Heathkit of the Month:
by Bob Eckweiler, AF6C

AMATEUR RADIO EQUIPMENT
Heathkit HA-14
"KW Kompact" HF SSB Linear Amplifier

Figure 1: HA-14 "Kompact Kilowatt" HF Linear Amplifier
Photo courtesy of Dave Lien -W6OVP
http://www.qsl.net/w6ovp/

Introduction:

In March I received an email from Dave Lien - W6OVP. He commented: "*I didn't see an article on the Kompact Kilowatt line. You might find something of value towards such an article in my web site dedicated to the HA-14.*" This is one kit I was planning on covering, but lacked enough information to make it worthwhile; lacked, that is, until I surfed to Dave's HA-14 website. At that time I had three articles in the pipe and another outlined. However, the "Kompact Kilowatt" is an interesting Heathkit worth moving up a notch in the cue.

In HOM #33 the Heathkit SB-200 HF Linear Amplifier was featured. In table 1 of that article the HA-14 was mentioned. Heathkit announced the SB-200 in mid 1964; 10 months later they announced the HA-14 which draws a lot of its design from the RF section of the SB-200, but was modified for compactness and ease of operation, traits that make it ideal for mobile operation. Still, the HA-14 remains a capable amplifier for use in the ham shack.

HA-14 KW SSB Amplifier:

The HA-14 measures 12-3/16 W x 3-3/16 H x 10" D and weighs all of seven pounds. It was introduced in the May 1965 catalog supplement (#800/54). Over its life it sold for $99.95. The HA-14 stopped production sometime in 1968; it did not appear in the major 1969 catalog.

In order to make an amplifier this small the power supply is external. Heathkit manufactured two power supplies especially for the HA-14. The HP-14 DC supply for mobile use ($89.95) and the HP-24 AC supply for use in the shack ($49.95). Heathkit recommends the HP-14 be mounted under the hood of the car due to allow the use of a short lead directly to the battery. The HP-24 can be mounted out of the way under the desk in the shack. More on these power supplies in a later section. The specifications of the amplifier are shown in Table I.

The HA-14 (Figure 1) is styled after the HW series of ham equipment which in turn borrowed a lot of its styling from the concurrent SB line (HOM #30) by using the SB series knobs and meters. At first I wondered why this kit hadn't received an SB designation; but upon closer scrutiny the HA-14 has all the features of the HW line including a green vs. gray cabinet with HW style ventilation holes. The only thing it is missing that is common to the early HW line is the two-tone front panel; the HW line front panels generally uses two colors, light green-gray and dark green, with the nomenclature white on the dark green and black on the light green-gray. The SB line is solid dark green with white nomenclature. What makes the HA-14 look, at first, like a member of the SB line is its single color dark green front panel.

Earlier, Heathkit had introduced the HA-10 "Warrior" KW linear (1961) and the HA-20 Six-Meter 125W linear (1962); both of these amplifiers were styled after the TX-1 Apache and RX-1

HA-14 Specifications:

Bands:	80, 40, 20, 15, 10 meters
Input Power SSB:	1,000 W PEP
Input Power CW:	not specified
Driving Power SSB:	100 W PEP
Driving Power CW:	not specified
Duty Cycle SSB:	50% voice modulation
Duty Cycle CW:	33%
3rd Order Distortion:	-30 dB or better @ 1KW PEP
Output Impedance:	50Ω to 75Ω
Max. SWR:	2:1
Tubes:	Two 572-B / T160-L in parallel
Power Reqs.:	2,000 V DC @ 500 ma peak -120 V DC @ 60 ma. (bias) 12.6 V AC/DC @ 4 amperes
Size:	12-3/16" W x 3-3/16" H x 10" D
Net Weight:	7 lbs.
Ship Weight	10 lbs.

Table I

Mohawk with silver/chrome knobs and light green, dark green paint. After the HA-14, Heathkit produced a line of VHF amplifiers, and a discone antenna that carry the HA designation.

Figure 2: HA-14 shown in mobile service above an HW "Monobander" Transceiver

The width of the HA-14 is quite close to the width of the single-band HW-12, HW-22 and HW-32 transceivers so it will fit neatly above or below in a mobile setup as shown in the main 1967 Heathkit catalog (Figure 2).

HA-14 Controls and Connections:

The front panel controls are listed in Table II. The HA-14 has a few unusual features. First, the meter measures only relative power output and SWR. Tuning is done for maximum output on the meter. When the amplifier is off, the transceiver power is fed directly through the amplifier and through the meter circuit so the meter also reads relative exciter output and SWR. The meter doesn't measure, grid current, plate voltage nor plate current, all are measurable on the SB-200. Yet, for mobile operation that is sufficient for performing a quick adjustment.

HA-14 Front Panel Controls (L to R):

TUNE	White arc segments marked: **80, 40, 20, 15, 10** Variable HV Capacitor 150 pF
BAND	**80, 40, 20, 15, 10** 5-position rotary switch
Power	**OFF - ON** Toggle switch
METER Switch	**FWD - SWR** 2-position rotary switch
SENSitivity	White arced arrow Potentiometer located concentric with the METER Sw.
Meter	**REL PWR** (top scale) White arc with 6 ticks and **SET** above the full-scale tick **SWR** (lower scale) **1, 1.5, 2, 3** (3 at mid-scale) Meter movement 0-1 ma, 100Ω

(nomenclature **in bold** is as printed on the panel)

Table II

HA-14 Rear Panel Connections (L to R):

HV	Single pin connector Millen 37001D (red) mates with: Millen 3700C (red)
POWER	12-pin male connector Cinch-Jones P-312-AB * mates with: S-312-CCT *

Pin	Function
1.	GND (parallels pin 2)
2.	GND (parallels pin 1)
3.	12V Filament (parallels pin 6)
4.	Not used.
5.	Not used.
6.	12V Filament (parallels pin 3)
7.	Power Switch (**ON** connects to pin 8)
8.	Power Switch (**ON** connects to pin 7)
9.	ALC threshold voltage (from pwr sup)
10.	–120 VDC Bias
11.	ALC output (to exciter)
12.	Ant. relay (Ground to operate amp)

RF INPUT	RCA jack, ceramic mates with: RF capable RCA plug
RF OUTPUT	SO-239 UHF connector Mates with PL-259 UHF plug

Table III

* These Part #s are **believed** correct. Please check prior to purchasing.

The second unusual feature is the absence of a variable load capacitor in the pi-network output circuit. Instead, a fixed 350 pF 5 KV capacitor is installed; and on 80 meters an additional paralleled 500 pF capacitor is switched in. This provides loading but reduces the ability of the amplifier to tune quite as efficiently; it's a small price to pay for the benefits of compactness and ease of tuning in a mobile environment.

The rear panel of the HA-14 has just 4 connectors; they are listed in Table III along with their mating connectors. Besides the **RF INPUT** and **RF OUTPUT** connectors common to HF amplifiers, the HA-14 has a separate **HV** connector and a 12-pin Cinch-Jones **POWER** connector. The pinout of the power connector is also given in table III. Not only does it accept bias, filament and ALC threshold voltage, it also provides switching leads for controlling the external power supply, an ALC output for the exciter and a lead that the exciter switches to ground to switch the amplifier into transmit mode.

The HA-14 vs. the SB-200

The HA-14 linear amplifier circuit is similar to the SB-200 RF section in many aspects and as such it uses many of the same parts. The ALC circuit is identical (except for the external threshold provided), as is most of the input circuitry. Since the HA-14 offers mobile capability, the 6.3V filaments are wired in series for 12.6 V operation. Though the filament current is half of that used by the SB-200 they both use the same bifilar 10 µH filament choke part. The input networks are identical for 80 through 20 meters, but on the 15 and 10 meter bands the SB-200 uses an L-network and the HA-14 uses a pi-network. The output pi-network uses the same variable tuning capacitor and coil for 80 - 20 meters but, again uses a different coil for 15 and 10 meters. As mentioned earlier the loading capacitor is fixed (350 pF on all bands except 80 where it is 850 pF). The antenna relay control is similar to the SB-200 circuit except for a few component changes, The same relay is used.

While the SB-200 uses forced air cooling via a fan, the HA-14 relies on convection cooling for the two tubes. This is probably the reason for the lower duty-cycle specification for this radio. Since the HA-14 power supply is external, its associated heat is absent in the amplifier. Also, the low-boy design and extensive ventilation holes allows almost unimpeded airflow around the tubes (See Figure 3).

Mobile Operation:

Since the HA-14 is specified for mobile operation Heathkit took certain steps to prevent failure from vibration. Both the SB-200 and the HA-14 use the same tubes and tube sockets, but the HA-14 includes a mounting ring that

clamps the tube base to the socket, preventing the tube from coming loose. Also the 12-pin Cinch Jones power connector includes locks to prevent the connector from coming loose. The HP-14 mobile power supply also uses locking Cinch Jones connectors.

Circuit Description:
The HA-14 uses two 572B/T-160L triode tubes in parallel in a grounded-grid configuration. Each tube has a plate dissipation of 160 watts and a maximum DC plate input of 600 watts. The tubes are biased for class-B operation, which corresponds to a grid bias of just a few volts negative. This bias voltage is created across a small resistance in the grid circuit, and is effectively near zero. Both tube's grid is bypassed with capacitors to keep their RF potential near zero also. Since the filaments also accept the driving RF, the filament voltage is isolated by a bifilar choke. Normally, as on the SB-200 the filament, return to ground is accomplished at the center-tap of the filament transformer. Since this is not possible one side of the bifilar choke is grounded and the 12V is fed to the other end. The 12V filament power also drives a #53 lamp that illuminates the meter.

Input Circuit:
The input circuitry is a pi-network on all bands except 80 where an L-network is used. No adjustment is provided as these networks are broad enough to function properly with standard component tolerances. The correct network is selected by wafer "A" of the band switch; which also shorts out the unused networks. The output from the selected network is capacitively coupled to the tube filaments.

Output Circuit:
The high voltage to run the finals comes in through a separate Millen high-voltage connector. The voltage is marked as 2,400 volts, but probably sags a bit under load. With each tube drawing somewhat under 250 ma a DC input of 1 KW peak DC input power is easily achieved.

Figure 3: HA-14 Sans Cover
Photo courtesy of Dave Lien -W6OVP

A 150 pF variable capacitor, the same part as used in the SB-200, tunes the plate in conjunction with the proper segment(s) of the output coils. An extra 100 pF of capacitance, needed on 80/75 meters, is switched in in-parallel with the tuning capacitor by the band switch wafer "B". As mentioned earlier, the output pi-network uses fixed capacitors for loading. A 350 pF fixed HV capacitor is permanently connected and a 500 pF capacitor is switched in parallel with it on 80/75 meters by the band switch wafer "C", which also selects the desired coil tap for the selected band; and shorts out the unused coil segments.

Antenna Relay Circuit:
The external power supply also provides a negative 120 volts to operate the antenna relay and bias the amplifier tubes beyond cut-off when in standby. The –120 volts connects directly to the DPDT antenna relay coil, which for some reason is rated for 110 VAC. The relay coil is shunted by a fixed resistor. The other side of the coil goes to the grids of the tubes through an RF choke; it also goes through a small 33 ohm 1W resistor to pin 12 of the power connector on the rear of the HA-14. Grounding pin 12 (ANT RELAY) causes the relay to energize and the bias on the tubes to drop from negative 120 volts down to just a volt or so negative, biasing the tubes from cut-off into class B. In its un-

energized state the relay connects the rear panel RF INPUT and RF OUTPUT connectors together. When activated, the relay connects the amplifier circuit between the RF INPUT and RF OUTPUT connectors. The meter circuit sits between the relay and the RF OUTPUT.

ALC Circuit:

Except for some minor RF bypassing changes necessitated by a remote power supply, the ALC circuit is identical to the SB-200 (See figure 5). RF from the grid is divided by capacitive voltage divider made up of C8 and C9. Until this RF voltage gets high enough it is effectively shorted to ground by capacitors C3 and C32. A positive ALC threshold voltage is supplied through pin 9 of the power connector from the external power supply. On the HA-14 this voltage is about 6 volts, and keeps diode D1 biased off. However when the RF energy exceeds about 6.6 volts peak, D1 begins to conduct. and a net negative voltage, filtered by R1, R10, C3 and C32, appears on the ALC output line (pin 11). This voltage is fed back to the exciter and lowers its RF output to prevent overdriving.

Figure 4: Rear view of the HA-14 With HP-24 AC Supply on top. Photo courtesy of Dave Lien -W6OVP

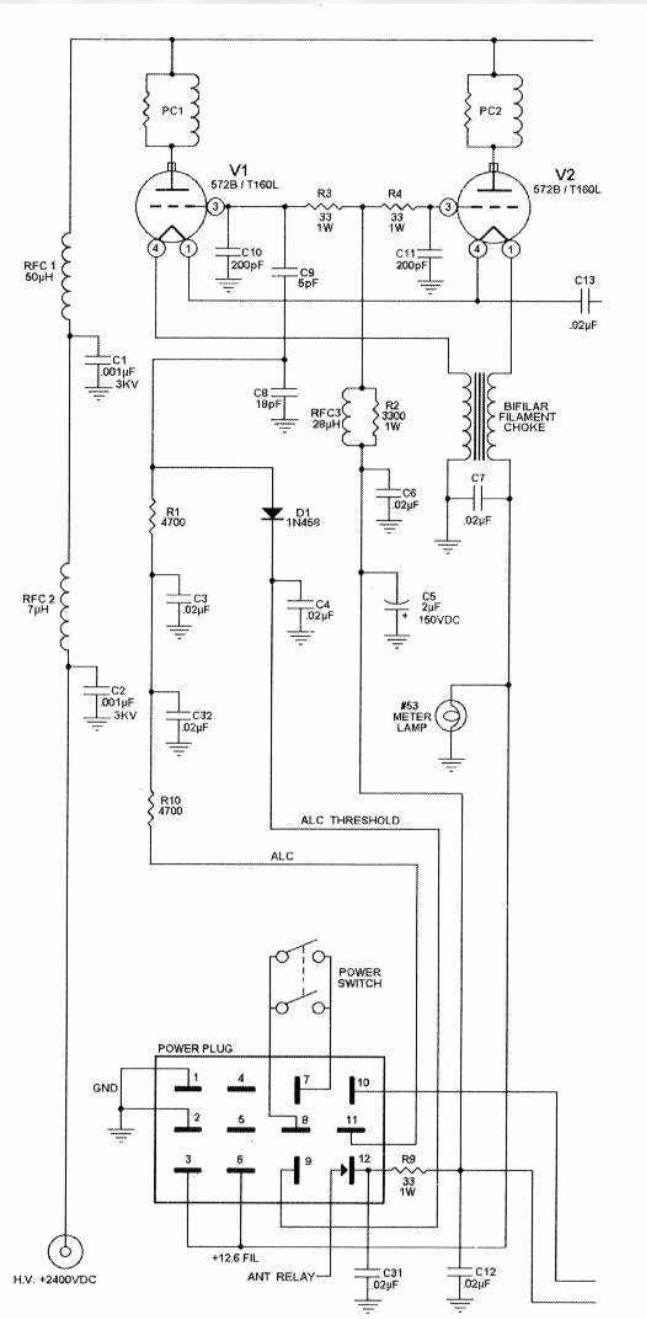

Figure 5: The ALC circuit of the HA-14.
Full schematics and manual PDFs for the HA-14, HP-14 and HP-24 are on Dave's web site.
http://www.qsl.net/w6ovp/

While the HA-14 uses an ALC voltage of about 6 volts, the SB-200 threshold voltage is set at 10 volts. The reason, I surmise, is because the SB-200 is rated for a slightly higher output than the HA-14 due in part to the HA-14's lack of forced air cooling (1,200 watts vs. 1,000

watts). I imagine with a well placed fan the HA-14 could operate at the higher power level.

A Word of Caution!

Transmitters and amplifiers with external power supplies can pose a serious risk. The problem arises should the HV be connected to the amplifier yet the ground between them is missing. This puts the RF section at a fatally high voltage potential. Heathkit does a good job of protecting the user by having the power switch on the amplifier assuring the power cable is connected. *Yet I feel assured that, somewhere out there, there are some hams who defeated the remote switch on their HP-24!* It is wise to be sure the amplifier and radio are properly grounded together.

I still remember the story I heard as a novice about a local ham who had a homebrew AM amplifier in a six-foot rack. Plate modulation was the technique in those days and he removed the modulator, which had its own built-in LV power supply but also used the main HV for the modulator tubes. After doing some repairs, he decided to check the amplifier before reinstalling it in the rack. The modulator was sitting on a wooden table but to get it out of the rack he had removed the large grounding braid. Eager to test his repair he turned on the amplifier's power supply, let everything warm up and then grabbed the D-104 mic... The fact he was in his basement on a concrete floor did not help his situation. SAFETY FIRST!

The HP-24 AC Power Supply:

I briefly covered the HP-14 in HOM #40, but failed to mention the HP-24 when I covered the HP-23 (HOM #26). The HP-24 was built specifically to power the HA-14. Its measurements are identical to the HP/PS-23(-) series that powers so many Heathkit tube transceivers from the HW-12 to the SB-102. About the only distinguishing feature that sets the HP-24 (Figures 4 & 6) apart is the red Millen high voltage connector. The power supply specifications are given in Table IV.

Figure 6: HP-24 AC Power Supply
Photo courtesy of Dave Lien -W6OVP

The major differences between the built-in SB-200 power supply and the HP-24 are the power transformer and HV bleeder chain. The power transformer, besides having a different mounting style, has a 12.6 volt filament winding. The high-voltage windings on both are 800 volts which feeds a voltage doubler. One assumes the

HP-24 AC POWER SUPPLY Specifications

High Voltage:	2,500 VDC no load 2,000 VDC @ 300 ma. 1,900 VDC @ 500 ma. (min.)
Duty Cycle:	SSB: 50% @ 500 ma. peak (normal voice operation) CW: 33% @ 500 ma. (normal telegraphy operation)
Bias Voltage	–180 VDC no load –120 VDC @ 60 ma.
Duty Cycle:	Continuous @ 40 ma.
Filament Voltage:	12.6 VAC @ 4 amps.
Power Reqmts:	120 V @ 16 amps. max. 240 V @ 8 amps. max. (VAC @ 60 cps.)
Dimensions:	9" L x 4-3/4" W x 6-3/4" H
Net Weight:	18-1/2 lbs.

Table IV

800 volt rating is given under load since 885 volts is required to give the 2,500 volts no-load specified. The bleeder resistors in the HP-24 are composed of 6 each 100KΩ 2 watt resistors while the SB-200 has a heavier chain of 6 each 30KΩ 7 watt resistors. In both chains there are additional small resistors to generate the ALC threshold voltage, and, in the case of the SB-200, to measure the plate current. One other difference, though it's hardly worth mentioning, is the interesting fact that the SB-200 uses eight rectifier diodes per chain and the HP-24 uses seven. The diodes and voltages are identical, so perhaps Heathkit gained some additional confidence in the reliability of their 57-27 diodes? These are 1N2071 diodes (600 PIV 750 ma).

CW Operation:

The manual for the HA-14 mentions CW operation in two paragraphs that total barely 2-inch columns in length; no ratings are given on the manual's specification page. The first short paragraph sets the duty cycle limit to 33% and recommends that the HA-14 only be used with the HA-24 AC power supply for CW operation.

HP-14 DC POWER SUPPLY Specifications

High Voltage:	2,300 VDC no load 2,000 VDC @ 500 ma.peak
Duty Cycle:	SSB: 50% (normal voice operation) CW: (not specified)
Bias Voltage	–130 VDC no load –110 VDC @ 60 ma.
Power Reqmts:	12 - 14.5 VDC (neg. ground.) 25 amps. average. 50 amps. maximum.
Switching Freq.	1.5 kc (approximately).
Dimensions:	7-3/4" L x 8-3/8" W x 2-5/8" D
Net Weight:	8 lbs.

Table V

Figure 7: The HP-14 DC Switching Supply Photo courtesy of Dave Lien -W6OVP

The second paragraph gives a brief description on how to tune up the exciter for CW operation with this amplifier. Still, CW input should reach a full KW with 100 watts of drive. Indeed this has been confirmed by Dave - W6OVP.

The HP-14 DC Power Supply:

In order to operate the HA-14 mobile, a power supply that will operate off a vehicle's battery and alternator is needed. Heathkit filled this need with their HP-14 DC Power Supply (Figure 7). Table V gives its specifications.

The HP-14 appears similar to the HP-13 but is actually about an inch longer and a 1/4 inch deeper. Most obvious is its use of four switching transistors mounted on heavy heat sinks instead of two. The HP-14 uses the same transistors as the HP-13, germanium (Heath part # 417-60 - early models and 417-120 - later models). These transistors are nearly impossible to find. The transistors cannot be interchanged without making some other changes to the circuit. See Heath service bulletin HP-14-1D. This bulletin, as well as some suggestions for possible transistor substitutions are given on the W6OVP

website. I have not yet seen any modifications that use silicon transistors. This is possibly due to the design of the transformer which is wound to drive transistors with lower V_{BE} voltages than silicon transistors offer.

Under mobile operation the power supply doesn't need to generate any filament voltage as it is be supplied directly by the battery. Thus the car's raw battery voltage is fed to the filaments and only switched by the power supply. The 572B/T160-L tubes are instant warmup. but they are also a bit voltage critical, rated at 6.3V ± 0.3V. When in series that means the voltage reaching the filaments should be between 12V and 13.2V. Heathkit is probably counting on some voltage drop in the circuit to lower the 13.8 - 14.2 volts nominally put out by the alternator. Still, the higher filament voltage will not destroy the tubes, only somewhat shorten their life.

Summary:

The HA-14 "KW Kompact" is an impressive little 1KW PEP linear amplifier. While not the most common Heathkit amplifier, they do show up on eBay fairly often. For a ham with limited space or living in a trailer or on a boat they make a good compromise between compactness and performance. The ability to work from 12 VDC or 120 VAC, with the proper power supply, also makes them handy for emergency, in the field, operations. If one ever comes my way, I may pounce on it.

There are modifications for putting the HA-14 on 6 meters (though the 572B tubes are rated only to 30 MHz for full output). Operation on the WARC bands (30 meters excluded) are also possible for this rig just by following some of the modifications offered for the SB-200.

Overall, the HA-14 is one of the more interesting RF amplifier kits put out by Heath. One can only guess that many were sold, even when there was stiff competition with the SB-200. It is an amplifier, that if you come across, might just be an asset to your operations - mobile or fixed.

Acknowledgements:

I can't end without thanking Dave Lien - W6OVP for peaking my interest into writing about this kit earlier, rather than later. His website has been an important asset to this article, as I'm sure it is to the many users of the HA-14 "KW Kompact". On his website you will find the manuals, schematics, repair help, modification data and all kinds of other information to help you if you are restoring, fixing or using an HA-14. When you visit his HA-14 website :

http://www.qsl.net/w6ovp/

be sure to spend a moment looking at the pictures of the eleven HA-14 amplifiers Dave has stacked up (once there were thirteen, he says). Dave has used them mobile and in fixed locations and has had great success with them on the air.

Most all of the photographs in this article came from the W6OVP website and are used with his permission.

Next month I'll probably be taking a break to work on some other projects. But I will be back soon with yet another prize from one of the Heathkit catalogs. Oh, and beware! I may have found my topic for next April's Heathkit article, and it's not powered by gasoline!

73, from AF6C

This article originally appeared in the December 2014 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.

Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

Thanks - AF6C