PCARA Update

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Field Day 2006 - a washout

For Field Day 2006, Mother Nature and the Palisades Park Commission were agin us. By the evening of Friday June 23rd, it had become apparent that there would not be a PCARA Field Day encampment on Bear Mountain due to the very nasty weather. A few brave souls had volunteered to set up a mobile outpost on the summit on Saturday June 24th. En-route to the peak they were greeted by a locked gate at the entrance to Perkins Memorial Drive. The Palisades Park Commission had also thought it a good idea to keep folks off Bear Mountain in such nasty weather. Well there's always next year!

It seems that the Gremlins that had plagued the 449.925 UHF machine have now relocated to the 2 meter repeater. Our leading Gremlinologist Bob, N2CBH has indicated that it might be a good time to start thinking about a new, more modern machine as a replacement. Now, this brings up the uncomfortable topic of money. The 2m repeater is the most frequently used workhorse of the club. It has the best range and most features of all the machines. It is critical to, and essential for our mission as an organization. We need to ensure that this valuable asset remains available. A way is needed to raise funds relatively quickly to replace the current unit with a new one before the Gremlins finish their work. Please contact me with any ideas, suggestions, or comments you may have on how we can accomplish this.

Bob, N2CBH casts light on the gremlins visiting the 2 meter repeater.

Please don't forget that there are no meetings in July and August. The next meeting is 3:00 pm Sunday September 10, 2006 at Hudson Valley Hospital Center. I look forward to seeing each of you there!

– 73 de Greg, KB2CQE

Bear Mountain shrouded in mist — as seen from the Goat Trail on Saturday June 24.

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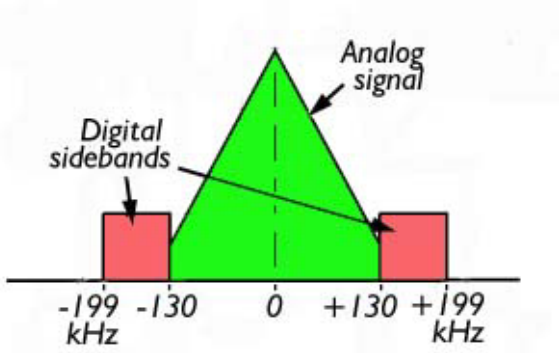
In-Band On-Channel digital broadcasting

an installation perspective — N2CBH

Recently, my firm Broadcast Devices completed the installation of two digital transmission systems in the Buffalo, NY area. Today, many radio stations are converting their plants for digital transmission to augment their analog broadcasts. I would like to share some of our experiences of installing this equipment along with some of the engineering challenges that go along with experience.

First, I will talk a little theory about the new, "In-Band On-Channel" system for FM otherwise known as IBOC, pronounced: "EYE BOCK". Ibiquity Corporation is the licensor of the new broadcast technology.

What Ibiquity has developed is a system whereby a digitally compressed version of the analog audio is impressed on a number of orthogonal, frequency domain multiplexed carriers. These carriers are spaced just below and just above the analog carrier center frequency. The level of the carriers is kept low enough so as to maintain the channel envelope that the station is licensed to operate within but high enough to give the station more or less equivalent digital coverage compared to analog.



The FM IBOC hybrid-mode signal combines the analog FM signal (triangle) with IBOC digital carriers (rectangles) inserted on both sides.

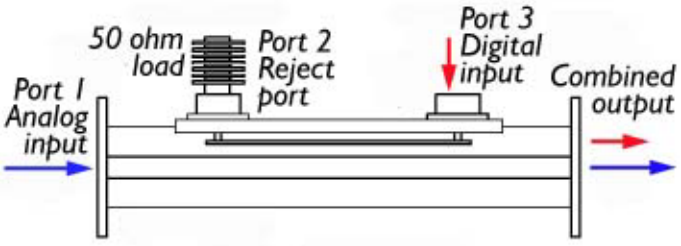
This is really a shoe horn fit situation and a compromise at best. The end result is that the analog signal is more or less left alone while the digital signal falls a little short of the promise of equivalent coverage. The thinking is that eventually the analog signals will be shut down, allowing the digital carrier strength to be increased, thus providing the promised enhanced coverage.

In this author's humble opinion the jury is still out on this. First of all, I am not certain that we will see a sundown of the analog system — as is the case with digital television — as there is no legislation dictating it as with television. Secondly, I am not certain the digital system will ever be as robust as the analog system it is seeking to replace.

WKSE-FM, which is licensed to Entercom Corporation, was our first installation challenge. WKSE's transmitter site is located on Grand Island, NY, which is a small island that sits in the middle of the Niagara River very near the Canadian border. You can actually look across the river and see real live Canadians! The site is actually a former studio site for the station but is now used only to house the transmitters and a lot of junk! This is a common practice in the radio industry. Old equipment never dies, it just gets stored at the transmitter site awaiting the call to come out of retirement.

WKSE is a class B FM which means that it is a 50 kW equivalent station. Currently, they use a Collins broadcast transmitter that generates 19.5 kW. Yes, Collins used to make broadcast equipment. The line continues as the Collins broadcast division was sold to a Texas company called Continental. The station has a Continental too. This is simply a later version of the Collins. The challenge at WKSE was to somehow add the digital signal from a separate transmitter to the analog signal and share the same antenna. Another requirement is to not have the two transmitters interact with one another. This would create unwanted intermodulation distortion.

To accomplish this task a four port device called a hybrid is employed. Hybrids are common in the broadcast business and see some use in amateur radio as well.



10dB injector adds the new digital signal to the existing analog FM signal.

Referring to the diagram, port 1 is the analog input port and port 3 is the digital input. Port 4 is the combined output port and port 2 is the reject port.

Here's how it works, the analog signal passes through the hybrid to the output. Some amount of analog signal is lost in the reject port and this is called the insertion loss of the hybrid. It works out to be about 10% or -10 dB of the original analog signal and in the case of WKSE about 2 kW. The digital signal has a tougher time of it. Only about 10% of the digital signal makes it to the output port and a whopping 90% ends

up in the reject load!

The reason for this is that in order to have maximum isolation between analog and digital transmitters there needs to be isolation. In order to take advantage of the hybrid's isolation, one of the carriers will have a high insertion loss. The digital carrier is chosen for this as it is already at a much lower level to start with. So losing 10 dB of signal is significant — it works out to be about 2 kW which is manageable. The good news is that WKSE only needs about 200 watts of digital power to feed to the antenna to cover the market. The bad news is that about 1800 watts is lost to the reject load. The load has to absorb the combined digital and analog "waste" of about 4 kW. This is nearly the power that local station WLNA uses to broadcast with! The so-called advantage of this is that the same transmission line and antenna can be utilized, saving on installation cost. The disadvantage is the increase in the power bill for the station.

Broadcast Electronics FMi-703 2.8kW IBOC transmitter alongside the Collins 25kW FM transmitter at WKSE.

Injector hybrid installed at WKSE, 98.5 MHz FM.

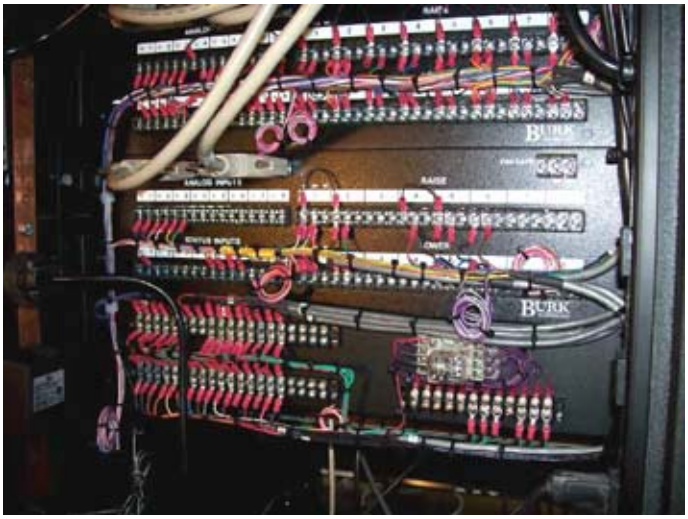
The photo shows part of the R.F. system that we installed. The gold-color line at the top left is the injector. The smaller line with the elbow into the injector at left is the reject load feed. You might recognize the silver line section as a Bird dual directional coupler. Those slugs in the coupler are very much like the slugs we might use in a Bird Model 43 wattmeter to measure our shack output. This line section feeds a Bird "Wattcher®" which is a forward and reflected wattmeter. The reflected meter has an alarm circuit which can be set to trigger when the VSWR exceeds a predetermined amount.

The next picture shows the Broadcast Electronics FMi 703 analog/digital transmitter. To its right is the Collins 25 kW rig. The Collins is a beautifully made transmitter from the 1970s. It's a testimonial to Collins Radio that this brute is still in service after 30 years! The BE digital rig is capable of three modes of operation; analog only, digital only or hybrid mode. The hybrid mode is where the transmitter itself combines the analog and digital signals, negating the need for the digital hybrid injector described earlier.

Oh, by the way the BE transmitter is all solid state. The Collins is good old hollow state in the RF section. A pair of 4CX250B's drives a 4CX20000A. You might ask — if the digital transmitter is capable of dual hybrid mode, why have the wasteful injector? The answer lies in the fact that in order to pass the digital signal, the RF power amplifier in the rig has to be linear, which is inefficient. Sort of like our amps that pass SSB or AM that need to be linear, otherwise they distort the incoming wave. In order to build a linear amplifier to handle WKSE's analog and digital power it would need to consume nearly 50 kW of power. Remember the electric bill? As it turns out, the "wasteful" hybrid isn't so wasteful after all.

What we did at WKSE was to install two four-port RF switches, the digital injector hybrid and a 5 port patch R.F. patch panel. We were also contracted to install a new remote control system and to clean up a lot of the messy wiring. One of the four port switches selects between the Collins and Continental analog transmitters feeding the hybrid. The second selects a main or auxiliary antenna. The digital transmitter is fed through the patch panel. With this system, the station can select between analog rigs, antennas and various modes of operation by use of the 5 port patch panel.

The next shot shows the remote control interface that N2CBH installed. My coworker on the project by the way was Ron N1WT. He was the chief architect of the R.F. switching complex. He was also in charge of keeping me from getting too cranky! The RF lines were



Control wiring at WKSE.

mostly 3.125" rigid line with some flexible 1.25" line. We used a pipe cutter like a plumber would to cut pipe for your kitchen. Measure twice, cut once. Well, this worked most of the time!

It took nearly 6 days to ready WKSE for digital transmission. In addition to the R.F. plumbing a digital audio path needed to be created. WKSE Chief Engineer Tom Karvelis readied the digital STL (*studio to transmitter link –Ed.*) and digital switching and distribution gear.

A side note — WKSE already uses Broadcast Devices, Inc. products in its transmission path. They had for many years used one of our analog composite switcher DA products and had recently purchased our newer AES switcher DA product. "AES" is a commonly-referred-to digital audio standard that was developed by the Audio Engineering Society. It is actually the AES3 standard that is adhered to by most of the broadcast gear that is made to work with it.

With digital signals applied to the digital transmitter and the transmitter connected to the test load we were ready to fire it up on test, prior to putting it on air. All systems were checked, including the safety interlock and we pressed the **on** button. The rig came to life, came right up to power and ran for about 20 minutes before a power supply in the rig failed!

Well, so much for new technology. This is why we like to test off the air first. You never know what is going to happen. A call to the factory was made and another power supply was sent to us. It was installed and the transmitter came up without further incident.

We then put the rig on the air by rearranging the patch panel jumpers. Buffalo NY now had a digital version of WKSE-FM on the air. Did anyone notice? I am not sure because other than the digital car radio in the Chief Engineer's vehicle I am not sure any other digital radios exist in Buffalo! Hopefully that will change.

RF patch panel at WLKK, 107.7 MHz FM

WKSE was the more difficult of the two installations that we undertook. We also installed virtually the same system at WLKK, Wethersfield NY. Wethersfield is located about 30 minutes away from downtown Buffalo and is really a world away. It is literally in the middle of a cow pasture in the country. The photo (left) shows Ron, N1WT on the ice bridge outside the building inspecting the RF lines.

This install took about half the time as there was no remote control system to install and much of the R.F. transmission system was pre-existing. This is actually quite an interesting site in that it was originally built to house an FM station as part of the Rural Radio Network back in the late 1940s. One of the promises of FM broadcasting in the early days was that one could

Ron N1WT inspects the RF feeders at WLKK, Wethersfield.

create a network of stations by simply relaying the over-the-air audio from one station to another. This was actually pioneered by Edwin H. Armstrong, the inventor of FM. His company, Radio Electrical Laboratories built much of the early FM broadcast transmitters and receivers that were used just prior to World War II. Armstrong's Yankee Network, which was distributed throughout New England, used this approach. An originating broadcast from Alpine NJ was received at Poughkeepsie NY where it was received and relayed to Hartford CT and so on.

2m repeater located at WLKK, Wethersfield.

The Rural Radio Network of which the predecessor to WLKK Wethersfield was a member used the same technique. If you Google "Rural Radio Network" there is a lot of great information about this system that was in use I believe until the early 1960s.

One more note about WLKK Wethersfield NY. The site is the home of 2 meter and 440 amateur machines. I took a photo of the 2 meter rack. Wouldn't we love to have some space inside the building like this?

The installations that I have described will no doubt seem quaint in a few years as the technology evolves. Perhaps there will be a day without analog broadcasting and higher powered digital-only transmitters will rule the radio airwaves. To be honest, I hope it happens long after I have written my last QSL as there is a sort of romance to receiving a weak AM or FM signal from far away. Maybe the QSLer of tomorrow will have new romances with ones and zeroes instead of Cat Whisker/Galena detectors and 6L6's!

- 73 de N2CBH, Bob

Adventures in DXing

-N2KZ

Rain, Rain, Go Away!

It was a dark and stormy night, and day, and night (actually several!) ARRL Field Day 2006 was celebrated underwater. Inches and inches of rain fell, clouds enveloped Perkins Drive at Bear Mountain State Park, and the PCARA contingent headed home. All was not lost!

Weather forecasts had dissuaded us for days. Heavy rain, followed by heavy rain, followed by heavy rain with a garnish of thunderstorm activity was the gloomy portrayal of a weekend that wasn't to be. After several impromptu on-air meetings, and some last-minute encouragement from Bob, N2CBH, we all headed out around noon on Saturday, June 24th to climb Bear Mountain defiant of what might lie ahead. Our strategy was to operate two HF stations and one VHF station from our cars, primarily using car-mounted antennas, to guard us from rain and lightning. Ray, W2CH, arrived first to Perkins Drive, the road leading to the Bear Mountain summit. He radioed the bad news: "The gate is locked. The mountain is closed."

We re-grouped at a scenic turnoff just south of the Bear Mountain Bridge on the east side of the Hudson River. Present were Malcolm, NM9J, Ray W2CH and his wife Marylyn, KC2NKU, Joe, WA2MCR and his son Alan and myself. After a few minutes of strategic brainstorming, we all headed home with our tails (and antennas) dragging behind us. Upon arrival at home, I became **N2KZ 1B ENY**.

At about 4 pm, I hopped on six meters and began to chase what CW signals I could find. My operation

Foiled Field Day competitors from PCARA gather at the "Overlook" on Bear Mountain Bridge Road, June 24. L to R, Joe WA2MCR, Alan, Marylyn KC2NKU, Ray W2CH and Karl N2KZ.

Santec MX-6S 6 meter SSB/CW transceiver.

consisted of a Santec MX-6S, at one watt, to a folded dipole antenna running on a set of AA batteries. Six meters featured several very local operators running high power and large antenna arrays chasing barely discernible warbly DX. One signal melted my receiver: K1UHF in Ridgefield, Connecticut. Del's signal was a full kilowatt into an antenna array worthy of Radio Central. His signal can be described in one word: Pow! Take a look at his magnificent arrays at: http://www.qsl.net/k1uhf/rig.html He heard my flea-power signal with ease.

I moved on to 40 meters which was a high-powered zoo. My rig here was my trusty battery-powered one watt Small Wonder Labs SW+40. Although I was being heard, the power of most other stations left me with very little competitive clout. Shortly, I moved on to another Small Wonder Labs rig: A DSW-II on 20 meters. With five powerful watts and a nicely placed antenna, I found quite a following of my QRP signals.

Small Wonder Labs DSW-II CW transceiver runs 5 watts output on 20 meters.

Twenty meters was the place to be, even in the dead of night. With my modest five-watt transceiver, I could sit on a frequency, call CQ FD, and receive regular replies easily. It really helps to jump right into the din and find a comfortable spot where there isn't a lot of traffic. My best spot was 14.025 MHz, where I could have sent CQ FD all night to relentless replies. I even achieved pile-ups several times. Most stations were from 500 to 1500 miles away to the south and west. I found CW QRP operation to be an attractive option. Each CW contact is worth 2 points and the QRP multiplier for battery operation is 5 times. At ten points per QSO, your totals can add up quickly!

As Field Day continued, time took its toll. After logging hours and hours with their paddles, you could hear CW operators' accuracy slowly disintegrate. Early Sunday morning, there was code being fired off that sounded like encryption. Electronic keyers can send very fast code, but also encourage sloppy sending. Some stations had automatic keyers sending out endless strings of CQ FD, but no one was listening to make replies.

At 2 p.m. Sunday, the madness stopped. The contest was over and hams were packing up their gear nationwide. All the bands dropped to near-silence, like the solitude of a hurricane's eye. The big storm was over for now. Of course, by 4 p.m. Sunday, the sun was again shining at my QTH. Curses! Foiled again!

Mid-year Resolutions

Why should I wait six more months for another New Year's Day just to plan for improvement? Here are my mid-year resolutions (inspired by a soggy Field Day):

I will continue practice using keyer paddles to send CW. Sending by straight key can be laborious hour after hour. No wonder "bugs" were invented over one hundred years ago! Even back then, CW and telegraph operators tired quickly. I have grown to understand why memory keyers are so indispensable. (One press of a button, and your CQ has been sent. Another button pressed and your exchange is sent. You almost don't have to manually send at all!)

I will also work on copying random five word letter groups. I use code every day. I even listen to code traffic on a communications receiver in my bathroom! After about six and a half years of casual operating, I was still challenged by quick rattles of stations and districts like 4B NTX or 6C SJV.

I will try to participate in some contesting to improve my rapid-fire sending skills. (Joe, WA2MCR, suggested a PCARA effort for the ARRL September VHF QSO Party on September 9 and 10.) This would not be a bad idea. Field Day is the only contest I ever participate in! Rain or shine, Field Day is always an adventure!

Until next month, happy trails de N2KZ, Karl "The Old Goat"

Essential$_2$ radio

"Essential$_2$" is a campaign sponsored by the American Chemistry Council, an organization that represents the leading companies engaged in the business of chemistry. ACC's public education campaign is designed to show that chemistry is essential to safety, health, innovation, the environment, the economy… essential$_2$ our lives. Perhaps you have seen the TV commercial where various, important items disappear from a doctor's office, one by one…

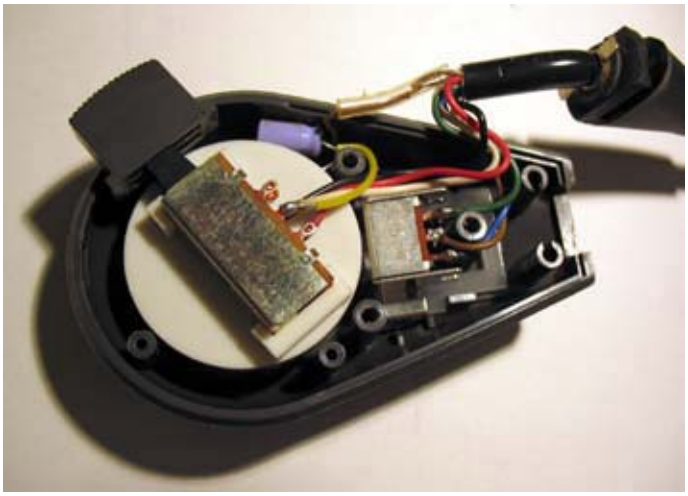
Well, the same applies to amateur radio — many of the things we take for granted around the ham shack spring from chemistry. You can thank lots of clever chemists (with a hand from the metallurgists and material scientists) for all sorts of items that are **essential to radio.**

Typical amateur radio PTT microphone.

Essential$_2$ my mic

Let's start with the humble microphone and its curly cord. That curly cord probably has a jacket made of black polyvinyl chloride – PVC – a polymer I had some familiarity with in a "past life" with my previous and present employers. Under the outer jacket are several brightly colored wires, also insulated with PVC. Polyvinyl chloride on its own is normally a rigid material – think of UPVC plastic water pipe. When blended with a plasticizer, such as dioctyl phthalate, PVC becomes flexible and rubber-like. Pure PVC has an unfortunate characteristic — when heated or exposed to light, it tends to decompose, losing hydrogen chloride. In order to prevent this, all types of PVC have to be formulated with a heat stabilizer in order to prevent decomposition — something else I was very familiar with in a former life.

(By the way, a glance around your shack will reveal other electrical cabling, from heavy duty power leads to shielded audio and coaxial cables. For all those products, the outer jacket is usually PVC.)



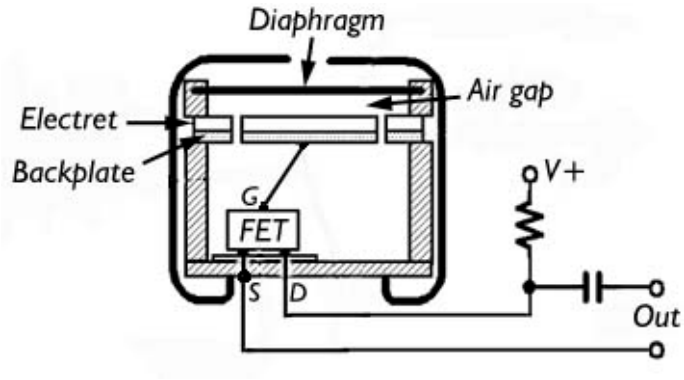
The microphone case is molded in ABS.

The microphone's case is manufactured from a common thermoplastic – ABS – a copolymer of styrene and acrylonitrile with polybutadiene. Thermoplastics melt when their temperature is raised, so they can be injection molded into complex shapes such as a microphone case, a loudspeaker cabinet or a key cover. The polymerization reaction that forms the polymer from its components is usually initiated with an organic peroxide — another product manufactured by the company I work for.

Modern microphones contain an electret element, which is capable of providing the high audio quality of a condensor (or capacitor) microphone at low cost, with no HV polarizing supply and with low interference from magnetic fields. The full name of this device is the "electret condenser microphone" or ECM.

HM-133 hand microphone from Icom IC-2720 transceiver. Arrow shows the electret capsule mounted on the circuit board.

The electret consists of a thin layer of plastic film that has been exposed to a strong electric field, becoming permanently charged — and therefore acting like a charged capacitor when adjacent to a metal conductor. The electret microphone was invented in 1962 by Jim West and Gerhard Sessler at Bell Labs. One of the key parts of their invention was the use of metallized Teflon® foil as the electret material, stretched tight like a drumskin. Teflon is polytetrafluoroethylene, another product of the chemist's bench.



Cross section of an electret condenser microphone. The electret material is metallized Teflon.

When the metallized Teflon vibrates in sympathy with incoming sound waves, the adjacent metal backplate acts as one plate of a capacitor and picks up a small electric charge. This tiny, high impedance signal is amplified — usually by a junction FET — and the amplified signal then emerges from the electrical connections at the back of the electret element.

Electret microphones are not just used in microphones for transceivers. They are also widely used in modern telephones, sound recorders and computers.

Before we leave the microphone, let me mention that not everything in the chemical garden is always 100% rosy. PVC insulation is often formulated with stabilizers containing basic lead compounds. Those lead compounds are safe while locked into the PVC matrix, but they can be released as toxic pollutants if the insulation is burned off the cable to recover the copper wire. Phthalate ester plasticizers have also come under suspicion as possible "endocrine disruptors" that might mimic the effect of estrogen in the body. Dell and HP have recently pledged to phase out use of PVC and other potentially toxic materials from their electronic products.

Essential$_2$ Display

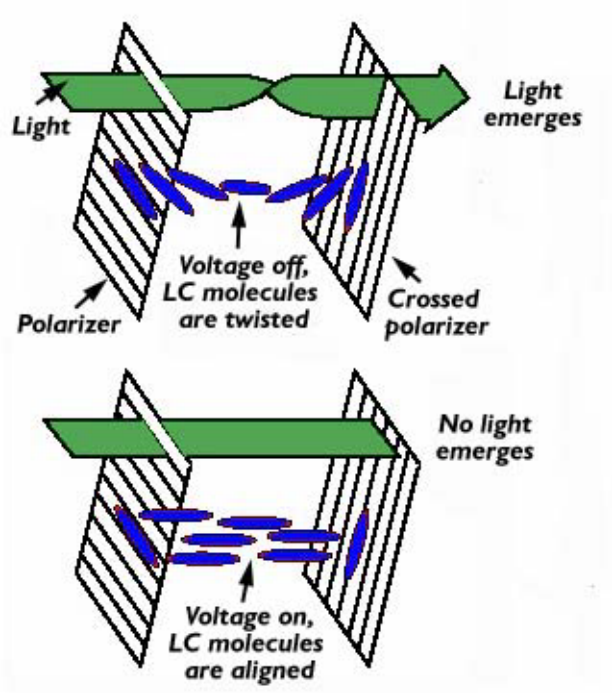
Moving on from the microphone, let's take a look at the transceiver it's connected to. The first thing we usually notice in a modern radio is the brightly backlit display, showing frequency, signal strength and at least

Modern radios, like this Yaesu FT DX 9000D, depend on one or more liquid crystal displays to present frequency and transceiver status information.

twenty seven other indications. Modern radios depend on *liquid crystal displays* (LCD) which are simply brimming with chemistry.

A liquid crystal display has two, crossed sheets of linear polarizers – like the polarizers in Polaroid sunglasses. Light passing through the first polarizer is filtered into a single plane of polarization, and is then unable to cross the second polarizer, aligned at 90 degrees to the first.

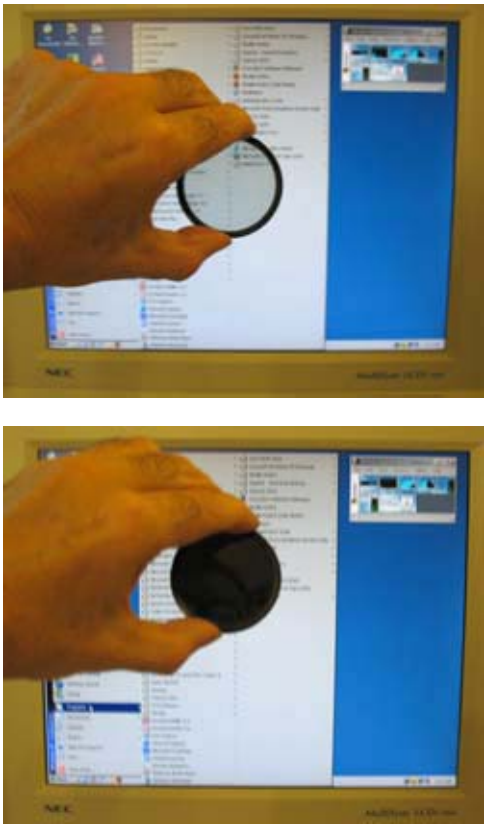
In between the two polarizers, a layer of liquid crystal is interposed. Liquid crystals are materials that have an intermediate state between completely solid and completely liquid, in which there is still some order in the way their molecules are arranged. This twisted order can rotate the polarization of incident light, so the light can now pass through the second, crossed



Liquid crystal display has two sheets of polarizing material arranged at right angles. The liquid crystal material in between the polarizers reacts to changes in applied voltage, changing its natural twist. As a result, polarized light passing between the polarizers is rotated to a greater or lesser extent.

polarizer. But when an electrical voltage is applied to the liquid crystal, the molecules line up with the field, the twist is lost, light polarization is no longer rotated and the display becomes dark.

If you are not certain whether a particular display uses LCD technology, here's a simple test you can try. Locate a pair of Polaroid sunglasses or a polarizing filter from a 35mm camera. Hold the polarizing material up in front of the display, then, while you look through, rotate it by 180 degrees. If the light passing through the filter reduces and becomes very dark at one angle, then you are seeing the polarized light from a liquid crystal display.

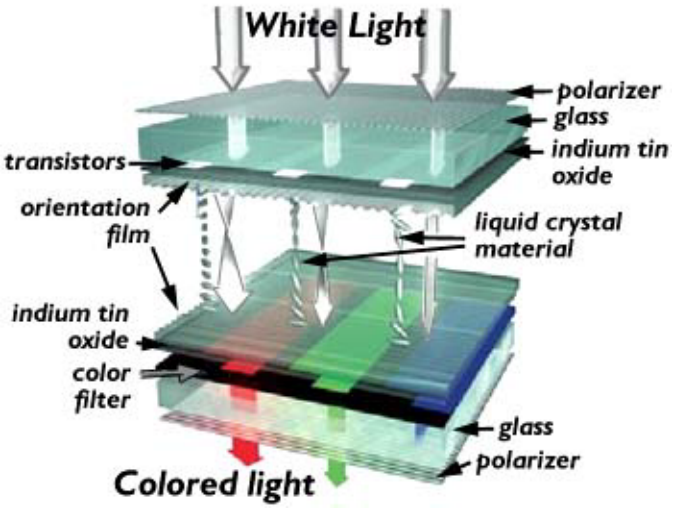


Rotating a photographic polarizing filter in front of the screen shows that this liquid crystal computer display emits polarized light.

The "original" liquid crystals of the 1880s were made from cholesteryl acetate and cholesteryl benzoate. The first liquid crystal displays were developed at RCA in the 1960s. LCD wrist watches were one of the first commercial developments in the early 1970s.

Modern displays employed in transceivers, computer monitors and flat screen TV sets now incorporate **color** LCD technology. Demand is growing rapidly, especially for large-screen LCD televisions, and for the complex chemicals that are used in their manufacture.

The polarizer material is made by stretching and combining layers of polyvinyl alcohol and triacetylcellulose film, while the liquid crystals are made from organic compounds such as cyanobiphenyls, phenylcyclohexanes and cyclohexylcyclohexanes. The liquid crystals, color filters and transistors are held between two sheets of glass substrate, with a transparent, conducting film of indium tin oxide deposited on the glass surface. The transistors that turn the pixels on and off are built up on these glass sheets using photoresist techniques similar to an integrated circuit.



Structure of a single pixel of a color liquid crystal display (after Merck KGaA, the number one supplier of LCD materials.) The red and green elements are transmitting light through their color filters, while the blue element has a voltage applied to line up its LC molecules and prevent light transmission through the blue filter.

Next time you look at a liquid crystal display, think about the elegant chemistry that is contained between those two delicate sheets of glass, with organic molecules twisting back and forth under the influence of electrical voltages, modulating the polarized light for your delight and information.

- NM9J

Peekskill / Cortlandt Amateur Radio Association

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Archive: http://home.computer.net/~pcara/newslett.htm

PCARA Information
PCARA is a **Non-Profit Community Service Organization.** PCARA meetings take place the first Sunday of each month* at 3:00 p.m. in Dining Room B of the Hudson Valley Hospital Center, Route 202, Cortlandt Manor, NY 10567. Drive round behind the main hospital building and enter from the rear (look for the oxygen tanks). Talk-in is available on the 146.67 repeater. *Apart from holidays.

PCARA Repeaters

W2NYW:	146.67 MHz -0.6, PL 156.7Hz
KB2CQE:	449.925MHz -5.0, PL 179.9Hz (IRLP node: **4214)**
N2CBH:	448.725MHz -5.0, PL 107.2Hz

PCARA Calendar
July-August: Summer Break
Sun Sept 10: September meeting, 3:00 P.M. HVHC

Hamfests
Sun Jul 9: Sussex County ARC Hamfest, Sussex Co Fairgrounds, Plains Rd. off RT 206, Augusta NJ. 8:00 a.m.
Sun Aug 13: Tri-State ARA Hamfest, Matamoras Airport Park, Matamoras, PA off Exit 53, I-84. 8:00 a.m.
Sat Aug 19: Ramapo Mountain ARC Hamfest, American Legion Hall, 65 Oak Street, Oakland, NJ. 8:00 a.m.
Sun Sep 10: LIMARC Hamfest, Briarcliffe College 1055 Stewart Ave, Bethpage, NY. 9:00 a.m.
Sun Sep 17: Candlewood ARA West Connecticut Hamfest, Edmond Town Hall, Rt 25, Newtown CT.

VE Test Sessions
Jul 2: Yonkers ARC, Yonkers PD, 1st Precinct, E Grassy Sprain Rd, 8:30 a.m. Contact D. Calabrese, 914 667-0587.
Jul 17: Columbia Univ ARC, Watson Labs, 612 W 115th St. New York, NY, 6:30 p.m. Contact Alan Crosswell, 212 854-3754.
Aug 6: Yonkers ARC, Yonkers PD, 1st Precinct, E Grassy Sprain Rd, 8:30 a.m. Contact D. Calabrese, 914 667-0587.
Aug 10: WECA, Westchester Co Fire Training Center, Dana Rd, Valhalla, NY. 7:00 p.m. Contact Stanley Rothman, 914)831-3258.
Aug 21: Columbia Univ ARC, Watson Labs, 612 W 115th St. New York, NY, 6:30 p.m. Contact Alan Crosswell, 212 854-3754.

Reminder — new Technician Question Pool from July 1, 2006.

Peekskill / Cortlandt Amateur Radio Association Inc.
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