two Power Supplies, two Modulation Drivers, two RF Drivers, and two RF Driver Amps. I was able to pull the Exciter Drawer out of the transmitter and "swap" power supplies – the power supplies are on the *underside* of the drawer. My option was either lay flat on my back on the floor and, working upside down, swap supplies – or pull the drawer and flip *it* upside down. I chose the latter this time.

After swapping supplies, the hum was gone. I checked the schematic and would order a replacement filter cap for the supply. But Exciter B was still not operable.

We do not have a backup for this transmitter, so, since my troubleshooting was going to result in multiple interruptions to programming and the carrier, I would have to come in early-early in the morning. There are times I hear myself saying, 'I'm getting too old for this," and times I really *enjoy* coming in when no one else is in the building. I must be at that transitional age.

Anyway – I came in early a couple mornings later and started tracing signals and comparing exciters A and B to see where the problem might be. Apparently, I should have come in a few hours *earlier* because 5:00 a.m. was approaching and I was nowhere near finished. My plan, before I started actually comparing signals at test points, had been to swap cards or assemblies to see when we would loose output. The only thing I had swapped was the RF Drive Amplifier – and it made no difference. I didn't have time to put them back in their original positions, so I left the amp in the B position disconnected – I'll come back to this later. (By the way, connections on this amplifier are a BNC at the top (RF input from the RF Drive pcb) and a black Molex circular connector at the bottom (for power supply and RF Out).)

Coincidentally, I was contacted by Jeff Welton from Nautel saying he would be in my neck of the woods as he traveled from La Crosse, WI to St. Cloud, MN in a little over a week. I decided I would leave this transmitter issue until Jeff was here.

When Jeff arrived, I gave him the 75-cent tour of our facility, then we started talking about my transmitter issue. All was fine until I pulled the Exciter Drawer out, to point-out what I had done. Remember that I had left the connections to the B RF Drive Amp disconnected? One of those is a BNC. As I pointed to the BNC laying on the drawer shelf (you can see it in **Figure 1**), it slipped down and came in contact with the FET's of the RF Drive Amp for the A exciter – we were *OFF THE AIR!* In hindsight, I should have insulated the BNC with tape or plastic or something but sadly, I didn't.


Figure 1

I'm still claiming this transmitter is so reliable that I (almost) never have to troubleshoot it – hence I'm not as familiar with the "innards" as I'd like to be. But Jeff was here! So, we (he) started checking voltages and checking test points. A quick multimeter test of the FETs in the RF Driver Amps determined one in each was not working like it should. I had two spares in the spares kit. We decided to replace one in each amp. That done, it was still a no-go.

Jeff called Nelson Bohorquez to discuss it and every indication pointed to those FETs. We had used what I had, so replacements were ordered – for Saturday a.m. delivery.

FedEx indicated delivery would be between 8:00 a.m. and noon on Saturday. I got here at 7:00, just in case they were early. Besides, the office is closed on weekends and I wanted to be sure the driver didn't walk away because no one came to the door. The package was delivered at 11:45!

I replaced both FETs in both amps – still nothing. To make a long story short, that Monday I found a blown 1 Ohm, 5 Watt resistor (**Figure 2**) mounted on the underside of the "Transformer Chassis." Of course, there was no spare in the spares kit, so I ordered one. Then I called a TV repairman friend to see if he had one – *he did!* After a quick 30-mile drive to New Ulm and back, I soldered the resistor in place and we were back on!

Full disclosure – Exciter B is still not working ... I'll get back to it.

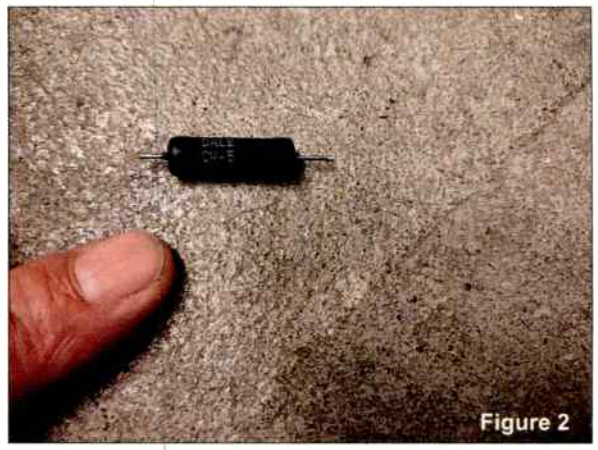


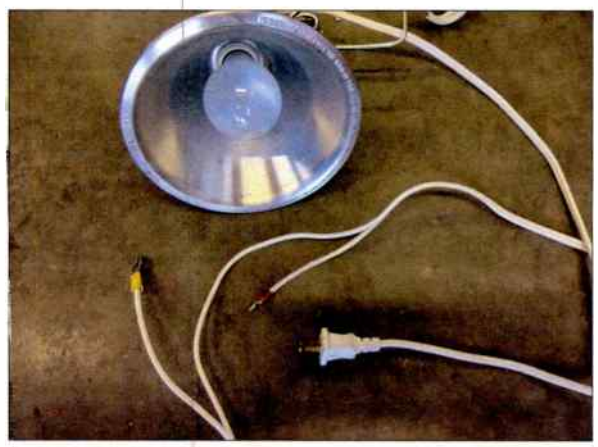
Figure 2

In the meantime, Keith Petermeier from our Marshall location called because one of the FM's running a Harris HT-20 was tripping the high voltage breaker in the breaker panel. He put a lower power backup on-line so we were back on the air, then we talked about it a little bit.

I told Keith that wall breaker tripping was an indication of a shorted high voltage rectifier stack. There had been a time when I seemed to be changing stacks fairly frequently, but I hadn't changed any for some time. I told him about a couple techniques for testing them, but since this was in the high voltage power supply, we both decided it was best if he waited until I got there.

Have you heard of testing rectifier stacks with a light bulb? You can make a tester yourself by cutting the HOT lead of the power cord of a trouble light. Connect the HOT wire (the one coming from the plug) to the AC input of the stack and the wire going to the bulb to the POS, then the NEG terminals. If the rectifier is good, the light will be at half brightness. If the bulb is full brightness, that half of the rectifier is shorted.

All three stacks tested good. Sorry – I don't have any pictures of the light during a test. But I do have a picture of the *modified* light cord.



While I was finishing putting the high voltage vault cover back in place, Keith removed the cover of the PA Cavity – *we should have done this first.*

If you're familiar with this transmitter, you know there are three "hose clamps" that fasten the plate blocker to the tube and the cavity. Instantly, Keith saw that one of those clamps had overheated and broken. The way it landed put a direct short from the high voltage to ground! We cleaned the surfaces where these clamps contact and replaced them.

Maybe the point was made that it's better to look at the broader picture (full transmitter) than narrowing in on one area or compponenet at the beginning.

I think that's going to do it for this time. I hope your summer is going well. And 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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FCC Focus

Advertising for State and Local Issues

Propositions and Referendums

by Gregg P. Skall, Member – Telecommunications Law Professionals PLLC

Earlier this year, the FCC released a Report and Order updating the political file rules to make them consistent with the Bipartisan Campaign Reform Act of 2002. The political file rules now codify the extension of the requirement that any request for the purchase of advertising time that communicates a message relating to any political matter of national importance (i.e. issue ads) requires that specific information be placed in the station's on-line public file.

Upon receiving such a request, the broadcast licensee must place and maintain in their on-line political file, a record of the request together with all the records identified in Section 315(e)(2)1 for issue ads, including whether the request was accepted or rejected, the rate charged, the date and time the ad was aired, the class of time purchased, the issue to which the communication refers, and the name and contact of the individual or organization purchasing the ad. *However, that material is not required for ads that pertain to state or local issues of public importance.*

Propositions, Referendums & the Political File

During the political season, many issue ads deal with how states or local governments should address matters that may also be the subject of national political debate. While the issues might appear to deal with matters of national political importance, and may even be the subject of national legislation, advertising for or against the proposition is focused on persuading registered state or local voters to cast a vote for or against the proposition. In that way, the proposition is uniquely designed and limited to address a local issue, and issue ads of state or local importance are not subject to the BCRA political file rule.

Consider for example a ballot proposition advocating that all school teachers must be vaccinated against Covid-19. Vaccination as a qualification for employment has risen to be a national issue since some states allow it while others ban the practice. But because it would be a proposition on the state or local ballot, the actual issue addressed by the paid advertising would be whether local voters should vote for or against the proposition. As such, it would be reasonable to consider it a uniquely state or local issue.

FCC staff has indicated in similar situations that a matter involving a state or local election is by its nature a local matter, and that it will defer to a licensee's good-faith judgement should it treat it as such. Last year, the FCC released an order that addressed this issue, stating it will apply a standard of reasonableness and good faith decision-making to the efforts of broadcasters to comply with the Political File Order. The FCC concluded that applying a reasonable, good faith standard strikes an appropriate balance between the burdens that broadcasters bear in maintaining full and complete political files and the public's right of access to critical information about issue advertisers.

State and Local vs Federal Issue Ads

For state and local issue ads, the only public file requirement is compliance with the FCC Sponsorship Identification Rule at §73.1212(e).3 The rule requires that where a corporation, committee, association or other unincorporated group, or other entity is paying for or furnishing the broadcast matter, in addition to making the normal sponsorship "paid for" announcement, the station must also place a list of:

- the chief executive officers

-or-

- members of the executive committee

-or-

- the board of directors

in the On-line Public File and maintain it there for two years. The sole exception is where the broadcast is originated by a network. The list may then be retained at the headquarters office of the network or in the public file of the originating station.

On-line Public File Sponsorship ID: Where Does It Go?

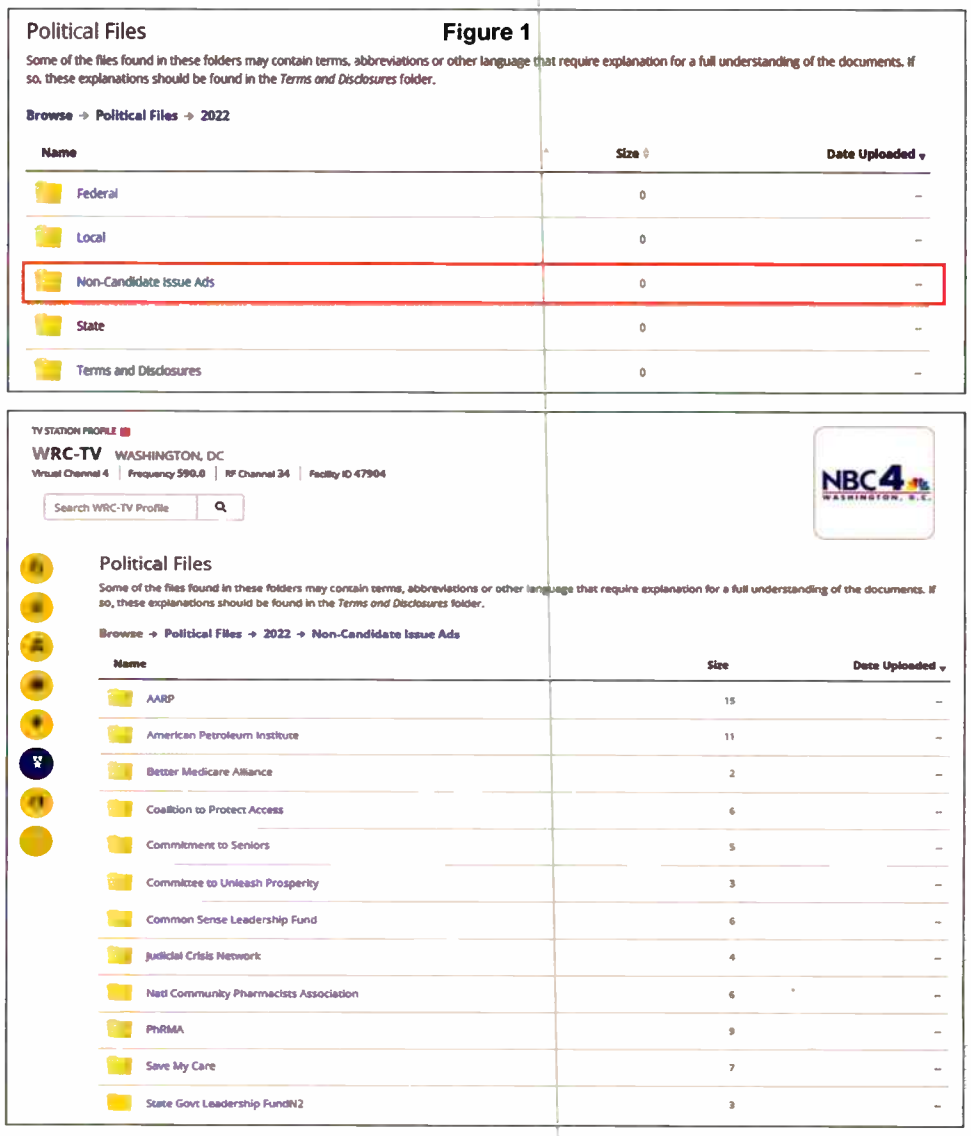
The rule only requires that the sponsorship information be placed in the station public file. As a holdover from the days of the paper public files, it does not specify a particular location in the station public file. Based on discussions with the FCC staff responsible for political file enforcement, it was determined that the station would be in compliance with the rules if it is placed anywhere in the public file, but the logical place for it would be in a station created sub-folder linked to the Non-Candidate Issues Folder in the political file. For ease of reference, a suggestion might be to name the folder, "State – Local Non-Candidate Issues Ads."

The FCC has created a folder, ***Non-Candidate Issue Ads***, in all station political file folders. **Figure 1** is an example from the On-line Public File of WRC-TV, Washington, DC.

That folder is intended and created for National Political Issues of Public Importance. Within that folder, however, a station can create its own sub-folders. The FCC staff thinks this is the natural place for State and Local Issue Ads sponsorship information.

So the station can create a folder titled ***STATE/LOCAL Issue Ads*** for placement of the sponsorship information required by section 73.1212.

Figure 1



Conclusion: ***Create a State/Local Issue Ad*** folder now so you'll be ready for the coming onslaught of proposition issue ads.

This column is provided for general information purposes only and should not be relied upon as legal advice pertaining to any specific factual situation. Legal decisions should be made only after proper consultation with a legal professional of your choosing.

Gregg Skall is a member of the law firm of Telecommunications Law Professionals PLLC. He frequently lectures on FCC rules and regulations, represents several state broadcaster associations and individual broadcasters and other parties before the FCC.

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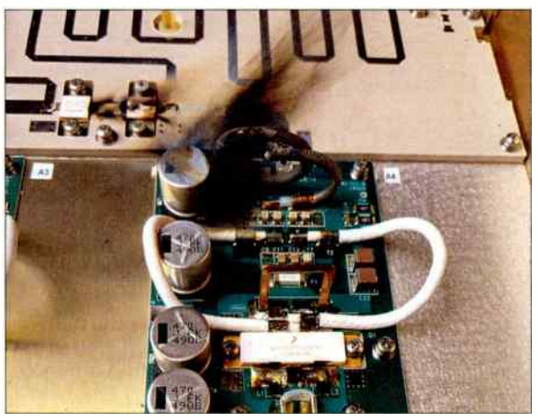
Inside the Box

Fan Speeds and Heatsink Temperatures

by Paul Thurst, CPBE

Routine maintenance is key to reliable transmitter operation, long-lived power amplifiers, and working switching power supplies. Almost all modern radio broadcast transmitters operate various solid state devices which are temperature sensitive. Gone are the days of the big tube transmitter cranking out power at an unconditioned transmitter site with an outside temperature of 98 F (37 C).

Solid state RF devices are expensive to replace. Failed devices will often lead to unbalanced power in amplifier output combiner which can stress additional parts and create more failure points in load reject resistors or coaxial load impedance transformers. Often, downstream damage from a failed device is worse than the failed device itself. I have seen reject load resistors burned open and traces burned off of combiner boards from unbalanced loads.



Switching power supplies also have several semiconductor devices that are sensitive to heat stress and expensive to repair or replace. All of these systems require cooling and more often than not, cooling fans.

All cooling fans have some type of motor bearing which, after many years of service, will eventually wear out. Regular readings on fan speeds and/or heatsink temperatures will show a trend over time. As bearings wear down, fan speeds slow down and heat sink temperatures will rise.

FM5C TRANSMITTER

SYSTEM:

FWD PWR	4.5	KW
RFL PWR	[illegible]	WATTS
P.S. VDC	43.7	VOLTS
INLET TEMP	20.6	Deg. C

Figure 1

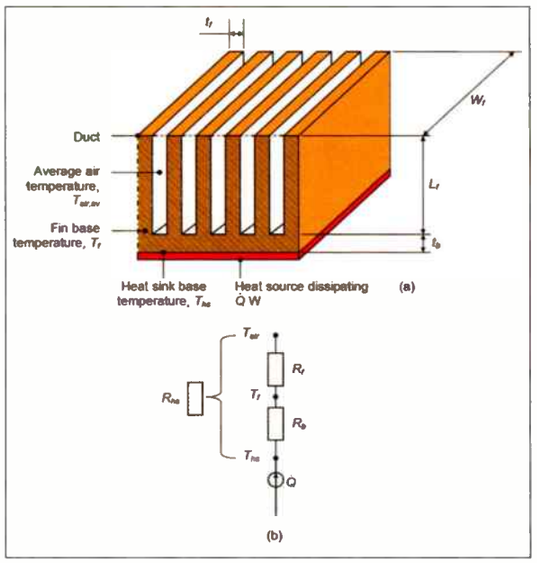
MODULE	FWD. PWR	PA CUR	PA VDC	TEMP
1	475	15.1	43.5	42.3
2	486	15.1	43.4	39.2
3	487	14.9	436	42.7
4	473	14.9	436	38
5	483	15.1	435	42.9
6	487	15	43.4	36.3
7	482	15	43.5	42.3
8	472	14.9	436	37.1
9	484	15.1	43.6	40.3
10	490	14.8	435	37

EXCITER

FWD	126W	WATTS	PAI	7.4A	AMPS
REFL	3w	WATTS	AFC	6.1V	VOLTS
PAV	23.8V	VOLTS			

While most solid state transmitters have high temperature shutdowns to protect RF devices, like all control and monitoring circuits, they can malfunction or become miscalibrated. Further, a transmitter shut down on high temperature takes the station off the air. Many smaller stations no longer have backup transmitters nor do they have a lot of money to replace transmitters every few years.

Figure 1 is a maintenance log for a Broadcast Electronics FM5C. This transmitter uses MRF-151G RF amplifier devices. The maximum junction temperature for this MOSFET is 200 °C and the efficiency is 50%. At full power, each device in this transmitter has to dissipate 300 Watts and there are twenty of them. This particular station has a TPO of 4,800 Watts. This transmitter must be able to dissipate 4,800 Watts of waste heat continuously.



Heatsink Thermal Resistances ***(Courtesy of Wikimedia)***

Heatsink thermal resistance depends on several factors; the material the heatsink is made of, the area of the heatsink base or spreader (area connected to the semiconductor device die), the thickness of the heatsink base, the area of the heatsink fins and the flowrate of the heat transfer medium across the fins. The greater the temperature differential between the heatsink base and the ends of the fins, the lower the heat resistance in the heatsink and the more heat can be dissipated. Thus, a consistent volume of air is required.

This maintenance log (**Figure 2**) shows that the heatsink temperatures on RF modules 3, 5, and 7 are going up by a good amount (almost 10 °C in some cases). Looking at the front of the transmitter, we can see that those modules are in the middle of the transmitter on the upper level. Obviously, this is something that needs to be investigated.

The first thing to look at is the air filters for blockages or other issues. Air filters need to be checked and cleaned or replaced periodically as needed. This transmitter has a cleanable metal mesh type filter that can be rinsed with warm soapy water and vacuumed with a shop vac. This particular site is conditioned, so it is a closed system and stays very clean. At transmitter sites that use outside air for cooling, dirt, dust, dead insects, or other debris can get caked to fan blades causing a drop in efficiency as well as premature wear on motor bearings. If the site is not kept clean, the fins on the heatsinks can get clogged which will greatly reduce heat transfer efficiency. While it is more expensive to install and maintain air conditioning units, in the long run, it reduces the need for transmitter cleaning and the associated labor costs. Closed systems generally have longer lived transmitters (depending on other factors such as quality of installation). Besides, it is kind of a drag to clean caked on dirt off of heatsink fins.

FM5C TRANSMITTER

SYSTEM:

FWD PWR	4.5	KW
RFL PWR	[illegible]	WATTS
P.S. VDC	43.6	VOLTS
INLET TEMP	22.7	Deg. C

Figure 2

MODULE	FWD. PWR	PA CUR	PA VDC	TEMP (°)
1	465	15.0	43.3	52.9
2	481	14.9	43.3	43.4
3	478	14.8	43.4	55.3
4	463	14.6	43.3	44.8
5	466	14.7	43.4	57
6	482	15.0	43.2	44.8
7	467	15.2	43.4	60.1
8	457	14.9	43.4	46.5
9	475	15.2	43.4	47.6
10	466	14.6	43.3	42.5

EXCITER

FWD	130	WATTS	PAI	7.6	AMPS
REFL	3	WATTS	AFC	6.3	VOLTS
PAV	24.2	VOLTS			

Another useful thing to look at in this situation are the PA module currents which would indicate a load or combiner issue. Higher module currents would require more heat dissipation. As there is no significant change in the current readings, I can deduce that the middle cooling fan in the transmitter is slowing down.

The original fans used by BE are Comair Rotron CLE3L2 with 550 CFM at 0.33 inches water column. At some point, BE replaced that model with an Orion Fan OA254AN-22-1TB. This unit is the same size but moves slightly more air than the OEM fan. Due to supply chain issues, BE did not have a stock of these units, so I had to source three of them from the outside world. Mouser had them for $85.35 each. When looking for suitable replacement fans from non-manufacturer sources, several specifications are important; operating voltage, physical size, frame type, airflow rate and operating pressure. Airflow is very important since this was the manufacturer's original design criteria for proper operation of the RF devices.

Two of the fans were original to the transmitter (1998) and the other one was replaced in 2006, I figured it was best to replace all three at once. The station does not have a backup transmitter, so some early evening work was scheduled. It took about 30 minutes to replace the fans, including soldering the leads with the Molex connector onto the new fan's lugs. After I was done, I went and ate some dinner then came back to the site to check on the heat sink temperatures. After an hour or so of operation, they all returned to factory test sheet values, which is a good outcome.

It is nice to catch these issues before the station goes off the air on Christmas Eve. Since this is a locally owned and operated station, they do not have a huge equipment repair and replacement budget. As contract engineers, our most important function is to keep equipment operating and in a good serviceable state for as long as possible. Good maintenance processes might be dull and unglamorous, however, it is the core of our existence.

Paul Thurst, CPBE, is co-owner of Data Wave, LLC. He can be reached at paul.thurst@datawave.us

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Engineering Perspective

Know When to Say No

by Steve Callahan

We radio engineers are busier than ever, trying to keep multi-station clusters, with tower sites in all different directions, on the air. We all have more complex studios that ever before and it seems with smaller and less experienced air staffs that need instruction and constant guidance.

We are also trying to do a lot more with a lot less budget than just a few years ago. Sometimes we just have to say "No!"

It's in Our DNA

We are radio engineers because we like to make things work. Nothing is more satisfying than to hit the "plate on" button of a previously dead transmitter and have it spring back to life. As kids, we took things apart and put them back together again.

It's in our DNA to be able to rationally work through a technical problem, come up with a resolution plan, execute that plan, and have the outcome be successful.

Fast Forward to 2022

You have to budget your time carefully and be constantly ready to revise your list of priorities based on the next unanticipated emergency.

I start off each week with a very long list of things-to-do, which are subject to constant change throughout the week.

Some are legitimate problems that need immediate attention and some are not. However, as radio engineers, we frequently take on any project that is dropped in our laps.

I'll admit that years ago I once was asked to go to the general manager's house to hook up his personal stereo. If I hadn't helped him, his stereo would still be sitting in the box today. You want to be a team player and help the boss, but your time is a very perishable commodity.

Protecting Your Time

I hear stories all the time about station engineers who are pressed into service painting the studio, or moving surplus office furniture to the transmitter site.

All too often, we allow others to hijack our time and resources and we have to later adapt. If you find yourself being hijacked constantly, you have to know when to say "No!"

Not the Plumber

When I was the Chief Engineer at a station in Boston, I got a frantic call from the sales manager that there was a flood in the sales area. I immediately ran up the hall and what I found was a wave of water coming from a stopped-up toilet in the ladies bathroom.

Apparently, no one else could figure out how to work the moving parts in a plunger so I solved the problem.

I could have just said no at the time, but I first resolved the problem and then suggested that we have a plumber's number handy for the next time it occurred.

Not the Mover

I once worked for a station that was consolidating from two floors in a downtown office building to one floor. The station owner didn't ask but demanded that the entire staff meet on a Saturday to move office furniture down one floor, and to store anything not immediately needed at the AM transmitter site.

This was so wrong for so many reasons. Aside from hijacking the entire staff's Saturday, someone could have been seriously hurt lifting file cabinets and desks.

A better way of handling this would have been to pay a moving company that does this type of work everyday, and use it as an introduction for the sales department to get a possible advertising contract from the moving company in the future.

Your Time Has Value

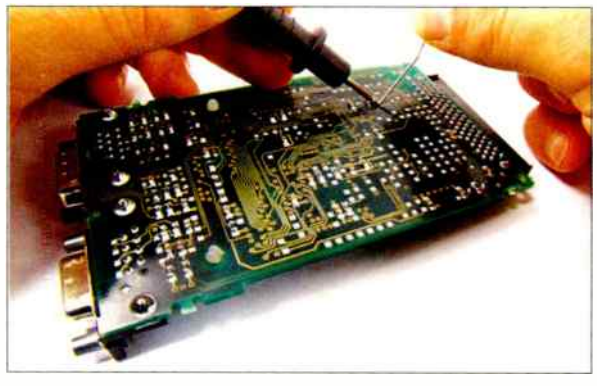
Take a look at what your IT consultant bills per hour or what it costs to have a mechanic work on your car. Both are probably billing a very healthy per-hour rate.

Most electricians or plumbers won't walk in the door for less than $80 to $125, to cover their first hour of time and overhead.

I have a friend who paid $150 for a service call on his washing machine. This was the minimum charge for a tech to drive to the home, 15 miles one way, evaluate the problem and perform the repair (*if* it took less than an hour to fix the problem). If not, it was an additional $75 per hour after the first hour. The tech had the part in his truck and was on site for just 20 minutes.

So What Are Your Skills Worth?

If you do contract work, are you billing at the market rate? Are you getting paid for your experience and knowledge? How about for your travel and tools?



I once did contract work for a station owner who paid me with a lunch he traded at a local diner, and a traded tank of gas. However, the station owner drove a new Mercedes. It took me several months to realize that it would not get any better at this particular station and I knew when to say no.

Don't Work Cheap

A fellow contract engineer told me recently that he works so cheaply because if he didn't, the station owner will just find someone else to do the work. This is the mind set of far to many contract engineers.

I had to explain to this misguided individual that good, reliable contract engineers don't have to accept a low rate for contract work because there aren't as many of us available these days to do the work.

Ask around at your next SBE meeting and see what other contract engineers are getting paid in your area, and then adjust your rates accordingly and hold your ground.

Don't be afraid to say "NO!" to that station manager or owner who doesn't respect your time and talent. Often they will threaten to get someone else for less, but this is sometimes just a tactic to drive your prices down. Whatever you do, try not to fall into their trap.

Use references from other stations to support your pricing structure and the value of the quality work you do.

Be Proactive

Too often we are the "guy with the tools" who sits in that room with all the machines.

It's been preached before, but you have to demonstrate that you are a part of the station's management team and that your knowledge, experience and talent are a part of your station's success.

Have you ever taken your general manager to your transmitter sites? My personal policy is to maintain the appearance of my sites so that an owner could visit unannounced at anytime and be proud of the way it looked. It doesn't take much to keep the inside of a transmitter building clean and looking like a professional work space.

Make the Station Money

When was the last time you offered to generate income for your station? Station owners and managers rarely hear those words from their engineer's lips!

Do you have a possibility to rent or lease your surplus tower space? How about leasing your FM SCA?

Is there another AM station in your market that could benefit from diplexing with your station? Talk with the GM about these – it will show that you are thinking like they do.

Don't Speak a Foreign Language

We radio engineers speak a strange and foreign language that only we understand. Try not to speak engineer-ese when you are communicating with other staff members. Learn *their* lingo so you can better understand what they are trying to do with the limited resources they have.

Whether it's the on-air staff or the sales staff, if you express interest and really listen to what they are doing and their problems, then you will get a much clearer view of what they really need you to help them with.

Time to Walk Away

A while back, I had the opportunity to visit a nearby AM station that was interested in having me do some contract work for them.

I spent some time in the studios watching the station employees struggle with broken and ancient equipment. I took the time to examine their Public File because I've found that the maintenance of the Public File is a clear barometer of how serious a licensee is of properly operating its radio station. I spent some time at the station's tower site with the local manager and took copious notes.

When I spoke to a representative of the licensee on the phone, I was not surprised when he immediately said that his station was a rundown junkyard because of the "economy."

That signaled loud and clear to me that he had no respect for his employees and his few listeners, and that I would have to fight for every dollar needed to bring his station into the 21st century – and to even get a paycheck for my efforts. I terminated the telephone conversation, and just said "No!"

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

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So you want your headphone monitor feeds to sound great. Really great. As great as your station sounds. Problem: it's nearly impossible to monitor processed audio live these days – because, you know, latency.

Just so happens we have a gadget for that: the Chameleon C3 Headphone Processor.

C3 delivers that huge radio sound right to your headphones, instantly.

The technology of Audio Chameleon was invented by Cornelius "Corny" Gould, so of course it sounds amazing. Punchy, powerful audio that sounds just like you're listening off-air, but with a clean, open soundstage that's never smashed or clipped.

To top it off, the high-fidelity headphone amp delivers enough headroom to ensure that every nuance comes through crystal clear.

Your talent gets that great "radio" sound they love. You get their gratitude, which you'll love. And at just $689 (MSRP), you can spread the love around with a C3 at every talent position. But wait: there's more!

AUDIO CHAMELEON

Delayed Gratification.

Why do they call it "live" streaming when so many streams sound lifeless? They'd all sound a lot better if they were processed. But who's got time to fiddle around with that many processors – let alone the budget?

Have we got a solution for you: the Chameleon C4 Livestream Audio Processor. Unlike other processors, Chameleon uses an advanced form of A.I. that continually adapts its processing parameters to optimize incoming audio.

The C4 has a precision look-ahead limiter and loudness controller that conforms to both existing and proposed loudness recommendations from AES, Apple, Amazon, etc. You'll be legal before the laws even exist.

The result is fantastic. Livestreams have never sounded so great – smooth and clean, with dynamic control that makes every stream sound fuller and more lifelike, but never "busy" or over-processed.

Some broadcasters will even use it to process HD channels. Only $989 (MSRP)? Operators are standing by.

Chameleon is streaming now at www.AngryAudio.com. Hear it for yourself and you'll be hooked.

Power Principles

Solar Technology Today

by Wiely Boswell

Solar collector panels are creating more electricity today than ever. Now they are called PV, Photovoltaic panels, and they have been around for years. Today, solar collectors have been incorporated into some serious systems touting a high output per square foot of panel. These systems have been made possible by high efficiency switching power supply technology combined with processor control and a whole new chemistry group of batteries. Wind power has come a long way also. They are very mechanical and the true life expectancy of these, like PVs, is just being to reveal some service history.

So much is being discussed today, about energy and where we are going to get it – today and in the future. What really is the best? Should we just drop everything and plug up all the wells and plug in cars? Well, that's just not possible but will happen eventually. The entire battery swap out idea may help the time-required-to-charge drawback. We should always be coming up with ideas and testing new sources. Just one big technical breakthrough could make gas powered cars obsolete. It would result in our national fossil fuel resources losing value. From what I have heard, other countries have all the natural resources required to make the critical parts needed for electric cars and PVs. With all the push to go low emission, I keep thinking we need to get our wells going strong, providing jobs and producing lots of revenue while we can, before something replaces fossil fuel.

Technology in batteries has come a long way. Solar power battery management has also come a long way. I have recently gotten a lot of experience with a large array, built by a friend of mine that got bit by the bug. He really likes the idea of getting off the grid. It certainly ends up costing a lot for what he put in. I would like to take some time here to look at this technology.


Figure 1

Figure 1 shows the panels installed at the edge of a pond. The location was such that some reflection from the pond would hit the panels at a certain time of day. These are fixed panels, so the power drops off rather fast when the sun starts moving off of a 90 degree angle to the panel. They also have to be cleaned occasionally for best performance. These arrays are split in half and each half has its own power controller that work in tandem to charge the batteries. Each half outputs roughly 150 VDC. There are monitoring devices that show the detailed status of the system.

Figure 2 shows two large gray power charge controllers at the top. Controller 1 on left is the master control and controller 2 mounted on the right, tracks with controller 1. There is a low amperage fuse in #1 which makes it the master and no fuse is in #2.

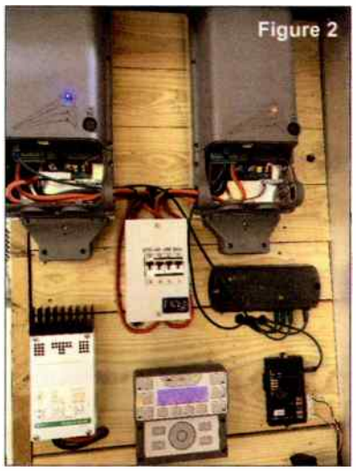
Figure 2

The panels in full sun feed 150 VDC. into the controllers and the output goes to a 48 VDC battery string through breakers shown in the middle. The controllers float the batteries, based on a setting in the controller, at a voltage appropriate for the type of battery, and is charged based on its charge characteristics. There are basically two stages – bulk charge and absorb charge – and it ends at a float voltage.

The bulk charge is basically the main charge which typically brings batteries back to 80% of full charge. The absorb phase takes much longer to "top off" the batteries. At full charge you then need a productive load to use the excess power to keep from wasting it. You hear about car charging stations and the bulk stage is the high current initial fast charge. It is a current limited charge and then voltage limited in absorb phase. The box below the right controller is basically an IP switch that allows components to talk to each other and can feed the Internet for remote access. A voltage state of charge monitor is the black box on bottom right. On the bottom in the middle is the main control. It can watch the batteries, the array, and diversion of power to an inverter that powers any 120 VAC gear. A generator can be a controlled, as well making it an off-the-grid operation at that point. These are very specialized components for solar, wind turbines, or hydro power. On the bottom left is another small controller. It regulates charge as well and in this case takes power from a small water turbine. **(See Figure 3)** The water gravity feeds from the pond in on both sides to the turbine using jets. Depending on water flow and pressure, more jets can be added to increase output. The whole assembly lifts up for maintenance, only requiring disconnecting a main water line union. Water systems require inlet screen cleaning and jet cleaning.

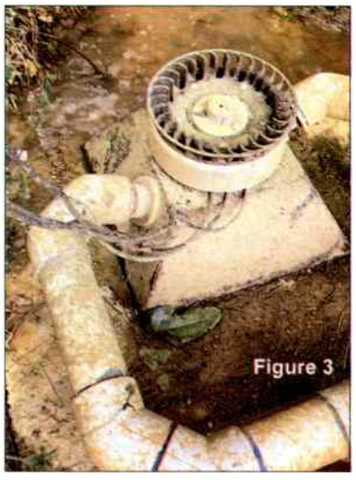
Figure 3

This permanent magnet based generator has a three phase output. There is a three diode rectifier that rectifies the voltages into somewhat rippled DC to the small controller. The batteries are professional recombining gel cells made to withstand the heat in an outdoor environment. So when you consider the tax incentives that encourage massive deployment of all this equipment (Solar is required on all new houses in California since 2020), and knowing it does not last all that long, we end up with a lot of hazardous waste; so we have a whole new problem.

Figure 4 shows the system batteries – two 48 VDC strings in parallel, a large main breaker for batteries, and an inverter at the top providing 120 VAC for loads.


Figure 4

I have read that quite a few stations in the US are proudly using solar power. It really is a draw at this time comparing money saving verses expense of batteries, power converters, solar panels, installation and taking into account life span. There are serious variables such as the cost of electricity and equipment to consider. If you have a mountain site with no power, it could easily prove viable and have a backup propane generator. Panels can also have a lot of wind loading in the open requiring some costly large base and frame supports.

A premium system would incorporate sun tracking, to provide maximum power available all day and during different seasons.

Panels are rated at max open voltage (Voc) and max short circuit current (Isc). Manufacturers specify the maximum power deliverable by the correct voltage Pmax (Vmp) and a certain current Pmax(Imp). The more directly you can use the power the less conversion loss occurs. One very practical direct function is to supplement power to a mini split HVAC system. When the sun is the strongest, the panels work hard when you need it the most. These systems typically take 220 VAC and convert to some where around 260 VDC to run the variable speed motors in the system. They also have a soft start-up load.

If a panel array can produce >260 VDC, and was diode steered into the power circuit, it would start taking the load away from commercial power. Split systems such as this are available and the savings are translated to the SEER rating of the unit. SEER ratings as high as 35 can be achieved.

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

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Facility Focus

Rats and Other Small Stuff

by Tommy Gray - CPBE CBNE

Hopefully this time, the title of this article got your attention. Though I am an engineer by trade, I usually write on IT topics, especially Linux related. This time however, I am going to deviate just a tad, because of several things have happened since my last article. First off, I have come out of "semi-retirement" and started a new job, and have moved off from my normal habitat. In the routine of my new position, I did an inspection of several properties owned by my new employer. A young man who had been groomed to be CE here unexpectedly passed away, leaving them without engineering help for a few months, and in the interim a retired contract engineer came in to help out. Because his time was limited, all he was able to do was just keep them on the air. In the midst of all that, the former Corporate Director of Engineering retired and moved across the country. This left them in a fix. Some projects that were in progress immediately came to a screeching halt.

One such project was the rebuilding of a small transmitter site up in Kansas where the rural power company for some reason, lost the neutral, and caused serious damage to almost everything in the building. Over the ensuing months, the young man who was CE had been spending a lot of time at the site, which was very far away from where he called home. He had managed to get some things working and had filed an STA and put the station back on the air with an Internet link and a Crown exciter and amp.

He then set about to try to rebuild the transmitter. He had a lot of it repaired and was making good progress when he unexpectedly passed away. So as a result, the site was left abandoned running on the small amp for several months.

When I came on board, I set out to inspect all the properties in our cluster and when I came upon this one, I was shocked. We opened the door of the site, that had been left on its own for about three weeks, and the place looked like a tornado had gone though it! Something had been in the building and totally worked it over. Hence the title "Rats!" Somehow, and we have not figured out how yet, they had infested the building and done more damage in those three weeks than I have ever seen in a site before. Almost nothing was left undamaged, and ironically the amp and Internet box that was sitting on the very tip top of the rack, with the cabling coming in from high up on the wall, were the only things untouched and the station was *still* on the air!

The main reason we went to this site first, was that the remote control had stopped working and we were not able to take meter readings or control the site. When we came into the building, it was immediately apparent why this was the case. The first thing I am going to show you is a picture of the backside of a Sine Systems RP-8 relay panel. At first, I thought someone had taken a pair of cutters and snipped off all the cables. Look at the picture and you will probably think the same thing. When I saw it, is when I started looking at everything else and found out that critters had been at work.

As you can see, they did not leave much. Fortunately they did not chew up the connectors. They ate the phone cables and the power cable. Since we did not expect to have to make this kind of repair, we did not have any spare cables or many tools with us on this trip, so we had to schedule a contractor to seal and paint the building to hopefully eliminate any future infestation. Looking at the following pictures, someone will invariably mention, "Did you wear a mask?" Well on this day, we did not because we weren't expecting rats, so we quickly took pictures, took a quick look to determine what we needed and left, planning to return with everything necessary to clean up the site and clear the infestation.

Sine Systems RP-8 that the Rats had for Breakfast!

Since it was known that the former engineer had managed to get a lot of stuff fixed and had it almost ready to put back together and fire up, we weren't expecting some of the other things we saw. In this picture you will see the inside of the newly repaired transmitter.

Harris Z5 Transmitter ***(Rodent Playpen)***

As you can see, they made a new home inside the front of the transmitter. There were some boxes and packing materials in the corner of the building and they literally shredded them to make bedding and the transmitter became the *"Rodent Ramada."* With all the feces and debris, it was looking more and more like the transmitter would be a loss and resigned to the trash bin. After looking at other places inside, we discovered that the wiring harnesses had met the same fate that the Sine unit did and they were destroyed. What the power company did not blow up the rats ate! So now our plan had changed dramatically. We knew this was a "Parts Transmitter" from now on.

We left the site and headed back south to Oklahoma and began to make plans as to how to restore the site to fully operational status. First of course, was to clean out the building and evict the new tenants! So I made a few calls to contractors to clear out everything and seal and paint the building in preparation for the new equipment. We had a spare transmitter at another site down south that was available to use there for a while, that would make full power. After looking at my pictures later on,, I discovered that apparently the rats loved the light gray insulation on some cables and not the other types on some others. They ate the gray ribbon cables, and the gray phone cables, and ate the insulation off a multi-conductor cable that had been on an old remote control in the rack but did not eat the colored wires inside the cable! In the next picture you can see what I am talking about.

They loved the light gray soft insulation and the small stranded wire.

If you will look at the individual strands of colored wire going to the old Gentner remote control, what you don't see is that they ate the outer jacket off the cable but not the wires! Strange for sure. In case you are wondering, that gray power cord in the picture is hanging in space in the center of the rack and they apparently did not want to perform an acrobatic act and try to get it. It came off the power amp at the very top and I guess they could not climb up there to get at it. In a future column, I will share some pictures of the finished rebuilding of the site, and hopefully it will look much better! As they say, "Stay tuned for coming attractions!"

Other Small Things

One of the things I ran into when I got to the new abode was a very nice Gatesair FAX 20 FM + HD transmitter that was being monitored and controlled through Splashtop and the Internet. Since there was a computer at the site that the Gatesair GUIs were being displayed on, for both the exciter and the transmitter, it left me an option. Of course, there is no way to monitor anything in the building except the transmitter (unless there are capabilities I have not run across yet), I saw a perfect opportunity to use an Arduino to monitor building power, air conditioning, alarm system, etc. Having a trusty Arduino Mega with an Ethernet interface already on it. I set about to take the software I had developed early on in my Linux articles, pick an IP address on the local LAN and compile it – then pare it down to just a few basic functions to fill in where the transmitter GUI was deficient. If you have these or maybe a Nautel (or others) and don't have a full blown remote control, stay tuned to the next article and I will share some basic and easily modified code for the Arduino to "fill in the gaps." The beautiful part of that is all of it can be done for way under $100!

Until Next Time!

Tommy Gray is a veteran Broadcast engineer currently serving as the National Director of Engineering for Stephens Media Group, headquartered in Tulsa, Oklahoma.

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Is It Time to Turn Off the SCA?

By Steve Callahan

I was at a radio station the other day,, that I knew had a radio reading service on their SCA or Subsidiary Communications Authorization. My trusty portable SCA radio told me that there was no modulation on their 67 kHz SCA. The station manager was confused and showed me the radio that they use for off-air monitoring which happened to be an Internet-capable radio tuned to their webstream. I asked how long had the over-the-air SCA signal been silent and the general manager shrugged and said, "probably months."

Back in the early days of FM radio, it was pretty special to have a multiplexed stereo signal and even more special to have an SCA. Early on, the uses of a station's SCA were limited to a reading service for the blind, the Physician's Reading Service or the relay of remote control telemetry from the transmitter site back to the studio. The remote control commands were relayed to the site transmitter site via a TRL or Telemetry Relay Link on a narrow 450 link. Some early FM stations, which had affiliations with newspapers, experimented with an overnight, SCA delivered, facsimile headline delivery service that never really caught on.

Back many years ago, I worked at an FM station that played entirely instrumental Beautiful Music from hundreds of 10-inch metal tape reels which I was responsible for loading in the correct order during my eight hour shift. Around the corner from the main channel automation was another automation system for the station's SCA-delivered background music, which used 14-inch metal reels, which moved very slowly, and were recorded on four mono tracks which the automation played sequentially. I didn't have to change the 14-inch reels as often as the 10 inch reels but I learned very quickly never, never, ever let the SCA tapes run out, because the station was making more money from the SCA than from the main channel. Seems they had an awful lot of stores and restaurants in the area as their background music clients.

Years later, a company called Cue Paging approached a station I was working for with a proposition. They wanted to use our station's SCA to talk to their pagers (you do remember pagers don't you?) and, of course, station management couldn't wait to sign up as long as the station was going to get paid. They even gave us a couple of free pagers for us to use at the station which, or course, went immediately to the engineering staff. Cue Paging was very technically adept and designed and built their own hardware to interface to the station's signal.

Everything went well, with Cue Paging paying their bills to the station and selling their paging service, until the FM station I worked for dropped off the air and the station management tried to page us with the SCA pagers. Management hadn't thought that if the station dropped off the air, there wouldn't be any SCA and therefore, no paging.

The next day we got some real pagers and not too long after that, Cue Paging disappeared, leaving all of their proprietary equipment behind.

In the early days of SCA, many stations were skeptical of adding an SCA channel because SCA generators were very primitive and often there was a fair amount of "birdies" or sub-to-main bleed or crosstalk. Program Directors were especially wary of anything that might impinge on their music, even if it meant "non-broadcast revenue" to the station. There were many brands of SCA generators, some you would know and some with no manufacturer's label.

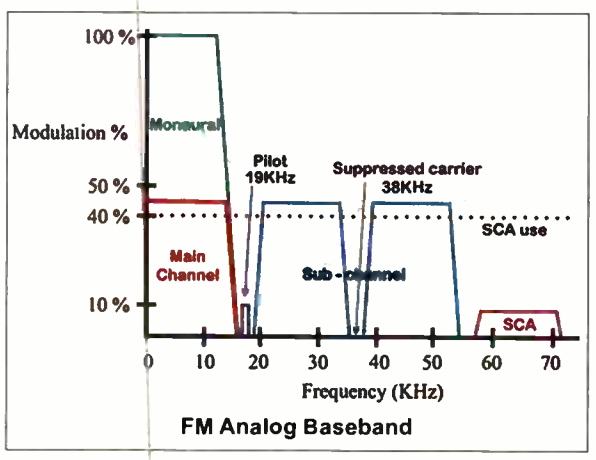
CRL Systems Model SCA-300B Modulation Generator

Enter Eric Small, a truly brilliant scientist who invented and developed the Modulation Science Sidekick SCA generator. It had some truly great solutions for problems that had plagued SCA operation for years. You could loop the station's composite signal through the Sidekick if your exciter didn't have an SCA input – and many didn't in the early days. There was a built-in crosstalk tuning feature that was very handy but, most importantly, there was integrated audio processing. Other SCA generators depended on external audio processors which were of dubious quality. Many times, when station management said they had a previous bad experience with SCA crosstalk into their main channel, I offered to do a little test. I told them that I would install the Sidekick and if they could listen to the main channel and tell me when I turned it on, I would immediately take it out. No one ever heard any "birdies" from a well-installed Sidekick and I installed quite a few.

Modulation Sciences Sidekick SCA Generator

Radio Reading Services for the Blind used SCA's for many years. Almost every state had a reading service and I built the Massachusetts Radio Reading Network starting with an SCA on a local FM station, WATD. We then expanded to the SCA of WERS, Emerson College's student radio station. We then added a third affiliate, WSMU at Southeastern Massachusetts University. Off-air relaying the audio from station to station was challenging, because the 67 kHz SCA comprised only 10 percent of the station's total baseband. We were quite proud to be able to relay the WERS SCA from Boston to Worcester's WICN, which was a 60 mile hop which gave us a fourth affiliate.

As with any "daisy chain" relay, there are small amounts of noise which is added by each relay and has a cumulative effect at the end of the chain. To go further west, we utilized the TV equivalent of an SCA or a SAP, which is Secondary Audio Program. This enabled us to use the higher power UHF TV station to get all the way to the New York border. It also gave us an extra benefit of bringing our signal, via SAP, into each of the cable systems serving the state's 351 cities and towns. It was then simple to provide an audio feed to any or Public, Education or Government channel (PEG) that wanted our audio on when they weren't feeding programming.



FM Analog Baseband

One problem that plagued SCA delivery of programming to the blind was the SCA receivers that the services "loaned" to their listeners. They were approximately $100 each and had to be fixed-tuned to pick up the intended SCA channel. The background music folks didn't want anyone getting free access to their background music! To make operation simple for someone with little or no sight, there was just one knob which was for on and off and volume control. Names like McMartin, Norver, Compol, Metrosonix made SCA receivers, which came and went through the years. At one point Panasonic built a prototype SCA receiver which we field tested and found it was excellent. We reported back our findings to Panasonic and they decided not to mass produce their SCA receiver because of the limited marketability of it just to SCA users.

Another SCA use was for foreign language programming. If a market had a large foreign speaking population, some enterprising member of the community would lease a station's SCA and then sell SCA receivers to his fellow countrymen.

In recent years, the Internet has substantially changed the SCA world. Blind listeners can use Internet radios or voice-recognition devices to connect to reading services. Many states have shutdown their statewide reading services but several still exist and continue to provide a valuable service to their constituents.

It's very true that technology, like time, marches on.

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

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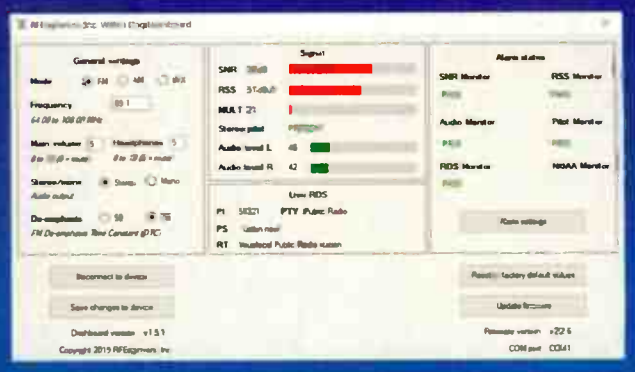

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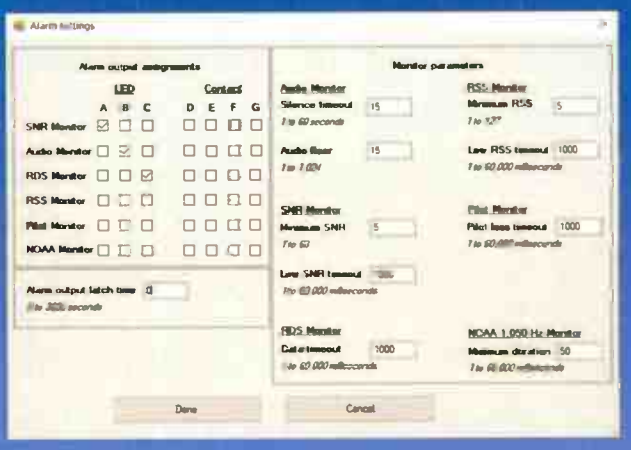

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Maintenance Guide

Maybe It's Not *That* Funny…

by Jim Turvaville

I was working on a transmitter recently and, since everything reminds me of a song, in my head I heard the classic written by Willie Nelson and sung by a dozen artists through the years. Interestingly the song is also the same age as me, having debuted in the summer before I was born. You all know it, I'm sure, it's called, *Funny How Time Slips Away*. One stinging line in the verse says, *"It's been so long now and it seems that it was only yesterday. Mmm, ain't it funny how time slips away?"*

So you may wonder why working on a transmitter had that recollection – well, it had seemed like it was only yesterday that I had been working on that same transmitter and doing routine maintenance. But alas, the massive amount of dust and crusty critter crumbs inside the unit let me know that mind was playing tricks on me – it had *indeed* been a long time since I had done that. And, as the cobwebs of the brain gradually cleared, I realized it had been not a couple of months, but more like a couple of years since the place had been touched. Time to shut it all down, open the box up, blow out the residuals inside, clean the filters and dust off everything. It had, indeed, been way too long for such a practice but it had just not been done.

I also recently took a call to go to a tower site and replace some equipment for the client – an out-of-state group owner. I do not regularly visit this station's tower, but am available on an as-needed basis for an on-call trip. This was not an off-air situation but rather one where a piece of IP gear was becoming unreliable. They had shipped me the equipment to change out, and I carried it in my work vehicle until their location was convenient to my schedule the next week. When I arrived, the mind went back to the last time I was there – likely for a similar equipment swap process – and as I opened the door to the building I immediately wondered if anyone had even been there since my last visit. Being one of those licensees who actually keeps the "Station Log" at the tower on a clipboard, I picked it up and realized that I was, indeed, the last person to be in the building; and that it had been 13 months ago. While that is often the drawback of great reliable equipment, that "out of sight out of mind" state we get lulled into when nothing breaks can never turn out to be a good thing.

When I was in Corporate management, I was advised to plan 30% of my day with the Important things that needed to be done. The other 70% would come along and plan itself, in the form of *Emergency* and *Urgent* items. Yes, that means your *Important* things will always fall to #3 on your list of getting things done each day; so don't over-plan the expectation of those Important things, or they will get bumped and might not ever end up back on your daily list. Don't tell me it won't happen! My supervisor initially tried to get everyone to keep track of our daily tasks, and to note which category each fell into – Emergency, Urgent and Important – as an object lesson to us on how this principle really plays out in our daily work. I have to tell you, it's pretty eye-opening, and often embarrassing, to realize how easily we can get distracted from the things that are really important in our work.

While nowhere near comprehensive, a sample list of what is Important to get done might look like this:

Tower Preventative Maintenance Schedule

Transmitter sites *must* be visited on a regular basis and things checked to prevent those locations becoming Urgent or Emergency one day. This involves exterior maintenance of brush and critter control around the building, tower and guy anchors; as well as interior items like cleaning or changing air filters, A/C unit maintenance, testing of backup equipment, transfer switches and generators. Check tower light operations (in both day and night modes as appropriate) and light monitoring systems to see that they are working and alarming as designed. Having a tower light out for two weeks before someone calls to tell you, is not a sign of good maintenance. Audio, RF and program delivery

(Continued on Page 28)

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Maybe It's Not *That* Funny...

– Continued from Page 26 –

equipment needs checked regularly, beyond what their external GUI can tell you. Clean out or replace air filters on a schedule, get the dust out of the inside of equipment – it can build up and create cooling as well as electrical issues. Keep the building or room clear of trash and keep the floor clean. I prefer to use a shop vac to a broom, as I can set the vac unit in the door to exhaust outside while I suck up the dirt in the building without stirring up more with a broom. But your situation may vary, so just do what is needed to keep it clean. You have a large repository of suggested transmitter maintenance schedules in this and other Industry publications – take the initiative and set one up that fits your specific needs.

Studio Routine Maintenance

With everything moving more to a computer based existence, some of the things we used to think of quite often as necessary in a studio, might be slipping to the back burner. Check all of the microphones in the studio and see that they are all working properly, levels are still calibrated and processors (if used) are working and adjusted correctly. Talent may not ever complain if something has slipped out of proper calibration or alignment over time, but you can spot those things quickly not being there and using it every day. Talley lights and controls may stop working without being noticed. And just taking a good clean cloth and some Isopropyl Alcohol to wipe all of those nasty finger marks off of the equipment will give the entire place a more like-new look. I was shocked recently at how much dust had accumulated on my main on-air studio console, simply because it just works fine all the time and no one pays attention to how it looks. And please dust off all of those computer monitors – front, sides, top and back. Especially the back and whatever mount you may be using to support it. Oh, while you're at it, dust those mic arms in and around those springs – the ones in my studio are black in color and you can forget what they look like when they are clean.

Office Maintenance

Yes, in most places it is the job of the engineer to maintain things around the office as well, since so many of them fall under IT items as well. So while you are making sure everyone has their computers updated properly with the newest OS security patches, and the productivity software has been updated and is current, take a few to check out the office printers, scanners and copiers. Yes, many times those items are in a maintenance contract from some third party, but those guys and gals do not come in and dust out the cobwebs and check the cables, etc. One of my clients just recently told me that two of their sales offices quit printing to the office network printer. Well, that becomes Urgent now, doesn't it? And that's our problem, not the printer company who comes around and changes toner and stocks the paper boxes. And on the subject of office computers, I urge you to meet with management and decide on a reasonable life-cycle for all of those boxes. You don't have to be a 2 or 3 year stickler like some larger companies are, but at least have *some* kind of planned obsolescence program for your office computers. Honestly, three years is probably the maximum allowable time of replacement for reliable operations, but you make that decision based on your specific situation. Make sure accounting is aware of that plan and see that replacement of computers is included in every year's budget process. Software updates depend on you keeping up with hardware updates – having new software on a five year old computer will mean things don't work like they are designed, and it's not the software company's fault.

Keeping a written schedule is great – I have a notebook that I carry in my vehicle at all times for a travel log and work notes. I have another good engineering friend who uses Google Calendar on this phone to schedule Important things like the above; it works great for him, and it might be a good idea for you as well. There's no "right" and no "wrong" way to do this kind of thing – the idea is to find a way that works for you and use it. I'm often reminded of a common saying from another great Engineering friend of mine – *"You know if it's silly, but it works; then it's not really that silly, is it?"* I wish only happy and safe PM work to us all, friends.

Jim "Turbo" Turvaville is semi- retired from 43 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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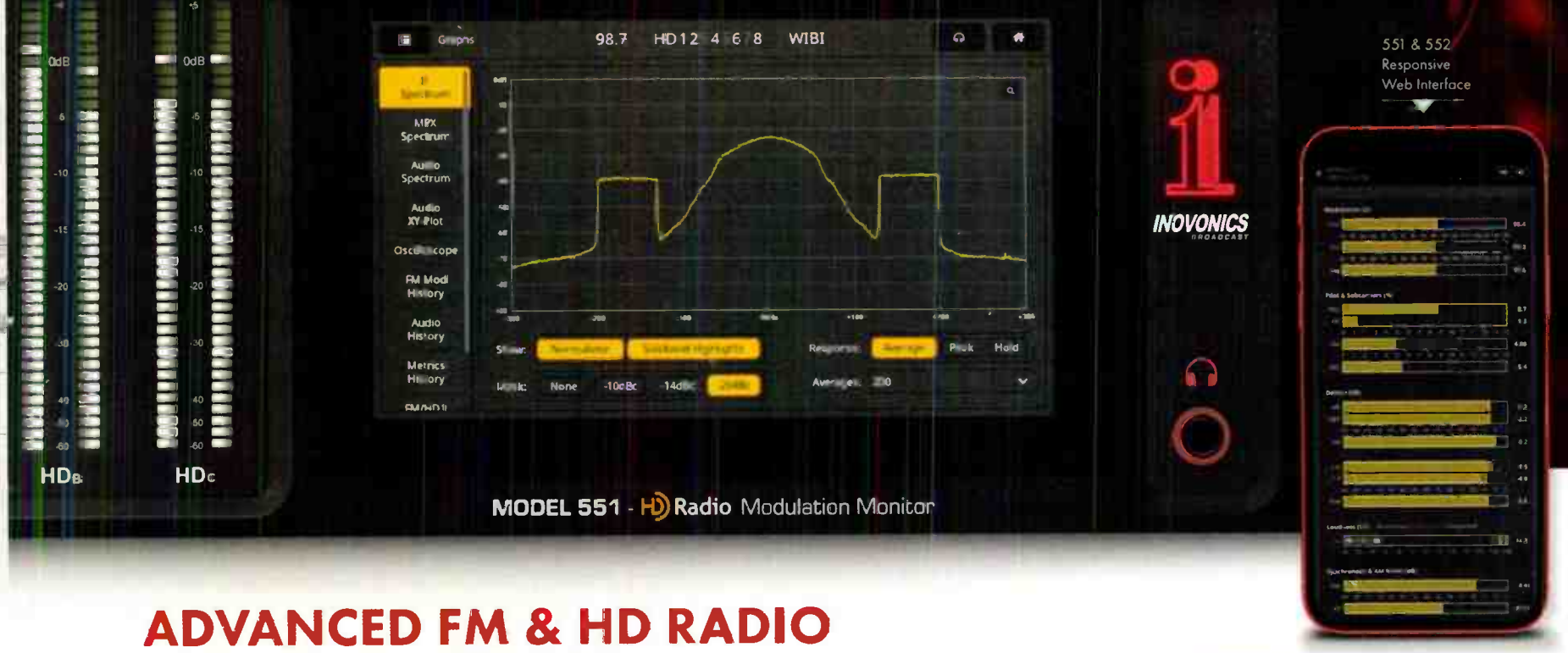

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How Hard Can Two Towers Be?

by Bob Reite, CBT

I was called in to repair a two tower directional AM array near the top end of the dial. The array is two 1/4-wave towers, 60 electrical degrees apart. The pattern is basically a cardioid with some minor lobes.

Upon entering the transmitter building I discovered that the two controls for power tower 2 and common point "tune" were outright missing from the phasor. The controls for power tower 2 and phase tower 2 were there, but just knobs sticking through the front panel. No turns counting dial. It looked like they had been there at one time – there were four small holes for mounting screws and a rectangular cutout that the tuning shaft went through.

The missing input tuning control had been replaced by a tapped coil but there was nothing to replace power control 2. Since tower two was the reference tower, maybe this control was not really needed. I drew out the "as found" schematic shown in **Figure 1**.

L1, L2, C1, and L3 are a T network to match the common point to the 50 Ohm transmitter output.

L1 is the "tune" control and L3 is the "load" control. L2 is a coarse adjustment to get L1 and L2 within range. L4 is basically an autotransformer to drop the power going to tower one. L5 and C2 are a series network for adjusting phase. The value of C2 is chosen to have a reactance of 50 Ohms at the operating frequency. The maximum inductance of L5 is chosen to have a reactance of 100 Ohms. Therefore adjusting L5 within its range should make this circuit vary from 50 Ohms capacitive reactance to 50 Ohms inductive reactance. If L5 is at 50% the circuit will be resonant and have zero reactance. It is possible to get plus or minus ten degrees of phase change with this type of control.

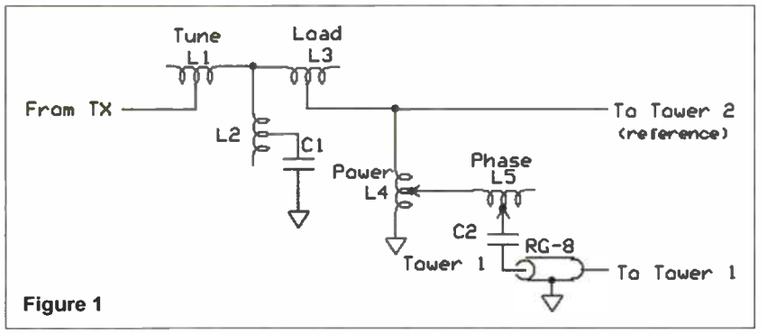

Figure 1

The coiled up section of RG-8 coax was an attempt to get the correct total phase shift between the towers.

There was no documentation at the site, except for a scrap of paper inside the phasor that showed a reading of -88 degrees and a ratio of 0.5 That did not seem right. I was finally able to get a copy of the license that gave a ratio of 0.83 and a phase of 170 degrees.

I used a Sharpie™ to mark where the coils were currently set and tried to bring the array back in. I discovered that the phase control had no effect. The power control worked, but I could not get more than a 0.6 ratio to tower one.

Time to check the ATUs. They were a standard T network, with an abandoned tower lighting system. I wondered why the under 200 foot towers had even required lighting. My guess is that at one time there was a small general aviation airport near the array which has since been closed. In any case I used the lighting chokes as a static drain choke which the system was lacking.

The sample system used toroid current transformers. At least I would not have to climb towers to fix sample loops on this job.

Does It Tell the Truth?

Because of the inability to get any phase change on the antenna monitor, I assumed that the antenna monitor was broken and pulled it to the lab for repair and recalibration. We were still operating the station at reduced power to avoid interference since the pattern was so off. Before reapplying power, I made sure to short the sample lines going to the towers. It is necessary to short the output of a current transformer if the primary is not disconnected, otherwise it will develop a high voltage across the secondary that it is not insulated for and be damaged.

(Continued on Page 32)

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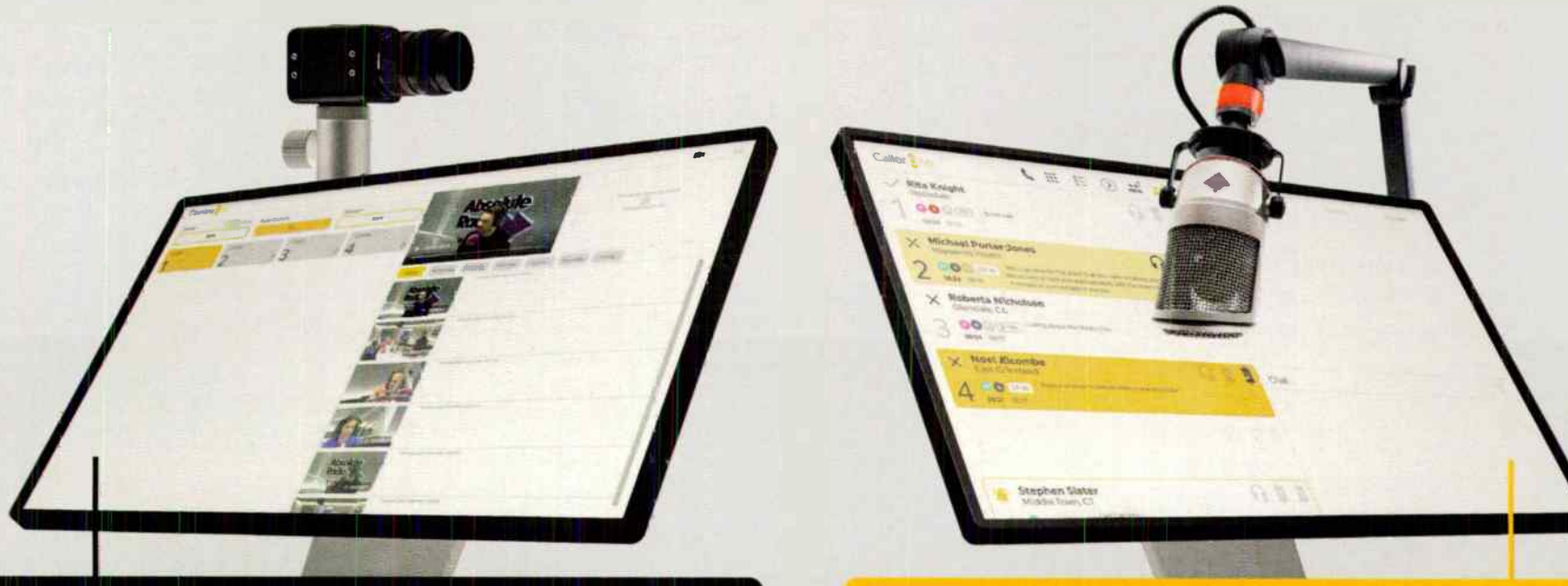

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– Continued from Page 30 –

Back at the bench, the antenna monitor tested good. So maybe it was the sample lines? The transformers had to be good as I was getting ratio readings, but at this point I did not trust anything about this site. I shut the station down, disconnected the sample lines at the current transformers and used my VNA set up as a TDR to check that the lines were good and the same length. They were correct within 10 cm for a phase error less than one degree. I hooked the current transformers back up and confirmed that they had similar characteristics.

I finally realized that the series LC phase shifter will not work if it has inductive reactance for a load. Time to revisit the ATUs. Some of the taps had been changed, but there were white paint marks that perhaps the original installer made to show the correct tap setting. Some were on the marks, some were not. I marked odd ones with a black Sharpie™ and moved them back to the original.

Redesigning and Restoring the Phasor

Still no joy. It looked to me like the length of RG-8 was not original, but an attempt by someone else to get it to work. One thing that probably complicated the matter, which I found out my next trip out there, is that one time there was an FM antenna on tower two, which had been removed, so now it has a different base impedance. So the marks on the tower two ATU coils were probably no longer correct.

I used my operating bridge to adjust the ATU to give 50 +J0 to the transmission line. Finally some progress. The phase control now was actually capable of changing the phase plus or minus ten degrees. I still was not able to bring the phase within tolerance without some more ATU adjustments to get the phase shift needed. I was sure glad that this system was near the top end of the band rather than down on 540 kHz. I still got a lot of unplanned exercise on this job.

Now that I had the phase within three degrees, I had to get the ratio correct. One would think that having the reference tower at maximum would work, but there is mutual coupling between the towers. Besides, at one time the phasor did have a tower 2 power control, so time to put it back. It so happened that there were a couple of extra roller inductors of sufficient inductance and current rating to replace the missing control. After installing this, I was able to get the ratio to the correct value.

All through this process I had been operating the transmitter at only enough power to get a usable reading on the antenna monitor or operating bridge. Next, to adjust the T matching network. I ran out of inductance for the tune control. I put the second roller inductor I had found in series with the original L1 set for maximum and I was finally able to get a 50+J0 impedance at the transmitter.

Figure 2 shows the reconstructed phasor.

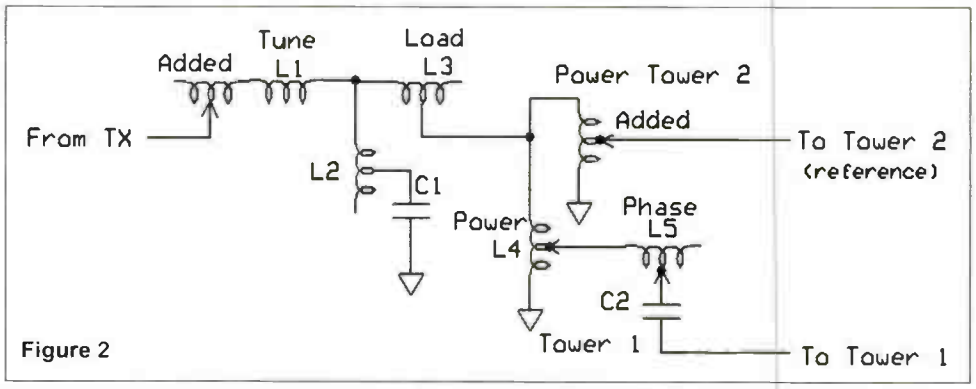

Figure 2

Checking the Monitor Points

Now to check the monitor points. Yeah, it took them awhile to find an old license that had them, but at least there were only two of them to check. One of the two deep nulls (the other one in theory should be identical) and the minor lobe 180 degrees from the main lobe. I had to use GPS bearings to actually find the point, the house numbers on the street had changed but otherwise the description matched. There was no question about the other monitor point as it was defined as the SW corner of an intersection. Thankfully the monitor points were within tolerance the first try.

BE AM-1A Update

In the May-June 2022 issue of *Radio Guide* I gave a list of parts kits for changing the Broadcast Electronics AM-1A to different frequencies. These kits are no longer available. There have been enough revisions in the AM-1A over the years that the same coils will not work in all versions of the transmitter, so the whole unit has to be sent to the factory to change the frequency at a cost of over $3,000.00, not including the freight going or coming. This cost should be taken into consideration if buying a used AM-1A that is not on your frequency.

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

The Reporter.

Remotes are hard. After hauling out the kit, connecting everything, searching for power, finding working Internet, double-checking the algorithms and bit rate, you call the studio and wonder if it'll work.

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The Anchor.

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And since you're wondering, yes, CallMe is compatible with pretty much all of the other codecs out there — even those needlessly complex and expensive ones.

Visit AngryAudio.com/callme to learn more.

Shop Talk

by Steve Tuzeneu, CBT

Misc. Tech-Tips and Thoughts

With the busy schedule I have, it's always a challenge to find the time and material to put into this column. One of the sources I have is you, the reader. I always welcome thoughts from readers who can spare a few minutes to send an email. Emails from my readers make writing this column worthwhile.

Reader Email

I recently heard from Dave Scott, CEO of RadioMusic.com. He wrote to share about software that does file conversion. Interesting that for some reason he addressed his email, "Hi Stu." I guess I have a new first name. Here is what he wrote:

Hi Stu,

A friend (and former 25 year employee) has a useful software package for radio techs who have audio recordings for one kind of studio automation but are converting to another brand. His name is Alan Freeman and the software is radioconverter.com – Dave Scott

Thanks, Dave, for your email.

DST Thoughts

By now you have heard that the powers that be in our government are planning to make Daylight Saving Time all year. There is some concern in the broadcast community that this will adversely affect daytime AM radio stations, and I agree, it could. I think our government should follow the lead of the FCC and ask for input on the matter, especially from AM broadcasters who own daytime stations.

I think they should have us permanently set our clocks, so AM daytime stations get the most airtime possible at both the beginning and end of their day. While this may not be the perfect solution, it seems to make the most sense to me. Then the FCC should give them enough power to cover the city of license at least for a couple of hours at the beginning and end of each day.

Tubes

It seems to me that the days of the tube-type transmitter are numbered. I really like solid state transmitters for a lot of reasons. The first reason is tubes. About 30 years ago, I could send a tube into my favorite rebuilding company and get a tube back, install it into the transmitter, and it would work with no problem whatsoever. In the last 20 years or so, it has been a fifty-fifty proposition. I have had to send tubes back that didn't make full power and ask them to rework it. One of the radio networks I worked for, installed a new tube into a transmitter, and after a short time, it failed. If getting a tube rebuilt wasn't trouble enough, there are fewer and fewer duds available to rebuild to meet the demand. I hope I never have to work on a tube-type transmitter again.

Small Modular Transmitters

If I didn't know better, I would think that someone at Nautel reads my column. I say that because they came out with a small transmitter that is modular. A number of columns ago I wrote about my displeasure with the small compact transmitters that companies were building. I expressed my unhappiness with how much work it took to replace a module or a fan.

Newer Transmitters

Anyone who has worked on a, 5 kilowatt or larger, Gates Air or Nautel transmitter knows how easy it is to remove and replace a drawer with RF modules in it. You flip a switch, which lets the control circuitry know you're removing the drawer of modules, loosen a bolt and slide the drawer out. Some of the newer transmitters will automatically ramp up the power of the remaining modules to return you to full power.

I was working on a 20 kW Nautel transmitter with another engineer and was surprised to see Ethernet cables going from one circuit to another – there must have been a half a dozen Ethernet jacks on this one card. Inside this transmitter was a box they called the "controller," which I found out is a computer that monitors and controls nearly everything inside the unit.

It amazes me how far we have come from the old-fashioned tube-type transmitter. The newer solid-state transmitters are more reliable, can be connected to your LAN, and you can log in and check fault logs from nearly anywhere on the planet.

Finding Engineers

In the last issue of *Radio Guide,* I wrote about locating your new engineer. This is a problem that seems like it won't go away, and finding qualified engineers is becoming harder every year. Several of the writers here in *Radio Guide* have written articles about how to find one. I wrote an article about this as well. The pandemic had made that even more difficult with people staying confined to their homes.

One of the places where you can find an engineer is to look for help from the Society of Broadcast Engineers (SBE). The

(Continued on Page 36)

"When your competitors ask what you put on the air, you can chuckle knowingly."

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Shop Talk

– Continued from Page 34 –

SBE will run your help wanted ad for free. They also will list situations wanted ads from engineers. If that doesn't help you find someone, you can go to the SBE website and look for a chapter near you. There is always the possibility that the local chapter chairman knows of someone who is interested in a new or better job.

If the SBE can't help you, you should try searching for your local Amateur Radio club. Some of the extra class amateurs might be interested in an engineering career. Extra class amateurs are more qualified than your average IT person or someone off the street.

If you can't find any good candidates for your job opening with the help of the SBE or your local amateur club, try doing a search for local technical schools or colleges that teach electrical engineering. You can plan to attend a career day at one or more of those schools, and I wouldn't be surprised if you find someone just right for your assistant or Chief Engineer position.

Another thing you might try is to recruit a retired or semiretired engineer. Except for the heavy lifting, an older engineer can do most everything you need to have done.

If all else fails, consider hiring a contract engineer. The SBE has a directory of companies that might be able to help you out.

When it comes to compensation, remember that you are asking someone to be married to the job. Working long hours and caring for 5, 10, 15 or more stations is a lot to ask. The compensation should be significant. I think it's unrealistic to expect an engineer to take care of more than three radio stations for $50,000 a year or less. Remember, too, that the cost of living has gone way up in the last year or two. Some engineers have left radio to go into IT, which pays much more.

Receiver Assessment

I read recently that the FCC is going to look into the performance of radio receivers. I certainly hope they do. I also hope they consider the poor design of most AM receivers. When I was a teenager, I used to listen to WABC in New York. This was a time when they played top 40 music, and when the audio bandwidth wasn't restricted to 10 kHz. That station sounded great for an AM signal. Today, however, with the NRSC requirements, a typical AM station sounds rather poor. Granted, some stations invested the time and money to make their AM station sound good, but with the limitations of most radios, they don't sound as good as they could. While they are at it, I wish the FCC would work with other branches of the federal government to enforce noise limits on every electrical appliance and device. The electrical magnetic interference to AM radios today is one of the problems that has eroded listenership.

Clean Feed

Are you using CleanFeed.net? I would love to hear from you. I would like to know more about your experience with this service. Is it reliable? What's the audio quality like? I would like to know for myself and share your experience with my readers.

Spot the Problem

Before I close out another article, I want to play a game. Examine the photo of this tower site. Look at the photo carefully and tell me what's wrong. I don't have a fabulous prize to offer you, but I will mention your name in my next column.

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. Apparently, another national publication liked my idea of apps and they started listing their favorite apps in their magazine. Feel free to contact me at stuzeneu@sbe.org; your useful information will be appreciated by my readers and me.

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 licensed by the FCC as an engineer and is a Certified Broadcast Technologist with and member of the SBE, and an extra class radio amateur who has been in radio broadcasting since 1973.

Small Market Guide

Two Batteries Are Always Better Than One

by Roger Paskvan

It's no secret, every radio station in Smallmarketville has a cruiser or station van all lettered up for doing those remote broadcasts, being in parades, a billboard on four rubber tires, or just a mobile sign with your call letters. This is a tale of a small market station that dolled up their van with a lot of electronics and made it into an exotic cruiser. The owner wanted a high power PA system so they could talk/play the station as they drove through town. There was even a STL (Marti transmitter) in the van (a dinosaur, but it worked) The roof had a number of lights/speakers and some bright LED floods. Under the van were exotic blue lights that looked real cool in the evenings. This station vehicle was a converted ambulance. It looked similar to the vehicle in the movie "Ghost Busters." The fun was great as long as the engine was running. All this electronics was a considerable drain on the engine battery and if the vehicle shut off with all this equipment running, the car had to be jumped to start. Well, this went on for a while until one day on July 4th, the vehicle stopped the entire parade – the battery went dead in the middle of the street. Now *that* was embarrassing to the station.

A surviving picture of the "Original Hot Hit Machine."

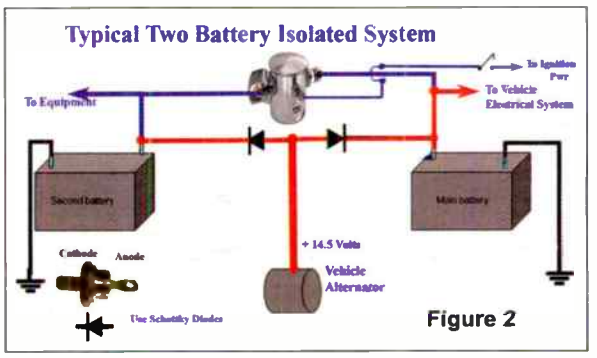
The station owner called me and wanted to know if I could install a second battery in their station vehicle, called the "The Hot Hit Machine." He told me to just parallel the two and that should solve our problem. I replied yes, but it's not that simple. I told him that there would have to be some type of separation between the batteries – it's not as simple as paralleling two wires from one battery to another. That always ends in two dead batteries, and both with shortened lives. He said, "Make it work, and send me a bill." So begins this story.

Paralleling two batteries begins as a good thing, providing that both batteries are the same cell voltages. Say both batteries are 12.3 Volts each, all is well until one of the batteries starts to age and the cell total drops down to say 12.1 Volts. Immediately, the higher voltage battery will start charging the weaker battery. This will happen whether the car alternator is running or not. One battery is constantly being lugged down by the weaker battery. Eventually, the higher voltage battery will not be fully charged because some of its load is always being stolen by the weaker paralleled second battery. In the end, you end up with two weakened batteries, but this does take some time to happen. There is a better way.

The most convenient way of solving this problem is to use two dedicated separate batteries. One battery runs the car engine as usual and the second battery runs all the electronic toys. The most difficult part of this project is finding a suitable place to locate a second storage battery, somewhere on the vehicle. Usually, there was always some extra room in the engine compartment. With today's pollution control devices, space is a premium.

Remember, do not mount the battery inside a closed up vehicle. Charging the battery gives off very flammable hydrogen gas that is not a good thing in a closed up car. A spark from the dome light switch could blow up your car when you open the door. Make sure the physical, second battery has adequate ventilation and locate it preferably in the engine compartment.

The electronic solution to the two battery problem is to install diode isolation so one battery cannot discharge into the other. At the same time, a means of allowing the alternator to charge both batteries must be provided. Also, remember the wire size must be able to handle the current that could be near 60-85 Amps (#6 wire). The basic idea of the isolation concept is two diodes with the alternator DC feeding the batteries from the center of the diode isolator (**Figure #2**).



Schematic of a build it yourself isolator diodes.

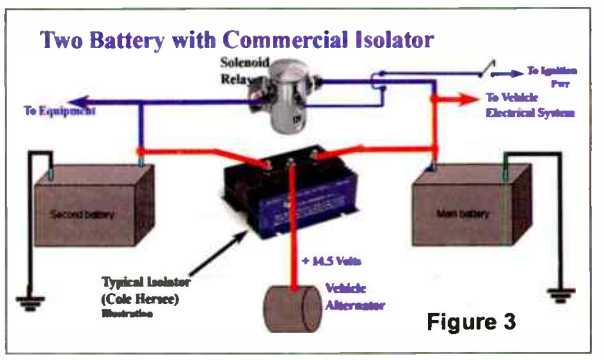
A diode passes current in only one direction. This property allows the alternator to charge both batteries while stopping either battery from flowing into the other. Notice the polarity of the diodes; make sure the anode and cathode are correct (cathode is the threaded stud). These diodes are stud diodes able to pass 75 Amps and must be mounted on a small aluminum heat sink since, at that current; a good amount of heat will be generated. Since the cathode is threaded and mounts into a threaded hole in the heat sink, that heat sink must be insulated from any metal contact to the vehicle frame.

The better way to solve this problem is to order a type DO5 mounting kit that will physically isolate the stud diode from the aluminum heat sink. This will allow you to attach the aluminum heat sink anywhere on the vehicle and still radiate heat away. The do-it-yourself method for a station engineer is great and provides trouble free operation of two batteries that are always automatically charging. An optional car solenoid relay can be installed, switchable from the dash to parallel the two batteries if needed. This relay must be powered from the ignition switch so it un-parallels the batteries with the key off, thus returning the system to a two separate battery state.

To understand the electrical process, follow the current flow in **Figure 2**. The higher 14.5 voltage alternator current will be seen by the diode as a positive (forward bias) input allowing the current to flow into either 12 volt battery. Since both diodes are back to back, neither battery can flow into each other. As just mentioned, If parallel battery operation is desired for large loads, an optional ignition controlled dash mounted; lighted switch can turn on a relay solenoid that will parallel the two battery positive posts as shown in the top of the schematic. If that switch is left on, the solenoid power will drop out when the vehicle ignition is turned off, therefore putting the isolator back into action, automatically un-paralleling the batteries.

Although regular high current silicon diodes could work for this isolator, they drop a constant 0.6 Volts which means the alternator needs to have at least 14.5 Volts output to provide enough charging current. A better approach is to employ Schottky diodes since they have a lower voltage drop. Schottky diodes typically drop 0.25-.30 Volts across their junction. This makes charging operations possible even with lower voltage alternators. A typical 13.8 Volt system would still be charging at 13.5 volts – enough safety margin to do the job.

Fortunately, there are a number of companies that make commercial diode isolators in the $50-100 price range, available on Amazon, DigiKey and other sources. An alternative to the do-it-yourself above is to purchase a battery isolator already fabricated and wire it between your two batteries. The installation is fairly simple; just connect three heavy wires to the isolator(replacing the diodes) and the two batteries. Make sure you have the equipment to crimp-on some big lugs that make good contacts. At 50 Amps just the smallest ohmic loss can cause a large voltage drop at a connection. Most commercial isolators utilize Schottky diodes and are ready-made to just mount in the vehicle. The heat sink is already isolated, so you can mount it anywhere (**Figure 3**).



Schematic modified for use with a commercial isolator (Cole-Hersee, company).

Well, the conclusion to this story is that the two battery system solved the problem. The station could now run the vehicle electronics equipment off a separate battery and always start the vehicle off of the other original battery. For heavy current draws, like a winch or massive lighting, the selectable solenoid switch did the trick by parallel both batteries to provide the needed current, then returns to normal operation.

Parts list for do it yourself construction.
(Mouser Electronics numbers)

1. Schottky diode (2) - 78-VS-70HF160m
2. Heat Sink – 532-531202B001
3. Do5 stud mounting kits (2) - 534-4730
4. #6 stranded copper wire and heavy lugs. *(at most auto parts stores)*

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

Tips From the Field

Building a Radial "Sniffer"– *Part 1*

by Roger Paskvan

Issues with transmitter to tower coaxial cables can be a huge problem, especially in AM radio facilities, where there are buried radials to consider.

Our station needed to replace the feed line to its AM towers. This sounds so simple until you tackle the problem of getting through the 120 buried wires that provides the ground field surrounding your AM towers. No you cannot cut the radial wires – they are a very necessary part of your antenna system.

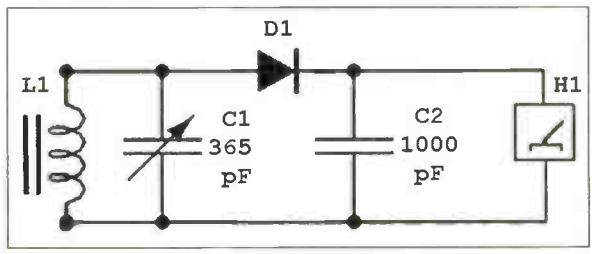
The Radial Sniffer

In this first part, of a two part article, we will expose the little meter – a "radial sniffer" that our station built to locate these buried wires. In part two, we will provide details of how to use this device – the geometry and procedure of how to locate your radial wires. This is good preparation for that unfortunate day when your engineer says, "I think you have a broken coax to your tower."

For some reason, metal locators can pick up coins, nails and a lot of junk, but have trouble with copper wires. The only reliable way to find the wires is to read the radiation coming from the wire itself by utilizing an RF sniffer and a highly directional antenna. Although this may sound complex, it turns out that an old style AM radio loop antenna connected to a detector is the perfect component for this job.

The circuit is just a simple diode detector with a very sensitive meter in the 30-50 microamp range. The key to the operation is the 788 uH resonant loop, stick antenna that is turned to your station frequency. This little ferrite antenna is a very high Q coil with directional characteristics. It nulls from the ends and this is what allows you to see a change in the meter reading as you sweep over the buried radial wire in the ground.

Any non-ferrite coil will become swamped from the tower's strong signal giving a constant meter reading. The ferrite loop antenna was stolen from an old AM transistor radio we had laying around.



RF Sniffer Schematic

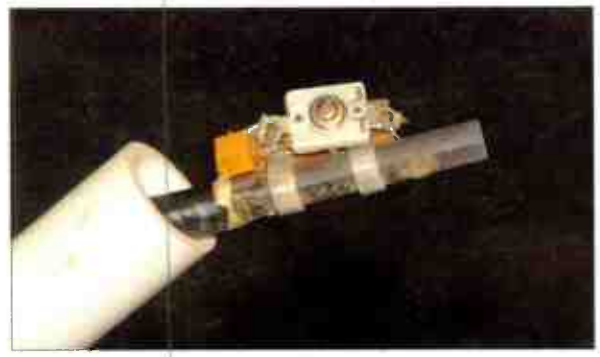
Setting Dip

Utilizing some type of indicating instrument, like a dip meter or network analyzer, adjust the trimmer capacitor across your loop stick antenna for resonance on your AM station frequency. This resonance is very important for maximum signal indication on your meter.

Easy and Inexpensive

We built the simple circuit inside an LB box and wired it to the 50 microamp meter. Our original circuit had a potentiometer to turn down the meter signal, but the signal never gets much over 25 microamps so the pot was not needed.

Cut a 3/4" PVC pipe about three feet long and mount the meter in the plastic LB box on the top end. Run two wires to the bottom of the pipe and solder these to the ferrite antenna assembly. Secure the ferrite antenna with foam rubber inside the PVC pipe with the ferrite rod end pointing down. (Frankly, that's the only way it will fit inside the 3/4" pipe.) Put a cap on the end of your pipe and you have a nice wand for sensing current in the radial wires.



The ferrite antenna at the end of the probe.

To use the device, hold the sensor pipe about a half-inch above the ground. You will get a relative 20 microamp meter reading. As you pass over the buried radial, you will see a "DIP" in the meter reading above each wire location. Sweep back and forth to narrow your location technique and mark the wire. More on how to locate your AM tower radials in part two of this article.

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

Tower Topics

High Intensity Tower Light Project – *Part 2*

"Three vs One"

by John L. Marcon, CBRE CBTE 8VSB Specialist

On the first part, we looked at our old lighting system and the reasons why we decided to acquire a new lighting grid. We soon realized that this will be the first time in a long time that we will have a tower lighting project of this kind. If this is a simple 200 or 300 feet tower, it is much easier because it would just be a single light on top of the tower and it only needs a medium intensity light. However, this project is for a thousand-foot tower and the FAA/FCC requirements are much different. Selecting the best and most cost-effective tower lighting company would not be a breeze. If this was a transmitter project, it would be much easier because I have done transmitter projects for many years. I have some ideas on transmitter companies to consider, the specs and some knowhow in installing a transmitter.

However, this time, it's not about RF but about lights (although technically they are same). At any rate, the project needs to be successful not only in the short term but also in the long term. This means choosing a tower lighting company that has been in the industry for many years and with a good track record. The strobe lights that we have now are from a company that has been in business for a long time but our experience with them has not always been satisfactory. With tower lights, you always seem to be at the mercy of the tower light repair and manufacturer. We would like to have more control but it looks like this is not going to happen. The other thing is that you always pay the tower light repair company a hefty price for parts and repair. There are a few of them but those that can work on a tower that is a thousand feet or higher are even fewer.

As mentioned before, our first decision on this project was to use LED instead of strobe. It's not just because of problems with strobe but also the claim that LEDs have longer lifespan. Secondly, we decided that the provider should also be the one to install the lighting system. In other words, they need to have their own tower crew. If the tower crew is from a different company, the provider and the tower crew can pass the blame on each other if there is a problem on the installation. The next step in the process is to choose the best company at the most reasonable price. We are looking at this in the long term because it is likely that we may work again with whoever we choose to do the project. Thankfully, the Society of Broadcast Engineers (SBE) website has a list of these kind of high intensity tower light companies. As I mentioned in the first part, they were Lumenserve, Drake, Slatercom and Unimar. I quickly found out that Lumenserve, Slatercom and Unimar are all vendors for Dialight. Drake is the only one different and they use a system from Technostrobe of Canada. Tips on the installation can of course be obtained from other engineers who recently (in the last 5 years at least) have installed this type of high intensity lighting system. As we all know, there are broadcast engineering groups on Facebook. One thing with Facebook is that you get a lot of comments especially from folks who have "buyer's remorse" from a product.

Dialight vs Technostrobe

I already mentioned from the first part that Dialight was the first to introduced the high intensity lighting system in 2006. Their basic LED assembly consists of three modules that are bolted together. Each of the three are mounted on an angle, such that all of them cover 120 degrees of the tower perimeter. Three assemblies cover the whole 360 degrees for a three legged tower. Inside each one of the modules is a series of LED lights. The top and bottom of each module are made of metal while the front, where the LED flashes the light, is made of polycarbonate. All three modules weigh about 75 pounds.

Dialight High intensity LED modules. The modules shown just came out of the box and I was trying to weigh the assembly. This is quite different from our old strobe tower lights.

The assembly has its own power supply that is also installed on the tower. This means that, per tier, there are three power supplies and three light assemblies. The voltage going up the tower is 208 VAC. Only the main controller is inside the building. The system also comes with its own software, called the INEM, with features that are helpful to the station engineers. The software can be loaded on a PC or phone. With the phone app, the engineer can basically check on the tower lights from anywhere. It can send a text message whenever there is an alarm and you can also force the system to go on any mode (day, night or twilight) if a test is needed. In our old lighting system, this could only be done manually. The program also shows operational history and other information.

Each of the three Dialight vendors differ in the way they sell the system. Lumenserve is an interesting company because they have an option of doing the tower light as a service. They call it the TLaaS or Tower Lighting as a Service. Quoting from their website, *"Lumenserve will purchase and install a new LED system for your tower at our cost, maintain it and perform the required compliance & monitoring services. That means you do not have to buy a lighting system now or at any time in the future. We have it covered. Since we own and operate so many LED systems nationwide, we use our size, scale and expertise to save 100% of our customer's time and money."*

This sounds good, especially if you do not have the up-front cash to pay for a whole system. It also means that you will not have to worry about tower lights – ever. Isn't that great? It does sound "free," but we know there is nothing free in this world. This offer simply means that you will be paying more in monthly or yearly terms. The second option they offer is for you to purchase the system outright and then they will do the monitoring and repair. They will even do the NOTAM for you. The third option is of course you buy the system from them and do the monitoring and compliance yourself. That works too. I was surprised that there are a number of tower users that took the TLaaS option, as this is a bit more expensive than doing it yourself. The company has its own engineering team and tower crew and they are able to adapt to whatever technical situation you have with your tower. Their representative, and even the company president, answered all my questions about their service and customers. They said they have close to one thousand users of their system. Their coverage is nationwide and they have a central monitoring system for their customers, especially those that avail off the TLaaS option.

The other company that installs Dialight is the Oregon based Slatercom. They do not provide tower lighting as a service. They only sell and install the lighting system. They do not have their own crew to install but they work with a number of tower companies that are certified to install the Dialight system and they can integrate them in their offer. They said that they have installed about ninety of this lighting system. A number of engineers in the Facebook group used Slatercom in their tower light installation and they were actually satisfied with their handling of the project and the performance of the new LED lights. Some of them see a longer time between service compared to the old strobe system. The last, but not the least, is Unimar. This company is from the East. Unimar only sells the system and the costumer has to find the tower crew to install them. All of these vendors offer the same warranty of five years on the lights and other materials. However, the tower owner has to pay the tower climbers to repair or replace the lights.

(Continued on Page 42)

Tower Topics

High Intensity Tower Light Project – *Part 2*

– Continued from Page 40 –

On the other hand, the Technostrobe (or Drake) system is quite different in design compared to Dialight. The LED assembly is shaped like an arc to cover 120 degrees of the outside view from one leg of the tower. The control unit and the power supply are installed inside the building. To show us how it all works, their sales guy went down to our office and made a demo of their system. He brought an actual light assembly, a control and power supply unit. We were impressed with their system, especially because there are no other electronics on the tower beside the light assembly. The top side is all polycarbonate, the same material used for car headlights. This material becomes a point of discussion because, as we know, car headlights fade after a few years. He said the warranty for the polycarbonate is 10 years and they use a special formula for the coating of the polycarbonate surface. One other thing about their system is that, because the power supply is in the building, the voltage running up the tower is DC and not AC. The red light is also integrated inside the assembly, which is a plus.

We would think that there are no other electronics on the tower. However, the lighting assembly itself actually has some driver ICs (Integrated Circuits) for the high intensity LEDs. So, it is not totally 100% no electronics on the tower but it is much less compared to Dialight. The one downside is that the customer will not be allowed to do repairs on the power supply or controller. In the first five years, their system is under warranty and they will replace any defective unit. However, after five years, the costumer has to pay for the whole assembly (power supply or controller) if any one of them fails.

... To be continued.

DRAKE tower light controller and LED light assembly on demo. The light assembly on top of the box covers 120 degrees on one leg of a three-legged tower. Three of them cover the whole 360 degrees around the tower.

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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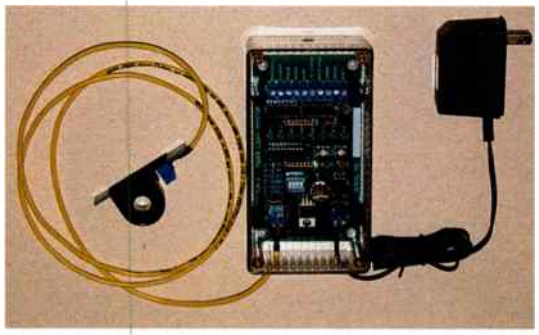

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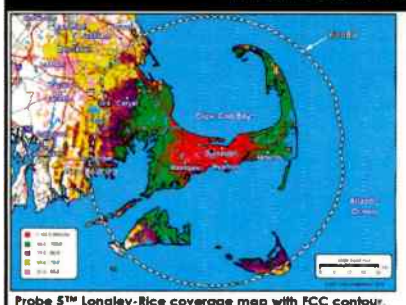

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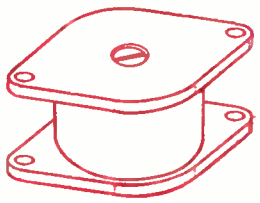

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Inovonics 551 Demo

by David K. Peabody

Backdrop:

BSL LLC, dba Broadcast Signal Lab, Is the latest iteration of a standards and calibration lab having its origins in Cambridge Crystals and Cambridge Thermionics in the 1930's. We have been providing compliance testing services and frequency monitoring as Broadcast Signal Lab for almost 40 years. The lab currently owns an Inovonics 531N FM Modulation Analyzer. We have long been concerned with the limitations of the instrument in the presence of HD signals. With HD signals, the instrument will not output useful data as to Total Modulation. The much older QEI 691 (circa 1976) "deals" with the HD signals, after a fashion, by still functioning and the user applies predictable adjustments to the Total Modulation data when in the presence of the HD signals. Neither instrument is of any use in analyzing HD signals. The lab has been looking for a better alternative that would allow for off-air signal analysis. Certain imported alternatives are simply cost prohibitive. Our current use of an Anritsu Spectrum Analyzer for some FM measurements is cumbersome and generally requires locating at the transmitter site connections with a transmission line tap.

Testing:

On Monday March 7, 2022, courtesy of Mr. Grady Moates of LOUD and Clean Broadcast Science, BSL was able to "demo" the Inovonics 551 HD Radio Modulation Monitor. Mr. Moates is currently beta testing Inovonics' new offering. He is a mostly silent partner in BSL, LLC. However, when he sees an opportunity, method, or device that will enhance BSL's capability he is, thankfully, not shy in relaying that information to us.

During the demonstration, I was gleefully stunned.

In every aspect, the 551 HD Radio Modulation Monitor exactly met requirements, and exceeded expectation. It was being used in an off-air application, and able to obtain lab quality measurements. Grady was able to demonstrate for me many of the functions of the machine while admitting there were many layers that he was still learning about.

In every display, the instrument produced clean and actionable data. Often, functions for adjusting sidebands and subcarrier can only be done with monitoring that is attached directly to the transmission line. This instrument may make that canon no longer valid. A station engineer, monitoring group, or even the station owner, could "remote in" to this device and "see" **all the data** which, aside from transmitter operations, would be needed to assess the signal quality. The station owner could even listen in on the station through the webpage. Depending upon the transmitter's interface, the station engineer could adjust the signal from his home or from any field location capable of receiving the signal.

With me asking questions and Grady answering, I tried to find flaws or places where this instrument could not function as needed. We found none.

The Inovonics 551 handled discrimination from next channel incursion as if the adjacent channel was just one more piece of data, and did not degrade the output of data for the channel selected. It was free of the "multipath" hiccups that the lab's Inovonics 531N was prone to.

As part of the assessment, we elected to compare the Inovonics 551 to plots created by my Anritsu MS2721A Spectrum. Using the Peak Max Hold configuration, the Anritsu produced a waveform representation of our subject FM signal which was almost identical to the recorded screen capture from the Inovonics 551. The only discernable difference being its relative position on the analyzers and that is a function of each instruments "noise" floor and amplification.

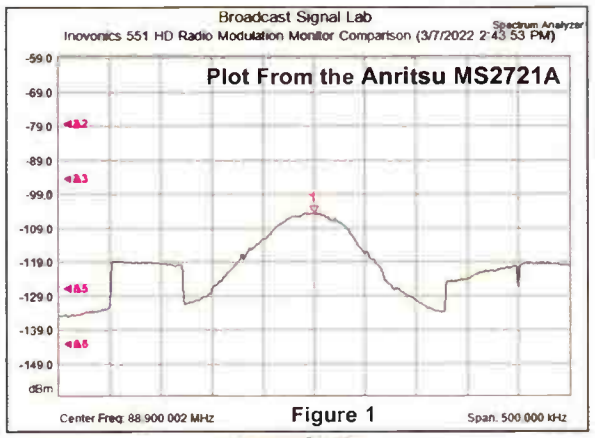

Figure 1

Measurement Parameters

Trace Mode	Max Hold	Frequency Span	500.000 kHz
Reference Level Offset	0.0 dB	Reference Level	0.000 dBm
Input Attenuation	0.0 dB	Scale	10.0 dB/div
RBW	1.0 kHz	Serial Number	512106
VBW	1.0 Hz	Base Ver	V1.78
Detection	Peak	App Ver	V1.79
Center Frequency	88.900 MHz	Date	3/7/2022 2:43:53 PM
Start Frequency	88.650 MHz	Device Name	
Stop Frequency	89.150 MHz		

Figure 1 and 2 were obtained from the same antenna feed roughly 30 seconds apart. They do not represent identical audio as they are separated in time, but the similarities between the two are impressive.

With the center peak represented as zero, what follows is the comparison of specific points on the two plots:

POINT	ANRITSU	INOVONICS 551
FM signal peak	0	0
Lower sideband inner valley	-26.92 dBc	-27 dBc
Lower sideband inner edge peak	-15.42 dBc	-15.3 dBc
Lower sideband outer edge peak	-14.1 dBc	-14 dBc
Upper sideband inner valley	-29.05 dBc	-29 dBc
Upper sideband inner edge peak	-20.27 dBc	-20 dBc
Upper sideband outer edge peak	-15.58 dBc	-15.5dBc

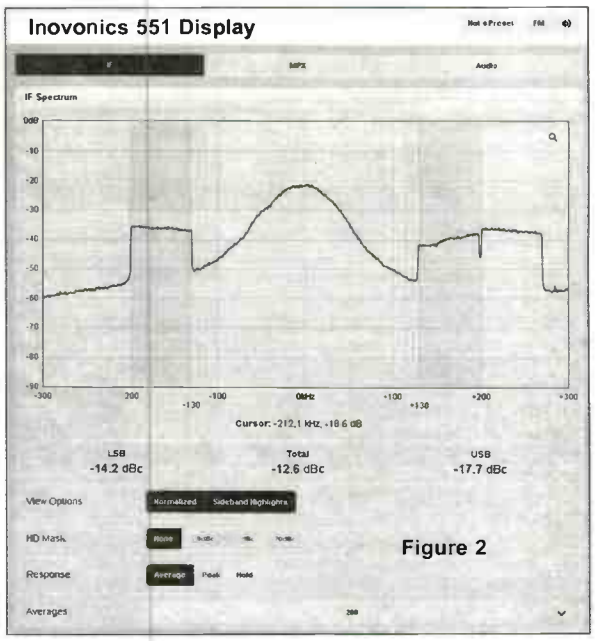

Figure 2

Plot From the Inovonics 551

Please note: the numbers derived for the Inovonics 551 were derived by placing a metric graphical grid over a .jpg of the printed capture from the Inovonics 551 screen, and the Anritsu data was calculated from plots metadata as stored in the Anritsu Spectrum Analyzer.

I raised a question as to how frequency accurate the Inovonics visuals were, compared to the center peak of the FM signal as seen on the Anritsu. The deviation from assigned frequency was +90 kHz which closely mirrors BSL's last Lab reading of +89 kHz taken on February 28, 2022 at our lab in Gardner, MA. The thought and question centered around the idea that, with an instrument (the Inovonics 551) that is so accurate, it might be relatively easy to add a port into which a frequency standard could be fed, thereby supplying the function of a frequency counter for checking center carrier positioning. This would be in addition to all the things the 551 already does.

In the course of the discussion we did not get back to using the Inovonics 551 to look at an unmodulated carrier from our subject station.

It is my understanding that, currently, the Inovonics 551 and Inovonics servers are relatable to the Naval Observatory, but do not have real time correction. Please pardon me if I stated that inaccurately or poorly. A GPS antenna and standard might be a useful addition to this system.

At the surety of being redundant, I was truly impressed and look forward to owning the Inovonics 551 or 552 in the near future.

Inovonics Model 551/552 information can be found at: **https://www.inovonicsbroadcast.com**

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