Heathkit of the Month:
by Bob Eckweiler, AF6C

The Heath HD-4040
Terminal Node Controller.

Introduction:
In 1985 packet radio was an up and coming ham radio mode, bringing computers and ham radio into the same fold. The Internet was just starting up with *symbolics.com* becoming the first URL in March. It was quickly followed by numerous colleges acquiring *.edu* URLs. Online access for the average home computer enthusiast was usually limited to local bulletin boards over the phone line or isolated online services like *The Source, Compuserve* or *AppleLink* which later became part of *AOL*. Modem speeds were 300 and 1200 baud, and a Hayes 1200 Baud *Smartmodem* sold at a list price of nearly $700; slower 300 baud modems were going for around $300 (Acoustic modems somewhat less).

Packet radio offered the ham enthusiast who was also interested in computers a chance to communicate with other hams digitally. It also allowed the forwarding of email, and on-the-air packet bulletin boards where information could be stored and shared. On VHF FCC bandwidth rules allowed 1200 baud operation, but on HF the lower bandwidth limitations allowed only 300 baud. As packet grew in popularity bulletin boards sprang up across the nation, and distant bulletin boards could be accessed on VHF using multiple packet relay stations known as digipeaters and even sometimes hardwired or HF links.

Heath HD-4040 TNC-1 Kit:
Heathkit introduced their first packet radio mode TNC to the ham community in mid 1985 as the HD-4040 Terminal Node Controller (TNC) kit. The HD-4040 was a licensed copy of the TNC-1 designed by Tucson Amateur Packet Radio (TAPR).

First introduced in the Fall 1985 Heathkit catalog (#870) the HD-4040 was originally priced at $299.95, but dropped to $249.95 by the end of the year. There were no accessories available for the HD-4040 in the Fall catalog, but in a

Front View

Rear View
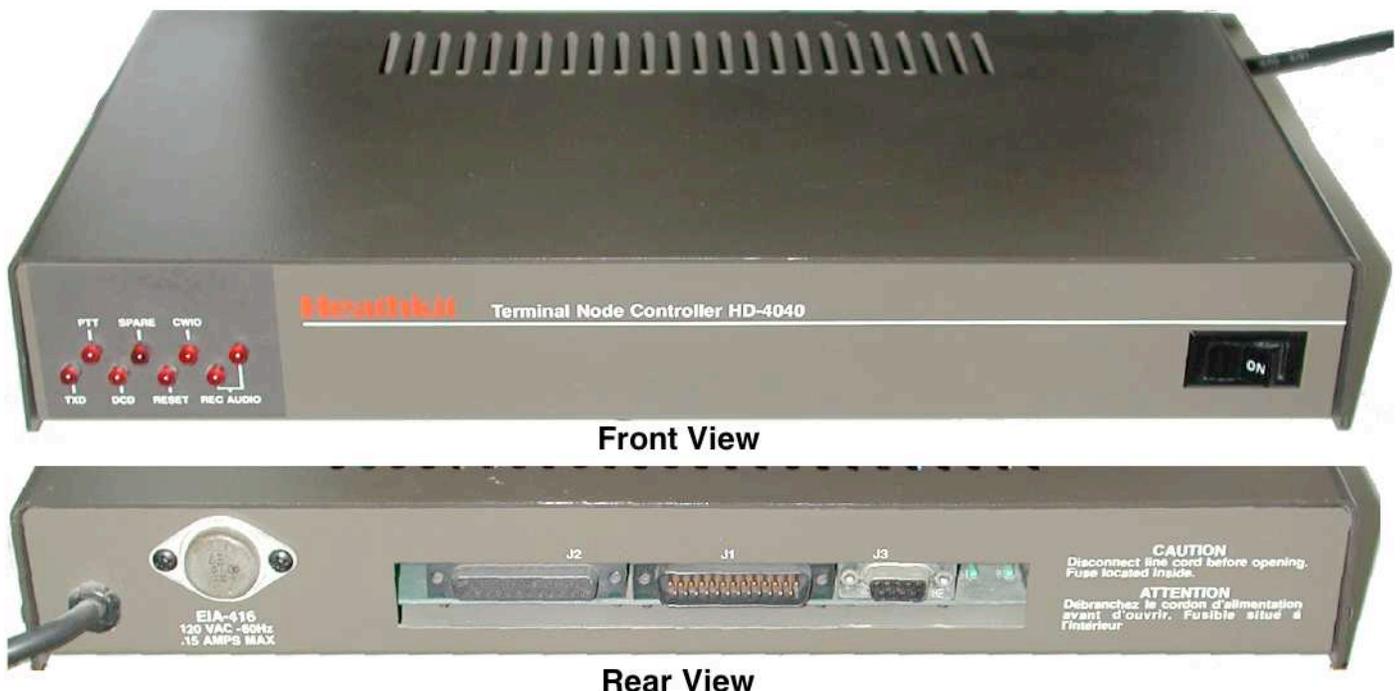
later 1985 catalog the HDA-4040-1 TNC Status Indicator ($29.95) and HDA-4040-2 TNC HF Header Kit ($9.95) were introduced. The former shows the status of the TNC mode and connection. The latter allows operation at 300 baud with an HF SSB transceiver. Near the end of 1985 Heath offered an HDS-4040-2 package that included the TNC, Status Indicator and 300 baud HF kit. Shipped to the west coast from Benton Harbor Michigan the package cost $253.91.

As received, the HD-4040 operates at 1200 baud and includes the TAPR TNC firmware in four 8 kilobyte 2764 chips (EPROM). RAM memory is 8 kilobytes in a single 6264 static RAM chip. the board contains an expansion memory socket where an additional 6264 chip can be installed bringing the total RAM to 16 kilobytes. In 1985 a 6264 8Kx8 static RAM memory chip sold for $40. A 128 byte NOVRAM chip (electrically alterable ROM) provides two switchable 64 byte banks where user data (ham call, timing parameters, etc) can be saved. An internal switch allows switching between banks so two separate sets of parameters can be setup and switched between easily.

To get on packet with the HD-4040, or any other TNC-1 involves doing only two things. First is interfacing the TNC to a radio, and the second is connecting the TNC to a dumb terminal or to a computer using a terminal emulation program. The computer has to have an RS-232 or RS-422 (common on older Macintosh computers) serial port or serial card. In the mid eighties the most common radio used was a two-meter transceiver, as this was where most of the activity was. HF, UHF and other VHF bands were not a popular but were also in use to varying degrees around the country.

Interfacing to a radio can be very simple or difficult depending on the radio and configuration wanted. Many transceivers have multi-pin auxiliary connectors where transmit and receive audio connections can be accessed without

having to tie into the speaker and microphone connectors. Some radios even have audio inputs and outputs designed especially for packet where the audio bypasses internal filtering designed to enhance voice signals. The other part of interfacing involves wiring the TNC to the push-to-talk (PTT) line of the radio, so the radio can key the transmitter when needed. The HD-4040 TNC (as well as the nearly identical TNC-1) have a watchdog timer hooked to the PTT circuitry that prevents the radio from being keyed continuously should the TNC lockup. Heath included a three page brochure that shows how to interface to about 30 popular radios of the period. They also included a "Radio Interfacing Data" sheet that you could fill out with information on your radio and send to Heath's Technical Assistance group.

Alternate Firmware:
While the TAPR firmware came with the HD-4040, many hams replaced or reprogrammed the EPROM chips with the WA8DED "host mode" firmware that was offered free on many packet bulletin boards by Ronald Raikes - WA8DED. The WA8DED firmware fit in just 16K of ROM and used only two of the four ROM sockets. With a slight modification that could be done using a header socket and not modifying the board at all, the other two ROM chips could be replaced with two additional 6264 chips bringing the RAM up to 32 kilobytes.

Almost all of the parts for the HD-4040 mount on a single circuit board which is identical to the TAPR design. The only parts not on the board are the power transformer and switch, the fuse and AC wiring and the LM-309 voltage regulator that mounts on the rear panel. The TAPR board has a place for the LM-309 and an associated heatsink, but Heath decided to take advantage of the chassis to provide a large heatsink.

Heath discontinued the HD-4040 in 1987. TAPR had introduced the TNC-2 by then which was smaller and packed in more features.
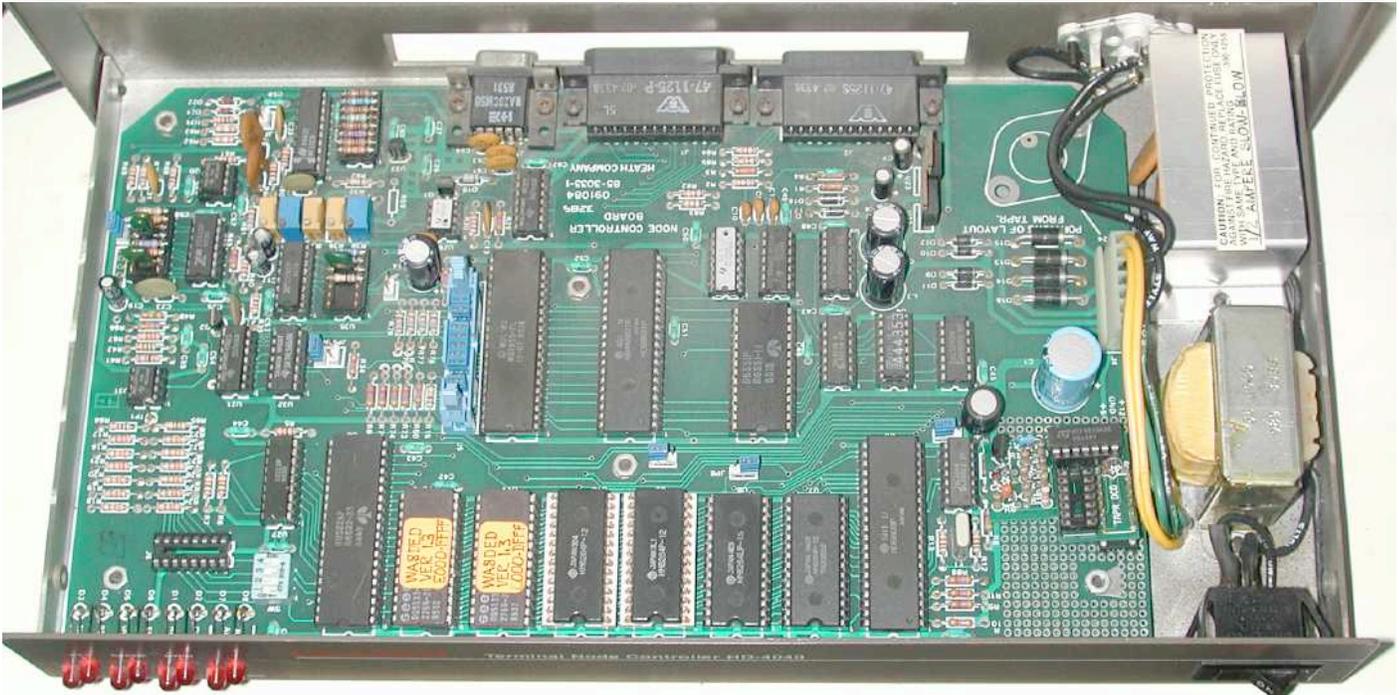
Heath HD-4040 top view showing circuit board

Heath HDA-4040-1 TNC-1 Status Indicator Kit:

Heathkit offered the HD-4040-1 Status Indicator which decodes information on the parallel port of the HD-4040 (or any TNC-1's parallel port) and provides status in the form of eight LED lamps. It also provides an audio tone to signal when someone connects - this turned out to be a very good feature as it is hard to no-

tice the connect light, and you may not be looking at the terminal screen when a connect occurs. The HD-4040-1 derives its power over the parallel port and requires no other wires except the parallel port connection. It was one of those accessories offered with a lot of equipment that was actually useful.

Heath HDA-4040-2 TNC-1 HF Header Kit:
The HD-4040 came set up to run on VHF at 1200 baud. It can be used at faster rates, such as 9600 baud by employing a separate modem. The TNC-1 has a connector for an external modem. Heath never offered a faster modem. However they did offer a 300 baud HF Header kit called the HDA-4040-2. This simple kit contains 12 resistors and three capacitors, all of which mount on two 16 pin plug-in headers. These replace two headers already plugged into the board (TAPR designation U30 and U34) that control the modem tones and shift.

Heath HK-232 (A) (B) All Mode TNC Kits:
Around 1987 Heath replaced the HD-4040 with the HK-232 which was a kit clone of AEA's PK-232 all-mode TNC which runs Packet, RTTY, AMTOR, NAVTEX, ASCII and even CW. It has two separate ports and can be switched

between two radios. It can also copy weather FAX with the right graphics setup.

Heath upgraded the HK-232 to the HK-232A in 1989 and HK-232B in the early 90s. They also later offered the assembled HKA-232-5 Mailbox board that lets you set up your own mailbox or bulletin board; this board works with any of the HK-232 models and sold for $49.95, but was often offered for free with the later PK-232-B. Power requirements for the HK-232 series are 12 volts at 1 amp. An optional HKA-232-4 12 volt 1 AMP power supply sold for $19.95 assembled.

The HK-232 line sold initially for $299.95 decreasing to $259.95 over several years. The HK-232B was available as a special package with the HKA-232-5, and HKA-232-3 Technical Manual (normally $24.95) for $259.90.

Not long after introducing the HK-232 kit, Heathkit also introduced the *Pocket Packet* TNC called the PK-21 and an optional HKA-21-1 rechargeable battery pack ($17.95). The PK-21 could also run off the ($7.95) multipurpose PS-2350 battery eliminator. The PK-21 sold for $219.95 and later for $199.95. It came assembled and was not available in kit form.

Final Comments:
Heathkit stopped selling its TNCs just about the time they went out of business in the early nineties.

If you want to know a bit more about the allure of building a Heathkit, check out the following 1992 article from the New York Times announcing the end of Heath's kits. This article originally appeared on the front page of the March 30th 1992 issue of the New York Times:

http://www.nytimes.com/1992/03/30/business/plug-is-pulled-on-heathkits-ending-a-do-it-yourself-era.html?sec=&spon=&scp=1&sq=heathkit&st=cse&pagewanted=all

73, from AF6C