

Heathkit of the Month:
by Bob Eckweiler, AF6C



**Heath DX-100
HF AM/CW Transmitter**

Introduction:

This past April the Heathkit DX-40 amateur transmitter was featured in this column. Also discussed were the DX-20, DX-35 and DX-60 family models. They all were either strictly CW or AM/CW using controlled-carrier modulation (low-level screen-grid modulation). Each larger numbered model ran a tad more power, with the DX-60 running 90 watts input on CW. These transmitters were very popular with novices and new hams between the fifties and mid-seventies.



Original DX-100 from a 1956 Heathkit ad.

The Heathkit DX-100:

Heathkit also made a much higher performance big brother transmitter in the DX series, the DX-100. The DX-100, was introduced in 1955 for \$189.50. It produces 150 watts input on AM and 180 watts input on CW. AM mode features high-level plate modulation to produce a more efficient AM signal than controlled-carrier modulation. The transmitter has a built-in VFO, or it can be crystal controlled. It covers

160 meters through ten meters including the eleven meter band, which was a ham band back in 1955. The DX-100 is a battleship of a transmitter and can easily qualify as a boat-anchor; yet AM-ers still use and covet it today.

What makes the DX-100 such a battleship? First, it weighs in at a solid 100 pounds. Much of that is from the iron of two massive power transformers, two power supply chokes, and a big modulation transformer. Put all that in a large 20-7/8" W. x 16" D. x 13-3/4" H. heavily TVI shielded steel rack cabinet that is a kit unto itself. Oh, also stuff in a pair of finals with a pi-network, two modulator tubes, four power supply rectifier tubes, a voltage-regulator tube and six other tubes needed to get the transmitter to work. Add nine massive 16" guns on three triple-gun turrets ... - no wait, that's the wrong battleship!

The Power Supplies:

The Heath DX-100 has two separate built-in power supplies. The low voltage (LV) supply transformer powers the RF stages up to the final amplifier, as well as the audio stages up to the modulator. It uses a 5V4G rectifier tube in a capacitor input filter with a hearty choke for good regulation and a solid 350 volts output. An OA2 voltage-regulator tube, driven by the low-voltage power supply, provides a constant 105 volts to the electron-coupled VFO for stability. A small 6AL5 rectifier tube takes voltage off a tap from the LV transformer to provide negative 75 volts bias power for the clamp circuit and final amplifier.

A 12 volt center-tapped filament winding on the LV transformer supplies filament power to all the six and twelve-volt filaments. The need for 12 volts is driven by the choice of the 1625 modulator tubes. All the six-volt filaments are driven from one leg of the grounded center tap except for the finals which are driven off the other leg. The two modulator tube filaments and the modulator driver are driven directly across the 12 volt line. The HV and LV rectifier

tube filaments are driven by two separate 5-volt windings on the LV transformer.

The high-voltage supply that powers the final amplifier and modulator uses a separate 1,800 volt center-tapped transformer and a 5.5 henry choke in a choke input filter arrangement with 63 μF of output capacitance to provide a well regulated 740 volts. Rectification is provided by two 5R4GY heavy-duty rectifiers in parallel. (The silicon diode rectifier was still a some years from becoming practical!)

The Modulator and Audio Stages:

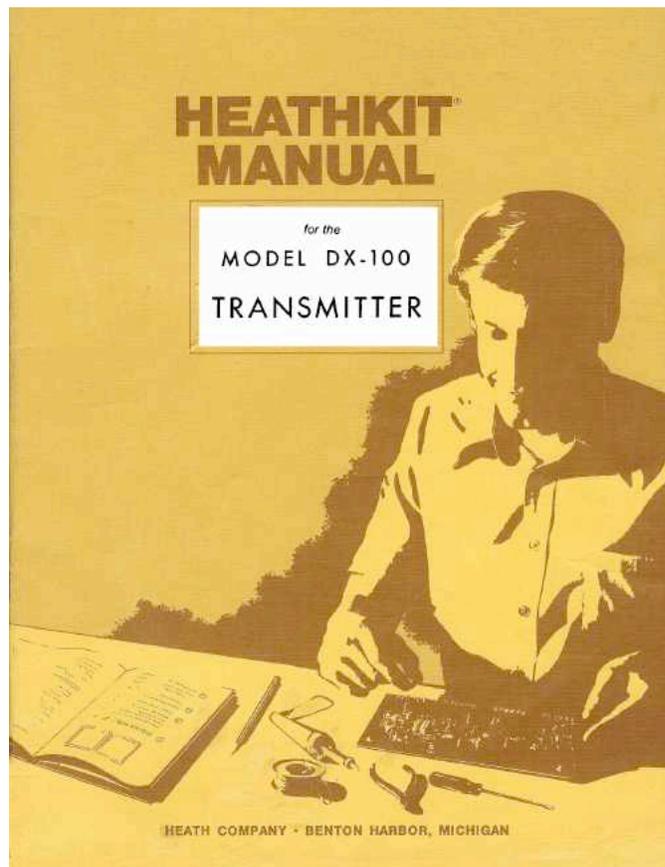
During World-War II many ARC-5 (SCR-247N) transmitters were built for the war effort. They flew in Navy and Army fighters and bombers. The HF transmitters use a pair of 1625 tubes in the final RF amplifier. After the war these tubes were plentiful and very inexpensive. They are identical to the 807 except that they have a 12-volt filament and use a different tube socket (seven-pin vs. five-pin). Heath chose to use a pair of 1625s as their modulator tubes. The tubes run in push-pull class AB_2 and can produce about 85 watts of audio power.

The audio preamplifier is designed for a high-impedance crystal microphone, such as the then very popular Astatic D-104. Two sections of a 12AX7 twin-triode provide audio amplification and also set the audio response to 300 - 3000 cycles per second, ideal for AM communications audio. The second triode section's output is fed into a 12BY7 audio driver tube that is coupled to the grids of the two 1625 modulator tubes through an interstage transformer. The 1625 tubes vary the voltage on the plates and screens of the RF final tubes through the modulator transformer.

If you want to use the DX-100 to drive an external plate-modulated RF power amplifier, the DX-100 may be easily adapted to provide 85 watts of 500-ohm audio output. This is sufficient to drive most plate-modulators designed for a 1KW AM amplifier – the maximum power permitted for radio hams at the time the DX-100 was in production.

RF Stages:

The built-in electron coupled VFO used in the DX-100 is nearly identical to the Heathkit VF-1 VFO that was available for the other DX-series rigs. VFO output frequencies for the bands are: 1750 - 2000 KC (covering 160M and 80M) 7000 - 7425 KC (covering 40M, 20M, 15M, and 10M) and 6740 - 6807.5 KC (covering 11M).



The VFO is followed by a buffer / crystal oscillator stage that uses a 12BY7 tube. In the VFO mode this circuit isolates and amplifies the VFO signal. If the user has selected a crystal instead, this stage acts as a crystal oscillator. Up to four internally mounted crystals or the VFO may be selected by a front panel control. Crystal frequencies in the ranges of the VFO output may be used for the given bands. In addition crystals in the 3500 - 4000 KC range may be used for the appropriate bands.

The RF buffer stage also acts as a frequency multiplier depending on the band. On 160M and 80M the buffer output is untuned. It is

tuned to 40M for operation on 40M, 20M and 15M and it is tuned for 20M for operation on 11M and 10M.

The output of the buffer is fed to the RF driver stage that uses a 5763 tube. This stage acts as a multiplier when required for a given band. The driver output is coupled to the final amplifier by a low-pass PI network. The PI network has fixed loading and a tap on the coil is switched by the band-switch. Driver tuning is adjustable from a control on the front panel. A front panel potentiometer adjusts the drive level by adjusting the driver tube screen voltage.

The Final Amplifier:

The final amplifier uses two very popular 6146 tubes driven in parallel in class-C. No frequency multiplication is done in the final amplifier. The final amplifier is coupled to the antenna using a Pi network output. On CW the plate and screen voltages are supplied directly by the HV power supply. On AM the modulation transformer is switched into the HV circuit modulating both the final screen and plate voltages. The screen grid voltage is dropped through a resistor and is also connected to a clamp tube. This tube conducts heavily if the drive to the final is lost, preventing excessive plate current and damage to the final tubes.

Keying Circuit:

The keying circuit of the DX-100 uses conventional cathode keying. Only the VFO and buffer / crystal oscillator stages are keyed.

Meter Circuit:

A single 0 - 1 ma meter with appropriate printed scales monitors the transmitter via a front panel selector switch. The switch has five positions:

- [RF] **Driver** [plate current] 0 - 50 ma.
- [RF Final] **Grid** [current] 0 - 10 ma.
- [RF Final] **Plate** [current] 0 - 500 ma.
- [RF Final Plate] **Volts** 0 - 1,000 volts.
- **Mod**[ulator plate current] 0 - 500 ma.

Front Panel:

Controls are staggered in two rows across the upper and middle, with a third row along the bottom of the front panel. Two of the bottom controls have concentric shafts for dual purposes:

Top Row (left to right):

- On the left is the meter.
- On the top center is the lighted VFO **Frequency** dial window. Arcane by today's standards but quite a technical achievement in the fifties.
- On the right is the Heathkit logo and model nomenclature.

Staggered Middle Row (left to right):

- Directly under the meter is the meter selection switch.
- Just left of middle is a large **Driver** tuning knob.
- In the middle is a large VFO **Frequency** knob that moves the dial in the window.
- Directly below the VFO knob is the plate HV on indicator lamp.
- Just right of middle is a large plate **Amplifier** tuning knob.

Bottom Row (left to right):

- **Mike** conn. (Mate: Amphenol 75-MC1F)
- **Audio Gain** potentiometer
- **Power (Off / On)** toggle switch
- Left Concentric controls:
 - **Xtal 1 - 4 - VFO** (Outer)
 - Final Grid **Drive** (inner)
- **Band selector (160 - 10)**
- Right Concentric controls:
 - Plate **Loading - Fine** (Outer)
 - Plate **Loading - Coarse** (inner)
- **Plate HV (Off / On)** toggle switch
- **CW / Phone** mode switch
- **Key Jack**.

DX-100 Tube Lineup (15 total):

- HV Rectifier: 2 x 5R4GY
- LV Rectifier: 5V4G
- Bias Rectifier: 6AL5
- VFO Voltage Regulator: 0A2

- Speech Amplifier: 12AX7
- Audio Driver: 12BY7
- Modulator: 2 x 1625
- VFO: 6AU6
- Xtal Osc / Buffer: 12BY7
- RF Driver: 5763
- Final Clamp: 6AQ5
- RF Final: 2 x 6146

The DX-100 was manufactured from 1955 to 1957 when it was replaced by the DX-100B. No DX-100A ever was manufactured.

The DX-100B:

In 1957 Heathkit began production of the DX-100B. Single Sideband was beginning to become popular, and perhaps one of the biggest reasons for changing the DX-100 to the DX-100B was to make a rig that would work with a planned sideband adaptor being designed at Heath.



Heathkit DX-100B.

(Photo by Mark, K3MSB - Used with permission)

The DX-100B is nearly identical to the DX-100, with the following changes:

The two dual concentric controls on the front panel have been eliminated. The left outer concentric switch that selected one of four internal crystals or the VFO was moved to inside the cabinet, and the number of crystal sockets decreased from four to one. The left inner dual concentric control, (Final Grid Drive) took over the full spot on the front panel.

The right dual concentric control that was composed of an outer Coarse and inner Fine Plate Loading control on the DX-100 is now a single control with a geared drive hooked to a larger variable load capacitor.

The rack-like DX-100 cabinet was replaced with a lighter one-piece prebuilt cabinet. The top of the new cabinet has a trap door that allows access to the Xtal/VFO switch and crystal socket. Crystal use was evidently waning in popularity because of the stable VFO.

The knobs were updated slightly; they now feature a triangle instead of a line as their pointer.

The DX-100B chassis came already punched and ready for the additional connectors and wiring to support the Heathkit SB-10 Single Sideband Adapter. This adapter could also be used with the earlier DX-100 model, but required drilling and punching of the chassis for the necessary connectors. SSB was quickly becoming the mode of the future and many hams updated their DX-100 series transmitters to use the SB-10 adapter.

Although the DX-100B was only available until 1960 it was also quite popular. Units can be heard in operation today on many of the AM nets on the lower bands. The DX-100B remained for sale for over a year after its replacement was introduced attributing to popularity of this transmitter.

Observations:

In 1960 I was leant a DX-100 to play with by a fellow ham, Marty Brody - K2MDL. My experience at the time was with a DX-40. The DX-100 ran cleanly and the quality of my audio reports were excellent. With three times the audio power in the AM sidebands I also found it easier to make and keep contacts when the band conditions weren't favorable. The rig worked well on CW too, though I can't say I noticed many difference over the DX-40, except the obvious thrill of knowing you have the additional power. VFO stability was great by 1960

standards! When I had to give the DX-100 back it was a sad day!

Conclusion:

The Heathkit TX-1 Apache replaced the DX-100B. Completely restyled outside, the TX-1 has an updated audio section that uses clipping, a modulator that uses modern EL-34 tubes and, when built, is fully wired for the SB-10 SSB adapter.

Perhaps in a future column we'll discuss the Apache TX-1 and Mohawk RX-1 companion receiver. I never did buy a DX-100, though I did upgrade to the TX-1 Apache in 1961.

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 September 2008 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.