



## TWO EASY-TO-BUILD AM RADIO KITS

by Karl J. Zuk

**Introduction:** There are two very inexpensive radios in kit form that retail for under \$20. The Radio Shack Archerkit 28-4029 sells for \$12.95 and the Heathkit GR-1009 sells for \$18.95. They are designed as beginner's kits and are very easy to assemble, taking no more than four hours of work to complete. They both feature very easy construction, and have components that are very spread out for easy assembly and later modifications, if desired.

**Overall Performance:** For under \$20, you just cannot expect a "DX Machine", although I have been able to pull in a fair share of DX on both. If you have never assembled a kit, or want a good scratchpad to experiment with radio design and modifications, these were made for you. The Archerkit needed some minor modifications to even put it in the running. The Heathkit suffered from very poor audio due to a bad matching of audio output stages to the very inexpensive speaker that was provided with the unit. If Heath and Radio Shack investigated each other's products and combined their ideas, they could probably come up with a great sounding, very inexpensive kit. Both of these radios have been on the market for several years, and as far as I know, they have never been improved upon.

**Sensitivity:** Both units suffer from typical inexpensive radio design. Poor sensitivity was noted, especially under 1000 kHz. The unmodified Archerkit was so insensitive, it could only pick up the strongest of stations locally. With the modifications explained later in the article, the sensitivity increases about 15 dB, to a useable level for casual listening. The Archerkit has slightly better strong signal handling capacity than the Heathkit, but the Heathkit's overall sensitivity is at least 10 dB hotter than the Archerkit. The Heath was much more prone to images and internally created harmonics due to signal overload; the Archerkit was predisposed to shortwave images.

**Selectivity:** The Archerkit has a very broad selectivity curve, approaching 20 kHz from the carrier frequency. It would make a good low cost reception monitor for a broadcast station because of its broadband response and fairly hefty audio output that could drive an efficient bookshelf loud-speaker to a reasonable level. I found the high frequency response to be too good for the small speaker provided with set, creating a shrill sound. I created a low-pass filter to cure that. The Archerkit can split two channels apart (i.e. 880 to 900 kHz) without any problem; one channel width apart if both stations are fairly weak. The Heathkit uses two 455 kHz ceramic filters for comparatively narrow and sharp selectivity. It will easily split 10 kHz channels, and pick up strong 5 kHz splits. Don't expect a lot of transoceanic DX with this unless you fly there to pick it up! The Heathkit has a muddier, less-pleasing sound, but can cut the cheese better.

**Design and Appearance:** The Heathkit is larger and much heavier than the Archerkit, being  $3\frac{1}{2}$  x 6  $\frac{5}{8}$  x 1  $\frac{5}{8}$  inches to the Archerkit's  $3\frac{1}{2}$  x  $5\frac{1}{2}$  x  $1\frac{1}{2}$  inches. Both are powered by a standard NEDA 1604 9 volt battery. The Heathkit has about three times the components and is much more sophisticated than the Archerkit. The Heathkit has 8 transistors and two ceramic filters and 7 diodes. The Archerkit has two transistors, one LM386 audio amp chip, and one diode. Each feature a 455 kHz superhet design with one mixer stage and one IF amp stage; the Heathkit has an added RF amplifier stage. The Heathkit is easier to build with a clearer, almost over-elaborate assembly manual. The Archerkit left a few gaps in assembly description, but common sense made minor questions in assembly disappear. Both sets are housed in "high impact" plastic boxes. The Heathkit has a slide on and off battery compartment door for battery access, leaving the componentry permanently sealed in the cabinet. The sliding plastic piece will wear out quickly and/or break leaving the battery hole uncovered. A little hinge or clasp arrangement would have been nice. The Heathkit also features a jack for powering the unit via an outside power supply, which the Archerkit lacks. The Archerkit's back comes completely off to replace the battery, exposing all the components with it. In this case, the back will probably wear out, eventually making the housing of the radio cumbersome and poor. Most inexpensive radios today employ one of these two methods of battery removal, so I suppose these drawbacks are a part of modern life.

As for battery drain, the Heathkit claims 60 hours at two hours of daily use. The Archerkit is slightly better. Both are pretty efficient when it comes to battery consumption. Finally, there is a lot of room to add things in the Archerkit, should you want to modify or add to it. The Heathkit is fairly well packed in comparison, but still has a decent amount of room to move. I had to file some burrs away from the Heathkit's cabinet to make the capacitor and volume control knobs fit without rubbing.

**Antenna Coils:** Both units use ferrite rod antenna coils for signal pickup, but both have problems. The Archerkit coil must be tuned for optimum signal pickup during assembly, and uses enameled wire interwoven with cotton, that leads from the coil through a hole in the printed circuit board to the foil side for soldering. Although this is a common technique used in pocket radios, I sleeved these leads with tubing to prevent eventual shorting or breaking. The Heathkit had a serious problem with its coil. They preassembled the coil wires to metal pins that would fit through the board like component leads. As the pins are crimped onto a weak piece of cardboard and sealed with wax, the coil eventually comes loose from the pins, reducing your sensitivity to nil. The Archerkit uses two strong plastic mounts to hold the coil in place which is much better than the Heathkit. I managed to repair the Heathkit's coil by delicately soldering the wires back to the four connecting pins, and then, before remounting the coil, putting a good amount of household silicon seal where the coil will sit, then easing the repaired coil onto the silicon and soldering it in place. I then reinforced it with more seal. It hasn't come apart yet, and it much better than the original which fell apart in a matter of days.

**Flaws and suggestions to the manufacturers:** The Heathkit is a very ambitious kit for such a low price. It is generally well built and is sophisticated in design, but has a very serious flaw in its audio. It uses an inexpensive, small magnet 2 inch speaker that sounds just dreadful. I realize that I cannot expect high fidelity from such a set, but I returned three speakers to Heathkit before I gave up and bought a Radio Shack equivalent which sounded only marginally better. All their good circuitry is wasted by ignoring the set's audio quality. The Archerkit uses the same size speaker, but with a nice hefty magnet, and it sounds really nice. The Heathkit will break into miserable distortion at just above a quiet listening level, while the Archerkit will play wide open and sound great.

The Archerkit also has a fatal flaw. It suffers from very poor sensitivity unless modified. I built this kit over a year ago, and found it so insensitive that I just shelved it and wrote it off to a quick fun experience. Luckily I chanced upon an article in QST, written by Doug DeMaw, in their August 1985 issue. Entitled "A Semi-Kit Receiver for 75/80 Meters", it shows in great detail how to modify the Archerkit to receive the 75/80 meter amateur bands. Before getting into modifying the unit for ham use, he suggested the following to increase the sensitivity of the unit. Replace R8 with a 100 ohm unit. R7 changes from 560 to 100 ohms. R12 is deleted and replaced with a jumper wire. C13, connected between pin 1 and pin 8 of the LM386 chip, is replaced with a 1 k resistor and .05 uF capacitor in series with one another. I mounted the .05 disc in the place of C13 and used the holes provided for J2 and mounted the 1k resistor there, which is also electronically correct and neat. Then connect a .22 uF capacitor and a 2.2 kilohm resistor in series from pin 8 of the chip to a convenient ground. I mounted these on the foil side and covered them with black electrical tape to insulate. This increases the sensitivity greatly. Thank you, Doug, for saving my kit from the dust piles! I added an external antenna connection by connecting a wire from foil point W to a small capacitor; I used a .01 uF at 100 volts, to an earphone type "mini" jack mounted on the top of the cabinet to the right of the antenna coil. This improved reception under 1000 kHz greatly with a five foot piece of wire. Anything longer overloaded the set. I also found the sound of the set to be shrill after modification, so I replaced C5 with a .05 uF capacitor. This lopped off the high end of the audio for a more pleasing sound. Be sure to fully realign the Archerkit after modification. Save yourself the trouble, and assemble the set initially with these modifications, and you'll have a much more enjoyable kit. I would like to see Radio Shack make these changes, since they would cost very little extra, and make the set much better in performance.

**Conclusions and Recommendations:** I have a hard time deciding which set I prefer. The Heathkit can certainly pick up more stations because of its superior selectivity, but only a seasoned static-listening DXer, who is used to muddy and distorted audio would tolerate its sound. Although the Archerkit is a much simpler radio, it has a nice sound for casual listening and you find yourself not caring about its lack of selectivity. It is

