

**Heathkit of the Month #90:
by Bob Eckweiler, AF6C**



AMATEUR RADIO - SWL - CB

**Heathkit GW-31
HAND - HELD TRANSCEIVER.**

Introduction:

On September 11th 1958 the FCC created the Class D Citizen Band (CB) service which divided the 11-meter amateur band (26.96 - 27.23 mc.) into 23 CB channels. While not yet the craze that CB became in the late sixties, it did start to grow. Initially, under FCC Part 19 rules, a license was required to operate a CB radio. However, under Part 15 of the FCC rules, unlicensed operation was allowed on CB channels 2 - 23 with heavy restrictions on power and antenna size.

Heathkit entered the CB market with the CB-1 in late 1959. The CB-1 "Lunchbox" design soon led to the HW-19, HW-29(A) and HW-30 transceivers for 10, 6 and 2 meters respectively. The CB-1 sold for \$42.95 in kit form and \$60.95 factory wired. It required a CB license to use. Heathkit followed it with a line of CB radios into the mid-70's.

In late 1960 Heathkit produced the GW-30, a hand-held CB transceiver that met the requirements of Part 15 and could be used without a license. The GW-30 sold for \$32.95 (\$64.95) in kit form and \$50.95 (\$99.95) factory wired. The prices shown in parentheses are for the radios when bought in pairs.

Here is a link to the index of Heathkit of the Month (HotM) articles:

http://www.w6ze.org/Heathkit/Heathkit_Index.html



Figure 1: A pair of GW-31 Hand-held CB Transceivers.

In the Fall - Winter 1961 catalog Heathkit began offering two new hand-held CB transceivers, the GW-21 and the GW-31; like the GW-30, both could be operated without a license. The GW-21 sold in kit form for \$44.95 (\$84.95) and factory wired for \$71.95 (\$136.50). The GW-21 featured nine transistors and a superheterodyne receiver with RF amplifier. The lower cost GW-31 was a redesign of the GW-30, offering a more compact unit at a lower cost. The GW-31 sold for \$24.95 (\$46.00) as a kit and \$37.75 (\$71.95) factory wired. The GW-31 remained in production until 1966 when it had an extensive makeover and was rebranded the GW-31A. The GW-31A sold for \$19.95 (\$35.00).

The GW-30 Hand Held Transceiver:

Heathkit's first handheld "Walkie Talkie" was the GW-30 (Figure 2). It is housed in a simulated black leather case and has a shoulder strap for "convenient carrying". The radio weighs just under two pounds with the battery installed, and measures: 6-1/2" H x 3-1/4" W x 2-3/8" D. The four transistor circuit has a regenerative receiver, a 90 mW input, crystal controlled transmitter and two stages of audio with built-in speaker (which



Figure 2: GW-30 Heathkit's first CB Walkie Talkie

also acts as the microphone). Audio output is 30 mW. The GW-30 has just two external controls; a large black volume control, with an OFF - ON switch at its fully counter-clockwise position and a "Push-to-talk" (PTT) button. "Set and forget" receiver regeneration control and receiver oscillator adjustable coil are not accessible for adjustment when installed in the case. The pull-out whip antenna extends to 40" and collapses to 7-1/2".

The GW-30 requires an older style 9-V NEDA #1602 battery (Eveready #246) which provides a 75 hour life under "normal intermittent use". The NEDA 1602 battery is now only available from specialty battery manufacturers. Amazon is selling an alkaline version of the NEDA 1602 for just under \$24 each. Heathkit was offering them for \$2.95 for two in mid-1961. Luckily, the common NEDA 1604 9-V battery will work, but not provide the life that the NEDA 1602 would. Still, you can buy a lot of common 9-V batteries for \$24.

The GW-31 Hand Held Transceiver:

The GW-30 didn't stay around very long. It was superseded by the GW-31 which is very similar electrically, but more compact, and lighter; all for \$8 less. At 5-7/8" H x 3-1/8" W x 1-1/2" D it is only 27-1/2 cubic inches in volume compared to 50-3/16 cu. in. for the GW-30. At 1-1/4 lb. is almost 3/4 lb. lighter.

GW-31 Controls:

The GW-31 OFF - ON / volume control is a thumbwheel type located near the top of the front panel above the speaker/mic. The PTT button is located on the left side of the unit. Two holes in the rear panel allow access to the receiver oscillator coil and the regeneration potentiometer so they can be adjusted without opening the case, when needed. The whip antenna extends to 36" and collapses to just 1" outside the case, making it less susceptible to damage than the GW-30 antenna when collapsed.

GW-31 Circuit:

The GW-31 uses the same four transistors as the GW-30. They are germanium PNP types. Refer to **Figure 3** for the GW-31 schematic and **Table I** for the transistor types.

The Transmitter:

The transmitter uses a single TI R424 HF transistor (V4) as a crystal-controlled class-C oscillator. The crystal is a subminiature third overtone plug-in type that was buyer specified and Heathkit supplied for one of the, 23 CB original channels (Channel 1 was only usable for licensed CB operation). L4 and C20 form the tuned output circuit. L4 has two taps, one provides feedback to the crystal through C18; capacitor C17 sets the feedback level. The second, low impedance, tap feeds the antenna. L1 is a loading coil for the shortened antenna. Class-C bias is provided by R12 through R14; C19 provides AC bypass for the emitter bias resistor.

The Audio Stages:

In transmit, the speaker acts as a microphone; audio is amplified in two cascaded audio stages, each using a 2N185 transistor. The class-A first amplifier (V2) has a, ballpark calculated, voltage gain of around 40. In reality it is somewhat less.

The second audio stage (V3) operates as a class-A power amplifier that drives an audio transformer (T2). In transmit, the primary of the transformer provides modulated voltage to the transmitter collector (V4), and the transformer secondary provides a low impedance modulation voltage on the ground return to the emitter of V4.

In receive the cascaded (V2 and V3) audio stages amplify the audio from the super-regenerative detector and drive the speaker.

The Super-Regenerative Detector:

A 2N1108 transistor (V1) operates as a super regenerative detector that can be tuned to receive any of the 23 original CB channels from 26.965 to 27.255 mc. In receive, the signal from the antenna is coupled by C7 to a tuned circuit made up by L2 and C5. C7 is small to reduce the oscillating detector signal that radiates from the antenna during receive. The detector oscillates due to feedback provided by C3. This oscillation is at the frequency of the tuned circuit.

The detector is actually continually going in and out of oscillation due to voltage accumulating on C1. This is occurring at the "quench" frequency, and is adjustable by R1, the REGENERATION control. R1, along with R2 and C1, sets the quench frequency. Quenching is occurring at a rate much higher than the audio frequency range. The gain of V1 is at its highest just before the oscillation starts. This detected signal is coupled through T1 to the volume control. C4 and C8 bypass the higher quench frequency, leaving

the detected audio intact. In the first audio stage C10 and C12 further reduce the quench signal, which is heard as a hiss in the receiver speaker. There is no audio squelch.

T / R Switching:

A momentary 4PDT pushbutton switch activates the transmitter when pressed; when released a spring returns the switch to receive. Each switch pole is designated with a letter from A to D in the schematic.

A - Receive: The antenna, with loading coil, is connected through C7 to the low impedance tap on L2, the detector tank circuit.

A - Transmit: The antenna, with loading coil, is connected through C16 to the output tap on T4, the transmitter tank circuit.

B - Receive: The crystal is shorted to assure no oscillations occur in the transmitter circuit.

B - Transmit: C6 and R13 are effectively connected across L2 detuning the detector to prevent spurious radiation during transmit.

C - Receive: The output of the audio amplifier is connected to the speaker.

C - Transmit: The transmitter (V4) emitter is connected to ground through the secondary of the audio output transformer, turning on the transmitter.

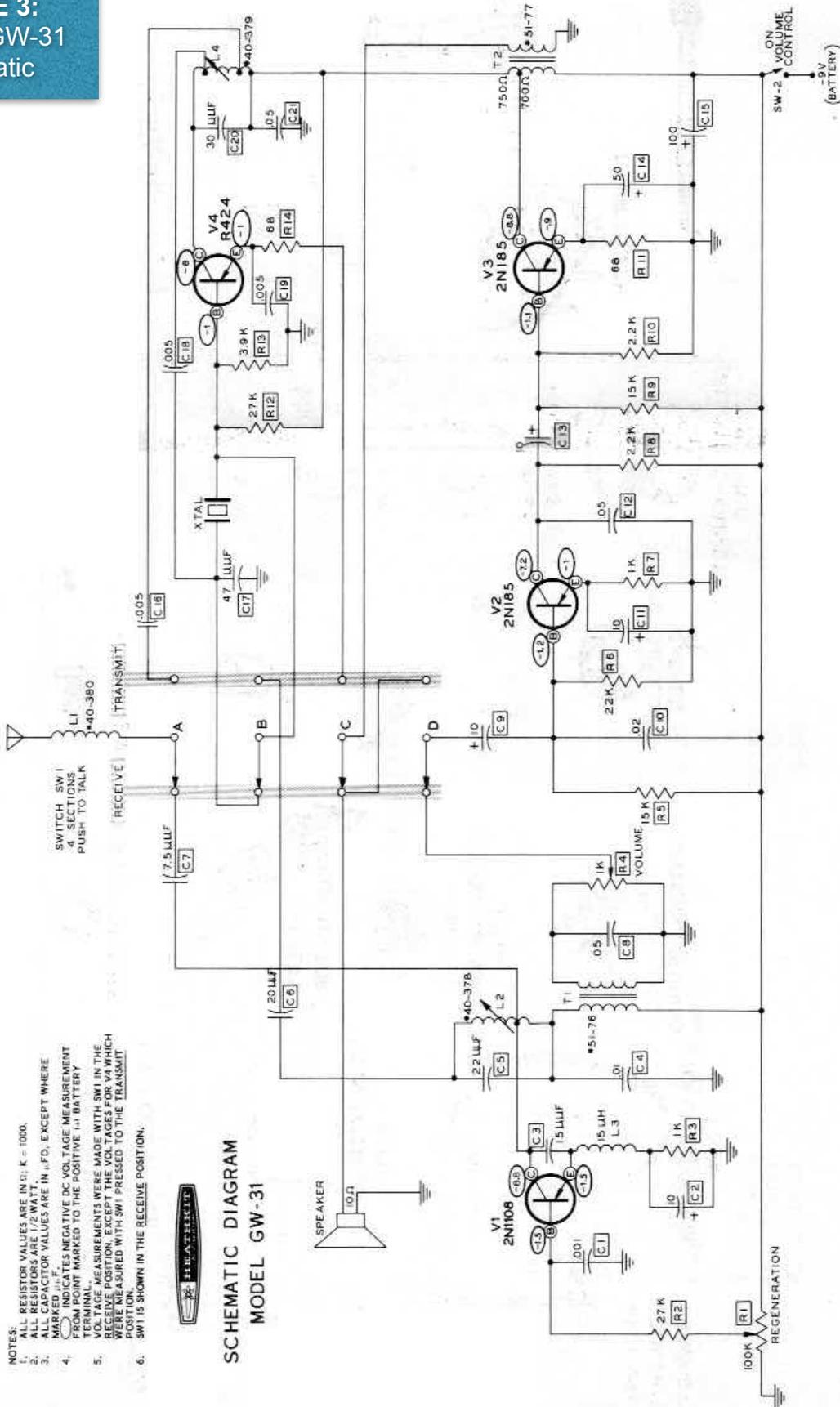
D - Receive: The super regenerative detector audio, after the volume control, is connected to the audio amplifier input.

D - Transmit: The speaker, acting as a microphone, is connected to the input of the audio amplifier.

GW-31 Assembly:

Just about all the electronic components of the GW-31 mount on a single circuit board including the PTT switch and volume and regeneration controls. Sockets are provided for the transistors and the crystal. Even the

FIGURE 3:
Heathkit GW-31
Schematic



speaker, which is wired externally, bolts to the circuit board. The collapsable antenna bolts to a small bracket also mounted to the circuit board. The bracket provides the needed electrical connection. A plastic grommet isolates the collapsable antenna where it exits the metal case.

The battery doesn't mount on the circuit board. It uses a standard 9-volt battery connector which also fits the common NEDA 1604 battery. (If you use the more common 9-volt battery, you will need to place some filler in the battery compartment to keep the battery in place).

Inside the battery compartment section are three FCC mandated labels. A battery type label, a transmitter identification label and a certification label. These labels are provided by Heathkit and are required under sections 15.208 and 15.209 of the FCC Part 15 rules.

Heathkit also included a *Citizen's Band License Package* with each kit. This packet contained instructions and forms to obtain a CB license at the time. Unlicensed operation could only be used between two part 19 devices. Communication on Channel 1 or between this Part 19 radio and a licensed Part 15 radio was not allowed.

GW-31 Adjustment:

Alignment is required after assembly. The first adjustments set the regeneration control, followed by preliminary tuning of the receiver. Then the transmitter is tuned, and finally the transmitter input power is measured to be sure it is below 100 mW to meet FCC Part 19 rules.

Setting the regeneration control involves turning it slowly from fully CCW to where the hiss is loudest. Then the transmitter is keyed momentarily. If the hiss doesn't return upon receiving, the control is turned slightly

CCW and the procedure repeated until the hiss returns reliably.

Setting the receiver close to on frequency is cleverly done. Just remove the transmit crystal and hold it close to the receiver tank coil. Then adjust the coil for minimum hiss. The crystal is a sharply tuned circuit and the crystal absorbs energy from the coil near resonance.

A dummy load is used to adjust the transmitter tank coil for maximum output. Using the previous procedure, once peaked, un-key and key the transmitter and turn the coil slightly CW until the transmitter starts reliably.

Final assembly is done next; it involves putting the radio into its snap-together metal cabinet. If you need to re-open the case a coin can be inserted in a slot and twisted to snap the case back apart.

Once assembly is complete, Heath recommends you have someone operate the transmitter you will be communicating with from a distance and do a final adjustment on the receiver tuning coil.

The Heathkit GW-31A:

In 1966 Heathkit replaced the GW-31 with the GW-31A. The transistors were changed to silicon NPN types. The circuit remained similar, though with the higher gain transistors, only one stage of audio was needed for

GW-30/GW-31:		GW-31A	
V1	Detector 2N1108 Ge PNP	Q1	Detector 2N2712 Si NPN
V2	1st Audio 2N185 Ge PNP	Q4	Mic Amp 2N2712 Si NPN
V3	Audio out 2N185 & /Modulator Ge PNP	Q2	Audio out 2N3390 & Modulator Si NPN
V4	Xmtr R424 Ge PNP	Q3	Xmtr 2N3646 Si NPN

Table 1: GW-30, -31 and -31A Transistor Lineup

receive. The transistor lineup is shown in **Table I**. Note the change in designator letter from V to Q and the changed numbering. The GW-31A was sold until sometime in 1968.

10-Meter Ham Operation:

In the February 1961 QST *Hints and Kinks* K8BLL discusses putting the GW-30 on 10 meters with additional power. A similar idea will work for the GW-31 & 31A handhelds. For licensed ham operation Part 15 restrictions no longer apply.

Author's Comments:

Back in the early sixties I built a pair of GW-31 transceivers. They disappeared during the move from NY to CA. My impression of their operation was not favorable. They worked, but the constant hiss was annoying, their range was poor, and they needed adjustment frequently. Still my friends and I had a lot of fun with them. I think these radios soured me on super-regenerative receivers more than any other device I've ever used.

Of special interest is the dummy load. My kits each came with a coil that you soldered to a #49 lamp bulb (**Figure 4**). The coil was placed near the transmitter tank and used to



Figure 4: Dummy load used on my GW-31 units.

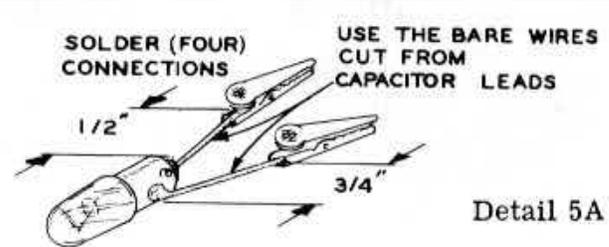


Figure 5: Dummy load using #1804 with alligator clips used on other GW-31 units.

adjust for maximum power. Other units used alligator clips for direct connection to the circuit board (**Figure 5**). Which was used first is unknown. Both lamps are rated at 60 ma, but the #1804 is 4-volt and the #49 is 2-volt.

Next month:

In late January I'm expecting a heavy work load so I may not have time to put together a Heathkit article for the February issue. I should be back on track for March. Meanwhile I'm open for suggestions for the April article.

As some might know, I try to find an abstruse Heathkit to write about to celebrate April 1st. I'm open to suggestions. A Heathkit Candle Stick, Heathkit 'freebee' flashlight, Heathkit 26 lb. "Laptop", Heathkit Log-Splitter, Heathkit Motor Bike, and Heathkit Trash Compactor have starred in past April issues. there must be more out there!

I'd like to thank Chuck Penson, WA7ZZE for sending along the GW-31 manual that played an important part in me writing this article. His trilogy of books on Heathkit belong in every Heathkit fan's library.

73, from AF6C



This article originally appeared in the January 2019 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.

Always on the lookout for old Heathkit Catalogs and Manuals.

Thanks - AF6C