# The Spectrum Monitor®

Amateur, Shortwave, AM/FM/TV, WiFi, Scanning, Satellites, Vintage Radio and More

Volume 4 Number 2 February 2017


## Russian "Woodpecker" Remembered

Plus:

Over-the-Horizon Radar Today

Boys' Life Radio Club

Put a New Antenna on Your HT

Computers and Ham Radio 001

# The Spectrum Monitor®

Amateur, Shortwave, AM/FM/TV, WiFi, Scanning, Satellites, Vintage Radio and More

**Volume 4 Number 2** **Table of Contents** **February 2017**

***On the Cover:***

***Duga-1 array within the Chernobyl Exclusion Zone. The array of pairs of cylindrical/conical cages on the right are the driven elements, fed at the facing points with a form of ladder line suspended from stand-off platforms at top right. A backplane axel reflector of small wires can just be seen left of center, most clearly at the bottom of the image. (By Necator - the English language Wikipedia (log), Public Domain, https://commons.wikimedia.org/w/index.php?curid=4870433)***

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# Dear TSM:

*Send your comments to editor@thespectrummonitor.com*
*The Spectrum Monitor reserves the right to edit comments from readers for clarity and space availability.*
*Anonymous comments will not be published.*

## Comments, Advice, Kudos and Questions from Readers

***Actor Robert Strange, portraying the head of a spy ring, uses a Hallicrafters SX-25 to communicate with his minions in a Republic Pictures movie serial. (Courtesy: Eric Beheim)***

**Mystery Radios of the Cinema**

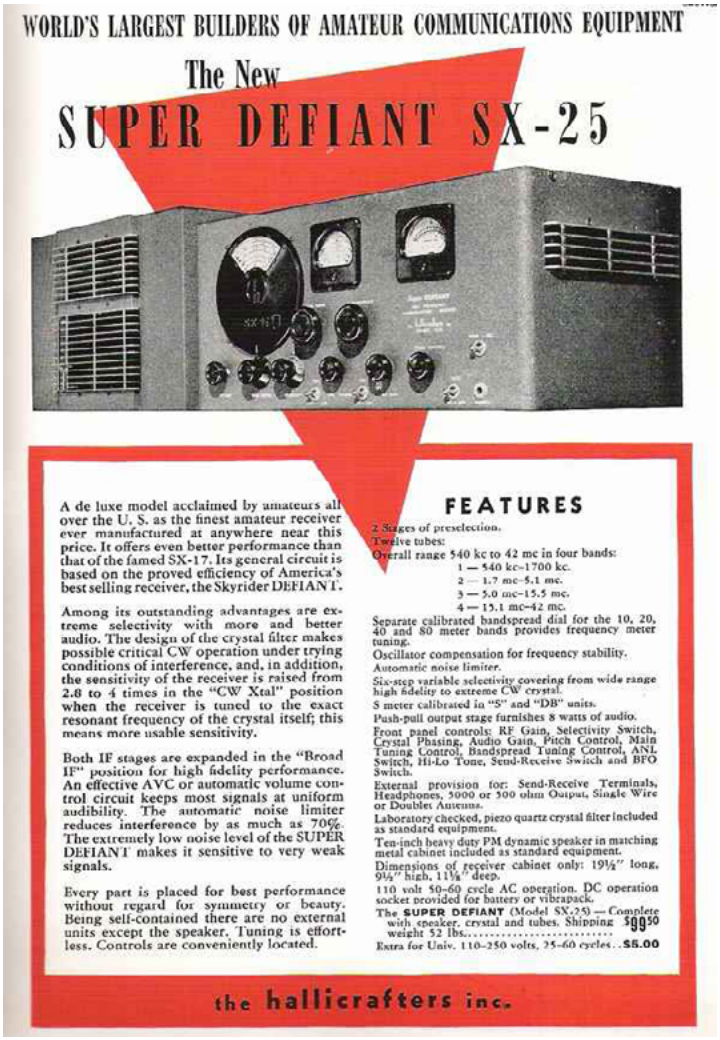
"Eric Benheim's screenshot in January 2017 *TSM* shows a Hallicrafters SX-25 receiver with that company's signature speaker. The SX-25 was introduced to amateurs in the February 1940 issue of *QST* and sold then, 'Complete with tubes, crystal and speaker...' for $99.50. As a kid of thirteen I lusted for that receiver but had to be satisfied with a one-tube regenerative set built from an article in *Popular Mechanics*. My patience was rewarded recently by the purchase of an SX-25 for only $90 on eBay!

"It's encouraging, as a Charter Subscriber, to see *The Spectrum Monitor* once again begin another year of publication with such a an interesting lineup of articles by a talented staff that seems never to run out of new topics." – Bob Thomas W3NE

*Many other TSM readers responded with the correct answer, including Dan Steinhoff, who provided the excellent period advertisement for the Hallicrafters SX-25 Super Defiant seen upper right on this page. Here are just a few more responses. – Editor*

"My guess is that it is more likely an SX-25. It looks like there are skirts around the two knobs under the main tuning dial, which was a feature of the SX-25." – Charlie W8CFO

"That radio sure looks like my old Hallicrafters SX-25 Super Defiant. I spent many hours in my teens through my thirties with my SX-25, which had the added bonus of heating my bedroom! Sadly it went up in smoke one day..... it was beyond repair. I did replace it with a modern classic: a Kenwood R-5000." – Ken McKenzie

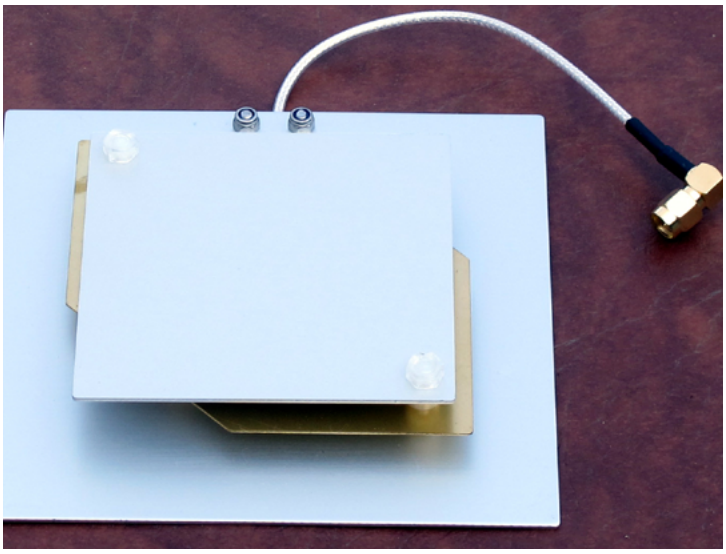



***Hallicrafters SX-25 period advertisement (Courtesy: Dan Steinhoff)***

**More Mystery Radio in the Cinema**

"Here is another frame grab showing an old radio that appears in the 1937 movie serial 'Zorro Rides Again.' Set in the 'modern west' of 1937, it stars John Carroll as a descendant of the original Zorro. When his family's railroad is repeatedly sabotaged by the henchmen of big city gangster Noah Beery, Carroll assumes the identity of Zorro to set things right. A noted screen villain, Beery (Wallace Beery's brother) uses a radio identical to this one to issue orders to

*(Above) Eric Beheim's next vintage radio mystery. A master crook uses the latest technology, shortwave radio, to communicate with his henchmen. (Screen shot courtesy of Eric Beheim)*



*Outernet L-band antenna for the free service that moved from Ku-band Free-to-Air satellite to Intelsat I4-F3. The move makes the service much easier to receive. (Courtesy: Kenneth Barbi)*

his men from his skyscraper office in a big city. The two henchmen seen here are veteran movie bad men, Richard Alexander and Bob Kortman. Let's see how long it takes your readers to identify this set!" – Eric Beheim

**Going Mobile with an SDR**

"Great article on current SDR technology that can be taken mobile ["Going Mobile with SDR," by Robert Gulley AK3Q, *TSM* January 2017]. That is a great point, as most folks think of portable SW radios in the traditional sense when afield. Why not add SDRs to the list of mobile listening options? Surely you've given readers a lot of great points to ponder in your article; you covered mainstream SDRs and their mobile applicability very well! Congratulations on the excellent article!" – Mario N2HUN

**"Hidden" Signals on Satellite-TV**

"I remember the old C-band days when there was no encryption. [FTA Satellite-TV Part II, Radio 101 January 2017 *TSM*] Almost everything on any cable system was on the birds. We bought a 4-section fiberglass dish and steel mount with a ball-jack style actuator to steer it to the desired satellite. Then they slowly started to encrypt the feeds. There was a debate in congress about pay access to services for users with home satellite systems at that time.

"One comment on the not so hidden signals: A while back there was an article on Outernet. I purchased the parts needed and setup an old Ku-band DirectTV 18-inch dish and was having fun with it. I got into it on the tail end and they switched to an L-Band setup. The satellite is the I4-F3. I get a good signal with the patch antenna inside my room looking into a window. They have a nice weather map and lots of user content. They have APRS lists and a condensed version of AMSAT news. I can use some of the same components to receive ADS-B with software and tutorial form **http://stratux.me**. The SDR dongle has many fine uses and project to boot." – Mike Hoblinski

*Mike refers to an article about Outernet from TSM September, 2015, "Outernet: Bringing Free, Global, One-way Internet Content to the World via FTA Satellite," by Kenneth Barbi. Look for an update article on Outernet soon. – Editor*

**KSDK-TV Celebrates 70 Years on the Air**

"KSDK-TV will be celebrating 70 years on the air in St. Louis in February 2017. Starting in February 1947, as KSD-TV Channel 5, the first TV station in St. Louis, and one of the first in the U.S. after WWII to go on the air.

"It was affiliated with KSD radio, 550 kc on the AM dial, carrying the NBC network, and owned by Pulitzer Publishing of the St. Louis Post-Dispatch newspaper.

"I remember Frank Eschen was the TV reporter on the street, studios were located at 12th & Olive streets, at the old *Post-Dispatch* building.

"Our family bought our first RCA TV—a 10-inch console set in December 1948, but was not delivered until January 20, 1949, and saw the inauguration of Harry Truman. An outdoor antenna was installed on the roof. TV signals were low power compared to today. I was 12 years old at the time." – Mike Kudelka

**Eddystone Replica Radio Parts**

"Warm greetings from Scotland. If readers would like full construction details for the Eddystone All World Two ["A Salute to the Esteemed Regenerative Receiver," by Richard Fisher KI6SN, December 2016 *TSM]*, in addition to sources for the antique parts, please email me at gm8wny@gmail.com. As the proud owner of a replica AW2, I would

indeed be pleased to help anyone interested in this unique receiver." – David Searle GM8WNY Hamilton, Scotland

**Mystery Digital SW Pirate Signal**

"I stumbled across a digital transmission on 4060 kHz, December 24, 2016, at 21:49 UTC. I was scanning around using my recently purchased SDRPlay SDR unit with the SDRUno software using a relatively low 43-foot horizontal wire running south to north at roof level at my home in central Columbus, Ohio. The broadcast was playing the Kinks song 'Do It Again' and shut down after that song. I did catch the tail of another song just before the Kinks tune so maybe they were active for a while and I missed most of the broadcast. The waveform of the transmission was what caught my eye initially and as I scanned across it in AM mode I could tell there was music there but it wasn't until I changed to the built-in digital mode in the software that it popped out correctly.

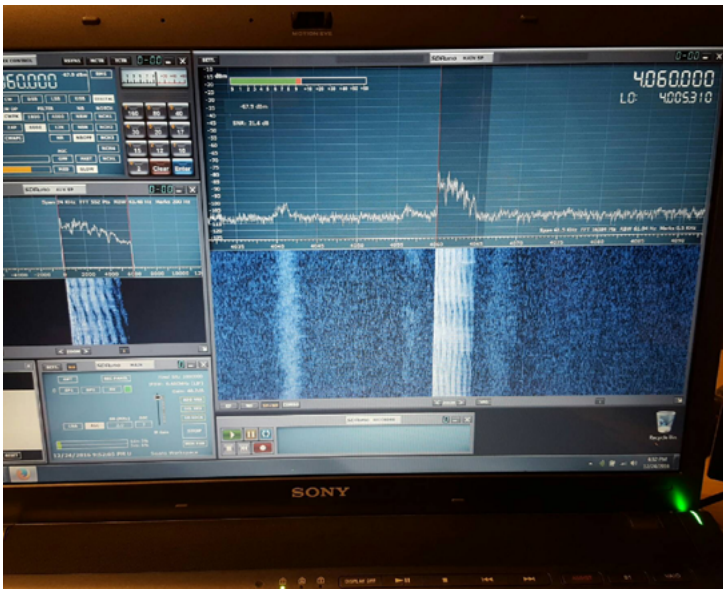
"I have heard of other pirates using this and nearby frequencies but this was very clear and strong at S9+. I will keep scanning this frequency for a while. Anyway, due to it being in Digital mode, I thought it was more interesting than some other reports. One issue that I really need to look into is that the SDRPlay folks haven't published anyplace the details of their receivers digital mode. I am assuming it would be DRM? I'm an old hat to amateur radio and some SWL activity but have not been doing anything with SDR devices until this one." – Sean McHenry KB8JNE

***TSM*'s Utility Planet columnist, Hugh Stegman, responds:**

"It would be newsworthy indeed if we had a DRM pirate. Obviously, Christmas Eve is a peak activity time for pirates in general. The people who license DRM have a very tight control over who uses it, though I suppose the pirate could have paid for it like anyone else. Also, the typical pirate radio transmitter would have to be run at greatly reduced power due to DRM's high peak/average ratio. DRM would be a huge buzz exactly 10 kHz wide, sometimes with three bright lines, though it does come in various versions. The waveform [shown] looks right for OFDM, with the sudden drop off on the left. (No 6 dB points here.) The nonlinearity is kind of odd, though, like it's getting severe fading. I don't recall ever being able to get audio from DRM that badly hosed. It's a strong-signal mode, really. This would be a good place to use the recording feature on an SDR."

**Identifying Unknown Digital Transmissions**

*TSM* reader, Todd Dokey, found a web site that's a good source for helping to identify digital transmissions you may run across using an SDR. Frequencies range from VLF to UHF. Currently, HF has the most digital signals identified with 184. Categories include All Identified Signals, Unidentified Signals, Military, Radar, Common/Active, Rare/Inactive, Amateur Radio, Commercial, Aviation, Marine, Analog, Digital, Trunked Radio, Utility, Satellite, Navigation, Interfering Emissions, Requested, Numbers Stations and Time. Each entry includes a screen shot and audio recording, if available. **http://www.sigidwiki.com/wiki/Signal_Identification_Guide**




***Could this pirate HF digital radio signal, heard on 4.060 MHz, be in DRM format? If so, it could be a first. (Courtesy: Sean McHenry KB8JNE)***

**Drake TR-7 PTO Question**

"Do you know of any literature concerning replacing the PTO (as Drake called it) with a more stable VFO in the TR-7?" – Gary Britton

***TSM* Vintage Radio guru, Rich Post KB8TAD, responds:**

"Here is a note from WB4HFN on installing the Cumbria Designs X-Lock VFO Stabilizer in the TR7 **http://www.wb4hfn.com/DRAKE/DrakeArticles/TR7-Installing-XLock/TR7_Improvements.htm**

"A PDF of an article by Marinos Markomanolakis KI4GIN/SV9DRU in which he details the installation in his TR-7 is a link at the bottom of that page. Note Marinos' comments on slowing the lock to 10 seconds to keep the X-Lock from locking the frequency while he is fine-tuning!

"Here are some reviews on the X-Lock **http://www.eham.net/reviews/detail/8437**

"Here is the X-Lock page with experiences of hams installing the X-Lock in a variety of equipment. There are two more write-ups of the X-Lock in a TR-7 as well as the article from Marinos.

"There is even a write-up of an X-Lock installation in a couple of tube rigs, a Heathkit HW-101 transceiver and a Knight-kit V-44 VFO. **http://www.cumbriadesigns.co.uk/x-lock_solutions.htm**

"It looks to be a very useful product that would improve the frequency stability of many PTO tuned radios."

**BC348-O and R100-URR found at Kutztown**

"I picked up a BC-348-O and R100/URR at Kutztown, Pennsylvania, this past fall and both are in quite clean shape. Got the R100 working due to a blown fuse (couldn't find cause, but I did clip the line cap just in case leakage was too high), a few tubes had little emission so and I think one had an open filament, after replacement and a slow power up it sprang to life. I recapped it but it still has an issue on I think the high band where I get a weak howl on a couple spots on the dial but haven't dug into that yet, one tube is still marginal because I didn't have the tube for it.

"A couple quick questions: On the BC348-O where the dynamotor went I have several green wires that were cut- is that where the terminal strip was? Also a power cable was run out where the original plug was so I have to still figure out whether it was rewired for 6 volt filaments or if it was left as original-I put it aside to work on the R-100. Any tips on what to look for on the chassis? Finally, are the oil caps likely to fail, on a YouTube video one person fixing one found a shorted oil cap but not sure if that's common or not. Thanks." – Wayne Wlocka

**Rich Post KB8TAD Responds:**

Your R-100/URR is a nice find. That morale radio was designed by the Signal Corps and made by a number of manufacturers including Espey, Zenith, Majestic, and Grunow. *[See: "From Army Pirates to Morale Radio," April 2014 TSM – Editor]*

For the BC-348O, it's difficult to suggest an answer to your first question without some detailed pictures of your "O" chassis. From your question, I am assuming your radio was converted to be fed by an external supply. If you have several disconnected wires at the empty dynamotor bay, *and* the filaments and B+ are being fed from some external power supply, then you need a minimum of four wires into the chassis from that external supply; filaments, chassis ground, B+ and a separate B-.

I assume you have downloaded a manual, preferably AN 16-40BC224-3, the Signal Corps manual for the "O" and similar (link is to James Moorer's high quality scans for the manual). **http://www.jamminpower.com/main/bc348.html http://www.jamminpower.com/PDF/AN%2016-40BC224-3.pdf**

The "O" schematic (figure 39, pages 83-84) shows 5 connections to the dynamotor deck terminals; chassis ground, 28 volts power in, 28 volts back to the 2 sets of series tube filaments, B+ output and B- output. So it is possible that those loose wires were connected to the dynamotor deck terminal strip. However, the wires I have seen were all color-coded.

It is important to note that B- in the BC-348 series


***WWII-era "Morale Builder" radio model R-100/URR (Courtesy of Larry Long KB3WBB)***

is not wired directly to chassis ground but is several volts negative relative to chassis by way of a choke which is also part of the audio output transformer. That negative voltage provides the bias for the type 41 audio output tube (VT-48) and some other circuitry.

That circuit combination was designed originally to contribute to voltage stability from the dynamotor. Beware of conversions that feed the high voltage negative directly to the chassis instead of the B- connection at the dynamotor terminals.

Finding out whether the radio has been converted to 6 volts for filaments is easy, just feed the filament line at 6 volts and chassis ground and measure the current draw. If it is less than an amp, the tubes are still series wired. You can also check to see if the tubes and pilot lights light to a normal glow if fed 6 volts. Another option is to simply pull VT-48 ( type 41) tube in the one series string and any tube in the other series string shown on the schematic. If the filament current draw drops to zero, you have your answer.

The three I have worked on are all the later BC-348Q models which only use octal tubes. The metal-encapsulated capacitors have usually surprised me by being in good condition. Check some of your "oil-based" caps which I assume are also of the metal-encapsulated types for electrical leakage. That said, I would at least replace the critical caps (to input grid of the audio output tube and the AVC cap) and add a proper fuse for the B+ supply. After all, these puppies are over 70 years old and haven't seen voltage in a while.

The BC-348 series were intended for use with high impedance headphones. Use with a speaker requires a matching audio transformer. The on-board transformer can be wired for either 4000 ohms (the most common connection, embossed with "HI" on the BC-348Q models) or for 300 ohms (embossed with "LO").

Pictures of my most recent BC-348Q are here. See the pic of the output transformer and the embossed terminal markers. **http://boatanchorpix.x10host.com/BC348Q_3.htm**


*Rich Post's restored Hallicrafters S-38B, inspiring readers to try it themselves. (Courtesy: Rich Post KB8TAD)*


*Radio Garden website: thousands of the world's AM and FM radio stations are just a click away. (Courtesy: Radio Garden)*

Change that audio transformer tap as needed. The 300-ohms output matches nicely as an input to modern powered speakers. That also solves the major complaint of low audio level (which I have not found to be the case. Just use a high efficiency speaker). For that external B+ supply, don't exceed 245 volts in order to avoid distorted audio.

**TSM to the Rescue!**

"Again *TSM* has come to my rescue, I have two S-38's, the first one never got restored it is still in a box. I was fairly new to restoration at the time and had a difficult time with it. It was in rough shape and I could tell someone else was in it.

"Recently, I purchased another one in great physical condition with all the knob's and even the back is in place. Now with the article by Rich Post on the S-38B in the January 2017 issue of *TSM*, I will have renewed enthusiasm.

"Thanks again for a great magazine.....there is always something for everyone." – Jim Stellema KA8ZXJ

**Wandering in the Radio Garden**

*Thanks to TSM reader, Tom Greenli, for passing this link along:* ***http://radio.garden****. It's an extraordinary take on Internet radio listening. The website presents the entire planet as an enormous radio dial. When you click on the link, the website opens to a radio station nearest your Internet Service Provider (ISP). Using the cursor and placing the white circle on any green dot on the globe, that station's online stream will begin playing. Clicking on any other green dot stops the current stream, plays the sound of a radio being tuned and then starts the new stream you've selected. It's quite addictive.*

*In the screen display above right, the station that Radio Garden is tuned to is a low-power FM station from Richmond, Virginia: WRIR 97.3 FM. Other streaming services within the circle are listed at the lower right in the screen, including Madison County Sheriff's department as well as other AM and FM stations. Clicking on any station in the list brings that stream up.*

*I spent some time wandering around the Dakotas, listening to small stations, one of which was KLND 89.5 FM, Little Eagle, South Dakota, part of Native Voice 1, the Native American Radio Network—I heard some very interesting traditional and contemporary Native American music.*

*You can bookmark a find for later listening and when you click on a bookmark, the program whips the world around to that location and zooms in on the station. Amazing!*

*I listened to a station in the Faroe Islands; found a list of 55 stations in Moscow, Russia; six stations from Palermo, on the Island of Sicily; one station in Bamako, Mali; Radio Ndeke Luka, Bangui, Central African Republic; 100.2 Galaxy FM from Kampala, Uganda, was playing Bob Marley's "One Love," there were eight stations from that city available. I heard Cajun music on Highland Radio from Letterkenny, Ireland, and I could have spent hours touring the offerings from Australia.*

*I found streaming stations on remote islands in the Indian Ocean and above 60 degrees latitude. I listened to a station (KBRW) in Barrow, Alaska; the appropriately IDed KICY in Nome, Alaska. I heard jazz on a Sunday evening on CFIM 92.7 MHz Cap-aux-Meules, in the Gulf of St. Lawrence on Isle de la Madeleine—that was a treat!*

*Streams come and go around the globe, so you'll have to keep checking to see what's playing and where. Not all radio streams are listed and not all listed are actaul radio stations, some are webcasts only.*

*There are other features with this site including archived radio jingles (many US listeners will recognize these jingles), radio history and personal listeners' stories.*

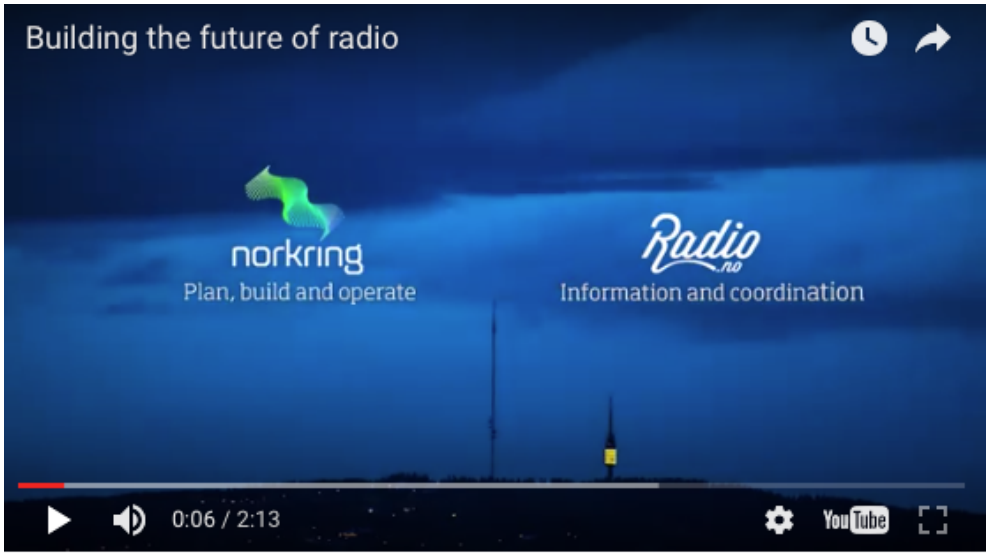
*As with radio waves, there are no state, province or international borders on this site and the light green station dots sometimes blend in with the green of Mother Earth, so look carefully! – Editor*

TSM

# RF Current

## News from the World of Communications

*RF Current is compiled and edited by Ken Reitz KS4ZR from various news sources and links supplied by TSM readers. If you find an interesting story pertaining to amateur, shortwave, scanning, broadcasting or satellites, send a link to editor@thespectrummonitor.com*




***Norwegian English language YouTube video promoting the digital changeover. (Courtesy: World DAB)***

### Norway Ditches Analog FM

Six years ago, Norway's parliament decided to close analog FM broadcasting, replacing it with DAB (Digital Audio Broadcasting), a digital broadcast format. The switchover began January 11 of this year and will proceed across the country county by county until all analog FM transmissions will be have been closed by December 13, 2017.

Proponents say the move will save the government, which provides most radio services in that country, some $25 million in operating costs and deliver higher quality audio to listeners.

Among the issues facing Norwegians this year is having to buy a digital set to hear stations they've listened to since the 1950s when FM broadcasting began in that country. The *New York Times* reports that some 2 million car radios are not equipped to tune in the DAB signals and converting car radios costs individuals the equivalent of $232.

The online publication, *NewsInEnglish.no*, reported January 12, the day after the shutdown began, that nearly 8 million otherwise functioning FM radios would become obsolete over the next twelve months and asked for solutions to the expected enormous pile of electronics showing up in their landfills, noting that, "at least 93 percent of the materials in a radio can be recycled and used for something new." One idea was to export the radios via humanitarian organizations for international distribution.

US FM radio listeners need have no fears of such a switch being made here for many years, if not decades, to come. The pace of conversion of US FM stations to HD Radio, the only FCC approved digital format, is very slow with virtually no converters available and very few HD-capable radios on the market. Even in the auto sector, the vast majority of new cars sold in the US today are not equipped to receive HD Radio transmissions.

### AT&T Shortwave Station Poles to Come Down

Wooden and metal antenna supports that provided AT&T's shortwave service transmissions for 80 years in a marsh in New Jersey are finally being taken down. According to an article by the *Shore News Network*, nearly 500 wooden poles and 19 metal masts, that covered more than 200 acres in an area known as Good Luck Point, off Berkeley Township, will be taken down at a cost of $1.7 million. The money is part of federal Hurricane Sandy aid, according to the article. AT&T had shut down the site in 1999 along with two sister locations in Florida and California, *Shore News Network* reported.

### CES Hits and Misses

CES 2017, January 5-8, marked the 50th anniversary of the show that tech lovers await like children just before Christmas while the rest of us try to see through the blizzard of media hype. It's the show that hopes to bring us a glimpse of a bright and techno-laden future in the middle of what most of North America experiences as the real-life winter of today.

As usual, because CES is held in Las Vegas, there was a lot of glitz and ballyhoo with innovation awards going to everything from a smart dog collar, a food recycler and of course, the absolutely greatest thing since the invention of water—self-driving cars. I'm always reminded, when these awards are announced, of similar breathless announcements not too long ago about 3D-TV and HD-Radio among many others, neither of which seem to have figured much in our daily lives so far.

One company from China, called Muzen, offered a vintage take on a new

*Muzen's retro-looking Wi-Fi radio, a CES Innovation Award winner. (Courtesy: Muzen)*

*Apple iPhone 7 sans traditional headphone jack. (Courtesy: Best Buy)*

Wi-Fi radio. It was the company's fifth innovation award and you probably never heard of them.

According to a company press release, "As an emerging global company, Muzen is bridging the highest level of radio and audio technology to bring quality and craftsmanship that is unsurpassed by other audio and radio devices. Muzen's MK Radio line-up features…wood and metal, as well as a line of tube amplifier radio and Bluetooth speakers, which are expected to begin US distribution in Q2 2017. The award-winning Internet radio product will launch later in the year. Suggested retail price is $140."

On perhaps the other end of the scale is LG's Signature 7727 TV, featuring Organic Light-Emitting Diode (OLED) screen technology that delivers 4K Ultra High-Definition TV (UHDTV) at 3840 x 2160 pixel resolution on a screen almost 77 inches diagonal measurement and just 3.3 inches thick. The price: $20K. Dog food commercials never looked so good.

**Of Headphone Jacks and FM Chips**

For years, the broadcast industry was convinced that their industry was not doing as well as it might because smartphone service providers had turned off the radio receiver option built inside smartphone chipsets. And for years, the National Association of Broadcasters (NAB), according to a 2013 story on National Public Radio (NPR), had been asking mobile service providers to change this. "But the mobile industry, which profits from selling data to smartphone users, says that with the consumer's move toward mobile streaming apps, the demand for radio simply isn't there." To their credit NPR noted that they, along with the NAB, have been part of a lobbying effort to require this free radio feature to be enabled.

Three years later, in 2016, *Wired* magazine was still asking, "Your phone has an FM chip. So, why can't you listen to the radio?" The answer was still the same: wireless carriers want customers to use up their data streaming, not save data by tuning in over the air. Some carriers, AT&T and T-Mobile, were "embracing activation for all Android phones, following a move Sprint made in 2013," according to the article in *Wired*. Not so with Verizon or the elephant in the room—Apple, which wouldn't even bother commenting for the *Wired* piece.

At the time, Congress held hearings on the matter but failed to do anything (no surprise there) and FCC Chairman, Tom Wheeler, opined that, "the issue may be resolving itself in the marketplace." Whatever that meant.

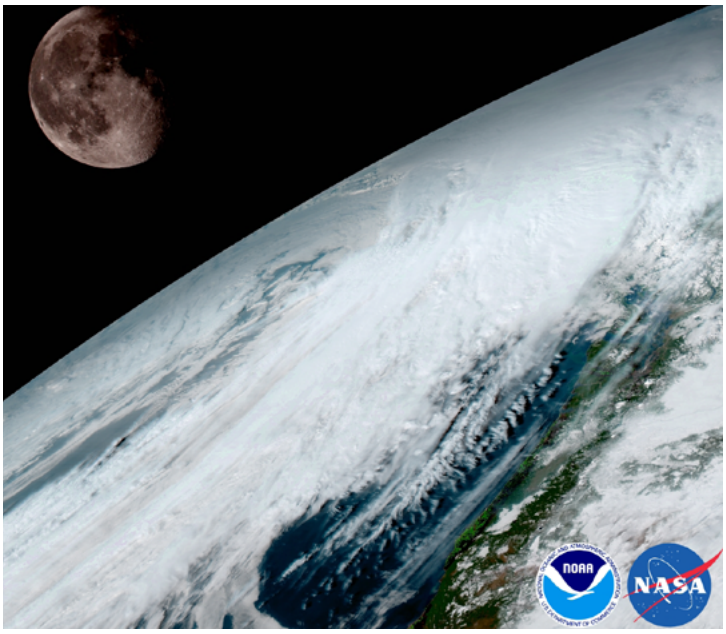
Now comes more trouble for smartphone users—the headphone jack has slowly been disappearing from various models, including Apple's iPhone7, which launched this past September without the ubiquitous 3.5 mm phone jack. Later, HTC10 Evo and Motorola's Moto Z models, both Android devices, also launched without the 3.5 mm phone jack. By December, rumors were rife among avid smartphone watchers that Samsung would also ditch the headphone jack in their flagship device, the new Galaxy S8, yet to be launched. Then word came that the jack would in fact remain on the S8. Then it might not. Samsung is still expected to release the new S8 later this month.

And, finally, at the first of this year AT&T officially shut down its 2G network, thus rendering any remaining original iPhones as doorstops, according to an article in *Fortune* magazine. It's not known if there were actually any 2G phones in use that day.

**Amateur Radio Satellite Ops Score ISS Launch; Fox-1 Set Back**

According to a press release from Japan Aerospace Exploration Agency (JAXA), on December 19, 2016 a total of six microsatellites were successfully deployed into orbit from the Japanese Experiment Module (known as "Kibo") on the International Space Station. Satellites carrying amateur radio payloads included ITF-2, Waseda-Sat-3, AOBA-Velox-3, and TuPOD (including Tancredo-1). University of Tsukuba designed and built ITF-2, with a downlink of 437.525 MHz. Waseda-Sat-3, a project of Waseda University, downlinks

***Deployment of ITF-2/WASEDA-SAT3/FREEDOM from the Japanese Experiment Module aboard the International Space Station (Courtesy: JAXA)***




***GOES-16 captures the Moon as well as the atmosphere of the Earth in one of its first images, January 15, 2017 (Courtesy: NOAA/NASA)***

CW and FM telemetry on 437.29 MHz. AOBA-Velox-3 downlinks GMSK telemetry on 437.225 MHz. Tancredo-1, a Brazil middle school project, will transmit AFSK on 437.200 MHz.

According to the AMSAT website, RadFxSat, the first of four Fox-1 CubeSats that was to launch March 16, has been rescheduled for August 29, 2017. The announcement, made by AMSAT Vice-President for Engineering, Jerry Buxton N0JY, noted, "RadFxSat is a partnership with Vanderbilt University ISDE and hosts four payloads for the study of radiation effects on commercial off the shelf components. RadFxSat features the Fox-1 style FM U/v repeater with an uplink on 435.250 MHz (67.0 Hz CTCSS) and a downlink on 145.960 MHz. Satellite and experiment telemetry will be downlinked via the 'DUV' subaudible telemetry stream and can be decoded with the FoxTelem software."

**NOAA's GOES-16 Begins New Weather Era**

Launched November 19, 2016, NOAA's latest geosynchronous orbiting weather satellite, known as GOES-16, began sending live images to Earth January 15, 2017. It is the first of a series a new higher resolution satellites, according to a NOAA press release, that "can provide a full-disk image of the Earth every 15 minutes, one of the continental US every five minutes, and has the ability to target regional areas where severe weather, hurricanes, wildfires, volcanic eruptions or other high-impact environmental phenomena are occurring as often as every 30 seconds." Its field of view is from pole-to-pole and the coast of West Africa to Guam. The satellite will continue to undergo testing and should be fully operational by November 2017. Additional GOES-R series satellites, beginning with GOES-S will launch in the spring of 2018.

**FCC's Outgoing Chair: "Successful Auction"**

On his way out the door, January 18, now former FCC Chairman, Tom Wheeler, issued a statement on the "Incentive Auction" that changes the landscape of OTA-TV for the foreseeable future. According to an FCC press release, Wheeler said, "There is still a long road ahead to successfully implement the post-auction transition of broadcast stations to their new channels and bring the new wireless and unlicensed spectrum to market. This will be an extremely important task for my successor and the new Commission; I wish them well." A happier man in Washington, DC, will be hard to find.

Wheeler's successor is current Commissioner Ajit Pai, a Republican, who was appointed to the Commission by President Obama in 2012. According to his profile on the FCC website, Pai had been a partner at the Washington, DC, law firm Jenner & Block, LLP, prior to his appointment to the Commission. He had been Special Advisor to the General Counsel, Associate General Counsel and Deputy General Counsel to the FCC and served for two years as Associate General Counsel for Verizon Communications, Inc.

Pai is described by many media sources as, "cable and wireless industry-friendly." According to an *Associated Press* technology report, Pai opposes "net neutrality"—that Internet Service Providers (ISPs) should not be able to "favor some Internet sites and apps over others"—and he is said to be in favor of mega-mergers among communications companies. The FCC is structured so that the chair of the Commission is a member of the party currently in the White House and that three of the five members of the full Commission are members of that party. There are currently two vacancies on the Commission.

TSM

***Duga-1 array within the Chernobyl Exclusion Zone. The array of pairs of cylindrical/conical cages on the right are the driven elements, fed at the facing points with a form of ladder line suspended from stand-off platforms at top right. A backplane axel reflector of small wires can just be seen left of center, most clearly at the bottom of the image. (By Necator - the English language Wikipedia (log), Public Domain, https://commons.wikimedia.org/w/index.php?curid=4870433)***

# The "Russian Woodpecker" HF demon of the 1970s – 80s

## By John Piliounis

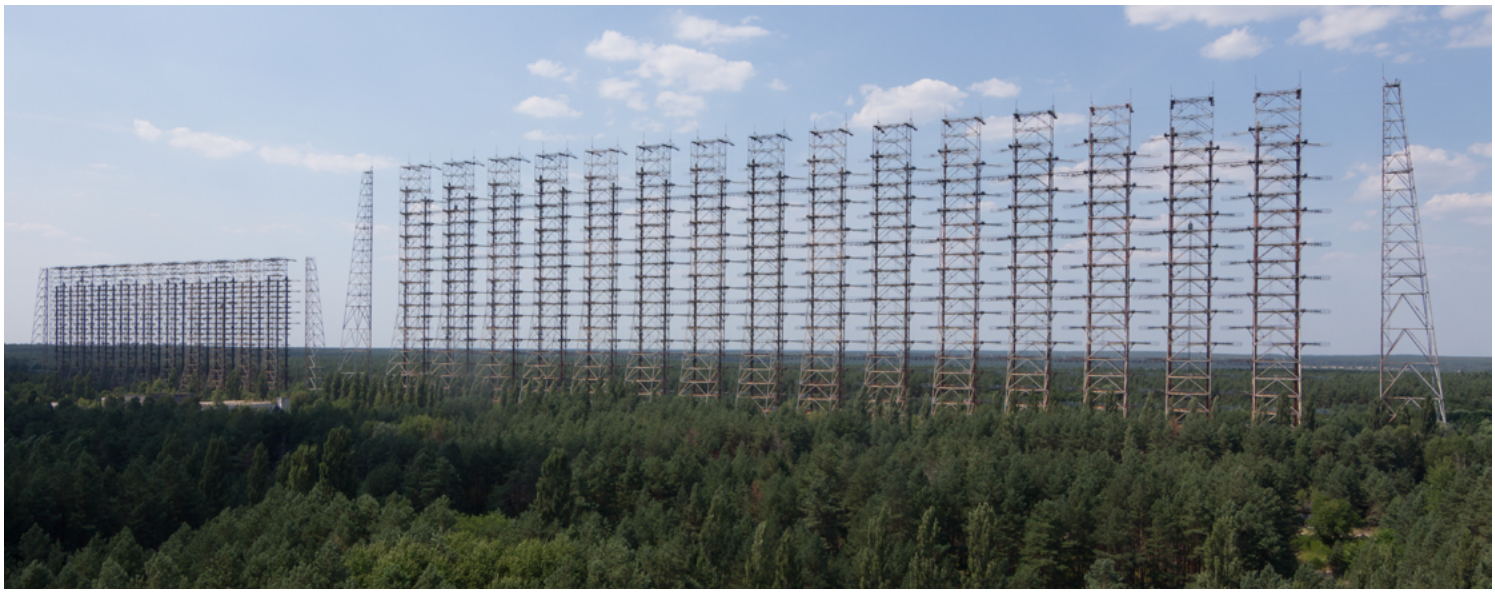
We'll start this journey into one of the wonders and mysteries of the HF spectrum by leafing through the pages of *Monitoring Times*, from August 1985, v.4, No.8. There, at page 5, we'll read an article by David Wilson regarding the Russian Over-the-Horizon Radar (OTHR) dubbed by the West as the "Russian Woodpecker." That name was given to the signal because of the sound pattern of its transmitted pulses at HF frequencies as heard on any shortwave radio's speaker around the world. What you were hearing was a Russian early warning anti-ballistic missile radar system that came into operation in late 1971.

The Woodpecker's pulses were broadcast from the area of Chernobyl in the Ukraine, which was then part of the USSR, which were hopping between four broadcast time windows at four distinct frequencies: 16450, 16490, 16570 and 16390 kHz—one for each window.

At a bandwidth of 40 kHz, each pulse had a length of 3 to 6 ms and was broadcast typically for 10, 16 and 20 times per second followed by a 72 ms silent period. That was the so-called "static" mode. In the "dynamic" mode, four frequencies that could have also been used on other areas of the HF band (8070, 8230, 8310 and 8260 kHz, for example) were all transmitted sequentially in each and every time window in intervals of 6 ms.

In the most usual 10 Hz mode, where the four frequencies were transmitted every 100 ms, the duration of each distinct frequency's transmission window was a 7 ms, thus resulting in a 27 ms continuous broadcast followed by 72 ms of silence, all adding up to 100 ms. Many transmission hopping and timing techniques were used by the Soviets to avoid jamming of the transmit frequencies and/or spoofing of the received echoes. Because of the power and range of this system, it was very annoying to all the shortwave listeners as well as amateur and commercial HF operators around the world.

Theory has it that these signals, aided by the ionospheric and surface reflections, can travel thousands of kilometers over our planet's surface. The electromagnetic waves are re-



***Full view of the two Over-the-Horizon radar antennas in the Chernobyl-2 complex. The height of the larger antenna is about 150 m, the smaller one is about 90 m high. By Ingmar Runge (Own work) [CC BY 3.0 (https://commons.wikimedia.org/wiki/File:DUGA_Radar_Array_near_Chernobyl,_Ukraine_2014.jpg)***

flected by objects, including airplanes, missiles or even ships found in their path, and return to the source on the receiving antenna, following the same path and eventually alerting the receiving station about the object that caused the reflection.

Used alone, it was a very risky method of identifying with any certainty the launch of an ICBM (Intercontinental Ballistic Missile). However, this core idea used on top of any other kind of detection method was that if a missile was fired somewhere, the receiving antennas would get an echo-back-reflection of the Woodpecker signals due to the alteration of ionospheric propagation caused by the ICBMs exhaust gases that very seriously affect the concentration of ions in the ionosphere. But only HF electromagnetic waves could be used for this kind of ionospheric detection because only the shortwaves can be reflected by the ionosphere.

So with that shortwave broadcasting and receiving installation system of Chernobyl-2, the Soviets could calculate the distance, speed, height and direction of any ICBM at any time on its course after it had entered the ionospheric region. But this system's detection capabilities were not only aiming to early warning for ICBMs. Many sized ships as well as large aircraft bodies could be sensed anywhere on the earth, although with moderate levels of accuracy.

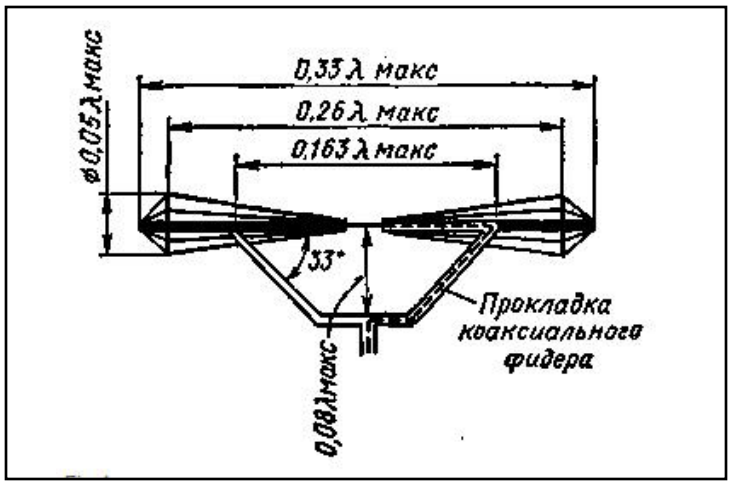
The broadcasting installation at Chernobyl, actually about 30 Km northwest of it, and 9.5 Km away from Chernobyl's ill-fated reactor, was huge as you can see from the photographs. This system was built from 1970-71 and Soviets had named it "Chernobyl-2" while the West called it DUGA-3. Actually, a DUGA-3 system never existed or named as such by the Russians. DUGA-1 and DUGA-2 systems were the only ones that ever existed. The Soviets were using the names DUGA-2 and Chernobyl-2 interchangeably when they wanted to refer to the specific Woodpecker installation. For some reason, most likely a misunderstandings, the West still refers to this antenna installation as DUGA-3.

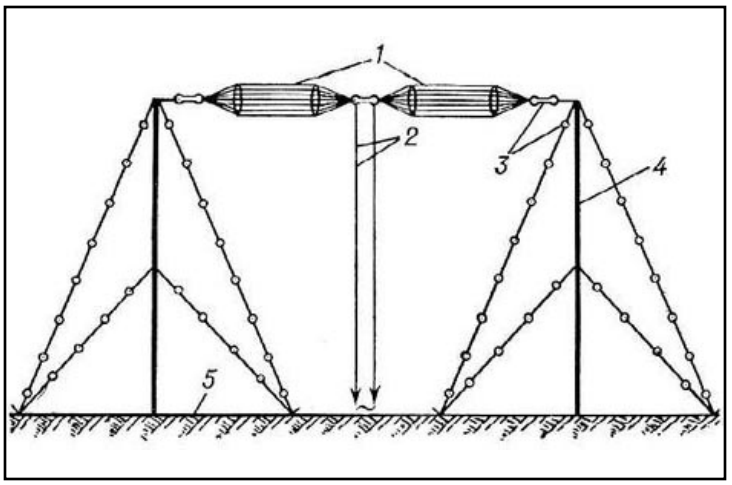
The height and the width of the receiving antenna of Chernobyl-2 installation are 150 meters and 500 meters respectively, while the transmitting antenna's dimensions are 90 meters and 250 meters. The antennas design is of the curtain dipole type (**www.antenna.be/hr.html**). The amount of EIRP that this monster was pouring into the air was in the neighborhood of 10 MW and more. The phasing control of the broadcast beams was so intelligently designed, that the transmitted pulses could be of as low as 5 degrees of beamwidth or even sharper. At the back of the dipole-array structures, as can be seen in some photos, are the thin wire reflector grid, which ensured that no precious dBs would be lost.

Use of this system, as it was designed, officially ended in 1989 because satellite systems were far more accurate for the job. While the Soviets kept the system running for a couple of more years, mostly for educational and experimental purposes, operation of the Chernobyl-2 broadcasting system actually ceased after the Chernobyl's nuclear disaster in April 1986. From then on, after taking out all the valuable huge tube and electronic units used for the transmitting and receiving systems, they eventually left it to die.

Although 25 years have already passed since the abandonment of the system, the structure is still there alive and strong. Now it is inside Ukrainian territory and a sense of awe is what one feels when facing it for the first time. Pictures on the Internet and those accompanying this article give only a small fraction of the imposing size of the structure.

The worldwide HF spectrum during the late 1970s up to late 80s was suffering a lot from the "Russian Woodpecker" signal of the Chernobyl-2 OTH radar. The signal was not exhibiting a steady pattern either in its broadcasting mode, steady or dynamic, nor in the HF bands it was using. One could hear it emerging out of his HF receiver at any time




***Diagrams from Sergei Nadenenko's book "Antennas," in the original Russian, show cage dipole antenna on which the Russian OTHR Woodpecker was based. (Courtesy: www.antennatop.org)***

of the day and in different HF bands, although there were periods that the broadcast pattern seemed to be steady over a considerable time span. Sometimes, numbers and other Russian coded words were transmitted as voice during the silent periods of the Woodpecker signal or even simultaneously. In any case it was an obnoxious problem for amateur communications and so an international association of users was formed to officially demand that the USSR stop bothering the spectrum. Many countries, including U.S., had officially asked the USSR through the U.N. to stop violating the spectrum but, during the "dark ages" of the Cold War, such efforts were of zero result.

The strength of the system's signal was so intense that sometimes, under certain ionospheric and weather conditions it could be even heard by people around the globe while they were talking over the telephone systems of the time.

Western agencies, using triangulation methods, quickly learned that the position of the installation was somewhere within the area of Ukraine, but nothing could be done to stop it except for some efforts to jam it. That proved to no avail as well since the coded hopping patterns of the frequencies used in the broadcast bands were almost completely unpredictable.

The antennas of Chernobyl-2 were and still remain the biggest directional HF antennas in the world. The curtain dipole arrangement of this antenna type was invented by the Soviet scientist and engineer, Sergei Nadenenko (1899-1968). Nadenenko's dipole, as seen in the above diagram, if repeated so as to form a dipole array of the curtain type, was used in the Chernobyl-2/DUGA-3 system. If all dipoles are fed under proper phasing control, then any lobe's bouquet geometry, polar or azimuthal, any preferred direction and preferred power could be achieved. The Nadenenko dipole came into use in 1937. Nadenenko's specific dipole is classified as a symmetrical, large diameter, open-wire feeder which exhibits a very small radiation resistance thus being capable of transmitting in different wavelengths over a wide-band with nearly negligible loss of the input signal's power. Its input resistance is only slightly dependent on the wavelength. At the specific Chernobyl-2/DUGA-3 installation, one can see that there is a periodic dipole feeding which happens on every other line and set of columns of dipoles.

The dipoles are fed from 300 - 550 Ohm centered ladder-type feeding lines. The book "Antennas," by Sergei Nadenenko and published in 1959 in Russian, is a wealth of information for these types of antennas. It is believed that under Russian copyright rules the book is in the public domain, the copyright having expired in 2009. A copy of it is offered on the website **www.antennatop.org**. Although written in Russian all calculations and schematics are understandable. Another information source for this type of antenna can also be found here: **http://w8ji.com/curtain%20sterba%20USIA%20array.htm**.

One can listen to the sound of the Woodpecker signal at the following YouTube video link, **https://www.youtube.com/watch?v=aOMVdOc9UbE.** Many more breathtaking videos can also be enjoyed, some of which were filmed by various young Ukrainians and Russians of today who climb up the DUGA structure and let their cameras reveal the magnitude and, for the acute eye, the technological details of the structure. One can see the actual installation on Google maps at the 51-18-20,17N, 30-04-02.60E co-ordinates. Until today, many ham expeditions and Ukrainian hams have used the structures of the DUGA antenna to tie their own antennas for tests and ham operating contests.

*About the Author*

*John (Ioannis) Piliounis, holds a BSc in Physics and a MSc in ECE from Ioannina and Athens Universities of Greece. He works as a senior system analyst and programmer in a Hellenic group of Security Systems companies and also develops complete solutions for automation and control communication systems based on the ARM Cortex family of processors platform. His spare time is unequally divided between family and research interests on the field of the electromagnetic phenomena. He can be reached at, jopil@atlascom.gr*

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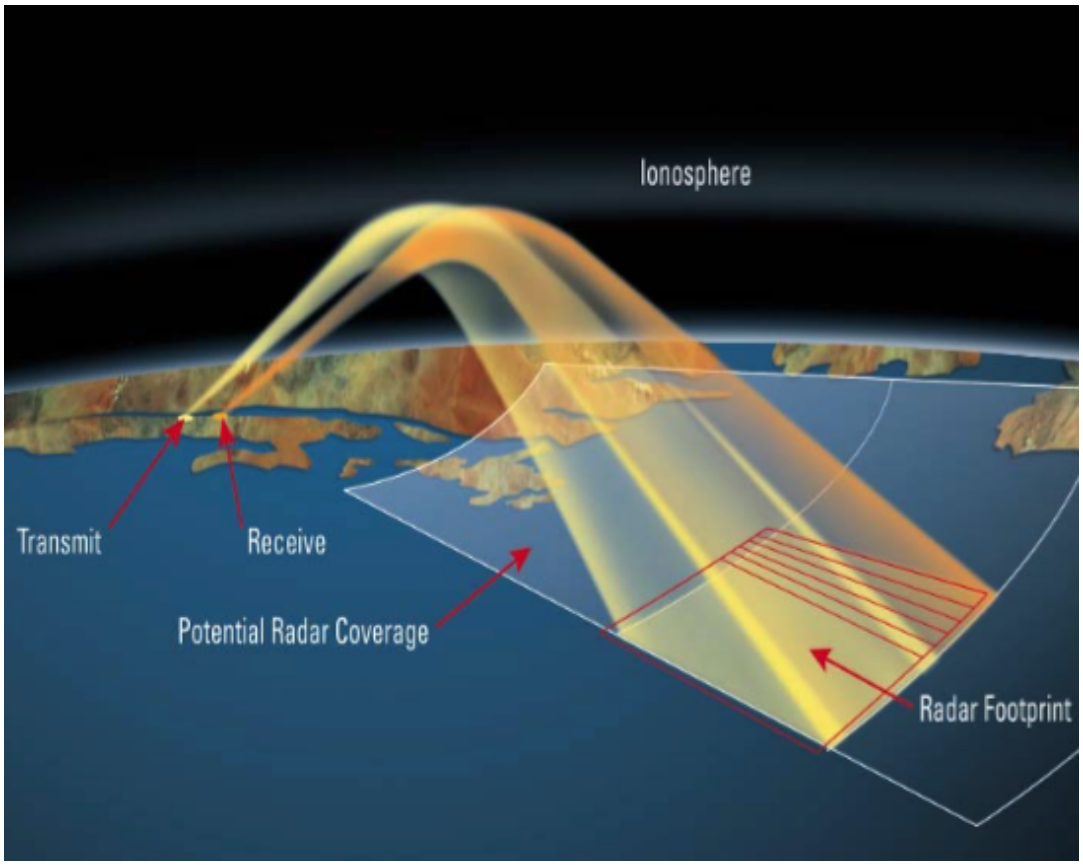



***An OTHR is a type of radar designed and operated specifically to see 'over the horizon'. Conventional microwave radars such as those commonly seen at airports propagate in a straight line and cannot detect objects beyond their line of sight i.e. beyond the visual horizon. OTHRs overcome this limitation by 'bouncing' High Frequency (HF) radio waves off the ionosphere. OTHR utilizes the refractive properties of the ionosphere to refract or bend transmitted HF electromagnetic waves back to Earth. When these refracted HF waves hit a radar reflective (metal) surface of sufficient size — either airborne or maritime — some of the energy is reflected back along the transmission path to the OTHR receiver. Sophisticated computer systems then process the received energy to discern objects within the radar's footprint. (Caption text and graphic copyright Royal Australian Air Force JORN factsheet)***

# Over-the-Horizon Radar Today

## By Ken Reitz KS4ZR

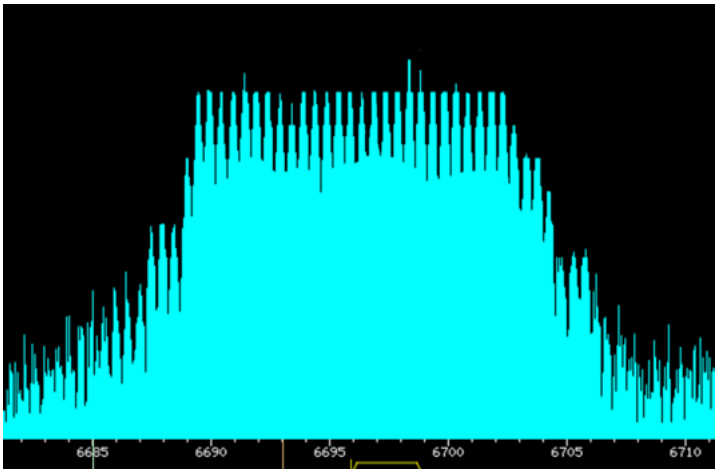
Despite the advances in satellite technologies over the last 50 years, the use of OTH radar systems worldwide on HF frequencies is extensive. It includes High Frequency Surface Wave Radar (HFSWR); Over-the-Horizon Backscatter (OTHB) radar; Pulse Doppler Over-the-Horizon Backscatter (PD-OTH-B) radar, and Relocatable Over-the-Horizon Backscatter (R-OTH-B) radar, among others. And, though none of them alone compare to the havoc created by the Russian "Woodpecker," they all add up, especially when they come down unannounced in the middle of any of the amateur radio or international broadcast bands. Some have even been found on Medium Wave broadcast frequencies.

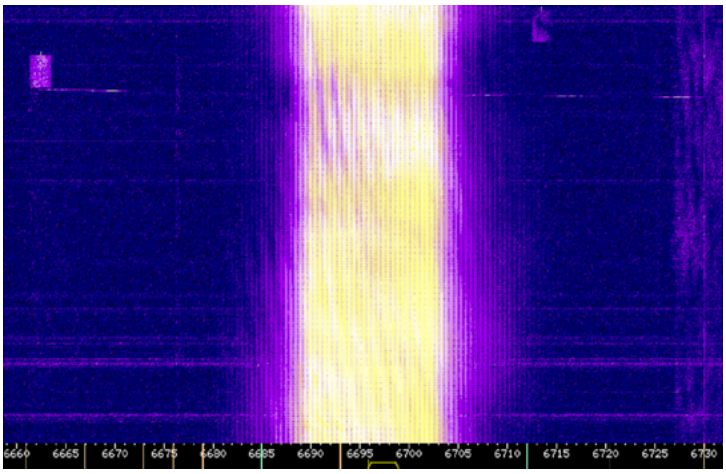
As explained in Hugh Stegman's Utility World column for December 2016, we can expect an increase in such interference with new transmitter locations beginning service this year and next. Over the last 10 years, many countries have operated systems either for their own purposes or on behalf of other countries including Australia, Canada, China, Cyprus, France, Italy, Iran, Japan, Russia, Turkey, Ukraine, United Kingdom and the United States. But, it's not just about national defense. Various science and law enforcement organizations have also found a use for OTH radar, including meteorologists, shipping interests and drug interdiction programs.

The International Amateur Radio Union Monitoring System (IARU-MS) keeps track of intrusions by all non-amateur signals in the amateur radio bands worldwide and report a great number of such intrusions on the ham bands every day. You can visit their website here: **http://www.iaru-ms-r1.org**. You can also see a log of the latest such intruders by clicking "Latest Intruder News," on the left hand side of the page. On the day this was written, Australian OTHR system, JORN, was on the 30-meter amateur band; Russia was on two frequencies in the 20-meter band; China was on 40-meters, and OTHR from western Turkey was said to be on the 15-meter band. The site is maintained by Wolfgang Hadel DK2OM, coordinator for IARU-MS Region 1, and Peter Jost HB9CET, vice-coordinator for IARU-MS Region 1.

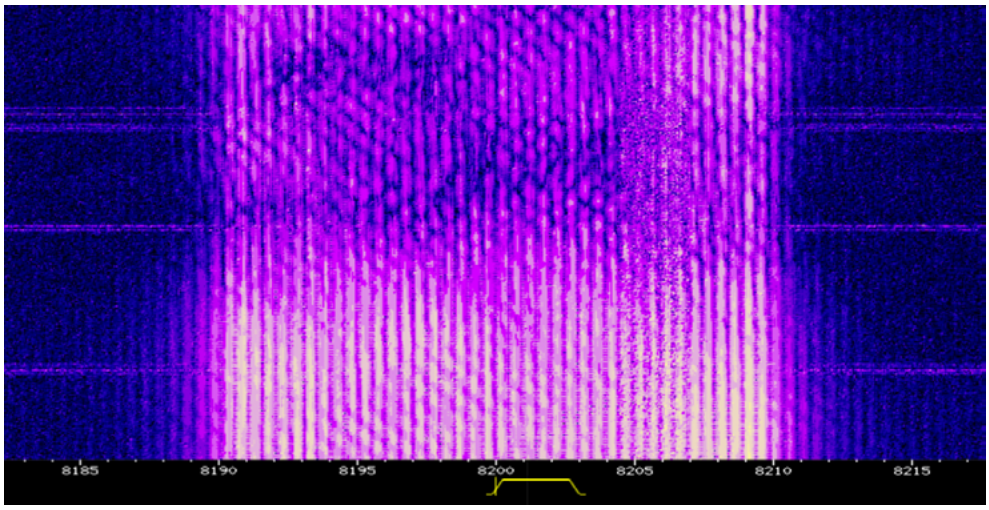
The most that any person or group can do to combat OTHR activities in the amateur bands is to complain. But there's little evidence that such complaints from hams and shortwave listeners register in the planning rooms of nations when it comes to strategies for protecting their coasts or borders against perceived threats or even the potential for perceived threats.

One interesting side topic is finding the actual locations of the OTHR installations using Google Earth. *TSM* digital HF contributor, Mike Chace-Ortiz, wrote recently that he




***Russian OTH radar today as heard on the Netherlands WebSDR. Above left is the spectrum, above right is the waterfall. The waterfall shows how splattery this radar is, compared to the sharp dropoffs of Pluto-II. That's due to its FM-on-pulse type of modulation. (Graphics and caption courtesy of Hugh Stegman)***

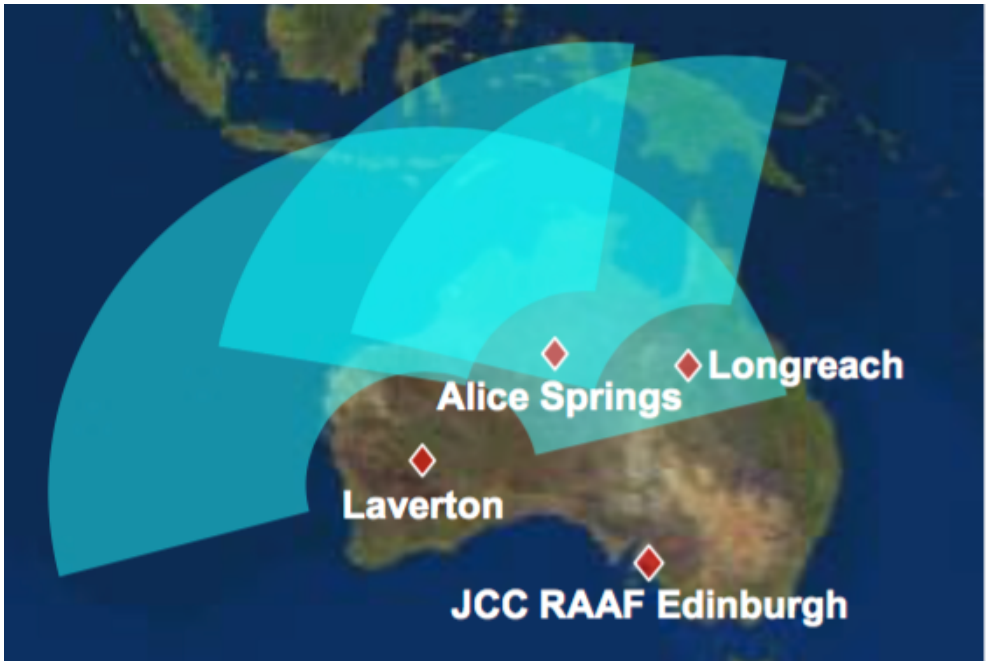



***At right: The United Kingdom's Pluto-II site at Akrotiri, Cyprus. Hugh Stegman notes, "The grungy place between 8404.5 and 8407 kHz is a STANAG 4285 transmission being stepped on by the radar. If this was 29B6 (Russia's "Kontayner" OTHR), it would have been obliterated altogether because the online receiver is right in its primary coverage area." (Courtesy: Hugh Stegman)***

had found the Akrotiri Pluto transmitter and receive site as well as transmit/receive sites for the US ROTHR in Puerto Rico, Corpus Christi (Texas), Chesapeake (Virginia), Australia's JORN OTHR and France's "Nostradamus OTHR," which he says he has not heard for a while. He notes, "I have been assured several times that Turkey has an HF OTHR and was given a rough area to look, but I have been unable to find it. I remain skeptical. There is one in Iran too, which I found but can't locate anymore."

A five-minute YouTube video of current Russian 296B radar can be viewed here: **https://www.youtube.com/watch?v=BMoztHw84a4**

With an increase in interest in the uses of OTH radar, and increasing tension among allies and adversaries alike, as well as increased terror threats worldwide, there will likely be no end to OHTR activities for many years to come. TSM




***Australia's Jindalee Operational Radar Network (JORN) locations and coverage. JORN does not operate on a 24-hour basis except during military contingencies. The JORN radars have an operating range of 1000–3000km, as measured from the radar array. The above graphic depicts the locations of the three OTHR systems and the JORN Coordination Center (JCC), and highlights the coverage of each radar. Of note, the Alice Springs and Longreach radars cover an arc of 90 degrees each, whereas the Laverton OTHR coverage area extends through 180 degrees. (Caption text and graphic copyright Royal Australian Air Force JORN factsheet)***



***Left: As a young teen, Bob Swan was one of the early members of the BLRC and still has his membership certificate to prove it. (Courtesy of KC3W). Right: A replica of the official Boys' Life Radio Club QSL takes its place beside a two-tube, two-band regenerative receiver built with parts and a construction style reminiscent of the early 1950s. (Courtesy of KI6SN)***

# Boys' Life Radio Club

## By Richard Fisher KI6SN

*Remember the Boys' Life Radio Club? It was one of the biggest SWL organizations of the 1950s nobody's heard of.*

Since its kickoff more than 100 years ago, *Boys' Life* magazine has been a young man's entre to the important things in life—camping, fishing, knot tying, orienteering, glider building, sports, civic duty and a million other interests.

It is not well known that for many years, beginning in the early 1950s, *Boys' Life* hosted what would become one of the largest and most active shortwave and broadcast band radio clubs in the country—at least during the 1950s. With more than 22,000 members at its peak, the Boys' Life Radio Club encouraged kids from all 48 states—yes, the stars for Alaska and Hawaii hadn't been added to Ol' Glory just yet—to become active listeners and to consider getting into amateur radio.

The headline "Announcing the Boys' Life Radio Club and Contest" topped a one-column story on page 30 of the magazine's October 1952 edition. The club sent out thousands of membership certificates to kids requesting them.

There were also certificates in recognition of listening achievements including LACA (Logged All Call Areas), LAS (Logged All States) and LAC (Logged All Continents).

The club was very active and a lot of fun, given its large membership. For a couple of years in the club's infancy, major prizes were awarded the top listeners in two of the club's contest categories:

Class A was for boys using manufactured receivers, including converted war surplus radios.

Class B was for listeners with homebrewed receivers – built from scratch or from a kit.

Hallicrafters donated as prizes a ton of radios, including its S-38, SX-62, S77A, S-53A and S-54. Meanwhile, the National Co. generously followed suit with NC-183, NC-125 and SW54 receivers.

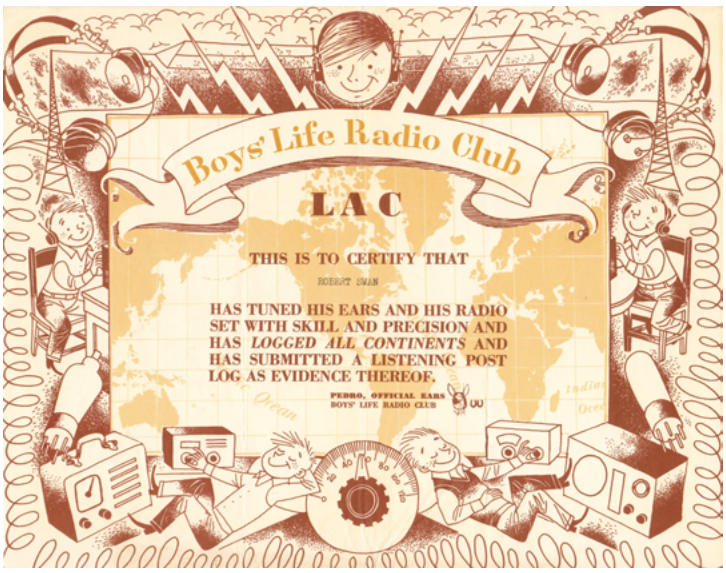
In addition, there were more than 100 prizes for runners up, ranging from American Radio Relay League publications and the Eldico Novice Course ("with code practice record") to dipole antennas and Sylvania tube sets for the Boys' Life transmitter and power supply. Details about home brewing the set-up were featured in the magazine.

In many ways, the 1950s should be counted as one of the heydays of shortwave listening and worldwide amateur radio operation.

### Boys' Life opens the Door to a Life's Career

For then-15 year-old Brian Cieslak, the Boys' Life Radio Club was "the launching pad for my pursuing degrees in Broadcast Engineering (the First Class Radio Telephone


***For logging all amateur radio call areas, Bob Swan earned the radio club's LACA certificate. (Courtesy of KC3W)***




***Bob Swan achieved his LAC certificate (Logged All Continents) after submitting confirming reports to the Boys' Life Radio Club. (Courtesy of KC3W)***

license meant more than an Associate's degree) and a bachelor's degree in Physics and Computer Science.

Along the way, he said, "microcomputers and I came of age. I've actually been involved in embedded systems design and programming for 30 years in both the medical imaging and industrial control fields. I retired a couple of years ago."

As a teen, Brian was attending an all-boys technical and trade high school, "which was pretty much the equivalent of a tech college these days. I was in the electronics program. I had several friends who were in the radio club there.

"One day I saw a blurb in Boys' Life about the radio club and sent away for the membership package." The rest, as they say, is radio history. By the way, Brian had replicas made of the official BLRC QSL card and was kind enough to send me one. You can see it next to the accompanying picture of the home-built receiver.

"My uncle was very supportive of my radio interest since he was a radioman in the Army," Brian said. He bought me a set of Howard W. Sams Code Practice records, (back) when Radio Shack actually sold radio stuff."

Later, Brian's dad brought him a National NC-300 receiver "and we strung a 40-meter dipole in the back yard. I used that to scan the bands. I also read a book titled 'There's Adventure in Electronics' by Julian May that really set the hook. It was about a boy who lived next door to ham radio operator and they developed a friendship that led to his getting a ticket." Brian is on the air today as K9WIS, Amateur Extra class.

**History's Overlooked SWL Community**

The Boys' Life Radio Club was a major SWLing player in the 1950s, although you'd never know it from hearing most reflections on the era. Many cite Cleveland as the location of the 1950s popularization of mid-century radio clubs. That is where DXer Joe P. Morris began distributing SWL identification signs in about 1955.

They were sent out on little strips of paper, assigning WRØ prefixes in return for an SASE. Legend has it that Joe got the FCC's OK to take on this naming convention. It does not appear he had a club. He was just an SWL ID-sign kind of guy.

But Joe wasn't breaking any new ground. The BLRC had been in operation for several years before WRØs monitored the airwaves.

As Tom Kneitel, former K2AES, and later W4XAA (SK), tells it, Joe became overwhelmed with the paperwork and sent an SOS. "I volunteered," Tom noted in a Web posting years ago. Tom inherited the initiative and solidly built on it.

"At that time I was writing for *Popular Electronics*," he said, "and asked Perry Ferrell, the editor, if they would like to sponsor the project as a service to readers. They agreed and said they would publicize it as a *Popular Electronics* program, print up the certificates, etc. I was put in charge of the project and my signature was printed on the certificates. We also decided to reorganize the project and replace the WRØ prefix with WPE. The original run of certificates had pre-printed IDs running from WPE1AA through WPEØZZ."

The Poptronics Short-Wave Monitor program became wildly popular. "I believe they announced the project late in the 1950s and the response was overwhelming," Tom said. "I processed the applications and typed in the names and dates. It didn't take long for me to run through all of the certificates.

"The next batch of WPE certificates – to cover IDs with three-letter suffixes – did not have pre-printed IDs. We did not keep records as to the specific ID assignments. I typed in the IDs, names and dates on those certificates.

"I handled this program until the spring of 1961 when I became the editor of another radio magazine (Popular Communications). At that time, Popular Electronics redesigned



***Left: In the Boys' Life Radio Contest, held in the first couple of years of the club, Hallicrafters donated a bunch of prizes, including its S-38 four-band shortwave receivers. National Radio did likewise in helping to recognize the top achievers of club listeners. (Courtesy of Rich Post KB8TAD) Right: SWLer Jerry Berg, of West Hartford, Connecticut, was assigned WRØIBM as part of a relatively obscure mid-1950s SWL organization started by shortwave DXer, Joe P. Morris, in Cleveland, Ohio. (Courtesy of Jerry Berg)***

the WPE certificate, removed my signature, and replaced it with those of Perry Ferrell and Hank Bennett, the DX editor of *Popular Electronics*. I don't know much about the program after that, but I know it existed for a number of years." WPE would morph into several SWL club spin-offs including WDX and WPX. On New Year's Day 2012, *Popular Communications* launched a listener club with KPC and WPC prefixes. When the magazine folded, the PopComm Monitoring Station club and its approximate 1,500-members went down with the ship.

**BLRC's lasting impact**

True, the Boys' Life Radio Club has been routinely overlooked in SWL history. But not by Bob Swan, who went on to achieve the top-tier Amateur Extra amateur radio license with KC3W as his call sign.

He joined the BLRC in around 1953. "I began listening to shortwave radio broadcasts from other countries when I was about 14," he said. "My first shortwave radio was a Zenith Trans-Oceanic bought with money earned from delivering newspapers. It took quite a while to accumulate enough money. I used the radio's built-in antenna.

"I read the series of articles about radio which ran in *Boys' Life* and I participated in their first radio listening contest. When *Popular Electronics* started (its SWL program) in October 1954, I joined as a charter member. From there my interests expanded. I purchased a Hallicrafters S-38C and put up a 50-foot-long antenna," Bob said.

"On my own I studied Morse code and radio theory. There was no Elmer nearby. Fortunately the code came easy for me. I passed my Novice and received WN8SQH in Ohio on August 3, 1954. It was good for a year. Then I built a new Heathkit AT-1 transmitter and was on the air using CW – which I still use today."

**Another Testimonial . . .**

Curt Milton, today at the top of amateur radio licensing as WB8YYY, said he remembers a *Boy's Life* announcement "for a radio publication (about SWLing and amateur radio) that I sent for." If memory serves, "it had green and black ink," he said. It was a compilation of radio articles that had run in *Boys' Life* along with details of the club. To see the pamphlet in black and white, copy this URL into your Web browser: **gimli.whoi.edu/hamradio/Reprint.pdf**

As an SWL, "I remember reading it and logging many stations . . . I was not yet licensed while a Boy Scout, but I do have a radio merit badge. I remember the emphasis then on home construction of radio gear, but, of course, it all seemed over my head.

"In our school library there were books on ham radio, and even a few (amateur radio) novels written for youth. I eventually became a ham in high school, and operated a Drake TR4C at our school station. While the technology is certainly different, there were certainly some thoughts to engage current youth with hands-on participation and with stories of people doing ham radio." Thank you BLRC!

**Imagining the BLRC Experience**

If you have even one nostalgic bone in your body, how can you resist wishing you were around for all this BLRC excitement? I was only 2-years old in 1952 and wouldn't be drawn to SWLing for another five years. Unfortunately, too little and too late.

Imagine you were there at BLRC's start. In my mind's eye, I was in Class B with a homebrew two-tube, 40- and 80-meter regenerative receiver. I leaned in to listen to far-away signals – mostly on the 40, 41- and 49-meter bands. Radio Moscow, Radio Havana, Ecuador's HCJB, the Voice of America and Radio Australia were heard regularly and

loud. I strained to listen for the more obscure SW stations in the static, as well.

My radio log filled up fast and soon a BLRC LAC (Logged All Continents) certificate arrived in the mail. It earned a place beside the membership certificate at my listening post.

**Replicating a BLRC-era Receiver**

The regen you see in the accompanying photograph was built mostly with parts and construction techniques of the 1950s. Jerry Fuller W6JRY, featured the circuit in a 2007 article in *CQ* magazine.

The receiver uses a pair of 955 "acorn" tubes that were war surplus and are cheap and plentiful today. I imagined as a teenager, scrounging for all the parts and crafting a "chassis" by hand. Building a period radio today challenges the homebrewer to come up with some components that are now really hard to find.

Receiver audio transformers – 3:1 – can be pretty scarce and pretty expensive. But the transformer from a common 6-volt "wall wart" turned out to be a great substitute.

I used a 2.5 mH RF choke from the period, but it would be easy to wind your own if you've got access to lots of fine wire – as you would find inside a discarded power transformer.

Lots of DIY receiver and transmitter designs call for contemporary pill bottles as coil forms. They seem to be everywhere, but an amber plastic bottle in the midst of vintage parts can look out of place. The one-inch diameter coil form in the accompanying picture was sprayed with several coats of black paint. Not perfect, but it nicely fights off the scourge of anachronism.

The chassis is all scrounged. The sides were made with pieces of three-eights-inch plywood. The top, front and back panels were cut from paint-stirring sticks given out free at most big box, hardware and paint stores.

Believe it or not, those classic 955 triode "acorn" tubes from World War II are pretty cheap and easy to find today – especially on the Web. Their unique sockets can be found there, too, but can be a bit pricey. If you don't want to fool with these little fellas, you can substitute using a 9002 (also designated VT-202) seven-pin miniature triode, which is in a normal tube envelope and fits in a normal miniature tube socket, **http://www.r-type.org/exhib/aaa0254.htm**.

Of course, if you'd just like a really neat, sensitive regenerative receiver to put at your listening post, forget about scrounging the old stuff and use modern parts. Even the large tuning capacitors can be easily replaced with inexpensive and plentiful polyvaricons.

If there is sufficient reader interest in building this "acorn" receiver, drop me an email at: KI6SN@aol.com. I'll be glad to give the details in an upcoming feature or will post the particulars on the Internet. Where to find the parts will be included, as well.


POPULAR COMMUNICATIONS

Pop'Comm Monitoring Station

CERTIFICATE OF REGISTRATION

This certificate has been issued upon recognition that

Larry Shaunce

Located at

Albert Lea, Minnesota

has shown active interest in radio, television or digital communications, possesses the necessary receiving equipment and has shown the ability to monitor transmissions. This listening post and operator have hereby been assigned the Popular Communications Monitoring Station Identification Sign:

KPCØAKX

On this

January 28, 2012

Richard Fisher, KPC6PC
Editor, Popular Communications

Jason Feldman, WPC2COD
Director, Pop'Comm Monitoring Station Registration

***Shortly after Popular Communications opened membership to its newly minted Pop'Comm Monitoring Station program on January 1, 2012, SWL'er, Larry Shaunce WD0AKX, of Albert Lea, Minnesota, signed up and was issued station identification sign KPCØAKX. Larry has his own YouTube channel https://www.youtube.com/user/RadioHamGuy. (Courtesy of KI6SN)***

**Scouting and Radio**

The Boy Scouts' interest in radio began 99 years ago when the wireless merit badge was created. Recent figures show that more than 50,000 of them, now known as the radio merit badge, have been earned through the years. In 1922, copying Morse code at 10 words-per-minute was a requirement. That was reduced to 5 wpm in 1933 and the code requirement was dropped altogether in 1984. Under any requisites, learning about radio is a very good thing.
From its start in 1952, the Boys' Life Radio Club lived on well into the 1960s and '70s, and even obtained an amateur radio call sign: K2BFW. Famed space engineer and antenna expert Walt Maxwell W2DU (SK), helped the Scouts obtain its now-famous K2BSA club call from the FCC, before vanity call signs were ever issued. He was an avid BSA supporter.

**Guarding the memory of the BLRC**

It is fair to say that the Boy's Life Radio Club was one of the biggest shortwave and medium wave listening clubs of which almost nobody has heard. Thanks to the remembrances of SWLers K9WIS, KC3W and WB8BYY, an important part of radio history is being protected and preserved.

TSM




***Left and right: Advertisements from 1928-29 for "Free Radio Instruction" appearing in Radio News magazine. It was hoped that such instruction would lead eventually to a career in radio sales and service. Center: Junior Radio Guild pin, originally awarded to those who built one or more stages of the receiver, as part of the radio instruction course. The receiver had to work satisfactorily. Later in the program the pin would be given as a membership perk. (Courtesy of the author)***

# The Junior Radio Guild

## By Jerry Berg

I had no idea what the Junior Radio Guild was when I came upon an interesting half-inch diameter lapel pin with the group's name and the depiction of a lightning bolt. With a little research I discovered that for most of its life, from the end of 1928 to mid-1931, home was *Radio News* magazine, published by Experimenter Publishing Co. But the origins of the Junior Radio Guild appear to have been in *Boys' Life* magazine.

The first signs of the group were in some small advertisements in the December 1928 and January and February 1929 issues of the magazine, published by the Boy Scouts of America. The ads encouraged boys to take up radio construction, earn money and learn the radio business. It was a "free course of instruction to ambitious boys," who were invited to write to the guild in Bellaire, Long Island.

Readers had to wait until April 1929 for a short *Boys' Life* article with more information. The article was presented by "Sparks Chard," a youth character created by *Boys' Life* and, since 1926, appeared often in the magazine's "Radio Listening Post" column. "Sparks" reported that the guild had been organized by a group of unnamed radio manufacturers to provide a course in radio design and construction, first offering a one-tube set, then adding on various features to eventually make it a five tuber and finally a shortwave receiver.

The lessons, five in all, were described, and there was to be an unlimited advisory service as well, all provided at no charge. When the first two lessons had been mastered and the one-tube radio constructed, the third lesson could be requested; when it had been mastered the fourth was sent, and so on. The guild was open to all, whether Boy Scouts or not. The objective was to interest youth in "the radio game."

Parts could be bought wherever the builder chose. Consideration was being given to making the parts available through the guild for those who did not have a ready source of supply, but it does not appear that this was ever followed through on.

Applicants were asked to submit name, address, age, school, and number of radio sets already built. A pin—the one I had in my possession—would be awarded to all who actually constructed one or more of the stages of the receiver (which had to work satisfactorily).

Alas, the April 1929 article about the Junior Radio Guild was the group's final appearance in *Boys Life*. It resurfaced in September, with its lightning bolt logo, in *Radio News*, one of the leading radio magazines of the day. The objective was the same, to teach boys the essential principles of radio and to "earn while learning," although the exact way that might happen was not explained. It was a general invitation to join the world of radio technicians, one of the main audiences of *Radio News*. Some 12,000 boys were already members, it said. The new address for the guild was *Radio News* headquarters.

From the guild's advertisement it appeared that the pin would now be a membership pin, not connected with any particular level of accomplishment. And there was a 25¢ membership charge. A few guild ads also appeared in another experimenter publication, *Science & Invention*.

Instead of waiting for the lessons to arrive by return mail, however, one now had only to read on, for the lessons were reproduced in the magazine. First there were the five lessons covering the one-tube receiver, the growth to five tubes and the addition of shortwave. Additional lessons on other radio-related topics appeared most months. With the

***Right: Advertisement for the Junior Radio Guild as it appeared in issues of Radio News in 1929. (Courtesy of the author) Below: Page from March 1931 Radio News goes into great mathematic detail for the youngsters. (Courtesy of the author)***

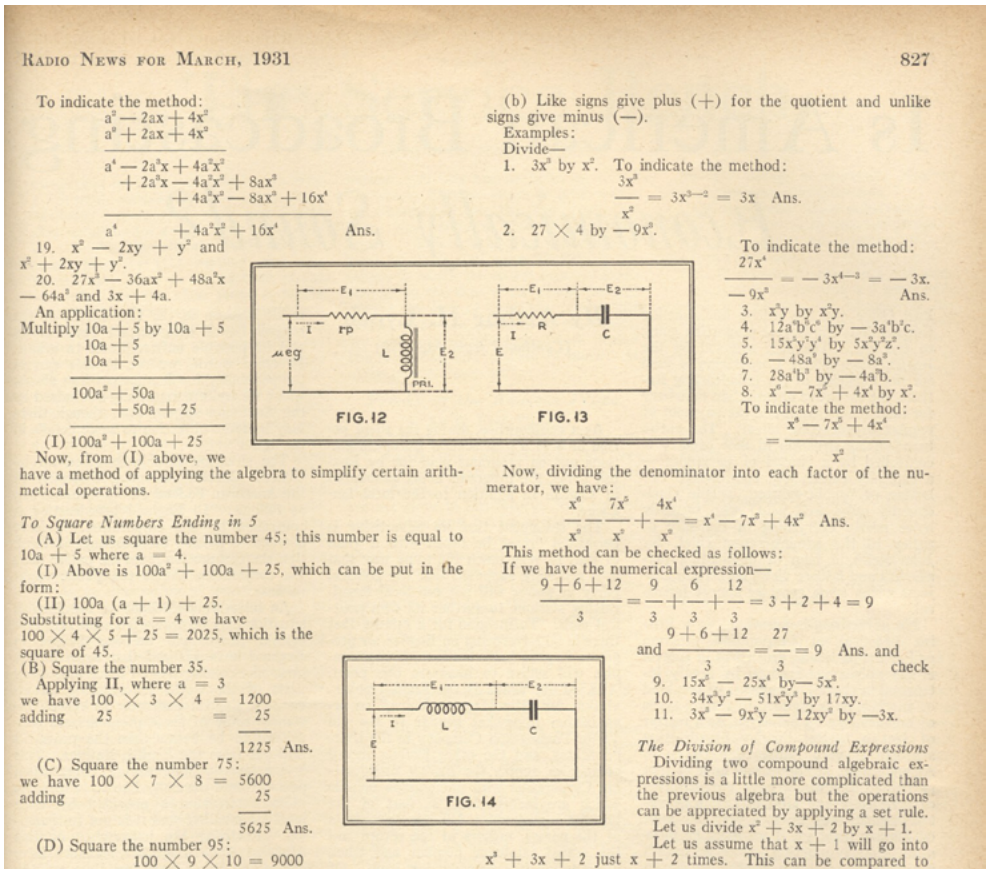
15th lesson, in December 1930, there began what was called "a simple course in radio mathematics." It was called "Using Mathematics in Radio," and it quickly became the guild's focus—all the additional Junior Radio Guild columns were devoted to it. As the reproduction of one page of the column from March 1931(below) suggests, it must have caused many scouts' eyes to glaze over.

While the Junior Radio Guild column continued to appear, promotions for it, invitations to join and get the guild pin, etc. soon disappeared. However, optimism about the guild was expressed in an April 1931 editorial review of the magazine by its new editor, Laurence M. Cockaday. "Many of our younger readers, who are seriously trying to learn the rudiments of radio, seem to be getting real information from The Junior Radio Guild," he said, noting that plans were afoot to increase its scope and make it "more helpful than ever."

But without explanation, the Junior Radio Guild disappeared after the July 1931 issue of the magazine. Some new columns were announced, but no mention was made of the demise of the Junior Radio Guild. In August 1931, *Radio News* announced that a book, "23 Lessons in Radio," which was a compilation of all the Junior Radio Guild columns, was now available free with a two-year subscription to the magazine. The "Mathematics of Radio" series was untethered from the guild and continued long after, into 1933, when the whole undertaking came to an end.

*About the Author:*

*Jerry Berg has been DXing shortwave since the 1950s, and now devotes most of his time to shortwave history, especially shortwave broadcasting. He has written four books on the subject* ***www.mcfarlandbooks.com*** *and he posts regularly to his website* ***www.ontheshortwaves.com****. He is an attorney, and before retirement he was with the Massachusetts District Courts.*



RADIO NEWS FOR MARCH, 1931 827

To indicate the method:

$$\begin{array}{r} a^2 - 2ax + 4x^2 \\ a^2 + 2ax + 4x^2 \\ \hline a^4 - 2a^3x + 4a^2x^2 \\ + 2a^3x - 4a^2x^2 + 8ax^3 \\ + 4a^2x^2 - 8ax^3 + 16x^4 \\ \hline a^4 + 4a^2x^2 + 16x^4 \end{array}$$ Ans.

19. $x^2 - 2xy + y^2$ and $x^2 + 2xy + y^2$.

20. $27x^3 - 36ax^2 + 48a^2x - 64a^3$ and $3x + 4a$.

An application:

Multiply $10a + 5$ by $10a + 5$

$$\begin{array}{r} 10a + 5 \\ 10a + 5 \\ \hline 100a^2 + 50a \\ + 50a + 25 \\ \hline \end{array}$$

(I) $100a^2 + 100a + 25$

Now, from (I) above, we have a method of applying the algebra to simplify certain arithmetical operations.

*To Square Numbers Ending in 5*

(A) Let us square the number 45; this number is equal to $10a + 5$ where $a = 4$.

(I) Above is $100a^2 + 100a + 25$, which can be put in the form:

(II) $100a(a + 1) + 25$.

Substituting for $a = 4$ we have

$100 \times 4 \times 5 + 25 = 2025$, which is the square of 45.

(B) Square the number 35.

Applying II, where $a = 3$

we have $100 \times 3 \times 4 = 1200$

adding $25 = 25$

$1225$ Ans.

(C) Square the number 75:

we have $100 \times 7 \times 8 = 5600$

adding $25$

$5625$ Ans.

(D) Square the number 95:

$100 \times 9 \times 10 = 9000$

FIG. 12

FIG. 13

FIG. 14

(b) Like signs give plus (+) for the quotient and unlike signs give minus (—).

Examples:

Divide—

1. $3x^3$ by $x^2$. To indicate the method:

$$\frac{3x^3}{x^2} = 3x^{3-2} = 3x \text{ Ans.}$$

2. $27 \times 4$ by $-9x^3$.

To indicate the method:

$$\frac{27x^4}{-9x^3} = -3x^{4-3} = -3x.$$ Ans.

3. $x^3y$ by $x^2y$.
4. $12a^3b^2c^4$ by $-3a^2b^2c$.
5. $15x^2y^3y^4$ by $5x^2y^2z^2$.
6. $-48a^3$ by $-8a^2$.
7. $28a^3b^2$ by $-4a^2b$.
8. $x^6 - 7x^5 + 4x^4$ by $x^2$.

To indicate the method:

$$\frac{x^6 - 7x^5 + 4x^4}{x^2} =$$

Now, dividing the denominator into each factor of the numerator, we have:

$$\frac{x^6}{x^2} - \frac{7x^5}{x^2} + \frac{4x^4}{x^2} = x^4 - 7x^3 + 4x^2$$ Ans.

This method can be checked as follows:

If we have the numerical expression—

$$\frac{9+6+12}{3} = \frac{9}{3} + \frac{6}{3} + \frac{12}{3} = 3 + 2 + 4 = 9$$

and $\frac{9+6+12}{3} = \frac{27}{3} = 9$ Ans. and check

9. $15x^2 - 25x^4$ by $-5x^2$.
10. $34x^3y^2 - 51x^2y^3$ by $17xy$.
11. $3x^3 - 9x^2y - 12xy^2$ by $-3x$.

*The Division of Compound Expressions*

Dividing two compound algebraic expressions is a little more complicated than the previous algebra but the operations can be appreciated by applying a set rule.

Let us divide $x^2 + 3x + 2$ by $x + 1$.

Let us assume that $x + 1$ will go into $x^2 + 3x + 2$ just $x + 2$ times. This can be compared to


*The author's array of amateur radio HTs and portable scanner receivers sporting a variety of antennas. His MFJ-269C antenna analyzer is in the center. (Courtesy of the author)*

# Putting My Handheld Antennas to the Test

## By Robert Gulley AK3Q

Ever wonder about your handheld radio antenna—how it really performs? Well I did. Actually, I wondered how my many handheld amateur, scanner, marine and multiband antennas performed and compared to each other. Sure, there are anecdotal stories, myths, and assumptions whenever HT antennas are mentioned, but since I own an antenna analyzer, it was time to do some testing. So, I pulled out my MFJ-269C, gathered my various antennas and adapters, and went to work.

### A Little Background

Some folks never change out the original antenna that came with their radio, particularly for one that is significantly larger. I understand their reasoning—for them a handheld should be able to be carried easily without the antenna getting in the way. Or they want an antenna/HT combination that can be easily stored in a go-bag, briefcase, or similarly convenient place.

For me I rarely am concerned with the size of the antenna, but when necessary I will put on a stock antenna for size considerations only (with one exception I talk about below). I am one of these weird guys who will carry an HT clipped to my belt or pants pocket and live with a floppy antenna hitting my shoulder. In other words, I want the antenna which best serves my radio needs on the HT whenever possible. But which antenna? Ah, that is the question!

In doing these tests I have not set out to determine which antenna is the greatest of all time, or tell you, the reader, which antenna(s) to buy. As thorough as I have tried to be, my results and your results will be different, maybe just a little, or maybe significantly. There are many, many factors which influence antenna performance; I have just tried to make sense of my own inventory, and perhaps provide some useful suggestions along the way. In other words, as people say today "your mileage may vary."

### How You Use Your Handheld

How you use your handheld radio will play a big part in antenna performance. HTs are greatly influenced by the capacitance presented by our bodies. The closer a radio/antenna is to us the greater the capacitive coupling and the greater the signal attenuation. This is a useful thing when doing a "Foxhunt" (direction finding), as holding a radio tight to your body while turning in a circle can give you relatively reliable sense from which direction a signal is originating.

In normal use, we typically want an antenna in the clear

as much as possible to receive signals from multiple directions. If I am scanning multiple repeaters or transmitting towers I typically want 360° coverage. If I am walking around with my radio attached to my belt with a speaker mic plugged in, a longer antenna is more likely to pick up signals than a small rubber duck antenna.

Most of my receiving and transmitting work is done with radio in hand, or sitting on a table. While this puts any antenna more or less in the clear, in most cases a longer antenna will out-perform a shorter antenna. Here's why.

| Frequency 1λ | 1/2 λ | 1/4 λ | 1/8 λ | 1/16 λ | 1/32 λ |
|---|---|---|---|---|---|
| **10m / 33 ft.** | **16.5 ft.** | 8.25 ft. | 4.125 ft. | 2.06 ft. | 1.03 ft. |
| **6m / 19.6 ft.** | **9.8 ft.** | 4.9 ft. | 2.45 ft. | 1.22 ft. | 0.61 ft. |
| **2m / 6.6 ft.** | **3.3 ft.** | 1.65 ft. | 0.82 ft. | 0.41 ft. | 0.20 ft. |
| **1.25m / 4.1 ft.** | **2 ft.** | 1 ft. | 0.5 ft. | 0.25 ft. | 0.125 ft. |
| **70cm / 2.3 ft.** | **1.15 ft.** | 0.575 ft. | 0.29 ft. | 0.145 ft. | 0.073 ft. |
| **33cm / 1 ft.** | **.5 ft.** | 0.25 ft. | 0.125 ft. | 0.063 ft. | 0.032 ft. |
| **23cm / .75 ft.** | **.37 ft.** | 0.185 ft. | 0.092 ft. | 0.046 ft. | 0.023 ft. |

***Table 1: (23cm ~ 1.2 GHz, 33cm ~ 900 MHz, 70cm ~ 440 MHz, 1.25m ~ 222 MHz***

**A Little (Lite!) Antenna Theory**

First, antennas follow the electrical law of reciprocity. In simple terms this means an antenna's performance is basically equal in transmitting and receiving. If an antenna is matched to a given frequency it will transmit and receive equally well. As amateur radio operators know, a good match in resonance is required for effective transmissions. What is often forgotten, however, is the same radiation pattern is how an antenna receives – the law of reciprocity.

The second concept is a related one – the closer the match in frequency the better reception will be, but with much more latitude. For receiving antennas there can be a rather significant mismatch in resonance while still being able to hear a signal. A discone antenna for scanner reception is a perfect example of this. Often discone antennas are extremely broad-banded, sometimes as much as 25-1300 MHz. The different lengths of radials have something to do with this certainly, but they also work because reception can be much more broad-banded than transmission. A discone might only be resonant for transmission over one or two segments of a band, such as 2-meters, if at all.

Conversely, HTs usually do not make good wide-band receivers at lower frequencies, even if the radio claims this capability, because any single antenna on the radio is going to be only a very small percentage of a wavelength. (Remember the higher the frequency the shorter the wavelength). HF wavelengths are roughly 33 ft. long at 10 meters (28-29 MHz), and roughly 264 ft. (or slightly longer than a jumbo jet!) at 80 meters. A six-inch antenna atop your HT is not likely to hear much on 80 meters!

Even with the higher frequencies (and thus shorter wavelengths), there is only so much one antenna can do. If we go back to the transmitting side of things, the ideal match for a radio to an antenna is at the electrical half-wavelength. This allows the alternating current to travel up ½-wavelength (the length of the antenna), reverse, and come back down an equal amount, providing a 1:1 resonance match. The chart above (Table 1 above) gives some approximate antenna lengths for matching resonance (assuming 50 Ohms antenna resonance and ½ - wavelength λ).

Hopefully several things are instructive here as we look at wavelengths, ½-wavelengths, and subsequent antenna lengths/ratios. A typical 4 or 5-inch antenna will only be resonant at ~ 1 GHz. Below those frequencies, it starts becoming a fraction of a fraction, and thereby reducing its effectiveness in small steps at first, but with increasing magnitude the smaller the fractional length becomes. Let's look at the same chart (Table 2 below) and represent this graphically – note the orange color indicating the approximate fraction of the wavelength as we move down in frequency. The 2-meter band is about as low in frequency as we can go to still get enough signal out to transmit effectively. Obviously if you can see the repeater you are trying to hit, even 1/64th or smaller might work, but in practical terms 1/8λ to 1/16λ is about all we can expect assuming we are not too far from the repeater antenna.

The typical telescopic antenna runs at about 21 inches to 33 inches, which means they can be resonant at lower frequencies as in Table 3 (top of next page). The advantage to a telescopic antenna is the ability to adjust the

***Table 2: The ~5-inch antenna is resonant at 1 GHz, but by the time we get to 2 meters, its wavelength is ~1/32.***

| Frequency 1/λ | 1/2 λ | 1/4 λ | 1/8 λ | 1/16 λ | 1/32 λ |
|---|---|---|---|---|---|
| **10m / 33 ft.** | **16.5 ft.** | 8.25 ft. | 4.125 ft. | 2.06 ft. | 1.03 ft. |
| **6m / 19.6 ft.** | **9.8 ft.** | 4.9 ft. | 2.45 ft. | 1.22 ft. | 0.61 ft. |
| **2m / 6.6 ft.** | **3.3 ft.** | 1.65 ft. | 0.82 ft. | 0.41 ft. | 0.20 ft. |
| **1.25m / 4.1 ft.** | **2 ft.** | 1 ft. | 0.5 ft. | 0.25 ft. | 0.125 ft. |
| **70cm / 2.3 ft.** | **1.15 ft.** | 0.575 ft. | 0.29 ft. | 0.145 ft. | 0.073 ft. |
| **33cm / 1 ft.** | **.5 ft.** | 0.25 ft. | 0.125 ft. | 0.063 ft. | 0.032 ft. |
| **23cm / .75 ft.** | **.37 ft.** | 0.185 ft. | 0.092 ft. | 0.046 ft. | 0.023 ft. |

| Frequency 1/λ | 1/2 λ | 1/4 λ | 1/8 λ | 1/16 λ | 1/32 λ |
|---|---|---|---|---|---|
| **10m / 33 ft.** | **16.5 ft.** | 8.25 ft. | 4.125 ft. | 2.06 ft. | 1.03 ft. |
| **6m / 19.6 ft.** | **9.8 ft.** | 4.9 ft. | 2.45 ft. | 1.22 ft. | 0.61 ft. |
| **2m / 6.6 ft.** | **3.3 ft.** | 1.65 ft. | 0.82 ft. | 0.41 ft. | 0.20 ft. |
| **1.25m / 4.1 ft.** | **2 ft.** | 1 ft. | 0.5 ft. | 0.25 ft. | 0.125 ft. |
| **70cm / 2.3 ft.** | **1.15 ft.** | 0.575 ft. | 0.29 ft. | 0.145 ft. | 0.073 ft. |
| **33cm / 1 ft.** | **.5 ft.** | 0.25 ft. | 0.125 ft. | 0.063 ft. | 0.032 ft. |
| **23cm / .75 ft.** | **.37 ft.** | 0.185 ft. | 0.092 ft. | 0.046 ft. | 0.023 ft. |

***Table 3: Now we are getting into a more usable range between typical applications. This length is resonant at 444 MHz, a ¼-wavelength at 222 MHz,and a little better than 1/8-wavelength at 2m.***

height for resonance as needed. For example, in the aircraft band range of 118 -139 MHz, the best match came by adjusting the antenna height at the low end, while keeping it fully extended at the high end. Obviously since I do not transmit on the aircraft band the match is not as crucial, but it does illustrate the value of a telescopic whip.

**Now to Some Results!**

My methodology was fairly simple: I created a spreadsheet large enough to test 12 different antennas, some brand name and some generic or stock from the manufacturer. As I noted earlier, this is not intended to be a critique or review of any antenna, rather simply to report on my particular collection of antennas and the conclusions I drew from my tests.

I measured the antennas through a range of frequencies representing most of the typical bands in use with a handheld. Only a few of the antennas were actually designed or claimed wideband capabilities, and I will note those as I go along.

I tested the 2-meter band (144-148 MHz), 220-225 MHz band, 420-450 MHz band, Public Service bands (151-159 MHz, 453-459 MHz), Civilian Air band (118-139 MHz), Marine Band (156-162 MHz), and the Railroad and Weather bands (160-162 MHz). Unfortunately my analyzer has a gap in coverage between 230-417 MHz, so milcom aviation could not be tested properly. However, some generalizations can be made and will be noted below as well.

My results were (at least to me) somewhat surprising. Most of the antennas did at least part of what they claimed, and some antennas were surprisingly good in places I would not have expected. A few antennas were surprising in the other direction – they did not perform nearly as well as I might have expected.

Another somewhat surprising experience during testing was how differently the various antennas were affected by capacitance, both from nearby objects and by me. Some antennas showed a greater VSWR reading if I had both hands holding the analyzer, while others were greater if I used just one.

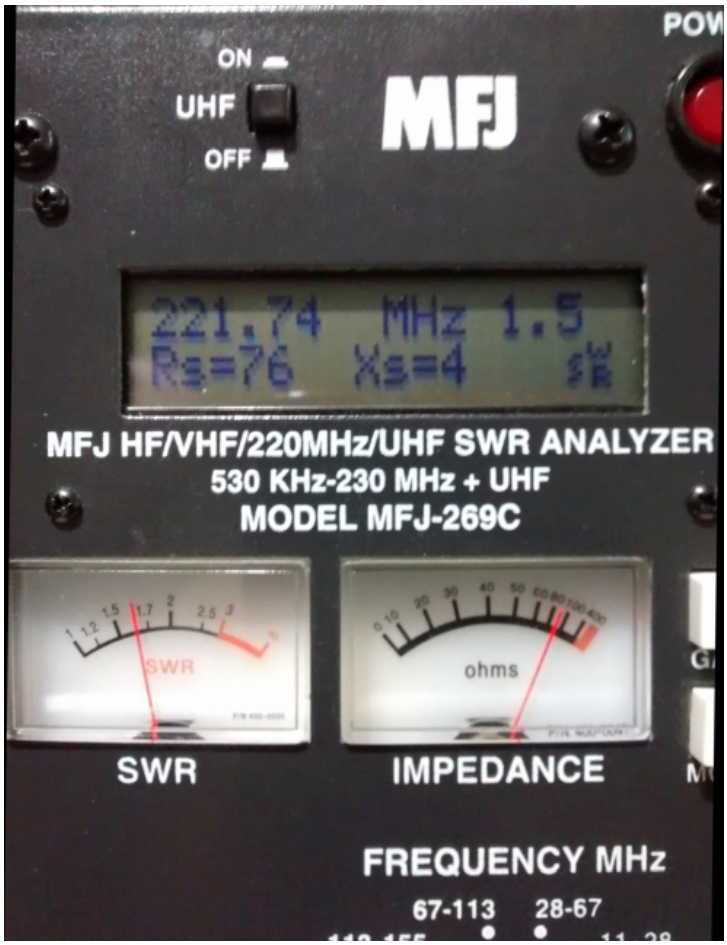
For some antennas I had to move into a room away from the computer and other electrical devices, while others showed better results in the same room.

Likewise, some antennas showed better results held as far away from my body as possible, while with others it made no difference if held it close or far away. In each case I tried to give the benefit of the doubt to the antenna, meaning I found its best position and then took the readings. This is another reason why I cannot give definitive answers as to what is the best antenna – there are simply too many variables.

I only tested three stock antennas for several reasons. First, I did not set out to find which stock antenna worked the best. At 4-5 inches on average, they simply cannot perform as well as I want (see comments above under Antenna Theory). Second, I was looking to see how versatile various antennas could be, and the stock antennas just do not fit the bill. One exception to this is an antenna which was stock on a 1.2 GHz-capable HT I own. The supplied quite short antenna can hit a 1.2 GHz repeater which my tri-band antenna supposedly covering 1.2 GHz cannot. This is a case of "sometimes smaller is better," similar to the increase in quality reception that can occur with an antenna designed for 800 MHz on a scanner – the smaller antenna usually out-performs larger antennas.

The last reason I did not test many stock antennas is rather simple – I have given many of them away or left them in the original boxes. I simply know I prefer larger antennas in general. Over the years I have purchased or traded a number of different 1/4- or 3/8-wavelength antennas, and now and again I run across a new one that sounds interesting, so I try it. As such, regardless of which radio I grab, chances are good I will have a long antenna available to match the connector on top.

In addition to the three stock antennas (2 amateur and 1 scanner), I included in my testing three telescopic antennas, 3 SMA and three BNC long antennas, one 800 MHz scanner antenna, and one "stub" antenna, for a total of 14 antennas. Two of the 14 were identical to 2 others in the test. I mainly wanted to test those just for comparisons between same make and model. I did not bother recording the duplicates on the spreadsheet, merely noting differences for my own reference. There were indeed some differences between the two sets of like-models, but nothing that would make one or another unus-




***MFJ HF/VHF/220 MHZ/UHF SWR Analyzer. (Courtesy of the author)***

able.

Eight of the 12 antennas I tested all came in under 2.0 SWR on 2 meters, with the four that did not being the stock scanner antenna, the 800 MHz scanner antenna (no surprise there!), the "stub" antenna, and the stock 440 antenna.

My Jetstream Tri-band antenna (144, 220, 440) was fine on 2 meters, but shaky on 220 and above 3.7 VSWR or more on the 440-band. As it turns out, it is quite serviceable on the Air, Public Service, Marine and Railroad bands. This means it will see life as a scanner antenna from now on.

The Diamond SRH 320A was the best of the fixed antennas, coming in under 2.0 SWR on almost ALL of the tested frequencies (it is marketed as a wideband receive antenna). This has been my go-to antenna for amateur 2m/440 work, as well as some scanner usage. The testing proved what I long suspected – it is simply a great performer on the 2-meter band (and almost everywhere else), beyond what the numbers even show.

When working a Public Service event some years ago along the Ohio River, I was in one of the boats going a number of miles upstream and back from the launch location, and as far as I could tell I was the only person who was able consistently to hit the net control station, despite bends and turns in the river. I confirmed this with the Net Control operator, who said my signal was always strong and clear.

The only other antenna that does better in some areas

***Left: Jetstream JTH2 tri-band flexible antenna. (Courtesy: Jetstream) Center: Smiley Tri-band telescoping antenna (Courtesy: Smiley Antenna) Right: Pryme AL800 telescoping antenna (Courtesy: DX Engineering)***

(but worse in a few others) is the 33-inch telescopic Pryme AL-800 antenna. While it does get better numbers in some places, it must be adjusted in length to achieve those numbers. This is not a criticism of the antenna, rather simply a note concerning operation. I do not mind making the adjustments, but some people will not want to be bothered with it for only slightly better results over the fixed Diamond.

I will say I was impressed with the price/performance characteristics of the Pryme AL-800, so much so I ordered two more of them from eBay for around $11 each, including shipping. I paid more than this when I bought my first one, so I hope these perform comparably. I also have two of the Diamonds SRH 320As – truly great antennas.

The Smiley Tri-band flexible telescopic is an interesting antenna, with four positional settings depending on the band/response desired. It is a ¼-wavelength 2-meter antenna when fully extended, a ¼-wavelength 440 antenna when fully collapsed, a 5/8th wavelength antenna on 440 with two sections down, and a ¼-wavelength 220 with 4 sections down. And yes, I tested it in these four configurations, as well as checking it out in other configurations!

The suggested positions give the best results, but I must say it was not impressive on the amateur bands to which it is targeted: 220 was usable, while 440 is bordering on unusable for transmitting. It does, however, make a fine scanner reception antenna with good numbers across the VHF range, and OK numbers in the UHF public service range.

The Diamond RH951S Tri-band 144, 440, 1200 antenna is another multiband that seems to fall short of expectations

| Brand or Type | Description | 2m 144 -148 | 220 -225 | 420, 444, 450 | Air 118-139 | PS-151-159 | Railroad 160-16 | Marine 156 | PS 453-459 |
|---|---|---|---|---|---|---|---|---|---|
| Jetstream | JT776SMA Triband SMA Connector | 1.4 | 2.8 - 3.0 | >5*, 4.1, 3.7 | 3.9 -1.8 | 1.8 - 2.5 | 3.0 - 3.4 | 2.2 - 3.4 | 3.4 - 3.1 |
| Diamond | SRH320A Dual Band SMA | 1.8 | 1.7 | 3.4, 1.2, 1.4 | 1.9 | 1.8 | 1.8 | 1.8 | 1.6 - 2.6 |
| Smiley | Tri Band SMA 4-position 21.5" Telescopic | 1.9 | 2.0 - 2..4 | 2.5, 3.2, 3.5 (5/8 height) | 2.1-2.2 | 2.2 - 3.0 | 3.1 - 3.2 | 3.0 - 3.2 | 3.9 - 4.1 (5/8 |
| | | 1.8 | 5.0 - 5.7 | >5, 3.0, 2.9 (1/4 height) | 1.7 - 2.1 | 1.8 - 2.5 | 2.6 - 2.8 | 2.2 - 2.8 | 2.9 |
| Pryme | 2m/440 BNC 33" Telescopic | 1.2 - 1.6 | 1.9 | 1.4, 1.3, 1.2*** | 1.2 - 2.8*** | 1.4 - 1.5 | 1.5 | 1.5 - 1.7 | 1.5 |
| Diamond | RH77CA BNC Dual Band | 2.1 | 4.8 - 5.0 | 2.9, 1.4, 1.5 | 5.9 - 2.7 | 2.1 | 2.2 - 2.3 | 2.1 - 2.3 | 1.6 - 2.0 |
| Diamond | RH951S BNC 144, 430, 1200 Wideb | 1.4 - 1.0 | 1.2 - 1.1 | 2.8, 3.9, >5 (432MHz 1.1) | 11.0 - 1.7 | 1.1 - 1.3 | 1.3 | 1.3 | >5 |
| 800 MHz Unknown | Possible Old Radio Shack | NA | NA | 2.8, 3.5, 3.5 | NA | NA | NA | NA | 3.7 - 3.9 |
| Yaesu | Stock 2m HT | 1.5 - 1.8 (1.1 at 146) | NA | 3.1, 3.0, 3.0 | NA | NA | NA | NA | 3 |
| Yaesu | Stock 440 HT | NA | 2.0 - 2.4 | 1.6, 2.0, 2.0 | NA | NA | NA | NA | 2.4 - 2.5 |
| Uniden | Stock Analog Scanner HT | NA | NA | 3.8, >5, >5 | NA | 5.2 - 1.8 | 1.8 -2.2 | 2.6 - 2.2 | >5 |
| Stub - Unknown | Size 50mm SMA | NA | NA | >5, >5, 4.7 | NA | NA | NA | NA | 3.4 - 2.2 |
| Radio Shack | right-angle Telescopic Base Scanne | 13.7 - 9.8 | 2.6 - 3.2 | >5 | 3.6 - 26.3 | 6.5 - 3.8 | 3.2 - 2.8 | 4.4 - 2.8 | >5 |

* >5 out of range of MFJ-269c
? = not measureable on MFJ
Lot's of influences on signal; can skew readings
*** usable range but length must be adjusted across wide bandwidth

on the amateur bands for which it is intended. On 2-meters the antenna is great; at 440 it has a 444 MHz reading of 3.9 SWR, and at 448 MHz it is over 5 SWR. Its best numbers come in at 220 MHz, a band for which it is not advertised. This is the 1.2 GHz antenna with which I could not break a local 1.2 GHz repeater (but my stock Alinco antenna could!), but this is as far as I can test the Diamond. For use at 220 MHz and below, the antenna is great, with good coverage of non-amateur VHF bands, including the aeronautical band.

I will add that mine was received second-hand, and so it is possible something was damaged affecting the 440 and above range, so your results may be different than mine, just as with all of these antenna/test combinations.

The 800 MHz antenna performed well at 440 MHz and the UHF Public Service portions of the spectrum, while below this the antenna was out of range. This is to be expected as the antenna is actually designed for 800 MHz Public Service, so the 440 and above coverage is a bonus. Likewise, the "stub" antenna was usable at 440 and above, but not any lower. I will have to make a mental note to check out my 900 MHz and 1.2 GHz radios with this antenna – could be interesting!

The last antenna on the spreadsheet is the right-angle Radio Shack telescopic scanner antenna. I found it to have a fairly limited range, basically between 2-meters (but not for transmit) and 220. It does not do well in the 440 amateur or UHF Public Service bands.

**Wrap-Up**

This was a fun experiment and an informative one. While hardly lab-like conditions (my shack would never be mistaken for such!), the testing was consistent and fair, and I gained much more insight into my HT antenna collection. I now have a spreadsheet to which I can refer for choosing the best antenna for a given situation, and I can rest comfortably in knowing each antenna will be able to do the work I need.

I had also wondered if several of the telescopic antennas might be tall enough to show adequate service on 6 or 10 meters, but they did not. Even the 33-inch Pryme was not long enough to get even close on 6 meters, so I write off those bands on my scanners.

I highly encourage you to test your own antennas if you have a means to do so, or to find a friend or club member with an analyzer to see how your antennas live up to their claims. As an amateur radio operator, I need to make sure the antennas I take out on a Public Service (or emergency service) event are capable transmitting antennas for the expected needs, and for my scanning and recreational listening I want to make sure I can match the right antenna to the radio(s) I am using.

Finally, these tests underscore the value of having external antennas attached whenever it is convenient to do so, as a full-halfwave antenna for 2-meters or for any band you are using will pull in more signals than a fractional 1/8, 1/16, or 1/32 antenna. When inside a car, an external mobile antenna is invaluable even just for reception. I have both a scanner antenna and a tri-band amateur antenna on my car, and the difference in reception and reach is truly amazing.

If the external antenna is long enough for 6- or 10-meter reception, you can likely get some use out of the VHF low and even CB portions of the band with your handheld scanner. Most scanners these days start at 25 MHz, so an external antenna can be quite useful here.

While most any HT antenna can pull in some signals, it never hurts to know where the weak spots are and to keep an eye out for an antenna bargain to fill those gaps!

TSM

# World Radio TV Handbook

## By Gayle Van Horn W4GVH

A new year brings many things for radio hobbyists, including new goals to enrich their listening opportunities. Ultimately, world listeners welcome the annual edition of World Radio TV Handbook, now in their 71st edition.

The new edition begins with receiver reviews. The Icom IC-7300 offers an excellent overall rating, as one of high quality, good performer, as well as good value and functionality. As the popularity of software-defined radios continues to expand, the Reuter Elektronik RDR55D is the newest addition to the market. Discerning listeners who prefer a self-contained SDR will discover this new addition significantly advances the state of the art. SDRPlay RSP, a lower cost SDR known as a dongle, is a very good introduction to the capabilities and limitations of the software-defined receiver. A review of the wideband loop antenna Wellbrook ALA1530LNP is complimented for its performance, and an outstanding value.

Listener's using more than one radio receiver will welcome the new Bonito AAS300. Called an 'Active RF Splitter,' by the manufacturer, it provides three outputs from a single input. Compared to other multicouplers, it covers a wide frequency range, and works very well.

A stalwart of each edition is the features section. The Mighty KBC explores the well-known radio station, popular to medium wave and shortwave listeners. Who knew KBC had such an interesting and surprising history? KBC, a small private station has big plans for their future. Remote Reception delves into the modern SDRs located half a world away - and available to a world audience via the Internet.

Freelance writer and active radio enthusiast Hans Johnson, resumes his radio travelogue expertise covering CKZN St John's. Follow Han's travels on the history and current use of the most easterly shortwave transmitter in North America.

Australian radio hobbyist and DXer Rob Shepherd shares his travels in South America and the Pacific, including a bit of DX, and reminds us, "radio is alive and well in South America and the Pacific."

Vagn Fentz reminisces about radio times long ago, working with the founder of WRTH, Olaf Johansen, on one of the very first editions.

Michael Pütz, of Business Radio at Media Broadcast GmbH and Chairman of the IRDR Project Working Group, outlines setting up and the progress so far in organizing an HF disaster relief radio network. The IRDR Project, explains this vital role of radio providing life-saving information at critical times.

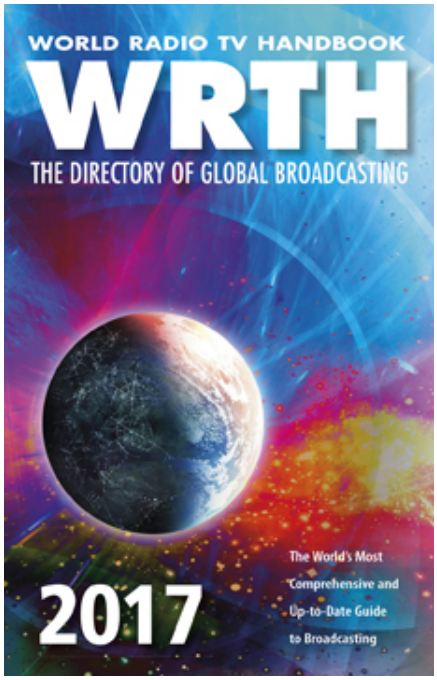
Ulf-Peter Hoppe updates the annual HF Broadcasting Reception Conditions Expected. During 2017 he predicts good year of reception.

The National Radio section includes domestic radio stations broadcasting to a national listening audience on medium wave, shortwave, and FM

Listings are grouped by country and include frequencies, transmitters, kW, contact and website information. International Radio contains the same information from international broadcasters airing to a world audience.

Clandestine and Other Target Broadcast list stations broadcasting politically motivated programming, or those targeted at zones of local or regional conflicts. A one-page listing of Religious Broadcasters Cross Reference Table closes this section.

The Frequency List covers by-frequency medium wave stations by-region, SW Stations of the World and listings of shortwave station broadcasting in English, French, German, Portuguese and Spanish, plus DRM International Broadcasts schedules.




***(Courtesy: WRTH)***

The by-country National Television section includes information on national stations, networks and contact information for each country listed.

Lastly, there contains an extensive Reference section. Informative includes indexes, abbreviations and symbols, target area codes, transmitter sites, Standard Time and Frequency stations, clubs and organizations and selected Internet resources.

This year's 71st edition, as in past editions, continues their reputation as a comprehensive exemplary reference book for the radio listening audience. It remains the very best, most authoritative reference book for the radio and television hobbyist. Teak Publishing wishes WRTH many years of continued success.

World Radio TV Handbook 2017, is available from the WRTH website at **http://www.wrth.com/info.html**. Click on "How to Order" for information link. It is also available in the United States from Universal Radio Inc. Go to **http://www.universal-radio.com** for the online catalog.

*Gayle Van Horn W4GVH is the former shortwave editor at Monitoring Times, currently CEO of Teak Publishing and author of The International Shortwave Broadcast Guide. She blogs at:* ***http://mt-shortwave.blogspot.com.***

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*Pivotal articles in popular magazines about building your own computer. Left: July 1974 Radio-Electronics Right: January 1975 Popular Electronics. (Courtesy of AmericanRadioHisotry.com)*

# Computers and Ham Radio – Part 001

## By Cory GB Sickles WA3UVV

Younger readers may find it difficult to imagine a time when computers and amateur radio were not somehow intertwined. However, there was a time when computers were many times more expensive than a house, required special electrical service, extreme air conditioning and filled a large room. Amateur radio applications might have been run on such machines, if some lucky ham was working there as a programmer and found some free machine time available to run some sort of beam headings, propagation predictions or impedance calculation applications. Such applications would be written in the computer's native assembly language or perhaps a high-level language such as FORTRAN (FORmula TRANslator).

In Part 1 of this series, I'm going to take you back to some of the origins of minicomputers and microcomputers, touch on a few of those machines of times past and bring things up to the present – with state of the art processors than seem to be embedded in transceivers, tuners, keyers and make possible certain modes we enjoy.

I strongly suggest you research further the topics I cover on you own, for more in-depth information. There's only so much information I can cover in the space allowed and there is a tremendous amount of content available.

Also, as much as I would like to present this in a nicely organized linear timeline, I am a non-linear thinker. Plus, there are times when so much was happening simultaneously, it would be cumbersome to organize things that way. Know that this is not a so much a history lesson as one of archeology. I hope you will find it to be informative and enjoyable – both to those who lived through such times and those learning about it for the first time.

Back to the "Big Iron," my first hands-on exposure to a computer was a Honeywell 200 – which could emulate the rather successful IBM 1401 (in software) with the "Liberator." (You may have heard the term "IBM Clone" when referring to personal computers, but such engineering to "compete and beat" was being done well before that term was coined) Memory was laid out in drawers and each bit was comprised of a miniscule ferrite toroid – referred to as a magnetic core. (Because of this, memory was simply called "core" – a term that stuck even when solid-state memory took over in most applications.) Thousands upon thousands of them had to be hand-wired (woven, really) into memory planes, then packaged together in drawers. If memory (mine) serves, the H-200 I played with had 12 KW (kilowords) of 6-bit (actually 9-bits, with overhead) core. The memory assembly occupied what would take up a good deal of doors and drawers worth of counter space in medium size kitchens.

As recently as one year ago, I was still working with (much smaller) systems (PDP-11/05) still employing core memory – in 8KW or 16KW variations of 16-bit memory. While not nearly as compact as solid-state memory, core has a valuable, non-volatile characteristic. You can turn off the power and when you bring the computer back up again, whatever you had in memory is still there. It's the best of ROM (Read Only Memory) and re-writeable RAM (Random

Access Memory) combined.

As time progressed, multi-million dollar computers and their enormous size shrunk somewhat, to the point where a new product line was announced – the minicomputer. Such machines used faster processors than the 1401, although large-scale computers were faster, still. If you had a need for a computer, but could live with smaller storage and speed limitations, you could save some serious money by going with a minicomputer. By this point, word length was more likely to be 8, 12 or 16 bits. We still used the term "word" to denote a collection of bits that defined a single character, Op Code (Operation Code – a command) or number – although "byte" specifically refers to a word with an 8-bit length. The longer the word length, the more data can be manipulated at a time, plus larger numbers can be handled with fewer cycles – making such computers faster.

I think it's safe to say that the most popular minicomputer of the era was the Digital Equipment Corporation (AKA DEC) PDP-8. DEC never referred to these as computers, by the way, hence the moniker of "Personal Data Processor." Ken Olsen – founder and CEO – felt that the term "computer" was scary to business owners. He also famously saw no reason that anyone would want a computer in their home.

The PDP-8 was a value-packed asset. Now, in less size than a single home refrigerator, you could have a computer with 8KW of 12-bit memory, capable of handling high-level programming languages (making it easier to create and modify applications) for a low-low starting price of $18,500 in 1965 dollars – or just north of $140,000 today. That's still a lot of money, but it was a breakthrough price, especially when compared to the millions required just a few years prior.

A fully featured PDP-8 with printing terminal (most commonly a Teletype Model 33ASR, having a paper tape punch and reader) and a language like FOCAL (similar to BASIC) and some magnetic tape drives would drive up the price a bit, but it was still a bargain.

With only eight basic instructions, (instead of dozens) programming was easy to learn and understand – even when entering programs and data directly with the front panel switches. With many considerations in play – such as cost, size, simplicity, speed, etc. – the PDP-8 series became the most popular computer ever sold, until it was eventually overtaken by sales of the original Apple II.

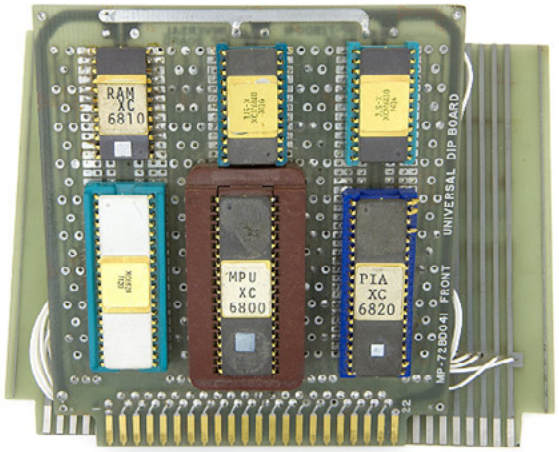
While the PDP-8 was a relatively inexpensive minicomputer for business, it did not exactly fit into someone's home budget. Still lower prices and component breakthroughs were needed. In 1971, a fairly young company by the name of Intel announced a product that was such a breakthrough. It sent ripples across the electronics industry we still feel today, while providing opportunities for some to become millionaires (and billionaires). This device was the 4004 microprocessor – a 16-pin IC (Integrated Circuit) that represented the first reprogrammable logic on a chip. I believe its original use was in airline terminals.


***First introduced in 1965, over a 25 year span, Digital Equipment Corporation (DEC) manufactured more than a dozen variations of the PDP-8 and sold over 10,000 machines. (Photo by Mark Richards, image and caption courtesy of the Computer History Museum http://www.computerhistory.org)***

With its 4-bit (nybble) architecture, it was limited, if viewed as the foundation of a general-purpose computer. Soon after, the 8-bit (byte) 8008 microprocessor was introduced and the concept of an affordable, hobby computer began. Initial versions could run with a clock speed up to 130 kHz, with a second-generation device capable of speeds up to 500 kHz. Read that carefully – kilohertz – frequencies notably lower than the AM broadcast band.

The 8008 was comprised of 3,500 transistors, a more extensive instruction set than the PDP-8 and could access up to 16 KB (kilobytes – it seemed like a lot at the time) of solid state RAM – that had not yet broken the penny-per-bit price threshold. Inspired by the Mark-8 Minicomputer featured in *Radio Electronics*' July 1974 issue, (note that the term "microcomputer" had yet to be coined) I decided to build a computer of my own. Using a set of the diagrams and plans for the Mark-8, I wire-wrapped a board set with the 8008 and support chips, plus toggle switches, LEDs and a whopping 256 bytes of RAM.

Admittedly, it was not the most useful computer I've ever owned. I could do some simple binary math; make the LED's blink in various patterns. At some point, I added more memory and was able to generate CW - using it as a memory keyer to call CQ on the ham bands. It had no way to save programs, so I tried to keep it powered at all times.




***First introduced in 1974, Motorola's 6800 microprocessor came with a family of compatible peripheral chips that enabled widespread use in computing, communications, and industrial systems. (Photo by Mark Richards, image and caption courtesy of the Computer History Museum http://www.computerhistory.org)***


***Popular Electronics featured the MITS Altair 8800 microcomputer kit in January 1975. Under $500, Altair became the leading "homebrew" computer, inspiring Bill Gates and Paul Allen to write a BASIC interpreter program. Their company, then called "Micro-Soft," survived. MITS (Micro Instrumentation Telemetry Systems) did not. (Photo by Mark Richards, image and caption courtesy of the Computer History Museum http://www.computer-history.org)***

Sometimes, I wish I still had that computer, but when Intel released the 8080 – a substantially more advanced microprocessor – I re-tasked it to support the new chipset and eventually bumped it up to 4 KB of RAM.

By this time, the January 1975 issue of *Popular Electronics* magazine had a feature on the Altair 8800 Minicomputer Kit. With a price of under a kilobuck and a nice case, the hobby market truly began to take off. Also, while microprocessors were still rather expensive at this time, Intel made "cosmetic reject" chipsets - processor, clock generator, DMA (direct memory access) and a few pounds of documentation available as "Student Special" packages for a very reasonable $60 price tag. Cash-strapped kids like me jumped at the opportunity.

Soon, there were a variety of computer kits on the market. Computer clubs, newsletters and magazines were popping up everywhere. Radio amateurs were – no surprise – the most active subset of early microcomputer experimentation. We knew which end of a soldering iron to hold and weren't too afraid of smoking a chip or resistor, now and then. Plus, we'd been experimenting with solid-state electronics for some time. The challenge of learning about digital electronics and new terms like Buss Latency, DMA and Write Cycle was welcomed by many – as was learning to think in binary, octal and hexadecimal notations.

As additional single board kits became available that supported other microprocessors (1802, 2650, 6100, 6502, 6800, F-8, SC/MP, Z-80 and more) and costs continued to drop. With the variety of choices and new hobbyists coming into the community of computer experimenters, "religious wars" began in certain circles with "my chip is better than yours" debates.

Certainly, not all of these were popular successes and many have become footnotes in computer history, but there are some notables and many are – surprisingly – still in use today.

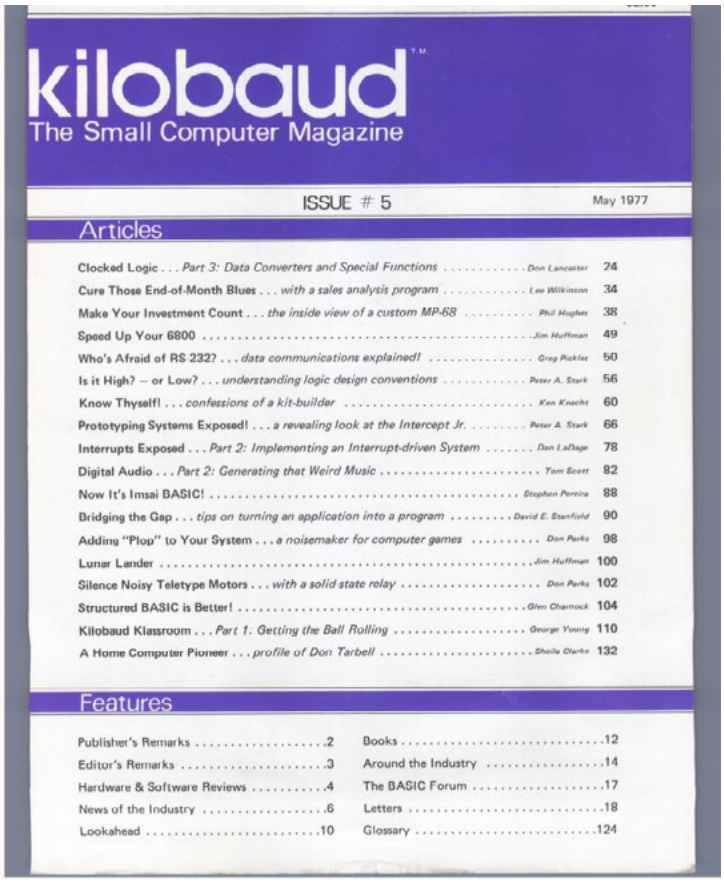
Zilog's Z-80 was a binary compatible of the 8080 with higher speed, increased registers (special on-chip memories) and an extremely important hardware feature – the ability to handle the refresh cycle required by dynamic RAM. That was a huge breakthrough, as dynamic RAM was significantly less expensive than static RAM – which was the previous standard. One common product was a piggyback board that plugged into the 8080's socket. Voilà, instant upgrade!

RCA developed the first CMOS (Complimentary Metal Oxide Semiconductor) microprocessor and several CMOS support chips. CMOS chips have the advantage of running with a much lower current consumption than "regular" MOS and can be operated with a wider variety of voltages – making them idea for battery-powered applications. Also, you can vary the clock frequency all the way down to 0 Hz, then back up again with no loss of data. A radiation hardened SOS (Silicon on Sapphire) version of chips proved popular in high-altitude aerospace applications – including spacecraft.

Another company – Intersil – released the 6100, which was also CMOS. It offered great promise as a low power foundation for micros that could fully emulate our old friend, the PDP-8. This 12-bit chip could conceivably use the readily available library of software (some of it obtainable for no or low cost) – which was a massive collection.

While DEC used the chipset for a line of work processing workstations, it never saw the potential to seize a major piece of the emerging microcomputer market. With a rea-


***First issue of Byte magazine, September 1975. The magazine lasted until December 1986 and attracted a lot of amateur radio early computer adopters in early issues working with the Altair 8080 kits. (Courtesy of Americanradiohistory.com)***




***Kilobaud magazine began in January 1977. Issue #5 from May 1977 featured articles such as, "Speed up your 6800," and "Silence noisey Teletype motors." (Courtesy of archive.org)***

sonably priced computer system that supported disk drives, magnetic tape and other peripherals, plus high-level languages and that previously-mentioned extensive applications library, they would have had everything in place to market a turnkey, yet hobbyist-friendly, line of business and home computers. Alas, Mr. Olsen's myopic view of the market and his refusal to lower the price of "cash cow" languages doomed any such hopes.

In short, DEC had an excellent opportunity to become a standard-bearer in the micro market at an opportune time, but didn't come to realize the significance of this until it was too late. Their eventual entry into the fray was a classic "too little, too late" by the time they saw the light. Even their retail stores – designed with a very clean concept like Apple would eventually execute superbly – wasn't enough to compensate for previous errors.

Motorola decided to get in on the fun and came up with a fairly straightforward design – the 6800. They also supported this 8-bit microprocessor with a serious array of additional chips for serial and parallel I/O (Input/Output) plus disk controller and video display functions. Their marketing was geared more toward engineers, for industrial applications, but companies like Altair and Southwest Technical Products (whose experience had been in the audio industry) created a line of kits and peripherals based on the 6800 and its friends. They also introduced some new bus (alternately "buss") standards – in the form of the SS-50 and SS-30.

What's a bus? What bus should I get on? Well, a bus is just a standard way of interconnecting all of the plug-in boards associated with a computer system of that time, so that there was an agreed-upon means to enable interchangeability of options and assemblies.

When the Altair 8080 kits came on the market, they offered a 100-pin bus and simply named it the Altair Bus. Later, it became better known as the S-100 bus and much later, became standardized further with the IEEE-696 designator.

While most Altair/S-100 played well with others, there were a few noticeable "fails," due to some pins being left unassigned. This encouraged various manufacturers to use such pins to carry signals between board stack products (video cards, floppy disk controllers) If you purchased the wrong combination of options, a "fun time" was had by all.

Looping back for a moment, microprocessors could still be seen as expensive and beyond more modest budgets. The 6800 – for example – was initially priced at $300. Motorola - no exception to the industry – wanted to get their R&D money back as soon as possible. As a reference, $300 in mid-1970 money is about four times that today. Of course, if you spent $600 on a new Kenwood TS-520, that may not seem like such a bargain (actually, it was) in retrospect.

Potential customers of the 6800 thought the price was high, as well. If they were going to use this as an intelligent controller in their products, they were hoping for a price that was closer to to about 10 percent of that. A key designer at Motorola – Chuck Peddle took notice of this and – with a select few of his coworkers – started a rogue project to reduce the costs associated with the 6800. When Peddle showed his supervisors what he and his clandestine team were working on, they were not impressed – feeling that the 6800 was properly priced as it was and these efforts were not in Motorola's best interests.

Chuck and the rest of the team felt there truly was a future in what they were doing and decided to start their own venture. They went to MOS Technology – a low-cost chip fabricator – and offered their design team to form a symbiotic relationship. Soon after, the 6501 was born. It was about as directly compatible with the 6800 as you could get. With the business combination they'd formed, MOS Technology could offer it at the low price point that potential customers wanted. An almost immediate feeding frenzy ensued.

When Motorola heard about the 6501 and figured out who was behind it, they did what any giant corporation would do – they filed suit. After a fair amount of dust was kicked up, both sides settled. The chip had to be re-designed and all existing 6501's were to be destroyed. (Many were, but a few are still out there as prized elements in certain vintage computer collections.) With the redesigned chip available for a single piece price of $25, the 6502 was very attractive.

MOS Technology wanted to get the 6502 in the hands of designers as effectively as possible, so they created the KIM-1 SBC (Single Board Computer) with 1 K of RAM, (expandable on-board to 5 K) serial and audio cassette I/O, expansion connectors, 6-digit LED display and programming keypad – all for just $245. In short order, the hobbyist market's hunger for this SBC outpaced the intended market and another "hit product" was gaining explosive support from users.

The 6502, by the way, was the foundation of the Apple II, Commodore, Atari, Ohio Scientific, Rockwell and several other product lines. Most notable would be Apple, where an inexpensive processor, genius-level designer and impassioned pitch man combined to birth the most successful computer manufacturer of all time.

Radio amateurs were attracted to the KIM-1. It was well covered in *73 Magazine* and other Wayne Green, W2NSD/1, (SK) publications, such as Kilobaud. Wayne was a prolific publisher and I believe he had more than half a dozen computer magazines on the presses for several years. With significant coverage in 73 and other ham radio magazines of the day, more micros were sold, more software was written and more peripherals were released – all driving still more coverage. New companies and new products were being introduced every month. It was a challenge to keep up with the frenetic pace.

On the day Radio Shack announced the TRS-80, they had more orders than Tandy's conservative graphite commandos had projected for six month's worth of sales. With deep pockets to create the manufacturing resources required and over 5,000 retail stores, Radio Shack enjoyed tremendous success with the product – creating yet another standard and becoming a major player in the personal computer market.

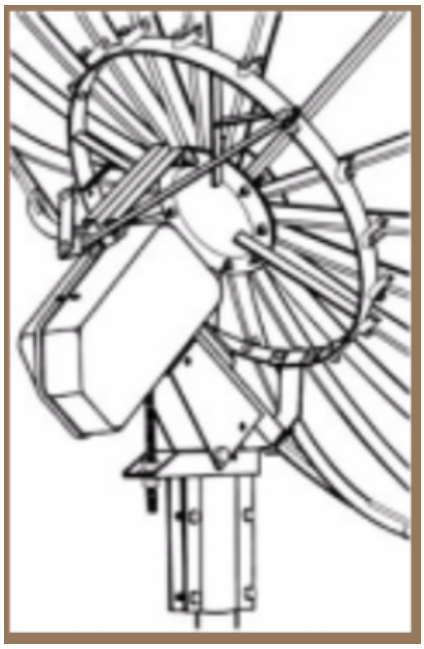

***First introduced in 1977 and based on MOS Technology's 6502 microprocessor, Commodore's Personal Electronic Transactor (PET) became an early favorite in schools and homes. (Photo by Mark Richards, image and caption courtesy of the Computer History Museum http://www.computerhistory.org)***

All of this – plus much, much more – was going on well before IBM decided to start development of a microcomputer – eventually releasing the 5150, AKA the "IBM PC." There was also a rapid evolution (really more of a revolution) of programming languages, applications, floppy disk operating systems and more.

I've covered a lot of history to give you some foundation and understanding of how it all began. In case you think the PDP-8 and KIM-1 are just distant history, rest assured there are still ways to experience these platforms and get an intense, hands-on experience – one that can open up doors for possible career opportunities and more fun with amateur radio.

In Part 2, I'll focus on software (the thing that makes all the hardware actually do something) and how another pair of entrepreneurs made a bundle. Plus, you'll get a good idea of how everything fits together – in the past and present. Also, you'll see what technologies came together to make some of the most exciting aspects of ham radio possible and as enjoyable as they are. So stay connected, there's more data to follow.

TSM



***Paraclipse was a satellite antenna manufacturer that made outstanding products for commercial and backyard satellite-TV installations, some with horizon-to-horizon actuators driving C-band dishes from 10 feet to 16 feet in diameter allowing reception of 180 degrees of arc across the Clarke Belt. (From a vintage Paraclipse brochure courtesy of the author)***

# Horizon-to-Horizon Actuator Motors and Systems

## By Mike Kohl

This month we will have a history lesson, concentrating on some devices that are no longer being manufactured, have not been for over 15 years, but may be lurking out there waiting to be discovered by the satellite equipment scrounger. The Horizon-to-Horizon (known as H-to-H) motor was used in many high-end deluxe C-band and C/Ku band satellite systems. As is the case with many commercial and semi-commercial products, it was priced in a league that was out of the reach for many home users. This did not discourage thousands of dish owners from spending extra cash in order to have a dish mover capable of sweeping up half the sky, in a near 180-degree azimuth movement.

A typical polar mount driven with a linear actuator can cover between 90 and 120 degrees of azimuth travel. This is quite acceptable for the former North American satellite arc, between 87 and 139 West, using a 24-inch linear actuator. The further the attachment points between the pivot of a polar mount and where the moving end of the linear actuator connects to the back of the satellite antenna, the lesser potential distance across the satellite arc can be covered.

Many commercial installations use a 36-inch length actuator to cover the same number of degrees in left/right azimuth travel, but with much better stability than that offered by the average mesh antenna's polar mount assembly. Many mesh antennas might have only a 12 to 15-inch distance between these attachment points, and while they may require only an 18-inch actuator, this combination creates a situation where only a moderate amount of wind movement will force the antenna off a signal. You can go to a 24-inch actuator on such a system, but end up not being able to use all of the actuator's length to much advantage without over-extending the arm and wrapping it around the dish mounting pole. This is why few 36-inch arms are installed on anything other than stable, commercial grade mounts. Motorized C/Ku and Ku-band only systems require three times the pointing accuracy of C-band only, so only a commercial mounting system that has little or no play in the wind is acceptable.

The existence of many satellites over the middle of the Atlantic and Pacific oceans has created the need to travel a full half circle in many locations, in order to be able to physically view all possible satellites from one antenna. Another factor that requires more east-west travel comes into play as you enter the tropics, at latitudes 25 degrees and less: much higher swing between satellites in elevation, as well as larger numbers of azimuth degrees. You truly need a 180-degree capable mount to see it all, or use multiple satellite antennas. The latter may be cost-effective if you are scrounging smaller diameter antennas, but H-to-H systems come into their own in larger diameter systems from a cost effectiveness standpoint. If you do not need 24/7 continuous access to a signal, and are able to use a motorized system or systems rather than create a "mushroom farm" with many dishes, an H-to-H design is also cost effective. The cost of real estate is also a limiting factor in commercial installations, where users may have to actually rent pricey square footage at a rooftop location.

Other reasons why H-to-H may be a better choice over a conventional linear actuator motor system:

Ability to operate at lower temperatures. Those in frigid Arctic-like climates have removed the conventional lubricating grease from H-to-H motors and replaced it with Lithium grease to allow movement at lower temperatures.

Real estate. In an H-to-H motor mounted at the center of a dish, there is no motor drive hanging out in the way of traffic, sometimes causing problems when mowing lawns or shoveling snow.

Longevity. Properly installed H-to-H motors are more easily accessed for periodic maintenance, and have a longer lifespan before needing replacement.

Cautions to consider when using an H-to-H system:

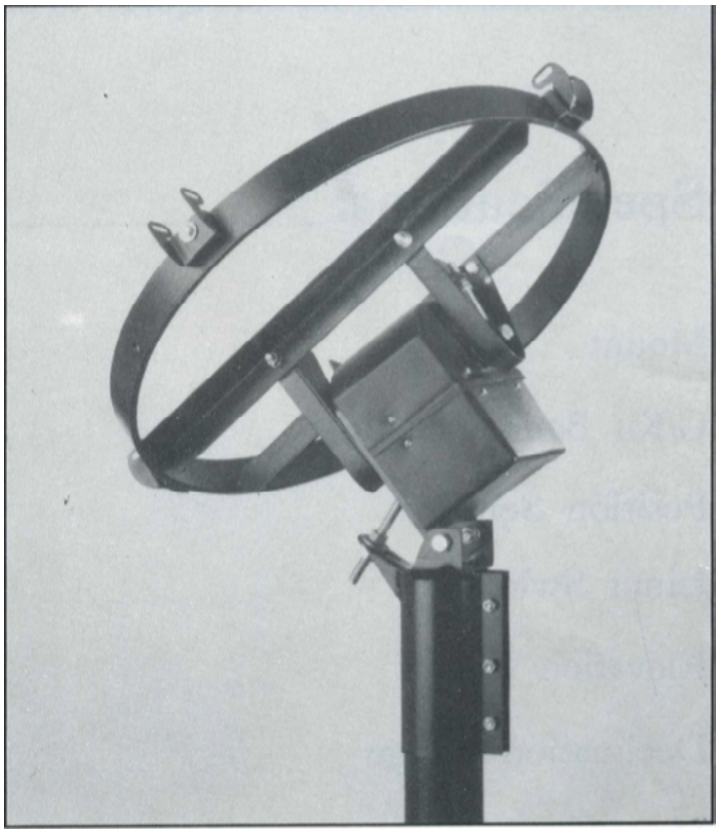
Availability of spare parts. The parts most commonly failing include the reed sensor, as well as limit switches.

The longtime national satellite TV retailer, Skyvision, previously obtained a reed sensor from either Mouser Electronics or Digi-Key, and carefully installed them on a sheet of heavy plastic. You might want to investigate your options while the system is working properly, to create spare parts assemblies in advance. Limit switches need to be sourced from elsewhere. DC motors can often be re-wound by electrical repair facilities offering motor rewinding services.

The common DC motor used by Ajak Industries (no longer in business) on some of their HH motors was the same one offered by a U.S. Big Three truck manufacturer for a windshield wiper motor, with just a different winding specification. But enough where the owner of Ajak had to order 500 or more motors at a time just so the manufacturing facility would consider shutting down the assembly line for wiper motors for one day to fulfill Ajak's order.

Accessibility of Motor covers. Not normally an issue, but it is very easy for birds and rodents such as mice to get inside the motor cover and create a nest, gumming up the motor, gears and chain assemblies. Solution to this problem can be accomplished with a mesh bag such as those used for fruits and fill with mothballs. Secure it inside the motor housing away from any moving parts. Smell should discourage birds and rodents from nesting.

Horizon-to-Horizon versus Dual Axis Azimuth over Elevation mounts: The first heavy users of 2-axis mounts were probably the military as well as commercial uplink teleport operators. These needed massive power supplies and various gear reduction schemes, and because of the high number of inclined orbit satellites, very costly components were integrated together to create reliable systems. And then there were the Russian Molniya (Russian for "lightning") satellite clusters that used a polar orbit and sometimes switched through 3 or 4 satellites throughout the day, that needed continuous tracking. Hughes Aircraft built a number of systems for the U.S. Military, and Russia's space industry built their own. All had fairly complicated component structures and, as time went on, antenna sizes dropped so that less demanding control systems were required. A modified polar mount concept was introduced, some with a separate motorized declination for elevation, and others that simply stuck a linear actuator and extension brackets into what was previously the elevation adjustment assembly.



***Ajak Industries Patriot horizon-to-horizon dish actuator. Not as popular, but intended for six and seven foot mesh antennas, which had less weight capabilities. This author has used several and modified them with my own brackets, to attach to 3 and 4-foot offset Ku-band antennas, for travel across the arc. The logic was that the Ajak Patriot has got to be more reliable than a smaller DiSEqC motor, and one can use the added gain of a 4-foot offset dish to overcome most signal difficulties. (From vintage Ajak Industries brochure courtesy of the author)***

The 1980 Olympics in Moscow were not shown in the U.S., because of a large boycott stemming from the invasion of Afghanistan by the then Soviet Union. This and other circumstances came together to create a moment that year in Miami, where passers-by in a shopping center got the treat of viewing TV live from a Russian satellite, from a trailer-mounted satellite dish. This spectacle got companies such as Hero Communications in Miami much free publicity, and the orders started coming in from not only Latin America, but from around the world. Some very large C-band antennas were installed around the globe, many with the means to point with a horizon-to-horizon motor. Orbitron later sold their 20 and 24-foot antennas, with motorized declination and horizon-to-horizon drive, with many ending up in the Middle East and remote areas previously without live TV reception. In North America, Birdview went through several reorganizations that saw a well-made solid 9' antenna with a proprietary horizon mount for the high end of the residential market. Paraclipse made a name for itself with a 16-foot antenna using a chain drive and D-ring system, getting a highly

visible customer called NASA.

Antennas larger than 12 feet almost always used some sort of D-ring with attached tensioned chain drive, to spread the weight out and allow installation of a counter-weight on back of the structure. Paraclipse had this design on 12, 14.5 and 16-foot antennas, combining the portability of knock-down type frame construction with on-the-pole assembly, enabling installations with minimal need to hire a crane to lift heavy parts.

A number of North American manufacturers did well in the mid-1980s, especially after President Reagan signed the Satellite Viewer's Rights Act in 1984, legitimizing the industry to the masses, and peaking probably between 1984 and 1986, with a true "Wild West" of variations in antenna designs for all parts of the market. Such lack of standards handicaps us now when trying to salvage old systems, because many are unrecognizable and without a current source of spare parts. Many companies went out of business shortly after scrambling was introduced to premium TV channels beginning in early 1986, but there were a few that thrived during the truly legitimate phase of the subscription industry, peaked by adoption of the 4DTV Digital Receiver in the late 1990s. As the 90s ended, fierce competition from DBS companies decimated the big dish hardware market, starting with satellite antenna manufacturers dropping out of the market one by one.

1995-1998 was likely the peak for the most popular horizon-to-horizon system manufacturer Ajak Industries, based in Florence, Colorado. They had three different models of H-to-H motor, which were shipped to many satellite antenna manufacturers serving mostly the home industry, with adapter brackets made for mounting of the Ajak motor to the back ring assemblies of each company's dish.

Most popular was the H-180, meant for the 10 and 12-foot mesh antenna, and sold by almost every antenna manufacturer. Orbitron was probably the biggest beneficiary of this niche market, needing them for distributors in the Middle East, Africa, Asia and the South Pacific. The 12-foot Orbitron SX12 antenna with H-180 was immensely popular in Saudi Arabia and the Persian Gulf region, getting satellites from an Intelsat bird at 27.5 West all the way over to Asiasat at 105.5 East. That takes about 165 degrees of true azimuth movement in places such as Riyadh and Jeddah. The H-180 was Ajak's largest seller, being paired with many different manufacturers. Because of the often unskilled installers, it was most popular with a motorized elevation adjuster using an 18-inch actuator, to cover up a less than perfect installation when not perfectly aligned on easternmost satellite Asiasat at 105.5E.

Orbitron could pack over 400 of their knockdown model SX-8.5 (2.4 meter diameter) into a 45 foot ocean container and include the medium duty Ajak Aimer HH mount. This took care of most middle class family installations that did not need the exotic Asiasat service, and was a very cost-effective combination across the Middle East. The alternative was to use a cheap Chinese actuator and a polar mount, but

***Horizon-to-horizon motor for 36-inch Ku-band dish. (Courtesy: Mario Filippi N2HUN)***

those wanting to do it correctly the first time insisted on this mid-level Ajak motor.

In America, Orbitron sold a lot of Ajak Aimer motors with 7, 8.5 and 10-foot models. While a ten foot antenna was pushing the loading limits of the Ajak Aimer, it worked well in most installations that were not attempting movement from elevations of 5 degrees and lower.

Not as popular, but intended for six and seven foot mesh antennas, was the Ajak Patriot, which had less weight capabilities. This author has used several and modified them with my own brackets, to attach to 3 and 4-foot offset Ku-band antennas, for travel across the arc. The logic was that the Ajak Patriot has got to be more reliable than a smaller DiSEqC motor, and one can use the added gain of a 4-foot offset dish to overcome most signal difficulties.

The beginning of the new century saw two things happen rather quickly. Some Chinese HH motors were purchased by remaining dish companies including KTI, Orbitron and Paraclipse, for integration to their antennas, with very bad results coming from poorly machined inner parts. Ajak fell out of the picture because of personal issues between the company's owners.

Except for finding used Ajak motors, or hidden surprises of lost inventories of never-opened motors at some distributors or dealers, this was the end of HH for big dish antennas in North America. Newly rising Ku-band Free-To-Air systems quickly grabbed onto the concept of miniature DiSEqC motors on DBS diameter mounting pipes, coupled to 30 to 36 inch dishes. Quality control and a lot of counterfeit Chinese knock-offs have ruined that industry's former acceptable reputation. Where things will go is anyone's guess, but it is doubtful that anyone will step in soon to restore the novel H-to-H DiSEqC motor for reliable use with Ku-band antennas.

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# Scanning America

**By Dan Veeneman** **dan@signalharbor.com**

## TETRA, LTR, and Two New York, Texas Counties

Upgrades to two-way radio networks are common as evolving technology and new regulations drive system operators to replace outdated equipment and become more efficient. This month we take a look at two counties that are currently in this process.

### Chemung County, New York

Chemung County, New York, will be replacing their existing analog radio system with a new voice and data system to provide communications for the county transit service (CTRAN). The unusual feature of the new system is that it will be built on TETRA (Terrestrial Trunked Radio) technology.

Chemung County is located on the border with Pennsylvania in what is called the "southern tier" of New York. It is home to nearly 90,000 people, a third of whom live in the county seat of Elmira. The county covers an area of 411 square miles, with rolling hills and river valleys, creating somewhat of a challenge for adequate radio coverage.

As we covered in the October 2016 Scanning America column, TETRA is a digital two-way radio standard developed by the European Telecommunications Standards Institute (ETSI) primarily for emergency services, government agencies and transportation organizations. It uses a four-slot time division multiple access (TDMA) method in 25 kHz channels, meeting the FCC spectral efficiency mandate for fitting one user equivalent into just 6.25 kHz of bandwidth.

The first TETRA voice network began operation in Norway in 1997, and since then more than 250 TETRA networks have been placed into service around the world. To date TETRA has not made much headway in the United States, although it is extremely popular in Europe and Asia.

New Jersey Transit went live in 2013 with a TETRA network operating in the 800 MHz band in the Newark area. It is NJ TRANSIT's Bus Radio System and provides voice and data services for more than 4,000 radios. It replaced an analog voice system that dated back to 1988, which was becoming difficult and expensive to maintain due primarily to a lack of available spare parts.

Last year the New York Metropolitan Transportation Authority (MTA) awarded a five-year, $202 million contract to install a 35-site TETRA network for the city's 6,250 buses and support vehicles as well as 1,250 portable radios.


*Chemung County, New York*

### Logic Trunked Radio

Replacing the existing Logic Trunked Radio (LTR) system is the first goal for Chemung County. The second step is to upgrade dispatch consoles and add real-time location tracking using the new system's data capability and Global Positioning System (GPS) receivers on each transit vehicle.

Logic Trunked Radio is an early method of sharing radio channels, developed in 1978 by the E.F. Johnson Company. An LTR system can support up to 20 channels, and each of these can carry voice traffic. There is no separate control channel. Each channel has a dedicated, independent repeater.

These repeaters are interconnected, allowing each repeater to know which repeaters are idle and which are busy, and if busy, which talkgroup is active on it. This information is typically transmitted from each active repeater via a 150 Hz tone, which is below normal voice frequencies and won't be heard because it is normally filtered out by a scanner's audio section.

Each LTR radio is assigned a "home" repeater, to which it listens when it is not engaged in a conversation. It receives and decodes the sub-audible data stream, looking for talkgroup announcement messages and keeping track of which repeaters are idle. If the user presses the push-to-talk switch to start a conversation and the home repeater is busy, the radio will switch frequencies to an idle repeater in order to make an assignment request.

LTR talkgroups are composed of three values, in the

form A-HH-UUU. The first value is called an "area code" and has a value of either 0 or 1. It will be the same for all talkgroups in a system and is used in situations where two different LTR systems are operating in close proximity. One system will use an area code value of 0 and the other will use 1. An LTR radio assigned to area code 0 will ignore talkgroups with an area code set to 1, and vice versa.

The second value is the home repeater, a number between 1 and 20. There is no requirement that repeaters be numbered sequentially; in fact, most LTR systems will have regular gaps in the numbering scheme.

The third value is an individual identifier, from 0 to 254, that serves to uniquely identify a particular radio or talkgroup.

Chemung County operates two LTR systems for non-public safety agencies. Both systems carry voice in analog format and can be tracked by any scanner with LTR capability.

**Chemung County LTR System 1**

| Repeater | Frequency |
|---|---|
| 01 | 856.2625 |
| 05 | 857.2625 |
| 09 | 858.2625 |
| 13 | 859.2625 |
| 17 | 860.2625 |

| Talkgroup | Description |
|---|---|
| 0-01-002 | Van Etten Highway Department |
| 0-01-017 | County Transit (Telephone Patch) |
| 0-01-051 | County Transit |
| 0-05-010 | County Highway Department |
| 0-05-019 | County Transit (Telephone Patch) |
| 0-05-020 | County Transit (Telephone Patch) |
| 0-05-023 | Ashland Highway Department |
| 0-05-028 | Erin Highway Department |
| 0-05-044 | Southport Highway Department (Channel 2) |
| 0-05-046 | County Transit |
| 0-05-052 | County Transit Buses |
| 0-05-061 | County Transit |
| 0-05-102 | County Transit (Telephone Patch) |
| 0-09-050 | County Transit STAMP (Paratransit service) |
| 0-09-060 | Southport Highway Department (Channel 1) |

**Chemung County LTR System 2**

| Repeater | Frequency |
|---|---|
| 01 | 857.2125 |
| 05 | 858.2125 |

| Talkgroup | Description |
|---|---|
| 0-01-018 | County Department of Public Works |
| 0-05-028 | Erin Highway Department |

Public safety agencies in the county operate on conventional (non-trunked) frequencies listed below. Note that some of these frequencies carry voice in digital P25 format, and a handful of those, primarily law enforcement, are also encrypted.

| Frequency | Description |
|---|---|
| 45.24 | New York State Emergency Management |
| 45.44 | New York State Emergency Management |
| 45.60 | County Emergency Management Office |
| 45.64 | County Fire Channel 6 (EMngment Office) |
| 46.14 | County Fire Channel 5 (Fireground) |
| 46.18 | County Fire Channel 1 (Dispatch) |
| 46.22 | County Fire Channel 2 (Truck-to-Truck) |
| 46.32 | County Fire Channel 3 (Fire Police) |
| 46.34 | County Fire Channel 4 (Portables) |
| 46.28 | County Fire Channel 8 |
| 151.0325 | Public Safety (Mutual Aid) |
| 151.1975 | Public Safety (Mutual Aid) |
| 154.0550 | County Emergency Services |
| 154.1450 | County Police [P25] |
| 154.7625 | Public Safety (Mutual Aid) |
| 154.8450 | Public Safety (Mutual Aid) |
| 154.8750 | Sheriff (Dispatch) [P25] |
| 155.1800 | Sheriff Ch. 11 [P25] |
| 155.2500 | Co. Fire Paging (Patched with 46.18 MHz) |
| 155.2800 | County Emergency Medical Services |
| 155.3650 | Elmira Police Channel 7 [P25] |
| 155.4225 | Elmira Police Channel 2 [P25] |
| 155.4900 | Elmira Police (Dispatch) [P25] |
| 155.7600 | Elmira City Services |
| 155.8200 | Elmira City Services |
| 155.8800 | Elmira City Services |
| 155.9250 | Elmira City Services |
| 156.0300 | Sheriff Ch. 10 [P25] |
| 453.0750 | Elmira Fire Channel 3 (Fireground) |
| 453.1250 | Elmira Fire Channel 10 (Code Enforcement) |
| 453.1625 | Elmira Water Board |
| 453.5750 | County Emergency Services |
| 453.7375 | Elmira Water Board |
| 453.8500 | Elmira Fire (Dispatch) |
| 453.8875 | Co. Fire Dispatch (Patched with 46.18 MHz) |
| 458.8500 | Elmira Fire Channel 2 (Fireground) |
| 460.3250 | County Fire (Chemical Fire Main) [P25] |
| 460.3625 | Co. Fire (Chemical Fire Channel 2) [P25] |
| 460.5875 | County Fire (City Fire) [P25] |
| 465.1000 | Co. Fire Channel 4 (Fireground District 1) |
| 465.1625 | Co. Fire Channel 5 (Fireground District 2) |
| 465.1875 | Co. Fire Channel 6 (Fireground District 3) |
| 465.4625 | County Fire Channel 8 (Airport/Fire Police) |
| 465.5000 | Co. Fire Channel 7 (Fireground District 4) |

**Collin County, Texas**

Collin County, part of the Dallas/Fort Worth Metroplex in north central Texas, is nearing completion on its public safety radio system upgrade. The upgrade is essentially an expansion of an existing APCO Project 25 network. The county will fund the construction of nine new repeater sites

and integrate operations with nine existing sites that are owned and maintained by the City of Plano. The combined system will operate in the 800 MHz band and use Project 25 Phase II standards. All 18 repeater sites will transmit the same information at the same time in a process called simulcasting (simultaneous broadcasting), which extends system coverage across a much greater geographic area than what could be covered from a single site.

Collin County is located just north of Dallas and has about 800,000 residents. The county seat is the City of McKinney.

The county will be replacing a Motorola Type II SmartNet analog trunked system that began operation more than a decade ago from two repeater sites, serving the Sheriff's Office, Detention Facilities, County Constables, Fire Marshal and Emergency Management, as well as the Police Departments of Celina, Fairview, Farmersville, Lavon, Melissa, Parker and Princeton as well as the Volunteer Fire Departments of Anna, Blue Ridge, Farmersville, Lowry Crossing, Melissa, Nevada, Princeton, Westminster and Weston.

The upgrade will provide improved radio coverage and capacity, as well as additional features for two dozen agencies and departments. The use of P25 Phase II will also allow the county to meet the Federal Communications Commission (FCC) efficiency standard of one voice channel equivalent in 6.25 kHz of bandwidth.

The system is expected to be completely up and running by the middle of next year. In the meantime, the current Collin County public safety will continue to operate on the following frequencies: 851.2250, 851.7250, 852.2250, 852.7250, 853.1250 and 859.5875 MHz.

| Decimal | Hex | Description |
|---|---|---|
| 16 | 001 | County Fire (Common 1) |
| 48 | 003 | County Fire (Common 2) |
| 80 | 005 | County Fire (Emergency) |
| 112 | 007 | Allen Fire |
| 144 | 009 | Blue Ridge Fire |
| 176 | 00B | Branch Fire |
| 208 | 00D | Fairview Fire |
| 240 | 00F | Farmersville Fire |
| 272 | 011 | Frisco Fire (Backup) |
| 304 | 013 | Josephine Fire |
| 336 | 015 | Lavon Fire |
| 368 | 017 | Lowry Crossing Fire |
| 400 | 019 | Lucas Fire |
| 432 | 01B | County Jail (Booking) |
| 528 | 021 | County Jail (Minimum Security) |
| 560 | 023 | County Jail (Dispatch) |
| 592 | 025 | County Courthouse |
| 624 | 027 | County Facilities Maintenance |
| 656 | 029 | County Roads and Bridges |
| 784 | 031 | County Streets |
| 816 | 033 | County Road Work |
| 848 | 035 | County EMS (Dispatch) |
| 880 | 037 | County Fire (Investigations) |
| 912 | 039 | County Fire (Dispatch) |
| 944 | 03B | Anna Fire |
| 976 | 03D | Celina Emergency Medical Services |
| 1008 | 03F | Weston Fire |
| 1040 | 041 | Prosper Fire |
| 1072 | 043 | Sheriff (Dispatch) |
| 1104 | 045 | Sheriff (Records) |
| 1136 | 047 | Sheriff (Investigations) |
| 1168 | 049 | Sheriff Field Operations |
| 1200 | 04B | Sheriff (Emergency Response Team) |
| 1232 | 04D | County Constable Precinct 1 |
| 1264 | 04F | Co. Constables (Warrant Service) |
| 1296 | 051 | County Jail Operations 1 |
| 1328 | 053 | Sheriff and Municipal PD 1 |
| 1360 | 055 | Sheriff and Municipal PD 2 |
| 1424 | 059 | Sheriff (Narcotics/Vice) |
| 1456 | 05B | Sheriff (Negotiator) |
| 1616 | 065 | County Maintenance |
| 1680 | 069 | McKinney Fire (Backup) |
| 1712 | 06B | Murphy Fire (Backup) |
| 1744 | 06D | Nevada Fire |
| 1776 | 06F | Parker Fire |
| 1808 | 071 | Plano Fire |
| 1840 | 073 | Princeton Fire |
| 1872 | 075 | Royse City Fire |
| 1904 | 077 | Westminster Fire |
| 1936 | 079 | Wylie Fire |
| 2096 | 083 | County Jail Operations 2 |
| 2192 | 089 | Melissa Fire |
| 2352 | 093 | County Constable Precinct 2 |
| 2384 | 095 | County Constable Precinct 3 |
| 2416 | 097 | County Constable Precinct 4 |
| 2608 | 0A3 | Celina Police |
| 2736 | 0AB | Sheriff (Traffic) |
| 2768 | 0AD | Parker Police |
| 2800 | 0AF | Princeton Police |
| 5008 | 139 | Sheriff (Tactical) |

**Plano, Allen, Wylie and Murphy**

The City of Plano operates a Project 25 Phase II digital network serving the city and several other local communities, including Allen, Wylie and Murphy. The system is referred to as "PAWM" and will be half of the new Collin County system. PAWM currently operates on the following frequencies: 851.1500, 851.1750, 851.6500, 851.6750, 851.9625, 852.1500, 852.1750, 852.6500, 852.6750, 852.9625, 853.2750 and 853.3000 MHz

| Decimal | Hex | Description |
|---|---|---|
| 3 | 003 | Plano Police (Dispatch) |
| 5 | 005 | Plano Police (Dispatch 2) |
| 4 | 004 | Plano Police (Records) |
| 6 | 006 | Plano Police (A-Sector Talkaround) |
| 7 | 007 | Plano Police (B-Sector Talkaround) |
| 8 | 008 | Plano Police (C-Sector Talkaround) |
| 9 | 009 | Plano Police (D-Sector Talkaround) |

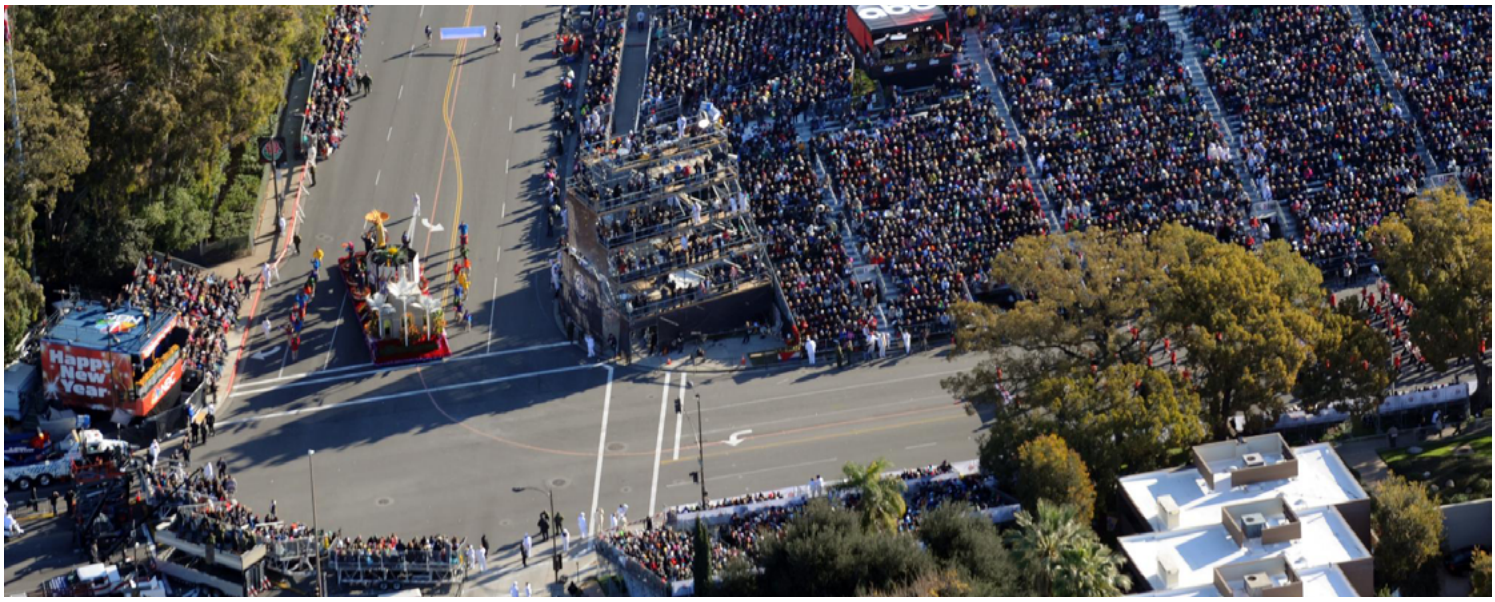
| | | |
|---|---|---|
| 10 | 00A | Plano Police (Operations 1) |
| 11 | 00B | Plano Police (Operations 2) |
| 12 | 00C | Plano Police (Operations 3) |
| 13 | 00D | Plano Police (Operations 4) |
| 14 | 00E | Plano Police (Events) |
| 15 | 00F | Plano Police (Supervisors) |
| 16 | 010 | Plano Police (Traffic) |
| 19 | 013 | Plano Neighborhood Patrol Officers |
| 20 | 014 | Plano Police (Canine) |
| 21 | 015 | City Jail |
| 24 | 018 | Plano Police (Supply) |
| 25 | 019 | Plano Police (Training) |
| 27 | 01B | Plano Police (CIDivision 1) |
| 28 | 01C | Plano Police (CIDivision 2) |
| 29 | 01D | Plano Police (CIDivision 3) |
| 33 | 021 | Plano Police (Narcotics 1) |
| 34 | 022 | Plano Police (Narcotics 2) |
| 35 | 023 | Plano Police (Narcotics 3) |
| 100 | 064 | Plano Fire (Dispatch) |
| 101 | 065 | Plano Fire (Status Updates) |
| 102 | 066 | Plano Emergency Medical Services |
| 103 | 067 | Plano Fire (Channel 4) |
| 104 | 068 | Plano Fireground |
| 105 | 069 | Plano Fireground |
| 106 | 06A | Ambulance to Medical City Plano |
| 107 | 06B | Ambul'ce to Presbyterian Hospital of Plano |
| 108 | 06C | Plano Emergency Medical Services |
| 109 | 06D | Plano Fire Auxiliary |
| 110 | 06E | Plano Fire mutual aid with Frisco |
| 111 | 06F | Plano Fire mutual aid with Richardson |
| 112 | 070 | Plano Fire (Training 1) |
| 113 | 071 | Plano Fire (Training 2) |
| 114 | 072 | Plano Fire |
| 116 | 074 | Plano Fire |
| 215 | 0D7 | Plano Facilities (Dispatch) |
| 216 | 0D8 | Plano Facilities (Mechanics) |
| 218 | 0DA | Plano Facilities (Technicians) |
| 219 | 0DB | Plano Enviro Waste Ser. (Bulk Collection) |
| 223 | 0DF | Plano Environmental Waste Services 1 |
| 224 | 0E0 | Plano Environmental Waste Services 2 |
| 225 | 0E1 | Plano Environmental Waste Services 3 |
| 226 | 0E2 | Plano Environmental Waste Services 4 |
| 227 | 0E3 | Plano Environmental Waste Services 5 |
| 228 | 0E4 | Plano Environmental Waste Services 6 |
| 234 | 0EA | Plano Animal Control |
| 258 | 102 | Plano Parks and Recreation 1 |
| 259 | 103 | Plano Parks and Recreation 2 |
| 274 | 112 | Plano Public Works Operations (Streets) |
| 278 | 116 | Plano Water Utility |
| 301 | 12D | Plano Ind. School District (Facilities 1) |
| 302 | 12E | Plano Ind. School District (Facilities 2) |
| 305 | 131 | Plano Independent School District (Security) |
| 306 | 132 | Plano Independent School District (Buses A) |
| 307 | 133 | Plano Independent School District (Buses B) |
| 308 | 134 | Plano Independent School District (Buses C) |
| 502 | 1F6 | Allen Police (Dispatch 1) |
| 512 | 200 | Allen Police (Dispatch 2) |
| 503 | 1F7 | Allen Police (Records) |
| 504 | 1F8 | Allen Police (Operations) |
| 505 | 1F9 | Allen Police (Animal Control) |
| 495 | 1EF | Allen Police (Traffic) |
| 511 | 1FF | Allen Police (Canine) |
| 514 | 202 | Allen Police (Events 1) |
| 516 | 204 | Allen Police (Car-to-Car) |
| 500 | 1F4 | Allen Police (Event Center) |
| 520 | 208 | Allen Police (Citywide Events) |
| 601 | 259 | Allen Fire (Dispatch) |
| 602 | 25A | Allen Fire Operations 2 |
| 603 | 25B | Allen Fire Operations 3 |
| 604 | 25C | Allen Fire Operations 4 |
| 605 | 25D | Allen Fire Operations 5 |
| 606 | 25E | Allen Fire Operations 6 |
| 607 | 25F | Allen Fire Operations 7 |
| 608 | 260 | Allen Fire Operations 8 |
| 609 | 261 | Allen Fire (Training) |
| 610 | 262 | Allen Fire (Prevention) |
| 611 | 263 | Allen Fire (Events) |
| 701 | 2BD | Allen Building Facilities |
| 702 | 2BE | Allen Water Meter Readers |
| 703 | 2BF | Allen Water Utilities |
| 704 | 2C0 | Allen Streets |
| 800 | 320 | Wylie Police (Dispatch) |
| 801 | 321 | Wylie Animal Control 1 |
| 802 | 322 | Wylie Animal Control 2 |
| 804 | 324 | Wylie Police (Event 1) |
| 805 | 325 | Wylie Police (Event 2) |
| 806 | 326 | Wylie Police (Records) |
| 810 | 32A | Wylie Police (Operations 1) |
| 811 | 32B | Wylie Police (Operations 2) |
| 825 | 339 | Wylie Fire Rescue (Dispatch) |
| 826 | 33A | Wylie Fire Operations 1 |
| 827 | 33B | Wylie Fire Operations 2 |
| 828 | 33C | Wylie Fire Operations 3 |
| 829 | 33D | Wylie Fire Operations 4 |
| 831 | 33F | Wylie Fire (Event 1) |
| 834 | 342 | Wylie Fire (Training) |
| 835 | 343 | Wylie Fire (Administration) |
| 837 | 345 | Wylie Emergency Medical Services |
| 838 | 346 | Wylie Fire Operations 5 |
| 900 | 384 | Murphy Police (Dispatch) |
| 901 | 385 | Murphy Police (Records) |
| 903 | 387 | Murphy Police Operations 1 |
| 904 | 388 | Murphy Police Operations 2 |
| 925 | 39D | Murphy Fire (Dispatch) |
| 926 | 39E | Murphy Fire (Operations 1) |
| 927 | 39F | Murphy Fire (Operations 2) |
| 928 | 3A0 | Murphy Fire (Operations 3) |
| 929 | 3A1 | Murphy Fire (Command) |
| 950 | 3B6 | Murphy Water Department |
| 953 | 3B9 | Murphy Streets and Traffic Div. |
| 1001 | 3E9 | Plano Outdoor Warning Sirens |

TSM

# Federal Wavelengths

By Chris Parris cparris@thefedfiles.com

## Scanning Los Angeles




*An aerial view of the first turn of the Tournament of Roses Parade in Pasadena, California, known as "Broadcast Corner," which is where all the broadcasters were located, including the author. (Courtesy of Tournament of Roses Parade)*

Los Angeles, California, like other large metropolitan areas of the country, can be quite a challenge for scanner listeners. The city of Los Angeles (LA) is the second most populous city in the United States, behind New York City. Los Angeles County has literally hundreds of smaller cities and towns that often have their own police and fire frequencies, as well as thousands of business frequencies and radio systems. The challenge is figuring out what to listen to amongst the thousands of busy radio frequencies that are in use.

The LA area can also offer a huge number of federal and military radio channels that can be monitored. And despite the trend towards encryption on federal agency radio systems, there are plenty of active, clear frequencies and opportunities to find military and federal radio traffic. But there is encryption, for sure. But don't let that keep you from searching for activity!

One of the major federal radio systems in Southern California is part of the federal Integrated Wireless Network project, or IWN. This Justice Department-managed system is a series of linked and stand-alone conventional VHF P-25 repeater sites that are utilized primarily by the CBP Border Patrol, Customs and Border Protection and other agencies including the Coast Guard. The IWN is mainly used to the south of the LA area, in San Diego County and the border area, but some of the IWN traffic can be heard in Los Angeles.

I do make trips to the Los Angles area quite often and always find something new when I scan the bands there. Over the years my logs have shown more than a few analog entries that eventually turned into P25 digital. And now more DMR digital is starting to show up in the UHF federal bands. To get you started, here is my list of what I have logged while on my visits to the city:

| | | | |
|---|---|---|---|
| 122.7500 | AM | LA helicopters air-to-air 3 | |
| 122.8500 | AM | LA helicopters air-to-air 4 | |
| 123.0250 | AM | LA helicopters air-to-air 1 | |
| 123.0750 | AM | LAPD Downtown Hooper Heliport Operations | |
| 129.2750 | AM | Helicopter photo air-to-air | |
| 150.7000 | | USCG Auxiliary 4 | |
| 155.4750 | | LARTCS - Federal Interop | |
| 162.2250 | | US Coast Guard | |
| 162.6625 | | 100.0 PL | CBP NET 44 |
| 162.7625 | | N167 | FBI |
| 162.7750 | | N293 | |
| 162.8875 | N653 | LA Federal Interoperability (FIO) 2 - Input | |
| 162.9250 | N117 | FBI TAC 3 | |
| 163.1000 | N653 | LA FIO 1 - Input | |
| 163.1000 | | Federal Interop repeater | |
| 163.1125 | N496 | | |
| 163.1375 | N293 | USCG NET 113 | |
| 163.1750 | | | |
| 163.2125 | N100 | | |
| 163.2375 | | | |

163.2625 D503 West LA VA Medical Center - Police
163.4375 131.8 PL Army Corps of Engineers
163.5875 85.4 PL
163.6750 N173 Immigration & Customs Enforcement (ICE)
163.6750 N217 ICE
163.7500 100.0 PL
163.7500 N109 ICE LA-2 MA
163.8250 N111 ICE LA-2 SP
163.8375 N167 FBI - Input to 167.7375 MHz
163.8500 N016 Transportation Security Administration (TSA) - LAX
163.9125 N167 FBI
164.0000 118.8 PL
164.1000 100.0 PL
164.1625 110.9 PL
164.1625
164.4000 N001 US Secret Service - PAPA
164.6500 N001 US Secret Service – TANGO
164.8750 141.3 PL
164.9375 103.5 PL Angeles National Forest
165.0125 D114
165.1875 110.9 PL Army Corps of Engineers
165.2125 N001 US Secret Service - MIKE
165.2375 N301 CBP Field Operations DNET 1
165.2875 N650 BATFE-NET 1
165.3125 N293 USCG Ops with BLACKFIN & SECTOR
165.3250 N293 USCG NET 122
165.4125 100.0 PL CBP - OTAR
165.5875 N293 US Marshals
165.7250 N293 US Marshals
165.7875 N001 US Secret Service BAKER
165.8250 N108 ICE LA - ALPHA 4
165.8250 N420 ICE LA - Simplex
165.8750 N108
165.8750 N225
165.9000 N306 IWN Border Patrol TAC 3
165.9250 N112
165.9250 N359 FBI
165.9500 N009 US Treasury Department - IRS
166.2250 82.5 PL US Postal Service
166.3750 103.5 PL BLM ADMIN NET, also 110.9 PL
166.4625 Federal Common
166.5125 151.4 PL
166.5875 100.0 PL DHS CBP input to NET 3 - 10A562 calling SECTOR
166.6375 N820 CBP Marine Common System – Common Input
166.7500 N455 BLM Law Enforcement
166.8875 N354 IWN Santiago Peak
166.9125 N245 IWN MA-4 SP Repeater
166.9500 N294
167.2250 N107
167.2250 N374 FBI
167.2375 N293 FBI
167.2375 N365 CBP JIOP
167.2500 100.0 PL
167.2875 N167 FBI ALPHA-1
167.3125 N167 FBI BRAVO-7
167.3375 N167 FBI
167.4125 N167 FBI BRAVO-1
167.4625 N167 FBI ALPHA-5
167.5125 N283 FBI
167.5250 N247 IWN Otay Mountain
167.5375 N167 FBI
167.5375 N293 US Marshals
167.5500 N178 IWN El Cajon 2 Repeater
167.5625 N167 FBI
167.5875 N167 FBI
167.6000 N234 FBI
167.6375 N167 FBI
167.6625 N167 FBI ALPHA-7
167.7000 N176 IWN San Clemente POE
167.7375 N167 FBI ALPHA-3
167.8250 N241
167.9625
168.3500 N653 LA FIO
168.5000 N199 IWN El Cajon 1 Repeater
168.5875 N169 ICE
168.6000 103.5 PL
168.7500 103.5 PL CLEVELAND NATIONAL FOREST-FOREST NET
168.8000 N170 IWN JIOP SP
168.8250 N104 ICE LA-1
168.8250 N108 ICE
168.8250 N10E
168.8250 N241 IWN CBP Border Patrol
168.8500 N110 ICE
168.8750 N118 ICE LA - TAC 2
168.9250 N115 ICE LA-3 LAX
168.9250 N153
168.9250 N454
168.9750 N106 CBP Border Patrol LA-2 Repeater
168.9750 N119 ICE LA TAC 3
169.2250 N293 FAA
169.2625 N001 TSA @ LAX
169.2625 N016 TSA @ LAX
169.3875 N001 TSA @ LAX
169.4125 N002 TSA @ LAX
169.4500 100.0 PL CBP NET 2 - OTAR
169.5000
169.5500 100.0 PL CBP Field Operations at LAX
169.6125
169.6375 N172 IWN BP, Field Operations
170.0625 N193 IWN Border Patrol Chula Vista 2
170.1000 N301 CBP Field Operations
170.4625 103.5 PL Cleveland National Forest
170.5500 131.8 PL
170.6250 N114 ICE LA-1 G
170.6750 N113 ICE LA-1 V
170.6875 N167 FBI
170.7500 N293 US Marshals Service – LA Federal

Courthouse
170.8000 N293 US Marshals Service
170.8375 N248 IWN Border Patrol MA-4 CP
170.8500 N864 US Marshals Service
170.9125 N229
170.9500 N156 DEA VHF
171.1875 N820 CBP Marine Common System – San Nicolas
171.3125 N820 CBP Marine Common System
171.3250 N820 CBP Marine Common System – Mt. Solidad
171.3375 N252
171.3500
171.3875 N156 DEA VHF
171.3875 165.5 PL
171.4000 203.5 PL
171.4875 N293
171.5375 N180 IWN CBP Lyons Repeater
171.6250 N153 DHS CBP-JIOP
171.6500 203.5 PL
171.7000 100.0 Channel Islands National Park
171.7250 N455
171.7875 N40B Cleveland National Forest
172.1500 N002 TSA @ Ontario
172.1875 N167 FBI
172.1875 N195 IWN CBP Brownfield 2 Repeater
172.2125 N187 IWN CBP Imperial Beach Repeater
172.3750 103.5 PL Angeles National Forest
172.4000 N176
172.4125 N653 LA Federal Interoperability 2
172.4500 N001
172.4500 N148 IWN CBP MA1SP Wide Area – Santiago Peak
172.5000 N148
172.5125
172.5250 110.9 PL Santa Monica Mountains National Recreation Area
172.7125 N820 CBP Marine Common System - San Pedro
172.7250 110.9 PL
172.9000 N001 TSA Burbank (BUR)
172.9000 N013 TSA
172.9000 N016 TSA LAX
173.1000 N167 FBI
173.1250 N167 FBI
173.1625 N156 DEA VHF
173.4500 N197 DHS CBP Brownfield 1
173.4750 N189 DHS CBP Imperial Beach 1
173.5500 N653 LA Federal Interoperability 1
173.6000 N653 LA Federal Interoperability 3
173.8000 N293
173.9750 N191 CBP Chula Vista 1

406.1125 N293 LA Area VA – linked repeaters
406.1250
406.2750 N001
406.3375 N08C
406.3375 N482 US Postal Inspection Service
406.5000 D172 VAMC Maintenance Long Beach
406.6625 D165 Federal Reserve Branch Bank LA
406.8000 156.7 PL LARTCS - Federal Interop linked to other frequencies
406.9375 DMR US Postal Service - CC01, Time Slot1
407.0750 D245 VAMC Long Beach
407.2250 107.2 PL US Army Corps of Engineers
407.3375 DMR
407.4250
407.5000 DMR Color Code 1, Time Slot 1, Talk Group 3
407.5375 DMR US Postal Service - Color Code 1
407.6000 D364 VAMC Long Beach
407.7750 N482 US Postal Inspection Service
408.0000 D754 VA
408.1000 DMR
408.1375 D565 US Postal Service
408.3500
408.4000 N167 FBI Link
409.1000 D565
409.1250 D047 LA Area VA
409.1750
409.1875 103.5 PL US Forest Service - link
409.5250 N293 Department of State Diplomatic Security Service
409.7250
409.7375 DMR
410.2000 D125 GSA Federal Buildings
410.2000 D245 GSA Federal Buildings
410.3000
410.5500 N293 LA Area VA – linked repeaters
410.5750 CSQ NOAA UHF link to weather broadcasts
410.7875 103.5 PL San Bernardino National Forest - link
410.8000 127.3 PL Federal Protective Service LA
411.0125 Paging Data
411.4500 156.7 PL
411.4500 N005 TSYS SYS 001, SITE 101, WACN 00001
412.2875 N293 Department of State Diplomatic Security Service
412.4500 N005 TSYS SYS 001, SITE 101, WACN 00001
412.6500 N167 FBI Link
412.7000 123.0 GSA Federal Buildings
412.9750 N293 USCG NET 409
413.0250 N293 USCG NET 411 – Coast Guard helicopters at LAX
413.4500 N005
413.5125 136.5 PL
413.5250 DMR
414.0250 156.7 PL DEA HIDTA
414.0500 156.7 PL DEA HIDTA

| | | |
|---|---|---|
| 414.4000 | N293 | LA Area VA – linked repeaters |
| 414.7250 | 156.7 PL | DEA |
| 414.7500 | | US Postal Inspectors |
| 415.0500 | | US Postal Inspectors |
| 415.2000 | 118.8 PL | Federal Protective Service |
| 415.2750 | N001 | |
| 415.3000 | D503 | VAMC Los Angeles - Security |
| 415.5250 | 103.5 PL | Cleveland National Forest - link |
| 415.9125 | | |
| 416.0000 | | VAMC La Jolla |
| 416.8750 | | FAA - Data |
| 417.1500 | | |
| 417.2000 | 127.3 PL | Federal Protective Service |
| 417.3500 | | |
| 417.4000 | N167 | FBI Link |
| 417.5750 | CSQ | Joshua Tree National Forest - link |
| 417.9125 | N167 | FBI Link |
| 418.3000 | 82.5 PL | US Postal Service |
| 418.6750 | 156.7 PL | DEA |
| 418.9000 | 156.7 PL | DEA - OTAR data |
| 418.9750 | 156.7 PL | DEA |
| 419.1000 | CSQ | NOAA Link to VHF weather broadcasts |
| 419.1750 | 103.5 PL | Federal Protective Service |
| 419.1750 | 127.3 PL | Federal Protective Service |
| 419.5500 | N293 | |
| 419.6500 | 107.2 PL | |

My logs represent just a portion of what you can hear if you search the federal bands. If you want to check out a much larger database of what is happening on Southern California federal frequencies, be sure and check out the "SoCal FedCom" web page at **http://socalfedcom.blogspot.com** In addition to the above conventional federal and military frequencies used in the Los Angeles area, you can hear several trunked radio systems used by federal government agencies. One is the P25 digital trunked site used at the Los Angeles Air Force Base, located just south of Los Angeles International Airport (LAX). LAAFB is headquarters to the Space and Missile Systems Center (SMC), part of Air Force Space Command. The trunked radio site is a part of the nationwide, networked system linking multiple Air Force installations around the country. Here are the site specifics:

**Los Angeles Air Force Base - P25**

| | |
|---|---|
| System ID | 157 |
| WACN | BEE00 |
| Site | 1-007 |

386.0750, 386.1375, 386.2250, 386.2875

There are also two federal prison facilities using trunked systems in the LA area. The first is the Federal Correctional Institution Terminal Island. FCI Terminal Island is located at the entrance to Los Angeles Harbor, between San Pedro and Long Beach. It is an actual island and is shared with the Coast Guard. Here is the radio system information:


***Milsat Command, whose mission is to "Develop, acquire, deploy, and sustain space-enabled, war-winning, global communications to support national objectives," is headquartered at the Los Angeles Air Force Base. (Courtesy: Milsat Command)***

**FCI Terminal Island - Motorola Type II**

| | |
|---|---|
| System ID | D01B |
| Base | 406.2625 |
| Step | 12.5 |
| Offset | 380 |
| P-25 NAC | 1B5 |

407.0125, 408.8125, 409.2125, 409.4125, 410.5250

The other federal prison facility is the Metropolitan Detention Center in Downtown Los Angeles. It mainly holds prisoners attending federal court in the city and federal prisoners with short sentences. Here is the MDC LA system information:

MDC Los Angeles – Motorola Type II

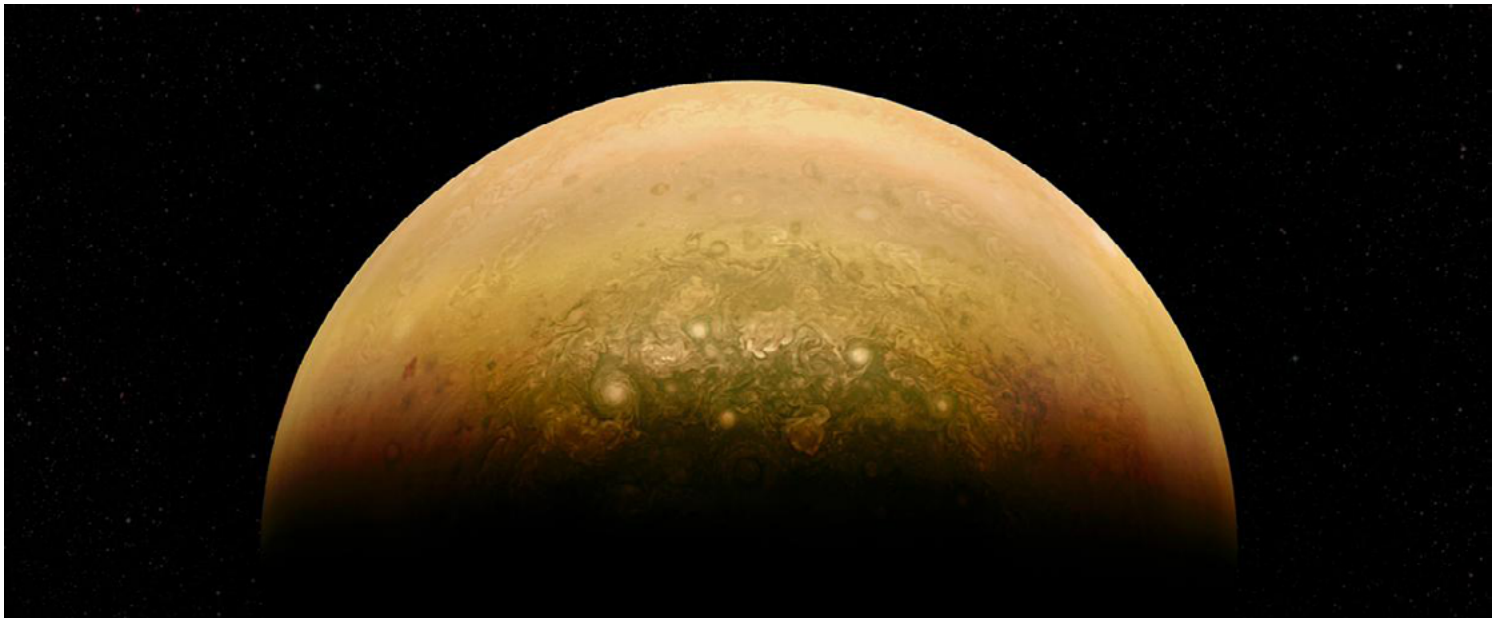
| | |
|---|---|
| System ID | CA0B |
| Base | 406.0000 |
| Step | 12.5 |
| Offset | 397 |
| P25 NAC | 0B5 |

406.8125, 409.4125, 409.6750, 409.9500, 410.5250

**Jet Propulsion Laboratory**

Another interesting federal facility to give a listen to is the Jet Propulsion Laboratory. For those who have seen the movie "The Martian," the JPL plays a large part in the fictional story, but it also plays a real life role as a major support facility for NASA missions.

The Jet Propulsion Laboratory is a federal funded research center located in Pasadena, California. It had its beginnings before World War II, and started out as a military facility. It became the Jet Propulsion Laboratory in 1943, managed by Caltech (California Institute of Technology) for



***Jet Propulsion Laboratory (JPL) is part of the California Institute of Technology, which is headquartered in Los Angeles. This image of a Jupiter rise is from the Junocam on the Juno mission to Jupiter taken January 19, 2017. (Courtesy: JPL)***

the U.S. Army. JPL officially became part of NASA in 1958, but to this day, JPL is still managed by Caltech.

The JPL is located to the northeast of downtown Los Angeles, but since it is nestled in the hills above Pasadena, the radio traffic tends to carry quite far south. I have a number of frequencies that have been allocated to JPL operations, but over the years, some have upgraded from analog to P-25 digital, while others have fallen into disuse. That doesn't mean that they might not be used again, or for low-power use on site. Give these a listen and see what might be active:

| | | |
|---|---|---|
| 162.0250 | 136.5 PL | JPL Bus |
| 162.1125 | | |
| 162.6125 | | |
| 162.9875 | N293 | JPL Fire Dispatch |
| 163.0000 | | |
| 164.2000 | | |
| 164.9875 | | |
| 168.3500 | | |
| 169.4000 | | |
| 170.3500 | | |
| 171.0000 | N293 | JPL Police Dispatch |
| 406.2250 | | |
| 410.0000 | | |
| 413.8000 | 103.5 PL | Reported maintenance operations |
| 413.8250 | | |

**2017 Rose Parade Wrap Up**

And speaking of Pasadena, one thing that always comes to mind when talking about this city—the annual Pasadena Tournament of Roses Parade. This annual New Years Day event has been a major attraction for the city for over 100 years. The parade has also become a major television event, being broadcast over multiple national television networks and channels. The first telecast of the Rose Parade was on KTLA-TV in 1947. It was also one of the first network color television broadcasts in 1954 on NBC.

And television is one of the reasons I get to attend the Rose Parade. I help engineer the broadcast for one of the national TV networks, using about 20 cameras and video feeds shared between broadcasters. And since this is a high-profile media event, there has been concern over possible disruptions of any major gathering of the public, so extra precautions have been taken over the last decade, some involving federal agencies.

Here is what I logged on the day of the parade (which was on Monday, January 2, this year, as the Rose Parade has a "Never On Sunday" rule). Quite a few of the FBI and some of the ICE frequencies were in the clear, with lots of radio checks prior to the events. While not all of these are directly related to the Rose Parade and Rose Bowl game, many were:

| | | | |
|---|---|---|---|
| 118.5750 | AM | Air Operations over Rose Parade/Rose Bowl | |
| 162.8875 | | N653 | |
| 162.9875 | | N293 | |
| 163.1125 | | N769 | |
| 163.1375 | | N293 | |
| 163.7000 | | N164 | ICE |
| 163.7000 | | N169 | ICE |
| 163.8250 | | N111 | |
| 163.8375 | | N167 | FBI |
| 163.9125 | | N167 | FBI |
| 164.7875 | | N169 | ICE |
| 164.8750 | | 131.8 PL | |
| 165.8250 | | N108 | ICE |
| 166.7500 | | N455 | |
| 166.9125 | | N245 | |
| 167.1625 | | N650 | BATFE |
| 167.2875 | | N167 | FBI |

167.3125 N167 FBI
167.3375 N167 FBI
167.4500 N301 CBP
167.4625 N167 FBI
167.6625 N167 FBI
167.7375 N167 FBI
168.8250 N104
168.9625 N293 CBP AIR 2 – OMAHA helicopter
169.9125
172.1875 N167FBI
172.4125 N653LA Federal Interoperability 2
172.7125 N820CBP Marine Common System
173.1000 N293

A highlight for the people attending the Rose Parade (and scanner listeners as well) is the flyover of the B-2 aircraft to signal the start of the parade. A B-2 is flown over not only the parade start, but also the national anthem over at the Rose Bowl football game later in the day. The usual procedure has two B-2 bombers fly into the area and time their arrival to fly over the events as the final chords of the Star Spangled Banner are sung.

This year, things looked a little dicey for the flyover early on Monday morning, as we still had very low clouds in the area and could have made the flyovers difficult to see. However, as the sun came up and temperatures warmed, the clouds cleared and were high enough not to effect air operations. The B-2 bombers used the call sign REAPER for this mission, and were heard as REAPER 11 and REAPER 12. Both are with the 509th BW out of Whiteman AFB in Missouri. While in the area, the REAPERs were refueled by GUCCI 60 out of Travis AFB.
284.7000 – LA Center
341.7500 – Air to Air and coordination timing with ground controller
351.9000 – LA Center

One of the things that was missed this year was the over flights of the EPA aircraft taking measurements of the parade route. In past years, the Environment Protection Agency used a light aircraft loaded with sensors to monitor air quality and look for possible chemical or biological agents that might be deployed. They usually did base-line measurements of the area on the day before the parade and flew a large grid pattern at low altitude over the greater Pasadena area. They would then fly an identical pattern just before the parade started early in the morning to see what might have changed. This year, however, low ceilings and light rain appeared to have kept the EPS over flights grounded.

That's all for this month. I will be back next month with some information on the 58th Presidential Inauguration in Washington DC, as well as Super Bowl 51 in Houston!

**Federal Wavelengths Frequency List Legend**

Unless otherwise noted, frequencies listed are FM and frequencies are shown in Megahertz (MHz). Frequencies listed will show additional information as follows:

| | |
|---|---|
| PL | CTCSS Tone Squelch |
| D | DCS Digital Coded Squelch |
| RID | APCO P25 Radio Identification Number |
| CSQ | Carrier Squelch, no squelch tone |
| N | APCO P25 digital Network Access Code (NAC) |
| DMR | Digital Mobile Radio, marketed by Motorola as TRBO |
| NXDN | Nexedge Digital, marketed by Kenwood |

WACN Wide Area Communications Network, an APCO P25 trunked network Identifier

TSM

# Utility Planet

**By Hugh Stegman** **mtutilityworld@gmail.com**

# FEMA Planning Exercises with Hams and Others for 2017

The U.S. Federal Emergency Management Agency (FEMA) has just announced monthly interoperability exercises for all of 2017. These could be pretty good. Unlike the usual secret national security activities of FEMA, these are announced and open to several other types of stations, including amateurs on the 60-meter band. They are likely to bring out some interesting players, in both voice and digital. With luck, they will also be audible in parts of the U.S. that don't usually get good signals on the Feds.

It all started last December, when FEMA's Region X (Roman numeral ten), held a communication exercise (COMMEX) on 60 meters. This region includes Alaska, Idaho, Oregon, and Washington. The idea was to test how well FEMA could operate with several other types of stations, some of them FCC-licensed amateurs and Native American tribes.

The exercise was a success. Therefore, according to the ARRL Letter (link given later), Region X has called for exercises on the third Wednesday of each month in 2017. The Feds have always liked to do radio things on Wednesday mornings (local time). Hard core Federal DXers have already noted that this is the same Wednesday used by the mysterious U.S. Department of Defense "Three-Letter Net." This net, named from the 3-letter ALE addresses used, is not always as active as it used to be. It still exists, though. It's been widely theorized that the net's mission relates to continuity of operations or government in dire emergencies.

FEMA's monthly COMMEX will go from 1500 to 2100 Coordinated Universal Time (UTC). The Regional X communication coordinator describes them as intended "to test and exercise interoperable communications (federal/ state/ local/ tribal/ amateur) during a major disaster, where communications infrastructure would be significantly damaged or destroyed." The FEMA station will use its government call sign of WGY 910. Other potential players are said to include SHARES (SHAred RESources) members, Military Auxiliary Radio System (MARS) stations, and the aforementioned amateurs. The area of operation is defined as the entire Continental U.S. (CONUS).

SHARES is always interesting. The network has had its ups and downs, but it's been in something of an expansionary phase since being transferred to the Department of Homeland Security (DHS). It has been described as a U.S. Federal frequency pool. Various agencies contribute


***Federal Emergency Management Agency (Courtesy FEMA)***

frequencies from their allocations. MARS stations used to be major players, but now the network seems to be looking for more local emergency agencies. Specific stations from these agencies apply for SHARES membership. On a good day, SHARES nets bring out quite a few Federal players that otherwise aren't heard much on HF. For this and other reasons, FEMA's new exercise could really be great for DXers. It should also be very interesting for hams, General Class or higher, who are encouraged to participate.

The frequencies will continue to be on the 60-meter band. It's a good place for a number of reasons. Not the slightest of these is that U.S. amateurs already share the band with existing government and military stations. International regulations established an amateur allocation in this utility band a few years ago, but the implementation has varied widely between countries and regions.

While a continuous band of spectrum exists in some areas, the U.S. is still channelized. The exercises will use all five channels. These are 5330.5, 5346.5, 5357, 5371.5, and 5403.5 kHz. While amateur practice has always been to use lower sideband (LSB) below 10 MHz, these channels are upper sideband (USB). In order to minimize interference, the FCC has a few picky rules. Voice and digital both have to be centered 1500 Hz up from the listed frequencies. Bandwidth is limited to 2.8 kHz. Peak envelope power is limited to 100 watts. It's definitely worth checking the transceiver manual when getting "netted in" on this band.

All of this could bring out some interesting stations. With luck, some will be in places we don't usually hear in these Wednesday exercises. While the future is unknown, we might have some potentially good stuff here.

**French Time Signals Continue**

Radio gets weird sometimes. In this case, one of the world's most powerful radio stations has left the air without leaving the air.

It all started when the French government decided to cut costs by phasing out all of its AM broadcast transmissions. Medium wave went away at the end of 2015. Long wave, the venerable France Inter feed on 162 kHz, stopped a year later. First, the French government announced that its two-megawatt Allouis transmitter would lose its broadcast license effective local midnight on December 31, 2016. Sure enough, as the new year approached, a quick French countdown led to a sudden end. That was that.

Ordinarily, this would have been followed quickly by the final permanent carrier drop, for the first time revealing any other transmissions near the channel. Not this time. The mighty wave stayed up, all of it. As of mid-January, it was still going strong.

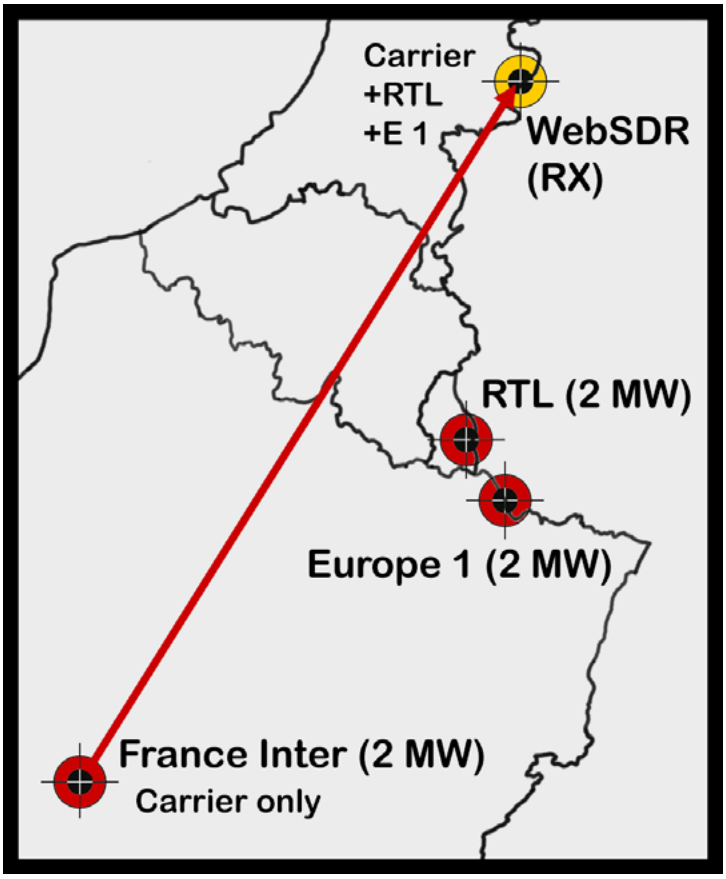
Given today's electricity and maintenance costs, maintaining such a huge signal is far from cheap. The problem, though, is that they have to. It's because the France Inter carrier is slightly phase-modulated to provide France's standard time reference. It synchronizes an estimated 200,000 devices, some at critical railroads and airports. All of these would have stopped working. Simply switching to Germany's DCF77 was not an option. Therefore, the transmitter and its authorization were shifted to several other government agencies, and the time service continued on as before.

The result, right now at least, is the world's most powerful time station. Its mighty ground wave covers about a 2000-mile radius. Even with the rubbery time sync of Internet radio, I can extract relatively accurate decodes of the signal over remote SDRs. Given that the effective frequency deviation is only about 6.37 Hz, that's pretty good. Along with time and date, you get the day of the week, and whether summer (daylight saving) time is in use.

**It Gets Better (Luxembourg Effect)**

Many radio geeks have heard of the Luxembourg Effect. It was discovered in 1933, when listeners in the Netherlands heard Radio Luxembourg, one of the original longwave flame-throwers, superimposed on a Swiss station. Something similar was observed in Gorky, Russia, where some powerful Moscow transmitters came out on several stations to the west. Many people consider this discovery to be the basis of active ionospheric research.

What we have here is a form of cross modulation, taking place in the air. It's especially audible in Europe, where




***Map showing station locations and Luxembourg Effect (Author)***

super-power AM stations are relatively close together on low frequencies. The resulting multiple audio programs make it sound as if more than one station is tuned in. Nothing's wrong with your radio, though. Something's wrong with the ionosphere. It's getting zapped by the huge RF fields of the other stations. These excite electrons the same way HAARP does, though not as much. The effect changes the ionosphere's conductance, and therefore its absorption of signals passing through. These changes follow the modulation on the signal. The resulting open-air amplitude modulator adds faint audio from the other stations.

Let's describe the effect heard on the U. of Twente WebSDR. Its location is fairly close to where the original Radio Luxembourg discovery was made. It's perfect. And so, here we go.

First, a transmitter in central France produces a steady carrier on 162 kHz. Minus audio, it's the perfect empty canvas for other stations to paint on. Since this is long wave, it travels in pretty much a straight line northward toward the Netherlands. It's not sky wave propagation, but the effect works just the same. Just off our straight line, to the east, we have good old Radio Luxembourg, in French, with two megawatts on 234 kHz. It's called RTL now, but it's the same people, and it's still a variable RF attenuator for passing signals. Slightly farther away, we have yet another super-power station, namely Europe 1, in French on 183 kHz. It's also getting in its two megawatts worth.

Finally, the 162 kHz carrier finishes its trip up from France, appearing on the Netherlands receiver. Now, though,

it has two relatively weak audio programs on it. RTL is loudest, and fairly intelligible, if bassy. Europe 1 is weaker, but quick A/B switches during distinctive music can identify it.

Obviously, the effect depends on the location of the receiver. One can verify this easily enough by trying other online radios. I checked another WebSDR, this one located in Peterborough, UK. Sure enough, it was different. At this location, the 162 kHz carrier has a very weak modulation from powerful BBC Radio 4 on 198 kHz. A second station's audio is even weaker underneath, but it's too low to identify. All this is fun stuff, and you might even be able to set your clock while you're at it.

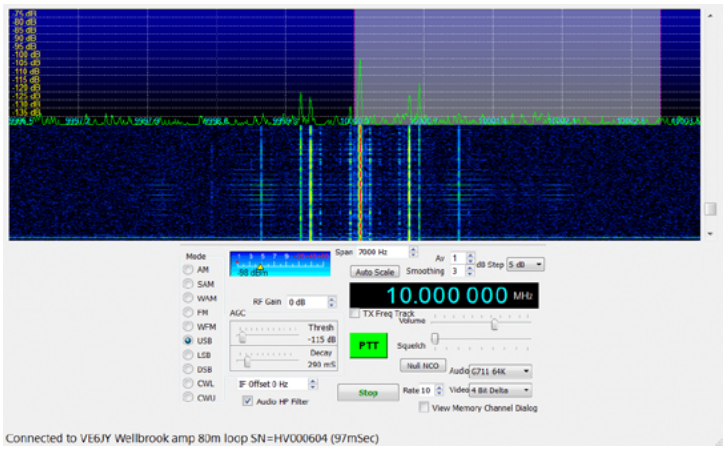
**WebSDRs**

We hear a lot about the University of Twente WebSDR in the Netherlands. This one is at a university engineering department's radio club, and the students are pretty sharp technically. It was the first to cover DC to just below 30 MHz, and ever since it always seems to have new features before anyone else. The usage is still up since the YouTube mention, and 300 users seems to be the new normal these days. It's rather remarkable that this many can be supported with no noticeable loss of quality. It's also interesting because, to hear some people moan about the state of the hobby, you wouldn't think there were 300 people left in the world who cared about this stuff. Obviously, they're wrong.

Thing is, though, that other web-connected software defined radios are popping up all over the planet. Some of these are pretty good. Those seeking general coverage will want to check out the gateway at sdr.hu. It currently lists 102 receivers. Most of these do cover DC to 30 MHz, using the KiwiSDR software. Most are in Western Europe, but other locations include Australia, New Zealand, U.S., Canada, Japan, and Russia. A few of these are sensitive and in nice quiet locations, and they get everything. The only limitation is that the software only allows four simultaneous connections. Therefore, sitting on a frequency for hours is not advised.

The WebSDR software pioneered at the U. of Twente is also in worldwide use. Its gateway is at www.websdr.org. Radios are registered automatically, and the number varies. Right now it seems to be oscillating between 153 and 155. The majority of these cover HF amateur bands and a few narrow ranges on either side of these. Others have more exotic frequencies and equipment for various ham radio specialties.

Some of these radios are pretty spectacular. A favorite here is the KFS WebSDR, using a majestic TCI 530 wire log periodic of the type that we drooled over last month. Best yet, it's in a nice quiet location, at nothing less than the old KFS/Globe Wireless receive site south of Half Moon Bay, California. It's ham bands only, but the receivers live up to the antenna, and the performance is the way HF used to be. As we mentioned earlier, the 60-meter amateur band is still shared with utilities, and the 30-meter receiver also covers adjacent broadcast and utility bands. I've notched a few nice




***Screen capture of WWVH on Australian remote SDR (Courtesy of the author)***

catches here.

Another WebSDR, which I have on right now, is in Greenland. It only covers 80 and 40 meters, but the location makes it all worth it. Not only is it quiet (aurora willing), but also everything is DX. JT65 is a real blast. In the past few minutes on 40 meters, I have logged (alphabetically): DL7VEE (Germany), EA8JT (Spain), F4CYH (France), IK-3PQG (Italy), PT2ZM (Brazil), R2ABM (Russia), JA3FQQ (Japan), and YV5FRD (Venezuela). Once again, we have HF the way it used to be.

The more geeky listeners might already know about direct-connect SDR clients. These run on your own computer. There are getting to be quite a few of these. My only experience with them has been using one called RemoteSDRclient. It connects to SDR-IQ and Cloud-IQ radios running that company's servers. I used it to hear several U.S. government exercises of the sort that always seem to come in better on the East Coast. It worked well enough to copy some tricky modes like MIL-STD-188-110A/B/C over the Internet. There's also a version for Android, which opens up all kinds of wild possibilities. I haven't tried it, though.

This sort of thing can keep utility hunting interesting in these times of low solar fluxes and frequent coronal holes. It's also a good way to zero in on elusive numbers stations or low-powered military. There will never be anything like grabbing your own vibrations straight from the ether, but sometimes this comes close. Happy grabbing until next month.

**Resources:**

ARRL Letter item regarding FEMA exercises: **http://www.arrl.org/arrlletter?issue=2017-01-05#toc01**

SHARES site on DHS.gov: **https://www.dhs.gov/shares**

Technical details of French TDF time signals: **https://en.wikipedia.org/wiki/TDF_time_signal**

Links to many amateur band plans: **http://hflink.com/band-plans**

**TSM**

# Shortwave Utility Logs

## Recent Shortwave Utility Logs Compiled by Mike Chace-Ortiz

| Freq (kHz) | Callsign | UTC | User, Location | System Details |
|---|---|---|---|---|
| 2321.20 | ??? | 0323 | NATO MIL, ??? | 600bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 2415.20 | ??? | 0323 | NATO MIL, ??? | 600bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 2789.00 | FUE | 0400 | French Navy, Brest | 600bps/L STANAG4285 HF modem, “all de fue” marker in 5N1 mode (on USB) |
| 4098.50 | ??? | 0020 | Russian MIL, ??? | AT3004D 12 tone HF modem, tfc (on USB) |
| 5056.00 | ??? | 2030 | NATO MIL, ??? | Link-11 CLEW, tfc (on USB) |
| 5160.20 | PBC | 0020 | Dutch Navy, Goeree Island | 600bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 5427.70 | JWT | 2208 | Norwegian Navy, Stavanger | 600bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 5512.00 | 4XZ | 0033 | Israeli Navy, Haifa | Hybrid FSK/2400bd PSK HF modem, tfc (on USB) |
| 5656.00 | 1718*** | 0320 | "India Mike" Net, Africa | 100bd/170 CCIR493-4 Selcall, calls “1716”, “1703”, “1707” (at +1780Hz on USB) |
| 5755.00 | VMW | 1238 | Australian Met Service, Wiluna | 120lpm/576/800 Fax, weak |
| 6243.00 | ??? | 0300 | NATO MIL, ??? | Link-11 CLEW, tfc (on USB) |
| 6342.00 | RDL | 2250 | Russian Navy, Moscow | 50bd/250 BEE, tfc |
| 6423.20 | CFH | 0100 | Canadian Navy, Halifax | 300bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 8338.00 | ??? | 0330 | Russian MIL, ??? | 75bd/200 FSK UNID System, sync, cont, ACF=0 |
| 8965.00 | OFFNPR*** | 0256 | US Air Force NIPRNET, Offutt AFB | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 8965.00 | JNRNPR*** | 0900 | US Air Force NIPRNET, Salinas PR | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 9830.00 | NAU | 1126 | US Navy, Isabela PR | 50bd/850 FSK UNID System, sync, cont, ACF=0 |
| 9940.50 | EAD*** | 1400 | US Army MARS, ??? | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 9940.50 | CCM*** | 1400 | US Army MARS, ??? | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 10247.00 | ??? | 1245 | Russian MIL, ??? | 75bd/250 FSK UNID System, sync, cont, ACF=0 |
| 10438.20 | ??? | 0100 | UK MIL DHFCS, Crimond | 1200bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 11015.00 | ??? | 1242 | UK MIL DHFCS, Crimond | 1200bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 11039.00 | DDH9 | 1240 | Deutscher Wetter Dienst, Pinneberg | 50bd/400 Baudot, "ryryry... cq cq cq de ddh47 ddh8 ddh9" |
| 11086.50 | GYA | 1300 | Royal Navy, Northwood | 120lpm/800/576 Fax, schedule |
| 12546.00 | MCE*** | 1900 | ???, ??? | 125bd/1750 MIL-188-141A, ALE LQA with "MCC" (on LSB) |
| 12546.00 | MCF*** | 1900 | ???, ??? | 125bd/1750 MIL-188-141A, ALE LQA with "MCD" (on LSB) |
| 12546.00 | MCA*** | 1900 | ???, ??? | 125bd/1750 MIL-188-141A, ALE LQA with “MCB”, “MCC”, “MCE” (on LSB) |
| 12577.20 | WLO | 2130 | ShipCom, Mobile AL | 100bd/170/E SITOR-B, sea condx |
| 12590.00 | RDL | 1255 | Russian Navy, Moscow | 50bd/200 BEE, tfc with sync=[0x1eb41eb2952] |
| 13174.50 | KKL23 | 2000 | Global Link, Vashon WA | 100bd/200 PacTOR, channel free marker w/ CWID “cq de kkl” |
| 14404.00 | ??? | 1343 | Russian Navy, ??? | 50bd/250 BEE, short messages |
| 15120.00 | ??? | 1521 | North Korean Embassy, West Africa | 600bd/600 FSK UNID ARQ System, tfc (on LSB) |
| 16106.20 | MKD | 1229 | UK MIL DHFCS, Akrotiri | 1200bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 16113.00 | ??? | 1440 | ???, ??? | BPSK63, tfc no decode |
| 16123.00 | NAU | 1135 | US Navy, Isabela PR | 50bd/850 FSK UNID System, sync, cont, ACF=0 |
| 16222.00 | 99902*** | 1240 | Egyptian MFA, Cairo | 80bd Codan Chirp, calling Embassy UNID Embassy "22201" (on USB) |
| 16250.00 | SEK*** | 1550 | Ghanaian Navy, HQ Sekondi | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 16250.00 | TEM*** | 1550 | Ghanaian Navy, HQ Tema | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 16250.00 | NHQ*** | 1550 | Ghanaian Navy, HQ Accra | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 16250.00 | 9GT3*** | 1550 | Ghanaian Navy, UNID Vessel | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 16321.00 | XSS*** | 1458 | UK MIL TASCOM NCS, Forest Moor | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 16830.50 | SVO | 1319 | Olympia Radio, Greece | 100bd/170/I SITOR-B, sports news in GG in SBRS mode |
| 16951.50 | 6WW | 1319 | French Navy, Dakar | 600bps/L STANAG4285 HF modem, “faaa de 6ww 6ww 6ww” in ITA2 mode (on USB) |
| 16966.00 | FUB | 1627 | French Navy, Saissac | 600bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 17016.80 | KPH | 2106 | Global HF Net, Bolinas CA | CW, “VVV VVV VVV CQ DE KPH KPH KPH QSX 500 4/6/8/1UA/16/22 OBS?…” |
| 17063.40 | FUG | 1131 | French Navy, La Regine (Saissac) | 1200bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 17121.00 | FUO | 1300 | French Navy, Toulon | 1200bps/L STANAG4285 HF modem, crypto tfc (on USB) |
| 17146.40 | NMG | 1830 | US Coast Guard, New Orleans | 120lpm/576/800 Fax, WX pix |
| 17151.20 | NMC | 1933 | US Coast Guard, Point Reyes CA | 120lpm/576/800 Fax, WX pix |
| 17180.00 | FUG17 | 1350 | French Navy, La Regine | 600bps/L STANAG4285 HF modem, “de fug17 fug17 fug17" marker in ITA2 mode (on USB) |
| 17362.00 | WLO | 2100 | ShipCom, Mobile AL | USB, YL/EE synthesized voice with weather outlook |
| 17416.70 | SSE | 1402 | Egyptian MFA, Cairo | 100bd/170/E SITOR-A, signing off with Dar Es Salaam after Codan tfc, wkg Havana |
| 17501.00 | NHQ*** | 1622 | Ghanaian Navy, HQ Accra | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 17501.00 | 9GT3*** | 1650 | Ghanaian Navy, UNID Vessel | 125bd/1750 MIL-188-141A, ALE LQA with “9GQH” (on USB) |
| 17501.00 | 9GT2*** | 1622 | Ghanaian Navy, UNID Vessel | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 18224.00 | RAPTOR*** | 1322 | US Army, Kosovo | 125bd/1750 MIL-188-141A, ALE sounding (on USB) |
| 18360.00 | ??? | 1450 | Algerian MIL, ??? | Thales Systeme 3000 HF modem, ALE bursts (on USB) |
| 18606.70 | ??? | 1324 | Egyptian Diplo, ??? | 100bd/170/I SITOR-A, signing off |
| 18650.00 | ??? | 1508 | North Korean Embassy, ??? | 600bd/600 UNID FSK ARQ System, tfc (on LSB) |
| 18764.00 | RIT | 1412 | Russian Navy, Severomorsk | 50bd/200 BEE, tfc with sync=[0x1eb41eb2952], [0x1414bebe64c] & [0x1414bebe952] |
| 18875.00 | XSS*** | 1253 | UK MIL TASCOMM, Forest Moor | 125bd/1750 MIL-188-141, ALE sounding (on USB) |
| 19100.00 | ZUG*** | 1600 | UNID Swiss Net, Zug | 125bd/1750 MIL-188-141A, ALE LQA with “HORBEN”, “MANPACK3” (on USB) |
| 19100.00 | CAMP*** | 1700 | UNID Swiss Net, ??? | 125bd/1750 MIL-188-141A, ALE LQA with “HORBEN” (on USB) |
| 20536.00 | RCV | 1400 | Russian Navy, Sevastopol | 50bd/200 BEE, idle on reversals, tfc on sync=[0x1eb41eb2952] |
| 20892.00 | ??? | 1943 | UK MIL, Ascension Island | 2400bd UNID 24QAM HF modem, idle (on USB) |

# Shortwave Utility Logs

## Recent Shortwave Utility Logs Compiled by Hugh Stegman

| Frequency | Callsign | User, Location | Time | System Details |
|---|---|---|---|---|
| 40.00 | JJY | Japanese NICT, Fukushima | 2213 | Successful decode of standard time signals, also on 60 kHz |
| 60.00 | MSF | UK NPL, Anthorn | 2303 | Successful decode of standard time signals |
| 66.67 | RBU | Russian IMVP, Moscow | 2258 | No decode on loud time signals |
| 77.50 | DCF77 | German PTB, Mainflingen | 2252 | Successful decode of time and other information |
| 147.30 | DDH47 | German weather office, Pinneberg | 0011 | RTTY (85/50), marine observations in German, then ID and RYs |
| 162.00 | Unid | French ITFAM, Allouis | 0000 | Successful decode of time signals remaining after France Inter closed |
| 198.00 | BBC Radio 4 | British Broadcasting Company, UK | 2319 | Successful decode of time signals on AM broadcast carrier |
| 310.50 | 652 | DGPS, Bachu Jiao, China | 0313 | MSK (200 baud), GPS corrections over transmitter #626 |
| 486.04 | IA | Serbian aero beacon, Indija | 2328 | CW (on-off keyed), long dash and ID |
| 518.00 | "V" | ICI, Sellia Marina Radio, Italy | 2322 | Sitor-B, Navtex warning VA90 for weapons exercise |
| 2255.00 | 3GI | U.S. Army MARS | 2337 | USB, net control, checks with 3AV, 3GY, 3QW and VA7 |
| 3275.00 | GA3 | U.S. Army MARS | 2357 | USB, voice and encrypted MIL-STD 188-110A with GA7 |
| 3315.00 | AFT3SH | USAF MARS Region 3 | 2327 | USB voice, rogering clear and encrypted MIL-STD 188-110A |
| 3347.00 | NCS042 | U.S. NCC | 0017 | USB, taking check-ins for SHARES Northeast net |
| 3622.50 | JMH | Japan Meteorological Agency | 2100 | FAX (120/576), noisy FSAS48 48-hr surface prognosis chart |
| 3831.00 | ZRUE | German Customs Boat *Ruegen* | 2224 | ALE, calling ZLST, Customs control in Cuxhaven |
| 4211.90 | UGC | St. Petersburg Radio, Russia | 0008 | CW, repeating marker "DE UGC" |
| 4235.00 | NMC | USCG, Pt. Reyes, CA | 0155 | FAX (120/576), clear Pacific satellite picture in progress |
| 4532.00 | RIS9 | Chinese Military (M89) | 2130 | CW, repeating "V M8JF M8JF M8JF DE RIS9 RIS9" |
| 4645.00 | Tallin Airport | Estonia Volmet | 1659 | USB, aviation weather in English |
| 4712.00 | Kazan Radio | Russian Aero Net | 1704 | USB, radio checks in Russian with Rostov, Penza, and Samara |
| 4724.00 | Handball | U.S. Military | 1714 | USB, with 30-character EAM beginning T5MHVK |
| 4755.00 | System | Russian Airport Net | 1711 | USB, female with test call in Russian |
| 5154.40 | "M" | Russian Navy, Magadan | 2159 | CW cluster beacon, repeating ID, also 8495.4 |
| 5165.00 | XS45 | Algerian Military | 2222 | ALE, calling PY50 and XS58, similar on 6854.5 |
| 5208.00 | MA1JOC | MA National Guard | 2302 | ALE, Joint Operations Center calling NM6JOC, New Mexico |
| 5233.50 | C8L | MO National Guard, Columbia | 1507 | ALE, calling H8N, Hannibal, MO |
| 5652.00 | FX0945 | FedEx freighter | 0118 | MD-11 reg N642FE, HFDL position for Riverhead, NY ( not heard) |
| 5706.50 | Unid | Mexican Navy, Rosarito | 0122 | USB, clear Spanish voice with Tadiran tones |
| 5800.00 | 575 BRAVO | TN National Guard | 1543 | USB, net control with 547B, 580A, 597A, others |
| 6250.00 | Unid | Japanese Navy | 2159 | PSK, "Slot Machine" idler and traffic, also 6417, 6445, 8588, and 8703.5 |
| 6676.00 | Sydney | Sydney Volmet, Australia | 2314 | USB, machine voice with Australian airport weather |
| 6685.00 | 76745 | Russian Air Force IL-76MD | 1413 | USB, calling Davlenie and Korsar in Russian |
| 6733.00 | TASCOMM | UK DHFCS | 1432 | USB, selcal check and enroute weather for C-17 Ascot 6428 |
| 6739.00 | Red Alder | USAF ground station | 2214 | USB, echoey EAM with circuit whine, again 2235 |
| 6757.00 | Dozor | Russian Air Force | 1329 | USB, calling 76413 (IL-76MD) in Russian |
| 6765.00 | Bangkok Meteo | Thailand weather broadcast | 2235 | USB, electronic musical tune, then weather in Thai |
| 6775.00 | JJT88 | Japanese Air Self-Defense Force, Tokyo | 2142 | CW net control, hand sent testing with "VVV VVV JJT88 SK" |
| 6793.00 | RIS9 | Chinese Military (M89) | 2130 | CW, repeating "V M8JF M8JF M8JF DE RIS9 RIS9" |
| 6885.00 | Korsar | Russian Air Force, Pskov | 1344 | USB, taking ops-normal from aircraft 82030, in Russian |
| 7535.00 | Lightning Strike | U.S. Navy vessel | 1514 | USB, testing clear and secure voice with SESEF NORFOLK |
| 8023.00 | WNG940 | VA Dept. of Health, Richmond | 1449 | ALE and voice with WNG911, U.S. Centers for Disease Control, GA |
| 8264.00 | V2DV8 | Container Ship *K-Storm* | 1544 | USB, position for WLO, ShipCom, Mobile, AL |
| 8414.50 | 566877000 | Singapore flag bulker *Sagar Kanta* | 2203 | DSC safety test with 006452700, Mauritius Radio (Indian Ocean) |
| 8424.00 | SVO | Olympia Radio, Greece | 2142 | Sitor-B, sports news and currency exchange rates, in Greek |
| 8927.00 | GA0654 | Garuda Indonesia flight | 2210 | B737 reg PK-GFV, HFDL position for Guam (not heard) |
| 10075.00 | XA0026 | Comlux Malta A319 (9H-AVK) | 2119 | HFDL ACARS for Al Muharraq ground station, Bahrain (heard) |
| 10175.00 | 315013 | Turkish Civil Defense | 2251 | ALE sounding, then same from 306013, 371018, and 360018 |
| 11170.00 | 674 | Unknown (E17z) | 0800 | USB, English callup "208 5," and msg end 00000, again 0810 on 9820 |
| 11175.00 | Doom 21 | USAF B-52H | 1655 | USB, flight with Doom 22, calling Red River (probably Barksdale AFB) |
| 11180.00 | LBJ | Norwegian Joint HQ, Bodø | 1306 | USB, working air transport Norwegian 335A, enroute from Turkey |
| 11354.00 | 17004 | Russian Naval Air Transport | 1220 | USB, calling Priboj (Central Sector, Moscow) |
| 12186.00 | Unid | Russian Government (M42d) | 1330 | RTTY (200/1000), Message #062 on Link 49237, again 1350 on 8175 |
| 13468.00 | 842 | Russian Intelligence (S06) | 0930 | USB, Russian callup "842 139 48," and message ending 00000 |
| 14396.50 | KLM529 | U.S. Dept. of Veterans Affairs, NM | 1620 | USB, checking into SHARES Administrative net |
| 15867.00 | TSC | U.S. CBP Technical Service Center, FL | 1530 | ALE, FL, calling NMH (USCG TISCOM, VA) |
| 15967.00 | Unid | Russian Intelligence (XPA2) | 1400 | Polytone (MFSK-16/20), 5F message, again 1420/13384, 1440/12217 |
| 16167.00 | Unid | Russian Intelligence (XPA2) | 1400 | Polytone (MFSK-16/20), 5F message, again 1420/14663, 1440/13923 |
| 19313.00 | Unid | Russian Government (M42d) | 1000 | Null message on Link 49202 |
| 20562.00 | Unid | Russian Government (M42c) | 1300 | RTTY (200/500), null message, again 1310 on 18194 and 1320 on 17107 |

# Digitally Speaking

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# Looking Out Over the Horizon

All good things must come to an end and with the coming of the new year, it appeared as though Yaesu's significantly discounted and popular DR-1X repeater pricing had been terminated. As you might imagine, this quickly resulted in "procrastinator's remorse," expressed on the many email reflectors and social media groups. Thankfully, Yaesu did renew the program after a two-week recess; at least until the end of the quarter. Lesson learned, one would hope that if you want to take advantage of such discounts, then there's no time like the present.

The most current application can be downloaded from Yaesu's web site at **http://yaesu.com/pdf/DR1-X_Installation_Program_Final.pdf** and filled in accordingly.

In my neck of the woods, System Fusion continues to grow at a steady pace. I moved back to a more rural area, within the Laurel Highlands and Appalachian Mountains. As I wrote recently about the advantages of using VHF repeaters for DV (Digital Voice) operations, a nice hilltop can give a repeater a generous footprint. The 145.370 MHz System Fusion repeater, high above Parsons, West Virginia, is such an example. The repeater is slightly less than 60 miles from me. When using it with analog FM, it takes about 50 watts for me to be heard "full quieting." When using DV, I'm "solid copy" with just 5 watts. Even though I have a good understanding of why, it still impresses me as to just how well DV works.

I'm looking forward to the same sort of experience when a new System Fusion repeater in Frostburg, Maryland, gets to its final location, which will be well up a 300 foot tower on a mountaintop at 2,900 foot HASL (Height Above Sea Level). As it will be a "mere" 44 miles away, I hope to regularly connect with some of the hams I've already met from the Allegany County (Maryland) area.

I also have the luxury of heading into the nearby hills myself. Within a half hour's drive, I can find myself sitting 2,600-2,700 feet above sea level in the comfort of my car. With a short hike, I can be overlooking eight counties and three states. In decades gone by, I would head up with a 12-channel, 2-watt portable and Hustler 5 db gain antenna. Eventually, the radio was upgraded to a 10-watt mobile—a common power level for the time.

From such vantage points, it was amazing just how many repeaters I could work. Even more, it was impressive to discover how far I could go with low power on one of the simplex frequencies. The better radio I had – an Icom IC-22S

***Is a sixth DV methodology on the horizon? Motorola and others are producing TETRA products, with lower pricing that may eventually appear on a ham band near you. (Courtesy: Motorola Solutions)***

– offered a very sensitive and clean receiver. I continued to use it for several decades, until tone squelch became a necessity and I thought it would be better to buy a newer radio, to use as my daily mobile workhorse.

Today, it's still fun to spend a few hours seeing just how far I can get with a handful of watts–digitally. There are lots of System Fusion repeaters in the area, plus a few D-STAR machines, along with one DMR and another P25. But the real challenge is to see how much simplex activity I can scare up.

As you might guess, most of that DV activity nearby is System Fusion. I do make a number of D-STAR contacts as well, plus I'm still game for some fun with good ol' analog FM.

There are several clubs across North America that sponsor FM simplex contests throughout the year. These are good opportunities for Technician class licensees to get a taste of contesting – with the equipment they already have. Operation from home or portable at a high point is encouraged. Sometimes, a tropo opening happens on those same weekends and participants find themselves jockeying to get in some DX contacts.

I've been thinking that with the substantial increase in DV activity, it may be time to encourage some DV VHF contests. I've proposed the idea before, with some positive results. It doesn't take much for a club to sponsor such a thing. A nice certificate and some advance notice through area sec-

tion web sites and social media groups would be good places to start. Allow enough time for area net announcements, too. Also, be sure to have details on the sponsoring club's web site and social media page. If you think that's something your radio club would like to sponsor – as something of a DV leadership role – then suggest it at your next meeting.

By the way, it wouldn't have to be something that spans the entire weekend. Chances are that a six-hour contest would be enough time. While all System Fusion gear covers VHF, DMR, D-STAR, etc., bands should be chosen on whatever is most popular, repeater-wise, thus allowing everyone to use the equipment they already have. As we head into spring and summer, I'd like to see such activities become a reality. Until then, I may just be high up on a mountaintop, all by myself.

On to an indoor activity, a DMR Workshop was recently held in Cuyahoga County (Ohio) to help those interested in this methodology better understand their radios, network topology and, most importantly, how to build and modify a code plug. As DMR radios (like their NXDN and P25 brethren) need to be programmed in advance with a computer, one of the elements of this particular learning curve is how properly set up a transceiver.

All too often, we see requests such as, "Anyone have a code plug for a _____ in the _____ area?" This is essentially the call of the "appliance operator" who doesn't want to create his or her own or, alternately, one who does want to, but doesn't know how. Workshops such as this solve the latter problem and help fellow hams to better understand what DV radio has to offer.

In this case, Ohio Section Emergency Coordinator Mathew Nickoson KC8NZJ, organized the event and had a little over 40 participants. Generalized information was presented and then individual breakout sessions helped owners of Connect Systems, Motorola and TYT radios; representing the most popular models in that area.

This is an excellent idea to help promote DV, no matter what methodology you are focused on. In addition, you could organize small sessions to introduce the concepts of DV radio and answer some common questions—a big help for "newbies." At my local Eat'n Park restaurant, there's a back room that is semi-isolated and can be used for more private breakfast/lunch/dinner sessions.

The nearby Dairy Queen has a private "party room" with flat-screen TV (suitable for PowerPoint presentations) that can easily seat twenty or so attendees. I think people bond better over food, so a "DV at the DQ" get together once a month or so is attractive and easy to arrange (plus, you can get a tasty dessert!). Opportunities can go a long way toward encouraging the growth of DV in your backyard. It can also go a long way toward growing your club, as it's just one more set of opportunities for non-hams to attend and learn something about what's going on in the amateur radio community today, plus make some new friends.

As a long time PIC (Public Information Coordinator) please allow me to point out the importance of advertising

***Mathew Nickoson KC8NZJ, Cuyahoga (Ohio) County Emergency Coordinator organized a workshop to introduce DMR concepts and teach attendees how to create their own code plugs for popular radios. This is a much better way to understand what's "under the hood," than just getting a code plug from someone else. (Courtesy: Mathew Nickoson KC8NZJ)***

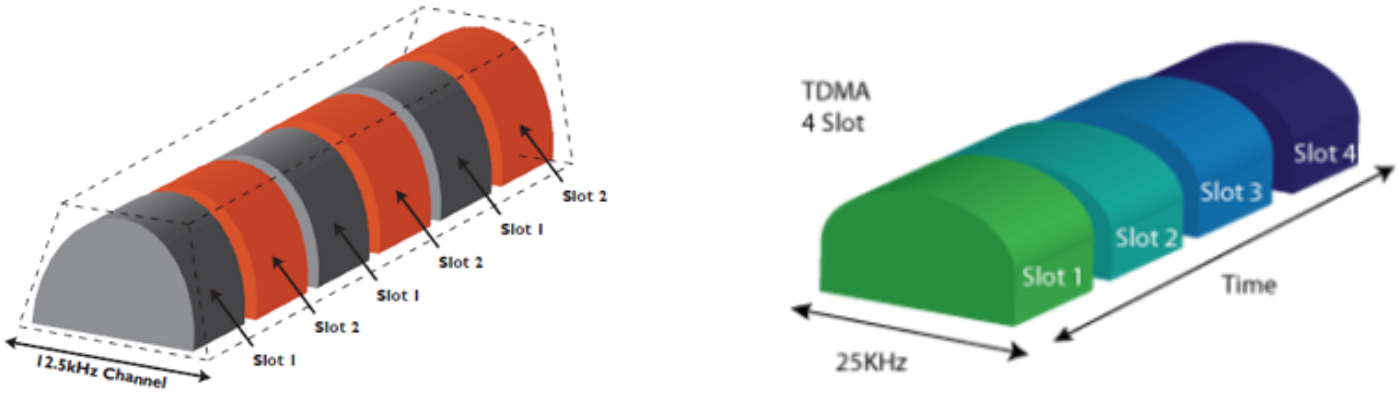
workshops and other events. If you don't let others know you are doing these things, then don't expect much of a turnout. Here again, announcements made through nets, area club newsletters, cable "bulletin board" channels and local radio station "community calendar" are just a few of the places you want to use to get the word out.

Also, employ some sort of RSVP, so you'll know how many attendees to expect. If you get a larger response than your chosen venue can hold, you'll know that you should quickly schedule additional workshops. It's better to handle such things up front, rather than have to turn away people after they've driven a distance with anticipation. Always show respect for your attendees—a lesson I wish some hamfest organizers would learn.

Additionally, get the names, callsigns and email addresses of attendees for follow up and to answer questions you may not have been able to have adequately answered during the workshop. It is far better to keep things moving along, especially if you only have your venue for a limited time. A basic answer is usually best for the overall crowd, with more detailed follow up for specific people, or a good topic to cover at an upcoming workshop. Even within a particular methodology, there are basic, intermediate and advanced topics.

Try to stay focused and keep the information you are imparting in easy to digest "bites." Your audience will walk away with more retained information, than if you try to make them "drink from a fire hose" by covering too much.

Finally, please include some "hands on" opportunities at your workshops. Hearing about a topic is one thing. Getting to actually make use of it is another. One of the most compelling aspects of DV radio is the clarity of the audio. Don't just talk about it. Let everyone experience it, even




***While DMR manages to the fit the equivalence of two 6.25 kHz assignments into 12.5 kHz, in order to comply with narrowbanding requirements, TETRA takes the TDMA concept further, by doubling the number of slots into 25 kHz—the same as used by just one analog FM channel. (Courtesy: Tait Communications)***

if it's just a matter of stepping out of the room and making simplex contacts. It's the "sizzle" that needs to go with your "steak."

If you can arrange for a solid (and I mean solid) network connection that allows attendees to experience the long distance power of DV radio, that would be a good thing to add. If your network connection is in any way a bit "wonky," then skip it. I know of many situations where presenters didn't check out conditions in advance or inadequately prepared, when it came to setting up a network node. People walked away unimpressed; a lasting impression that could have easily been avoided.

Everyone has a budget, when it comes to getting some additional piece of equipment or station accessory. Some are able to get the top of the line model, as their entrée into DV – while others are more comfortable with basic models. In many cases, it makes more sense to get a portable first and then move onto a mobile or more featured option. When I've tried out a new band or methodology, I've typically opted for a portable. (This is a subject I've covered more extensively, in past issues)

That's been the method for most, but sometimes there are exceptions. In the world of System Fusion, the dual band FT1 currently has a street price of about $300. If most of the repeaters in your area are VHF, then perhaps the FTM-3200 makes more sense, with a current street price of half of that might make more sense to your budget.

With a bit of creativity, you can use the FTM-3200 (or just about any other mobile, for that matter) as a portable. It's just a bigger portable. My Drake TR-22C wasn't exactly a hand-held radio, but it could be slung over your side and worked nicely on batteries. It can be operated at the 5-watt level, with a relatively small battery pack and antenna—all packaged in something like a camera case. Plus, such a compactly enclosed arrangement can be readily placed in a car and removed, should you wish to take it with you.

One other option would be to use a popular plastic ammo can as a carry around enclosure. Years ago, Motorola offered portables like this, some of which made use of tube finals, in a configuration that was mostly battery pack. Here again, this sort of hard case can be quickly secured in a vehicle to extend its usability and versatility.

Cost, along with the popularity of UHF vs. VHF repeaters, is part of what encouraged Icom to market the ID-31A single-band portable. With the "near repeater" feature, it soon became a popular option for those wanting to get involved with D-STAR for a lower cost. I somehow ended up with three of these. One was purchased new, while the other two were acquired as previously owned at substantially discounted prices. I subsequently sold one of them and used the money to help fund a new ID-51 50th Anniversary model—in teal blue.

Used equipment is always an option and an especially good one, if you know the owner and/or can see that the radio was taken care of nicely. My P25 portables are used Motorola Astro Sabers; one for VHF and one for UHF. I got them from a used radio dealer and they came with drop-in chargers, new batteries and new antennas. They were $150 each and included programming. As there were only a few repeater and simplex frequencies I needed for each, this was an excellent deal. Even though they were manufactured over 15 years ago, the units I have look almost new and work well.

The XTS series is newer and has some additional features, with less weight, but there's just "something" I like better about the Astro Sabers. Maybe it has to do with my first portables—a Wilson 1402SM, Motorola HT200 and Standard SR-C146A—being about as big. (Interestingly, the Standard was originally advertised as the "smallest hand-held available" for the amateur radio market, at the time) Of course, if someone were to give me a (comparatively small) Vertex-Standard VX-P829, I wouldn't say "no."

DMR enthusiasts can choose a new Motorola XPR-series portable or TYT MD-380. The latter is substantially less, with street prices for the UHF version as low as $95. As it includes the programming cable and there is a good amount of crowd support, it really is a good value for those wanting to get their feet wet.

Used gear can become available whenever someone wants to upgrade to a newer, more featured model or decides it's time to "thin the herd." If you are thinking about getting a portable, ask about battery age and condition. Even if you


***The BridgeCom Systems BCR-220 FM Repeater is built for amateur ham radio. It operates in 222-225 MHz 1.25m range of the RF spectrum. The BCR Repeater is a feature rich repeater/base station packed with loads of RF power and dual fans to run cool in the harshest environments. It is an excellent choice if you're considering a 220 repeater for your club or personal use. It is also an excellent choice for A.R.E.S./R.A.C.E.S. operation, and emergency management. Get on the 1.25m band today with a built in the USA BCR-220 repeater. (Caption and graphic courtesy: Bridgecom Systems)***

are told it's taking a full charge, budget for a new or spare one. Also, look at the antenna. If it looks good and the radio isn't covered in scratches, then chances are good that it was well taken care of.

In sharp contrast to older gear, a new development was announced recently. The first known D-STAR repeater on the 222 MHz band is officially on the air. Comprised of a Bridgecom BCR-220 repeater system and NW Digital Radio UDRC controller, it operates on 224.56 MHz and is located in Edmonds, Washington.

The UDRC (which I've praised a number of times) is the same board that has allowed so many to add D-STAR to their DR-1X System Fusion machine. With the availability of Kenwood's TH-D74 tri-band D-STAR portable, (and anticipated mobile, later this year) I'm sure this repeater will soon be joined by others, bringing DV to an underused band.

On the horizon in North America, is another TDMA methodology—TETRA. Whereas DMR gives us two slots for communications within 12.5 kHz, TETRA (TErrestrial Trunked RAdio) offers four, fitting within 25 kHz – the same as a single analog FM signal. While TETRA gear has been considered generally expensive and well beyond the typical amateur budget, prices have been steadily falling.

As with DMR, TETRA comes to us from Europe, as an ETSI (European Telecommunications Standards Institute) standard. While there are just under two dozen TETRA repeaters in use by hams on the European continent, this is not something we've seen in North America. That could soon change, as some hardy experimenters decide to give it a try.

Portables such as the Motorola MTP3250 are now available in a frequency range that is usable by hams, with some caveats that I'll explain in a moment. I've seen them offered in the $300-$500 range, which is "reasonable" for what it is. Exciter and control modules for repeaters are being regularly offered in a similar frequency range, for under $1,000. The output power is well under one watt, so some amplification will be needed.

The real "gotcha" at the moment is the frequency range—the very low end of our 70 cm allocation, around 420 MHz. While some of the repeater foundations I've seen can be "tweaked" upward a bit, this would not be good news to ATV (Amateur Television) and weak-signal enthusiasts. However, it is "possible."

Even without repeaters, some radios (which easily go up to 430 MHz) can be used as a sort of "bridge" to connect one radio to another, when they can't directly connect to each other. This is an interesting feature, akin somewhat to a digipeater's function in a packet radio environment.

If the more "hardcore" DMR enthusiasts think about what four slots would mean to a busy repeater in their areas, they'll soon find TETRA to be additionally attractive. With some additional software work, it would be possible to link TETRA and DMR networks together, while staying entirely in the digital domain. Upgrades to the MMDVM (Multi-Mode Digital Voice Module) could allow TETRA on existing homebrew repeaters and again, fit this higher efficiency within 25 kHz channel centers. With some adaptations to the Brandmeister network, this new methodology could be integrated into the existing DMR infrastructure with minimal disturbances. After I see what's new at the Hamvention this year, I'll pen a column on TETRA, with some more clearly defined ideas of what may be coming.

As I often say, the world of DV continues to grow and expand. Things like TETRA in North America may be some time away, but at least I've given you something to think about and some vision of our DV future.

TSM

# VHF and Above

**By Joe Lynch N6CL** **VHFandabove@gmail.com**

## The Find

Rex Nishimura KK6VXY, his wife Chuie-Wei Yuen KK6YVO, and their 13-year old son, Jared Nishimura KK6YAY, are relatively new amateur radio operators who live in the North Edwards area of California. One of the things they like to do together is go hiking and camping near the Courtright Reservoir in the Sierra National Forest.

They made one of their trips over the Memorial Day Weekend last year. Ironically, it was a trip they had not planned on making. Originally, they were going to meet some friends at Lake Isabella, which is over five hours away. Their friends got sick and the fishing forecast was not good.

Their plan was to fish at the lake formed by the reservoir. It was a simple plan, not requiring much equipment. Nevertheless, they packed copies of the topography maps, their GPS, a signaling whistle and their handheld ham radio equipment.

Fishing on the lake was cut short by thunderstorms. The family thought of packing up and heading back. However, it was late in the evening so they decided to spend the night.

Around 9:30 a man suddenly appeared at their campsite, very distraught. He told them that he was looking for his fiancée and their dog—both had been missing for about five hours. Rex advised the man that he would watch for her.

Then, Rex started to analyze the situation: They were two hours away from a sheriff's station and a search and rescue team could not begin to look for her until morning. It was getting later and colder. If the woman was hurt, he and his family, oddly over equipped for their trip, might be her best option for a rescue.

Chuie and Rex assembled a rescue kit, consisting of an extra jacket, compasses, the whistle, matches, flashlights, the GPS, and their ham radios. With their kit assembled, Rex and son Jared set out to find the missing woman and her dog, leaving Chuie behind with her ham radio.

After walking across the dam, Rex and Jared arrived at the stranger's campsite. He told them the direction that her fiancée had been headed. Rex and Jared set out in that direction. Even though they were in the dark and only had their flashlights for illumination, Rex felt they were going in the right direction.

Suddenly, Jared exclaimed, "I hear something!" They stopped and Rex heard it also, a woman's voice faintly crying for help. Rex determined their position and then radioed Chuie. He gave her their position and advised her that they thought they had heard the woman's voice. Chuie radioed back that a sheriff's deputy had arrived at their original campsite.

Walking further, Rex started blowing his whistle. The woman replied. For another 30 minutes of walking in the dark, Rex and the woman carried on their improvised communication. Finally, Rex and Jared spotted the woman and her dog in the distance.

Coming up to her, he asked her if she was Lynn and she said yes and started crying.

Surmising the situation, he found her to be dehydrated, nearly hypothermic and confused. They were only a mile from Lynn's campsite. However, it was all uphill.

When Rex was able to do so, he radioed Chuie to tell her that they had found Lynn and her dog and were headed back to their campsite. Arriving at 3 a.m., Lynn and her fiancé were reunited with an extended hug.

Rex reflecting on the whole ordeal, thought about how their being at the Courtright Reservoir was their second choice of a Memorial Day weekend trip. Then, he thought about all the gear he decided to take, which seemed at the time excess for this trip. Additionally, he thought about the role that amateur radio played in communicating their whereabouts with his wife.

Finally, he reflected on what Lynn's fiancé said to him after her safe return to him, "You and your boy were sent from heaven."

This story is from Rex's account in his article "The Search" which appears in the December/January 2017 issue of the magazine *Mysterious Ways: More than Coincidence*. The magazine is a spin-off of the very popular *Guideposts* magazine and contains several other inspiring stories of seemingly coincidental circumstances that have positive and uplifting endings.

Rex's mention of how amateur radio played such as significant part in his story caught my attention. I researched their names on QRZ.com and located their call signs. I am sure you agree with me that it is a great story that again documents the innate altruism that is so much a part of so many of us in our hobby.

**Ulrich Rohde N1UL, Recognized for his Pioneer work in Software Defined Radio Communications**

One of IEEE's Fathers of Radio Science, Ulrich Rohde

N1UL, recently was honored for his pioneer work on software defined radio (SDR) communications by inviting him to present a history of SDR during a joint session of the IEEE MTT, AT and EMC Societies in Hyderabad, India. His talk was titled "Next Generation Networks: Software Defined Radio—Emerging Trends." A slideshow of his talk is available here: **goo.gl/LFz4jH**.

According to Wikipedia's website list of commercially available SDR radios (**https://en.wikipedia.org/wiki/List_of_software-defined_radios**), currently, there are over 100 radios for sale, ranging from a price of around $25 to more than $6000. One of the more recent entries is the LimeSDR, which began shipping late last month and will continue to ship throughout this month. Lime Micro CEO Ebrahim Bushehri, has promised on numerous occasions to keep the LimeSDR radio in the open-source arena. In short, the LimeSDR will become a reasonably affordable tool for developers worldwide. I am looking forward to receiving mine so that I can work on weak signal UHF and above transceivers.

**The Ultimate Raspberry Pi Project**

Paul McWhorter KF5ZBY and Chase Mertz KG5KKX, host a fascinating video (here: **http://www.toptechboy.com/2017/01**) as an introduction to their ultimate Raspberry Pi project in which they launch a balloon early this month. Identified as Eagle VI, the payload is expected to attain an altitude of around 110,000 feet. The package will contain two Arduino micro-controllers, a pressure sensor, a 9-axis inertial measurement system, a temperature sensor, and a Raspberry Pi microcontroller that manages the data communications.

The package will send data back to earth, including live video over amateur radio. The telemetry will incorporate an innovative technique they have labeled as Ethernet over Ham Radio. They will use the 2.39 GHz ham band, which is just below the commercial Wi-Fi frequencies.

McWhorter is a high school teacher at Eldorado High School, in Eldorado, Texas. Mertz is a high school student in the high school's Eldorado Space program. Her cover-featured article appears in this month's *QST*, beginning on page 76.

McWhorter states that he got into amateur radio because of his teaching engineering at Eldorado High School. He encouraged his students to design and build electronic instrument payloads that were launched using high altitude balloons. To date his students have had five successful launches, beginning in July 2013. This video (**https://www.youtube.com/watch?v=x6xjpAM5bFw**) shows the launch of the second flight on May 9, 2014. This video (**https://www.youtube.com/watch?v=thlqMWysmMM**) shows approximately six minutes of the flight, just before the balloon burst. Finally, this video (**https://www.youtube.com/watch?v=1ZiqtU6SorE**) shows the landing. You might get a bit dizzy watching it and might be startled as it crash-lands.

Mertz expects to graduate this spring and then attend the University of Texas at Austin in the fall. Along with being a licensed amateur radio operator, she also is a skydiver and an accomplished rodeo competitor.

**MFJ Partners with InnovAntennas and G0KSC**

MFJ Enterprises has signed an agreement with InnovAntennas and Justin Johnson G0KSC to increase the U.S. availability of its products. MFJ previously acquired Cushcraft and Hy-Gain, two legacy brands. MFJ will build some of the smaller antennas (read VHF and above) at its Starkville, Mississippi, facility.

Several years ago, I toured the facilities and was impressed with the amount of effort and money that Martin Jue K5FLU, has invested into maintaining and enhancing these icon brands. No doubt Johnson will have the same experience with his antennas.

**WSPR-X: The New Voice in VLF Weak Signal Communications**

For the better part of two decades Joe Taylor K1JT, has been developing and revising software designed to enhance weak signal communication. Included in his bundle of programs are JT65 and WSJT, popular on the VHF and above frequencies.

Addressing the HF weak signal requirements, he designed WSPR, which, as he states on his website (**http://physics.princeton.edu/pulsar/K1JT/wspr.html**) "implements a protocol designed for probing potential propagation paths with low-power transmissions."

An outgrowth of his revising is WSPR-X, which is designed for use on the VLF frequencies of 137 and 472 kHz, and possibly 160 meters. I mention this here because a significant number of VHF and above enthusiasts also explore weak signal communications on HF and 160 meters. Some of these WSPR efforts have reached back onto VHF, particularly 6 and 2 meters. This (**https://www.facebook.com/groups/361822510505153/?fref=nf**) Facebook page is devoted to reporting on 6-meter WSPR activity.

# Amateur Radio Insights

**By Kirk Kleinschmidt NT0Z** **nt0z@stealthamateur.com**

# Big Sammy's Bulging Caps and the Fickle Flicker of Hope

Just before the start of this year's RTTY Roundup, my shack PC's screen began flickering wildly—if it stayed illuminated at all. I could get the monitor to stay on for a while by repeatedly switching it on and off (six to 12 times in a row), but the fix only lasted a few minutes.

I could have swapped the Big Flickerer—a large Samsung wide-screen I'll call Big Sammy 1—with one of several smaller Hail Mary screens that live in the storage room for just such an occasion, but I had been looking forward to working the RTTY contest with a big monitor. After all, between the logging software, the RTTY software, and whatever other software turned out to be necessary, a big screen (or two) helps a lot. Unless you're running a regen paired with a one-tube transmitter (which is just fine), don't tell me you don't have several PC monitors in or near your shack!

This particular monitor was a "really good deal" on craigslist. Perhaps the flickering issue had something to do with it? I had used the monitor on and off for a few weeks without noticing any funny business, but with monitors, one never knows!

When it comes to LCD monitors and TVs, there are several common failure modes that plague the industry. This is bad for consumers, but good for DIYers who have even a minimal ability to follow video tutorials and wield a set of irons—soldering and de-soldering. Dead, but easily fixable, monitors and TVs are often free for the taking. These can make excellent shack monitors, and if they have succumbed to the usual maladies, fixing them usually costs between $5 and $20 (for a handful of parts).

Bad caps: The main problem is bulged and blown filter capacitors on the power supply board. Most TVs and monitors have two internal circuit boards: a power board, which powers the screen and the screen's light source (LCD or LED), and a logic board, which handles signal inputs and video processing.

For a variety of reasons that range from unconscionable cost-cutting on the part of the manufacturer, to sustained fraud on the part of certain capacitor manufacturers (see "Capacitor plague" on Wikipedia, https://en.wikipedia.org/wiki/Capacitor_plague), to harsh environmental conditions inside the unit's enclosure, the bottom line is that, sooner or later, the filter caps on the power board are likely to fail. And


***These electrolytic capacitors are bulged on top, which means they're dead or nearly so. If your shack monitor is flickering, blacking out, or behaving badly, chances are good that you'll find these inside. The good news? They're relatively easy to replace. See text. (NT0Z photo)***

when this happens, replacing them, which is relatively easy, restores the monitor to full functionality in most cases (70% to 80% seems about right).

Inverter and Backlight: In the troubleshooting matrix, if the power board is functional but your monitor or PC screen is still blacked out (but the power light comes on?), the next culprits are the backlight and/or the backlight inverter.

Conventional LCDs don't "make their own light" as do some new display technologies such as OLED or AMOLED. The LCD panel needs a light source to make anything on the screen visible. Although most new LCDs use LED backlights, billions of older units have fluorescent backlights—just like the finicky, blinky bulb in your kitchen ceiling!

LCD monitors don't use ballasts in the same way that fluorescent shop lights do, but they do require some fairly precise—and fairly high—voltages, which are provided by inverter circuits. In laptops these are small and well insulated to keep high voltages contained in cramped internal spaces. In desktop monitors and TVs the inverters are on PCBs that are usually inaccessible (to humans and pets) when the sets are assembled and in use.

In a practical sense, backlights and inverters either work or they don't. If the power board is fully functional it's not

usually practical, cost-effective, or even safe to troubleshoot or replace inverter parts at the component level (relatively low current but hundreds or thousands of volts!). Inverters and backlights can be replaced (with new and/or used parts from eBay and Amazon), but successfully removing them, sourcing the right replacement, and installing these parts is not nearly as easy as fixing common power board faults.

Replacement LCDs are much less expensive nowadays, and many can be sourced with new backlights and inverters. The problem is, the screens may still not work at all, or the replacement panels may not "look" or function exactly like the old ones (brightness, screen surface, contrast, etc). Over the years I have replaced my share of screens, backlights and inverters, mostly in laptop PCs, with results that range from fantastic to horrible (but mostly somewhere in-between, with results that are "better than nothing" but not "as good as new").

With prices so low on new monitors and TVs (with commensurately tragic quality control and life expectancies), I have a new policy when it comes to servicing these things: Because power board repairs fix most broken monitors, if that doesn't restore the unit, the unit gets recycled! If the screen is particularly interesting, exotic, expensive or of some historical significance, I may persist, but that's not typical.

**Big Sammy 1**

Big Sammy 1, as detailed above, was flickering and "blacking out" before the RTTY Roundup, but the power LED turned on and off with the unit's power switch. This behavior is common, even for units manufactured by respected vendors such as Samsung. The main culprit is bulged, failed electrolytic caps on the power board. Now that my "shop stuff" was unpacked after the move to a different QTH, I was ready to crack the case on the monitor.

As with every repair of this type, a quick search of Google and YouTube is the first step. These sites often have instructions and comments from dozens to thousands of folks with similar—or exact—problems. Why go it alone when these fantastic resources are available?

Lots of people, as it turns out, had flickering issues with their versions of Big Sammy 1 (and many other Sammys), with bulged electrolytics or popped fuses on the power boards being the most common. YouTube had several detailed videos on the subject and the repairs (exact model!). For those who know how to safely replace electrolytic caps, details of exactly how to disassemble the case and extract the PCBs are most helpful.

It wasn't obvious from the outside, but Big Sammy 1 was pretty easy to disassemble with the help of the video. Routing the signal and power cables and dealing with the potentially tricky connectors also make the videos tremendously helpful.

As I extracted the power board and flipped it parts-side up, the bulged caps—five of 'em—were obvious. With


***Testing the bulged, failed caps with a Peak ESR70. All tested bad in some way. The cap under test is bulged on top, can't be measured for capacitance value (leaky), and has an equivalent series resistance (ESR) of 2.0 ohms (should be about 0.1 ohms). See text. For more about the meter, see www.peakelec.co.uk/acatalog/jz_esr70.html. (NT0Z photo)***

increasing hope that I could successfully repair the monitor, I went to my shoe box full of caps to see what I had on hand.

Big Sammy 1 had blown a handful of 820-uF, 25-V radial electrolytics and a single 330-uF radial can, but had several smaller-value electrolytics that weren't obviously bulged. See the photo. From reading the many online posts about the repair, I learned that the smaller caps rarely fail. The focus was on the Big Boys.

In my goody box I had a dozen 1,000-uF, 35-V units from a leftover project. The values were reasonably close to 820 uF, and the extra voltage rating was an actual benefit. I was elated until I realized that the caps were physically too large to fit the available space. Darn!

I read more posts and dug in a bit deeper to discover that the required electrolytics, in addition to the capacitance and voltage requirements, should also be low-ESR types, conform to certain physical dimensions (20 mm "tall," 10 mm in diameter, with 5 mm lead spacing), and have certain temperature-handling characteristics (rated for at least 105 C).

Wow. These weren't the garden-variety caps I had assumed them to be. I imagined that they might be prohibitively expensive, but I was wrong. They're dirt cheap and readily available! Multiple vendors on eBay and Amazon actually stock capacitor-replacement kits for a large variety of TVs and monitors. These kits add 30% to 50% to the cost of individually sourced caps, but the convenience is undeniable. Typical kits cost $10 to $20.

Being a "value oriented shopper" who lives close to Digi-Key in Thief River Falls, Minnesota, I naturally chose to find my own replacements! I prefer Panasonic low-ESR electrolytics, although there are other good brands out there from fellow Japanese makers Nichicon and Rubycon. I purchased six of the big caps and two of the smaller units. With

shipping (First Class mail), my parts totaled $8.

**ESR: How Low Can You Go?**

In "extreme" service, unlike the 12-V utility power supplies we hams build as rites of passage, a capacitor's equivalent series resistance (ESR) is just as important as its voltage and capacitance ratings. When fully loaded (and working every moment that the unit it powered on), Big Sammy 1's filter caps pass a lot of current and live inside an enclosed space with minimal airflow. And from Ohm's Law we know that current flow causes heat. And heat—like speed—kills!

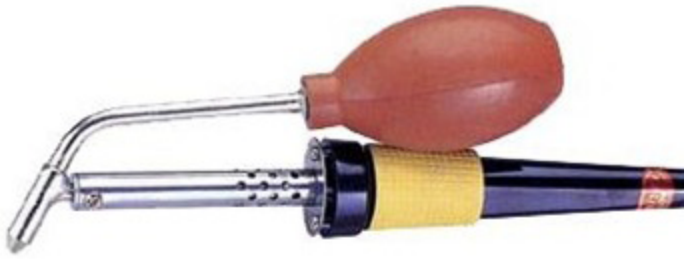
As current flows through a filter capacitor it encounters a small—hopefully small—amount of "equivalent resistance." You can't measure this resistance with your pocket ohmmeter—that would be actual resistance!—but the ESR causes the capacitor to get hot in proportion with its "equivalent" resistance. The higher the ESR, the more heat is generated. Ditto for the current passing through the capacitor. High current with high ESR means high heat. High heat means immediate failure (as the internal electrolyte "boils" and bulges the top of the capacitor can, perhaps exploding or making a loud popping sound) or premature failure (of a similar, if less spectacular type). Either way, the cap is no longer a cap, or it's seriously degraded, with typical follow-on consequences. In Big Sammy 1's case, the follow-on consequence was backlight flicker/failure.

To give electrolytic capacitors in extreme service a fighting chance, manufacturers build low-ESR variants to minimize unwanted resistive heat. In any cap, lower is always better when it comes to ESR, as an ideal capacitor exhibits no resistance, but practical construction and formulation issues preclude "zero-ESR" electrolytics. That's why these caps are also rated for a certain number of hours of endurance at a certain temperature. Big Sammy 1's caps were rated at 105 C (no endurance specified), which is common for caps in TV and monitor service.

In addition to measuring caps in terms of capacitance and working voltage, evaluating caps in terms of ESR can make or break their successful use in certain circuits, especially power supplies. Many ESR meters (see the photo) can detect "bad" capacitors even when they're still "un-bulged" and in-circuit (the Holy Grail of troubleshooting components and existing circuits).

I was eager to test my Peak ESR-70, a respected "pro-consumer" capacitance and ESR meter, on the faulty power board. After all, I could see which caps were obviously "blown," so I was hoping that the ESR-70's readings would identify the bad caps in-circuit and correlate with the visual cues. Unfortunately, for the most part, they didn't, which wasn't completely unexpected.

According to the ESR-70 user manual, an 820-uF electrolytic cap should have an ESR of about 0.12 ohms or less. Unless current through the cap is massive, such a small amount of equivalent resistance shouldn't generate much heat at all.



***60-watt desoldering iron with vacuum bulb ($15 plus shipping) from http://www.showmecables.com.***

When tested in-circuit, however, the ESR measurements of the obviously bad caps mostly showed as good. Several of the caps were in parallel, so I guess that's to be expected. I replaced all of the bulged caps and one large unbulged cap in the same capacitor group for good measure.

As shown in Table 1 (below), once removed from the PCB, all of the caps tested bad in one way or another, but there were a couple of surprises. With sufficient fiddling, the monitor would work for a few minutes at a time, so there had to be some filtering provided by the otherwise bad caps.

Specifically, Cap 1 was textbook. It had a high ESR, it was bulged, and measured as "leaky," meaning that no capacitance value could be measured. Cap 2 had an ESR that was quite close to spec, but it, too, was bulged and leaky. Cap 3 has a very high ESR and some measurable capacitance, but only a slight bulge. Cap 4 had an in-spec ESR, but was bulged and leaky. Cap 5, looked good and had a great ESR, but measured as leaky!

**Table 1**
**ESR Test Summary of Five Failed 820-uF Electrolytics**

| Cap | ESR (ohms) | Condition | Result (uF) |
|---|---|---|---|
| 1 | 2.0 | Bulged | "Leaky" |
| 2 | 0.18 | Slight bulge | "Leaky" |
| 3 | 1.46 | Slight bulge | 151 |
| 4 | 0.12 | Bulged | "Leaky" |
| 5 | 0.08 | Normal | "Leaky" |
| 6 | 0.06 | New | 800 |

**Note: See text.**

I replaced all of the problematic caps regardless of the in-circuit ESR tests, as the repair videos clearly identified the usual suspects. All of the new caps tested spot on before installation.

I had a few exciting moments during the repair process. First, I couldn't get my Hakko soldering station to solder anything gracefully, regardless of its temperature setting. And I was using Kester eutectic solder. If you can't solder with that yummy stuff, forget it! After switching to my old Ungar soldering pencil—my emergency iron—everything went fine and the Kester flowed like warm butter!

My desoldering iron is the type with the built-in red squeeze bulb. To use it, you squeeze the bulb, place the iron's tip on the joint to be desoldered, let the solder melt, and carefully release the bulb. The vacuum sucks up the solder and the part is easy to remove. Before unsoldering another joint, squeeze the bulb while the desoldering iron's tip is "aimed" at a safe surface that won't be bothered by the still-melted solder that spits out.

My first use should have gone well, but I squeezed the bulb while the tip was aimed at my PCB, which splattered the board with ancient, melted solder. Yuck! I had to use a solder wick and some elbow grease to clean up a couple of inadvertent solder bridges on Big Sammy 1's power board! Everything else went just fine.

So, how did everything work out after reassembly? Just like cake! I can now turn the monitor on and off, and the backlight comes on in a jiffy and stays on without any flickering. The backlight still takes two or three minutes to reach full brightness—it's fluorescent, after all—but it's solid. I consider it a good outcome. I bought the big monitor for $15, fixed it with $8 in parts, got to use my ESR-70, learned a bunch of stuff, and am enjoying the "DIY glow" that only fixers and home-brewers can share. I could buy a new big monitor for $100 (on sale, but not a Sammy), but I can't buy the "rest" of the process with money alone.

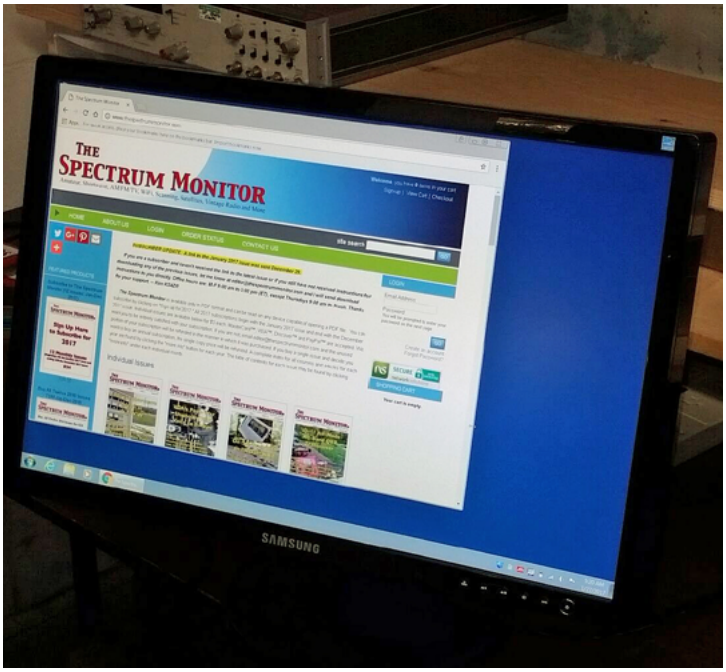
Careful readers will note that I didn't get to use Big Sammy 1 in the RTTY contest because of the two-day shipping turnaround for the Digi-Key parts. Darn!

**Big Sammy 2**

Big Sammy 2 is a 24-inch LCD monitor with an even higher resolution (1920 x 1200), which isn't really manufactured any more, as economy of scale has decided that 1920 x 1080 is the way to go. That's too bad, because the extra 120 pixels in the vertical dimension are really useful! Big Sammy 2 hails from about 2005, when these high-end monitors typically sold for about $600!

I met Big Sammy 2 three or four years ago when I stopped by a seller's house to pick up yet another craigslist purchase: a new-in-the box Realistic DX-160B shortwave receiver with matching external speaker, a Radio Shack random wire SWL antenna (also NIB), and the original sales receipt, all for $50. I didn't even negotiate, as that would have been in poor taste considering the already low asking price! I had lusted mightily for the '160B in the local TV shop window as a Middle Schooler, so I was thrilled that nobody else had snatched this "new" unit up.

As I was walking toward the front door with the boxed




***Big Sammy 2 is a $600 "better than HD" monitor that was given to the author in non-working condition. The fix? A YouTube video, 20 minutes, and a single 68-ohm resistor! (NT0Z photo)***

SWL receiver, I noticed Big Sammy 2 and said something about its niftiness. The owner told me that he had bought it new and had used it for only two years before it stopped working. When he said the magic words—"the power light comes on but the screen stays blank"—my head turned a bit! Before I could react further, he asked me if I wanted it. He was moving across the country in two days time and I'd be doing him a favor by taking it if I thought I might be able to fix it. (Thanks, Mayo Clinic, for providing plenty of educated, affluent, transients!)

What self-respecting tech-hoarder could pass up a free Big Sammy 2, complete with a telltale power LED? Not me!

Truthfully, the big monitor had been sitting around my house for several years because it had a reputation for being very difficult to open and work on. I should have researched it more thoroughly at the time, because with the usual YouTube video repair tutorials, it wasn't difficult at all (although it would have been maddening without the video).

In addition to the usual bulged power board caps, Big Sammy 2's power board often fails because a half-watt resistors becomes "discontinuous"—that is, it "fails open," leaving an open circuit in place of a 68-ohm resistor.

Once I had extracted the power board, which took less than five minutes once the video revealed the secret handshake required to split the case, I was surprised to see that the electrolytic caps all looked great. In fact, the monitor's interior was pristine.

Some YouTubers had suggested that their caps, too, were fine, but that one of three 68-ohm resistors mounted near the edge of the board had failed open, leaving the screen blank but the power LED functioning.

I scraped away the sticky stuff that kept the resistors from moving and measured each one in circuit (a proce-

dure that was okayed by the service video). Sure enough, although it looked perfectly fine, one of the three 68-ohm resistors was open and measured as "infinite ohms."

I went to my stockpile of resistors looking for something close to 68 ohms. My intentions were to replace all three resistors (always a good practice), but I wasn't really finding much in that neighborhood with sufficient dissipation. I did find three 220-ohm, 1/4-W resistors, however, so I connected them in parallel (about 72 ohms) and used them to replace only the failed resistor. If it worked I'd order a few 68-ohm, 1-W units and wait to see if any other issues showed up (or if the caps fail after turning the AC power on and off a few dozen times!).

I wasn't really expecting it to be that easy, but in the end, it was. After reassembly, I connected Big Sammy 2 to an old laptop and held my breath as I pushed the power button. There was a single tiny flicker of the shop lights as those big capacitors charged for the first time in several years, but the laptop screen image soon appeared, and it was lush, beautiful, and gigantic (see the photo on previous page)!

I power-cycled the screen about 20 times as if taunting it to fail! All I could think about after the initial rush (no pun intended) was that I could have had Big Sammy 2 in service for YEARS if I'd only YouTubed a bit further back in the day. Oh, well. I ordered the 68-ohm resistors and earmarked the electrolytics, which I may choose to preemptively replace.

This monitor is worth some extra attention. Big Sammy 2 is massively heavy and sturdy when compared to modern counterparts, which seem to be made from fairy farts and spider silk. Compare a 1973 Plymouth Gran Fury III to a Ford Fiesta to get the idea!

**Monitor Rehab Tidbits**

If a monitor's backlight fails, but the rest of the monitor is still receiving power, connect a video source to the monitor and turn it on while shining a flashlight into the screen at a 45-degree angle. Often, if the LCD is working but the backlight isn't, you can see faint images or image outlines by providing a bit of off-angle, exterior "front lighting."

When researching a potential monitor repair, spend enough time searching through related posts and watch several online repair videos, if possible, as the "magic combination" of repair techniques often emerges from a synergistic combination of multiple sources. Plus, some videos are awesome, while some are pretty useless, so you want to at least put in enough effort to find the "awesome" video!

Most modern monitor power supplies bleed their filter caps automatically, but you must assume that they do not when working on them to keep yourself safe. Use a large screwdriver with a well-insulated handle to discharge all of the electrolytic capacitors on the power board in question BEFORE testing, and use safe practices when handling and removing these boards.

Don't poke around the inverter circuit with your garden-variety multimeter when troubleshooting blacked-out LCDs! (If you have access to an inverter while the monitor is under power, you're probably working on a laptop PC or a large TV, as most PC monitors don't have accessible power boards when powered on.) The voltage at the inverter outputs may exceed 1,000 V, which may not kill you if you contact it, but it will almost certainly fry your multimeter and cause chaos! Laptop inverters are "super insulated" for a good reason. Now you know! Replace them if you so desire (power off, battery out, circuits drained), but don't get "touchy feely" and keep your probes to yourself!

When replacing power board electrolytics, as long as the parts fit physically you can almost certainly replace a part with another that has a higher voltage rating, but be careful not to swap filter caps that have too much "extra capacitance."

For example, I would have been okay with replacing Big Sammy 1's 820-uF filter caps with my 1,000-uF units if they had fit into the available space, and I might have even gone down a bit in value if I had otherwise suitable replacements on hand (a working half-size capacitor has to work better than a blown full-size unit, right?), but I wouldn't have gone with higher-value caps.

Why? Wouldn't more capacitance provide even better filtering? In a perfect world, yes. But larger caps also produce more "inrush current" whenever the unit is switched on. Most modern monitors are pretty tightly designed (that is, designed to fail a week after the warranty expires), so while the extra capacitance might indeed provide more filtering, it's all for naught if the extra inrush current destroys something else in the process!

Laptop and desktop LCDs are shack necessities these days, which makes them legitimate for DIY repairs. And with a wealth of excellent troubleshooting and repair tutorials floating around on the Internet, repairing a typical LCD is a heck of a lot easier than repairing a modern transceiver. With a pile of free source monitors on which to practice, your shack can soon look like a Wall Street brokerage—sans the investment-grade bank account!

My burning question? Do I preemptively replace the power board caps on my main productivity monitor (28 inches, 1920 x 1200, no longer manufactured), which has been in daily use since 2010, or do I wait for something to fail before performing surgery? When caps fail (sounds like a T-shirt slogan!), other downstream stuff can fry. So, do I risk breaking something else by opening the case "early," or will early intervention likely extend the monitor's life?

If you know the statistical answer, let me know!

TSM

# Radio 101

**By Ken Reitz KS4ZR** **ks4zr1@gmail.com**

# How to Prepare for the FCC's Repacking of the US TV Bands

Last summer the FCC began its "Incentive Auction," which was to free some 84 MHz of licensed TV spectrum so that it could be sold to wireless broadband entities and used with all the amazing future mobile devices connected to that spectrum. I assume that means that you'll be watching "America has a Million Talent Shows," from the back of your self-driving car on a 72-inch screen that will be where your windshield is now located. I can't wait.

As of the middle of January the insanely complex reverse/forward 10-stage auction had somehow freed up 70 MHz of TV spectrum, or at least that's what I think the FCC's Auction Data Projects 1000 website says. Anyway, this process will continue until all 84 MHz are finally secured—maybe March or April (I forget which year). When that happens, the FCC says, the final TV channel assignment plan will be determined, which could take more than three years to implement (actually not a joke).

The actual wording in the September 30, 2016 FCC press release was, "the need for a post-incentive auction transition timetable that is flexible for broadcasters and that minimizes disruption to viewers with the need for a schedule that 'provide[s] certainty to wireless providers and [is] completed as expeditiously as possible' the Commission [has] established a 39-month period for reassigned stations to transition to their post-auction channel assignments."

FCC press release writers are still awaiting the invention of the comma. The last bracket [has] was mine. Like most FCC documents, the original didn't make any sense. I don't think I wrecked the quote with my little edit. But, the translation is, "We've made such a pig's breakfast of the TV band that we doubt that the few hundred households still watching OTA-TV will mind or understand and anyway, since we are mostly controlled by the wireless broadband industry and individually can't agree on the time of day, this is the best that we could do."

Since the beginning of the Incentive Auction last summer, the Commission has thrown a PR blackout over the entire affair, prohibiting any participant from commenting on anything having to do with the auction. This has worked so well that I defy you to find out any more than I have on the subject. Even savvy professional broadcast bloggers are silent on the subject. No wait, they're asleep! And, who can blame them; listening to the 10-meter beacon band at the bottom of the solar cycle at the beginning of the Maunder Minimum is infinitely more exciting.

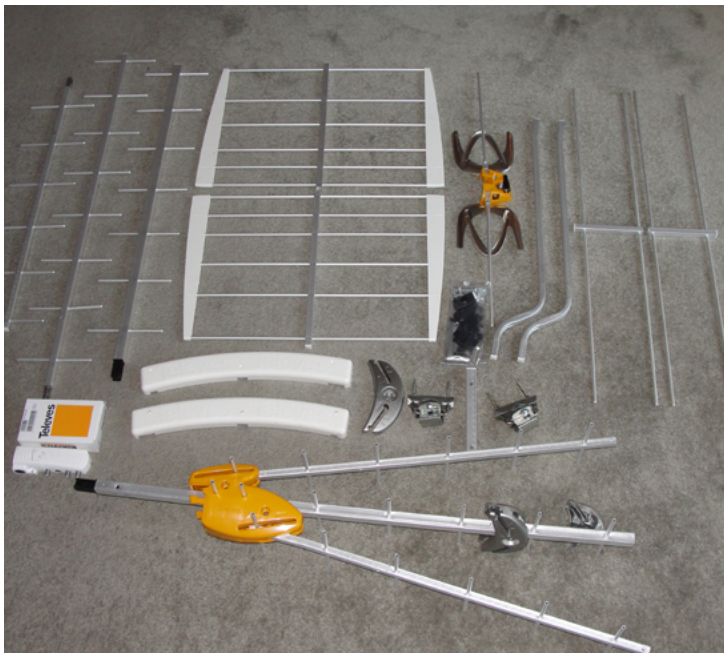
***Televes DAT-790 amplified VHF/UHF-TV antenna. (Courtesy: SolidSignal.com)***

**What to do about the Future?**

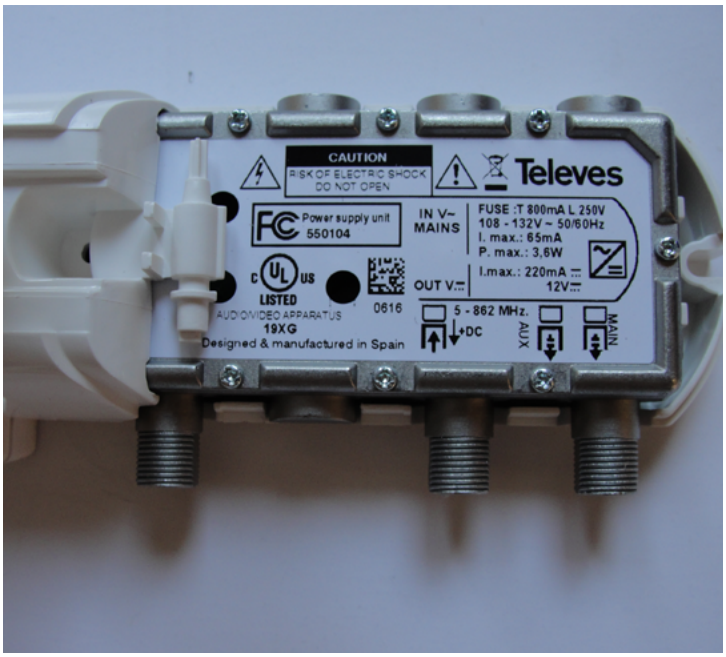
Whatever the outcome, and I've been assured that the Incentive Auction will make the Industrial Revolution and the Space Age look like kindergarten projects by comparison, there is still Over-the-Air TV to be seen—for free—for anyone bothering to plug an outdoor antenna into the back of their smart-TV.

Depending on where you live, those stations still broadcasting (despite their owner's secret plans to flee to Central America with the proceeds from cashing out their licenses) can be on either VHF or UHF channels. And, when Hell finally freezes over and the Incentive Auction finally ends, there's a good chance that whatever stations still own transmitters connected to antennas will be broadcasting on VHF and UHF frequencies. So, this might be a good time to put up a new-fangled VHF/UHF TV antenna.

Since the Great 2009 Digital TV Swindle (I'm sorry, I meant Cable-Satellite-TV Windfall, sorry again, I of course meant Changeover) we were told that we only needed a UHF-TV antenna to receive great, free (well, great is playing too loose with the term and free, if you don't count the



*All of the parts for the Televes DAT-790 amplified VHF/UHF-TV antenna with 40 elements on UHF and four elements on VHF. It's well designed, easy to put together and the parts, including extra bracing, are quite sturdy. (KS4ZR photo)*




*Indoor amplifier (yes, this product was designed and manufactured in Spain) has three F-connector ports: the furthest left carries the voltage to the antenna pre-amplifier and the two F-connectors on the right feed two separate TV sets. (KS4ZR photo)*

endless commercials) OTA-TV. Of course that was incorrect because some localities still offered VHF in addition to UHF channels. So, as a simple hedge against the future, I recommend putting up an amplified VHF/UHF TV antenna.

But doing so, in this age of Homeowners Association (HOA) rules against just such installations, despite FCC rules to the contrary, which are supposed to have the effect of federal law, except that it's somehow up to the consumer to enforce such laws, is without reward. That's why I'm suggesting viewers try one of two amplified VHF/UHF-TV antennas that I've found really work.

I live in a rural area plagued with multi-path distortion and wacky weather patterns that can cause even the biggest transmitted UHF TV signal to totally disappear from the scanned list. These two antennas answer just about all questions that viewers may have about the current and future state of off-air reception. I hope.

**Televes DAT-790 Amplified VHF/UHF-TV Antenna**

In the May 2016 issue of this column I reviewed the Winegard FlatWave VHF/UH-TV antenna and refer you to that issue for full details on that product. Last year *TSM* contributor, Mike Kohl, steered me to a new antenna that he was raving about. Mike tends to rave a lot, so initially I paid him little mind. Then I took another look.

Made in Spain, the Televes DAT-790 amplified VHF/UHF-TV antenna looked interesting. It was certainly not a stealth antenna. Measuring almost seven feet in overall length and with a bright orange tri-boom connector, this is one TV antenna that's easy to spot from the ground. There's no hiding this from the antenna cops. If HOA rules are a way of life for you, stick to the Winegard FlatWave.

It's the tri-boom feature that sets this antenna apart from most new VHF-UHF-TV antennas on offer today. The theory is that instead of having all 40 UHF director elements stretched out on a boom in the front of the antenna (making it insanely longer), they use three booms with a combined 40 elements, making the overall length of the director much smaller than a normal long-boom UHF Yagi. The trick is that all three are a different length. I asked antenna guru, Bob Grove W8JHD, about the arrangement and design. He noted, "If they face the wave front in unison so that they share the same phase angle, then yes, they would add another (rough guess) 5 or so dB of gain over a single set of directors." A 5 dB increase is a big deal on anybody's antenna.

A corner reflector acts to add more signal into the driven element and limit ingress of signals from the opposite direction. An additional four longer VHF elements behind the UHF elements add signals from that band. All signal energy is sent down the RG/6 coax to an amplifier/splitter in the house to which you attach your TV sets. Yes, I said plural. The amplifier lets you power two separate TV sets from the one feed. According to the manufacturer's specs, 12 volts of power at 220 ma for the mast-mounted pre-amplifier is sent to the antenna via the coax.

Now, I was quite skeptical of what seemed to me an anemic VHF antenna design. Are you kidding—four dinky elements for VHF? In the old days you needed big honking elements for good VHF-TV reception and plenty of them. I was also skeptical of the tri-boom array. Well, I would give it a try.

*Televes VHF/UHF-TV antenna compared to old Channel Master UHF-only TV antenna—basically, the same number of UHF elements on a much shorter boom with the addition of VHF elements at the back. (KS4ZR photo)*


*Part of Televes DAT-790 instruction sheet, shows connecting 75 ohm coax to the antenna's driven elements. (Courtesy: Televes)*

**Assembling the Televes DAT-790**

The antenna was packed very nicely and all elements and components made it from Spain to my door in good shape. I was impressed by the quality of the components—much sturdier aluminum stock than I'm used to with US and Chinese-made antennas. A colorful instruction sheet shows in very clear illustrations, without a lot of words, how the thing goes together. As you can see from the parts laid out on the floor (previous page), there are plenty of parts. It all went together smoothly and it was obviously a sturdy antenna. I give it high marks for packaging, instruction and assembly. It took an hour or so to put together and that includes my running around looking for a screwdriver. Of course, with the Winegard FlatWave, there was no assembly; it comes out of the box ready to mount.

**Mounting the Televes DAT-790**

My original plan was to put the antenna on a rotator on its own mast to take full advantage of its reception possibilities. The old Channel Master UHF-only antenna that I had used for decades had been taken down and I was refurbishing the mast. But, winter was fast approaching and I was running out of time. I would need lots of extra time to put up the refurbished mast, rotator, rotator control wire and RG/6 feed. Instead, I opted to put the Televes antenna on the mast of the big FM array (see this column "FM Mayhem Parts 1 and 2," June and July 2016 issues of *TSM*). It would, of course, be a big compromise—lower antenna height, placed right in the middle of a 16-element FM array and having to "see" through a roof on the house. Not the optimal test for reception capabilities.

The Winegard FlatWave came with a small mounting bracket that was easily screwed into the side of the house. All I had to do was mount the antenna on the bracket, run a length of RG/6 coax, plug it into the antenna and rotate the antenna for maximum signal. Once that was done, I locked the antenna in place and haven't had to do anything else.

**Reception on the Televes DAT-790**

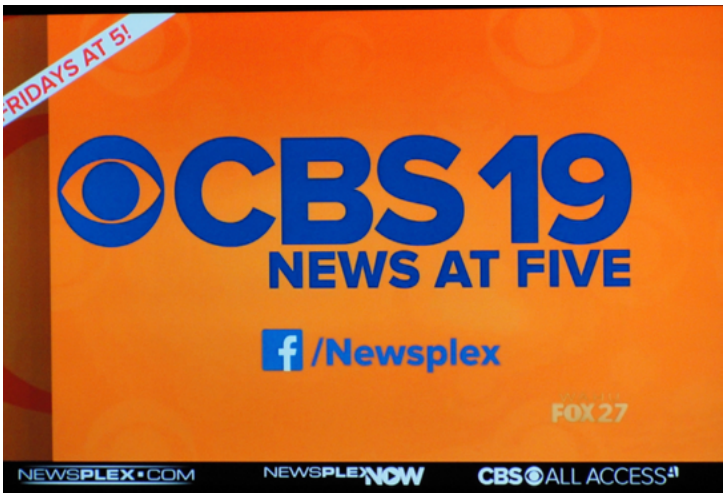
After lugging the seven-foot antenna to the top of a ladder against the east gable of the house, I secured it to the mast that supports the FM array and connected the RG/6 that had fed the old UHF-TV antenna. After adjustments to aim it roughly in the direction of Richmond, the nearest big city, I did a scan.

But first, some comments about reception devices—they are not all the same. I tried four different sets on this antenna and found that some are better receivers than others. The TV I'm using basically as a monitor for my FTA satellite viewing, is an older Sharp TV that while it's OK, could not compete with the LinkBox 8000 HD Local Premium Free-to-Air satellite receiver, which has terrestrial reception capability built-in. A newer Sony TV was second best, a Vizio TV was third best and the Sharp was last.

I had been dubious about the antenna's VHF reception capability and on the Sharp TV there was no sign of the one VHF channel in the area (channel 12 some 45 miles away and only putting out 26 kW ERP). But, connected to the LinkBox FTA receiver, channel 12 came in nicely (as seen in the photograph on the next page). The other three sets were able to tune in the VHF station as well.

In all, the LinkBox, connected to the Televes DAT-790, pulled in all available OTA-TV channels from Richmond—20 channels, including second and third channels and the one VHF channel (plus two subchannels), despite the challenges of the setup. Curiously, several UHF stations from the opposite direction came in on the backside of the


*VHF-TV WWBT channel 12 (with just 26 kW ERP) from 45 miles away using the Televes amplified antenna. And, the antenna isn't properly pointed yet. (KS4ZR photo)*




*CBS-TV's channel 19 from Charlottesville comes in from the opposite direction to where the antenna is pointed. (KS4ZR photo)*

antenna as well. Channels in Richmond average between 40 and 50 miles away from my location, depending on which side of the city the antenna is located.

It will be interesting to see how well the Televes performs once I get it out from under the influence of the FM array, the signal-blocking roof, at a higher elevation and on a rotator to fine-tune the direction.

I'm impressed with this antenna. While the Winegard FlatWave performed as well on the UHF stations, it could not pull in the one VHF station (no surprise there, considering its much smaller size). I recommend the Televes antenna particularly if you will end up in a location that has VHF as well as UHF stations in your OTA-TV landscape. Time will tell and, while the FCC wants a minimum of disruption for broadcasters as well as viewers, it's possible that you might not see much in the way of change. Others may find their UHF-only antennas must be swapped out for ones that cover VHF.

**Sources for Televes DAT-790 VHF/UHF amplified TV antenna:**

The Televes DAT-790 VHF/UHF amplified TV antenna can be found at a number of sources including Amazon, where it is sold through Solid Signal ($80 with free shipping for Prime customers). At Solid Signal it's also $80 but you may end up paying for shipping too, though I have seen this antenna on sale for $69. At jet.com, it's also $80 but you get free shipping and you can get 15 percent off your first three jet.com orders (new customers only) if you apply the discount code at checkout, making the total price $68, a good bargain. If you Google Televes DAT-790 VHF/UHF antenna, those buying sources will show up.

**Update on the Winegard FlatWave**

Since my review in the May 2016 issue of *TSM*, Winegard continues to offer the FlatWave amplified VHF/UHF-TV antenna for $100 with free shipping. Here's a comparison chart of the FlatWave with the less capable and lower priced Winegard products: **http://www.winegard.com/flatwave#chart**. I'm still very impressed with the FlatWave antenna and believe that if you live closer to more powerful VHF-TV stations, this may also prove a good hedge against the FCC's next moves in repacking the TV band. It remains the go-to TV antenna for anyone needing a stealthy approach to OTA-TV viewing or who want a great indoor antenna that doesn't look like any kind of antenna.

**Best Tool for TV is a Fool**

To see what your current OTA-TV landscape looks like go to **www.tvfool.com** and enter your ZIP code. You'll get an analysis of what stations are available and how far away they are. You can adjust the height of the antenna and see just how that may affect your reception. There's also a coverage map associated with each station that lets you see exactly how much power the station is using. As an example, the VHF station I was searching for (channel 12) has a maximum ERP of 26 kW while the UHF PBS station at nearly the same distance is putting out 160 kW. The two most powerful stations in the area have a maximum ERP of 1,000 kW each. The range of output is quite amazing. TVfool data is taken from the FCC database.

**Televes DAT-790 Specs (According to the Manufacturer):**

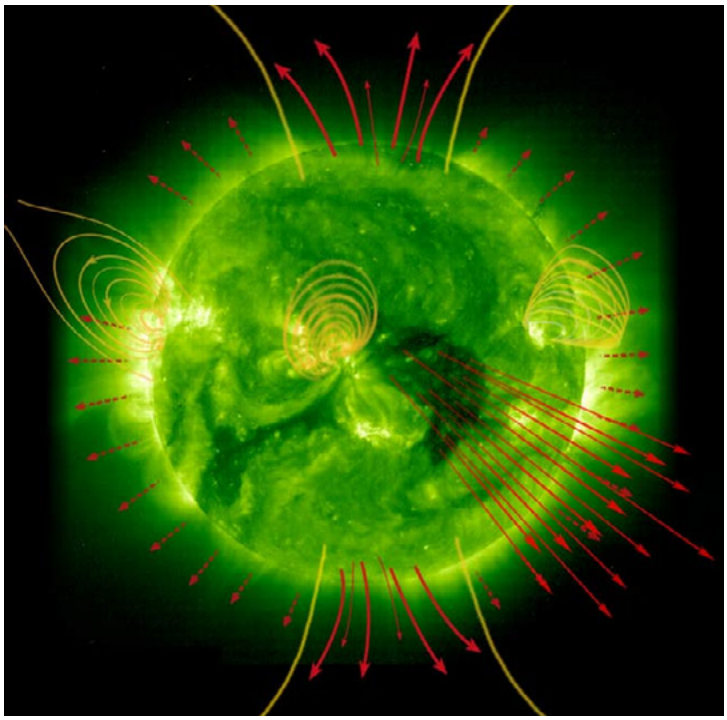
This antenna is an active antenna and between 174-216 MHz (high VHF) it claims a maximum of 21 dBi of gain. In the UHF-TV band, 470-698 MHz, it claims a maximum of 31 dBi. It has a beam width of 30 degrees.

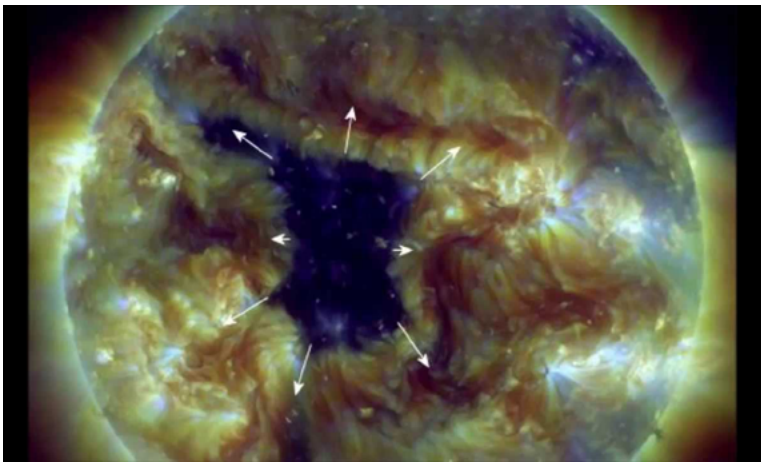
TSM

# Radio Propagation

**By Tomas Hood NW7US** **nw7us@nw7us.us**

## Storm-Triggering Holes





***The image at left (the falsely-colored green Sun) illustrates the Sun's atmosphere which is threaded with magnetic fields (yellow lines). Areas with closed magnetic fields give rise to slow, dense solar wind (short, dashed, red arrows), while areas with open magnetic fields -- so-called "coronal holes" -- yield fast, less dense solar wind streams (longer, solid, red arrows). The second image, above shows an SDO image of a very large coronal hole. Credit: SOHO/ SDO***

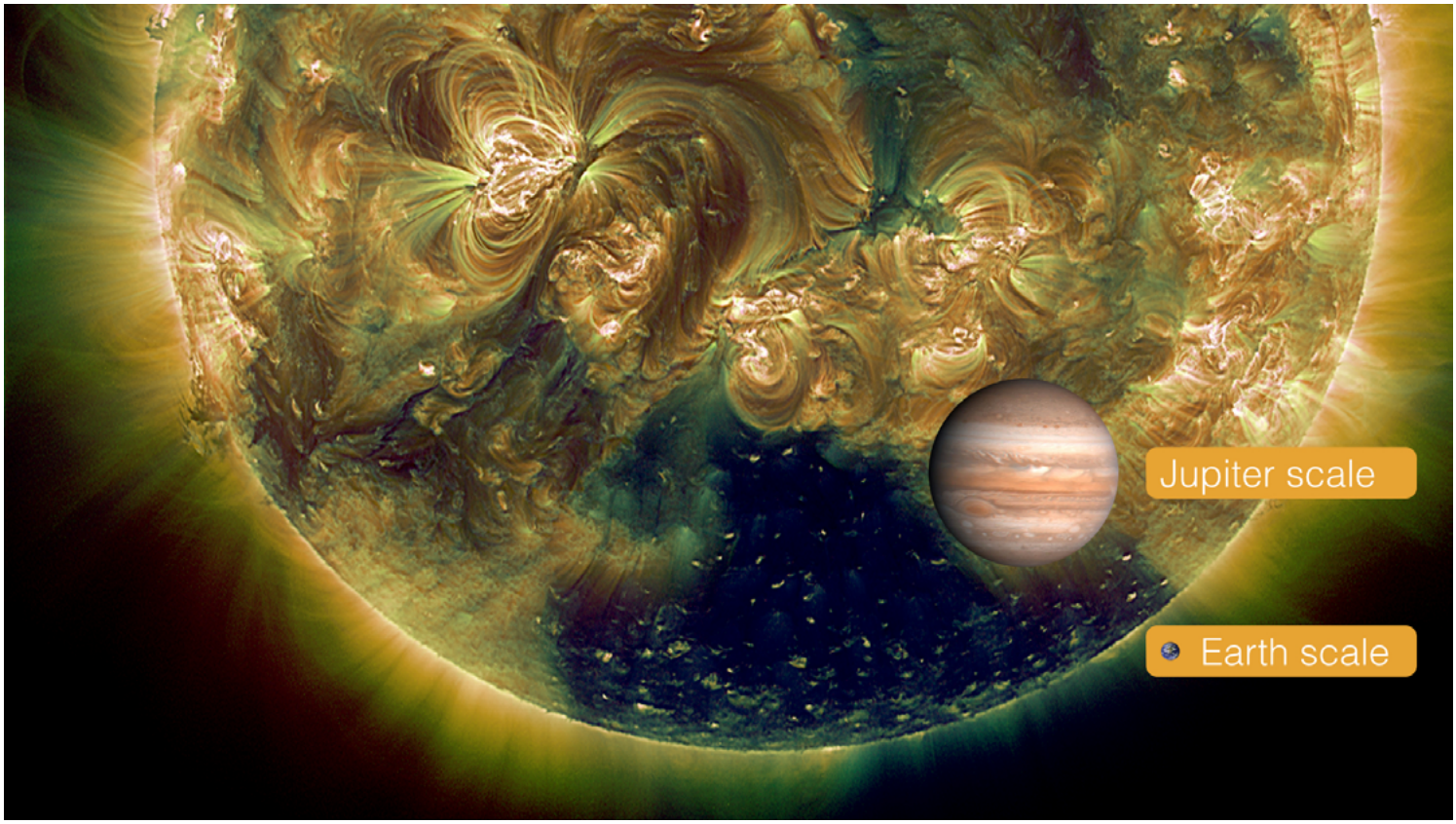
Experienced shortwave radio listeners and amateur radio operators know that there are seasonal changes in propagation, as are changes during a solar cycle, from the period of no sunspots during the solar cycle minimum, to the solar cycle maximum when there are many sunspots. We know that the radio spectrum we love, from the top of the medium wave frequencies to the bottom end of the very high frequency range, come alive during solar cycle maximum, because of sunspot activity. The adage is that the more active the Sun (as measured by sunspot count), the better conditions become on the high frequencies. At least that is true, generally; there are other types of activity occurring on the Sun that degrade conditions on our loved HF spectrum.

A major source of degradation of HF radio propagation is the occurrence of coronal holes and the resulting ionospheric depressions. Coronal holes release huge clouds of solar plasma that spew out on the solar winds. When the Earth is under the influence of high-speed solar winds, we often experience periods of geomagnetic disturbances that can develop into significant storms. Of course, while this can degrade HF communications, these disturbances can trigger aurora (Northern and Southern Lights), which in turn often creates conditions on VHF that radio hobbyists look forward to.

Fast solar winds originate in coronal funnels within a coronal hole, with a speed of about 10 km per second at a height of 20,000 kilometers above the Sun's photosphere. Just below the surface of the Sun there are large convection cells. Each cell has magnetic fields associated with it, which are concentrated in the network lanes by magneto-convection, where the funnel necks are anchored. The plasma, while still being confined in small loops, is brought by convection to the funnels and then released there, like a bucket of water is emptied into an open water channel.

The solar wind plasma is considered to be supplied by plasma stemming from the many small magnetic loops, with only a few thousand kilometers in height, crowding the funnel. Through magnetic reconnection plasma is fed from all sides to the funnel, where it may be accelerated and finally form the solar wind.

In addition to the leaking plasma associated with a coronal hole, there are also events where a filament of plasma breaks away from the Sun. When the Sun unleashes this plasma, an event known as a coronal mass ejection (CME)




***A view of a southern polar coronal hole using the SDO/AIA 171, 193 and 211 angstrom channels from Jan. 3, 2015. Images of Earth and Jupiter are included for scale. The visible portion of the coronal hole has a surface area the equivalent of at least 400 Earths surface areas. Credit: NASA/SDO/helioviewer***

projects a billion-ton blast of plasma into space at millions of miles per hour. The solar wind is gusty, much like winds on Earth, and range in speed from about 750,000 miles per hour (approximately 350 kilometers per second, to 1.5 million miles per hour (700 kilometers per second).

Since the solar wind is made up of electrically charged particles, it responds to magnetic fields that permeate the solar atmosphere. Solar wind particles flow along the invisible lines of magnetic force. When the magnetic field lines stretch straight out into space, as they do in coronal hole regions, the solar wind will move along these magnetic lines at a very high rate of speed. But, when the magnetic field lines bend sharply back to the solar surface, like the pattern you see with iron filings around a bar magnet, the solar wind emerges relatively slowly.

When the interplanetary magnetic field lines (IMF lines) are oriented opposite to Earth's magnetospheric field line orientation, the two fields connect and allow solar wind particles to collide with oxygen and nitrogen molecules in the upper atmosphere of these ovals. This causes light photons to be emitted. When the molecules and atoms are struck by these solar wind particles the stripping of one or more of their electrons ionizes them to such an extent that the ionized area is capable of reflecting radio signals at very high frequencies. This ionization occurs at an altitude of about 70 miles, very near the E layer of the ionosphere. The level of ionization depends on the energy and amount of solar wind particles able to enter the atmosphere.

While correlations exist between visible and radio aurora, radio aurora could exist without visual aurora. Statistically, a diurnal variation of the frequency of radio aurora QSOs has been identified that suggests two strong peaks, one near 6 PM and the second around midnight, local time.

VHF auroral echoes, or reflections, are most effective when the angle of incidence of the signal from the transmitter, with the geomagnetic field line, equals the angle of reflection from the field line to the receiver. Radio aurora is observed almost exclusively in a sector centered on magnetic north. The strength of signals reflected from the aurora is dependent on the wavelength when equivalent power levels are employed. Six-meter reflections can be expected to be much stronger than 2-meter reflections for the same transmitter output power. The polarization of the reflected signals is nearly the same as that of the transmitted signal.

The K Index is a good indicator of the expansion of the auroral oval, and the possible intensity of the aurora. When the K Index is higher than 5, most readers in the northern states and in Canada can expect favorable aurora conditions. If the K Index reaches 8 or 9, it is highly possible for radio aurora to be worked by stations as far south as California and Florida.

For the daily conditions, you are welcome to check my propagation resource at http://SunSpotWatch.com where I have the current Planetary-K Index (Kp), links to various aurora resources, and more.

**HF Propagation**

Let's look at this month's solar activity and the resulting radio propagation environment. We are starting to approach the end of the winter season. The period of darkness is growing shorter, causing the average daily maximum usable frequencies (MUF) to rise a bit. Noise levels are still low, at the same time, making for reliable DX. The solar activity is low, but at times still holds enough ionization to keep the mid-HF spectrum alive with signals. Generally, conditions are expected to be fair to good for HF propagation throughout February, with just some days forecast to hold degraded HF propagation due to coronal hole influence.

Nineteen meters through 15 meters will open shortly after sunrise, and will remain open until early to late evening, when the 10.7-cm flux is higher. Morning and evening DX openings between some areas in the Northern Hemisphere on these bands are very short, because the band in question closes on one end of the path before it opens on the opposite end. Transequatorial propagation on these bands will be less likely than previous years.

Paths on 30 through 20 meters remain in their seasonal peak much like in January, but with longer openings. Continue to look for great openings between North America and Europe in the morning and between North America and Asia during the late afternoon hours. Twenty meters will often be the best daytime DX band, with 30 running a close second.

Eighty through 40 meters will be useful almost 24 hours a day both locally, and regionally. Daytime conditions with marginal skip openings and low to moderate signal strength are possible, but expect this to decrease during midday.

Nighttime will be good. Generally, the usable distance is expected to be somewhat greater on 40 meters than on 80 meters. DX activity tends to increase later in the evening toward midnight. Look for Africa and South Pacific (Australia, Papua New Guinea, and so on) on 80 through 60 meters throughout the night. On 40 meters and 60 meters, long path DX is possible along the gray line.

The 160-meter band continues to remain stable, with very low noise levels. Throughout the winter season, high noise may occur during regional snowstorms. The band opens just before sunset and lasts until the Sun comes up on the path of interest. Except for daytime short-skip signal strengths, solar activity has little impact. Continue to look for Europe and Africa around sunset until the middle of the night, and then Asia, the Pacific, and the South Pacific as morning approaches.

**Propagation on VHF and Above**

There are no major meteor showers during February that could provide any VHF meteor scatter propagation. But, other modes may be possible. Check for 6-meter short-skip openings during the daylight hours. Some short-skip openings over distances of about 1200 to 2300 miles may occur. The best times for such openings are during the afternoon hours.

Auroral activity often occurs during periods of radio storminess on the HF bands. Look for days where the Planetary-A Index (Ap) is climbing, when the Planetary-K Index (Kp) reaches 4 or higher. These are the days on which VHF auroral-type openings are most likely to occur.

**Solar Cycle 24 Today**

The Royal Observatory of Belgium, the world's official keeper of sunspot records, reports a monthly mean sunspot number of 11.3 for December 2016. The mean value for December results in a 12-month running smoothed sunspot number of 24.9 centered on June 2016. Following the curve of the 13-month running smoothed values, a smoothed sunspot level of 26 is expected for February 2017, plus or minus 14 points.

Canada's Dominion Radio Astrophysical Observatory at Penticton, British Columbia reports a 10.7-cm observed monthly mean solar flux of 75.1 for December 2016. The twelve-month smoothed 10.7-cm flux centered on June 2016 is 90.4. A smoothed 10.7-cm solar flux of about 85 is predicted for February 2017.

The geomagnetic activity as measured by the Planetary-A Index (Ap) for December 2016 is 10. The twelve-month smoothed Ap centered on June 2016 is 11.4. Geomagnetic activity this month should be about the same as for January 2017. Refer to the Last Minute Forecast for the outlook on what days we might witness degraded propagation (remember that you can get an up-to-the-day Last Minute Forecast at http://SunSpotWatch.com on the main page, in the left column.

**Feedback Requested**

Do you have propagation-related questions, or a topic related to the Sun, the Ionosphere, or the Sun-Earth connection, that you'd like answered? Please send in your questions and comments, for possible inclusion in this column.

Your columnist has a website dedicated to space weather, at **http://SunSpotWatch.com** and also provided a Facebook page at **https://www.facebook.com/spacewx.hfradio,** which features daily updates with solar images, space weather graphs, data, and educational tidbits, all day long, so please take a look. There are quite a few space weather and radio videos on this columnist's YouTube channel at **https://YouTube.com/NW7US**. Be sure to check out the Tumblr blog, **http://blog.nw7us.us** , in which daily space weather posts are available.

On Twitter, radio propagation and space weather Tweets are provided in regular updates by @hfradiospacewx ( **https://Twitter.com/hfradiospacewx**). Your columnist is on Twitter, as @NW7US (**https://Twitter.com/NW7US**).

TSM

# The World of Shortwave Listening

**By Andrew Yoder** **info@hobbybroadcasting.com**

## SW DX Contest, SWLFest, and Global HF Weekend

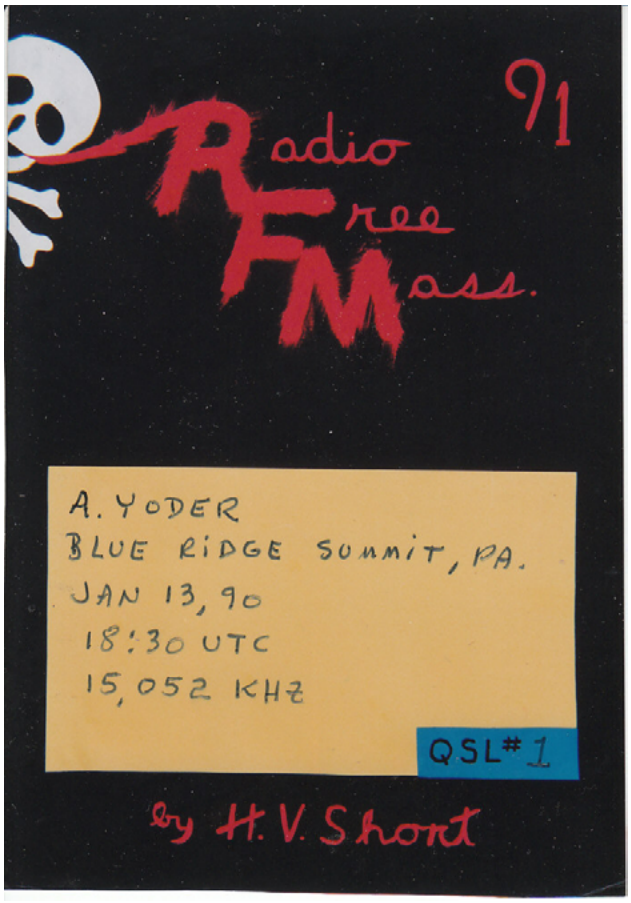
Being in the depths of winter, it's time to spend time by the receivers while dreaming of summertime activities. If you're in an especially cold climate, it's nice to have a tube radio or two available to warm your hands by.

Best of all, for this January, DXer John Cooper organized a DX contest, sponsored by NASWA, CIDX, and Universal Radio. The contest was open to North American listeners and ran from January 7 to 29, 2017. The concrete goal for listeners is to log as many shortwave stations that are actually broadcasting from different countries as possible. John said "I entered my first DX contest in 2013. I really enjoyed it. I also became a member of the NASWA that year.

I entered DSWCI DX contests and ODXC DX contests. In June 2016, I started to wonder why in the USA we didn't have a contest in the four years I've been in the hobby, especially one sponsored and run by NASWA the biggest SW club in North America." John developed a participation survey and a contest form, located sponsors for the event, and now it's running. But not for long; John said that this is the last contest he plans to organize. If you would like to keep the ball rolling and organize it for next year, now is the time to contact John or NASWA.

As I type this column, I'm participating in the contest because it's a great idea. I haven't had time to DX lately for a variety of reasons (not a lack of interest), but I want to make an effort to log a few stations here and there. I fully expect to be near or at the bottom of the results, but I think that this is a case where just participating is a fine thing. So, on January 17 at 0400 UTC, I entered 4000 kHz on the keypad and started tuning up so that I could get an easy log of Radio Verdad (Guatemala) on 4055 kHz. Before I could get there, I found a strong signal on 4040 kHz USB with what initially sounded like two-way conversations. The longer I listened, the more I realized that at least some of this was movie audio from The Hunt for Red October! The pirate never IDed or had any standard programming, just movie audio.

I'd bet against receiving a hand-delivered QSL from Sean Connery for this broadcast, but it was strange (and interesting) to stumble across.




***A 1990 QSL from RFM for a 19-meter test broadcast when H. V. was trying to hit Europe. (Courtesy of the author)***

### Goodbye to RFM

Longtime pirate listener Joe Filipkowski noted that H. V. Short of 1980s-'90s pirate RFM passed away at the age of 79. After a dark period of inactivity from shortwave pirates in 1986 and 1987, RFM was one of the new crop of regular shortwavers on the air that ushered in unprecedented pirate activity in North America. RFM (although RFM meant Radio Free Massachusetts, the initials were used on air) was


***A flyer from KULP, a low-powered Part-15 station rebroadcasting pirate programming during the Winterfest more than 20 years ago. (Courtesy of the author)***

known for playing a mix of light rock and jazz, mixed with brief announcements from H.V. and fake ads from the movies UHF and Amazon Women on the Moon.

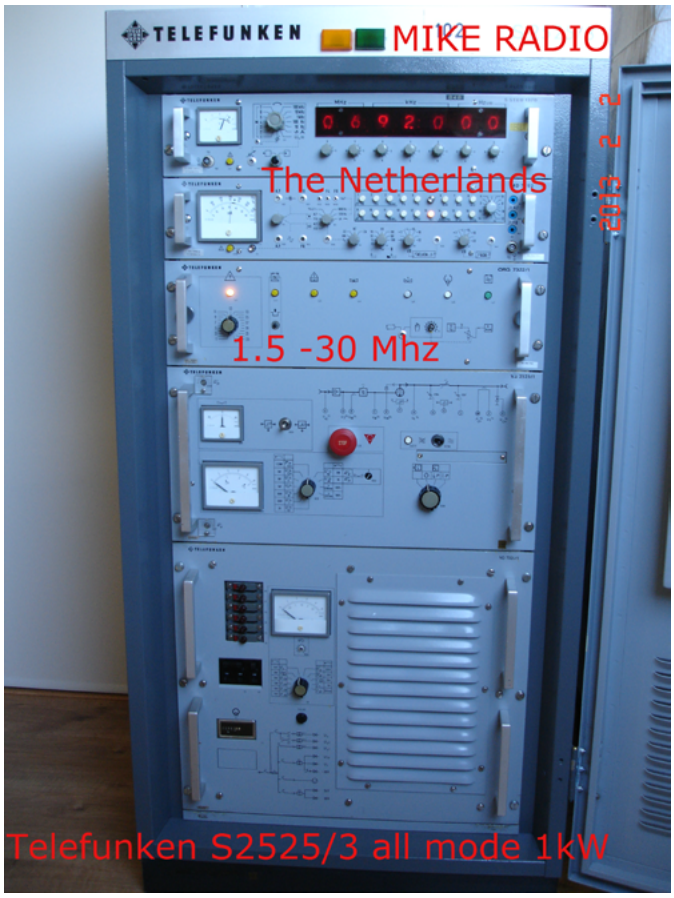
H.V. was an electrical engineer and used a modified Johnson Viking II and Challenger transmitters for much of his broadcasting career. He mostly avoided building transmitters from scratch, aside from a few experiments in the late 1990s as "L.V. Short of Solid-State Radio" because he said it "seems too much like work." Between H.V.'s engineering background, the subtle programming, and his love of operating on the edges of the broadcast bands, RFM was probably mistaken for a licensed broadcast station more than once. Some of the bands he operated in or around included 19, 31, 41, and 49 meters, and even on 1620 kHz AM (before the band expanded).

RFM might have blended in on the radio bands, it did not in QSL collections. At a time when other stations were sending out photocopied letters or card stock QSLs, H.V. sent full-color photo QSLs, made by painting a poster board and then photographing and printing it. New QSLs were available annually and each was numbered, starting over again each year (Fig. 1).

RFM had not been on the air in more than a decade, but H. V. was still posting messages from time to time on the pirate radio forums. Last year, I e-mailed him to say hi and also ask about the possibility of interviewing him on his pirate radio "career." He said "How many years has it been for us? Gads, I'll be 80 on my next birthday! Where has the time gone?" Sadly, I never got that interview.

### High-Powered Dutch FM Pirates

A few months ago, I wrote about massive FM pirates in Holland. TSM reader Jens Kolk wrote to me with information and links. The link I'm including here is




***An older transmitter from Mike Radio, which was active during the last Global HF Pirate Radio weekend. (Courtesy of Mike Radio)***

from EV1 TV in Germany, showing the video of the station's antenna tower.

"I've read your article in *The Spectrum Monitor* and thought you might be interested in some links on Netherlands FM pirate stations. Those were often set up in Germany near the border of the Netherlands in areas with little population and with impressive technique. I used to live in that area and we often could listen to the programs with a signal strength that was even higher than the 'normal' FM stations in the region. I also heard from parties where first the station was set up and then people would dance to that music from the program. **https://www.youtube.com/watch?v=YzcUfu730c4**"

Operations like those shown in the link seem to have the Dutch telecom on edge. As reported on the Dutch radio site radio.nl, on January 12, they discovered that someone had installed a transmitter and antenna on a state forestry tower. Government agents quickly dismantled and destroyed both the antenna and the transmitter to prevent further unlicensed broadcast violations. But at some point, the telecom agents either noticed or were notified that they had just destroyed the equipment of licensed station Vechtdal FM! On January 16, radio.nl reported that Dutch telecom would replace Vechtdal FM's equipment, but that the station is currently on the air with temporary equipment and the signal has a much smaller footprint.

### DRM Pirates and 4060 kHz

I was forwarded an e-mail from *TSM* HQ from a listener who heard a digital broadcast on 4060 kHz on Christmas Eve at 2149 UTC. The DXer said:

"I was scanning around using my recently purchased SDRPlay SDR unit with the SDRUno software. . . . The broadcast was playing the Kinks song 'Do It Again' and shut down after that song. I did catch the tail of another song just before the Kinks tune so maybe they were active for a while and I missed most of the

broadcast. I have heard of other pirates using this and nearby frequencies but this was very clear and strong at S9+. I will keep scanning this frequency for a while. Anyway, due to it being in digital mode, I thought it was more interesting than some other reports. One issue that I really need to look into is that the SDRPlay folks haven't published anyplace the details of their receiver's digital mode. I am assuming it would be DRM? I'm an old hat to amateur radio and some SWL activity but have not been doing anything with SDR devices until this one."

I don't have DRM capabilities with my receivers, but I've been checking the boards, newsletters, etc., and I haven't seen any reports of stations using DRM or any other digital audio modes. I can't imagine that DRM pirate radio will take off, but it is a fascinating experiment.

With the MUF being so low and so many hours of darkness, it's not out of the question to hear pirates on these lower frequencies. Dating back to the mid-80s, the most popular of the low-frequency ranges for pirates was 3400 to 3500 kHz, just below the 80-meter ham band. But over the past year, we've seen a bit more activity just above 80-meters, most likely because of Wolverine Radio, which sometimes operates in 43-meters until the band skips long and over most of its listeners, then the op will switch down to a lower frequency to reign the signal back in. And that's just what happened on January 22, when Wolverine was reported on 6940 kHz USB before switching down to 4020 kHz USB. The frequencies above and below 80 meters have only been used during the heart of winter in the past, so it's worth checking this area in February, but the activity will probably drop off on these frequencies from March until possibly Halloween.

**Winter SWLfest**

Now in its 30th year, the Winter SWLfest is just around the corner—from March 2 to 4, in Plymouth Meeting, Pennsylvania. Because this is an anniversary year, the organizers are celebrating by adding an extra day (Thursday) over a typical year's SWLfest. I've written about the Winter SWLfest in the past and don't want to spend column space on a topic that's been well covered before (and probably in other columns in TSM). As of this writing, the schedule of sessions has not yet been posted, but rest assured that at least one pirate radio talk will be on tap. If you're interested in attending, please see the event's site at **http://www.swlfest.com**.

**Next Global HF Weekend: March 30-April 2, 2017**

It's still a few months away, so be sure to mark the next Global HF Pirate Weekend on your calendar. The last one, which occurred during the first weekend in November was a sort of trial run. Cupid Radio and Mike Radio from the Netherlands were both widely reported in North America, and the former even made it to Japan. Sluwe Vos Radio wasn't reported as much in North America, but this Dutch station was reported in Brazil during the last GHF weekend.

**March 30-April 2, 2017** General frequency ranges: 15010-15100 kHz and 21455-21550 kHz. Basic schedule: European morning, 0800-1200 UTC from Europe to Asia/Japan/Oceania. European afternoon, 1200-1600 UTC from Europe to North America and vice versa. European night, 2200-2400 UTC from North America to Asia/Oceania.

Of course, these are general frequency ranges where pirates have broadcast during previous Global HF Pirate weekends. Some stations will surely operate on frequencies and times outside of these ranges. These will be updated on HF Underground and on the Hobby Broadcasting blog as it happens.

**Trump Inauguration Broadcasts**

The bands weren't full of programs protesting or supporting the new president on January 20. Most of those people were evidently either duking it out on the streets of DC or having it out verbally on Facebook. But a few stations were on the air.

Most dedicated to the inauguration was the Trump Alert Network, which broadcast a TV news feed (thought by one listener to be from CNN), from 1300 until signing off at 1720 UTC on 6925 kHz USB. The feed continued even through ads, including those from Geico and Nationwide Insurance. Listeners didn't report any Trump Alert Network audio; all IDs were in Morse code.

An Internet phenomenon, Filthy Frank, has a YouTube channel, with video programs that occur in a separate universe, where every character is played by him. Filthy Frank also performs music as Pink Guy and Joji. A pirate station identifying as "Filthy Frank Radio" made its premiere on January 21, with plenty of songs by Pink Guy that were described by one listener as "dirty rap songs." The audio content included some anti-Hillary Clinton songs, and the op sent a handful of SSTV images during the show, which lasted from 1440 to 1610 UTC on 6925 kHz USB. One depicted Trump as a Nazi and another as a Satan follower. Between the two, the FFR op doesn't appear to be fond of either of the presidential candidates.

**Other New Stations**

Over the past month, DXers have welcomed a number of new pirates to the airwaves, including KVR, Gospel Radio Shortwave, Skippy Radio, Euro Temptations Shortwave, Tango One Six Five, Coca-Cola Radio, Electric Circus, and Fly by Night Radio (KFBN). Maybe some of these will remain active long enough to warrant mentions in future columns.

TSM

# The Shortwave Listener

**By Fred Waterer** **programming_matters@yahoo.ca**

# Interesting International Programming via Shortwave and Internet

Welcome to the February edition of The Shortwave Listener. February is the coldest time of year here in Canada and the long nights make for many opportunities to hear radio stations from all over North America and around the world. February may just be my favorite time to listen to the radio.

Sprechen Sie Deutsch? If you speak any German you can still hear broadcasts in this language daily from Austria on 6155 kHz. This is a shortwave relay of Osterreich 1 programming. While I am not a "German scholar," I know enough of the language to note there is a distinctive Viennese accent. Listen around 0600 UTC on weekdays, to hear Morgenjournal (Morning Journal), Guten Morgen Osterreich (Good Morning Austria) and Leporella a cultural program. On Saturdays, you can hear Morgenjournal and Guten Morgen Osterreich, but they are followed by Schon gehort? Schon gehort is "The Ö1 Club broadcast." Current events and offers from the Ö1 cultural partners. On Sunday, tune in to hear Nachrichten (News) and Erfullte Zeit, a religious program.

Afrikaans is a unique language spoken in South Africa. Radio Sonder Grense, translated as Radio Without Borders, is an Afrikaans-language radio service run by the South African Broadcasting Corporation for the whole of South Africa. Afrikaans is one of South Africa's 11 official languages and the SABC is required to carry an Afrikaans-language service on both radio and television. RSG is the radio part of this Afrikaans-language service. RSG broadcasts mostly on FM utilizing transmitters owned and operated by Sentech, the former signal distribution division of the SABC. Radio Sonder Grense broadcasts on shortwave and can sometimes be heard on 3320 kHz anywhere from 0100 -0300 UTC.

Afrikaans is an interesting language, an amalgam of Dutch and African words. Back in the day, Radio South Africa, the Apartheid era broadcaster from Johannesburg, even offered a course "Afrikaans by Radio." If you know a little bit of German or Dutch, Radio Sonder Grense makes for interesting listening. Even if you don't know these languages, give it a listen anyway!

Speaking of German, what about programming from Germany? Oddly enough, Germany no longer broadcasts on shortwave in German. But Deutsche Welle does broadcast on shortwave to Africa in a number of languages including English. Try for Deutsche Welle's (DW) English programming on 9820, 15290, 15315, 17690 and 17710 kHz at 1600-1700 UTC.


***Radio Sonder Grense is an Afrikaans speaking radio station from South Africa, heard by many hobbyists. (Photo courtesy rsg.co.za)***

Weekdays at 1600, you can hear AfricaLink, a 30-minute program covering world news and Africa-themed stories; a fascinating daily look at Africa and African affairs. Following AfricaLink on Mondays, one can hear Inside Europe, DW's long running current affairs program "from the heart of Europe." Inside Europe is a compendium of the latest developments in Europe mixed with stories "off the beaten track." Inside Europe can be heard UTC Mondays at 1630 and UTC Sundays at 1600 UTC. On Tuesdays, Spectrum follows AfricaLink. Spectrum is DW's weekly program about science and technology—interesting stuff indeed. Wednesdays at 1630, Pulse can be heard. This is DW's "youth show" for young listeners in Africa and around the World. Following this 20-minute program is Crime Fighters, a radio drama that provides "thrilling edutainment." On Thursdays at 1630, World in Progress examines all aspects of globalization, including economic development, human rights, culture and more. On Fridays at 1630 Living Planet explores environmental stories that touch our lives every day.

Saturday's one-hour broadcast is entirely devoted to the program WorldLink bringing you personal stories from around the world, and looking at the people behind the news.


***Crime Fighters is an innovative radio drama heard weekly on the English Service of Deutsche Welle (Photo courtesy dw.de)***

Sunday you can hear repeats of Inside Europe, Pulse and Crime Fighters.

These 1600 UTC transmissions are the last English output on shortwave for Deutsche Welle. Some of these frequencies carry other languages such as Hausa after the English broadcasts end. Deutsche Welle programming is a key component of the CBC Radio (One) "Overnight" programming block and of course can be heard via the DW website at dw.de.

The times they are a-changing. Radio Romania International was once the voice of the Ceausescu dictatorship, an independent, yet orthodox communist voice from the East, not always the easiest of the Warsaw Pact countries to hear.

Fast-forward to 2017, and RRI is the only broadcaster from Eastern Europe still broadcasting on shortwave from a transmitter located in the host country. Not only that, but RRI programming and information is available from a surprising number of sources.

On shortwave, RRI broadcasts to North America at the following times: To Eastern North America on 6170 and 7310 kHz between 2130-2200 UTC; on 5960 and 7325 kHz from 0100-0200; and to Western North America between 0400 and 0500 on 6020 and 7340 kHz.

As the late night television commercials often say "But wait! There's more!" You can also listen to RRI's English language programming live over the Internet (rri.ro) on the same schedule given above. Go to the "RRI Live!" section in the top-right of the RRI website, choose channel "2" for English and then select your desired audio format (WMA, MP3 or ACC).

RRI broadcasts in English are also available for listening on demand via the RRI website. The "On Demand" feature is located immediately below the "RRI Live!" section in the top-right of the RRI homepage. To listen to a program all you need to do is select the date of broadcast from the drop-down list and then click the desired program. RRI programs become available for listening on demand two hours after the original broadcast.

Finally RRI is very active in social media. RRI can be found on Facebook, Google+, Twitter, Youtube, Vimeo, Dailymotion, Flickr, Pinterest, LinkedIn, Tumblr, SoundCloud and Instagram! It beats waiting weeks for an airmail response from the station. Sort of.

Turkey has been in the news an awful lot, for all the wrong reasons. Between an attempted coup, the assassination of the Russian ambassador and countless acts of terrorism, not to mention military operations against insurgents


***Dra Isabel.jpg Dra Isabel is a self help guru, heard on Radio Marti, among other stations. (Photo courtesy draisabel.net)***

in Syria, the Voice of Turkey has become a very important source of news and information. Try for English around 0400 UTC on 6080 and 7240 kHz. Spanish at 0200 UTC on 9650 kHz is also well heard here in North America.

Once in a while a radio program slips right under my radar. Admittedly I haven't listened to a lot of WWCR programming in some time, but recently, I discovered The Talking Machine Show on that station. Hosted by Phil Patton. This show is right up my alley, and probably yours too. The program broadcasts really old recordings, often including Edison cylinders and the like. I love listening to these old recordings from a bygone era. If you do too, then tune in WWCR at the following times and frequencies: Saturdays at 1100UTC on 4840 kHz; 1800 UTC on 12160 kHz; 0000 UTC Sundays on 5935 kHz; 0200 and 0500 UTC Sundays on 4840 kHz.

Spanish anyone? I missed this announcement, but last year, Radio Martí began broadcasting the nationally recognized radio program "Dra. Isabel" hosted by Cuban-born psychologist and best-selling author Dr. Isabel Gomez-Bassols, known to listeners as "The Angel of the Radio." In the U.S., millions nationwide tune in to the friendly, firm advice of the Spanish-language radio host, and thanks to an alliance with Hispanic Communications Network (HCN)-La Red Hispaña, the daily talk show will now air in Cuba and take calls and emails from Martí's audience on the island.

She is seen as a credible self-help voice. "My purpose is to give heed to callers' unique needs and teach them to find the power they have within themselves to overcome obstacles," said, Dr. Isabel, a noted psychologist, educator and specialist in domestic violence.

"I look forward to having "Dra. Isabel's" program on Radio Martí, knowing our listeners stand to benefit from her sound advice and expert opinions on a wide variety of topics that affect Cubans everyday lives," said Malule Gonzalez, Director of the Office of Cuba Broadcasting.

"Dra. Isabel" is produced by Hispanic Communications Network (HCN)-La Red Hispana, which is a mission-driven

media and cause marketing organization based in Washington, DC. HCN is the largest producer of media content with an educational focus to improve quality of life for Spanish-speaking consumers in the United States.

"Dra. Isabel" will air live Monday through Friday from 1:00 pm to 2:00 pm (E.S.T.) on Radio Martí.

Cubans on the island will be able to call (305) 639-4277 or send e-mails to draisabelmarti@gmail.com to ask questions and/or give opinions.

Upcoming Programming in February from the BBC

The BBC Media Centre often has information on upcoming World Service programming but is more often than not, posted just a bit late for this column. However, check it out at bbc.co.uk/mediacentre to get a heads up on programming coming up in the next week or so. Just making it in time for this month's column are the following program tips:

**The Forum: Goethe - The Story Of Color**

The German polymath Johann Wolfgang von Goethe was so fascinated by the way different colors affect our moods that he recorded hundreds of observations about this and eventually collected them into a book, known in English as Theory of Colour (Zur Farbenlehre).

Even by the standards of science in the 1810s, when the book was published Farbenlehre was outdated, but it has had a surprisingly long and fruitful afterlife in the fine and applied arts.

Bridget Kendall talks to art historian Alexandra Loske, writer Victoria Findlay and Zambian textile maker Odette Steele about the renewed interest in color at the turn of the 18th century, when new pigments, new scientific discoveries and new ideas about hues and shades marked the beginning of a color revolution. Tuesday 31 January 9.00-9.50am

**Assignment: Unarmed Black Male**

Unarmed Black Male follows the murder trial of a white police officer in Portsmouth, Virginia, accused of shooting an unarmed black teenager.

On 22 April 2015, Officer Stephen Rankin responded to a report of shoplifting at a Walmart store. Minutes after arriving in the parking lot he shot and killed William Chapman.

After Chapman's death, Rankin was fired from Portsmouth Police Department and charged with first-degree murder. Chapman was just one of 306 black men who were killed by police in the US last year, but just 14 police officers faced any charges - Rankin was one of them.

With extraordinary access to the prosecution and defense, as well as to Chapman's family and friends, and those closest to Officer Rankin, this powerful documentary from filmmaker James Jones follows the drama as the trial unfolds - and unpicks Rankin's troubling prior record in the police department. Thursday 2 February 7.30-8.00pm


***(Courtesy: BBC World Service)***

**The Compass: My Perfect Country**

Global listeners join the My Perfect Country conversation to debate the policies chosen so far.

Fi Glover, Martha Lane Fox and Henrietta Moore are on the hunt for solutions to the world's problems. Their aim is to create the perfect country made up of the best global policies that actually work.

In this special program discussing how the perfect country is shaping up, the team hear the views of the World Service audience to see what they make of the panel's decisions so far.

The program looks back on the policies that made it into the perfect policy pile in the first series, including Estonia's digital e-society, Costa Rica's green energy policy and Portugal's decriminalization of drugs. Policies debated in the latest series include Bermuda's water policy, Peru's poverty reduction program, Japan's gun control, Tunisian women's rights, Shanghai's numeracy education and Australia's anti-smoking laws.

Listeners who have first-hand experience of these policies give their personal reflection and feedback on the verdicts of the My Perfect Country panel, and members of the audience from around the world give their views on whether the policies could work where they are. Thursday 2 February 8.00-8.30pm

Well, dear reader that's a wrap for another month. Let us know what you are hearing on the international bands and better yet, why you like, or dislike it! This is your column. We appreciate your feedback always. 73 until next month!

TSM

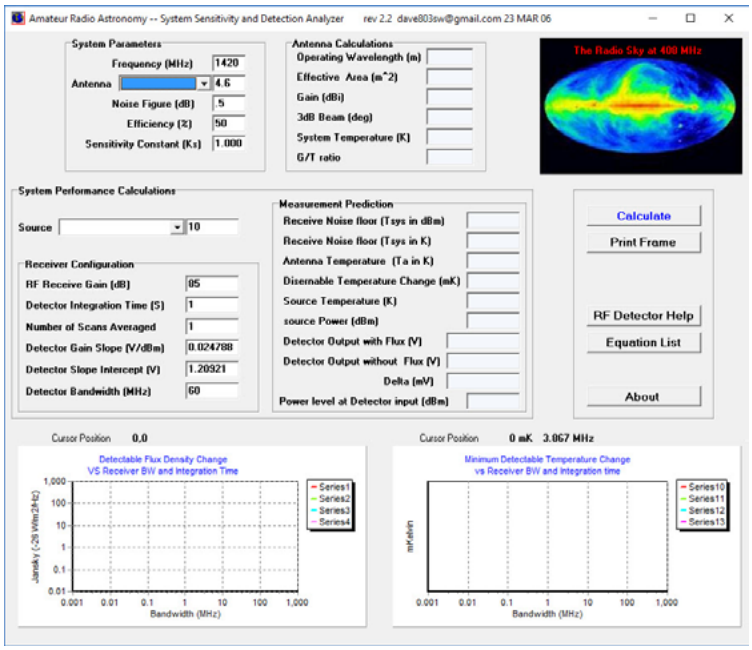
# Amateur Radio Astronomy

By Stan Nelson KB5VL stan.nelson@RoswellMeteor.com

## Back to the Basics

Radio astronomy has a long history that began in earnest in the 1930s but blossomed after World War Two. After the war, surplus equipment with improved performances allowed astronomers to begin to detect faint EM (Electro-Magnetic) waves in the radio bands that often were not associated with visible objects. Today, most amateurs can obtain equipment that can detect many of the objects modern astronomy sites can. Not all of them, though, since big dishes and complex antenna arrays are required to detect the weak radiation. But that shouldn't hinder us from trying. One of the major challenges is obtaining adequate sized antennas with fairly large gain. Cost always is a factor to be able to achieve good results. You should be familiar with the various factors that help you achieve detecting celestial radio sources.

Let's review the concepts of radio astronomy and the techniques useful to amateurs. First, download a useful software tool or calculator by Dave Halley. It's called "Minimum Detectable Signal Program." It's available from **radiosky.com/tminishere.html**. I park mine on my desktop. The program doesn't require installation. Just click on the executable and its running. This program allows you to discover how much power a proposed dish size, frequency and bandwidth will deliver to your detector. Here's a screen shot of the software when first run. We'll review a few of the basic features in order to appreciate the relationship between the dish size, frequency, and bandwidth being detected. We'll begin by using some real world large dishes.



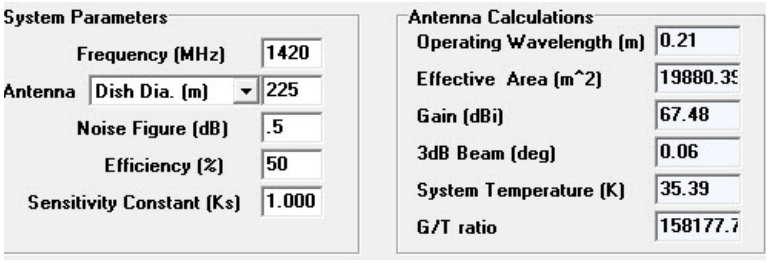

*Minimum Detectable Signal Program. (Screen shot courtesy of the author)*

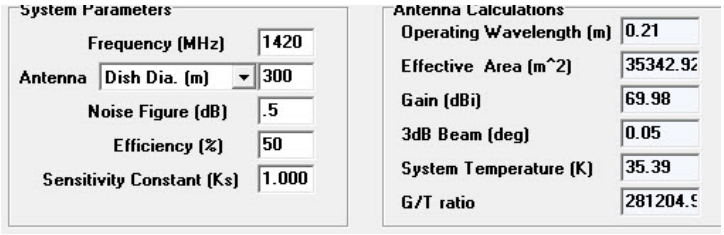
A new radio telescope called FAST was recently constructed in China, a detailed article of which appears in the February 2017 issue of *Sky & Telescope*. What's amazing is that it was similarly built in a depression like Arecibo, Puerto Rico. Arecibo's diameter is 305 meters. FAST is 500 meters. FAST is now the largest single dish in the world. The article compares the two dishes and notes the effective dish apertures are 225 meters for Arecibo and 300 meters for FAST. Let's plug the numbers into the program above see what's the difference using the frequency of 1420 MHz, which is in the operating range of frequencies used by both FAST and Arecibo. I don't have all of the parameters for these sites but the charts below give us a comparison for discussion purposes.

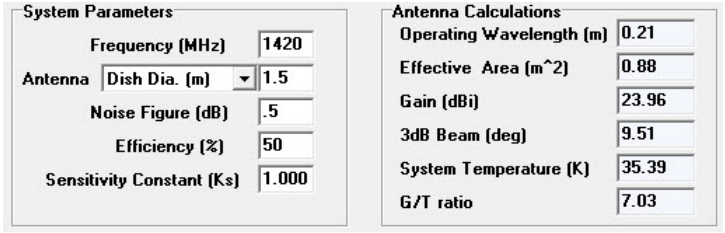
The beam widths are important in order to resolve objects and building large dishes helps achieve a narrow beam width. In the charts below the beam widths are shown as 0.05 degrees for FAST and 0.6 degrees for Arecibo. Of course these are based on some of my assumptions in the program. To achieve a higher degree of resolution, multiple antennas using synthesized arrays are used.

### Arecibo

The chart below shows the diameter of the Arecibo dish in meters. Using Pi times R^2 (pi times radius 112.5 meters squared), the area of the dish is 39,761 (m^2) meters/squared. The efficiency factor is based on one sensor using either vertical or horizontal polarization, which gives us 50 percent efficiency. That makes the effective area of the dish equal to half of the area of the dish or 19880 m^2. If you were using a circularly polarized feed that gathers both vertical and horizontal waves, one would approach 100 percent efficiency and the effective area becomes nearly the whole






dish's area. This is a simplified view and there are other factors that affect the real world calculations.

The chart above uses the same assumptions as the one on the previous page except for FAST's dish diameter.

You may have noted the G/T (gain to temperature ratio) numbers. The FAST dish cranks that up nicely from 158177 to 281204. A dish generally is pointed upward towards the sky and exhibits a fairly low noise background temperature. The Earth is about 300 K (degrees Kelvin). Some of the Earth's noise gets into the dish due to spillover depending dish design.

A comparison of the FAST and Arecibo giant dishes to a very small dish (mine) will give you a laugh. Note the beam width of 9.51 degrees. And the G/T ratio. Only 7.03 compared to FAST's 281204. (See chart at top of next column)

One of the interesting items mentioned in *Sky and Telescope*'s article is the frequency ranges of both sites. FAST covers 70 MHz to 1.8 GHz and Arecibo covers 327 MHz to 8.5 GHz and can do radar for planetary work.

**Parabolic vs Spherical Dishes**

A parabolic curve is designed to reflect incoming rays of light or radio waves to a common focal point. The concentrated beams can be sent to a detector in the front of the dish or reflected back through the dish to detectors mounted behind the dish, conveniently mounted in a small shelter often housing multiple receivers. There is another curved surface used which is essentially an arc of a circle. The focal points in this type of reflector do not all come together at one focal plane but exist along in a straight line. FAST uses mechanical means to distort the surfaces to achieve a paraboloid surface from its basic spherical surface. The *Sky and Telescope* article noted they did have issues with the system that reshapes a portion of the dish.

A design consideration of any dish radio telescope is the accuracy of the surface. Using the mathematical formulas that describe the curve or surface is easy. Building a dish that approaches the ideal is the challenge. Radio waves are a bit more forgiving that light waves. The rule is that if you have a surface variation or deviation from the ideal curve that is 1/20 of the wavelength then the reflector is close enough to the ideal. In the calculations used above, the wavelength for 1420 MHz is 0.21 meters or 21 cm (8.27 inches). A dish's curve should not vary more than 0.0105 meters (0. 413 inches) at that frequency.

```
(* rxpower = Watts at detector *)
rxpower = 1.20 * 10^-19 ;

(* anteffarea = effective area of antenna in Meters^2 *)
anteffarea = 1.20 ;

(* bandwidth in Hz *)
bandwidth = 2.00 * 10^6 ;

(* fluxdensity in Janskys (Jy) - 1 Jansky = 1.0 x 10^-26 W m^-2 Hz^-1 *)
(* Read that as Janskys equals watts per square meter per Hertz (Hz) *)

fluxdensity = (rxpower / (anteffarea * bandwidth)) / 10^-26
```

**Flux Density**

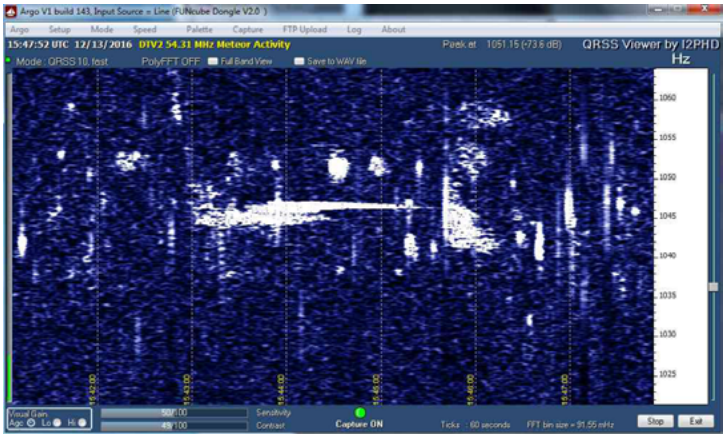
In the chart above, Flux Density is a measure of how much power is flowing through an area of one square meter/Hz. As you increase the bandwidth you detect more power.

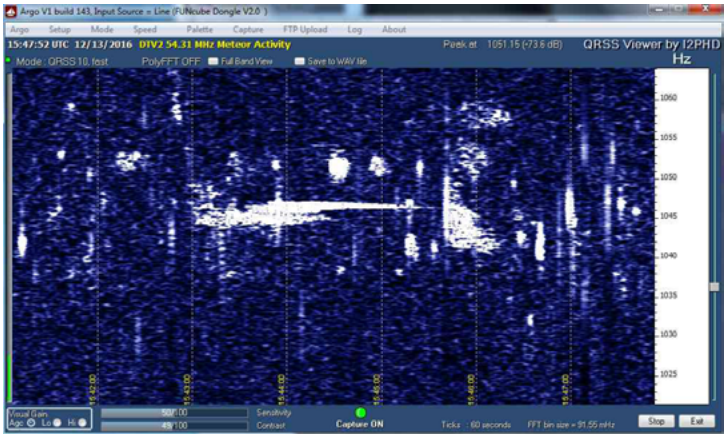
Based on the inputs above, the output of the calculation is 5 Jy. Using the FAST's effective area 300 meters, the flux density in Jy is calculated to be 0.2. Why is that less than the smaller dish with an effective area of only 1.2 meters? It is because the effective area is so much bigger for the larger dish and we are detecting the same power. A larger dish can detect fainter objects because it gathers more photons or energy. For a given source of a certain strength, the larger dish will produce a higher output to the detector, all else being equal.

**Green Bank Observatory**

I visited the Green Bank, West Virginia 100-meter radio telescope in 2013. It is a fully steerable radio telescope. It was a National Radio Astronomy Observatory (NRAO) facility of the National Science Foundation (NSF) but it is now being phased out and turned over to others to fund and operate. Hopefully it can remain viable. Green Bank is visited each year by SARA (Society of Amateur Radio Astronomers) for their annual conference. A quick check on the old NRAO web site shows they folks are migrating over to a new website called **www.greenbankobservatory.org**. They have adopted the name Green Bank Observatory.

They are involved in a program called BREAKTHROUGH LISTEN. The details of what this program will do is amazing. They will survey a 1,000,000 closet stars to Earth! And they can detect signals from any of the nearest 100 stars in the manner of aircraft radar. Other telescopes have been involved in the search. Arecibo in Puerto Rico has been feeding data to the BOINC projects that include SETI@Home. The powerful dish Green Bank should increase the odds of detecting intelligent communications, which would





***December 13, 2016 Geminids meteor shower (Courtesy of the Author)***

suggest life. Drop into their site and give them support. They accept donations.

**Geminids Meteor Shower 2016**

The weather was cloudy and moonlit on December 13, here in the Land of Enchantment (New Mexico). Not the ideal conditions for visual meteor observing. If you have been reading this column regularly you probably know I have reported on meteor activity on techniques using radio. Currently the radios are set to DTV (digital TV) channel 2 that operate around 54.31 MHz. The radios are tuned to USB and log the audio to the ARGO charts. The two charts at the top opf this page were recorded around the peak times for the Geminids.The chart at right shows a long trace or echo that's lasts for over two minutes.

Below is a chart created by the SpectrumLab program that is setup to count meteor activity using the same audio that creates the charts above. The bar graph on the left is for the day I pulled the chart. The matrix chart on the right shows counts per hour starting a 00h UT at the top and 23h at the bottom. The days or columns start from the right.

The count data the program saves is imported into the Colorgramme software, which creates a monthly chart updating itself each hour. This is the December 2016 chart. Note the red hot spots on the 13th of December for the hours of 11 to 12 UT (4 to 5 am MST.) The counts are close to a 100/hr. The software doesn't count everything that could be classified as a meteor but it does give a good snapshot of when the meteor hour peaks. Not all meteor showers are as conveniently tracked since they have low counts in the 10 to 20 per hour. Other meteors occur that may not be associated with the meteor show of interest. To do that one needs a tracking radar or system that can calculate the source of the meteor's trail.

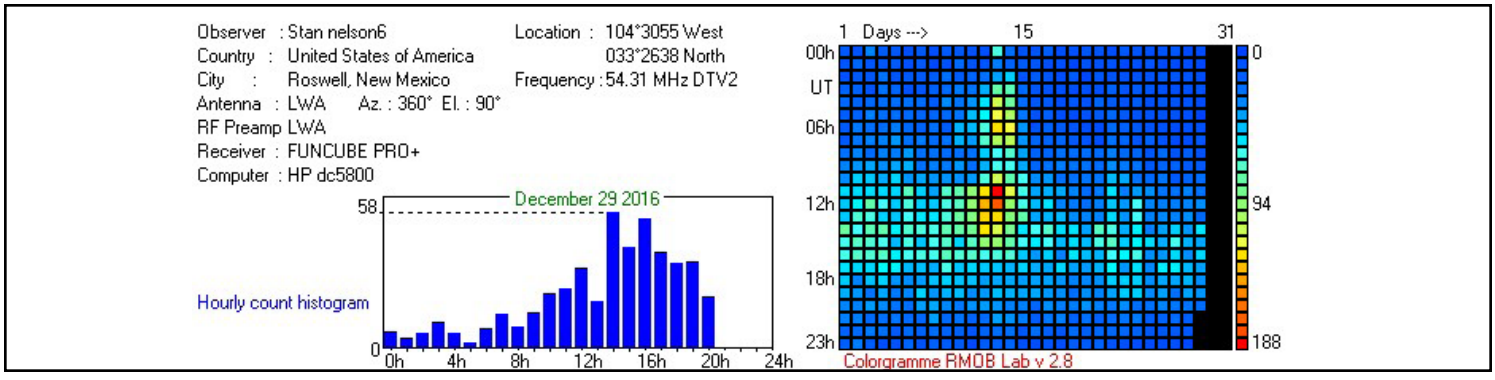
Visit this site to see other Colorgramme charts uploaded by other stations around the world at: **www.rmob.org/livedata/main.php#Stan Nelson7**.

**Books for Radio Astronomy**

Fundamentals of Radio Astronomy, Observational Methods by Marr, Snell, and Kurtz. Published by CRC Press. 2016.

Occasionally I have reviewed or listed a number of textbooks on radio astronomy that you may find helpful in the hobby. Most textbooks are expensive these days and I often obtain used books from sites such as ABE Books. They offer some good deals on radio astronomy books that are out of print and/or out of date. I also do a search now and then on Amazon to see if there are new radio astronomy books.

This book came up and the price ($60.00) was somewhat cheaper than the usual textbooks. What caught my eye is it is written at a level that is much easier to understand and includes numerous problems and answers on many topics with good explanations. There are the usual mathematics but most are presented with more insight than advanced texts. Chapter 1 is filled with introductions to radio waves, understanding the celestial sky, and basic telescopes—all essential in understanding the hobby. Other chapters cover radiation physics, radio telescopes, single dish observations, interferometers, and aperture synthesis. TSM



# The Longwave Zone

**By Kevin O'Hern Carey WB2QMY** **wb2qmy@arrl.net**

# 630-Meter Action and Readers' Reports

February is typically one of the best months of the year for longwave DXing in the Northern Hemisphere. Historically, natural static is about as low as it gets, and the hours of darkness are still long, promoting long distance reception. Year after year, some of the best intercepts I've received from LF listeners have been made in February. So what do you need to join in the fun? Well, you can start with the information sources we've presented here over the past several issues. They'll help you know where to look on the band, and how to get the most out of your listening sessions.

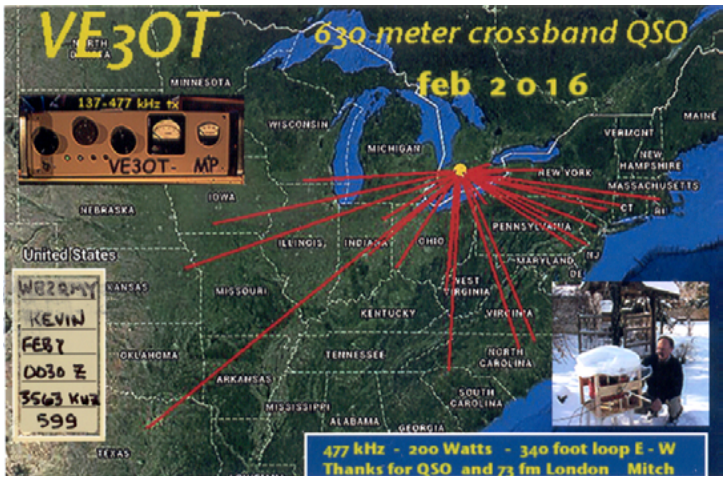
Many DXers prefer to look north at this time of the year in search of high-powered Canadian beacons in the remote, sub-arctic regions of the country. Their higher power (often 400 watts or more), combined with less congestion here in the U.S. (due to recent shutdowns), means that you can pull in some very distant catches. Some also like to look to the far south and Pacific regions for exotic DX from the likes of Columbia, Brazil, and Easter Island. These are all possibilities at this time of the year.

If targets closer to home are your thing, be sure to check out the 472-510 kHz spectrum for amateur and experimental operations. While U.S. Hams still don't have authorization to begin operating in the 472-479 kHz (630 meter) band, there are many stations operating nearby this range with experimental FCC licenses. Also, ham operation is underway in Canada on 630-meters, and in many other countries of the world. Some surprising distances can be achieved on this band, which is just below the AM Broadcast band. You will often find signals in standard keyed-carrier CW mode, but more and more stations are also trying "WSPR" digital operation. WSPR is particularly well suited for weak signal work.

We continue to hear more and more about shutdowns of U.S. aero beacons here in the U.S. It took more than 15 years from the time rumors first began about their demise, but it is happening very quickly now. The benefit for us, just as with shortwave listeners, is a clearer band. Stations that were once buried in a sea of competing signals are now often quite audible. If it's been a while since you've scanned longwave, now may be a good time to get reacquainted!

**Mailbag**

Below is a note from reader Dennis Hanley KB6C on some recent shutdowns in the State of California. Note the "WRLBxxxx" callsigns cited. These are FCC identifiers for




***I received this QSL card to confirm a cross-band contact with Canadian ham VE3OT (Ontario). I heard him transmitting on 630 meters in CW, and he copied my reply on 80 meter CW. This is the next best thing to being on 630m myself!***

the licensee, but they are not used on the air. The beacons used traditional 3-letter on-air identifiers, and their operations were coordinated through the FAA, as with other beacons in the 190-535 kHz range.

Dennis writes: "Hello Kevin, I have been following your column for quite some time now, going back to the *Monitoring Times* days. Thank you for writing it for these many years! I've been meaning to send an update for a few months now, so here goes. The County of Los Angeles operates five general aviation airports, four of which had NDBs. I noticed a while back that two went off the air for a few months, and then came back on. I thought this was very strange. Now all four are gone. A little research reveals that the licenses were canceled."

The five airports are:

- General Wm J Fox Airfield in Lancaster, CA

WRLB2469, 282 kHz, "GWF" canceled 12/2/15

- Compton Airport, Compton, CA

WRLB2470, 378 kHz, "CPM" canceled 12/2/15

- Whiteman Airpark, Pacoima, CA

WRLB2472, 370 kHz, "PAI" canceled 2/12/16

- El Monte Airport, El Monte, CA

WRLB2473, 359 kHz, "EMT" canceled 12/28/15

- Bracket Field, La Verne, CA

Never equipped with an NDB

"Also, The Burbank Bob Hope Airport had an NDB on 252 kHz "UR," which is also off the air, but I can't find any

license information for it *[this may have been an FAA-run beacon—K.C.]*. I suppose it's a sign of the times, and there are fewer and fewer stations to catch on longwave as time goes on."

I was also pleased to hear from frequent contributor Carl Schmidt WA8ZTZ (MI):

"Hi Kevin, LW conditions have been outstanding here recently, day and night. I have never seen it this good. Early this morning I heard my first NDBs in British Columbia. I have never received any beacons this far west in the past:
YQZ 359 Quesnel, BC 1,932 mi
ZP 368 Sandspit, BC 2,320 mi. (my first +2000 mi. catch)

"Propagation wasn't just favoring the west as the following NDBs were also heard:
PN 360 Port Menier, QC 1,021 mi.
JT 390 Stephenville, NL 1,249 mi.
YPH 396 Port Harrison, QC 1,112 mi.
CBC 415 Cayman Brac, CYM 1,600 mi.

"All of these were logged from my Rochester, Michigan, location using an Alinco DX-SR8T receiver with a PAR EF-SWL antenna."

**SAQ 17.2 kHz Report**

The folks at historic alternator station SAQ/17.2 kHz in Grimeton, Sweden had another successful transmission on Christmas Eve. Their signal was logged heavily in Europe, but also heard by some listeners in North America. The station reported: "On December 24, 2016 the traditional transmission with the old Alexanderson alternator SAQ at World Heritage Grimeton Radio Station, Sweden took place at 08:00 UTC on 17.2 kHz CW. Unfortunately, our web site got overloaded and could not broadcast any live video this time.

"The transmission has been reported by over 400 listeners, a new record! We would like to thank all listeners for their efforts and feedback. The summary report with all listeners can be viewed and downloaded here: **http://alexander.n.se/wp-content/uploads/2017/01/SUMMARY-REPORT-ON-SAQ-TRANSMISSION-CHRISTMAS-2016-12-24-1.pdf**"

**Selected NDB Loggings**

Our logging contributors this month are Richard Palmer (MO), Tom Root (MI), and Russ Hill (MI). Each contributor is identified by their initials and state in the right-most column. Bolded entries indicated favorite catches, and these are explained in the contributor's comments. My thanks to all for submitting logs for this issue. Loggings are always welcome at the e-mail address in the column header. Ask for our free loggings template, and it will be sent out to you. Some even find the template helpful as an e-logging tool, but we also hope you'll send your catches in to The Longwave Zone!

**LF Link Of The Month**

NDBRNA Website: **www.classaxe.com/dx/ndb/rna/signal_list** This site provides an advanced lookup tool for signals received in the Americas, plus Hawaii. You can enter a frequency (or frequency range), ID, or other criteria to search for stations. You will get a summary of who has heard a particular station, when it was last reported, and an exact definition of the ID tone in Hz. This is a highly recommended site, especially for active DXers looking for the latest status of a signal.

| kHz | ID | Location | By |
|---|---|---|---|
| 204 | GB | Buffalo, NY | R.P. (MO) |
| 206 | EF | Castlegar, BC | R.P. (MO) |
| 209 | IB | Atikokan, ON | T.R. (MI) |
| 214 | YIO | Pond Inlet, NU | R.P. (MO) |
| 216 | CLB | Wilmington, NC | T.R. (MI) |
| 218 | RL | Red Lake, ON | T.R. (MI) |
| 219 | YMG | Manitouwadge. ON | T.R. (MI) |
| 219 | ZRS | Regina, SK | R.P. (MO) |
| 220 | FZ | Syracuse, NY | R.P. (MO) |
| 223 | YYW | Armstrong, ON | T.R. (MI) |
| 224 | MO | Moosonee, ON | T.R. (MI) |
| 227 | YAC | Cat Lake, ON | T.R. (MI) |
| 227 | 9X | Brooks, AB | R.P. (MO) |
| 233 | QN | Nakina, ON | T.R. (MI) |
| 235 | CN | Cochrane, ON | T.R. (MI) |
| 236 | ZRJ | Round Lake, ON | T.R. (MI) |
| 241 | HF | Hearst, ON | T.R. (MI) |
| 243 | YVB | Bonaventure, QC | T.R. (MI) |
| 245 | CB | Cambridge, NU | R.P. (MO) |
| 246 | ZXJ | Fort Saint John, BC | R.P. (MO) |
| 248 | WG | Winnipeg, MB | T.R. (MI) |
| 250 | UBP | Playa Baracoa, CUB | R.P. (MO) |
| 256 | YXN | Whale Cove, NU | R.P. (MO) |
| 256 | YCY | Clyde River, NU | R.P. (MO) |
| 258 | ZSJ | Sandy Lake, ON | T.R. (MI) |
| 260 | YAT | Attawapiskat, ON | T.R. (MI) |
| 263 | QY | Sydney, NS | R.P. (MO) |
| 265 | YKO | Akulivik, QC | R.P. (MO) |
| 266 | YFH | Fort Hope, ON | T.R. (MI) |
| 272 | GLS | Baltra Island, GAL | R.P. (MO) |
| 273 | DOM | Marigot, Dominica | R.P. (MO) |
| 277 | YLC | Kimmirut, NU | R.P. (MO) |
| 285 | UHA | Quaqtaq, QC | R.P. (MO) |
| 290 | YYH | Taloyoak, NU | R.P. (MO) |
| 304 | ZQM | Riverview, NB | R.P. (MO) |
| 304 | FH | Whitecourt, AB | R.P. (MO) |
| 309 | GPI | Guapi, CLM | R.P. (MO) |
| 315 | UBR | Cayo las Brujas, CU | R.P. (MO) |
| 323 | UWP | Argentia, NL | R.P. (MO) |
| **323** | **TAB** | **Crown Point, TRI** | **R.P. (MO)** |
| 323 | KR | Schefferville, QC | R.P. (MO) |
| 328 | YTL | Big Trout Lake, ON | T.R. (MI) |
| 329 | YHN | Hornepayne, ON | T.R. (MI) |
| 329 | HMA | Hondo, TX | R.P. (MO) |
| 332 | YFM | LaGrande 4, QC | T.R. (MI) |
| 332 | QT | Thunder Bay, ON | T.R. (MI) |
| 332 | RPF | Carthage, TX | R.P. (MO) |

| | | | |
|---|---|---|---|
| 332 | DKA | Kenansville, NC | R.P. (MO) |
| 335 | YLD | Chapleau, ON | T.R. (MI) |
| 340 | YY | Mont Joli, QC | T.R. (MI) |
| 340 | YY | Mont Joli, QC | R.H. (MI) |
| 341 | YYU | Kapuskasing, ON | T.R. (MI) |
| 341 | YYU | Kapuskasing, ON | R.H. (MI) |
| 344 | YGV | Havre-St-Pierre, QC | R.P. (MO) |
| 344 | FCH | Fresno, CA | R.P. (MO) |
| 346 | YXL | Sioux Lookout, ON | T.R. (MI) |
| 346 | YXL | Sioux Lookout, ON | R.H. (MI) |
| 351 | YKQ | Waskaganish, QC | R.H. (MI) |
| 353 | IN | Intern'l Falls, MN | T.R. (MI) |
| 355 | YWP | Webequie,ON | T.R. (MI) |
| 359 | YAZ | Tofino, BC | R.P. (MO) |
| 360 | PN | Port Menier, QC | T.R. (MI) |
| 360 | PN | Port Menier, QC | R.H. (MI) |
| 360 | BFI | Beef Island, VRG | R.P. (MO) |
| 361 | HI | Holman, NT | R.P. (MO) |
| 362 | GND | Point Salinas, GRD | R.P. (MO) |
| 365 | YGZ | Grise Fiord, NU | R.P. (MO) |
| 365 | PAL | Palma, EQA | R.P. (MO) |
| 366 | YMW | Maniwaki, QC | T.R. (MI) |
| 369 | ZDX | St. Johns, ATG | R.P. (MO) |
| 371 | GW | Kuujjuarapik, Q C | R.H. (MI) |
| 372 | YCO | Kugluktuk, NU | R.P. (MO) |
| 375 | PJS | Newport News, VA | R.P. (MO) |
| 375 | BD | Moose Jaw, SK | R.P. (MO) |
| 378 | UX | Hall Beach, NU | R.P. (MO) |
| 379 | BRA | Asheville, NC | T.R. (MI) |
| 379 | SGT | UNID* | R.P. (MO) |
| 382 | YPL | Pickle Lake, ON | T.R. (MI) |
| 382 | APT | Jasper, TN | R.P. (MO) |
| 385 | TKL | Tikal/Flores, GTM | R.P. (MO) |
| 388 | PK | Parkersburg, WV | R.P. (MO) |
| **390** | **JT** | **Stephenville, NL** | **T.R. (MI)** |
| 390 | VP | Kuujjuaq, QC | R.P. (MO) |
| 391 | 3B | Brockville, ON | T.R. (MI) |
| 391 | DDP | San Juan, PR | T.R. (MI) |
| 392 | ML | Charlevoix, QC | T.R. (MI) |
| 396 | GOI | Godman, KY | T.R. (MI) |
| 396 | YPH | Inukjuak, QC | T.R. (MI) |
| 396 | CQB | Chandler, OK | R.P. (MO) |
| 397 | CIR | Cairo, IL | T.R. (MI) |
| 399 | ZHD | Dryden-Thunder, ON | T.R. (MI) |
| 400 | XW | Flemingsburg, KY | T.R. (MI) |
| 401 | YPO | Peawanuck, ON | T.R. (MI) |
| 401 | YPO | Peawanuck, ON | R.H. (MI) |
| 402 | L4 | Nipawin, SK | R.P. (MO) |
| 405 | 9G | Sundre, AB | R.P. (MO) |
| 407 | ZHU | Montreal H/B, QC | T.R. (MI) |
| 409 | YTA | Pembroke, ON | T.R. (MI) |
| 410 | EGQ | Emmetsburg, IA | R.P. (MO) |
| 413 | YHD | Dryden-Regional, ON | T.R. (MI) |
| 414 | LK | Louisville, KY | R.P. (MO) |
| 415 | SLS | Salinas, EQA | R.P. (MO) |
| 415 | CBC | Cayman Brac, CYM | R.P. (MO) |
| 512 | HMY | Lexington, OK | T.R. (MI) |
| 516 | YWA | Petawawa, ON | T.R. (MI) |
| 362 | SB | Sudbury, ON | R.H. (MI) |
| 368 | SOY | Sioux Center, IA | R.H. (MI) |

** SGT/379 kHz is an unidentified beacon that has been reported by a few people. Does anyone have any further information on this one? There is an SGT listed on 269 kHz in Stuttgart, AR, and it's possible this is a recent frequency change. Can anyone verify if Stuttgart is still on the air at 269 kHz? I'd be especially interested in any daytime reception of SGT/379 kHz from any TLZ readers.*

Notes on Loggings:
• All loggings received at 300 miles/483 km or greater distance are welcome.
• For ITU codes, refer to: **https://en.wikipedia.org/wiki/List_of_ITU_letter_codes**.
• All logging times are in UTC format, as broadcast by WWV or CHU Canada.
• Please double-check the spellings in your location data.

**Contributor's Information**

• Richard D. Palmer (MO): Receiver(s) Used: ICOM R-75 Antenna(s) Used: Clifton Z1501 active, base up 25 foot, 10 foot whip; Audio Processors: Timewave DSP-599zx and a Ratzlaff 9 Hz in series

**Comments:** I was able to log 758 beacons this month, 31 more than last month. This included three all-time new ones and 31 more for the yearly list, bringing the yearly total to 957 beacons. In comparing 2016 to 2015, it showed a 104-beacon increase. This was mostly due to more listening time being spent at the radio. 44 of these were new loggings this year. TAB/323 kHz was one of my most-wanted NDB's. This frequency is full of stations and this one at 2,658 miles was not an easy catch.

• Russ Hill (MI): Receiver(s) Used: Kenwood R5000 Antenna(s) Used: Palomar Loop

• Tom Root (MI): Receiver(s): ICOM R-75 Antenna: Clifton Z1501F active antenna with a 10' whip; the antenna base is ~12'7" above earth ground.

**Comments:** Wow, what great winter fun! On good listening nights I always hate to have to pull the plug prematurely, but personal needs sometimes beckon. And with CIR, HMY, ZHD, JT, GOI and YVB as absolute new catches for me, it was difficult to decide on JT/390 kHz, Stephenville, NL 01/09 0624Z at 1,264 miles as my favorite for this period.

**TSM**

# Adventures in Radio Restoration

**By Rich Post KB8TAD** **kb8tad@gmail.com**

# Raymond Loewy meets Rube Goldberg: The Hallicrafters SR-75


***Hallicrafters S-38B and SR-75 side by side. The key knows which is which. (KB8TAD photo)***

It was obviously one of the most unusual radios Hallicrafters ever designed. From the schematic and pictures in the manual, it looks like someone took a Hallicrafters S-38B, added a separate set of controls and knobs on the back, stuck a battery holder for a couple of "D" cells inside, sandwiched in a 7-pin miniature tube between the usual octal tubes, added sockets for a plug-in coil and crystal on top of the chassis, and attached a 5-pin jack for a code key and tuning lamp on the back. An antenna wire pigtail hangs off the back, separate from the receive antenna terminals. All of this was mounted on the hot-chassis of an S-38B. Industrial designer Raymond Loewy was responsible for the nice half-moon dial face of the S-38B, but from the pictures and the description, I wondered if Rube Goldberg had helped with the engineering for the SR-75! I was quite sure that UL may not have approved of this version of the S-38B.

**The Novice License**

In 1951, the FCC created the Novice class license. The entry-level license required code proficiency of 5 words per minute and passing a test on theory and regulations. The license was valid for only one year and was not renewable. After one year, it was expected that the Novice would pass the requirements for the General or Technician class license. Several companies including Hallicrafters quickly moved to capture a share of the expected sales of equipment for the new licensees. The 1951 ARRL Handbook, published in December 1950, mentions that the new license class was imminent, but not yet in force.

However, Hallicrafters already had an ad for the SR-75 transceiver in that Handbook edition. The ad announced, "New Transceiver with Amazing Performance" ... "Transmitting section uses electron-coupled Xtal oscillator plus output


***SR-75 ad in 1951 Allied catalog. (Author's collection)***

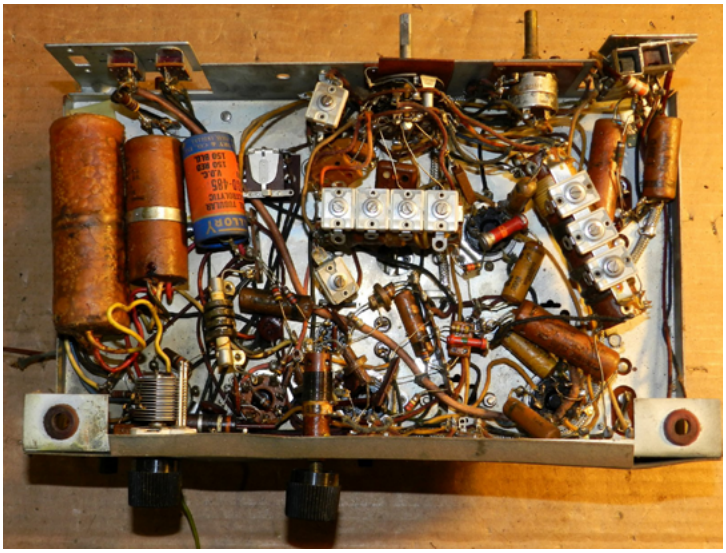
tube of receiver. Oscillator keying, through relay, is completely isolated. Voltage doubler rectifier to increase plate voltage...The Receiving section is substantially the same as our S-38B."

The transmitter covered the 80, 40, 20, 11 and 10-meter ham bands at an input power of 10 watts. Output was optimistically advertised at 7.5 watts on 80 meters and 4.5 watts on 10. It was only sold from 1950 to 1951, according to Chuck Dachis' book, "Radios by Hallicrafters."

The introductory price of $79.95 was thirty dollars more than the price of the S-38B itself in a day when one dollar was worth $9.26 in today's economy. That price climbed to $89.95 in the May 1951 Hallicrafters ad in Radio News, nearly twice that of the S-38B itself. The SR-75 was prominently featured in the 1951 Allied catalog (see picture) but disappeared from their 1952 catalog. I suspect that "Elmers," those amateur radio mentors to the new Novices, who also administered the code and theory tests, steered many new hams away from the set. There were options, including adapting military surplus such as Command transmitters that were widely available, more powerful and cheap or perhaps building a simple ARRL Handbook "slat board" transmitter.

In the spring of 1953, Heathkit introduced its AT-1 transmitter rated at 35 watts input for $29.50. That along with Heathkit's transformer-operated AR-2 receiver with its active BFO at $30 including the cabinet eclipsed both the price and performance of the Hallicrafters offering. The result is that the SR-75 is relatively scarce today.

I had only seen the transceiver in pictures and read about it in advertisements having never had hands-on or even the opportunity to see one close-up. At an antique radio swap meet, I spotted what looked like an S-38A or B, but a closer look at the model number revealed that it was indeed an SR-75. My curiosity was piqued. Despite some obvious cosmetic



***The SR-75 chassis bottom as found. (KB8TAD photo)***

issues as well as a missing back and broken send-receive slide switch, it was reasonably priced and I quickly purchased it. It came with one plug-in coil for 80 meters and unknown to me when purchasing, a 40-meter crystal plugged in the chassis-mounted socket.

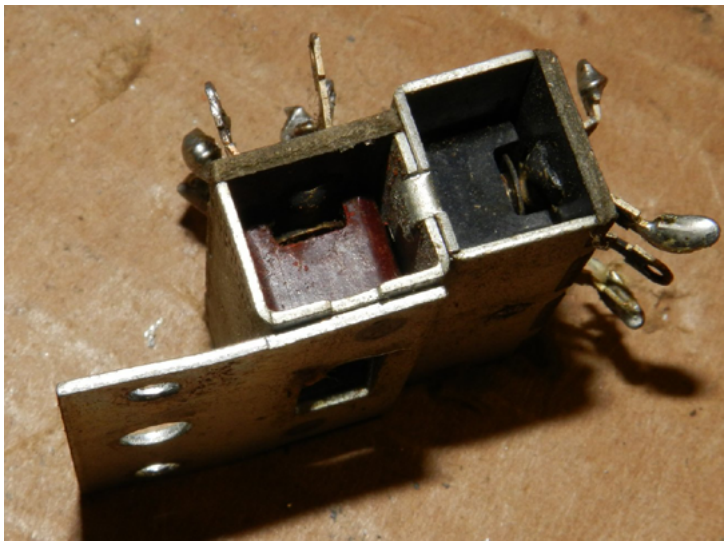
The manual is available on the net as either a PDF [1] or DJVu download [2]. Studying the schematic, it is apparent that the 50L6GT audio output tube has had several components added to the S-38B circuit to make it double as a transmitter RF output tube. Voltage doubling is by way of a 117Z6GT rectifier which substitutes for the 35Z5 in the S-38B. Although the Hallicrafters ad in the 1951 Handbook states the transceiver is AC-DC, voltage doubling at the rectifier will, of course, only work if connected to AC. A DC input would provide only a bit less than half the "B" voltage needed for the set. The Allied catalog ad corrected that error.

**First Looks**

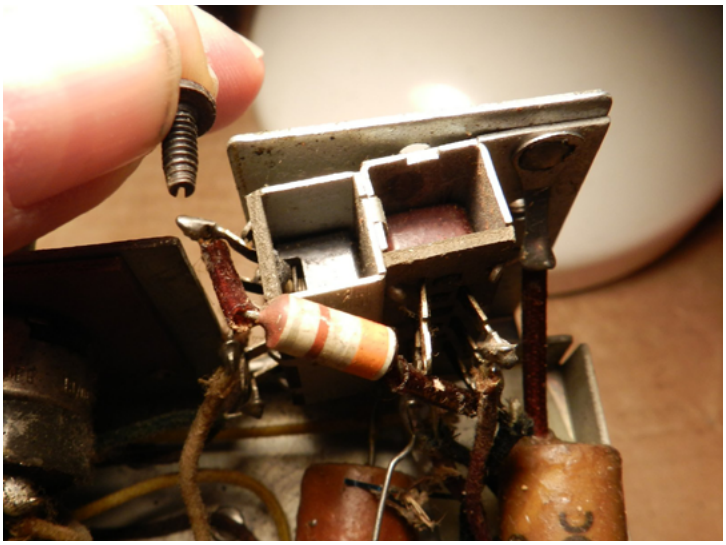
The battery holder and two "D" cells provided the power source for a small keying relay. At least this little transmitter would not have substantial voltage on the code key, but the real purpose of the relay was to prevent contact with the chassis which, like the S-38B, would be live with line voltage switched either directly to it or through the cold filaments when switched off. The radio had a power cord interlock like the S-38B but the back was missing, not surprising since the back had to be removed every time another crystal or coil was needed. Like the S-38B, the SR-75 allocates substantial space for the electrolytic filters under the chassis.

The chassis had two large multi-section paper and wax covered electrolytics. It also had a third paper electrolytic that was likely added as a replacement or for additional filtering. With the big electrolytics removed, there might be enough room under the crowded chassis for an added isolation transformer as I had installed in the S-38B.

Besides cosmetics, broken dial cord, missing banana



*The broken transmit-receive switch assembly. (KB8TAD photo)*



*The cabinet mounting screw that bent the switch plate. (KB8TAD photo)*

pin on the 80-meter coil, and the missing back, the biggest issue for the set was the broken slide switch for transmit-receive. That switch would be used often, actuated every time a ham went from listening to transmitting and back. Looking at the switch from the chassis side, I realized that this was a lot more switch than the simple single pole send-receive switch in the S-38B. The plastic slide actuated two separate switch sections of double-pole, double-throw physically mounted in tandem. The result was a four-pole double-throw switch assembly with a total of 12 terminal connections moved by a simple sliding plastic piece. Some friction on the switch might have contributed to the eventual breaking of that little plastic piece. The switch base had also been bent because the wrong front panel mounting screw had been used which did not have proper clearance pushing part of the switch out of place at an angle. One of the mounting screws was indeed a very short one, which would have allowed for proper clearance but the screws had been swapped and forced into place.

There was no simple repair for the switch. I did find a possible replacement at an on-line distributor, but it was a different design than the original. I drilled out the rivets holding the broken switch to the insulator-mounted switch bracket and opened the broken switch to see what it would take to rebuild it. The original switch insulator had a notch cut out that actuated the second switch, something that could possibly be cut into the plastic of a donor switch. However, the switch was unique in design. There were no matching donor switches in the "boxe de junque."

One option to the broken switch was to use a simple SPST slide switch and a small relay, an option that might allow the use of any maroon-colored slide switch like the originals in the S-38 series assuming a junk chassis could be located. I decided on the relay option with a simple slide switch of black color that would suffice until a more proper switch could be located. The "boxe de junque" yielded a small 4PDT relay with a 110-volt DC coil, something that could easily be powered by the circuits of the SR-75. In wiring the relay, I kept the original lengths of the switch connecting wires in case I later found a proper replacement or a donor switch. I also took copious notes to avoid any mix-up of all the wires that were now to be moved to the relay.

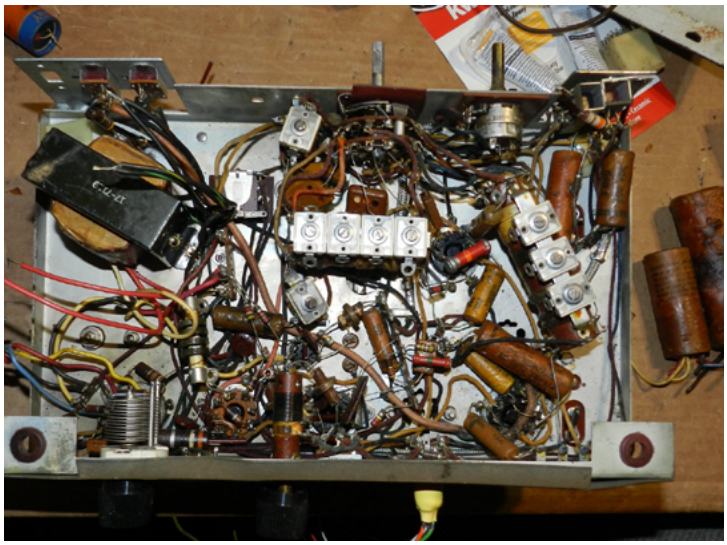
**Isolation Transformer, No New Holes Needed**

The SR-75 requires more wattage than the S-38B. After removing the multi-section electrolytics, I checked to see if a Triad N-68X isolation transformer rated at 50VA would fit in the space under the chassis. The Triad is still available from distributors as described in last month's restoration column for the S-38B. As luck would have it, the SR-75 chassis already had an unused extra hole near a terminal strip that was probably intended for the S-38B but now would be used for one bolt for the isolation transformer. The other side of the transformer fit neatly under the insulator for the switch bracket, which was now no longer as important with an isolation transformer on board.

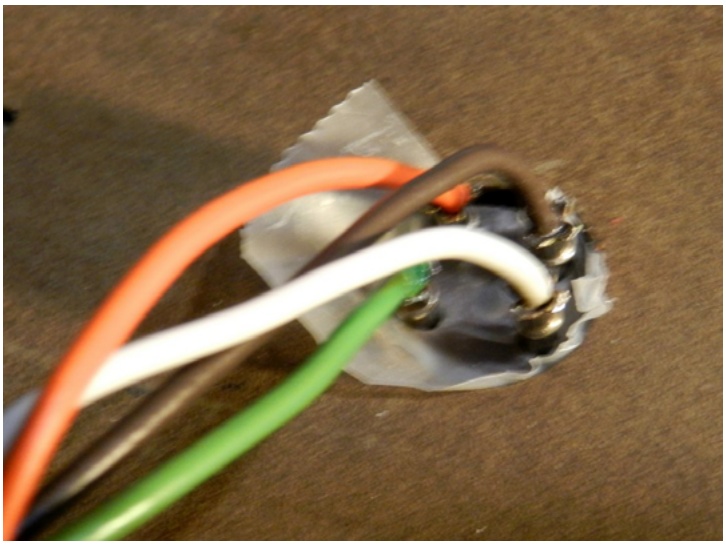
As with the transformer added to the S-38B, I was concerned that the voltage might be too high given today's higher line voltages. Testing the Triad N-68X revealed an output of 141 volts at no load and 128 with a 40-watt load. Like the S-38B, I opted to wire the isolation transformer in reverse both to limit the voltage and reduce any possibility of saturation. Reversing the transformer would allow it to run cooler.

**Electrolytics and Split High Voltage**

The two multi-section electrolytics had the typical color-coded leads. One of the capacitors included two negative leads; unusual, but appropriate for a voltage doubling arrangement. I clipped the wires about an inch or so from the cap body, leaving enough of the leads to identify the colors. However, the printing on the caps was totally obscured by the dark and roughened outside wax. A close encounter with a heat gun melted the wax so that the markings were tem-



*Dry-fitting the isolation transformer in the place that had been occupied by the electrolytics. (KB8TD photo)*



*The pins that will be part of the new plug piercing the cellophane tape. (KB8TAD photo)*

porarily visible once again. It was then fairly easy to match the color codes of the wires to the values for the replacement caps. All but one of the sections was 40 MFD. The voltage doubling arrangement basically provides both positive DC relative to chassis and a negative DC source relative to chassis. The 50L6 is fed with negative 118 volts on its cathode when transmitting and is self-biased with the usual +6 volts or so when receiving. According to the voltage chart in the manual, the cathode at negative 118 relative to chassis added to the positive 118 on the plate relative to chassis together add to 236 volts when transmitting. Since the recommended loading is to 40 mA as indicated on the meter, which is in parallel with a 100-ohm resistor, that represents an input power of about 10 watts as advertised. Given that both the positive and negative sources are half wave, the set obviously requires an AC power source to transmit.

**Molding a Plug for the Key and Meter-Lamp Lack**

I did not have a matching plug for the 5-pin jack on the back of the chassis for connecting the external key and a socket for the type #49 tuning lamp (60 mA at 2 volts) or optional 100 mA meter. In checking the size of the pins for that plug, I determined that they were the same size as used on octal tube bases. I removed the pins from a junk tube base, carefully nipping away the Bakelite so that the serrated tops of the pins that gripped the Bakelite remained intact. After soldering wires to each pin, I placed some cellophane tape on the jack exterior and pushed each of the pins through the tape into the jack. The serrated portion at the top of each pin was left exposed above the jack. Then a piece of heath-shrink tubing that just fit into the slightly recessed jack opening was pushed into place and some two-part "J-B Weld" epoxy was applied into the void between the exposed upper part of the pins and the heat shrink tubing which was now acting as the outside form for the plug.

After the epoxy had hardened, I removed the now solid plug from the jack and placed another piece of heat shrink tubing over the top, shrinking the piece into place. The result was a very solid molded plug. Although the J-B Weld epoxy states that it is "Steel reinforced," a quick check with the ohmmeter on its highest range confirmed that it was indeed a good insulator. Automobile body putty such as "Bondo" could also have been used to form the plug body.

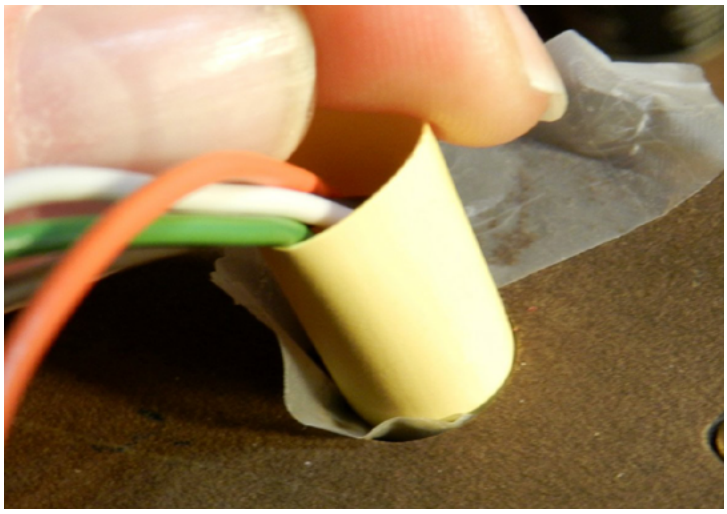
**Replacing the Wax Capacitors**

The schematic shows 5 sections of 40 MFD electrolytics and one section of 60 MFD. However, C16C, the 60 MFD section in one electrolytic and C36C, a 40 MFD section in the other are wired in parallel, allowing the option of replacing those two with a single 100 MFD cap. Two electrolytics had their negative leads tied to the plate pin of rectifier.

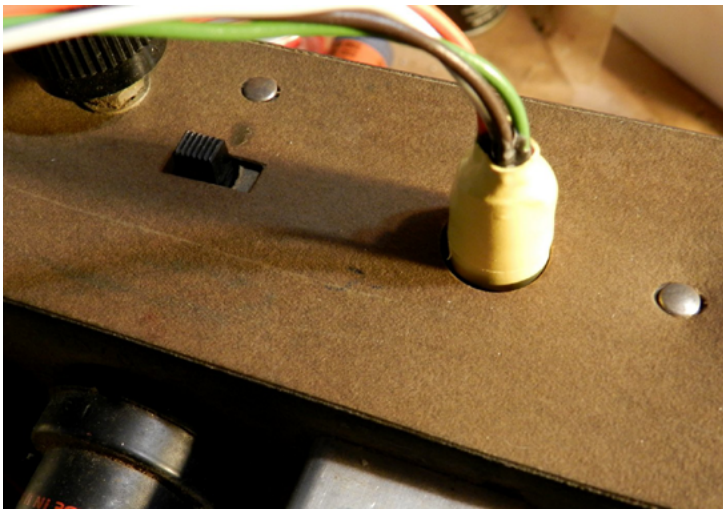
One of those had its positive connection tied to chassis and the other to the B+ side. There are also 8 tubular dry capacitors, two of which are no longer needed with an isolation transformer installed. I replaced the remaining six. All the other capacitors were ceramic and mica, which seldom need replacement. Before replacing each cap, I measured each resistor, replacing several that were out of tolerance. One 1200-ohm resistor had nearly doubled in value.

**That 117-Volt Rectifier**

All of the series-string filaments along with two 39-ohm resistors are fed directly off the now isolated power line. The 117Z6 rectifier filament is also fed directly off the line all by itself. That 117-volt filament at 75 mA is responsible for nearly 9 watts of heat. Since no other tube is dependent upon that filament draw, a plug-in substitute with a couple of silicon diodes can readily replace that rectifier. As a plug-compatible and easily reversible change, I made a substitute from an octal tube base and four 1N4007 diodes. I only needed two of those diodes but since they are cheap, I prefer two in



*Fitting the heat shrink into the recessed jack location. KB8TAD photo)*



*The newly formed molded plug in place. (KB8TAD photo)*

series for each leg since that doubles the PRV (peak reverse voltage). The silicon diodes would be more efficient than the tube rectifier. However, I had reversed the isolation transformer, which lowered the voltage a bit. I expected that the more efficient diodes might compensate for that lowered voltage.

The plug-in solid-state rectifier replacement would also let me test the B+ and B- voltages since I could feed the radio with 12 volts AC or less by way of the Variac. That would let me see the action of the rectifier and the electrolytics, therefore checking my work before committing the set and all its new parts and connections to full line voltage.

The added relay had been connected so that receive was the unpowered default. I had not yet hooked up power to the relay coil, preferring to check the radio receive function before trying the transmitter portion. I also needed to find a 110-volt DC source for the coil. The coil resistance was 10K ohms so it needed a small dropping resistor to power it off the set's B+ line which was expected to be higher than 110 volts. The current required for the coil would be 11 milliamps. With just a few volts of line input, I checked the B+ and B- lines. Both sides gave a proper indication. There were no apparent shorts or errors in wiring.

With a bit more confidence now, I applied some DeoxIT to the band switch, the volume control, the speaker-headphones switch, the CW-Phone switch, and the ground feelers on the variable cap. After making sure the band switch shaft was full clockwise on the AM broadcast band and the switches in the proper position for broadcast, I hooked the chassis up to my shop speaker, added a length of wire to the receive antenna terminal and then cranked up the Variac. The pilot light glowed nicely and the current draw was as expected. After the usual warm-up, the receiver came to life on the local broadcast stations, probably for the first time in many years. The next step would be to measure the B+ voltage and wire up the new relay coil through an appropriate resistor.

A series resistor of 680 ohms was placed between the main B+ line and the relay coil. I mounted the relay with hot melt glue close to the switch bracket that now held a simple SPST switch. Alignment of the receiver circuitry was identical to that of the S-38B.

**Tube Surprise**

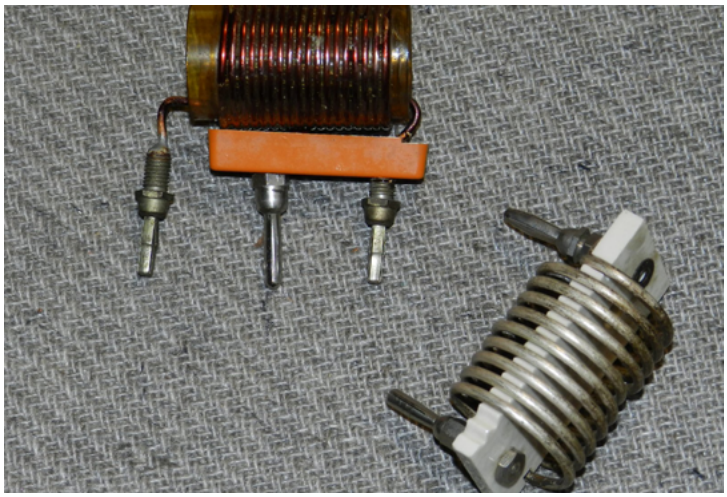
Testing the working radio receiver by placing the switch in transmit position did not increase the wattmeter draw noticeably. However, I noticed a spark inside the miniature tube that had accompanied the set. I had assumed it was the correct 12BA6. A quick check showed that the tube was marked as a 12BF6. I should have checked the tube more closely before assuming it was correct. Had I damaged the radio or the tube? A quick check of the 12BF6 showed it was still OK. A spare 12BA6 was quickly located.

**Coils**

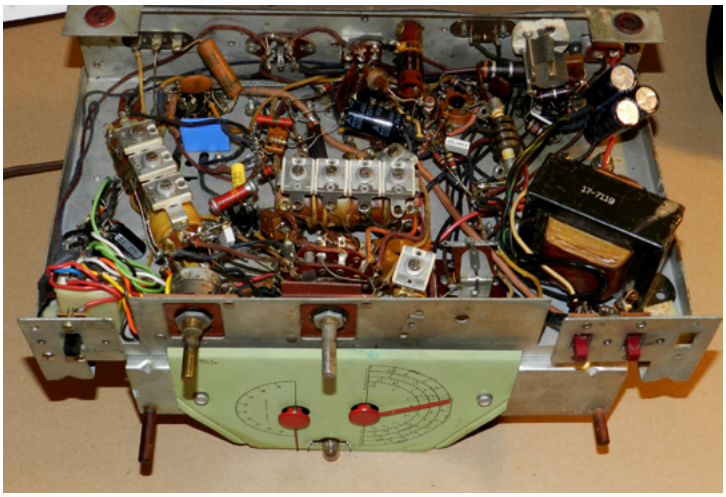
The 80-meter coil that came with the SR-75 was missing one of the banana plug pins with female thread matching the bolts on the coil. The "boxe de junque" yielded a replacement. I also wanted a 40-meter coil but did not know the dimensions required. I assumed that I could lash up a trial coil using the same dimensions for a form as those of the 80-meter coil.

While searching for the proper banana pin for the 80-meter coil, I also looked for a possible form for creating a 40-meter coil. That search yielded a complete ready-made homebrew coil with soldered-on banana pins. I just had to move the heavy wire somewhat to change the distance between the pins to match that required by the SR-75. I thought the coil might be useful for 40 meters but wasn't sure.

The inductance of the 80-meter coil measured 20.9 uH. The possible 40-meter coil measured a 5.9 uH. Using an on-line calculator [3] and working backwards from the 20.9 uH coil, I determined that the parallel variable cap was likely 100 pF. Therefore, the 5.9 uH coil should be capable of 40 meters. I also located another coil with heavy wire on a flat ceramic form that measured at 2.3 uH. That might be usable on 20 meters and possibly 10 if I shorted a few turns.



*Homebrew and re-purposed 40 and 20-meter coils to fit the SR-75. (KB8TAD photo)*



*SR-75 chassis bottom after installing new components. (KB8TAD photo)*

**Transmitting**

It was time to see if the transmitter portion was working. I installed the 80-meter coil and crystal, cleaned the battery holder terminals, and installed two "D" cells. A code key was hooked up to the appropriate wires from the plug I had made. The battery-powered keying relay clicked nicely when the key was pressed. The other two color-coded plug wires for the tuning lamp/meter were hooked to my VOM on its 120 mA scale. A 15-watt candelabra bulb was connected between the antenna pigtail and chassis as a dummy load. My portable frequency counter was ready to sniff the oscillator.

The set was warmed up on receive. After the broadcast station sound came up, I pushed the slide switch up to the transmit position. The frequency counter sniffed the proper crystal frequency. Pressing the key caused an increase in current consumption and an indication on the VOM milliammeter scale. I tweaked the tuning a bit and then twisted the knob on the compression trimmer used as the load control.

The dummy load showed a bit of light. Tweaking the tuning cap increased the light just a bit but cranking down the little compression trimmer to its maximum made the dummy load light up. I substituted a 7-watt bulb and estimated an output of about 4 to 5 watts. The load control needed more capacitance than the trimmer would allow for the dummy load bulb, but the set was working as it should.

The possible 40-meter coil and crystal also lit the dummy load bulb but doubled in the final! No amount of tuning adjustment would make it go to 40 meters. Looking at the schematic, I had noticed that the 80-meter coil had a 120-pF mica between the plate capacitor side of the coil and the third ground pin. The 40-meter coil as shown on the schematic did not have that arrangement. It just used the two pins. Taking a hint from the 80-meter coil, I temporarily rigged up a 39-pF silver mica between the plate cap side of the presumed 40-meter coil and that third ground pin. That made the difference. The final and the coil were now active only on 40 meters. I modified the coil to permanently add a third pin and that silver mica cap.

I also modified the third coil, removing its ceramic standoff insulators. Male banana pins were added. The two holes in the flat ceramic bar did not quite line up to the SR-75 banana jacks, so one of the banana pins was attached to both the wire and the mounting hole in the ceramic bar and the other to just the very heavy wire which allowed a bit of adjustment by bending the wire. However, the result was very sturdy due to the thickness of the silver-plated wire making up the coil. Testing it resulted in good 20-meter tuning and loading.

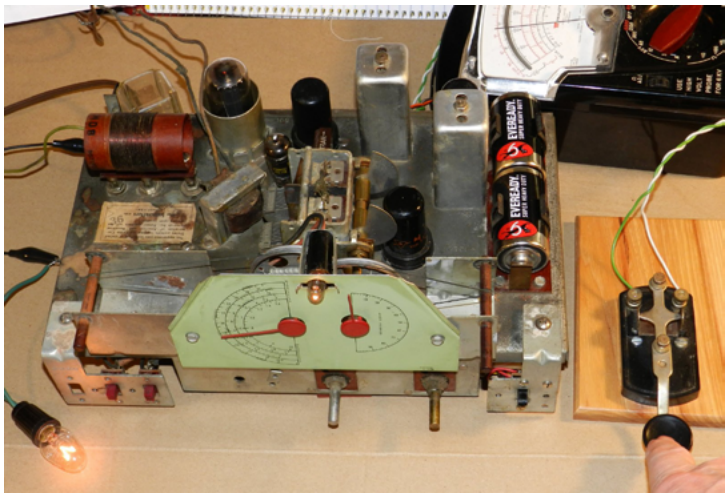
**Dial Cord Restringing and Cosmetics**

The dial pointers and the dial face need to be removed to access the variable capacitor pulley, but the dial stringing is straightforward. A diagram is shown in the manual. I used my favorite old standby, 65-pound Spider-Wire brand multistrand fishing line. Masking tape to temporarily hold the line on the pulley and forceps to clamp the line while making the final knot are handy tools for dial string replacement.

The dial cover plastic needed to be replaced. Since it is flat, I simply cut a piece of packaging plastic to fit. The cabinet has three bendable metal tabs inside that fit into small slots that can easily be cut into the replacement plastic. The tabs are then bent back into place, firmly holding the dial cover.

I tried some touch up of the cabinet with paint that I already had that had been matched to a Hallicrafters SX-71 by the folks at Sherwin-Williams. Their minimum mix is a quart and that is more than enough for multiple radios. The color and sheen were very close to the original of the SR-75, not surprising since the SX-71 is from the same era. The touch-ups improved the looks, but the SR-75 cabinet cosmetics can best be considered a work-in-progress.

A total repaint would improve the looks some more but that would require replacing the silk-screened lettering. Decals are an option such as those sold by RadioDaze[4] for the S-38 series, but given the rarity of the SR-75, the unique



*SR-75 chassis transmitting to dummy load bulb. (KB8TAD photo)*


*Completed SR-75 lighting both a dummy load bulb and a #1804 tuning bulb (near the key, rated at 60 mA at 4 volts which I substituted for a #49 (60 mA at 2 volts). (KB8TAD photo)*

decals for it are not available. Let me know what solutions you have tried for replacing silk-screened labels at reasonable cost. An S-38B cabinet in good condition with changes to the model number and transmit-receive labels would be one option since the cabinets are otherwise identical. Although I have a spare S-38B in addition to the one restored in the previous column, I have no desire to cannibalize a good radio for its cabinet to restore another, so for now I will hold off with further cosmetic improvement.

**Operation on the Ham Bands**

Since the transmitter portion of the SR-75 is basically a crystal-controlled MOPA, there should be no problem operating it as a QRP transmitter. Its signal is less likely to chirp when compared to that of a powered oscillator such as the Ameco AC-1 or homebrew ARRL slat board. I monitored the signal on a digital portable about 20 feet away. There was considerable "back-wave," from the oscillator itself. A slight chirp was noticed when on transmit but that was largely due to the light bulb dummy load and its changing resistance as the filament went from dark to light.

The receiver with a proper antenna is a decent performer given its wide bandwidth, no RF amplifier stage, and regenerative IF as BFO. But that combination would definitely be a challenge to operate, especially beyond 40 meters. Nevertheless, I easily listened to stronger CW signals on the 80 and 40-meter bands and could follow some of the SSB conversations although with some difficulty, wishing for more injection. SSB grew into a dominant mode after this radio was sold. However, the regenerative "BFO" works quite well on CW, its intended purpose. If a Novice in 1951 had used an isolation transformer, the set would have been safe to operate. The coil and crystal can only be accessed after removal of the interlocked back and a vacuum tube or two so I assume the Novice operator would spend most of his time transmitting on one band at a single crystal-controlled frequency. He would have had to tune around for any response to a CQ. As an either-or transmit-receive system, he would not have had the means of spotting his own signal on the receive dial. In a word, the arrangement was workable but definitely primitive by modern standards.

In an article in January 2007 *QST*, Mike O'Brien K0MYW, makes mention of the Hallicrafters SR-75 as the first mass-produced American ham HF transceiver, although wisely using the wording "resembling a transceiver." In my search for Internet information on the SR-75, I could not find any account of anyone having actually used one on the ham bands. I also asked on a couple of Internet forums if anyone had ever operated with one. That elicited plenty of comments but no reports of actual on-the-air operation, so my main goal was to get this set to safely function on transmit as well as receive.

Operating with one of these on ARRL's Straight Key Night (SKN) or a similar low pressure "contest" might just provide unique bragging rights! I'm actually growing fond of the little set despite its limitations. Break-in keying? No, just primitive operating and having fun like a Novice might have had in 1951 but with a bit more knowledge and back-up equipment such as a spare modern receiver. If you have ever communicated with an SR-75 on the ham bands either in the more recent past or especially in the 1950s, please share your experiences. Comments? Questions? kb8tad@gmail.com

**Notes:**

(1) SR-75 manual in PDF format
**http://gmcotton.com/ham_radio/misc%20manuals/Hallicrafters/Hallicrafters_SR75%20HF%20Tranciever_Manual.pdf**

**http://jptronics.org/Hallicrafters/manuals/halli.sr-75.pdf**

(2) Hallicrafters SR-75 manual in DJVU format
**http://bama.edebris.com/manuals/hallicra/sr75**

(3) Resonant Frequency Calculator
**http://www.1728.org/resfreq.htm**

(4) **http://www.radiodaze.com**

TSM

# Antenna Connections

**By Dan Farber AC0LW** **ac0lw@att.net**

# Antenna 101: A Timely Review of What We've Learned

Welcome back, my friends. This month, I was counting on erecting the big loop on my property, testing it, and reporting on it to all of you. Unfortunately, your antenna columnist slipped on ice and fell hard, all 220 pounds of him, and has been nursing a very sore hip. On doctor's orders, the big loop is postponed until I'm hale and hearty again.

So, instead, I'd like to take the opportunity to look back over some of the concepts we've talked about, and make sure we're all on the same page. Radio, and electronics in general, is kind of a unique school of study; nothing's visible. We can look inside a radio, or a tuner, or look at feedline and antenna, but we can't put hands and eyeballs on what's actually going on. If you think about it, most technologies aren't like this; we can actually see what's going on, even if tools like a microscope or a telescope are necessary to make it visible. Radio waves, on the other hand, are completely invisible. So we have to trust the math to tell us what's really going on. For some, this "blind spot" can make grasping the concepts a lot more difficult. Let's cut 'em down to a manageable size.

**Ground Means Different Things**

The word "ground" does a number of jobs, and this can be confusing. We have RF ground, safety ground, AC ground, DC ground, all built off the one word "ground." Let's untangle this knot.

RF ground often has nothing to do with THE ground, although it can, as when we lay out a field of radial wires under a vertical. But the radials don't work because they're lying on the ground; they work because they're under the vertical radiator and represent a low impedance return path for RF energy. Note well: A quarter-wavelength conductor is a low impedance. When connected to GROUND on a radio or tuner, it provides this low impedance path. The actual "ground," in the sense of the Earth's crust, has nothing to do with it; it's about providing a low impedance return path for RF energy, completing the circuit and maximizing results.

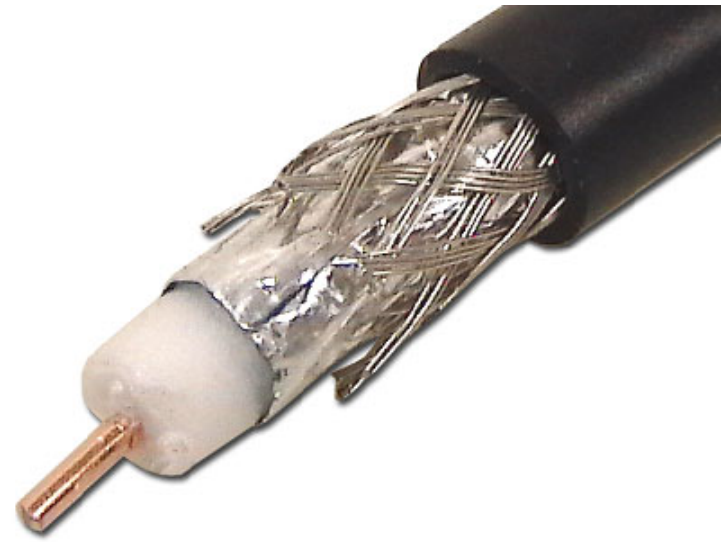
Indeed, being so close to the ground, in our vertical antenna scenario, means that several radials are necessary, to form a sufficient ground image, even though they are lying on the "ground." In general, other than the special case of a typical vertical antenna, a simple piece of insulated wire, a quarter-wave long at or near the desired frequency, connected to the tuner or radio's ground connection at one end and left free at the other end, satisfies this scenario nicely.

***Safety ground at my station. NOT a valid RF ground. (Photo by author)***

Safety ground, on the other hand, is connected to the ground, usually via a ground rod driven into the Earth or via cold water piping, which is buried in the ground for miles and miles. The emphasis here is on the facts of life of lightning; lightning wants the Earth, and will punch though anything that's in its way to get to the Earth. Connecting a conductor to the Earth provides a constant draining off of any static charge before it can build up to strike potential.

This how the device called a "lightning arrestor" works: a tiny air gap constantly drains away any static charge build-up before it can grow into a lightning strike. A station that lacks any lightning arrestors can still be made safe by disconnecting all antennas from equipment and connecting them to a heavy wire going to a ground rod. The same principle applies; grounded to the Earth, the antennas cannot build up any static charge to initiate a lightning strike.

The electrical power coming into your house is protected the same way. There are two "hots," with 240 volts between them and 120 volts from either hot leg to the neutral wire. It has long been a legal requirement in this country that the neutral wire is "bonded" to ground, and solidly connected to Earth ground, again via a ground rod or, sometimes, cold water piping. This scenario describes what is sometimes



*Coaxial cable—great stuff if it's properly matched. (Photo by author)*


*My trusty MFJ 969 tuner. Loads up just about anything fed with ladder line. (Photo by author)*

called "AC ground." Think of the many, many miles of electrical service that run from pole to pole throughout the nation; what a terrifying target for lightning they would be without this grounded neutral system!

"DC ground," similarly, has one polarity, often the negative, connected to the chassis of any equipment we use. Since the third, "ground" wire of incoming AC power is connected to the chassis, the DC circuits also have a full-time, solid connection to Earth ground.

**The Almighty Quarter Wave**

Just as the quarter-wave conductor satisfies the RF ground requirement nicely, it also makes the most basic building block of almost all antennas. The quarter-wave vertical is an obvious example. Others may be not so immediately obvious, such as our old friend the dipole. The basic dipole, as we know, is a half-wave long at the desired frequency. A closer look, though, reveals a break at the center where the feedline is attached—to two quarter-wave conductors!

The dipole is, in turn, the driven element of a Yagi; even with solid all-metal construction, with the elements connected directly to the metal boom, the center of each element is at zero voltage since the boom forms a local "ground." What protrudes on each side? Quarter wave conductors, in the case of the driven element; shorter lengths for directors, longer for reflectors, but all based on the quarter-wave length at the desired frequency.

Once we notice this, we can see that many antennas have this "a quarter-wavelength conductor is a low impedance" principle as their basis. The idea is often extended to the notion that odd multiples of a quarter-wavelength represents a low impedance, while even multiples—a half-wave, say, or a full-wave—have a high impedance. Try to load up a dipole at twice its resonant frequency—say, a 40-meter dipole on 20 meters. Now the dipole, a full wavelength long, is composed of two half-wave conductors. The resulting impedance is very high, far beyond coaxial cable's limitations. Of course, there's an alternative to coaxial cable, which brings us to our third "Golden Rule."

**A Balanced Feedline is Very Forgiving; Coaxial Cable Ain't**

Coaxial cable is wonderful. It's compact, self-contained, can be run almost anywhere, even taped or wire-tied to gutters or other metalwork, has a neat appearance.

Ah, but there's a trade-off—as there usually is. Coax works great when connected to its characteristic impedance at both ends, like a 50-ohm radio antenna jack and a 50-ohm antenna. The radio end at 50 ohms we can pretty much count on. The 50-ohm antenna load, though, is harder to arrange.

Even a dipole cut correctly for a target frequency and hung at a good height will still wander quickly away from the vicinity of 50 ohms impedance once we move very far in frequency. This is true even if we arrange a matching network at the antenna end to bring the antenna impedance to 50 ohms; a high-dollar Yagi on a fancy tower and rotator fades quickly when we QSY very far from its target "resonant frequency." Even allowing for some antennas that do have a broad SWR bandwidth—by which we mean how far from the "resonant" frequency we can QSY without exceeding 2:1 SWR—an antenna cut or built according to a target resonant frequency is the rule. And with coax, a tuner at the radio end is gravely misleading; it can bring about a 1:1 match between the tuner and the radio, but does nothing to cure the mismatch on the run of coax to the antenna.

Herein lies the greatest weakness of coaxial cable—it cannot withstand very much of a mismatch, especially at higher power levels. The "hot," center conductor is trapped inside the braided "ground" connection throughout its length. You can think of the cable, then, as a long skinny capacitor. When it's matched, everything's just fine. Create a large

enough mismatch at a high enough power level, though, and the reflected SWR power begins to heat up the cable. At a high enough power level, it will actually blow holes in the jacket! This is not a good scenario, friends. The only far-reaching solution is to use a remote tuner (at the antenna instead of at the radio), and unless the antenna in question is a ground-mounted vertical, placing and securing a remote tuner becomes very problematic.

The alternative to coaxial cable, of course, is balanced line. This comes in many forms: 300-ohm twin-lead, 450-ohm window-line, homemade open-wire line, and so forth. With balanced line, there's no "hot" enclosed by "ground," making a slender capacitor that will self-destruct at a high enough SWR; instead, both conductors are "hot," with the line's impedance largely determined by the spacing between conductors. Since both conductors are "free," that is to say unenclosed by a grounded braid, SWR suddenly becomes practically meaningless; a high SWR may (and often does) exist on the line, but virtually no losses are incurred. A balun-equipped tuner at the radio end dials up a 1:1 SWR, or as close as possible, between the radio and the tuner; since the line is practically lossless, almost all of the tuner's output appears at the antenna. Also, since the line is lossless, a resonant antenna is no longer required; whatever load a random antenna presents receives all the power sent to it.

This is the real advantage to balanced line—resonant antennas are no longer necessary. Instead of carefully measuring a dipole's length, and trimming it to resonance at a target frequency on a single band, a whole world of flexibility opens up to us. Generally, at any frequency where a dipole is at least a quarter-wave long (there's that magical quarter-wave again), balanced line and a tuner at the rig will give us every band at that point and higher. For example, a 130-foot dipole will now load up, and work, on every band from 160 meters on up. Even a dipole only 65 feet long will give us every band between 80 meters and 6 meters (6 meters is generally the extreme high frequency reach of tuners made for HF; some are limited to 10 meters as their highest frequency). Suddenly, a single antenna, the exact length of which is unimportant, gives us the entire HF spectrum.

Contrast this with coax-fed antennas, which must resonate at a target frequency to work a single band, or carefully cut to resonate for two or three bands, such as a Yagi on a tower. There are other advantages too; consider the multi-band dipole we just discussed. Each band will show a different radiation pattern and gain, meaning good coverage of the nation and the world. Not bad for two hunks of #14 wire and a length of ladder line! For the SWL the same type of advantage is gained; a single dipole at least a quarter-wave at the lowest listening frequency desired will also yield coverage, and even some gain, at the higher frequencies.

We can even add a third scenario to this story—single-wire feed. Now there actually is no feedline—the single-wire feed is to all intents and purposes part of the antenna. A good RF ground is crucial in this scenario; with "part of the antenna" in the radio room, stray RF can spray

***A good view of some homemade ladder line. (Photo by author)***

everywhere, generating RF burns on metal surfaces, wiping out PCs, TVs, even the landline telephone. However, like balanced line feed, antenna length becomes unimportant; a tuner at the radio will allow loading up all sorts of random wires, on numerous bands, because there is no coaxial cable to suffer from the high SWR caused by mismatches.

**And So…**

Maybe some of my readers might feel I lean a little too hard on these principles; but I feel they are essential to getting the upper hand on antenna issues. Random antennas are crucial to stealth operation, and even when stealth is not an issue, many of us cannot erect full-sized antennas, as we would like. Balanced line, or single-wire feed, in tandem with a tuner and whatever antenna we can erect, is our ticket to success. After all, what we all really want is to make QSOs, not spend hours pruning the length of a dipole so it will match well to coaxial cable!

That's all for this month. Join me here in March for more antenna adventures. When I regain the use of my right hip, I'll have a big loop tale to share with you, honest. Stay safe, and happy operating!

TSM

# Radio Horizons

## Product Announcements of Interest to *TSM* Readers

# Channel Master's "Antenna Success" Product Line Helps Consumers Solve OTA-TV Issues

Las Vegas, NV, January 5, 2016 – Channel Master, the leading provider of alternative TV solutions and the nation's first TV antenna manufacturer, today announced the Antenna Success™ product line designed to provide do-it-yourself consumers with a successful digital TV antenna experience.

Antenna Success products were developed as a response to signal-issue enquiries received by Channel Master's on-site public call centers over the past 24 months. The company analyzed over 50,000 consumer calls from across the U.S. and Canada to identify the most common signal-fail issues in DIY home installations.

"When consumers experience signal issues they are most likely to believe that the issue is related to either the TV antenna or the set-top box", said Adam Long, vice president of operations at Channel Master. "However, 90% of the time the problem lies between those two items, such as the coaxial cable, connectors, or even a poorly-constructed HDMI cable."


***Channel Master's Antenna Success line of OTA-TV products includes LTE filter (top) and Amplify adjustable gain pre-amplifier for optimizing digital OTA-TV signals and filtering potential interference. (Courtesy: Channel Master)***

**The Antenna Success product line includes:**

- Antenna Success™ RG-6 Ultra-Shielded Coaxial Cable

  Patented enhanced foil layer provides superior shielding, reducing noise and interference inherent to OTA signals.

- Antenna Success™ Continuity Locking Connector

  Patented continuous grounding and enhanced shielding design minimizes OTA macro-blocking and other OTA signal issues due to movement or loose connection.

- Antenna Success™ Ultra-Shielded Premium-HDMI™ Cable

  Premium-HDMI™ rating ensures cables support full 18Gbps and 4K video, and superior EMI protection minimizes interference with wireless signals.

- Antenna Success™ Amplify™ Adjustable Gain Pre-Amplifier. Optimized for digital OTA signals, includes out-of-band filtering and heavy-duty weatherproof construction for outdoor use.

- Antenna Success™ LTE Filter

  Filters frequencies used by cellular phone transmissions that can be problematic to OTA tuners and amplifiers.

Antenna Success products were specifically designed to eliminate the most common installation errors and signal failure points experienced by a growing group of cord cutters who are discovering the value of a TV antenna.

"Cord-Cutters have not had the go-to technical resource that they did when they paid for subscription TV services," said Joe Bingochea, executive vice president of product development for Channel Master.

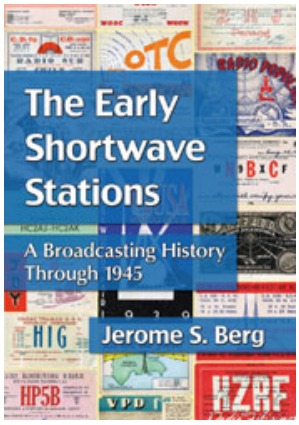
"The Antenna Success program and products fill that void and Channel Master is here to help ensure consumers have a reliable OTA experience with do-it-yourself installations."

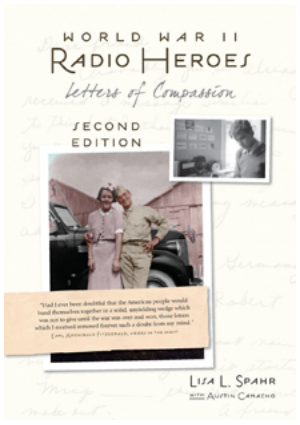
Consumers can receive Antenna Success assistance with planning, products, and post-installation support by calling Channel Master at 1-877-746-7261, or purchase products directly from **channelmaster.com**.

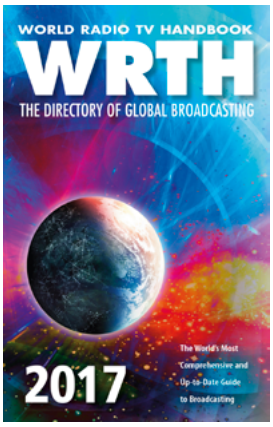
*[Text and graphic courtesy of Channel Master]*

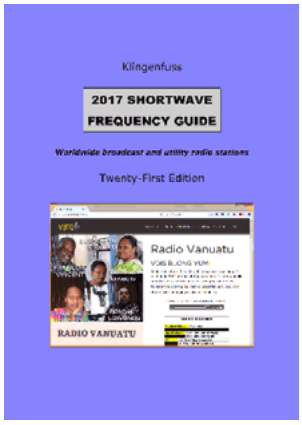
# T S M Bookshelf

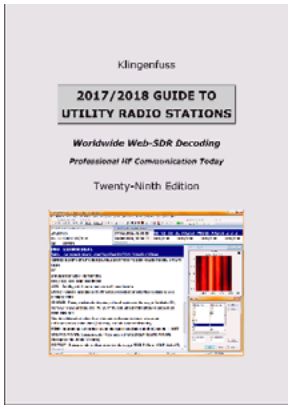
## Books of Interest to *TSM* Readers to Enhance your Radio Listening

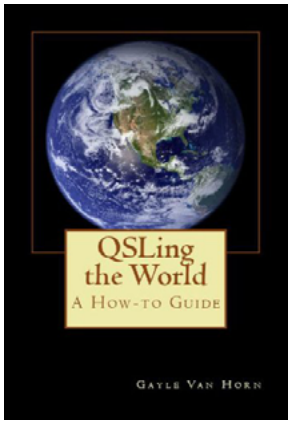


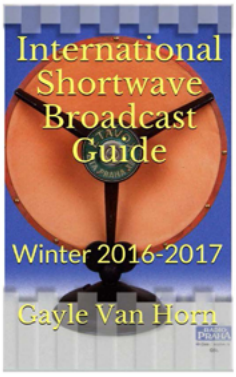



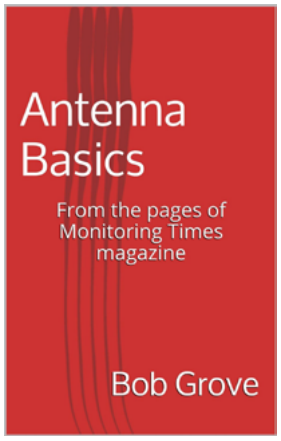



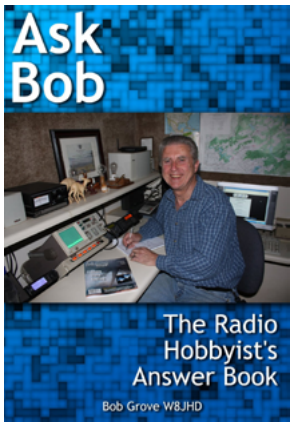



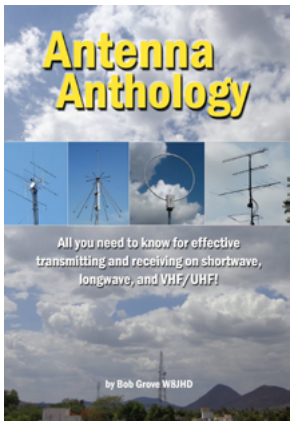



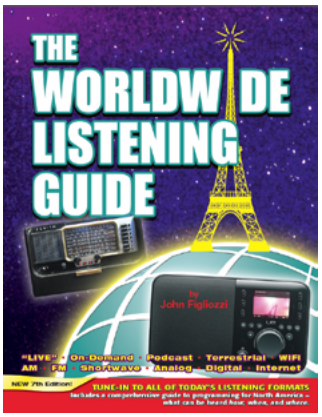



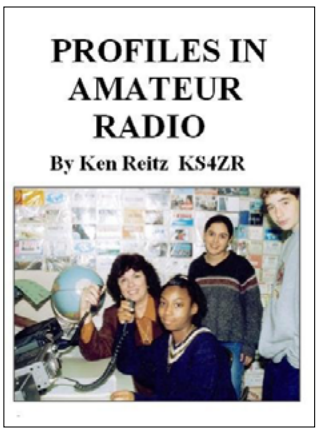


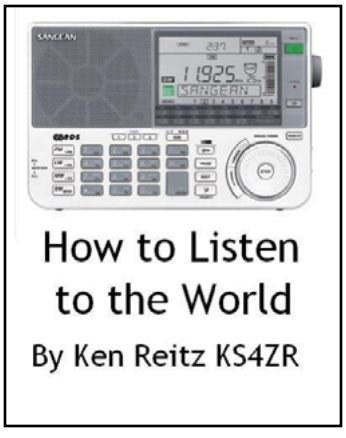



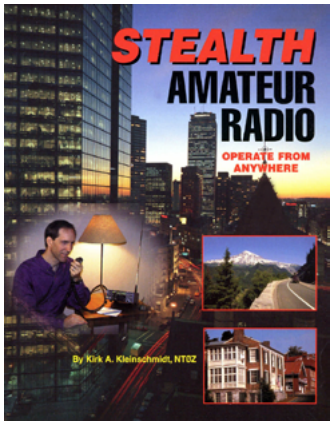



# T S M Bookshelf

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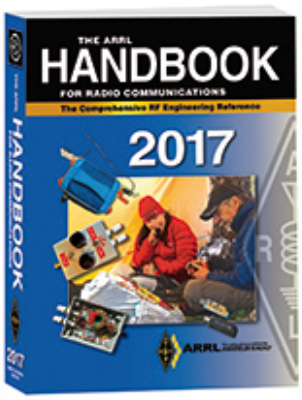



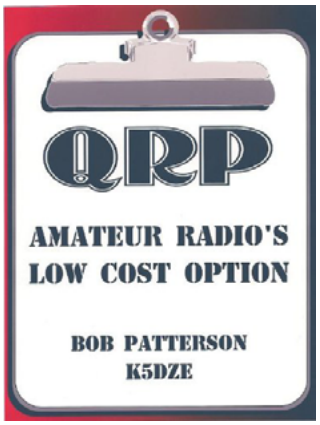


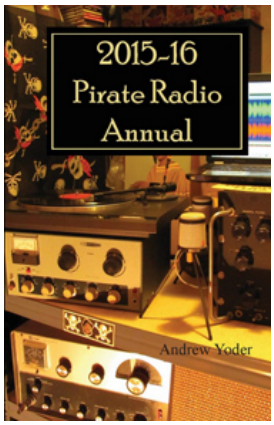



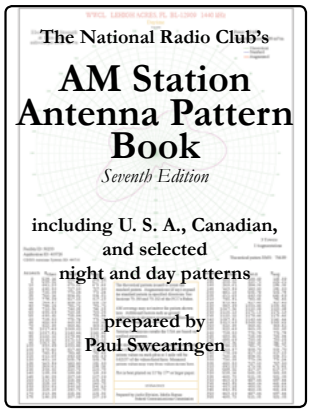


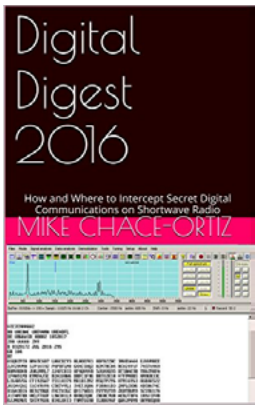


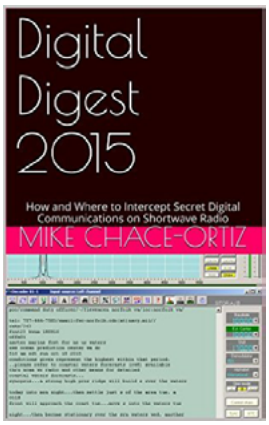


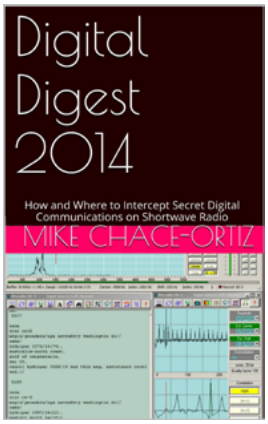



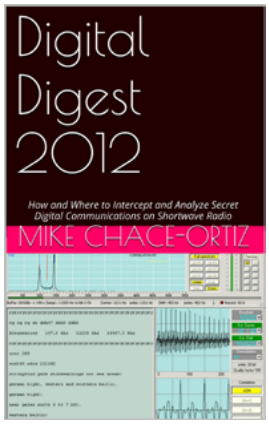


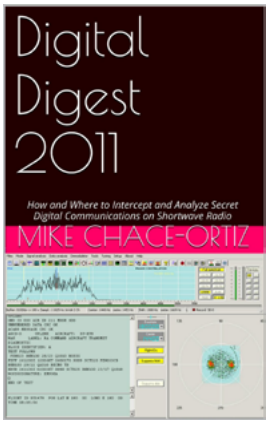


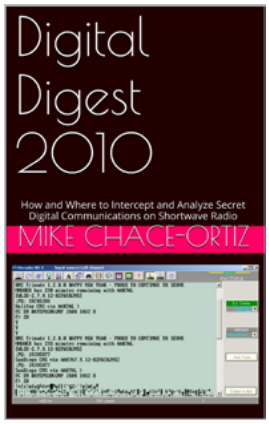


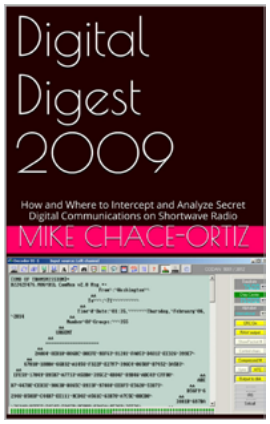


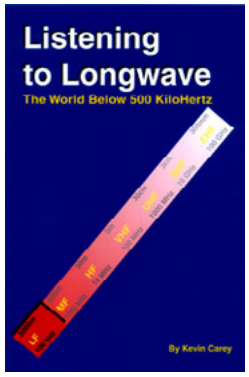

# About Us

## *The Spectrum Monitor Writers' Group*

*The Spectrum Monitor* is edited and published by Ken Reitz KS4ZR, former managing editor, features editor, columnist and feature writer for *Monitoring Times*. Former feature writer and columnist for *Satellite Times*, *Satellite Entertainment Guide*, *Satellite Orbit*, *Dish Entertainment Guide, Direct Guide;* contributing editor on personal electronics for *Consumers Digest*. Author of the Kindle e-books "How to Listen to the World" and "Profiles in Amateur Radio." E-mail: editor@thespectrummonitor.com

*The Spectrum Monitor* Writers' Group consists of former columnists, editors and writers for *Monitoring Times* and *Popular Communications* magazines. Below, in alphabetical order, are the columnists, their amateur radio call signs, the name of their column in *The Spectrum Monitor,* a brief bio and their websites and contact information.

**Keith Baker KB1SF/VA3KSF, "Amateur Radio Satellites"**

Past president and currently treasurer of the Radio Amateur Satellite Corporation (AMSAT). Freelance writer and photographer on amateur space telecommunications since 1993. Columnist and feature writer for *Monitoring Times*, *The Canadian Amateur* and the *AMSAT Journal*. kb1sf@hotmail.com **www.kb1sf.com**

**Kevin O'Hern Carey WB2QMY, "The Longwave Zone"**

Reporting on radio's lower extremes, where wavelengths can be measured in miles, and extending to the start of the AM broadcast band. Since 1991, editor of "Below 500 kHz" column for *Monitoring Times*. Author of "Listening to Longwave" (http://www.universal-radio.com/catalog/books/0024u.html). This link also includes information for ordering his CD, "VLF RADIO!," a narrated tour of the longwave band from 0 to 530 kHz, with actual recordings of longwave stations. E-mail: wb2qmy@arrl.net

**Mike Chace-Ortiz AB1TZ/G6DHU "Digital HF: Intercept and Analyze"**

Author of the *Monitoring Times* "Digital Digest" column since 1997, which follows the habits o f embassies, aid organizations, intelligence and military HF users, the digital data systems they use, and how to decode, breakdown and identify their traffic. **www.chace-ortiz.org/umc**

**Dan Farber AC0LW, "Antenna Connections"**

*Monitoring Times* antenna columnist 2009-2013. Building ham and SWL antennas for over 40 years. E-mail: ac0lw@att.net.

**Richard Fisher KI6SN**

A veteran journalist with a 35-year career in daily newspapers, and an amateur radio operator living in Riverside, California, Richard has been an editor and writer for *Popular Communications, WorldRadio Online*, and *CQ Amateur Radio* magazines. Among his previous responsibilities have been the monthly "Emergency Communications," "Trail-Friendly Radio" and "Easy Does It" columns for *CQ*, and has written for several QRP publications, including *QRP Quarterly* and *QRPp* magazine. An avid homebrewer, he is a co-founder of The Adventure Radio Society. Write to him at ki6sn@aol.com.

**Tomas Hood NW7US, "Radio Propagation"**

An Extra Class operator since 1990, Tomas enjoys CW and digital modes on all HF bands. He is a contributing editor to *CQ Amateur Radio*, the former *Popular Communications* and *CQ VHF* magazines, an ARRL publication on QRP communications, and *Monitoring Times*. He runs the Space Weather and RadioPropagation Center at **http://SunSpotWatch.com**. Web site: **http://nw7us.us** Twitter: **https://twitter.com/NW7US**.

**Kirk Kleinschmidt NT0Z, "Amateur Radio Insight"**

Amateur radio operator since 1977 at age 15. Author of "Stealth Amateur Radio." Former editor, "ARRL Handbook," former *QST* magazine assistant managing editor, columnist and feature writer for several radio-related magazines, technical editor for "Ham Radio for Dummies," wrote "On the Ham Bands" column and numerous feature articles for *Monitoring Times* since 2009. Web site: **www.stealthamateur.com**. E-mail: nt0z@stealthamateur.com

**Joe Lynch N6CL, "VHF and Above"**

Currently Director of Religious Education for the Army at West Point, New York. He holds a Doctor of Ministry, Master of Divinity, an MBA and is an adjunct instructor for four colleges and universities and a retired United Methodist minister. He served as the editor of *CQ VHF* magazine for 12 years and the VHF editor for *CQ* magazine for 22 years.

**Stan Nelson KB5VL, "Amateur Radio Astronomy"**

Amateur radio operator since 1960. Retired after 40-plus years involved in mobile communications/electronics/computers/automation. Active in radio astronomy for over twenty years, specializing in meteor monitoring. He wrote the "Amateur Radio Astronomy" column for *Monitoring Times* since 2010. A member of the Society of Amateur Radio Astronomers (SARA). **www.RoswellMeteor.com**. E-mail: Stan.Nelson@RoswellMeteor.com

**Chris Parris, "Federal Wavelengths"**

Broadcast television engineer, avid scanner and shortwave listener, freelance writer on federal radio communications since 2004, wrote the "Fed Files" column for *Monitoring Times*. h**ttp://thefedfiles.com http://mt-fedfiles.blogspot.com** Twitter: @TheFedFiles E-mail: cparris@thefedfiles.com

**Rich Post KB8TAD, "Adventures in Radio Restorations"**

As a teenager Rich Post repaired radios and TV sets. He passed the exam for a First Class FCC license when he was told he needed one to repair his CB. He later received his amateur radio license as KB8TAD. Rich now holds a University Emeritus title having retired from Ohio University as Assistant Dean and Director of the Instructional Media and Technology Services. One of his hobbies is collecting and restoring "boat anchors." He maintains the web site Boat Anchor Pix at **www.ohio.edu/people/postr/bapix**.

**Tony Roper, "Military Air and Naval Reception"**

A Civil Air Traffic Controller in the UK as well as previously being in ATC in the Royal Air Force, totaling 25 years experience. He has worked as a part-time aviation photographer/writer and has been published worldwide. He also provides photos and research for IHS Jane's, principally Jane's Fighting Ships. His photography website is **www.rogdabbit.co.u**k and his blog is **http://planesandstuff.wordpress.com**

**Cory GB Sickles WA3UVV, "Digitally Speaking"**

First licensed as a Novice over 40 years ago, he enjoys exploring various facets of amateur radio, from the latest state of the art technologies, to the elegant simplicity found with a one-tube transmitter and straight key. He has an extensive background with computers and likes to restore 8, 12 and 16-bit classics from the 1970s. He owns a television production company and creates series programming, as well as marketing and training videos. wa3uvv@gmail.com.

**Hugh Stegman NV6H, "Utility Planet"**

Longtime DXer and writer on non-broadcast shortwave utility radio. Former "Utility World" columnist for *Monitoring Times* magazine for more than ten years. Web site: **www.ominous-valve.com/uteworld.html** Blog: **http://mt-utility.blogspot.com** /email: mtutilityworld@gmail.com Twitter: @UtilityPlanet

**Dan Veeneman, "Scanning America"**

Software developer and satellite communications engineer writing about scanners and public service radio reception for *Monitoring Times* for 17 years. Web site: **www.signalharbor.com** E-mail: dan@signalharbor.com

**Ron Walsh VE3GO, "Maritime Monitoring"**

Retired career teacher, former president of the Canadian Amateur Radio Federation (now the Radio Amateurs of Canada), retired ship's officer, licensed captain, "Boats" columnist and maritime feature writer for *Monitoring Times* for eight years. Avid photographer of ships and race cars. E-mail: marinecolumn @gmail.com.

**Fred Waterer, "The Shortwave Listener"**

Former "Programming Spotlight" columnist for *Monitoring Times*. Radio addict since 1969, freelance columnist since 1986. Fascinated by radio programming and history. E-mail: programming_matters@yahoo.ca