

The SPARC NEWSLETTER

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110 Years of Radio Builds

(part one)

by W3IHM

Last month's article was about a stack of QSL cards. On those cards there was usually a description of the OP's radio equipment. Did I mention that most transmitters were home builds? Nowadays, that is not so. Why? Are we hams "dumbed down"? Or, was there something else going on here?

Well, yeah, there was. There has been a radical progression of radio construction building techniques over the past 110 years. This is no small cookie. These techniques were and still are being influenced by economics and international commerce, driven by consumers, us. You know, we always strive for "More bang for the buck". That's economics. So let's dive into this and see what has happened to us radio consumers and the things that we contemplate, the dials we read, and knobs that we turn.

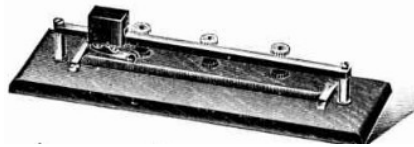
I will break this down into ten year segments, because things were a steady flow of change over the past century. Calling out each change would present too many small steps to see any progression going on. So I am decade lumping. Also, I am not looking at "first to..." kind of events, but more of like what one would see over time, when examining a hunk of freshly slaughtered radio gut, in general.

I can often peg a certain build by examination, to a decade. Perhaps, you also will be able to do this after suffering through this diatribe. Also, if you want a more confused, technically hampered video presentation, check out the talk I gave at the September SPARC meeting. Anyway, let's start at the beginning, which is probably the best place to start.

1910's

In 1915, or before, radios were made of assemblages of “instruments”. Think of this as individual components mounted on little pieces of wooden varnished board. I picked a few examples out of the catalogs, to help you get a feel for this.

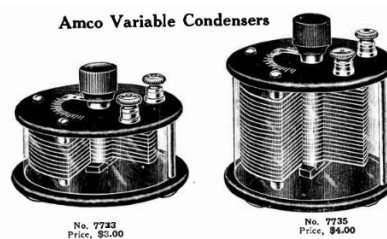
Like, take a variable resistance, or potentiometer. It may just be a piece of carbon rod attached to a board with some sort of sliding connection as the wiper. Here’s a picture of one I cut from an old catalog. Incidentally, I got these pictures mostly from perusing old catalogs. Many beautiful photos were available of reconditioned units from collectors, but I wanted to show this as it was, in 1915:



See, it has three terminals, just like a pot today. But that thing won’t fit inside a Baofeng, nooo, so yes, things change, (duh...) and that’s what we are trying to show here.

Take something, known as an electrical charge storage device, that was also variable. When combined with inductors, such things were and still are also useful for Hertzian wave detection.

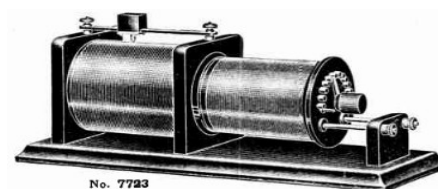
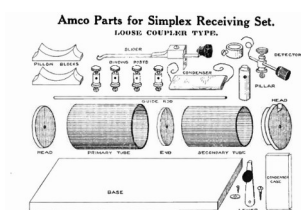
Such an instrument, called a variable condenser, or capacitor, would be used to “tune” a circuit to resonance. Here is one example having an air dielectric, with a glass tubular sleeve protecting the delicate metal rotating plates from dirt and damage. I have seen these old instruments, and they are now quite beautiful and impressive when the wood is finished and the brass polished. Remember the makers of these instruments were trying to impress the purchaser into buying one:



For fixed values of capacitance, home made Leyden jars were often used, or stacks of photographic glass plates, or sheets of mica, would be interspersed with tin foil. This stack was then sank in a bath of some sort of insulating oil inside a wooden box to form a fixed capacitor.

For some sort of complimentary inductance, also useful for Hertzian waves, usually some sort of a variable alternating current transformer, consisting of two coils. These two coils were resonated by external capacitance, and could be built or acquired. These were known as “loose couplers”, with the mutual inductance transformer coupling adjustable, and often

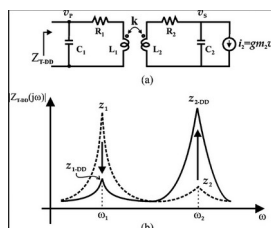
looked like this, where the inner coil slid in and out of the outer one. Such a “double tuned transformer” was still used in many radio IF circuits, up until the early 2000’s and DSP:



One could make their own loose coupler from a kit of parts, or purchase a ready made version with shellac and nickel coated brass metal machined parts and shiny wire to impress, all built up.

The inductance of each coil was varied either by multiple taps and a rotary selector switch, or a sliding contact across the coil. Both types of inductance tuning were used in the loose coupler. The coupling between the two coils was adjusted by sliding the coils in and out. I still find these things quite useful for tinkering, but no one makes them anymore.

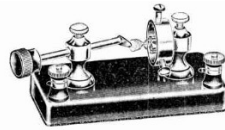
With these two parts, one could build something like this, forming an adjustable narrow band network:



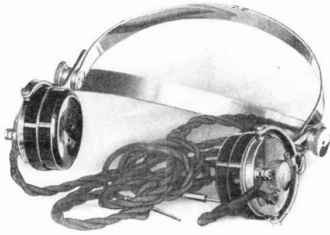
Ok, so some sort of detector device was also required to detect and rectify the rapid current oscillations of Hertzian waves. There were several kinds, changing as they developed, some using shaken metallic filings, known as “Coherers”. Maybe a shipborne operator may use a “Flemming Valve” diode type vacuum tube, or another detector type may use some form of wet chemistry, known as an “electrolytic” detector.

But most common among the first time novice radio aficionado, was to exploit the properties found in certain mineral crystals, such as Galena (PbO). Perhaps a piece of carborundum from a broken sharpening stone was also found to do this rectification. These were known as “crystal” detectors.

Every small boy was shoving whatever stones they kicked up on the way home from school into their detector to find out if they may discover the latest super detector magic stone. Some of these school kids grew up and developed solid state electronics, but more on that later. Anyways, what fun! A magic stone “crystal” that makes voices come out of the thin air!

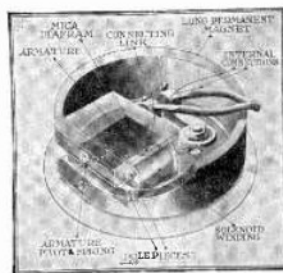


Oh, I forgot the most important part. To witness the invisible currents and voltages being present, a “telephone” receiver would be pilfered from the house telephone to convert the minuscule currents into audio. If you were discouraged from cannibalizing the house telephone, a set of custom made head telephones would be made or purchased. These alone were the sign to other aficionados that you were a serious Radio Wave Detecting Expert.



These head-telephones, or headphones, were being manufactured with many brands. But the rumored best were made only in Salt Lake City by a cloister of virgin Mormons. For an exorbitant sum of like \$20, a set of Baldwin ‘phones, the prize trophy of repute, could be obtained. These, with their patented mica diaphragms, were supposedly able to hear the static discharge generated by a single butterfly wing at ten paces. Every serious radio expert had them.

This illustration shows the amplifying mechanism in a Baldwin unit. Note that four pole pieces of single solenoid act on the armature, which in turn connects with the super-sensitive mica diaphragm.



Type “C” Navy standard\$16.50
 Type “E” Super-sensitive 20.00
 Type “F” light weight 21.00
 Units for loud speakers
 Type “C”\$8.50
 Type “E”10.00

But by the early 1920’s Baldys had dropped in price. The magic didn’t happen, even with mica diaphragms. Something more was needed to amplify the weak currents and voltages from radio waves.

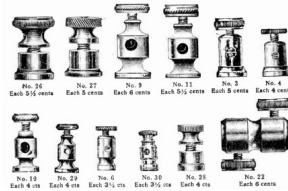
ORIGINAL BALDWIN PHONES	
These are the Genuine Nathaniel Baldwin “Mica Diaphragm” Phones, complete with silk cord and headband. Special at.....	\$9.95
Genuine Baldwin “Mica Diaphragm” Type “C” Loud Speaking Units. Special	\$4.65

Anyway, a small boy often wore his ‘phones throughout the day to school, sometimes around the neck, as a magic talisman, as a way to summon the Hertzian waves in the evening. On some rare occasions, actual magic signals filled them, when connected to the instrument radio hookup set.

Although occasionally useful, these ‘phones were more for conversation. A wondering question from another kid at school would instantly have their ears filled with bravado, stories, and even hearing some “voices from the dead”. All rather good stuff for a young kid

in school, eh? And, yes, some things have not changed, either. Ever listen to George Noory, or Art Bell (W6OBB), Late At Night?

After assembling your “set” of instruments, the important connections of each were brought out on machined brass terminal binding posts of all kinds, like these shown. These posts, interconnected with whatever house or fencing wire, attached your instrument collection into some magical connection. This interconnection was sometimes called a “hook up” or “circuit”, a term borrowed from the railroads, referring to a train’s path around the various lines.

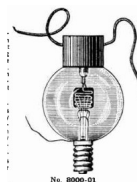


Setting aside wood carbonization and moisture conduction, these interconnecting circuit wires had to somehow be straight and true, to prevent waves from “jumping or leaking off”. It was found that placement of your instruments and their hookup circuit configuration greatly affected the performance of your set.

Possessing a set of instruments was like baseball cards, or Poke’mon cards, in that young dabblers in magical electrical currents would collect them, to amaze their peers. Then, as to bring them to life, an aspiring young radio ham may collect such a set of components, such that a radio circuit could be accomplished with their particular “set”, to bring the magical Hertzian waves out of the empty nothingness of the night’s sky. This was absolutely magical for a young kid.

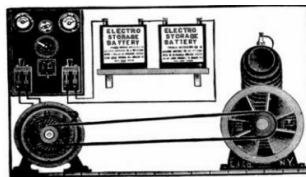
But there were some serious efforts, too. Grownups were also messing around with radio. These folks could afford to purchase a “DeForest Audion” RJ4. And, if you were a lucky radio kid who lived next to one of these radio adults, you could maybe experience “Armstrong Regeneration” reception.

A young kid who was accustomed to a weak, noisy, fussy, galena detector, may come over to see one of these grownup radio setups, and after listening to the rush of signals on a DeForest RJ4 connected as an Armstrong regenerative detector, leave thinking they had visited a god of the ether. The DeForest company also made a few bucks while they were at it. The “audion” was the first active electrical device, a triode vacuum tube. It could be used to amplify weak voltages and currents more so than any pair of Baldys ever could:



These radio adults were predominately engineers who were, at this time in history, busy electrifying the country. If they themselves didn't yet have electric power, they would often have and maintain their own electrical lighting plant in their house. These could be modified to generate high voltage.

The shaft horsepower energy supplied from a small gasoline engine would drive their generator sets to power their massive spark transmitters. One would often also charge the neighbor's batteries for other's radio sets as well, as a favor and QRM peace offering. So one would also have to know something about internal combustion engines to do the radio thing:

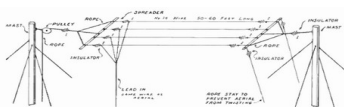


Many of these engineers were also busy sussing out the theory of radio operation with math instead of magic headphones, lore and hyperbole. Unlike the small boys, they were curious, but were equipped with the scientific method. These modern reasoning skills were focused to pursue fun and even perhaps a profit margin.

Electrical engineers at this time were deeply familiar with alternating current theory from the power industry and telegraphic system transmission line theories. Things were coming together to form a new area of science and engineering. Hey, there was money to be made here!

Antennas were and are always the main thing as far as radios go. Everyone would hang up an “ethereal adornment” to attract both neighbors and signals. Of course, the complaints would always follow. Much like always, there was a barrage of unproven or unverifiable accusations, based on scapegoating and NIMBY. Documented complaints such as: “Your gadget makes my cow give sour milk!” “That thing summons daemons!” “That causes sterility in my chickens!” were not uncommon.

It reminds me of when microwave ovens first came out. I recall all sorts of hub-bub and nonsense dallied about back then. (...go look!) Now everyone chucks their popcorn in the microwave and thinks nothing about it. Heck, in some communities, radio was flat out outlawed for a time. So HOA rules are nothing new. Like horses, with every change, it took some time for the herd to settle down.



But I get too much into the things and forget about the path, so let me get back on it. Let me just say that early radio hookups were illustrated radio set interconnections, like for a transmitter and receiver. The instruments illustrated were small sketches of the actual components necessary. Here is a receiver and transmitter pair using a loose coupler and fixed capacitor in the receiver and a Ford model-T ignition coil as spark source in the transmitter:

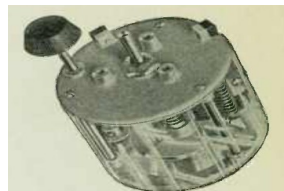


Each part was a drawn image of the particular instrument. These diagrams were arranged with interconnecting wires. These were loosely assembled on a table and a radio set was made. So enough about it. Let's move on to the 1920's.

1920's

By the mid 1920's, components began to be manufactured with mounting holes and were then screwed down to a single wooden board, often the "breadboard" used to slice bread on, from the kitchen. So the term "breadboarding" meant to hook up components in a circuit to see if and how they worked. The term "radio set" stuck around anyway, but now, all components were on one board. Some breadboards were contained inside wooden box enclosures, with no electrical shielding, to keep hands off, and give cats a place to sleep upon. Components that were designed to mount to a front panel began to appear.

Interconnect terminals were mounted on the individual components, sometimes still incorporating binding posts, but not always. Sometimes only a copper strap or wire was used. Here is a variable capacitor from the early 1920's, with built in vernier separate adjustment. Just as an aside, I have a few of the antique things mentioned, if you want to see them. My intent was to show them along with the talk, but that never happened. Oh well.



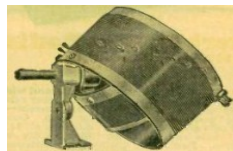
Note that this is designed to be mounted, with the control shaft protruding through a panel. There also are no binding posts, but wire interconnects were to be soldered to the brass strap connections. Note that by the 1920s, construction methods had changed. Soldering interconnects was becoming popular.

At this time soldering was done by heating a large thermal mass copper “iron” in a fire or on your home gas stove or handy Bunsen burner. Then solder connections would be made until the iron cooled and had to be reheated. If you were lucky and had electricity, you could get an electrically heated iron that just screwed into your single electric light socket. The electric lighting currents kept your iron hot, so you would not have to reheat it on the gas stove. Luxury.

Here’s an example of a 1920s soldering iron set, ready to screw into your light bulb socket. Notice that it is complete with a lead-tin mix of solder “wire” and acid “salts” to prepare the surfaces for soldering. A weak acid was made with the salts by mixing them with water, and applying, with a small paint or “flux” brush, to the metal you wished to solder. Imported rosin acids had not been popular yet, so mild acids, even lemon juice or vinegar, were used. Too much acid, though, and your wire or device terminal dissolved and was destroyed. Skill was necessary:



The loose coupler was being replaced by the variometer and tuning capacitor. A variometer was a cleverly designed variable inductor that utilized the cancellation of fields to change inductance instead of switched taps or sliding contacts. Here is a variometer that is meant to be panel mounted, with a ¼” shaft for mounting a tuning knob:



Low frequency and audio transformers were also now becoming modules, and were made to be fastened to the breadboard. There are various forms, depending on the frequency range to be used. The common types being inter-stage “amplifying” audio (Acme, A-2) transformers, and for the newest hookup, RF “superheterodyne” (Dubilier) intermediate frequency (IF) transformers. Two types are shown here, but many manufacturers produced all sorts of types, each with some claimed aspect that made their ones superior to all other. In a free market, this is how it works:



Since about 1910, the Radio Corporation of America (RCA), led by David Sarnoff, had acquired, collected, collated and assembled all the patents regarding the electron vacuum

tube. Thus RCA held ownership of the sole right to produce tubes in 1910. So, for our patent rights of 15 years, up until 1925, all vacuum tubes were manufactured by the sole patent holder, RCA. Amplification by the triode tube was a proprietary corporate possession. And this was really the only thing that worked.

The two most common types produced by RCA were the only tube kind known at that time, both being triodes, of course. These were designated as the UV200 and UV201 tubes, with UV being a base designation used during WW1. The UV200 had a “soft” vacuum, an inert gas backfill, mostly nitrogen (atmosphere), which somehow aided in adjusting regeneration, and ran only 22 volts on the plate. The UV201 had a “hard” vacuum, for audio amplification, and could reach up to 90 volts on the plate for high audio gain.

The UV200 was called a “detector” tube, and the UV201 was for amplifying. They both initially had 6 volt filament “A” battery voltages, with straight tungsten filaments, requiring one amp of current, and burned bright white (5000 degrees) to obtain useful electron emission, like a regular tungsten light bulb. Radio front panels had little screen windows to look in to see how bright your tubes were burning, plus a rheostat for each tube to adjust the filament voltage and brightness for happiest operation.

Later UV200 and 201 versions had slightly radioactive thorium added (dipped) to the filament, which reduced current to a mere 200 mA for the same amount of electron emission. These versions burned a dull red color, with electrons ready to leap off at these low temperatures. These were known as “low current” tubes, extending the radio filament “A” battery life, thus listening time, by five times. By the early 1920’s the brass and porcelain tube bases gave way to cheaper Bakelite single piece tube bases.



Even later, a form of vacuum “getter” was used that absorbed the out-gassing by electrical induction heating during manufacture, and so had bulbs with a mirror coating on inside that prevented you from seeing the filament at all. Heating up the tube would thus cause the vacuum to be “hardened” by activating the “getter”.

Heating up a tired tube by just leaving the filaments on would sometimes “fix” a tube that had been over-driven excessively. Over-driving would spoil a tube’s vacuum by electron etching some of the plate away with excessive filament electron bombardment current. Oops. Don’t DO that! So RCA profited, but also did a lot to develop tube technology. But sockets, well.. they could be made by anyone:



The vacuum tube patents explicitly prevented commercial use except in “experimental and amateur” usage. If you look at this picture of a UV200, you can just make out the statement stamped on the brass base of every tube made before 1925.



Because of this, up and until 1925, RCA could pretty well control receiver design by other radio manufacturers that used their vacuum tubes. Sarnoff and his directors were not as foolish as to establish a strict monopoly, but instead, would license a radio manufacturer to use their tubes in their own designs, only after the manufacturer submitted their radio design to RCA for their approval. RCA also manufactured their own line of receivers, with the latest developments becoming available in their in-house brand radios first. The latest innovations were provided indirectly via the patent process, naturally. So every competitor was at a distinct disadvantage.

Ultimately, though, the patents did run out. In the long run, RCA did lead development of tubes, and new radio designs. They also sponsored broadcast stations, networks, and eventually grew the entire radio broadcasting industry, with each transmitter and associated license usually somehow influenced by RCA.

Politicians who sought public exposure (which don't?) flocked to the newly introduced radio medium. Since RCA was so involved in radio, RCA was able to influence radio law by heavy lobbying in the federal government. Assistance with obtaining a station license would certainly go easier if you had planned to install an RCA transmitter.

Before being a corporate leader, Sarnoff was a radio hobbyist, so Sarnoff knew he needed to foster competition and developments from the amateur community. And having just witnessed the continuous development of radio by “open source” hobbyists and professionals alike, RCA's corporate attitude was mostly to foster the environment, and harvest it's yield. Maintaining radio hobbyists was in their corporate interest.

Among many companies, General Electric had a special position with RCA. Having had several patents (many by Tesla) that RCA wanted, an amicable arrangement was hashed out where GE did a lot of tube manufacture for RCA. Of course, GE also farmed out work to several manufacturers, so the whole business was booming, with everyone on board, getting some slice of the pie. Tubes from European manufacture sometimes appeared as well. I have an apparently French (?) tube with an RCA base, complete with RCA stampings. So lots of wheeling and dealing was inevitable.

By the end of the 1920s, the headphones were fading away, being replaced by loud-speaking telephones, or “loud-speakers”. Magnavox had a roaring lion as their advertising moniker, with the lion head roaring out of the horn. Ooh! Scary!



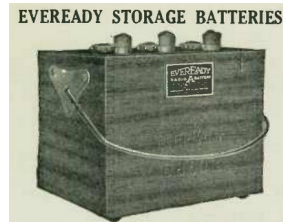
Frost Radio was also an early manufacturer of loud speakers, as well as other components. Frost had made headphones for years, but branched out into loudspeakers, as soon as tubes were available from RCA that could drive them. In today’s audio amplifiers with 1000’s of watts, the output was less than a watt to drive these horns, so acoustic efficiency was paramount.



As far as consumers were concerned, having a loud speaker sitting atop your radio receiving box was a sign of technical prowess, and innovation, plus an invitation to dance with any young ladies in the parlor! Vroo-hoo-hoo! Radios were a thing now, appearing in American parlors across the country. Music, news, and weather were only some of the programming filling the new media.

But back then, most houses did not have electrical power, so batteries were used. A person would take their storage battery in to town weekly to have it charged at the radio store, while reading what broadcasts were available for the upcoming week. One would then plan

the following week, as to what program to listen to, and at what time and day. When you had to lug a battery, you didn't just leave your radio on. Playing a radio was a luxury to be rationed. Among many manufacturers, Eveready was known for wet rechargeable filament "A" batteries. Burgess had the one-use striped plate "B" batteries. They claimed that "B" stood for Burgess.



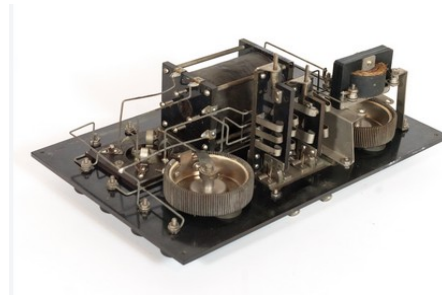
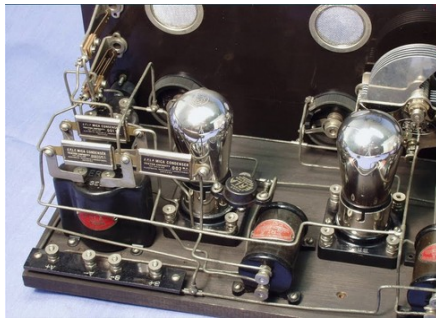
With RCA conducting the market by building transmitters, controlling patents, and selling everything, a new media was definitely emerging. Dissemination of information was no longer point-to-point, being hobbled and controlled by the politically minded newspaper unions, editors, and political controls, but now broadcast radio could let any one, both idiot and genius, of all political and religious flavors, both liar and truth, speak to anyone instantly. Because of this, what was also happening was that radio receivers, among many other things, were slowly becoming a consumer product, filling homes. Kinda sounds like social media nowadays, eh?



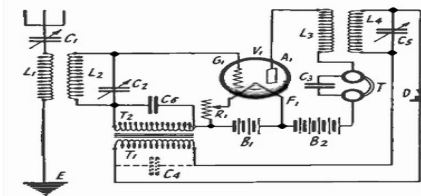
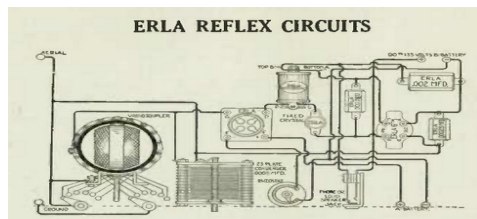
But again, I spun off. I try to stay focused on builds, but the economic drivers are part of the story, so they come up. Anyway, here's a build of a 1925 radio. The radios were available as assembled, or kits of parts. Or you could obtain a diagram, and roll your own to your liking. Here's a kit of parts:



All the parts came in a nice cardboard box. You just provided the breadboard or cabinet, and wired everything up. If you were good, your build would look like this:

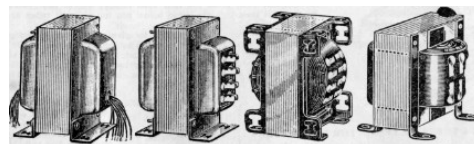


Interconnects were now predominately soldered. There were still some individual “instruments”, but they were now screwed down to the breadboard. It was more of a chore to reconfigure your “set”. But what guided these builds? As before, diagrams showing parts could be found, but also a new diagram type was becoming more common, the schematic diagram. See these? The schematic diagram was the new language of the radio expert.



1930's

By now, the wood breadboards and boxes had to give way to shielding. Metal punched hole, stamped soft steel chassis became the building framework to hold all the components. Economics had pushed part costs down considerably, and designs had pushed complexity and component numbers up. Domestic component manufacturing soared with cheap reliable components, produced and consumed in the USA.

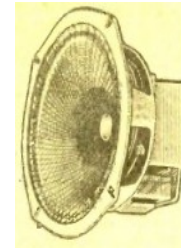
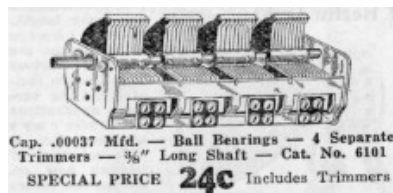


Standardization of component values was also necessary, so vendors could reduce cost. Radio Manufacturers Association (RMA) not only contrived fixed component values, but also broadcast and phonograph recording equalization standards, so that everyone's record and radio broadcast would sound the same, no matter who's equipment was used to listen. This was critical to prevent only certain manufacturer's products (RCA) working with only

their transmitters. Solder also became the interconnect standard, with wire leaded components and terminal strips filling a chassis.

RMA COLOR CODE	
Fig.	Color
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

Explanation of Use:
Ten Colors are assigned to the Figures as shown in table above.



Here are a few examples of chassis construction that became standard during the 1930s. Parts were placed under the metal chassis, connected by short wires, and larger components were poked through the chassis by stamped holes. A separation between sensitive components could then be accomplished by placing some parts under the chassis, with the high gain sensitive parts topside. Layout became less critical. Front panels could also support controls, and provide shielding.



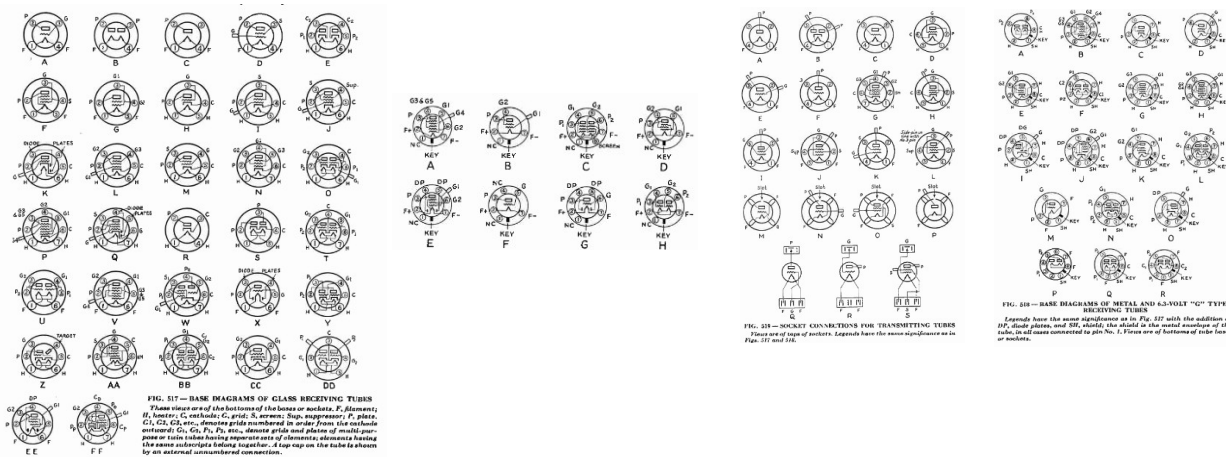
The steel chassis could then be placed in a wooden or Bakelite cabinet. Bakelite is a form of early thermoplastic, that is brittle, but provides sufficient insulation resistance. Radios became cheap mass produced consumables.

Since radios were now a commodity to be purchased by consumers, some who had little knowledge of the actual electrical working of the radio, the cabinet became important. So product differentiation by the case design became the main selling point. Here are some beautiful examples of cabinet designs, with the actual design and function of the radio secondary to the appearance. Look at these:



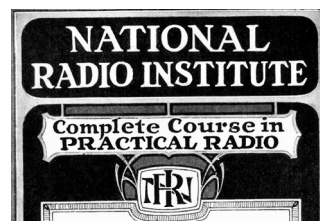
A radio was a thing of beauty in your house parlor. But technology did not atrophy. Money was still to be made. By this time, indirectly heated cathodes in vacuum tubes had been developed, isolating the filaments, allowing for AC powered heaters and more elaborate designs.

Instead of only the triode, multiple element tubes, such as tetrodes and pentodes were developed. Beam electrode designs allowed for higher power output with indirectly heated cathodes. Self shielded metal tubes were developed. To simplify construction, multiple tube configurations had been developed inside a single glass envelope.



With all this equipment in the uneducated consumer's hands, repair schools and businesses became a viable career path. It was not just radios, but record players, kitchen appliances, lighting, wells, furnaces, and even automotive electrics, had filled people's lives with things that used electricity to do their thing. Houses had outlets and wiring, not just single light bulb sockets in rooms.

Someone could profit in repairing and installing all this electrical stuff, so naturally, someone did. Schools popped up to instruct students in the ways of servicing radio. Many times, this fell on the shoulders of the local town ham or radio whiz kid, who was most likely neuro-diverse and hyper-focused. So they were an excellent business manager. (not!)

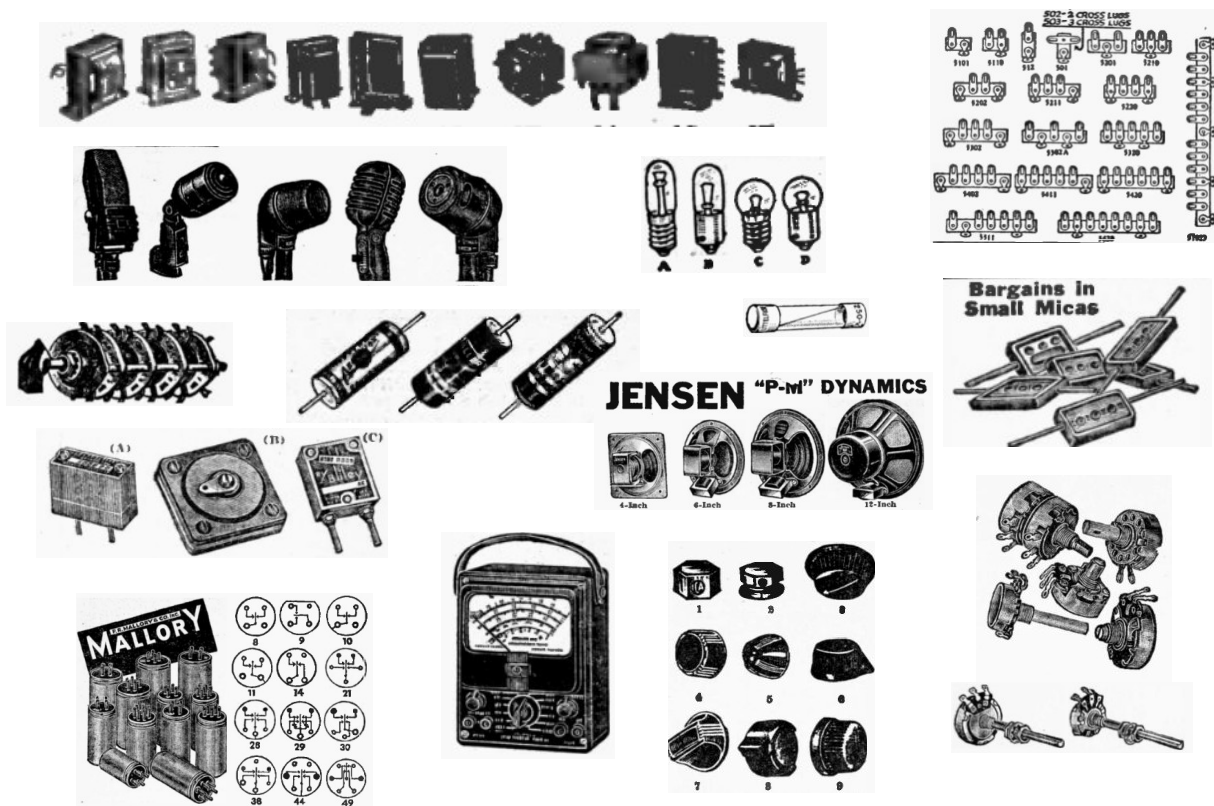


There's so much more I can prattle on about, but we will be moving on.

1940's

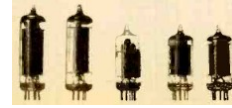
By the 1940s, in order to feed the continuously growing consumer market, the number of domestically produced available, cheap components had exploded. The early half of the decade was dominated by a big shift in manufacturing, called WW2. Consumer consumption was eliminated. Things just stopped, and everything went to the war effort.

By the war's end, American component manufacture had been incredibly honed to produce an excessive amount of components, extremely expediently, and at very cheap cost. So just after the war, there was an explosion of components available for designers to pour into a new chassis, but there were still shortages hampering delivery. Some designs just used what was available:

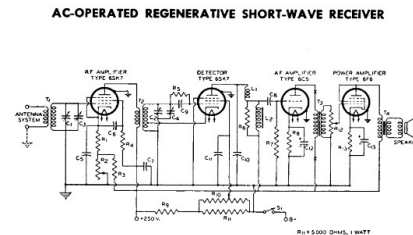
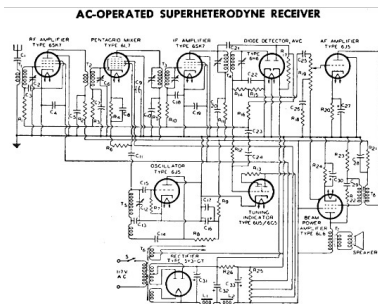


Just about anything you would want was available, as long as you could get the raw materials to make it. And if not, a manufacturer could quickly re-tool to make you the part variant you desired, as war production was very fluid. So expertise in rapid retooling and quick design changes was plentiful.

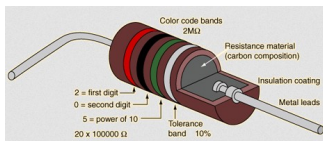
The vacuum tube also underwent a serious conversion during the war. The standard octal tube, with a large glass envelope, and separate bases, disappeared. New miniature baseless tubes showed up. Also, with the war economy, higher power triodes became affordable to the amateur and experimenter for pennies on the dollar. So a boom in amateur power amplifier designs that used these cheap tubes proliferated.



Broadcast receiver bakelite cases and “transformerless” hot chassis designs made a home AC powered receiver extremely cheap, along with RCA’s patented all-american five (AA5) design. Yes, RCA was still in the game. In the back of the RCA tube manual were RCA designs that worked, and were available for license and manufacture. Many ham and experimenter would build one of these, to gain proficiency. (me! – revisit for fun?)



Instead of graphite or carbon rod lengths for resistors, cheap compressed carbon paste resistors were everywhere. These were manufactured with carbon paste, compressed in a phenolic tube, with wires inserted in the ends to form a resistor. Although noisy and sensitive to humidity, vacuum tube shot noise was greater, so nobody seemed to notice.



But on the better side, new “ceramic” tubular capacitors had been developed during the war. These capacitors used a sintered dielectric that was more stable than papers, and less expensive than mica. The ceramic dielectric was impervious to leakage, but their characteristic temperature drift would have to be compensated for in circuit design. This was just a challenge for the circuit designers.



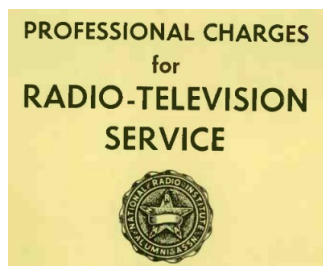
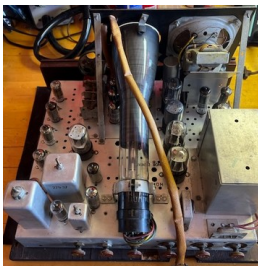
The ceramic tubular capacitors have proven longevity. But, by 2026, unfortunately, carbon paste resistors have not held their values. Once moisture creeps in, their values change,

although maybe baking them could fix this? Paper capacitors also develop leakage primarily due to paper acid decomposition and moisture penetration. Silver mica capacitors suffer from silver migration along the leads and through the mica. So just as an aside, components in radios from this era and before generally need to be replaced to keep the old gear running as designed. Although, a good coating of nicotine seems to help! I digress.

Here are a few examples of builds. Many amateurs started on CW with the compact ARC-5 Command sets. These sets even have built in test capabilities. The National HRO-7 was the peak of receiver design after the war. It had an all metal cabinet with metal chassis providing double shielding. It also removed switch instabilities by using plug-in coils, with an external power supply to reduce magnetic interaction with sensitive receiver circuits. Designs had markedly progressed during war efforts.



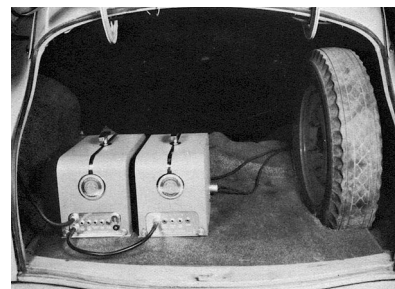
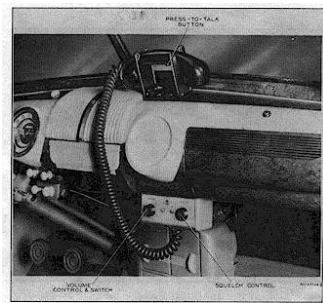
But just after the war, there was another shakeup. A new media, spearheaded by RCA (of course) was now in the offing. Tele-vision, that is, “radio sight”, as some newspapers described it, began. Television was a new hurdle for the repair technician, so many schools had to update their curriculum to accommodate it. To make way for new VHF and UHF television, there was a “reshuffle” mix-up in the spectrum allocations. But television builds were only slightly different than radio, so servicing them was all about knowing the new technology, not having a completely new form of build to contend with.



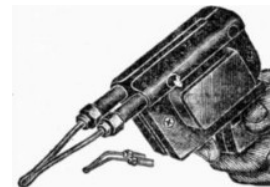
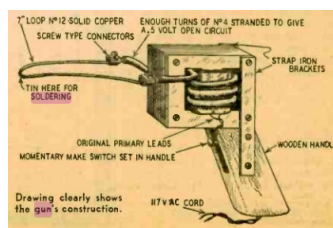
There was also a new set of radio services that utilized two-way radios. Initially fueled by war surplus two-way radio “donations”, local municipalities had their first taste of two-way radio, and were addicted. These two-way radios were used for business, air, police, and fire.



Two-way radio manufacturers generally established their own service structure, handled by their particular radio system, but radios would also occasionally fall into the local radio and TV service shop. Their construction was not much different than anything else that would need service. They were just in the car.



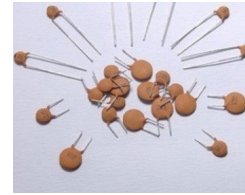
Solder and leaded components with terminal strips were still used throughout, but new “instant on” soldering irons were introduced by the Weller corporation. Ral Collins came up with the original idea, and released it for free to the public, and Weller capitalized on it. Again, innovation was free to the public, at first.



One could open a radio, unsolder a part, solder in a new one, and replace the cabinet, in no time, making repair quick and easy. No need to wait on even heating up the iron.

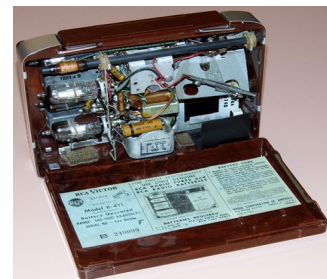
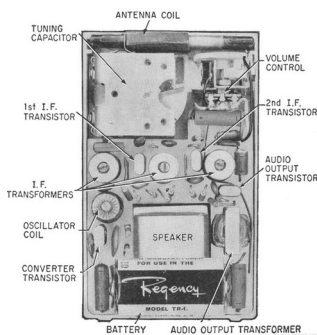
1950's

In the next decade, solid state devices, component miniaturization and circuit boards were becoming common. Resistors were still carbon, but the tubular ceramic capacitor was replaced with a disc ceramic, for smaller space designs. Larger capacitors were still paper dielectric, with the largest always being electrolytic.



Solid state products were often constructed using phenolic circuit boards with copper traces etched on one side, called “printed circuit boards”. Wiring between components was made by masking off copper traces desired, and removing unwanted copper by chemical etch. Then holes were drilled to mount leaded components on the opposite side, and the component leads poking through could be soldered to the copper traces.

This was the build method used in the Regency TR-1 transistor radio. Although printed circuit boards were a new construction technique, some solid state radios still used sockets and open wiring, with transistors in sockets. Radios such as the Heathkit DF-2 marine radio shown used this technique. Before the transistor became economical, miniature tube radios were common at the beginning of the decade. These were produced using traditional point to point terminal strip wiring, and small metal chassis, such as the RCA tube battery portable shown.



The circuit board would come to be standard for consumer radios by the end of the decade. Circuit boards were less labor intensive, and alleviated wiring errors. There was usually only one way to put the parts into a circuit board, and all the solder connections could be done at once on the trace side of the board. This was often done with a soldering “bath” or “tank”, full of molten solder. After all the components were inserted into the board, flux would be applied, and the board would be floated through the hot solder bath, soldering all the connections at once. Then leads would be trimmed, and the underside inspected.

These boards were routed and designed by humans. Mylar sheets with “artwork” would be used as photographic negatives. The copper side of boards would be coated with photosensitive etch resist. These circuit trace mylars would be attached to the board,

exposed to UV light, and then the exposed resist washed off, leaving only resist on the desired traces. Then these boards would be chemically etched. After this holes would be drilled, and components could then be inserted.

Injection molding had also progressed from brittle Bakelite cases to plastics, offering shatter resistance and more color choices. The small, portable, transistor radio would become the cell phone of the 1950s. There would always be someone in a crowd with an earphone, listening to an AM transistor radio. They may shout out important news flashes at any time, to anyone who would listen. People would also hide these radio earphones in their ears at church, or school, listening to whatever, instead of paying attention to what was going on at that time. Cell phone distraction is nothing new.



Over the years, manufacturers also developed a method to where consumers could still share in the responsibility of their own equipment maintenance. This had always been a thing with electronics, but a consumer was always given the option of servicing their own electronic equipment, if they wanted to.

The cost of a new radio or especially a TV made repair a very attractive alternative to purchasing new equipment every time a fault occurred. Used TVs, record players, and radios were always for sale in newspapers.

By the 1950s, vacuum tube reliability had extended to 10,000 hours, which exceeded that of most all the other components in a radio. Still, a consumer was still given the choice, if they wished, to learn how their device worked, and participate in it's repair. Many thrifty customers would pull the tubes from their television or radio, take them onto their local drugstore, and test them themselves. Tube testers would have stocks of replacement tubes in their cabinets, for quick replacement purchase.



If the tubes all checked good, then the store tester owner would suggest a visit to your local repair shop or public library. Right next to the books on how to fix your car, public libraries stocked books on how to repair your own radio or TV, if you wanted to do the entire service yourself. Just like how many mechanics and mechanical engineers got their start working on a car, many electrical engineers, ham operators, technicians, and scientists got their initiation trying to fix a simple AM radio. A visit to the library would also sometimes result in an invitation to local electronics or ham radio classes, if one wanted to pursue this.

So there was a path for those interested. It is where our current generation of engineers, technicians, and physicists were born. Critical thinking of diagnosis and function were some people's gift, that just needed a way of expression. This was often that way.

Although always a desire, newer equipment also developed with a total focus on audio reproduction quality. Although intelligible, audio from the horn speaker, or paper cone speaker in a tin box, would not accurately reproduce natural sound very well.

High fidelity accurate reproduction became a pursuit specialty of some equipment manufacturers, appealing to musicians and those with finer hearing. Many musicians used not only sheet music and instruments to practice their craft, but also electronic reproduction equipment to rehearse, and refine their skill.

Many people first experienced stereo by radio broadcast. This was arranged by broadcasters with one channel being on the AM band and the other on the new FM allocation. Some receivers were designed and manufactured to play both AM and FM simultaneously, because FM stereo multiplex broadcast had not been settled yet. A new market of Hi-Fi components was born. But still, builds were now either by circuit board, or traditional point to point wiring.



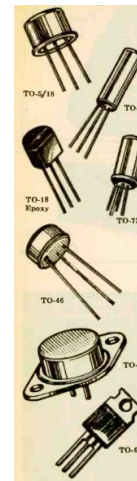
But the vacuum tube was still used in many instances, as plenty were available. Their price was also quite attractive, and often their function could not be duplicated with an equal expense of transistor part cost, or just could not be done at all with current transistors.



But components were still similar. There were only a few changes. Small transformers for solid state electronics were manufactured, along with new polymer plastic dielectric epoxy dipped capacitors. Miniature PCB controls and variable capacitors were mass produced to fit inside small radios.



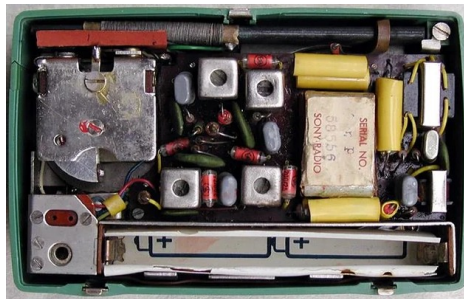
Wiring also was plastic, with cloth insulation no longer popular. Heat shrink tubing also was used in production. Single function complete circuit boards were manufactured, along with small speakers, to provide audio amplification in modular format. Transistor packages were standardized.



A transistor radio could be purchased for less than \$5. Inside were all the new parts and techniques for low cost, on display. Phenolic etched circuit boards, miniature transformers, variable resistors and variable capacitors were used throughout. Mylar and ceramic disk capacitors and miniature electrolytic capacitors also filled the box.

Although these radios were easily serviceable, with plenty of information available, they were of such low cost that it was hardly worth it. Consumers would often discard the

broken low cost radio instead of paying labor costs that would exceed the value of the radio. Producing disposable consumer goods became a thing, driven by a low cost pressure. But most important was that these radios were often no longer produced domestically.



Foreign consumer product production grew during this time. Components were also made internationally. The US economic consumer electronic market opened up to international trade. Countries recovering from WW2, such as Japan and Germany started to achieve sufficient infrastructure to make international manufacture possible. Having a consumer product still made in the U. S. A. became a selling point.

HALLICRAFTERS 3-Band Radio
\$20 OFF AT RADIO SHACK!
 EXCLUSIVE! Radio Shack bought Hallcrafters entire stock of 5-119 receivers to sell below dealer cost while they last. Hear 2-5.5 mc and 5.7-16.4 mc shortwave, also regular broadcast. Wired, not a kit. **Made in U.S.A.** Metal cabinet, speaker, voice/cord and speaker/fine switches, straight AC, superhet handwired circuit, 64-wave shortwave booster. It's the fabulous "Sky Buddy", the biggest bangbang in Radio Shack history and just in time for Christmas gifts. Order by mail while supply lasts. Add ship. 9 lbs. Tune in the world and save \$5 at Radio Shack!

SAVE 40%
 Regularly **\$49.95**
29⁹⁵

HIGHWAY HI-FI

Made in U.S.A. 109⁹⁵

MINIATURE CAPACITOR PACKAGE
 4000 mfd for \$1.00

High quality, metal cased completely sealed electrolytic capacitors **made in USA** for use in transistor auto radios, power supplies, communications equipment, "ham" gear and many other applications.

SEND TODAY for this package of 3 units; totaling 4000 mfd rated 16 volts DC; each unit 1 1/2" max dia by 2 1/4" max hgt.

SEND \$1.00 CHECK OR MONEY ORDER for each package, postage prepaid to:

LINDA SALES CORPORATION
 PO Box 68, Harrison, N.J.

Unbeknownst to everyone, the consumer electronic market slowly became international. Components could be produced in any country, assembled in another, and shipped to a third. Where was this radio made? Often, it was "assembled" in one country, but when examined by the service technician, the device contained parts from all over the world. Obtaining replacement parts was sometimes an international trade effort by the service technician. Like cars now, and so many other consumer products, "Made in ..." really did not mean anything anymore.

But, in the 1960's, as before, radio was still listened to, no matter who made them.



(Whew!)

Well, that was the first six decades. I have another six decades to go, and this letter is already up to 21 pages! So I will drop anchor here, and we can sail again next month for the conclusion to bring us up to present. Thanks for bearing with me so far. Give yourself a break, and we will continue in the next issue.

-...-

Stylish Club Kit

by

Harry, N3FMO

Did you enviously see someone with a custom SPARC shirt, sweater or hoodie? Well, envy no more. You, too, can possess your own SPARC clothes. There is an on-line store that has just been launched.

The direct link for the store is: <https://etownsportinggoods.chipply.com/SPARCk3ir/>

If it does not work, contact the host store.

Contact: Mitch Gibson
Elizabethtown Sporting Goods
7173676633
info@etownsportinggoods.com

W3RRR Fest Table Help

by

Harry, N3FMO

SPARC will be hosting a table at the W3RRR Hamfest in Beautiful New Holland, this Saturday, October 3. Come help. This Tuesday is also the fifth Tuesday of the month. So, we need to use this evening to prepare for the Red Rose Hamfest on Saturday. We need to get things lined up. Come on out and join the fun. You know, the yearly W3RRR fest:



Then Friday we need a few helpers to get tables and equipment loaded. Saturday we need some helpers to man the selling tables. No experience required.

Also, Sunday, Oct 3, is the annual SPARC picnic at Sam Lewis State Park, ...

(Here's something we don't do anymore, but I found myself doing it out of habit!)

... south of Wrightsville. across the river from Colombia. Take the Cool Creek road exit off 30W right after you cross the bridge, and head south. Take a left on Mt. Pisgah road. You can't miss it! Talk-in on 146.52 MHz. ...

(I left it in anyway, for nostalgia. Things have changed. - The Editor.)

Start time is somewhere between 11 and 12.

Meeting Night

The SPARC monthly general membership meeting is the fourth Tuesday of the month at 7:00 PM. The meeting is being held at the Clubhouse. Bring your snacks and hike out your trash.

License Test Sessions

Testing is conducted at the SPARC site on the first Tuesday of every month. Fee to take the exam. It is \$14.00 payable on the K3IR website or in person, cash or check only.

You can pre-register to take the technician test, or upgrade, at Hamstudy.org. There is also a link on the K3IR web site. If you do not already have one, go to fcc.gov and register for a FRN (Federal Registration Number).

Looking For Volunteers

SPARC currently has 131 "active" members on the roster. We have a lot to offer to our members. At this time we have a dedicated group of hardworking volunteers who keep the site running. Some say this is typical with most organizations. I don't think SPARC should be "typical" We need more real active members. Jobs range from the highly technical to the mundane but ALL are important. Please look at the list below and see if there is a place for you.

IT Team

Tower climbers and ground help

Operating building maintenance and cleaning

Operating building equipment maintenance and improvement

Porta Potty cleaning (not Pumping!)

Adopt a Highway crew

Elmers and Elm'ettes

Hamfest help, planning, etc.

Meeting programs and talks

Antennas! ...always more, bigger, higher.

Someone to take the trash home and pitch it when it's full.

Someone else to either eat or toss the old stuff in the fridge.