Heathkit of the Month #23:
by Bob Eckweiler, AF6C

Heathkit HD -1416
Code Practice Oscillator.

Introduction:
The first electronic project I ever built as a kid was a code practice oscillator; the year was around 1957. The plans came from *Popular Electronics,* and it used a single Raytheon CK-722 germanium PNP transistor. Transistors were quite new on the market, and expensive portable transistorized radios in their leather cases were all the rage. Taking a portable radio to the beach no longer meant lugging large units with tubes and large "B" batteries.

Figure 1: The CK-722 Transistor
Photo courtesy of N4MW

My first code practice oscillator had just a few components but it would drive 2,000 ohm ear phones at a decent volume and had a clean tone. It ran off a pair of AA batteries as I recall. I used it to learn the code and get my novice ticket in 1959.

Jump ahead some fifty-three years and I acquired another code practice oscillator (CPO); it was at the OCARC auction, and of course it was a Heathkit! The HD-1416 CPO.

Heathkit manufactured Three different models of transistorized code practice oscillators over the years. The first was the CO-1 which was manufactured between 1959 and 1967. In 1967 Heath replaced the CO-1 with the HD-16. Then in 1975 Heathkit introduced the HD-1416 which, over its life, was updated twice to the HD-1416A and the HD-1416H (case color changes only). All the Heathkit models came with a simple telegraph key.

The Heathkit CO-1:
Heath's first code practice oscillator, the CO-1 (figure 3) uses a single 2N238 germanium PNP transistor, not too different from the CK-722. A socket was used to hold the transistor, reflecting the fragile state of the early transistor. Figure 2 shows the simple circuit:

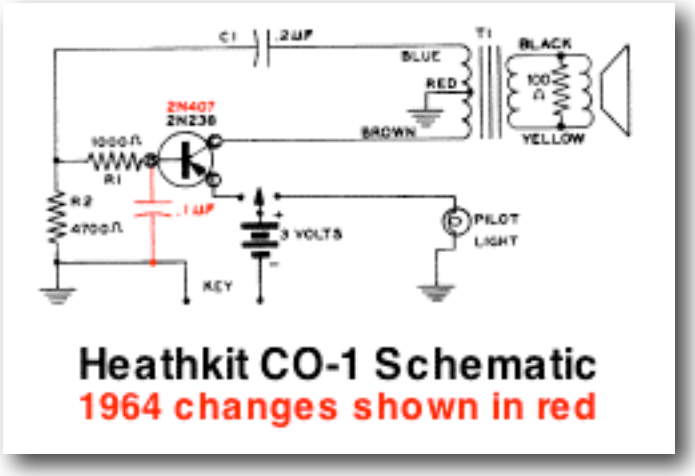

Figure 2: CO-1 Schematic with changes

Notice that the CPO drives a speaker and also has a switch that allows sending code using a light instead of a tone. The oscillator produces a tone around 1,000 Hz. A pair of "C" batteries power the CO-1.

The CO-1 measures 6" x 3" x 2–1/8". The panel has a small speaker grill, a switch to choose light or tone, a small #14 pilot lamp for the light and screw terminals for a key.

Later in the production of the CO-1 (February of 1964) Heath made a design change to the CO-1. They changed the transistor to a 2N407 and added a 0.1 μF disc capacitor between the base of the transistor and ground - evidently to reduce key-clicks. The model number was not

changed, but an addendum was supplied with the manual as were the new parts. I have that addendum sheet if anyone is looking to upgrade their early CO-1. The circuit changes are shown in the figure 2 schematic of the CO-1 in red.

Figure 3: Heathkit CO-1 CPO
Photo courtesy of N4MW

The Heathkit HD-16:

By 1967 the unijunction transistor had been introduced and became popular for a lot of oscillator devices. Heathkit took this opportunity to introduce a new CPO. The HD-16, shown in figure 4, utilizes a single unijunction transistor oscillator. The schematic is shown in figure 5. It uses a rather obscure GE 4JX5E670 transistor, which I believe is similar to the later popular 2N2646.

Like it's ancestor, the HD-16 drives a speaker and can be switched to drive a lamp instead of a tone oscillator. The case has a sloping front (quite similar to the first case I built my CK-722 CPO into) and is styled after the SB ham line color scheme of green and grey. The #49 light is on top of the case, the high impedance (150Ω) speaker and light - tone switch are on the sloping front and the volume and tone controls, as well as 1/4" phone jacks for the key and phones are on the vertical part of the front panel. The HD-16 uses three batteries, two NEDA 1604 9V batteries for the oscillator circuit and one 1.5 volt 'C' battery for the lamp.

Figure 4: The Heathkit HD-16 Code Practice Oscillator
Photo courtesy of N4MW

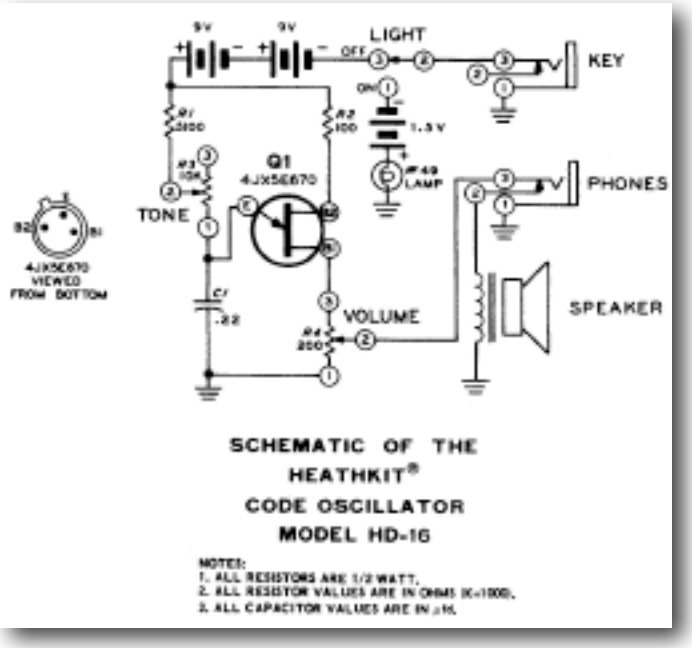

Figure 5 - HD-16 Schematic

The Heathkit HD-1416:

The HD1416 was introduced in 1975. It is a three transistor circuit using two transistors as a multivibrator, and one transistor as a class A audio amplifier. The unit is built into a small plastic case with a metal front panel. A printed circuit board mounts off the front panel on a small angle bracket. The back of the case is open, and the speaker, mounted in an aluminum bracket, at an angle to horizontal, bolts to the circuit board.

Figure 6: The HD-1416 CPO

The HD-1416 is powered by a 9 volt NEDA #1604 battery that mounts in the speaker bracket, held by four pieces of foam tape. Additional foam tape is located under the board to support the back of the printed circuit board.

The transistors used in the oscillator are a pair of 2N5249A silicon NPN transistors; the class-A audio amplifier uses an MPS-A20. A feature of the HD-1416 is that the keying arrangement allows it to be used with a ham transmitter using grid block keying (up to -400 volts), which most of the Heathkit transmitters/transceivers of the time utilized (such as the SB-400/401, HW-100/101, SB-100/101 to name a few).

The front panel is very simple with a 1/4" phone jack for phones, a volume control and two binding posts (red and black) for the key. A circuit board mounted control, easily accessible from the open back, of the cabinet, adjusts the tone from about 200 to 850 hertz. Unlike previous models, light for visual Morse code is included with this CPO. The telegraph key continues to be provided.

In late 1985 Heathkit introduced the HD-1416A with a brown case and black binding posts for the key. In 1989 Heath again changed the color to black and designated the CPO the HD-1416H.

Figure 7: The HD-1416 Less Case.

The HD-1416 originally sold for $9.95, in 1975, which is the same price that the CO-1 and HD-16 originally sold for. During the early eighties the price jumped to $13.95 (Christmas 1980 catalog), $14.95, (Christmas 1981) $16.95 (spring/summer 1982), $22.95 (winter 1983) and $24.95 (Christmas 1983). In 1985 Heathkit introduced the HD-1416A and dropped the price to $19.95 (fall 1985); it was back to $24.95 by the time the HD-1416H came out in 1989. That is the last price I have for the HD-1416H before Heathkit quit the kit business.

Restoring the HD-1416:

This is a simple kit. The one picked up at the club auction did not work when I got home; also the speaker was loose, as was the circuit board. Removing the unit from the case revealed a missing screw from a bracket that

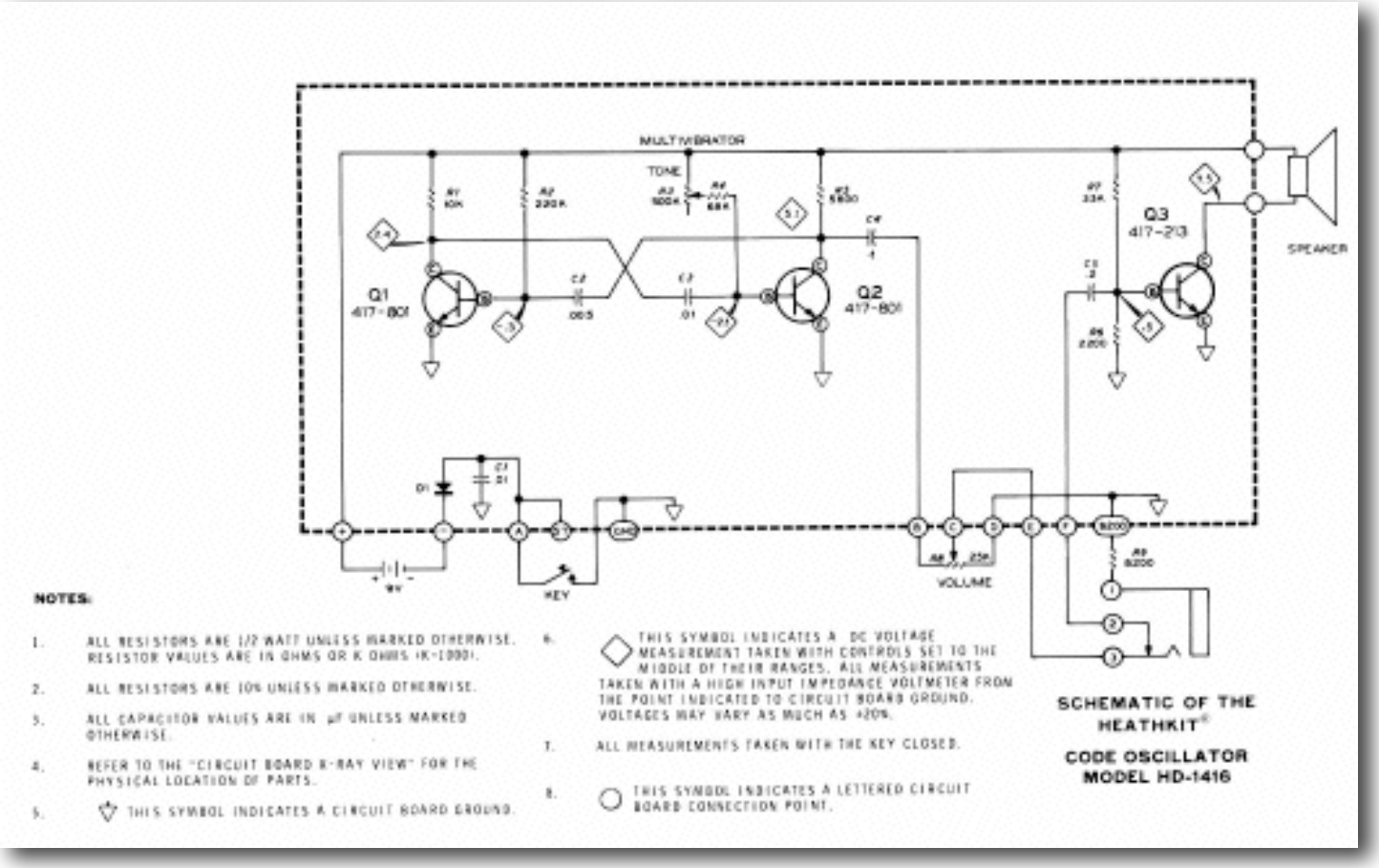

Figure 8: Schematic of the HD-1416 Code Practice Oscillator

mounts off the lower banana jack. Another problem, probably the biggest, was that the five pieces of foam strips that hold the battery and help support the circuit board had dissolved into a gooey mess. It was carefully cleaned up with rubber cement thinner (hard to find now-a-days but a great solvent for lots of adhesives). The circuit board was examined and a wire from the earphone jack to the board was found to be broken. It was replaced. Finally, new closed cell foam, normally used to insulate windows, was trimmed to replace the original foam. No specifications or size could be found on the original foam other than the Heathkit part number 73-39. A "best guess" was used to trim the sizes. Reassembling the kit; installing a used 9-volt battery and attaching a key (The original key was not included in the auction sale) resulted in a sweet, though harmonic note of CW as the key was operated.

Tube Code Practice Oscillators: (Ameco, Bud and Gonset)

Before the Heathkit ever put out a code practice oscillators there were numerous other manufacturers who produced numerous models. In the fifties and even into the seventies four tube-based models were very popular in the ham world.

Bud Radio manufactured two of the units, the Codemaster CPO-128A for $19.13 and the Codemaster CPO-130A for $16.50 (1962 prices). The two units were identical except the 130A required an external speaker. Bud also manufactured some variants of these models.

Ameco (American Electronics Company) manufactured the CPS that was available as a kit (-K) or built (-B) and with (T) or without (L) tubes; the price ran between $11.95 for a kit without tubes to $14.95 for a built unit with

tubes. Ameco also made code records and later code tape cassettes for learning CW.

Gonset manufactured the Monitone #3022 ($32.80 in 1962). It was similar to the other units but built to match their line of ham equipment.

All 4 units use a 35W4 rectifier and a 50C5 audio amplifier vacuum tube, and run off 117 V AC/DC. They all feature a 4" speaker except the Bud CPO-130A. The Bud and Gonset units came ready to use as an on-the-air CW monitor; the Ameco CPS had instructions to modify the unit to add this feature (losing the normal feature). The differences in price reflect the the different components. While the inexpensive Ameco unit uses screw terminals for the key and phones, the Gonset unit has phone jacks and a rotary switch to select the function as either a CPO, a CW monitor or an AM monitor.

Early on, the Ameco and Bud units were a shock hazard because the rectified line voltage (about 140V) was present on the key terminals and contact with it while touching a grounded radio would give a good shock. Both units were updated during their production to put the key in the speaker lead and eliminate the shock hazard. Bud changed the part number to the CPO-128B, but Ameco kept the original part number.

Figure 9: Early Ameco ad for their CPS Code Practice Oscillator from an early sixties Arrow Electronics Catalog

The Code Practice Oscillator Museum:
Since this is a Heathkit series, we just touched the surface of the many other CPO manufacturers and models. On the web, Dave - N4MW masters the excellent *Code Practice Oscillator Museum* website. There, numerous code practice devices are detailed; Dave has over three hundred in his collection. You may visit his virtual museum at:

http://www.n4mw.com/cpo.htm

Dave has graciously allowed me to use some of the photos from his website, including a photo of the classic CK-722 transistor.

73, from AF6C

Remember if you come across any old Heathkit Manuals or Catalogs that you do not need, please pass them along to me.
Thanks - AF6C

This article originally appeared in the November 2010 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.

If anyone has access to Popular Electronics of the mid to late fifties, I'd really enjoy finding the code practice oscillator article that used the CK-722. and that I built way back then.
Thanks - AF6C